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Mechanical and Electrical Power

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How to Join Electric Wires

1-4 K.W. Transformer

Bronzing Recipes

Forging for Amateurs

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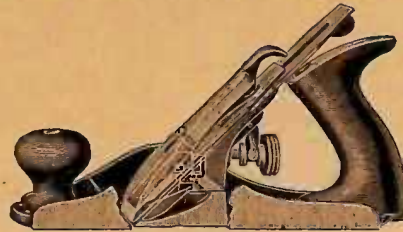
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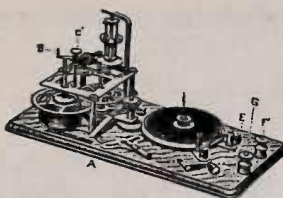
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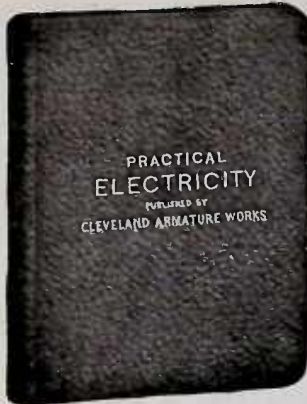


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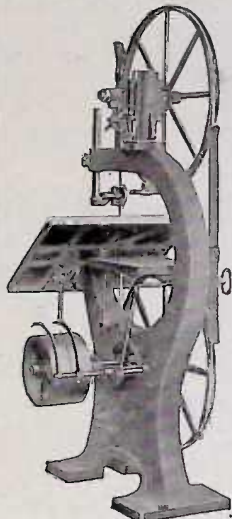
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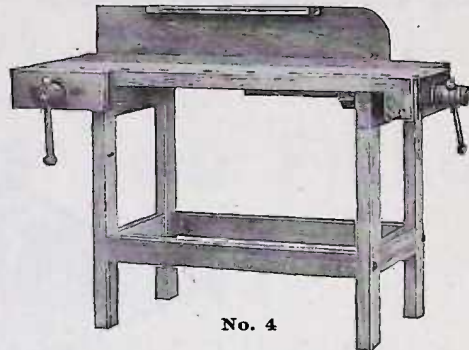
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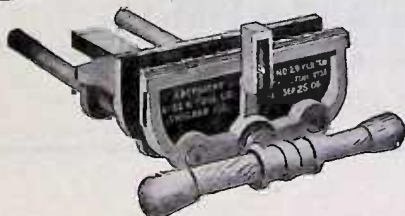


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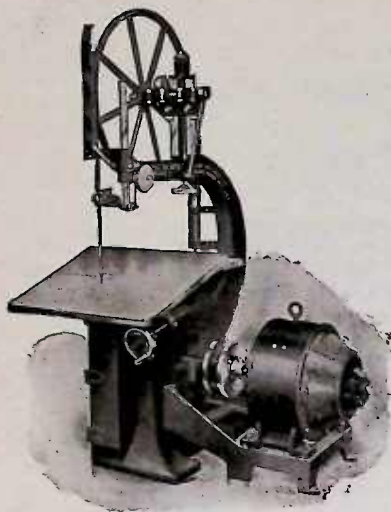
JULY, 1909

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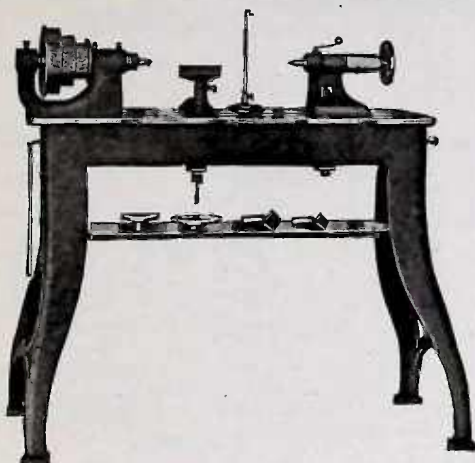
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VOLUME XX

JULY, 1909

NUMBER I

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

KENNETH RICHARDSON

THE RECEPTOR

In the last issue of this magazine was described the construction of the transmitter of a 25-mile outfit. The receptor or complete receiving apparatus will receive messages from large transmitting stations from 200 to 500 miles distant at night with a good aerial and ground.

The receptor comprises:

a.—A receiving inductance or tuning coil.

b.—A variable condenser of low capacity.

c.—A microphonic detector.

d.—A silicon detector.

e.—A two point switch to switch in either detector. Also a one point switch to switch the battery on or off.

f.—A battery of three small dry cells.

g.—A potentiometer of high resistance.

h.—A high resistance telephone receiver.

i.—The aerial wires.

j.—The ground connection.

a.—A wireless outfit will work without either a transmitting or receiving inductance coil, but it would not work satisfactorily or for long distance—ten miles and up. The wire on a receiving inductance coil is longer and finer than that on the transmitting coil. The use of a receiving inductance coil is to add inductance and capacity to the aerial wires, thereby varying the wave-length of same. The receptor should be in tune with the transmitted oscillations. The receiving inductance coil is described below:

First a frame, upon which the wire is wound, is made. Cut out two discs of oak or other hard wood, $\frac{3}{4}$ in. thick by 12 in. in diameter. The circumferences are divided into eight equal parts. At each division a space 1 in.

wide by $\frac{3}{8}$ in. deep is made. Eight wooden uprights, 1 in. wide, $\frac{5}{8}$ in. thick by $15\frac{1}{2}$ in. long, are screwed into the spaces in each disc of wood. Four rubber feet about $\frac{1}{2}$ in. by $\frac{3}{4}$ in. by $\frac{3}{4}$ in. are fastened to one of the discs to support the frame. This frame should now be given a few coats of wood stain or varnish. When dry, wind very closely, but not extra tight, with No. 20 annunciator wire. About 650 ft. or $2\frac{3}{4}$ lbs. of wire will be required. Fasten each end to a binding post screwed in the periphery of each disc. There should be from 175 to 200 turns. Next the slider. Cut out of $\frac{1}{8}$ in. brass, two pieces each 2 in. long by 1 in. wide at the wide end and tapering to $\frac{1}{4}$ in. The tapering begins $\frac{3}{4}$ in. from the narrow end. A hole is drilled $\frac{1}{8}$ in. from the narrow end in the middle to take a small metal screw. Two $\frac{1}{8}$ in. holes are drilled through the wide end, the hole near the centre of the piece to be 1 in. from the wide end. A recess in the top disc is cut out to allow one of the brass pieces to lie flush with the top. The recess is over one of the uprights and made so that the narrow end of the brass piece sticks out $\frac{3}{4}$ in. from the disc. Screw the piece in place, using one screw and one binding post. The other brass piece is fitted in the same way under the same upright, Fig. 5. The insulation on the turns of wire on the upright between the two brass pieces should be scraped or burned off for a width of $\frac{3}{4}$ in. A brass rod $\frac{1}{4}$ in. square by $15\frac{1}{2}$ in. long is threaded at both end faces to fit the screw in the narrow end of each brass piece. A square, seamless brass tube that will easily slide on the rod is required. It is $\frac{3}{4}$ in. long. A fairly stiff piece of spring brass 2 in. long by $\frac{1}{4}$ in. wide is soldered to one side of the tube. This piece

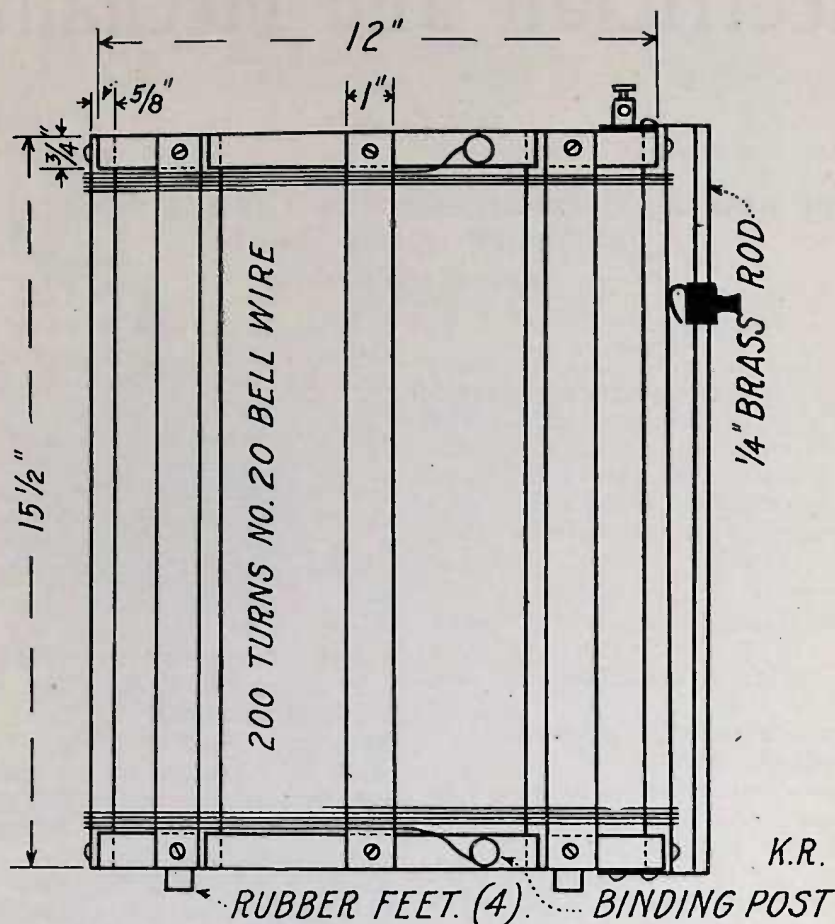


FIG. 5—THE RECEIVING INDUCTANCE COIL.

of brass makes contact with the bared turns of wire. The opposite side of the tube is fitted with a wooden or ebonite handle. Now put the slider on the brass rod and screw the rod to the brass pieces. See that the spring makes good contact with every turn of the wire.

Greater selectivity in the reception of messages is obtained by adding another slider with its support. It is constructed like the first one and over the upright, either side of the first slider. One of the sliders is directly grounded. The wave-length of this inductance coil is 800 meters, which allows to tune in many large stations.

b.—The adjustable condenser of the receptor is of lower capacity and insulation than the high tension condenser of the transmitter.

Nineteen plates of semi-circular $\frac{1}{16}$ in.

brass are required. The greatest diameter is 5 in. Ten of these plates are bolted together with $\frac{1}{4}$ in. washers between each plate. The bolt passes through the middle of the curved part near the edge. The other nine plates are likewise bolted together, but the bolt passes through the wide part. The first set of plates are fastened horizontally in a box. The other set are so placed in the box that they may be turned so that they intermesh in the first set of plates. The box should be large enough to allow the second set of plates to completely turn out of the first set. In no position should there be a connection between the two sets of plates. A wooden or ebonite handle should be fitted to the movable bolt. This handle extends through the top of the box and is fitted with a pointer which moves over a small

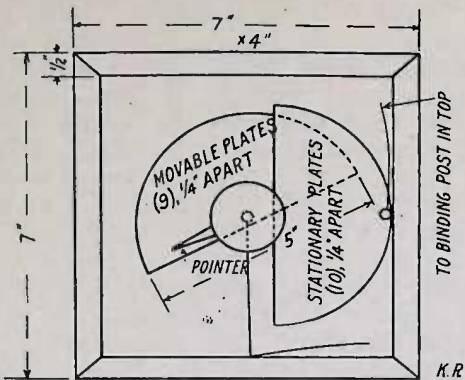


FIG. 6—THE VARIABLE CONDENSER. (TOP REMOVED)

scale. Wires from the sets of plates connect with binding posts. The variable condenser is now finished and the box may be given a few coats of stain or varnish.

c.—The microphonic detector is fairly sensitive and easy to regulate. It is made as follows:

Get a block of wood 4 in. long by 3 in. wide by 1 in. thick, and bevel the edges. At $\frac{1}{2}$ in. from each side, make a cut $1\frac{1}{2}$ in. long, $\frac{1}{4}$ in. wide and $\frac{1}{2}$ in. deep, beginning $\frac{1}{2}$ in. from one end. Now file out two pieces of carbon (not from a battery, as it would be apt to contain some salty substance which would destroy the sensitiveness of the detector) $1\frac{1}{2}$ in. long by $1\frac{3}{8}$ in. wide by $\frac{1}{4}$ in. thick. File one side of each carbon to a sharp edge with a clean fine file. Do not touch these ridges with your fingers or anything moist or greasy. Now fit the carbons in the cuts, fastening a short piece of Nos. 26 or 28 copper wire between the carbon and the wood. The carbons should fit tight to make good contact with the wire. A new set of carbons may be substituted at any time. Fasten the wires to binding posts, screwed into the base 2 in. apart and 1 in. from the end farthest from the carbons. A fairly large sewing needle rests on the carbon ridges. A small permanent magnet is placed under the needle to steady it. Fig. 7 explains the details of construction of this detector.

d.—It is always best to have more than one detector, because, if one becomes inoperative, another can be switched into service. The less sen-

sitive detector is generally used for receiving messages short distances. The silicon detector is the most reliable, sensitive and fool-proof detector made,—so far. No battery or potentiometer is needed with this detector, but they are sometimes used.

The base is of hard wood, 4 in. long by 3 in. wide by 1 in. thick, with bevelled edges. Two binding posts are fastened in the top of the base, in the middle, and $\frac{5}{8}$ in. from the sides. Another binding post is fastened in the middle, $\frac{1}{2}$ in. from one end. A brass rod $\frac{1}{8}$ in. in diameter by 1 in. long is threaded at one end for a distance of $\frac{1}{4}$ in. The part not threaded is filed down, so that it fits the hole in the binding post. The inside wall of one end of a brass tube $1\frac{1}{2}$ in. long by $\frac{1}{8}$ in. inside diameter is threaded for a distance of $\frac{1}{4}$ in. to take the brass rod. Another brass rod, barely $\frac{1}{8}$ in. thick and 1 in. long, is rivetted to a small main-spring barrel of a watch. The diameter of the barrel should be about from $\frac{1}{2}$ to $\frac{3}{4}$ in. The cogs should be filed off. Over the rivet, a thin disc of brass, the diameter of the inside of the barrel, should be hammered. A fairly strong spiral spring about $\frac{5}{8}$ in. long is placed in the tube, and the rod, rivetted to the barrel, presses against this spring. Now saw out a brass standard $\frac{1}{4}$ in. in diameter by $\frac{3}{4}$ in. long, and thread a hole in one end and screw it to the top of the base $\frac{1}{2}$ in. from the end. This standard also has a $\frac{1}{16}$ in. hole drilled, the height of which is the same as the hole in the binding post. This hole is threaded to take a $\frac{1}{16}$ in. steel rod about $1\frac{3}{4}$ in. long, threaded its whole length. The rod is cut to a fairly sharp point. A set

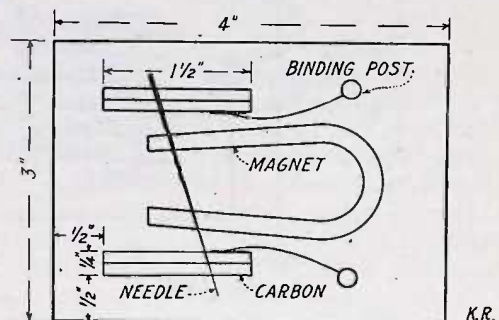


FIG. 7.—THE MICROPHONIC DETECTOR.

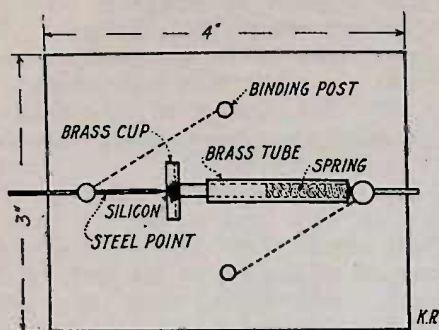


FIG. 8.—THE SILICON DETECTOR.

screw is fitted in the top of the standard to tighten the rod. The silicon, which should be fused, is held between the steel point and the brass barrel. The binding posts are connected in the usual way. A small condenser, made of about 25 sheets of tinfoil 3 by 4 in. between paraffined paper, is sometimes shunted around the silicon detector; but this is not necessary. This detector may be used as a carborundum detector, by substituting a stronger spring for the one in the tube and, of course, using carborundum between the electrodes.

The silicon detector is shown in Fig. 8.

e.—The two point switch is used to switch into operation either detector.

A one point switch is needed to open or close the battery circuit.

f.—The three small dry cells are connected in series. The Mesco is a good kind.

g.—The potentiometer comes next

in order of construction. Detectors have a certain critical voltage flowing through them when most sensitive. This critical voltage is just slightly below that necessary to break down the poor contact of the detector. When an extra current (electric wave) comes down the aerial, the conditions at the poor contact of the detector are changed, and the critical voltage is sufficient to break down the poor contact, allowing the current to flow through the telephone receiver. The potentiometer is an instrument to get this critical voltage. The silicon detector does not need the potentiometer and battery, because it does not operate on the poor contact principle. The potentiometer is simply an instrument made of a number of turns of resistance wire wound on a frame with a sliding contact to vary the resistance, thereby varying the current flowing through the detector. It is made as follows:

Two discs of hard wood 6 in. in diameter by $\frac{1}{2}$ in. thick have their circumferences divided into six parts. At each division a strip of hard wood $\frac{3}{8}$ in. by $\frac{3}{4}$ in. by 11 in. long is screwed, making a frame on the same plan as the inductance coil frames were made. About 575 ft. of No. 28 D. C. C. German silver resistance wire is required. Wind the wire the same as on the receiving inductance coil, fastening the ends to binding posts screwed in the wood discs. The slider is made along the same plan as the one for the receiving inductance coil was made. This po-

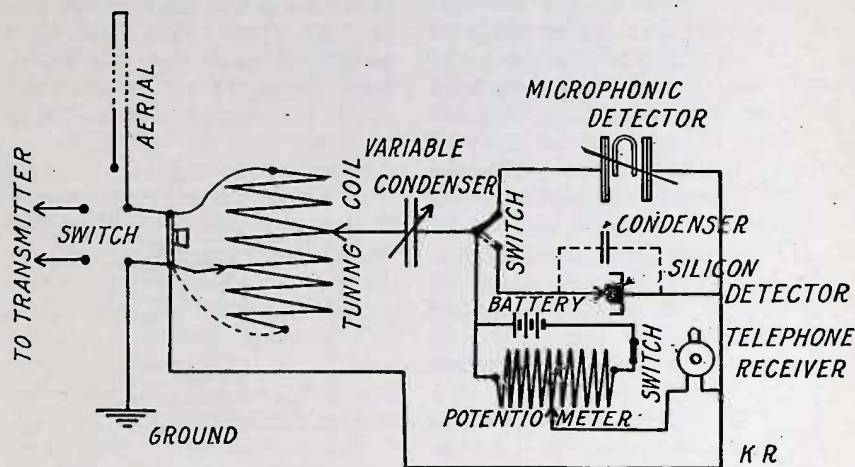


FIG. 9 — CONNECTIONS OF THE RECEPTOR

tentiometer has a resistance of about 600 ohms.

h.—The telephone receiver is of the double-pole, high resistance type, preferably double and fitted with a head band. It should be especially made for wireless and by a reliable company. The resistance should be at least 500 ohms, to get the right number of turns in the restricted space. It is not the resistance that is to be desired in a telephone receiver, but it is the number of turns of wire that can be wound in a certain space. Now it takes very fine wire to get a great number of turns in a certain space and this fine wire has an unavoidable high resistance. The closer the wire is wound to the magnets, the more efficient the receiver is. If this fine wire had little or no resistance, the receiver would be enormously more efficient. Receivers wound with wire having a special form of thin insulation are the best, as more turns may be wound in a given space. Thin diaphragms are also a great improvement.

i, j.—The aerial and ground wires of the transmitting instruments are also used for the receiving instruments.

k.—A double-pole, double-throw knife switch is used, as shown in Figs. 4 and 9, to switch in either the transmitter or the receptor. It should be a large one, so that there will be no leaking between the contacts. The receptor is connected as shown in Fig. 9.

The total cost of the receiving instruments exclusive of the aerial and ground wires is as follows:

The receiving inductance coil	\$2.00 to 3.00
The variable condenser	1.50 " 2.50
A microphonic detector	.15 " .25
The silicon detector	.50 " 1.00
A two point switch and a one point switch	.25 " .25
Three small Mesco dry cells	.50 " .50
The high resistance potentiometer	1.25 " 2.00
A double-pole, double-throw knife switch	1.00 " 2.00
A good 2000-ohm telephone receiver (2), with head-band	7.00 " 12.00

Total cost \$14.15 " \$23.50

The 25-mile wireless is now complete,

and will, under a competent operator and reasonably good conditions, work easily 25 miles, and, at night, may work 100 to 150 miles over water.

Plating Over Scratches or Cracks

Many persons consider the process of electroplating the same as that of soldering or painting, where a liquid material is applied to the surface and all scratches, cracks, holes or similar imperfections are covered up. Imperfections will not be covered up by electroplating, but, on the contrary, they will frequently become larger.

The explanation of this fact is that the deposit faithfully follows the outline of a scratch or crack in the metal, and, even under the microscope, it will be found that every little detail has been actually reproduced. This may be given a trial by making a deep scratch in the surface of a piece of sheet brass and attempting to cover up by depositing upon it an acid copper solution. As it goes on, it will be found that the scratch really appears larger than smaller.

The same is true of a joint composed of two pieces of metal. No matter how tight this may be, the two pieces of metal will not become joined by the deposit, says the *Brass World*. It is impossible to "solder" them together by depositing a thick coating of metal on them.

The preceding facts are of great importance in polishing metal. They serve to indicate that, in order to obtain a good surface on electroplated metal, that of the base metal must be free from all imperfections. Imperfections cannot be removed by plating.

According to the *American Machinist*, the greatest single consumption of brass is for condenser tubes; a battleship alone having from 30,000 pounds to 40,000 pounds of condenser tubing in it; and owing to the corrosive effect of sea water this tubing must be continually replaced. The material used is usually either Muntz metal—60 per cent. copper, 40 per cent. zinc—or else a mixture of copper, 70; zinc, 29; and tin, 1.

MECHANICAL AND ELECTRICAL POWER

G. W. NICOLL

ENERGY

When an electric current flows from a higher to a lower potential, energy is expended and work is done. This energy expended may reappear in the form of heat, and, as this heat is dissipated into the surrounding atmosphere, the energy is not destroyed, but merely exists in another form, having gone to increase the temperature of the air.

The law of the conservation of energy proves that energy, like matter, cannot be destroyed and always exists in one form or another.

In order to convert energy from one form to another, it requires work to be done. Therefore, when current flows through a conductor, electrical energy is converted into heat energy by the current overcoming the resistance of the conductor, and work is done. Now as heat is a form of energy, and energy is the ability to do work, it is reasonable to suppose that some relation exists between heat and energy (or work).

MECHANICAL EQUIVALENT OF HEAT

By careful experiment, Dr. Joule found that the heat, which is generated by doing 778 foot-pounds of work, is exactly equal to the amount of heat required to raise the temperature of one pound of pure water 1° at its maximum density and under a pressure of one atmosphere. This amount of heat is known as one British Thermal Unit (B.T.U.); therefore, the mechanical equivalent of heat may be written as

$$778 \text{ foot-pounds} = 1 \text{ B.T.U.}$$

ELECTRICAL EQUIVALENT OF HEAT

Upon investigating the amount of heat generated by the electric current, when overcoming the resistance of a conductor, Joule found that one ampere of current, flowing through one ohm of resistance during the time of one second, always developed .0009477 B.T.U. Also, that the amount of heat generated was proportional to the resistance of the conductor, to the square of the strength of the current,

and to the time during which the current flows.

From this, we may write the formula known as Joule's Law for determining the heat developed in any electrical circuit as

$$\text{B.T.U.} = .0009477 C^2 R t$$

now as $C^2 R t = J$, then $\text{B.T.U.} = .0009477 J$

where C^2 = current squared.

R = resistance.

t = time.

J = Joules.

We have now established a complete relation between electrical work, mechanical work, and heat energy, since we know that .7373 foot-pound of mechanical work is equivalent to one Joule of electrical, and since one Joule of electrical work equals .0009477 heat-unit, it is clear that anyone of these three energies can be mathematically expressed in terms of the other.

MECHANICAL POWER

If a weight of 1000 lbs. is raised 100 ft., a certain amount of work is done. If this weight is raised 100 ft. in one minute, the total amount of work done is exactly the same as when it is raised in one hour. As will be seen 100,000 foot-pounds is the result in both cases. In other words, the total amount of work done is independent of time.

The unit of mechanical power is the foot-pound per minute, which is the measure of the work done in a given time; or in other words, foot-pounds per minute expresses the rate at which work is done.

It will be seen that while the total amount of work done (as cited above) is the same in either case, the power required by the first condition is much greater than that for the last. For example

Power = foot-pounds $\div$ minutes;
therefore for the first case we have

$$\frac{100 \times 1000}{1} = 100,000 \text{ foot-pounds per minute,}$$

and

$$\frac{100 \times 1000}{60} = 1,666 \text{ foot-pounds per minute.}$$

In mechanical work, the unit of time is the minute, and in electrical work, the unit is the second.

ELECTRICAL POWER

As the Joule is the unit of electrical work, Joule per second is the measure of the work performed in a given time, and, therefore, is the unit of electrical power. This unit has been named the watt. The formula expressing the power exerted in any electrical circuit is determined as follows:

Watts = Joules per second, where
Joules = volt-coulombs.

Therefore, Joules per second = volt-coulombs per second, also Watts = volt-coulombs per second.

Coulombs per second = amperes.

Now, if we substitute amperes for its equivalent, "coulombs per second," we have the equivalent for electrical power.

Watts = volts $\times$ amperes.

Using notation, when W = total watts exerted in the circuit, we have

$$W = E \times C,$$

when the voltage and current are known,

When the current and resistance are known, we derive the following

Watts = $E \times C$ $E = C \times R$; then substituting the values $C \times R$ for E , we obtain

$$W = C \times C \times R \text{ or } W = C^2 R.$$

If the voltage and resistance are known, the formula for power is obtained as follows:

$$W = E \times C \text{ and } C = \frac{E}{R} \text{ substituting } \frac{E}{R} \text{ for } C, \text{ we have } W = \frac{E}{R} \text{ or } W = \frac{E^2}{R}$$

WATT HOUR

We will now consider the "watt hour," as it is by this unit that a consumer of electricity is charged.

This unit is used to express the work delivered to the consumer; as may be clearly seen, it cannot be expressed in watts, for watts = Joules per second, or the rate at which electricity is being consumed.

Therefore, on the watt-hour basis, the consumer is charged for the electricity he uses by the rate and the length of time it is used. As watt-hours expresses the work, it is independent of the element time. It makes

no difference whether 500 watts are delivered for one hour or ten hours, as in both cases work is being done at the rate of 500 Joules per second, or 500 watts.

In the first case, we have 500 watt hours, in the second 5000 watt-hours. Let us work these two cases out side by side:

First Case

$$500 \text{ Wh.}$$

Now $W = J$ per second, or $\frac{J}{S}$ and one

hour = 3600s; therefore

$$500 \text{ Wh} = 500 W \times 3600s$$

expressing this in Joules

$$500 W \times 3600s = \frac{500J}{S} \times 3600s$$

or

$$500 J = \frac{500 W \times 3600s \times S}{3600s}$$

by cancellation

$$500 J = W \times S$$

First Case

$$\text{or } \frac{500 \text{ Wh}}{J = W \times S}$$

Second Case

$$5000 \text{ Wh}$$

$$5000 \text{ Wh} = 500 \times 36000s$$

$$500 W \times 36000s = \frac{500 J}{S} \times 36000s$$

$$500 J = \frac{500 W \times 36000s \times S}{36000s}$$

$$500 J = 500 W \times S$$

Second Case

$$\frac{5000 \text{ Wh}}{J = W \times S}$$

In other words, watts $\times$ the time or watt-hours, are equal to Joules, and as the Joule is the unit of work, the watt-hour is simply another unit of work, being much larger than the Joule.

One watt-hour = 3,600 Joules.

In practical work, the watt, as also the foot-pound per second, is found too small, so the unit horse-power is substituted in both cases.

HORSE POWER

The horse power in mechanics is equal to 33,000 foot-pounds per minute, and when adopted as a standard of mechanical power was supposed to be

about equivalent to the power that a strong horse could exert. Hence the name "horse power."

The unit horse power, as applied to electricity, is falling into disuse—the unit kilowatt (1000 watts) taking its place.

The relation between the electrical and mechanical horse power is obtained as follows:

One mechanical horse power = 33,000 foot-pounds per minute. $33,000 \text{ ft. lbs. per minute} = 33,000 \div 60 = 550 \text{ foot pounds per second.}$

Therefore, 1 foot per second = $\frac{1 \text{ h.p.}}{550}$

Now one Joule = .7373 foot-pound: therefore one Joule per second = .7373 foot-pound per second and as one Joule per second = 1 watt, then—

1 foot-pound per second = $\frac{1 \text{ watt}}{.7373}$

As we have found the equivalent of the foot-pound per second, both in terms of horse power and watts, we may write

1 foot-pound per second = $\frac{1 \text{ h.p.}}{550} =$

$\frac{1 \text{ W}}{.7373}$ From this we find the value of

1 H.P. = $\frac{550}{.7373} = 746 \text{ Watts.}$

Some experiments have recently been made by M. Jagou, as reported before the French Academy of Sciences, on the use of a number of electrolytic detectors connected in series and in parallel. He finds that the detectors when connected in series are less sensitive than the most sensitive one of their number. When connected in parallel, however, the sensitiveness of the series depended upon the most sensitive of the individual detectors. He suggests that several electrolytic receivers might thus be connected in practice, so that if one of the detectors should lose some of its sensitiveness, it would not affect the series. The phenomenon is explained by the fact that the Hertzian waves act only on the most sensitive one of the detectors when the waves are weak; but when they are strong, the others are acted upon at the same time.

It has often been suggested that a dy-

namo be used as a telephone relay by placing the field winding in the primary circuit and the armature winding in the secondary circuit, so as to reproduce in the latter the fluctuating current of the former. The principal objection to this system seems to lie in the design of a suitable collecting device, which will not produce any disturbing effects. The *Electrical Review* and *Western Electrician* describes an invention which is adapted to overcome this difficulty. It consists in the use of a dynamo with the field winding and the armature winding stationary, while the only moving part is an inductor, which is magnetized by the field winding. This inductor has a natural frequency which is much higher than that of the telephone currents, so that each pulsation of the telephone current will correspond to a large number of alternations induced by the inductor. The variation of current in the primary circuit of the field winding does not change the frequency, but does change the amplitude of the armature currents.

* * *

Very few of us have any trouble in counting our coin by hand. In mints, however, in banking houses, in the offices of electric railways, and in many other establishments, vast quantities of coin have to be counted and packed daily. An electrical machine lately devised counts coins of any size from pennies to dollars, and wraps them at the rate of 420 per minute as long as the current is transmitted and the coins are fed into the hopper. An expert, while he is in good working order, can count and wrap fifty coins a minute; so it will be seen that the machine does the work of eight men. It takes one man to run the machine. His work consists in sorting the coins, picking out plugged pieces, blanks, and buttons, which in some cases seem to get mixed with good money. The machine receives the sorted coins at one end, and delivers them all smoothly rolled in bunches to suit and with the wrapper pasted. It is the invention of a man whose business it was to collect coins from slot machines and to sort, count, and bundle them.

* * *

When water is frozen solid it expands about one-tenth its bulk.

HOW TO MAKE A SMALL BALANCE

WINSLOW A. KINGMAN

To make a small balance, as shown in the accompanying sketch, prepare for the base a board with a suitable finish such as shellac and wax; the best material is poplar or well-seasoned white pine; make this 16 in. x 6 in. x $\frac{3}{8}$ in. In both corners of the underside of the base at "A," place two large round-headed tacks about $\frac{3}{4}$ in. from the corners. Do not allow the points to come through the base, but cut them off with a pair of pliers.

At the other end of the base B, place a levelling screw "L," which can be made by soldering a small round disc $\frac{1}{2}$ in. in diameter to the head of a wood-screw, the point of which is filed flat.

Make two supports "C" $4\frac{5}{8}$ in. tall x $\frac{3}{8}$ in. thick, which are fastened to the base 1 in. apart and $3\frac{3}{4}$ in. from the end "A" of the base.

The lever "D-E" is made of such material as pear-wood, an old broken straight edge will do very well. Make this 12 in. over all and $\frac{1}{8}$ in. thick. The end of the lever "E" should be $\frac{7}{16}$ in. broad for a little over 9 in. $1\frac{1}{8}$ in. from the end of the lever "D," glue two blocks $\frac{1}{2}$ in. x $\frac{7}{8}$ in. x $\frac{1}{8}$ in., one on each side of "D-E," and made of the same material. Through these, bore a $\frac{3}{32}$ in. hole perpendicular to the face of "D-E" and about $\frac{1}{32}$ in. above the top of the arm "E." File out this hole to an equi-lateral triangle, with the vertex towards the bottom, and just in line with the top of "E."

File a piece of $\frac{1}{8}$ in. brass wire, so that it just fills the hole in "D-E." This is to be the main bearing or knife edge and which determines the accuracy of the scale as well as the deli-

cateness. This should be $1\frac{3}{4}$ in. long and have one of its edges a true, smooth yet sharp straight line. Finish this edge off on an oil stone or with very fine emery. Place this in the hole already made in D, so that equal parts protrude on either side and fasten in with strong glue.

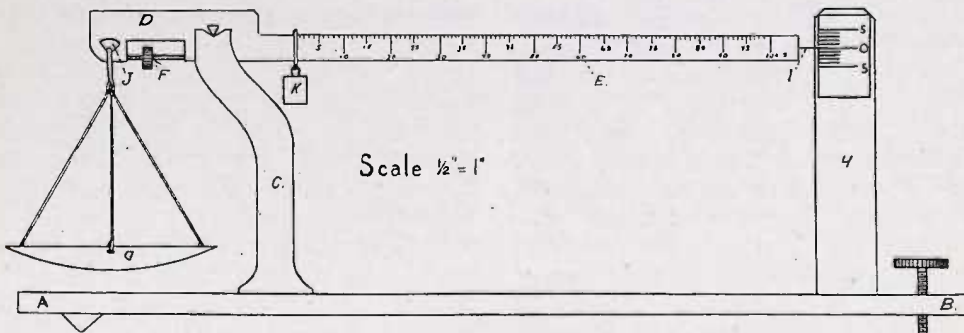
At the end of "D," make another hole "J" $\frac{1}{4}$ in. from the end, and with a broad angle at the bottom, which reaches within $\frac{1}{8}$ in. of the lower edge. From this hole the pan will be hung by means of a knife edge, but, as there is very little motion here, no metal bearing will be put in.

At "F," place a small screw $1\frac{1}{4}$ in. long with a round milled nut on it. Push the screw through a small hole made in the end of "D," then put the nut in place, and push the screw on into another small hole beyond.

At the other end of the bar, insert a common pin, so that only about $\frac{3}{8}$ in. is sticking out. Cut the head off with a pair of pliers, leaving the pointer as shown at "I."

For the pan, get a disc of brass $3\frac{1}{2}$ in. in diameter, which should be hammered into the surface of a sphere of 4 in. radius. Drill three $\frac{1}{16}$ in. holes equally distant from each other.

To suspend the pan to the beam, make a "U" shaped device, $\frac{3}{16}$ in. across the top, of brass wire or sheet. Make the "U" $\frac{1}{2}$ in. long, and solder a small $\frac{3}{32}$ in. ring to the bottom. Next make a small knife edge long enough to fit between the ends of the "U." Put one leg of the "U" through the hole "J," which should be low enough down that the "U" will not



be bulged in revolving around the material below it, if it binds while revolving, remove a small portion of the wood from the bottom. Now solder the knife blade between the ends of the "U," after which remove any solder that has gotten onto the knife edge by filing gently. This is hard, but with patience and a little ingenuity a neat job can be done.

Suspend the pan by means of three linen threads, which, for looks, may be colored green. Take care that the pan is perfectly level.

On the inside of each of the two supports "C," place a piece of sheet brass about $\frac{1}{16}$ in. thick, filed to the same shape as the support, but only extending down about $\frac{3}{4}$ in. from the top. Cut the top out to an angle of about 120° , leaving the brass a trifle higher than the wood. The main knife edge rests on these last two pieces of brass.

For a balancing weight, take a piece of brass rod, weighing about 20 grams, that is, about $\frac{9}{16}$ in. in diameter by $\frac{9}{16}$ in. tall. Solder two pieces of brass wire in an upright position to the end of the weight and a cross piece across the ends of the wires, which is to be made into a knife edge, leaving $\frac{1}{2}$ in. between the knife edge and the weight, and $\frac{3}{16}$ in. between the upright wires.

Take a piece of material the same as the base and make "H," 1 in. x 5 in. x $\frac{3}{8}$ in., with the top corners bevelled. Place this slightly back of the centre line $1\frac{1}{2}$ in. from the end B. Shellac and wax this the same as the base and then attach a card or piece of writing paper at the top, so that, when the base is level and the lever is horizontal, the pin will stand in the centre of the card, which should then be graduated, as in the sketch.

Place the weight on the bar, so that it exactly balances, and make a notch here, then place the weight in the notch and adjust the nut "F" till it is again exactly balanced. Now put a 5 gram weight on the pan and move the weight till it is again balanced, without moving the adjusting nut "F."

Put five more grams on the pan and repeat the process till 100 grams have been marked off, each time making a slight scratch with a knife, but without

removing any material. The scale should be divided off, as is shown in the sketch, best water-proof India ink being used. Each division of 5 grams should be just as long as every other 5-gram division. The single gram marks, such as 21, 22, 23, 24, can be made as the other divisions and then transferred with a pair of calipers to all of the other divisions.

The weights can be used at a high school physics laboratory, when calibrating the scale.

No weights need be used after this scale is once calibrated, and its accuracy will be surprising.

Prof. Boermel is the author of a design for an earthquake-proof building, the essential features of which are a massive foundation, consisting of a massive bowl upon which is placed a rocking foundation, the radius of whose curved bottom surface is somewhat less than that of the bowl. At its centre is a half-spherical pivot, fitting into a cup bearing at the centre of the foundation. Upon the rocking foundation is built the house or other desired construction. To prevent the movable portion from canting too freely, and to bring it back to the vertical position after the earthquake shock has passed, it is supported at eight points, near its periphery, by a series of spring buffers, which are bedded in the lower bowl-shaped foundation. The shock of an earthquake is transmitted to the building through the yielding springs, and its interior steel-frame structure is relied upon to take care of any remaining stresses that pass through the springs to the building itself.

The proposal to improve the efficiency of the steam-turbine propelled vessel by interposing electric generators and motors between the turbine and the propellers is being made the target for much spirited criticism. Although it must be admitted that the higher speed of rotation, which is necessary when a steam turbine drive is used, causes some loss of efficiency, it has yet to be proved that the conversion of mechanical into electrical energy, and of the electrical energy back into mechanical energy, will not involve losses greater than those which it is sought to avoid.

THE CARE AND OPERATION OF A SMALL MOTOR BOAT

HAROLD WHITING SLAUSON

The length of life of a motor boat and engine is so dependent upon proper care that it will pay every owner of such a craft to understand thoroughly the vital points to be remembered and to see to it personally that the boat and power plant are kept in the top-notch of condition. If he does this, motor boating will become a pleasure, and no serious trouble should be anticipated from unexpected and inconvenient breakdowns.

It would seem almost unnecessary to state that every present or prospective motor boat owner should first become familiar with the mechanism of his motor boat before he starts to operate his boat—that he should know the function of all parts of the ignition system, the carburetor, and the reverse gear—but from the number of accidents that have been caused by ignorance of the why and wherefore of these parts, it appears that such cautions are important. There is probably no better way of becoming thoroughly familiar with the details of construction of a marine motor than to personally perform or inspect its complete overhauling at the beginning of each season.

If possible, the boat should be hauled out of water at the end of each season in order to protect the hull from the ice and snow and to afford a convenient means for painting the bottom during the succeeding spring. If the boat and motor are small, it is sometimes advisable, before hauling the boat out of water, to remove the heavy parts of the motor, which would be taken apart subsequently for cleaning, and thus avoid the strain which probably would be caused by the extra dead weight of these parts. If the motor has a solid cylinder head, the entire cylinder, piston and connecting rod, and flywheel and crank shaft should be removed, and as these parts constitute almost the entire weight of the engine, the work of drawing the boat out of the water should be lessened considerably. Before these parts of the motor are stored for the winter, all exposed iron or steel surfaces, such as the crank shaft, piston, and inside

of the cylinder, should be covered with a heavy coating of grease, to keep off the moisture and prevent rust. All smaller parts, such as nuts, bolts, and screws, should be placed in a box by themselves and kept with the larger pieces of the engine.

The smaller and medium-sized boats should be supported in at least three places, when they are hauled out for the winter, so that the weight will be distributed evenly between the bow, stern, and amidships. Precautions should be taken also to prop the hull on an even keel, and while "bilge-blocks" are often used for this purpose, this is hardly as satisfactory a method as that in which wooden forms, shaped to fit the curvature of the hull, are placed against the boat amidships. If there is no building in which the boat may be stored for the winter, a stout canvas covering, cut to fit the cockpit and decks of the craft, should be made to protect these parts from the snow and rain. If the boat is of the open type, two supports, on which is fastened a ridge-pole, should be placed at either end of the cockpit to form a frame which will give a sufficient slant to the covering to enable it to shed water.

The precautions which apply to the calking and painting of the hull both above and below the water line, the varnishing of the decks, and the drying out of the interior are the same for a motor boat hull as for a sailing craft, and cannot be described in detail here. Suffice it to say that the proper care of the hull—both inside and out—not only adds greatly to the appearance of the boat, but will also increase its length of life by several years.

Of course the vital part of a motor boat is the motor, and too much time cannot be spent each year on the thorough cleaning, readjustment, and replacement of lost or broken parts of this small power plant. Inasmuch as the power developed by a gasoline motor depends to a large extent on its compression, and good compression, in turn, is impossible without perfect fitting piston rings, it will be realized that these small circular pieces of cast

iron require considerable attention. It is quite possible that one or more of these may have become "stuck" in its grooves, due to an insufficient supply of oil or excessive carbonization in the cylinder, and if such is the case, great care must be exercised in loosening these rings without cracking them. They should be worked and loosened gradually with the aid of thorough applications of kerosene and oil, and even the most recalcitrant one may be removed if sufficient care and patience are used.

After this, the rings should be scraped and cleaned thoroughly and all of the carbon deposit removed from the grooves. Each ring should then be replaced in the same groove from which it was removed, as otherwise some slight difference in thickness may be found, which would make one too tight and another too loose a fit. Even though all the rings are found to be intact, it is quite possible that some may be so badly worn that they would allow the charge in the cylinder head to escape past them, and such rings as are found in this condition should be replaced by entirely new ones. The fact that a certain ring has been "leaking gas" will be evidenced by the blackened appearance of the piston and ring where the burning charge has scorched the metal on its way to the lower part of the cylinder. It is not advisable for an amateur to endeavor to fit new rings in the piston, as this is a very particular and delicate operation and requires the services of an expert gas engine repair man.

While it is possible for an engine to run with leaky piston rings, there are other parts which require careful attention and adjustment, before even a single "put" may be had out of the motor. In fitting up for the season, absolutely fresh dry batteries must be used, for even though the cells gave a good spark at the end of the previous season, their long rest will have so caused them to deteriorate that they will be unfit for ignition purposes. The timer and its parts should be cleaned thoroughly with kerosene, and fresh oil applied to the moving parts. In case it is found necessary to remove any part of the

timer or commutator, care should be taken to replace these parts in the proper manner, so that, with the timer handle set in the centre, the spark will occur at the top of the piston's up-stroke.

When fresh batteries are supplied, the timer cleaned, and the proper connections made, the quality of the spark at the plug should be tested. In case this does not appear to be a strong, blue-violet spark, the trouble may lie either in the spark plug or in the platinum contact points of the coil. In the former case, all soot and carbon should be removed, fine emery cloth used to polish the sparking surface, and the points of the plug so set that the spark jumps a gap of about one thirty-second of an inch. If the trouble is found to lie in the coil, the thumb screw and vibrator should be removed, and the platinum contact points polished with emery cloth, until all signs of a pitted or corroded surface disappear. It is very probable that these adjustments on the plug and coil will have to be made several times a year, and in case trouble is found with the ignition system, when it is certain that the batteries are sufficiently strong, the whole operation of cleaning and testing may have to be gone through with as at the beginning of the season. In other words, because the ignition system has been put in good shape early in the season, it is no guaranty that it will remain in this condition throughout the summer. Piston rings and bearings are parts of the motor that may reasonably be expected to stay in shape for a year, but the future behavior of the ignition is often a source of doubt.

It is to be assumed that when the boat was put up for the winter, all the gasoline was drained from the tank and carburetor. Before filling the fuel tank at the beginning of the season, the fine wire strainer, generally located in the supply pipe near the carburetor, should be removed and cleaned of all the dirt and foreign matter which may have collected from the gasoline. The needle and air-intake valves of the carburetor should not need grinding or cleaning, as there is very little wear on these parts and the gasoline acts as a good

dirt remover. Possibly a slight adjustment may need to be made in the height of the cork float which operates the gasoline valve, but any change in this should be made with very great care, as a slight turn of the regulating nut will make a considerable difference in the quality of the mixture and the action of the carburetor. Care should be taken to see that there are no particles of sediment or loosened solder in the gasoline tank, which could find their way into the supply pipe and clog the flow of fuel to the carburetor.

In a small engine, it is not probable that the bearings would need any attention, aside from cleaning, in several years. The crank shaft and the connecting rod bearings should be examined, however, to see that they are not unduly worn and to make certain that they have been getting their share of oil. None of the bearings should be very tight, as this would cause the babbits to heat and possibly burn out—an occurrence the results of which would be more serious than those caused by too loose a bearing.

About the only other part of a marine motor which will require attention at the beginning of the season is the lubricating system. It is of the utmost importance that all pipes running from the oil cups to the piston, crank case, and bearings should be absolutely clean, to allow a free flow of lubricant to these parts. The best way to clean these is to fill all oil cups with kerosene and allow it to run through the connecting pipes, until the old or gummed oil is entirely dissolved. The crank case should be cleaned out and supplied with fresh oil. If the lubrication is forced by the pressure-feed system, the pipe running from the engine cylinder to the oil tank should also be cleaned thoroughly in the same way.

Before the boat is put in the water, the flywheel, shaft, and propeller should be turned to make certain that the boat has not warped or sprung during the winter and thrown these parts out of line. If it is found that the propeller shaft does not line up properly with the crank shaft of the engine after the boat is placed in the water, the angle or slant of the motor should be changed until the correct alignment

is secured. This may be accomplished by loosening the bed bolts of the motor and raising the front or rear part of its base, as the case may be, and holding it in the proper position by means of thin wedges of tin. After the proper alignment has been obtained, the motor should be bolted securely to its bed again.

When a man has once prepared his boat and motor for the season, he will have but little trouble in maintaining both in good condition. The ignition system, the fuel supply, and the lubricating materials are about the only parts which should require any further outlay of time or money, and a few minutes each day spent in cleaning, testing, and replenishing will not be wasted.

Every man who operates a motor boat should own a pocket ammeter, or battery tester, with which to keep himself informed of the condition of his source of ignition current. Dry batteries, when new, should show from twenty to thirty amperes on this instrument, and should be available for ignition service until the current output has dropped to six or eight amperes. Two sets of six cells each should be used alternately, so that one set may be recuperating while the other is furnishing current. The length of life of a set of batteries will depend upon the amount of running which the motor is called upon to do, but one hundred hours of intermittent running for two sets of six cells each may be taken as a fair average performance.

The spark plug should be cleaned and tested frequently, and several extra ones should always be kept on board to be used in case of necessity. The timer should be kept absolutely free from dirt and grease, but, paradoxical as it may seem, a goodly supply of oil on the brushes or contact points will help, rather than interfere with, its operation. The liability of short-circuits in the ignition system will be lessened greatly, if care is taken to protect all wires from grease, gasoline, oil, spray, or rain, and if the batteries and coil are kept in a dry place. The copper terminals, connecting the high tension conductor with the coil and spark plug, should be soldered securely

to the wire, and the battery and all other connections should be so tight that it will be impossible for them to jar loose. The contact points of the coil should be kept bright and smooth, and should be so adjusted that excessive sparking does not occur at this place. It is the heat formed by these sparks, or electric arcs which, in a large measure, is responsible for the corroded and pitted condition of the platinum contact points.

The warning to always ascertain the amount of fuel on hand before starting out for the day would seem almost unnecessary, and yet the number of motor boats which will be found stalled on account of a dry gasoline tank attests to the fact that this is a precaution which is not always heeded. Almost as necessary as gasoline is a sufficient supply of lubricant, for whenever the motor is running, a constant stream of cylinder oil is required. If this supply is stopped or diminished beyond a certain point, the motor will become excessively hot, the piston will expand, and the whole machine finally will cease to run. The only way to start the motor again, after an accident of this kind, is to allow it to cool, and then, with the aid of copious quantities of kerosene and cylinder oil, to "limber it up," till the fly wheel turns as easily as it did before. The piston rings and cylinder walls must necessarily have suffered some, however, due to the excessive friction of the unlubricated parts. It is necessary for the operator to cast his eye occasionally on the sight-feeds of the oil cups to see that each is delivering its proper amount of oil. The relief cocks on the cylinders also should be opened at frequent intervals to make certain that the engine is discharging a slightly bluish vapor. This bluish vapor is generally an indication of a sufficient supply of oil for the pistons.

If a well-made motor, properly installed in a staunch hull, is operated by a man well versed in the attention required by his engine and boat, power boating should become a pleasure for him and those of his friends fortunate enough to be his companions on a trip or cruise. Marine motors are, after all, simple in construction, and, after

the mastery of a few details, a man, having only an average knowledge of mechanics and machinery, should be able to operate one under all conditions with scarcely any trouble whatsoever.—*Gas Review*.

Considerable interest is being taken in a new primary battery which has been invented by Mr. W. A. F. Bleek, a young electrician, a resident of Brisbane, Queensland. The battery is said to be very simple, compact, and most easily charged, and, when charged, goes to work at once. Of the battery itself, Mr. J. S. Badger, manager of the Brisbane tramways, says: "I do not know of any commercial battery which gives so high an electro-motive force; neither do I know of any battery which, combined with such a high e.m.f., shows such a constancy for so long a period." Professor Thomas R. Lyle of the Melbourne University speaks very highly of the invention: "It has a much larger useful current than that of any cell I know." Demonstrations were given at the Technical College, in the presence of a large number of Brisbane doctors and scientific men, all of whom were deeply interested in the work of the battery. The running of a sewing machine, electric fan, cauterizing instrument, and Rontgen-ray apparatus were all successfully shown by the inventor.

Bare aluminum wire may safely be used in coils without any insulation except between successive layers, owing to the existence of a film of oxide on the surface of the aluminum. The film in its natural state will resist 0.5 volt; but, by exposing it to the air at a temperature about 100 deg. C., it is possible to get rid of the hydrates contained in the film, and thus increase its resistance, so that it will withstand a high voltage. The insulation between the layers of the coil should be non-hygroscopic, and the coils should be covered with insulating paint, to prevent moisture from entering.

One of the most remarkable peals of bells in the world, both because of its size and elevation, has just been installed in the tower of the Metropolitan Life building in New York, 46 floors above the street.

HOW TO JOIN ELECTRIC WIRES

Before an amateur can attain any proficiency in the art of electric lighting, fitting bells, or telephony, it is essential that he should be able to connect wires or cables together properly. This may sound an easy job, but it is not so, and the slipshod connections made by bad workmen is the chief cause of faulty electric bells, inefficient and indistinct communication in telephony, and (if passed by fire offices) serious trouble in electric lighting.

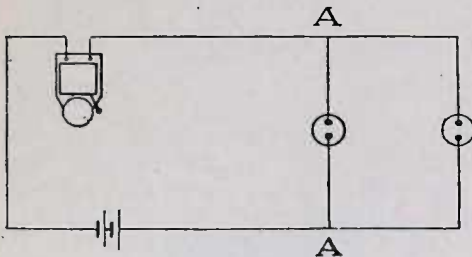


FIG. 1.

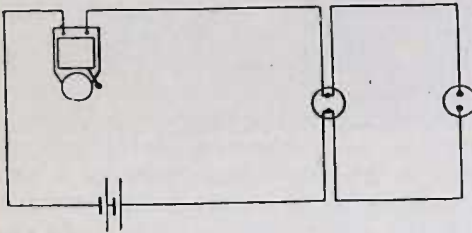


FIG. 2.

The making of all joints in electric wiring is always entrusted to a careful man, as a single badly-made joint not only puts the whole installation out of order, but the difficulty and annoyance in locating and remedying the defect is often very great.

It is the best plan to do without joints altogether, even if extra wiring is required, as the initial cost of the wire is not a great item, and a few yards, more or less, matters little, especially when the time and trouble in making the joint is taken into account. Suppose, for instance, that we have a house bell ringing from two pushes, as shown diagrammatically in Fig. 1. Joints will be required normally at the parts marked A, but if the system of looping in the wiring is adopted, the joints mentioned will not be needed. All that is necessary is to take the wiring

down to the push, give it a turn or two round the stem of the terminal screw, and take to the bell in the usual manner. Of course, the insulation must be stripped off an inch or more, in order that this may be done; and perhaps another hole will have to be made, or, at any rate, a larger one may be required in some devices, such as bell pushes.

An ordinary electric bell push is shown with the top removed in Fig. 3, and this is the kind of push which would be used in Fig. 2. The two contact pieces are fixed to the base by screws, where indicated by the black dots, *a a*. The centre holes ordinarily take the screws for fixing the ends of the wires as shown, but, in looping the wiring, the holes are made larger and the wires are stripped of their insulation, as previously explained, and bent, as in Fig. 4, and passed in the holes, finally binding round underneath the screwheads in the usual manner. Occasions, however, often arise in which joints are absolutely necessary, either on the score of the expense of the extra wiring, or for other reasons. We, therefore, consider the easiest and most efficient kind of joints.

Take, as first example, the connection of one wire to a main at right angles, as at A, Fig. 1. The first step is to strip off the insulation for two or three inches on the main wire, and about the same or a little less on the branch wire. Thoroughly clean the bare metal

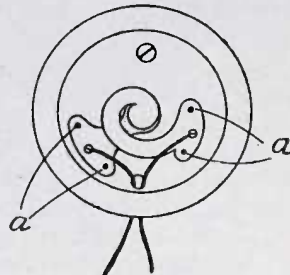
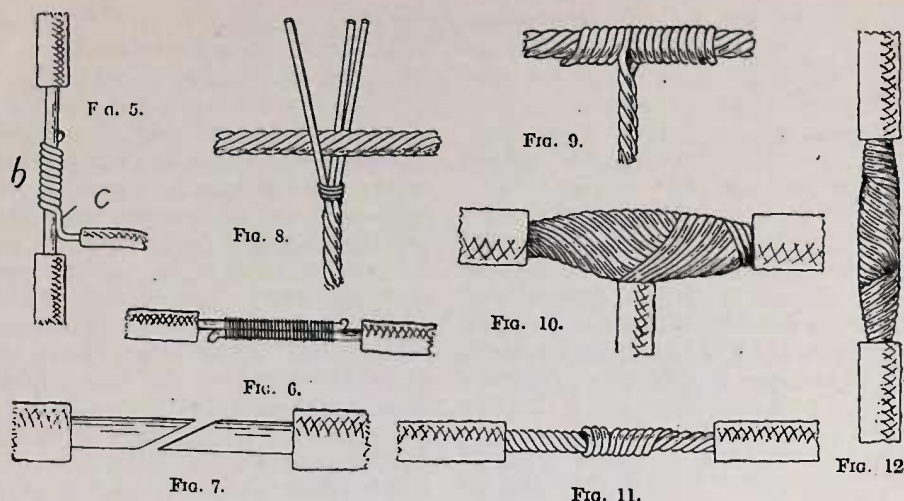


FIG. 3.



FIG. 4.

with emery, and wind the end of the branch wire round the main wire. Next solder the spiral part, marked B, Fig. 5, but do not carry the solder along the part C, because any stress



or side-play on this part would break off the solder. This is the sort of thing which happens, if the branch wire is taken straight off at right angles, instead of laying it along the wires as at C. The joint is then trimmed and the insulation restored to it. This covering operation must be done thoroughly, or leakage of current cannot at some time or other be avoided. The insulation is generally wound on, spiral fashion, so that it is a fairly easy matter to wind on again. Should it be required to join two short lengths of wire, then the joint, Fig. 6, can be employed, using thin copper binding wire to make a good contact. Large single wires can be cut bevelled fashion, as in Fig. 7, and then bound with wire and soldered, etc., as before.

When several wires are bound together under the same insulation, the combination is called a cable, and these are used in small electric lighting installations, in order to make the resultant wire flexible. In jointing such wires, each individual strand is cleaned before commencing to connect. Fig. 8 shows the first stage, and Fig. 9 the final way of binding before soldering, whilst Fig. 10 shows the joint ready for taping. Continuous jointing is shown in Figs. 11 and 12, and these figures are self-explanatory. The taping and outer-covering is restored, making the resultant joint rather more bulky than the plain wiring.

Another method of uniting two lengths of cable in one and the same straight

line is to solder the metal wires into a solid mass all round the circumference of the wires, then scarf or bevel them together, as indicated in Fig. 7.

Always bear in mind that it is a perfect metal to metal contact, and see that nothing intervenes to produce oxidization. This is prevented if carefully cleaned and well-soldered. A good-sized soldering-iron is best for this work, and one that has a groove in the end for resting the wire in. Have the soldering-iron perfectly clean, and hot, and use only resin as a flux. No acid or salts must on any account be used. Any rough points of wire or solder must be filed off before restoring tape. In removing the insulation, do not nick the metal wire, especially for electric light work. A careful study of the illustrations which are given will make the whole process perfectly clear.—*Home Handicrafts*.

In the recent opening of a new wireless post office station at Bolt Head, on the Devonshire coast, England, the postmaster general said that the principal objects in erecting the station were to carry out the obligations thrown on the post office by the radiograph convention of 1906, and to make sure that other parties to the convention live up to their obligations. The most important object, however, was to carry out the deliberate policy of the post office of preventing the growth of any form of monopoly in wireless telegraphy.

DESIGN OF A ONE QUARTER KILOWATT TRANSFORMER FOR
WIRELESS TELEGRAPH TRANSMITTERS—Part II

W. C. GETZ

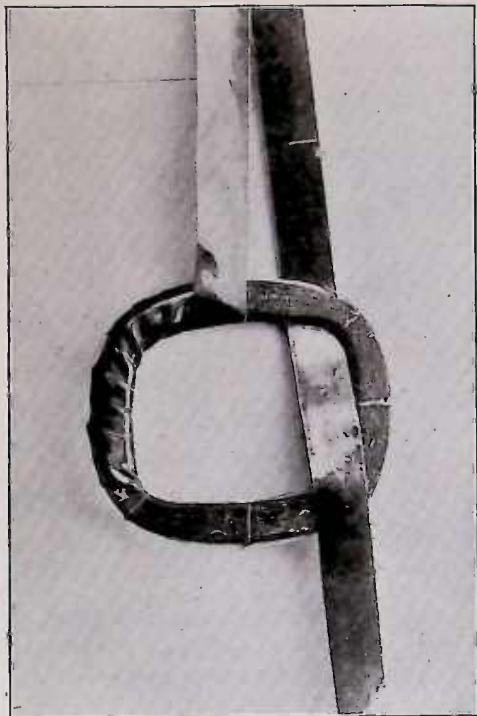


Fig. 7

We now wrap it with Linotape, as shown in Fig. 8. This tape should be applied so that each successive turn overlaps the preceding turn by at least 3-16 in. In fact, although it will take a little more tape, it would be advisable to make it overlap $\frac{1}{4}$ in. After taping up a section, mark on the outside, the direction in which it was wound, and bring out the terminals at the proper places—one on the right hand inside point; and the other on the outside left-hand point. It is absolutely essential that the arrow point, showing the direction of the winding, be accurately placed on every section, as otherwise, in connecting up, a section might become reversed, and cause much trouble.

On each leg is placed twelve sections making a total of twenty-four sections altogether. This will require about 120 oz. or $7\frac{1}{2}$ lbs. of wire. As before stated, the experimenter may find it much cheaper to purchase these sections already wound at but a small advance

over the cost of the wire and tape. This would save the cost of making a winding form, and as the latter would materially increase the cost of the transformer, and would probably only be used once or twice, it would really pay to have this part of the work done by experienced constructors.

Having now finished the secondary sections, and insulated them with tape, we will now consider the assembling of the transformer. With reference to Fig. 3 again, it is seen that every alternate "A" plate projects $1\frac{1}{2}$ in. on one end, and sets back $1\frac{1}{2}$ in. on the other end from the adjacent plates.

Now stand the completed primary legs on end, so that the two inside primary terminals are on the lower end, and the outside terminals are at the top. It is very important that this should be done right, as otherwise if not this way, the transformer may become poled wrong, and either burn out when put on the current, or else cause other trouble.

Move the two legs within 3 in. of each other, as shown in Fig. 9, and in the spaces between the alternate "A" plates, insert the "B" cross-pieces; first one on



Fig. 8

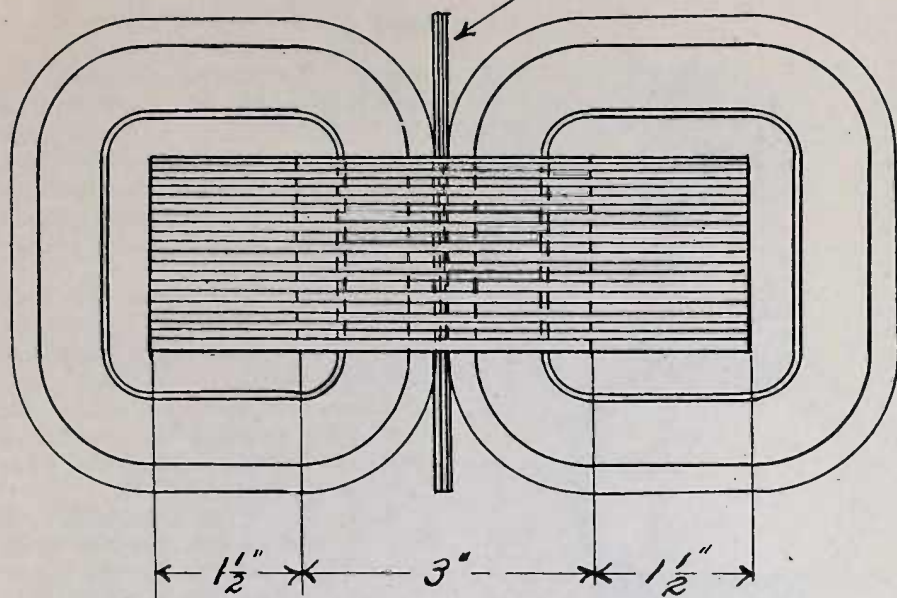
Insulating Shield.

Fig. 9

the right hand leg; the second on the left hand leg and so on. It will be noticed that the first "B" piece's right hand end goes between the first and third "A" pieces on the right hand leg; while the left hand end of the first "B" piece is perfectly flush with the first "A" piece on the left hand leg. In the same manner the second "B" piece's left hand side is between the first and third "A" pieces on the left hand leg, while, the right hand side of the second "B" piece is flush with the third "A" piece on the right hand leg. In this way there is no air gap at the juncture, and the transformer is also mechanically stronger at this point. Continue placing the "B" pieces in this manner until the first 2 in. pile is used up. This should completely finish one end of the transformer, as there should be as many "B" pieces as there are "A" pieces. After this end is assembled, it may be tapped with a mallet to square is up and give the iron a neater appearance.

Having assembled the cross-pieces of one end, we will now place our sections on each leg. Cut 12 pieces of Empire cloth to the dimensions given in Fig. 10. Three of these are to be placed at the lower part of each leg, 1 in. above the cross-pieces. They should fit over the primary insulating winding very tightly.

Now referring to Fig. 11, we have given the connecting diagram that will be used with our secondary sections. It is to be noted that every other section is reversed, and the inside terminal of section 1 is joined to the inside terminal of section 2; the outside terminal of section 1 goes to binding posts, while the outside terminal of section 2 is connected to outside terminal of section 3; the inside terminals of 3 and 4 are connected together, and so on, up to twelve, the outside terminal of which goes over to the outside terminal of the similar section on the other leg.

By studying this out, it is seen that by reversing every alternate section and connecting the inside to inside and outside terminals to outside, allows the wire to continue going around transformer core always in the same direction, as if it were one continuous winding without any breaks ever made in it. It answers the same purpose, as if the sections were all put on facing the same direction (tell this by arrow-points previously mentioned), and the inside terminal of the first connected to the outside of the second, as is popularly described in treatises on induction coils. The objection to this latter method is that it is necessary to run a connecting wire up, paralleling the

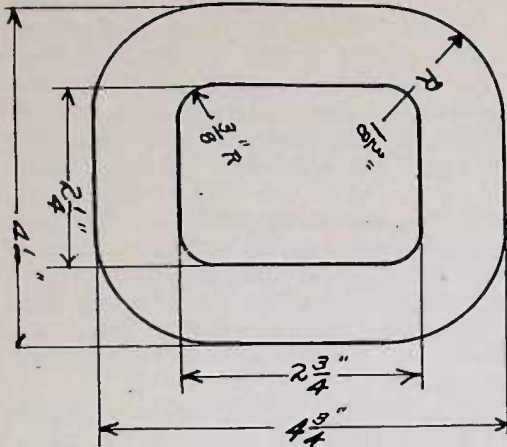


Fig. 10

section as shown in Fig. 12, which is sooner or later going to cause a break-down.

The plan given in Fig. 11 represents the method in vogue among the best coil makers, and it invariably gives the best results. It is not to be supposed that by saying reverse every alternate section, means that these sections have to be wound backwards. Such action would lead to endless confusion. All the sections are wound on the lathe, the form always revolving in the same direction, and they are so marked when taped up. When used according to Fig. 11, they are alternately turned around, so that the arrow-points of no two adjacent sections are pointing the same way. The inside winding of one section is connected to the inside winding of an adjacent section on one side, and the outside winding of that section is connected

Fig. 11

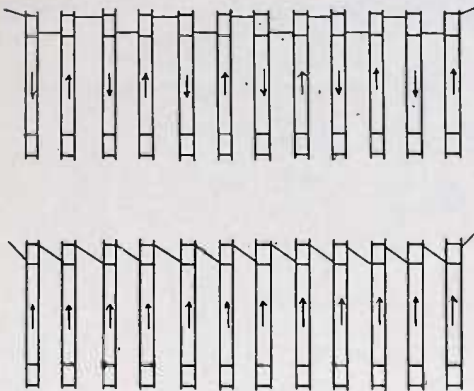


Fig. 12

to an outside winding of another adjacent section on the other side.

Connect up each leg in this manner, placing the three insulating washers in each case at the bottom and top of each group of sections on each leg. These washers are to give additional dielectric strength to the secondary sections at the point where there is the greatest danger of break-down, as there might be an arc formed with the core pieces that would act as a short-circuit on the secondary.

Now referring to Fig. 13, which is a side view of the assembly, it is seen that the twelve sections on each leg occupy a space of about 4 in. Connect the two bottom secondary terminals—the outside terminals of No. 12 section on each leg—together, and allow enough slack in the top secondary terminals—outside terminals of sections 1 on each leg—to run to suitable binding posts.

Having now placed all of the sections in position, and after properly connecting same, after putting 3 washers of Empire cloth on the top of each second-

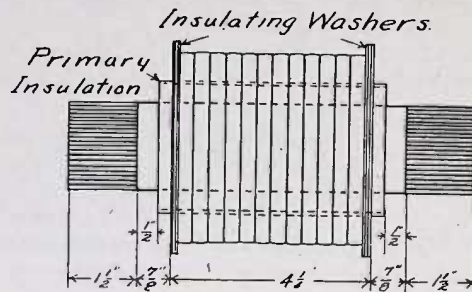


Fig. 13

ary winding, take the remaining 2 in. pile of "B" plates and insert, as described before.

After the top end is completed, make an insulating shield of Empire cloth, 4 in. x 6 in., and insert between the two secondary windings. This should be made of at least ten thicknesses of cloth.

The transformer may now be mounted on a board, which has previously been thoroughly treated with paraffin or insulating paint, or it may be immersed in a can of transformer oil, which is by far the best plan.

If the latter plan is adopted, cleats of hard wood should be made to fit under the "B" ends of the transformer, so that it will lay flat in the can, but with at least 3 in. between the secondary and



Fig. 14

any part of the can. If it is desired to stand the transformer on end, the secondary windings must be blocked up with strips of glass, as otherwise there is great danger of them slipping down and touching the core.

All terminals should be brought out through glass tubes to a rubber plate, situated on the top of the can. The primary terminals should be kept as far away from the secondary terminals as possible, and ample insulating space should be allowed between the terminals of the secondary. The transformer

should be covered at least one inch overall by oil. Only the best quality of transformer oil should be used.

Fig. 14 shows a photograph of the completed transformer, before it is mounted or immersed in oil. We will now figure on what the output should be.

The primary is to work on 110 volts at a frequency of 60 cycles, taking a maximum safe working value of 3 amperes. Each layer of the primary has 75 turns, and as there are 3 layers on each leg, the total number of primary turns is 450.

The secondary has 24 sections of No. 34 wire, each section having 2,100 turns, which makes a total of 50,400 turns. This is in a ratio of 1.112 to the primary. Therefore, if the primary E. M. F. is 110 volts that of the secondary will be 110×112 or 12,320 volts, as there are really more than 2,100 turns to the section, it is safe to assume 15,000 volts as our secondary E. M. F. The current delivered by the secondary will be about .015 amperes.

Fig. 15 shows the method of connecting this transformer in with a tuned circuit wireless telegraph transmitting outfit. This is similar to the diagrams and explanations appearing in my articles in the August, September and December issues of this magazine, which every experimenter should keep on file for reference. Those issues give full

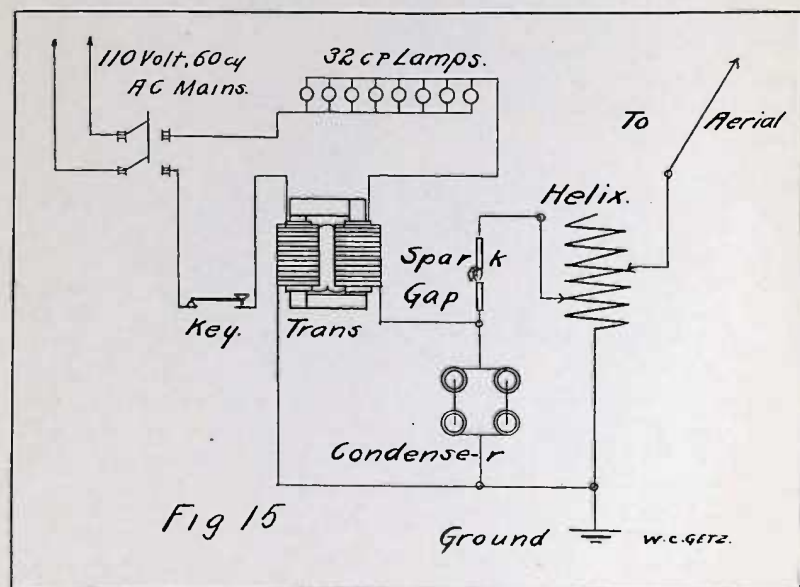


Fig. 15

directions for making and connecting, as well as operating and testing the different instruments specified.

It will be noted that a lamp bank consisting of 8 32 candlepower lamps is inserted in the primary circuit between the transformer and the mains. This is to allow regulation. When sending to nearby stations, it is hardly ever necessary to use the full amount of energy. In order that sufficient current will flow, the primary of the transformer is proportioned to take full load with 8 lamps burning; three-quarter load with 6, and so on. By having this regulating lamp bank, you can modify your local communications so as not to interfere with any commercial or government station nearby.

In conclusion, I would advise every experimenter who has access to a 110 volt

60 cycle alternating current, to try a closed core transformer, but try it when you will not interfere with any nearby government or commercial station. Many of the experimenters accidentally interfere with important messages, and thus earn the ill will of the very men from whom they can get valuable information. Remember that others may want to "use the ether" besides yourself, and they may have important business, whereas you are merely entertaining yourself. For unless there is a very quick change from the way the experimenters are now interfering, extreme measures may be taken by Congress that would deprive the experimenter altogether of his wireless station. It is not wise to make yourself a nuisance to the "powers that be."

SOME USEFUL BRONZING RECIPES

Bronzing is a very effective method of decorating metal, leather, etc. By this means, iron, brass, or an inferior metal can be made to assume the appearance of a superior one, as for example, bronze, copper, etc. Apart from the apparent deception of the quality of the metal—a deception which does not in any way deceive an expert—the practice of bronzing metals affords a very ready means of decorating metallic work. What looks more effective than blackened ironwork and dull copper? But there are cases in which copper could not be used constructively to afford the requisite strength, therefore, in such a case, a bronzing to imitate copper would not only prove effective but would be allowable.

BLACK BRONZE FOR BRASS

Clean the brass article of grease, etc., by dipping it in nitric acid, and rinsing off with water, and then dip it in the following fluid until it turns black.

- 12 oz. hydrochloric acid.
- 1 oz. of sulphate of iron.
- 1 oz. of pure white arsenic.

When taken out of the mixture, rinse it in clean water, dry in sawdust, polish with black-lead, and then lacquer with green lacquer.

GOLD BRONZE FOR SHEET BRASS

Ingredients:

- 1 gallon of sulphuric acid.
- $\frac{1}{2}$ pint of nitric acid.
- $\frac{1}{2}$ pint of hydrochloric acid.
- 6 lbs. nitrate of potash.

Dissolve the potash salt in the sulphuric acid and then add the other acid a little at a time, stirring with a stick.

GREEN BRONZING COMPOUND FOR BRASS

Ingredients:

- 2 quarts of strong vinegar.
- 1 oz. of red umber.
- 1 oz. of sal ammoniac.
- 1 oz. of gum arabic.
- 1 oz. of sulphate of iron.
- 4 oz. of Avignon berries.

Boil the mixture, and strain when cold, and for use cleanse the article to be bronzed with a weak solution of nitric acid and then rinse off the acid and apply the above liquid with a brush. If the color is not dark enough, heat the article until it can be held in the hand, and then give a coat of spirits of wine, mixed with a little lamp-black; finally, give a coat of spirit varnish.

GREEN BRONZING FLUID FOR COPPER ALLOYS

Ingredients:

- $8\frac{1}{2}$ drachms of copper.

- 1 oz. of strong nitric acid.
- 10½ fluid oz. of vinegar.
- 6¾ drachms of liquid ammonia.

Put the mixture in a bottle, loosely cork it, and then let it stand in a warm place for a few days before use. After applying the fluid to the articles to be bronzed, dry them before a stove, and when dry give a coat of linseed oil varnish and dry that also by heat.

BLACK BRONZE ON BRASS ARTICLES

- 1 oz. of carbonate of copper.
- 8¾ fluid oz. of sal ammoniac.
- 20 oz. of water.

Dissolve the copper carbonate in the spirit of sal ammoniac and then add the water, and for use suspend the article by brass or copper wire in the solution until the black color is produced, and polish if necessary by rubbing with coarse emery powder.

A STEEL BLUE ON BRASS

Is obtained by placing polished sheet brass in the following mixture (warm) until it assumes a steel blue coloration.

- (a) 90 grains of sulphide of antimony.
- 2 oz. of calcined soda.
- 15 fluid oz. of water.
- 2¾ drachms of kermes.
- (b) 165 grains of tartar.
- 330 sodium hyposulphite.
- 15 fluid oz. of water.

Prepare (a) by dissolving the first two salts in the water, and then adding the kermes mineral, and when the salts are dissolved in the water in (b) mix the two solutions, and for use make the mixture warm before dipping the brass therein.

DEAD METAL ON BRASS

Ingredients:

- 1 oz. of iron rust by weight.
- 1 oz. of white arsenic by weight.
- 12 oz. of hydrochloric acid.

Preparation: Digest the salts in the acid, and then brush this over the brass until the color is obtained, oil the surface of the metal, dry it, and afterwards lacquer it.

GILDING FLUID FOR COPPER

Ingredients:

- 4 oz. of mercury.
- 2 oz. of zinc.
- 1 oz. of gold.
- 8 oz. of hydrochloric acid.
- 1 oz. salt of tartar.

Preparation: Mix the mercury with the zinc and gold, and then digest in the acid, well clean the copper article, and then boil it in the above fluid until it has acquired a bright gold color.

BRONZING COMPOUND FOR COPPER

Ingredients:

- 30 oz. of carbonate of ammonia.
- 10 oz. of common salt.
- 10 oz. of cream of tartar.
- 10 oz. of acetate of copper.
- 100 oz. of acetic acid of moderate strength.

Preparation: Cover the copper article with the above compound and let it dry at the ordinary temperature for 24 hours, when the copper will present a variegated appearance of various tints. Brush the metal with a waxed brush. By touching the green portions with ammonia, a blue color can be imparted, and carbonate deepens the color on which it is laid.

GILDING FLUID FOR BRASS

- 33 oz. of caustic soda.
- 24 oz. of water.
- 5½ oz. of moist carbonate of copper.

Preparation: Dissolve the salts in the water, and dip the metal in the fluid, the depth of color produced depends on the length of time of immersion. After removal from the fluid, dip it in water to rinse, and dry in sawdust.

COMPOUND FOR PRODUCING A SILVER LUSTRE ON BRASS

Ingredients:

- 23 oz. of cream of tartar.
- 2 oz. of tartar emetic.
- 500 oz. of hot water.
- 25 oz. of hydrochloric acid.
- 62 oz. of granulated tin.
- 15 oz. of powdered antimony.

Dissolve the first two salts in water, and then add it to the tin and antimony. Steep the brass in the fluid for 30 minutes.

GILDING FLUID FOR COPPER AND BRASS

- 1 gallon of water.
- 25 dwt. of gold converted into chloride.
- 64 oz. of bicarbonate of potash.

Preparation: Convert the gold into chloride by dissolving it in *aqua regia* (i.e., mixture of nitric and hydrochloric

acids), then dissolve in the distilled water, and add the potassic salt and boil the mixture for two hours. For use, the article to be gilded is immersed in the warm fluid for a few seconds.

COMPOUND FOR SILVERING COPPER

- 3 parts of nitric of silver.
- 2 parts of chloride of sodium.
- 210 parts of cream of tartar.

Mix and moisten with water, and rub on the metal like lacquer.

SILVERING FLUID

- 10 oz. of distilled water.
- 14 oz. of chloride of silver.
- 21 oz. of potassic oxalate.
- 30 oz. of chloride of sodium.
- 7½ oz. of chloride of ammonia.

Mix altogether, and apply by rubbing on the metal with a piece of flannel dipped in the fluid.

SILVER PASTE FOR COPPER THAT CAN BE SCRATCHED AND BRUSHED

Ingredients:

- 7 oz. of chloride of silver.
- 142 oz. of cream of tartar.
- 21 oz. of chloride of sodium.

Water sufficient to form a paste.

Mix and keep in a bottle that is protected from the light.

DIPPING FLUIDS FOR BRONZING COPPER, BRASS AND ZINC

- (a) For brass: Dissolve 5 oz. of nitrate of iron, 3 oz. of perchloride of iron in 1 gallon of water.
- (b) For copper: Dissolve 5 oz. of nitrate of iron and 2 oz. of sulphocyanide of potassium, in 1 gallon of water.
- (c) For zinc: Same as for brass.

These are for black to brown shades.

Brown to red shades:

- (a) For brass: Dissolve 16 oz. of nitrate of iron and 16 oz. of hyposulphite of soda in 1 gallon of water.
- (b) For copper: Digest 1 oz. of sulphur and 8 oz. of pearl-ash in 1 gallon of water.

For Zinc: Garacine infusion made to the consistence of cream.

Olive Green for Brass:

Dissolve 4 pints of perchloride of iron in 1 gallon of water for zinc, greengrey. Dissolve 4 oz. of ferrous-chromate in 1 gallon of water.

Steel Grey:

- (a) For Brass: Dissolve 8 oz. of muriate of arsenic in 1 gallon of water.

- (b) For copper: The same as above, but heated to 100 degrees F.

- (c) For zinc: Dissolve 4 oz. of sulphate of copper and 4 oz. of ferrous-chromate in 1 gallon of water.

LACQUER FOR BRASS, RICH GOLD COLOR

- 12 oz. of annotta.
- 12 oz. of turmeric in
- 12 oz. of spirits of wine.

Digest for 12 hours, then filter, and to the filtered fluid add

- 12 oz. of shellac.
- 12 oz. of juniper berries.

Red Color:

- 1 quart of methylated spirit.
- 2 scruples of dragon's blood.
- ½ drachm of red sandal wood.
- 36 grains of oriental saffron.

Filter, and then dissolve in the fluid 5 oz. of seed lac, 2 oz. of amber resin (powdered), and 2 oz. of copal resin (powdered), and to prevent these resins coloring, mix with them 4 oz. of coarsely powdered glass. Dissolve the resin at a gentle heat, and with frequent shakings, and when dissolved, pour off or strain the clear fluid from the sediment, glass, etc.

Rich Red Orange Color:

- 1 quart of methylated spirit.
- 16 oz. of dragon's blood.
- 16 oz. of annotta.
- 16 oz. of gamboge.

After 24 hours digestion, strain and dissolve in the strained fluid 1 lb. of shellac.

Rich Yellow Color:

- 1 quart of hot methylated spirit.
- ½ drachm of saffron.
- 1½ oz. of turmeric powder.

Digest twelve hours, and then filter, and add to the filtered fluid:

- 1½ oz. of gamboge powdered.
- 4 oz. of sandarac resin.
- 4 oz. of elemi resin.
- 4 oz. of seed lac.

The addition of ½ to 1 oz. of dragon's blood to the above imparts a rich orange color.

Pale Yellow Color:

Digest gamboge in powder in hot spirits of wine for several days, and after straining dissolve:

- 6 oz. of seed lac and
- 20 oz. of calcined spirit.

LACQUER FOR DIPPED BRASS

- 1 quart of spirits of wine 95 per cent of strength.
 2 oz. of seed lac.
 1 drachm of copal resin.
 1 drachm of English saffron.
 1 drachm of annotte.

Digest the coloring matter in the spirit, strain, and then dissolve therein the lac.

GOLD COLORED LACQUER FOR BRASS
NOT DIPPED

Ingredients:

- 1 gallon of spirits of wine.
 12 oz. of turmeric.
 $\frac{3}{4}$ oz. of gamboge.
 28 oz. of sandarac resin.
 2 oz. of shellac.
 5 oz. of turpentine resin.

Prepare as above.

LACQUER FOR BRONZED BRASS

To 1 pint of the lacquer prepared as above, add 1 oz. of gamboge and after mixing it add an equal quantity of the first lacquer.

LACQUER FOR COPPER

- 1 quart of spirits of wine.
 8 oz. of mastic resin.
 6 oz. of camphor.
 15 oz. of sandarac resin.
 16 oz. of shellac.

Digest altogether.

ANTIQUE BRONZING FLUID

Ingredients:

- 1 oz. of sal ammoniac.
 3 oz. of tartar powdered.
 3 oz. of chloride of sodium.
 12 oz. of barley water.
 8 oz. of saturated solution of nitrate of copper.

Dissolve the three solids in the water, add the cupric nitrate and for use, cleanse the articles free from grease, and then give one or more applications of the above fluid at intervals sufficient to allow a green verdigris to appear.

No. 1 Dipping Solution.

- 1 gallon of water.
 232 grains of verdigris.
 292 grains of sulphate of copper.

No. 2.

- 1 gallon of vinegar.
 87 grains of verdigris.
 437 " sulphate of copper.
 87 " nitrate of copper.
 146 " chloride of sodium.
 233 " sulphur.

No. 3

- 1 gallon of water.
 5 fluid drachms vinegar.
 240 grains of verdigris.
 540 " sulphate of copper.

The metal to be bronzed should be boiled in the solution until it has acquired the color desired. Copper, when thus treated in No. 3 solution, becomes a rich brownish red.

No. 4 DIPPING FLUID FOR PROVIDING A
BROWN BRONZE

Ingredients:

- 5 oz. of hydrochloric acid.
 8 oz. of iron scales.
 $\frac{1}{2}$ oz. of arsenic.
 $\frac{1}{2}$ oz. of solid zinc.

Boil the mixture until the iron and arsenic are dissolved, and keep the solid zinc in the mixture while in use, dipping the metal in the fluid. — *Hobbies*.

A sensitive mono-telephone has been described by Henry Abraham before the French Academy of Science. In place of the ordinary diaphragm, an armature of sheet iron is supported on two steel wires stretched tightly across the magnet of the telephone. The armature is of such size that it barely covers the magnet. The tone produced by the armature may be varied by adjusting the tension of the wire. The instrument is thus made as sensitive as the ordinary receiver, but is particularly sensitive to frequencies corresponding to the natural sound period of the armature. The instrument is particularly designed for use in wireless telegraphy on systems tuned to a certain wave length.

Those naval specialists who are perturbed at the growth of what they are pleased to call the "speed mania," will be startled to learn that the latest battleship cruiser to be laid down for the British navy is designed for a contract speed of 28 knots. The sister ships were designed for 25 knots and made, on trial, from 27 to 28 knots. Therefore, it is not improbable that, in two or three years' time, we shall be confronted with the spectacle of an 18,000-ton warship that is able to transport her battery of eight 12-inch guns at a speed, for a short dash, of 30 knots and a sustained speed of over 27 knots.

FORGING FOR AMATEURS—Part VIII

F. W. PUTNAM, B. S.

FORGING HOOKS

The making of hooks to be used for chains, as well as for hoisting and other purposes, is an important part of forging work. Fig. 103 shows such a hook and is made with an eye and connected with a chain and varies in size between that eye and the point. This variation is for the special purpose of so distributing the metal that the hook will be the strongest at those points where it is subjected to the greatest stress. If we should consider the depth of the metal to be two inches, with a width of one inch at the point of largest section, the hook shown can well be made of iron two inches in diameter.

In fulling the metal to be used for a hook, select a bar having about the same area of cross section as the largest section of the hook. This will do away with considerable labor of drawing out the stock. It will be noticed that this hook is so shaped that the throat or opening is plenty large enough to slip easily over the link of the chain turned edgewise, but still too narrow to slip down off this link on to the next one, which passes through the first link at right angles to it. To make a hook of this kind, first upset the bar slightly for a short distance near the end and flatten out, as shown at A, Fig. 103. This part will serve to round up for the eye, as shown at B, Fig. 103. The eye is formed over the corner of the anvil, as indicated in Fig. 104. This eye must be carefully forged, since it is hard to round the edge after it has been punched. In fact, about the only way that this can be done after punching is to take a tapered punch, cool it in water, press it through the hole and then hammer the edge of the eye to the desired shape. If the hole has been punched to receive the link, the inside edges of the hole are rounded off over the horn of the anvil, as shown in Fig. 105. When the eye is completely finished, it will appear, if properly forged, as though bent up from round iron. I mean by this that all the square corners are to be rounded off, as shown

in Fig. 106. When the eye is completed, the body of the hook is drawn out straight, forged to the correct size and then bent over the horn of the anvil into shape. Notice in Fig. 103, that the greatest amount of stock occurs at the bottom of the bend, this being the place where the greatest strain would come. You will notice that the stock is to be entirely formed before bending, and so the length of the straight piece must be carefully measured, as indicated at A, Fig. 107. This figure shows the iron all formed and ready for bending. To determine the exact length of the stock required for the finished hook, either the drawing or a sample hook must be measured with a string, measuring along the centre of the stock from the extreme point to the centre of the eye.

I have said that the greatest strain on almost any hook comes at the bottom bend. When the hook is strained by a heavy load, there is a tendency for it to straighten out, and this tendency must be resisted by a sufficiently large cross section of material at this point. The bottom of the hook is to be kept as thick as possible along the line of strain. Fig. 108 shows a very convenient way to start the eye for a hook which is to be forged. A top fuller and a bottom fuller are used, and the hook is shaped or grooved, as shown at A. The bar must be turned edge for edge, between each two or three blows, so as to get the grooves of the same depth. After these grooves are cut, the edge of the eye is forged, as has just been described.

A special style of grab hook, frequently used on logging chains, is shown in Fig. 109. This hook is forged from square stock, by flattening and forming one end into an eye and then pointing the other end. The hook is then bent over the horn of the anvil into the required shape. Sometimes hooks have their eye made by welding, instead of forging from the solid stock. Fig. 110 shows the method of forming the joint for the welded eye: A showing the completed hook, B, the end of the

eye scarfed and bent into shape ready for closing up, and C showing the eye closed and ready for welding. The end of the scarf must be pointed the same as for any other round weld. It will be noticed that there is a considerable length of joint to be welded and great care must be taken to see that the whole of the stock is up to the welding heat. This sort of weld is hardly as strong as an eye forged by the methods previously described; but for all of that the eye is usually as strong as the rest of the hook, for the eye is generally considered stronger than any other part of the hook. A universally accepted design for a hoisting hook used on a crane is shown in Fig. 111.

The formula for figuring out the size of the dimensions shown in this figure has been worked out by Henry R. Town in his excellent book, "Treatise on Cranes." I give below the results of his investigations for this type of hook. Let T equal the working load in tons of 2,000 pounds. Let A equal the diameter of round stock used to form the hook. The size of stock which will be required for a hook to carry any particular load is given below. The upper line gives the capacity of the work in tons. The figures in the lower line, directly under any particular load in the upper line, give the size of bar required to form a hook to be used at that load.

T = $\frac{1}{8}$	$\frac{1}{4}$	$\frac{1}{2}$	1	1½	2	3	4	5	6	8	10
A = $\frac{1}{8}$	$\frac{1}{4}$	$\frac{3}{8}$	1½	1¼	1¾	1¾	2	2¼	2½	2¾	3¼

The other dimensions of the hook are found by the following formula, all the dimensions being in inches.

D = .5 T + 1.25.	I = 1.33 A.
E = .64 T + 1.6.	J = 1.2 A.
F = .33 T + .85.	K = 1.13 A.
G = .75 D.	L = 1.05 A.
O = .363 T + .66.	M = .5 A.
Q = .64 T + 1.6.	N = .85 B — .16.
H = 1.08 A.	U = .866 A.

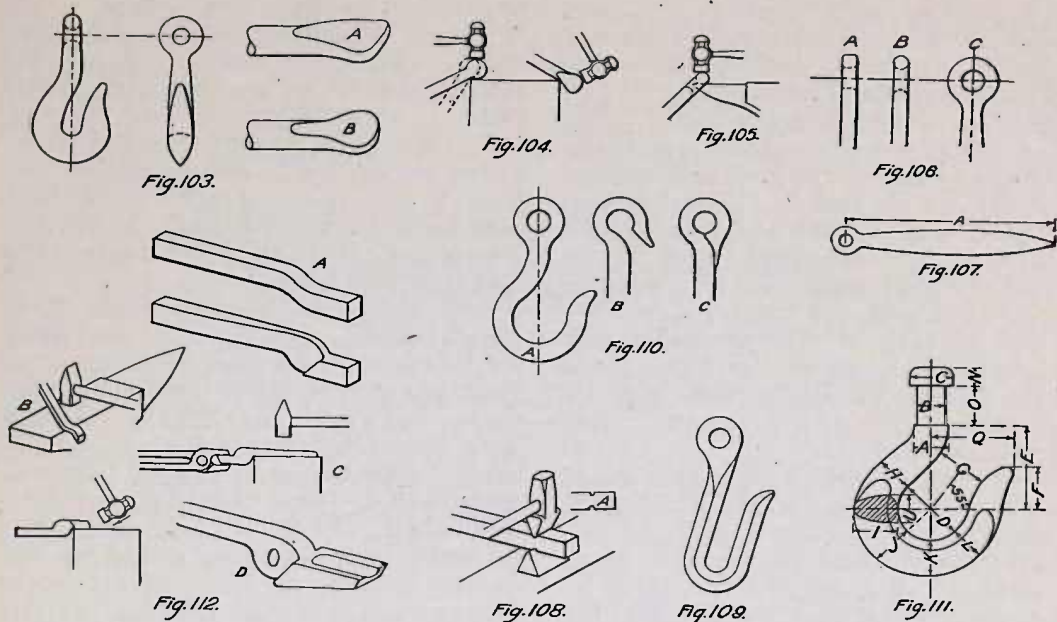
To illustrate the use of the table, suppose a hook is wanted to raise load of 1000 lbs. In the line marked T in the table is found the figures $\frac{1}{2}$, denoting a load of one half a ton, or 1000 lbs. Under this are the figures $\frac{3}{4}$, giving the size stock required to shape the hook. A load of 1000 lbs.

The different dimensions of the hook would be found as follows:

$$\begin{aligned} D &= .5 \times \frac{1}{2} + 1.25 \text{ in.} = 1\frac{1}{2} \text{ in.} \\ E &= .64 \times \frac{1}{2} + 1.6 \text{ in.} = 1\frac{5}{16} \text{ in., about.} \\ H &= 1.08 \times \frac{3}{4} = 1\frac{3}{16} \text{ in., about.} \\ I &= 1.33 \times \frac{3}{4} = 1 \text{ in., about.} \\ M &= .5 \times \frac{3}{4} = \frac{3}{8} \text{ in.} \\ &\text{Etc.} \end{aligned}$$

TONGS

Every blacksmith is constantly being called upon to make his own tongs. If he expects to do his work well and quickly, whether it be on carriage work or the ordinary work of a country forge, he must be well supplied with tongs, and they must be well made. It is no uncommon sight to see a man working at the forge depending wholly on one or two tongs for holding all kinds of work. If the jaw happens to be too narrow, it is heated and a blow from the hammer opens it, or if the jaw opens too wide, the same operation is gone through to close it. This makeshift for tools is very unsatisfactory, and is apt to brand the workman as a poor blacksmith. What would be a complete list of tongs for one man might not be a complete list for another, since many workmen are particular as regards special tools. An assortment that comprises those that should be on every bench may be said to consist of the following: Two pairs of tongs for $\frac{1}{8}$ in. iron, two pairs for $\frac{1}{4}$ in. iron, two pairs for $\frac{3}{8}$ in. iron, two pairs for $\frac{1}{2}$ in. iron and one pair for each succeeding $\frac{1}{8}$ of an in. up to $1\frac{1}{4}$ in., and, above that, a pair for each succeeding $\frac{1}{4}$ in. up to the limit of size. Blacksmiths, as a rule, prefer to make their own tongs. The blacksmith who stands all day at the forge working with poor tongs will find when the day's work is over that the hand that held the tongs is much more weary than the one that held the hammer. There are two methods of forging tongs: One is to make the jaw and handle of a single piece without welding. The other is to forge the jaw and weld on the handle. For light tongs the first method is more common, but for heavy work the second is almost invariably employed. Fig. 112 shows the operations gone through with in the making of a pair of common flat



jaw tongs, such as are used for holding stock up to about $\frac{7}{8}$ of an inch thick, and are made as follows:

Stock $\frac{3}{4}$ of an inch square should be used, being first bent, as shown at A, Fig. 112. The eye is formed by laying this bent piece across the anvil, in the position shown at B, the stock being flattened by striking with a sledge at the edge of the anvil. This will form the shoulder for the jaw. A set hammer can be used to form this shoulder by placing the piece with the other side up flat on the face of the anvil and then holding the set hammer, so as to form the shoulder with the edge of the hammer; then flatten the eye. The handle is then drawn out with a sledge, the metal being worked, as shown at C. Notice particularly, that when work is drawn out this way, that the forging is to be always held with the straight side up, the corners of the anvil then forming the sharp corners up against the shoulder on the piece. If you were to turn the piece the other side up, there would be danger of striking the projecting shoulder with the sledge, and so knocking the work out of shape. A set hammer or swage must be used for finishing the stock up against the shoulder, and the handle should generally be smoothed off with a flatter or else between the

top and bottom swages. The jaw may be flattened toward a point, as shown at D, if desired. Usually the inside face of the jaw is slightly creased with a fuller, so as to make sure that the tongs will grip the work firmly with the sides of the jaws and not by simply touching at the one point in the centre, as jaws will frequently do if this crease is not made. After the tongs have been shaped and finished, the hole for the rivet must then be punched or, better, drilled. The rivet should drop easily into the hole, being about $\frac{1}{32}$ of an inch smaller in diameter than the hole. The straight end of the rivet should be brought nearly to a welding heat, the two parts of the tongs placed together with the holes exactly in line, the rivet inserted and the end headed over. This heading should be done with the pean end of the hammer. After the rivet has been fastened, the tongs will naturally be somewhat stiff, but if the jaws are opened and shut several times with the rivet still hot, the tongs will soon work finely. Generally the tongs should be finished by getting the jaws parallel when the handles are separated, by a fair amount when at the end by fitting to a piece of stock of the size for which the tongs are to be used.

Fig. 113 gives dimension drawings

for a pair of light tongs. The jaws should be made from either Bessemer steel, or American tool steel, which is a better grade of steel. The handle should be made from Norway iron, $\frac{1}{2}$ in. square. The scarfing for the welding together of the jaws and handles is shown at A and B. The ends of the handles are upset and scarfed and then welded to the jaws, using borax or some other flux. It will not be necessary to give any further directions for the making of this particular pair of tongs, as the same directions given above should be amply sufficient for the amateur to readily complete this exercise successfully.

Frequently light tongs are made from flat stock, by making a cut with a small narrow fuller at the right distance from the end of the bar, so as to leave stock enough with which to form the jaw between the cut and the end, as shown at A, Fig. 114. This end is then bent over, as shown at B, and a second fuller cut made, as shown at C, this to be used in forming the eye. The other end of the bar is then drawn out to form the handle, which is indicated by dotted lines in the figure. The jaw is then shaped, the rivet hole is punched or drilled into tongs, and finished, as shown at D, in the usual way.

TONGS FOR ROUND STOCK

Tongs for holding round stock may be either of the methods just described, the operations in making being precisely the same, with the single exception of shaping the jaws. This is usually done in this way. A top fuller and a bottom swage are used, the swage being of the size at which it is wished to finish, the outside of the jaws and the fuller being the size of the inside of the jaws. The jaw is held on the swage and the fuller is placed on top, as shown and driven down on it, forcing the jaw to take the desired shape, as shown at A, Fig. 115. The jaws are then riveted together and generally fitted with a piece of stock of the proper size held in the jaws.

When tongs with welded handles are made, as shown in Fig. 113, it was noticed that a short bar only was

forged, and to this was welded a bar of round or square stock to form the handle. Fig. 116 simply shows the relative lengths of the jaw and handle before the weld is made.

Fig. 117 shows a pair of pick up tongs. These tongs are usually drawn out from a flat piece of stock and then bent, as shown in the figure. No further description should be necessary for making these tongs.

Bolt tongs are usually made from round stock, although square stock may sometimes be used to advantage. First, the bar is bent into the shape shown in Fig. 118. This is usually done with a fuller over the edge of the anvil, as shown at A. When the extreme end is bent, the bar should be held nearly level at first and then gradually drop them, as shown by the arrows, until the end is properly bent. The top edges of the anvil proper are usually rounded sufficiently, so that this may be done without making a crack in the bar. The eye is then flattened with a set hammer and bent between the jaw, and the eye is then worked down to the required shape over the horn of the anvil, and generally on the anvil itself with the same tool. The jaw is rounded and finished with a fuller and swage, as shown in Fig. 119. This might be termed a side view, the end view of the same tool being shown in Fig. 115.

There is a common tendency, in making bolt tongs, for the spring of the jaw to open up altogether too much in forging. If this happens, the jaw may be bent back into shape with a hammer, as shown at B, Fig. 102, or else on the face of the anvil, as shown at A. The first bend may also be made by another method, as shown in Fig. 121, where a fuller and swage block are both used, or a swage of the proper size might be used in place of a swage block. In order to bend the iron successfully with a swage block, it must be brought to a very high heat.

The next article will contain the description of some other simple forgings. We have nearly reached the point where we shall take up the discussion of the making of tools which require tempering. As these are made from steel, I wish at this time to give

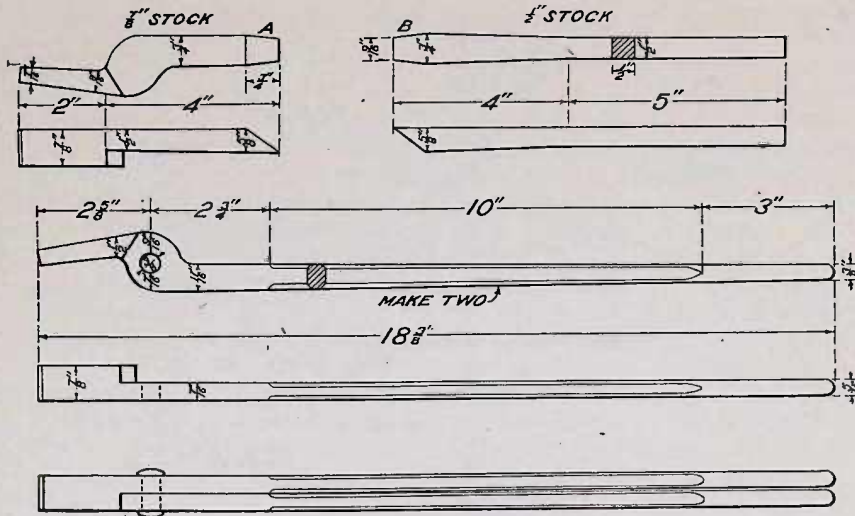


Fig. 113.

a little further information on steel to supplement that given previously in the discussion of metals in one of the earlier articles.

The designation of steel was formerly confined to those forms of iron which could be hardened by heating to redness and then plunging in cold water. The introduction of the Bessemer processes marked a new era. The metal produced by this process lacked the fibrous character associated with wrought iron, and took on more or less the character of steel. Those varieties possessing more than 3% of carbon sensibly harden when treated in the same manner as steel, but with less carbon this is not the case. Other processes producing similar soft metal sprang up, and the term steel has come to include a large variety of material having very widely different properties. Some of these varieties are even softer than wrought iron and cannot be hardened. The hardening property depends directly on the amount of carbon the metal contains, so that a classification based on the percentage of that element is the most convenient. Steel containing less than .5% is classed as *mild* steel. Steel proper contains from .5% to 1.7% of carbon. The different nature of these metals is shown by the use of such titles as Bessemer, Siemen's or open-hearth steel. Some of these contain as little

as .13% of carbon, less than is usually present in wrought iron. They differ from that metal in being free of fibre, more even in grain and, unlike it, are obtained in a state of fusion and cast in ingots.

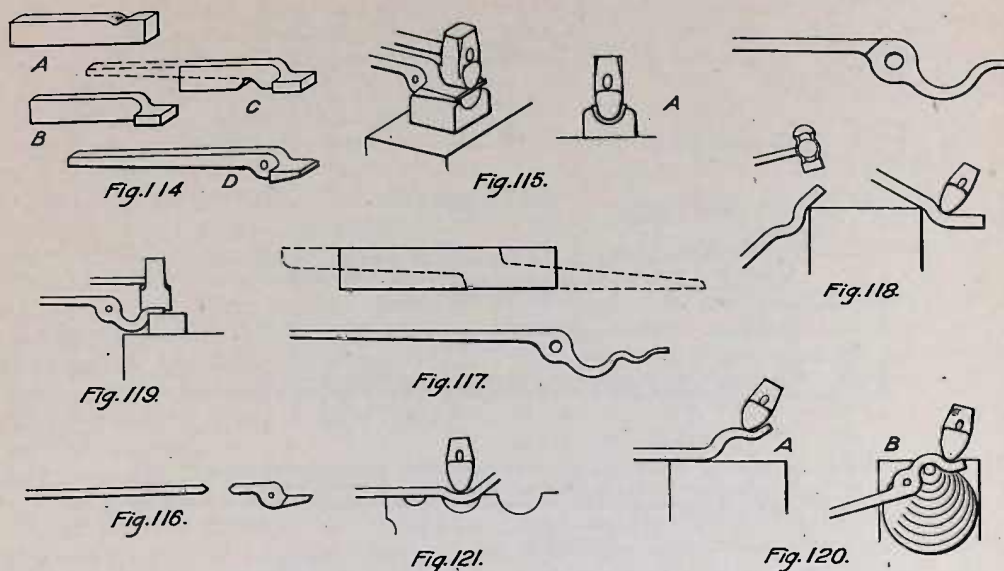
The fracture of steel becomes finer the larger the proportion of carbon present, but is affected by such treatment as hammering cold. Steel of hard temper, breaks with a bright, uniform, bluish, gray, finely granulated fracture. After hardening, the color is somewhat whiter.

It is very malleable, but requires working more carefully and at a lower temperature than wrought iron. Steel containing less than 1.25% of carbon can be welded. A lower temperature must be employed than for malleable iron, or the steel will be burnt. To render the surfaces clean at the lower heat, borax mixed with about one-tenth of its weight of sal ammoniac is employed to dissolve the scale.

The specific gravity varies from 7.624 to 7.813, in the unhardened state, and 7.55 to 7.75 in the hardened condition, showing that expansion occurs.

The melting-point varies with the proportion of carbon. The softest melts a little below 1,600 degrees C. The hardest, at about 1,400 degrees.

The tenacity varies from 22 tons in mild steel to upwards of 70 tons in steel of hard temper. Its *elasticity*



exceeds that of wrought iron, while its ductility is equal to the best qualities of that substance. The mild varieties suffer a lengthening and diminution in area, when subjected to a stretching force greater than wrought iron. The lengthening of the harder varieties is much less, but the elastic limit is high.

The methods of producing steel may be classed as follows:

1. *Direct methods:*
 - (a) From iron ores.—Catalan and analogous processes.
 - (b) From cast iron.—Puddled steel.
2. *Indirect Methods:*
 - (a) By the carburization of malleable iron in an unfused state.—Cementation and case-hardening processes.
 - (b) By carburization of molten malleable iron.
 - (1) Fusion of bar iron with carbon in crucibles.—Cast crucible steel and Wootz processes.
 - (2) The carburization of molten malleable iron obtained by complete or partial decarburization of pig iron. Bessemer and open-hearth processes.

Excellent steel of middle temper can be made in open hearths of this type, by giving the tuyere less inclination,

so that the blast does not play so directly on the accumulating mass of metal, and removing the slag more frequently than in malleable iron.

In making steel in these hearths, less small ore is added, so that the slag is less basic, and less blast employed. By these means, the reduction is somewhat prolonged, affording opportunity for carburization by decomposition of carbon monoxide by the spongy iron, while the direction of the tuyere and the removal of the slag prevent decarburization by the oxide of iron it contains, and by the air. The presence of manganese in the ore is also favorable to the production of steel. Its oxide gives greater fluidity to the slag, and is less energetic as a decarburizing agent.

Steel can be made in the puddling furnace by arresting the process before decarburization is complete, sufficient carbon being left to constitute steel. White pig irons containing manganese and free from sulphur are best adapted for the purpose.

(To be continued.)

Weather-resistant Plaster Mortar.—Mix 6 parts of freshly-burned plaster, 3 parts of brick dust, and 4 parts of blast-furnace slag sand with sufficient water, into a mortar and immediately before use add 2 parts of iron filings.

AN OLD BICYCLE CONVERTED INTO A GRINDER

As there may be some amateur mechanics (particularly automobilists) who do not possess a grinding and polishing machine, although they would find such an appliance of considerable use, it is thought that the accompanying description and illustration of a machine, made by the writer in about an hour's time and at practically no expense, might be of interest.

The cheapness and ease with which it can be made are due to the utilization of certain parts of a bicycle (which is usually available or can be obtained for a small sum, second-hand) for the driving mechanism, and to the employ-

the rear wheel, and nailed to a board at the top, so as to clamp the bicycle frame tightly between them, with the axle in the holes previously mentioned. This board should be firmly fastened to the top of the bench, and should be long enough to bring the grinding wheel in a convenient position, while its width should be sufficient to cover the tops of the axle supports. An upright board should support the head of the frame, so that the pedals will clear the floor by about 2 in.

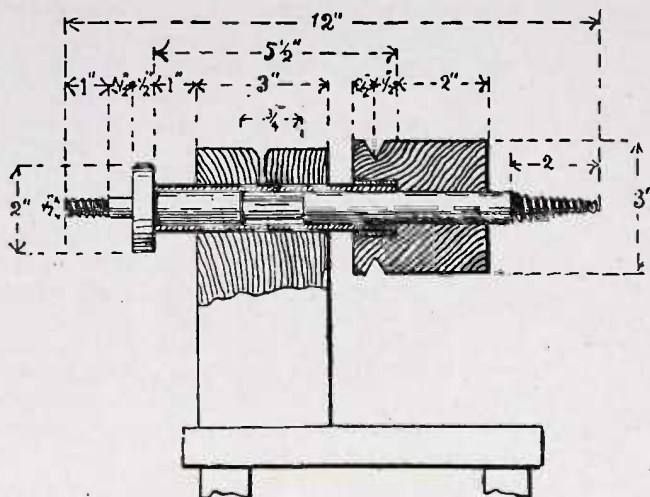
The grinder head, used with this foot-power device, consists of a block of wood about 3 by 3 in., fastened firmly on to the top board by nails or screws, and of sufficient height to bring the grinding spindle to the desired position, a brass bushing, which is of about $\frac{1}{2}$ in. iron pipe size, tightly fitted in a hole in the top of the block, a grinding spindle, and grooved wood pulley. The spindle is the only piece requiring lathe work, and even this may be eliminated by using a straight rod (the bushing tube being of a size selected to fit it), and very carefully threading it with a $\frac{1}{2}$ in. 12 die for the collar and clamping nut.

It is, however, much more satisfactory to have a turned spindle, as it can then be made a better fit in the bushing, and the inner collar and part carrying the wheel can be turned true with this bearing surface. The part of the spindle that goes into the inner



ment of a convenient work bench or strong table as a stand. The bicycle should have as high a gear as possible (it is not injured, and can be re-assembled and used on the road again) and should have its front wheel, forks, handle bar, and back tire removed.

In order to support the remaining parts, two boards about $1\frac{1}{4}$ by 4 in., reaching from the floor to the top of the bench, should be provided, and these should each be drilled 16 in., from the bottom, with a hole of a size to fit tightly on the nuts on the ends of the rear axle. These boards should be nailed to the floor on each side of



DIMENSIONS OF THE GRINDER HEAD.

collar should be made a drive fit in the collar, and the latter should be turned while in place on the spindle. A nut and large washer should be provided for clamping the grinding wheel on the spindle.

The other end of the spindle is formed with a threaded taper for polishing and buffing wheels, although it would be cheaper to leave it blank. It could also be arranged to carry a second grinding wheel, if desired. The pulley

which goes on this spindle is cut (if possible turned) out of a piece of hard wood, and is bored so as to make a tight fit on spindle.

If it should show any tendency to slip, a set screw can be run through it and against the spindle. This completes the machine with the exception of a $\frac{3}{8}$ in. leather belt, a grinding wheel ($\frac{3}{4}$ by 6 in. is a good size), and, if desired, a tool rest which can be rigged up around the wheel.—*Home Handicrafts.*

THE POULSEN WIRELESS SYSTEM

All systems of radio-telegraphy at present in commercial use are founded on the principle that when energy is released in the form of an electric spark it creates a disturbance in the ether, which conveys some of that energy to a distance in the form of waves, the presence of which is detected by appropriate instruments. To use an acoustical simile, energy is given to a stretched string by drawing it to one side. This energy may be dissipated chiefly in the form of air waves by suddenly releasing the string. Drawing the string to one side represents the charging of a condenser, while the release of the string is like the spark discharge, followed in both cases by the generation of waves. Electrically speaking, relatively long pauses follow each train of ether waves; it is, therefore, obvious that if these inactive periods could be filled up by a continuous stream of waves, more energy would be available for detection at the distant stations, and therefore better telegraphic results would be obtained.

Poulsen of Copenhagen solved this problem, says the *London Times*, by putting a Duddell singing arc into a magnetic field and feeding it with hydrogen gas. The Duddell arc consists of a continuous current arc shunted by a capacity and inductance. Acoustically speaking, Duddell found that the stretched string could be made to vibrate continuously (though feebly) by bowing it, and Poulsen supplied resin to the bow. Very little energy is necessary to throw a body into vibration, provided it receives impulses corresponding exactly to its natural period of vibration. This principle

of resonance holds true electrically, and it was at once seen what an important factor this would become in power economy with a Poulsen arc as an impulse generator, seeing that a continuous stream of definitely timed impulses would be available at the receiving station, besides being noiseless in operation.

To take full advantage of resonance it was necessary that the waves should be constant, and research was conducted on the original Poulsen lamp by Messrs. von Traubenberg, Tiedemand, and Balsillie, with the result that the new generator gives a wave of such constancy that its extreme variation is only .035 per cent.; in other words, a wave one kilometre long has a maximum variation of 35 centimetres. The efficiency of a Poulsen generator is high, being about 60 per cent., but the interesting point is that with a loose inductive coupling the efficiency rises instead of falling, as is the case with spark systems. The detection of these continuous waves is best accomplished by a very ingenious and simple device invented by Pedersen (a colleague of Poulsen), consisting of two cross wires in rapid vibration, which alternately make and break the circuit, and is called a "Tikker." When the contact is broken, the waves, which have too high a periodicity for the ear to detect, charge a condenser, and when the contact is made again the accumulated energy is discharged through a telephone or other detector. As its name indicates, by the heating of a thermojunction it rectifies the high frequency current set up in the oscillating circuit (with which it is in series) into a continuous current which

can be used to actuate a relay or measuring instrument.

Another interesting receiver is an adaptation of the Edelmann thread galvanometer, whereby the passage of oscillations through a thin gold wire in a magnetic field cause it to sag; this movement is photographically recorded on a moving strip of sensitized paper which is automatically developed and fixed. As there are no mechanical parts, and therefore no inertia to overcome, the speed at which this recorder will work is far greater than any transmitter yet invented is capable of sending. With an automatic transmitter, messages have been sent and printed at a rate of 120 words per minute over a distance of 560 miles. It is interesting to note that this detector works with one one-hundred-millionth of an ampere.

A very important feature of the Poulsen system is the ease with which disturbing elements can be eliminated at the receiving station, and this is a matter of vital importance in practical work. Resonance being exact, the tuned circuit can be removed so far from the antenna inductance—in other words, the coupling can be loosened—until all disturbance is cut out and only the signals from the transmitting stations are distinguishable. For this purpose a coupling of as much as 8 feet has been used.

As a proof of the exactness of tuning, two messages have been simultaneously received on one antenna where the difference in wave length was less than 2 per cent.; one transmitting station was 210 miles away, and the other 560 miles. In addition to telegraphy, it was evident that telephony was also possible. By means of a microphone, the voice could be easily made to alter either the intensity or length of the continuous waves. Experiments over short distances gave such excellent results that rapid strides were made, until at length the station at Weissensee, Berlin, was able to transmit audibly to Lyngby near Copenhagen, a distance of 260 miles overland. Over smaller distances, the wireless telephone is marvellously clear, and the absence of sound distortion is remarkable. A thermo cell is used as detector, though it would be interesting to try one of Dr. Fleming's ionized gas detectors; but the problem in long distance radio-telephony

is not so much with the detector as in finding a microphone capable of carrying sufficient energy for transmitting purposes.

The achievements of the Poulsen system may be summed up as follows:

TELEGRAPHY AND INTERCOMMUNICATION

Portable station, 6 K. W.—270 miles over land.

Duplex receiving with 2 per cent. difference in wave length—560 miles over land and sea.

Auto-transmission and reception at 120 words a minute—560 miles over land and sea.

Fixed stations, 5 K.W. and 3 K.W.—2,100 miles over land and sea.

TELEPHONY

260 miles over land.

The future of commercial radio-telegraphy probably lies in long distance work, to which the Poulsen system particularly lends itself. A large station has been erected on the west coast of Ireland, for the purpose of demonstrating the possibilities of the system on a large scale by transmitting at high speed to a similar station in Canada. As the distance is but 2,800 miles, while 2,100 miles have been successfully covered with but five k.w. high frequency energy, there is no room to doubt that with the large power installed in Ireland, another trans-Atlantic radio-telegraphic service will soon be available. Sir William Preece hailed Poulsen's discovery in its early days as sounding the death knell of spark wireless telegraphy.

The development of this system has entailed an expenditure of \$500,000, and also research of a most exhaustive nature.

A successful test of wireless telephony was recently conducted between the British cruiser "Furious" and the schoolship "Vernon." Both vessels were steaming at full speed, separated by a distance of 50 nautical miles. The De Forest system was used. The inventor operated the transmitter on the "Furious," while Mrs. De Forest received the messages on the "Vernon." The test consisted largely in repeating stock quotations and it is stated that out of 154 figures, there were only two mistakes.

THE PRINCIPLES OF THE STEAM INJECTOR

BY F. L. BAILEY

It is really appalling how few engineers truly understand the working principles of the steam injector. Ask, and a very large percentage of them will frankly tell you that they do not understand it and that no one else does. Others will give you theories of it which go straight against the rules of steam and hydraulics. There

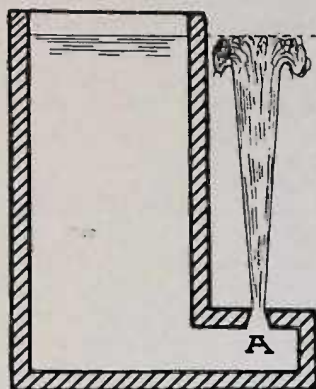


FIGURE 1



FIGURE 2

are very few who can tell you its true principles. It does seem hard to understand how steam can leave a boiler under pressure, pass through this little contrivance, and then re-enter the boiler against the same pressure, carrying with it a stream of water. It is hard to see why the steam does not escape down the suction hose or the overflow. However, in spite of all this, the operation of the injector is no miracle, nor perpetual motion, and, like everything else, has its reason.

Now let us study the action of the steam and water in the injector. To understand it thoroughly we must know a few rules of hydraulics. In Fig. 1, water issuing from the orifice "A" will rise to the same height as the head of the water, minus the head lost in friction on the sides of the orifice and the resistance of the air. These two losses will amount to a great deal where the opening is small and the

head high. According to this rule, water discharging from pipe "A," Fig. 2, into pipe "B" will produce the same pressure in the latter as the pressure is in the former minus the friction—which would be a good deal in this case.

Now, keeping these two rules in mind, see Fig. 3, which shows one of the simplest forms of the injector. It is composed primarily of a steam nozzle "A," condensing tube "B," and delivery tube "C." To operate the injector, the lever "E" is drawn back, which removes the ground plug "D" from the steam nozzle. The steam then rushes through the condensing and delivery tubes against the check valve, but being light has not power to open it, so it lifts the overflow valve "F" and passes through a tube connected around the injector to the pipe marked "overflow," and thence to the atmosphere. The steam, being expansive, of course passes through the condensing tube at a very great velocity, much greater than would water or any non-expansive fluid, but, according to the rules of hydraulics, even the much slower water will produce pressure to re-enter the boiler minus the loss in friction. Now, if we could only get water to pass through the condensing tube, at a velocity even near as great as the steam, its momentum would be great enough to enter the boiler. Just a glance will show how the injector is able to give the water this velocity. The steam passing through the condensing tube produces a partial vacuum in the feed water pipe, which causes the water to rise. The steam then catches it and blows it through and out the overflow. For a time steam and water pass together out this pipe, but soon enough water rises to condense all the steam before it gets through the condensing tube. This leaves a solid stream of water, moving at a velocity nearly equal to that of the steam to strike the delivery tube. The result is ample pressure to enter the boiler. As soon as the water begins to enter the boiler, the overflow valve closes, which prevents any air from interfering with the operation.

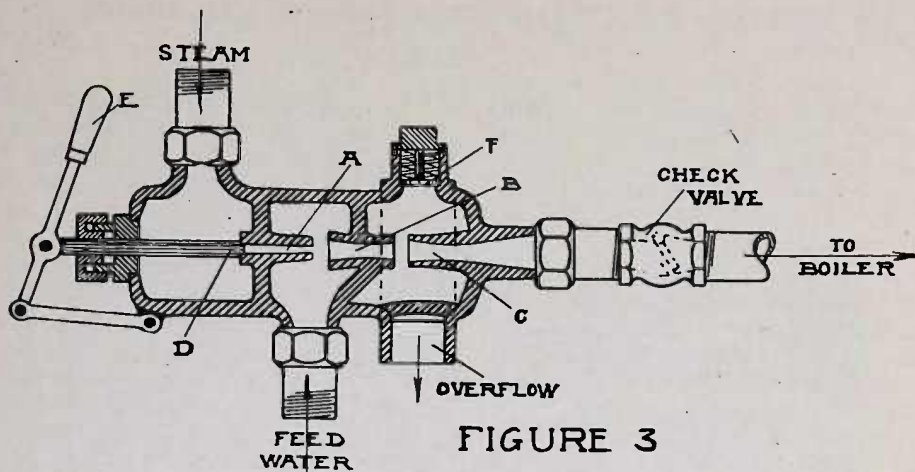


FIGURE 3

It is very important that engineers should know the theory of the injector, for, by doing so, they are able to tell more readily its ailments, when it refuses duty. For instance, when a stream of steam and water continues to flow out of the overflow, it is evident that the feed water valve is not open wide enough or the pipe has an obstruction in it, as there is not enough water to condense all the steam. When a stream of water flows from the overflow, especially if it is not very hot, it is almost certain there is not steam enough to give it the required velocity; and, if more steam does not remedy it, the check valve is either stuck on its seat or the delivery pipe obstructed. When a mixture of steam, air and water escape from the overflow, the overflow valve is up. When stopping the injector, always see that the check valve closes. This may be told by the sharp click it makes, as it goes shut, or by watching the overflow for a few moments. If it has failed to close, first water and then steam will escape from the overflow, and, if tapping on the valve with a stick does not remedy the trouble, the fire will have to be pulled out, as the escaping water will soon leave the boiler dry. On account of this, most injectors are fitted with a stop valve between check valve and boiler, which may be closed in such emergencies, and then the check valve removed and cleaned at leisure.

An electric barometer has recently been invented, which depends for its operation upon the short-circuiting of a U-shaped carbon filament by means of a barometric mercury column. The filament dips into the top of the column, and as the atmospheric pressure increases, the mercury rises in the tube, cutting down the length of the exposed part of the filament, and thus reducing the resistance. As the mercury is also affected by temperature, a second filament and mercury column is provided. In this column the tube is sealed, so that the mercury will not be affected by atmospheric conditions. As the filament is more or less covered by the thermometric column, the resistance correspondingly varies, and this variation in resistance is introduced in the circuit of the barometric filament, so as to counteract the temperature variations in the latter.

The government telegraph lines in France have adopted a system of charging only one centime or a fifth of a cent per word for messages dispatched at night. This rate applies to messages containing at least fifty words. In this way it is hoped to keep the wires almost as busy at night as in the daytime. The value to the commercial world will be that a business man can send by telegraph a communication, comparable in length with an ordinary letter, and at but little over regular postage rates, with the assurance that the message will be delivered the very first thing on the following morning.

WIRELESS TELEGRAPH SIGNALLING ON RAILROADS

FRANK C. PERKINS

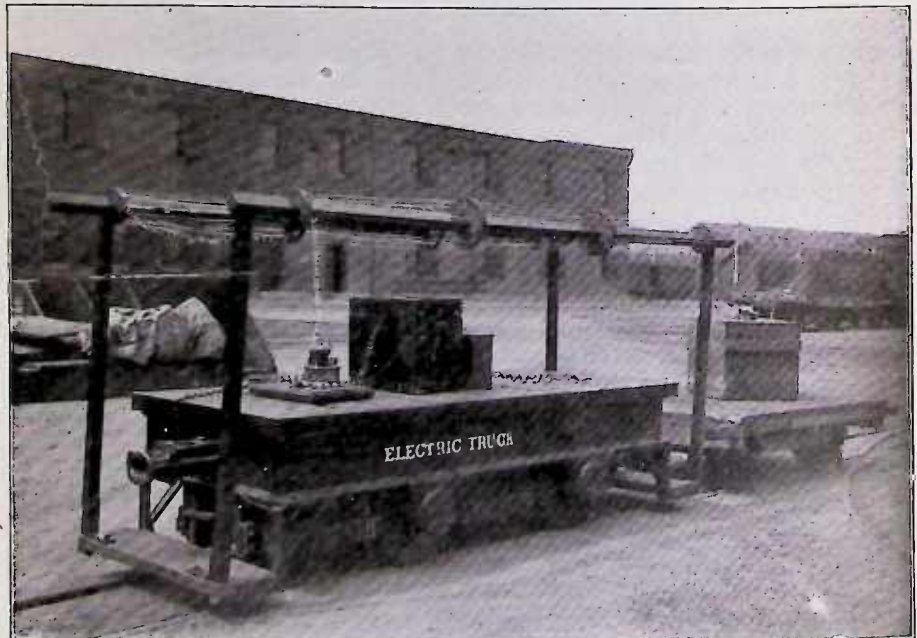
The accompanying illustration shows an experimental car used for demonstrating the transmission of signals to moving trains by wireless or radio-telegraphy, as designed by Dr. F. H. Millener and constructed at the Union Pacific Shops at Omaha, Nebraska. The car carries antennæ which receive the current and transmit it to relays and magnets which, in turn, start a motor attached to the car controller, thus starting the car as one of the experiments.

Dr. Millener states that his experimental car is not operated by power transmitted from a remote point, but is operated by a storage battery and that the experiments were simply the transmission of impulses from a central point as a means of starting the car, ringing a bell or imparting other audible signals to the operator in charge of the car.

This experimental car was so arranged that by wireless telegraphy relays opened and closed circuits to operate a whistle or bell, and, if desired the mechanism could be designed to set the brakes by the wireless transmission of current from a central station.

It is stated that in actual practice on long roads the method of stringing a wire parallel to the track and transmitting the current to the car by the induction method would be entirely satisfactory. It is stated that the central station method has been used over distances of about five miles, and that this limit was due to a lack of facilities rather than inability to transmit to a greater distance. It is said that the practicability of this wireless system of transmitting signals over greater distances for railway service is to be demonstrated on the Union Pacific Railroad between Omaha and Fort Leavenworth.

The inventor holds that there is little chance of transmitting power for commercial purposes by a wireless system and maintains that telephoning to a moving train is not a success, due to inability to provide a satisfactory telephone instrument for this service; but that equally good results can be obtained by a system of transmitting signals by wireless telegraphy to the trains, as there is no particular benefit to be gained by the engineer conversing with the train dispatcher.



Wireless Truck Equipped in 1907



Wireless Controlled Electric Truck, designed and operated by Dr. Frederick H. Millener, E.E.

Dr. Millener maintains that he can communicate with as high as thirty-five trains, selecting any train without signalling the others. A remarkable feature of this experimental electric truck is that by the use of a mechanical selective system, the inventor has been able to move the storage battery car shown in the illustration, or rather control it, giving it four speeds ahead, stop it, and reverse it at the same number of speeds, or starting or stopping it at will. It was also possible to ring a bell without interfering with the other signal, and the inventor maintains that he sees no reason why gates or bells at a crossing, as well as moving trains, may not be so operated and signalled.

The largest induction motor in the world was started recently at Gary, Ind., where it is installed in a large rolling mill. The motor is rated to develop 6,000 horse power. It is of the three-phase 25-cycle type, and two 2,000-kilowatt Curtis turbines generate the current necessary to operate it. The motor receives the current at 6,600 volts. By using a step-by-step controller starting at 1,350 volts, the motor was successfully started in the proper direction, coming to full speed in 45 seconds.

The first popular application of electric heating for household use was in connection with the electric sad-iron. Now there are a large number of heating apparatus in use, which are proving very successful for occasional use or in certain special circumstances, although not in the least competing with coal for ordinary heating purposes. In a paper presented at the recent meeting of the American Institute of Electrical Engineers by Mr. W. S. Hadaway, Jr., on electric heating, he estimates that one watt will heat one square foot of common radiator surface through 1.26 deg. F. The cost of a kilowatt hour he places at 6.7 cents, and the cost of one steam-heating unit at 40 cents. On this basis, electric heating would be fifty times as expensive as steam heating. No doubt the time will come, however, when the current which is generated from heat at the power station can be reconverted into heat at the house with sufficient economy to compete with the coal furnace.

Ask poor people "which would you rather have—talent or wealth?" and they will answer "Wealth." Ask rich people the same question, and many of them would answer, "Talent."

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.

1044. Material of Brushes.—Transformer. F. P. H., Baltimore, asks: (1) I have a $\frac{1}{2}$ h.p. Crocker-Wheeler motor which I am going to run as a dynamo and which will furnish 12 volts and 10 amperes. Which would be better and more efficient to use, copper or carbon brushes, and what size? (2) Are the attached drawings and dimensions suitable for a small stepdown transformer, to reduce 110 volt a.c. to 5 volts? The iron core is to be made of annealed sheet iron, the primary on one limb and secondary on the other limb. Give size of wire for both primary and secondary, and number of layers on each, so as to allow a current of about 10 amperes, or as much current as possible for this size core, to be taken without undue heating. Would it be practical to divide the secondary into 5 windings, so as to make a rectifier in the circuit, or so as to obtain from 5 to 25 volts by combining the different windings, and would this affect the size of the wire? Also give the watt capacity of the transformer. Ans.—(1) Carbon brushes are ordinarily preferable, but are not usually possible for machines that generate less than 50 volts. (2) You will get poor regulation if you dispose the two windings on separate limbs of the core. Better place half of the primary and half of the secondary on each limb. Also, let the primary be over the secondary. That is, make the primary large enough to slip over the other, with plenty of room between for insulation. Instead of winding so many sections, it will probably suffice to have only two, which you can put at will in series or parallel with each other. Let each secondary consist of two layers, 32 turns per layer, of No. 13 wire. Each of the two coils will generate 5 volts and be capable of carrying 5 or 6 amperes, so you can get 5 volts and 10 to 12 amperes with parallel connections, or 10 volts and the lower current with the series connections. Primary will consist of 90 turns per layer, and 8 layers in each of the two coils, of No. 24 wire, these two coils being permanently connected in series. We do not understand your reference to a rectifier.

1045. Interchanging Motors. L. N. A., Chester, S.C., asks: Why cannot two direct current generators be used as motors to advantage in a mill that is changing over from steam drive to electric drive? They have

been used heretofore for lighting purposes. The first one was made by the Westinghouse Elec. & Mfg. Co., $37\frac{1}{2}$ k. w., —e. m. f. 125—amps. 313—speed 900. The second was made by Triumph Elec. Co., Cincinnati, 50 k.w.—125 volts—900 rev., and compound wound. They are both belted machines. The current for them to be run by is 3 phase, 125 volts, alternating, at approximately 60 cycles per second. If they can be used to advantage, about what h.p. would they generate as motors? Ans.—The two direct current generators probably have four poles; therefore, as alternating current machines, the speed to care for 60 cycles would be 1,800 rev. per min. Undoubtedly they would not stand this speed. If they could, they might be used as synchronous motors, but they would not be self-starting, and would require some source of direct current to energize the field magnets. Three rings would have to be attached to each armature, probably by displacing the commutator. In consequence of the double speed, they would be capable of fully twice the present h.p. rating.

1046. Potentiometer. E. G., Rochester, N.Y., asks: (1) Where can German silver resistance wire for a potentiometer be obtained? (2) I have a bipolar d.c. dynamo, with armature of the Gramme ring type, having 15 coils and 15 segments in the commutator, and is wound with No. 24 wire. I have the same size on the field coils. How can I change the machine into an a.c. single phase generator for 110 volts? Ans.—(1) Almost any electrical supply house. Try Manhattan Electrical Supply Co., New York City, if you cannot obtain it in your city. (2) You have given no dimensions, and we cannot conjecture what voltage the machine will generate. If you will wind paper over the commutator, slip on two separate copper rings, attached respectively to as nearly opposite points in the winding as is convenient, separately excite the field magnet with direct current, you can get alternating current from the rings. For 60 cycles a speed of 3,600 revolutions per minute will be necessary. The voltage we cannot predict, but it will be about .7 of whatever direct would be generated at that speed.

1047. Motors. A. D. P., Island Falls, Me., asks: (1) What is the mechanical difference between shunt winding and series winding in dynamo and motor making? (2)

How long will a dry cell battery last in continual use? (3) How long will it keep its strength if laid by and not used? Ans.—(1) The same machine can be wound in either manner, or indeed can have exchangeable windings of both sorts. In actual use, however, the applications of motors with these two fundamentally different principles are so marked as to lead to few instances of confusion. The shunt winding is needed for ordinary stationary purposes, where a fairly constant speed is desired, or is imperative. The series motor is inherently a variable speed device, like a steam engine without a governor, and is, therefore, selected for railway and elevator uses,—in every case the armature being definitely geared or coupled to its load, and directly under the control of an attendant.

1048. **Voltmeters and Ammeters.** J. J. R., Newton, Kansas, asks: (1) Why does a high resistance galvanometer measure amperes and a low resistance galvanometer measure volts? (2) From what company can I obtain metals and chemicals for electroplating? (3) Where can I obtain sheet aluminum? Ans.—(1) We think you have quite the wrong idea. Considering the instruments as a whole, the very opposite is the truth. A voltmeter must have a high resistance, else it will steal too much current for economical working, and also the heat resulting will endanger its own existence. An ammeter is inserted directly in the main circuit, hence it must have a low resistance, so as not to waste an undue voltage in forcing the current through it. In the case of permanent-magnet movable-coil ammeters (Weston), most of the current is passed through a low resistance shunt. Read Chapters XIX and XX of the Engineering Series. (2) Hannon & Van Winkle, Newark, N.J. (3) Pittsburg Reduction Co., New Kensington, Pa.

1049. **Toy Alternating Current Motors.** J. R. E., Christiansburg, Va., asks: (1) How is it that a toy motor with commutator and brushes runs on an alternating current, and why is it that the alternations do not counteract one another and produce no effect upon the armature? An ordinary direct current motor will operate as an induction motor if the brushes are short circuited. That is what the books say, and that implies that they will not run unless the brushes are connected. (2) How long will one of the d.c. motors with cast field thus run without heating too much? Ans.—If you try a direct current motor on its intended circuit, the armature will rotate in a certain direction. In this test you made no particular reference to which binding post you attached a given wire. Now, if you exchange these two wires, thereby reversing the current in the motor, the direction of rotation will still be the same. No matter how fast you make the exchange, the result will be as before. Therefore, if you apply a current that is rapidly alternating, there is no reason why the direction of rotation should be affected. The only detraction is that sparking and heating will result. See Chap. XVI of the Engineering Series.

1050. **Armature Winding.** B. E. Co., Richmond, Va., asks for diagram of a drum armature that has three or more wires going to each segment of commutator, also what style of winding it is? Ans.—The only difference from the ordinary kind is that two or more wires are wound in multiple, rather than a single large wire. The bundle of small wires is more easily arranged on the core, is easier to bend, and generates less eddy currents than the single equivalent wire.

1051. **Field Magnet Winding.—133-cycle Motor.** H. L. S., Coldwater, Mich., asks: (1) With 12 slot laminated armature 3 in. diam., $1\frac{1}{2}$ long, wound with 12 coils, 50 turns each of No. 22 wire, connected with 12 segment commutator, what will be the correct shunt winding with field magnet of "Manchester" type? What will be the voltage and output? What should the speed be? (2) Would it be practicable to rewind an old 133 cycle induction motor for 3,600 R.P.M. on a 60 cycle 110 volt line, by combining four poles on each side for one, and winding somewhat like the slotted stators of large motors? Would it be better to combine three poles instead of four, leaving two vacant? Ans.—Your sketch of field magnet does not indicate whether the cores are of wrought or of cast iron. Supposing the former to be the case, we should think the machine should be capable of generating 50 volts, and if so, a shunt winding of 3 lbs. of No. 25 single cotton-covered wire should suffice. (2) For 3,600 revolutions per minute on a 133-cycle circuit the actual number of active field poles will be four. The rest you mention must belong to the starting coils. For 1,800 revolutions on a 60-cycle circuit, you still need four poles, which you can get by dispensing with the starting coils and winding new main coils that will embrace adjacent pairs of the entire eight poles. Probably No. 22 wire will suffice.

1052. **Re-energizing Permanent Magnets.** R. C. B., Northport, N.Y., says: I have a magneto sparker with two permanent magnets, size of sketch on other side. Magnets are weak, and I wish to recharge to saturation. How many turns of what size wire required on each leg of magnet, using 110 volt direct current, with how many 16 candle incandescent lamps in series? Ans.—It really makes little difference what particular winding you use. Take any wire you happen to have on hand, and wind two coils that will fit over the limbs of the magnet, extending the entire length of the straight portions, and leaving an eighth of an inch of clearance for insulation at the corners. If you have No. 18 wire, use a bank of five or more lamps,—of course, in parallel with each other, but the group in series with the coil. Of course the current is to be kept on for an instant only. Two pounds of wire will suffice.

1053. **Pocket Storage Battery.** F. O. S., Morgantown, W. Va., asks: In replacing dry battery in a coat flash light, I plan to make 3 cells 1 in. in diam. and about 4 in. high, connecting them in series and using a 5-volt lamp. (1) Which plate should be the +

and which the — in the sketch herewith of one of the cells? (2) Give formula for making the paste for both plates. (3) Should there be holes punched in the half inch lead pipe? (4) Can these cells be charged on a 220 volt alternating current, using an aluminum rectifier, by using lamps as resistance to cut down the voltage, or must I use a transformer along with the rectifier? Give full directions for charging these cells. Ans.—Your ideas of similarity between storage and dry cells are rather erroneous. The paste that is on one of the lead plates or tubes must not by any means be allowed to come in contact with that on the other. Furthermore, you seem to make no allowance for sulphuric acid at all. Watson's new book on "Storage Batteries" will be helpful to you in understanding some of the fundamental principles involved. With the proper construction adapted, you will need a transformer to step the voltage from 220 to 10 or 15, and then a rectifier to change to direct. A voltmeter and ammeter of the permanent magnet type, and a hydrometer are essentials for any one who proposes to meet with success with storage batteries.

1054. **Small Power Transmission.** C. C. H., Washington, Kansas, asks: (1) What additions will be necessary to the common winding of the Ajax battery motor to make it run on the current of No. 7 hand power dynamo, which will light a 12 volt 10 c.p. lamp and run small electrical railway? The dynamo has two commutator segments and the motor has three. (2) How large an engine would be required to run No. 7 Dynamo at full speed under full load, and light lamp as above stated. Which would be the more satisfactory, a steam or gasoline engine? Ans.—(1) The ordinary two and three coil armatures have solid cast iron cores, and are not, therefore, well adapted for continuous economical use. Considerable heat will be developed from the flow of eddy currents. Besides, the numerous turns of wire in such few coils imparts a highly fluctuating character to the current, somewhat imitating alternating currents, and the resulting self-induction brings the actual power of the apparatus to a rather low figure. We think it not worth while to try to make much improvement in the existing windings but to make different machines. (2) $\frac{1}{4}$ h.p. would be ample. The danger and trouble of attending a steam boiler is so much that you will now scarcely ever find one used for such small experimental work. The gasoline engine has quite supplanted the small steam engine.

1055. **Single-phase Rotary Converter.** C. A. M., Tacoma, Wash., asks: I have a small dynamo I wish to reconstruct and make a rotary converter for single phase 110 v. 60 cycles. Field ring and poles are one solid casting of a good grade of cast iron. It has 4 poles $1\frac{1}{4}$ in. square, faces concave. Diameter of ring inside $7\frac{3}{4}$ in., outside 9 in. Width of field ring 3 in. Thickness of ring $\frac{3}{8}$ in. Diameter of armature 4 in., distance between bearings $5\frac{1}{2}$ in. diameter of shaft $\frac{7}{16}$ in. As old armature cannot be

used, I want to get a new one. Give correct number of slots, size of wire for armature and field, number of turns, also where can an armature be purchased? Ans.—The action of such a machine is rather disappointing. With only a single phase the limit of load is soon reached, and your proposed machine is so small as to be of limited usefulness. In consequence of the desirable qualification for experimental purposes of variable electromotive force, you might find a direct-coupled motor-generator set more appropriate. Without making a drawing to scale, with especial data as to air gap, we could not safely state just what the winding should be. We could calculate it for a special fee of one dollar. You do not state whether armature is toothed or smooth-core. If the former, the teeth will induce eddy currents in the solid poles and heat them, and in the latter case, there are difficulties in providing a well anchored four pole winding. In general, your problem is to design a direct current dynamo for about 150 volts, provide two collector rings attached to four points in the armature winding, in addition to the regular connections to the commutator. This latter should have at least 36 segments. To start the machine, you will have to observe the procedure necessary in starting any synchronous motor, such as was described in Chap. XV of the Engineering Series. As earlier mentioned, the self-starting induction motor coupled to a direct current motor would eliminate these difficulties.

1056. **Induction Coil.** J. A. G., Tipton, Ind., says: (1) I have an iron core made up of No. 20 soft iron wire $1\frac{1}{4}$ in. x 16 in. The primary winding consists of two layers of No. 12 double cotton-covered magnet wire, wound over the entire length of core. Primary and wire have been boiled in paraffin and fitted into a hard rubber tube, having a wall $\frac{1}{32}$ thick. I wish to wind the secondary in sections or rings $\frac{1}{4}$ in. thick, using No. 36 single silk-covered copper wire and filling about 10 or 12 in. of the length of the primary. How many sections and pounds of wire will be necessary to get the greatest length of spark? (2) What should the correct diameter of the sections be, and what material is best to use as insulation between sections? (3) Is the thickness of the rubber tube sufficient to withstand the stress between primary and secondary? Ans.—The best we can do is to refer you for useful directions in the article on the construction of a 4 in. spark coil, contained in the April, 1907, number of our magazine. Of course yours will be larger. We think you should have a glass tube over the hard rubber; have the sections in pairs, so as to let both ends of winding be outside ends, these double sections being about $\frac{1}{2}$ in. thick; and finally immerse the whole structure in a glass jar containing paraffin oil.

1057. **Mercury Arc Rectifier, etc.** H. L., Yorks, England, asks: (1) What alterations should be made in electric soldering copper (described in Sept., '06, issue) to adapt it for use on 200 volt alternating current circuit? (2) Attached sketch shows connections of

primary circuit of telephone set, working on 24 volt accumulator set. This circuit was previously worked with 3-4 volts, without retardation coil and condenser. When voltage was changed to 24, the retardation coil was put in series as shown in sketch; the condenser being absent, the speech was now very faint. On placing the condenser shunt with transmitter and primary of induction coil, the speech became efficient. What is the action of condenser? (3) Can you give information with regard to the Mercury Arc Rectifier used for converting alternating currents to direct currents? Is there any book written on the subject? Ans.—(1) Use the same weight of wire, but two sizes smaller. (2) A condenser possesses electric elasticity, for currents can surge into and out of it. A coil on an iron core possesses magnetic inertia. The combination of a condenser in a circuit with the primary of induction coil of transmitter sets up oscillations that greatly intensify the secondary current. The condenser allows the alternating on-opposed current generated on the primary of the induction coil to pass without entering the retardation coil. However, the direct current cannot pass through the condenser and must go through the retardation coil. The function of the latter is to prevent "cross-talk" on a common battery system. (3) See Chapter XVIII of our Engineering Series. Data on same may be obtained from General Electric Co. of Schenectady, N.Y., or of the London Office, 83 Cannon St., E.C.

1058. **Condenser—Aerial—Detector.** G. T. C., Chelsea, Mass., asks: (1) Is a 2 M.F. condenser as good or better than .02 M.F., for a receiving set? (2) Please give me height and construction of an aerial (including material used) that will receive a message 100 miles away. (3) Which detector would you consider best? Ans.—(1) A variable condenser from .02 to 2 M.F. is best. (2) Four strands 60 ft. high, carborundum detector, tuning coil, pr. of 1,500 ohms to the set, receivers, one dry battery, and a condenser. For electrolytic detector: potentiometer, three dry cells, tuning coil, 1,500 ohm receivers, and condenser. (3) Either of above detectors are good. Electrolytic is known as the most sensitive. Apply A.B.C. Wireless Specialty Co., 111 Broadway, New York City, who will give you full data.

1059. **Spark Coil.** A. J. E., Claremont, Cal., asks: (1) In the construction of a 4 in. spark coil, described in July, 1907, E. & M., to use for wireless work, I have been advised to use No. 33 or 34 wire for the secondary, as a thick heavy spark is desired. Would you advise the use of larger wire? (2) Is it necessary to have the 40 sections in the secondary, and would it not do to make 20 of them $\frac{1}{4}$ in. thick instead of 40 of them $\frac{1}{8}$ in. thick? (3) Would it be an advantage to immerse this coil in oil, the same as a transformer? (4) I have a primary ready wound, and a hard-fibre tube about $1\frac{3}{4}$ in. O.D. $\frac{1}{4}$ in. thick. Would this do for the insulating tube, or is it too thick? Would not silk-covered wire be a great deal better

than cotton? (5) Could I use this coil on the 110 v. alternating current, with an electrolytic interrupter, successfully, and would I get a full 4 in. spark, being wound with No. 34 wire, and a glass plate condenser bridged across the secondary terminals, cutting out the vibrator? (6) Would it do any harm if the core was a little larger than $\frac{7}{8}$ in. diameter, say 1 in. or $1\frac{1}{8}$ in.? How far would this send messages? Ans.—(1) No. (2) 40 sections are a great deal better on account of insulation which is absolutely necessary. (3) No. Providing coils are well boiled in paraffin. (4) A thinner glass or vulcanite tube is considerably better. Silk is best. (5) With the electrolytic interrupter correctly adjusted to 110 v. and using condenser, as described, excellent results may be obtained. (6) Make core as described.

1060. **Electromagnet.** O. A. V., Reinbeck, Iowa, asks: (1) What size steel and size and amount of wire shall I use to make an electromagnet to lift 10 lbs. with 4 dry batteries? (2) Can an electromagnet be made with No. 18 annunciator wire to be used in series with a 16 candle power lamp on 220 v. direct current? (3) Do you have a book on electromagnets? Ans.—(1) A satisfactory electromagnet for lifting 10 lbs. may be made as follows: get a piece of $\frac{3}{8}$ in. soft iron rod about 14 in. long, and have it bent into horseshoe form, so that the two ends are 2 in. apart. Make two wooden or paper spools $4\frac{1}{2}$ in. long (outside measurement), and with holes through the centre of such size that they will slip over the legs of the iron core. Wind them with about 400 turns each of magnet wire, using No. 16 or No. 17. The armature may be made of any convenient piece of iron of sufficient length to go across the poles. This magnet should lift from 10 to 20 lbs. with the current from four dry batteries. (2) If this magnet were wound with No. 18 annunciator wire, putting on about 500 turns per spool, it could be used in series with one 16 candle power lamp on a 220 volt direct current circuit. (3) Electromagnet by Charles R. Underhill, \$1.50, and Electro Magnets, by A. N. Mansfield, 50 cts.

1061. **Current Density.** O. H., Fairmount, Ind., asks: How do you find the current density for the armature conductor on a dynamo or motor? Ans.—The current density in the armature conductors of a machine depends on the total current supplied to or by the machine, the size of the armature conductors, and the method of connecting the winding. In a two-circuit or series wound armature there are two paths for the current, so that the current per conductor is one-half the total current. The current density in circular mils per ampere, which is the notation usually employed, is found by dividing the area of cross section of the armature conductor by the current flowing through it, the area being expressed in circular mils. In a parallel wound armature, there are as many paths as there are poles, but with this difference the method is the same.

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.

We have received the following communication from P. B. F., Princeton, N.J.: "The sending circuit designed by 'R. W. Y.' on page 490 of the May issue, contains a very serious mistake. As shown, the transformer secondary is short-circuited through the sending helix, an arrangement which would give no spark at all, and might burn out the transformer. The condenser, helix, and spark gap are to be connected in series, and the transformer connected across either the condenser or gap.

R. W. Y. answers as follows: I wish to thank P. B. F. for his criticism of the sending circuit bearing my initials which was printed in the May issue. The spark-gap should be in series with the sending helix, with condenser shunted across the secondary terminals. I hope the error has caused no serious inconvenience to any reader of the magazine.

Mr. R. C. Dickson, President of the Chicago Wireless Club, delivered a lecture on the subject of Wireless Telegraphy at the Central Park Church, Chicago, on the 9th inst. The lecture was delivered in a non-technical manner, and that it was understood and appreciated was evident from the questions asked and the vote of thanks tendered Mr. Dickson at its close. The Chairman, Mr. Cauffer, in his introductory remarks, stated that, ever since the recent sinking of the Steamship Republic, he had been on the lookout for a man qualified to lecture on Wireless Telegraphy and also demonstrate it, and was confident he had found one in Mr. Dickson.

The lecturer gave a brief outline of the work already accomplished in the wireless field. He also spoke of the apparatus used in modern stations, systems of tuning and distances reached. He gave it as his opinion that, so far as the transmission of intelligence over land was concerned, the wireless system would be used merely to supplement the present methods of wire communication. On the sea the wireless would be found to be indispensable.

A convincing demonstration was given by Mr. Dickson, assisted by Messrs. Richards and Maypole, also members of the Chicago Club.

A set of wireless instruments at the speaker's stand was used to exchange messages with another located in the gallery.

The New England Wireless Society had a meeting at Young's Hotel, May 7th, which was very instructive. The meeting was

brought to order at 8.15 p.m. It was voted that Young's be made the regular meeting place of the club, on the first Friday of each month.

Mr. Crocker read a paper on "Efficient Transformers for Wireless Purposes." This called forth much discussion, questions, etc., during which further information was brought forward by Mr. Sewell Cabot. It was adjourned at about 10 p.m.

The initiation fee to the society is five dollars, with dues of 25c per month. Applicants must be 18 years of age or over.

The members, at present, are mostly business men (former telegraphers in many cases), and almost to a man are strongly in favor of proper regulation and of the discouragement of interference. Many of us who have both sending and receiving stations are seldom heard from (i.e. sending), preferring to raise our receiving apparatus to the highest efficiency possible with small antennæ. With a membership of 20, at present, we find great benefit from such a grade of instruction.

To the Editors of ELECTRICIAN AND MECHANIC:

Complaints have been showered right and left lately about the amateur wireless station. The cause for this complaint has been that the amateur stations have interfered seriously with the operation of the commercial and government stations. In most cases, there is no doubt that the amateur has been unaware of the fact that he was unnecessarily breaking in on important business, but in other cases it has been found that intentional and malicious messages have been transmitted to commercial and government stations, and have caused considerable trouble and expense.

For example, a message calling C.Q.D., etc., and asking for help to a burning vessel at such a latitude and longitude. Help was immediately despatched and when the designated point was reached no boat could be found. Four days later the boat said to have been on fire arrived safely in port after a successful trip.

Such messages are an idle waste of time, and it is such acts that stir the government against amateurs. Of course, there is only one person out of a hundred who would do such a thing, but it is that one person who is going to deprive the other ninety-nine of the pleasure and benefit of experimenting in this line if he does not refrain. So, out of consideration and respect for your co-workers, let amateurs cease such business.

Frederick B. Gilbert.

TRADE NOTES

The problem presenting most difficulty in the construction of a high grade telephone receiver is primarily a problem of adjustment. The accurate winding of the spools to stated resistances; the bringing of the greatest number of wire turns in closest proximity to the magnet; the magnet strength and the quality of materials used; these are mechanical problems readily solved by any manufacturer employing modern machinery and expert workmen.

At the first glance, it would seem that a receiver, so constructed as to afford opportunity for varied adjustments, would solve the main difficulty; but further consideration conclusively disproves the "adjustable" theory, for the reason that receivers, so built, tend to "disadjust" themselves when subjected to any hard usage.

The head receivers for wireless telegraphy, manufactured by Wm. J. Murdock & Co., of Chelsea, Mass., are examples of the type in which permanent and absolute adjustment is assured. Once adjusted, always adjusted, for their construction, the patented "Solid," precludes the possibility of change.

The mechanical details in these receivers are excellent. The snug-fitting head-bands and the light weight, make them very comfortable, especially when they are to be worn for long periods.

These features, so desirable in receivers for wireless work, are unquestionably present in the Murdock type, combined with a positive adjustment, indispensable for sensitive receiving.

* * *

Booklet No. 3770, just issued by the General Electric Company, describes a useful piece of apparatus known as a Telephone Line Insulating Transformer. As stated in the booklet, the purpose of this apparatus is twofold:

First, to safeguard the users of telephones from the dangers of high voltage, due either to induction or accidental contact between telephone and power lines.

Second, to improve the telephone service by removing the ordinary small ground gap carbon arrester from direct connection with the line, as well as providing ample insulation between the interior wiring, instrument, batteries, etc., and the line.

The booklet contains illustrations of the apparatus and its method of installation, and is of general interest.

* * *

The automobile is a great invention and an excellent mode of conveyance. But for real health value it does not compare with the once-popular bicycle. Many men and women found both pleasure and health in country tours on their wheels. And while some had the "scorching" fever and rode in a fashion that was dangerous to themselves and to others, they were few compared with the many thousands who gained physical health and vigor through the proper use of the bicycle.

Walking clubs are fine for both health and recreation; but it would be an excellent thing for the people if "cycling" should again become as popular as it was a decade or more ago.

For a very few dollars you can buy a wheel of the latest type from the Mead Cycle Company, Chicago.

Get their new catalogue of bicycles and supplies. If you wish they will send you a wheel for ten days' free trial.

* * *

The Long Distance Wireless Instrument Company of Boston have recently placed on the market a new portable receiving set for wireless telegraphy in which they offer many new and excellent features. The set consists of a special wound tuner by which great selectivity is made possible without the use of loose coupling of the double coil type. The detector is of the lateral spring type which allows the experimenter to use any sensitive mineral that he chooses, which will be an advantage for those wishing to conduct experiments along this line. The condenser is handsomely mounted in hard rubber and polished brass, and the complete set, as it comes on a mahogany base with binding posts for antenna, ground, and telephones, makes a very neat and efficient piece of apparatus.

* * *

Mr. R. M. Merritt has resigned as New England Manager of the Hoyt Electrical Instrument Works to become associated with the Wetmore-Savage Company, Boston. Mr. E. W. Carter will look after the New England interests of the Hoyt Electrical Instrument Works.

* * *

The New York Electrical Trade School will be advertised and known as The New York Electrical School. The reason for this change is, that they are communicating knowledge which is in advance of a trade, and at the same time following a system which is a departure from that originally followed by the school.

* * *

Messrs. E. S. Ritchie & Sons, Brookline, Mass., coil makers for over 40 years, have issued an illustrated catalogue of Induction Coils and Alternating Current Transformers adapted especially for wireless telegraphy. They have designed a 25 watt and 50 watt coil to operate on dry cells or storage battery. This feature will appeal to those desirous of establishing a short range wireless station where a source of electrical energy is not at hand. Their alternating current transformers are designed for use where 60 cycle alternating current is available. It is of the open magnetic circuit type and with it is furnished an oscillation condenser of such value as to produce electrical resonance in the secondary circuit. The transformers are designed for $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ and 1 or more k.w

PRACTICAL 25 CENT BOOKS

Pyrography or Burnt Wood Etching, by Bolas and Leland. Revised by Ball and Fowler. Full directions for the successful practice of this most fascinating home art, with numerous full page designs and text illustrations. 28th thousand, with additions and emendations.

Stencil Cutting and Stencelling, by Jack Plane. Shows how to design and cut stencil plates in metal, paper, celluloid, etc., and how to use them on paper, fabrics, etc., with a section giving all details of stencilling in house decoration, preparation of clear-cole, distemper colors, etc.

Stone Cutting and Polishing, by George Day. Instructions whereby an amateur, with very little outlay, may cut and polish pebbles, shells, etc., and mount them as geological specimens or as simple jewelry and small useful articles, with hints as to where and how to find the decorative stones of the seashore — agate, chalcedony, cornelian, etc.

Bent Iron or Stripwork, by Geo. Day and C. G. Leland. Clearly giving the first steps in Venetian Bent-iron Work, but also suggesting and illustrating ways in which the results may be made more varied and artistic.

Leather Work, by Hallton East. Simple instructions for blind and colortooling; gold blocking, leather mosaic, applique, and patchwork, pressed, modelled and moulded leather; leather-covered relief, cuir bouilli, carton cuir, and cut leather or scroll work.

Home Bookbinding. Gives understandable directions for collating, refolding, sawing, sewing, and all the other operations necessary for the binding of books in cloth, with more than a score of working drawings and diagrams of details in the process, on six full page plates.

Bamboo Working. Full instructions for cutting, shaping, fitting and joining bamboo and other canes. The construction of several typical articles of furniture described step by step, in plain, simple language, and illustrated by many diagrams. With six plates of designs for a great variety of bamboo articles, from the simplest to those which are fairly elaborate.

Stained and Leaded Glass. The first book ever published which has fully described this useful craft as an amateur hobby. Instructions for making window screens, fire screens, fancy windows and transom lights, hall lamps, glass doors for china closets, etc. So simple that any deft-fingered person may learn.

Home Handicrafts. Edited by John Black. This book will be appreciated by every one who takes advantage of their spare moments to construct or decorate some detail of their homes. A valuable book for the handy man.

The Use of Colors. A valuable treatise on the character, use, and mixing of colors, their permanent and fugitive qualities, of the different pigments and their suitability. Also a short treatise on the practice of painting in oil and water colors.

Lettering. A neat book containing directions for lettering drawings, giving ten alphabets, monograms, figures, headings, cards, initials, titles, borders, etc.

Outdoor Carpentry. This little book gives brief instructions, with carefully drawn plans, sketches and details, for doors, gates, stiles, fences, seats, summer houses, garden arches and arbors, dog kennels, cycle or tool houses, hen runs, chicken coops, plant stands, hanging baskets and window boxes, forcing frames and greenhouses, and many similar constructions. With 20 pages of illustrations, including designs of some fifty subjects.

Utility Fowl Houses and Appliances, by H. Francklin. With about forty measured drawings and plans and with concise instructions, not only for home construction, but for guidance in purchasing for the fowl-yard. Treats of ventilation, site, aspect, etc., of houses; the laying out of large and small runs, construction of nest boxes, coops, etc.

Garden and Grounds: How to Lay Out and Arrange, by T. W. Sanders. Suggestions for laying out, planting and improving the small plot, or the country grounds of several acres. The best aspects and positions, considering appearance with economy of space, labor, and expense. With plans and sketches.

Propagating Plants, by seeds, cuttings, layers, grafts, buds, etc., by D. S. Fish. Propagation of all classes of plants by many methods with lists of those suitable for the various treatments, hints on the preparation of seed beds, etc. Many illustrations.

Cold Greenhouses and Frames, by D. S. Fish. How to secure foliage and bloom through the whole year. Lists of most useful plants, with brief description and cultural directions.

Wiring Diagrams, by E. W. Smith. A pocket manual with diagrams of wiring for bells, telephones, telegraph, gas lighting, induction coil, electric lighting, storage battery system, dynamo connections, etc.

Bricklaying. Edited by John Black. Describes how to build walls, bonding, piers, window openings, chimneys, cornices, gables, etc.

Plastering. Edited by John Black. This book contains quite a fund of information useful to the apprentice as well as the old hand at the plasterer's trade.

Slatting and Tiling. Edited by John Black. Many buildings now have slate or tile roofs, and this book gives concise information about the various points besides containing a general article on various forms of roof coverings.

Plumbing and Lead Working. Edited by John Black. Deals with roof covering, water supply, sanitation, closets, baths, development of surlices, hydraulics, soil pipes, traps, sinks, flashings, etc.

Practical Hints on Joint Wiping. For beginners in plumbing. Showing by photographs how to prepare the pipes previous to wiping, with full directions how to use all the tools and appliances.

Carpentry. Edited by John Black. This book treats on the principles of the subject, the strains in framed structures, roofs, dooring, trusses, etc.

Practical Joinery. Edited by John Black. A book that points out the best methods in joiner's work. A companion volume to "Carpentry."

The Steel Square, by F. T. Hodgson. This work is intended as an elementary introduction for the use of those who have not time to study the larger works on the same subject.

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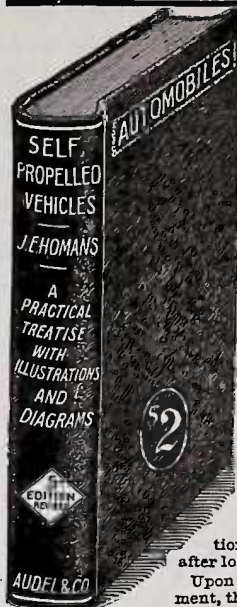
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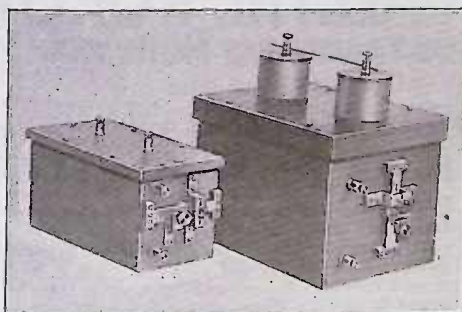
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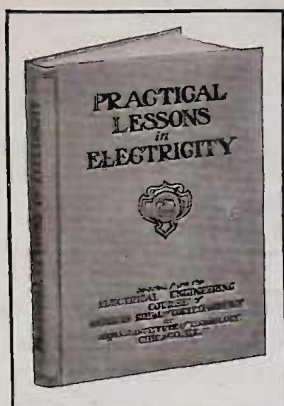
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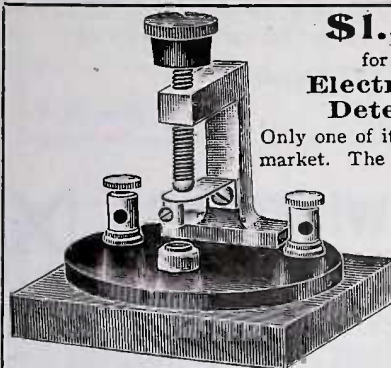
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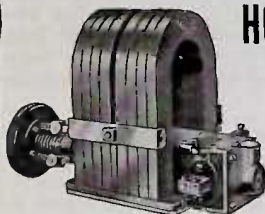
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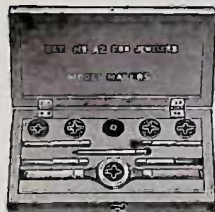
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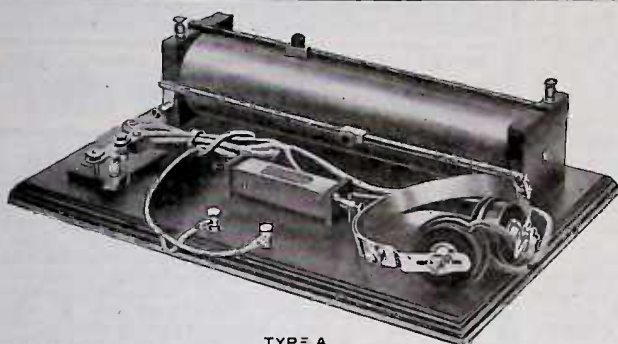
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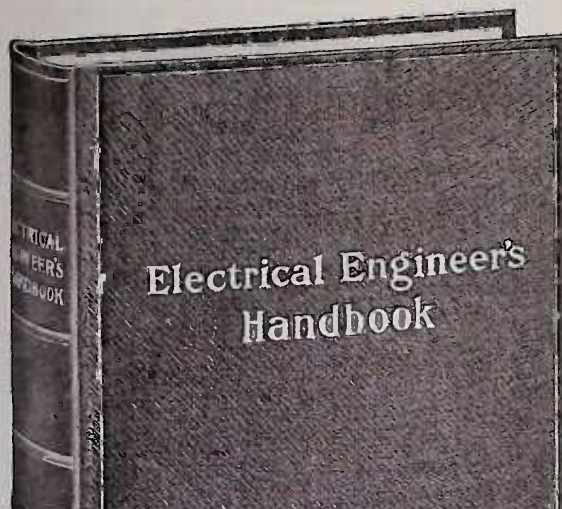
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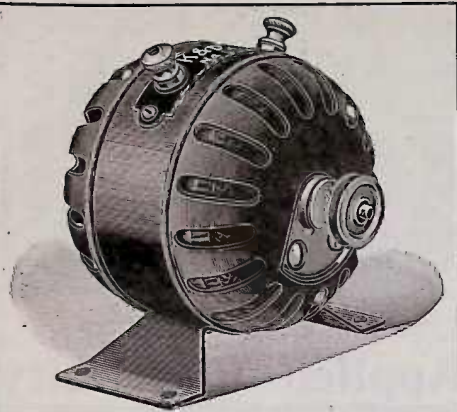
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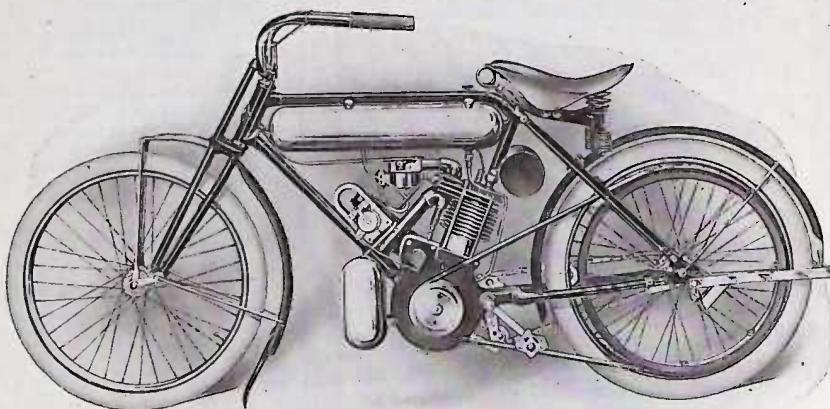
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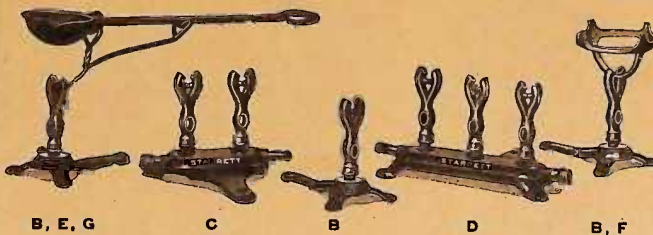
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