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ELECTRICIAN & MECHANIC

Practical Electrical Testing

Loose Coupling Tuning Coil

Manufacture of Denatured Alcohol

Rustic Table

Adjustable Rheostat

Forging for Amateurs

Peroxide of Lead Detector

Circuit Breaker

PUBLISHED MONTHLY BY

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Electrician and Mechanic

VOLUME XX SEPTEMBER, 1909 NUMBER 3

PRACTICAL ELECTRICAL TESTING

TESTS WITH THE TELEPHONE RECEIVER AND BATTERY

W. C. GETZ

Electrical testing may be roughly divided into two general classes. The first class consists of the various tests made to find the nature of the trouble, or the condition of material under test; the second class of tests consist of those necessary to determine either the degree, position or intensity of the trouble, or certain standard data essential in all electrical work.

In this article we will only deal with the first class of tests and will therefore consider only such instruments as are required for this specific class.

It has been the custom in the past, for electricians to use the magneto generator and bell, for all testing, whether telephone or electric light work. The magneto, a type of which is shown in Fig. 1 usually costs from $6.00 to $15.00, according to the style selected. In use, it will only be available for a given range, and while it has proven extremely useful in its day, it is now being rapidly replaced by more efficient and compact instruments.

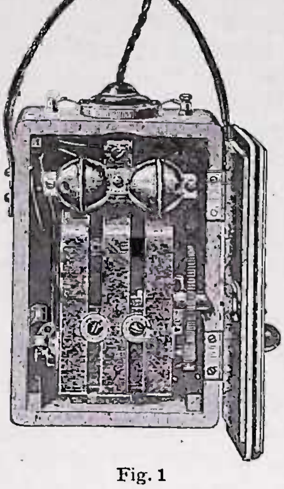


Fig. 1

Of these instruments, the telephone receiver is the cheapest and most sensitive. The average telephone receiver, having a resistance of about 80 ohms, can detect a current through one megohm of resistance, with an E.M.F. of 1 volt. In operation, there is no necessity of employing an extra man to turn the crank as is the case of a magneto, the electrician being able to work in most cases with both hands free.

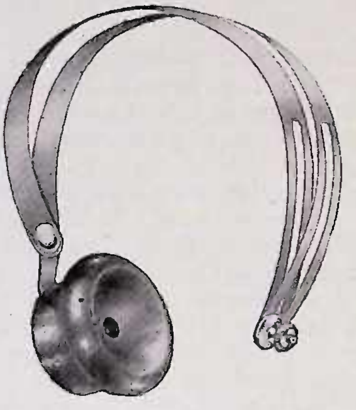


Fig. 2
Courtesy Western Electric Co.

There are various types of telephone receivers, ranging in price from 55c to $10.00. For general testing any type of receiver will do, although it is advisable to purchase one equipped with a head-band, as it will save the trouble of using one hand to hold the receiver. The type shown in Fig. 2, which is a standard Western-Electric Co.'s head receiver, is very well adapted for this class of work.

As it is necessary to have some source of current in conjunction with the receiver, we will consider the best available means of same. For general testing, where the resistance is not very great, ordinary dry batteries are

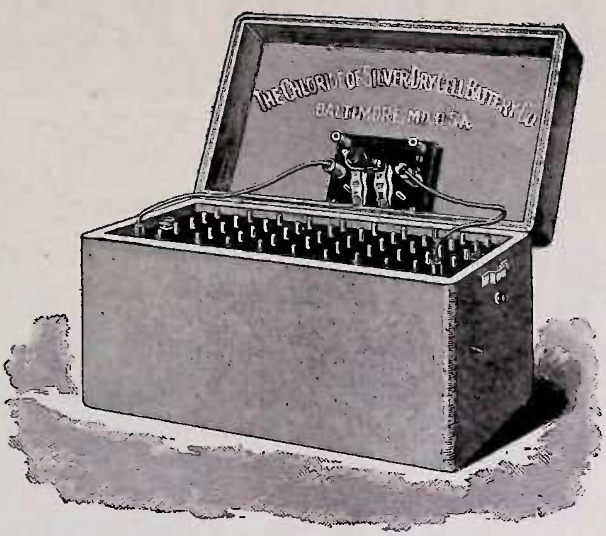


Fig. 3

suitable. Where, however, a high resistance is to be tested through, or insulation tests made, it is best to use from 20 to 110 volts. For this purpose, either 110 volt direct current, from nearby lighting circuits, if any, may be used through proper resistance, or a standard testing battery may be obtained.

Of the latter, the best known, and most generally used, is the chloride of silver dry cell battery, made by the Chloride of Silver Dry Cell Battery Co., of Baltimore, Md. This battery is especially built for electrical testing, having a fairly constant E.M.F., nonpolarizing element, and what is most important, a light weight and compactness not to be found in any other cell. Fig. 3 gives a view of the standard 50 volt testing battery used by many of the foremost telephone companies in the United States.

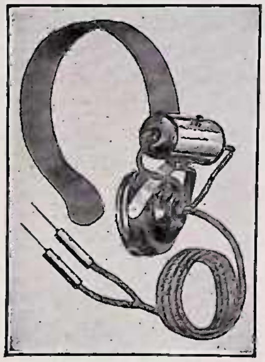


Fig. 4

A most ingenious device that has recently appeared is the Murdock "Circuit Detector," of which a view is given in Fig. 4. This little device consists of a standard testing battery, mounted on a sensitive head telephone receiver, and having a long telephone cord with specially made testing terminals attached. One of these terminals contains an automatic switch which cuts off the battery, when the instrument is not in use, thereby preventing wasting the current by accidental contact of the terminals.

The advantage of always having the battery at hand, as well as the freedom of movement that the testman has with same, is only one of the many desirable features of this little instrument. The price is very low, being but little more than the cost of a good receiver.

Therefore, in the tests to follow, either a telephone receiver with dry batteries, chloride cells, or 110-volt current, or a Murdock circuit detector may be used. As the latter can also be used in connection with the chloride cells, care being taken to pole its battery properly with respect to the terminals of the outside battery, the Murdock circuit detector may be used in all insulation tests, where the resistance is high.

TEST 1—TEST FOR CONTINUITY

Referring to the sketch in Fig. 5, we have a conductor "W," which is to be tested; a battery "B," and a telephone receiver "T." "B" and "T" may be advantageously replaced by a circuit detector. In this case, "W" represents a wire having two terminals "m" and "n" within several feet of one another.

Now with the battery and telephone connected as shown, if the free end of the telephone cord be touched to n, a click should be heard. If the circuit is incomplete or "open" at the point "x," the current cannot pass through the wire "W," and the battery click will not be heard in the receiver. This test is called the continuity test, as it is made to determine if the wire is a complete electrical circuit or is continuous from the electrical standpoint.

At this point it would be advisable to discuss the nature of the aforementioned "clicks" that are audible in the telephone receiver. There are four separate and distinct classes of "clicks" that every electrician should become familiar with, if he uses the telephone for any testing whatever. When the battery is directly connected to the receiver through a low resistance conductor, and the circuit is made and broken, there will be a movement of the telephone diaphragm for each make and break of the circuit, each movement of which will give forth a click varying in intensity, according to the conditions of the apparatus. This is usually called "battery" or "circuit."

In a conductor of very high resistance, the click will be very faint. This is usually termed a "leak." It does not necessarily mean a condition of trouble, but it is really an arbitrary term used to differentiate between the heavy and light flows of current.

Now if a sensitive receiver is used, or the conductor is long, even if "open," a click will be sometimes heard when the terminals are first touched. When the cord tip is taken away, there will be no "back click," as in the case of "battery" or "leak." This is due to the electrostatic capacity of the conductor charging or discharging through the telephone receiver, and is called the "capacity." Generally, if the terminal is touched several times in quick succession, if insulation of the conductor is good, the click of "capacity" is only discernible on the first and second taps, being much less the second time than at first. The action is identical to the discharge of a Leyden jar—where at first a big spark is obtained, then the intensity of the sparks rapidly decreases until in a second, no spark is perceptible. This will be treated of later, in the test for insulation.

The fourth click is that due to induction, and rather than a "click," it is generally a humming noise, heard as long as the contact is made. This is often found when a telephone is put on a circuit that is parallel to feed wires or other conductors carrying intermittent or alternating currents, and is readily distinguishable from "battery," "leak," or "capacity."

APPLICATIONS OF TEST 1

a—For Testing Coils of Low Resistance.

For such coils, as motor or armature windings, primaries of transformers or induction coils, where the resistance is not over 500 ohms, the circuit detector, or a dry cell and telephone is very good.

b—For Testing Coils of High Resistance.

Where the object is of high resistance, such as the secondary winding of an induction coil, polarized relay magnets, etc., use either a 110-volt current tapped off from a lighting circuit, as shown in Fig. 6, or a chloride of silver battery with the telephone. In case the 110-volt lighting main is utilized, an 8 C.P. 110-volt lamp must be placed in series with the receiver.

c—For Testing Fuses, Battery Lamps, etc.

For this class of testing, as shown in Fig. 7, the circuit detector is to be recommended as the most useful instrument. This will be found invaluable to telephone men in the cable terminal rooms for testing fuses, carbon arrestors etc., as a test can be made on from 100 to 600 fuses in a few minutes without flashing the operator or interfering with a busy line. It is also of value to the troubleman, especially after a storm, as he can test out all the tubular fuses in a cable box without removing them from the arrester. All that is necessary is to run the terminals of the telephone down each side of the fuse, and listen for the battery click.

d—Where the Terminals are Distant.

Where the terminals of a conductor that is desired to test are not within convenient reach of each other, as shown in Fig. 8, it becomes necessary to provide a return circuit for the current. Say "W" represents a telegraph wire several miles long. Now with "m" and "n" "open" and one side of battery "B" connected to a good ground, touch "m" with the telephone tip. If "W" is not grounded, only the "capacity" will be heard. Assuming in this case that "W" shows clear, we then ground it at the terminal "n." Then by touching the telephone tip to "m," we should get battery if "W" is continuous. If "W" extends some distance, a 50-cell or 100-cell chloride battery should be used. And if another wire is parallel to "W," it may be used as a return, instead of the ground, if this wire is known to be good.

TEST 2—FOR GROUND AND LEAKS

This test particularly applies to telephone and bell wiring, magnet windings, automobile wiring, etc., being similar to the continuity test (No. 1). The difference is that the battery click indicates a condition of trouble instead of the opposite. In Fig. 9, "W" is a wire having the terminals "m" and "n" "clear." One side of the battery "B" of the test set is grounded, while the free cord of the telephone receiver is touched against "m." If "W" is free from trouble, only the capacity click will be heard. By touching "m" several times in succession, this capacity will be disseminated, if the insulation of "W" is good. However, if "W" is grounded, say at a point "X," as shown by the dotted lines, a battery click will be heard, if "X" is a low resistance ground. However, if "X" is of a high resistance, as is often the case in telephone cable trouble, only a "leaky" condition will be found.

APPLICATIONS OF TEST 2

a—For Picking Out Grounded Wires.

In Fig. 10, "W" is a cable with a number of conductors, "a," "b," "c," etc. If it is a telephone cable with a lead sheath, one side of the battery is attached to this sheath, and then grounded. The terminals of the conductors are brought out and scraped for several inches on the end "m," so that contact may be made with them at will. They are fanned out, however, so that there is no danger of them coming in contact with one another. At end "n," the conductors are cleared from the cable sheath, which has been stripped back about 5 in. Extreme care must be used to prevent them from touching either the cable sheath or one another, in a way that might cause an electrical circuit. Now by applying the tip of the telephone cord to the free ends of the successive conductors, on the end "m," if any one of these gives a click, it will be grounded to the cable sheath. The click may be battery or leak, this of course depending on the resistance of the ground.

b—Where a Coil or Electro Magnet is to be Tested.

In this case, connect up, as shown in Fig. 11, one side of the battery going to one terminal of the winding, and the free end of the telephone cord touching the core of the magnet. If grounded, a click will be heard. It is advisable to apply the continuity test to this, as if the winding is open and grounded beyond the open, it would test clear from one end. The circuit detector is invaluable for this class of testing.

c—Testing High Resistance Windings.

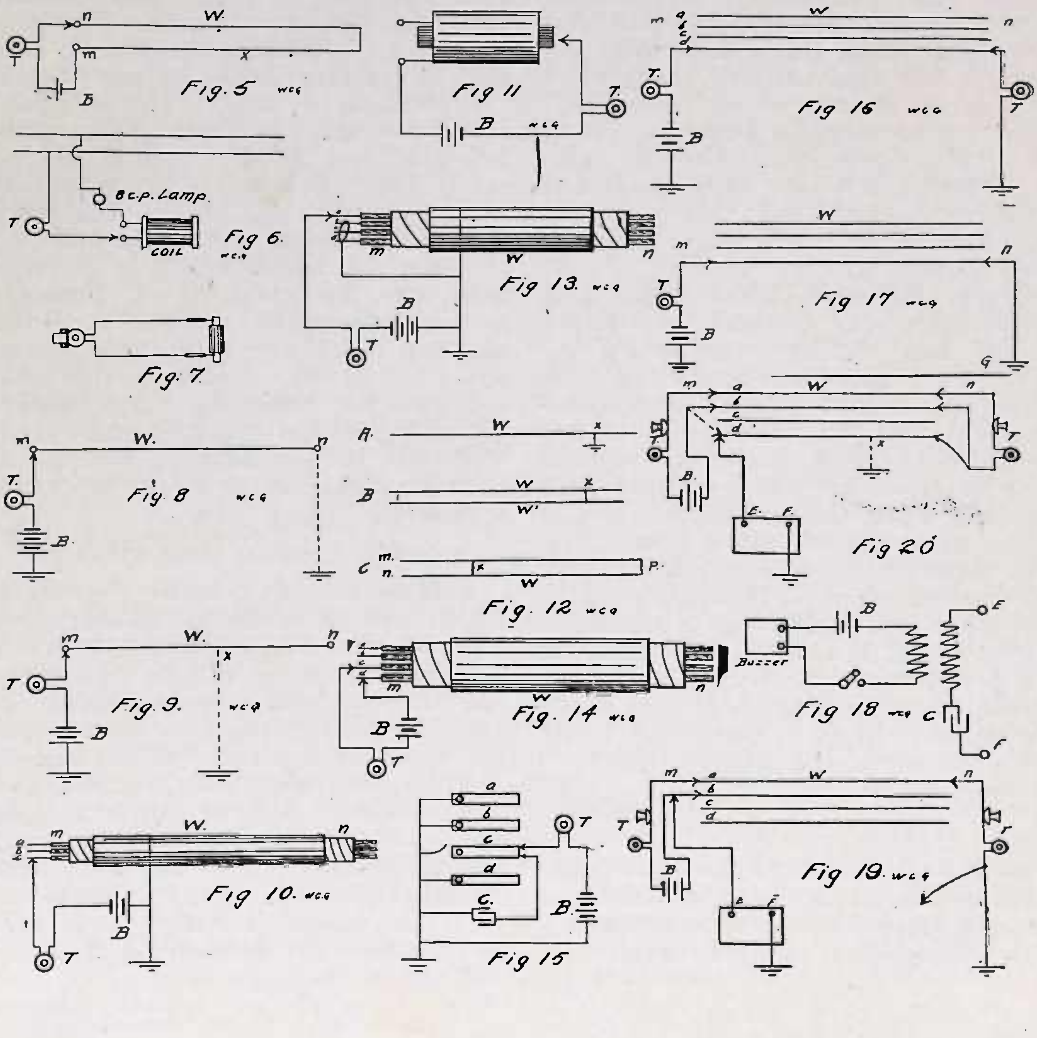
Where the windings are of a high resistance substitute a chloride of silver battery of from 25 to 100 cells, or a 110-volt direct current in place of the dry battery, connecting this in a manner similar to that shown in Fig. 6, but making the connections suitable for this test.

TEST 3—INSULATION TESTS

While this class of testing really includes the simple tests given for locating grounded and leaky wires in Test 2, the methods given under this heading are more efficient and take into consideration, not only electrical circuits between the conductors and the ground or cable sheath, but also any circuits that may be between the individual conductors themselves. A circuit from one conductor to the cable sheath is always termed a "ground," whether the sheath is actually grounded or not. If between individual conductors, the circuit is termed a "cross"; and if it is across two portions of the same conductor, it is termed a "short circuit."

In Fig. 12, the wire "W" is "grounded" at a point "X," in case A. In case B, wires "W" and "W1" are "crossed" at a point "X." And in case C, the conductor "W" is "short-circuited" at the point "X." This last condition cannot be determined by the telephone test unless it is possible to open "W" at a point "P" beyond the short circuit, and test across "m" and "n" with battery and telephone.

Referring to Fig. 13, we have a cable "W" with a lead sheath, having the terminals of the conductors cleared at "n," and at "m," they are stripped of insulation for a few inches, to permit electrical connections. These ends should be carefully prepared, and in the case of a paper insulated telephone cable, they should be paraffined thoroughly before making the test, to exclude moisture. They must not touch against the cable sheath. At "m," the terminals are "bunched" together with a piece of wire. This wire is carried to the cable sheath and then to ground. A battery from 5 to 50 chloride cells and a telephone receiver or circuit detector are now connected as shown. Now remove wire "a" from the bunch, and tap it several times with the free end of the telephone tip. The capacity click should be heard on the first taps only. If, however, the capacity is picked up for several successive taps, the wire is leaky to the cable sheath or



to another conductor. If the click is very loud, the conductor is either crossed or grounded.

Assuming that wire "a" shows battery, we again tie it in with the bunch, but tag it so as to identify it again as a bad wire. We then remove wire "b" from the bunch and test it in a like manner. Let us call wire "b" clear. It is then pushed aside, so as not to touch the bunched wires, and it is not necessary to further test this wire. Next try wire "c," and say it shows battery. As with "a," tie it back into the bunch, properly tagging it. Assume that "d" also shows battery and is tied back. Continue with the rest of the conductors of the cable if any more—and assume that they, like "b," are clear.

Now we have three bad wires out of this cable, which may be either crossed among themselves or grounded to the sheath. Remove the bunching wire from these three, and with the battery still connected to the ground and cable sheath, touch wire "a." If we get battery, we know by test 2, that "a" is grounded. Now try wire "c." Suppose it now tests clear, and when we also touch "d," it is clear too. Yet when these wires were bunched, both showed battery.

This is evidently a cross between these individual wires. Connect the battery to "c" and "d," as shown in Fig. 14. We should get the battery click, if these are crossed. That proves conclusively that "c" and "d" are not grounded to the sheath, but are crossed with each other. As they were both bunched when the insulation test was made, when one was taken from bunch and tested, it showed grounded, since the current went through the cross to the other wire which was grounded in the bunch. Likewise, when we returned the bad wire to the bunch, and came across the other crossed wire, it would also show battery, as the circuit would again be completed through the cross to ground.

APPLICATIONS OF TEST 3

a—In all telephone and telegraph cable work, where lead-covered, or circular loom cables, etc., are used.

b—Where it is desired to test for crosses, grounds, and leaks in cables connected to terminal frames, instruments, etc.

c—For testing very short lengths of cable, a modification of the above test must be used. As it is sometimes difficult to detect a very slight leak on a cable or arrestor of little capacity, it is necessary to use the plan given in Fig. 15. "A," "b," "c," and "d" are parallel arrestor strips or cable conductors of very short length that are to be tested. They are bunched together as shown, and grounded. "C" is a condenser of about 1 M.F. capacity. "B" is a suitable testing battery, and "T" is the telephone receiver.

Now take the bunching wire off of "c," and attach the condenser terminal to same. It should be stated here that the terminals of the telephones, battery, etc., should be well insulated, so that there will be no leak from contact with the testman's hands. Now tap "c" with the telephone terminal. One click of capacity should be heard, when the condenser charges, tap it again, about five seconds later. If the insulation is very good, no click will be perceptible. If, however, the insulation is bad, capacity will be detected every time the telephone touches the arrestor, as when the telephone tip is removed each time, the condenser will discharge through the leaky arrestor and will absorb a fresh charge when the telephone again touches it. Proceed in this manner with the remaining strips, always grounding all but the strip under test. This test is well adapted for testing the insulation of wireless telegraph apparatus.

TEST 4—SELECTING WIRES

This test is used to identify the various conductors of a cable, so that they may be correctly connected at every terminal. This will require two men—the testman and a helper. On one end, the testman has his battery and telephone, as shown at "m" in Fig. 16, and on the other end the helper is equipped with a head telephone. An insulation test should be first made, and all grounds, crosses and leaky wires should be noted. The testman now places one side of his battery to ground, and fastens the free terminal of his receiver to one conductor. The assistant then grounds one side of his telephone, and with the other terminal, he runs over the ends of the wire, until he gets a click. He then communicates to the testman by saying "hello" through his receiver (using the receiver as a transmitter) and gives the number of the wire on his end. The testman then tags the wire he is on, and proceeds with another wire, when the operation is again performed in the same manner. This is done until all the wires are tagged properly. All grounded and crossed wires must be left until last, as otherwise they might be numbered wrong.

b—Where the cable only runs a short distance, as in the case of the sparking circuits on an automobile, one man can perform this test by using a ground wire on end "n," as shown in Fig. 17, and a circuit detector. The testman can go from "m" to "n" and ground the wires properly in turn.

c—Where the cable is very long or where it is connected to a common battery telephone system, the buzzer tone test should be used. The buzzer test set consists of a bell buzzer connected in series with several dry cells, and the primary of an induction coil. The secondary of the coil is in series with a condenser "E," and the free ends go to suitable binding posts "E" and "F,' as shown in Fig. 18.

In Fig. 19, is given the diagram of connections for use of this instrument. "a," "b," "c," and "d" are conductors of a telephone cable. The testman is at the end "m" with the buzzer set and also a separate talking battery that is connected to a regular transmitter and head receiver. The helper at "n," has also a transmitter and receiver, but no battery or buzzer. However, to one side of his telephone set, he has an extra cord called a "feeler" attached.

It is necessary for the testman and helper to get on the same talking wires to begin with. As most telephone cables have their conductors twisted into pairs of wires, the testman puts his battery and telephone set on a certain good pair of wires, if the helper can identify this pair at his end, he goes direct in on it.

Usually he cannot, and does not know which wires the testman is on. To signal him, the testman connects one side of his buzzer set to ground, and places the other side on his talking pair, as shown in Fig. 19. The helper on reaching his end, places one side of his telephone to ground, and runs over the wires with the other side until he detects the buzzing. He then connects in on this pair "metallic," and if the right wires, he talks to the testman, the latter's talking battery energizing both instruments. The testman then disconnects his buzzer from the talking pair, and proceeds to place the terminal on the first wire to be identified, as shown in Fig. 20. The helper then takes the extra terminal or "feeler" and runs over the wires on his end until he catches the buzz; he then gives the testman the pair number, and they continue in this manner until all the wires are tested. Although the testman is not connected to the buzzer on his end, he gets the buzz as loud as the helper, when the feeler touches the right wire, from the induction of the parallel wires in the cable.

If a wire is grounded or open, no buzz will be heard. To find which of these conditions it is, the testman removes one of his test set terminals, as shown by the dotted lines in Fig. 20, to the wire under test. This should give him battery if the wire is grounded. If open, no click other than a slight capacity will be heard. In the first case, the talking battery passes through his telephone set over the one talking wire to the helper's telephone set and through the feeler to the grounded wire and back to the testman's terminal and battery.

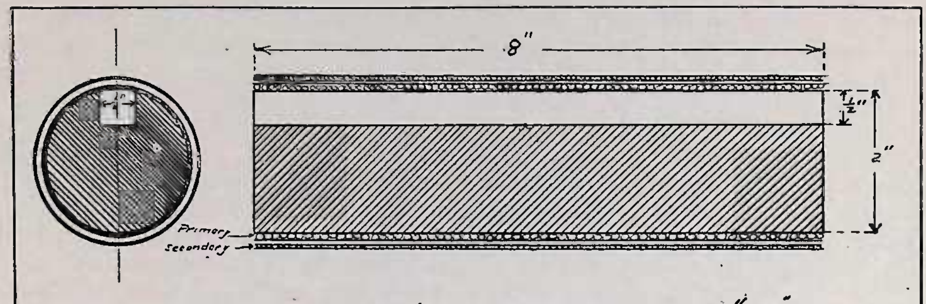
On very short telephone cables, under 200 feet, the buzzer test will not work well, and the battery test should be used. The foregoing tests cover the majority of cases met in telephone and electric light wiring, bell and annunciator work, elevator and telephone cables, as well as other wiring circuits, where such as automobile work, etc., is concerned. In the next article, tests with the Galvanometer, Voltmeter and Ammeter will be given.

Take care of the dollars and every one of them will take care of a hundred cents for you.

A LOOSE COUPLING TUNING COIL

ARTHUR B. COLE

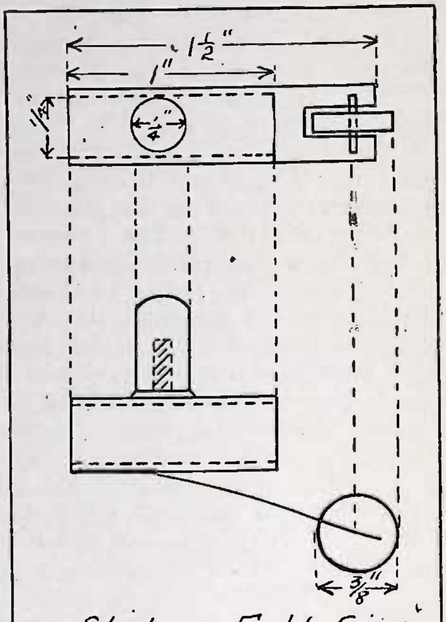
The common form of tuning coil, or oscillation transformer, consists of a single coil of wire wound on a wooden core. Tuning is generally accomplished by moving two variable contacts to which the detector circuit is connected. This movement allows the inductance of the aerial circuit, and that of the detector circuit to be varied independently of each other. Where there is considerable interference, however, more close tuning is essential. The tuning coil described here allows of far more accurate tuning than the ordinary single coil type, and is coming into general use in most commercial stations for this reason. This coil is made as follows:



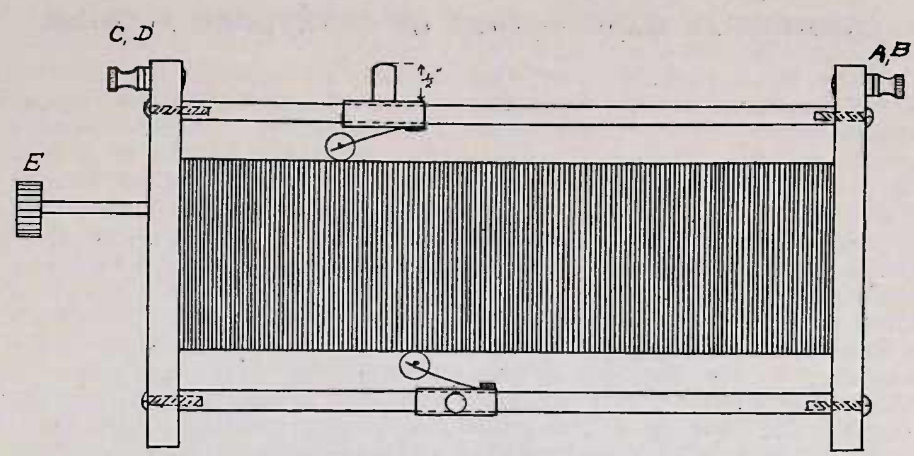
Core and Windings   Scale ½" = 1"

A wooden rod 8 in. long, and 2 in. in dia., has a space ½ in. square cut its entire length, so that contact can be made by a slider in this space with the primary coil, which is wound around the circumference of the rod. The primary coil consists of a single layer of No. 18 bare copper wire. The secondary coil consists of a single layer of No. 25 bare copper wire, wound over the primary coil, and separated from it by a layer of thin cardboard. The individual turns of both primary and secondary are separated from each other by heavy thread, which is wound on along with the wire. This method of insulating turns of wire does away with scraping insulation afterward, and gives a better surface with which the slider can make contact.

One sliding contact is used for the primary coil, and two for the secondary. These contacts are made by sliders of square brass tubing, moving along square brass rods. Each slider carries a piece of spring brass, at the end of which is a small brass wheel, which revolves as the slider moves along the coil. The wheel makes the necessary contact with the wire of the coil. The slider for the primary is moved by a brass rod passing one of the standards of the coil, and threaded into a hard rubber handle, E. This slider moves along a square rod, passing through the ½ in. square space in the core, and makes a contact on the inside of the



Slider. Full Size.



Finished Coil Scale ½ = 1

primary coil. The sliders for the secondary coil are moved by hard rubber handles into each of which a machine screw is threaded, the heads of the screws being soldered to the sliders. These sliders make contacts on the outside of the secondary coil, one above, and the other below it.

One end of the primary coil is connected to binding post D. The other end of the coil is free. The rod on which the primary contact moves is connected to post C. The upper secondary contact is connected by means of the rod on which it slides to post A, and the lower secondary contact is connected in the same way to post B.

From the diagram of connections, it will be observed that by moving the primary contact, the inductance of the aerial circuit will be varied. By changing the distance between the secondary contacts, the inductance of the detector circuit can also be varied. In the diagram, the active turns of the primary are between C and D, and those of the secondary are between A and B. The greatest effect will be obtained in the detector circuit when the active turns A-B are between active turns C-D. If, now, active turns A-B are changed to another position by moving the secondary contacts, keeping the distance A-B the same, so that turns A-B are no longer near the centre of turns C-D, less lines of force from the primary will pass through the secondary, and consequently the intensity of all signals, caused by the electromotive force induced in the detector circuit, will be decreased, and in this way the operator can make undesirable signals very faint, and still keep the desired signals loud enough to hear.

In operation, the primary contact is first adjusted until, when the active turns of the secondary are near those of the primary, the signals have the greatest intensity. The distance between the secondary turns is now varied to obtain maximum intensity of signals from the desired station. Keeping this distance nearly the same as found, the centre of the active secondary turns is moved away from the centre of the active turns of the primary, until the signals desired are heard through all others.

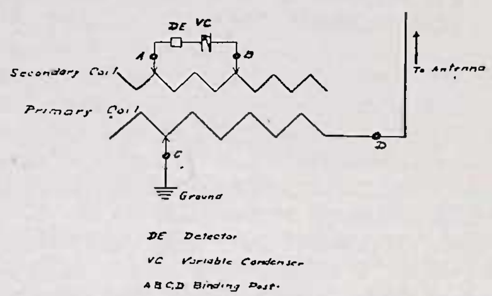


Diagram of Connections

This type of tuning coil is considered to be the nearest approach to selectivity yet discovered, and those familiar with it obtain excellent results from its use.

COMMERCIAL MANUFACTURE OF DENATURED ALCOHOL

One of the most striking stories of the rise of denatured alcohol from the experimental stage to its commercial use is told in the following article, which appeared in a late issue of *Harper's Weekly*.

After you have passed Pittsburg and its smudge, and crossed the smiling state of Ohio, you will notice on either side of the railway that the corn fields become more and more frequent. Indiana, according to the last census, was producing 183,893,767 bushels of corn.

In Illinois the waving fields grow thicker and thicker. Green and bright and shining, the broad leaves of the corn rustle under the summer sun, thriving along toward the harvest. The record shows that Illinois turned out for human use 347,169,585 bushels in a year, and you can well believe it as you journey on through the endless monotony of corn fields. Every little railway station—and no matter how little—has its platforms for loading corn into the cars on the sidings, and long rows of cribs to receive the corn contribution of local farmers to await shipping facilities.

In these corn-raising sections, the man who travels the road afoot at night thrusts into his hip pocket, when he fares forth, not a revolver, but a lusty and rock-hard ear of Dent as a protective weapon against the possible attack of tramp or footpad.

Corn is everywhere and everything. It is food, clothing, and rent. It is to Illinois what steel and coal and iron are to Pennsylvania, what rice is to South Carolina, what tobacco is to Kentucky, and cotton to the Gulf states.

And as you go on westward, the picture does not change. In Iowa the corn crop amounts to three hundred and seventy-three million and odd bushels, in Missouri it is two millions and a quarter, and in Nebraska a little more, with other states turning in their additional millions to the common hopper.

This corn when harvested goes many ways. St. Louis grinds a lot of it. Iowa feeds it to the hogs, and ships it to Chicago and the East in that form. As a matter of fact, there are more bushels of corn fed in Iowa than are grown there, but a vast quantity of corn products of other states finds its way into Illinois, and is ground up in the giant distilleries of Peoria.

Corn explains Peoria, in a way. The town lies on the banks of the Illinois river, in the midst of what is declared, and rightly, to be in summer-time one of the hottest sections in the United States. Peoria was there when folks travelled by stage and water, and to this day is not touched by the main line of any railroad. The Rock Island and the Alton put in branches there, and over these millions upon millions of bushels of corn and a mass of other grains, principally rye and barley, are trundled into Peoria.

In this thriving town of seventy-six thousand inhabitants or thereabouts, there are factories galore making one thing and another, and people busied about diverse pursuits. But Peoria is not famous for these. It is the distilleries, seventeen all told, that have made Peoria famous. It is the centre of spirit manufacture. It would be cruel to the thirsty to tell how many three-finger drinks of the wine of the country are pressed out in Peoria every year. And the reason for this is in the corn-field.

Here is, or has been until the last few years, the very heart and geographical middle of the corn belt, and the other grains are not so far distant as to involve an excessive haul. This is the economy of manufacture, to be near the raw materials.

One of the biggest and most thoroughly equipped of the great distilling establishments of Peoria was the Atlas—a sky-scraping collectoin of brick buildings in the outskirts of the town, with a row of mighty steel stacks towering up into the sky.

When the knowledge of what Germany and the other European countries were doing with denatured alcohol began to be disseminated in this country, when its big utility for purposes of heating, lighting, motive power, and commercial manufacture were made known, the Atlas Distillery stopped making whiskey. The last gallon of the national stimulant was shipped out from its doors some three years ago, and to-day, instead of contributing its thousands upon thousands of barrels of strong drink, its mills are grinding grain, its cookers and vats and stills are seething with the processes that go to the making of denatured alcohol.

The Atlas has ceased to be a drink-maker, and is helping to turn wheels and heat houses by the new cheap agent and assisting the cunning works of commerce and the arts.

It is no longer the Atlas Distillery. The name on its letter-heads now is "The United States Industrial Alcohol Distillery," and about its dark, noiseless buildings, above the ancient savor of John Barlycorn, there hangs the pungent odor of benzine and the scents of numberless chemicals used in the formula by which the denatured alcohol is fitted for various useful purposes.

But corn is still the key-note. Last year the establishment used something over three million bushels of corn, rye, and barley, and the long trains, grain-laden, drawn in by the railroads from various sections of the farming country, are taken over its sidings and up to the unloading sheds at the side of one of the tall buildings. They don't stop to fool with bags and things in this part of the country. Where corn is handled by the millions of bushels, it has to be handled quick.

From the car doors, it is shot down through a grating at the side of the track under the long shed. Underneath this is a hopper from which the flying carriers, whisking up and down on their swiftly moving belting, take it up into the big storage receptacles high up in the roof.

Thence it is delivered as needed to the groaning mills, and all the air is resonant through the long days with the sound of the grinding. When ground, it is transferred to the "cookers" in an adjoining room, vast metal receptacles that themselves look like big boilers. Here, in the shape of mash, the grain lies for an hour, and then is forced by vacuum pressure into a vat, where a revolving beam keeps it constantly agitated and through which with only brief delay it is pumped into the fermenting tubs

These are gigantic wooden affairs, with their tops away up in the shadows under the roof.

Here the grains lie for seventy-two hours. Underneath the iron-grated floor of the gloomy house where these tubs are crowded together, there is a huge cistern, into which the mash drops from the tubs. From this cistern, after a short period of retention, it is pumped into a beer-still. At this stage of progress the mass is known to the distillerymen as "beer."

While it laid in the fermenting-tubs, the yeast was introduced, so that now, when it reaches the beer-still, it is in a lively state of fermentation and vapors are thrown off, which are the first material results of the changes it has undergone. Inside of the still when these vapors rise to the top they are condensed into high wines, which are drawn off, while the mash, with its remaining moisture after all the high wines have been collected, is carried away to the feed-house.

Now that Nature's mysterious work of chemical extraction has been perfected, modern ingenuity takes the grains in hand to see what can be made of them. Here is where science achieves her finest triumphs and becomes the true servant, for it is in the saving of every atom of waste, the conversion to profit of things already used and which former ages considered of no worth, that latter-day manufacture makes its surest margin of gain. Millions have thus been added to the wealth of the world in the past decade.

When the mash, now known as "slop," heavily saturated with moisture, is first taken to the feed-house, it is subjected to heavy pressure and all possible liquid squeezed out of it. The residuum of the grain is then dried by being run through heated chambers and over spiral evaporators and packed as feed for cattle.

There still remains, however, the liquid, and this upon examination was found to be high in nutritive elements. After sundry experiments, a mechanical method was obtained of converting this into solid form, and now it comes out from the final stage of reduction in the shape of a thin, breadstuffy brown sheet which, when it first leaves the compressing rollers, has the appearance of crepe paper. Added to the dried-out grains before mentioned, about four pounds to the bushel, there results a nutritious cattle feed, which, wet down with corn-stalks and other solid fodder, is one of the most effective of milk-producers, showing as high as thirty-three per cent of proteids, fourteen per cent of fats, forty per cent of carbonhydrates, and from twelve to fourteen per cent of fibre. This utilization of the fluid residuum adds about one cent a pound to the value of the feed. Thus the last elements of worth in the grain are saved, and preserved in this way go back through the medium of manure to the land to make more corn.

This is a digression, in a way, but meantime the work of making denatured alcohol goes on without interruption. The high wines, which were solidified from the vapors thrown off from the mash in the beer-vat, are again vaporized by means of steam coils and redistilled in a similar fashion, after which they come out in the shape of alcohol.

It is at this stage that the real making of denatured alcohol for these several chemical and manufacturing processes begins. The pure grain alcohol is carried over in long pipes from the distillery to the denaturing bonded warehouse in another part of the great plant and stored in an immense tank. It is a strange, silent place, this. You see very few men about—only three or four figures moving through the gloam.

All along one side of the place are huge, white-painted wooden tanks, and at the head of the line a weighing-tank with scales attached, into which the pure alcohol is drawn for measurement, and where wood-alcohol and benzine are added before the denaturing process begins. Pipes lead to each of the denaturing tanks, one tank being reserved for each of the formulas at present prescribed by the government.

Uncle Sam keeps scrupulous watch of the manufacture to see that no pure alcohol escapes to any quarter without paying its due portion of tax, and that all is used in the denaturing processes which render it, nominally at least, undrinkable.

On a desk in this manager's office is a file of bulletins sent out by the government, stating the various formulas and in what processes they are to be employed. They are known by numbers as follows:

No. 1. For cutting shellacs used in the finishing of furniture; for embalming fluid; for finishing photographs, and in the manufacture of thermometric and barometric tubes.

No. 2. Used in the manufacture of celluloid, mercerized cloths, and similar products.

No. 3. Used in making transparent soap.

No. 4. Used in making smoking and chewing tobacco.

No. 5. Used in photo-engraving.

No. 6. Used in making fulminate of mercury.

No. 7. Used in the manufacture of watches in removing traces of oil from the works.

No. 8. Used in the manufacture of sulphonmethane.

No. 9. Used in the purification of rubber.

No. 10. Used in the manufacture of paste and varnishes from soluble cotton.

No. 11. Used in the manufacture of photographic collodion.

No. 12. Used in imitation leather.

No. 13. Used in the making of sulphuric ether.

No. 14. Used in making ethyl chloride for anæsthesia.

No. 15. Used in making nitrous ether.

No. 16. Used in the manufacture of alkaloids and fine chemicals.

The use of these denatured compounds diminishes the cost of every sort of commercial manufacture in which alcohol is used by removing the tax of $2.08 per gallon which is imposed upon pure alcohol. What is known as the "complete" denature is made up of ten gallons of wood-alcohol to one hundred gallons of grain alcohol and the further addition of one half gallon of benzine.

This is the mixture as it is weighed in the weighing-tank and cast off thence into the other tanks where special formulas are prepared. Off at one side of the warehouse is a room in which are stored all the materials used in the different commercial denatures.

This is a place of many odors. It smells like the back room of a drug store. Here are benzol, benzine, ether, camphor, petro-naptha, caustic soda, castor-oil, oil of nicotine, ammonium iodide, sulphuric acid, pyridine, cadmium iodide, and a multitude more which are kept under lock and key and accounted for by the storekeeper, and which are added in prescribed quantities in the various tanks to the "complete."

When these denatures are finished, the barrels are rolled up and filled from the tanks, and the gaugers keep record of it all. To distinguish the denatured alcohol in shipment from the ordinary alcoholic products green-painted barrels are used to contain it, and for the shipments to the great chemical manufacturing houses of the East, steel drums are employed.

The representatives of the revenue department have a little office in the corner of the building, where a record of the workings of the plants is kept. Every bushel of corn and rye and barley that is unloaded at the doors is entered here, every milling process, every gallon of high wines or alcohol, every ounce of chemicals used, every shipment. By his books the representative can tell at any time just how much material in bushels should be in the grain-elevators, just how much in process, and just how much manufactured material is stored. It is a simple proposition, so far as the government is concerned. Under the present arrangement it remits the tax in order to aid commerce, and to place at the disposal of the manufacturer in his business, of the farmer in the running of his machinery, and of the housewife in keeping the home warm and alight, an agent which will be available, cheap, and safe. It is possible, indeed, for the farmer to manufacture denatured alcohol from much of the refuse of his acres. Peoria has the commercial way of doing it. Nothing but clean grains is used, and the denaturing distillery runs when the "booze" factories are "shut down".

—*Gas Review.*

Even a legless man can run through a bank account.

Lunar rainbows are seldom observed in the temperate zone. Very likely the physical phenomenon occurs frequently, but is invisible because of the faintness of the moon's light. On September 12th, 1908, an observer at Coxyde saw to the northwest, over the sea, a band of light, striped horizontally but without perceptible color. The band moved slowly eastward and remained visible nearly all night. On the following day this observer learned that a lunar rainbow had been seen at the epoch of full moon, on September 10th. In the tropics, where moonlight is more intense, lunar rainbows are more frequently observed. They are by no means rare at Reunion Island. At all places the phenomenon is most frequently seen at full moon when the moon's light is highest, but it has been seen in various phases of the moon. It was first observed by Aristotle. A lunar rainbow is produced at full moon by the spray of the great Victoria Falls of the Yguassu, in Brazil.

There are in commercial use at least two methods of balancing a three-wire, direct current system supplied from generators of the over-all voltage of the system; one is to provide a motor-balancer, consisting of two machines exactly alike connected in series and rigidly coupled together, the extreme terminals of the pair being connected to the outside conductors of the system, and the junction between the machines being connected to the neutral conductor; the other is to provide two auto-transformers for each generator, the terminals of each being tapped into the armature winding at points between which the maximum difference of potential occurs periodically, the points of connection for one transformer lying halfway between the points to which the other transformer is connected. This latter arrangement changes an ordinary generator into what is popularly termed a "three-wire" machine. The neutral conductor of the system is connected to the middle point of each auto-transformer. There is a third method which is practical under some conditions of operation,—that is, to connect a battery of storage cells between the outside wires of the system, and connect the neutral conductor to the middle point of the battery.

—*American Electrician.*

A RUSTIC TABLE

A. L. READE

The accompanying illustration (Fig. 1), shows a table in rustic work, suitable for the garden, lawn or summer house. It is constructed on a very simple principle, and can be made by any handy man in a few hours.

Fig. 1

It stands 2 ft. 4 in. high, the octagon top measuring 2 ft. 8 in. across when complete. The first thing to do, will be to make the wood top, which should not be less than 1 in. thick, and is first made 2 ft. 6 in. square. There is no need to be particular about the joints, in making out the width, and any rough sound boards will do, dowelled or nailed together; as it will be sufficiently strengthened ultimately by the battens, hooping and overlay. To get the octagon fairly true, the square board may be marked 7 in. from each corner, these points being the eight angles; it is then marked across the corners and cut off. The battens are of 3 in. by 1 in. section, and are nailed on the under side even with the edges, in the manner shown by Fig. 2, the nails being long enough to clinch.

A stout piece of fir or other suitable material 2 ft. 3 in. long, by about 5 in. in dia., is required for the centre stem. It must be cut square at the top end, and then the wood top is strongly nailed on, quite central. Four sticks may now be cut about 1 ft. 3 in. long, by 1½ in. thick, to be fitted as struts, to support the top on the stem. They are cut slant at the ends and may be fitted more neatly by using a coarse half round rasp to hollow the ends of the struts to fit the stem. They are fixed on with wire nails—using two to each end and must point to each alternate angle of the top. (See Fig. 2).

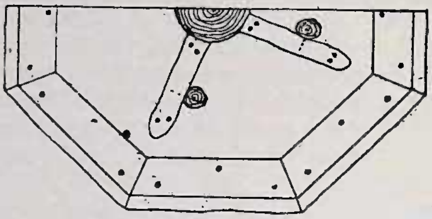


Fig. 2

Four more pieces, 1 ft. 9 in. long, are next required for the legs, and should be rather thicker than the struts, to be nailed on the same way. They must splay out, that the end will be slightly in, as compared with the angle of the top above it. When the legs are secured, four sticks of 1 in. thick stuff, 1 ft. 2 in. long, must be cut, to be nailed round the lower end of the stem, about 3 in. up, being also nailed to each other at the inner ends, the other ends to be fixed to the legs—(see Fig. 3)—and cut off slant. Sticks of the

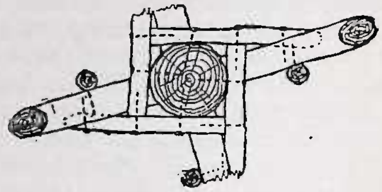


Fig. 3

same thickness, about 1 ft. 10 in. long, are then nailed from the legs to the struts, extending to the top. The legs will require to be cut slant, to fit the floor, and that the top may be level. This should bring the lower end of the centre stem almost to touch the ground.

If the table is intended to be left out of doors, exposed to all weathers, it will be well to bore small holes through the top all over, that the rain

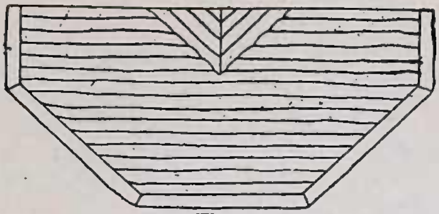


Fig. 4

finding its way between the overlay, may drain through, and the under wood should be coated with pitch. Split sticks of hazel will make a nice covering for the top, and they can be obtained fairly straight. Any design can be worked on, but that shown by Figs. 1 and 4 is very simple and straightforward; a square of 8 in. by 8 in. is first marked in the centre, and four pieces put on to the mark, mitred at the corners and fixed with fine wire nails. Other squares are then worked into the centre. The remainder is quite plain, putting the pieces across the grain of the wood, and cutting off even with the edges, which are finally covered with a hooping of wider split stuff, mitred at the angles and nailed on.

The table, being now complete, should prove very strong and rigid. The ends of the feet and stem should be tarred or painted to close the grain, so as to prevent the moisture from the ground striking in and causing decay. The surface can be improved by rubbing over with coarse sandpaper, then the table is ready for varnishing, which will greatly enhance the appearance and protect against the climate. A good outside oil varnish should be used, and if a coat is given to rustic work once or twice a year, it will always look well, and keep in good preservation.

DIAGRAMS

Fig. 1.—General view of rustic table.
Fig. 2.—Half under view of top.
Fig. 3.—Part underneath view of bottom work, showing construction.
Fig. 4.—Half plan of top.—*Hobbies*.

The annual report of the British National Physical Laboratory contains an interesting account of a series of experiments carried out by Mr. W. A. Price with a view to devising a satisfactory form of electric heating unit. The form finally adopted was to wind a thin strip of Eureka resistance material on a thin sheet of mica, the electrodes of copper strip being then threaded into the mica and hard-soldered to the Eureka strip. A thin sheet of mica is laid on each side and sewn round the edges, and the whole is slipped into a thin copper envelope, which is let into and soldered to the lower side of the bath. This envelope being a nice fit round the mica, the unit unit can be easily removed for renewal or repair without moving or emptying the bath. Some of the units, it is stated, have been in use for several months for heating baths up to 100 degrees Cent., without a single case of breakdown. Each unit is made in two sections, each of which will take four amperes at 100 volts—i.e., a total of 800 watts per unit —and by means of switches they can be put in series, or singly, or in parallel, as occasion demands.

A series of experiments in construction of hollow concrete fence posts, conducted by the professors of the department of agricultural engineering of the University of Winconsin, has proven the many advantages of that type over the solid post. For the past three years the hollow variety has been made and used on the experiment farm. They have been found fully as strong as the solid reinforced posts, much lighter to handle, and materially cheaper in construction. A little more than 4 lbs. of cement is saved in each post by making them hollow. The mixture used was the ordinary 1:2:4, which included 1 part cement, 2 parts sand, and 4 parts stone, none of which was larger than would pass through a ¾ in. screen. The forms used were the ordinary ones, 4 in. wide, 4 in. deep, and 7 ft. long. For reinforcement a ¼ in. round steel rod at each corner, the distance of its own diameter from the outside of the post. In making the hollow posts, a 2 in. core, composed of 4 pieces of wood, is necessary. A central piece of wood 1 in. square is surrounded by 4 flat pieces rounded on the outer side, forming the round core.

DIP SILVERING WITHOUT ELECTRICITY

The following is a very satisfactory silver dip without the use of the electric current, says the London *Jeweler and Metalworker*. Small articles of copper, brass, composition iron, steel and other alloys, in which copper forms the basic metal, can be coated with silver by simply dipping them in the hot solution, if they are perfectly clean. The deposit of silver will be white, but very thin, so that the cost of a silvered surface will be very little by this method. The solution is best prepared for use in an enameled iron vessel, and the ingredients consist of:

Fine silver of nitrate	5 dwts.
Cyanide of potassium	1½ oz.
Water	1 quart.

The silver, in the form of grain fine silver, is dissolved in nitric acid and water, about ½ oz. each, and then evaporated down to a small quantity or until it begins to thicken in consistency, when it is placed aside to cool, at which stage it will shoot into crystals. Dissolve the cyanide in about half a pint of the water. Dissolve the crystallized nitrate of silver in another half pint of the water, and then mix the two together with gentle stirring. The cyanide of potassuim and nitrate of silver may be dissolved together in one lot of water, but it is better to dissolve each separately in different portions of the water which is to make up the "dip," and then mix the two, as the solution of each is rendered more complete. Water is then added to make up to one quart. This dip must be used hot, and the most suitable temperature is about 180° F.

The thoroughly cleaned articles, slung on copper wires, upon being dipped into this solution, become silvered almost immediately; if the process is carried out with skill, and the instructions carefully followed, a white coating of silver, with a beautiful appearance will be the result. If the surface of the articles is bright, and a very thin coating only is required, the articles will come out of the "dip" perfectly bright, but if a thick deposit is required, the articles will have to remain longer in the "dip," when they will come out of the solution with a dull matt appearance. Dead surfaces also receive the silver deposit in a dead condition. A much larger quantity of cyanide of potassium is required in a simple dipping solution than in an electro-plating solution; a large quantity of *free* cyanide—that is, more than sufficient to hold the silver in the liquid state—is needed. To make it work well, about six times the weight of the fine silver intended to be used in the "dip" is necessary.

A silver solution which contains no free cyanide cannot be used for a "dip," and one which contains only a small quantity does not give a good coating of silver, the film not being of good color. The action of the free cyanide being that it attacks the metal of which the articles are composed, and, as their surfaces become slightly dissolved, the silver is released from the solution in equivalent proportions and takes the place of the removed metal. This solution should not be replenished by new additions of cyanide and nitrate of silver, but only with water, to make up for that lost by evaporation.

As the color suffers, it is much preferable to use it until the silver is exhausted; and then empty the remains into the waste tub for subsequent treatment for the recovery of the precious metals, for experience has found that a dip of this description does not give good results when replenished time after time, for which reason it is best to use a dip to exhaustion, and then make a new one. If a new bath works slow, then it is admissible to increase the silver nitrate and, may be, the cyanide of potassium also.

It is estimated that in the Borough of Manhattan there are about 10,000 passenger elevators and 12,000 elevators for freight service. In twenty-six office buildings of eighteen stories and over, with a rentable area of 116 acres, there are 231 elevators, which travel between 1,000 and 5,000 miles of vertical distance each day. and carry 615,000 passengers, There are 8,000 elevators in office buildings alone.

A USEFUL ADJUSTABLE RHEOSTAT

J. E. DUSSAULT

The following is a description of a simple adjustable rheostat which I made a while ago. Having a voltmeter and ammeter to calibrate, I found that with the ordinary rheostat the variation in the resistance is not gradual enough, *i.e.*, the resistance cannot always be made of such value as to have the meters indicate EXACTLY 1 ampere or 1 volt (as the case may be).

The rheostat here described is able to regulate current strength, by throwing in resistance, say up to 10 ohms (depending on the size and length of wire employed), by very gradual increase in the length of resistance wire, through which the current has to flow.

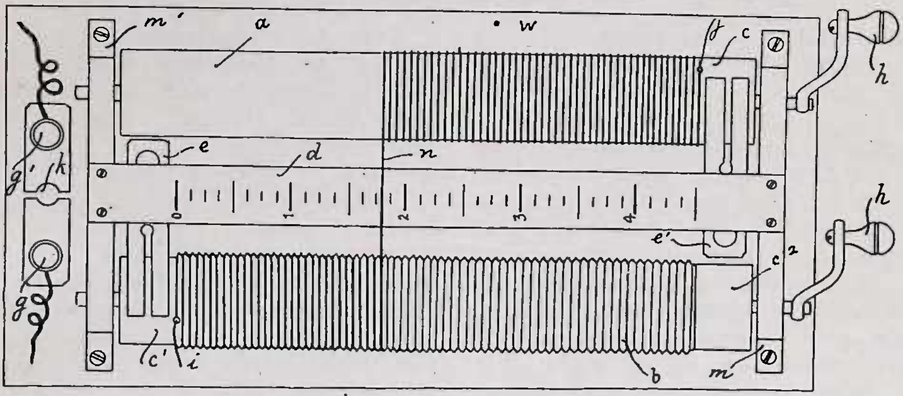


Fig. 1

The principle of working is very simple. A certain length of resistance wire is made to wind on two rollers, one of which is made of wood and the other of brass. The current, arriving through the coiled wire on the wooden roller, circulates through each turn of wire, then passes to the brass roller from whence it flows back to the other pole, through the brass roller itself. It is clear that the more wire there is on the wooden roller, the higher the resistance is; and also that by slightly revolving one of the rollers, the resistance is also slightly varied.

As to the construction: W, Fig. 1, is a piece of fairly thick wood, about 7 by 3½ in., on which two brass standards m and m^1 are screwed. Between these, the two rollers a and b, set at a convenient distance apart, can be revolved on their axis through holes drilled in the standards. At one end of each of the rollers, is fixed a small handle h h. Roller a is of brass and b of wood. To prevent adjacent turns of wire coming in contact, a suitable thread is cut on the wood nearly the full length, leaving spaces c^1 c^2 smooth for brass rings to be slipped on tight. One end of the wire is connected to the brass ring c^1 at i, then wound the full length of the roller, the other end being screwed to j on the brass roller.

E and e^1, Figs. 1 and 3, are copper brushes, conveying current to c and c^1; V, Fig. 3, is a binding post to hold brush, a similar post holds the other brush. (Note that these post come well below the top of the standards to leave room for scale plate d).

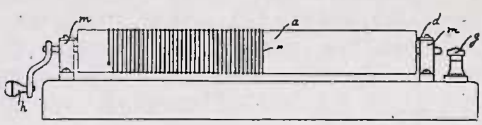


Fig. 2

D is a brass or ivory plate screwed across the standards, graduated in *inches or ohms*. G and g^1 are binding posts to put instrument in circuit. At k may be inserted a plug to short circuit the instrument when needed.

The path of current is as follows: Form binding post g, Fig. 1, to brush e. then to brass ring c^1; through the coils of wire on wooden roller, then to the brass roller; to brush e^1, lastly to binding post g^1.

Besides calibrating voltmeter and

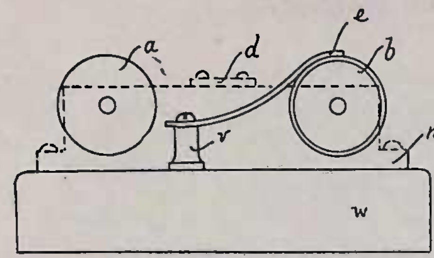


Fig. 3

ammeter, the instrument is useful for use with a Wheatstone bridge, or tangent galvanometer. The writer warns the prospective builder on the following points:

1. The screw i, Fig. 1, must not come in contact with the spindle or it will short circuit the rollers.

2. The rollers must be set far enough apart to leave room to operate handles.

3. Make brushes e and e^1 of good stiff brass or copper, to prevent uncoiling of wire and at the same time make a good contact.

HOW TO USE WATER PAINT OR DISTEMPER

There is painting *and* painting. The difficulty with the outsider is to distinguish good, honest painting performed by the practical, conscientious workman from that which so often passes for painting. We frequently hear it said, "Oh! anybody can do a bit of painting!" Well, anybody can buy a tin of ready-mixed stuff called "paint" and spread it over some surface and call it painting; but it is only by using pure materials, laid on by competent workmen, under right conditions, that satisfactory and lasting results can by any possibility follow. This applies equally in the case of oil or water (distemper) painting, and the object of the writer will be to show *how to do it*—not how *not* to do it.

In this article we will deal with water-painting, or, as it is technically known, distempering—a term that properly describes all work executed by mixing whiting with water and size—and includes everything from the "whitewashed" ceiling to the most elaborately tinted color-work in the decorative scheme of public or private rooms, etc. Please let us here draw the line between what is ignorantly called whitewashing, by many, and lime-washing. Do not use the terms interchangeably, but remember that what is here called distempering does not contain lime as a base, and the reader is cautioned against using lime, except in its proper place, as much otherwise good work is utterly spoiled by having had a coating of lime, applied either from the want of knowing better or by the unscrupulous workman *to save time, trouble or cost.*

Let us, then, suppose we have a ceiling to rewhiten. First we must find out its condition, whether it is very dirty, smoky, or has much old distemper upon it. In any case, if we wish to do it as it ought to be done, it will require "washing off," and if there is already a very heavy coating accumulated, it will also have to be scraped. In the former case we simply take a pail of clean water and with an ordinary distemper brush well wet the ceiling, when, with a little scrubbing the old material will come away. Don't be afraid of using plenty of water in order to swill or rinse your surface clean. If the old stuff is *hard* to get off, let it well soak, and scrape, using sufficient care not to "dig" or injure the ceiling. Next see that all cracks and holes are well repaired with plaster-of-Paris, applied with a trowel.

This done, we must now "prepare" our ceiling, which is done by mixing whiting (well soaked beforehand) in just sufficient quantity to give a little body, a small bit of soft soap to stop the suction and make it smooth to work, with size enough to "bind" it in order to bear going over with the "finish"—we may get to know the strength by spreading a little on a piece of paper and drying it by the fire or over the gas, when, if it is strong enough, it will bear a good pressure when rubbed without coming off.

After covering your ceiling with this preparation, it must stand until perfectly dry before going over it again. Sometimes, if very badly stained, it will require two coats of preparation, and in cases where very smoky, just a little bit of lime-putty will help to "kill" it; sometimes it is advisable to stain the preparation with a little blue or blue-black.

When perfectly dry, you can "finish" with distemper made as follows, and which works better when cold or "jellied": Break sufficient washed whiting into a pail of water and well soak, then pour off all surplus water, add sufficient melted size just to slightly bind. Use without any staining at all, if for a perfectly white ceiling. Any tint, either for ceilings, cornices or walls, may be made from this white by simply adding the stain, or color required; and the preparation of walls is just the same as for ceilings, but where the finish is to be in dark tints it is best to have the preparation somewhat the same.

For the general colors or tints, the following hints may be useful:

Rub down with a palette knife (or even a table knife) and a little water on some flat, smooth surface the dry colors (or stains) until free from lumps before mixing with the body of distemper.

Use a medium self tint for the "foundation" or main stain, and modify with a lighter or darker tint, as may be desired.

For greens, a middle Brunswick should be chosen and lightened with raw sienna for softness, with yellow ochre for dull or dead appearance and yellow chrome for brightness. If to darken, add drop-black, blue-black, blue, umber or Vandyke brown. Either of the above can be modified by adding burnt sienna, Indian red, or Venetian red, or a combination of any two or more. By a little practice any tint, tone or shade can be obtained— from the brightest, palest apple green to the deepest bronze, Quaker or peacock greens.

The same method may be followed with the yellows and browns, remembering that blue and yellow produce a green, blue and red produce purple, plum, grey, etc., according to the preponderance of one or the other.

Red and yellow produce orange, peach, coral, terra-cotta, salmon, etc., and may be darkened or lightened by using stains accordingly.

For some of the heavier tints, *no whiting at all* should be used, remembering that whiting makes all the darker tints appear muddy. Use more size on walls or wherever it is likely to be rubbed against. An excess of size on a ceiling or where there is much heat causes cracking.

I have said nothing of the various washable water-paints or patented proprietary articles on the market, as full directions are given for use by the various makers, and very beautiful and artistic effects are produced when these materials are handled by skilled and experienced workmen, while they can be used by any man or woman of ordinary intelligence and taste; but to the unprofessional let me say, use it freely and not too thick, for the very opposite holds good in distemper work to that in oil, always a good flowing coat (but not enough to run) comes out with a better finish than when used too stiff or "brushed out." The main thing is to spread evenly and quickly, so as not to let the "edges" begin to dry from one sweep to the other, or the joints will show and look uneven when finished.

Never touch up a wall when once finished. —*The Woodworker.*

The use of candles in dining-rooms of hotels and restaurants makes a very pleasing decoration. However, the ordinary paraffin candle is entirely unsuited for the purpose, owing to its unsteady light and the drip of the paraffin wax. The ideal candle would be an electric one, but the objection to the use of electricity heretofore has been that it required connecting wires running to the source of power. Recently an electric table lamp has been devised, which carries its own storage battery. This little lighting device is rather more ambitious than a candle, being set in a vase in which cut flowers may be placed. The light passing through the flowers and water contained in the vase gives a very soft, pleasing effect.

A motor-operated revolving door has recently been installed in a Boston store.

A CONVENIENT ALARM CLOCK ATTACHMENT

CLAUDE L. WOOLLEY

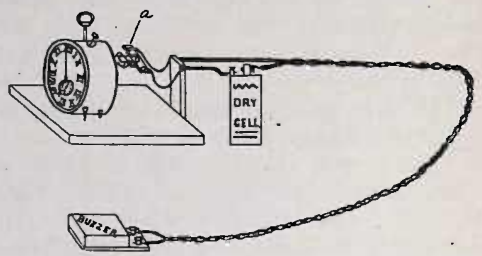
It often happens, that one desires to be awakened at a certain hour without arousing others within hearing distance of an ordinary alarm clock, and to be so thoroughly awakened, as to prevent of falling asleep again.

This may be effected by a simple and inexpensive apparatus, constructed as follows: A wooden base about 5 by 8 in. is made, as shown, in the drawing, in the centre of one end of which, is erected a wooden post, as shown, about 1½ in. wide, and about the height of an ordinary alarm clock.

Procure a small ordinary iron box buzzer, and attach to the binding posts a piece of twisted incandescent lamp cord, long enough to reach from the pillow of the bed to the place where the clock is to be placed; the clock may, for this temporary purpose, be placed in a chair near the bed, or at a more remote point if more convenient.

Cut one of the conductors of the cord, at any convenient point, and connect to the two ends formed, one or two cells of dry battery, in series; the remaining ends of the cord are opened for a few inches, the insulation scraped off for an inch at the ends, and one of the ends secured on each side of the wooden post near the top with small staples. Two pieces, each about 3 or 4 in. long, of the stranded conductor removed from the centre of a piece of similar conducting cord, or that obtained from the inside of the conducting cord known as "tinsel," are twisted firmly at one end to the two terminal wires on the top of the post, the remaining ends being passed through two holes, one at each end of a piece of fibre or hard rubber, about 1¼ in. long and ½ in. wide and 5/32 or ⅛ in. thick, as shown at A, and the ends twisted or tied with thread; the ends being thus insulated from each other and held apart by the piece of fibre. In the centre of this piece of fibre is secured by riveting a small spring clamp, similar to those used on suspenders. The buzzer may, if desired, be wrapped in a piece of cloth. the ends drawn around the cord, where attachment is made to the buzzer, and the cloth sewed firmly in place, to avoid soiling the pillow.

In use, the buzzer is placed beneath the pillow of the sleeper; the clock, from which the bell may be removed, is set for any desired hour, and the alarm wind given three or four turns only, it then being placed on the wooden stand, and the spring clamp sprung on to the alarm wind. When the alarm is sprung, the fibre cross-piece is given a few turns, which causes the bare conductors to cross and be twisted tight, and as a result, the buzzer is put in operation, and it "continues to buzz" until the sleeper awakes and arises and disconnects the clamp.



The buzzer, while it makes little noise in the room, beneath the ear of the sleeper makes a noise that is sure to awaken him, without disturbing others. The spring clamp, may be attached to the fibre cross-piece, by means of a short spiral spring, thus affording some compensation if too many turns be given to the alarm wind, but in either form it works very satisfactorily.

If any difficulty is experienced in clamping the spring clamp on the wind of the alarm, the wind may be covered with a layer of electrical adhesive insulating tape.

The cost of the material is from 75c to $1.00, and the battery used this way will last for a year or more.

The writer, who is entirely deaf in one ear, originally devised the appliance to meet the circumstance, that in the event that his "good ear" was buried in the pillow, he could not hear the ordinary alarm, and, in his case, allowed the bell to remain on the clock; thus if his good ear, was exposed, he heard the bell, and if the reverse was the case, he was awakened by the buzzer; the general utility of the contrivance afterwards suggesting itself to him.

WIRELESS ALARM

R. E. BRADLEY

In the days when the art of wireless telegraphy was in its infancy, when coherers were used, it was very easy to have the polarized relay close a local circuit and ring an alarm bell. At the present time, much more sensitive detectors than the coherer are in use, requiring such an excessively small current to operate them that they do not have the slightest effect upon even the most sensitive form of relay. Hence no alarm bell can be used, and unless the person desired is at his instrument and has his telephones on, there is no possibility of getting him. With the large commercial and naval stations, this is no drawback, because there is always an operator on duty. With amateurs, however, it is quite different. In this case, it is often very desirable to have some way of letting the person desired know that someone is calling him.

This result may be accomplished as follows: Take a sensitive telephone, wound to at least 1,000 ohms, and replace the regular diaphragm by a much thinner one. To the centre of this, cement a piece of graphite about ⅛ in. long having a groove cut around its middle part, so that it stands out perpendicularly from the diaphragm. This graphite can be taken from a lead pencil. In the groove around the graphite, wind and fasten some very fine copper wire, the finer the better. Leave several yards of this free for connections.

From the back handle of the telephone arrange a stiff piece of wire, so that its end will come in front of, and not far from, the hole in the ear piece. From this, hang a small piece of graphite or arc light carbon by a fine copper wire. Incline the telephone, and adjust the hanging piece of carbon until it presses lightly against the piece on the diaphragm.

Suspend the whole from the ceiling by long spiral springs to take up the vibration from the house. As connections use long spirals of very fine copper wire. Connect the magnets of the telephone to the detector. Connect the wires from the pieces of carbon in series with two dry cells and a low wound telephone, to the mouthpiece of which is fixed a large megaphone.

Whenever the diaphragm of the high-wound telephone vibrates in response to the waves striking the detector, it will cause a very slight motion of the pieces of carbon. This slight movement alters the contact resistance between the two. This will be made manifest by a loud scratching noise in the second telephone. A six or eight foot megaphone will concentrate the sound so that moderately strong signals can be heard all over the house.

Instead of the second telephone and megaphone, a very sensitive relay with one cell of gravity battery can be used. After adjusting, tighten the armature spring until the armature is almost but not quite pulled away from the inner contact post. Use the other post to close the circuit of a single stroke bell. The armature of the relay must have very little play. Any alteration of the contact resistance between the two pieces of carbon will cause the light armature of the relay to tremble back and forth and close the bell circuit. This, however, is not as delicate as the telephone and megaphone arrangement.

Of course these alarms will not work on signals so faint as to be barely heard when the telephone is over the ear, but they will work well with ordinary working signals.

Ear caps should not be used unless there is so much noise in the room that they are absolutely necessary. They give a hollow, disagreeable sound and decrease the strength of the signals noticeably. They make the telephones stand off from the ear too much for delicate work. Weak signals which can be read with difficulty without the ear caps are quite unintelligible with them.

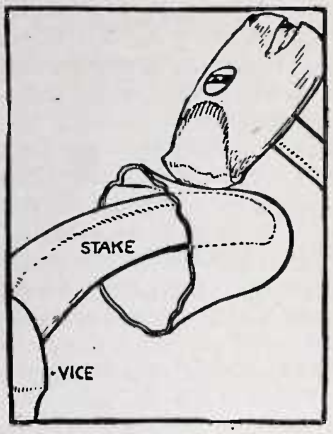
Scorchers in Philadelphia have been giving the police the slip so easily that the commissioner has ordered his motor cops to don plain citizen's clothes and try their luck in that manner.

HOW TO MAKE A SILVER BOWL

A correspondent asks instructions for making a bowl of sheet copper or silver and wishes the hammer marks to show.—The following method, after Wilson, will give you the information you desire: Take a sheet of metal, size 14, if the cup is to be small, to 16, if the cup is fairly large. Cut out a circle, the diameter of which is a little larger than the contour of the cup.

Take the compasses and lightly scratch on one side of the sheet a series of concentric circles, the smallest about an inch in diameter, increasing the radius of the succeeding circles by quarter inches. These circles are to guide the hammer strokes. Now take a round-headed boxwood mallet and beat the metal into a rough cup-shape by beating it into a cup-shaped hollow in a wooden beating-block. This rough cup or shallow bowl must now be hammered into shape with a hammer shaped as in Fig. 12, on a stake shaped as in Fig. 13. Then begin on the inside, and with the round-faced hammer, and keeping the elbow close to the side, beat round in circles, using the hammer from the wrist and not from the elbow. Repeat this, taking care to keep the blows in concentric circles, and to work regularly until the metal begins to take shape and to feel springy. Then anneal it, and, still using the same stake, beat on the outside from the innermost circle outward, taking care to leave the thickness of the brim untouched. It may happen that the cup has become uneven in shape;. this can be remedied after heating, by beating it out again from the inside, with the box mallet, into the cup-shaped depression on the beating-block. Care must be taken not to stretch the metal unduly while doing this.

The work is then continued and is almost wholly done from the outside, still keeping the blows in circles, turning the cup round with the left hand. A skilful hammerman at this stage, by regulating the inclination of the hammer face, can drive the metal in any direction, thickening the rim or the bottom or the sides of the cup as may be necessary. After the shaping of the cup is completed, it must be planished by using a hammer with a polished face, on a stake also polished for this purpose. When carefully done, this leaves the surface true and bright, and covered all over with brilliant facets. This method produces a cup beaten out of one piece. The form can naturally be varied at will, but it will often be found that the shapes taken by the cup during the progress of the work are much more interesting than those we set out to do.



A method which has been used for polishing brass is to rub the metal with rotten stone mixed with sweet oil, then rubbing vigorously with a cotton flannel cloth and finally polishing with a piece of soft leather. A weak solution of oxalic acid rubbed on tarnished brass will remove the tarnish but the acid should be washed off with water and the paste then polished with whiting.

—*The Keystone.*

Belgium's complete system of narrow gauge steam railways, connecting all the towns and villages with the main centres, is being electrified.

FORGING FOR AMATEURS—Part X

F. W. PUTNAM, B.S.

Fig. 121 shows a form of welded angle, and also a welded T. These exercises are made from Norway iron, and illustrate the work explained in a previous article, in connection with Figs. 101 and 102.

Fig. 122 shows a ring attached to an eye bolt, such as would be used in the ordinary barn scuttle. The figure shows clearly how the ends of the piece of stock are first upset, and then scarfed. At A, is shown the scarfed pieces, shaped and joined together, ready for welding. The welding of rings has been explained carefully, in connection with Fig. 86, so that no further directions will be found necessary.

Fig. 123 shows a ladle, which may be made of two pieces welded together, one piece forming the handle, and the other, the bowl. Fig. 124 shows the piece of stock from which the bowl is to be made. For this, a square piece of stock of the proper thickness is cut and marked out, as is shown in the figure. The diagonals of the square are first drawn, so as to get the centre of the piece. A circle is drawn as large as possible, having its centre on the intersection of the diagonals. The piece is cut out with a cold chisel to the circle, excepting in the place where the handle is to be welded on, and also the projections for the two pouring lips. The projection for the handle is readily scarfed and welded to the strip, forming the handle. To form the bowl, this circular part must be heated very carefully to an *even, yellow heat*, and then placed over a round hole in a swage block or some other object. The metal is then bent into the shape of the bowl, by using the pean end of the hammer, the pounding being done over the hole in the swage block. The metal in the centre will be forced downward by the blow of the hammer, and the material in the vise is prevented from following by the swage block.

Fig. 125 shows the position of the block and the piece of stock, when the first bending takes place. Care must be taken not to hammer out the metal, except at the right heat. If the heat becomes too low, the metal will be very apt to split. After the bowl has been prepared properly, the lips are next formed, and the top of the bowl ground off, straight and even, on a grinder. To form the lips, hold the part where the lips are to be, against one of the small grooves in the side of the swage block, as shown in Fig. 126. The stock is driven into the groove by placing a small piece of round iron on the inside of the bowl, and striking sharply on this iron, with the hammer.

The common size bowl for a ladle, is 4 in.; the dia. of the circle, cut from the flat stock, should be about 4¾ in. The stock, which is usually of Norway iron, or better yet, machine steel, should be about ⅛ in. thick. If ordinary wrought iron is used for the bowl, the metal is very apt to split, unless the right heat is maintained throughout. No directions should be necessary for welding on the handle, as the process is the same as when handles are welded on to tongs. Bowls and other objects of similar shape are often made in the manner just described, but in the making of them care must be taken not to do too much hammering in the centre of the bowl, as this is the part the most liable to be hammered too thin.

Fig. 127 shows what is known as a chain stop, and will serve as a good example of a very large class of forgings, which have a comparatively large projection on one side. In making objects of this type, especial care must be taken in selecting stock that will work into the proper shape with the least amount of effort. The stock, of course, should be as thick as the thickest part of the forging, and as wide as the widest part. For the chain stop shown in the figure, stock should be used ¾ in. by 2 in.

Fig. 128 shows the three important steps necessary in the working up of this forging. In the first place, two cuts are made 2 in. apart, as shown at A. These cuts are then widened out with a fuller, as shown at B. The ends are then forged down square, as shown at C. The piece is then finished by punching the hole, and rounding the surfaces, D and E, and finally finishing the ends round.

Fig. 129 shows the position of the fuller in this exercise. Notice that it is held somewhat slanting, instead of perfectly straight up and down. The reason for this is that we have to force the metal toward the central part, in order to leave a more nearly square shoulder, instead of the slanting shoulder that would of necessity be left, if the fuller had been held exactly straight up and down.

Before taking up the use of steel in the forging of machine tools, I wish to discuss briefly, a few general forgings, which may well make up a considerable part of the average blacksmith's work. I have in a previous article, discussed at some length, the calculations required for stock used in forgework, and I will add but one simple rule to this. In calculating the amount of stock required to make a forging, when the regular shape of the stock is to be altered, calculate the volume of the forging, and add an allowance for stock loss in forging, and cut a length of stock, having the total volume, or in other words, the forging will contain the same amount of volume or metal, no matter in what shape it may be. Of course, allowance has to be made, for calculating the burning of the metal, as well as for parts cut off in making. Any forging can usually be separated into several simple parts of uniform shape, and in this form, the calculation can then be easily made, if one will remember that the amount of metal remains the same, and that in the forging, merely the shape, and not the volume, is altered.

WEIGHT OF FORGINGS

To find the weight of any particular forging, the volume may first be found in cubic inches, and this volume multiplied by .2779, which is the weight of wrought iron per cubic inch. If the forging is made of steel, instead of wrought iron, multiply by .2836, instead of .2779. This will give the weight in pounds. I give below the weight of cast iron, wrought iron and steel, both in pounds per cubic inch and per cubic foot.

	Lbs. per cu. ft.	Lbs. per cu. in.
Cast iron weighs	450	.2604
Wrought iron weighs	480	.2779
Steel weighs	490	.2936

FINISH FOR FORGINGS

Frequently, forgings are machined or finished, after leaving the forge shop. The drawings, from which the blacksmith usually works, are made to represent the finished work, and also the finished dimensions, so it becomes necessary for the blacksmith to make an allowance for this finishing when he makes the forging, and all parts which have to be machined and finished must be left with extra metal, which is later to be removed. In finishing, all parts which require finishing should be marked on the drawing. Sometimes the finished surfaces have the word *finish* marked on them, and sometimes the finishing is shown by the symbol "F," which is placed on every surface requiring finish. When all the surfaces of a forging are to be finished, the words *finished all over*, are usually placed on the drawing. The allowance for the finishing up of small forgings is usually about 1/16 in. on every surface; that is, if a block were wanted, to finish 5 in. by 3 in. by 2 in. and 1/16 in. were held for finishing, the dimensions of the forging when finished by the blacksmith, would then be 5 1/8 in. by 3 1/8 in. by 2 1/8 in. On larger work, from 1/8 in. to 1/4 in., or even more, is held for machining. The amount held for finishing, depends to a very large extent on the way that the forging is to be finished. If filing must be done, the forging should be made as nearly to size as possible, leaving only a very slight amount for finish, 1/32 in., or even 1/64 in., being sufficient in some cases; all of this must be taken account of when first calculating stock, and the calculation made for the forging with a sufficient allowance for finishing, added to the drawing dimensions, and not simply for the finished piece.

Among the several general classes of forgings, there is a large variety, which may be classed under one head, namely *Knuckles*. Under this head, will come such forgings as the marine connecting rod, the knuckled parts frequently used in rods and other

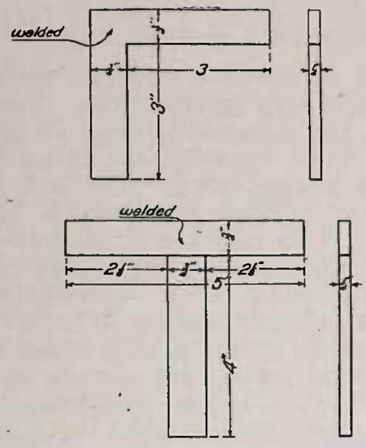


Fig. 121

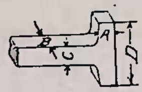


Fig 130

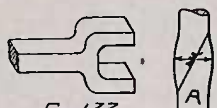


Fig. 133

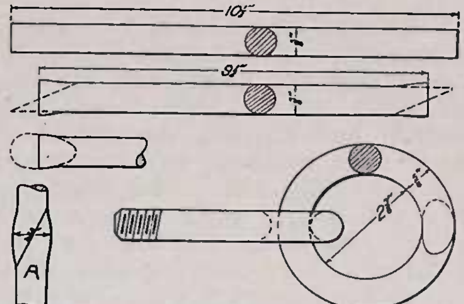


Fig. 122

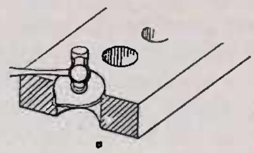


Fig. 125

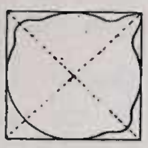


Fig. 124

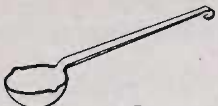


Fig. 123

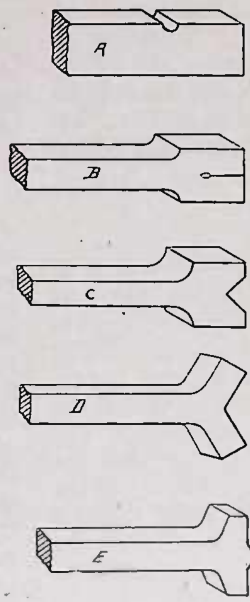


Fig 131

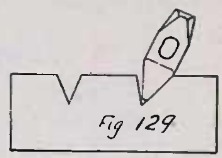


Fig 129

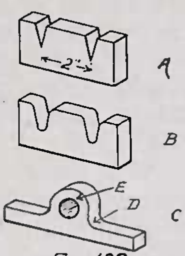


Fig 128

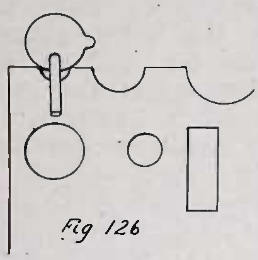


Fig 126

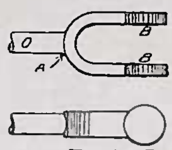


Fig 135

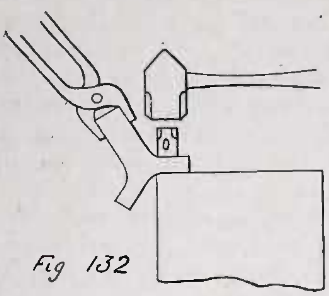


Fig 132

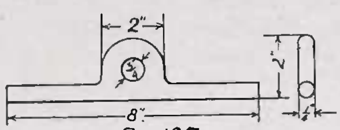


Fig 127

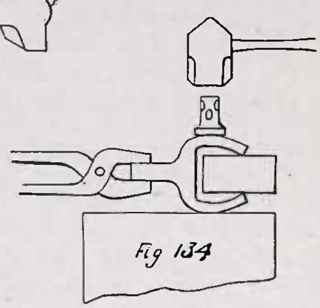


Fig 134

things of this character, such as are shown in Figs. 133, 135 and 137.

Fig. 130 shows the shaped end much used on the crank and all connecting rods. The method of forming this is very simple. The stock used should be as wide as B, and somewhat more than twice as thick as A. Fig. 131 shows the various steps taken in getting the shape shown in Fig. 130. The first step taken requires two fuller cuts, as shown at A, using a top and bottom fuller, and working on both sides at the same time. When a bar is worked in both sides in this way, it must be turned frequently, bringing first one side, and then the other, as the top side. In this way, the cuts will be worked to the same depth on both sides. If the work had been held in one position, however, one cut would probably have been deeper than the other. Having finished these cuts, the left hand end of the bend is next drawn out into the proper size, and a cross-section of B x C, and the right hand end is next punched and placed, as shown at B. If the length, D, Fig. 130, is comparatively short, and the stock sufficiently wide, instead of being punched and slanted, the end of the bar is then notched, and cut out, as shown at C, Fig. 131. This being done either with a right angle or else a curved cutter. The slanted ends are next spread out into the position shown at D, and are drawn down to the proper size, over the corner of the anvil, as shown in Fig. 132. These ends are then bent back into the proper position for the finished forging. Frequently, after working out these ends, and bending them back, a lump will be left, as indicated by the arrow point at E. This must, of course, be trimmed off along the dotted line.

KNUCKLES

Fig. 133 shows a knuckle, which is started in exactly the same way as the previous exercise. After the ends have been forged out straight, usually the tips of these ends are bent down, forming a U-shaped loop, which is very nearly the same shape as the finished knuckle. A bar of iron of the same dimensions as the inside of the finished knuckle is then placed between the sides of the loop, and the sides closed down flat, as shown in Fig. 144.

FORKED END CONNECTING ROD

Fig. 140 shows the end of a connecting rod. This is made in the same manner as just described. The shaped O is drawn down into shape and rounded up before the other end is slanted. After the slanted ends have been bent back perfectly straight, the shoulder, A, is finished up with a fuller, as shown in Fig. 136. This gives a fillet to the shoulder, and strengthens the forging materially. The rounded ends, B–B, are formed before the piece is bent into shape. If several of these connecting rod ends are to be made of the same size, the bending can best be done over a cast iron model of the right shape and size. This is almost invariably done if the forging be a large one, and several of the same kind are to be made.

HOOK, WITH A FORKED END

Fig. 137, E, shows a forging, which also is one of this general class. This forging, as the dimensions show in the figure, are to be followed, to be made from ⅜ in. square stock. The end of the bar is first drawn out round to 3/16 in. in dia. This round end is heated to a bright yellow heat, and put through the hole of a heading tool. The square part is then slanted with a hot chisel, as shown at B, and the cut widened out, and the sides hammered out straight, as at C. They are then brought to the required U-shape, by bending over the horn of the anvil, as shown at D, after which, the hook is bent into the form, as shown at E, Fig. 137.

OPEN END WRENCHES

Open end wrenches of the same class, shown in Fig. 138, may be made in several different ways. One method, frequently followed, is to make the wrench, following the same general method just given for making the forked end of the connecting rod. Ordinary sized wrenches, however, are much more easily made in the way shown in Fig. 139. Where a piece of stock is used wide enough and thick enough to form the head of the wrench, this end is worked in on both sides by means of a fuller, and the head rounded up, as shown. A hole is then punched through the head, and the piece then cut out with a cold chisel, or hot cutter, to form the opening, as indicated by the dotted lines at B, Fig. 139.

Fig. 140 shows a simple tool, frequently called for, and known as an S wrench. This wrench is usually made with a gap or opening at each end suitable for nuts of different sizes. The jaws at the end are, of course, parallel with each other. A line drawn from one jaw to the other should make an angle of about 30° with the centre line of each jaw. There are two ways in which such a wrench can be forged. The first method has already been described, where the jaws are cut from a solid piece of material, and the piece between them is then drawn down to the proper size for the handle. This method is preferable. The second

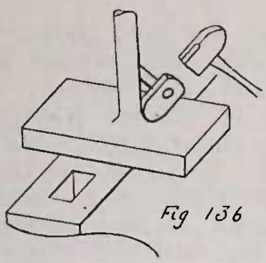


Fig 136

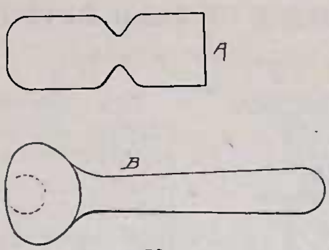


Fig 139

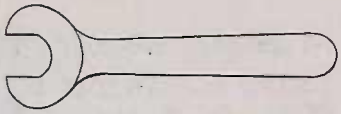


Fig. 138

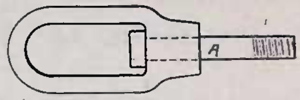


Fig. 141

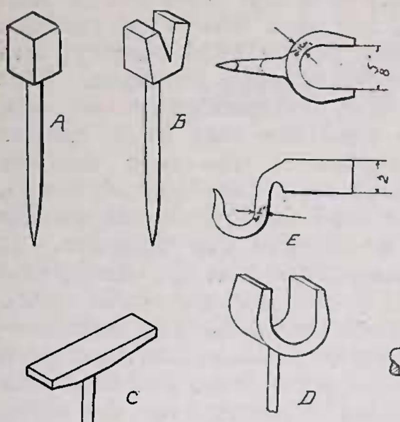


Fig 137

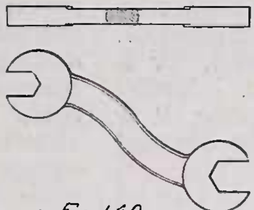


Fig 140

Fig 142

Fig. 143

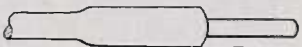


Fig 144

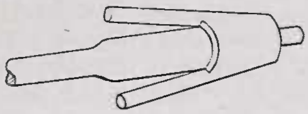


Fig. 145

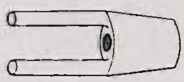


Fig 146

method is to forge the jaws separately, and then weld them to the handle, which has been previously bent into the right shape.

In forging such a wrench, the outer edges should be slightly rounded, so that they will not cut the hand, and the inside of the jaws should be kept perfectly square wth sharp edges. The finishing can best be done either by grind or file.

Fig. 141 shows a swivel. For this exercise, use a bar of Bessemer steel, ¾ in. square, and flatten it a little, and then draw out to ⅜ in. round, as shown in Fig. 142, which shows how the piece is flattened and drawn out. Next, cut off the bar long enough to draw out the other end, the same way, leaving the centre the full size, as shown at Fig. 143. Next, punch the hole through it. Having made a mandrel shaped as shown in Fig. 152, heat the metal to a welding heat, and put the mandrel through the hole, turning up the two ends, as shown in Fig. 145. Having bent the ends up, finish the forging on the mandrel with a light hammer, leaving it as shown in Fig. 146. Next take a piece of ⅜ in. round iron. Upset one end to form a head, and cut a thread on the other end for a nut. This slips through the hole in the collar of the swivel, as shown at A, Fig. 141. The two ends are then bent over and welded, forming the complete loop, to which a chain link can be fastened.

The next article will take up the use of steel in the making of small machine tools.

France is considering an enormous hydro-electric undertaking. The plan is to dam the Rhone, below the rapids, some thirteen miles from the Swiss frontier, and utilize the water in a fall of 230 ft. The entire upper valley of the Rhone would thus be formed into a long, narrow lake. The plant would generate 240,000 kilowatts, half of which would be transmitted to Paris, about 280 miles distant, at a tension of 120,000 volts. It is estimated that this work would cost about $16,000,000 and could be completed in seven years' time.

A PEROXIDE OF LEAD DETECTOR

ALFRED P. MORGAN

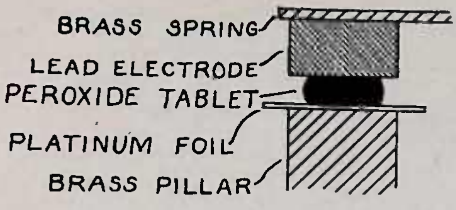


Fig. 1

The peroxide of lead detector, recently invented by S. G. Brown, may be classified as an electrolytic detector. But in this it is rather novel, for it makes use of no liquids. Unlike the Fessenden type of detector, it is very portable, and especially adapted to field work.

This new detector consists of a pellet of lead peroxide, PbO_2, held between an electrode of metallic lead and one of platinum. Fig. 1 shows a diagrammatic representation of the sensitive part of the detector. The resistance of the combination is increased by the electrical oscillations, which, in passing, stimulate chemical action, and increase the counter electromotive force. This increase causes a consequent diminution of the current sent through the detector by the local battery.

The chemical action which takes place, may be outlined in detail as follows:

The current of the local battery in passing decomposes part of the lead peroxide into lead and oxygen, and causes the lead to become positively electrified, and exhibit a tendency to pass upwards to the lead electrode, while the oxygen takes on a negative charge, and passes to the platinum electrode. But the lead and platinum electrodes, with the intervening lead peroxide, act as a source of current, independent of the local battery, and flowing in the opposite direction. This current thus independently set up, tends to send the ions in a reverse direction; that is, the now positive oxygen ions seek the lead electrode, while the lead ions (now negatively charged) go towards the platinum. It must be understood that the two actions described above, do not take place separately, or are not distinct as regarding the element of time, but that both occur at the same time, and that the second, being contrary to the first, merely tends to neutralize it, as it were. Upon the passage of electrical oscillations, the counter electromotive force is increased. This causes a drop in the battery current and corresponding sound in the telephone receivers.

Fig. 2 shows the construction of a simple peroxide of lead wave detector.

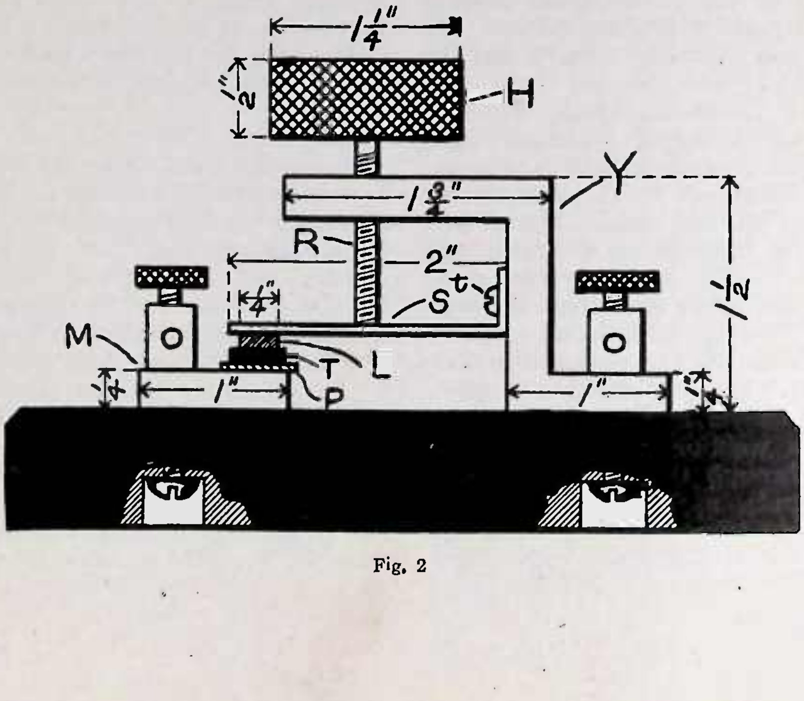


Fig. 2

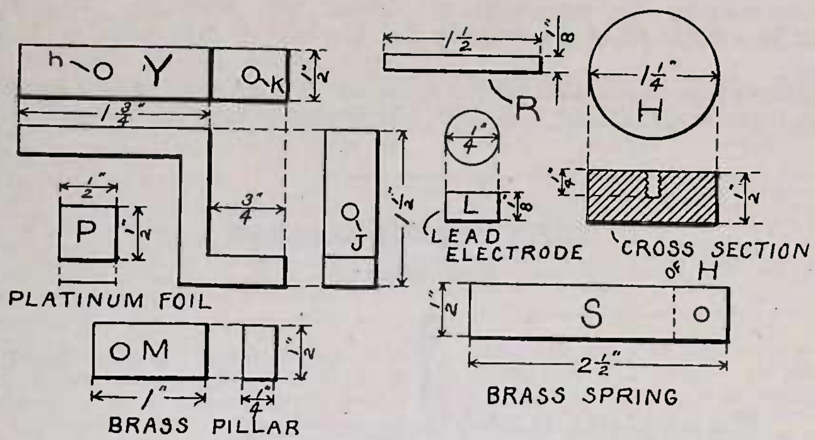


Fig. 3

The yoke, Y, is a piece of brass ¼ in. thick, ½ in. wide, and bent into the shape shown. A hole, *h*, is bored ¾ in. from one end and tapped to fit a threaded piece of brass rod, R, ⅛ in. in dia. and 1½ in. long, which serves when fitted with a head, as a screw to regulate the tension of the spring, S, on the peroxide pellet. The head of the adjusting screw is a piece of hard rubber or fibre, 1¼ in. in dia. and ½ in. thick. A small hole ¼ in. deep is bored in the centre and tapped in order to receive the upper end of the adjusting screw.

A second hole, *j*, is bored in the upright part of the standard, Y. This hole is tapped to receive a small machine screw, *t*, which holds the spring, S, in place. A third hole, *k*, in the foot of the standard and ½ in. from the end, permits a binding post to be mounted thereon, the screw of which, by passing through the base, holds the standard, Y, firmly in place.

The spring, S, ½ in. wide and 2½ in. long, is cut from No. 20 gauge sheet brass. A hole is bored at one end to receive the machine screw, *t*, which binds it to the standard. This end is then bent up at right angles, at place indicated by the dotted line in Fig. 3.

The lead electrode is circular in shape, ¼ in. in dia., and ⅛ in. thick. It is best cut from sheet lead and must be brightened up before use. It is placed on top of the lead pellet, T, and underneath the spring, S, so that by raising or lowering the screw, R, the pressure of contact between the lead and lead peroxide may be regulated.

A brass pillar, B, ½ in. wide, ¼ in. thick, and 1 in. long, is so mounted that one end comes beneath the lead electrode. A piece of thin platinum foil, ½ in. square, is laid on this end of the pillar, and the lead peroxide pellet placed on the platinum foil. A binding post, the screw of which passes through the base and holds the pillar firmly, serves to facilitate connections.

The detector is mounted on a base, 5 in. long, 4 in. wide, and ¾ in. thick.

The lead peroxide tablets cannot be made at home, unless a proper press is convenient. It is best to have a druggist stamp out ½ doz. peroxide of lead pellets in a tablet press. He should apply as great a pressure as possible, in order to harden the tablets and prevent crumbling. The resistance is also thereby decreased. It is very necessary that the pellets be kept perfectly dry, as otherwise a continuous roaring and

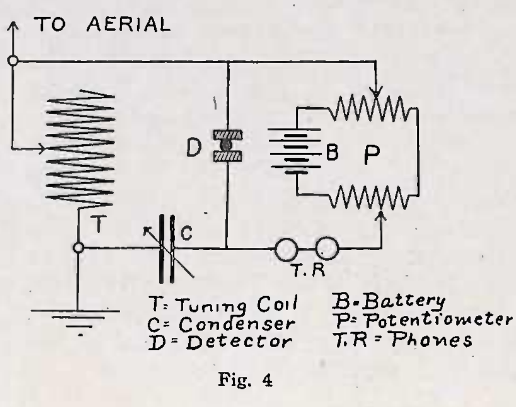


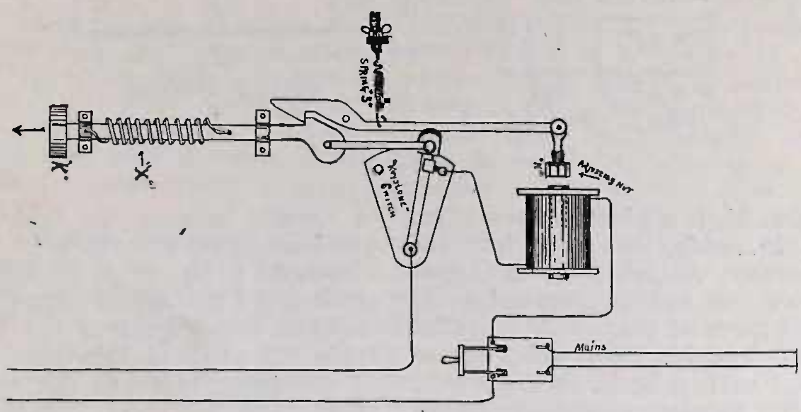
Fig. 4

hissing, due to the decomposition of water, will be noticed when the detector is in use.

The platinum is made the positive of the local battery, and the lead electrode, the negative. The remainder of the circuit is similar to that of the ordinary electrolytic detector with the usual condensers, potentiometer, etc. It is shown by Fig. 4.

SIMPLE CIRCUIT-BREAKER

F. R. FURNAS



A circuit-breaker is a very convenient device to use in experimental work, as it will often save damage, where a fuse would not. For instance, if one is taking current from a lamp-socket, at 110 volts, an accidental "short" means "something doing" before a fuse will "have time to blow."

When the average experimenter is at work, there is not much likelihood of the fuse blowing in any event, as before commencing his work, he usually replaces the 6 ampere fuse plug, used on 12 lamp circuits, with a large fuse to avoid trouble at that point.

Here is just where the circuit-breaker fits in, as it will automatically break the circuit, if the current exceeds that for which the device is adjusted. The one described in this article is easily made and is very sensitive in action.

The drawing explains itself, showing the device set, ready for work. The magnet pulls the iron nut in to its core, releasing the catch, which allows the extension spring to draw up and jerk out the blade of the "keystone" switch, thus breaking the circuit instantly. It is instantly reset by pushing in the knob, K, again.

The amount of current necessary to trip the machine can be adjusted by the nut, N, and the tension spring, S. The magnet should be wound with about 75 turns of No. 14 B. & S. wire. The large spring, X, should be just strong enough to jerk out the switch easily.

Recognizing that the steel beams used in grillage foundations for tall buildings, because of their being concealed from examination, should be absolutely protected from corrosion, the firm of Miliken Brothers have been conducting experiments in the galvanizing of the beams after the shopwork upon them has been completed. By using the hot process in a large bath, they have succeeded in galvanizing not only I-beams, but a complete riveted-up steel column. Experimental grillages, containing galvanized steel, were broken open after they had been in the ground for six months, and the concrete was found to be in close and firm contact at every point.

More than 50,000 church bells have been cast in Troy, N.Y., since 1825.

QUESTIONS AND ANSWERS

Questions on electrical and mechanical subjects of general interest will be answered, as far as possible, in this department free of charge. The writer must give his name and address, and the answer will be published under his initials and town; but if he so requests, anything which may identify him will be withheld. Questions must be written only on one side of the sheet, on a sheet of paper separate from all other contents of letter, and only three questions may be sent in at one time. No attention will be given to questions which do not follow these rules.

Owing to the large number of questions received, it is rarely that a reply can be given in the first issue after receipt. Questions for which a speedy reply is desired will be answered by mail if fifty cents is enclosed. This amount is not to be considered as payment for reply, but is simply to cover clerical expenses, postage, and cost of letter writing. As the time required to get a question satisfactorily answered varies, we cannot guarantee to answer within a definite time.

If a question entails an inordinate amount of research or calculation, a special charge of one dollar or more will be made, depending on the amount of labor required. Readers will in every case be notified if such a charge must be made, and the work will not be done unless desired and paid for.

1100. **Non-Inductive Potentiometer.** O. C. La F., Brock, Neb., asks: (1) What is the construction of a non-inductive potentiometer as compared with one that is inductive? (2) What h.p. will it take to operate dynamos of from 12 to 40 watts output? (3) Can lead pencils connected in series be used for securing a high resistance? Ans.—(1) Wire wound in the form of coils, especially if on an iron tube, or if composed itself of iron wire, will allow the current to set up magnetic fields, or induce magnetism, therefore, such are spoken as "inductive." Wound of non-magnetic material, and in zig-zag manner, this effect is avoided. (2) The power is so small as to be not accurately measurable. More power would probably be used in driving the belt and shafting, than the dynamo. One h.p. equals 746 w. (3) Yes, but different grades of pencils are obtained by mixing the graphite with different quantities of clay, and you will need to measure or try quite a variety of grades before finding just the resistance or current capacity desired.

1101. **Storage Battery.** E. R. P., Roxbury, Mass., (1) has a storage battery that has been disused for two years and now it will not hold its charge. What is the reason? (2) How can a "Kent No. 8" dynamo be rewound so as to increase its output? (3) Where can he get a "Perikon"? Ans.—(1) You should remove the plates from vessel, clean out the sediment, and set it up afresh with acid of the right specific gravity. Then charge for at least 50 hours. See our articles on storage batteries,—in the April and May, 1908, magazines. Also, Watson's new book on "Storage Batteries" gives a great deal of useful information on the operation and care of such apparatus. (2) Only by using coarse wire on the armature, and driving it at a higher speed. (3) Perikon detectors may be had of Wireless Equipment Co., West Arlington, Md.

1102. **Plating—Bicycle Enamel.** C. V. Iowa City, Iowa, asks: I am building a small 1½ h.p. gasoline engine of my own design. (1) How can I plate the small parts and fly wheel rims in brass? I wish them heavy enough so I can polish them. (2) How can I enamel the parts to a finish like sewing machines are? (3) What kind of enamel is used? Ans.—(1) Brass plating is impracticable, use the metal or nickel plate. (2) Bicycle enamel to be had from any cycle dealer.

1103. **Testing and Calibrating.** J. A. C., E. Cleveland, Ohio, asks: (1) How do you test a watt meter for its accuracy, A.C. and D.C.? (2) What book shows tests for electric machinery in regard to winding, also lengths and insulation of wire? (3) What book gives calculations and designs of starting boxes, controlling devices, rheostats, etc.? Give names of publishers of books and prices. Ans.—You will find a great deal of useful information along these lines in Clayton and Craig's "Questions and Answers." Price $1.00, of our publishers.

1104. **Wireless Transmission.** E. R., jr. Swarthmore, Penn. Referring to question No. 899 in February, 1909, issue, how far will a sending station send, consisting of a coil like the one in your April, 1908, issue, only wound with No. 33 s.s.c. instead of No. 36 s.c.c., a zinc spark gap and a tuning coil, like the one described in your issue of August, 1908, and an antenna 70 ft. high and 240 ft. long of No. 14 aluminum wire? Ans.—Using a tuned transmitting and receiving circuit, a radius of 100 miles should be obtained with the transmitting side, etc. I wish to ask if this answer is correct, as I am making this coil wound with No. 33 s.c.c., expecting to send 60 miles with 80 ft. antennæ. If it will not transmit this distance, how far will it transmit? Ans.—Certainly the answer is correct, and the distance can be easily covered if the proper precautions are taken, and a good ground is secured.

1105. **Reducing Voltage.** A. H. N., Mineral Wells, Texas, asks: I have 11 60-ampere 2-volt storage cells and want to reduce the voltage to 2 and amperage to 40, kindly advise how this can be done. Ans.—If your cells are fully charged, one cell will be sufficient to supply 40 amperes at 2 volts for the full ampere hour capacity. Storage cells are usually rated on their ampere capacity for 8 hours, so these cells would have a capacity of 60 x 8, or 480 ampere hours. At a rate of discharge of 40 amperes, one cell would last 12 hours. The current should be regulated to the correct amount by means of a rheostat of proper capacity inserted in series with the battery.

1106. **Caloric Engine.** Wm. C., Newark, N.J., asks: I got the last issue of Electrician and Mechanic and saw therein a small caloric engine. Now I made one and cannot get same to run, can you tell me what is the matter? Here are the dimensions: length of transfer cyl., 5 in.; inside dia. transfer cyl., 2 in.; length of transfer piston, 2¾ in.; dia. of transfer piston 1⅞ in.; dia. of power cyl. 1⅜ in.; length of power cyl., 1⅜ in.; stroke of cranks, 1¾ in.; flywheel, 6 in. dia., ½ face. You do not show in the cut you have in the May number how you set your cranks, whether one is set ahead of the other or opposite. Ans.—The cranks are to be set 180 degrees apart. Your failure to get your model to run is very probably due to leakage by the piston of the power cylinder or else too much friction. If you will send us the model, we will be glad to examine same and point out the difficulty in getting it to run easily.

1107. G. W. T., Buffalo, N.Y. I am particularly anxious to know about the size of wire, length of wire, for the choke coils, the amount of tin foil for condensers, and if a special form of transmitter is necessary. I would also like to know about the size of wire, length of wire, size of core for the transformer. I have read up the information in my possession on the Duddell operating arc, but cannot anywhere find suitable detail given. Ans.—We would refer you to U.S. Patent covering above.

1108. **Silicon-Carborundum Detectors.** J. P. C., Tampa., Fla., asks: (1) Can a carborrundum detector made of two strips of copper be used in place of the electrolytic detector? (2) Is the potentiometer wound in the same way and with the same size wire as the tuning coil? (3) On the tuning coil are the two slides necessary? Ans.—(1) A silicon detector is far superior to carborundum, although carborundum may be used as you describe. (2) No, the potentiometer should be made of No. 30 or No. 32 German silver wire wound on bobbin 4 in. long x 1¼ in. dia. (3) Yes, for good tuning two slides should be used.

1109. **Tuning Coil.** D. T. M., Spokane, Wash., asks: (1) Could you tell me whether I could construct a 1,000 mile station that would work satisfactorily? (2) I have a tuning coil 14 in. x 2½ in. wound with one layer of No. 10 B. & S. primary, and over one end I have about 300 ft. No. 45 B. & S. Could I use that on that set? It has sliding contact. (3) Please name instruments that would be required. Ans.—(1) We presume that you mean a receiving station only. (2) The instruments you would need are good, loose coupling receiving transformer or double slide tuning coil, variable condenser, set of high resistance phones, fixed capacity condenser for phones, and a good detector. We would not recommend a coil such as you describe, although if the primary were about No. 22 and the secondary No. 30, the results would be better.

1110. **Receiving Condenser.** N. H. K., New Haven, Conn. Could you give me any idea of how to find out whether my receiving condenser is in working order or not, as I have just made one size 12 sheets tinfoil 3 in. x 4 in. and paper same as sample enclosed? Ans.—To determine whether your condenser is short circuited or not, you might connect one side to a battery and one side of your telephone to the other side of your condenser, if you get a sharp click in your phones when you make connection with the battery with the other wire of your phones, it will indicate a cross in the condenser. To find if the condenser is "open," connect it in your receiving circuit in series with the phones, and if you can receive signals in this manner, the condenser is all perfect. Would suggest that your condenser is too large, use six sheets of foil.

1111. **Receiving Radius.** A. H., Leominster, Mass. (1) What will my receiving radius be, using the following instruments: horizontal aerial, 53 ft. above ground; 200 ft. No. 18 copper wire; fixed and variable condensers; 1,300 metre wave-lengths tuning coils; improved silicon detector; two 1000 ohm receivers; excellent ground? (2) What will be my sending radius, using a coil giving easily 1½ in. spark, carefully and finely tunable circuits, same aerial and ground as above? (3) Can add diagonal aerial, 100 ft. long, from end of aerial, above mentioned, to about 15 ft. from ground. How will this effect the sending and receiving radii? Ans.—(1) You should have no trouble to receive two to three hundred miles with the set which you describe. (2) Over land you will probably be able to send 10 or 15 miles—over water, much farther. (3) Do not add more aerial from aerial end farthest from your leading in wires, but it would be an advantage to add in the opposite direction, thus making a T aerial.

1112. **Wave Lengths.** C. F. H., Brooklyn, N.Y. (1) Please let me know how the wave length is figured when we have a flat top aerial. It is stated that its length is figured from the spark gap to the top of the aerial, but what becomes of the horizontal portion when the top is on one end and when in centre of the horizontal? (2) It is also claimed that the helix can be used for regulating the wave length. If such is so, why not use a short aerial and make up the difference in the helix—it seems to be very necessary to have a large aerial to get wave length enough to reach. Ans.—(1) On a vertical antenna the length is figured to the top of aerial; on horizontal types from gap to ends of horizontal wire. (2) The helix lengthens the wave, by adding extra inductance in the sending circuit which has the primary effect of lengthening the aerial. We recommend that you use about 1,000 meter waves, which will not interfere with government or commercial stations. You may do this on an ordinary aerial by the use of a helix.

1113. **Rewinding Motor.** R. E., Philadelphia, Pa., asks: What size and weight of wire to use on a "Manhattan No. 3" motor, at present adapted for 3 dry cells, so as to make it operate properly on a 8-volt circuit? Ans.—Use same weight of wire as now, but let it be 3 sizes smaller.

1114. **Transformer Design.** C. N. P., Canton, O., asks: If we can give him some simple rules for designing any size of transformer? Ans.—No, we cannot give any *simple* rules, for the subject is very complex. No detail of electrical engineering has received more attention than transformer design, and the amount of literature published on the subject is appalling. Such rigid specifications are imposed on transformer regulation and efficiency as to require every part be calculated to a nicety. Then again, it is a field in which experience avails as much as theory. To design any piece of apparatus, may be somewhat like designing a house—no two architects will produce just the same thing, but each may have its peculiar qualifications of economy or simplicity. We will gladly refer you to numerous books on the subject, but you must be well fortified with mathematics, before you can fully appreciate all the bearings.

1115. **Wireless.** M. H. S., Gloucester, Mass., asks: (1) How far should I be able to receive and send under the best conditions using tuned circuits, with aerial 50 ft. high, and four No. 20 copper wires each 35 ft. long; receiving apparatus: tuning coil, potentiometer, battery, condenser, silicon detector, and one 1000 ohm receiver; sending apparatus: ¼ k.w. transformer on a 110 volt 60 cycle current, and a helix? (2) Is a helix made of copper ribbon better than one of wire, regardless of space, and, if so, what length, width and gauge should be used for above set? (3) Is a condenser made of brass any better or as good as one made of tinfoil for a ¼ k.w. transformer? If so, give dimensions for one to be used on above transformer. Ans.—(1) The circuit you mention is for electrolytic. Range 100 miles, more or less. For silicon, to obtain the best results, the material to be used is a tuning coil, a pair of receivers, 1,500 ohms to the set, and a fixed condenser. Sending distance about 25–35 miles. (2) No. (3) The best condenser is Leyden jars.

1116. **Wireless Telegraphy.** C. C. H., Washington, Kansas, asks: How can a small current converter of the vibrator type be made to be used on D.C. and A.C., the kind that is used in the big power stations to keep the current at the proper potential without rheostat, and how much would it cost? (2) How much No. 40 enamel wire can be wound on the spool of pony 75 ohm silk-covered wire receiver so as to make the highest proper resistance, an ohm to the foot and would it be advisable to wind it myself? (3) I have a 1 in. Continental spark coil. Will this coil be suitable for wireless work and how far would it send? Ans.—The construction and cost depends entirely upon the amount of current you intend to use. Cheaper to buy than to make. (2) You can wind six to eight hundred ohms in each receiver according to the size of the bobbins. Yes, you can do it yourself. Yes, one to three miles with a good antenna.

1117. **Shocking Coil.** A. S. W., W. Somerville, Mass., asks: Will you kindly explain the following incident: Intending to make a small shocking coil, I took a 6 in. bolt and wound it with 2 layers of No. 18, the coarse sample enclosed. After dipping in wax and covering with paper for insulation, I wound a half pound of No. 26, the fine sample. Both were thoroughly insulated. After connecting with my batteries, there was no magnetism whatever in the core. I do not understand this. Still, I hope you can explain it. Ans.—The primary is either open or short circuited. You should have three or four layers instead of two, and for a shocking coil the secondary should be smaller than No. 26—say No. 34 or 36. A bolt is not nearly as good as a core would be made of a bundle of soft iron wires. A coil of this size would be more than a person could take the full strength of with one cell of dry battery.

1118. **Induction Coil.** P. B., Akron, Ohio, asks: (1) Would a primary coil consisting of a soft iron wire five eighths of an inch in dia. and six and one-half inches long wound with three layers of enclosed wire be right? I have this core and would like to use it, if possible. (2) How many pounds would be required in a secondary of No. 30 wire, using the above as primary to get 1 in. and 1½ in. spark? How much current could be supplied with dry batteries, and how many? Would such a coil give spark enough for six mile wireless station? Ans.—(1) Core and primary are o.k. (2) You will need about 1½ lbs. of wire. Use six to eight dry cells. This coil will send six miles, if your circuit is tuned properly. The diameter of your coil when finished should be about 6¼ in. to get the best efficiency.

1119. **Wireless Telegraphy.** C. J. B., Ronneby, Minn., asks: (1) Why is it necessary to use a wire of such a minute diameter in the electrolytic detector? (2) Why is it made of platinum? (3) How is it that a wire carrying a current of 500 volts is very dangerous to a person, while a one half inch spark coil gives about 2,000 volts, and is by no means dangerous to life? Ans.—(1) The smaller surface exposed in the electrolytic the more sensitive it is to the minute receiving currents. (2) So that the acid will not affect it. (3) The ordinary 500 volt circuit carries heavy amperage, while the amperage of a spark coil is very low.

1120. **Wireless Telegraphy.** D. R., Grant, Mich., asks: (1) How high should an aerial be to telegraph fifty miles? (2) What size induction coil should be used? (3) How many and what kind of batteries should be used? Ans.—(1) It depends entirely upon what power you have to send with. We should say at least 50 ft.; and the sending radius will increase greatly with the added height of the antenna. (2) About a 3 in. coil of the ordinary type, but less on a coil built for wireless purposes (such coils are not rated by the spark length, as this has little bearing on the actual work that may be done by a coil). Use storage batteries, if possible, if not use any good Leclanche or dry cells.

1121. **Wireless Telegraphy.** H. R. S., Colorado Springs, Colo., asks: I would like to know where I can get a cable of copper wire tin plated, 7 strands No. 21, B. & S. guage or smaller size? (2) How far can I receive with 50 ft. pole and 1,075 ohms receivers with silicon detector? Ans.—(1) Write to the Long Distance Wireless Instrument Co., P.O. Box 2203, Boston, Mass. (2) Two to three hundred miles, if your other apparatus is good.

1122. **Wireless Telegraphy.** H. W. Y., Coldwater, Mich., asks: Can you please tell me if a step-up transformer will work in wireless telegraphy and if not, why? Would it be on account of the number of ampere turns and size? How far would a ¼ k.w. transmit? The transformer referred to, is one for 110 volts 60 cycle current, primary 2,300 volts. If this wouldn't work, where can I get one? Is a transmitter better than a coil? I have a ½ in.

coil; how far will it send with good apparatus? What is the station nearest here? Ans.—For wireless work, you will need at least 20,000 volts in the secondary. You say you have 2,300 volts in the primary. No doubt you mean in the secondary. This is too low, being that the ampere turns are too little. A ¼ k.w. under good conditions will work about 25 to 40 miles. You can get a transformer, either oil or air cooled, at A. B. C. Wireless Specialty Co., 111 Broadway, New York City. A transformer is better than a spark coil. A ½ in. coil under good conditions will work one mile. The nearest station to you is in your own city, B. S.

1123. **Transformer.** W. E. B., Moosup, Conn., asks: Please tell me through Electrician and Mechanic if the transformer described by W. C. Getz can be used on 110 v. direct current with electrolytic interrupter, and how far will same send with 60 ft. pole, using tuned circuits? How far will it send on 110 volt a.c. I do not understand whether the primary is wound with two ends or with four. Ans.—(1) No, the transformer described by Mr. Getz is only suitable for use on alternating current circuits having an E.M.F. of 110 volts and a frequency of 60 cycles. (2) Using a 40 ft. aerial, it should send about from 10 to 40 miles. (3) The primary is wound with four ends. That is because it is wound in two sections, each section of which has two ends. However, when connected up, it is so connected that only two ends are in use for the main feeds, the other wires of the respective sections being in series.

1124. **Wireless Distances.** B.W., Phila., Pa., asks: How far could I hear with electrolytic detector, potentiometer, 1,500 ohm receivers, tuning coil, and fixed condenser? The aerial to consist of ten wires 60 ft. long, and 2 ft. apart, stretched between chimneys and being 2 ft. above the roofs of houses 25 ft. high. Could I hear New York or Atlantic City? Ans.—Assuming that your aerial is 25 ft. above your instruments, you should be able to receive from the above mentioned stations, if your apparatus is of a reliable make. In a recent test, using a pair of high efficiency receivers, multiple unit condenser, tuning coil and improved silicon detector, a range of 350 miles was obtained, using an aerial whose top was 25 ft. above instruments; the above types mentioned being the standards manufactured by the Wireless Equipment Co., of West Arlington, Md.

1125. **Wireless Telegraphy.** R. R. R., Whitestone, L. I., asks: (1) What are the names of the instruments used for sending and receiving in wireless telegraphy? (2) What kind of wire do you recommend for aerials? (3) What would be a good ground? Ans.—(1) You will need for sending, a spark coil or transformer, spark gap, key, Leyden jars, and helix. For receiving, you will need a detector, tuning coil, 2,000 ohm receivers, potentiometer and condensers. (2) Phosphor bronze or copper wire is best. (3) A water pipe makes an excellent ground.

1126. **Wireless Telegraphy.** J. N. V., jr., St. Joseph, Mo., asks: (1) How far, and with what extra instruments can a 1 in. coil be made to send three miles? (2) Is a silicon detector as sensitive as an electrolytic? (3) Which detector is best for wireless telephone? Ans.—(1) With a 50 ft. aerial, using a one qt. Leyden jar and good conditions, you should receive three miles. (2) The electrolytic detector is the most sensitive detector known. (3) Any good detector will do for wireless telephone.

1127. **Wireless Telegraphy.** J. S. C., New York, N. Y., asks: (1) How many ohms do I need for the telephone receiver, to receive a wireless message from 10 miles? (2) How large and what wire do I use for the tuning coil, to receive 10 miles? (3) How large and what is the best wire for the aerial for 10 miles? Ans.—(1) Receivers for wireless work are usually wound to 1,000 ohms. (2) Tuning coil wound with No. 20 wire on coil 3 in. x 12 in. will be an A1 coil. (3) 50 ft. high, and stranded phosphor bronze or No. 12 copper.

1128. **Wireless Telegraphy.** L. A. F., Norwood, Mass., asks: Erected upon the roof of a house I have constructed a mast 40 ft. in length, the top of which is 65 ft. above the earth. Suspended from this I have a 4-wire vertical loop antenna of number 12 bare copper wire which is 45 ft. in length. According to a recent survey, the top of the mast is 53 ft. higher than any other object in town. Am situated at the summit of the highest hill within several miles, the greatest of which is Blue Hill, which "as a crow flies" is at least eight miles distant. The instruments used consist of a tuning coil rated at 600 meters, electrolytic detector, potentiometer of from 1 to 500 hundred ohms resistance, variable and fixed condensers, and single telephone receiver of one thousand ohms resistance, manufacturers of which guarantee that said receiver is wound with No. 50 silk-covered copper wire, and has one thousand ampere turns upon its spools. (1) What would be the receiving distance of such a station? (2) What should be the approximate wave length when the antenna is loaded (tuning coil completely cut in)? (3) Where can silicon detectors be purchased? Ans.—(1) Your receiving distance should be from 300 to 500 miles. (2) The only way to figure your wave lengths is by a wave meter. (3) A. B. C. Wireless Specialty Co., 111 Broadway, New York City, sell silicon detectors.

1129. **Small Dynamo.** C. N. G., Bloomfield, N. J., sends a sketch of a ⅙ h.p. Robbins & Myers' motor, and asks what winding will adapt the machine for generating 12 volts and 10 amperes? Armature is 2¾ in. in dia. and 2 in. in length, and has 12 round holes ⅜ in. in dia. Field is of cast iron, with very small air-gap, space for winding being ¾ in. long, curved so as to require coils somewhat concentric with the armature. He proposes No. 13 wire for armature and No. 20 for field, with speed at 3,000 Ans.—If you had given the cross section of the circular portion of the rim os field magnet, also the exact dimensions of the air-gap, we could have figured much closer. As it is, there remains quite an element of guess work. No. 20 wire will do for field magnet, but let this be of the single-covered grade; the voltage is so low as not to need the double-covered, and the single will allow a few more turns in the given space. You will need to get about 500 turns in each coil, and you may find some difficulty in shaping the coil to fit the space. The resistance of the two spools in series will be upwards of 8 ohms, and under a pressure of 12 volts, the coil will not get too hot. No. 13 certainly will not do for the armature. No. 18 will be the coarsest you can find room for, and even then you cannot get in quite the number of turns we figure as necessary. Still, this is the smallest you can use and take 10 amperes from the armature. You can readily get 24 such wires (d.c.c.) per slot, but you need over 30. A good way to do will be to wind the field coils as stated, but put a temporary winding of the No. 20 wire on the armature, say with 30 wires per slot. Upon testing this, you will get reliable data for the final winding.

1130. **Experimental Dynamo.** F. E., Kirkpatrick, Ind., asks: (1) Which would be more useful for such purposes, a series wound dynamo for 4 volts and 5 amperes or a shunt wound one for 10 volts and 2 amperes? (2) Has an article been published on the construction of a 4-volt storage battery? Ans.—(1) The latter. (2) No storage cell gives a useful output of more than 2 volts. A 4-volt or 6-volt equipment consists of 2 or 3 cells connected in series.

1131. **Experimental Dynamo.** H. H. H., Somerville, Mass., is proposing to purchase a 70-watt dynamo, and asks how to connect the field coils in various combinations along with field rheostat so as to allow machine to supply outputs between the ranges of 1 volt, 20 amperes, and 20 volts, 1 ampere? Ans.—While you can make almost any desired combination of the field coils, there is none you can impose upon the armature. The only opportunity with that is to vary the speed, and of course any change of that nature does not affect the size of wire, and, except for better radiation with higher speeds, no increase in allowable current. If the machine has a maximum rating of 20 volts and 20 amperes, the actual full load rating would be 400 watts, yet you admit it is of only 70. The chances are that 3½ amperes will be the safe maximum current, and the best you can do will be to have all the field winding in series and run armature at full speed for 20 volts, and let the field rheostat control the potential down to 10 volts. Below that figure, the machine will be in a sort of unstable equilibrium, when small changes of load will vary the voltage between annoying limits. Your next combination will be to put the two field spools in parallel with each other, rather than in series, and to drive the armature at half speed. You can then control the voltage from 10 volts to about 5. Operation below 5 volts will be rather doubtful, for the resistance of carbon brushes is so much as to prevent the machine from "building-up," or holding its field magnetism. You can accomplish the desired results by merely including a rheostat in the main circuit also. If this solution fills your needs, we will send a sketch, or publish one, showing how to connect a d.p.-d.t. (double-pole double-throw) switch that will accomplish the desired combinations. For field rheostat, use bare German silver wire, of same size as field wire, and of such a length as to have about the same resistance. Have at least 20 contacts. Your diagram showing the terminals of voltmeter directly connected to brushes, and ammeter inserted in the main external circuit is correct. For main line rheostat use 12 in. "hard" electric light carbon.

1132. **Wireless Telegraphy.** F. S., Lexington, Mass., asks: (1) How far can I receive messages from ships at sea or stations on the coast with the following apparatus? I am ten miles from Boston. A 4 wire aerial 50 ft. long connected with a 42 ft. aerial, 50 ft. from the ground, a 300 ft. tuning coil, an electrolytic detector with .0001 in platinum wire, a potentiometer and battery, a stationary condenser, a variable condenser made from aluminum sheets. (2) How far could I receive, leaving out the electrolytic detector potentiometer and battery and putting in a silicon detector? (3) How far could I send with same aerial one inch coil variable condenser and helix? Ans.—(1) With the size wire mentioned in your electrolytic detector, you could work only about 100 miles. (2) If you use the Improved Silicon Detector, as sold by the Wireless Equipment Co., you could probably receive from 150 to 150 miles. (3) From fifteen to twenty-five miles, according to conditions.

1133. **Receiving Capacity.** F. S., Lexington, Mass., asks: How far can I receive messages from ships at sea or stations on the coast with the following apparatus, 10 miles from Boston? (1) A four wire aerial 50 ft. long connected with a 42 ft. aerial, 50 ft. from the ground. (2) A 300 ft. tuning coil. (3) An electrolytic detector with 0.0001 in platinum wire. Ans.—(1) If properly insulated, about 300 miles. (2) With silicon detector, you should receive about 500 miles. (3) Using about 6 to 10 volts, about 6 to 12 miles.

1134. **Transformer.** C. C. R., Seattle, Wash., asks: (1) I have built a transformer for wireless work, but do not think I get enough spark at spark gaps. The core is 7¾ in. long by 4 in. wide and ⅞ in. square. It is built up of stove pipe iron and each corner is bolted down. On one leg of transformer, there is 3 lbs. of No. 31 s.c.c. magnet wire (B. & S. gauge) wound in 18 sections. On the other leg there is about 160 turns of No. 16 s.c.c. magnet wire (primary). At the spark gap I get a spark 3/10 in. long and ⅛ in. thick. What is the trouble as it doesn't seem to give a good spark in proportion to the amount of wire on secondary? Have I not enough wire on the primary, or have I got too much? I work the transformer on a 110 v. A.C., in series with the key I have a resistance. Ans.—Place about 40 sheets of tinfoil 6 x 6 on double thick window glass, leaving 2 in. margin all around this will lengthen out your spark. The secondary must have condensers bridged across, so the primary can get the proper amount of current to saturate it. Wind about 4 lbs. No. 14 s.c.c. wire on 1 in. core 15 in. long for inductance or choke coil.

TRADE NOTES

The B. F. Sturtevant Company of Boston has been reorganized, and its capital stock increased from $500,000 to $2,500,000, all of the stock being taken by the present stockholders. The officers of the new corporation are: John Carr, president; Eugene N. Foss, treasurer, and E. B. Freeman, general manager. This increased capitalization represents mostly capital expenditures during the last year, the Company having erected a new plant at Hyde Park, which cost over a million and a half. The annual business of the Company is $3,000,000. The fan and blower business of the Sturtevant Company has so increased, that even this enlarged capital and plant will soon be insufficient for the needs of the business, and its plan is to build a further large addition to the factories next spring.

* * *

North Bros. Mfg. Co., Philadelphia, Pa., have ready for distribution a circular describing their new Yankee breast drill, which they will be glad to send to any of our readers. This is an excellent tool of the well-known Yankee quality, and every electrician and machinist should learn about it.

* * *

C. G. Willoughby, 814 Broadway, New York, N.Y., has ready for distribution his photographic bargain list No. 119, and will be glad to send it to any of our readers interested in photography. As it is certain to save them money, we would advise them to send for it as soon as possible.

* * *

Bulletins No. 202A and No. 202B of the Holtzer-Cabot Electric Co., Brookline, Mass., list telephone receivers and cords of all styles, including several especially adapted for wireless work. These bulletins will be sent on application to any of our readers.

* * *

The Electric Goods Mfg. Co., of Boston, Mass., will be glad to send on application, a copy of bulletin 10T on annunciator systems, with telephone attachments. Wiring diagrams and prices are given, and the bulletin should prove of interest to all electricians.

* * *

Among the high class wireless instruments manufactured by Harold P. Donle of Providence, R.I., there has recently been placed on the market, a portable receiving outfit. The outfit is built on original designs, and possesses many points of advantage over the ordinary receiving outfits. The price of this being $9.00, places it within the means of every one to own a powerful, efficient and finely finished receiving outfit.

* * *

Keuffel & Esser, 177 Fulton St., New York, have just published an eight page pamphlet, entitled "Log Log Duplex Slide Rules." This new slide rule will not only handle any problem which can be solved with the ordinary slide rule, but many others heretofore impossible. By means of it, we can extract any root or raise to any power, integral or fractional. Hyperbolic logarithms are read direct. The single tangent and co-tangents are given from one second to ninety degrees. Many electrical calculations can be made on this slide rule.

* * *

An electrical show, the first of its kind in Boston, will be held in the great exhibition hall of the Mechanics Building on November 15th to 25th inclusive. Exhibits will be made by the leading electricians and electric supply houses in America, and all the novelties in time, labor saving and comfort giving devices—in fact, everything up-to-date in the electrical world will be displayed and operated.

The decorations and lighting effects are to be novel and elaborate, and the whole show will be a "wonder world." Expense will not be spared to this end, and Mr. Chester I. Campbell, long and favorably known as a promoter of mammoth expositions, has entire charge of all the details, and has outlined a policy which will give Boston amusement lovers and knowledge seekers an electrical treat.

Many of the exhibitors have already submitted plans for their spaces which involve the expenditure of thousands of dollars, and, from present indications and the enthusiasm displayed upon the part of the general trade, the exposition will prove an educational event.

Special departments will consist of exhibits of the amateur wireless operators, unique inventions and ideas of amateurs, and prizes awarded to the deserving suggestors or inventors of practical ideas.

The association promoting the exhibition is known as The Electrical Exposition Association and is composed of some of the leading concerns and individuals in the electrical trade, and, in fact, any exhibitor may become a member of the association and share in the benefits of the association, the object being by the hearty co-operation of the members to hold exhibitions that will advance the interests of the trade. All communications as to particulars and plans should be addressed to Chester I. Campbell, General Manager, 5 Park Square, Boston, Mass.

THINGS RECEIVED

Manhattan Electrical Supply Co., 17 Park Place, New York, N. Y., catalogue of massage vibrators, medical apparatus, electros and other accessories.

* * *

Long Distance Wireless Instrument Co., P.O. Box 2203, Boston, Mass., catalogue of wireless instruments.

* * *

Prague Electric Co., 107 Westminster St., Providence, R.I., catalogue of wireless signal apparatus.

* * *

Grönkvist Drill Chuck Co., 18 Morris St., Jersey City, N.J., catalogue of "Johansson" combination standard gauges. These gauges are accurate to one millionth of an inch, and the finish is such that if two are pressed into contact, atmospheric pressure will hold them together, so one may be lifted by the other

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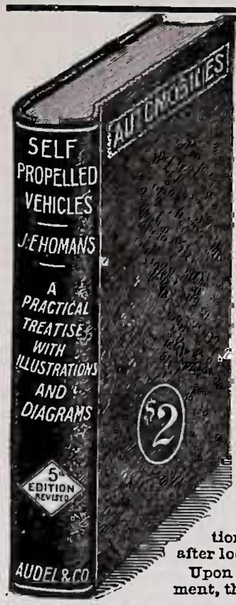

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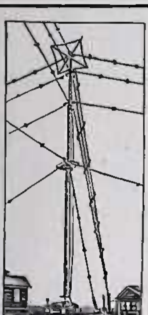

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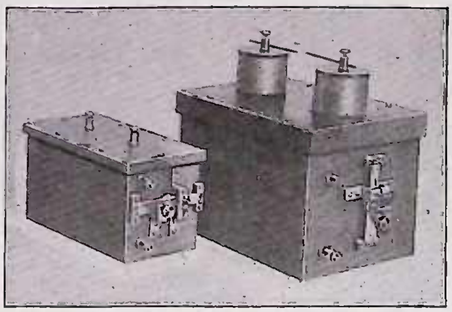

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FOR SALE OR EXCHANGE—All kinds of first class, long distance wireless instruments, including spark coils, gaps, etc., sending and receiving transformers, detectors, etc. Will sell cheap or exchange for tools, desk, drawing instruments or mechanical books. CHAS. MARTUS, Agent, 413 East Seventh St., So. Boston, Mass.

SPECIAL PRICES—1,000 ohm wireless receiver, double pole, special diaphragm, $1.75; leather-covered headband, single, 60c, double, $1.00. "Sealed in Point" electrolytic detector, $2.00; "Eclipse" double slide tuning coil, $3.00; sending helix, 450 meters, $2.75; "National" receiving condenser, 30c; Blueprint of Wireless Telephone for amateurs, 20c. WATERHOUSE BROS., Bourne, Mass.

EXCHANGE—A 5 in. induction coil, minus the original vibrator, the secondary insulation of which has been punctured. Want 1 to 2 in. coil in good condition, or what have you. A. C. GOWING, Dublin, N.H.

1000 OHM HEADPHONES, $4.00. Chalcopyrites and Zincite 25c set. Silicon 50c oz. Large piece 10c. Send stamp for catalogue of Wireless Instruments. DU TREIL, 518 Eleonore Street, New Orleans.

ON HAND, a few d.s. tuning coils identical to those used by a certain commercial company. In first class condition. Will dispose of them cheap. JOUSLIN & NATHANSON, 437 South Main Street, Providence, R.I.

WIRELESS EXPERIMENTERS. Resistance Rods for your potentiometer. 1000 ohms and over 50 cents. 5000 and over $1.00. A. H. MILLER, 382 Brooklyn Street, Detroit, Mich.

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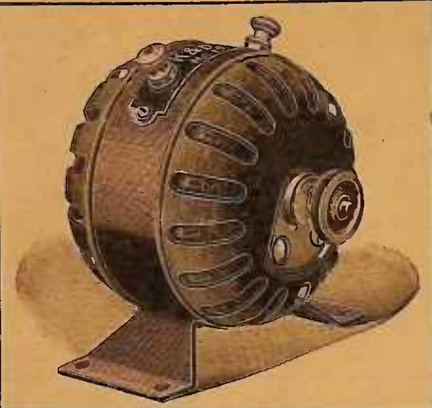

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This Screw Driver is the same as our No. 557, illustrated on Page 188 of our No. 18 Catalog, except that the handle is covered with hard rubber for insulation from electrical currents, and is nicely ribbed so as to insure a firm grip when using the tool. It has four blades of different widths, any one of which may quickly be taken from the telescope handle and inserted in the end, where it is automatically locked and firmly held for use. Any or all of the blades are carried in the handle, where by a spring pressure they are held from rattling when carried in the pocket, or from being lost when the cap is off. While the cap may be readily pulled off or put on it is rigidly held from turning and frictionally held from coming off, with no screws to bind or bother.

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