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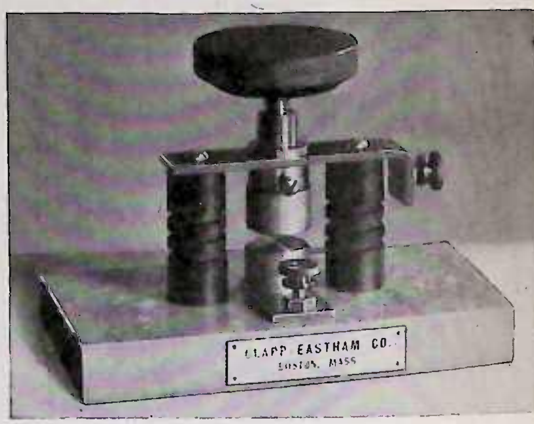

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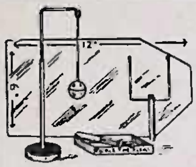

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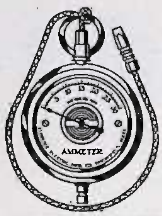

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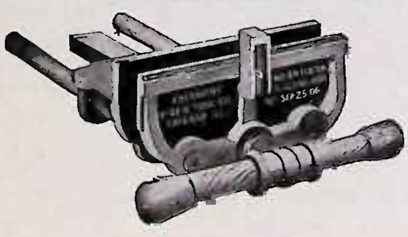

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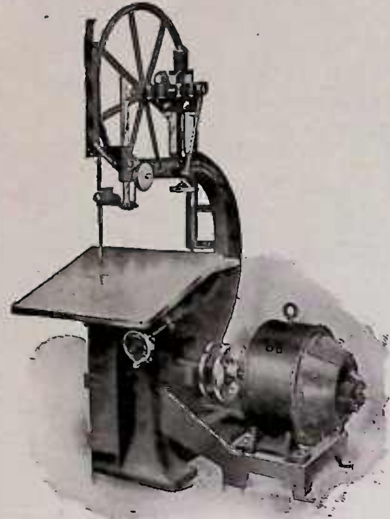

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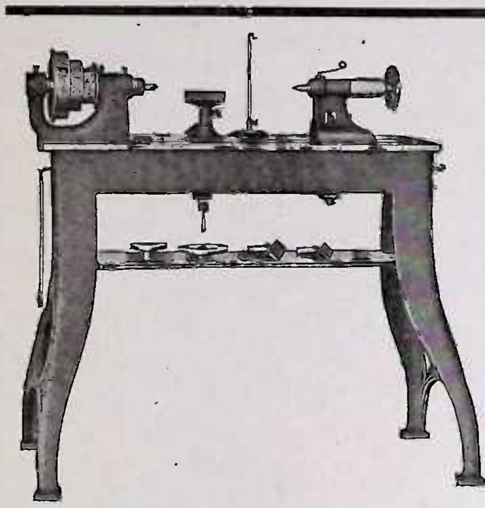

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VOLUME XIX JUNE, 1909 NUMBER 12

THE STARTING OF POLYPHASE (TWO AND THREE-PHASE) INDUCTION MOTORS

PROF. WM. R. BOWKER

It is often desirable that an "induction" motor should start under load without demanding an excessively larger current than that utilized when running at full load. Under such circumstances the "rotor" (secondary) windings must have a certain resistance.

In practice this resistance can be inserted by having a three-phase "rotor" winding, the ends of which are connected to "slip rings" with brushes. In this "secondary circuit" a three-armed rheostat switch is connected, and the resistance which it controls can be gradually cut out at starting, until when running at full speed all resistance is cut out, and the three brushes are short circuited. After this the rotor windings may be short circuited by means of a short circuiting device fixed on the rotor itself, generally placed at the slip ring end of the "rotor" shaft. Under such circumstances the brushes can be lifted, which prevents wearing of the brushes and rings.

The "slip ring" type of motor differs from the "squirrel cage" motor only in the "rotor" (secondary) circuit, which is coil wound and connected to slip rings for starting with resistance in the "rotor" windings.

Once the motor is started, and the "rotor" (secondary) short circuited, its characteristics are similar to those of the "squirrel cage" type.

If a motor is required for purposes where it is not necessary to start under load, the "squirrel cage" rotor is preferable; for the dispensing with slip rings and brushes possesses practical advantages.

The "squirrel cage" induction motor is started by supplying a lower voltage (than the normal working E.M.F.) to the "stator" (primary) windings by means of an auto-transformer. Various voltages may be obtained by connecting to different tappings or steps on the auto-transformer.

By means of applying different voltages to the (primary) stator, by means of auto-transformers and controller tappings, variable speed can be attained, a very desirable requirement, under certain practical working conditions.

The "torque" of the "squirrel cage" type of motor varies as the square of the E.M.F. applied to the "stator" (primary) circuit.

This type of motor can be started up under load, but it requires a very heavy and abnormal current, which is disadvantageous.

For starting under heavy load, where gradual speeding up is required, the "slip ring" coil wound "rotor" (secondary) is preferable to the "squirrel cage" type; because in starting against a heavy load the starting current is not so great.

Any starting torque required, within reasonable limits, can be obtained without producing undue strain on the generating plant.

With the slip ring motor the control is effected by varying the resistances in the "rotor" (secondary) circuit of the motor as hereafter described.

For variable speed where constant stopping, reversing and starting again is required, both the "squirrel cage" and "slip ring" motor may be used. The former is more suitable for starting at light loads and the latter for starting under heavy loads.

Both types of motor are ideally suitable for constant speed work. In fact the constant speed type can be built to carry a considerable overload with a comparatively small drop in speed.

As previously stated polyphase current induction motors may be provided either with or without slip rings.

In case of the induction motors with

squirrel cage wound rotors, which possess no "slip rings" nor yet metallically connected to the external supply circuit, the "rotors" are started and rotate inductively.

They can be started by simply closing the field (stator) or primary switch, and the motor will then carry its load up to

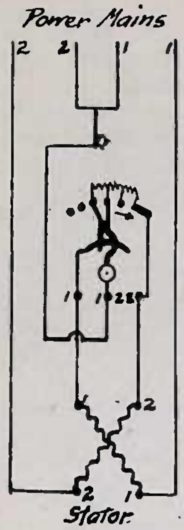


Fig. 1.

nearly "synchronous" speed, but with a large first rush of current.

In order to cut down the starting current in this form of motor, when the maximum starting torque is not required, a rheostat, compensator, or auto-transformer special starting switch can be used.

In the case of "two-phase" motors, a rheostat, compensator or special starting switch should be used; and in the case of "three-phase" motors, a compensator or special starting switch.

The "rheostat" consists of two equal resistances inserted between the "line" and the two "phases" of the motor, and a switch by which the line resistances may be gradually cut out of circuit. These resistances should only be in circuit at "starting," and when the motor is "running" the switch should be left in the position in which the resistance is short circuited. The method of connecting such a "rheostat" in circuit is shown in the diagram, Fig. 1.

Fig. 2 shows the diagram of connections employed for a "three-phase" motor with compensator. The "compensator" (auto-transformer) consists of coils (two for "two-phase" and three for "three-phase") wound upon a laminated iron core.

When the switch is in circuit in the starting position, the current from the line passes through the compensator, the windings of which are provided with a number of taps (Figs. 2 and 5), so that

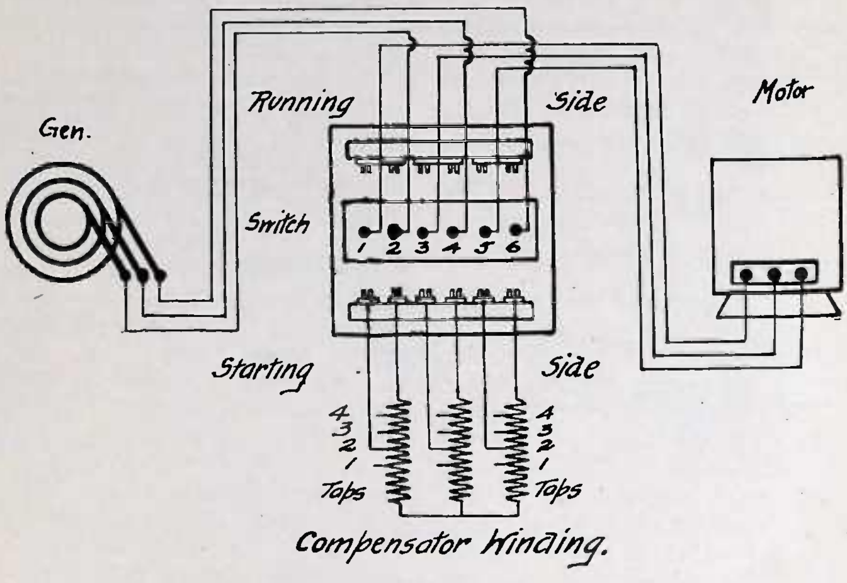


Fig. 2.

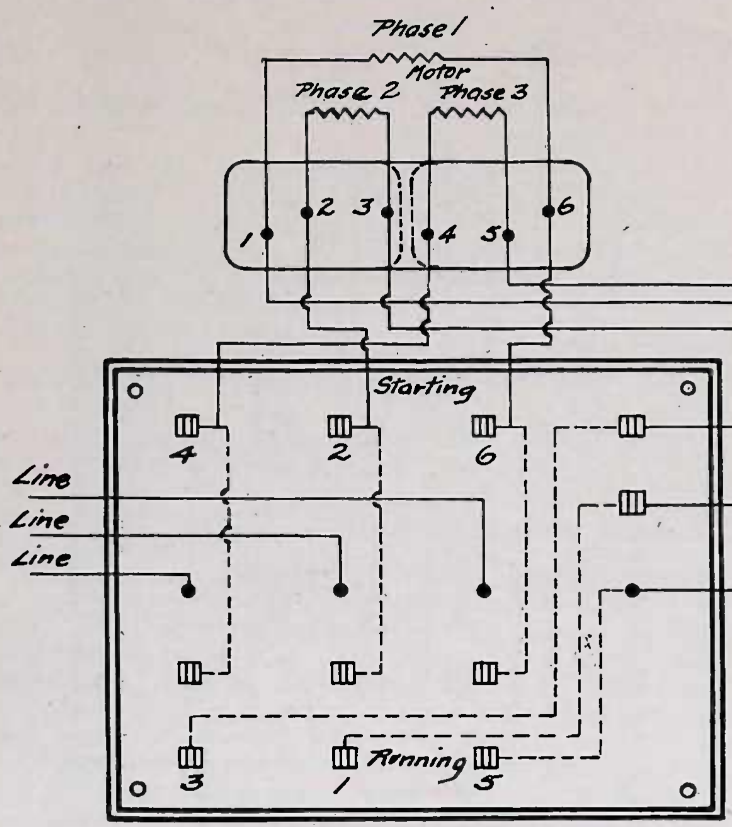


Fig. 3.

motor current may be obtained at various voltages less than the line voltages.

Switch blades 2, 4 and 6, Fig. 2, are in the main line, and 1, 3 and 5 are connected to the motor.

Compensators (auto-transformers) are usually supplied connected for the lowest starting voltage and torque. If the motor will not start its load, the next higher voltage taps should be tried and so on until taps are found that give the required torque.

In the starting of polyphase motors of the type under consideration (squirrel cage without slip rings), the switch is inserted in the contacts of the "starting" side, and this places the compensator windings in circuit with the "stator."

When the "rotor" has attained its speed the switch is quickly pushed over on to the "running" contacts. The "compensator" windings are then entirely disconnected, and the motor is practically "short-circuited," and takes its current directly from the lines at full voltage.

The special starting switch for use with "three-phase" motors effects a change in the connection of the "stator" winding from "Y" (star) connection at "starting" to "delta" △ (mesh) connection when "running." Fig. 3 illustrates the diagram of connections. To reverse the direction of rotation of the "rotor" interchange any pair of leads from the line.

In the case of "two-phase" motors, the special starting switch effects a change in the connection of the coils of the "stator," from "series" at starting, to "parallel" at running. Fig. 4 is a diagram of connections for a "two-phase" four-wire system.

To reverse the direction of rotation of the "rotor," interchange any two leads coming from the line to either phase.

Figs. 5 and 6 illustrate respectively a diagram of connections for a two-

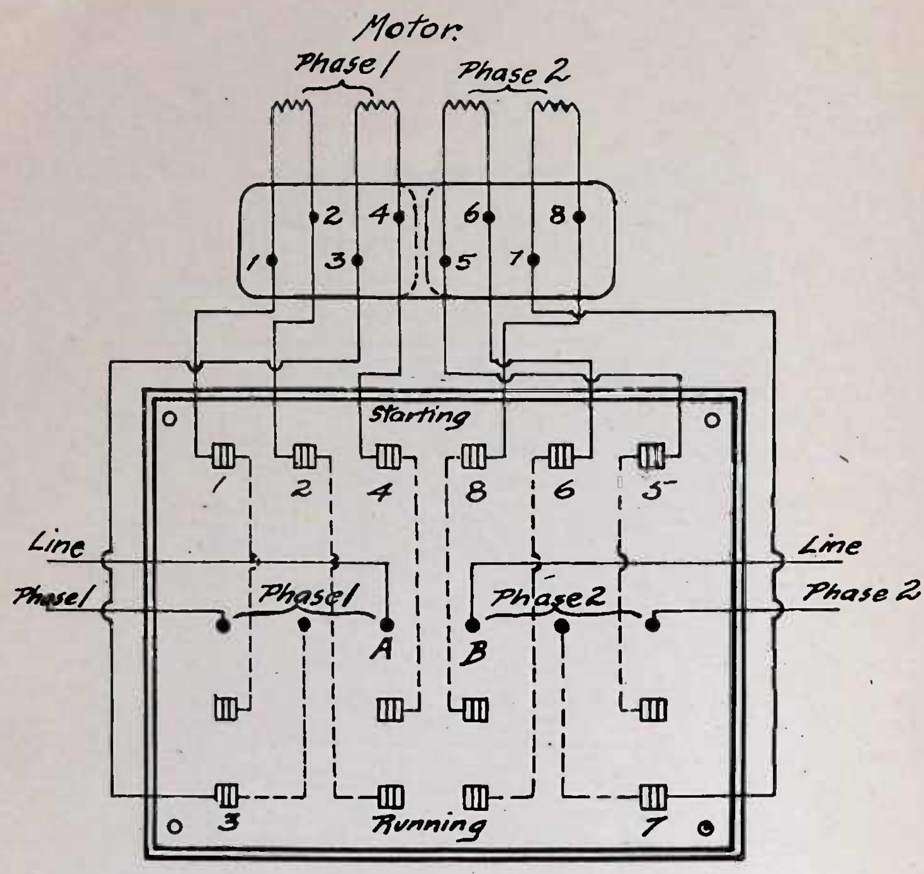


Fig. 4.

phase four-wire system, and an outline dimensioned diagram of a 30 h.p. auto starter.

In the case of a "two-phase" three-wire supply system, the terminals marked A and B, Fig. 4, on the back of the switch, should be connected together and to the middle wire of the supply.

In the case of motors of small sizes, they can be started by merely closing the main switch and are not, as a general rule, furnished with a starting resistance or compensator.

Fig. 7 illustrates a two-phase and three-phase motor connected to "auto-starters.

The above conditions are referring to "squirrel cage" wound motors. In the case of induction motors with "former" (coil) wound "rotors," it is of a practical advantage to insert in the "rotor" circuit, through the intermediary of "slip rings," a starting "rheostat." The diagram of connections is shown in Fig. 8.

In starting, the main switch is closed and the motor started by moving the handle of the starting rheostat slowly from contact to contact, allowing time enough on each contact for the motor to attain its maximum speed. The interval, however, should not be much longer than 30 seconds, since overheating of the rheostat might ensue.

When a "short-circuiting" device on the "slip-rings" is used, it should be inserted in circuit, after the "rheostat" handle has been moved over to its last position. The handle of the starting rheostat may then be returned to its starting position.

The speed of induction motors is practically constant and does not vary with slight changes of voltage.

The output of an induction motor varies with the square of the voltage at the motor terminals. For example, if the terminal voltage happens to be 15 per cent. low (85 per cent. of the rated voltage), a motor, which at the rated voltage, gives a maximum of 200 per cent. of its rated output, will give only $\left(\frac{85}{100}\right)^2 \times 200 = 144$ per cent. of its rated output.

Two hundred and 400 volt motors may be safely operated at 220 and 440 volts respectively, since all motors have an ample margin in heating.

At the higher voltage the "efficiency" and "power factor" will be decreased at light loads; the full load constants being approximately the same.

Although the output of the motor may be increased by raising the voltage, the current taken when running light will be increased in direct proportion, while the current at full load will be changed to a less extent, depending on the characteristic of the machine.

Standard 50 cycle motors may be operated on 60 cycle circuits at their rated voltage. The maximum output will be decreased about 10 per cent. and the apparent efficiency will be slightly higher at all loads.

The smaller sizes of motors with squirrel cage "rotors" are started by simply closing the main switch without any starting device. At starting, these motors require from five to six times full load current, and give about twice full load torque.

Similar wound motors of larger sizes with "compensators," take about full load current in the line on the first step of the compensator, and exert about 30 per cent. of the full load torque. On the second step, both "torque" and "current" are increased proportionally. If the compensator is not used at starting, the motors will require from six to eight times full load current and will give 1½ to 2 times full load torque.

POLYPHASE MOTORS IN COMBINATION WITH TRANSFORMERS

While with a "non-inductive" load, such as incandescent lamps, the regulation of transformers is within 3 per cent., with an "inductive" load (such as induction motors), the "drop" in potential between no load and full load increases to about 5 per cent. If the motor load is large and fluctuating, and close lamp regulation is important, it is desirable to use separate transformers for the motors.

For the operation of "induction"

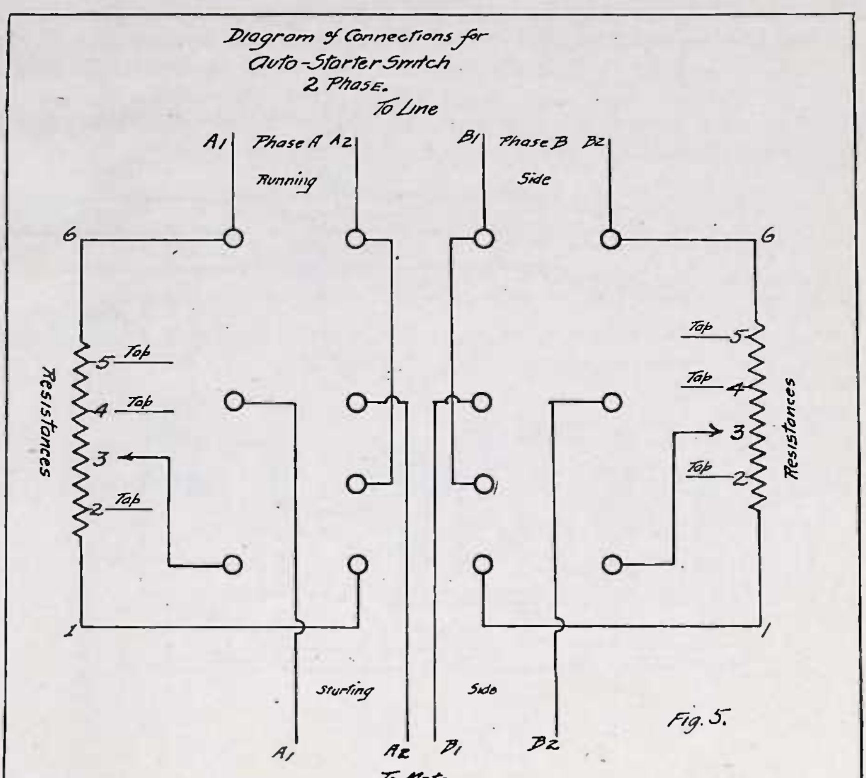


Fig. 5.

30 H.P. Auto Starter.

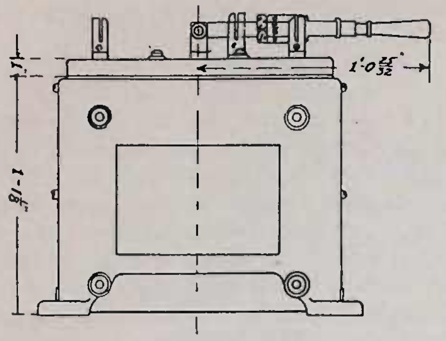
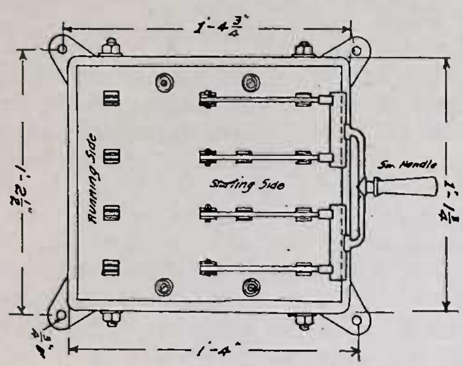


Fig. 6



motors on "three-phase" systems, either two or three transformers may be used. Wherever a suitable size of transformer is available, however, three transformers are preferable, since in this case each transformer acts as a reserve to the two others, and thus provides for the operation of the motor, even if one of the transformers should become disabled.

For the larger "motors" the capacity of the "transformers" in "kilo-watts" should equal the output of the "motors" in "horse power." Thus a 50 h.p. motor requires 50 k.w. in transformers.

Small motors should be supplied with a somewhat larger transformer capacity, especially if, as is desirable, they are expected to run most of the time near full load, or even at slight overloads.

The three transformers, with their "primaries" connected to the "generator," and their "secondaries" to the "induction" motor, in a "three-phase" system, are shown in Fig. 9. The three "primaries" are connected between the three lines leading from the generator, and the three "secondaries" are connected to the three lines leading to the motor, in what is called "delta" Δ (mesh) motor, in what is called "delta" Δ (mesh) connection.

The connection of two transformers for an "induction" motor on a "three-phase" circuit is shown in Fig. 10. It is identical with the arrangement in Fig. 9, except that one of the transformers is left out and the two other transformers are made correspondingly larger.

The copper required in any three-wire "three-phase" circuit for a given power and loss is 75 per cent. of that necessary with the two-wire "single-phase" or four-wire "two-phase" system having the same voltage between lines.

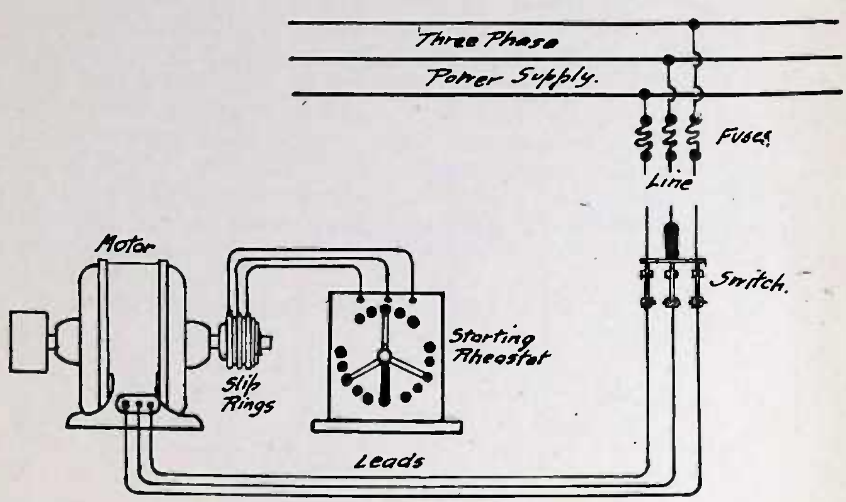


Fig. 7.

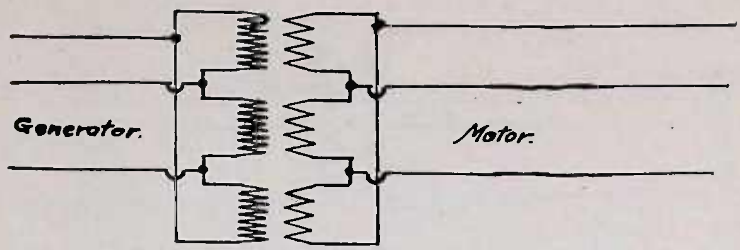


Fig. 8.

The connections of three transformers for a low tension distribution by the four-wire "three-phase" system are shown in Fig. 11. The three "transformers" have their "primaries" joined in "delta" △ (mesh) connection, and their "secondaries" in Y (star) connection. The three upper lines are the three main "three-phase" lines and the lowest line is their common "neutral." The difference of potential between the main conductors is 200 volts, while that between either of them and the neutral is 115 volts.

Two hundred volt motors are joined to the mains, while 115 volt lamps are connected between the mains and the "neutral." The neutral is similar to the neutral wire in the "three-wire" system and carries current only when the lamp load is out of balance.

The potential between the main conductors should be used in calculating, and the section of the neutral wire should be made in proportion to each of the main conductors that the lighting load is to the total load. When lights only are used, the "neutral" should be of the same size as the main conductors.

The copper then required in a four-wire "three-phase" system of secondary distribution to transmit a given power at a given loss is about 33.3 per cent., as compared with a two-wire "single phase" system or a four-wire two-phase system having the same voltage across lamps.

The connections of two transformers for supplying motors on the four-wire "two-phase" system are shown in Fig. 12. The leads from one transformer are connected to terminals 1 and 3 respec-

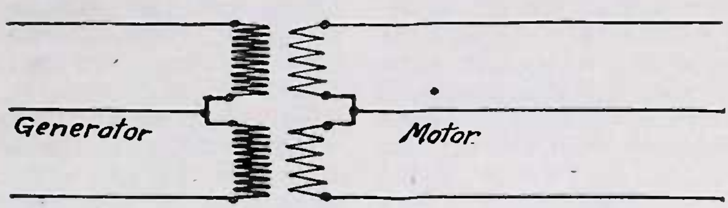


Fig. 9.

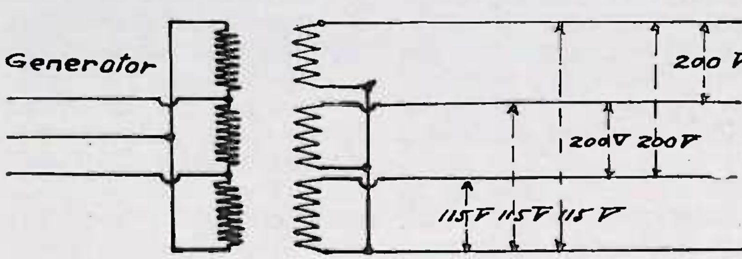


Fig. 10.

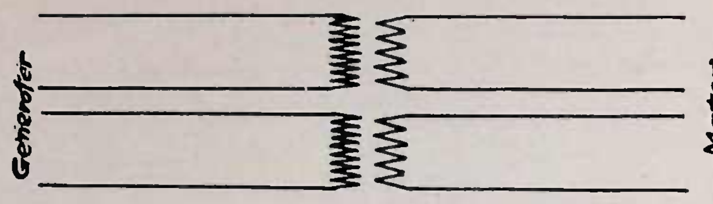


Fig. 11.

tively, and the leads from the other transformer to terminals 2 and 4 on the connection board of the motor.

This system consists practically of two separate "single-phase" circuits, half the power being transmitted over each circuit when the load is balanced. The copper required as compared with the "three-phase" system to transmit a given power with a given loss and voltage between the lines, is 133.3 per cent. —i.e. the same as with a "single-phase" system.

Each lead for a "three-phase" motor should be 58 per cent. of the cross-section of each wire of the "single-phase" system, based on the same apparent kilowatt capacity and voltage.

The "drop" of voltage in lines supplying motors alone is due to "inductance" as well as "resistance."

Before starting the motor, the three secondary voltages should be tested by means of a "voltmeter," or an incandescent lamp, to ascertain whether the connections have been properly made, since with wrong connections excessive currents will flow and burn out the transformers and possibly even the motors.

Long-Distance Typesetting

What may be described as a long-distance linotype machine, operated by wireless telegraphy, is suggested by Hans Knudsen, a Danish resident of London. According to an account in the London *Chronicle*, this has already been successfully used in connection with an ordinary typewriter. Says the paper just named:

"The possibility of somebody in the future sitting before a keyboard in St. Petersburg and setting up type in a London newspaper office by wireless telegraphy was suggested to a little company of wondering people at the Hotel Cecil last evening. They were inspecting a remarkable apparatus invented by Hans Knudsen, a Dane, who has been a resident here for the last eight years. Twelve months ago Mr. Knudsen conceived the idea that a valuable saving of time would be affected in a newspaper office if a wireless message could 'arr ve in type.' Till then he had taken no active interest in wireless telegraphy. He set to work in earnest, and the result of his experiments was seen at the Hotel Cecil yesterday. Mr. Knudsen appears to have hit upon an extremely simple contrivance. For one thing he dispenses with the Morse code. All the operator has to do in fact is to spell out his message on a keyboard containing the letters of the alphabet. Over the keyboard there is a traveling contact-carrier. As it passes over a key which has been pressed down by the operator there is an electric spark. At that moment the carrier on the receiving instrument which is working in perfect harmony with the transmitter, halts at the same letter. In this way, letter by letter, the message is received. Yesterday a typewriter, attached to the receiving instrument, recorded each letter as it was sent by the transmitter. In its place, for the purpose of typesetting, there will be, of course, a linotype machine."

The machine thus shown is merely a model, but *The Chronicle* states that Mr. Knudsen hopes to give a demonstration with the complete apparatus.

Only flaming arc and high-efficiency incandescent lamps are used in the business portions of Berlin, and 90 per cent. of the outdoor lighting is now done with flaming arc lamps. Both tantalum and tungsten lamps are used, but the former are seen usually in old fixtures where the lamp cannot be placed vertically.

THE DESIGN AND CONSTRUCTION OF A 25-MILE WIRELESS TELEGRAPH OUTFIT—Part I

KENNETH RICHARDSON

The enthusiastic wireless fiend does not content himself with coherers, relays, etc., but uses the more efficient apparatus—detectors, tuning coils, condensers, telephone receivers, etc. The cost of a coherer-relay set is too great for the average experimenter, and besides, they do not work as accurately or as far as the newer apparatus. The coherer-relay set is nevertheless used in twice as much power is needed to transmit messages in the day as in the night. The transformer is about twice as efficient as the spark coil and costs about half as much. A one-quarter kilowatt transformer can easily transmit 25 miles and at times it can transmit up to 150 miles over salt water. A transformer is operated by alternating currents at a pressure of from 110 to 500 volts. The

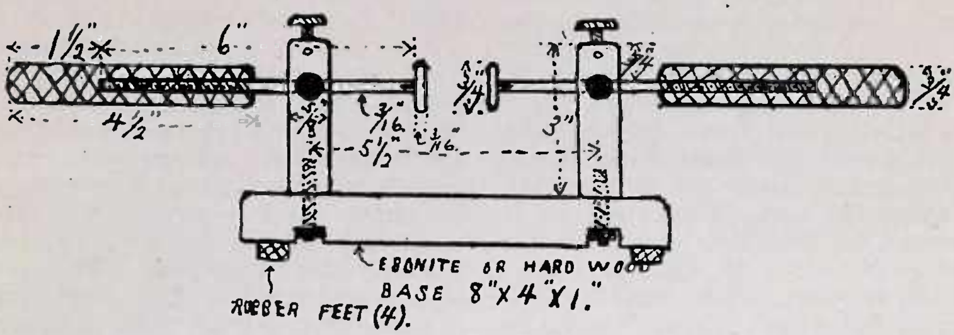


Fig. 1. Spark Gap

many stations to call the operator. Instruments constructed from the following plans will be found to be very simple and efficient. The cost is far below that of a coherer-relay set. The experimenter may make many small variations of construction to better suit the circumstances.

The instruments of the transmitting side are listed below in order of construction.

a—The Induction Coil. This may be either a spark coil or better, a step-up transformer.

b—The Spark Gap.

c—The High Tension Condenser.

Three one-point switches are required to vary the capacity of this condenser.

d—The Sending Inductance Coil.

e—The Aerial Wires.

f—Ground Wires. The same aerial and ground wires used in transmitting are also used for receiving.

a—We will not consider the construction of the induction coil, as one can be bought at about the same price as one can be made successfully. A three-to five-inch coil, according to the power of the spark, will be required to transmit messages 25 miles day or night. About secondary, being wound with more turns of finer wire than the primary, raises the voltage to from 10,000 to 50,000, according to the design of transformer.

The spark coil or the transformer is connected to the source of current in series with a telegraph key, through a double-pole, single-throw knife switch with proper fuses. The telegraph key may be of the ordinary form if heavy platinum contacts are used. The key should be shunted by a condenser made of ten or twelve sheets of double thickness paraffined paper 5 inches by 7 inches with eight or ten sheets of tin-foil between. Some large wireless telegraph keys have magnetic blow-outs, contacts in oil, etc., to reduce the arcing at the contacts.

b—The spark gap made of rods of zinc is the most efficient known. From 1-inch oak or ebonite, cut out a piece 8 inches long by 4 inches wide, and bevel the edges. In the middle of this base 3-16 in. holes are bored 5½ inches apart. Two standards of brass 3 inches long by ⅝ in. in diameter are now made. At three-quarters of an inch from one end of each standard is drilled a full 3-16 inch hole which is to receive the spark

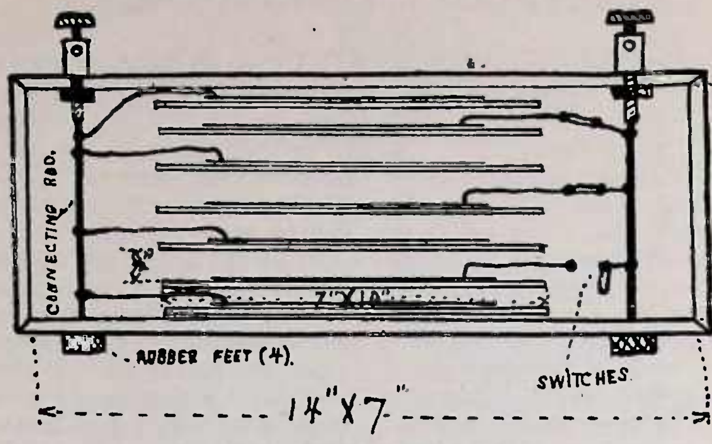


Fig. 2. High Tension Condenser

gap rods. A hole is drilled in each standard for a thumb screw to tighten the spark gap rods when regulated. About one-quarter inch from the top of each standard another hole 1-16 inch in diameter is drilled to take the connecting wire. A thumb screw is fitted in the top to clamp the wire. Each standard is now tapped at the other end to take a 3-16 inch brass screw which, with washers, holds each standard perfectly upright in the holes in the base. The screw heads are countersunk in the under side of the base.

Now cut out two pieces of brass rod 3-16 inches in diameter by 6 inches long. These rods are fitted with ebonite or hard wood handles ¾ inch in diameter by 4½ inches long. The rods extend 3 inches into the handles. A disc of zinc 3-16 inch thick by ¾ inch in diameter is soldered or screwed to the end of each rod. All edges and points must be filed off, especially the edges of the zinc discs.

The cost of the materials for this spark gap is from $1.50 to $2.50. A spark gap for a transformer is the same as the one described, with the exception that the brass standards should be 2 inches apart from centre to centre, the base and rods being shorter in proportion. At no time when the primary of a transformer is fully energized should the spark gap be wide open. It might cause a rupture in the secondary.

c—The high tension condenser comes next in order of construction. It is of the glass plate type. Seven glass plates 7 inches by 10 inches are required. Double a small piece of tin-foil around a piece of No. 30 copper wire 12 inches long. This piece of tin-foil is pasted between the tin-foil sheets and the glass plates, serving to make connections. A similar connection is made on all the six plates. The tin-foil sheets are 4 inches by 7 inches and are pasted only on one side of the glass. A margin 1½ inch wide all around the glass is wide enough because the spark gap electrodes are only about ¼ inch apart when the coil is working most efficiently. Each plate is now given three or four coats of pure paraffin wax, letting each coat get cold before applying the next. The plates are arranged in a rack, so that they are ½ inch, apart and are connected as in Fig. 2, using three one-point switches to vary the capacity.

d—The object of the sending inductance coil is not only to vary the inductance and capacity of the aerial, but also to increase the energy radiated by the aerial by making the inductance and capacity of the open circuit (aerial and ground) equal to that of the closed circuit (spark gap, condenser and part of the inductance coil) or vice versa. This equalization is accomplished by varying the capacity of the closed circuit, by varying the inductance of the closed circuit and by varying the inductance of the open circuit. The best adjustment is found when a hot wire ammeter in series with the aerial gives the highest reading. This form of ammeter is operated by the heating of a very fine wire. The oscillations surging through the aerial cause this wire to contract and elongate, which moves a very light needle over a scale. The hot wire ammeter is not necessary. A small Geissler tube may be put in place of the ammeter if desired.

The inductance coil described below

was designed for use with many different systems of wireless telegraphy. The inductance can be varied over wide limits.

First a frame is required. The ends are made of hard wood ¾ inch thick by 12 inches in diameter. Eight uprights each ¾ inch by 1½ inches by 14 inches long are screwed on, equal distances apart, with the outside ¾ inch face on the circumference of the discs. A wooden frame is thus formed upon which to wind the wire. Four blocks of wood or rubber 1 inch by 1 inch by 1 inch are screwed on the bottom of the bottom disc to serve as feet. The whole frame should now be given two or three thin coats of shellac varnish, allowing the first coat to dry before applying the next, etc. Now wind the frame with fourteen turns of No. 8 bare copper wire, first passing a few inches through a hole in the lower end of one of the uprights to fasten it, and fasten it to a large double binding post screwed in the middle of the periphery of the lower disc. Each time the wire passes an upright it should be stapled there with small wire staples. The turns are one inch apart. When the turns are all in place, the upper end of the wire is passed through a hole in the same upright as the other end, led through and is fastened to a large double binding post in the upper disc. Wire connectors are used to make contact with the turns of wire. The connectors are soldered to stranded electric lamp cord or better, to some high tension flexible cable.

The object of the wire being stranded is because of its flexibility and ease with which it can transmit oscillating currents. Two or three such connectors are needed. The coil is now finished and should look very professional like.

All the instruments of the transmitting side are now finished and the aerial and ground wires remain to be made.

f—The aerial may be of many forms but the one described below is as good as any, considering the cost.

If you live in the country you have a great advantage because high trees can be used from which to suspend the aerial wires, and there is not so much "static" and induction from nearby electric wires as in the city. Two trees from 75 to 200 feet apart and 50 to 100 feet high should be selected. One tree from 60 to 100 feet high will do, but the results will not be quite so good. If you live in the city, a

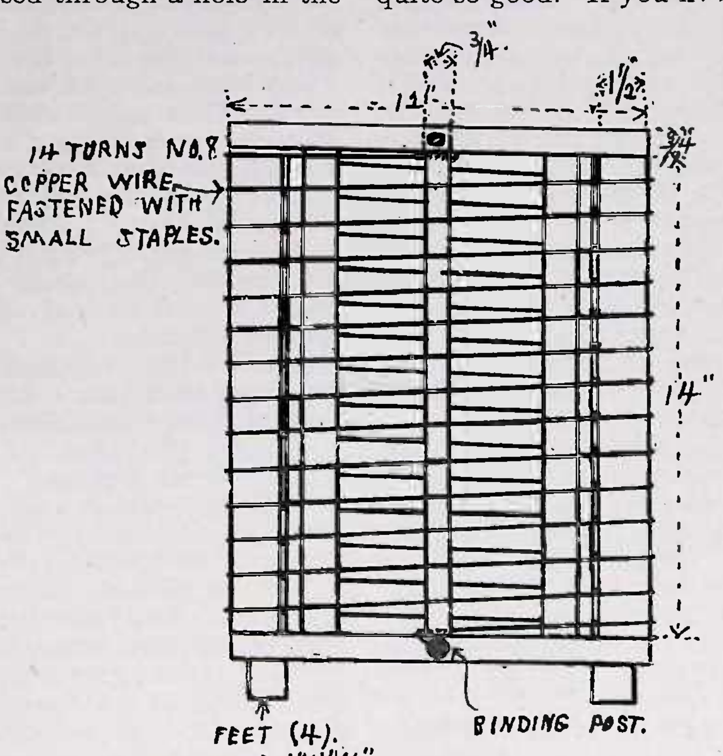


Fig 3. Sending Induction Coil

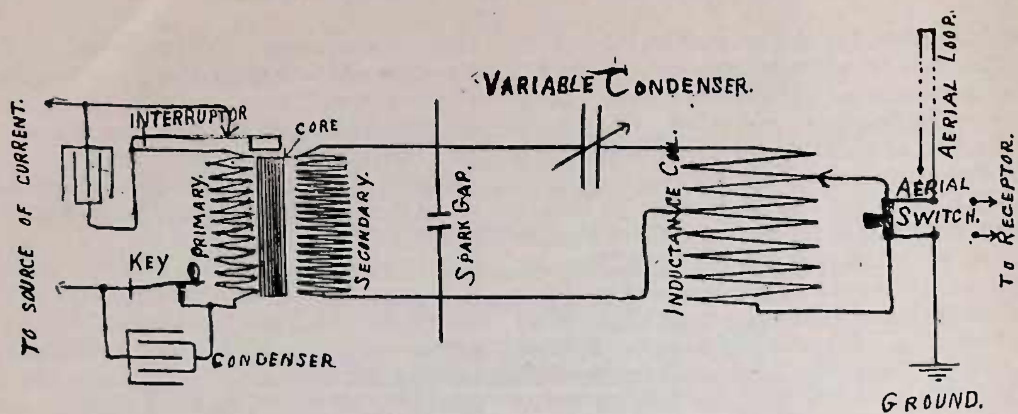


Fig. 4. Connections of Transmitter

25 to 50 foot pole will be satisfactory, if erected on a fairly high roof. The higher and longer the aerial wires, the better the results in every case. The aerial consists of two lengths of copper wire No. 12 which are joined at the top. The other two ends are separately connected to high tension cables which lead through porcelain tubes into the building. This insulated part of the aerial is called the rat-tail. The wires are held four feet apart by wooden spreaders spaced about every 75 feet. The upper ends of the wires are fastened to a spreader from which lead two ¼ inch braided ropes. The ropes are connected together about five feet from the spreader. Another rope is fastened to this connection and it leads through a pulley to the foot of the tree or pole. The pulley itself is fastened by a short piece of rope to the upper part of the tree or pole. The rope and pulley allow the wires to be lowered to make any variations or in case of a violent storm. The aerial wires should be kept at least fifteen feet away from any leaves or branches.

In the city, the wires should best be lowered in case a violent electric storm is overhead. They should at least be grounded when not in use and before a storm. Lightning arresters are useless in connection with any wireless telegraph instruments, as the lightning would destroy the instruments long before it would have any affect on the arrester. In the country the trees supporting the aerial wires form a slight protection against lightning, but as stated before, the aerial should be grounded.

g—The ground wire is nearly as important as the aerial wires. The best ground that can be easily obtained is the water pipe. One copper wire, preferably stranded, No. 12, is led from the instruments to the water pipe where it is clamped and soldered. It is necessary that a permanently damp ground be used, which is sometimes hard to find in the country. When water pipes can not be used, metal plates may be used. Two copper or zinc plates about 1 foot by 3 feet are buried on opposite sides of the building in permanently damp ground. The depth of the plates should be as great as possible. Three feet to eight feet, according to the dampness of the ground, is not too deep. The two plates are joined by a No. 12 copper wire from which leads a No. 12 wire to the instruments. The same aerial and ground wires are used also for receiving. The instruments are connected as in Fig. 4.

The cost of the transmitting instruments inclusive of aerial and ground wires and exclusive of induction coil with battery or dynamo is as follows:

Condenser for key.....	$ .15	to	$ .30
Spark Gap	1.50	"	2.50
High Tension Condenser	1.50	"	2.50
Sending Inductance Coil	1.25	"	2.00
Ground Wires and Zinc Plates (2).........	1.00	"	3.00
Aerial Wires, Pulley, Rope, etc........	2.50	"	3.50
Total cost of above....	$7.90	"	$13.80

The complete set of receiving instruments costs less than the complete set of transmitting instruments.

These transmitting instruments should easily transmit 25 miles over land day or night in the hands of a fairly competent person.

A FEW EXPERIMENTS WITH ALLOYS

An alloy is a compound of one metal with one or more others. Alloys generally possess properties very different from those of the component metals. In some instances, their specific gravity is greater; in others, they are more fusible; sometimes they are more ductile and elastic, or they may vary in color or durability. In a few instances, they lose their magnetic property and in others, they become far more sonorous than either metal in its separate state. The following experiments, which can be performed by any one who has access to a fairly hot fire with forced draught, will prove interesting, and may be of use to any one interested in the properties of metals. A beautiful alloy, which is not very well known, but which is occasionally employed by the French and the Japanese, in some of their artistic work, can be made by melting together equal quantities, by weight, of copper and antimony. This alloy can be cast in a mould, when it will be found to possess a beautiful violet hue, and to be much harder than either of its components. When copper and tin are melted together in proper proportions, the resulting alloy will be found to possess a much higher specific gravity than either of its components; or, in other words, the same weight will occupy much less bulk.

To prove this, let the operator procure a small bullet-mould and cast therein four separate balls, two of copper and two of tin. If, now, these four balls be melted together and the resulting alloy be cast in the same mould, it will be found that only three balls of the alloy can be produced, so great is the shrinkage, though the weight will be the same as before. Gold is known to be one of the most ductile of metals, yet this ductility, or power of being drawn into a fine wire, is entirely lost if the minutest quantity of antimony be mixed with it. For instance, if a crucible containing a small quantity of molten gold be placed in the vicinity of a similar crucible containing antimony or bismuth, the fumes arising from the latter metal will be sufficient to destroy entirely the ductility of the gold and render it incapable of being beaten into thin leaves or drawn into fine wire. Another very useful alloy, which possesses the property of expanding as it cools, and which is therefore invaluable for getting sharp impressions from any object, is that known as "type metal." This is made by melting in a crucible 4½ oz. of lead, adding thereto an ounce of antimony, and, finally, when this latter has melted, throwing in half-an-ounce of bismuth. This alloy is very much used for making stereo plates, and each foundry adopts different compositions for the purpose. Some form an alloy with eight parts of lead, two parts of antimony, and ⅛ part of tin, all by weight. Another remarkable property possessed by some alloys is that of melting at a remarkably low temperature. This is especially marked in that known as "fusible alloy," which is made by putting in a crucible eight parts by weight of bismuth, five parts ditto of lead, and three parts of grain tin.

The resulting alloy can be cast in the shape of bars, and, if one of these be given to a silversmith, he can make it into tea spoons.

If such a tea spoon be given to a stranger wherewith to stir his tea, as soon as it is poured out from the teapot, he will be not a little surprised to find the spoon melt in the tea cup. The fusibility of this alloy is certainly surprising since the melting point of each of its components singly is higher than twice that of boiling water; Bismuth fuses at 476 degrees Fahr., lead at 612, and tin at 442 degrees; whilst water boils at 212. Another remarkable fusible alloy is obtained by melting together, in the order given, 1 oz. of zinc, 1 oz. of bismuth, and 1 oz. of lead. Although each of the metals separately requires considerable heat to melt it, it may be melted by even moderately hot water; and it is stated that this alloy will remain in a fused state on a sheet of paper held over the flame of a lamp or candle. This last composition, with the addition of a small portion of mercury, is sometimes made use of for injecting the vessels of various anatomical preparations and also for taking correct casts of different cavities of the body, such as those of the ear. The animal structure may be corroded and separated by means of a solution of potash and water, when a metallic cast will be extracted in an isolated state. It is found that the magnetic properties of iron are largely influenced by the metal with which it may be alloyed, so that while, on the one hand, iron may be rendered almost indifferent to magnetism by the addition of a small quantity of the metal manganese, its retentivity for magnetism is largely increased by the addition of a small proportion of the metal tungsten.

It is not by any means easy to melt pure iron, so that the operator would find considerable difficulty in performing these experiments without he have access to a reverberatory furnace or similar contrivance for producing a high temperature. But the experiment can easily be tried on a small scale by making a bundle of fine iron wire of the weight, say, of one ounce, along with which a grain or two of manganese metal is enclosed. If this then be introduced in a crucible and brought to a white heat, and the bundle be welded together by hammering, the resulting alloy will be found to be eminently non-magnetic, being incapable of acquiring or retailing magnetism, and hardly influenced by the magnet at all. On the other hand, the magnetic properties of iron and steel into which a small proportion (not exceeding three per cent. of the metal tungsten) is introduced, becomes remarkably sensitive to magnetization.

The alloy may be prepared either directly by the process given above, tungsten being substituted for manganese, or a rather rich alloy of tungsten may be prepared in the first instance from the tungsten ore, smelted along with iron, and this rich tungsten iron added in due proportion to the iron or steel, while being worked up. It is to the presence of tungsten in the steel that the superiority of the alloy turned out by the "Allevard" Works is due, for all purposes in which powerful magnetism is required. The electrical conductivity of metals is also largely influenced by their combination with other metals; as a general rule, it may be said that pure metal has a much higher conductivity than admixtures, and it is really wonderful to note the great variety which may obtain in this respect by the addition of a very small quantity of a dissimilar metal. We need only mention, as an example, the case of copper. Now, copper has a conductivity very nearly as high as that of pure silver; say, for example, that the conductivity of silver is equal to 100, that of pure copper is 99, while that of an alloy of 5½ parts of copper to ½ part of zinc, and ¼ part of the metal arsenic (known as German silver) has a conductivity of only 13. Added to the above facts, the extraordinary properties of hardness, softness, of unctuousness, and other qualities conferred upon metals by alloying, render this subject of the highest interest and worthy of careful experiments at the hands of the student.—*Hobbies.*

A combined carbon-filament and mercury-vapor lamp is being introduced in Germany. The filament is inclosed in a U-shaped tube in which is a drop of mercury. The air in the tube is exhausted, and in its place an inert gas is introduced, to permit the conduction of heat from the filament to the mercury. The U-shaped tube is inclosed in a bulb similar to the ordinary incandescent electric lamp bulb. When the current is turned on, the carbon filament is immediately rendered incandescent and the mercury gradually vaporizes, increasing the light intensity to more than double the value of that of the filament. A maximum intensity is obtained in about five minutes. The lamp consumes from 1.5 to 1.6 watts per candle power, and its life is from 600 to 1,000 hours. The light it yields is perfectly white, containing none of the blue-green rays of the ordinary mercury-vapor lamp.

Some interesting conclusions have been arrived at by the Swiss commission for studying electric operation of railways. According to this report, the maximum acceleration at starting should be 0.2 meter per second for express trains, 0.3 meter for passenger trains, and 0.1 meter for freight trains. The retardation should be 0.5 meter per second for passenger and express trains. The maximum speed of the electric train should be no greater than that now allowed, namely, 90 kilometers per hour (about 60 miles per hour) on trains with automatic brakes, and 45 kilometers per hour (about 30 miles per hour) on other trains.

A CLOSED CIRCUIT BURGLAR ALARM ON ONE SET OF BATTERIES

H. B. BOOSE

The apparatus here described was more particularly designed with a view to its application on buildings some distance from the house or wherever it becomes necessary or desirable to string wires in the open.

The closed circuit is especially desirable for out door work, as whenever the circuit is broken from any cause the alarm will be given at once. The design here given will be found the most economical, as but one set of batteries are required for both main line and local. It is easily made by the amateur and is valuable in the sense of security and real protection it affords.

I have recently constructed and placed in operation an outfit of this type and have in circuit a chicken house, carriage house and laundry, all on two cells of bluestone gravity battery.

By having the magnets in relay, Fig. 1, of greater resistance than those of the local bell, Fig. 3, you obtain a main line safety or check on your batteries; as when the magnets of greater resistance on main line, are, by reason of a weakened battery, no longer able to hold the armature 2, Fig. 1, in position, the local circuit will close and there will be enough strength of battery remaining to work the magnets of less resistance in the bell.

In constructing this apparatus, sheet brass 1-16 in. thick will be found heavy enough for the brass work. The brass from an old clock that had been rele-

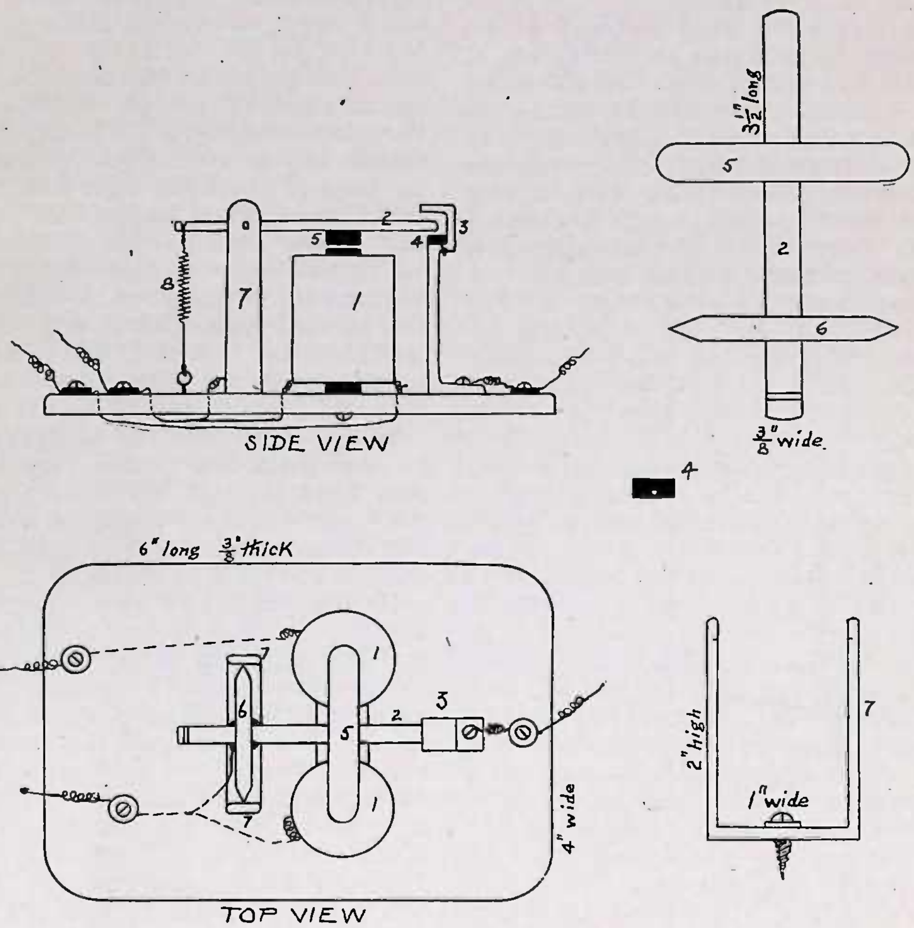


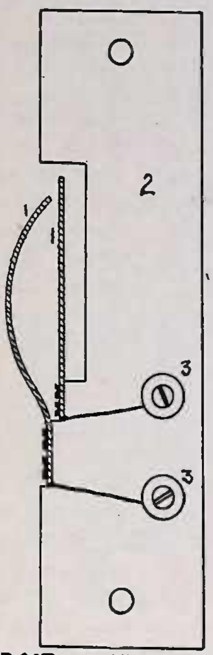
Fig. 1

1. Magneto
2. Armature
3. Stop and contact point for armature
4. Rubber insulating block
5. Soft iron plate
6. Trunnion Pivot
7. Trunnion
8. Spring

gated to the scrap pile was what I utilized. The height of 3 and 7, Fig. 1, would of course be governed by the size of the magnets you used. For binding posts I use the ordinary round head wood screw with two copper washers. A cheap telegraph sounder, one in which 3, Fig. 1, did not rest on a metal base, would serve splendidly for a relay in case the reader did not care to construct it himself.

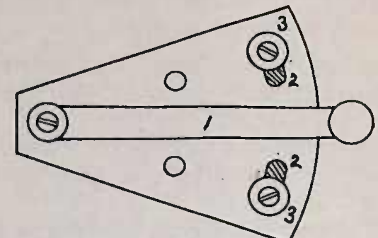
Trunnion pivot 6, Fig. 1, should have smooth points filed on each end, as in the illustration. The bearings 7, Fig. 1, for these points are simply holes drilled half way through the brass. The sides are then compressed so that 6 will be held when slid in. Care should be taken not to have pressure exerted by the sides, as this would interfere with the armature's freedom of movement.

Not having anything better, I used a screw eye to hold the end of spring 8, Fig. 1. No. 4, Fig. 1, is a small rubber block, a pencil eraser will do, secured to 3 by a fine wire or glue. As its use is to insulate 2 from 3, Fig. 1, when the main line is closed, the binding wire, if wire is used, must be run through the rubber so that there will be no possibility of it making a contact between 2 and 3.



DOOR AND WINDOW SPRING
Fig. 2

1. Brass springs
2. Base 2 in. x 4 in., ½ in. thick
3. Binding screws



SWITCH

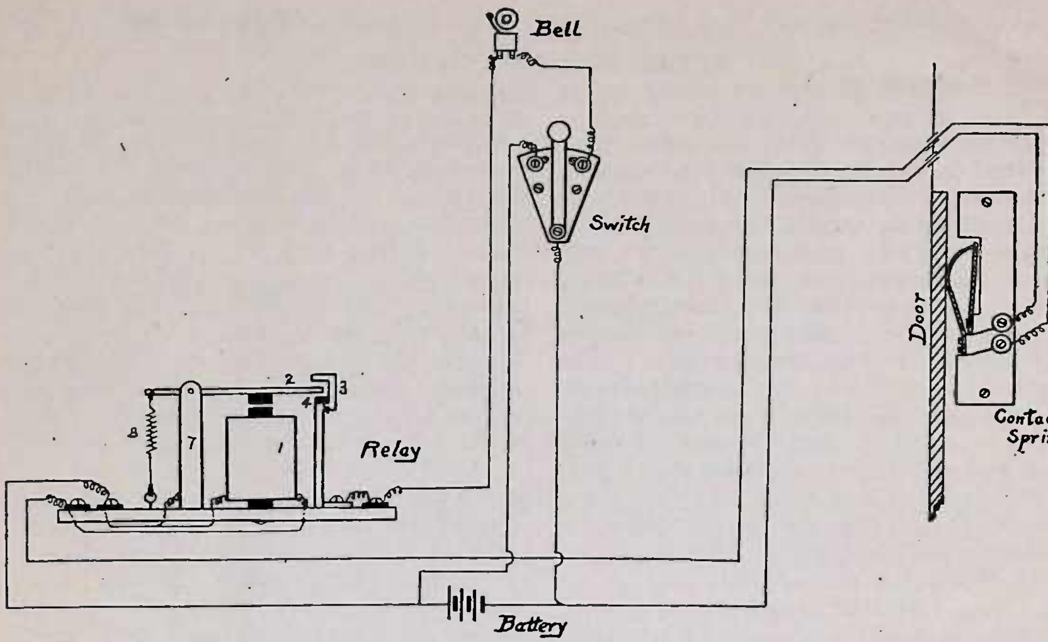
1. Brass lever
2. Brass lips projecting from under washer
3. Washers and screws

The space for the door or window contact points, Fig. 2, may be chiseled into a door or window and the arrangement be entirely concealed, but where one does not wish to mar the wood work, as in the case of those who do not own their own homes, the plan given here is recommended. The flat brass springs are 3-16 in. wide. Shoulders should be cut out, as in Fig. 2, and the springs, after being screwed on the block and the circuit open at that point, should have the position of Fig. 2. When closed they should appear as in Fig. 3. This block, the base of which is 2 in. x 4 in. x ½ in., should be screwed to the door jamb, so that when door is closed the curved spring will be forced against the straight one and the circuit kept closed, which is the normal state of this set. A recess should be cut out, as in the illustration, to allow the flat spring to bend back also and prevent injury to the springs.

In Fig. 3 we have the instruments set up and main line circuit closed. Current flows through the battery into the relay, drawing down the armature against the rubber insulating block, and out to the line and back to battery.

Now suppose the door were opened. The contact springs would then separate and the main line circuit open. As no current would then be passing through magnet 1, the spring 8 would pull the armature 2 up against the stop 3 and the local circuit would be closed, the current flowing through battery to binding post of relay, up through 7 and out 2, through 3 (2 would now be up against 3) to the binding post and up to the bell and down through the switch to the battery again.

When the alarm was heard, the switch could be thrown to the other side and your battery kept closed. If the outside



1. Magneto
2. Armature
3. Stop and contact point for armature
4. Rubber insulating block
7. Trunnion
8. Spring

connections were not wanted during the day the switch can be used for keeping the batteries on a closed circuit and saving them until such time as the alarm was desired in operation.

If the door were again closed and the switch thrown back, as in Fig. 3, we would once more be on the main line.

No. 7 must be connected either at top of base with binding post or on under side base with wire leading to the battery.

It will of course be seen that a cut or break in the main line will operate the alarm as readily as the door or window spring.

Restoring Burnt Carbon-Steel Machine Tools.—When lathe or planer tools of carbon-steel have been overheated or burnt by being heated up to a temperature of say 2,100 deg. F., near the melting point, they may be restored, according to Mr. George T. Coles, in a recent article in the *American Machinist*, by reheating to 1,100 deg. F., or a very dark red, and then quenching in boiled linseed oil. This treatment is very simple and inexpensive, with no nostrums or chemicals to be used, and may be the means of saving a good tool, so that it can be used with satisfactory results.

During the earthquake and fire at San Francisco, the trolley poles in the city were badly bent. How to repair this damage proved quite a serious problem. It was considered impractical to take out the poles, straighten them, and then replace them, and the other alternative of tearing them up and putting in new poles involved too much expense. The problem was finally solved by straightening the poles without removing them from their positions. The method of doing this, as described in a recent issue of the *Electrical Railway Journal*, is quite interesting. The apparatus used consisted of a 10-ft. section of railway rail and two U bolts, with wooden fulcrum block. The rail was fastened to the upper end of the pole on the convex side of the bend by means of one of the U bolts, the legs of which passed through the flanges of the rail. Just below this the fulcrum block was placed, and then the lower end of the rail was forced inward against the pole by turning the nuts on the second U bolt. The cost of straightening the poles averaged about $3.50 each, whereas if new poles had been used to replace the bent ones, the cost would have been $40 each.

"SPOTTING-OUT" LACQUERED WORK AND CLEANING OF METAL FOR LACQUERING

W. A. JONES

There are several little matters in regard to the cleaning of metal for lacquering, and the "spotting-out" of plated and lacquered work, that the writer has thought would be of interest to electroplaters and manufacturers. Of course we have these propositions before us all the time. The finisher is apt to blame the discoloration of his metal to the lacquer, and the lacquer manufacturer is just as apt to blame it on the metal. I have been particularly impressed with the different kinds of complaints we get from different sections of the country, depending upon the care and manner in which the work is prepared for lacquering.

THE GREEN DRIP

In the old days there used to be a good deal of complaint on account of green drip. This, however, is now practically eliminated throughout the East; and in nearly every case I would say on a complaint of green drip in the East, that the lacquer was at fault. This statement is based upon experience gained in following up such complaints. The natural tendency of a lacquer is to be acid, and there is almost no possibility of its being alkaline. This will be understood if one stops to consider that soluble cotton lacquers are made of nitro-cellulose, and if this is not properly washed it will contain traces of free acid; and even if it is thoroughly washed and rendered absolutely neutral, it is a stable form of nitrocellulose. If it decomposes, it will liberate nitrous acid and become acid in reaction.

TROUBLES FROM ACID

The same tendency is true of amyl-acetate. It is first necessary to remove from this any traces of free acetic acid. If this acid is not thoroughly removed in the first place, the amyl-acetate will decompose into amyl alcohol and acetic acid in the presence of water. It will be understood, therefore, that the solvent, as well as the soluble cotton will be either neutral or else become acid. This brings me to a point to which attention is called: Practically all of the discoloration found on lacquered work in the East is not green, but a reddish brown. If there is acid in the lacquer it would react with the copper (of the lacquered metal) and all of the copper salts are green. Apart from the free acid in the lacquer, the lacquer might become of acid reaction by using a galvanized iron dipping tank, or by allowing small articles to drop into the lacquer and stay there. All manufacturers know that their lacquer must be free from acid when it is shipped out. In the same way, metal finishers generally understand that galvanized iron will decompose a cotton lacquer, and they also know that copper or brass plated metal, if left in the lacquer, will decompose it and turn it green. It will be understood, therefore, that the trouble along this line is very well understood by the manufacturer and user, and is not very often met with in the East. The acids used in plating are all readily soluble in water and, therefore, the work, when it is washed and cleaned, gives up this acid very readily.

THE BROWN SPOTTING

The preceding remarks cover the troubles from acid and bring us to the brown spotting which is *always* due to an alkaline reaction. Platers have generally traced this down to cyanide, and there is no question at all that the brown spots do come from cyanide. If all of the cyanide is removed from the work, there will be no trouble from brown spotting. On two classes of work the removal of cyanide is a very difficult matter, and is not altogether a case of cleaning on the part of the finishing room. On cast brass and on cast iron objects that have been brass or copper plated, brown spots are most apt to be found. In some cases, any amount of washing with hot soap solution or boiling water will fail to stop this. In many cases, if these brown spots be examined under a magnifying glass, a little pit or flaw will be found in the casting itself. As nearly as we know, it is impossible to make perfect castings; and certainly where there are little sand holes or pits, the usual method of washing will *not* remove the cyanide from them. I have given the spotting a great deal of study, and while I would not make the statement, I have pretty well made up my mind that in these pits, the cyanide is *not* there as free cyanide, but in combination as copper potassium cyanide. The edges of these little holes are apt to be spongy and, of course, the cyanide would attack the metal and stay there more readily than on a smooth, hard surface. Also on a smooth surface the buffing would cut off the copper potassium cyanide, but this cutting action would not get into the little holes.

A CASE IN POINT

A case of this cyanide spotting came up about a year ago in a finishing room run by a first-class man. He realized thoroughly well that the trouble was cyanide spotting, but he could not find any way to remove the cyanide before lacquering without using chemicals that would destroy the polish of the work. I suggested to him that he try, very carefully, the dissolving of some oxalic acid in the lacquer thinner and washing off the work with it before lacquering. He tried it and it worked in an excellent manner. He then tried dissolving some oxalic acid in a small amount of thinner, and adding it directly to the lacquer and then lacquering his work with this cotton solution containing traces of oxalic acid, but without any extra preliminary cleaning of the work. He claimed that this entirely overcame the spotting, and he has had no trouble since. The use of oxalic acid in a lacquer is not a thing that I would recommend to the ordinary finishing room. Too much acid, or carelessness in following up their work, might make more trouble than the cyanide spotting itself.

CAUSE OF BROWN SPOTS

It is generally known that, if potassium cyanide is exposed to the air, it will gradually decompose. Hydrocyanic acid will be extensively given off, and the potassium will be converted into potassium carbonate by the carbon dioxide of the air. It is unquestionably this form of breaking down which in all cases produces the brown spots, and it is finally the potassium carbonate that acts on the copper and forms the carbonate or oxide of copper—probably the mixture. The bleaching action of the oxalic acid, as I figure it out, is due to the neutralizing and taking up of the potash.

It is undoubtedly known that in the absence of moisture, chemical action is impossible. In the case of this chemical combination of cyanide and copper, the light seems to play a very important part. In one factory down East, on cast work that was plated, they used to have a great deal of trouble with spotting of this kind. Upon examination they found that on flat work, one side would have a number of these little brown spots from the size of a pin point to a pin head, and the other side would be free from them. They traced the matter over very carefully and found the side that was spotted was the one which was laid upon their table before lacquering and in this way exposed to the light. The bottom side next to the table was, of course, in the dark, and this was the side free from spots. After the work was cleaned, they immediately covered a lot of the metal with a heavy piece of canvas, allowing the work to remain covered up for a week and then lacquering. They used the same lacquer, and the same method of cleaning that had always been used, and found that, if the work was taken from the dark and immediately lacquered, the spots were entirely overcome. I have never run through this experiment, but have noticed it a number of times; and in fact I have a cast brass paper cutter on my desk which is badly spotted on one side and is entirely free from spots on the other side.

A UNIQUE METHOD

The spotting is even worse on iron castings that have been plated than on cast brass. I understand that some of the manufacturers in the Naugatuck Valley have overcome the spotting in a way of their own. The iron castings are first flashed in a cyanide copper solution. If the castings were then plated in an acid copper solution, without further treatment, brown spots appeared in great numbers. This is overcome by taking the castings after they come from the cyanide copper solution and washing with a hot salt solution. The work is then rinsed and put into an acid copper plating solution and carried through in the regular way before lacquering. No brown spots then appear. This method is also used, to my knowledge, in one other large plant in the State of Connecticut. I do not know if it is generally known.

It will readily be appreciated how copper potassium cyanide could be formed when plating with cyanide copper on the casting. I do not understand how the salt solution could break down and render harmless such a combination.

—*The Keystone.*

A UNIVERSAL DETECTOR

S. FULTON KERR

Since the silicon and carborundum detectors were introduced to the art of wireless telegraphy a few years ago, there have been many detectors invented having the same principle of operation but using different substances in lieu of the silicon, such as zirconium, silver telluride, etc.

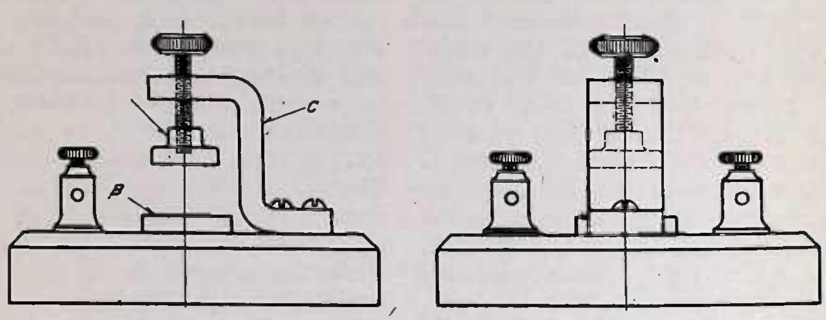


FIG. 1.

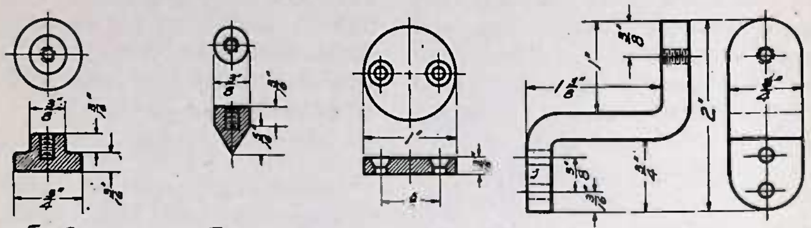


FIG. 2. FIG. 3. FIG. 4. FIG. 5.

The writer thought it would be appropriate to design a detector, which not only could be used as a silicon detector, but one in which different substances could be tried and the results noted to see which gave the best results.

The experimenters who make his detector can experiment with different metals and minerals and perhaps they may stumble upon some substance which is more sensitive than silicon or carborundum.

A general view of the completed instrument is shown in Fig. 1. As can be seen by referring to the drawing, the detector consists of the metal base B and the clamp A, and the substance to be used is clamped between these two contacts, the sensitiveness being varied by adjusting the thumb-screw.

The base of the instrument is made from oak or other hard wood about 4 inches square and one inch thick. If the edges of the base are beveled it will improve the appearance of the instrument greatly.

The metal base B on which the substance is placed is shown in detail in Fig. 4, and consists of a circular piece of brass 3-16 inch thick and one inch in diameter. Two holes are drilled and countersunk to accommodate flat head wood screws to fasten it to the base.

The standard C should be made next. Fig. 5 illustrates this in detail. It is made from a strip of brass 3½ inches long, ¾ inch wide and ¼ inch thick, and bent into the shape shown. The standard is made of material this thick, so that it will be solid and steady and will not be affected by shocks. It should be so fastened to the wooden base that the hole in which the thumbscrew turns will be exactly over the centre of the brass plate B under it.

The thumbscrew should have as fine a thread as possible, and if a thumbscrew can be obtained with a micrometric thread it should be used by all means. The finer the thread the better. The hole in the standard will of course have to be tapped with the same thread as the thumbscrew.

The clamp that is fastened to the end of the thumbscrew is shown in Fig. 2. It is made from a piece of round brass rod ¾ inch in diameter and turned down on a lathe to the shape and dimensions shown. The hole in it should be tapped with the same thread as the thumbscrew and then screwed on same.

The instrument is now completed with the exception of the binding posts and connections. Two binding posts are mounted upon the base, and the standard is connected to one and the brass plate B is connected to the other.

To prevent the thumbscrew from working loose, a steel spring should be coiled around it below the standard, as this will put a tension on it.

Although the plan of placing the substance between two flat surfaces as A and B is very good, it will increase the sensitiveness of the instrument considerably if a fine point is used to make contact instead of the flat contact A. The latest types of silicon detectors employ this method of using a point to make contact; but as this is an experimental detector it will be a good idea to make both kinds of contacts, as results may be obtained with the flat one that perhaps can not be obtained with the sharp point.

If the metal parts of the instrument are nickel-plated, it will present a very handsome appearance. If the parts are taken to a plating establishment, they can be nickeled at a very small cost or they may be plated by the experimenter himself if he has the facilities.

If it is impossible to have the parts nickeled, they should be lacquered, which will give the instrument a very finished appearance. In this case, however, the two contacts A and B should not be lacquered, as it would form a film of insulation over them.

A good lacquer can be made by dissolving a clear solution of shellac in alcohol. Make another solution by dissolving picric acid in alcohol and add these two solutions. The pieces to be lacquered should be heated and then apply the lacquer with a clean brush. The brush should be carried over the article with one stroke without stopping.

It is a well known fact that this type of detector does not require any local battery, as there is a current set up by thermal action, a phenomenon which is produced when two different metals are joined and heated. This thermo current is generated when the waves striking the antenna flow through the two dissimilar contacts, thereby setting up a small degree of heat; the presence of the current thus generated being detected in a telephone receiver.

For experimenting a 75 ohm telephone receiver will answer; but for practical work the results will be much more appreciable when resistance telephone receivers of 1000 to 1500 ohms resistance are used.

Having experimented with this detector a great deal, the writer thinks that if one dry cell is used with a potentiometer of 300 to 400 ohms resistance in connection with it that the sensitiveness is very much increased. In this case, however, the positive pole of the battery must be connected to the upper contact of the detector, this contact being connected to the antenna through the tuning coil.

A few of the substances which can be used with this detector aside from silicon and carborundum are zirconium, oxyde of titanium, silvertelluride, molybdenite, carbon, etc., and even results can be obtained experimentally with small lumps of coal.

A detector of this type will prove very interesting to the experimenter, as all kinds of experiments can be made with it.

Nuts that are rusted fast can often be loosened by giving a hard turn in the tightening direction.

FORGING FOR AMATEURS—Part VII

F. W. PUTNAM, B. S.

In the last article I explained the making of bolt heads, both by upsetting and by welding. Fig. 82 gives dimensions for a practical exercise in bolt making. Fig. 83 shows a set of exercises in upsetting and drawing out of material. There are several styles of pins shown, and use will be made later of one of these designs in the making of the pin or a turn buckle, and also for a swivel.

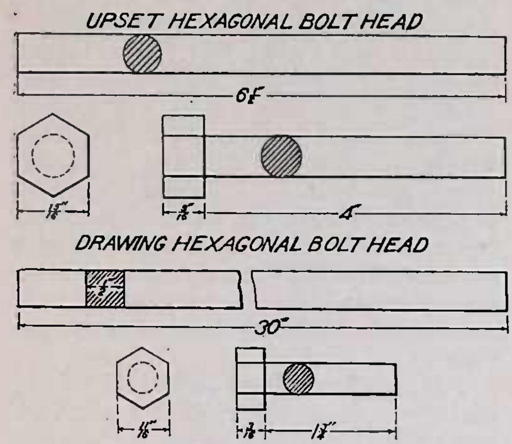


Fig. 82

I have explained the method by which a flat lap weld is made. We are now ready to discuss the round lap weld. Ordinarily, when two round bars are to be welded, each is beveled as shown in Fig. 84. This beveling is called scarfing and should be so done that when the weld is completed, there will remain but a very slight enlargement of the newly formed bar at that point. The directions I have given for making the flat lap weld will apply equally well to the round lap. It will be noticed, however, that the scarf is shaped rather differently. The proper shape for the scarf is shown in Fig. 85, which gives two views of the piece. One side is left perfectly straight and the other three sides are tapered to meet this side in a point. The scarf should be made about 1½ times the diameter of the bar. You must be very sure, especially in small work, that these pieces are shaped or scarfed to a point and not merely flatened out. This brings in one difficulty and that is that the points of the pieces will cool very rapidly after leaving the fire and care must be taken that these points are well welded. The weld is hammered square at first and afterwards rounded. The reason for hammering the weld square is that the weld is not so apt to split while being hammered. After the weld is formed, it can, of course, be easily hammered to the required size and shape. I have said that the scarf must be hammered down to a point. If the scarf were made wide on the end, the same as the ordinary flat lap weld previously described, it would be necessary to hammer all the way around the bar in order to close the weld. After the pointed scarf is made, however, one blow on each point should stick the work in position, thus making it more quickly and easily handled.

A ring when formed from round stock is usually made in one of two ways. That is by scarfing before or else after bending into shape. If it is scarfed before bending, the length of stock must be carefully calculated, a sufficient amount heated for the welding and then the ends upset and scarfed exactly the same as a round lap weld Notice particularly that the scarfs come on the opposite sides of the piece. Fig. 90 shows a piece of stock scarfed ready for bending and welded into a ring. After the piece has been scarfed it should next be bent into a ring and welded. Fig. 86A shows the method taken when bending, so that the piece will lie in the proper position. B Fig. 86 shows the incorrect way of placing the points of the scarf, after the points are lapped, as shown at B. Most of the welding must be done over the horn of the anvil. This makes it very much more awkward to handle the ring with the tongs. If the scarfs are left as shown at A, the piece can be welded when the ring lies flat on the face of the anvil, the shaping being afterwards done over the horn. The other method of welding the ring is about the same as that of making a chain link, and as I wish to take up the making of chain links for our next exercise, the same description of scarfing will serve for both. In this second method, the stock is cut and bent into a ring with the ends a little distance apart. These ends are then scarfed, as described later for the

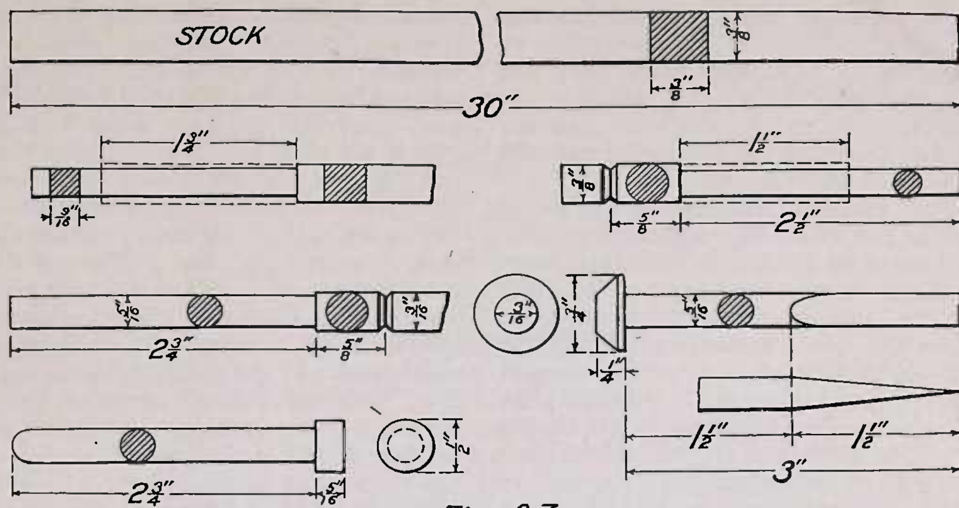


Fig. 83.

link scarf, and then welded in precisely the same way, as described for making the other ring.

MAKING CHAIN LINKS

In making links for a chain, the first thing to do is to bend the iron into a U-shaped piece, care being taken to keep the legs of the U exactly even in length. The method of bending the stock for a U has been explained in the making of the staple. One of the most exasperating troubles with making chain links is the holding of the stock with the tongs. The piece must be gripped at the lower end of the U, the two ends then being brought to a high heat, scarfed, then bent into shape together and finally brought to the welding heat and welded. Fig. 81 shows the position of the link on the anvil ready for the scarfing of the end. Place one end of the U on the anvil, as shown, and strike one blow on it. Then move it a short distance in the direction shown by the arrow and strike another blow. This is to be continued until the edge of the corner of the piece is reached, moving it after each blow. This operation will leave a series of little ridges on the end of the piece, and the stock will be worked out to a fairly good pointed shape, as shown in Fig. 88. It is sometimes necessary to bring the scarf more to a point by a few blows over the horn of the anvil. The ends should then be bent together and welded. Fig. 89 shows clearly, I think, the steps used in making the link together with two views of the finished link. The link is frequently left slightly thicker through the weld. To make a chain a second link is made, all but welding, and the first link put on it, closed up again and welded. . A third is then joined to this and so on. When chain links are made on a commercial scale, the links are not scarfed but simply bent together and welded in one heat. Norway iron should properly be used for the making of the links of a chain. For small links made of Norway iron, no flux is necessary, unless because of a fairly dirty fire, it is advisable to dip the points in sand just before the welding heat is reached. A deep fire should be kept with plenty of burning coal under the iron and a fire that is free from clinkers and clean. The iron should be kept well covered and turned occasionally, so as to heat both sides evenly. If the air gets to the iron before all the oxygen is consumed, it will unite with the iron and the scintillating sparks that I have spoken of will be given off. When there are many sparks, the fire must be looked after. As soon as the sparks appear in the flame, watch the iron carefully and soon it will look clean and shiny or watery. When in this condition over all the parts to be welded, remove quickly to the anvil and strike one or two light rapid blows to set the points of the scarf, afterwards shaping the weld over the horn of the anvil. When carrying from the forge to the anvil, rap the tongs to shake all the slag from the welding parts. Strike as soon as the metal touches the anvil, or else, especially with small iron, it will be found to have cooled below the welding heat. The scarfed laps must not be too long or wide, and when they are lapped over each other the points must be on the top or the outside. If the point is on the inside, it cannot be reached with the hammer to weld.

Fig. 90 shows a method of making a ring from flat iron. This figure shows the stock before and after it has been bent into shape. Notice how the scarfed ends are made, one on the upper and the other on the lower surfaces of the stock. The stock should be cut to the correct length, upset and scarfed exactly the same as for a flat lap weld, after which the piece is bent into shape and welded over the horn of the anvil. The points should be drawn slightly, and the ring when heated and welded, must be brought to the welding heat very carefully, otherwise the outside lap will burn before the inside becomes hot enough to weld. Let me repeat that care must be taken to have the scarfs come on opposite sides of the stock.

In making a washer or flat ring, the stock used must be bent edgewise into a ring without any preparation. The corners of the ends are trimmed off parallel after the stock is bent, dotted lines in Fig. 91 showing the lines along which the ends are trimmed. The ends are next scarfed with a fuller or else the pean end of a hammer and then rapped ready for welding, as shown in Fig. 92. It will be noticed that no upsetting has been done on the ends of this flat ring. If the work requires correct finished dimensions, then the ends of the ring should be upset somewhat before bending into shape. When the under side gets up to a welding heat, quickly dip it in sand, taking care that none gets on the inside, and return to the fire, repeating, if necessary, and keeping in the fire until the other side is in proper condition.

BUTT WELDING

Sometimes a weld is made without scarfing. Such a weld is called a butt weld. The ends are slightly rounded, as shown in Fig. 93. If the ends are convex, as shown, the scale and other impurities sticking to the metal will be forced out of the joint. As the ends are forced together, the metal flows outward, forming a ring at the joint. This is then hammered down to the diameter of the joint by the use of top and bottom swages. If the pieces are heavy and can be stood up endwise under a steam hammer, it starts the best weld, but if the pieces are long too much of the force of the hammer blows is lost in traveling from the end of the bar to the weld. The pieces are welded by being struck on the ends or driven together. This, as I have said, forms a ring at the weld and leaves the piece as shown in Fig. 94, showing a split ring where the rounded edges of the ends meet. If the pieces are long enough they may be welded right in the fire. This is done by placing the pieces in the proper position for welding. A very heavy weight is then held against the projecting end of one piece, and the weld is made by driving the pieces together by hammering on the projecting end of the second piece. This can be much facilitated by having the two pieces to be welded run through round collars, which are used as bearings for keeping the pieces in line. As soon as the work is *stuck*, the weld is taken from the fire and then finished on the anvil. When a small bar is to be welded to a heavier piece of metal, and a butt weld is used, it is said to be *jumped* on. Such a weld is shown in Fig. 95. In preparing the parts for this weld, the bar should be rounded at the end and the heavy piece left flat or slightly cupped. If the piece which is to be *jumped* or butted on can have its end upset so as to flare out and form a sort of flange, better results can be obtained. This flange, as indicated by the arrow in Fig. 95, can be welded down by a hammer or set hammer and making a fairly strong weld. The edges of the scarf will burn away to a certain extent in heating. The scarf should, therefore, be made enough larger so that the weld may be a full size after completion.

SPLIT WELDS

It frequently happens that two very thin pieces of stock are to be welded, and it is found difficult to join these pieces with the ordinary lap weld, because the stock is so thin that when the pieces are taken from the fire, even though they are at the proper heat, they will cool off too rapidly to weld before they can be

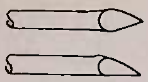


Fig. 84.

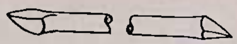


Fig. 85

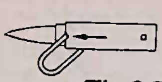


Fig. 87.

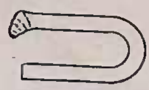


Fig. 88.

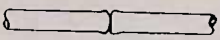


Fig. 93.

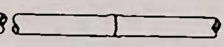


Fig. 94

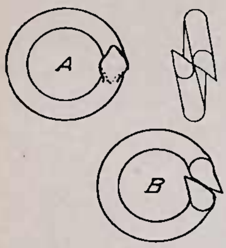


Fig. 86.

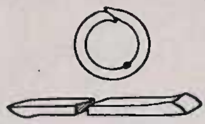


Fig. 90.

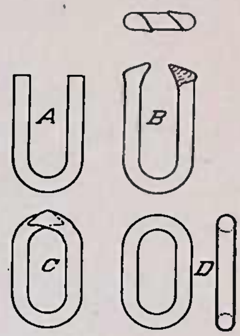
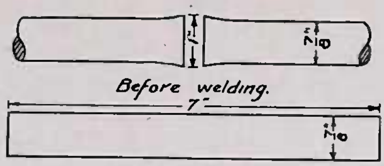


Fig. 89.

Fig. 91.

Fig. 92



After welding.

placed properly together on the anvil. It is possible to get rid of a large part of this difficulty by scarfing the ends, as shown in Fig. 96, the ends upset and tapering to a blunt edge and split down the centre for about ½ in., the amount depending on the thinness of the stock. One-half of each split end is then bent up and the other down. These ends are then pushed tightly together and the split parts closed down tightly on each other, as shown in Fig. 97. This joint is then heated carefully, using sand to prevent the tips from burning and finally welded. This form of weld is sometimes used for welding spring steel or iron to steel.

For welding heavy stock, a split weld is sometimes used which is shown in Fig. 99, Fig. 98 showing the two pieces before the points are hammered down to hold them together. In this form of weld, the ends of the pieces are first upsēt and then scarfed. One piece is split and shaped into a Y, and the other has its end brought to a point, with the sides of the bar just back of the point, bulging out slightly, as shown at A and B, Fig. 98. This bulge or swelling is necessary to prevent the two pieces from slipping apart. After the two pieces are properly shaped, they are driven together and the sides or lips of the Y-shaped scarf are closed down over the pointed end of the other piece. These lips must be long enough to well lap over the bulge on the end of the other piece, so as to prevent the two pieces from slipping apart. The pieces are then ready to heat and weld. The iron must be heated slowly, so that the pointed part may be brought to a welding heat without burning the outside points. For this welding, a flux should be used, either clean river sand or borax. The weld is useless for welding steel or for welding steel to iron. For this purpose, borax is generally used.

Fig. 100 shows a method of roughing or notching the faces of the scarfs with a chisel, this being done to prevent the pieces from slipping apart. This form of weld is the one much used for welding tool steel to iron or mild steel. If tool steel is welded to iron or mild steel. the pieces are usually heated separately. The tool steel will weld at a much lower temperature then with wrought iron or mild steel, and if the two pieces are heated separately the other metal may be raised to a much higher temperature as will be necessary to get it to a welding heat without burning the tool steel which welds at a much lower temperature.

The next form of welding to be con-

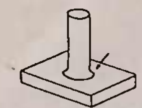


Fig. 95.

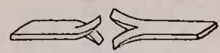


Fig. 96.

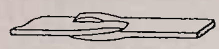


Fig. 97.

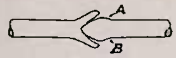


Fig. 98.

Fig. 99.

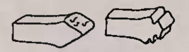


Fig. 100.

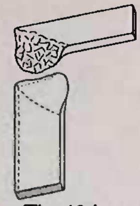


Fig. 101.

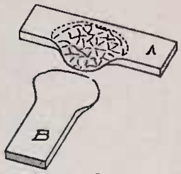


Fig. 102.

sidered is that used in the welding of angles. Up to this time I have in my discussions of welding, given only one or two methods for performing certain operations. Frequently there are several perhaps equally good methods of scarfing for the same kind of welding and I do not wish my readers to think that the methods that I have described are the only good methods that might be used for the particular weld under discussion.

Fig. 101 shows one way of scarfing for a right angle weld or corner plate, which is made of flat iron. Both pieces are scarfed exactly the same. This scarfing is done with the pean end of the hammer. For a corner plate, Norway iron should be used. The ends should be heated for about 2 in. and then upset back ½ in., the ends of them scarfed with the pean end of the hammer, drawing the hammer at right angles with the edge. The scarf should not extend more than ¾ of an inch back from the end. When the pieces are heated for welding, the points, or tips, should be held up slightly from the fire to prevent burning, and when the welding heat is reached they may be twisted down a little if necessary. As in all other welds care must be taken in shaping the scarfs, so that when they are placed together, they will touch in the centre instead of around the edges, so as to leave an opening for forcing out the impurities which will cool on the surfaces to be welded.

What is known as a T weld is shown in Fig. 102. The end of A should be slightly upset and is placed on the bar B when welding, the dotted lines indicating about the amount of lapping over of the edge of the stem A.

The results of a series of experiments which have been performed at Berlin, may be interesting as regarding the welding capacity of steel. The test pieces used were flat, round and square in section, the largest being 3.149 by 1.181. Each piece was swelled up on the anvil when hot .196 to .392 in., and after heating to the proper degree, the two pieces were laid on each other and welded together by hand or steam hammer. In the chief experiment, the steam hammer was employed. Each piece after welding was tested in the usual way for tensile strength, the limit of electricity, contraction, extension and other strength being determined. The same quantities have been measured for pieces of exactly similar quality, section and length, but without a weld. The limit of electricity in both steel and iron is nearly always reduced by welding and this is without exception the case as regards the extension. The contraction of welded is less than that of unwelded pieces, when the fracture takes place in the welded portion. The general conclusion arrived at when they have steel the best welding temperature is just at the transition from a red to a white heat. A quick fire and smart handling are necessary, as the pieces should not be long in the fire. In welding tool steel, the general method of scarfing is the same, as I have previously described; but when tool steel is to be welded either to itself or to wrought iron or mild steel, much greater care must be taken in the heating; but when working with the softer metals alone, the proper heat for welding tool steel can only be learned by experiment. If the tool steel is heated until the scintillating sparks are given off, it will be found that a light blow of the hammer will cause it to crumble and fall to pieces. For welding tool steel, a flux, made up of one part of sal ammoniac to four parts of borax, is generally used. High carbon tool steel and tool steel used for files, small lathe tools, etc., cannot be welded satisfactorily without a great deal of experience. Frequently what looks to be a first-class weld may be made, and, in fact, the tool may be machined and finished without showing any signs of the weld, but when the tool is hardened, it is almost certain to crack open.

The next article will take up a series of simple forgings based on welding.

DESIGN OF A ONE QUARTER KILOWATT TRANSFORMER FOR WIRELESS TELEGRAPH TRANSMITTERS

W. C. GETZ

In the design of a closed core transformer for wireless telegraph work, it is necessary to depart somewhat from the rules governing the general types of lighting and power transformers, and therefore the data given must be the result of continued experiment with practical apparatus, rather than pure theoretical calculation.

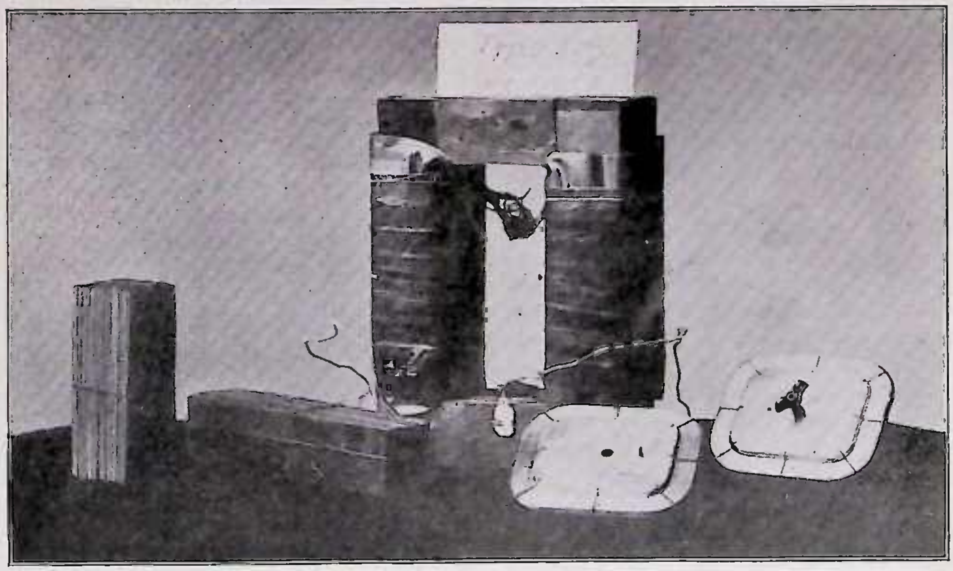


Fig. 1

The fundamental principles of transformer design in itself would require a special article, and so it is therefore the purpose of the writer to give in this article construction data covering a One Quarter Kilowatt Closed Core Transformer. suitable for working on a lighting current of 110 volts, 60 cycles, with a secondary electromotive-force sufficient to work the transmitting apparatus of a tuned circuit wireless telegraph system efficiently.

Many types of small transformers are now being sold; and it is interesting to note that while these are sold for wireless telegraph work, simple precautions against break-down universally adopted in induction coil construction are rarely found in these transformers. The high potential windings are in most cases layer wound, and should it so happen that any trouble would occur like a breakdown of one or more layers of insulation, at least one-half, and probably the whole secondary, would have to be rewound.

A few very cheap types of closed core transformers that are now being put on the market are made with the primary on one side and the secondary on the other. This causes a great loss of efficiency, as the lines of force of the two coils have a large air-gap to span. The closer the primary and secondary windings are placed, with proper insulating precautions, the higher will be the efficiency of the transformer. This is to be seen in the commercial types of transformers, which invariably have the primary and secondary windings each split into two halves or "legs," but each side of the transformer contains both a primary and a secondary winding.

Now considering the better types of transformers made, we find that the primary or low voltage side is wound directly over the iron core. This core is divided into two halves, as shown in Fig. 1, the halves being joined at top and bottom by short iron cross pieces. Each of these halves are technically known as a "leg," and these legs are supposed to contain equal amounts of primary and secondary wire.

As before stated, the primary is wound on the core, after the latter has been properly assembled and insulated. Over this primary a number of layers of insulating material is now placed. Now the secondary winding may be either layer wound or section wound. For a transformer such as is used by the lighting and power companies, where the highest potential is about 3000 volts, sufficient insulation can be secured in the layer wound secondary. But in wireless work, 10,000 to 30,000 volts is required, and unless the layers are very carefully insulated, trouble is bound to occur.

However, if we wind the secondary in sections, as shown in Fig. 14, each section may be perfectly insulated from the adjoining sections, except when the proper connections are made, and there is but little or no danger from a break down or trouble between sections.

This is because the voltage between the sections is little when compared with the total voltage of the transformer. For example, if the transformer is to give 20,000 volts, which is equivalent to a one inch spark, if it is layer wound, it is probable that there will be a break down near the ends of the windings, as has often happened with layer wound induction coils. But if we use 20 sections, each section will have a voltage of 1000, and a maximum arcing distance of 1-20 in. in open air. Two sections at the points of opposite polarity might then be supposed to have a maximum arcing distance of 1-10th in., so that if these sections are entirely uninsulated they may be arranged along each leg, each 1-8th in. from the adjoining sections without danger of arcing.

Therefore, by insulating these sections as will be explained later on, we can place them against one another without danger of arcing, and we then have a much more serviceable transformer than one of the layer wound type. Other important advantages in this style of winding are the ease of repairing in case of trouble—simply remove end core pieces and take out bad sections—and free ventilation between the windings, allowing the heat to be carried off quickly.

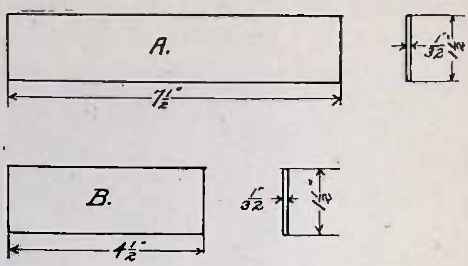


Fig. 2

Referring again to Fig. 1, we have a photograph of the assembled core and primary. It is noticed that the iron of the core pieces laps in with the iron of the legs. This is so that there will be a continuous magnetic circuit at the point of juncture, with little or no air-gap between the respective sections of iron.

In Fig. 2, we are given the dimensions of this iron. The "A" sizes are the iron plates for the "legs" and the "B" sizes are for the cross-pieces. This iron should be of a thickness not less than .015 in. nor more than .03 in. Enough iron should be cut to make two piles of each size, each pile being 2 in. deep when pressed together. This really makes a total of each size 4 in. deep.

After cutting to size, it is essential to insulate the core iron. This may be easily accomplished by dipping each piece of iron in some insulating varnish like "P. B." or "M. I. C. Compound," either of which may be obtained from electrical supply houses.

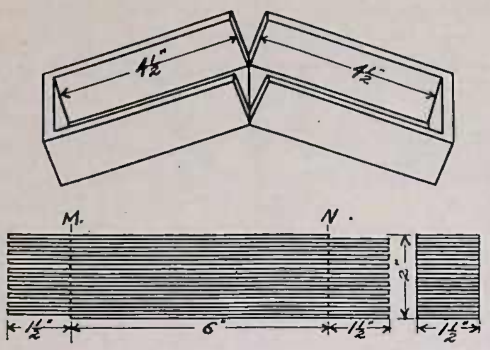


Fig. 3

Now we have two piles of each size "A" and "B" enameled iron, each pile being 2 in. deep. For the time being, we will only consider the "A" sizes. Make a hinged box, as shown in Fig. 3, each half of which is 4½ in. across the bottom, inside measurement. This may be roughly made of any old box at hand, as it is only to be used for construction purposes. Two hinges are placed in the centre of the bottom, so the box may be split open outward, as shown. The forward end of this box, when in use, should be proped up on about a 30 degree angle with the work-bench. The bottom halves should then be opened so that they make an angle of about 240 degrees with each other—when facing same. Now take a pile of "A" plates, and insert one on the left hand side of the box; the second on the right hand side, and thus continue alternately from one side to other, until all of the plates of one of the 2 in. piles is exhausted. This will leave the plates interleaved with one another, but on an angle.

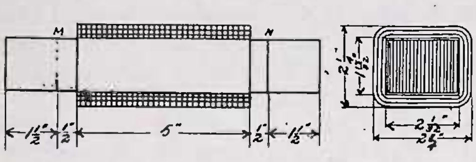


Fig. 4

We now want to get all the plates parallel. Set the box flat on the work bench, and gently press down on it, at the same time tapping the plates with a mallet, to keep them from rising away from the box. When the bottom of the box is entirely straight, the plates should all be in a compact pile, as shown in Fig. 3, every alternate plate extending 1½ in. beyond the adjacent plates on one end, and being 1½ in. in from the adjacent plates on the other end.

With the other set of "A" plates, proceed in the same manner, and when completed, bind each set between the parts designated as "M" and "N" with friction tape. Over this place one layer of "Empire" insulating cloth. We now have completed the cores for the two legs of the transformer.

We are now ready for the primary winding. Since the primary at 50 per cent overload is only to take 4 amperes, No. 18 B. & S. gauge magnet wire is sufficiently heavy to suit our purposes. By referring to suitable tables of permissible carrying capacities of magnet wire, it is found that No. 18 B. & S. wire can carry 5 amperes without heating, and can safely carry 8 amperes with but slight heating effects.

Each leg of the primary will require approximately 1 lb. of No. 18 D. C. C. magnet wire, so about 2 lbs. should be secured for the complete transformer. As the core is of a cross section of 2 in. x 1½ in. and the insulating tape and cloth adds about 1-32 in. to each of these dimensions, we have an inside winding section of 2 1-32 in. x 1 17-32 in. We are to wind each leg in three layers, each layer to have 75 turns of wire of the above size. No. 18 B. & S. gauge wire, measures .0403 in. bare. The double cotton covered insulation adds approximately .008 in. to this value, giving a total of .0483 or say .05 in. Therefore three layers will take up .15 in. Between the layers is placed a single layer of "Empire" cloth .007 in. thick. As there will be but two of these wraps, we now have .014 in. added to .15 in., which gives us .164 in. as total depth of winding. This is a little less than 11-64 in. Adding 11-64 in. to the inside dimensions previously obtained, we get an outside cross-section of 2 13-64 in. x 1 45-64 in. We can now place about ten wraps of Empire cloth over the entire primary, which will bring the completed primary dimensions to a little less than 2¼ in. x 2¾ in. The last wrap of Empire cloth can be held in position by a layer of "Linotape." This is made of the same stuff as Empire cloth and is especially used for winding form wound coil. Both are oiled linen fabrics.

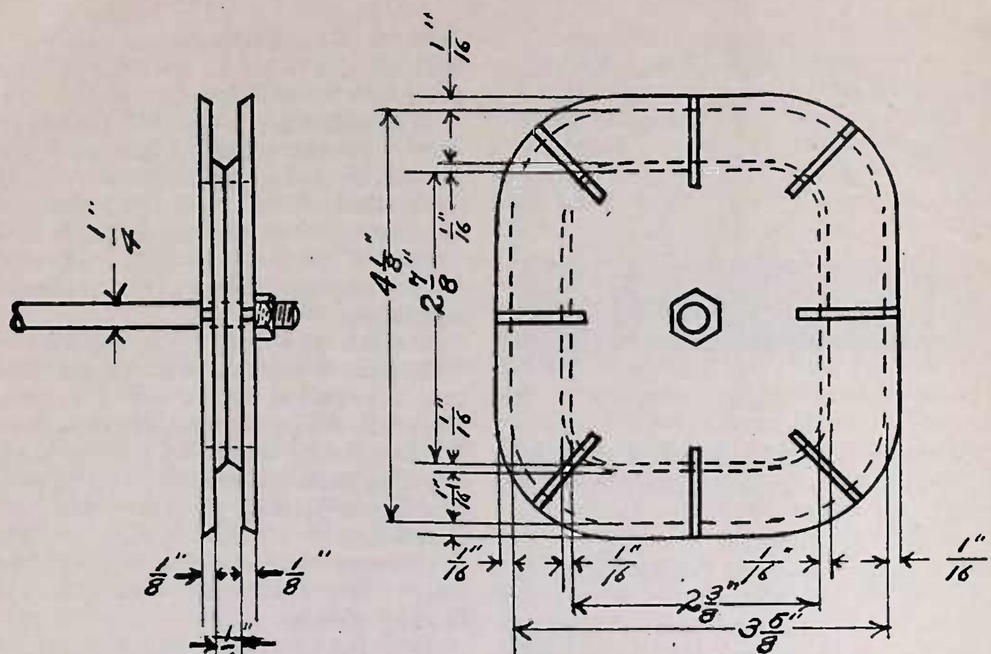


Fig. 5

The completed primary will have the appearance of that shown in Fig. 4. The 75 turns of No. 18 wire of each layer will occupy a space about 5 in. long. This will leave ½ in. clearance on each end from "M" and "N." This is to give good insulation to the primary winding. It may be stated here that all lengths of Empire cloth should be cut 6 in. wide, so that a good margin is always on each side of the primary winding. This size of cloth is supposed to stand 7,000 volts per thickness and is known as No. 7 cloth. A good allowance is made for any increase in the size of the primary windings, due to difference in insulation, so that the experimenter is perfectly safe in following the figures given above.

We will now consider the secondary windings. As already stated in all of the best types of transformers, the secondary consists of a number of sections. This is wound by means of the winding form shown in the right hand side of the assembled core in Fig. 1. This form should be made of at least ⅛ in. brass, to give it the required mechanical strength, and all parts should be perfectly true. As many experimenters cannot readily make this form, and as it would cost about $4.00 to have it made at any machine shop, the secondary sections may be purchased, already wound and taped to suit this particular transformer, from certain advertisers in this issue.

Fig. 5 gives full details and dimensions for this winding form. This is made in two halves, the centre of the plane of the section being the dividing line. Slots are cut in the sides, as shown, to permit tying a section after winding. This prevents any "caving-in" of the section, when removing from the winding form.

Fig. 6 shows the dimensions of the sections, which correspond to the inside dimensions of the winding form. Each section is ¼ in. wide, and ⅝ in. deep. Thus the cross-section of winding is ¼ in. x ⅝ in. or 5-32 in. The wire to be used is No. 34 B. & S. gauge black enameled wire. In a section of this size, it is possible to get about 2,100 turns of this size wire.

At this point, it is advisable to discuss some of the advantages of enameled wire over silk or cotton insulation. Enameled wire may be heated to 450 degrees Fahr. without impairing its insulating qualities. With silk or cotton covered wire, any rise in temperature above 270 degrees Fahr. will cause the insulation to char. It is also realized that with a given cross-section of wire, the greater the number of turns to be gotten in a given winding space, the higher the efficiency of the winding. Recent examples of this phase are shown in the high efficiency telephone receivers wound by the writer. With No. 40 enameled wire, it is possible to get 10,000 turns of wire on a given receiver. This has about 1,650 to 1,700 ohms resistance. Now using single silk wire of the same size, it is only possible to get 3,000 turns, with a resistance of 300 ohms. To overcome this difficulty, firms prejudiced against the use of enamel wire use No. 50 silk covered wire. They then get the resistance, but they are losing something by far more important—that is, the ampere turns. In fact, certain unscrupulous dealers have been using German silver wire—they get the high resistance receivers—but the poor experimenter wonders why he does not get any results!

The antagonism to enameled wire is due to the fact that many firms do not know how to handle it. It is different altogether from fibre insulated wire, but it takes experience to learn its fine points. The mere fact of the enormous increase in ampere turns for a given winding space should alone recommend it to every electrical designer.

For example, take No. 34 wire that we are to use on this transformer. For a given winding space of 1 square inch it is possible to get 21,002 turns of No. 34 enameled wire. With single silk covered wire only 13,060 turns per square inch may be had; while with single cotton covered, it is only possible to get 7,440 turns.

In weight, No. 34 enameled wire runs 8,093 ft. per lb., against 7,646 ft. for single silk covered wire, and 6,317 ft. for single cotton covered wire of the same size copper.

In cost, enameled wire is as cheap as single silk covered wire. So it is to be seen that outside of the immense value of insulation properties alone, enameled wire will give more ampere turns per winding space; has fully 6 per cent. more feet per lb. for No. 34 gauge wire than single silk covered wire; and costs less per equal length than silk covered wire.

After completing the winding form, as shown in Fig. 6, place same in a lathe, or other convenient device. and, using No. 34 enameled wire, wind the form full. The wire should be carefully wound on, no kinks nor rough places run in; if there are any splices to be made, same should be soldered and insulated with paraffined tissue paper. The form is proportioned to contain 2,100 turns of this size wire. This will be about five ounces, so that every pound of wire will make a little more than three sections.

The form being wound full, we then take some thread and, slipping the end through the slots in the form, bind the section tightly at the eight points indicated. Then unscrewing the lock-nut, remove the upper half of the form. Carefully invert the lower half and the complete winding will easily drop out on your hand. This should be immediately placed in hot paraffin wax, and allowed to boil out until all traces of moisture have disappeared.

Then remove the section from the hot wax, and place it under a suitable weight, so as to press it back to its original thickness when hardening.

When completely cool, the section will be found very rigid, and it may be easily handled without danger of caving.

To be continued.

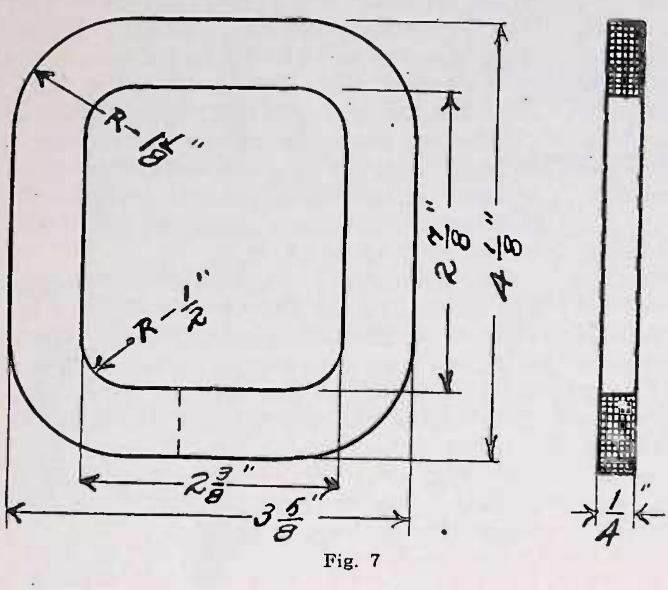


Fig. 7

DOVETAIL JOINTS

To make a good dovetail joint is the ambition of the average woodworker, whether amateur or professional. By many these joints are believed to be difficult to make successfully; but this is really not the case. In fact, they are as simple and as easy as the mortise and tenon, and if the student will follow out our instructions taking the trouble to learn how to use the saw and chisel properly, he will have no reason to again speak of the difficulties of these joints.

Fig. 1 shows two pieces of wood dovetailed together at right angles, what are usually called "ordinary" dovetails being used. Before going further, it will perhaps be as well to devote a few words to the correct shape of the "tails" or pins. It will be noticed that in Fig. 1, and more plainly in Fig. 2, the angles are very acute. A great many persons make the mistake of thinking that this is wrong, and that the angles should be as Fig. 3. But while this would be true if we had not the grain of the wood to consider, if the tails are cut as in Fig. 3, there is the risk of splitting the wood at each side, and thus spoiling the work. If, however, they are cut as in Fig. 2 this risk is reduced to a minimum. Another mistake which is often made is shown in Fig. 4, where, instead of starting with a half-dovetail at each side, as A, Fig. 2, whole ones only are used. This is entirely wrong, both as regards strength and convenience.

After these preliminary remarks, we can proceed with the setting out of the actual work, taking it for granted that the material is at hand, cut to size, and planed up truly. A very good article to try one's prentice hand on is a small box, made from not too thin wood—say three-quarter inch board, which is, in reality, five-eighths thick.

The two sides—or, strictly speaking, the front and back—should be placed together as in Fig. 5, *face to face* as shown. While held by a pair of clamps or a brad or two, they must be squared across to the size required, and sawn off to the mark. The marks B must then be squared across and continued all round, using either a marking knife or a chisel. A pencil will not do for any but the very roughest work.

Now set out the dovetails on one side, as in the drawing, first the half at each edge T, the others evenly between. For good work the tails may be as close together as half-an-inch; but for ordinary work, in deal or any soft wood, from 1½ to 2 in. is correct. The more tails there are used, the stronger the job will be, and, of course, the longer it will take. All the tails, having been set out, square across the ends of the wood, as in Fig. 5, and then proceed to saw them in, cutting as cleanly as possible with a tenon saw, and taking care to cut down to the marks but on no account beyond them.

The two pieces can now be taken apart, and the setting-out lines squared across the two face sides, which before were out of sight. The ends can now be prepared. Assuming that they are planed up truly, place them face to face in the same way as in the case of the sides. Square and cut off the ends, and also square across the marks to which the dovetail pins are to be cut down to (C, Fig. 6), which should be far enough from the ends of the wood to leave the pins about a quarter of an inch longer than the actual thickness they have to go through.

The ends may now be taken apart, and the lines, C, continued on the face sides. They are then ready for marking in, which is the most important thing of all.

The best way to mark in correctly is to fix one of the end pieces upright in the bench vice, face side to the bench. Then lay one of the sides on it, face down, and with the two face edges level, as in Fig. 7. Then mark on the end of the upright piece with the point of the tenon saw. In laying on, the side for marking in the squared-across mark, must exactly coincide with the inside of the upright piece in the vice, as at D, Fig. 7.

As each corner is marked in, it must be numbered, as in the drawing (No. 1, Fig. 7). If the face marks are kept right in relation to each corner, there can be no mistake when putting the work together later on. Each pin must now be squared down, as E, Fig. 6, and then they can be sawn down, keeping just outside of each mark, as at F, which shows one of the pins sawn in.

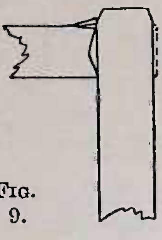


Fig. 9.

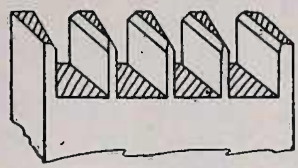


Fig. 10.—Dovetail Pins.

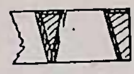


Fig. 11.


Fig. 12.

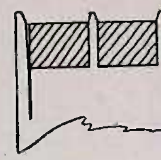


Fig. 16.

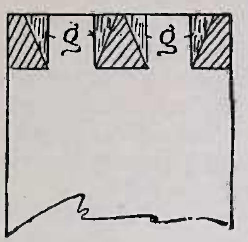


Fig. 13.
Bad Pointing.

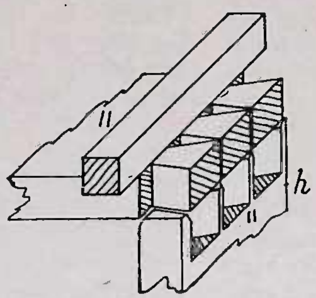


Fig. 14.
Putting Corners Together.

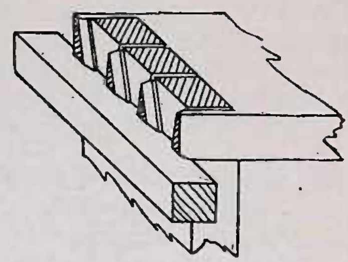


Fig. 15.
Corners Joined.

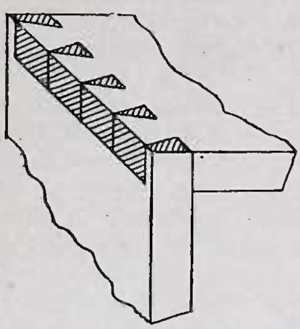


Fig. 1.
Dovetail Joint.

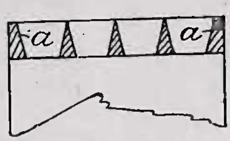


Fig. 2.
Shape of Dovetails.

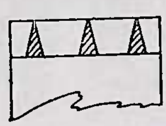


Fig 4.
Faulty Spacing.

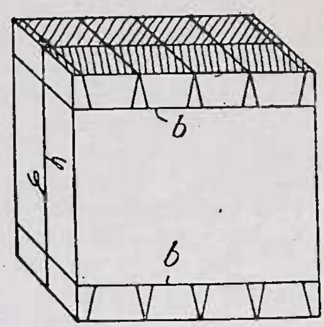


Fig. 5.
Method of Setting Out.

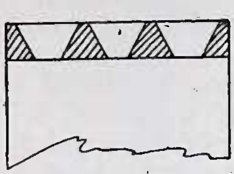


Fig. 3.
Faulty Dovetails.

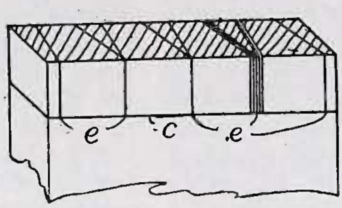


Fig. 6.
Setting Out.

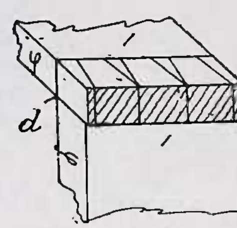


Fig. 7.—Parts Placed for Marking.

After all the pins are sawn in the spare wood can be cut from between them, and also the tails cut out, using sharp chisels and cutting as straight from both sides as possible. The tendency is to cut under, but if this is done to any great extent, there is a great risk of splitting a piece out when putting together, as in Fig. 9.

After cutting away the waste wood, the pins should be pointed as in Fig. 10, to make them enter the tails easily, and to generally facilitate the putting together. Take notice that the correct way to trim the pins is as shown in Fig. 11, not as in Fig. 12. If this pointing is not done, it often causes the fault shown in Fig. 9, and also that in Fig. 13, where the pins have driven out the shaded triangular pieces. G.

To put together, stand one end upright (as H, Fig. 14), glue the pins quickly, and then place a block across as shown and drive down firmly. Drive the same side on to the other end in the same way, then turn up and glue both the other sets of pins and drive on the other side. The driving-on block should be kept close up to the tails, as in Fig. 14, so that when the joint is down, it is as in Fig. 15. If kept so, it acts as a safeguard against the pins splitting pieces out (as Fig. 9). If the dovetails fit well, glue only should be sufficient to hold them, but before cleaning off, it is as well to allow the glue to set hard.

These joints differ from others in that they must be made correct the first time. If fitted and altered, they rarely turn out satisfactory. The exact allowance to make for tight-fitting in cutting the pins varies according to circumstances. With large dovetails and soft wood, a sixteenth of an inch outside each mark is not too much, but with small dovetails and hard wood a very little is required. This is a matter in which experience is the only teacher. In any case a little less allowance should be made in cutting the half-dovetails than in the whole ones, otherwise when putting together the effect may be as Fig. 16—the half will split and spoil the work.

—*Home Handicrafts.*

Flaming Arc Lamps

About two years ago the first of a new kind of arc lamp made its appearance which, as it became more generally known, caused considerable stir among those who were particularly interested in artificial lighting. This lamp, known as the "flaming arc," is being adopted for the illumination of streets, and more particularly for the fronts of amusement places, department stores and other mercantile establishments. It is estimated that over 6000 are now in use in New York City.

The "fire ball" effect which is produced by the exceptionally strong, orange-colored light emitted by these lamps makes them a particularly valuable attraction when installed at the front of any mercantile establishment.

These lamps are operated either upon direct or alternating currents.

The current consumption is exceptionally low, considerably less per candle than that of any other arc lamp. Then, too, by simply trimming them with specially prepared carbons the color quality of the illumination can be changed either to pink or white, the most popular color, however, being yellow.

The distinguishing feature of the flaming arc lamps is that instead of burning the carbon pencils one above the other, they burn in a downward direction, thus eliminating the shadows cast by the interference of the lower carbon. Then, too, the carbons used are impregnated with a luminous substance which, when burning, greatly increases the candle power of the lamp.

Most of the earlier flaming arcs that were put on the market gave trouble through flickering and through their frequently going out. These defects, however, have been eliminated on the better makes of this type of lamp and the light now provided burns steadily and continuously.

At first, the central stations of the various cities which control the local public electric lighting did not take kindly to the flaming arcs, chiefly on account of the enormous efficiency of the lamps as compared with the decrease in current consumption. It was only inevitable, however, that the flaming arcs should one day be in demand and in use, and now these local electric lighting head quarters have fallen in line and are advocating them. Particularly is this so since it has been found that by cutting their weekly current bills, their customers would add more light to their stores, factories and other buildings.

The larger cities, and more particularly New York, Chicago and St. Louis, are showing considerable interest in this lamp. The smaller cities and towns, as is usually the case with improvements of this character, will undoubtedly before many months have many of them represented in their streets.

—*Dry Goods Economist.*

In Denmark only the inter-provincial, the inter-communal and the international telephones are worked by the state, while the local telephones are worked by private limited companies, under concessions.

BLACK AND BROWN BOOT POLISHES AND HOW TO MAKE THEM

The popularity of the "Wax polish" for boxcalf and other high-class leather, was explained recently when the chairman of one of the oldest blacking makers told the shareholders that they had practically ruined the sale of liquid blacking. The ease, facility, cleanliness, etc., and high polish obtainable by these wax polishes, are their chief recommendation, but their advent was due to the fact that the peculiar tannage by which the leathers were made, would be ruined by ordinary blacking which contains all sorts of ingredients, acids, and even coal dust, treacle and vinegar, lampblack and glucose.

Now, the production of these wax polishes is very simple and requires no expensive apparatus, an ordinary saucepan, gas-stove, and the tins to put the polish in, being all that is needed; therefore there is no reason why amateurs should not enter upon their manufactory, either with a view to their own use, or for sale to others; there must be a fair market for these polishes even in small towns.

The question is, what are the ingredients to use, and how are they incorporated?

The ingredients for wax polishes are:

Carnuaba wax; this is the ingredient that imparts the high polish; it is a very hard, brittle, greyish-looking wax, and to succeed in getting the highest gloss it must not be used in excess. Next comes Ceresine or yellow wax; this wax enables the polish to remain moist and not dry up or cake, but it requires to be largely mixed with turpentine to retain it in this condition. There are no polishing qualities in the Ceresine, as it gives only a dull smear.

The third ingredient is Japan wax; this is a hard, but not very brittle wax, white in color, and imparts a fair amount of gloss when rubbed or brushed.

The final component is the turpentine; this has to be added so as to bring the waxes into an unctuous pasty condition, and prevent it caking.

The coloring matter for black is "oil black" or "alophate" black; these blacks are readily soluble in oil, spirits, waxes, etc. For brown polish "oil brown" is used.

The relative proportions of the ingredients will depend on the quality of the carnuaba, that wax varies, so likewise does the quality of the ceresine, so that it would be useless to state in definite amounts what quantity of each component to use, but a good polish is obtained by using the components in the following proportion (all parts by weight):

1 part of Japan wax.

2 parts of ceresine.

Carnuaba equal in weight to 1-24th of the other waxes.

Coloring matter 1 to 2 drachms to the pound of the waxes; turpentine q.s.

THE METHOD OF INCORPORATION

Put all the waxes and coloring matter into a common iron saucepan and slowly heat them over a gas stove until they melt; be careful that the white fumes given off from the ceresine do not become too dense (if they do put on the saucepan lid at once) as they are inflammable if they come in contact with a naked flame. Raise the heat to a fairly high temperature, otherwise the waxes will not thoroughly combine, and stir well, then remove the saucepan and allow its contents to cool, until it is safe to add the turpentine without fumes of the latter igniting (it spontaneously inflames at a low temperature); stir well and allow the mass to cool, until it is of the consistence of butter. If the polishing qualities are found, on trial, to be satisfactory, it can be warmed and put into the boxes for sale. If, however, the mass is firm, or too hard, it must be heated again and more turpentine added until the right consistence is obtained. If the gloss is not of a high class, the mass should be heated, a little carnuba wax should be added along with some ceresine and that stirred into the hot mass and well incorporated.

By commencing with a small quantity of the ingredients, after a few trials the correct proportion will be obtained. And these proportions of waxes, etc., should be adhered to.—*Hobbies*.

There are no stripes on a flagstone, but if one falls on it hard enough he will be likely to see stars.

A SIMPLE POTENTIOMETER

DOUGLAS HILLYER

As is generally known, a really efficient potentiometer such as is necessary for use in wireless telegraphy, is rather too high-priced for the average beginner. However, no one need longer be without one on that account, for one may be made that will accomplish its work fully as well as higher priced instruments, at the cost of a few cents.

The materials necessary for its construction are a fairly "hard" lead pencil, an oblong piece of white wood, and two binding posts, and a square brass rod.

To make the base, plane off, and true up a piece of the wood to a length of 7 in., a breadth of 2 in., and a thickness of ½ in. Exactly in the centre, make a groove 1-16 in. deep, and 3-32 in. wide. Opposite, i.e., at one side of either end, ¼ in. from groove, bore a hole, and countersink to admit binding posts. At the opposite sides from the binding posts, screw down a thin strip of brass, long enough to cross the groove and be held down by the binding post, and ¼ in. wide.

Now split open your lead pencil, keeping the lead unbroken, and insert the lead in the groove. Lap over your brass strips, and fasten them down by the binding posts; insulate one post by putting a fibre or rubber washer between the bottom of the post and the brass strip. This will hold your lead in tightly, and all that now remains to be done is to arrange a slider, for varying the contact, and therefore the resistance. There are many ways of accomplishing this, and the author leaves it in the hands of the reader, and he can suit himself.

Beveling the edges and staining the base gives it a more finished look. Besides being used for wireless work, it makes an excellent rheostat.

Many diagrams showing connections are being and have been shown in articles on this subject, and, therefore, are not shown here.

A clear solution of shellac in alcohol, with an addition of picric acid and 1 per cent. of boracic acid, makes a gold varnish that produces a fine hard surface and brilliant finish on metals.

G. A. Haffner in German patent 201,-976 claims a process for the manufacture of matches with invisible heads. Two methods are described. According to the first, the ends of the match stalks are roughened, placed in powdered sulphur, and heated to 120 deg. C. or more. According to the second method, the end of the match is treated with a mixture of nitro-hydro-carbons and stearin or paraffin or petroleum. Suitable igniting materials are then introduced into grooves or holes suitably prepared in the wood. These grooves may be impregnated with solutions of which the one contains potassium chlorate or chromic acid, the other barium chlorate. In place of the chromic acid metallic salts may be used, such as nitrates, acetate, or organic nitro compounds. Their purpose is to prevent the efflorescence of the chlorates and to increase the sensitiveness of the match. The mass of the match-head consists of 100 parts potassium chlorate, with or without 20 parts of barium chlorate; 50 parts of a mass prepared by fusing together 30 parts of sulphur, 25 parts of powdered zinc, 15 parts potassium bichromate. To this is further added 10 parts of powdered glass, coloring matter, and a suitable quantity of water. The striking surface should be painted with mixture of 15 parts dextrine, 1 part gum tragacanth, 25 parts hyposulphite of lead, 20 parts lead peroxide, 10 parts antimony trisulphide, 2 parts of glass, and 100 parts of water. To this mass 1 to 2 per cent. of amorphous phosphorous may be added.

An Acid Resisting Cement

An investigator has discovered that a mixture of the following ingredients forms an acid-resisting cement for tanks, floors, etc.:

Silicate of Soda (water glass)	6	parts
Glycerine	1	part
Red Lead	3½	parts
Fine Cinders	10	parts

The silicate of soda and glycerine are mixed and then the red lead and cinders added to make a mass resembling putty. This is used for the cement. It soon sets or hardens and when heated to the temperature of boiling water unites with brick or Portland cement to form a strong joint.—*The Brass World.*

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.

1017. **Wireless Telegraphy.** L. H. B. R., Algomah, Cal., asks: (1) With horizontal 200 ft. long, about 50 ft. high, aerial, using 600 meter tuning coil, electrolytic detector, potentiometer, two 1,500 ohm receivers of 9,000 turns each, and variable condenser, at what maximum distance should I be able to hear powerful stations along the coast which communicate with each other over distances of 1,500 miles, meaning that I should experiment late in the evenings? (2) Am in northern California, with 275 miles (air-lines) of mountainous, timbered country between here and San Francisco. Should I be able to hear latter city with one 1000 ohm receiver and above set? (3) How can there be positive and negative poles to secondary of a coil when the current is alternating? I see often where one end of a Geissler tube shows the positive pole, etc. Ans.—(1) With a sensitive detector, you should have no difficulty in receiving from 200 to 500 miles. (2) Yes, if you can get a good ground. (3) There is really no positive or negative pole, but a static charge of positive or negative sign may be obtained from the secondary terminals. This is due to the condenser action of the secondary winding.

1018. **Silicon Detector.** N. H., Chicago, asks: In the silicon detector for the piece that makes the connection with the silicon is it best to use a brass rod ground to a point or to have some other substance such as iron (like a needle) touch the silicon? Ans.—A blunt point of brass, about a 32d of an inch is used generally.

1019. **Wireless Set.** A. W. K., Newark, N. J., asks: I have the following apparatus which I have constructed: tuning coil 14 in. long, 2½ in. diameter, wound with 1 layer No. 18 insulated copper wire (scraped for contact). The secondary of coil is made of 40 turns No. 30 copper wire. An adjustable condenser made of 2 sheets of brass 1-16 in. thick, 3 in. x 4 in., separated by a glass plate 3 in. x 8 in. One plate is stationary, and the top plate slides. An electrolytic detector; carbon cup platinum wire .0001 diameter. Ordinary telephone, double pole receiver. Can have aerial 75 ft. high. (1) Can I wire up this apparatus for a wireless? (2) How could I increase its efficiency? (3) How far under ordinary conditions would such a set reach? (4) Is an aerial made of chicken netting 8 x 10 ft. on top of a building 75 ft. high a satisfactory aerial? Ans. (1) Yes. (2) By using high efficiency receivers, with "gold" diaphragms, or having your receiver rewound. Also by using .00002 in. platinum wire. (3) The set as you now have it would work ten or fifteen miles. With the apparatus stated in (2), this could be increased to several hundred miles. (4) No, though it will probably work, it will not give as good results as the aerial described in the June, 1908, issue.

1020. **Wireless Telegraphy.** M. H. S., asks: (1) What is my receiving radius with a 50 ft. aerial and using tuned circuits? I have a tantulum detector, as described in the Feb. issue of E. and M., and use a 75 ohm receiver. (2) The wiring diagram does not show the position of the battery. Should it be placed in shunt or series with the potentiometer? Mine will not work either way. (3) If my spark gap is used over a flame, the length of the spark is greatly increased. Does this increase the sending distance? Ans.—(1) Your receiver should be rewound to a high resistance by a reliable manufacturer, as you are losing quite a lot of efficiency by working with a low resistance receiver. (2) If you mean the wiring diagram in the article on the tantalum detector, you should connect the battery direct across the potentiometer. (3) No; this length does no good.

1021. **Induction Coil.** M. A., Milford, Ohio, asks: (1) In regard to the construction of the four in. spark coil, described in the April, 1908, issue, if No. 32 D.C.C. wire was substituted for No. 36 in the secondary, how much wire would it take to wind it? (2) In regard to coil as above, could the sections be wound and paraffined as directed, and then, after the whole coil is assembled, could the whole coil be submerged in a tank of linseed or paraffin oil? Would this be a good insulation? (3) About how many volts and amperes would this coil require for its operation at full capacity? Ans.—(1) It would take the same amount of No. 32 wire. However, you could not get a 4 in. spark from it then. It would be best for wireless work with No. 32 wire. (2) Yes. (3) From 12 to 30 volts and from 6 to 15 amperes, according to conditions of service.

1022. **Spark Coil.** F. R., San Diego, Calif., asks: (1) What would be the length of spark of the following coil: coil 4 in. x ⅝ in., primary 3½ in., three layers No. 18 B. and S. secondary eight sections ¼ in. x 4 in.? How many 4 in. x 5 in. sheets of tin foil should be used for primary condenser? (2) Would it be a good plan to lengthen the core to 6½ in., using only two layers of wire? If so, how many sheets of tin foil 4 in. x 5 in. should be used? (3) Please tell me how much No. 40 B. and S. enameled wire is an ounce? Ans.—(1) You do not state size of secondary. If No. 34 wire is used, it should give about a ¾ in. spark. (2) Yes; make the core length 11 times the diameter. (3) No. 40 enameled wire sells for $8.00 per lb., list. In oz. lots it is probably from 50c to 75c.

1023. **Spark Coil.** A. L., Waltham, Mass., says: I have a spark coil which gave a 1 in. spark on 6 volts a while ago. Now it only gives a thin blue ½ in. spark on 8 volts. The only thing I can think of which I have done to damage it is to work the coil without any spark or connection between the secondary terminals while performing certain experiments. There is an extra large spark at the vibrator contacts, and by advice from a certain party that the condenser was injured, I made one with 12 sheets of tin foil, each 4 in. x 2½ in. between glass plates, 5 in. x 3½ in. This reduced some of the sparking at the vibrator, but did not lengthen the secondary spark at all. The coil in question is enclosed in an insulating compound in a hardwood case, so I cannot see any way to examine either the coil or the condenser. It would do me no good to send it to the factory for repair, as that would cost almost the price of a new one. Would it not be better to use paraffined paper instead of glass plates for the condenser? Ans.—For the primary condenser, you should use about 10 sheets of tin foil 4 in. by 6 in., with paraffined paper between. Probably your coil has broken down between the primary and secondary windings. Also try the secondary with a telephone and battery, and see if the circuit is complete.

1024. **Aerial.** H. A. C., San Mateo, Calif., asks: (1) Is the wire enclosed any good for any of the fine wire detectors? Electrolytic, wollaston, or tantalum? (2) Is copper annealed wire any good for an aerial? (3) Is it best to have as little wire as possible on an aerial? (4) Which is the best to use as a condenser, a plate glass variable or a plain tin foil one? Ans.—(1) No, it will not do. You should get some very fine wire from some of our advertisers. (2) Yes, although 7 strand No. 21 tinned copper cable is best. (3) It is best, for sending, to have enough wire so that there is no brush discharge. (4) For sending condenser, use the Leyden jar or plate glass types.

1025. **Enameled Wire.** F. S. C., Hartford, Conn., (1) I would like to ask you if enameled wire can be used on the secondary of a coil and if in winding No. 36 there is any danger of the wire breaking, as I understand that the wire is rather brittle? (2) I would like to ask if in the near future you would give an article in your magazine on the changing of A.C. current to D.C. by means of an apparatus made of aluminum plates? Ans.—(1) Yes. We are informed by Mr. Getz, that enameled wire is to be preferred to any other make for coil work, as many more turns can be secured in a given space, and there is little danger of open circuits when winding with this wire. (2) An article on the chemical rectifier appeared in the November, 1908, issue of this magazine. Another one will appear shortly.

1026. **Wireless Telegraphy.** S. S., Danbury, Conn., asks: (1) Please inform me which of the aerials shown in enclosed sketch will give the best results? (2) In either case the height (about 30 ft.) would be the same, and the same instruments would be used, namely: receiving transformer, one or two adjustable condensers and a small fixed one, double head phones, electrolytic detector, potentiometer and battery. I would use No. 14 aluminum wire for the aerial. (3) There is a trolley line within 75 ft. of the aerial, that is if the 175 ft. one was used, but if the aerial was only 85 ft. long this distance would increase 30 or 40 ft. (4) I would also like to know which batteries are considered best for operating a coil for wireless, those made on the plan of the Edison or the bichromate ones? Ans.—(1) The loop aerial as shown in June, 1908, issue is the best. (2) This would work best with loop type. (3) The trolley should give you no trouble. (4) The Edison batteries will be best.

1027. **Wireless Telegraphy.** F. W. B., New York, asks: (1) I have an aerial on roof of building 70 ft. from ground, composed of 3 strands of aluminum wire, 40 ft. long, set 10 in. apart, and joined to the aerial wire in the middle, silicon detector, 75 ohm receiver, 200 meter tuning coil and condenser. What should be the range of this outfit? (2) Will a transformer made like the one in enclosed diagram work? (3) Do the large stations, such as the Marconi Co., use Morse or Continental? Ans.—(1) You are using poor instruments with a good aerial. You should get a high resistance receiver; and also, your silicon detector is of a poor make, that is not sensitive. Using high resistance receivers and the improved silicon detector (patented), your radius would be about 500 miles. (2) Yes. (3) The Continental and Morse codes are both used

1028. **Wireless Telegraphy.** R. B. J., Redlands, Cal., asks: (1) Would 800 or 1000 ft. of about No. 25 bare copper wire sent up with a kite to about 500 ft. high give better results as an aerial than an ordinary 40 or 50 ft. aerial, such as is erected by the ordinary amateur? (2) Does the size of the wire, if copper or phosphor bronze, affect the sending or receiving distance? In the last number you state that 7 strands of No. 21 make the best aerial. Does the stranding give better results or merely give a more flexible cable? (3) If the silicon detector is patented could I obtain drawings or data from the patent office? If so, what charge would the patent office make? Is it against the law to make patented articles for amateur use? Ans.—(1) No, the variation of the kite would make delicate tuning out of the question. (2) The larger the surface of the aerial wire, the better it is for transmitting. A cable made up of a given number of stranded wires is better than a cable of equal length and weight, but solid, as the former has a greater surface. (3) Yes, you can obtain a copy of any patent, if you send 5c in coin, together with the patent number. It is decidedly against the law to make patented articles for amateur use, and in the case of the silicon detector, the patented article can now be purchased from the proper parties, and this is much more sensitive than the infringing types, as a rare grade of silicon is used.

1029. **Induction Coil.** F. F., Dorchester, Mass., asks: (1) I have a core 6¾ in. long and ⅝ in. diameter, wound with 2 layers of No. 18 single cotton covered wire. The whole primary is covered by a hard rubber tubing. Please tell me amount and size of wire to use on the secondary? (2) How long a spark will it give? Ans.—(1) You should have used No. 16 D.C.C. on primary. Make secondary of 1½ lbs. No. 34 enameled wire. (2) Spark will be about 1¼in.

1030. **Refinishing Steel.** Rev. J. M., Ravenna, Neb., (1) Is it possible to make bright old rusty swords, as bright as when they came from the factory, without sending them back? (2) If it is possible, please, give some instructions concerning the process? Ans.—(1), (2) The only way in which knives and swords, which are rusty, can be restored to brightness, is by grinding them flat on an emery wheel, and then buffing and polishing in the same way as is done in the factory. Unless you have the proper tools, it will, of course, be impossible for you to do this work except by the exercise of hard manual labor with emery cloth and polishing powders.

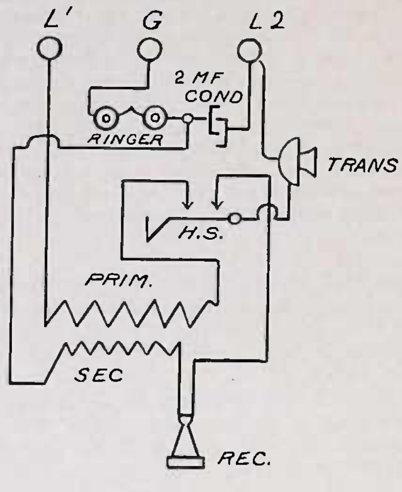
1031. **Books.** A. M., Chicago, Ills. From what firms can I purchase books? (1) On calculating windings for armatures and fields (for designing engineers). (2) Books on gear cutting and milling machine work? Ans.—We can furnish you the following books: Milling Machines and Processes, by P. N. Hasluck, $5.00; American Lathe Practice, by O. E. Perrigo, $2.50; Tooth Gearing, by J. H. Cromwell, $2.00; Armature Windings of Direct Current Dynamos, by F. B. Degrasse and E. Arnold, $2.00; Practical Calculations of Dynamo Electric Machines, by A. E. Wiemer, $3.00. There are other books on these subjects but the above will probably meet your requirements.

1032. **Induction Coil.** C. M. K., Ipswich, Mass., asks: (1) How large an induction coil is necessary to send to stations 50 miles away with an antenna 30 ft. high? (2) Can you give me directions to make a tuner and potentiometer? Ans.—(1) A 2 kilowatt coil or transformer is necessary. (2) See article by W. C. Getz in July, 1908, issue, in which he fully describes making the instruments mentioned.

1033 **Condenser.** F. S. C., Dorchester, Mass., asks: (1) Can a "helix" be made on the same plan as a tuning coil? If so, will you please give connections? (2) Please explain how to make a glass plate condenser (for sending). (3) Has anything more been done about stopping amateur stations? Ans.—(1) No, make it as shown in W. C. Getz's article in August issue. (2) Get a good quality of clear glass, and use copper or tin foil plates, cut about 1½ in. less than the glass on all sides. Place a plate of glass between every sheet of metal, connecting alternating metal sheets to the two terminals. (3) No, and if the amateurs will not continue to interfere, there will be nothing done. However, if they continue to disregard the warnings, and remain nuisances, there will be drastic measures taken. We have entered your name on our wireless list with pleasure.

1034. **German Silver Wire.** R. H. B., Washington, D.C., asks: (1) Where can I sell or trade 2 pounds of double cotton covered German silver wire, No. 28, B. & S.? (2) Is No. 28 B. & S. gauge wire too small for a tuning coil? (3) Where can I have the resistance of my head receiver determined? Ans.— (1) We do not know. You might advertise in the classified column. (2) Yes. (3) Send it to W. C. Getz, of 345 N. Charles St., Baltimore, Md., who has full facilities for testing same.

1035. **Telephone Connections.** R. H. C., Nashville, Tenn., asks: (1) Please give connections or diagram for telephone connections, having common battery system, pieces consisting of receiver, transmitter, induction coil, condenser, and ringer. (2) How many volts are necessary in alternating current of 60 cycles to jump an air gap of one inch, of one half inch? (3) How much No. 24 magnet wire does it take to have the same resistance as a 16 candle power lamp? Ans.—The attached sketch is the standard "Bell telephone" com-



mon battery diagram. (2) It is figured that it takes a pressure of 20,000 volts to jump one inch, with a high frequency current. At 60 cycles, the initial voltage would probably be about 35,000. (3) It would require 8,584.4 ft. of No. 24 copper wire to equal the resistance of one 16 c.p. 110 volt 56 watt lamp.

1036. **Aerial.** V. E. D., New York, asks: (1) Does an aerial have to be higher than the surrounding houses and trees, some of which are in the way of the wave? (2) Would No. 20 bare copper wire be suitable for an aerial? (3) What kind of wire should be used to go to the aerial, the coil being a half inch one? Ans. —(1) No, not if they are not too close. (2) No, you should use a cable of 7 strand No. 21 tinned copper wire. (3) No. 14 rubber covered wire.

1037. **Aerial.** C. R. E., Lawrence, Mass., asks: Describe the construction of a suitable aerial for use with the following instruments: "Ferron" detector, tuning coil, tubular condenser and 2000 ohm telephone receiver. Ans.—See article on aerial construction in June, 1908, issue.

1038. **Wireless Telegraphy.** R. R., Hemet, Calif., asks: (1) Is the platinum wire found in electric light bulbs suitable for electrolytic detectors. (2) With a 65 ft. mast, with aerial consisting of four aluminum wires 30 ft. long, and using an electrolytic detector, tuning coil and 1000 ohm head phones, what would be the receiving radius? (3) How far will a 100 watt transformer send, the mast being about 65 ft. tall and with good aerial wires? Ans.—(1) No, as the size generally used for wireless is .00002 in. in diameter. (2) From 50 to 300 miles under favorable conditions. Using "gold" diaphragms in your receivers will materially increase this. (3) From 5 to 20 miles, under favorable conditions.

1039. **Wireless Telegraphy.** G. W. S., Chambersburg, Pa., writes: I have completed my station, pole 109 ft. high at north end, aerial extends from this to a pole on house, which is about 55 ft. from the ground, aerial is directly north and south, and is about 150 ft. long, wires to instruments drop from the centre of the aerial. I am able to hear New York only when there is a strong gale from the north. I get a few words here and there only, what is the trouble? I am located anywhere from five to ten miles from the mountain range which runs as high as 2000 ft. above sea level. I am 640 ft. above. Is the trouble caused by not having pole high enough? It appears this is the trouble, as I hear various stations very plainly, but only when the wind comes my way. Ans.—The wind in itself has no influence on the electric waves, although it may indirectly cause a change in the atmospheric electrical charge which will bring these results. Your trouble must be in your instruments. Probably your receivers or detector are not sensitive.

1040. **Hot Wire Meter.** F. McC., Hamilton, Ont., asks: (1) How much wire will be required for secondary of 6 in. coil described in answer No. 897, Feb. number. (2) Will enameled wire stand the hard usage and bending, as it takes up much less room? (3) Is the wire run through paraffin or the coil insulated in any other manner. (4) How do I space divisions on scale of hot wire meter, and does it have to be calibrated in series with a standard instrument or would the instruments described in the Dec., 1903, number of *American Electrician* be more accurate and suitable for general work? Ans.—(1) About 20 lbs. (2) Yes. (3) No, the wire is run on the winding form dry, but after completed the section is paraffined to give it mechanical strength. (4) If you wish to use the ammeter for direct or alternating current work, it should be calibrated with some standard. For wireless this is unnecessary.

1041. N. L. M., Jamaica Plain, Mass., asks: (1) Will an arc lamp run on an alternating current, if not, why? (2) Recently while working near a 32 c.p. incandescent lamp it suddenly burst and flew into fine pieces. What was the cause? Ans.—(1) An alternating current arc lamp will. (2) Probably the filament became short circuited, and the sudden rush of current caused an expansion of the gas in the bulb, producing an explosion.

1042. **Series Motor to Shunt.** C. F. C., N.Y., asks: (1) Give approximate rule for changing windings of series motor to shunt, speed and voltage remaining the same. (2) Give rule for changing windings from one voltage to another for motors and dynamos shunt and series. (3) Name some firm in my vicinity where the proper kind of paraffin wax can be bought for spark coil construction. Ans.—(1) To change the windings of a motor from series to shunt, the speed and potential remaining the same, it will be necessary to wind a new set of field coils which will have the same number of ampere turns as those now on the machine. This means that if your series field has, say, 100 turns and carries a current of 10 amperes, you must make a new winding to carry a much smaller current, and increase the turns in proportion as the amperes are reduced. For instance, the field could be replaced by one with 10,000 turns, and would require a current of 1-10 ampere. In the latter case the current is limited only by the resistance of the field winding, so that it would be necessary to use wire of such a size as will give the required resistance. Resistance of wire can be found in any standard electrical text-book. (2) Direct current machines cannot be changed from one pressure to another without completely changing the windings, if the same speed and power are desired. It is usually undesirable to wind an armature for a higher pressure than originally designed for, as it will have a tendency to spark. (3) Manhattan Electric Supply Co.—about 25 cents per pound.

1043. **Motor.** F. L., Scranton, Penna., asks: (1) Would design submitted make a good motor? (2) If so, what size wire and how much should I use for the fields and armature? Ans.—(1) The design you have submitted for a motor will work if a few changes are made. If the armature is to be 1¾ in. long, the pole pieces should be about the same length. It would also be better to extend the outside casing of iron you have shown carrying the feet also around the bottom of the frame. In this way you will balance up the magnetic circuit and make the bottom pole as strong as the others. The armature has not enough slots to make a good machine. If you had double the number it would be much better. With these changes you should be able to make a practical machine. (2) You do not state what circuit you expect to run your motor from, and whether you desire to build a series or a shunt wound motor. If the former, you could wind the field coils with a No. 12 or No. 13 wire, as many turns as you can get on the fields. If you can make the armature slots ⅛ in. wide by ¼ in. deep, with 16 slots around the armature core, a winding of 8 No. 18 wires could be used for the winding. This motor would then be suitable for operation on several dry cells. If you can send a more detailed description, a much more complete answer can be given. Let us know how you come out, if you decide to use the above winding.

WIRELESS CLUB

This department is devoted to the Club members and those interested in Wireless Telegraphy. We will publish experiences, discoveries, and suggestions, which may be helpful to all interested.

In response to numerous requests we reprint the Morse and Continental codes, with in addition the U.S. Navy Wireless Telegraph Code.

	Morse	Continental	Navy
A	. —	. —	— —
B	— . . .	— . . .	— . . —
C	. . .	— . — .	. — .
D	— . .	— . .	— — —
E	.	.	. —
F	. — .	. . — .	— — — .
G	— — .	— — .	— — . .
H	. . . .	. . . .	. — —
I	. .	. .	.
J	— . — .	. — — —	. . — —
K	— . —	— . —	— . — .
L	———	. — . .	— — .
M	— —	— —	. — — .
N	— .	— .	. .
O	. .	— — —	— .
P	. . . . .	. — — .	. — . —
Q	. . — .	— — . —	. — . .
R	. . .	. — .	— . .
S	. . .	. . .	— . —
T	—	—	—
U	. . —	. . —	. . —
V	. . . —	. . . —	. — — —
W	. — —	. — —	. . — .
X	. — . .	— . . —	— . — —
Y	. . . .	— . — —	. . .
Z	. . . .	— — . .	— — — —
&	. . . .		
1	. — — .	. — — — —	. . . . .
2	. . — — . .	. . — — —	— — — —
3	. . . — .	. . . — —	. . . —
4	. . . . —	. . . . —	— — — .
5	— — —	. . . . .	. . — —
6	. . . . . .	—	— — . .
7	— — . .	— — . . .	. — — —
8	—	— — — . .	— . . .
9	— . . —	— — — — .	. — — .
0	———	— — — — —	— . . —
Period	. . — — . .	. . . . . .	
Comma	. — . —		
Colon	— . — . .		
Interrogation	— . . — .	. . — — . .	
Exclamation	— — — .	— — . . — —	
Semicolon	. . . . .		
Wait		. — . . .	
Understand		. . . — .	— — — —
Don't understand		— . . . . — .	
Call		— . — . —	
Finish		. — . — .	
Error			. — . — . —
Danger C Q D	. . . . . — . — . .	or — . — . — — . — — . .	
Interference 99	— . . — — . . —	or — — — — . — — — — .	

When you hear either of these signals, STOP ALL SENDING. Listen all you want to, but don't interfere. Life may be at stake, and amateurs should keep out of the trouble and let those who are responsible do their work without interference. If they don't do it voluntarily, Congress will shut up their stations next winter.

The New England Wireless Society, 18 Tremont Street, Boston, Mass.,was incorporated under the Statutes of the Commonwealth of Massachusetts on Feb. 4, 1909, for the study and improvement of wireless communication. The regular meeting is held the first Friday in each month.—Gordon S. Wallace, Clerk.

A. D. Bannerman, Dawson City, Y.T., would like to get in touch with wireless members of our club. All those who are interested in writing to this gentleman can learn something of wireless matters in the Arctic region.

G. C. Sabin, R.R. Station Belchertown, Mass., would like to correspond with club members with a view to bettering the knowledge of wireless, or getting into wireless communication.

Magee Adams, Milford, Ohio, would like to get in touch with other members of our club living in his vicinity.

The fifth regular meeting of the Chicago Section, E. & M. Wireless Club was held March 27, 1909, in the club rooms, 52 Auditorium Bldg. After the customary receiving practice the meeting was called to order by Vice-Pres. McGaffage. After accepting the minutes of the previous meeting the discussion of a suitable letter-head design was resumed, having been left on the table from the previous meeting. Mr. Disser was made a committee of one to secure designs to be submitted at the next meeting. The membership of the club was increased by the entrance of some new members who take a very live interest in wireless experimenting, and at this meeting the club quarters were more than comfortably crowded. Arrangements will be made to secure additional room to meet the requirements of our growing organization. The business meeting was disposed of early, to enable the general informal discussion of topics of mutual interest to proceed. The meeting adjourned at 10.00 p.m.

The Chicago Section will be pleased to correspond with any other of the club members or local organizations and exchange experiences.

While opposing such radical legislation as the elimination of the amateur or experimental wireless telegraph stations, which has been suggested on the ground that they interfere seriously with the operation of the regular plants, President Harry E. Upton of the New England Wireless Society concedes at the same time the advisability of granting licenses, subject to revocation like automobile licenses, to those who qualify in ability and responsibility, these licenses to govern the power of sending stations their wave length.

Mr. Upton cites as particularly objectionable nuisances the buzz-buzz of the amateur who likes to bear his own spark and breaks in heedless of the legitimate business he is interrupting, and the gossip, or "shop-talk," of many of the operators of the regular boats and shore stations. Too stringent measures, however, he feels, would work much harm to the advancement of the art and very unjustly curtail the rights and privileges of many an old telegrapher or experimenter who is always ready to give way to official or "C.Q.D." messages.

I have one of the largest experimental stations in New England and the very largest north of Revere with the exception of Prof. Pickard's. I use the very best of modern inductive, loose-coupled apparatus both in my sending and receiving circuits, which of course means great selectivity and most efficient work. I can send 200 miles at sea under favorable conditions and use anywhere from one-half to three k.w. in sending, according to the impedance cut in. Of course my transformer is run on A.C. current. I use a stone hook-up on sending and a Pickard hook-up on receiving.

My aerial is three hundred feet long spread ten feet at the ends and twenty-eight feet in the centre with the lead taken off the middle. It is swung between two tall pine trees about fifty feet high. With this set I have worked 2,000 miles on receiving. Call H. E.

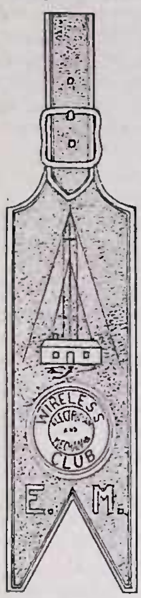
Harry E. Hurd.

WIRELESS CLUB WATCH FOB

Winslow Kingman, No. 409

Watch fobs are one of the most popular kinds of ornaments for both men and women.

A fob made of carved leather or stamped leather is shown in the cut. This particular fob I designed to wear my "Wireless Club" pin on. Other fobs can be made with a high school name and a class year on it. Such a fob retails at about 50 cents, and I may say that an industrious person could make quite a bit of pocket money in this way.



In making such a fob, the pin, which is to be placed on it should be taken into account. If the color of the pin is very bright, as the Wireless Club pin, select a color of leather that will match it nicely. I find that the prettiest effect is a dark brown colored leather for this pin.

A small groove is made all around the edge of the fob, and then a narrow flat space is left and inside of this the designs are made, preferably raised from the rest of the leather with a dotted background. The tools and method are left for the reader to work out, as there are several good books on this subject.

A flat surface is left for the pin to be stuck into. This should be perferably round and a trifle larger than the outside of the pin. The pin should be put into the leather and woven in and out a few times; care should be taken not to stick the pin straight in, but at an angle, so that it will not wrinkle the fob.

The buckle should be a small nickel-plated one and attached to the main part of the fob. The strap which goes through the ring of the watch should be sewed to the back of the main part of the fob. Sew this strap on so that the rough side of the leather in both pieces comes together. If you don't do this the rough side will be out and can not be carved to match the rest of the fob.

This same design can be modified to some extent and used as a burnt leather idea. However, the carved leather is the best, as burnt work seems to roll up and does not look well when used to any great extent.

March Song entitled "C. Q. D." has been received from the Co-Operative Music Pub. Co., Los Angeles. The words and music are by Wilson & Jackson and are as follows:

C. Q. D.

Smash, crash, a shipwreck, and a hero was born.
* * The man who worked the key
His name and fame on the ether were borne
When he signalled the letters o'er the sea.
He never once faltered, his nerves were made of steel,
He stuck to his post most gallantly.
'Twas his call in the dark with a spark
That has made him beloved by you and me. For

C. Q. D. was the message he sent.
C. Q. D., all knew well what it meant;
Shipwreck and disaster they all could plainly see,
So they all made haste to answer Binns when he
Called C. Q. D.

Now Uncle Sam, if you are half of the man
* * I know that you can be
Let all flags wave just to honor the brave
Little man who sent out that C. Q. D.
He may be our subject and may be not at all;
But let that be now just as it may,
For his call in the dark with a spark
Was a favor we never can repay. For

C. Q. D. was the message he sent
C. Q. D., all knew well what it meant;
Shipwreck and disaster they all could plainly see,
So they all made haste to answer Binns when he
Called C. Q. D.

TRADE NOTES

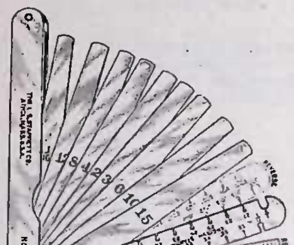
The prospectus of the New York Electrical Trade School indicates that they expend all their energies along electrical lines only, and aim to do it in as thoroughly a practical manner as conditions will warrant. The school is open to the public, and investigation and inspection is invited. No students are enrolled until they have seen the school and equipment. A thoroughly practical course of electrical instruction is given. We advise all those who may be interested in such a course to write for the booklet.

* * *

One of the greatest improvements in the marking of Measuring Tapes is embodied in a new idea, which The Lufkin Rule Co. have termed **Instantaneous Readings.** Users of long tapes are aware of the inconvenience which arises from the fact that the number of feet is only registered at the end of each twelve inches. When a tape is out some distance and an exact measurement is required, which happens to fall between two foot marks, it is necessary, having ascertained the inches, to go back carefully to discover the last registered foot. The simple inovation now introduced, by which the foot is registered at each inch space, makes it possible to read at a glance, instantly, and with no risk of error. Patents are pending for this improvement which cover broadly all its applications, which will be fully protected by the Lufkin people in the manufacture and sale of same.

* * *

We call to the attention of our readers several new tools made by The L. S. Starrett Company, illustrations of which are shown herewith. The electrician's pocket screw driver is intended for wiring work, being furnished with a hard rubber insulating handle. It has four blades of different widths, which may be easily and quickly inserted at will.



A very convenient gage for the use of marine engineers, machinists, etc., combines a taper gage showing thickness in sixty-fourths up to three sixteenths, English standard, wire gages from nineteen to thirty-six, with values in decimals of an inch, and nine thickness or feeler gage leaves of various thicknesses up to one sixteenth of an inch, all folding in a convenient pocket case.

* * *

The Utica Drop Forge & Tool Company, of Utica, N.Y., will, from the first of April, 1909, sell their own product direct to the trade. This company is the largest Nipper and Plier factory in the world, having more than an acre of area under roof, and uses a mile of industrial railroad upon their premises in carrying their product from department to department. Their plant is new (as their old plant was destroyed by fire about two years ago) and is now rebuilt on the most modern and improved lines for heat, light, air and sanitation, together with the economic and rapid handling of their product. The durability of their product is exceptional, and they lead the world in the design, style and finish of their tools.

* * *

The Cleveland Industrial Exposition, which will take place June 7th to 19th, 1909, under the auspices of the Cleveland Chamber of Commerce, will be the largest exhibition of home products ever held in the United States, if not in the world.

So great has been the enthusiasm of the Forest City manufacturers that nearly 300 exhibits have been arranged and the number of articles to be displayed will run high into the thousands.

The general illumination promises to be dazzling, as the lighting arrangements call for 15,000 incandescent globes.

Probably the most striking feature of Cleveland's Exposition will be the large number of "live" exhibits, where a great variety of modern machinery will be seen in constant operation.

* * *

The first commercial wireless telephone system in the world has recently been thrown open to the public in Portland, Me.

Four out of thirty stations which connect Portland with the Islands of Casco Bay are in commission and selectivity is now an established fact. In order to prove that the problem of secrecy was solved, A. Frederick Collins, the inventor, and Mayor Clifford, of Portland, G. B. Reynolds, a U.S. Navy wireless operator, and a newspaper correspondent talked at the same time and each receiving telephone got its message without interfering with the others.

* * *

The Isolated Lighting Plants is a most attractive booklet from the Gould Storage Battery Co., New York City. This publication is intended to direct attention to the various systems developed by the above Company for the applications of batteries to such installations and to assist in selecting one which will best fulfil the requirements. Generously illustrated.

* * *

"The Star Expansion Bolt Company of Bayonne, N.J., whose standard line of Expansion Bolts, Toggle Bolts, Cable Hangers, Drills, and Drill Holders are so well and favorably known to the trade, have removed their general offices from Bayonne, to 147 Cedar Street, New York City, where a very complete stock will be maintained at all times, and where the Company hope to have the pleasure of receiving their friends who may be either located permanently in the city or just there to see the sights.

SALE AND EXCHANGE

Advertisements under this heading, without display, 3 cents per word, cash with order, minimum, 75 cents. Black-faced type, 4 cents a word, minimum, $1.

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SILICON—SILICON—SILICON for electrical experimental work. Large piece 25c. Small piece 10c coin. Sent postpaid anywhere. ODELL ELECTRIC CO., 7 Ericsson St., Belmont, Mass. (6)

INSTRUCTION IN WIRELESS TELEGRAPHY.—Send 25 cents in coin for the best wireless instruction book published. Everybody can understand it. Make your own wireless outfits. All kinds of wireless apparatus at low prices. Send stamps for catalogue. THE ELECTRICAL EXPERIMENTERS' SUPPLY CO., Room 502, 622 Wells Street, Chicago, Ill. (8)

WIRELESS EXPERIMENTERS, ATTENTION!—EVERYTHING AND ANYTHING IN WIRELESS WE HAVE IT. ENCLOSE A 2c STAMP FOR A CATALOGUE. THE I. W. T. WIRELESS TEL. ENGRS., 728 M. BROADWAY, BROOKLYN, N.Y. (6)

15 WIRELESS DIAGRAMS FOR 15c—Straight and inductive receiving. Direct and inductive sending. Specifications for induction coil and transformer. How to make inductive receiving couple, etc. MANUP, Box 24, Everett, Mass. (6)

ENAMELED WIRE FOR TUNING COILS—300 ft. No. 28 for 25c; 125 ft. No. 24 for 25c. **Rewind your own receivers.** 1,000 ft. (1,000 ohms) for same, of No. 40, enameled wire, 50c. **Large cardboard tubing**—3½ and 4 in. diameter for "loose coupled" receiving tuners. 12½c per ft., either size. MIDDLESEX WIRELESS SUPPLY CO., 94 Antrim St., Cambridge, Mass. (6)

"COMMERCIAL" TUNING COILS, wound on a specially prepared core 11 in. long with No. 24 enameled wire in a manner which absolutely prevents all stretching and loosening, 2 sliding contacts of a new design giving quick and easy adjustment while not injuring the wire, polished dark mahogany ends, etc., making the most efficient and handsome tuning coil on the market. Price $3.00. HAROLD P. DONLE, 9 Phillips St., Providence, R.I. (6)

1000 OHM WIRELESS RECEIVERS $1.75—Very sensitive and absolutely reliable. New Detector. You want to know about both. Send stamp for descriptive circulars. ALDEN WIRELESS CO., Campello, Mass. (6)

INTENSITY COILS, 1 to 4 in., guaranteed for one year, suitable for wireless telegraph and experimental work. For descriptive circular address J. O. FISHER, Muncie, Ind. (6)

GRAPHITE RODS—50 to 1000 ohms. 6 in. long; for potentiometers. 25 cents, 3 for 50 cents silver. C. E. HALE, 644 W. King St., Decatur, Ills.

TRANSFORMER BUILDERS.—You can get Iron cut to size and enameled for Transformer in article in this issue for $2.00. Sections wound and Insulated, wire included, each 60c. Empire Cloth—12½c per sq. foot. Linotape—5c per yard. Winding Forms, each $4.00. WIRELESS EQUIPMENT CO., W. Arlington, Md.

FIRST CLASS WIRELESS RECEIVING SETS $6.50. All parts of the different instruments unfinished or finished to order as desired. Experimental work for inventors or amateurs by experienced workmen. All prices very low. JEROME REDDING & CO., 40 Hanover St., Boston, Mass.

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CHICAGO WIRELESS SUPPLY CO., 52A. Auditorium Bldg. Chicago.

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FOR SALE.—Complete set of castings, with blueprints of ¼ h.p. gasoline stationary engine; includes governor and timer, screws, etc., $10. COMET MOTOR WORKS, 17 W. Madison Street, Chicago, Ill. (8)

READ THIS—200-watt dynamo, rough castings, $4; blueprints 50c. If castings are ordered within 30 days after prints, price of prints refunded. 100-watt dynamo, blueprints 50c. ⅛ or ¼ h.p. water motor, blueprints 25c. LEE, HARRIS & CO., Dept. C., Box 414, Jamestown, N.Y.

PATENTS

PATENTS.—H. W. T. JENNER, patent attorney and mechanical expert, 608 F Street, Washington, D.C. Established 1883. I make an investigation and report if patent can be had, and the exact cost. Send for full information. Trade-marks registered.

BOOKS

BOOKS.—Trigonometry Simplified, 50 cents; Lettering, 25 cents; Electrical Dictionary, 25 cents; Lutes and Cements, 10 cents; Catalogue free NATIONAL BOOK CO., Cleveland, Ohio. (tf)

WANTED—To buy second hand books on electrical, chemical and other technical subjects. P. M. EAMES, Box 33, Salisbury, N.C. (6)

HELP WANTED

AGENTS, MACHINISTS, TOOLMAKERS, DRAFTSMEN, attention! New and revised edition Saunders' "Hand Book of Practical Mechanics," now ready. Machinists say, "Can't get along without it." Best in the land. Shop kinks, secrets from note-books, rules, formulas, most complete reference tables, tough problems figured by simple arithmetic. Valuable information condensed in pocket size. Price, post-paid, $1, cloth; $1.25, leather with flap. Agents make big profits. Send for list of books. E. H. SAUNDERS, 216 Purchase Street, Boston, Mass.

WANTED, YOUNG MEN AND BOYS to take subscriptions for a $1.00 musical publication. You make 25c on every subscription. Send two-cent stamp for information and copy of C.Q.D. CO-OPERATIVE MUSIC PUB. CO., 314 Currier Bldg., Los Angeles, Cal. (6)

PRINTING

BUSINESS CARDS, 250 for 75 cents with case; 100 white envelopes printed for 45 cents; 100 note heads for 50 cents; 100 letterheads for 65 cents; postpaid. RICHARD D. ELLIOTT, 1010 Olive St., Louis, Mo. (tf)

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KODAKS, CAMERAS, LENSES, EVERYTHING PHOTOGRAPHIC.—We sell and exchange. Get our latest bargain list; save money. C. G. WILLOUGHBY, 814 Broadway, N.Y. (tf)

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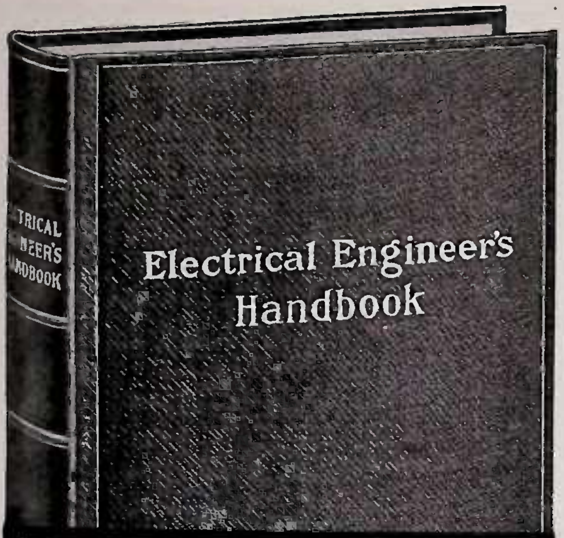

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This little book contains more knowledge about the electrical engineering and allied trades than any other book of its size in existence. It is compiled from the Courses of the International Correspondence Schools and can be readily understood by men having no knowledge of higher mathematics. The description of dynamos and motors, their faults, method of locating faults and remedying them, is clear and practical. Of much importance are the sections on alternators, alternating-current motors, diagram of connections, and tables. Information is included on the speed control of electric cars and multiple-unit trains, storage batteries, electricity and magnetism, direct-current dynamos and motors, electric batteries, AC wattmeter measurements, etc.

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Fig. 1. *Fig. 2.* *Fig. 3.*

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