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FORGING FOR AMATEURS — Part III

F. W. PUTNAM, B. S.

BEFORE commencing our forging exercises, I wish to explain how to calculate the length of stock for various bent shapes, it being very often necessary to cut the stock for a forging as closely as possible to the exact length required. Figure 28 shows a plain right-angle bend made from stock 1 inch square and 6 inches long on the outside surface of each leg.

Let us imagine this angle piece to be made of wood instead of iron. A piece of stock 1 inch square and 11 inches long would then be needed to make the angle by cutting off 5 inches from one end and fastening this piece to the end of the 6-inch piece, as shown in Fig. 29. This is in substance what is done when the angle is made of iron — only in place of cutting the iron in two and fastening one part to the other at a right angle, the bar is bent and hammered into the required shape.

We then may say this: that any method which will give the length of stock required to make a certain definite shape of uniform cross-section in wood, making no allowance for cutting or waste, will also give the length required to make the same shape with iron.

There is, perhaps, a still simpler way for calculating lengths of all bent shapes, and that is to measure the length of an imaginary line drawn through the center of the stock. The dotted line shown at the center of the stock in Fig. 28, if measured, would give the length of each leg as $5\frac{1}{2}$ inches, and thus the length of stock 11 inches, as obtained in first case. It makes no difference what the shape of the stock is, providing it is of uniform width the whole length, and the length of straight stock required to make the bent shape may always be found by measuring the length of the center line on the bent shape. I give below a very simple experiment by which the above statement may be easily proven. Consider a straight bar of iron, having square ends, to be bent into the shape shown in Fig. 30. Measure the length of bar on the inside edge of the bend and then on the outside, and it will be found that the outside length is considerably greater than the inside length. The inside edge will also be shorter than the original straight bar, while the outside edge will be longer. The metal has evidently been squeezed together or forced together on the inside and stretched or drawn out on the outside. This being the case, there must be some portion of the bar which, when it is bent, neither squeezes together nor draws out, but still retains its original length; this part of the bar lies almost exactly in the center, as shown by the dotted line *ab*. The measuring must then be done on this line, so as to determine exactly the original length of the straight bar, for this is the only portion of the stock which remains unchanged in length when the bar is bent.

Suppose a bar of iron is taken, polished carefully on one side, and lines scratched upon this surface as shown in the lower half of Fig. 31, and this bar then bent into the shape shown in the upper half of Fig. 31. Measure the length of each one of these lines and you will find, on comparing the measurements obtained with the length of the same lines before the bar was bent, that the line *aa*, on the outside of the bar, had lengthened considerably; the line *bb* would be somewhat lengthened, but not as much as *aa*, and *cc* would be lengthened less than *bb*. The line *oo*, through the center of the bar, would measure almost exactly the same as when the bar was straight. The line *dd* would be shorter than *oo*, and *ff* shorter than any other. The line oo, at the center of the bar, does not change its length when the bar is bent; and so, to calculate the length of straight stock necessary to bend into any shape, simply measure the length of line following the center of the stock of the bent shape.

In Fig. 32 is shown still another example. Imagine a center line to be drawn as shown by the dotted line. The various lengths figure out as follows: —

A = $3\frac{1}{2}$ inches
B = 6 inches
C = $3\frac{1}{2}$ inches
E = 3 inches

Total, 16 inches = length of stock required

There are several methods in common use for determining the length of stock used in circles and curves, but the same general principle is always followed in any case; the length of the bar must be measured along the center line of the stock. A simple method is to lay out the work full size. On this full-size drawing a string or very small flexible wire is laid in such a way that it follows the shape of the bend through its entire length; care must be taken to lay the string or wire exactly along the center of the stock. The string is then straightened and the length measured directly. Irregular curves or shapes are very easily measured in this way.

Another common method of measuring stock for scrolls and irregular curves is to step around a scroll with a pair of dividers, with the points a short distance apart, and then lay off the same number of spaces in a straight line, and finally measure the length of that line. This is a common drafting-room method.

Still another method of measuring directly from a drawing is by the use of a light measuring wheel similar to the one shown in Fig. 33, mounted in some kind of a handle. This wheel is thin and light in weight and usually has a circumference of about 24 inches. The side of the run is frequently graduated in inches by eighths of an inch. The wheel is used by placing it lightly in contact with the line or object which it is wished to measure, the zero mark on the wheel being set to correspond to the point from which the measurement is started. The wheel is then pushed along the surface following the line to be measured, with just pressure enough to make it revolve.

The revolutions are counted and the pointer is set to correspond to the end of the line when it is reached, so that it becomes an easy matter to push the wheel over a straight line for the same number of revolutions as shown by the pointer, and in this manner measure the length. If the wheel is graduated, the length run over can of course be read directly from the figures on the side of the wheel.

The length of circles and arcs of circles may be calculated mathematically, and in nearly every case this is probably the easiest and most accurate method. This is done in the following manner: The circumference, or distance around a circle, is equal to the diameter multiplied by 3.1416. As an illustration, the length of stock required to bend up the ring shown in Fig. 34 is calculated as follows: —

The inside diameter of the ring is 4 inches and the stock 1 inch in diameter. The length must, of course, be measured along the center of the stock, as shown by the dotted line. The diameter of the circle made by this dotted line is used for calculating the length of stock. For convenience, this is usually called the "calculating diameter," shown by C in Fig. 34. The length of this calculating diameter is equal to the inside diameter of the ring, with one half the thickness of stock added at each end; in this case this would be $\frac{1}{2}+4+\frac{1}{2}$ inches = 5 inches. The length of stock required to make the ring would be 5 inches $\times$ 3.1416 = 15.708 inches; or, in other words, to find the length of stock required to make a ring, multiply diameter of ring, measured from center to center of the stock, by 3.1416.

Many shapes can be divided up into straight lines and parts of circles and then readily calculated. The U-shaped figure in Fig. 35 may be divided into two straight sides and a half circle end. This end is half a circle, having an outside diameter of 2 inches. The calculating diameter of this circle would be $1\frac{1}{2}$ inches, and the length of stock required for an entire circle this size is $1\frac{1}{2}$ inches $\times$ 3.1416 = 4.71 inches, which, for convenience, we may call $4\frac{3}{4}$ inches, as this is close enough for ordinary work. As the forging calls for only a half circle, the length needed would be $4\frac{3}{4}$ inches $\div\frac{1}{2} = 2\frac{3}{8}$ inches. The circle is 2 inches outside diameter; so half of this diameter, or 1 inch, must be taken from the total length of the U to give the length of the straight part of the sides; that is, the dis-

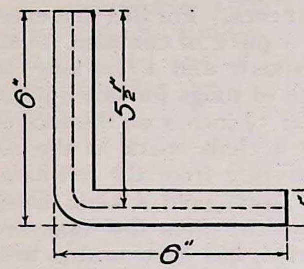


Fig. 28.

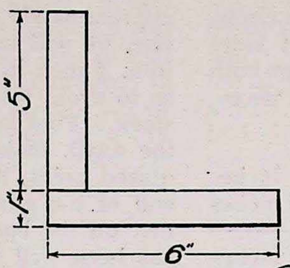


Fig. 29.

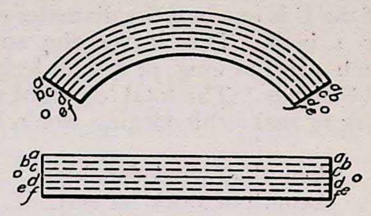


Fig. 31.

Fig. 30.

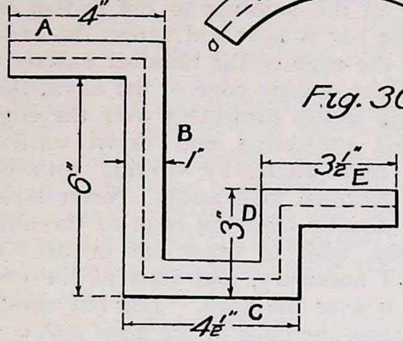


Fig. 32.

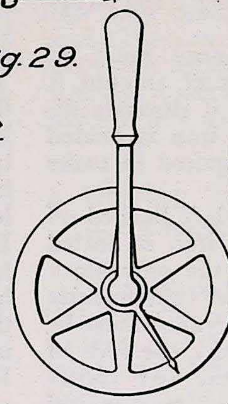


Fig. 33.

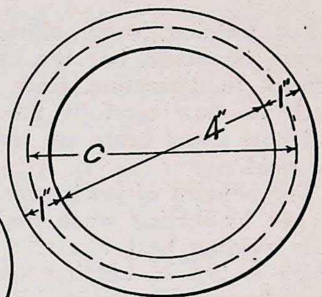


Fig. 34.

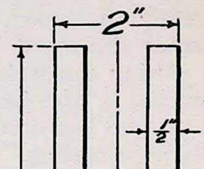


Fig. 35.

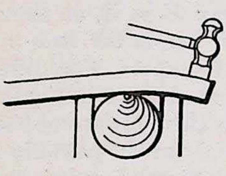


Fig. 36.

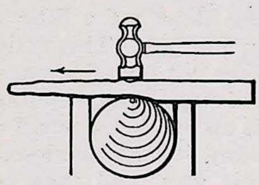


Fig. 40.

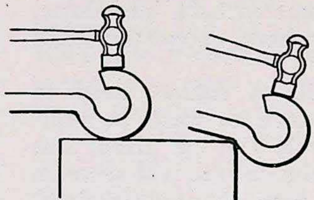


Fig. 39.

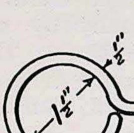


Fig. 37.

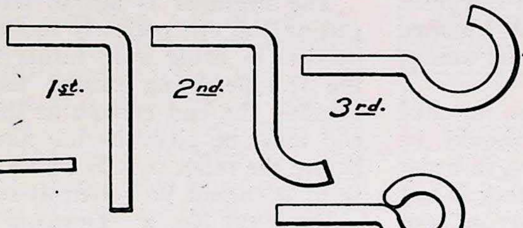


Fig. 38.

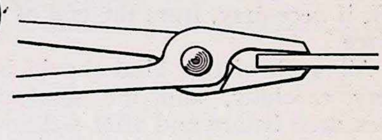


Fig. 42.

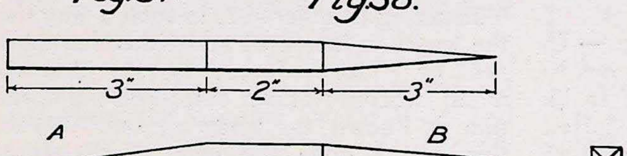


Fig. 41.

Fig. 43.

tance from the line A to the extreme end of the U is one half the diameter of the circle, or 1 inch. This leaves the straight sides each 4 inches long, or a total length for both of 8 inches. The total length of stock necessary to make this forging would be: —

Length of stock for sides.....	8 inches
Length of stock for end......	$2\frac{3}{8}$ inches
Total length of stock for forging...	$10\frac{3}{8}$ inches

For welding, some allowance must, of course, be made, but the exact amount is difficult to determine, since it depends directly on how carefully the iron is heated and how many heats are required to make the weld.

The amount of stock which is burned off or lost by scaling when the iron is heated to a welding heat is really the only stock which is lost in welding and consequently the only waste for which allowance must be made. When making the weld, the ends of the stock are upset, and the bar consequently shortened, and the pieces are still further shortened by overlapping the ends in closing the welded joint; but all of this material is later hammered back into shape, so that no loss occurs here, except the slight loss from scaling.

The beginner will, of course, need to make quite an allowance for waste in welding. No absolute rule can be given, but the following approximate rule will serve as a guide. For the waste on welding rings, allow a length of stock equal to three fourths the thickness of the bar. When making straight welds, allow one half the thickness of the bar; the extra stock can be trimmed off, if necessary, from the end of the welded piece.

All work of this kind should be watched very carefully, and the stock should be measured before and after welding, in order to determine exactly how much stock is lost in welding. In this way one may soon learn just what the necessary allowance for waste is.

EXERCISE NO. 1. *Ring bending.* — In making a ring, the first step is, of course, to calculate the proper length of stock to be used. The bend should always be started from the end of the piece. Figure 37 shows the size of the ring or eye that we are to make. The length of stock necessary for forming the eye is found by calculating the length of the circumference of a $1\frac{7}{8}$-inch circle, which is found to be 5.89 inches, or approximately $5\frac{7}{8}$ inches. For this first exercise, we will take a piece of common round iron, $\frac{3}{8}$ inch in diameter and 2 feet long, so as to avoid the use of tongs for holding the stock. First lay off $5\frac{7}{8}$ inches on the face of the anvil, making a chalk mark at the required point, measuring from the left-hand end of the anvil. Next hold a hand hammer on the bar, which, when the forge fire has been well started, has been heated to a cherry red heat, with the edge of the hammer directly in line with the end of the anvil. This of course then measures $5\frac{7}{8}$ inches from the edge of the hammer to the end of the bar. The bar is now laid across the anvil, bringing the edge of the hammer exactly in line with the outside edge of the anvil, thus leaving $5\frac{7}{8}$ inches projecting over the edge. Bend this projecting end down until it forms a right angle, by striking with the hammer BEYOND THE EDGE. Never strike the iron directly over the edge of the anvil unless you wish to draw out or dent it. Repeat, if necessary, and start at the end, working it over the horn. The bar should be fed across the horn of the anvil and bent down as it is pushed forward. Do not strike directly on top of the horn, but let the blows fall a little way from it, as shown in Fig. 36. This action bends the iron and does not pound it out of shape. The different steps in the bending are shown in Fig. 38. If an eye is too small to close up around the horn, it may be closed as far as possible in this way, and then completely closed over the corner or on the face of the anvil, as shown in Fig. 39.

The beginner is apt to have trouble in getting the eye perfectly round. It usually persists in being oval, rather than circular, the trouble being caused usually by not bending the end enough at the start. The end must be given its full amount of bend before the other part is bent at all, as afterward it cannot be gotten at so readily.

EXERCISE NO. 2. *Drawing out at a white heat.* — When iron is worked out, either by hammering or otherwise, in such a way that the length is increased and either the thickness or width reduced, we say that the metal is being "drawn out," and the operation is known as "drawing out." When this work is done, the metal should always be heated as hot as possible without burning. A bar is drawn out under blows of the hammer, usually by working over the horn of the anvil rather than on the face, because if a piece of iron is laid flat on the face of the anvil and struck with a hammer, it will flatten out, and spreads both lengthwise and crosswise thus making the piece longer and wider. As the piece is to be increased in length and not in width, it becomes necessary to turn it on edge and strike it in this position, when it will again increase in length and also in thickness, and will have to be thinned out again. It will be seen, then, that when drawing out iron on the face of the anvil the force of the blow is used up in forcing the iron sidewise as well as lengthwise, and the work used in forcing the iron sidewise is wasted. As a result, only about one half of the force of the blow is actually made use of in doing the work required.

Figure 40 shows a method of drawing out iron by hammering over the horn of the anvil. By this method the iron is very largely kept from spreading out sidewise, and the bar will lengthen out very easily. The horn of the anvil acts as a sort of a blunt wedge, forcing the metal out in the direction of the arrow.

Figure 41 shows Exercise 2, which is an exercise in drawing out at a white heat. Take a bar of $\frac{1}{2}$ inch square, common iron, 2 feet long, and place one end in the fire about 2 inches under the surface and the same distance in from the edge of the fire. When at a white heat, remove quickly, hitting the heated end smartly on the edge of the anvil to get rid of as much scale as possible, and draw out with the hammer, as explained above, to get the chisel end as shown at A, Fig. 41. Notice that the surface opposite the slanted surface is to be in a straight line with the rest of the bar. Next estimate the length of bar necessary to complete the exercise when end *B* has been drawn out to a square point, and cut off on the hardie. A pair of tongs must now be used to hold the piece of metal, the other end of which is then heated to a white heat and drawn out to a square point, as shown at *B*, Fig. 41.

Tongs should always be carefully fitted to the work they are to hold.

Figure 42 shows a piece of stock which is not held securely by the tongs. In the first case shown the jaws are too far apart, and in the second case they are too close together. Figure 43 shows the jaws touching the work the entire length, and is what would be termed a properly fitted pair of tongs.

In order to fit a pair of tongs to a bar of iron, heat the jaws to a cherry red, place the bar to be held in position, and close the jaws down as tightly as possible by use of a hammer. The handles should not be brought too close together while the tongs are being adjusted, and so a short piece of stock should be held between them a little way back from the jaws. Should the handles be too far apart, a few blows of the hammer just back of the eye will close them up.

In drawing out the iron in Exercise 2 the iron may crack, showing that it was not worked at a proper heat. As it cools, hammer more lightly. When formed, heat to a dull red and hammer lightly all over to bring to size and give it a smooth finish.

(To be continued)

A SIMPLE WAY OF MAKING TURNING TOOLS FOR THE AMATEUR

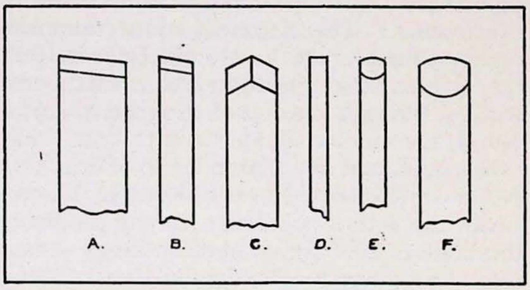
L. H. GEORGES

It has often been the case with the writer to need extra screw-driver, file, and hammer handles. In order to make them, the first thing was where to get good but inexpensive tools. I have found that very suitable ones can be made from old files, which are almost useless for anything else.

They can be found around most any machine shop and bought for almost nothing. With little or no time, more tools of different shapes and sizes can be made than you would naturally care to buy at one time.

The secret of making a success of this work is, not to draw the temper when grinding them. If properly ground and stoned, they can be used in turning any kind of wood, either hard or soft.

I should say that six tools would be enough to begin with. The illustration below gives some good shapes and sizes.



A and B are turning chisels $\frac{1}{2}$ inch and 1 inch in width, beveled on both sides; C is a spear point $\frac{3}{4}$ inch in width, beveled on one side only; D is a parting tool $\frac{1}{4}$ inch in width; E and F are gouges $\frac{3}{8}$ inch and $\frac{3}{4}$ inch in width, beveled on the under side.

INDUCTION MOTORS IN CASCADE

"CALCULUS"

In this short article I propose to deal with induction motors connected in cascade, and to consider the behavior of motors connected in this manner. Although this system is very little used in this country, it is possible as time goes on that it will come more into prominence, especially if the three-phase systems and high tension direct current are not superseded by single-phase. As a matter of fact, there is a form of converter for changing alternating current into direct, or *vice versa*, which is making considerable headway in this country, and this machine closely resembles two induction motors connected in cascade, except, of course, that it has a commutator, and that one side of the machine is excited with direct current. In principle, the motor converter, which is the name of the machine to which I refer, closely resembles two induction motors in cascade, and if the principle of the latter be understood, it will help very materially in understanding the action of the motor converter. In the present article, however, induction motors in cascade will be dealt with only.

In the cascade method of working induction motors, the rotor shafts of two similar machines are connected together with a coupling, or the two rotors may be built on the same shaft. In the accompanying illustration the two induction motors under consideration are shown diagrammatically at 1 and 2; the rotors, as above stated, being assumed to be rigidly coupled together. The rotors are of the slip ring type, each being wound three phase and connected in star, the three free ends of each of the rotor windings being connected to the three slip rings represented by the circles in the center of the motors. The electrical connections are really self-explanatory. It will be seen from the diagram that the three stator leads protruding through the top of the case of stator No. 1 are connected to the supply as indicated, and that the stator leads of machine No. 2 are connected to a resistance. As regards the rotors, as shown in the diagram, the brushes rubbing on the slip rings of one rotor are connected to the brushes rubbing on the slip rings of the other rotor, hence the rotors are both mechanically and electrically connected. The stator of No. 1 machine may be looked upon as the primary of a transformer, and the rotor of No. 1 machine the secondary of the same transformer which supplies the rotor of No. 2 machine with current; the rotor of No. 2 machine may, therefore, be looked upon as the primary of the other transformer, and the stator of No. 2 machine its secondary.

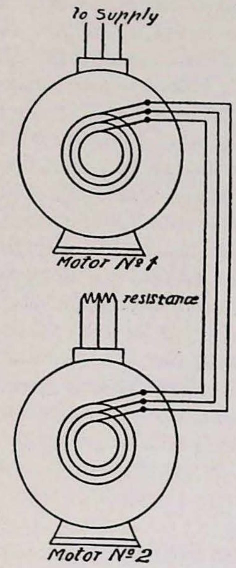
It is evident, however, that we might connect the slip rings of No. 1 machine to the stator leads of No. 2, and the slip rings of No. 2 machine to a resistance. This is sometimes done, but it is necessary to notice that the two machines can no longer be identical, but they must be wound for different voltages. For the sake of simplicity, therefore, it will be assumed that the connections are made as shown in the diagram, which represents the most common practice. The question to be settled now — a very interesting one, by the way — is how will these two motors behave when No. 1 machine is supplied with current from the mains. Assuming that both motors have the same number of poles, the maximum speed when the motors are connected as shown cannot exceed one half of that which either motor would run at when connected across the mains by itself. The reason for this requires explanation. The periodicity of the currents in the rotor of any induction motor is dependent upon the slip. If the rotor of an induction motor revolves at the same speed as the revolving field, there can be no current induced in the rotor windings, from which it follows that such a condition cannot exist unless the rotor is driven by some independent means; such, for example, as another motor. The rotor of an induction motor, therefore, must always run at a lower speed than the revolving field, and the difference in the speed of the rotor and the revolving field is known as the slip. The periodicity of the alternating currents induced in the rotor of any induction motor are proportional to the initial periodicity and the slip; hence, if an induction motor is supplied with current at a periodicity of 50 cycles and the slip is ten per cent, the frequency of the currents in the rotor would be 5 cycles. Again, at half speed the periodicity of the currents in the rotor would be fifty per cent of the periodicity of the currents in the stator.

In the case under consideration, since the two rotors are connected together electrically, the frequency of the currents in No. 2 rotor would be fifty per cent also. As regards the connections between the two rotors, it must be mentioned that the two rotors must be connected together electrically so that the field set up by No. 2 rotor revolves in the reverse direction to the field of No. 1 rotor. This is easily effected by crossing any two leads just as we interchange any two stator leads of an induction motor to cause it to revolve in the reverse direction. It will be noticed from the diagram that the top brush of one motor is connected to the bottom brush on the other. The arrangement of these leads obviously depends on whether the two rotor windings of the two motors are connected up exactly alike, and to get the correct connections may be a matter of experiment.

Another point which should be observed when approaching the behavior of two induction motors connected in cascade is that if the speed of the rotor of any induction motor exceeds the speed of the revolving field the motor becomes a generator and supplies current just as an ordinary alternating current generator. Now, when we switch the motors on to the mains by connecting the stator leads of No. 1 motor to the supply, the slip at starting is one hundred per cent, and the periodicity of the currents in the two rotors is the same as the periodicity of the supply. Now, as the speed of the combination rises, the periodicity of the currents in the rotors goes down, because the rotor of No. 1 machine is revolving in the same direction as the revolving field due to its stator, and if the rotor were to revolve at the same speed as the field, there would be no alternating current in either rotor. Therefore, if it be kept in mind that as the speed of No. 1 rotor goes up the periodicity of the currents in the rotors goes down, it is not difficult to see that when the rotors are revolving at half the speed of the revolving field due to the stator of No. 1 machine, the revolving field of the rotor of No. 2 machine will be revolving at the same speed as the rotor itself, but in the opposite direction; hence, there will be no relative motion between the revolving field and the stator of No. 2 machine and there will be no current induced in the stator windings of No. 2 machine.

This, then, is the condition which exists when two induction motors are connected, as shown in the sketch, and are running light at half synchronous speed. Suppose the speed did try to rise, then immediately the rotor of No. 2 machine would revolve faster than its field, and it would act as a generator and supply a large current to the resistance connected across the stator windings of No. 2 machine. This means that No. 1 machine would have to supply a powerful torque; but it must be observed that No. 1 machine is working with fifty per cent slip and is only capable of developing a small torque, partly because of its large amount of slip, and partly because its rotor windings are connected to the rotor windings of No. 2 machine. In order to get a large torque from an induction motor when it is working with a large amount of slip, it is necessary to insert an ohmic resistance in circuit with its rotor windings. It is because with ordinary squirrel-cage induction motors this cannot be done that such motors will not give a powerful torque at low speeds. In the case under consideration, the conditions are worse than with a squirrel-cage motor, because we have in circuit with No. 1 rotor winding the highly inductive winding of No. 2 rotor, so that any demand for torque from No. 1 motor by reason of the combination rising above half synchronous speed cannot be met and the combination always runs at approximately half speed. When a load is thrown on two induction motors in cascade, the speed drops slightly and the field in No. 2 motor revolves faster than the rotor itself and a torque is given out to deal with the load.

There are other ways of explaining the action of two induction motors connected in cascade, but to the writer the one given seems to present the least difficulty. It will be interesting to some, no doubt, to know the principal advantages gained by connecting induction motors in cascade. In the first place, it enables a better starting torque to be obtained without the use of wasteful resistances in the rotor circuit. To start an ordinary single induction motor with a good torque means that there must be a considerable amount of ohmic resistance put in the rotor circuit. With a slip ring motor there is no difficulty in putting resistance in the rotor circuit, which serves not only to give the motor a good starting torque, but also enables a wide speed regulation to be obtained. This practice in connection with railway work, for instance, however, where continual starting and stopping and wide speed variation has to be contended with, the introduction of resistance in the rotor circuit would mean very great waste. When we have two induction motors connected in cascade, they start with a good torque because the periodicity has been lowered; one motor, in fact, may be looked upon as a frequency changer. Obviously, with a reduced periodicity synchronous speed is nearer zero speed, and the motor behaves proportionally better. As regards speed regulation with the cascade system, a very wide speed regulation can be obtained in a most economical manner. For high speed, for instance, the brushes of No. 2 machine could be disconnected from the brushes of



No. 1, in which case when No. 1 machine is switched on to the mains, full speed would be obtained; the motors could then be connected in cascade so as to give half speed. Further, if one of the motors is designed so that the number of poles can be changed, say, in the ratio of 2 to 4, then a very wide speed variation could be obtained in a most economical manner. Up to the present it has been assumed that both motors have the same number of poles, but this is not necessarily the case.—*The Engineer-in-Charge.*

AN INTERESTING EXPERIMENT

L. H. LOVETT

ALTHOUGH Hertzian waves are continually traveling through the air, but few are aware of it, principally because we can neither see or hear them.

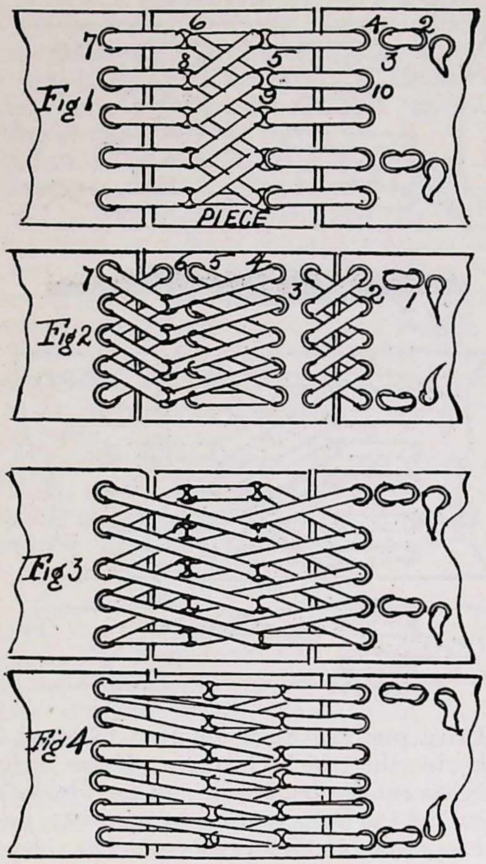
Hertzian waves are set up by an electrical discharge of any kind, as that of an induction coil, which is used in wireless telegraphy; also by a flash of lightning, discharge of a Leyden jar, sparking of a dynamo, and the spark that is made when the wheel jumps off the transmission wire over a trolley car. These all produce electrical waves, which travel with the speed of light, with no conducting matter but the ether. We can readily prove their existence by the proper instruments; viz., the coherer, and several different wireless detectors. But as they are expensive and the more sensitive they get the more expensive they are, I will describe a simple and inexpensive experiment. Although not very sensitive, it will readily detect lightning flashes from quite a distance, and of course other electrical discharges if strong enough.

Secure an old, dry battery carbon, and make two pieces an inch or two long. Fasten them on a wooden base 3 or 4 inches square. Have the carbons about $1\frac{1}{2}$ inches apart. Make their tops sharp, like a knife edge. Connect one carbon to a wire running up in the air a way and the other to the ground. The wires should be insulated from surrounding objects. Connect an old battery and a telephone receiver in series with the carbons. Then lay a steel needle across them. Almost any old battery will do if not completely worn out, as a telephone receiver is very sensitive. If you have no old battery, you can make one that will work just as well by taking a piece of copper and zinc, and suspending them in a teacup filled with salt water or vinegar. The receiver may be taken from your telephone. Loosen the binding-posts on the side of the phone, tie the receiver hook down with a string, then remove the receiver. (This might be inconvenient if some one called you up.—ED.)

There is a certain amount of danger in having too high an aerial wire during a thunder storm. The writer has had good success with an aerial only 6 feet high in a room, and a piece of copper and zinc 1 inch square in a tablespoonful of salt water for a battery. At every flash of lightning there is a sharp click in the receiver. You can hear the flash long before the thunder comes rolling in, and if properly set up you can hear a distant storm too far away to hear the thunder. Sometimes you can hear several distinct clicks when what appears to be a single flash is seen.

PUTTING A PIECE IN A BELT

One of the most annoying things which may happen to machinery is to have the belt run short, necessitating either the substitution of a longer belt or the addition of a piece. The belt's shortness may be due to two or three causes. Perhaps some poor unions have been made at the joints and these have broken under the running strain,



causing the ends of the belt to tear and become disordered. The ragged end may have been trimmed off, thus shortening the belt. After the belt has been trimmed several times, as it will not stretch enough to make up for this loss of leather surface, the joint must either be expanded by letting out the laces, or a very tight belt must be run.

Perhaps the piece is added. The belt cannot be run with the ends of the leather belting at the joint separated a few inches to make up for the surplus torn edges which have been cut off, because the lace leather does not work well on the pulleys, nor can the break in the belt run smoothly. A very tight belt can never be run to advantage. One does not want to remove the belt, just because it is a few inches short and put on an expensive new one of more length, so one usually puts in a piece. The illustrations are given to explain the process.

Let us suppose that we have a belt of moderate speed and a fair amount of work to do. The union must be strong and even. We take the ragged edges of the worn belt ends in hand, and trim off the butts, using a square for the marking and a sharp knife for cutting; then we make our intersecting joining piece likewise square on the ends so that it will fit snugly and properly. Next we punch the holes, having first lined the hole points with a ruler. The piece is then inserted and the process of lacing may proceed according to any of the plans shown in the sketches. If we conclude to do the sewing on the plan exhibited in Fig. 1, we draw out our long lace leather and put the proper tapering points on the same to enable it to enter the holes readily. We can lace double or single, or adopt the single sewing system and double back. Supposing we interlock the lace as shown in No. 1. Then we drop to hole 2 and up through 3. This gives us the grip required for holding the end of the lace leather. Then we lace to hole 4 and cross underneath to 5, thence over to 6 and out to 7, then back to 8 and over to 9 and 10, and so on the other edge of the union. Just one half of the body of the lacing will be completed by this plan. Then in order to finish the other half, we simply work back through the holes on the same plan. This gives a strong union with the intersecting pieces fitted firmly in position. In the event that an extra amount of lacing will be required for heavy service, the trip over and through the lace holes may be repeated.

Figure 2 is another form of lacing in which the crosses of the belt are all on one side. This is more practical than the other method of union. In the first example there are crosses and straight laces on both sides and no distinction can be made.

It is far better to run the joints with the straight laces on the face of the pulley. Hence, if the laces are straight on one side and crossed on the others, as in Fig. 2, the belt can be adjusted more easily. In the formation of this union, the ends are prepared and the mode of lacing is similar except the dropping of the lace through, to make the crosses on the first sample and the holes are punched. The lower side is changed so as to bring the crosses on the face of the sewing. We begin at hole No. 1, and go to hole No. 2, then pass to 3, and thence to 4. We then pass the lacing to 5 and 6, finishing that crossing at 7. We can run the lace back again by following the lay of the laces in the cut without further description.

There are also forms of inserting a piece of leather belting in a joint, by sewing with extended lace, as in Fig. 3. It will be observed that the laces take a long jump from hole to hole. Some men prefer to use this wider expanse of lace leather. I find that some like to make the lace leather go as far as possible, and they economize space by shortening the laps, but it is better to be liberal in the distribution of the lace leather in making these types of joints. Therefore the extended lays of laces can be recommended for general surface. For exceedingly high-speed belts, however, it would not be advisable to have so much lace leather exposed.

I would not run into entangled lacing as in Fig. 4. I have seen belt-driving systems put out of effective running order due to the superabundance of lacing leather which is piled on to the laps. A sample of this kind of reckless lacing is shown in the model mentioned.

A very plain, yet useful, method of inserting a section of a belt is shown in Figs. 5 and 6. It will not be necessary to go into the details of the insertion of the individual strands in these models, as the plan can be easily followed. There is a great deal of lacing employed, because the laces are crossed and then passed over by the longer loops. The finished union is thereby rendered rather bulky. It might be better to omit the crosses on the face.

In Fig. 7 is another combination which attracted the attention of the writer. One may find some rather unique forms of lacing by traveling through shops. Almost every man has a way of his own. In the making of this joint (Fig. 7), the plan does not differ materially from the first one, except that there are crosses made on the under side as well as on the upper side. This is done by redrawing the strands. A second trip has to be made. This method will result in an extremely strong joint, but it will not avail unless the leather in the belting is exceptionally powerful. The lace will pull out the edge of the leather wherever there is undue strain. Ordinarily this union is very satisfactory.

We have the round belts to lace as well as the flat ones, and our last example (Fig. 9) illustrates one of the round kind with a piece inserted.


Fig 5

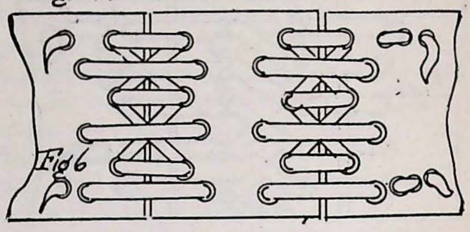


Fig 6


Fig 7

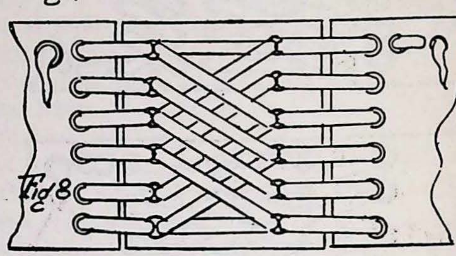


Fig 8

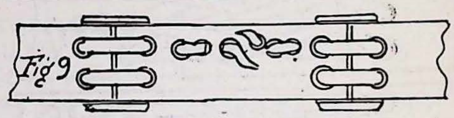


Fig 9

Drive punches must be used to insert a hole in the thick leather. These drive punches can be bought at any tool dealer's. Then cut the holes and insert the piece, and lace as shown in the drawing. — *The Operative Miller.*

THE German army airship constructed by Major Gross set out the other day from Tegan, near Berlin, upon a long-distance trial. It appears that the three occupants of the airship, who were making for Hanover, completely lost their bearings, and in the small hours of the morning they decided to descend, as they were passing over water and were unable to ascertain whether they had already reached the Baltic. The airship actually descended into the Stettin Haff and floated ashore near Wollin, where it was landed only after considerable injury had been done to the machine.

FACTS ONE SHOULD KNOW ABOUT A GAS ENGINE

L. H. SNYDER

To be able to intelligently converse and write on the subject of gas engines, one should be familiar with the everyday expressions and terms that he will encounter, also a few things worth considering in purchasing a gas engine and its care.

Horse Power. — This is a comparison or relation, and was established by James Watt as the power of a strong London draught horse working a short interval, and was used by him to measure the power of steam engines, and is equivalent to the continual lifting of 550 pounds a foot a second.

A boy is capable of exerting 1 h. p. if he can move fast enough, illustrated as follows:—

Say he weighs 110 pounds and can run in one second up a flight of stairs which is just 5 feet in perpendicular height above the starting point; he will have lifted the equivalent of 550 pounds 1 foot in one second.

There are two horse power ratings which a gas engine has, and one should be careful that he thoroughly understands just what they mean.

The indicated horse power, often written I. H. P., means the power which an engine is capable of developing in the cylinders. It is obtained from the following formula : —

$$P\ L\ A\ N \div 33{,}000$$

33,000 is a constant and is the number of pounds that would have to be lifted in a minute (550×60). P is known as the mean effective pressure, written M. E. P. This is obtained by means of an indicator and a planimeter. The indicator reproduces graphically the exact operation of a complete cycle of the gas engine. L is the length of the stroke in feet, A the area of the piston in square inches, and N the number of explosions per minute.

From the above, it can be readily seen that the above rating would be a builder's rating, and is the one generally used by them.

One may roughly determine the I. H. P. of a gas engine by the following formula : —

$$\text{I. H. P.} = \frac{D^2 \times S \times N}{12.5}$$

where D is the diameter of the piston in inches, S the length of stroke in inches, and N the number of cylinders. This is based upon the assumption that the engine will make one thousand revolutions a minute and is a 4-cycle; also the assumption is made that the average M. E. P. is 80 pounds per square inch.

A formula which is often used is

$$\text{I. H. P.} = \frac{D^2 \times N}{2.5}$$

The writer prefers the first formula, as it takes into account the length of stroke.

If the engine is a 2-cycle one, it is the rule to take the I. H. P. as two thirds of the above formula.

D. H. P. (developed horse power) is the horse power that the engine actually delivers and may be measured by means of a Prony brake. This consists of a strap fastened around a wheel and attached to an arm with an adjustment for tightening and loosening the strap. The arm should rest upon a standard placed on a scale. It will be necessary to determine the constant. This is done by revolving the wheel forward and then backward, noting the reading upon the scale in both instances. These should be added and divided by two. The scale should be set so that it exactly balances the maximum tension that you can get upon the brake band without stopping the engine, and the scale reading noted. Deduct from this the value obtained by rotating the engine forward and backward, as indicated above, and use the following formula : —

$$(6.28 \times G \times N \times A) \div 33{,}000$$

where G is the reading on the scale (after making the deduction as indicated), A the length of arm from the center of the flywheel to the point of contact on the scale in feet, N the number of revolutions per minute. This will give the horse power the engine is capable of delivering.

$$\text{The Mechanical Efficiency is} = \frac{\text{D. H. P.}}{\text{I. H. P.}}$$

Compression. — After a mixture of gas and air is drawn into the engine (the third stroke in a 4-cycle engine and the second in a 2-cycle engine), it is compressed, and the intensity of violence of the explosion depends upon the compression.

There are two methods used to obtain a high compression. First, to make the compression space very small. Second, a tight fit between the piston and cylinders.

Leaky compression is caused by fouled piston rings or a poor fit between the piston and cylinder walls. Conditions are always better where flake graphite is used with the lubricating oil.

The object of the flake graphite is to attach itself to the minute irregularities which exist in the metal surfaces, building up a graphite to graphite coating of marvelous smoothness.

Where splash lubrication is employed, the graphite may be put into the crank case in the proportions of about a teaspoonful to pint of oil.

I know of a gentleman using flake graphite in his automobile engine and he is able to start on compression after standing for over forty-eight hours. He was not able to do this before he used graphite.

Sometimes a false head is put into a clearance space to decrease it, thereby making higher compression. This should be done only by a competent person, as it may increase the compression so high that the engine parts will not stand the strain or there may be serious back-firing.

When purchasing a gasoline engine, one should test the compression by closing the pet cock and turning the engine over. Where there is more than one cylinder, try one at a time with the pet cocks on the others open.

In starting gasoline engines, start on a lean mixture and gradually increase its richness until the proper amount is reached. This experience will teach.

Have the spark adjusted so that the engine is fired at just the right part of the stroke. A rough rule is about one quarter stroke.

A smoky exhaust indicates there is too rich fuel or too much lubricating oil, a white smoky exhaust shows too much lubricating oil, while a black smoky exhaust shows too much gasoline.

In shutting down, close off the fuel supply first, then open the switch. — *Gas Review.*

A NEW BLOCK PUZZLE

I. Z. Y.

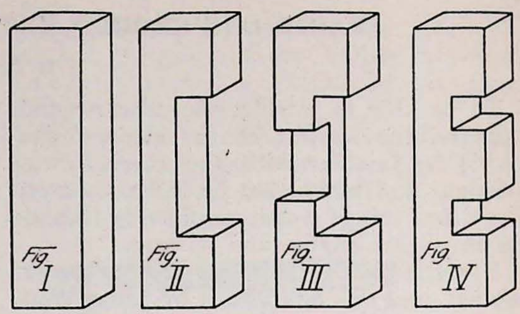
TAKE a piece of soft, straight-grained wood, ½ inch square, by a little more than 12 inches in length.

Cut the stick up into six blocks, each 2 inches long.

One of the blocks, Fig. I, is the key, and is complete as shown.

The others have different shaped grooves cut in, as follows:—

Four blocks have one long groove, the width of the block, ¼ of an inch deep by 1 inch long, as shown in Fig. II.



Two of these four blocks have an extra cut made in the side, ½ inch in length, and ¼ inch deep, shown in Fig. III.

The two grooves shown in the remaining block, Fig. IV, are ¼ inch square and equally spaced, ½ inch from each end of the block, with ½ inch between them.

To put the puzzle together: —

Remember that all the grooves must face the center of the group.

Figure V shows the puzzle assembled, with the exception of the square key block, which is purposely omitted, that the opening for it may be clearly seen.

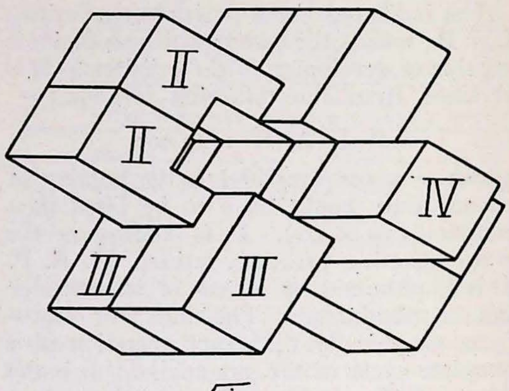


Fig. V

The two blocks, II, are placed around the block IV. Then the pair marked III, corresponding to blocks illustrated in Fig. III, are put in position, facing each other.

The key block, Fig. I, is then pushed into position, and the puzzle is complete.

The sizes given are conveniently made with a jack-knife. If a larger size puzzle is desired, a saw and tools will be necessary to construct them.

It is well to use soft wood at first, but a piece of hard wood, highly polished when the blocks are made, will look much neater, and give better satisfaction.

FLOWERS AND INSECTS TRANSFORMED INTO METAL

T. C. HUTCHINSON, D. D. S.

THE art of transforming flowers, leaves, insects, or the like, into metal, is a science which is new with this year's progress along the lines of invention, and bids fair to become very popular.

The writer conceived the idea of changing a flower or insect into metal from a little story told by an Irish dentist at a banquet table held during one of our district conventions, when he said, speaking in a jovial way of the possibilities of casting: "That he was going to quit dentistry and take up the manufacturing jeweler's business; that he was going to hire a lot of children to go into the woods to catch beetles, they to bring them to his factory, where he would stick a pin in them, invest them, and burn them out (no residue) and force metal in the form made vacant by the burning." This, in a nutshell, is my method of reproducing animal and vegetable matter in metal, differing only in that where flowers or leaves are to be cast, I use the stem of said flower or leaf as a sprue instead of a pin. While my friend little thought it possible to accomplish what he had said, yet it is true that the finest lines of the flower, viz., the ribs, stamen, and the hair-like parts of the moss rose, or the antenna or legs of the butterfly, can be reproduced with this new method of casting with pressure.

THE DENTIST'S METHOD

I will in a few words tell what the dentist of to-day is doing along these lines, and from this you will readily call upon your imaginative powers the many places in which this casting with pressure will be useful to you in your work. The dentist prepares a cavity in a tooth that is to be filled, with no under-cuts; he then takes wax and fills said cavity, packs it full and trims off the surplus, so that it will be just as he wants his gold or silver filling to be; he then takes it out of the cavity, puts it on a sprue pin, and then places the pin in a crucible former, then puts a metal ring or flask over this and pours investment material, filling it up to the top of the ring. This investment material is composed of two parts silica and one part plaster of Paris. After this begins to set, the crucible former and pin are removed, this then leaves the investment with a concave surface with the sprue or hole reaching to the wax. The next procedure is to heat over a Bunsen burner slowly until the investment is freed of moisture, then the blow-pipe is used to hasten heating and to burn out the wax. When this is accomplished the metal nugget is placed in the crucible and melted to a white heat. The flask is brought in position under the metal disk of the casting machine, the latter is pressed downward upon the flask, and in so doing, automatically lets on the air, forcing the molten metal to place. This operation takes about 25 minutes. The size of the wax object to be reproduced makes little difference.

POSSIBILITIES OF THIS METHOD

If it is possible for a dentist to accomplish this, it is possible to reproduce any form of wax, animal, or vegetable matter into metal. Wax burns out with the ordinary heat from a Bunsen, while the flower, or the like, requires a blast heat to burn up the ashes, etc. Inasmuch as vegetable and animal matter are largely composed of water, especially the former, evaporation from the heat removes the bulk of the invested flower, etc. There are many casting machines now used, having different methods of producing pressure, viz.: the air, steam, vacuum, and centrifugal force machines. I have used them all, and while any one of these will accomplish ordinary work, yet I favor the air machine for doing extensive work. The clover leaf, not much thicker than newspaper, requires more force to cast than a rose, etc. It is possible to braze one metal to another, viz.: silver to gold, or *vice versa*. — *The Keystone*.

THAT the Japanese are not always the mere imitators which some people would have us believe, is shown by the decidedly original method they have adopted for carrying two submarines from England to Japan. The "Transporter," a ship specially designed for this purpose, has been built by Messrs. Vickers, Sons & Maxim for carrying submarines intact. The engines are located aft, and forward of them the main deck for two thirds its length has been removed. To place the submarines on board, they are floated into the dry dock alongside the "Transporter." The latter is sunk to the bottom of the dock, and the submarines are then floated into position above a pair of cradles built into the hull of the ship. The water is then pumped from the dock, and, as it subsides, the submarines settle into their respective positions in the hold of the steamer. The main deck is then replaced, and the ship is pumped out until she is afloat.

ROPE CRAFT — KNOTS

CLOVE HITCH

The making of knots is one of the most important branches of seamanship, and from an amateur point of view, perhaps, the least studied. How many minor accidents on small boats are due to the wrong knot having been used! And how often one sees a knot tied which, after a severe strain has been put upon it, refuses to come undone again — a sure sign that the wrong knot has been used! The making of knots, bends, and splices, and all the fancy work attached to ropes and gear, is a most fascinating study to any one who is fond of boats. If much of it is not necessary, it is certain that the more one plays with rope the better one will understand the handling of it and realize why a particular knot is the best for a particular piece of work.

The following knots and bends are all simple ones. Most of them should prove useful at one time or another on small boats. A few, perhaps, are more ornamental than necessary; but every one must admit that, say, a Stopper Knot on the end of a draw-bucket lanyard is more shipshape looking than a figure of eight, and that a certain amount of fancy work improves the appearance of handlines to an accommodation ladder.

All the most usual knots should be so well known that they can be made in the dark and under trying circumstances, and it should never be forgotten that the great recommendation of most of these knots is, not that they hold better than any other, but that they are undone easily; for it is often more important to be able to undo a knot quickly than to make it.

The most common of all is undoubtedly the Reef Knot (Fig. 1). It is unnecessary to describe it or attempt to specify its uses; but a Granny, an absolutely useless knot, is so often made in mistake for a Reef that the two have been illustrated to show the difference.

A Clove Hitch (Fig. 2) is also so well known that description is unnecessary.

A Rolling Hitch (Fig. 2) is used to fasten one rope to another or to a spar when it is necessary that it should not slip. It is made much like a Clove Hitch, but two turns are taken round the standing part and whatever one is tying it to before the final hitch is taken. The two turns are taken on the side to which one does not wish the rope to slip. (In the illustration it will not slip from right to left.) Should it, however, insist on slipping, owing to greasy ropes or any other cause, the end must be bocked (see dotted line) and several turns taken and then seized down.

Figure 3 illustrates the usual and best method of making a rope fast to a bollard. The seizing is not necessary, but it acts as a deterrent on small boys who are fond of undoing ropes.

A Timber Hitch (Fig. 4), as its name implies, is used for making a rope fast to a spar or plank, more especially when towing. A half hitch is first taken and the end of the rope used up by twisting it round its own part. This is the Timber Hitch. But it is usual to take another half hitch near the end, as in the illustration, when a spar has to be towed. (A spar, by the way, should always be towed thick end first.)

Figure 5 consists of a Blackwall Hitch, a Blackwall Hitch with two turns, and a Midshipman's Hitch, all used to fasten a rope quickly in a book. The illustration shows how these knots are made. The only important thing to remember is to get the round turn well up the neck of the hook.

A Marline-spike Hitch (Fig. 6) explains itself. It is used when an extra pull is wanted in putting on a service or lashing.

A Sheet Bend (Fig. 7), or, as it is sometimes called, a Swab Hitch, is handy when two ropes must be fastened together hurriedly, as when sending a hauling-line ashore or running out a kedge. It is far better for this than a Reef Knot, which may capsize and run out if it catches against anything. If two turns are taken, it will hold better and it is not so liable to jamb. To make the knot, form a loop in one rope, and pass the other rope up through this and round the two parts of the first rope and under its own part.

A Carrick Bend (Fig. 8) is the best knot for fastening two ropes together where any long and heavy strain has to be endured, as in a tow-rope.

To make it hold the white rope, as in the illustration, but with the end as shown by the dotted line, pass the other rope up through the loop thus formed over the cross in the white rope and again up through the loop. Both ends are then seized down. This bend will never jamb, and the ropes "take" in so many places that it is not so likely to chafe through or part at the knot as a sheet bend.

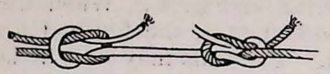


FIG. 1.

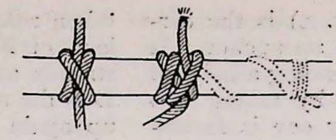


FIG. 2

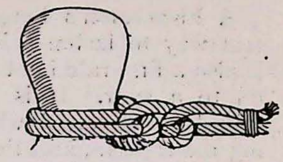


FIG. 3

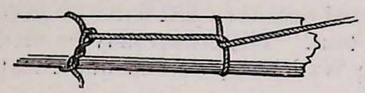


FIG. 4.

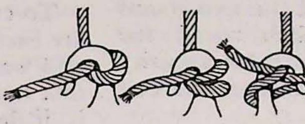


FIG. 5.

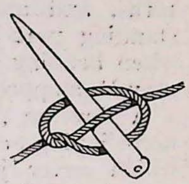


FIG. 6.

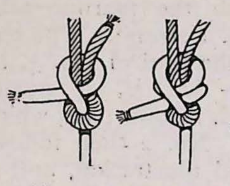


FIG. 7.

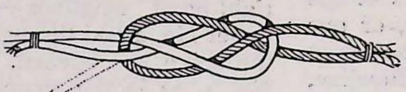


FIG. 8.

FIG. 9.

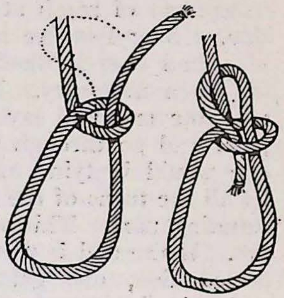


FIG. 10.

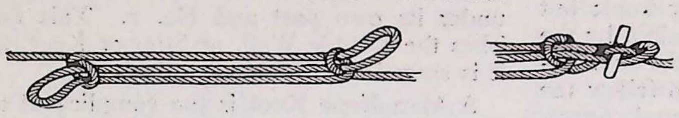


FIG. 12.

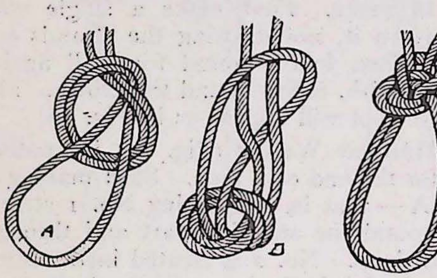


Fig. 11

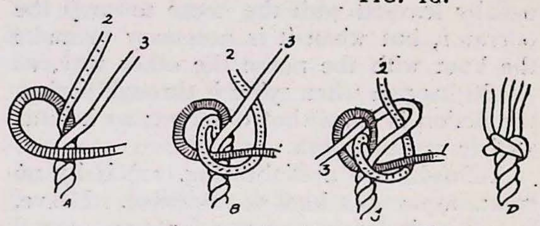


FIG. 13.

FIG. 14.

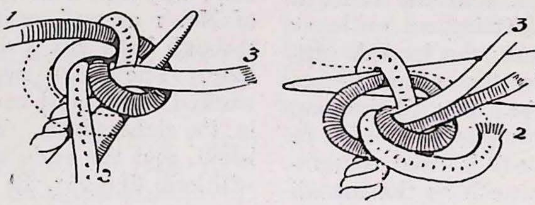


FIG. 15.

FIG. 16.

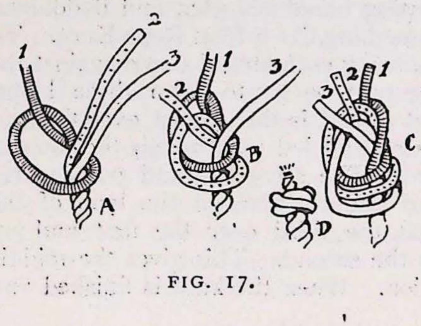


FIG. 17.

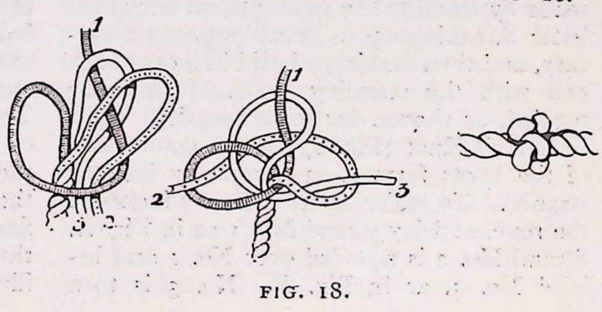


FIG. 18.

A Fisherman's Bend (Fig. 9) is the correct way to fasten a line to an anchor. It is also a first-rate knot for bending a halyard on to a spar. It is made by taking two round turns round whatever one is fastening the rope to, and then taking a half hitch round the standing part and the two round turns, and another half hitch round the standing part alone. For greater security when bending a line to an anchor, the end may be stopped back.

A Bowline (Fig. 10) is used whenever a non-slipping noose is required. It is a knot which never jambs, and therefore can always be undone in a moment. In certain harbors where the rings one has to tie up to are out of reach at certain states of the tide, a long Bowline must be used, or one may find oneself unable to cast the ropes off when necessary. To make a Bowline, take the end and lay it over the standing part, and go through the same action that one would in tying an ordinary knot; but let all the turns of the knot be taken by the standing part. This will give the first figure. If the end is then made to follow the dotted line, one gets the second figure, which is the complete knot. This knot is usually learned with the noose towards the operator, but when it is necessary to make the knot with the noose the other way, as would happen when tying it through a ring, the action is somewhat different; so it is as well to practice both ways.

A Bowline in a Bight (Fig. 11) is by no means as useful a knot as a Bowline. I have, in fact, only found one use for it on a small boat — it makes an excellent bo's'n's chair, one loop forming a seat and the other a back. It is made by forming an ordinary knot, as in the first figure; the loop A capsized over the knot gives the second figure. Now haul on the two parts B until the loop comes down to the knot; this will finish it.

A Sheepshank (Fig. 12) is used to temporarily shorten a rope, such as the topsail sheet when the mainsail is reefed. It is made by forming the rope into an elongated letter S, taking up as much rope as necessary, and then making a half hitch over each end with the standing parts. It may be toggled, as shown, for extra security.

A Wall Knot (Fig. 13) is the commonest of the knots formed on a rope by its own strands. To make it, unlay 6 or 7 inches of the rope, and lay strand No. 1 as in Fig. A. Strand No. 2 is now led over No. 1 and behind No. 3, as in Fig. B. No. 3 is then taken round No. 2 and passed through the loop of No. 1, as in Fig. C. When these strands are worked taut, the finished knot D is the result. The ends may now be laid up again and sewed, or the knot may be crowned.

To crown a Wall Knot (Fig. 14) the ends are each passed over their left-hand neighbor and worked taut. The crown may be made first and the Wall Knot worked underneath it, if desired.

A Double Wall Knot (Fig. 15). This figure represents a single Wall Knot seen from on top, and with the marline-spike opening the loop of No. 1 strand. The end of No. 1 now follows the lead of No. 3, its right-hand neighbor — that is, it passes under No. 2 and through its own part, which the spike has opened. No. 2 then follows No. 1, as in the second illustration, and is tucked under its own part. Finally, No. 3 follows the lead of No. 2, and is tucked under its own part and No. 1. This finishes the Double Wall, or Stopper Knot, as it is sometimes commonly called.

A Man Rope Knot is too complicated to illustrate in construction, but is really quite easy to make. First make a single wall and crown it, not drawing the strands too tight. Then follow round the wall again, and, to finish, follow round the crown. The finished knot will appear as in Fig. 16.

A Matthew Walker (Fig. 17) is another knot for the end of a rope. Start making it as in A — that is, by passing No. 1 strand right round the standing part and through its own loop. No. 2 is treated in the same way, only that it also passes through the loop of No. 1 as well as its own. No. 3 passes through both No. 1 and No. 2 and its own loop. The knot must now be carefully worked tight, and each strand made to lie in its right place. When the knot is finished, and the ends laid up and secured, it will look like Fig. D.

A Diamond Knot (Fig. 18) is useful for ornamenting handlines, etc., and if doubled looks something like a Man Rope Knot. To make it, bring each strand down against the standing part so as to form three loops. The first strand is then taken over the end of the next and led up through the loop of the third. The second strand passes over the third and up through the loop of the first, and the third over the first and up through the second. This gives the middle illustration. When the knot is finished and the ends laid up, it will look like the third illustration. A Double Diamond is made by following the ends round again, as in a Double Wall Knot.

All these knots have been shown in three-strand rope, but they may be made in the same manner in four-strand rope, the fourth strand being treated in the same manner as all the others. The heart of the rope must either be cut out, or, if the rope is to be laid up again when the knot is finished, it may be allowed to come out of the middle of the knot and the strands laid up on it again. When it is desired to lay the rope up again after the knot is made, it is as well to try to keep the natural lay of the strand, as it facilitates the laying up considerably. — *The Yachting and Boating Monthly.*

HOW TO MAKE A SIMPLE TIE-PIN

WITH a few inches of gold or gold-filled wire, a blowpipe and spirit lamp, a little solder, and a few files, it is surprising how many small articles of jewelry may be made.

Unless one wants to go in for jewelry work thoroughly, there is no need to have a large stock of tools, and the few which are needed are quite inexpensive.

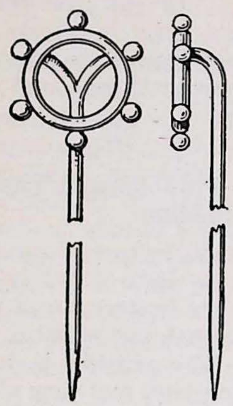


FIG. 1. TIE-PIN.

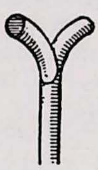


FIG. 2.

The tie-pin, illustrated at Fig. 1, is a very simple piece of work, the only difficulty lying with the soldering.

The wire used should be a little over 1-32d inch in diameter. First of all, the ring should be made, and to do this a mandrel of round wire should be provided. Ordinary French wire nails, trued up a little with a fine file, are very useful, and for this particular purpose a 3-inch nail will be the best.

Carefully wrap a portion of the wire around the nail, and when it forms an even ring, file across and fit the ends together. If more than one ring is required, it will be advisable to wrap the wire around the nail several times, draw the resulting spiral off, and saw along the length with a fretsaw, and the rings will then fall off.

The next stage of the work is to solder the ring. We shall require a carbon or charcoal block on which to place the work, next a spirit lamp burning methylated spirit or a Bunsen burner burning gas, a mouth blowpipe, a small quantity of borax, and a little solder, either silver solder or gold a few carats less than that used.

The borax should be rubbed down on a saucer with a little water to form a paste; the solder should be cut into small pieces or may be filed down with a coarse file and placed on a piece of paper in readiness. It may be advisable, before actually soldering the ring, to have some practice with the blowpipe, and in that case the small beads attached to the outside of the ring may be made. First, cut off six 1-16th inch lengths of wire, and drop them into the borax solution; next take one bit out and place it on the charcoal block; direct the blue portion of the flame directly upon it, as shown at Fig. 3; keep up the flame with long breaths, and it will be seen that the wire will get white hot and then gather itself together and form a glistening ball. The beginner will find a little difficulty at first in keeping a steady current of air flowing through the blowpipe; it is best to keep the cheeks well filled, and take fairly long breaths.

When the six beads have been made, it will not be so difficult to do the soldering.

To solder the ring, paint the two portions which are to be joined with the borax solution. A match stick, bruised at the end, makes a good brush; place the ring on the block and place a piece of solder, or a few of the filed grains, on the join. The flame should now be directed around the solder until the work is all thoroughly heated, and it will be seen that the solder will bubble up. When the borax has ceased boiling, direct the flame right on to the solder, and as soon as the sides of the join get red hot, the

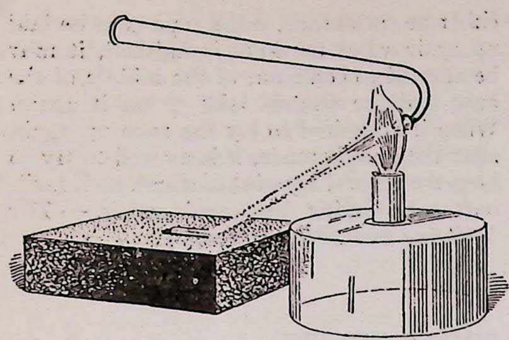


FIG. 3. THE BLOWPIPE AT WORK.

solder will run and fill the space. It is possible that the beginner will not be able to effect this at the first time, for if the heating up takes too long, the surface of the metal will become oxidized and the solder will not flow. If it is found that the solder has not thoroughly flushed the joint, the ring should be dipped in a pickle to remove the oxide. A suitable pickle will be found in a solution of sulphuric acid one part and water eight parts. When the ring is removed from the pickle, wash and well dry it in a little clean sawdust and then paint with borax solution; place on more solder and heat up again in the same way.

The ring should now be properly joined, and may be cleaned up with a very fine file; at each point where a bead is to be soldered on, the round surface should be slightly flattened with the file. Next hollow out, with a penknife, a space in the charcoal to take the ring, and at each point (six in all) where the beads are to be placed, scoop out a little hollow, so that they will fit tightly against the side of the ring and there can be no possibility of their moving during the process of soldering.

To insure a secure joint, one side of each bead should be filed a little to give a small, flat surface, which should fit against a corresponding flat surface on the ring. Paint each joint with the borax paste, place small bits of solder on the joints, and heat up the whole ring, touching each joint in turn until the whole of the solder has run. When finished, place the work in pickle and file off any projecting bits of solder.

We have now to make the pin, which should be from 2½ inches to 3 inches long and forked at the top, as shown at Fig. 2.

First, cut off a length of wire and bend over one end; next take another piece about ⅜ inch long, bend it to the same curve and file one end to fit against the other piece, paint the joint with borax, tie up with a little bending wire, and solder it up. Clean up in the pickle and file up smooth, and then bend it over to the curve shown at the side view of Fig. 1. The ends of the fork should now be filed with a small, round file to fit against the back of the ring, and when nicely fitted, paint with borax, file the portions on the ring where the ends of the pin are to be placed, and lay on the charcoal block. The ring may be put in the hole previously prepared and the pin placed in position and tied down with binding wire before soldering.

The end of the pin should now be filed down quite smooth, and, if desired, the small spiral usually made on the pin may be filed out with a small, fine, round file.

The whole work should be polished first with finest pumice powder, afterwards with rouge, using first a fine plate brush and then a chamois leather.

A brilliant finish may be given to the work by burnishing. An old steel spindle well polished makes a good burnisher, but small, hardened steel burnishers may be bought very cheaply and will be found most serviceable.

Storage Battery Troubles and Their Remedies

SULPHATING is caused by over-discharging a battery and allowing it to stand in that condition, or letting the battery stand without being over-discharged, but with the electrolyte too strong. The remedy is to remove by scraping the plates and then charging at a low voltage for a long period, says *The Practical Engineer*. In this way, by fully charging and only partially discharging, the sulphating is eliminated. Sulphating can also be removed by adding a small quantity of sodium sulphate, which decomposes and dissolves the sulphate.

Buckling is caused by an unequal expansion of the plates, which is due to the sulphate lodging on the plates, thus preventing action from taking place at that point and by excessive charging. If the plates are not badly buckled they can be placed between two boards, and with a little pressure applied, they can be straightened out quite easily.

Short circuits are caused by sediment forming at the bottom of the cell. Raise the plates and place them on glass or wood separators; in small cells the clearance is generally 1 inch and in large cells about 6 inches.

INSTRUCTIONS FOR MAKING A GARDEN SEAT

A. C. HORTH

THE essential point to consider in designing this popular garden object is stability, and although this is often associated with massive work, it does not follow that thick and heavy timber should be used. The main thing is to have sound joints, for with correct construction, great strength may be gained by the use of comparatively slender material.

will be impossible to saw this groove out, but with a wide chisel and a mallet cuts may be taken *across* the grain until the waste is cleared out. If this piece of work is beyond the skill of the worker, a slot may be cut right through the underside, as shown at D, Fig. 3, shortening the length of B to fit into the slot, which should not be more than $\frac{3}{4}$ inch deep.

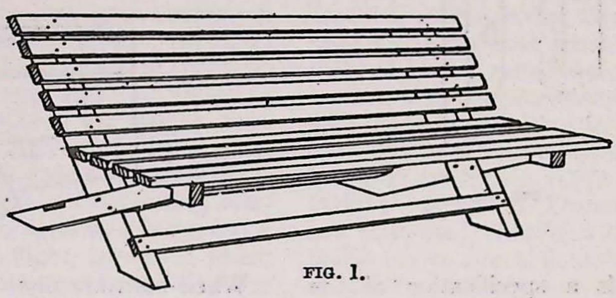


FIG. 1.

The seat illustrated at Fig. 1 is an example of simple construction, utilizing the lapped halving joint only. The length may be anything from 3 feet to 10 feet, but for the purpose of estimating quantity of material required we will take a length of 5 feet. The seat should be about 15 inches wide and 17 inches above the ground, and the spread of the legs 21 inches.

Figure 2 shows an end elevation of the trestle framing, and in Fig. 3 is given the separate parts showing the grooves. The wood used for the above framing should be 3 x 2 inches, one length of 3 feet 4 inches, another 2 feet 6 inches, and a third 1 foot 7 inches being required for each frame.

The joint at the part where the two longer lengths cross each other should be at right angles to the sides and the groove, 3 inches wide, in the piece A should be $10\frac{1}{2}$ inches up and at B 1 foot 3 inches up, and being a lapped halving joint the depth should be 1 inch. It will be advisable to cut these grooves first, place the pieces together and then mark out the position of the piece joining them "C." This piece fits into the back "A," but does not go halfway through, $\frac{5}{8}$ inch being quite sufficient. The end of piece "B." fits into it, being cut out, as shown at Fig. 3; in making this joint cut out to the shape shown at the end of "B" and then place in position on "C," when it is fitted in the back mark out the shape. It

When the joints are finished, this should be glued and pegged together, first boring a $\frac{1}{4}$ inch hole right through, and then inserting a round or octagonal length of oak previously dipped in glue.

Both trestles should exactly match, and when they are ready the bottom rails may be fitted in and the seat and back rail nailed or screwed in position. All the rails may be of $2\frac{1}{2}$ x 1 inch wood, with the two top corners slightly chamfered, and altogether we shall require nine lengths each 5 feet long, and two lengths 4 feet 2 inches long for the two lower rails. The distance between the trestles being 4 feet 2 inches.

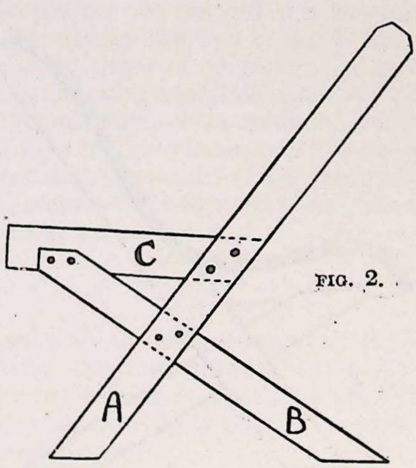


FIG. 2.

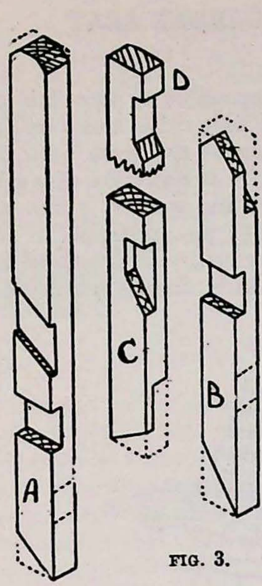


FIG. 3.

scribed above, but not above $1\frac{1}{4}$ or $1\frac{1}{2}$ inches wide. The trestle ends should be jointed up in the same way as the plain seat, leaving the curves until all the joints have been cut and fitted together.

The curve is easily drawn, and when one is drawn out the shape should be sawn out carefully with a bow saw and finished with a spokeshave. The other end should be marked out from this, sawn out and shaped in the same way.

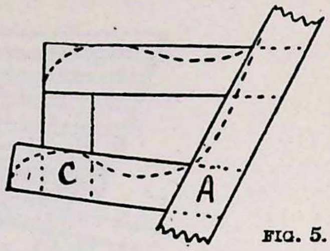


FIG. 5.

The following is a specification of the timber required: —

For pieces A, two lengths, 3 feet 4 inches x 3 inches x 2 inches yellow deal.

For pieces B, two lengths, 2 feet 6 inches x 3 inches x 2 inches yellow deal.

For pieces C, two lengths, 1 foot 7 inches x 3 inches x 2 inches yellow deal.

For rails of seat and back, nine lengths, 5 feet x $2\frac{1}{2}$ inches x 1 inch yellow deal.

For rails underneath, two lengths, 4 feet 2 inches x $2\frac{1}{2}$ inches x 1 inch yellow deal.

In Fig. 4, is given a side elevation of the framing, shaped to make the seat more comfortable. The size of the framing in this case should be $3\frac{1}{2}$ or 4 inches wide, but may only be $1\frac{3}{4}$ or $1\frac{1}{2}$ inches thick. The rails should be the same thickness as those de-

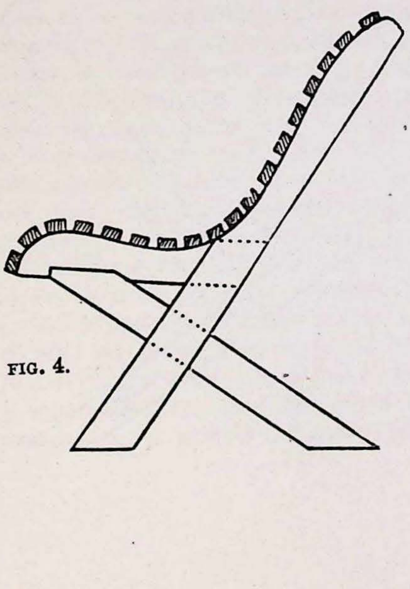


FIG. 4.

When both are done, prepare the rails or seat laths and either nail or screw them on. The number of laths required depends on the width, a space of $\frac{1}{2}$ to $\frac{3}{4}$ inch being left between each.

For the benefit of those workers who would like to make arms to their seat, a diagram is given at Fig. 5, showing how this may be fitted. Wood of the same size as framing should be used, dovetailed or halved into the pieces A and C and joined at the corner by means of the stub mortise and tenon joint, the tenon being two thirds the width and about half the distance through.

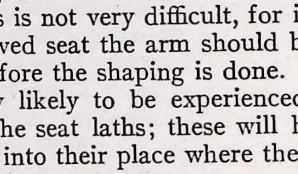


FIG. 6.

Figure 6 shows a section and a side view of this joint. The actual work of making the arms is not very difficult, for in the case of a curved seat the arm should be fitted in place before the shaping is done. The only difficulty likely to be experienced is in fitting in the seat laths; these will have to be tenoned into their place where the arms join the framing.

A chair similar in shape to Fig. 1 may be easily made of rustic timber, small round logs or branches of larch being most suitable. For the trestle ends use the round stuff entirely, but for the seat and back laths smaller branches may be sawn down the middle and then lapped halved joints cut to fit them into the trestle ends, so that the flat portion is on top.

A small single chair suitable for the garden may be made in the same way as Fig. 1. Supposing the width to be 1 foot 6 inches, the trestle framing should be made of stuff about $2\frac{1}{4} \times 1\frac{1}{4}$ inches, jointed up as shown above. The laths should not be more than $\frac{3}{4}$ inch thick and a width of $1\frac{1}{4}$ inches will be sufficient.

The above chairs could be made of oak or pitch pine and varnished, but if made of yellow deal, should be painted at least three coats before being exposed to all weathers.

THE *Scientific American*, in summing up the recent progress in aeronautics, says that after his failure to make satisfactory flights in this country last summer, and after losing to Wilbur Wright the prize of the French Aero Club for the longest flight up to October 1, Henry Farman has at last shown himself to be, after all, one of the world's most daring aviators, while at the same time he has opened a new era in aeroplane flight, an era in which the flying machine will be put to practical use in the transport of individuals from place to place. After a 25-mile flight above the camp at Chalons, France, on October 28, and a mile flight with a passenger the same day, Farman made some changes in his machine to improve its stability. Then, on the 30th, he again soared aloft above the camp; but this time, after describing one or two circles, he flew straightaway across country at a height of 100 feet, and did not alight until some twenty minutes later, when he reached the outskirts of Rheims, after traversing a distance of 17 miles. Not to be outdone by his compatriot, M. Louis Bleriot the next day made a 9-mile flight with his aeroplane across country from Toury to Artenay; and, after making a slight repair, returned to the starting-point, making one stop en route.

These two remarkable performances have put France in the lead as far as practical cross-country flight is concerned. They have shown the possibility of winning the $50,000 prize of the *London Daily Mail* for a flight in stages from London to Manchester, and also the prizes totaling $10,000 for a flight across the English Channel. Furthermore, they have assured the holding of a cross-country aeroplane race next summer in France. A prize of $20,000 has been put up by the Aero Club of France, and it is proposed to run the race from Paris to Bordeaux in five stages.

Had it not been for his unfortunate accident it is probable that Orville Wright would have made the first cross-country aeroplane flight at least a month before Farman, as the Government requirements called for a 10-mile flight of this kind in making the speed test. As no such performance was required by the syndicate which has bought the Wright patents in France, Wilbur Wright has contented himself with making lengthy flights above a level field, in windy as well as in calm weather, and also with teaching several men the operation of his machine. He does not favor such spectacular performances as that of Farman, which, he claims, could not have been made save under ideal weather conditions and with the running of an extreme risk of accident.

After lengthening the rail from which his aeroplane starts some thirty-five feet, in order to enable him to attain the necessary speed by means of his propellers alone, Mr. Wilbur Wright competed successfully on the 13th instant for the prize for height offered by the Aero Club of France. The rules forbid the use of a dropping weight for starting the aeroplane, so Mr. Wright was obliged to dispense with his usual starting apparatus. His machine, however, started readily under its own power. At the end of a five-minute flight he cleared the line of small balloons placed at a height of 30 meters (98.4 feet), by 49 feet, making a total height of 147.4 feet. In a second flight of 11 minutes' duration, Mr. Wright is said to have risen to a height of 196 feet above ground. These are the first official records for height that the American aviator has made.

NEARLY all German railway stations have automatic slot machines which, for a $2\frac{1}{2}$ cent piece, delivers a ticket, without which one who has no railway ticket is not allowed on the platform.

THE CONSTRUCTION OF A HOT WIRE METER FOR USE WITH TUNED CIRCUIT TRANSMITTERS

W. C. GETZ

There have been many requests of late for information regarding the construction of a hot wire meter, such as is used in tuning the transmitting apparatus of a wireless set to resonance. It is therefore the purpose of this article to fully explain the construction of a simple type of meter that can be made by any experimenter, as well as to give an idea of the more sensitive models in present use.

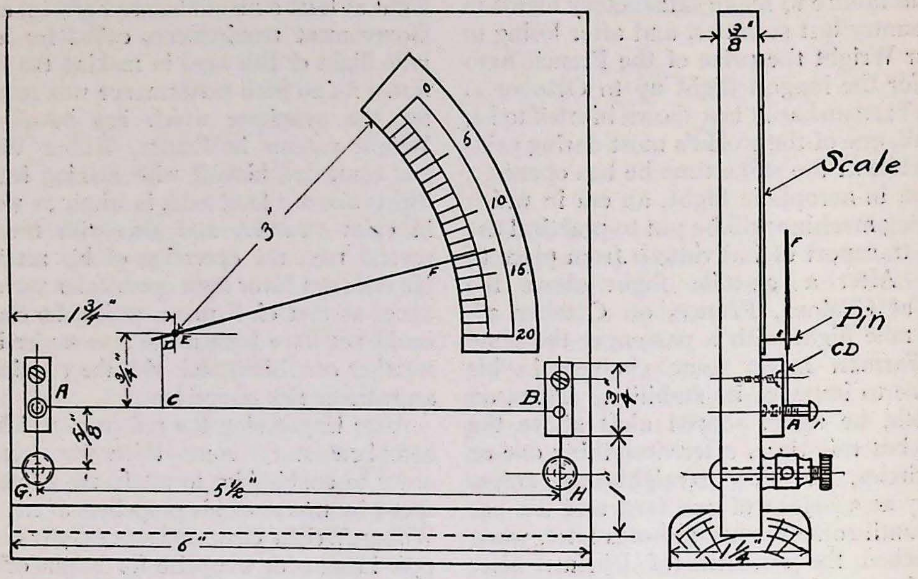


Fig. 1

The theory upon which the action of the hot wire meter is based, is that when a current of electricity passes through a conductor it generates a certain amount of heat, in direct proportion to the resistance of this conductor, and this heat will cause the conductor to expand or elongate a definite amount. Thus, this expansion or elongation can be measured, and by noting the simultaneous variations of the current and the expansion, a table can be made for that certain conductor that will give the amount of current flow in amperes or fractions thereof, for any degree of expansion obtained.

Now referring to Fig. 1, we have a plan view and side elevation of an exceedingly simple, yet effective form of hot wire meter. The wire A-B is soldered to the posts A and B, which are connected to the respective terminals, G and H. Post A should be made adjustable so that the wire may be tightened or loosened at will. An 8-32d x $\frac{3}{4}$ inch machine screw, fitting tightly into a metal socket, as shown in Fig. 2, will work very well.

At the point "C," on the wire A-B, a silk thread is fastened. Now DEF is an ordinary broom straw, about $3\frac{3}{4}$ inches long. At E, $\frac{1}{4}$ inch from one end, a steel needle or pin is forced through the straw and into the baseboard. The straw should move freely on this pivot. At D, $\frac{1}{8}$ inch from the pivot, the end of the thread is now attached.

A piece of bristol board or cardboard is now secured, and with a $3\frac{1}{2}$ inch radius for the center line, the scale is constructed. A neat looking scale can be made by using 3 inches as the radius of the innermost line; $3\frac{1}{4}$ inches for the second line; $3\frac{1}{2}$ inches for the third or center line; and $3\frac{3}{4}$ inches for the outer line. Fix this scale to the baseboard with shellac, taking care to have the lines centered with respect to the pivot E, so that when the pointer DEF moves, it does not overrun the scale at any point.

Now tighten up the post A, until the pointer is opposite zero. In practical use, the meter should stand in an upright position. By cutting a groove $\frac{1}{4}$ inch deep in a piece of wood that is about 5-16ths x $1\frac{1}{4}$ x 6 inches, the width of the groove to make a tight fit with the baseboard of the meter, a very neat stand may be thus made that will allow the meter to stand in a vertical position.

The meter may now be connected to the aerial and sending inductance, as explained in the December issue, the binding-posts G and H being for that purpose.

When the high frequency current passes through the meter to the aerial, it causes the

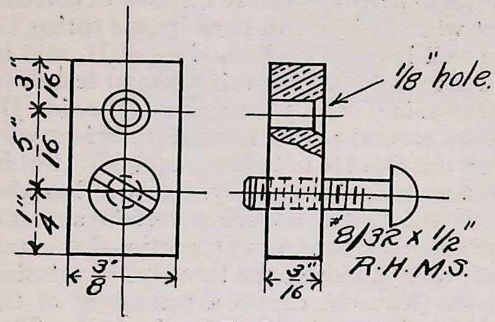


Fig. 2

wire AB to expand. This in turn allows the silk thread (which has been kept taut by the weight of the part EF of the pointer DEF) to move slightly. Since ED is $\frac{1}{8}$ inch and EF is $3\frac{1}{2}$ inches, the movement of F at the end of the pointer is 32 times as great as distance D moves. Thus when the silk thread moves only 1-64th inch, this will let D move 1-64th inch, and F will move 32 × 1-64th inch, or $\frac{1}{2}$ inch.

As the wire cools again after the current,

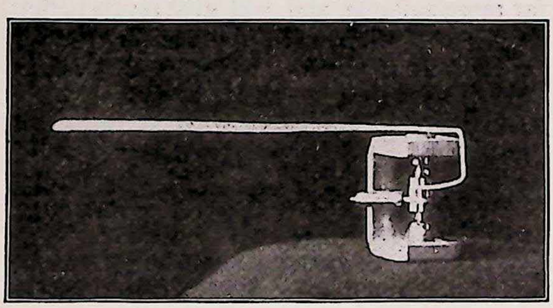


Fig. 3

ceases to flow, it will contract, and drawing in on thread CD, will cause EF to move up until F is again opposite zero.

It must be remembered that any change in temperature due to atmospheric conditions, will also cause the pointer F to move, and for this reason the adjusting screw is placed at A to compensate for this movement.

For small stations No. 40 B. & S. gauge bare copper wire should be used at AB. For larger outfits having transmitting transformers of 1 or 2 kilowatts, No. 36 B. & S. gauge wire can be used.

While the above type of meter is suitable for most experimental outfits, yet for very sensitive work it is necessary to have the pointer mounted on jeweled bearings. This is, of course, much more expensive, but when it is remembered that many experimenters and schools pay from $50 to $100 for a reliable voltmeter, the several dollars spent in obtaining sensitive moving parts is insignificant when compared with the results possible with same.

Figure 3 shows a very sensitive movement adaptable to either a voltmeter or hot wire meter. An aluminum pointer is carried on a hardened steel axis which rests on adjustable jeweled bearings centrally located

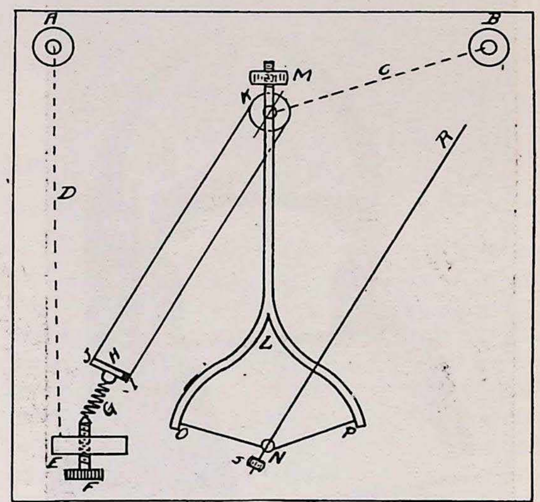


Fig. 4

in the trunion. An adjustable counterweight is also fastened to the axis, and this serves either to keep tension on the wire when used in a hot wire meter, or to balance the coil when used in a voltmeter. This movement may be bought of certain dealers in experimental supplies, at very low prices.

Figure 5 shows a sensitive hot wire meter using the above-mentioned movement. This meter is intended for use by wireless inspectors who require a portable, yet compact and accurate instrument. It is protected by a polished wood case, and is provided with a suitable strap for carrying purposes.

In Fig. 6 is shown the plan of the Whitney hot wire meter. This type of meter is self-compensating for all atmospheric conditions, and as a wire of a special alloy is used. It has many advantages not to be obtained in other types of meters.

The binding-posts A and B are the terminal connections of the meter. The post A is connected directly to the block E, which has the adjusting screw F mounted thereon. The spring G is fastened to a swivel pivot on the end of G, and it pulls against the cross-bar H. H is made up of a piece of metal, with one corner insulated (as shown by black section). To the uninsulated side of H is fastened the end J of the wire JKI, while the end I of the wire goes

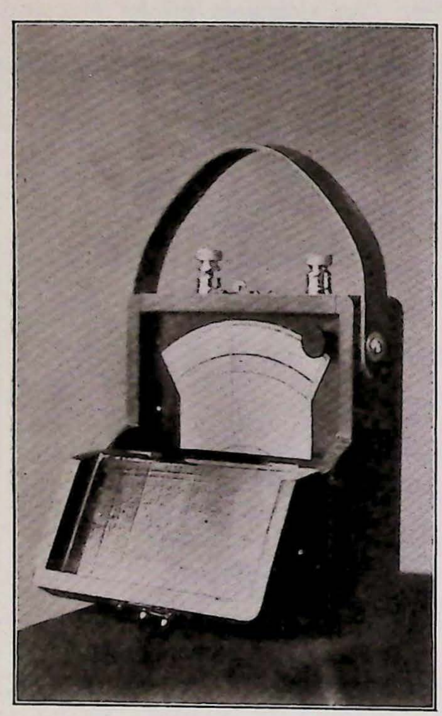


Fig. 5

on the insulated end. This wire runs around the pulley K, making an electrical contact with same. K is mounted on an axis which also carries the multiplying lever L, and connection is made from the binding-post B to K (as shown by dotted lines). The lever L carries the counterweight M on one end; on the other end a silk thread, OP, is fastened between the forks, and is drawn taut against the drum N. The drum N is mounted on an axis which carries the pointer R, the latter being also provided with a counterweight S.

Now when the current passes through the terminal A, its course is first to block E, thence through screw F, through spring G, to H. As the end I of the wire is insulated, the current can only pass through J to pulley K, thence out to terminal B. As it passes through J it causes the portion of the wire JK to expand. This allows the spring G to retract a little. As, however, no current passed through the portion IK, this side is the same length as before the flow of current. But when H is drawn back by the spring G, the pull is equal on both sides of H, and in order to make up for this unequal length of the two sides of IKJ, a portion of the side JK passes around pulley K, until sufficient wire is on the side IK to balance equally. But in passing around the pulley, the wire has also made the pulley revolve a certain amount. This causes L to move a proportional amount, and when L moves, the thread OP, pressing on the drum N, causes a movement of the axis bearing drum N, and pointer R. This later movement is much greater than the original movement of the wire JK, and deflections caused by very minute currents may be obtained with this type of instrument. Now when the temperature changes, say, getting warmer, it causes each half of the wire IKJ to expand equally, and the spring G takes up the slack without any movement of pulley K.

As previously stated, the wire of the meter, shown in Fig. 1, may be of copper. For accurate work, an alloy known as platinoid is far more suitable, and will give much better results. However, with the instrument constructed as described, results to satisfy the average experimenter can always be obtained.

Wireless Telephony

By the Poulsen method conversation has been carried on between wireless telephone exchanges across the whole breadth of Denmark, from Lyngby to Esbjerg, a distance of 170 miles, the voice of the speaker being not only distinct but recognizable. The music of a phonograph played in Berlin was clearly heard, by the same method, at Lyngby, 290 miles distant. Mr. Poulsen, in a lecture in London on April 15th, enabled his auditors, with the aid of telephone receivers, to hear music radiated from a phonograph to a telephone box in the roof of the London Institution, where the lecture was given.

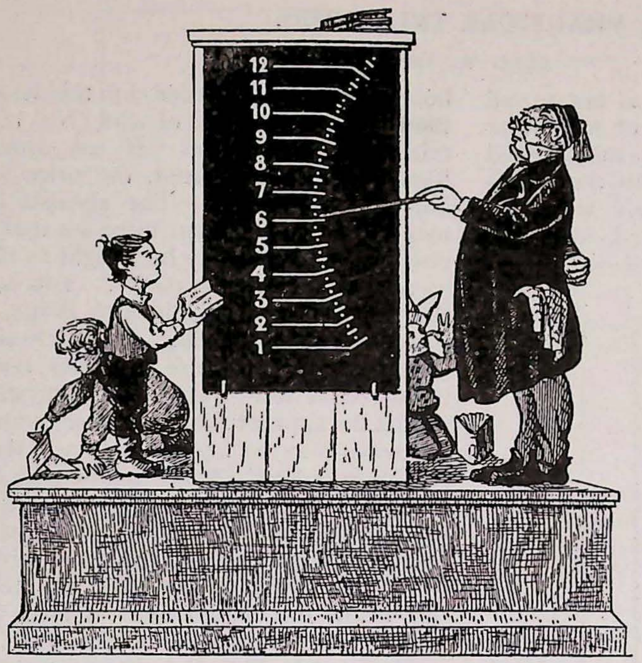


Fig. 1

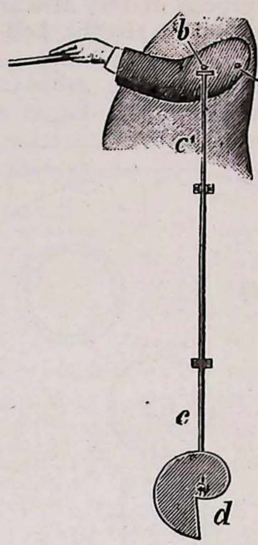


Fig. 2

AN AUTOMATON CLOCK

ROBERT F. X. NATTAN

AN interesting little mechanical novelty is the unique clock illustrated herewith, which may be made without any difficulty by any one with an aptitude for mechanics. The originator, by the way, of this timepiece was a French watchmaker, named A. Poitel.

An appropriate name for this clock would be "School Days," particularly in view of the recent vogue of a popular song of that title. As shown in the drawing, a typical village schoolmaster, with the much feared ruler, points to the hours drawn on the blackboard. One schoolboy is paying strict attention to the pedagogue's demonstration, while two other little scalliwags are engaged in all kinds of mischief. The means of constructing the clock is shown in Fig. 2.

At ***a*** is pivoted the arm of the figure. A short distance from ***a*** a pin, *b*, is attached to it. The pivoted rod, *cc'*, moves between suitable guides, the lower end being attached to the circumference of a cam, ***d***. This cam, otherwise known as a snail, is placed on the hour hand arbor of any mantel clock or alarm movement, which is concealed beneath the figure. This cam makes one revolution in twelve hours, and thus forces the rod *cc'* upwards. The point of the ruler, during this period, passes over the scale drawn on the blackboard. After the ruler has reached the highest point, — for example, 12.45, — it drops of its own weight back to the numeral 1. The cam must be revolvable on the hour arbor with some friction in order that one may be able to set the pointer, and moreover the two lever lengths ***a***, *b*, and the distance from ***a*** to the point of the stick or ruler, must be so adapted to the depth of the cam that the ruler will just traverse the scale, while the rod *cc'* ascends from the lowest to the highest point of the cam. Some difficulty may be experienced in the beginning in determining all the measurements. A few experiments, however, will simplify matters. Either set the pin *b* farther away from the pivotal point ***a***, when it is desired to make the arc described by the pointer smaller, or *vice versa*. A simple method would be to make the blackboard only when everything else has been completed, and to adapt the blackboard's size and the spacing of the hour scale according to the lift of the pointer, actually caused by the cam. The pointer may be shortened or lengthened as necessity may demand.

A PRACTICAL TELEPHONE

FRED W. LANE

THE purpose of this article is not to tell how to make an electric bell or any other requisite for a telephone; so many good pamphlets have been written on these subjects that anything I might add would be superfluous. Many amateurs, I am sure,

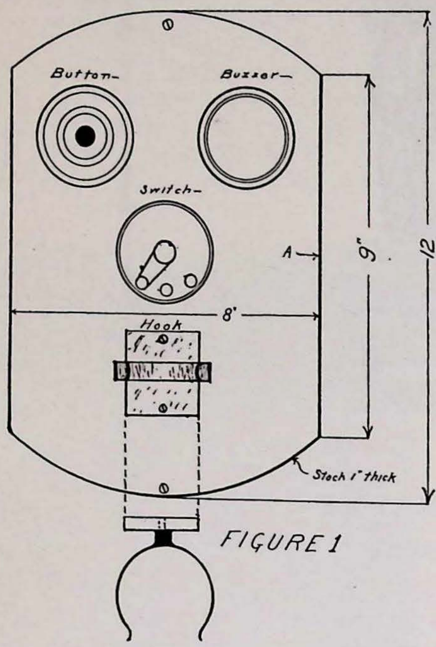


FIGURE 1

have made much of the apparatus needed for this telephone. They only await some suggestion as to how they can put it to the best use. I shall endeavor to give plain directions for setting up a telephone line which will be of real value if connected with your friend. Having set up and used one of these telephones for over a year, I can vouch for its efficiency.

The Outfit. — Complete outfit for two stations consists of the following. If you do not care to make your own apparatus, the prices set down may be of value.

Two pounds No. 16 wire....	\$0.35 per pound	\$0.70
Four dry cells............	.25 each	1.00
Two mahogany boards......	.20 each	.40
Two push buttons..........	.10 each	.20
Two buzzers..............	.25 each	.50
Two 3-point switches.......	.25 each	.50
Four-foot incandescent lamp cord..................	.02 foot	.08
Two receivers.............	1.00 each	2.00
Two hooks...............	.10 each	.20
Screws, staples, tape, etc....		.10
Total................		\$5.68

The above list gives the cost of A1 material. Of course the amount of wire to be bought will be governed by the length of the line. Each pound of wire (No. 16) contains about 150 feet. If sal ammoniac liquid cells are preferred, the price will be about 45 cents each. The cheaper boards may, of course, be substituted for mahogany ones; the switches may be bought as cheaply as 10 cents each, if necessary. You can buy the boards in the rough, and shape, sandpaper, and apply a little *filler* yourself.

Setting Up. — Figure 3 shows the electrical connections; Fig. 1 is a suggestion for setting the apparatus on the board. Outside, the wires may be fastened at each terminal to picture knobs screwed to the sills of second-story windows. Instead of running the wires into the house under the window-frame, thereby crushing them whenever the window is raised or lowered, run them in just below the clapboards. A neat way to do the wiring is shown in Fig. 2. On the inside, use small staples to fasten the wire, but do not put the two lines of wire under the same staple — run each line separately. To fasten the board to the wall, screws about 2¼ inches long will be needed. In order to leave room for wiring on back of board, make two wooden washers by cutting pieces about ¼ inch thick from a brush or broom handle and drilling holes the size of the

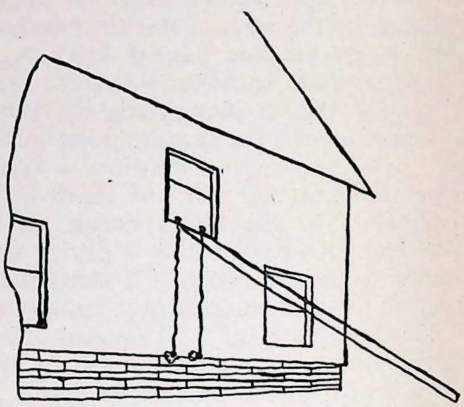


FIGURE 2

screws through them. The manner in which the different parts are to be connected will be readily understood by consulting Fig. 3. Run the wire to the receiver from under the board at A (Fig. 1). If you fasten the board to the wall with one edge against a door casing, the wires may be made very incon-

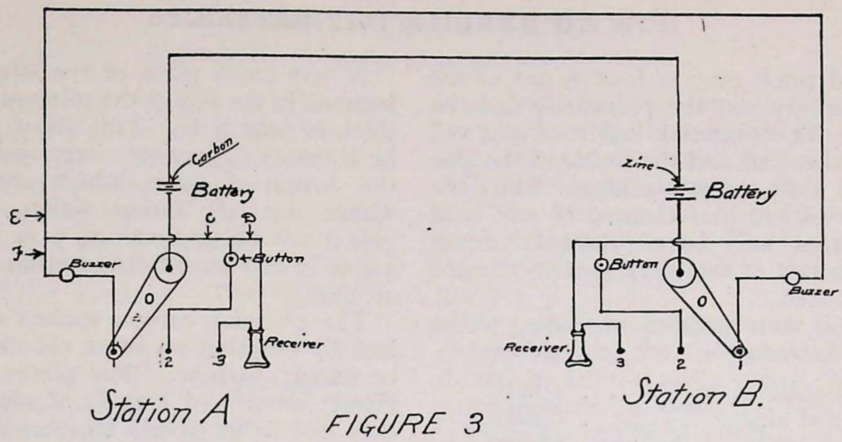


FIGURE 3

spicuous by running them up the side of this casing to the board. By following Fig. 3, any one should be able to set up and operate this telephone. Only general carelessness, such as loose connections, should cause trouble. Great care should be taken to see that the batteries of the two stations are so connected that they will not work "against" each other. That is, the carbon plate of the battery at station A should be connected with the zinc plate at station B. See Fig. 3.

How It Works. — In Fig. 3, O represents the levers of the switches; 1, 2, 3, represent the other points. The lever must always rest on point 1 when the telephone is not in use. When station A wishes to call station B, the lever O is moved to point 2 and the button pressed. In this ringing, the current starts at the battery at station A, let us say, and flows down through O, point 2, and the button. It cannot flow out through D and the receiver, for the circuit is broken at point 3. Its only course is to follow wire C. The current cannot flow by wire F and the buzzer, for, at the time of ringing, the lever O is on point 2, so the circuit is broken at point 1. The only way it can find a circuit is by following wire E to the other instrument. At station B it flows through the buzzer (point 1), through O, the battery, and back to the point of starting. Had the lever O not been on point 1, station A would have been unable to call station B. This is why the levers must rest on points 1.

When station A has rung, the lever O is pushed on to point 3. In answering, station B pushes O immediately on to point 3, not stopping at 2. With both levers on the points 3, one can see at a glance that the receivers are now a part of the circuit and the stations may converse. Therefore, when telephones are not in use, the levers should rest on points 1; to call, push lever to point 2 and press button; to converse, both levers must be on points 3. By studying Fig. 3 a little and applying a test similar to that given above, you will be able to see why the current flows in a manner to produce the required operations, instead of by some other wire. The one thing that must be remembered in doing this is that *the electric current must have a circuit around which to flow.* By following this principle, plans to produce any required action are formed. The batteries are needed for ringing purposes only, and could be dispensed with as far as the working of the receivers goes. However, in my telephone I used the cells on the main line, and will give it to readers in the same way. If at times the voice of the person with whom you are speaking seems far off and indistinct, but at others loud and clear, see if the screw in the end of your receiver (if the instrument is built in this way) is tightly in place. This defect caused me much extra work, and it was only after going over the whole system several times that I discovered the cause of the trouble. Of course it must be seen that the single receiver at each end must be used both as a mouth and ear piece. It may seem, too, that, to use the plain board with the switch, occasions much more inconvenience than would be presented if the current were governed by a receiver hook. Perhaps this is so, but, after using my telephone a few days, I found that it was very easy to turn the switch and use the same instrument both for mouth and ear piece. And as regards neatness in appearance, this instrument is a fitting supplement to the best room in the house.

HOW TO REBUILD DRY BATTERIES

THE old pitch plug is broken out of the original battery and the pieces saved, to be remelted. The material inside of the cell is then shaken out and the inside of the zinc cup given a thorough cleaning. Then the carbon is washed and cleaned of any hard sediment that may have collected thereon and the contact of the binding-posts cleaned and brightened.

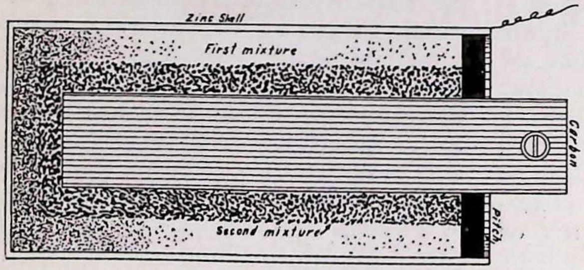
A paste is then made up according to the following formula: —

Sal ammoniac..............	1 part
Chloride of zinc............	1 part
Plaster of Paris............	3 parts
Wheat flour................	.87 parts
Water.....................	2 parts

A wooden plug or cylinder somewhat larger in diameter than the width of the carbon is then inserted in the center of the zinc shell, and the above paste firmly packed in about it. While the above solution can be poured in readily, it sets very quickly, becoming stiff enough to stand while the plunger is being withdrawn. This leaves a space inside of the dry cell a little larger in diameter than the carbon. The carbon is now inserted in this hole, and the surrounding space is filled with another mixture composed of the following: —

Sal ammoniac................	1 part
Chloride of zinc..............	1 part
Peroxide of manganese........	1 part
Granular carbon.............	1 part
Plaster of Paris...............	3 parts
Flour........................	1 part
Water.......................	2 parts

These are thoroughly mixed and poured into the space about the carbon. The pitch



which was taken off of the original cell is then melted and poured back over the top, thoroughly sealing it and preventing evaporation.

A very small piece of rye straw may be inserted in the top of the mixture before the pitch is poured in. This straw could then be withdrawn, leaving a very small vent for the escape of gases, which are generated within the cell during action. This will give a new battery with an e. m. f. of about 1.4 volts and an internal resistance of .3 of an ohm.

The granular carbon spoken of may be had by crushing up some old electric light or battery carbons. The pieces should be about the size of kernels of corn, so that they will lie as closely together as possible. Dry batteries made according to this formula will give the very best of service, and they may be recharged from time to time, until the zinc shell is completely worn away.

BELLINI and Tosi, Italian scientists, who with the sanction of the French Government have been conducting experiments in wireless telegraphy for the last eighteen months on the coast of Normandy, announce that they have solved the problem of independent wireless communication. This result, they say, has been secured by means of two rectangular aerials fixed at right angles and so attached to the apparatus for reception and transmission as to permit the transmission of unequal currents. By the simple law of mechanics these two electromagnetic forces unite and produce an electromagnetic field, and the Hertzian waves are projected in a single vertical plane which can be alternated instantly by means of a coil.

The inventors say that they have picked up messages at will from every English wireless station and from ships at sea, and they have transmitted messages from Pourville to Havre and other points without the waves being perceptible at the other stations lying just off the line of transmission. They assert that their system insures absolutely independent communication and opens up immense advantages in the use of wireless telegraphy. Among these are the determination by triangulation of the exact position of a ship in distress, the position and speed of a hostile squadron, and the reading of secret exchanges between friendly fleets and armies.

A TANTALUM DETECTOR

ALFRED P. MORGAN

A DETECTOR has recently been devised which makes use of the metal tantalum. It consists of a fine wire of this material in contact with a globule of mercury.

It is especially suitable for the amateur experimenter, in that it gives very loud tones and therefore does not require high resistance telephone receivers. This is due to the great change in resistance when an oscillation is received. Its normal resistance is from 1000 to 2000 ohms, which drops as low as 250–70 ohms when struck by an oscillation of ordinary strength. The silicon and electrolytic types of detector are more sensitive than the tantalum for very weak signals, but for oscillations of the average wireless station the tantalum produces tones in the telephone receivers several times as loud as the other two.

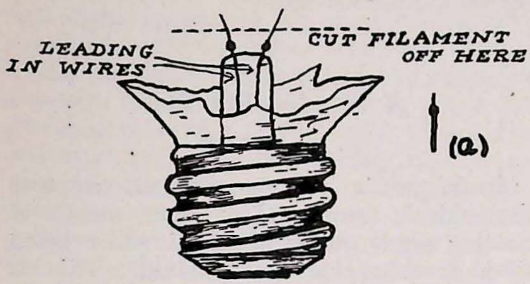


Fig. 1

Those experimenters who have a detector of the electrolytic type making use of a Woolaston wire, may change it into a tantalum detector very easily. Simply fill the little cup with mercury in place of dilute nitric acid and substitute a piece of tantalum wire for that of platinum. The tantalum wire is taken from an incandescent bulb of that type. Only a very short piece is desired,—about 1-16th to $\frac{1}{8}$ of an inch. In order to facilitate fastening this short piece of wire to the adjusting screw, it is necessary to secure it with a small piece of the leading-in wire of the bulb fastened to it. Therefore break the globe of such a lamp very carefully, so as not to damage the filament to any great extent. If you wish to be sure about this, a good idea is to groove the bulb with a file moistened with turpentine and camphor. If the grooves are in good and deep, you may crack the bulb without its flying to pieces. Another method to prevent the bulb from shattering in a thousand parts is to snip off the little tip of the globe with a pair of pincers. This will admit the air and prevent an explosion when you break it. The filament can best be cut with a small pair of scissors. The tantalum point ready for the adjusting screw should look like Fig. 1 (a).

To secure the loudest tones and farthest distant signals, the voltage of the battery should be from 0.2–0.4 volts. Therefore a potentiometer is necessary. Those who care to make the complete detector will find some directions given below. They do not have to be closely followed in design, but the experimenter is free to carry out his own ideas and suit his resources. Figure 2 gives a side view of the detector. The carbon cup is made from the carbon of an old "ever-ready" dry cell, the brass connecting-cap serving very nicely both to fasten the cup to the base and to make connections to. It has a recess cut or bored in the top about $\frac{1}{2}$ inch in diameter and $\frac{1}{4}$ inch deep to contain the mercury. You will find you can make a good-looking job of it by smoothing up any rough edges with a file. The cup should be about 1 inch high.

The yoke is made of a piece of $\frac{1}{8}$-inch sheet brass about $\frac{3}{4}$ inch wide, bent in the shape shown. Two small holes are drilled in the feet to serve to fasten the yoke firmly to the base and also to make a connection to.

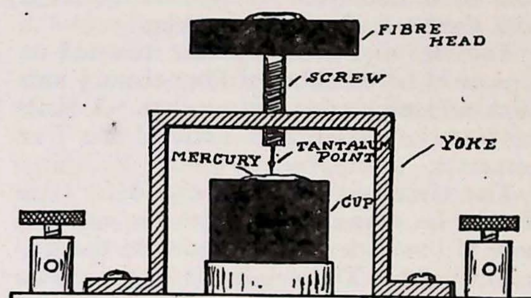


Fig. 2

The adjustable screw may be made from a screw taken from the carbon of a dry cell. To permit of accurate adjustment, it should be fitted with a large head. This can best be made from a piece of ¼-inch hard rubber or fiber cut in a circle about 1¼ inches in diameter. Bore a small hole about 3-32d inch in diameter through the center and force it on the screw up to the brass head.

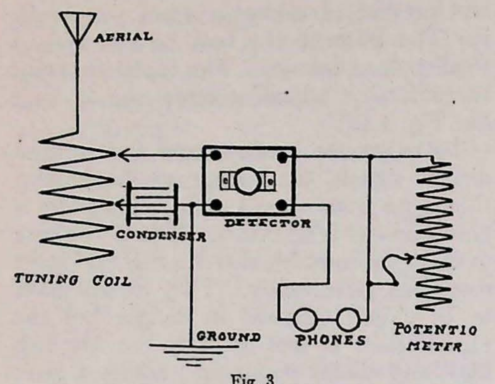


Fig. 3

A hole is bored and tapped in the center of the yoke to receive the screw. If you do not possess a tap, bore a ¼-inch hole and solder a battery nut directly over it. A fine wire spring between the head of the screw and the yoke serves very nicely to keep it in adjustment. As to fastening the tantalum point to the screw, if you have secured it with a piece of the leading-in wire attached, you may solder it. If not, bore a 1-16th-inch hole about ¼ inch deep in the center of the end of the screw, place the wire in it, and pack fine tin-foil around it with the head of a sewing needle.

The cup and yoke are best mounted on a piece of hard rubber or fiber about ½ inch thick and measuring 3 x 4 inches. A binding-post is placed near each of the four corners.

The circuit is given in Fig. III. Care should be taken to see that the negative pole of the battery is connected to the tantalum point. The condenser in the circuit is about 0.1 of a microfarad in capacity. Directions are given in so many books and periodicals that they are not repeated here. In order to make it of the above capacity, use twelve sheets of tin-foil 3 x 4 inches interposed between thirteen sheets of parafined paper or mica 5 x 6 inches.

The potentiometer is made by winding some No. 25 B. S. single cotton-covered German silver wire, or any of the nickel-steel alloy wires on a piece of curtain pole 2 inches in diameter and 1 foot long. Wind it on tightly and then scrape the insulation off for a path about ½ inch wide, running the full length of the rod.

A tuning coil may be made in the same way, but for this, use No. 25 B. S. single cotton-covered copper wire. The experimenter should mount the coils and arrange sliding contacts to rub up and down the bare space to suit himself.

To adjust the detector, connect the battery and screw down the point until a sharp click is heard. Then adjust first the tuning coil and then the potentiometer until the signals are the loudest.

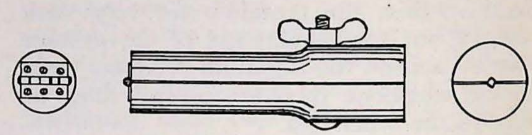
A Wooden Pin Vise

A. P. H. SAUL

It frequently happens that the amateur mechanic is hard put for some means of holding small pieces of metal while being filed or otherwise manipulated. This is especially true when the workman is not the possessor of a pin vise.

Indeed, for many purposes a pin vise is not adaptable, for the reason that the steel jaws of the vise are apt to mar the work.

For this purpose a home-made wooden pin vise, as shown in the sketch, will come in very handy.



It is preferably made of hickory, but any other hard, tough wood will answer. It is made by turning up in the lathe a spindle of any convenient size, differing with the individual taste of the workman. This spindle is sawed through lengthwise, on a plane with its axis, as shown in sketch, and a hinge, preferably a brass butt, is screwed to the smaller end, while a small stove bolt with a thumb nut is put through the larger end, as shown.

A coat or two of shellac, well rubbed down, completes the job, and the amateur has a very serviceable tool, and at practically no expense whatever.

The projects for electric railways which have been put forward in Japan since the war aggregate an estimated expenditure of $390,000,000.

ELECTRIC TRANSMISSION FOR MARINE WORK

A PAPER upon the transmission of power from marine engine to propeller was presented by Mr. William P. Durtnall to the British Institute of Marine Engineers the other day. It was chiefly of interest for the reason that it afforded an opportunity of an exchange of views upon a system of propulsion which has many favorable points notwithstanding a certain amount of complication which it introduces into the propelling machinery of modern vessels. It would at first sight appear to be unmechanical and needlessly complicated to interpose between a marine steam turbine and the propeller a system of electric machinery by which the mechanical energy of the prime mover was converted into electrical energy and reconverted by the motor attached to the propeller, besides incurring a loss in the double conversion. But, as has been frequently pointed out, the regulation of speed is rendered easier by such a system and the "astern" turbine is not required, for the electric motor runs equally well in either direction, and the reversal can be effected through a switch which may be placed upon the bridge or in any convenient position. Mr. Durtnall advocated polyphase transmission, notwithstanding the fact that continuous current motors are more easily controlled through a range of speed, but continuous current generators are open to serious commutator troubles which have not yet been fully overcome in fast-running armatures. The figures which Mr. Durtnall quoted are open to question, especially in the saving in boiler capacity of forty-one per cent, which he claims would be made by the adoption of turbines driving alternators. Mr. Durtnall said that there was little doubt that until a satisfactory internal combustion engine of comparatively large power was produced, the steam turbine would remain the simplest and most efficient prime mover. In its direct application for marine propulsion it labored, however, under important disadvantages, having to be designed to run at very low speeds in order to permit of the use of a propeller of high propulsive efficiency. This increased the weight per brake horse power developed to a marked extent, and there was undue consumption per horse power of work developed. Another disadvantage of the direct application of the steam turbine for marine work was the difficulty of reversing for maneuvering and going astern, and under such conditions the turbine was not economical in steam. It was evident, therefore, that in order to secure the future complete success of the steam turbine in its application for ship propulsion some means must be provided to allow the turbine to run at high speeds and the propellers at comparatively low speeds, and so secure economy in both cases, and at the same time provide reverse motion for all shafts. Electrical power transmission appeared to offer the greatest possibilities of achieving this end, and would bring the steam turbine within the range of application to fast passenger liner, combined passenger and cargo steamers, as well as to slow cargo tramps. In his opinion electrical power transmission for marine propulsion could only be successfully carried out by means of polyphase alternating current with synchronous generators and squirrel-cage induction motors, not only on account of the great simplicity of the machines, but by reason of their low cost and low weight per horse power developed. In the polyphase system with revolving field alternators were to be found all the features required for marine work. It would be quite within the range of possibility to design and construct polyphase induction motors of from 1000 to 10,000 horse power which would weigh from 35 pounds to 30 pounds per horse power developed, and this without any sacrifice of efficiency which would range from about ninety-three to ninety-seven per cent. The author had worked out the figures of a vessel fitted with four propellers, each requiring to rotate them 1000 b. h. p. at two hundred and fifty revolutions per minute. The figure for steam consumption came out at 13 pounds per shaft horse power at top speed, compared with 22 pounds per shaft horse power, with direct coupled turbines working under similar speed, while at half speed the saving would be only slightly less, the saving in the first case being estimated at forty-one per cent, and in the second at thirty-seven per cent. The saving in weight in boiler-room equipment he estimated at not less than forty per cent, and in coal consumption there should be a saving of 1-6 ton per hour. He commended the proposition to the owners of cargo vessels, as in such a system the propellers would be run at about the same low speed as was usual in such boats.

OVERHEAD TROLLEY CONSTRUCTION

NEW methods of overhead trolley construction, which will decrease materially the cost of operation, will, it is expected, characterize the high-speed electric trolley line between Boston and Providence, which will likely be established by the New York, New Haven & Hartford Railroad. The new feature of operation is the design of Vice-President McHenry of the New Haven road. It consists in suspending a steel wire under the copper trolley wire. The copper insures conductivity and the steel wire provides a hard wearing surface which can be replaced at comparatively low cost, and this greatly reduces the expenditures for the expensive metal. William S. Murray, electrical engineer of the New York, New Haven & Hartford, says of the device: "It is anticipated that ordinary forms of overhead construction would not be adequate to handle the through trains on the electric division of the New Haven system, and, an original form of construction, therefore, was designed for the new conditions. On the New York & Stamford line the catenary bridges are 300 feet apart. The messenger cables, which are the two top ones in each set of spans, are supported on insulations attached to the bridges. In the original construction there were three wires in the triangular construction; in Mr. McHenry's design there are four wires. In both designs the third wire, or the wire just beneath the messengers, is made of hard drawn copper. The fourth wire in the spans is of bright Bessemer steel, and it is to be noted that this is supported from the copper wire by clips installed midway between the hanger points of the copper wire. Very soon after the commercial service was put on an electric basis it was found that the current-collecting device on the electric locomotive, commonly known as the shoe, was producing two very serious effects on the copper wire: (1) Reducing its cross section by wear and (2) kinking it badly at the point of suspension. The result of the combination brought about fractures of the trolley (the messengers never breaking), and on account of the extreme roughness of the copper wire, due to kinking, the locomotive shoe was constantly interrupted in its contact with the trolley, delivering and in turn receiving hard blows in its uneven progress along the line and causing great sparking, which was both bad to the electrical equipment and injurious to the eye of the locomotive engineer. The fourth wire has proved the panacea of all of these troubles. In the original form of construction, where the locomotive shoe made contact with the copper wire, it was found that on account of the high expansion properties of copper wire changes in temperature lengthened considerably the span between the hanger points, and because of the ductility of the copper, the passage of the shoe at high speed, with some considerable upward pressure, gathered up the slack in the form of a kink at the hanger point. The first thing to be noted is that the steel wire has a much lower expansion coefficient than copper, and is not ductile. And further, and most important of all, instead of being supported at a rigid point, as in the manner of support of the copper wire from the triangular hanger, it is suspended by a light clip hung to the copper wire midway between hanger points. Thus great flexibility is secured, and it is immaterial with this form of construction what may be the variations in temperature. Hot weather will simply lower the steel wire, and *vice versa* for cold weather.

"The resemblance between the catenary form of overhead trolley construction and a regular suspension bridge is interesting. If a suspension bridge is to be built the bridge engineer first asks: What is to be the traffic density; how much load is to be placed on it, and how wide is it to be; how many wagons may pass; how many car tracks; in short, what is to be the commercial duty of the bridge? Having obtained this he then designs the cables and general members of the bridge, and finally the floor, the latter usually being cheap and easily replaced."

AT the last meeting of the Iron and Steel Institute in Great Britain, Henry E. Armstrong, professor of chemistry of the London Central Institute, said that he found it "difficult to keep calm" when he reflected on the ruthless way in which the world's stores of timber, iron, coal, and oil were being used up. The public, satisfied that science would discover a substitute for coal, was seemingly indifferent to the inevitable consequence of the present lavish waste. Science, however, is in no position, at present, to confidently state that any substitute for these fuels will be available in that near future when our present supplies will be exhausted.

Oil Fuel for Ships

THE use of oil as fuel has engaged the attention of the British Admiralty for some time, and it has recently been decided to establish oil storage tanks in various parts of the United Kingdom to insure convenient sources of supply. Birkenhead, directly opposite Liverpool, has been selected as one of the supply centers. The experiments conducted by the Admiralty during the past twelve years were not at first satisfactory, and two adverse reports were made prior to 1902. Since then the tests have been of such a character as to reverse the original judgment of the Admiralty, and it may now be said that the importance of oil fuel is recognized by that body, and that its use will be extended in the future as rapidly as possible.

It is claimed that through the use of oil the number of men now required to do the stoking and trimming would be reduced by two thirds, as the moving and stoking of oil is automatically accomplished by steam pumps and pipes, instead of by stokers and trimmers, as in the case of coal. While it is difficult with coal fires at full speed to maintain sufficient steam, it has been demonstrated that with oil fuel this difficulty would be overcome, and that when the speed is reduced the boilers are under such perfect control that the safety valves do not lift.

The oil, it is suggested, could be stored in the double bottom, now taken up by water ballast. In the case of the navy, one of the great advantages claimed for oil is the absence of a great volume of black smoke when vessels are proceeding at great speed, and which serves to give information to the enemy. The evaporative value of oil is much greater than that of coal, so that while 45 cubic feet of bunker space are required for a ton of coal, only 38 cubic feet are needed for a ton of oil. It will readily be seen how significant this difference would be to the great ocean-going steamers, and how much space now set apart in them for the storage of coal would be released for cargo purposes and the accommodation of passengers.

The British navy has in service oil-using torpedo boats with a capacity of 34 knots. One of the drawbacks at the present time to the extensive use of oil fuel at sea is the high cost and the difficulty in many instances of securing it. The cost of oil in Great Britain has no doubt seriously interfered with its adoption for steamships and for a variety of industrial purposes. With a reduction in price the field for its employment would be greatly enlarged. The advantages of oil fuel briefly summarized are ecomony of space, absence of soot and cinders, elimination of the loss of time consumed in burning down and cleaning fires when coal is used, the ease with which oil can be bunkered, and the quickness with which a full head of steam can be generated.—*Gas Review.*

Electroplating Non-metallic Articles

THE prime requisite in producing an electrolytic coating on wood, paper, cloth, or other non-metallic material, is that the latter shall first be made capable of receiving such a coating. Once this is done, the article can be coated as readily and permanently as though consisting of metal. For many purposes, a coating of fine graphite suffices to make it sufficiently conductive; but naturally this process cannot be employed with very delicate articles, such as flowers; since the application of the graphite would destroy the texture and structure by filling up the fine lines.

One of the best processes for making the surface of the article an electric conductor consists in giving it an impalpable coating of metallic silver. This can be done by first immersing it in a ten per cent alcoholic solution of silver nitrate, and letting this dry on; then dipping in a ten per cent solution of yellow phosphorus in carbon disulfid. There will at once be formed a deposit of metallic silver, on which a further deposit of silver or any other metal may readily be made by the aid of a battery in the usual manner.

Another process consists in dissolving silver nitrate in several times its weight of distilled water and adding ammonia until the precipitate which at first forms is redissolved. A second solution is then made of formaldehyde in three times its weight of distilled water. The article to be electroplated is dipped in ordinary collodion and let dry. There is next made a mixture of the two solutions in the proportion of one part by weight of the first to two of the second. This is at once applied to the collodioned article. In a few minutes the silver is reduced and precipitated on the article to be metalplated, and the process of electroplating in the ordinary manner may then be taken up.

THE PROGRESS OF RADIO-TELEPHONY

LEE DE FOREST

While the installation of radio-telephone apparatus on twenty-six ships of the United States Navy, prior to their "Round-the-World" cruise, demonstrated the great utility of wireless telephone communication for inter-fleet work, it also demonstrated the necessity for making this apparatus more nearly automatic, to put it into the hands of unskilled operators, or whoever wished to use the instruments.

Lessons were learned from these installations which no amount of theory or laboratory experiment could have taught. Following upon reports of the engineers who went with the fleet to Trinidad, the aforementioned improvements were developed and were installed upon the fleet when it arrived at San Francisco, and on its way to Honolulu. Reports from the latter point as well as those received from Western Australia indicate that the radio-telephone service has been rendered much more efficient by these automatic adjuncts.

About the same time the improved apparatus was demonstrated before the French Government at the Eiffel Tower station. Using the small antenna similar to those on shipboard, voice communication was maintained from Paris to Melun, 60 kilometers (36 miles), and later at Marseilles, 130 kilometers (80 miles). During two nights when the high antenna on the Eiffel Tower was in use, it was reported by the French Government wireless operator at the Mediterranean station near Marseilles, that gramophone music was heard over that distance, approximately 550 miles.

Following these demonstrations in Paris, the French naval officers, especially lieutenants Colin and Mercedier, continued experimenting with apparatus which they built following the De Forest designs, and have since reported very satisfactory results from Eiffel Tower to Dieppe, 150 kilometers (93 miles).

The Italian Government purchased four sets of radio-telephone apparatus for marine work, which the writer installed at Spezia last May.

The apparatus has been still further improved during the last summer, and in September, at the request of the British admiralty, an official demonstration was made between H. M. S. "Furious" and "Vernon" at Portsmouth, England. During these tests perfectly clear and accurate voice communication was maintained up to a distance of sixty English miles, although this was by no means the limit attainable with these instruments on shipboard. As a test of accuracy during these tests, long lists of numerals were read into the transmitter on board the "Furious" and written down at the receiving station on the "Vernon." A comparison of these figures, namely, at the distance of 44 miles, shows an accuracy of ninety-eight per cent.

Further development and refinement has progressed since the Admiralty installation. The apparatus is being continually simplified and its range increased, so that it is now fair to say that the radio-telephone is to-day applicable to a large number of vessels which cannot afford to carry a Morse operator and which will be content with 100-mile communication.

Significant of large development in the near future is the fact that a contract has been made with the Metropolitan Life Insurance Company for the use of its new tower (680 feet high) as a wireless telephone and telegraph station. This will give the tallest antenna of the world, except that at the Eiffel Tower, and it is reasonable to expect some long distance records from this station during the coming year. — *Electrical World.*

Results obtained in several tests of the Maxim silent firearm before the United States Army Board are reported to have been decidedly encouraging, the report of the explosion being only faintly audible. The muffling of the discharge is necessarily obtained at some expense of velocity, though the reduction is said to be only about six per cent. If the loss of velocity and energy be no greater than this, the silencing of the report unquestionably increases the military value of the weapon.

The general public will learn with some surprise that of the total freight moved on all railroads during 1904, amounting to 641,680,547 tons, only 4,809,340 tons represented petroleum and all other oils; and that the total amount of petroleum shipped by the Standard Oil Company amounted to 2,887,500 tons, or less than one half of one per cent of the total tonnage moved on all railroads during the year.

THE SCIENTIFIC COLD STORAGE OF DRINKS FOR OCEAN VESSELS

At one time there was a good deal of risk attached to storing liquors in general, and beers in particular, but this has been greatly minimized owing to the action of the brewers in producing three different strengths of the same liquor. The bottles containing this beer and stout are labeled "Outward" and "Home," meaning to be used on the outward journey or return, and between these two classes there is a "medium" class, which is so labeled. The beers are of varying strengths, as the motion of the vessel has such a disturbing effect on them that it is claimed that the "outward" variety, even with the aid of cold storage, could not be kept until the return voyage, that the bottles could not stand the strain of fermentation. All the drinkables on board ship, except what is required for immediate use, are kept in cold chambers, and the different strengths are packed in distinct places. Cold storage has a varying effect on different liquors. Taking the spirits, for example, it is claimed that it improves the whiskies, but has a deteriorating effect on the gin. A gentleman whose duty it is to attend to this important part of a ship's victualing says that cold storage takes the "life" out of gin, not that there is a great deal of "life" in it at any time, but improves the other spirits. As regards the beers, it retards the "coming to a head" by at least three weeks longer. The chemists who take such a large part and hold such prominent positions in the brewing world to-day have given this subject their consideration, and in two cases can produce a beer which they can guarantee for any length of time if full particulars as to the nature of the cold chambers and their position on board, and the average speed of the vessel, are given. It is not necessary to say that the two beers in question are in large demand for ships' trade. As regards what is called the medium beer, no guarantee is given for this. It is designed to be used as a relief from the first stock, and is sold cheaper, though many people prefer it to the higher quality. The carriage of wines, especially port, has always been a very delicate matter, but during the last few years, when the wine carried on leading vessels equals in every respect that to be obtained at the very leading hotels, the utmost care has been taken in the storage of this and other delicate wines. The most recent vessels have a totally distinct chamber for their wines, in which no other article is allowed to be placed. The man whose duty it is to attend to this chamber at sea is provided with a card of printed instructions as to how to attend to his precious charges. Such wines as these are for saloon consumption only, and are never to be met with in other parts of the vessel. — *Kuhlow's German Trade Review.*

Note on the Electrical Resistance of Metals

W. Guertler in *Metallurgie* has recently made some observations upon the electrical conductivity of metals and alloys. He divides the metals and alloys possible for conductors or resistance into two classes: —

1. Whose which melt with difficulty. Iron, nickel, copper, platinum, silver, and gold comprise this class.

2. Those which melt easily. Magnesium, aluminum, zinc, tin, lead, antimony, and bismuth are the metals belonging to this division.

A review of the properties of the alloys of these metals with one another, as well as with the non-metallic elements like carbon, silicon, and phosphorus, shows that: —

1. Search for a new metallic conductor of a conductivity approaching that of copper or silver must be fruitless. The only possibility is that a conductor might be discovered which, with the least possible diminution of conductivity, should exhibit the greatest improvement in mechanical or chemical properties.

2. Alloys for resistances, in which the temperature coefficient must be as small as possible, can only be found amongst those consisting chiefly of metals of the first group. The field for investigation here, however, is practically unlimited.

A Royal Inventor

Prince Henry, brother of the German Emperor, has invented an automatic window washer. It is not for the relief of tired housewives, as one might at first suppose, but is to keep the rain wiped off the glass wind-break on the front of automobiles, so that the driver can see the road before him in a storm — a sort of royal window washer. Prince Henry, it may be added, is a watchmaker by trade, all the male members of the German royal family being compelled to learn some branch of practical mechanics.

Electrician and Mechanic

Incorporating

Bubier's Popular Electrician......*Established* 1890
Amateur Work................*Established* 1901
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EDITORIALS

OWING to the constant demand among our wireless workers for books on wireless matters, we have given elsewhere in this issue a list of books which include everything in print on the subject. This includes the latest publications as well as the older ones, together with prices.

* * *

THE date of issue of the magazine is now advanced to the fifteenth of the month previous to date. We know this will be gratefully received by many who anxiously await the arrival of the magazine each month. Our Western friends, too, will get the February magazine before the first day of February, and this will make many happy.

OWING to the fact that a great many of our readers have found the time far too short in which to obtain subscriptions towards winning the wireless set, we have decided to extend the closing date to April 1, 1909. This will give many who did not learn of our contest at first sufficient time to procure subscriptions from friends and acquaintances who are interested in matters covered by our publication.

* * *

WE are to exhibit at the National Motor Boat and Engine Show, which is to be held in Boston from January 23 to 30, inclusive. Two wireless stations will be in operation, and we shall be pleased to see all of our readers and subscribers who may find it possible to attend.

* * *

ALL newsdealers should carry the ELECTRICIAN AND MECHANIC on their counters all the time. If by chance you should learn that a dealer is not supplied, we would deem it a great favor if you advise us of this fact.

* * *

WE know that many of our readers are buying from newsdealers and there is no reason why our magazine should not be easily procured in every city, town, and village. Write us, if this is not so.

* * *

WE have had made an attractive yellow and black button for members of our Wireless Club. This is now being sent out to the old members and will serve as a means of identification. Although the number of the Club members is many hundred, we want more, and we trust you will advise all your wireless friends of this organization.

* * *

At the last meeting of the Iron and Steel Institute in Great Britian, Henry E. Armstrong, professor of chemistry of the London Central Institute, said that he found it "difficult to keep calm" when he reflected on the ruthless way in which the world's stores of timber, iron, coal, and oil were being used up. The public, satisfied that science would discover a substitute for coal, was seemingly indifferent to the inevitable consequence of the present lavish waste. Science, however, is in no position, at present, to confidently state that any substitute for these fuels will be available in that near future when our present supplies will be exhausted.

WITH a view to proving it possible by modern methods to build a house in a day, finishing it ready for occupancy by the owner, W. C. Carl of East St. Louis, Ill., recently put up a substantial four-room frame cottage containing parlor, dining room, kitchen, bedroom and bath, doing the work with thirty men in twelve hours. To construct the building 11,000 feet of lumber were cut and fitted; 12,000 shingles were put on the roof; 75,000 nails were driven; 6000 laths were used on the walls and ceilings, and 375 yards of plaster applied.

* * *

A NEW process for the manufacture of copper wire in one operation from crude copper, such as Bessemerized copper bars, has been perfected by Mr. Sherard Cowper-Coles of London. The scope of the invention is the electro-deposition of the copper on a revolving mandrel or drum running at a critical speed, this latter having been determined by rotating a cathode in the form of a cone, that portion which gave the smoothest and toughest deposit being the critical speed for the conditions under which the copper was deposited. Very dense copper is produced by this means, which has a considerably higher tensile strength than that obtained by the orthodox process of annealing and drawing or rolling.

The theory of the process is that each molecule of copper as electro-deposited is burnished or rubbed by the friction of the electrolyte on the mandrel, insuring a more homogeneous metal than is possible by applying great pressure to a large mass of metal by swaging, rolling, or drawing.

Copper so electro-deposited crystallizes at right angles to the surface on which it is deposited; this fact has been turned to account by making a spiral scratch which must be V-shaped on the mandrel, so as to cause the crystals to make a weak line of cleavage. If the scratch is rounded at the base the crystals form radially, and no weak line of cleavage is produced. Four or five miles can be made on a mandrel. The strip is unwound and passed through a set of dies to remove the burr or fin and to form a round section.

* * *

THE Pennsylvania Railroad has awarded prizes to the amount of $5400 to the supervisors and their assistants who maintained the best stretch of track during the last year. The tracks were inspected from a special train. One of the tests was to place glasses of water on the sills of the windows, and count the number of times they were spilled in running over a stretch of track.

* * *

TANTALUM, when pure, melts at a temperature of about 2200° C., its hardness varies from 9 to 10, and it has a specific gravity of 16.5 to 16.6. A somewhat remarkable property of the metal is, that although very ductile under ordinary conditions, after hammering it becomes extremely hard. Thus, in one experiment a beaten sheet 1 mm. thick was drilled for seventy-two hours with a diamond drill making five thousand revolutions per minute, with the result that a depression of 0.25 mm. was produced in the sheet, and the drill was much worn. A use which naturally suggests itself from the result of this experiment is the employment of tantalum-edged tools in deep bore holes in place of those of "bort" (black diamond) now used. The tensile strength of the metal, when in the form of fine wire, amounts to about 95 kilos per square mm., as compared with 85 kilos given by the best steel. Thin wires when ignited in air burn with low intensity and without any noticeable flame.

The great hardness of tantalum, its high melting point and freedom of attack by the majority of chemical reagents, have suggested many uses for the metal, and it is stated that during the last three years over two hundred patents have been secured by those who are trying to produce it on a commercial scale. Its substitution for the carbon filaments of electric incandescent lamps has given it prominence of late. But here, although the article under notice does not say so, it has not proved wholly satisfactory; tantalum filaments are not suitable for alternating currents. The use of the metal as an alloy has presented difficulties which will no doubt be surmounted. Added to iron in small proportions, it gives a hard, yet ductile, material, and iron so alloyed has been used for edged tools, watch springs, and other goods. A small percentage of iron added to tantalum gives an alloy from which pens are made. It is also used for dishes and crucibles for chemical work. "It is inferior to platinum, inasmuch as it is attacked by hydrofluoric acid and fused alkali, and oxidizes when heated in air, but it has the advantage of being unattacked by aqua regia."

QUESTIONS AND ANSWERS

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

Owing to the large number of questions received, it is rarely that a reply can be given in the first issue after receipt. Questions for which a speedy reply is desired will be answered by mail if fifty cents is enclosed. This amount is not to be considered as payment for the 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.

885. **Transformer.** T. M., St. Louis, Mo., asks: (1) Is there always the same amount of current flowing though the primary coil of an electric lighting transformer, whether lamps be turned on or not? (2) What should be size and amount of wire for an induction coil to give strong shocks, core to be 3 inches long, ½ inch in diameter? Ans. — (1) There is always a small current in primary when secondary is open. Though this is small, transformer manufacturers are using every device known to make it still less. When lamps are lighted, additional current flows through primary, directly proportional to the load on secondary. (2) Two layers of No. 18, and ¼ pound of No. 38.

886. **Alternating Current Motor.** G. M. G., University Place, Neb., asks: (1) If a "Wonder" alternator that will run on direct currents and give off alternating, will also run on alternating and give off direct? (2) Can a direct current shuttle armature be run from alternating current mains, if a battery be used to excite the fields and collector rings be substituted for the commutator segments? (3) Why will not a jump spark coil operate on alternating currents without the aid of an interrupter? Ans. — (1) We are not exactly familiar with the internal construction of this machine, and you ought to address the manufacturers. The insulation might not be adapted to stand a regular lighting voltage, and the frequency of the alternations might be unsuited. (2) Yes; but for a standard frequency of 60 cycles you would need first to get the armature speed at closely 3600 revolutions per minute, and excite the field to proper strength before closing the switch that connected with the alternating current. The winding should be proportioned to generate nearly the same counter e. m. f. as the supply. These principles have been dwelt upon in the engineering articles published in this magazine during the last two years. (3) The alternations are far too slow.

887. **Wireless Telegraphy.** E. E. H., New York, N. Y., asks: (1) Have wired my transmitting set in accordance with diagram No. 1 described by W. C. Getz in the August issue. I obtain a spark, however, between condenser connections, instead of at the spark-gap. I use a condenser made up of six glass plates, coated with tin-foil and connected as shown in my drawing. I have examined all connections, and find they are exactly as per diagram. What is the trouble? (2) Is an aerial made up of aluminum wire as efficient as one made up of phospher bronze wire? (3) Does a good connection in a water pipe make a good ground? Ans. — (1) If the spark jumps at S, on your diagram, it is evident that the condenser connections are too close together. And in your sketch you do not show the sending inductance. If you carefully follow the diagram given in the August issue, and separate your condenser terminals more, you will have no trouble. (2) An aluminum aerial wire is not to be desired, as the nitric and other acid fumes in the air, due to smoke, etc., quickly attack the aluminum. (3) Yes, a water pipe makes an excellent ground.

888. **Wireless Telegraphy.** E. K., Orlando, Fla. I have read one of your November issue, and would like to experiment with one of the rectifiers which you describe, but am at loss on making the auto transformer; but see later that this can be found in one of the series, which I believe is E. Also construction drawings of electrical apparatus, and would like to know some particulars about it, and would like to ask you to send me some information concerning it at your earliest chance. Ans. — The drawings referred to are one set of a series of drawings sold by Mr. W. C. Getz, of 645 N. Fulton Avenue, Baltimore, Md. The set in question gives full details for constructing a step-down transformer, designed to operate on 110-volt, 60-cycle alternating current, the secondary voltage being 10, 20, 30, or 40 volts. The primary takes about 4 amperes at maximum.

889. **Wireless Telegraphy.** N. J. R., Newark, N. J., asks: (1) Will you kindly allow me to know how I can make such an arc lamp as would be used for a high frequency arc in the Poulsen system? (2) Also, how are the reactance coils made as Mr. Getz described in the September issue, on page 101, and will Mr. Getz publish a description on the transformer and spark-coil for wireless? Ans. — (1) Details of this apparatus will be published in a later issue. (2) The reactance coils can be made by winding about fifty turns of No. 14 D. C. C. magnet wire on a core 2 inches in diameter. Taps taken off every ten turns will give various ranges of adjustment. Several of these coils should be made. Mr. Getz will shortly get out a set of drawings covering a ½ kilowatt closed core transformer, and it is probable that an article on the subject will shortly be forthcoming.

890. **Wireless Telephone.** L. W. V., Seattle, Wash., asks: Please tell me where I can get the specifications for a wireless telephone. Ans. — Mr. Newell A. Thompson, 31 Brook Street,

Brookline, Mass., may be able to supply you with same. As all the various systems are covered by patents, why don't you get patent specifications from the patent office at Washington?

891. **Wireless Telegraphy.** C. O. S., Los Angeles, Cal. I have a coil that I am thinking of changing. Would like to get a little advice. Core is 1¾ x 18. Primary, two layers of No. 10; secondary, twenty-eight sections of No. 29; length of secondary, 15 inches; inside diameter. 3¼; outside diameter, 6; 20 pounds of wire What I propose is to put about three or four layers of No. 14 on primary instead of present winding. What would be your advice? I expect to get a 4 or 5 inch spark from secondary. Is that about what might be expected? Ans. — Would advise you to leave coil as it is, unless you are sure that the primary takes too much current. A coil of this size should give only a 2½-inch spark, but it is far better for wireless work than a coil with a much longer spark. Try it on your current supply, and see how it acts before making any changes.

892. **Wireless Telegraphy.** L. T. W., Augusta, Me., asks: (1) What size and quantity of wire to use for a secondary to produce a ½-inch fat spark if the primary is 7 inches long and wound with two layers of No. 18 double covered magnet wire? (2) Would this do to experiment in wireless telegraphy? (3) Would silicon detector do to take place of electrolytic in connection with tuned systems? Ans. — (1) Use No. 32 B. & S. gauge enameled wire. Wind in ¼-inch sections, each about 4½ inches outside diameter. (2) Yes; if made correctly. See drawings of W. C. Getz on coil construction. (3) Yes; if it is one furnished by the owners of the "silicon detector" patents.

893. **Wireless Telegraphy.** H. N. J., Los Angeles, Cal., asks: Would you please inform me with a wireless, made in every way to the drawings of Mr. Getz in the July and August numbers, located on a hill 100 feet above the level of the city, what would the sending [and receiving distance be? The country here is fine for wireless stations, and there are a great number of small stations here. Ans. — With 1500 ohm receivers, such as sold by our advertisers, the receiving distance, using a 40-foot vertical aerial, should be about 150 miles. The sending distance, with a ¼-kilowatt transformer should be about 75 miles.

894. **Wireless Telegraphy.** C. C., Flushing, L. I., N. Y., asks: (1) Would you kindly tell me the formula for calculating size of station as to kilowatt? (2) Are the secondary connections the same for an induction coil as for a transformer? Ans. — (1) See article of Mr. Cabot in January, 1909, issue. (2) If you mean in a tuned circuit system, the connections of the secondary to high-tension side is same whether an induction coil or a closed core transformer is used.

895. **Wireless Telegraphy.** W. H. G., Beverly, Mass., asks: Is there any appliance to connect with a magneto, when testing for grounds on a street lighting circuit, to stop bell from ringing when not turning crank? Ans. — The fact that the bell rings when connected in on the circuit shows that there is either a cross on the line with another power wire which is connected to a generator, that is either grounded intentionally or in trouble, the magneto thus completing the circuit back to ground, or else the line runs parallel to an alternating current circuit, and the induction from the alternating current circuit causes the bell to ring. In the latter case, the wire must be grounded at the far end, as otherwise the alternating current would not complete circuit. This being the case, any device to be used to prevent the bell from ringing on this foreign current would also prevent the bell from ringing on the magneto current. The voltmeter is the best instrument for testing power lines, where foreign current is encountered, as it will tell at once the conditions existing on the line.

896. **Wireless Telegraphy.** A. E. N., Britt, Iowa, asks: (1) If I make a transformer with a "U"-shaped coil, ½ inch in diameter, and wind each limb with 12 ounces No. 30 D. C. C. copper wire, B. & S. gauge, and outside the primary coils I wind one 1 pound No. 18 D. C. C. magnet wire, would the results be satisfactory if I used a Sears, Roebuck & Co. No. 5 magnet bridging telephone generator, guaranteed to ring through 125,000 ohms resistance, for the primary winding? (2) Would it improve the efficiency of the above transformer if I closed the magnetic circuit with a soft piece of iron? (3) It is stated it requires 600 volts to cross the smallest space of air. One time I was turning the crank on a No. 4 magnet Kellog telephone generator. When I turned it at a rapid speed, there was considerable sparking at the carbons in the lightning protector. The telephone was not connected to any line. Is it possible the potential was 600 volts at its peaks? Ans. — (1) The transformer would hardly give you any results. In the first case, if you desire to use it as a step-up transformer, the primary should be wound on the core first, and the secondary over it, as the low-tension side should always be next to the core. And again, on any closed core or semi-closed core transformer, the frequency of alternation of the primary current should be taken into consideration, as the cross-section of the iron must be proportioned accordingly. As the magneto frequency is high when compared to the frequency usually encountered, you will find a straight core transformer to give better results. In other words, an induction coil, without the interrupter, will probably suit your purposes. (2) No; for above reasons. (3) It is hardly possible that the voltage of the magneto was over 110 volts at the greatest. The chances are that some fine carbon dust had settled across the arrester gap, as frequently happens after a storm, and the sparking was due to the current passing through this metallic dust. This is a common source of trouble on long overhead telephone lines, especially in districts where magneto system is used, for on the common battery system this leaky condition or ground would cause the light to burn on the operator's answering jack, or cause cross-talk on the affected lines.

897. **Wireless Telegraphy.** F. S. C., Dorchester, Mass., asks: Would you please give the dimensions, including the size of wire and number of layers, for a spark-coil 6 inches long? Ans. — If you mean an induction coil giving

a spark 6 inches long, use the following dimensions: Core, 2 inches in diameter, 22 inches long. Made up of No. 20 B. W. G. soft, annealed iron wire. Primary, wound on core, which has been previously wrapped with insulating cloth, three layers No. 12 D.C.C. magnet wire. Insulating tube, micanite — with ⅜-inch wall. Secondary, thirty sections of No. 32 S.C.C. or enameled wire; 3½ inches I. D. by 7 inches O. D., each 3-16ths inch thick. Section insulation to consist of disks of empire cloth and paraffined paper.

898. **Wireless Telegraphy.** R. W. M., Fitchburg, Mass., asks: (1) What length of spark would a coil of the following dimensions give? Core of iron wires, 8 inches long, 1½ inches in diameter, wound with two layers of No. 16 magnet wire. The secondary wound with two pounds No. 38 S.S.C. in sixteen sections, ¼ inch wide, with insulation ⅛ inch thick between them. (2) Would it work farther for wireless if the secondary was wound with a larger wire, — say, No. 24 to No. 29? (3) How far would such a coil work as mentioned in the first question, under favorable conditions? Ans. — (1) About a 4-inch spark. (2) No; it would be of little use in wireless, unless wound with about No. 32 or No. 30 B. & S. gauge wire. (3) This is impossible to answer, as the length of aerial, tuned system, etc., alter the conditions greatly.

899. **Wireless Telegraphy.** S. P. M., San Antonio, Tex., asks: (1) How far will a sending station send, consisting of a coil like the one in your issue of April, 1908, only wound with No. 33 S.S.C. instead of 36 S.C.C., a zinc spark-gap, and a tuning coil like the one described in your issue of August, 1908, and an antenna 70 feet high and 240 feet long No. 14 aluminum wire? (2) Which of the following potentiometers is the best: German silver, wound on a mandrel, or a graphite rod about 8 inches long? (3) Is a silicon detector with tuning coil and adjustable condenser as sensitive as an electrolytic detector? (4) Is molybdenite as sensitive as silicon? Ans. — (1) Using a tuned transmitting and receiving circuit, with the transmitting side, a radius of 100 miles should be obtained; the receiving radius, using 1500-ohm telephone receivers, and a sensitive detector will be about 500 miles. (2) German silver is the best, as the wear is less; it is not much affected by atmospheric conditions, and the temperature changes in the resistance is constant throughout. (3) It depends on the style of detector used. Many cheap infringements on the silicon patents are now on the market, some of which are no good at all. The owners of the silicon patents are preparing a very sensitive detector for experimenters, and will shortly enter suit against infringers and the users of infringing apparatus. (4) Not quite as sensitive. This substance is also broadly covered by patents, and it is not advisable to purchase or use either of the above types of detectors, unless through the owners or licensees of the patents, as even using same for experimental purposes constitutes an infringement, and is illegal.

900. **Electrolytic Rectifier.** R. L. M., Oakland, Cal., asks: (1) In your article on "The Construction of an Electrolytic Rectifier," it is stated that the transformer required may be made by instruction from complete data and dimensions found in "Series E" Construction Drawings of Electrical Apparatus. Do you sell this book? If so, at what price? (2) What is the length of time that the solution in the rectifier can be used, if replaced at intervals with water, as per statement (pages 206–220)? (3) What is the best method of straightening "buckled" storage cell plates? They are positives. Ans. — (1) This is a set of blue-prints sold by Mr. W. C. Getz, 645 N. Fulton Avenue, Baltimore, Md., the complete series "E" set costing 40 cents. (2) The length of time varies with the amount of current used. 300 ampere hours is about the maximum. (3) Lay them singly on a smooth floor, place a stout, smooth board on them and stand on it.

901. **Dynamo Design.** R. G. L., Jewell, Ohio, would like to build a dynamo, capacity about 8 volts and 40 amperes at seven hundred or eight hundred revolutions per minute. The reason he wants such a low speed is that he would like to couple it direct on a ½ h. p. gasoline engine. Is there any 25-cent or 50-cent book on how to build such a dynamo, and do you know where one could buy such castings? Ans. — We do not know of any one having designs for a machine of just this size and winding, but we would be pleased to design one for you that would fill the specifications. You must realize, however, that such a dynamo would be rather expensive for its output. Why not use a smaller machine, and belt it? Watson's ½ h. p. dynamo makes an excellent plater. A short sketch of a suitable winding for it can be found on page 145 of the last October issue.

902. **Ammeter.** E. J. S., Wilmington, Del., asks: (1) What size wire and how long a piece is required to make a watch case ammeter, the magnetic vane type, 0 to 30 amperes? (2) What size and how much wire is required for spark-coil magneto generator for a 4 h. p. gasoline engine? Could old files be used for field? (3) What is the best way to space armature slots? Ans. — (1) No. 8 wire will suffice, but the exact length and number of turns will so depend upon your particular construction as to preclude us from giving any semblance of further information. (2) Let armature be 2½ inches in diameter and 4 inches long. Wind with No. 18 wire. We assume you mean to utilize a shuttle armature, but a laminated toothed drum armature will be much better. (3) Use a milling machine.

903. **Steam Gauges.** T. J. M., Ancon, C. Z., asks for an answer to the following question on steam gauges. "A" claims that in adjusting faulty gauges, with a test gauge, all that is necessary is to pump any number of pounds on test gauge (say 100), note difference of the two gauges, and then remove the hand or pointer, on faulty gauges, and replace to correspond with test gauge. "B" claims this is entirely wrong, for when a gauge becomes "weakened" by use, the pointer does not move, but rather, the hollow spring tube which controls the working mechanism becomes weak, and must be stiffened an amount sufficient to bring the pointer back to correspond to test instrument, letting the pointer remain in its original position on

pinion staff. Who's right, and how should a gauge be tested? Ans. — Undoubtedly instances will be met when either or both methods of correction must be used. It is common experience that the pointer has become dislocated upon its staff, and it is a simple matter to set it right again in some known position. It is also certain that elastic materials are prone to change their behavior, and then less simple means are necessary to restore the accuracy of the readings. In general, it will not be sufficient to depend upon the verification of one point in the scale, unless that be the regular working point. Then, too, an appreciable difference is often encountered in taking readings with increasing pressures and those with decreasing. For the lower pressures, it may not be wise to depend too much on standard gauges of the flat tube sort, but to use a mercury column, regarding every 2 inches in height as giving 1 pound pressure.

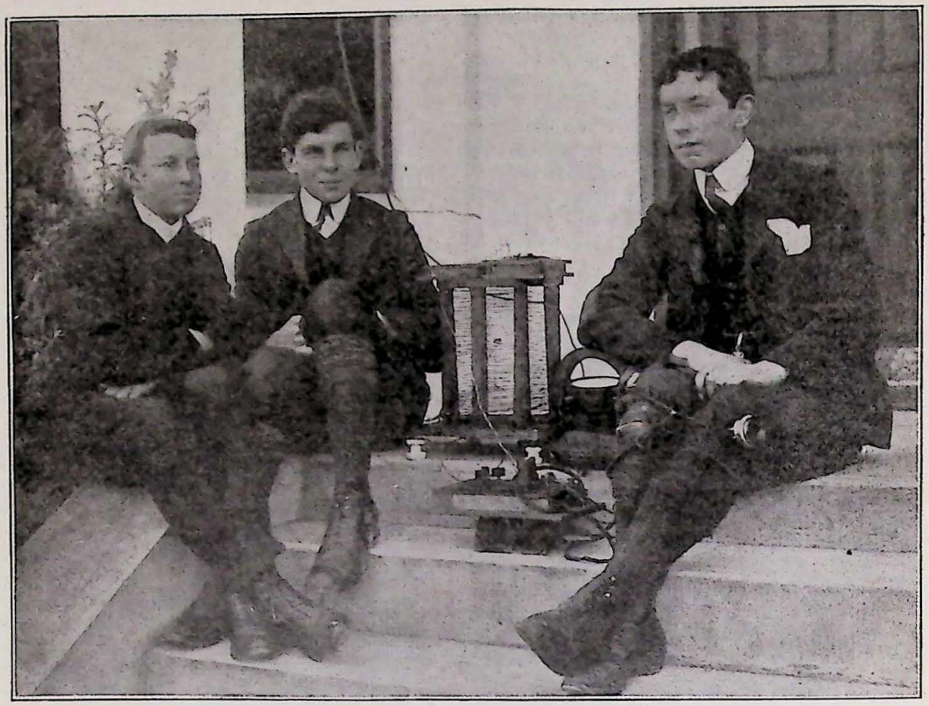
904. **Interrupter for Coil.** E. R. P., Roxbury, Mass., asks: (1) I am making the 4-inch coil described in the April, 1908, issue of ELECTRICIAN AND MECHANIC, and I have thought of the following interrupter instead of the one described. Do you think it practicable and good for the coil, that is, would the insulation be liable to a breakdown? A small ratchet of fifteen teeth is geared on to a gear of sixty teeth by a pinion of six teeth, which is attached to shaft of small motor of one thousand revolutions per minute. The ratchet bears on a spring, drawing same away from contact, thus breaking primary circuit; the result would be about twenty-five hundred interruptions per second. Is this possible? (2) In the electrolytic detector would a cup or glass of porcelain, with a piece of carbon in it, do instead of a carbon cup? Ans. — (1) This is one of the most primitive forms of interrupter, being used on coils made by Ritchie fifty years ago. The principal defect is their short life. A host of devices for the purpose has been invented, and it is hard to state which gives the most trouble. All are bad enough. A common laboratory form is one which uses a platinum wire dipping into a cup of mercury. Vibration of this point just into and out of the mercury is kept up by an ordinary electric bell arrangement, various rates being secured by adjustment of a counter-weight. About 2 inches depth of glycerine on the mercury keeps down the spattering and burning. (2) It is perfectly easy to make a small carbon cup by boring a hole in a piece of arc light carbon.

905. **Telephone-wiring.** H. B. N., Lamont, Okla., asks if any interference with the transmission of messages will result if telephone wires are run through underbrush and young trees? Ans.—Yes, but the trouble will be principally felt in wet weather, when the wood is a partial conductor.

906. **Reversal of Polarity.** P. A. S., Sagamore, Pa., writes of his experience and difficulties in running a particular compound wound 500-volt generator in parallel with other generators, and when the load is light, in running it alone. This particular machine has no adjusting shunt across the terminals of the series coil, and the result is so strong a series field that when carrying a load of 400 amperes the voltage is so high as to require the insertion of considerable resistance in the shunt field winding by use of regular field rheostat. Under such conditions the circuit breaker often opens as if showing an overload, and on one occasion the polarity of generator was reversed. He asks for a simple statement of the method of correcting the polarity; also for the proper order of closing the three single pole main switches, when placing machine in parallel with others, and for an explanation of the first-mentioned behavior. Ans. — Your questions are clearly put, and bring out important points of dynamo design and operation. Some mention of these principles was made in Chapter XII of our Engineering series. Ordinarily some difficulty will be experienced in operating generators of different "characteristics" in parallel. The degree of saturation of the iron of the field-magnets, under all conditions of load, must be the same, else three will not be an equal distribution of the load. It would appear from your description that the speed regulation of the single generator was not good, and the over-compounding of the field was to offset this defect. To allow this generator to operate alone you can readily apply a suitable shunt to the series coil, a strip of German silver ribbon being commonly employed. This can be connected through a single-pole switch, when desired. When so much resistance is put in the shunt field rheostat, the no load condition of the iron is far from saturation, and when the load does come on, the series field builds it up altogether too much. You must increase the current in the shunt winding and lessen that in the series. Whereas the apparent load may be 400 amperes, the instantaneous actual load may far exceed that figure. To correct the polarity, remove one set of brushes, that is, all belonging to one set, say the positive. It is unnecessary to go to the trouble to remove both sets. Perhaps the common rule to remove all is to insure that a sufficient number be removed and not by some error to leave on some that were inconvenient of access. With some other generator running and connected to the bus bars, and field rheostat resistance of the reversed machine all in, close the equalizer and negative switches,—that is, assuming the equalizer to be on the positive side, — in any case it is the equalizer and the one of other polarity. This act will allow current to flow from the bus bars around the shunt field in the direction to give the desired polarity. If desired, the field rheostat may be turned to give the full strength, but it must be turned back again, so that when opening the main switches, the minimum flash will result. With main switches now open, replace brushes, and start the generator in the ordinary manner, when the polarity should be correct. After adjusting the voltage to the proper value, close first the equalizer switch, then close the single pole main switch of same polarity, readjust voltage, then close other main switch. This order prevents the incoming machine from suddenly assuming too disproportionate a share of the load. The proper share should be controlled by the field rheostat. The cause of reversal of polarity was due to shutting down the generator without first opening the main switches. Some motor that was left running became by its momentum temporarily a generator, and sent current in the reverse direction around the series coil of the compound wound machine, thereby reversing its magnetism.

WIRELESS CLUB

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



CYRIL BRANDON, RAWSON STARK, AND STANTON HICKS OF NEW ZEALAND WITH THEIR RECEIVING APPARATUS

ALTHOUGH Chicago, Ill., has local No. 1 of our Wireless Club, we are pleased to say that there has been a wireless club in existence in Portland, Ore., for a year. The name of this club is "The Rose City Wireless Club," and it has at present thirty members. The names of the officers are as follows: Charles L. Austin, president; William Anderson, vice-president; Dolph Thomas, secretary; D. Schanafelt, treasurer.

* * *

WE have just completed the installation of a 2 kilowatt Wireless Station in Pawtucket, R. I., which will be in operation daily after January 1, 1909, from 10 to 12 A.M. and from 8 to 10 P.M. As this station will be more for experimental than commercial purposes, we will willingly answer all members of the Wireless Club in our vicinity who use the call N. E. B.

* * *

OUR mast is 90 feet high and the total length of the aerial is 200 feet; with this we are able to obtain a wave length of 225-320-630 meters. We are much interested in the Wireless Club, and hope to help it as much as we possibly can. G.

* * *

THE picture at the head of this page represents three of the newest and most remote members of our Wireless Club, Rawson Stark, Stanton Hicks, and Cyril Brandon, who live in the far distant colony of New Zealand. New Zealand is a portion of the British Empire, in the whole of which the Marconi Wireless System is a government monopoly, and consequently Wireless experimenters must obtain a government license. The consequence is that there were no Wireless Stations for experimental purposes in this country until recently. Mr. Stark made a trip to the United States a few years ago and became interested in Wireless. On his return he interested a couple of his friends, and by means of books in the Public Library they learned something about Wireless and began to experiment. It is unnecessary to tell the story of their difficulties. Suffice it to say that they succeeded, and now possess well-equipped sending and receiving stations, a photograph of one of which is shown on the opposite page.

* * *

ON September 10 they had a semi-public exhibition of their stations, and the mayors of Dunedin and Ravensbourne and West Harbour communicated with each other by means of these stations. Messages were also sent to the Postmaster-general of New Zealand and to the Prime Minister, and Parliament. Complimentary replies were received from these latter officials, and the government telegraph officials who were present pronounced the installations decidedly successful.

* * *

MOST of the papers of New Zealand have published photographs and descriptions of the workers and their stations, and the government has tacitly given them permission to continue their experimenting without license. Others in the colony have become interested, and it is probable that a number of experimental stations will shortly be in full operation in this country.

* * *

INASMUCH as these young men had to manufacture every portion of their apparatus themselves, the description of it may not be uninteresting.

* * *

RECEIVING apparatus has a modified Massie Detector, the tuning coil is 115 turns, No. 14 annealed copper wire, wound on an octagonal frame 36 inches in circumference, and spaced 1-8th inch apart. The condenser in circuit has a capacity of about .015 microfarad. The aerials consist of wires hung to poles from 40 to 50 feet high; the wires were let into the houses through broken bottles or pieces of glass tubing. One of the sending coils was a 10-inch coil with a home-made mercury brake, the other was a 6-inch coil over twenty years old, picked up in a junk shop. The spark-gaps were home-made, from pieces of cadmium rod, and were found very efficient, the inductances were also home-made, and the power was furnished by home-made storage batteries.

* * *

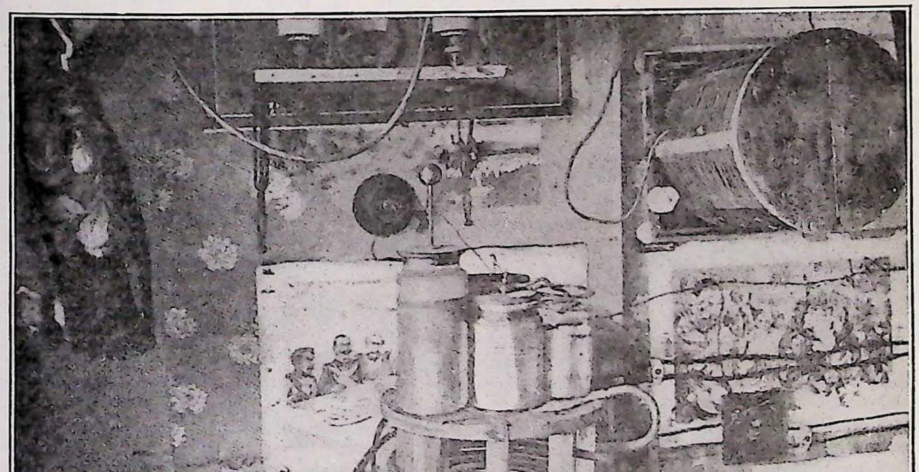
WE hope to present some more photographs of these stations next month, and will say that the whole plant without the 10-inch coil cost but $17.

THE first post-office wireless station in England was opened by Postmaster-general Buxton on December 11, 1908. The station is situated at Bolthead, on the Devonshire coast, and is intended primarily for communication with ships at sea. Mr. Buxton, in a speech at the opening, intimated that a series of similar offices would be scattered throughout the United Kingdom.

* * *

ONE of the noteworthy features of the Sportsmen's Show recently held in the Mechanics Building, Boston, was a novel wireless telegraph exhibit under the auspices of the Acme Wireless Construction Company of Cambridge, Mass. Equipment of this type is now guaranteed to operate successfully over distances of about 30 miles in the woods and from 60 to 150 miles in the clear. The wave length used is about 1500 meters.

The equipment consists in the main of a transmitting helix with adjuster for tuning the helix and antenna to the desired wave length, a transmitting key designed to carry the current necessary to operate the equipment, a power plant consisting of a $2\frac{1}{2}$-h.p. gasoline engine and a 110-volt, 15-amp generator specially designed for close regulation under inductive load, a loosely coupled receiver, transformer, and aerial. All this apparatus is portable and the largest piece carried separately weighs only 50 pounds. The aerial consists of from 5 wires up, suspended horizontally above the ground at a height of from 80 to 100 feet, and about 80 feet long, deadened on each side to trees. The wire preferred for this service is No. 12 rubber-covered. The voltage at the base of the antenna averages from 40,000 to 60,000. The cost of a set of this type is about $600.



WIRELESS STATION OF STANTON HICKS

BOOK REVIEWS

PRACTICAL INDUCTION COIL CONSTRUCTION. By John Pike, London, Percival Marshall & Co. Price, 50 cents. Illustrated.

This is a very excellent practical handbook which goes with some thoroughness into the theory of the construction of an Induction Coil made for practical use. The coils whose construction the author describes will give a 9-inch spark, and with care can be made by any amateur.

ALTERNATING CURRENT MACHINERY. By William Esty, S. B., M. A. Illustrated. Chicago, American School of Correspondence. Price, $3.

This lucid description of Alternating Current Machinery is written for the student. It assumes that the reader has some acquaintance with the simple elements of electricity and mechanism, but does not involve any complicated mathematics. Clearness of expression has been sought for throughout, and the book can be thoroughly recommended.

PRACTICAL LESSONS IN ELECTRICITY. Illustrated. Chicago, American School of Correspondence. Price, $1.50.

This book is an example of the practical instruction offered by the American School of Correspondence, and contains four chapters, "The Elements of Electricity," "The Electric Current," "Electric Wiring," and "Storage Batteries," which, although somewhat unrelated, are all of great practical value. It also contains examination papers of the subjects which should be of great value as showing the degree of proficiency the student has attained after studying the chapters.

HOW TO UNDERSTAND ELECTRICAL WORK: A Simple Explanation of Electric Light Heat, Power, and Traction in Daily Life. By William H. Onken, Jr., and Joseph B. Baker. With a Dictionary of Electrical Terms prepared by Joseph H. Adams, and many illustrations. New York, Harper & Brothers, 1908. Price, $1.75.

This book tells us how and why "the wheels go round" when the force that drives them is electricity. We know that trolley cars are impelled by an electric wire, we recognize the third rail of electric trains when we see it spitting flame in snowy weather, we hear of powerful electrical furnaces, and at home we read and sometimes cook by electricity. The question that every one naturally asks is, "How is it done?" The object of this book is to tell this story. The book differs from many "descriptions" of electrical appliances because it is written by practical men, and because there is no popular book on the subject so thorough and complete. The language is simple, everyday language, which requires no special knowledge for comprehension. Some of the chapters are entitled, "Electricity in the Home," "On the Farm," "In the Hospital," "On Shipboard," "In Mining," "Electricity the Protector and the Destroyer." Fully illustrated from photographs, drawings and diagrams.

ELECTRIC FURNACES: The Production of Heat from Electrical Energy and the Construction of Electric Furnaces. By Wilhelm Borchers, Privy Councillor, Doctor of Philosophy, Professor of Metallurgy and Director of the Institute of Mines and Electro-Metallurgy at the Royal Technical College, Aachen. Translated by Henry G. Solomon, A. M. I. E. E., Consulting Electrical Engineer. With two hundred and eighty-two illustrations. New York, Longmans, Green, & Co., 1908. Price, $2.50 net.

Dr. Borchers has probably done more work on the electrical furnace than any other experimenter, and nobody could be more competent to write the history of this subject. The electric furnace is to-day playing a tremendous part in industrial development, and this book affords the only complete description of methods and processes in this field. The application of electric furnaces in the metallurgy of iron, steel, aluminum, magnesium, and the alkali metals, and in the production of abrasives, is not only one of the most important branches of electro-chemistry to-day, but bids fair to be far more so in the future. This book, consequently, is one which every electrician should read and possess.

ARTIFICIAL ICE-MAKING AND REFRIGERATION. By Louis M. Schmidt, Ph. B., Third Edition, revised and enlarged. Illustrated by two hundred and five engravings. Philadelphia, Philadelphia Book Company, 1908. Price, $3 net.

This book, now in its third edition, may be regarded as one of the standard treatises on the subject, and covers very thoroughly the science of refrigeration, as it is understood to-day. There is no information which the engineer in charge of a refrigerating plant may need which he will not find in this book. Not only is the history and theory of the subject very completely treated, but all the practical systems at present in use are carefully described and illustrated.

THE MECHANICAL WORLD POCKET DIARY AND YEAR BOOK FOR 1909. Containing a Collection of Useful Engineering Notes, Rules, Tables, and Data. Manchester, Emmott & Company, Ltd. Price, 25 cents.

The twenty-second volume of this most valuable and handy pocket diary for the engineer contains all of the valuable information of former editions completed and brought up to date in the light of the most modern mechanical products. This should be of great value to every engineer.

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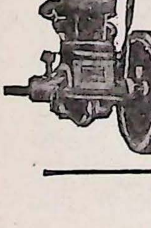

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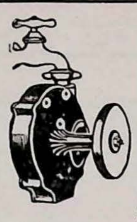

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