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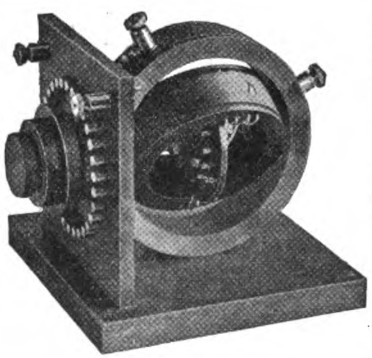

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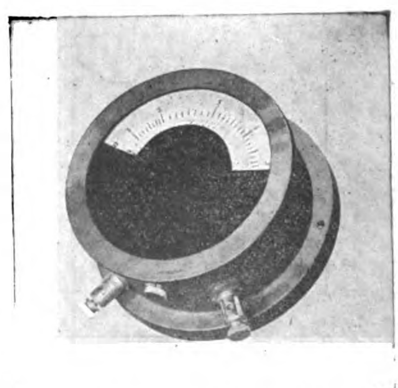

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ELECTRICIAN & MECHANIC

VOLUME XXVI JANUARY, 1913 NUMBER I

## QUANTITATIVE MEASUREMENT OF THE LOGARITHMIC DECREMENT

HARRY B. KIRTLAND, Captain, Ohio Signal Corps

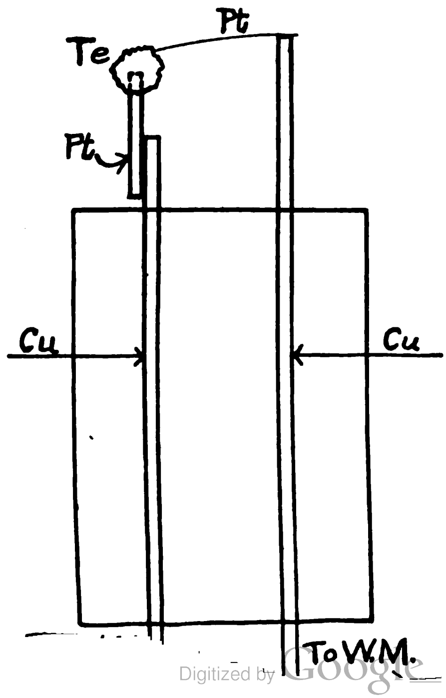
In the September number of the ELECTRICIAN AND MECHANIC, Mr. H. B. Richmond explained in non-technical terms the nature of the logarithmic decrement and the practical application of that part (4th Regulation, Sec. 4) of the latest Act to Regulate Radio-communication which prescribes a maximum limit to the decrement.

I purpose here to describe a means of ascertaining quantitatively, employing only a wave-meter and hot-wire ammeter (or galvanometer with Austin thermo-element), the logarithmic decrement of any radio-transmitter.

The method in question was worked out by First Lieutenant J. O. Mauborgne, United States Army Instructor at the Army Signal School, one of the foremost radio investigators in the world, and is in daily application in the radio work of the United States Signal Corps. It is a simplification and condensation of the elaborate and involved operations and formulae employed by Bjerknes and Fleming for the same purpose, and amply meets all requirements of the practical radio constructor, inspector or operator.

The necessary apparatus consists of a wave-meter (Pierce or other), and either (1) a hot-wire ammeter calibrated from 0 to 100 milli-amperes, or (2) a low resistance galvanometer (such as a single pivot Paul), shunted around a platinum-tellurium thermo-element (Austin) con-

about 3 mm. apart, Fig. 1. To the protruding end of one of these solder about 5 mm. of .02 mm. platinum or constantan wire. Heat a short piece (¼ in.) of No. 20 platinum wire white hot, and insert one end of it in a bead of tellurium, thus making practically a resistance free contact. Then solder the other end of this piece of No. 20 wire to the protruding end of the second copper wire.



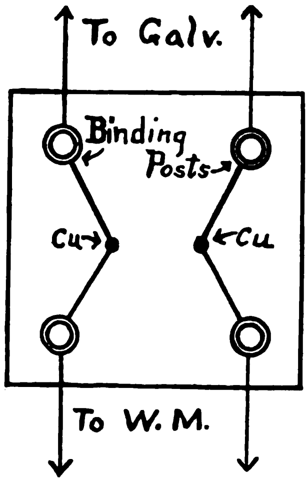



Fig. 2—Connections of Thermo-element

Allow the end of the fine (.02 mm.) wire on the one copper support to rest against the tellurium on the other, and weld the two together electrically by means of a small induction coil having a high resistance in series with the secondary. The contact will be less fragile if the welding is done in an oxygen-free atmosphere, and it will be found advisable not to undertake this welding until the element has been placed in the test-tube mentioned hereafter.

The thermo-element, thus prepared, may be put in a test tube, and the whole enclosed in a wooden box lined with cotton or felt, the hard rubber base serving as the top of the box and also as a support for four binding-posts, to each pair of which leads should be run from each copper wire of the element, as shown in Fig. 2.

Such a thermo-element will have a resistance of from 5 to 50 ohms, depending on the excellence of the welding. The lower the resistance, the better.

The function of the device is this: the galvanometer cannot respond to the high-frequency currents of the wave-meter circuit. Those currents, however, heat the platinum-tellurium junction of the thermo-element, and the thermo-electric current thereby created deflects the galvanometer, the deflections varying with the square of the current, which in turn depends on the heat produced by the high-frequency currents, and varies with their intensity. A galvanometer shunted about the thermo-element may therefore be substituted for the hot-wire ammeter.

#### SETTING UP THE CIRCUITS

For measurement of the damping, we must put either our hot-wire ammeter or our thermo-element with shunted galvanometer in series with the capacity and inductance of the wave-meter. Few wave-meters now in use were intended for the measurement of damping, and therefore no binding-posts for our purpose will be found on them. Other means of making the connections will have to be improvised, a matter, however, of little difficulty.

Figs. 3 and 4 illustrate the circuits with either form of indicator, the inductance and variable condenser shown in each being, of course, those of the wave-meter, and calibrated to wave-lengths in meters.

#### PRECAUTIONS TO BE OBSERVED

It is essential, in the measurement of damping, that the coupling between the wave-meter circuit and the circuit under measurement be constant, and that the energy supplied the primary of the transmitter be as constant as possible. Furthermore, the coupling between the wave-meter and transmitter circuits must not be too close: if it is, the damping will have too great a value. In case of doubt as to whether this coupling was loose enough, a second measurement should be made with the wave-meter farther away from the circuit measured. If a smaller value be obtained with the looser coupling, it is at once evident that the other was too close.

#### MEASUREMENT

(*a*) With Galvanometer and Thermo-element

Let $\delta_1$=decrement of the damping of the circuit under measurement.

Let $\delta_2$=decrement of the damping of the wave-meter circuit.

Setting up the wave-meter circuit, with sufficiently loose coupling, near the oscillation transformer of the transmitter to be measured, press the transmitter key. Adjusting the wave-meter until resonance is obtained, take the wave-length reading in meters, calling it $\lambda_m$, and observe the scale deflection of the galvanometer, calling this quantity $D$.

Now, by turning the handle of the wave-meter pointer, reduce the scale reading of the galvanometer to $\frac{D}{2}$, and take the corresponding wave-length reading of the wave-meter, calling it $\lambda_1$. Then,

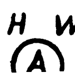
$$(\delta_1+\delta_2)=\pi(1-\frac{\lambda_1}{\lambda_m}) \text{ (where } \lambda_m \text{ is greater than } \lambda_1)$$

This gives us the sum of the decrements of ($\delta_1$) the circuit under measurement, and of ($\delta_2$) the wave-meter circuit itself. If the latter ($\delta_2$) be known, it then remains only to subtract the quantity ($\delta_2$) from the quantity ($\delta_1+\delta_2$), the result being the decrement sought.

However, the writer knows of only one wave-meter the value of whose self-damping is furnished by the makers (the Telefunken E.G.W. meter), and ordinarily it is necessary to determine this as follows:

Insert a piece of fine resistance wire (No. 36 Climax), 6 to 10 in. long, with sliding contact, in the wave-meter circuit, as shown in Fig. 5. Call decrement of this resistance wire $\delta^1_2$.

Set the wave-meter pointer at the value of $\lambda_m$ found before, and while transmitter key is depressed, move slider along resistance wire until you again get a galvanometer deflection $\frac{D}{2}$. Then, without changing position of slider, turn wave-meter pointer until scale deflection of galvanometer is equal to $\frac{D}{4}$. Read the corresponding wave-length reading of the wave-meter, calling it $\lambda_2$.



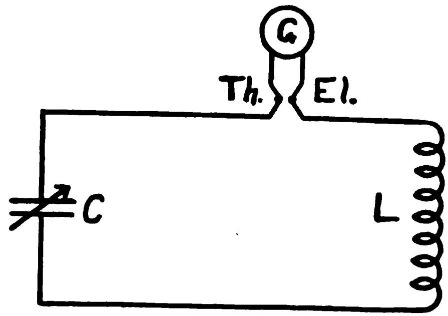




Fig. 4—Wave-meter with Thermo-element and Galvanometer in Circuit

Then,

$$(\delta_1+\delta_2+\delta^1_2)=\pi(1-\frac{\lambda_2}{\lambda_m})$$

Let $(\delta_1+\delta_2+\delta^1_2)=X^1$
and $(\delta_1+\delta_2)=X$.
Subtracting $X^1-X=\delta^1_2$, the decrement of the resistance wire.

The decrement of the wave-meter circuit ($\delta_2$) is then equal to $\frac{X^1\ \delta^1_2}{2X-X^1}$, which quantity, of course, is to be deducted from the quantity ($\delta_1+\delta_2$), to give us the decrement of the transmitter circuit under measurement.

(*b*) With Hot-Wire Ammeter.

Using a hot-wire ammeter instead of the galvanometer and thermo-element, the formulae are the same, but owing to the fact that the readings of the ammeter vary with the current and not, like those of the galvanometer, with the square of the current, slight changes in procedure are involved.

These are as follows:

1st.—For the initial deflection *D*, of the galvanometer, substitute the initial milliampere reading of the ammeter at resonance, and call this quantity *I*.

2d.—In each of the two instances

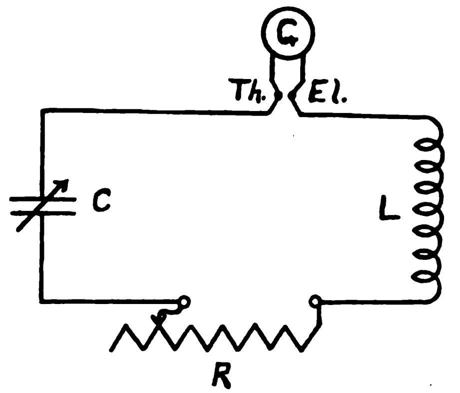



Fig. 5—Wave-meter and Thermo-element with Adjustable Resistance Wire in Circuit

the wave-meter pointer was turned until a deflection $\frac{D}{4}$ was obtained, it must now be turned until the milli-ampere reading is equal to $\frac{I}{2}$.

In all other respects the procedure with either indicating device is the same, and the formulae serve without change for both.

The methods just described are equally applicable to the measurement of the damping either of a closed oscillatory circuit containing a spark gap, or of a coupled transmitter consisting of such a circuit and an antenna circuit tuned to the same period. In the latter case, if the spark gap be of the open variety, and the coupling is close, the energy is radiated, of course, in two wave-lengths, one shorter and one longer than the wave-length to which each of the circuits was tuned. This need occasion no difficulty, if the two wave-lengths lie sufficiently far apart, for the damping of each hump may be measured separately. Where the coupling of the two circuits is very loose, or a quenched spark is employed, there will, of course, be practically only one hump, a single wave-length, radiated.

In practical work, it has been found that very sharp tuning is impracticable when a wave train contains less than 15 oscillations. This corresponds to a decrement of .2, the limit set by the statute. The experimenter will find, with most oscillation transformers, that this limit will not be exceeded if he has not more than two turns of his helix in common between his closed oscillatory and radiating circuits. If on measurement, the damping of the coupled system is found too large, inductance may be added, or the coupling be loosened, in order to decrease the resistance and hence the damping. If it be impracticable to change the wave-length, the aerial must be shortened to decrease its capacity, the same wave-length being retained by adding inductance.

Knowing the value of the damping ($\delta_1$) of a closed oscillatory circuit, a number of other important calculations may be worked out. If its inductance in centimeters is known, or can be measured, and the high-frequency resistance $R$ of the inductance can be calculated from the dimensions of the wire, then, knowing the frequency, $N$, corresponding to resonance ($N = \frac{V}{\lambda}$), one can calculate the resistance $r$ of the spark gap from the formula

$$r = \frac{4NL\delta_1}{10^9} - R,$$ $R$ and $r$ being measured in ohms.

Likewise, by Fleming's rule, the approximate number of complete oscillations $M$ in the wave train, before the amplitude of the oscillations falls to 1 per cent. of the maximum, may be found by the formula

$$M = \frac{4.605 + \delta_1}{\delta_1},$$ which quantity divided by two, gives the periods.

---

The crews of Italian submarines have been undergoing a series of practical tests of their staying powers, says the *Engineer*. The trials were begun in July by the *Glauco*, which remained for 22 hours submerged, and this performance has now been exceeded by the *Squalo*, in Venice arsenal, with what is believed to be the record time under water of 24 hours. Her crew, composed of 20 men, including the officer in command and a navy doctor present to study the effect of the long immersion, was in absolutely normal condition when the submersible came to the surface. The experiments will be continued.

# PRACTICAL REMEDIES FOR MOTOR AND GENERATOR TROUBLES

P. LE ROY FLANSBURG

Motors and generators, like all other kinds of machinery, are subject to derangements, but due to the peculiar and elusive nature of electricity, it is often quite difficult to ascertain the exact cause of the trouble. Each different kind of trouble, however, has its own peculiar characteristics by which it may be recognized, and once the trouble is located it is often quite easy to remedy it.

In this article I will consider the causes and remedies of that most common trouble, sparking.

### SPARKING WITHOUT APPARENT CAUSE

Very often a machine will spark quite badly without there being any apparent cause. In such cases it is very probable that a wrong material has been used for the brushes. The manufacturers generally furnish or specify a certain kind of brush to be used with their machine, and no other kind should be substituted. The quality, shape and size of the brushes have a considerable effect on the satisfactory commutation of a motor or generator. Therefore, since the manufacturer has found by actual test the type of brush that gives the best results with his machine, his advice should be strictly followed.

### SPARKING ON ADJUSTMENT OF THE BRUSHES

Sparking on adjustment or removal of the brushes may be due to one of several causes. It sometimes happens that the brush holders stick on the spindles and do not turn freely, causing the brushes to bear at only a few points. The remedy for this is to repair the brush-holder so that it may rotate freely.

Another quite common cause of sparking is a bad contact between the brushes and the commutator. This is due to the fact that the brushes are not properly ground to fit the commutator. If carbon

The sparking may also be due to the fact that the brushes are covered with oil, dirt, grease, etc. Both the brushes and the commutator should be looked over carefully, and if this is the case, thoroughly cleaned with gasoline or kerosene.

### SPARKING DUE TO IMPROPER POSITION OF BRUSHES

If the brushes are in a wrong position, it can easily be detected, for the amount of sparking will change as the brushes are moved backward or forward. The brush-rocker may be in the wrong position or the relative position of the brushes may be wrong. If the latter is the case, moving the rocker will stop the sparking at some of the brushes and cause it to begin at others which formerly did not spark. The brush-rocker should be first rocked backward and forward slowly until there is a minimum of sparking. If the sparking continues, make sure that there is an equal distance between the brushes, by counting the commutator bars between each brush. In a two-pole machine the brushes should be exactly opposite; in a four-pole machine, 90 degrees apart; in a six-pole machine, 60 degrees apart, etc.

### SPARKING DUE TO IMPROPER COMMUTATOR MATERIAL

The quality and material of the commutator will often be found to be the cause of the sparking, when no other cause can be found. Carbon brushes work satisfactorily only on copper commutators, and if the latter is made of bronze or gun-metal, as is sometimes the case, trouble is bound to ensue. The quality of the copper in the commutator may vary with the depth, and as the commutator wears down, trouble begins. The only possible thi armature or any single armature coil may show no excessive heating, but if current is sent through the armature while it is being slowly rotated, sparking will again occur. To remedy this, the screws fastening the bar and conductor should be tightened, or conductors should be resoldered. If it is found that the break occurs in one of the coils, the only remedy is to rewind the armature.

#### SPARKING WITH LOW ARMATURE VOLTAGE

On first starting a multi-polar machine, one or more sets of brushes may spark heavily, while the armature voltage is low, although the speed and field current are normal. This is due to one of the field coils being connected in the reverse direction, so that it opposes the other field coils. It is an easy matter to locate the faulty coil by following the direction of the windings. The coils should be connected alternately clockwise and counterclockwise, so that the consecutive fields produced are in opposite directions. A compass may also be used to determine whether this condition is obtained. When the coil is located, the end connections should be reversed.

#### SPARKING WITH ONE FIELD COIL UNDULY HOT

Sometimes one or more sets of brushes spark heavily as before, but one of the field coils is unduly hot while the others are colder than usual. This may mean that a portion of one of the field coils is short-circuited so that the pole does not become excited. Dampness in the coils may produce this short-circuit, and therefore great care should be taken always to have the coils dry. Another possible cause is the short-circuiting of the wires joining the field coils. The coils should then be rewound or the connecting wires insulated.

#### SPARKING MORE APPARENT AT CERTAIN SPEEDS

Sparking may occur only occasionally and be more apparent at certain speeds. This is due to the vibration of the machine, which may occur at all speeds or only at certain critical speeds and which depends on the unbalanced condition of the armature or pulley. The pulley should be removed and "turned" true. If it were the pulley that was at fault the trouble would then disappear, but if the armature were at fault it would be necessary to balance it by adding a small weight to one of its sides. This weight might be either a small amount of lead or babbitt poured into slots provided for just such purposes on the inside of the armature flange. If these slots were not provided, the weight might be bolted to the inside of the armature. The weight added must be so adjusted that if the armature is mounted on knife edges it will not rotate of its own accord.

#### SPARKING WITH INCREASE OF LOAD

When the load on a dynamo is increased, sparking will frequently occur. This shows that the machine may be running at too high a speed. The machine should therefore never be run at a speed higher than its rated speed. When the machine is running at an abnormally high speed, the shunt field current has to be decreased in order to keep the same voltage. This is because with an increased load, the armature current increases, and the armature reaction is increased, weakening the field. The field due to the armature finally reaches a point where it nearly overcomes the field due to the poles and sparking occurs. Overload may produce sparking even in a perfect machine, and the remedy is to reduce the load as soon as possible.

#### SPARKING DUE TO A ROUGH COMMUTATOR

Sparking may occur and the brushes vibrate slightly while the commutator is apparently smooth. This comes from the fact that the mica insulation between the commutator-bars is slightly harder than is the copper, and therefore does not wear out as rapidly. The remedy for this is to turn down the commutator, or to file down the mica alone, with a triangular file.

#### SPARKING DUE TO ARMATURE OUT OF CENTER

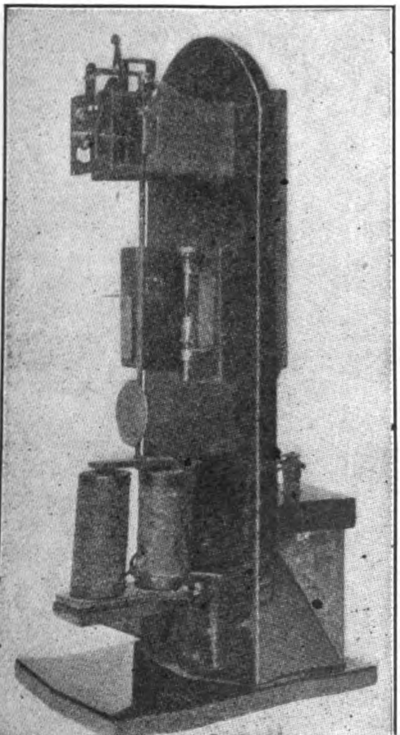
If the armature is not properly centered the air gap will not be of uniform width at all points between the armature and the pole faces. Such a condition is liable to occur, especially in large machines, as the bearings become worn with use, and unless some method is employed

(*Concluded on page* 18)

# AN ELECTRIC CLOCK AND HOW IT WAS MADE

F. COLLIER FLETCHER

The clock just completed by the writer, and herewith illustrated, is a purely electrical timepiece, as it is not dependent on another clock for its motion. It is self-contained, the batteries being placed as shown in Fig. 1, so that the whole can go under a glass shade and stand on a bracket or mantelshelf; an excellent timekeeper as well as an electrical novelty. From an examination of the photographs and sketches, it will be seen that there is a pendulum which has a soft-iron armature at its lower end, swinging over an electromagnet, which gives impulses to the pendulum as required. About the center of the rod is the contact-maker, a V-shaped piece of steel pivoted at the top. As the pendulum swings this piece catches the notched piece fastened upon the spring, but as long as the pendulum has a good swing it rides over the notch, but when the swing gets short the bottom of the V-piece catches in the notch and pushes



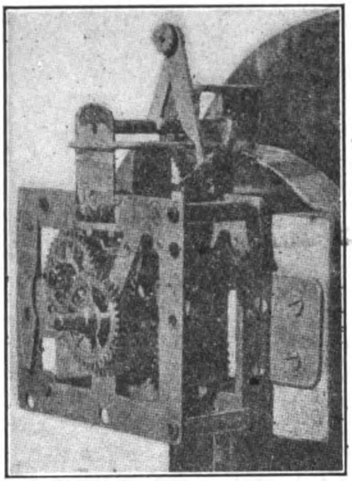


Fig. 2—Clock Mechanism

it down, and the end of the spring—which has a short piece of silver wire affixed—is depressed into the mercury cup shown on the right-hand side of the photograph, Fig. 1. This makes electrical contact, actuating the magnets, and gives another impulse to the pendulum, which swings a number of times from its own momentum before contact is again required.

Fixed at the top of the pendulum-rod is the ratchet-lever driving the works. This lever is so arranged that, no matter what the swing of the pendulum may be, it pushes one tooth of the ratchet-wheel each second. As the length of pendulum regulates the time-keeping, the armature is made adjustable, and the magnets form a sliding bracket to adjust to the armature. The works are adapted from an ordinary cheap, circular alarm clock, with the balance arrangement and the alarm works taken out. Now that the principle of the working of the clock has been described, the construction can be considered.

The pendulum-rod is a piece of $\frac{3}{16}$ in. round brass rod, 11 in. long, the bottom end threaded for 1 in. A circular disc of sheet brass, 2 in. diameter is soldered to the rod, the center being ... the bottom from the bottom of the rod. The V-piece is of steel ½ x ¼ in., filed nicely to shape and drilled an easy fit for the steel pin. Two small collars of brass are soldered on the pin as shown, Fig. 8. The V-piece must have no play, yet swing freely. Next obtain a piece of soft-iron for the armature, 2¾ x ¾ x 3/16 in., bore a hole in center, and tap same to screw on bottom of pendulum-rod. A 3/16 in. nut is also required to lock the armature on rod. Slightly flatten out the top end of the pendulum-rod by hammering, and bore a 5/32 in. hole for the pivot. The magnet bobbins are turned out of some hard wood to the dimensions given (Fig. 9) and bored 7/16 in. Wind the bobbins with No. 22 covered wire, about 4 or 5 oz. on each. Connect them so that one has a north and the other a south pole. If cotton-covered wire is used, cover the bobbins with green silk, first pasted on paper for appearance. The magnet cores are of 7/16 in. soft iron and are driven a tight fit into the soft-iron base, 3½ x 1 7/16 x 3/16 in. Two holes for wooden screws are drilled as shown in Fig. 10. The centers of the cores must be about 2 in. apart. The sliding bracket carrying the magnets needs no comment and need not be made accurately to size. Four wooden screws in the runners tighten up the bracket when it is adjusted.

The contact arrangement should now be taken in hand. The part *A*, Fig. 7, is strip brass, the top portion being bent over at right angles ¾ in., as shown. A piece of watch spring 5½ in. long is soldered to *A*. Underneath the other end of the spring, solder ½ in. of silver wire. From a semi-circular piece of brass ¼ in. wide and as deep as the spring, file a notch as *C*, Fig. 7, to catch the V-piece on pendulum-rod. The part *B*, Fig. 7, is also made from strip brass tapped 3/16 in. top and bottom, and with a screw at top and lock nut. The bottom end of this screw is drilled, and a peg of vulcanite is inserted to insulate it from the spring. The little mercury cup is made from a cycle lubricator with a 3/16 in. screw and lock nut *B*, Fig. 7. Next obtain a circular tin-cased alarm clock. It will be noticed on removing the case that the wheel next to the escape wheel has 60 teeth and revolves once a minute. Get a wheel made the same size, but with 60 ratchet teeth, and fit to the spindle in place of the other wheel. In the writer's clock this wheel was 1⅛ in. in diameter. The balance springs and alarm works can be removed, as they will not be required again.

From some strip steel ⅝ in. wide by 1/16 in. thick, make the bearings for the pendulum pivot, one being shown in

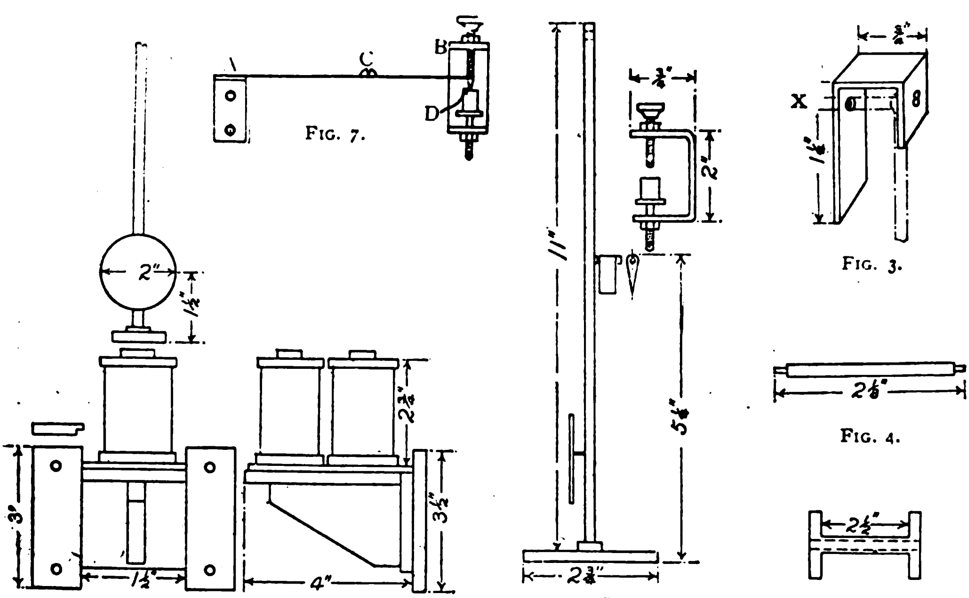



Fig. 7. Fig. 3. Fig. 4. Fig. 6. Fig. 8. Fig. 9

Details of the Electric Clock

Fig. 3; the front one being as shown in the photograph, Fig. 2. The hole *X*, Fig. 3, is larger than the pivot, so that it will not touch there. Solder the bearings to the front and back of works, as shown in Fig. 2. The pivot of steel rod 3/32 in. in diameter is shown in Fig. 4, and the ends are reduced to about 3/32 in. They must be a nice easy fit. To make the ratchet-lever, file a strip of brass to dimensions of *C*, Fig. 5, and solder to pivot as shown. At the top, pivot the piece *D* on a steel pin, so that it hangs freely, but without side play. Solder a length of fine watch-spring to a convenient part of the work, to bear against the ratchet-wheel *H*, Fig. 5, and prevent it from slipping backwards. Obtain a 2 in. length of darning needle or cycle spoke, and solder to the front bearing, as shown in Fig. 2. Before doing this, however, it would be advisable to fit the other parts together on the woodwork, as this ratchet-lever is rather difficult to adjust correctly.

The base is a piece of mahogany 7 x 8½ x ½ in. thick, and the upright is a similar piece, 18 x 6½ in., screwed to the base, and with angles pieces of wood to support the upright as shown in the photograph, Fig. 1. As the back plate of works has to be 2½ in. in front of the upright, screw blocks of wood to same and solder a piece of brass on each side of the works. Blocks of 1 x 1 in. mahogany go behind each side of the contact breaker to bring it the correct distance from the upright. Fit the parts together. Solder the top of pendulum rod to pivot and put the wheels in the works. Screw works to the blocks of wood and these blocks to the upright. Fix the magnets underneath armature centrally and screw the contact breaker in position with the spring horizontal, and fill the cup with mercury. The V-piece on pendulum rod comes over the spring; the bottom of V should be ⅛ in. below the notch in *C*, Fig. 7, and this notched piece should be soldered

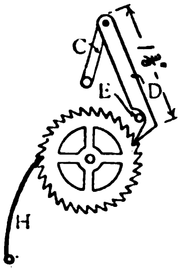



FIG. 5.

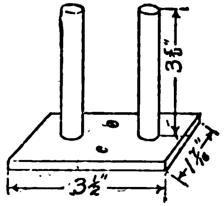



FIG. 10.

center of the notch, the V drops in same and contact is made.

The wire *E*, Fig. 5, must be so adjusted to the curve in lever *D* that it only pushes one tooth of the ratchet-wheel, no matter what the swing of the pendulum is. The curve in *D* will have to be carefully filed to ensure a correct position, and the spring *H*, Fig. 5, adjusted to suit *D*.

The batteries can be two Leclanché cells; the writer uses Empire cells joined in series. The wiring is as follows: One wire from the magnets goes to a terminal of the battery, the other wire goes to the mercury cup. The opposite side of the contact breaker *A*, Fig. 7, is connected to the other terminal of the battery. It will make a neat job if the wires are all carried behind the woodwork out of sight. To minimize sparking in the mercury cup, a condenser should be made, consisting of about 56 sheets of tin-foil 5 x 4 in., interleaved with paraffin paper, as on a spark coil. The ends are joined one to each side of the contact breaker. In the photograph, Fig. 1, the condenser will be seen fitted in a narrow wooden box and screwed to the back of the upright above the batteries. The dial arrangement is the only part now required to complete the clock, and a celluloid dial should be purchased from some wholesale jeweler. It is glued in place of the old one. A glass bezel should also be purchased. Turn a mahogany ring, as shown in the photograph, to fit friction-tight and come flush with

## LACQUERING

V. W. DELVES BROUGHTON

I believe most amateurs have experienced the same difficulties in lacquering their work, that I have, so I make no apology for giving the following hints, says Mr. Broughton in *The Model Engineer and Electrician.*

To lacquer a plain cylindrical object, chuck the same in the lathe, and after thoroughly polishing, finish off with a clean rag covered with whitening, running the lathe at a high speed and using considerable pressure. It will generally be found that sufficient heat has been developed by this process; if not, the article must be warmed by a spirit lamp or Bunsen burner till it is as hot as can be comfortably borne by the back of the hand. The article is then quickly dusted with a clean cloth, and the lacquer applied with a pad, much like French polishing, but taking care to go only once over the object with a light but firm touch. In a similar manner large flat surfaces can be treated.

Small and irregular-shaped pieces can be treated in the following manner: First, they are finished and polished or dipped in acid; then they are dipped in caustic potash (American potash will do equally well), about a 10 per cent. solution, which is better used hot if there is any fear of contamination with grease; then quickly rinsed in clean water and dipped into the following bath, which must be kept nearly, but not quite, at the boiling point. Take 1½ oz. of best Scotch glue, and soak the same in 5 pt. of water till quite soft; then melt over the fire and add 1 oz. of bichromate of potash. Just before dipping, the scum on the surface should be removed with a piece of card. The articles must be left in the bath for a sufficient time for them to become heated to the temperature of the bath, so that when removed they will dry almost instantaneously. The articles are next exposed to sunlight for about an hour, when it will be found that the film of bichromated glue left on the surface has been rendered perfectly insoluble. The protection of metallic surfaces in this manner is very thorough, and, thin as the protecting film appears, it offers a wonderful resistance to atmospheric influences.

If the articles to be lacquered are polished aluminum, or alloys of that metal, the caustic potash bath must be omitted, and the articles brushed with fine powdered bicarbonate of soda just sufficiently moistened to stick to the brush. Caustic potash will give aluminum a frosted appearance, especially if used hot.

This manner of protecting metallic surfaces has the advantage that it scarcely shows at all; and if good gelatine is used instead of glue the film would be still more imperceptible. For white metals, chrome alum might be substituted for the bichromate, and ¼ oz. instead of 1 oz. used to the same quantity of glue or gelatine and water. Placing in the sun would then be unnecessary, as chrome alum has the power of rendering most coloids insoluble without the agency of light. I mention this last recipe more as a suggestion than as a proved process, for, although I have used it, I have not kept by me the articles that have been treated in this manner for a sufficient length of time to test its resistance to the atmosphere.

All lacquering should be done in daylight, as it is nearly impossible to see if it is laid on properly by artificial light, and work that looks perfect by gaslight will appear a mass of smears in the day time.

If deep colors are admired, the following may be added to the lacquer employed (but it should be noted that the deeper the color the more difficult it is to lay on the color evenly)—Bismark brown, a deep copper color; dragon's blood, a fine deep golden color; turmeric and gamboge, both of which give a good light golden color. Saffron gives a good color to the liquid used in the glue-bichromate process, and may be used alone or with a mixture of tincture of logwood. The glue-bichromate solution may be kept for a long time if bottled, but should be filtered through two or three thicknesses of good flannel before use. I do not know whether the addition of coloring matters would affect its keeping qualities; it is cheap enough, however, and there is very little expense or trouble in making up a new bath when required.

## A METHOD OF CALCULATING DIFFERENTIAL INDEXING

STEPHEN HOUSE

The mathematics of the universal milling machine are interesting in the extreme, and to the enquirer the method of differential indexing is one which compels attention. Plain indexing is simple enough; compound indexing is ingenious, but is not so handy as the differential. Compound indexing lends itself more to error than does the differential, as it is not so easy to keep the direction of two separate calculations and movements in mind as it is to remember that the crank moves in only one direction. The only difference between plain and differential indexing is the admission of some easy gearing into the latter case; the principle of indexing and the movement of the crank is precisely the same in each case. How to arrange for the necessary gearing for the differential without reference to the tables which Brown & Sharp issue with their machines or in the absence of any such assistance is what every operator of a milling machine ought to know.

Differential indexing is the sum or difference of fractions to give the required advance of the crank for one division on the piece milled. In this it resembles compound indexing. There is this difference, however: whereas in compound indexing the machinist must attend to both crank and plate movement, in the differential indexing the crank only demands his attention, the plate being moved backwards or forwards by the gears used.

Suppose for instance that we wish to cut 51 teeth. No index plate usually found in the shop will enable us to do this by direct indexings, as we would require a 40-hole move on an index circle of 51 holes. That is, the crank would move $\frac{40}{51}$ of the circumference of the plate for every division cut. As this is an impractical fraction by direct indexing let us get as near as we can by this method: $\frac{42}{51}$ is very near to $\frac{40}{51}$, and can be obtained by taking 14 holes on a 17-hole index circle, since $\frac{42}{51}$ is the same as $\frac{14}{17}$. But, if we adopt this fraction we are $\frac{2}{51}$ in excess of what we need. Hence it will be at once seen that we must arrange the gears in such a way as to counteract and cancel this excess. This can be done by causing the index plate to move backwards $\frac{2}{51}$, whilst the crank moves forward $\frac{42}{51}$, or $\frac{14}{17}$ of the index circle. $\frac{2}{51}$ movement negatively of the plate per one division of 51 is manifestly 2 whole turns by the time we have gone the 51 divisions. That is to say, while the spindle has made one complete revolution (=51 divisions made) the index plate has made two complete revolutions, and this would only be effected by using gears on the spindle and worm in the ratio of 2 : 1. Those recommended by Brown & Sharp in their tables are 24 on the worm and 48 on the spindle. 28 and 56 would do just as well, or any other convenient two, so long as the ratio spindle : worm : : 2 : 1, holds good.

All gearing, however, does not work out so simply as this, and it is sometimes necessary to try both a positive and a negative movement of the plate before deciding which to adopt. This is well illustrated in the case of a 99 gear. Direct indexing demands a 99 circle with the sector set for a 40-hole move. This is impractical, but $\frac{40}{98}$ is near to $\frac{40}{99}$, and $\frac{40}{98}$ is obtained by 20 holes on the 49 circle. We want 99 teeth, however; not 98 teeth. So we must arrange for an extra tooth. Hence, the index plate must move in the direction opposite to that of the crank, and the amount of negative rotation per 1 tooth cut is plainly the difference between $\frac{40}{98}$ and $\frac{40}{99}$; $\frac{40}{98}-\frac{40}{99}=\frac{3960-3920}{9702}=\frac{40}{9702}$. Therefore the total negative movement of the plate by the time the 99 teeth are cut $=\frac{40}{9702}\times 99=\frac{40}{98}$; that is, whilst the spindle has made one complete revolution the index plate has made $\frac{40}{98}$ of a complete revolution in a direction opposite to that of the crank, or, working in whole numbers, if the spindle were to make 98 revolutions, the index plate would make 40 only. Gear on spindle to gear on worm, must then be in the inverse ratio of their relative movements, that is, 40 : 98. 40 : 98 = 1 : 2.45, and there are no gears in common use which give this ratio exactly, though 40 on the spindle and 100 on the worm give a close result, yet not near enough. Apparently, then, all our working is for nothing. Let us try the other tack, however, and instead of $\frac{40}{98}$, let us try what $\frac{40}{100}$ will do. 100 teeth being 1 too many, we shall have to cause a rotation of the index circle in the direction the same as the crank. The amount of movement is obtained as before: $\frac{40}{99} - \frac{40}{100} = \frac{40}{9900}$ per 1 tooth: $= \frac{40}{100}$ per 99 teeth : $= \frac{40}{100}$ of 1 turn for one complete revolution of the spindle. Hence, gear on spindle : gear on worm = 40 : 100.

That is, a 40-gear on spindle : 100 on worm. Here is a case where simple gearing will not do. We must resort to compound gearing, remembering always this rule. The product of gear on spindle and first gear on stud to product of second gear on stud and gear on worm must be equal to the required ratio. In this case, 40 : 100 = 2 : 5.

The usual gears are 24, 28, 32, 40, 44, 48, 56, 64, 72, 86, 100, and we must investigate to find two pairs such that the quotient of their respective products equals $\frac{2}{5}$. This step may need a little time, but is not impossible, as is shown thus: $\frac{28 \times 32}{40 \times 56} = \frac{2}{5}$. Consequently, we immediately set our gearing 28 on spindle and 32 as first gear on stud; 40 as second gear on stud with 56 on the worm.

As another illustration let us take 125 teeth, which by direct indexing would require $\frac{40}{125} = \frac{8}{25}$. No index plate will give this fraction, but we can obtain $\frac{9}{27}$ or $\frac{13}{39}$, or $\frac{7}{21}$, on index circles, and these fractions are very close to $\frac{8}{25}$. As a matter of fact, they are slightly larger, so that the plate must be given a negative movement.

Proceeding as before: $\frac{9}{27} - \frac{8}{25} = \frac{1}{3} - \frac{8}{25} = \frac{25-24}{75} = \frac{1}{75}$.

That is, the index plate must move negatively $\frac{1}{75}$ of a revolution per 1 tooth, which is $\frac{125}{75}$ of a revolution per 1 revolution of the spindle, or $\frac{5}{3}$ of a revolution per 1 revolution of the spindle.

∴ Gear on spindle : gear on worm = 5 : 3. 40 on spindle and 24 on worm satisfies this condition.

It will be noticed that when the denominator of the fraction adopted is greater than the denominator of the true fraction, it is necessary in order to correct the difference to advance the index plate in the same direction as the movement of the crank. For instance, $\frac{40}{99}$ is greater than $\frac{40}{100}$, and, since the latter fraction is the one we adopted, it plainly becomes the work of the index plate to make up the difference, to give 99 teeth instead of 100. Every time the index plate moves forward it increases the fraction represented by the movement of the crank alone, and *vice versa*, when it moves backwards (that is, in a direction opposite to that of the crank) it decreases the fraction represented by the crank movement. The larger the fraction of a revolution that the spindle makes per tooth, the fewer the teeth, and contrawise. Hence, if our adopted fraction as, for instance, $\frac{42}{51}$ represents less teeth than we require, the index plate must equalize matters by moving backwards. So that it is only necessary to remember whether the fraction is greater or less than the true one to determine whether our index plate is to make a forward or backward movement, relative to the movement of the crank. A forward movement is obtained by the use of one idler, a backward movement by the use of two idlers. Two gears on a stud are the same as one idler in their effect.

By this method of fractions gears may be determined for any number of divisions up to or beyond the 382 which ends Brown & Sharp's tables. It takes a little time, perhaps, but when one has done a few examples in this manner, he is able to decide almost intuitively what fraction to adopt. By one movement or the other, forwards or backwards, this method gives correct results.

# PRIZE CONTEST

**ENTRY NO. 1**

## AN ASTATIC GALVANOMETER

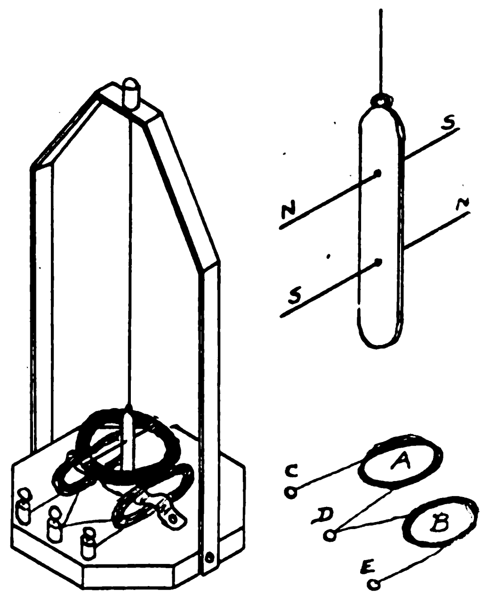
LEONARD MORAN

The Astatic galvanometer is a very sensitive instrument, and so it is a great help in a wireless station. It consists of two magnetic needles, two coils of wire, three binding-posts, hardwood base, strip of copper or brass (never tin or iron) to form a bridge, and a cork. All tacks and screws are of brass.

Each coil is made separately of 10 ft. of No. 30 insulated copper wire, wound about the base of a drinking glass, to give it its shape, and then pressed into an elliptical shape, and fastened to the base block with a brass or copper strip, held down with small brass screws.

The base-block should be 4 in. square. First cut off the corners of the base block, and then give it several coats of shellac. The bridge is made from brass 1/16 in. thick, 1 in. wide and 7 in. long, which is screwed to the outside of the block, as shown in the illustration. A small hole is drilled through the top of the bridge to admit a cork and screw-eye. Ordinary large compass needles may be used or magnetized pieces of highly tempered steel piano wire will do. A short piece of wood can act as the carrier-bar for the needles. When the needles are arranged properly, suspend them from the screw-eye, fastened in the cork, by a thread. A circular indicator disc of cardboard is marked and attached to the top of the coils with a few drops of wax.

Three binding-posts are now placed on the base block and to them the end wires of the coils are attached as shown by the illustration. When making connections for a strong current, attach one of the leads to the middle binding-post and the other lead to one of the outer binding-posts. For a weak current, at-




An Astatic Galvanometer

taken in wiring the instrument. As the needles and coils are very sensitive, it is best to cover the entire apparatus with an inverted glass jar. A bluestone or gravity battery jar will serve very well for this purpose.

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[The article by Mr. Moran is one of the articles submitted in our Prize Competition. The winner of this Competition will receive a prize of $10.00, and articles which do not win the prize, but which are of sufficient practical value, will be purchased by us at our regular space rates. Let us hear from some of our other readers who can tell "How to Build" experimental ... The Prize Com-

## WIRELESS TELEGRAPH AUXILIARY SETS FOR STEAMERS

LEO F. WHITEHEAD

The new "wireless" law, which went in effect October 1st, requires all ships having wireless apparatus to carry two operators, one of whom shall be on duty at all times when the ship is under way. This law applies to all ships that came under the previous act requiring that they be equipped with wireless apparatus. Concurrently there is an enactment making it necessary for all such ships to have an auxiliary power capable of transmitting signals a distance of 100 miles over sea under all conditions. This power is to be used in case of emergency, and to operate independent of the ships' ordinary power supply.

The Marconi Wireless Company uses the storage battery almost entirely as a means of obtaining this power. The entire wireless equipment is so extensive that the reader can readily see to what enormous expense the wireless and steamship companies are under to provide for the safety and comfort of the people who travel by water. If anything should happen to the ships' electric generators—and in the past it has been customary to depend upon them—the wireless set is thereby put out of commission; and if generator troubles occur on land, there is still greater opportunity for them at sea. At sea, the ship's power is one of the first things to go "dead," particularly if water gets in between decks. The storage battery is installed in the wireless room, which in most cases is on the top deck, therefore the last place where water would reach it. The sort of battery being installed at the present time is the lead type, which has a capacity of at least from 40 to 60 ampere-hours. There is a switchboard with the necessary apparatus for controlling the charge and discharge. This size of battery is sufficient to operate a 10-in. spark coil specially used with this set. One end of the spark gap is connected with the deck [illegible] Only one key is required, for a double-hole double-throw switch is used to throw the large or the small set in operation. The storage batteries are charged from the ship's electric light mains. The line voltage ranges from 110 to 220, and in some cases is even higher. This makes it necessary to charge the batteries through a limiting resistance, the amount of which is made to correspond with the ship's installation and thereby adjusts the rate at which the batteries are charged. A voltmeter is used to show the condition of the batteries. An under-load relay is in series with the batteries. It has a disc attachment which makes and breaks the circuit. The batteries cannot be charged until the disc makes a contact. The aerial switch closes the key circuit. This is the means of safeguarding the receiving set.

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### Intermarriage in China

President Yuan Shih Kai has issued a "mandate" enjoining on the five races who compose the population of the republic the desirability of intermarrying, to the end that in time they may become welded into a single people.

"As the present form of government," says the document, "is based upon the union of the five families for the formation of a new nation, it is essential that territorial distinction should be entirely eliminated and mutual good feeling should be daily enhanced. According to the rules of old, prohibitions existed as regards intermarriages between Chinese and Manchus, as well as between Chinese and Mongolians; and there have also been few marriages of the two families of the Moslems and Tibetans with that of the Chinese.

"During recent years proposals to abolish these old prohibitions, with a view to assimilating their customs and [illegible]

# NOTES ON WIRE AND METAL GAUGES

GEO. GENTRY

The following hints have been put together not necessarily in any concise form or as an exhaustive reference (for the latter, see any good tool-dealers' catalog), but as they have occurred to the writer in some few years of light workshop experience. The master hint of all is to use your tools fairly and within reasonable limits for the purpose for which they are intended. For instance, don't take the shank of your 1-1000 in. micrometer to drive in a tack; even if you have mislaid your tack hammer and cannot wait to find it; it will be cheaper to go out and buy another hammer.

### WIRE AND SHEET GAUGES

It is suggested that the writer commence with some notes respecting wire and plate gauges, and as so much remains to be learned as to the proper use of the different gauge plates sold, no doubt a few hints will be useful.

There are some two dozen different standards for gauging wire, sheet metal and drills in constant use in America, England and the Continent. The following are those which can be referred to as representative and most useful for the workshop.

The Imperial Standard Wire Gauge has limits from seven 0's (.5 in.) to one 0 (.324 in.), and No. 1 (.300 in.) to No. 50 (.001 in.)—57 sizes in all—and is the only legal standard for wire of all metals in England. The Board of Trade fixed these equivalents in 1884. All engineering tables and most trade catalogs give accurately the equivalents. The usual forms of gauge are the folding round notch gauge, Fig. 1, the folding oval notch gauge, and oblong notch gauge. The first-named is the most compact and handy form, especially when put up in a leather case. The usual limits are either from 1 to 26 inclusive, or 1 to 36. Twenty-six sizes are quite sufficient for ordinary use. It should be noted that I.S.W.G. gauges are always of notch form, as this form is more convenient for calipering a strand of wire selected from a hank and also for gauging a sheet of metal. This gauge is sometimes known as the standard wire gauge, and abbreviated

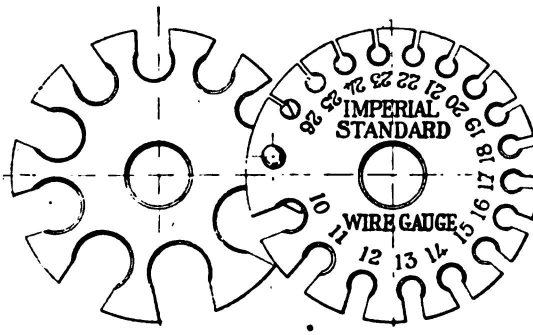



Fig. 1—Folding I. S. Gauge—(Full Size)

S.W.G. Note that the most useful numbers to remember are No. 3=¼ in. 2-1000ths full; No. 6=3-16 in. 4½-1,000ths full; No. 10=⅛ in. 3-1000ths full; No. 16=1-16 in. 1½-1000ths full, and No. 21=1-32 full.

The Birmingham Wire Gauge is identical with that known as Stubb's Iron Wire Gauge, and was the general gauge used before the introduction of the I.S.W.G. Care should be taken in buying second-hand or using old-gauge plates—usually oblong patterns—that (unless you particularly need B.W.G. sizes) the notches are not those sizes, for, although Nos. 1, 15, 21, 22, 24 and 26 are alike in both, other sizes give as great a difference as .011 in. For reference as to equivalents, see Pfeilschmidt's "Wire and Sheet Gauges of the World."

Perhaps one of the most useful ideas respecting gauges for wire or plate ever devised is that of the Whitworth decimal gauge in which the designating numbers correspond to the thousandths of an inch. No. 1=.001, No. 2=.002, and so on. No table equivalents are necessary, as the number designates the size. This gauge is very little used among wire manufacturers on account of its range, there being, as a matter of course, 250 sizes up to ¼ in. No gauge plates are sold to W.D.G. sizes, as the micrometer is better adapted for testing these.

Stubb's Steel Wire Gauge, also known as Lancashire Pinion Wire Gauge, was many years ago introduced by Messrs. Peter Stubbs, Ltd., Warrington, and the most reliable gauge plates sold now

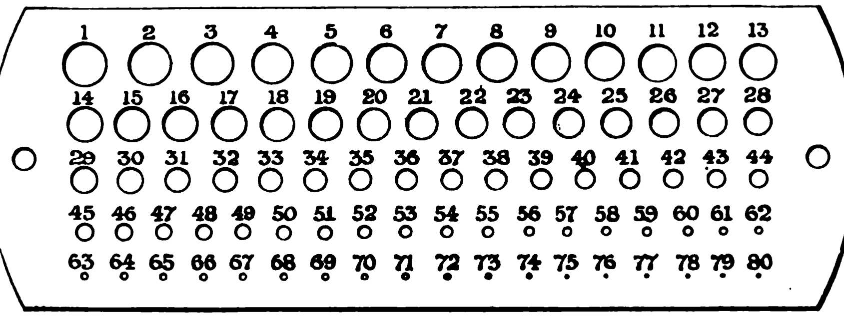



Fig. 2—Stubb's Gauge Plate—(Full Size)

bear the name of that firm. The limits are from H1=.494 to A1=.420, from Z=.413 to A=.234, and from No. 1=.227 to No. 80=.013—114 sizes in all. The usual form of gauge plate has holes and not notches. See Fig. 2 (an illustration of the number sizes only). It is used for gauging short lengths of crucible cast steel (more generally known as silver steel), which is rolled bright and used for the purpose of making tools, such as taps, drills, reamers, etc., and for spindles in light machinery. It is also used for gauging broaches.

What are known as standard English taper broaches are gauged to Stubb's sizes at the shoulder or maximum diameter, and the numbers of such correspond to the same. There are also on the market twist reamers made to these equivalents. It should be carefully noted that although tool manufacturers state in their lists that twist drills are made to Stubb's gauge, this is only applicable to the letter sizes, A to Z. For some reason unknown to the writer, the present practice of the Morse Twist Drill & Machine Tool Co. and nearly all makers of wire twist drills is to vary the number sizes in relation to Stubb's gauge, the average variation being about .001 of an inch. For reference as to Stubb's equivalent, see "Pfeilschmidt" for complete range. The expression "Steel Wire Gauge" in reference to Stubb's gauge is applied in relation to the gauging of finished tool steel in short lengths, the range of sizes and the whole form of gauges being most suitable.

The I.S.W.G. is also used for steel wire in the hank, but the greater jump from one size to another renders it less useful for gauging tool steel, as it would necessitate more turning for intermediate sizes than is the case with the finer gradations in Stubb's gauge. A table is appended, giving the most suitable sizes of bright silver steel wire for making Whitworth and B.A. taps and screws, the numbers referring to Stubb's gauge. A copy of this should be useful in the workshop.

**TABLE OF STUBB'S STEEL WIRE GAUGE**
**Equivalent to Whitworth and B.A. Screws**

*Whitworth*

| Size | Stubb's No. | Error |
|---|---|---|
| 1-16 in. | 52 | .0005 full |
| 5-64 in. | 46 | .00087 full |
| 3-32 in. | 41 | .00125 full |
| 7-64 in. | 34 | .00062 full |
| 1-8 in. | 30 | .002 full |
| 9-64 in. | 27 | .00237 full |
| 5-32 in. | 21 | .00075 full |
| 11-64 in. | 17 | .00012 full |
| 3-16 in. | 11 | .0005 full |
| 13-64 in. | 5 | .00087 full |
| 7-32 in. | 2 | .00025 full |
| 15-64 in. | A | .00038 bare |
| 1-4 in. | E | None |
| 17-64 in. | H | .00037 full |
| 9-32 in. | K | .00025 bare |
| 5-16 in. | O | .0035 full |
| 3-8 in. | V | .002 full |

*British Association*

| No. | Stubb's No. | Error |
|---|---|---|
| 16 | 67 | None |
| 15 | 64 | None |
| 14 | 60 | None |
| 13 | 55 | .003 full |
| 12 | 55 | .001 bare |
| 11 | 53 | .001 bare |
| 10 | 50 | .002 full |
| 9 | 48 | None |
| 8 | 43 | .002 full |
| 7 | 39 | .001 full |
| 6 | 34 | None |
| 5 | 30 | .001 full |
| 4 | 27 | .001 full |
| 3 | 20 | None |
| 2 | 12 | None |
| 1 | 3 | .003 full |
| 0 | B | .002 full |

The Metal Gauge, or Birmingham Metal Gauge (abbreviated B.M.G.), has a useful range of sizes for gauging metal

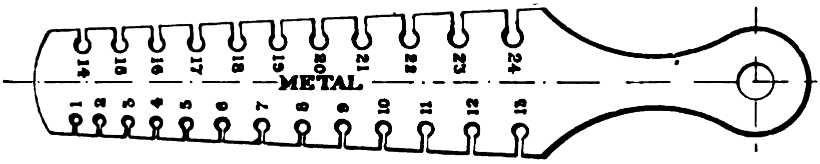



Fig. 3—"Magna Charta" Metal Gauge—(Two-thirds full size)

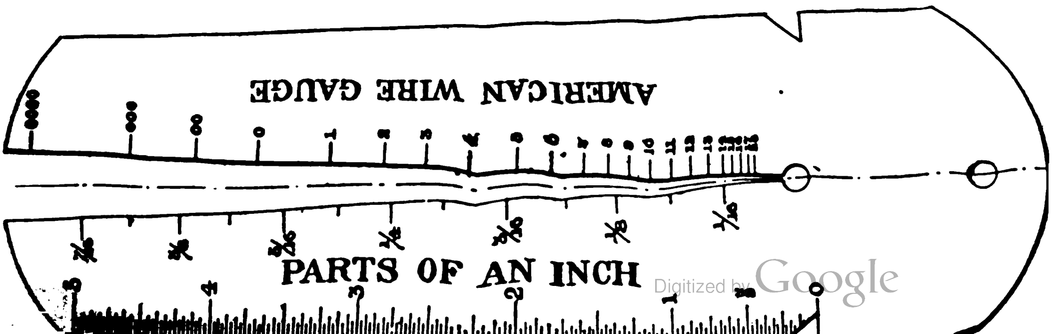
sheets, and is used principally by artists in metal work and also by workers in the precious metals. It is sometimes called the "Shakespeare gauge" by jewelers and silversmiths, on account of the fact that Messrs. Shakespeare & Sons, of Birmingham, supply gauge plates principally to the jewelry trade. The usual form of gauge is notched as shown by Fig. 3, which is an illustration of the "Magna Charta" metal gauge. It should be noted that the numbers range upwards, No. 1 being the smallest size. This is contrary to the usual practice in gauges. As the writer knows of no accurate reference for the equivalents, he has appended a table of the usual sizes—Nos. 1 to 40—which was kindly supplied by Messrs. J. Edelston & Sons, of Warrington, and confirmed by Messrs. Shakespeare & Sons. Sheet metal, such as is used in plate-workers' shops, in iron, mild steel, brass or copper, is generally gauged by the I.S.W.G. and not by the metal gauge. In addition to the metal gauge there is a special gauge for sizing hoop and sheet iron used in the Staffordshire District (abbreviated B.G.). This is of no particular interest to the reader, but is mentioned to put him on his guard against mistakes due to the similar abbreviation to the metal gauge.

**BIRMINGHAM METAL GAUGE (B.M.G.)**
**Table of Equivalents in Accordance with Metal Gauges as Sold**

| No. | Decimal Inch | No. | Decimal Inch |
|---|---|---|---|
| 1 | .0085 | 21 | .069 |
| 2 | .0095 | 22 | .073 |
| 3 | .0105 | 23 | .077 |
| 4 | .012 | 24 | .082 |
| 5 | .014 | 25 | .091 |
| 6 | .016 | 26 | .102 |
| 7 | .019 | 27 | .112 |
| 8 | .0215 | 28 | .124 |
| 9 | .024 | 29 | .136 |
| 10 | .028 | 30 | .150 |
| 11 | .032 | 31 | .166 |
| 12 | .035 | 32 | .182 |
| 13 | .038 | 33 | .201 |
| 14 | .043 | 34 | .216 |
| 15 | .048 | 35 | .238 |
| 16 | .051 | 36 | .249 |
| 17 | .055 | 37 | .270 |
| 18 | .059 | 38 | .278 |
| 19 | .062 | 39 | .289 |
| 20 | .065 | 40 | .301 |

***Note.***—6 = 1-64th full; 11 = 1-32d full; 19 = 6th bare; 28 = 1-8 bare; 36 = 1-4 bare.

There is a Continental gauge known as the Westfalia Millimeter Wire Gauge, the designating number referring to the unit of 1-10th of a millimeter. The best plate known to the writer is that of the "Progress" screw gauge plate (holed and notched), which is cut to these sizes. Pfeilschmidt gives full particulars in millimeter and inch sizes, and a note about the gauge as applied to "Progress" screws will be found in Section 7, "Screws, Threads and Twist Drills." There is also a Swiss-made plate sold by watch tool dealers in London giving one hundred sizes—*viz.*, from .1 to 10 mm. by tenths millimeters.

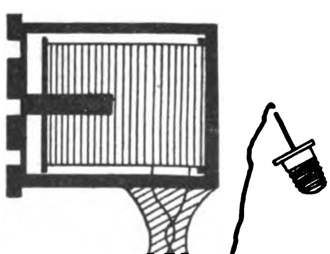


The above gauges constitute practically all and more than are necessary in ordinary workshop practice; and in concluding this portion of the subject, passing reference may be made to B.A. gauge plates giving screw, outside and tapping diameters for B.A. screws. Either whole or notch form gauges are made for outside diameters also. Special gauges of notch form are sold for testing lead and zinc sheet, plate glass and music wire (piano wire), each of which have their particular equivalents. The principal gauge in use in America is that known as the American, or Brown & Sharp, wire gauge; and in addition to this there is an American legal standard for sheets, which has the peculiarity of following the fractional inch decimal equivalents from ½ by 1-32 down to 9-32, and by 1-64 down to 1-16 in., after which finer fractions are given, which include 1-32, 1-64 and 1-128. An out-of-the-ordinary form of gauge is shown in Fig. 4, made by Messrs. Brown & Sharp to the American equivalents, one notch doing duty for all sizes. The only weak point in this design is that a slight strain would throw the whole out of caliber and render it useless, while bracing over the open end to strengthen would practically put it—for usefulness—on a par with the hole gauge, and consequently, not adapted for measuring wire in the hank. The question of strength in this design has been obviated by making them much thicker than gauges are as a rule. Messrs. Brown & Sharp also make a closed-over pattern. The writer has seen a similar form of folding gauge graduated to the I.S.W.G. The notched inch rule shown on the side is for measuring the overall length of countersunk headed machine screws, while the reverse side of the long notch is graduated to American machine screw gauge diameters. A similar form of gauge is sold to jewelers graduated to 1-1000ths of an inch. A good plate gauge is also made by the same firm and stocked by most London tool dealers for testing twist drills from 1-16 in. to ½ in. by 1-64, similar to Fig. 2.

## HOW TO MAKE AN ELECTRIC VIBRATOR

STANLEY RADCLIFFE

A very simple and inexpensive vibrator can be made in the following manner: First, procure a wooden cup 2½ in. in diameter by 3 in. deep. Then make a cover, in which several ½ in. holes are bored. We now have the container which is to hold the working parts. A solenoid is made by winding enough No. 24 magnet wire on a ½ in. mandrel to form a coil 2½ in. long and 2 in. in diameter. This coil is then fastened to the bottom of the wooden cup by a couple of small screws. Secure a round piece of thin sheet iron 2½ in. in diameter, and attach to its center a piece of soft iron 5/8 in. in diameter by 1½ in. long. This is used in converting the electrical energy into mechanical energy. The disc is put over the coil and fastened in place between the cover and the cup. The connecting wires are brought out through the handle, as shown in the sketch. The device can be used in connection with alternating current, and by using an interrupter, it can also be used with a battery.



### Practical Remedies for Motor and Generator Troubles

(*Concluded from page* 6)

for raising the armature pedestals or lowering the field frame bad sparking will occur at the brushes. Probably the

# MECHANICAL DRAWING

P. LEROY FLANSBURG L. BONVOULOIR

## CONVENTIONS—(Continued)

Although it is customary to represent V-threads in working drawings by the conventions explained last month, square threads are usually drawn as shown in Fig. 1. The construction is very simple.

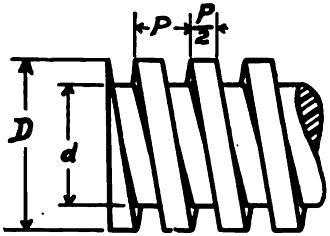
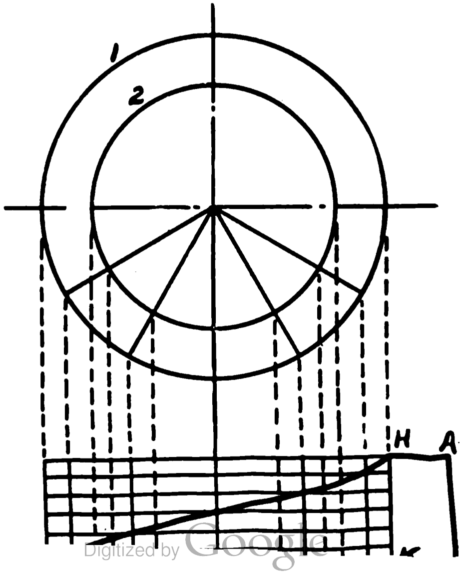



Fig. 1

It will be seen from the figure that the thickness of the thread is the same as that of the space between the threads, or, in other words, if the pitch of the screw is $P$, the thickness of the thread is $P/2$. If $D$ is the outside diameter and $d$ the root diameter, lay off lines parallel to the axis of the screw at distances $D/2$ and $d/2$ on both sides of this axis. Lay off distances equal to $P/2$ along one of these lines, and then project these points on the other lines. Connect the corresponding points on the outside and inside lines, getting the angles as explained in last month's article. The lines going behind the screw will be visible for only a very short distance, and care must be taken to get these right. A careful study of the cut will show the construction more

Draw circles 1 and 2 with diameters equal to $D$ and $d$ respectively. Divide the lower semi-circles into any number of equal parts by radial lines; in this case, 6 parts. From the intersection of these lines with the outside circle, draw parallel lines and extend them a short distance downward. On these lines lay off a distance $HK$ equal to the half pitch, $P/2$, of the screw. Divide the distance $HK$ into the same number of equal parts as was the circle, and project the outer extremities of the radial lines till they cut all of the lines which are drawn parallel to $FK$ through the points which were found on $HK$.



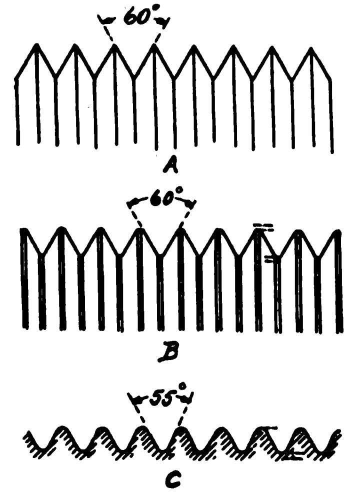


Fig. 3

We will then have a rectangle $HKG$. Point off the intersections of the first right-hand line with the first top line, the second right-hand line with the second line from the top, etc., and draw a smooth curve $GH$ through these points of intersection. Proceed in the same way for the rectangle $CJD$, making $CJ$ equal to $P/2$ and $JD$ equal to the diameter of the smaller circle. The intersections of the radial lines with the inner circle are projected on the rectangle $CJD$, and the curve $DC$ drawn as in the previous case. Carefully trace or scratch these curves on a piece of transparent celluloid, and cut out carefully in some such form as indicated by the letters $ABCJDEFGHA$. Care must be taken to have the sides $AB$ and $FE$ parallel to each other and to the axis of the circle. To use this templet, the screw is drawn as previously described, but instead of drawing straight lines between the corresponding points, the ends of the curve $HG$ are placed on these points and the curve drawn. The curve $DC$ is drawn in the same manner, but it will be noticed that one-half of the curve appears on one side of the thread, and the other half of the curve on the other side of the thread. It is obvious that a different templet must be used for different sized threads.

Different kinds of thread sections are used depending on the kind of work for which they are to be used. The various forms of thread sections are shown in Figs. 3 and 4.

The most common form is known as the V-thread, and is shown in Fig. 3*A*. The sides of the thread are inclined at an angle of 60 degrees. The sharp corners of this thread render it liable to injury, so that a modified form of the thread is generally used.

The Sellers or U.S. Standard thread, shown in Fig. 3*B*, is the same as the V-thread, except that the thread is shortened by one-eighth of the depth, both at top and bottom. The strength of the thread is materially increased by this means.

The Whitworth or English Standard, Fig. 3*C*, has the sides of the thread inclined at an angle of 55 degrees, and the tops and bottoms of the thread rounded off to one-sixth of the depth of the thread.

Where the thread is used to transfer motion, as is the case of the lead screw in a lathe, large bearing surfaces are necessary, and the square thread can here be used to advantage. It is not quite as strong as the V-thread, since it has only one-half of the shearing surface of the latter. Fig. 4*A* shows the usual form of square-thread, where the width of the thread, width of the space between threads, and the depth of the thread are all equal.

The Acme Standard, Fig. 4*B*, is the same as the square thread, except that its sides are inclined at an angle of 29 degrees. This gives increased bearing

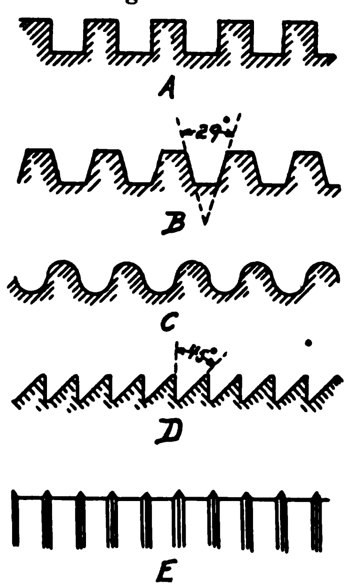


Fig. 4

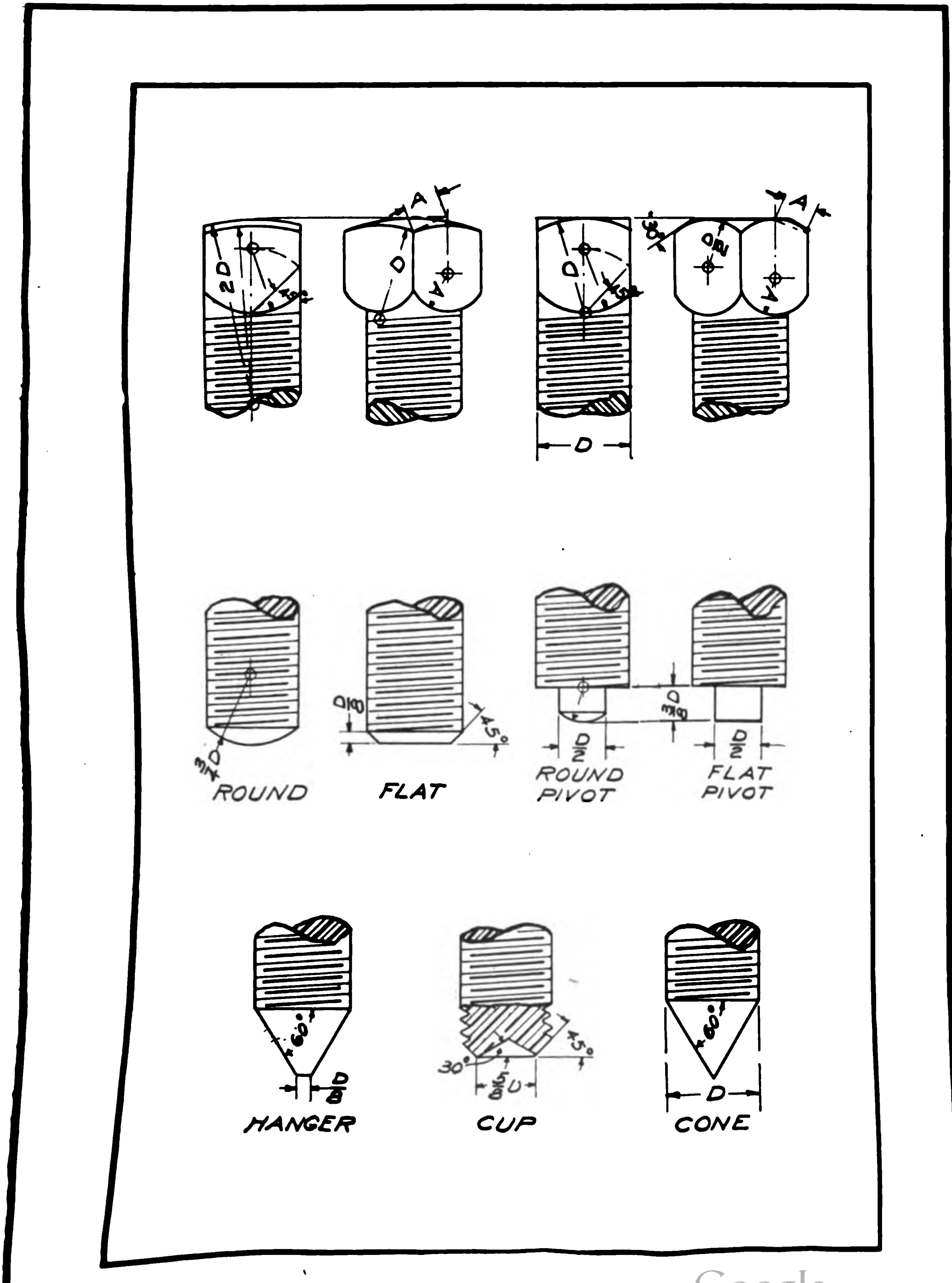

A
A
2D
D
A
D
30°
D/2
A
D
ROUND
FLAT
ROUND
PIVOT
FLAT
PIVOT
60°
D/8
HANGER
45°
30°
CUP
60°
D
CONE


Fig. 5—Machine Screws

and shearing surfaces, and also permits of a clasp-nut being used.

Fig. 4*C* is a modified form of the Acme Standard with rounded edges. It is used for rough work and may easily be cast, making its manufacture much less expensive.

Fig. 4*D* shows a form of thread which is used where the pressure on the thread is always applied against the same side. One of the sides is perpendicular to the axis of the screw, while the other is inclined at an angle of 45 degrees. The tops and bottoms are slightly flattened.

MACHINE SCREWS

| No. | Threads per inch | Dia. Body | Dia. Heads Flat | R'd | Fil. | Lengths |
|---|---|---|---|---|---|---|
| 2 | 56 | .0842 | .163 | .155 | .133 | 3/16 – 9/16 |
| 3 | 48 | .0973 | .190 | .179 | .155 | 3/16 – 5/8 |
| 4 | 32–36–40 | .1105 | .216 | .203 | .175 | 3/16 – 3/4 |
| 5 | 32–36–40 | .1236 | .243 | .227 | .199 | 3/16 – 7/8 |
| 6 | 30–32 | .1368 | .269 | .252 | .218 | 3/16 – 1 |
| 7 | 30–32 | .1500 | .295 | .276 | .240 | 1/4 – 1 1/4 |
| 8 | 30–32 | .1631 | .321 | .294 | .261 | 1/4 – 1 1/4 |
| 9 | 24–30–32 | .1763 | .348 | .324 | .281 | 1/4 – 1 3/8 |
| 10 | 24–30–32 | .1894 | .374 | .348 | .304 | 1/4 – 1 1/2 |
| 12 | 20–24 | .2158 | .427 | .393 | .345 | 3/8 – 1 3/4 |
| 14 | 20–24 | .2421 | .479 | .437 | .389 | 3/8 – 2 |
| 16 | 16–18–20 | .2684 | .532 | .487 | .430 | 3/8 – 2 1/4 |
| 18 | 16–18 | .2947 | .585 | .525 | .471 | 1/2 – 2 1/2 |
| 20 | 16–18 | .3210 | .637 | .569 | .520 | 1/2 – 2 3/4 |
| 22 | 16–18 | .3474 | .690 | .611 | .556 | 1/2 – 3 |
| 24 | 14–16 | .3737 | .742 | .653 | .601 | 1/2 – 3 |
| 26 | 14–16 | .4000 | .742 | .694 | .643 | 3/4 – 3 |
| 28 | 14–16 | .4263 | .795 | .736 | .692 | 7/8 – 3 |
| 30 | 14–16 | .4520 | .848 | .777 | .724 | 1 – 3 |

Certain standard forms and dimensions of screws are generally used in practice, and are variously known as *Machine Screws*, *Set Screws*, *Cap Screws*, etc. The following tables and cuts should be made into study plates, similar to Study Plate 10, as this work will give invaluable practice in lettering and the plates will also be of considerable value as reference plates. Each kind of screw with its accompanying tables should be put on a separate plate. The arrangement is left as an exercise to the student, Plate 10 merely serving as a model. Number the plates as follows:

Machine Screws—Study Plate 6
Pipe Threads—Study Plate 7
Cap Screws—Study Plate 8
Cap Screws—Study Plate 9

There are three kinds of machine screws, as shown in Fig. 5, and they are known as *Flat Head*, *Round Head* and *Filister Head*. Assume a diameter of screw, and you can at once obtain its dimensions from the tables. All threads are U.S. Standard. Machine screws vary in length from 3/16 in. to 1/2 in. by 16ths; from 1/2 in. to 1 1/2 in. by 8ths; and from 1 1/2 in. to 3 in. by 4ths.

The tables may be put at the top or at the bottom of the plate, as preferred, care being taken to have the plate well balanced.

Fig. 6 shows the standard pipe thread. It will be noticed that the threaded end is tapered 3/4 in. per ft., and that the last two threads are cut off at the top, while after a distance *L* from the end, the threads are also filled in at the bottom.

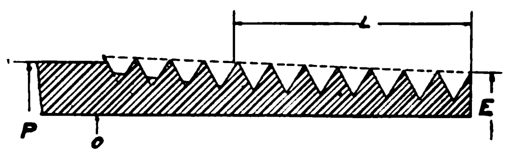


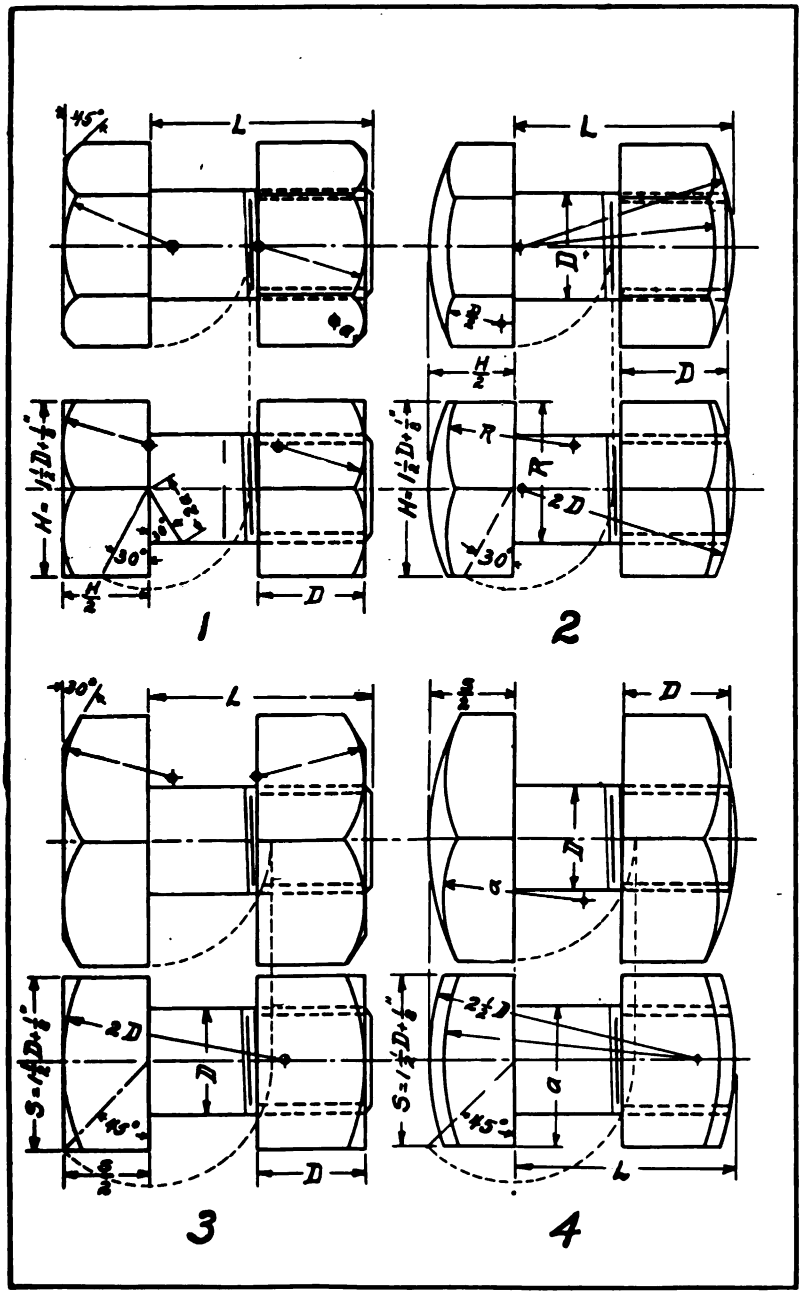

Fig. 6—Pipe Thread

Assume any desired pipe diameter, and, as before, you can readily get the dimensions of the standard thread from the tables.

Fig. 7 shows two different kinds of heads used on Cap Screws, *i.e.*, Hexagonal Heads and Square Heads. The construction is clearly indicated in the figures. *H* is the distance between opposite faces and the length of the 30-degree line, drawn from the axis to the edge of the head, gives the half-width of the other view of the head. The lengths *T* may vary by 4ths between the limits given. $T = \frac{3}{4}L$ up to and including 1 in. in diameter and 4 in. long.

STANDARD PIPE THREAD

| Pipe Size | | 1/4 | 3/8 | 1/2 | 3/4 | 1 | 1 1/4 | 1 1/2 | 2 | 2 1/2 | 3 | 3 1/2 | 4 | 4 1/2 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Outside Dia. Pipe | P | 0.54 | 0.68 | 0.84 | 1.05 | 1.32 | 1.66 | 1.90 | 2.38 | 2.88 | 3.50 | 4.00 | 4.50 | 5.00 | 5.56 | 6.63 | 7.63 | 8.63 | 9.69 | 10.75 |
| Inside Dia. Pipe | O | 0.36 | 0.49 | 0.62 | 0.82 | 1.05 | 1.38 | 1.61 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |




Study Plate II

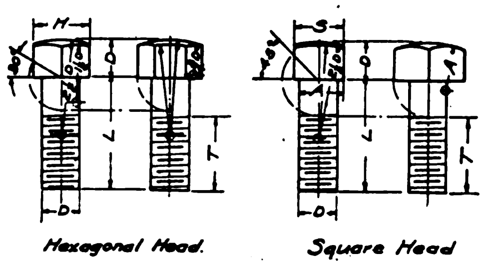



Fig. 7—Cap Screws

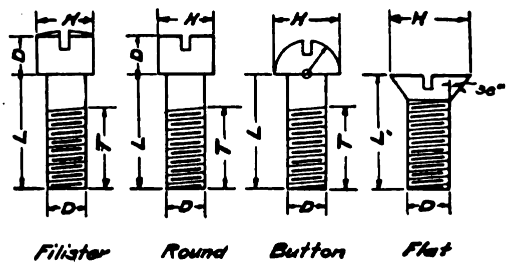



Fig. 8—Cap Screws

There are also four other kinds of Cap Screw heads, *viz.*: Filister, Round, Button and Flat. The construction is similar to that of the previous ones, and is shown quite clearly in Fig. 8.

Study Plate 10 shows the various forms of Set Screw hea . and points. The heads are known as Round square head and Chamfered square flat head. The points are known as round, flat, round pivot, flat pivot, hanger, cup and cone. The differences between the various kinds of points are clearly shown and their construction should not be difficult.

Study Plate 11 shows in detail the construction of the U.S. Standard Bolts, both hexagonal and square, with both flat and spherical tops. All of the dimensions are given in terms of the diameter. After finding the width *H* of the bolt head, the width of the other view is obtained by drawing a 30-degree line and projecting the length of this line on the other view, in the same way as for the Cap Screws.

The dimensions for the border lines of these six study plates are the same as for all the study plates which have been given.

All of these study plates should be drawn carefully and saved for future reference, as a designer is constantly using these standards in his work. The lettering should be done carefully and neatly, and no fancy lettering should be used, a simple kind easily made and easily read being preferable.

Such study plates, which have been drawn by readers of the ELECTRICIAN AND MECHANIC and sent in for criticism, show remarkably good workmanship for men who are not draftsmen. If any readers would like to have their work criticised, send it in to the ELECTRICIAN AND MECHANIC, addressed to the Mechanical Drawing Department and inclosing return postage. In order to make this department of the magazine still more helpful to the readers, a few Study Questions will be given from time to time. It will be excellent practice for the novice to try to answer the questions.

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## STUDY QUESTIONS

1. Draw two converging straight lines which make an angle of 30 degrees with each other. From some point within the angle and at a distance of 3 in. from the vertex let fall perpendiculars to each line.

2. What may be said of the angles and sides of a quadrilateral which encloses the maximum area with a given perimeter? Name the figure.

3. Inscribe a regular octagon in a circle.

CAP SCREWS

| Dia. Screw | Hexagonal Head | | Square Head | |
|---|---|---|---|---|
| | H | L | S | L |
| 1/4 | 7/16 | 3/4 to 3 | 3/8 | [illegible] |
| 5/16 | [illegible] | [illegible] | | |

CAP SCREWS

| Dia. Screw | R'd & Filister H'd | | Flat Head | | Button Head | |
|---|---|---|---|---|---|---|
| | H | L | H | L | H | L |
| [illegible] | [illegible] | [illegible] | [illegible] | ... to 1 3/... | 7/32 | 3/4 to 1 3/4 |

# THE PRODUCTION OF ACCURATE SCREW-THREADS IN THE LATHE—Part I

FRANCIS W. SHAW

Strange though it may seem, it is nevertheless a fact that very few turners are sufficiently gifted to be able to turn out an accurate screw-thread in the lathe. The competent screw-cutter can cite many little experiences from his apprenticeship days of difficulties encountered and overcome. It is not an uncommon thing to see advertisements for turners bearing the words, "must be accustomed to screw-cutting." To the tyro, no doubt, the production of clean, accurate threads is by no means a simple affair. Perhaps a careful analysis of the difficulties met will afford some clue to means of annihilating them.

First of all, what are the main difficulties? These will be best seen by a critical examination of the first finished production (perhaps unfinished would be the more descriptive term) of the embryo screw-cutter.

Here is a scrap job, the result of one of the first attempts to cut a Whitworth thread. What does an examination disclose?—taperness, smaller at the commencement; drunkenness, bottom of space too sharp; general roughness, interrupted by several deep gashes—features, it may be imagined, not inherently characteristic of the Whitworth form of thread. True, the Whitworth thread is one of the most difficult threads to master; nevertheless, the difficulties are not insurmountable. What lack does our examination show on the part of its producer? Merely lack of the knowledge that a chaser is but a finishing tool, not a tool for gouging out vast quantities of material. The defects seen in the work show that the chaser has been used to remove far more material than necessary. Inability to maintain

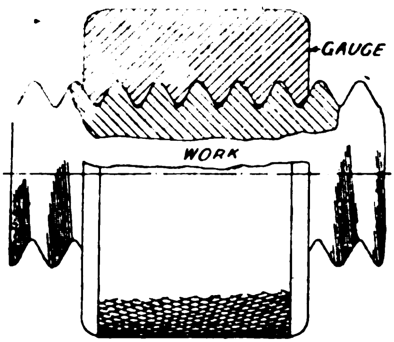



Fig. 2—Showing External Thread cut deeper than Standard

of the screw, aided a little, perhaps, by lack of homogeneity in the material, has resulted in producing a taper, rough and drunken thread. Further, a screw-cutting tool ground to a sharp V has resulted in a thread sharp in the root angle, ready to snap off at the slightest provocation.

The lesson to be learned is surely obvious. Greater attention must be devoted to accuracy of tool forms, accurate setting, and manipulation of tools. Before going into means for insuring such care and accuracy, let us proceed a little further in our exploration of results.

Here is a square thread, or, rather, the result of an attempt to produce a square thread. It suffers from many complaints, chief amongst which are: some threads thicker than others, the commencing threads appreciably thicker than the rest; flanks of the threads are rough, and "out of square"; the nut is with difficulty started on, then becomes "easy." Obviously another case demanding consideration.

Another example: A double-threaded screw, one land of which is distinctly wider than the other, showing a lack of of ensuring equal

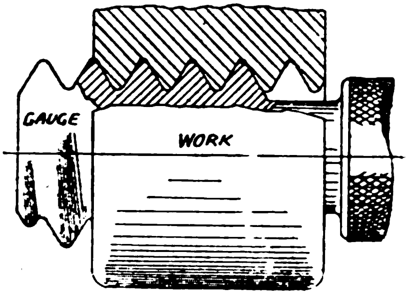



Fig. 3—Showing Internal Thread cut deeper than Standard

its advantages, derived from a stronger resultant screw, and in the durable form of the round-pointed tools used in its production, it also has many disadvantages over the sharp V or flatted V threads, in that these last forms are more easily generated from first principles. Difficulties of gauging, too, are rather less intense.

In cutting any form of thread there are two distinct cases to be met. First, where the product is merely to form part of some mechanism; second, where the product is a thread-forming tool, such as a tap or die. A recognition of this difference will permit of some little saving of time in work of the first category. In the production of these threads the root diameter is not a very important factor: hence production will be slightly facilitated by using a threading-tool, having its point slightly less blunt than the theoretical form. Figs. 2 and 3 show how this will affect the work. It is obvious that this will reduce somewhat the work of the finishing tool or chaser, particularly at the ends of the teeth where wear is most rapid.

The essentials to success in screw-cutting, in addition to skill on the part of the operator, are:

(*a*) An accurate machine.

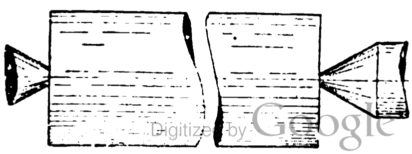
(*b*) Accurate and convenient tools.

(*c*) Accurate setting of tools in relation to the work.

Absolute perfection in machines—or anything else—is recognizedly impossible of acquirement; but the greater the vious; these must not be overlooked. The lathe-spindle and guide-screw must be free from end travel, which may be consequent in imperfect arrangements for taking the end thrust. The author has known cases where thrust washers and locknut inclined to their axes have resulted in considerable end travel. A case in his own experience will serve to illustrate the importance of this factor.

#### A DEFECTIVE LATHE

The first job of screw-cutting on a new lathe was a square thread screw of 1/10 in. lead (10 threads per inch, single). Examination of the finished job showed an appreciable difference in thread thickness at different points. A second screw was commenced with a view of assuring whether the defects on the second screw were merely accidental or due to some imperfection in the lathe. The defect being repeated on the second screw led to the conclusion that the machine was at fault. Suspicion was, naturally, directed first of all to the guide-screw; but careful testing proved the suspicion unwarranted. The change-wheels then underwent casual examination; but a little thought, aided by a rough calculation—showing that quite a big error would have very little result on the work—quickly disposed of this. Examination of the spindle afforded no clue. Finally the trouble was traced to its lair, in the thrust-washers and locknuts, which retained the screw from bodily end movement. Not only were these found to have their acting faces unsquare with the axis of the screw, but the bracket facings upon which they bore were also "out of square." Result—end travel. A more critical examination of the work showed that similar inequalities repeated themselves every ½ in. in the length, corre-



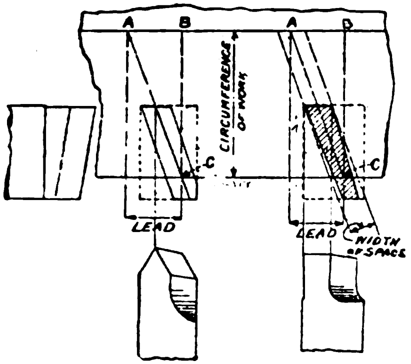



Fig. 5—Laying Out Angle of Lead

sponding with the lead—½ in.—of the guide-screw.

#### THE TERMS "PITCH" AND "LEAD" DEFINED

Before proceeding further it will be well clearly to define the terms "pitch" and "lead," some little confusion existing in their use. Throughout this article, "pitch" will be used to denote the distance at which adjacent threads are *pitched*; "lead"—the distance traveled by the nut for each turn of the screw. In a single-threaded screw, the pitch and lead will, of course, be equal; but in the multiple thread screws the lead will be as many times greater than the pitch as the value of the multiple. Thus, a screw which in one turn compels the nut to travel 1 in., and having a quadruple thread, would be spoken of as 1 in. lead, ¼ in. pitch.

Accuracy in the machine is of prime importance. Next in importance comes accuracy in tools. If results are to be certain, it is not sufficient to grind tools in any haphazard way, rough out the thread and depend on the chaser for correcting the resultant inaccuracies. Means, too, must be provided for checking the work, not merely when it is finished, but during every stage in its progress.

#### SETTING TOOLS IN CORRECT RELATION TO WORK

In this case it is necessary to assume th[illegible]

care must be exercised in setting the tool-angles in correct relation to the work. One method of insuring this result is shown in Fig. 4. This entails the grinding of the side of the tool against which the square rests, and the location of the cutting angles in relation to this side. This is far better than locating from one of the special angle-gauges usually sold for the purpose. In practice it is very difficult to locate from the comparatively short lengths of cutting edge in the V-thread tool.

Fig. 5 shows how the tool must be ground to conform to the lead-angle of the thread. The illustration is a development of the circumference of the work. Any plane surface, such as a marking-out plate, surface-plate, even a block of wood or piece of paper will serve the purpose. Two vertical lines, *A* and *B*, are drawn the same distance apart as the lead. It will be evident that the angle of the diagonal *AC* will corre-

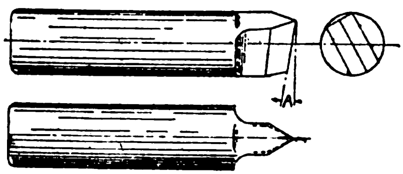



Fig. 7—Showing change in Plan Angle, when Cutter is Tilted

spond with the lead-angle of the thread. To this angle the end-angles of the tool must be ground, and, in the case of a square-thread tool, the sides also, the latter being ground to give some 4 to 6 degrees bottom clearance, as shown in the right-hand view. The mathematician will not need to employ this graphical method, for to him it will be obvious that the lead-angle whose sine is

$$\frac{l}{\pi d}$$ where $l$=lead and $d$=diameter

is the correct angle to which tools must [illegible] Theoretically, a tool thus

### TOOLS WITH CYLINDRICAL SHANKS

More universal tools are those made from round stock, held in a special tool-holder, as shown in Fig. 6. This form of tool is open to the objection that the cutting-angle changes as it is rotated to the correct lead-angle. Fig. 7 shows the change in plan-angle due to rotation from normal. The objection is serious only in extreme cases, and may be overcome by making several tools, each covering a small range. Increasing the angle *A* lessens the difficulty, and is a useful expedient in fine threads. For convenience in showing the change in plan-angle, the lower view has been improperly projected.

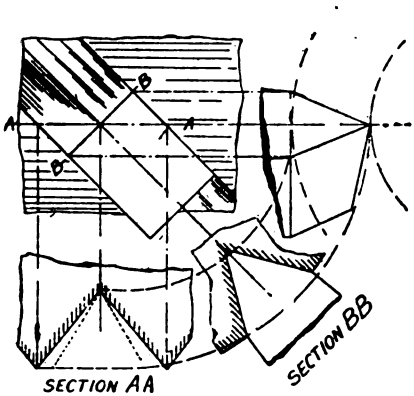



Fig. 8—Showing Result of making Cutting Face Normal with Thread Angle

### INFLUENCE OF INCORRECT SETTING OF TOOLS

The cutting or top face of screw-cutting tools must always be parallel with the line of centers or axis of work. Many turners make a mistake in grinding the face normal or at right angles to the lead-angle, as denoted by the line *BB* in Fig. 8, a geometrical analysis of the resulting thread deformation in an extreme case. Section *BB* is a view of the tool at right angles to its top face. In this view the

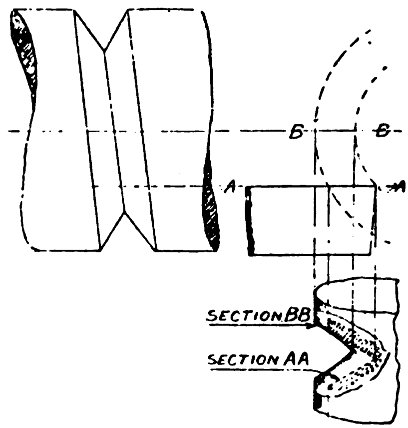


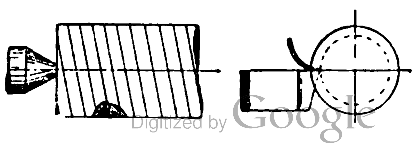

Fig. 9—Showing Effect of Setting Cutting Edge Below Center

depth, however, remains the same when the point of the tool is in the position shown. Section *AA* shows clearly the effect, the dotted lines denoting the correct form.

Fig. 9 shows the result of setting the tool below the center line. If the tool is fed in the theoretical depth, the true section will be on the plan *AA* in the upper view. In plan, the section at this plane is shown in Section *AA*. The axial section shows (Section *BB*) that the thread where it should be of the theoretical form is much shallower, and the flanks are curved. A careful consideration of Figs. 8 and 9 will be sufficiently convincing of the importance of keeping the plane of the top face in the line of centers, and of avoiding grinding the top face normal with the lead-angle.

### TO INSURE CLEAN THREADS

The chips must peel away freely. To insure this—a well-understood fact—endeavor must be made to produce flat chips. The superiority of straight cut-



ting-edges in modern turning and planing tools over the old-fashioned round-nose tools is not gainsaid by the practical man. The theoretical aim points out that a chip of curved section increases the friction on the tool-face, causing more rapid destruction than a chip of flat section. Fig. 10 illustrates this point. The V-chip shown is obviously more difficult to shear-up than the flat chip; hence, greater pressure is applied to the tool-face. In cutting a V-thread the chip will be flat if the tool is fed in at the angle of the thread, as shown on the left-hand view, the small section on the work between centers showing the nature of the chips removed at successive cuts. In this way the angle of the thread at one side is controlled not merely by the tool form but by the angle of the inward feed of the slide-rest.

This suggests one method by which extra accurate V-threads may be produced. First, rough-out the thread with an ordinary V-tool, afterwards finishing each flank independently by means of side-tools controlled in their inward feed by setting the slide-rest over to the requisite angles.

(*Concluded in February Issue*)

## WHEN BUYING A GAS-ENGINE

Decide on the maximum amount of power you must have. Remember if your engine is to be used on the farm that in addition to running the cream separator, churning, running washing machines, corn sheller, etc., you will often want to pump water, saw wood and do other work where one or two extra horsepower comes in handy.

Buy your engine through a reputable dealer whose place of business is near you. Such a man will take a personal interest in having your engine run well and you can, if necessary, get parts quickly.

It does not pay to buy your engines from a comparatively unknown concern a long distance from you. Such people as a rule make their customers pay for their experiments, repair parts cost high, and take a long time to get, and they have no personal interest in whether or not you succeed in using the engine properly.

Gasoline as fuel gives the best service for a small engine, but kerosene and other heavy oils are rapidly coming into favor for the larger sizes. An experienced engine salesman will tell you which is the best fuel for your purpose and which will cost you the least.

If ... it to drive machinery that ... slow-speed engine-timed magneto with visible timing feature. This machine eliminates all batteries, coil and switch, and furnishes the current for sparking the engine as long as the engine runs.

These slow-speed alternating current magnetos are the same as used on automobiles only the more simple and reliable make-and-break igniters are used on the engines instead of the spark plug as used on the automobile.

As the magnetos have no belt or friction wheel and require no speed governor, they should not be confused with the cheap little sparking dynamos used for this purpose.

Ignition troubles are by far the largest proportion of troubles that beset the engine user. The built-in engine-timed magneto eliminates these and really costs no more than a set of high-grade closed-circuit batteries with the necessary coil and switch.

After getting the engine, read the instruction book carefully before trying to operate same. Don't let some one who has another make of engine tell you how to start and run yours, as instructions for different kinds of engines differ. Here is where purchasing your engines

The troubles with engines are usually dirty igniter points, stopped up gasoline or water pipes, lack of oil, or the valves are out of adjustment. Any of these troubles are easily remedied by any one with common sense without having to take the engine apart. An imitation expert can always be told by pretending to know exactly what is the matter with the gas-engine almost instantly and by the fact that he will immediately want to tear the entire engine apart.

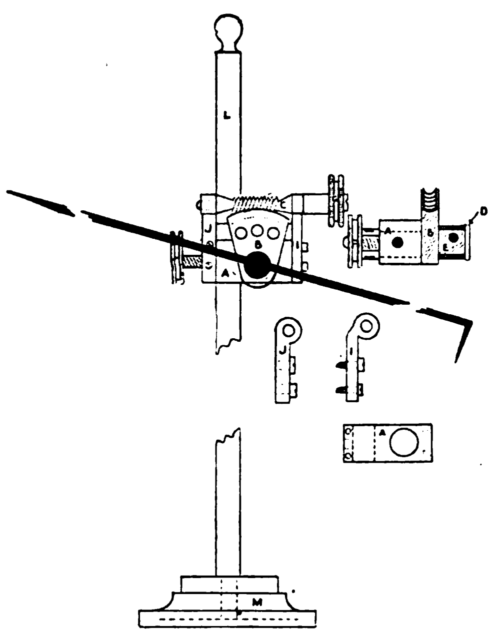
On engines having a battery or the cheap friction-driven ignition sparkers, such as many of the older engines are equipped with, ignition troubles were plentiful and these require an expert for their location and remedy, but with the more modern magneto-equipped engines these troubles are eliminated; and in fact the only thing that can go wrong is the timing, as the magneto revolves in time with the engine unless a gear should slip in some way. Now, a magneto should be selected in which provision is made for checking against this slipping, without the necessity of opening the magneto. The choice of an engine equipped with a magneto of this character will result in good reliable service.

If the engine is to be used in one place, bolt it down to a good foundation. Don't bolt it to a lot of loose timbers set on a dirt floor.

Get a good storage tank for the liquid fuel and put it preferably under ground. Read instructions sent with the engine and see that the tank isn't buried so deep that the engine fuel pump won't draw.

## A USEFUL SCRIBING-BLOCK

I have the pleasure of introducing a novel mechanical adjustment applied to a scribing-block, says Wm. Barnett, in a recent issue of *The English Mechanic and World of Science*. I think the enclosed rough sketch will give your readers a clear idea of the above. They may find some difficulty in making the female screw on the quadrant. I would suggest to them to make a steel screw ¼ in. diameter, 28 pitch; then file some groove on an angle along it, and use same as hob in lathe; then place quadrant on slide-rest, to revolve on center, and be sure that center edge of quadrant is central with hob. All parts are of mild steel, except quadrant (brass) and iron casting for bases. The following are the measurements in mm.: *A* 35+16+16, *I* and *J* 35+4.5, *B* 28+7, screw 28 pitch, the millhead *G* on end of screw *C* fitting on taper with 6 *BA* to tighten same. It must be noticed that *J* is fastened to face of block *A*, and *I* to the end, allowing the quadrant more movement, and the screw-holes in *J* must be elongated to take up loss of time in *C* and *B*. The holder of *K* 4.5—that is to say, the bolt *D*—must be easy-fitting in *A*, also the loose sleeve *E*; but *B* must fit tight on *D*. Length of *L* 255+9, *K* 164; weight complete 1 lb. 5 oz., base 12, mechanical adjustment part only 5.



Useful Scribing-Block

The mechanical efficiency of a steam engine, plus its necessary auxiliary appurtenances, is but little in excess of that of a gas-engine of equal indicated horsepower.

The phenomena of the storage battery were first observed by a French chemist, Planté, in 1860.

## REAL OR TRUE CONSERVATION

In the preface to Bulletin 47, Notes on Mineral Waste, written by Charles L. Parsons, chief mineral chemist of the Bureau of Mines, which has just been issued, Dr. Joseph A. Holmes, the Director, gives his views upon what he terms real or true conservation.

Dr. Holmes says: "During the past year, in producing 500,000,000 tons of coal we wasted or left underground, in such condition that it probably will not be recovered in the future, 250,000,000 tons of coal; we turned loose into the atmosphere a quantity of natural gas larger than the total output of artificial gas during the same period in all the towns and cities of the United States; we also wasted or lost in the mining, preparation and treatment of other important metalliferous and non-metalliferous minerals from 10 to 15 per cent. of the year's production of such minerals. These losses serve to indicate the importance of inquiries and investigations by the Federal Government for the purpose of lessening the waste of essential resources—investigations on the same general lines as those looking to a reduction in the loss of life in the mining operations of the country and the far more extensive investigations looking to the more efficient production and use of agricultural products, both of which are being conducted by the Federal Government.

"In a consideration of the possible activities of the individual, the State, and the Federal Government in behalf of a less wasteful use of our mineral resources certain facts and principles should be kept in mind.

"That the present generation has the power, and it will exercise the right, to use as much of the country's resources as it actually needs; there can and there will be no such thing as stinting the present generation by bottling up resources for the use of the future.

"That the Nation's needs are not likely [illegible] needs will increase

"That the men of this generation will not mine, extract or use these resources at continuous financial loss to themselves in order that something may be left for the use of future generations; there can be no such thing as a mineral industry without profits.

"Furthermore, it should be clearly understood that the mineral resources of this country have required long ages for their accumulation and that of these resources the Nation has but the one supply. There are no known substitutes available to meet the Nation's further needs when that supply will be exhausted and, to the best of our present knowledge, this one supply must serve as a basis for both the needs of the present and the far greater needs of the future.

"In a higher way our mineral resources should be regarded as property to be used and to be held in trust with regard to both the present and the future needs of the country. It should be remembered that neither human labor nor any human agency has contributed to their origin or to their intrinsic value, and that whatever rights the individual may possess have been derived from the General Government and from the State as the original owner. The State does not surrender its right, and should not neglect its duty, to safeguard the welfare of its future citizens by preventing the wasteful use of these resources. Though the individual may claim the right to use the resources in proportion to his needs and the needs of the community, he certainly has no right to waste that which is not needed for present use but is certain to be needed hereafter.

"Those in charge of the investigations of the Bureau of Mines recognize the rights and duties of the Federal Government as being limited to the carrying on of inquiries and investigations with a view to determining the nature and extent of this waste of resources, the means by which it may be diminished, and the [illegible] sary inquiries and investigations have been conducted and the results put in shape for publication.

"In the preliminary work along these lines, the representatives of the bureau have received the cordial co-operation of the engineers and chemists associated with the varied mineral industries of this country and also of the owners and the operators of the mines and the metallurgical plants."

Copies of this bulletin may be had by addressing the Director of the Bureau of Mines, Washington, D.C.

## CLOCK RUN BY ELECTRICITY FROM THE EARTH

The only piece of machinery in the world to be operated entirely by electrical forces drawn from Mother Earth is now running at Camp Hill, Pa. It has been in continuous operation since 1870, with the exception of a short period involved in its transfer to several different localities. In the late '60's Daniel Drawbaugh, to whom every one in that locality gives credit for inventing the telephone, and who succeeded his inventions in telephony by constructing hundreds of marvellously ingenious mechanical and electrical devices for furthering the world's work, conceived the idea that he could make a perfect clock operate under the guidance of latent electrical forces in the earth. Time has shown that Drawbaugh has come closer to perpetual motion than any other inventor.

In the Drawbaugh timepiece, which stands about 6 ft. in height, and is unlike all other clocks, the pendulum is the motor. It is suspended on an edged pivot of hardened steel in order to reduce friction to a minimum. This pendulum weighs about 45 lbs., its central rod terminating midway between the ball and the point of suspension, where there is an ordinary permanent magnet. Fastened against the back part of the clock base at right angles to the permanent magnet is an electromagnet, the wire of which runs into the ground, the earth becoming the battery feeding the electromagnet.

When the pendulum is swung away from the perpendicular, the opposite poles of the two magnets first attract and then repel, thus keeping up the oscillation. At the top of the case the wheels are fastened to tubes or hollow spindles which are suspended in turn upon steel studs or pins, which in their turn are [illegible] into a main metal base receives its motion from two pawls pivoted upon the upper crossbar of the pendulum rods.

One remarkable feature in the construction of the clock is that there are only four bearings that are subjected to the least friction. Drawbaugh confidently stated that his clock would run for hundreds of years before any part would have to be renewed. In making the clock ready for work it is necessary to dig a hole in the earth about 3 ft. in diameter and 6 ft. deep. Metal plates are placed in the hole with enough coke to hold moisture, and the timepiece can be run so that it will not gain or lose two seconds in a year.

The clock is now running in the office of Charles H. Drawbaugh, the inventor's son, at Camp Hill, where many visitors marvel at its simplicity and the ingenuity displayed in its construction.—*N.Y. Sun.*

### His Greatest Gift

"That man over there with the white hair gave me the greatest gift I ever received," said one successful business man to another. "It wasn't money," he continued in answer to his companion's look of interrogation, "it wasn't any material substance. When I was a youngster, struggling to get ahead, he listened to me as I told him my dreams and told me that he believed in me and in my ability to make good. He also said that he would keep watch because he wanted to see me grow as he knew I would grow. He probably forgot all about it years ago. But the effect of his speech was such that I have never forgotten how I felt when he said: 'I believe in you,' and I've never been able to shake off the feeling that he has always watched me. He has in that way done more than any other man to help me win the success

# CONSTRUCTION OF AN ARMATURE LAMINAE NOTCHING PUNCH

CHAS. F. FRAASA, JR.

The amateur, after having carefully designed a small dynamo or motor, often finds it necessary to modify his design because of not being able to find suitable armature laminae. Or, he may have to make his design with a view of using some standard laminae, which is difficult under certain conditions. The following design provides a means of avoiding this difficulty. The punch is easily constructed, at little expense, and besides making it possible to use any size and type of disc, enables one to make the discs cheaper than they can be bought.

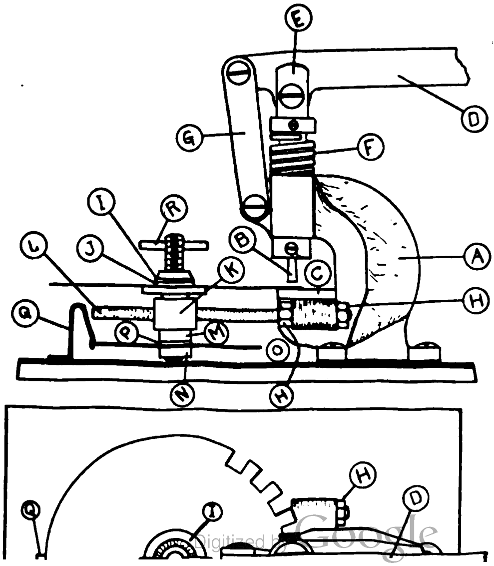
The construction of the punch is illustrated in Drawing 1. It consists of a castiron frame *A*, the punch and die-plate *B* and *C*; an indexing support for locating the slots; a lever *D* actuating a plunger *E* carrying at its lower end the punch *B*.

The pattern for the punch frame, Fig. 1, Drawing 2, should be made of soft white pine. For this purpose, get six pieces of 5 x 5½ x ¼ in. white pine. The pattern will be made in two parts, and will be divided along the line *AB*, Fig. 1. Each part will then be made of three of the ¼ in. pieces, which should be glued together. Then clamp the two parts of the pattern in a vise and drill the ¼ in. holes *A* in them. These holes are for ¼ in. dowel-pins, which hold the pattern together while working it, and also help to locate the two parts when moulding. Then lay out the design on the pattern, and trim it down with a sharp knife to the dimensions and shape shown in the drawing. The projections *B* which support the indexing device should be carefully glued in place after trimming to shape.

Almost any foundry will make this casting for you at a small expense. If the casting has not been cleaned when you get it, carefully scrape and finish all parts with a file and emery cloth. Plane or file the top surface *C*, the bottom. Drill the ¾ in. hole *H*, in the top of the casting for the plunger, and the holes in the base lugs for bolting the punch to a base. The side holes *G* in the casting are dril ed ⅜ in. in diameter. When doing this the casting should be bolted up against an angle plate to insure that the holes will be parallel. The punch frame may then be given a coat of black paint or enamel.

The punch plunger, Fig. 2, is turned down from a piece of steel rod to the dimensions indicated. The collar *A* is removable, being fastened in place by the set-screw *B*. The object of this collar is to hold the spring *F*, Drawing 1, in place. The upper end of the plunger has a ¼ in. slot cut in it to receive the lever, Fig. 3. Drill the ⅜ in. hole *C* in this end also. In the other end drill a 5⁄16 in. hole to receive the punch, and the hole for the set-screw *D*, which binds the punch in place.

The spring *F*, Drawing 1, may be made from some stiff spring wire. This should be heated red and plunged into lubricating



oil and then into water to harden it after it has been wound, or the spring may be cut from any old spring which may be available.

The lever, Fig. 3, is cut from some strip iron or steel 1/4 in. thick. The long end should be forged to a tang, to take the handle, Fig. 5. The side connecting pieces *G*, Drawing 1, are also cut from strip iron or steel 1/4 in. thick. They are dimensioned in Fig. 4. Two of these will be required. The lever handle, Fig. 5, should be turned from some hard wood, and finished with a coat of paint or varnish. On one end place a ferrule, and drill a hole for the tang of the lever.

The indexing device is dimensioned in detail in Figs. 6 to 12. The side guides are turned from steel rod, the 3/8 in. portions of each being threaded on both ends as shown. Two 3/8 in. nuts, *H*, Drawing 1, should be provided for each rod. The mandrel, Fig. 7, can be turned from a piece of 3/4 in. steel rod. Both ends are threaded, and one end has drilled in it a 1/8 in. hole. This hole should be reamed out so that a 1/8 in. rod will enter it easily.

The nut, Fig. 8, should be turned down to size, and bored and tapped to fit the 3/8 in. mandrel, Fig. 7. The washer *J*, Drawing 1, dimensioned in Fig. 9, should have a circular projection turned on it as shown, the diameter of the projection being equal to the diameter of the shaft hole in the core disc. For each disc having a special shaft diameter, a special piece *J* will have to be provided. The washer, Fig. 10, fits down over the disc, and the projection on the part, Fig. 9, which should have a hole in it of a slightly larger diameter than the diameter of the projection on the part 9.

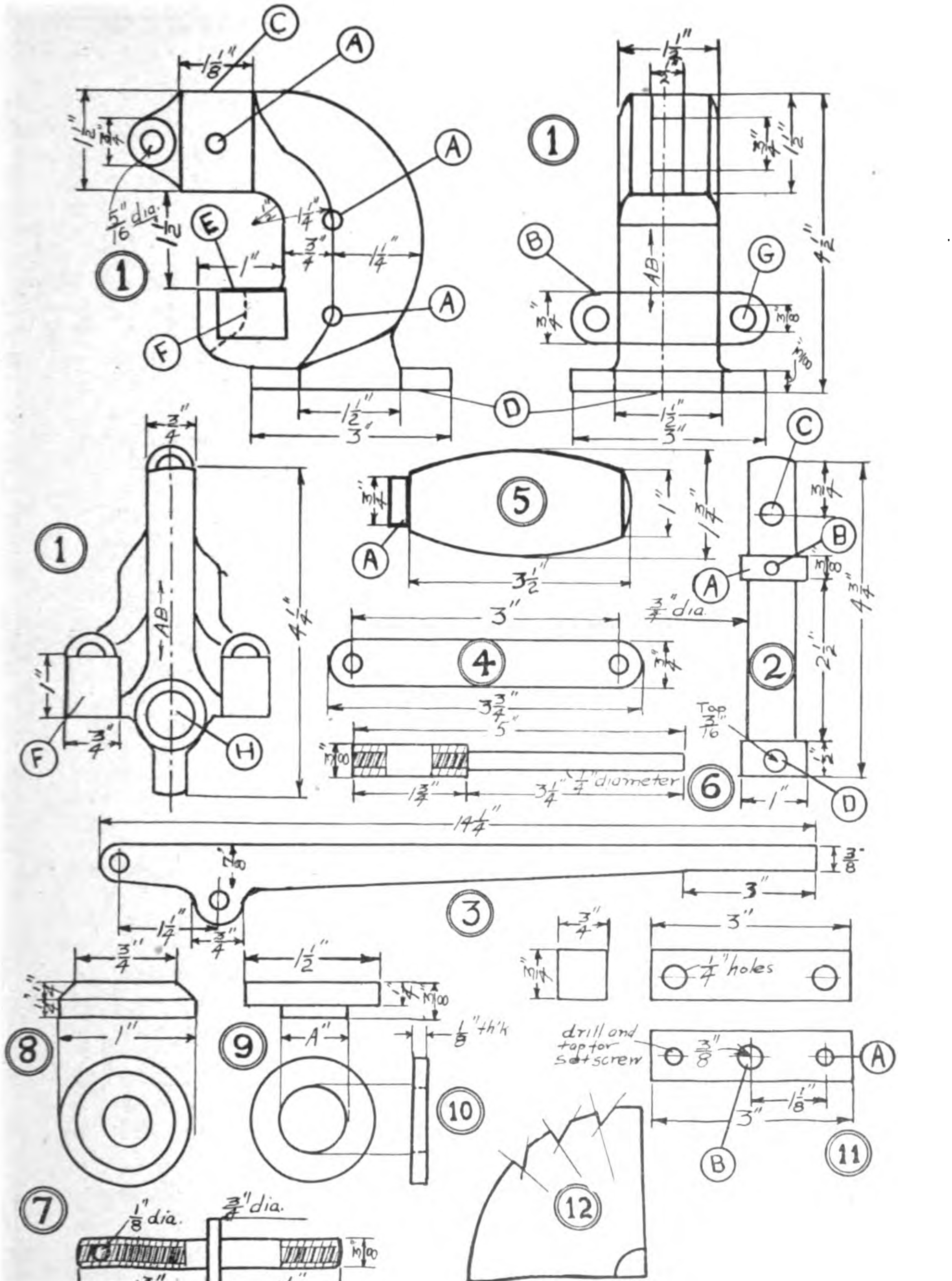
The mandrel is mounted on the part *K* shown in detail in Fig. 11. This is a piece of steel or iron having two holes drilled in it to enable it to slide on the side rods *L*. These holes should be reamed so that it will slide freely. The two holes *A* are drilled and tapped for set-screws to bind the slide in certain positions on the side rods. The hole *B* is drilled 3/8 in. and reamed for the 3/8 in. mandrel, which should turn freely in it.

The two nuts *M* and *N* are 3/8 in. hexagon nuts of standard dimensions. The indexing disc *O* is clamped between them, a washer *P* being provided between the two. The indexing disc, Fig. 12, is cut from some thin brass or iron. It should have as many notches in it as there are to be slots in the armature disc. A special indexing disc will have to be made for each special armature disc which is to be punched. Be very careful when locating these notches, as upon this depends the spacing of the slots in the completed armature discs. This completes the machine work on the laminae punch.

Drawing 1 shows how the punch is assembled. The indexing stop *Q* will have to be provided. This stop is made of a piece of brass spring wire bent to the shape shown and fastened down to the base on which the punch is mounted. It bears against the indexing disc, and the end falls into the notches in the disc. The disc can only rotate one way, since the stop can get out of the notch only on the side which slopes out to the periphery.

The size of the punch and the slot in the die-plate will depend upon the size of the slot to be punched. The die-plate *H* is to be made of annealed steel, which any dealer will provide, if told what it is to be used for. The slot-hole is drilled into the plate, and if the slot is to be rectangular should be filed to shape. An ordinary drilled hole will do for the round slots. The hole should taper out in all directions on the under side of the die-plate. A hole should be drilled in each end for screws which are to hold it to the punch frame. Having made the slot-hole, the die-plate should be tempered. To harden it, the steel should be heated to a bright red, and then dipped into oil or lukewarm water, but not cold water, for this would make it very brittle. Draw the temper in the flame of a Bunsen burner, wiping the steel frequently with an oily rag during the process. If the reader is not familiar with the hardening and tempering of tool steel, it would be better to have this done by someone having experience.

The punch *B* is also made of annealed tool steel. This should be bought in the most convenient shape, and machined to the proper dimensions. The one end is to fit in the hole in the end of the plunger, and the other is to make a very snug fit in the hole in the die-plate. The greatest care should be exercised in this




Drawing 2—Armature Punch Details



work to have all parts and dimensions in it is placed over the mandrel on the rod *R* used to turn the disc is inserted through the mandrel. The set-screws in the slide are loosened and the whole device is moved up to the proper distance for punching the slots in the disc, where it should be fastened by tightening the set-screws. The disc is rotated until the stop *Q* falls in one of the notches. Then turn a slight distance in the opposite direction until it is stopped by the projection on the indexing disc. Then push down the lever, forcing the punch through the lamination. Repeat this operation until all the slots are punched, when another disc should be placed on the mandrel.

Since most of the readers will not be able to design their armature cores, it seems to the writer that it would not be out of place to include in this article, some armature data.

The armature core consists of a number of discs of thin sheet steel of the best quality, known as laminae, each having a number of slots around its periphery to receive the winding. To prevent eddy currents' heating the core and causing a loss of energy, the laminae are insulated from one another by a coat of japan or enamel on one side of each sheet. The slots may be round or rectangular, as desired. The armature is slightly smaller in diameter than the bore of the field magnet. This allows of an air-gap between the pole faces of the field magnet and the armature core. This air-gap should be about 1/32 in. all around the core in small-sized armatures, and about 1/16 in. in the larger sizes, making the total air-gap from 1/16 to 1/8 in.

In designing the armature it is well to observe the following ratios of length to diameter: for two poles, the diameter of the armature should be about equal to the length; for four-pole fields, the diameter should be twice the length, and for six-pole fields, three times the length.

on the shaft, between two heavy pieces of iron, and turn them down to the required diameter. The discs may then be removed and punched.

A very good material for armature construction is the ordinary black iron handled by all tin-shops, No. 27 to 29 being of about the right thickness. This will cost about 50 cents per sheet for a sheet 24 x 96 in.

This punch was designed to punch a slot having 1 in. perimeter in a No. 27 sheet, thickness 0.0172 in.; a slot having a perimeter of 1¼ in. in No. 28 and 29, 0.01565 in. and .01405 in. thick, respectively.

Tables 1 and 2 give data as to the number of slots for armatures of different diameters, and different slot dimensions. These are based on the density of magnetism in the air-gap at between 20,000 and 25,000 lines of force per square inch, which is usually allowed in small machines. The number of slots given should not be exceeded, as this would raise the density in the iron between the slots, which is already high, thus impairing the operation of the machine. If an odd number of slots is to be used, use one slot less than the number given in the table. In a two-pole machine the writer would advise the use of an odd number of slots.

TABLE 1

**Armature Data—Using Round Slots**

| Core Dia. | 1.75 | 2 | 2.5 | 3 | 3.5 | 4 | 4.5 | 5 |
|---|---|---|---|---|---|---|---|---|
| **Number of Slots** | | | | | | | | |
| ¼ in. dia. | 12 | 12 | 18 | | | | | |
| 5/16 in. dia. | 10 | 12 | 16 | | | | | |
| ⅜ in. dia. | | | 10 | 12 | 14 | 18 | 20 | 22 |
| Shaft dia. | ¼ | 7/16 | ½ | ⅝ | ⅝ | ¾ | ⅞ | 1 |

TABLE 2

**...ctangular Slots**

# THE INSTALLATION OF A SMALL ELECTRIC MOTOR

FREDERIC H. TAYLOR, ASSOC. M. INST. E.E. ASSOC. M. INST. M.E.

Everyone interested in model engineering who possesses a workshop, however modest it may be in point of size, soon feels the desirability of having power available for turning, drilling, shaping, etc. For the ordinary amateur, ½ to 1 h.p. will suffice for his requirements, and it is therefore a machine of about this size which will be considered in this article.

It might, perhaps, at first be asked if an electric motor is really the best form of prime mover for the amateur to adopt. If electric current is available from local mains, there can be but one answer—yes. Even if the current is sold at a fairly high price per kilowatt hour, it will still be well worth having, as the cost of working the motor will not be excessive, and the facilities and convenience gained, coupled with the safety, simplicity and reliability, render the electric motor a very good investment.

*Points to consider before buying the Electric Motor.*

(*a*) Whether the current available be "alternating" or "direct," and, if the former, whether single-, two- or three-phase.

(*b*) What is the voltage of the supply?

(*c*) In the case of the alternating supply, it will also be necessary to know the "periodicity" of the current.

Information on these points (*a*, *b* and *c*) can, of course, be obtained from the local

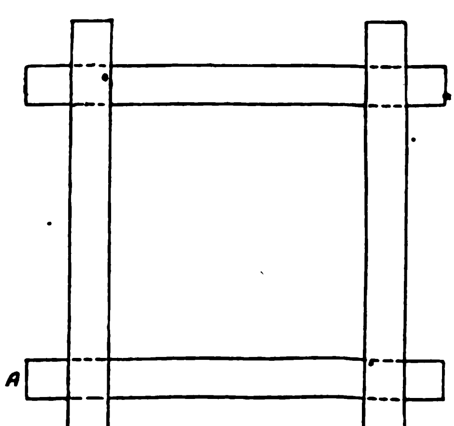



Fig. 1

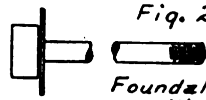


Fig. 2.
Foundation bolt with plate

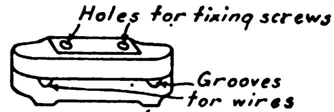



Fig. 3.
Double china 2-groove cleat

electric light company, who will also furnish particulars as to price, and will give the prospective customer the names of several firms which sell small motors.

In order to buy to the best advantage, it is best to accompany your enquiry with a brief specification showing what is wanted. It will then be found, if several prices are obtained, that they are comparable, as each dealer is presumably quoting on the same basis.

*Specifications of D.C. Machine.*—To be of — h.p., of the semi-enclosed type, and complete with cast-iron pulley of — in. diameter and — in. width of face, crowned. Also slide rails, tightening screws and holding down bolts. The machine to be capable of maintaining its full horse-power for not less than 5 hours continuously without undue heating or injury to any part, and to withstand an overload of 50 per cent. for one hour and 100 per cent. momentarily without injury of any kind. The motor to have been tested satisfactorily under load and for insulation resistance before leaving the factory. The manufacturer to supply with the motor a suitable starter, properly enclosed in a metallic case and fitted with a no-volt automatic release.

For ordinary machine tool work the motor should be shunt wound, since this class of machine runs at a practically constant speed under a varying load, provided the line voltage remains constant.

*The Alternating Current Machine.*—Where the supply is alternating, the purchaser must be careful to find out whether it is single-. two- or three-phase,

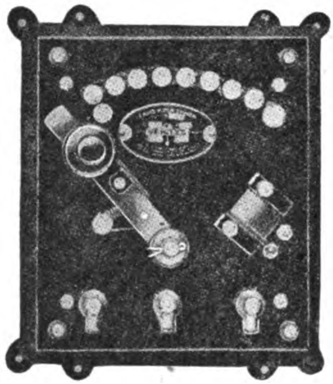


Fig. 4

and its periodicity. Two types of motor are available; namely, the "squirrel-cage or short-circuited rotor" and the "wound rotor or slip ring" type. For small powers up to, say, 3 h.p., the former is most suitable, being cheaper and more robust than the latter. As this type of motor is not adapted to starting under load, it should be provided with a double width pulley arranged to drive to a fast and loose line shaft, so that it may be run up to speed before the load is put on. The specifications for the A.C. motor will be similar to those for the D.C., but the following points must be remembered:

*Speed.*—The speed of any small motor is high; for a 1 h.p. machine from 1,400 to 1,500 revolutions per minute. The buyer will do well to take a motor of standard speed, and adapt the drive to the motor speed.

Most makers list and sell standard sizes of pulleys for their motors, and if these can be used, it is best to do so. For instance, a 1 h.p. D.C. motor would ordinarily have a pulley of size 3 x 2½ in. or 4 x 3 in.

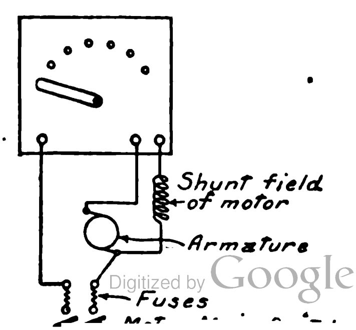
The semi-enclosed pattern is mentioned above. This is a good type to adopt in a very large number of cases, the open type being too liable to injury from dust, dirt, damp, or other causes. The totally enclosed type naturally has the additional advantage that it can be fixed in really bad positions. For this type one

machines, and prevent a lot of trouble which otherwise might occur because of a belt's becoming slack.

Motor manufacturers do not, as a rule, make the starters for their machines, but it is well to obtain this apparatus through the motor dealer, as he then takes the responsibility of the starter's being suitable for the machine. Many people do not employ a starter for very small motors. This, of course, means a saving in first cost, but is not necessarily the best thing to do. Starters vary considerably, the A.C. being quite different in design from the D.C.

*Erecting.*—The erecting of a small motor is a simple matter, but like other simple matters may readily cause a lot of trouble and *continual trouble*, if not properly done. In order to assist the amateur to avoid such trouble several different cases are considered.

(*a*) Assuming that the floor of the workshop is of the ordinary timber construction, the motor may be bolted down to the joists on which the boards are fixed, that is to say, the slide rails will be coach-screwed direct on these joists; ½ in. or, at the outside, ⅝ in. coach screws being amply sufficient for this purpose. If the floor is an old one, more or less rotten and generally irregular, as is often the case, in the only room the amateur can obtain, it is an advantage to first make a rectangular wooden frame, as shown in Fig. 1, out of deals, say, 3 x 6 in., and coach-screw this to the joists, the slide rails being coach-screwed down to the frame. This will enable



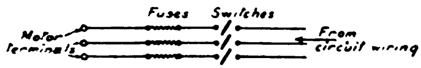



Fig. 6—Diagram of 3-Phase Connections. Squirrel-cage Motor

the motor to be mounted level, and will have the advantage of spreading the weight over a large portion of the floor. This method is also very useful where it is found that to get a convenient drive it is necessary to fix the slide rails parallel with the floor boards, and where the bolt-holes of the rails do not coincide with the distance apart of the joists. The underneath timbers *A*, *A* of the frame can, of course, be spaced to suit the joists.

(*b*) Assuming that the floor of the workshop is concreted, the cheapest and best way to go to work, is to cut out the holes in the concrete which will be required for the slide rails. These holes will be anything from about 8 in. to 12 in. deep, according to the length of the foundation bolt supplied by the makers. It is best to cut the holes, say, not less than 3 in. square, and somewhat larger towards the bottom. Usually the bolts provided are ordinary straight bolts with a loose plate at the bottom, as per Fig. 2. The bolts, with their plates fastened on, should first be dropped down into the holes; the rails will then be placed over them and the nuts loosely put on, to hold them in position. The motor can then be set on the rails and lined up with the pulley or shafting it is intended to drive. This having been done, the holes can be filled up with thin concrete (grouting). Ordinarily a week is sufficient time for the grouting to set hard. When this is done the nuts can be drawn up tight on the foundation bolts.

(*c*) A motor is sometimes placed on wall brackets, owing to lack of floor space. This method should only be adopted when absolutely necessary, as, naturally, it is always best to keep [illegible] chinery on the [illegible] th[illegible]

*Wiring for and connecting up the Motor, etc. Voltage Arrangements.*—As a general rule, the electric light company will provide current for a small motor, such as 1 h.p., at the ordinary voltage adopted for lighting. Larger sized machines commonly have to be supplied at the power voltage which is often double that adopted for lighting purposes. Where the electric light is already in the house, it is, of course, a great convenience to be able to adopt this voltage, as it simply means running a pair of wires to a local distributing board. If this board does not possess a spare "way" or circuit, it is best to take the new motor circuit direct from the bus bars of the distributing board, taking the precaution of inserting a pair of single-pole fuses in the wires as soon after leaving the board as possible. This will prevent the possibility of blowing the main or sub-main fuses, which supply the distributing board, should any mishap occur to the motor circuit. It will be best to provide for this purpose a pair of 10 ampere fuses for any size of motor up to 1 h.p.

The wiring may, of course, be done in several ways, each having its own merits, according to the conditions of the particular case. If the existing wiring is in wood casing, this system may well be extended, provided the room is thoroughly dry. On the other hand, if tube work has been used, this method of wiring had best be continued for the motor. For the amateur who has never installed any wiring work, ordinary wood or china cleats, which can be obtained very cheaply of any good electrical supply house, will save a lot of trouble and make a satisfactory job. Double cleats should preferably be used, as these keep the wires away from the wall. Fig. 3 illustrates the cleat suggested.

The wiring having now been carried up to the motor, a main switch and fuse for the motor, and in most cases a starter,

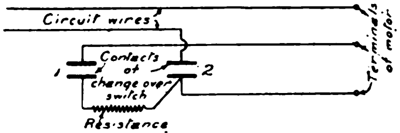



Fig. 8—Diagram of Connections for Single Phase Motor. Contact 1 is starting position, Contact 2 is running position and "Off" is midway position.

*D.C. Motor Starter.*—It might at first be asked why the motor should not be switched directly on the circuit. Certain small motors are so treated, but it is not really good practice. When a *D.C.* motor is starting from rest, it takes a much larger current than when running at a fair speed, and if it were switched directly on the circuit, without a graduated resistance being interposed, the initial current may be sufficiently great to either heat up the coils of the motor or cause the circuit fuse to blow. Besides, the sudden jerk given to the motor *and to the machine driven by it* is not good for either of them.

This device shown may be best described as an "automatic no-volt release starter." As will be seen from the illustration in Fig. 4, the apparatus mainly consists of a lever which is made to pass over a row of contact studs, which are connected to resistance coils contained in the starter. This lever carries at its end a soft-iron armature, which, when the lever has been brought to its final or running position, is attracted by and held to the iron core of a small electromagnet against the pull of a spiral spring fastened to the center of the lever. This electromagnet is in parallel with the line and is therefore always energized so long as electric current is available. Should the current on the line fail (no voltage being available), the electromagnet ceases to attract and the lever is thereby returned to the starting position by the pull of the spring, all the resistance being thus cut into the circuit again, and so protecting the motor from improper starting.

The ordinary starter for a D.C. shunt motor commonly has three terminals, which are marked respectively *A*, *F* and *L*, meaning, of course, armature, field and line. The connections for such a case are as per sketch, Fig. 5. In this sketch a D.P. switch and pair of S.P. fuses are shown in the circuits.

These starters are sometimes fitted with an automatic overload release, which comes into operation as soon as a dangerous overload comes on the motor. The writer would, however, prefer to rely on the reasonable conduct of the user and on the protection afforded by the fuses, rather than install the "overload release" on the starter.

*A.C. Motor Starting.*—The A.C. motor is usually "polyphase," that is, either two- or three-phase. For small power installations, such as are being considered in this article, "squirrel-cage" or "short-circuited rotor" machines are almost invariably used. These are more simple to start up than a D.C. machine, as no special starter is required. Consequently the motor (either two- or three-phase) can be switched directly on the line. The sketches, Figs. 6 and 7, show the connections in diagram form. In either case the switches used must be linked together, so as to make or break the circuit on each conductor simultaneously.

This is quite imperative and is a very simple matter. Ordinarily, "tumbler" switches may be used, and these (either three in the case of three-phase or four in the case of two-phase) may be mounted together on one common base block and coupled together in the usual way by means of a hardwood handle-bar, as is done in the double-pole tumbler switches used for lighting work. Fuses are shown in the diagrams between the switches and the motor.

The starting up of a single-phase motor is, electrically speaking, not quite so simple. Usually this machine has two windings on its "stator," one being the "starting" coils and the other the running coils. The starting switch will therefore be a change-over switch, having three positions, namely: "starting," "running," and "off," the last being the mid-position. The arrangements vary, but Fig. 8 is a fairly typical diagram of connections.

*Directions of Running of the Motor.*—It is possible that when the motor is set up in position, it is found that the direction of rotation is wrong. This is quite easily altered. If a D.C. machine, it is simply necessary to change the direction of the current in the armature or the field, *not* both. If A.C., simply change over the leads in *one* phase.—*Model Engineer and Electrician.*

# WOODWORKER

## NOVEL WRITING-TABLE AND BOOK-CASE

HENRY JARVIS

The table, shown in Fig. 1, will be found a very suitable article for the amateur carpenter or cabinet-maker to construct, and a very useful piece of furniture when finished. I say suitable to make, because there are no complications of any kind, no mortises or tenons, and very little gluing.

Before beginning the actual making, the front and end elevations, Figs. 2 and 3, should be well studied, and when the details are mastered, the materials can be cut out, according to the specifications given below, and all of the pieces "planed up" true as regards width and thickness.

One-half of the framing is shown in Fig. 4, from which it may be seen that the legs are formed in skeleton; that is, the two pieces of which each leg is made are fixed together at right angles, the joint being tongued.

The legs and also the upright bars are let into the shelves and top, to the extent of half of their respective thickness, thus the shelves and the top have to be cut away as Fig. 5. If these are all fastened together and cut at one time, they will be all alike, and the bars will fit properly.

The top, *A*, runs over the whole article, and as a matter of strength the grain should run lengthways. This will then secure the two side frames firmly together, as far as the upper part is concerned.

The four laths which come towards the center of the table, *B*, must be rabbeted on the inside to take the board *C*, which forms the back of the book-shelves, and these two boards (the grain must run vertically) in turn must be trenched to take the board *D*, which forms the bottom of the drawer case. This board is fixed in the trenches, by screwing through, from the inside of the book-case *E* at each side, and particular care is necessary in getting this of the right length, or the two parts of the framing will not be parallel.

The bars should be a tight fit in the notches made to take them in the shelves and top, the latter clipping them as in the vertical section, Fig. 6. They may be glued in, but they will require nailing or screwing, and I recommend the latter, using brass screws, and sinking the heads exactly level with the wood. One screw should be inserted through each part of the legs and the bars *B*, with each shelf

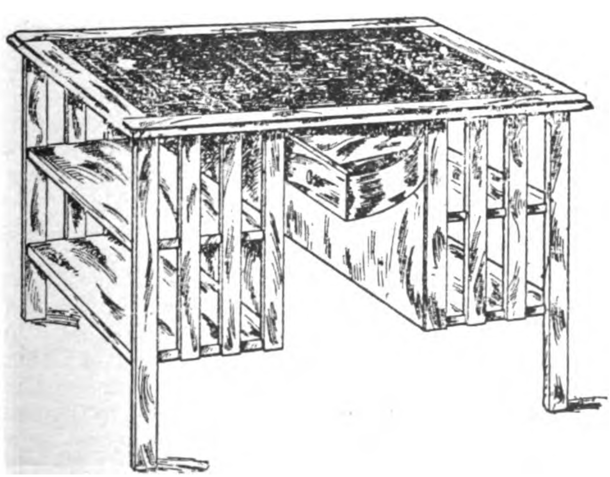


Fig. 1—The Completed Writing-Table and Book-Case

and the top, and two through the other bars. If spaced evenly the screws are more ornamental than otherwise. The top *A* is only for the purpose of fixing the parts together, and is covered by the real top, therefore there is no need for it to be of hard wood throughout. The outside edges and ends must be of the same kind of wood that the table is made of, but the inner part (shown grained in Fig. 4) may be of pine or American white-wood. The top proper should be framed up as Fig. 7, the outside rim projecting slightly above the center panel and rather more below it, as in Fig. 8. This method of forming the top makes it convenient for attaching a piece of leather or cloth to the top for writing purposes, *F*, Fig. 8, and also allows the top to clip the framing, thus adding to the strength of the whole. It must be understood that the latter makes it necessary for us to have the framing of the top the same width as the projections at ends and sides over the framing, that is, 1½ in. and 2 in. respectively; or perhaps it is better to say that the center panel must be exactly the same size as the framing of the table.

The top is easily secured by screwing up from underneath through the top *A*.

We now come to the drawers, which are two in number, one on each side of the table, and as shown in Fig. 9. They are made in a novel manner. The actual making need not cause anyone the least misgiving, as it is not so difficult as it looks. The square corner of each drawer should be lapped dovetailed in the ordinary way, Fig. 10. The other ends of the fronts can be cut away, leaving the lap on the outside, so that the curved part can be screwed into it, and it is also fixed in the same way to the drawer side.

The curved part may be formed by two or more pieces of three-ply wood, bent round a block cut to the right shape. If glued together and kept under pressure until the glue is dry, they will permanently keep their shape.

As these curved parts form the back of the drawer, they must be kept ½ in. less in width than the front and side, so that the bottom will nail on. They will, of course, fit in grooves in the other parts in the regulation manner.

As may be imagined, these drawers do not slide in the ordinary way, but are hinged at the corners, *H*. This may be done with pivots passing down through *A*, and up through *D* into the fronts; but the better way is to hinge them to the bars *B*, using a single hinge the full depth of the drawer front. When the drawers are finished and in position, small blocks should be glued to the under side of *A*, in about the position shown at *I*, Fig. 9. These will prevent the drawers from opening completely out and straining the hinges.

I give in Figs. 11 and 12 alternative suggestions for moulding the vertical bars, and in Figs. 13 and 14, sections of the leg and sections of the edge of the shelves moulded.

SPECIFICATIONS OF THE NECESSARY MATERIAL

8 pcs. 2 ft. 4 in. long, 1½ x ½ in. (legs)
12 pcs., 1 ft. 9 in. long, 1½ x ½ in. (bars)
2 pcs., 1 ft. 7 in. long, 9 x ½ in. (top shelves.)
2 pcs., 1 ft. 7 in. long, 9 x ⅝ in. (bottom shelves)
1 pc., 2 ft. 9 in. long, 19 x ½ in. (top *A*)
1 pc., 1 ft. 2 in. long, 19 x ½ in. (*D*)
1 pc., 2 ft. 9 in. long, 20 x ¾ in. (top panel)
2 pcs., 3 ft. 1 in. long, 1½ x ⅞ in. (top framing)
2 pcs., 1 ft. 11 in. long, 2 x ⅞ in. (top framing)
2 pcs., 1 ft. 1½ in. long, 4 x ⅞ in. (drawer fronts)
2 pcs., 1 ft. long, 4 x ⅝ in. (drawer sides)

About 4 sq. ft. of 3-ply wood (drawer backs and bottoms), hinges and brass screws as required.—*Hobbies.*

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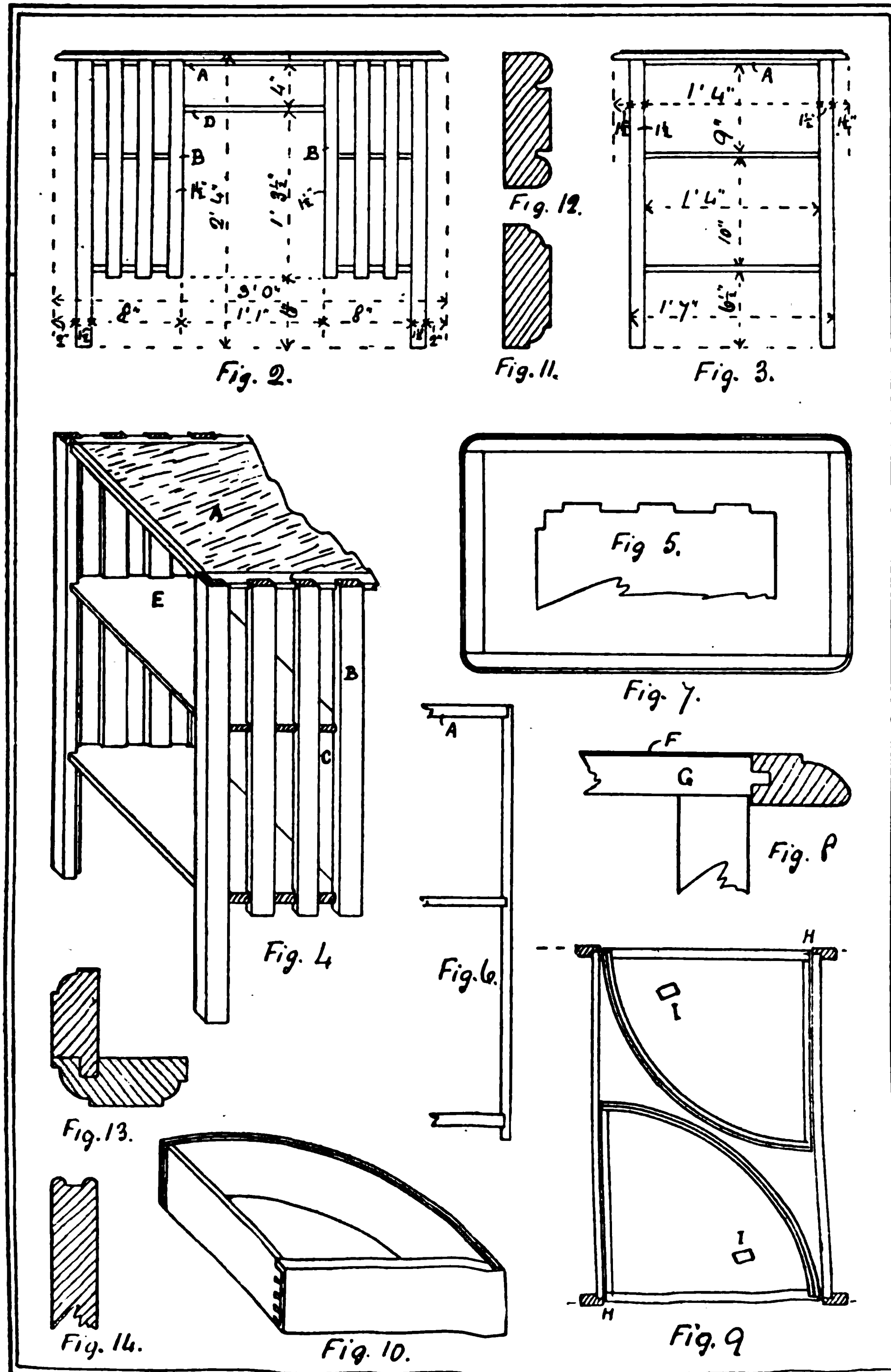
In Germany the railroads furnish excellent facilities for transporting invalids and cripples. A first-class car is provided for those who can afford to pay the rate. This car is fitted with every convenience. A special apartment opens on the level of the station platform with a double door which enables a stretcher to be carried in without the least difficulty. In the remainder of the car there is a kitchen where meals can be prepared, and in the rear a beautifully upholstered section for the family or friends. For invalids who travel second class or third class there is an apartment on an ordinary car which opens to the platform by means of a double door. A special rate, of course, is charged for the extra convenience.




Novel Writing-Table and Book-Case

Fig. 2.—Front elevation of table. Fig. 3.—End elevation of table. Fig. 4.—Isometrical sketch of half framing. Fig. 5.—End of shelf cut to take bars and legs. Fig. 6.—Vertical section showing

# HOW TO LINE A LATHE

D. L. KELLY

First, fasten a piece of straight pipe in the chuck, with one of its ends nearly flush with the face of the chuck. Then plug this end of the pipe with wood, revolve lathe-spindle, and with a pencil find center. Insert a fine sewing-needle, with pliers, and true carefully.

Take center and key out of tailstock-spindle, paste a piece of smooth paper over end of same, find center of spindle on paper and draw vertical line 0.0′, Fig. 1, through center. Bring tailstock-spindle close to needle point, and adjust screws in tailstock-block till needle and line 0.0′ coincide. Clamp, with needle revolving, pierce hole *A*, about ten-one-thousandths inch in diameter. Turn spindle half a turn, and if needle enters same hole again, headstock and tailstock are at the same height.

Run out tailstock spindle till the distance from point of spindle to end of tail-block equals length of base of same. Bring tailstock close to needle and clamp. Pierce the hole 1. Give spindle a half-turn and pierce the hole 2. Using a magnifying-glass, measure the distance between holes 1 and 2. Call it 1/64 in., and the needle is in hole 2, the tailstock is high at back. File and scrape V's of block till needle enters hole *A*, then the tailstock-spindle is parallel to bed.

Fig 1

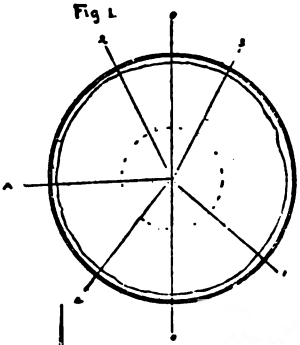


Fig 2

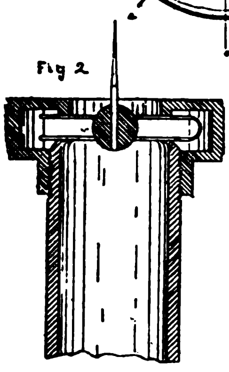
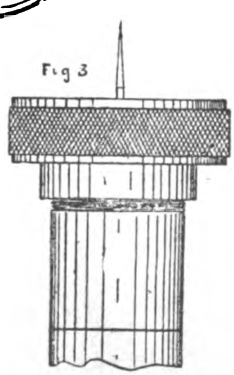


Fig 3



To test headstock, release pipe and draw out till the distance from needle-point to end of headstock base equals length of same. True needle and proceed as before, pierce holes 3 and 4, and if needle is in hole 4, the headstock is high at back, and the amounts will be one-half of either the vertical or transverse distance between the holes. File and scrape accordingly till needle enters hole *A* correctly in all positions.

The carriage is on separate V's, and is tested in the same manner; clamp a jig-bush in toolpost, and get another to fit inside, center correctly, paste the paper on the inner bush, and proceed as before. If the lathe has a cross slide in carriage, it may be tested with a jack on faceplate, in the usual way. The sag of needle, when pipe is out far enough to multiply the actual distance four times, may be found by reversing the operation. After the tailstock is lined correctly, put a drill-chuck on tailstock-spindle, and mount the same length as used. Put a piece of wood with a hole in center of lathe-chuck, paste paper over hole, draw vertical line through center, true needle, and pierce hole; half turn lathe-spindle and pierce again; half the distance between holes is the sag.

I have found it difficult to true the needle correctly when mounted in wood. A needle-holder that will facilitate that operation is shown in Fig. 2, and consists of a pipe threaded at end and spun inwardly, a cap to fit pipe, double disc connected at side, ball with needle placed between disc; when not in use turn needle inward to protect point. The needle is marked at three places where the diameter is 5, 10, 15 thousands. To mark these, copper needle and open micrometer to 15 thousands, take needle between finger and thumb, twist it between points; it will leave a bright ring.

If a hole is pierced 15-thousandths diameter, and if you move the piece over till the needle touches one side of that hole at the 10-thousand mark, then the piece has been moved 2½ thousands and at intermediate points accordingly.—*Buffalo Item.*

# AN AMATEUR'S VISE BENCH

W. F. MANLEY

The chief requirement of a vise bench is stiffness and freedom from vibration. The details of construction depend somewhat on the circumstances attending each individual worker, as the height of the user must be taken into consideration, so as to obtain the best results with the least amount of labor. The top of the vise should be about level with the elbow when standing ready for work. This height will be found to vary between 40 in. and 44 in. from the floor, so the writer is taking 42 in. as an average, allowing 4 in. for the height of the vise itself; the top of the bench proper may be 38 in. from the floor.

If there is no difficulty in knocking a couple of holes in the workshop wall, and if there is a brick or concrete floor, the method shown in Fig. 1 will be found a very strong one. The uprights and cross-pieces in all cases will be 3 x 2 in., and the bench top 1 in. or 1¼ in. material. For the bench shown, two holes should be made in the wall about 6 in. deep x 4 x 6 in. in cross-section, and centers 1 ft. 10 in. apart horizontally, also two holes of the same size in the floor, and the same distance apart, and centers 1 ft. 4½ in. from the wall outwards. Cut two pieces of the 3 x 2 in., 3 ft. 5 in. long, and two pieces 1 ft. 10 in. long, at one end of each piece, making the halved joint, Fig. 6, and bolt up with a couple of ¼ in. bolts in each. In the ends that are to be cemented into the wall and floor put in five or six strong cut nails, with their heads projecting about 1 in. Stand the supports in position, and level them up, and carefully fill up the holes with cement with a few small pieces of stone about the size of a nut mixed in. Leave a couple of days to set before putting the bench top on. This may be made of two 9-in. widths

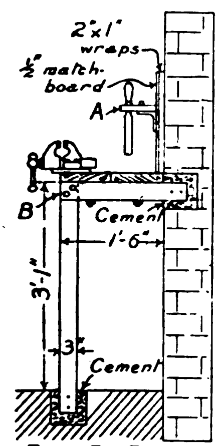



FIG. 1.—END ELEVATION.

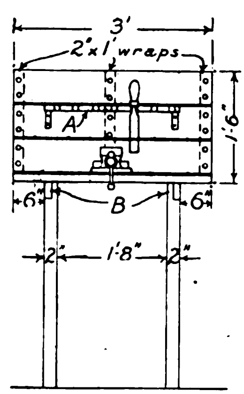



FIG. 2.—FRONT ELEVATION.

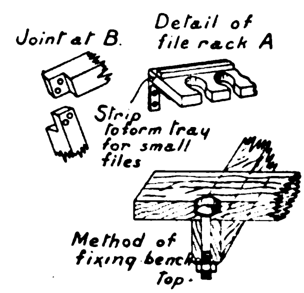



FIG. 6.

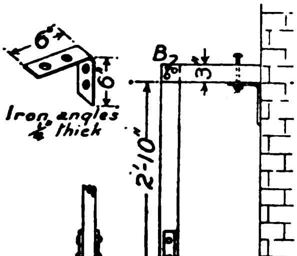



FIG. 3.

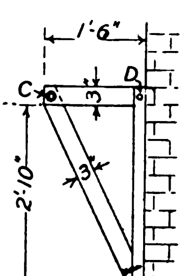



FIG. 4.

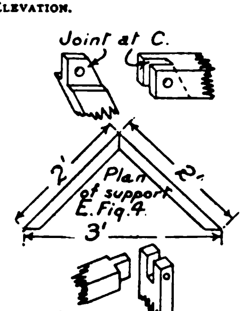



FIG. 7.

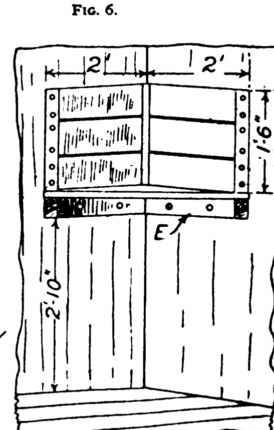



FIG. 5.

How to Construct an Amateur's Vise Bench bolted to the crosspieces by ⅜ in. bolts, as shown. The vise may be bolted wherever desirable.

The toolboard at back is made of ½ in. matchboard 6 in. wide, screwed to three pieces of 2 x 1 x 18 in. long. The latter are first attached to the wall by cut nails, and carefully lined up level. The rack for files is to be made of 1-in. material, and of any convenient width and length. The straight slots are cut wide enough for the tangs of the files only to pass through, and the circular parts slightly larger than the ferrules. The rack is secured to toolboard by iron brackets.

Where the above method cannot be followed, the uprights can be fixed by strong iron brackets, as shown in Fig. 3, or made after the style of a bracket table, as in Fig. 4. A corner of the workshop may be used, if found more convenient, and in this case the construction is simpler and, as shown in Fig. 5, measurements for the last three methods of construction are left for the maker to work out, as much depends on the space and position at the disposal of each individual user. The elevations for supports in Figs. 3 and 4 only, are given; the distance apart and other measurements are as in Figs. 1 and 2. Sketches of joints, etc., are not to scale.—*The Model Engineer.*

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## ELECTRICITY IN THE PLATING ROOM*

S. E. HUNERFAUTH

The subject of electricity in the plating room is a very important one. In the earlier days before the introduction of dynamos, batteries were used to supply the currents. These were very satisfactory except for the expense of maintaining same, and the limited amount of current which was available. At this point I wish to say that the current given off by the battery is the most direct or continuous current to be had. The first dynamo to be used for electroplating was invented in the year 1842 by J. S. Woolrich. This was what is known as a "magneto-electric" machine. Mr. Wild, however, was the first to construct a dynamo which was really suitable for the purpose. He invented a large dynamo with field magnets that were separately excited from the small magneto machine. His first machine was used for many years by Messrs. Elkington. It was necessary to keep the armature in this machine cool by means of a stream of water circulating through it.

About the year 1867 Mr. Wild introduced a multipolar dynamo with a redressing commutator. Weston introduced a small machine for electroplating which had steel cores on it, with the main circuit around them, and supplied with an automatic cut-off to break the current and prevent the magnetism from reversing by back current from the tanks. Gramme, in 1873, built a special form of dynamo with armature wound with strips or bar wound, having commutators at each end, with an output of 1,500 amperes at 8 volts. Siemens and Halske were early in the field with machines having bar winding. Brush also constructed machines of low resistance, giving a voltage from 3.3 to 4.1 volts. Thus, we have a brief history of plating dynamos. From about the year of 1880 there were numerous types and makes of dynamos in use. We will now take up the different types of dynamos.

### VARIETY OF DYNAMOS

First, we have the magneto dynamo, which was constructed with the regular armature, but the field magnets or the poles were permanent magnets, having no coils on the poles. The objectionable features of this dynamo were that the voltage was not regular, there being quite a drop in the same from no load to full load of the dynamo.

Second, we have the shunt-wound dynamo—self-exciting. This type of dynamo was in use for a great many years, and there are some in use to this day; in fact, there was one concern that continued to build them up to a few years ago. In fact, the shunt-wound dynamo was a great improvement over the magneto, and also over the series-wound dynamo. The greatest objection to a

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* Paper read before the Chicago Branch of the National Electro-Platers' Association.

shunt-wound self-exciting dynamo is that the voltage is not constant at the different loads. Thus, to do plating and have a nearly constant voltage it was necessary for the operator to change the field rheostat or shift the brush-rocker every time he changed the load in his tanks to keep a nearly constant voltage.

Third, we have the compound-wound dynamo. This is a combination of the old series dynamo and the shunt-wound dynamo. The compound-wound dynamo has two sets of coils on the poles, one called the shunt coil, which is used to excite the dynamo, and which takes only a small fraction of the current generated by the armature. The series coils circuit with the armature, and by the aid of the compound or series coils we are enabled to hold the voltage constant regardless of the load in the tank. Thus, you will readily see that when the operator sets the voltage of the dynamo, it is then self-regulating. It is not necessary to keep shifting the rheostat at every change of load; in fact, any good compound-wound dynamo should hold its voltage constant, whether you are using 5 amperes or a full load of the dynamo, thereby enabling the plater to do more and better work with a uniform deposit than with dynamos not containing these characteristics. It is now possible to build low voltage dynamos having all the characteristics of modern power dynamos, including self-regulating brushes, compound-winding and all of the other features contained in power generators.

Fourth, we have the shunt-wound separately excited dynamo, and in the writer's opinion this is the ideal plating dynamo, whether small or large, and especially in large dynamos. The separately excited dynamo has its fields excited from an external source, either from the power or lighting circuit in the building or from a small exciter. This type of dynamo has practically the same characteristics as the compound-wound dynamo, for the reason it will hold its voltage nearly constant, from no load to full load graduation in adjusting the voltage, and cool operation.

### GOOD DYNAMO AN ESSENTIAL

Thus, you can see it is very important to have a good dynamo to do good plating. But the fault does not always lie in the dynamo for poor work and insufficient amount turned out for a day's work. At this time the writer wishes to say that he has visited a great many plating rooms and has often found that the dynamo and the conductors from dynamo to tank receive very little care. It is very often a fact that the plating room may be equipped with a good dynamo, but the results obtained in the plating are very unsatisfactory. It is very often a fact that the conductors are of insufficient size and are very poorly erected. Connections are very poor, badly corroded, and, in fact, are sometimes very loose and produce considerable heating at that point. This not only causes a waste in current, but also a loss in voltage and an insufficient amount of work which the plater is able to turn out. As an example, the writer was once told by one of the largest stove manufacturers that he did not know what the matter was with their plating room—that it was taking from 45 minutes to an hour to turn out a batch of work, whereas they formerly did it in 25 minutes. I made an investigation and found the copper conductors from the dynamo to the tanks were insufficient. The joints were bad; in fact, badly corroded. The dynamo was of ample size. I doubled the size of the conductors, soldered all the connections and joints; the results were, he later said, that he was turning out double the amount of work that he did before. This is true not only in this case, but the same is also true in a great many plating rooms now operating under similar conditions. Too much care and pains cannot be taken in installing the dynamo and conductors in the plating room.

### AN IDEAL PLATING ROOM

The writer had the pleasure recently

If the same care were exercised in erecting the dynamo and appliances connected therewith as in making up the different solutions, you would have much better results than you would have at the present. This is not given in the sense of criticism, but in the spirit that it may be of some benefit to you.

Next, we will take up rheostats and their use in connection with plating solutions. Nearly every plater of today uses a rheostat in connection with the tank that he has in the plating room. Rheostats are essential where you operate one or more solutions from the same dynamo. It is very often necessary to reduce the voltage in a tank lower than you can or dare to do on the dynamo for the reason that it will interfere with the other tanks; therefore, it is necessary to provide each tank with a rheostat, but rheostats are often condemned for the reason that they are often ordered by the number of square feet or amperes required. To make this clear, *A* might have a tank containing 400 gallons of solution for his work and a 300-ampere rheostat might be the proper size, while *B* might have 400 gallons of solution, but different kind of work, and a 400-ampere rheostat would be suitable for his tank. The size of the rheostat depends upon the average number of square feet of work you have in the tank and the kind of solution. If you can give this information to your dealer, he can generally give you just the size rheostat required for your work. Do not condemn a rheostat if it does not cut down the voltage to the point to which you would like to have it or if the wires get hot. It is not always the fault of the rheostat, but simply because you have not the size rheostat required for your work. The drop of voltage across the rheostat depends upon the amount of current you are using.

### VOLT-METERS

This is an instrument that is almost impossible to dispense with. You would not think of operating a steam boiler without a steam gauge. Then, how can you expect to operate your plant without a volt-meter unless you simply guess at the voltage in your tanks and turn out your work accordingly? Every modern and up-to-date plating plant is equipped with a volt-meter, which enables the operator not only to read the voltage of his dynamo, but of each tank independently. Still, there are a number of plants operated today without a volt-meter, and are operated simply by guess. Ammeters are used for measuring the current, either in a tank or for the entire output of the dynamo. While it is possible to operate a plating room without an ammeter, still, they are useful in determining the amount of current you are consuming in turning out your work. —*Keystone*.

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## A Movement in Silver

Silver is now selling at the highest price reported since 1907, the recent advances having been due in part to speculative activity, and in part to an actual demand for the metal from India, and to the probable increase in the demand for China, says the *Engineering and Mining Journal*. The speculative activity has been based largely on the belief that the Indian government would soon be obliged to buy largely for coinage purposes, the reserve of silver rupees having been drawn down to a point which seemed low in view of the probable demand for money to pay for the good crops of the present year. This anticipation has proved to be correct, but the result has not been altogether pleasing to the powerful group of eastern speculators which has been carrying heavy stocks of silver in London and in India for some time. It now appears that the Indian government, with unusual shrewdness, had been anticipating its needs and had been buying silver quietly on the open market for some time. There were some suspicions as to its action, but the fact was not fully known or accepted until a short time ago, when the steamers to Bombay and Calcutta carried out shipments amounting to £750,000—about 6,050,000 ounces—on government account. It is understood in London also that further large shipments will be made soon. This movement has caused some surprise, but it has entirely frustrated an attempt by the Indian speculators to corner the market.

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Your time belongs to your employer when he pays you for your work; then to "kill time" is *robbery*.

# AN AUTOMATIC SECTION WINDER

JESSE O. FISHER

I have read several articles in different magazines describing section winders, but as yet have failed to find any that would paraffin the wire, either as it was wound on the coil or wound in the section. I have, therefore, designed one, and I think that it will give satisfaction in most cases, or at least suggest a good plan.

In Fig. 1 is shown the completed machine. It is designed to operate by a small battery motor. The motor drives the paraffin wheel *D*, which by friction drives the section. By use of the friction drive there is enough power delivered to the section to keep the wire tight, yet the tension is not sufficient to break it. The machine can also be constructed to wind quite a number of different sized sections by using different forms in winding.

You will need to determine the dimensions of the machine from the diameter and thickness of the sections to be wound.

To construct this machine, we will begin with the base. All wooden parts should be made of some hard wood, such as maple, oak or mahogany. The base should be heavy and of ample size to balance the machine well. Two mortises are made in the base to fit the projections on the standards, shown at *H*, Fig. 3. The edges may be beveled to add to the appearance.

The standards, Fig. 3, need not be quite so heavy as is the base, but should be at least 3/8 in. thick. A slot *F* is accurately cut in the top of each standard, and the edges are made smooth. The shaft *E* turns in this slot and should be made a snug fit, but still free to move up and down. A small bearing *G* is provided for the main shaft, and to this shaft are fastened the pulley and paraffin wheel. It will add greatly to the easy running of the device if the two bearings are fitted with brass bushing. On the inside of each standard are fastened, by means of screws, cleats which support the paraffin tank. The projection *H*, Fig. 3, which is on each of the standards, is so cut as to fit tightly in the mortises which are in the base, and the standards are glued firmly in place.

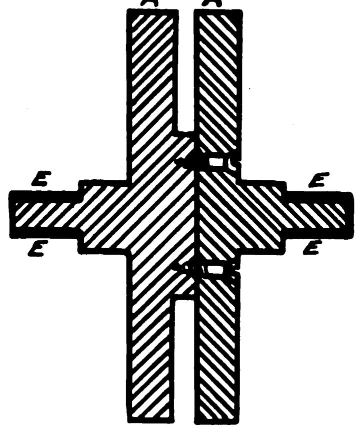
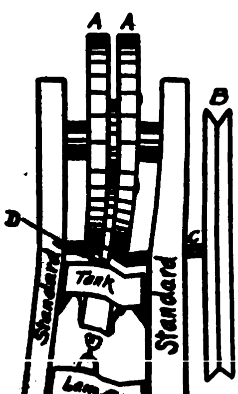



Fig. 2—Cross-section of a Form

The paraffin tank is made of galvanized iron. If you are not an experienced tinner and have not the proper tools, you had better have the tank made by a tinner. There must be no soldered joints in the lower part, as the heat from the lamp would, of course, melt the solder. The advantage of having the tank in the shape shown is to give it a large capacity and allow the wheel to gather nearly all of the paraffin.

The paraffin wheel is the same width as is the section to be wound. It should be turned true in a lathe and rigidly fastened to the main shaft. A strip of



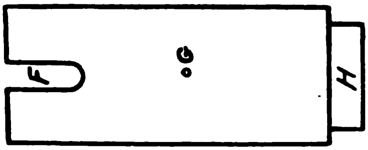


Fig. 3—Standard

The pulley is also turned and is fastened to the same shaft as is the paraffin wheel. The pulley should have such a diameter as will allow the motor to run at its proper speed.

A cross-section of the form on which the section is to be wound is shown in Fig. 2. At first, it is turned to the proper shape in a lathe, from a solid block of hard wood. The slot is made the width of the section plus the width of the saw-cut, in order that when the block is cut in two, the slot will be the proper size. Before the block is cut, insert two screws as shown in Fig. 2, then withdraw them and cut the block as shown. If the work is not done in this manner, it will be found difficult to center the two blocks and put the screws in the proper place. On each end a brass tube is placed over the wooden bearing. This is shown by *EE*, Fig. 2. This tubing should be of a size to fit and yet turn freely in the slot *F*, Fig. 3. Any number of these section-forms may be made, each of a different size. If the thickness of the section is changed, the paraffin wheel will also have to be changed. Any small lamp may be used as a heater, but I would suggest an alcohol lamp or a small gas lamp, as the fumes from coal oil are objectionable.

Fill the tank with paraffin (this should be done first, in order to allow the paraffin time to melt, while you are getting the other things ready.) Belt the motor to the winder and pass the wire which is to be wound through a small hole in the side of the form, similar to those holes which are on all spools of wire. The switch to the motor should be placed where it can easily be reached. When winding a section hold the wire between the thumb and forefinger, and guide it on smoothly and closely; the machine will do the rest. To remove the section remove the screws and separate the form.

## THE DEPOSITION OF NICKEL ON NICKEL

EMMANUEL BLASSETT, JR.

A correct method of renickeling work has never been described in any of the text-books on plating, and the opinion prevails among many platers that it is impossible to plate nickel on nickel so that it will adhere in a perfect manner. Occasionally this statement appears in print and the self-styled experts maintain that it is impossible to deposit an adherent coating of nickel on nickel. They are responsible for spreading considerable misinformation, and it is with the hope of imparting correct instruction on the subject that this article is written. After so many years of progress in all branches of electro-deposition, it would be a sad reflection on the ability of the American plater if he were unable to deposit nickel on nickel as readily as on steel or brass, and with the same good results.

The deposition of nickel on nickel is not a difficult matter when the proper work required to be refinished without removing the previous deposit of nickel may be replated without danger of peeling, and the deposit may be made to adhere as perfectly as the original coating.

The method to be followed in cleaning nickeled work for plating is to remove the buffing composition and grease, as far as possible, by running the work through an electric cleaner or a potash solution. The work is then preferably run through a hot muriatic pickle and again put through the potash. The work should then receive a very slight coating of copper, just enough to cover it, then be rinsed in water and put through the following dip:

Sulphuric acid . . . . . . . . . . . 5 parts
Nitric acid . . . . . . . . . . . . . . 1 part

This dip is used cold and as little water as possible should be allowed to enter when running work through it. It will be found that this dip will remove the minute to remove the copper, and the work should never be allowed to remain in it longer than is necessary to remove the copper deposit. When the work is removed from the dip it is rinsed in water and given a final deposit of copper, and after again rinsing it is immediately transferred to the nickel bath. By following the operations described the second coating of nickel will adhere perfectly, and it will stand bending, and filing, or any other mechanical operation that it may require. It will adhere as well as the original deposit.

On first-class work where a close inspection of the deposit is made, there will frequently be found pieces that are cut through, owing to the carelessness of the buffer, or the difficult nature of the work to be buffed, or possibly on account of the deposit's being too light. The expense of removing the nickel by stripping and polishing from work that is cut through is considerable, and by such a method the work is generally refinished at a loss to the manufacturer. Stripping and repolishing is too expensive and unnecessary, and all such work may be refinished as described in this article. Job shops frequently receive work to be refinished with the nickel worn off a little, on the edges, such, for example, as stove trimmings. Such work may be refinished by brightening the deposit on a buff wheel and smoothing down the spots that are cut through with tripoli. This is the most economical way, to say nothing of the desirability of having two coats of nickel on the article instead of one. A deposit of nickel on nickel, on such work as stove trimmings, may be made to adhere sufficiently well, by brushing the surface with slacked lime and copper-plating lightly previous to nickeling. On all large pieces that do not require a severe test it is unnecessary to use the dip described in this article. The dip should be used on all small work where brushing is too expensive or difficult and a perfectly adherent deposit is required.

Nickel may be deposited on nickel successfully without copper-plating, and the method subsequently described may carbon anodes. This dip is made as follows:

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|---|---|
| Muriatic acid | 10 parts. |
| Water | 2 parts. |

This dip may be used cold, but usually better and quicker results are obtained if it is heated to about 100 degrees F. The work to be replated should be attached to the cathode rod for a few seconds only, immediately rinsed in clean water and transferred to the nickel bath. It is not necessary to use the dip previously described in connection with this method, although it may be used, if desired, to ensure against failure. The work should be chemically clean previous to treatment in the muriatic acid solution. Four to six volts are used in working this solution. In conclusion it may be stated that nickel may be deposited on nickel, with little danger of peeling, by removing the grease in a potash solution and vigorously brushing with pumice stone. The objection to this method is that pumice stone scratches the nickel, and the finished article, when buffed, would be covered with scratches. It is also expensive and difficult to brush certain classes of work. The point to remember in renickeling work is that the surface should be acted upon very slightly by a dip such as described in this article, when a perfectly adherent deposit will be produced. —*The Metal Industry.*

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A company of young electrical engineers in England have invented a device to indicate the approach of another vessel and thus prevent collisions at sea. The invention consists of a large drum 9 ft. in diameter, which is swung aloft away from possible interference from deck sounds. It is provided with sixteen receiving mouths which receive all sound waves. At the bases of these receivers contact breakers are fixed which are sensitive to general sound waves, but stable to mechanical vibrations. Each of these receivers receives the sound from a particular direction. The contact breakers are connected electrically to

## THE FIRST WIRELESS TIME SIGNAL

Captain J. L. Jayne, United States Navy, Superintendent United States Naval Observatory, Washington, D.C., writes:

"I notice in your number for August, 1912, in an article entitled 'The First Wireless Time Signal,' that the claim is set forth that the first time signal was sent from the Marconi station, from Camperdown, Nova Scotia, in 1907. As a matter of fact, the United States Navy anticipated this by over two years. The fact that arrangements for such signals were being made was announced in the 'Notices to Mariners,' published by the Hydrographic office in November, 1904, and signals were actually sent out in January, 1905. The navy has been regularly sending out radio time signals from some of its coast stations since that date. It is possible that our work suggested the idea to our northern neighbors. I hope you will correct the impression that the Camperdown station got ahead of us. The facts that I have given above are matters of record in the Navy Department.

"I read with pleasure the resolution of congratulation passed by the Jewelers' Association. I note, however, that the resolution spoke of the 'New Enterprise.' As a matter of fact it is only new in that the station is new and powerful and possibly some other details.

"It is now expected that a radio (wireless) time signal will be sent out from the new station at Arlington at noon each day in exactly the same way as to grouping of sounds as those being sent out at present over the Western Union wires. It is probable, however, that a similar signal may also be sent out at night, on account of the fact that signals carry farther at that time. No decision has yet been made as to this point."

The articles on wireless in the *American Jeweler* during the last six months, and in connection with the subject which are yet to be solved. It is not known what wave-length will be most effective at the wireless station. Furthermore, it is not certain just how far over the Alleghany Mountains the new station will be able to reach. It is expected that the flashes from Ft. Meyer will go 3,000 miles out to sea; but whether they will reach more than 1,500 miles to the west, or even that far, is yet to be shown. Therefore jewelers are warned not to purchase apparatus which may prove useless to them unless it can be tuned to the proper wave-lengths.

Synchronization of the railroad, postoffice and other public clocks throughout Germany by wireless telegraphy is also under way in Germany. This does not mean that the clocks are automatically synchronized, like a self-winding clock wired in the Western Union system in this country, but merely that wireless time signals will be sent out by the German imperial postoffice from the tower now being constructed at the town of Fulda. This tower will be over 300 ft. high, and the signals will be sent once each minute by a master clock closing the circuit of the radio transmitter.

The London City Council has ordered that all public clocks must be synchronized, or in other words must be so regulated as to be within a reasonable distance of Greenwich time. For a number of years past it has been a standard subject of sport with the daily papers in London to make fun of the clocks. Recently one of the daily papers took a census of the public clocks in London with the result of showing a variation of 21 minutes, the clocks giving actual time being just over 3½ per cent. of the total and on no street could more than two clocks be found to coincide. The difficulty has been owing chiefly to care-

# THE MARCONI VALVE DETECTOR

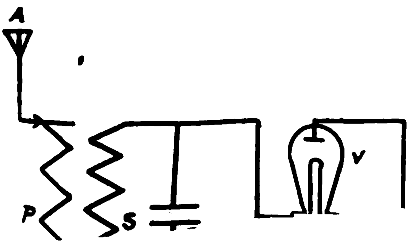
CHAS. H. COLLINS, JR.

The Marconi valve or "lamp" detector is rapidly coming into favor with the wireless experimenters of America. The adoption of this instrument in preference to its liquid and crystal brothers is probably due to the fact that the valve requires no minute adjustment, which is so bothersome when using the crystal and liquid rectifiers. Furthermore, the valve is unaffected by close proximity to powerful radiating stations, a fact alone which would make the valve a favorite of the experimenters.

The Marconi valve was not invented by Marconi, as the name might imply, but it is a product of the fertile brain of England's foremost expert, Dr. Fleming. Fleming invented the valve in 1904, and several years later DeForest patented an instrument which he called an audion, but which in reality was nothing but a form of Fleming's valve.

When first used, the valve consisted of an ordinary small incandescent lamp, with a small metal plate suspended directly above but not touching the carbon filament of lamp. In present-day practice the carbon filament has been replaced by tantulum or other equally refractory metals which are supplanting carbon in the present-day construction of filaments. In many cases the metal plate has been replaced with a metal grid. The grid, or plate, outside connection consists of a platinum wire sealed through the glass. See Fig. 1.

Fleming found that when the carbon filament was rendered incandescent by



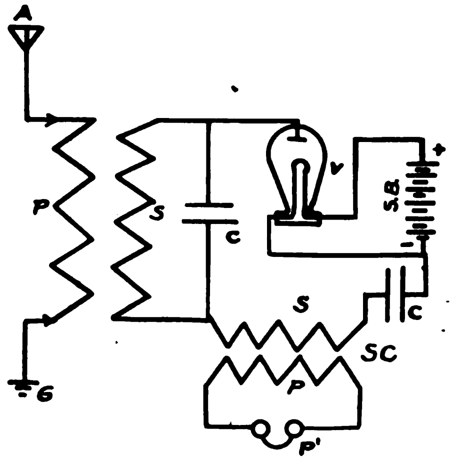




Fig. 2

an electric current the space between the filament and plate possessed unilateral conductivity, or, in other words, negative electricity will pass from the filament to the plate but not in the opposite direction. Prof. Pierce, of Harvard University, has shown this same state to exist in carborundum detectors. When a circuit is formed, as in Fig. 1, in which the metal plate, or grid, is connected to the negative wire of filament, oscillations set up in the aerial can be detected by the use of the head phones. On this basis the valve becomes a good detector for use in radiotelegraphy.

It has been stated by many prominent experimenters that the valve lacks the sensitiveness attributed to the crystal and liquid types. In the writer's experiments he has found that the valve is only slightly less sensitive than the bare-point electrolytic and perikon detectors, and far more efficient than the other liquid and crystal types. In general cases the experimenters who complain about the lack of sensitiveness of the valve are using improper and inefficient methods a loose coupler to a circuit containing a Marconi valve and the secondary of an ordinary spark or induction coil. Coil should be at least of the 6-in. type, and preferably of the 10-in. pattern. The primary of the induction coil is in circuit with the telephones, the latter to be of usual wireless type. Condensers placed as shown. For good results the battery should be of the storage type with an e.m.f. of 12 volts. From experience the writer has found that dry batteries are not suitable for good work. This is probably due to the sudden fluctuations in voltage which is usual in dry batteries.

In action the oscillations from the transmitting station strike the aerial of the receiving station, are then transformed by the loose coupler, rectified by the valve and sent through the fine wire secondary of the spark coil. Naturally, the spark coil increases the current value, and the waves are readily detected in the head phones.

Experimenters who are complaining about the lack of sensitiveness of the Marconi valve detector will do well to try this arrangement, and I am sure there will be no future complaints about the delicacy of the valve for receiving long-distance stations.

## WIRELESS TIME SERVICE

G. BIGOURDAN

The employment of wireless telegraphy has recently given an unexpected extension to the distribution of time-signals over long distances. The best-known European services are those of the radio-telegraphic stations of Paris (Eiffel Tower) and Norddeich, Germany. The Paris station, retarded several months by the Seine floods, began sending its signals at night only on May 23, 1910. From November 21, it also sent them in the morning. The times of signalling have since undergone some changes, especially through the change of the legal time brought about by the law of March 9, 1911.

The Norddeich station commenced its time-signals at about the same moment. But astronomers had already for several years carried out the wireless transmission of time-signals, and used them for the determination of longitude.

At first the precision aimed at did not surpass half a second; but nowadays there is a demand for all this precision arrived at in determining the time in the best-equipped observatories.

In Paris, the "warning signals" are at present given by hand, and the hour signals proper, three in number, are given will be, partly, at least, transformed into hour signals, given by the clock itself in an automatic and regular manner, for the employment of rhythmic signals would considerably increase the accuracy of reception.

We may imagine wheel trains, which, added to those of the clock, would effect the transformation of warning signals into hour signals, given, say, every second. But there are simpler means, and I propose to describe one device probably already put to other uses, which gives the best results for the purpose, although only carried out in a rough way.

The principle is as follows: An electric circuit is closed by the pendulum of a clock, the lower end of the pendulum touching the summit of a meniscus of mercury forming part of the circuit.

The very ordinary clock which I have experimented with has a pendulum with lenticular bob and rod of varnished wood. It beats seconds, and is suspended as usual by a flat steel spring. A copper wire, *b*, runs along the pendulum-rod, and its lower end *a* projects a few millimetres beyond the end of the pendulum. The wire *b* goes up to the metallic collar *c* of the same rod, and *c* is in contact with the end of the tube. This tube is carried by a support capable of adjustment, especially as regards height.

It is seen at once that in order to make the clock give, say, one signal per second, it suffices to place the meniscus at the equilibrium position of the pendulum, and to adjust its height. For giving one signal every two seconds, the meniscus is brought to one of the extreme positions of the pendulum. Besides, each second can be subdivided, equally or unequally, by substituting several wires for the wire *a*, or by arranging several mercury drops in the track of the wire *a*. To suppress certain seconds, deflect the current from the circuit *a b c d e f g* by hand, or by an easily-devised mechanism.

The contact is highly adjustable. Its duration can be made to vary between 2-100ths and 3-10ths of a second, by choosing an appropriate radius for the drop. Longer durations could be obtained by employing a long meniscus.

A similar arrangement is very useful for working a chronograph, or relay, for driving a free pendulum, or regulating a series of clocks from a master clock. A feeble current suffices, and the break spark is barely perceptible, 2 to 4 volts being sufficient.

The friction produced by the passage of the wire *a* through the mercury every second only produces a slight effect on the clock used. With a meniscus traversed to the extent of 2 mm. it was not found necessary to increase the driving weight, and the amplitude only diminished to 1-10th of its value.

To show the passage of the current, I make it light a small lamp having a short metallic filament, such as are on the market, with a very short period of lighting and extinction. Thus one obtains almost instantaneous signals, which can be used for observing pendulum coincidences in determinations of gravitational force.

One could also obtain the marking of seconds, or fractions of seconds, in the photographic registration of transits.—"Comptes Rendus."

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## ARLINGTON NAVAL WIRELESS STATION WORKING

First tests of the navy's new high-power wireless station at Arlington, Va., made October 28th and 29th, were a complete success. Officers in charge decline to discuss the performance of the world's greatest wireless plant further than to say that the first step in a system which is to extend around the world, with stations at Colon, Hawaii, Guam, Pearl Harbor and the Philippines, and put every ship in the navy and the insular possessions in instant communication with the capital, has successfully been taken.

Wireless operators, professional and amateur, on one side of the globe have had their instruments at their ears straining to catch the faint buzzes as the powerful apparatus sputtered out its calls for sparked off N-A-R, the call for Key West, 975 miles off. No official messages were sent, but the results of the test were noted at all stations on the Atlantic coast, as well as at Key West and Colon.

The radius of the new plant will be about 3,000 miles when it is in working order. This range, probably the acme of wireless operations, will be attained gradually, and it may be weeks before the big plant is "tuned up" to its highest efficiency. Communication with the Pacific coast will be attempted only at night for the present, but throughout the day the Secretary of the Navy, at his desk in Washington, will be within instant communication with Key West, Guantanamo, Colon, the naval coaling communicate with the powerful plant at Arlington, but they may relay messages to the various stations for transmission to Washington.

Three huge steel towers on the brow of a hill overlooking the Potomac and dwarfing the Washington Monument hold the aerials which fling off the messages to the ether. In their construction, skilled ironworkers who have braved death on a skyscraper declined to work at such dizzy heights. One tower is 600 ft. above the hill where its base rests, and that is 200 ft. above the river. The others measure 450 ft.

At the base of the towers are the soundproof workrooms, quarters for the operators and barracks for the marines who will guard the towers. The base of the tallest of the structures is 150 ft. square, and the other two have 120-ft. bases.

The station, which has cost $200,000, is on the summit of a high hill about a mile south of the drill-field at Fort Meyer. The buildings consist of three brick buildings. One is occupied by the officer in charge of the station. Another is the "receiving" building. In it is the apparatus for the reception of messages. The building also contains an office for the officer in charge, an office for the operators, a dining-room, kitchen, living-room, for the personnel of the station, a room for experimental purposes, dormitories and a large reading-room. The third structure is known as the transmission building. It contains an engine-room, machine shop, laboratory and a radio museum. In the high-ceiled engine-room a 200 h.p. motor, belted to a 100 k.w. generator, is installed. A 15 k.w. oil-driven generator set is also used for charging storage batteries and conducting experimental work.

What is known as the inclined flat top antenna is used at the station. The ground connection is made by burying copper wire and common chicken netting over a considerable area. If, because of the dryness of the ground, a good con-

The two wings of the station are separated by short vestibules from the central machinery plant. The vestibules are wooden. The connections of the vestibules with the brick-work are padded with linofelt, which takes up the vibration from the machinery plant and avoids corresponding complications in the operating rooms. There are two of these rooms. One is occupied by the radio operators, the other by those who man the telephone and telegraph wires connecting the station with the outside world. The radio operators' room is unique. It is built somewhat upon the style of a huge refrigerator. It is absolutely sound-proof, and when its door is closed the radio operator on duty cannot be bothered by any sound from without, or by vibrations. The only entrance into the radio operating room is through a double refrigerator door. The room has no windows, is artificially lighted and ventilated. Even the air used in doing this is sound-proof, as it passes through a series of air ducts in which "baffle plates" are strung so as to baffle any noise that may attempt to creep with the ventilation into the radio operating room.

A separate room has been set apart for use by operators of the land wires. Connecting it with the sound-proof radio operating room is a telautograph. When a message is to be sent by wireless it is not taken through the refrigerator door into the radio operating room, but is laid down there by the outside operator through use of the telautograph. The outside operating room does not have to be storm- and vibration-proof and is connected with the outside world in three ways: by public telegraph, and private and public telephone. There is a private telephone wire leading direct from this outside operating room into the Bureau of Navigation in the Navy Department. This avoids any leak of official messages through use of the city telephone service. Should anything happen to this official wire the plant has

To man the station at Arlington twelve enlisted men are necessary, as it will be open for messages day and night, all but two of whom are to be expert electricians, radio operators and telegraphers specially trained for this service at the Naval Electrician School at the Brooklyn Navy Yard. The duty is very exacting and requires the services of men of a high order of intelligence.

To avoid smoke, dust and vibration the power for the operation of the plant is derived from the electric conduits of the city of Washington. This power drives a 200 h.p. electric motor, which in turn drives what is described as a 100 k.w. 500-cycle alternating generating plant. Two currents, one of which is primary and of 100 volts, the other secondary and of 12,500 volts, are produced by this generator. The primary current passes into a novel transformer, which "steps up," and is increased into a high current of 12,500 volts in the secondary circuit.

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## LOW POTENTIAL ELECTRIC GAS-LIGHTING

M. C. SAEGER

It should not be considered a luxury to possess an electric gas-lighting equipment, and the accompanying illustrations will show how easy it is to construct a coil suitable for gas-lighting purposes.

A.

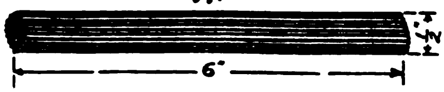
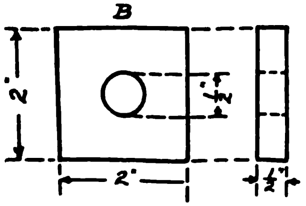


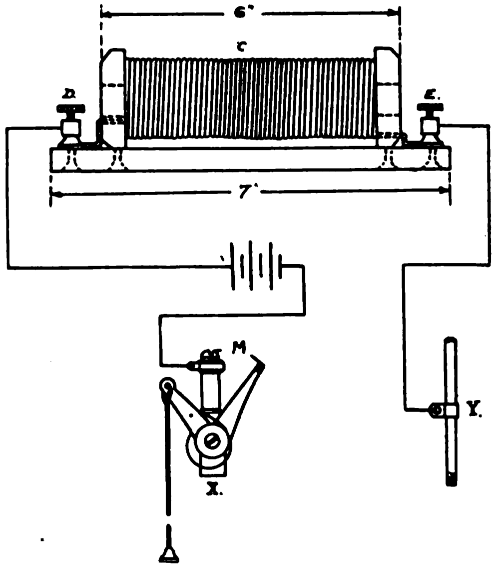

Fig. *A* shows a cylindrical core 6 in. long and ½ in. in diameter, composed of No. 14 soft iron wire. A small piece of wire or cord should be tied around each end of the core to hold the wires in place and the core must then be immersed in shellac and left to dry.

A piece of "empire cloth" or paraffined paper, 5 x 2½ in. in size, should be wrapped around the core and two blocks of wood, as in Fig. *B*, slipped over the ends of the core. Three layers of No. 15

B




B.&S. gauge, cotton-covered wire are wound on the core, care being taken that the wire is wound on evenly, as in Fig. *C*. One end of the wire is to be connected to terminal *D* and the other to terminal *E*.




when three dry cells of the high amperage or ignition type are connected in series with it.

Fig. *X* shows a design of a plain make-and-break igniter which has but few parts to get out of order. Fig. *Y* is a portion of a gas main which is used to ground the wire leading from terminal *E*. One coil of the type just described will operate as many gas burners as may be desired.

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According to the *Financial News*, a ton of steel made into hairsprings for

## WIRELESS OPERATORS RUSH TO GET LICENSES

### Veterans and Amateurs Must Comply with Federal Law by December 13

Since the first of the month the office of the electrical school at the Brooklyn Navy Yard has daily been crowded with veteran, neophytic and embryonic wireless operators, all panting to write down what they know about radio communication, its uses and abuses, and so get a license from the Department of Commerce and Labor.

All this rush is due to the fact that on December 13 there goes into effect an act for the regulation of radio communication, whereby all wireless operators and all apparatus which work across State lines or can communicate with ships at sea are required to be licensed.

This act is one of the by-products of the Berlin international treaty, ratified in April by the Senate.

Examinations are being held at United States navy yards and army posts all over the country during this month, and according to reports thousands of operators are availing themselves of the opportunity of getting themselves registered as regular flashers before December 13.

The fact that there are some 10,000 wireless stations, most of them amateur ones, around New York accounts in the minds of the examiners at the Brooklyn navy yard for the daily crush in their office. The amateurs know that the act doesn't pass them by entirely.

The veriest beginner amusing himself on a housetop in Flatbush by sending burning messages to his up-to-date friend in South Brooklyn is aware of the fact that he must get a second grade license right away if he wants to practise radio communication, or run the risk of having his precious paraphernalia pulled down by a stealthy inspector.

Anybody who wants a license must first go to the Custom House or to the electrical school at the navy yard and present an application, telling whether

written ones, and they are corrected by the examiners under the supervision of the Department of Commerce and Labor.

One of the questions which is likely to hit a trembling beginner in the face is: "How can you tell if your antenna is radiating?"

The applicants for commercial licenses, of which there are now five grades, may be asked to "describe in detail the adjustment of a transmitter for a certain wave-length (as 600 meters) so that only a single hump would be present."

Applicants for third grade licenses, which is the technical class for experiment and instruction, also have a little leeway in the matter of questions.

Everybody, regardless of class or grade, swears to keep secret any messages he may pluck out of the air, unless ordered to divulge those messages by a court of competent jurisdiction.

This stipulation was embodied in one of the most important amendments made by the House when the administration bill for Federal control of wireless operations passed through its hands. Furthermore, the beardless dabbler in sparks solemnly vows to cease troubling the air with his machinations when there are important messages flaring around the sky.

Apparently the amateurs about New York are right up to the scratch when it comes to swearing or knowing their business, for 90 per cent. of all the applicants examined at the navy yard during the first three weeks passed, according to one of the examining officers.

One fact the officers have noticed with surprise during the kaleidoscopic comings and goings of applicants; that is, that there have been no women in the line.

One recalled yesterday, however, that when the wireless division of the Com-

## SOME OF THE CURIOUS SUPERSTITIONS OF SAILORS

Why does a seafaring man—captain, cook or cabin boy—consider it unlucky to ship a man who neglected to pay his laundry bill?

Why does a sailor nearing port after a lengthy voyage gather up old clothes and shoes unfit for further use and ceremoniously commit them to the deep?

Why does he like to sail on a ship which displays a shark's tail firmly nailed to the bowsprit or jib-boom?

Why does he like cats?

Why does he place great faith in the merits of a pig as a weather prophet?

The simplest answer to these questions is—because the average sailor is superstitious.

During rough weather at sea it would be hard to convince any old-time sailor that there wasn't a Jonah aboard. Many captains of the old school, who ought to know better, are so superstitious in this respect that it is not uncommon for them to take intense dislike to officers who have happened apparently to be the harbingers of bad weather, and especially fog. It is quite usual on board ship to find members of the crew nicknamed "Foggy Jones," "Heavy Weather Bill," or "Squally Jack."

Cats on board ship are considered lucky, and many a stray one finds a comfortable home and careful attention with Jack for its friend, although, on the other hand, our domestic pet has at times been held responsible for the continuance of bad weather and had to play the part of Jonah to the full extent.

Perhaps the most amusing superstition of the sailor is considering it a crime for any member of the crew to leave port with his washing bill unpaid, as this neglect is generally believed to be the cause of bad weather being encountered just after leaving port.

The ways of invoking the gods of the elements to bestow fair weather and winds are numerous. Among the best known is that when nearing port after a lengthy voyage. Old clothes and shoes unfit for further wear are collected and thrown overboard with much ceremony and faith

One of the most curious superstitions is that dealing with the capture of a shark. The natural dread and antipathy with which those monsters of the deep are viewed cause a capture to be hailed with much rejoicing.

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### Thirty Years of Edison Light

INVENTOR FIRST TURNED ON CURRENT IN NEW YORK, SEPTEMBER 3, 1882

Thomas A. Edison had another anniversary and an important one for himself and New York City. On September 3d, 1882, Mr. Edison started in operation the world's first central station for the supply of incandescent electric lighting for commercial purposes. This was in an old brick building, a converted warehouse, in lower Pearl Street. The steam was turned into a single dynamo and current sent through underground cables into about 400 lamps that had been distributed through a territory about a mile square.

The newspaper accounts of the demonstration read curiously in this day. While it was generally admitted that the exhibition had been a success so far as proving that the incandescent bulbs give light, there was a dubious feeling running through the reports as to whether the invention could be made commercially successful.

Since that day New York has had electric lighting with only two interruptions, the second and most serious one of which was in 1890, when the Pearl Street station was destroyed by fire. Thirty years ago 15 miles of underground cable sufficed to connect all the installations. Now 1,400 miles of "underground" sends current to the 5,250,000 lamps, while the bills are ticked off by 159,000 meters.

The first electric motor was put on the lines in 1884. Today in New York City 337,000 h.p. is used in motors. Instead of the old reconstructed brick building at No. 257 Pearl Street that housed the

## CHANGE IN WIRELESS CALLS

When the United States Senate subscribed to the Berlin Conference, April 3d, it made it necessary to change the calls, both of the commercial and amateur stations within the United States. For this purpose the calls beginning with KOA to KZZ, inclusive, and those beginning with N and W, have been assigned to the United States. These are all three-letter calls and will be assigned to the Government and commercial stations. So far as possible the Government stations will begin with N and the commercial and ship stations of the Atlantic Coast with K, and those on the Pacific Coast with W. This is an insufficient number of calls for the whole United States and application has been made to the Convention for 156 additional calls. These calls will be assigned when the licenses of the stations are issued. Because it will be impossible to issue these licenses entirely before the first of January, it will be impossible to get out a regular issue of the Government Call List on the first of the coming year. This list will appear early in the Spring and will contain all revised calls.

For the amateur calls, the system of numbers has been adopted. Each call will contain at least three items, the first of which is a number representing the district in which the amateur is located. These calls will be assigned by the radio inspector and will be assigned in order of application of licenses. If the number is followed by two letters, this will permit of less than 600 calls, which is far insufficient for any district. When this assignment is used up, the number will be followed by three letters. A station in New England will have its call letter beginning with the Fig. 1, because it is in the first district. The calls X, Y and Z will be omitted from general amateur use. These calls are to be reserved for special licenses. A call beginning with a figure followed by the letter X and some other distinctive letter, will represent an experimental station. That containing a Y in place of the X is for a technical or training school. That containing a Z is for a special amateur station. In case this number of calls is not sufficient for technical, experimental and special amateur stations, it will be necessary to resort to three letters preceded by a figure. The radio inspector will assign these calls and his orders are to keep a chart in his office in which these calls may be found.

Any amateur who is found using any call other than that which is assigned by the radio inspector will be punished in the same way that a person forging another's name will be punished. In any district it will always be necessary to use the figure preceding the call to distinguish it from commercial stations and amateur stations of other districts. In the assignment of calls such combinations of letters as SOS, PRB, and calls such as III, SSS, will be omitted for obvious reasons. These calls will be ready for use about the 13th of December, when the new law goes into effect.

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### Study Wireless in Grammar School

The Freeman school of North Adams, Mass., probably is the first grammar school in the state where pupils are given an opportunity to study wireless telegraphy.

Principal Winthrop H. Lamb of the Freeman school has installed a wireless telegraph station at the school and will teach all the boys who wish to take the course the rudiments of wireless telegraphy. Mr. Lamb has had considerable experience with wireless telegraphy, and will supervise the work of the boys in this class. It is not expected that the course will equip the boys to be expert operators, but it is designed to give them an insight into a science which is deeply interesting and may prove profitable to the boys in after life.

The receiving and transmitting instruments are located in Principal Lamb's office, and the wires are on the roof of the building. The work of fitting up the station was completed under the direction of Warren Ford.

Many of the boys at the school have expressed an eagerness to take up the course which will undoubtedly prove both interesting and profitable.

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### School Days

"Oh, Ella, your exercise is simply full of mistakes."

"I did it on purpose so that my master will stay longer with me."—*Fliegende Blaetter*.

# EDITORIAL

With the first number of a new volume and a new year, we again extend to our readers our thanks for their support, and our best wishes that the forthcoming year may be a fruitful one for each and all. We venture, also, to voice the aspiration that ELECTRICIAN AND MECHANIC may be able to help a little toward the achievement of this end. Our mission is to aid our readers, and this is our highest ambition, for, in this world, he who is most helpful to his fellow-men reaps the richest harvest of actual success, and need not, as a rule, worry about the material rewards of his efforts.

In order that the magazine may be as helpful to its readers as they would wish, we must again emphasize the fact that co-operation is necessary. The editors are not infallible. Their best efforts are directed toward making a magazine which will be of the utmost possible use, but every expression of opinion on the part of any reader as to what will help him solve his problems and fill his wants will help the editors to make a better magazine for all. We are always glad to receive letters telling of your troubles, your needs, and your desires, either to help us in the problem of producing the magazine or in order that we may aid you directly and immediately by answering your questions.

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At this season of the year it is the custom of the American people to subscribe for the magazines which they desire for the next year. Undoubtedly three-fourths of all the magazine subscriptions of the United States are entered during the months of December and January. We would not only like to have our readers renew their own subscriptions at this period, but it would help us a great deal if they would interest their friends, by showing them the magazine at this particular season of the year, and inducing them to send in subscriptions. We have, for several months past, published in the advertising pages an offer whereby some very valuable technical books can be obtained in connection with the subscriptions, at a very small addition to the regular price, and if these offers are called to the attention of non-subscribers, they will undoubtedly feel interested. Another offer which is interesting to those not already subscribers to the magazine is that, as long as the supply lasts, we will give any new subscriber who asks for it a dozen back numbers containing a large number of valuable and practical hints and articles on all phases of mechanical effort.

To any of our readers who are willing to start, even to a small degree, in the interesting business of getting subscriptions, we are prepared to furnish outfits, consisting of sample copies and receipt forms, and to give them a good commission on any subscriptions they may get. We shall be glad to hear from those interested in this proposition.

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As this number goes to press, the time is approaching when the new wireless law, for the regulation of amateurs, goes into effect, and examinations for licenses are being given in many localities throughout the country. There has been much delay in the preliminary arrangements for the enforcement of the law, and ELECTRICIAN AND MECHANIC undoubtedly performed a great service to wireless interests throughout the country, by making accessible in its last three numbers the terms of the laws and regulations, which were not ready for general distribution at the times when we printed them. There was also considerable delay in the appointment of wireless inspectors in many districts, and it is not probable that all of the licenses applied for will be issued before the 13th of December. The amount of work devolving upon the inspectors was tremendous. It is stated that in the New York district alone more than ten thousand applications were filed within three weeks after the appointment of the inspectors.

It is needless to say that the Government will not enforce the letter of the law to the disadvantage of any individual who has made a sincere effort to comply with it, and that no prosecutions will be undertaken for infringements caused by its own delay. Nevertheless, any amateur possessing a station who has not made known his existence to the inspector in his district and made the necessary application for license on the proper form may find himself in serious trouble as soon as the inspectors can get to his case, and we would advise every reader to be sure, by personal application to the nearest wireless inspector, that he is in full conformity with the law.

It is doubtless true that many hundreds feel that the law unduly hampers their activities, and that all of its provisions are not for the best interests of the art. Nevertheless, the law has been enacted and it must be obeyed. Its weaknesses will be discovered after it has gone into effect; and when a sufficient time has elapsed for a concensus of opinion to be arrived at, an organized effort to amend it in the interests of more latitude for amateurs, and especially freedom to use a longer wave-length, may prove successful. Before such an attempt can be made, however, a body of facts must be accumulated and logical reasons, supported by evidence, produced to show the hardships which it is alleged will exist.

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A striking result of the new wireless laws, in their application to steamships, is that there is a great scarcity of operators. It is almost impossible to get enough expert men to fill the responsible positions, and there is no doubt that many half-trained operators are now some time to come, there will be plenty of berths for good operators. In spite of this, the various commercial schools report that it is very difficult to get young men to enroll, and under the circumstances we would advise our readers who are interested in wireless telegraphy to study carefully the possibilities of this profession, and write to the various wireless schools advertising in this issue for information. We would not say that the life of a wireless operator is a bed of roses—like every other desirable position in the world it demands stamina—but a young man with a serious purpose, who is willing to put his mind upon his work and embark upon it with enthusiasm, can find in wireless telegraphy an opportunity for getting a fair salary, a responsible position, and a chance to see something of the world.

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An index to Volume XXV of ELECTRICIAN AND MECHANIC has been prepared and will be mailed to any of our readers who may apply for it and enclose a stamp for return postage. If you desire to have the book bound, the index and title page are essential to the appearance of the volume.

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This issue of ELECTRICIAN AND MECHANIC goes to press before the close of either of the competitions which were announced in the October and December issues. A prize competition article is published on page 13 of this issue and others which are considered worthy of publication will be presented in succeeding issues of the magazine. This competition offers the unknown writer an opportunity which he should not overlook. The prize will go to the person sending in the best article which fully describes the construction of some piece of experimental apparatus. No limit is placed on the length of the article and the chief requirement is that it be thoroughly practical. As the contest does not close until March 1, 1913, there is still ample time to enter the competition.



The contest for the best phrase which

## BEST RADIO OPERATORS PRODUCTS OF AMATEUR FIELD

"Amateur wireless operators, generally considered to be detrimental to the use of the wireless, are useful to the wireless business," said H. C. Gawler, recently appointed supervisor of New England wireless stations. Mr. Gawler said that the amateurs did not cause interruptions of communications nearly as much as they are credited with doing, and that were it not for the amateurs, many of the best operators in the commercial fields would not have taken up wireless at all. From the extensive field of amateurs, the greater part of professional operators are selected.

In connection with interruptions Mr. Gawler said that many of the commercial ships themselves cause the disturbance that breaks the connection by the character of tuning waves from their own instruments. He also said that some of the amateur stations are more efficient and better equipped with more up-to-date instruments than are many of the commercial stations.

Mr. Gawler is given the entire New England district to look after. It is his duty to issue licenses to amateur operators who comply with the regulations regarding stations, operators and instruments.

Up to the present time about 200 amateurs have applied to Mr. Gawler for licenses, all from Boston or the immediate vicinity.

Mr. Gawler is classing all amateur stations as "coast" stations until he finds those that do not interfere with commercial stations. When he finds the range of a station too short to bother the commercial or official coast stations, he classes them as inland stations.

In his work here Mr. Gawler stated that his duty was greatly facilitated by customs officers who had gathered data covering much ground and who assisted him considerably. He also praised the other branches of the government service.

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### New Wireless Telephone

Dr. Riccardo Moretti of Rome claims to have solved the problem of wireless telephony by means of a special generator of electric oscillations of his invention, which has been successfully experimented

through one of which flows a thin continuous jet of water.

The water is evaporated by an electric spark between the ends of the poles, and an alternating current of extraordinary rapidity is consequently generated, since the oscillations thus produced are calculated at several hundred thousands per second. As the oscillations exceed in number and rapidity the vocal vibrations, by means of this generator it is possible to transmit the voice over long distances.

Dr. Moretti has experimented with his invention in connection with the naval wireless installations with the addition of ordinary telephone receivers and transmitters, but he is now working on a hydraulic transmitter, particulars of which are still undivulged as it has not yet been patented abroad. Dr. Moretti is the nephew of Prof. Marchiafava, the Pope's physician.

He admits that he owes his invention to Marconi, and insists that it is nothing else but an application of wireless telegraphy to the telephone. Dr. Moretti has granted the prior rights of his invention to the Government and, in fact, a wireless telephone station is already being installed between Tripoli and Rome. Meanwhile an Italian syndicate has been formed for the exploitation of the Moretti generator of electric oscillations.

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### Wireless Time Signals Between Europe and America

The exact time at a given moment in America and Europe will be established shortly by wireless telegraphy. About the middle of November it was possible for the first time to establish with precision the longitudes of America and Europe in their relation to each other by the exchange of wireless signals between the great naval wireless station at Arlington, Va., the Eiffel tower in Paris and other European stations.

H. H. Hough, at the international time conference at Paris, declared that the observatory in Washington was now distributing time with errors of only one-thousandth part of a second. Hitherto European and American time has been established by cable, allowances being

## CARE OF GAS-ENGINE BATTERIES

Gas-engine users who want the best battery ignition, do not use only five batteries in series as is commonly done, but use what is known as the "series multiple" arrangement, in which four groups, five in a group, are used. When 20 cells are so arranged, their life is *8 times* that of 5 cells. But even with this arrangement, the battery will give trouble *sometimes*, as regardless of *the number* or kind of batteries used, or their arrangement, batteries become exhausted with age, even if not in use.

It will be well to remember that a battery will not give a uniform spark all day. In the morning, when the engine is first started, the spark may be entirely satisfactory. In the afternoon, after the engine has run several hours, and the batteries begin to weaken, the spark weakens, and the engine begins to miss. This means that the batteries are getting weaker. Do not attempt to remedy this trouble by adjusting the engine igniter, but give the batteries the attention they demand.

Rough treatment tends to shorten the life of batteries. Handle them gently. Do not remove the pasteboard covers.

Excessive heat shortens the life of batteries; cold makes them inoperative until thawed out.

Don't keep batteries in a hot place. Don't lay them on sides, but always stand on end. Don't buy so many that you will have to keep them on hand for months. Get *new fresh* cells as needed.

Slow-speed engine-timed built-in magnetos are an up-to-date device for the gas engine. They are independent of heat and cold. As the magneto forms part of the engine, it will run anywhere and give a good spark as long as the engine runs. The "built-in" type of magneto should always be specified on engines to be used for portable and farm work, as they are entirely independent of the many conditions which so seriously affect battery ignition. Magneto ignition is always uniform, as it depends upon the engine power and not chemicals, for its generation. The best magnetos have means for visibly timing them, so that anyone can readily determine if the engine is properly in time, and if it is not, one can adjust the magneto.

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## THE CHEAP BLACKENING OF BRASS

The following solution for blackening brass is nothing new; in fact, it has been known for a long time. Owing to its cheapness, ease in working, and adaptability for many purposes, it has been deemed advisable to bring it again to notice. Many platers, of course, will recognize it as an old solution known to the plating industry for many years; but they may not have realized its advantages for some classes of work. The solution is made as follows:

| | |
|---|---|
| Water | 1 gal. |
| Sugar of lead | 8 oz. |
| Hyposulphite of soda | 8 oz. |

The solution is used as hot as possible, and the brass work is simply dipped in it, and allowed to remain until black. This takes about a minute or less. The articles are then rinsed in cold water, then in hot water, and dried. If scratch-brushed dry, the black deposit will have a high luster.

When dipped into the solution, the surface of the brass article becomes yellow, then blue, and finally black. The article should not be taken out until all the surface has become blackened. The deposit on it is sulphide of lead. The articles should always be lacquered, as otherwise the black deposit is likely to oxidize and fade; but if coated with lacquer, it seems to be quite permanent.

For a cheap class of goods that require a black finish, this solution can frequently be used to a good advantage. It requires no electric current, being used as a dip. The color, to be sure, is not coal black, but resembles a graphite black more than anything else, and has a slight gray shade. It is sufficiently black, however, to answer many purposes, and it is so easily applied that it can be used on cheap goods with only a slight increase in cost.—*Brass World.*

# CORRESPONDENCE.

Editors, ELECTRICIAN AND MECHANIC,

Dear Sirs: I would like to say a few words about the gyroscopic action in a windmill.

If it were not for the fact that there is necessarily a little play to the swivel joint at the top of the tower and that this allows the windmill to turn so as to face the wind, the gyroscopic resistance to turning the windmill out of the wind would be absent.

The action of the windmill in this respect is complicated by the fact that when the windmill is turned part way on, some of the vanes of the windwheel are nearly perpendicular to the wind, while others are nearly edgewise to it. In such a position as shown in Fig. 1, with the lower vanes catching most of the wind, the bottom of the wheel will be pushed back. Now a force applied, as if at *A*, to push the edge *A* back, will, by gyroscopic action, be carried around and act as if it were applied at *B*. Thus the action of the force applied to turn the windmill off will push the top of the wheel back and the bottom forward. As the bottom was previously pushed back by the pressure of the wind, it will have a little play-room, and gyroscopic forces will come into action.

Of course, the tail can be brought up, parallel to the wheel, but this will be done against the pressure of the wind. The relation of these facts to the windmill, storage battery, charging problem may not be entirely obvious, so permit me to add a word.

The reaction of the vertical shaft of a power windmill tends to turn the windmill either into or out of the wind, according to the design of the windmill. It would seem desirable to use this property to turn the windmill off and avoid overloading the dynamo, but it is a question whether gyroscopic action would not make this impracticable.

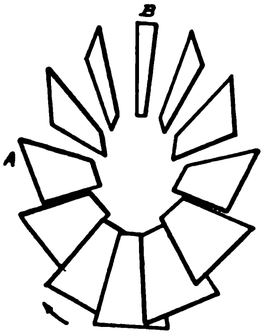


Fig. 1

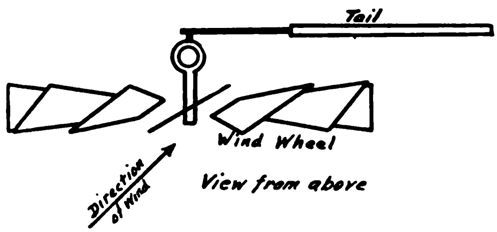


Fig. 2

My own windmill tends to turn into the wind as the load increases, so I have added a side rudder. I would like to hear from anyone who has had experience with a windmill that turns itself off when the load increases.

E. A. FINCH.

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Editors, ELECTRICIAN AND MECHANIC,

The Wireless Club of Baltimore was reorganized on November 18, 1912, and formed into the Radio Club of Baltimore, with the following officers: president, Winters Jones; vice-president, Raymond Kendall; secretary, Alvin L. Miller; treasurer, Louis E. Richwien. Anyone wishing particulars as to membership, etc., in the above-mentioned association should communicate direct with either the president (whose address is 728 N. Monroe St., Baltimore, Md.) or the secretary.

Very truly yours,
THE RADIO CLUB OF BALTIMORE,
Per A. L. Miller, *Secretary.*

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Editors, ELECTRICIAN AND MECHANIC,

Will you be so kind as to print the following notice in your excellent magazine?

The Electro-Mechanical Association of Columbus, Ohio, with the following officers: Howard Meyer, president; Robert Poole, vice-president; Stephen Davis, treasurer; Fred Dennis, chairman; Chester Otto, librarian; John Dolby, secretary, 512 W. State St., extends to all prospective members a most hearty welcome. The name of the Association was derived from the magazine of Knowledge, "ELECTRICIAN AND MECHANIC." Atpresent the Association has no complete wireless station, but expects to have a good equipment of electrical and mechanical apparatus in a short time. A library has already been established with each month's ELECTRICIAN AND MECHANIC at hand at all times.

# 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 the letter, and only three questions may be sent 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.

1899. **Blitzen Transformer.** P. R. L., Lebanon, Pa., asks: I have a lot of wire as per sample enclosed, which you will note is single-covered, size No. 31 American Wire Gauge. What I would like to know is, can I use this wire for the construction of the secondaries for the ¼ and ½ transformer (Blitzen), as described in the August issue of the *Electrician and Mechanic?* I would think the primary wire for the ¼ and ½ k.w. Blitzen transformer would be changed to different sizes to be used in connection with the above size wire. If so, kindly advise what sizes I should use for the primaries, both for the ½ and ¼ k.w. transformer. Ans.—The wire is suitable for use in the ½ k.w. transformer, providing you use the number of turns specified in the article. The primary winding need not be changed.

1900. **Right Over Left Transposition.** C. O. K., Port Moody, B.C., says: I have found some trouble in knowing what is a right over left transposition telephone or high tension, for the reason that what is known as right over left in the Eastern States is left over right on this coast. Is there a standard ruling on this point, and if so, please let me know it, as I would like to know who is doing the work properly? Ans.—A "right over left" transposition is the same wherever transpositions are made. The peculiarity you notice is due to a difference in the pin count. Some companies count their pins with the back to the controlling office, while others count them facing it. In the first instance, looking in the direction of the pin count, if the left-hand wire dips under the right-hand wire, the transposition is a "right over left." Facing the other way and counting the pins in the opposite direction would make the same transposition a "left over right." There is no standard ruling on this point, but as a general thing, a line starting at the *A* pole with a right over left transposition, would continue that construction throughout.

1901. **Field Magnet.** H. R., Holden, Mass., has a small toothed armature, dimensions being 3 in. in diameter, 2½ in. in length. Winding consists of 44 wires per slot, in 20 slots. Commutator has 20 segments. He asks some advice as to the proper sort of field magnet to make. Ans.—Of the three designs you have sketched we would advise the upright bipolar, somewhat resembling the typical Edison. Do not, how- symmetrical four-pole field would be to have the diameter twice the length. Probably you intend to use cast iron for the magnet, and if this is the case, do not have the section within the spools less than 4 sq. in. Round spools are the easiest to wind, and in this case have the iron about 2¼ in. in diameter. The section of iron in the upper block should be fully as great, say 1½ x 2¾ in. Let field bore be 3$\frac{1}{16}$ in. Each of the two spools should be wound with 2½ lbs. of No. 25 single cotton-covered wire. At a speed of 2,400 revolutions, armature should generate about 50 volts; allowable current will be 4 amperes.

1902. **Transformer Winding.** H. W., Ohio, asks: I have a 1¼ in. iron core for closed core transformer 8 x 8 in. I also have a secondary from a large induction coil containing 5 lbs. of No. 30 enameled wire. (1) How much and what size wire ought I use for the primary on the above core, so I could use same on 110 volts, 60-cycle alternating? (2) How many glass plates coated on both sides 10 x 12 would be needed for the condenser? Ans.—(1) A transformer such as this would be, when constructed, very inefficient and unsatisfactory. If you want to try it use 6 lbs. of No. 14 wire on the primary. (2) About 30; but the new law for amateur stations will not permit over one-third of this amount being used.

1903. **Receiving Transformer.** W. H. W., Asbury Park, N.J., asks: Can you give me specifications for building an inductive tuner that will be capable of tuning to a wave such as is used by the Glace Bay, Clifden and New Arlington stations? This tuner to be used with an aerial 75 ft. in length, six strands. Ans.—Primary, 7 x 5 in. wound with No. 26 wire. Secondary, 7 x 4¼ in. wound with No. 30 wire. Two series loading coils for the primary, each of the same dimensions as the primary. One coil should have taps every 100 turns.

1904. **Slide Wire Bridge.** R. F. A., Carmine, Tex., asks: (1) I wish to make a resistance set for a slide wire bridge with steps as follows, viz.: 5, 10, 25, 50, 100, 300, 500, 1,000 and 5,000 ohms, and wish to know what size German silver wire to use. (2) What is the largest number of telephones that can be used on one line (bridging); phones are equipped with 5 bar generators and 2,500 ohm ringers? Ans.—(1) The resistance of German silver wire varies greatly with the

(2) Line conditions, such as length, size of wire, quality of construction, etc., determine to a great extent the number of instruments that can be placed on one circuit. The fact should always be kept in mind that as all the bridging ringers operate at once, great confusion will result if more than a reasonable number of instruments are used. The actual number of instruments it is possible to operate on one line is limited only by the power of the generators and the sensitiveness of the ringers. 1,600 ohms is becoming a standard resistance for bridging ringer movements, as 2,000 and 2,500 ohm ringers do not give a very loud ring, the stroke being rather weak, owing to the small amount of current that can force its way through the high-resistance coils. The 1,600 ohm ringer gives a sufficiently powerful ring to insure satisfactory operation, and permits the maximum number of instruments to be placed on one line. Four bar generators are the standard for bridging service, and the greatest number of instruments it is practicable to operate on one line may be successfully rung with them. Where line conditions are very severe, or where a large number of instruments are used, five bar generators are desirable. Four bar 1,600 ohm ringer instruments will operate satisfactorily 20 per line; 5 bar 1,600 ohm 25 per line, or more if conditions are favorable.

1905. **Induction Motor.** A. H. J., Montreal, Can., has a 300 h.p. and a 10 h.p. induction motor that are disused during the winter, and are compelled to remain in places that are very damp. He asks how he can keep them dry. Will the ordinary electric lighting current be helpful? Ans.—It would seem practicable to box the motors where they are, using matched boards, and covering the whole with tarred paper. Have a double pane of glass in each box, an air space being between, and a thermometer just within. Have several incandescent lamps near the floor in the large case, but perhaps a single one will suffice for the small one. The window will be useful for keeping track of the temperature within, also for reaching through and renewing a lamp, if one burns out. The boxes can be made in a permanent manner, put together on certain sides with screws, whereby for times of use of the motors the sides can be removed and then assembled again for the next winter's storage. The line wires for bringing the lighting current may be somewhat undersized, whereby the lamps will not get full voltage, and by burning somewhat dimly will last all winter. Your second question, as to the method of finding how many poles an induction motor has, can be answered in several ways. Often the information is given directly on the name plate. Thus there may be given the name of the type or class as 1–8–10–900. These numbers would mean "Induction–8 poles–10 h.p.–900 revolutions per minute. If the number of poles was not thus given, but the cycles and speed, you can compute the number by applying the definition that the cycles per second equal the number of pairs of poles ... marked 60 cycles and 150 revolutions per minute, the number of poles will be 48.

1906. **Drum Armature.** A. J. A., Lithonia, Ga., has a drum armature 4 in. in diameter and 3½ in. in length, space for wires being 18 holes ½ in. in diameter. He wishes to make a field magnet that will permit machine to be used as a generator to be driven by a windmill at 450 revolutions per minute, and develop 35 volts and 10 amperes for charging 14 cells of storage battery. He sends a sketch of a four-pole field magnet, representing a wrought iron ring about 15 in. in outside diameter, of ¾ x 4 in. section, with radial cast-iron poles. He asks if the design is good, and what a proper winding should be. Ans.—At the speed you propose, the greatest voltage for a 10-ampere current is about 20. Therefore you would have to double some factor, presumably the speed. Again, a four-pole field magnet does not very well fit the armature you have. To be in economical proportions, the diameter of armature should be about twice the axial length. Yours is very good, however, for a two-pole field. Again, for four poles the number of armature slots should be divisible by four, or in case you preferred to utilize a series armature winding, it should differ from unity by such a divisible number. If you did put a four-pole winding on present core, a given coil should go from slot 1 to slot 5, and then when on opposite side of core, from slot 10 to slot 14. You will find it much simpler, and giving far better commutation, to adopt a simple two-pole field magnet. Armature can then be wound with No. 17 wire, 48 or more wires per slot. You have shown pole cores about twice as long as are necessary. Let space between tips of pole pieces be ¾ in. at center of armature, and about 1¼ in. at edges of core. You will find helpful descriptions of a two-pole design in Watson's "How to Make a One-Kilowatt Dynamo."

1907. **Mechanical Drawing.** F. M., Harrisburg, Ore., writes: I have been unable to make satisfactory drawings in ink, as the ink does not feed down the pen with sufficient regularity to make clear, even lines. When the pen is adjusted for fine lines, the ink will not feed at all. The drawing instruments are almost new, the ink a standard article and the paper a good quality of drawing paper. Can you suggest any remedy for my difficulty? Ans.—Although your instruments are new, the ruling pens may not be ground exactly right, and it will be well to look them over carefully and see if they are quite sharp, smooth and well rounded at the points. If the nibs of the pen are not of exactly the same length, this might cause the trouble. The ink you mention is a standard ink, but you may have left the bottle uncorked for too long a period and the ink may have thickened. Try a fresh bottle of Post's or Higgins' India ink and see if you get any better results. Clean your pen often and have a small cloth handy, so that you can wipe the nibs carefully before you fill the pen and before you put it away. If ink is allowed to harden on the points of the pens it

1908. **Enameled Wire Medical Coil.** H. S. S. San Francisco, Cal., asks: If there is any medical coil with enamel wire on the primary, and whether it is practical to put enamel wire on both primary and secondary. Ans.—It has been argued by several manufacturers that enameled wire is superior to cotton- or silk-covered wire in the construction of coils. It is more customary to use it on secondary windings than on primary windings, because of the fact that the primary is more liable to be subjected to undue heating than is the secondary. Still, satisfactory coils have been constructed with enamel wire on both the primary and secondary.

1909. **Rectifiers.** W. S. H., Carleton Place, Ont., asks: (1) Would you please tell me how the late models of rectifiers are made? Is it with wire? They do not appear to have jars such as the electrolytic type, *viz.*, lead and aluminum plates. Do you print anything on the subject? (2) Where is the cheapest place to buy a small ohmmeter? (3) Is the "Atlas" storage battery a good make? I believe they sell a 6-60 A.-H. battery at $5.00. Where are they located? Ans.—(1) There are several types of rectifiers constructed without the use of an electrolyte. The one which you probably have reference to is the magnetic rectifier. This type of rectifier is based on the principle that the poles of an electromagnet depend on the direction of the current. When the current is flowing in the positive direction an armature on the end of the magnet permits current to flow in the external circuit, but when the direction is reversed the pole of the magnet changes, causing the armature to break the external circuit, so that the result is a direct pulsation current in the external circuit. As yet nothing has been printed in this magazine on the subject, as the matter is generally understood by persons using such rectifiers. (2) Are you sure that you want an ohmmeter? These instruments are not in very general use. Any reliable electrical dealer should be able to furnish you with such an instrument. A fair price for a good instrument is about $40.00. (3) We have not had any experience with this battery and do not know the name of the maker. If this battery is reliable your electrical dealer should be able to furnish you with information on request.

1910. **Majorana Microphone.** B. F., Modesto, Cal., asks: (1) Could you give me data for making a Majorana microphone, capable of carrying 15 to 20 amperes, like the one mentioned in the article "Progress in Wireless Transmission of Speech," in the November, 1912, number of *Electrician and Mechanic*, or the names and addresses of companies that manufacture Majorana and Dublier microphones. (2) Could No. 4 B.&S. gauge aluminum wire be used in winding the Blitzen type oscillation transformer, instead of the edgewise copper strip, and give good results? How far apart should the wire be spaced? (3) Would a silver dollar, melted and molded into two cylindrical solids in form, be sufficient as contact points on a large key, which is to be connected up with a transformer using 1 k.w. of current? If not, how much silver should be used? Ans.—(1) The apparatus of Majorana and Dublier is as yet in the process of development, and is not upon the market to our knowledge. Until it is, no authentic data can be secured. Its action is based upon the fact that a stream of water falling from an elevated vessel through a small orifice may have its uniformity modified by extremely minute mechanical jars imparted to the containing vessel. The device is actually a liquid transmitter, and is designed to take advantage of this property. The containing vessel terminates at its lower end in a small hole through which water is allowed to flow continually in the form of a minute stream. Interposed in the path of this stream is a small gap. Means, in the form of a thin diaphragm introduced as a portion of the wall of the containing vessel, are provided to affect the diameter and contour of the stream in accordance with the vibrations of the voice. The center of this diaphragm is connected by a light rod to the center of another diaphragm, which is acted upon by the voice through a suitable mouthpiece. The vibrations of the double diaphragm are communicated to the volume of liquid in the form of variations of pressure manifested at the orifice and resulting in similar variations in the volume of water constituting the stream. Such modifications of the stream produce at its juncture with the platinum electrodes of the aerial corresponding variations in the resistance of the gap. It is obvious that this action produces corresponding variations in the intensity of the radiations. (2) Yes; but its efficiency will not compare with that of the copper strip. Keep a 5/16 in. space between the turns. (3) Yes. Brass also is nearly if not quite as good for your purpose. The main point is to keep the contact faces smooth, bright and absolutely parallel.

1911. **Inductive Telephone.** J. J. H., Norfolk, Va., asks: In your issue of November, 1912, in an article on "Progress in Wireless Transmission of Speech," the article states, "By employing coils of sufficient size and suitable microphones, speech can be transmitted over several yards, while by replacing the coils with cables, each end of which terminates in an earth plate, it has been possible to transmit clear speech over a distance of about thirteen kilometers." Please give directions for Inductive telephone to cover distance of two miles. Ans.—The article you refer to was written merely for the purpose of describing the results obtained from some of the more recent experiments in radio-telephony. We regret that our space here is entirely too limited to attempt even general directions for the construction of an instrument such as you suggest. Unless you have an unlimited amount of direct current of high potential at your disposal, 500 volts at least and preferably higher, the results obtained would probably be very unsatisfactory to you. Again, unless you are thoroughly familiar with the handling of high voltages, do not attempt it.

1912. **Wireless Aerial.** R. H. S., Burlington, Vt., asks: (1) What is the better place for an aerial? (2) How should I construct it (number of strands; where inlet should be connected)? (3) Could I receive 200 to 300 miles with a standard equipment? N.B.—There is a difference of 200 ft. or more in elevation. Ans.—(1) On the house. (2) Read some book on this subject. The forms of aerials are about as numerous as the persons who construct them. (3) Yes.

1913. **Small Dynamo.** W. R. P., Saginaw, Mich., proposes to make a machine of the Edison type of field magnet, for an output of 8 volts and 6 amperes, speed being 2,500 revolutions per minute. Magnet cores are to be 3½ in. long, ¾ in. diameter, magnet yoke 4½ x 1½ x ⅝ in. Armature is 2¼ in. diameter, 1½ in. long, with 12 round holes, each ⅜ in. diameter. He asks what the winding should be? Ans.—You will have better proportions in the field magnet and get a larger electrical output if you will make the cores 1¼ in. in diameter; also, if you have plenty of sheet iron punchings, let the armature core be longer, say 2 in. Put No. 19 d.c.c. wire on armature—about 36 wires per slot—18 turns per coil—and connect to a 12-segment commutator. On field magnets put 3 lbs. —1½ per spool—of No. 21 s.c.c. wire.

1914. **Dynamo for Small Lighting Plant.** C. H., Cleveland, Ohio, proposes to make a 4-hole 20-volt dynamo for incandescent lighting, to be used in connection with storage batteries. He proposes an armature 4½ in. diameter, 3 in. long, with 25 slots, series wound. Commutator is to have 1 in. face. Field magnet has poles of sheet iron, 3 x 2 in. face, and 3 in. long, cast into an iron yoke of ¾ in. thick, 9½ in. inside diameter. He asks what the winding should be. Ans.—The armature teeth should be slender, therefore highly saturated with magnetism. Let slots be 28 in. wide and ⅝ in. deep, leaving about 22 in. width inside of insulation. Eight No. 11 d.c.c. wires will fit in them—2 wide and 4 deep. You intend, of course, to wind the coils on a form and then lay them in place, as in case of regular armatures for 4-pole field magnets. For field magnet poles, if you can make iron 2⅛ in. instead of 2 in., it will be better. In connection with storage batteries a plain shunt winding is preferable to compound. Let it consist of No. 15 s.c.c. wire, 5 lbs. or more per spool—all you can get on. The current allowable from armature can be 30 amperes, and your proposed commutator is too short, or else you must use brushes in all four places. Speed can be about 1,500 revolutions per minute.

1915. **Induction Motor.** N. O. W., St. Louis, Mo., says: I have a ⅛ h.p. Westinghouse induction motor of the following style and dimensions: Style No. S.O. 466119—110 volts, 133 cycles, 2,500 revolutions per minute, single phase, squirrel-cage rotor, 48-slot stator, inside diameter $3\frac{15}{16}$ in., outside diameter 7 in., depth of slot ⅞ in.; thickness of core, 1¼ in. The winding was around three teeth, 18 turns, five and seven teeth, 27 turns of No. 17 d.c.c. wire for the main; and around five teeth, 20 turns, seven teeth, 40 turns of No. 27 d.c.c. wire for starting coils, as per sketch. I wish to rewind for 110 volts, 60 cycles, 1,800 revolutions per minute, and as much power as can be had without much heating. How many turns and what size will I have to use and how will windings be distributed? Ans.—To adapt winding for the lower frequency you will need about 25 per cent. more turns in each circuit—main and starting, as at present. To give the desired speed, the grouping should be for four holes in place of six. If you will number the stator slots 1 to 48, you can wind one starting coil that will fully occupy slots 1 and 11, and half occupy slots 48 and 12; similarly full coils for slots 13 and 23, 25 and 35, 37 and 47, and half coils in slots 12 and 24, 24 and 36, 36 and 48. A main coil can occupy slots 5–7, 4–8, 3–9 and 2–10, omitting slot 6; a second coil will fill slots 17–19, 16–20, 15–21 and 14–22, omitting slot 18; coil 3 will occupy slots 29–31, 28–32, 27–33 and 26–34, omitting slot 30; finally, coil 4 will occupy slots 41–43, 40–44, 39–45 and 38–46, omitting slot 42. (*a*) As you have not given width of slot, we cannot state proper size of wire to use. (*b*) The connections for closing and opening the starting coil circuit can be as at present.

1916. **Machinist.** H. B. N., Shelby, S. Dak., asks: (1) Where small machine tools and supplies can be obtained. (2) Has the Allis-Chalmers Co. in Milwaukee an apprentice course for those desiring to become machinists? Ans. (1) There ought to be numerous dealers in Omaha, and a letter directed to the postmaster there might supply you with the names. Also, C. A. Strelinger, of Detroit, Mich., makes a specialty of machinists' supplies. (2) Yes, but various other large concerns have similar courses. We would advise you to correspond with the General Electric Company, at their headquarters at Schenectady, N.Y., or at the Fort Wayne, Ind., works. In the erecting and care of a great variety of machinery, Swift & Co., of Chicago, are inviting young men to train in their employ. Do not worry as to the lack of the name of proper official. Address your letter to the Apprentice Department of the company and it will bring you a ready answer.

1917. **Logarithmic Decrement.** F. F., Brooklyn, N.Y., says: Your answer to my first question does not clear up my difficulties, for you merely state that the first decrement must be multiplied by two in order to obtain the correct decrement, however giving no reasons for doing so, further than saying that the first is per one-half and the second per full period; but this is not sufficient to make clear the impediment. The answer to my second question is not very comprehensible, but you say, in postscript, that a more extensive explanation will be given in the January issue, and I will await its receipt. I suggest that, if necessary, you introduce higher mathematics in order to elucidate. Ans.—We cannot possibly understand why you want a long mathematical discussion of a thing which does not require it. You are perfectly right in taking the decrement per half period and stopping there. There is no need of going further, since the value per half period is as correct as the value per complete period. If you are at all familiar with the "Principles of Electric Wave Telegraphy and Telephony," by J. A. Fleming, you will be well aware of the fact that if there is a possible chance for him to use his Calculus or Vector Analysis he does so, but this is the manner in which he answers your question: "Some writers define the logarithmic decrement to be the Napierian logarithm of the ratio of two successive oscillations in the same direction that is separated by one whole period. In that case the symbol taken for it is equivalent to $2\delta$ as used above."—Chapter 1, Section 1, page 4, edition of 1912.

## TRADE NOTES

The Peck, Stow & Wilcox Company of Southington, Conn., Cleveland, Ohio and New York City have recently issued a new catalog describing their line of mechanics' hand-tools, which is well worthy of the attention of all dealers. This catalog, known as 12B, is a substantial book, well bound and nicely illustrated and printed. It contains 152 pages and is printed upon paper of fairly light weight, although of good quality permitting high-grade printing. The cover design and title page are attractive, and there is a well-designed advertisement of the complete P.S.&W. line upon the back cover.

In many ways this catalog shows an advance over most books of this kind: It is divided into convenient sections devoted respectively to braces and auger bits; chisels, gouges and drawing knives; steel squares; hatchets and hammers; pliers, wrenches; tinners' hand-shears or snips; and miscellaneous hand tools. One of the things which impresses one in looking over these pages is the great extent and variety of the P.S.&W. line. In fact, the makers claim that it is the largest line of mechanics' hand tools offered by any manufacturer. The various sections are each preceded by a designed title page, and a special introduction calling attention to the interesting features of that particular group of tools. There is also a general introduction to the book, giving a great deal of useful information to the hardware dealer.

This is one of the very few cases to our knowledge where a manufacturer has thus included in his catalog practical information and selling talk for the benefit of the jobber and dealer who handle the goods. A strong argument is also included for the advantages of a line of guaranteed tools, each of which bears the trade-mark of the manufacturer as a protection to the distributor, dealer and user. The book is preceded by a complete index, and it contains several pages of advertising matter calling attention to other lines manufactured by the Peck, Stow & Wilcox Company. Among items of special interest to the hardware dealer are the P.S.&W. Samson Brace with ball-bearing chuck; Samson Solid-Center, Single Twist Auger Bits; P.S.&W. Expansive Auger Bit; the very large and complete line of P.S.&W. Chisels, Gouges and Drawing Knives; P.S.&W. Rafter-Framing Square, and Samson Take-Down Square; a very extensive line of box-joint and lap-joint pliers and splicing clamps; and a solid-handle wrench made in but three pieces, excepting the wood facing of the handle.

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## BOOK REVIEWS

*Soldering and Brazing.* By James F. Hobart, M.E. New York, Van Nostrand Co., 1912. Price, $1.00 net.

Soldering is one of the subjects of perennial interest to all persons having mechanical tastes. There are already a number of books on the subject, mostly low-priced, but the present or brazing of any description which is not thoroughly covered. The descriptions are simple and workmanlike, and the illustrations are numerous and helpful.

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*Elbow Patterns for All Forms of Pipe.* A Treatise upon the Elbow Pattern, explaining the most Simple and Accurate Methods for Obtaining the Patterns for Elbows in all Forms of Pipe made from Sheet Metal. By F. S. Kidder. Published by The Sheet Metal Publication Co., New York, 1912. Price, $1.00 net.

One of the most difficult tasks for the average sheet metal worker is the construction of elbows for pipes of various shapes and sizes, and the man who can cut a pattern for any special job is one whose merits are always recognized. The draftsman who is versed in descriptive geometry, of course, has no difficulty in laying out such patterns, but the average workman is not an expert in this somewhat dry subject, and to him this book, with its quick and often empirical methods, will prove extremely valuable. It covers the subject thoroughly.

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*Mission Furniture.* How to Make It. Part III. Chicago, Popular Mechanics Co. Price, 50c.

Like the two previous books on the same subject, this is a reprint of designs for various articles of easily made furniture which have already appeared in *Popular Mechanics.* Like all the books of this series, it is extremely good value for the money.

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*Brasses.* By J. S. M. Ward, B.A., F.R.Hist.S., New York, G. P. Putnam's Sons, 1912.

The subject of this excellent little manual is monumental brasses, which are common upon tombs, especially in England, though also found elsewhere in Europe. The subject is of considerable artistic and archaeological interest, and the present manual gives an excellent treatment. The author has made his classifications rather by historical periods than in the earlier fashion of classifying by subjects, and in this way has been able to shed new light upon the subject. The index contains an excellent and valuable list of English brasses.

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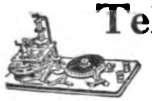
*Alternating Current Machinery.* A practical treatise on alternating-current principles and systems, commercial types of alternators, synchronous motors, transformers, convertors, induction motors, switchboard and station appliances, etc. By William Esty, S.B., M.A. Chicago, American School of Correspondence, 1912. Price, $3.00.

Professor Esty, who is head of the Department of Electrical Engineering at Lehigh University, has long been recognized as an authority on the subject of alternating current machinery and his writings have enjoyed a well-deserved popularity. We are, therefore, glad to see this new book on the subject by him, which is fully revised and almost entirely rewritten, using as a basis the similar book previously published by the same publishers. It is unnecessary for us to give a detailed description of the book,



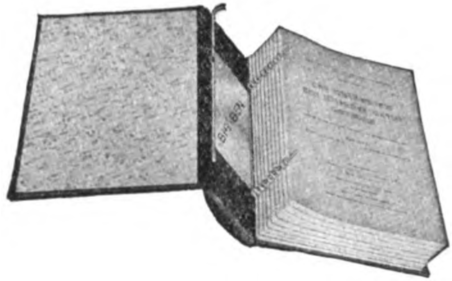








# Preserve Your ELECTRICIAN and MECHANIC



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