Practical Electrics

EDITED BY H. GERNSBACK

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July 1922

How to Make A PHONOGRAPH LOUD TALKER
See Page 354

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New York Electrical School
31 West 17th Street, New York
REMARKABLE NEW APPLICATION OF TELE-PHOTOGRAPHY

By Dr. Alfred Gradenwitz

TELE-PHOTOGRAPHY, i.e., the art of transmitting photographs, drawings, etc., to a distance in a manner similar to that employed for transmitting words by telegraphy, had, immediately before the war, reached a stage justifying its ultimate development on a commercial scale to be foreseen for the near future. For obvious reasons connected with the state of war and because all long-distance telegraph and telephone lines were taken into possession for purposes of more immediate necessity, the tele-photographic press service installed between several European capitals, e.g., between Berlin and London, London and Paris, Copenhagen and Stockholm, as well as all experimental work in the field, had to be temporarily abandoned.

However, the pioneer of that art, Dr. A. Korn, professor at the Berlin Engineering College, has just returned from Italy, where his tele-photographic methods—both those used in connection with the pre-war press service and some new ones developed in the meantime—have on the Government's initiative, been submitted to a series of conclusive and most successful tests. In a recent interview the writer received from him some interesting information on new applications of tele-photography tested in this connection.

The check represented in one of our illustrations is the tele-photographic reproduction of a fingerprint, intended to identify a criminal. Professor Ottolenghi of the University of Rome, director of the Scientific Police School, takes the greatest interest in this new development by which the tracing and capturing of criminals will be made much more effective than heretofore. When it is realized that the portrait of an original check. Just fancy the possibilities included in these wired drafts (shortly even to be supplemented by wireless ones)! The whole banking practice may be revolutionized by this innovation, the more so as signatures are in the same manner transmitted and checked over the telephone wire.

Other possibilities are illustrated—the tele-photographic reproduction of a fingerprint, intended to identify a criminal. An example of thumb or finger prints, illustrating the value of this invention for the capture of criminals.

The check represented in one of our illustrations is the tele-photographic reproduction of a fingerprint, intended to identify a criminal. Professor Ottolenghi of the University of Rome, director of the Scientific Police School, takes the greatest interest in this new development by which the tracing and capturing of criminals will be made much more effective than heretofore. When it is realized that the portrait of any suspected person, along with his or her finger-prints, can, within a few minutes, be transmitted to any distance, it will indeed be understood that the police of a near future will have much more efficient methods at its disposal than those of the present time and that the criminal's chance of escaping the avenging arm of Justice is becoming more and more precarious. This is to be more developed, as wireless methods will soon allow portraits, signatures and finger-prints to be transmitted broadcast in all directions.

The method used in connection with our illustrations is a telautographic one, i.e., a method intended for the transmission, not of shades as in a photograph, but of points and lines as in a drawing or half-tone. The original picture is reproduced on a zinc or copper sheet on which the drawing is made with some electrically non-conductive ink, and is wound on the metallic cylinder constituting the most conspicuous part of the transmitter. A metallic stylus follows a helical course, like that of a phonograph needle on its cylinder. The cylinder rotates and advances in a parallel direction to its axis, so that the stylus travelling over the whole surface of the cylinder, passes a current to the receiver every time the stylus touches a metallic point of the original picture. In order to reconstitute the picture at the receiving end by means of the currents coming from the transmitter, an apparatus of similar disposition is required, viz., a rotating cylinder on which the photographic paper destined to receive the reproduction is wound, and a recording device. The latter is of remarkable rapidity and sensitiveness and mainly consists of a string galvanometer opening or closing, as the case may be (according as to the passage or otherwise of any current from the sending station), a slot through which the light from a Nernst lamp is allowed to strike a given element of the photographic paper, thus reproducing one by one, the various "elements" of the original picture. Up to 2,000 elements per second can thus be reproduced so that any photograph, sketch or drawing can be transmitted in a few minutes. A photograph must, previous to being transmitted by the telautographic method, be converted into a half-tone by printing through a fine grating.

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World Radio History
Electricity in the Abattoir

By Jacques Boyer
Paris Correspondent, Practical Electrics

The French are inclined to admit that in model abattoirs the United States, the Argentine, Australia and two or three other countries were in advance of their own. But recently they have been attempting to bring some of their slaughter houses quite up to date.

The illustration shows the use of an electric knife; it seems that hitherto, using the ordinary knives of the old-time butchers, great skill was required on the part of the operative, so that competent specialists in butchery were very rare.

It is claimed that in the use of the older methods only 15 per cent of the hides were exempt from damage by the knife. The electric knife we illustrate, called the Perco apparatus, enables even a practically inexperienced man to do first-class work. The illustration shows the instrument in the hands of a workman. It has three wings, each carrying at its end three branches with a sharp disk on each one. These are held between two disks some four inches in diameter; a handle about a foot in length is provided for its manipulation.

A quarter-horsepower electric motor with a flexible shaft drives the knife, the wings rotating at a speed of 2,800 turns per minute. The manipulation is simplicity itself; in removing the hide from the animal the instrument is placed flat against the flesh and pushed forward, between hide and flesh, separating the skin perfectly without any damage. It works so quickly that after a few days' apprenticeship a butcher can skin the largest animal in twenty minutes. This is not considered much of a gain in time, but when it is remembered that the old-style knife injured 85 per cent of the hides, a strong point is made for its introduction in advanced establishments.

Toggle Wall Switch

The switch illustrated herewith is an interesting innovation on the ordinary type of button switch, where pressing one button inwards lights the lamp and pressing another button, also inwards, extinguishes it.

This switch is constructed on the toggle principle, and its action depends on the swinging of the little projecting knob from top and bottom of the circular aperture in the wall-plate through which it protrudes. The hand is simply swept up or down, as the case may be, over the plate; the finger touches the button and it swings across the opening, lighting or extinguishing the lamp, according to the connection. If so placed that swinging it down will light the lamps, swinging it up will extinguish them.

It can, of course, be placed horizontally, providing for a horizontal motion of the hand. It makes an exceedingly neat fixture, and the good construction of it, the substantial way in which it is put together and the effectiveness of the installation are brought out in the illustration showing the interior so placed that swinging it down will light the lamps, swinging it up will extinguish them.

There are bronze auxiliary contacts which take any arc that may possibly form, the idea being to protect the main contacts. The whole switch and plate and finger piece lies very close against the wall, the protuberance of the little knob being very slight—just enough for the finger to catch.
Electrical Heart-Beat Tests

The two illustrations show a patient being treated by what is known as the "wave bath." It is said to give heat, light and electrical treatment simultaneously. In this apparatus the patient's body never is in direct contact with an electrode, but all the action comes from the excited conductors through space, not by direct conduction.

It is said that the machine takes the place of five large-sized pieces of apparatus formerly used in succession, one after the other, to give the same treatment, which is here given at one time and in one process.

The patient shown in the picture, who certainly does not look like an invalid, is Miss Florence Macbeth, famous soprano. From all appearances she is enjoying the treatment and we hope she is receiving benefit too.

It often happens that electricity as applied in therapeutics, is quite disagreeable. The electrodes give the tingling effect which is not tolerated by everyone, but here we seem to have a milder system of applying the electric discharge, which appears to be tolerable by delicate patients, the discharge being of course modified by its distance from the surface on which it is operating. The different positions which the patient can take, open up quite a range of possibilities. The patient in the illustration is really an invalid, although her appearance would belie any such assertion.

It is rather interesting to see on this page two typical applications of electricity, the one to diagnosis, registering heart action permanently for future reference during the treatment of a case,—the other, the purely healing application of the electric agent, to effect a cure where perhaps an electrical diagnosis has indicated what the ailment of the patient is.

Electro-Magnetic Wave Bath

A very elaborate apparatus for registering the trace describing the action of the heart has been installed in one of the great English hospitals, The National Hospital for Heart Diseases, London. The electric cardiograph is taken to the ward or room where the diagnosis of a patient or applicant is to be obtained.

Here the instrument does its work and the interesting feature is that the heart action as interpreted by the electrical instrument is telegraphed to any desired place in the hospital. In the illustration the electric cardiograph proper is supposed to be three floors removed from the registration instrument, so while the patient is having his heart action tested, it is in a room three stories below that the recording instrument, actuated by the heart beats telegraphed to it, receives the traces of a stylus on a paper strip, so that the patient knows nothing about the story told, or of the history of his case, which is often a desirable situation.

It will be seen that in this way the records of a great hospital may all be taken in one room and the information for the diagnosis is placed there on file.

Another advantage of the system is that the permanent records produced are all kept filed away so that the changes from time to time and new developments can always be watched for.

Above—Electrical wave treatment received by a patient in a recumbent position.

Right—The patient sitting up in a chair receiving wave treatment in a different position.
High-Power Lightning Flash

WE reproduce the photograph of a very wonderful lightning flash which was taken shortly after midnight in a Western city.

Those who know the Northwest will see in the horizon line of trees a feature identified with much of the scenery there. Visitors to Vancouver will recognize this feature, the background of the Canadian Pacific terminal, which is crowded with trees, most of them denuded of foliage by forest fires, forming a characteristic setting for the houses.

The high degree of illumination produced by the discharge is a very remarkable feature, because a photograph of a lightning flash rarely shows so much of the country and so much of the foreground as well portrayed as we find it here. The reader will notice that even the letters on the advertisement signs can be read.

It brings out, too, another interesting feature of the lightning flash—the accepted artist's reproduction of the lightning flash is a zigzag, whereas actually the line taken by lightning is strictly sinuous, the zigzag being practically unknown, as all photographs of these discharges demonstrate. The power of this discharge must have been incalculably great. It would be a curious speculation if the lightning discharge lasted for a minute, or even for a second, to determine the full energy. The shortness of its discharge, a minute fraction of a second, goes to indicate that the electric energy in the clouds is not anything great. It is the potential only that is enormous.

One of the latest developments in the way of a lightning arrester provides an air gap for the discharge to spring across to the ground. On one side of the air gap is what is known as a flash rod, connected to the line, and providing a great number of minute gaps. Then there is a main discharge gap to the ground. The flash rod is ready with the increase of voltage or frequency to induce a discharge across the gap. When the surge comes it forms an arc, and at each end of the flash rod and gap there are horns diverging at the top, which catch the arc and dissipate it.

The Teletype

A transmitter which sends a telegraph message to a receiving station and caused it to be printed there by the receiving instrument.

The combined receiving and transmitting instruments; the keyboard is used for sending and is copied from the standard typewriter keyboard.

The receiving instrument; the message is printed on the tape, which is seen emerging from the left of the instrument.

A diagram illustrating the five-interval system on which the Teletype is based.

The signalling code which transmits the character is the five-unit code. If a given unit of time is divided into five intervals, current may be transmitted in any one interval, or in any two variously spaced, and so on for three and four intervals until current is transmitted into all five, or current may be transmitted in none. If this be followed out it will be found that 32 combinations can be made in this way. These 32 take care of the alphabet in one series, and of numbers and varying signs in the corresponding parallel series, like the shift in the typewriter.

It is out of the question for us, within the limits of our space, to describe the exact mechanism. Of course, in any machine of this sort the problem of synchronizing comes up. The way this is regulated is somewhat similar to that used in the transmission of pictures by telegraph. The receiver shaft, the shaft of the distant receiving instrument, is made to rotate slightly faster, 14 per cent is the figure,

(Continued on page 370)
Combined Cigarette Picker and Lamp

A cigarette holder at the base of a lamp, with a stock which, when the finger presses a key, automatically picks up a cigarette for the expectant smoker.

This appliance is a very nice addition to the cigarette smoker’s table. A rectangular box holds cigarettes and from the box a lamp standard arises, carrying an electric lamp. Towards the edge of the box there is a plunger, which, when depressed by the finger, opens the lid of the compartment containing the cigarettes and makes a little bird bob over and pick up a cigarette from the selection below. On releasing the plunger it springs up, the bird goes back to its position, the lid closes, and the smoker has a cigarette at hand, ready for use, presented to him by the bird.

The combination is a most attractive one, and, as the illustration shows, the decorations of the box show an oriental strain, in accordance, we presume, with the bird. The Nipponese artists are specially fond of storks and it will be seen that the birds on the box have all the life given them that one anticipates from the Nipponese artists.

A very prettily designed incense burner and deodorizer for the smoking room and for the boudoir in the present day, when ladies smoke cigarettes, is presumably highly to be desired. Here we have a young lady seated at the base of the lamp, the function of which base is to hold a burner which disseminates incense or a special vapor which will effectively cope with the odor of tobacco left in an apartment by a smoker.

We have already illustrated a number of electrical incense burners, which are really getting to be a quite attractive phase in the application of electric current.

The incense burner proper is contained within the base of the lamp, which accounts for the large size of the base. The lamp burning in the shade above it produces an up-draft, so that as the smoke or perfume issues from the base it will be caught in the air currents due to the lamp and disseminated through the upper part of the room.

This quick dissipation of the perfume is one of the improvements claimed for the combined apparatus.

Small Charging Rheostat

The illustration shows a very compactly constructed resistance box to be used in charging storage batteries from direct current sources such as power or light lines, generators such as are used on farm equipment, or other isolated plants.

A rheostat for charging small batteries, mounted in a network case so as to be perfectly cooled; change of temperature, changes the resistance of most metals.

It consists of a series of resistance coils, which are arranged to be connected in series or parallel, or in other arrangements, so as to modify the resistance as required. The illustration shows that the coils are very well ventilated, which avoids overheating, and the whole apparatus is only 5 1/2 by 9 inches and weighs but ten pounds.

The general idea of the different types made is to give a charging rate varying from a very low figure of only 2 or 3 amperes, up to as high as 12 amperes, and they are constructed for three voltages.

One voltage is 22, which is the potential generated in the standard farm plant. Another one operates at 110 volts, and yet another at 230 volts, thus taking care of the standard lighting circuit.

A minor feature is the handle, by which it can be lifted about, and shifted around as desired — making a very convenient piece of apparatus, and one which is adapted to take care of the conditions encountered in every-day practice.

We have had frequent occasion to describe in our columns applications of the fan motor for doing various things about the house or laboratory. The fact that a number of suggestions of this nature have reached us indicates that there is really a field for a small motor adaptable for many requirements. The one we illustrate is a most convenient piece of mechanism which has been developed for laboratory and amateur workshop use and for experimental work. One of its uses is for experimenting with centrifugal and rotary phenomena.

Much work is to be done in this line.

The attainment of kinetic and dynamic balance in rotating machinery is still to a certain extent a desideratum. To the scientific lecturer, too, a whirling apparatus is of use for his demonstrations in centrifugal and rotary phenomena.

The motor is cylindrical in shape, 3 1/2 inches in diameter and 4 3/16 inches long. The shaft, 1 1/16 inches in diameter, extends out 1 inch from each end. The motor is carried by a pedestal. To the top of the upright of the pedestal it is attached by a swivel joint, by which it is possible to tilt it in any direction. A thumb-screw fixes it in the desired position. The support contains two sockets, one vertical and one horizontal, which still further increases the range of position which is possible with the motor.

The base of the pedestal contains a speed regulator by which a very complete variation of speed can be obtained.

The motor is wound for a 110-volt circuit, and worked on either direct or alternating current, whose frequency may vary from 25 to 60 cycles. Its maximum no-load speed is approximately 30,000 revolutions per minute. In the full load the speed drops down to 6,000 revolutions per minute, and the motor then develops about 1/20th of a horsepower, or not far from 25 watts. Its weight is about eight pounds.

Laboratory Motor

A very neat and compact little laboratory motor which will find uses for many purposes, even in ordinary household work. It can be inclined at different angles for all requirements.
**True Electrical Experiences**

Including Description of Some Electric Problems Encountered in Practice, and Their Solution

(Continued)

*By H. Winfield Secor*

Associate Member, American Institute of Electrical Engineers

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An accident which might have been a very serious one, due to the fact that the electrician stood upon a wet support. A very bad shock was received.

In the June issue of this journal, the writer described in his article entitled "True Electrical Stories," some rather unusual experiences, and in the present paper, he will endeavor to explain a few practical problems which he has faced in his experience, with their solutions, which may be of value to the electrical student.

Some years ago when the writer was a "trouble-shooter" for an electrical repair shop in Philadelphia, he was sent to a fish market to repair a chandelier, which illuminated several large marble slabs or tables on which oysters were opened. For several reasons, it was hardly possible to replace, but even then the sensible electrician will always see what he is standing on before he touches a fuse, unless both fuse terminals are rendered absolutely dead by suitable cut-out switches. Usually, however, one side of the fuse terminals is left alive, and care must be taken to see that you do not stand on damp ground or on any metal object, such as a register, which may be grounded through a heating or other system, as an unpleasant shock may be obtained when the screw driver or the fingers of one hand touch the live side of the fuse.

Small cartridge fuses can be plucked from their spring clips straight outward, and should be inserted the same way. Large cartridge fuses invariably have to be removed by pulling first one end out and then the other. Removing cartridge fuses is greatly facilitated by employing a pair of pliers made of fibre or bakelite, after the design shown above. In removing link fuses more care has to be exercised than in the case of cartridge fuses, as when the screws are loosened, the fuse may loosen and fall across to the metal fuse box or to another terminal, and cause a short circuit which may melt the wire with a terrific flash and injure the eyesight or burn the hand. It is a good idea to place a piece of rubber packing, cloth, fiber, cardboard or any good insulator like this, at least between the link fuses, and preferably around both sides of the bottom of the box, so that the screw driver cannot touch the live fuse terminal and the metal box. It is surprising how frequently otherwise, one will drop a screw driver or a pair of pliers across terminals, so as to make contact with one live terminal and the grounded conduit box, causing more havoc.

Did you ever connect up a long string of lamps for a lawn festival or picnic, and when you threw the main switch, find that the lamps toward the far end of the circuit were burning much more dimly than those nearest the switch end of the circuit? The writer remembers a case like this, and no doubt it has happened to many readers. Referring to diagram, you will see clearly what is meant: at A the 500-foot circuit with lamps spaced say 10 feet along it, is fed from one end, and the solution of this problem so as to give an equal potential to each lamp, is to connect one of the feed wire cables to the opposite end, as shown in B. By tracing the circuit through the lamps at either extreme of the run, it becomes evident that the length of circuit through the feed wires and any lamp is practically equal, thus equalizing the voltage distribution among them. Another way of more equally dividing the voltage drop on such a long circuit, is to connect the feed wire cable at the center, instead of at one end.

What would you think of the following electrical conundrum? Suppose you were called in to look at a dynamo, and it was explained that when the dynamo was started up and brought to normal speed, the voltmeter on the switchboard indicated full voltage, while the pilot lamp on the machine also glowed brightly; but when the lamp load was connected to the
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been effected, and the nuts had not been put in place before the engine was started. The result of this was that the wires had been ripped loose from the terminal connections on the dynamo connection block, and while they looked as if they were in their proper places—the answer was that they distinctly were not—and the diagram clearly shows that two of the wires were transposed. With the aid of a series field, and the natural residual magnetism in the iron field frame, the machine would build up and register approximately full voltage; but load on the shunt field winding being short-circuited on itself, there was not sufficient field strength to take care of the load, and so the voltage fell off rapidly. When this fact was ascertained, and the lead wires replaced in their proper positions, that is, simply transposed, the dynamo took care of its load without trouble.

The testing of compound wound dynamos and motors is not one of the easiest conditions involving scarcity of instruments are such that the correct polarities of the series and shunt field poles cannot be determined. One of the members of our old armature connected as shown here at (A). A good and practical way of determining polarity in the field, with simple appliances.

The trick we refer to, of making these tests in the field when rheostats or other apparatus was available, such as a storage battery or a lamp bank to permit of passing sufficient current to magnetize it for testing, resolved itself simply into operating the machine as a series motor (even if it was a dynamo), by quickly opening and closing a switch connecting a 110 volt supply with the series field and armature connected as shown here at (A). If the armature spun in the right hand direction, let us say, viewed from the pulley end of the machine, then this was checked with another resistance in series with the armature. The usual way, and the direction of the rotation of the armature noted. If the armature rotated in the same direction as the case may be; in the differentially connected machine, the series field windings "buck" the shunt field windings, for reasons which do not have to be explained here, but both of these types of connections are fully described in dynamo and motor text books.

In making shop tests, the polarity of the field poles due solely to the series or heavy windings, is determined by passing a fairly heavy current through them from a rheostat connected in series. Then a second test is made with the shunt field, checking up the polarities in both cases with a compass needle or otherwise.

The result of this was that the wires had been transposed from its base in the morning, due to the fact that some change in the driving arrangement had been produced, especially after the circuits had been tested and found to be complete through the field and armature; but by mental deduction and a little questioning of the engineer in charge of the plant, it was suspected that some of the connections on the dynamo connection block, in which the wire terminals acted differentially. Usually it will be found feasible to connect a lamp bank or other resistance in series with the armature circuit, shown at (A), as the fuses are liable to pop when this trick is tried, unless the series field has a relatively high resistance. In making the test as a shunt machine with the series field cut-out, i.e., the second test referred to above, the usual connections for any shunt machine should be followed, the resistance being cut out of the armature circuit gradually, to allow the machine to accelerate. If you try to connect the 110 volt supply circuit directly across the armature and shunt field, the low resistance of the armature will be very likely to cause it to be burned out, and in any event will blow a string of fuses clean back to the power station.

A permanent steel magnet, used to determine the polarity of different parts of a field—like poles repelling, the unlike poles attracting. With powerful fields, or for other reasons, it is not always desirable or possible to bring the compass needle up close to the poles, which may cause it to be demagnetized and remagnetized and cause confusion and a mistake in the test. To prevent overpowering the compass needle therefore, it is a trick among experts to use a screw driver or piece of iron bar, one end of which is placed in contact with the pole face or shoe under test, and the compass needle is then brought near to the other end of the iron bar. (C) shows well how two iron bars (files or screw drivers have been used) may be employed to determine the polarity of two field poles. If the two poles are of opposite polarity, then they are of the same polarity and the terminals of the coil at one of these poles should be reversed in order to correct the polarity.

A compass needle is not always at hand and some other method of testing field poles is always welcome; (C) shows well how two iron bars or other drivers have been used) may be employed to determine the polarity of two field poles. If the two poles are of opposite polarity, then they are of the same polarity and the terminals of the coil at one of these poles should be reversed in order to correct the polarity. The testing of compound wound dynamos and motors may not be amiss, armatures connected as shown here at (A). A good and practical way of determining polarity in the field, with simple appliances.

Another simple method of determining the polarity of adjoining poles of a stator.

Trouble shooting—staff used to have a trick way of determining whether or not the shunt and compound fields were magnetizing the poles on their union or differentially. Usually, it should be stated, the shunt and compound or series field windings act in unison, that is, each magnetizes one end of the pole north or south,

As in both tests, the fields were connected in unison or aided each other; if the armature rotated oppositely in each test, then the shunt fields were bucking or acting differentially. Usually it will be found feasible to connect a lamp bank or other resistance in series with the armature circuit, shown at (A), as the fuses are liable to pop when this trick is tried, unless the series field has a relatively high resistance. In making the test as a shunt machine with the series field cut-out, i.e., the second test referred to above, the usual connections for any shunt machine should be followed, the resistance being cut out of the armature circuit gradually, to allow the machine to accelerate. If you try to connect the 110 volt supply circuit directly across the armature and shunt field, the low resistance of the armature will be very likely to cause it to be burned out, and in any event will blow a string of fuses clean back to the power station.

A few words on the testing of north and south polarities of the field poles of dynamos and motors may not be amiss. An ordinary pocket compass, the smaller the better, is moved slowly from pole to pole; drawing the compass away from the pole, as indicated by the dotted line, and then moving it toward the second pole as in (II), the two alternate poles, if they are north and south polarity, will attract opposite ends of the compass needle.

With powerful fields, or for other reasons, it is not always desirable or possible to bring the compass needle up close to the poles, which may cause it to be demagnetized and remagnetized and cause confusion and a mistake in the test. To prevent overpowering the compass needle therefore, it is a trick among experts to use a screw driver or piece of iron bar, one end of which is placed in contact with the pole face or shoe under test, and the compass needle is then brought near to the other end of the iron bar. (C) shows well how two iron bars (files or screw drivers have been used) may be employed to determine the polarity of two field poles. If the two poles are of opposite polarity, then they are of the same polarity and the terminals of the coil at one of these poles should be reversed in order to correct the polarity.
New Things Electric

English Marine Ovens

Two views of an English electric oven, designed especially for marine use; the left hand view showing the oven divided into six compartments, the right hand view showing another type with fewer divisions.

Our illustrations show electric ovens manufactured by an English firm, and especially designed for use on shipboard. They are constructed of steel plate with several ovens. In some there are heating elements above and below so as to secure any distribution of heat, and as each set of elements is controlled by its own switch, any effect may be produced in the oven, in the way of top or bottom heating as may be required.

The ovens are provided with a window in the front, and a light at the back, so that the interior can be inspected at any time without opening the door—which would seem to be quite desirable. The doors are secured in different ways; in one construction the rotating of a central handle shoots out four bolts, above and below and to both sides. In another oven a simple connection at the opening end is used.

A steam boiler with glass water gauge, safety valve and automatic water feed is a part of one type of oven. In this oven there are several compartments, and provisions are made for steam heating. Thus, two widely different types of oven are produced. There are steam jets provided for each oven, in order to secure steam cooking.

The total loading ranges from 10 to 30 kilowatts; for cooking cannot be done without heat, and heat resolves itself into power.

Bird Lamp Shades

Small Battery Chargers

A lamp shade in the shape of a bird, a very pretty and suggestive design which can be modified and worked up readily.

From our English cousins comes the very pretty lamp shade illustrated here, of which quite a series is manufactured. The series are all reproductions of birds, the bodies made of cork and silk-covered. The spread wings of silk as well as the body and expanded tail, are hand-colored, so as to produce certainly a very life-like effect and really an ornamental one.

It is quite the fashion now to avoid absolutely direct illumination, and these pretty little birds, hung as shown in front of the bulb, prevent light rays from reaching the eyes of the observer directly, while light is disseminated through the apartments. The birds are supplied in all colors, as well as the body and expanded tail, as we would call them, are supposed to be adapted for theatres and restaurants as well as for private houses. We presume that for Maeterlinck's use, a bluebird lamp-shade would be in order.

The illustration speaks for itself, and the shields, as they are called, or shades, are hand-colored, so as to produce certainly a very life-like effect and really an ornamental one.

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The machine contains a transformer, which cuts down the voltage of a lighting circuit to a maximum at the terminals of the secondary, of 12 volts. From one terminal of the secondary a wire goes to the 12-volt binding post. From the center of the secondary another wire goes directly to the 6-volt positive post. As the central connection makes only half the secondary active, the possible terminal voltage of 12 is cut in two.

The electro-magnet coil is in parallel with a 6-volt division of the circuit. The other terminal of the secondary passes through the armature of the magnet. At the other end of the armature is an adjustable contact, so that a make-and-break is established here. When attracted, the

(Continued on page 379)
A marine dynamo, with all parts enclosed as far as possible, protecting it from moisture incident to marine conditions. The lay-out is a model of completeness and compactness.

This dynamo illustrated by us are designed for marine use, for supplying the lighting circuit and charging storage batteries. The description of the machine implies two qualities—that they are constructed on conservative and established lines, not on anything novel, and that the best materials are used so as to secure high efficiency.

Soft electric iron is used for cores of field and armature to secure the best results in establishing a field of force. The armature is laminated, of course, and made up of punchings, in accordance with the usual practice. The armature slots are insulated with fibre, and the armature windings are double insulated, while the field windings are made up, taped, and baked before being inserted into their place in the field. The commutator is often a source of trouble, and in this case is made of special copper; the enamel insulation between the leaves of the copper is supposed to wear away at an equal rate with the copper. Such, at least, is the statement of the manufacturers.

The generators are all small sized and are given ball bearings which are very reliable for light machinery. Storage batteries may be floated on the line, in which case an automatic control connects and disconnects the battery, according to the voltage, so that when the battery voltage runs down, the generator is automatically thrown into circuit to recharge it. Zinc plating, so-called galvanizing, is used where required, and the general finish of the apparatus is a baked enamel. It may be regarded as well protected against rust—a great trouble on the salt water.

Some of the generators are adapted for charging Edison storage batteries in motor boats. The Edison battery can be charged with a very heavy current, and these machines will give it.

Another feature of this machine is that the adjustments are done away with—all positions of parts being fixed.

Another view of the dynamo, showing how by tipping it on its frame the belt tension may be regulated, this being a substitute for the ordinary system of slide-rest.

A four-wheeled car carries a 1½-horsepower motor, wound to match the house circuit. This operates a series of centrifugal fans, with a speed of 3,500 revolutions per minute, which arrangement gives 44 inches' water gauge vacuum, and passes 130 cubic feet of air per minute. The dust separator, it is claimed, is so perfect that the exhaust of the machine can be used for blowing purposes while the vacuum end is cleaning. In some cases this gives the cleaning a double speed, both ends working at once. The whole, including motor, fans and dust receiver, with its case, are carried on a channel-iron frame with ball-bearing wheels.

As the illustration shows, most of the weight of the apparatus is on the left of the center; the wheels on the left end, whose axle is under the motor, are of large diameter, while those in front, which have only comparatively little weight to (Continued on page 879)
THE present high cost of fuel and labor demand the employment of efficient labor-saving devices in order to keep down the cost of production and successfully meet competition. One of the most novel of labor-saving devices is, no doubt, the present electric rivet heater which has just made its appearance in England.

The furnace is of the resistance type, to be operated on single-phase direct current circuits. In the furnace, the rivets being heated by conduction and radiation in actually a non-oxidizing atmosphere. There being no products of combustion to be dealt with, the rivets are heated under ideal metallurgical conditions. They are fed into the furnace with the shank foremost, and are automatically discharged at the other end of the furnace at the correct temperature for riveting.

The rotation of the cylinder effects the travel of the rivets through the furnace, the speed of rotation being adjusted to give the output of rivets required per minute. In the event of the rivet being fed into the furnace with the head instead of shank foremost, the rivet is automatically discharged at the feed end of the furnace, making the apparatus fool-proof against improper feeding.

Rivets smaller in diameter than the maximum size for which the furnace is constructed, are automatically heated and discharged, the correct efficiency being thus maintained, although the speed of rotation of the furnace may remain constant. The time taken for a rivet to travel through the furnace is dependent on the speed of rotation, the size of the rivet, and the rate of travel. The length and diameter of the rivet. As an example, when heating rivets of the same diameter but of unequal length, the heavier rivet takes longer time to travel through the furnace, thus automatically obtaining the longer time element required for heating a large mass of metal to the same temperature, and vice versa, when heating small rivets.

These unique features enable this rivet heater to operate at practically full load with maximum efficiency, irrespective of the size of the rivets which are being heated. The electrical gear for controlling the motor and current input to the furnace is mounted on a panel conveniently situated for easy control. The motor and heating circuit are electrically connected in parallel, so that when the motor is stopped the current is automatically cut off from the heating circuit. Tests made with the type of machine illustrated demonstrated that 150 rivets, three-quarters inch in diameter and two inches long, were heated with current consumption of 5 B.O.T. units, inclusive of the current required for driving the motor. The time required for the rivet heater to reach its maximum temperature from the first opening of the switch is approximately 26 minutes. The heating chamber is of special refractory material, capable of standing temperatures up to 1,000° Centigrade without softening or distortion. The heating element consists of a winding of special alloy wire and the method of winding adopted is one which eliminates all electrical joints, providing ample provision for expansion and contraction due to thermal effect.

Recently we illustrated a rivet heater of widely different construction in which the principle of the electric welder was utilized for heating each rivet individually. In its use the attendant had to put in each rivet individually and according to the width of the machine more or less rivets could be heated simultaneously—the idea, of course, being to heat them just as rapidly as the attendant would take them from the clamps and replace them one by one. In the machine, which represents the English version, the automatic feature appears, and it would seem to be exempt to a great extent from the danger of overheating, which is at least suggested by the incandescent system utilized in the other machine. It hardly appears natural to find our cousins across the sea surpassing us in the introduction of the automatic feature into a mechanism.

It would certainly seem a great advantage to be free from such detail as the placing of the rivets one by one with at least some degree of accuracy in the clamps.

The European solution of the problem of heating rivets is this English machine working automatically, and which seems to embody the intelligence of a rivet boy.

New Electrical Massage

The Montefiore Hospital in New York has been giving a great deal of attention to the use of electrically driven apparatus for treating certain types of illnesses. This development is somewhat in the line of massaging by machinery.

One of our illustrations shows a patient having the muscles of the back massaged by a rotating apparatus, which carries a series of rollers, mounted in cylindrical contour, which is turned around, while pressed against the back. The object is to restore muscles to their proper strength and flexibility. Other cylindrical surfaces than the roller arrangement can be applied to the back, so that, by the use of different rotators, any variety of massage can be given.

Another illustration depicts the treatment of the feet by a foot-vibrator. The patient is having the soles of the feet massaged by the rotating cylinder shown. The machine illustrates a vigorous massaging applied to the soles of the feet, probably more intense than could be done by hand.

The results of these mechanical appliances the authorities at the hospital seem to have found very beneficial. The main object in all this treatment is to restore the use of atrophied muscles.

Our readers will recognize in this massage apparatus an excellent substitute for the "Volvetti Ofn," of which we have so much now. It is impossible that such massaging as here produced would be most beneficial to the patient, and it certainly is a great point that it can be done by the all-adaptable electric current, without requiring the assistance of the professional masseur or masseuse.

There are, of course, innumerable other applications which could be carried out in this line for electricity lends itself to every possible variety of treatment. In both cases illustrated here the degree of pressure is left to the judgment of the patient herself.

It is evident that this apparatus would lend itself to electric excitation along with the mechanical massage, that the always thought prudent to permit a patient to apply electric treatment to himself to any extent that may appeal to him, but this apparatus certainly suggests the possibility of applying most efficacious electrical treatment.
Combined Bell and Buzzer

Electric bells have a mysterious way of announcing by his signal, ring or buzz which rings, and on pushing the other, the buzzer sounds. In this way a visitor announces by his signal, ring or buzz which door he is at. A single apparatus does the work. When one button is pushed, which may be at the front door, the bell signal may ring; then the button at the other door when pressed will cause the buzzer to sound, and the reverse arrangement can be brought about by shifting the connection. It is a sort of two-in-one apparatus, for ordinarily there would be a buzzer for one door and a bell for the other.

Electric bells have a mysterious way of getting dirty. The appliance we describe is so completely enclosed, bell and all, that there is no chance for dirt to get in.

We have all heard of the Wisconsin Idea. This term is applied often to some of the many new ideas in politics, and the administration of law originating among the inhabitants of this progressive State. Now we have their idea of how to light a cigar and study an advertisement simultaneously.

Within the case shown there is a reel which carries 17 different advertisements. As the reel turns, the advertisements are shown, one by one, through the window in the top of the case. Alongside the window is a cigar lighter, and below is a switch handle. When the switch is depressed, the cigar lighter becomes hot and ready to light the cigar. To its left, an advertisement, one of the 17 varieties, is displayed for the contemplation of the smoker.

The current is supplied from the regular service line, so that no battery is needed; the machine takes care of itself.

Compared Storage Battery and Charger

W e illustrate a very interesting example of a storage battery enclosed in a wooden case which it half fills. The other half of the case contains a rectifier, so that there is a complete battery and rectifying plant provided. The battery is seen on the left and the rectifier is on the right of the case.

The right-hand compartment, as we look at the battery, contains a rectifier, so that an alternating current lamp socket can be used for charging. The combination of the whole thing in one case and the arrangement by which for charging nothing is necessary except to tap the every-day lamp socket, constitutes a most convenient battery.

One of the interesting points about the storage battery on an automobile is that it is constantly being automatically charged. No one gives any attention to it, and

here we certainly approach the automatic principle, for the moment one notices the voltage being somewhat low, or finds the electrolyte falling in specific gravity below the proper amount, a few seconds connects it to the house circuit, and the charging operation begins, and is completed in one night.

We add to this description the following items from "Things Worth Knowing About a Storage Battery," which we are sure will interest our readers:

That a battery receives its life acid at its birth and should receive no more.

That a battery will freeze at zero, when half charged.

That a battery can stand 90 degrees below zero when fully charged.

That a battery that has been frozen once, never regains its former strength.

That it is very injurious to a battery to let it stand in a discharged condition.

That it is as injurious to overcharge a battery as it is to have it stand in a discharged condition.

That a fully discharged battery requires from 24 to 36 hours to recharge.

That a fully charged battery should read 2% volts when connected to a 5-ampere charging line.

The reason why overcharging may injure a battery is because it is liable to become heated, and this injures the plates.

It is little less than astonishing, however, to realize the abuse which storage batteries will stand. This is seen on automobiles which start badly, and where a battery has its charge drawn upon far in excess of the proper maximum.
Gasoline Supply Alarm

This description and diagram is of an automatic gasoline supply alarm which can be used on any make of automobile.

Near the bottom of the tank is connected a small cylindrical chamber in which is laid a wooden float with a thin strip of conductive material, copper, fastened to the inner side of the float. On each end of the float are two knobs, one of which is on a level with a similar one in the side chamber. The circuit is made up of an electric bell, a lever switch for breaking the circuit when not needed and the battery, either storage or dry cell. As the gas is being used, and as its level sinks, the float reaches the bottom of the side chamber, closes the circuit by touching the two knobs and rings the bell, which warns the driver that his gas supply is low.

Contributed by HOWARD J. STOVER

Protective Circuit Alarm

The ordinary automobile generator, when connected in circuit with the starting battery, delivers between six and seven volts. Should the circuit be opened while the generator is in operation the generator voltage will immediately rise to approximately twenty-four volts.

The generator designed with low resistance for the six volt circuit will have enough amperage forced through the internal circuit by the higher voltage to cause excessive heating. As a result, the shunt field will be burnt or the solder will be melted and thrown out of the commutator by centrifugal force.

The burning out of generators, accompanied in many instances by the burning out of all lights on the car, from this cause, happens frequently as automobile electicians well know. The reason for the increase in voltage requires no lengthy explanation. The battery circuit, having lower resistance than the field circuit, takes most of the current delivered by the armature. Upon opening the battery circuit, the shunt field coils, receiving the current that formerly went to the battery, build up the field magnetism, the increased strength of the field flux in turn building up the armature voltage until the results mentioned obtains.

An attachment to prevent damage to the electrical equipment is herewith described. One side of a twenty-four volt lamp (1) is connected to the positive terminal (A) of the generator. The other side is connected to a ground or the negative generator terminal depending on whether the car has a grounded or two-wire system. A resistance (C) which is approximately of the same value as the resistance of the battery, is shunted around the lamp in series with a single pole switch of any type. This switch is normally left open.

In operation, when the battery circuit is closed, the six volts generated are not sufficient to cause the bulb to light up. The small current which leaks through the lamp is negligible. However, in case of an accidental open circuit in the main line the rise in voltage will cause the lamp to light. When the lamp lights, the switch is to be closed, throwing the resistance in the circuit, the resistance then taking the place of the battery in holding down the voltage. The lamp will then go out again, and it will be safe to continue driving until an opportunity presents to get to a service station, where the trouble may be remedied.

The globe and switch are to be mounted on the instrument board, where the lighting up of the globe would immediately come to the attention of the driver.

It would, of course, be possible to close the switch automatically by means of a cut-out such as is used in the battery circuit, but that would defeat the purpose of the arrangement which is to draw the operator's attention to the fact that trouble exists.

Contributed by ARTHUR C. BONN

Some of the Interesting Articles Appearing in the July Issue of Radio News

Portraits Radiated Through the Ether. By Dr. Alfred Gradenwitz.

The Development of Radio on Airplanes in France During and Since the War. By the Paris Correspondent of Radio News.


The Simplest Storage Battery

From a French contemporary we take the following description and illustrations of a very ingenious and simple storage battery, whose construction is so obvious that the illustrations alone almost tell the story. We translate the following description from La Nature:

The new battery which we present here solves some of the troublesome problems where the private person wants a high potential storage battery. Instead of using, as is the custom, battery jars of glass or celluloid, one alongside the other, and connecting each element to its neighbor, by a small conductor, for getting the requisite voltage, the battery jars are here piled up, one on the other, exactly like a Volta pile, built up with discs of copper and zinc.

But that which constitutes the originality of the system is that these plates are in the form of trays, are made of lead, and are at once negative electrode on one side of the metal, and positive on the other. The metal of the tray acts as the conductor between the two poles, little blocks of insulating material between the trays maintain their proper separation, and it is enough to fill the tray with acidulated water of the storage battery strength, to constitute a battery answering all small requirements.

The standard model is contained in a glass jar and gives a potential of 40 volts. The use of a glass-enclosing vessel makes it possible to carry the battery about without danger of spilling the acid on the floor or on one's clothes.

On the other hand, it is possible to construct these batteries of any desired potential in individual installations, at little expense—a very interesting feature. Charging can be accomplished very easily, and at a high rate, without any danger, from any source of direct current or rectified current, as long as the voltage of the circuit used is greater than that of the battery.

The filling is very simple; finally, in case of accidental sulphation, due to neglect of maintenance, it is easy to take down the battery completely, to wash off each electrode, and to obtain, after a somewhat prolonged charge, a completely new battery, so that the duration of these little batteries is almost unlimited. The bottom of each tray is corrugated.

An Alternating Current Battery

By Raymond B. Wailes

We generally think of a cell, whether wet or dry, as giving out a direct current of electricity. A small cell which actually produces an alternating current can be assembled by the experimenter.

Two sheet iron electrodes are required. They must be brightly polished and free from grease. These electrodes when placed in a chromium acid solution constitute an alternating current cell. The chromic acid solution is made by mixing 1 part of sulphuric acid with 5 parts of water and allowing to cool. A strong or saturated solution of sodium (or potassium) dichromate is now made, and equal quantities of the dichromate and acid solution are mixed and placed in the battery jar or other container.

It is best to use an indicating instrument of fair sensitiveness, and one that has its pointer or needle in the middle of the scale, so that different flowing currents produce a different needle deflection. If an instrument of this type is not available, the needle should be moved, by means of the adjusting screw, from zero to a point near the center of the scale.

When the electrodes are immersed, the pointer or needle will move in one direction, away and then return to the zero point, then pass it and go to the other side of the scale. After this, the needle comes again to zero and swings to the initial side as before. The deviation will continue for some time.

It is thought that the action of the hydrogen in the chromic acid electrolyte has a bearing upon the alternating current which is produced. Probably the acid causes the iron to become passive, with the production of an electric current, this production being gradually influenced by another passive-phase, generating a counter-current.

When iron is made passive, it sometimes assumes a condition when strong acid will not attack it; immersion in nitric acid has this effect, and it is sometimes accounted for on the theory that magnetic oxide of iron is formed, coating the metal. This principle has been applied in making iron rust-proof.
Phonograph Music at a Distance

By H. Gernsback

Member American Physical Society

It is sometimes desirable to project the music from a phonograph to a distant location. Such occasions arise frequently. For instance, the phonograph dealer in the summer time may find business dull and in order to attract prospective customers, is at times forced to place his phonograph near the door of his shop. This does not always produce much sound outside, and a much better way would be to project the music outside of the store by means of a loud talker, as shown in our front cover. Then there are many other uses as when we have a lawn fête and do not wish to transport the phonograph from the house outdoors. Our young electricians will wish to have the music out on the lawn or garden and it can readily be accomplished.

When you have a phonograph stationary in the house, but wish to have the music in another room as, for instance, in case of sickness, for children, or if you wish to dance to the phonograph music in another place, all this can be accomplished without moving the phonograph at all. Nor is it difficult to do this and any wide awake young man who is handy with tools should be able to build the few instruments necessary to accomplish it.

In the first place, we must build a microphone, which is the keynote of the apparatus. If you do not wish to spoil the sound box on your phonograph, it would be best to pick up a second-hand one, and make the sound box into a sensitive microphone, which can be tuned very easily as shown in our illustration. The sound box is simply opened up and the mica diaphragm taken off. A carbon diaphragm, which may be bought from any electrical specialty house, is then attached to the arm that carried the needle. A screw and a nut usually hold this arm to the mica diaphragm and the same screw and nut can be used to fasten it to the carbon diaphragm. It is important, however, that when the screw and nut have been fastened, a small drop of hot sealing wax be applied on the front of the diaphragm, which will secure the lever and the diaphragm in such manner that there will be no rattling.

In the back of the sound box a carbon plate is placed. This carbon plate takes up the entire back, and is of course circular. Inasmuch as no sound passes through the tone arm, the carbon plate should be solid and usually measures about 2 1/2 to 3 inches in diameter, while the thickness may be 1/10 of an inch or thereabouts. In case no carbon plate can be obtained, use a metal plate against which you place a carbon diaphragm. The metal plate is simply to stiffen the back diaphragm and keep it from vibrating.

The space between the back carbon and the front diaphragm should be % of an inch in thickness. A felt washer keeps the diaphragm away from the back plate, and the resulting space is filled up loosely with highly polished carbon grains secured from any electrical specialty house. It is necessary to experiment a little here, because if too much carbon grain is used, the microphone will not function well. It is rather better to use a little less than too much.

When the microphone is in its vertical position, the grain chamber should not be entirely full. From 90 per cent to 95 per cent capacity will do. This will leave the grain rather loose, which is satisfactory.

Between the carbon diaphragm and the clamping ring we use a soft rubber washer which is usually supplied with a sound box.

Some sort of insulation must of course be placed between the back carbon plate and the front carbon diaphragm. One connection is taken from the front diaphragm and the other from the tone-arm, as the latter is grounded to the back diaphragm. It should, of course, be understood that the front carbon diaphragm from which the one connection is taken is well insulated, as otherwise there will be a short circuit.

When the microphone is entirely finished, it should be tested out, which is done by means of an ordinary two cell battery and a 75 ohm receiver. When operating the phonograph, the music should be reproduced loudly in the telephone receiver, as a matter of fact, so loudly that it hurts the ear. This shows that the microphone transmitter is well built.

We now come to the loud talker, which can be constructed readily at an expense that is not high. The original loud talker has actually been built by Mr. F. R. Kingman of Lremont, Washington, to whom the author is indebted for the simplified construction. This loud talker, which works on the same principle as a Magnavox, can also be used for radio by making slight changes.

In connection with radio, the loud talker must of course be used with a two or three stage amplifier, and the results will be excellent.

The following tells how to construct a loud speaker that operates on the magnavox principle, but instead of using powerful electro-magnets, permanent ones are used, thus doing away with a storage battery.

This type of loud speaker is, perhaps, a little larger and more bulky, but its difference in size is of no great disadvantage so long as it operates as effectively as other types of loud speakers.

In building this loud speaker the writer used the magnets of an old magneto. The over-all length of the longest magnet was a little over six inches and the width of the short one was four inches. There appears an article in the October, 1920, number of Radio News on the construction of a loud speaker, by H. W. Secor. This article will give you a good idea on the construction of a loud speaker using electro-magnets.

In building a loud speaker using permanent magnets, the exact size of the instrument will depend upon the size of the magnets used. For best results the diaphragm should be about three inches in diameter and should be made out of sheet mica or spring sheet phosphor bronze. The moving diaphragm coil should be about one-half by three-fourths of an inch over-all size.

The size of the coil will vary as to the resistance to which it is wound; however, the coil should be about the size shown in the drawing. For a 50 ohm winding, an adequate length of No. 35 enameled wire is...
required. The method of winding the coil is shown in the drawing; the thickness of the thin part of the coil is one-sixteenth of an inch.

After the coil has been wound the upper part is to be tied with silk thread, and is then impregnated with shellac. A way to make the thin part of the coil hold its form until the shellac is dry, is by clamping the narrow part of the coil between two flat plates.

The wrought iron pole pieces can be made of soft iron, tool steel or tungsten steel. If the steel has been fitted on, it can be taken off, hardened and magnetized, thus increasing its strength.

The horn can be constructed out of heavy paper, cardboard or wood. The writer recommends a wooden horn or at least some kind of a wooden sound box constructed of spruce or cedar, for best results.

A telephone induction coil can be used, as shown in the drawing; however, one can make a transformer. A modulation transformer can be used. Data on the construction of a transformer for this type of loud speaker may be had from the radio department of Science and Invention for August, on page 408.

The outside case of the loud speaker can be made out of a piece of brass tubing. The base of the instrument should be of hardwood and covered with felt to eliminate all vibration.

The permanent magnets should be magnetized to their full capacity before assembling them. The diafragram should be of the proper thickness, otherwise the instrument will be sluggish in its action and will not reproduce distinctly. For mica the thickness should be about .006 of an inch. Magnets of an old magneto vary in size, but the large ones having an over-all length of not less than six inches should be used.

The distance between the poles should be one-sixteenth of an inch. If the builder wishes, however, to vary the magnetic field between the pole pieces, he may place some kind of a magnetic shunt across the pole pieces so as to control the strength of the field. It is like varying the strength of an electro-magnet by changing the current strength.

There are a number of ways of fastening the moving coil to the diafragram; the best way is by making a clip as shown in the drawing. The builder can construct several of these coils of different resistances, as he will find that coils having a greater number of turns will prove more effective at times than one having only a 50 ohm winding. For radio work a three stage amplifier and a 50 ohm winding are probably most suitable.

The principle on which this loud speaker works is patented and it must not be built to sell. After building the loud talker, and after it has been tested, the connections are made as shown in our diagram. A four or six volt storage battery should be used for best results.

A rheostat is put in series with the circuit, and has the function of either increasing or decreasing the loudness of the music. When too much battery is used it will be noted that the transmitted music is harsh and disagreeable.

It should be understood that the line that runs between phonograph and loud talker must be of sufficiently low resistance, particularly where the distance is great. If the distance is more than 100 feet, it will be necessary to have an induction coil near the loud talker, and another induction coil near the microphone transmitter. In that case, a rather high resistance line can be used, as for instance, a No. 20 or No. 22 wire. Where the distance is less than 100 feet, the wire should not be less than No. 16 B. and S. gauge, otherwise there would be too much loss in transmission.

It should be understood that in a scheme of this kind we could also dispense with the loud talker and use a great number of telephone receivers, should we so desire. When using a high resistance telephone receiver, such as one of 1000 ohms, a great number of people can listen in to the phonograph music by placing all the receivers in series or series parallel as found best by experiment.

There are many uses for such an instrument that will readily suggest themselves to all.

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**Conduit Box Switch**

It will be observed that there are two knurled thumb nuts; one is seen in the illustration directly above the apparatus, and that, of course, is connected to the fixture. The other is to connect it to the conduit box. A short chain and six or more feet of cord, with terminal ball, complete the equipment, so that it can be used from no matter what height the ceiling may be.

The chain is made that it replaces, as regards its work, four or five other switches, so that the device takes the place of four upon the dealer's shelves.

The illustration shows a spring reel, one which winds up automatically, coiling up around its drum as it does so a flexible cord. At the end of the cord there is an electric lamp, and the lamp when the cord winds up fits into a holing socket on the nozzle of the coil, so as to have a rigid place. It is especially designed for use on automobiles.

The cord is connected to the electric system, grounded or not grounded as the case may be; and for the inspection of any part of the car in the dark, the reel feeds out all the flexible cord required up to a length of 12 feet. The reel presumably being connected to the dashboard, 12 feet of conductor is more than enough to reach any part of the car.

The same system, of course, can be used for carrying electric power to portable drills and other small machinery, and it would really seem to be quite an interesting addition to a garage. The annoyance with the ordinary trouble lamp is involved in the cure and disposition of the loose coil of wire ordinarily used, for which there is no place specifically provided.
Uses for Electric Light Carbon Ends
By T. O’Conor Sloane, Ph.D.

A battery plate is made by soldering several carbons together at their upper ends; the copper is removed from the ends entering the solution. A simple cup made with pointed carbons, suggesting a bunch of cigars; they are soldered solidly together.

We suppose many electricians, especially the younger ones, have picked up electric carbons from the ground where they have been thrown by the lamp trimmer. It always seems as if some use could be made of them.

They form excellent carbons for batteries. A good way of arranging them for a small battery is to have a wooden cover for the jar, with a rebate around it, so that when in place it cannot shift sideways. Through this holder holes are bored of size to receive the carbons tightly. As each carbon is inserted, a wire is put in to extend perhaps barely through the thickness of the wood; but if the carbons are copper coated, each wire may be twisted around its carbon very near the top and soldered there. The effect of this last arrangement will be that the carbons can only go through the wooden cover of the battery jar until the wire ring comes in contact with the top. The copper should be removed from the lower ends of the carbon, although in the battery it is fair to assume that this will take place anyhow.

Other holes in the cover receive the zines, which wires also are soldered; round Leclanché zines are excellent for this purpose. Of course, by following out these lines all sorts of arrangements of carbon and zines can be made.

To obtain a flat carbon battery plate, as many carbons as desired may be placed parallel to each other, and pressed together by an improvised clamp, and soldered, first on one side and then on the other. An inch of soldering will suffice to hold them, and the rest of the copper may be removed by nitric acid or left to the mercies of the battery.

It is easy to see that all sorts of changes may be rung on this basis; the carbons may be soldered into a hollow cylinder, to receive the zinc in the middle.

The carbons can be used, however, in other ways and for other purposes than for the making of battery carbons; they may be fastened around a piece of dwelling or a piece of pipe; they must fit in the sense that while against the pipe each carbon will come in contact with the other one, and can then be soldered. Before doing this, the tapering ends must be cut off. Above these carbons there comes another set, and so on until the whole pipe is enclosed. Where they join, a brass hook or hand will be placed tightly around them, so as to hide the joint. This gives a very pretty standard for a lamp, and is shown in one of the illustrations.

We have spoken of soldering them in a hollow cylinder for use in a battery; by carrying out this idea, a cylindrical vessel is made, in which case, of course, the soldering extends the entire length of the copper. By picking out carbons, whose joints are practically identical, the body for a vase may be produced, with a sort of picketed top, possibly suggesting cigars. The bottom may be of plate copper, also secured by soldering. By bunching half a dozen carbons around a piece of dwelling and soldering them, a stem for the vessel can be made, whose upper end goes into a socket soldered to the brass or copper bottom already referred to, and whose lower end enters the hole in a solid base of wood.

All sorts of changes can be made along these lines, and the illustrations are intended to suggest to our readers how they may try their ingenuity. If the carbons are not copper coated, the electrician can easily give them an electrolytic deposit himself, and after the soldering is completed it is a simple thing to give them a plating of silver or nickel.

Too much reliance must not be placed upon the strength of the carbons, except in cases where solder is applied for the entire length; if this is done, it will, of course, fortify them greatly. It may be advisable also to shellac or varnish them to prevent any dust coming from the surface. Our readers can exercise their ingenuity in evolving other designs, and we shall hope to hear from them. Carbon ends are not so common as they used to be, as the tungsten lamps gradually replace the arc lamps, but they can always be procured.

It is to be noted that the vases and other articles depend for their strength on the adhesion of the copper to the carbon. This may not be very great. Therefore, where strength is essential, the system of soldering a brass or copper ring around the bunch of carbons must be resorted to, and the interstices between this ring and the carbons can be filled with solder. The end of the opening to be thus filled should be stopped up with kneaded bread crumb, and the copper on the carbons and of the band or ring should be tinned in advance. Heavy copper plating may be experimented with as a substitute for soldering.

Heavy copper plating may be experimented with as a substitute for soldering.
A Polarized Rectifier and Its Use
By Arthur G. Raabe

Alternate current is the type of current now generally supplied by electric companies. This makes it impossible to recharge storage batteries, to electroplate, or perform experiments requiring direct current, unless one purchases an expensive rectifier, a mercury arc or motor-generator set, or makes one himself.

The necessity of purchasing one can be obviated, following these instructions, for constructing one:

Procure a telephone ringer of about 1,000 ohms resistance. Remove the bell, clapper, and rod from the armature (Fig. 1), fastening an insulated contact maker (Fig. 2), consisting of fiber washers and bushing for insulation, nuts and a screw which is filed down on one side. The screw is insulated perfectly from the armature and a brass contact spring is soldered neatly to the flat side of the screw, as shown. Flexible leads bring the A. C. current to the contact spring and the armature, which are held in their respective positions by nuts, according to Fig. 2.

The importance of neat workmanship is obvious, as an immediate short circuit will result if the insulation breaks down and the screw comes in contact with the armature.

Arrange contact post and adjust the same, according to Fig. 3, so that the moment the insulated contact spring touches contact points (E) or (G), the distance between the armature and contact points (D) or (F) shall be equivalent to the thickness of two business cards. The moment the armature touches contact points (D) or (F) the distance between the armature and the core of the attracting coil should also be equal to the thickness of two business cards. This method of adjustment causes the current to open or close at contact points (D) or (F), thereby bringing the arc caused by this action close to the magnetic field, which has a tendency to quench the arc. If platinum or tungsten contacts are desired, they need only be placed on points (D) and (F).

The principle of the apparatus is this: A permanent magnet lying parallel with the coils maintains the armature magnetized with the same polarity—south, for example. As the current passes, the armature is attracted by the north pole of the electro-magnet and closes the circuit, making (D) positive and (E) negative. As the A. C. current drops to zero, the armature is released. The current is reversed. The armature, being then attracted in the opposite direction, closes the contacts (F) and (G). Since the current has already been reversed, (F) and (G) now have the same polarity as originally, and a direct current is delivered at the terminals (P) and (N).

Now, knowing that direct current is obtainable at terminals (P) and (N), the next step is to determine which is positive and which is negative. This can be readily done by attaching a strip of lead to a wire from terminal (P) and likewise from (N). Place the two lead strips in a clean tumbler containing a little storage battery solution. Keep the lead strips from touching each other, even for a second, and turn on the current for a few minutes. The strip of lead attached to the positive wire will turn brown on the end that is immersed in the solution. Mark the terminals so you will know which is positive and negative in order that you need not perform the above test every time you desire to know the polarity of terminals (P) and (N). Should you have taken the solution from one of the cells of your storage battery, you should return the same solution after the test, to preclude any fear of endangering the cell.

If the rectifier is not receiving its alternating current from a step-down transformer delivering from 60 to 10 volts, it will be essential to insert a 5-ampere fuse between (P) and its feeders, (D) and (G); also between (N) and its feeders, (F) and (E). This means, should you accidentally short circuit the wires leading from terminals (P) and (N), a fuse will blow. Be careful and you will save fuses.

It will be desirable to regulate the flow of current in recharging storage batteries. This can be accomplished with a rheostat, or lamp resistance. Lamp resistance is the preferred method, consisting of lamps strung in parallel, as in Fig. 5. When charging by this method, use the rate given on the name-plate of the battery.

Connections for charging a storage battery, in which a bank of incandescent lamps is used as a resistance.

This rate determines the number of lamps to be used, as follows:
One 32-candlepower carbon filament, or 100-watt Mazda for resistance, gives one ampero.

(Continued on page 381)
CONSIDERABLE attention has been given recently to the exploration of the subterrain by use of electricity. In SCIENCE AND INVENTORIES, some months ago, a Hughes balance was illustrated, which was constructed to locate metals deposited under ground, such as pipes or treasure—as some sanguine souls believe there is a probability of finding buried gold.

But this balance is of very questionable utility for such purpose, though it can be made to show varying resistances. This was really one of the first attempts to scientifically explore the underground regions of our earth, and it was based on the modification of the magnetic field, and diversion of its lines of force by the presence of an electric conducting mass, even though one of high resistivity.

One of our Italian contemporaries, L'Audion, has published quite an elaborate article on the subject of finding and defining mineral deposits by electricity. During the war it is said that the Germans used the induction balance. It is believed that they could detect distant vessels—of course, the advantage here being that there was no question of an imperfectly conducting mass of mineral matter, but of a particularly good conductor of iron and steel. It is said to be useful in finding buried unexploded shells.

Again keeping to the elementary attempts, the use of the compass, horizontal or dipping, is to be cited. This, of course, applies only to magnetic deposits, such as pyrite and magnetite. For such it is quite practical and useful.

The density of rock beneath the surface, and not too far removed therefrom, affects the period of oscillation of the pendulum and this gives a clue to a non-electric method of finding minerals.

One form of portable induction balance consists simply of two coils wound at right angles to each other, and an alternating current from a battery-actuated induction coil is passed through them; a telephone in circuit discloses any unbalancing attributable to minerals or metals in the vicinity. Curiously enough, the subject was not treated by our contemporary without allusions to studies by a German physicist, Hoppe, on the subject of radium— which is nothing but the old divining rod.

Another, quite different, matter occurred; the resistance there will be cut down and the deposit will be indicated.

The current takes a straight and limited path—instead of which, it really spreads out to an indefinite extent, spreading-fashion.

The contacts may be made by burying spheres in the earth or by driving pointed iron bars down to a good depth.

A mineral deposit causes an increased distance to be produced between points of equal resistance, following Ohm's law.

The passage of a current through the earth, illustrated diagrammatically; it will be seen that the earth reaches a considerable depth below the surface.

A vein of ore is seen crossing the equipotential line; the ore being a good conductor, the ohmic resistance between the potential lines where the vein crosses them is much less for an equal length of vein than in sterile ground. So, as before stated, by simply following the line of demarcation it will be seen why the potential lines are bowed out where they overlie the vein of good conducting material. The vein in this case was one of hematite, red
An apparatus layout, using a telephone for determining lines of equal potential; where the telephone is connected to the earth while the alternator is running, the potential difference is zero.

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Terminating lines of equal potential; where the tele-conductor, but is far superior, of course, running, the potential difference is zero. The telephone connected with the area, as long as the current is passing, will produce sound to the frequency of the current. But if there is a mineral deposit there, it will have the effect of concentrating from a certain extent the current. In itself, robbing, as it were, the country rock thereof, so that the telephone will be silent. This phenomenon lends to another method of research.

Another interesting illustration is a mass of copper pyrite found in France, which pyrite was mixed with a certain amount of other minerals, 40 per cent of silica alone. The general elliptical form measures 100 meters in length by 100 in width. It is interesting to see how closely the lines follow the contour of the deposit. A more direct and quicker method has been entitled the "zone of silence system." From what has been said before, it will be understood that if a discharge of alternating current is maintained in an area, the telephone connected with the area, as long as the current is passing, will produce sound to the frequency of the current. But if there is a mineral deposit there, it will have the effect of concentrating from a certain extent the current. In itself, robbing, as it were, the country rock thereof, so that the telephone will be silent. This phenomenon lends to another method of research.

The great difference in conductivity already spoken of is the basis of this method, which is illustrated in diagram. A central point is established and an insulated conductor is stretched across it of equal length on each side. A generator, which must be of some power, or else an induction coil operated by a storage battery, excites the circuit. Earth contacts are placed at each end of the conductor. In homogeneous soil if the telephone is connected at two points, as already described, keeping to the line of the conductor or following a line parallel thereto, the telephone will give a sound. If there is a mineral mass this will have the general effect of concentrating the current within itself; so that to all intents and purposes the current will abandon the surface, and the telephone will be silent. The area under the deposit is determined by rotating the straight conductor around the central point and continuing the tests. There is something more direct in this system than when equi-potential lines have to be drawn, but this gets at the direct determination of the outline of the deposit.

Another way of carrying out this system is to lay out the straight conductor from A to B, the other pole of the generator being connected directly to the earth. An operator with a reel of insulated wire connected to the extremity B makes contact with the earth at points representing in a general way the prolongations of radii from the point A. The operator with the telephone makes his own private contacts parallel with the radial lines thus determined, or on such lines, until if there is a mineral deposit the telephone will cease to sound. In this method, as the zone of minerals is approached, the sound of the telephone will grow weaker. This system gives greater facility of research in rough ground than the resistance method, and can be carried out within the interior of mines, and is a considerable advance over the resistance method. As a test of this process, a plate of copper was buried, and its location and size determined by the silent method, with the result that its area was given with wonderfully close approximation. This was a crucial test.

The general disposition of the apparatus is shown in the illustration; the reeils carrying the insulated wire are shown terminating in the points to be driven in the ground, while the bottom piece carrying the telephones with the two contact points is also there.

An interesting modification of the process is carried out sometimes by the telephone operator having plates of metal attached to his robe with points to penetrate the soil, and his telephone wires are connected to these plates.

Finally, the Hertzian discharge is made the basis of a similar system. It is known that the Hertzian spark will cause the detector to answer through a stone wall, but that a metal plate will cut the effect off. A deposit of a mineral mass, it is found, will act in the same way; so by proper location at a distance from each other of the Hertz discharger and of the detector, lines are determined through which the discharge takes place readily, and others where it is interfered with. Those where the interference occurs pass through mineral masses. The illustration, which speaks for itself, shows the Hertzian method applied in a mine; by shifting about the discharger and detector, the shape of the deposit can be very accurately found.

Recently an attempt at treasure trove by an alleged effective detecting apparatus has been made in Canada. A legend of a chest of gold articles which fell into a river some centuries ago induced a party to go there with the apparatus mentioned, and with it the inventor or operator claimed to have located the chest. Dredging and sounding operations were commenced, and a hard object was encountered, which they believed to be the treasure chest. A diver descended and found that the hard object was nothing but a rock, so according to the last account the search resulted in nothing.

The amount of fraud which has been perpetrated in the past by alleged treasure finders, inclines one to discredit even serious work in this field. But what is described here is a purely scientific attack on the problem, the application of absolutely correct methods, all of which is certified to by the fact that good results have been attained.

The Germans and English have been considerably victimized by the daven rods, but what we have described here is serious scientific exploration.
Laboratory Ultra-Violet Electric Lamp

The ultra-violet laboratory lamp, used in polarization work in the investigator's laboratory.

The ultra-violet lamp is applied to spectroscopic work in the investigating laboratory. The same lamp is used here as an illuminant for microscopic work, giving a very pure, almost monochromatic light.

The ultra-violet rays produce acute sunburn, and if applied to an area infected by X-ray burns, they will cause the skin to peel off, and it is not impossible that in this application a cure for X-ray burns may be found.

We are all familiar with the mercury vapor arc. Everyone has seen the tubes, three or four feet long, illuminated by a rather ghastly blue light, but one of considerable intensity, and which has a very extensive use in photographing plays for moving pictures. In the mercury vapor arc, which is seen in these tubes, there is a large percentage of ultra-violet rays. But they are cut off almost entirely by the glass, so that the mercury vapor arc is a very safe light to work under and, despite its peculiar appearance, has been found to be very good for the eyes, although it is fair to say that it has not improved the complexion, as seen under its radiations. The face and hands appear ghastly, but this is only while the light shines upon them, as no permanent effect is produced, the light being quite innocuous.

If for the glass tube a quartz tube is substituted, a most intense illumination is produced, particularly charged with ultra-violet rays, exposure to which of the un-protected skin is quite injurious, because transparent quartz does not sift out the ultra-violet rays.

Hitherto, the quartz tube lamp has been one of the very few cases of ultra-violet ray work. It is much so that it has been used for illuminating railroad yards and similar large areas. When used for such purposes it is installed on the top of a high pole, and the hundreds of feet or more of air, which the light has to penetrate, takes out the ultra-violet ray and the illumination is perfectly safe.

From all that is said, it will be seen that a considerable interest attaches to the ultra-violet ray from the practical standpoint, for in our brief category only a hint has been given of what it does in the technical field.

We illustrate with this article a very small extra-violet lamp which is produced for laboratory uses. The lamp is of such a design as to require considerable power, and giving a candlepower running up into the thousands, is far too powerful for laboratory work.

The tube which contains the mercury vapor arc is perfectly transparent fused quartz. When quartz is melted into a glass it is pretty nearly exempt from the effects of sudden changes of temperature. It can be made white hot and dipped into cold water without cracking. Glass cooking utensils are made of glass very rich in silica, which in a sense approaches the composition of melted quartz, and they stand the fire almost as well as metal.

The laboratory arc lamp we are describing has an effective area or light source of 1/4 inches long, and one-quarter inch wide; the arc is enclosed in a metal casing, to protect the observer. Its spectrum has been worked out with considerable care and the quality of the radiations can be affected by the use of screens. Mercury is a material which absorbs the very "far" or extreme ultra-violet rays, when they are not needed. On removing the screen, some 25 ultra-violet lines are admitted along with the radiations. Various filters are used for as nearly as possible isolating special lines. Of course, there is the possibility of isolating a single line, but very nearly monochromatic light can be obtained, which is peculiarly advantageous to polarimeter work. A vast quantity of such work is done in sugar houses for the determination of the percentage of sugar, and there are many other uses for it.

The United States Bureau of Standards has adopted the mercury green line as the official spectrum line for polarimeter measurements. Frequently a sodium flame is used for monochromatic light, which it replaces very closely in quality; but when the light is maintained for any con-
A n experimenter who possesses a spark coil can make use of it to operate an Oudin coil with the latter placed in the apparatus many interesting experiments in high frequency current may be performed.

On a cardboard tube six inches long and three inches wide wind one layer of No. 30 double cotton covered magnet wire. It is well to space the turns, for insulation by winding on a piece of string at the same time as the wire is wound. Shellac the tube and turns well, and, while the shellac is still wet, unwind the cord, leaving the wire alone, and being careful not to dislodge it. After the shellac has dried, apply another coat to be sure that the wire stays in place. Two coil ends should be turned up and fastened in the ends of the tube with glue. One end of the wire should be led to a binding post in the base of the instrument. The other end should be connected to a metal ball at the top, as in the figure. An old brass bed is often a source of small brass balls suitable for the discharge balls of Oudin and Tesla coils, Leyden jars, and other apparatus.

The tube should be fastened to a suitable hardwood bench by screws passed through the base and into the coil ends. In a circle concentric with the secondary coil a wire with dowels glued all around is installed. The diameter of the circle is to be four and one-half inches. Around these dowels twelve turns of No. 10 copper wire should be wound and evenly spaced. This is to be the primary, and as such will be referred to hereafter. The lower end of the primary turns is to be connected to the post referred to above, to any convenient ground. An adjustable clip should be provided to make connections with the turns on the primary. For the sake of convenience in connecting and disconnecting the different pieces of apparatus used in connection with the Oudin coil, the clip may be connected by a flexible cord to a second binding post in the base.

It is to be connected from the adjustable clip, through a condenser, to one of the secondary terminals of an induction coil. A second wire must be connected from the other binding post, referred to above, to the other terminal of the induction coil secondary. A spark gap should be shunted across the secondary binding posts to the induction coil. If the induction coil is now operated, long streamers of bluish fire should appear around the ball at the top. If none appear, stop the coil, and vary the position of the clip on the primary of the Oudin coil, or close or open the spark gap electrodes. After a few trials the desired effect will be observed. A piece of metal held in the bare hand and brought close to the ball will cause long sparks to leap to the metal. No harm will be done whatever. The wire should be observed that when the metal is grasped tightly there is no sensation felt, but when the metal is held loosely there is a quite a pronounced feeling. This latter effect is also observed when the hand is insulated by a layer of cloth or paper. Interesting stunts may be tried by placing plates of glass and other substances in the path of the spark.

Contributed by Fred O. Rodgers.

Electricity of Animal Organs

A ccording to general opinion, the production of electric current depends on atomic changes by which various constituents of the muscles are oxidized. This can be shown experimentally.

Claude Bernard has shown that, when oxidation processes of the body are checked by ether, electric current is produced. But this current is not produced by nerve and muscle fibers, but on the living substance in the cells—on the protoplasm.

If an elementary organism, the ferment of beer, is placed in a vessel with sugar an electric current is produced. But this phenomenon ceases and reaches zero when the protoplasm is exposed to the action of ether; and if a muscle is put out of action by ether, the same annihilation of the current appears.

Among all the muscles, the heart is especially interesting. It is a well known fact that every heart beat is accompanied by an electric impulse. Dr. Walter, in London, has published interesting observations on this electro-motive power of the heart. He used in his observations Lippmann's mercury electrometer. Concerning the heart itself all that need be said here is that it shows by the rising and falling of a column of mercury the intensity and polarity of an electro-motive force actuating a current passing through it. This instrument made it possible to observe the electro-motive force of the heart, even in a living subject.

If one immerces both hands in a vessel of water, into which two wires of an electrometer are also dipped, then every heart-beat shows the electro-motive force of the heart by the change in height of the mercury columns. These experiments prove also that it is not immaterial which sides of the body are connected to the electro-meter. If one selects, for instance, two parts of the body upon the two sides of the body—upon one foot and the left hand, or upon the right hand and on the head, the current does not move. But if the right hand or one of the feet, or, as already mentioned, both hands are connected to the electrometer, the electro-motive force of the heart is at once shown. As we all know, the heart in the normal subject is on the left side of the body, and the electro-motive axis is directed towards the left. By the experiments adduced to in the text, it is shown that a plane perpendicular to this axis and passing through the heart divides the human body into two unequal parts, with the result that the particular electro-motive force (a) on one side, connected with the electrometer, simultaneously with the point (b) on the other side, causes a movement of the mercury column, while connection with points (a) and (a), or (b) and (b), each pair lying in the same division of the body, occasion no movement of the mercury.

It is proved that the position of the separating plane is determined definitely by the position of the heart, because the plane takes the opposite position, if the heart is inclined in the other direction, which occurs in many cases of sickness, as well as by the experimenting with the body of an animal such as a cat or dog, in which the heart is more symmetrically placed, and gives therefore a symmetrical position of the two divisions of the body.

In these experiments it follows that the contractions of the four chambers of the heart do not occur all at once, but that there is a progressive movement. In warm-blooded animals this progressive movement begins at the lower extremity of the heart and progresses towards its top, while the contraction of the cold-blooded animal progresses from the top to the lower end. If, on the other hand, all the chambers contracted simultaneously, the impulses would go out to both portions of the body, so that there would be no electric current, and the mercury in the electrometer would not move.
From A. S. Johnstone of Groombridge, Kent, England, we have the following account of his laboratory, which in the electrical portion, as well as chemical, seems to be very complete and is an interesting example of what is being done in England:

"My laboratory is divided into two parts—electrical and chemical. In the electrical division I have a very complete range of voltages from 25 to 440 D. C. and from 50 to 20,000 A. C. The various voltages up to 440 A. C. and D. C. are taken from the lamp sockets on the main switchboard, the high voltage of 10,000 to 20,000 volts being taken from the terminals on the left-hand side. The transformers and potentiometers for varying the voltages are set into the wall behind the main board, all of which I have made myself. I am now constructing a radio set, but the restrictions over here are still very severe.

"In the chemical half I have a very complete set of all the ordinary reagents, 296 solid and 68 liquid; I have done quite some analysis work of alloys used in electrical machinery, and have made a fair study of the various grades of oils, both for power and lubricating.

"I am now making a study of the common aniline dyes, and have made quite a number of them.

"A quantity of the apparatus is kept in cupboards below the reagents' shelves."

This description of Mr. Johnstone's laboratory is of particular interest to us, as it shows what our English workers are doing, and there is a certain difference, we think, to be observed between the technique of the English student and experimenter as contrasted with the same individual in our country. Mr. Johnstone's laboratory with its quite efficient appearance, does not suggest as much of the rough and ready, as will be observed from our American students.

His list of reagents is quite impressive, aggregating nearly 350, which he modestly terms "all the ordinary reagents." We certainly think the description is very modest, and he must have a wonderfully equipped laboratory.

I have a wireless receiving set, employing an audion for detector. I perform many interesting experiments with my Tesla high frequency coil and my large spark coil. The Tesla coil is shown in the photograph. I have three motors, each of a different kind, besides much other electrical apparatus.

My chemical outfit is composed of about sixty different chemicals, test-tubes, delivery tubes, gas generator, alcohol lamps, mortars and pestles, and much other chemical paraphernalia.

In view of what is said above, this seems to be a very practical, every-day workshop, and it is quite interesting to have on the same page the typical laboratory of English and American workers. We only wish that the American laboratory was represented by a view which would do it fuller justice.

Weiss Laboratory

From the Northwest Pacific Coast comes the description of Mr. Carlyle Weiss' laboratory in Seattle, Wash.:

"The accompanying photograph shows my electrical and chemical laboratory."
Mr. R. Joyce R. McLEMORE of Wise, Va., writes us as follows in regard to his workshop:

"My laboratory building is eight by ten feet and was built by myself of one-inch lumber and two by four inch framing. It has a rubber roof, large double windows, and there are honeysuckle vines growing over it, which enhance the appearance and help keep it cool on a hot day.

"Strung between two high trees above the building is a two-wire aerial about 75 feet long. This aerial is used only for experimental work, because of the lack of the proper instruments to listen to the big government stations. With a one and one-half inch spark coil, a telephone receiver and galena detector I have talked a distance of about three-quarters of a mile to a small field set. I use my chemical laboratory for quantitative and qualitative analysis, food testing, water testing (for natural salts in solution), chemical magic and almost everything a laboratory can be used for.

"The chemicals and apparatus were selected with care, with the result that almost any experiment possible with the average laboratory, can be performed.

"It contains Florence and Erlenmeyer flasks, all sizes of beakers and test-tubes, gas generators, mortar and pestle, alcohol lamps, gasoline blow-torch, wash bottles, balances with complete set of weights, ring stands, thistle-tubes, funnels, graduates, and numerous other apparatus, besides the chemicals.

"My electrical laboratory is used for constructing apparatus, for repairing toys and apparatus and for experimenting in everything electrical in its scope.

"I use a step-down transformer for all the experiments which it will do. I have also experimented with a rectifier.

"Under the workbench is a set of drawers and shelves which are very convenient to keep tools, screws, bolts, wire instruments, etc., in.

"Among the apparatus I have constructed are the following, for which I found the directions in my copies of the Electrical Experimenter and your other magazines. (Have every copy since May, 1915, which I value very highly.) Electric arc searchlight, Geissler tubes, detectors, Tesla coil, condensers, galvanometers, motors and telegraph instruments."

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Mr. John D. LAWLOR of New Bedford, Mass., thus tells of his work:

"Enclosed you will find some 'shots' of my electro-chemical laboratory, and one view of yours as per usual. I have about 300 different chemicals, acids, reagents, mixtures, compounds, etc. and all the paraphernalia necessary for the conducting of a large number of experiments. Florence and Erlenmeyer flasks, test tubes, retorts, graduates, scales and all the rest of the junk necessary to and usually found in such a hangout. I have also a home-made Liebig condenser that would make old man Liebig himself wonder what it was for, but it works. At times the results of my many experiments are most astonishing, to say the least.

"The electrical end has three switchboards, one large and two small ones. The large one is the main source of supply, 110 V. A. C., and contains all the switches to the lighting circuits, transformer, etc. One of the smaller ones gives from 5 to 30 V. A. C., by means of a step-down transformer, and is used in the main to run small motors, buzzer system, 14 V. electric lights, etc. The other small one is a D. C. one, giving from 4 to 40 V. D. C. by means of an electrolytic rectifier described in a previous issue of 'E. E.' This is used for experimental purposes mostly, as it is not as reliable as it might be, and is doing duty chiefly with my Audion 'A' and 'B' batteries. There are six small motors and two large ones, electric fan, soldering iron, induction coils, choke coils, retardation coils, resistances, buzzers, bells, ammeters, voltmeters, galvanometers, etc.

"I have also established telephonic, telegraphic and buzzer communication with a friend next door. All the apparatus is home-made and installed.

"The mechanical end includes a complete list of tools for every purpose."
**Junior Electrician**

**Home-Made Dimming Switch**

The piece of card board that hangs by a string to your door knob to announce your presence or absence in the office is nearly always turned the wrong way. However, if the automatic device hereinafter described is used, it will be found to be much more dependable, and in addition, will announce the arrival of a client.

To make the Announcer procure a cigar box. From the lid of the box, make a partition to be fastened across the middle, so that it lacks about one-half inch of reaching the top of the box. Take narrow strips of wood around the inside, even with the top of the partition. Place two miniature electric lights in the box, one on each side of the partition, and run the connecting wires out at some convenient place. Fit a piece of glass into the top of the box. Place your sign over the top of the glass so that the words “Walk In” will be on one side of the partition and “Out,” on the other. This sign must be of thin paper so that the light will shine through. Over this place a mirror having only a thin coat of silver and no paint on the back. Plain glass with a thin white paper pasted on the back will answer the purpose. Now secure the glass in place with putty and your announcer is complete.

To make the hat switch, take a piece of wood about 1” x 1” x 12”. Bend one end of the strip about a long brass screw to form a hinge. Then screw it into one edge of the board near one end. Near the other end, and on the same edge, screw two more brass screws, placing the brass strip between them so that it will rotate about one-quarter inch play. Now bend the projecting end so that it will accommodate a hat. Across the side, at about the middle of the block, cut a groove about one-half inch deep. Into this fasten a spring so that it will hold the strip against the back screw when not in use. Now wire to a push button and buzzer as shown in the diagram.

When a client pushes the button the buzzer will sound. If your hat is on the rack, the words “Walk In” will appear, if not, the word “Out” will appear on the announcer.

**Tesla’s Electrolytic Clock**

The main part of this clock is a copper disk perfectly balanced in a solution of copper sulphate and sulphuric acid. The disk is fastened on an axle, the latter being horizontal and free to rotate.

On both sides are copper electrodes connected to a battery. In electro-plating, metal is taken from the anode and deposited on the cathode.

Therefore from the anode electrode copper is deposited on the side of the wheel nearest it, unbalancing the wheel. From the other side of the wheel copper is deposited on the cathode electrode and the wheel is dissolved slightly, still further unbalancing it. This causes the wheel to rotate slowly. The speed is controlled by a rheostat.

This instrument measures time. Another electrolytic instrument for measuring current consumption was used by Edison on his first power line in New York.

**Making Your Hat Work**

A switch operated by the weight of your hat; when you hang your hat up, the switch is made to operate an “out” sign.

Operating a lamp with a transformer, from a 110-volt alternating current circuit, a very effective and easily arranged connection.

**A Transformer and Lamp**

A description of a transformer which will light a 3-volt lamp brilliantly, and can easily be made, is given below:

To construct this transformer an old 80-ohm magnet taken from a telephone ringer and about 20 feet of No. 24 S. C. C. wire are required. The wire on the magnet will be used as the primary of the transformer and the secondary can be made by winding the No. 24 wire in even layers on the outside of the primary wire.

Attach a circuit of 110 volts A. C. to the primary and attach a 3-volt light to the secondary leads, and the light burns brightly.

**Contributed by Paul Botsford.**
Mouse-Trap Alarm

An alarm operated by a clock in which the connection is made by the tripping of a mouse trap, the whole is contained in a neat case, and a small lamp is lighted at the specified time so as to show the face of the clock.

A MOUSE-TRAP alarm, operated by an alarm clock, one which has given good service for a considerable time, is shown in the accompanying diagram, and possesses the desirable quality of making the sleeper arise to shut it off, providing it is placed at a reasonable distance from the bed. The whole outfit is enclosed in a wooden box having two doors in front, making a neat, cabinet-like affair.

The bell is removed from the clock so that the hammer is exposed. The mouse-trap is screwed to the back of the box in such a position that the trigger is in line with the hammer of the clock.

A strip of tin is tacked across one end of the trap and a wire connects this to one side of the switch fastened to the floor of the box. Another strip of tin, bent hook-shape, is connected by means of a string to the trigger of the trap and is placed around the hammer.

The tin should be carefully bent to an "L" shape, and the string must be of just sufficient length so that when the clock alarm begins to off the hammer will jerk the string and release the trigger and at the same time throw the tin hook off the hammer. This prevents the string from being broken every time the trap is sprung.

A miniature light for seeing the time during the night, without getting out of bed, is placed above the clock and an extension cord is run through the side of the cabinet, at the end of which is connected a push button. The connections are shown in the diagram.

Contributed by John W. Knight.

Resistance Switch

A ordinary knife switch, whose resistance is zero, can be transformed by the appliance shown here into a resistance switch, to cut down the current to any extent desired.

A piece of fibre or hard rubber rod is wound with resistance wire of any desired size and resistance. This wire must be calculated for the voltage of the circuit so that it will not be heated when such voltage is permitted to force a current through it.

A knife-switch converted by a resistance coil wound on an insulating bar into a resistance switch, reducing the current as desired.

The rod is provided on both ends with plates; these represent the knife blade contacts of the switch, which will be seen is of the familiar knife blade type. These enter, one into a clip above the switch, and one into a special clip attached to the middle point of the blade of the switch bar. The illustration shows the whole arrangement; the ends of the wire are wound, and soldered into the plates at the end, or may be attached thereto by screws and in any case it is well to solder them.

If a zero resistance connection plug is wanted, the resistance coil is discarded and the switch bar is swung into position into the upper clip in the normal way. If resistance is required, the switch bar is swung down and the resistance element is inserted in the clip as shown.

A number of such resistance pieces may be provided to cover different continuities.

Contributed by H. L. Smelzer.

Photographic Studio Connection

THE illustration shows a switch with connections for dark-room use by the photographer. In the dark room there has to be a ruby lamp properly shielded, and in a room in the house, the power is to be used. The appliance shown here into a resistance coil, so as to operate as a gas stove lighter.

Attach four dry cells by a second pair of wires to a simple brass switch on the handle of the lighter and lead from there to primary terminals of spark coil.

Thus, by holding the lighter over the gas and pressing down on the switch, a spark jumps the plug gap and ignites the gas.

By touching plug points to paper or tinder any fire can be started by this lighter.

Contributed by William Weiber.

Electric Drive for Dash Churn

IT is a simple matter to connect an electric motor by belt or gear to any appliance which needs to be rotated. In the case of the modern churns, where the dashers are turned by hand, it is a simple matter to remove the crank, put a belt wheel, connect the motor and let electricity do the work.

When we come to the old-fashioned dash-churn, however, in which the dasher is moved up and down vertically with the barrel-shaped churn, on its face at least it is not so simple a matter to connect an electric motor. By utilizing a stand of an old sewing machine, the old-fashioned churn can be operated to great effect by a motor.

A all accounts of former days tell us that no work was more distasteful than churning with the dash-churn, but by the appliance illustrated, all one has to do to is to turn an electric switch and the universal servant does the rest. For such is the title which electricity has won.

Spark-Plug Gas-Stove Lighter

A GAS STOVE can be lighted with a common automobile spark plug, as shown in the sketch, and the use of matches is eliminated.

Make a handle of rubber or some non-conducting material, drill out a hole about one-half inch deep in one end, and then solder a plug terminal head to the top of a wood screw as shown. Twist the wood screw into the end of the handle and thread the porcelain shank of the plug into it firmly.

Tap the shell of the plug for one wire and carry a second wire to the central terminal; these are to be led to the secondary terminals of a spark coil, and then
Electric Flasher

A flasher, which turns on and off a bank of lamps or sounders, is used for giving signals and shortening the time of sounding. It consists of three independent segments, all three lamps being extinguished by a quarter turn.

Contributed by O. E. Johnson.

Electric Articles in August

Perpetual Motion—Is It Possible?
By H. Gernsback.

Automatic Airplane Stabilizer.
By G. H. Daly, D.S.M., Late of the Royal Flying Corps.

Ship Fire Detectors and Extinguishers.
By Robert G. Skerrett.

Motion Pictures Transmitted via Radio.
By S. R. Winters.

New Vacuum and Compressed Air Railway.

Truth Enforced by Electric Machine.

Home-Made Carousel.

The Oracle—Question and Answer Box.

Latest Patents.


Resonator for Telegraph Sounders

The phonograph horn mounted on a box enclosing the sounder, may be used for increasing the range of action of the telegraph sounder, as well as for directing the sound waves in any desired direction.

To increase the volume of sound produced by the telegraph sounder, and direct the waves to the ears of the operator, serving the same purpose as the factory constructed device, the horn of an old phonograph is attached to the sounder as shown in the illustration.

To construct this alarm a board is required in the upright block of wood and is attached to the lever and serves to revolve the lever slowly.

When the lever comes in contact with segment No. 1, the current from the batteries or other source flows through the lamp (F), contact to the lever being made through the motor shaft. The lamp (G) and (II) are lit in succession, and when the lever comes to the fourth contact, which is composed of three independent segments, all three lamps are connected in parallel.

A projectile from the great war, utilized as a memorial of something which, if it were possible, should be forgotten.

Contributed by L. M. Jordan.

Electrical Articles in August Science and Invention

Adjustable Electric Alarm

Alamk Clock

An alarm clock which will ring an alarm at any time within the hour; its uses are restricted to cases where intervals of less than 59 minutes are in question. It cannot be used as an alarm clock to wake you in the morning, however.

To construct this alarm a board is required in the upright block of wood and is attached to the lever and serves to revolve the lever slowly.

When the lever comes in contact with segment No. 1, the current from the batteries or other source flows through the lamp (F), contact to the lever being made through the motor shaft. The lamp (G) and (II) are lit in succession, and when the lever comes to the fourth contact, which is composed of three independent segments, all three lamps are connected in parallel.

Contributed by Paul G. Edwards.

Projectile Standard Lamp

A projectile lamp, which I made from a relic of the war, is submitted herewith. I was confronted by the problem of having three lamps flash singly and then together. A flasher of the following construction accomplishes this very nicely: a board, about three inches by three inches by one-half inch, is mounted in an upright position on a base (B). On this board are arranged four contacts, three being single plates, while the fourth is in three segments. A lever (E) is secured to a shaft which passes through a bearing in the upright block of wood and is attached to the other side to a small gear. A worm gear, attached to an extended motor shaft, meshes with the gear attached to the lever and serves to revolve this lever slowly.

When the lever comes in contact with segment No. 1, the current from the batteries or other source flows through the lamp (F), contact to the lever being made through the motor shaft. The lamp (G) and (II) are lit in succession, and when the lever comes to the fourth contact, which is composed of three independent segments, all three lamps are connected in parallel.

Contributed by Paul G. Edwards.

Contributed by L. M. Jordan.
Electric Wind Vane

Allow me to submit an article on the construction of an electrically recording wind vane, which I hope will appeal to the readers of your fine magazine.

The mounting of a wind-vane, with its switch blade, contact ring and eight-point connection, to show the direction of the wind in a room or hallway of a house.

The vane was made of thin tin taken from a cracker box. The point was triangular in shape. The wing was 5 inches wide and 8 inches long; the strip is made from an old yardstick cut in two, and the tin wing and point clamped between the pieces by two 3/16-inch stove bolts. The balance of the vane is then found, and a rod threaded at one end is placed between the strips and a nut at each side holds the vane straight.

A lamp board, with eight lamps corresponding to eight points on the wind vane; whichever lamp is lighted, indicates the direction of the wind. The light is sufficient. Both bearings should be connected to the battery, the nine posts on the left are connected to the wind vane. The wiring diagram is self-explanatory.

After the apparatus is finished the vane is mounted on a chimney or any clear place where the wind will strike it from any direction. It is advisable to mount it close to the room where the recording panel is located, to save wire, but it must be in an exposed place.

A single drop of oil or the bearing is sufficient. Both bearings should be connected by a piece of wire for the current to pass through the rod to the switch blade.

The instruments are then wired as in the diagram; the lamps are marked on the panel as shown.

Contributed by Belgrave F. Gostin.

Protecting the Refrigerator

About this season of the year the youths of the neighborhood become afflicted with making excursions to nearby refrigerators and relieving them of "goodies" and most tempting food. This is a costly and dangerous sport that should be discouraged, as it often results in serious injury to the mischievous youths and expense to the victim of the robbery.

This is the electrical age and there are very few problems that cannot be solved by electricity. These young robbers, alley cats as they are called, can be effectually discouraged without serious injury by the proper use of electricity.

The refrigerator is shown on the back porch in Fig. 1. In order to open the refrigerator door the handle (H) must be lifted, which causes the lever (L) to rise out of its socket, forcing the rod (R) up to the insulated wire (K), making a connection of the primary circuit of a small induction coil. The secondary terminals are led to the lock (J) and the socket; when the primary circuit is completed the victim receives a severe, though not serious shock.

In order that the housewife will not be exposed to the unpleasantness of an electric shock, an automatic switch (S) is fixed on the kitchen door. A brass strip is nailed to the side of the door and when the door is closed the brass strip closes the circuit, but when the door is open the circuit is broken. All the housewife has to do is remember to keep the kitchen door open when she goes to the refrigerator.

Diagram 2 shows another attachment to the refrigerator for chasing intruders. The same switch (S) is used on the kitchen door and an electric bell is placed in the circuit. On the refrigerator door there is a switch (S1), shown in detail in Fig. 3. The essential difference between this switch and switch (S) is the position of the door when the switch completes a circuit. When the refrigerator door is closed the circuit is broken, but just as the door is pulled open the brass strip comes in contact with the ends of the wires, closing the circuit and causing the warming bell to ring.

The third plan is to connect the electric bell so that it will ring as the screen door on the back porch is being opened. The switch (S) is fixed on the door and as the culprits slyly open the door they are greeted by the loud ringing of the bell.

Any one of these three plans will safeguard the contents of your refrigerator and save you many times the cost of the materials used in the construction of your silent sentinels.

Contributed by Edward L. Friedman.
Fixation of Nitrogen

The illustrations show an inventor's workshop, in which the fixation of atmospheric nitrogen is being studied.

The process applied is the well-known arc process, in which air is passed through a flaming voltaic arc. The arc of the electric light is employed, except that it is much longer, on account of the electrodes being widely separated. When air is passed through the flame of such an arc, the high temperature reacts upon the oxygen and nitrogen of the air, bringing about a combination of nitrogen and oxygen, forming oxides of nitrogen, which, by absorption in water and subsequent oxidation, give nitric acid.

A great deal has appeared in the newspapers of late on the subject of Mussel Falls, and the proposal for the utilization of the water-power there, which has been presented to the Government, are generally supposed to include the fixation of atmospheric nitrogen as one of the principal objects. This gives special interest to any serious work in this direction.

The laboratory we illustrate is in Cincinnati and the inventor of the process being worked out there is Charles H. Loutit. In the one photograph are seen four combustion chambers, within each of which an arc is maintained, and through which air at atmospheric pressure and temperature passes. The large bottle seen above the four combustion chambers is used for further oxidation. The gases are then passed through water, which, absorbing the oxidized nitrogen, forms nitric acid, and final passage through a bottle containing an alkaline or alkaline earth hydrate absorbs any that may escape the water, forming a nitrate of the base employed.

Everything, of course, in the laboratory is done on the miniature scale; in the next photograph we find the oxidizing chamber dispensed with, and a vertical tube, representing an absorbing tower, filled with gravel, over which water trickles, used to absorb the gas.

When it is remembered that the world is largely dependent for its supply of nitric acid and nitrates on the natural deposits of Chile, and that the consumption of the derived chemicals is constantly on the increase, it will be seen how important an industry is involved in this synthesis.

In old times potassium nitrate produced on a very small scale, comparatively speaking, by a natural decomposition and recombination, gave the world its "villainous sulphurets," whose principal use was then the manufacture of gunpowder. The introduction of artificial fertilizer and the development of the chemical industry, especially in the production of dyes, all accomplished in quite recent times, have given a great impulse to the industries based on nitric acid. The old artificial nitrate beds, in which the potassium nitrate was slowly produced, have sunk into utter insignificance, and the great deposits of Chile will soon be supplemented on a very large scale by the fixed nitrogen of the air.

It was the fixation of nitrogen which enabled the German powers to prolong the war, giving them the requisite nitrogen oxides for their explosive gases.
A very complete X-ray apparatus, which takes up less than 20 square feet of floor space, and which operates satisfactorily on the standard 110-volt alternating current available at any lamp socket, is now offered to the medical profession by Mr. Frank Bieber of San Francisco.

The Bieber fluoroscopic unit is shown in the accompanying photos, and is a complete X-ray plant—everything from the transformer to the tube and screen, mounted as one unit.

It can be set up and used independently in a large X-ray plant—or it may be used to handle the entire X-ray work itself, and may be used wherever current and darkness are available. It operates without noise, inconvenience or distracting adjustment.

The equipment is provided with a finely balanced examination table—a touch tilts it from vertical to horizontal, and beyond. By means of this facility an operator can examine any part of a patient instantly and effectively, with a maximum of comfort to the patient and to the operator.

At the pressure of the foot of the operator on a foot-operated control arm, a brilliant X-ray image on the screen, with or without extreme contrast, is produced. A combination fluoroscopic screen and photographic plate holder, centered with the X-ray tube, is held in place in front of the examination table by a metal arm, adjustable along a line parallel with the direction of the rays.

The X-ray tube, fluoroscopic screen, and photographic plate holder are attached to a transverse carriage which also supports the screen shutter control, the meter and filament control. A special feature of this machine is that the tube and fluorescent screen and plate holder are always the same distance apart and directly in line.

The advantage of this arrangement is that results are always uniform, because the screen is always at the same distance from the tube.

The transverse carriage is supported on a perpendicular carriage which operates on a track fastened to the inside of the table, the entire assembly being carried by chains and counterbalanced; it has an up and down movement of 20 inches, a cross movement of 18 inches, and a back and forward range of 8 inches to accommodate stout or thin patients.

The examination table is counterbalanced by the weight of the transformer, which is firmly attached to the lower part of the table and can be removed in less than half a minute.

In front of the transformer is an electrical unit containing a 4-wire conductor under tension, which can be quickly removed. This will prove an advantage in the event that it becomes necessary to make repairs, as the conductor can be lifted out and the entire unit sent to the manufacturer for repairs and another unit is connected to the transformer by a T-point slotted plug so that the connection is always made in the proper position.

There is a foot-switch for fluoroscopic work and a pull-switch which is used in radiography. Five milliamperes suffice for fluoroscopic work and 30 milliamperes for radiography. For bringing the current up to 30 milliamperes the operator merely pulls a string (on the pull-switch) and holds same until the exposure is made, and then releases the pull-switch. The instant this switch is released the current is automatically shut off and the machine remains set for fluoroscopic work.

One of the desirable features of this equipment is the fact that the Coolidge tube is enclosed in lead shields as shown by the arrow at (A) in the photograph. This provides protection to the operator from any vagrant X-rays except those used for the examination and exposure. The Coolidge tube is enclosed in lead glass painted black, thus eliminating all light from the machine, making it possible to keep complete darkness in the room at all times, as this darkness is absolutely necessary for the best fluoroscopic work.

The entire outfit can be easily moved from one room to another. The X-ray may Advisory bulletin with one of the miracles of modern electricity, although we now accept it as a matter of course, refusing to be astonished at anything less than the 3000-mile transfer of sound waves by radio. But what the physician would do today without the X-ray is hard to say. He would feel as if he were deprived of his first assistant.

The operator is also adequately protected; as stated above, the X-ray tube is shielded by lead glass. As the apparatus is intended for fluoroscopic work and not for radiography, provision is made for leaving the room dark, by painting the lead glass, which encloses the Coolidge tube black. It is absolutely necessary to preserve the sensitiveness of the eye of the operator where he has to depend entirely upon what he sees, and where he obtains no permanent photographic record of the interception of the rays. He must see the silhouette in greatest perfection.

The apparatus shown with all the details for manipulation as described in the article, indicates an important advance in the science.

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If you want good electrical articles on various subjects, and here is your chance to make some easy money. We will pay one cent a word upon publication for all accepted articles. If you have performed any novel experiments, if you see anything new electrical, if you know of some new electrical stunt, be sure to let us hear from you. Articles with good photographs are particularly desirable.

EDITOR.
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!

Beneath these clouds lies Walter Penn.
He thought 2200 was 110.

Lie sleeping here, Joe and Mrs. McFife.
He didn't think when he asked for his knife.
—L. Hunt.

Beneath this stone rests Farmer Julius Lenz.
He didn't look when he touched the fence.

In peace here lies Mrs. Miriam Hughes.
She grabbed the pipe while fixing the fuse.
—Nelson Hall.

ELECTROCUTED IN BATH TUB IN HOME
Daughter of Edward B. Clark, Newspaper Writer, Killed
In Omaha, Neb.

Omaha, Neb., March 3.—Death of Mrs. Frances Devereux, 29, Omaha society woman, who was electrocuted by an electric heater in a bath tub at her home here yesterday was accidental and no Inquest would be necessary, the coroner announced today. Mrs. Devereux was the daughter of Edward B. Clark, Washington correspondent of the Chicago Evening Post.

The heater, according to Dr. J. H. Henske, was found on a wet towel which was wrapped around her feet. There was no water in the tub and the heater is believed either to have fallen into the tub or to have been placed there by Mrs. Devereux to warm her feet.

Mrs. Devereux was heard to scream, but the bathroom door was locked and her two small children and a servant summoned a locksmith.

This simple grave holds Tommy Wade.
He stood near a leader when lightning played.
—Harold Gelick.

The above article reproduced from a daily newspaper shows that our "Short Circuits," comic as they are, have a sad basis in fact. The Latin poet says, "What prohibits a laughing man from telling the truth?"
An Electric Hand Shake

A SKETCH of an electric shocker which I think might interest the readers of Elec-Tricks in Practical Electrics, is submitted herewith.

It is composed of a Ford coil, three two volt flash-light batteries and five feet of high tension cable, and a switch. The coil is connected with the batteries as shown in sketch. The high tension cable connected with coil runs under the owner's coat and down his sleeve into his hand. The end in his hand is connected to a coin. By wearing a rubber glove he may offer the coin to a person. When the victim tries to take the coin he turns on the switch and he receives a shock. He may place his hand on a metal object which others are in contact with and give them all a shock. This is not half the fun possible with this electric shocker which may be constructed at a very moderate cost.

Next place a brass or wooden brace between the two rods to keep them in line. The wires pass down from the magnets to a key or automatic circuit breaker and batteries in the distance.

Place a canvas covering over the framework and paint the features of a person on it, and also put a piece of cloth in each hand. Your device is now ready to work when placed among the branches of a tree where the birds are eating the fruit.

When the circuit is closed the electro-magnets pull the iron plates down, which scares the birds.

Contributed by H. R. Chernen.

An Electric Scarecrow

THIS plan should prove a great help to farmers and town folks whose fruit trees are depleted by birds.

First make a wooden frame in the shape of the toy called a Jumping Jack, but do not attach the arms to the body until you are ready for them. After you have made the framework, put a piece across the body from side to side to hold two large electro-magnets. Two powerful electro-magnets go on the cross-piece and are fastened firmly.

Next make the arms and pivot them to the framework of the body by means of large screws, leaving about six inches on the inside for each arm. One end of these rods you must secure to the holes in the arms, and at the remaining ends fasten thick round pieces of iron plate as armatures for the magnets.

Next place a brass or wooden brace under his coat.

When the circuit is closed the electro-magnets pull the iron plates down, which then pulls the arms up, and when opened the arms fall down, which scares the birds.

Contributed by Harold McVicker.

Important Articles Appearing in the August Issue of Radio News

Radio Telephotography. By Dr. Alfred Gradenzwitz.
How to Build a Loud-Speaker. By Paul G. Watson.
Practical Information on Reception of Radio Signals. By B. Bradbury.

Electric Spiritualism

J UST think! all the spiritual messages you want for about fifteen cents and a codfish box!

Punch a small hole (about 3/16 inch) in the top of a codfish box and directly under it and in the center of the box fasten a small porcelain socket; miniature base type. Remove the battery from your flashlight and pack the battery in the box so that it will not roll and make any noise. Bend a piece of No. 18 copper wire and pass it through a small hole in the box to make contact with a piece of tinfoil, as shown. A piece of S. C. C. No. 24 wire is soldered to this and the battery; or it may be held to the battery by a couple of feet of tape securely wrapped around it. The tinfoil must be stripped down and connection may be made to it by a tack through it, by winding the wire around the tack and then pounding it down. Now cover the whole box with a colored silk rag if possible; and practice turning the light off and on by the concealed switch under the cover a few minutes till you have it always under control.

Spiritualism as perpetrat by a simple electric appliance, but which by its very simplicity will mystify the audience.

The next thing to do is to purchase a small towel rack for about 15 cents, and remove the glass rod (it must be a glass one). The end of the rod must be broken off at about 45° in order to work. A file or grindstone will smooth the surface, although a break is not so apt to arouse suspicions.

To operate you enter the dark room amid many magic words and place the box on a small stand; seat yourself behind it; take the glass rod by the unbroken end in your left hand and place it exactly over the hole (a little practice and you won't miss the hole). He sure the broken part is towards the guest for best results. At least always have it at back or front, never sideways. Touch the switch and just the broken part will be filled with light. If your friend is a radio bug perhaps the spirits will use the International Code. But the best is, they will not see the manipulation. In case the rest of the rod does light up, slightly dilute the light with more silk rag.

Contributed by Richard Pitt Ballon.

Surprising the Chickens

MUCH amusement can be obtained with the aid of an old telephone magnet. Connect it up to a pan or water trough.

An elec-trick, this time for the benefit of chickens; the electrician may try the effect of either grounding or insulating the water trough.

If the magneto is weak, get two horse-shoe magnets from an automobile magneto and fasten them on the outside of the magneto. Then watch the chickens.

Contributed by August W. Gustafson.
A puzzling trick supposed to represent perpetual motion; the power, of course, comes from the concealed battery and solenoid.

The Inexhaustible Pail

SOME months ago we described an inexhaustible bottle. This bottle was a very neat illusion, and produced a very good effect. On the same order is the inexhaus-
Electro-Magnet and Aluminum

Aluminum disc

This illustration shows how an aluminum ring or disc is affected by an alternating current passing through a coil over which the disc is placed.

(120)—F. W. Ehret, Erie, Pa., asks:
Q. 1.—Is there any electro-magnet which will attract aluminum?
A. 1.—There is no electro-magnet which will attract aluminum.

A. 1.—There is no electro-magnet which will attract aluminum.

Noisy Telephone

Microphone

Gauze

Felt lining

Rubber bands

A suggested silencing box to be used on the telephone system to prevent noise in the receiver.

(121)—Russ A. Dunn, Herrin, Ill., asks:
Q. 1.—The operation of a one-wire telephone system, which I have installed at my office, cannot always be depended upon. I am located in a railroad yard, where

the electric locomotives, which I use to haul coal, make transmission and reception very noisy. Is there any way in which I may eliminate this noise?

A. 1.—There are many reasons why your telephone is noisy. It may be that the vibration due to the trains causes the wire of the circuit to tremble. A portion of this wire may have been bared and touched some grounded projection; consequently, short-circuit your telephonic system intermittently. Artificial electrical disturbances, such as those set up by the locomotives, may cripple the lines temporarily, in much the same manner as local atmospheric disturbances. The most probable cause, however, is the shaking of the microphone due to the vibrations set up by the trains, which tends to agitate the carbon granules in the microphone around.

Noisy Telephone

Diagram of the layout of a transformer for delivering current at different potentials. This illustrates the connection and general construction.

A. 1.—The core of this transformer is made up of very thin iron laminations, measuring % inch by 2% inches for the long legs, and % inch by % inch for the shorter parts of the yoke. One of these legs is built up to a thickness of 1 inch, staggering the laminations, so that alternate iron strips are placed ¾ inch from the others. Two cardboard flanges are then glued in place about % inches apart, and the core wrapped with a layer of insulating tape. Soldering a piece of lamp cord to No. 34 silk or enameled wire, the winding is started at one end.

Transformer Data

(122)—George W. Zoll, Lead, S. D., asks:
Q. 1.—I have a sheet-iron core size 5¾ inches by 4% inches by 1 inch. Please give windings for a ¾-kilowatt 10,000-volt transformer, with 110 volts on the primary.

A. 1.—We would advise that you wind 150 feet of No. 18 double cotton covered wire, as the primary on your iron core. The secondary of the 10,000-volt transformer should contain 13,500 feet of No. 46 cotton covered wire wound in pies or sections; 27 pies to 500 turns each are enough.

Fuse Blowing

Details of the core and winding of a transformer with intermediate taps, showing how the core is built up and how the winding is held in place.

A. 1.—The electrolytic rectifier you have constructed is correctly designed. We would advise, however, that you use a saturated solution of ammonium phosphate.

The reason your fuses blow is because the resistance of the liquid is not great enough. A lamp bank may be used to cut down the current. This comprises 5 lamps all arranged in parallel and in series with one of the conductors to the A. C. mains. The lamps should preferably be of the 100-watt type, and the winding is continued. At 505 turns from the beginning of the winding another tap is taken off, and the winding is continued to a total of 1,840 turns.
Large Ozonator

A. 1.—An ozonator consists of a step-up transformer capable of delivering approximately 20,000 volts in a second. Within a box are mounted a series of flat aluminum plates connected alternately to the outer terminals of the step-up transformer. These plates are separated just far enough to prevent a discharge in the form of a spark, but between which a high discharge having a bluish radiance constantly takes place, particularly noticed in a dark room. Air is gently wafted between the plates, with no measurable square as much as ten inches square. The oxygen of the air turns in part into ozone.

Molding Iron

A. 1.—It is not necessary to reduce the voltage of the 32-volt direct current farm charging a storage battery. Simply use the hook of at least 32 watts. Lamps supply a convenient and known resistance.

Solenoid to Lift 1,000 Pounds

Mysterious Third Rail

Q. 1.—If a trolley pole jumps off the wire and there is no guide to pull it on again, would it be possible to climb on top of the car and place the pole on the wire without danger of shock?

Q. 2.—By connecting an electric motor and dynamo, could perpetual motion be secured?

Electromagnet Query

Q. 1.—I have a cable buried about 12 inches in diameter with approximately 300 turns of No. 28 wire. Connect two ends to a telephone and you are ready to begin your hunt. By connecting the loose end of the buried cable to one side of 110-volt A. C. mains, and grounding the other side of the main, it will be possible to trace the direction of the wire by means of the coil current described above. Within a certain distance, if A. C. lines are already grounded, as you must ground the side of the circuit already grounded. Starting at the point where the current is connected to the cable, and holding the exploring coil in hand, it will be possible to trace the course of the cable by means of the humming sound heard in the telephone receiver. When the humming sound stops, you will find the point at which your cable is broken or grounded.

Practical Electrics for July, 1922

Making Storage Battery Plates

Q. 1.—How can I make a resistance to molten or well iron?

Q. 2.—What is the construction of an electric motor and dynamo?

Electrolytic Rectifier

Q. 1.—Give me three solutions to use in an electrolytic rectifier.

Making Storage Battery Plates

Q. 1.—How is the paste for a storage battery plate made?

Q. 2.—What else is done to a plate before it is finished, aside from adding paste?

Speed of Electric Motor

Q. 1.—There will be a difference of speed because of the friction of the air upon the larger disc and because of the expenditure of energy in driving the air outwards by centrifugal force as the rotating element. How can I tell if an exploring coil to locate this, and what is the method of exploring to employ?

A. 1.—We would advise you to construct an exploring coil as follows: Wind a coil about 18 inches in diameter with approximately 300 turns of No. 28 wire. Connect two ends to a telephone and you are ready to begin your hunt. By connecting the loose end of the buried cable to one side of 110-volt A. C. mains, and grounding the other side of the main, it will be possible to trace the direction of the wire by means of the coil current described above. Within a certain distance, if A. C. lines are already grounded, as you must ground the side of the circuit already grounded. Starting at the point where the current is connected to the cable, and holding the exploring coil in hand, it will be possible to trace the course of the cable by means of the humming sound heard in the telephone receiver. When the humming sound stops, you will find the point at which your cable is broken or grounded.
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A Solenoid Question

Q. 1.—I have a D. C. circuit of 7-volt minimum, 1.1-volt maximum, and from 27A. to 3A., with a resistance of 12,000 ohms (internally, resistance of source). In this circuit I wanted to insert a solenoid with a plunger of 5-inch diameter, whereas the spool has an outside diameter of 25/32 inches, which would be the inside diameter of the winding. I have a few hundred feet of No. 13 B. and S. cubic wire S. C. C., which I should like to use if practical. The solenoid may be as long as eight inches if necessary. How should I wind this solenoid? What can I do to make it as sensitive as possible? What is the actual pull of the plunger?

A. 1.—The solenoid which you desire data upon could not possibly exert much attraction with the low current and the low pressure which you intend to supply. Such a solenoid, however, of carefully constructed, would not even lift the weight of the core, using your data as the basis of the design.

A Telephone Magnets

Q. 1.—How can I adjust a telephone magneto so that it will light three or four miniature 4-volt flashlight bulbs?

A. 1.—The way in which to change the magneto so that it will light 3- or 4-volt miniature bulbs is by reducing the armature of the same with No. 22 single cotton-covered wire, and to mount a pair of slip rings upon the shaft, and then you must connect brushes with these slip rings, as shown in the accompanying sketch.

Gold Electro-Plating

Q. 1.—Please publish the formula for a solution for gold plating and the general method of procedure.

A. 1.—For gold plating, use a gold anode and a battery giving a pressure of from 1% to 4 volts. The correct voltage will have to be determined by experiment. The following solution is used:

Water .................... 1 gallon
Potassium cyanide ........ 10 ounces
Gold chloride ........... 3 ounces

The potassium cyanide is dissolved in warm distilled water. To this solution is added the gold chloride. The quantity of potassium cyanide needed may be varied to secure the desired color. The article to be plated is first cleaned with caustic soda and water, after which it must be handled by tongs or wire, and must never be touched by the hands. It is then immersed in the bath and the current allowed to flow through the electro-plating solution. It is shortly removed and slightly scratch-brushed, washed, taken out of the tank, and immersed and left until the coating is completed. It is desirable to mount the cathode (that is the part to be plated) in such a way that it will allow for considerable swinging movement, and the article to be coated should be kept in motion in order to obtain a uniform deposit.

Motor as Generator

Q. 1.—At what speed should this be run to deliver 9 amperes?

A. 1.—The output of the motor if run as a generator will be about 94 per cent of its current consumption when run as a motor. Therefore, this motor should be driven at a speed a trifle above 3,000 revolutions per minute in order to give a 9-ampere current at the same pressure viz., 220 volts.

Decreasing Direct Current

Q. 1.—Is it possible to make a coil which will cut down the voltage and increase the amperage? I do not want to change the windings. I must decrease the voltage, however.

A. 1.—There is one simple method of doing what you desire, and that is to cut down both the voltage and the amperage by connecting a resistance in series with your apparatus or coil. Of course, you cannot increase the amperage and lower the voltage in this manner; both amperage and voltage will be affected at the same time.

If the requirements were not for so small a current, a motor generator in which your circuit would run the motor while the generator was used as a motor should approximately the same wattage at any desired voltage, according to the windings, would accomplish the result.

Another way to do it is to charge a storage battery in series and discharge it for use in parallel.

A Three-Inch Spark Coil

Q. 1.—Please give all dimensions of a 3-inch spark coil.

A. 1.—Here are the dimensions of a 3-inch spark coil: the length of iron core is 72% inches; diameter of the core is 1% inches. The core is made of soft iron wire about 0.20 size and is packed into a fiber tube one-eighth of an inch thick. The tube is then wound with two layers of No. 14 D. C. C. wire. The secondary is wound in 16 miles and 8 pounds of No. 32 wire, 11 and 8 gauge, is used. The condenser contains 120 sheets of tinfoil, 9 by 7 inches, which are separated by waxed paper. A pressure of 12 volts is used in the primary circuit.

Q. 2.—Is it practical for an amateur with limited appliances to construct so large a coil?

A. 2.—It is certainly practical, yet it is rather a large coil to start with. You should have the best winding and testing facilities, so as to watch the progress of the work. All the work is much easier under such conditions. We wish to encourage the amateur, but would it not be better to start with a smaller unit?
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Tesla and Oudin Coils

(141) — H. A. Welsh, London, England, asks:
Q. 1.— What is wrong with my Tesla or Oudin coil which will not generate more than an inch spark from the same, using a 6-inch spark coil to excite it.
A. 1.— The answer is that you did not obtain very good results from your Tesla or Oudin coil was undoubtedly due to the fact that your condenser in the secondary circuit was not the proper capacity for this outfit. The cost of constructing an Oudin coil is very reasonable. We would suggest that you build one according to the following specifications:
On a tube 3 feet long and 4 inches in diameter wind No. 32 single silk-covered wire, separating the turns at least one-sixteenth of an inch from each other. This is mounted on two uprights at either end, or attached vertically to a base. No screws or nails are used anywhere in the construction. The primary will then consist of 11 turns of No. O, or larger B. and 8. gauge copper tubing or brass tubing, or aluminum wire of the size. This wire may be wound on a wooden or rubber cover 12 inches in diameter and located centrally. The capacity of this coil horizontally. This primary may be easily added, mounted, so that the apparatus can be in any form with either an Oudin or a Tesla type of coil. If the magnetic field of the tube is placed on the side of the tube or the cove may be placed at the base if the coil is mounted in a vertical position. We would then suggest that you employ a pointed spark gap, and that Leyden jars be used in the circuit instead of glass plate condensers.
We believe that those coils you built would have given satisfaction if proper condensers had been used in the circuit. It is possible, however, that your 6-inch spark coil is delivering very little energy from the secondary binding posts.

In Which Direction Does an A. C. Motor Run?

(121) — H. Cheney, Phoenix, Ariz., asks:
Q. 1.— In which direction does an alternating current motor run?
A. 1.— The direction in which an alternating current motor will run depends entirely on the direction of the current being of the induction type. The simplest forms of induction motors will travel in either direction, depending upon the direction in which they are started.

Hydro-Electric Development in Remote District

A new reservoir for the city of Bradford, England, is, according to the London Electrician, about to be built in the remote fastnesses of the Yorkshire moors, and all the motive power for the machinery of building is to be derived from a hydro-electric plant. The water will be turned by water conveyed in a pipe line from an existing reservoir. In addition, this plant will provide light and make possible a motion-picture show in the village which will be erected for the workmen near the reservoir site. Nor will the development stop there. The electrician also anticipates that it had lost its residual magnetism when it was in a north and south direction for a short time. If the steel bar is placed on its base 90 degrees, so that its shaft or electric magnet and the second pole, as becomes evident.

The test at Fig. 6 (C) is sometimes used in the simplified form, by placing a bar of iron across the two poles. If they are magnetized correctly, that is, north and south, the iron bar can be made to conform with either an Oudin or a Tesla type of coil. If the magnetic field of the tube is placed on the side of the tube or the cove may be placed at the base if the coil is mounted in a vertical position. We would then suggest that you employ a pointed spark gap, and that Leyden jars be used in the circuit instead of glass plate condensers.

We believe that those coils you built would have given satisfaction if proper condensers had been used in the circuit. It is possible, however, that your 6-inch spark coil is delivering very little energy from the secondary binding posts.

In Which Direction Does an A. C. Motor Run?

(121) — H. Cheney, Phoenix, Ariz., asks:
Q. 1.— In which direction does an alternating current motor run?
A. 1.— The direction in which an alternating current motor will run depends entirely on the direction of the current being of the induction type. The simplest forms of induction motors will travel in either direction, depending upon the direction in which they are started.

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A Power Vacuum Cleaner
(Continued from page 340)

Curry, in the shape principally of the dust separator, are of small diameter, mounted on a swivel axle, and when turned under the car permit a very short turning. It is from this end that the car is manipulated, with a handle by which it is pushed and pulled about as required. The apparatus is 44 inches in length, and its highest part is 28 inches above the floor. Its weight is 250 pounds.

Six different tools are supplied for connection to the hose, including a blowing apparatus. It is 44 inches in length, and its weight is 250 pounds. When the receiving instrument has completed a revolution, it has gone a little bit ahead of the transmitter, and at this instant is brought to rest. Meanwhile the transmitter is used to aerate pillows, mattresses, etc. Nothing here is needed but the electric wire or flexible cord plugged into a burner socket on the wall, which is certain a great improvement on the heavy hose with special piping to supply connections in the case of other large-type cleaners.

The Teletype
(Continued from page 344)

A starting impulse as this revolution is completed causes the receiving instrument's shaft to start revolving, and again its rotation slightly ahead of the transmitter, stops and is started only when the transmitting shaft has executed its full rotation.

The usual type of motors are for 110 volts and 220 volts direct current, and 110 volts alternating current, the frequencies varying from 60 to 60 cycles. If voltages run too high they may be reduced by rheostats.

The apparatus as installed is encased very neatly, so that it really resembles a magnified typewriter. It can send the rate of 40 words per minute, and if there is no one at the receiving instrument it makes no difference, as the message is printed there. Its great field of use, it is said, is for inter-department communication in large business establishments.

Small Battery Charger
(Continued from page 348)

armature closes the circuit, and immediately opens it for the other cycle of the alternating current received. The lead then goes from this contact at the front end of the armature, through a safety fuse, to the ammeter, and then to the positive binding post. A cover is provided to enclose the magnet, leaving exposed the armature and binding posts beside it.

The other type of charger is built on the same lines, but with certain variations. The other type is a small battery charger designed for radios purposes charges a 4-watt battery, a 24-volt battery, and those of higher voltage. The case is glass-lined.

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This Course has been considerably revised in order that it meet some of the many important changes which have occurred in Radio Telegraphy and Telephony within recent years. Much valuable data and illustrations concerning the Vacuum Tube has been added. This comprises the theory of the Tube as a detector and as an amplifier, and in addition has been included modern amplification circuits of practical worth. Incidentally, space has also been devoted to the development of the Radio Compass as operated and controlled by the United States Navy with its consequent great aid to present-day navigation.

The beginner and general student of radio will find this Course of great value in securing the necessary fundamentals of a most fascinating and instructive vocation, or avocation—as the case may be. Radio holds out considerable inducements as a career.

The Publishers

The Experimenter Publishing Co., Inc.
53 PARK PLACE
NEW YORK, N. Y.
Salt is diffused through the atmosphere by photo-microscopy, where the great actinic power of the ray gives very short exposure time. What is more interesting are its uses in quartz lenses and fluorspar lenses. Such a lens is required; yet whose uses are very many, and are going to increase continually. It is found that the full-size mercury vapor lamp will burn continuously for many months before giving way, so that it is probable that the laboratory ultra-violet lamp will last still longer, as, of course, its use is intermittent.

One interesting feature of the construction of this class of lamp is the connection of glass tubes to the quartz tubes. This is done by a graded system; thus, the material for the inner vessels, which is very difficultly fusible and which has a very high percentage of silica, is used as the intermediate gradation between the quartz and the common glass for the rest of the lamp. It is quite possible that there may be more than one method of making this connection. Several steps have been used by several glasses succeeding each other in order to avoid the bringing together and melting into one of glasses of highly differing coefficients of thermal expansion.

A Polarized Rectifier and Its Use (Continued from page 307)

One 16-candlepower carbon filament, or 50-watt Mazda lamp for resistance, gives one-half expected performance. For example: A battery whose finishing rate is 3½ amperes requires three 12-candlepower, or 100-watt lamps, and one 16-candlepower, or 50-watt lamp.

The time required for charging depends upon the number of amperes hours (product of amperes and hours) in the battery. This can be determined by the hydrometer readings which give the specific gravity of the electrolyte (battery solution). The following table shows the discharged condition of the battery for various specific gravity readings:

<table>
<thead>
<tr>
<th>Specific gravity</th>
<th>Battery empty</th>
<th>Specific gravity</th>
<th>Specific gravity</th>
<th>Battery charged, half discharged</th>
<th>Specific gravity</th>
<th>Battery charged, one-quarter discharged</th>
<th>Specific gravity</th>
<th>Battery charged, one-third discharged</th>
<th>Specific gravity</th>
<th>Battery charged, one-half discharged</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.150</td>
<td>Battery empty</td>
<td>1.180</td>
<td>Battery charged, half discharged</td>
<td>1.215</td>
<td>Battery charged, one-half discharged</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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