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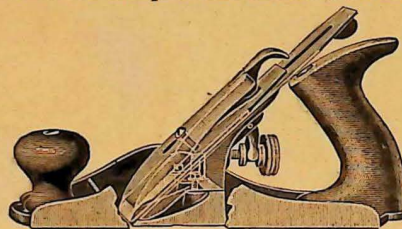
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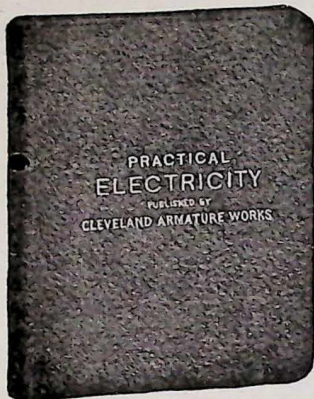
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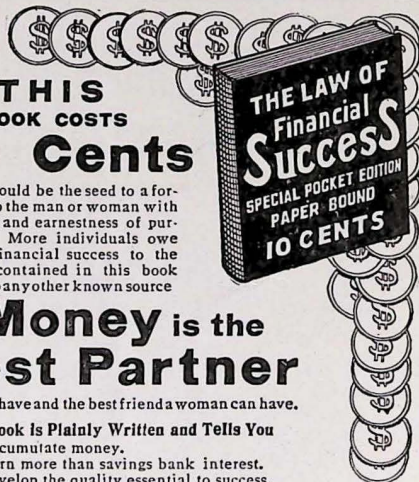
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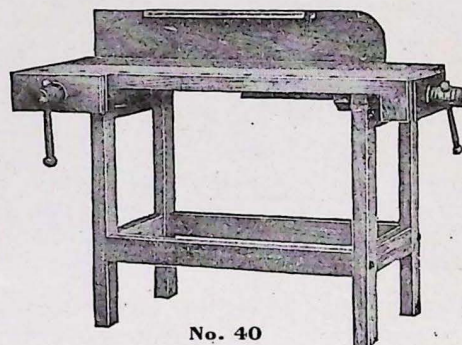
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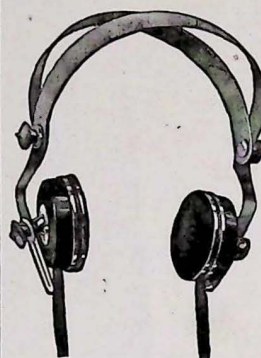
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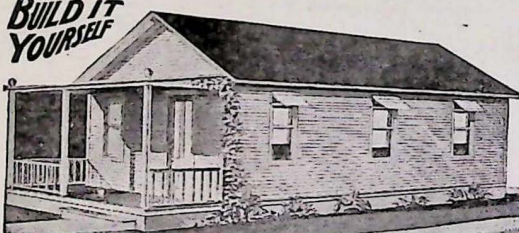
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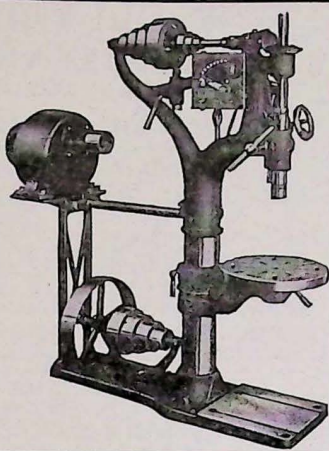
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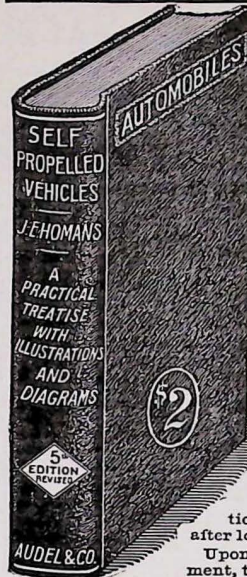
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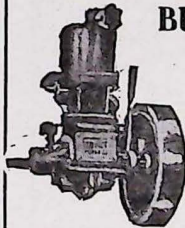
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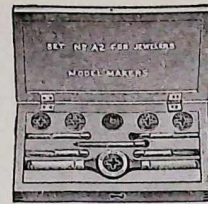
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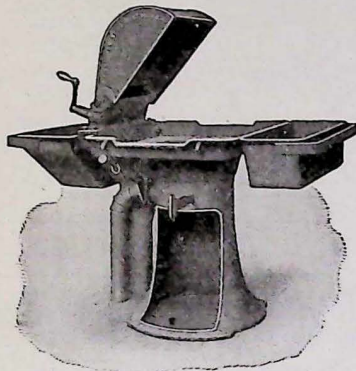
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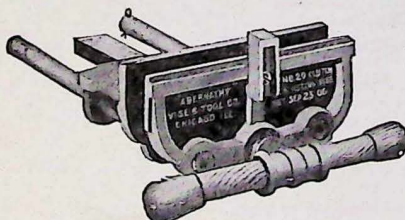
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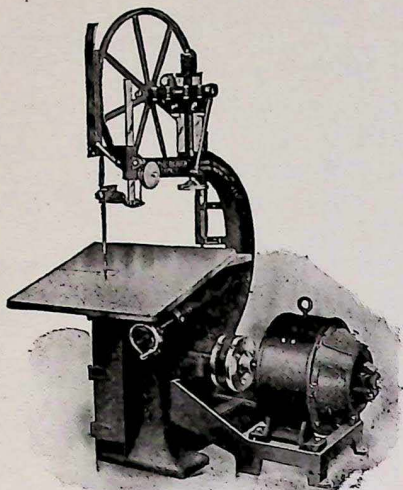
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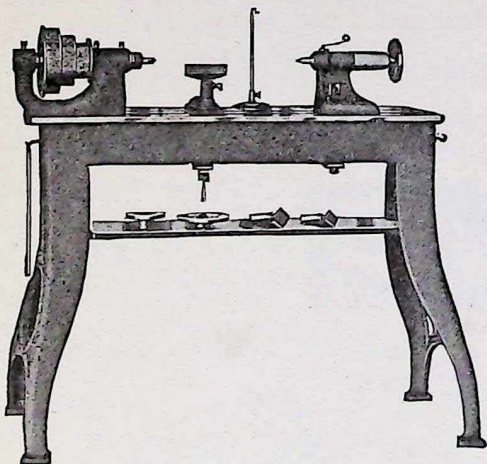
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NUMBER 10

FORGING FOR AMATEURS—Part V

F. W. PUTNAM, B. S.

EXERCISE 3. AN ANGLE IRON

Figure 60 shows an angle iron which is to be made from Norway iron. In bending angles it is usually necessary to make the bend at some particular point on the stock. The measurements are, of course, more easily made while the stock is cold and it is, therefore, best to mark out the stock before heating. Mark the point at which the bend is to be made with a centre punch, usually on the edge of the stock instead of the side. A cold chisel should not be used for this marking unless it is hit very lightly on the edge of the stock. Should a slight nick be made on the side of the piece of stock which is to be bent, and then the stock bent at this point, the nick being on the outside surface, you will find that the small nick will expand, opening up quite a crack in the surface of the stock. If the nick, on the other hand is on the inside of the bend, it very frequently will cause a bad cold line which may extend very nearly through the stock before the bending can be completed. In bending the stock it is very convenient to hold it in a vise, since the piece can then be gripped at the exact point where the bend is to be made. If the bend is to be made over the anvil then the stock should be laid flat on the face of the anvil with the point where the bend is to come almost up to the outside edge of the anvil. Hold the bar down firmly on the anvil by bearing down heavily on it with a sledge, as shown in Fig. 61.

The sledge should be placed so that the outside edge of it is about in line with the outside edge of the anvil. By this means it is easily possible to make a short bend with much less hammering than when the sledge is not used.

Fig. 60 shows an angle having the outside corner forged up square. There are several ways in which the stock may

be bent to finish in this shape. The first way is to take a piece of stock of the required finished size and bend the angle, forging the corner square, as it is bent. If this method is used, the following is the process to be gone through with: First bend the bar so that it forms very nearly a right angle, keeping the bend as sharp as possible as shown at A in Fig. 64. This must, of course, be done at a high heat, since it is much easier to bend the iron at a high heat and consequently a sharper bend would result. The iron should again be heated nearly to a white heat and the outside of the bend forged into a sharp corner, using the hammer in such a way as to force the iron out where it is needed. Be careful not to let the angle bend in so that it becomes less than a right angle or even equal to one. At B, Fig. 64, is shown the proper way to strike, the arrows indicating the direction of the blows. Be careful that the stock rests on the top of the anvil while this is being done and do not allow it to project over one corner, since the stock would then be probably hammered too thin. The angle must be kept greater than a right angle, because the metal at the corner of the bend is in reality being upset. In Fig. 65 is shown the bent piece held on the face of the anvil. The blows from the hammer are supposed to come on the bend A in the direction indicated by the *heavy* arrow. The metal which has been heated to a high heat at C will upset part of it, causing it to form the sharp outside corner and the remainder flowing as is shown by the *smaller* arrow at C and making a sort of a fillet on the inside corner. Now, if the obtuse angle had been allowed to become an acute angle as is shown in Fig. 66, the metal which is forced downward by the blows of the hammer on A would take with it a portion of the metal on the inside of

the bend B and a cold crack would probably be formed on the inside of the angle. To forge a perfectly sound bend then, the corner must be forged at an angle greater than a right angle. When the stock has been brought to a sharp square corner, the remaining step is to square up the bend over the edge of the anvil.

The second method of making a bent angle with a forged square corner is to first start with stock which is considerably thicker than the finished forging is to be, and then draw down both ends to the required finished thickness, leaving a thin, sharp pointed ridge straight across the bar at the point where the bend is to come, this ridge, of course, forming the outside or square corner of the angle, where the stock is bent. If desired, this ridge may be formed by upsetting the stock.

Fig. 67 shows this method of forging a bar. The dotted lines indicate the size of the original piece, the ridge being shown at C. When the bar is bent, the ridge C is to form the outside sharp corner of the angle. For light work the first method will usually be found to be the more satisfactory. At A in Fig. 60 is shown the position of the ridge which would be left by hammering down the stock from this point or by upsetting the stock if the second method just described is used. It will be noticed that the angle shown in Fig. 60 has two tapering sides, forming the inside angle which is somewhat greater than ninety degrees. The bend should be made first and the square corner completed at B before the legs or sides of the angle are tapered. A piece of stock six inches long will be sufficient for this exercise, since the stock at the ends of the legs is only $\frac{1}{4}$ in. in thickness, instead of $\frac{3}{8}$ in. the original thickness of the bar used. The excess stock should be kept all on one face. Where a vise is not handy, I find the Hardie hole to be very useful for holding the stock when being bent.

EXERCISE 9. A BRACKET ANGLE IRON

This exercise is very similar to that shown in Fig. 60, but requires much more care in the filling out of the sharp corner at A, since the stock is much thinner near this corner. If the stock is upset to form extra stock for the bend,

it will appear as shown in B of Fig. 68. If the bar has been upset, it should then be reduced so as to have one straight surface as shown at C of Fig. 68, the upper surface being hammered in about the same shape as shown, the ridge coming at D. The $\frac{1}{4}$ in. holes should not be punched until the angle is entirely finished. The edges of the legs are to be bevelled slightly as shown. This can be done partly with the hammer and then finished with a fairly coarse file with the angle held in a vise.

The next exercise to be taken up will be that of making bolt heads, but as one method requires the welding of a piece of stock to a round bar to form the head, I will first take up the beginning of the work on welding.

WELDING

The process of welding consists of heating the faces of the two pieces to be joined until they are at what is known as the point of fusion, which is called the welding heat, and then uniting them by quick sharp blows of the hammer. The temperature of wrought iron when at a welding heat is usually about 1,900 degrees Fahrenheit. A piece of wrought iron or mild steel when it is heated becomes softer and softer as the temperature increases, until at last at the above named temperature a heat is reached at which the iron becomes so soft that if another piece of iron which is at the same time heated to the same point touches it, the two will stick together. Should the iron be heated much beyond this point it will burn. The appearance of the metal when the welding point is reached is nearly white and when exposed to the air it will give forth scintillating sparks. It will also give forth a slight noise similar to that produced by the escape of a small jet of steam. The metal becomes practically semi-liquid and these semi-liquid particles of the metal are joined as they are welded into the same conditions of close contact that they have in other parts of the bar. All metals cannot be welded in the sense in which the term welding is usually understood. Some metals on being heated will remain very dense and will retain almost their initial hardness until a certain heat is reached, when a very slight increase in temperature will cause them

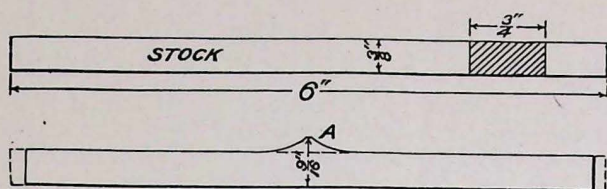


Fig. 60.

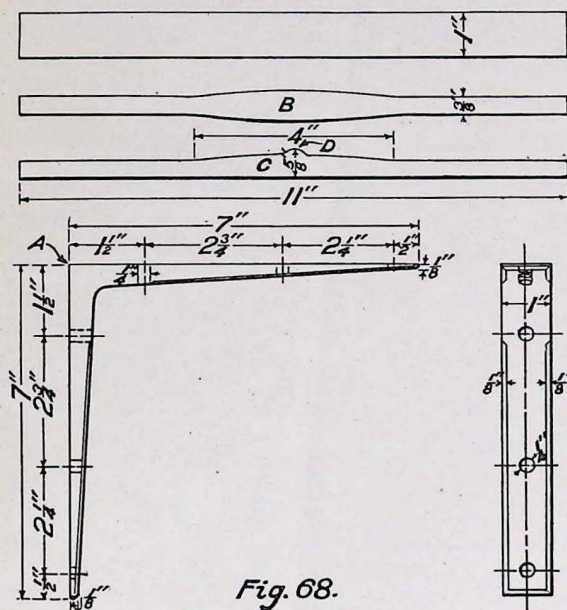


Fig. 68.

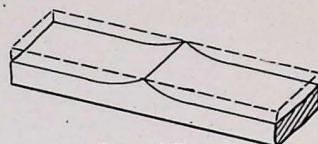


Fig. 67.

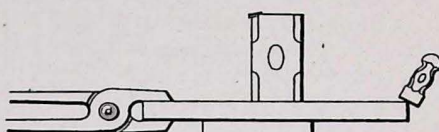


Fig. 61.

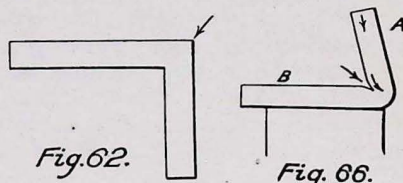


Fig. 62.

Fig. 66.

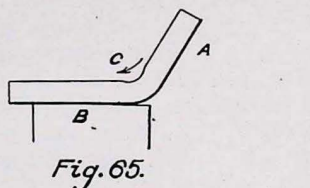


Fig. 65.

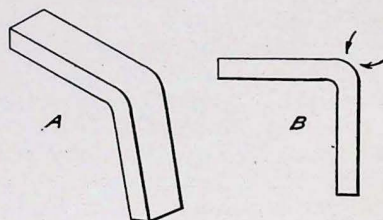


Fig. 64.

to either crumble or melt. We usually consider that only those metals can be welded which, with an increase of temperature, will become gradually softer, changing slowly from the solid to the liquid state. This fact will be found to be true, that the greater the range of temperature through which the metal remains in its semi-liquid or pasty form, the more easily may it be welded. The greatest trouble met with in welding is the inability to heat the metal properly. A clean bright fire is an absolute neces-

sity or the result will be what is known as a dirty heat; by that I mean that small pieces of cinders and other dirt will stick to the metal and thus get in between the two pieces and so cause a poor weld. If the two surfaces to be welded form a pocket upon being brought together, then the same difficulty of welding will be met with. If iron is heated to any temperature above a cherry red, its affinity for oxygen increases. When it is a straw color, or hotter, this affinity is very great, and

results in the formation of an oxide of iron, known as *scale*. This scale as it forms on the surface of the metal between the time when it is drawn out of the fire and the completion of the weld will effectually prevent the union of the metal wherever the scale is present.

In saying that the temperature of iron when at a welding heat is 1,900 degrees Fahrenheit, I do not mean to infer that the welding of all metals is done at the same temperature. I have spoken of the necessity in welding of a certain condition of pastiness of the surface. If this condition is not reached, welding will fail, due to excessive oxidation. Now, the temperature of this special condition of pastiness will vary with the composition of the iron, consequently irons having different welding points cannot be thoroughly welded to each other in an oxidizing flame. In order to prevent the formation of this scale and to permit the welding of irons of different compositions, a flux is generally used, a flux being understood to mean a substance that aids in the fusing of metals. Too much care cannot be used in welding. If the pieces are not heated to a high enough temperature, they will not stick and no amount of hammering will weld them. On the other hand, if they are kept in the fire too long and heated to too great a temperature, they will be burned and burned iron is of course absolutely useless for welding. Care must be taken to heat the iron slowly, so as to insure its heating evenly all the way through. If the iron is heated too rapidly the outside may be at the proper heat, while the interior metal is very much colder, and as soon as the metal is taken from the fire the colder metal within and the air without will almost instantly cool the surface to be welded below the welding temperature, and it will be then too cool to weld by the time any work can be done on it. The two pieces when they are properly heated for welding should feel quite sticky when they are brought in contact. When welding is to be done, be sure that everything is ready to use before the iron is taken from the fire. All of the tools should be in a box where they may be picked up instantly. The face of the anvil should be perfectly clean and the hammer should be in such position that

it will not be knocked out of the way when the work is placed on the anvil for welding. One very important thing in welding is to have tongs which perfectly fit the work and they should be held in such a way that the pieces can be easily placed in the exact position for welding without changing the grip or letting go of them. When everything is ready, the blast should be shut off, if power blast is used. The pieces should be taken from the fire and placed together on the anvil and tapped slightly on the edge of the anvil to remove whatever scale may have formed and then welded together with sharp, rapid blows of the hammer. After the pieces are once stuck together, the thin parts should be hammered first, since these are the parts which naturally cool the quickest. It is often said that a bar of iron cannot be burned. This, however, can be easily disproved by heating a bar of iron in the forge, using considerable blast until sparks are seen coming from the fire. These sparks which are quite unlike the ordinary ones from the fire are white and scintillating and appear to expand and form little white stars. These sparks are small particles of burning iron which have been blown upward out of the fire. If the bar of iron is taken from the fire at the time these sparks appear the end of the bar will look white and sparkling. If the heating be continued long enough after this point is reached, the end of the bar will be partially consumed, forming lumps similar to the clinkers taken from a coal fire. In order to burn iron, there are two things which are essential. First, a great enough heat and second, the presence of oxygen. Care must be taken not to have too much air from the blast go through the fire, since a large amount of scale will be formed. If the fire is not an oxidizing one, the danger of injury to the iron by burning and the forming of scale is consequently lessened. Iron which has been over-heated and partly burned is brittle and crumbly and has a rough, spongy-like appearance.

I have spoken of the use of flux for welding. For welding iron, clean river sand or powered sand stone will be found to make a good flux. It is absolutely useless, however, for welding steel or steel and iron. Borax is generally used

for this purpose. The flux should be applied first before the metal reaches the welding heat, no matter what the temperature of that heat may be. This flux will melt on the surface of the metal forming a slag, and this covers the surface to be welded and prevents oxidation. When the two surfaces are brought together and subjected to a pressure, or blows, this slag flows or is pressed out from between these surfaces and actual contact is then secured. The scale or iron oxide which is frequently formed on the surface to be welded is not fluid except at a very high heat. If a flux is not used the iron must be brought to high enough heat to melt this oxide, which is then forced from between the welding pieces by the blows of the hammer. When ordinary iron is welded, this heat may easily be reached without injury to the iron, but certain machine steels and especially tool steel cannot be heated to a high enough temperature to melt the oxide without burning the steel. The flux has a double action. In the first place, as it melts it flows over the piece and forms a protecting covering, which prevents oxidation and also when raised to the proper heat will dissolve the oxide that is already formed. It will be found that the oxide will melt at a much lower heat when combined with the flux than without it. To melt the oxide is the principle use of the flux. Of course, borax contains considerable water which causes it to bubble up when heating. If the heating is continued at a high temperature, the borax melts and runs like water. This melting borax when cooled is called borax glass. Sal ammoniac mixed with borax will be found to clean the surface better than borax alone. I usually use one part of sal ammoniac and four parts of borax, particularly when welding tool steel. There are several patented welding compounds on the market and most of them have borax as a basis. The flux does not in any way aid in sticking the pieces together as would cement or glue, but is used principally to help melt the oxide already formed and to prevent the formation of more.

The next article will take up in detail some simple exercises on welding. At this time I think it would be well to give a brief summary of what has been covered in these articles up to the point of

welding and I therefore give below a series of simple questions with answers on Iron and Iron Working, Fuel and Iron Forging.

IRON AND IRON FORGING

What metals are most used in blacksmithing? Ans. Wrought iron and steel.

What is the chemical difference between cast iron, steel, and wrought iron? Ans. Cast iron contains most carbon, steel much less, and wrought iron the least.

What is the character of cast iron? Ans. Cast iron cannot be forged or welded, and breaks under the hammer, showing a crystalline fracture. Can be melted and run into moulds.

What is the character of steel? Ans. Steel can be forged and welded and can be hardened and tempered for tools.

What is the character of wrought iron? Ans. Can be easily forged and welded but cannot be hardened. Fracture shows fibres.

How is cast iron obtained? Ans. By smelting from the ore, and is usually run into pigs containing from 2 to 5 per cent. of carbon.

How is iron produced? Ans. By puddling cast iron which expels the carbon. Perfect wrought iron has no carbon.

What is malleable iron? Ans. Cast iron that has been treated so that it will bend without breaking. It is produced from charcoal, pig iron, and scraps of wrought iron, melted and cast; then annealed in an oven or muffler.

Why is it unfit for smith's work? Ans. It cannot be forged or welded and has no fibre.

For what are steel and wrought iron generally used? Ans. Steel is used principally for tools. Wrought iron is used for all parts of building work exposed to bending or liable to receive a sudden shock.

What is a hot-short and cold-short iron? Ans. Hot-short is brittle when heated; cold-short works best when heated.

How can the quality of wrought iron be tested? Ans. By bending cold; heating; nicking with chisel; and breaking. By the character of the fracture the quality of the iron can be determined.

Is the exterior appearance any guide to a choice? Ans. No. The surface shows only the quality of the workmanship in manufacture, and very poor iron may have a good exterior.

Is the appearance of the fracture a certain guide? Ans. Iron is considered good if the fibres are drawn out in breaking instead of showing crystals. But a slow break will show fibres and a sudden one crystals.

What is the usual effect of heat on metals? Ans. They are made softer and able to be beaten thin, and melt when heat is sufficient.

What are the heats observed with iron? Ans. Black heat; low red heat; bright red heat when black scales are visible; white heat when the scales almost disappear; welding heat, when the iron begins to burn with bright sparks and a crackling noise.

At what heat is iron generally worked? Ans. Bright red and white heats.

What is the risk of working at too low a heat? Ans. Injuring the fibres of the metal.

What is the risk of working at too high a heat? Ans. Burning and permanently injuring the metal.

How are cracks and defects most easily shown? Ans. By heating to a dull red.

How can overheating be remedied? Ans. Careful heating and thorough hammering will sometimes remedy it, but it is not to be trusted.

Why is bar iron sometimes twisted before forging? Ans. To make the fibres, which in common iron are frequently irregular, run straight, and to detect seams in the bar.

What is the effect of dipping heated iron in water? Ans. Pure iron is little affected. Impure iron is sometimes hardened, but otherwise it does harm as it destroys the fibre and crystallizes the iron.

What peculiarity of iron makes it so useful? Ans. It is able to bear heat and cold, in moderation, without loss of strength.

What is the effect of corrosion on iron? Ans. Corrosion, or rust, eats into the surface and interferes with forging and welding.

Can iron be heated without fire? Ans. Rapid hammering will heat it.

What elements are most injurious to iron? Ans. Oxygen (which is in the air), moisture, sulphur, and acids.

What is the effect of rolling and hammering on the quality of iron? Ans. It improves the iron.

Why is round iron generally inferior to other shapes? Ans. Has had less hammering and is usually made of inferior metal.

Can wrought iron be melted? Ans. Not when exposed to the air. It will burn first.

What element determines the capability of melting? Ans. Carbon. Wrought iron melts more easily when it is nearest to cast iron in the amount of carbon it contains.

FUEL

What kind of coal is used for smith's work? Ans. Bituminous coal of good quality.

Why is anthracite coal unfit? Ans. Usually has sulphur in it and has not body enough to give necessary amount of heat.

What fuel is best for small work? Ans. Charcoal or coke.

Why should coal be moistened? Ans. To make it cling together.

Can the sulphur be removed? Ans. Partly by washing.

What care must be taken of the fire? Ans. It must be kept clear of cinders and clinkers; and copper and other metals must not be heated at the same fire as iron.

IRON FORGING

What is the first operation of forging? Ans. Measuring material and comparing with drawing.

What general rule should be used in forging? Ans. To work at lowest heat possible and re-heat seldom.

Should the working heat be the same in all cases? Ans. No. It varies with the quality of the iron.

Why should heat be applied slowly? Ans. So as not to heat the surface before the interior is affected.

How should the soundness of a forging be tested? Ans. By bringing it to a welding heat and working it with a hammer. Some test it cold.

(To be continued)

RECENT CONTRIBUTIONS TO ELECTRIC WAVE TELEGRAPHY

PROF. J. A. FLEMING, M.A., D.SC., F.R.S., M.R.I.

*Pender Professor of Electrical Engineering in the University of London**(Continued from page 386)*

In the next place we have the electric arc method, to which so much attention has lately been directed, employing a continuous current arc with a condenser and inductance placed in series across the terminals of the arc. As in many other cases, the seeds of this invention were sown in the form of discoveries by several workers. In July, 1892, Prof. Elihu Thomson filed a United States

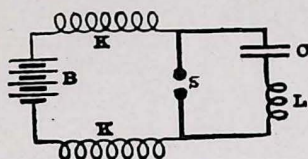


FIG. 8.—Elihu Thomson's method of producing oscillations.

Patent No. 500630, in which he proposed a method for creating high-frequency alternating currents by connecting a condenser and inductance to a pair of spark balls, and this spark gap was also connected through two other inductances with a source of continuous current supply such as a storage battery or dynamo. (See Fig. 8.) An air blast or magnetic field was employed to continually extinguish the continuous current arc formed. The operation of the arrangement was thought to be as follows: When the arc is blown out, or before it is formed, the condenser is charged by the dynamo.* When the arc is re-established the condenser is discharged with oscillations. In the above specification nothing is said about the use of a continuous current arc between carbon poles, but Profes-

*An interesting and not very dissimilar device has recently been described by Mr. S. G. Brown. He employs a revolving aluminum wheel against which a copper spring presses lightly. The spring and wheel are connected through an inductance and resistance with a source of direct current supply, and also by a circuit consisting of a Leyden jar in series with a coil of wire. When the wheel revolves an arc is formed at the loose contact, and high-frequency oscillations are set up in the Leyden jar circuit. (See *The Electrician*, Nov. 23, 1906, Vol. LVIII, p. 201.)

sor Thomson asserts that oscillations with frequency up to 50,000 could be obtained. In 1900 Mr. Duddell showed that if a suitable condenser and inductance were shunted across the poles of a continuous current arc formed with solid carbons, high frequency alternating currents were set up in the condenser circuit and the arc emitted a musical sound. (See Fig. 9.)

Much discussion subsequently took place as to the causes of the effect and as

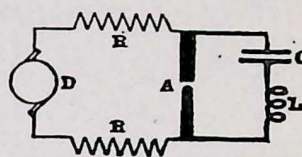


FIG. 9.—Duddell musical arc.

to the highest frequency of oscillation it was possible to secure by this method. Duddell and others based their explanation of the phenomenon upon the known fact that a small decrease in the current through the carbon arc is accompanied by an increase in the potential difference of the carbons. The continuous arc with solid carbons was said therefore to have a negative resistance.*

The explanation of the manner in which the continuous current arc maintains undamped oscillations in the condenser circuit is then as follows: If a condenser and inductance are shunted across the arc, the condenser begins to be charged, and this robs the arc of some current. This change, however, raises the potential difference of the carbon poles and the charging of the condenser therefore continues. When the condenser is full the arc current is again steady.

*The term negative resistance is a very inappropriate term. It is better to call the curve for an electric arc showing the relation of current through the arc to potential difference of the electrodes or poles the *characteristic curve* of that arc, following a usual nomenclature in connection with dynamos. This characteristic is a curve sloping downward when the current is taken as abscissa and the P.D. as ordinate.

The condenser then begins to discharge back through it, and this increases the current through the arc and therefore decreases the potential difference of the carbons. The condenser therefore continues to discharge. The action resembles that by which the vibrations of the column of air in an organ pipe control the behavior of the jet of air from the mouth which impinges against its lip, forcing the jet of air alternately into and

positive charge on that plate. They are, so to speak, sucked into the condenser. Accordingly this action either annuls or reduces the current in the arc. When the condenser is charged to the potential difference then existing between the terminals of the arc, no more electrons enter it, and they then all travel across the arc. This increase in the arc current is accompanied by a fall in the electronic density difference, or the potential difference of the arc terminals, and the condenser then begins to discharge across the arc, and still more reduces this potential difference. Owing to the inductance in series with the condenser, or in other words in consequence of the kinetic energy of the moving electrons, the condenser is not only discharged but charged up again in the opposite direction.*

It parts with the excess of electrons forming the negative charge on its plate in connection with the negative arc terminal and that plate is left with a deficiency of electrons, that is with a positive charge. Then the process repeats itself over again. Two conditions seem necessary for the automatic continuance of this process. First, the arc must be formed with terminals of such nature and in such surroundings that rapid variations of current through it must cause correspondingly rapid and large changes in the potential difference (P.D.) of the terminals in an inverse sense, that is, as H. T. Simon has shown, there must be a steep falling characteristic curve for the arc. (See Fig. 10.)†

Secondly, the arc must have the power of restarting itself if entirely extinguished for a short time, but this should not take place until the P.D. between the termi-

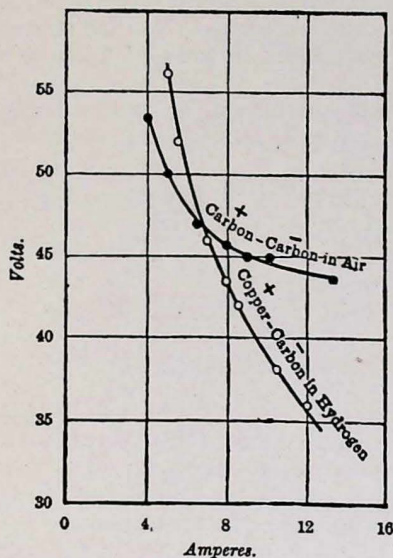


FIG. 10.—Characteristic curves for continuous-current arc in air and hydrogen (Upson) Arc length = 1.25 mm.

outside the organ pipe, and so maintaining stationary oscillations in it. The jet of air from the mouth of the pipe corresponds to the continuous current arc, the closed or open pipe associated with it is a resonant circuit and corresponds with the condenser and inductance.

Consider the state when the oscillations have been set up in the condenser circuit. We must assume that there is a stream of electrons from the negative terminal of the arc making its way across the interspace to the positive terminal. If, then, we consider the state at the instant when the condenser has reversed its charge, so that the coating connected to the negative arc terminal is positively charged, we see that there is a tendency for the stream of electrons to enter the condenser and supply the deficiency represented by the

*The amplitude of the potential difference of the condenser terminals may and does become very much greater than the mere steady potential difference of the electrodes between which the arc is formed. Thus, with a P.D. of 220 or 300 volts across the arc the R.M.S. of the condenser plates may reach 1,000 or 1,500 volts.

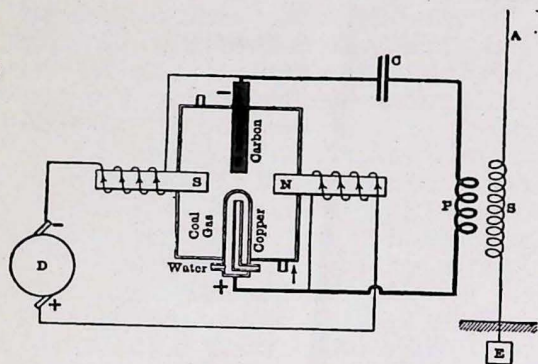
†A careful study of the phenomena of the electric arc between metal and metal and carbon terminals in air and hydrogen has recently been made in my laboratory, under my direction, by Mr. W. L. Upson. It has been found that for an arc between a cold metal and a carbon terminal in hydrogen for the same length of arc, the rate of decrease of terminal voltage with increase of current is always greater than for an arc in air between two carbon terminals.

nals exceeds a certain value, that is, it must not take place too easily or at too low a voltage. If the arc is formed between solid carbon terminals then it appears that these conditions are only fulfilled up to a certain frequency, that is when employing a rather large capacity in the condenser circuit. We then obtain Mr. Duddell's musical or singing arc, which emits a sound because the rapid variation of current through the arc, by varying the energy expended in it, expand and contract the column of incandescent vapor forming the true arc, and therefore the layers of air next to the arc, and hence send out air waves which are heard as sound. Frequencies up to 10,000 or so are possible, although many physicists, such as Bannti, Corbino, and also Maisel, contend that much higher frequencies can be obtained. In 1903 Mr. Poulsen introduced a further improvement. He found that by inclosing the arc in a vessel containing hydrogen or coal gas, and forming the arc between a cold metal terminal, which is the positive, and a large carbon terminal, which is the negative, the arc being also tra-

we can obtain in this last circuit electric oscillations having a frequency of a million or more depending on the capacity and inductance used. If a suitably tuned antenna is connected to one terminal of this condenser, and one arc terminal to the earth, as shown in the diagram, we are able to radiate from the antenna undamped trains of electric waves.

I have before me an apparatus of this kind with which much work has been done in my laboratory during the last few months. It consists of a water-jacketed brass cylinder with marble ends, through which project at one end a thick carbon rod, kept in rotation by a motor, and at the other a water-cooled brass tube with copper beak at the end. An electric arc is formed with 400-500 volts between these terminals taking 6-10 amperes.

The terminals are connected by a sliding inductance and by a condenser. Then, in addition, a long helix of wire is connected to one terminal of the condenser. This helix is tuned to the condenser circuit and may be taken to represent the antenna when the apparatus is used in wireless telegraphy. If we start the arc, then high-frequency oscillations are produced in the helix, and by the action of resonance the potential at the free ends becomes large enough to create an electric brush discharge. There is, of course, a strong oscillatory electric field outside the helix, and vacuum tubes held there, particularly neon tubes, glow brilliantly. It has been contended that these oscillations are undamped and continuous, but I can show you a simple experiment with a neon tube which proves that they are not always uninterrupted. If I hold a neon tube near the helix, and move it rapidly to and fro, you see a broad band of light, due to persistence of vision, but this is cut up by dark lines and spaces. In the same manner if a neon tube is rotated near the helix it does not produce a uniform disk of light, but the disk presents the appearance of radial dark bands and bright spaces. The same effect is seen with a vacuum tube filled with any other gas, provided the tube is sufficiently narrow in the bore. It appears to me that this proves incontestably that the oscillations are not uninterrupted, but are cut



11.—Poulsen's apparatus for creating undamped oscillations.

versed by a strong magnetic field, much higher oscillation frequencies could be obtained than with the double carbon arc in air. (See Fig. 11.)

He also found it is an advantage to rotate the carbon terminal. When this arc is shunted by an appropriate small condenser in series with an inductance,

In other words the volt-ampere characteristic is steeper. Also it has been found that in the case of a carbon arc in air the current can be interrupted for a much longer time without permanently extinguishing the arc than is the case for the metal-carbon arc in air or hydrogen.

up irregularly into groups of various lengths.*

To obtain these high-frequency oscillations the various contributory factors—strength of magnetic field, length of arc, supply of coal gas—have to be carefully adjusted with reference to the capacity and inductance used and the voltage on the arc. No one who has practically worked with the apparatus can say that it is a simple and easy one to use. A very little want of exact adjustment causes the arc to be extinguished or else it fluctuates greatly in current, and compared with the extremely simple appliances required for spark telegraphy, the advantage in ease of working is largely on the side of the spark. But we have to consider whether there are not counterbalancing advantages as a generator of telegraphic electric waves which make up for the increased difficulty of working and greater complexity of apparatus. The claim made for it is that if the transmitter produces undamped continuous oscillations these can be reduced to such small amplitude that they will not affect other neighboring wireless nonsyntonic receivers even if only a little out of tune, but can by the cumulative effects of resonance actuate their own corresponding or exactly syntonized receiver at the same or a greater distance. This claim is based on the known fact that for certain types of receiving circuit, the current created in them can be largely increased by increasing the number of oscillations in the incident train of waves, so that if oscillations or waves are undamped they can make up for feebleness by their persistency. This, however, depends essentially upon the nature of

the receiving circuit, and is only true within certain limits.

When electric waves radiated from one antenna fall on another syntonized or tuned secondary circuit they set up oscillations in the latter of the same period. It might be thought that if these impinging waves are undamped, we should have an infinitely large current produced in the secondary circuit. As a matter of fact, we do not. The electro-motive impulses from the sender only increase the secondary current up to a certain point. The secondary circuit necessarily possesses resistance and other sources of energy dissipation which rapidly increase with the current induced in it. Moreover, when the secondary circuit has an antenna attached, this itself radiates part of the energy it absorbs. Hence it follows that beyond a certain point the energy thrown into the secondary circuit is no longer utilized to increase the current in it, but only just suffices to maintain it. The case is exactly analogous to that of a body being warmed by radiant heat. A thermometer exposed to full sunshine only rises to a certain height.

A comparison between the damped and undamped radiation, to be valid, must be made as follows: Assume that we have two wireless transmitting stations side by side, one sending out intermittent trains of feebly damped oscillations, the other continuous trains of undamped oscillations, and let them be so adjusted that the transmitters take the same mean power to work them. Let the frequency of these damped and undamped waves so radiated be the same. At a distance let there be a suitable movable receiving station, say a ship, with receiver tuned to the same frequency. Then the principal question at issue is, whether the undamped waves can affect this receiver at a greater distance than the damped waves of the same integral energy. Otherwise, at the same distance can the undamped wave station affect the receiver when using less power than the damped wave station? Since however, by assumption the undamped waves from one station have the same integral energy as the damped waves from the other, the latter will have a higher initial value in each train to compensate for their decreased

*Previous experimentalists seem to have been satisfied with examining in a revolving mirror the flaming arc or brush produced at the secondary terminals of a transformer, the primary of which forms the inductance in the condenser circuit, and finding the image drawn out into a band of light concluded that the oscillations were continuous. The neon tube is a more delicate test, and reveals the discontinuity mentioned above. This discontinuity of the train of oscillations seems to depend to some degree upon a want of perfect regularity in the rotation of the carbon terminal. It may also be brought about by the energy transferred to the condenser circuit being radiated or dissipated faster than it is supplied.

value and intermittent cessation. Hence we may ask another question, viz.: What will be their relative effect on receiving stations in their neighborhood not quite in tune with the emitted waves? Can we bring the undamped waves nearer into tune with these out-lander stations without disturbing the latter, than we can in the case of the damped waves, and if so within what ratio of wave length? Claims have been made for a great superiority in this respect in the case of undamped waves, but we are still awaiting quantitative confirmation. Among other assertions it has been stated that the undamped waves are less easily "tapped" to use the newspaper expression. This is a fallacy. With the proper experimental appliances a receiving circuit can be gradually adjusted to any electrical frequency, and when it comes to the right frequency, it must be affected just as much as true receiving stations for which the waves are intended. It is all a matter of apparatus and skill. To illustrate the first point, viz., the effect of the nature of the receiving circuit, we may take an instance from optics. When we look through a telescope at the stars, we can see a certain number down to some limiting magnitude. No amount of prolonged gazing when using the eye as a wave receiver increases the effect produced by a just invisible star. If, however, we use a photographic plate the effect on it is cumulative, and we can by a sufficiently long exposure obtain impressions of invisible stars in countless numbers. The photographic film is a wave detector of quite a different kind to the retina. In the case of the film it can make up by time what is wanting in intensity in the wave motion. In the case of wireless telegraphy it is clear, therefore, that the nature of the receiver has a great deal to do with the possible advantages of undamped waves, and it is not merely a question of the tuning or the transmitter.*

*In order that he may take the utmost advantage of the principle of resonance, Mr. Poulsen uses in the receiver a device he calls a "ticker." This serves to keep the condenser-inductance circuit of the received closed, until resonance has exalted the oscillations to the utmost. The ticker then opens it at intervals and inserts the particular oscillation detector, whether electrolytic or other, which makes the

Again, the ordinary 10-inch induction coil and spark transmitter as used on ships take up one-fifth of a horsepower when in full work, and can send wireless messages 200 miles or more when an appropriate receiver is used. I find it very difficult if not impossible to obtain sufficiently high frequency oscillations by the arc method unless at least 1 or $1\frac{1}{2}$ horsepower is being expended in the arc. Hence, for short distance work on the point of economical working as well as simplicity of apparatus and ease of working the spark method has advantages denied to the arc. We were told not long ago by an eminent electrician that the arc method of creating undamped waves sounded the death knell of spark telegraphy. It is always advisable to exercise some caution in issuing obituary notices of well tried inventions prior to their actual decease, and in this case although the power to create continuous trains of electric waves will doubtless greatly assist space telegraphy, it does not follow that their generation by the arc method is the best or final method.

In the production of continuous oscillations we are not limited to the arc method. Mr. Marconi has for some time past been engaged in developing an ingenious method of creating undamped electric waves for telegraphic purposes which involves neither an arc nor alternator, but is a new mechanical method of great simplicity.

This method is capable of producing astonishingly large alternating currents of very high frequency, in other words, so called undamped or persistent oscillations. I have recently witnessed some of his experiments, and was surprised at the results obtained. Long distances have been telegraphically covered with every prospect of great efficiency. Unfortunately, the incomplete state of cer-

audible or visible signal. In his syntonic receiver Mr. Marconi has adopted a similar plan for he keeps the coherer terminals joined by a condenser which closes the secondary circuit of the receiving jigger. A point of interest not yet considered is whether we do need absolutely undamped waves to gain all the possible practical advantages derivable from them. It may be that very slightly damped trains containing, say, 50 oscillations per train and following each other several hundred times per second will with an appropriate receiver give us all that we can obtain from the use of forced undamped waves.

tain foreign patents prevents me from entering into details of this method now, but I hope he himself will be able to do so soon. Turning then from transmitters to receivers, we may notice one or two recent types. By far the larger portion of electric wave telegraphy was until a few years ago conducted by means of some form of coherer, either requiring tapping or else self-restoring. The coherer in certain forms has the advantage that a current of about 0.1 to 1.0 milliampere can be passed through it, and hence through a relay, so that messages can be printed down by it when using a Morse inker in dot and dash signals. After that came Mr. Marconi's magnetic detector, making use of a telephone to create an audible signal. This is now the instrument employed by him on all long distance work. In Germany and the United States a type of telegraphic wave detector has come into use, commonly called the electrolytic receiver. In one form it was invented in the United States by Fessenden, and called by him a liquid barretter. It was inde-

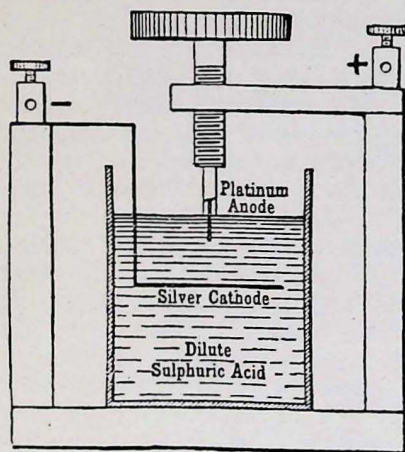


FIG 12—Electrolytic detector.

pendently discovered, and described shortly afterwards in Germany by W. Schloemilch, and is generally there called the electrolytic detector. (See Fig. 12.) It consists of an electrolytic cell or vessel containing some electrolyte, usually nitric acid. In it are placed two electrodes, one a metal or carbon plate of large surface, and the other an extremely fine platinum wire prepared by the Wollaston process, a very short length of which is immersed in the liquid.

A convenient plan is to prepare a Wollaston wire of silver, having a core of platinum which is drawn down until the latter is only one one-thousandth of a millimeter in diameter. If the electrolyte is strong nitric acid, then when the above wire is immersed to the depth of a millimeter the acid dissolves off the silver

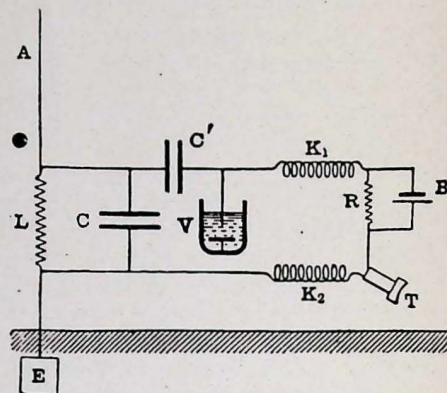


FIG 12A.—Electrolytic detector with shunted cell and telephone.

and leaves the fine platinum wire exposed as an electrode. This cell has its two electrodes connected respectively to a receiving antenna, and an earth plate, and also to a circuit containing a shunted voltaic cell and a telephone. (See Fig. 12A.) The voltaic cell sends a current through the electrolyte in such a direction as to make the fine wire the positive electrode or anode. Some dispute has taken place whether the cell will work when the fine wire is the negative electrode. Fessenden, who adopts a thermal theory of the cell, claims with Rothmund and Lessing that it is equally sensitive, whether the small electrode is positive or negative.

According to one theory, the action of the cell as a wave detector depends on the power of the oscillations to remove the so-called polarization of the electrodes or adhering films of ions. According to another theory it is due to the heating action of the oscillations on the small electrode and liquid in its neighborhood. In any case, the action is just as if the resistance of the electrolytic cell were suddenly changed, either increased or decreased. It has also been found by Rothmund and Lessing that the cell may be made to supply its own electromotive force. If we form a simple polariz-

able voltaic cell with fine zinc and platinum wires immersed in dilute acid and connect a telephone or high resistance galvanometer to these elements; then, when electric oscillations pass through the cell, the current sent by it through the telephone or galvanometer is momentarily increased. That the action is not altogether due to the removal of polarization films is shown by the fact that the fine platinum wire in the Schloemilch form of detector wears away or is dissolved in the nitric acid when oscillations are passed for some time through the cell, and there is some evidence that gold and platinum can be made to dissolve even in dilute acids by the action of electric oscillations.

In 1904 I was so fortunate as to discover another and quite different principle on which a sensitive electric wave detector can be based. If a carbon filament glow lamp has a metal plate carried on a third terminal sealed into the bulb, it is well known that a current of negative electricity flows from the plate

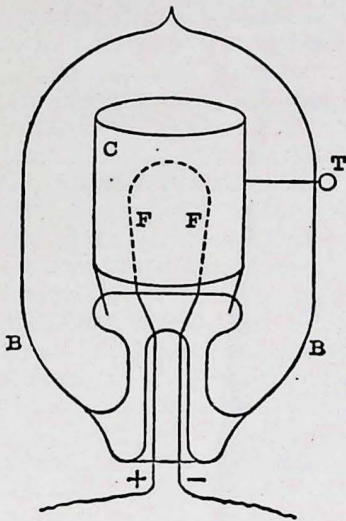


FIG. 13.—Oscillation valve (Fleming)

to the positive terminal of the lamp, when the filament is rendered incandescent by a continuous current. This is the so-called Edison effect. It is also now known that incandescent bodies discharge negative corpuscles or electrons from their surface, and incandescent carbon, when in a vacuum, exhibits this power in a marked degree. Negative electricity escapes freely from it,

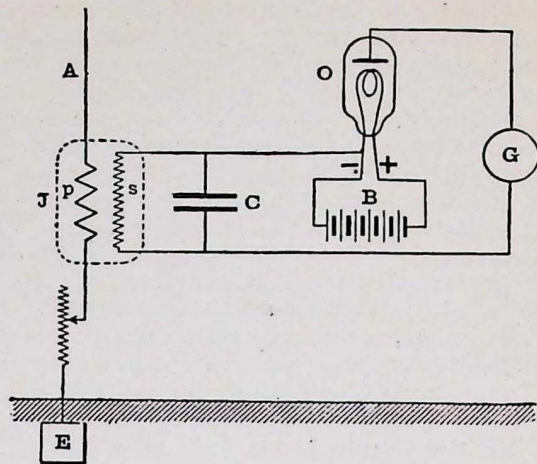


FIG. 14.—Oscillation valve or glow lamp detector used as a receiver in electric wave telegraphy.

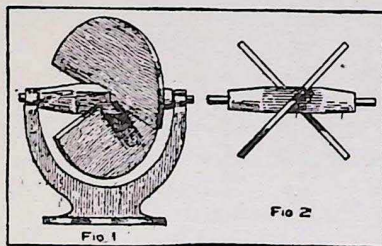
but not positive. In 1904 I was endeavoring to find some way of rectifying electric oscillations, that is, of separating out the two sets of alternate currents and making them separately detectable by an ordinary galvanometer. It occurred to me to make use of a carbon filament lamp, having a metal cylinder insulated in the bulb surrounding the filament, the cylinder being connected to a platinum wire sealed through the bulb. (See Fig. 13.) This lamp was then used as follows: A circuit was connected between the terminal of the metal plate and the negative terminal of the filament, the latter being made brightly incandescent by a small battery. In this circuit a galvanometer and one circuit of a small transformer or induction coil was inserted. On connecting the other circuit of the transformer between an antenna and the earth, I found that the oscillations set up in the antenna caused a deflection in the ordinary mirror-galvanometer. (See Fig. 14.) The action is as follows: The antenna oscillations induce others in the circuit of the transformer, which is in connection with the lamp. A movement of electricity in this circuit, which consists in the flow of negative electricity from the filament to the plate through the vacuum, can take place, since this negative electricity is, so to speak, carried across the vacuous space by the electrons emitted from the hot carbon. On the other hand, negative electricity can

not flow in the opposite direction. Hence the glow lamp separates out the two oppositely directed movements of electricity and allows only one to pass. I therefore called the appliance an oscillation valve. This instrument was shown by me to the Royal Society early in February, 1905, and was employed by Mr. Marconi soon after as a long-distance wireless telegraph receiver, in conjunction with other improvements. M. Tissot, of the Naval College, Brest, in France, has made use of this glow-lamp detector, and with a sensitive galvanometer has received signals at a distance of 50 kilometers.* Employing a special form of transformer, and a telephone in place of a galvanometer, Mr. Marconi has used it for some time past over distances of 200 miles or more, and finds it a very sensitive form of receiver. Since this particular form of electric wave detector was brought to notice by me, Doctor Wehnelt has found that a metallic wire, coated with oxides of calcium, barium, or other earthy metals, may be substituted for the carbon filament in the vacuum bulb.

(To be continued.)

A Novel Windmill

A windmill that can be fixed down to one spot and will run regardless of the direction of the wind, is here illustrated. Mills of this kind can be built of larger size and in some localities have been used for pumping water.



Two semi-circular surfaces are secured to the axle at right angles to each other and at 45 degrees angle with that of the axle as shown in Fig. 2. This axle and wings are mounted in bearings on a solid or stationary stand or frame. By mounting a pulley on the axle with the wings it can be used to run toy machinery.

*See The Electrician, Vol. LVIII, p. 730, Feb. 22, 1907. M. C. Tissot, "On Ionised Gas Electric Wave Detectors."

Varnishes and Varnishing

The use of varnish is of a two-fold nature—first, the preservation of, and second, giving additional beauty to the object it is used upon. In order to obtain the best results it is necessary to use the best materials, and also to know the suitability of the varnish to the article, or articles, to be varnished, as well as the various influences affecting the same.

The variety of kinds, qualities, and values of varnishes is innumerable. The two principal classes are "oil" and "spirit"—the former for durability and resistance to climatic influences; the latter for special purposes, highest brilliance, and hardness of surface, but on account of its brittleness, it should never be used for outside work.

The materials used in the making of varnishes are various gums, resins, etc., dissolved in linseed, cottonseed or nut oils, spirits of turpentine, denatured alcohol, or naphtha, either by a cold process or the application of heat. The quality, durability, and beauty of the higher-class varnishes is dependent upon the greatest care, both in the selection of materials and their skilful manipulation in the process of manufacture. Many of the most popular varnishes also are kept for longer or shorter periods to "mature" before being sent out to customers, and all varnish manufacturers of note keep a careful register of the date, both when "boiled," "bulked," and "bottled"—the date always appearing on the label, the age adding to its value.

The best quality of varnish is made from the finest selected "fossil" resin, and the purest refined Baltic linseed oil at a carefully regulated and steady heat over sand-bath protected furnaces to prevent its firing, and is used for high-class decorations, carriage, and other work, when cost is not the first consideration. It is a slow dryer, but is of great lustre and durability. It should be used in a room of uniform temperature of from 70° to 75°, where all draughts must be rigidly excluded.

A very high-class varnish is made from selected gum copal a small addition of gum dammar (to give elasticity), oil, and turpentine, and is used on good-class work, is suitable for decorators,

etc., and is equally applicable for inside or outside work

The various lower-class varnishes are made from the same kinds of gums, oils, etc., of lower grades and darker shades with the addition of common resin (rosin) cotton, rape, fish and other oils, and the cheaper spirits, such as coal-tar spirit, mineral naphtha, benzoline, and also rectified petroleum, as adulterants, finding purchasers mainly amongst tradespeople and others whose chief object is to get the maximum quantity at a minimum cost, and these qualities, like everything else of the "cheap and nasty" kind, are dear at any price; yet, so long as our ruinous competitive system is pursued, honest, conscientious methods will have to give way to bad workmanship and worse materials.

It might be here pointed out that the more delicate the tint, shade, or color of the object to be varnished, the paler must be the varnish, or otherwise much well-finished work will be spoiled. It is also a mistake to use a dark, opaque varnish upon such self-colors as blue, green, red or black, as it nearly always produces a muddy or blurred finish. Mixed, medium, or "broken" colors are almost the only allowable cases in which these varnishes should be used. Should a varnish prove "brittle" or "too quick" in use, the addition of a very small quantity of linseed oil may be allowed; if "fatty" or "too thick" with age or exposure to air, use a little turpentine, but in all cases where practicable use intact.

Let these points be borne in mind: Always see that every under-coat, whether of paint or varnish, is perfectly dry and hard before applying varnish, or it is apt to "bloom," "sweat," "blister," or "crack," and the same may happen if there is an excess of moisture in the air, or the surface of the work be damp from any cause.

If any surface has stood too long, or become too hard or dry, wipe all over with a damp wash-leather, or rub with a soft cloth on which you have dusted a little whiting

If there are knots, sappy places, or parts that have been touched up, they should be "killed" by a coat of knotting or spirit varnish, or otherwise they will show when finished and the resin in the

knots will come to the surface when exposed to the sun.

Now a word as to spirit varnishes. All quick-drying varnishes, from French polish, brush polish, to floor stains, are more or less spirit, and are made, or should be, by dissolving shellac, sandarac, or other brittle gum in turpentine or denatured alcohol. Sometimes these so-called spirit varnishes are little more than common resin, which is almost valueless as a preservative.

Spirit varnish is used principally upon furniture, floors and for other domestic purposes. A finer class is also used (on account of the hardness of its surface) for pianos and office and other heavy furniture requiring much handling. There is also a spirit varnish used for wall papers, prints, maps, etc., all of which require to be sized before applying the varnish, which should be made with the softer gums and turpentines, by the application of heat.

Do not adulterate a varnish for the sake of cheapening, as any addition of oils, japan, terebene, etc., will spoil the best of varnish when used for such a purpose; but, of course, an exception is to be made in such cases as previously mentioned, for "slowing," etc., alone. If a cheaper varnish is required, buy a cheap one—don't attempt to "let it down" yourself, unless you are an expert and know fully its nature. Always take the salesman into your confidence if you are a novice; tell him what the varnish is for, and he will advise you as to the best varnish to use.

Should it happen that you have some varnish that has been standing for a long time, and it has become ropery in the bottle, place it on a warm stove, add a little turpentine, also warmed, and shake until complete amalgamation takes place before using.

If you wish to re-varnish any surface, after standing any length of time, thoroughly cleanse and rub over with a little weak lime-water, and allow it to dry before applying the new coat. Do not be niggardly in the use of varnish. Give a good "flowing" coat, working it well in all directions with the brush, so as to prevent its running.

Follow all these instructions, and your work will be a success.

—*The Woodworker.*

THE FORGE EQUIPMENT AT THE TECHNICAL HIGH SCHOOL
SPRINGFIELD, MASS.

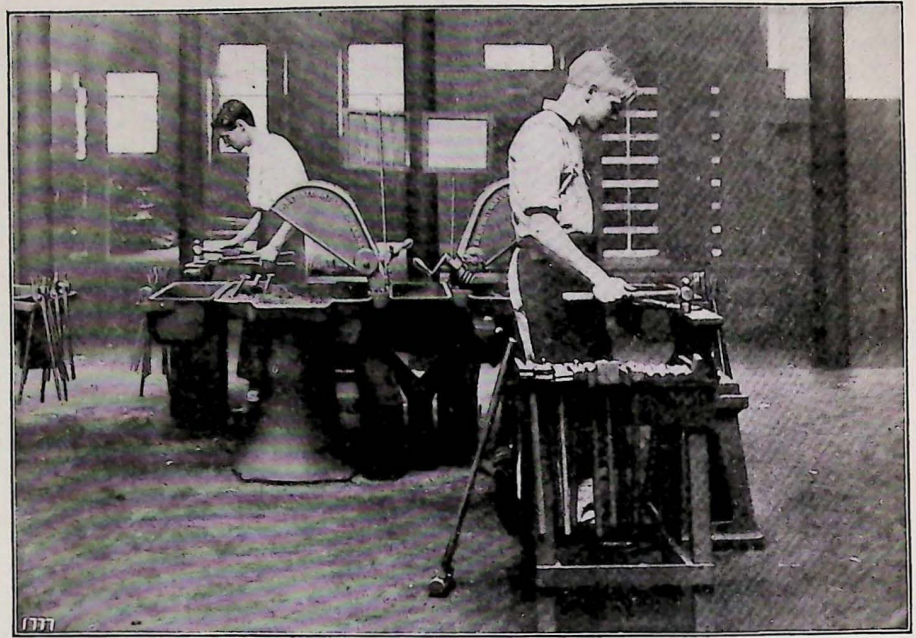


Fig. 1

Special work or service requires special apparatus. This is as true of the equipment of a forge shop as of any other work room, and more so if the forge shop is for instruction. The ordinary blacksmith has a great variety of work to do and naturally his forge is developed to do this

work; the locomotive shop or shipyard must have its forges, but they must be large and in many cases have special devices for heating long and peculiarly-shaped pieces, and such forges frequently must have the tuyeres arranged in sections, each with an independent blast

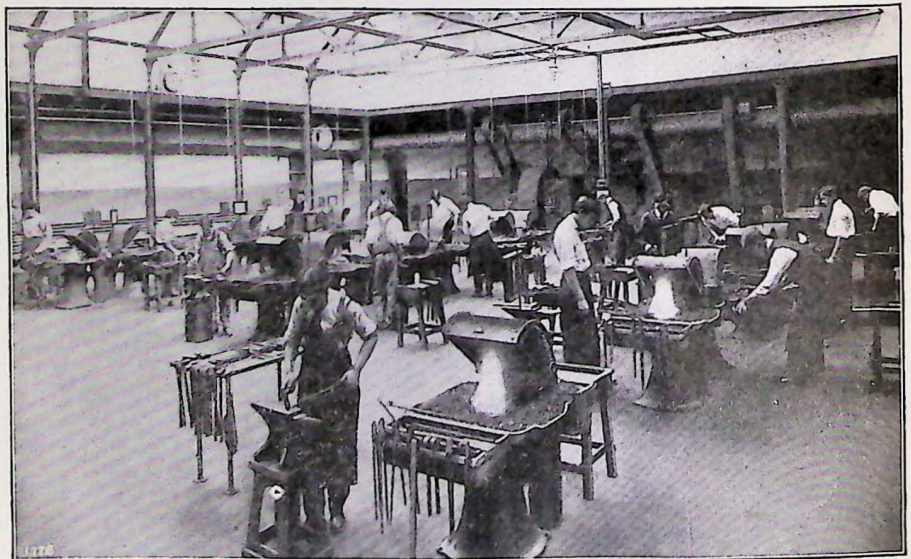


Fig. 2

connection so that the fire may be the whole length of the forge or any part of it.

Thirty years' experience in making and using forges has enabled the B. F. Sturtevant Company to produce forges so highly developed that each becomes a special forge adapted to its particular service. For manual training schools, the Sturtevant forges are of three kinds: the first, the recognized standard, is of cast iron with open base for the reception of a hod to catch the refuse from a dumping tuyere; another, is also of cast iron with four legs in place of the cast-iron base; while the third, of double forge, is of steel-plate construction for base, hearth, and pans. This type can be used in a smaller space than the others, but it costs somewhat more.

In the well known Technical High School of Springfield, Mass., there are nine double and one single cast-iron forges, known as Type H-1. These forges are 29 inches high with a fire pan 26 inches by 30 inches. The coal and water tanks are 24 inches long, 9 inches wide, and 7 inches deep. Each forge is provided with an anti-clinker dumping tuyere. As shown in the accompanying illustration, each forge has a hood with sides of cast iron and back of sheet steel. An inner plate in the hood protects it from the heat of the fire, and brings a portion of the suction to the edge of hood. The hoods are readily adjustable by means of the worm operated by the crank.

In addition to the type H forges there is, for the instructor, a larger forge of type J, 28½ inches high with a fire pan 38 inches by 40 inches. This forge, like the others, has a down-draft hood of the same construction, and a dumping tuyere.

The nine double forges are arranged in three rows, with the blast and hood levers so placed that the students must work on opposite sides of each pair of forges. The anvils are located as shown in Fig. 2. To provide blast for the forge fires a "Monogram" blower, on a platform, discharges downward into a pipe which conveys air to each forge fire by means of 4-inch blast pipe. The pipe is placed in a cement-lined duct as shown.

The atmosphere of the forge room is kept free from smoke and gas by connecting each down-draft hood to the duct

which surrounds the blast pipe. The duct is connected to an 80-inch steel-plate exhaust fan which draws the smoke and gas through the duct and discharges into the atmosphere outside. The blower and exhauster are of sufficient size to care for ten additional forges should it be necessary to install them.

How to Make a Simple Zinc Spark Gap

BERNADOTTE ANDERSON

Perhaps some of our wireless experimenters using spark coils, have never thought how easily an efficient zinc spark gap can be made at a slight cost. Zinc has been found to be the best material for a spark gap owing to its peculiar qualities. The writer has made one which has proven very satisfactory and is as good as those you pay as high as \$1.00 and upwards for.

Secure a piece of well seasoned wood and cut to dimensions 4 x 7 inches having a thickness of about one inch. Bevel the corners and plane the surfaces smooth, after which give same a coat of shellac. When this is dry, a coat of wood stain of any desired color can be applied which will make the appearance better. Next secure two common battery zincs, such as those used in sal-ammoniac batteries, having screw terminals at the ends where connections are made. These zincs when purchased are usually square half of the length and round the other half. If a lathe is at hand, these can be turned down to a round surface, or can be filed down, as zinc is almost as soft as lead. Secure two porcelain cleats of the two-wire kind, with wood screws, and fasten them on the finished board about two inches from each end. Before tightening down, the zincs can be inserted between each of the cleats and the spark gap adjusted and screwed down tight. The gap can be adjusted by loosening up the screws in the cleats and the zincs brought together to the proper position. However, the experimenter will find after once ascertaining the proper gap length, he will not have occasion to re-adjust it.

The government will erect at Washington a wireless tower and station capable of communicating with any ship within 3,000 miles, on the Fessenden system.

WIRELESS INTERFERENCE

ROBERT A. MORTON

The part played by wireless telegraphy in the accident to the steamship Republic has called universal attention to the subject of wireless in general, and to the great progress that has been made in this new method of communication in the few years since it has left the laboratory and become of practical use. The accident has also caused a renewal of the discussion relating to the question of Government regulation of wireless telegraph stations. At the last session of Congress a bill to license all stations and thus to place them in a certain measure under Government supervision was defeated. A bill now before Congress provides for the compulsory equipment with wireless apparatus of all passenger vessels, and because of the present agitation on the subject the measure will no doubt become a law.

Although most of the large steamship companies have already found it profitable to install wireless instruments on their boats, the law will bring a large number of new stations into existence and further complicate the problem that the navy has been facing for some time—the problem of interference. Every year the erection of new stations along the coast seriously increases this difficulty, and in the past two years the construction of dozens of amateur stations has brought matters to such a pass that under the present management of the naval stations the efficiency of the naval wireless system has been impaired to a surprising extent.

Probably no station suffers more from amateur interference than the Charlestown Navy Yard, says the *Boston Transcript*. When the Republic was reported in trouble off Nantucket Shoals, and the naval vessels in the vicinity of Boston were ordered to go to her relief, the interference or "butting in" of amateur stations was responsible for a delay of several hours in the reception of the official despatches. Later, when the revenue cutter Gresham was standing by the Republic, the conversation of the amateur operators prevented communication with the shore stations of the navy. To quote the expression of a navy man, the naval stations about Boston

are "snowed under" by a number of school boys who take to wireless telegraphy as a pastime, and who have constructed stations equal if not superior to those operated by the navy. The question of how much the navy department is to blame for allowing the "kids" to get ahead of them in this way will be discussed later.

In Europe the matter of interference with Government stations has been easily settled. The building of amateur stations is absolutely prohibited, and every commercial station must operate under a Government license. In this country an attempt to regulate wireless telegraphy by means of legislation was made at the last session of Congress. The bill was opposed by the commercial companies, and by the amateurs. The amateur operators around Boston were especially active against the bill. A wireless association was formed, and the members voted on resolutions denying the right of the Government to secure a monopoly of the ether through legislation. Letters were written to congressmen explaining the position of the association; and although the question of just how much the amateurs were responsible for the defeat of the bill is one that will admit of discussion, the incident gives an idea of their strength and organization.

The Navy Department admits the novelty of the situation. No other problem of this nature has ever been encountered, and there is neither statute nor precedent upon which to attack the problem. The official Government despatches are copied by the amateurs as accurately as by the naval operators. At times, when the naval stations have broken down, the amateurs have obligingly handled the Government business and sent and received messages to and from ships at sea. Several of the amateur stations have succeeded in receiving messages from greater distances than the naval stations were capable of reaching, and during the Republic affair the amateurs were among the first to receive authentic reports by wireless. In order to understand the situation from both the naval and amateur standpoint,

it will be necessary to obtain a general idea of the organization of the naval wireless system.

Early in the development of wireless telegraphy the Navy Department was quick to see the importance of this new branch of science because of its utility in regard to the control of naval vessels at sea in times of peace as well as war. It has been claimed that the attitude of the department has not favored the development of commercial systems, but that it has been inclined to regard wireless telegraphy as being of primary importance in naval work. The ships of the navy were equipped with wireless instruments as rapidly as possible, and plans were made for a chain of naval stations at important points along the coast from Maine to Alaska. Since that time the entire navy, including revenue cutters and colliers, has been supplied with wireless apparatus, and the coast stations are increasing in number every year. On land the Government stations are located mainly at the navy yards, forts and lighthouses. As will be shown later, it cannot be said that the efficiency of the naval system has increased in direct proportion to its growth.

The work of the land stations of the navy is of a varied nature. They are supposed to control, and do control to a certain extent, the movements of the fleets. They are required to accept commercial telegrams from ships at sea, to send out weather reports and storm warnings, and to be ready for any case of emergency. Their work is, therefore, of considerable importance, and it is unnecessary to say that the safeguard of life and property at sea should demand that the naval stations be kept up to date, and that the quality of the work should be the highest obtainable.

Another line of stations numbering about fifty has been erected along the coast parallel with the naval system. These are owned and operated by the commercial companies, and are in some cases located within a short distance of the naval stations. Of these stations the United Wireless Telegraph Company owns or controls the large majority. The Marine Transmission Company of Providence has a number of stations along the Sound and on the Pacific coast, and the Marconi Company, controlling the

principal transatlantic lines, operates four stations on this side of the water. A number of new stations for commercial work in the interior are about to be constructed by the United Wireless Company.

Last, but by no means least, are the stations owned by amateur operators, numbering two or three times the combined forces of the navy and the commercial companies. Most of these stations have been designed by schoolboys who started building their apparatus out of all kinds of electrical junk, and who by experimenting and improving, have made remarkable progress. Around Boston alone there are about fifty such outfits that are capable of putting the near-by naval stations completely out of business as far as receiving messages is concerned. In addition, there are probably two hundred smaller amateur stations not powerful enough to make trouble for the navy. A number of firms in Boston make a business of selling wireless telegraph apparatus to amateurs guaranteed to work up to several hundred miles.

The term "interference" as used in connection with wireless telegraphy should be clearly understood. Wireless messages are sent through space in the form of electric waves or vibrations in the ether. The transmitting part of a wireless station contains apparatus for the production of these electric waves, while the receiving part has instruments to detect the presence of the waves and to convert them into readable signals. The propagation of a vibratory disturbance in the ether may be compared with what takes place when a stone is thrown into the water. A series of ripples growing weaker and weaker spread out in all directions. A chip of wood placed near to the centre of the disturbance will be vigorously agitated, while another chip where the ripples can barely be seen will move very slightly.

In much the same way the electric waves fly out from the aerial of a wireless telegraph station in all directions. If the chips of wood are represented by receiving stations, it may be seen that the instruments nearer the transmitting apparatus will be more strongly affected by the electric waves than those at a distance. Thus a message sent from the

Charlestown Navy Yard to a ship at sea will also be received by every other wireless station in the vicinity, and the nearer the station the clearer will be the message.

Now, suppose the navy yard is receiving a message from a ship some distance away, when suddenly a nearby amateur starts to transmit a message. Two separate series of waves will now reach the receiving apparatus at the naval station, as a result of which the incoming message will be rendered unintelligible. While the amateur station is sending, the naval station finds it impossible to receive an outside message. This, roughly speaking, is what is meant by wireless "interference."

In practical work other conditions enter into the question of interference, as the distance and power of the opposing station, together with another factor called the wave length. When the wave lengths of conflicting stations differ by a certain amount, it is possible with the old forms of apparatus still used by the Government, to "tune out" one station at the expense of the other; that is to say, when other conditions are favorable. As a general rule, however, only one station in a vicinity can transmit messages at a time.

The naval and commercial stations, wherever they are situated close together, avoid interference by awaiting their turn. The commercial stations do not "butt in" when the navy is working, and the naval operators respect the rights of their neighbors. In New York harbor, the busiest wireless spot on the coast, the naval and commercial stations carry on their work without difficulty.

With the amateurs, however, the Navy Department meets an entirely different proposition. From early in the afternoon until late at night the navy stations are practically at the mercy of the amateur operators, who call up each other's stations and carry on long conversations on every conceivable topic. Some of the navy operators have copied down pages of this aerial chat, and a portion of the record reads as follows:

"How do you get me today? I am using my new transformer and my helix is hitched up different. How are your batteries holding out? Say, old man, I get you fine as silk. You have the navy

skun a mile. My aerial came down last night, but I fixed it up again. Did you go to that show last night you spoke about? I have been too busy to go to town this week. Have you got any number 32 copper wire? Thought you would drop over last week. Say, old man, I met your lady friend yesterday. Ha, ha! Quit your kidding. Say, do you know the fellow who is putting up a new station out your way? I think he is a ham. Will call you up in ten minutes. Say, old man, must go to supper now, but will be on the rest of the night. O K, O K, will see you later."

This goes on hour after hour, during which time the naval stations are cut off from communication except for very short distances. When important messages are expected at the navy yard, the operator tells the amateurs to "keep out," and if they understand what he says, they will as a general rule stop working for a few moments. But where there are a great number of stations in one locality, as in Boston and at other points along the coast, serious interference is inevitable. The naval operators never know when to expect an emergency call, and it has been stated by navy men that while the amateurs are working a dozen ships might send out the international "C Q D" and never be heard at the Government stations.

A few weeks ago, when the naval stations were anxiously awaiting news of the Republic accident from the naval vessels at the scene, the amateurs were especially active. Several times the navy operators sent out this message: "Will you fellows please stop working for a few hours. A ship out there is in distress." Some of the amateurs did stop as requested, but a number worked their apparatus continually. When the navy objects to the interference in more forcible language, the answers run like this: "Say, you navy people think you own the ether. Who ever heard of the navy anyway? Beat it, you, beat it."

It is only fair to say that many of the amateurs try not to bother the navy, and have at times been of assistance to the naval operators. Yet there are so many chances for unintentional interference that all amateur stations in operation interfere more or less.

Another form of interference for which

the navy and commercial operators are alone responsible has been a cause for recent complaints. This is the abuse of the stations by the operators, who sometimes carry on long and unnecessary private conversations, thus delaying the work of other stations. Officials of the various navy yards have been inclined to regard the navy stations as provided for their personal convenience, and have at times made use of them for unofficial and trivial matters. A case of this kind occurred on Christmas Day of last year, when a message from one navy officer at a certain navy yard to the commanding officer at another naval station wishing "a merry Christmas and a happy New Year," held up all commercial work in the vicinity for over an hour.

It is clear to those who are familiar with the situation that the question of amateur interference can be met in only one of two ways. Either the operation of amateur stations must be prohibited by law, or the Navy Department must take advantage of the scientific progress made in wireless telegraphy in the last few years and equip the naval stations with the latest devices for the prevention of interference. Apparatus that has proved successful in eliminating interference has been on the market for over three years. This same apparatus has been thoroughly tested by the bureau of equipment, and the reports of the tests made by the Government officials substantiate the claims of the inventors.

Considering the importance of the naval wireless system, it is difficult to understand the slowness of the department in adopting improved apparatus. One of the best operators of the navy stated recently that the equipment of the naval wireless stations was three years behind the times. Amateur stations are provided with instruments that entirely do away with the same interference that is making a farce of the work of the land stations of the navy.

Mr. G. W. Pickard of Amesbury, Mass., who has invented a number of the newest wireless telegraph appliances, treats of the amateur problem as follows:

"There are at present a large number, perhaps, fifty, amateur stations in and about Boston. The situation as regards the Charlestown Navy Yard is at present a serious one, partly because this station

is not equipped with proper selective receiving apparatus, and partly on account of the character of the interference.

"Selectivity principally depends upon the number of oscillations in each wave train from the transmitter. In the early days of wireless, each discharge of the transmitting station set up a strongly damped train of perhaps three waves, and tuning, at least in the sense in which the word is now used, was impossible. Modern wireless transmitting apparatus, using the spark system, easily reaches from ten to fifty waves at each discharge, and a receiving station with suitable tuning means should be able to reach a selectivity of one or two per cent, i.e., should be able, when two equally distant and powerful sending stations are in operation, to read one and practically exclude the other when their wave lengths differ by more than one or two per cent. By the use of so-called sparkless or undamped wave methods, in which the wave trains are continuous in the same sense as an alternating current, still greater selectivity may be obtained, even to one-tenth of one per cent.

"Primarily, in order to obtain great selectivity, the transmitting must be accomplished with as persistent wave trains as possible. Unfortunately, the greater number of ship and shore stations at present are either not equipped with apparatus capable of sending long trains of waves, or are not properly adjusted to this end.

"Secondly, the interfering stations should be under some control as regards wave lengths, as it is easy to see that however sharply tuned are the transmitting and receiving stations, an interfering station of the same, or nearly the same, wave length will always cause interference.

"Lastly, the receiving station must be capable of very sharp tuning; that is to say, exclude from its detector circuit all oscillations but those within a per cent or so of the desired wave length. Because the equipment is defective in these respects, the Charlestown Navy Yard probably suffers more from amateur interference than any other station on the Atlantic coast."

Professor R. A. Fessenden, the recognized authority on wireless telegraphy

in this country, whose transatlantic experimental wireless station at Brant Rock was in operation before the Marconi Company began transatlantic work, agrees with other wireless experts that the troubles of the Navy Department are due mainly to the lack of improved apparatus. Professor Fessenden says:

"With reference to interference, the question of interference has now been solved for five or six years. Exhaustive tests were made by the Navy Department at New York in 1904, which demonstrated conclusively that interference could be cut out from a full power station only 226 yards away, while reading messages from a station at a distance.

"At the official hearing last year before the Senate Committee on Foreign Relations, the officers of the navy, in response to direct question from the chairman of the Senate committee, admitted that it was possible to keep out interference.

"Numerous offers have been made to the navy during the last five or six years to supply the department with apparatus guaranteed to prevent interference. Such apparatus is in regular use at our own stations, and we have not been troubled with interference for four or five years. Up to date, however, the navy has declined to purchase such apparatus, although its efficiency has been shown by their own tests above referred to, and was admitted by them at the Senate committee investigation referred to."

The tests conducted by the Government at New York in 1904 concerned mainly the efficiency of the instruments in transmitting and receiving for accuracy and speed, in preventing interference, and in transmitting messages with absolute secrecy. The naval stations in the vicinity of New York, together with several stations on board navy vessels, were utilized for the experiments. Although the conditions of the test were made as difficult as possible, and the apparatus worked under disadvantages such as are seldom encountered in practical wireless work, the results as shown by the official reports were remarkably successful. In the matter of secrecy it was found after the test that the commercial operators in the vicinity had not the slightest idea that wireless messages were being transmitted. Other careful tests taken with the same

apparatus on navy vessels at sea verified the first experiments.

In July, 1905, Professor Fessenden offered to supply the Navy Department with wireless apparatus as follows:

1. Apparatus for measuring wave lengths accurately to $\frac{1}{4}$ per cent.
2. Apparatus for wireless telephony up to a distance of ten miles or more.
3. Apparatus for wireless telegraphy for use up to distance of 1000 miles.
4. Apparatus for secret sending which is guaranteed to send and receive messages without possibility of their being read by other vessels not equipped with this apparatus.
5. Apparatus for locating the positions of ships at sea at all distances within 200 miles of shore.
6. Apparatus for indicating the position and course of ships within range of three miles in fog.
7. Apparatus guaranteed to prevent interference.

Strange as it may seem, the bureau of equipment refused these offers, just as they have refused to purchase improved apparatus from other inventors. Since then the department has done little except to duplicate and replace the old style instruments.

Not until January of this year has the navy offered to erect a wireless station that will fulfill the conditions outlined above. Nearly four years after the proposition was first submitted, a contract has been awarded to Professor Fessenden providing for the construction of a wireless telegraph station to be located in the vicinity of Washington, D.C., and equipped with the most modern instruments:

"The station to be capable of transmitting messages at all times and at all seasons to a radius of 3000 miles in any navigable direction from Washington, D. C. Such messages must not be interrupted by atmospheric disturbances, or by intentional or unintentional interference by neighboring stations. The station to be capable of transmitting and receiving messages with entire secrecy."

This same station might have been erected two or three years ago, and the apparatus with which it is to be equipped might have been installed in the important naval stations where the most serious interference has been experienced.

It is plain, from these facts, that legal action providing for the control by the Government of wireless telegraph stations is at the present time immature and unnecessary. Wireless apparatus guaranteed to prevent interference has for some time been at the disposal of the Navy Department. Moreover, any attempt to eliminate amateur stations would simply ward off for a time a problem, the solution of which must finally be found by the scientist, not the lawyer. The future development of wireless telegraphy in this country will mean the building of hundreds of new stations, and the further complication of the question of interference and secrecy. Considering, however, the progress already made there is every reason to believe that the laboratory will be equal to the future demands. The interests of all concerned demand every freedom from legislative restraint.

A Home-Made Chemical Weather Glass

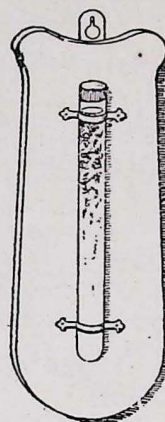
Many different types of weather glasses which may easily be made at home have been recommended from time to time, but unquestionably the most popular is that which consists of a tube of cloudy liquid and sometimes called a camphor barometer. This pattern is often to be seen in opticians' shop windows, and the weather is forecasted by the appearance of the solution in the glass tube. This type of glass, devised it may be said nearly 200 years ago, cannot ever be looked upon as strictly accurate but rather as a scientific toy, for temperature rather than atmospheric pressure is the main factor in altering the appearance of the liquid. The liquid is made up of the following:

Water	2 oz.
Absolute alcohol	2 oz.
Camphor	2 dr.
Potassium nitrate	$\frac{1}{2}$ dr.
Ammonium chloride	$\frac{1}{2}$ dr.

A glass tube 10 in. long and $\frac{3}{4}$ in. in diameter is obtained at a chemist's or elsewhere, and nearly filled with the above solution, and is then hermetically sealed, or otherwise made perfectly airtight.

The tube should then be mounted on a wooden block after the fashion of cheap thermometers. The best and safest way

is to cut a bed in the wooden block to hold the tube; a bed of a quarter inch or thereabouts in depth will be sufficient. Two small bands, one at the top of the tube and the other at the bottom will serve to hold the tube in its place.



The tube should be hung where the air can freely get at it, and the weather indications are as follows:

(a) In warm weather, if crystals of a small size rise in the liquid, while the latter remains clear, rainy weather may be safely expected.

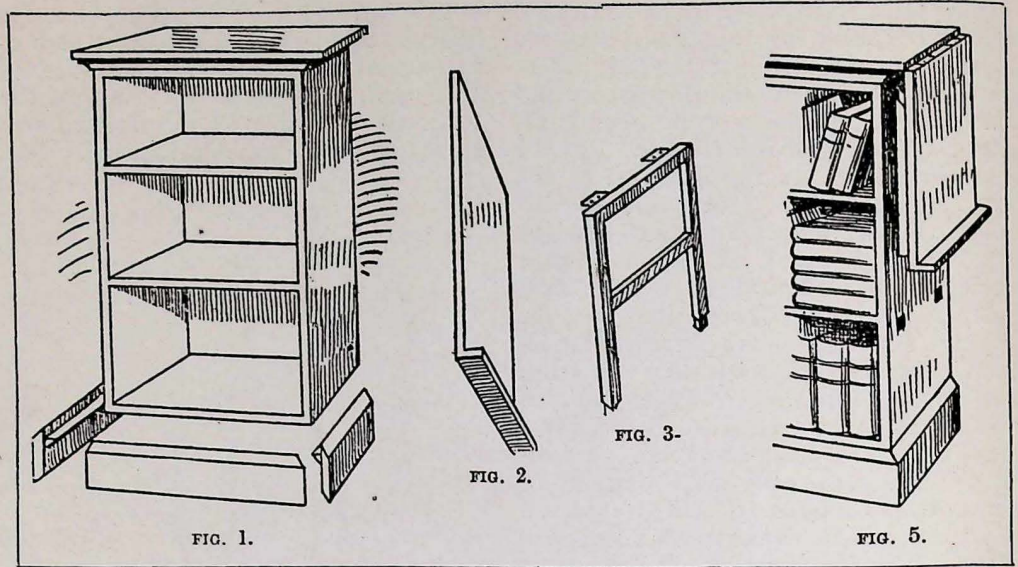
(b) In cold and frosty weather, rain may be expected if the top part of the liquid becomes thick and cloudy.

(c) If in moderately cold weather, beautiful fern-like or feathery crystallization develops at the top of the tube or all through the liquid the weather will be colder. The lower the crystallization in the tube the colder the weather.

(d) When the upper portion of the liquid in the tube is quite clear and flakes of crystals rise to the top and aggregate, very windy and stormy weather may be expected.

(e) Sharpness in the points and features of the structure of the crystals may be taken as a sign of fair and summer-like weather; but when they begin to break up or are not very well defined, unsettled weather may be expected.

(f) The clearer the liquid as a whole the better will the weather be. During warm and summerlike weather all the crystals dissolve and the solution becomes nearly, if not quite clear. The greater the proportion of clear liquid the greater the probability of fine and very dry weather.



FROM GROCERY BOX TO BOOKCASE

The beginning of this is a grocery box, or a shoe box, of such size and shape that when placed on end it will be thirty inches in height, fifteen inches wide, and twelve or fourteen inches deep. An extra top is screwed or nailed to the top of the box, projecting beyond the box about two inches at sides, front and rear, a little "finish" beading being tacked about the box beneath the projecting edge of the top. A beading three inches in width is also tacked about the base of the box, thus raising it about two inches from the floor. Two shelves are now to be placed within the box, making accommodation for three rows of books. This construction can be seen in Fig. 1.

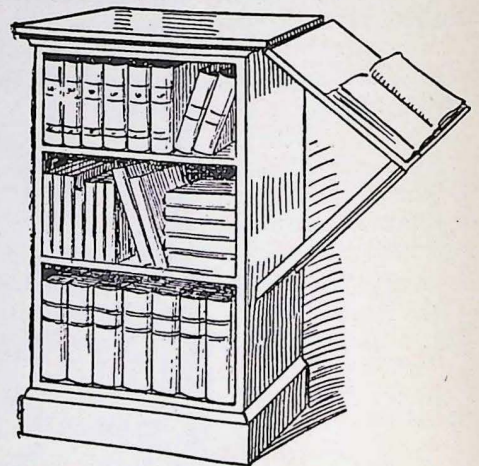
Now to make a reading or writing desk, construct a shelf like that shown in Fig. 2, just as wide as the top that was added to the box, and hinge it to the top, as shown in Fig. 4. If it is desired that this added shelf shall be level with the bookcase top, the legs, which are shown in Fig. 3 (which are to be hinged beneath the outer edge of the shelf), should then be made as high as the bookcase. The shelf can then be used as a table, or the legs can be inclined inward until they rest in the angle made by the box and the floor, which will give an inclined reading desk similar to that shown in Fig. 4.

But if it is desired that the shelf and legs be capable of folding up out of the way, in the manner shown in Fig. 5, the

legs must be made a little shorter than the length of the shelf, when they will fold up within the space between the dropped shelf and the side of the bookcase. In this case the lower ends of the legs are fitted to enter two holes in the side of the bookcase, as suggested.

Instead of three shelves for books, one shelf can be fitted up with two drawers if desired, where pen, ink, paper, and pencils can be kept, thus giving still greater convenience to the device.

When the carpentry work has been finished, the whole can be given a stain of some attractive color, following this with an oil finish, well rubbed in.



THE MAKING OF A USEFUL LADDER

The making of a ladder is a comparatively simple matter, often undertaken by the amateur with perfect confidence, and yet the result frequently turns out unsatisfactory, for the reason that he is unaware of certain pitfalls into which he drops, and does not find out the fact before it is too late, and even then he cannot see where the mistake is, or how it could have been remedied or avoided. This, however, we hope to make clear, so that these pitfalls will no longer exist.

The best and strongest form of ladder is made from a round pole, cut through the middle, lengthways, being in section, after cutting, as Fig. 1. Should you have the opportunity of choosing, pick one out which has little taper from end to end, so as to have the bottom of the ladder comparatively slight, and the top equally strong in proportion.

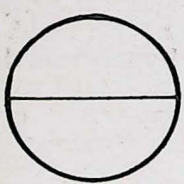
After the pole is cut, open the two parts out, and fix them on two blocks or stools, with the sawn sides quite level widthways. The fixing is best done by inserting a pin through each into the block, as A, Fig. 2, keeping these quite close to the ends, as they must be cut off as waste eventually. The sides must now be set out for the rounds or staves; to do this, make a central line up the middle of each side, with straight edge or chalk line, as B, and on these lines

make the marks which give the spot where to insert the point of the boring bit as shown, first marking off for the bottom of the ladder, close to the fixing pins. The best way to mark off the rounds is to cut a strip of wood, nine inches long (the distance from centre to centre) and mark them with this, they will then be exactly alike, a result not always obtained when the holes are set out by measuring each one, or when the compasses are used.

The holes are best bored with a twist bit in a brace, the proper size being three-quarters of an inch (for a long ladder a few of the bottom holes may be an eighth of an inch larger, and a few at the top an eighth of an inch smaller than this) and on this being done properly depends the success of our efforts in ladder making.

In the first place always stride the pole when boring the holes, thus ensuring accuracy as regards the width; secondly, if you start at the bottom end, facing the top, that is, facing to the right in the drawing, bore alternate holes only, thus, the first, third, fifth, and so on will be bored while facing this way, then turn round and bore the remaining holes while facing to the left.

Both sides should be bored the same, that is, the same holes in the one should



FIG

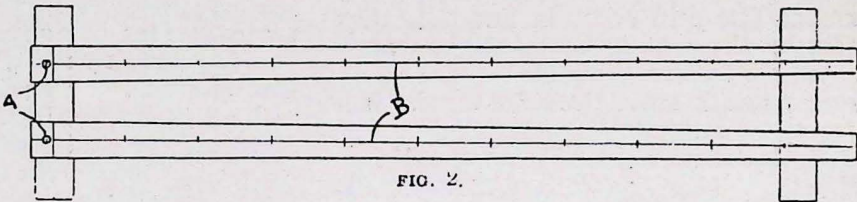


FIG. 2.

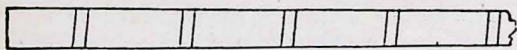


FIG. 3.

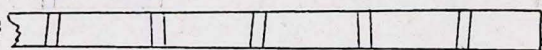


FIG. 4.

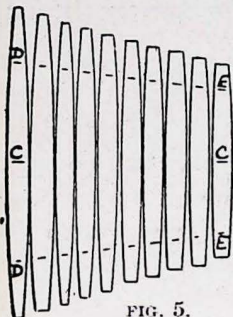


FIG. 5.



FIG. 6.



FIG. 7.

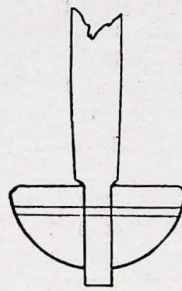


FIG. 8.

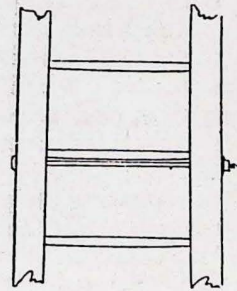


FIG. 9.

be made while facing each way, as in the other, or the chances are that the precautions taken will in a great measure be useless. The reason for the trouble taken in boring is this, if the holes are all bored while facing one way, the chances are all in favor of them all being as in Fig. 3, which would cause the ladder to be out of square, but by reversing the position, the holes are likely to be as in Fig. 4, in which case one counteracts the other, and the sides being both bored the same these act in the same way, one pulling against the other, and making both correct. The sides should now be planed on the sawn parts, and the sharp edges chamfered off, and we can then pass on to the rounds themselves. These may be made out of any odd ends of oak (old fence rails do admirably) or they may be purchased. The rounds should be in assorted lengths, ranging from eighteen

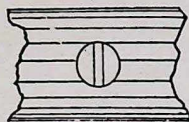


FIG. 10.

down to twelve inches, and they should be laid out as in Fig. 5, a mark made on the two outside ones as nearly in the middle as possible, as C, and from these measure off the width of the ladder inside, at top and bottom, in the present case twelve inches (D) and eight inches (E), then connect these marks across all the rounds as shown, which gives the distance each round has to enter the sides for the ladder to be straight when finished.

Each round must now be shouldered as Fig. 6, at each end, the marks made showing the shoulder line. To ensure correctness in size of the reduced parts of the rounds, a template should be made in hard wood, as Fig. 7, and if each round is so reduced as to enter the hole up to the shoulder comparatively easy, it will go into its hole in the ladder side without any risk of splitting the latter. Fig. 8 shows one round in position in the ladder side, and fixed with a pin passing through, this being by far the better way of fixing.

In putting together, drive all the rounds the full distance into one of the sides, then drive on the other side, pin up at once, and cut off the rounds level

with the sides, finishing off with draw knife and plane.

Immediately under the second round from top and bottom of the ladder, a slight iron bolt should be inserted, passing through from side to side, as in Fig. 9, and if the ladder is longer, other bolts must be used in a similar manner. One bolt to every eight or ten rounds, is about the right arrangement. Should wedging the rounds in be preferred to the pins as described, take care to put the wedges at right angles to the ladder sides, as in Fig. 10, otherwise these latter will be likely to split; in this case, too, every round should be wedged. The great objection we have to wedging is the liability of the wedges to gradually work out, whereas the pins will never do so.

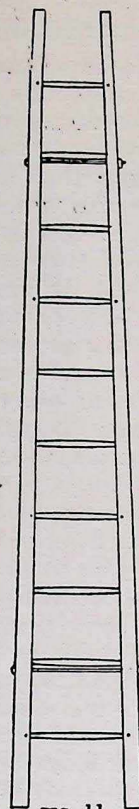


FIG. 11.

The ladder sides above the top round and below the bottom round must be cut off at the nine inches from the centre of the round, taking off the edges neatly at the same time.

Ladders should always be painted, that is, the sides and the rounds about two inches in; do not paint the rounds all over, as it makes them slippery and dangerous in use. We would also caution one and all against using any other wood than oak for ladder rounds, except perhaps Spanish chestnut, and even this is not so good as oak.

In making longer ladders the width at the bottom should be increased slightly, but do not make it in any case more than fourteen inches between the sides; the eight inches as mentioned at the top should be the same, whatever the length of the ladder.

EXPLANATION OF DRAWINGS.

Fig.

1. Section of ladder pole after cutting.
2. Ladder sides fixed on blocks for boring.
3. Result of boring holes all from one way.
4. Result of boring holes alternately from each way.
5. Setting out ladder rounds.
6. Method of shouldering rounds.
7. Template for testing rounds.
8. Section of ladder side with round pinned in.
9. Ladder with strengthening bolt inserted.
10. Method of wedging rounds in.
11. Ladder complete.

THE RE-PLATING OF OLD STEEL KNIVES

Although there is now much less done in the re-finishing of old silver-plated steel knives than has been carried on in the past, considerable business still exists, and much more could probably be obtained by job platers if they would make a specialty of the business. Silver-plated steel knives, when worn, have a more unsightly appearance than other kinds of flatware, as the scratches and pits worn through the silver deposit are black and quite conspicuous. This fact leads people to have the knives replated more frequently than spoons or forks.

Let it be said at the start that if a silver-plated steel knife is in a very bad condition and the pits are deep in it as well as numerous, and in addition the surface is badly attacked by rust, it will not pay to attempt to do anything with it. Pits and rust spots can only be removed by grinding, and when these are completely removed from a badly corroded knife, the blade is left too thin to be of service. A little experience on the part of a plater will enable him to judge whether such re-finishing will pay. The majority of the knives brought to the job plater for re-finishing, however, are not badly corroded and will repay for the labor put upon them.

PRELIMINARY CLEANING—STRIPPING

The knives as received should first be cleaned from grease in the regular manner by means of hot potash, caustic soda or other well-known cleaning agents. This operation is necessary to give a clean surface for stripping. The stripping is not absolutely necessary, if the knife is to be ground down (as it always should be for a good job), but it is preferable as the silver can be saved and the stripping is easily done. It also enables the plater to ascertain, in the best way, how the blade shall be treated. If the surface is not pitted at all, and only the edge has worn through, as frequently is the case, then very little grinding is necessary. The stripping is carried out by "backing-off" in a cyanide of potassium solution, made up as follows:

Water.....1 gallon

Potassium Cyanide...1 lb.

Caustic Soda.....1 lb.

The knives are hung as the *anode* by

means of *iron* wire. Pieces of sheet iron well cleaned or sheet steel are used for the cathode. A strong current may be used as the cyanide does not attack the steel knives at all. The full six volts of the dynamo can be employed if desired, and the stripping operation will then be hastened. A weak current, of course, is satisfactory, but the stripping is accordingly prolonged. The silver deposits on the sheet iron or steel cathodes in the form of a spongy coating, which, as it becomes thicker, falls to the bottom of the tank. The cathodes should be cleaned from time to time by shaking or brushing as the passage of the current is often impeded if it is allowed to become too heavy. The silver may be recovered from the bottom of the tank, whenever desired, by filtering. This stripping solution is also employed for stripping iron racks and hooks used in silver plating. It may be used without the addition of the caustic soda, although it works better with it. It serves to increase the conductivity of the solution.

Many job platers, who only occasionally have steel knives to re-plate, do not desire to make up any regular strip. In this case, the strike may be used for a strip, or even the regular silver plating solution; but care should be taken to prevent the silver deposited on the iron or steel cathodes from falling to the bottom. It can easily be removed from the plate after it has accumulated for a short time. When this is done, a strike can be used for stripping the knives. It is better than the regular silver solution. While the stripping of knives in these solutions cannot be called the best practice, on account of the liability of injuring the composition of the solution by the addition or withdrawal of the silver, it is extensively done in small job shops where economy must be practised. There is no danger of dissolving the steel, as it is not attacked by the cyanide. Some makers of silver-plated steel knives nickel plate them before silvering. This fact will soon be discovered in stripping the silver. When the nickel is reached, the stripping will stop and its removal will have to be done by grinding. There is no satisfactory method of stripping nickel from iron or steel without incurring the

danger of pitting the surface. Grinding it off is, in reality, the only good and safe method.

CUTTING DOWN THE SURFACE

Scratches, pits and rust marks are often deeper in old steel knives than is usually believed. After stripping, the depth may be readily noticed. On some knives, which have had little service or were exceptionally fine examples of silver-plated cutlery, the sign of wear is on the edge, bolster and end of the handle. While on such knives very little grinding is required to remove the defects, it is seldom that a job plater is blessed with cutlery of this description. The greater part of the knives which he receives for replating will be in bad condition and require much cutting down. The subsequent instructions for cutting down, therefore, have been given on this assumption that the surface of the knife is in such shape; but if not as badly corroded as assumed, the first cutting down operation may be omitted. For the cutting down, a leather-covered wood wheel is used. This is coated with glue and then with No. 100 emery in the usual manner. This wheel should not be too small in diameter, and is usually run at a speed of from 1500 to 2000 revolutions per minute. After grinding with No. 100 emery, the knife is next ground on another leather-covered wheel "set-up" with glue and No. 150 emery. While this surface might answer for plating, if the surfacing has been well done, the wheel is rather too coarse for the necessary finish. It is better, therefore, to finish with flour emery. The finishing wheel is preferably of felt and the flour emery glued to the surface. With this wheel, the knife is left with a surface sufficiently good for the finest class of work. Some platers use emery paste on the felt wheel instead of the emery flour and glue. The paste is applied to the surface of the felt wheel in the same manner that rouge or tripoli is employed. While efficacious, and easily used, it leaves a film of grease on the surface of the steel. The finishing on the glued wheel does not do so. Preventing the knife from coming in contact with any grease or oil is certainly conducive to good results, and experience has demonstrated it to be so. A wheel containing

grease forces it into the metal so that it is difficult to remove. The knives are now ready for plating, but as the steel is clean and bright, it is apt to rust if left without special treatment. Steel or iron will not rust in a solution of sal-soda, and this is used for preserving the knives previous to plating. To make the sal-soda solution dissolve 8 oz. of sal-soda in 1 gallon of water. Place the knives in it and (completely covered) allow them to remain. They will not rust at all under such circumstances.

CLEANING THE KNIVES

While the knives are almost free from grease if the finishing has been done on the flour emery wheel, there is enough on the surface to prevent the silver from adhering perfectly. The handling which they receive in polishing is the reason. Knives which have been finished on a wheel treated with emery paste have, of course, a very tenacious film of grease on them. This grease is often of the worst kind as it is of a mineral nature. Considerable mineral grease, such as petrolatum, is used in making emery paste, and this material does not saponify. It is, accordingly, hard to remove. The great advantage of finishing on a wheel "set-up" with flour emery and glue is at once apparent. If the knives have considerable grease on them, a preliminary benzine or gasoline dip is useful for the removal of the greater part of it. After this, the knives are soaked for some time in a hot potash, lye or other cleaning compound solution. If the knives have considerable grease on them, from thirty minutes to an hour may be necessary in cleaning; knives finished on the flour-emery wheel do not require as long, and often a few minutes only are required. The knives are now removed from the kettle, rinsed in cold water and scoured with pumice and a stiff bristle brush. A hand brush or a wheel running at about 200 revolutions may be used. The pumice is wet with water containing a little sal-soda to keep the steel from rusting. The old method has been to use pumice wet with water containing cyanide, but the poisonous nature of the cyanide is objectionable, and the sal-soda gives equally as good results. Neither is it poisonous, nor does it attack the hands. The surface of the

knife should be carefully examined and if there are stains, such as rust spots, they can be removed by vigorous scouring with the pumice, but if they resist this treatment a little emery flour will accomplish it. When the knives have been well cared for, however, there will be no difficulty of this nature. When the scouring has been completed, the surface will have a dead appearance. The pumice leaves the steel in excellent shape. A highly polished surface, like that produced in "glazing" steel, is not as good as one with a scoured finish. After scouring, the knife should be at once rinsed in *cold* water. Hot water dries and leaves stains on the surface. If necessary to leave the knives for any time, they can be placed in the stone crock containing the sal-soda solution. It is better, however, to avoid leaving them any longer than is necessary as the best results are always obtained by immediate treatment after scouring. The knives should be wired or racked and placed in the potash solution again for a short time to remove any grease left by handling. A momentary soak in the kettle is usually all that is required. If left longer, it does no good and the steel may be stained. After "sousing" in the potash kettle, the knives are rinsed in *cold* water and then passed through a dip composed of the following:

Water 1 gallon
Muriatic Acid 1 pint

The object of this dip is to remove any slight film of rust or oxide that may be on the surface of the steel, and leave it in a chemically clean condition. This dip is used cold in summer and slightly warm in winter. If used hot the action is usually too violent. The knives are not allowed to remain in this dip for over a moment or the surface will be attacked. It is used as a dip and *not* as a pickle. The plater now has the opportunity to inspect the surface of the knife to ascertain if it is clean. The water will break on the surface if it is not, and if it covers it evenly, the steel may be assumed as in a fit condition to plate. Rinse the knives in *cold* water and then *immediately* go to the first strike. Under no circumstances should the surface be allowed to dry or even to remain wet for any time. If this is done, a minute film of

rust forms, which prevents the adhesion of the silver.

THE FIRST STRIKE

The best knife platers use two strikes. The first is one made particularly for steel, and consists of a small amount of silver and a large quantity of cyanide. It is used with both copper and silver anodes. The use of the copper anode is conducive to good results, as it introduces enough copper in the solution to give a strongly adherent deposit, but does not change the appearance of the silver noticeably. Some platers used rolled anodes of equal parts of silver and copper, but these are unnecessary. Good results are obtained by the use of silver and copper anodes. The solution for the first strike is made as follows:

Water 1 gallon
Potassium Cyanide 2 lbs.
Silver Chloride 1¼ pennyweights

The silver chloride for this solution is made by dissolving 1 oz. of fine silver in nitric acid and precipitating with common salt or muriatic acid, and then washing as usual. The anodes used consist of pure copper and pure silver. The copper anode surface should be about four times that of silver. From 1½ to 2 volts are used in the plating. The knives should be moved about or rocked while the striking is taking place. The operation will take several minutes, and when the surface of the steel is covered with a yellowish film of silver, the striking operation is finished. The knives should now go immediately to the second strike.

THE SECOND STRIKE

The second strike is the regular silver strike used for all classes of silver-plated work. It is made in the following manner:

Water 1 gallon
Potassium Cyanide .. 8 oz.
Silver Chloride ½ oz.

The chloride of silver is made by dissolving ¼ oz. of fine silver in nitric acid and then converting into chloride in the usual manner. The knives are run in this strike until they are well covered. A few minutes are usually taken for the completion. While the striking is going on, the knives should be moved gently

in order to prevent marks. They are then ready for the regular plating solution.

REGULAR SILVER PLATING SOLUTION

The solution employed for silver plating steel knives differs from that used in plating German silver in that it contains slightly less silver and considerably less free cyanide. The object of this is to prevent pits and blisters. Experience has taught that it is preferable for such a purpose. The solution is made up as follows:

Water 1 gallon
Potassium Cyanide . . 6 oz.
Silver Chloride 3 oz.

While the solution can be made by dissolving a given weight of chloride of silver in one of cyanide, the strength of cyanide varies considerably so that it is preferable to make it in a more certain way. The solution should contain about $2\frac{1}{2}$ oz. of silver and $1\frac{1}{2}$ oz. of free cyanide to the gallon. Dissolve $2\frac{1}{2}$ oz. of fine silver in dilute nitric acid and convert into chloride. Then dissolve in just enough of a strong cyanide solution (made by dissolving cyanide in water) to take it up. Now add water enough to make 1 gallon and dissolve in it $1\frac{1}{2}$ oz. of cyanide for free cyanide. This will give the desired solution. It will stand about 7 or 8 degrees Beaume. The knives from the second strike are now placed in this regular solution. Plenty of anodes should be used on both sides of the knives to obtain an even deposit. A current of not over 1 volt pressure should be employed. The sharpness of the blade causes the silver to "burn" when this amount is exceeded. *The knives should be constantly moved while the plating is going on or the deposit will be streaked.*

DURATION OF PLATING

The length of time that this final plating should take depends entirely upon the kind of job the plater desires to do. If he wishes to turn out good work and render the knives equal to new (and perhaps better), he will have to allow the electrodeposition of the silver to go on for from one to two hours. The best grade of work on steel knives gives what is known as a "12 dwt." deposit. This

means that a dozen knives have 12 pennyweights of silver on them, or one pennyweight on each knife. Roughly speaking, it takes from one to two hours to produce the deposit. As a job plater has no scales like those employed in the manufacture of silver-plated ware for determining the weight of the silver actually deposited on the work while the electrodeposition is going on he will have to judge by the time. If a light silver deposit is to be put on, it must not be so thin that it will not stand buffing. From fifteen to twenty minutes is about the least time that can be given the knives and still not run any risk of cutting through in buffing. When the knives have been completed, they are finished either by burnishing or buffing. Burnishing gives the best work as it hardens the silver. After the silver deposit has been put on it is lightly buffed with a soft buff and rouge to remove the marks of the burnisher. Previous to burnishing, the silver is scratch brushed. Very few job plating establishments are fitted to do burnishing, and even could they do it, the cost is such that it usually does not pay. The customer rarely will stand the extra expense. The burnishing, however, gives a very superior knife and one that will outwear several of the buffed ones. If the knife is to be buffed it is first carefully scratch-brushed with a soft, brass brush, and then buffed by means of a soft rag wheel and silver rouge. A hard rouge intended for nickel must not be employed for the buffing, as it will remove some of the silver from the edges. Even with the soft rouge much care is needed in buffing to avoid removing the silver from the exposed parts. The various operations of re-finishing and re-plating old steel knives with silver may be summed up as follows:

1. Cleaning the knives from grease.
2. Stripping the silver by "backing it off" (using as an anode).
3. Grinding the defects from the surface.
4. Removing grease by boiling in potash or lye.
5. Scouring with pumice.
6. Cleaning in the potash or lye again.
7. Rinsing in cold water.
8. Dipping in the muriatic acid dip.
9. Rinsing in cold water.
10. Striking in the "first" strike.

11. Striking in the "second" strike.
12. Giving the regular silver deposit.
13. Scratch-brushing.
14. Burnishing or buffing.

While the preceding directions will enable a plater to produce work equal to the best grade of work turned out by the leading manufacturers of silver-plated ware, the conditions of the majority of the trade neither allows nor calls for such perfection. A customer rarely expects old ware to be equal to new. For this reason, several short cuts may be taken, and yet have a job of good appearance.

SHORT CUTS

The stripping may be dispensed with and the cutting down commenced immediately. The preliminary strike may also be omitted and only the second strike used. Unless the knife is to be burnished, little difference will be noticed. While a knife may not stand burnishing, it will stand buffing. The scratch-brushing, too, may be passed over and the deposit buffed directly. Scratch-brushing is so simple, however, and takes so little time that it does not add to the cost appreciably. It acts as a sort of burnishing operation and serves to harden the deposit. The charge that is made for refinishing and silver plating old steel knives ranges all the way from \$2 to \$3 per dozen. Some concerns in the East easily obtain \$3 per dozen, but they burnish the silver. The current opinion that new silver-plated steel knives may be purchased for 10 cents apiece at the so-called "5 and 10-cent stores" so that there is no need of having old flatware refinished at a greater cost is quite true, but the quantity of silver on such knives is exceedingly small. In fact, such knives will frequently rust in a short time if placed in water. They are made to sell and not for service. One purchase is usually all that is desired.

—*The Keystone.*

The figures of coke production in the United States in 1907 exceed all records in the history of coke making in this country, the total amount reaching 40,779,564 net tons. Over 35,000,000 tons of this total was produced in the beehive type of oven.

The Fuming of Oak

Oak, if darkened, has always a better appearance when fumed with ammonia. This is a rather difficult process for the amateur, as an airtight case is required, and, therefore we should not recommend amateurs to attempt very large work. In the majority of cases, however, oaken articles are not too large for dealing with in an amateur fashion. In such cases try the following:

Procure a tin biscuit box, or any other metal receptacle of good proportions, and ascertain that, as far as the sides and bottom are concerned, it is airtight. Place a saucer of ammonia in this, and arrange the article in the tin above the saucer, so that the fumes will get well around it. There will be no difficulty in this; the article may be propped up with small sticks, or suspended by string. The chief consideration is to see that no part of the wood is covered up, but that it will all be exposed to the ammonia. The lid should then be placed on the box and all the joints sealed up by pasting stiff brown paper over them. If the nose is applied close to the tin, it will very soon be apparent if there is any serious leakage, which can easily be stopped by a further application of paper. A hole may be cut in the lid, and a piece of glass be fitted in, care being taken that all the edges be closed up; by this means the process may be watched and the article removed when the oak is fumed to the desired shade.

Wood stained in this manner should not be French polished or vanished, but waxed.

The process of waxing is simple. Take some beeswax; cut into fine shreds, and place it in a small pot or jar. Pour in a little turpentine, and let the mixture stand for half a day, giving it an occasional stir. The wax must be thoroughly melted, and then some more turpentine added till the preparation has the consistency of a thick cream. It can then be applied with a rag, and afterwards brushed up with a stiff brush. Waxing is very suitable for oak, but on mahogany and walnut it will not produce such a bright gloss as French polish.

Show this magazine to your friends when you have read it.

BUILDING A STAINED GLASS WINDOW

One of the most interesting operations in all art craftsmanship was described in detail in a recent issue of *The Craftsman* by Genevieve V. Cowles. This operation is the building of a stained glass window which is described as follows:

METHOD OF PROCEDURE

To begin work, our designs—the cartoon and the color scheme—must be ready. The cartoon is a drawing in charcoal or water color, or possibly a carbon print. It is usually the exact size of the window, showing all the lead lines, and often suggesting the light and shade. From this there have been made three drawings on paper, the working cartoon, the pattern cartoon, the glazing cartoon. The design appears flat and abstract in the working cartoon, where the heart of the lead is defined by thin carbon lines enclosing the patterns, and every pattern is numbered—two thousand patterns in our particular window. The pattern cartoon is cut up into its separate patterns, and here also each pattern is numbered and tacked lightly in its place on the glazing cartoon.

Next there is the outline of our window, full size, traced in black on a sheet of rolled glass, termed the easel, and placed before a window ready for building. There stands the workman ready to select the glass. He is the "builder." We "build" the window and we call the window "she." Our window will be an ornamental one of American glass; there will be no painting with brush. The drawing is in outlines of lead. These outlines are vastly important, but do not think of a window as you would of a wrought iron fence, a grille of hard lines between patches of color. There are ways extraordinary of making these lead lines disappear. And because the glazier will modestly hide the extent of his labor and a beholder of a finished window may never follow all the intricacies of lead, therefore the color scheme hardly suggests the lead lines. The color scheme is usually in water color, because the processes of this medium resemble those of glass. The color scheme is small and done to a scale, say an inch to a foot. It

is small and suggestive only, because you cannot find in glass the exact color put on paper. The process is more like transposing in music, only this is transposing in color.

Our palette is the floor and the "bench" where glass lies gathered for our selection. We begin with our brightest and strongest contrasting colors.

A DIFFICULT DESIGN

This design is iris flowers. For the iridescent yellow petals the builder holds up a sheet of softly glowing yellow glass, slowly passing the sheet over the opening where the petals are drawn. We look until we find a patch where movement and color of glass convey the impression of flower petals. The workman lays the pattern over this patch, and the cutter cuts it out, as you would cut a pattern in cloth. His diamond wheel glides swiftly around the edge and roughs it out, then with soft iron pincers he nibbles off the glass to the exact shape. These patterns must be exact. If in cutting the pattern itself the scissors had slipped, making the tiniest cleft in the edge of the paper, that would have been fatal when the diamond wheel made its circuit, gently guided by the resistance of the paper. Our yellow petals are cut and stuck on the easel with tiny lumps of thumb wax. Now for the purple petals. What magnificent purples of opalescent glass! But, beware! seen closely the purple petal may be quite small and delicate; at a distance it looks twice its size. You never meet this difficulty in extreme form in oil or in water color, where light falls on color. Here light coming through color makes it spread. Purple spreads more than any other color, and how it changes as you advance or retreat! Seen closely, it is soft and subdued, at a distance, an ink blot! Or the reverse, close by, just the value desired; far off, a hole of thin pale violet.

LABORIOUS MATCHING

One piece of glass after another is tried until the right thing is found. Presently other difficulties appear; opalescent glass is marvelous. On the bench it may look black, dark blue, dark green, and

prove almost transparent when held to the light. Not only is American glass of manifold colors, greens, blues, reds, one shade flowing into another, one color veining another like marble, one hue changing to many variegated hues, its surface may be smooth or wrinkled or granulated or rippled; it also varies in density, due to the fact that more or less porcelain is mixed with clear glass. You start with a certain degree of density that modifies the entire scheme, then a piece of glass too thin appears a hole, a piece of glass too dense, a blot.

We proceed. The artist stands at a distance, the "builder," standing by the window, holds up glass for selection. Bit after bit is chosen and stuck up with thumb wax or rags dipped in wax, or wires, if the pieces of glass are very large and heavy. The interstices of light between the pieces of glass are filled in with putty. As the mosaic grows, you become increasingly conscious of the effect of one color, or one mass of color, over another. These iris flowers are very vivid, and what intensely green leaves! It hurts you. But at this stage you must have patience and faith, for to obtain the loveliest results of luminous shade and glowing light, one surface of glass is not enough. The thing begins with intensity, almost crudity, and is subdued later on. Finally the whole mosaic is laid in and the next stage begins.

SECOND STAGE OF THE WORK

In the next stage, the glass is removed from the easel and cleaned. The glazing pattern is laid on the bench and a portion of the glass is laid over it. The glazier binds around each bit of glass the silvery-looking lead. Seen beforehand these leads resemble small double railroad tracks. A thin heart of lead divides glass from glass; the leaf of lead holds the glass in place. This leaf or flange is what shows in the window. It may vary in thickness from one-sixteenth of an inch to half an inch. Each size is numbered. A solder of tin and lead is used to secure joints. The workmanship must be fine to leave these lead lines fair, smooth, even. The tips of our leaves are "mitred," that is, instead of bending a lead around a tip, the lead is cut diagonally and meets its fellow in the fine point de-

sired. After the solder, comes the putty of red lead carefully rubbed in, or else the cement. Our window must lie still for some hours, or else the cement may flow and run down. Woe if a tiny pin point escapes notice! Once a large window was placed fifty feet high in a church wall. In the shop it had looked all right, but seen from the pavement of the church, behold a blaze of unaccountable light in a shadow. A workman climbed up, felt the window all over; in one spot he discovered an infinitesimal opening where the cement had failed. This pin point from below let in a glare of light.

SUBDUING THE COLORS

Finally, our window is once more set up against the light. Now a very important part of the work begins. We subdue our colors with plating. Plating glass may resemble washes of water color. It may be clear as crystal with here and there streaks or clouds of color, pink, blue, green, amber. Our purple petals are too intense. We subdue them with a touch of pale green, a faint reddish tone modifies our vivid leaves. It is possible to have five thicknesses of glass in a window, one in the centre, two in front, two behind. We plate down portions of our windows. Then we "pull the whole thing together" by a sheet of violet laid over the entire surface and cut at the crossbars. It may be graded between the bars from a deep shadow to a tender mist of violet. Once more the window is removed, glazed and cemented. A final view is taken, then, if satisfactory, it is sent to its destination. En route a breakage may occur. Once a tall saint reappeared at the shop with broken halo and tattered raiment. But our window arrives safely. After it is put in place, the bars are secured. Lead is too soft to stand wind pressure, so the window is strengthened by bars of steel. These are tied securely by copper wires, springing from the intersections of lead, at the central surface and passing through the platings.

EACH WINDOW A PROBLEM IN ITSELF

I have described a rich deep-colored, ornamental window. We might have a pale window, with clear glass for the background, and ornamentation in light translucent tones, no plating. You can-

not gage one window by another, each is more or less an original problem. A figure window of opalescent glass is much more complicated than an ornamental window. American glass windows are supposed to cost from eight to twenty dollars or more per square foot, to put into glass. The artist usually receives an amount equal to that paid the glass company. A small figure window is far more costly in proportion to its size than a large window. The heavy lead lines and thick glass present great difficulties to the designer, especially if no painting is permitted. A small window may have as many patterns, and take as long to cut as a big window; possibly as much glass may be consumed in the course of selection. Delicate glazing with the smallest of leads and mitring of fine points may require as much labor as it would cost to produce a figure eight feet instead of three feet high. These facts do not apply to English glass; I am speaking of American glass.

WORKING DRAWINGS

The process of making working drawings, easel tracing, selecting glass, resembles the methods followed with the ornamental window, only it is a more delicate task to find glass that gives not only the tint, but the movement desired to express folds of clothing and the body underneath. The painting of the flesh is the hardest of all. Head, arms, feet are cut of white opalescent glass, outlines are traced and fired. Then you make three separate puddles of glass color, mixed with turpentine and Venice turpentine. One puddle, canary yellow, one brick red, one celestial blue. First you paint the head with hatched lines of canary yellow, then with fine cross lines, brick red. The complexion first resembles knitting work. You add lines or dabs of blue, all the time thinking "this is a lovely face." Then with fear and trembling you send her into the fire. On emerging from the flames she has a nice complexion and she smiles.

Sometimes one color eats up another in the kiln. The face may return a vivid green or a brilliant red—sometimes only a ghost arises. Sometimes the flesh is nearly right, but too hot or too cold. You get the right effect by plating over. This is only one method. You can paint

in a series of "mats" (washes of color) usually mixed with water and lightly brushed or stippled over with the tip of a big brush. In the mat, the lights may be brushed out with the stub of a brush, or needled out with a needle; and the deeper shadows painted with oil color afterward; it is all very queer. The kindly Italian who fires the glass will let you peep through the peephole into the kiln and see the painted glass on its bed of plaster under the licking flames. He turns off the fire and you see a red glow arising from the molten surface of the glass, showing that the glass color has literally melted into the glass itself.

TO MAKE FAITHFUL WORKERS

If the artisans find you are sincere, they serve you with true devotion. Almost every body in the shop will have something to do with your window. The "stockman" ransacks labyrinths, stacked high with glass, to find just what you want; another builder comes in with bits of gorgeous color in his hand and approaching your builder says, "I thought this might do for you, Jack"; even the taciturn German who says he doesn't care much, "he just cuts for twenty years"—even he is watchful, and when you are changing an offending note in your window, he suddenly utters a sigh of relief and mutters, "De whole shop vas kicking at that piece." The young apprentices eye your window with furtive interest and run to serve you. If you are in trouble with your painting, you fly to the office, where one of the gentlest of glass painters is willing to place his large experience at your disposal. You waylay the head of the firm, as he glides past at noon, and get his advice. You set an ambush for the particular genius, the special builder of the "La Farge windows." You tell your doubts, and he points out just where the faults are. But the great genius of the place is the master, John La Farge.

TIME AND PATIENCE NECESSARY

You cannot hurry, and make a window as fair as it would be if due time were given. If the patron only knew the pain he causes in the glass shop when he gives too little time and insists that, "My window must be in place this particular Easter." I have seen a builder

working tensely; only the smash of discarded glass told the pain he endured. When he saw in your eyes that you understood, he only said, "I can't do as I like, orders from the office, so much must be done this afternoon, I can't get it right." And I have seen that his clear eye detected discord in the color scheme before him. He felt he could have done that window better by himself. But the order was given to follow that design; follow it he must. If it is cheap work, he still knuckles down to it with grim patience; orders must be obeyed. But the eye of the journeyman kindles when he sees fine draughtsmanship in a cartoon or real harmony in a color scheme. He silently listens to you as you unfold the great idea that you wanted your window to express, and says, "I will do the best I can." Fidelity, obedience, courtesy, self-control: these virtues are required of the workman in glass. There are veterans in the trade; men who have served fifteen, twenty, thirty years; men trained not only to suit the requirements of Mr. La Farge, but the requirements of many styles and of many opposing masters. It is not only the fire of genius in the artist, but the courageous perseverance of the artist-artisan that has raised the standard of stained glass making, and resisted the encroachment of the commercial spirit so fatal to art.

A Mission Umbrella Stand

The novice at woodworking can very easily make this simple stand. If he does not wish to take the trouble of cutting out, and planing up the pieces, he can get them made at a carpenter's shop or mill, for very little.

Four sticks, an inch and a quarter square by two feet six inches long; and eight pieces of three quarter inch boards, three inches deep, by ten and a half inches long, is all the wood necessary, except twenty-four dowel pins, or pegs, three-eighths of an inch in diameter and about six inches long.

The bottom ends of the uprights, and the ends of each board, must be made perfectly true and square with the long edge.

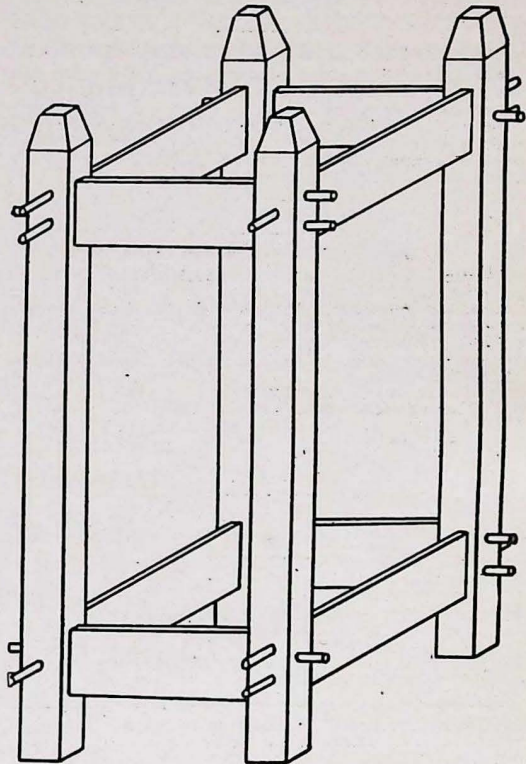
The holes in the four uprights are bored all the way through, about three eighths of an inch diameter. The holes in

the boards are about two or three inches deep. The boards and the uprights are bored alike, but assembled differently.

There need be no trouble, however, if the sketch is watched closely.

The pegs or dowels should be fairly tight, and after being driven home, should be further secured with glue.

Smooth the whole work over with sandpaper, and give it a mission finish, then give it to your best girl.



Hints to Electric Bell Fitters

When wiring with twin wire do not connect on to the battery until last thing. Should the ends of the wires come in contact, the battery would soon run down. When economy of wire is desired, and a gas or water pipe connection is pretty handy at each end, it is possible to make the pipe serve as one conductor using only a single wire as the other. Solder a wire to the pipe at each end, and lead them to the battery, bell, or push as the case may be. There being a large area of metal in the pipe, the resistance is no more than that of a wire, assuming good metallic contact at the joints.

—Model Engineer.

Electrician and Mechanic

Incorporating

Bubier's Popular Electrician...Established 1890
Amateur Work.....Established 1901
Building Craft.....Established 1908

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VOL. XIX. APRIL, 1909 No. 10

EDITORIALS

The interests, commercial and naval, which are interested in prohibiting the use of the ether by amateur wireless experimenters seized eagerly upon the opportunity afforded by the collision of the steamers Hall and Dimock in Vineyard Sound to make a series of attacks on amateurs who, it is claimed, prevented the Hall from sending messages for help. The facts of the case, however, seem to place the blame rather on these interests themselves. As a matter of fact the operator of the Hall sent but one message which was received in good

order by the naval stations, but which failed to give the position of the ship. Owing to the rapid sinking of the Hall, the dynamos were soon put out of commission and no further communication with land was possible. As soon as the message was received numerous stations, ship and shore, naval, commercial and amateur, endeavored to get into communication with the Hall, but, of course, fruitlessly. In a few minutes so many stations were in operation that nobody was able to get anything in the jumble. Meanwhile, we are informed by some of our amateur correspondents, the operator at one of the naval stations was sending out weather signals without regard to the C. Q. D. call.

* * *

In general it may be said that the better equipped amateur stations in New England seem to be able to pick up and sort out the messages they are interested in most of the time, without regard to who is sending. The commercial stations apparently suffer a little interruption, while the naval stations have the most trouble because of inferior equipment. The present standing of the case is well put in an article published elsewhere this month.

* * *

Compared with the tremendous increase of telephones in the last five years, of which mention was made last month, the preliminary report on telegraphs of the census bureau shows a striking contrast. The increase in the mileage of telegraph wires is only about twenty per cent. in five years. The increase in messages is about thirteen per cent., while the increase in income is twenty-six per cent. The average increase in the industry in all departments is about thirty per cent., against nearly two hundred per cent. increase in telephones.

* * *

We regret to state that by an error on the part of our printer, no credit was attached to the article entitled "How to Build a Canvas Canoe," which appeared in our issues for December and January, 1908. This article was reprinted from *The Woodworker* of London and in accordance with our usual custom, credit should have been given to this periodical.

QUESTIONS AND ANSWERS

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

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

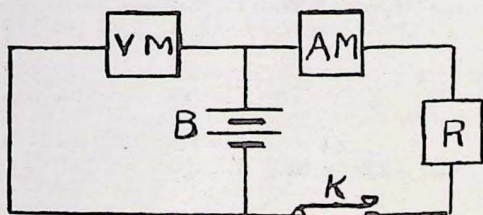
If a question entails an inordinate amount of research or calculation, a special charge of one dollar or more will be made, depending on the amount of labor required. Readers will in every case be notified if such a charge must be made, and the work will not be done unless desired and paid for.

951. **Wireless Telegraphy.** A. J. S., Maynard, Mass., asks: (1) Would the mechanical vibration interfere with the working of a wireless mast if the mast was erected on the top of a large hill? (2) Could the station be placed in or near the engine room of a large electric power house, or would the generators interfere with the working of the receiving instruments? (3) What code is used by the large commercial wireless companies and do they use cipher as a rule? Ans.—(1) Not unless it was strong enough to break the guy wires or mast. (2) Yes, if about 100 feet from generators. (3) Usually Morse or Continental. Cipher only used on secret messages.

952. **4 in. Induction Coil.** J. C. R., Leominster, Mass., asks: Kindly give dimensions and amount of wire for a four in. jump Spark coil. Ans.—See articles in April, 1908, and August, 1908, issues. A complete description would take too much time and space for this column.

953. **Amperes of Induction Coil.** C. O. S., Los Angeles, Calif., asks: (1) I would like to know how to find the number of amperes of an induction coil, also how to find the resistance of dry and storage batteries. (2) Please print a formula for computing the output of the transformer. Ans.—To find the number of amperes used by an induction coil, simply put an ammeter in series with the coil. The internal resistance of a battery may be determined as follows: Obtain a voltmeter VM and an ammeter A M. Also get a resistance R, that when inserted across battery will let about a normal current flow. That is, a current such as the battery is supposed to supply when working. Now connect up as shown in Fig. 1. With key open take voltmeter reading which we will call E. With key closed take simultaneous reading of voltmeter which we will call E' and ammeter which we will call I. (2) The internal resistance of the battery then

is equal to the following $x = \frac{E - E'}{I}$



954. **Induction Coil.** F. P. R., Gilman, Ill., asks: I have a spark coil which consists of an iron wire core $\frac{3}{4}$ in. diameter and $8\frac{1}{2}$ in. long. This core is wound with 5 layers of the wire, a sample of which is enclosed, for a distance of 8 inches. The iron wire of the core is rusty at the ends and a new core must perhaps be made. Please answer the following questions in your magazine: (1) I want to make a powerful coil using the above as a primary. How can I do it? (2) What would probably be the length of spark obtained from such a coil? (3) Could the coil be used for X-Ray and wireless work and how far could I send messages with such a coil? Ans.—(1) The rust on the iron will not hurt anything. It is really an advantage as it prevents eddy currents to a certain extent. You should make an entirely new coil, as the size primary you have is only suitable for a 1 in. spark coil. (2) If made as described in the July issue a 3 in. spark may be obtained. (3) A coil suitable for wireless work will not answer for X-Ray work for reasons given in article mentioned above.

955. **Wireless Telegraphy.** E. L. D., New-castle, Pa., asks: (1) Please give me a short description of an aerial to be used for 50 miles using 4 in. spark? (2) Do the members of your Wireless Club have to be subscribers of the Electrician and Mechanic? (3) Is there any restriction on using a silicon detector of my own make, not made on any of the bases employed by the manufactured detectors; if there is, why? Ans.—Construct one as shown in article by W. C. Getz in June, 1908, issue, using 40 foot pole. (2) No. (3) The patents granted to the manufacturers of the silicon detector cover not only every form in which silicon itself may be used, but also any other type of thermal detector, such as perikon, etc. You are at liberty to make any patented article for your own use, but it can not be used commercially in any way.

956. **Wireless Telegraphy.** G. U., Brooklyn, N. Y., asks: (1) The size of enclosed wire? (2) What size spark coil could be made using thirty oz. for the secondary, and size of condenser to be used. (3) What would the receiving distance be using the tuned circuit diagrams of W. C. Getz, using a 75 ohm receiver? Ans.—(1) No. 32 B. & S. gauge. (2) About a $1\frac{1}{4}$ in. spark coil. Use No. 16 on primary. Make primary condenser of two rolls of tinfoil, each 12 in. x 6 feet, with paraf-

finer paper in between. (3) About ten miles with sensitive detector and 30 foot aerial. If you get a pair of 1,500 ohm High Efficiency receivers, this may be increased to 150 or 200 miles.

957. **Induction Coil.** J. B., Bridgeport, Conn., asks: Will you please explain to me these points: How to make a spark coil to give me about $\frac{1}{2}$ in. spark, diameter of cord, size of wire and how much. Do I need paper between the cord and the wire, also other points if you will? Ans.—Core diameter $\frac{3}{4}$ in. Length 7 in. Primary—2 layers No. 16 D. C. C. Insulating tube—10 thicknesses of Empire cloth. Secondary 1 lb. No. 32 enameled wire, wound into ten sections, each $\frac{1}{4}$ in. thick, with paraffined disks in between. See article on transformer construction in this issue, as it covers many details in coil making.

958. **X Ray. Fuller Batteries.** R. W. H., Lavelle, Penna., asks: (1) Is it possible that good X-Ray work can be done by using the induction coil as described in the April issue? The coil is wound with five pounds of No. 36 S. C. C. wire instead of $4\frac{1}{2}$ pounds of No. 36. With No. 30 wire I can easily get $1\frac{1}{2}$ in. full spark. By experience No. 30 wire carries too much current for the X-Rays, it shortens the life of the bulb to a great extent. I thought to improve matters by building a suitable Tesla coil, this to be operated from the present induction coil instead of a lighting circuit. Will such arrangement be possible, and will it produce a more penetrating ray than otherwise? (And make the bulb more lasting.) (2) Will Compound Fuller Batteries suffice for operating induction coils (for wireless) where lighting circuit is not available? (3) Am making a tuning coil wound with 500 feet of No. 26 bare copper wire on a wooden core 22 in. long, and 2 in. in diameter. Will this prove to be any advantage over that described by Mr. W. C. Getz, in the July issue? Ans.—(1) Yes, that coil is suitable for X-Ray work. Tesla coils are not often used in X-Ray work, but you might try them. (2) Yes, though Edison Lalande cells are more economical. (3) The only advantage may be that the additional length will give you a slightly longer range, though this can also be obtained by using adjustable condensers.

959. **Wireless Telegraphy.** R. L. G., Annona, Texas, asks: (1) What instruments would be required for two wireless stations, one mile apart? (2) What would a complete set of instruments for said stations cost? (1) For transmitting—induction coil, tuning coil, key, batteries, and sending condensers. For receiving—detector, high resistance telephone receiver, receiver tuning coil and condenser. (2) Any of our wireless advertisers, can furnish you with prices on this apparatus.

960. **Wireless Telegraphy.** A. R. M., Everett, Mass., asks: What length of spark would be required to send messages 1,000 miles? (2) Which receiving apparatus would work the best, telephone receiver or telegraph relay? (3) How many k.w. would be required in the generator? (4) Where can I have such coils wound? Ans.—(1) The spark length would be cut down to about $\frac{3}{4}$ in. (2)

Telephone receivers, of the 1,500 ohm type, are much better than a telegraph relay. (3) The generator should be about 15 K. W. (4) Clapp Eastham Co., of Boston; W. C. Getz, of Baltimore, and Acme Wireless Construction Co. of Cambridge, Mass., should be able to give you prices on these.

961. **Ruhmkorf Induction Coil.** R. J. D., Roxbury, Mass., asks: What is the matter with a $\frac{1}{2}$ in. Ruhmkorf induction coil that will spark only for about a second and then it will not go for two or three minutes afterward? Ans.—Contact points of vibrator probably dirty, or not enough condenser on primary.

962. **Wireless Coherer.** M. J. M., St. Paul, Minn., asks: (1) Give me some information as to how a wireless telegraph coherer could be made; to receive messages within eight or ten miles. (2) Could a relay be used with this coherer? (3) Could an ordinary rheostat be used as a tuning coil? Ans.—(1) The following is description of sensitive coherer. Glass tube 1-10th in. in diameter, with two silver plugs fitting snugly in same. Plugs are separated about 1-32 in., and one third of space between them is filled with nickel filings and slight trace of silver. (2) Yes. (3) No, it is not constructed on the right principle.

963. **Wireless Telegraphy.** C. S. P., Gloucester, Mass., asks: (1) Is the height of the aerial measured from the earth up to the top of the aerial, or if the sending instruments are considerably above the earth (25 ft.) is the height measured from the instruments to the top of the aerial? (2) Is it sufficient to make the ground on a wireless system by attaching it to a gas-pipe or is it better to ground it to a pipe leading into a cistern which is built on a ledge? (3) My aerial is 35 ft. from the ground and in the form of a circle $2\frac{1}{2}$ ft. diameter. I use a relay and a coherer and decoherer, the relay is 200 ohm one. I am on a ledge $\frac{1}{4}$ of a mile from Gloucester harbor with nothing to obstruct my wireless. Could I receive a message from Boston under any conditions. How could I fix it so I might? Ans.—(1) Height of aerial is figured from instruments to top of aerial. See article by W. C. Getz in December issue. (2) Never under any condition ground to gas pipe. Should there be a bad joint anywhere in the gas pipe between the instruments and ground, the sparks jumping across might cause a serious fire. (3) Discard the coherer set, and used tuned circuit instruments with 1,500 ohm receivers and a sensitive detector.

964. **Dynamo-Motor Engine.** C. A., Brooklyn, asks: (1) I have a K. & L. Dynamo Motor No. 8 and wish to purchase a small engine suitable for running it. What kind of engine would you advise me to buy. I live in an apartment house. (2) Give names of manufacturers of these engines. Ans.—(1) Owing to insurance regulations a gasoline engine would be out of the question for you to install. Recommend your using a small steam engine and boiler outfit such as you can obtain from (2) Sipp Electric & Machine Co., Paterson, N. J., Parsell & Weed, 131 W. 31st St., New York City, or Chicago Model Works, 179 E. Madison St., Chicago.

965. **Dynamo-Motor Engine.** C. H. C., Reading Centre, N. Y., asks: I wish to install a 50 light (16 c. p.) dynamo. Where can I get such a dynamo and what power gasoline engine I would need to drive it? Ans.—For a 50 light (16 c. p.) dynamo I would advise a 5 h. p. gasoline engine. Suggest your writing Lunt Moss Co., Boston, Richardson Engineering Co., Hartford, Ct., or Fairbanks & Morse Gasoline Engine Co., Chicago, if you wish to purchase complete outfit consisting of engine directly connected to dynamo or else belted to it, together with switchboard, etc., or if you desire a dynamo only write to General Elec. Co., Schenectady, or Westinghouse Elec. Co., Pittsburg.

966. **Fan Motor.** W. H. D., N. Cambridge, Mass., asks: Would you be so kind as to tell me where 110 volts, 125 cycles fan motor could be purchased, or what cities or companies are using the same. Ans.—In regard to your question from whom a fan motor, such as you described, can be purchased, we would recommend the following: The General Electric Co., Schenectady, N. Y., Crocker-Wheeler Co., Ampere, N. J., The Westinghouse Electric Co., Pittsburg, Penna.

967. **Electric Welding Machines.** G. W., Holly, Mich., asks: Where can electric welding machines be purchased to be run with, say, one horse power not assailable. Ans.—Would recommend The Thomson Electric Welding Machine Co., Lynn, Mass.

968. **Patents.** P. R., Bentonville, Ark., asks: Do you tell for one dollar whether an invention will work and be a commercial success? Ans.—We will gladly give the above information without charge through our Patent Bureau, if you will send us particulars and description with rough sketch of your invention, as directed elsewhere in this magazine.

969. **Wireless Telegraphy.** H. O. L., Providence, R. I., asks: (1) In building a wireless outfit to use over 20 or 25 miles of level country, from Wickford, R. I., to Providence. It will be possible to erect poles at least 50 ft. high. As there is no electric power available, I want to use sal ammoniac batteries which I have on hand. (2) Would like list of apparatus necessary, specifications for building together with the connections. Hope to build most of the apparatus myself, but I'm only an amateur in wireless work, although I have a technical training in electricity in general. (3) If houses are in the near neighborhood, will any trouble be experienced with the antenna? Kindly give me such information as you think will be necessary for this particular lay out. Ans.—(1) Would not advise the use of sal ammoniac batteries, as they have not a long life. Edison Lalande will be much better. (2) Transmitting apparatus—Tuning coil or inductance, induction coil, two Leyden jar condensers, spark gap, and key. Receiving apparatus—Detector, high efficiency receivers, 3000 ohm double pair, adjustable condenser, and battery. (3) Unless the houses are made of steel construction, they have but little detrimental effect on the wireless outfit.

970. **Fan Motor.** W. W., Chicago, Ill.,

asks what should be the winding of a 104-volt 125-cycle fan motor to adapt it for use on a 110-volt 60-cycle circuit? Machine has four poles. Ans.—The machine you describe is a standard General Electric construction, with which we are somewhat familiar, but we are at loss how to account for the number of poles you mention. The 125 to 133 cycle motors regularly have eight poles, while those for 60 cycles have four. If yours has actually but four, the winding for 110 volts is quite proper for 110 also, but if there are eight poles, you will have to wind four rectangular shaped field coils, of the proper span and curvature each to embrace a pair of poles, thus giving the effect of only four. The total number of turns should be about 40 per cent. greater than now comprised in the present entire winding. This you probably get by using one size smaller wire than at present.

971. **75-Watt Transformer.** L. A. P., Malden, Mass., asks if a small transformer can be made that will step the 40 to 50 volts available from his 75-watt dynamo up to 110? Ans.—This is possible, but in your case we should say that it was impracticable. The dynamo is so small you can hardly afford to spare any of its output to supply the inevitable losses in a transformer. If you need 110 volts, we should advise you to rewind the armature with three sizes smaller wire. Still, it would be good practice to make a transformer, which you can do with a pound of annealed tinsmith's iron wire and about half a pound of copper wire. Wind the iron wire in the form of a ring with a central opening about 2.5 in. diameter. A section of the ring will be a bundle of wires about .75 in. in diameter. Bind the wire together with a layer of twine, cover with cloth, and wind on two layers of No. 20 wire, counting the outside; it will make about four layers in the inside. Then insulate again and wind four layers of No. 23 wire for the step-up secondary. You can leave out taps or loops on intermediate layers or points in both windings, though well reinforced with insulation, and thus allow for experimenting with various ratios of transformation. You must recognize that a 16 c. p. carbon filament lamp requires about 55 watts, and you have no great surplus of energy to waste in a transformer. Perhaps you will find the new tungsten lamps now made for battery use will fill your requirements without further preparations.

972. **Choke Coil.** E. M. B., Richmond, Ind., asks: In the October number of the Electrician and Mechanic the article on page 158 "How to make a choke coil" in last paragraph says "The lamp will consume about 50 amperes" does it mean 5 amperes or 50 volts? Ans.—To project motion pictures on to a screen requires a very powerful light and this choke coil is intended for this purpose. D. C. arcs for this purpose require from 35 to 40 amperes depending on the distance to the screen and the size of the picture, but on account of the lower efficiency of the A. C. arc lamp more current is required. The author of the article in the October issue has a machine which pulls 60 amperes and throws a picture 10 ft. wide 100 ft. from the machine,

so the last paragraph of the above mentioned article means just what it says.

973. **Wireless.** C. W., New Haven, Conn., asks: (1) How many miles will the transformer published in the August issue send messages with a 100 ft. aerial? (2) What is a potentiometer? (3) What is an anchor gap? Ans.—(1) Under favorable conditions about 200 miles at maximum. (2) A device to vary the potential existing in a circuit. In wireless work, it usually consists of a high resistance coil of wire wound in a single layer on a mandrel, with a sliding contact to the successive turns. (3) An anchor gap is an auxiliary spark gap used at the point where the aerial lead wires go to the helix.

974. **Lightning Arrester.** G. H. N., Hackettstown, N.J., asks: Will a lightning arrester be perfectly safe in a storm, i.e., will there be any danger to a house if apparatus is put on house just outside window to cut out a wireless set. If this is not safe please give directions for a good one? Ans.—Yes, this is all right, but you must remember that lightning has a way of playing strange freaks, and it might jump across the gap. It is better to use an ordinary wire connector, and open the wires about 3 feet apart when not using them.

975. **Oil for Insulation.** W. G. L., Barton, Md., asks (1) What is your opinion of spark punctured oil as an insulator. (2) What reasoning does W. C. Getz use in finding that

$$\frac{3 \times 10^3 \times 10^2}{5} = 6$$

as shown on page 232, formula (4) in December number? (3) How do you figure 50 watts with only 25 volts and $\frac{1}{2}$ ampere, as stated in your answer to Question 847, December number? Ans.—(1) Hardly think that oil is suitable for the high tension side other than for use as a transformer insulator. There will be a certain amount of carbon formed by the spark which will no doubt prove troublesome after a while. (2) This is a typographical error. It should read

$$\frac{3 \times 10^3 \times 10^{-2}}{5} = 6$$

(3) The $\frac{1}{2}$ should have been 2.

976. **Receiving Set.** J. C. A., Somerville, Mass., asks: (1) What is the receiving distance of the set described in the magazine for July, 1908? (2) Where may I obtain directions for making a long distance wireless receiving set? Ans.—(1) With a 40 foot aerial and 1,500 ohm receivers, it is possible to receive from 100 to 400 miles, under favorable conditions. (2) Same may be obtained from W. C. Getz, 345 N. Charles St., Baltimore, Md.

977. **Wireless Telegraphy.** O. S. E., Danvers, Mass., asks (1) Where do I begin when reckoning the length of aerial, at instruments or at outside the building? (2) How do I use enameled wire in making a tuning-coil like one described in July, 1908, issue. (3) What distance will station receive with 30 foot aerial, silicon detector (described in July, 1908, issue) tuning coil, potentiometer, adjustable condenser, battery and 75 ohm telephone receiver? Ans.—(1) The vertical height of aerial is reckoned from the instruments to the top of aerial.

See also article in December, 1908, issue. (2) Use it in same way as described, only using several coats of shellac. (3) With 75 ohm receiver, you may be able to work five miles under favorable conditions. If, however, you get a 1000 or 1500 ohm receiver you can work much further, probably 150 miles.

978. **Wireless Telegraphy.** C. v S., College Point, N.Y., asks: (1) How far should I be able to receive with the following instruments: Silicon detector and current regulator made as described in the July issue, pair of 75 ohm receivers with head band, tubular condenser made approximately according to the dimensions of the adjustable condenser in the July issue, three dry cells and an aerial composed of one galvanized telephone wire strung from the peak of our house to one chimney, a distance of about 30 feet and the highest point of which is about 30 feet above the instruments? (2) How much would a potentiometer and tuning coil, made according to the directions in the July issue, increase this? (3) Is a transformer needed when electric bells are worked by tapping the electric light circuit? Ans.—(1) Probably you will be able to work one-half mile. Get a better pair of receivers, or have those rewound. You do not need three dry cells with a silicon detector. Only one cell should be used, and that should be bridged around by a potentiometer. (2) Increase the range about 6 times as far, but you cannot get any results with an inefficient receiver. (3) Yes, either a transformer or rectifier.

979. **Wireless Telegraphy.** H. W. Q., Chicago, Ills., asks: (1) What size induction coil and what size transformer will be necessary to transmit 50 miles? (2) Can two 5 in. coils be connected to give a 10 in. spark? (3) Would a transformer of the following design give good results, and would it send 50 miles when using 110 volts and 5 amperes? Core $\frac{3}{8} \times 1\frac{1}{2} \times 6$ in., 4 in. between poles and magnetic circuit closed with laminated iron bars same size as field poles, each pole wound with one layer of No. 12 D.C.C. magnet wire, which will make about 100 turns on the primary. Secondary 10,000 turns of No. 30 D.C.C. wire on each pole. The whole thing to be immersed in boiled linseed oil. Would this coil give a large spark? Ans.—(1) Using a 50 foot aerial a 1 k.w. transformer will cover the distance, under favorable conditions. The induction coil should give a good 3 in. spark. (2) We doubt if this will be efficient. (3) This transformer is not proportioned right. The primary will need at least 600 turns of wire to choke back the current to 4 amperes.

980. **Transformer.** C. A. F., Roseville, Cal., asks: (1) I wish to reduce a 220 volt 60 cycle A.C. to 110 volts, two and half amperes required. How shall I go about it? (2) Please explain what the aerial wire is in a wireless station. Ans.—(1) Make a transformer having a core inside dimensions 3 in. x 6 in. Cross section $1\frac{1}{2}$ in. x 2 in. Wind on each leg 175 turns of No. 18 D.C.C. This is the secondary. Over this wrap 350 turns of No. 22 D.C.C. on each leg. This is the primary and is connected to the mains. (2) The wire that is connected to the instruments from the top of the mast.

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.

I have the pleasure to inform you that Section 3, after two unsuccessful trials, has been formed with a membership of twelve. As very few of the members residing in Brooklyn found it possible to attend the charter meeting, and as there were but four at the first two meetings, the club was not formed until the 5th inst. I have a suggestion to make for the benefit of Brooklyn members especially. Although Brooklyn is a borough of New York City, it takes a long time to get to the city proper, therefore the majority of Brooklyn members stay home. Why can't another section be organized in Brooklyn? We can send delegates to each other frequently thereby keeping in touch.

Temporary officers: Wm. Russell, chairman; J. J. Kehoe, vice-president; R. W. Yeaton, secretary. Charter members: J. Wm. Broome, W. S. Browne, E. Peterson, E. Everett Hill, Herbert Mendolsohn, Jerome J. Kehoe, J. R. F. Purcell, John Rosenfeld, Wm. R. Russell, H. W. Vilhomirson, F. A. Biderman. Meeting held at 1523 Madison avenue, New York City.

The second regular meeting of the Chicago Section No. 1 of the E. & M. Wireless Club took place Friday, Feb. 12, 1909, in the Auditorium Building. The meeting was called to order at 8 p. m. by the presiding chairman, Mr. Dickson, who announced that the election of officers would take place, in accord with previous notification. The results of the election were as follows: President, R. C. Dickson; vice-president, W. J. McGuffage; secretary-treas., D. J. Stump. Previous to the election of officers 30 minutes were devoted to practice in receiving of wireless messages. After appointing a committee to draw up the constitution and by-laws, the meeting adjourned at 10 p. m.

The third regular meeting was held at the usual place in the Auditorium Building, Saturday, Feb. 27, 1909. As usual, 30 minutes were devoted to the receiving practice, in which the members are becoming proficient. The meeting was then called to order by the President, and after the minutes of the previous meeting had been read, the preliminary draft of the Constitution and By-laws was discussed. After some necessary changes and additions, it was decided to have the revised form brought up at the next meeting for discussion and adoption. It was agreed that the dues should be \$3.00 per annum, payable in monthly installments at the first meeting in every month. It was also decided by vote that the meetings should be held on the second and fourth Saturdays of each month. It was suggested that the club turn out in a body to witness the production of "Via Wireless," now playing at a local theatre. This being put to a vote resulted unanimously in

favor of the suggestion, and a committee of one was appointed to secure the seats and make the necessary arrangements. The meeting then adjourned, at 10.00 p.m. Those present were: R. C. Dickson, W. J. McGuffage, D. J. Stump, J. Maypole, Franklin Richards, J. Erwood, Jr., G. E. Carlson, Norman Huffaker, A. Heller, K. B. Sheldon.

Orville F. McKibben of Augusta, Kentucky, would like to be put in touch with wireless workers and experimenters in his vicinity. We ask all our members who can reach him by wireless or mail to communicate.

Salem Section No. 2 of the Electrician and Mechanic Wireless Club met at the home of Cyril Hartley, 36 Fairmount street, Friday, Feb. 26, 1909. Names of officers were discussed, and it was decided that only two officers were needed. These were president and secretary. A vote was taken by ballot, by Chairman pro tempore H. M. Shackelford, and when the votes were counted, the following members were elected: Cyril Hartley, president; Harry S. LeFavour, secretary. The President then took the chair, and the members voted on the number of times a month and the day the club should meet. It was decided that twice a month, on Friday evening, would be sufficient. The club wishes to promote both wireless and social interests, for the improvement of its members. The following are members: H. Earle Brown, Cyril Hartley, H. R. Hutchinson, H. S. LeFavour, Alex. Michaud, Laurence B. Pedrick, Lyman Quincy, Robert C. Leaman, A. E. Woodbury.

Washington has surpassed many of the great cities in the advancement of wireless telegraphy. When Marconi got wireless to a commercial stage, boys of Washington took hold of it and started to experiment. They got hold of every wireless book that was published, from the Congressional Library. They would sit by the hour and read all the principles of this new discovery. They experimented with the coherer and decoherer and got that to working fairly well; but later Fessenden brought forth the electrolytic detector. The boys took an old electric light bulb, broke the tip off and took out the carbon filaments. Then they filled the bulb half full of 25 per cent. nitric acid. To make a connection they took a strip of sheet brass, bored a hole in it for a small stove bolt and bent it. With that much done they took a piece of fine platinum wire and attached it to a piece of copper wire, which in turn was attached to the brass strip. For tuning coils, they used mailing tubes, Mason jars or curtain poles, and wrapped wire around the one which they could get their hands on. The telephone receivers were in form of a watch case, their resistance being only 80 ohms, and the cost only seventy-five

cents. Aerial wires were attached to poles which were fastened to brick chimneys. Some of these aerials were but nine feet long and consisted of one wire. The only stations they heard were the Navy Yard and Fessenden experimental station. The sending was very crude indeed. They generally would go to auto garages and electrical supply houses and purchase second-hand coils for little or nothing. For a key, they took a piece of tin and nailed it to the bench or table, the other contact also being a nail. For current they went to auto garages and bought up all the old used batteries for a penny apiece. These batteries would last a month or so, according to the use. This has all changed in the last year. If one should inspect one of these stations at the present time, he would see apparatus that talks for itself: detectors of the latest type, fine tuning coils wound on hard rubber, telephone receivers of the latest type, sending coils that can reach at least 40 miles, and storage batteries. They have no trouble in hearing long distance stations. Stations like New Orleans, Pensacola, Key West, St. Augustine, Charleston, Philadelphia, Fire Island, Manhattan Beach, Newport, Boston, Cape Cod and Portsmouth, N.H., can be read very distinctly. As all know, Cape Cod works between 10 and 12 and sends out press to all the ships at sea. Complaints are registered every day at the Navy Department by the different naval stations regarding continual interference by the amateurs along the Atlantic Coast. There are two plans under consideration, it is understood. One is to limit the amateurs to certain hours in the day, these hours being from 3.30 to 7. The other is to license all private wireless stations. This action, officials claim, is made necessary by the large number of amateur stations. Some time ago, an amateur here in Washington wanted to have some fun. He sent a message to Navy Yard and signed it "Dolphin." This boat was then down in Cuba. The operators knew the Dolphin did not have a strong enough set to transmit that distance. They waited a while and later found the offender. They reported the case to Commandant Leutze, who took up the matter with the police authorities. The young man was brought before the District Attorney. Nothing could be done with him, but he promised to "be good" when it was explained just what damage his pranks with wireless might do. Aside from this one occurrence, the Washington amateurs have behaved themselves.

The Construction of a Tuning Coil. A short time ago the writer built the tuning coil here described, which gives such good results for the cost of construction that it was thought worth while to describe it for readers of the *Electrician and Mechanic*. The entire coil was built at a cost of less than a dollar and as it contains in the neighborhood of a thousand feet of wire it is useful for many experiments in wireless telegraphy.

Procure a six-inch drain tile two feet long and by means of a file or coarse sandpaper remove all irregularities from the surface. Now wrap a wire tightly about the tile at a distance

of twenty inches from the end having no flange. This is to serve as a guide in cutting the tile. This operation is easily performed by using a cold chisel held at a slight angle. Using the wire as a guide make a small groove in the surface of the tile all the way around. A close fitting board should be put into the inside of the tile and moved around as the cutting progresses to form a support and prevent breaking. If this is done properly there should be no difficulty in obtaining a straight even edge.

Now make two pieces of three quarter inch hard wood seven inches square. Drive small screw eyes at the centre of each piece. Next obtain a spring such as are used on screen doors. Hook this into one of the screw eyes, fit the end to the tile, draw the spring out at the opposite end and attach to the other screw eye. This should hold the ends on very tight. Put in a few long screws projecting through the wood, so placed as to keep the ends from slipping off the tiles. They should come through close to the inside of the tile. Now give the tile and ends a coat of shellac.

The above core should now be wound to within a quarter inch of the ends with No. 20 or 22 S.C.C. wire. A space one half inch should be scraped or burned bare along the top and the whole shellacked.

Procure two rods one half inch square of some smooth hard wood. These are for the sliding contacts which are made of No. 18 Spring brass, bent firmly around the wooden rods. Notches should be cut in the corners of the coil ends to receive the rods. Contact with sliders is secured by soldering two pieces of flexible lamp cord to the brass. Three binding posts should be mounted in one end of the coil to which are attached the two wires from the sliders and one terminal of the coil.

This coil can of course be used in any system but the connections shown in Mr. W. C. Getz's article in the July issue of this magazine will prove very sensitive.

The size may be varied by using different sizes of tile. A very good one may be wound on a five inch tile a foot long in which case no cutting is required. However as stated the size described is a very good one and has a great range of usefulness.

L. B. Lathrop.

Having used practically every combination of wiring of the apparatus used in Wireless Telegraphy, I have concluded that the drawing below represents as good a circuit for the experimenter as can be found.

In using these connections, I make use of several instruments that, while they are all, except the sending key, the common type, I have altered in small details.

The spark-gap is made of zinc, $\frac{1}{4}$ inch rods, pointed on the ends; one electrode fixed, the other governed by a spiral spring and adjusting screw, so that the gap can be lengthened or shortened by merely turning a thumb-screw.

The receiver is wound to 4000 ohms, and enclosed in a sort of sounding box, which is connected with the operator's ears by a rubber tube.

Aluminum is used in every possible place, making the outfit exceedingly light. The aerial is also of aluminum.

My tuning coil is shaped like an unwound clock-spring. I use this mostly for a sending helix, as its length is too short for receiving long waves.

The sending key is of the magnetic blow-out type, and with a certain double-break, will stand fifteen amperes at 110 volts. I can send 40 words a minute with six amperes.

Instead of a hot-wire ammeter for tuning the open and closed oscillatory circuits, I use a small incandescent bulb, as shown in diagram; the size depending on the size spark.

In concluding, I will say that large wire (14 to 10 B. & S.) gives better results when used for connecting instruments, than ordinary bell wire, which is commonly used.

THINGS RECEIVED

The 1909 catalogue of Henry Disston & Sons, Keystone Saw, Tool, Steel and File Works has recently been issued. It is a cloth bound book of 204 pages and is the most beautiful catalogue of tools which has ever come to our desk. The typographical and pictorial makeup and mechanical execution may be characterized as perfection. We cannot conceive how pictures of tools could represent them better than is done in this catalogue. The photographs are reproduced on tint grounds, the full size of the page, throughout the book.

The Hill Clutch Co., Cleveland, Ohio, has reprinted for free distribution, "Tests of Friction Clutches for Power Transmission," by Prof. R. G. Dukes, a paper presented before the annual meeting of the "American Association of Mechanical Engineers." A copy will be sent upon request.

Catalogue "D" of the Johnson Friction Clutch, issued by the Carlyle Johnson Machine Co., Hartford, Conn., gives very full descriptions of the construction and operation of their various styles of clutches together with price lists.

The Eck Dynamo & Motor Co., Belleville, N.J., issue a sectional catalogue and data describing their lines of motors and dynamos in various sizes, from 1-16 h.p. up. They manufacture a large line of electrical machinery and would be pleased to mail circulars to any of our readers who may be interested.

We are continually in receipt of questions as to where subscribers can get electrical material. A careful reading of our advertising pages would in many cases make such questions unnecessary. If, however, you write for a copy of "Something Electrical for Everybody" published by the Manhattan Electrical Supply Co., 17 Park Place, New York, N.Y., you will never have to ask such questions, as they carry in stock everything electrical and list most of it in this catalogue.

If you are planning to buy a bicycle this spring, write to the Mead Cycle Company, 23 North Clinton St., Chicago, Ill., for a catalogue of their Iroquois bicycles. These bicycles are fully and absolutely guaranteed and give universal satisfaction.

BOOK REVIEWS

General Lectures on Electrical Engineering.

By Charles Proteus Steinmetz, A.M., Ph.D. Robson & Adey, Schenectady, N.Y., 1909. Price \$2.00.

This well printed volume of about 300 pages contains a series of lectures delivered a year ago to a class of young electrical engineers. The use of mathematics has been entirely avoided, thus making the book valuable for those who have not a mathematical training. The lectures give a broad review of the entire field of electrical power, generation, transmission, controlling, etc., showing the close relation and dependence upon each other of all the factors of the problem. As will be inferred from Dr. Steinmetz's reputation the consideration of each topic is not only thoroughly adequate but extremely illuminating.

Shop Tests on Electric Car Equipment for Inspectors and Foreman. By E. C. Parham, M.E., and J. C. Shedd, Ph.D. New York, McGraw Publishing Co., 1909. Price \$1.00.

This book which covers a field on which little literature existed, treats practically of the testing of electric car equipment with the instruments and facilities likely to be at hand in a car house. As it is written for men who are not always thoroughly educated in theoretical electricity, the instructions are so devised that they may be followed even if not thoroughly understood. The methods are practical in all cases, even if some times not those which would be adopted in a well equipped laboratory, but in all cases the directions given will work. The book covers measurements of current, voltage, and resistance; tests of high voltage insulation, armatures, etc.; and instructions on help to the injured, and closes with a series of questions and answers covering the subject matter of the book.

Making Wireless Outfits. By Newton Harrison, New York, Spon & Chamberlain, 1909. Price 25 cents.

This is a simple and concise series of directions for building a simple untuned wireless set, using a coherer as detector. The directions given are practical and cover all parts of the apparatus, and will enable any amateur to easily and cheaply construct a wireless station of moderate efficiency. The book, however, gives no details of the modern tuned systems, nor directions for use of any of the more modern forms of detectors which the amateur of any experience requires. As a simple introduction to wireless telegraphy, however, the book fulfills a useful purpose.

Electrical Circuits and Diagrams, Part II.

By Norman H. Schneider. New York, Spon & Chamberlain, 1909. Price 25 cents.

This carefully executed and well planned series of diagrams includes alternating current generators and motors, single phase and polyphase transformers, alternating current and direct current motor starters and reversers, arc generators and circuits, switch, wiring, storage battery diagrams, meters connections, etc. It forms a desirable and valuable supplement to Part I of the same title, which has had a large sale.

HASLUCK, PAUL N. Handicraft Series. A Series of Practical Manuals. Edited by Paul N. Hasluck, Editor of "Work," "Technical Instruction Series," etc. Price, each, postpaid, \$0 50

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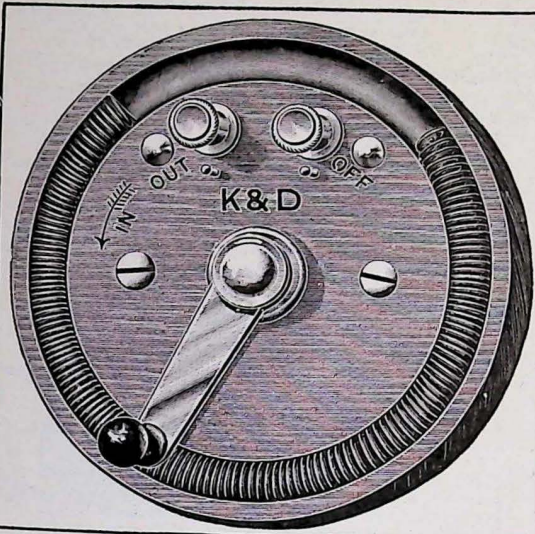
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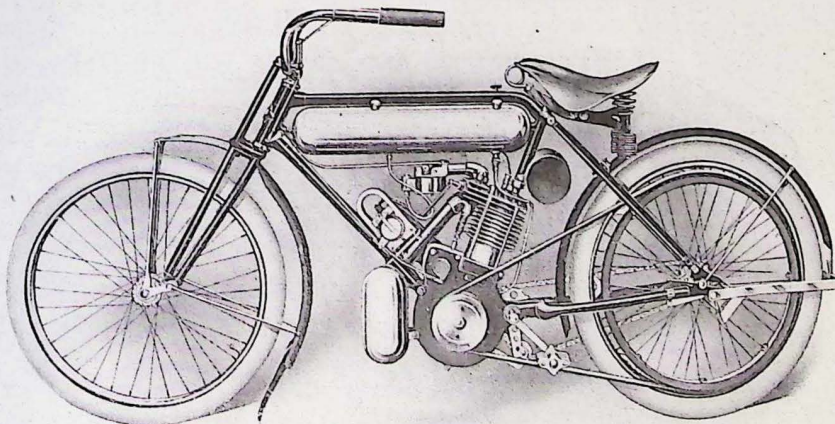
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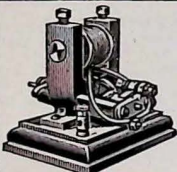
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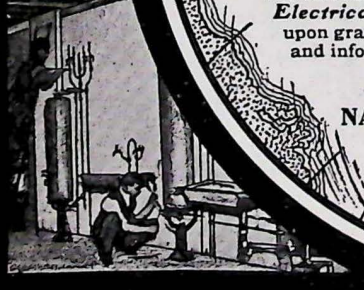
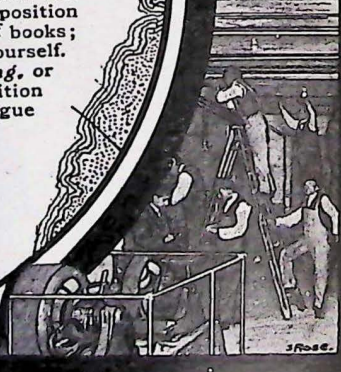
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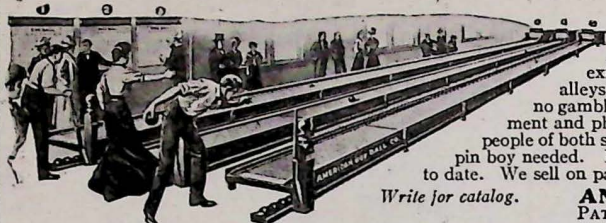
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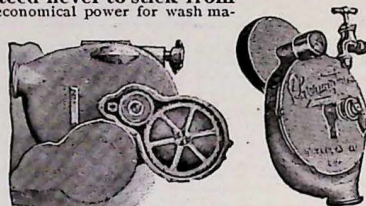


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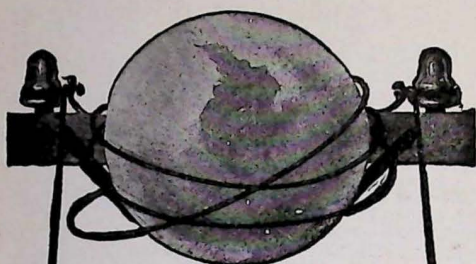
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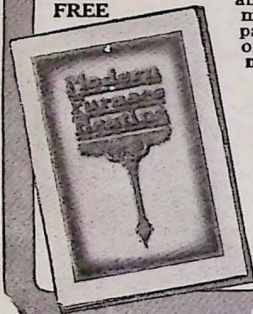
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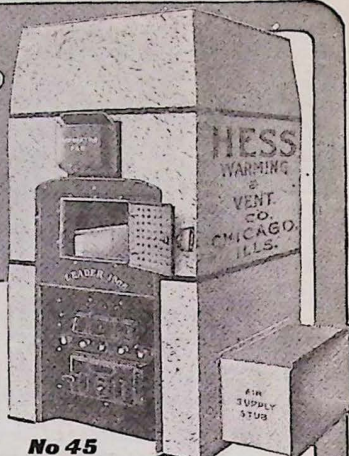
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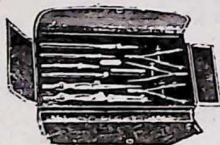
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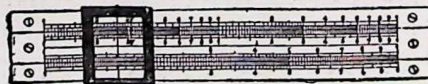


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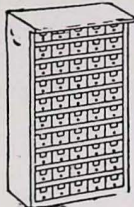
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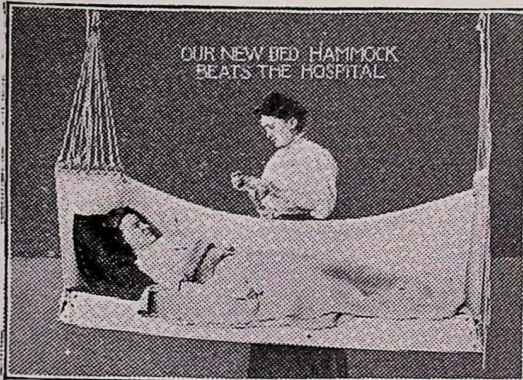
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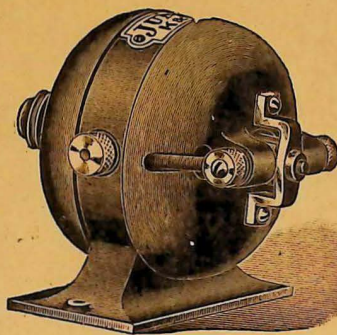
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