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POPULAR ELECTRICITY

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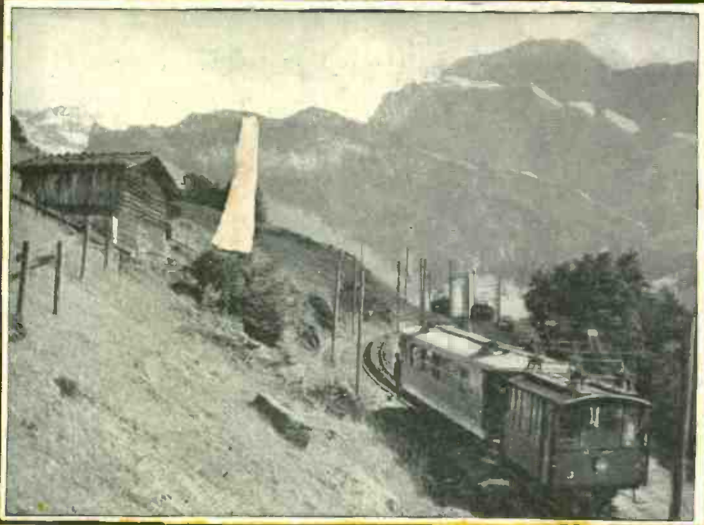

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Vol. II. MARCH 1910 No. 11

One Dollar

Puts the "RICHMOND" Suction Cleaner in Your Home

You see here an electric suction Cleaner which weighs but *ten* pounds—instead of sixty.

All that any vacuum cleaner or suction sweeper can do, this one does.

And it does, besides, some things which no other machine can do.

You can, for example, use this "RICHMOND" Suction Cleaner either *with*, or *without* the hose.

Points about the "RICHMOND"

—costs less per month for electricity than the average family spends for brooms.
—after a year of consistent use you couldn't find a thimbleful of dirt in a fourteen-room house if you took all the carpets up.
—no more spring or fall "house cleanings"—no more "sweeping days"—no more "dusty Fridays."
—its total cost is less than the cost of one single annual house-cleaning—to say nothing of saving the wear and tear which house-cleaning brings to furniture.
—cleans furniture, walls, upholstery, bedding, clothing, decorations, bookshelves, tile floors, hardwood floors, nooks and crannies, as well as making old carpets look like new.
—equally valuable in homes, offices, stores, hotels, hospitals, libraries, schools, churches, theatres, public buildings.
—without any change or adjustment, uses either direct or alternating current; universal motor of our own construction.
—thirty feet of electrical cord, with connecting socket, comes with the sweeper—everything ready to start—any one can do it.
—handsome in appearance—all exposed parts are highly polished—operates with easy gliding motion, no pressure required.
—absolutely guaranteed for one year, and without abuse should last as long as a watch.
—One Dollar brings it—you pay the balance out of the month-to-month money it saves you.

For Hair Drying

Also a special attachment for hair-drying, pillow renovating, etc.

The hose attachment slides on and off with the same ease that your foot slides into an easy slipper.

Slip on the hose and you have a machine that cleans everything, for we furnish, without extra cost, special tools for cleaning portieres, walls, books, bedding, upholstery, clothing, hats.

Slip off the hose, and you have a floor machine which weighs two pounds less than an ordinary carpet sweeper—and glides over the floor more lightly, more easily than even the lightest carpet sweeper.

But light weight and easy operation are but two of the "Richmond's" exclusive superiorities. There are many more.

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The vibrating brush taps the caked dirt out of the carpets and fabrics which no other machine could clean.

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And without the brush the "RICHMOND" will do all that any machine—vacuum or suction—can possibly do without working injury to even the finest fabrics.

Many have written us that they were so delighted with the "RICHMOND" that they desired to own it outright at once—

Many have written us that they were so delighted with the "RICHMOND" that they desired to give it to someone as a present—

And for these reasons they ask us, as a favor, if we would not make them a special cash price, so that they could own the machine outright, and present it to the friend whom they had in mind.

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POPULAR ELECTRICITY

IN PLAIN ENGLISH

HENRY WALTER YOUNG, Editor

Vol. II — MARCH, 1910 — No. 11

CONTENTS

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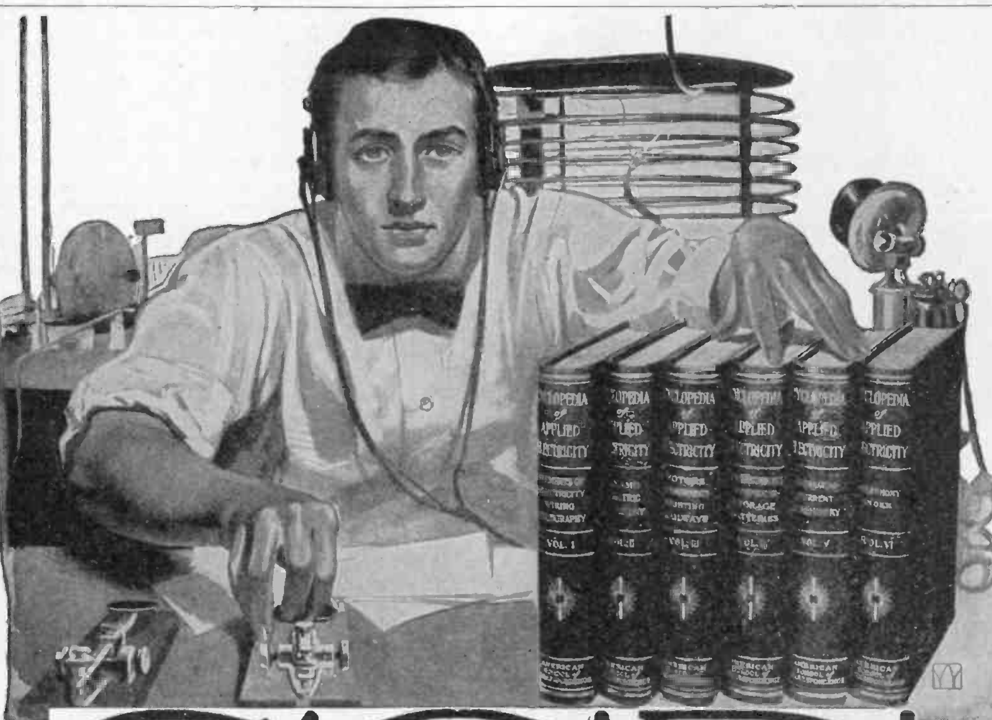

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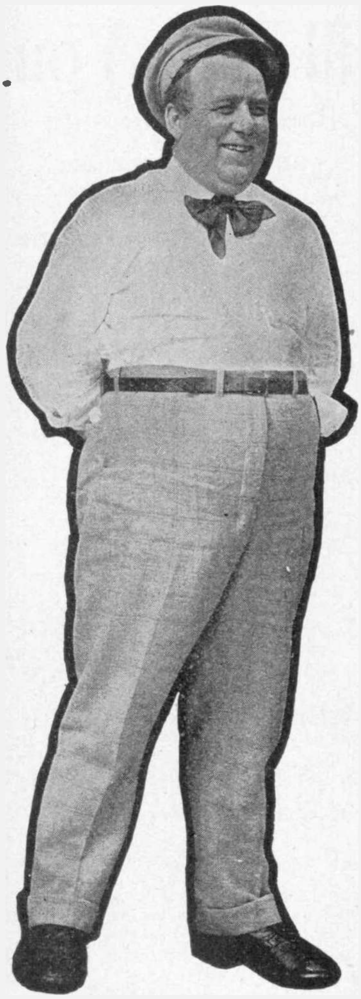

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VIEW IN THE COLISEUM, CHICAGO, DURING THE ELECTRICAL TRADES EXPOSITION

POPULAR ELECTRICITY
IN PLAIN ENGLISH

VOL. II MARCH 1910 No. 11

Wonders of the Electrical Show

What delights to be enjoyed, what new sights to be revealed to the wondering eye, what mysteries to thrill our fancy are conjured up by the word "Show." To the knickerbockered youth the shimmering lights and the tinsel of the circus tent are a magnet which draws him with an irresistible power. It is a "show" and he must see it to quench that craving desire to be astonished, to be mystified. And we never get over that longing to see a "show." Although it may be an exposition in scope we would never think of it or term it anything other than a "show" for the world.

To a show therefore we throng, collectively speaking, first to be interested and mystified and then of necessity to be educated, for it is but natural that after wonder takes hold of us there should follow the desire to understand.

There are shows and shows, particularly in the larger cities. They are of every kind and description covering the new developments in many industries. But as electricity stands out today a great and spectacular force which in a few short years has bounded into the first place as a factor in human affairs, so the Electrical Show stands out among all the others as the biggest and most attractive.

Electrical shows or expositions are now held in a number of the large cities, but Chicago as the pioneer in this respect still holds the distinction of giving annually the largest and best attended one of its kind. It is held each year in January and continues for a period of two weeks. It is given by the Electrical Trades Exposition Company, in the Coliseum Building. Nightly this great steel arched hall, 300 feet long and 170 feet wide, is thronged by delighted thousands.

This year the Chicago Electrical Show was more splendid, if possible, than ever before. Let us take a trip to the Show, then, in our minds, those of us who were not fortunate enough to visit it in person and try to imagine what it all looked like and what there was new to see.

As we enter the doorway we step from night into day—the daylight of thousands of tungsten lamps which have so lately come into prominence and favor owing to their pure white light. Upward we gaze in wonder for down from the vaulted roof of the hall hang thousands of streamers of tinsel and ribbons of varied hues. These streamers, some 20 or 30 feet long, are so closely hung that the eye cannot penetrate to the darkly covered ceiling and we appear to be looking upward into unbounded space. Restlessly they wave too and fro, now in little eddies and swirls, now in great progressive waves, while all the time three searchlights, like rising suns in the end balconies, shoot their colored rays through the shimmering depths.

In the center of all, suspended by invisible wires, hangs the original Wright aeroplane—the very one in which the famous aeronaut made his first world-startling record. This is now the property of the United States Government and jealously guarded. It was brought here for the occasion and installed under the supervision of Lieut. Foulois. It possesses added interest from the fact that here at the Show there has been installed upon it a wireless telegraph equipment, the first time such an equipment has ever been

A COMPLETE ELECTRICAL REFRIGERATING OUTFIT

used on an aeroplane; one which actually sends and receives messages from a station located in another part of the building. But this interesting feature will be left for a more complete description in another part of this issue.

Within the hall are the booths of the manufacturers and dealers in all things electrical and we see as we begin to traverse the broad aisles that they have sought to bring to the attention of the public those applications of electricity which most closely affect the people; that is, the big machinery which is of interest more to engineers than to the housewife and the business man has been left at home to give place to the smaller electrical conveniences of every-day life. The Show thus becomes not only an interesting and entertaining exhibit but also a medium of public education.

A MACHINE THAT BOTH MAKES AND SETS TYPE

ART AND UTILITY COMBINED

HERE MAZDA LAMPS WERE THE RIVAL OF DAYLIGHT

To those who have visited the shows of two or three years ago the fact is particularly evident that there has been a marked change in electric light. But a short while ago the tungsten filament lamp was only an experiment to be exhibited and wondered at as a curiosity. This year we find its magnificent white light the only illumination of the great hall, the lamps being mounted in ornamental reflectors of remarkable beauty situated over the various booths, which are all of uniform architectural design.

An attempt to describe, briefly even, all the things of interest exhibited would be impossible within the confines of a single article, therefore let us single out a few of the most striking features which are characteristic.

Naturally, we find that the Commonwealth Edison Company, whose great central power station supplies Chicago citizens with most of their current, is interested from an educational viewpoint as evidenced by its great industrial exhibit which extends entirely across one end of the hall. Here are shown many of the uses to which electric current may be put in the various industries, so you or I as a printer, a machinist, a baker or whatever our vocation may be had better go slowly for we are going to run into something which will give us new ideas to apply to our own business.

First we come to a complete refrigerating plant behind the glass case of which are hung choice quarters of beef, poultry, hams, etc. We are told that the plant which furnishes the refrigeration for this equipment is operated by electric motors and automatically at that, the temperature being kept constantly at just a shade above freezing. We are also told that similar plants are now built on a small scale for household purposes and that in addition to keeping the perishable materials cool will manufacture 15 or 20 pounds of pure ice per day for the drinking water.

A little farther on is a curious oven shaped arrangement used by bakers. On top of it is a folding leaf which is heated by electricity for pressing out and baking thin wafers of all sorts, there being little dies on the under side for impressing a trade mark upon the wafers.

Close by stands an electrically heated tool tempering furnace provided with a hood and chimney for carrying off offensive gases. A little well in this furnace contains a pool of red hot barium chloride boiling away at a temperature of 1400°F. Into this the tools are plunged and heated to the desired temperature for tempering.

Next comes a fairly complete machine shop with lathes, drills, grinders, etc., all operated by individual electric motors. It should be remembered at this point that all up-to-date machine shops now are designed to be operated by electricity, as there is less danger of accident, better light, better control and less power waste than was the case when the antiquated line shafting and myriads of belts were used.

A machine that both makes and sets type next commands our attention. It is the monotype machine, later even than the linotype. This is but the beginning of a whole printing plant installed right here in the exhibit to show people how printed matter is turned out at a speed almost unbelievable to the uninitiated. There is a gigantic paper cutter which snips through 500 sheets of paper at a time; a stitching machine which punches the little wire clips through booklets with lightning speed; a folding machine into which great sheets of printed paper are fed and in the time it takes to wink twice come out neatly folded in book form; then there are the large flat bed presses for printing magazine and book forms and a small Gordon press for job work. All these are motor driven and controlled to a nicety by the merest turn of a hand.

Farther on in this exhibit is an electric soldering equipment such as is used in tin shops, together with electric driven machines to roll out the tin and crease it properly for making tin cans, etc.

But we can't spend all our time at this one exhibit and we pass on to a large space which we note bears the sign of the National Electric Lamp Association's engineering department. Here we shall, no doubt, get some more information on this lamp question and we are not mistaken. The Association is made up of a large number of manufacturers of electric incandescent lamps, who maintain an elaborate engineering and research department, the sole object of which is to devise better and still better lamps. These engineers are never satisfied. "More light for less current" is their motto and they are all the time trying out new materials for filaments, more economical methods of manufacture, studying the qualities of light, its effect on the eye, etc. From now on you will hear a great deal about the Mazda lamp, and when you do it will be well to remember that the word "Mazda" stands for the very best lamp which this body of noted engineers can devise. Today it stands for the high efficiency tungsten filament lamp; next month or next year it may stand for some entirely new and better filament—always better—; in a decade it may stand for bottled Aurora borealis if these persistent engineers keep up their indefatigable work. Anyhow, when you find the word Mazda on a lamp you will know that it is the trade mark signifying the best efforts of this research department.

Just now Mazda stands for best tungsten, and, as we pass through the exhibit space we find many of these lamps in evidence, ranging from 40 watts up to 250 watts, or, in other words from 30 candle power up to around 200 candle power. These are for purposes of general illumination. There are others much smaller for special purposes ranging in size from a single candle, not much larger than a bean, for dentists and surgeons, to those of two to four candle power for electric signs.

In a rack we also find two rows of lamps burning. One row is of tantalum and the second of carbon filament. The candle power of each of the rows is the same but the moving parts of the electric meters attached to each row do not travel at the same speed. The tantalum meter moves quite slowly and the carbon filament meter far outstrips it. This furnishes a very good occular demonstration of the relative current comsuming capacities of these two types of lamps.

There is another interesting thing in this booth. It is a big black box-like affair mounted so as to revolve like an old fashioned barrel churn. There is a hole to look into as you turn the box and inside are mounted a lamp and reflector with a curious arrangement of mirrors to throw the light from the lamp to the eye. As the box is revolved the lamp and shade are shown at all angles; now you look directly into the bottom of the shade; now you see it at an angle, now straight from the side. The strength of the light coming to the eye in each case is different and the arrangement shows plainly the planes of distribution of light from a lamp.

ONE OF THE MOST COMPLETE EXHIBITS OF HOUSEHOLD UTENSILS

The line of household devices is unusually complete this year, embodying every type of cooking utensil. The exhibits of the General Electric Company, Westinghouse Electric and Manufacturing Company, and the Simplex Electric Heating Company show literally hundreds of these devices, including toasters, percolators, electric ranges, disk stoves, water heaters, chafing dishes, ovens, waffle irons, etc. Demonstrators are on hand to tell us how each thing works and to give out some samples of real electric cooking.

Electric vacuum cleaners are also strongly in evidence, there being a great many different types from the small portable cleaner for strictly household purposes to the more pretensious machines for hotels, stores and the like. As we study them we find that they all consist of some type of suction pump which creates a partial vacuum in the dirt chamber. The outside air rushing in through the nozzle of the cleaning tool carries dirt and dust, pieces of string, shreds of paper, etc., through the tube into the chamber. There must, of course, be an exhaust outlet in order to produce the constant vacuum and in order that the dirt may not rush out again through the exhaust opening the air as it passes through the chamber is, in most of the machines, strained through muslin bags. The exhaust is also utilized in some types as a compressed air outfit, for at that point the air blows out instead of rushes in and this escaping air may be utilized by passing it through a hose or tube to blow out inaccessible nooks and corners.

EVERYTHING FROM MOTORS TO CORN POPPERS

What is this we see in the booth of the Allis-Chalmers Company? Apparently it is a section cut out of a cylindrical casing containing some curious disks mounted on a long shaft passing through the casing, each successive disk being smaller as you go toward one end. The disks, instead of being solid, are made up of little obliquely mounted blades extending from the center out toward the rim where their ends are bound together by a band. We are told that this is a steam turbine such as is now largely used to drive electric dynamos. Although it is scarcely over three feet long it will develop 125 horsepower. How much different it is from the old fashioned steam engine. The steam rushes in at one end of the turbine and impinges upon the blades of the disks exactly

THE TELEPHONE AND ALL ITS DETAILS

as the wind does upon the fans of a wind mill. Passing through it strikes upon the next disk and so on to the end, passing out finally at low pressure and leaving most of its energy imparted to the disks which are made to revolve at a tremendous rate.

Electrical methods of communication including telephony, wireless telegraphy and wireless telephony attract the attention of thousands. Telephones of all kinds are to be seen at the booths of the Swedish-Amercan Telephone Company, and the Stromberg-Carlson Telephone Manufacturing Company. And over in the center of the hall is a complete telephone exchange put in by the Chicago Telephone Company. The crowd is so dense around this latter that we can scarcely make our way through in order to try and determine what becomes of our telephone message after it leaves our transmitter and flits away to that mysterious "Central."

Another thing that attracts our attention is the intense light that comes from some of the arc lamps that are exhibited. We have often seen these lamps as they hang in front of theaters and shops. The light is of a sort of orange tint. We never knew exactly what they were before but now we find that they are called "flaming" arcs. They had their origin in Germany and were here considered a curiosity three or four years ago. The carbons of these arcs are of special manufacture, and as they burn away give out more of a flame than the common arc, hence their name. One type of flaming arc, which we

SOME BEAUTIFUL DESIGNS OF MACBETH GLASSWARE

THE LATEST TYPES OF FLAMING ARCS

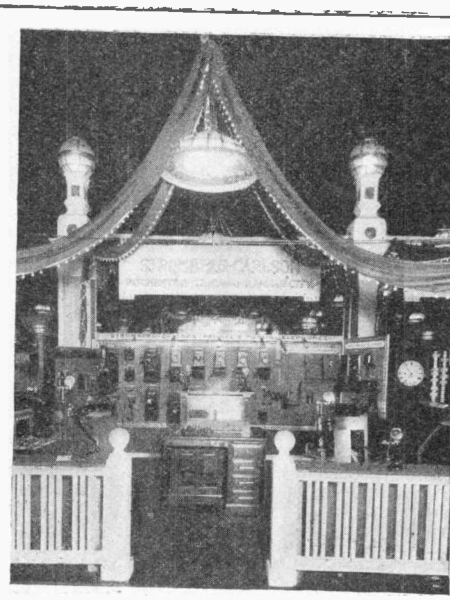
find in the booth of Chas. Kiewert, is called the Trucolor arc and gives a very intense white light instead of orange They also show a very ingenious method of show-window lighting by means of these arcs. The lamp is mounted above a false ceiling in the window. A hole is cut in this ceiling and any inverted Holophane shade fitted into the hole. The intense light from the lamp above shines down through the shade and is diffused throughout the window. At the same time the inflammable materials in the window are not in danger of catching fire from falling sparks.

Another thing that we do not want to miss at the Show is the new Edison storage battery which is shown at the garage station in the annex. You will remember, perhaps, that the original Edison storage battery was launched six years ago and was in many respects the best storage battery, up to that time, produced. Quite a few were manufactured and put into operation on electric vehicles in New York City where they were carefully watched. Though they would suit most people and are giving good service today they would not suit an Edison, so he withdrew the battery from the market, closed the factory, scrapped the machinery and started out afresh. He made nine thousand experiments before he obtained the result he wanted. These nine thousand experiments are now of no use to him except, as he tersely put it, "I now know nine thousand things *not* to do." Finally, however, he made a battery near enough to his ideals so that he was willing to place it before the public. Here at the Show we see it.

The retaining can is nickel plated. The negative plate consists of 24 flat rectangular pockets supported in three horizontal rows in a nickel-plated steel grid, each pocket filled with an oxide of iron very similar to what is called iron rust.

Each positive plate consists of a grid of nickel-plated steel holding 30 tubes filled with the active material in two rows of 15 each. The tubes are made of very thin sheet steel, perforated and nickel-plated. The active material in the tubes is interspersed with thin layers of pure metallic nickel in the form of leaves or flakes.

The electrolyte consists of a 21 percent solution of caustic potash in distilled water.



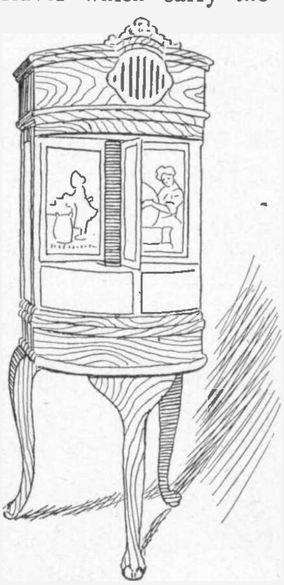
FROM SUBSCRIBER TO CENTRAL

The plates are mounted in the case and the latter is sealed up. The electrolyte is poured in by a special filling nozzle through an opening in the top, the stream being cut off automatically when the electrolyte reaches a certain height, by an electrical arrangement which at the same time rings a bell. The advantages of the battery are that it requires little attention, only water need be added to keep up the solution, there are no fumes and the battery weighs about half as much as a lead battery for the same output.

THE ELECTRICAL SHOW AS SEEN IN DETAIL

Oral and Motion Advertising

This advertising device both talks and moves, thus attracting and compelling interested attention through the ear as well as through the eye. It consists of a handsome oak cabinet which stands over seven feet tall. It has a rounded plate glass front through which are visible the successively turning leaves which carry the advertisements. In the top is placed a phonograph concealed from view.

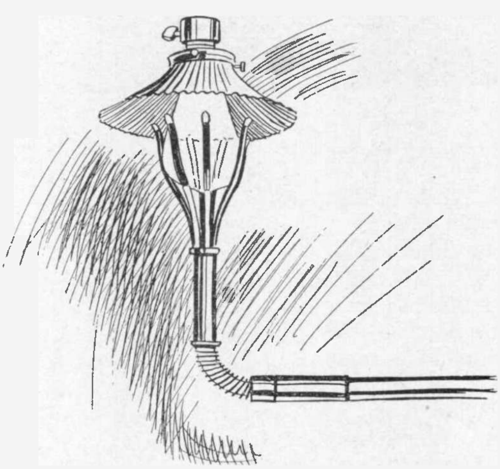


ORAL AND MOTION ADVERTISING

An electric motor operates all the mechanism. As you stand in front and watch it you will see a little finger, which travels back and forth in a semi-circular groove in the bottom of the case, move over to the left, take hold of the lower edge of the one of the advertising leaves, lift it up ever so little and move it over to the middle position and let it down again. At the same time what was previously the middle leaf is moved in a like manner over to the right. This is kept up continuously and all the leaves, of which there may be several dozen, are displayed to view over and over again. At the same time the phonograph in the top is talking to you in regard to the advertised articles, reproducing music, giving a lecture or whatever else is desired.

Adjustable Lamp Changer

Electric lamps which are out of reach in high fixtures and other inaccessible places must be renewed and cleaned the same as any others. The Adjustable Lamp Changer is mounted on a long pole and consists of prongs of springy steel which grip the lamp. Being covered with rubber they may be pushed on over the bulb without danger of breakage. There is a sliding collar which may be moved up and down over the lower ends of the springs, shortening or lengthening the grip so as to grasp any lamp from the smallest little four candle power affair to the big 250-watt tungstens nearly five inches in diameter. There is also a flexible coiled spring below the grip which makes a uni-

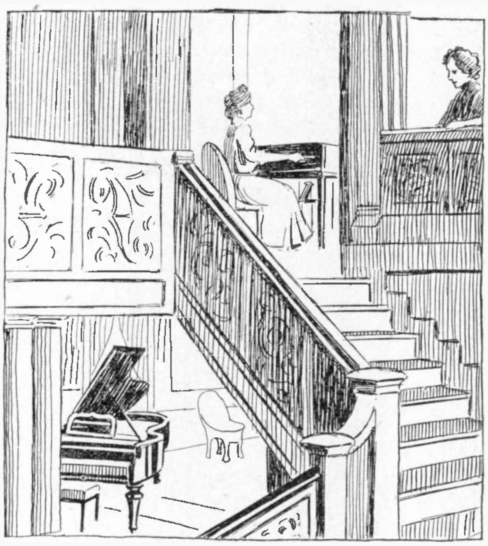


ADJUSTABLE LAMP CHANGER

versal joint in the pole so that it can be used in a slanting direction or even at right angles as shown in the cut.

The Tel-electric Piano Player

There was a little room in the Coliseum partitioned off from the rest of the Show and from within you could hear that there was a continuous piano recital going on. Stepping inside you could see a piano in one corner of the room with no one near it, though its keys were moving up and down in a mysterious manner and beautiful strains of music



TEL-ELECTRIC PIANO PLAYER

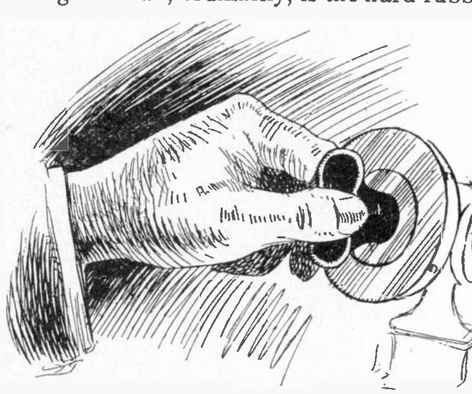
were issuing from it—now soft, now loud, now fast now slow, with all the inflections which could be given by a human operator. Looking for an explanation you could see a small cable leading from the piano over to a little desk-like cabinet in another corner of the room where a man sat manipulating two little knobs. When the composition was finished the man would give you a lecture explaining that this was the Tel-electric piano player operated exclusively by electricity.

Underneath the keyboard of the piano, concealed in a long box scarcely visible, were a number of little vertical electro-magnets, one to each key. When current from one of the pairs of wires in the cable flowed around one of these little electro-magnet coils a plunger within the coil would be pulled down, following a well known principle of electricity, and strike the key to which it was attached. At the operating cabinet you would find a traveling roll of paper similar to that in a pneumatic piano player. Through the perforations in this roll all the various circuits in the cable were closed and the electro-magnets operated to strike the various keys at the proper instant as the roll progressed. The knobs which the operator turned controlled the speed of the roll and also the voltage or electrical pressure of the current to the electro-magnets. When he wished to play a heavy passage he increased the voltage, which would bring the keys down with a crash. Similarly he decreased the voltage in playing the lighter passages.

With the Tel-electric system the piano may be in one room and the player cabinet in another room and you can sit and hear yourself play at a distance, so to speak. The piano may also be operated independently of the electric player without making any changes or disconnections.

Flexible Rubber Telephone Mouthpiece

A telephone mouthpiece of flexible rubber is the latest novelty introduced by the Swedish-American Telephone Company. Its most admirable feature is the fact that it is unbreakable. When you knock your telephone desk set off onto the floor, which is bound to happen once in a while, the first thing to break, ordinarily, is the hard rubber

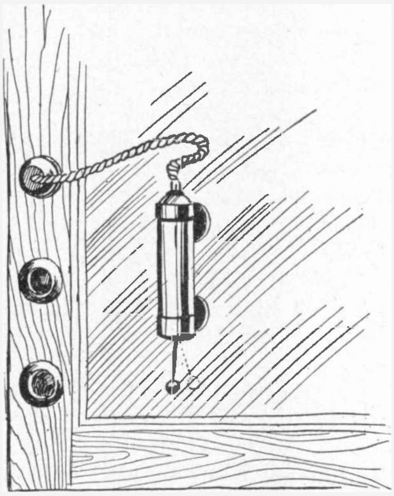


FLEXIBLE RUBBER MOUTHPIECE

or composition mouthpiece. It sticks out like a sore thumb to get itself into trouble. Not so with the flexible rubber mouthpiece. You couldn't break it with a sledge hammer.

A Periodic Window Tapper

If you were walking along the street and some one were to tap on the window pane just as you were going by it would be pretty sure to arrest your attention. Well there is a new electric device made for this very purpose. You have probably heard electric tappers before this, used for advertising purpose. They tap constantly while this one taps intermittently. It is quiet for a few moments and then gives half a dozen quick



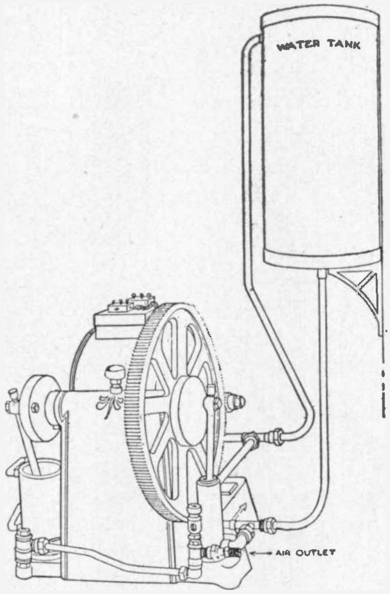
PERIODIC WINDOW TAPPER

taps and then is silent again. This is more apt to call your attention to the display window than if you were to hear the thing going constantly from a block off.

The Thorne tapper sticks right to the window pane by means of two rubber suction cups with a little adhesive preparation to keep the air from leaking in and causing them to let go. The little hammer acts on the same principle as that of an electric bell and it hits the window pane at each blow. Of course if there were not some way to prevent the current from flowing constantly to the magnets which operate the hammer the tapping would be constant. To cause an intermittent flow of current and consequently an intermittent tapping they use what is called a thermostat. This consists of two strips of dissimilar metals riveted tightly together. Ordinarily these metal strips when straight close a contact which allows current to flow through the tapper magnets. But there is a little winding of fine wire around the strips which also carries current. The current flowing through the fine wire heats it up and at the same time heats the strips. The latter being of dissimilar metals, with different coefficients of expansion, one expands more than the other and draws the pair into a curved form, opening the circuit to the tapper magnets and silencing the tapper until the metals cool down, straighten out and again close the circuit, when the operation is repeated.

Automatic Electric Air Pump

It was interesting to watch the almost human automatic air pump of the type used in automobile garages to furnish compressed air for the tires. It would work along gaily for a few minutes and then stop as if to take a rest. Then it would start up again as if ashamed of its idleness and work at a terrific rate. It pumps the air into an 18-gallon tank and the air is taken from the tank to

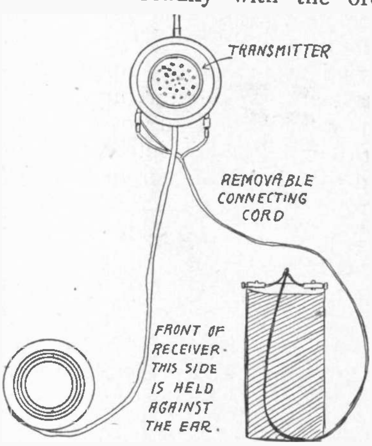


AUTOMATIC ELECTRIC AIR PUMP.

fill the tires. The Eureka pump, as it is called, furnishes sufficient air to fill a tire every minute and automatically maintains a pressure of 100 pounds per square inch or less if desired. The pump works only when the pressure in the tank is reduced below a certain limit. When the proper pressure is reached a switch, operated by the air pressure in the tank, is opened and stops the motor. When the pressure falls again, either from filling tires or slow leakage, the switch automatically closes and starts up the motor. The pistons of the air pump are subject to heating, so they are water-jacketed, the cooling water being supplied by a tank mounted above the pump, a constant circulation being maintained through the system.

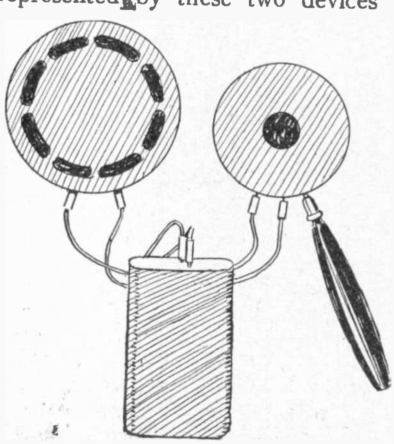
Aids to Hearing

There were two devices on exhibit at the Show which are a blessing to deaf people, they were the Stolz Electrophone and the Acousticon. Few people who are partially deaf can hear readily with the ordinary



STOLZ ELECTROPHONE

sound magnifier, for no two people hear exactly alike. The electrical aids to hearing as represented by these two devices were



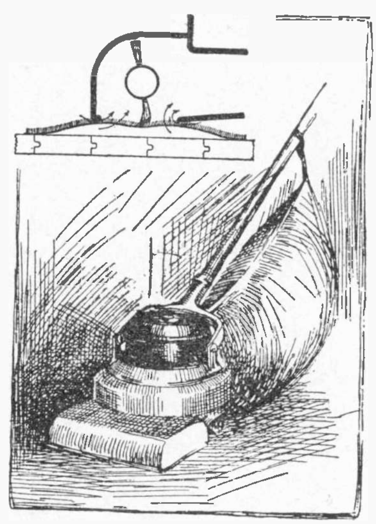
.THE ACOUSTICON

consequently developed as much more susceptible to these differences in the degree of ability to hear on the part of various people.

In both the devices there is a battery of small pocket size, a telephone transmitter and a telephone receiver. The transmitter is ordinarily located somewhere in the clothing, preferably over the chest as most readily affected by the voice of the speaker. Then the receiver is either held to the ear or fastened there by a band over the head. If you whose hearing organs are perfectly normal use the Acousticon or Electrophone and some one talks to you the sound is almost deafening in volume. To the person who is partially deaf—one who can ordinarily hear only the loudest sounds—this may mean the difference between fairly good hearing and almost aural oblivion.

Combined Suction Sweeper and Broom

The Hoover sweeper combines vibration, sweeping and suction and is a very striking departure from the usual types of suction sweepers. The illustration shows the principle of this unique machine which is oper-

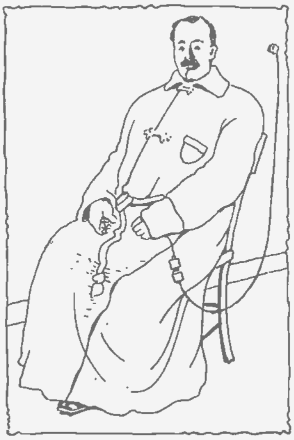


COMBINED SUCTION SWEEPER AND BROOM

ated by a vertical electric motor. This motor operates the usual vacuum pump, the air being drawn in through a device like an ordinary carpet sweeper which projects out in front. In this projecting member there is a revolving brush also driven, by a belt, from the motor. The combined action is shown in the diagram. The suction of the in-rushing air lifts up the carpet under the sweeper carrying most of the dirt through into the bag. At the same time the brush gives the carpet a thorough sweeping and shaking. After the machine has passed over, the carpet is left with its pile spread, loosened and straightened into its normal upright position.

Taking a Turkish Bath at Home

The electric heated garment is made up in the form of a bath or lounging robe of woolen material. There is an interlining in which there are 7,000 feet of specially constructed magnet wire through which current taken from the lamp socket is allowed to pass. The wire is so constructed that it is as pliable as thread and very durable. The additional weight of the wire is only 20 ounces. As the current passes through the wire it is heated up in a very few minutes to any temperature desired.



ELECTRICALLY HEATED ROBE

There is no electric shock experienced when wearing the garment but the heating effect is wonderfully efficient. They say that using it is like taking a Turkish bath at home, the heat causing profuse perspiration which is efficient in breaking up colds, treating rheumatism, etc.

The Dictograph

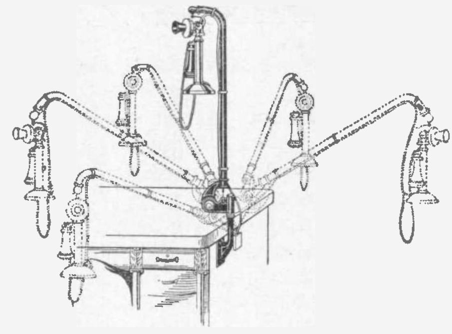
With a Dictograph upon your desk you can communicate instantly with any officer, clerk, or employee without placing a receiver to your ear or speaking directly into a transmitter. You can walk about the room, refer to books and papers, look up data and keep right on talking in a conversational tone. The sensitive transmitter on your desk detects every tone and inflection and transmits them over wires as in any telephone, and the party at the distant receiver hears every word as if he were in the room. The receiving end embodies a little telephone receiver to be held to the ear. Some of the things you can do with it are astonishing. You can dictate to your stenographer located in another office; you can listen to a committee meeting in another room and take part in the conversation if you desire; you can give orders to one or more employes in distant parts of the building simultaneously, and so on.

Floor Surfacing Machines

A device that will surface composition floors of all kinds without showing disk marks was exhibited, known as the Schlueter floor surfacing machine. The main part of the machine carried a good sized electric motor which not only propelled the machine but also gave a reciprocating motion to the rubbing stones or blocks which projected out in front. The whole was steered about by a handle as one would manipulate a lawn mower only there was no pushing to do. A small child could easily guide it about. Another machine somewhat similar was made to sand paper floors by means of a revolving cylinder covered with sandpaper.

Perfectly Adjustable Telephone Arm

Here is an adjustable telephone arm called the Radio, which, if used in the office, makes one telephone do for several people without any inconvenience whatever. It can be used sitting or standing, is just as good in the home as in the office, and is perfectly adjustable

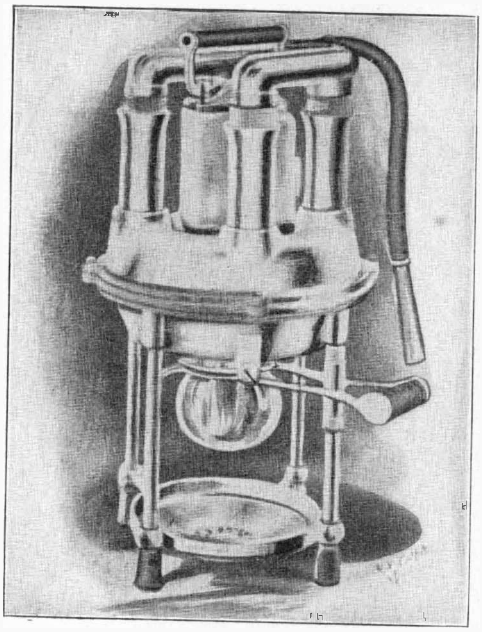


ADJUSTABLE TELEPHONE ARM

to all positions, the weight of the telephone just balancing the tension of the spring so that the arm "stays put" in all positions. The telephone instrument is always vertical and in a position ready for use, as it is hung from the top by a universal joint.

Electric Air Washer and Purifier

Here is a machine to wash and purify the very air you breathe. In appearance the Duntley electric air washer is not pretentious but it is surprising how quick it will make the air fresh and sweet in any room. It stands only 16 inches high and weighs but 10½ pounds. The glass cup in the lower part of the machine, as seen in the illustration, contains a liquid purifier and disinfector. Through this the air in the room is drawn by a vacuum pump operated by a

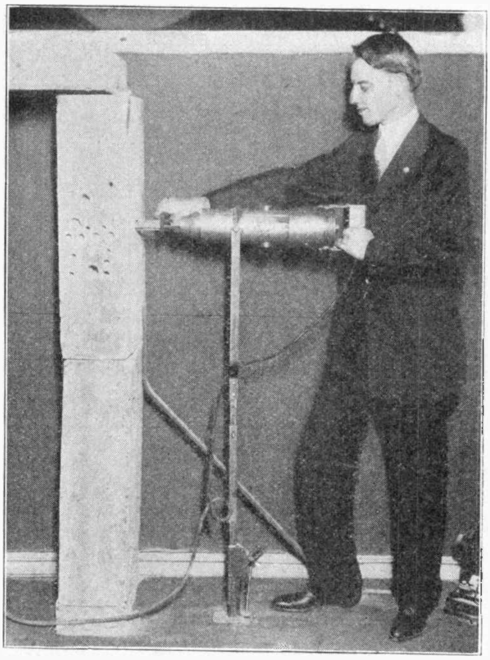


AIR WASHER AND PURIFIER

tiny electric motor. As the air has to pass through the liquid all dust particles and germs are taken from it, making it sweet and pure. The purified air is then blown out through the room. This device is recommended by physicians for the home, for hospitals, churches, theaters, etc.

Electric Drill

Manufacturers have had a hard time in turning out a really satisfactory electric drill, that is of the reciprocating type such as is used for rock drilling. The Electro-magnetic drill exhibited at the Show appears to be able to do the work judging from the manner in which it eats into a solid block of concrete. It is only necessary to turn on the current and press the drill point against the rock, twisting it around meantime so that



DRILLING IN CONCRETE

the blows of the drill point do not fall all the time in the same spot. The advantage of an electric drill for quarry and mine work lies in the fact that electric current carried through wires and cable is much more simple a proposition to handle than is a compressed air system, also more economical for there is less waste.

Electric Laundry

One of the many features of the Simplex Electric Heating Company's exhibit which was of never-failing interest to visitors at the Show was the electric laundry. This laundry was complete in every respect as far as the ironing and finishing were concerned. The laundry workers, four of them, attired in spotless linen, "did up" the various articles of apparel before the eyes of the spectators. Of course, only electric irons were used. There were no soot or ill-smelling gases and the irons were always ready on the instant that they were needed and at just the right temperature. There were many questions asked concerning "just how an electric iron works." Well, if you can understand how an electric incandescent lamp operates you can understand the iron. We know when electricity is passed through a restricted portion of its circuit, such as the very fine filament of a lamp, that the resistance encountered, you may call it electrical friction if you desire, causes heat to be developed which raises the temperature to the point of incandescence. In the base of the electric iron there are concealed what are called heating elements which consist of fine wires or ribbons of metal which correspond to the filament of an incandescent lamp. The current comes down one wire of the flexible cord, passes through the high resistance heating element and out through the other wire. The heating element then becomes very hot and this heat is communicated to the iron.

DEMONSTRATING THE ELECTRIC LAUNDRY

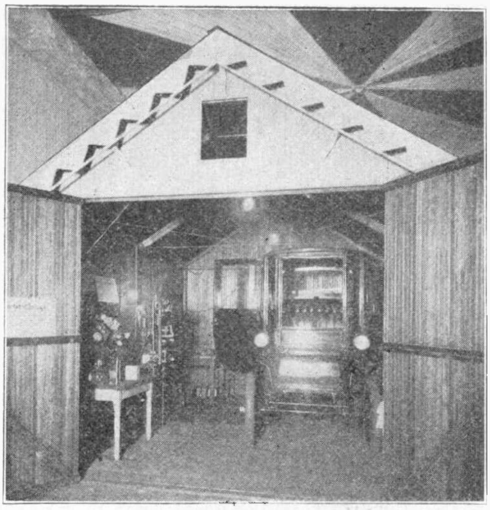
Showing the Effect of Different Illuminants

There is all the difference in the world between the various kinds of electric lights when it comes to bringing out color values. An admirable way of showing this difference was displayed in the exhibit of the Electrical Testing Laboratories. In a long case, lined and covered with black cloth and divided into six separate compartments were situated six different kinds of electric lights—the mercury vapor lamp, flaming arc, intensive carbon arc, Nernst lamp, tungsten lamp and carbon filament incandescent lamp. These lamps were located each in a separate compartment with no mingling of light between. Through the whole case, from end to end traveled an endless belt made up of different colored ribbons, passing continuously under all the different lights. This showed very clearly how the different lights would bring out the various colors. The mercury vapor lamp, for instance, showed none of the red colors for there are no red rays in its light. The tungsten lamp showed all the colors probably the nearest to their correct relation, for the light from the tungsten lamp very nearly approaches sunlight in character, it being almost clear white.

SHOWING THE EFFECT OF DIFFERENT ILLUMINANTS

Portable Garage

To illustrate the simplicity of charging the batteries of an electric automobile by means of a mercury arc rectifier a portable garage was erected in the Annex of the Coliseum. The little portable house was large enough to contain an electric vehicle together with the charging apparatus which latter was in

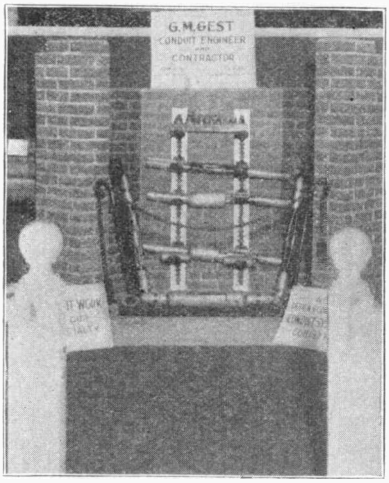


PORTABLE GARAGE

operation at all times for the visitors to see. The rectifier takes the ordinary alternating electric current which is most commonly used for lighting purposes and converts it into direct current (current which flows constantly in one direction) which is the only kind that will charge a battery.

Manhole for Underground Cable System

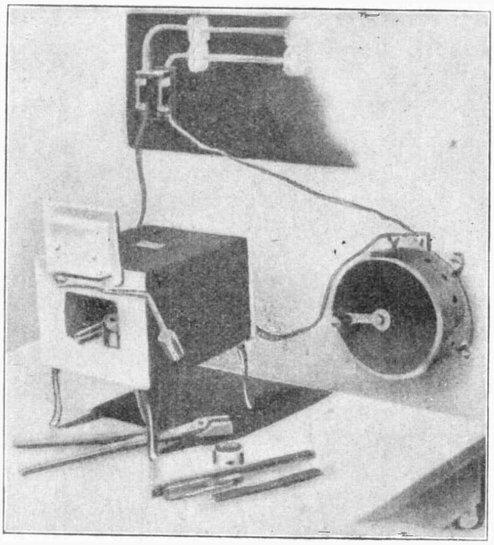
In any city there are miles and miles of electric cables running underneath the ground through conduits. You will realize that all the ramifications of this conduit system make it necessary to provide frequent openings or wells called manholes to facilitate drawing in the sections of cable, making splices, joining on branch cables, etc. One of the unique exhibits at the Show consisted of a vertical section of a manhole, with conduits leading into it and with sections of cables joined together exactly as you would see them if you were to be let down into one of the manholes in the street. A view of the system of manhole construction is shown in the cut and is that of G. M. Gest.



A MANHOLE IN CONDUIT CONSTRUCTION

Laboratory Furnace

Talk about heat! Electricity will make about the fiercest heat imaginable. The electric arc as is well known reaches the highest temperature that can be obtained in any way, but it is not always adaptable, so other forms of electric furnaces have been devised. The Hoskins electric laboratory furnace shown in one of the exhibits was going full blast, and as one gazed into its white-hot interior it was hard to imagine that the inferno within was created by electricity flowing through fine resistance wire concealed behind the fire brick lining. This wire is composed of an alloy of nickel and chromium having an electrical resistance 10 times that of platinum. Ordinary wire would be burned up in a short time, but the



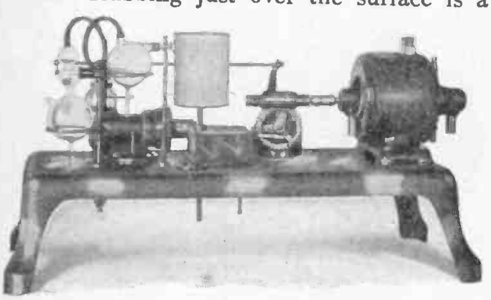
LABORATORY FURNACE

special alloy has a very remarkable resistance to oxidation. The space between the embedded resistance wire and the furnace casing is filled with divided pure silica, a poor heat conducting material. This prevents any serious loss of heat through the furnace walls.

Automatic Smoke Recorder

One of the distinctly new things at the show was the Hamler-Eddy smoke recorder which shows with infallible accuracy to just what extent a stack is smoking at any hour and any minute during the day. It may be located right in the boiler room where the fireman can watch it closely and govern his firing thereby. He doesn't need to walk half way around the block to see if his stack is clean or smoking.

The Eddy machine produces a picture of the condition of the chimney on the roll of ruled paper which you see on the vertical drum. This roll revolves at a constant rate and the screw carries it down one space every hour. Rubbing just over the surface is a



AUTOMATIC SMOKE RECORDER

specially constructed nozzle-like arrangement seen at the left. Through this nozzle and against the paper are constantly being blown little puffs of the air and smoke drawn from the chimney through a small pipe. The little cylindrical arrangement under the paper roll is the pump which draws in the smoke. The little globes and tubes of glass are for taking out any moisture which may be in the air so that the nozzle will not become clogged with damp soot. The motor at the right runs the pump and turns the paper roll.

When the chimney is smoking heavily a heavy black line is left on the paper at that particular hour and minute. When there is no smoke the paper is left clean; and there are all gradations between. The chief engineer examines these sheets at his leisure. If they are fairly white and clean he does not fear a visitation from the smoke inspector. On the other hand if they are covered with black lines he comes down on the fireman "like a ton of brick."

The Inscrutable Turk

At the booth of the Empire Vacuum Company a genuine Turk performed the work of demonstrating the cleaner. Possibly this was done because Turks and rugs have be-

THE INSCRUTABLE TURK

come so closely allied with one another in the public mind. This vacuum cleaner is contained in a neat case and can easily be moved from room to room, its lightness being one of the features. It is called the Imperial.

Will Scandinavia Fertilize the World?

Recent estimates of the water power available in the principal European countries show that Norway and Sweden each have some seven million horsepower available, Moreover this water supply is unusually constant throughout the year, owing to the high altitude of the water sources and the abundant rainfall.

Between them, Norway and Sweden probably nave more available water power than Great Britain, Germany, France and Italy combined. But these last four are manufacturing countries, which Sweden and Norway can hardly expect to be. The scant population alone precludes extensive manufacturing. For instance, four-fifths of Norway's area consists of bare mountains and forests; in the rest of the area the population averages less than a hundred per square mile, with three horsepower of water available for every man, woman and child in the nation.

What, then, are these countries to do with the enormous water powers which are now used to so slight an extent? Perhaps the answer is to be read in the start already made towards what our scientists call "the fixation of nitrogen," which means the fastening of nitrogen to some base which will make it easily transported to distant farm and pasture lands for use as a fertilizer. Nitrogen forms about four-fifths the volume of our air, from which it can readily be separated by a sort of electrical furnace operated at a high voltage.

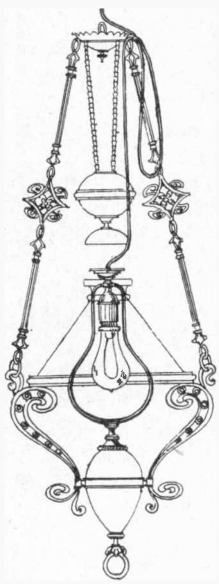
Unlike most manufacturing processes, the fixation of nitrogen requires very few men in proportion to the power used, so it would seem to fit the conditions in these two northern countries. The demand for fertilizers is steadily growing and suitable nitrates for these can readily be made electrically, so with the spare power available in the Scandinavian lands, we may look to these countries to become large exporters of these semi-electrical products before another decade is over.

What the Germans Call Fuse-Plugs

Why do we use so curt and unmusical a term as "Fuse Plug" to designate the removable part of the safety devices used on our lighting circuits? We wonder what the Germans think of so short a term for this article. They call it a "Silverwire-Meltstopper" (Silberdraht-Schmeltzstoepsel) or sometimes, for short, merely a Silverwire-stopper! Is not that truly a musical term compared with "fuse plug"?

Electrifying Oil Lamps

The difficulty of converting some of the older folks to the use of really up-to-date lighting fixtures, is instanced by the accompanying cut taken from a recent catalog of a fixture manufacturer at Mainz, which is one of the most ancient cities in Germany. It shows an attachment by which an incandescent drop light is substituted for the kerosene lamp in a heavy, old fashioned hanging lamp. Just what is gained by retaining the cumbersome structure of the old lamp frame, may be hard for some to understand. It probably pleases the fancy of older ones who do not like to part with familiar fixtures even when yielding to the introduction of a modern illuminant, and it may take another decade to introduce equally modern fixture into these same homes.



AN ELECTRIFIED OIL LAMP

There's a Poet at Nauvoo

The news of the proposed Mississippi dam at Keokuk, which will bring cheap electric power to Burlington and other nearby towns, has enthused a young Tennysonian in the old Mormon town, who breaks forth thus:

"Ring out, wild bells, ring in the new,
It means a *Trolley* for Nauvoo.
Ring out, ye bells! Ye whistles, blow;
We'll get the power we've needed so.
Our dream's come true, 'tis no "wind-jam"
They're going to build the Great Big Dam!"

Elementary Electricity

By PROF. EDWIN J. HOUSTON, A. M., PH. D., (Princeton)

CHAPTER XXIII.—THE ELECTRIC MOTOR.

Like the dynamo-electric machine, the electric motor was the invention of Faraday, who produced it in 1821, about ten years before the dynamo-electric machine. The invention of the electric motor was made shortly after Oersted's discovery of the manner in which magnetism can be produced from electricity, which, as will be remembered, was about 1820.

The electric motor nearly equals the dynamo-electric machine in commercial importance. This can be readily seen from the great extent to which the electric motor is now employed in machine shops, mills and similar locations for the individual driving of tools and machines; from its employment in street-car trolley systems and electric locomotives; for the driving of electric fans, as well as for the many varied purposes the reader may readily recall.

Faraday's original motor was such a puny, insignificant device that no one then could have imagined the enormous growth it afterwards was to have in size, number and the variety of its applications. As shown in Fig. 151 it consisted of a wire (a b), so suspended at its upper end, (a) as to be free to move around the pole (N) of a permanent magnet (N S). This magnet was placed in a glass tube and mercury poured around it so as to leave the pole (N) partly projecting above the mercury surface. The lower end (b) of the wire dips into the mercury.

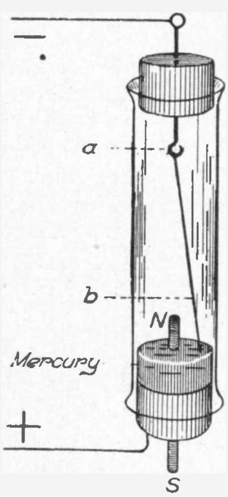


FIG. 151. FARADAY'S ORIGINAL MOTOR

As long as no electric current is flowing through the movable wire, it remains stationary, but as soon as an electric current is passed through it, as by means of the circuit wires shown at (+) and (—), it begins to rotate around the pole of the magnet, and this rotation will continue as long as the current passes. Since the lower end (b) of the wire dips below the surface of the mercury, in all positions, the current continually passes as the wire continuously rotates around the magnet pole.

The direction of rotation of the wire (a b), called an active conductor, while the current is passing through it, depends on two circumstances; i. e.:

(1) On the direction of the flux of the magnet.

(2) On the direction of the circular flux around the active conductor.

The direction of rotation of an active conductor can therefore be readily changed either by changing the polarity of the magnet

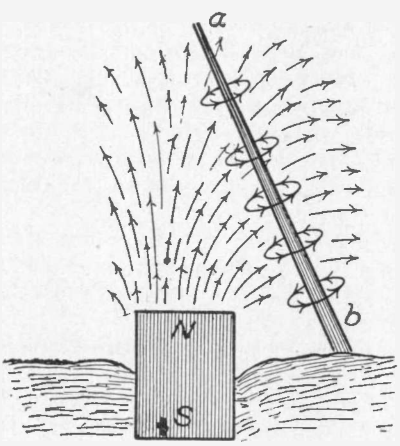


FIG. 152. THE PRINCIPLE OF THE ELECTRIC MOTOR

or by changing the direction in which the current flows through the active conductor.

The force that causes the rotation of an active conductor is known as the electro-dynamic force. It may be defined as the mechanical force that is exerted on a conductor, placed in a magnetic field, as long as an electric current flows through it. The electro-dynamic force is due to the interaction of the flux of the magnet and the flux of the conductor; for, as can be shown, magnetic fluxes attract or repel one another according to the direction in which they are passing. This is not unlike the attractions and repulsions produced by electric charges.

In Fig. 152, the active conductor is represented by (a b), and the magnet pole around which it is placed at (N). The magnetic flux will come out from the north pole (N) in the directions indicated by the arrows, and after passing through the surrounding space will re-enter at the south pole (S). This latter, however, is not shown in the figure.

At the same time on the passage of an electric current through the movable conductor (a b) will produce the characteristic circular flux or streamings as indicated. It is the mutual interaction of these two fluxes that produces the electro-dynamic force and therefore results in continuous rotation of the active conductor.

The value of the electro-motive force depends on the amount of flux produced by the magnet and that produced by the active conductor. This force can therefore be increased either by increasing the strength of the field magnet (A) or the strength of the current that flows through the active conductor. Since, however, in all practical electric motors, the field magnets are energized by electric currents, the electro-dynamic force of a motor can be increased by increasing the strength of the electric current that drives it.

The electric motor assumes a great variety of forms, but practically all of them are based on Faraday's simple device above described and shown.

It has long been known that the unlike poles of magnets attract, and their like poles repel one another. Repeated efforts were made, many years ago, to produce a continuous rotation by the attraction of the opposite poles of steel magnets when aided by the repulsion of their similar poles. These efforts have all been unsuccessful for the following reason:

There is no difficulty in causing either pole of a magnet to attract the opposite pole of another magnet. Nor is there any difficulty in causing the pole of a magnet to be repelled by the similar pole of another magnet. The difficulty was in changing the polarity of the magnets. Before the discovery of Oersted in 1820, as to how magnet poles can be produced by electric currents, and changed by changing the direction of the electric currents through the magnetizing coils no means were known whereby, the magnet after it had drawn another magnet, or a piece of soft iron to its poles, could be caused to lose its magnetism and acquire an opposite magnetism, so as to produce repulsion. As soon, however, as Oersted showed how the polarity of a magnet can be instantly changed by changing the direction of electric currents through the magnetizing coil, it was comparatively easy to obtain continuous rotary motion by magnetic attractions and repulsions.

It is not surprising, therefore, that, almost immediately after the announcement of Oersted's discovery, a number of scientific men began working on the invention of the electric motor. Two of the most distinguished of these workers were Dr. Wollaston and Michael Faraday.

Faraday's early form of electric motor, consisting as it did of but a single conducting loop, was of extremely feeble power. In the motors produced today it is easy greatly to increase the amount of electro-dynamic force by placing a number of conducting loops at equal distances apart on the movable part of the motor or, as it is called, the armature. When such an armature with its numerous loops is placed in the flux produced by powerful field magnets, these loops, excited by the current that drives the motor, have electro-dynamic forces set up in them that result in a rotation in such a manner as to move them into a position in which each encloses the greatest amount of flux it can hold, and no further motion will cause this amount of flux to vary. As soon as this occurs the electro-dynamic force ceases. If therefore a continuous rotation is to be obtained, the direction of the current in one or more of the loops must be reversed. This is effected by the action of a commutator that changes the direction of the current through the loops at the moment they arrive at a position when the force on them ceases.

In all cases the amount of work done by the moving loops will depend on the strength of the driving current passing through them as well as on the quantity of flux per second that is introduced into or removed from the loops in a given time.

It is possible, as in the case of Faraday's early devices, to construct electric motors that produce a continuous rotary motion when completely destitute of iron or steel. But in order to produce electro-dynamic forces sufficiently powerful for industrial work, the amount of flux must be increased by the introduction of soft iron or steel into the magnetic circuit. As already described in a previous chapter, the increase in the amount of flux thus ensured depends not only on the decrease in the magnetic reluctance or resistance of the circuit due to the presence of the iron or steel, but especially to the flux due to the aligned or structural M. M. F. of the soft iron or steel.

The increased power of electric motors containing iron or steel in the cores of their armatures and field magnets led at a comparatively early date to the production of a number of motors of this type. Among these may be mentioned a motor invented by Jacobi in 1834, of sufficient power to drive a ten-oared boat twenty-eight feet in length, and seven and a half feet in breadth, by means of paddle wheels. It was loaded with twelve to fourteen people, on one of the rivers of Russia, and progressed at the rate of three miles an hour against the current. The electricity employed for the driving power was obtained by means of a battery of series-connected Bunsen cells.

Another early electric motor of still greater power was invented in 1850 by Professor Page of the Smithsonian Institution of Washington, D. C. The field magnets consisted of two solenoidal coils provided with movable armature cores of soft iron. When the driving current was sent alternately through these coils the cores were successively attracted or drawn into the coils through which current was passing. As soon as one core had been drawn half-way down into its coil, the motion was stopped, the current being cut off from this coil and switched into the other coil, when its core was then drawn towards it. The see-saw movement thus produced was employed by suitable means to rotate a wheel, the solenoid coils, with their iron cores or plungers, acting like the cylinders of a steam engine, with their reciprocating pistons.

It is interesting to note that Page's electromagnetic motor was employed on the 29th of April, 1851, on the Baltimore & Ohio Railroad's tracks to drive a car between Washington and a nearby town ten miles distant. The driving power was a battery of 100 cells of Groves' nitric acid type.

Neither the Jacobi nor the Page motors were successful in commercial practice. This was not so much due to fault of design or construction, as to the fact, that the voltaic batteries employed for furnishing the driving current were unable to produce the current either continuously or cheaply. This eventually caused the abandonment of electric motors driven by voltaic batteries.

Improvements in the construction and operation of dynamo-electric machines were attended by marked improvements in the design of electric motors, so that today there are in actual use a great variety of motors far better in construction and operation than any of the earlier forms.

The principal parts of an electric motor of the direct current type today consist of an armature and the field magnets. The armature contains a number of wires or conductors corresponding with the conductor (a b) of Faraday's early motor. The field magnets are electro-magnets excited by the driving current. Besides the armature and the field magnets, brushes must be provided for leading the driving current into and out of the armature. These three parts of a motor, the armature, the electro-magnets and the collecting brushes, correspond to similar parts of the dynamo.

In the electric motor it is generally the armature that revolves and the field magnets that are stationary. In some cases, however, the reverse is true. The armature is stationary and the field magnets revolve. This is especially so in some forms of alternating-current motors in which no little difficulty sometimes exists as to which part may properly be called the armature, and which the field magnets. In order to avoid this difficulty the part that rotates is called the rotor, and the part that remains stationary, the stator.

There are many points of resemblance between the dynamo and the electric motor. In the dynamo, in order to generate E. M. F.s in the armature loops, they must be rotated in the magnetic flux of the field magnets, so as alternately to fill and empty them with flux. When the E. M. F., so produced, set up an electric current in these loops, a considerable force must be applied to the armature in order to turn it. This force is necessary in order to overcome the electro-dynamic force produced in the armature loops by the interaction of their fluxes with the flux of the field magnets. In other words, a dynamo-electric machine acts also as a motor, and produces electro-dynamic forces that tend to oppose the force driving it

In a similar manner, when an electric motor has a current passed through its armature coils, the armature is rotated under the influence of the electro-dynamic force. But its rotation through the field sets up electro-motive forces just as if the armature had been rotated through the flux by means of a pulley. These electro-motive forces, however, are oppositely directed as regards the electro-motive forces that are sending the current through the armature and the external circuit. They are, therefore, known as counter-electro-motive force. In other words an electric motor acts also as a dynamo and produces the electro-motive forces counter in direction to those of the driving current.

It is by reason of the above facts that any dynamo is capable of acting as a motor; and, conversely, any motor is capable of acting as a dynamo, or, in other words, the two devices are reversible. This was shown during the Vienna Exposition in 1873. A Gramme dynamic-electric machine driven to produce electric current, was caused to drive a second dynamo-electric machine as a motor placed at a distance from the generator and connected with it by an electric circuit.

The importance of the above general principle can be readily understood from its application to the electric transmission of power, since by this means it is possible to employ dynamos or generators at one end of a line where power is cheap, as for example at a waterfall, and transmit the current so produced to the other end of the line, where by passing it through another dynamo, drives it as a motor. In this way it is possible practically to utilize the energy of cheap water power, convert it into electric energy and transmit it to almost any distance.

Direct-current motors can be divided into three different classes according to the connection between the circuits of their field magnets and armatures, or according to the number of coils of wire on the field-magnet cores. These classes include shunt-wound motors, series-wound motors, and compound-wound motors, motors that agree practically in construction with the series-wound, shunt-wound, and compound-wound generators referred to in the chapter on the dynamo-electric machines.

The counter electro-motive force produced by a motor while rotating under the influence of a driving current through its armature coils acts as a spurious or false resistance, so as to oppose the passage of the driving current. Consequently, as the speed of an electric motor increases the strength of its driving current becomes less, until, when a certain maximum speed is attained very little current passes. When, however, a load is placed on the motor, that is, when it is caused to do work, its speed of rotation is reduced and the counter electro-motive force is decreased, so that the amount of driving current increases. In this manner the load on an electric motor automatically regulates the current required to drive it. In this way electric motors are extremely economical in operation.

Generally speaking the losses occurring in electric motors are similar to those in dynamo-electric machines. They arise from mechanical friction; magnetic friction or hysteresis; i. e., from the expenditure of energy in reversing the magnetism in the iron or steel of the motor; and from electric losses due to the production of eddy or foucault currents in the iron or steel of their cores, or in the copper of their armature loops.

Of late years alternating-current motors, or those operated by alternating currents, have increased so rapidly that motors of this class bid fair greatly to exceed in number direct-current motors.

When two alternating-current motors are connected in the same circuit as a generator and motor respectively, the motor will not start from a state of rest as will a direct-current dynamo. The alternating current motor must first be brought up to the same speed as that at which the generator is rotating. Such motors were called synchronous alternating-current motors, and were brought up to required speed by means of special windings placed on the armatures that permitted them to act as direct-current machines under light loads; or, the necessary speed was given to them by means of storage batteries or auxiliary motors. This difficulty has been obviated by the development of what are known as multiphase alternating currents employed to drive what are called multiphase motors.

As we have already seen, multiphase alternating circuits are circuits through which two or more independent alternating currents possessing a difference in phase are passing. Alternating current systems consist practically of two different kinds, diphase and triphase systems.

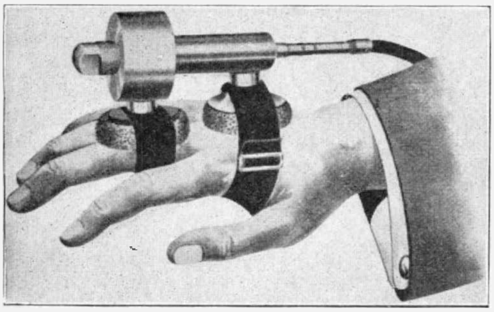
Without going into a description of the multiphase alternating current motors, it is sufficient to say that such motors are constructed so that when the stator or stationary coils are traversed by multiphase currents the rotor or rotating coils are set into motion.

Roughly speaking, multiphase motors can be divided into two classes, both of which are provided with rotating fields. In one class the rotating field acts on a magnetized armature which after being set in rotation keeps in step or synchronism with the rotating field. The other class is provided with a rotating field that acts to induce currents in the armature by the difference in speed between the rotating field and the rotating armature. The armature, therefore, never quite attains the speed of the field but lags behind it by an amount that is dependent on the load. The first class include what are known as synchronous, multiphase motors, and the second what are known as induction motors.

(To be Continued.)

Combining Hand and Vibratory Massage

Hand massage has its peculiar advantage in that the deftness of touch of the skilled operator and the certain amount of personal magnetism which may be imparted have a soothing effect on the subject. Likewise, purely mechanical massage such as is obtained by the electrically operated vibrator has the



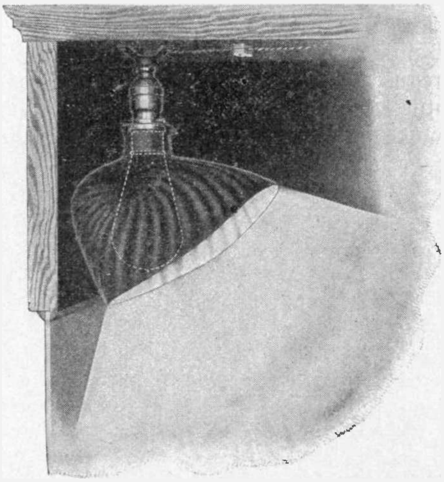
AN ODD ELECTRIC VIBRATOR

advantage of deeper action and the stimulating effect of impact upon the tissues.

In the unique vibratory massage device here shown strapped to the hand of the operator, a new principle is involved, and the advantages of both hand massage and mechanical vibration are secured. The little pads strapped to the back of the operator's hand are made to vibrate by power imparted from an electric motor through the agency of the flexible shaft shown. These impacts or vibrations are transmitted through the hand to the subject. At the same time the effect of ordinary hand massage is obtained.

"Scoop" Reflector for Window Lighting

In these days of constantly increasing cost of operating expenses in the conducting of a business, it must be interesting for the merchant to realize that in the department of window lighting, at least, better results can be obtained and at the same time at a very great saving in cost. This is due largely to



REFLECTOR FOR AVERAGE SIZED WINDOWS.

the high efficiency tungsten lamp and advanced ideas in window illumination.

While reflectors have been made for extremely high windows (12 feet or over), and for low windows, that handle the illumination economically, there has been a great demand for an efficient reflector to handle the illumination of the average sized window to use with tungsten lamps.

The most recent development along this line is the "scoop" so called owing to its peculiar shape. It is a one piece, pure silver plated reflector, having the greatest efficiency known.

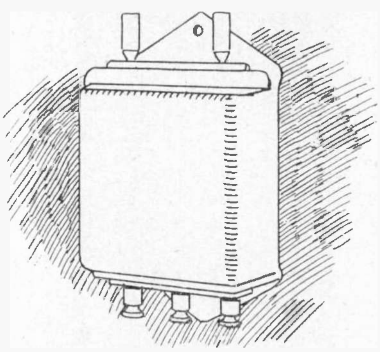
The great demand by the merchant is for a reflector that will take the tungsten lamp in pendant position and numerous inquiries have been made for an appliance of this kind. This reflector not only takes the lamp pendant, but is so designed that it will handle the rays of light correctly from the 40, 60 or 100 watt tungsten lamp.

It is easily attached to the ceiling, an ordinary socket and crowfoot being used for this purpose, and is comparatively inexpensive.

As will be noticed by its shape, the window side of this reflector comes in at a slight angle, which cuts the rays of light sharply at the lower window line, bringing the greater intensity of the illumination just where required throughout the window and decreasing in brilliancy at the upper part.

How to Get Low Voltage Current

Many times in experimental work and also in the operation of electric bells, annunciators and similar apparatus it becomes necessary to reduce the ordinary 110 volt alternating lighting current to, say, from four to 12 volts. The accompanying sketch represents a type



TRANSFORMER TO OPERATE ELECTRIC BELLS

of small transformer for this purpose, known as the Wayne, which, when connected across the 110 volt mains gives three different voltages from the secondary terminals, namely, four, eight and 12 volts.

In electric bell wiring, due to the fact that frequently the bell wires are run along the floor and are apt to be short circuited, this transformer is designed so that it will run for several hours on dead short circuit without danger of burning up. This feature makes the transformer especially valuable for this class of work. It is also designed so as to have ample capacity for ringing large size bells.

The casing is of cast aluminum with a heavy coat of black japan, making it ornamental and far more pleasing in appearance when installed than the dry cells commonly used. This allows the transformer to be installed in places where the appearance of the dry cells would not permit of them being placed.

American Exposition in Berlin

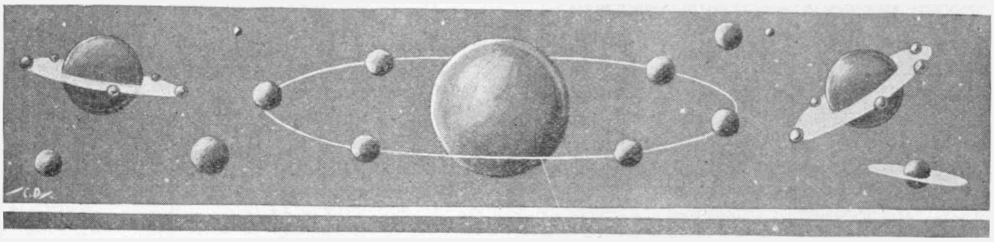
Manufacturers and business men throughout the country are displaying a lively interest in the American Exposition which is to be held in Berlin during June, July and August of this year. It is but natural that the United States should seek to hold an all-American exposition in Europe, for our export trade in that direction has reached splendid proportions and is constantly increasing.

The Exposition will afford the electrotechnical industry of this country a splendid opportunity to show the advance that has been made in America along this line. Americans are heavily interested in Europe and the industry could be greatly benefited by a representative exhibit at the Exposition.

There has just been issued by the American committee, whose office is at No. 50 Church street, New York, an attractively arranged prospectus of the Exposition, which, in addition to outlining the objects and advantages of the enterprise, contains many photographic views of the Exposition Palace and portraits of the distinguished sponsors of the undertaking.

It is interesting to note that the prospectus emphasizes the practical benefit of an Exposition held in the heart of Europe rather than making an appeal to the national pride of prospective exhibitors. The booklet draws attention to the illustrious auspices under which the Exposition is to be held and lays stress upon the value this will have in enhancing American interests abroad. Prince Henry of Prussia, brother of the Emperor, is president of the German Reception Committee, while in this country J. Pierpont Morgan is president of the committee which is directing the work of selecting representative exhibits. Former Governor Francis is first vice president and John Wanamaker, the merchant prince, is second vice president of the committee.

ELECTRIFIED SATELLITES OF UNSEEN WORLDS



THE ELECTRON THEORY OF ELECTRICITY

By DAVID PENN MORETON

When we stand out of doors on a frosty winter night and gaze into the heavens as far as our puny human eyes will permit, we try to obtain a conception of the Infinite. We try as best we can to realize that the hundreds of thousands of stars which we see, at distances which to us are inconceivably great, are, to the universe which lies beyond and beyond, of relatively no more importance than the atoms which go to make up the water of the sea. It is but an easy step then to imagine that the universe is one immense solid made up of atoms which are the stars, groups of these stars, like our sun and its planetary system forming molecules as we conceive of them in the study of chemistry of physical substances.

However vague and fantastical the above theory may be it will be a help to us in understanding that substances which we know as solids—the point of a lead pencil, a bar of steel, a granite mountain—may well within the limits of our imagination be made up of an infinitely great number of minute particles which do not touch but are separated from one another by distances which, compared with their diameters, are tremendously great. In other words it is no more difficult to comprehend the infinitely small than the infinitely great, and in what is to follow let us try and pin our imaginations down to the idea that everything which we see and know as solid matter is made up of unseen worlds all operating according to Nature's laws.—Editorial Note.

There is no branch of human knowledge in which greater difficulties have been encountered in framing an adequate theory than in the science of electricity. The great variety of electrical phenomena, the constant increase in facts and new discoveries, and the intangible nature of electricity itself have all combined to render the formulation of a theory, that would hold under all conditions and tests, very difficult.

A theory must fulfill two requirements: first, it must register a large number of isolated facts in due order; second, it must give an insight into the connection of these various facts with each other and to forecast new facts and discoveries. The electron theory of electricity fulfills the above two requirements in a manner which no previous theory of electrical phenomena has been able, even remotely to approach.

This new theory gives an insight into electrical and magnetic phenomena which was impossible so long as we knew nothing about the real nature of electricity. Electricity is now treated as a kind of subtle fluid, consisting of electrons or very small corpuscles, something like thirty thousand times smaller than the atoms of ordinary matter. The electron theory reduces all electrical and magnetic phenomena to the distribution and motion of these electrons. Then in order to understand this theory we must first get a clear grasp of the nature and properties of the electron.

An electron is the smallest electrified body capable of separate existence. Its mass is approximately $.61 \times 10^{-27}$ grams. It may be explained that 10^{-27} means, to the mathematician, one divided by 10 raised to the 27th power, or in other words, one divided by 10 with 26 more ciphers added. This is certainly contemplating almost the infinitely small when it is remembered that a thousand grams equals only 2.2 pounds. The radius of an electron is estimated at

10^{-13} centimeters. The charge it possesses consists of what has been called "negative electricity"—the electricity possessed by a piece of sealing-wax that has been rubbed with wool. This electron has a fundamental property which distinguishes it from ordinary matter, it repels another electron instead of attracting it, as two particles of matter would do. If it were possible to place two electrons one centimeter apart in a vacuum there would be a force of repulsion of something like $1.16x10^{-19}$ dynes, which in every day language is something like a quadrillionth of a pound. (The dyne is the force which, acting for one second on a mass of one gram, will produce a speed of one centimeter per second.)

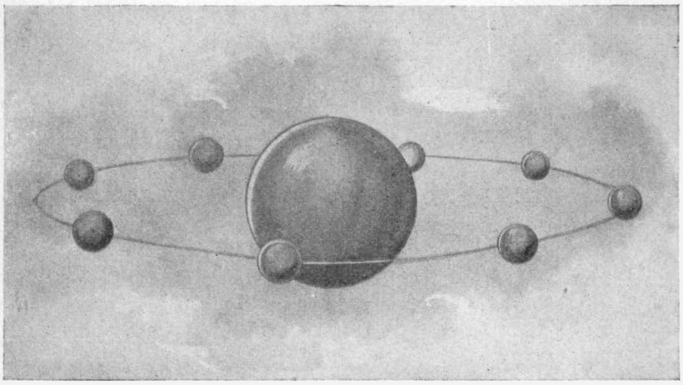
This force is extremely small in comparison to any the greater majority of persons may have in mind. It, however, is enormous when compared to the gravitational attraction, which accounts for the weight of bodies on the earth's surface and the motion of all heavenly bodies. The force between the two electrons is approximately 10^{43} (10 multiplied by itself 43 times) times as great as the gravational attraction.

The following imaginary experiment may illustrate to a better advantage the relation of the two forces. If two masses, say of lead, weighing one gram each, were placed one centimeter apart they will attract each other with a force of $6.6x10^{-8}$ dynes, which is entirely too small for any known instrument to measure. But let two grams of negative electricity be placed one centimeter apart and there will be a force repelling the two of approximately $31.4x10^{34}$ dynes or about 320 quadrillion tons. If now one gram of the electricity be replaced by an electron the force repelling the two will be approximately 194 million dynes.

From the above it is quite evident we are dealing with a very minute quantity of free electricity in all ordinary electrical phenomena. The amount can be approximately determined in the following way. The laws of electrolysis state that every atom of matter is capable of uniting with a definite quantity of electricity, it does not depend upon the nature of the element, but is directly proportional to its chemical valency. If hydrochloric acid is decomposed by electrolysis each atom of chlorine carries to the anode a definite quantity of negative electricity and this quantity is measurable with a galvanometer. The weight of the chlorine given up by the acid and the weight of the chlorine atom will furnish a means of calculating the quantity of electricity transferred by each atom of chlorine. This quantity of electricity corresponds to one electron as near ac can be determined by the above method. This leads to the conclusion that every chlorine atom in the electrolytic cell has an electron associated with it, and in such a manner that it can be detached when a finite force is brought to bear upon it.

Other elements as well as chlorine, such as hydrogen and the metals, do not carry this electron with them when they are in the normal state, hence they are not charged. Each one of the atoms contains a certain number of electrons, but they produce no external effect, it being compensated by some force within the atom which is called positive electricity. Hence when a body has an excess of electrons it is said to be negatively charged and when there is a deficiency of electrons the body is said to be positively charged. When a ball is charged the electrons or positively charged atoms do not leave the surface of the ball due to their mutual repulsion, but on account of the great resistance they encounter at the surface they take a position of equilibrium on the surface itself and stay there, leaving the interior of the body uncharged.

The question might properly be asked, does the charging and discharging of a body produce any apparent change in its weight? This question can be answered in the following way. Suppose two copper balls were suspended side by side by insulating fibers one meter long. Then suppose, they each have imparted to them equal negative charges of electricity so that they are repelled apart to a distance of one centimeter. The force required to cause the balls to assume this position is about one two-hundredth part of their weight for this particular length of fiber. This being the case how many free electrons must there be to produce the necessary repulsion? Let the radii of the balls be one-tenth of a centimeter. The weight of each ball then would be 0.0375 grams and the force of repulsion would be .000187 grams or .184 dynes. Since each electron produces a force of repulsion of $1.16x10^{19}$ upon another electron one centimeter away, the number of free electrons required on one ball, if there were only one free electron on the other, would be $1.587x10^{18}$. If these free electrons were distributed equally between the two balls there would be 1260 million on each. This seems to be a very large number but it is only a small part of the total number of electrons present. Each of these balls would contain about 5150 billion atoms. Copper being divalent there will be twice as many detachable electrons as atoms or 10,300 trillion. The ratio



WHEN ELECTRON ORBITS ARE IN THE SAME PLANE THE SUBSTANCE IS PARAMAGNETIC.

of detachable electrons to free electrons in each ball would then be

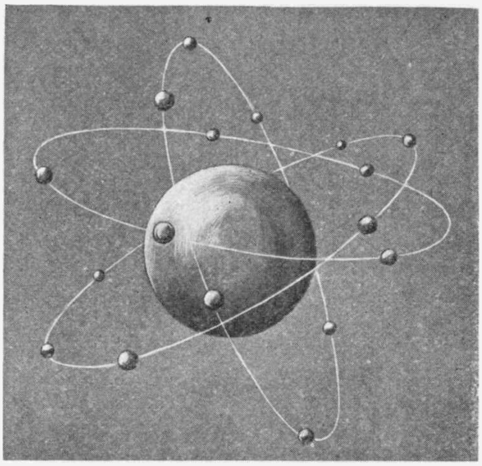
$$\frac{10{,}300 \text{ trillion}}{1{,}260 \text{ million}} = 8 \text{ billion}$$

It is found practically impossible to remove more than one-billionth of the detachable electrons or to add more than that proportion of what was already there. Hence there is no appreciable change in the weight of a body when it is charged and discharged. In some cases, however, a body is disintegrated due to the continuous discharge of electrons or positive atoms, as the cathode in a vacuum tube.

The distinction between conductor and insulator according to the electron theory is made in the following way: The electron is supposed to revolve about the atom with such a velocity that the centrifugal force from this motion is equal to the force the atom is exerting on the electron. All metals are thought of as being a mass of closely packed metallic atoms so that the electrons can easily change from one atom to another with very little loss of energy. In an insulator the electrons are not capable of moving outside the range of the atoms to which they are attracted. They are displaced by an electric force but return to their original position, more or less rapidly, when the force is removed.

The magnetic properties of all bodies can be explained by means of the elctron theory in the following way. The atoms of all bodies are surrounded by electrons describing orbits about them just as all the planets rotate around the sun. When all of these orbits are nearly in the same plane the substance is magnetic or rather paramagnetic. If in addition to this the orbits are large enough to influence each other across the distance separating the atoms the substance is ferromagnetic like iron, cobalt and nickel.

When, however, these orbits, in which the electrons move around the same atom, are not in the same plane the substance is not paramagnetic. They are usually spoken of as diamagnetic. All bodies are really diamagnetic, and paramagnetism is a special property which masks the inherent diamagnetism of the bodies. Hence a permanent magnet is a paramagnetic body



ELECTRON ORBITS IN DIFFERENT PLANES MEANS A DIAMAGNETIC SUBSTANCE

in which the orbits of the greater number of electrons are in the same parallel plane and the position of the orbits is maintained by the attraction of the orbits upon each other.

The treatment of the electron theory in this article has been based upon the existence of the electron, which is one thousand times smaller than the atom of hydrogen. The hydrogen atom has been considered the smallest material particle until recent years. If a vacuum tube is exhausted to one-millionth of an atmosphere, the luminous phenomena previously observed gives away to the phenomena of cathode rays which proceed in straight lines from the cathode or negative electrode and produce a green fluorescence on the walls of the tube. These cathode rays are electrons projected by the cathode at an enormous velocity. The above statement has been proven by repeated experiments and following facts:

(1) The rays convey a negative charge.

(2) They consist of minute particles of matter.

(3) These particles have a mass about one thousand times smaller than hydrogen.

(4) They move with a velocity little less than that of light.

The above results lead to a view of electrification which is very similar to Franklin's "One Fluid Theory of Electricity," which was announced in 1750.

The electrons have been discovered in several fields of research, for instance, the phenomena presented by radium.

In general all the phenomena of electricity and magnetism can be accounted for by the following assumptions:

1. The electric current is the motion of small particles called electrons having a definite and constant charge.

2. These electrons are usually associated with the atoms of ordinary matter around which they move with periods approaching those of visible light waves.

3. There is a force that is constantly acting between the atom and electron but decreases very rapidly with increase of distance.

4. Atoms deprived of electrons repel each other.

5. Electrons mutually repel each other.

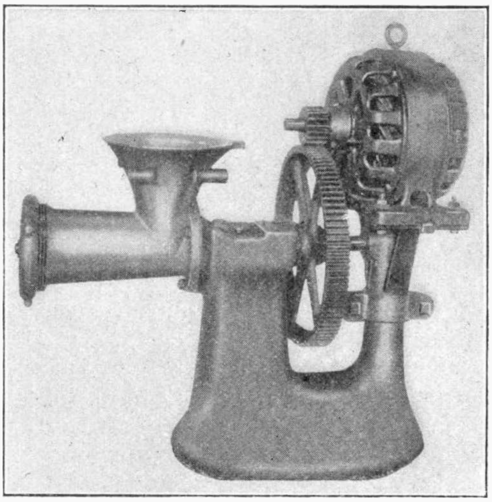
6. When electrons are moving side by side they attract each other with a force proportional to their speed and inversely proportional to their distance apart.

7. A change in momentum of one electron produces a change of momentum in every other electron in the opposite direction.

The above assumptions and their corollaries account for practically all the facts that have thus far been accumulated. The assumptions in this case are not nearly so numerous as in the older theories. If this theory accounts for practically all facts will it be final and the science of electricity then complete? No theory is complete, for the human mind is never contented to take things for granted and is continuously trying to explain the unaccounted-for facts by some new theory.

A New Device for Packing Plants

Improved sanitary conditions as well as efficiency secured by avoiding moving belts and shafting, are important results of employing electric drive in the preparation of food stuffs. A striking example of this is the compact motor driven meat chopping machine shown in the picture. The chopper



MOTOR DRIVEN MEAT CHOPPER

has a capacity of cutting and re-cutting 1500 pounds of beef three times per hour or 3000 pounds of pork twice per hour. The electrical parts are mounted above the floor which is always more or less wet and greasy in a sausage room. Besides the protection from dirt and grease thus afforded the motor, virtually no space is wasted by the driving apparatus. The self-contained construction also prevents the stirring up of dust and foreign particles in the chopping room. The motor is of 10 horsepower, although only about 7½ horsepower is required for normal operation.

Talks With the Judge

HE WANTS TO KNOW ABOUT WIRELESS TELEGRAPHY

"Of all the wonders of electricity wireless telegraphy is to me the most mysterious," said the Judge to me one afternoon as we sat in his library with nothing more important on hand than to smoke some of his "advertising cigars" and let the conversation run to our favorite topic, electricity. As we gazed out of the window we could barely discern in the dusk the skeleton outlines of the 200-foot steel tower of the wireless telegraph company. As it stood there in its symmetry and strength but with no outward manifestation of the throbbing messages which might even then be leaping with the speed of light from the graceful sweep of its antennæ wires we felt a little awed.

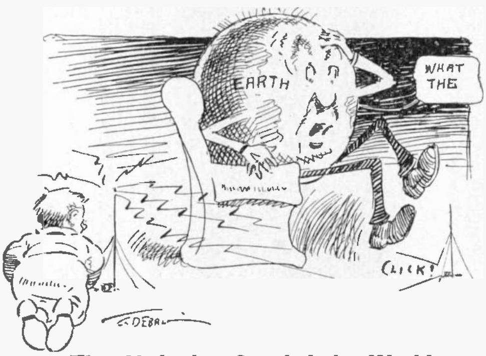
"It isn't human, it isn't mechanical, I might almost say it isn't natural," said the Judge, after a moment's pause. "But there it is. The fellow in that little house underneath the tower jabs a key, so they tell me, and two hundred miles up the lake a man in a steamer hears and understands—and nothing is between them but the howling elements. I've tried a good many times to find out how it is done. A lot of people have tried to tell me. But maybe I'm dense is the reason I couldn't seem to interpret their wise looks and technical jargon."

I puffed a little ring of smoke out into the air. "See that ring, Judge?" said I. "Scientists have built up one of the most beautiful theories you ever heard of on the nature and construction of matter, based on that little whirling circle or vortex of smoke particles. The light which you see coming from the evening star is a form of vibration, only, which tickles your optic nerve and makes you think you see a star. These are only theories built upon the results of countless experiments coming at the subject from every conceivable standpoint, but when they in every case bear out the results of observation we have the right to say that they are true until disproved, and to use them to work out new problems. Therefore, as wireless telegraphy is based on a theory which so far has apparently held good and enabled experimenters working upon it to go ahead and perfect the system I am going to insist that you take the theory as I expound it to you as Gospel truth. If you do that I think I can make you understand in a measure how wireless messages are sent and received."

"That Vibrating Jelly Gets Me"

"In the first place the medium which transmits wireless messages is not the air as many suppose, but a medium which we are pleased to call the "ether." The ether fills and permeates everything through all the depths of infinite space. It fills up what would otherwise be the "emptiness" of the universe. In this ether float the sun, moon and stars; in it also float the infinitely small particles which go to make up an apparently solid bar of steel, block of wood or any physical substance. The ether is also perfectly elastic and you may think of it as a vast mass of jelly susceptible to vibration. It is through the vibrations of this ether that light is transmitted, also electrical disturbances which affect wireless apparatus.

"When the ether is disturbed by certain electrical means, as I shall try to explain later, vibrations are sent out in all directions and through all substances, for the ether permeates them all. Far away other electrical devices are set up to be affected by these vibrations and so to transform them that they may be perceived by our senses. Take sound as an analogy. Your vocal cords set up vibrations in the air, which



The Click that Startled the World

travel out in every direction and reaching the ear drums of the hearer cause them to vibrate in unison.

"Now I will attempt to explain how the vibrations are set up in the ether, taking as an example only the most simple devices used for the purpose. The essential device is a "spark coil" as it is called. It doesn't vary essentially from the ordinary induction or medical coil from which you have no doubt received a shock at some time or other. Without going into the theory of the coil it may simply be said that a very high voltage or pressure is developed between the two terminals of its secondary winding which is enough to make a spark or discharge jump across from one terminal to the other.

"Hertz discovered that this discharge from an induction coil would set up vibrations in the ether called after him Hertzian waves. A little later Marconi applied them to wireless telegraphy. Therefore, every time the operator presses the key which closes the circuit of the coil a spark jumps across the spark gap and in so doing sends out an ether wave. It was soon found that this wave was made to travel out much more effectively if one terminal of the spark gap were grounded and the other connected to a wire or wires run up into the air, which wires are called the antennæ, meaning "feelers." This is about all there is to the most simple form of sending equipment.

"At the receiving station we find the same antennæ wires suspended high up in the air. From the antennæ a wire runs down and enters one end of a little sealed glass tube, terminating in a little disk. From a similar disk a half an inch or so along in the tube a wire runs out and down to the ground. The space between the disks is filled with loosely packed metal filings.

"Now a peculiar thing happens to these filings when a message is being received. The ether wave sent out by the distant station affects the receiving aerial and a sort of electric shock or vibration runs down the aerial which magnetizes the little metal filings. These particles then become small magnets and they immediately arrange themselves with their long diameters all in the same direction.

"Strange, isn't it, but theory said they ought to do it even before someone found they would do it.

"It now remained a simple matter to connect a wire from a battery to the wire leading into the tube. Then a wire from the other side of the battery was run through a telegraph relay and sounder and from there a wire was led to the wire which came out of the tube on the opposite side of the filings. There you have a complete local circuit with a battery to give power and work the telegraph sounder.

When the filings are all mixed up every which way they make poor contact with each other and the battery current can't get through.

"Crash! The distant operator's key has been closed and an ether wave has jumped across the intervening space in an instant of time, electrified the receiving aerial and magnetized the filings. They are now all arranged end to end and clinging together so tightly that an easy path is made for the battery current which rushes through, and Click! goes the sounder. A wireless message has been received. When Marconi first produced this click he startled the world.

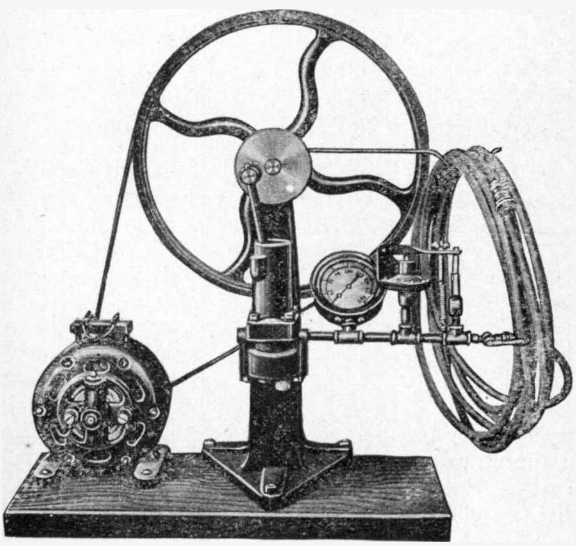
"At first Marconi had to tap the glass tube to decohere the filings so that they would be ready for the next signal. Then he rigged up an automatic tapper or decoherer worked by the battery. Then other types of detectors were discovered which would affect a telephone receiver and cause its diaphragm to click. But they are all modifications and I have explained to you as well as I can the fundamental principle of wireless telegraphy.

"Hurray!" said the Judge. "I almost get you, all except the ether part. That vibrating jelly gets me."

"That's the theory part," said I, "but I told you in the beginning that you would have to take the theory for granted. Because the ether is a theory doesn't prevent the wireless telegraph from operating, does it? If it hadn't been for the theory that there was an ether, it isn't likely that Hertz would have started nosing around trying to disturb it."

Automobile Tire Filler

This little machine, consisting of an improved type of air pump driven by a one-sixth horsepower motor will fill an automobile tire, having a capacity of four gallons of air space, to a pressure of 100 pounds to the square inch, in four minutes. It is provided with hose and attachments, pressure gauge and safety valve. The pump has but few parts, all extra heavy to insure against breakage and wear. Simply set the safety valve, shut the stop cock and start the motor. Then turn the thumb nut of a simple regulating device until the gauge registers what you want. It is done in a jiffy.



IT WILL FILL AN AUTOMOBILE TIRE IN FOUR MINUTES

Electrically Heated Oil Filter

One step in the "Eclipse" process of filtering oil is to wash it in hot water. The oil

OIL FILTER

is liberated at the bottom of a washing-chamber partly filled with water, which is kept at a certain temperature. Usually, this hot water washing-chamber is equipped with a coil through which hot water, or exhaust steam, can be circulated.

If the location of the filter makes this inconvenient, or if steam, or hot water, is not available, an electric heater may be used effectively. This scheme is particularly useful in gas engine electric and hydroelectric plants, sub-stations, etc.

The heater can be controlled with different plugs or switches, so as to produce to a nicety the temperature desired for a certain rate of flow of oil through the filter.

Heating the filter electrically is, of course, not as cheap as if steam or hot water were used, that is, in plants where there are boilers installed. But in waterpower and gas-engine plants this is not the case.

Where Electricity Stands in the Practice of Medicine

By NOBLE M. EBERHART, A. M., M. S., M. D.

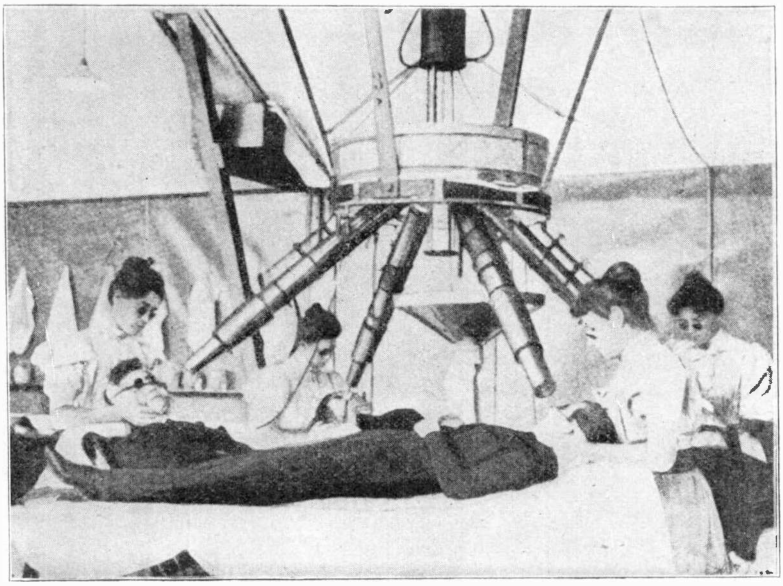
CHAPTER III.—THE FINSEN LIGHT AND X-RAY IN LUPUS

How many of my readers have amused themselves in childhood days by breaking up a beam of sunlight with a glass prism, producing thereby the colors of the rainbow?

How many of those who in after years observed the working of that useful instrument, the spectroscope, ever thought of the possibility of applying the different colors to use in the treatment of disease?

If you never experimented with a prism you certainly have used a lens and concentrated the rays of the sun until the heat evolved set fire to wood or paper; and you have noted the chemical changes wrought on the sensitive surface of a photographic plate by the action of light.

In all probability, if you knew, you scarcely gave a second thought to the fact that the heat in the first instance was due principally to the red rays contained in the white light; and the chemical effect on the photographic plate to the blue and violet rays (chemical rays).



FINSEN'S APPARATUS FOR TREATING WITH ULTRA-VIOLET LIGHT

The white beam when split up by the prism shows the following colors, in the order named: red, orange, yellow, green, blue, indigo and violet, and these are known as the prismatic colors, and were formerly considered also the primary colors. Of late years there has been a tendency to drop out the orange and indigo as primary colors.

These colors are the result of vibrations representing different wave lengths and also difference in speed. The more rapid the vibrations the shorter the wave length. The lowest number of vibrations produces the red and the highest the violet. Between these, the others are graded. Vibrations below the red that produce heat, but are not visible to the human eye, are called the infra-red rays. Those more rapid than the violet, and also invisible, are called ultra-violet. Infra-red rays are also spoken of as ultra-red.

The red rays produce heat, the yellow and green are luminous or light rays and the blue and the violet are the actinic or chemical rays.

That dreaded disease, lupus, was conquered through the observations of Finsen on the effects of the various forms of light.

Lupus, which is Latin for "the wolf," is well named, for it fastens its fangs on the human skin with the pertinacity and ferocity of the animal for which it is named.

It is in reality tuberculosis of the skin and is a disease much more common abroad, especially in Northern Europe, than it is in America.

The history of Finsen's life, and of his investigations and experiments, reads like a romance.

His primary observation was of an old cat "sunning herself." As the shadow of the tree beneath which she lay would creep upon her, pussy would get up and stretch herself and move into the sun. This fondness of the cat for the sun first awakened Finsen's interest.

Later he observed that insects disporting on the surface of a stream hastened back into the sunlight when they had floated into the shadow of the bridge on which he was standing.

From this he carried on experiments to ascertain the effects of different colors on insects.

That the sun contained chemical rays to which had been ascribed "germ-destroying" or "disinfecting" powers was already known. In subjecting insects to the action of light, they were placed in a box covered by panes of different-colored glass.

Earthworms, earwigs and butterflies were the chief objects experimented on. This is tersely described by Riis, who had his information directly from Finsen's own lips. Finsen noted first that the bugs that naturally burrowed in darkness became uneasy in the blue light. As fast as they were able they got out of it and crawled into the red, where they lay quiet and apparently content. When the glass covers were changed they wandered about until they found the red light again. The earwigs were the smartest. They developed an intelligent grasp of the situation and soon learned to make straight for the red room. The butterflies, on the other hand, liked the red light only to sleep in. It was made clear by many such experiments that the chemical rays, and they only, had the power to stimulate; to "stir life." Finsen called it that himself.

"That this power, like any other, had its perils, and that nature, if not man, was awake to them, he proved by some simple experiments with sunburn.

"He showed that the tan boys so covet was the defense the skin puts forth against the blue ray. The inflammation of sunburn is succeeded by the brown pigmentation that henceforth stands guard like the photographer's ruby window, protecting the deeper layers of the skin against the effect of the blue or chemical rays.

"The black skin of the negro is no longer a mystery. It is his protection against the fierce sunlight of the tropics and the injurious effect of its chemical rays.

"Searching the libraries of Copenhagen for records of earlier explorers in his field and finding little enough there, Finsen came across the report of an American army surgeon on a smallpox epidemic in the South in the thirties of the last century.

"There were so many sick in the fort, that every available room being filled, they had to put some of the patients into the bombproof, to great inconvenience all around, as it was entirely dark there. The doctor noted incidentally that, as if to make up for it, the underground patients got well sooner and escaped pitting. To him it was a curious accident, nothing else.

"Upon Dr. Finsen, sitting there with the seventy-five-year old report from over the sea in his hand, it broke in with a flood of light. The patients got well without scarring because they were in the dark. Red light or darkness, it was all the same. The point was that the chemical rays, that could cause sunburn on a glacier, were barred out. Within a month he jolted the medical world by announcing that smallpox patients treated under red light would recover readily and without disfigurement."

Thus Finsen, who had never seen a case of smallpox, discovered a means of lessening its disfiguring effects, as well as abrogating the severity of the disease.

His attention was then directed to the blue rays. If they could produce chemical effects, why could they not be utilized for beneficial results under suitable circumstances?

The first difficulty was in the lack of penetration possessed by these rays. How could they be made to destroy germs within the skin, when they could not penetrate its deeper layers?

He experimented with sensitized paper, placed behind the lobe of his wife's ear. After a five minutes' exposure the paper was unaffected. Then he reasoned out that it was the red corpuscles in the blood which blocked the blue rays, and proceeded to press out the blood in the ear lobe by placing it between two layers of glass. The sensitized paper was again exposed and was darkened by twenty seconds' exposure.

He had solved the problem!

In the Finsen apparatus a powerful arc light is used consuming sixty to eighty amperes of current. The heat rays are filtered out by cool water passing through the tubes and lenses. The latter are made of rock crystal, because glass, to a certain extent, obstructs the passage of the chemical rays.

The attendants press a lens over the part under treatment to press out the blood and permit the rays to penetrate the tissues.

The light which comes through the lens contains only blue, violet and ultra-violet light. It is perfectly cold and leaves no irritating effect in its passage deep down into the underlying tissues.

One of the illustrations shows Finsen's original apparatus treating four patients at one time.

The duration of a treatment is one hour. The London Hospital lamp is also now frequently used throughout England and this country in place of the Finsen apparatus.

There is something pathetic in Finsen's patient and courageous work, suffering, as he did, from an incurable disease which caused his death at the early age of forty-three.

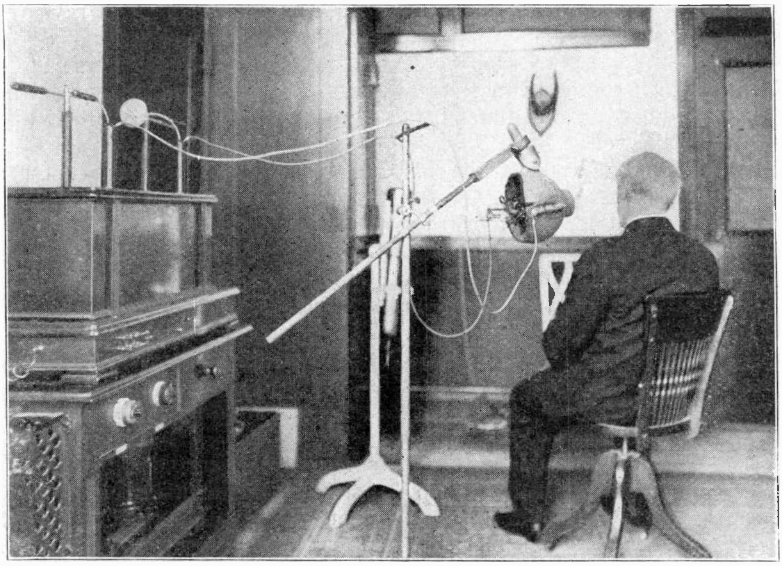
None of his discoveries were patented. All were given freely for the benefit of humanity. It was with difficulty that he was induced even to accept part of the Nobel prize which was awarded him. Regarding this prize Finsen said, "They gave it to me this year, because they knew that next year would have been too late."

This was only too true, for in less than a year he was dead.

In this country, owing to the scarcity of the Finsen apparatus, the X-ray has been used almost universally for the treatment of lupus.

As between the Finsen light and the X-ray, the former is unquestionably superior for lupus, but the percentage of superiority is comparatively slight, and probably overcome by the greater convenience in using the ray as well as its accessibility.

Lupus occurs in several forms. The ordinary type of it is known as lupus vulgaris.



ILLUSTRATING THE X-RAY TREATMENT FOR LUPUS

The Latin term vulgaris means common; therefore, the term literally signifies "common lupus." This is the type which has been successfully treated by the X-ray, and statistics go to show that with reasonable care on the part of the operator, and with proper co-operation on the part of the patient, the result will be the curing of about 80 per cent of the cases. Another form of lupus known as lupus erythematosis, does not as a rule yield to the X-ray and it should not be counted upon to cure this form.

In using the X-ray, a treatment of from five to ten minutes is given, with the X-ray tube about eight to ten inches from the patient. Another of the illustrations shows the application of the ray in an actual case of lupus.

If one is expert in the use of the ray a low vacuum tube placed within four or five inches of the patient, giving a ten-minute treatment three times a week, will be found efficacious. It is customary to cut a hole in a sheet of lead about ½ inch larger than the lupus and thereby protect surrounding parts from the ray. Practically I find that with a tube-shield as shown in the illustration and the use of a little common sense in watching the effect of the ray, it is ordinarily unnecessary to protect surrounding structures in this manner.

The high frequency current is curative in these cases and is applied with the glass vacuum tube, employing a spark of ½ or ¾ of an inch, and passing it back and forth over the lupus for from three to five minutes. This will set up a superficial inflammation with the formation of scabs or crusts which should be allowed to heal before additional applications are made. This treatment is most satisfactory when used after each X-ray exposure.

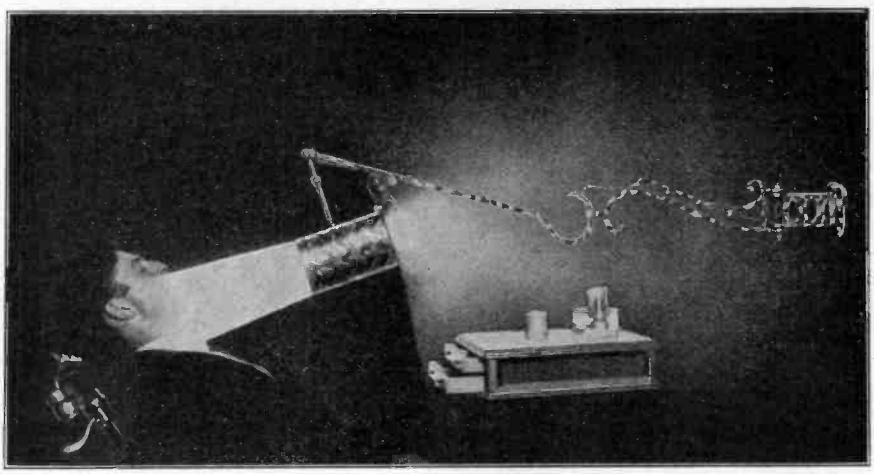
The high frequency spark should be applied especially to the little hard lumps or nodules which exist.

A new method of treatment, which has come into prominence during the last year or two is the application of solidified carbon dioxide, which freezes the part to which it is applied, and which later separates, leaving a smooth scar.

(To be Continued.)

Dentists' Bracket Light

Dentists will find the new Bosworth bracket light particularly convenient. The picture tells almost more plainly than words the unique arrangement of the device. The incandescent lamp as you will notice is so arranged that the rays are projected through a hollow cylindrical reflector so as to strike the face of the patient reclining in the chair, but not so that they will reach the eyes of the operator standing above. At the same time the direct rays of the lamp are allowed to fall upon the instrument stand. The whole arrangement is adjustable to any position.

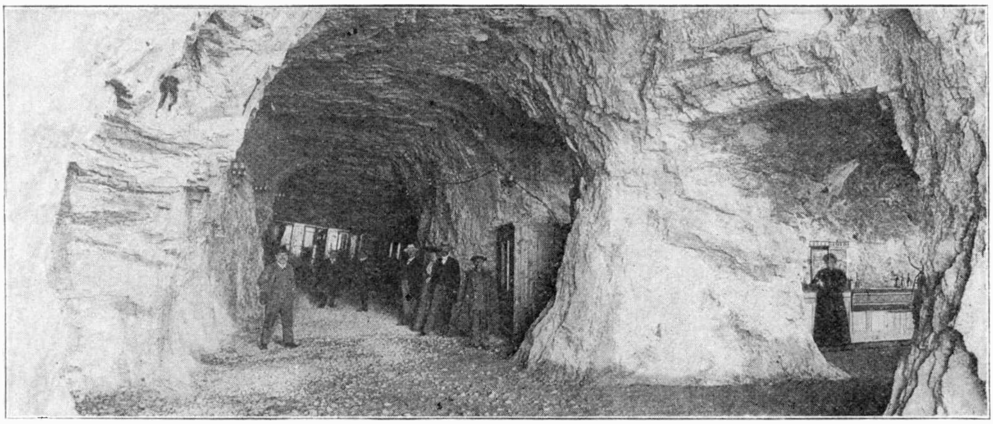


DENTISTS' BRACKET LIGHT

Switzerland—Country of Electric Railways

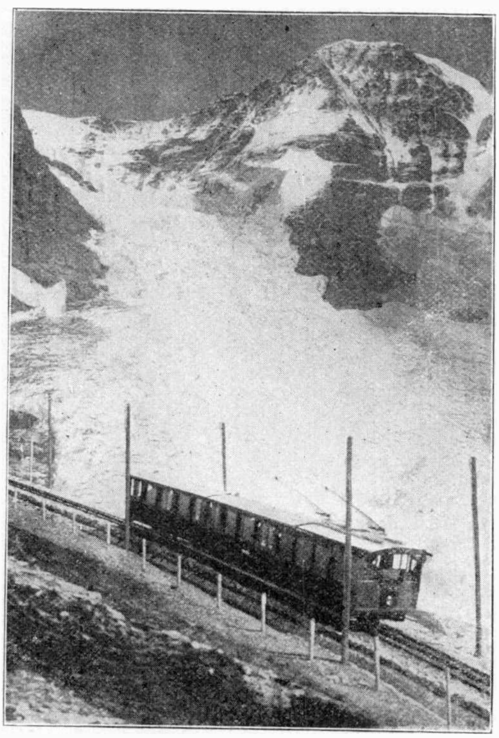
By EMILE RUEGG

It has often been asked why a small country like Switzerland should have such a vast number of electric railways, advancement in this respect seeming to have been very rapid in the last few years. The reason why this fact is not only explainable but very natural may easily be detected when we come to consider the tremendous natural water powers which this country yields and which can all be transformed into electric energy of millions of horsepower with comparatively small means.



TUNNEL STATION ON THE JUNGFRAU RAILWAY

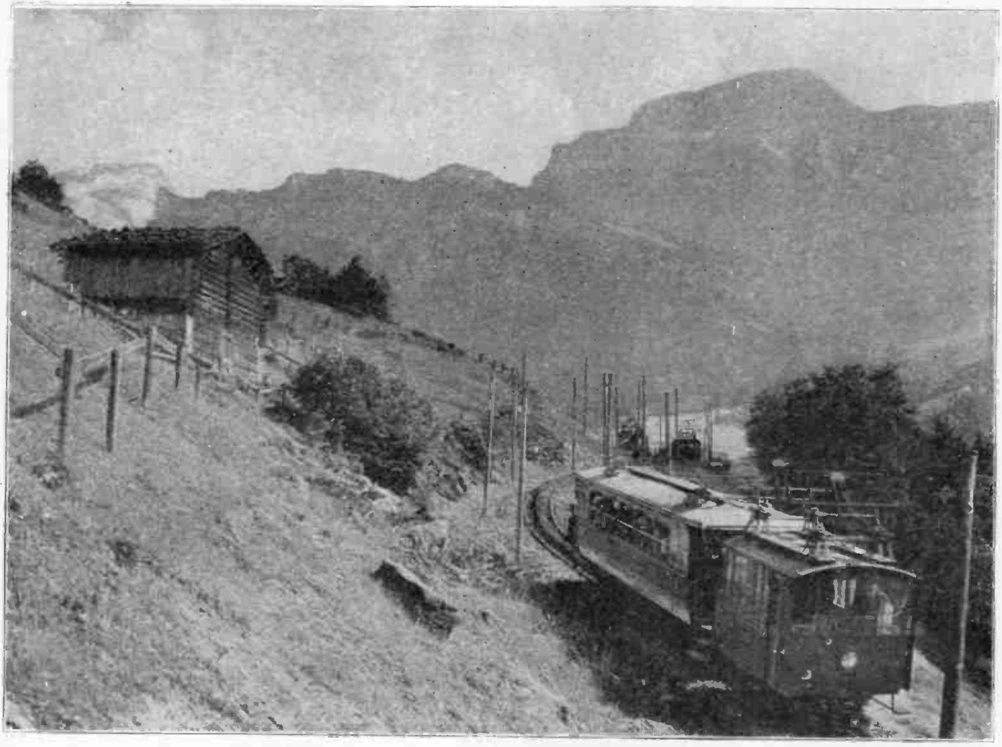
Electric traction is by far the most convenient and economical of all railway systems, especially when the energy to supply the current is water pressure which costs very little. The total expenses to run electric railways being very much smaller than those of steam railways it follows quite naturally that the fares are lower too, a fact which is greatly appreciated by the inhabitants of the little Republic.



JUNGFRAU ELECTRIC RAILWAY

We take it for granted that none of our readers will question these facts and will therefore proceed to show with a few illustrations what a small country can undertake even if its financial resources are very limited.

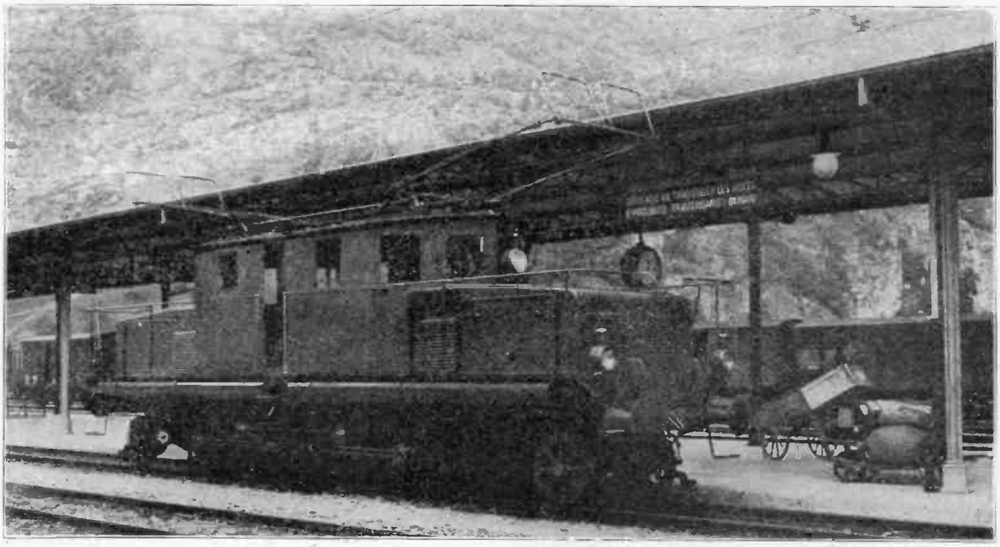
One of the illustrations, which shows an electric locomotive at a station platform, brings before our mind the future locomotive of all our railways. This electric locomotive is of the type used at the world renowned Simplon Tunnel, and the fact that it proves entirely satisfactory in all respects speaks loudly



BEAUTIES OF THE ENGLEBERG MOUNTAIN ROUTE

enough for a possible reformation of the (present) steam railway system.

In another of the pictures there is represented the Engelberg Bahn which is a very successful enterprise like most of these railways. Many a thrifty farmer has been looking at these trains with pleasure as the realization of the most economical railway system. I heard such a farmer once say: "What's the



ELECTRIC LOCOMOTIVE OF THE SIMPLON TYPE

use of running four trains a day with half empty cars when we can have an electric system with two or even one car running every half an hour? When we want to go somewhere we don't want to wait half a day for a dirty black vehicle to take us along."

Perhaps the most gigantic electric mountain railroad in existence is the Jungfrau Railway in the Bernese Oberland. It climbs to the sublime height of 13,664 feet by means of cogwheels. The steepest gradient is 25 per cent. The power station at the foot of the Wengern Alp develops by means of enormous turbines 2,650 horse power, which is led to the top of the Jungfrau. Much of this railway runs in the bowels of the gigantic mountain, the stations being tunnel stations and having the record of being the highest on earth. One of the pictures shows such a tunnel station. Not seen in this picture is the opening, which all of these stations have, giving to the waiting passenger a prospect into the snow and ice region in all its overwhelming grandeur.

All words and human expressions are altogether inadequate to express the stupendous and awful beauty of a sunset seen from these sublime heights. We owe it all to the power which brings us free of danger into the regions of the gods—Electricity.

Electric Light and Power for Country Homes

By LOUIS A. PRATT

PART II.—HOW TO WIRE A HOUSE

Owing to the varying conditions and number of lights which may be met with in residences, general suggestions as to how work should be done are here given. Assuming that if conduit or greenfield construction is installed a regular electrician will be employed, four other methods of installation; namely, concealed knob and tube work, moulding work, open work and fish work are considered. A combination of these methods may be resorted to where circumstances require. A plan, even if only a pencil sketch, should be made out and followed, and the work done carefully. No connections should be made without knowing just why. Any one accustomed to using tools and with a good knowledge of elementary electricity, and possessed of patience should be able to wire the average farm house safely.

The following tools are necessary: One rule, 2-foot; one claw-hammer, No. 13; one blow torch; screw-drivers; one ratchet brace No. 33, with bits; one gimlet bit; one wood chisel; one pair line pliers, 8-inch; one soldering copper, No. 3; one plumb bob; one hack saw, 10-inch; one saw, 20-inch; friction tape; rubber tape; solder and flux.

Assuming that the generating plant is located outside the building to be lighted, service wires (two-wire) must be brought in. The size of these wires depends upon the number of amperes of current the entire installation in the building will take, and for mechanical strength, should not be smaller than No. 12 B. & S. gauge, which will carry 17 amperes or the equivalent of 34 sixteen candle-power carbon lamps.

As previously stated in this series of articles, suppose 110-volt carbon filament lamps be used as a basis for feeders and that all devices are to be "on" at one time. To illustrate how to figure current and to show methods of construction, assume the following to be supplied:

40 110-volt, 55-watt carbon filament lights	2200 watts
2 110-volt, 8-inch fans	75 "
1 7-pound pressing iron	400 "
1 Electric motor for washing machine	100 "
1 Electric sewing machine motor	75 "
1 3-unit electric radiator (250 watts per unit)	750 "
1 Electric toaster	500 "
	4100 "

4100 ÷ 110 = 37 + amperes

As all of these devices will never be used at the same time, provide No. 8 rubber covered wire which is rated by the National Code to carry 33 amperes.

A service switch and fuses may for convenience be installed where the wires enter the building, but insurance rules do not require this if the fuse on the switch board is small enough to protect these wires. Fig. 1 illustrates one way of bringing in service wires in conduit which is continuous from the "goose-neck" (A) into the switch cabinet in the basement. Metal straps (S) secure the conduit by wood screws to the side of the building, and a lock nut and bushing should be provided where the conduit enters the box. The cabinet should be of at least one inch lumber, filled and painted and lined with one-eighth inch asbestos tacked in. Line the door also and provide with substantial hinges and a catch.

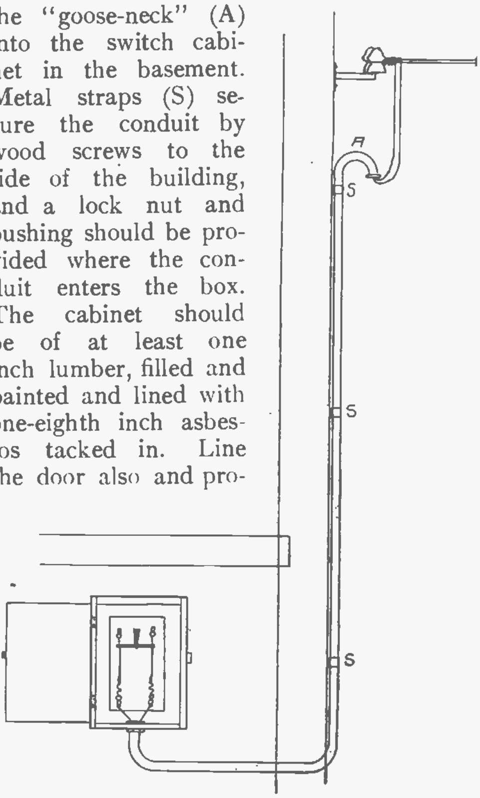


FIG. 1. SERVICE WIRES AND SWITCH

Fig. 2 shows how glass insulators are supported by metal brackets. The brackets and insulators are sold already to put up.

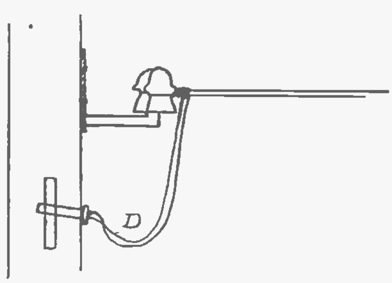


FIG. 2. DRIP LOOPS

Drip loops (D) and porcelain tubes slanting upward towards the inside are shown.

Fig. 3 represents the continuation of wires from Fig. 2, these coming down in the partition on split knobs through the floor line to the basement. Note that above the porcelain tubes running through the wood another set of tubes is provided. These protect the wires from mice and also from plaster which may fall through the lath on "roughing in" the work. In Fig. 3, (PP) shows the porcelain tubes protecting the wires into the wooden cabinet. Cartridge fuses (CC) are shown protecting the service switch. (EE) are two-wire, single-branch plug fuse cut-outs from which lighting circuits may be run up through to the first and second floors where they may be controlled by a snap switch.

In Fig. 1 two wires may be taken off the upper terminals of the knife switch and run up to a cut-out or plug fuse cabinet in the hall from which branch lights may be run to various parts of the house. This method is quite often used and may be, of course, worked out for either way of bringing in the service. In Figs. 1 and 2 the glass insulators should be 12 or 15 feet from the ground.

For concealed knob and tube work split knobs (Fig. 4) are required, and screws instead of nails and leather washers, called "leather-heads" must be used to secure the knobs in place. Fig. 5 illustrates how to protect concealed wires in ceilings or partitions by porcelain tubes through woodwork. Another requirement is shown, that of protecting the wire from the last porcelain support inside the partition to a point at least one inch beyond the outlet (O) by flexible tubing called "loom." In concealed work the wires should be kept at least five inches apart and one inch from the surface wired over.

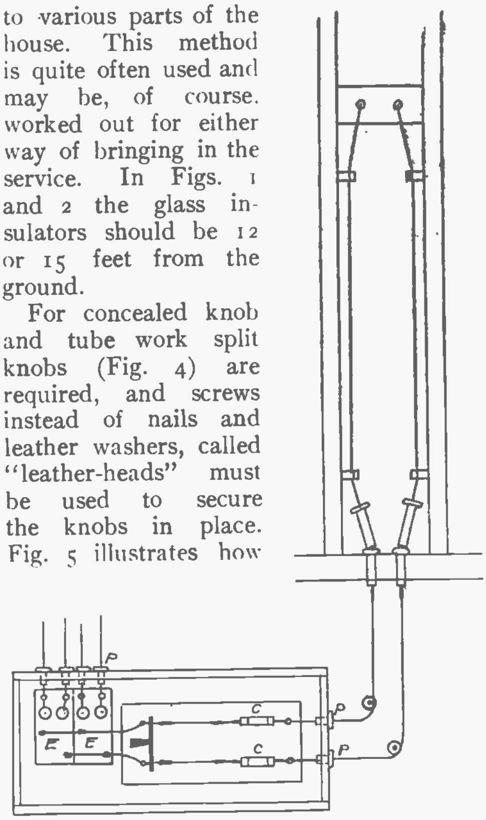


FIG. 3. CONCEALED SERVICE WIRES

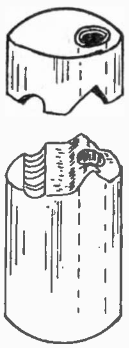


FIG. 4. SPLIT KNOB

Open work may be installed either on split knobs (Fig. 4) or with cleats (Figs. 6 and 7). Two wires are run in each cleat, and by it are separated $2\frac{1}{2}$ inches and kept one-half an inch from the surface wired over. Screws should here be used for fastening the cleats in place. Two men can work more rapidly and do better work than one on all electrical construction. Wires should be strained so that all slack is taken out while the second man secures the wire in the cleat or knob.

Fig. 7 illustrated two ways of coming from the ceiling down to a drop light with flexible cord. On the drop having the socket in place, the cord is tapped on the main

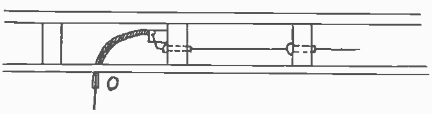


FIG. 5. ENCLOSED KNOB AND TUBE WORK

wires on one side of the cleat and brought through the cleat before dropping down to the socket. The cleat thus anchors the cord so that there is no strain on the joints. In the left of Fig. 7 is shown a second way of

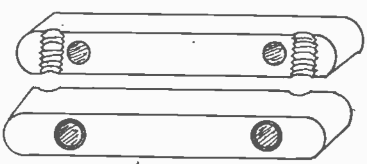


FIG. 6. PORCELAIN CLEATS

dropping down to a light by means of a porcelain ceiling button, in which are provided holes for tying the cord, or an opening in which a knot in the drop cord is held. At the lower end of this cord and under the shell cap of the socket a half square knot should be tied as shown, to take the strain off the binding screws in the socket.

Fig. 8 shows how moulding work may be used to come down a side wall; porcelain tubes being used on wires through the floor. A one-inch wooden base block is also shown, its purpose being to raise the mouth of the tubes one inch up from the floor to prevent dirt and water from getting to the wires. At the top of Fig. 8 is shown one way of making a tap joint in branching off in moulding. Porcelain cross-over blocks are required by recent rules on this work. Moulding may be run on the ceiling and

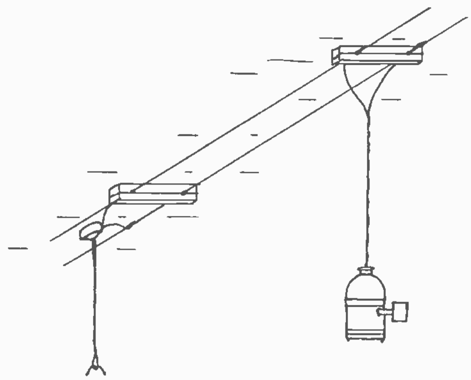


FIG. 7. OPEN WORK ON CLEATS

drop lights taken off by bringing one tap out on each side of the moulding, cutting away just enough under the capping to bring out the cord, and then using a porcelain rosette or tie button, Fig. 7, on the moulding. In fastening the moulding to the ceiling screws may be used, first drilling through the middle or tongue of the moulding a hole just the proper size for the screw to be used.

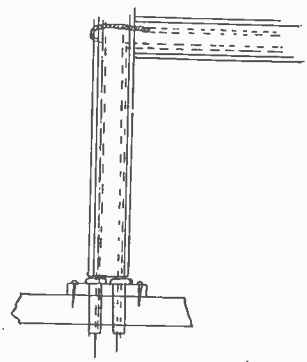


FIG. 8. MOULDING WORK

Fig. 9 shows a combination of moulding and "fish work." In this work the wires must be separately encased in flexible tubing from outlet to outlet. This work is often resorted to in finished buildings and is usually done by two men. One man takes a wire sufficiently long to reach from one opening to the other, and, after bending a small hook in one end in such a way that it will not catch easily on obstructions, pushes this end into one opening and by twisting and working the wire about forces it toward the other opening while his helper with a wire provided with a hook tries to catch the other wire through his opening. When

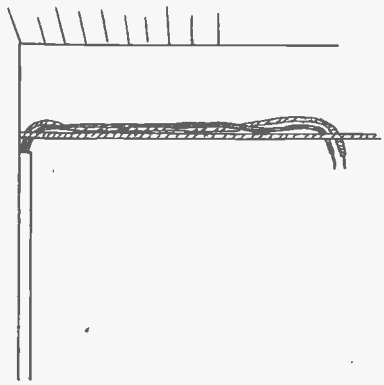


FIG. 9. FISH AND MOULDING WORK COMBINED

this has been done the conducting wires encased in tubing are fastened to the wire already pulled through and drawn in.

Fig. 10 illustrates a crowfoot used to secure a fixture to the ceiling and also the method of bringing out wires to a fixture from concealed work, either knob and tube or fish work. No. 16 or 18 B. & S. gauge rubber covered wire is usually provided in the fixture.

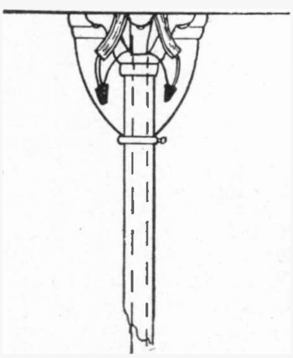


FIG. 10. CROWFOOT AND FIXTURE

Fig. 11 illustrates the best way of running by pipe. A porcelain tube is placed on the wire and taped in place. It is best to run over water pipes, but either over or under gas piping.

Fig. 12 shows one way of making a splice in main line circuits. At the right is shown a way of taking off a branch wire. By cutting away the rubber insulation on the slant as shown at (C), taping is more easily done than if the knife blade is run through the insulation all around the wire leaving a square shoulder and a nick in the wire where the insulation is removed. Wire "nicked" is apt to break easily. Wire at joints should be well cleaned by scraping with a dull knife or by using emery paper. On the joints use the following soldering fluid:

Saturated solution of zinc chloride 5 parts
Alcohol .... 4 parts
Glycerine...................... 1 part

Heat the joint with a gasoline or alcohol torch and drop solder on the center allowing it to flow both ways. After the joint cools

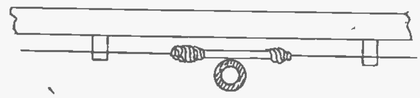


FIG. 11. BUSHING AND PIPE

tape first with rubber and then with friction tape, this latter to secure the former in place.

Fig. 13 illustrates a circuit from plug fuses feeding three sets of lights, each controlled by a single pole snap switch. (LLL) shows how to connect up a three-

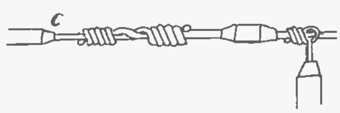


FIG. 12. JOINTS

light fixture, (LL) a two-light fixture, and (L) to a single light. Each circuit in the house may be laid out like this to assist in understanding the wiring of same. Fig. 14 illustrates the method of connecting a double pole switch to a circuit. All circuits carrying over 660 watts, such as some electric heaters, should be equipped with these switches. As the wires if open work are separated at least one-half an inch from the surface wired over, so at each snap switch or wall socket this spacing should be preserved

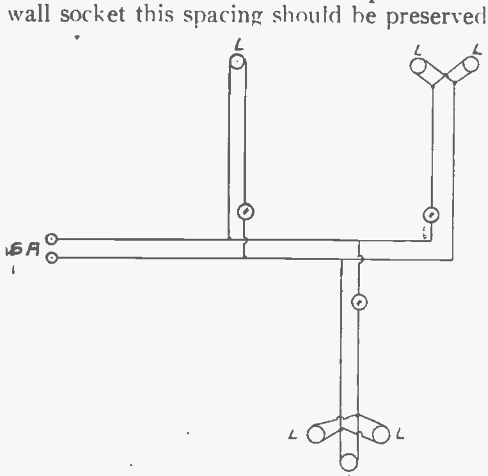


FIG. 13. BRANCH LIGHTING CIRCUIT AND SNAP SWITCHES

by providing a ½-inch porcelain sub-base for these devices. A cleat broken in two is sometimes used although regular bases may be purchased. Snap switches or wall sockets may be mounted on moulding without this sub-base.

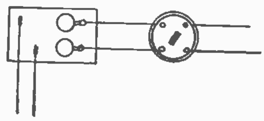


FIG. 14. DOUBLE POLE SNAP SWITCH

Fig. 15 shows how to wire so as to control or turn on and off a light or lights from three points, as in the basement, at the first floor and at the landing between the first and second floors. Two three-way switches are used at the ends and a four-point switch in

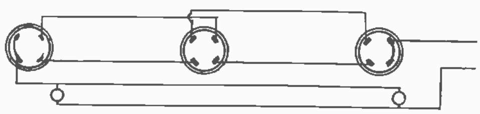


FIG. 15. CONTROLLING LIGHTS FROM THREE POINTS

the middle. If the control is desired at only two points the middle switch may be omitted.

Fig. 16 illustrates how to run a circuit for a pressing iron. The fuses (FF) may, if desired, be located back in the cut-out or fuse cabinet. If the iron takes over 660 watts a double pole snap switch should be used; if less than 660 watts is required a single pole switch may be provided. Below the snap switch a low candle-power lamp is recommended to indicate when current is on and off. At the lower part of the circuit is shown a receptacle into which the plug of the pressing iron cord is placed. For each heater it is best to provide a separated circuit from the fuse cabinet. If the cabinet is in the basement this can be easily done by coming through the floor at the wall in moulding to the proper point on the kitchen wall, doing the work as shown in Fig. 8.

In doing work the following general points should be put into practice: On cleat or knob work provide supports every 4½ feet for the wires; see that all slack in wires is removed; provide porcelain tubes on all wires through walls, floor or ceilings; separate all wires at least 2½ inches on open work, and 5 inches on knob and tubework; solder and properly tape all joints; use no smaller than No. 14 B. & S. gauge rubber covered wire for branch lighting circuits;

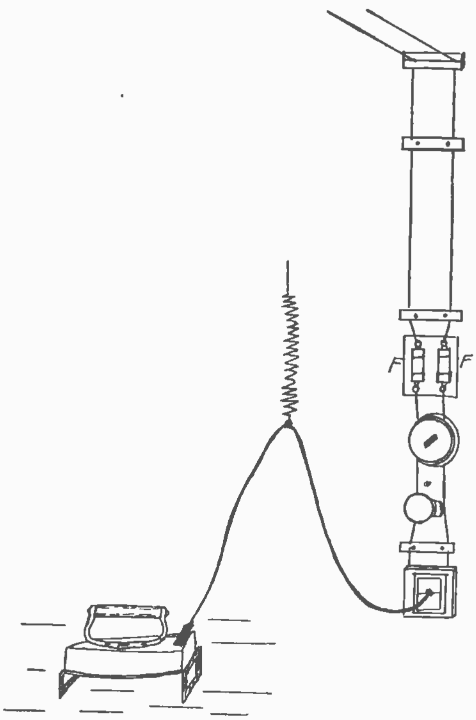


FIG. 16. ELECTRIC PRESSING IRON CIRCUIT

provide fuses of not over six amperes capacity on branch lighting circuits; no branch lighting circuit should feed more than twelve sixteen-candle-power 110-volt carbon filament lamps or the equivalent of 660 watts.

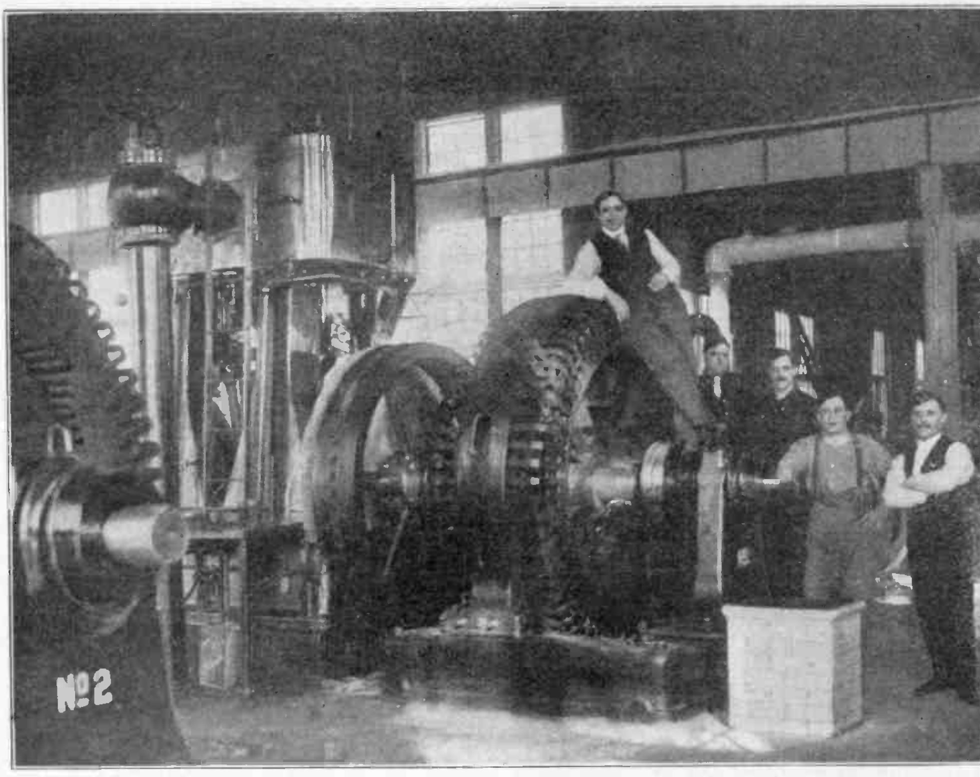
Nothing has been said regarding the switchboard of the plant. Generally this is furnished complete ready to put in place. If motors are to be used these two will have sent with them a wiring diagram showing how they should be connected, and the same is true of wattmeters sent out to plants or stations.

(To be continued.)

Coupling Big Alternators in Parallel

By WARREN H. MILLER, E. E.

The more one studies the science of electricity, the more one appreciates how wonderful are the actual practical applications of the scientific discoveries of the laboratories. For instance, it is very generally known, among students at least, that the voltage or electrical pressure produced by an alternating current dynamo, or alternator as it is called, and likewise the current delivered by it, is first in one direction and then in the opposite direction. The pressure starts at zero, rises to a maximum, falls to zero, rises to a maximum in the opposite or negative direction and falls back to zero again, and so on in constantly succeeding cycles. The current goes through a like procedure. Plotting the instantaneous values of current or voltage for a given period of time and connecting all the points we would have the current or voltage represented by a curved line with nearly equal loops above and below the horizontal line which latter we take as our basis to represent zero value. These are called the current and amperage curves of an alternator and they approximate quite closely what mathemeticians call sine waves, varying from plus to minus full voltage and amperage with tremendous rapidity, 7200 times a minute for the ordinary 60-cycle machines and 3000 times for the 25-cycle.



OLD HANDS TRAINED FOR MONTHS IN PARALLELING ALTERNATORS

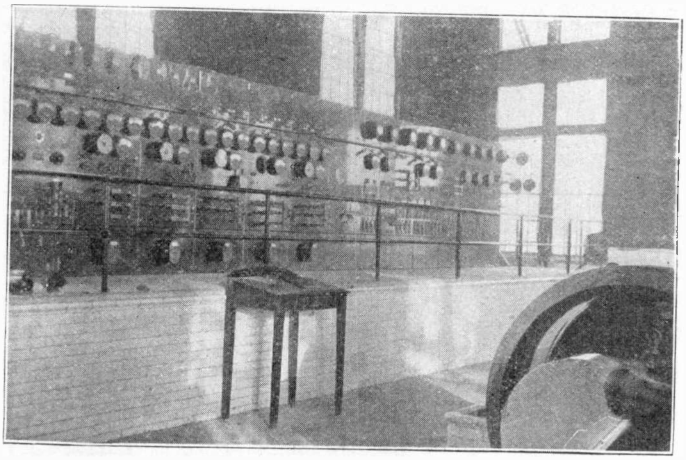
If the machine is three-phase, there will be three of these waves, all at different states of growth at the same instant of time. One wonders how they dare put two or three or even a dozen great 10,000 kilowatt generators together in parallel, since science tells us that all of them must be making the identical waves at the same instant of time, and practice adds to it that if any one of the big 13-foot flywheels is as much as ⅜ of an inch out of its proper position of turning, all the ammeters and wattmeters on the switchboard will be soaring like a flock of gulls, and all the lights, motors, and factories out on the city lines will be acting as if possessed.

In Europe they sometimes put a bell on each flywheel, throwing the main switch when the bells clang together, and this will answer for small plants of comparatively slow speed. But a glance at the switchboard in the illustration, where 1200 ampere currents on 480 volts are handled, will show you that a mistake in throwing in is no joke.

Did you ever open 1200 amperes on that voltage? Better wear a glove, or your hand will be in a sling for a month with spattered molten copper, and the switch will be a sorry looking affair when the arc is through with it. Those queer-looking objects at the top of the board are time-limit circuit breakers, put there for the very purpose of opening the circuit, as this particular plant is run by gas engines, which often surge very badly because they cannot all run at so precisely the same speed as to keep all the flywheels inside of that ⅜ of an inch permissible. Sometimes, when the gas is bad and all the engines balk and back-fire, some of them have to be yanked bodily off the load or the whole power house will be shut down.

What happens when two alternators are put in out of phase? Well, a variety of things, and they all happen at once, and most of them happen so suddenly that there is no possible chance to take any of it back before things go up in smoke and destruction. In the first place, if completely out of phase, or out of step as we may put it, there will be a difference in potential between the two machines of nearly a thousand volts, since one is at the top of its plus wave and the other at the bottom of its minus wave. It is just twice as bad as a dead short-circuit, and strains the insulation excessively, sometimes ending in a brilliant pyrotechnical display. If the incoming machine does not at once jump into step with the load, everything slows down and will stop, unless the main switch is pulled or the new engine gets into step. If it is a belted machine, it is "motored" into step *instanter* and you can hear the belt scream. If put in about one-third out, all types of machines will jump into phase, and there will be a great surging in the ammeter and wattmeter needles for a few minutes, as the machines' flywheels oscillate like a spring inside of that ⅜-inch limit. Beyond that it is "motored" by the other engines, and the drag forcing it to stay in step is very powerful—more so than the strength of its own engine if the generator has been properly designed.

The apparatus for telling when they are in step consists of two small transformers, one connected to each machine on the same phase. The secondaries of the transformers are hooked together in series with a lamp in the circuit. Now, if the machines are in step, they will add their secondaries together, and the lamp will burn bright; if out of step the secondaries are opposed and the lamp goes out. They still connect them this way in England, but we have found that the lamp stays bright longer than it stays dark, because the heat remains in the filament, and so we always cross one of the machine leads so that the lamp will be dark *in step* and bright *out of step*. We thus get a more definite point of being in phase, as the period of darkness is comparatively short. The diagram herewith will explain

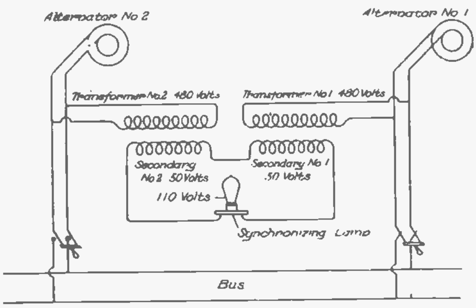


WHERE 1200-AMPERE CURRENTS ARE HANDLED

to student or practical operator the principle of the synchronizing lamp.

The instrument on the upper swinging bracket at the far end of the board is a synchroscope, which is connected in the secondary circuit of the transformers as well as the lamp. Its needle tells when the machines are in step, and whether it is too fast or slow, but it is only for the oiler at the throttle of the incoming engine, not being accurate enough for the engineer to throw the main switch by.

You can easily see from all this that there is still a chance to get them in wrong, *the first time*, because some one of the leads may have been crossed somewhere or the main generator leads themselves may have been reversed somewhere, so that one is making a positive wave when the other is making a negative, and therefore you do not know



SCHEME OF PARALLELING ALTERNATORS

whether the machines are in phase or lamps bright or dark. So the men will never put in a new generator for the first time. In the various power plants under the writer's jurisdiction, this is one of the interesting jobs up to *him*. It is worse than the stock market—if it is all right you are rich; if all wrong, busted! No matter how carefully all the leads have been traced you are never *sure* whether the lamp is bright or dark in phase, until the main switch is thrown for the first time. So you can picture the wretched creature standing at the board with the big switch in his hand. Here are $80,000 worth of apparatus at stake; which shall it be, right or wrong? Of course, as a matter of fact, no such risks are taken, as there are several infallible checks, such as first plugging in the lamp on the 'bus, when it should be dark, as both transformers are now receiving current from the same source. Nevertheless, the writer always has the main leads of the new machine unbolted, and 100 amperes fuses inserted at the first trial, which hang on a few seconds if everything is all right, and blow like a rapid-fire gun if wrong.

But, even after putting in the first time and all the leads being found correct, the generators are occasionally thrown in half-out, when the engineer gets a bad case of "rattles," or is crowded for time; and a nervous man will occasionally try to open the main switch again, when the load is heavy and he sees everything going down. You will find the switch all burnt the next morning, and the engineer "not in today." And even old hands that I've trained for months in paralleling powerhouse alternators, sometimes get so overcautious and fussed up when some big magnate is looking on as to put in the incoming machine with the lamps nearly dull red!

The Germans have gotten up an automatic switchboard appliance to couple alternators in parallel without requiring any man's judgment at all. It was recently described abroad by Herr Max Lutz, the inventor.

The introduction of an automatic apparatus like that into American power houses would not only save accidents but would also save time, as it would put in the incoming engine the very first time it passed through phase with any reasonable slowness, whereas the powerhouse men often take a great deal of time, and go through phase half-a-dozen times, before their judgment tells them the precise moment has arrived to throw the main switch.

A Radium Institute

Vice Consul General R. W. Heingartner, of Vienna, in writing of the interest manifested by the Austro-Hungarian Government in matters pertaining to radium, its study and sale, says:

"A private donation of 500,000 crowns (about $100,000) some time ago made possible the erection of a new institute devoted to radium research in Vienna, which is now rapidly approaching completion. The building has four stories and will contain laboratories only, seven on each floor. This will be the first radium institute in the world and will have an international character, being at the services of scientists for purposes of radium research. Though the institute is donated by private munificence, the Government has undertaken the cost of maintenance.

"The Ministry of Labor has hitherto been unable to accede to the many requests which have come from numerous sources, both inland and foreign, for radium. There was a certain quantity of it from Joachimsthal on hand, but it could not be sold until the exact percentage content of pure radium in the ore was established. The work of examination is now being carried on and the sale of radium will soon be begun. The radium will be sold in vials, each to contain 60 milligrams of 5 per cent radium or 30 milligrams of 10 per cent radium, the price of such a vial to be 1,080 crowns (about $216), as the present market value of pure radium is estimated at 300,000 crowns ($60,000) per gram. For the present only inland institutes will be sold to, and numerous applications from such are already on file. Many medical clinics have likewise made requests for radium in order to test its therapeutic value."

Electric Automobile Horn

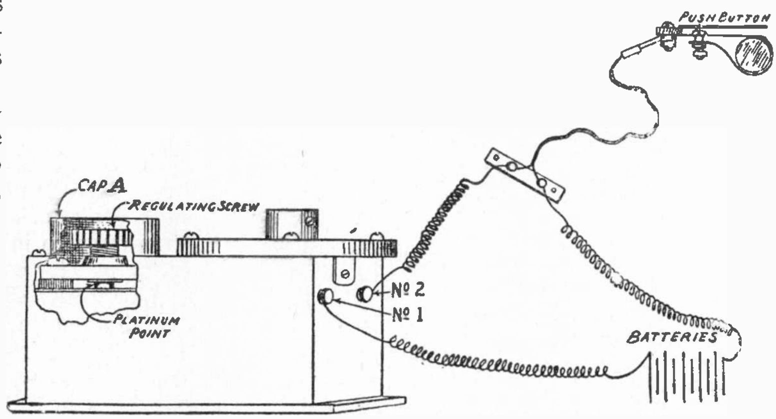
The ordinary automobile horn, operated with a rubber bulb, has its disadvantages, as automobile users know to their sorrow. The bulbs deteriorate rapidly and must be renewed frequently. The hand must be taken from the steering apparatus to push the bulb, which is inconvenient. When the machine is at rest the horn is "honked" by every small boy that passes by.

A new electric automobile horn without these disadvantages is called the Electro-Corno. It is operated by a push button on the steering wheel. There are no bulbs, no reeds and no motor, for it operates on the principle of the vibrator of an ordinary induction coil. One of the illustrations shows the apparatus in a form applied to motor boats. For automo-

ELECTRIC AUTOMOBILE HORN

biles the horn instead of being connected direct to the top of the box containing the vibrating mechanism is connected thereto by a flexible tube.

The diagram shows the connections of the apparatus. A wire from the battery, which may be five dry cells or a six volt storage battery, enters the box and is connected to the adjustable contact. From this contact current passes through a vibrating strip, not shown, and around the winding of a magnet coil and out to the push button; thence back to the battery. Current flowing around the coil magnetizes its core and draws down the

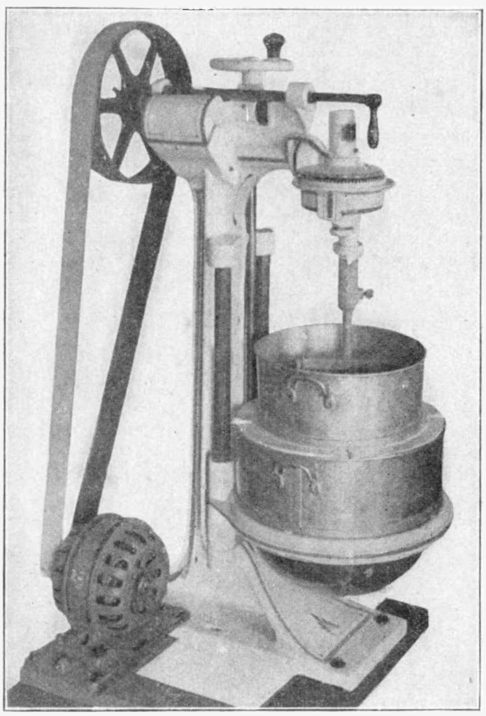


HOW THE AUTOMOBILE HORN IS CONNECTED

vibrator as in the ordinary induction coil, breaking the circuit. This make-and-break goes on continuously and rapidly as long as the button is pushed. At every throw of the vibrator a little point on its outer end strikes against a metal diaphragm located under the horn outlet. The diaphragm thus vibrates in unison and produces a loud and peculiar sound in the horn.

An Easy Way of Mixing Dough

The tedious labor of dough mixing, egg beating, etc., is performed economically and quickly by the electric motor, while the work done is considerably more thorough than that accomplished by human agency. The superior sanitary advantages of the



DOUGH MIXER FOR BAKERIES AND LARGE KITCHENS

electrically driven apparatus are also important considerations in the preparation of a food stuff. Moreover, the mixture is assured to be uniformly and completely worked, without the attention of a skilled operative or baker.

A "Baby-grand" dough mixer is shown in the illustration, being adapted to large kitchens or bakeries. With the aid of a suitable belt and gears the electric motor drives a sort of paddle wheel which does the mixing. There are two pans for holding different sized batches of the mixture. By means of the handwheel at the top these pans may be raised and lowered to a position where the paddle will work to the best advantage.

Enameled Wire

The extremely fine wires which are used in medical coils, spark coils for wireless work, small electro-magnets, etc., have hitherto been insulated either with a double covering of cotton or, for the very small sizes, a single covering of fine silk thread. Recently, however, a new wire has come into use quite extensively and which is known as enameled wire. The composition of the enamel is a secret with the manufacturers, nevertheless a brief description of how this enamel is put on will be interesting.

In the first place the wire is run off the spools through a viscous mixture, called by the workman the "dope," composed of the secret ingredients, from which it runs into a specially made oven. From there it comes out a smooth, glossy wire, called enameled wire.

In the making of enameled wire six strands of wire are run parallel through the mixture and into the oven, thus making all wires uniform in thickness and hardness.

The mixture is kept at a temperature of 35° to 42° C., according to the size of wire or the roughness or thickness of the same; so if wire is rough, with the mixture at 35°, the temperature is raised a few degrees, which thins out the mixture, and lets it run off more readily before entering the oven, making the insulation thinner and harder, and therefore smoother; for the thinner the insulation the harder it bakes on, and hardness makes smoothness.

But great care must be taken not to let the insulation run too thin, as it then would bake on too hard and would not adhere to the wire enough to stand its first test; that is when the wire is stretched to its elastic limit the insulation would crack off.

The heat of the oven, we will readily see, is also an important factor in manufacture of the article, for if the temperature is not correct the insulation would either be too soft or too hard.

In first trying out the wire, only one wire of the six is run, as it would be a great expense to the company to run a large quantity of wire which is too soft or hard.

When it is found that the one wire is smooth and will not peel off or crack off when stretched, it is given an electrical test.

We take a piece of wire about three feet long, bare one end for a terminal, and wrap the insulated part around a metal mandrel. The terminals of an electrical source are then applied, one to the mandrel and the other to the bare end of the wire. In this way the insulation is subjected to a certain electrical pressure which is measured with

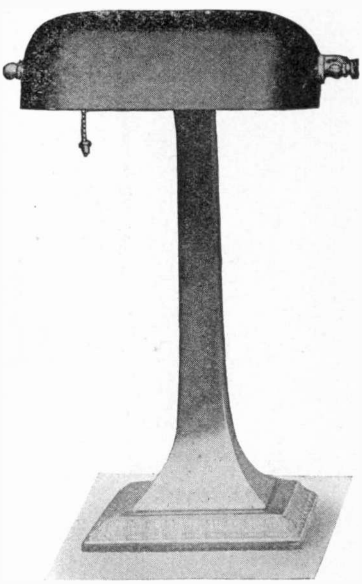


TABLE LAMP

a voltmeter. It is first given about 110 volts. If the insulation wrapped around the mandrel does not flash, we know that it stands a voltage of 110 volts. We now turn to the rheostat and keep on giving it more and more voltage till the insulation flashes, and then the voltage registered is the breakdown voltage of our insulation.

We have been running say a 34 B. & S. gauge wire which is not much thicker than a hair, on which the insulation can neither be peeled or cracked, and it also stands a required voltage of 250 volts. Now we start the other five wires going and we are running a wire which is far superior to silk or cotton for these reasons:

First: It is moisture proof, and current cannot leak across from coil to coil.

Second: Alcohol, turpentine, etc., have no effect on it, and it will readily stand a temperature of 600° F., without charring.

Third: Having a greater di-electric strength than silk, it need be only applied about one-fourth the thickness of silk, making a smaller and neater coil.

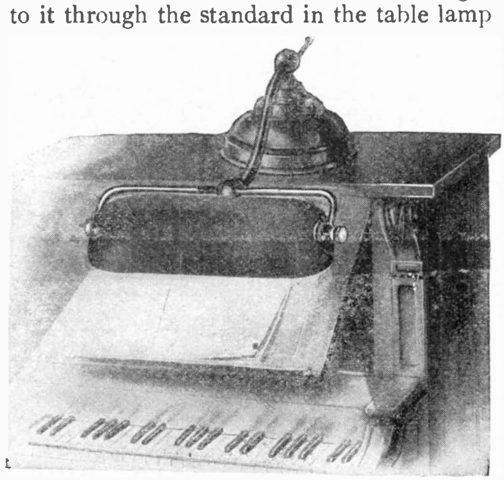
Fourth: One pound of 34 B. & S. gauge copper wire, with silk insulation, contains about 7650 feet of wire, while it takes about 8100 feet to make a pound of enameled wire, a saving of about one-tenth in favor of enameled wire at the same price.

J. BERGER.

Desk and Piano Light

A new style of portable electric lamp which will enhance the appearance of any well-appointed office, music room or library is known as the "Emeralite" lamp. Two types are shown, one to use on a roll-top desk or piano and the other for flat-top desks, library tables, etc. The beauty of light lies in the fact that it casts no shadows. The principal feature of novelty is of course the shade which is of rich green glass lined with opal glass, making a permanent reflecting surface. The shade being open does not collect dust and it may be adjusted at any desired position by means of an automatic adjusting clamp at the end.

An ordinary incandescent lamp is mounted under the shade and the wires are brought to it through the standard in the table lamp



PIANO LAMP

and through the bracket arm in the piano lamp. In the latter type the base is made heavy enough to hold the light securely.

Electric Glue Heaters

Those of us who have no occasion to visit large wood working establishments, box factories or pattern shops little realize to what extent glue enters into the manufacture of certain products. There it is used literally by the barrel, and special heaters must be kept going constantly to keep it in just the proper liquid state. Gas burners were used largely in the past to heat the glue pots, but were a constant fire hazard and besides gave off heat and fumes into the surrounding atmosphere. Within the last few years, however, it has been found that electric heaters are far more satisfactory for this work, and the accompanying illustrations show the forms which some of these devices take.

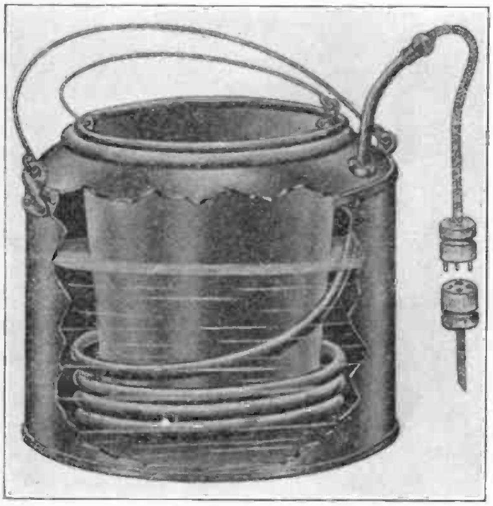


FIG. I. SIMPLE ELECTRIC GLUE HEATER

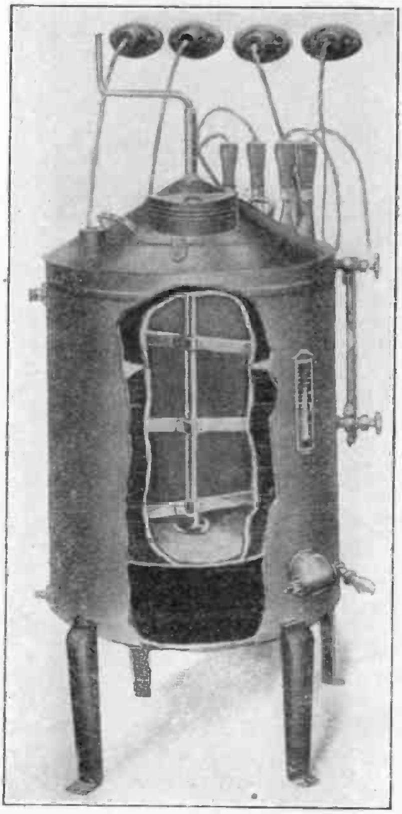


FIG. 2. GLUE HEATER OF 50 GALLONS CAPACITY

Fig. 1 shows a simple electric glue heater. This consists of a heater coil in a bath of water surrounding the glue pot, the water serving to prevent burning of the glue. The electric wires from the flexible cord terminate in resistance wires inside of the spiral pipe, and the current flowing through the resistance wires heats them and raises the temperature of the water bath to the proper value.

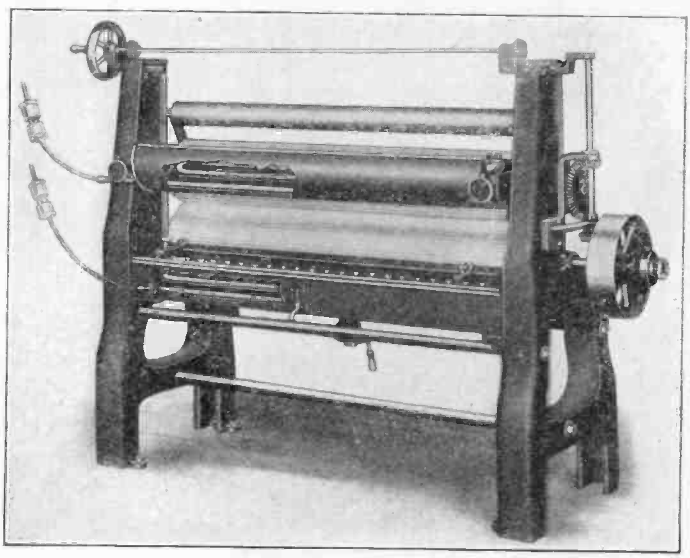


FIG. 3. ELECTRICALLY HEATED GLUE SPREADER

Fig. 2 shows a unique electric glue heater of 50 gallons capacity provided with a heat retaining jacket. This device is said to properly dissolve every particle of fibre in the glue, maintaining the proper temperature of 150 degrees in order to give the best consistency. A thermometer is provided with a brass agitator and water guage in the water chamber. The inner chamber holds the glue, next to that is the water jacket and finally there is a chamber packed with mineral wool.

It is stated that when a heat-retaining jacket of mineral wool is employed the maximum current is required only for from half to three-quarters of an hour in the morning, after which the electric power may be shut off until noon. After the noon hour the current is again turned on for a short time. Altogether the current is turned on about one and one-half hours during the day.

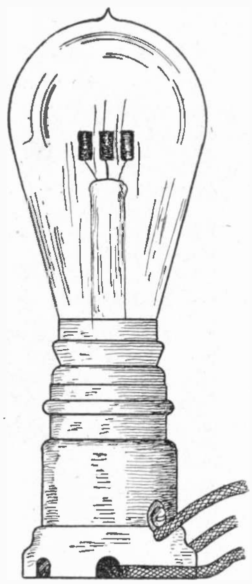
In Fig. 3 is seen the construction and method of operation of an electrically heated glue spreader. The upper roll automatically raises and lowers to accommodate stock of different thicknesses, and the electric glue heating coils are arranged in the roller as indicated. Three-way switches are provided, enabling the operator to regulate the temperature from minimum to medium or maximum, as desired.

Lightning Arrester for Telephone Lines

A lightning arrester, which in outward appearance is very much like an ordinary incandescent lamp, is a new development in the telephone field. It consists of a hermetically sealed glass bulb mounted on a porcelain base and having terminals for the ground and the lines. The type shown is for a metallic circuit telephone line and has three terminals. Each terminal connects to one of the electrodes shown within the bulb. One terminal is then connected to one wire of the line, the second terminal to the other wire of the line and the third terminal, which leads to the middle electrode, to the ground. These electrodes are separated by a space of less than $\frac{1}{8}$ inch.

It is plain to be seen, therefore, that all there is to prevent current from either wire of the telephone line from passing direct to the ground is the little $\frac{1}{8}$-inch space between the outside electrode and the middle or grounded electrode. This space, especially as it is in a vacuum, is sufficient effectually to prevent such currents as are used in telephony, telegraphy and signal work from escaping, for to them it presents a very high resistance.

Not so with the lightning discharge which is a form of electricity known as static. Static electricity passes easily through a



LIGHTNING ARRESTER

vacuum, so when a lightning discharge hits the line it is allowed to escape to earth through the middle electrode and its grounded terminal, by jumping the space between the outside and middle electrodes.

A New Battery Cell

The new Anhydrous battery cell is built upon a unique principle. The liquid necessary to make the cell operable is put in when you get ready to operate it. The ordinary dry battery (which term is a misnomer for it does contain a liquid or paste though sealed up) is liable to dry out if left to stand on the shelf. Thus you are apt to buy a poor battery at the start. The Anhydrous battery cell will keep indefinitely the contents being dry as powder. When you want to put it into service pour in water through a specially made opening which is provided for that purpose.

Sunspots and Earth Currents

Some connection apparently exists between sun spots and the electrical disturbances which usually appear simultaneously on the earth. At such times the Aurora Borealis is also unusually active. The most recent disturbance of this kind occurred on September 25th last, and the magnetic ray, or whatever it might be called, which shot out from a great 40,000 mile sunspot clogged with contending currents every electric wire on the earth. This effect was most noticeable on the telegraph wires and communication became extremely difficult.

During the height of the disturbance the measuring instruments in the telegraph offices registered the presence on the wires of upward of 500 volts of electric current from the mysterious source. This is a greater voltage than is supplied for the operation of any of the land wires and it lighted the incandescent resistance lamps and flashed brilliant sparks across the gaps when the telegraph keys were opened.

Such disturbances are usually to be expected when large spots cross the sun. Director F. Schlesinger of the Allegheny Observatory of Pittsburg had this to say of the phenomena at the time:

"We have been observing this spot on the sun during the last week; it is unusually large. The spot is about 40,000 miles across, and it usually takes such a spot about two weeks to cross the surface of the sun. The storm always becomes most violent when the spot nears the center of the sun's surface, where it is now. The spot can be seen by the aid of a smoked glass, and it will no doubt take another week before it passes off the surface of the sun.

"In the case of these magnetic storms there is no high wind, no thunder and lightning or rains, but merely an atmospheric disturbance. The atmosphere is highly charged with electricity, that is liable to affect telegraph and telephone wires, and it is possible that an aurora borealis phenomenon may occur in the same time."

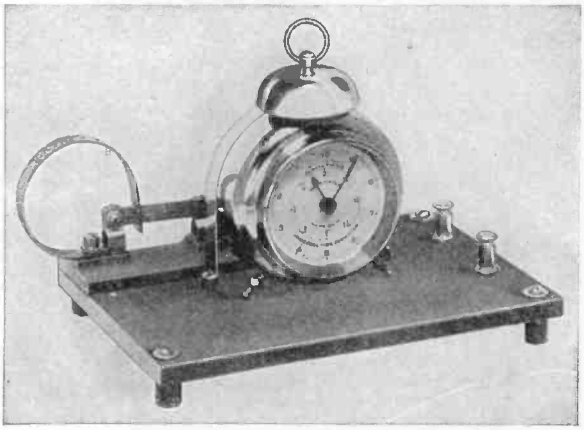
Professor Edwin Frost of Yerkes Observatory was also quoted as follows;

"Auroras often occur as the sun's activity is dying down, but are more likely during what we call the sun's maximum, when the greatest number of sun spots are visible. This is every eleven years. The sun is now approaching its minimum, and the maximum will not be reached for about five years.

"When you turn the earth in the field of a sun spot you get a current on the earth, which in turn affects the telegraph wires and causes trouble. Auroras frequently occur without affecting the wires. We have seen a number of them this summer—of a white appearance, not with the brilliant effects seen in the North."

Automatic Time Switch

Cases often arise in which it is desired to leave a few lamps burning in a show window, for instance, or a small electric motor is to be left running for a certain length of time. But it is desired after the proper interval of time has elapsed to shut off the current from the apparatus without, however, making it necessary for an attendant to stay around to perform the trivial operation. For this purpose what is known as a time switch is usually employed.



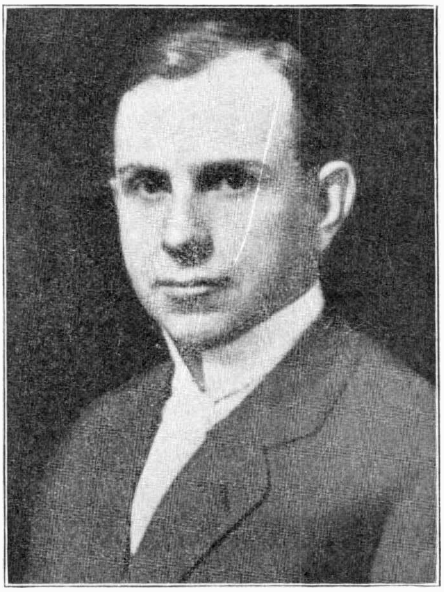
AUTOMATIC TIME SWITCH

A new type of time switch for the above purpose is shown in the picture. A clock and an ordinary knife switch are mounted rigidly on a slate base. To keep the lights or motor in operation the switch is closed against a spring as shown and held closed by a catch or trigger at the back of the clock. At the given time for opening the switch, however, the clock mechanism releases the catch.

Electrical Men of the Times

W. WINANS FREEMAN

In the electric-service business, as in every other business, personality counts for much. If there is such a thing as a "personal equation," that of Mr. W. Winans Freeman, vice-president and general manager of the Edison Electric Illuminating Company of Brooklyn, N. Y., must be very high indeed, for it is probably true that everyone brought in contact with him learns not only to admire him for his ability but to like him thoroughly as a man.



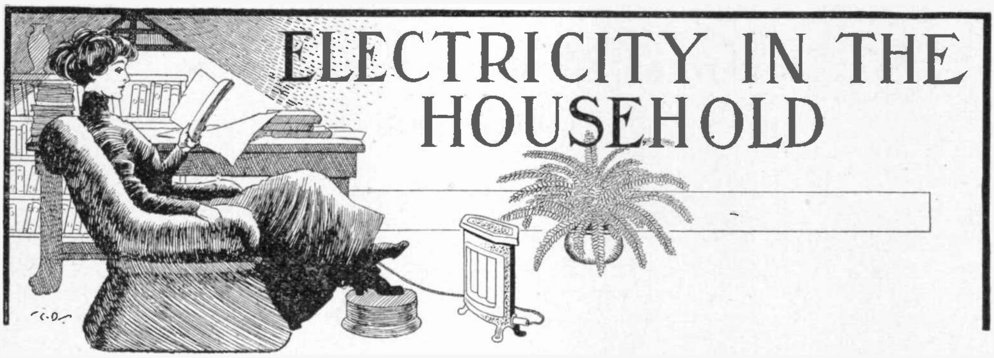
Mr. Freeman has a positive genius for making friends. Tall, erect, with a strong, open countenance, a ready smile and a fine voice, his very appearance invites confidence, and his moral and intellectual equipment is such that the favorable first impression is deepened by further acquaintance. Further, he has one requisite for success that is indispensable—the capacity for hard, steady work.

With these characteristics, it is not strange that this man, still well under forty, has been successful. He is the working head of his company, and it ranks among the five largest central-station companies in the United States, with assets valued at more than $25,000,000.

Mr. Freeman was born in Exeter, Ontario, Canada, June 8, 1872. After a high-school education, he became a stenographer, and in 1889, at the age of 17, he determined to seek his fortune in the United States. He entered the service of the Edison Electric Illuminating Company of Brooklyn as stenographer and private secretary to the general manager. His advancement was steady and sure. His first promotion was to the position of assistant secretary of the company. Then he was made secretary, next secretary and treasurer and later vice-president and general manager, as which he is the active executive, reporting direct to the board of directors. Mr. Freeman is otherwise a man of large business interests.

In furthering the properties placed in his charge by extending the use of electricity for light, power and heat in Brooklyn, Mr. Freeman has exhibited a broad-minded, progressive policy. In treating customers, in making rates, in going after new business, in selecting equipment, in adopting improved types of apparatus, as the tungsten lamp, he has been honest, enterprising and clear-headed, winning the approval not only of his business associates and of the Brooklyn public generally, but of electrical men the whole country over, by whom he is regarded as standing in the front rank of central-station operators. He is past-president of the Association of Edison Illuminating Companies, first vice-president of the National Electric Light Association, a member of the American Institute of Electrical Engineers and of a number of other societies. In the National Electric Light Association he also holds the very important position of chairman of the public policy committee, which has to do with the relations of public-service companies to the public.

Mr. Freeman is married and has three children. Of his church and club life there is not space to speak, but he is active in both.



The Electrical Show As a Woman Saw It

THE COLISEUM, Jan. 24, 1910.

My Dear Nora:

If I have been less prompt in answering your letter, you will forgive me, I'm sure, when I remind you that this is "gala" week for us. The Electrical Show is in full swing, you know, and naturally we women are spending as much time as we can possibly spare at the Coliseum, where *everything* electrical is displayed with courteous and very patient people to explain their uses to the visitors.

It is a very good-natured crowd, everybody seems glad, and no wonder, for these electric people have at last solved the servant problem for us.

How simple! Just to hop out of bed, make a hurried toilet, and while "he" is shaving, start the percolator, make the toast, have the water boiling for the eggs; and with a dish of fruit you have a breakfast fit for any "him."

Should you care for a more elaborate breakfast, there is the electric chafing dish, absolutely perfect to my eyes.

Good-bye to the nasty smelling old alcohol chafing dish! Who would have one *now?* And, dearie, with the chafing dish comes the dandiest little book of dainty recipes; everything imaginable, good to eat, so simple to make and so delicious to the taste. Get an electric chafing dish, and every man of your acquaintance will try to win you.

I saw an electric stove or range that was simply *grand.* With it, was every kind of cooking utensil from tea kettle to meat roaster, and there was a perfectly splendid kitchen table.

I will try to tell you (if you promise not to show my letter to any man) just how this wonderful table is built. The table proper is just like any other kitchen table. At one end is a motor, and running directly through the centre is a rod—or perhaps shaft is the right word to use. Attached to this shaft by little wheels and chains is every conceivable device with which to prepare a meal. For instance—coffee grinder, egg-beater, potato or apple parer, vegetable slicer, bread and cake mixer, meat grinder, cherry stoner, raisin seeder, grater and polisher. What *could* be more convenient than to start the motor and use in turn any one or several, or all of these things, as you might need them?

Just think, we could make that delicious white cake that you are so crazy about in less time than it takes to get the things together. Imagine—beating the eight whites to a stiff froth, while you are creaming the three-fourths of a cup of butter and two cups of granulated sugar in the cake mixer. Isn't it interesting? Now we have but to add alternately four cups of flour into which we have sifted thoroughly two teaspoonfuls of Price's baking powder and the beaten whites, adding a half cup of cold water, which I maintain is better than milk, as the cake does not dry out so quickly, and after adding one teaspoonful of vanilla, our cake is ready for the oven (which must not be too hot). All this time the little mixer has been working like a Trojan, and the result is a fine, smooth batter and cake that will actually "melt in your mouth."

Speaking of cake reminds me of a trip we took together once. Do you remember that day we missed our train at Decatur, Alabama? How tired and hungry and thirsty we were, and how everything was closed, being a holiday, and we couldn't even get a cup of tea? I thought that day would *never* end, didn't you?

But time has changed things now, my dear, and if ever we are caught again like that, we can easily master the situation by having in our grip one of those cunning little traveling bags. It is of leather, and contains a small electric iron used to press shirtwaists, handkerchiefs and laces. This iron has a hole in it to heat the curling iron. Then you can turn the iron over on the handle and set the tin cover on the face of the iron, which affords a quick way to heat fresh water for "the cup that cheers."

Another thing that carried me back in "memory's ship" to the old days when ice cream freezing was the "bone of contention" (and still is, down where the thermometer registers 97 in the shade) was a freezer run by electricity, for family use. Of course we all hear lots about things electrical, but to see them in operation makes us realize fully just how independent we can be of servants after all.

Even the washerwoman has lost power to make us weep when on Monday she fails to put in an appearance. Instead, we bustle into the laundry, fill the washing machine half full of hot water, shave some good laundry soap into it, add a few drops of ammonia (to make the clothes white) press a button, and in ten minutes (think of it) that tub of soiled clothes that were, are as white and clean as when new. When you are ready to wring, you have only to press another button, the wringer is set in motion, and in a few moments the clothes are wrung free of suds into a tub of clear water. The reversible wringer takes them back into the bluing water then into the starch and you are ready to hang out without a bit of *actual* labor.

Hanging up the clothes is the part I like best to do any way, because it takes me out into the sunshine or the clear, crisp air. Reaching up is good exercise, and after they are on the line, there is a feeling of pride that "passeth all understanding," not only because 'tis the fruit of your (supposed) labor, but because they are the whitest of them all!

Ironing day follows, of course; then the electric iron comes into service, and when you understand the management the cost is comparatively small. And such a comfort! I'd rather give up my piano.

One firm is showing an "ironer," for flat work, table cloths, towels, sheets, etc. It is a great time saver, requiring only a few moments for a table cloth, whereas twenty-five minutes is the usual time by hand.

Of course we all know something about vacuum cleaners, but I doubt if many know just how complete some of them are. For instance, I saw one with every useful attachment imaginable. Besides the sweeper for rugs and carpets, a tool for draperies, curtains and furniture, a brush for hardwood floors and a stair-edge cleaner, there is a clothes brush, shoe brush, an atomizer, and all the vibrator attachments. Just think of that! One need never grow old. *Everybody* can be beautiful; no excuse to be too fat or too lean. It should be a penitentiary offense for a man to be bald! And from the standpoint of good health they are indispensable. And it only costs two cents per hour to run these things.

I wish you could have seen this Electrical Show. Truly, the subject is inexhaustible, and very interesting, at least to me. So you may as well be resigned and listen patiently.

But wait! Here is something that will interest you who love to make those dainty little waists and pretty lingerie, but who dare not do so against the doctor's order. A sewing machine run by electricity. No, it isn't "too good to be true." There is a little motor that is adjustable to any machine. All you need to do is to guide as before. A cord or wire (I suppose that is the word) connects with the treadle and you can control the speed of the motor, start, or stop the machine by a slight pressure of the foot; not one bit dangerous or clumsy; just a neat little affair that is hardly noticeable. I was told that these motors can be rented at very small cost.

And, honey, in the next booth I saw, ah, such beautiful and quaint novelties for illumination. *Grand* would be a better word. Some are made of French bronze, and others of beautiful white bisque, equipped with gorgeous silk shades, and glass ones, according to one's taste. Some of the floral designs for table decorations would *positively* defy detection.

One piece in particular was a lovely design of pale pink la France roses and maiden hair fern, arranged so gracefully and naturally that I wondered how those roses kept so fresh looking with all those electric lamps buried among them, when suddenly it dawned upon me that they were electrical flowers. Imagine decorating a fine old southern house with electric foliage for a grand reception—and it isn't a bit impossible either, for there are orange trees with tiny lamps concealed in the oranges and glorious palms, and Jackson vine, galore.

These same people are showing accessories for "milady's boudoir," a mirror, equipped with two dandy candelabra lights. It is French plate, of course, and mounted in a beautiful gilt frame, and there is a wonderful self-heating curling iron with the "plug" (I hope that's the right word) concealed within the handle. And there's a foot-warmer for her dainty though perhaps cold feet—not a bit unsightly! It is finished in black enamel. Wouldn't your dear old grandmother appreciate one of these warmers? And, oh, yes, for that selfsame "him" a shaving outfit that will do wonders toward putting him in a *liberal* (?) humor. After using the little electric lighted mirror that can be adjusted to any angle, throwing a strong light just below his eyes, enabling him to shave in any room at any time of day or night, "Thou shalt ask what thou wilt and it shall be *cheerfully* given."

I nearly forgot to mention a warming pad to take the place of the clumsy hot water bottle which, by the way, is more often a *cold* water bottle. The warming pad is always ready, keeps an even temperature, is soft and flexible and the current can be regulated with no fear of getting it too hot. It is said to be an almost infallible cure for neuralgia, you know.

Oh, yes, my dear girl! I've got my heart set on your seeing the *next* Electrical Show. It really is wonderful, and the old Coliseum is indeed in gala day attire. The color scheme is pale yellow and blue. All the booths are alike, draped in yellow; soft, shimmering stuff like silk. The thousands of electric lights are shaded by yellow and blue globes. Suspended from the dome shaped ceiling are thousands of yards of four-inch ribbon of the same colors interspersed with ropes of tinsel. The ends of both ribbons and tinsel are left loose and hang straight down. Six tremendous search lights of different colors are used to illuminate their shimmering depths, and the effect beggars description.

I dare say, Nora, after reading this letter you will think me "electric mad." As a matter of fact I am simply "electric glad."

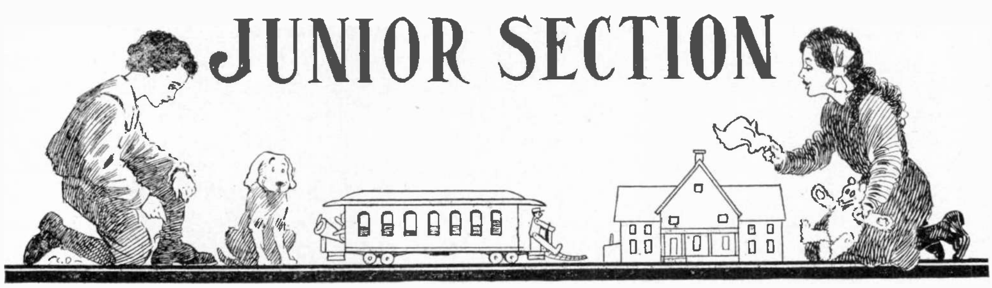
With lots of love

F. L.

The Any-Angle Dressing Fixture

To dress before a mirror when the lights are in the center of the ceiling or on distant wall brackets, is vexing to say the least. There isn't enough light or else you are in your own light, one or the other. This trouble is met with particularly when traveling, as hotels are only too often fitted up with very little attention paid to the requisites of successful illumination in the guest rooms. This little device called the "any-angle" fixture is made to clamp to the top of the mirror without the aid of screws. It is provided with two swinging bracket arms, which, together with proper shades on the lamps, enable you to throw the light, and plenty of it, just where desired. It comes already provided with a ten-foot cord to which is attached a plug which may be screwed into the nearest lamp socket. The whole thing folds up compactly and may be carried in a grip when traveling.

THROWS THE LIGHT JUST WHERE NEEDED



An Electrical Laboratory for Twenty-Five Dollars

By DAVID P. MORRISON

PART III

THE ALTERNATING CURRENT TRANSFORMER

For many purposes in your electrical laboratory you will find that it is necessary to use alternating current at a different voltage or pressure than that obtained from the lighting circuit. To enable you to do this an alternating current transformer is used; that is to "step" the voltage up or down.

The alternating current transformer consists of a magnetic circuit interlinked with

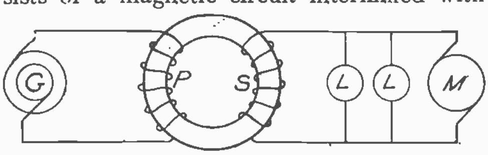


FIG. 18. SHOWING THE PRINCIPLE OF A TRANSFORMER

two or more electric circuits. A very simple arrangement is shown in Fig. 18. One of the coils, called the primary, is connected to some source of alternating current supply, which in this case is the lighting circuit from the generator (G). The other coil, called the secondary, is connected to the consuming device which may be lamps, motors, etc.

The operation of a transformer is based upon the principle of electromagnetic induction. When current flows in a wire there is a magnetic field created around the wire. We imagine this field to be little lines of magnetic force circling around the wire. When the current flows straight away from you in the wire the magnetic lines flow clock wise around the wire; that is in the direction that the hands of a clock turn. When the current flows toward you they encircle the wire in the opposite direction. When alternating current flows in the primary coil of a transformer the magnetic field, therefore, rises up, dies down to nothing, then rises up in the opposite direction as the current reverses. If another coil of wire is placed in this field (the secondary coil) a current of electricity is produced in this second coil by induction, even though the two coils are not connected. This current in the secondary may then be used to light lamps, etc. The whole principle of a transformer, therefore depends upon a field of magnetic lines of force created around the primary which rises up or spreads out and then dies down, and which lines of force are cut by the wires of the secondary thereby causing a current to flow in the latter; just the same as when the wires of a dynamo armature cut the lines of force of the fields and have a current generated in them. In a transformer the coils are wound around an iron core to strengthen the effect of the magnetic field.

There is a definite relation existing between the voltage impressed upon the primary winding and the electromotive force induced in the secondary winding (neglecting certain losses in the transformer) which is the same as the relation between the primary and secondary turns. That is to say, if there are 10 times as many turns in the secondary as in the primary the secondary voltage will be 10 times as great as the voltage impressed upon the primary. If the number of turns in the secondary is only one-tenth of the number in the primary the voltage will be only one-tenth as high.

The current in the two coils, however, varies in the inverse ratio. For instance, suppose the transformer is a "step-up" one, having 10 turns in the primary and 100 turns in the secondary, the voltage of the secondary will be 10 times as great as of the primary but the current flowing in the secondary will be only one-tenth of that flowing in the primary. Since the watts or energy used equals volts times amperes you can see readily that the input to a transformer is equal to the output if we do not consider the small losses which occur in the transformer and are dissipated in the form of heat.

The advantage of this relation of the electromotive forces and currents can be better illustrated by the following example, which corresponds to that of the electrolytic rectifier. Assuming your secondary voltage will never have to be more than 30 volts, and that you will want a maximum current of five amperes.

If your primary circuit is to be connected to a 110 volt line the ratio of the primary and secondary voltages will be equal to $\frac{110}{30}$ or $3\frac{2}{3}$. The primary winding must have $3\frac{2}{3}$ times as many turns as the secondary winding.

The relation of the primary and secondary currents will, as above stated, be in the inverse ratio or $5 \div 3\frac{2}{3}$ which equals $1\frac{4}{11}$ amperes, the primary current.

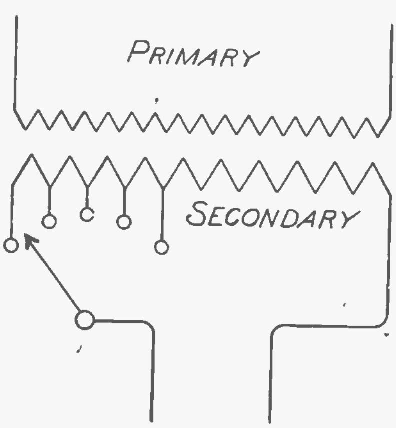


FIG. 19. HOW TAPS ARE TAKEN FROM THE SECONDARY

If a rheostat had been used the main line current would have been five amperes, hence the transformer results in quite a saving.

Where it is desired to vary the voltage supplied by the secondary of the transformer it can be accomplished in the following manner. In winding the secondary coil if taps are taken out at certain points, and arrangements are made so that the connection of the circuit being supplied with current, can be shifted from the terminal of one tap to the terminal of any other, the ratio of the primary and the secondary turns will in this way be changed and hence the secondary voltage. Such an arrangement is shown in Fig. 19, this being nothing more than a diagram of the circuit. The variation in the voltage in the secondary can be made any value desired from zero to full value. The value of each step of course depends upon the number of turns between the taps and their relation to the total number of secondary turns.

There are two distinct types of transformers, the difference being in the relation of

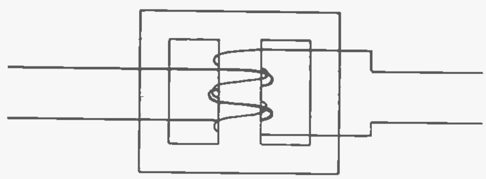


FIG. 20. SHELL TYPE TRANSFORMER

the two windings and the magnetic circuit. In one, the magnetic circuit is surrounded by the windings and is called the "core type." In the other, the magnetic circuit surrounds the windings and is called the "shell type." Fig. 18, represents a "core type" transformer, while Fig. 20 represents a "shell type." Each of these types has its advantages and disadvantages, but we must pass on to the actual construction of a transformer, since that is the primary purpose of this article. It is quite essential, however, that you understand the fundamental theory of the transformer, that has been given, if you want to know how it operates.

The transformer whose dimensions are given below is a "core type." To construct the core of this transformer you should have two piles of pieces of the thinnest soft iron you can obtain, three and one-half inches high. The pieces in one of these piles should be, $1\frac{3}{4}$ inches wide and $7\frac{1}{4}$ inches long, those in the other pile should be $1\frac{3}{4}$ inches wide and $5\frac{1}{4}$ inches long.

From the longer pieces form two cores one and three-fourths inches high and nine inches long by allowing the pieces to project alternately at the two ends one and three-fourths inches, as shown in Fig. 21. Now cut, from some one-fourth inch hard wood, four pieces whose dimensions correspond to those given in Fig. 22. Make sure that the opening in these pieces will fit fight on the ends of the cores. Cut eight washers from some insulating cloth the same size as the wooden pieces. Slip four of these cloth washers on each core and then place one of the wooden heads on each end, allowing one and three-fourths inches of the core to project through. These ends will have the ap-

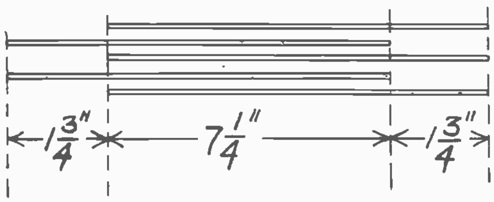


FIG. 21. HOW THE CORES ARE FORMED

pearance of a dove-tailed piece of wood. Holding the core firmly in a vice, tape it thoroughly with some good friction tape between the blocks. Then wind on two or three layers of insulating cloth, holding it in place by means of two or three turns of friction tape. If the cloth is cut one-half inch wider than the distance between the blocks, and its edges notched to a depth of one-fourth of an inch at the corners, it will extend up on the sides of the blocks and greatly improve the insulation.

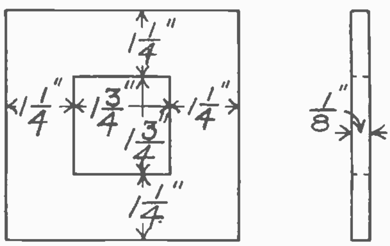


FIG. 22. WOODEN RETAINING PIECES

You should purchase about 450 feet of No. 18 B. & S. gauge double cotton covered copper wire, to be used for the primary, and 200 feet of No. 12 B. & S. gauge double cotton covered copper wire, to be used for the secondary.

The primary winding is to consist of 550 turns or 275 turns per core. The smaller wire will be wound on the core first, as you will want to make connections to the secondary winding at several points, and this can be more easily done if the secondary is on the outside. Solder to the end of the No. 18 wire a piece of flexible conductor, such as a piece of lamp cord, that is to form one terminal of the primary. This joint must be thoroughly insulated with tape.

Pass the flexible conductor through a suitable opening in one of the blocks near the core and bind its inner end to the core with several turns of friction tape. This will prevent any strain that may come on the terminal, from breaking the electrical connection. The 275 turns will make about three layers and the other terminal will come out of the block at the opposite end. The different layers should be insulated from each other by at least one turn of insulating cloth. Pay particular attention to the insulation at the ends of the layers. After completing the primary windings test them to see that they are not connected to the core.

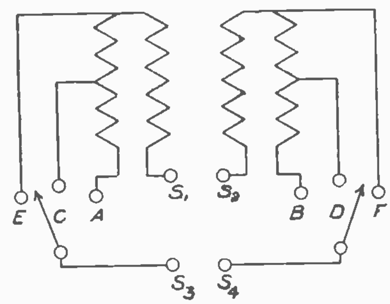


FIG. 23. ARRANGEMENT OF TAPS FROM THE SECONDARY

This can be done by connecting one terminal of a 110 volt line to the core and the other terminal to one end of the primary winding. Place in the circuit before making the last connection a very low current carrying fuse, which serves as a protection to your power circuit. If you get only a very small spark, due, no doubt, to the capacity between the winding and the core, your winding is O. K. If, however, there is a large spark or the fuse is burnt out, you must remove the wire and rewind the coil. When you have made sure your windings are all right, place outside of them three or four layers of insulating cloth and then several turns of friction tape to hold it in place.

The secondary is to consist of 200 turns, 100 on each core. This number of secondary turns will give more than 30 volts, but it may be desirable in some cases to have this increased value, as the secondary voltage will decrease with an increase of load on the transformer. The secondary voltage can be changed as previously described by changing the number of secondary turns in series with the load.

There will be two layers of secondary windings on each core, and if taps are made at three points on each outer layer as shown in Fig. 23 it will result in the following variation in the secondary voltage.

A to B = 40 volts
C to B = 35 volts
C to D = 30 volts
E to D = 25 volts
E to F = 20 volts

An increase in the number of taps or rather a decrease in the number of turns between taps, results in a decrease of the voltage variation per step. You should use stranded conductor for the leads from the secondary winding to the terminals of the transformer. The stranded conductor is so much more flexible than the solid conductor that it is not as easily broken, nor will it subject the secondary winding to so great a strain when being bent as a solid conductor would. All of your connections must be soldered and well insulated. Several turns of stout twine wound around the winding on both sides of the various leads will relieve the secondary windings of any undue strain. These windings should be tested as the primary windings were, making sure there is no electrical connection between the primary and secondary. After testing both coils you can finish them with friction tape and schellac, or a turn of black paper, similar to that around magnets, may be placed around

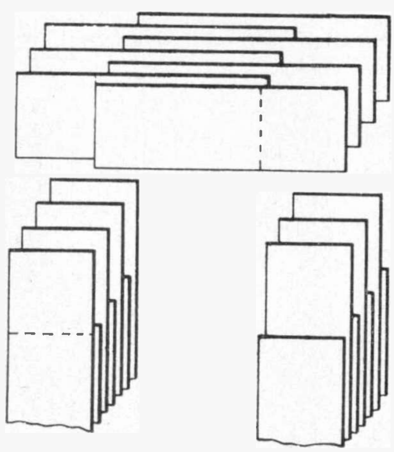


FIG. 24. FITTING ON THE ENDS OF THE CORES

them. The friction tape will afford a better insulation and mechanical protection for the windings than the paper. The terminal leads should all be at least fifteen inches long.

The transformer is now completed by placing the two cores side by side and the short metal pieces are placed in the dove tailed ends thus closing the magnetic circuit of the transformer. Fig. 24 shows how the ends should be finished. After these pieces are all in place, two wooden pieces should be bolted across each end as shown in Fig. 25. These clamps improve the magnetic circuit, by causing the various sheets of iron to come into better contact, and they also make the transformer very rigid.

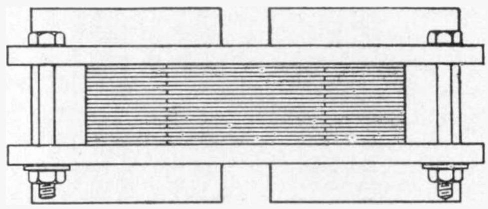


FIG. 25. BOLT ON TWO WOODEN PIECES FOR CLAMPS

You are now ready to mount your transformer.

Cut from a piece of one inch hard wood two pieces 10 inches wide and 12 inches long. One of these pieces is to form the base, while the other will be used as a terminal board, which will be taken up shortly. You can fasten the transformer to the base by means of bolts or screws through the base and into the wooden clamps on the ends of the core. Fasten four uprights in the corners of the base, whose height is about one inch greater than the depth of the transformer. The terminal board can now be mounted upon these uprights by four round-headed brass screws.

All the terminals of the transformer are to be connected to binding posts and switches placed on the top of the terminal board. Fig. 26 shows a top view of this board. The four posts at the top are the terminals of the two primary windings. The two posts marked (S1) and (S2) are the two inside terminals of the secondary coils. The posts marked (A), (B), (C), (D), (E) and (F) are the terminals of the various taps taken from the secondary winding. (S3) and (S4) are the terminals of the secondary winding to which the load is to be connected. The common points of the two switches are connected permanently to the posts (S3) and

(S4) while the other ends may be connected to the various taps of the secondary winding by turning the brass arms of the switches.

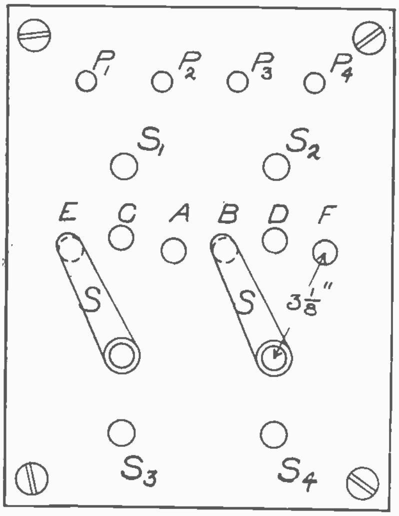


FIG. 26. THE TERMINAL BOARD

These switches can be made in the following way. Cut two pieces from some one-sixteenth inch brass, whose dimensions cor-

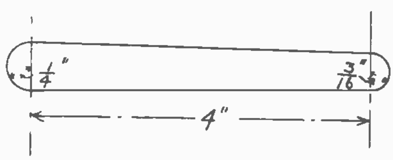


FIG. 27. SWITCH CUT FROM ONE-EIGHTH INCH BRASS

respond to those given in Fig. 27. Secure eight one-eighth inch brass bolts 1½ inches long. Each of these bolts should have three

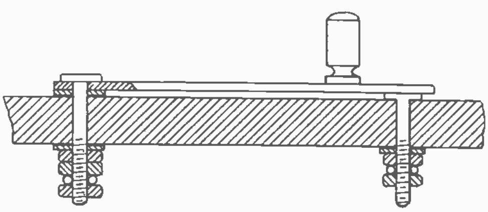


FIG. 28. CROSS SECTION THROUGH SWITCH AND BOARD

nuts and one copper washer. Drill eight one-eighth inch holes in the board, as shown in Fig. 26, and then fasten the bolts in place. Fig. 28 is a cross-section through the completed switch.

In winding the secondary coils make sure that the induced electromotive force in the two coils will be in the same direction, with respect to the external circuit when their inside terminals (S1) and (S2) are connected.

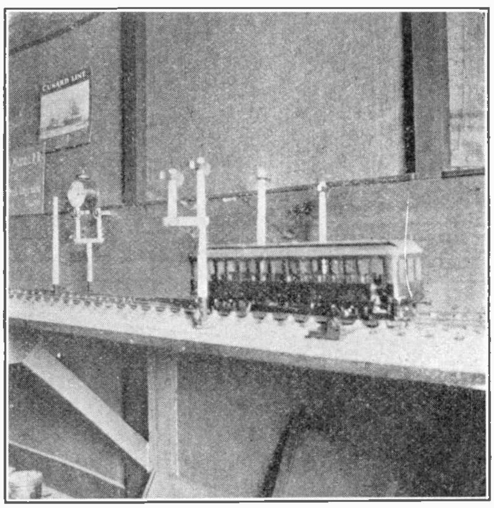
You should make sure that the two primary coils are connected in series, so that the current in both coils tends to magnetize the core in the same direction. If this is not the case you may destroy your primary winding, when you connect it to the line.

The transformer can be constructed to operate on a 220 volt circuit by using 1100 primary turns instead of 550. You can then change it to a 110 volt circuit by connecting the two primaries in parallel.

(To be continued.)

A Model Electric Railway

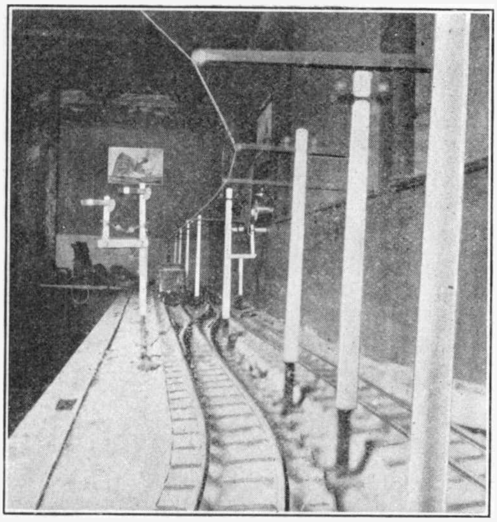
Great ingenuity and resoluteness of purpose are evidently attributes in the person-



A MODEL ELECTRIC RAILWAY

ality of J. Alfred Larralde of Los Angeles, Cal., who designed and built the miniature electric railway shown in the picture at a cost of more than $250. It took him 18 months, working at odd times to bring it to its present stage. Three months more will see every detail complete.

The car, track, semaphores, trolley line, etc., are built to a scale of seven-sixteenths inch to the foot. The gauge of the track is two inches. The car can be reversed at any point desired by means of a polarized switch. A motor is mounted on each truck, giving a



TROLLEY AND TRACK OF MODEL RAILWAY

speed of about 400 feet per minute. The system includes about 50 feet of track, one cross-over and a Y-switch.

The builder is a member of the Society of Model Engineers, (London).

To Make Your Own Sal Ammoniac

Without doubt most of the readers of the Junior Section have used the ordinary sal ammoniac battery in their electrical experiments. Some have possibly also made their own batteries; that is, everything except the battery compound. The following description will tell you how to make the sal ammoniac and at the same time constitute a simple and very interesting experiment in chemistry.

In the diagram, Fig. 1, (A) is an incandesoent lamp bulb with the plug removed. The plug may be removed as follows: File a small hole in the glass near the plug (which will take some time), to admit the air. Then wind a wet string several times around the glass just above the place where the plug is to be severed, as illustrated in Fig. 2. Then run a hot piece of metal between the string and the plug. The glass will then crack in a straight line all the way around. With a slight blow the plug will fall off.

In Fig. 1, (B) is a rubber stopper with three small holes (not too small) and (C) and (C′) are two bent glass tubes which pass through (B). The acid vapors enter the bulb through these.

A straight glass tube (D) passes through (B) between (C) and (C′). It should extend about three-quarters of the way down the blub. This tube allows the excess air and gases (which are harmless) to escape.

The bottles (E) and (E′) contain muriatic acid and ammonia respectively.

Of the other parts, (F) and (F′) are two holed rubber stoppers, (G) and (G′) are two bent glass tubes which are connected to (C) and (C′) respectively by the rubber tubes (H) and (H′), and (L) and (L′) are also two bent glass tubes, on one end of each there being attached a plumber's furnace bulb. The other ends dip almost to the bottom of the liquid.

A small stand for the lamp bulb may be made as follows by taking a piece of large gauge copper wire (about No. 8 or 10) and bending it into a loop to fit the bottom of the bulb.

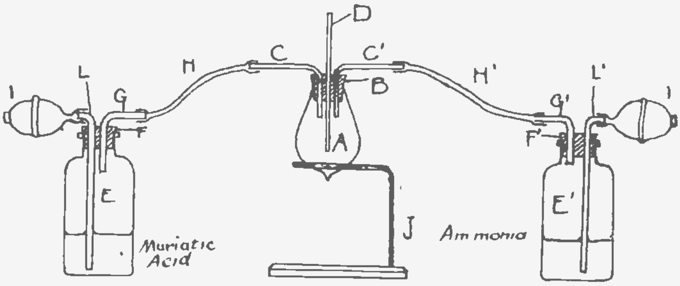


FIG. I. APPARATUS FOR MAKING SAL AMMONIAC

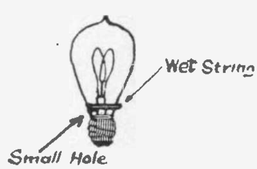


FIG. 2. SEVERING THE PLUG FROM THE BULB

Then bend the remaining piece at a right angle and insert the end in a base.

One thing is certain that to make the experiment work right, all joints must be tight.

Now by pressing each of the plumber's bulbs simultaneously and with equal pressure, an equal amount of each of the gases enter the tube. As the gases mix in the bulb they unite to form sal ammoniac which will gather on the sides and bottom of the glass in white, flaky crystals. When the bulb is full scrape it out and proceed as before.

FRANCIS B. COYLE.

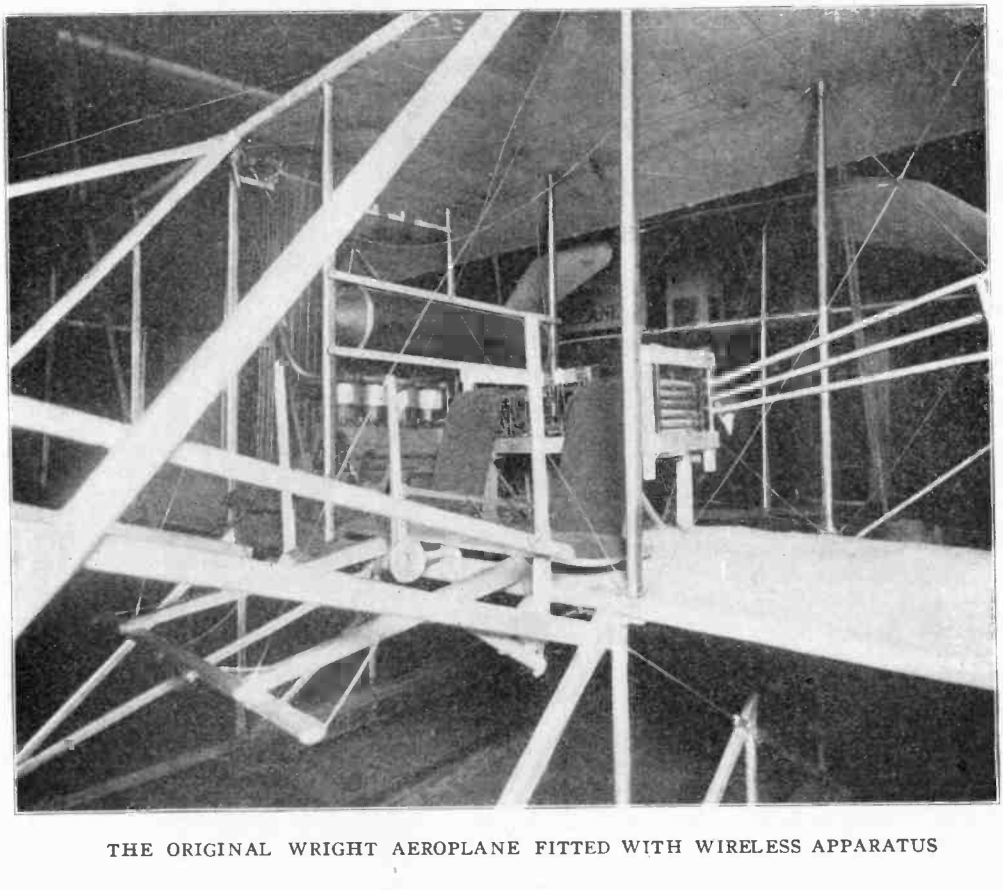
POPULAR ELECTRICITY WIRELESS CLUB

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.

The First Wireless Equipment on An Aeroplane

A casual inspection of the historical Wright aeroplane, now owned by the United States Army, as it hung overhead in the Coliseum at the Chicago Electrical Show could hardly be expected to reveal a most interesting bit of wireless construction. However, people who visited the Show should realize that this heavier than air Wright's machine is the first aeroplane that has ever been fitted up with wireless telegraph apparatus for practical service.

In presenting the Wright aeroplane in



THE ORIGINAL WRIGHT AEROPLANE FITTED WITH WIRELESS APPARATUS combination with the wireless telegraph, and probably wireless telephony, the purpose of the Government and the Exposition Company was to place before the people of the great West a combination of two of the greatest wonders of the age.

It should be borne in mind, previous to this occasion no wireless message has ever been sent to or from an aeroplane. It is understood therefore that the Signal Service, in equipping the government aeroplane in the Coliseum with wireless telegraphy, naturally did not wish the exhibit to be looked upon as anything more than a very rough experiment under the most disadvantageous circumstances. In fact, owing to the immense amount of metal in the Coliseum, the supporting and guy wires for the aeroplane, the network of electric wires, cables and other metallic obstructions throughout the building, no tests from aeroplane to the ground station in the annex, or from the station to the aeroplane can be looked upon as being conclusive.

ARMY WIRELESS STATION AT THE ELECTRICAL SHOW

In fitting up the aeroplane, with its wireless equipment Lieut. Ben D. Foulois, the Signal Service officer, in charge of the exhibit, in conjunction with Mr. Frank L. Perry, of Chicago, has devised a system of antennæ and wiring in combination with the army portable wireless telegraph set that will, likely, be tested thoroughly later on in the experiments which Lieut. Foulois expects to carry on during his flights over the plains of Texas.

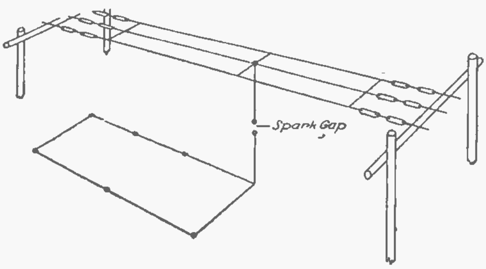
To any one who has not given the subject much study, it would seem to be an extremely simple matter to lay out a system of antennæ in and about the aeroplane. It was found, however, that owing to the surprising number of wires, braces and other metalic parts in the Government aeroplane it was, to the contrary, quite a problem. With the realization that it was decidedly inadvisable to have any loose or hanging wires attached to the aeroplane owing to the revolving propellers, the possible action of the air during flight together with the fact that the aeroplane has to run along close to the ground, etc., Lieut. Foulois in this first experimental outfit confined the antenna wires within the outside dimensions of the aeroplane.

The top antenna consists of three horizontal, parallel, overhead, stranded, copper wires about No. 14 in size, strung along as indicated just beneath the upper plane of the two main surfaces of the aeroplane.

This upper antenna "surface" is maintained in position on a system of porcelain cleat insulators supporting the antenna at its extremities. The wireless army telegraph sending and receiving set may be seen in the photograph located just behind the aviator's two seats in the aeroplane. One stranded wire from this wireless set makes connection, as indicated, at the center point of the three wire overhead antenna system.

No little difficulty was found in plotting out the position of the lower antenna. As it was desired to produce, in effect, a vertical Hertzian oscillator within the confines of the aeroplane's outside dimensions, Lieut. Foulois and Mr. Perry figured that a loop of wire strung around the lower edge of the aeroplane's "runners" would best accomplish the result. Further, from an aviator's standpoint Lieut. Foulois felt that such an arrangement of the lower antenna would not in any way interfere with the starting or landing of the aeroplane in actual service. Connection from this lower antenna loop around the aeroplane's runners, is made by two wires brought up from the antenna proper, through a rubber tube set in the muslin of the lower plane, to the wireless set just alongside of the aeroplane engine. The line drawing shows in a general way the arrangement of the wires.

Messages were received in the Annex at the Signal Corps wireless station by Lieut.



GENERAL ARRANGEMENT OF THE ANTENNAE ON THE AEROPLANE

Foulois's operators within a few hours after the hanging of the aeroplane.

Lieut. Foulois's plans purposed not only to experiment with wireless telegraphy, but also, during the exposition period, to utilize some experimental telephone apparatus from Mr. Perry's laboratory with the idea of carrying out Major G. O. Squier's wishes that every possible opportunity be utilized for preliminary experiments in wireless telephony.

Relative to the receiving station "on the ground," so to speak, in the Annex of the Coliseum, this consisted of an army tent within which were placed the regulation Signal Corps wireless sending and receiving sets.

The regular army antenna pole and "umbrella antenna" were set up and messages were every few minutes dispatched to and from the aeroplane and this station on the ground.

In addition, there were within the confines of this space a very beautiful exhibit of aeronautical pictures that about one year ago were presented by Major G. O. Squier of the Signal Corps to the American Society of Mechanical Engineers after his lecture on "The Present Status of Military Aeronautics."

The Directive Aerial

The increasing difficulty of communication by wireless telegraphy due to interference, especially in well populated districts, has led to the development of many devices for the selective reception of signals. Most of these devices apply to methods of tuning, but there is at least one of a different nature which not only increases the selectivity of a station, but also aids materially in long distance reception of signals. This device is the "directive aerial."

It has been found that an oblique or inclined wire as shown in Fig. 1 responds most readily when the direction of propagation of the waves is in the plane of the wire and its "leading in" wire. The directive aerial is composed of several slanting or horizontal wires with wires leading from their lower ends to the operating room. The upper ends may all be connected together, or may also have wire connections leading into the operating room to porcelain base switches, so that they may be connected together in various ways, as in series or parallel.

Fig. 1 shows one way of connecting up a directive aerial, (sss) being porcelain base switches by means of which one of more aerial wires may be connected to the re-

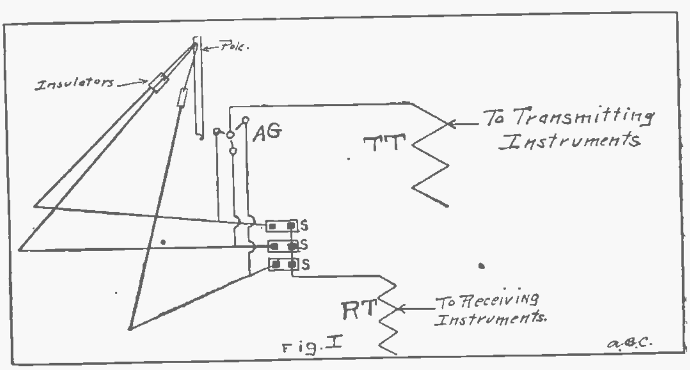


FIG. I. ARRANGEMENT OF THE DIRECTIVE AERIAL

ceiving tuning coil (RT). (AG) is an anchor gap, or equalizer, from whose central post a wire leads to (TT), the transmitting tuning coil.

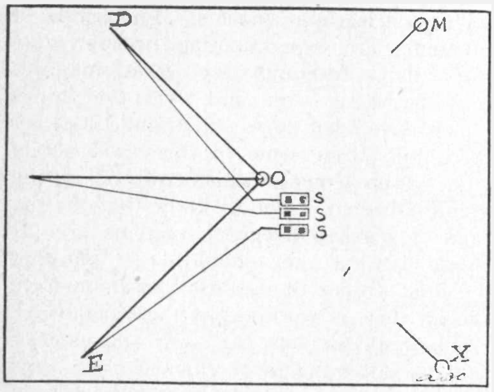


FIG. 2. TOP VIEW OF DIRECTIVE AERIAL

Fig. 2 is a view of the aerial from above. The operating room is generally directly under the pole, which supports the aerial at (O).

Suppose that a station is at (X) and another is at (M), both sending at the same time. It is desired to get signals from (X) but not from (M). All wires will be disconnected from the receiving tuning coil by opening the switches, except that connected to wire (D). The greatest intensity of will now come from the signals of station (X). Likewise, if station (M)is to be heard, wire (E) will be used.

Horizontal wires radiating from a point may also be used as a directive aerial by bringing a wire from the further end of each aerial wire to a switch in the operating room.

The directive aerial is now being used by a number of commercial stations, of which the Manhattan Beach station of the United Wireless Company is a good example. The aerial of this station is composed of 22 sections, the height of all being 210 feet from the ground.

A. B. COLE.

What a Wireless Club Member Is Doing

One of the members of Popular Electricity Wireless Club, Clayton R. Gerstenslager, of Cleveland, Ohio, sends us a very good photograph of his equipment, which is reproduced herewith.

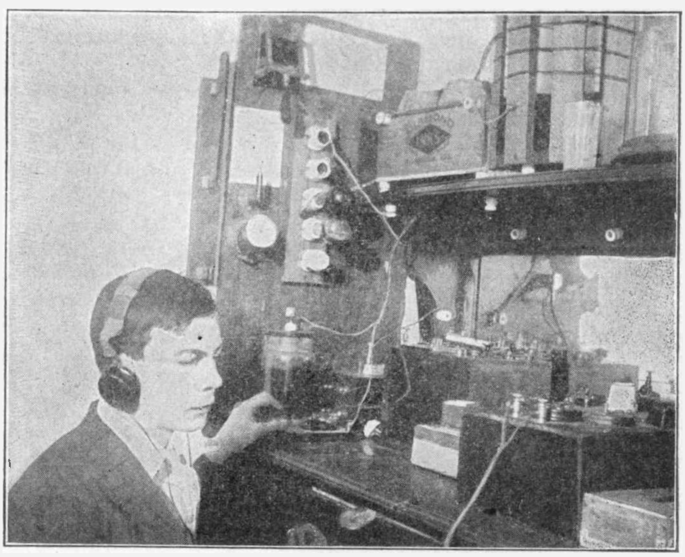
For his sending outfit he uses a ¼-kilowatt transformer, operated by an ordinary telegraph key, the spark gap terminals being of zinc. In addition there are four leyden jars, a sending helix and electrolytic interrupter. When he wants to do telegraphing afield he uses a portable set containing a ½-inch spark coil.

The receiving instruments comprise three detectors. (electrolytic, carborundum and silicon), variable condenser, tuning coil, and a pair of 1075-ohm receivers. He also has a Marconi type receiver set consisting of a coherer, decoherer, two sounders and two relays of 20 and 150 ohms.

He says that he can receive from any commercial station bordering Lake Erie, also from the lake boats.

"I am learning electrical engineering," says our Wireless Club friend, who by the way is only 17 years of age, "and find no magazine better than Popular Electricity for hints on electricity and wireless."

We hope this is the case with all the members of the Club and readers of this department. Wireless is one of the most fascina-



A MEMBER OF P. E. W. C. AND HIS EQUIPMENT ting lines of experimental work in the field of electricity and to the boy or young man who becomes interested in wireless there cannot help but come a desire to know more of the wider application of electric current.

Give the Amateur a Square Deal

It is safe to say that by far the greater part of the talk about interference of amateurs with the commercial and government stations is absolutely without foundation. Especially is this so since amateurs have begun to band themselves together in the form of clubs and associations for the general uplift of their cause.

As an example of how wild and absolutely inaccurate stories may start and do incalculable harm to the cause of the amateur experimenter, take the case of the late accident to the S. S. Puritan on Lake Michigan. She had broken her rudder and her captain had to send out a wireless call for help to save his ship from being blown on the shore and wrecked. A story was printed and widely circulated that several Chicago amateurs "broke in" and their calls of C. Q. D., accompanied by alleged humorous remarks bothered the shore operators, who were trying to learn the ship's position quickly that aid might be sent.

Now as a matter of fact no such thing occurred, and as far as can be ascertained there was no interference from any amateur, which is acknowledged by the operators of the stations who were trying to locate the ship. One of the members of the Chicago (Amateur) Wireless Club heard the messages of distress and immediately called up the president of the club by telephone that steps might be taken to prevent any interference from the stations of the club. The president, Mr. R. C. Dickson, immediately telephoned all the members who had apparatus of sufficient power to cause such interference and warned them to refrain from using their transmitting instruments until the ship was out of danger. That there was no such interference can be ascertained from any of the operators on duty at the commercial stations at the time.

Let the amateur be treated fairly in these matters. There are bills proposed in Washington now to pass legislation against the amateur. No such step should be taken unless it is desired to stamp out one of the most fruitful sources of improvement to wireless telegraph systems. Thousands of amateurs are experimenting tirelessly day after day. Although the great majority may be doing over and over the things which have been done a thousand times before, still, from some of them will surely come improvements which will be of the greatest benefit. We all know that the details of wireless telegraph systems are far short of what they should be. Why not let some of these thousands of amateurs have the privilege of working out these details?

The amateur with his clubs and associations is becoming more efficient every day. Though in the beginning he may have been at times indiscreet, that time is passed and he realizes now more fully than the careless ones who start malicious stories about him, the enormity of the offence of interfering when interference may mean loss of life and property, or the hampering of the business of commercial stations.

Give him a square deal.

Hartford Wireless Association

The Hartford (Conn.) Wireless Association was organized recently, having for its object to further the art of wireless telegraphy and telephony. W. J. Hickmott, Jr., is president, D. N. Cole, treasurer, and H. E. Chapman, 320 Wethersfield Ave., secretary. The association invites all amateurs interested in wireless work, and living near Hartford, to write to the secretary for membership blanks.

Texas Wireless Association

The Texas Wireless Association has been organized with the following named officers: George Mackenzie Douglas, president; Roy M. Kinkaid, vice-president; Howard G. Smith, secretary and treasurer.

The membership roll shows 116 members. Any one wishing to become a member should send the necessary data to the nearest of the following addresses: Texas Wireless Association, 1212 Prairie Ave., Houston, Texas; William C. Fraser, care of Fraser Bros., Plumbers, 411 North Oregon St., El Paso, Texas; Louis Joseph Nau du Treil, 518 Eleonore St., New Orleans, La. The data given should include name, age, address, occupation (if any), description and radius of aerial and set used; also state if a member of any other clubs.

WIRELESS QUERIES

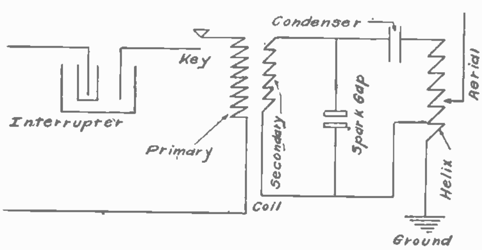
Answered by A. B. Cole

Questions sent in to this department must comply with the same requirements that are specified in the case of the questions and answers on general electrical subjects. See "Questions and Answers" department.

Construction and Operation of Sending Instruments

Questions.—(A) I have a wooden core 15 inches long, $4\frac{1}{2}$ inches in diameter for a tuning coil. What kind of wire shall I use? How much will it take? How many contacts? (B) My aerial is 40 feet high and runs parallel with many wires in the vicinity. I get a loud humming in my receiver. The condensers I have made seem to do no good. How can I overcome this difficulty? (C) What size wire should be used to connect the different instruments? (D) How can I tell the positive and negative poles of my spark coil secondary? (E) Why is it when I connect my ground to my spark coil I get no spark? (F) How shall I connect a "Gernsback" interrupter, one inch spark gap, condenser, helix and key? (G) How shall I make a good sending condenser?—H. J. T., Richmond, Ind.

Answers.—(A) Wind the core full with No. 20 single cotton covered copper wire. About 440 feet will be needed. This will



CONNECTIONS FOR INTERRUPTER

require about two pounds. Three contacts are sufficient.

(B) Ground the lower end of your tuning coil, that is, the end which is not connected to the aerial.

(C) No. 14 copper wire is large enough.

(D) Hold a sheet of heavy paper between the spark gap terminals. Allow the spark to puncture the paper and then look closely at the place where the spark passed through. You will observe that the holes made by the spark are not clean cut, but look as though a pin had been pushed through the paper. On one side of the paper a ridge has been raised in the same way a pin would have done, and from the above points you will be able to decide which side of the gap is positive or starting point, since it is from the smooth side of the hole that the spark starts.

(E) Your question is rather indefinite, but if we assume that you have an aerial connected to the other secondary terminal of the coil the reason for the decrease in spark length is that the aerial and ground act like a condenser and therefore cause the decrease in spark length as would any condenser connected across the spark gap.

(F) See diagram.

(G) Cover eight photographic plates, each five by seven inches, to within one inch of the edges with tin foil. Then coat each plate and foil with two or three layers of shellac. Support the plates in a suitable frame, and connect alternate foil sheets together.

Tuning Coil; Detector; Spark Coil

Questions.—I am making a single slide tuning coil wound with No. 28 single cotton covered wire on a core five inches long and five inches wide. (A) How can I make the wires stay in their place after leaving a space the width of the wire? (B) Would it be all right to varnish it and leave it bare where the slider touches it? (C) Do you need batteries for an electrolytic detector? (D) What kind of wire do I need for the primary in making a one inch spark coil? Also give length and diameter of core, kind of wire for secondary and how much? (E) How can I make a receiving tuning coil? Can I use fixed condensers for receiving? (F) What will be the wave length with a 75 foot antenna of above coil? (G) What is the best mineral to use for a detector, silicon, carborundum, perikon, etc.? (H) Can I use rheostat instead of potentiometer? (I) For making a spark coil is it best to wind in even layers or by sections?—B. H., Chicago, Ill.

Answers.—(A) Wind the wire on tight, and then fasten each end to a small wire nail driven into the core. Then give the wire several thick coats of shellac. When dry scrape a path for the slider. A flat file does this well.

(B) Yes, but shellac will do better than varnish.

(C) Yes.

(D) Primary, 2 layers No. 18 D. C. C. magnet wire; core, $\frac{1}{2}$ inch diameter, $5\frac{3}{4}$ inches long; secondary, $\frac{3}{4}$ pounds No. 38 S. C. C. magnet wire.

(E) Wind the core you mention above with one layer No. 28 S. C. C. magnet wire. Arrange one or more sliding contacts to move along the coil, so that more or less turns of wire can be used. Fixed condensers can be used for receiving purposes. See article in Jan., 1909, issue on "Condensers in the Receiving Circuit."

(F) About 100 meters if you use an untuned transmitting system.

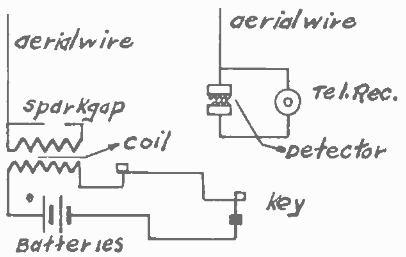
(G) Perikon is considered the most sensitive of the mineral detectors.

(H) Yes.

(I) Small coils, up to two inch spark, are generally wound in two sections, and larger coils are wound in more sections, depending on the spark length.

One-Hundred-Foot Wireless Equipment

Question.—What apparatus must I make for a small wireless receiving and sending station to operate across a room about 100 feet wide, not using any ground connections?—J. C. R., Marshall, Ill.



100-FOOT WIRELESS EQUIPMENT

Answer.—For transmitting you will need a ½-inch spark coil; five dry or wet batteries, telegraph key, spark gap, and an aerial wire five or ten feet long. For receiving you will need a silicon or perikon detector, a 75-ohm telephone receiver, and an aerial wire as above. Connect the apparatus as in the diagram.

Long Distance Receiving Equipment

Questions.—(A) Would an aerial consisting of two aluminum wires No. 12, suspended from a kite 1,500 feet high be good for long distance work? (B) I intend to erect a station at Prince Edward Island, Canada. Could I hear any European stations with the following instruments: aerial as above; ground five square yards of zinc buried in damp soil; loose coupling tuning coil; fixed and variable condensers; electrolytic and perikon detector; double pole receivers, 4,000 ohms; potentiometer and battery. (C) How can I improve the above station?—J. B. M., Chester, Pa.

Answers.—(A) Yes, this method has been used several times for this purpose.

(B) You should be able to accomplish the above result if your telephone receivers are made by a reliable concern.

(C) If the tuning coil is of good design, and the receivers are high grade you have about as good a set as is made at the present time.

Protection for Receiving Instruments

Questions.—(A) What is best to protect the receiving instruments from strong currents, a single fuse in the aerial circuit or a gap shunted across the two lead-in wires? (B) Is ordinary lamp cord suitable for leading in the aerial? (C) In my ground switch the distance between contacts is nine inches. Will lightning jump this gap if the aerial wire is grounded?—G. W. Z., Chicago, Ill.

Answers.—(A) The former is better.

(B) Yes.

(C) No.

Ground for Portable Wireless

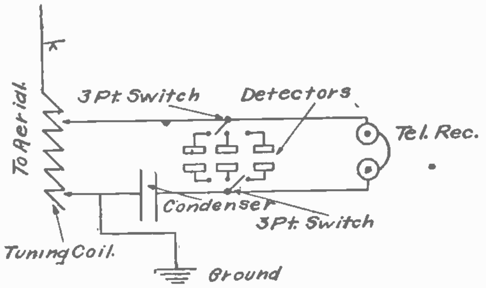
Questions.—(A) Can you suggest a portable ground to be used with a portable wireless in an automobile? (B) In a slanting aerial is it necessary to connect the lower end to the instruments and if so, why?—H. T. E., Haverhill, Mass.

Answers.—(A) An iron or brass pipe, about five feet long, and one inch in diameter will do very well. Drill a hole in one end and insert a binding post, to which connection may be made. The pipe may be driven into the ground where desired.

(B) It is not necessary, but better, since the general direction of the aerial should be up rather than first up and then down, or entirely down.

Sending Radius; Testing Crystals

Questions.—(A) How may I use a tantalum filament from a tantalum lamp to make a detector and what electrolyte should I use? (B) How far should I be able to send over land with a 1-inch coil, two leyden jars, tuning coil, aerial four No. 14 copper wires 35 ft. high 50 ft. long? (C) Please give diagram of connections used in testing crystals. I am having trouble with my carborundum crystals.—T. F., So. Whitley, Ind.



CONNECTIONS FOR TESTING CRYSTALS

Answers.—(A) Clamp the filament in the holder of the fine platinum wire of an electrolytic detector, or in any other way, such as by means of a battery binding post. Mercury is used in place of the electrolyte.

(B) From three to five miles.

(C) See diagram.

QUESTIONS AND ANSWERS

Use of this department is free to readers of Popular Electricity, but attention will not be given to questions which do not comply with the following rules: All questions must be written in the form of a letter addressed to the Questions and Answers Department and containing nothing for the other departments of the magazine; two-cent stamp must be enclosed for answer by mail, for space will not permit of printing all answers; the full name and address of the writer must be given.

How to Ask Questions

Attention of users of this department is called to the requirements printed at the top of this page, which will be strictly adhered to. We spend a lot of time and money on this department which is undoubtedly one of the best features of the magazine, to the practical worker. The questions which are answered from month to month in the magazine pages are but a few compared to those which are answered direct by letter. The service, moreover, is free.

In return for this service we shall insist that questions be sent us in intelligible shape. If the information is worth asking for it is worth asking for right. If the question comes in scrawled on a postal card, or buried in the midst of a letter to some other department or without a stamp for the answer no attention will be paid to it. Address all questions to the "Questions and Answers Department," Popular Electricity.

Another thing to remember is to give us specific and complete data which will enable us to answer your question. When you write in, for instance, and say: "How much and what size wire shall I use to rewind my dynamo to give 50 volts instead of 110 volts?" you might just as well say: "How far will a gun shoot?" Well, that will depend largely, as you can see, on whether the gun is a .22 rifle or a 13-inch toy such as they use on Dreadnaughts. In the above instance you would need to tell us the length and diameter of the armature, the size and shape of the field magnets, etc.

Make your questions as clear and concise as possible. Write them on a typewriter if you can and if you can't do that write them in as close an approximation to standard Spencerian chirography as possible and let them speed on their way.

Overloaded Lighting Circuit

Question.—When you put an arc lamp on an incandescent circuit why does it put out all the lights. I placed a small one on a circuit at the Missouri Pacific depot and the fuse plug burned out.

Answer.—The smallest wire permissible for use on a branch lighting circuit is No. 14 B. & S. gauge. By National code rules this must be protected on lighting circuits by fuses not larger than six amperes in capacity. This, at 110 volts, allows 660 watts of energy on the line, or the equivalent of twelve sixteen candle power carbon lamps. By adding three and one-half to five amperes more or from 385 to 550 watts, the energy required by an arc lamp, the circuit was overloaded and the fuse becoming heated from this blew out and opened the circuit.

Transformer Design

Questions.—(A) I have in my station a 2300 volt line which I would like to connect to a two K. W. transformer. What would be the amount and size of wire for the primary winding of such a transformer? (B) For the secondary? (C) What size of core should such a transformer have?—C. R., Reading, Mass.

Answers.—(A) You do not state to what voltage you wish to step down the 2300 volts, so we assume 110. The usual allowance in transformers is 500 circular mils of sectional area of wire for each ampere of current. At 2300 volts the primary of a two K. W. transformer would carry about 0.9 of an ampere. No. 23 B. & S. gauge wire has a cross sectional area of 509 circular mils if the above rule is strictly complied with. Use at least No. 18. Assuming one ampere flowing in the primary, tests and tables state that nine ampere-turns per inch length will give 30,000 lines per square inch, magnetic density, about right for a two K. W. transformer on 60 cycles.

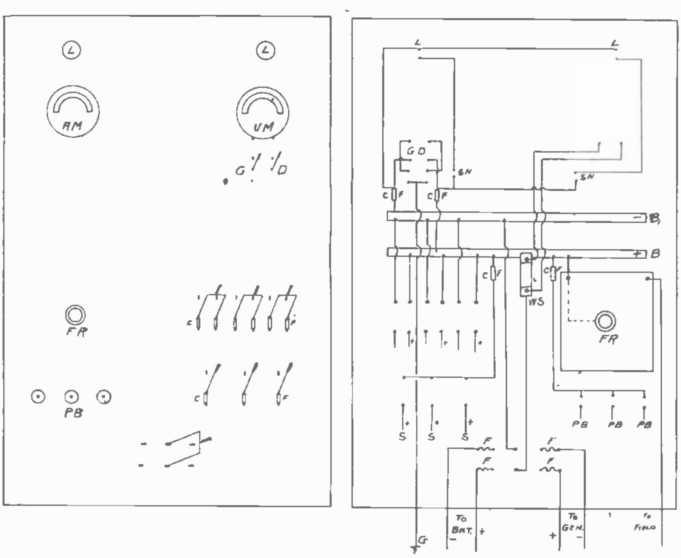
(B) For the secondary winding giving an output of about 18 amperes, 9000 circular mil wire or No. 10 B. & S. gauge would be required.

(C) Provide for 48 cubic inches of core.

Switchboard Diagram

Question.—I want to build a switchboard but am not sure how to connect it up. Could you aid me by giving a wiring diagram? I want a double-pole double-throw main switch so arranged that I can throw batteries on the bus-bars when the switch is thrown one way, and when the switch is thrown the other way the dynamo will be connected to the board and the batteries cut off. In addition the ammeter and voltmeter light must each turn on independently. There must also be three double-pole knife switches for controlling lighting distribution; three single-pole knife switches; and three push-button switches. —R. E. R., Central Village, Conn.

Answer.—The accompanying diagrams of the front and back of a switchboard shows one way of making the connections you desire. The pilot, or instrument lights (L) are controlled by snap switches (SN), (back view.) The ground detector connections (GD) are taken off the same fuses. These latter should not exceed six amperes in capacity. The ammeter is shown as connected to a Weston shunt. The single-pole switches are connected to a common wire or bar protected by a fuse (CF). The other side of these circuits as well as the push-button circuits will have to be brought back, after connecting through the device to be operated, to the negative bus-bar. It is not safe to operate bells off a 110-volt circuit unless the bells are specially built for this voltage, and the wiring to them installed the same as electric light wiring.



FRONT AND BACK VIEWS OF SWITCHBOARD

Power of a Magneto Generator; Connections for Direct Current

Questions.—I have a magneto generator which is supposed to generate enough current to light a 16 candle power, 110-volt lamp. One terminal is connected to the axle and one to a slip ring insulated from the axle. When the armature is turned, a connection to the axle and slip ring will give a heavy shock but will not light either a 16 candle power 110-volt lamp or a 4-volt lamp. (A) Please explain what is the trouble. (B) How should it be connected for direct current? (C) What position should the segments of the commutator occupy in relation to the armature? (D) Does it matter if the brush touches both segments at the same time when crossing from one segment to the other?—E. W., Westport, Conn.

Answers.—(A) You evidently overestimate the power of your magneto. From the description we judge it to be an ordinary telephone generator. These generate 75 to 85 volts on open circuit; enough to give quite an appreciable shock, but have such a high internal resistance that when connected to a resistance such as a lamp, the voltage decreases and the maximum current only reaches about .06 ampere. The total watts are only about 2.4, while a 16 c. p. 110 v. lamp requires about 55 watts. Yon have neither the power nor current capacity to light either lamp. You might rewind the armature with about one-twentieth as many turns of No. 22 wire as there are turns of fine wire and get enough current to light the 4 c. p. lamp.

(B) Paste a piece of paper, equal in length to one-half the circumference of the slip ring, on the slip ring, in such a position that the ends are on a line perpendicular to the armature core and leave the connections same as now. This will give you a direct pulsating current over half a revolution; or, fasten by any convenient method, two insulated metal semi-cylinders to the axle in such a manner that the breaks between the segments are on a line perpendicular to the core and connect the ends of the armature winding to these segments.

(C) The segments will extend towards the pole pieces.

(D) The brushes should be set at top and bottom midway between the permanent magnets, in which position there will be no voltage generated when the segments are in position so that the brushes touch both, and it will make no difference if they touch.

Secondary Taps for Various Voltages; German Silver Rheostat

Questions.—(A) I wish to transform 110 volts 60 cycles so as to get voltages from 10 up to 90 volts in 10-volt steps. What size wire will I have to use on the secondary and how many turns before tapping out to get these voltages? (B) What size and length German silver wire is necessary to reduce 110 volts to 60 volts at 2 amperes?—W. J. S., Binghampton, N. Y.

Answers.—(A) The size of wire will depend entirely on the current output. See table of carrying capacities in Aug., 1909, issue. Tap out at proportional intervals. Using the transformer described in Sept., 1909, issue as a guide, you would have put as many turns on the secondary as on the primary. By making the core slightly longer you can put on a primary and secondary of 550 turns each of No. 20 wire and you will get 10 volts by tapping out at the 50th turn of the secondary; 20 volts at the 100th turn, etc., and up to 100 volts at the 500th turn, and 110 at the 550th turn; or you can leave off the last 50 turns of the secondary and only work up to 100 volts, using the line voltage for the 110. This transformer thus modified will only have an output of about two amperes without heating and if you require a heavier current you will have to increase the size of the wire and core proportionally.

(B) You will have to absorb 50 volts at two amperes requiring 25 ohms. See table of resistances of German silver wire in Aug., 1909, issue. You will require about 300 feet of No. 16 gauge 18 per cent or No. 14 gauge 30 per cent German silver to do this without much heating. You can use shorter lengths of finer wire if the heating will not interfere.

Charging Dry Batteries

Question.—Is there any way to recharge a flash light battery? —C. F., Bunceton, Mo.

Answer.—See the Question and Answer Department of the November, 1909, issue.

Reducing 110 Volts A. C. to 10 Volts.

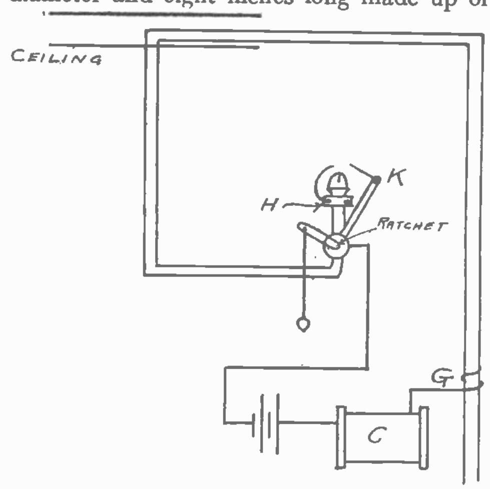
Question.—Please tell me what kind, what size and how much wire I would have to use to reduce 110 volts A. C. to 10 volts, as I want to use it as a 25 point rheostat.—G. R., Wilmette, Ill.

Answer.—It is impossible to answer this question satisfactorily as the voltage at any resistance terminal depends on the current flowing and you have not stated this. To reduce to 10 volts at the terminals the rheostat will have to absorb 100 volts. This divided by the current you will use will give the resistance required. If you want two amperes you will need 100 divided by 2 or 50 ohms in the rheostat and you will have to calculate for each step. Use German silver wire and see table of resistances in August, 1909, issue. See also answer to W. J. S. in this issue. Would advise you to construct a small transformer as described in our Sept., 1909, issue, and carry out numerous taps from the secondary for various voltages.

Electric Gas Lighting

Question.—Please give a diagram of an electric gas lighting outfit and explain.—N. L., Iowa City, Ia.

Answer.—Referring to the diagram a spark coil (C) is used to give a good spark. This coil consists of an iron core ¾ inch in diameter and eight inches long made up of



GAS-LIGHTING CIRCUIT

soft iron wires. Wind on five layers of No. 18 wire and connect as shown. When the pendant is pulled the gas is turned on, (K) making contact with the wire tip opposite. A spring brings (K) back and at the break a spark occurs. The gas pipe forms part of the circuit. A second pull of the pendant turns the gas off. Five or six cells of battery are necessary. Rubber covered wire is advised for use on the circuit when the gas piping is not made a part of it. The underwriters' rule reads "Electric gas lighting, unless it is the frictional system, must not be used on the same fixture with the electric light." This rule does not apply to gas fixtures only. In general, however, it may be said that electric gas lighting systems are a constant source of trouble unless taken care of.

Leyden Jar

Questions.—(A) How can a Leyden jar be charged? (B) Do Leyden jars have to be constructed so that air cannot get inside?—O. W., Carthage, Mo.

Answers.—(A) Static electricity is used in charging a Leyden jar and is produced by a static machine in medical practice. The old way was by the use of the frictional machine.

(B) No. Further, Franklin found that the charge in a Leyden jar is not on the tinfoil, but on the glass, and he proved it by making coatings that could be separated from the jar after the latter had been charged. He found the coatings held very little electricity which was neutralized and the coatings replaced. The jar was now found to have the charge, having held it on the glass, so his conclusions were that the tinfoil or coatings served merely to distribute the charge.

Telegraph and Telephone Instruments on Grounded Line

Question.—Have just installed a grounded telegraph line, one block long. I also have one full equipped telephone set and an extra receiver. (A) Can I operate a pair of telephones and the telegraph instruments simultaneously? (B) Is an induction coil necessary to fit out a second telephone instrument to transmit that far?—S. H. B., Joliet, Ill.

Answers.—(A) You cannot operate the instruments simultaneously on a single grounded line without elaborate and expensive apparatus. If you wish to use them at the same time you will have to provide a metallic circuit and connect as shown in answer to T. G. in the October 1909 issue. However, for such a short length it would be more practical to operate the sets separately if you run an extra wire. You can arrange a simple switch at each end of your grounded line so as to use either the telephone or telegraph instruments but not at the same time.

(B) An induction coil is not necessary. Simply connect a receiver and transmitter in series with a battery. You can talk into the receiver and leave off the transmitter if you wish but that is rather inconvenient.

Exciting Generator Fields

Questions.—(A) Please explain how to excite the fields of a D. C. generator in case they lose their magnetism. (B) If the fields become reversed how would you excite them in the other direction? (C) I have only one generator and no chance to connect to other source of current. What can I use as a source of energy?—E. C. M., Dayton, Ohio.

Answers.—(A) If your machine is compound-wound it may be made to pick up by disconnecting the shunt coils, and short-circuiting the generator through a small fuse. A machine may sometimes be made to build up a field by short-circuiting the armature by holding a copper wire across the brushes, or by rocking the brushes back from their neutral position.

(B) Reverse the field terminal connections.

(C) Other means not being available use several cells of ordinary battery. If this fails, connect the fields so as to obtain the least possible resistance, put them in series with the armature through a small fuse, and speed the armature up above its normal rate.

Gravity Battery; Battery Motor

Questions.—(A) Will one cell of gravity battery such as telegraph companies use run a battery motor? (B)How many gravity cells will I need to run a 15-volt battery motor? (C) What size wire and how much do I need for the field coil on such a motor? (D) What size and how much wire do I need on the armature?—L. M., Plainfield, Ill.

Answers.—(A) Yes, if the cell is in good condition, and the motor requires only one volt and one-quarter of an ampere of current. For continuous work the above figures are the most economical output of a gravity cell.

(B) It will depend upon the current required by the motor. Fifteen cells in series will furnish one-quarter of an ampere at fifteen volts, but if the motor is wound to require say one ampere, then four sets of fifteen cells in series would be required.

(C) and (D) Assuming that your motor is bipolar and requires fifteen volts and one ampere to run it use two ounces of No. 26 wire on the armature, and ten ounces of No. 26 on the field magnets.

Notes on Patent Infringement

By OBED C. BILLMAN, LL. B., M. L. P.

Of Patents for Combinations; of Patents for Compositions of Matter

Of Patents for Combinations—*In General.*—A combination which substantially embodies the principle of a prior patented combination and employs all the elements thereof for the accomplishment of the same result, in the same manner, is an infringement, notwithstanding formal or colorable changes.—Lake Shore, etc., R. Co. v. National Car Brake Shoe Co. 110 U. S. 229; Heaton Peninsular Button Fastener Co. v. Elliott Button Fastener Co., 58 Fed. Rep. 220. This rule, however, is subject to the limitation that a patent which is limited to be a specific combination or arrangement of old elements is not infringed by a different combination or arrangement of the same elements.—Seymour v. Osborne, 11 Wall (U. S.) 516; Lalance, etc., Mfg. Co. v. Haberman Mfg. Co., 54 Fed. Rep. 517. In any event, a substantially different combination as one which differs substantially in construction, mode of operation, and result does not infringe.—Adams Electric R. Co. v. Lindell R. Co. (C. C. A.) 77 Fed. Rep. 432; Electric Railroad Signal Co. v. Hall Railroad Signal Co. 114 U. S. 102; Smith v. Fay, 6 Fish. Pat. Cas. 446, 22 Fed. Rep. Cas. No. 13,045.

Use of Part of Combination.—When Patent Covers Combination Only.—When a patent is sustainable only as for a combination of elements or ingredients, either because the invention consists merely of a new combination of old parts or because the patentee claimed the combination and nothing more as his invention, it is not infringed by a subsequent combination which omits one or more elements essential to the integrity of the patented combination or claimed by the patentee as material, without substituting known equivalents therefor, even though the later combination produces the same result.—Smith v. Fay, 6 Fish. Pat. Cas. 446, 22 Fed. Cas. No. 13,045; Dudley E. Jones Co. v. Munger National Hollow Brake-Beam Co. v. Interchangeable Brake Beam Co. (C. C. A.) 106 Fed. Rep. 693. The omission of an element claimed as material avoids the charge of infringement, even though it is in fact immaterial or unnessary.—Consolidated Roller Mill Co. v. Coombes, 39 Fed. Rep. 25; Kinzel v. Luttrell Brick Co. (C. C. A.) 67 Fed. Rep. 926, but the omission of an immaterial element not claimed as material does not.—Mast v. Dempster Mill Mfg. Co. (C. C. A.) 92 Fed. Rep. 327.

When Patent Covers Specific Devices Only.—When a part of a combination is new, and is claimed by the patentee as his invention, aside from his claim of the combination, its use without the rest of the combination is an infringement.—Moody v. Fisks, 2 Mason (U. S.) 112 17 Fed. Cas. No. 9, 745; Adair v. Thayer, 4 Fed. Rep. 441.

Substitution of Equivalent.—A patent for a combination is infringed by the use of some of the elements of the combination, and the substitution of known equivalents for those omitted.—National Cash Register Co. v. Boston Cash Indicator, etc. Co. 156 U. S. 502; Standard Folding Bed Co. v. Osgood (C. C. A.) 58 Fed. Rep. 583. But infringement is avoided when the elements substituted for the omitted elements are substantially different or are new, or, if old, were not known at the date of the patent as proper substitutes for the omitted elements.—Bavey Pegging Machine Co. v. Prouty (C. C. A.) 107 Fed. Rep. 505; Fuller v. Yentser, 94 U. S. 288; Webster v. New Brunswick Carpet Co., 1 B. & A. Pat. Cas. 84.

Of Patents for Compositions of Matter.—*In General.*—A patent for a composition of matter is infringed by a subsequent composition which is substantially similar—that is, which contains substantially the same ingredients operating in the same manner, and accomplishing the same result—even though it may be slightly or colorably different.—Matthews v. Skates, 356 1 Fish Pat. Cas. 602, 16 Fed. Cas. No. 9,291; Ready Roofing Co. v. Taylor, 15 Blatchf, (U. S.) 95, 20 Fed. Cas. No. 11,613. But where the differences are substantial, there is no infringement.—Goodyear v. Berry, 2 Bond (U. S.) 189, 3 Fish Pat. Cas. 439, 10 Fed. Cas. No. 5,566.

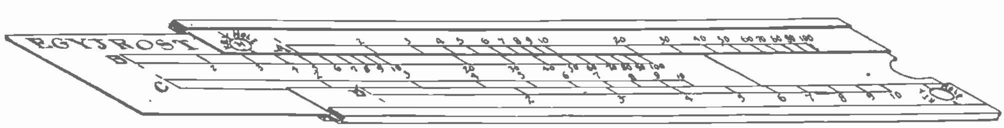
Omission of Ingredients and Substitution *of Equivalents.*—A composition which omits one or more of the essential ingredients of the patented composition does not infringe. —Smith v. Murray 27 Fed. Rep. 69; Otley v. Watkins, 36 Fed. Rep. 323, unless it contains known equivalents for the omitted elements.—Goodyear v. Central R. Co. 2 Wall, Jr., (C. C.) 356, 10 Fed. Cas. No. 5,563; Holliday v. Schulze-Berge 78 Fed. Rep. 493.

Response to Test of Identity.—When a composition responds to the tests of identity prescribed by the patent, it is prima facie an infringement.—Holliday v. Schulze-Berge, 78 Fed. Rep. 493; but when it fails to respond to such tests the presumption is that there is no infringement.—Matheson v. Campbell, (C. C. A.) 78 Fed. Rep. 910.

BOOK REVIEWS

Slide Rule for Mathematical Calculations.

One of the most valuable instruments ever devised to solve mathematical problems *mechanically* is the slide rule. All engineers are familiar with the slide rule and its labor-saving possibilities, not so the layman, although he may have computations to make in which the slide rule would be invaluable to him if he were to use it. There are various forms of slide rules which are in reality graphical and easily handled logarithm tables. You can multiply, divide, extract the square and cube roots of numbers, do examples in proportion, reduce gallons to cubic inches, meters to feet, and scores of other things, all by a few simple manipulations of the sliding rule. As you become proficient in its use you are able to multiply long strings of numbers, divide by other numbers, if desired, as fast as the slide can be run back and forth for the various settings, the final result being read at a glance at the end of all the operations. This makes it invaluable as a quick and accurate check for running through previously computed problems. It saves hours of time and thousands of figures. The illustration shows in a very rough way the general appearance of a slide rule. The common length is 10 inches and with a ten inch rule the calculations are correct to the third place. That is, suppose you obtained a slide rule result of 798,264. You would be absolutely certain that the first three digits, 798, were correct. The next three, however, would be in doubt because the human eye could not read accurately enough in making the interpolations without the aid of a microscope, to be sure of the last three figures.



SLIDE RULE

George W. Richardson, 4212 24th Place, Chicago, Ill., is the inventor and maker of a new and simplified slide rule by which it is possible to make almost any common mathematical computation and is especially designed for the solution of practical everyday problems. With this rule is included a complete instruction book and sample problems. The book contains 25 pages. Book and rule sell for $1.50.

Ignition, Timing and Valve Setting.

By Thomas H. Russell. Chicago: The Charles C. Thompson Company (Not Inc.). 1909. 233 pages with 71 illustrations. Price, flexible leather, $1.50, cloth $1.00.

Ignition troubles are the worst that the automobilist runs up against. To learn what to do in case of ignition troubles it is imperative to learn something definite about the principles of an ignition system used on a car. The object of this treatise is to equip the reader with such knowledge of the ignition system as will enable him to go ahead intelligently and diagnose the trouble and treat it. If you follow the teachings of this work it will go a long way toward stripping the ignition bogey of its terrors. The mere consciousness that you understand the principles and construction of ignition apparatus will add immensely to your comfort on the road.

ON POLYPHASE SUBJECTS

National Electric Light Convention

Announcement is made by the executive committee of the National Electric Light Association that the next annual convention will be held in St. Louis May 23-28 with headquarters at the Coliseum. The convention will mark the 25th anniversary of the association, and there is every indication that it will be unusually successful. There has been an extraordinary growth in membership since the last convention, and it is believed that record numbers will be reached upon this occasion. Active measures are already being taken in St. Louis by local interests to give the Association a true southern welcome. Full particulars may be obtained from T. C. Martin, Executive Secretary, 29 West Thirty-ninth street, New York, N. Y.

A Burlesque on Electricity

What won't a man do these days to try and make a little money? One of the most audacious schemes to come to light recently is that of an agency in Walla Walla, Wash., which sells a set of pamphlets called "Allen's Political Essays," written by one John Bateman Allen, covering such subjects as "Electric Power," "Telephones," "Secret Societies," "Conservation," "Financial Situation," etc. We are told that these pamphlets are being quite widely circulated through the West and if they are all of the ridiculous nature of the one on "Electric Power," which we have before us, the West does not profit by such circulation.

As there is absolutely no connection between the author's statements, we feel at liberty to quote a few paragraphs selected at random which speak for themselves and his lack of any knowledge of his subject.

"Influenza and la grippe seem to have come to this country identically with the advent of gas and electricity."

"One will notice that the seasons are much earlier where there is a heavy electrical transmission and consequential air evaporation. Later in the Spring when the effect is counteracted by equinoctial changes and spring rains, the early summer is noticeably backward."

If it wasn't for poor old Electricity and a few other things early summer would not be backward, according to Mr. Bateman.

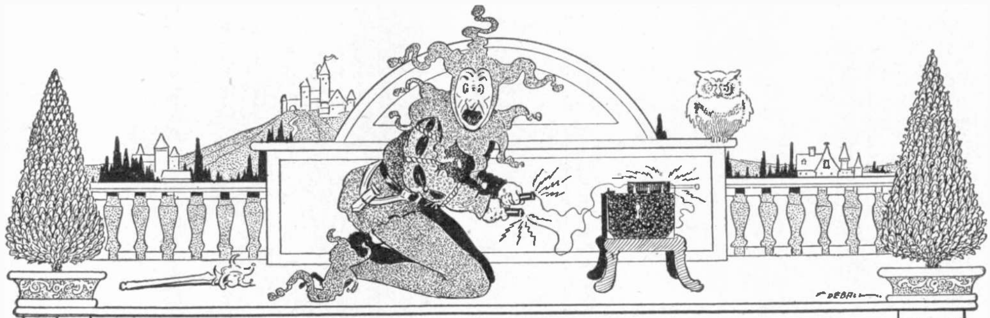
Here's another rich one: "Winds come from vacuums in the air caused by heat and electrical action. Artificial electricity, in some degree, causes the same effect, hence so many storms, attendant fogs and accompanying rains that often come in the form of a deluge and run off as surface water to the detriment of the soil, which it does not permeate but helps to wash away. The fact that the top soil is usually dust from previous electrical action facilitates this erosion."

A versatile thing is Electricity, isn't it? One day makes everything dry and dusty and the next causes disastrous deluges.

"The increase in ptomaine and mineral poisoning from metal leached canned goods and cooking utensils has been enormous." He just threw this in as a filler between two long paragraphs without further comment. Evidently forgot to add that such poisoning is more frequent "during heavy electrical transmission."

Just one more—"This superabundant electrization radiates throughout contiguous territory, and, aided by the aforesaid mind-reading psychics is used for every purpose, from intimidating public servants to finding where a man keeps his valuables." Here's a suggestion for you, Mr. Central Station Manager. Don't worry about line losses any more but turn them into a useful by-product and do a high class, psychic burglarizing business.

To those having only the most elementary knowledge of electricity and its operation statements such as the foregoing are of course only laughable and need no refutation. There are others, however, who have made no study of the laws underlying electrical phenomena who might be inclined to believe some of this stuff. To them we hold forth the warning—"Don't let him tease you."



SHORT CIRCUITS

A certain prominent English jurist was transferred from the chancery court to the admiralty court rather unexpectedly. While conversant with English law to a surprising degree, this gentleman had spent little time in marine law, and was rather dubious as to his ability to cope with the duties of his new office.

His colleagues, in recognition of the occasion, gave him a dinner, after which he was called upon for an address. He made a long and serious speech, which embraced about everything, from free trade to England's foreign policy. Then, pausing a moment, he glanced round the crowded room and said.

"Gentlemen, in closing, I can think of no better words than the lines of Tennyson:

"'And may there be no moaning of tne bar
When I put out to sea.'"

* * *

In one of the leading cities of the Middle West a high church dignitary is obsessed with the monomania that one of his legs is gradually becoming petrified. To test its condition he pinches it at frequent intervals. At a dinner party of men and women he made the usual test after the soup and became greatly excited to find that he felt no sensation from a most vigorous pinch.

"It has come, it has come!" he cried in alarm; "at last my leg is completely petrified!"

The matron sitting next to him whispered hoarsely: "Excuse me; it is not petrified and it is not yours."

* * *

Small Girl: Why doesn't baby talk, father?

Father: He can't talk yet, dear. Young babies never do.

Small Girl: Oh, yes, they do. Job did. Nurse read to me out of the Bible how Job cursed the day he was born!

* * *

The fair young debutante was surrounded by an admiring crowd of officers at the colonel's ball. Mama was standing near by, smiling complacently at her daughter's social success. The discussion was over the quarrel of the day before between two brother officers.

"What was the *casus-belli?*" asked the fair debutante.

"Maud!" exclaimed mama, in a shocked voice; "how often have I told you to say stomach?"

* * *

"I want to know," cried the irate visitor, "whether that item of yours in regard to me is an intentional slur or merely editorial stupidity?"

"What are you talking about, my dear sir, and who are you?" asked the editor.

"I'm Dr. Killiam, and I refer to your announcement of the sudden illness of the Honorable John Jones, in which you say, 'Mr. Jones is in great danger. Dr. Killiam has been called in.'"

* * *

"How realistic your painting is! It fairly makes my mouth water!"

"A sunset makes your mouth water?"

"Oh, it is a sunset, is it?" I thought it was a fried egg."

A young cadet was complaining of the tight fit of his uniform.

"Why, father," he declared, "the collar presses my Adam's apple so hard that I can taste cider!"

* * *

Papa was about to apply the strap.

"Father," said Willie, gently but firmly, "unless that instrument of chastisement has been properly sterilized I must protest."

The old man gasped.

"Moreover," continued Willie, "the germs that might be released by the violent impact of leather upon a porous textile fabric but lately exposed to the dust of the streets would be likely to affect you deleteriously."

The strap fell from a nerveless hand, and Willie flitted.

* * *

"Can you keep anything on your stomach?" the ship's doctor asked.

"No, sir," he returned feebly, "nothing but my hand."

* * *

Ticket-Seller—How many?

Absent-Minded Student—Two standing rooms—together.

* * *

The Bull Pup—How did you lose your tail, old man?

The Yellow Cur—In a trolley accident.

The Bull Pup—Do you miss it much?

The Yellow Cur—Not as much as the boys do who used to tie tin cans to it.

* * *

A gentleman took a friend to an opera. The music, grand as it was, sounded a little noisy, more especially when the bang of drums and the crash of the cymbals occurred at intervals. But the friend's face remained unmoved.

Gentleman—"Doesn't this glorious volume of sound affect you?"

"Oh, not in the least!" was the calm reply. "You forget I am a boilermaker."

* * *

One cold, winter morning a man of tall and angular build was walking down a steep hill at a quick pace. A piece of ice under the snow caused him to lose control of his feet. He began to slide and was unable to stop.

At a crossing half-way down he encountered a large heavy woman. The meeting was sudden, and before either realized it a collision ensued and both were sliding down hill, the thin man underneath, the fat woman on top.

When the bottom was reached and the woman was trying to recover her breath and her feet, these faint words were borne to her ear:

"Pardon me, madam, but you will have to get off here. This is as far as I go."


- A HOBO FINDS A DOLLAR -
1
HE OBTAINS A NEW OUTFIT OF CLOTHES
DROP 50 CENTS IN THE SLOT AND GET A NEW SUIT OF CLOTHES HAT ETC.
SIZE
34 36 40 42
2
HE TAKES HIS ANNUAL BATH
DROP ONE CENT IN SLOT & PUSH THE BUTTON
NEW CLOTHES
3
IS THE RAZOR ALL RIGHT?
DROP 5¢ IN THE SLOT
HE GETS A SHAVE AND HAIR-CUT AT AN ELECTRIC BARBER SHOP
4
DROP PENNY IN SLOT
ELECTRIC SHOE SHINER
HE GETS AN ELECTRIC SHINE
5
ELECTRIC RESTAURANT
PUT 10¢ IN SLOT & GET A SIX COURSE MEAL
MENU
6
DE BALL.

ELECTRICAL DEFINITIONS

Below are defined a few of the most common electrical terms. They are reprinted from month to month and will be of assistance in understanding the magazine text

Accumulator.—See secondary 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. The international ampere is the current which, under specified conditions, will deposit .001118 gram of silver per second when passed through a solution of nitrate of silver in water.

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.

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 outgoing 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 which retards the flow of alternating current. See 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 on a dynamo shaft for gathering the circuit from the various coils of the armature and sending it out over the line as direct current. On a motor it takes current from the line and passes it on to the armature coils.

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.

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.

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 such as a magnet or a wire carrying current.

Fuse.—A short place 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.

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.

Neutral Wire.—Central wire in a three-wire distribution system.

Ohm.—The unit of resistance. It is arbitarily 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.—Open space between the two electrodes of a spark coil or 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.

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.

VIBRATION IS LIFE!

Read What Others Say

Here are a few of the hundreds of unsolicited testimonials from people who have used the White Cross Electric Vibrator and know what it has done. It will do the same for you.

PARALYSIS TREATED BY VIBRATION

Upon the request of my sister, who urged me to use her great Electric Vibrator on my son when I was thoroughly hopeless of his cure from physicians' treatment, I write you this recommendation. My son is 16 years old, and eight months ago became paralyzed from the after-effects of diphtheria. He was so badly afflicted that his arms and limbs were twisted out of shape and was confined, all doubled up, in his bed. Medicine and attention did no good, and I had become discouraged in all ways. After treating first his spine at the base and then his limbs with your vibrator he felt such relief that I kept up the treatment regularly, with the result that we soon had him around in a wheel chair. Next he was going around on crutches, and now, after three months' treatment, he is going around with a cane and will soon be entirely cured.
3122 Indiana Ave., Chicago. MRS. C. KNIGHT.

WHAT A DOCTOR SAYS

I have received your Vibrator, and to say that I am well pleased with it is not enough. I wish I could tell every physician just how bad he needs one in his office. I am sure he would not hesitate to place his order for one at once.
Longmont, Colo. DR. W. H. EASTER.

VIBRATOR BEST FOR RHEUMATISM

My husband uses your vibrator for rheumatism and says he never had anything so good in all his experience. I would not be without it myself, as I find it is good to relieve stomach pains, back ache, and besides I continually use it for face massage. I used to go down town for that, while now I save the money and the time, besides being comfortable in my own home. MRS. S. H. BROWN,
2935 Vernon Ave., Chicago, Ill.

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With the White Cross Vibrator you can make a perfect vibrating chair out of any chair. A chair which will give you the same results as the kind used in the biggest hospitals and sanitariums. You cannot do this with any other vibrator in the world. **Swedish Movement** right in your own home. You can give yourself the very same treatments for which specialists and sanitariums charge from $2.00 to $3.00 each. The nervous, irritable, worn-out man or woman will obtain quicker and more permanent benefit from a few minutes each day in the vibrating chair than from hundreds of dollars worth of medicines.

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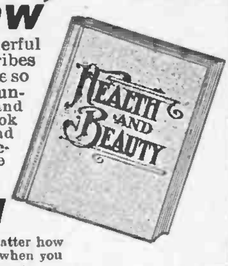

This wonderful book describes the human body in health and disease so plainly and clearly that anyone can understand. It tells how to get healthy and beautiful and how to keep so. This book tells you what vibration will do for you and how you can get the **White Cross Electric Vibrator** sent right to your home for an actual free trial.

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Without obligations on me please send me free your special reduced price offer, free Book on Health and Beauty, treatment of disease by vibration and electricity, and complete catalog.

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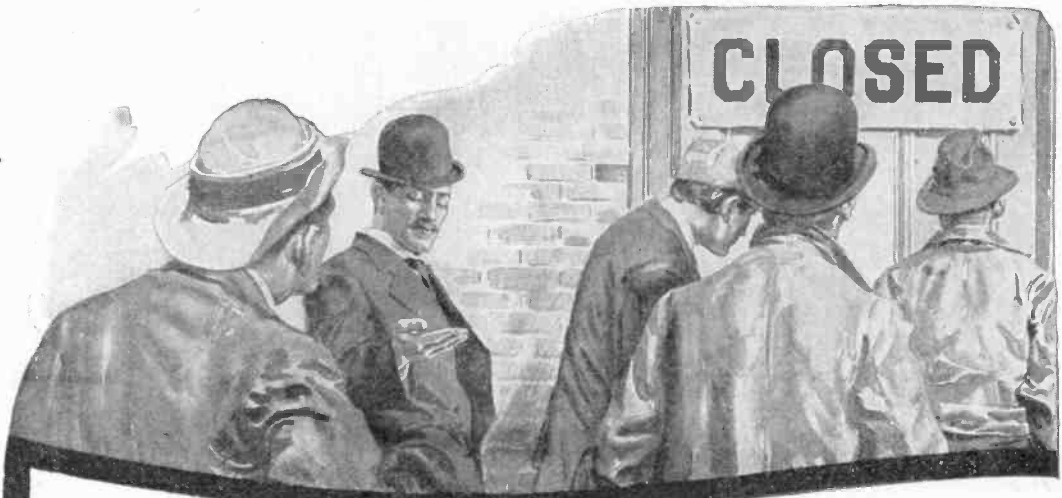

If This Should

Suppose on going to work to-morrow you found the place closed, *and yourself out of a position*. What would you do? Would you be compelled to take your chance with the army of unemployed, or would the fact of your being an expert in some *special* line of work assure you ready and lucrative employment?

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Stories which Prove

I started my Course when I was a dynamo tender. The knowledge I gained has enabled me to steadily advance my position and I am now Chief Electrical Engineer in the L. I. State Hospital and have increased my earnings 200 per cent.

HERBERT B. BRAND,
L. I. State Hospital,
Brooklyn, N. Y.

I was a carpenter in a planing mill when I became an I. C. S. student. I am now a Mechanical Draftsman with the Ledgewood Manufacturing Company and have increased my earnings 400 per cent. In my opinion your Schools have attained an unparalleled degree of efficiency.

ARTHUR RAMSAY,
80 Joralemon St.,
Brooklyn, N. Y.

I enrolled for my I. C. S. Course when I was an apprentice in a tin shop. I am at present Senior Partner in a plumbing, heating and electrical establishment. My income now amounts to twenty times what it did when I enrolled. No ambitious man who desires to advance can afford to go without a Course in your Schools.

E. J. YOUNG,
P. O. Box X, Calgary, Can.

When working as a bookkeeper I enrolled for a Course in the I. C. S. I am now an Architect in business for myself and have very greatly increased my earnings. I think your system of training is a most excellent one.

WM. P. ENDEBROCK,
124 Jackson St.,
Trenton, N. J.

My I. C. S. Course has been of great advantage to me. When I enrolled I was employed as a lineman by the Western Union Telegraph Co., and I am now Superintendent of Maintenance for the North Eastern Telegraph Company of Portland, and my salary has been increased about seventy-five per cent.

O. S. BOWEN,
30 Kedder St.,
Portland, Me.

I was working as a carpenter when I enrolled for my Course in the I. C. S. I am now Contractor in business for myself and have very materially increased my earnings. I recommend the I. C. S. to any ambitious tradesman.

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The following testimonials tell the story of I. C. S. help. On an average 300 students every month ***VOLUNTARILY*** report advancement as the *direct result of I. C. S. training.* During November the number was 302. To have *your* salary raised, ***MARK THE COUPON.***

I. C. S. Training Pays

While employed as workman in a sash and door factory at $1.50 per day I took out a Course in the I. C. S. This Course has been of great benefit to me and has enabled me to advance my position to that of Draftsman and to more than double my earnings. Your Schools certainly afford a fine opportunity for ambitious workingmen to advance.

CHAS. T. BRASFIELD,
Natchez, Miss.

I am of Polish birth and came to the United States about 15 years ago. I had a common education at home, but had not studied English at all. The I. C. S. is certainly all that can be desired by any student. It showed me how to become a Contractor and how to increase my salary about 400 per cent. I have nothing but good to say about your Schools.

ANTHONY BURRY,
1103 Front St.,
Ft. Worth, Texas.

Through the excellence of the instruction I received from my I. C. S. Course I have been immeasurably benefited in advancing my position from that of coal passer to that of Electrician and Foreman of the Boiler Room and my earnings are now double what they were when I enrolled.

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Please explain, without further obligation on my part, how I can qualify for employment or advancement in the position before which I have marked X

Bookkeeper	Mechan. Draughtsman
Stenographer	Telephone Engineer
Advertisement Writer	Elec. Lighting Supt.
Show Card Writer	Mech. Engineer
Window Trimmer	Plumber & Steam Fitter
Commercial Law	Stationary Engineer
Illustrator	Civil Engineer
Civil Service	Building Contractor
Chemist	Architec'l Draughtsman
Textile Mill Supt.	Architect
Electrician	Structural Engineer
Elec. Engineer	Banking
	Mining Engineer

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The Perfect Light

To the man who wants the best of everything in his home, there is but one light

THE COLUMBIA MAZDA

This new lamp gives a brilliant, mellow glow like "bottled sunlight," and is the finishing touch to the perfect home. It also is

The Cheapest Electric Light

because this wonderful lamp gives twice as much light for the same current as the old style carbon incandescents with which we all are familiar.

The Columbia Mazda is one of the most remarkable of recent electrical delevelopments. We sell them in all sizes—small lamps for the home, large lamps for office, shop or store.

Come and allow us to demonstrate to you.

The Columbia Incandescent Lamp Company

ESTABLISHED 1889

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BRANCH OFFICES:

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Electric Coffee Percolator

The Quick, Clean, Convenient Way to Make Uniformly Good Coffee

The utility of the Coffee Percolator and its attractive appearance on the dining table make it one of the most popular of electric appliances. No danger—no inconvenience; costs less to operate than an alcohol lamp.

The following prices are on nickel finish percolators. Supplied also in copper finish and—on special order—in silver finish.

1½	Pints Size,	400 Watts,	106-115 Volts,	$10.90
3	"	500 "	"	12.40
4	"	500 "	"	14.25

Add $1 for Express Charges

Electric Hot Water Cup

A Great Convenience For the Man Who Shaves Himself

Just the turn of a switch and you have hot water in a minute—no bother—right on the dressing table. The convenience of the hot water cup, especially in summer, is quickly appreciated.

The cup is enameled with ornamental aluminum base, attaching plugs and wire are furnished—apparatus ready for use. Can be operated on an ordinary lighting circuit.

150 Watts, 95-125 Volts, Express paid, $2.75

Electric Chafing Dish

At Once a Luxury and an Economy for the Home

Convenient, cleanly, safe. Either pan (food and water) can be quickly clamped to the stove. Regulating switch gives three degrees of heat—each steady and dependable. Free from danger incident to using alcohol flame. Costs less to operate.

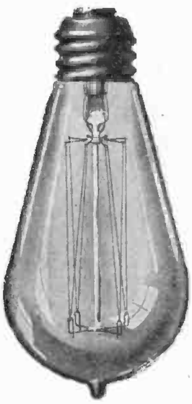
Pans are of heavy copper, double tin lined and nickel plated.

3-pint size, 6-in. heater, 500 Watts, $16.00
Add $1.00 for Express Charges
Others at Lower Prices

Electric Shop

Michigan and Jackson Blvd.
CHICAGO, ILL.

Light Your Store or Home Properly



The cost of electric light is very reasonable now that we can supply the

Sunbeam Mazda Lamps

Two and one-half times the light of the old carbon filament lamp—a soft, white, brilliant light that you can read by for hours without hurting your eyes.

No other light can compare in quality, convenience, safety or practical economy with electric light, and no other lamp can compare with the

SUNBEAM

The lamps manufactured by this Company strictly comply with the Standard of Quality set by the Engineering Department of the National Electric Lamp Association, of which we are a member.

Sunbeam Incandescent Lamp Company

Established 1889

CHICAGO TORONTO NEW YORK

Western-Electric

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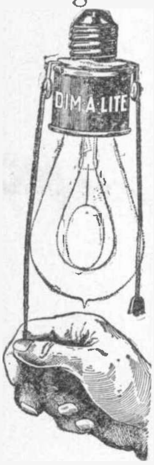
GENERAL DISTRIBUTORS

New York, Chicago, San Francisco — Philadelphia, St. Louis, Seattle — Los Angeles, Boston, Cincinnati — Kansas City, Pittsburg, Minneapolis — Denver, Salt Lake City, Atlanta — Omaha, Dallas

FEDERAL ELECTRIC COMPANY

The Modern Home

is made more convenient and attractive by the use of the articles shown below. Utility and low price are combined with excellent design. You will find dozens of uses for them in your home.



The Dim-A-Lite

saves electricity by turning down the light. By pulling the cord the light is reduced to a low light desirable for halls, bathrooms or the sick-room. A further pull turns the light completely out.

It cannot get out of order or burn out. Screws into the ordinary socket and uses ordinary Edison lamp.

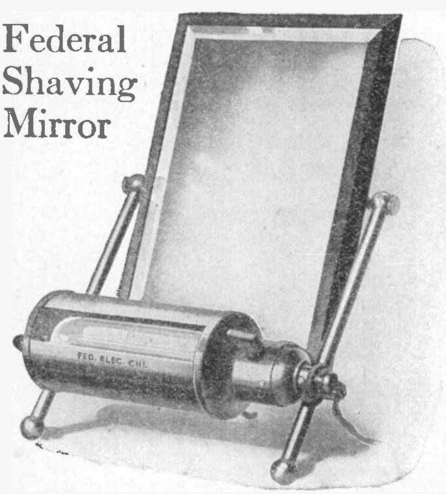
Gun Metal Finish $1.00
Brush Brass " $1.25

Federal Couch Bracket

A portable reading lamp for table or desk. Can be hooked over head of bed by adjustable handle for reading at night. Handsomely finished in antique brass.

Price Complete - Each, $4.50

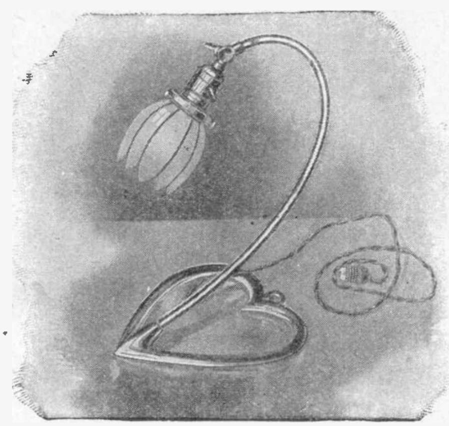
Federal Shaving Mirror



For men who shave themselves

Throws strong light on face below the eyes, relieving the eyes of strain and making a quick shave possible.

Price Complete - Each, $3.75



Old Vienna Portable Electrolier

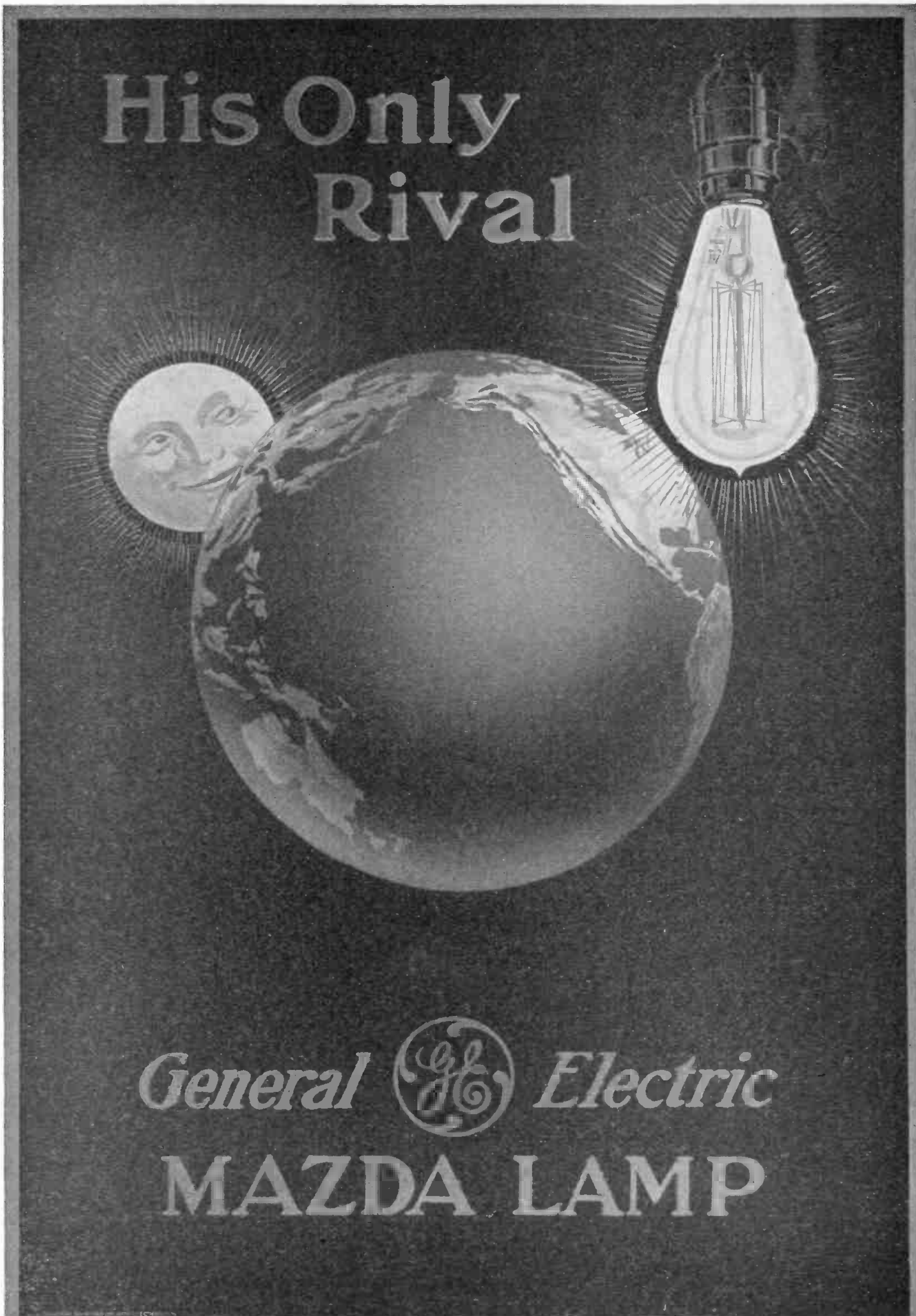
An artistic lamp which can be used on the table or hung on the wall. Its graceful proportions and lines make it harmonize with any furnishings. Low priced and convenient.

Price Complete - Each, $3.15

Buy of Your Dealer or Write Us Direct

Federal Electric Company

Lake and Desplaines Sts., Chicago


His Only
Rival
General Electric
MAZDA LAMP

CLASSIFIED ADVERTISING

Advertisements in the section of Popular Electricity, will cost 40 cents a line, cash with order, and in order to secure proper classification must be in this office the first of the month preceding date of issue

AGENTS

WANTED—BUYERS AND AGENTS TO SELL our cement block, fence-post, brick-making machinery and concrete mixer. Send for circulars and prices. Address W. L. Keller Cement Block Machine Co., Kearney, Neb.

AGENTS—STAMP NAMES AND ADDRESSES on key checks, name plates, watch fobs, hotel and baggage checks; we supply blank stock and stamping outfits; sample free. Hart Manufacturing Co., 82 Guernsey St., Brooklyn, N. Y.

RELIABLE MEN AND WOMEN AGENTS wanted to sell our specialty. Big money easily earned; write today. Falls City Specialties Company, 209 E. Jacob St., Louisville, Ky.

I'LL MAKE YOU AGENT IN YOUR TERRITORY for a product that sells on sight and turns over a good profit to you. Write today. Dr. Miller, 1099 Bushwick Ave., Brooklyn, N. Y.

AGENTS MAKE BIG MONEY SELLING OUR new sign letters for office windows, store fronts and glass signs. Any one can put them on. Write today for a free sample and full particulars. Metallic Sign Letter Co., 400 N. Clark St., Chicago, Ill.

ELECTRIC LIGHT COMPANIES EVERYWHERE want men to sell electric current and appliances. Learn the How and Why by reading SELLING ELECTRICITY, published monthly at 74 Cortland St., New York—$1.00 per year.

WONDERFUL INVENTION—CANCHESTER Kerosene Incandescent Lamp burns with or without mantle; 6 times brighter than electricity, gas, acetylene or gasoline at 1-10 cost. Burner fits any lamp; saves 75 per cent oil. No trimming wicks. $10 daily. Beware of imitations. Handsome outfit furnished. Canchester Light Co. 26 State, Dept. P. E. Chicago.

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ELECTRICAL BOOKS. ALL SUBJECTS. Write for our new illustrated book catalog. Free. Popular Electricity Book Dept., Monadnock Block, Chicago, Ill.

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MAKE MIRRORS AT HOME. BIG PROFITS with little outlay. One 18x36 in. mirror, costs $2.00 to $5.00. You can silver a glass this size for 20c. Send 50c. in stamps or money order and we will send you EXPLICIT DIRECTIONS how to do it; also how to emboss, grind, foil, gold leaf, frost chip and make imitation stained glass. How to transfer photos on glass, bore holes in glass and cut skylights. George L. Patterson & Co., Dept. 4, Brooksville, Ky.

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$300—DAILY MAIL-ORDER BUSINESS, Established 1876. Easily conducted by anyone, anywhere. Part cash, balance from business. Trial given. Prof Anderson, 6949 N. Clark, Chicago.

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An Empire of Small Farms

The Great Land Rush from the North to Florida

By CLEMENT YORE

There are in America today one hundred millionaires rich beyond the dreams of an ordinary man, and all of these mighty commercial princes made their money out of the natural resources of the wonderful state of Florida!

These men did not create their enormous fortunes by fostering and developing this wonderful state, but by robbing it, making it destitute and giving in return nothing to the vast resources from which they took away much of the natural wealth with which Nature had endowed Florida. They cut down and sold the vast timber forests, they dug up and shipped to foreign ports the rich phosphates, which, if they had distributed over the soil of any section of the world, would have brought them ten times the wealth and have made for themselves enviable records in their native land. They robbed the pine-tree of its turpentine, and after they had done all this they left Florida, thinking that that was all the wealth of the state. They never looked into the soil—they saw only the trees, their possibilities for lumber, turpentine and rosin, and the vast possibilities of the rich lands of Florida for fertilizing the poor soils of states and countries yonder!

CHARLES H. SIEG
The Pioneer of the Small Farm in Florida

The soil of Florida is rich, far beyond the conception of mankind. It is almost solid fertilizer, and yet these men did not attempt to people this wonderful state with human beings, whose sufferings they could have alleviated and whose contributions to the nations would have made easier the life and living of the masses. The greatest man of Florida is Henry M. Flagler; he developed the east coast of the state and built great cities for pleasure seekers of the world, and is today a veritable giant in matters of commerce.

Now he is a railroad king, and with mighty wealth and unlimited genius at his command, he is pushing a railroad into the sea and linking the United States with Cuba.

There is to be built a deep sea ship canal across the state of Florida that will cut down the journey around the dangerous Florida Keys so that vessels will save 1,000 miles to South American, Mexican and United States ports. When the Panama Canal is opened this Florida ship canal will be one of the most highly traveled sea paths in the world!

The work that these one hundred men did was stupendous and the results obtained were larger than the combined wealth of many European monarchs. But they were not builders, they did not take from Nature and give to man in a manner that paid Nature for her sacrifice, and they overlooked the priceless gem, which the law of the Great Absolute says is the richest above all other treasures in the storehouse of Nature—a fertile soil.

But what was left undone by these multi-millionaires was accomplished by one man! This man had the "grain of mustard seed" as regards faith—faith in himself—faith in the soil and in Nature — and fatih in the people! He looked upon the ground in Florida. He saw that it was rich beyond the dreams of most soil experts. This man had been a student of the question, "What shall the poor man do?" He set to work, he carefully mapped out his ideas into definite form, and today Florida is reaping the benefit, and this benefit comes in the form of thousands upon thousands of farms inhabited by Northern men and women.

A Marion County, Florida, Home

To the man who sits alone in his home and reads this story, it does not seem possible to understand what a "land rush" means. But if any man will board a train headed for Florida he will rub elbows in the sleeping, smoking or dining-cars with men and women who are bound for Florida to engage in the ideal life of a small Florida farm. And why not?

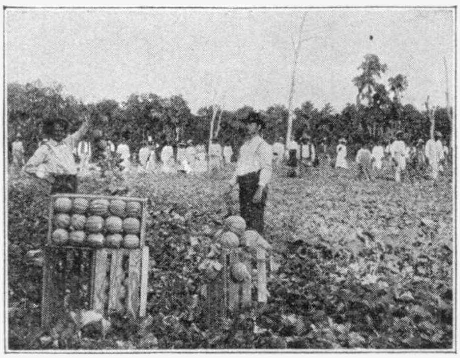
From $2,500 to $5,000 a year is the net saving of the fully cultivated Florida small farm! It is this fact which one learns, with the five physical senses, that proves this statement, and it is this fact that has made, and is making, this absolute land mania on the part of the public for Florida farms. And the cause of all this is one man—Charles H. Sieg is his name. Mr. Sieg went to Florida three years ago to complete his idea of placing the people upon the soil that would take care of them in comfort, give them luxuries, and at the same time enable them to save enough out of their earnings to take care of themselves in their old age—to leave a competency to their children.

Mr. Sieg found that the soil overlooked by the multi-millionaires would do everything that he desired. But he wanted to prove to himself that this soil did not need the expert agriculturalist to make it produce these crops. With this in mind Mr. Sieg sent to Florida Jim Fraser, a cab driver; Joe La Rue, a telegraph operator, and J. W. Card, a carpenter. These men verified every estimate made by Mr. Sieg of the wealth of Florida's soil, and this proof was made in the actual dollars and cents which these men took from the earth! When this was accomplished, Mr. Sieg was convinced. He purchased many thousands of acres of land. He offered it to the public upon terms of 17 cents per day for every 10 acres purchased.

His was the mind that made it possible to buy a farm upon less terms than you can purchase a suit of clothes!

Many of the friends of Mr. Sieg said, "You're foolish. You will fail." But Mr. Sieg knew the people, and in thirty days after his first announcement appeared throughout the press of the United States and Canada, there was not an acre remaining of the 30,000 he had purchased, and he had 1,500 applications which he was compelled to return to those who had applied. He purchased 36,000 acres more, and again he sold it out at the rate of almost a thousand acres a day.

Then it was that the skeptics saw the error of their way! The truth had been driven home and the great aggregation of capital saw that Mr. Sieg was right! Imitators of his plan sprang up on every side and this great Florida land rush began. The people are positively "land hungry!" They are sick with the fatigue of the cities and they know that the high cost of living, the low rate of wages and the insecure investments are the influences which exhaust the wages of the people and leave them destitute when their ability to earn is over.



A Cantaloupe Field in Marion County

Take a train, if you will, at New York City or Chicago, and at almost every important junction point people will board that train who are interested in Florida. It is estimated that today one million men and women have either invested, or will invest, in Florida. Sections and townships of this state are being populated at the rate of 100 per cent increase in a single year. Tracts of land that but a few months ago were a tangled mass of rich prairie, are today garden spots, rose gardens; and bungalows and pretty cottages are dotted over the land.

These are hard, cold facts—not fancies of fiction. They are sights one sees from the Pullman windows as one travels down over the "Rainbow State."

And all this came from one man—Charles H. Sieg!

Mr. Sieg is at present engaged in his third, and greatest, colony. He has seen fit to call this The New South Farm and Home Company. The insistence of the disappointed applicants to his other two colonies made him purchase a larger tract of land and in doing so, armed with the experience of the other two colonies, he was able to offer more than he had ever done before. He went to Marion County, Florida, and there purchased this land, which he is now colonizing at the rate of hundreds of acres per day.

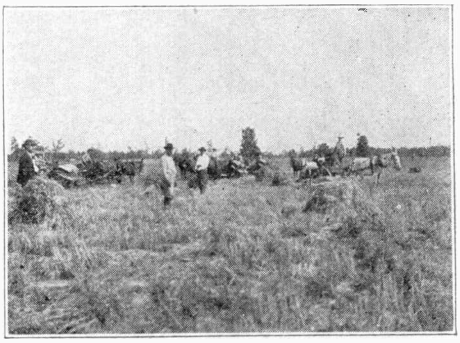
I had the pleasure of meeting this busy man upon my return. He reminds me of nothing so much as one of those ninety-horse power, six-cylinder machines that give one the impression of enormous reserve power under the hood. There is power under *his* hood a-plenty!

"What do you propose to do next?" I asked him, to which he replied:

"I am going to place 10,000 people on farms, build a city—Silver City—and keep in close touch with Jacksonville Heights and St. John's Park, my two growing colonies," he said.

"I have sent some 8,000 people down there now, my boy. Children are going to school, churches are going up; stores, homes, libraries, opera house, are being built. Oh, there is plenty to keep me out of mischief," he said, with a smile.

"I am going to start the new colony by giving away 300 city lots to the first 300 farm buyers," he added. "And I believe the fortunate ones who get these lots will sell them later on for enough to build them a fine home on the farms they own."



A FIELD OF OATS SHOWING HOW LEVEL MARION COUNTY IS

"More than that, I am going to say to all who buy farms in this new colony, '*If you don't like your bargain, this Company will buy it back at your purchase price, plus 6 per cent interest, any time you ask for the money* '"

"That's somewhat risky, isn't it," I put in.

"Not if you know what this colony will look like twelve months from today," he replied.

"There isn't a farm in the whole lot that won't be worth from three to five times what was paid for it.

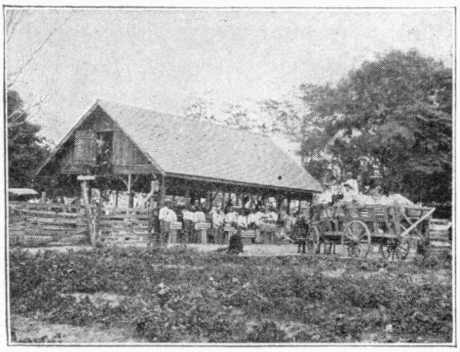
"We will be very glad to buy them in at the first cost price."

I hadn't thought of that.

Marion County is, without question, the banner county of Florida. It is not an experiment—it is a fact. To take an automobile or a carriage and drive over Marion County is as great a pleasure as one would desire. Do not think that you are going to see land where drudgery is the word! Do not think that you are coming to a region where the barn is four times the size of the house and where nothing but work, work, work stares one in the face wherever one may look! In Marion County the fruit growers and truck farmers live like merchant princes. Many of them have their own automobiles; their homes are beautifully laid out, elegantly lighted, hot and cold water, telephone, the daily paper, and the food that goes upon the table is of that same quality which we people in the North are delighted to buy ever and anon, at the famous hotels and restaurants, and then speak of, after the order of him who goes to a feast.

This is Marion County of the present day —1910. And this is the county in the heart of which Charles H. Sieg has located the Burbank-Ocala Colony.

Not only does this colony insure a man a perfection of soils the equal of those farms lying all about Marion County, but Mr. Sieg has arranged for this colony to receive the mighty genius of Luther Burbank, in the shape of his farm products, which will be grown and produced upon this colony land from a producing station—an experimental farm—and given to the colonists of the Burbank-Ocala Colony.



A FRUIT AND VEGETABLE PACKING PLANT NEAR OCALA

Men who last fall broke their ground, planted their seeds and built their homes will, before the frost is out of the ground in the remainder of this country, be sending their crops North and receiving more money

MARION COUNTY LAKES AND STREAMS ARE FAMOUS SPOTS OF BEAUTY

in actual dollars and cents of profit than it took to buy their farms.

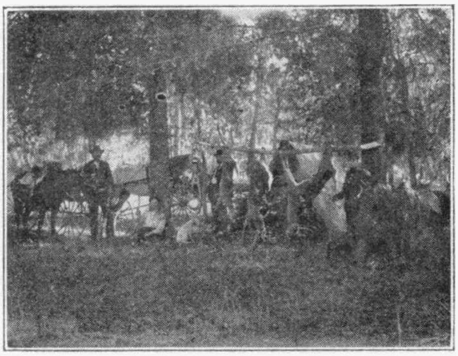
These are also facts capable of being proved by the five physical senses.

It is truly remarkable to visit this great colony. There is to be a Colony House, where a corps of experts will assist the colonists with those questions which come up in their daily life. There will be agricultural and horticultural experts. These men will devote themselves, exclusively, to the needs and requirements of the Burbank Producing Station and to the colonists who will be located around it.

It is positively strange, and almost uncanny, to move in and among these Northern men and women—clerks, expert laborers, office men, doctors, dentists, actors, farmers, mechanics, etc.—and listen to their tales. These people would not go back to their former mode of living under any conditions. They show you their bank books, they tell you what they were for many years. Some of them were sick, broken in health and mind. They have come to Marion County, which is recognized all over the world as one of the most healthful sections in the United States. These people are anxious and willing, and they consider it their duty to talk for this great region, and they look with pitying eyes back at their friends and acquaintances who are doing the slavery that used to belong especially to their lot.

Ocala is the county-seat of Marion County. It is a thriving city of 7,000 people. Two great trunk lines run directly through Ocala and, likewise, the Burbank-Ocala Colony. These are the Atlantic Coast Line and the Seaboard Air Line. Distributed all along these great railroads are the fruit and vegetable storage warehouses, where the great commission men and fruit buyers come each year and pay the truck and fruit growers of Marion County high prices, right on the spot, for their products. Then these products are loaded into refrigerator cars and sped northward at the rate of mail trains to the eager and anxious and waiting markets.

The New South Farm and Home Company has prepared a large book, fully describing



AN IDEAL SPOT FOR BIG GAME

the history of the present land rush in Florida. It tells a plain and unvarnished tale of Florida. It places him who reads it directly face to face with facts. It is irresistible, this book, and its mass of accompanying proof. It is sent absolutely free to anyone who asks for it. No matter what position you may be in today—no matter where you are thinking of ultimately locating the place that you will call home, you owe it to yourself to read this book. It is far more fascinating than a piece of fiction; it is better than a night spent at the play; it will open up lines of thought to you supported by actual proof from bank presidents, government and state officials, merchants, farmers, fruit growers and men and women whose words you must believe!

This is the story of the achievement of Charles H. Sieg. And it is a greater achievement, by all odds, than the entire life work of the one hundred millionaires who cut down the stately pines or robbed them of their turpentine and then abandoned the land as worthless.

This book tells how the poor man is now having his last great opportunity to buy land at terms which he can meet and at prices that were made to attract him to the soil.

The book shows how to buy a home upon terms that will cramp no man—which he can meet, if he has but 17 cents a day—where there are no taxes, no interest, no brokerage fees, and where there is all the wealth and pregnant riches that Nature has generously blessed Florida with more than she has any other state of this great Union.

It is because of these facts, told in a convincing, common sense and understandable manner, that this great book, which we will send free to anyone for the coupon below, is selling more land per day than has ever been the record of any land company in the United States.

No man or woman who works for wages, or is of ordinary means, can afford to deny himself or herself the pleasure of reading this great book, and once read, the pictures of the pen and the camera—not of theories and idealities, but of hard, cold twentieth century facts, leave in the mind of the reader a sense of truth, and one has the desire to own one of these farms simply for the reason that one is absolutely certain that the money which is placed in this land will return not only ample, but enormous profits for one's investment.

Write for this book now, today—which will be sent free to any address—without any obligation to buy whatsoever—simply upon receipt of the coupon below.

FREE BOOK COUPON

New South Farm & Home Co.

900 Merchants Loan and Trust Bldg., Chicago, Illinois

Gentlemen:—As per the announcement in Popular Electricity, send me your great book "10 acres and freedom" describing the Burbank-Ocala Colony Farms which you are selling upon the plan of 17 cents per day for each 10 acres, together with actual photographic reproductions of present day scenes in Marion County, letters from bankers, state officials, Luther Burbank, and others. It is understood that you will send everything free, postage paid, and that I am not under obligation to buy land. I will say that if you send this expensive literature to me that I will read it carefully.

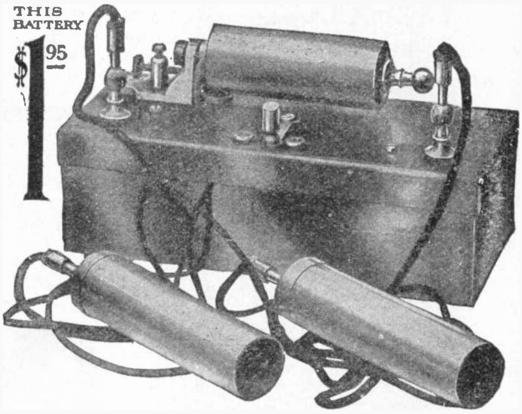
Name.. *Address*..

Town.. *State*..

ELECTRICITY BOOK FREE

Profusely Illustrated with Photos from Life. Write for it today.

This splendid book is compiled from the **best authorities in the world.** Explains how electricity as supplied by inexpensive batteries cures Rheumatism, Dyspepsia, Insomnia, Liver and Kidney Trouble and all nerve affections and diseases due to poor circulation. Explains how to enjoy the famous electric baths and beauty and health massage at home at little cost.



This book also lists the latest improved Batteries (Prices **$1.95** to **$24.00**), which we send on 10 days' free trial.

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

Write today for our free book.

Deaf Persons Can Now Hear

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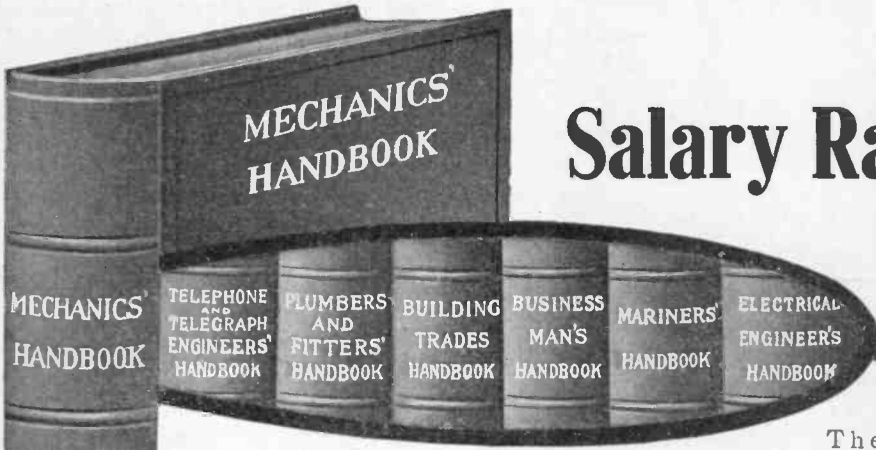

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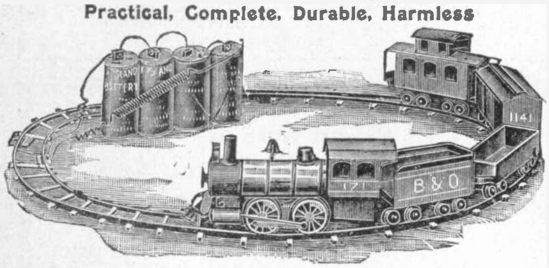

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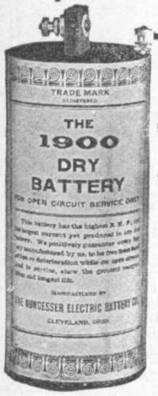

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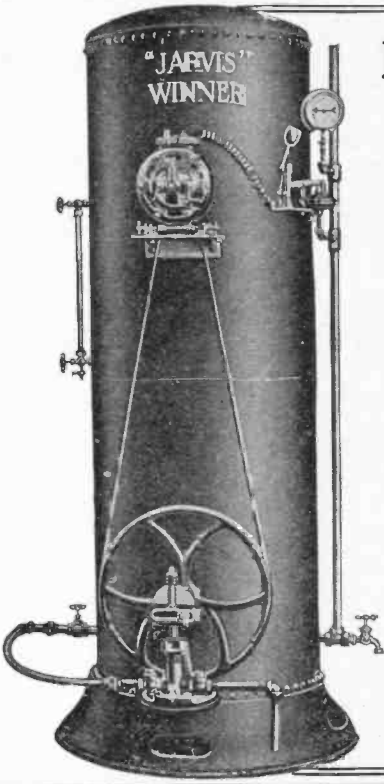

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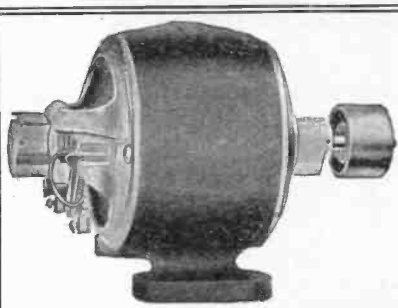

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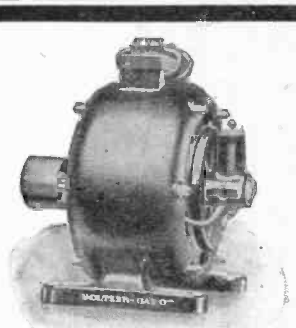

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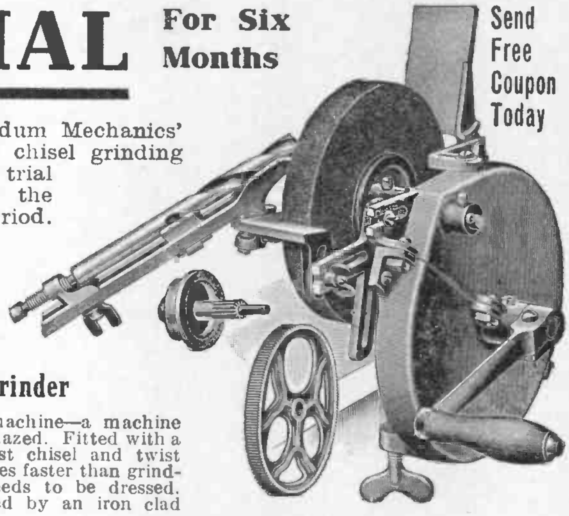

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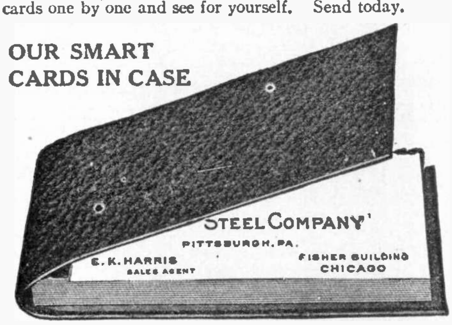

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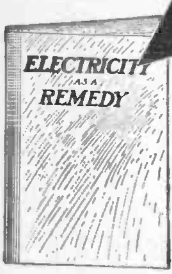

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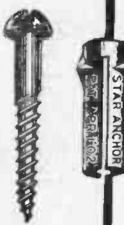

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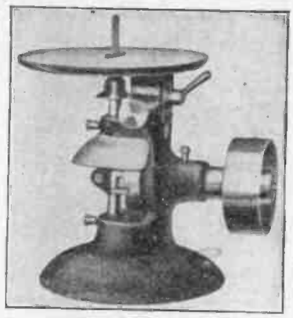

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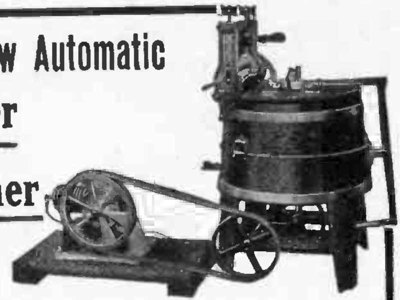

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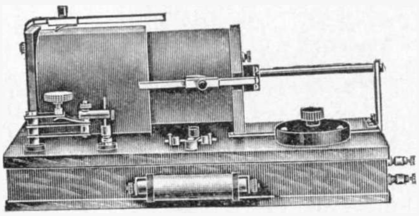

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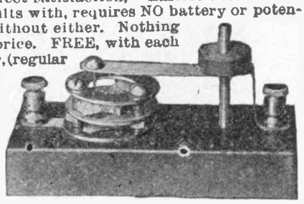

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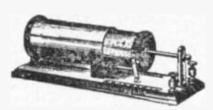

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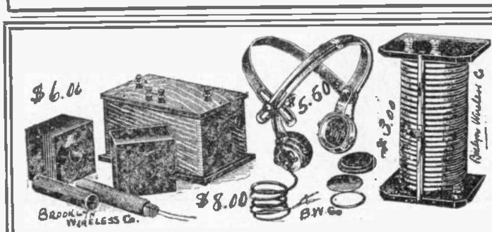

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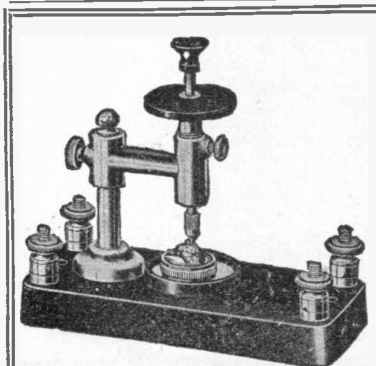

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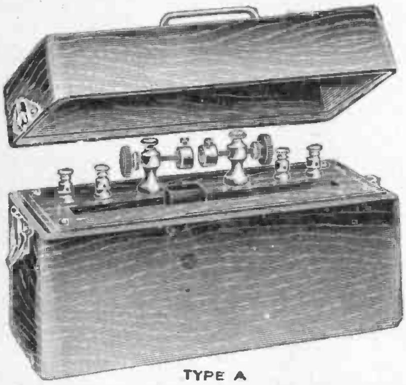

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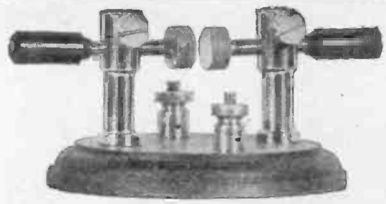

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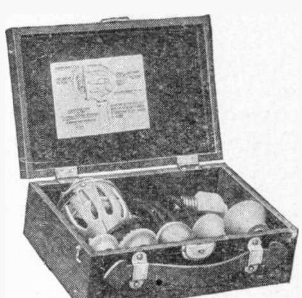

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