WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

VOL. IV.—No. 166.] SATURDAY, MAY 21, 1892. [PRICE ONE PENNY.

WORK WORLD.

LIGNUM-VITÆ is found superior to all other woods for brake blocks, and it is also serviceable for bearings in the form of cylindrical plugs; these are let into the wearing surfaces of the brasses.

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A bicycle railway is one of America's newest things. Experiments have been made, and the thing is said to be an assured success. At a dinner recently in honour of the inventor, the conviction obtained that by this system a speed of 200 miles per hour is attainable with perfect safety.

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There has been a good deal of doubt about the reliability of anemometers, but recent experiments seem to indicate that a very reliable form for ordinary use is found in the "air-meter." This consists of a single screw blade made of thin aluminium in the form of a portion of a helicoid. The dial should be protected from the weather.

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A triplet Safety bicycle has been built and tested on the road. It is said to be the fastest form of cycle yet built. The machine, mounted by three good riders, is reported to have covered ten miles on the road at the rate of 21 miles 538 yards per hour, the last mile being ridden in 2 min. 10 sec. This feat has not yet been accomplished by any single cycle rider.

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Polarite is a new metallic substance which is claimed to be remarkably efficient as a filtering medium for water supplies. Local authorities in England have adopted it, and the Egyptian Government has concluded a series of experiments in purifying the waters of the Nile, with the result that Polarite has given satisfaction to the chemists engaged. The water supply of Boston, U.S.A., has also been treated by it.

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The Plumbers' Registration Bill is virtually dead, for the present session at least. It may come up before the House again on June 29, but it cannot become law this session on account of the determined opposition on the part of the ironmongers. Many amendments remain to be prefaced to the Bill, which, unless in the main agreed to, will defeat it. We hope not, for it is most essential that the classification of trades should be better defined than has been the case since the old guilds age. Let the plumbers' craft be open, however, to all who can qualify for it.

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It has been shown, by a long series of experiments, that diluting the liquid of a galvanic battery by water or alcohol, liquefying either of the metals by mercury, diluting either of these amalgams by mercury, or diluting one solid metal by alloying it with another, has the effect of increasing the mean electro-motive force of the diluted and diluting substances, provided they are mixtures not chemically combined. Thus the electro-motive cell force is increased.

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Dr. Schrœder's lens bids fair to cause a stir in the optical world, for it is said to be the only new lens since Petzval's lenses in 1841. The new lens is the product of the investigations and elaborate calculations of a practical and theoretical mathematician of great experience, who, on the introduction of the new Schott Jena glass in 1886, was requested to thoroughly investigate the possibility of constructing a perfect lens, which should be free from roundness and curvature of field, as well as astigmatism, distortion, coma, ghost, and flare.

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The Titan crane at Peterhead Works, for setting in place the concrete blocks at the breakwater, has been tested with a full load of 62½ tons at the radius of 100 ft. The crane is the largest travelling crane in the world. It is 75 ft. high. The lifting gear was composed of eight steel wire ropes of a total thickness of 5½ in., and these were attached to two lewis bars, which were passed through the load and fixed at the bottom with T heads. The total weight of the mass put in motion was 550 tons, and the steadiness of the entire body was remarkable.

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There is a demand for shorthand writers in Australia, and the following extract of a letter from a magistrate in Fiji should be noted:—"Two months ago there was an examination held in Melbourne for shorthand writers to be licensed to practise in the Courts. Out of thirteen who presented themselves only six passed the test of 120 words a minute, and fewer still the test of 150. There seems, indeed, to be a dearth of shorthand writers in Australia. Sir John Thurston tried to get one for correspondence the other day at £200 per annum and his keep. A young fellow was sent up who turned out quite unable to write with any speed or to read his notes afterwards. He was sent back again, and Sir John commissioned one of the Fiji officials, who has gone on leave, to select another, but he could not get one. The fact is, that Australians are mostly lazy, and have not sufficient application to master shorthand, and those shorthand writers who come out from England rapidly rise beyond correspondence clerkships. The only one I know is now manager of one of the branches of the Union Bank of Australia." London Schools of Shorthand—take note!

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The art of moulding is one possessing considerable attractions, and requiring for its satisfactory practice great care and skill. A youth who proposes to make, say, a model engine, would really like to make it himself, and not merely put together a number of purchased parts each complete in itself. The difficulty in carrying out this wish lies in the high melting points of the metals used for the working parts; this cannot be altered, but we may get round it. Take, for instance, a steam-engine cylinder: a piece of brass tubing may be used as lining for the length in which the piston moves and the body of the cylinders with steam passages cast around it, the brass lining tube being embedded in the core. A brass port face for the slide-valve to work on may be fixed to the casting by small countersunk screws, or it may have short screws fixed in it, and be put into the mould so that the casting will be run against it and hold it by the screws. In the covers and gland small brass tubes serve for piston and other rods to work through. The castings may consist of an alloy of six parts lead to one of antimony. The lead is first to be melted and raised to the highest temperature obtainable over an ordinary open fire, and the antimony, broken small, added; the latter will be dissolved by the melted lead, and the resulting metal will be easily cast and sufficiently rigid; the brass linings should be heated before pouring in the metal.

An expensive lightning conductor has just been placed on one of three new chimney stacks, octagonal in section, and over 300 ft. high, belonging to Coats' Paisley thread mills. The conductor is of an improved type, made by a Greenock firm. It is in the form of a ribbon of copper 1¾ in. broad, and ⅜ in. thick. This is attached to the middle of one of the eight sides facing south-west. On the coping of the chimney is a ring of copper similar to the ribbon some 36 ft. in circumference, and out of this ring rise eight vertical rods, harpoon formed at the points, and composed of platinum. This is said to be the most effectual form of conductor yet devised, and some idea of its costliness may be obtained when it is mentioned that it contains 26 cwt. of copper, which, at 1s. per lb., amounts to £145 12s., and this exclusive of the precious metal platinum, other fittings, and labour in the making and fitting up.

HOW TO CONTROL THE GAS-METER.

BY ONE WHO KNOWS.

"Gas companies put a separate governor to each of their lamps." I remember seeing the above statement in a trade circular, I forget for the moment where; it was simply stated as a fact, but to me it spoke volumes.

A very short time afterwards the Company's meter inspector came to take the state of my meter, and left a paper which informed me that from that *moment* the gas would be so much more per 1,000 ft. No notice was given, no right of appeal; simply pay or be put in darkness. It was then that the statement above came fully home to me in all its selfishness.

For a long time I had put up with the annoyance of flaring and screaming gas jets, caused by the varying conditions of pressure in the Company's mains, and the enormous waste of gas for which I hitherto had paid, to say nothing of the half-consumed gas vapours escaping into the room, rendering the atmosphere extremely unhealthy and dangerous. But after this last display of high-handedness on the part of the Company, I decided that I, too, would have a governor to each of my lamps, or lights, and in addition I would have a governor on the main supply pipe, close to the outlet of the meter, and this is the only way you can "control the meter."

It appears strange that, knowing so well as the writer does the benefit to be derived from a good governor, I had not had one before, but although I have had a great deal of experience in gas matters, I let the matter slide, and grumbled and paid; but this is just what I don't want my readers to do. I can assure them that anyone burning the amount of gas necessary for an ordinary household, could not lay out their money to greater advantage—that is to say, with a certain gain of 20 per cent.

The cost of a good main governor, for a moderate consumer, would be about 50s., and a good governor burner about 1s. 6d. It would be invidious on my part to attempt to say whose make of governor was the best, when there are so many good ones.

A self-acting gas-valve or governor to the main supply should be fixed either by the maker or a competent gas-fitter, but the ordinary governor burner can readily be screwed on to the gas fittings by the consumer himself.

Another source of gain to the gas companies, and consequent loss to the consumer, is caused by small escapes of gas, so I will now endeavour to tell you how these can be remedied.

Directly a smell of gas is detected, and there is a doubt as to where it occurs, put out all gas, see that every tap is properly turned off, and watch the unit hand of the index of the gas-meter; by examining this carefully you can tell if the gas is really escaping, and if so, to what extent.

An ordinary gas-burner burns about five feet of gas an hour, so if, in the course of half an hour, the unit hand has not moved, you can be sure there is no escape of gas, unless it is in the fittings beyond the taps, or the smell must arise from some other cause; for instance, a tap being left partly turned on.

If the hand has moved to the extent of one foot in half an hour, you may know there is a serious escape somewhere; and on no account should a light be used to trace it, especially by an amateur, as an escape of this size generally makes itself known so unmistakably. The gas should be turned off at the meter, and a gas-fitter sent for, unless the escape is in a part easily got at, and you feel confident of being able to cope with it; but on no account attempt to do anything while the gas is turned on. If the hand only moves such a trifle in half an hour or so that it can be only just said to move, you can proceed to find the leakage with a degree of confidence, as far as danger is concerned, that you could not have done before examining the index of the meter.

First test by smelling all the brackets and fittings in that part of the house where the smell is, with the various gas burners alight, or, of course, there would not be any gas in the brackets if the tap was not turned on. The brackets and fittings are the seat of five out of every six of small escapes. If you think you have discovered the escape, apply a light to make sure, blowing it out at once if you *have* found it. A tap or two with a small hammer, or a turn of the screw of the tap or cock, or taking the plug of the cock out, and filing the washer of the plug a little thinner, so as to allow the plug to be screwed tighter into its seating, or a touch of white lead, will generally put these escapes to rights. To take out the plug of a bracket it is necessary to turn off the gas at the meter.

If there is a pendant light, particularly examine the cup and ball joint, and the joint of the ceiling-plate with the piping directly above it, being careful not to use a light to test them; for if there happens to be a leakage there, and it lights (as it will), it is very apt to blacken the ceiling. A light should never be applied to a supposed escape against a painted or papered wall or ceiling, or anywhere where you could not at once put your finger on it. If a leakage is found in the cup and ball joint, take the pendant down and the ball joint to pieces, thoroughly clean it, and touch the ground or rubbing parts with a piece of tallow candle. This joint often gets corroded with dirt; sometimes the fact of moving the joint backwards and forwards will put it right, but it is better to take it to pieces and clean it.

If the leakage is found to be in the ceiling-plate, unscrew the pendant and ceiling-plate and temporarily plug the opening or supply left, and then turn on the gas and see if the escape is the connection of the piping and the screwed connection by taking up the floor above; if this is not so, you may be sure it is in the screwing up of the ceiling-plate, and a little white lead on the thread before re-screwing up is generally all that is required.

If you cannot discover the escape in any of the fittings, you must trace the whole of the piping, and test it—first by smelling and afterwards with a light, being careful to keep the light away from that part of the pipe that goes behind skirtings, through walls, or into ceilings, as there may be an accumulation of gas in a confined space. If the pipe is papered over, slit the paper between the pipe and wall with a sharp knife, especially where it is held in position with a gas-hook. Do not apply a light to test a pipe on a papered surface if you have any respect for the paper.

If the escape is not discovered above the floor, there is nothing for it but to take up the floor-boards directly over the pipes—these boards, if not already *screwed* down, should be so when replaced.

A careful examination of all the pipes is sure to show you where the escape is, and it can generally be stopped with a touch of white lead; but if it is any larger than a pinhole it should be properly made good by a gas-fitter, if you cannot manage it yourself.

A periodical examination of the index of the meter should be made to see if there is any escape going on when no gas is alight; for, although you may not detect it, on account of the smell being carried away by a current of air, if it exists at all it is, in most cases, going on the whole of the twenty-four hours, and the meter inspector puts it all down on the card.

There is an instrument used in the trade for testing the soundness of gas-pipes, which hardly comes within the scope of this article, but I hope to give a description of it later on.

HOW TO LEARN DRAWING OFFICE WORK.

BY ARTHUR BOWES, A.M.I.C.E.

Instruments — T-Squares — Adjustable T-Squares—Set-Squares of Wood, Vulcanite, and Celluloid—Special Set-Squares—To Test Set-Squares—Parallel Rulers—Special Forms for spacing Lines—Straight-edges—Testing—Substitute for Straight-edge.

Before entering into a description of the various instruments used in the drawing office, it will perhaps be necessary to remind the reader of what was pointed out in the first of these articles—that a certain acquaintance with the tools and methods of such work will be pre-supposed. It would take up more space than can be spared here to describe at length the varied forms of the thousand and one instruments which are used by the draughtsman, and, in consequence, our attention must be devoted in these columns principally to such recent improvements in the appliances as may be considered comparatively novel. The commoner instruments will only be dealt with to point out the several merits or demerits which belong to them, and to recommend those which have stood the test of experience.

T-*Squares*.—T-squares are usually made of pear-tree or mahogany. However wellseasoned the wood may have been, it will be found difficult to prevent their warping or bellying in time, and care should be taken to keep them as far as possible in a position free from damp or excessive heat. The form of T-square shown in Fig. 15 is perhaps the most useful for general use. The blade is tapered, thus getting rid of some superfluous weight, and it is secured to the head or stock by screws, as shown. The advantage of this arrangement is that in drawing diagonal lines with the set-square, the latter can be brought along the edge of the T-square past the edge of the drawing-board, as shown in Fig. 16, whereas this cannot be done with those T-squares which have the blade inserted into the thickness of the stock. This latter construction is shown in Fig. 17. It must, however, be said in its favour that a T-square of this latter style can be used from either side of the drawing-board in case the drawing should be longer than the blade of the T-square, while with the former this is impossible. A bevelled strip of ebony is usually attached to the working edge of the blade.

Adjustable T-Squares. — A very useful form of T-square is the one shown in Fig. 18, where the stock or head is in two portions, one being movable on a centre-pin, while the other is permanently fixed at right angles to the blade. By placing the T-square with the movable stock next to the board, the blade can be set to any desired angle, and a series of parallel lines drawn with as much facility as though they were horizontal or perpendicular. For railway and tramway work, or in particular architectural features, such as roof details and classical pediments, it is a convenient instrument, especially when it is remembered that by turning the instrument over the rigid half of the stock can be used as in an ordinary T-square without disturbing the movable head. The arrangement is also of utility in cases where the lines of a drawing are found to have shifted through the contraction or expansion of the paper—a circumstance which is by no means of rare occurrence where the atmosphere of the drawing office is subject to considerable changes of moisture or temperature. In such cases the T-square can be adjusted in a moment to conform with the existing lines. In the T-square we have so far been considering, as shown in Fig. 18, the adjustment is made by simply setting the stock by hand to the desired angle; an American refinement on this method, where the adjustment is made by a regulating screw, is shown in Fig. 19. A somewhat similar arrangement was described in WORK, No. 103, page 827.

Set-Squares. — The style of set-square which meets with most approval is the one shown in Fig. 20, being formed of three slips of mahogany, tongued and pinned at the angles, with slips of ebony to form the working edges. Sometimes the edges are bevelled, but it must be noted that in this case the set-square cannot be reversed to work with the angle either right or left. The chief advantage of this form of set-square is that it has only a small surface in

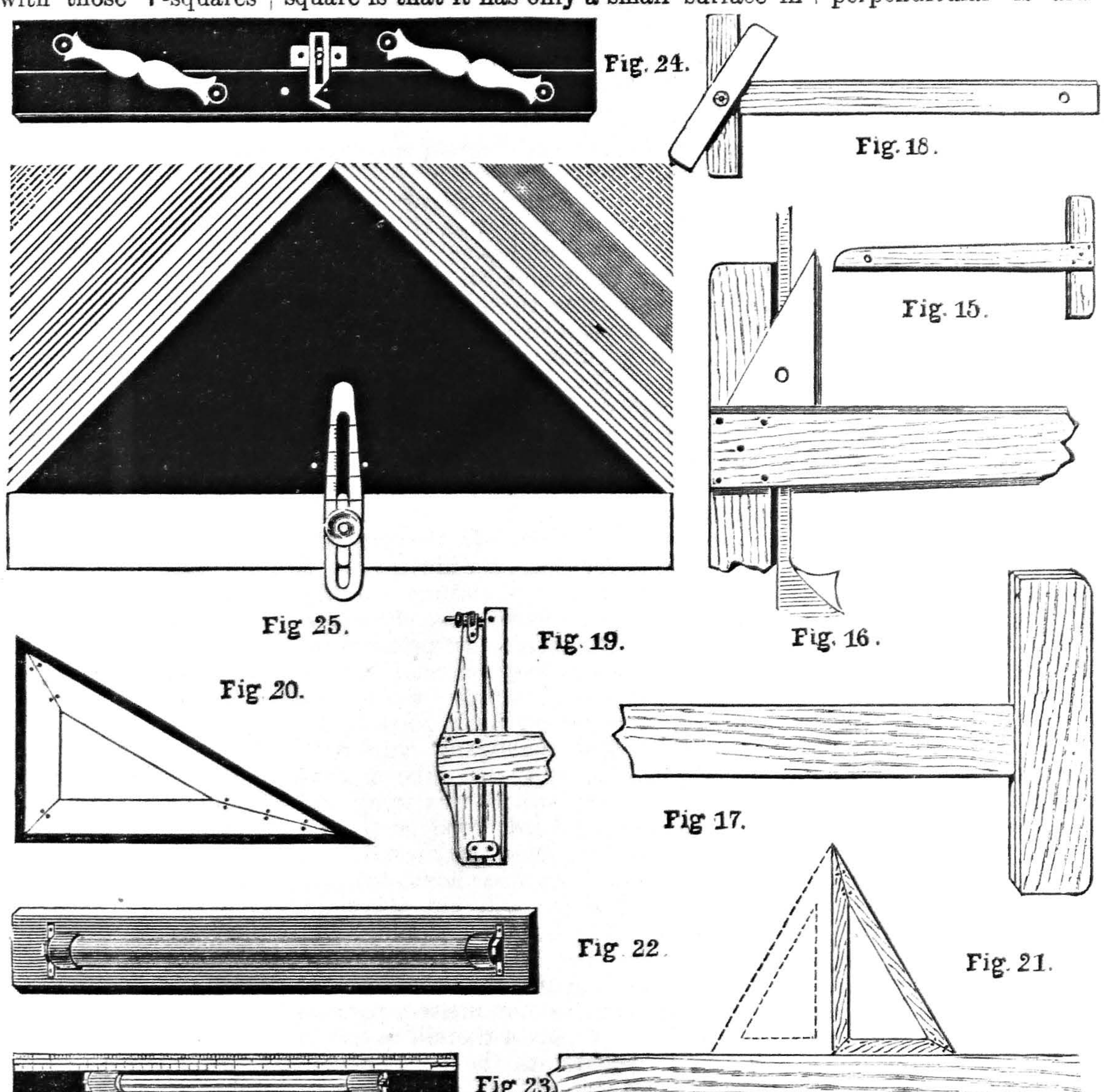


Fig. 15.—T-Square. Fig. 16.—Form of T-Square allowing Set-Square to be used up to extreme edge of Paper. Fig. 17.—T-Square with Blade inserted into solid Stock. Figs. 18 and 19.—T-Squares with adjustable Stocks. Fig. 20.—Set-Square. Fig. 21.—Method of testing Set-Squares. Figs. 22 and 23.—Rolling Parallels. Fig. 24.—Parallels for spacing Lines at regular intervals. Fig. 25.—Set-Square for spacing Lines.

contact with the paper, and so is not liable to soil it by the continuous scrubbing backwards and forwards. Set-squares made of vulcanite have an admirably smooth and sharp edge, but in the matter of accumulating dirt are most objectionable. This appears to be due in a great extent to an electrical attraction for the floating dust of the atmosphere, for if a vulcanite set-square be rubbed briskly with a duster to clean it, the particles of dust will be seen at once to settle upon it in greater profusion than before. Such squares require a frequent scrubbing with soap and water to keep them in decent condition.

An excellent material for set-squares has lately been found in celluloid. Set-squares made of this substance are very light and clean, and are so transparent that the lines of the drawing can be seen through them.

In addition to the usual angles of 45° and 60°, special set-squares are procurable adapted to the various pitches of roofs, slopes, and batters of embankments, angles of nuts, and other standard requirements. A set-square used in setting-out lettering will be described at length in the chapter devoted to that subject.

A useful little article to have by one in many classes of work is a small set-square, measuring not more than an inch and a half on the edges; this is so light that it is moved about very easily and quickly, and yet is large enough for much fine detail work.

To test the right angle of a set-square, a perpendicular is drawn by using the T-square and the set-square together, as shown in Fig. 21. The set-square is then reversed, and another perpendicular drawn which should exactly cover that drawn first. Any error existing in the square will be easily detected, as the amount of discrepancy is doubled in the divergence of the two lines—that is to say, an error of one-hundredth of an inch in the right angle of the square will cause a divergence of one-fiftieth of an inch between the two perpendiculars — an amount which is easily appreciable to the eye.

Parallel Rulers.—Parallel rulers are convenient as enabling the draughtsman to dispense with the T-square and drawing-board, as there is no necessity for the paper to be permanently fastened down when working with these instruments. They are not to be recommended, however, where accuracy of work is a desideratum. There is always the liability of the instrument to slip on the paper to contend with, besides the accumulated errors of judgment which necessarily arise in adjusting the parallels to the existing lines. The old form of parallels, consisting of two straight flat rulers hinged together with brass links, may be dismissed at once as of little use, principally on account of the time taken in stepping the instrument from one position to another. The rolling parallel, on the other hand, is sometimes a very useful instrument. Figs. 22 and 23 show two varieties, the latter having ivory scales on both edges.

As a guide to assist in drawing a number of parallel lines moderately close together, say, for example, in screw-threads or in sectioning, a small ivory wheel is sometimes placed at the end of the brass wheel. The ivory wheel is divided into tenths and twentieths of an inch, and the divisions are read off from a line on the top of the brass bearing. Several special instruments for the same purpose have been devised, and afford a much safer means of spacing the lines accurately. The one shown in Fig. 24 has a small brass attachment slotted to receive a clamping screw, by means of which it can be fixed in any desired position. An angular piece is cut out of the lower part of the brass slip, and in this space will be seen a small pin, which is attached to the lower half of the parallel ruler. On trying to open the instrument in the usual way, this pin comes in contact with the brass stop, and prevents the parallels opening beyond a certain limit. By altering the position of the sliding piece, the play of the instrument, and consequently the spacing of the lines drawn, can be adjusted as desired. Fig. 25 is a very neat arrangement for effecting the same purpose. In this case a set-square is used with two small pins or stops, which are fixtures. A straight-edge, against which the set-square is used, carries a brass sliding piece of tapered form. The varying taper allows the set-square to be moved to a greater or less extent, according to the adjustment. The tapered tongue is graduated, so that the amount of play of the instrument and spacing of the lines can be adjusted to any definite measurement within the scope of the instrument. It will be seen from an inspection of the figure that the set-square and straight-edge when in use are to be advanced alternately one step to each line drawn.

Straight-edges.—Although the T-square is the instrument most in use for the drawing of straight lines, it is desirable to have at hand straight-edges of various lengths, ranging up to six or eight feet, or for special cases, much longer. For accurate work, steel will naturally be the material used for their construction, though mahogany or pine will generally be sufficient for the longer lengths. A useful size for a steel straight-edge for general use, though the requirements of draughtsmen naturally differ widely, is from eighteen to twenty-four inches in length by an inch and a quarter wide. One edge should be bevelled, and in using the straight-edge for drawing ink lines, the bevel is placed downwards, and prevents the ink from running underneath the straight-edge.

A usual mode of testing the accuracy of a straight-edge is to hold it up to the light, with its edge in contact with the edge of another one. Any discrepancy between the two edges will then make itself visible by the light showing through the spaces. It must be remembered that this is no test of either of the straight-edges being truly straight, but only of their agreement one with the other. A little consideration will show that one straight-edge may be round and the other hollow to just the extent that ensures a perfect fit. To test the accuracy of the line formed by the edge, three straight-edges must be compared, each with both of the other two. If two of these be respectively round and hollow, they cannot both fit the third one, nor can a perfect agreement be obtained amongst all the three until each one is absolutely straight.

An excellent substitute for a long straight-edge will be found in an adaptation of the carpenter's chalk-line. A drawing-pin or needle-pricker being first fixed at one end of the desired line, a length of silk thread or sewing cotton, which has been previously rubbed with blacklead, may be looped over it, and the other end of the thread passed round a needle fixed at the other end of the line. The thread may then be "snapped" against the paper, and the loose blacklead leaves a line sufficiently distinct to enable a firm line to be drawn over it. Or the blacklead may be dispensed with and points pricked with a needle at short intervals, immediately under the line of the thread. These points being afterwards joined up with the help of a shorter straight-edge will give the desired line.

INDUCTION COILS: HOW TO MAKE AND WORK THEM.

BY G. E. BONNEY.

How to Make a Small Spark Coil—The Bobbin for the Coil—The Core of the Coil—The Primary Wire of the Coil—The Secondary Coil of Wire—How to Test the Wire for Continuity—Winding the Secondary Wire—The Automatic Interrupter or Break—Fixing the Parts of the Coil—Plan of Connections—Testing the Power of the Coil.

How to Make a Small Spark Coil.—Having in previous articles on this subject studied some of the principles of construction in making induction coils, we will, in this, set about putting those principles into practice by making a small coil capable of giving a short spark at the terminals of the secondary wire. As this small coil will be the counterpart of larger coils hereinafter to be described, we will exercise the same care in its construction as in that of its larger congeners, and build up its parts piece by piece.

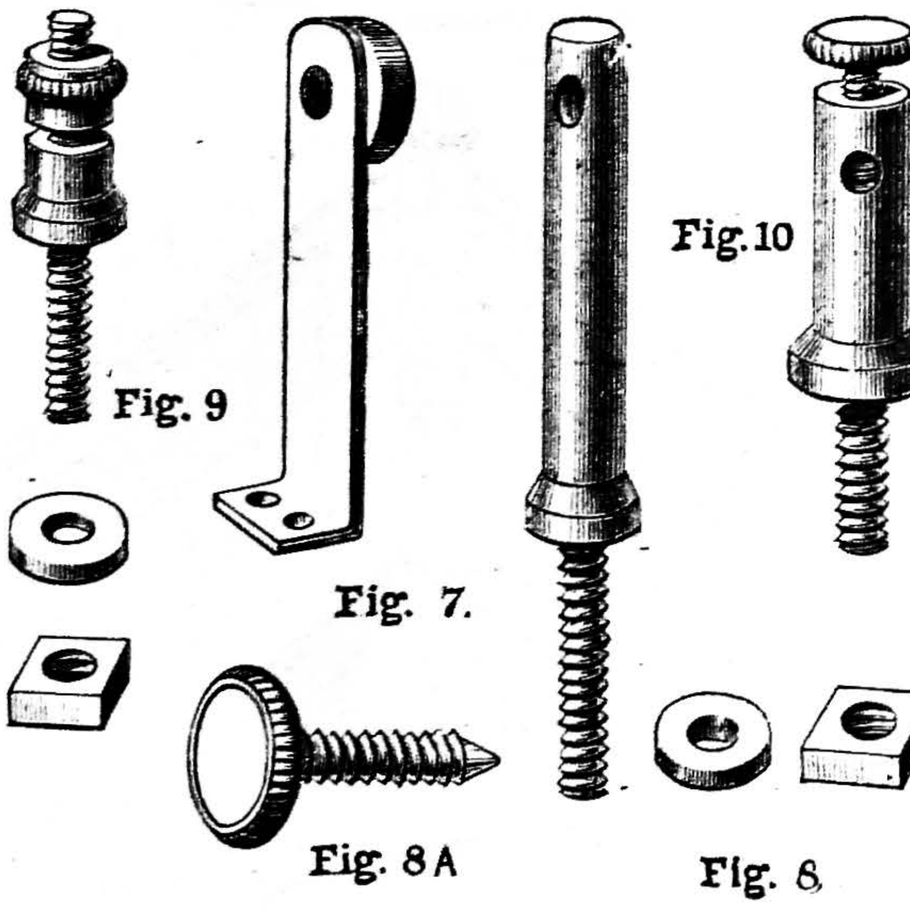
The Bobbin for the Coil.—In the construction of bobbins for coils, a wide licence is allowed in the choice of material for the bobbin ends. In expensive coils, ebonite is employed. In coils of meaner pretentions, any good hard wood may be used for the bobbin ends. Boxwood is rather too brittle, holly and hornbeam are both good tough woods, walnut and mahogany will both serve the purpose, and also take a good polish. The bobbin ends for this small coil may be two discs of hard wood or ebonite $1\frac{1}{2}$ in. in diameter by $\frac{3}{8}$ in. in thickness. They may also be made square, hexagonal, or octagonal, as the shape will not affect the working of the coil; but they should be at least $1\frac{1}{2}$ in. across the widest part. When cut out and made smooth, they should be, if of wood, immersed in hot melted paraffin wax and allowed to remain therein until the wax has well soaked into the pores of the wood, say for a quarter of an hour or twenty minutes. They should then be taken out and all the surplus wax rubbed off whilst still warm. A $\frac{5}{8}$ in. hole should now be cut in the centre of each end with a centre-bit to receive the tube and core to form the body of the coil, and two fine holes pierced through one of the ends near the centre hole to pass the ends of the primary wire through. The body of the bobbin may be of sheet ebonite $\frac{1}{16}$ in. in thickness, and 4 in. in length, rolled into a tube $\frac{5}{8}$ in. in diameter, and glued into the holes in the bobbin ends. It may also be made of papier-mâché of the same thickness well soaked in paraffin, or a thin paper tube may be formed on a round ruler or glass rod, using thin glue to stick the sheets together; but it is advisable to soak this paper tube in melted paraffin before mounting it as a body of the bobbin. Coils have been made with plain wood heads merely polished and varnished, and tubes made of paper soaked in melted beeswax or coated with shellac varnish, but these do not equal paraffin as insulators.

The Core of the Coil.—The coil bobbin may be made up in the following manner, commencing with the core of the coil, and this method is perhaps better than any other for building spark coils. First get a tube with an internal bore as large as the intended core of the coil—in this case $\frac{1}{2}$ in. in diameter—and pack the tube tightly with soft iron wires of No. 20 or No. 22 gauge cut to the length of the required core. This done, tie a piece of strong twine around the protruding end of the bundle and draw it out of the tube whilst winding the twine tightly round it. This done, immerse the bundle of wires in melted paraffin, let it soak therein for a quarter of an hour, then set it up on end to drain and cool. Meanwhile, get some wide tape and soak in the paraffin. Unwind the twine from the core of wires and wind on the paraffined tape until the bundle has been smoothly covered with tape. The ends of the bundle should now be dipped into some good glue and fitted tightly into the bobbin ends, leaving one end of the bundle protruding from one of the ends about $\frac{3}{8}$ in. or $\frac{1}{2}$ in. to form a pole of the magnetic core. When the glue has set and the ends are quite firm, get a strip of strong thin paper soaked in melted paraffin, and envelop the core with two or three layers of this before winding on the primary wire. When coils are built up in this manner, there will be no power lost between primary and core, either by bad insulation or over insulation. Some writers on this subject recommend the ends of the core to be capped with thin iron caps soldered to the ends of the core before soaking in paraffin. This makes the ends compact, but is open to the objections of weakening inductive effects, and liability to retardation of magnetic effects through the use of hard iron. If the ends of the wires forming the core are neatly trimmed to form a smooth end opposite the break, this will be all that is necessary.

The Primary Wire.—The primary wire for this small coil may be of No. 20 or of No. 18 silk-covered copper wire. Pierce a small hole with a fine bradawl through one of the bobbin ends down near the body of the bobbin, and pass one end of the primary wire, to the length of 5 in., through this hole from the inside, then wind on the wire until the tube has been covered with four layers of the wire. Leave 8 in. of the back end free, and pass this out through another small hole made in the same bobbin end as the first. These two wire ends will be used for connecting the coil with the battery, and directions will be given for this further on; at present, coil both of them into spirals around a pencil to keep them out of harm's way, and leave them as two small curls at one end of the bobbin. Before winding on the wire, it will be advisable to see that it is properly covered with silk and to make good any defects observable; and, to make sure of the insulation, it will be advisable to run the wire through some melted paraffin. Now, after winding the coil, it will still further improve the insulation to baste the primary with the hot wax whilst holding it over the vessel in which the wax is melting. Then have some strips of thin strong paper, soak them in paraffin, and envelop the primary with two or three layers of paraffined paper, smoothing all well into a compact coating. This is specially advisable in building the primary of larger coils.

The Secondary Coil of Wire.—The secondary wire of a spark coil must be of soft copper, and should not be of a larger gauge than No. 36 Birmingham wire gauge. It may be of No. 40 with advantage in this small coil, especially if No. 20 be used as a primary wire. It must be continuous throughout the whole length to be employed in the coil (4 oz. of No. 40, or 6 oz. of No. 36, will be needed for this coil), and free from kinks. To test its continuity, it will be advisable to carefully unwind it from the bobbin on which it is wound when purchased, and to wind it on another bobbin mounted on a metal spindle. Pass the commencing end of the wire through a hole in one of the bobbin ends and clean off the silk covering, then twist the end of the wire around the spindle. Have the galvanometer on the bench, and also a battery of one or two cells, any kind will do; wind the wire from one bobbin to another slowly, and keep a sharp look-out for knots and bare uncovered spots. Should one of the first appear, unfasten it, and test the continuity of the wire by connecting it in circuit with the battery and galvanometer in this way: connect a wire from the battery to the bobbin spindle, the other wire being connected to the galvanometer, then touch the opposite galvanometer stud with the end of the unfastened wire; if the needle moves, the wire is continuous so far, and the knot must be remade by baring the ends, cleaning them, twisting ½ in. of the ends together in the form of a long splice, and tinning the splice with a little solder. The uncovered spot must now be made good with a thread of soft silk wound around the joint to fully cover it. Uncovered spots must be tested in a similar manner by touching them with a wire connected to the galvanometer, and then coating them with silk. If the needle does not move, we may be certain that there is a bad joint or a break in the wire, and must then search back until the fault is found. Sometimes the copper wire is broken, and only the silk covering holding the parts together. Sometimes the wire has been broken and a knot tied with the covered wire. These faults must be made good, and then, when a movement of the galvanometer needle shows that the wire is continuous throughout, it should be run back through melted paraffin, kept hot in a pie-dish by a kind of glue-pot arrangement with hot water in an outer dish. If a small pulley, such as a blind-cord pulley, is put on a piece of bent wire, the covered wire may be run under this whilst held in the hot paraffin, and thus all danger of abrading the silk covering may be avoided.

Winding the Secondary Wire.—The secondary wire may now be wound on the primary whilst the bobbin is being revolved in a lathe or similar machine for producing rotary motion. I hope to give an illustrated description of a coil winder in a future paper. Wind on the secondary wire in the same direction as the primary, having first coated this with two or three layers of paraffined paper. Run the bobbin containing the wire loosely on a round steel or iron spike held in the left hand or fixed on a support at a little distance from the lathe. Pass 8 in. of the first end out through a hole in the coil bobbin end, and coil it in the form of a helix. Revolve the lathe slowly, and guide the wire on by hand. If the hand is held some eight or ten inches away from the coil, and allowed to follow the wire, this will run on evenly in turns side by side as if guiding itself. Some coil makers prefer a turn of foreign post paper soaked in paraffin between each layer of secondary wire; to this I have no objection, providing only one turn is used, as its helps the amateur in winding the next layer. Hot melted paraffin wax may be basted on instead if preferred. Layer after layer must be thus run on regularly side by side and over each other until all the wire has been used. The commencing end of the wire, coiled up as a helix at one end of the bobbin, may now be carefully straightened out, and led in a fine saw-cut up to the top of the bobbin, where it should be soldered to the foot of a small brass pillar to form one terminal of the secondary. The other end of the secondary must be taken to the opposite bobbin end, and there secured to another pillar. These parts will be described further on. The whole bobbin between the ends may now be coated with a piece of silk or a piece of fancy leather bound tight down over the wire, and secured to the underside by a lacing of silk cord. This gives the coil a finished appearance, and it may now be fastened down to the base or stand (made of polished walnut or mahogany, 7 in. by 4 in. by ¾ in.) by four brass screws passing up



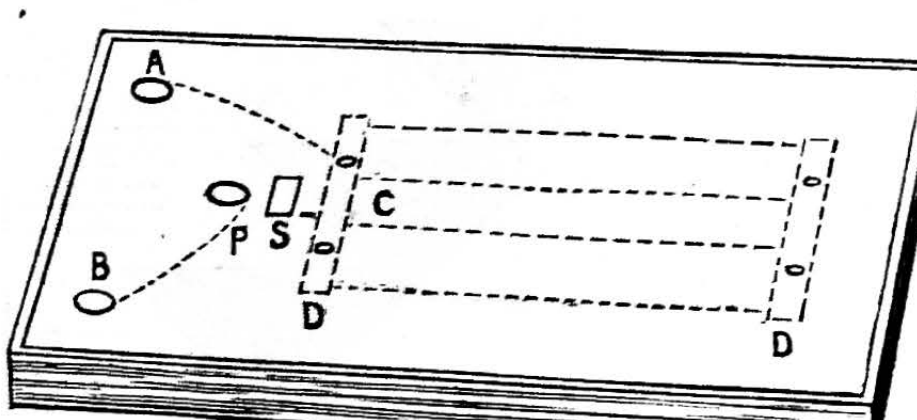


Fig. 11

Induction Coils. Fig. 7.—Break Spring and Hammer. Fig. 8.—Break Pillar. Fig. 8 A.—Platinum-tipped Contact Screw. Fig. 9.—Terminal Binding Screw, Nut, and Collar. Fig. 10.—Terminal for Secondary Coil. Fig. 11.—Plan of Baseboard for Coil—A, B, Position of Terminals for Primary Wire; C, Core; D, D, Position of Bobbin; P, Break Pillar; S, Position of Break Spring.

through the base—two at each end—into the wooden ends of the bobbin.

The Automatic Interrupter or Break.—When the coil is fixed down to its stand or base, measure the distance from the top of the core to the base of the coil, and cut off a piece of thin sheet brass or German silver ½ in. longer than this to serve as the break spring. That will be, in a coil of 1½ in. in diameter, a strip of spring brass or of spring German silver 1¼ in. in length by ⅜ in. in width. This should not be too stiff, or it will vibrate too quickly for a spark coil. Round one end, smooth the edges, and bend ⅝ in. of the other end to form a foot for the spring. In this drill two small holes for two brass screws. At a spot in the rounded end, exactly opposite the centre of the core when the spring is fastened down in place, drill another ⅛ in. hole to receive the tang of the break hammer. The hammer must be of soft iron with a face of the same diameter as that of the core, and from ⅛ in. to ¼ in. in thickness. The head of a large iron clout nail will do for a small coil. The hammer may be riveted or soldered to the spring as may be deemed convenient. On the opposite side, at the back of the break spring, must be soldered a speck of rather thick platinum foil. This spring (Fig. 7) may now be fixed to the base of the coil with the hammer face at the distance of ¼ in. from the face of the core end, one end of the primary wire being secured under the foot of the spring, or soldered to it before fixing it in its place. The other end of the primary wire will go to a terminal binding screw on the baseboard.

The break pillar shown at Fig. 8 is merely a piece of ⅜ in. brass rod 2 in. in length, turned to the form shown in the figure. In the upper part, opposite the speck of platinum on the break spring, drill and tap a ⅛ in. hole to receive a brass screw ⅞ in. in length, furnished with a milled head. The end of this screw must be tipped with platinum wire soldered into a slot cut in the end of the screw. This is named the contact screw. The lower part of the pillar should be turned down to $\frac{3}{16}$ in., and a thread cut on ½ in. of this to receive a nut. This part of the pillar will pass through a hole in the baseboard, and the end of a short piece of No. 16 wire will be clipped between the nut and a brass collar to connect the pillar with a terminal binding screw on the base of the coil. These screws are shown at Fig. 9.

Fixing the Parts of the Coil.—At Fig. 11 I give a plan of the base of the coil showing the position of its various parts. The bobbin should be fastened down to the base, midway between the two sides, and with its back end 1 in. from the edge of the baseboard. The spring of the break should be fastened down to the base so as to bring the hammer face ¼ in. from the end of the core. The break pillar must be fixed near enough to the spring to allow its platinum-tipped screw to just touch the spring when the screw is half-way into the pillar. This will allow room for adjustment both ways. The screw should be furnished with a lock-nut to keep it from getting loose. The two terminal binding screws for the ends of the primary wire will be screwed into the base at the two corners, as marked A and B on the plan. One end of the primary wire will be fastened to the foot of the break spring. From the foot of the break pillar, beneath the base, a short piece of No. 16 wire will connect this with one of the terminal binding screws, as shown by the dotted line from B to P. The other end of the primary will pass down through the base of the coil and be carried under to the terminal binding screw A.

We may now test our coil by connecting a one pint bichromate or chromic acid cell to the terminal screws. Adjust the contact screw until a steady to and fro motion has been obtained, then span the terminals of the secondary with a piece of wire and note the spark. This will not exceed ⅛ in., but the length will be increased after a condenser is added. The terminals may also be spanned with the finger and thumb of one hand if the maker cares to test its stinging shock. Its efficiency as a spark coil will be increased by the use of a condenser and spark dischargers.

SLATERS' WORK.

BY A MASTER SLATER.

Ridges.—The ridges and hips of slated roofs are generally covered with vitrified ridge tiles. These are made in various colours, red, blue, yellow, and white, and of various shapes: Fig. 9 is plain ridge; Fig. 10, rolled ridge; Fig. 11, capped ridge; Fig. 12, ventilating ridge, used on warehouses and mills; Fig. 13, crested ridge. A groove is formed in the top of the ridge, and the cresting fixed with cement. Ridge tiles are also made of cement concrete, and in dressed freestone, the latter being generally used for grey slating, or in very exposed situations.

Ridges are also made with lead: a wooden roll is fixed on the ridge, and the lead dressed neatly over it. In order to prevent the wind blowing the lead up, cramps of galvanised iron should be screwed on about 3 ft. apart. Ridges of slate are also used. There are three kinds:—Williams' ridge (Fig. 14) is in two pieces, Thomas' ridge (Fig. 15) is in three pieces, Davey's ridge (Fig. 16) is fixed together by cramps, and is fixed the same as ordinary ridge. The joints of these ridges are sometimes rebated.

The ridge tiles should be bedded in lime and hair mortar, and fixed to a line to keep them straight.

When the hips are covered with ridges, a galvanised iron cramp should be fixed at the lower end to prevent the tiles sliding down.

Sometimes the hips are cut so as to meet closely, and the slates are bedded in mastic and oil; sometimes steps of thin sheet lead are inserted at the hip and then turned across the hip, and sometimes a slate roll, with a notch on the underside, is screwed on to finish the hip. When the ridge tiles are not carried down to the hip, the ridge is finished with a tile similar to Fig. 17, or if an ornamental ridge is used, a finial (Fig. 18) is set at the end. The ridges should be pointed with Portland cement, mixed with sifted smith's ashes to darken it.

When three or more ridges intersect each other at the same level, special-made tiles in one piece can be had, by sending a sketch to the makers. These make much better work than mitring the ridge tiles. The tiles are also made to suit different pitched roofs from 50° to 135°, the higher numbers being flattest.

On some old roofs covered with grey slates, the ridge tiles have been obviated by cutting notches in each side of the slate 3 in. from the top, and fitting one into the other; these are called "hangers." The ridge tiles should always be selected to suit the pitch of the roof, so as to bed down with a neat, close joint on the slates.

Pointing.—After the ridges are fixed, if the slates have not been bedded, they are pointed inside with lime and hair mortar: the pointing should be on both sides of the laths and across the joints. The eaves should be well filled up with mortar, and when the slating is carried over a gable wall, the space between the top of the wall and the underside of the slates should be well filled up, to prevent the wind getting in.

When coping or water-tabling is fixed on a gable, the slates should be inserted at least $2\frac{1}{2}$ in. under it, and the joint pointed with Portland cement. When there is no coping on the gable, the slates are made to project a little over, and a broad joint pointed down and cut off on the underside to a rule; this is termed "pointing the skew."

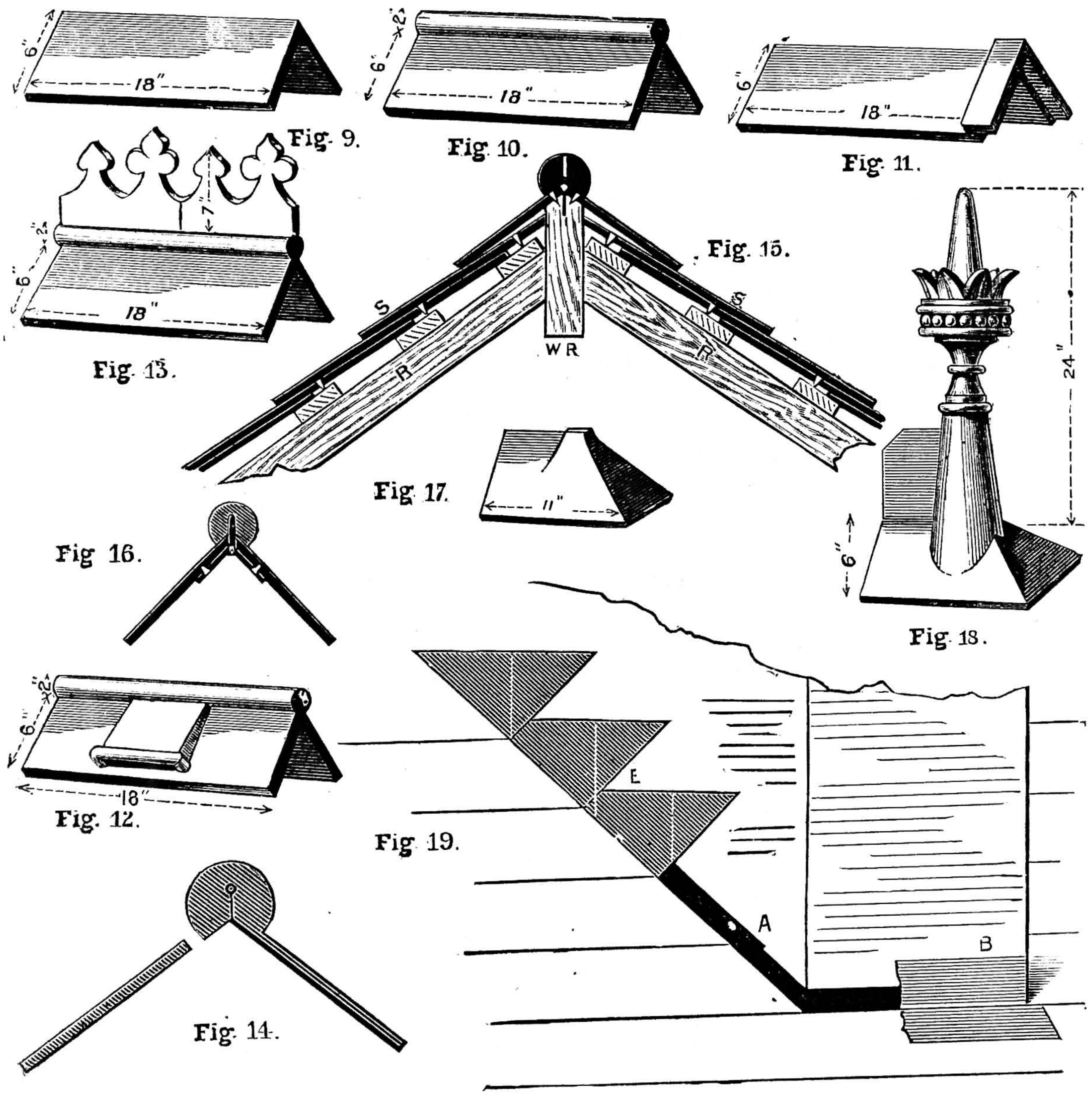
Steps and Flashing.—When slating up to a wall or chimney, lead or zinc steps should be inserted in each course; these are about 6 in. wide, and turned up $1\frac{1}{2}$ in. They should be dressed close up to the wall, and covered with flashing cut into triangular pieces, and fixed into grooves cut in the wall. Sometimes the flashing is put on in one piece, the groove being cut parallel to the slating; the flashings should be pointed with Portland cement. Sometimes the flashings are not put on, and the joint is collared down with mortar or cement, but this will crack sooner or later and let in the wet. Fig. 19 shows steps at A, and flashing at B.

When lathing up to a wall or gable end, a lath $\frac{1}{4}$ in. thick should be nailed under the slate-laths on the end rafter, to throw up the outside of the slates and cause the water to run from it.

In fixing metal skylights, they should be made so that the slates at the top and sides lay on the metal, while the bottom of the skylight should be tilted up, and lay on the slates. For wooden skylights, steps and flashing must be used, the flashing being fixed to a roll on the top edge of the wood.

When a roof is to be repaired which is not stripped to the ridge, as the last course of slates cannot be nailed, they are bedded in mortar or cement, and held up by straps of lead or copper, or by pieces of strong copper wire nailed to the top lath, and bent upwards over the tail of the slates.

Measuring.—Slaters' work is measured by the square of 100 ft., or by the square yard of 9 ft. In measuring the roof of a rectangular building, multiply the length by the girt from one eave to the other, measuring over the ridge, and the product will be the area. In a hipped roof, add the length of the eaves and the ridge together, and divide by two for the average length, and multiply this by the girt for the area of the sides; for the area of the end, multiply the length of the eave by the depth of the spar, and divide the product by two. An allowance of 1 ft. is made for all eaves, hips, and valley gutters to cover the expense of cutting. No deduction is made for ordinary chimneys or skylights, but for large openings, deduct the net area, and allow 1 ft. all round for cutting. For irregular-shaped roofs, multiply the average length of each side by the depth of the spar, and add the products together, adding the eave, hip, or valley measure. Ridges are measured by the lineal foot or yard. Pointing to flashing, skews, etc., are measured by the lineal foot or yard. Lead or line strips are counted by the dozen.



Slaters' Work. Fig. 9.—Plain Ridge. Fig. 10.—Rolled Ridge. Fig. 11.—Capped Ridge. Fig. 12.—Ventilating Ridge. Fig. 13.—Crested Ridge. Fig. 14.—Williams' Ridge. Fig. 15.—Thomas' Ridge. Fig. 16.—Davey's Ridge. Fig. 17.—Ridge End Tile. Fig. 18.—Finial. Fig. 19.—Steps and Flashing.

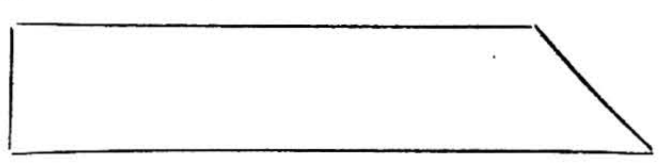
HOW TO MAKE AND WORK THE SPECTROSCOPE.

BY CHARLES A. PARKER.

Adjustable Slit—Preparation of the Jaws of Slit—Bevelling Jaws—Testing Edges—Connecting-Bars for Jaws—Blacking the Jaws—Collimator Hood—Cutting Opening in Cover of Hood—Fixing Jaws to Cover of Hood.

Having in the previous papers described the construction of a bisulphide of carbon prism, let us now turn our attention to the preparation of the spectroscope itself, commencing with the adjustable slit (which is shown in plan and section in Figs. 12 and 13). The slit about to be described will doubtless tax the powers of the amateur to the utmost; and those who can successfully execute the remainder of the work, but experience a difficulty in making this portion of the instrument, will do well to call in the aid of some skilled metal-worker. Practically speaking, the essential parts of the slit may be said to consist of a couple of perfectly parallel knife-edges which shall be capable of being opened and shut according to the width of opening desired, this movement usually being effected by means of a sliding piece of metal actuated by a milled screw and spring. The adjustable slit about to be described takes the form of a pair of parallel knife-edges, so arranged as to move in unison by means of a milled screw; and as all the working portions are enclosed in the interior of the collimator hood, it presents an extremely neat and finished appearance.

Commencing with the jaws, cut off a $2\frac{3}{8}$ in. length of perfectly flat strap brass, $\frac{3}{8}$ in. wide, and barely $\frac{1}{8}$ in. thick; then proceed to file one of the long sides of this to a sharp bevel at an angle, something like this:—



In order to ensure an accurate bevel being formed, take a sharp point and draw a straight line along the entire length of the brass before commencing to file the metal: and if this line is situated at about $\frac{1}{8}$ in. from the edge to be bevelled, it will afford a very useful guide for the file. A second-cut file should be used for roughing-out the bevel, but a dead-smooth flat file may with advantage be employed for finishing it up true, the greatest possible care being taken to get a correct and well-finished bevel.

When the bevel has been filed up in the manner above directed, the brass should be sawn in half, so as to form two separate jaws, each of which must measure $1\frac{1}{8}$ in. long (as shown in Fig. 14) after the ends have been filed up true. The finishing touches are now given to each bevel by rubbing it on a *perfectly level* oilstone until the two jaws—for such they may now be called—will close with a perfectly light-tight join when placed, bevelled edges together, on a sheet of glass and then held up to the light.

If it should happen that a slight hollowness is apparent between the two closed jaws, as is generally the case when first tested, each jaw in succession will require to be again rubbed on the oilstone until a couple of edges have been produced which are perfectly light-tight when held up to the light. It is of the greatest importance that a perfectly level portion of the oilstone should be selected for this operation; otherwise it will surely affect the bevels with round or uneven edges. Too great stress cannot be laid on the importance of carefully finishing off these edges, as an imperfectly-made slit will fail in the very particular for which it is required, and will give horizontal lines in the spectrum. When quite satisfied that the edges of both the jaws are as perfect as it is possible to make them, it will be time to see about joining them together, with the bevels inwards, something similar to a parallel rule. For the two connecting-bars, file up to a uniform size a couple of thin strips of flat brass, each one measuring $\frac{3}{4}$ in. long and $\frac{1}{8}$ in. wide; then, by the aid of a pair of compasses, mark the position for a hole in the exact centre of each bar, and another one at an equal distance from either end (as will be seen by reference to Fig. 15). As it is important to have all three holes planted on the same line, it will be found advisable to first divide the metal with a line longitudinally along the centre, and then cross this one with another line at either end in the position to be occupied by the holes, the latter being afterwards drilled just where the lines cross each other.

When the two bars are quite ready, they should be attached to the jaws by means of screws driven into holes drilled and tapped in the latter. In order to find the exact position for the holes to receive these screws, draw a line across both ends of each jaw, at exactly $\frac{1}{8}$ in. distance from the edge of the metal, and another line along the opposite

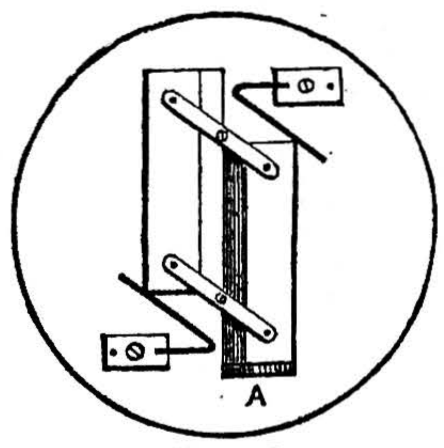


Fig. 12.

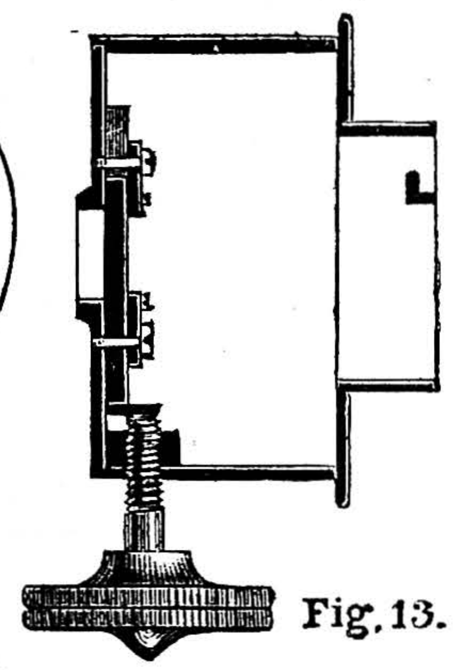


Fig. 13.

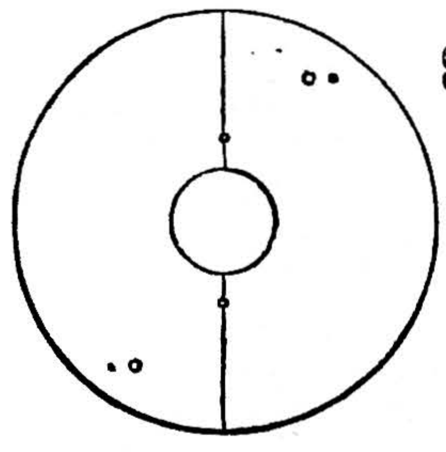


Fig. 16.

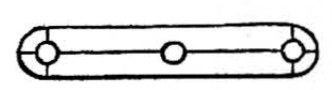


Fig. 15.

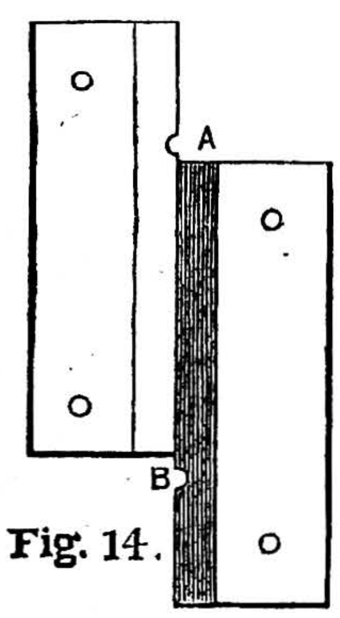


Fig. 14.

The Spectroscope. Fig. 12.—Cover of Hood, with Jaws of Slit attached. Fig. 13.—Section of Collimator Hood. Fig. 14.—Plan of Jaws of Slit. Fig. 15.—Connecting Bar of Jaws. Fig. 16.—Disc fitted to Hood.

sides and parallel to the bevels; and when this has been done, a centre-punch mark, made just where the lines cross each other, will serve to indicate the position for the screw-holes, which are then drilled and tapped to take a couple of small, suitable screws to each jaw. The jaws may now be joined together by the two connecting-bars, which are placed one at each end, and attached to the jaws by means of the screws just fitted, which should be screwed in sufficiently tight to allow them proper freedom without being too easy.

At this stage of the proceedings a small semicircular piece of brass should be soft-soldered to the end of the lower jaw (in the position indicated at A in Fig. 12). It is against this plate that the screw which regulates the width of the slit is made to act.

Before the jaws are attached to the cover of the collimator hood, they should be coloured a dull black by the following chemical process:—

Drop several small pieces of copper wire into a bottle containing nitric acid until it appears to be saturated, when it will refuse to dissolve any more; then pour off all the clear liquid, and dilute this with about three times its bulk of rain-water, when it will be ready for use. Make the work to be blacked rather hot, and then dip it in the liquid—or apply the latter to the surface by means of a soft brush—afterwards heating the article again over a gas or spirit flame until it assumes a good dull or dead black.

If the jaws have been properly adjusted, they will open parallel to about $\frac{1}{8}$ in., or will be capable of closing together so perfect as to prevent the passage of any light between the knife-edges. The uniform evenness of the jaws would appear to be merely a matter of very careful grinding upon an oilstone, and accurate fitting; but in actual practice it is scarcely so easy as some might imagine to get them to act properly.

We shall now be ready to prepare the collimator hood, to the cover of which the jaws are attached. For the body of the hood we shall require a stout $1\frac{1}{4}$ in. ring of drawn brass tubing, $2\frac{1}{4}$ in. in diameter, to one end of which a stout brass disc is brazed, in order to form a kind of box with a bottom to it. This done, the hood is mounted in a lathe for a slight recess to be turned round the inner edge of the open end, into which a stout disc of brass of suitable size may be tightly sprung in precisely the same manner as the cover of a watch or clock barrel. In point of fact, a disused barrel from a clock or musical-box will be found to answer admirably for the collimator hood, as will be shown later on.

Now take the disc just fitted to the hood (see Fig. 16), and, having first made a punch-mark in the exact centre of the metal on both sides, take a needle-point and draw a straight line across the diameter of the disc, in order to ensure the jaws being correctly centred when they are subsequently attached to the metal. When this has been done, the disc should be turned over to the other side, and then mounted in a lathe for a hole $\frac{1}{2}$ in. in diameter to be cut through the centre of the metal; and if a slight stilt is left to surround the aperture, it will considerably add to the appearance of the instrument when finished. In any case, however, it will be found advisable to clean up the surfaces of the metal before removing it from the lathe.

Thus prepared, the disc will be ready to receive the jaws. Take a pair of dividers, and, having adjusted them to the exact distance between the central holes in the connecting-bars of the jaws, make a couple of corresponding marks, one on either side of the opening in the disc and on the central line previously scratched across the disc (as will be seen by reference to Fig. 16, which clearly shows the position of the holes). A couple of holes are now drilled and tapped in the position indicated, and then fitted with suitable screws, for the purpose of affixing the jaws to the plate; but before this is done it will be necessary to take a rat-tailed file and make a slight groove at one end of the knife-edge of each jaw (in the position indicated at A and B, Fig. 14). This is a necessary precaution; otherwise the knife-edges will come hard against the stems of the screws by which the jaws are attached to the disc; but, at the same time, great care should be exercised in filing these grooves, as it is undesirable to make the cuts deeper than is absolutely required.

It will add considerably to the appearance of the collimator hood if the cover or disc is finished off a good dead black by the chemical process previously described. This would require to be done before the jaws are affixed to it, and it would be needful to exercise great care in the subsequent operations, so as not to spoil the surface.

WORK

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What is Bi-metallism?—As there is a somewhat increased activity just now amongst bi-metallists, it may not be uninteresting to point out what bi-metallism really means. In this country gold is the only legal tender for debts exceeding 40s. Bi-metallists want silver to be raised to the same rank as gold in this respect, and to be made a legal tender for debts of any amount. If it were left to the option of debtors to pay in either of two metals, clearly they would always choose the cheaper metal, or, rather, the metal that involved the least outlay to themselves. For instance, suppose a debt of £100, and suppose that at the time it was contracted that the gold in 100 sovereigns were equal in value to the silver in 2,000 shillings, such a debt would be fairly discharged by the payment of either 100 sovereigns or 2,000 shillings. Suppose, however, that before the debt were paid silver were to fall, say to the price it is now—viz., about 40d. per ounce—then, as an ounce of silver is coined into $5\frac{1}{2}$ shillings, the silver in $5\frac{1}{2}$ shillings would be worth only 3s. 4d., or the sixth part of a sovereign, and the silver in one shilling would be worth the sixth part of a sovereign divided by $5\frac{1}{2}$, or $\frac{1}{33}$rd of a sovereign; 2,000 shillings, which were the equivalent of 100 sovereigns when a shilling was worth $\frac{1}{20}$th of a sovereign, would now fall far short of that, and would be worth just over £60 10s. To prevent creditors from being defrauded in this wholesale manner, the bi-metallist proposes to fix by legal enactment the price of silver in terms of gold—usually in the proportion of about 15 to 1—so that 15 oz. or 15 lb. of silver shall always be of the same value as one ounce or one pound of gold. Just now the ratio of silver to gold is about $23\frac{1}{2}$ to 1, so that to make 15 oz. of silver equal to $23\frac{1}{2}$ oz. would be a very fine thing for the proprietors of silver, just as it would be a very fine thing for the proprietors of other commodities to have their prices raised by more than half as much again. Of course, if any other class except those interested in silver came forward with a demand that their commodities should be increased in price by the legislature, they would not get a hearing at all. The reason that bi-metallists are listened to is because our silver coins pass current at a value so much above the value of the metal they are made of. They think that because an artificial value is conferred upon the coins, a similarly artificial value can be given to silver all round. This is just the same as if it were proposed to give the value of bank-notes to the paper they are made of.

Steam by Creosote.—Ere another winter is upon us, large works and factories where the generating of steam is a necessity will probably become protected against the loss and inconvenience occasioned by the recent coal strikes. Among the substitutes for coal, our experience of creosote deserves to be regarded. In the case to which we particularly refer there were three double furnace boilers, and a single pipe or jet was applied to two furnaces of one boiler and one furnace of the other, the furnace not in use being closed so as to prevent any air passing in. The creosote was put into a wrought-iron tank, in which a steam coil was placed to melt the creosote, which then flowed into the pipes leading to the furnaces, where it was "sprayed" by the jet of steam and blown through the flues, producing a beautiful clear frame, perfectly free from smoke, and leaving all the heating surface perfectly free from soot or any other non-conducting deposit. Although the engine was at full work, a slight tap on the regulating cock would cause the steam to blow off at the safety-valve, and generate more than the engine could use, the heat being so great that pumice-stone was quickly run into glass; in fact, it was almost impossible to use the apparatus at its full power. As the result, it was found that, weight for weight, it did three times the duty of coal, was easily managed—in fact, one man could have easily tended a dozen furnaces—and that there was nothing to go wrong in the apparatus. So soon, however, as the facts relating to its use became known, speculators and others stepped in, and what up to then could almost be had for taking it away, or at the most at a farthing a gallon, went up to $2\frac{1}{2}$d. and 3d., at which price it was found no cheaper than coal; so the matter gradually dropped, and can only be profitably used by those who have the control of the market or the production of the material. Extended experience of its use has shown it to be capable of evaporating from 20 lb. to 26 lb. of water for each pound used; and as the products of its combustion are free from sulphur, and it produces a clear, clean flame of almost any length, there ought to be many purposes for which, if even the cost were the same as coal, its employment would confer a great benefit. In Russia locomotives and steamships are worked by the aid of mineral oil, and are found very convenient and reliable, as well as economical. In England some locomotives are at work using ordinary gas tar, but we do not think this so suitable for the purpose as the creosote or mineral oil. The men working the latter have given us a high character of their powers and convenience, and we believe that experience will soon render them of extended adoption from the better results obtained. The fuel question is a very important matter in ordinary household life; but when we step into the broad area of commercial usage the matter assumes an enormous magnitude—so great and widespread are the interests concerned.

BENT IRON WORK, AND HOW TO DO IT.

BY J. H.

A Screen.

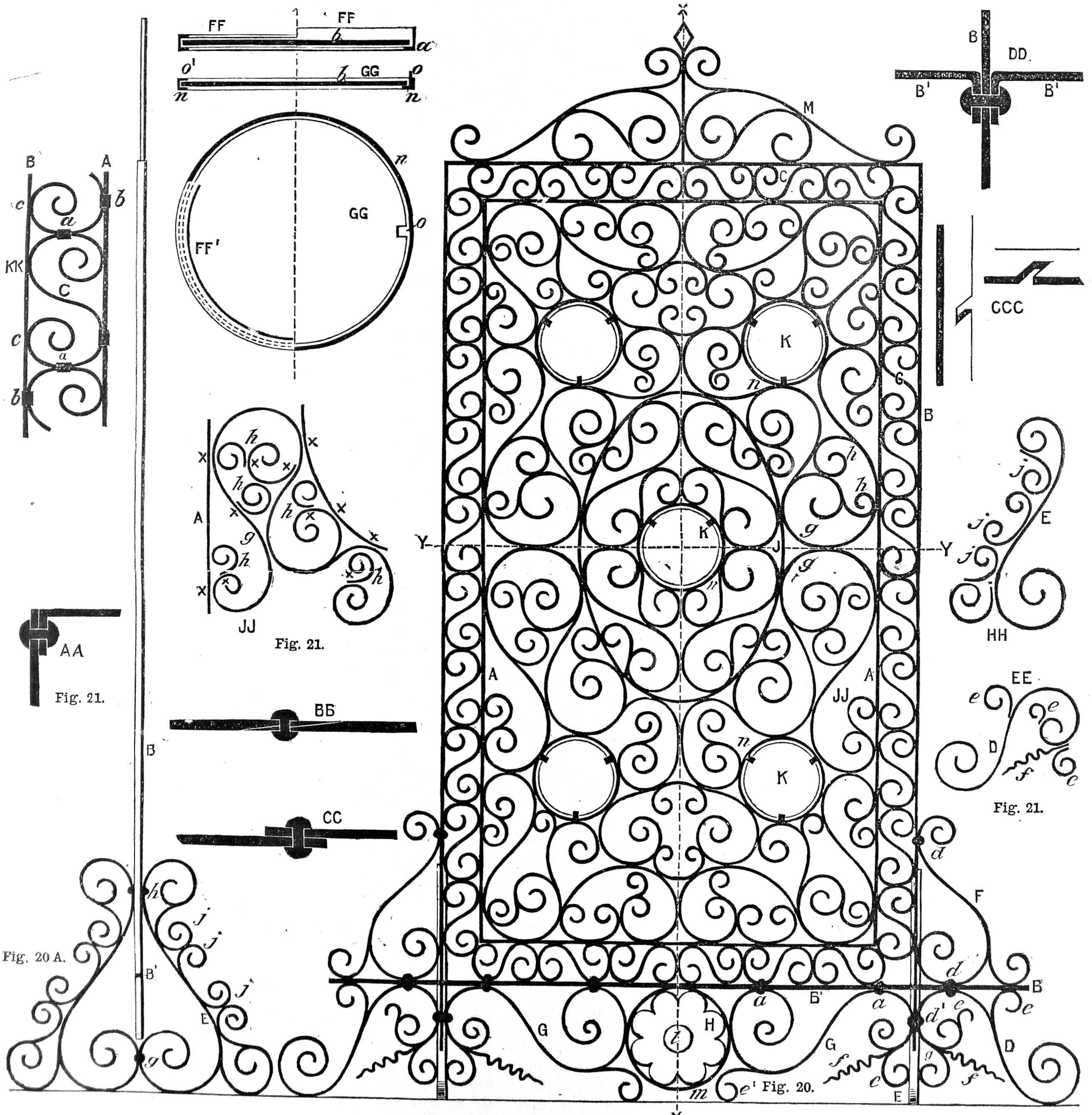
Proportion of Screen—Iron in Framing—Construction of Framing: The Inner Frame — The Outer Frame — Precautions—Uniting Scroll Work—The Clips—Supporting Scrolls — Their Details—Feet—Bottom Curves—Centre Rosette—The Panel, Glass Discs, and Scrolls—Modes of Securing Discs—Second Method—Top Ornament.

Proportion of Screen.—The screen (Fig. 20) is a design suitable for the fire, or for ornament merely. Its height may be from 2 ft. 6 in. to 4 ft. 6 in., and other dimensions in proportion. It should be drawn out to full size, a scale being selected proportional between the illustration and the size of the screen intended to be made. There is a little heavy work in the framing, but the whole of the tracery is formed of the thin strips of iron.

Iron in Framing.—The framing is formed of iron bar, having a section of $\frac{3}{8}$ in. by $\frac{1}{16}$ in., or $\frac{1}{2}$ in. by $\frac{1}{16}$ in. There are inner and outer frames, A and B respectively, connected with the scroll work, C. I cannot properly indicate the joints in the general figure, but give them in detail (Fig. 21).

Construction of Framing: the Inner Frame.—The inner framing, A A, may be made of one strip, or more. If short lengths of iron only are available, then joints may be made at the corners, or at any positions that may be convenient, by the method shown in Fig. 21, A A, turning down the ends and riveting them to the verticals, the rivets being either of the cup or of the countersunk form. If, however, a strip sufficiently long is available, then it may be bent round at three corners and riveted at the fourth, in the fashion also shown at A A; or it may be bent round at all four corners and riveted in the centre of a length, as in Fig. 21, B B, the joint being made of the scarfed form and riveted. The latter is the neatest method. Or the joint may be lapped merely, and riveted as at C C; this, however, is not neat. The corners to be bent are well hammered over the keen edge of an anvil or of a block of metal.

The Outer Frame.—The outer frame, B, is almost of necessity made in separate pieces. It is true the top and sides of the frame might be bent round in one piece and fitted



Bent Iron Work. Fig. 20.—Front View of Screen. Fig. 20 A.—End View. Fig. 21.—Details of Screen.

into the horizontal, B′, with a half-lap joint (Fig. 21, C C C), and if solder were run round, and the adjacent scroll brackets well secured, the frame would be firm. But the better plan is to fit the bar, B′, in three lengths to the verticals, B, with turned-down ends and rivets, as shown in Fig. 21, D D. The strength of the bar is thus preserved entire.

Precautions.—When putting large frames like these together, two points have to be observed : to hammer the bars quite straight in the directions of both width and thickness, and to take care that the frames are free from winding when riveted together.

Uniting Scroll Work.—The two frames are united by means of the scrolls, C (Figs. 20 and 21), made of iron ⅜ in. wide. They are arranged symmetrically on each side of the centre line, X—X. As there are so many precisely alike, one should be made first and tried between the frames, and when corrected, all the others should be tested by that one as a pattern.

The Clips.—When fixing scroll work, security is assured by as many clips as the parts will conveniently take. I do not show the clips in the general view. The enlarged Fig. 21, K K, shows them, as used for these scrolls. The scrolls are united to each other at their ends, *a*, *a*, and to the verticals A and B at two points, *b*, *b*. They could, of course, be also fastened at *c*, *c*, but this is unnecessary, as the clips shown in the figure are amply sufficient to afford security and rigidity to the parts.

Supporting Scrolls.—Upon the scrolls, D, E (Fig. 20), the weight of the screen is supported, and they cannot, therefore, be made of the thin strips, but must be of the same section as the verticals, or about ½ in. by $\frac{1}{16}$ in. It will be better, too, though not so necessary, that the scrolls, F, be of the same strong section, and so also may G. Being of thick section, these scrolls will be riveted, and not clamped to the verticals, B, and to the horizontal, B′, at *d d*, the rivets being of the snapped form, as shown, or else countersunk. These scrolls cannot be bent with pliers, but must be hammered over the anvil-beak, either while cold or at a red heat. They will be tried upon the drawing, and each upon its fellow, for symmetry.

Their Details.—The scrolls are formed of more than one piece, as seen in the detailed view (Fig. 21, E E), where the parts are slightly separated to enable them to be easily distinguished from one another. Thus, *e e* are formed of separate pieces, and fastened to D. The best way to fasten these is either by soft soldering or brazing, and the joint can be scarfed to make the scrolls appear as if worked from one piece. The tendrils at *f* are made, again, of separate strips, and inserted and brazed between the two scrolls, all being held together with solder.

Feet.—The feet, E (Figs. 20 and 20A), which stand out sideways, are required to give steadiness of base. These are made of the same heavy section as the framing. They are riveted together at the bottom curve, *g*, and are united at the top curve, at *h*, to B, with stout clips or with spelter. In these, E is the main curve, to which the smaller, merely ornamental, curves are fastened with clips or with solder. These several distinct parts are shown separated at Fig. 21, H H.

Bottom Curves.—The curves, G, may be made either of stout or of thin strips. It is better to make them of heavy section—½ in. by $\frac{1}{16}$ in. These will be riveted at *d′*, at the end, a single rivet passing through D, G, and B. The minor scrolls, *e′*, and the tendrils, *f′*, are soldered or brazed, as in the case of those on the opposite side of B.

Centre Rosette.—The centre, H, of the bottom portion is a flower, or rosette, made of copper. In this example there are two such, placed back to back, fastened to each other with the rivet, *l*, that also forms the centre boss or disc. These flowers are cut from sheet copper of thin gauge, and after the dentations are formed by filing, the surface is hollowed with a round-faced punch upon a block of pitch or prepared bedding, used in repoussé work. The circle, *m*, that encloses the flower, is of iron, and is soldered, or fastened with rivets, to G G. I shall have more to say about copper floral ornaments later on.

The Panel, Glass Discs, and Scrolls.—The panel of the screen is tastefully relieved by the coloured glass discs, K. These can be purchased of almost any glazier. As the scroll work covers a large area, every point of contact ought to be firmly secured with a clip. The main curves, *g*, form the connection between A and the ellipse, J, and also partly support the frames that enclose four of the glass discs. The curves above the line, Y Y, are not symmetrical with those below, because the ellipse is placed above the middle line of the panel ; but all the corresponding curves to right and left of the vertical centre line, X—X, are symmetrical, so that, when one set has been worked, the corresponding set will be tried upon them. All the minor curves, *h*, are fastened to the main ones with ordinary clips. The clips are not shown in Fig. 20, but at J J (Fig. 21) an enlarged view of the corresponding part, marked J J in Fig. 20, is shown, with its several scrolls, *h*, separated, and the positions of the clips are indicated by crosses.

The curves enclosed by the ellipse, J, are secured with clips, both to one another and to the ellipse.

Modes of Securing Discs.—The glass discs, K, may be held in position in either one of two ways. A strip of thin iron, *a*, can be bent (Fig. 21, F F) into an angular section, turned into a circle, and soldered at the ends. Then the disc of glass, *b*, can be laid upon the horizontal flange, and the top edge of *a* burnished or turned over by pressure, to cover and enclose the edge of the glass, as at Fig. 21, F F′.

Second Method.—But this is a rather troublesome job, and the following will answer equally well, and it is the method I have shown in Fig. 20. Make a true ring, *n*, of the ordinary iron strips, and solder three or four short strips (Fig. 21, G G, *o*) to the outside of the rings equidistantly. Next unite the rings at their points of contact with the scrolls by means of the ordinary clips. Then the glass discs, *b*, will be slipped in, and the free ends of the short strips, *o*, turned over against the face of the glass, as at *o′*.

Top Ornament.—The ornament, M, at the top of the screen calls for no remark. It is made of the thin ⅜ in. strips, and bent, and held with clips similarly to the other scroll work.

MODEL BOAT-MAKING FOR BOYS.

BY A CRAFTSMAN.

Bulwarks—Stand—Rudder—Painting Hull—Deck Fittings—Capstan.

The hull must next be thoroughly sandpapered all over, to make it as smooth as possible, and the bulwarks fitted on. These are made of ¼ in. material, walnut-wood being perhaps the most suitable. They are fixed on to the deck with nails or screws at such a distance from the edge that a ledge ¼ in. wide projects all round. A half-rounded strip of wood (C D, Fig. 8) is then fastened round the outside of the hull slightly above the water-line, and is brought to a point at the bows. A thin piece of sheet copper is nailed across the bows from the bulwarks down to the metal keel, to prevent the wood from being damaged in case a collision occurs.

The stand is the next part that must be constructed. Its shape is represented by Fig. 5. It consists of two upright pieces of wood, supported at a certain distance apart by a stout wooden bar. It is generally constructed of oak, and slits are cut half-way down the centre of each of the uprights, of such a width that the keel will fit loosely into them.

The shape of the rudder is shown in Fig. 6. Its upper part, which is rounded, is made to fit into the brass tube which was passed through the deck, and is of such a length that about 1 in. projects above the deck. The top of the part which projects is reduced in size for a short length, and a piece of brass tube is fitted on to it.

In Fig. 6, A is the brass wire, B the brass tube, C the rounded part of the rudder, D the part which is in the water. The brass wire, A, is about 3 in. long, and is used for turning the rudder. Instead of having its end curled up as shown in Fig. 6, a small wooden handle may be attached to it. The rudder can be fixed in any position by the brass arrangement shown in Fig. 7. It consists of a piece of brass (A B) which is about ¾ in. in height, and has a series of notches cut in its upper edge. It is fastened down to the deck in a curved position, almost above the rudder, by brass flanges, which are soldered on to it and screwed down to the deck. The brass wire coming from the upper part of the rudder is placed in any of the notches which holds it in the requisite position, and is so bent that it presses downwards, and cannot therefore spring upwards.

The hull, as far as you have now advanced with it, is shown fixed in its stand in Fig. 8, where the ledge of the deck which projects is represented by the double line A B, and the rounded strip of wood which you fastened just above the water-line by C D.

Before going any further it will be best to paint the hull. All cracks and holes must be stopped up with putty, and the paint laid on in thin even coats. The upper part, from the top of the bulwarks to C D (see Fig. 8), is usually painted black. The lower part, with the exception of the keel, if the latter is made of lead, can be painted with vermilion, dark red, or brown paint. The belt may be painted white or gold. When all the coats of paint have been laid on, the whole must be varnished. The deck can be varnished or left plain, as you please.

The deck fittings must now be arranged in their places. Fig. 9 is a plan showing how the deck fittings of a two-masted vessel can be arranged. The rectangles A, B, and C are hatchways, those represented by the letter D are skylights, E is a piece of wood which holds the end of the bowsprit, F is the capstan, G is a piece of wood which supports the anchor, H is a hole into which the foremast is fitted with the aid of a socket, I is a similar hole for the mainmast, J is the binnacle containing the compass, K is the top of the rudder, L is the brass arrangement for fixing the top of the rudder, and the lines denoted by the letter M are brass wires along which ropes attached to the jibs and mainsails slide in tacking. The short lines or dashes near the mast holes are cleats on to which the ropes which regulate the sails are fastened. The number and size of the deck fittings vary according to the taste of the constructor. They are easily made, or can be bought ready-made at several shops. If you are making a boat about 4 ft. or 5 ft. long, a small brass bell, in imitation of those used on real ships, may be suspended in front of the mainmast, and several swivel cannons may be fastened on the deck in various positions. A few small boats may also be secured on to or suspended above the deck, in such positions that they will not interfere with the free motion of the sails.

It is best to settle on the number and size of the deck fittings before the deck is fitted on. The holes to receive them must be neatly cut out with a keyhole saw or bored with a centre-bit.

The simplest kind of hatchway is made by constructing a box of thin wood without any top or bottom to it, and of such a size that it will fit tightly into the hole previously cut in the deck, and project a little above it. A lid is made to slightly overlap it, and is fastened on with two hinges. A hole may be cut in the lid, and fitted with a piece of glass to form a skylight. It can be fitted with some fastening arrangement to keep it firmly down, so that no water can get into the hold. The skylights may be constructed in the same way that the hatchways are, only with glass roofs instead of wooden lids; or they may consist of plain pieces of glass let into the deck.

For circular skylights, lenses fastened into a round hole with putty can be used. They may also be constructed in the forms shown in Figs. 10 and 11; but these are rather complicated: they should only be used on a 5 ft. boat. The pieces of glass are fastened into the wood with putty, and protected by pieces of brass wire fastened across them. The skylights can also be constructed of an oval or hexagonal shape, and may have curved roofs.

The piece of wood (E, Fig. 9) which holds the end of the bowsprit is shown in Fig. 12. A hole of the same size as the bowsprit is bored about half-way through it, and it is fastened down to the deck with two screws.

The capstan is shaped something like Fig. 13. It is turned out of boxwood, and its lower part is made smaller than the rest, so that it can be fitted into a hole bored in the deck. The rope from the anchor is tied on to its middle part and wound round it. It can be made with a cog-wheel and spring catch arrangement, so that the rope can be wound up by simply turning it round. A hole is bored through the bulwarks near the capstan for the anchor chain to pass through, and a small piece of brass tube is fitted into it to prevent its sides from being worn away. The support for the anchor (G, Fig. 9) is simply a flat piece of wood fitted into the lower part of the bulwarks. A loop of string hanging down from it holds up the fluke of the anchor. One end of a long piece of chain or whip-cord is attached to the anchor, and the other end is fastened to the capstan, round which the remaining part of it is wound.

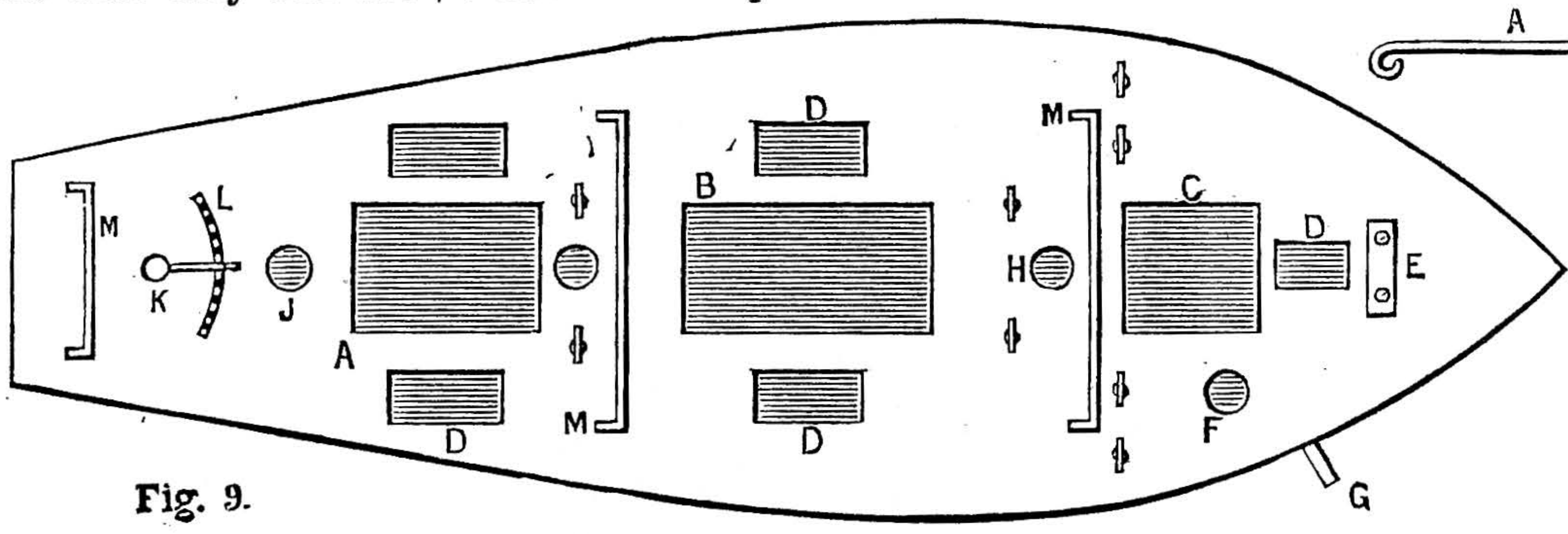


Fig. 9.

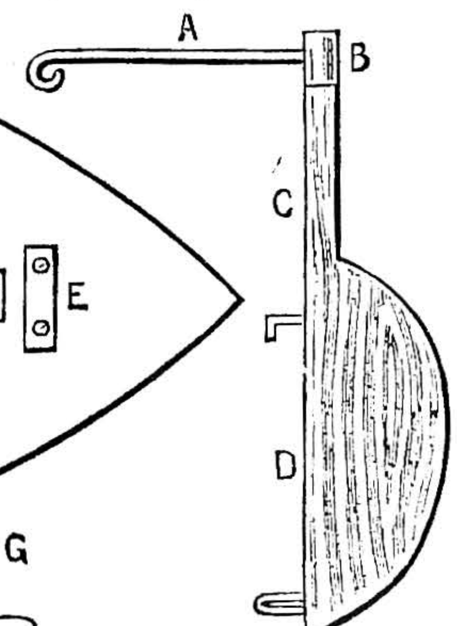


Fig. 6.


Fig. 5.

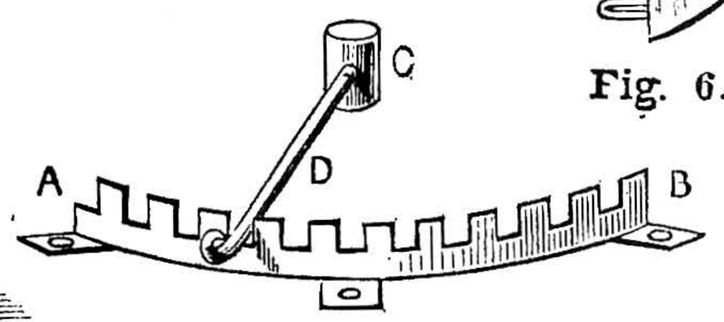


Fig. 7.

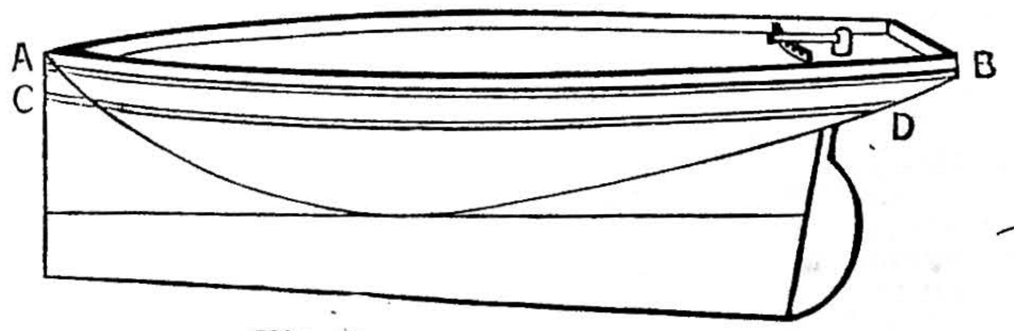
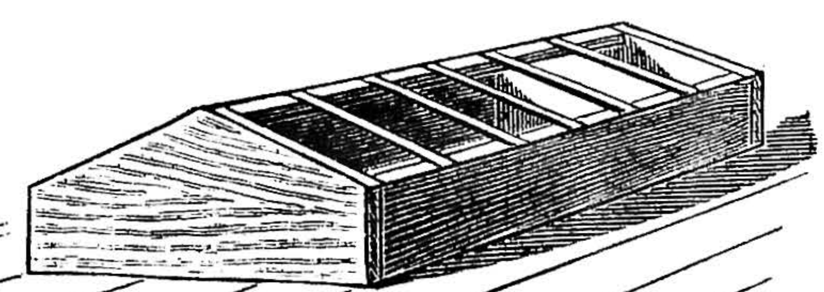


Fig. 8



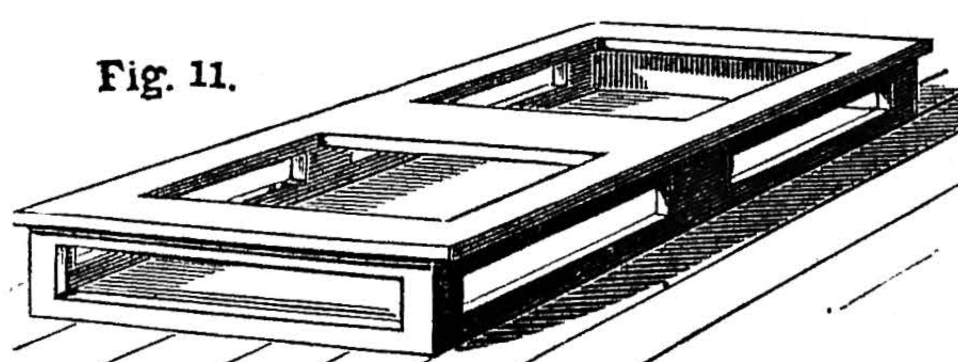


Fig. 11.

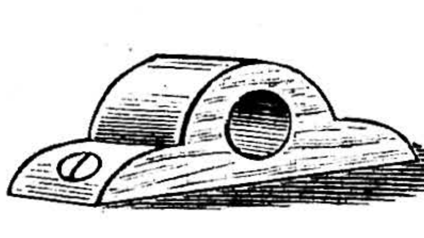


Fig. 12.

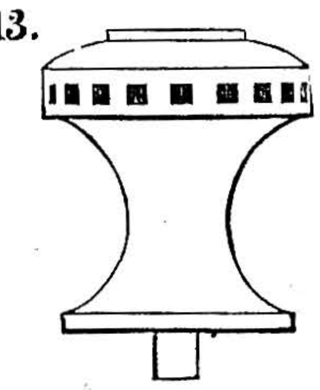


Fig. 13.

Model Boat-Making for Boys. Fig. 5.—Stand for Boat. Fig. 6.—Rudder—A, Brass Wire; B, Brass Tube; C, Rudder Rod; D, Rudder. Fig. 7.—Steering Apparatus—A B, Piece of Brass; C, Top of Rudder; D, Brass Wire. Fig. 8.—View of Hull completed. Fig. 9.—Plan of Deck, showing Description of Fittings—A, B, C, Hatchways; D, Skylight; E, Socket for Bowsprit; F, Capstan; G, Beam for Suspending Anchor; H, Socket for Foremast; I, Socket for Mainmast; J, Binnacle; K, Top of Rudder; L, Brass Rackwork; M, Sliding Arrangements for Sheets. Fig. 10.—Skylight for Deck. Fig. 11.—Skylight for Deck. Fig. 12.—Socket for Bowsprit. Fig. 13.—Capstan.

SCIENCE TO DATE.

The New Star.—Mr. Anderson, the discoverer of the new star in Auriga, wrote to *Nature* in the following terms, which need no comment: "My case is one that can afford encouragement to even the humblest of amateurs. . . . All the means I had at my disposal on the morning, when I made sure that a strange body was present in the sky, were Klein's 'Star Atlas' and a small pocket telescope which magnifies ten times."

Extraordinary Calculator.—A young man was presented lately at one of the meetings of the Academy of Sciences at Paris with the most marvellous powers of mental calculation. Without seeing the figures, which were read to him, he performed the following subtraction almost instantly:

4,123,547,238,445,523,831
1,248,126,138,234,128,910

He was next asked, "What number is it, the sum of the square and cube of which is equal to 3,600?" "It is 15," he said in a few minutes. Then, whilst he calculated the age of M. Betrand in seconds, he was asked to find the value of $\sqrt{\sqrt{4801}-1}$. In two or three minutes he had mentally solved them both. A commission of the Academy has been appointed to inquire into this marvellous faculty.

Carbon and Barium.—M. Maquenne has found that when barium is heated with carbon to a high temperature, the two elements combine, forming a compound — C_2Ba — which may be regarded as acetylene—C_2H_2—in which the two atoms of hydrogen have been replaced by an atom of Ba. To prepare the substance, an amalgam of 1 part barium and 4 parts mercury is heated with powdered retort charcoal in an atmosphere of hydrogen. When the temperature reaches a red heat, and all the mercury is expelled, an energetic reaction takes place between the barium and the carbon, and the new substance is obtained as a grey friable mass. Barium acetylide, as it may be called, can be heated to redness without alteration, but when thrown into water, it is decomposed with effervescence, giving rise to acetylene gas, which may thus be obtained in a remarkably pure state.

Pure Boron.—Up to the present time the element boron has never been prepared in a pure state, but recently Moissan has succeeded in obtaining it by reducing fused boric acid with metallic magnesium. Pure boron thus obtained is a brown powder. A study of its properties is to be undertaken.

Tobacco.—Researches which have been carried on by the Agricultural Department at Washington tend to show that the special aroma of each kind of tobacco, which is developed especially during and after fermentation, is due to micro-organisms. Each variety of tobacco has its special bacterium, and by inoculating inferior qualities of tobacco with the bacteria of the finest qualities, the former acquire the taste and aroma of the latter. If this is true—and experiment will decide—smokers will probably be able to enjoy the finest tobaccos without paying more than moderate prices.

New Use for the Electric Light.—Experiments have been made in the Bay of San Francisco with regard to the employment of the electric light for fishing purposes. A strong light was sunk below the water, and it is stated that fish of every species were attracted and caught in large numbers.

Ancient Races in Africa.—Explorations made amongst the ruins of the Great Zimbabwa, in Mashonaland, by Mr. Bent and his wife and Mr. Swan have raised some interesting questions. Mr. Bent has come to the conclusion that the ruins were not in any way connected with any known African race. It seems that the ruins formed a garrison for the protection of a gold-producing race, and that there is little doubt but that the builders and workers came from Arabia.

TRADE: PRESENT AND FUTURE.

*** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

PLUMBING AND GLAZING TRADES.—In Bolton and district plumbers and glaziers have struck work on a question of "country money"—6d. per day for country work—which, though paid for a time, has been stopped. In Aberdeen the plumbers' dispute has been settled, most of the proposals put forward by the men being agreed to.

SILVER AND ELECTRO TRADES.—Our Sheffield correspondent writes:—There are signs that the depression which has characterised the silver plate trade is lifting. America is taking increased quantities of goods, specially designed and got up for that market.

METAL TRADE.—The copper market has been quiet, only a moderate amount of business being done. Values opened at £45 12s. 6d. cash, and gradually declined. Prices, however, subsequently recovered, and the market closed at £45 8s. 9d. cash. The total stocks in Liverpool, London, Swansea, and Havre show a decrease of 229 tons for the fortnight. Yellow metal sheets are 5d. to 5⅛d. per lb. Tin market irregular, closing at £93 12s. 6d. for Straits, £93 17s. 6d. for Australian, £96 to £97 for English, and £76 to £89 for Peruvian, according to quality. Lead market has been quiet, and closed at £10 10s. to £10 11s. 3d. for Spanish, and £10 13s. 9d. to £10 16s. for English. Spelter market is also dull, values declining to £21 15s., but closing at £25 5s. per ton. Quicksilver quiet but steady at £16 14s. per bottle for Spanish. Bar silver has been irregular; prices, varying between 39¾d. to 40$\frac{1}{16}$d., closed at 38⅞d. Antimony, market firm at £45 to £46 per ton. In Aberdeen the tinsmiths are exceedingly slack.

TIMBER TRADE.—The import of timber during the last month has been on an average scale, but of deals and boards it has been exceptionally light. Mahogany wood of good size remains firm, but small and inferior wood is not wanted, and the markets are heavily stocked. Cedar, good-sized wood, is in satisfactory demand, there having been no imports, but stocks are heavy.

COKE TRADE.—Durham cokes have risen about 10s. per ton above contract prices, and are rising.

CYCLE TRADE.—There is no sign of the price of first-class cycles falling off. A well-known firm has just booked an order for thirty specially light racers at £30 apiece, and they have an offer for twenty more at £45, list price, provided they are reduced to a certain weight. Most of the Coventry cycle factories are working from twenty to thirty hours' overtime per week. In Sheffield the cycle sections are extremely busy, though not so well employed as they were a fortnight ago. Activity still prevails in Birmingham, Coventry, and other centres. Several Coventry firms are now making, and in other cases making preparations for making, their own stampings and accessories, which it has hitherto been the rule to buy from Birmingham and other places. It is estimated that at least half a million of money is thus paid away annually by Coventry manufacturers.

CARPENTRY AND JOINERY TRADES.—The state of trade in Aberdeen is very good, men being in demand both in the city and district. In Rochdale and district the stone-masons are on strike for ½d. an hour advance in wages. The bricklayers' labourers are at work again. Painters and plumbers are, as a rule, busy.

COTTON TRADE.—The dispute in the cotton trade, which has been agitating Lancashire for some time past, has been settled. By the terms of the settlement the operatives have virtually gained the whole of the demands for which the Stalybridge hands were originally agitating. Another correspondent writes:—It cannot be said that either side has obtained any very great advantage, although each claim to have accomplished their object. The employers have agreed that when bad work is proved, the men shall be entitled to compensation for loss of wages until that grievance is removed; but, on the other hand, the question of the employment of non-unionist labour has been left in abeyance, and this practically amounts to a gain by the employers. In Rochdale and district the lock-out is over, so that much trouble for many classes of operatives is averted.

ENGINEERING TRADE.—The unsatisfactory state of trade still continues, and as far as can at present be ascertained, there is little prospect of any improvement taking place for some considerable time. Some of the builders of large stationary engines in the Bolton district have lately booked some good orders for large mill engines, principally for export, while in the Barrow district both shipbuilders and engineers continue busy, the latter being principally occupied in converting compound marine engines to those of the triple expansion or quadruple expansion types. Most of the machine tool makers continue to report a great scarcity of orders, and boiler makers, who, up to within a few weeks, have continued fairly busy, now find new work with difficulty. Locomotive builders have very little new work coming forward, and the large machinists, while still busy completing orders in hand, have very little new work in prospect. The change in the iron market is slight, but in a favourable direction. Both for raw and manufactured material, however, buyers still purchase for immediate requirements only. A fair amount of business is reported in some of the district branches, but in almost every case the orders are not of any considerable weight. As contracts expire consumers are only renewing them for quantities considerably less than usual. In the steel trade a stronger tone prevails, but both in raw and manufactured material prices are irregular and unstable.

FILE AND STEEL TRADE.—Sheffield file and steel makers who are supplying the Spanish markets are very busy.

IRON AND STEEL TRADES.—The Sheffield rolling mills are far from busy. This falling-off is in a measure due to the late "stop week." But for the strike at Durham, the Bessemer, spring, and wheel and axle works would remain busy until the close of the year.

GRANITE POLISHERS' TRADE.—The Aberdeen men and masters have agreed that overtime to the extent of one hundred and sixty hours in a year shall be allowed, to be paid for as time and a quarter; and beyond that limit overtime shall be paid for as time and a half, with thirty days' notice of any strike or lock-out. Trade is, on the whole, good, and the prospects better.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

I.—LETTERS FROM CORRESPONDENTS.

Plumbing.—JOURNEYMAN PLUMBER writes:—"Ironmongers do the majority of tinker's work. Why should they touch the plumbing trade? We plumbers might just as well start and sell ironmongery. When the Plumbers' Registration Bill becomes law, it will not prevent them from soldering tins, etc., which is all they can expect; such work is not plumbing."—[Glad to know your views. Undoubtedly it will be a good thing for the plumbers to enrol themselves into a select body, and the Bill should protect your craft. Certainly householders will rejoice to be freed from the unqualified plumber! You know the saying, "Every man to his trade."—ED.]

Hobbyists' Emporiums.—BONÂ FIDE writes:—"In your leaderette on Hobbyists' Emporiums, in WORK, No. 160, you suggest a much-needed want among workers and hobbyists. Could not an Amateur Co-operative Society be formed among the readers of WORK, who would open depôts or bazaars in various towns for the disposal of their work? There might be exhibitions, and sales of the goods during the exhibition, or by auction at the close of such. I should be pleased to have the opinion of fellow-readers on the subject."—[Our readers should let us have their views.—ED.]

Celluloid Collars.—J. C. K. (*London, N.W.*) writes:—"One who wore them complained of their turning yellow, and of their breaking at the button-holes after three months' wear, to a friend who wore them longer with more satisfaction, and was advised what to do. Cut an inch slit in the front button-holes to get on and off easily, and wash with a little soap and water and an old tooth-brush the soiled parts of the collar each time it is taken off; the result will be comfort and cleanliness, giving longer wear."

Personally Conducted Lectures.—H. S. G. (*London, S.W.*) writes:—"Mr. Abbot, F.G.S., the lecturer on Gems, etc., at the Horological Institute, Northampton Square, E.C., has lately given two demonstrations—one at Jermyn Street Museum of Practical Geology, the other at the Mineral Gallery, Natural History Museum, South Kensington. They were both well attended; but if they were better known, there would have been a hundred members of the jewellery trade present, instead of the dozen or two actually there. To be taken from case to case, and in each one to have the best examples picked out and discoursed on, surely no better or more useful hours can be spent anyhow! Now that such lectures have been started in one direction, is it not possible to arrange for parties in other trades too? Would the keepers or curators of the different museums consent to guide and explain their treasures to parties from the different polytechnics? I for one should like to find these national treasure-houses much more used and appreciated."—[Possibly keepers and curators will address the Editor of WORK on this subject.—ED.]

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Papier-Mâché.—CAP-À-PIE.—Articles appeared in WORK, Nos. 3, 6, 12, 17, 22, 25.

Mineral-Water Boxes.—BOXER.—Purchase the stain of any oil and colourman, and apply it yourself to taste. Then stencil your name over the stain. Your name you will get cut for a small outlay from any stencil-cutter in Birmingham.

Designing.—STUDENT.—There will shortly be placed before the readers of WORK an original series of papers, which, it is hoped, will enable them to set about learning the art of designing.—ED.

Technical Class Work.—TEACHER.—If you, or indeed any other teacher of technical work carried on in classes throughout the country, will communicate with us as to your work and wants, we will endeavour to assist you in WORK.—ED.

Graining.—F. P. S. (*Hemel Hempstead*).—Articles on the above appeared in Nos. 55, 62, 65, 69, 72, 76, 79, 84, 89, 93, 95, 98, 100, and 103 of WORK.—ED.

Sheet Metal Work.—R. F. (*Kirkintilloch*).—Articles on the above appeared in Nos. 67, 71, 78, 81, 93, 127, 134, and 138 of WORK.—ED.

Vibration of Sewing-Machine.—W. H. W. (*Lambeth*).—Your question, which seems a very simple one, is really very difficult to answer. You say your machine (a well-known make) vibrates during running to a disagreeable degree. It is very difficult to locate the point of vibration in such a complicated piece of mechanism as a sewing-machine; there are so many wearing surfaces, any of which may be the cause and seat of the mischief of which you complain. But if the vibration reaches the table, as it would seem from your letter it does, the best way for you to do would be to examine the framework, and tighten any loose bolts or screws you may come across. There is bound to be a great deal of vibration in a machine with a reciprocating shuttle such as yours, but the table and its frame ought to be rigid enough to withstand it. If, however, it is not thus rigid, the vibration will make itself felt on the arms of the operator. Want of oil is also a frequent cause of undue vibration, and this should be carefully attended to. Without seeing the machine, I could scarcely advise you any further; but if you could tell me rather more fully where the evil seems to be situated, I could, perhaps, do better for you. I am writing a series of articles for WORK, in which I hope to deal exhaustively with sewing-machines. They will, no doubt, with the Editor's permission, appear very shortly.—CYCLOPS.

Bichromate Battery.—H. McM. (*Bootle*).—As the volume of current obtainable from any battery is dependent upon the internal resistance of the cells, it is most important that the internal resistance be kept low when a large volume of current is desired from a battery. As the internal resistance of a cell is lessened by the use of large plates and the nearness of the plates in the solution, it follows that you will get more current from your bichromate battery if you have the zinc rods 8 in. by ½ in. replaced by zinc plates 8 in. by 4 in., so placed between each pair of carbon plates as to leave only ¼ in. of space between them. As, then, the probable resistance of each cell will be about ·08 ohm, and the E.M.F. of each cell 2 volts, the ampères of current obtainable from a battery of three cells arranged in series will probably be: $\frac{\text{E.M.F. } 2 \times 3 = 6}{\text{R } \cdot 08 \times 3 = \cdot 24} = 25$ ampères. This could be obtained only for a moment or two on short circuit. As your accumulator cells have only ⅓ sq. ft. of positive surface in each cell, you will only get a charge of 2 ampères in each cell. By connecting two accumulator cells in series with the bichromate battery of three cells in series, you may get the above-named charge in one and a half hours.—G. E. B.

Electric Belts.—J. S. (*Sheffield*).—Information respecting electric belts appeared in "Shop," on pp. 174, 203, 204, 251, 315, 349, 396, 413, 427, 588, and 796, Vol. III. of WORK.—G. E. B.

Wells' Dynamo.—EDISON.—From the sketches enclosed with your letter, I should think the machine is an elongated simplex dynamo. I cannot, however, express an opinion on its merits without seeing the dynamo and learning more about it than is reported in your letter. If Mr. Wells wishes to have my opinion respecting the value of his dynamo, I shall be very pleased to hear from him direct.—G. E. B.

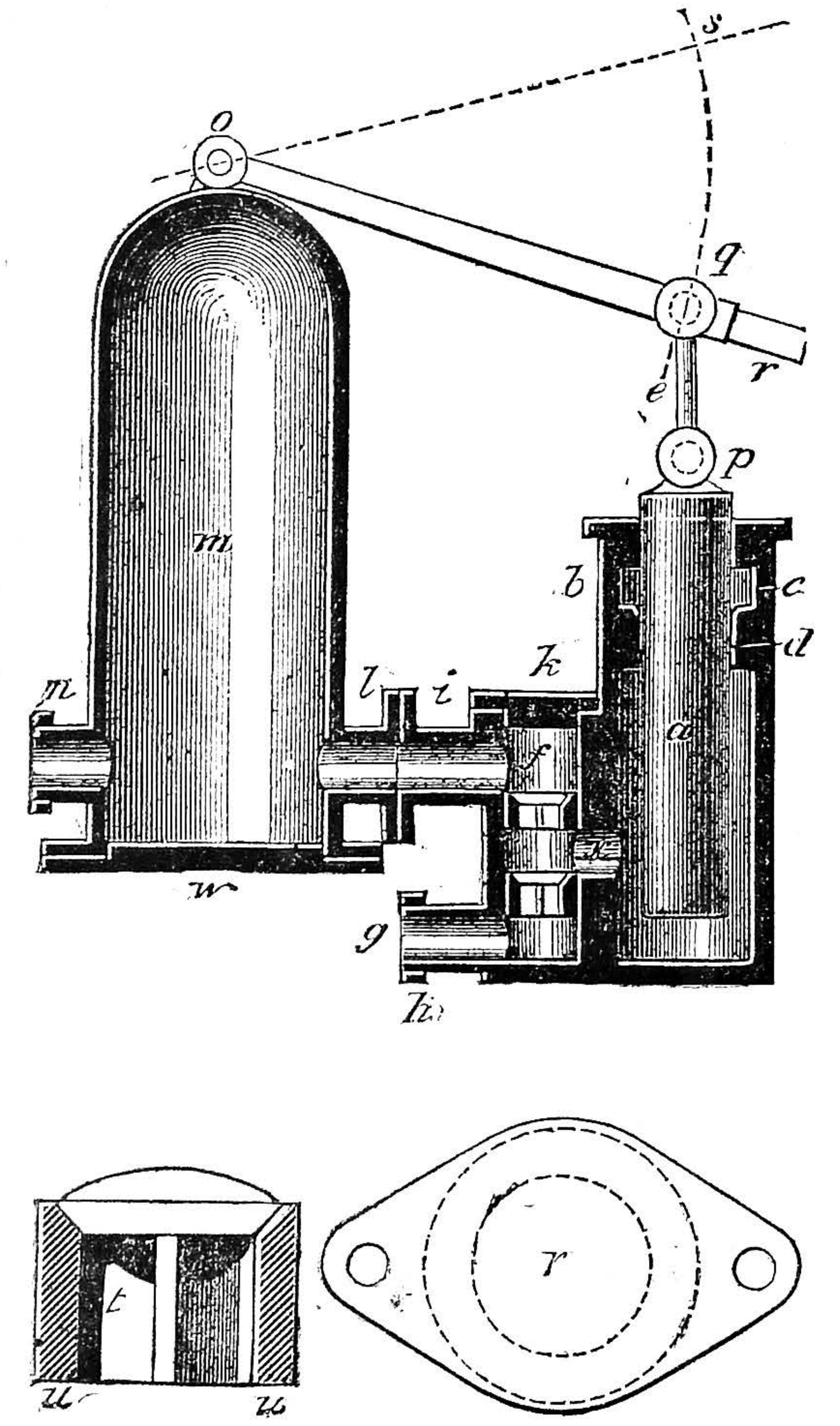
Electrician.—J. P. H. (*Hull*).—You are at perfect liberty to style yourself an electrician and have this title placed on your business cards. I know of no law forbidding you to advertise yourself as an "electrician by examination"; in fact, you have both a legal and moral right to this qualification, seeing that you have successfully passed an examination in electricity and magnetism.—G. E. B.

Dynamo for Arc Light.—R. M. (*Barnsbury*).—If you will let me know the size and horse-power of your model engine, I will give you the dimensions of a dynamo to be worked with it. I cannot plan a dynamo to work three arc lights unless I know the candle-power of the arc lamps, nor can I plan a machine to be worked by a model engine unless I know the horse-power of the engine.—G. E. B.

Steel Spindles and Levers for Anti-vibrator.—CYCLIST will not be able to obtain these ready-made, but any blacksmith will make the spindles for him if shown the article in WORK

No. 130, p. 407. The levers he will have to make a pattern of as described, and have them cast in malleable iron at a foundry. They will probably not cost more than if purchased ready-made.—Cyclops.

Portable Hand-Pump.—J. S. (*Ramsbottom*).—I subjoin a vertical section of a force-pump drawn to a scale of 1½ in. to a foot, and details half full size, which, I think, will give you the information you require. The plunger, *a*, is 2 in. in diameter by 9½ in. long, and has a stroke of 6 in. It may be turned out of the solid and draw-filed, that it may work easily in the leather collar in the recess, *c*; it has an eye at *p*, and is connected by a link, *e*, which has forked ends, with the lever, *r o*. This lever is fulcrumined at *o* to a double lug cast on the air-vessel, *m*. The connecting pins at *o*, *p*, and *q* should be ⅜ in. diameter, turned to fit bored holes in the parts connected. The plunger works in a barrel, *b*, cast in one piece, with a valve-box, *f*. A passage, *x*, makes communication between the pump-barrel and valve-box. At the lower part of the valve-box is a neck, *g*, with a collar, *h*, to screw on to retain the coupling of the suction hose; at the upper part is a neck, *i*, with a flange, whereby it may be bolted



Portable Hand Pump.

to the flange of the neck, *l*, on the air-vessel. The valve-box is closed by a cover, *k*, shown enlarged in plan at *v*. The air-vessel, *m*, has a discharge neck, *n*, shown with a screw collar to retain a hose coupling; it is closed at the bottom by a cover, *w*. The air-vessel is 5 in. inside diameter, and 14 in. high; it may be of copper or cast-iron. The connections may be made with ⅜ in. bolts, canvas spread with a mixture of white and red lead being placed between the surfaces brought into contact. The valves are plain three-ribbed stalk valves, as shown enlarged at *t*, the metal of the valves being ⅛ in. thick throughout; the valves are turned to fit bored seatings, *u u*, which are also turned outside to form a tight fit in the bored-out valve-chamber, *f*. The top seating should be a shade larger than the lower one, to allow the latter to pass freely down to its place in the valve-box. To the squared end, *r*, of the lever, *r o*, a socketed handle is to be fitted, of such length that the hand is 18 in. from the pin, *q*. A guard may be arranged to limit the travel of the lever to the arc, *q s*. The object of the air-vessel, *m*, is to maintain a continuous stream of water. By using a longer lever greater heights of jet may be obtained. The thickness of the barrel and valve-box is nowhere less than ⅜ in., and the air-vessel, if of cast-iron, may be the same. The whole arrangement may be bolted down to a timber-carriage mounted on wheels.—F. C.

Air Pump.—J. S. (*Bath*) asks for "drawing of an air-pump to work with a wheel to be driven by a small engine." Will J. S. kindly state his case definitely? Is it for practical use, such as for rarefication or condensing in connection with some branch of business, for lecture-table use, or for mere amusement? To work an air-pump with a steam-engine, unless on a somewhat costly scale, would be a most unsatisfactory mode, and to work a mere model it would be more unsatisfactory still. J. S. is aware that for a steam-engine to work satisfactorily, the resistance to be overcome must be somewhat continuous, but working an air-pump the resistance rapidly increases with each stroke. Until a more definite question is presented, I am afraid to answer would only be to waste valuable space in "Shop." If J. S. will say what he really wants, I will help him if possible, or hand him over to someone who can.—O. B.

Safety Bicycle.—H. F. (*Taplow*).—(1) To find the gearing of a machine, multiply the diameter in inches of the driving wheel by the number of teeth in the chain wheel on the crank shaft; then divide the result by the number of teeth in the hub of driving wheel, thus:

Driving wheel	30 in.
Chain wheel teeth	16
	180
	30
Hub wheel teeth	9)480
Result	$53\frac{3}{9}$ in.

Or thus:

Driving wheel	28 in.
Chain wheel teeth	20
Hub wheel teeth	9)560
Result	$62\frac{2}{9}$ in.

The gearing of safeties is fully described in its place in "Safety Construction," Vol. III. of Work. (2) To remove a keyed-on crank is a difficult matter without the requisite tools. To attempt it by hammering, if it is firmly fixed, is sure to damage something. Repairers have an instrument that will *start* the most obstinate crank. My advice would be: Take the machine to one of these gentlemen.—A. S. P.

Telephones. — Telephonic. — I am pleased to learn that you have been able to make a pair of telephones from the instructions given, but sorry that you have not succeeded in connecting them up with one line wire. I could not make the diagram any plainer if I repeated it, so you might try and master it. If you cannot, try and draw out a diagram of what you think is meant, and send it to me through Work, and I will try and put you right if you are wrong.—W. D.

Telephone.—S. F. C. (*Stoke Newington*).—Full instructions have been given in Work for making a telephone. There is, therefore, no need to give the name of any other publication. If you have No. 28, you will find full instructions for making receivers, and in No. 36 a transmitter, and many given hints as to batteries and connecting up. Look up these numbers if you have them, and if not, procure them from the publishers, and begin your work; and if you find anything wanting to be explained or described further, please write again.—W. D.

Incubator.—A. J. J. (*Tipton*).—An "ordinary" thermometer will not do. In the first place, it will be too long, and in the second place, it is more than likely to be incorrect at 106 deg. Not one in a dozen is correct often, and I have found them as much as three and four degrees out. Don't spoil your ship for a ha'porth of tar.—Leghorn.

Contract.—J. D. B. (*Ilkeston*).—If the agreement to pay £2 a week is not stamped, you cannot legally enforce payment. You can, however, get it stamped now, but it will cost £10; and as your claim will be for nine weeks, is it worth spending £10 and running the risk of a lawsuit to gain £18? You had better consult a solicitor before doing so. I should advise you to try and induce the contractor to allow you something for the inconvenience rather than resort to legal proceedings. The withholding of £40 for two months will date from the time the architect certifies that all the work has been completed. If the down-pipes are out of the run of ordinary spouting, and are not particularly specified, you will be liable for extra payment.—M.

Engineering.—S. M. L. (*Goderich, Canada*).—The firm referred to by you is still in business. The goods would take about three months. You had better write again; if this fails, employ an agent here.—M.

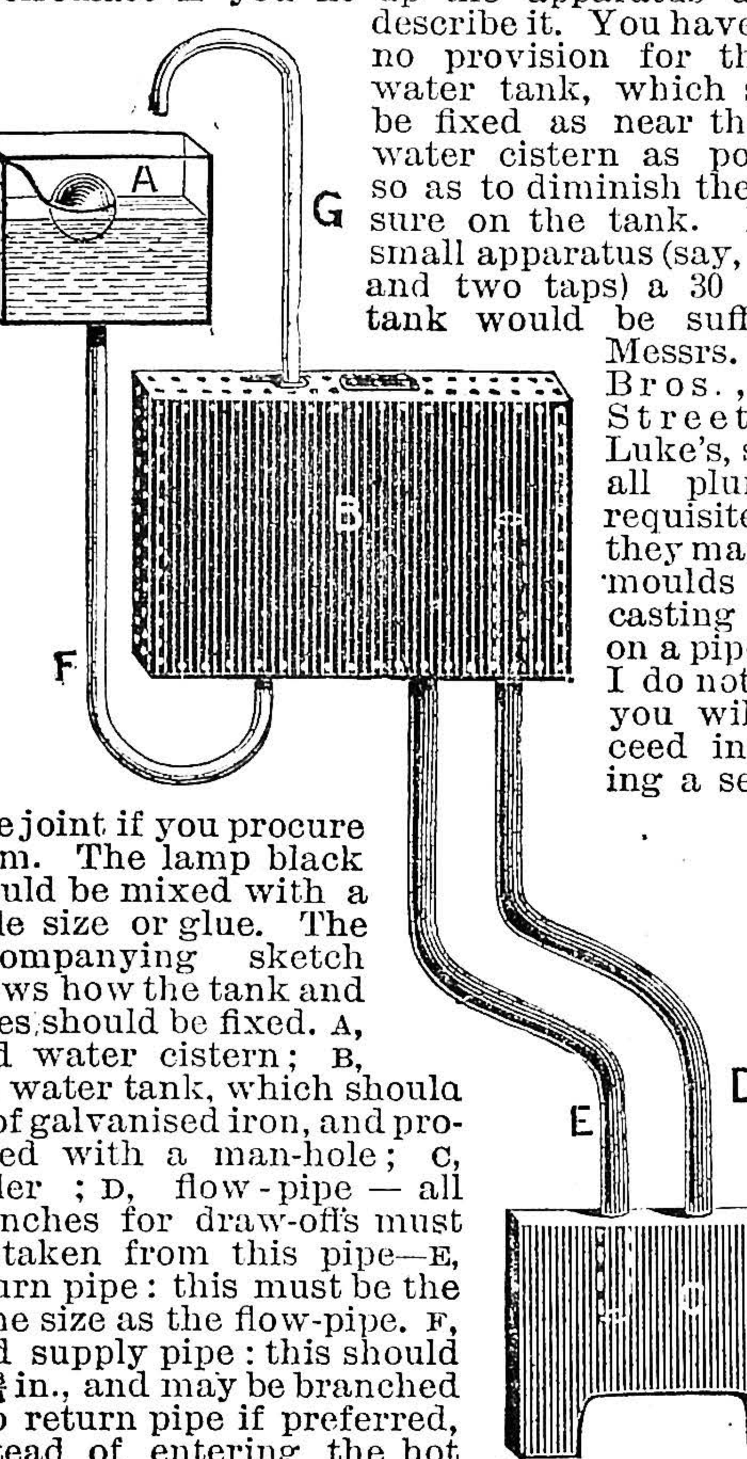
Sulphuric Acid.—R. P. (*Boulogne-sur-Mer*).—The address of the firm that have a new method for the transport of sulphuric acid is the Blaydon Manure & Alkali Co., Blaydon, near Newcastle-on-Tyne.

Oak Armchair.—H. W. F. (*London, N.*).—(1) To fumigate your oak chair, you will require an air-tight box large enough to hold the chair when glued up. The liquid ammonia is placed on the bottom in an open dish; for the size of box you require it will take ¼ pint. But this does not give the black-brown colour of old oak, such as is usually seen on the kind of chair you have made. Personally, I use asphaltum dissolved in turps, and "fill in" with black filling; and I know a dealer in curios who makes his antiques in woodwork by wiping them over with Brunswick black thinned down with turps. (2) As to your query of what should be the proper dimensions of a chair without arms, it is difficult to answer without knowing the kind of suite you are making. The chief consideration should be comfort. A chair from which you can slide forward, and in which, when seated, the legs are propped up clear of the seat, and in which the head rolls hither and thither in quest of a resting-place, should be avoided. (3) You will do well to read the whole of the articles on "An Armchair: How to Make the Frame and Upholster it," in No. 78, Vol. II., p. 409; No. 82, p. 481; No. 89, p. 595; No. 100, p. 730; No. 102, p. 807, of Work.—Lifeboat.

Gas-Engine Valves. — Snap.—You ask where you can get valves for your gas-engine, but you do not say what sort of valves. What can I say to help you? The obvious answer is: Get the valves from the maker of your gas-engine.—F. A. M.

Punching Holes. — Subscriber. — Lay the bar upon a sloping lump of cast or wrought iron sloped to the same angle as the bar, and having a hole in it a trifle larger than the hole to be punched. The punch can then be used in a vertical direction. A small punch should be employed in the first place, and the hole drifted afterwards to size required. The bedding block should be provided with a set-off or flange turned down to fall over the edge of the anvil, to prevent it from being driven back by the force of the blows upon the punch. The heels must be welded on roughly as rings, and thinned down on the top face afterwards.—J.

Kitchen Boiler Supply.—Nigel.—I am sorry to have to inform you that your sketch is entirely wrong, and that it is impossible for the water to circulate if you fit up the apparatus as you describe it. You have made no provision for the hot water tank, which should be fixed as near the cold water cistern as possible, so as to diminish the pressure on the tank. For a small apparatus (say, a bath and two taps) a 30 gallon tank would be sufficient. Messrs. Hugh Bros., Old Street, St. Luke's, supply all plumbers' requisites, and they may keep moulds for casting joints on a pipe; but I do not think you will succeed in making a serviceable joint if you procure them. The lamp black should be mixed with a little size or glue. The accompanying sketch shows how the tank and pipes should be fixed. A, cold water cistern; B, hot water tank, which should be of galvanised iron, and provided with a man-hole; C, boiler; D, flow-pipe — all branches for draw-offs must be taken from this pipe—E, return pipe: this must be the same size as the flow-pipe. F, cold supply pipe: this should be ¾ in., and may be branched into return pipe if preferred, instead of entering the hot water tank, but in either case should be syphoned, as shown, to prevent the hot water from entering cold water cistern. G, expansion or steam pipe, which should be ¾ in.—T. W.



Hot Water Tank and Pipe.

Incubator.—J. B. (*Burton-on-Trent*).—I expect, from your description, that the damper is not properly balanced — *i.e.*, too heavy at the large end. Your lifting rod is also too large, and therefore too heavy. Your tube is too small to work properly with such a heavy rod. Had you followed my instructions to the letter you would have had no trouble. *Remedy:* See that damper is accurately balanced; substitute for your not quite ⅛ in. rod a piece of fine wire (hard-drawn wire is best), and you will probably get over your difficulty; if not, the only remedy is a larger tube. I presume you have diluted your ether as described. Neat ether might help to cause your trouble, being in itself too sensitive. Four ounces of mercury should be quite sufficient. If you cannot now overcome your difficulty, write again.—Leghorn.

Dissolving Rubber.—Indiarubber.—Solutions of indiarubber cannot be satisfactorily moulded. For moulding purposes, the rubber requires to be mixed very intimately with sulphur, and then moulded by the aid of heat and pressure. The satisfactory preparation of the sulphur compound, however, involves the use of powerful and expensive apparatus, and it is better for an amateur to purchase rubber composition ready prepared, which may be done at any large shop at which rubber goods are made a speciality.—Qui Vive.

Harness' Constant Current Battery. — Constant Current. — This so-called "constant current" battery is only a modified form of the Leclanché battery, known in other hands as the Victoria Leclanché. It is a square walnut box fitted up with carbon rods enveloped in canvas, with zinc outside this, the whole being covered with pitch. It is no more suited for a constant current than the ordinary Leclanché; in fact, less suitable, because the cells are very small and soon become exhausted. When they are exhausted, they are very difficult to repair and recharge. You will have to melt out the pitch, and get out the elements whilst the pitch is hot. The chances are ten to one that you will smash most of the carbon and mess the whole so much with pitch as to become useless. They are recharged by packing the carbons in new canvas bags with broken carbon and peroxide of manganese, and charging the cells with the usual sal-ammoniac solution. The recharging process, however, does not pay, so it is cheaper to have new cells.—G. E. B.

Book on Electric Machines.—JEFF (*Chester*).—I do not know of a better book on the subject than Bottone's "Electrical Instrument Making for Amateurs," advertised in the first number of Vol. IV. of WORK. The magneto-electric machine and the shocking machine are both described in that book. If you want a book describing other electric machines and instruments, get "Electricity in the Service of Man," published by Cassell & Co.—G. E. B.

Drill-Chuck.—W. M. (*Portland*).—We could hardly read your questions. I think with the angle you show, you will require a finer pitched screw than $\frac{3}{4}$ in. iron gas, which is what I suppose you intend to use; I would have a thread of 20 to the inch, and think even then you will have none too much hold. Anyone who has a slide-lathe should be able to cut the threads for you. I confess I don't like the look of the chuck. Draw it again as closed on a small drill, and you will see there is hardly any of the conical surface left to bear on the jaws. Also, when chuck is open, as you have drawn it, there is nothing to prevent the top jaw dropping on the lower one, and then it might come right out at the front.—F. A. M.

Incandescent Electric Lamp.—P. S. (*Leigh*).—If the wire inside the globe of an incandescent electric lamp were of the same thickness as the wire outside the globe, it would be necessary to increase the volume of the current considerably—probably some three or four times as much—to get a light from it, since it would carry some three or four times as much current without becoming white hot. Reasoning the opposite way, if the wire inside and out were the same, both would become white hot at the same time. Apart from this, however, the wires are of different material, and this is most important. The loop of wire inside the globe is made of carbon, the two strips of wire passing through the glass are of platinum, and the conducting wires of the line are of copper. It is the carbon wire which becomes white hot and gives out light.—G. E. B.

Storage Battery.—G. W. W. (*South Shields*).—Storage batteries, accumulators, and secondary batteries, are all names given to batteries employed in storing the surplus electric energy generated by dynamo-electric machines. The construction of accumulators has been described and illustrated in No. 101, Vol. II. of WORK. Any size of storage battery may be charged with a ten-candle power dynamo, providing the commutator of the dynamo has more than two divisions, and the armature is of the ring or drum type. Dynamos with only one coil in the armature, and only a two-part commutator, are useless for this purpose, because the battery will discharge itself across the commutator almost as fast as it gets charged. If you have a dynamo with a ring or drum armature and a commutator of several parts, you may charge a storage battery, but the charging process will occupy a long time, because the volume of current obtainable from a 10 c.-p. dynamo is very small. Kindly get No. 101, and learn from that how to make a storage battery.—G. E. B.

Mysterious Clock.—AMATEUR wishes to know where he can obtain the Geneva watch movements required for the above. Below I give the addresses of some refiners in London to whom he might apply, but I cannot guarantee that they will supply him: Messrs. Bryer & Sons, Barbican, E.C., Messrs. Robertson, Aldersgate Street, E.C., and Messrs. S. Roper & Sons, Garnault Place, Clerkenwell. If still unsuccessful, he might try Mr. Cox, watch repairer to the trade, Clerkenwell Road, E.C., or Mr. A. T. Boon, Great Sutton Street, E.C.—C. A. P.

Breeding Cages.—E. P. (*Southampton*).—Can you get wood already planed for making bird-cages? No, unless you order it. Wood that professional bird cage makers use is 8 cut or 10 cut deal; you would find no difficulty in planing nice clean pine if it is cut into 6 ft. lengths. I would advise you to read up articles on "Bird-Cage Making," in Nos. 54 and 108 of WORK.—F. H.

III.—QUESTIONS SUBMITTED TO READERS.

. *The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Small Power Engine.—HALIFAX writes:—"I have a pair of steam cylinders, size of bore 4 in. × $10\frac{1}{2}$ in. long, which I intend using for a double horizontal engine; the sizes of ports are $\frac{3}{8}$ in. × $1\frac{1}{4}$ in., exhaust do, $\frac{1}{2}$ in. × $1\frac{1}{4}$ in. (1) Are these large enough for the engine to work advantageously? (2) The cylinders will be coupled by the steam-chest, centres of cylinders 12 in. apart; what diameter should the crank-shaft be in bent wrought iron? (3) What diameter piston-rods in milled steel to work on the plan of the $\frac{1}{4}$-horse power by F. A. M.? (4) What size steam-pipe to supply the two cylinders, and what size exhaust-pipe for each cylinder? (5) What size and weight fly-wheel will be required? (6) What would be the estimated effective power of such an engine at, say, 50 lbs. pressure? N.B.—The stroke would be 8 in. (7) Would a double cylinder engine be equal in power to two single cylinder engines (separate) of the same size cylinders, etc.? (8) Will anyone give me the address of one or more London firms where I could get a few malleable iron castings from my own patterns, as I cannot find one by any advertisements?"

Japan.—PENHOLDER writes:—"I want to japan penholders black, red, and green. Can anyone give me formula for wood, and also steel?"

Slide Rule.—W. W. (*Carbrook*) writes:—"Would any reader tell me where I can buy this book, viz., 'The Handbook of the Slide Rule' (Bayley)? It is out of print. Also the best slide rule and book on the same?"

Tin Moulds.—X. Y. Z. (*Liverpool*) writes:—"Will some kind reader inform me how to make hollow tin moulds in different designs? The moulds are required for making *papier-mâché* models."

Cricket Balls.—F. H. C. (*Slingsby*) will be obliged for a solution suitable for coating over the lapping on cricket balls, to give the lapping a more solid and durable surface.

Soap-making.—A. C. (*Manchester*) will thank any reader for full particulars regarding cheap soap-making.

Case for Stuffed Birds.—IVY LEAF writes:—"Would some kind reader give me a detailed design for the above? Dimensions—1 ft. 6 in. wide, 2 ft. 6 in. high, 3 ft. 6 in. long."

Crystoleum Painting.—HANSOT writes:—"I should be greatly obliged if any fellow-reader could inform me where I may obtain an instruction book on crystoleum painting."

Acts of Parliament.—J. H. S. (*London, S.E.*) writes:—"Can any reader give me names and prices (and where to buy) of any Acts bearing on engines and boilers, such as 'Road Locomotives' Acts,' 'Smoke Acts,' 'Boiler Inspection Acts,' etc.?"—[Try Messrs. Eyre & Spottiswoode, New Street Square, London, E.C.].

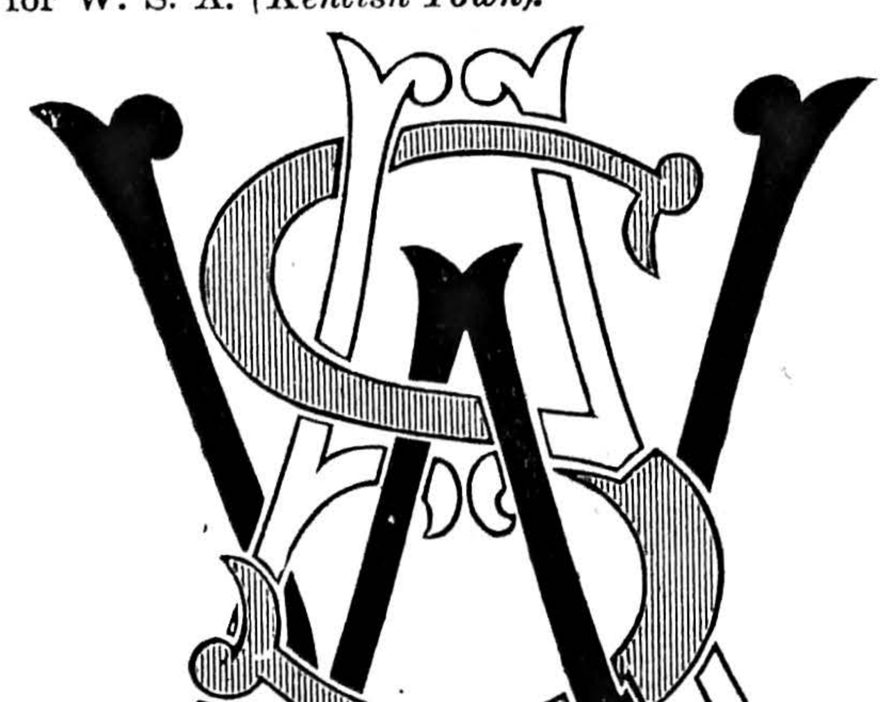
French Polishing in Lathe.—J. H. S. (*Tooley Street*) writes:—"Will someone be kind enough to tell me how to French-polish my work in the lathe after I have turned it—plain polishing light articles in pitch pine, beech, and oak; no colouring, only polishing?"

School Banner.—A. M. (*Glasgow*) writes:—"As the summer will soon be on us again—which is the special time for excursions—would any of your numerous readers kindly give me full instructions as to design, measurements, materials, etc., that would enable me to make a Sabbath School bannerette?"

Jewellery Gilding.—JEWELLER writes:—"Can any of your readers inform me how to mix chloride of gold for gilding without battery? I have a recipe from two works on electro-plating and gilding, in which the following quantities are given: gold chloride, 1 part; acid carbonate potassium, 31 parts; to be mixed with acid carbonate potassium, 30 parts; water, 200 parts. I have asked at several chemists for acid carbonate of potassium, and am told there is no such chemical. I should be glad to know what this is."

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

W. S. A. Monogram.—W. F. C. (*Coventry*) writes:—"I enclose simple sketch for monogram for W. S. A. (*Kentish Town*)."



W. S. A. Monogram.

Mill Bills.—EDDIFRA writes to W. H. J. (*Brentwood*) (see No. 155, page 814):—"Heat the mill bills to blood-red, and plunge them in water, or use a mixture of the following: 1 oz. arsenic, 1 oz. sal ammoniac, 1 oz. sal prunella, 4 gallons water."

Small Brass Castings.—M. (*Bishop Auckland*) writes to E. L. (*Woolwich*) (see No. 157, page 14):—"If you look at the 'Sale and Exchange' column of WORK, you will see where to get brass castings. Use wax and resin melted together, or gutta-percha, for the moulds."

Chip Carving.—J. A. (*Birmingham*) writes (see No. 159, page 46):—"I should recommend PETERBORO' to buy Miss Eleanor Rowe's 'Hints on Chip Carving,' to be obtained at the School of Art Wood Carving, City and Guilds Institute, Exhibition Road, South Kensington."

Chip Carving.—CAROLUS REX writes, in reply to PETERBORO' (see No. 159, page 46):—"PETERBORO' cannot use the *nom de plume* of CONSTANT READER, or he would have seen the two admirable papers on Chip Carving which appeared in Nos. 64 (p. 185) and 74 (p. 351) of Vol. II. of WORK. The first paper gives all requisite instructions as to the drawing of designs and the tools used, while the second embodies a good selection of designs, suitable for an immense variety of work. Let PETERBORO' get the entire volume if he wants to shine as a wood-carver; he will never invest a similar sum to better advantage."

Setting Tiles.—M. (*Bishop Auckland*) writes to PEN (see No. 161, page 78):—"Fix a lath the height of one course of tiles above the edge of sink, the face being straight, and projecting as far as the tiles are to project. Mark a line on the top edge of sink corresponding to the face of the lath, and bed the tiles between the lath and the line in Portland cement or plaster-of-Paris. As soon as one course has set, raise the lath to the height of another course of tiles, and so on till finished. It is a good plan to fix a rebated lath of hardwood on the top course of tiles to prevent them being loosened. The tiles must be well soaked in water before fixing."

Ice.—C. M. W. writes to J. J. McQ. (see No. 161, page 78):—"Ice may be kept a considerable time if stood upon a wooden rack covered with a damp blanket in a draughty position. The water from the melted ice should get away freely, as water is a much greater enemy than air."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—C. J. (*Redhill*); ANXIOUS GUNNER; G. B. (*Accrington*); K. M. M. (*Caterham*); F. T. (*Rochdale*); H. Y. W. (*Bromley*); C. M. S. (*Evesham*); A. J. C. (*Falfield*); R. C. M. (*Leicester*); A. O. (*Wortley*); J. J. (*Barrow-in-Furness*); J. H. (*Edinburgh*); H. J. G. (*London*); ENQUIRER; H. C. (*Ilkeston*); GAS ENGINE; J. S. (*Amsterdam*); MANIO; T. H. P. (*Huddersfield*); O. ST. O. (*East Dulwich*); A. R. (*Aberdeen*); J. B. (*Halstead*); W. L. (*New Swindon*); EFFBEE; H. W. T. (*Harrow Weald*); J. J. F. (*Southampton*); METAL; H. F. S. (*Hammersmith*); E. C. (*Kirkgate*); D. S. B. (*Dundee*); S. P. (*Plymouth*); W. P. (*Glasgow*); J. W. R. (*Finsbury Park*); F. A. (*Leicester*); W. P. W. A. (*Bishopstone*); A. R. (*Molesey*); G. A. L. (*Peckham*); INVENTO; IVY LEAF; J. G. (*London*); F. A. N. (*Hackney, E.*); JEWELLER; F. E. V. (*Hackney*); SUSPENSE; W. A. C. J. (*Newcastle-on-Tyne*).

NOTICE TO READERS.

THE Editor desires to draw attention to the following special papers which will appear among the usual contents of next week's issue of WORK—*i.e.*, No. 167:—

HOW TO MAKE A PHONOGRAPH. Fully Illustrated.

A ROSERY WALK. Being the First of a Series of Seasonable Articles on "RUSTIC CARPENTRY."

EASILY-MADE GARDEN APPLIANCES: A Plant Propagator; and

ASSYRIAN DESIGN AND ORNAMENT. Being the Third Article in the Series—"DESIGN AND ORNAMENT OF ALL AGES."