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FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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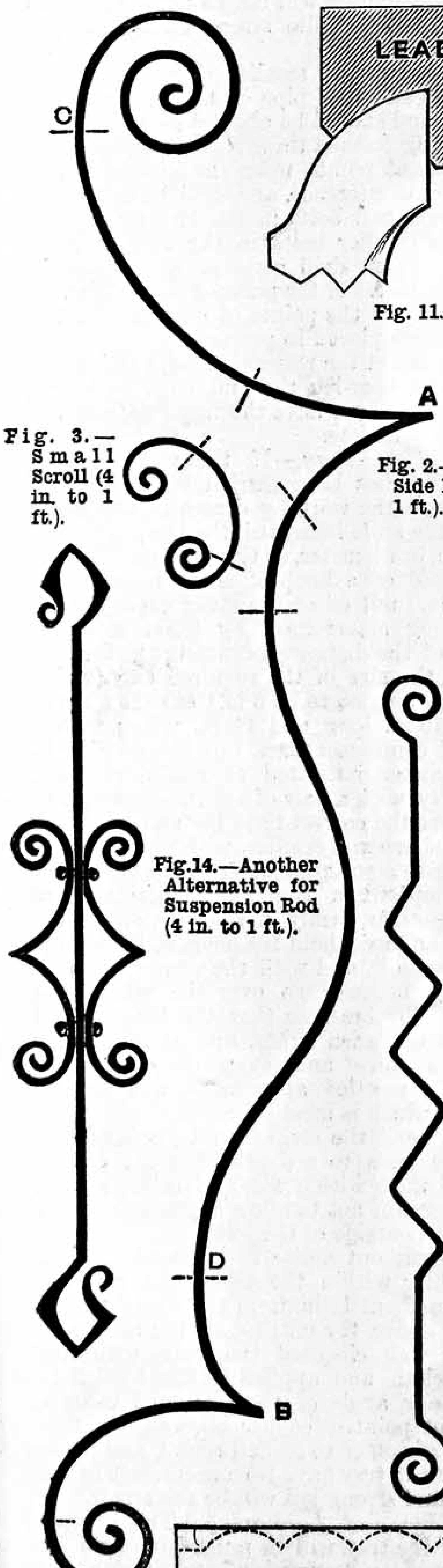


Fig. 2.—One of Four Side Pieces (4 in. to 1 ft.).

Fig. 3.—Small Scroll (4 in. to 1 ft.).

Fig. 14.—Another Alternative for Suspension Rod (4 in. to 1 ft.).

Fig. 13.—Alternative for Suspension Rod (4 in. to 1 ft.).

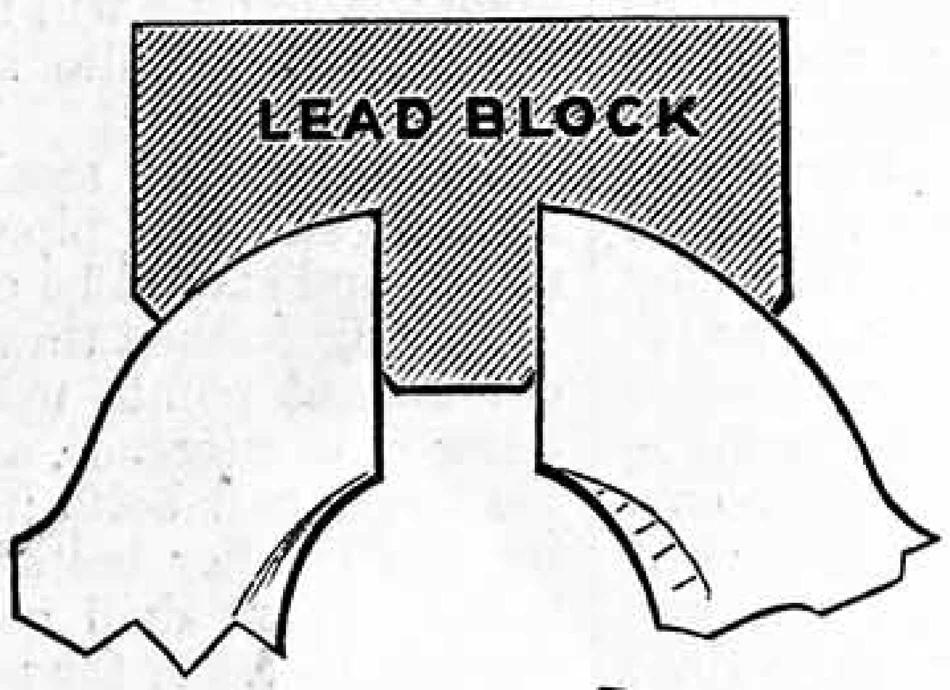


Fig. 11.—Lead Block.

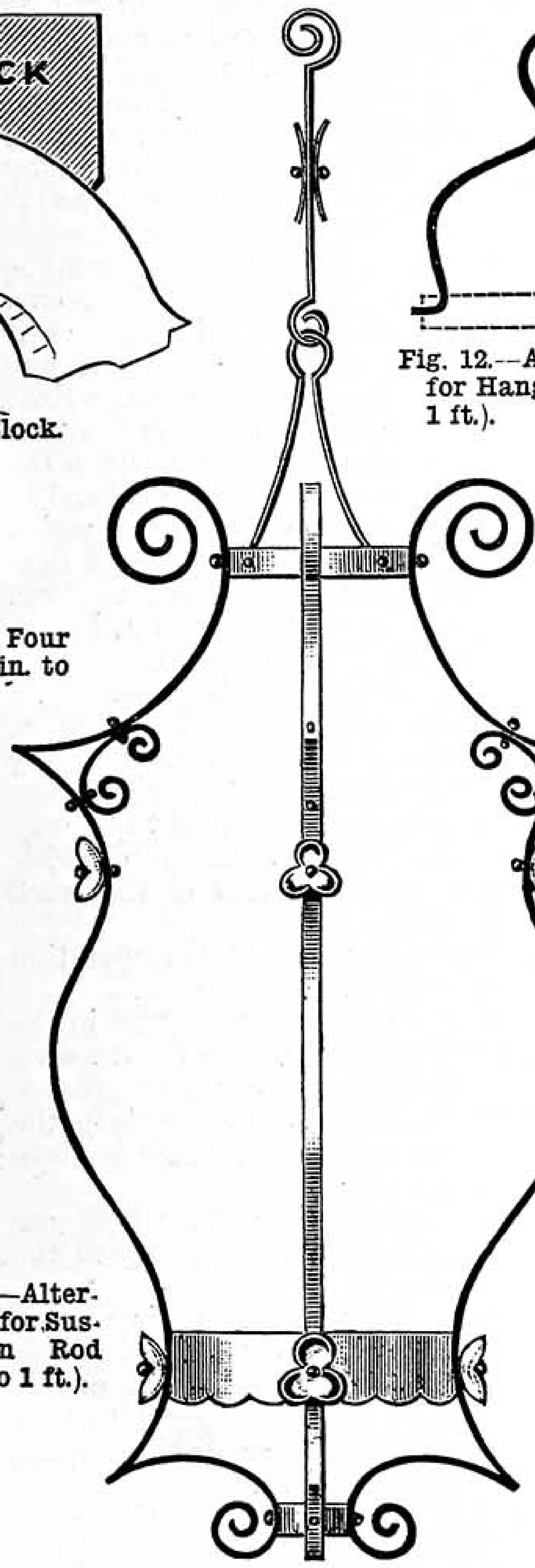


Fig. 1.—Elevation (2 in. to 1 ft.).

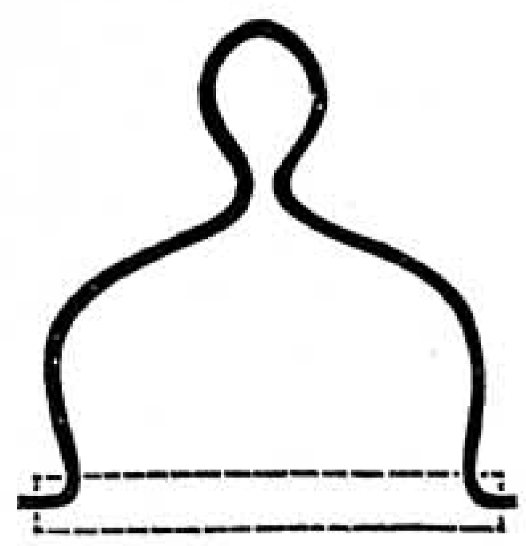


Fig. 12.—Arrangement for Hanging (4 in. to 1 ft.).

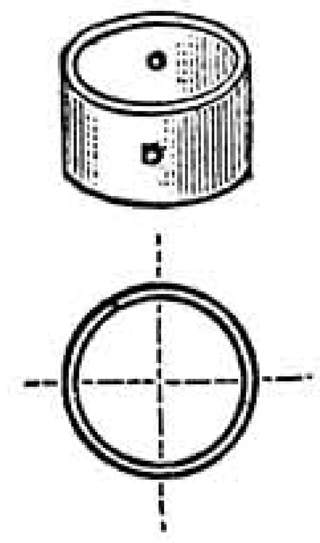


Fig. 5. — Sketch and Plan of $1\frac{1}{4}$ in. Ring (4 in. to 1 ft.).

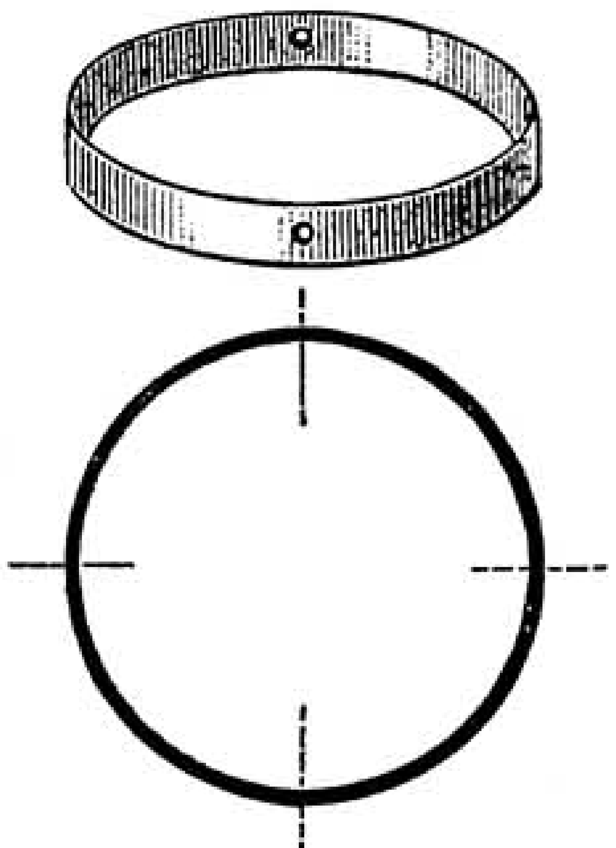


Fig. 4.—Sketch and Plan of 3 in. Ring (4 in. to 1 ft.).

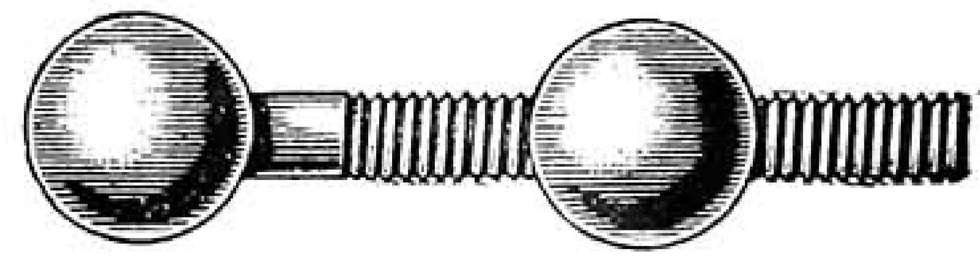


Fig. 6.—Ball Bolts (full size).

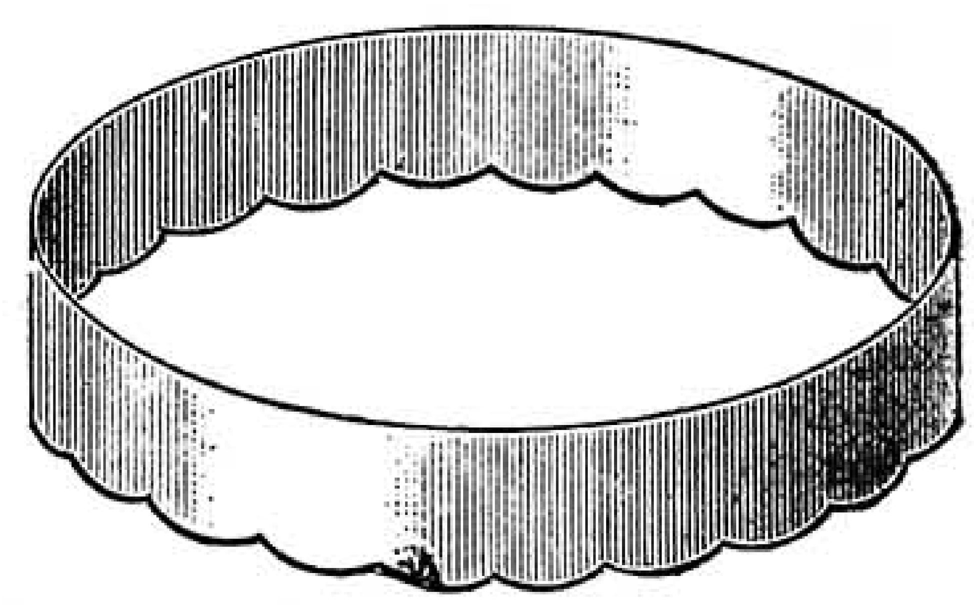


Fig. 7.—Sketch of Lamp-Tray (4 in. to 1 ft.).

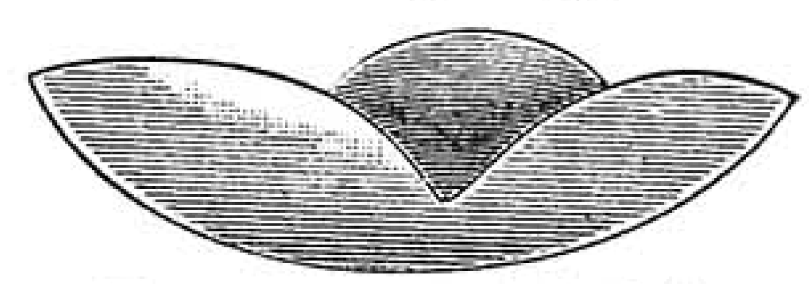


Fig. 10.—Trefoil (full size).

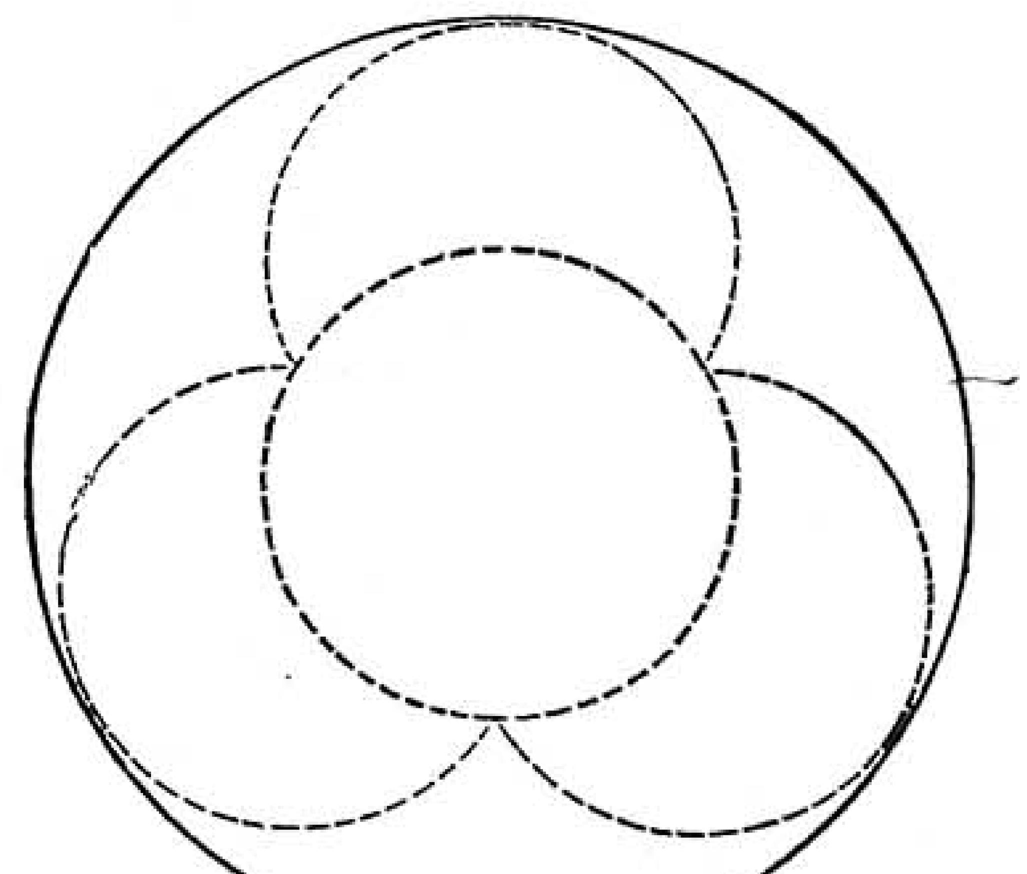


Fig. 9.—Method of cutting Trefoils (full size).

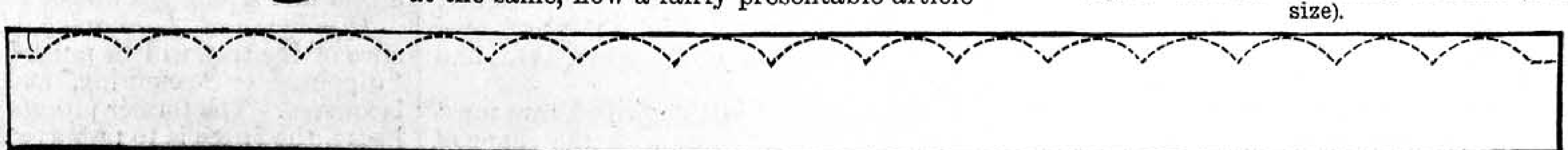


Fig. 8.—Method of cutting out Lamp-Tray (4 in. to 1 ft.).

A HALL LANTERN IN BENT IRON.

BY OPIFEX.

INTRODUCTION—MATERIALS—DETAILS OF CONSTRUCTION—BENT IRON SIDES—SMALL SCROLLS—PUTTING FRAMEWORK TOGETHER—LAMP-TRAY—DIPPING AND LACQUERING LAMP-TRAY—COPPER ORNAMENTS—FIXING LAMP-TRAY—METHOD OF HANGING LANTERN—SUSPENSION CHAINS OR RODS—BERLIN BLACK.

I HAVE endeavoured in this paper to describe, for the benefit of amateur workers in iron or those who desire to "try their hands" at the same, how a fairly presentable article may be manufactured at home; and if the processes and methods employed are not "up to the mark" from the professional standpoint, yet they may be found more suited to the amateur, who does not always possess the appliances necessary to carry out the work as, strictly speaking, it ought to be done.

I believe that we should always do work, of whatever kind, in the *correct* way when we know how, and when we *can*, but I do not hold with those who will not make the attempt to produce a result merely because they may not possess the most suitable means of arriving at it. After all, the *result* is the main thing, and if we achieve a good result, then all the more credit to him who achieves it under the most unfavourable circumstances.

I make these remarks in the interest of my fellow amateurs, as I know of cases where work proposed has been unattempted and work begun abandoned, the workers being disheartened because they had not *everything* to their hands. By all means be thorough, but do not imagine that thoroughness in work depends upon the possession of every possible facility by the worker.

For example, let no reader suppose that in order to make the lantern represented at Fig. 1 a smith's forge is a *sine quâ non*, or that a complete outfit of smith's tools is indispensable, for, as a matter of fact, a good ordinary fire and a few simple tools only are required, especially if supplemented by a pair of strong hands and a fair amount of skill in using them.

It is surprising how much may be accomplished in the way of artistic iron-work with the aid of a hammer, a strong pair of pliers, a vice, a smoothing-iron, and the kitchen fire—provided always that one is on friendly terms with the *queen* of the region just mentioned.

Of course, it goes without saying that if we possess a good workshop and all those things which I have said are *not* necessary, we will be saved some trouble, and ought to be able to accomplish better results; and I am not to be understood as advocating "hole-in-corner" methods, or slovenly short cuts, but only the motto, *Nil desperandum.*

Materials.—This lantern is composed of iron, brass, and copper—a combination which is highly effective, and which possesses the further recommendation that it is fashionable. The main portions are of flat ribbon or hoop iron. The lamp-tray is sheet brass, and the trefoil ornaments are copper.

For the iron-work we shall require not less than 20 ft. of ribbon iron, $\frac{1}{2}$ in. by $\frac{3}{32}$ in. (or No. 14 B.W.G.), with round edges. This should be of good quality, and may be obtained at almost any ironmonger's, or of Messrs. Pfeil & Stedall, Broad Street, Bloomsbury, London, W.C.

For the lamp-tray we require one piece of sheet brass 19 in. by $1\frac{1}{2}$ in., and No. 22 B.W.G.; also a piece of the same thickness sufficiently large to form a disc—say, $6\frac{1}{4}$ in. diameter. For the ornaments we must have sheet copper of the same thickness as the brass—or No. 24 B.W.G. will do—sufficient for eight discs 2 in. in diameter, or, say, a piece 8 in. by 4 in.

We also need a supply of ball bolts. Twelve of the size shown at Fig. 6 and twelve of a size smaller will be used, but it will be well to have more than the actual number. It is not always easy to obtain these bolts, and I am unable to give any address where they can be got, except the above-named Messrs. Pfeil & Stedall.

Details of Construction.—Having given some idea of the kind and quantity of materials necessary to make a start, I now proceed with the details of construction.

Bent Iron Side Pieces.—We commence by cutting four lengths of the ribbon iron, each 3 ft. 6 in. long, for the sides of the lantern, and having an exact full-size working drawing of Fig. 2 upon some suitable surface—I always use a large roofing slate, and draw with hard chalk—we are ready to begin the work of bending the scrolls, etc.

For this we need a good clear fire and a strong pair of wire, or round-nose, pliers. Place the iron in the fire so that about five or six inches may be made red hot, and be careful not to exceed a good bright red, as if there be a strong draught in the grate the iron may be burned and spoiled.

When bright red, grasp the *extreme* end of the iron in the pliers and form the small innermost turn of the spiral; then, by gradual bending, work the iron to the required shape—applying it from time to time to the working drawing—until the point A, Fig. 2, is reached. This point should now be marked with chalk upon the iron, or if the metal is of very good quality it will bear marking with a centre-punch. Heat to bright red as before, and double the iron so that the marked point may lie upon the centre of the bend. Now grasp this bend in the vice and screw up very tightly, which operation, if carried out quickly and dexterously, will be found sufficient to form the pointed portion of the scroll A, Fig. 2. A little "humouring" of the iron, however, and perhaps re-heating, may be necessary.

The further shaping until the point B, Fig. 2, is reached, will be comparatively easy, and may be done altogether with the hands, but the reader is advised to be very careful to follow the working drawing exactly, as the whole success of the work depends upon this.

To turn the point B, repeat the operation as at A, and so on to the final scroll.

The other side pieces are now bent in the same way, applying each one to the drawing and *also to the others* as the work progresses. In this way all four will be *precisely* the same both in size and shape, which is absolutely essential.

The Small Scrolls (Fig. 3), which are meant to give strength and rigidity to the sides, come next.

For these, cut four lengths of iron, each 9 in. long. The spirals are turned in the same way as already described, but a pair of flat pliers will now be necessary to hold the iron with the left hand, while the shaping is carried on with the right.

See that all four are exactly the same, and in agreement with the drawing. Now place them in position as indicated at Fig. 2, and mark off the points of contact with the side pieces. Draw lines with a red pencil, etc., across the flat of the iron at each of these points, and mark decidedly in the centre with a centre-punch and hammer.

The next step is to drill the sixteen holes which are required for fixing these scrolls. This may be done with any drill available, and if the worker possesses a lathe, so much the easier will the work be to him. These holes are for the smaller, or $\frac{3}{16}$ in., ball bolts.

Insert the bolts from the inside of the small scrolls, and screw up nuts as tightly as possible on outside of sides; cut off over lengths with a pair of "nippers," etc., and rivet.

In the operation just described, care must be taken not to interfere with the shape of the side pieces, which during the fitting of the scrolls should be placed upon the working drawing.

Putting Framework of Lantern together.—For this purpose we require two small hoops or rings, one 3 in. in diameter (Fig. 4) for the top, and the other $1\frac{1}{4}$ in. or $1\frac{1}{2}$ in. diameter (Fig. 5) for the lower part of the lantern. For the former, it will be necessary to bend a piece of iron 10 in. long into a small hoop, scarfing and lapping $\frac{1}{2}$ in. at each end, which, if the worker is sufficiently skilled, may be welded; or they may be neatly joined by a rivet, and if the holes be slightly countersunk at each side the ends of the rivet may be filed flush, and if well done the joining will not be noticeable, and the job will be quite strong enough for the purpose in view.

The other and smaller ring may be cut from a gun-barrel pipe of the required diameter, and should be about $\frac{3}{4}$ in. wide.

Having formed these rings, mark off four equidistant points upon the centre of the outer circumference, and drill holes to suit the larger ball bolts in the larger ring, and for the smaller bolts in the ring of gun-barrel. Next drill corresponding holes in the side pieces at the points C and D (Fig. 2), or exactly at the points of contact with the rings when placed in position.

Now insert the respective bolts and screw up. Cut over-lengths and rivet as before directed, and we have the framework of the lantern complete.

The Lamp-Tray.—If the work already described has been carried out in accordance with the working drawings, and made upon the scale indicated, the lamp-tray will be 6 in. in diameter, or thereabouts. This is composed of a hoop of sheet brass, $1\frac{1}{2}$ in. wide, and mitred on the lower edge (Fig. 7).

Having ascertained, by exact measurement of the distance between opposite side pieces, the size of the required tray (which we shall assume to be 6 in.), cut the strip of brass 19 in. long and $1\frac{1}{2}$ in. wide; with a pair of compasses mark out the mitring in the manner indicated at Fig. 8, and cut carefully with a pair of shears—or snips, as I believe the correct term is—and finish the edges, sharp and regular, with a fine file.

To give a suitable finish to the surface of the hoop, fix a common smoothing-iron, face upwards, firmly in the vice, and using this as an anvil, hold the hoop, right side up, flatly upon it, and with the round end of a riveting hammer go over the whole surface of the brass so that the indentations shall touch each other, and striking with uniform force and even distribution of blows, a mottled appearance will be imparted, which is most effective.

Now bend the strip into a *perfect hoop*; lap the ends to a depth of $\frac{1}{4}$ in., having scarfed them with a file, and solder neatly, being careful not to allow any solder to run upon the outside of the joint.

Next cut out a disc of brass which shall fit tightly within the hoop, and fix it in position about $1\frac{1}{4}$ in. from the straight edge, or just above the mitring, of the hoop, and having well cleansed the brass with fine emery-cloth, and applied "killed" spirit in the *inside* angle of the tray, and using a very hot pointed copper bit, cause a thin stream of solder to run all round, and if the parts of the tray have been accurately fitted, a neat and strong job will be the result.

Dipping and Lacquering.—The appearance of the tray will be much improved by "dipping" or "colouring," and it *must* be lacquered. The former process is to impart lustre, the latter is to preserve it.

A quart of nitric and a pint of sulphuric acid, with a "pinch" of common salt, makes a good dipping bath for brasses such as the subject in hand. Mix in a glazed earthenware vessel, and when cool the bath is ready for use. Wash the brass in a strong solution of washing soda and hot water to remove all grease, and using a hard nail-brush and finest ground pumice-stone, brush the whole surface of the brass, rinse in warm water, and allow to dry. Now run a piece of *brass* wire round the tray and across it, so that it may be firmly held, and having warmed it slightly, dip it completely into the acid bath; move it rapidly with a twisting motion for a few seconds, and then rinse immediately and thoroughly in clean cold water. It should now be dried in a box containing hot box-wood or beech-wood sawdust, moving or shaking it about until all the moisture is absorbed, and being careful not to handle it without placing a piece of chamois or old silk handkerchief, etc., between the fingers and the brass. When all sawdust is brushed off the tray is ready for lacquering.

Lacquering.—For directions on this subject I must refer the reader to page 346, Volume I. (No. 22), directing his attention especially to the last paragraph of the article under this head.

Copper Ornaments.—To make these, cut out eight discs of sheet copper, 2 in. in diameter, and with a pair of compasses mark out the trefoil pattern as shown at Fig. 9. Cut out with snips, and finish edges with file and emery-cloth. To shape these as indicated at Fig. 10, we need a small block of lead—an article which is indispensable to the worker in artistic metal work. This may be about 5 in. by 6 in. by 2 in.; and if made of the shape suggested at Fig. 11 (in section), so that it may be firmly fitted in a vice, it will be all the better.

With the round end of a riveting hammer make a slight circular hollow about the size of a sixpence near the edge of the lead block, and holding the leaf portion of the copper trefoil over this indentation, beat it down with the round end of a hammer. In this way the trefoil may be easily "knocked into shape," and by slight hammering over a larger, but *shallow*, concavity in the lead, the whole may be evenly hollowed as shown.

Having prepared the eight trefoils, a $\frac{3}{16}$ in. hole should be drilled in the centre of each, when they must be dipped and lacquered as before directed; the only point of difference in the treatment of brass and copper being that the latter should have a colourless lacquer, if available, but if not, the palest gold lacquer will do almost as well.

Fixing Lamp-Tray. — The lamp-tray should now be placed in position, and holes having been drilled for its attachment to the four side pieces, it may be fastened up with the larger-sized ball bolts, placing a trefoil upon each, as shown in the sketch, etc.; next attach the four upper copper ornaments, and we come to the last item in the construction of the lantern: viz., the arrangement (Fig. 12) for hanging.

Method of Hanging Lantern. — This should be of $\frac{1}{4}$ in. round rod-iron—of some such shape as suggested—and should be carefully bent so that the "legs" may be exactly the same length and shape. The ends are turned outwards at right angles, and need not be more than $\frac{1}{4}$ in. long. These are meant to pass through two holes in the upper ring, which holes should be drilled of a suitable size at exactly opposite points in the ring.

If accurately made and fitted as shown at Fig. 12, there will be sufficient spring to allow of the ends being inserted from the inside, when the lantern should hang true upon the pivoted bearings.

Suspension Chain, etc.—With regard to the suspension of the lantern, a very light iron chain may be used, or a sufficient number of suspension rods made to hook into each other may be made. For the latter I give two alternative suggestions at Figs. 13 and 14.

Berlin Black.—All the iron portions should be treated with two coats of Berlin black, to be applied *before* joining the parts together—a direction which it might have been better to give at the outset, but which, to avoid complication, I have left to the last.

MASONS' WORK.

BY MUNIO.

WORKSHOP — DRAWING INSTRUMENTS — GETTING OUT MOULDS — NUMBERING AND ORDERING STONES—SETTING—DOWELS, JOGGLES, CRAMPS —WINDOW-SILLS—YORKSHIRE PAVING AND KERB.

Workshop.—When a building is to be erected, containing a quantity of dressed stones, it is customary to build a shed, in which the stones are worked. This is generally open at the front, about 8 ft. or 10 ft. wide, and of sufficient length to accommodate the number of workmen which will be required. Bankers formed of large stones, or piles of bricks with a stone on the top, are erected on which the stones are laid while being worked. The shed should be as near the building as convenient, and there should be sufficient space near it on which to lay the stones as they come from the quarry.

A workshop should also be provided, in which a table or large drawing-board is fixed, on which the working drawings are made. These drawings are made full size generally, and as they should be thoroughly accurate, it is very important that a mason should be a practical draughtsman.

Drawing Instruments.—The instruments required for making the working drawings are a large square, set-square, straight-edge, chalk line, strong needle pointers, joiner's compasses, with guide and screw for fixing the legs, and beam compasses. For any drawings which may have to be made on paper, a large drawing-board, T-square, set-squares, and a set of mathematical drawing instruments will be required.

Getting out Moulds. — When the plans and detail drawings for the building have been received from the architect, a full-size drawing of such stones as require a mould for working them is made on the drawing-board, and from this the moulds are made. The best material for the moulds is thin sheet zinc. This must be tacked down over the drawing, and the lines marked upon it. The straight lines can then be cut by a steel scriber, and the circular lines by the point of the compasses. Figs. 40, 41, and 42 are detail drawings of a doorway, a ventilator, and roof corbels, from actual work, and from which the mason would make the working drawings and get out the moulds. Four moulds would be required for the doorway: one for the ventilator, one for each corbel, and one for the gable coping.

Ordering and Numbering Stones.—After the working drawings and moulds have been made, a list of the stones required in the building should be made out and sent to the quarry. Each stone, or group of stones, should have a number or mark set opposite to them. This should be marked on the stones before they leave the quarry, and if the same mark is put on the mould, there will be no trouble, when the stones arrive on the works, in selecting them for their place in the building. They should be numbered in such order that the stones which are required first should be sent in first, and this should also be attended to in working them, as it is much preferable to take them direct from the bankers to the building, than to have them lying about and liable to be damaged. The list should have the length, breadth, and depth entered in separate columns, marked at the top, as it is essential for the quarryman to know which is the bed of the stone, in order that he may cut it properly in the quarry. A copy of the list must be kept on the works for reference. When any stones are required of irregular form, a mould is sent to the quarry, to which they are roughly shaped, in order to save unnecessary carriage and extra labour in working.

Setting.—The setting or fixing of dressed stones is an operation requiring great care and skill. The stones are set with fine mortar, and in some cases oil putty is used, but as the pores of the stones sometimes absorb the oil, it discolours them. It should not be used for Bath stone; the best material for setting this stone is washed putty mixed with the stone dust. The stones should be plumbed on two faces and set straight on the outside face by means of a rule or line. In setting copings, cornices, etc., they should be raked or lined to each other by means of a long rule, and the top beds levelled. All stones should be solidly packed up at the tails with pieces of slates; they should be beaten down with a wooden mallet. The mallet for Bath stone should be of soft wood, or the stone will be bruised or stunned.

The joints should be thin, but there should be sufficient mortar between them to form a bed. In setting detached columns or pillars, a sheet of 4 lb. lead should be laid on the joint to within an inch of the edge, and the remainder formed of putty. This will prevent the edges of the stones being chipped when the weight comes upon them. Dowels should also be inserted between the stones.

In setting short piers between openings, where the inside is walled with rubble or bricks, the inside joints should be made as thin as possible, to prevent any settlement inwards, and it will sometimes be necessary to stay them till the heads are on, in order to obviate this.

In setting thresholds, window-sills, etc., they should be bedded solidly at the ends, and left hollow in the centre, or they will be liable to be broken when the work settles. When window-sills cannot be got in one stone, they should be in three stones; and if there are mullions in the window, the joints should be under a mullion.

In fixing mullions, tracery, etc., which require supporting till the whole are set, strong pieces of wood should be fixed across the openings to which they are temporarily fixed, till the whole window is set.

As the work is carried up, all projecting stones, angles of doorways, etc., should be cased with wood, to protect them from injury while the work is going on; and should any portion of a stone be broken off, it may be fixed by a solution of shellac dissolved in naphtha (by heat) till of the consistency of treacle.

For preserving a Bath stone front from

dirt, stains, etc., while being built, it is recommended to coat it with Bath stone dust, mixed with sufficient lime to make it adhere, and water, as it is built.

In setting spires, chimneys, and other objects built in courses at a high elevation, each course is fitted together on a level surface before being sent up, so that no cutting or paring is required after they are hoisted.

Bond stones should be laid on the tops of door- and window-heads after the walls are levelled up to them. There should also be bond stones under the ends of window-sills.

Dowels, Joggles, and Cramps.—Dowels are tenons fixed in the beds of stones to prevent them sliding upon each other; they are made of copper, bronze, wood, iron, and slate. Iron is not a suitable material for them, as if any dampness gets to them, it causes the iron to oxidise, and sometimes splits the stone. When iron is used, it should be tinned or galvanised. The dowels should be accurately fitted into the mortises cut to receive them, and to ensure their fitting properly the mortise hole should be cut in the mould, when it can be accurately marked and cut in as the stones are dressed. They are used in mullions, pinnacles, etc. Joggles are tenons formed on one joint of a stone, with a corresponding mortise formed on the adjoining stone; but as this causes a great waste of stone, joggle dowels are often used, a mortise being cut in each stone. They are used in jointing stone work of copings, parapets, etc.

Weather or weathered joints are those in which the under bed of the stone is notched upwards, leaving a piece of the stone projecting over the joint below, to protect it from the weather. They are used in gable copings, buttress slopes, etc.

Cramps are used for securing stones firmly together; they are made of copper and iron. When iron is used, it ought to be galvanised or tinned to prevent corrosive action. They are formed of flat bars turned down at the ends, and fixed in grooves or mortises cut in the stones; they are sometimes run in with melted lead, and sometimes with Portland cement. They are used for fixing the top stones of parapets, copings, etc.

Copper chain cramps are used in spires, chimneys, etc.; they are fixed in grooves cut in the beds of the stones.

Window-Sills.— Window-sills should be chamfered, or sloped from the front of the frames, to throw the water off, and the top bed on which the frame rests should be checked or rebated at the outside to prevent wet being driven in, the wood frame being correspondingly rebated at the back. In large windows with lead or iron lights a hole should be drilled through the sill from the inside, and a copper pipe brought through the wall to carry off the condensed moisture which forms on the glass. When the sills project in front of the face of the wall, a throating should be cut in the under

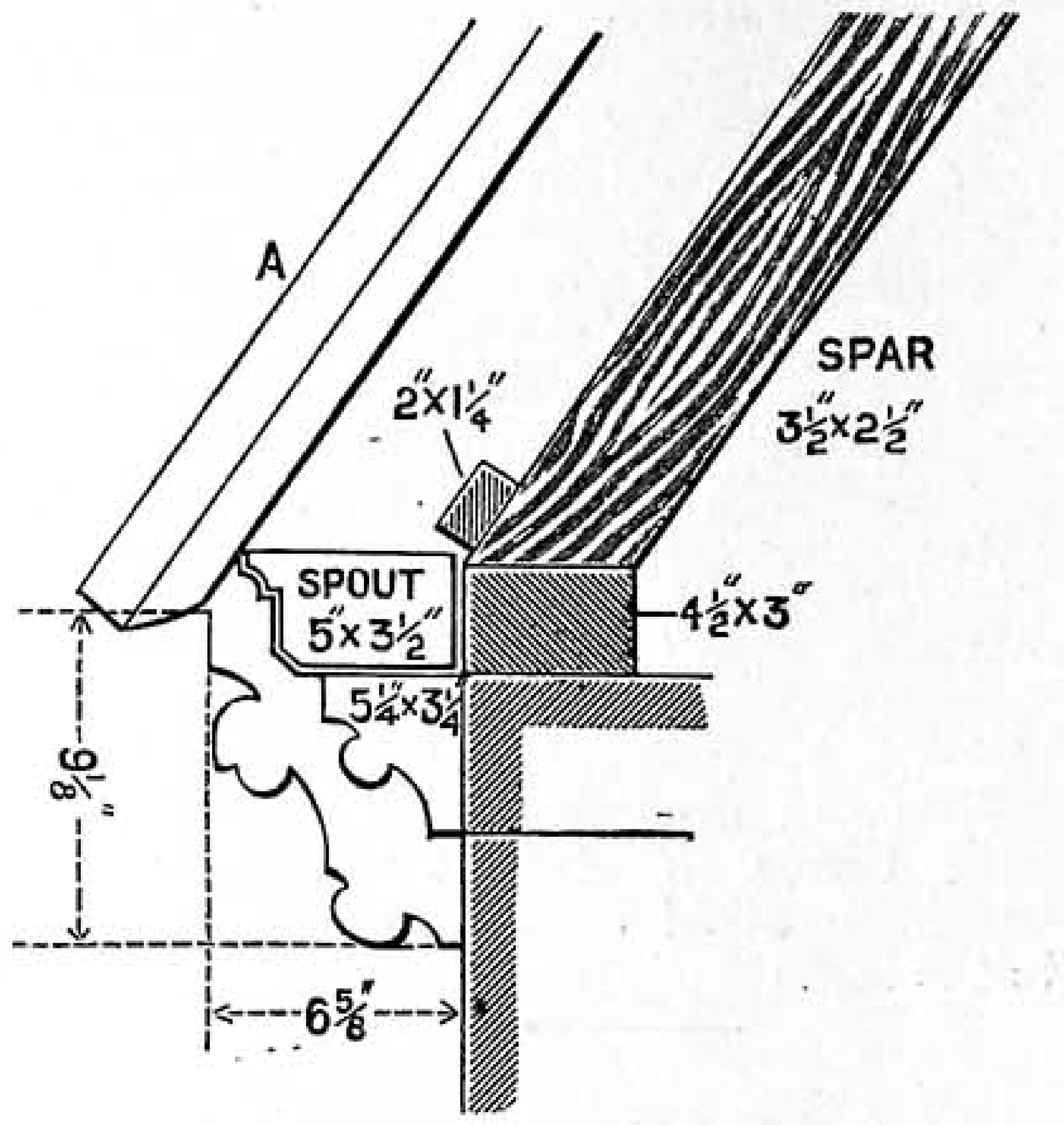


Fig. 42.—Section of Corbels, etc.—A, Corbel Coping.

bed to prevent the wet from running down the wall. The throating is a semicircular groove about ¼ in. in diameter.

Projecting string courses, copings, and all other stone work which projects from the face of the wall should be throated.

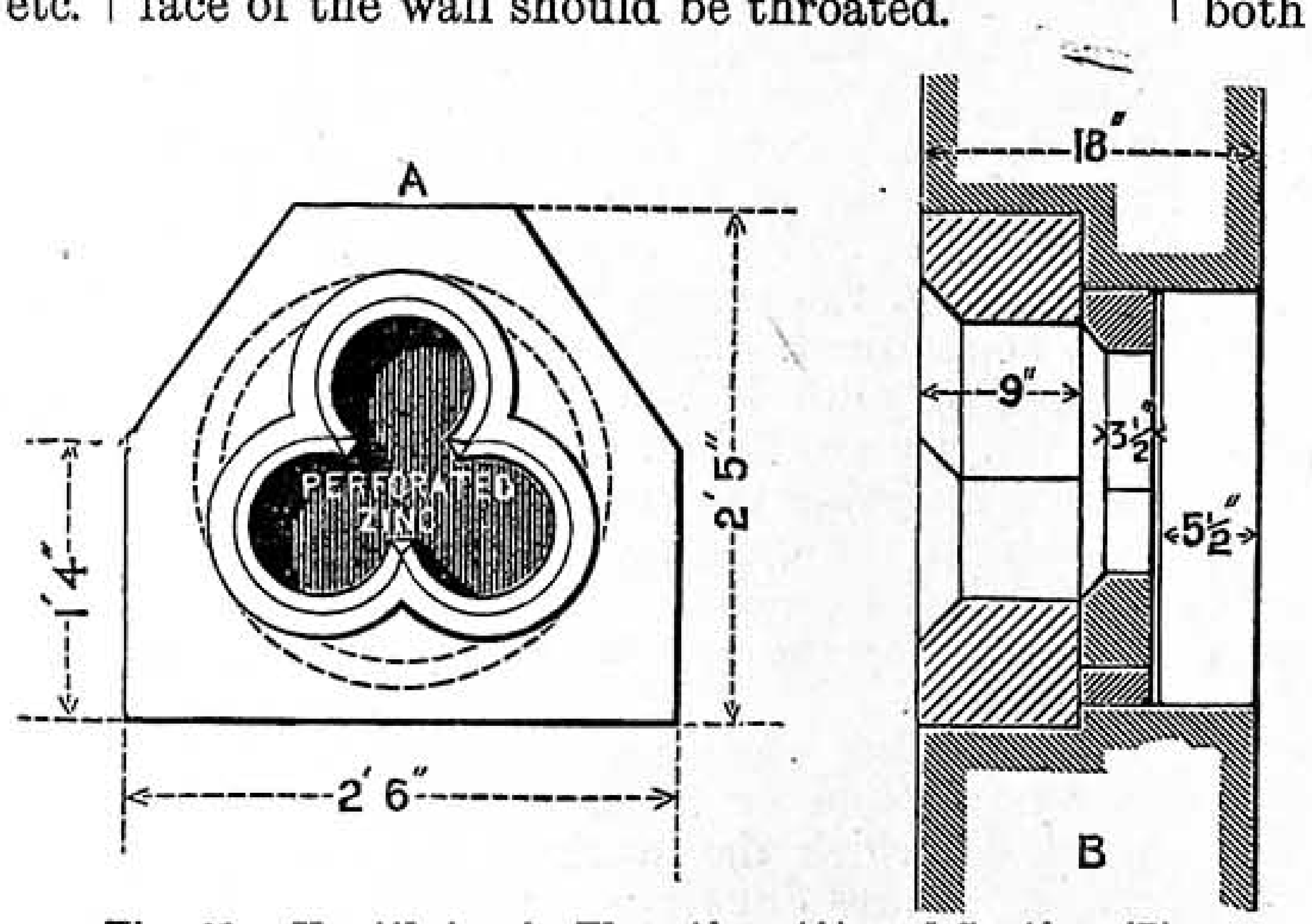


Fig. 41.—Ventilator in Elevation (A) and Section (B).

Yorkshire Paving and Kerb.—Yorkshire paving or flagging is of three kinds: self-faced, tooled, and polished flagging. Self-faced flagging is natural or quarry-faced; tooled flagging is tooled on the face; and polished flagging is boasted level on the face and rubbed or polished. The flags are from 2 in. to 4 in. thick, according to their size; they are selected into courses, and the edges jointed and squared. The joints should be kept square from the face for 1½ in. or more in large-sized flags; they should be bedded down solidly on dry sand, with a trowelful of mortar at each corner; they are jointed with fine mortar, and when laid outside for footpaths, etc., the joints should be pointed with Portland cement. They are laid level on the surface by means of a long rule, and raked to level pegs driven in at each side of the floor.

Paving is sometimes laid hollow on sleeper walls; it is then bedded in mortar and levelled on the surface.

Kerb is used at the side of a footpath and round area gratings, etc.; it is tooled or boasted on the top side and edge, and bedded and jointed. The joints are sometimes dowelled; it is bedded down solidly on mortar, and the joints made with fine mortar or cement. Where there is much traffic, granite kerb is sometimes used. The kerbs round area gratings are rebated for the grate to lie in.

Dressed kerbs are also fixed under iron palisadings and railings; they are tooled on both faces, and the top bed is chamfered or rounded. The holes for the rails are drilled after the kerb is fixed, and the rails run in with melted lead. Hearths are from 1 in. to 2 in. thick, boasted on the face, and polished; the edges are squared and jointed, and they are laid on the ground floor on solid foundations of brick or rubble work, and on trimmer arches on upper floors; they are made from 16 in. to 20 in. wide, and should be at least 6 in. longer than the width of the stove grate. Back hearths are laid behind hearths for the stove grate to stand upon.

Thus far the principal points and details in the manual work that is done by masons have been described and placed before the readers of WORK, briefly, it is true, but at sufficient length to afford assistance to the young professional, and also to give amateurs a fair insight into it if they are interested in it. I have, however, yet to deal with staircases and the various arches used in masonry, but the consideration of these must be left for my next and last paper.

It is not to be supposed that the amateur workman at home will find much attraction in masonry, but on the principle that all knowledge of a practical kind is useful, it is desirable to have a tolerably correct notion of the way in which every kind of handiwork is done, that if any particular kind of work is being done at one's own place, the person for whom the work is being executed may be able to form some idea as to the manner in which the work is being carried out, whether well or badly. The amateur in the colonies, however, will sometimes have to do a little stone-working for himself, if it is to be done at all, and he, at all events, will find the papers useful.

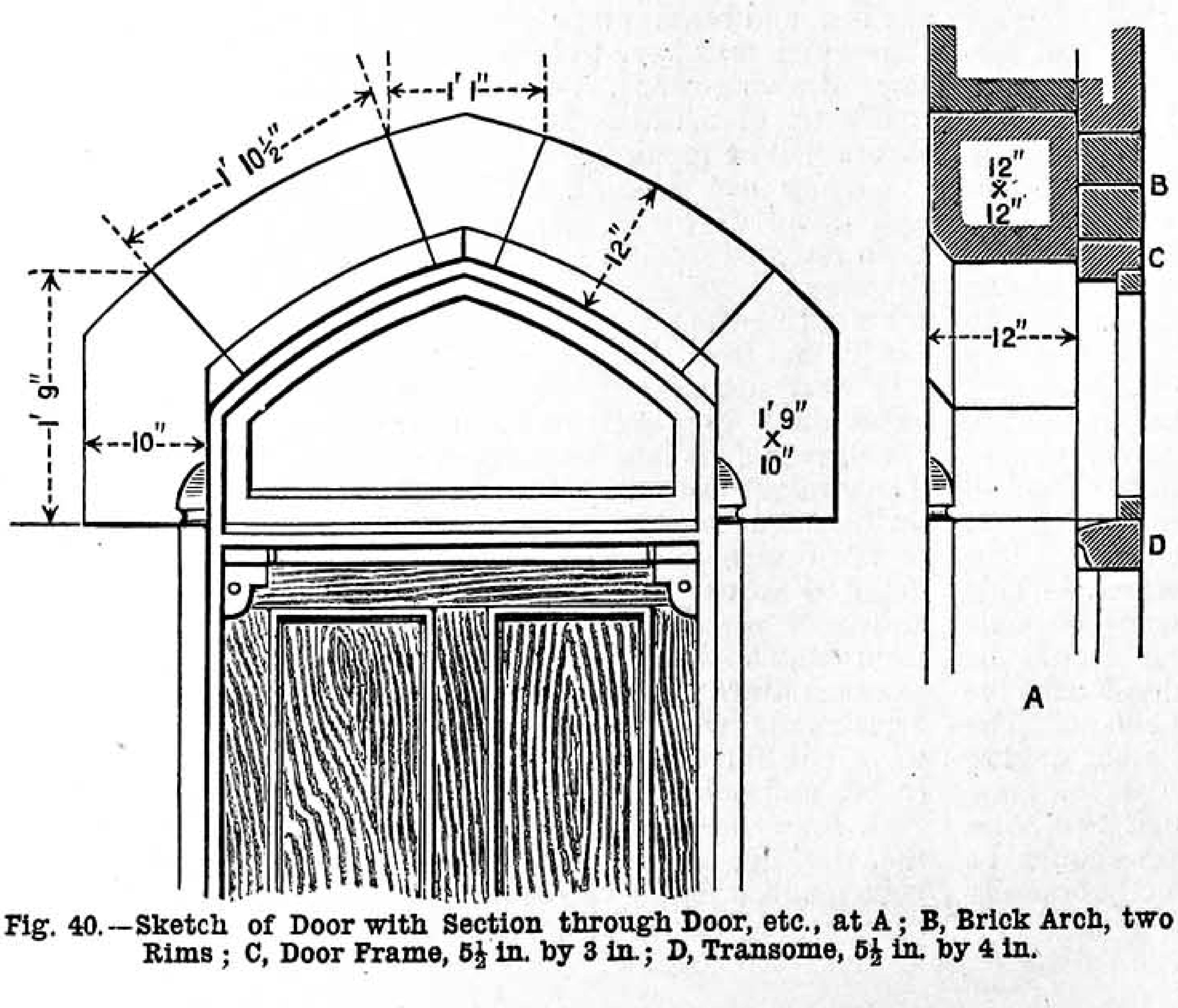


Fig. 40.—Sketch of Door with Section through Door, etc., at A; B, Brick Arch, two Rims; C, Door Frame, 5½ in. by 3 in.; D, Transome, 5½ in. by 4 in.

A CONTINUOUS-MOTION DRILL-STOCK.

BY FRANCIS CAMPIN, C.E.

Action of Reciprocating Drills — Ratchet-Drills—Conversion of Reciprocating Circular and Continuous Circular Motion.

Every mechanic, amateur or professional, has experienced the inconveniences that are inseparable from the use of reciprocating drills, whether used with the bow or in an archimedean stock. To obtain anything like a true hole is impossible, and yet no work can be put together without holes, and sometimes a great many of them. Holes untruly bored are also often responsible for the breakage of screwing taps, and thus the reciprocating drill is the cause of much damage, loss of time, and disappointment. With this form of drill there is no real cutting of the material; it is merely a matter of scraping, and most frequently with the scraping edge at a very bad angle for working.

A drill with a true cutting edge will, of course, only run in one direction, and, therefore, what is required for small purposes is a hand-stock that is capable of converting alternate rotary motion into continuous rotary motion. Of course, continuous motion can always be obtained for drilling where a lathe is accessible, but this is cumbrous for small work of the character we now have in view. A ratchet brace also is not suitable for small work, and is, moreover, too slow in its action, especially where very light cuts have to be taken. What is required, then, is a stock which will give continuous motion in one direction, and any rapidity that may be required, and to attain these ends the apparatus shown in the annexed illustrations has been designed. Fig. 1 shows a section taken just behind the driving ratchet-wheel, and Fig. 2 a longitudinal section along the centre line of the drill shaft.

The drill shaft, A, is made with an ordinary socket, cut away at *i*, as shown, to receive the back end of the drill at one extremity, and at the other it is fitted with a handle, G. The handle is shown broken off to save space, and its posterior end is shown in longitudinal section at H. Upon the shaft, A, a fly-wheel of disc form, B, is secured by screws, *k*, *k*, the points of which enter holes drilled in the shaft to receive them, and thus cause the wheel to revolve with the shaft. The weight of wheel, B, will, of course, depend upon the heaviest class of work for which it is proposed to use the tool.

A ratchet-wheel, C C, is fastened to the fly-wheel, B, by means of screws, *d*, *d*, etc., and turns when driven by pawls, *c*, *c*, carrying the fly-wheel round with it. The pawls, *c*, *c*, are hung upon pins, *m*, *m*, screwed into the division *o o* in a spring barrel, D D. It is important that the pawls, *c*, *c*, should be set diametrically opposite each other, to prevent inequality of bearing of the drum, D D, on the sleeve, F, upon which it is mounted, to revolve freely. It will be obvious that, so long as the two pawls act together, there is no pressure on the sleeve, F (except the nominal weight of the spring barrel, D D), and, therefore, no noticeable wear on the barrel at its bearings. The barrel is kept up to the fly-wheel and ratchet-wheel by a collar, E E, brazed, or otherwise firmly fixed, to the sleeve, F, while the sleeve itself—which runs easily upon the drill shaft, A—is longitudinally secured by a nut, *n n*, screwed on to shaft, A, and contained in a cavity in the end, H, of the handle, which is screwed on to the handle body at *g*.

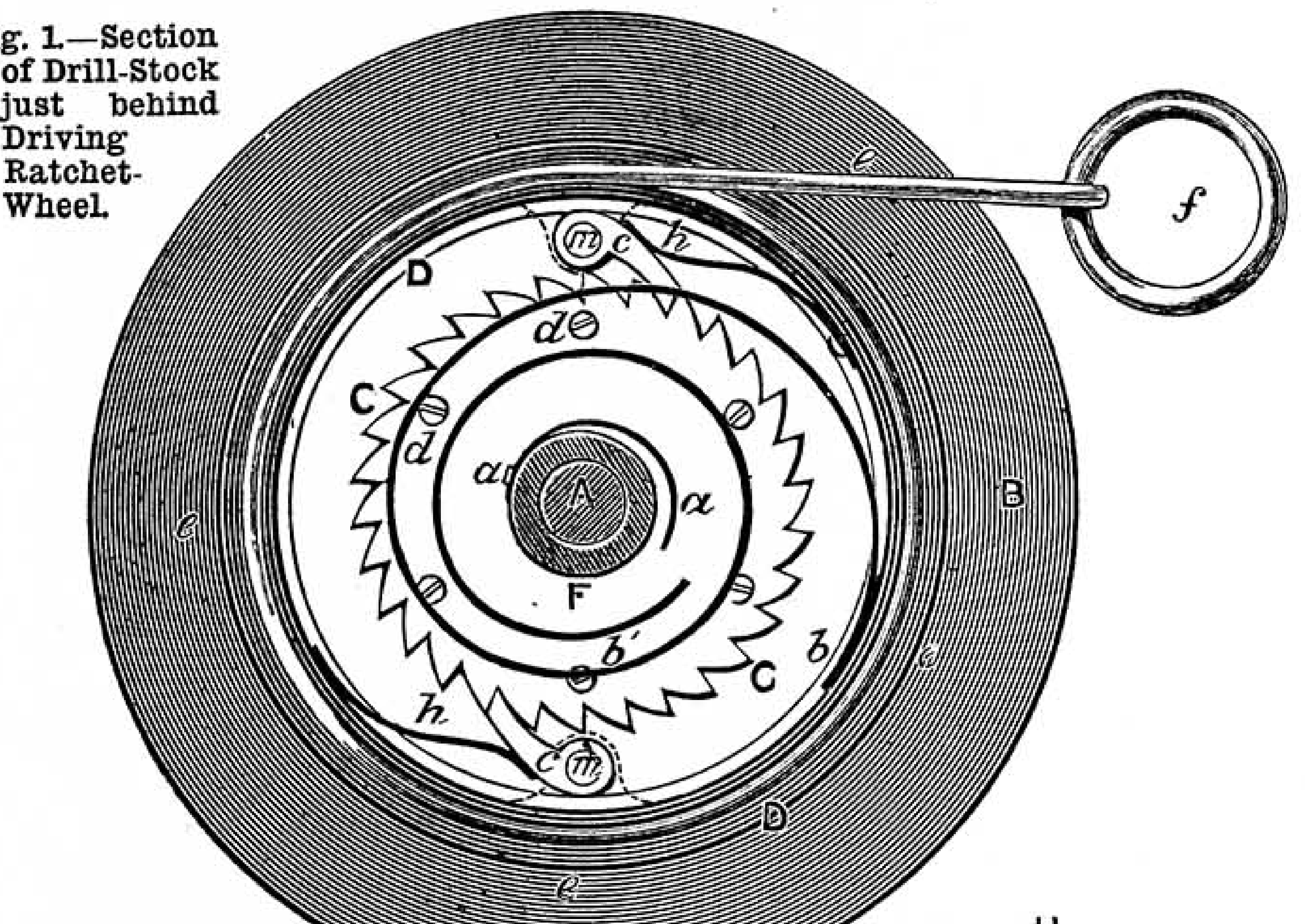


Fig. 1.—Section of Drill-Stock just behind Driving Ratchet-Wheel.

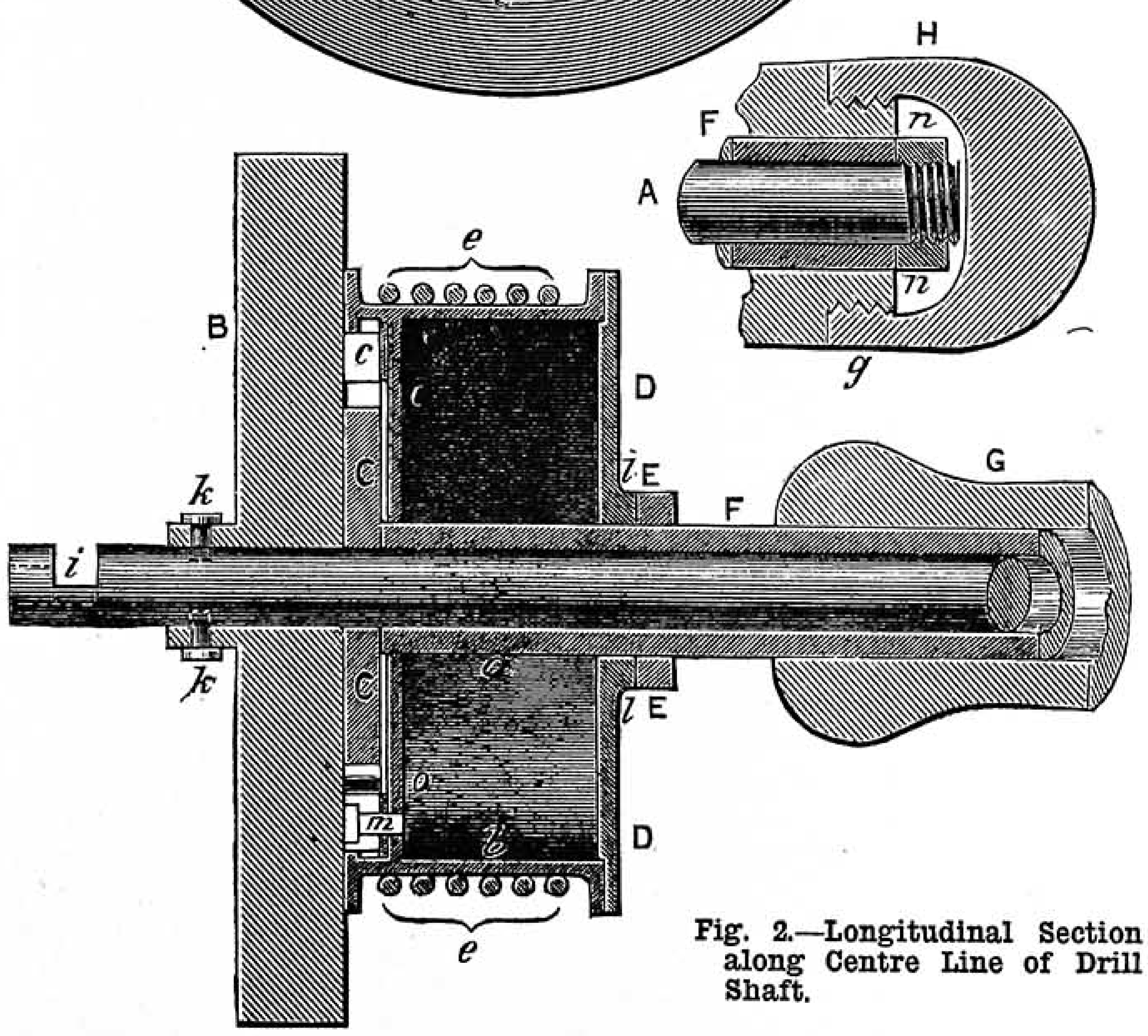


Fig. 2.—Longitudinal Section along Centre Line of Drill Shaft.

The barrel, D D, contains a strong clock spring fastened to the sleeve, F, at *a*, and to the periphery of the barrel at *b*. In Fig. 1, only the ends of the spring are shown, in order to allow the parts beyond to be clearly seen. To the barrel are also attached light springs, *h*, *h*, to hold the pawls, *c*, *c*, in contact with the teeth of the ratchet-wheel, C C. One end of a piece of catgut, *e e e*, is fixed to the exterior of the spring barrel, round which it is coiled for a few turns, its end being attached to a finger ring, *f*.

The apparatus is easily taken to pieces, if required, for cleaning or other purposes. When the screws, *k*, *k*, have been withdrawn and the nut, *n n*, all the parts will come asunder. The collar, E E, instead of being brazed on to the sleeve, F, may be cast in one piece with it. In order to adapt the stock to different kinds of work, several fly-wheels of different weight may be made to fit it, so that they will be interchangeable on the same drill shaft.

In use, the handle, G H, of the stock is held in the left hand, then on pulling the catgut, *e*, by finger ring, *f*, with the right hand, the barrel, D, is caused to revolve, and by the pawls, *c*, *c*, carry the fly-wheel and drill shaft round with it; at the same time, the spring, *a b*, is wound up. On letting the catgut loose, the spring re-winds it on the barrel for another pull, and during the re-winding the momentum of the fly-wheel, B, maintains the forward revolution of the drill, the pawls, *c*, *c*, passing meanwhile backwards over the teeth of the ratchet-wheel, C C, and thus a constant rotation of the drill in one direction is maintained. The drum and ratchet arrangements, drill shaft, etc., are shown about natural size. If a very high velocity of revolution is required, higher than can conveniently be obtained with the catgut coiled on barrel, D, the boss, *l*, of its back-plate may be made longer, and used as a barrel on which to wind it, which, for a given velocity of hand, will increase the number of revolutions three times. If it is desired, this contrivance may be fixed in a frame and clamped to a bench, to leave the left hand at liberty to manipulate work which is being drilled.

I am inclined to think that the advantages to be derived from a drill-stock of this kind will be obvious to every mechanic who is in the habit of using drills, and that the old hand-stocks will eventually be superseded by this new form. It is never safe, however, to speculate with any particular degree of confidence on what may happen with regard to new tools and appliances, which are departures from the beaten track, and it is often some time before a good thing is taken into favour.

A CHEAP CAMERA LUCIDA FOR MICROSCOPIC SKETCHING.

BY H. B. S.

Two Methods of Making: In Sheet Zinc—Materials Required—Method of Making. In Brass: Materials Required—Method of Making—Adjustment to Eye-Piece of Microscope.

Those readers of Work who have a microscope will know what a camera lucida is used for. It is similar to an ordinary camera lucida, but on a small scale, and is fitted to the eye-piece of a microscope to reflect the image, and thus allow of its being sketched. There are many kinds of camera lucida sold, and the price varies from six shillings to thirty shillings. The two I describe will cost not more than a few pence.

There are two methods of making a camera lucida which I have tried: first, in sheet zinc. Materials and appliances required:—Piece of thin sheet zinc 3 in. by 1¾ in., a pair of scissors, a pair of compasses, and one thin glass circle, same as used for covering objects.

Mark out a circle on the sheet zinc of about ¾ in. diameter, and within this a circle of ½ in. Cut out inner circle. Connect it as shown (Fig. 1) to the strip 3 in. by ½ in.; cut out with scissors. Take a ruler or any cylindrical object a trifle smaller than eye-piece of microscope, and bend the strip around it; it will then form a ring which will fit on to eye-piece. Now bend up the connecting bit slightly, touch around the circle with gum or glue, and having cleaned the cover glass, drop it on; if thought necessary, a ring of black paper may be put on over cover glass to keep it in its place (Fig. 2). Now allow

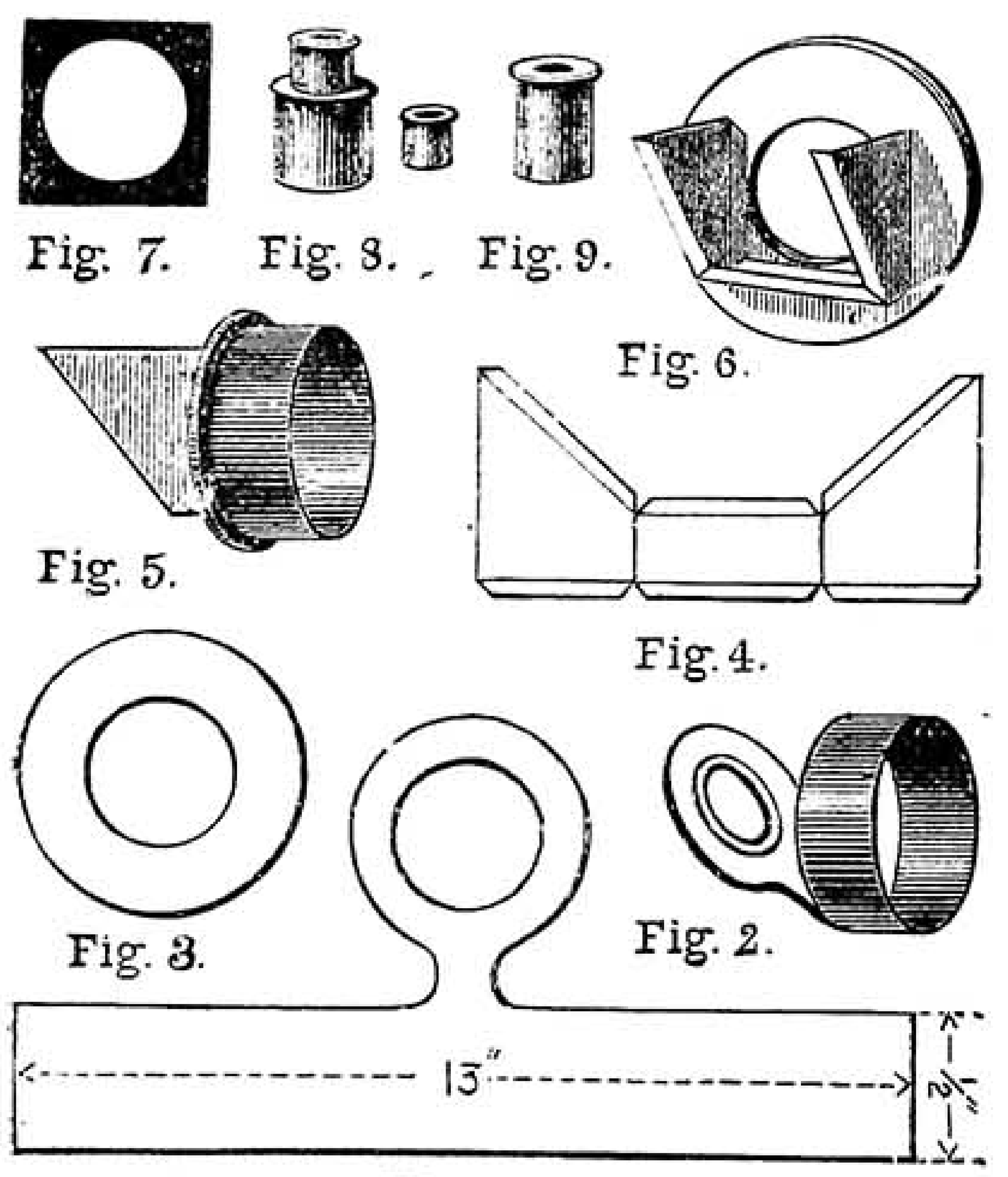


Fig. 1.

Fig. 1.—Plan of Camera Lucida in Zinc. Fig. 2.—Zinc bent into shape. Fig. 3.—Brass Ring. Fig. 4.—Pattern for Camera Lucida. Fig. 5.—Material bent into Box Form. Fig. 6.—End View. Fig. 7.—Cover Glass. Figs. 8, 9.—Eye-Pieces.

to dry, then place it on eye-piece of microscope, place the microscope horizontal, and having an object at stage of microscope, look down at cover glass, and see if the object is visible; if not, move the circle upwards or downwards until the object is visible, when the glass will then be at an angle of 45 degrees with tube of microscope. This adjustment and the sketching which may be done must be done in a dark room, when the lamp is used for direct illumination. Sketching cannot be done in daylight.

The second method is a little more difficult. A little thin sheet brass, shears, a soldering-bit, solder, brace and bit, and file will be required.

Measure diameter of eye-piece, and cut out a strip of brass long enough to make a ring that will just slide on to eye-piece; bend it round and solder, or maybe you can get a bit of tubing to fit; it must fit tight, and may be ½ in. or ¾ in. wide. Next cut a circle a trifle larger than the ring, drill a ½ in. hole in it (Fig. 3), and solder on to the face of the ring. Next prepare a piece of the sheet, and cut out as shown in Fig. 4, the angles exactly at 45 degrees, and bend up into the shape of a box, open at top and ends; turn down pieces for soldering inwards, also pieces on other side intended to hold glass, and solder it directly on to the face of the metallic cap you have made (Figs. 5 and 6).

All that is now required is a cover glass mounted between two pieces of black paper (Fig. 7). Let it rest in the box.

The first described will fit any eye-piece, but the second one will only fit the eye-pieces in which the front part may be detached (Fig. 8). It will not fit those having a milled edge larger than the rest of the eye-piece (Fig. 9).

I have made both kinds of camera lucida, and they are as good as any to be bought. The cover glass being so very thin, there is no double reflection, as you see in a thicker piece of glass.

MEANS, MODES, AND METHODS.

To Make Lime in Small Quantities.

Few who live in the country have not felt the difficulty of procuring small quantities of quicklime. In my own case, for instance, I have to send seven miles for it, which takes a man and horse the best part of a day, when I want, perhaps, but sixpennyworth of lime. I was bemoaning this fact to a lady friend of much practical common sense, when she astonished me by saying that when they wanted to whitewash the kitchen or any small piece of work, they put limestones in the kitchen fire and burned their own lime. On my return home I put the matter to a practical test, and lo! it was so. To use the words of my man, "I won't be without lime now when I want it." J. L. D.

Substitutes for a Short Screw.

Any of my readers who have observed a properly mounted grindstone will see that the stone is clamped between two flanges, one of which abuts against a shoulder in the shaft, whilst the other is pressed against the stone by means of a nut threaded on to a screw cut on the axle.

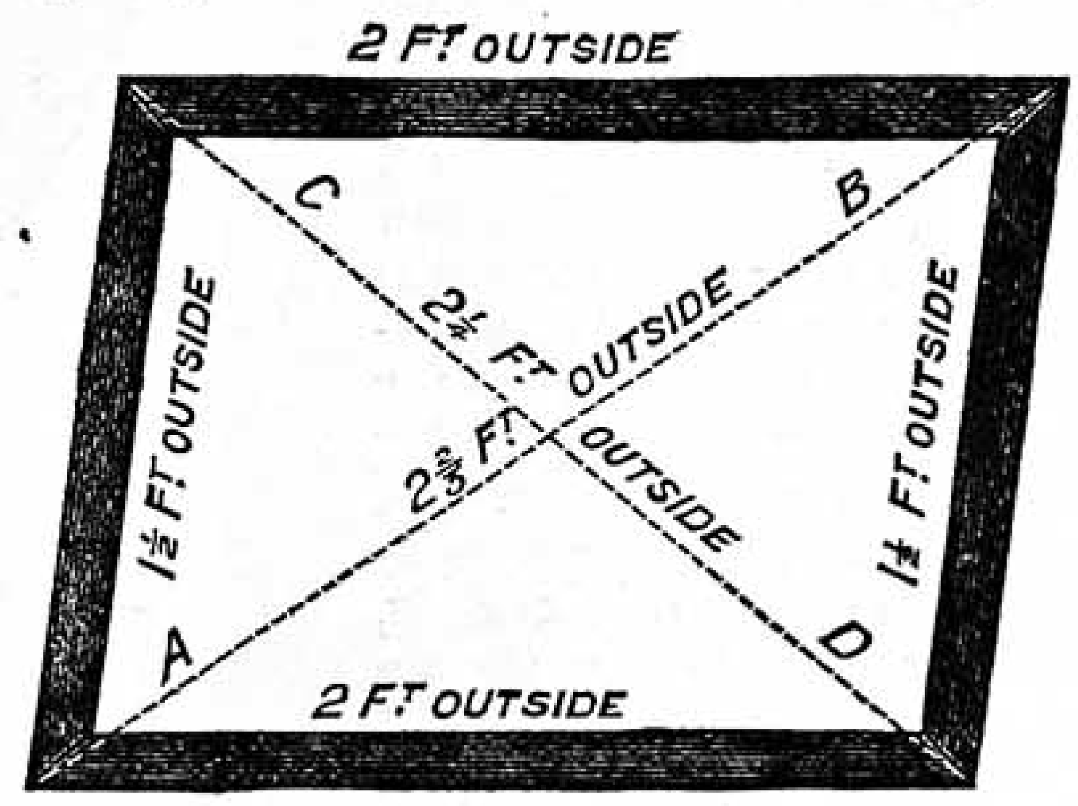
I wanted to mount a stone in this way, but had not dies of the exact fit for the axle. I consequently designed an efficient substitute for the screw as follows: I first put the stone on the axle, and marked the outside of the outer flange; then, a ¼ in. outside that I drilled a hole across the axle to take a ¼ in. steel pin. I next procured, as a washer, a back nut used by gas-fitters, which was ⅜ in. thick, and fitted nicely over the axle. I then filed nicks on the opposite sides of the washer ⅛ in. deep, and sloped the washer from the bottom of one nick to the top of the other. When the stone, flanges, washer, and pin were put in place, the washer, thus treated, acted as two half-threads of a double-threaded screw, and held the stone quite securely. J. L. D.

A Simple Way of Testing the Accuracy of Framework.

If there is one thing more tantalising than another to an observant person, I really believe it is to notice any such article as a picture-frame made out of the square. A certain picture-frame in my possession tormented me by its apparently bad workmanship, and I set about testing the angular accuracy of its four corners, in order to settle all doubts and ease my mind; and while doing so, was told by a looker-on of a simple means of acquiring the object in view. The advice was to measure the distance between two opposite corners of the frame crossways, allowing the string to pass over the centre of it, as per dotted line A B or C D, and then to place the string or measure between the two remaining corners. If this course is adopted, and both distances coincide in measurement, all is well; if not, it will thereby be discovered that something is wrong somewhere.

In the diagram an imaginary frame is drawn to a degree of inaccuracy so decidedly exaggerated that the most unfortunate possessor of distorted vision would hardly find it needful to resort to any mechanical method for the object of obtaining the truth as to the irregularity of its angles; but the sketch is so delineated in order to convey a better and clearer understanding of the means of testing, and a comparison of the variations of distances between the opposite points of the several parts.

It will be readily understood that in the case of a careless apprentice or workman making the mitre on any particular rail of the job wrongly, it would be a comparatively easy matter for him to mitre the adjacent rail in such a manner that it would perfectly fit it, although, however, the result would be the formation of an improper angle by the unison of the two rails.



Badly-made Frame with Faults exaggerated.

I am not aware whether this method is used among wood-workers—one must be a curiously well-informed being to not be ignorant of some things in this busy and knowing world—but it is a common practice among wire-workers when they wish to discover whether the squareness of their work is correct; and probably I may have to allude to this note during the course of my papers on Wire-work.

It must be obvious to all who have the intelligence to perceive the simplicity and efficiency of this method—and who has not?—that the application of the same would answer in every respect equally well for the determination of the accuracy of any kind of framed work, such as doors, etc., by either measuring within or outside the frame; in the case of a four-styled door, adopting the latter course, and in the instance of a door with one or more cross rails between the upper and lower styles, using the former.

If half of the difference between the two distances across the frame upon the lines A B and C D respectively be taken and added to the shorter measurement, that will give the correct length the work should be diagonally across from corner to corner either way—that is to say, supposing A B is 2 ft. 6 in. long, and C D 3 ft., the difference will be 6 in., one half of which, if added to the shorter distance (2 ft. 6 in.), will give the correct measurement, viz., 2 ft. 9 in. J. S.

HOW TO MAKE A QUARTER HORSE-POWER STEAM ENGINE.

BY F. A. M.

THE PISTON, SLIDE-VALVE, PORTS, AND CYLINDER COVERS.

THE PISTON RINGS—PISTON COVER AND BODY—THE PISTON-ROD AND NUT—THE VALVE-FACE—VALVE-BOX AND COVER—THE PORTS—SCREWING THE PARTS TOGETHER—TURNING AND THREADING THE STUFFING-BOX—THE SLIDE-VALVE AND ITS ROD—SCREWS FOR SECURING THE CYLINDER COVERS.

WE may now undertake the piston and rod, shown in detail in Fig. 5 (page 260). Begin with the casting for the brass packing rings; chuck this by the outside, and bore it out. It measures 1⅝ in. diameter inside on the drawing, but as it will have to be compressed, we will bore it out $\frac{1}{16}$ in. larger than this. Drive it on to a mandrel, and turn the edges outside to $2\frac{1}{16}$ in. diameter; turn the edges and part it in two, so that each ring shall be ¼ in. wide. By turning the edges of the rings at one chucking, you ensure their being parallel. Now take them to the vice, the jaws of which must be protected with lead "clams"—*i.e.*, sheet lead about ⅛ in. thick, bent over the jaws, to prevent them from marking brass or other work. We have now to file and scrape the edges of these rings till they are perfectly flat, and that without destroying their parallelism. We shall require a perfectly flat surface of some kind; perhaps the scraped surface of the lathe-bed might do, though it will not be very correct, or a piece of plate-glass is sometimes used. Much better would it be to obtain a reliable face-plate or surface-plate—one 3 in. by 5 in. will do for the work we have in hand; if of this size, it will do to correct the bed-plate facing on which the slipper guide works, as a 3 in. plate will go between the flanges. Get some Venetian red, and mix with machine oil in a little flat tin box, which you will keep ready at hand. Smear a very little of this "marking" on the face-plate, equally, all over it; then, when the rings are rubbed upon it, you can see those points which touch the surface, and at the same time you can feel on which parts it rocks. To hold the rings while being filed or scraped, take one of them, and, laying it upon a bit of wood, draw round it with a pencil, and hammer a few small nails into the wood upon the line, so that you can replace the ring on the wood between the nails, that they may prevent its slipping while you file it; the heads of the nails will be knocked down a little lower than the upper edge of the ring, that they may not interfere with the file. Callipers are sure to spring slightly, and, as the rings must be perfectly parallel, make a solid calliper by filing a notch in a bit of sheet iron to act as a gauge of width. File up and scrape one edge of each of the rings till they bear well all over on the face-plate; then file the notch for the gauge, trying it on the rings all round till it will almost go on at the smallest place; then bring up the other surface of each ring true, so that the gauge will go on equally tight all round. Handle the rings tenderly, as they are very easily bent and bruised; you could probably squeeze them flat with the grasp of the hand, and if they are dropped on a piece of iron, or a tool thrown down on one, it will get a nasty bruise, and require to be tried on the face-plate again. Screw a ring gently in the vice in the lead clams, one edge projecting about ¼ in., and take the hack saw to cut it across; the cut should not be straight across, but oblique, because then the edges of the ring are not so likely to wear grooves in the cylinder. The rings must be cut twice, about $\frac{3}{16}$ in. apart, so as to remove about ¼ in., leaving an oblique gap ¼ in. wide; this is necessary to enable us to close the rings to get them into the cylinder. Now take the cover of the piston; chuck it, face one side, and bore a $\frac{5}{16}$ in. hole through the middle. Chuck the body of the piston, hollow side out; true that side, and bore a $\frac{5}{16}$ in. hole through. Lay aside these two parts, and take a piece of round mild steel (such as Bessemer), 8½ in. long and ½ in. diameter; centre this, and turn it down to ⅜ in. full. Turn down one end to fit tightly into the body of the piston; cut a $\frac{5}{16}$ in. Whitworth thread on the end of this part, and make the brass nut which goes on there. Now drive this end of the piston-rod into the body of the piston, and put on the nut, screwing it hard up to secure the piston body on the rod; put all between the centres, and turn up the piston body. Take the piston cover and scrape up the inner surface; take off the nut from the end of the piston-rod, put the piston cover on in its place, and put the nut on again to secure it, screwing it on tightly. Now take the brass packing rings, and try whether they will fit into the groove; if too tight, turn off a little from the side of the groove which is part of the piston; if too loose, take off the nut and piston cover, and turn away a little from the face of the piston against which the cover fits. The width of the groove must be such that when the rings are in position, and the nuts screwed hard up upon the piston cover, the rings will be held tightly enough to stand turning; we must turn the outside of the rings again, because when they are compressed into the cylinder they will no longer be exactly round. First, turn the outside diameter of the piston body and cover to exactly fit into the cylinder; when trying it into the cylinder, be careful to wipe the turning dust off and have the bore of the cylinder quite clean, or you may be deceived. It is better to pass the piston-rod through the stuffing-box in the cylinder cover when trying the fit of the piston, because that will keep it from getting askew in the cylinder; therefore, at this stage it will be well to finish the piston-rod to size. Use the brass gland as a gauge of size, and, putting in a very sharp tool, with a light cut reduce the piston-rod till the gland will almost go over it; then take a worn, smooth file, and use that on the rod as it turns in the lathe till the gland can be pushed over it with some difficulty. Now take a smooth file and "draw-file" the rod, rubbing lengthways from end to end, whilst the lathe is at rest, so as to lay the grain of the scratches longways of the rod, and remove all circular scratches, which would rapidly wear out the packing, besides greatly increasing the friction. The gland should now slide freely over the rod from end to end, and in trying the fit of the piston in the cylinder the cover would be put on, and the piston-rod, with piston on it, would be passed in from the back end. The piston-rod, passing through the cover, would keep the piston true and level, so that the fit can be observed. When the fit of the piston in the cylinder has been adjusted so that it will pass freely up and down in the cylinder, take off the nut and cover from the piston, and put it just inside the cylinder, the rod passing, as before, through the stuffing-box in the front cover. Now take one of the packing rings, and, compressing it slightly with the fingers, press it into the coned-out mouth of the cylinder and over the body of the piston; now the other ring; now the piston cover and nut (but do not screw up the nut). On pressing, or gently driving, the piston forward, the rings will gradually close till they come to the parallel part of the cylinder. Try drawing the piston up and down, tighten the nut, and take out piston and rod. Now you will see the rings were not bearing very equally all round; there will be bright spots showing where they rubbed hard on the cylinder. Put the piston as it is in the lathe, and take a light cut over the rings; put piston in the cylinder, loosen the nut, and pull it up and down; fix nut, take out, and examine. The bright marks should now show all round the rings. If, however, the piston rubs hard in the cylinder, turn a little more off the rings, till there is only enough spring left in them to hold up tight without causing too much friction. One thing more remains to be done to the piston. The surface of the piston cover against which the rings rest is scraped, but the corresponding surface on the body of the piston is left from the lathe tool. This surface must now be got up with the scraper, taking off so much metal that the rings shall be released and able to move, even when the nut is tightened upon the piston cover; yet too much must not be taken off, for the rings must touch both sides of the groove in which they lie, and still not be pinched so tightly that they cannot expand. The shape of the piston body makes it impossible to use the surface-plate to try this last annular surface, but one of the rings can be used. Rub the edge of one of the rings with the marking, and rub the ring on the piston surface: thus you will be enabled to scrape it up. A little reflection will show that it would not have been sufficient to prevent leakage between the packing rings and cylinder, if we allowed the steam to get between the edge of the rings into the groove of the piston, and so out the other side; moreover, we must take care that, when we put in the rings, the two cuts do not come together. The cut place on one ring should be at an angle of 90 degrees (at right angles) with the other; then the steam cannot pass, and the rings will press equally all round the inside of the cylinder. The piston being now finished, all but the cross-head end of the rod, it should be oiled and put away.

Let us now undertake the valve-face of the cylinder, valve-box, etc. File up the valve-face, keeping it parallel with the bore of the cylinder by means of callipers, measuring from inside the bore to the valve-face, or laying this face on the surface-plate, and trying with a square whether the flanges of the cylinder stand square up from the plate; when this is the case, finish the face by filing and scraping to the face-plate. File up also the edges of the valve-box which make the steam-tight joint, keeping the sides parallel by trying all round with callipers; scrape and finish these surfaces. File up also the oblong cover or lid on its flat sides, scraping up the inner surface to make a steam-tight joint. Lay the valve-box on the valve-face, in position, and the cover on that, and observe whether the outside edges correspond; if not, they must be made to do so by the file. It is not, however, advisable to file up the outside of the box, but only to make the edges come fairly even. The inside of the box should be filed out square and true, that its walls may form a

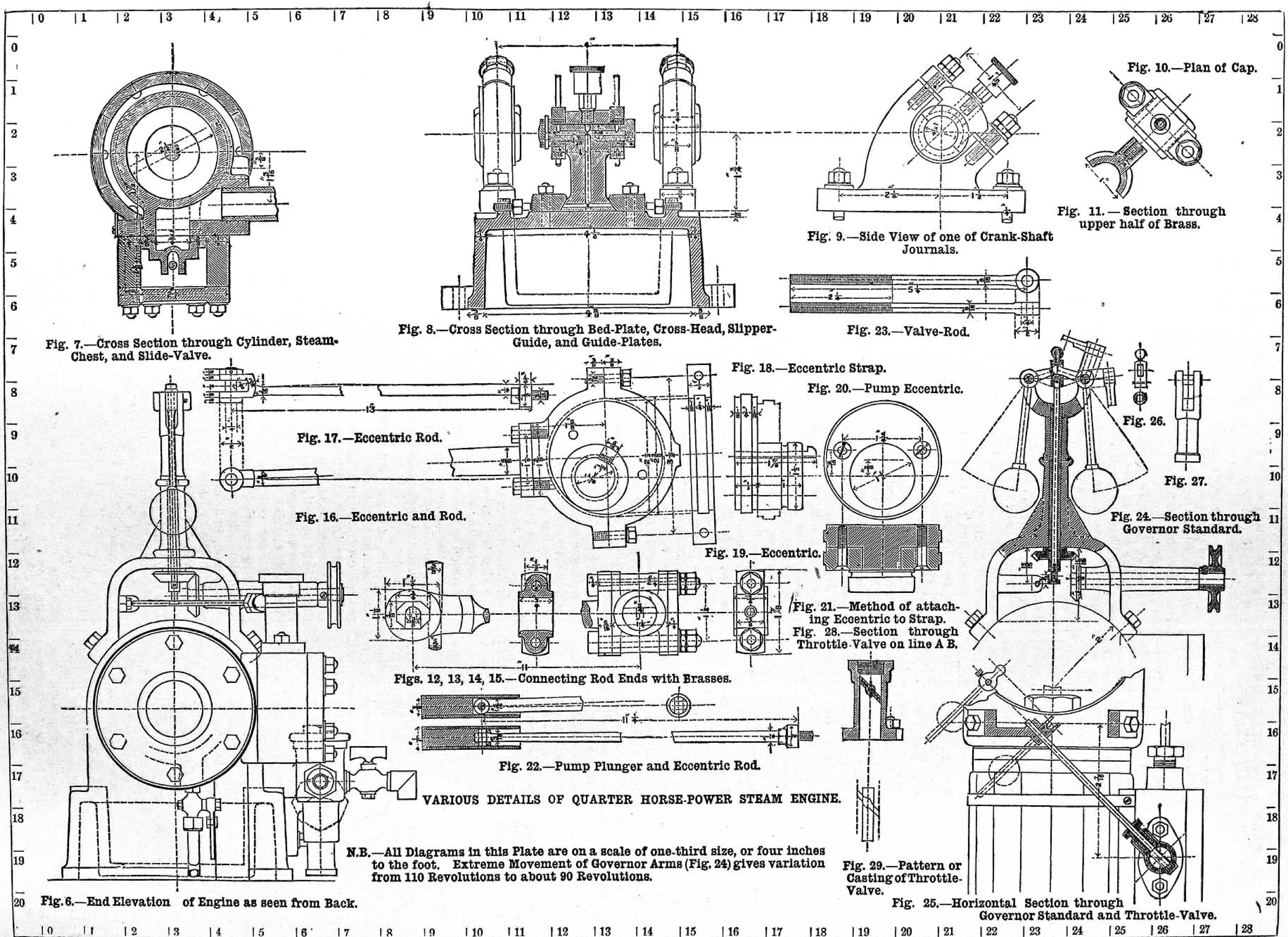


Fig. 6.—End Elevation of Engine as seen from Back.

Fig. 7.—Cross Section through Cylinder, Steam-Chest, and Slide-Valve.

Fig. 8.—Cross Section through Bed-Plate, Cross-Head, Slipper-Guide, and Guide-Plates.

Fig. 9.—Side View of one of Crank-Shaft Journals.

Fig. 10.—Plan of Cap.

Fig. 11.—Section through upper half of Brass.

Figs. 12, 13, 14, 15.—Connecting Rod Ends with Brasses.

Fig. 16.—Eccentric and Rod.

Fig. 17.—Eccentric Rod.

Fig. 18.—Eccentric Strap.

Fig. 19.—Eccentric.

Fig. 20.—Pump Eccentric.

Fig. 21.—Method of attaching Eccentric to Strap.

Fig. 22.—Pump Plunger and Eccentric Rod.

Fig. 23.—Valve-Rod.

Fig. 24.—Section through Governor Standard.

Fig. 25.—Horizontal Section through Governor Standard and Throttle-Valve.

Fig. 26.

Fig. 27.

Fig. 28.—Section through Throttle-Valve on line A B.

Fig. 29.—Pattern or Casting of Throttle-Valve.

VARIOUS DETAILS OF QUARTER HORSE-POWER STEAM ENGINE.

N.B.—All Diagrams in this Plate are on a scale of one-third size, or four inches to the foot. Extreme Movement of Governor Arms (Fig. 24) gives variation from 110 Revolutions to about 90 Revolutions.

guide to the slide-valve. (See Fig. 7.) As they come from the foundry, the ports in the cylinder will not have their edges perfectly straight and square. Those who have studied the introduction to these papers will know how important it is that the exact dimensions here should be adhered to; it will not do to depart by even $\frac{1}{64}$ in. from the dimensions written on the ports and valve in Fig. 5. Take a piece of stiff card, the size of the valve-face of the cylinder, and draw upon it very accurately, with a hard and sharp pencil, the exact shape and position of the three ports from the views and dimensions given in Figs. 5 and 7; cut out the ports in the card with a penknife, and lay it upon the valve-face, so as most nearly to correspond with the three holes cast in it; take a sharp scriber point, mark off the holes on the iron, and file the edges of the ports to these marks. We will now proceed to screw the parts together. Eight long studs are required of $\frac{3}{16}$ in. diameter (screwed with $\frac{3}{16}$ in. Whitworth thread by preference), and these may be made from iron wire; the eight nuts should be of steel, and should be hardened. The washers are not necessary, though they look well. First mark out the positions of the eight holes on both sides of the valve-box, squaring across carefully from one side to the other; or, better still, take the card again, mark the holes on that, and then, after cutting out the holes, lay the card on the four surfaces and mark them with the scriber, taking care to keep the same side of the card always to the positions of the same studs: thus, the card might be laid first on the valve-face, and, after marking there the eight holes, then on the inside of the valve-face, then on the outer face of it, and lastly, on the cover. It is not at all an easy matter to get these holes exactly opposite, and great care must be exercised. How annoying it would be, let my readers imagine, to find, after screwing in the eight studs, that the valve-box could not be threaded over them. The amateur who can place his holes so correctly that the box will go on at the first trial may congratulate himself; if it will not, he will have to use a small "rat-tail" file in the holes through the sides of the box, filing away towards whichever side of the hole binds against the stud. So much then by way of frightening my readers into taking care at this point. Having marked, by means of the card template, all the eight holes as accurately as possible upon the four surfaces, drill the valve-box first from both sides with a $\frac{1}{8}$ in. drill, to meet in the middle; the drill will revolve in the lathe, and the work be pressed forward by the boring-flange, which should present it squarely and true to the drill. Watch the drill as it starts, to see that it does not "run" to one side at all, and you may hope the holes will meet fairly in so short a distance; if they do not perfectly meet, rub them out inside a little with a rat-tail file, used all round, equally, so as not to alter their position. Now take a $\frac{5}{32}$ in. drill, and put it straight through the holes from one side: $\frac{5}{32}$ in. is the tapping size for $\frac{3}{16}$ in., therefore it is the size to be used upon the cylinder-face. Choose any two of these holes, far apart, and drill and tap these first; they are already marked on the cylinder-face. Take their distance apart in the compasses, and try whether it corresponds with the distance apart of the corresponding holes in the valve-box. If it does, drill and tap them, keeping the tap very upright; screw in the long studs; enlarge the two corresponding holes in the valve-box to $\frac{3}{16}$ in. full; and put it on over these two studs. Leaving the cover for the present, screw on two nuts, and so fix the valve-box firmly up to the cylinder-face. Now take the cylinder as it is to the lathe, pass the $\frac{5}{32}$ in. drill through the six remaining holes, and drill into the cylinder-face; by this means the drill will be so guided that it will be, of necessity, both upright and in correct position. Take off valve-chest, enlarge the six $\frac{5}{32}$ in. holes to $\frac{3}{16}$ in., tap the six untapped holes in the cylinder-face, screw in the six remaining studs, and try on the valve-chest. You can easily bend the long studs a little if they are not perfectly upright, and the holes in the valve-box might be a trifle over $\frac{3}{16}$ in., say, $\frac{7}{32}$ in., allowing $\frac{1}{32}$ in. for clearance, errors, etc. The holes in the cover may be drilled $\frac{5}{32}$ in. first, and then it should be tried on the valve-box, when it will be seen whether they all come opposite; if any of them appear to be to one side, correct them with a rat-tail file, and then bore them all $\frac{7}{32}$ in., when it will go on. Mark the cover and the valve-box with the centre-punch, so that you may put the parts together always the same way. Now take all apart, except the studs, and slightly countersink the holes on both sides of the valve-box and cover, so

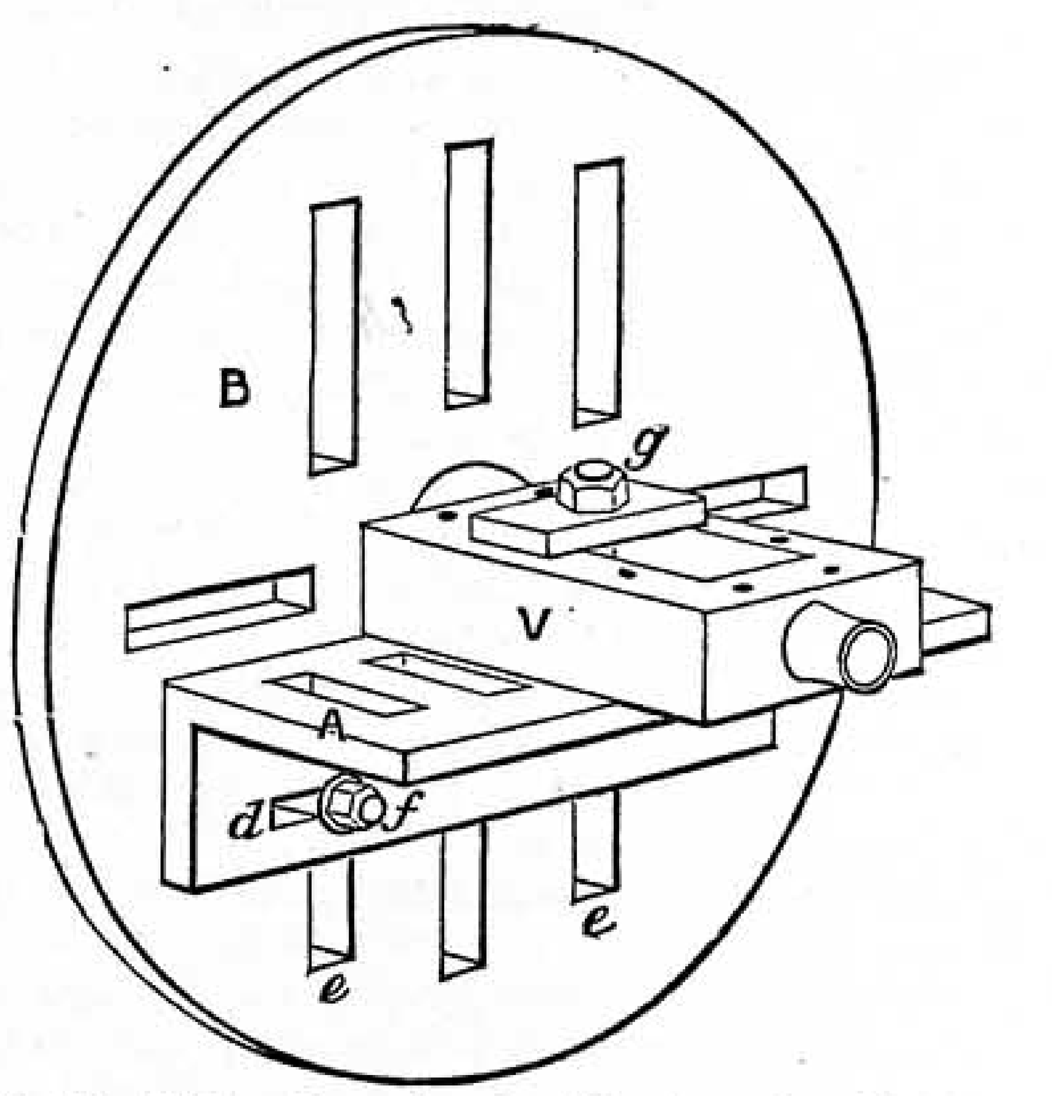


Fig. 37.—Valve-Box chucked for turning Stuffing-Box.

as to remove any rough edge that may have been raised up by the drilling, trying them on the surface-plate again to make sure the surfaces are still true. We will now turn our attention to the stuffing-box, which requires to be turned. To chuck this we shall require an angle-plate. An angle-plate is probably not often used by amateurs, but it is a very useful thing, and we shall want it again before we have done; it may cost to buy from five to six shillings, and is well worth the money. Fig. 37 shows how the valve-box, V, would be chucked upon the angle-plate, A; B is the face-plate, with its slots arranged rather differently to those in Fig. 36 (page 261); the parallel slots, *e*, *e*, are useful in connection with the long slot, *d*, in the angle-plate; two bolts, one of which is seen at *f*, pass through these slots, and thus the angle-plate can be moved in any position, up or down, by means of *e*, *e*, and sideways by means of *d*; this could not be managed by the radial slots shown at Fig. 36. The valve-box is secured upon the angle-plate by the bolt and oblong washer, *g*; and then the stuffing-box would be centred by moving the angle-plate on the face-plate, and fixed by *f* and its fellow, which is hidden. The two surfaces of the angle-plate must be strictly at right angles, and then the work done by its means will be true. The valve-box being fixed so that the stuffing-box is properly centred, $\frac{5}{8}$ in. from the inner face and $\frac{1}{2}$ in. from the other, start a $\frac{3}{16}$ in. drill very truly, and send it straight through the boss, to make a hole for the valve-rod; enlarge this with a $\frac{3}{8}$ in. drill for the gland to within $\frac{3}{16}$ in. of passing through; true out the hole with a slide-rest tool, and enlarge to $\frac{7}{16}$ in. Then screw it with the screwing lathe, or, failing that, use a gas-thread tap for "brass gas," $\frac{1}{2}$ in. diameter, and twenty-six threads to the inch: twenty threads would have been better, but twenty-six will do. The outside of the stuffing-box should be turned, and then the valve-box is finished.

Slide-Valve and Rod.—Take in hand next the casting of the slide-valve; file and scrape up the flat face, and then file the side edges square with the face, and parallel to each other, making the valve $1\frac{1}{2}$ in. wide, so that it will fit between the sides of the valve-box, as seen in Fig. 7. Now take the square and scriber, and draw four lines squarely across the face, and file to these, so as to make the flat edges $\frac{1}{2}$ in. wide, and the hollow space $1\frac{1}{8}$ in. wide, as shown in Fig. 5. The valve-rod is shown at Figs. 5 and 23; it might be turned down from a piece of round steel bar $\frac{9}{16}$ in. in diameter and $5\frac{1}{2}$ in. long. A piece of malleable cast iron is provided to make this rod. It must be turned down to $\frac{3}{16}$ in. and draw-filed, like the piston-rod, to prevent its wearing out the packing in its stuffing-box. A backstay will be required to support the rod against the lathe tool; a $\frac{3}{16}$ in. thread will be cut on the end of the rod for $2\frac{1}{4}$ in., and the four little nuts, for which castings are provided, would be chucked in a three-jaw chuck, which will hold them true by alternate sides. Then each nut would be drilled and partly tapped; then chucked on the tap while they are turned true (the tap being used as a mandrel) between the centres of the lathe. File the sides of the valve-rod joint flat, leaving a thickness of $\frac{1}{4}$ in. between two parallel planes, and bore a $\frac{1}{4}$ in. hole through for the pin, which hole must be strictly at right angles with the rod. The nuts upon the rod hold the valve between them—they are of brass, because otherwise they might rust fast to the rod; and they are in pairs, because then they can be locked together, turning one nut hard against its fellow, so as to prevent their working loose; besides, they enable us to adjust the position of the valve upon the rod, as we shall see further on.

Screws for Cylinder Covers.—At this stage, it may be well to fit the screws into the covers of the cylinder, and so complete that part of the engine. The screw-holes have already been bored in the two covers, six thoroughfare holes in each, $\frac{3}{16}$ in. full, to pass the six $\frac{3}{16}$ in. screws; place the bottom cover in position on the cylinder, taking care to put the two holes which are furthest apart opposite the port side; pass the scriber point through the holes in the flange of the cover, and mark their position on the flange of the cylinder. Drill these with a $\frac{5}{32}$ in. drill, and tap them with a $\frac{3}{16}$ in. thread. Make six screws of steel, $\frac{3}{16}$ in. diameter and $\frac{1}{2}$ in. long in the body, to secure this cover, and it would be well to harden their heads; make six more, $\frac{7}{8}$ in. long, for the top cover, since these have to go through three thicknesses of metal into the bed-plate. It is tedious, but very good practice, to file up the heads of these screws. The spanner would be made first to act as a gauge, then two opposite sides of the hexagon would be filed, holding the body of the screw in an universal chuck in the lathe, filing a little off each side alternately till the spanners will just go on. The spanner, if correctly shaped, will show whether the sides are parallel; the four remaining sides are done by making the two consecutive ones of equal size, and trying as before with the spanner. The screws would be made of soft steel that will not harden of itself. Their heads would be heated in a blowpipe flame, then rolled in powdered prussiate of potash, again heated full red, and plunged in water, when they will have a hard skin without being brittle and liable to twist off. It is only the heads of the screws that require to be hardened, to prevent their being bruised by the spanner. It is not necessary to do it, but it is better, and they need not be cleaned up bright after the hardening, but only well oiled, as the blackened appearance looks well, and forms a contrast to the bright work. The bottom cover can now be put in. The top cover is secured in a different way, the screws going through the cylinder flange first, then through the cover, and finally screwing into the bed-plate. It is not quite orthodox to secure two joints with one set of screws, because one cannot be separated without the other, but it may do well enough on this occasion. Use the top cover, as before directed, to mark the screw-holes on the cylinder flange, but drill these holes $\frac{3}{16}$ in. full; and now we must lay aside the cylinder, and undertake the bed-plate

OUR GUIDE TO GOOD THINGS.

**** Patentees, manufacturers, and dealers generally are requested to send prospectuses, bills, etc., of their specialities in tools, machinery, and workshop appliances to the Editor of WORK for notice in "Our Guide to Good Things." It is desirable that specimens should be sent for examination and testing in all cases when this can be done without inconvenience. Specimens thus received will be returned at the earliest opportunity. It must be understood that everything which is noticed, is noticed on its merits only, and that, as it is in the power of anyone who has a useful article for sale to obtain mention of it in this department of WORK without charge, the notices given partake in no way of the nature of advertisements.*

51.—Merrick's "Express" Gas-Heated Soldering Iron.

I have received from Mr. W. H. Merrick, 2, Summerfield Crescent, Birmingham, a specimen of his newly-invented "Express" Gas-Heated Soldering Iron. The appliance is in three parts, namely—a wooden handle, through which runs a tube, terminating at the lower end in a brass stop-cock, the end of which is shaped to receive an indiarubber tube communicating with the nearest gas-burner, the other end being screw-cut to take the lower end of the second part, through which runs a continuation of the pipe carried through the handle. This pipe terminates in a nozzle which enters the interior of the bit, which is hollow and pierced with two holes, by means of which the gas is ignited. The bit, which may be of any required shape, and which forms the third part, is about $1\frac{1}{2}$ inches in diameter at its widest part, and assumes a four-sided pyramidal form at its furthest end. The other end fits into a cup surrounding the gas-pipe that runs through it, and is held in place by a small set-screw. A portion of the cup is cut away at the shoulder to admit the atmospheric air. From this description readers will be able to form some idea of the construction of the iron. The following are the advantages claimed by Mr. Merrick for his gas-heated soldering iron over all others now in use:—1. It is constructed on a very light and compact principle, and is so made (as I have already explained) that the burner is inside the copper bit, thus doing away altogether with the outside arrangement of burners. 2. There is no stove required, thus doing away with the unhealthy fumes which rise from the coke stove. 3. The iron is ready for use in a few minutes after the gas is lighted, a very small supply of which keeps it up to the required heat, thus doing away with the use of extra irons, and the overheating and burning of the face, by which the face of the iron is always maintained in working order and never wears out, and a great amount of time and labour is saved. 4. By removing the reducing socket and replacing it by an elbow and tube, hatchet, glaziers, or pointed bits can be used interchangeably to suit any class of work. The use of this iron, Mr. Merrick urges, will be attended with great advantage in large factories where irons are constantly in use. Extra bits of any shape are supplied, and a price-list giving price of iron and bits will be sent by the inventor to any applicant. In the directions for use, instructions are given to light the gas at the "round hole marked 1," and this I take to be the upper and smaller of the two holes in the bit, as I can detect no mark on the bit before me. "If a still greater heat is required, the set-screw must be eased and the copper bit drawn out. To alter shape, remove socket and replace by elbow and tube. When in use the iron must not be raised to a vertical position." I have had the iron tried by a practical man, who tested it under various conditions; but he says that he finds a quantity of gas escapes unconsumed, and that there is a tendency to light back.

52.—"The Teacher's Handbook of Slöjd."

This is a handsome and well-illustrated volume of 216 pages, published by Messrs. George Philip & Son, 32, Fleet Street, London, E.C., under the auspices of the Slöjd Association. Its full title is "The Teacher's Handbook of Slöjd, as practised and taught at Nääs, containing Explanations and Details of each Exercise." The original Swedish work was written by Otto Salomon, Director of the Nääs Seminarium, assisted by Carl Nordendahl and Alfred Johansson, and it has been translated and adapted for English teachers by Mary R. Walker, St. George's Training College, Edinburgh, and William Nelson, of the Manchester Schools for the Deaf and Dumb. It is somewhat costly, its price being 6s.; but as it is intended for teachers and is not a text-book for use in schools, this will not militate against its sale and circulation. The first chapter deals with introductory remarks, showing what Slöjd is and the nature of the instruction to be given to the children, with remarks on the workroom, the position of the body during work, and hints and rules for the guidance of the teacher. The second chapter is devoted to an explanation of the structure and composition of wood, and the nature and characteristics of wood of different kinds. In the third chapter, the various tools in use and the manner of using them is explained, and instructions are given respecting the grinding and sharpening of tools. The fourth chapter is devoted to an exposition of the various modes of jointing; and the fifth chapter, to the exercises. The book is furnished with a good index; and at the end is given a price-list of tools and requisites as used in Sweden, and as supplied by Messrs. Philip & Son, who have been appointed agents for the Union of Slöjd Teachers in England, and from whom all the necessary tools, benches, diagrams, etc., can be obtained. The illustrations throughout the work are good; but special notice must be taken of, and special praise awarded to, the eight full-page engravings setting forth various positions to be assumed by the worker when engaged on different kinds of work. Such illustrations are always most helpful and valuable in the extreme to amateurs. The benches used are those known here and in Germany as German benches. They have an additional screw or bench vice at the end of the bench, to the desirability and utility of which English professional workmen are beginning to be alive.

Those who have not yet seen a bench of this construction should endeavour to have a look at one. It is by no means a difficult matter to do so, for many, if not most, tool-dealers on a large scale import these benches from the continent in different sizes and supply them to their customers. The Editor.

SUGGESTIONS FOR WORKERS AND HINTS TO INVENTORS.

Conjuring Tricks.—Few people, not professionally interested in such matters, know how valuable is any really good invention in the way of conjuring tricks, optical stage illusions, etc. Large sums have been realised by the inventors of the Flying Birdcage, Pepper's Ghost, "Magneta," "Thauma," "She," and other clever illusions which teach the public how easily the eye can be deceived under certain circumstances. The inventor of a really new illusion may feel secure of a more certain and prompt reward than usually follows the production of a most meritorious patent in another direction.

Etching on Glass.—Amateurs often inquire whether there is any simple process for etching on glass, and it happens that both French and German journals have recently devoted some attention to the subject. The German process is to mix common salt, carbonate of soda, and ammonium fluoride in equal proportions, which is placed in a gutta-percha vessel containing fuming hydrofluoric acid and concentrated sulphuric acid. A small quantity of potassium fluoride and hydrochloric acid are then mixed in a leaden vessel, and a little of this mixture is added to the former, with a small quantity of sodium, silicate, and ammonia. The composition thus formed can be applied to the glass by damping it with an indiarubber pad, or it can, of course, be used as an ink. The French recipe is far more simple. Dissolve 0·14 oz. sulphate of potash with 0·72 oz. fluoride of soda in half a pint of water. To another half-pint add 0·28 oz. chloride of zinc and 1·30 oz. hydrochloric acid. Mix the two solutions, and apply with a brush or pin. In about an hour after application the drawing or writing should be sufficiently etched.

Knife and Spoon.—A combined knife and fork has already been devised, but a knife which can at the same time be used as a spoon is yet to be brought out. The combination is by no means so difficult as it may seem, and once manufactured, it would meet with a certain amount of patronage for picnics, eating-houses, etc.

An Insulating Material.—Just at the moment the principal want in manufacturing circles is a good insulating material, air- and water-proof, non-inflammable, perfectly supple, and not too dear. In spite of all reports to the contrary, such a material has not yet been artificially produced, while gutta-percha and indiarubber are becoming more scarce and dear every year. It is worth trying to discover, as a fortune would await the discoverer or inventor.

A Much-Needed Invention.—Readers given to devising new apparatus, will be glad of a hint as to a profitable direction in which to employ their ingenuity. About five months ago, Captain de Place, a French gentleman, exhibited an invention called the Sciseophone in London, which, he claimed, would enable engineers to discover whether a piece of welded or cast iron or steel was free from flaws. As such an apparatus would be invaluable, if reliable in its results, the announcement of the trial attracted considerable attention. Unfortunately, it by no means justified the high expectations raised as to its success, and the world is still waiting for a flaw-detector that will enable the engineering world to be on its guard against defective axles, tires, etc. etc. The problem is not an easy one to solve, but electricity will, in all probability, be the main aid to its solution. It is most desirable that nothing be left to the judgment of the experimenter. No two people, for instance, attach exactly the same value to sounds, while the success of the Sciseophone depended chiefly upon the distinction between sounds of greater or less pitch. The results, moreover, should be self-recording. Very likely the Sciseophone indicates the direction of future success, but, as hitherto exhibited, it leaves so much to be desired as to justify anybody possessed of sufficient patience and ingenuity in devoting a large amount of trouble to the subject.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

*** *In consequence of the great pressure upon the "Shop" columns of* WORK, *contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of WORK *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given. Answers cannot be given to questions which do not bear on subjects that fairly come within the scope of the Magazine.*

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Removing Oil Marks.—ANXIOUS.—Repeated applications of oxalic acid dissolved in hot water (1 oz. to one pint of water) should effectually remove these from white holly or any other wood. Benzoline spirit will answer the same purpose, but must be used with caution, by keeping it a reasonable distance from naked lights.—LIFEBOAT.

Phonograph.—G. H. (*Camberwell*).—An article is in the Editor's hands upon this subject. Fittings cannot be bought at present.—W. D.

Marine Engineer.—GRAFTON.—In reply to the question of our correspondent, under the "Merchant Shipping Act Amendment Act, 1862," the certificates of steamship engineers are of two descriptions: viz., certificates of competency and certificates of service; and of each description of certificate there are two grades: viz., first-class engineers and second-class engineers. There is also the honorary certificate of "extra first-class." A second-class engineer must be twenty-one years of age. He must have served an apprenticeship to an engineer for three years at least, and prove that during the period of his apprenticeship he has been employed in the making or repairing of engines; or if he has not served an apprenticeship, he must prove that for not less than three years he has been employed as a journeyman mechanic in some factory or workshop on the making or repairing of engines. In either case he must also have served one year at sea in the engine-room as an engineer on regular watch in the foreign, home, or coasting trade, or he must have served at least four years at sea in the engine-room as an engineer on regular watch in the foreign, home, or coasting trade. When the workshop service has been performed in a place where steam-engines are not made, and the class of work done is similar to that required in engine-making, the service may be accepted with an additional year in the engine-room—that is, three years' workshop service and two years in the engine-room, of which one year must have been at sea. The approval of the Board of Trade must be obtained in every such case before the authority to receive a certificate is issued by the examiner. Service in a capacity below that of fourth engineer cannot be accepted as qualifying for any class of certificate, unless the testimonials of the candidate explicitly certify that during such service he has been taking regular watch in the engine-room, and that the chief engineer or superintending engineer considers him properly qualified by that experience to act as chief engineer of a foreign-going steamer of 99 horse-power nominal. In any case, the applicant must prove that he has had responsible charge of the engines or boilers for at least twelve months of sea service, of which for not less than six months he must have been in charge of the propelling engines, and rated on the articles not lower than fourth engineer. Service in the capacity of fireman, stoker, donkeyman, greaser, winchman, labourer, engineer's steward, or any other capacity than that of engineer taking watch on engines and boilers for propelling, will not be accepted. It is of the highest importance, now that such high pressures and scientifically constructed engines are used at sea, that there should be duly qualified and high-class steady mechanics to be entrusted with the charge of them, and for this purpose the Act was passed; and all engineers in charge of steamships must hold a first- or second-class certificate—either of competency or service—under a severe penalty both on the engineer and the captain who ships him. These certificates are obtained by an examination by a Board of Trade engineer, who, at certain appointed times, holds his examinations at different ports in the kingdom, when each candidate has to answer a set of appointed questions, and give satisfactory proof of his fitness to receive the certificate he seeks. If he fails, he is turned back, and he may meantime strengthen himself for those points where he was found deficient, and try again. If our correspondent thinks he would be able to meet the conditions laid down in the Act, he might apply to a superintending engineer or manager of a steamship company or owner to give him a chance of an engine-room job afloat. If he does not know any, let him get into a shop—such as Blair's—make up his mind to stick to it, get a good reputation for sobriety, steadiness, regularity, and perseverance, and he will soon get a chance in helping to erect or put engines into a boat, and then he may soon be able to get afloat. Let him spend his leisure in learning all he can relating to marine engines and steam, its nature, mode of action, and all relating to the care and management of marine engines and boilers, and try to get on, and he need not fear but his exertions will be attended with success.—C. E.

Detective Camera.—F. R. H. (*Rochdale*).—A full reply to your questions would occupy several pages of WORK if it was to be of any practical value, and consequently out of the question to be replied to in these columns. Why not get some elementary work on photography, of which there are many published, and make yourself acquainted with the requirements of the art before attempting to make the apparatus to use in it? The knowledge of what you want will be of great assistance. We may suggest that Abney's "Modern Photography" is a very reliable work on the subject.—D.

Pump.—W. G. C. (*Sierra Leone*).—You can get such a double-action pump as you require of Hayward, Tyler & Co., 90, Whitecross Street, London; or of S. Owens & Co., Whitefriars Street, E.C., both makers of good repute. Write them, stating requirements, and ask for prices. You will find it cheaper to purchase one complete than to make portions yourself.—J.

Delicate Machinery Oil.—OILY.—Rangoon oil, mixed with a little paraffin, is about the best lubricant for gun locks, etc.—T. W.

Vapour Bath.—NEW READER.—To answer your query fully would occupy too much space in "Shop." It will, therefore, be treated as a short article, and appear as soon as space will permit.—ED.

Field of a Griscom Electro-Motor.—A. F. (*Clapham*).—I give an illustration of the field-magnets and pole-pieces of the Griscom electro-motor. The fields and pole-pieces form a closed ring of soft iron (as shown at Fig. 2). The semi-circular cores are wound with wire (as shown at Fig. 1) in such a manner as to form a south pole of one of the pole-pieces (P), and a north pole of the other. This is ensured by winding both in one direction. You will see that the armature is of the

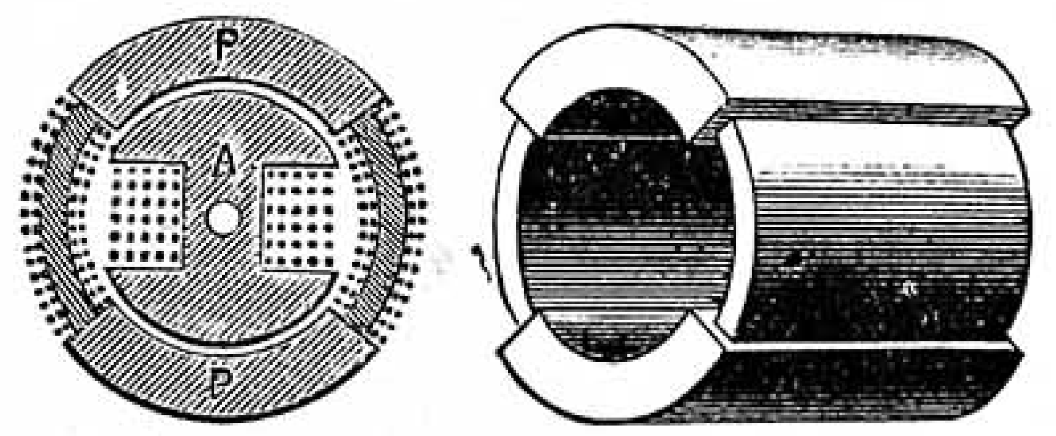


Fig. 1. Fig. 2.

Field of a Griscom Electro-Motor. Fig. 1.—Section through Field and Armature of a Griscom Electro-Motor—A, Armature; P, P, Pole-Pieces. Fig. 2.—Field of a Griscom Motor.

solid H girder form. The ring should be 3 in. in length by 3 in. in diameter. The armature should be 3 in. in length by 1½ in. in diameter. Wind the armature with 3 oz. of No. 20 silk-covered copper wire, and the wire spaces on the fields with about 1 lb. of No. 18 silk-covered copper wire. If properly made and fitted, this motor will drive a sewing-machine when worked with current from six gallon size bichromate cells.—G. E. B.

Moulding Plumbago.—T. J. (*Somerset*).—Mix the finely-powdered plumbago with sufficient fine, well-washed clay to bind the material together without impairing its colour and polishing properties. Or you may well grind together two-thirds plumbago and one-third part of fire-clay until the whole has been reduced to a fine powder: then mould this, whilst wetted, with a solution of silicate of soda, commonly named water-glass. This composition will set very hard when dry, and stand almost any high temperature. If you write to Mr. T. Fletcher, gas-stove manufacturer, Warrington, I think he can supply you with prepared fire-clay for the purpose.—G. E. B.

Composite Medical and Spark Coil.—A. K. (*Aberdeen*).—In reply to your letter and questions: (1) It is not advisable to construct a spark coil according to the sketch sent by you, because this shows a coil more suitable for medical than for spark purposes. The sliding secondary, the draw tube, the brass regulator, and the break, are all unsuitable to a spark coil. You would only get a ⅛ in. spark from this coil even when worked with three pint bichromate cells. (2 and 3) Observe the same proportions as to length and diameter of core—viz., 6 in. by ⅞ in.; make the bobbin ends as shown in your sketch; leave out all arrangements for sliding the secondary coil; and, for a brass regulating tube, place the regulating screw for the break at the back instead of in front of the break-spring; wind on two layers of No. 20 silk-covered copper wire, well coated with paraffin, for the primary, and 8 oz. of No. 40 selected silk-covered copper wire, well coated with paraffin, for the secondary wire. With a condenser of fifty sheets of tinfoil (2½ in. by 2 in.) beneath the coil, and a current from two pint bichromate cells, you should now get a ½ in. spark, providing, of course, all parts have been well made and fitted, and the wire properly wound. (4) The coil cannot be employed to furnish current for driving a small motor to revolve the vacuum tubes. The current for driving the motor may be taken from the same battery as that employed to work the coil, but must be conveyed to the motor by a separate line of wire. The induced current from the coil above described will light up small vacuum tubes, but will not furnish current to revolve the tubes. (5) Composite coils are rarely satisfactory productions. They are like composite tools—inferior to those made for a given purpose. The beneficial uses of medical or shocking coils in the hands of amateurs are very doubtful. One may just as reasonably give children an unlimited supply of whisky to play with, as to play at giving shocks from a coil.—G. E. B.

Moulding Compo.—SEPHTON.—Moulding composition is prepared from French chalk and China clay; three parts of the former to one part of the latter makes a useful mixture when thoroughly kneaded with water to the consistence of stiff putty; but when the mess and labour of mixing are taken into account, I consider it cheaper to buy than to make in small quantities. This compo. is intended for use as detailed in the articles of Rubber Stamp Making; but if preferred, the dry materials may be mixed with an equal bulk of the finest plaster of Paris, and a sufficient quantity mixed with water immediately before the forme is moulded.—QUI VIVE.

Rounding Wood in Lathe.—W. T. C. (*Derby*).—You will want a hollow mandrel with a chuck something like a pencil sharpener, except that the knife should not be arranged radially, as in the pencil sharpener, but the edge must slant somewhat spirally, so as not to tear up the fibres of the wood: only a slight obliquity will be sufficient to give a *slicing* cut. With this you can push in the squared wood, and have it come out round. The knife must, of course, be adjustable, and removable for sharpening.—F. A. M.

Soap.—BASSO PROFUNDO.—Very good soap can be made with olive-oil alone. The time during which the alkali will keep warm varies with the temperature of the surrounding air and the quantity of solution in question, but the solution may be re-warmed, if necessary, without injury. I have never observed any injurious result from the action of the caustic soda solution on either tinware or soldered joints.—HERBERT CLARK.

Type.—A. B. & Co. (*Belfast*).—Metal-bodied rubber types are imported by M. Lindner, 170, Fleet Street, London, E.C.—QUI VIVE.

Type.—A. J. H. (*Hulme*).—Is there not some error in your description of the transfer process to which you allude? The final result of the process as described by you would be a *reverse* impression identical in appearance with that of ordinary type viewed direct. Are the figures transferred to the *back* of a *transparent* dial?—QUI VIVE.

Clock Bracket.—F. H. M. (*Manchester*).—There is a design of a very pretty bracket for a clock in Vol. I. of WORK, which might meet with your taste. The index says, "Clock Case and Brackets," pages 241 and 264. If it does not suit you, however, place your query in our hands again. Refer to Indexes of Vols. I. and II. for brackets in fretwork, suitable for the same requirements. Have you examined all the fretwork designs in the available catalogues of the various firms advertised from time to time in this Magazine? If not, do so.—J. S.

Carpenter's Bench.—J. O. H. (*Wandsworth Common*).—Many allusions to carpenters' benches have been made in Vols. I. and II. of WORK. Refer to the Indexes. This subject is one which cannot be conveniently dealt with in the confined space of "Shop." Continue clamouring, ye carpenters, and if much demand is exhibited, rest assured our Editor will, as soon as possible, find a corner for the above article. I have retained your address privately, and if you will enclose the necessary stamps to the Editor, with query repeated, I will forward you the address of a professional bench maker who supplies "Curtain-Road" men. It would be out of place to print it here.—J. S.

Camera.—J. T. (*Rawtenstall*).—In the first volume of WORK will be found instructions and working drawings for making a camera according to the plan of George Hare, of 26, Calthorpe Street, London: a design that has been, more or less, adopted by many camera makers of repute as a convenient and thoroughly useful pattern, and up to the present time no better is in the market. Most of the material and brass work for constructing one may be purchased at H. Park's, 1, Orchard Buildings, Acton Street, Kingsland Road, London, N. With regard to coupons, we will give them our consideration. Any special form of apparatus sold by one firm only had better be procured for a pattern, as it is impossible for us to assist you in this matter and these columns otherwise than in a general way.—D.

Banjo.—BANJO SLOGGER.—If your banjo wants improving in tone, you will not be able to improve it by fixing a sounding-bell to it. There is a banjo made in London with a piece of metal across the inside of hoop very similar in appearance to a shallow dish, with a large hole in the centre. The edges of metal lay on the top edge of hoop underneath the vellum. I suppose it is a matter of taste, but to my mind this is not an improvement, as far as tone is concerned. Of course, the opinions of various individuals differ in regard to banjo matters as they do to various other things; we cannot all think alike. This banjo is patented, so you would not be able to make it. There is a banjo known as Dobson's bell model. The top edge of metal hoop is not spun over a wire, but is bent over in the shape of half a circle, about ⅜ in. in diameter, from which the banjo takes its name of bell model. The tone of this is very poor; instead of being an improvement it is just the opposite. Then there are banjos with metal backs to them, double rims, solid metal rims, and a host of other so-called improvements; but I have yet to see the *improved* banjo that will *equal* one with German silver hoop, edges of hoop spun over steel wires, the vellum put on properly, and everything about it being well made. There has been a great number of so-called improvements made in connection with the violin, but they soon die a natural death; and I think it will be so with the banjo: the double-spun-edge hoop will hold its own against all comers. You should look up your back numbers of WORK, and read my replies to correspondents. If your banjo can be improved, you will there find all the information you require. Please understand that I write this as my own individual opinion. I do not pretend to be infallible. If at any time I am wrong, I am always open to be corrected.—J. G. W.

Electric Light Materials.—NOVICE.—What power is driving your belt-wheel? Much will depend upon your reply to this question. Supposing you had a small machine with a driving pulley on it 1 in. in diameter. This, when driven from a wheel 1 ft. in diameter making 90 revolutions per minute, will only develop a speed of 1,080 revolutions per minute. As small electric light machines require to be driven at a speed of 3,000 revolutions per minute, you would not be able to drive the machine fast enough to get any light from it. It is possible to make a large machine to be driven at a very slow speed, but the cost would be something considerable.—G. E. B.

Water Motor.—M. G. H. (*Smethwick*).—Your 12 in. circular saw may be driven by your water motor in cutting soft wood up to 3 in. deep, and to greater advantage than if driven by hand. Any power that may be devised and maintained is far better than hand power, as it is impossible for a man to drive a circular saw by hand, even for a short time, near its standard speed. I cannot see that your suggestion in reference to pumping the waste water into the upper tank would be advisable. It will require all the power to drive the saw, and if the water was pumped up into the tank by the same motor while the saw is at work, the power required to drive the saw would be so diminished that it would be a failure. No power is so economical as water power. If you can so fix your motor as to have a regular stream of water equal to the power stated, you may drive your saw to advantage. As to a windmill to raise the water to the top tank, unless there is a certain pressure of wind it is impossible to raise the water; and should there be enough wind to drive the mill, it may stop at any moment, when the whole concern will come to a standstill: therefore I can say nothing in support of it.—A. R.

Engines.—A. T. (*Dublin*).—I replied to this question, or to one identical with it, some time since, saying that such engines could not be described properly except in a short series of articles.—J.

Workshop Agreement. — AN AMATEUR MECHANIC. — We do not undertake to answer legal questions.

Papier-Mâché.—GOOD IRON.—There are articles on Papier-Mâché in Vol. I., pp. 33, 87, 182, 265, 348, 387 (Nos. 3, 6, 12, 17, 22, 25); and in that and Vol. II. are also many answers on points connected with it in the "Shop" column.—S. W.

Photography.—J. M. (*Kilmarnock*).—(1) You can obtain the tools you require at many cutlers. Buck, of Tottenham Court Road, and Moseley, of New Oxford Street, supply them. (2) Coat the block with a mixture of twenty grains of chloride of ammonium, five grains of gelatine, and thirty grains of zinc oxide to one ounce of water. Let this be brushed equally over the surface, and dry. To sensitise it, brush over it a solution consisting of ninety grains of silver nitrate and five grains of citric acid in one ounce of water; dry, and print under a negative in the usual manner. Wash the surface with warm water, and fix with a solution of hyposulphite of soda, one part in four of water. Wash again, and dry carefully in a cool current of air, the block standing on its side. The application of moisture must be confined as much as possible to the surface, to avoid warping the wood. On no account attempt to dry by artificial heat, as over a stove or before a fire. The block must be allowed to dry spontaneously, as any curvature of the surface will totally unfit it for printing purposes.—D.

Steamboat.—O. M. (*Barrow-in-Furness*).—I presume you want to make a copper hull for your model steamboat, but imagining, from the tone of your letter, that you know very little about sheet-metal working, I should advise you, if you want a nice job made of it, to place the order in the hands of a competent coppersmith. I can recommend Stevens & Son, Whitecross Place, Wilson Street, Finsbury Pavement, London, who have given me the greatest satisfaction in sheet copper work, and at a very reasonable figure. Instructions for doing this are somewhat difficult to put on paper, but after cutting your plates roughly to size, they will have to be shaped by hammering on a suitable "stake," using a hammer with a slightly rounded fall. This causes the copper to expand at the point struck, and thus by judicious hammering on either side, according to shape required, the plates can be given the necessary curvature. Half an hour's practical illustration will do more good than a whole page of written instructions. You will want a deal of practice before you will be able to turn out a good job; but before you commence in earnest, practise on a few waste pieces. You will also do well to look up "Hints on Hollow Work in Sheet Metal" on page 282, No. 18, Vol. I. There were also, I believe, some articles on Sheet Metal Working in Vol. II., but as I have not my copy by me at present, I cannot give you the Nos. of the parts containing them.—H. E.

Wood Engraving.—T. M. (*Kilmarnock, N.B.*).—A wood engraver in London capable of producing work similar to that of the proof sent by T. M. would command about 10d. per hour. Of course, the time he mentions—seventy-five hours—would be considered extreme, as division of labour is carried out to great advantage here. We should not think of employing one man only to carry out the three operations of photographing, drawing, and engraving. A professional would take the original photograph: that would be passed on to a photographer on wood; a mechanical draughtsman would do the necessary working-up of same before it was passed on to the machine-ruler, who would engrave all tints and cylinders, leaving the engraver to "back up" tints and finish up all details.—T. P. C.

Ebony Stain.—A. C. (*Leicester*).—If only a small quantity is required, it will be better to buy the French black stain, as sold at most places where veneers are sold, at about 1s. per pint—sufficient to stain about eight square yards. I have had some very good from Kingston, Veneer Merchant, Pershore Street, Birmingham; but as the question is frequently asked how to make these stains, I append a few recipes, a glance at the composition of which will show you what is meant by saying it is cheaper to buy small quantities ready-made; besides, in the majority of recipes two distinct operations are required, using different substances, whereas in the French stain one application will give a satisfactory result; subsequent coats will increase the intensity of the blackness. You only ask for a dull black stain. I presume you can polish; if not, my advice is, don't take your first lessons on black work, or you may finish up by saying it's a failure. If, on the other hand, you have a fair insight into the art of polishing, it may be well to remind you to use a little vegetable or common black mixed with your "filling in," and a little ivory drop black, or Frankfort black, mixed in your polish, which latter should be what is called white or transparent: not the brown, as made from common shellac. Ebony stains:—(1) 2 oz. logwood chips, 1½ oz. copperas, one quart of water. Apply hot, giving several applications; then one or more coats of vinegar in which has been steeped 2 oz. steel filings to the half-pint of vinegar. (2) one gallon vinegar, 2 lbs. extract of logwood, ½ lb. green copperas, ¼ lb. China blue, 2 oz. nut-galls; boil in an open pot till dissolved, then add half-pint of iron solution, made by steel filings and vinegar, as in No. 1. (3) 14 oz. gall apple, 3½ oz. logwood extract, 2 oz. vitriol, 2 oz. verdigris, one gallon water, half-pint iron solution. (4) ½ lb. of logwood, three quarts of water, one handful of walnut peelings; boil for about three hours, then add one pint of boiling vinegar. Give several applications of this, allowing each coat to nearly dry before the next is applied; then give one or more coats of copperas solution—half-pint of copperas dissolved in one pint of water. It will be noticed that for the iron solutions steel filings are advised. Should any difficulty be experienced in getting these, old rusty nails—a handful to the pint of vinegar—will do.—LIFEBOAT.

Combe Down Stone.—E. L. (*Bath*).—I am obliged by your note referring to the omission of the mention of Combe Down Stone in the list of Bath stones in my article on Masons' Work on page 99. When I wrote the article I was quite aware of the name and qualities of the stone; but from information I had received some years ago, I was under the impression that very little, if any, of this stone could now be produced; and although I made inquiries, I could not hear of any firm which supplied it, and therefore omitted mentioning it. I am now, however, informed that it is supplied by Mr. Edwin Love, Odd Down, Bath. I have also been informed that there is another stone, named Monk's Park (not named by me), which is of similar quality to Corsham Down, and also that Bath stones are supplied by other firms than those named.—MUNIO.

Materials for Painting on Pottery.—NOVICE will, doubtless, be able to get what he wants by post from Brodie & Middleton, Long Acre, London, W.C.; or probably from Lechertier, Barbe & Co., Regent Quadrant, London, W.C.—S. W.

Calcined Bones.—RAYNOR.—The required article is, we believe, used in china-making, and could doubtless be got at china works; but surely, as so small a quantity is needed, it might more readily be made at home. There can be no difficulty in burning a few bones in the grate, pounding, and sifting through a piece of muslin to ensure the required fineness.—M. M.

Oil Canvas.—J. M. (*Grangetown*).—It would be much better to buy the canvas prepared, as you never would be able to prepare it so well. It is not expensive, as you can buy a canvas already fixed on stretcher for use—15 in. by 12 in.—for a shilling. However, should you not be able to get it, and so have to prepare it, you must get some white-lead, make it up with boiled linseed oil and a little patent driers, and cover the canvas evenly over, and as thick as possible. Let the colour be as round as you can get it on. Let it thoroughly dry, then paper it smoothly. Give it another coat of colour, with a little thinning of turps in it, and stain it with a little umber, making it a very pale stone colour—it is better to work on than white.—W. C.

Saws and Lathes.—A. C. (*No Address*).—By the time this meets your gaze, information in reference to saw hammering, fully answering your question, should appear in WORK. Lathes for the work you mention may be had from Thomas Robinson & Co., Rochdale, and from A. Ransome & Co., Chelsea, or from almost any maker of wood-working machinery. There is an automatic lathe made by an Ohio Company, for whom J. Sagar & Co., Halifax, England, are agents. This machine, I hear, will turn out 1,000 spokes per day. But as you want a cheap machine, I am afraid these will be too expensive for you; but you will find all cheap machines dear in the long run. I saw recently a rough-made copying lathe made by a maker of Exeter, whose address I have not to hand; price £15. It must be understood that the work when taken from these machines is not ready for painting; a buffing machine is required to remove the ridges caused by the cutters. The machine consists of two endless belts (or even one will do), covered with ground glass, which run at a very high speed over pulleys. The article, after being turned, is pressed tightly on the belt by hand, and the ridges left by the cutters removed. A machine with two belts will clean up from fifty to sixty spokes per minute. The first-named makers make a machine called the "Wheelwright," which will plane boards up to 13 in., and will square and joint scantlings up to 12 in. by 9 in.; also face up felloes; it will plane shafts and poles to any template; will mortise naves up to 14 in.; cut grooves from ⅛ in. to 1½ in.; tang spokes of wheels up to 6 ft. diameter after driven in stock; mould, bead, and rebate, and bore holes up to 6 in. deep up to 2½ in. diameter. It is claimed to do the work of at least twenty men.—A. R.

Soap Making.—S. (*Derbyshire*).—The water used for dissolving the alkali need not be boiled. Clean cold water is all that is required, but this will become very hot as the alkali dissolves.—HERBERT CLARK.

Soap.—BARBER.—I exceedingly regret that I am unable to give a satisfactory reply to your query as to shaving soap. Whether or not a lather made from the soap described in my article on Domestic Soap Making would "creep" I am unable to say, but I can safely assert that it will not irritate the skin if properly made according to my directions. A small proportion—say, one-eighth—of pearlash to the alkali would make the soap lather better, but I do not know whether or not the soap so formed would be too irritating for your use.—HERBERT CLARK.

Meaning of Voltage and E.M.F.—OBLONG.—E.M.F. are the three letters commencing the three words Electro-Motive Force, and are used instead of these three words to save time and space. This term means the pushing force or pressure of an electric current as expressed in *volts*, and this leads to the use of the other term "voltage," which is sometimes employed instead of the three letters E.M.F.—G. E. B.

Keeping Rubber Soft.—J. G. (*Rochdale*).—I know of no reliable means whereby rubber may be kept soft, as the softness depends very much on its purity and amount of exposure to atmospheric influences. Even pure rubber hardens on exposure to the air for some time, especially in cold weather, and much of the so-called rubber becomes quite brittle under such circumstances. The better descriptions of rubber, whether raw or vulcanised, may be considerably softened by being well kneaded at a temperature of eighty or ninety degrees Fahrenheit. Rubber articles retain their softness and pliability best when kept in use; and when out of use, preserved as much as possible from exposure to the air.—QUI VIVE.

Soldering Jewellery.—T. N. (*Halifax*).—This gentleman must dismiss from his mind all previous ideas that soldering means the use of lead or pewter solders. Soldering, when spoken of by jewellers or silversmiths, means the melting by heat of an alloy of gold or silver, such alloy being specially prepared for different qualities of gold or silver, and in many cases from the gold actually being used to make the article. The principle that governs the making of the solder is that the better the quality of the gold or silver the greater the heat that is required to melt it; and conversely, the lower the quality the easier it is to melt. For example, a writer gives the melting point of 18 carat gold at 1995 Fahrenheit, of 15 carat at 1992, and 9 carat, 1979, while easy silver solder melts at about 1802 Fahrenheit. This, I think, makes clear that, although one could use 9 or 15 carat gold to solder 18 carat, it is not possible to use 18 carat to solder 15 carat. The same principle applies to silver and brass: and the quality of the solder has to be known before any attempt should be made to carry out the actual soldering of an article. Another important matter to bear in mind is that thin gold articles, like brooches, will not bear so hard a solder as the same quality of gold will do when made up solid, as in the case of a bangle ring. Solder for 18 carat and 15 carat: take 1 dwt. of the gold, and add 2 grs. fine silver and 1 gr. fine copper; melt well together, and flat to size 6 or 7 Shakespeare gauge. For 12 carat, the addition of 3 grs. fine silver and 1 of fine copper to the dwt. is advisable; while for 9 carat the most useful solder is made from 1 part fine gold, 1 part fine copper, and 2 parts fine silver. For silver, a hard solder can be made by adding to 5 dwt. fine silver, 1 dwt. 8 grs. fine copper and 8 grs. of spelter; or else to the 5 dwt. of silver, add 1 dwt. 16 grs. of good quality brass wire or pins. These and the next alloy have a volatile metal—viz., zinc—and must have the silver melted first before the brass is put in, plenty of borax being used all through the operation. For easy silver solder, take 10 dwt. fine silver and 5 dwt. brass wire or pins, and melt and flat to size 6 or 7. For solder easier still, use spelter in place of brass wire. All these solders can be bought at any refiner's or jewellers' material shops, of which there are plenty in Birmingham and London. Once the proper solder is obtained, it is easy to do the actual soldering of plain, solid articles. All that is required is that the parts to be joined are held firmly in contact, iron wire being the usual means. These contact surfaces are scraped perfectly clean, all burr being removed as well. Next charge the join with a paste made from lump borax rubbed up with water on a piece of clean slate. This paste is used of a milk-like consistency for gold solders, but for silver soldering it should be quite as thick as cream. Next charge the seam with pallions of solder, and blow a jet of flame from gas or spirit on to it until the solder runs. The heat should be applied gently at first, for the borax will swell up, and is likely to move the pallions of solder away from the places they are meant to remain in until flushed. Pallions of solder is a name given to the square or oblong pieces produced by cutting a piece of flat solder into a row of parallel teeth, then by cutting again direct across these; their size being larger or smaller, according to the work in hand. Better that three or four small pieces be put on the work than one large one. The solder should be scraped before being cut, for on the perfect cleanliness of all the details the success of the soldering will now depend—that is, if the heat is correctly applied. And one fact to remember is that solder will run towards the place where the greatest heat is. I hardly know where to leave off, for soldering—a very simple process in itself—becomes a most difficult art to practise with success in the numerous and varied conditions of jewellery making and repairing. This, however, it will be well to bear in mind: no lead or pewter must be in work that is to be hard-soldered, else the portion covered by it will be destroyed. Look up in Vol. I., No. 14, p. 220; No. 19, p. 301; No. 38, p. 588; No. 46, p. 732; and in Vol. II., No. 76, p. 388; No. 104, p. 828, for replies bearing on soldering and jewellery repairing.—H. S. G.

Brazing.—A. E. (*Blackburn*).—You would have done well to have specified the particular kind of work or material that you wish to braze. The information then would be more likely to be of service to you; as it is, I can only answer you in a general way. Brazing is a method of uniting metals with a material called spelter, also called hard solder, to distinguish it from soft or tinman's solder. Requiring, as it does, a far greater degree of heat to melt it, the ordinary means used for soldering are of no use in this case. We must, therefore, look for some means whereby a great heat can conveniently and quickly be applied to the work. These means are found in the forge, the aëro-hydrogen blowpipe, and the self-acting blowpipe. The first named you are, no doubt, familiar with; the second is a means of producing a very powerful heat by means of ordinary hydrogen or coal-gas mixed with air under pressure. If you will write to Messrs. T. Fletcher & Co., gas engineers, Thynne Street, Warrington, for a list of their gas appliances for the workshop and laboratory, you will there find several of these blowpipes illustrated and explained. The third has been fully described in various Nos. of WORK (consult Index to Vol. I.), and need not be enlarged upon again here; suffice it to say that they are only suitable for small work, such as key-brazing, etc. The mode of preparing the work is varied, but in this, as in all other ways of uniting metal, the parts must be clean and free from grease. They must also be well fitted. Say, for example, you wish to braze a bicycle neck into the backbone. It is of the greatest importance to get a good fit. I remember a querist asking how much room he should leave for the spelter to run in. If any such thought as that is in your mind, I say none at all. Fit them together as neatly, as closely, and as firmly as if there were nothing else to be done to it. Next make a strong clear fire of small coke, and while the boy is blowing this clear, powder up some borax. Take a teaspoonful of this, and mix with a teaspoonful of spelter, and make it into a paste with a little water. You will also require, to put this paste on to the work, a small tool called a spatula; it is simply a piece of ¼ in. rod flattened out about the size and shape of a small mustard-spoon, and about 18 in. long. Having got the fire perfectly clear and free from smoke, place the work upon it for half a minute to get warm; then with the spatula pack round it some of the paste of spelter and borax; have close at hand some powdered borax without spelter. Now replace the work on the fire, and blow steadily, gradually increasing the pressure. At first the mixture will rise off the work as the heat is applied; it must then be pressed down with the spatula. This must always be dipped in cold water every time it is applied to the work, or it will drag the spelter off. As the heat increases, sprinkle some powdered borax on the work as it commences to run, add more spelter, and rub round with the spatula, keeping up a gentle blast till you see that the metal has run well in all round. Remove gently from the fire, and stand it by to cool gradually. I have not space to go into particulars as to brazing copper and brass, except to say that greater care is required, and spelter of a quicker fusibility than is required for iron. If you require more information, write again; we are always willing to help you.—R. A.

Wiped Joint.—BLOWPIPE.—A wiped joint is prepared in the same way as for a blowpipe or copper bit joint, as far as fitting and cleaning are concerned, but after that it is very different. (See Fig. 1, which represents two pipes fitted together.) The parts shaded are coated with a composition of lampblack and weak glue water, and a little stale beer or a little sugar. This is called "soil" or "smudge," and its object is to prevent the melted solder from adhering to the pipe where not required. The parts from A to B are scraped clean and rubbed with "touch" (tallow): the metal is then applied to the joint, either by splashing it on from a ladle with a splash stick, or by pouring over it with a small ladle metal dipped out of the metal pot, or by using sticks of solder and a blowlamp such as the Paquelin, which is very useful indeed for these joints, as the iron can be dispensed with. The metal is then wiped round to the proper shape (shown by the dotted lines). To do this, proper wiping cloths

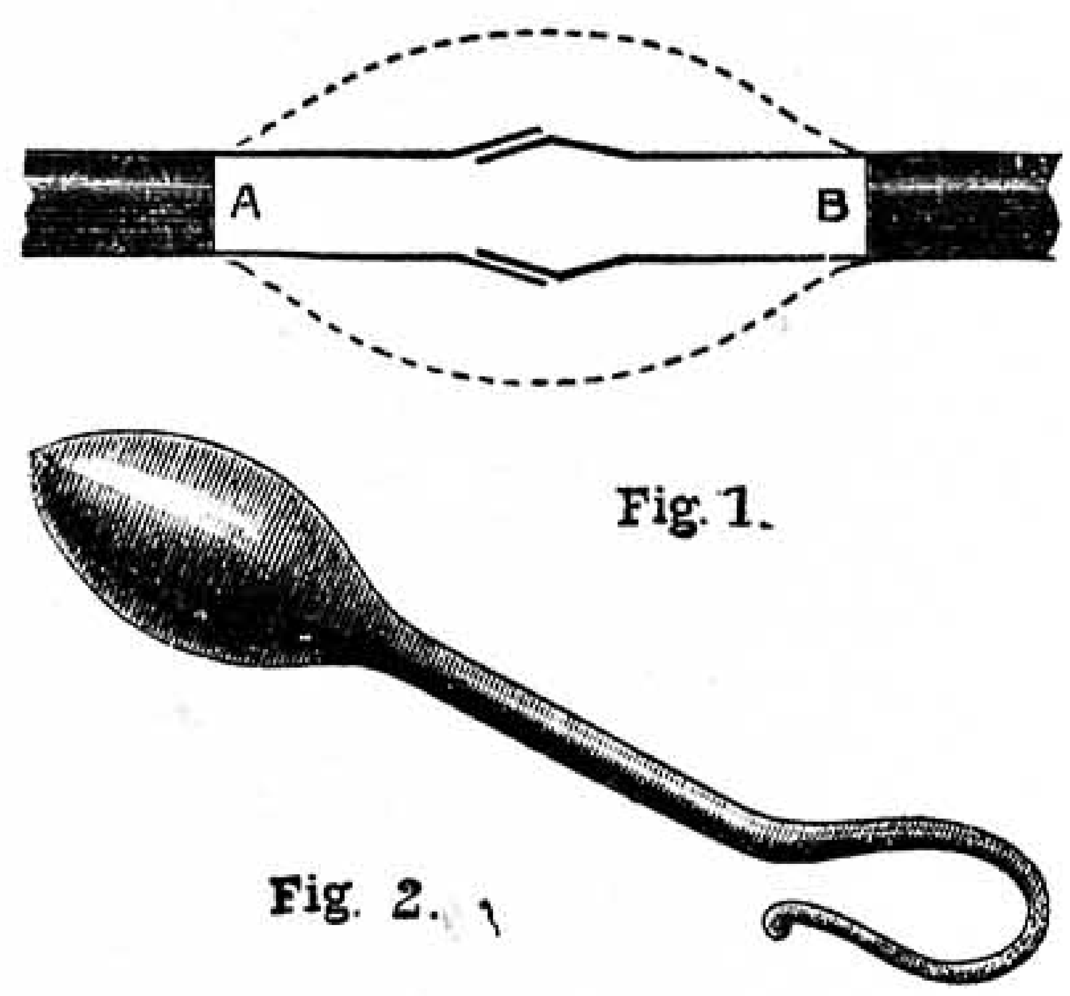
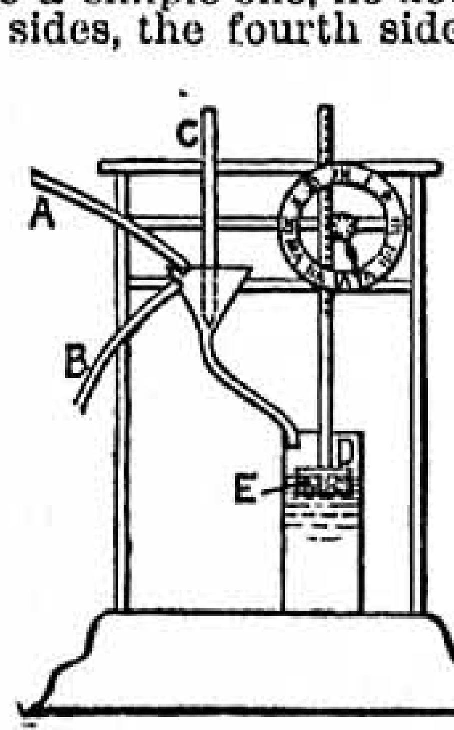


Fig. 1.—Plumbers' Joint. Fig. 2.—Iron.

must be used; they are made of several thicknesses of fustian or ticking stitched together, and should be well rubbed with tallow before using. Various sized cloths are required, from 2 in. square up to 5 or 6 in., according to the size of the work. The metal must be kept at just such a heat with either blowlamp or iron (Fig. 2) that is soft and plastic, but not liquid enough to run. Burnt fingers are usually the result of first attempts, but once the knack is attained it is easy enough—that is, simple joints such as you speak of. Proper plumbers' solder must be used.—R. A.

Sand Clock.—H. K. D. (*No Address*).—I have never seen a sand clock, and, I should think, it would be too bulky if you made one to go even thirty hours; but you could make a simple one, no doubt—say a tube of wood three sides, the fourth side of glass. Make a metal funnel with a small hole, and fix at the bottom, and have a box underneath to catch the sand. Fill your tube with dry sand, and having pasted a strip of paper outside on the glass, mark the hours, as the sand is falling, with your watch or clock. The tube could easily be fixed to the wall, and by experimenting you would be able to find the length and size of tube and hole in funnel at bottom, where it has nearly run out. Pick up the box and refill the tube; but I am afraid your tube would have to be large and long to get it to run even twelve hours without attention. You might use water instead of sand; let it drop in a glass vessel, with a paper with the hours pasted on its outside; or let it raise a float—say, a large cork with a wooden or metal upright fixed to it. On the upper part it can have teeth working in a wheel that shall have a hand fixed to it, and so revolve as the water rises, and show the hours. This is an old Egyptian style of clock, in use about 200 years B.C. This sketch may suit you; it explains itself.—A. B. C.



Sand Clock.—A, Feed Pipe for Water; B, Overflow; C, Conical Stopper to regulate Flow into the Cistern; D, Cistern; E, Float with Arm to work the Wheel carrying Hand.

Colouring House.—H. L. (*Higher Bebington*).—I am glad to find that your incubator promises so well, and hope you will derive great pleasure and profit from its use. With regard to colouring "the apiary," any colour can be obtained by first preparing a wash of whiting or lime as for ordinary whitewashing, and then mixing in colouring matter until the desired tint is obtained. For *pink*, use rose-pink; for *salmon*, Venetian red; for *lilac*, a little indigo and rose-pink; for *grey*, lampblack; for *French grey*, Prussian blue and lake; for *blue*, Prussian blue, indigo, or cobalt; for *green*, emerald green; for *buff*, yellow ochre; for *drab*, burnt or raw umber. To fix the colours, size should be used. I would advise you to mix a small quantity at first, and apply it to a patch of the back of the house. When it is dry, an estimate can be made of the effect. These colours usually dry lighter. I would advise you to get *Every Man his Own Mechanic*, which contains a world of useful information.—APIS.

Chemicals.—W. W. (*Chelsea*).—You can get the chemicals you require of Burgoyne, Burbidges & Co., 16, Coleman Street, E.C.; Townson and Mercer, Bishopsgate Street Within; or Orme & Co., 65, Barbican. The prices vary a little, but are about as follows:—Ferric oxalate, 1s. per oz.; ferric oxide, 8d. per lb.; ammonium oxalate, 3d. per oz.; hydrated peroxide of iron, 1s. per lb.; perchloride of iron, 9d. per lb.; protochloride of iron, 1s. 6d. per lb.; potassium ferrocyanide, common, 1s.: pure, 2s. 6d. per lb.; and potassium ferricyanide, common, 2s. 4d.: pure, 5s. per lb. These last two salts vary a good deal in price, different chemists charging differently according to which manufacturer they obtain it from. Oxide of iron is the same as ferric oxide, and chloride of iron as perchloride of iron. Ammonio-citrate of iron is *not* the same as peroxide of iron, it being a compound, consisting of ammonia, citric acid, and iron, whereas peroxide of iron consists of iron and oxygen. I do not know the price of it, but you can get it from the above firms.—F. B. C.

Penholder.—J. W. H. (*Chesterfield*).—The two samples sent are for an apparatus and arrangement to be applied to a particular purpose. Now, as the *second* consists of precisely identical parts, acting in an identically similar manner, and producing precisely similar effects, there is consequently no novelty in the *second* arrangement, for which any exclusive legal right could be obtained, nor which the law could support, as it would fail in not possessing the novelty required by law to make it a valid grant. If the *second* arrangement were manufactured and put on the market, the owner of the *first* could institute proceedings for infringement, and would, if the invention were novel, and his claims, title, and specification properly drawn, so that the law could support his right, be sure to win, with damages for the infringement of his exclusive rights by the *second* party. The use of the spring seems to be the only novelty, but to use the plan the *second* would have to obtain a licence from the *first*, always supposing that the first possesses a legal right to the invention.—C. E.

Thicknessing Gauge.—J. A. (*Peterhead*).—The gauge shown on page 85, No. 110 of WORK, is not on sale, but if you write me, through the Editor, I will make one for you.—B.

Violin Bass Bar.—B. F. E. (*Carlisle*).—To show you that the bar performs both functions, you need only string up to concert-pitch an otherwise properly constructed instrument, *minus the bass bar*. The pressure will cause the inner side of the bass sound-hole to become depressed below its normal position, and as this is not the case when the bar is in position, correct in size, etc., it is evident that it has a "mechanical" function: viz., to support the belly. The paucity of penetration and the decidedly nasal quality of tone will convince you that it has also an "acoustic" function. In both letters you state that you have formed a theory, after many years of study, as to the construction of the bar, and wish to know whether or not it is erroneous. How can I express an opinion without first knowing what your theory is? I imagine that a person who entertains a theory, and, putting the theory to a practical test, finds the result precisely that which he anticipated it would be, may fairly claim that the theory is correct. You say, in regard to the sound-post, that you found the best place for it, and left it there, but I do not gather from your letter that you worked out the *reason why* it was the best. Should you encounter any difficulty regarding the practical part of fiddle building, I will do my best to assist you; but I cannot undertake a correspondence the end of which cannot be foreseen respecting the theories of either one or another.—B.

Decanter Stains. — CONSTANT READER. — To remove old stains from decanters, several different articles may be used, such as egg-shells, shot, coke; but what perhaps answers better than anything else are small pieces of coal. Put some into the bottle, and shake well for some little time, when I think you will find it will be perfectly cleaned. What was used to dry the bottle in the case you mention I do not know; but if heat is too slow a process, methylated spirits of wine will almost immediately evaporate the moisture from anything. Whether you would care to use it in the case you mention, I must leave you to decide.—W. E. D., JR.

Slide Rule. — A. (*Preston*). — Slide rules are of several different kinds, and may be obtained at most mathematical instrument makers. We do not know who makes the rule our correspondent refers to, though we recollect some twenty-five years ago the person named having shown us some made in wood. Routledge's slide rule seems as good as any for ordinary all-round work; but we should advise our correspondent next time he is in Liverpool just to look in at the mathematical instrument makers, and see if he cannot find amongst the different kinds something approaching what he requires. He might also see what he can find at the engineers' tool makers either at Preston, Liverpool, or Manchester.—C. E.

Scrap Tin.—TIN.—Do you mean the cuttings such as are made by tinplate workers in the manufacture of goods, or do you really mean scrap tin, which I should understand to be scraps and oddments of the pure metal? If it is the latter, your possession of "some tons" of it is indeed a valuable one, as the price quoted for English ingot tin last month was £94 10s. per ton; and if you have several tons of this, it would be the best plan to send it to a metal merchant as it is. They could run it down cheaper than you could, and they would give you a fair price for it. Even if you went to the expense of running it into ingots, it is very doubtful whether you would find a sale for it at anything like tin price, as it would have no brand of guarantee upon it. All Cornish ingots have the mark of the Duchy of Cornwall on them—the lamb and flag. Now for the other case. If your treasure is only tin cuttings—that is, iron coated with tin—it is, comparatively speaking, of very little value, and you can soon calculate whether it will pay you to try and re-cover the tin. I estimate that you might get 2 lbs. of tin per cwt. of scrap. This would be 40 lbs. per ton; more likely less than more. The utmost value of this would be 35s., so that you might expect from four tons about £7. Deduct from this, say, 25s. for fuel, and take your time into account, and you will see that it is not a very profitable speculation, and that it would not be a very wise thing to buy bellows, or such like expensive appliances, to melt it down. I know it has been tried, but I think the only people who make it pay are the gipsies. They build up a big wood fire (which costs them nothing), throw a heap of cuttings and old kitchen utensils upon it, set it alight, and let the metal run on the ground, and when cold, dispose of it at the nearest marine store dealer's. If you treat your scrap in a similar way, it may pay you—that is, if your time is not of much value; but if it is, my advice is, have nothing to do with it.—R. A.

Camera.—A. W. (*Paisley*).—So far as we can make out by your post-card, there is nothing particularly new in the design; revolving backs have been some time in the market. You do not say what the intended improvement is to effect, or what mechanical movements are to be superseded. The diagrams are not sufficiently clear to enable us to form an opinion. Under any circumstances, we should hesitate to recommend taking out a patent.—D.

Back Parts of WORK.—A LOVER OF "WORK."—You can get any back monthly part or weekly number of WORK by ordering it through your bookseller or newsagent. Failing him, write to the publishers, Messrs. Cassell & Company, London, E.C.

Wardrobe.—DYKEHOUSE.—In No. 116 of WORK a writer deals briefly with wardrobes. You might gather sufficient instruction from his remarks serviceable to you. If you do not, however, a reference to Indexes of Vols. I. and II. will bring to your notice several details of wardrobes in "Shop" and elsewhere.—J. S.

Colouring Clays.—WORKITE.—The chalks are ordinary soft chalk. The depression made by a flat rose-cutter in a lathe, or a brace and bit, would answer. The cubing of the chalk may be done at a table with a circular saw or band-saw, a gauge, and two sides of a square; determine the cuts. Your experience of clays must show you how different clay is from chalk in its action under the effect of mixing with water, etc.—one, when dry, becomes hard and stony, the other remains soft still. There is no clay, such as pipe-clay, or very little, used in crayon making; the less the better. For black crayons, proceed as follows:—Take yellow wax, 32 oz.; curd soap, 24 oz.; washing soda, 1 oz. dissolved in water; Paris black, 7 oz. Mix gradually, adding to the heated mass as it burns the soda, and the black is stirred into it by degrees. Crayon making is a fine craft; many of the metals are blended with the chalk or calcium carbonate, as also, with some pipe-clays and china clays, gypsum, talc magnesium, bismuth, etc. The alcoholic solution of shellac, liquid gum, or turpentine are used for mixing. The best black for crayons is made from camphor into black; ivory black is also used. In working earths, chalk, or clays for crayons, reduce them to fine powder by triturating in water, and decant the liquor into a vessel for evaporating the water from the substances held in suspension. This is collected, and mixed with weak gum or other adhesive liquid into a stiff paste. It is then forced through dies, just as drain-pipes are made, on to an endless belt, a wire being used to cut them into lengths at the face of the die. For mixing to make coloured clays, use any coloured earths suitable, as umber, ochre, chalk, sienna, raw and burnt. For other colours use lakes. This is the name for almost every colour having chalk for its base—blue, green, yellow, purple, rose-pink, etc. These can be bought cheaper than they can be made, unless you have whiting, etc., to hand of which to make lake colours by staining them. I can meet with no clay-mixing books. Writers are so intent upon displaying their theoretical intelligence in chemical jargon that they omit the word clay from their writing about it. It is not in the "Encyclopædia Britannica," and the learned dunce constantly shows through the veneer of pseudo-scientific terms. A good English work on "Colours and Dyewares" is by J. W. Salter (Crosby Lockwood & Co., 7, Stationers' Hall Court, E.C.). Another, "The Dyer and Colour-Makers' Companion," by H. Carey Baird & Co. (810, Walnut Street, Philadelphia, U.S.A.); both low-priced works, I should think.—J. C. K.

"Safety" Gear.—J. P. A. (*Walthamstow*).—The gear of the Safety at present is 67½ in.—much too high for practical use. With ten teeth on the hub, the gear would be reduced to 54 in. The simplest method of lowering the gear would be to key on a lower chain wheel on the pedal shaft, say, fifteen teeth, which would gear with the present hub down to 56¼ in., or a chain wheel of fourteen teeth, which would gear down to 52½ in. To alter the hub cog-wheel would require a repairer, and a cog-wheel might not be got that would fit, in which case one would have to be made for it. Chain wheels can be had, any number of teeth, from 1s. 6d. to 2s., of the St. George's Cycle Co., Islington, London; or Brown Bros., 7, Great Eastern Street, London. There is no really practical arrangement for gearing while going.—A. S. P.

Re-touching Medium.—G.B. (*Edinburgh*).—An excellent re-touching medium is thus made:—Take 120 grains of gum dammar, and dissolve it in one ounce and a half of benzole, then add half an ounce of turpentine. When it begins to get thick by reason of evaporation, it may be thinned down by adding a little benzole and turpentine in the same proportions. There is seldom any necessity for filtering if the dammar is good. It may be broken up into a rough powder, put in a bottle, and the solvent poured over it.—D.

Cleaning Silver Plate.—F. W. J. (*Fulham*).—All silver is liable to discoloration on exposure to the smoke, fog, and gas-charged atmosphere of London. Pure silver is more liable to tarnish than alloyed silver. Electro-plated goods, being coated with pure silver, are more difficult to keep clean than goods made of sterling silver, but I do not know of any kind of plating which will resist the bad effects of an impure moist atmosphere. Silver-plated articles in show-cases in shops where gas is burnt soon go off colour, and show a number of dark specks where the gas-charged damp air has condensed on the cold metal. Wash the tarnished silver in soapy water, containing hartshorn, carbonate of ammonia, or liquid ammonia, then dry with soft linen rags. Brush engraved parts with a soft brush whilst in the liquor. This will clean tarnished plate with less wear than the use of plate-powder. Electro-plated articles dipped in kristaline will keep their colour for a longer time than those not coated with this preservative varnish. See "Our Guide to Good Things" on p. 202, Vol. III., of WORK.—G. E. B.

III.—QUESTIONS SUBMITTED TO CORRESPONDENTS.

Printing on Tin.—CURIOUS will be glad to know the process or preparations used.

Silk Weaving.—CURIOUS writes:—"How are silk-woven mantle or coat hangers made—*i.e.*, by what process and out of what material? And what is the name of the material used for 'stamped hat tips'?"

Paper Wheels.—W. H. K. (*Accrington*) writes:—"Can any reader give me information about the process of making boards and railway-carriage wheels, etc., from paper, or where I could get the information?"

Fret Machine.—LANCASHIRE writes:—"In WORK, No. 58, Vol. II., page 91, NORTH JACK has sent drawings for a fret machine. I am making one, but don't understand how the saw frame is fastened at the back of machine so as to work. Will NORTH JACK kindly tell how it is done? I want as perpendicular stroke as possible."

Mining Engineering.—S. H. M. (*Liverpool*) writes:—"Will anyone kindly send me all particulars of the profession of mining engineering? What is the course for it? what age does one enter? and what is the length of its course? Can certain kinds of mines be taken up *exclusively*? What number of examinations are there, and what are the colleges for it—at home or abroad? and any other particulars about it."

Electric Gas-Lights.—STRIKALITE will be grateful for instructions how to make an electric gas-lighter worked by frictional electricity; a diagram showing connections and dimensions will be useful. Also where the necessary clock-work may be obtained.

Rifle Rack.—A. S. (*London, S.E.*) writes:—"Will any kind reader of WORK give me a few hints as to making a rifle rack, to take eight rifles, to fix to the pole of a bell tent, the same as one sees at Aldershot Camp in August?"—[A Gun Rack was given on page 60, No. 108. Why not convert it for your purpose?—ED.]

Gold Blocking (Cards).—CURIOUS asks:—"Is there any process (dry) whereby the gold can be made to adhere to the card until blocked, same as in the case of books? But the process must be such as won't soil the card; glair would not do."

V.—BRIEF ACKNOWLEDGMENTS.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—EXCELSIOR; R. K. (*Brockley, S.E.*); R. P. C. (*Sunderland*); H. & R. (*Birmingham*); H. P. (*Bristol*); D. B. D. (*Glasgow*); W. F. (*Salisbury Square*); D. B. T. (*Dalbeattie*); J. S. (*Preston*); ANCONA; W. G. (*Manchester*); E. A. (*Salisbury*); C. H. C. (*Hornsey*); MERCURY; H. J. H. (*South Hackney*); J. A. (*Southport Lane*); KINNING PARK; S. T. (*No Address*); J. T. (*London*); C. T. (*Edinburgh*); S. F. R. (*Edinburgh*); C. BROS. (*Leeds*); B. J. B. (*Boddington*); J. M. P. (*Preston*); PUZZLED; L. G. (*Falmouth*); ADIA; J. H. (*No Address*); G. W. S. (*Tufnell Park*); F. G. (*Paddington, W.*); DUNDEE; W. C. (*Shrewsbury*); NEMO; J. A. J. (*No Address*); J. W. H. (*Nottingham*); J. G. (*Sunderland*); T. S. (*Pendleton*); W. A. (*Faversham*); J. H. (*Holloway*); H. B. (*Disley*); L. C. (*Ealing Dean*); E. J. A. (*Southampton*); G. F. R. (*Redditch*); C. B. H. (*London, W.*); F. B. J. (*Liverpool*); A. C. (*Langton*); E. W. C. (*Leicester*); J. R. (*Douglas*); A READER OF "WORK;" J. B. (*Manchester*); W. W. (*Elswick*); H. L. (*Urmston*); KILN BURNER; PATTERN MAKER.

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