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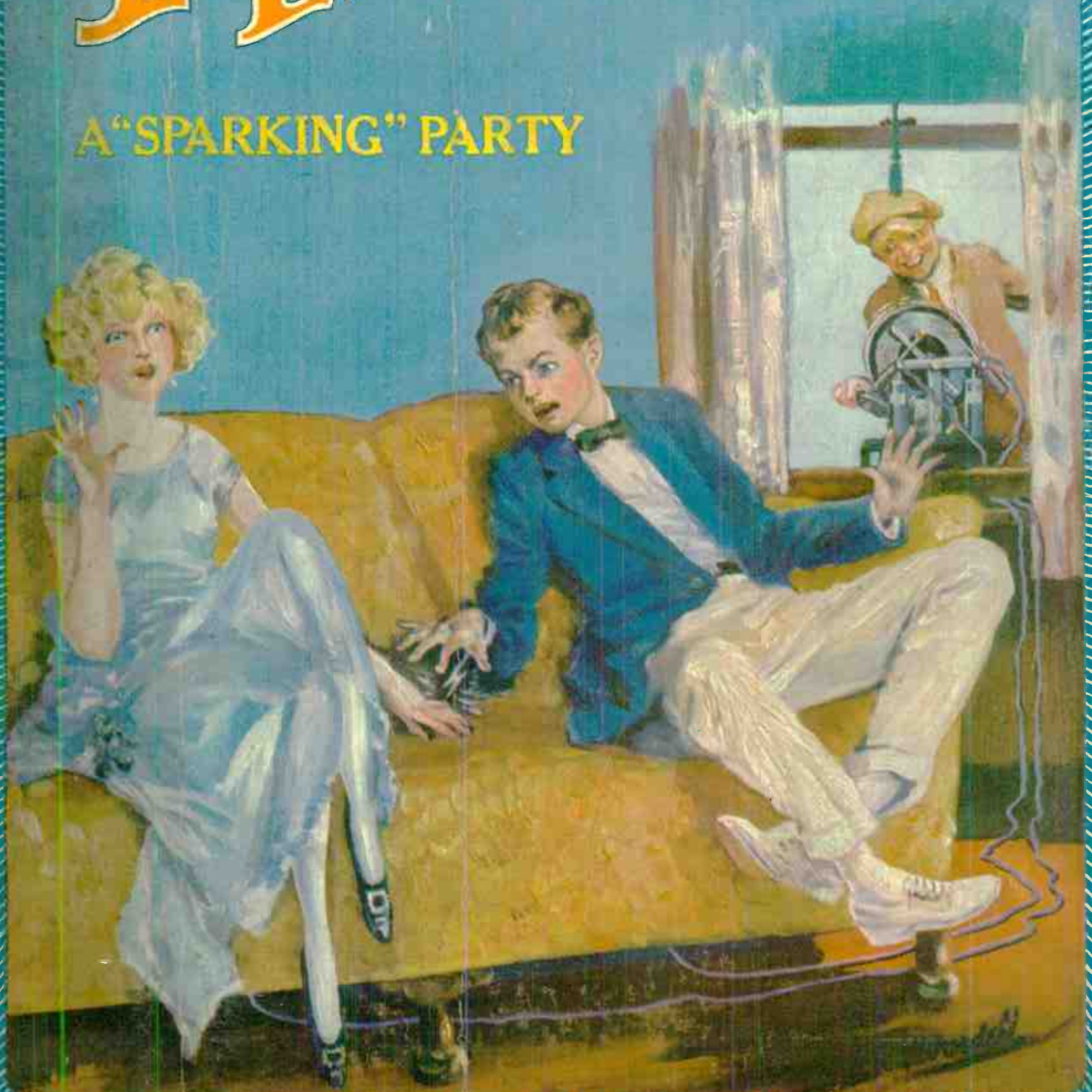

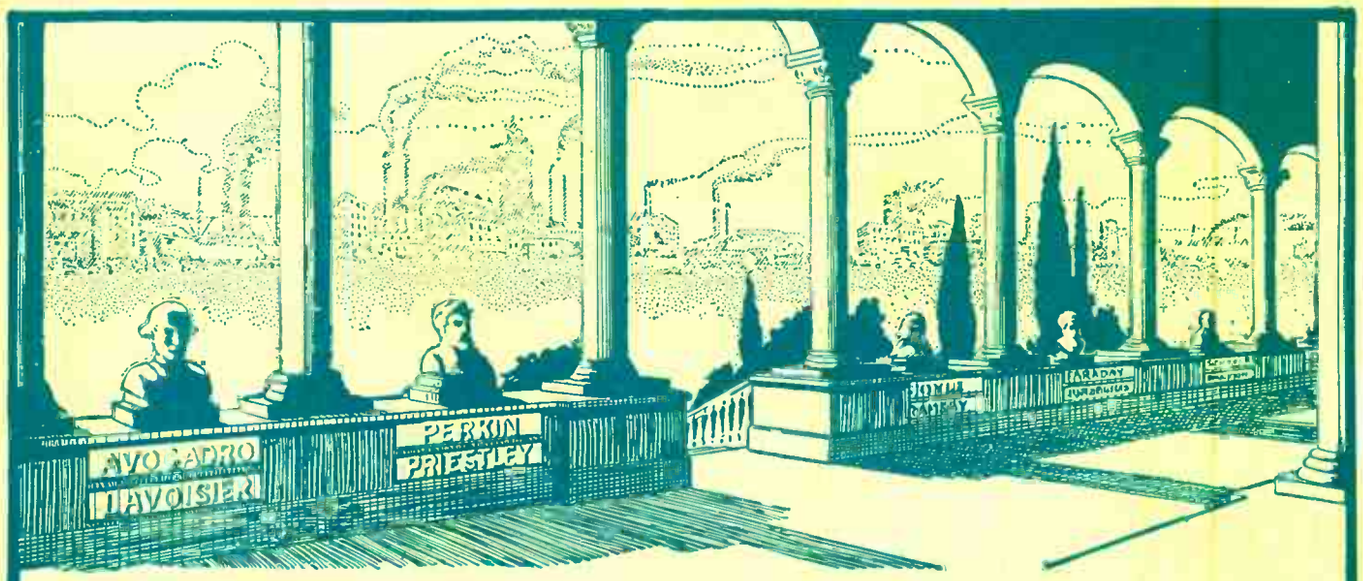

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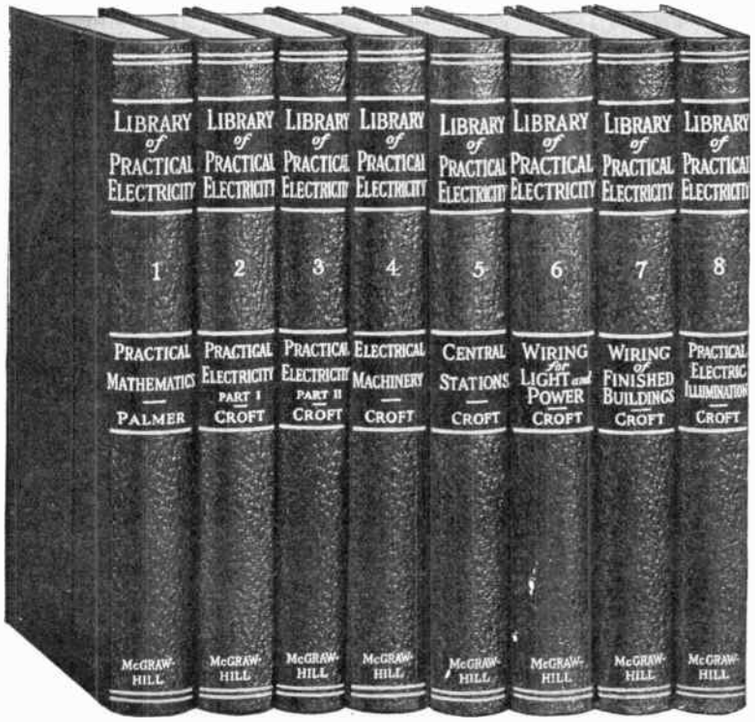

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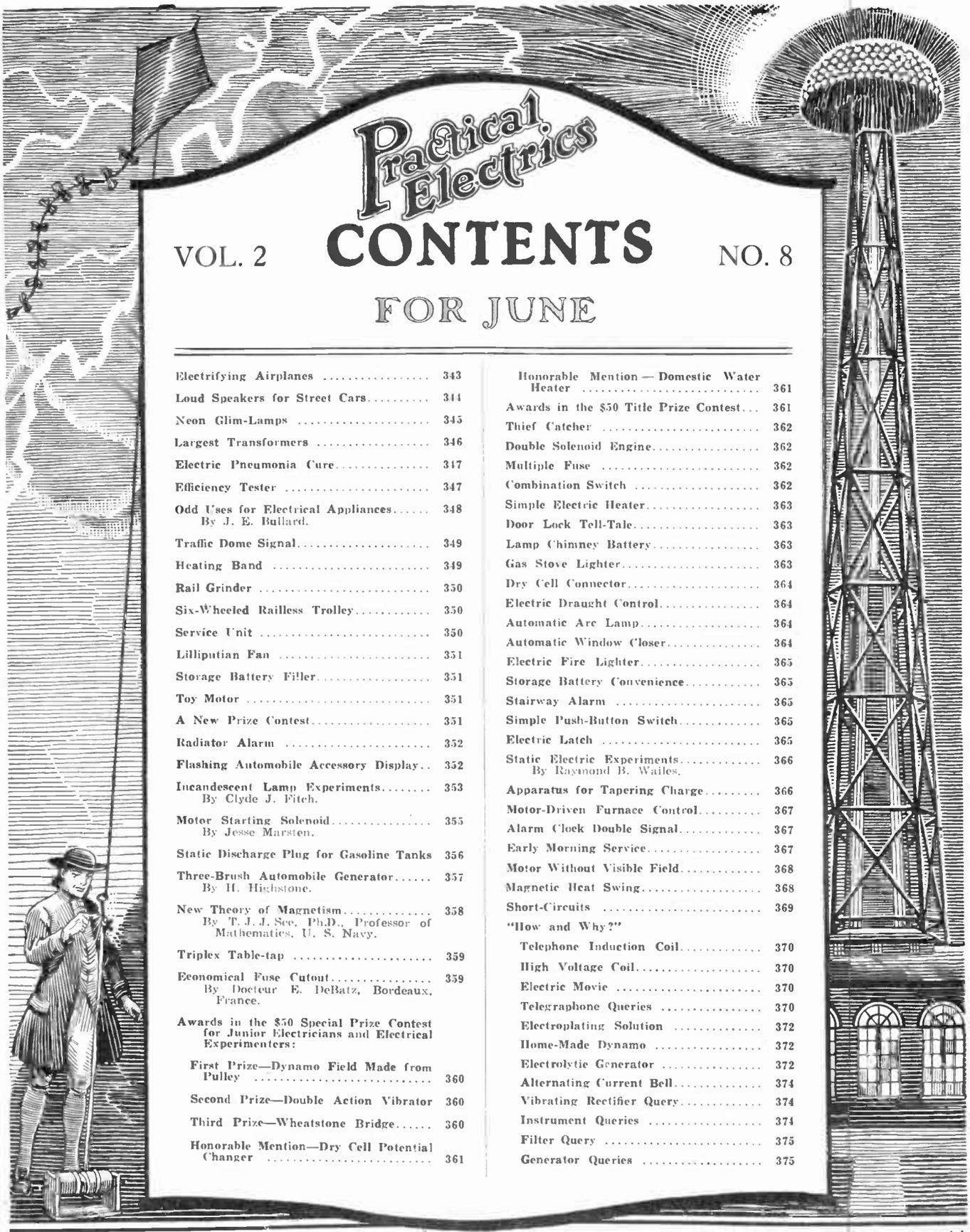

VOL. 2 **CONTENTS** NO. 8

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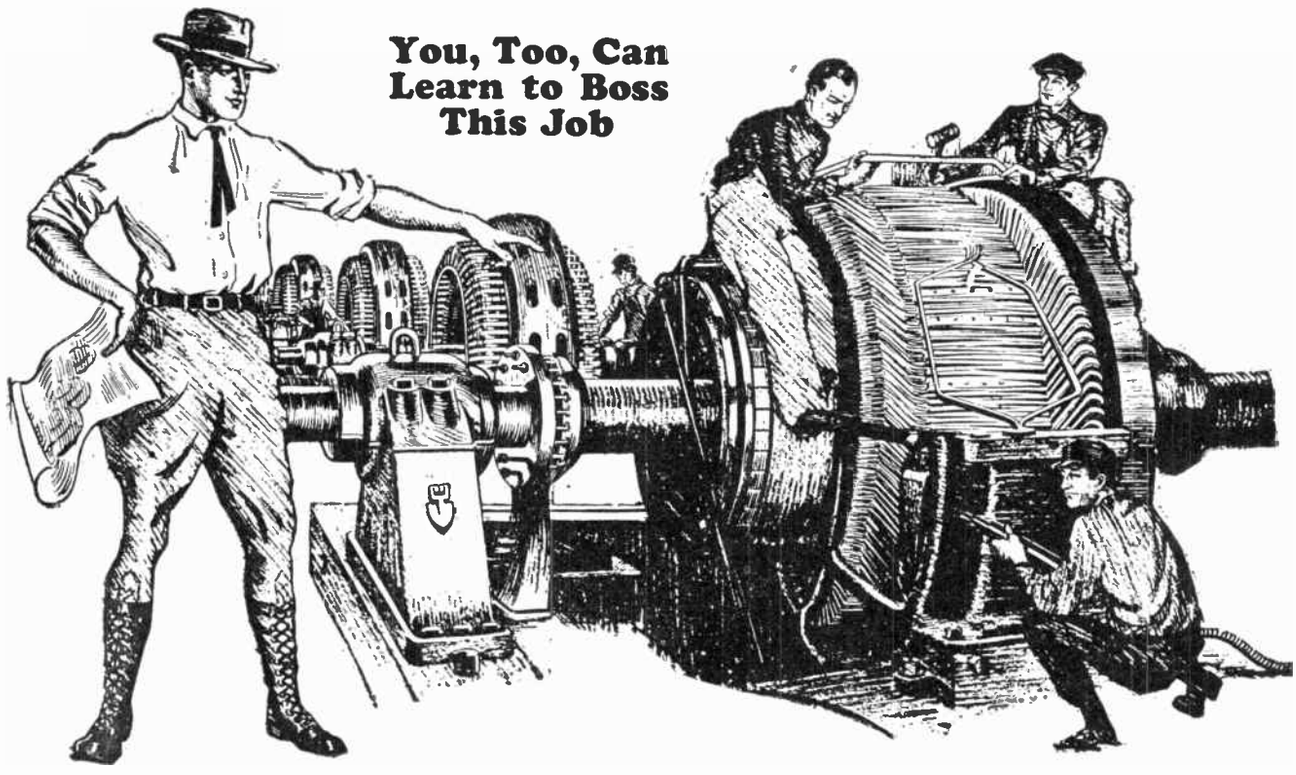

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Volume 2
No. 8

Practical Electrics

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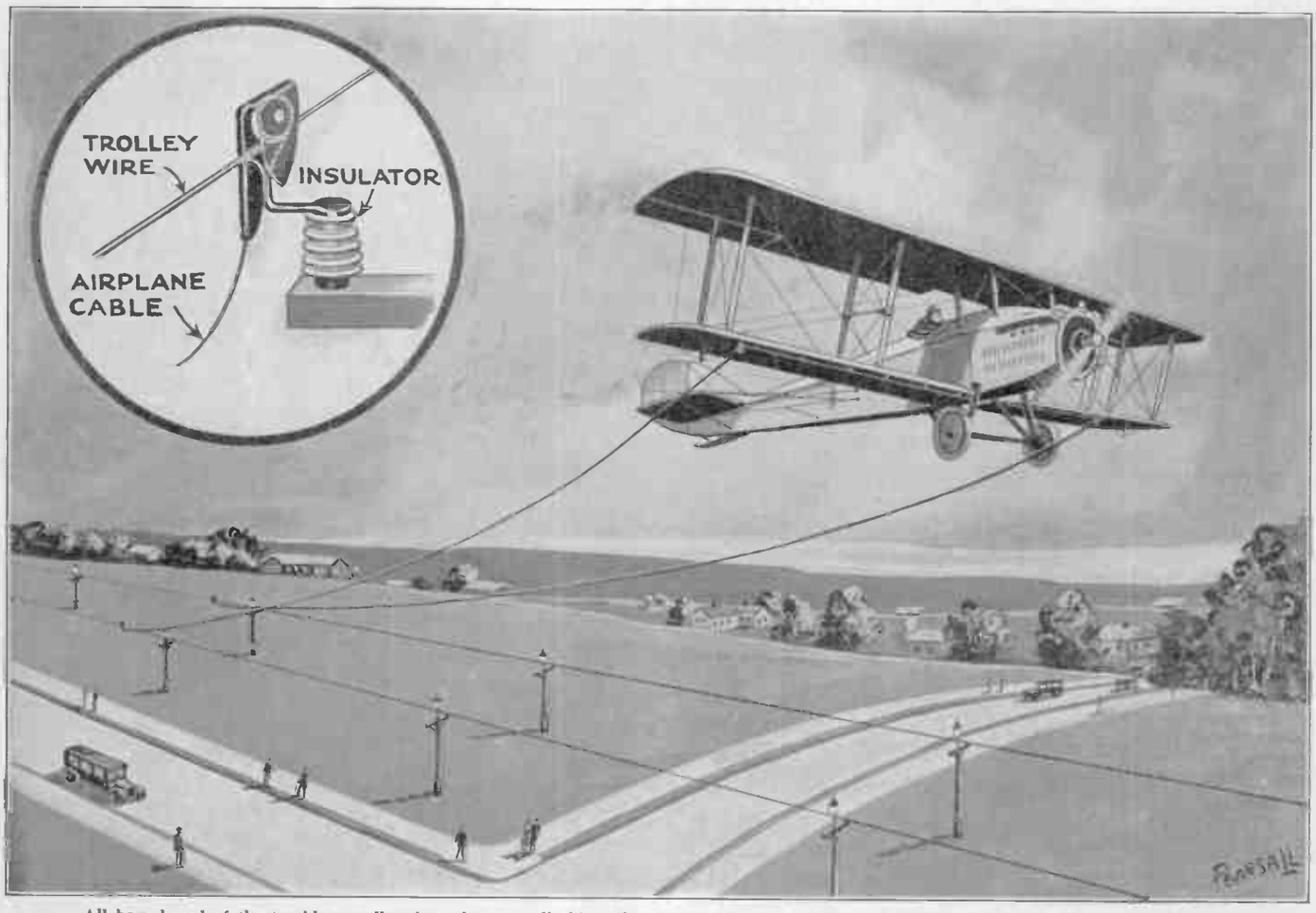
H. Gernsback, Editor and Publisher T. O'Conor Sloane, Ph.D., Associate Editor

Electrifying Airplanes



All have heard of the trackless trolley, but what to call this tethered aeroplane is a difficult question. The illustration speaks for itself, and the insert gives a suggestion for the trolley and insulating brackets for the wires. By using a high speed motor the weight may be kept down.

ELECTRICALLY driven vehicles are gradually taking the place of gas and steam propelled devices, as the advantages of electricity as a motive power over all other existing forms of power are becoming more widely appreciated.

Not so long ago electrically driven vehicles were few in number, the gas engines and steam engines being used almost exclusively. Then the electrically driven street car came into use, the electric motors in the car taking current through an overhead wire. As electrical development increased, the electrically driven motor bus, or trackless trolley car, taking current through an overhead wire, came into use. This car has finally been developed so that it may carry its own electric energy, stored up in storage batteries. Motor boats and submarines are other devices employing electricity as a motive power. One concern in New York operates electrically driven taxicabs exclusively.

Electric battery trucks and cars are used extensively in many industrial plants, and in some cases electric battery locomotives are used for hauling heavy freight trains. Perhaps the most important application of electricity is for electrifying the steam railroads. Electric locomotives are used exclusively in many cities in place of the smoky and noisy steam locomotives. They are also used in long tunnels where the smoke and steam would be objectionable, and in the near future we may expect all railroad companies to install electric locomotives in place of the crude steam locomotives.

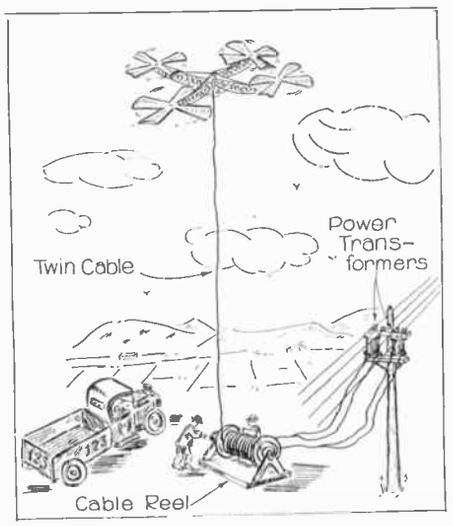
Perhaps the only vehicle that has not been electrified is the airplane. Why cannot the airplane be electrified as well as all other types of vehicles? Of course the difficulties involved are enormous, especially if we desire to have the airplane carry its own power, in the form of storage batteries. This would be impossible at the present stage of electric development due to the excessive weight. Obviously some form of trolley wire is required, such as the illustration shows. By this method the direction and height of the airplane's course would be limited; it would mean that the airplane route would be limited to one or more places, or wherever the trolley wires are strung. This, of course, would prevent the electrically driven plane from being used universally in place of the gas driven plane, but for some uses the electric plane would be desirable, especially where safety and dependability are of importance, such as in mail planes and passenger planes. For such needs an electric airplane route between the largest cities would be found very useful.

The altitude at which the airplane flies would be limited to perhaps 100 feet; in case of an accident or of an interruption in the power supply, the plane would only have a short distance to volplane to the ground. The ground under the airplane route would be leveled, so the plane could alight and roll on the ground. This would be taken advantage of probably when

traveling over a steep hill. At night the entire course would be illuminated by electric lamps, as a guide for the pilot.

Another condition that affects the electrifying of airplanes is the weight of the electric motors. The motor would require the same careful attention to design as did the gas engine. The present electric motors are four or five times as heavy for the same power as the gas engines, so that special light weight airplane motors would be necessary. Due to the practically constant speed of the propeller the motor could be of the alternating current induction type, which is the most reliable motor in existence. The use of alternating current would greatly facilitate the transmission of power over the line.

The design of the trolley wire and trolley would have to be carefully determined and tested out experimentally. The illustration shows one method, the current from the trolley passing through a strong cable, a small steel cable being used in order to reduce the air resistance as much as possible. By using fairly high voltage



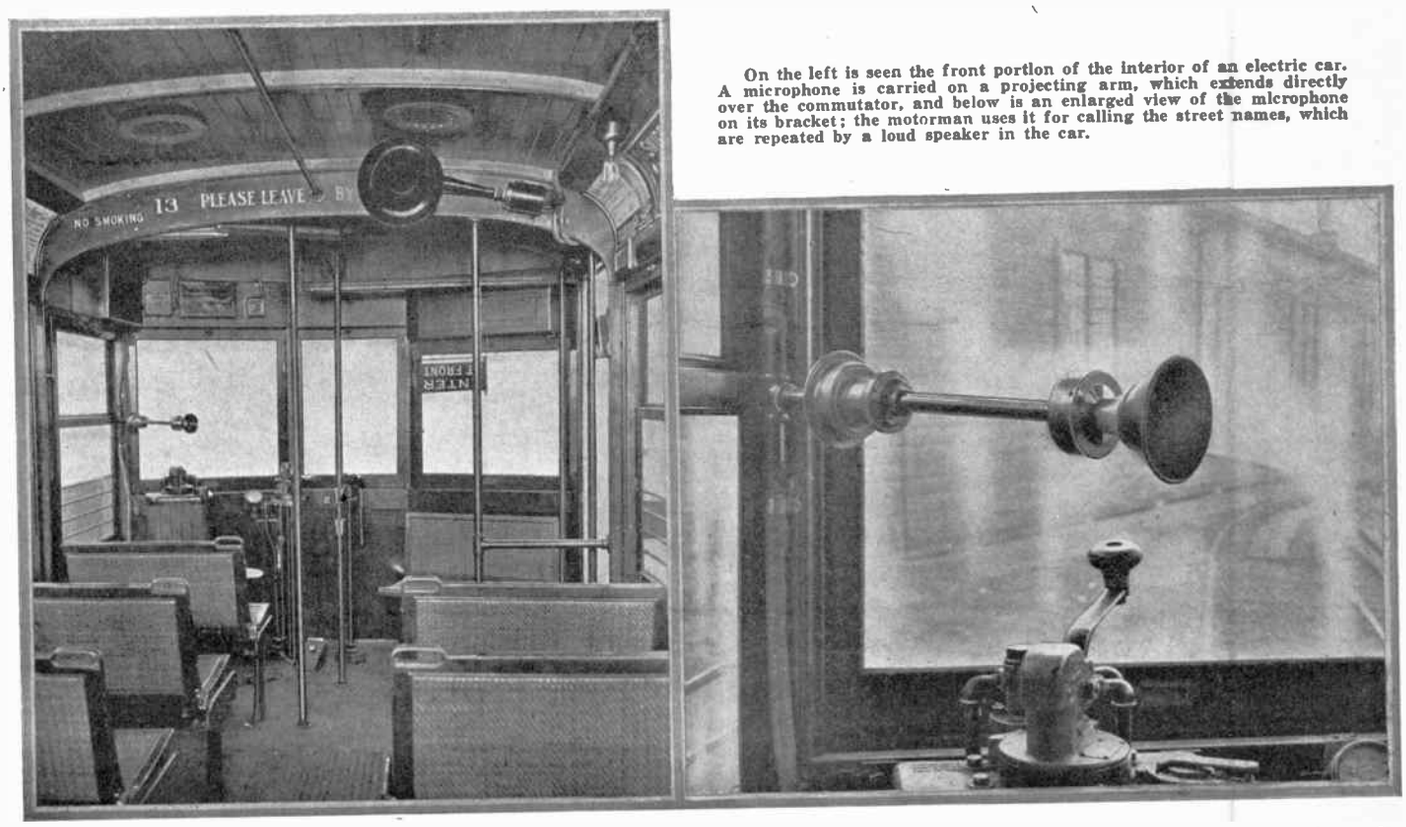
Possibilities of the electric helicopter. As it rises, a double electric cable is carried along to drive its motor. If the idea could be carried out in practice, it would afford a most useful exploratory agent, which could have extended use in peace as well as in war.

the resistance of the trolley contact and the steel cable would have little effect.

Now that the airplane is electrified, next comes the helicopter—a special type of airplane. By means of huge propellers this device rises straight up, vertically. Recent tests of experimental helicopters have shown that they may yet be practical, but in case of motor failure they crash to the ground. By electrifying them, using reliable electric motors in place of questionable gas engines, this danger is alleviated.

The illustration shows an electrified helicopter, with cables connecting the motors in the helicopter to the source of electricity on the ground. This device would be found useful in army work for aerial photography and for observations.

Loud Speakers for Street Cars



On the left is seen the front portion of the interior of an electric car. A microphone is carried on a projecting arm, which extends directly over the commutator, and below is an enlarged view of the microphone on its bracket; the motorman uses it for calling the street names, which are repeated by a loud speaker in the car.

THE introduction of an electric railroad in a community involves very heavy capitalization, which of course includes overhead charges and amortization. The capital has to have interest paid upon it, and a large part of the investment is devoted to introducing perhaps a conduit for the conductors or to erecting an overhead line of wire, with adequate supports, and laying a track which is of very expensive description and laid with very heavy rails.

To reduce the expense of running the cars, which of course is one way of meeting the overhead, the cars are made very large, so that the regulation two men, a conductor and a motorman, take care of a greater number of passengers.

As another way of meeting the emergency, the one-man car has been introduced. This is not a new idea, for in the old days of horse-cars, one-man cars were used very extensively, the driver being responsible for the collection of fares, often by a special fare box, in which the passengers were supposed to put the coin due for their ride.

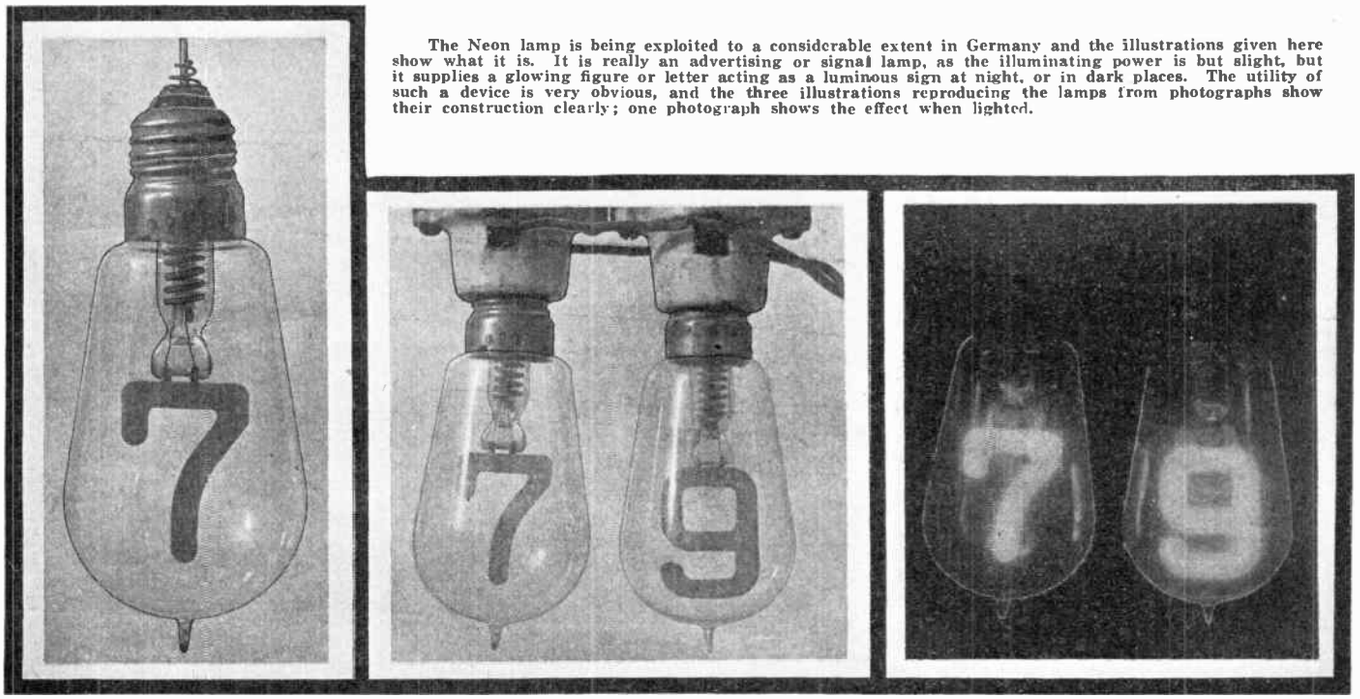
The motorman on a one-man electric car has much to do, and it is advisable that all his energies be conserved as far as possible. It is also desirable to have the names of the streets called out to the passengers, and the motorman with his back to the interior of the car is not well placed for calling the street names in a voice which will be effectual.

A speaker can talk into a microphone in a low, clear voice, and the sound can be reproduced through a loud talker so as to be increased in volume and given a proper orientation as regards the passengers.

We illustrate a one-man trolley car, in which the streets are announced to the passengers by a loud speaker. Immediately by the side and at the level of the driver's mouth, a microphone is carried on an arm projecting from the frame of the car over the commutator. This connects with one or more loud talkers within the car, so that all the driver has to do is in an ordinary, distinct voice, not too strong, to announce the street, and the loud speaker repeats it to the passengers in clear and distinct tones.

It will be seen that while the driver naturally talks with his face away from the passengers, the loud talkers face the passengers as they repeat the words. The apparatus is a very nice addition to the equipment of the car, and one which would naturally be supposed to increase the popularity of the line. Although we speak of it with reference to a one-man car, it obviously can be applied just as well to others.

Neon Glim-Lamps



The Neon lamp is being exploited to a considerable extent in Germany and the illustrations given here show what it is. It is really an advertising or signal lamp, as the illuminating power is but slight, but it supplies a glowing figure or letter acting as a luminous sign at night, or in dark places. The utility of such a device is very obvious, and the three illustrations reproducing the lamps from photographs show their construction clearly; one photograph shows the effect when lighted.

EVERY experimenter who has worked with a spark coil is familiar with the beautiful light effects obtainable from Geissler tubes. These are evacuated glass tubes of fanciful shape, with a short wire electrode sealed in at each end of the tube, and the tube filled with a rarified atmosphere of different gases, hydrogen, nitrogen, oxygen, carbon dioxide, etc., each gas having its characteristic color as the electric discharge passes through it.

The voltage on the secondary of a spark coil is usually 30,000 volts or more, so that the electrode distance of some five inches is easily bridged in the very low pressure gas. It will be also remembered that the two ends of a Geissler tube appear differently in operation, and that this difference may be reversed by reversing the flow of the primary current. The explanation of this is that the electric discharging phenomenon is distinctly different for the positive pole (anode) and for the negative pole (cathode). Near the former will appear a bright halo of a color depending upon the gas used there, while the immediate vicinity of the cathode will remain practically dark.

A comparatively new lamp, perfected recently in Europe and available on all markets abroad, the so-called Neon Glim-Lamp, is nothing but such a Geissler tube modified in several respects.

Instead of using a glass tube the conventional pear-shaped incandescent lamp bulb was retained. To reduce the operating voltage from several thousand volts down to a more convenient and less troublesome value the distance between the two electrodes was reduced from some five or more inches down to about one-sixteenth inch. It was also found that the minimum operating voltage required could be greatly reduced by using a gas within the bulb, which has a specially low electrical break-down coefficient. Continued research resulted finally in the choice of neon gas as best suited for the purpose.

Neon is one of the so-called rare gases, like helium, krypton or xenon. One million cubic feet of our air contain about 15 cubic feet of neon. By liquefying air and a very complicated separation process of all its other constituents, neon is obtained by a subtractive method.

In the Geissler tubes it was the shape of the glass, its fluorescence and the color of the electric discharge between the two sealed-in electrodes which constituted the purpose of the device. The new neon lamp is built with a different point in view. The shape of the electrodes and maximum luminosity are here the main factors. If, for example, from a thin sheet of aluminum or any other metal we cut two pieces, shaped in the form of, say, a letter "A," and mount these two pieces parallel to each other, about one-sixteenth inch apart, and enclose these fixed letters in a glass bulb filled with low pressure neon gas, with an electrode connection for each plate, a luminous letter "A" will appear upon applying a voltage of about 200 volts to the two electrodes.

If the voltage applied is giving direct current, one of the two opposing letter electrodes will remain dark, while the other one will glow with a pinkish-orange color, giving a very pleasing and penetrating hue. Reversing the current will cause the previously dark electrode to glow, and *vice versa*. If alternating current is used the glow will change from one electrode to the other at the rate of the frequency of the alternating current. With commercial frequencies of 25 to 60 cycles per second the change will be so rapid that both electrodes will appear evenly aglow at all times. But this is only an illusion, because the human eye cannot follow these rapid changes. As a matter of fact, with 25 cycles this constant change causes quite a pronounced flicker.

A very remarkable property of these lamps is the extremely small power consumption, which is between 2 and 5 watts, or only some 10 to 20 milliamperes at 220 volts per lamp. A small toy transformer, such as used to operate electric toy trains, if wound with a ratio of 110-220 volts, has ample power to supply a dozen of these neon lamps. Of course it is not to be expected that such a small amount of electrical energy can produce a large amount of light; the average neon lamp will give only about one candlepower. But general illumination is not at all the purpose of these lamps. They are being built and used as signal lamps, showing luminous letters or figures, or as fancy decoration lamps.

In a row of sockets, arranged closely one next to the other, may be fastened a number of neon lamps to spell out names, words or sentences for advertising purposes. Think of "EXIT" signs in theaters, of house numbers, of physicians' names over their house doors, of street names, and of safety signs in mines. A host of other possibilities offer a field for these new lamps. The low wattage is in all cases a great boon. Take, as an example,

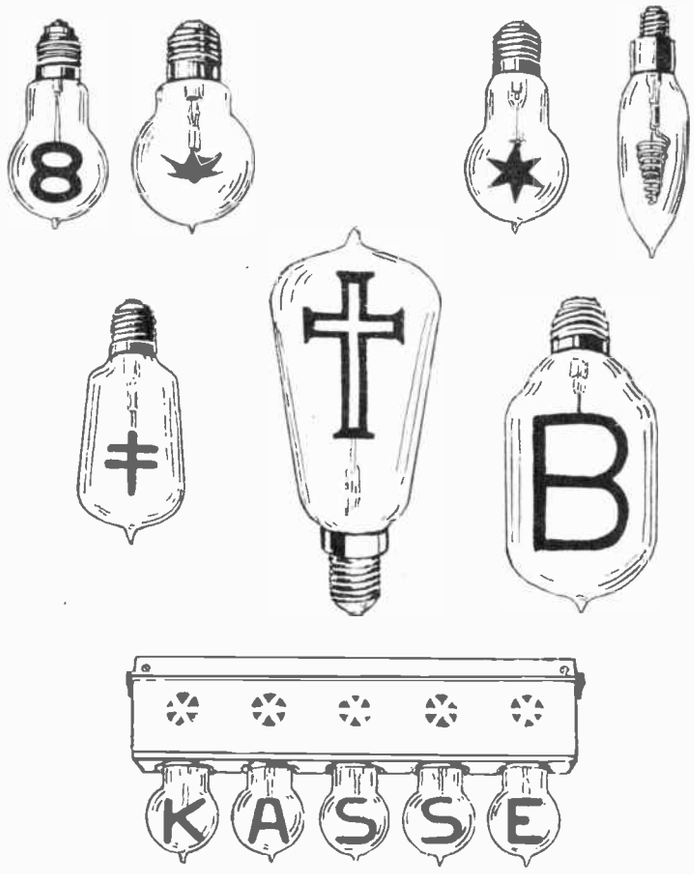
the word "EXIT"; its four lamps will consume on an average 4 times 3 watts. At 10 cents per kilowatt-hour the operation of this sign will cost about one cent for ten hours.

It is further possible to combine several letters or figures into one common glass tube. This reduces the price and simplifies the mounting of the lamp considerably. Such multiletter lamps are being made to order.

But there is another important use for these lamps, as switch position indicators in power houses or switching stations. By connecting a neon lamp in parallel with a switch on a circuit of 200 or more volts this lamp will light up when the switch is in open position, thereby indicating whether the circuit is closed (dark) or open (glowing). Because of the extremely high internal resistance of the lamp as compared with the relatively low resistance of current-consuming apparatus, such as motors, a light circuit, etc., the lamp will burn at practically its full rated luminosity regardless of the resistance of the circuit. Placed in parallel with a fuse, the glowing of the lamp will signal a blown fuse to the attendant. In direct current circuits of more than 200 volts the lamp can be used as a very simple polarity indicator.

For the present it is impossible to manufacture neon glim-lamps for voltages of less than 200 volts. This is the minimum critical voltage at which a discharge takes place through the gas. For American conditions, where 110 volts have been standard for most distribution systems, this is no doubt a very great disadvantage, requiring a 110 to 220 volt step-up transformer in alternating systems, and eliminating the lamps entirely in 110-volt, two-wire, direct current networks. But in Europe, where these lamps are on sale now, this is no handicap, as practically all the systems operate on 220 volts, both for direct and alternating current. A life of at least 1,000 hours is guaranteed for the lamps.

One other unique property of the lamps may be mentioned. With incandescent lamps a "flashing" effect must be produced by some form of electromagnetic or thermal interrupter, which opens and closes the circuit at regular intervals. Such devices have a limited range, and are liable to get out of order. But if a neon lamp is shunted with a condenser and with a resistance in series with the combination, regular blinking on alternating circuits without any moving mechanism, is automatically produced. By adjusting the condenser and resistance the frequency of blinks may be altered from one every ten minutes to 15,000 per second.



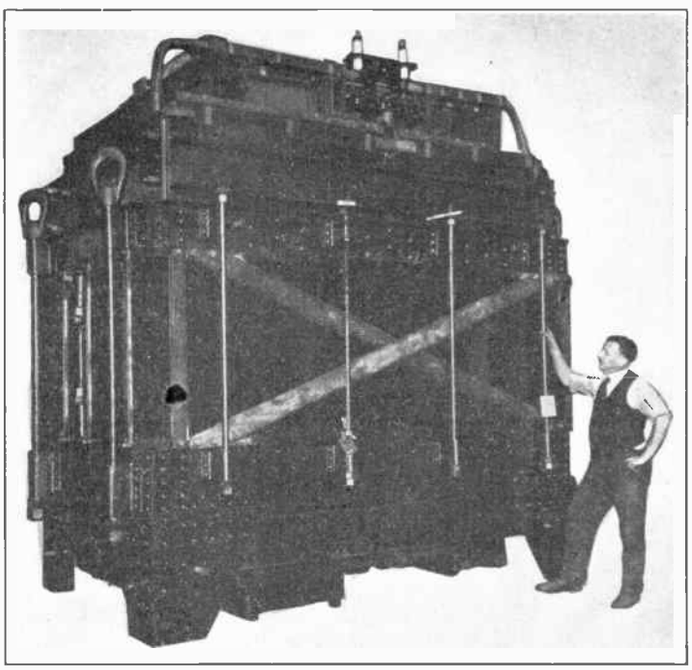
Various designs of the glim lamps, showing how well adapted they are for display. The sign at the bottom gives the German word for "Ticket Office" or the like.

Largest Transformers

THE Westinghouse Electric & Manufacturing Company has just completed six of the largest single-phase auto-transformers ever built.

The transformers are of the water-cooled type and are for outdoor service to form a part of the largest 220,000-volt power system in existence. Each unit is rated at 36,700 kv-a, 50 cycles, giving a bank capacity of over 100,000 kv-a, and is adapted for star primary and secondary connections with solidly grounded neutral, stepping down from 220,000 to 150,000 line voltages. A tertiary winding, connected in delta, is supplied for suppressing third harmonics in the voltage wave. The transformers are of the shell type and are designed to withstand without injury mechanical stresses due to short circuits, when unlimited power is supplied at the terminals. The tested efficiency was over 99 per cent.

The new transformers are to be used for changing the voltage of the two 150,000-volt lines now running between the Big Creek stations and the Eagle Rock sub-station to 220,000 volts. At present the city of Los Angeles is supplied with power through the Eagle Rock substation, the power being transmitted to Eagle Rock over two 50-cycle transmission lines from the great hydraulic development on the Kern River. These transmission lines are now operated at 150,000 volts, but the growth of the hydraulic development has made it necessary to change them to 220,000 volts in order to economically carry the increased amount of power.



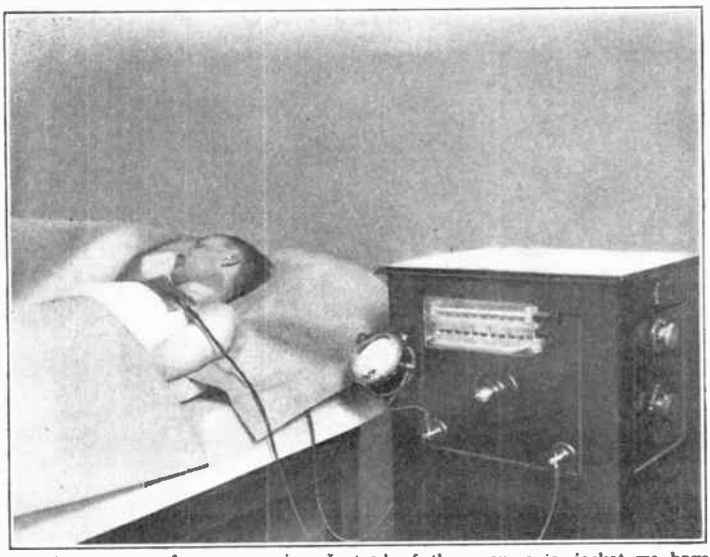
Gigantic transformer recently constructed for one of the western developments in California. The man at the side gives an idea of its startling dimensions. Interesting figures are given in the article.

In addition to being the largest auto-transformers ever built, these units are also the largest units in existence for stepping down from a 220,000-volt line. An idea of their size will be given by the following figures: The tank, which has flat sides and half round ends, is 10 feet 3 inches wide and 14 feet 3 inches long, and approximately 15 feet high. In order that it may be shipped, the side walls are divided near the middle so that the top portion can be lifted off. The height from the ground to the tip of the condenser bushings is about 27 feet.

Ten thousand pounds of copper and about 45,000 pounds of iron laminations were required for each transformer. Over one-quarter mile of copper tubing was required for the cooling coils, and, at normal rating, 75 gallons of cooling water per minute must be circulated through them. The total weight of the complete transformer is over 90 tons. Two standard flat cars were required to ship each tank and transformer without oil, and a tank car was needed to carry the 9,050 gallons of oil required for each transformer. The oil alone weighs about 30 tons, according to its specific gravity, which is variable.

Electric Pneumonia Cure

A NEW development in electro-therapy, called the diathermine treatment, which promises to be of great benefit to mankind, has been recently introduced in Hoboken by Dr. H. V. Broeser, X-ray specialist of St. Mary's Hospital. This is a new process for treating pneumonia, and was first conceived by Dr. Harry E. Stewart of Yale, a well known coach and athletic leader. Dr. Stewart treated twenty cases in the United States Marine Hospital on Staten Island, with remarkable results; in fact several, who seemed to have little chance of recovery, improved greatly under the application. The method is applied only in extreme cases, and so far not a case has been lost.



A new cure for pneumonia. Instead of the pneumonia jacket we have a heating system based on passing a current through the body for protecting the lungs.

The patient undergoing treatment is first prepared by being lathered on chest and back with ordinary shaving soap and water, after which a metal electrode, four inches by seven inches, is placed over the lathered portions and held in place with Turkish toweling. The illustration shows one of the electrodes on the chest of the patient, the towel being pulled aside to show the application. A circuit from a high frequency current apparatus is then connected to the electrodes, the excitation penetrating deep into the body of the patient and raising the temperature of the lungs. The soap is applied so that the skin is not directly in contact with the electrodes and it tends to prevent blistering, although an occasional spark jumps from the electrode to the skin and raises a slight blister.

The treatments last 20 minutes and are applied twice a day. For the first five minutes the current is gradually increased to the maximum, which is about 2,000 milli-amperes. The current remains at this value for ten minutes and is then gradually decreased. The patient receives no electrical shock; he sometimes complains of the sensation of heat, so that it is necessary to regulate the amount of current according to the different types of patients. Usually four treatments are sufficient, although some patients require as many as eight.

The benefit derived from this treatment is presumably due to the heat generated in the body of the patient by the action of the electric oscillations. This action directly or indirectly introduces heat deep into the lungs without burning the skin, and seems to soften or otherwise break up congestion, and a few treatments seem to cause rapid clearing up of the trouble. The temperature on the surface of the body is about 100 degrees, and the temperature within the lungs is from 104 to 106 degrees. In some experiments on dogs the temperature within the lungs was found to be 115 degrees.

In patients treated in this way the fever gradually subsides; heavy breathing stops; cyanosis or blueness disappears, indicating that the lungs are able to absorb greater quantities of oxygen. There is no sudden drop in temperature, as is the case sometimes with pneumonia treated in the usual fashion. There seems to be a dilation of the blood vessels of the lungs, with the relief from congestion.

The use of heat in the treatment of pneumonia is very old, and many people have been saved by the simple application of a mustard plaster; but this superficial treatment is very inefficient in getting heat into the lungs.

Electrical experimenters will be interested in noting that although two amperes of electricity act upon the chest and the back of the patient, there is no electrical shock. It has been known for years that a high frequency electric current will give no shock, and two theories have been advanced to explain the reason. One theory is that the high frequency current travels on the surface of the skin, and does not penetrate deep enough to effect the nerves, hence is not felt or produces no sensation of shock. The other theory is that the rapidly changing current reverses before the nerves have time to transmit the sensation of pain to the brain, and each reverse of current annuls the effect of the previous cycle of current. The results obtained from curing pneumonia by electricity would indicate that the high frequency current penetrated deep into the body of the patient, and this fact seems to support the latter theory, a sort of race between nerves and currents.

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

Efficiency Tester

GREAT agitation has been caused during the last year by Mr. Edison's questionnaire, evolved by him for determining the availability of candidates for employment in the great Edison laboratories. Mr. Edison took what must be recognized as a very sensible standpoint—that availability in a man may be determined by his general information—so his questions covered a wide range of history and many subjects outside of technology, even going so far as to ask how a certain hand in poker would be played.

In spite of all criticism there is a great deal of common-sense in Mr. Edison's method and it is understood that he personally is quite satisfied with his questionnaire.

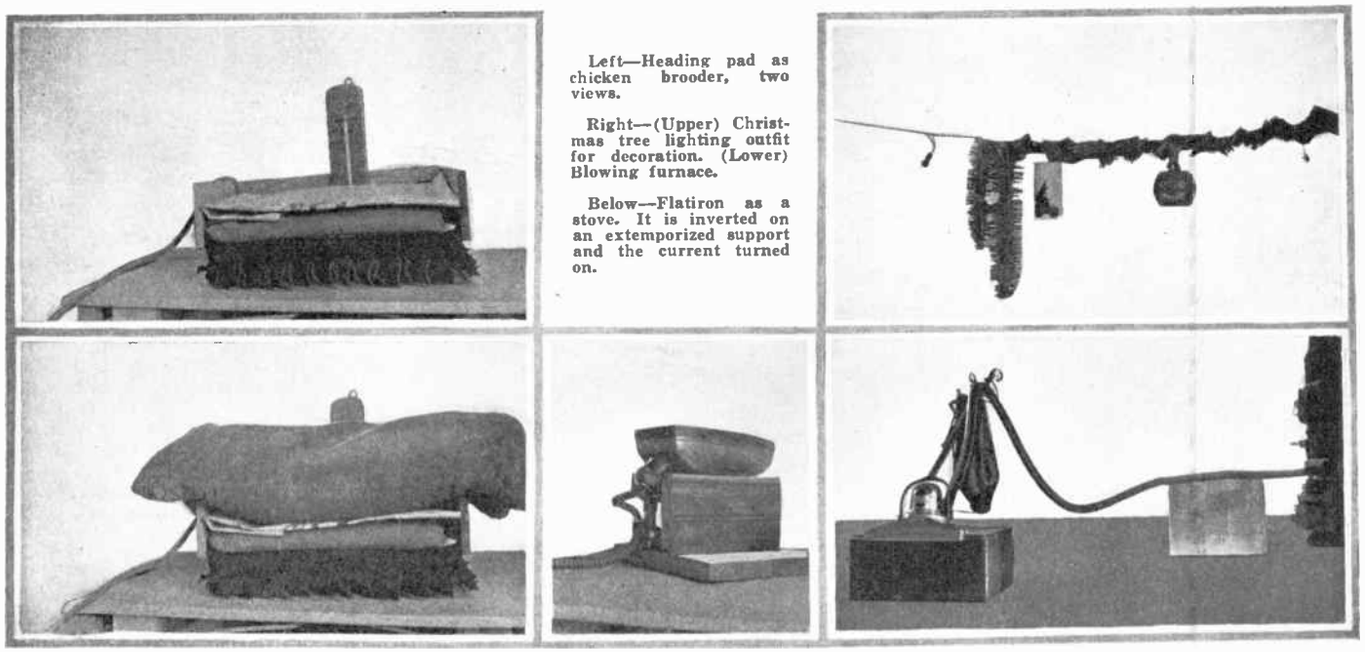
The illustration shows the application of electricity for determinating the capacity of clerical workers. The personal elements involved in the operation of a typewriter are being recorded electrically, a system adopted by the Prussian Ministry of the Interior and by the municipality of Berlin.

New electric questionnaire; a registering apparatus tells how a typist is affected by her work from the standpoint of efficiency.

The apparatus is here shown testing the work of a typist for determining fatigue points and special inaptitudes and aptitudes. The apparatus can be connected so as to record pulse beats, which give a clue to steadiness of nerve of the operator. There would be a suggestion, at least, that the mere idea of being subjected to such test would materially disturb the equanimity of the subject of examination, but perhaps to no greater degree than being confronted by Mr. Edison's formidable questionnaire.

Odd Uses for Electrical Appliances

By J. E. Bullard



Left—Heading pad as chicken brooder, two views.

Right—(Upper) Christmas tree lighting outfit for decoration. (Lower) Blowing furnace.

Below—Flatiron as a stove. It is inverted on an extemporized support and the current turned on.

SOME morning one is confronted by the fact that there seems to be no draft to the chimney. It is almost impossible to make the furnace fire burn as usual. Some sort of forced draft is essential if the house is to be kept warm.

An electric fan would answer the purpose admirably but the cord on the fan is not long enough to reach the nearest lamp socket and permit the fan to be placed close up to the ash pit door. Besides, experience has shown that when a fan is placed close to the door it soon becomes covered with fine ashes, which get into the moving parts and do serious damage to the fan.

Under such conditions the vacuum cleaner can be brought into service. This appliance has a cord long enough to be connected to the lamp socket, even though that socket be some distance from the furnace. If the air hose is connected to the blower part of the cleaner and the open end of the hose is placed just below the grate, when the current is turned on, all the air that is needed will be blown into the body of fuel.

The vacuum cleaner also has another advantage over the fan; it can be placed far enough away from the furnace, so that there is no danger of damage by the fine grit of the ashes set in motion by the stream of air. The end of the hose can be placed far enough away from the grate so that the heat will do no harm. It is better, however, to use one of the fiber tubes in the end of the hose, or even make a tin tube by cutting up a tin can, rolling the tin around a piece of round wood of the right diameter, tying it in place with wire and soldering the edge.

This makes an air-tight tube which will answer the purpose admirably; the cost is very moderate, so that if damaged it does not matter so much.

If the tube made from one tin can is not long enough, more cans may be used. Cut up the cans, press the tin out flat, and solder one sheet to the other until a strip long enough has been formed. It is well to have the different pieces overlap each other about a quarter of an inch. The overlaps should be the same size on all the pieces and only one side need be soldered.

Next, roll the sheet thus formed around the wooden cylinder with the soldering on the outside, fasten the tin in place with wire wound around it, and solder along the edge. An overlap is to be made at the edge in order to make the work of soldering easier. When this tube is used see that the overlaps of the sections on the inside of the tube point in the same direction as the stream of air. When they point in this direction a few small leaks at the spots where the soldering was done will not be dangerous.

On the other hand, if the overlaps point against the stream of air, air will be forced through the smallest leaks, and in addition these laps offer resistance to the flow of air, with the result that not as much is blown into the fire bed.

Should there happen to be some tin cans around, of just the right diameter to fit into the end of the air hose, making the tube becomes still simpler. Then all that is necessary is to cut off the tops and the bottoms of the cans, cut a short gash into one end of each with a pair of tinsmith's shears, force the cut end into the end of another can, and solder.

There will be less danger of damaging the air hose when this tube is inserted, if the end that goes in has its edges hammered in all the way around, forming a smooth rim free from all sharp edges or points. This hammering can best be accomplished by placing the tube over the piece of wood on which it was first formed, with the end of the tube to be hammered projecting about a quarter of an inch from the end of the wood, fastening the tube in place by means of a couple of tacks or nails driven in close to either end, and hammering the edge of the tube over with a wooden mallet. The wooden mallet will give a smoother edge than the use of a hammer.

After the edge has been hammered down flush with the end of the wood bar remove the wood through the other end and with a smaller hammer, a round nosed one is best, hammer this turned-in edge down flat against the inside of the tube.

A tube made in this manner will last a long time, will not damage the air hose, and can be placed quite close to the grate. Usually the air blowing through the tube will keep it cool enough, so that there is no danger of the solder melting even though the end of the tube is placed very close to the grate.

The vacuum cleaner, however, is not the only household appliance that can be used for various purposes. If a small quantity of hot water is desired in the morning for shaving purposes, the electric flatiron can be utilized to provide it.

A small stand is first made, of wire or wood. If made of wood, only three pieces are needed. Pieces of board seven-eighths of an inch thick are excellent for the purpose. One piece five by seven inches in size serves as the base of the stand. Two other pieces seven inches long and either four or five inches wide are nailed to this base.

These should be nailed with the five-inch edge nearest the center of the base, just touching lines that have been drawn 1¾ inch from the outer edges of the base, or in other words just far enough from the center of the base so that the handle of the flatiron will fit in between them when they are nailed in place.

Now by placing the flatiron upside down with the handle in the space between these two vertical pieces, there is a very serviceable electric stove upon which a cup of water may be heated, a slice of bread toasted, a small quantity of cocoa made, or any other heating or cooking done that is possible with a small electric stove.

One of the reflector type room heaters may not appear of much service during the hot weather in the summer. However, if the guard is removed and in place of the heating coil a large clear glass lamp is inserted, it will be found to serve very nicely for lighting up the back yard, if necessary to enter it after dark, perhaps working on a car at night.

If one has just purchased some young chickens which need to be kept warm and comfortable, the heating pad may be just the thing to supply the heat in a home-made brooder. A little experimenting will show just which heat will keep the brooder at the right temperature. The pad may be placed on a shelf just above the chickens and screened in so that it will not be damaged by the occupants of the brooder.

Christmas tree lights are usually packed away just after Christmas and not used again until the following Christmas, yet

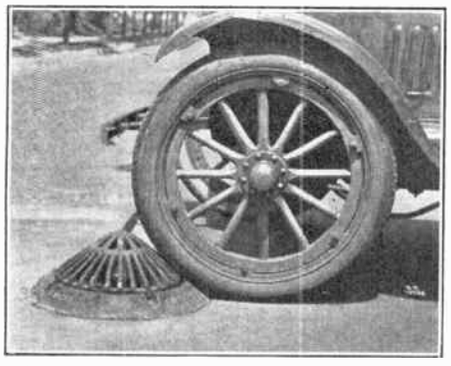
there are many other ways in which they can be of use. Perhaps a Hallowe'en party is to be held: Jack-o-lanterns fit in very nicely with the decorations, but as most of these are made of paper it is dangerous to illuminate them with candles.

If a couple of 16-light Christmas tree lighting outfits are available, eight lanterns can be hung on each of four strings or wires running from the center fixture of the room to the corners of the room, with a Christmas tree light concealed in each of these lanterns. It is then safe to use practically any other decorations desired and the room is made much more attractive than would have been the case had the Christmas tree outfits not been used. In addition, the fire hazard has been reduced to the minimum.

In using these lights, however, it should be borne in mind that they do generate a good deal of heat and light fluffy paper should not be brought into direct contact with them or be bunched directly above them.

These lights may also be used for other decorative purposes. For example, if some special decorations are desired for Fourth of July one might use card-board tubes covered with red paper to resemble fire crackers. The cord of the light is drawn through this tube and fastened so that the lamp will burn just at the top of the tube. Red carbon lamps used in this manner give quite a novel effect.

Traffic Dome Signal

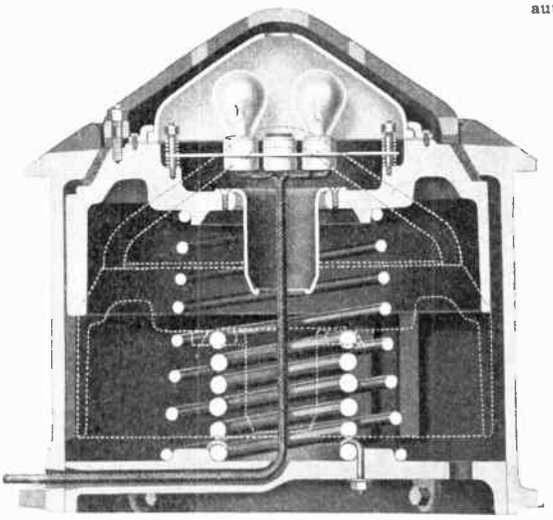


An automobile running against a traffic dome signal, constructed to sink under its weight.

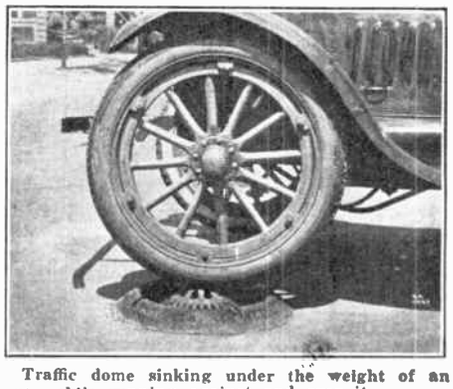
WE have before now illustrated illuminated safety domes to be placed on roads as traffic guides or warning. The idea has been to produce a light under heavy grating, which grating would be so low that a car which by any accident struck the dome, would run over it without disagreeable jar.

The objection to this arrangement was that the light was at too low a level and could not be seen with sufficient distinctness. The one we illustrate overcomes this difficulty. It comprises as before a heavy iron or steel grating, almost cone shaped, and carried within a heavy casing whose top is level with the ground. The cone projects eight inches above the street level, and within the cone are two 50-watt incandescent lamps. The cone is perforated to let the light show out, in two or three different designs; the cone is so high that the light is visible for a considerable distance, and there is no mistaking the signal. The part of the structure, including the cone with cylindrical base which carries the lamps, is telescoped into a second cylinder, within which it moves vertically up and down. To hold the cone in place, helical springs are provided; these hold it in the highest position. If a car strikes it by accident, the springs yield, and the cone with supporting cylinder is forced down into the containing cylinder, so that the car rolls along almost as if on the level.

The removable conical dome projecting nearly a foot above the pavement is at quite an effectual height, to give the light good range and visibility. The cone is approximately 22 inches in diameter at the base. In one design colored bull's-eye lenses are introduced in the openings of the dome. In others the light emitted is the natural light of the incandescent lamp.



Details of the telescopic construction and lighting arrangement of the traffic dome in cross-section.



Traffic dome sinking under the weight of an automobile running against and over it.

If a city erects a heavy warning signal in a roadway, which will injure any automobile striking it, there is always a suggestion of a damage suit by the owner whose car is injured. The idea of these low level, roadway signals is to warn passing cars, and to direct their courses, without any danger of injury.

It is recorded, we believe, that damages have been recovered by an automobilist who ran into a fixed signal post placed in the middle of the road. The traffic dome, while just as useful as the every-day type, can do no harm to automobile or wagon and they cannot harm it. This is more than can be said for the traffic signal post, which will destroy a mud guard.

Heating Band

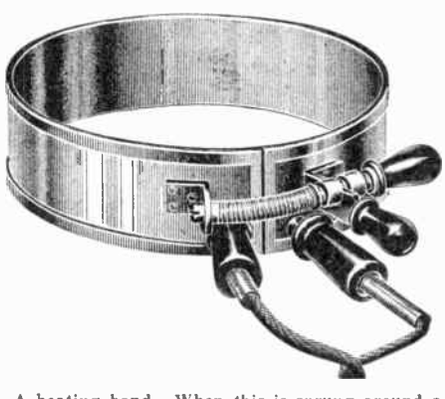
IT is often found to be a defect in electric cooking vessels that the heating element is a part of the appliance and is irremovable therefrom.

In the small immersion heaters which are so much used a separation of the heating element from the container is accomplished. Another solution is given by the apparatus we illustrate, of German origin.

What may be termed a heating band, with a spring to draw the ends together, is made of such size as to fit around the vessel to be heated. The heating element is made of chrome nickel and is covered on its outer circumference with a layer of asbestos to prevent loss of heat. The inner side is insulated by mica which, while affording electric insulation from the metal of the pot, is so thin that it does not cut off the heat noticeably.

There is a protective envelope which may be made of nickel steel, and sometimes an inner strip of copper also. To apply, the band is sprung around the pot, and here, as will be seen, it is necessary for the vessel to be of proper diameter, so where several vessels are to be heated in succession by one of these appliances it will be necessary to have the requisite number of vessels of identical size.

The helical spring draws the ends together so as to bring the mica in close contact with the side of the vessel. The band is about 1¾ inches high and is made in a number of different sizes for diameters ranging from 4 to 10 inches. There is a certain amount of difficulty in changing the heating element, replacing an old defective one with a new one, but this is not often necessary, as the life of the coil is very long. The connection with the circuit is very carefully carried out, so that there is no possible chance of burning out. The small sized bands with an expenditure of 500 to 700 watts will bring a quart of water to the boil in about eight minutes. The largest band takes about 1,100 watts.

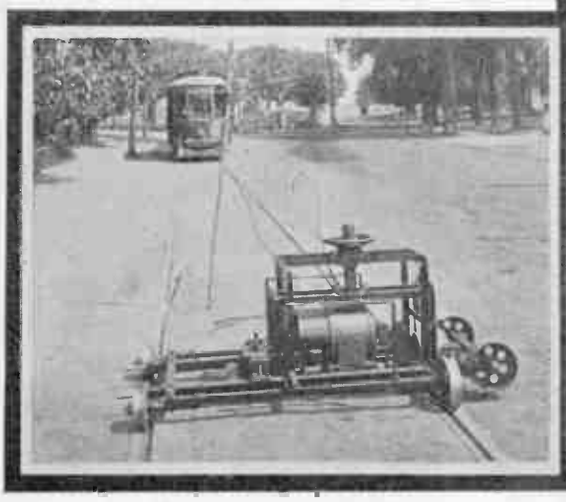


A heating band. When this is sprung around a vessel it heats it very effectually, and the heater does not come in contact with the contents of the vessel. It is intended for household use.

It will be seen that it is a very simple matter to distend the ring a little, so as to receive the vessel to be heated. It is, of course, quite essential that the contact between band and vessel should be good, and naturally the circular contour of the band must not be disturbed, although of course the spring will do much to draw it into shape. The ideal system would seem to be to keep it as permanently as possible on the saucepan or other vessel on which it is to be used. As shown in the drawing, the vessel is to be cylindrical, not conical, in shape.

Rail Grinder

A convenient machine for grinding the surface of trolley rails by an electrically driven emery wheel, the power being taken from the trolley wire proper. On one end of the machine are seen two small wheels, so that the machine can be pushed off to one side like a wheelbarrow.



AN almost disastrous element of expense incident to trolley lines is the track. The rails are extremely heavy and are laid on a very expensive foundation. They have a double purpose to fulfill; they must carry the car and carry it smoothly, and have to act as a conductor of current for its return to the generators in the distant power house.

The illustration shows a grinder for surfacing off and cleaning the rail tops. The current that goes through the car motors has to pass from car wheel to rail, so it is an object to have the surface of the rail clean; the trolley car runs so fast that any irregularities in the track produce considerable irregular movements in the car, small imperfections in the track seeming to be magnified as far as affecting the car is concerned. The emery wheel grinds many of these away.

The grinder is simply a little car in itself, carrying a motor to drive an emery wheel. The power is derived from the trolley wire, and the grader is, of course, fitted with all the required feeds and adjustments for doing its work, which is grinding the surface of the rails by a rapidly rotating emery wheel.

Two wheels will be seen carried on an axis parallel to the rails, which wheels are on the right hand, as the illustration shows the apparatus. If a workman lifts up the other end of the machine, these wheels rest upon the ground and the machine is completely lifted from the rails, and can be pushed away to one side, out of the course of the regular running trolley cars. Power can be taken from an overhead wire by a pole carrying a wire, with its own little overhead trolley to rest upon the upper surface of the wire, rather than to pass upward against the lower surface.

Directly over the motor will be seen the vertical feed, operated by a hand wheel and feed screw.

Six-Wheeled Railless Trolley

On the right, a double decked, six-wheeled, railless trolley of English construction.

THE trolley-bus, or electric railless vehicle, operated from an overhead trolley wire, is growing in popularity in thickly populated districts in England, where electric current is easily obtained. For interurban traffic the trolley-bus is showing economies in operation as compared with the petrol vehicle, where it is impossible owing to high costs to lay down tramway tracks.

The Tramways Department of the Bradford City Council has shown much enterprise in experimenting with trolley-buses of varied types, and one of the latest vehicles on the road is a six-wheeled car with a capacity of over 60 passengers. All four front wheels steer, and the drive from a 70-horsepower electric motor is taken through a counter-shaft to the rear axle. The rear wheel has twin tires and consequently the load is distributed over eight tires.

Without passengers the vehicle weighs seven tons, the load being distributed evenly between the two rear wheels and the four front ones. The front wheels steer independently from one steering column, being mounted automobile-fashion on stub axles and not carried bogie fashion. The capacity of the vehicle is almost equal to that of a tramway car, but the running costs are much lower as only the overhead equipment is to be provided at the outset.

In England the street cars not only lay their own track when a new service is begun, but they must maintain the road between the rails and 18 inches on each side so long as the service is run, although the ordinary street traffic contributes its share of damage to the surface.

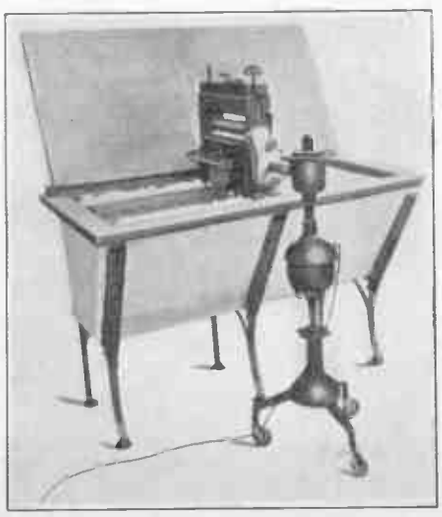
Contributed by G. CROWTHER.

Service Unit

WE show in our illustration what is termed a unit washer. The operation of washer and wringer is effected by a motor, which is carried on a three-legged wheeled stand, so that it can be moved about and made to do all sorts of things.

Here the unit is shown geared to a shaft, which drives a washing machine and a wringer, the coupling to the shaft of the wringer holding it in place, as the wheeled base gives no firm support. All sorts of attachments are supplied to be operated by the conveniently mounted motor. Any electric light socket supplies sufficient power. All the household appliances, washing machines, dish washers, ice cream freezers, an emery wheel for grinding knives and scissors, dough mixers, can be run by its aid, while in the garage it will pump automobile tires and recharge storage batteries.

There is little to be said about the apparatus, as the view we present showing one of its utilities gives the basis for the whole story. It is suggestively named by the manufacturers "The Electric Household Servant."



A most convenient little motor mounted on a wheeled tripod, so that it can be pushed about wherever its services are required, and can be made to do all sorts of work in the house.

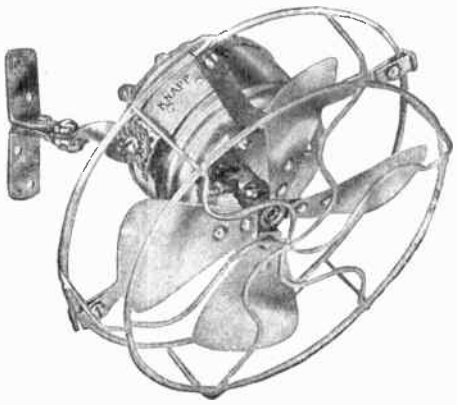
If a house is fitted up with electrical appliances, each with its own motor and connections, the expense will be very large. But by such an appliance as this, if one is content to operate one appliance at a time, the expense of installation will be greatly reduced, for this motor will operate anywhere within reach of a base socket or burner socket. As regards the variety of work which it can do, it may be taken as representing a number of electrically driven machines, if circumstances permit of their being operated singly.

Lilliputian Fan

AMONG the peculiarities of automobiles is their faculty of producing drafts when not desired, and of being decidedly warm in summer when standing, the drafts which may verge upon being obnoxious being really missed by the occupants of a motionless car.

The illustration shows a little electric fan which is designed for use in limousine cars especially. This is arranged to be attached to the ceiling or side and has a double adjusting bracket so that it can be twisted about to produce currents of air in any desired direction. Mosquitoes and flies are banished by operating this fan, and one very obvious suggestion is made that it be used in ambulances for the sick.

It is constructed for the voltage of an automobile starting battery, six volts, and is available for use wherever such a circuit can be drawn upon. Even small cabin boats, we are told, find such an apparatus a welcome addition to their cabin luxuries.



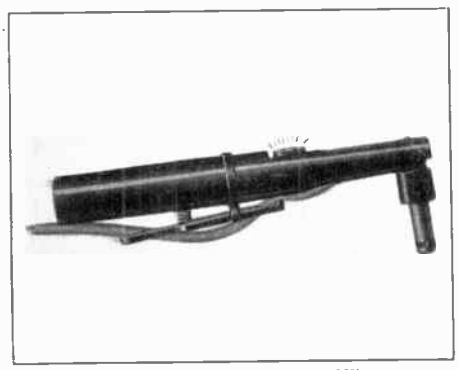
A small fan mounted on an adjustable bracket for use in motor boats, automobiles and similar places where the space to be operated on is small.

After the automobile has been used with sashes closed, as during a storm, the fan can be turned on when returning to the garage, so as to drive out the exhausted air, and it even may be used to circulate the air when the windows are closed, which after all is sometimes an alleviation, although not a strictly logical procedure.

It thus appears that in this Lilliputian fan a most useful accessory for the automobile, motor boat and the like is provided. In the automobile it may even operate to break up the drafts which sometimes are found to be so very annoying, in alleged closed cars, which are really, in many cases, unclosed, at least to the extent that gaps are provided for the most obnoxious kind of unexpected and disagreeable drafts.

Storage Battery Filler

CONSIDERABLE time and labor in filling storage battery cells is saved by the semi-automatic filler, a new device of extreme simplicity, illustrated here.



A most convenient apparatus for filling storage batteries which lights a lamp when the battery is full, so that the water can be turned off by hand.

By means of this the exact amount of water is permitted to flow into the cells without overflowing or causing the electrolyte to spill over. In addition to saving time, the use of this device will materially aid in keeping the battery tops dry and will be equally useful where one battery is kept or where a fleet is maintained.

The filler is connected with a supply of distilled water by a hose. A compression pinch-cock cuts off the water or lets it pass as desired.

The barrel end or handle of the filler is grasped with the index finger resting upon the trigger on the lower side. The nozzle end is inserted in the filling vent, the trigger is then pressed, opening the pinch-cock, and the water flows through the hose into the cell.

As soon as the level of the liquid reaches the proper height it causes a contact to be made and a small electric bulb signal lights. The trigger is then released, shutting off the water, and the operation is repeated in the next cell.

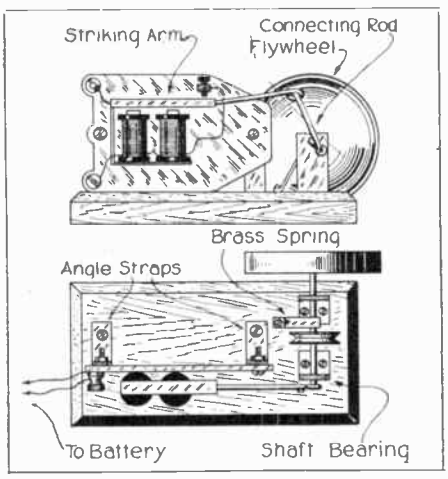
Toy Motor

THE basis of this motor is an old bell mechanism, and the illustration is so clear that a description is hardly needed.

A board or metal plate is mounted vertically on a base as shown and to it the magnet from an old bell is attached, with armature and contact. The armature with its wire prolongation constitutes the striking arm of the bell, and when current is turned on this arm will vibrate up and down very rapidly.

By means of a connecting rod connection is made with the crank on the end of the axle of a flywheel. As the armature of the striking arm goes up and down, it will turn the flywheel, whose inertia will reduce the rapidity of motion, so as to make the device practical.

As shown, the armature is attached to a vertical spring back of the magnet; it may be pivoted or carried by a horizontal spring; of course all such details are affected by the construction of the bell. The end of the wire projecting from the armature is bent into an eye to receive the upper end of the connecting rod, which is properly bent to correspond. A neater way would be to flatten both ends, to drill them and to insert a rivet, but this little engine is supposed to be constructed along the simplest possible lines.



A well designed, reciprocating toy motor, constructed from an old electric bell, really giving some interesting results.

A wooden wheel or roller, 3 inches in diameter, will answer for the flywheel. A grooved pulley can be placed in the center of the shaft to receive a thread or string to represent the belt. But little power is necessary for operation.

Contributed by HENRY RUFALL, JR.

A New Prize Contest

IN one of our forthcoming issues we will begin to give a series of prizes for letters giving odd and unusual electrical experiences.

Nearly every one of us has had an odd or unusual experience in electricity, sometimes humorous, sometimes pathetic, sometimes puzzling, and it would appear that our readers should let us have some of their personal experiences for the benefit of all the readers.

We are certain that this department will prove of much interest and instruction, and until further notice we shall pay the following prizes:

The more unusual the experience, the more chance you have to win a prize.

Illustrations are not necessary, but the letter should be either typewritten or written in ink. No penciled matter can be considered. Write only on one side of the paper.

First Prize	$20.00
Second Prize	$10.00
Third Prize	$5.00
Fourth Prize	$2.50

If two contestants should send in the same winning experience, both will receive the same prize. In the event of two or more persons sending in the same as best, second best, etc., each tying contestant will receive the prize tied for.

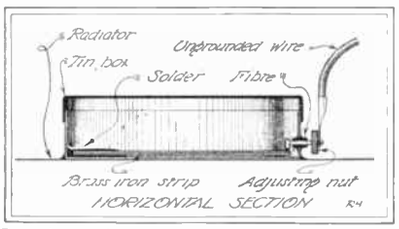
Prize winning letters will be judged as follows: The first prize will be awarded for the letter giving the oddest or most unusual experience. The second prize to the one considered next best, and so on.

Communications to this department should be addressed "Editor, Odd Electrical Experiences, c/o PRACTICAL ELECTRICS, 53 Park Place, New York City.

Motor Electrics

Radiator Alarm

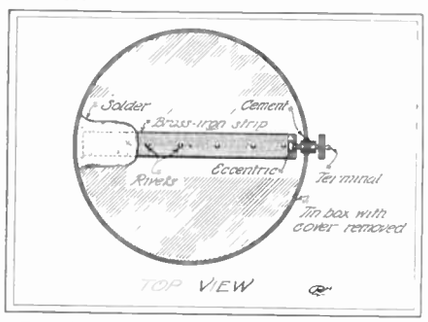
MANY automobiles are not equipped with motometers for indicating the temperature of the water within the radiator. A large number of those so equipped, have no facilities for lighting the gage at night. Therefore, at



Location and connections of a thermostat bar on the upper part of an automobile radiator, for giving an alarm when the temperature rises.

night, on a majority of cars, there is no way of telling from the driver's seat just how hot the water becomes. Under these conditions a radiator may freeze, the water circulation may become impaired, or serious damage result.

The accompanying illustrations show a home-made contrivance which closes a circuit and causes a small electric light bulb, which is located in the dash, to light up. The operation of this alarm, which is really a heat-affected switch, is obtained by a strip of brass and iron riveted together, with one end stationary. Brass has an expansion coefficient nearly 50 per cent greater than that of iron. When the strip lies flat at, say, 60 deg., it will assume a slight curve at, say 100 deg. Thus it is easy to assemble this switch so that it will close at any desired temperature. The apparatus is housed in an asbestos-lined metal box, which is soldered to the back of the radiator, just under the hood. A special thumb nut operating an eccentric, enables the operator to vary the temperature at which the light will burn. Thus, because of radiation, it will be set to close at a higher temperature in winter, than in summer.



Top view of the thermostat bar as installed by the filling pipe of the radiator on the top.

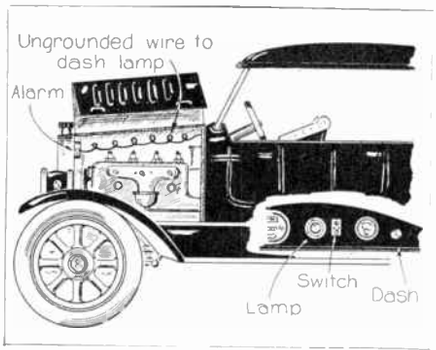
Procure a heavy metal box about three and one-half inches in diameter and one inch deep, which is provided with a screw-on cover. Cut two strips of iron and brass, each three inches long and one-half inch wide. These should be not thicker than 16-pound bond paper. The rivets used must be of rather soft metal to prevent buckling the strips, but they should be set solid.

One end of this strip is laid upon a raised-up area of solder placed at one side of the box, and then covered with more solder, forming the stationary end. The brass strip lies next to the box bottom, but with a clearance of at least one-sixteenth of an inch. If possible, the strip should be riveted at a relatively low temperature, not exceeding 80 degrees.

Drill a hole through the opposite side of the box, directly over the free end of the strip, large enough for a small fiber bushing. This hole should be squared slightly, and the bushing cut to fit, to lessen the possibility of its turning with the nut when in use.

Prepare a knurled nut of brass and mount it on a small brass shaft which fits the bushing rather snugly. On the inner end of this shaft, mount a small eccentric of brass or copper. Use a good cement to secure the bushing in place. For ease in connecting up the circuit, the thumb nut should also be provided with a small knob terminal. This takes the ungrounded wire.

Cut a piece of sheet asbestos to fit inside the box cover, and other pieces to fit in the bottom and along the sides, portions being cut away where necessary to prevent interference with the mechanism.



General layout and partial view of the switchboard of the heat alarm, which notifies the driver when his radiator is getting too hot.

This box is then soldered to the radiator as shown, and the circuit wired up, taking current from the storage battery and running through a switch, also mounted on the dash. The ground wire may be fastened to any metal part of the machine, insuring a good ground.

If desired, a two-way switch can be installed, so that either the light can be made to show at night when the circuit is closed, or a buzzer, located beneath the dash, can be made to give the warning by day.

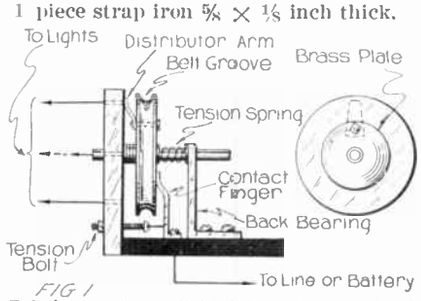
The thumb nut adjuster can be operated by lifting the hood. If the bushing fit is tight enough, an adjustment will not jar when the car is driven over rough roads. Though the two-metal strip is very thin, it is reasonably accurate because it stands on edge, immune to most up-and-down motions.

Contributed by DALE R. VAN HORNE.

Flashing Automobile Accessory Display

As flashers are quite expensive to buy, some of your many readers might be interested in this one. A small fan motor is the means of operation. The automobile accessories connected to this machine are a stoplight, flashlight, two spotlights, backing-light, tail-light and horn. The two spotlights are on the same contact, the stoplights and horn on another contact. The parts required are:

2 pieces of ¾ × 12 × 12 inch wood.
1 disc 10 inches in diameter ¾ inch thick of wood.
1 piece strap iron ⅝ × ⅛ inch thick.



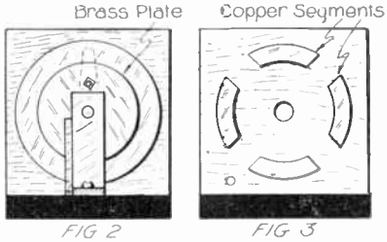
Belt-driven electric light flasher, designed by the writer for a window display of automobile accessories, but applicable to show windows in general.

1 piece round rod ¼ × 6 inches long.
1 piece brass 1/32 × ½ × 8 inches long.
4 copper strips 1/32 × 1 × 4 inches long.
1 brass plate 3 inches in diameter, 1/32 inch thick.
1 bolt ⅛ × 1 inch.
1 bolt 3/16 × 2½ inch.
4 small screws.
1 spring ¼ inch.

The two 12 × 12 inch pieces are nailed together as shown in Figure 1. A ⅜-inch hole is drilled 5 inches from the top and 6 inches from each side. A piece of ¼-inch copper tubing is pressed in this hole for bearing. The 10-inch disc is drilled in the center with a 7/32-inch drill.

It is then placed on the end board with the holes centered, and a circle is drawn on the board around the disc. The copper strips are then beveled at each end and tacked to the edge of this line.

A 3/16-inch hole is drilled through the top corner of each copper strip for lead wires. The 3-inch brass plate is centered on the disc and tacked in place, the tacks being kept close to the edge. The distributor arm is bolted to the opposite side of the disc, the bolts coming through at the edge of the brass plate. A ¼-inch shaft is forced through the central hole



Disposition of the electric contacts on the two faces of the belt-driven pulley used in constructing this very effective window display.

of the disc. This is then placed in the bearing, several washers being used to keep the disc from rubbing on the end piece.

The back bearing is then constructed as shown in Figure 1, the ⅝ × ⅛-inch strap iron being used. The spring is placed between bearing and disc. The contact finger is made from the ½-inch brass as shown in Figure 1. The tension bolt is fastened to the contact finger with the wire, a small hole being drilled through the finger for this.

Contributed by J. B. BURNETT.

Experimental Electrics

Incandescent Lamp Experiments

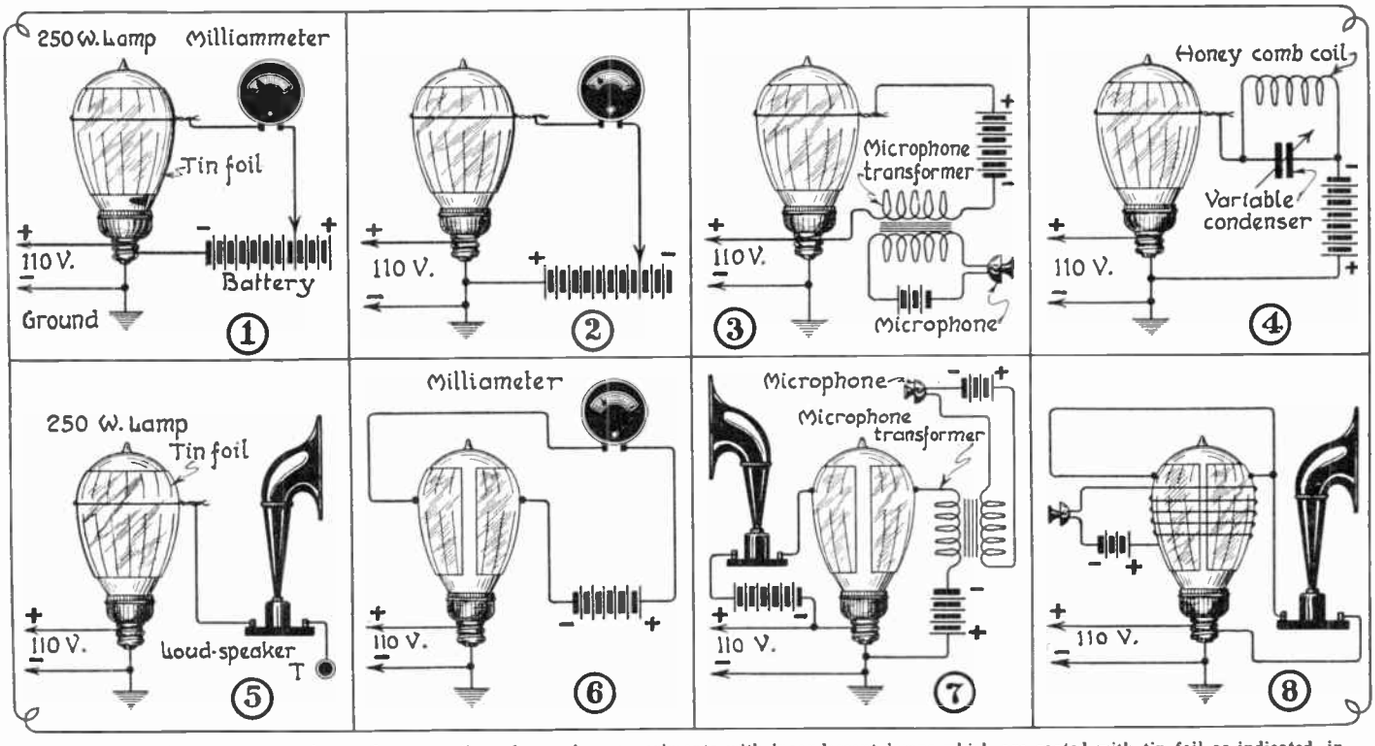
By Clyde J. Fitch

THE conduction of electricity through a vacuum by means of the electron flow from a hot filament to the plate, is a branch of science still in its infancy and affords scope for considerable research.

Many experimenters have been barred from working along these lines on account of the difficulty of constructing electron tubes, and consequently practically all of the discoveries and theories in electron emission have been made and advanced by research engineers, who have a large, well-equipped laboratory at their disposal. It is safe to say that if all experimenters had adequate facilities for experimenting in thermionic emission, the art would advance much more rapidly. However, many experiments based on this phenomenon may be made with the ordinary incandescent lamp.

It is well known that the specific resistance of glass is lowered a considerable amount by the application of heat—as will be demonstrated later in one of our experiments. Now, if we take an ordinary incandescent lamp and coat the outside of the bulb with tin foil, we have an excellent experimental electron tube, comprising a filament, which is made incandescent by the passage of current, and a plate, the tin foil coating on the outside of the bulb. The hot filament acts as a source of electrons and also heats the glass of the bulb, thus lowering the specific resistance of the glass to such a value that a considerable current can be made to pass from the tin foil coating on the outside of the bulb to the filament. The tin foil coating also prevents, to a great extent, radiation of heat and light from the lamp, and thus tends to keep the glass at a fairly high temperature.

It is necessary, in order to perform these experiments, to use a large size type B



In these illustrations are shown the connections for various experiments with incandescent lamps which are coated with tin foil as indicated, in some the tin foil being divided into two disconnected areas, in others the tin foil being all in one piece, or at least connected all the way around the bulb. The article describes in detail what each experiment is.

Mazda lamp. The type B Mazda lamps, in capacities over 100 watts, have been superseded by the type C Mazda lamps, which are filled with gas, and may not work properly, although experiments with the gas filled bulbs may reveal other new and interesting phenomena. There are a few type B Mazda lamps of over 100 watts capacity now on the market, and if possible a lamp of at least 250 watts should be obtained. This is the type and size of bulb used in the following experiments. Different bulbs of the same capacity and type have different characteristics, and the results obtained below will vary considerably with different bulbs.

The 250 watt Mazda B bulb was coated with tin foil, as shown in the diagrams. The tin foil strip, 5 inches wide, was wrapped around and shellacked to the glass as shown. After lighting the lamp the heat generated by the ignited filament thoroughly dried and baked the shellac and tin foil to the glass.

Fig. 1 shows the arrangement for the first experiment. The lamp was connected to the 110 volt direct current lighting circuit, with a dry battery and milliammeter in the circuit as shown. The negative terminal of the battery was connected to the positive side of the filament, and the positive terminal of the battery was connected to one terminal of the milliam-

meter. The other terminal of the milliammeter was connected to the tin foil coating on the bulb.

About one minute elapsed before the milliammeter registered any current flowing through the bulb; as the glass became warmer the current increased, in jumps, until in about five minutes the flow became steady. A curve was plotted, with the voltages of the coating as abscissas and the currents as ordinates.

Hereafter we shall speak of the tin foil coating as the plate, for it acts as such in these experiments. We now return to the curve which is shown at (A), below. It will be noted that with no battery voltage the plate current was 2.2 milliamperes; the current in this case passed from the positive side of the filament through the meter to the plate, and then through the bulb to the negative side of the filament.

There is nothing unusual in this phenomenon, which is just a special production of the "Edison effect," and the results obtained were as expected. Practically every electron tube will behave in the same manner. If higher plate voltages were available and the curve continued, it would probably flatten out at the top, as the supply of electrons from the hot filament is limited, and the current could not increase unless the filament temperature were increased.

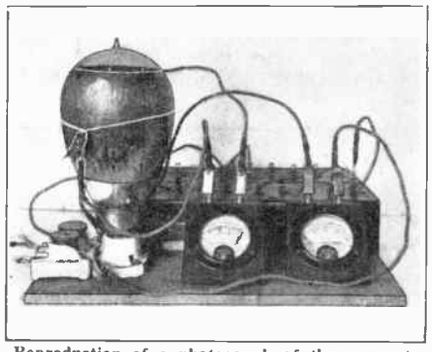
A most peculiar action of the bulb was observed in the experiment shown at Fig. 2. Here the battery was reversed, and the positive terminal of the battery was connected to the negative terminal of the filament. According to all theories and expectations, no current should flow through the meter. But a current did flow through the meter, and flowed through the bulb from the filament to the plate, the opposite direction of the current-flow through any ordinary electron tube. A curve of this current was plotted, which curve is shown at (B) below. With no battery voltage, a current of 1.2 milliamperes passed from the filament to the plate. The current gradually increased when the battery voltage was applied, until at 135 volts the maximum current was flowing. The next reading was taken at 157.5 volts, and the plate current was zero. At this voltage the bulb was a perfect rectifier, that is, current would flow from the plate to the filament, but not from the filament to the plate. At 180 volts the current was .05 milliamperes, and increased as higher voltage was established.

Another peculiar action observed was that when first taking the reading with no battery voltage the current was about 5 milliamperes, and was very unsteady. In about two minutes the current settled down to 1.2 milliamperes and became steady.

The explanation of these peculiar phenomena is not known. It may be the result of some secondary electron emission due to bombardment on the glass wall by the electrons from the filament, but it seems that with a negative charge on the tin foil coating, no electrons would strike the glass. Then again it may be due to ionization of the residual gas in the bulb due to an electron flow from the negative side of the hot filament in the bulb to the positive side of the filament in the bulb. Whatever the action may be, it is not due to leakage through the hot glass wall from the tin foil coating to the bulb socket, as the current drops instantly on opening the filament circuit before the glass cools. If it were due to leakage what, then, is the cause of the strange dip in the curve?

A voltmeter was connected between the plate and the positive side of the filament, and indicated a difference of potential of 28 volts, about one-fourth the voltage across the filament. The plate was negative with respect to the positive side of the filament. The voltmeter was then connected between the plate and the negative side of the filament, and also indicated 28 volts. The plate was positive with respect to the negative side of the filament.

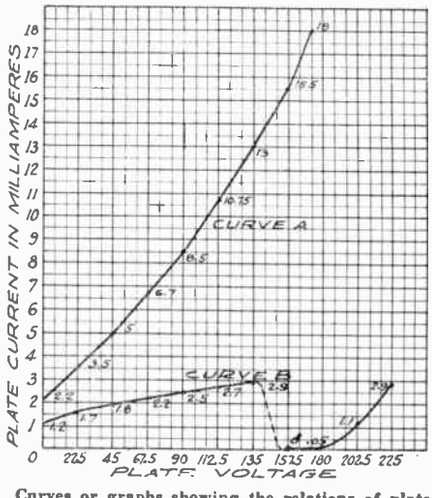
Fig. 3 shows a circuit in which the lamp reproduced, very faintly, words spoken into the microphone. The sound emitted from the lamp was probably due to a condenser effect of the tin foil coating, although the lamp reproduced no sound when extinguished. Probably the space within the bulb became conductive,



Reproduction of a photograph of the apparatus used in the experiments described in this article. This is the apparatus shown in diagram in the various illustrations of the preceding page.

due to the electron flow from the filament, and this space acted as one side of the condenser, of which the tin foil coating was the other side; the hot glass acted as an imperfect dielectric. The lamp would talk with the plate either positive or negative with respect to the middle point of the filament.

In trying to make the lamp generate high frequency oscillations by taking advantage of the dip in the curve (B), the circuit shown in Fig. 4 was used. A 1250-turn honeycomb coil was shunted by a variable condenser and connected in the plate circuit. The plate was kept negative



Curves or graphs showing the relations of plate voltages and plate currents in this interesting suite of experiments.

with respect to the filament by means of the battery. Current was flowing from the filament to the plate in this case. Sure enough, a high pitched squeal could be heard with the ear held close to the lamp, but later investigations showed that the variable condenser had no effect on the frequency of the oscillations, and that the lamp would sing either with or without the battery, but would not sing with a battery of over 135 volts.

An iron core choke coil was connected to the lamp in place of the honeycomb coil and condenser. This also made the lamp sing at the same frequency. Starting with a cold lamp, five minutes elapsed before the lamp would sing. The frequency of the singing note was later found to depend upon the area of the tin foil coating. With a smaller coating the frequency was much higher.

A smaller lamp, one of 60 watts rating, was coated with tin foil, but this lamp would not sing, and would not pass current from the filament to the tin foil plate, as did the larger lamp. One peculiar phenomenon observed in the smaller lamp was that the lower part of the glass which was uncovered by the tin foil, became coated on the inside with a silvery deposit, which gave it the appearance of a mirror. The glass covered by the tin foil had no deposit.

A loud speaker was connected to the lamp as shown in Fig. 5, and reproduced the singing note with great intensity. On touching the free terminal (T) with the finger, the intensity was greatly increased, due to the capacity of the body. The negative side of the filament in all of these experiments was grounded. A variable condenser was connected between the negative side of the filament and terminal (T) and the result was the same as when touching (T) with the finger. On shorting the condenser there was no change in the singing note. A battery connected between the negative side of the filament and terminal (T), with the negative side of the battery connected to terminal (T), increased the intensity of the singing note slightly. A large permanent magnet held in the vicinity of the lamp modified the singing note considerably.

The experiment shown in Fig. 6 proved that glass is a fair conductor of electricity when hot. The tin foil coating was removed from the glass in two longitudinal strips, thus leaving two separate tin foil plates on the bulb. A battery of 180 volts was connected to one plate and one side of the milliammeter. The other side of the milliammeter was connected to the other plate, and the lamp was then connected to the 110 volt line. In about five minutes, which was the time required to heat the glass, a current of two milliamperes passed through the meter. On opening the filament circuit, the current gradually died down to zero as the glass cooled.

Fig. 7 shows a popular vacuum tube amplifier hook-up. One tin foil plate was used as a grid, and the other tin foil plate was used as a plate. The plate and grid were, of course, on opposite sides of the filament, as in the old DeForest audions. Words spoken into the microphone were clearly reproduced in the loud speaker, but with very little or no amplification. Different values of plate and grid voltages changed the character and amplification of the speech.

Fig. 8 shows another circuit used for reproducing speech in the loud talker. In this case a coil of wire was wound around the lamp through which the speech currents in the microphone circuit passed. The words were clearly reproduced in the loud talker, but with no amplification.

Another 250 watt Mazda B lamp was coated with tin foil and subjected to the above tests. This lamp acted more peculiarly than did the first. The lamp would sing at a much higher pitch, and the singing note would gradually grow louder until it would suddenly stop, and a few seconds later start in singing again. Sometimes the bulb would emit a blue glow, due, of course, to ionization of the residual gas in the bulb. The lamp would emit this blue glow with no battery voltage applied to the tin foil plate.

These experiments have proved most interesting to the author and some unexpected results were obtained. The Edison effect which is involved is one of the great fundamental discoveries in electricity.

Motor Starting Solenoid

By Jesse Marsten

CONTRARY to the usual course, this automatic starter does not attract its iron plunger when the current in the solenoid is greater than a certain value, but it does attract the plunger when the current is less than this certain value.

In Figure 2 we have illustrated an iron framework (FF), built rectangularly, with an opening on the bottom. A soft iron plunger (P), narrower at the bottom than at the top, fits into this framework. There are three important air gaps in this arrangement. Two air gaps (DD, Fig. 2) are between the plunger (P) and the bottom of the framework (FF), and one air gap (U) exists between the top of the plunger and top of framework.

Figures 3, 4 and 5 illustrate this arrangement with the addition of a coil which has been wound around the plunger (P); the black circles represent the cross sections of the coil wires (CC). Now suppose that a large current is passed through the coils (CC). According to electromagnetic principles the iron becomes magnetized and magnetic lines of force flow through the plunger (P) and the

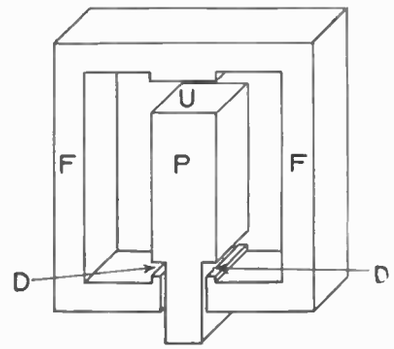


Fig. 2.—A diagram, giving the features of design and relations of the solenoid and its plunger or armature.

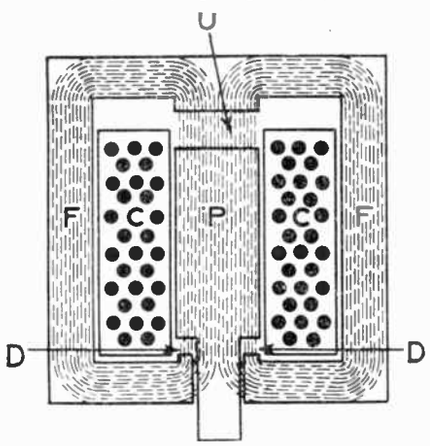


Fig. 3.—Effect of a strong current on the solenoid, the lines of force filling the air gaps, pulling the armature down.

framework (FF) as shown in Figure 3. It will be observed that the lines of force pass from framework to the plunger directly and also by way of the air gaps (DD) at the bottom. The reason for it is that since the plunger is narrow at the bottom it is more easily saturated than at the top, and hence can carry fewer lines of magnetic force. The excess above those which it can carry flows through the air gaps (DD) into the wider portion of the plunger. The lines of force also pass from plunger to framework via the air gap (U) at the top.

As a result of this current in the coil and the magnetic field thus set up there is an attraction, or an upward pull, on the plunger, by the lines of force in the air gap (U). However, this upward pull is opposed by two forces: (1) the weight of the plunger and (2) the attraction or downward pull on the plunger by the lines of force in the two air gaps (DD). Both these forces pull the plunger down and overcome the upward pull of the force at air gap (U).

Suppose, now, that the current in the coils (CC) decreases. As a result the lines of magnetic force flowing through the coil are less, and this condition is illustrated in Figure 4, which has fewer lines than Figure 3. Since there are fewer lines of force passing from the framework (FF) to the plunger (P) at the bottom, most of these lines can pass through the narrow portion of the plunger without saturating it. However, there will still be a few lines passing through the air gaps (DD), these few being the slight excess over the saturation amount in the narrow portion of the plunger. Since there are now fewer lines of force in the air gaps (DD) than

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Electric Thread Gauge.

Repairman's Test Panel.

Determining Moisture.
By George G. McVicker.

there were before, the force of attraction at these gaps pulling the plunger downward is less also, but since there are also fewer lines of force in the upper air gap (U), due to the decreased current, the force of attraction there pulling the plunger up is also less. As a result the weight of the plunger and the downward pull at (DD) are still great enough to

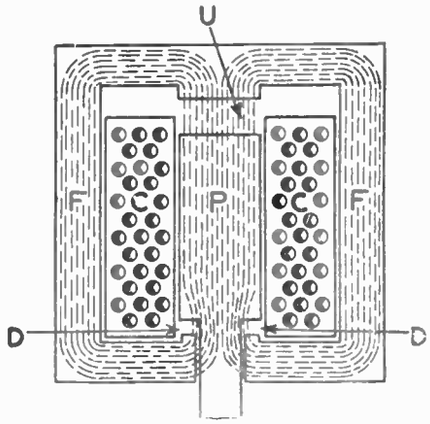


Fig. 4.—A medium current, which does not pull the armature upwards.

hold the plunger down against the upward pull at air gap (U).

If the current now decreases still further, the new state of affairs will be as depicted in Figure 5. Since the current in the coils has decreased, the lines of force have also decreased. This time the lines of force are few enough for all of them practically to pass through the narrow portion of the plunger without passing through the air gaps (DD). Since there are practically no lines of force through the air gaps (DD), there is practically no downward pull on the plunger, but there is still a heavy upward pull on the plunger. The plunger is therefore now pulled up to its new position shown in Figure 5.

It is thus seen that for such a construction of an electromagnet as is here given the plunger is not pulled up by heavy currents, but is pulled up when the current has decreased below a certain value. This is the principle of the automatic starter here described, and its construction is based on that shown in the illustrations.

Figure 6 illustrates the cross section of the automatic motor starter based on this principle. It is shown mounted on a slate panel. It has the iron framework (FF) and a plunger (P). It will be observed that the plunger (P) is narrower at the bottom than at the top and forms two air

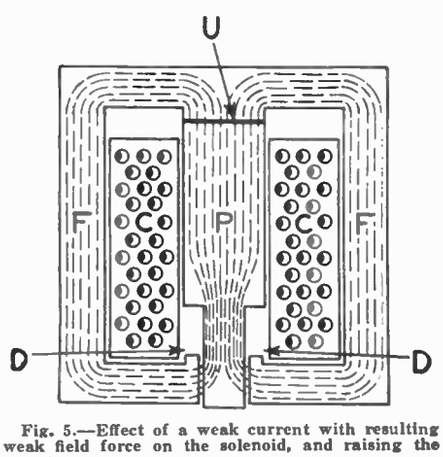


Fig. 5.—Effect of a weak current with resulting weak field force on the solenoid, and raising the armature.

gaps (DD) with the iron framework (FF). The plunger (P) forms the air gap (U) with the upper portion of the framework (FF). To the plunger (P) on the top is attached by means of a link rod a contact plate (CP). Its function will be explained later. The action of this arrangement is exactly as explained in the theory. When the current is reduced to a certain value the plunger is pulled up by the magnetic force at the air gap (U).

By shortening the air gaps (DD) we decrease the value of the current at which the plunger is lifted. On the other hand, if the air gaps (DD) are very long the opposite effect takes place. As a result, by increasing the length of the air gaps (DD) we increase the value of the current at which the plunger is lifted.

By adjusting the size of the air gaps (DD) we can set the value of the current at which we desire the plunger to be lifted. These adjustments are effected by means of an adjusting plug (AP) at the bottom of the framework, seen in Figure 6. This plug is seen to be threaded and hollow, the plunger (P) fitting inside it loosely. By screwing the adjusting plug (AP) up, the hollow iron tube moves upward and thus decreases the air gaps (DD). By screwing it downward, the air gaps (DD) are increased in size. In this way the device can be adjusted to operate at any particular current value desired, which current value can be read by an ammeter placed in series with the coils (CC).

The manner in which this device is used as an automatic motor starter is illustrated in Figure 7. We have here designated three of these electromagnets schematically. Referring back to Figure 6, we see that the plunger carries a contact plate (CP). Directly above the contact plate will be seen two laminated brushes (BB), more obvious in the photograph of Figure 8. When the plunger is lifted the contact plate connects these brushes and short circuits the coils above each solenoid. The starting resistances are designated by (R_1), (R_2) and (R_3) and are connected across the brushes and magnet coils as shown. It will be observed that the last magnet has a small shunt coil (SHC), the purpose of which will appear later. The manner in which this starter operates is now as follows:

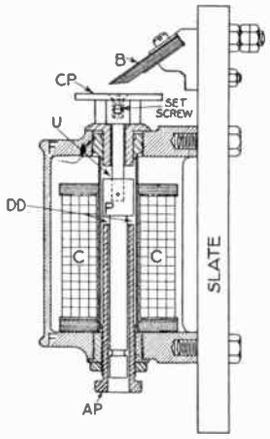


Fig. 6. Section of a motor starting solenoid showing the cylindrical case, coil, armature, and contacts.

The line switch (S) is closed and the main current flows through three paths: (1) through the shunt field, (2) through the shunt coil (SHC) by way of the auxiliary switch contact (AC), and (3) the main current through the motor. This last current flows from positive of the main through the motor armature; through the entire starting resistance (R_1), (R_2), (R_3); through magnet coil (C_1) to the negative of the main. Thus the motor starts up with minimum current since all the starting resistances are in circuit. As the motor picks up speed its current decreases until, depending upon the adjustment of magnet (1), the current has been reduced to a certain amount at which the plunger of the first magnet is pulled up and its contact plate (CP_1) makes contact with its brushes (B_1), and thus short circuits its resistance coil (R_1). The current now flows as follows: From positive of mains through motor; through starting resistances (R_2) and (R_3); through magnet coil (C_2); through brushes and contact plate (B_1) and (CP_1); through coil (C_1) to negative of mains.

The motor now continues to gain speed and the motor current decreases still further. When again this current is reduced to a certain low value, depending upon the adjustment of the plunger in magnet (2), the plunger is lifted and contact plate (CP_2) short circuits its brushes (B_2), thus short circuiting second starting resistance (R_2).

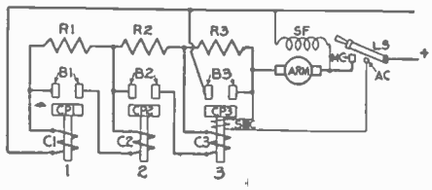


Fig. 7. Wiring diagram of starting solenoids. The one on the right is specially connected to carry out the operation.

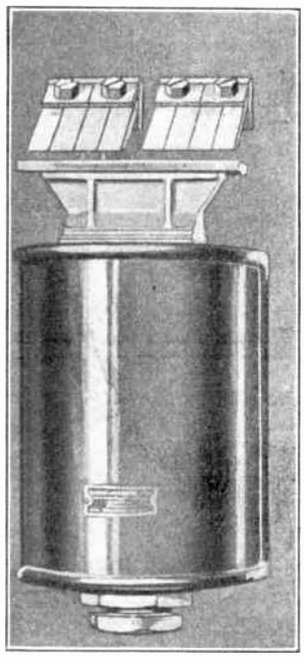


Fig. 8. The complete solenoid in its case with its contacts to operate in starting a motor.

The motor still continues to gain speed and the current in motor decreases until a value is reached, depending upon the adjustment of the plunger in magnet (3), when the last plunger is lifted and the contact plate (CP_3) short circuits the brushes (B_3), thereby short circuiting the last of the starting resistances (R_3). Thus all of the starting resistance has been automatically eliminated and the motor is now getting full line voltage.

It will be noted that since the last resistance is cut out there is no current flowing through any of the magnet coils (C), and both plungers (P_1) and (P_2) of the first two magnets are released. In order to prevent this last plunger from dropping when the current in its coil (C_3) is eliminated, a small shunt holding coil (SHC) is included which, although not powerful enough to lift the plunger itself, is sufficiently powerful to hold the plunger up once it has been lifted by the series coil (C_3). This shunt holding coil is therefore used on the last step of all these starters.

The number of magnets used in starting a motor depends upon the size of the motor. Thus a very small motor of one-quarter horsepower may require only one coil, since it can be started in one step. Larger motors require more steps, some of them requiring 5 or 6.

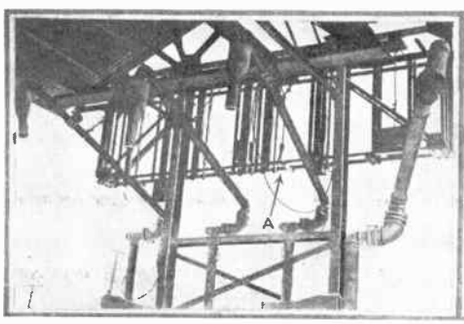
Static Discharge Plug for Gasoline Tanks

AUTOMOBILISTS or those connected with gasoline supply stations, have observed that sparks indicating a discharge of static electricity sometimes occur when gasoline is being poured into an automobile tank.

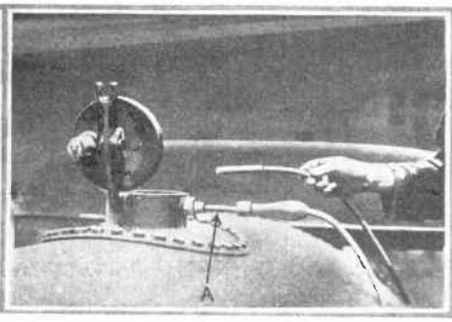
Numerous conflagrations have occurred which have been attributed to static electricity.

A general principle is that before introducing oil into the tank, whose friction might generate a sparking potential, a

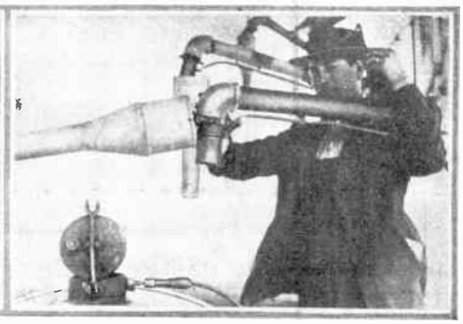
This grounding prevents sparks, and the tank can now be filled in safety. If the ground connection is merely a temporarily extemporized one, as where a truck is drawn up alongside the road to be filled, a chain may be used to give the ground.



Filling-pipes showing the ground connection. The arrow (A) points at the wire connected to the grounded metal.



The discharging plug in position on the top of an oil tank, inserted in the side of the filling neck, showing the cap wide open.



The operator is preparing to fill the tank which has been protected by the insertion of the anti-static plug. It will be noted the cap is wide open.

It will be evident that an automobile on insulating rubber tires, might become charged, Leyden-jar fashion with static electricity, and when sparks occur in the presence of air and gasoline vapor there is great probability of explosion and conflagration.

In the case of storage tanks, pumping stations, and trucks, the fact is recognized that there is a distinct danger of fire.

plug is inserted into the side of the filling nozzle, which plug is made of metal, and by a heavy wire or chain, connects with the ground. It will be observed in the central and right hand pictures, where the arrow (A) points at the plug, which has a handle for the operator, and it will be noted that the cover of the filling neck is open. Insertion of the plug opens the cap automatically.

Where this apparatus is used on a truck or automobile, the occupants can feel that if they are riding upon an insulated Leyden jar, at all events it is not a charged one.

In this connection it will be noted that the dragging of an iron chain upon the ground behind an automobile has been suggested as a means of keeping it safely discharged.

The Three-Brush Automobile Generator

By H. Highstone

IT has been the writer's experience, that to the ordinary car owner, and a majority of garage men, the theory and operation of the three-brush automobile generator is clothed in deep and impenetrable mystery.

In reality, the manner of operation of the third-brush controlled generator is quite as simple as the proverbial A B C, to anyone with a fair knowledge of electricity and electro-magnetism, as it is hoped the following discourse will show:

It goes without saying, of course, that an ordinary generator is entirely unsuitable for supplying the electrical system of an automobile with current; this is because the voltage and consequent supply of current would continually fluctuate over a wide range, according to the varied speeds of the engine.

The three-brush generator entirely overcomes this defect, supplying the battery, lamps, and other apparatus with a steady current at all speeds of its armature. As the name implies, three brushes are used, two being placed in the usual position of neutral field, and a third, generally movable, located between them, its position being determined by the amount of current desired.

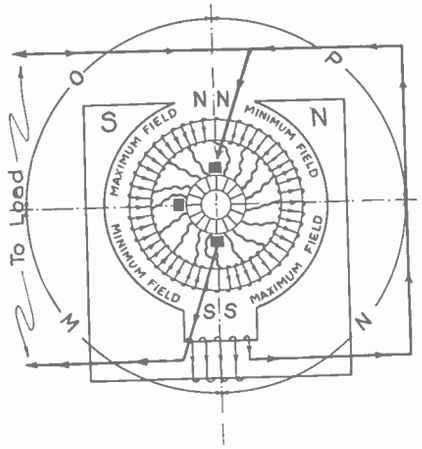


Diagram of a two pole generator with three brushes, but with the third one disconnected; showing the relations of the different parts of the field.

Before entering upon the explanation of its action let us go over a certain phase of operation of direct current generators not generally taken up in textbooks or schools. Above is shown an ordinary direct current generator, of the two-pole variety, and the direction of flow through its windings, considering it to be rotating in a clock-wise direction. A ring wound armature is shown for convenience, the action being identical on the ordinary drum wound kind, and is divided into the four 90 degree sectors, (M, N, O, P), to clarify the description.

Suppose the armature to be revolving at a certain speed, and supplying current to some device. Applying the "Rule of the Right Hand" to the direction of current flow in the armature, it can be seen that two south poles are formed on the armature in the sectors (M) and (N), and two north poles in the sectors (O) and (P), as diagrammed.

The opposition of the south pole on the armature coils in sector (M) and the south pole of the main field magnetism causes a weakening of the flux in this portion, while a strengthening action occurs in sector (O) due to the cumulative, or helping action of the north pole on the armature with the south field pole. On the opposite side the action is similar, except that the portion where the maximum density of magnetism occurs is in sector (N) and the point of minimum density is in sector (P). It appears, then, that instead of flowing directly across the armature from field pole to field pole, the magnetism runs diagonally from sector (O) to sector (N). The effect, however, is of a field of uniform strength, as the decrease of magnetism in sectors (M) and (P) is balanced by the increase in sectors (O) and (N).

Now let us examine the next drawing—a conventional diagram of a three-brush generator is shown. As can be seen, all the current supplied to the field windings is taken from the coils in the portion designated as sector (M), or where the magnetic field is weakest. Suppose now the armature to be revolving at a certain constant speed, supplying current to the battery, lights, etc., of the car.

If the speed is increased, as it will be if the engine is accelerated, the voltage and current supplied naturally tend to increase also. The increased current through the coils will cause the south pole on the armature in sector (M) to increase in strength, thereby increasing its opposition with the south field pole of the machine, and lessening the amount of magnetism cut by the armature coils at this point.

The voltage of the armature coils, which supply the field windings with current, will drop, and also the current, causing a decrease in the main magnetism across the entire armature. The subsequent drop of voltage across the main brushes will, in a properly designed machine, cause the current supplied to the apparatus to return to its original value. In an ordinary generator, the decrease in field density at this point is compensated for by the increased strength of field in sector (O), thus allowing a rise in voltage, but this machine cannot take advantage of such balancing effect, due to the fact that the field windings are not connected across the main brushes.

The higher the speed, which the armature attains, the greater becomes the current which attempts to flow through it, and the greater becomes the "bucking" action in sector (M), causing the current through the field coils to drop lower and lower, decreasing the field magnetism to compensate for the increased speed of the armature.

It is necessary, of course, that an abnormal current shall flow through the system for the regulating action to take place, but this excess current is so small, and flows for such a brief instant of time, that it is not to be taken into account.

When the speed of the armature drops below what might be termed normal, as it does when the engine is idling, the voltage across the main brushes would tend to drop, and likewise the current. The drop of current in the armature causes the south pole on the armature in sector (M) to weaken, the bucking effect between it and the south field pole of the machine is lessened, causing a strengthening of the main field magnetism at this point. This would cause the coils supplying the field windings with current to move across more magnetic lines of force per second, the voltage and current supplied to the field is increased, and thereby the main magnetic field. The increase in density of the main magnetic field causes an increase in voltage across the main brushes, bringing the current supplied to the apparatus of the car back to normal.

The reason why the moving of the third brush will increase or decrease the current supplied, is due to the fact that less coils supplying the field windings are in action as the third brush is moved nearer the bottom main brush, and so less current is sent through the field windings at a given speed. Therefore, a lesser current flow through the armature is required to cause a balance in the "bucking" fields in sector (M) for a given speed, than when the brush is higher up. The exact reverse is true when the brush is moved nearer the top main brush. It is by this means that the current supplied to the battery for charging is regulated.

The three-brush generator is one of the most freakish machines in the electrical world, and will run contrary to almost every conclusion, which might be made by an observer unacquainted with its vagaries. For instance, if a resistance develops in the battery circuit of the car, which is in parallel with the lamp and other circuits, the headlights will increase in brilliancy, and may even burn out, if the resistance is of sufficient value. This is caused by the generator increasing its main voltage in an attempt to bring back the current to normal, from which it has fallen due to the resistance in the battery circuit. In order that the reader may not be here confused, I will repeat that this device controls the current only, not the voltage. This may seem still more confusing, and in direct defiance of Ohm's law, but a review of the last few lines and a little reflection may make the matter clear.

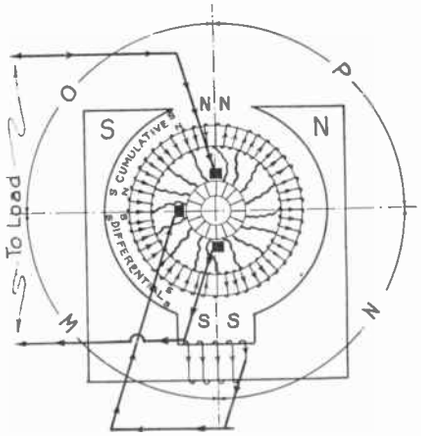


Diagram showing the operation of a two pole generator with the third brush connected; the two diagrams illustrate the reactions of this type of machine.

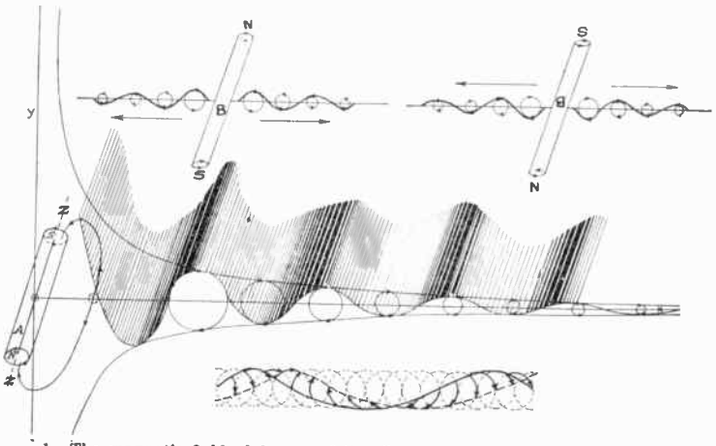
If all the load is suddenly disconnected from one of these machines, the voltage will rise to an incredible height, sometimes four or five hundred volts, and will almost instantly ruin the windings. This is caused by the opposition of the two south poles in sector (M) becoming practically zero, as only the current consumed by the field is flowing through the armature, and this is far from normal. There will ensue a stern chase of the current in the armature attempting to generate enough magnetism to stop the rise of field current, but naturally without success, as the greater the flow of current through the armature becomes, just so does the current through the field increase, and likewise the main magnetism, which in turn causes an increase of current in the armature—and so on, round and round in a vicious circle ending only when the machine goes up in smoke. It is for this reason that some manufacturers place a fuse in the field circuit to protect the generator should the main circuit be suddenly opened. It is well to remember this fact when searching for trouble in a generator which has suddenly "gone dead."

New Theory of Magnetism

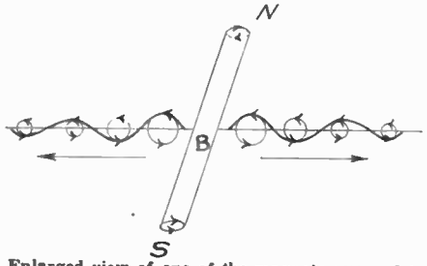
By T. J. J. See, Ph. D.
Professor of Mathematics, U. S. Navy.

IT is scarcely necessary to point out to the readers of PRACTICAL ELECTRICS that although we have had many notable treatises on magnetism since the first great work published in the year 1600 by Dr. Gilbert, of Colchester, physician to Queen Elizabeth, yet in all these modern treatises not a single explanation worthy of the name has been offered on the *cause* of magnetism! The result is a great need for a working theory of magnetism which will enable us to see what is going on in the field about a magnet.

The theory herein set forth was developed by the writer in 1916, and first published in a work entitled *Electrodynamic Wave-Theory of Physical Forces*, Vol. I, 170 pages, Boston, London and Paris, 1917; but has recently been extended in a series of papers on the *New Theory of Æther* just appearing in the *Astronomische Nachrichten*, the international journal of astronomy at Kiel, which is now in its hundredth year and 212th volume. As the *New Theory of the Æther* is a very extensive work of highly mathematical character, we are obliged to restrict the discussion to very simple outlines which will convey clear ideas to our minds.



1. The magnetic field of force and its effect upon, and the reaction between it and magnets adjacent to it. Decreased attraction in the left hand magnet, and increased attraction in the right hand one.



Enlarged view of one of the magnets assumed to be in the field of force, shown in the upper illustration immediately above the field.

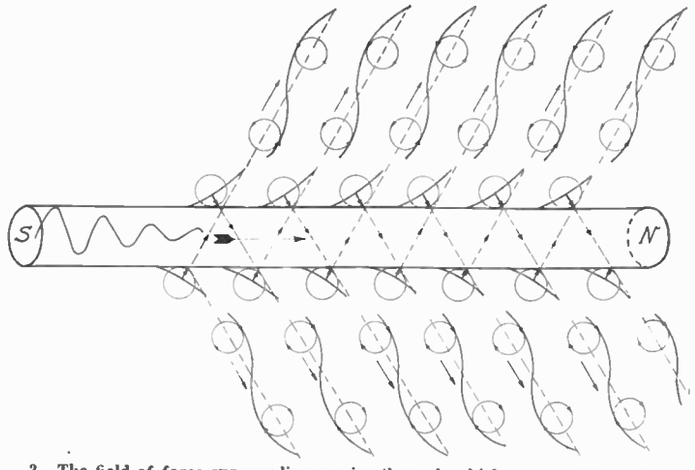
For a long time it has been known that all matter sends out a peculiar influence or *flux of energy*, which acts on other bodies; and ever since the publication of Sir Isaac Newton's *Principia*, 1687, it has been shown that all actions are mutual. Thus any influence exerted by one body on another will be based on the interactions of the two bodies, through the Etherial Medium enveloping both masses.

About 1850 it was discovered by the celebrated English electrician, Faraday, that all bodies are magnetic, but in varying degrees. Iron, steel and nickel are typical metals with strongly magnetic properties, and as far back as 1822 the celebrated French physicist, Ampère, explained magnetism by elementary electric currents circulating about the atoms. In the year 1917 the writer was able to show that this Ampère theory is identical with the modern wave-theory, in which the atoms are supposed to be vibrating and incessantly sending out waves through the surrounding aether.

When agitated violently the atoms are heated up and made to emit waves of heat and light. Accordingly, why may not these short waves correspond to parts of the longer waves of magnetism and of gravitation? Such was the question which has at length led to the very remarkable new theory of the ether, with simple and direct explanation of magnetism and electrodynamic action.

In the accompanying figure 1 we have outlined the body of a simple bar magnet, and also traced in detail the type of waves supposed to recede away from the magnet in the equatorial plane. It will be remembered that although the great mathematical physicist J. Clerk Maxwell was able to show that certain stresses are at work in the ether about a magnet, by which the lines of force tend to shorten themselves, he was unable to conceive of any physical cause for the action. Maxwell had not thought of waves of the type here imagined.

It is easily shown (cf. *Astron. Nachr.*, No. 5044, p. 54, May, 1920) that the *amplitude* of the waves follows the law here indicated,



2. The field of force surrounding a wire through which a current is passing, giving in diagram the effect upon the ether.

$$A = \frac{k}{r} \qquad (1)$$

or varies inversely as the distance.

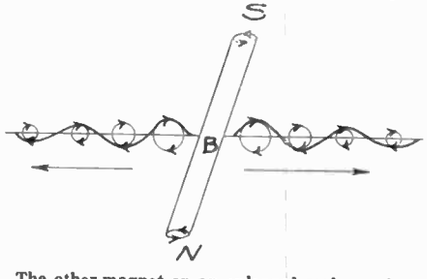
And it is proved in works on physics that the energy of the waves *is proportional to the square of the amplitude*, and thus the force they exert becomes simply:

$$f = A^2 = \frac{k^2}{r^2} \qquad (2)$$

This is the formula for gravitation, magnetism and similar forces which follow the law of the inverse squares.

Now it is very remarkable that the chief forces in nature vary inversely as the square of the distance. From this fact we know that if waves be the cause of the forces, the waves have to have amplitudes varying inversely as the distance, as shown in equation 1 above.

To deduce the law of the wave amplitude (1) in tridimensional space we proceed as follows: The displacement of any particle of a medium due to wave motion, of a given wave length, is independent of the periodic time; and since the oscillatory orbits of the particles are described in equal times, under continuous flow of the waves, these orbits will be proportional to the displacements or other homologous lines pertaining to the periodic paths of the particles. Let the velocities of the moving particles be v, and m their mass; then their kinetic energies will be represented by 1/2 mv². In the spherical expansion of the ether waves there will be no loss of energy in free space; hence on two successive sphere surfaces of thickness dr, the energies are equal, so that we have:



The other magnet on an enlarged scale, as shown to the right in the upper illustration.

$$4\pi r^2 . \tfrac{1}{2} m r^2 = 4\pi r'^2 . \tfrac{1}{2} m v''^2 \qquad (3)$$

or

$$v^2 : v'^2 = r'^2 : r^2 \qquad (4)$$

The kinetic energy of the vibrating molecules varies inversely as the square of the distance. But the velocity varies also as the amplitude, in simple harmonic motion; therefore, for the amplitudes A′ and A″, corresponding to the radii r′ and r″, we have by taking the square root in equation (4)

$$A' : A'' = r'' : r' \qquad (5)$$

$$A'' = \frac{A' r'}{r''} = \frac{k''}{r''} \qquad (6)$$

Accordingly the amplitude or side displacement becomes

$$A = \frac{k}{r} \qquad 7)$$

as shown in the accompanying figure 1.

To understand the mechanism of magnetism, imagine waves receding away from the larger magnet, as shown in the diagram, and let the smaller magnet (B) present opposite poles. This corresponds to the case of attraction. The waves from the small magnet (B) rotate in the opposite sense to those from the large magnet (A); and when the two sets of waves in-

terpenetrate, they undo one another as far as possible at every point of the wave-field.

Thus the larger waves tend to collapse when the smaller waves run through them; and this collapse or contraction gives rise to pulling. Such a *contraction* of the ether between the bodies is what we call *attraction.* The action when the aether contracts is like that of a stretched mass of India rubber—it pulls the bodies together, by forces depending on the two magnets, their size and power, or degree of perfection of magnetization.

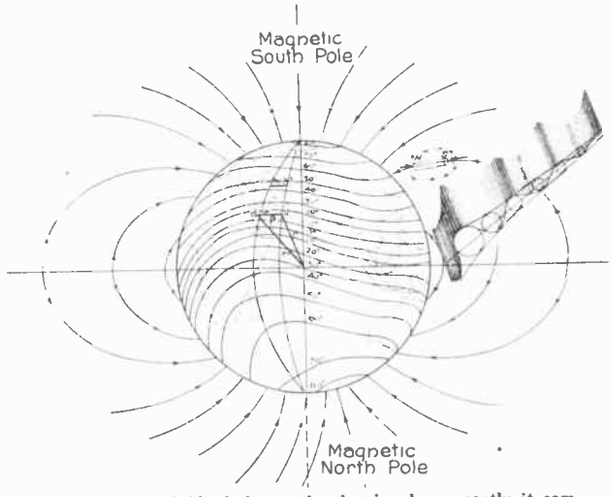
It is shown in the Wave-Theory (A. N. 5044, p. 55) that the light travels 904,000 times faster than sound, from which it follows that the aether is 689,321,600,000 times more elastic than air in proportion to its density. This number is enormous, and as the waves travel in free space with the velocity of light, and accumulate power by mere superposition, in proportion to the mass, or the number of atoms from which the waves proceed, we perceive that the action will depend directly on the mass, as in Newton's law of gravitation. Moreover, the intensity of the force will vary inversely as the square of the distance. This gives, therefore, a perfect explanation of the attraction of magnets which present opposite poles.

Let us now consider the cause of *repulsion,* when like poles are presented, which is exhibited in the second case on the right, in the same diagram. In this second case the waves from (B) rotate in the same sense as those from the larger magnet (A). When such waves interpenetrate, with the superposed rotations at every point in the same direction, one set of waves adds to the amplitudes of the other set; and the result is increased agitation of the æther, which thus tends to *expand* this medium between the two bodies. This expansive tendency of the æther thus gives rise to *repulsion,* and the magnets tend to push one another away. Thus we have a simple explanation of repulsion when like poles are presented.

Accordingly, we have a simple explanation of both attraction and repulsion, which no one has been able to devise heretofore. An explanation based on waves which is simple and direct has so much to commend it that we may pronounce it the true cause of the phenomenon. It thus appears as if we have at last discovered the cause of magnetism, and finally of electrodynamic action and universal gravitation.

An experiment by Dolbear (*Matter, Ether and Motion,* Boston, 1894, p. 95) throws great light on the tendency of Faraday's lines of force to shorten themselves.

"If a dozen disks five or six inches in diameter are set loosely an inch apart upon a spindle a foot long, so that they may be rotated fast, yet left free to move longitudinally upon the spindle, they will all crowd up close together as the pressure is less between them than outside. If one can imagine the spindle to be flexible and the ends brought opposite each other while rotating, it will be seen that the ends would exhibit an apparent attraction for each other, and, if free to approach, would close up, thus making a vortex ring, with the sections of the disks. If the axis of the disks were shrinkable, the whole thing would contract to a minimum size that would be determined by the rapidity of the rotary movement, in which case not only would it be plain why the ring form was maintained, but why the diameter of the ring as a whole should shrink. So long as it is rotated it would keep up a stress in the air about it. So far as the experimental evidence goes, it appears that a vortex ring in the air exhibits the phenomenon in question."



3. Magnetic field of the earth, showing how exactly it compares with the ether waves already illustrated and described

Now, according to the wave-theory, every line of force about a magnet is an axis of a rotating filament or ether vortex, and thus the lines of force tend to shorten themselves, as in Dolbear's experiment. The lines of force in the form of circles surround a wire bearing a current, which means that the wave rotations are flat in the planes passing through the axis of the wire. This arrangement is shown in figure 2. And as the magnet also sends out waves flat in the equatorial plane, at right angles to the magnetic axis, we see why a magnetic needle sets itself at right angles to the axis of the wire bearing the current, as first noticed by Oersted in 1819.

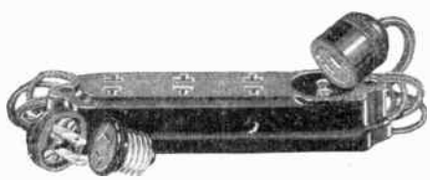
If we examine figure 2 we notice that the rotations in the waves above are opposite to the ones below. Hence, when two currents flow in the same direction the collapse of the ether waves between the wires causes the wires to attract, which conforms to observation. When the currents flow in opposite direction the rotations of the waves between the wires are in the same direction, and by the increase of amplitude thus arising, the ether expands itself, so that the wires repel, in accordance with observation.

Accordingly, waves are the cause of electrodynamic action. It only remains to add figure 3, to illustrate the wave field of the earth's magnetism. It should be noted, as shown by Gauss, 1838, that the waves receding from the earth depend on 1/1380th part of the atoms of our globe. These atoms are lined up in parallel planes—the other 1379/1380ths being arranged with their planes lying haphazard, and producing the central action of gravitation.

With the rotations of their waves directed so as to harmonize mutually, the compass needle lies in the hollow of the receding earth waves, and thus pointing steadily to the Pole, guides the mariner safely over the trackless sea. This gives a very direct and simple explanation of the earth's magnetic field. The wave field about the globe is so very beautiful to behold that we cannot but regret it was not made known to us long ago. But who will show it to us?

Triplex Table-Tap

"TRIPLEX TABLE-TAP" is the name given to a new electrical appliance. The manufacturer claims that with this device any householder can wire his own furniture in a few minutes. It consists of a block of strong, black, fireproof composition, and carries three beveled tee-slot outlets arranged multiple, as well as a blade connection for the motor plug.



Triple connection-block for use upon a table, so that by placing such block upon the table or fastening it to any part thereof, connections are supplied for three different articles.

This latest idea may be fastened to the under side of a table top, or upon a wall surface, by means of two screws through countersunk holes at the ends. The device is sold, completely wired, with eight feet of silk covered cord, a motor plug, and a separable attachment plug which fits any lamp socket or convenience outlet.

This Triplex Table-Tap is backed with green baize and may also be used as a portable outlet, on tea wagons, side-boards and serving tables; or on the work bench, around the car, or wherever a convenient tee-slot electrical connection might be required.

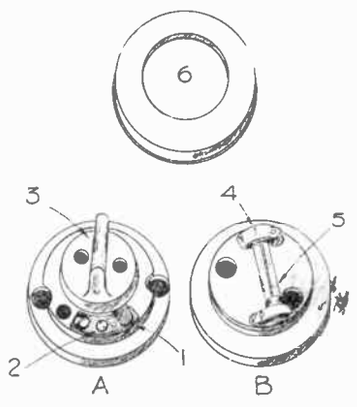
Economical Fuse Cutout

By Docteur E. DeBatz, Bordeaux, France

TAKE an old discarded switch (A). Remove the shaft and the contact spring. With strong scissors cut two strips of thin sheet brass and bend these with pliers as shown.

Insert these curved springs between the porcelain base and brass contact, and finally an automobile fuse is sprung in between the two springs. These automobile fuses were picked up from the United States War Department surplus for one franc the parcel of ten.

(A) is the old switch; (B) is the fuse when finished; (C) is the porcelain cover.



Utilizing a discarded switch for making a plug fuse—an interesting contribution from our distinguished French contributor.

Awards in the $50 Special Prize Contest
For Junior Electricians and Electrical Experimenters

First Prize, $25	Second Prize, $15	Third Prize, $10	Hon. Mention	Hon. Mention
Mr. Harold Jackson, R. No. 4, Box 141, Kankakee, Ill.	Mr. Amedeo Giolitto, 836 Illinois Avenue, Rockford, Ill.	Mr. Harry Cole, Box 285, Evanston, Wyo.	Mr. J. Leo Vanderheyden Buckingham, Iowa	Mr. Leo J. Coley, General Del., Glen Falls, N. Y.

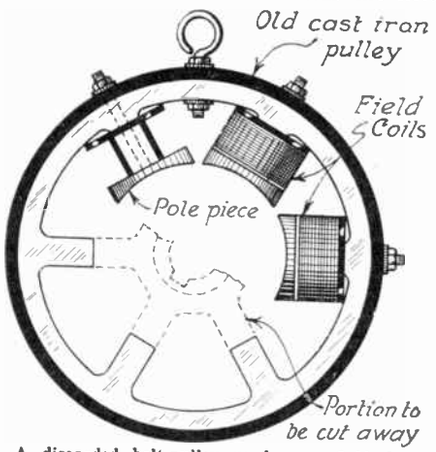
First Prize
Dynamo Field Made from Pulley

By Harold Jackson

A VERY satisfactory field for a small experimental dynamo or motor can be made of an old cast iron pulley, which may be about 12 inches in diameter with a face of about 4 inches.

The hub and inner end of the spokes are cut away, as shown by the dotted lines in the sketch. This is accomplished by sawing off the spokes with a hack saw, the exact length of the remaining portion of the spoke being determined by the size of the armature to be used.

Drill a ⅜-inch hole through the rim and down lengthwise through each spoke to receive the bolt which holds the field



A discarded belt-pulley used as a field for a multi-polar dynamo or motor. Each spoke is the core for one of the poles and carries its own pole piece.

coil and pole piece in place. This arrangement is clearly shown in the sketch. The pole pieces are small castings about three inches square, the inner surface of which is curved to conform with the cylindrical surface of the armature. The field coils are form-wound, and properly placed upon the cores to produce alternate north and south poles. This makes a very rigid and satisfactory field.

Second Prize
Double Action Vibrator

By Amedeo Giolitto

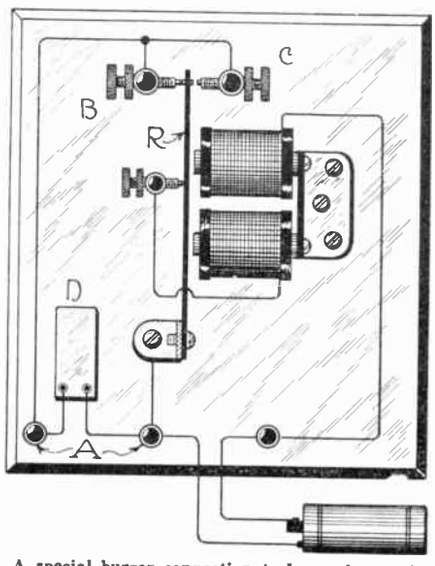
WITH this vibrator it is possible to interrupt the primary circuit of a spark coil with twice the frequency as is possible with the ordinary vibrator. As the voltage developed in the secondary of a spark coil depends a great deal on the speed at which the primary current is interrupted, this vibrator would greatly increase the secondary voltage. It consists of a pair of electromagnets mounted on a base and arranged to vibrate the steel reed (R). This reed, as it moves towards the magnets, breaks contact with (B) and makes contact with (C) and then in moving back to its normal position breaks contact with (C) and makes contact with (B).

Binding posts (A) are connected in series with the primary of the spark coil and some batteries. The dry cell connected as shown in the diagram supplies the current consumed by the magnets.

Now it can be easily seen that for every back-and-forth movement of the steel reed the primary circuit of the spark coil would be made and broken twice, whereas it would only be made and broken once with the ordinary vibrator. The double action vibrator has the disadvantage of requiring an extra dry cell, but the results obtained are worth while.

Sparking at the contacts (B) and (C) is prevented by connecting a one microfarad condenser (D) across the binding posts (A).

If this vibrator is to be used in connection with a spark coil which already has a vibrator, then the vibrator on the spark coil would have to be blocked so that it will not interfere with the action of this one.



A special buzzer connection to be used to make and break an induction coil primary, so as to give double the frequency that would be attained by the regular connection.

$50 IN PRIZES

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

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

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

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

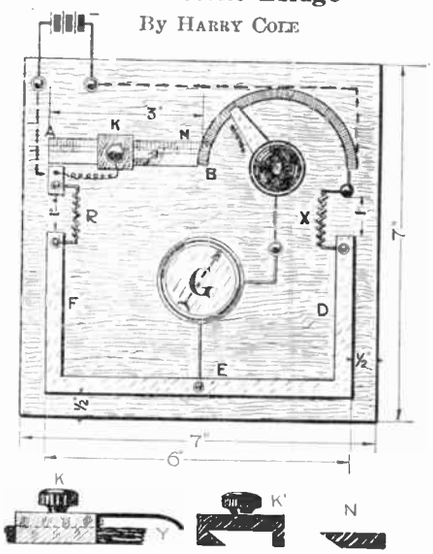
If in any way possible, a clear photograph should be sent with the idea; but if that is not possible, a good sketch will do.

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

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

Third Prize
Wheatstone Bridge

By Harry Cole



A Wheatstone bridge, which with two elements for changing resistance on one of the arms, gives exceedingly accurate results.

THE base of the bridge may be made of a piece of wood seven inches square. The rheostat, a long helical coil bent in the arc of a circle, may be wound on a metal rod which has been well insulated. German silver wire about No. 22 B. and S. gauge is used for the rheostat. The length of each turn should be measured and marked around the circumference of the rheostat.

A piece of wood taken from a yard stick or rule is cut off about three inches long and marked in sixteenths of an inch. One side is cut at an angle as shown at (N) below the large diagram, so that the key (K) will not come off easily.

A piece of resistance wire (A, B) is stretched over the piece of wood. The wire is of the same gauge as that used on the rheostat. The end (B) is connected to one end of the rheostat and the end (A) is left free.

The wooden part of the key is about three-quarters of an inch long and as wide as the rule (N). A piece of brass is used at the contact (Y, N); they key so as to make contact with (A, B). A piece of copper wire coiled as a spring is connected from the key to the binding post just below (A).

(D, E and F) are pieces of sheet copper about a quarter of an inch wide.

The galvanometer may be any sensitive one.

To use the Wheatstone bridge, a known resistance is connected at (R) and the unknown at (x). Then the key (K) and the rheostat are varied until there is no deflection. Then the length of wire from key to index and from index to (C C) form a proportion as follows:

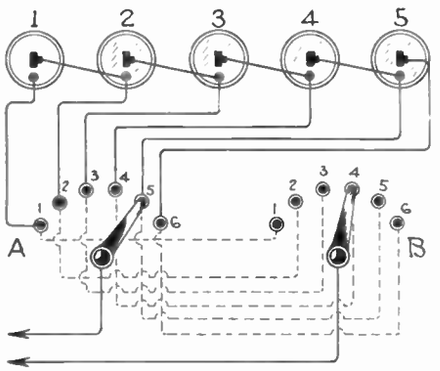
$$KI : IX :: R : CC.$$

If (R) is two ohms and (K. I) six inches and (I X) fifteen inches, $2 : x :: 6 : 15$ or $\frac{2}{x} = \frac{6}{15}$ and (x) would equal five ohms.

Honorable Mention

Dry Cell Potential Changer

By J. Leo Vanderheyden



A potential changer, using five dry cells and making a most convenient connection employing such cells for general laboratory purposes.

IN some of my experiments with solenoids and coils I was only able to secure variable voltage after connecting five dry cells with two 6-point switches, as shown in the illustration. I soon discovered several other advantages in this plan. First, I am able to secure the voltage of any one cell of the five, any two cells of the five, and so on; almost any combination I could want, providing the cells wanted stand side by side.

Another advantage is that it is possible to reverse the flow of current coming from any cell or any combination of cells.

The following is a table for the proper use of the 6-point switches. The first column of figures denotes the cell or cells wanted. The second and third columns refer to the contact points on the switches (A) and (B):

Travel of current: Switches—	Ordinary A	Ordinary B	Reverse A	Reverse B
Cell 1	1	2	2	1
" 2	2	3	3	2
" 3	3	4	4	3
" 4	4	5	5	4
" 5	5	6	6	5
" 1, 2	1	3	3	1
" 1, 2, 3	1	4	4	1
" 1, 2, 3, 4	1	5	5	1
" 1, 2, 3, 4, 5	1	6	6	1
" 2, 3	2	4	4	2
" 3, 4	3	5	5	3
" 4, 5	4	6	6	4
" 2, 3, 4	2	5	5	2
" 3, 4, 5	3	6	6	3

Honorable Mention

Domestic Water Heater

By Leo J. Coley

THE following described appliance gives hot water at a moment's notice and costs very little to make up. The materials required are:

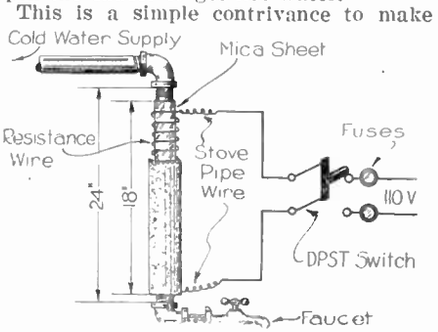
A piece of ¾-inch iron pipe, 24 inches long, threaded at both ends. Several sheets of mica, such as is used for stove doors. One spiral coil of resistance wire, such as is used for the heating element of an electric stove. Some asbestos powder mixed with plaster of Paris, and some asbestos sheeting.

Cover the pipe with sheet mica for a distance of 18 inches. Bind the ends with stovepipe wire. Over this wind resistance wire, which should have previously been straightened out. The turns are spaced one-eighth inch apart.

Over the completed winding spread a paste made of the mixture of asbestos powder and plaster of Paris with water. After being allowed to dry, the whole thing is wrapped with thin asbestos sheeting.

The finished pipe is installed before the faucet, and wires are run from the ends of the windings to a double pole fused switch. After connecting the switch to the lighting circuit, close the switch and open the faucet to get hot water.

This is a simple contrivance to make and can easily be adapted for a bath or wash basin if required.



Simply constructed appliance for heating water as it is drawn from the faucet.

Our $50 Title Prize Contest

THE editorial staff is pleased to disclose the results of the Title Prize Contest, announced in our issue of March, 1923.

If this contest is to be judged solely by the number of replies that were received, it may properly be considered a "howling success." If it is to be judged by the merit of some of the entries, we would feel justified in stating that it was disappointing. No great amount of ingenuity was evinced in many of the titles submitted, and the judges were hard pressed to award the prizes as shown.

Most of the suggestions were somewhat irrelevant, and not 5 per cent of the entire number were descriptive, which, under the rules of the contest, was one of the deciding factors. Here are a few examples of the "brilliant" outbursts:

"Studying His Job."
"Let the Ball (Bawl) Wait."
"When Tears Avail Not."
"Cause for Delay."
"Parting Ways."
"Broken Promises."
"The Inventor's Wife."
"Business Before Pleasure."
"Impractical Electrics."
"Practical Electrics." (About 2,000 of these.)
"Tears Versus Electricity."
"Separated by Electricity."
"The Power of Electricity."
"An Electrical Shock."
"The Radio Widow." (Several thousand of these, although it is difficult to say where Radio entered into this cover at all, there being no such intimation.

In awarding the prizes, the judges have chosen the titles not only descriptive but with some measure of cleverness as well. The prize winning titles follow:

FIRST PRIZE, $25

"An Electrical Interrupter"

Fred D. Vercellino,
239 3rd St., East, Dickinson, N. D.

SECOND PRIZE, $15

"Practical Neglectrics"

Allen Burke,
106 County St., Monett, Mo.

THIRD PRIZE, $5

"A Loose Connection"

B. Halpern,
80 Corona Ave., Elmhurst, L. I., N. Y.
also Roy S. Jones, Bethel, Me.

FOURTH PRIZE, $3

"A Non-Conduct-Her"

Jack Bowen,
1239 20th St., Detroit, Mich.
also Roy S. Jones, Bethel, Me.

FIFTH PRIZE, $2

"The Experimental Widow"

Charles T. Sage,
18 East Main St., Gowanda, N. Y.

HONORABLE MENTIONS

"A Loose-Coupler"

B. Halpern,
80 Corona Ave., Elmhurst, L. I., N. Y.

"Shocking Revolt, Eh Watt?"

William R. Westwood,
45 Union Terrace, Jamaica Plain 30, Mass.

"Technical Grounds for Desertion"

Molly Jacobs,
31 West 110th St., New York City.

"Electrical Interference

Beatrice Weathers,
102 North 15th St., Frederick, Okla.

"The Crucible Test"

W. L. Dysart,
Box 1515, Harlowton, Montana.

"His Bitter Half"

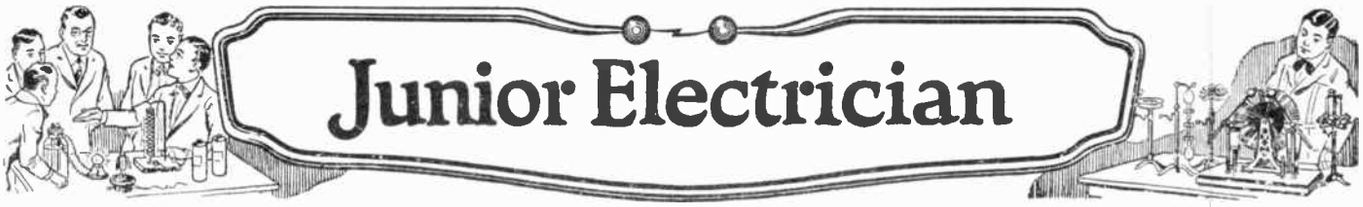
R. L. Sanders,
1839 Logan Ave., Des Moines, Iowa.

"A Hubby With a Hobby"

E. D. Hooey,
1306 West 58th St., Los Angeles, Calif.

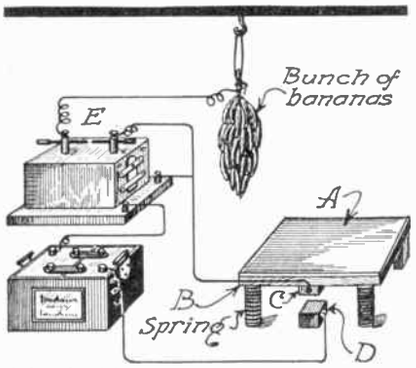
In clever as in prize winning answers, the East was in the minority.

All in all, the contest, we believe, was very satisfactory, and the results have been so encouraging that we shall stage another one in a coming issue.



Thief Catcher

IN our December issue we showed a boy who received a shock when he pulled



A bunch of bananas in this illustration is made a terminal of the secondary of an induction coil, so as to shock any enterprising youth who attempts to steal one of the fruit.

or tried to pull a door-bell surreptitiously. The present illustration shows a similar system of preventing the theft of bananas by the younger element.

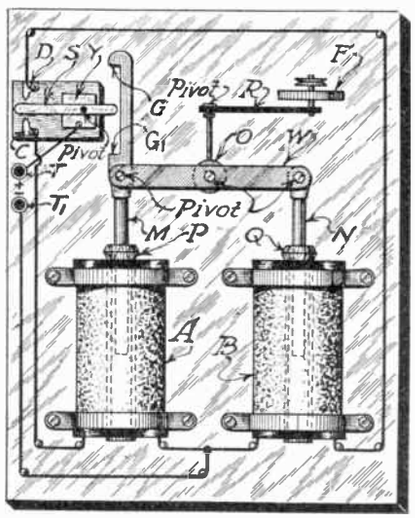
A board (A) has one end supported by springs, so that when depressed by the weight of anyone stepping on it, it closes an electric contact as shown. This board is covered with a metal sheet, which is connected also to the metal contact block (C). A round-headed brass screw will answer for the contact (D); when the board is stepped upon the circuit will be closed at (C D), the battery will operate the spark coil as shown, which is provided with a spark gap at (E), and which need not be much more than one-sixteenth inch long.

One of the secondary wires is carried to the bunch of bananas, and may be thrust through one or more of the fruit, or deep down into the stems. The pilferer is supposed to receive a warning shock, when he steps upon the board and tries to make off with a banana.

Contributed by PAUL STUCK.

Double Solenoid Engine

TWO solenoids (A) and (B), are wound upon two ordinary three-inch porcelain tubes (P Q), using 150 feet of wire.



Very nicely designed electric motor of the reciprocating order, using two solenoids; it represents in a sense a two-cylinder reciprocating steam engine.

Four flanges are made from stout cardboard and secured with sealing wax to the ends of the tubes, as shown by the dotted lines in the diagram. Then the wire, which may be ordinary bell-circuit or magnet wire, is wound on, 75 feet to each tube, and the coils are covered with paper or other material in order to improve the appearance.

Two armatures (M and N), composed of two 16-penny wire nails with tin strips soldered to their upper ends as shown, are constructed and fastened by pins to the oscillating cross-beam (W), which is mounted on a wooden pillar rising from the base.

The automatic switch is made in the following manner: A strip of stout brass (S), about 2 inches long and ⅜ inch wide, is pivoted on a wooden block about 1½ by 2½ inches in surface dimension. The pivot passes through a sheet of brass (Y), to which one of the wires is soldered.

The contacts (C) and (D) are thin pieces of brass fastened to the wood block by screws and set far enough apart so that the switch will not short-circuit them.

The wiring is arranged as shown in the illustration. When a battery is connected to the terminals (T) and (T'), and the switch (S) touches (D), the current flows through the right-hand solenoid; the armature (N) is drawn down, causing the cam-notch (G¹) to strike the switch (S), and set it on (C), which changes the flow of current to the left-hand solenoid; the armature (M) is drawn down, which causes the cam-notch (G) to strike the switch, setting it again on (D). Thus, the lever (S), fastened to the cross-beam (W), alternates back and forth with great speed, turning the flywheel (F) by means of the connecting rod (R). The flywheel can be taken from an old toy steam engine, and an 8-penny nail can be used for the connecting rod (S).

The signs + and — are used at the terminals (T) and (T') for simplicity in explaining.

Contributed by E. H. STIVENDER.

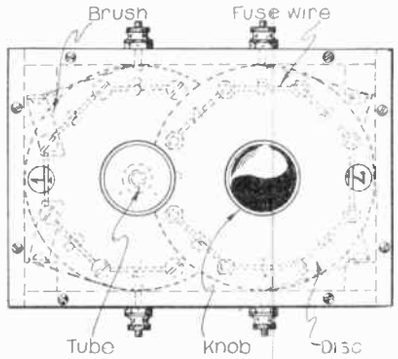
Multiple Fuse

IN cases where fuses are likely to blow out frequently the multiple fuse here described will be found most convenient. The simple turning of a knob brings another fuse into circuit, until a set of eight fuses have been burned out; the necessity of inserting a new fuse each time one is blown is thus obviated.

A multiple fuse can be made by anyone and will prove economical both as to time and expense. Any size fuse wire can be utilized and is easily renewed.

The box is 6 inches by 4 inches by 1½ inches, inside measure. It may be constructed of almost any kind of wood, is about ¼ inch thick and any desired finish may be applied.

Two disks 3½ inches in diameter are made of some kind of insulating and virtually fireproof material, such as slate, formica, etc. A circle 3 inches in diameter is scribed upon each disk, and 8 ⅛-inch holes are drilled equidistant around each circle. A ¼-inch hole is drilled in the centers of the disks. A brass bolt ½ inch long is placed in the holes on the circles and a thin brass nut is screwed on each. The fuse wire is wound around the circle, touching all the bolts just above the nut. A second nut taken from an old dry cell is screwed down against the wire. If desired, contact points may be used in place of these.



Multiple fuse system by which turning a handle or knob brings a new fuse into circuit when an old one blows out, saving a great deal of trouble in replacements.

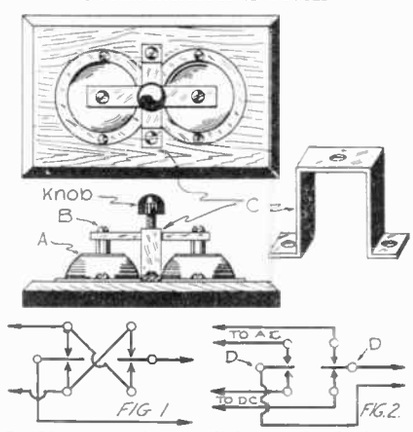
Two ¼-inch brass shafts with a small wooden knob on one end of each come next. One is ¾ inch in length and the other 1½ inches. A line is drawn lengthwise on the top of the box, and two 9/32-inch holes are bored on the line, 2 inches from each end. The shaft, ¾ inch long, is passed through the hole on the right and a washer is slipped on from the other side. One of the disks is put in place with the bolt to hold it, with the fuse underneath, and a nut is screwed on. The other shaft passes through the left hole and a washer, then a tube or bushing slightly larger than the shaft, is slipped on. This bushing is 1 inch long. Another washer is placed on the shaft and the other disk is affixed like the first one.

A piece of wood ½ inch square is secured in each corner of the box for the brushes to be affixed to. The brushes are made of spring brass ¼ inch wide, and are bent and mounted as shown. Copper wires are soldered to the brushes and connected to binding posts in the sides.

The disks are numbered from 1 to 9, under the center of each fuse, and two ⅜-inch holes are bored so as to be in line with the numbers as the disk rotates, which will indicate what fuses are in use.

Contributed by ROY C. HUNTER.

Combination Switch



Combination switch, utilizing as its basis two push-buttons specially arranged so that both can be pushed and held down.

THE switch illustrated is made out of two push buttons of the double contact type. These buttons are mounted on a wooden base and by the arrangement shown it is possible to press both at once by simply turning the knob in the right direction.

Round pieces of wood have been substituted for the buttons, that is, for the part which is pushed by the finger. These round pieces of wood (A) are mechanically connected together by screwing a length of brass strap (B) to them. The part (C) is also made from a piece of brass and is bent as shown. On the top of this piece a hole is drilled and then tapped to fit the screw on the knob. The switch is now ready to be connected up to the circuit; it may be connected in many ways and used for various purposes.

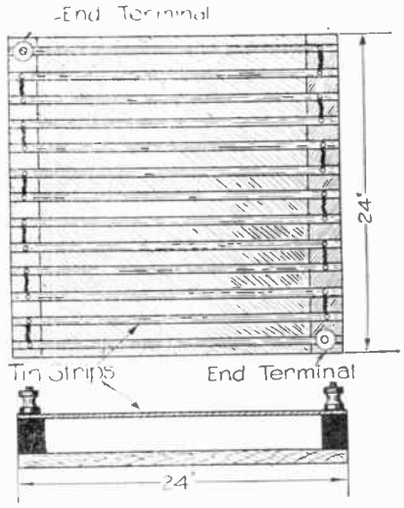
It can be used in any place where a small double pole, double throw, switch is required, as it is practically such. Figure (1) shows how the different contacts are connected together, when it is desired to use the switch as a reversing switch. Figure (2) shows the scheme of connections when used as a change-over switch. It will be noted that the lower contacts are connected to a D. C. circuit, while the upper contacts are connected to an A. C. circuit; the movable ones (D) are connected to some apparatus which is to be tested on both A. C. and D. C. circuits.

Then to change over from A. C. to D. C. it would be merely necessary to turn the knob, as this would cause the movable contacts to make contact with the lower ones. If now the knob is turned in the other direction, the movable contacts will be allowed to return to their former position, and they touch the upper contacts. It will also be seen that, if the knob is turned slightly, the contacts (D) will be moved to a position between the lower and upper contacts; when in such a position they would not touch either set of contacts and the switch would be in an off position and both circuits would be open.

By using ordinary push buttons instead of those of the double contact type it would be possible to construct a double pole, single throw switch in the manner described above.

Contributed by AMEDEO GIOLITTO.

Simple Electric Heater



A very nice electric stove of home construction, utilizing the simplest materials, which will give really efficient results.

A VERY simple electric heater, inexpensive and easily constructed, is made of ordinary tin of the kind used for lining boxes, or which is found in a five gallon oil can.

Unsolder the ends, bottom and top. Mark off, as shown above, a piece 24 inches long by 12 inches wide. This provides material for a heater of 1.6 kilowatt capacity; it will take 15 amperes on a 110 volt circuit.

The tin is cut into strips ¼ inch wide. The element is now ready to be placed on a piece of asbestos board to which have been attached telephone insulators or a couple of porcelain insulators. Two pieces of asbestos board about 1 inch wide are used as spreaders.

As a heater of this type does not acquire red heat, the warmth will last indefinitely; and its comparatively large radiation surface renders it more desirable to use than one that consumes more current and attains a red hot temperature.

Door Lock Tell-Tale

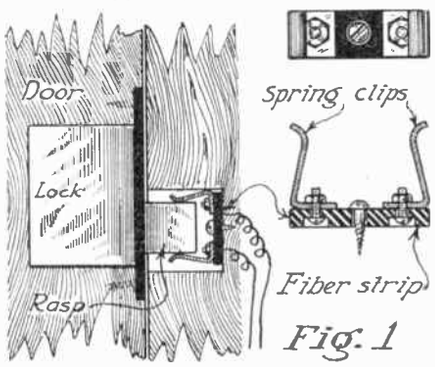


Fig. 1

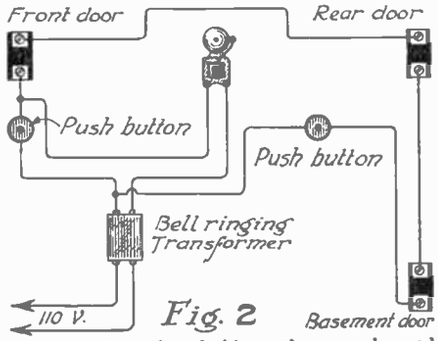


Fig. 2

Figure 1 shows how locking a door may be made to close a tell-tale circuit, and figure 2 shows the circuit proper. When one button is pushed it tells if the door is locked, as it is to be connected for all doors and windows of the house. The other push-button simply rings the visitors' bell.

A SIMPLE scheme for a door lock indicator is illustrated here. The connection is intended to conveniently indicate upon retiring that all doors in the house are locked.

The arrangement consists of simply constructed switches, one for each door, placed in series with a push-button located in some convenient place, say, the upper hall, and the whole in parallel with the doorbell circuit already in use.

If the doors are all locked the lock switches will give a complete circuit except for the main switch. Upon pressing the latter, the doorbell will ring, indicating that no door is left unclosed or unlocked.

The construction of the lock switches, if such are to be used, is very simple; such a switch consists of two small phosphor bronze springs, fastened to a fiber strip.

The switches, being small enough, will fit into the lock mortise of the door jamb. The whole can be neatly connected with bell wire.

Contributed by A. F. BEGIN.

Lamp Chimney Battery

MANY of our readers are interested in small sized home-made electric batteries, and from our contemporary, *La Nature* of Paris, we take a description of the Lampetaz battery.

The battery constructed by M. Lampetaz, a citizen of Lyons, is a gravity battery. It is composed of four elements, as he describes it, though of course any number can be used. The battery jars are cylindrical lamp chimneys, such as used for Argand gas burners, cylindrical tubes of about 1¾ inches in diameter and 7 or 8 inches long.

The tubes are placed upon a wooden base and they may be surrounded by a frame of wood nearly ½ inch high, which is to be filled with melted sealing wax. Care must be taken that the sealing wax is not put in so hot as to crack the glass.

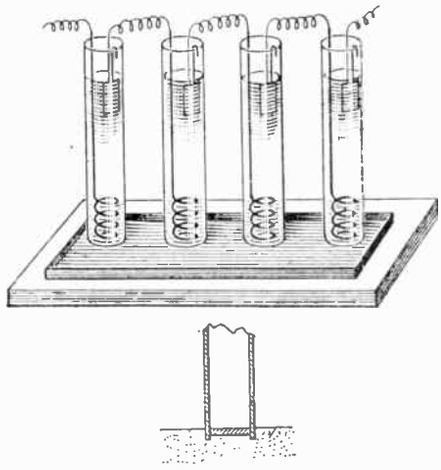
Another way is to bore holes in the wooden base, using perhaps a thicker piece, into which the chimneys will fit, and here quite an insignificant amount of wax will make them completely watertight.

The container is now complete; a heavy copper wire, wound into a spiral, is inserted in each chimney, the straight wire rising from it over the top. Four or five turns should be in the bottom of each chimney. The straight piece of wire rising through the chimney may be bent down over its top.

On the upper edge of each chimney a bit of zinc is bent over hook fashion so as to hang upon the edge, or it may be attached by a copper wire if it is of such thickness as to be unbendable. It is suggested that all sorts of scraps of zinc may be used for this purpose. It should descend about two inches from the top of the chimney and should be amalgamated by preference. A teaspoonful of copper sulphate is placed in each vessel, and water is poured in until the level reaches within an inch or less of the top. The water should be poured in very gently.

This gives us the gravity battery; it has considerable resistance, which is an objection, but possesses the advantage of great constancy as regards voltage. The originator employs this little battery for the charging of accumulators. The construction is considered not only simple but extremely economical, as no expensive parts are used. A suggestion is made that it may be provided with a box to cover it, keeping out all dust, and the box may, of course, carry binding posts if desired.

A battery using Argand lamp chimneys as the containers. They are set in holes in a board and secured by sealing-wax or other cement.



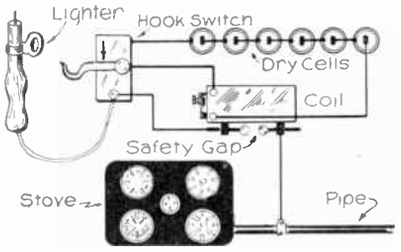
Gas Stove Lighter

THE gas lighter for the kitchen range can be built by any amateur handy with tools, who has a few odds and ends around his shop.

The coil can be any kind of a coil with a vibrator, such as a Ford coil. From four to six dry cells should be enough to operate this lighter. The hook switch can be taken from an old telephone, or one can be made very easily; it is installed in a small box on the wall near the stove.

The lighter can be made from any kind of a handle, such as a screwdriver handle.

I used a handle from an old electric soldering iron. The handle should have a long ferrule with a ring on the side to hang it on the hook. The wire from the box to the handle should be flexible, and



Stove lighting apparatus; the lighter proper, when not in use is carried on a hook switch like a telephone receiver, opening the circuit and saving the battery. The circuit is only closed for the few seconds used in lighting the stove.

should end in a small rod which passes through the handle.

The coil is equipped with a safety gap, that is, a ¼-inch gap, so when taking the handle from the hook the spark will jump this gap until the lighter is placed on the burner, then the spark will jump from the lighter to the burner, and light the gas. One side of the secondary terminals must be grounded to the gas pipe.

Such an outfit may be installed in the basement, and the three wires taken up through the floor to the switch box nearby the stove.

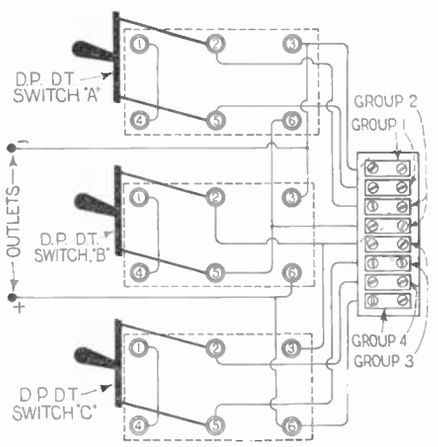
Contributed by A. Guy Christy.

Dry Cell Connector

A NEW and interesting method of quickly changing dry cell connections has been developed. The value of the method lies in the fact that all the cells are in constant use, giving longer life, and providing a convenient system of varying the voltage, within certain limits. This is obtained by changing the connections of the various groups of cells from multiple to series, and vice versa.

In this method, three double-pole, double-throw switches are connected as shown in the illustration. The connections for cell groups (any number in a group) are brought out on a panel as shown at the right of the illustration. Two binding posts, shown at the left, form the outlet. More switches may be added as may be necessary, controlling more groups of cells.

Switches "A" and "C" each control the connections between two groups of cells, (A) 1 and 2, and (B) 3 and 4 respectively. Switch "B" controls the connections between the outputs of switches "A" and "C." Any switch thrown to the right



Connection of eight dry cells, with three switches, so as to give a varying voltage according to how the switches are thrown.

connects the groups it controls in series. Any switch thrown to the left connects the groups it controls in multiple. Approximate voltages of 3, 8, 10 and 12 may be obtained, using two dry cells to each group.

Contributed by C. W. Butler.

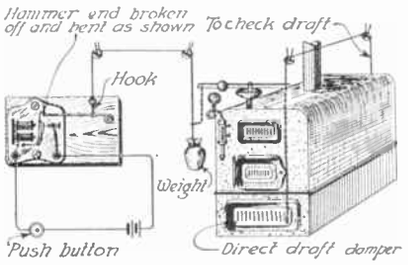
Electric Draught Control

THE apparatus illustrated operates as an electrically controlled weight-releasing device. In its construction an old bell is used; as shown, it opens the draughts of a furnace. A push button placed near the bedside is pressed at 5:30 A. M.; this opens the draughts, so that by 7:00 A. M. two pounds of steam will be generated in a low-pressure heating boiler.

The gong is removed from a bell and the stem of the bell hammer is cut off about a half inch from the end of the armature. The remaining stub is bent at right angles to form a catch, as shown in the diagram, to receive the end of the trigger.

The interrupter is short-circuited by connecting a wire from the interrupter regulating screw to the grounded binding post, as shown in the illustration. The trigger is made from about three inches of fairly stiff wire. One end is twisted to receive the screw on which it is pivoted, and the other end is flattened out to engage the catch at the end of the armature. The end of a rope or chain holding up a weight is hooked to the trigger about one-half inch from the bolt or screw, on which the trigger is pivoted.

The button may be located anywhere, and two dry cells are sufficient to operate the device. When the circuit is closed,



A furnace draft-opener. When the current is turned on, a suspended weight is released which opens the drafts. It can be made to open as many as desired by proper connections.

the armature is drawn to the magnets, releasing the trigger, which in turn releases the weight opening the draughts of the furnace.

Contributed by David M. Arthur.

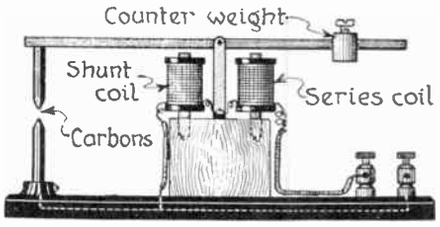
Automatic Arc Lamp

AN automatic arc lamp is described here, which is operated by two independent electromagnets. The materials required are:

One piece of wood for a base: one wooden block about 2 inches by 3 inches by 1½ inches; two small carbon rods: an old 2,000-ohm telephone ringer: a small iron rod about eight inches long; a small weight, and a small iron strip.

Near the middle of the base secure the wooden block so that it will be 2 inches high, 3 inches long and 1½ inches wide. The small iron strip is affixed to this, and bent so that it comes up from the block about three inches and forms a bend as indicated, giving a support for the iron rod.

Then take the coils from the ringer, remove the wire from one of them and rewind it with larger wire (about No. 20 D. C. C.). Mount them on the ends of the block, as shown here. The one with the large wire is the coil to be used in series with the arc, and the one with the small wire is to be shunted across it. On the end nearest the shunt coil mount one carbon as shown; fix the other carbon on one end of the iron rod. Then by means of a small pin and holes drilled in the rod and the standard, fix the rod so that it is free to swing up and down. The small sliding weight is put on and adjusted so that it is almost balanced, but the carbons will barely touch each other. Wire up as shown and it is ready adjusted for use.



A suggestive arc lamp employing two electromagnets, one in series and one in shunt, for its operation. This system is susceptible of other applications.

The arc is self-starting as the current comes through the carbons, then through the series coil, which pulls the lever down and opens the carbon points. If the carbons become too far apart the current through the series coil is smaller and that through the shunt is larger. This regulates the points again.

Contributed by Woodson Matthews.

Automatic Window Closer

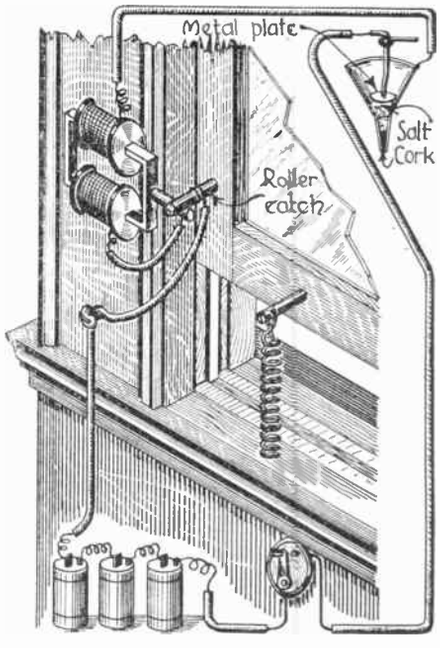
THIS device closes and opens a window in case of rain without disturbing the sleeper as do many kinds of rain alarms.

The funnel fills with rain water, closing the circuit between the metal plate and the metal of the funnel. The plunger of the solenoid is drawn back, releasing the catch. A metal roller is used as shown to minimize friction. As the solenoid armature releases the catch the window falls and the circuit is broken between the roller and the armature, thus breaking the circuit.

A weight may be placed on the window so that it will be certain to fall; or else a spring may be arranged to pull it down, by attaching one end of the spring to the sill and the other to the window.

A piece of felt may be fastened to the sash bottom, which will prevent noise when the window drops.

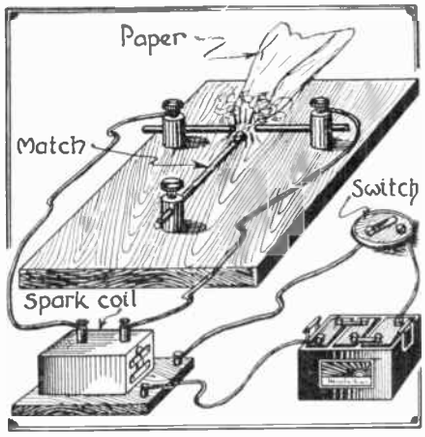
Contributed by Cecil Cook.



Window closing apparatus operated by a rainfall; which wetting salt and charging a funnel closes the circuit, withdraws a latch and causes the window to descend.

Electric Fire Lighter

IN rural sections where it is the custom to let fires go out during the night, and where wood is depended upon entirely for fuel, an apparatus of the following description will be found very useful during the winter time. When residing in the country the writer made one which worked perfectly.



A fire lighter, which ignites a sheet of paper so as to set kindling wood on fire and start a coal stove.

The apparatus is constructed of the following materials: Three binding posts, one ½-inch induction coil, four dry cells, a block of wood 4″ x 6″ x ½″, a match, a switch, and the necessary wire to make the connections.

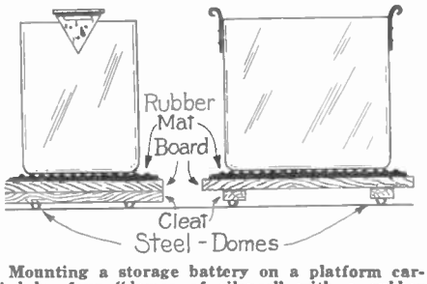
Mount two of the binding posts on the block opposite each other, and with the aid of two pieces of short wire make a spark gap. The third post is mounted about two inches back from the center of these two. Through the hole of this post a match is placed and securely clamped so that its head will fall in the spark gap between the other two binding posts. Make all the necessary connections to the coil and battery.

Before retiring at night kindling and wood are placed in the fire box of the stove. A piece of paper is trailed from the grate to the hearth, where the lighter rests, and arranged so that an edge of it will be adjacent to the match head.

When the current is turned on the spark will ignite the match and thus the paper will catch fire and trail up to the kindling in the stove. The result is a nice warm kitchen when the family comes down.

Contributed by HOWARD M. HARRIS.

Storage Battery Convenience



Mounting a storage battery on a platform carried by four "domes of silence" with a rubber mat to protect the wood, so that the battery can be conveniently pushed under the table and thus be easily disposed of.

HERE is a little idea which was worked out in a few hours and has proved to be a great help.

My storage battery is under the table and as is customary when necessary to test the battery, or fill it, I had to either crawl under the table or lift out the heavy battery.

I overcome the difficulty by building a very simple cart for it. First an automobile running board rubber pad was secured. This was fastened to a hardwood board of the same size. As for the size, get one about 1 or ½ inch larger than the battery base. Cleats were fastened to the board to give it strength. To the cleats "domes of silence" were fastened, two domes to each cleat.

The rubber protects the floor from the acid, and the domes prevent the floor from being marred, and slide with a minimum of friction.

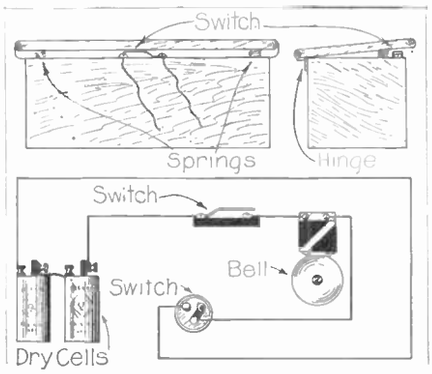
Contributed by W. F. ARP.

Stairway Alarm

A STEP is selected near the bottom of the stairs, then the thread or horizontal board is taken up and two hinges fastened to the side. The board is then replaced. A small spring is put under each end, so as to keep the step raised.

The springs may be fastened in place by drilling holes the size of the springs, one halfway through the step and another in the board directly under the hole in the step.

A switch is made by screwing a strip of copper to the board and soldering a wire to the strip. A screw is placed directly under the strip, and a wire is fastened to this screw and connected to one pole of the battery. The other wire connects to one terminal of a bell. The other terminal of the bell connects with a switch placed on the wall. A wire from the other battery binding post connects to the binding post on the switch and completes the circuit.



One of the treads on a flight of stairs is hinged with connections, so as to give an alarm if an intruder steps upon it.

When anyone steps on the stairs, the hinged board is pressed down, closing the switch and giving the alarm.

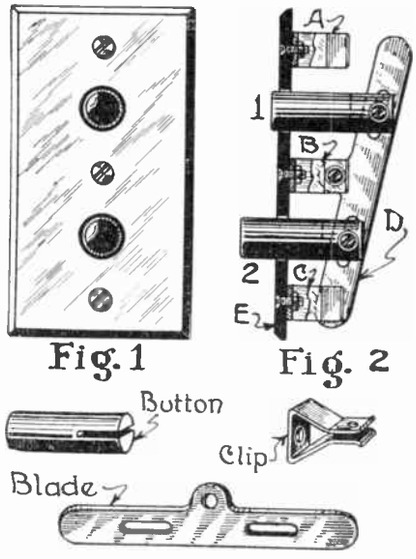
Contributed by WILLIAM MEAGHER.

Simple Push-Button Switch

THE construction of a very neat and simple switch of the push-button type is shown in the accompanying illustration. The main parts of the switch are three clips, which are easily made or may be taken from an ordinary knife switch.

These clips, (A), (B) and (C), are mounted on a piece of hard rubber as shown in the side view of the complete switch. It will be seen that the blade (D), journalled in the clip (B), is operated by the buttons (1) and (2). Pressing the button (1) the blade will break contact with clip (A) and make contact with clip (C), and at the same time the button (2) will be pushed out. If the button (2) is now pushed the blade will make contact with (A) and break contact with (C); consequently this switch could be used as a three-way switch, since it can open one circuit and at the same time close another.

It also can be used as an ordinary switch, and in this case the two wires leading to the switch are connected at (B) and (A), or (B) and (C). The different parts of the switch are shown in detail in the drawing, while a front view of the switch is also given. The blade



A well-designed push-button switch for home construction, giving perfect results.

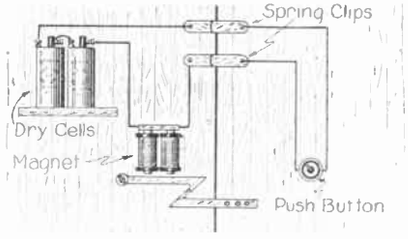
(D), which is made of copper, must be slotted as shown, providing a slight amount of parallel motion, so as to permit free movement of the buttons in the holes of the hard rubber piece (E). The buttons may be made from hard wood, although hard rubber buttons are much neater in appearance.

Contributed by AMEDEO GIOLITTO.

Electric Latch

IF you have a sliding door on your laboratory which requires a lock this is just the thing. The movable latch must be of iron or else the magnet will not lift it. Arrange the pivot so that when the latch is all the way up it will hit both magnets equally.

The drawing shows the connections to the battery and the push-button on the sliding. Some brass spring clips will be noted in the circuit at the edge. These conduct the current across the gap between the edge of the door and the frame, when the door is closed. They should



An electric door latch; it is designed for a sliding door and is operated by a small battery.

make a sliding and tight contact with the other strips on the door frame where the other ends of the wires are fastened. When the door is open the circuit is "broken" and the latch falls back into place or can be pushed down by hand, ready to lock the door when it is closed.

The door has to open quickly when the button on the door is pushed, as the minute the door opens a few inches the circuit is broken and the latch falls.

Contributed by HARRY L. ELDER.

Static Electric Experiments

By Raymond B. Wailes

Balloons as Pith Balls

WE have all tried the familiar pith ball experiments with static electricity, noting the attraction of unlike charges and the repulsion of like

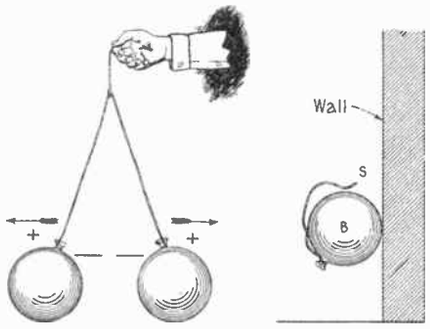


Fig.2 Fig.1

India rubber balloons used to show attraction and repulsion of electric charges; a very demonstrative substitute for the classic pith balls.

charges of electricity retained on the surfaces of the balls. By substituting toy balloons, the effects of attraction and repulsion can be shown with decided clearness, and, unlike the pith balls, to a large audience.

An inflated toy rubber balloon when rubbed with fur of any sort will acquire an electrical charge. Grasp the balloon tightly and stroke it against sister's fur piece or the family cat. The string attached to the vent will be seen to adhere closely to the entire outer surface of the balloon, as if it were wet. If the balloon be touched to a dry wall it will remain until the charges have seeped off. Fig. 1. The sparking of the charges can be clearly heard if the balloon is pulled or blown along the wall with the breath.

In a like manner, two inflated balloons tied as shown in Figure 2 with a string will repel one another, if both are rubbed on fur. One balloon should be grasped in one hand and the other in the other hand when charging them by rubbing.

Delivering Leyden Jar

A Leyden jar which delivers small charges slightly impairing the main charge can be made as shown in the illustration, Figure 3A. The jar is a wide-mouthed bottle with an inner coating of tinfoil (1C). The cork (C) is perforated in the center with a paper tube, through which a brass rod (R) passes. The rod is separated from the paper tube by sulphur, introduced by gently melting roll sulphur or sulphur flowers in a porcelain

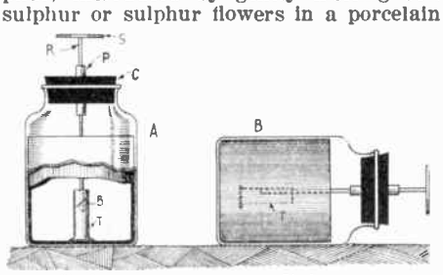


Fig.2 Fig.3

A simple construction of a Leyden jar, which can be discharged fractionally. The appliance used to do this is of the utmost simplicity and effectiveness.

dish and pouring the liquid into the paper coil, stopped at the bottom, and allowing it to cool. This makes a perfect insulator. The end of the rod (R) should contain metallic bristles. These can be made by soldering bits of fine copper wire on the end of the rod. The metal tube (T) has a flat bottom and in position (Fig. 2) rests upon the bottom of the bottle, or on the inner tinfoil coating of the Leyden jar.

When charged, the jar can be placed on its side on a sheet of glass, after slightly turning its mouth or stoppered end downward, as shown in Fig. 3. This causes the inner metal tube to recede from contact with the inner tinfoil coating, yet still retaining contact with the rod through the metallic bristles or wires. The charge can then be taken from the plate (S) on the outer end of the rod (R). To remove another charge from the jar, stand upright until the metal tube slides down on the little metal wire bristles and comes in contact with the inner tinfoil coating, then slant it until the mouth is downward and the metal tube (T) recedes from the tinfoil coating on the inner side of the jar as before. This can be repeated until the jar is completely exhausted of its charge little by little.

Charging a Leyden Jar from the 110-Volt Circuit

By making the cover for an electrophorous as shown in Figure 4, the Leyden jar can be charged directly from the 110-volt lighting circuits.

In the original Leyden jar a section of a metallic ointment box can be used, being inverted and soldered to the end of the rod (R), Fig. 4. The other half (T) of the tin salve container should be fitted

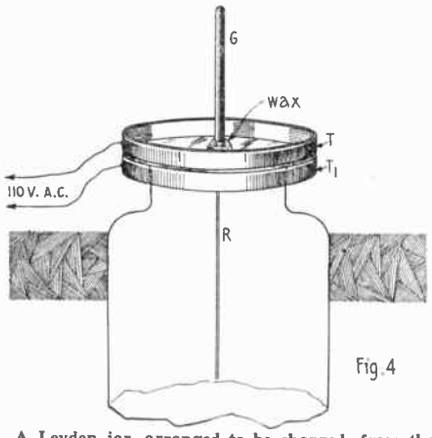


Fig.4

A Leyden jar, arranged to be charged, from the 110 volt lighting circuit—a potential normally too slight to give any tangible result.

with a glass or sealing wax handle as shown. Its flat surface should be given a coat of shellac which is dried, and may be baked.

When the cover thus formed is placed on top of the Leyden jar and the two are connected with the 110 mains, using a lamp or fuse in series, and the wires are separated, a charge can be obtained from the jar.

This arrangement can also be used to charge an electroscope, the rod (R) being bent into the form of a stirrup at the end and the gold or aluminum leaf supported by the base of the stirrup.

Apparatus for Tapering Charge

WHEN charging storage batteries, best results are obtained when, as the charging progresses, the charging rate constantly decreases. An automatic device for this purpose can be easily made, giving the battery a tapering charge and turning off the current at the end of the charge.

The actuating part of the device consists of a flat helical spring which tends to turn the rheostat in the direction of increased resistance. The unwinding of the spring is controlled by an electromagnet, controlled by a clock. Fig. 2 shows the spring, axle of the rheostat and a ratchet wheel. The ratchet wheel is soldered to the shaft; directly in front of it a spiral spring (which can be taken from an old alarm clock) is also fastened to the shaft. One end of the shaft is slotted; a flat piece of metal inserted in this slot serves as a handle to wind the spring. A brass tube is slipped over the other end of the shaft and soldered. The purpose

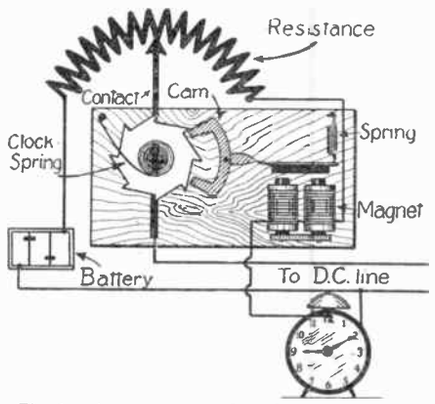


Fig. 1. An apparatus for charging a storage battery with a tapering current, which diminishes as the battery becomes more and more nearly charged.

of the brass tube is to couple the shaft of the spring motor to the shaft of the rheostat. One end of the brass tube is fitted with a thumb-screw, which is loosened when it is desired to wind the spring. If it were not loosened, the lever of the rheostat would interfere with the winding of the spring.

The rheostat is mounted back of the frame. The diagram also shows in detail the escapement pallet which is operated by the electromagnet. An alarm clock has a contact for the minute hand placed over the number 12, controlling the current through the magnet.

Connections are made as shown in Fig. 1. It is important that the leads of the rheostat should both be connected as shown, for if they were reversed the current would increase instead of decreasing, as the lever of the rheostat is turned to the right. One thing that should be noted is that the magnet is subject to the full line voltage when the rheostat lever is on the extreme end point. The windings must be able to stand the current, yet able to operate the catch when the lever is on the other end point with full resistance. When the minute hand of the clock passes over (12) it completes the circuit through the magnet, which pulls the pallet end down; the spring turns the rheostat contact arm a little to the right, but when the circuit is broken the magnets lose their magnetism and the spring pulls the catch back to its original position; this again allows the spring to turn the rheostat a little more to the right.

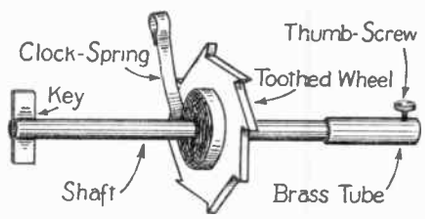


Fig. 2. The details of the ratchet wheel and spring which effects the tapering of the current for charging a storage battery.

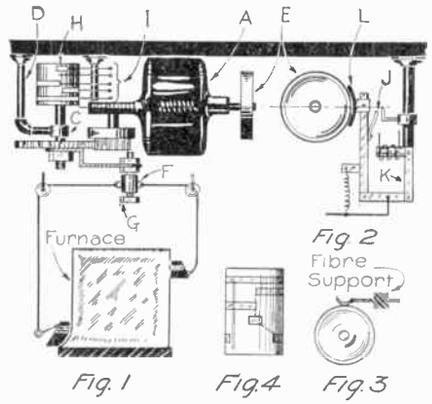
If the number of teeth in the notched wheel were increased, the apparatus would decrease the charging current at a slower rate, but on the other hand, if another contact were placed on the clock at (6) and connected to that on (12) the apparatus would decrease the current at a double rate; that is, every half hour the rheostat would be turned to the right.

Contributed by Amedeo Giolitto.

Motor-Driven Furnace Control

BELOW is described a home-made, motor-driven, furnace control, which has been in successful operation for several months.

Motor (A) is a Robbins & Myers oscillat-

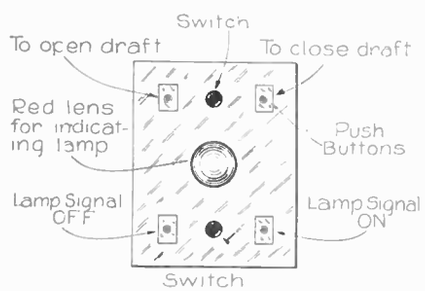


A number of details of an apparatus for controlling the drafts of a furnace which operates by turning current on and off, controlled by a rotating commutator drum, so as to get positive results.

ing fan motor; gears (B) and bearing (C) are from a Bosch magneto. The bracket-support (D) is made from ¼" gas pipe, which is fastened to the hose with a crow-foot. (E) is the brake drum, which is made from one of the flanges of a magnet wire spool. (F) is an insulated bushing, which moves freely over the bolt (G). (H) is the control drum with its contact strips, and (I) are the fingers, which are made from clock springs or spring tempered brass. At (J) are insulated contacts passing the current from the street service for operating the motor.

(K) is a magnetic contactor made from a low voltage coil of a Westinghouse 7½ horsepower type (A) automobile starter. It was rewound with No. 24 D. C.C. magnet wire for battery operation. (L) is the brake shoe. Fig. 3 shows the control drum and one finger. Fig. 4 shows the development of the control drum, which may be cut out and wrapped around a cylinder so that both edges met, and will then show the exact layout of the drum.

The drum used is about two inches in diameter and is made from a magnet wire spool. (M) is the thermostat, made from copper and zinc. (N) and (O) are plug switches or jacks. (R) is made from spring brass. The plug is made from 3/16" brass rod and a switch button. (P) and (P) are magnetic contactors made from buzzers. (Q) and (Q) are



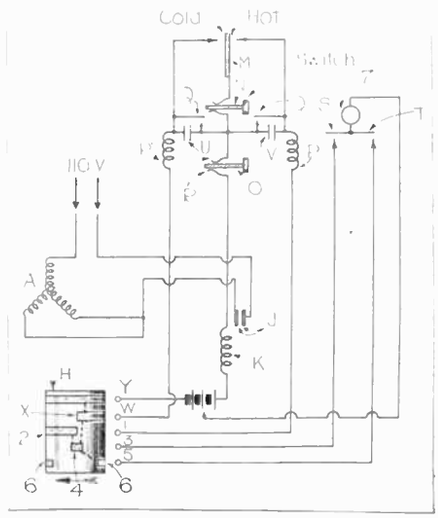
The switchboard of the furnace control; the switch arms are behind the panels and are not seen.

push button controls for operating the furnace by hand after pulling out the plug (N). The plug (O) is used to disconnect the control entirely.

We will assume that the control is set up and ready to operate, the drum to revolve in the direction of the arrow at the bottom. The finger (Y) is constantly resting on the ring (Z) which distributes current to all segments. (W) is supposed to be resting on (X) at (X). Finger 1 will not be making contact with segment 2. 3 will be making contact with 4, which will light lamp 7 when switch (S) is pressed, indicating that the draft is off.

When the thermometer returns to the position marked cold, contact (U) closes, contactor (K) also closes contact (J), which starts the motor (A) until the drum makes one-half revolution, which causes the finger (W) to leave its segment (X) and open the circuit. Finger 5 is now making contact with the segment 6, which will light the lamp 7, when the switch (T) is pressed, indicating that the draft is on. Finger 1 is making contact with segment 2, so the drum is ready for another half revolution. As soon as the thermostat returns to the position marked "hot," all segments on drum are connected together as shown by dotted lines.

Owing to the cost of the motor, some experimenters may be inclined to believe this device too expensive to construct. The whole affair, ready to operate, did not cost me over $2.00, as I obtained the motor



Wiring diagram of the furnace control, showing the commutator or contact drum. By following out the diagram the reader will have no difficulty in getting at the gist of the connections.

and the magnet parts from a junk dealer. The gears can be of any ratio to suit the builder. I used a 2-to-1 ratio, which takes about five seconds to close or open the draft.

Contributed by L. SAUNDERS.

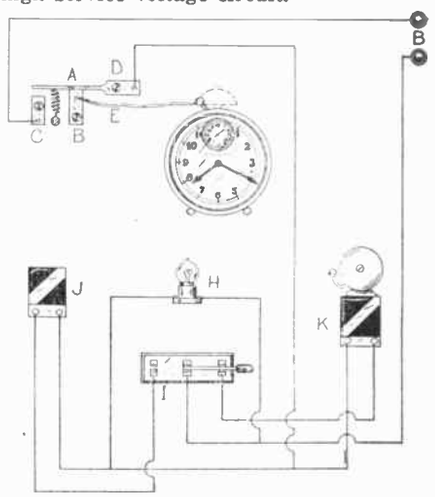
Alarm Clock Double Signal

THE illustration shows the use of an alarm clock for closing a circuit mechanically and operating one of two signals as desired. When it does this, an electric alarm bell or a buzzer is sounded, according to the way a double throw, single pole switch (I) is thrown.

The connections are shown very clearly. (A) is a switch pivoted at (D); if it touches the end of the contact (C), it closes an electric circuit. When the circuit is closed if the switch (I) is thrown to the right, an alarm bell will ring; if thrown to the left a buzzer will sound. (B) is a pivoted block insulated from the circuit and attached by a string to the clapper. The bell is removed from the clock, so that the clapper can have a good range of motion. The alarm clock is set for any desired hour, and when that time comes, the clapper (X) starts to vibrate, jerks the string and pulls the block (B) from under the switch (A) whose end then drops upon the contact (C) and gives the desired alarm.

A lamp (H) is connected so that when the switch below it is thrown to the right or left, it will light.

The system can be conveniently operated from a battery circuit, as it is hardly supposed to be operated upon a high service voltage circuit.



Arrangement for an alarm clock signal, which can be set by a double throw switch so as to ring either a buzzer or a bell, according to the way the switch is thrown.

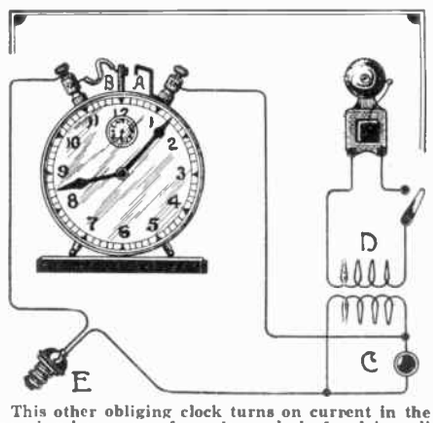
At (B) the terminals of the system are indicated.

Early Morning Service

THE bell is removed from an ordinary alarm clock and the ball of the clapper arm is cut off. Over this arm a piece of insulating material such as fibre, is secured, on which fibre is fastened a contact point. Two binding posts are fastened to the rim of the clock by screws, but thoroughly insulated from the rim. The contact piece, (A), is a strip of copper, which should be bent in such a manner as to allow the moving contact (B) to strike against it, but does not allow contact (B) to move far enough to vibrate. A single winding of the alarm lasts indefinitely.

There is a wall socket (C) to which is connected a coffee percolator, and across the line a bell ringing transformer (D) is connected. This transformer operates a buzzer through a single pole switch, which is used to control the buzzer. The whole outfit is connected by a swivel plug (E) to a wall socket (F) on the service circuit.

The movable contact (B) is reset by hand, and at the predetermined hour the



This other obliging clock turns on current in the morning by means of an alarm clock, for doing all sorts of things, warming coffee and other light dietary articles.

clock releases the alarm movement, contact (B) automatically closes the circuit, the buzzer sounds, and in a few minutes the coffee is ready. In the winter a heater may be connected at (C) so that the room is warmed also.

Contributed by WILLIAM F. LEATHER.

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

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

Motor Without Visible Field

By CLYDE J. FITCH

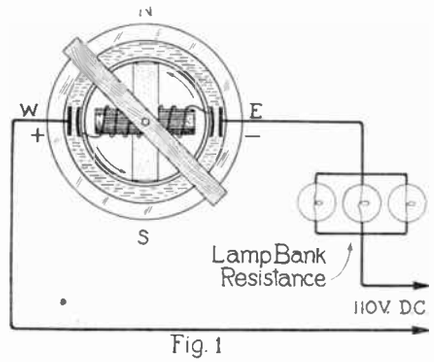


Fig. 1

The rotor of this apparatus is carried in a floating vessel; a bar extending across the outer basin operates by a pin to center the rotating part.

AN electric motor that depends upon the magnetic field of the earth for its action is shown in the illustrations. The rotor is a straight bar electromagnet floating in a dish of water. It makes about two revolutions per minute. Although the efficiency is almost zero, such a motor is very simple and interesting, and many experiments can be performed with it. For use as an attraction in a store window it may be suspended by two chains from the ceiling, like a lamp globe. The chains serve to conduct the electric current to the electrodes in the dish as well as to support the dish. The fact that the motor depends upon the earth's magnetism for rotation will baffle many "electrical experts."

The motor is very delicate and requires a great deal of patience and skill to construct, but when once running it will operate a long time without attention. The only drawback is that a potential of at least 110 volts on a direct current circuit is necessary to run it,

The diagram (Fig. 1) shows clearly the theory of action. The 110 v. line is connected through a lamp-bank resistance to the two electrodes in a dish of salt water. Three 50 watt lamps in parallel will give about the right value of resistance. The electrodes in the dish are placed east and west of each other referred to the magnetic meridian. The resistance of the salt water is high, so that part of the current flowing through the water will pass through the windings of the electromagnet and magnetize the iron core, and the polarized electromagnet will swing around and point north and south. At this position virtually no current flows through the windings of the electromagnet and the iron core loses its magnetism, but the momentum gained in turning so far will carry it a little farther so that the current will again flow through the winding but in the reverse direction. This will magnetize the iron core again. but the polarity will be reversed, and the magnet will continue rotating in the same direction until it again points north and south. This action will be continued as long as the current flows through the water.

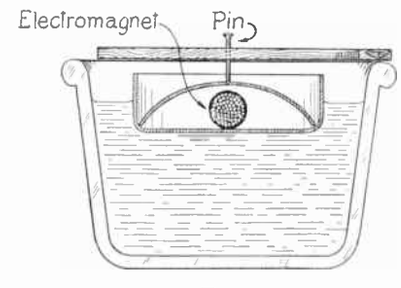


Fig. 2

Section of the above apparatus, showing very clearly how it is kept in proper position by the centering pin.

Another unique feature about this motor is that the lamps in the lamp bank resistance light up to almost full brilliancy when the magnet is pointing east and west, and are dimmed when the magnet points north and south. It is interesting to watch the lamps gradually light up brightly and then gradually dim down to a dull red. An ammeter placed in the circuit will show that the current increases and decreases as the magnet rotates.

The electro-magnet comprises three layers of No. 24 B. & S. enameled magnet wire wound on an iron core made up of a bundle of soft iron wires 2½ inches long. The diameter of the core is ¼ inch. It lies in a cardboard dish as shown, which is made waterproof by heating in paraffin. The terminals of the winding which are immersed in the solution may be of thin lead foil, and may be held in place by a rubber band encircling the floating dish. The electrodes hanging over the edge of the glass dish may be of heavy lead strip. It is important that no iron be used for electrodes or other connections, as the tiniest bit of iron near the rotor will stop it from running. The rotor is pivoted to keep it centrally located, as shown in Fig. 2. The solution may be of salt water or dilute sulphuric acid. The acid or salt should be added to the water until the lamps light a dull red when the magnet points north and south.

Fig. 3 shows how a small 3-volt lamp may be mounted on the motor to make it look more interesting. The lamp will gradually light up brightly and gradually go out twice every revolution, and will resemble a miniature flashing lighthouse. In this case the rotor is pivoted from underneath by means of a hat pin, the lower end of which is weighted with a piece of lead. Care should be taken to regulate the current flow through the solution so that the flashlight bulb will not burn out. A colored bulb, blue, for instance, will give the motor a more attractive appearance.

If a permanent horseshoe magnet is held over the rotor in such a way that its field will assist the magnet field of the earth, the rotor will race around at high speed and splash water out of the dish. Turning the horseshoe magnet around 180 degrees will reverse the direction of rotation of the rotor.

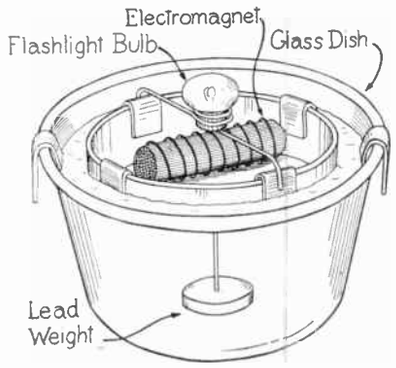


Fig. 3

Perspective view of the motor, of a somewhat different construction, provided this time with a flashlight bulb, and pivoted from beneath.

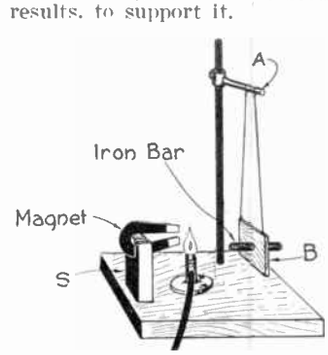
Magnetic Heat Swing

THE property of iron in becoming non-magnetic when heated suggests the construction of a novel and interesting magnetic heat pendulum.

The illustration is self-explanatory. The swing is made of two fine wires and has a wooden block suspended to its ends, which carries the iron or steel to be subjected to magnetic-heat action. The whole apparatus must be adjusted to proper working conditions, when the swing will oscillate for a considerable length of time.

The Bunsen burner (or alcohol lamp) is placed near the ends of a horseshoe magnet, but not touching the magnet, for the magnet must not be heated to the least degree. The swing is started in motion; when at the peak of its swing to the left-hand side the iron piece is attracted and held by the magnet. In this position it also is held above the flame of the burner, which heats the metal under test and in consequence reduces the magnetic attraction. The metal in the swing no longer is held by the magnet and swings off to the right, to at once return to the left towards the magnet again. During this double swing it becomes cooled to such an extent as to be again attracted by the magnet, the heat of the lamp again renders it non-magnetic, and it swings away.

As stated before, the adjustment is rather critical, but is not difficult to carry out. The swing proper must be made of thin wires. A ringstand can be used, with good results, to support it.



A magnetic pendulum, kept in motion by heat affecting its magnetic relations.

Short-Circuits

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

This little grave
Holds poor Tommy Slater.
He "shunted" a socket
With a radiator.
—STANLEY MORASKA.

Lies sleeping here
Aloysius Gump.
The man-hole had wires
That touched his pump.
—MAXWELL JACKSON.

Here rests in peace,
Alexander Tripper.
His hair was cut with a
Shorted 'lectric clipper.
—C. S. HOLT.

This monument's for
Emanuel Trout.
He grounded himself
Through a water spout.
—STANLEY ALBERT.

NEW KITE BAN TO BE SOUGHT

Children Cause Short Circuit of Power Lines

A new kite-flying ordinance will be sought by Ralph Wiley, chief city electrician, as a result of complaints from the Pacific Gas & Electric Co. that kites have short-circuited two of its lines carrying 11,000 volts of power.

The present ordinance forbids kite flying within the district bounded by Divisadero-st north to the bay and south to Army-st, then east on Army-st to the bay.

The new ordinance would extend the district to include the territory out to First-av, north on First-av to the Presidio, south on First-av to Fulton, over Fulton to Stanyan, south on Stanyan to Burnett and Palo Alto-av and then south to Army-st.

Here lies the body
Of Jehoshaphat Bragg.
He wiped his meter
With a very wet rag.
—MERLE HOLMES.

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

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

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

Telephone Induction Coil

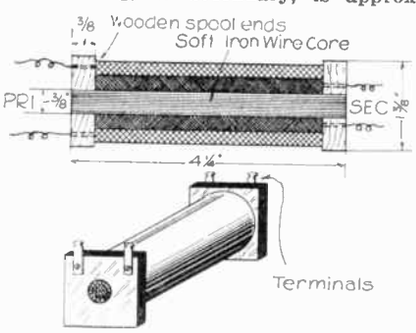
(283)—M. E. Munz, New York City, asks:

Q. 1.—Will you please tell me how to build a telephone transformer for use with a transmitter button? I would be interested in getting the best possible design.

A. 1.—Data for building a very efficient telephone induction coil is as follows:

On a soft iron wire core 4¼ inches long by ⅜ inch in diameter wind 400 feet of No. 28 B. & S. gauge enamel or silk covered copper magnet wire. This winding is the secondary of the induction coil. The finer and softer the iron wire used in the core the more efficient will be the induction coil.

The core should be wrapped with several layers of thin paper before winding the wire, and two wooden ends should be forced over the ends of the core as shown in the illustration. The resistance of the first winding, or secondary, is approxi-



Section and perspective drawing of telephone induction coil, showing relation of the different parts, coil windings, and heads.

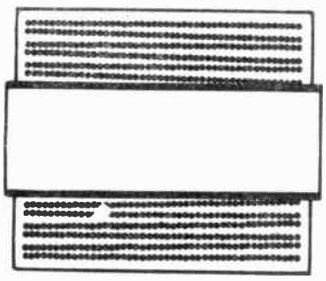
mately 27 ohms. On top of this coil several layers of paper are wrapped, and then the primary winding, comprising 400 feet of No. 26 B. & S. insulated copper magnet wire, is wound over the paper. The resistance of this primary winding is approximately 17 ohms. The primary winding is protected from mechanical injury by several layers of paper, wrapped around tightly and shellacked.

High Voltage Coil

(284)—K. F. Kaplan, Memphis, Tenn., asks:

Q. 1.—What is the most compact method for winding and insulating high voltage transformer coils?

A. 1.—A section of a coil that has the required amount of electrical insulation crowded into the minimum of space is shown in the illustration. There is a potential difference across each turn of the wire, so that as one layer of wire is wound over the other layer, the potential difference from layer to layer gradually increases, until at the end of the layer the potential difference is at a maximum and there is danger of the insulation breaking down at this point. In this type of coil, the insulation and distance between the overlying coils gradually increases with the voltage, so that adequate



Sectional view of a coil showing how the distance between wires of varying potential in the windings of such apparatus is increased as far as possible to prevent perforation.

insulation with a minimum of insulating material is assured.

Q. 2.—Is there any machine which will automatically wind these coils?

A. 2.—A coil winding machine was described in the March, 1923, issue of this magazine that will wind this type of coil. This machine will also wind several other interesting designs of coils.

"Electric Movie"

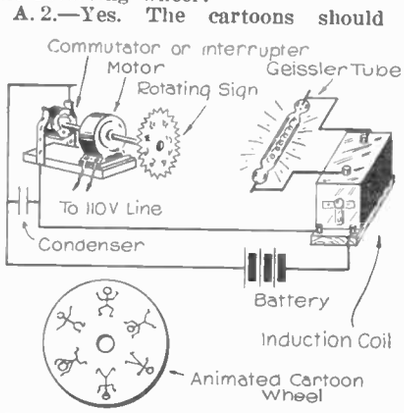
(285)—M. P. Boyd, Corpus Christi, Texas, writes:

Q. 1.—Please advise what kind of electric light tubes I can use for intermittently lighting a revolving sign so that it will appear stationary.

A. 1.—A Geissler tube may be used, and should be mounted as shown in the illustration. The revolving sign is driven by a motor, which motor also drives a commutator for making and breaking the primary circuit of the induction coil, so that the Geissler tube will flash on and off in synchronism with the revolving sign. In fact, a Geissler tube is not necessary if a fairly large induction coil is used, as the spark from the secondary of the induction coil, if placed in front of a reflector, will be sufficient to illuminate the revolving sign. The vibrator of the induction coil should be screwed down tight.

Q. 2.—Can I use this same apparatus for making a small animated cartoon on the revolving wheel?

A. 2.—Yes. The cartoons should be



Interesting experiment in the persistence of vision, using a Geissler tube for intermittent illumination, so as to produce the desired effect of a motion picture.

drawn on the wheel as illustrated, so that they will appear to move when illuminated by the interrupted light. Of course, if all of the cartoons are illuminated, all will appear to move, one being slightly behind the other in its motions. The experiment will give a very spectacular effect in a dark room.

Telegraphone Queries

(286)—L. C. Greer, St. Paul, Mo., asks:

Q. 1.—What size wire is used for recording messages on a steel wire telegraphone?

A. 1.—Number 30 B. & S. gauge steel piano wire may be used. The diameter of this wire is 0.010 inch.

Q. 2.—Kindly give data for constructing the magnet coils.

A. 2.—The two magnet coils are wound

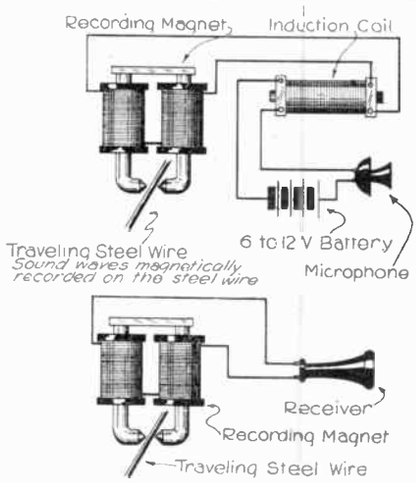


Illustration of the operation of the telegraphone, in which the message is impressed by magnetization on a steel wire.

to a resistance of 10 ohms each, on a soft iron core shaped as shown in the illustration. Number 24 B. & S. enameled copper wire may be used. The pole tips of the magnet are pointed and just touch the steel wire as it passes by. A microphone is connected in the primary circuit of an induction coil, the secondary of the coil being connected to the telegraphone magnet. The secondary coil should have a resistance of 20 ohms and the primary coil a resistance equal to the average resistance of the microphone.

On talking into the microphone the fluctuations of the electric current set up a fluctuating magnetic field across the poles of the electromagnet, producing corresponding polarities in the wire, which magnetically impress or record on the field changes on the moving steel wire, and are retained by it. The speech is reproduced by connecting a telephone receiver across the electromagnet winding in place of the secondary of the induction coil, and running the steel wire through again. The magnetized steel wire passing by the poles of the electromagnet induces currents in the magnet windings which

How and Why?

pass through the telephone receiver coils and actuate the telephone receiver diaphragm, thus reproducing the speech which originally produced the varied polarities constituting a record on the wire.

The steel wire is cleared of all magnetic irregularities by passing it over the pole of a strong electromagnet, called an "erasing" magnet, or "wipe-off" magnet.

A Common Error

(287)—K. U. Lang, Chicago, Ill., asks:

Q. 1.—I have been working with 110-volt current taken from a surface line and have had occasion to make some calculations. How can the current be called 110-volt, if, as I understand, it is the same all over the line, so that as great a current goes through one inch of the line as through a mile of it? There must be a catch somewhere, because the voltage on the inch of wire is very minute, compared to that on a mile of wire; so how can a current in the inch of wire be a 110-volt current?

A. 1.—You are evidently a little mixed in assuming that there is such a thing as a 110-volt current. This seems to be a historical error that became very popular in conversation, also in some books and magazines, and is still in use by some electrical students who should know better, but through force of habit still speak of a 110-volt current.

110-volt line, or 110-volt circuit, should be used in place of 110-volt current, as the voltage is on the line regardless of whether any current is flowing or not. It is customary to speak of a circuit as 110-volt A. C., the A. C. standing for alternating current, and is used merely to distinguish the line from a D. C. or direct current line.

Q. 2.—What is the direction of flow of current through an electron tube, such as the Fleming Valve?

A. 2.—The direction of current flow through an electron tube is assumed to be from the plate to the filament but in actuality because the plate is held positive with respect to the filament by means of the (B) battery, the electric current is a stream of negative electrons flowing from the filament to the plate. In the early days of electricity, before anything was known about electrons, the direction of current flow was unfortunately to be from the positive terminal of the battery or other source of supply, to the negative terminal; and when the electron tube came in vogue it was found and demonstrated experimentally that an electric current consists of a stream of electrons flowing from the negative pole to the positive pole. But the old assumption of current flowing from negative to positive has never been changed, which accounts for some of the confusion when studying vacuum tubes.

Electroplating Solution

(288)—Kenneth Norton, Rockwell City, Iowa, inquires with reference to copper plating.

Q. 1.—I have a copper plate which I propose to use for the anode and copper sulphate. To make the solution, how large should the container be for copper plating and how should I make the copper sulphate solution?

A. 1.—A 2½ gallon porcelain crock or glass jar will be found convenient for copper plating. The solution comprises 2 pounds of copper sulphate, 2 gallons of water, and 6 ounces of sulphuric acid. Six to 10 amperes to the square foot of plating surface should be used at a potential of from 1 to 2 volts.

Q. 2.—Please give directions for making a simple electrostatic machine that will give about a 1 inch spark.

A. 1.—A simple electrostatic machine was described in the December, 1921, issue of Practical Electrics.

A very simple electrostatic generator was described in the May, 1922, issue. This generator comprised two copper discs bolted on each side of a pulley and suspended in mid-air by a thick linen thread belt from the pulley of an electric motor. With the motor running at a speed of 3000 revolutions per minute, a spark ¾ inch in length is said to jump from the discs to a piece of metal held in the hand. The gyroscopic effect of the spinning discs keeps them balanced.

Home-Made Dynamo

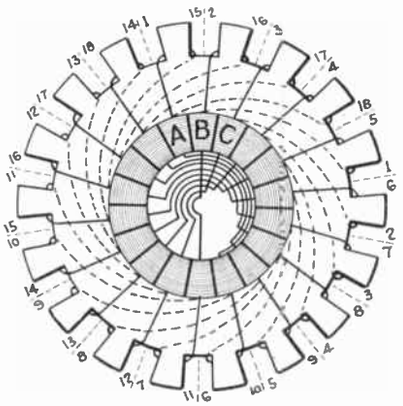


Diagram of winding of an 18 slot armature winding.

(289)—Mr. Fred Post, Auburn, Ill., writes:

I have a home-made dynamo which has a round field, four poles and is shunt wound. The armature is 4" diameter by 4" long, and has 18 slots; the commutator has 9 segments. This dynamo developed up to 40 volts. At low speed I use it to charge storage batteries at 9 volts and 15 amperes very successfully. But when I attempt to burn 32 volt lamps or to run 32 volt motors, or run the dynamo idle, sparking at the commutator is very bad.

I would like to rewind the armature with a double layer per slot and use a commutator of 18 segments.

Q.1.—Will you please draw a diagram showing how this can be done?

A. 1.—We show a diagram of the winding you ask for. Starting at commutator segment A the winding passes through slot 1-14, around the back of the armature to slot 1-6 and then to segment B. From B it passes through slot 2-15, around the back of the armature to slot 2-7, and then to segment C, etc. The commutator segments are connected diametrically across from each other as shown. Two collecting brushes are used and they are placed 90 degrees apart on the commutator.

Electrolytic Generator

(290)—H. A. Payton, Sacramento, Cal., asks:

Q. 1.—Is there any chemical that will produce electricity in any amount? There seems to be a general opinion that ordinary salty water does so to a limited extent.

A. 1.—There is no such thing as a chemical that will in itself alone produce electricity. Even chemicals that are used in batteries will not produce current unless the electrodes are present. Ordinary salty water in which a strip of copper and a strip of zinc are immersed will form a

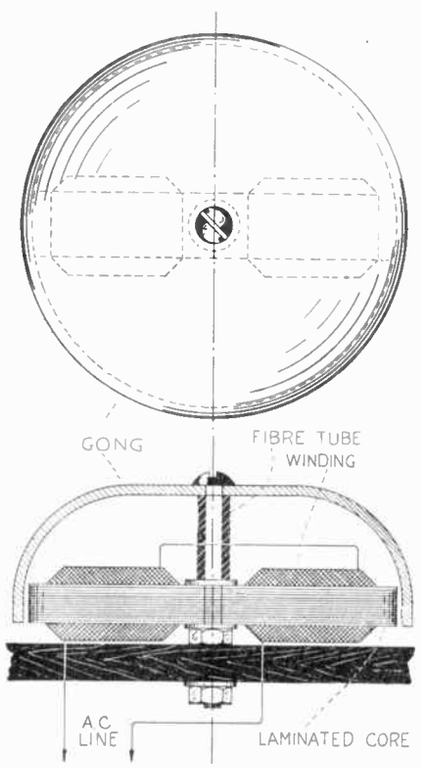
How and Why?

simple cell, but of rather high resistance, low potential quickly polarizing and one which deteriorates on standing.

Q. 2.—How would you connect a small generator and motor to pick up current from a chemical solution instead of from the atmosphere as is now standard practice?

A. 2.—You are evidently a little confused in stating that a generator picks up current from the atmosphere. A generator generates current, regardless of whether the atmosphere is present or not. In other words, a generator will generate current if placed in a perfect vacuum. A chemical solution will only interfere with the action of the generator and will in no way help the generation of electric current.

Alternating Current Bell



Plan and cross-section of an interesting alternating current bell.

(291)—L. T. Richards, Boston, Mass., inquires:

Q. 1.—Will you please show the construction of a bell that will operate on alternating current and will not have the harsh sound produced by the ordinary door bell?

A. 1.—The results you ask for are not easily obtained. However, the bell shown in the illustration may, with a little experimenting, meet your requirements. This bell depends for its action upon the alternating magnetic field set up by the alternating current in the electromagnet inside a gong. The gong is of magnetic material, iron or soft steel, and acts as the return circuit for the magnetic flux. The core of the electromagnet is just short enough to fit inside of the gong and leave a small air gap between the poles of the electromagnet and the gong. The alternating magnetic attraction between the electromagnet and the gong set the gong into vibration, at a frequency depending upon the frequency of the alternating current. If the frequency of the alternating current supply is 60 cycles, the frequency of the gong will be 120 cycles per second.

The main difficulty in constructing a bell of this kind is to find a gong that will have a natural frequency of vibration double the frequency of the alternating current supply. If the natural frequency of the gong is even slightly different, the gong will emit no sound.

We can give you no constructional details on this bell, as we do not know the size and shape of the gong which you may select or the voltage at which you intend to operate the bell. The electromagnet can be wound for 110 volts and operate on the house lighting circuit direct, or the magnet can be wound for a lower voltage and operate through a bell ringing transformer. The core must be of laminated construction so as to reduce eddy current losses.

You might try a tuning fork instead of the gong.

Vibrating Rectifier Query

(292)—William Nash, Handsboro, Miss., asks:

Q. 1.—I have a 100-watt synchronous vibrating rectifier and desire to rewind it for 500 watts. How many pounds and what size wire shall I use? The rectifier is to operate on 110 volts A. C. and deliver 10 amperes D. C.

A. 1.—The size of the wire in vibrating rectifiers is usually not taken into consideration unless these rectifiers depend for their operation on the current flowing through the coils.

In many vibrating rectifiers only a slight amount of current is used to keep the arm oscillating constantly, and current may be taken off as desired.

If the amperage or the amount of current rectified is not in excess of six or seven amperes, the device may be operated safely for quite a length of time. If a greater amount of current is required, the contacts must be increased in size and shunted by condensers; otherwise sparking results at this point.

Instrument Queries

(293)—R. Phillpps, Mineola, L. I., inquires:

Q. 1.—Kindly explain the difference between a voltage transformer and a current transformer.

A. 1.—These transformers are used with measuring instruments in power stations and on switchboards where it is of advantage to step down (*a*) the current or (*b*) the voltage to a value suitable to the measuring instruments and thus prevent passing the total current through the instrument or applying the total voltage to the instrument. The instruments are calibrated according to the step-down ratio of the transformers so that they will indicate the total voltage and current. Current transformers have only one or two turns on the primary, through which the line current passes. The secondary winding comprises many turns and is connected directly to the current measuring device. In case the current measuring device is to be disconnected for repairs or for other reasons, the secondary winding of the transformer should first be short circuited; otherwise dangerous voltages will be set up in this winding. Potential or voltage transformers have a primary winding of many turns, which is connected directly across the line; the secondary coil has only a few turns which connect directly to the voltage measuring instrument.

Q. 2.—Can any ammeter or voltmeter be used on both direct and alternating current?

A. 2.—There are several types of meters that may be used for measuring both al-

How and Why?

(Continued from page 222)

ternating and direct current, such as the hot wire instruments and the Thompson inclined coil instruments.

Q. 3.—Explain the operation of overload and underload circuit breakers.

A. 3.—Overload circuit breakers are arranged to open the circuit when the current rises to a predetermined value. There are many types, but all work on the principle of a magnet pulling an armature and releasing a catch, allowing the contacts to open under the influence of a powerful spring. Underload circuit breakers are just the opposite of overload circuit breakers; the circuit is opened when the current decreases to a predetermined value. In this case the maguet releases an armature and allows the contacts to open.

Filter Query

(294)—Clare R. Tracy, Toronto, Ont., writes:

Q. 1.—Will you kindly advise how to smooth out the current from an electrolytic rectifier?

A. 1.—The current from an electrolytic rectified may be filtered or smoothed out by means of a combination of choke coils and condensers. An iron core choke coil is connected to each lead from the rectifier and then a condenser is connected across the two leads from the choke coils. The current is withdrawn from the condenser. We can give you no data on the construction of the choke coils or the condenser as we do not know the voltage or current you are working with. However, if the voltage is under 100 volts and the current is of several amperes value, the choke coils will have more effect than the condenser; if the voltage is several hundred volts and the current only a few milliamperes, the condenser will have more effect than the choke coils.

Generator Queries

(295)—G. Philip Saxer, Fleetville, Pa., asks:

Q. 1.—Can a compound wound D. C. generator be used for charging storage batteries?

A. 1.—Yes. There is no reason why a compound wound generator may not be used for charging batteries.

Q. 2.—Can a 110-volt 25-ampere compound wound D. C. generator, speed 1,850, be rewound for 60 volts and deliver 25 amperes or more at a speed of 1,200 R.P.M.?

A. 2.—The generator may be rewound for the lower voltage, but we do not advise it as the voltage is more conveniently lowered by means of a rheostat either in the shunt field circuit or in series with the generator output line. Reducing the speed will also lower the voltage. We do not advise you to rewind the generator yourself, as this should be done by an experienced winder.

Home Heating by Electricity

COAL problems are not causing any particular worry to several householders of Tacoma, Wash., because their homes are heated wholly by electricity supplied by the electric public utility company. There are three or four homes in that city where this interesting innovation has been tried with success and according to reports the families in question are decidedly enthusiastic over the idea.

It is made possible by a special electrical installation and by means of a special rate of one-half a cent per kilowatt hour, established by the electric light company. Without such special rate it would not be economical for any family to electrically heat their home.

The household making the best showing for a typical winter season consumed 26,200 kilowatt hours of electric current for heating the house through the winter. At the special rate mentioned this amounted to $131, which compares well with the ordinary winter's coal bill—is substantially lower than many such bills, in fact. This house made a slightly better record than the others. The electric current was used in conjunction with an air furnace, and a separate electric meter was installed to measure the current used.

A big advantage was the elimination of ashes and dust, the handling of ash cans and especially the necessity for early rising to start the fire up. All that had to be done was to push a convenient switch and electricity did the rest. And, as stated, the dilemnia of securing coal is transferred to the shoulders of the public utility. If the latter uses water power instead of coal, the situation is, of course, easily met.

Electrical Don'ts

DON'T leave the electric iron connected to the circuit and go to talk over the telephone, answer the door or attend the baby. It costs money for the fire department to turn out for a run, even if it is only to put out a flaming ironing board.

Don't use paper shades or other inflammable materials or decorations against electric lamp bulbs.

Don't continue to use an appliance after its connection cord shows signs of worn or frayed insulation. Have it repaired.

"Dishwasher Does Dirty Work"

I CAN do my own cooking even though I work in an office," said a business woman when asked what restaurant she patronized, "and I do not have my hands soaked up in dishwater, either. I have an electric dishwasher which does the dirty work for me."

Waterpower Plants of California

CALIFORNIA is the premier state in waterpower electric development, and in one recent year 1,172,353 horsepower was utilized. The waterpower plants of the state are valued at $143,556,838.

A 1,000,000-Volt Transmission Line

AN increasing amount of attention is being devoted by our electrical engineers to high-voltage transmission problems and water power development. In two papers, read befor the meeting of the American Society of Civil Engineers recently, the possibility of transmission at 1,000,000 volts was considered, and both authors, Mr. F. W. Peek, Jr., and Prof. Harris J. Ryan, stated that it would be necessary to have a minimum of 100,000 kilowatts of power per circuit before transmission at this high voltage would be economically feasible, owing to the great cost of the lines and apparatus. Such transmission lines should have tubular conductors 6 inches in diameter, spaced 30 feet apart on 20-foot insulators on towers about 200 feet high. No doubt the limitations on the commercial use of higher voltages than those in operation at present (the highest transmission pressure is 220,000 volts) will not be due to engineering difficulties, but rather to the location of the sources of and markets for the power. At all events, it is significant that engineers are seriously discussing the possibility of 1,000 kilo-volt lines. Though there have been great developments in power distribution, followed by industrial expansion in California, it is probable that future progress will be even greater. The whole of the Pacific Coast is within 500 miles of the extensive water power resources of either the Colorado or Columbia Rivers, and we have no doubt that efforts will be made to overcome transmission obstacles, in order to find suitable markets for the power.

London Electricity

LONDON'S electric lighting bill will be cut by $5,000,000 yearly, it is believed, when a project now in course of completion is made effective.

This provides for the uniting of all electrical supply companies in London and the suburbs, covering an area of 1,660 square miles and affecting a population of close on 8,000,000 people. There will be only 12 generating stations in the whole area, against about 50 now in existence, and the saving will allow of a reduction in cost of something like 15 per cent per unit. England is following our example in developing large plants. New York has shown how to do it.

There's Some Use Crying Over Spilled Light; Rays Should Have Right Slant

DOES your electric lighting spill over your home, or is it sprayed, without waste, attractively and comfortably to the eye, in the places where it belongs?

Imagine a pipe of water, spilling quantities of water on the lawn in just one spot. That is what the current is doing with raw light in your home unless you have seen to its proper reflection, shading and direction.

The science of illumination teaches how to spray light, without waste, by means of reflectors that redirect the light rays, thus fitting it for the eyes that must use this light and the room it must brighten.

An Electric "Wear" Indicator

MY opinion has been asked several times recently concerning the bringing out of a device to indicate or announce bearing wear by electrical means. This is an ingenious device, which inserts an insulated tube into the bearing, and permits a pointer contained within the insulated tube, to be set within a certain distance of the shaft. That is, the bearing is drilled out at the appointed place, the insulated tube

fixed, and sufficient metal left just over the end of the pointer to allow the bearing to run normally until that amount is worn down. When this wear has taken place, the wearing seal is worn through, and contact made between the pointer end and the shaft. This completes a battery circuit, rings a bell, or lights a lamp, or may be used to also switch off the power. The method is most ingenious, but hardly necessary, except with machinery in which the wear is extraordinarily rapid and unavoidable. Obviously, the equipment is going to cost something to buy and fit up, and with the excellent long-wearing qualities of most bearings, and the ample margin in hand, the device scarcely has much scope. Any engineer, for instance, who permits motor bearings to wear so much that the rotor is down on the stator before he notices the fact, is not paying the attention to his job which he should do. This device might help such a man, but it is too costly to contemplate, and the type of man concerned not worthy of being trusted with a plant.

S. E. D.'s Classification of "Electrical Fires"

FIRE underwriters and other insurance organizations have expressed interest in the proposed classification of fires attributable to electrical origin which originated with the Society for Electrical Development some months ago, and the Electrical Manufacturers' Council, among others, has indorsed the plan. This classification as recently revised and agreed upon is as follows:

1. Fires caused by defective or improper wiring, substand apparatus and installations, etc.

2. Fires caused by overfusing and overloading electric circuits.

3. Fires caused by electric flatirons, curling irons and similar devices, worn portable cords, old electrical appliances, etc.

4. Fires caused by street-railway current, automobile electric systems, high-tension power lines, etc.

5. Fires caused by static electricity, lighting and electrical disturbances over which little control is as yet possible.

This scheme not only classifies electrical fires according to their origin, but puts the blame for each clearly and directly on the cause responsible.

Resistance Wire from Scrap

A GOOD resistance wire for operating are lights or furnaces, small motors, induction coils and many other things in the experimenter's shop may be had at an electric repair shop for little or nothing. Ask for old heating elements from electric irons. The wire may be mounted on porcelain tubes or in any way to suit the builder's fancy.

The wire may be soldered together with silver solder, using borax on the joint.

Contributed by HAROLD PYLE.

How to Adjust an Ammeter

IF your auto ammeter is out of true it does not need to be taken to pieces to be adjusted. Place one pole of a horseshoe magnet to one side of the meter, then quickly remove it; sometimes the needle will go further from the zero mark, then place the opposite pole of the magnet to the same side of the meter and remove quickly. This will bring the needle to the zero mark. If the needle is only slightly off the magnet will only have to be brought to a half inch of the meter.

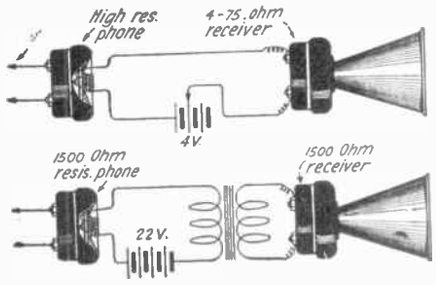
Contributed by BELGRAVE F. GOSTIN.

How to Hook Up -A Transmitter Button to Make an Efficient Loud Talker

A Transmitter button with a few dry cells and a telephone receiver will make a remarkably simple and efficient loud talker. A Microphonic amplifier of this type is just the thing for use with a radio set. The weak music and signals may be amplified many times their original value. It is possible to entertain a large audience with a simple radio equipment if a transmitter button is used in the circuit as explained in diagram A.

The cost is extremely low, and the results are comparable with those produced by highest grade of expensive loud talkers.

As may be seen in the diagram, two dry cells or a small storage battery are connected in series with the transmitter button and a 4 to 75 ohm telephone receiver. The transmitter button is secured to the diaphragm of the telephone in the radio receiving set. To accomplish this properly, scrape off the enamel (if diaphragm is enameled) on the face of the diaphragm and solder the small hexagon nut supplied with the button to the exact center. Care should be taken that the thin diaphragm is not bent or otherwisc harmed. The transmitter



button is then screwed into place. Connections, as shown in the diagram, are made with flexible wire. A horn may be placed over the low resistance receiver if desired. When the radio set is properly tuned and signals are being received, the transmitter button is operated by the vibration of the diaphragm of the receiver. As the receiver diaphragm vibrates, the mica diaphragm on the transmitter button also vibrates. The carbon grains are compressed at varying pressure; the current flowing through the local battery circuit is thus varied and results in an amplification of the sounds in the low resistance telephone loud-talker.

Diagram B, which includes a step-up transformer, is to be used with loud talking receivers of high resistance. The primary of the transformers should have a resistance of about 75 ohms. An ordinary telephone induction coil will serve as the transformer in this circuit.

You can get the above-described transmitter button FREE in subscribing to PRACTICAL ELECTRICS Magazine at $2.00 per year (12 months). Send your subscriptions today.

Make all remittances payable to Practical Electrics Co., 53 Park Place, New York City.

—Adv.

Wonderful Inventions

BELOW are given some queries just as I received them, although my answers have been embellished.

It may be of interest to some of my fellow insects to know that several new types of electric motors have been invented recently, and according to customers of the Denver Gas and Electric Light Company, they have been on the market for some time.

It is my duty to inform prospective customers as to the kind of current available in their neighborhood for power. One of these gentlemen desired to know whether we could furnish power for his 250-volt, direct current, 60-cycle, 3-phase motor. Of course I told him all our efforts at cross breeding generators had failed so far and hence no hybrid currents were available.

Scarce had I recovered from the shock occasioned by this startling request ere my ignorance was again uncovered. This time the gentleman wished to know if he could use his 110-volt, 60-cylinder motor on our lines. I tried to explain to him that only straight eights and double acting, inverse time element, reversed phase, intercompounded differential three-wire motors were allowed, but to no avail. Ere I had finished forty of the sixty cylinders backfired and sadly misused the telephone so that I failed to obtain further information concerning this wonderful invention.

Contributed by D. W. VALLOW.

Finding "Shorts"

A FUSE may blow out in some one's house, and when replaced blows again, no reason therefore being evident.

Usually a short is the cause, but finding it is another matter, for an inexperienced person. Usually it is a flatiron or a toaster or some other device, but fuses are too expensive to continue blowing them in the effort to obtain light, and they are usually scarce around the ordinary household.

Be sure one fuse is good; insert a lamp in place of the other fuse, first turning off all sockets and switches. Then turn them on one at a time; the lamp will give a dim light until the defective outlet is turned on when it will be bright. This outlet can be cut out and the others used until an electrician's services are available.

Contributed by W. C. JOHNSON.

Electrical Machinery, 1921

THE Department of Commerce announces that according to reports made at the Bureau of the Census the value of products of establishments primarily engaged in the manufacture of electrical machinery, apparatus and supplies amounted to $833,036,000 in 1921, as compared with $997,968,000 in 1919, and $333,170,000 in 1914, a decrease of 16.4 per cent from 1919 to 1921, but an increase of 148.8 per cent for the seven-year period, 1914 to 1921.

In addition, electrical products to the value of $49,003,000 in 1921, $65,558,000 in 1919, and $24,262,000 in 1914 were reported by establishments classified in other industries.

Of the 1,333 establishments reporting products valued at $5,000 and over in 1921, 220 were located in New York; 166 in Illinois; 161 in Ohio; 116 in Pennsylvania; 113 in New Jersey; 105 in Massachusetts; 73 in California; 60 in Connecticut; 54 in Wisconsin; 49 in Indiana; 47 in Missouri; 40 in Michigan; 16 in Minnesota; 13 in Washington; 12 each in Kentucky and Rhode Island; 11 in Maryland; 8 in New Hampshire; 7 each in Colorado, Iowa, and West Virginia; 6 in Oregon; 5

in Nebraska; 4 in Texas; 3 each in Louisiana; North Carolina, and Virginia; 2 each in Alabama, District of Columbia, and Oklahoma; and 1 each in Florida, Georgia, Kansas, North Dakota, Utah, and Vermont.

Four states reported products at more than $100,000,000 each. Illinois, the leading state in 1921, produced 20.2 per cent of the total value of products in that year; New York, 17.9 per cent; Pennsylvania, 13.9 per cent; and Ohio, 12.3 per cent.

In January, the month of maximum employment, 187,075 wage earners were reported, and in July, the month of minimum employment, 149,697, the minimum representing 80 per cent of the maximum. The average number employed during 1921 was 161,204 as compared with 212,374 in 1919 and 118,078 in 1914.

The general statistics for 1921, 1919, and 1914, are summarized in the following statement; the figures for 1921 are preliminary and subject to such change and correction as may be found necessary from a further examination of the original reports.

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

Of PRACTICAL ELECTRICS, at New York, N. Y. Published Monthly for April 1, 1923

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

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

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

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

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

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

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

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

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

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

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

(This information is required from daily publications only.)

H. GERNSBACK.

Sworn to and subscribed before me this 19th day of March, 1923.

(Seal.) Joseph H. Kraus
New York County Register's No. 3337.
Queens County Register's No. 2951.
New York County Clerk's No. 439.
My commission expires March 30, 1923.

OPPORTUNITY AD-LETS

You can place your ad in these columns for only 4c a word. It will pay you to read and investigate the offerings made from month to month in these columns, by reliable firms, dealers and individuals from all over the country. You are reading them now—others will read yours. Ad-lets for the August issue must reach us not later than June 20.

The Circulation of Practical Electrics is more than 57,000

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

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Large Shirt Manufacturer wants Agents to sell complete line of shirts direct to wearer. Exclusive patterns. Big values. Free samples. Madison Mills, 503 Broadway, New York.

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Send for New Illustrated Catalog of Books on Mechanical Subjects Free. Spon & Chamberlain, 122 E Liberty Street, New York.

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Enjoy Life Smoke "Old Field Tobacco." Sample 10c. Hast Mailing Company, Paducah, Ky.

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Aquarium cement resists action of water; sticks to all materials. Formula 15c. El Dorado Lab., Berwyn, Ill.

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$15 weekly, spare time, legitimate business. Capital experience unnecessary. No canvassing. Plans 25c. Harry J. Hesslein, 18 Nora, Spokane, Wash.

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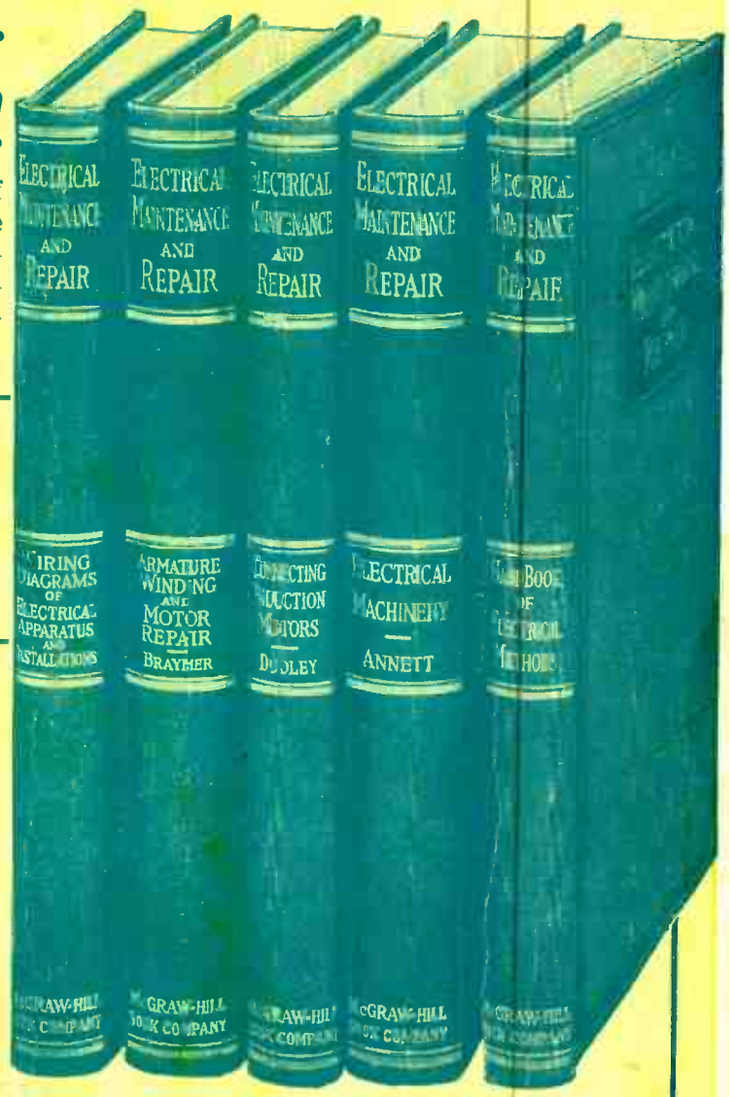

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