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AN INCUBATOR WITH A SELF-ACTING HEAT REGULATOR.

BY C. MAYNARD WALKER.

THE artificial hatching of the eggs of poultry, and indeed of every kind of bird, is by no means new, having, according to reliable history, been largely and successfully practised by the Egyptians and Chinese, probably for thousands of years; and in almost every work treating upon the subject of incubators this fact is harped upon to such an extent that the reader is apt to ask why not adopt the apparatus which has stood such a remarkable test? The answer is a simple one, viz., the method and the means employed in these countries are useless without the favourable climate which obtains there; and that only at certain seasons of the year, at which periods travellers inform us the temperature remains perfectly unchanged.

Under such conditions artificial hatching becomes very nearly as easy as that employed by the ostrich, which is supposed to lay its eggs and cover them up in the hot sand until, in due course, the chick emerges from the shell; but it is easy to see that in such a notoriously changing climate as that of the British Islands, where the average difference between the temperature of day and night amounts to some 20° Fahr., to say nothing of the sudden changes of heat and cold from day to day, it is quite another thing, so that it would appear that instead of the simple ovens or "mammals" of the Egyptians, we need, as a matter of first necessity, an apparatus which can be so regulated as to maintain a constant temperature during the process of incubation never exceeding on the one hand 105°, nor falling below 100° on the other; this I shall show is a very easy matter. Another condition of vital importance is that the eggs shall be open to perfect and *continuous* ventilation, and further, that the process of hatching shall be carried on in a moist atmosphere. Provided that these conditions are met, it matters little how roughly or of what form, shape, or material the incubator is made, or where it is used.

Fig. 1 represents in section one that was made by the writer of this paper, and successfully used as far back as 1882, excepting that the original was very roughly made, and was patched and altered as experiment proved, until it was made successful. The exterior was made from a wooden packing-case, and the boiler of zinc, and was capable of hatching twenty full-sized eggs, and was heated generally by an ordinary paraffin lamp, and sometimes by gas, where the latter was convenient. The question of size is one that each must determine for himself, but I apprehend that an incubator adapted to hatch from one to thirty eggs will be large enough for the majority of persons who will undertake the work of making up. I may mention here that anyone who can do soldering and rough carpentry can undertake the job with every prospect of success; and with the view of rendering the task as easy as possible, I will take care in the following instructions not only to make the work clear, but to give reasons why each particular part is of its particular form and arrangement.

For an incubator to hold thirty eggs an outer case will be required, measuring outside 16 in. long by 16 in. wide by 12 in. deep, to be made of not less than ¾ in. deal. If the maker can do dovetailing so much the better; if not, use French nails for the joining, about 2 in. long. The top, however, must be screwed on, to provide facility of getting at boiler in the event of repairs being required; the top, too, should be well battened at the ends, across the grain, to prevent it warping. It will be as well to completely make up the case as though it were a close box before making the fittings, then for the drawer aperture cut out an oblong opening 13¾ in. by 2¾ in. deep, from the top 5½ in.; this, of course, can be cut with a keyhole saw, and should be finished as neatly as possible.

The drawer itself is a frame with a lattice bottom, and the lattices should be formed of round wood about ½ in. thick, which can be bought at most timber yards in lengths of about ten feet; these are cut up, and then conveniently attached to the bottom by fitting them into holes bored in two sides of the framework, and the space between the bars should be 1½ in. The object of this arrangement is to enable the eggs to lie securely in their position, without jarring

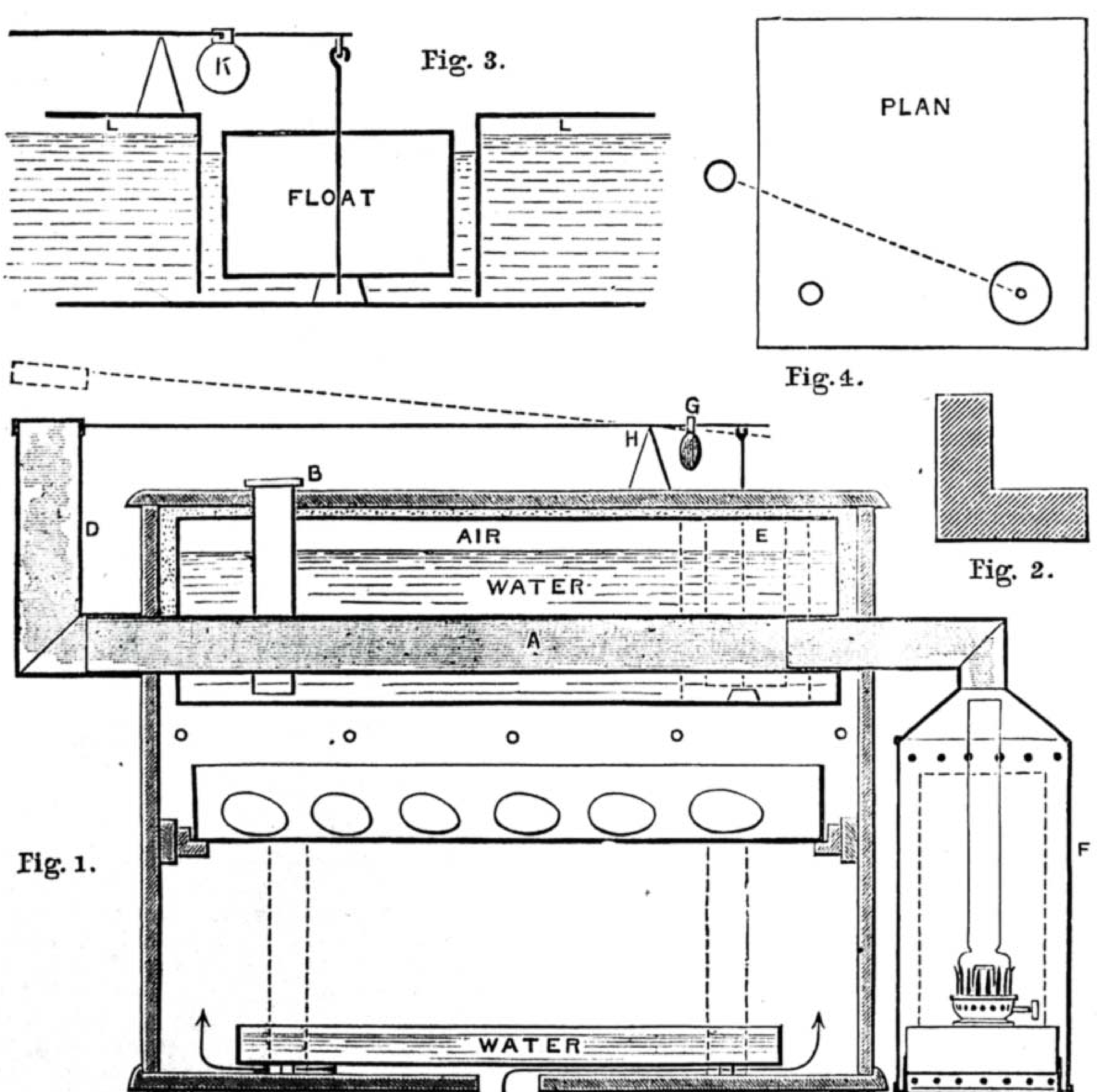


Fig. 1.—Sectional Diagram of Incubator, showing Arrangement when in use. Fig. 2.—Section of Drawer Runner from Front to Back. Fig. 3.—Diagram showing Metal Float Governor with Wire working in Centred Bridge at Base of Boiler—K, Adjusting Weight; L L, Air Space above Water of Boiler. Fig. 4.—Diagram showing Position of Well-hole.

against each other. The front side of the drawer is made sufficiently large to overlap the opening when shut. Inside the incubator a couple of runners are fixed to enable the drawer to run true, and should be fitted so as to move easily (Fig 2), and should be supported at both ends by uprights to bear the weight of eggs and drawer. It will be seen that the drawer is much smaller than the inside of case; this is to allow freedom of circulation of air on all sides of the eggs.

Next, nail on to inside of case, $3\frac{3}{4}$ in. from the top, two lengths of $\frac{3}{4}$ in. stuff to carry the boiler, these to run all along each side of the case; next, at each end of the case bore a $1\frac{1}{2}$ in. hole: these will be for the flue, described further on. Then at a line 5 in. below the top bore fifteen $\frac{1}{8}$ in. holes, five in front, five at back, and five at left hand, putting none at the right where the lamp would be liable to foul the air; also a $\frac{5}{8}$ in. hole in the centre of the bottom. The reason for these dimensions of holes is this: the area of the bottom or inlet hole is much larger than the sum total of all the holes at top—thus the velocity of the current is reduced, and the air gets practically warmed before it comes in contact with the egg chamber. It will be seen that when the incubator is at work there will be a continuous discharge of air from the holes at the upper end of case, impelled by the heat of the interior, and a constant flow of cold fresh air into the incubator at the bottom hole; this continuous ventilation is most important, and in the present form is as perfect as needs be. Two good handles should be fixed to front of drawer, and four knobs fixed to bottom as feet, size immaterial.

The woodwork of incubator may now be regarded as being complete; the metal part now remains. I find it a capital plan to cover the inside of case at this point with thick brown paper, using flour-paste. It is a good non-conductor, and ensures that no cracks interfere with the ventilation, taking care, of course, to leave the holes free. We now require to make the boiler. This should be made of strong tin-plate or copper (zinc is altogether unsuitable), the dimensions being 15 in. by 15 in. by $3\frac{1}{2}$ in. deep, the tube A to be soldered in 1 in. from the bottom; this should be of $1\frac{1}{4}$ in. brass, and in fixing it additional strength in the joint will be obtained if the holes are bored in the sides of the boiler about a $\frac{1}{4}$ in. too small, and then "rhymered" with a blunt tool to their proper size, this turning up a $\frac{1}{8}$ in. edge round the hole. The boiler tube should be nearly flush with boiler at one end, and project about 2 in. at the other; a filling tube 1 in. in diameter (B), and reaching to nearly the bottom, to be fitted in the position shown (Fig. 3), and provided with a screw-cap. The boiler must also have a circular hole (Fig. 4) $3\frac{1}{2}$ in. in diameter, and fitted with a circular well-piece reaching to about $\frac{1}{16}$ in. from the bottom of boiler, and soldered air and water-tight to the top; this is for the regulator, described further on.

The boiler is now perfectly ready to be placed in its proper position by passing the projecting tube through the left-hand hole of case from the inside, and letting it fall on to its bearings. The size of the boiler it will be seen leaves a space all round; this must be filled up with wadding, neatly packed on all sides and on the top, and, before putting on the cover, a couple of layers of brown paper; in this way very little heat will be wasted. A metal water-tray about $1\frac{1}{2}$ in. deep and about 10 in. square (with four feet to keep it clear of the central air-hole at the bottom) should be made, and stood on the bottom inside.

The next operation to this will be to make the lamp box. Whether we use oil or gas this will be required, and here let me say that quite half the trouble and attention necessary to an incubator will be saved by the use of gas. What is called an atmospheric burner should be used, as it makes no smoke; this can be bought of any ironmonger—ask for an upright ring boiling burner. The lamp box (F, Fig. 1) is simply a cylindrical case fitted with a door, and has an elbow joint at top, which passes into and fits the boiler tube, so that when the lamp or burner is lit the heat is passed through the boiler tube; the latter, at the other end, is fitted outside with an elbow (D, Fig. 1), which rises to about 2 in. above the top of the incubator.

The incubator is now practically complete, but if it was set going ever so carefully, with ever so good eggs, it is more than doubtful if any chicks would issue from it, for it still lacks one of the most important parts, viz., a regulator. Let us see how we can manage that. It is a well-known fact that most bodies increase in volume by heat, some but little, some very largely, amongst the latter notably air; so that if we leave about $\frac{1}{2}$ in. depth of our boiler unfilled and enclose it, we shall have about 112 cubic in. of air, which, in its expansion by heat, and its contraction by cold, serve as the motive power to work the regulator; and as there is plenty of it we may rely on its being able to automatically control the temperature. To do this we must fit a float into the circular well (E)—simply a support of tin-plate soldered air-tight—to which is attached an arm working on a hinge (H), having a cap at its longer end to fit loosely over the upright flue (D). If the boiler is now being heated, and the temperature has reached say 105°, if we pass the adjusting weight (G) along so that the cap is made to descend on the flue, all the draught and heat from the lamp will be stopped, and will pass out of the holes of the lamp box instead. It is clear then that the boiler will begin to cool, and the air therein contracts; the moment it does this the float will fall, and the cap be lifted off, allowing the heat from lamp to pass through the boiler, which, as soon as it gets hot, the air, by raising the level in the well, sends up the float, and again puts the damper on; and so on continuously, thus maintaining without any trouble, a regular temperature in the incubator, or rather in the boiler. Thus the incubator should be placed in some kind of outhouse where the condition will be reasonably regular—that is to say, it should not be exposed to strong draughts of wind, etc., or in spite of the regular heat of the boiler the interior of incubator would be disturbed.

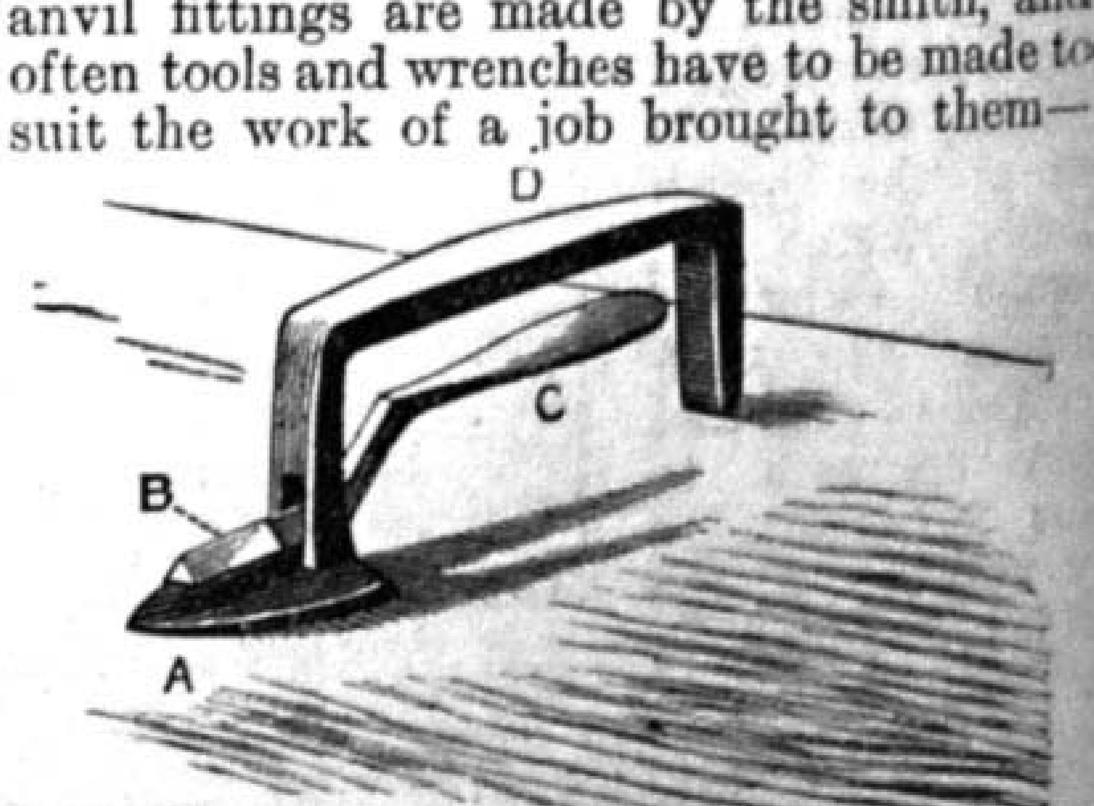
And now a few words relative to the management. Fill the incubator with water to within about $\frac{1}{2}$ in. of the top. To do this, a small vent-hole must be made in top, and afterwards soldered up when water is hot; trim your lamp, or see that your gas-burner is all right, charge the water-tray with cold water, and set the lamp going; put a thermometer into the egg drawer at about the same height as though it were on the eggs, leave it for several hours, and let the temperature get up to about 120°; the reason for this is to ensure sufficient power from the heating source to meet a cold change in the weather. Now adjust the regulator until a temperature of 105° is obtained, without interfering with the gas supply, or lamp, as the case may be. When finally adjusted, the level of water around float should be covered with about $\frac{1}{2}$ in. depth of sweet oil; use it in this way for a few days, up and down in temperature, before you entrust any eggs to be hatched. When eventually you do this, lay a piece of coarse house-flannel on the tray, and mark each egg on its opposite sides with some distinguishing mark—an O on one end and a X on the other will do. This is to facilitate the daily process of turning the eggs—all O's up one day, and X's another. This process is important, as if the eggs lay too long the embryo adheres to the shell and dies. The water-tray must be kept charged with water, adding tepid water when it gets low. The eggs will not require moistening if plenty of water is kept in the incubator, owing to the fact that warm air, if it can get it, takes up in suspension a quantity of moisture, so that the eggs are constantly in a moist atmosphere so long as the warm air can reach the water. It does not matter what kind of birds' eggs are used; they all hatch at the same temperature, whether as small as the tom-tit, or as large as the ostrich. When your chickens are hatched, they, too, for some time will require artificial warmth, and for this purpose a convenient plan is to make a wire cage somewhat larger than the incubator, cover a portion of it with glass, and stand it on top of the incubator, so that the glass pent receiving the heat will form an artificial mother. Having now told my readers what to do, permit me to warn them what *not* to do—*do not* expect to make a fortune with artificial incubation.

THE LATCH PINCERS.

BY J. C. KING.

It is said that a good workman can work with any sort of tools. If a good workman, he would not be content to keep on using inferior tools, but make superior ones himself to do his work with, if a worker in the materials of which the tools were made. This is especially so of metal workers, perhaps more so of blacksmiths than any others.

In most small shops in the country, hammers, tongs, pincers, bits, chisels, drills, and anvil fittings are made by the smith, and often tools and wrenches have to be made to suit the work of a job brought to them—



The Latch Pincers.

from the massive forgings of a "derrick," or a weigh-bridge, to the spring of a lady's purse. Few workmen are so ready in their comprehension of what is wanted and how to do it as are the handy smiths.

A smith was called upon to repair some very fine chain-mail, the links inside the size of a cedar pencil, the steel wire the size of hair-pin wire. He remarked: "The smiths in the time of the Crusaders made this armour; I ought to be able to mend it with a few links, especially as I see how it was done. It is a matter of tools."

These links showed they were alternately forged and riveted, the riveted ones serving to put the forged ones securely together. A fine needle drill was the essential tool for the job.

For another job in which delicate ironwork had to be tried, frequently on a pattern, he made a pair of pincers he called latch handle, or "latch pincers," from the resemblance to a latch handle and the action of the latch.

The illustration shows the tool. A is the thin flat under jaw that rests on the work or pattern; B is the upper nipping jaw; C the latch, which the closing of the hand causes the pincers to grasp the piece of work; D is the latch handle, about 5 in. long and 2¼ in. deep inside.

If any of the readers of WORK have light ironwork to handle and fit, they will find such a tool easy to make, and serviceable.

MODEL ELECTRIC LIGHTS.

BY GEORGE EDWINSON BONNEY.

PRIMARY BATTERIES—SMALL BOX BATTERY—ANOTHER BOX BATTERY—ELECTRIC LIGHT FOR PHOTOGRAPHIC DARK ROOM.

IN the two previous papers on this subject, I have given the amateur electrician some idea of the principles which govern the practice of electric lighting, and have also shown him how those principles may be applied by means of primary batteries. It will have been seen that the area in which these batteries can be used for electric lighting is very much circumscribed by considerations of cost and labour entailed in their maintenance. Within that area I now propose to work and show what may be done in a small way by the aid of primary batteries.

Primary Batteries.—I may as well explain here that the word primary is used in connection with electric batteries as a means of distinguishing those batteries which furnish electric energy direct by consuming in themselves fuel to develop electric energy, in contradistinction to those batteries which receive a first charge of electricity derived from another source to develop in them the capability of furnishing an electric current. For example, a battery in which zinc is consumed to furnish electric energy, is named a *primary* battery; but when this energy is sent into another battery composed of lead plates to make it capable of furnishing electric energy too, then the latter is named a *secondary* battery. A secondary battery is incapable of giving electric energy until it has been made capable by first sending an electric current into it, but a primary battery will furnish current right off at first hand, so to speak.

A list of primary batteries now known would be a very long one, and each week adds its quota to the list, as each experimenter and dabbler in electricity fancies he discovers improvements. I cannot claim to know them all; but of the many known to me there are very few that can be used for electric lighting with any chance of success.

A battery suitable for electric lighting must conform to the following conditions:—(1) Its electro-motive force must be high—as near 2 volts per cell as possible; 2·15 volts per cell being the highest obtainable from zinc under any condition. (2) Its internal resistance must be low—only a fraction of an ohm per cell is admissible, say from 0·04 to 0·10 ohm, the former being preferable. (3) The current at the terminals must be full and strong, and this it will be if the two first conditions are observed. (4) The force of the current must be constant through a series of hours—the longer the series the better will be the battery for electric lighting. (5) It must be free from a tendency to polarisation—that is, a tendency to alter the electric relation of its plates and set up within itself a counter electro-motive force. (6) It should be easily set up, and as easily taken in pieces to be cleaned. (7) The cost of its charge should be very low, since zinc in itself is a most expensive fuel.

Among batteries having a high E.M.F., we may rank the single fluid chromic acid battery, having an E.M.F. of 2·1 volts; the double fluid chromic acid battery, having an E.M.F. of 1·95 volts; the Grove and Poggendorff, each 1·96 volts; the Bunsen, 1·86 volts; and the Fuller, 1·50 volts. Now as to the second condition, namely, that of internal resistance. This will vary with the density of the solution employed to charge the battery, with the porosity of the porous cells, and with the nearness of the plates, together with their respective areas. Taking equal batteries together, and comparing them with each other, we find that the single fluid chromic acid battery offers the least internal resistance because of the superior conductivity of the solution employed to charge the cells, and the nearness of the plates to each other. A cell of this type having plates 6 in. by 4 in. placed not more than ½ in. apart, will have an internal resistance of less than 0·04 ohm. Next to this comes the single fluid bichromate of potash cell, but this has a strong tendency to polarisation when in constant work. The Bunsen comes next with an internal resistance of from 0·8 to 0·11 ohm. The double fluid chromic acid and bichromate of potash cells take equal rank with this. The Grove has an internal resistance of 0·1 to 0·12, whilst the Fuller has 0·5 to 0·7 ohm.

Respecting constancy, the Grove and Bunsen bears the palm over either chromic acid or bichromate of potash batteries, but will rarely run longer than six hours without being recharged. Both chromic acid and bichromate of potash cells have a tendency to flag in constancy as time goes on, and the light becomes less and less bright unless the solutions are frequently agitated. This fault is due to the use of an imperfect depolariser, or one inferior to nitric acid, such as that of bichromate of potash. This depolariser also forms crystals of its salt on the carbon plates of the cell, and thus increases the internal resistance of the battery. If chromic acid is used instead of bichromate of potash this tendency to crystallise is avoided. In a double fluid chromic acid battery, the depolarising quality of the liquid is much improved by mixing chlorate of potash with the chromic acid solution. Mr. S. R. Bottone, of Carshalton, to whom the invention of this new depolariser is due, says, in a letter to me:—"A mixture of chromic acid, chromate of potash, sulphuric acid, and water, in the following proportions—chromic acid 1 lb., chlorate of potash 2 oz., sulphuric acid 7 oz., water 1 quart, costing about one shilling—will, if placed in a double carbon, single zinc, porous cell battery of four cells, light up well for from twelve to fifteen hours a 5 c.p. 6 volt lamp."

I have already, in the last paper, shown that the Bunsen cannot be used in the same room with the required lamp, because of the noxious fumes of nitrous oxide given off whilst at work. The same objection is shared by the Grove, whilst this is a more costly battery than the Bunsen. The Poggendorff and Fuller are both double fluid bichromate cells, so we are left with the chromic acid batteries as being the best for small installations of the electric light.

I have already shown that an amateur cannot make his own lamps. These must be purchased from makers and vendors. But all other parts of a model electric light apparatus can be made at home, including specially the battery. I therefore give herewith some instructions on making some two or three small batteries suitable for lighting by means of small incandescent electric lamps.

Small Box Battery.—Beginning in a small way at first, I show a little box battery (about 6 in. square) made for me by Mr. Bottone, who lays himself out to meet the wants and wishes of amateurs with small means at their disposal. The box and battery are cheaply and roughly made to meet the demand for an electric light at low cost. It is shown complete with lamp at Fig. 7, whilst Figs. 1 to 6 give detailed sketches of its various parts. From these it will be seen that the battery is a double carbon, single zinc one of four cells, suitable for use with single fluid bichromate or chromic acid solutions. Fig. 1 shows the zinc element (with dimensions), cut out of ¼ in. rolled zinc plate. In the upper edge, drill and tap a small hole to take the end of a brass tang which must be screwed into the zinc to form a connection with it as shown in section at Fig. 4. The upper part of this tang receives a brass nut securing it to the copper connecting strip shown on the plan at Fig. 5. The zinc plate should be amalgamated with mercury, directions for which have already been given in the article on the "Bunsen Battery" in the first three numbers of WORK. It is then ready for use. Fig. 2 shows one of the carbon plates, with dimensions given. Close to the upper edge drill two small holes through each plate to form holding pins in the lead collar. Fig. 3 shows how the two plates are held in a lead collar. Fix them both in a mould of sand or plaster, 1¾ in. in diameter, and ⅜ in. in depth, with a core in the middle to form a hole for the zinc, and fill the mould with molten lead. Then cast each pair of carbon plates for each cell. Fig. 4 shows the arrangement of zinc and carbon plates in section, and Fig. 5 a plan of the upper side of the box cover, showing together how the plates are secured to the cover and connected to each other. Holes to receive the tangs of the zinc plates are drilled in the cover of the box, 1½ in. from each side, and 2 in. apart. Each zinc is then inserted between two carbon plates in the lead collar, and insulated therefrom by a strip of softened ebonite or by a collar of gutta-percha as shown at E E, Fig. 4. The whole (carbon and zinc plates with the lead collar) are then placed in position and secured to the cover as shown at Fig. 4, a brass screw going through the cover and into the lead collar as shown at C, to serve the double purpose of holding up the plates and connecting them to the copper strip above. In the figure, E E represents the insulating collar, L L the lead collar, C, C the carbon plates, and Z, Z the zinc and its connecting nut.

The battery box shown in section at Fig. 6, and complete with fittings at Fig. 7, is made to the size marked on sketch, of ⅜ in. pine, planed smooth, and stained black. It will be seen on reference to Fig. 6 that the battery is thrown into action by an arrangement made to lift the charged cells up to the elements secured to the cover, instead of lowering these into the cells. This lifting arrangement consists of a false bottom fitting loosely inside the box, on which the cells rest. To this false bottom is secured a small brass rod passing up through a hole in the centre of the cover and terminating in a screwed brass head. Halfway up the stem of this rod a hole is bored, to receive a wire pin to hold the cells up whilst they are intended to remain in action.

On referring to Fig. 7, and comparing it with the plan of the cover, Fig. 5, it will be seen how the plates of each cell are connected to those of the next. Starting on the left-hand side, the screwed tang of a pillar binding screw is screwed into the cover, passing through it into the lead collar of a set of carbons, and thus form the positive pole P of the battery. The tang from the zinc plate of this set comes up through the cover, and is secured to a thin strip of copper by a brass nut Z. The strip of copper terminates at C, where an ordinary brass screw passes through the cover and connects it with the lead collar of the next set of carbons. This arrangement is repeated with each set, until a solitary tang from the last zinc plate on the right-hand side stands up by itself. A short strip of copper is secured under the nut of this tang, and another pillar binding screw is also screwed into the cover through this strip, thus connecting it with the last zinc plate to form the negative pole N of the battery. In these pillars, the connecting wires of the lamp are secured as shown at Fig. 7, or the wires may be led to a separate lamp-holder if desired.

The cells employed in this battery are round pomade glass jars, about 2¾ in. in height by 2½ in. in diameter. If bichromate solution only is employed to charge the cells, these may be of stoneware, or even of wood, or of papier-mâché well soaked in hot melted paraffin wax, but glass alone can be safely used with chromic acid. I have seen stoneware jars deeply pitted and scaled with this acid after being in use for a short time. It has a peculiar attraction for anything coated with paraffin wax, and will readily fetch this out of the pores of wood or of papier-mâché. It will also attack ebonite or vulcanite, and soon reduce either of these substances to a crumbling mass. Therefore, glass cells are only admissible for use with chromic acid. Gutta-percha stands fairly well if the battery solution can be kept cool, but if the solution rises in temperature during work, the gutta-percha softens and soon becomes pierced with holes.

The solution to charge this cell is made up of chromic acid or of bichromate of potash, 3 oz.; sulphuric acid, 3 oz.; water, 1 pint. Dissolve the bichromate of potash in 1 pint of warm water, add the acid gradually whilst stirring the solution with a stick, and allow it to get quite cold before using it to charge the cells. In the case of using chromic acid, mix the acid with the water, and use the solution only when cool. If any reader "out of the way" fails to get chromic acid in his neighbourhood, Mr. Bottone will send a sample tin of it by parcels post to any address on receipt of a shilling postal order. The sample will be enough to furnish four charges for the battery, and each charge will light up a 5 c.p. 6 volt lamp for three hours. To charge the cells, unscrew the cap on the brass stem in the centre, unclasp the fastenings of the cover, take this off, lift out the false bottom of the box with its cells, charge and replace them. To set the battery in action draw up the cells by pulling up the stem, and secure it by the steel pin made to go through a hole in the stem. When the battery is not in use, pull out the pin and lower the cells. The zincs will need occasional cleaning and re-amalgamation, and the whole battery elements should be frequently cleansed by causing water to run in amongst them from a tap. Every part can easily be taken to pieces by unscrewing the various screws.

Another Box Battery.—At Figs. 8 and 9 will be seen a different form of box battery. The carbon and zinc elements are the same in every particular as regards size, mode of connecting the carbon plates together, and fastening these with the zincs to the cover of the box. The connections above the cover are also similar. The tangs of the zincs in this form are insulated from the lead collars by small collars of ebonite, vulcanite, boxwood, or gutta-percha made to fit the tangs closely, and furnished with flanges to keep the zincs from touching the lead collars. The box is made of hard wood such as teak or mahogany, and is finished in a superior style. It is also a little taller than the last described, to admit another box inside (which holds the cells), instead of a mere false bottom. This box is made out of ¼ in. pine, and is partitioned off in four equal divisions, as shown at Fig. 10. Each of these divisions is intended to hold a square glass cell. The box is lifted or depressed by means of a handle attached to two long ears made of iron or of brass, ¾ in. in width by ⅛ in. in thickness, forged to the shape shown at Fig. 10. The outsides of each ear, from an inch below the cover down to within an inch of the rim of the inner box, is scored with notches to form a ratchet on each ear. To the battery box are fitted two curved springs of steel, A, Fig. 9, with the ends filed to fit in the ratchet notches on the ears. By this arrangement the cells may be lifted to any height by pulling up the handle, and may be kept to any desired height by means of the ends of the curved springs engaging in the notches of the ratchets. When it is desired to lower the cells, the springs can be easily sprung back, and the box with its cells lowered one notch at a time. If preferred, the ears may be drilled with a number of holes ½ in. apart, and the springs made to terminate in pins fitting the holes. This would be an improvement, since then the cells could be raised to any desired height, and kept in position whilst the box is carried about.

If the battery box is made and fitted with lifting arrangement as shown at Fig. 10, the cover of the outer case, carrying the zinc and carbon elements of the battery, must be made to easily come off, for the whole inner box together with the cover must be removed when we wish to recharge the battery. Should this be deemed an inconvenience, it may be avoided by simply making a false bottom to the outer case and fastening the ears of the handle to this instead of to the inner box. In this case the ears must be made longer, long enough to go to the bottom of the outer case, and turn in under the false bottom about 1 or 1½ in. When thus constructed, the outer case may have a small door at the back as shown at Fig. 9, and the battery can then be recharged by withdrawing the battery box from the outer case through the doorway without disturbing the other parts of the battery. The cover can then be screwed down and the outside of the case made to present a finished appearance by fastening a few pieces of beading to the rim and corners, and polishing up the exterior. The cells to be used in this battery are square glass cells sold for the purpose by dealers in electrical goods, and obtainable from such dealers in the following sizes: A, 4 in. by 2½ in. by 1½ in.; B, 5 in. by 3 in. by 1⅝ in.; C, 6 in. by 4 in. by 1¾ in., at the cost of a few shillings the set of four cells. I advocate the use of these cells because, as I said before, glass cells are the only cells which may be safely used with chromic acid; but glass cells are liable to be broken by jostling against each other unless placed in a box divided into partitions, and square cells fit best in such a box. But round cells may be used in the same arrangement, and wide-mouthed glass jars or bottles may be utilised for this purpose. The dimensions of the box must therefore be made to suit the cells to be employed. For instance, if we choose the A size cells the outer case will have to be at least ten inches in height, since we must allow space above the cells to have the zincs clear when the battery is not in use. Such a battery as this will, when charged with chromic acid solution, light up a 5 c.p. 6 volt lamp for three, four, or five consecutive hours, according to the size of cell chosen, because large cells hold a larger quantity of depolarising liquid, and are not so soon exhausted. This is the nearest approach to a portable electric light by means of primary batteries that can be obtained. Other forms, involving the same principle of construction, have been made and sold, but the box batteries just described are the forms most easily and cheaply made by amateurs who wish to show their friends a small electric light, or wish to light up by this means some out-of-the-way niche where other lights would be inadmissible.

Electric Light for Photographic Dark Room.—At Fig. 11, I show an arrangement suitable to the requirements of photographers who may wish to use the electric light (enclosed in a ruby shade) whilst working in the dark room. On referring to the figure, it will be seen that the zincs and carbons are suspended to a board over the cells. They are attached to this board by the same method as that adopted to fasten the elements to the cover of the box battery just described and shown in detail at Figs. 1 to 5. The connections above the board may be made as shown at Fig. 5 if so desired, or as shown at Fig. 11, where each pair of carbons and each zinc plate terminates in a binding screw, and is connected to the next by means of a wire helix made of No. 16 copper wire. The board may be 14 in. by 5 in. by ½ in., and may be of fine teak or mahogany. The frame may be of pine, the base being made of the following dimensions: 16 in. by 8 in. by ¾ in., and the pulley supports at each end 14 in. by 2 in. by ¾ in. In the top of each end post must be inserted a small pulley of wood, iron, or brass, on which the cords of the lifting arrangement will run. The carbon and zinc plates should have a surface area of 5 in. by 3 in., and when these are fixed to the board, the whole should be exactly balanced by lead weights at each end as shown at Fig. 11. The cells may be glass pickle bottles having mouths a little over 3 in. in diameter, or round glass cells 5 in. by 2½ in. or over. The battery of four cells will, when charged with chromic acid solution as before directed, light up a 6 volt 5 c.p. lamp for some five or six hours, and this time may be taken out of it at

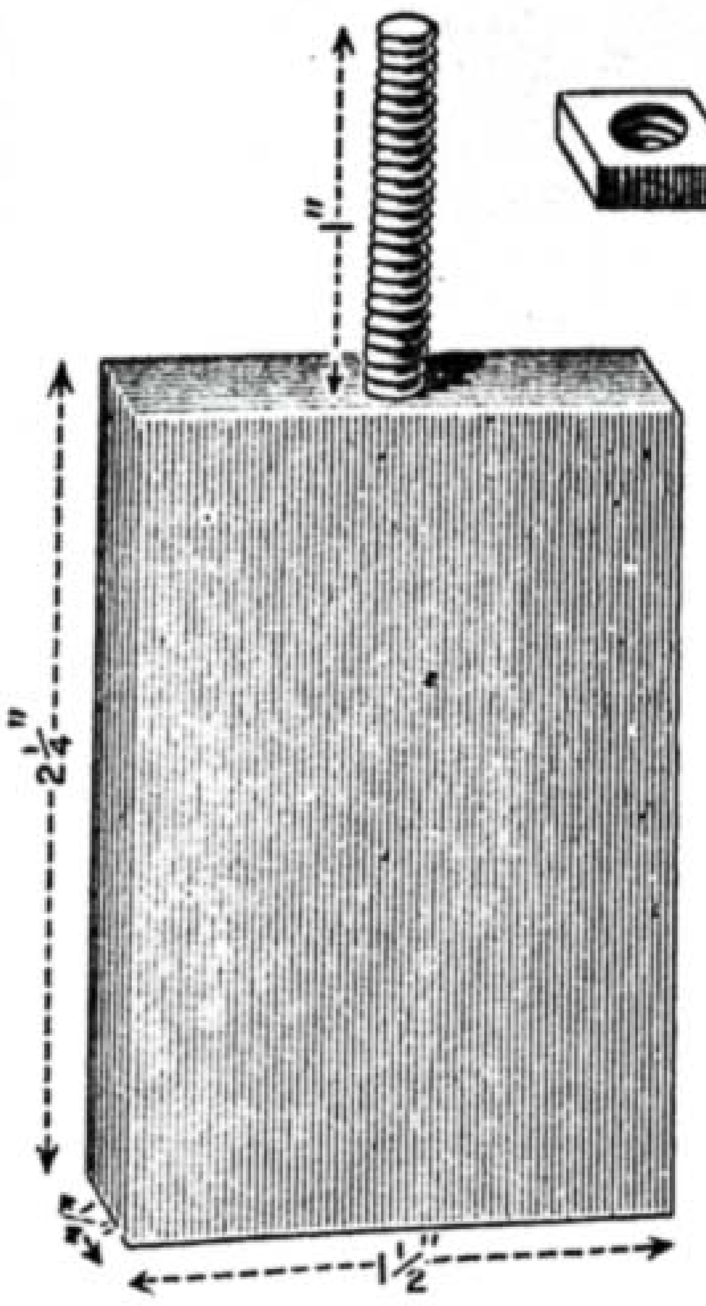


Fig. 1.

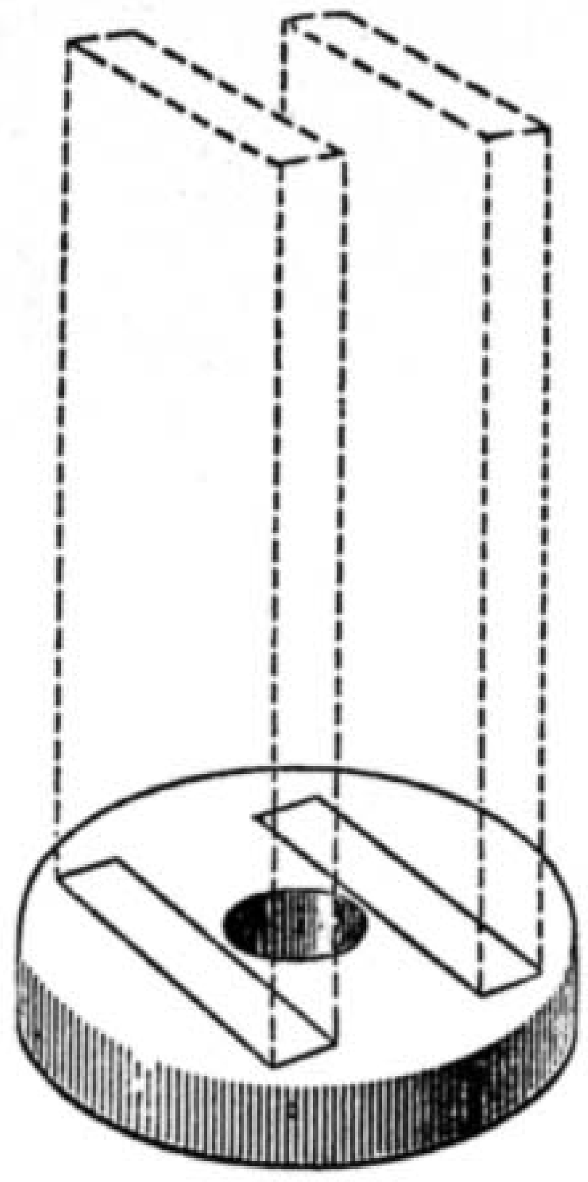


Fig. 3.

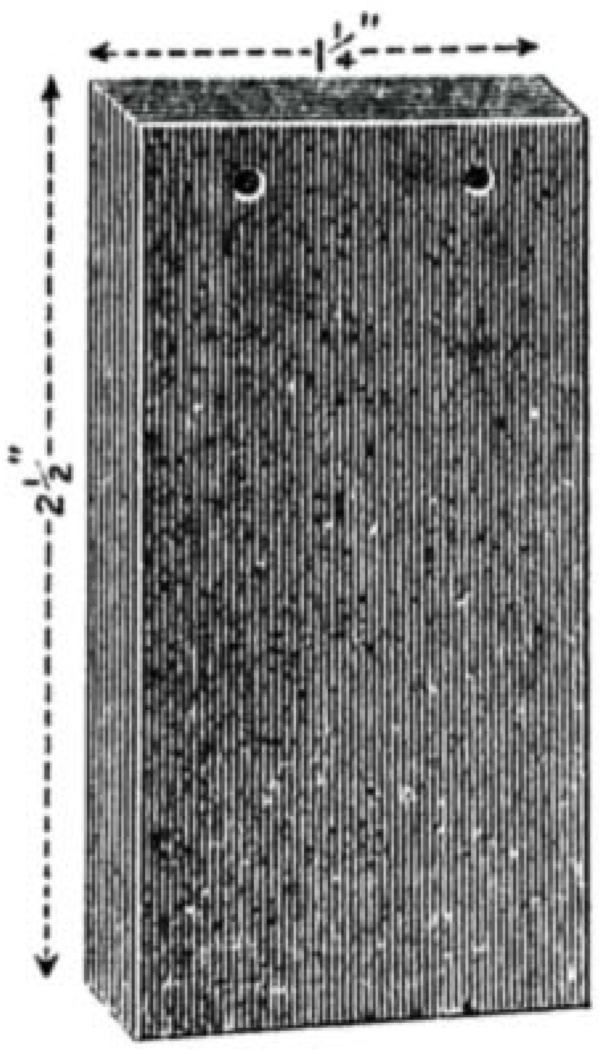


Fig. 2.

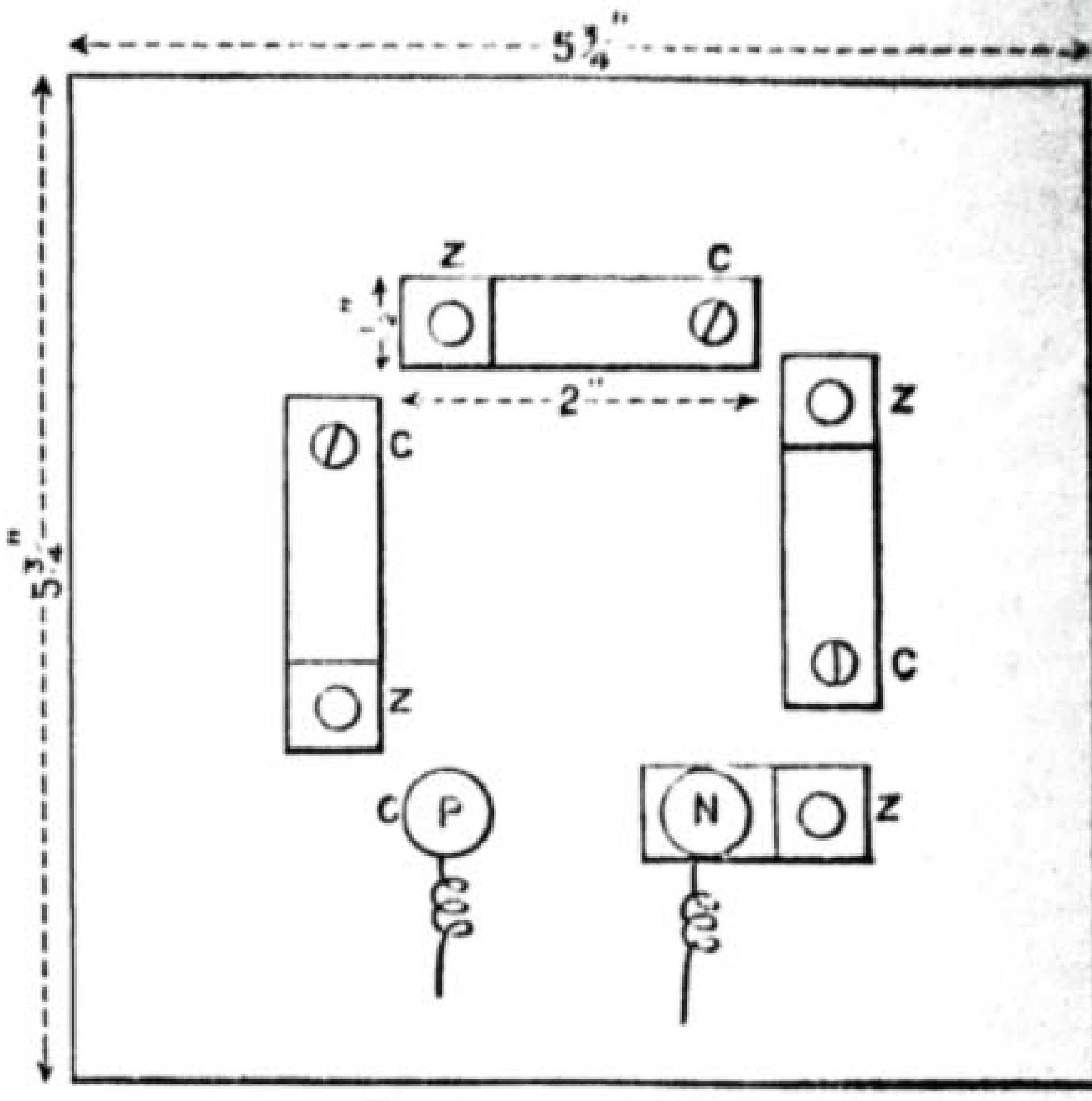


Fig. 5.

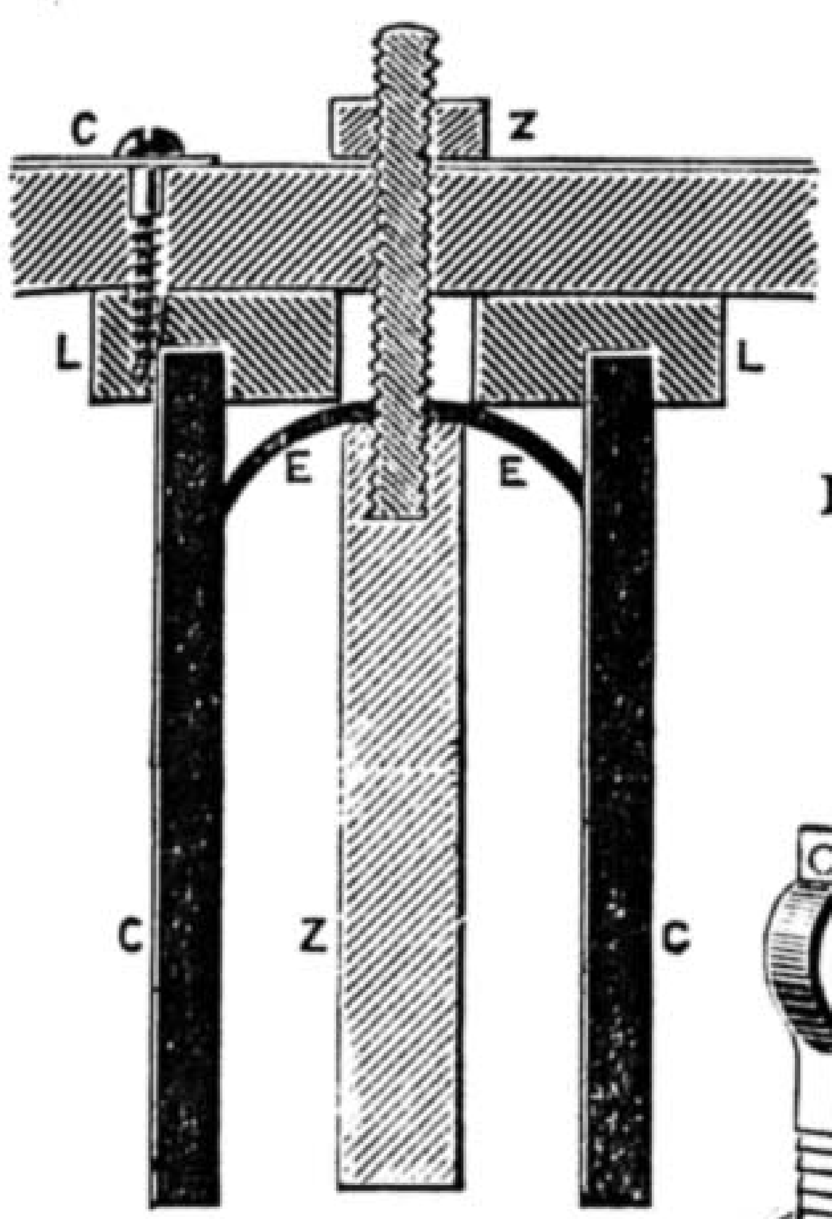


Fig. 4.

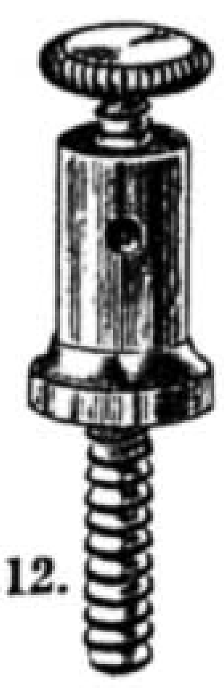


Fig.12.

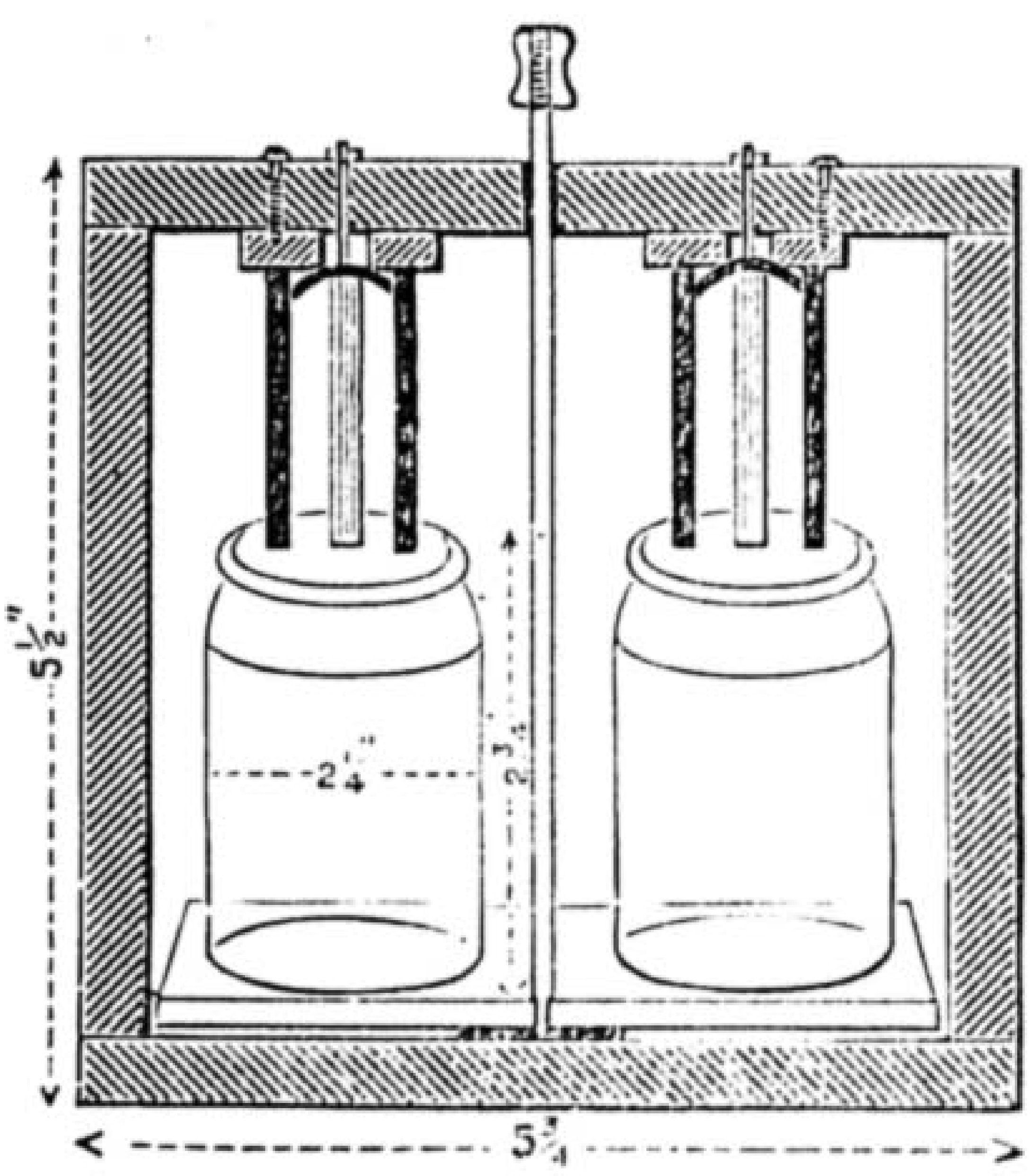


Fig. 6.

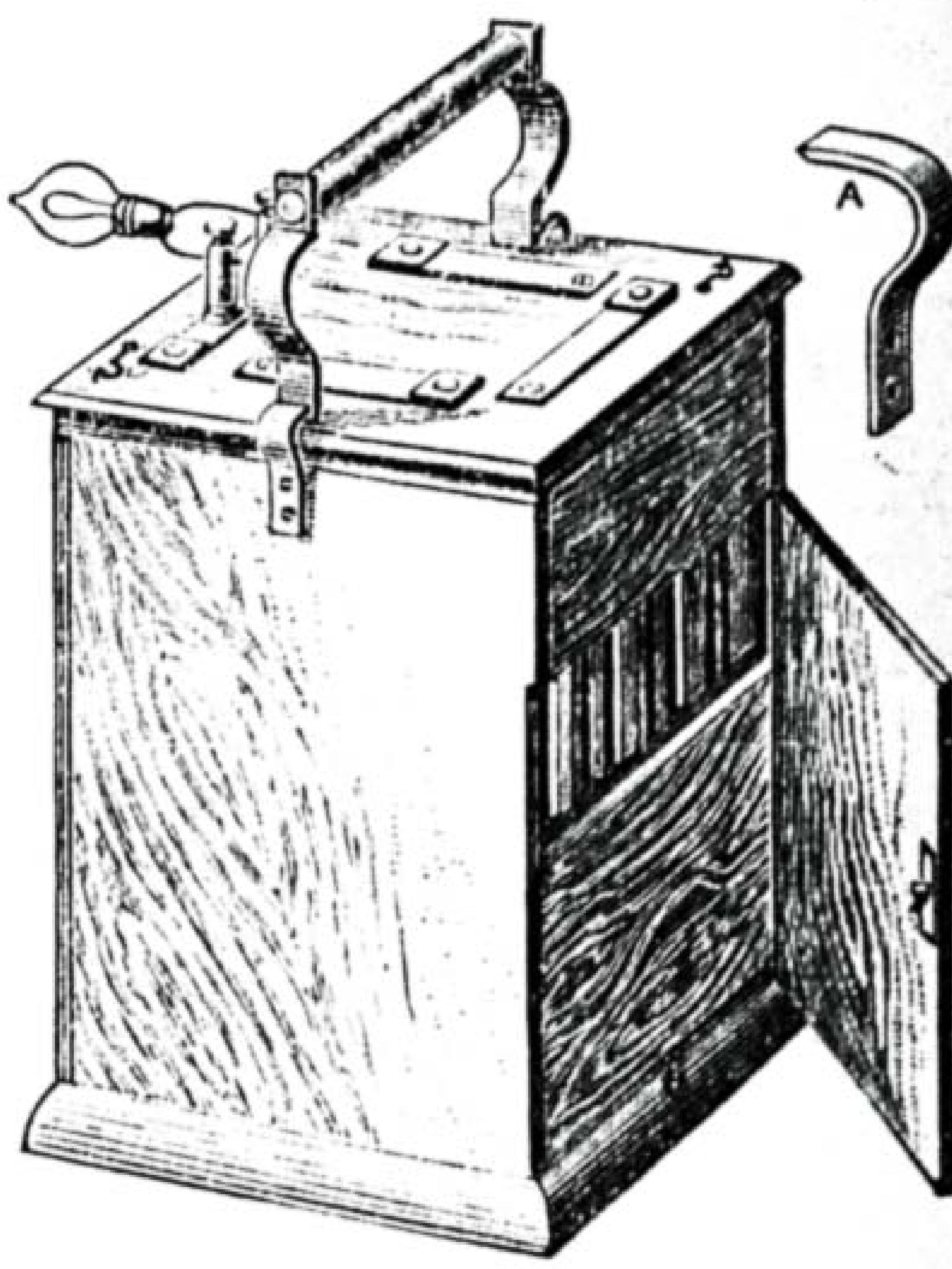


Fig. 9.

Fig.13.

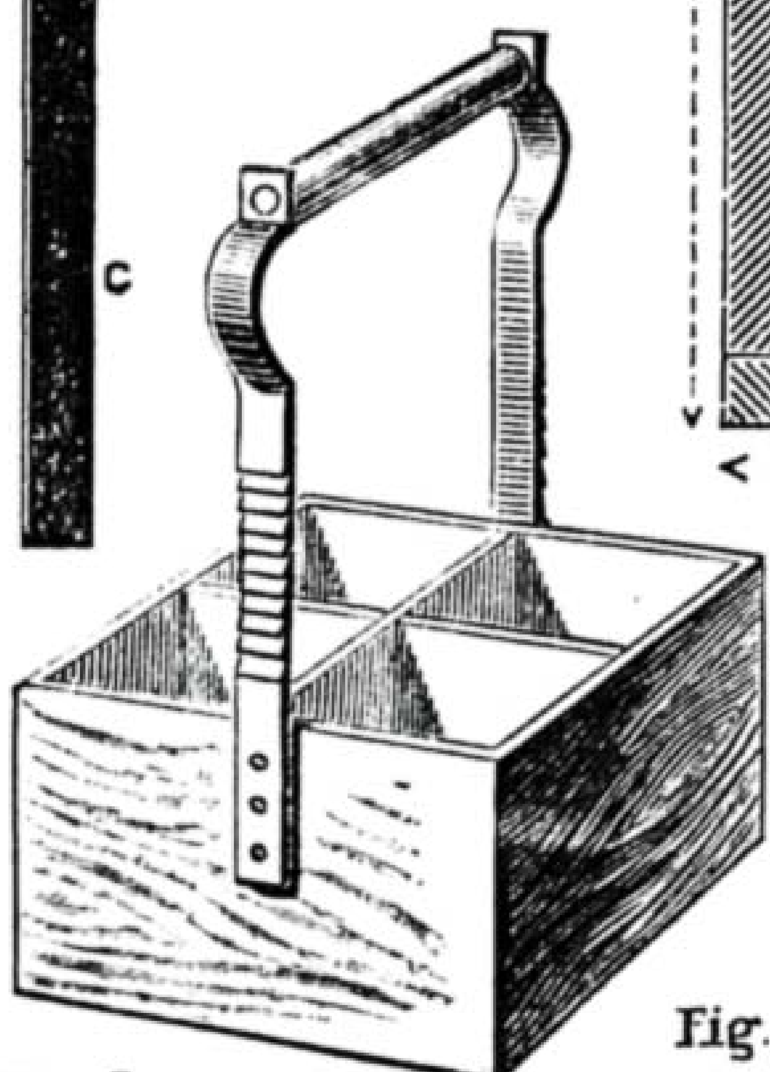
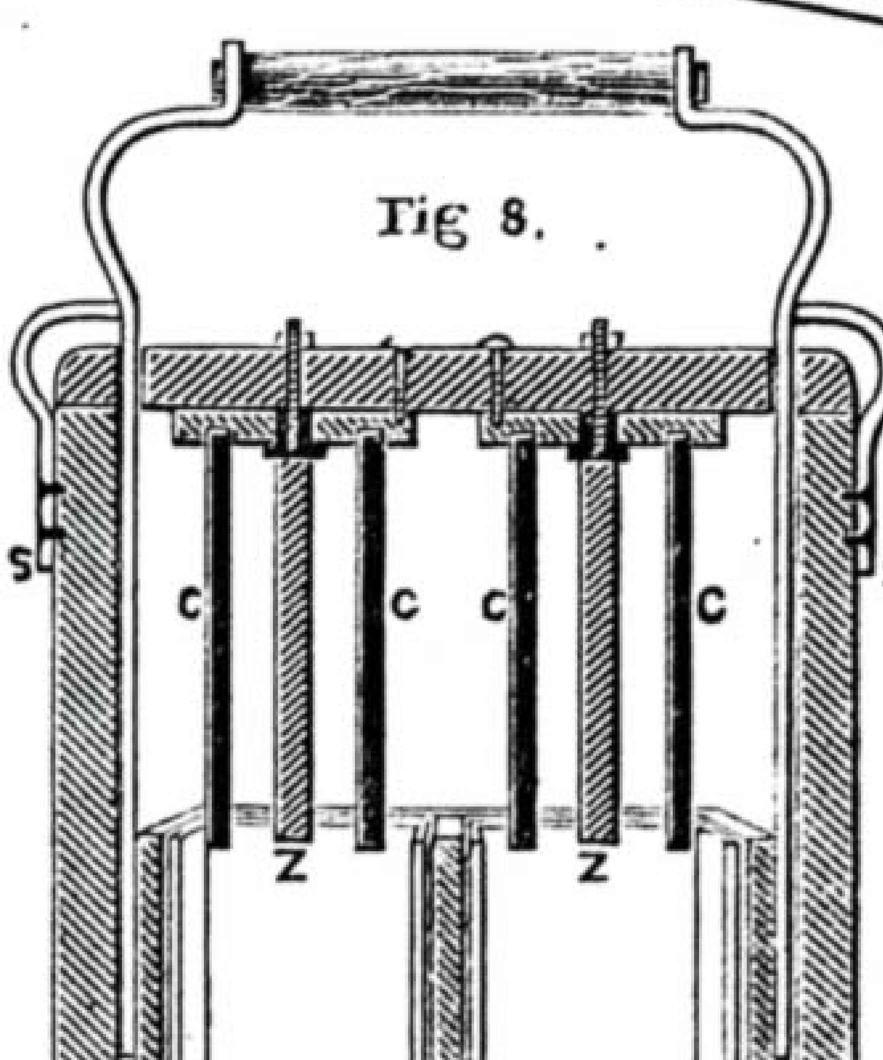


Fig. 10



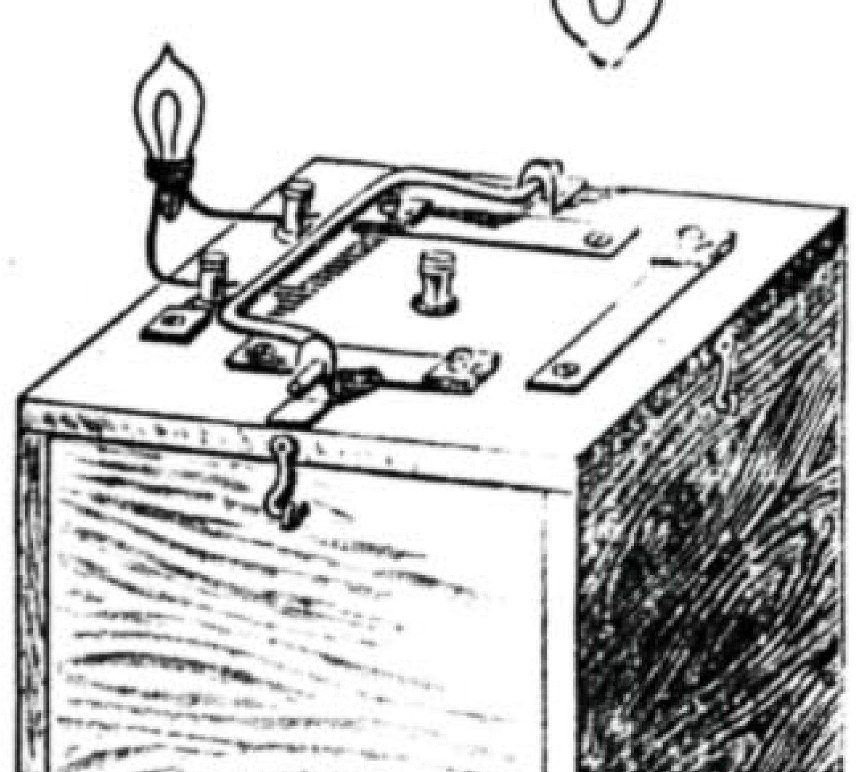


Fig. 7.

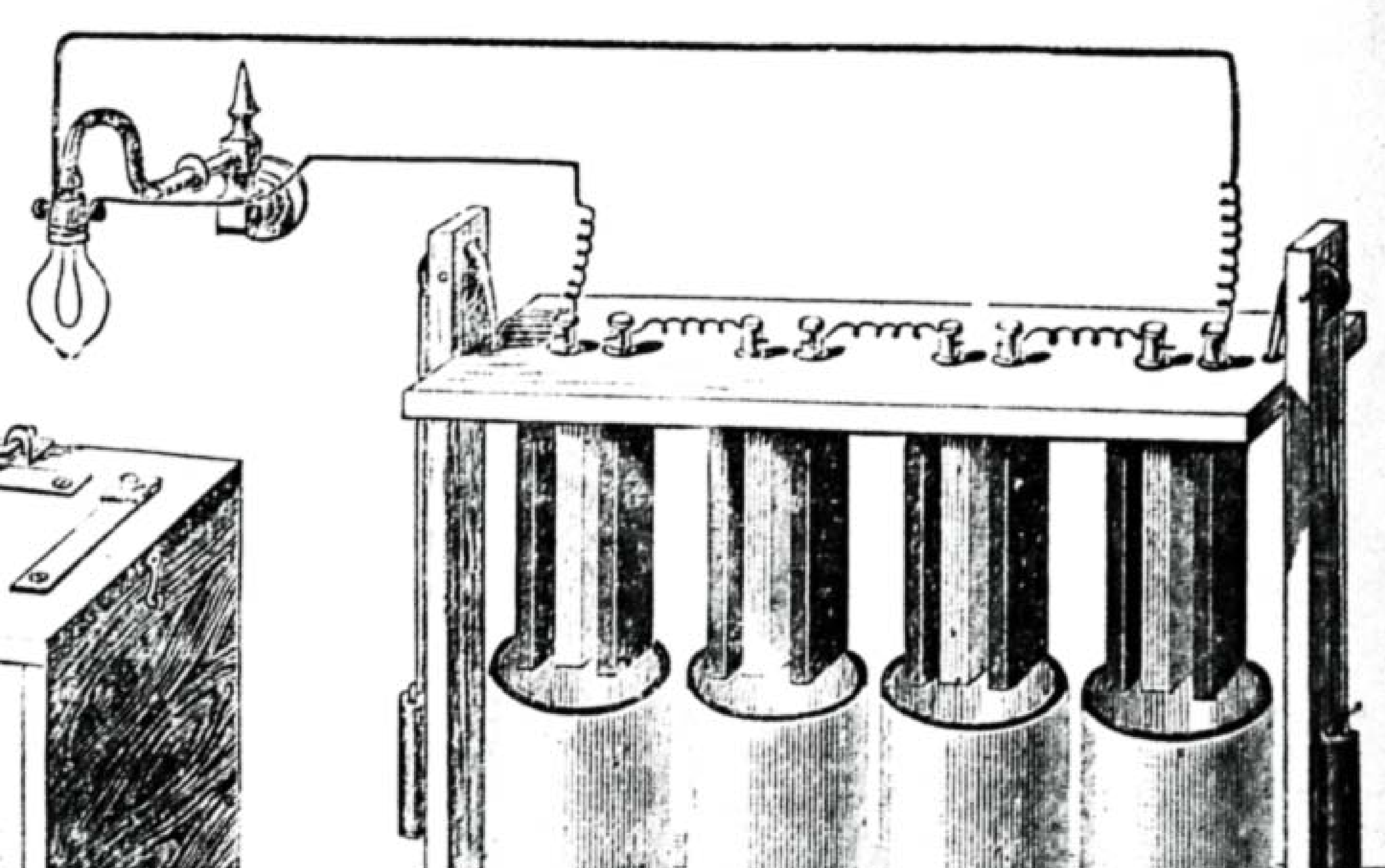


Fig. 11.

Fig. 1.—Zinc Plate with Screwed Tang and Nut. **Fig. 2.**—Carbon Plate for Battery. Fig. 3.—Plan of Carbon Plates mounted in Lead. **Fig. 4.**—Section of Battery Plates, showing Mode of connecting them. Fig. 5.—Plan of Battery Box Lid showing Connections. Fig. 6.—Sectional Plan of Interior of Box Battery. Fig. 7.—Box Battery and Lamp complete. Fig. 8.—Sectional Plan of Interior of Portable Battery. Fig. 9.—Portable Battery and Lamp complete. Fig. 10.—Battery Box and Handle of Portable Battery. Fig. 11.—Battery with Lifting Arrangement for Photographer's Dark Room. Fig. 12.—Pillar Binding Post for Battery. Fig. 13.—Ebonite or Boxwood Collar for Tang of Zinc Plate.

intervals as required, if the precaution is taken to lift the plates out of the cells when the battery is not in use. If the lamp is kept connected to the battery as shown in the sketch, it may be lit up at any time by pressing the plates down into their cells. In doing this, do not expose the full surface of the plates at once, but let them down gently, and so gradually raise the carbon of the lamp to the required light. If the full current is sent at once through the lamp it may rupture the carbon. This battery will require the same care as a box battery, to keep it in repair. A box may be made for it if so desired, by simply boarding up the sides and the ends, leaving the cover free to move in and out of the box. In this case one side should be hinged to fall down when required, for convenience in attending to the cells. If a stronger light is desired, another battery of similar size may be coupled to this, the terminal carbon of one to the terminal zinc of the other, and thus a 16 volt, 8 or 16 c.p. lamp may be lighted up. Any other intermediate voltage lamp may be run from two of these batteries by coupling the necessary cells together, reckoning each cell capable of giving 2 volts.

I have outrun the space at my disposal, so cannot now write any more here on other batteries that have been and are used for model electric lights. I shall be pleased, however, at any time to advise readers on this subject through the medium of "Shop."

THE ART OF GRAINING.

BY A LONDON DECORATOR.

GRAINING MAHOGANY AND SATINWOOD.

No particular variety of hard wood has been used more extensively by the cabinet maker than has mahogany; and no higher value has been placed upon either native or foreign grown tree than is recorded of the finest Spanish mahogany. Such being the case, it is, I believe, a somewhat rare matter to come across instances of its general use for the best woodwork of buildings until within more recent years. The erection of vast palatial buildings—the hotels, club-houses, museums, and other national piles, which mark the Victorian era—has, however, created a demand for materials—marbles and woods—for use in their interiors which our forefathers never dreamed of so using in this country; and whilst, apparently, mahogany has thus "come into fashion" for doors and such-like solid woodwork, it has "gone out" somewhat for its original purposes of cabinet-work.

This modern introduction of mahogany in the buildings indicated has naturally not been without some influence upon the architects and owners of less imposing edifices, so that what in earlier days would have been an oak door or panelled dado is now often substituted by mahogany—or that in combination with another wood. Such, in any case, has been the result of the writer's observation and experience gathered in various directions.

The growth, varieties, history, and nature of all woods of the mahogany (*Cedrelacæ*) order have already been dwelt upon in a very interesting and instructive *résumé*, contributed by Mr. Denning to Vol. I. of WORK, page 421; and this I would strongly advise the would-be grainer to turn up and well digest this before commencing his imitations. The object of my own brief dissertation is here to emphasise this accepted canon of the imitative art—that the imitation is right and acceptable, when properly executed, in those situations wherein the real thing might, or could, consistently be used in a building. To this end I recommend the rising students of graining to make, if not a special, albeit a thorough study of such a beautifully marked and coloured wood, believing myself that as each year goes on, and as the community at large gets educated up to and understands rightly the true mission and value of colour in the home, that the imitation of mahogany may eventually occupy as favoured a position in house decoration as was once generally accorded to the ever useful oak graining.

Oil Grounds for Mahogany Graining are best made with a basis of white lead, and in the same manner as oak grounds are prepared, then stained to the desired depth and strength of colour with pigments ground in oil. *Venetian red* of a good quality is the most useful colour for this purpose, and as it gives with white lead clean and bright tints, the addition only of a yellow pigment is required to make a good mahogany ground. The amount of yellow the grounding paint should give to the eye is a question that most grainers have each their individual notions upon. In cases where the imitation is desired to match with a piece of the real wood, an experienced worker can soon settle the point by judging the light portions of the mahogany against his paint, and making the latter slightly lighter than the real wood appears. Orange red with white lead is the favourite tint of some, but upon such a bright ground there must be the best of skill and judgment to get a good imitation. The two reds and white lead, or Venetian red, orange chrome, and white, give a good ground for light mahogany; but for all-round and general purposes I rather advise the white lead being stained with the best Venetian and bright yellow ochres, which give a medium orange tint, clean in colour, but not vivid in brightness. Experience in this matter will come soon enough to the learner; meanwhile the above will guide him.

The many varieties of figure and mottle which are to be found in mahogany wood are altogether beyond the scope of these papers to consider. I will therefore confine this description to the two principal kinds, usually known as "feathered," or Spanish, mahogany and baywood, the Honduras variety of the wood.

Baywood is usually considered an inferior article to the feathered mahogany; but for general imitative purposes its appearance is much to be preferred to the latter. When elaborate and brilliant mottling and feather are put into door panels, they seem to overpower the plain stiles, and there does not seem to be the repose in its entirety which we obtain by nicely worked baywood graining upon a door; whilst, furthermore, it takes a skilled worker to get a *good* imitation of the former.

Imitations of Baywood—like all descriptions of mahogany—are best grained in water colours and upon a hard and fairly glossy grounding paint. The ground should not be spread until a day or two before the graining. When it has been painted a week or two, it not only gets dirty, and often knocked and dented, but the water colours are spread with much difficulty; and, in fact, it is necessary to damp down the work with a little whiting water and a soft rag or sponge. Freshly grounded work can be grained upon without this process, a little extra rubbing with the tool or mottle only being necessary to spread the water colour. The ground for baywood is rather lighter than for Spanish mahogany; a little more white lead proportionately and the stainers before-mentioned will therefore produce it. The chief, or general, features of baywood are a fine grain running lengthways of the wood, crossed by mottle of varying depths and sizes, and through the whole of which a species of fine overgrain runs lengthways of the wood, similar to the outer overgrain of maple imitation. To produce this effect upon our painted ground, we take a little of burnt sienna and vandyke brown ground in water, and mix them to the desired depth in a vessel with a little beer and water, and keep also a little of each pigment handy wherewith to darken the same if desired. The tools required for mahogany are the usual "badger" softener, the large mottler, a piece of sponge, tool-brush, the sable and thin hog-hair overgrainers, and one or two camel-hair mottlers—all illustrated on page 40 of present volume. We commence by rubbing in the panel with either tool or mottler, using the mixed wash, and then wipe out some parts of it light by either drawing down the mottler sideways or using the piece of sponge. The mottler is then rinsed and wiped, and drawn down the panel, using the top only and with a light hand; this will soften the light into the darker portions, and will also give a slight appearance of the general grain. With the large mottler, and using the point only, we now draw it down the panel, leaving here and there lighter spaces and masses of mottle, chiefly upon the light portions of the work. Then taking up the camel-hair mottler, we quickly mottle across both the dark work and the mottle just formed, making bright and sharp lights. This having been done before the panel can dry, we lightly badger the mottle crossways of the panel, and leave it to dry. The final overgrain is then put on by using the thin hog-hair "oak" overgrainer dipped into a deeper wash of colour, and the hairs then divided with the grainer's comb made for such purposes. When executing a nice imitation of this variety having much mottle as above described, the overgrain may advantageously be worked for a slight distance with the pencil, thus getting an irregular heart grain, which the overgrainer is worked up to. As in maple, this last portion is "softened" as it is worked. The plainest variety of baywood may also be imitated by making the shades in the colour, as we spread it, more distinct, and sometimes giving the work a decided curl; we then mottle with the camel-hair tool to a less extent than above, soften it, and get the undergrain effect by sharply stippling over the plainest parts of the work and lightly softening this, lengthways; and, finally, we overgrain as above with the hog-hair tool.

Feathered, or Spanish, Mahogany has usually a deeper colour of ground, and the graining mixture is also used much stronger, so that the mottle is sharper and more brilliant. In the best polished specimens of Spanish we see also a decided purple or "lakey" tone of colour, and this we obtain in our imitation by substituting a little victoria, or mahogany, lake for the burnt sienna. This lake pigment is purchased ready ground in water, and is inexpensive enough to warrant its use by the grainer. Vandyke brown alone, or mixed with the lake and a little beer, may be used for first rubbing in the panel, but the lake is most necessary and effective for the final glazing of the feathered mahogany. The best samples of this beautiful wood present to us, in the case of a panel, a rich and dark centre portion, with the extreme limits of such at its lower end; out of this there springs a bright feather "stem"—if it may be so termed—from which, on either sides, bright silky mottle is thrown, and falls like the shape of a feather on either side in graceful and regular lines. The centre stem itself has usually a slight curve, and the top dies away into mottle like the off-shoots on either side. Nothing but a real specimen can give the learner a true notion of the nature of this wood, and the imitation can only be successfully learned from such.

The working method in general use is to quickly rub in the panel with the mixed graining colour, and then with a large flat fitch to put in the dark tones of the centre in consecutive portions. Commencing at the base, we make a dark curve with the brush, then leaving an intermediate space of the general colour, we put in a second curve rising above the first, and gradually decreasing them in size and strength of colour towards the top of the panel or surface. Without loss of time, we take up the *thin* hog-hair mottler, or "cutter," and with its top, used edgeways, cut out the bright rising lights which form the stem, and which then spray out on either side as I have described. We next take the camel-hair mottler, or, preferably, a "burnt-edge" ditto (see page 40)—especially if the former is quite a new one—and with this we put in the sharp, brilliant, and silky lights which flow out of the centre, giving them the naturally curving inclination, and avoiding any straight and harsh cuts or lights; this the camel-hair brush, with its pliable hair, enables us to do, and also lifts the colour off sharper and cleaner than does a hog-hair brush. As I have instructed in previous papers, the mottling tools require repeated rinsing in clean water, and then wiping on the leather, to free them from the colour taken up, enabling us to mottle sharp and clean. As in graining bird's-eye maple, the mahogany may now be wetted over, by drawing the mottler and clean water down the panel, and the contrast heightened by sharpening up lights or adding dark touches of colour with wash-leather and pencil respectively. The overgrain is now put in, using the thin hog-hair brush, and working the grain after the formation of the darker curves of colour—hence *crossing* the centre of the feather. Starting upon the one side, the brush is drawn gently up, twisted carefully across the feather with a wavy and spreading motion, and then returned down the opposite half in similar manner. As each journey is made we "badger" the grain slightly upwards from the base before it sets, and then leave the work to dry. The next process is to bind the graining down with, preferably, a coat of varnish, or else japanners' gold-size and turps. Upon this we work the final stage—a rich *overglaze*, as it is termed. Taking a wash of mahogany lake and beer, we rub it all over the work, and with the damp wash-leather we make a pad, and partly roll it over the work. This method leaves an irregular mottled effect, not decided enough to clash with any of our figure, but sufficient to give a relief to the plain portions and a rich general tone to the whole imitation. Should the previous work have plenty of variety and figure, it may be best to merely rub over the afterglaze, and to soften it without mottling; this question, and also the further advantage of strengthening any other previous work, are matters for individual decision.

Graining Satinwood is a process so similar in method and figure characteristics to mahogany, that the learner can execute the one with equal facility to the latter. Although both belong to the same natural order (*Cedrelacæ*), the satinwood is really one of the cedar tribe, but differs chiefly from mahogany in its colour, which is a rich golden yellow. The ground and general tone of satinwood are nearest to maple, but the former is rather fuller in colour. The oil paint for this imitation must therefore be stained to a delicate cream with yellow ochre, and our surfaces must be very finely prepared and painted. The graining colour with which we work the curls and mottle as in baywood should be *raw-terra-di-sienna*, finely ground in water. A little finest burnt umber or vandyke brown may be added to the sienna when we wish to soften down the colour, and a judicious combination of the yellow and brown pigments gives the most natural effect. In graining a door, the curl or feather is usually put in the panels rather softer in contrast than with feathered mahogany, and the surrounding mouldings and stiles are best mottled with some slight coolness of colour and in a simple manner. The final overgraining, with the sable-pencil or hog-hair overgrainers, is executed in precisely the same manner as in working mahogany; the colour used may be either a darker tone of the graining wash, or with a slight tinge of redness added to it. If satinwood be worked cleanly and quietly, care being taken to obtain soft *final* colours, it is an imitation that can be most advantageously introduced into the best decorative effects, and will harmonise with many colour schemes adapted for the drawing-room. As with maple graining, the varnish for satinwood must be the lightest copal that can be obtained.

AN ARMCHAIR: HOW TO MAKE THE FRAME AND UPHOLSTER IT.

BY DAVID ADAMSON.

THE TURNED WORK IN THE ARMS, LEGS, AND STRETCHERS OR RAILS.

FROM the seat and back having been taken first in these remarks about chair construction, it must not be thought that they must in actual practice receive prior attention to other parts. Something has been said about them first, as they seem the only parts about which a difficulty might be likely to occur; and those who understand about them will have no difficulty in understanding the jointing up and general arrangement of other portions. Of course, when making the chair, the various parts will be got and prepared by turning, squaring, etc., before putting them together, and few will need to be told that this should be done "dry," or without glue in the first instance, to see that all the joints, etc., are right. This takes up a little time, but is a precaution which should not be omitted. The making will have to be very good indeed, if none of the joints want a little rectification. Perhaps it will be as well to say that either dowels, or mortice and tenon, may be used at all of them, and if there is any doubt about those at the ends of the arms into the back holding, they may be wedged from behind. It will be as well to explain that, though spoken of here as dowels, this is rather misleading perhaps for the pins at the ends of the arms and stretchers below the seat, as they should be much stouter than is usually understood by this term. They ought, in fact, to be pins of, say, 1 in. in diameter, turned up on this part and not inserted into them. The turnings of the various parts of the chair are shown in Figs. 9 and 17, all lettered to correspond with Figs. 2, 3 (page 410), so that there will be no difficulty in knowing the places they are to occupy. Thus in Fig. 9, marked A, we see that it comes above the seat; Fig. 10, B, just below it, and so on. Only half the length of Figs. 9, 16, and 17 is given, as the other halves are merely repetitions; otherwise all of them are drawn full size.

In Fig. 1 (page 409) the chair is shown without casters, but for those who wish to add these, Fig. 13, showing an alternative foot suitable for them, is given. It will be seen that screw casters are most suitable, the ends of the feet being protected by a ring or rim, which can be purchased along with the casters. In turning, of course, due allowance must be made for the height of the casters, which will be, say, about $1\frac{1}{2}$ in. There is, however, no object in cutting the legs to their exact length till the casters are being put on, so they may be left full. It will be as well, however, to turn them down so that the rims fit on tightly, and as these rims are made in various sizes, it will be just as well to get them beforehand instead of deferring till they are to be fitted. Of course, the feet can be cut down to fit them, and it is often necessary to do this; but it stands to reason that if this work can be dispensed with, or rather, be done while the part is in the lathe, it will be more convenient than to trim them down afterwards.

The turning of the back feet is not shown separately, as no one who can do the work will find any serious difficulty in setting it out, and keeping the same character as the others.

The pieces marked G and H, and the arms, may well be of a little less thickness than the others—say, turned down from $1\frac{3}{4}$ in. or 2 in. stuff. The parts of the arms not shown on the full-sized turning of these parts are intended to be left square for the pads, with which Fig. 1 shows them to be finished.

Very likely some may prefer to leave the ends of the stretchers under the seat square, tenoning them to the legs, and then running pins through in the orthodox way of old woodwork. Well, they can do so without difficulty or much disfigurement to the chair, but even without this obsolete construction it ought to last a lifetime, and then descend to "generations yet unborn." Those who choose to adopt it may, of course, do so, but I do not advise it, simply because with good workmanship and material it is unnecessary. To be consistent, such people should not have the seat or back upholstered. A piece of tough hide stretched across the former, and a carved panel in the back, will last much longer than any modern upholstery. They will not be so comfortable, but then they will be ever so much more like the crudities of the year 1589 or thereabouts, and by all means let us "advance backwards" in furniture construction, because a few odds and ends of things have had time to become old, whereas our modern work has not had the same opportunities. I say this, because a few people have objected to the remarks in WORK which do not imply a profound reverence for all that is old, even though it is not very good, but simply because it is very old. I admire old things: not

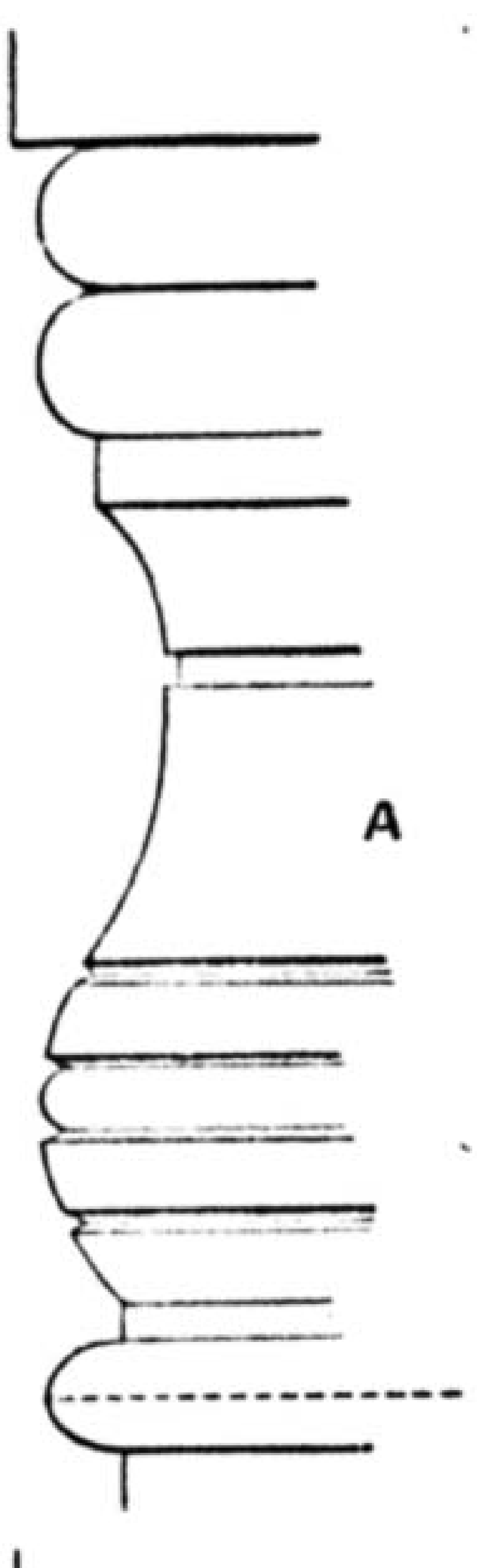


Fig. 9.—Part of Turning on Front Legs: Top, above Seat.

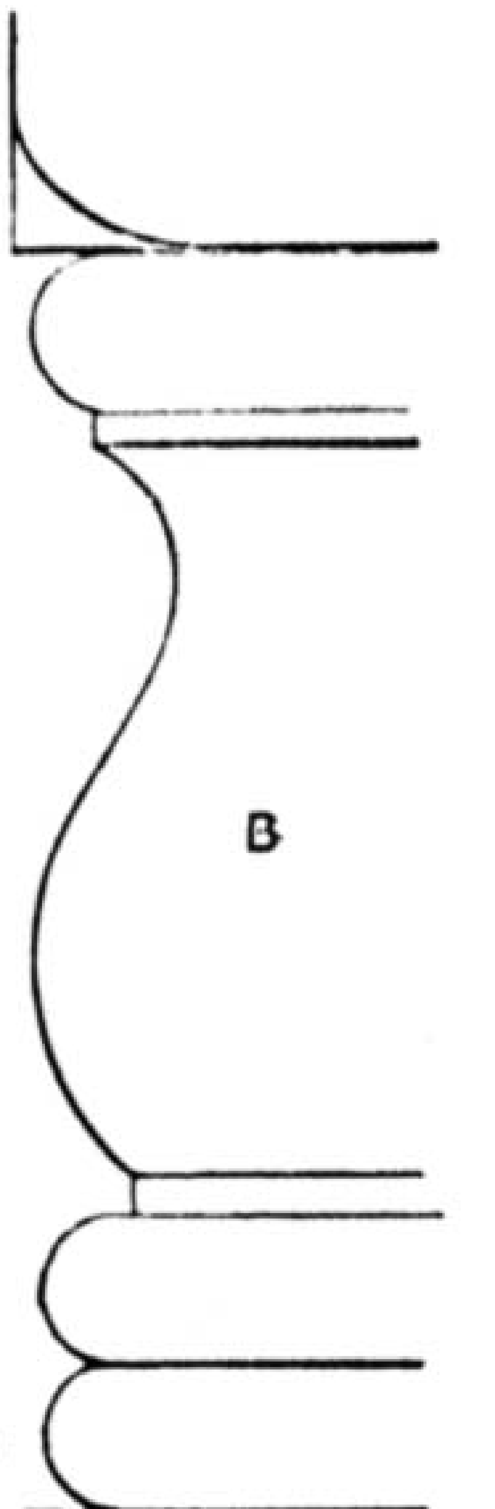


Fig. 10.—Part of Turning on Front Legs: below Seat.

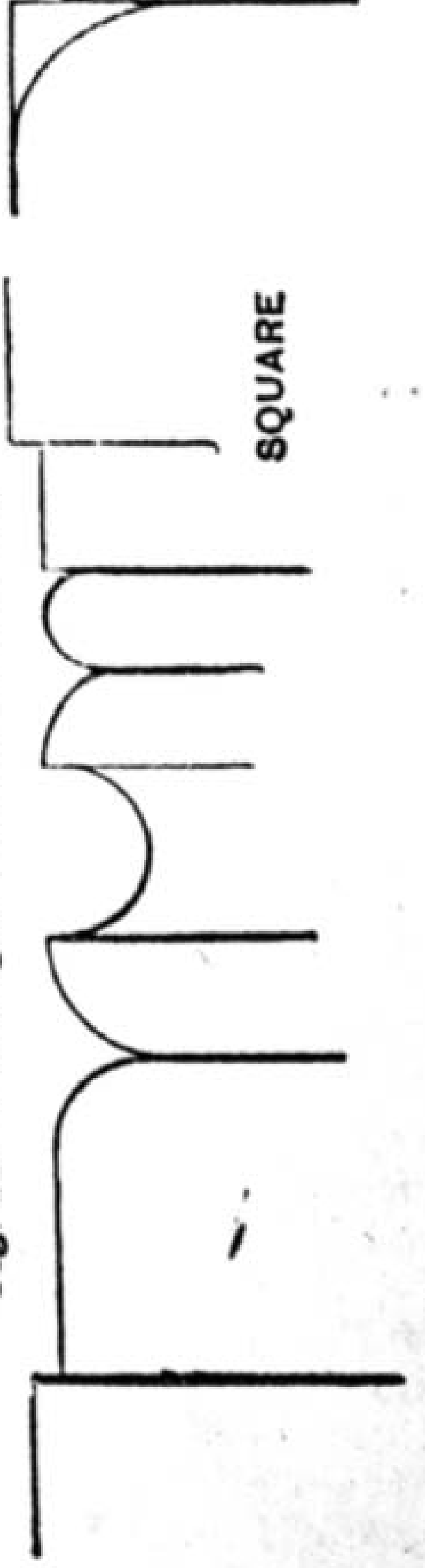


Fig. 14.—Turning on Front End of Arms.

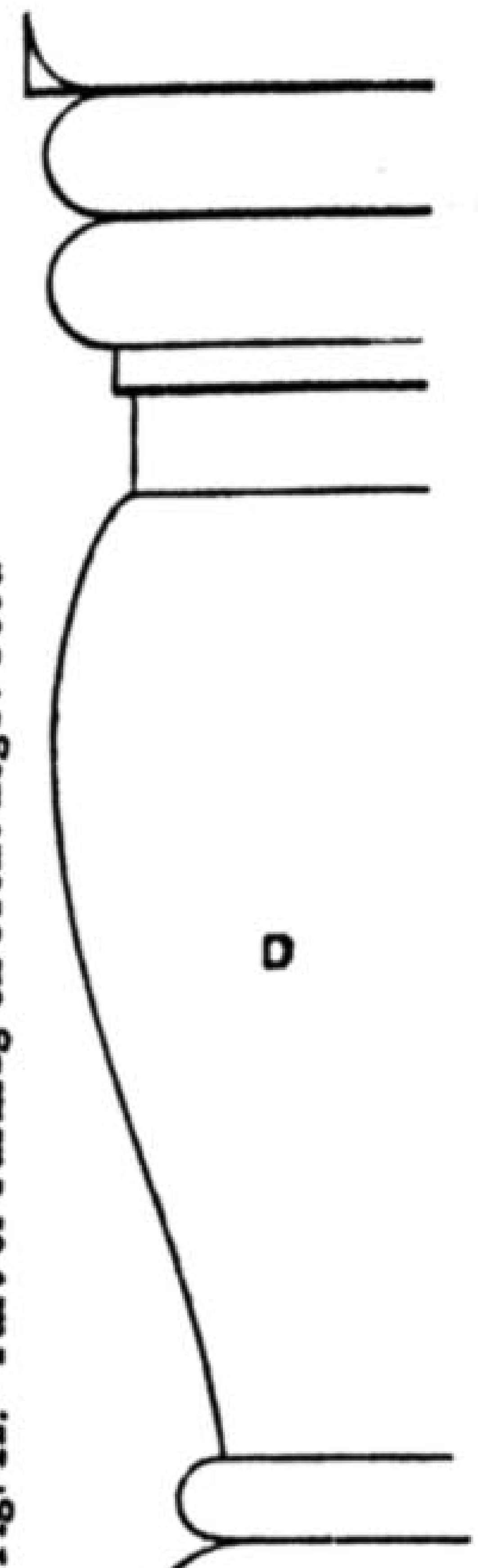


Fig. 12.—Part of Turning on Front Legs: Foot.

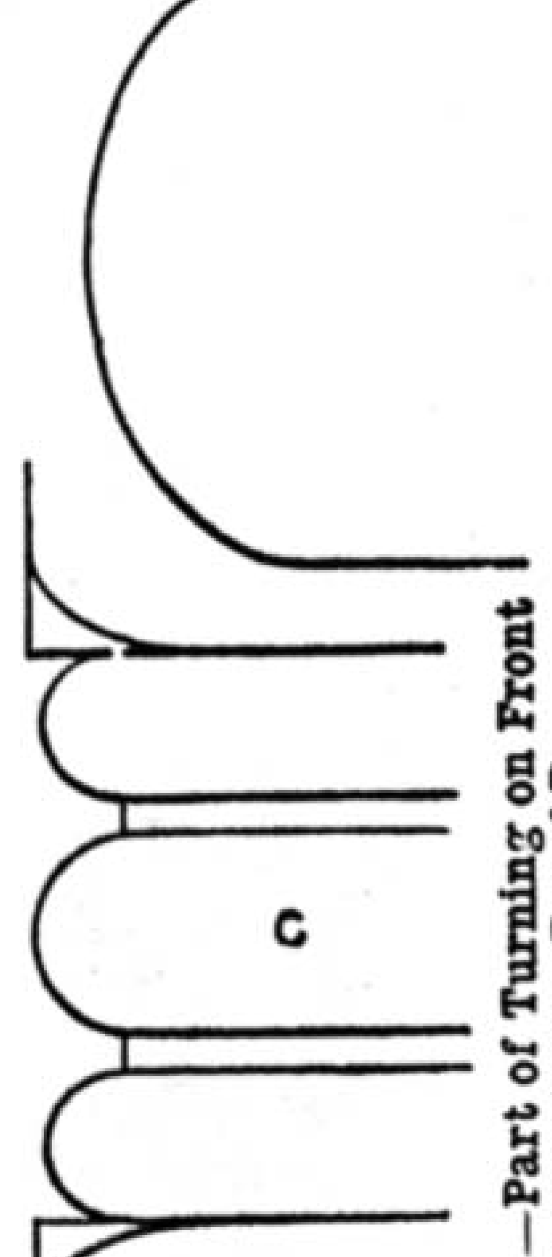


Fig. 11.—Part of Turning on Front Legs between B and D.

Fig. 15.—Turning on Hinder End of Arm.

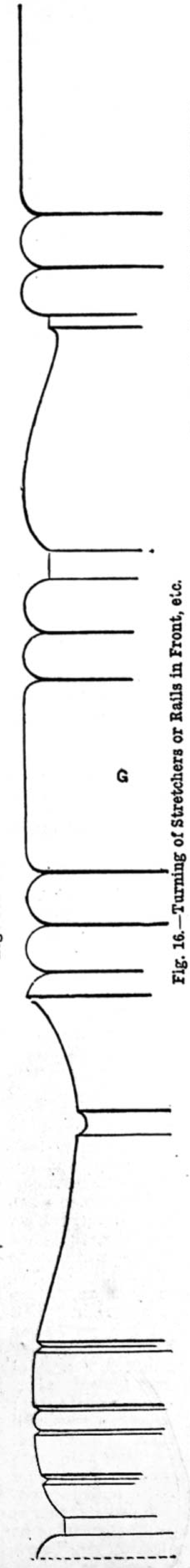


Fig. 16.—Turning of Stretchers or Rails in Front, etc.

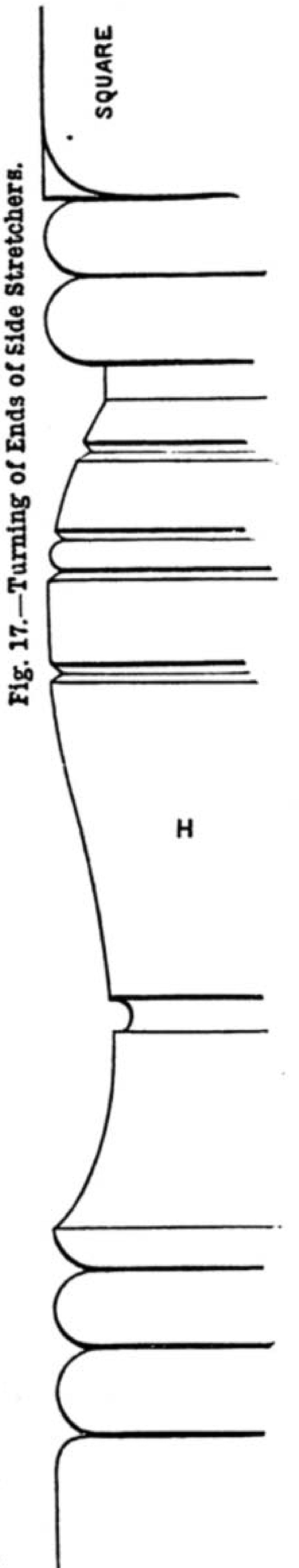


Fig. 17.—Turning of Ends of Side Stretchers.

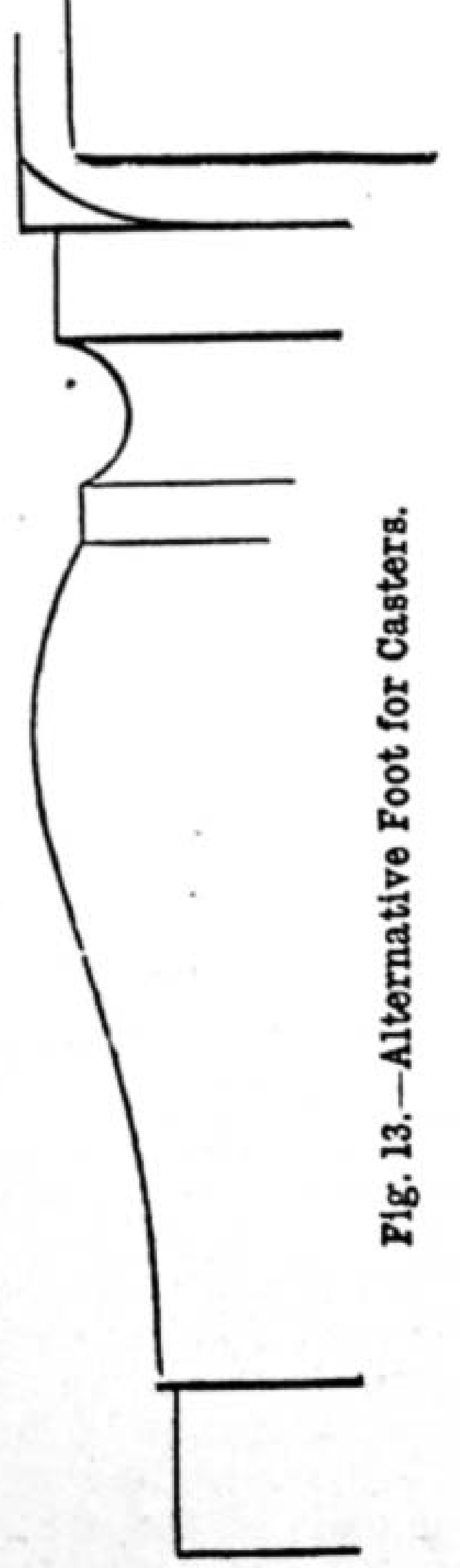


Fig. 13.—Alternative Foot for Casters.

indiscriminately, but just enough to learn any good lessons they may teach us; but I feel that the opinions of others ought to be respected. Therefore, I have much pleasure in—I was nearly writing, pandering to—their prejudices: but that will not do, so let it instead be said, of indicating the course to be pursued in endeavouring to rival the sound, substantial work of our ancestors, whose constructions still remain (often in a very rickety condition) to show to us effete moderns, addicted to every time-saving appliance and graceful finish, what manner of men they were, what primitive tools they used, and how horribly rough much of their work necessarily was. They did quite as well as a modern artisan would do if he were devoid of education, if he only had a few old-fashioned tools and plenty of time to work, seldom hurried, and without much competition. Yes, the old carpenters were wonderful people, considering their opportunities—nearly as wonderful as their modern representatives, from whom infinitely more is demanded, sometimes unreasonably. Surely, after these admissions, no artistic reader of WORK will venture to think that all due praise, not unlimited in extent, is not given to our old English craftsmen. Let me advise those who wish to imitate them in every way to begin by dispensing with, say, the modern lathe, and get an old-fashioned pole lathe instead. It will be much more cumbersome, and it will not do its work so well; but what does that matter? it will enable the turner to "live up to" the rough old times; and, yes, he must not use glue nor screw-nails, nor if he feels tired must he ever think of resting on any seat more comfortable than the old-fashioned "settle." In fact, he must discard every convenience and improvement which has been devised—not to go too far back—during the last two centuries. This leaves little to be said now to those who want to make a real good, sound, substantial, ugly, uneasy chair, in approved Tudor style, and having told them what to do, the worker who prefers modern ideas may be further directed.

Nothing has been said about the carving on the front legs, as it is of such a trivial character that sufficient indication of its style may be gathered from Fig. 1. It amounts to little more than a few incised lines, with just a little notching, suggesting rather than forming leaves or foliage. Of course, any amount of work may be lavished on the carvings, but, on the other hand, just enough to relieve the plain surface looks very well.

We may now consider the frame made, and ready for the next operation, which may either be the polishing or the upholstering, as far as the stuffing is concerned. The outer covering should not be put on till after the frame is polished. If any staining is required, it should be done before the upholstery is begun, unless, indeed, the wood is to be darkened by fumigation. Even in this case it may as well be done now, though if to be fumed, I should advise those who have no convenient air-tight room, cupboard, or box to hold the frame when put together, to do the darkening while all the pieces are loose. A comparatively small box will hold these, and the chair can be formed afterwards. If the chair is to be wax-polished, which is the best way of finishing fumigated oak, the polishing may be deferred, but if it is to be stained and French polished, this should be done before the cover is put on, leaving a final wipe over to remove any accidental marks or smears. The chair, in fact, should be completed otherwise, and only require touching up by the polisher to finish it after the covering is on. It is almost needless to say that such a chair will look better with a dull polish than with a highly glazed finish. Any of the ordinary brown stains may be used, but I would specially caution amateurs not to thickly coat it with varnish. If they prefer varnish to polish, let it be a spirit varnish, which will give quite sufficient gloss without "treacling" the wood. I do not know that anything more need be said about polishing, so I will get on with the upholstery in my next.

A HANGING MIRROR WITH BRUSH BOX ATTACHED.

BY ED. C. ROE, JUN.

A GREAT number of the newly erected smaller class of houses are built with halls, or rather entrance passages, of somewhat limited dimensions, and thus do not afford sufficient accommodation for an ordinary hat and coat stand or rack. But, however small a place may be, it is not any the less desirable that a piece of suitable furniture should be provided, the essential points of which should be a mirror and a receptacle for a hat and coat brush; a few hat pegs may be added at discretion.

In designing the mirror, care has been taken to render the details so that, while effect has not altogether been sacrificed, the work shall be comparatively easy to execute, and with the tools in the possession or within the power of the average amateur to make. Alternative sections are given of the mouldings.

Regarding material to be used, it is scarcely necessary to point out any particular wood, nearly every variety admissible for use in cabinet work being suitable—even pine or deal, which may be enamelled. It is largely a matter of individual taste; personally, wainscot oak is preferred. The only matter offering any really serious difficulty is the lid of the brush box, but in case this should prove beyond the power of any worker, an alternative method is shown at Fig. 1, and will be described in due course.

It is to be regretted that we cannot have a full-size elevation of at least the side brackets; yet we should be thankful for small mercies, for we have the remedy in our own hands, and it is to set it out for ourselves full size off the 2 in. to 1 ft., or one-sixth full-size, drawings. The sections given are two-thirds size, and each section of moulding should be enlarged to full size and traced from the paper, and then the tracing should be mounted on a thin piece of pine or mahogany, say $\frac{1}{16}$ in. thick, which when dry may be cut to the pattern indicated by the lines upon the tracing paper. We thus get a thin section of each moulding or bead. The use of these sections will be described as we proceed. It is intended that the mirror should be bevelled, the additional beauty afforded being well worth the extra cost; and if we can only do for ourselves, or in the absence of sufficient skill persuade a good-natured artistic friend to paint a few rushes or a spray of flowers from one angle outwards, it will add greatly to the general effect.

We will commence by making the frame which holds the mirror; the outside dimensions of it are 12 in. wide by 14¾ in. high. The width of the moulding is 1¼ in., thus making the right size 9½ in. by 12¼ in. It will not do to mitre together—that is, providing we adhere to the original section. The reason for this will be clearly seen upon reference to front elevation and section: the only part mitred is the ovolo on the inner edge. This being the case, it will be necessary probably would do were it mitred. The setting out for the scribing is exactly the same as for mitring, the difference being this: the stiles remain as they are with the moulding running through from end to end intact, and the ends of the rails are cut as shown at

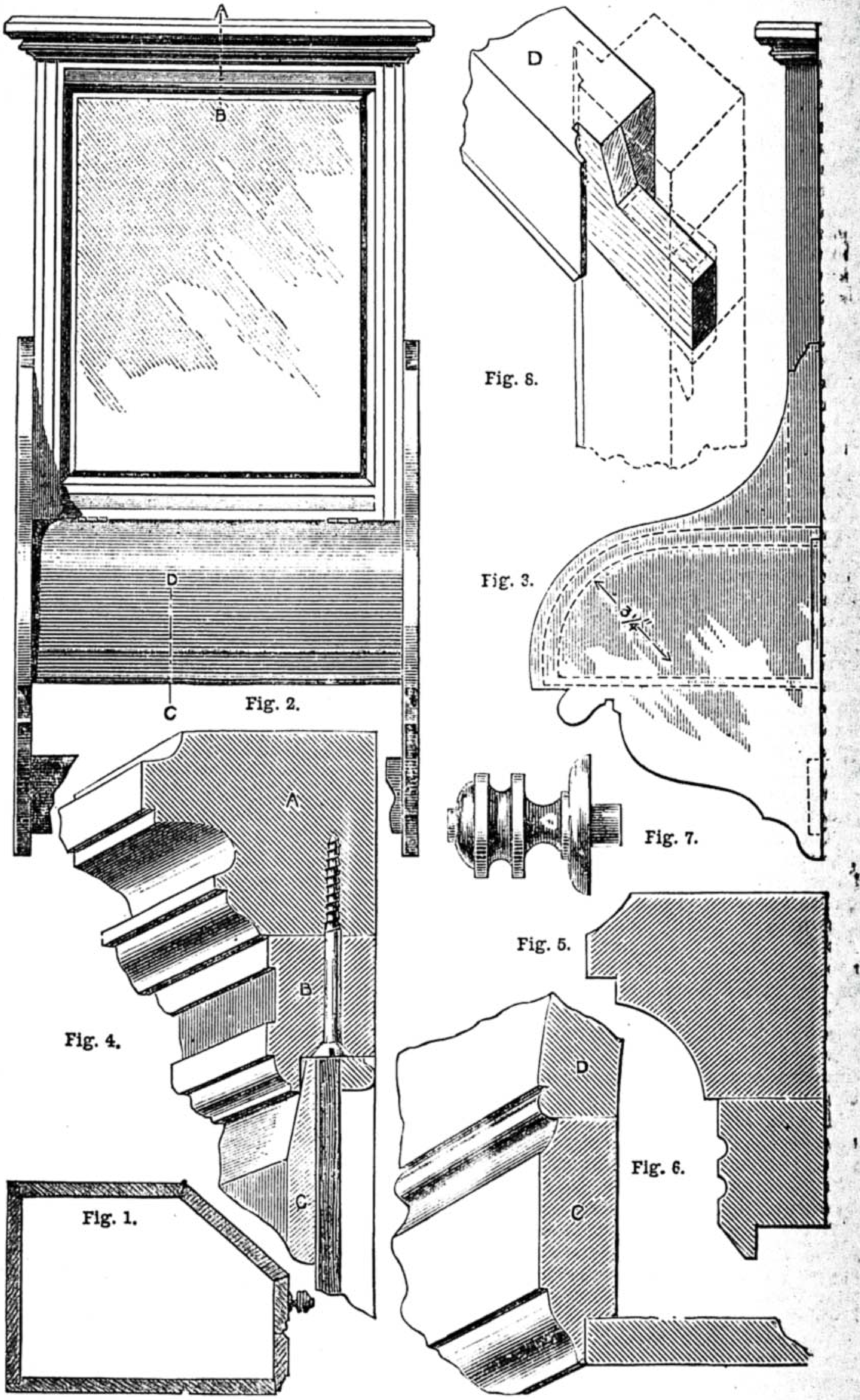


Fig. 1.—Alternative Lid for Brush Box. Fig. 2.—Hanging Mirror: front elevation. Fig. 3.—Ditto: side elevation. Fig. 4.—Section of Cornice of Mirror at A B in Fig. 1. Fig. 5.—Alternative Section of Cornice at A B in Fig. 1. Fig. 6.—Section at C D in Fig. 1. Fig. 7.—Knob of Brush Box. Fig. 8.—Mode of morticing and tenoning Rail to Uprights.

to use the mortice and tenon, which may be run through, or be merely stubbed in. The setting out is shown by dotted lines, and the finished tenons, etc., by thick lines.

Sometimes it is preferred to scribe the ovolo in lieu of mitring; in many instances this is desirable, as in the case of the material shrinking the joint will not gape, or, in other words, open, which it most

Fig. 8. The proper method of scribing is first to mitre the ovolo on rail in the same manner as though it was intended to mitre together, and then to clean out with a sharp tool the material which is within the surface affected by the bevel made. If this is properly executed, the exact counterpart of the corresponding moulding will be obtained, and if the mouldings are worked true to section, a

good fit should be ensured. It is rather a difficult matter to describe on paper; indeed, far more so than the actual work, for scribing is, with tools properly in order, a very simple and interesting job.

The frame being completed, let us turn to the side brackets; these should be a bare $\frac{3}{8}$ in. thick. The centres for striking the curves are given. The edge is finished square, and this being the case, great care should be taken to keep the arrises in perfect order.

In the inner face of each bracket we shall require the housings as shown by dotted lines, Fig. 3. These are to receive the ends of the hanging and front pieces, bottom and back, which may be at once got out and fitted; two-thirds size section of front and bottom is shown at C, Fig. 4. Of course, the portion occupied by the lid is not housed, neither where mouldings occur. Accurate fitting into the housings is most desirable. Take each in hand singly and work strictly to the sections. The use of the thin sections will now be apparent, taking as an example the front piece C. After fitting, the ends should be slightly chalked, the thin pattern placed on, and with a finely pointed pencil the outline marked; reversing the pattern, the same thing must be done to the other end, and thus we get a guide each end exactly similar to work to. Of course, proper care must be taken to work quite square. The moulding on the front edge of C should be worked in after fitting by means of a router or bead plane and round. Give great attention to the length of these pieces; the exact length is the width of frame plus the depth of the housings, which are in this case $\frac{1}{4}$ in. deep, this making the total length $12\frac{1}{2}$ in. Glue together with fresh glue, or, if not objected to, screw from outer face with brass cross-cut round-head screws as indicated upon side elevation. Glue is also advisable in conjunction with the screws.

The alternative method is shown at Fig. 1. It is much simpler, but scarcely so effective; nevertheless, the purpose will be served and look well. The section drawn to scale will show what is intended without further explanation; the joints should be tongued and glued. The position of the hinges is shown upon Fig. 2; $1\frac{1}{2}$ in. brass narrow guage pressed butts will do admirably. The various systems of hingeing have been so aptly dealt with in previous numbers that a description here may be considered unnecessary.

Having arrived at this stage, the frame may be cleaned off and fitted between the side brackets; great care must be taken in fitting. Strictly speaking the frame should be rebated into the side brackets, but it is scarcely necessary, and tends to make the job longer and more tedious. However, the suggestion is made, and some may possibly wish to act upon it; the same observation applies to bottom edge.

We should now prepare the capping or top moulding, section A. The length required is roughly 1 ft. 10 in.; this will allow ample for mitring. It is advisable to mitre the ends and not to return the moulding upon itself, as the latter method is a longer job, and seldom in amateur hands successful. If carefully mitred, good glue will hold sufficiently. The finished length will, of course, be governed by the width of the finished frame, thus: if the frame is exactly 12 in. wide, the extreme length of the capping will be $14\frac{1}{2}$ in. A couple of screws as indicated at A and B will suffice to fix.

Possibly a hat rail would prove a convenience, therefore one is indicated under the box, Figs. 2 and 3; should a rail be affixed a rebate must be cut in the sides, not through, but the thickness of the stuff one way and say $\frac{3}{8}$ in. the other. The remaining job is the knob; a suggestion for this is given in Fig. 7. This should be executed in the same material as rest of work. A small brass octagon knob might be used with advantage. Should a wooden octagon knob be preferred, the stuff must first be turned to pattern, and then with keen chisels, etc., cut to hexagon form, pencil lines being carefully placed thereon to work to.

When ordering the glass give the sight size, which is the size between the inner edges of frame. The rebate size may also be given in addition. When the glass is placed in the frame, two or three pieces of good stout new brown paper should be laid on the back prior to fixing the back in. By the way, do not omit to blacken the rebate of the frame and the edges of the glass; this operation being omitted, is often the cause of a disagreeable appearance of the edges after the glass is fixed and looked at from the front. The back need only be $\frac{1}{8}$ in. thick, as shown in section. The beads must be mitred round, and will make a capital finish to the back, which is too often neglected. Our job is now completed—that is to say, as far as the mechanical portion is concerned; the beautifying processes must perforce be left to hands more experienced in such matters, and upon reference being made to previous numbers, various methods of finishing will be found lucidly described.

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 any one 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.*

100.—NEW HAND-BEADING AND SASH-MOULDING TOOLS.

OF late years scratches and routers of the spokeshave class have come very much into use, and the two new tools that I am about to describe are very favourable specimens of their class. Of course, I do not pretend for a

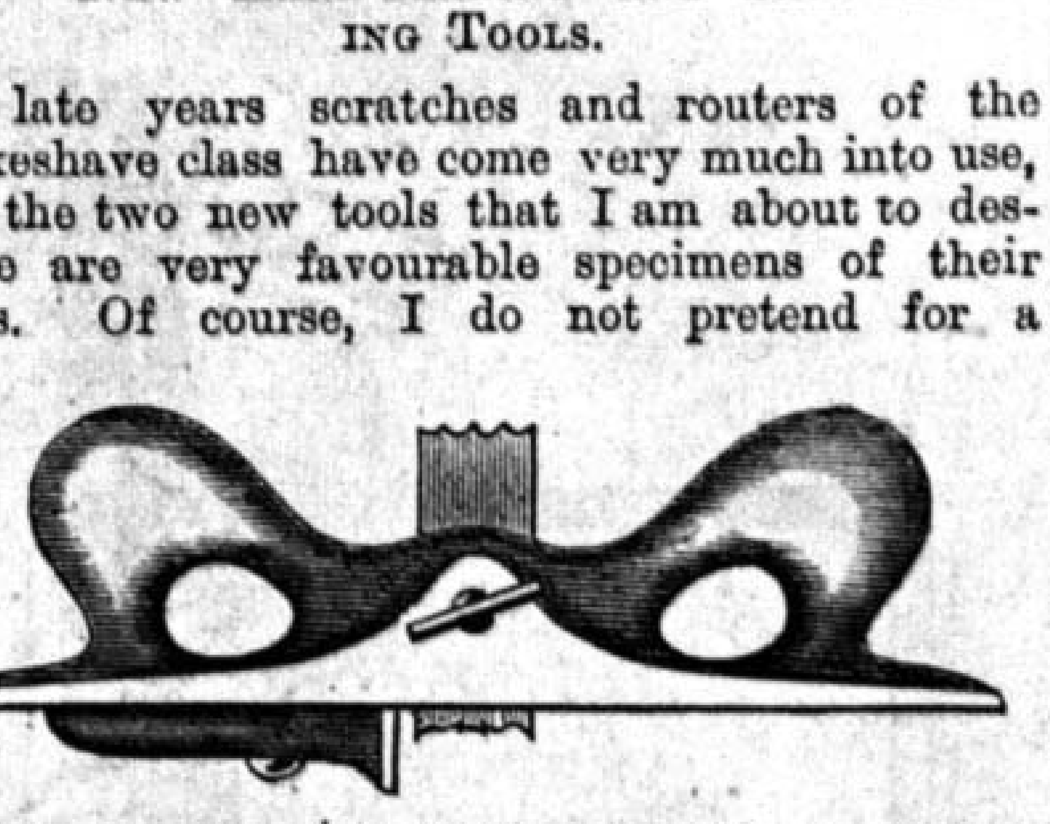


Fig. 1.—New Hand-beading Tool.

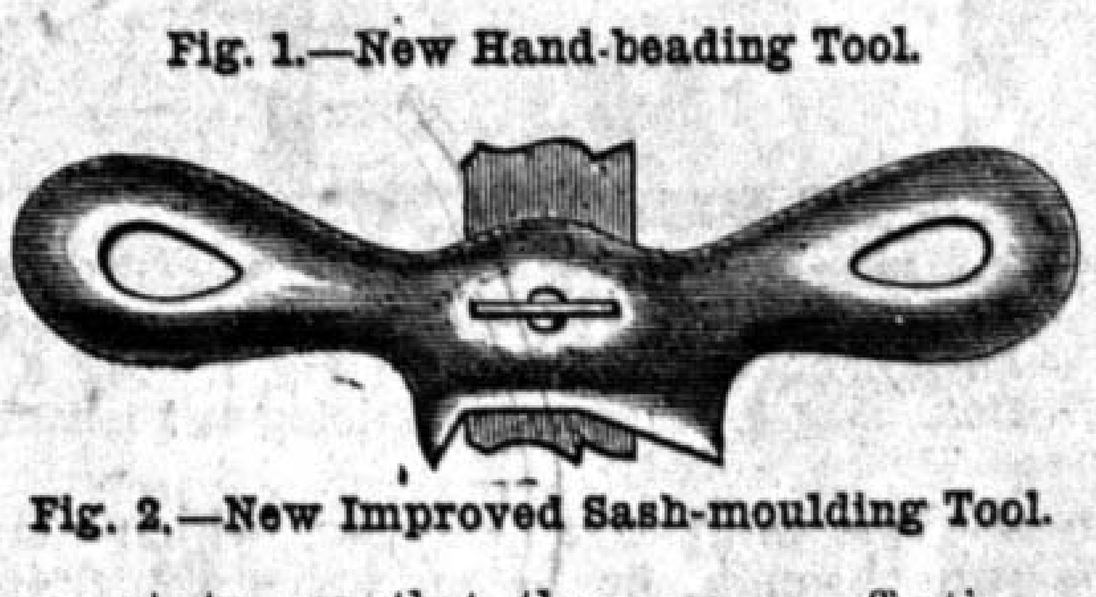


Fig. 2.—New Improved Sash-moulding Tool.

moment to say that they are as effective as planes made for the same purposes as those for which the tools now under consideration are intended, but planes are costly and beading tools and scratches are cheap, and therefore the latter are far more within reach of the amateur and even the individual workman who wants to do an odd job of the kind who would buy them and refuse the planes on the principle of the Jew caterer, who was wont to say that he always bought mutton "becos it vosh sheep," and never bought venison "becos it vosh deer." Possibly some reader may fail to see the joke, but should this be the case, I shall be happy, as many of my contributors say, to render further assistance in the way of elucidation in "Shop." These tools have been introduced by Messrs. Moseley & Son, Tool Makers and Cabinet and Builder's Ironmongers, 323, High Holborn, W.C. Fig. 1 gives a front view of the New Hand-beading Tool, which is accompanied by six irons, each having two cutting edges, comprising in the twelve cutting edges thus supplied, beads, reeds, quirks, rebates, and hollow and fancy reeds. This tool is supplied post free for 2s. 3d. The appliance itself is of japanned iron with a bright front. Its extreme length is about $5\frac{1}{4}$ in. Its construction, by means of the wings at the sides and the holes by which they are perforated, affords a secure grip between the thumb and index finger of the operator. A thumbscrew in front is used to secure or release the cutting iron which passes through a slot in the body of the tool. Below is a fence interchangeable to either side of the cutting iron, and possessing by means of two screw holes in the sole for the screw that secures it, a range of distance from the cutting iron not often found in tools of this description. Fig. 2 also gives a front view of the New Improved Sash-moulding Tool, which also has six irons, and therefore twelve cutting edges—six for lamb's-tongue moulding, and six for ovolo moulding, the irons for each description being $\frac{1}{2}$ in., $\frac{9}{16}$ in., and $\frac{5}{8}$ in., by $1\frac{1}{2}$ in.; $\frac{5}{8}$ in. by $1\frac{3}{4}$ in.; $\frac{5}{8}$ in. by 2 in.; and $\frac{3}{4}$ in. by 2 in. The extreme length of the body of this handy tool is $5\frac{3}{4}$ in., and its height $1\frac{3}{4}$ in. The cutting iron is held in position or released by a thumbscrew, as shown. It will be noted that the peculiar confirmation of the sole in which the cutting irons work is especially adapted for working sash mouldings with this instrument. Its price, post free, is 2s. 6d.

101.—A MANUAL OF WOOD CARVING.

This is a clearly written, beautifully and effectively illustrated, and well-printed guide to the attractive art of wood carving from the pen and probably the pencil of Mr. Charles G. Leland, F.R.L.S., M.A., who is well known as a practical writer on practical education. It is revised by Mr. John Holtzapffel, whose name is too well known to need any remark from me. Every one engaged on the book has done his best to render it one of the most perfect of its kind. The subject matter, instead of being divided into chapters in the usual way, is so distributed as to take the form of an introduction, twenty lessons, and an appendix. Of these the introduction gives necessary instructions regarding the woods and tools to be used, and on sharpening the latter, for tools possessing the keenest possible edge are always a *sine quâ non* to the wood carver. The lessons comprise technical teaching on the various operations necessary in wood carving, from indenting and stamping to spot cutting. Nothing is forgotten, and in consequence nothing has been omitted. Ample advice is rendered on repairing, gluing, colouring, staining, oiling, etc. The appendix deals with suitable objects for wood carving. Over eighty illustrations are to be found in the 160 pages of which the work consists, and these are supplemented by six full-page plates. I do not know the price, but this may be ascertained from the publishers, Messrs. Whittaker & Co., Paternoster Square, London, E.C.

102.—PRACTICAL BLACKSMITHING.

That WORK is becoming well known in the United States is supported by the fact that occasionally American publishers send through their London agents books for notice in its pages. "Practical Blacksmithing" is one so sent, and forms the third of a series of four, which purport to be "a collection of articles contributed at different times by skilled workmen to the columns of 'The Blacksmith and Wheelwright,' and covering nearly the whole range of blacksmithing, from the simplest job of work to some of the most complex forgings." The volume is compiled and edited by Mr. M. T. Richardson, the editor of the publication just named. Chapters 1 and 2 of this volume are devoted to the consideration of various tools and wrenches used in the smithy, and the remainder to various operations in forging, such as welding, brazing, etc., the last being devoted to plough work, a branch of blacksmithing of the utmost importance in the United States. The London publishers are Messrs. Kegan Paul, Trench, Trübner and Co., Limited. THE EDITOR.

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.*

I.—LETTERS FROM CORRESPONDENTS.

Size and Speed of Pulleys.—BRASS writes:—"In my reply to DICK, No. 83 of WORK, page 503, two slight mistakes have been made. In line 16 from top of reply, counting such as $\frac{V \times D}{v}$ as one line, there is printed the words 'in a *practical* form'; this should have read, in a *fractional* form. Again, in line 31, a sentence begins—'*Cut* down in the form of a fraction;' this should be '*put*,' etc."

To Make Reversed Tracings Quickly.—J. C. K. (*London, N.W.*) writes:—"Place the drawing face down on a sheet of clear glass with an electric light under it; by placing your drawing-paper over your pattern you can trace the finest lines distinctly."

Speed and Size of Pulleys.—A. R. (*Scorrier*) writes:—"Formulas in letters may be, and no doubt are, very simple to many readers of WORK. But when we think that WORK is chiefly for the working class, we should also think that there are many readers who are not highly educated, and that questions so answered, though very clear to some, may be very puzzling to many others. I notice E. D., in replying to STRAINS (see page 503, Vol. II.), said, 'Don't be startled at formulas, as they are only letters'; also BRASS, in reply to DICK, on the same page, said, 'If this is not clear to you, write again,' both indicating that such formulas may not be clear to some. Therefore I give, for the benefit of such readers of WORK, a very clear and simple rule for finding speed and size of pulleys. For instance, a pulley 60 in. diameter makes seventy revolutions per minute; what number of revolutions will be made by a 12-in. pulley when driven from it?

Example— 60 in. diameter of driver.
70 revolutions of driver.

12) 4200
350 revolutions of driver.

Again, what diameter pulley would be required to run 350 revolutions per minute when driven from a pulley 60 in. diameter, making seventy revolutions per minute? Example— 60
70

350) 4200
12 in. diameter required.

I think the above will be clear to all, and that it will be seen that the above rule will answer for pulleys of any diameter."

Oval Drawing.—J. B. (*Wallington*) writes:—"Surely your correspondent F. C. (*Leytonstone*) (see page 519, No. 84) cannot be in earnest when he says that it is impossible to draw a parallel to an ellipse either by trammel or peg and string. Strike an ellipse with a trammel, then cut three, six, or any number of inches off the end of the rod; if that does not strike an ellipse parallel to the first one, it must be 'awfully near it,' or I must have been working radically wrong any time this last twenty years. Perhaps the following few notes may be useful to F. C. or some of your readers:—(1) An ellipse is the section of a cylinder cut in an oblique direction. Cut it off the broom handle. (2) The circumference of an ellipse is continually altering in its direction. (3) The focii (is that Latin or Greek? suppose we call it focus) of an ellipse is the exact geometrical proportion between the two circles, which may be struck on the transverse and conjugate diameters of an ellipse. (4) Any two lines drawn from the focus of an ellipse meeting together in the circumference are together equal to the transverse or longest diameter. The above is the rule for the string and pin method. F. C., in altering the length of his string, neglects to alter the focus, or points in which his pins are placed."

Simple Wood Carving.—J. E. B. (*Ashton-under-Lyne*) sends, for the benefit of beginners in wood carving, his experience in following this pleasurable hobby:—"Most readers of WORK have, no doubt, read with interest the many articles from time to time inserted on the subject of wood carving, and yet so little has been said of the methods resorted to to produce the artistic carving which decorates the major part of our woodwork, that I venture to offer a few suggestions to the amateur, which, if carefully adhered to, will enable him, with practice, to become a proficient wood carver. The tools necessary for the beginner are few and inexpensive: they consist of a parting tool, which can be purchased, with handle complete, for one shilling, the ordinary joiners, gouges, and chisels of various sizes, and the punches, which can be easily made by filing the end of an ordinary bolt in a criss-cross manner from the necessary outfit of the wood carver. Thus armed, he provides himself with a sheet of black impression or tracing paper, and the wood upon which he intends to develop his designs. The designs can easily be secured by placing a piece of stiff paper over some old carving, and rubbing it with heel-ball until the design is plainly reproduced on the paper, after which the workman copies, by tracing the lines, by means of the impression paper, on the wood he intends carving. If the workman be able to draw and make his own design the copying process is not necessary, but any number of designs can be secured by the above process. The workman takes half his design to begin work on, and cuts out the lines with his parting tool, taking great care to keep the cutting a uniform depth, and to hold the tool firmly in the right palm, using the left as a brake to regulate the speed, and to carefully guard against mis-slips, and guiding the tool with the right hand until the outlines of the design be complete. The shapes of leaves, flowers, pateras, etc., are all outlined with the parting tool; they are next hollowed out with a gouge, a thin stem cut to form a centre, and the fibres finely cut from the centre to the outside edge of the leaves, which are next cut downward with a quarter gouge, a gentle tap with the mallet being sufficient to get the required depth; they are next finished off by gently cutting down to the quarter gouge mark a slant cut with an ordinary chisel. Fig. 1 represents half of a design, consisting of centre patera and leaves. To secure an exact copy of the work completed, the workman turns his design paper over, upon which he will see a fac-simile of the design which he has carved; this fac-simile forms the pattern for the completion of his work. The design in Fig. 2 is a very simple one for the young amateur. There are only two tools necessary in carving this; the centre stem and the outlines of the leaves are carved with the parting tools, and the leaves hollowed slightly with a gouge; the sprays are easily notched in with the parter by cutting in towards the stems about ¼ in. long by ⅛ in. deep; this class of work is known as incise, and opens the way for the amateur to the grander and more artistic raised work. By carefully noting the work of professional carvers the student will readily see how the work has been done, especially as he becomes by practice more and more familiar with the use of his tools; improvements and designs will readily make themselves apparent to the workman. Mr. Adamson's article in a late edition of WORK furnishes some excellent designs to work upon, and those readers who have retained copies of those numbers may easily enlarge the designs by means of a pentagraph, which may be purchased from any artist's colourman. The back numbers of WORK which contain carving designs can be had on application, and to those who still have them they will prove valuable as they gradually become good carvers. More important even than skill to the amateur is sharp tools—in fact, it is indispensable that the tools should be kept sharp, for if dull carving is monotonous, and robs the student of his object. For learners I should recommend cypress wood as being best suited for incise carving, for though soft and easily worked, it retains all the qualities of the harder woods, and cuts even, making a very nice appearance when carved and polished in the white. I do not see why more cabinet-makers and joiners do not add wood carving to their trade, when a very short time spent in practice would enable them to do most of their own carving."

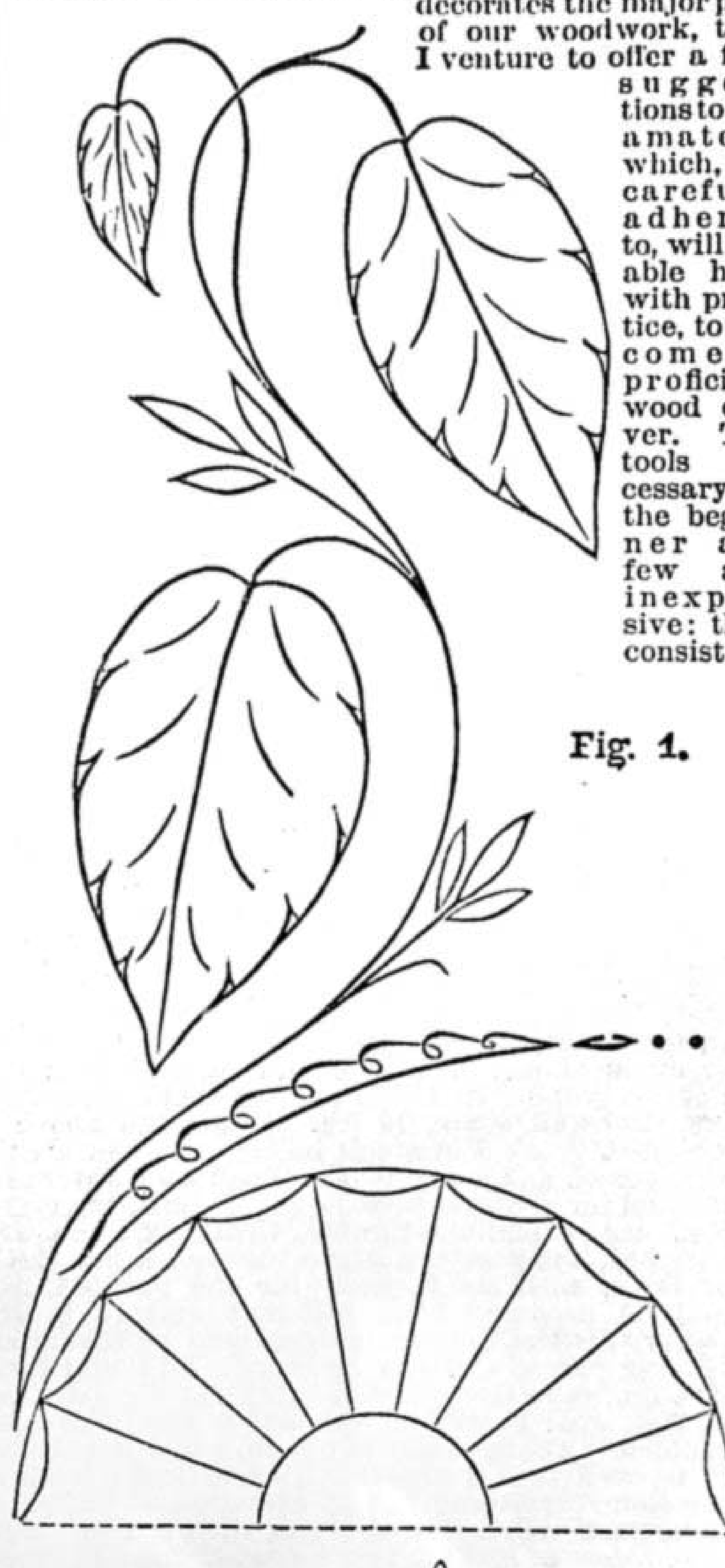
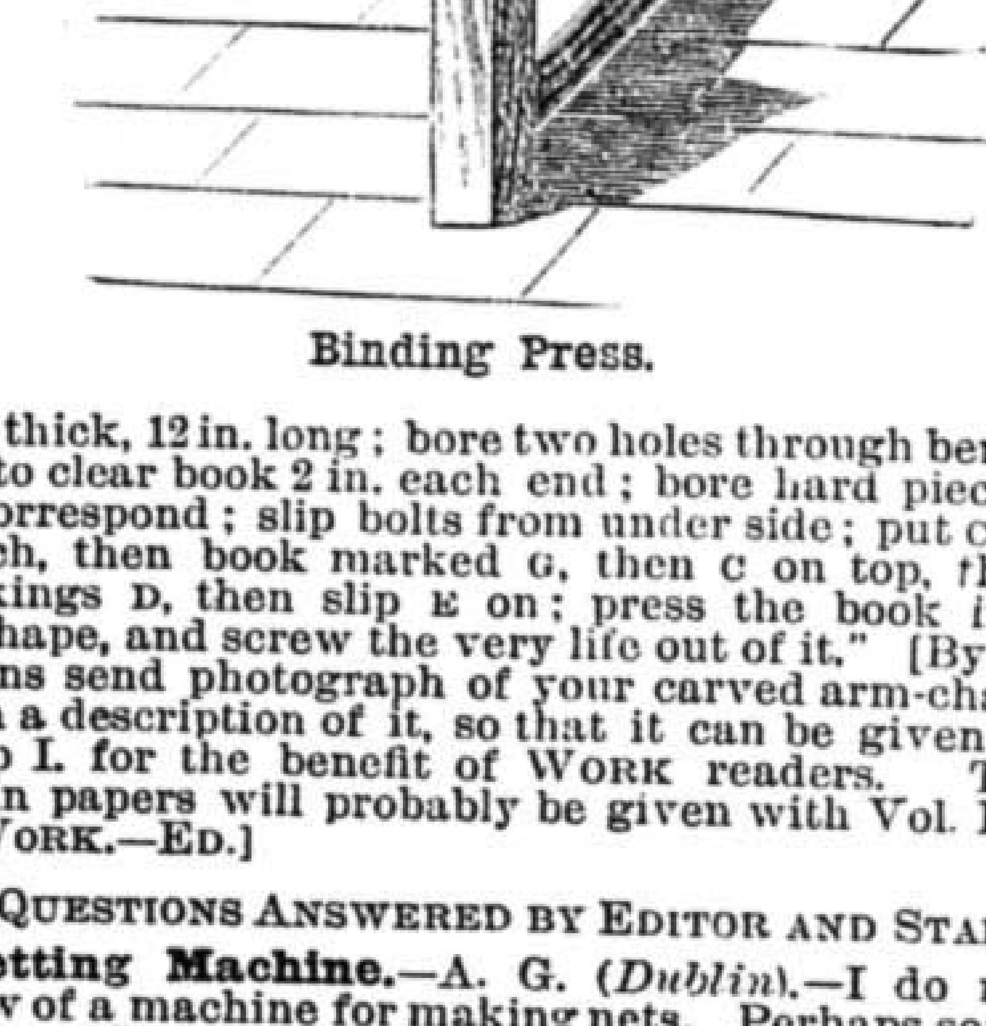


Fig. 1.

Fig. 2.

Simple Wood-carving Designs.

Binding Press.—E. P. (*Warrington*) writes:—"I give you an idea of my own for a binding press. It answers first-rate, and is cheap. I send rough sketch. A is top of work bench. If you have not a bench, get a piece of 3 in. plank. B, B, legs of bench; C, C, two pieces of pine about 9 in. by 12 in. by 1½ in. thick, planed square on edges; D, D, packing which keeps the top board C stiff; E, strong piece of hard wood 3 in. by 2 in., about 20 in. long; F, F, two bolts ⅝ in. thick, 12 in. long; bore two holes through bench top to clear book 2 in. each end; bore hard piece E to correspond; slip bolts from under side; put C on bench, then book marked G, then C on top, then packings D, then slip E on; press the book into its shape, and screw the very life out of it." [By all means send photograph of your carved arm-chair, with a description of it, so that it can be given in Shop I. for the benefit of WORK readers. The violin papers will probably be given with Vol. III. of WORK.—ED.]



Binding Press.

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Netting Machine.—A. G. (*Dublin*).—I do not know of a machine for making nets. Perhaps some reader of WORK may know of such a machine, and will give particulars of it—where it can be obtained, and the price.—G. E. B.

Maker of Electric Scarf Pin.—T. S. E. (*Birmingham*).—These articles are made in Paris. I do not know the maker's name. They are imported to this country by Messrs. J. E. Hartley & Co., 13, St. Paul's Square, Birmingham.—G. E. B.

Spon's Receipts.—STEEL WORKER.—The book you inquire after is "Spon's Workshop Receipts," four volumes, 5s. each, published by Spon & Co., 125, Strand, London.—K.

Bookcase and Piano.—A. E. S. (*London, S.E.*). You know nothing about polishing, and wish to have your furniture restored to its original beauty without running the risk of injuring it in any way. Undoubtedly it would be advisable to pay and have it done by a good man. From your remarks the bookcase probably only requires cleaning and "touching up," in which case the cost of doing it will not be so much as if it required entirely re-polishing. Your piano probably requires this.—D. D.

Re-lining Oil Paintings.—B. A. K. (*Sunderland*).—This work requires great delicacy and extreme care. If you are not accustomed to it, you had better not attempt it. Be content, if the pictures are of small size, with mounting them on a panel; or, if larger, restretching them on an ordinary frame.—D. D.

Decorating a Screen with Christmas Cards.—E. A. (*Dublin*) has a four-fold frame. He proposes "to first cover the frame with stout brown paper, and afterwards cover all with coarse canvas," on which he will place his Christmas cards. Covering the frame with paper will be unnecessary, as it will be covered with canvas or calico. We should advise straining not "coarse canvas," but calico over the frame, whether bleached or unbleached is no matter provided that it will strain, or so shrink as to become perfectly tight after being tacked on damp. All calico will not shrink, and it is better to try a sample before using a quantity. Copper tacks are held to be best, and the edges of the calico should be glued down: for this purpose Le Page's liquid glue is most handy. The calico should then be well sized, and afterwards papered. If the coloured or toned paper which is to serve as a background is moderately thick, this will suffice; but if it is thin, a tolerably thick, but smooth, paper should be pasted between it and the calico. The colour to be chosen must of course be a question for individual taste; but we presume that it will not be garish or staring. Ordinary paste will suffice for sticking his cards, particularly if the precaution be taken slightly to damp the cards before pasting, and after pasting to let them dry under pressure. Folding in a damp cloth is one of the best ways of damping; but by using the liquid glue instead, simply putting mere touches of it at intervals just round the edges of the card and pressing it down tightly. For this plan of sticking, any cards which are not quite flat should be made so by damping and pressing beforehand. The above-named liquid glue is a most handy cement, and a strong one, and may be bought everywhere. As to the arrangement of the cards, much must depend on the materials. White designs do not assimilate well with coloured ones, and the two should be kept separate. The best way is to play the cards about on the space to be filled till they are brought to compose in such a manner as is pleasing to the eye; and then to make a rough sketch on which each card should be numbered, the backs of the cards being numbered also. The multiplicity of straight lines, which must needs occur in any arrangement of such things, may be varied by introducing dried and pressed ferns, grasses, and leaves, which are best fixed on the screen with gum. The entire decoration should, of course, be eventually protected by a couple of coats of hard transparent varnish.—S. W.

Staining or Dyeing Wood.—TOPO.—The only way of making stains penetrate deeply into wood is by no means expeditious, and is not simple to those unaccustomed to the work. For ordinary purposes the ordinary stains are quite sufficient. For the mahogany colour of wood to be waxed, why not stain the wood first, and then wax-polish in the usual way?—D. D.

Magnetising Steel.—P. H. (*Pendlebury*).—Your arrangements for magnetising the horse-shoe pieces of steel are all that could be desired. The machine is short-circuited because the resistance of the two coils of wire is low, and admits too much current through them. Put a resistance of iron wire in the circuit, and thus keep back part of the current. Tap the magnets lightly with an iron rod whilst the current is passing through the coils. The steel loses its magnetism after a few days, because of one or more of the following reasons:—(1) The steel is of inferior quality. (2) The steel is not properly tempered and hardened. (3) The magnets have been heated or subjected to blows. (4) They have been thrown down carelessly, with like poles contiguous, or without iron keepers. Steel of the very best quality must be employed, and made as hard as fire and water can make it; but care must be taken in heating, so as not to burn the steel. The magnets must not be heated or hammered, and they should be fixed by brass screws to brass or gun-metal supports.—G. E. B.

Electric Lighting by Wind Power.—STUDENT.—If you already had a windmill and a dynamo, and wished to know how to utilise both machines for electric lighting, I would tell you how to set about it. But I cannot advise you to build a windmill for such a purpose. Wind power is most unsuitable for driving a dynamo electric machine, and specially unsuitable for electric lighting purposes. I should think you know very little about electric lighting, therefore advise you to read the articles on "Model Electric Lights" now appearing in WORK. From these you will learn the best means to be adapted to your purpose, and the cost of the undertaking. You will require six lights of ten candle-power each lamp, and these will absorb nearly half horse-power.—G. E. B.

Where to get a Book on Coils.—W. R. (*Chesterfield*).—"Intensity Coils: How Made and Used," by Dyer, is published by Perken Son & Rayment, 99, Hatton Garden, London, and is sold by all booksellers at 1s.—G. E. B.

White Spar Stone.—SPAR.—If you write to Mr. S. Barlow, 1, St. Luke's Street, Derby, I think you will get all the information you want.—E. D.

Body and Glaze for Raised Letters, etc.—G. A. K. (*Stoneycroft*).—It is difficult to answer G. A. K.'s inquiry on the above subject, as I do not know what convenience he has for carrying out this class of work, nor what appliances he may have at his command for preparing his clay and glaze, but as he asks for the simplest and best way of making same (I presume he is perfectly satisfied with the result of his moulds, though I should hardly think he has adopted the best means of getting them exact or of the best finish), I would advise him to make a fresh start, and proceed according to the following instructions. To commence, I should either model the letters I required or get them modelled (which would not be a difficult matter) with the same kind of clay that he intends to use; these will require to be made just about one-eighth larger than he requires the letters when fired. When he has procured these, the next thing to be done is to take a cast from each in plaster of Paris, and let them stand for about one hour to allow the plaster to properly set; then remove the clay from each, and he will have what we may call his block moulds. Now make a size, composed of soft soap, 1 lb., to about one quart of boiling water, and when this is cold the block moulds will require to be sized over three or four times with the above size, applied with a soft brush or sponge, and washed between each sizing with a clean wet sponge; re-size, and take another cast of each: these are termed the cases, from which a number of moulds for working from may be produced, either at once or at various times. Of course, the cases require to be washed and re-sized before running each mould. When the moulds are made they must be thoroughly dried, which requires to be done very carefully, not allowing them to get too hot, or they will be spoiled. Another thing to be observed in making the moulds is to mix the plaster well, or until it is free from any particles in a dry or rough state. Having prepared the moulds, we will pass on to the making of the clay, for which we shall require, if for regular earthenware, or, as it is sometimes called, opaque or stone china: Dry blue ball clay, 8½ lbs.; dry Cornish china clay, 15 lbs.; dry ground flint, 15 lbs.; dry Cornwall stone, 10 lbs. When the above is weighed, break it in small pieces, put it in a suitable vessel, and cover it with clean cold water; let it stand for about twelve hours, or until the clays, etc., are perfectly saturated, then mix them well together, and pass the whole through a fine sieve, or lawn, such as is used for the purpose, and may be procured from different makers in the pottery district if he cannot get them in Liverpool. Having passed the slip or clay in its liquid form through your lawn, which takes out any particles of grit, etc., evaporate the water until the mass is about the consistency of dough, when it requires to be well beaten or worked up to make it all of the same consistency, as in evaporating the water some parts will be rather dryer than others. Now the process of making may be commenced by pressing the clay into the moulds and allowing it to partially dry, when it will deliver from the moulds without any trouble. Afterwards, when sufficiently dry to allow of handling, trim round the edges and clear off all roughness. Now allow them to thoroughly dry, which must not be done too quickly, when they will be ready for the first firing; and during this process they must be protected from the flame, otherwise they will be discoloured, and therefore spoiled. After this burning they require to have all dust brushed off them with a dry brush, when they are ready for glazing, which may be done by dipping the parts you require to be glazed in one of the following mixtures:—

No. 1 Glaze or Enamel.		*No. 2 Glaze or Enamel.*	
White Lead ..	12 lbs.	Ground Felspar .	9¼ lbs.
Felspar	12 lbs.	" Cornwall Stone ..	6 lbs.
Flint	4 lbs.	" Flint ..	2 lbs.
		Whiting	2 lbs.
		Plaster	¾ lbs.

No. 1 glaze is rather soft and easy of fusion, though not so good in colour as No. 2, which requires a much stronger heat; either of the above glazes may be prepared for use in the same manner as the clay, only they require to be kept in the liquid state after sifting through the lawn. When it is ready for use, the glaze will require to be used about 27 or 28 ozs. to the pint for dipping in. Afterwards they require to be re-fired to complete the glazing. The heat required for this purpose can only be determined by experience, and must be continued until the glaze is sufficiently fused, when allow your kiln to cool slowly and thoroughly before removing the goods.—J. T. B.

Bookcase.—CAIRNGORM.—I do not know what kind of bookcase you require, but descriptions of several which I think might answer your requirements have been given in WORK. Buy the Index to Vol. I. and look the subject up. If there is nothing suitable, say what points you want information on and I will endeavour to assist you. From the things you have made with the aid of WORK, I am inclined to think you will have no difficulty in making such alterations as you may think necessary from the published description. By all means send a description of your contrivance for fret cutting, if the machine is a success, to the Editor, who will decide if it is worthy of notice in WORK.—D. D.

Bookcase.—J. McL. (*Govan*).—You may certainly make this of oak and stain it black afterwards if you prefer to do so. Oak will do just as well as pine for all practical purposes, but you must remember it is more expensive and more difficult to work. When a cheap wood will do equally well, it seems almost a pity to use anything more costly. If you do not consider pine is good enough for you, and you intend to stain the job black, or, as it is usually called, ebonise it, I should recommend you to use a cheap mahogany (baywood). If, on the contrary, you have not decided that the job shall be black, and for any reason prefer to use oak, you will find it look better if darkened either by staining or by fumigation. I must, however, point out to you that the construction of the bookcase as described is of a very simple and elementary character, much more so than if it followed the ordinary traditions of cabinet making. It is, in fact, designed for those who might have the ability to make a really efficient piece of furniture without having sufficient skill to follow the recognised methods of construction. I gather from your letter that you have not read the articles on "Artistic Furniture" which appeared in Vol. I. If I am correct in this surmise, let me advise you to do so, as from them you will learn more of the intentions of the writer in describing the bookcase about which you inquire.—D. A.

Unsound Silver.—OLD BRUIN.—*Re* the causes of silver cracking and blistering when rolled. Of course the rolling is only the means that makes the blisters visible. Rolling might, if unskilfully done, produce the cracks; but the real cause is to be sought more in the direction of impurities, such as zinc, tin, lead, iron, etc., or may be dirt, that has got mixed up with the silver in melting. Severe hammering and rolling, without annealing, would produce cracks, as would crossing in the mills. For the blisters quite another set of causes may have been at work, and before giving the means taken to minimise them I should like to ask this subscriber if he has ever noticed that coins very often blister; and I remember a few years ago one of the teachers of silversmith's work for the City and Guilds of London Institute asked me the same thing as you have done; even now one of the best refiners occasionally sends me in silver which blisters on being annealed, so one is perforce compelled to believe that they cannot be got rid of absolutely. So to minimise them is evidently the only course. The whole process turns on the purity of the metals used, on their being thoroughly mixed, and on their being poured clear and bright into a properly prepared ingot mould. Sterling silver should come out all right when melted with borax alone, but a little powdered charcoal put on top when it is in a fluid state, and before the final heating, improves it; and, in addition to that, a little sal-ammoniac (either as powder with the charcoal, or as a rod with which to stir it) will give nice, bright, tough, working silver. I am told that sub-carbonate of potash is as good. The ingot mould, into which we will pour our metal, must be perfectly clean, and slightly, but thoroughly, greased, and should be hot. I had written at first "warm," but I have got good results from skillets that I could not bear my hand on; so make it hot, but not too hot, else you will find the silver spit just as much as if the skillet were cold. The grease or oil must *not* be dried up. The position is something too: it should slant somewhat, so that the continuous stream of metal can run down and fill the skillet right into the very corner, which it will hardly do if let drop to the bottom, for then it gets chilled; pour quickly and steadily. Of course everything else (charcoal, borax, etc.) must be kept out of the skillet—that is done by holding the poker, or even a piece of wood, across the mouth of the pot in such a position that the silver may be able to run unimpeded, while the floating matters are held back. Professor Chandler Roberts, who is either chemist or assayer to the Mint, has stated that plumbago (in powder) was better for preparing skillets than was oil or grease of any kind. I trust, with the foregoing description, that you will obtain sound workable silver; but it is, I hope, evident that it is a matter of skill to obtain it. As you may not be up to the simple fluxes used to get silver right, here are one or two: sal-ammoniac for obtaining tough and clear ingots; to destroy lead or tin, use corrosive sublimate; for iron, saltpetre or sandiver. One word—above all, look to the copper you use for alloying; it is cheapest to get the best, I find. I do not know of the application of a current of air with reference to this metal in the way you state.—H. S. G.

Enlarging Camera.—AMATEUR PHOTOGRAPHER.—An article on this subject appeared in WORK, No. 13, page 193.

Bicycle Lamps not Burning.—(*Goudhurst*).—One of the many reasons why a lamp goes out while in motion is that the wick is too small and gets jolted down. Examine your lamp directly it goes out, and see if the wick is lower than it was when alight. Or the wick may be too large, and thus prevent the oil from being drawn up properly. A burner in this condition may burn easily while stationary, but when moved or jolted would easily go out. Again, the air and ventilation holes may be too large or too small. Too large will admit too much air, causing a draught; too small, insufficient air to keep up combustion. Bad oil or a dirty reservoir will cause it. Some of the best makes have the failing of yours. Why not buy a new one of a different pattern? You say yours is a round one. This must be a very old make. I have a small lamp in use now which cost me about 1s. 7d. net, and I could not wish for a better one.—F. C. P.

Change of Trade.—W. W. (*Caverton*).—I have received yours of the 6th inst. It is impossible for me to remember the names and addresses of all persons who write to me, and the subjects on which they write; but I am under the impression that I received a letter similar to yours a short time ago, and that I wrote a brief answer to appear in "Shop," and directed the stamped envelope to be returned, with an intimation that replies cannot be sent by post. Your father, with whom you say you have served your time, is the best person to advise you in choosing your path in life. He knows your capabilities, and I do not. I may, however, say that, in my opinion, you had better stick to the trade you have learnt, especially as you have to live by your labour. You are a carpenter now, but you want to be a machinist or engineer. Better remain a carpenter than try to turn your hand to filing and fitting in an engineer's shop. If you are, as you say, "just too light" for carpentry, I do not think you would be heavy enough for filing and fitting. If you are not content with what I say, you had better visit Glasgow, where you say you have friends, and judge for yourself. Again, after intimating your inclination to try Glasgow, you continue:—"Now, dear sir, you must mention what wages I would receive, as I would have to know that I could keep myself before setting out, and if you approve of the plan. I am twenty years of age now; if you want any more information you must let me know." To go backwards: firstly, you have given me sufficient information to warrant me in saying that you are, or ought to be, old enough to determine for yourself the course that it is best for you to pursue, and I do not wish for any more. Secondly, as far as I dare take upon me to judge, I do not approve of the plan, for reasons given above. Thirdly, it is utterly beyond me to say what wage you would receive, but I should think not much. I know that many Scotchmen—to their honour, be it said—live at times on the merest pittance, and nurture body and mind at the same time on a few pence per diem; but whether or not you are a Scotchman of the same calibre you will best know. Doubtless you will be still disappointed with this reply, but you would be more disappointed if I said "Go to Glasgow and prosper," and you found eventually that the result was not a fitting sequel to the advice. I cannot take upon myself the responsibility of advising in your case. Like my fellow men, I am liable to make mistakes, but I take care never to make a mistake if I can avoid it. An astrologer who could cast your horoscope, a chiromancer who could read your hand, or a prophet who could see into futurity, would be the best man for you to apply to. I am only an editor, which some people seem to think is just one remove from a fool, and I am sufficiently conscious of my own incapacity to feel sure that it is neither desirable nor warrantable for me to say any more than I have said. And I have said as much as I have in your case hoping that it may act as a sedative and deterrent to other inquiring spirits who would seek advice on such points as you have submitted to my judgment.—ED.

Taking Out a Patent.—J. B. (*Dundee*).—I am not aware of any rule debarring a Government servant from patenting an invention to be used in the Government service, but the case is one in which the *employé* would do well to take the opinion of one of his superiors in his department.—C. C. C.

Imitation of Woods.—P. S. (*Kenmare*).—Read carefully the papers on "The Art of Graining" now appearing in WORK, if you wish to imitate by painting; but if by staining, use Stephens' stains, which you can buy, or ought to be able to buy, of any oil and colourman.

Clock Stopping.—LIMITED.—You do not say whether the clock is a weight or spring, ancient or modern, English, French, German, Swiss, or Vienna, so I can only go on guess-work, which is never very satisfactory. If a spring clock the springs may, perhaps, be bound in the barrels, or the oil on them be got thick, or the pivots may be dry; if a weight clock, the same applies, or the lines may be off the barrel and round the arbor, or the clock may be in need of cleaning and repairing, or a little oil to all the pivots, etc., may be all that is required; evidently in winding it takes off the power, by setting the train of wheels backwards, and then it has not the power to start afresh. Try a little oil first; the very best salad oil will do if you cannot get the proper clock oil; if it still stops, write again, giving more particulars; also say if you use a *fan* or *crank* winder.—A. B. C.

Voixophone.—A SUBSCRIBER.—The instrument about which you inquire (and which had entirely escaped my memory when replying to your former letter) was brought out by Messrs. Beare & Son a few years ago, and patented by them. Being thus protected by law, it is obvious that you run some risk if you make one even for your own use; but, leaving aside the law question, I may say that it is by no means a satisfactory instrument either to make or play. Your sketch is fairly correct, except that the compass is three and a quarter octaves. If you still wish to know more of it, I should advise you to apply at the Patent Office for a specification—price 8d., I think.—R. F.

Glass Embossing, etc.—MIEUX QUE ÇA is referred to the reply to W. C. in No. 79, Vol. II., page 436, but nothing less than long articles would suffice to answer all his queries satisfactorily. As to getting a battery for electro-gilding, an electro mechanician in any large town can supply it; or if our correspondent is moderately ingenious, he can contrive one for himself.—S. W.

Patentee's Agent.—J. H. (*Glasgow*).—A directory will give the required information.—C. C. C.

Hardening and Tempering Screw Taps, etc.—A. B. (*Birmingham*).—The question is, can these be hardened and tempered at one operation, and how? Cheap taps are, as a rule, not let down; they are made of inferior steel, and do not become very hard in the first instance; a large box of such screwing tackle having been tested, every tap and die proved soft enough to file. Good steel can be hardened and tempered at one operation by plunging the tool at red heat into a vessel of water having about three inches of oil floating on the top; the shank may require tempering if it, too, has been made hard; but that need not be the case. The great point seems to be to get a good heat to the right degree for the steel, and equal all over the part to be made hard. Where several tools are to be hardened it is a good plan to heat them in melted lead, because that ensures the same heat all over; if, however, any of the lead adheres between the teeth of the tool, that spot so covered will prove soft. Watchmakers, engravers, etc., are very fond of hardening and tempering their small tools at one operation by plunging them when red hot into sealing wax repeatedly till cold. The reason seems to be that the sealing wax and oil cause the heat to be abstracted more slowly than if water were used, and, therefore, make the tool rather less hard and less brittle, so that it does not require the usual "letting down."—F. A. M.

Gilding Copper.—F. B. (*Llandaff*).—Copper can be easily gilded by the electro-gilding process. The most easily made solution for the purpose is prepared by dissolving two or three drachms of potassium cyanide in a pint of hot rain-water, and dissolving enough gold in this to form the gilding solution. Make up a battery of two cells Daniell, Smee, or Bunsen, connect a strip of pure gold to a wire leading from carbon or copper of the battery, and hang the strip in the hot potassium cyanide solution. Connect another strip of gold to a wire leading from the zinc of the battery, and hang this also in the solution contained in a stoneware vessel. A current will pass from one strip of gold to the other, and dissolve some of the gold. At the end of an hour's time, remove the strip of gold from the wire leading to the zinc, and replace it with the piece of copper you wish to gild. The electric current will then dissolve gold from the strip of gold on one side of the solution, and deposit it on the copper on the other side of the solution. Keep the gilding bath hot during the process.—G. E. B.

Electric Bells and Galvanic Battery.—ELECTRIC.—Electric bells are worked with electric current obtained from galvanic batteries. The little machine you have heard about as being good for neuralgia is not a galvanic battery, but a small magneto-electric machine—one of the oldest forms of the magneto-dynamo. These little machines generate an electric current at a high pressure, and this, when sent through a person, gives a series of shocks which are said to be good for the nerves. I do not believe a word of what is said about their merits for this purpose. They are only toys. Similar results are obtained from machines named shocking coils, worked with current from galvanic batteries. I hope to tell readers of WORK how these are made at some future time. You will learn how electric bells are made if you read my papers on "Burglar Alarums," published in Nos. 12, 18, 20, and 27, Vol. I. of WORK. A good book for your purpose is "Electric Bells, and all about them," price 3s., as this also tells you about galvanic batteries. You can get this through any bookseller, or I can get it sent to you by post if you experience any difficulty in obtaining it elsewhere.—G. E. B.

Xylophone.—A. B. L. (*Barnsley*).—For the construction of this instrument see WORK, Vol. I., page 669, otherwise No. 42. The number can be had of any bookseller or newsvendor for 1d., or post free of the publishers for 1½d.

Wiring Dulcimer.—G. E. (*York*).—I am really surprised that you should have experienced any difficulty in stringing your dulcimer. If you will refer to page 645, No. 41, Vol. I. of WORK, you will find there a diagram of the dulcimer, and on this diagram, those letters which appear on the right indicate the notes which are to be strung with brass, and those in the centre the notes that are to be strung with steel wire, the latter being divided nearly halfway by the bridges, whilst the former have the bridges only a short distance from one end. The only other way I can think of to make it plainer to you is to tell you to number all the holes in the *outside* row in the wrest-pin block, commencing at the bottom with No. 1, and continuing to the top, which, of course, would be No. 20; and then string the *odd* numbers with brass, and the even ones with steel wire. From your letter, you appear to have had a good deal of advice on the subject, most of it evidently from those who did not know much about it (hence, probably, their anxiety to give it). But if you find any further difficulty, do not be afraid of writing; we like to smooth away difficulties, and that particular one raised by one of your friends, pertaining to the scale, you will find vanish almost as soon as you commence practising. So far from its being really difficult, I can assure you that it is one of the easiest to learn. On this subject, see also reply to P. J., page 436, No. 79.—R. F.

Leakage of Water Barrows.—KALULU.—I cannot see how your barrows should leak if you have used red lead at the joints; our way of making barrows watertight is to paint all the joints with red lead ground in boiled oil only, no turps or driers being added when dry next day. We mix some of the very best and purest red lead with boiled oil into a stiff paste, and cement all the joints, laying it on with a putty knife, just the same as a bricklayer would in setting a brick. Then put the pieces together and screw down. White tub lead and red lead mixed with a drop of boiled oil make a very good cement, which sets as hard as a stone, if left a few days before being painted over, for if painted too soon it keeps the putty soft. In making a barrow watertight you require the cement between the joints, and not at the outside. In the corners of the barrow, both inside and out, we nail three-cornered pieces of wood, well embedded in this cement. When thoroughly dry, clean off with a knife, and paint the barrow, the first coat having more boiled oil in than the after coats. If you have to take the sides out of your barrow, have the joints thoroughly dry before using the red lead cement, or it will not adhere to the boards if wet with damp.—W. P.

Cleaning Coral.—W. A. P. (*Hackney*).—You give no details as to whether the large piece of coral is in the rough, or if it has been cut and polished. Washing it in warm water with soap and a brush (no soda) should clean all kinds; but as the chances are that some little polishing is required as well, if that be so, use finest putty-powder; that being, perhaps, inconvenient to obtain, then try either powdered rotten-stone, fine whiting, or jewellers' rouge, any of which will improve a polished surface when used with water and applied by means of leather buffs, linen rags, etc. etc., or, in fact, anything that will enable the polishing material to be brought with considerable friction into contact with the work. It can be washed afterwards, to remove the powder from the crevices.—H. S. G.

Imitation Stones.—McA. (*Barrow-in-Furness*).—Write to R. Pringle & Co., 40 and 41, Clerkenwell Road, or Brown & Langley, 124, St. John Street, Clerkenwell, or to W. A. Couch, 45, Great Sutton Street, Clerkenwell. One or the other can supply the desired colour and quality of imitation stones. The last mentioned I know turns out very good and well-finished plasters. The other two I know only from good reports. Give all particulars as to size, cut, colour, etc., or better send them a specimen if you can, even if it be a real stone. This is particularly necessary with regard to cairngorms, for they vary so much in colour. I am sure the stones in Scotch work used to be genuine, so I trust no reply of mine will help to introduce imitations in a class of goods which has up to now been one of the very few thoroughly genuine styles that survive.—H. S. G.

Cleaning Plaster Casts.—T. P. (*Shooters Hill*) would have done well to have spoken more particularly of the "old casts," which he wishes to clean. He should have said whether they have or have not been painted. If they have not been painted—are merely the natural plaster—and are only become dusty, his plan will be to sprinkle new plaster (fine) over them and work it about with a soft brush. This will bring away with it dust and any slight discolorations which are quite on the surface; but it will not touch any stains which have sunk into the substance of the plaster. Nothing, so far as I am aware, will clean plaster so stained and discoloured. The only thing to be done is to paint, or gild, or bronze it. If T. P. wishes to clean old casts that have been painted (*i.e.*, to soften and remove the paint which chokes up the modelling, before repainting them), let him make a strong solution of American potash, mix this with sawdust, and cover the cast with the mixture. In a few hours the paint can be washed away with cold water and a sponge, a soft brush being used for the hollows.—M. M.

III.—QUESTIONS SUBMITTED TO CORRESPONDENTS.

Illuminating.—GILT writes:—"I have never before talked in 'Shop,' but shall be glad if any reader can help me by giving information on the following points:—During some of my spare time I have attempted a little illumination in gold and colour, and in gilding I have obtained good results by using oil gold size on paper that had been previously prepared with thin gum on the parts to be gilt, to prevent the oil in size spreading; when tacky, I lay on the gold leaf, and then burnish with a piece of cotton-wool by briskly rubbing; but I should like to go a little further—I believe there is a water gold size used by illuminators that may be afterwards burnished with some kind of burnisher made on purpose, which gives to the gilt surface great brilliancy. Can anyone tell me how to make the size and burnisher, or where to get it, and afterwards how to use it?"

Paint for Tickets.—A. J. S. (*Moseley*) will be thankful for the best opinion as to the most desirable paint to use in making tin window tickets—*i.e.*, paint that will dry with a smooth glossy surface, and whether it is necessary to stove the tickets to obtain this end.

Gilding.—JACK writes:—"Would some reader of WORK be kind enough to tell me how to use or gild with leaf gold?"

Hanging Paper.—JACK OF ALL TRADES writes:—"I wish to decorate one of my rooms with Japanese leather paper. Would some reader of WORK be good enough to tell me how to hang this class of paper, and give the names of one or two firms where to buy it?"

Waterproofing. — OLD TIPTONIAN writes:—"Can any valuable helpers tell me if there is any oil or indiarubber solution with which I could coat a cart sheet or cover, as it is called? The continual wear has made it quite useless as a waterproof covering, for which it is required."

Banjo.—W. P. (*Burnley*) writes:—"I should be greatly obliged if R. H. H. (*Crewkerne*) (see page 503, Vol. II.) or F. H. (*Streatham*) will give me information as to size for good banjo; also price of same for a good plain instrument; and also what is the difference between the ordinary banjo and Brewster's grand orchestra size banjo? Which is best—five or seven strings, and why? Is the banjo a difficult instrument to learn?"

Bird Cages, and Address Wanted.—Will J. G. (*Nottingham*) (see page 734, Vol. I.) advertise his address in the "Sale and Exchange," WORK, for M. D. C., Liverpool, who wishes him to undertake some bird-cage front making?

Lathes.—B. S. (*Edinburgh*) writes:—"Barnes' foot lathe, No. 4, for which Churchill & Co. are agents, costs £9. Does any reader know of a lathe that is as good and cheaper?"

Fretwork Cabinet.—J. W. L. (*Hull*) will be obliged to any reader who will kindly tell him the best way to finish a small fretwork cabinet in white holly, and how to proceed as to polishing.

Chocolate.—"I should be obliged if any reader would give me a few hints on sugar boiling and sweet-making, such as toffy, brandy balls, cocoanut candy, etc; also the tools required, and how to fix and work them; also the pans required, the best form of furnace, and about the cost of the whole. Diagrams will oblige."—[This "sweet" question is hardly within the scope of WORK. However, it is submitted in the hope that some tool or boiler maker will kindly enlighten CHOCOLATE concerning the appliances which he will need in order to administer adequately to the cravings for confectionery exhibited by the juvenile portion of the community, in which, of course, we all take interest.]

Cabinet Fittings.—W. H. (*Hinckley*) writes:—"Will any reader tell me where I can get handles for drawers and fasteners, door to match, to suit cabinet in fretwork issued with No. 1 of WORK?"

Luminous Paint.—INQUISITOR asks—"Where can I obtain luminous paint in small quantities, about the price, and is there a special way to apply it?"

Sash-bar Dowelling. — W. H. (*Hinckley*) writes:—"Will any workman give me information through 'Shop' on sash-bar dowelling?"

Camera Fittings.—J. C. (*Glasgow*) will be glad of the experience of any readers as to the best place to obtain brass fittings for a half-plate camera, what they would be likely to cost, and also the price for racks and pinion only.

Lithographic Stone Press.—R. T. (*Glasgow*) writes:—"I am instructing myself in photo-lithography, and wish for a press to pull a few proofs. I want a press to print from a lithographic stone about seven inches long by four and a half inches wide. Will any reader oblige me with a description, or even a few hints, how to make one, if possible in wood, if not, in iron?"

Zinc Plates.—SIGNBOARD asks for addresses of makers of zinc plates, also for the strength to make acid, so as to bite, say, ¼ in. deep.

Blocking Powder.—JOINT writes:—"Could one of our many helpers let me know through 'Shop' what powder is used for blocking Dutch metal on fancy cards, boxes, etc.? I have a powder for gold leaf, but it will not take the Dutch metal on card-board. The metal rubs off after blocking. Of course I know about glair, but that won't do. I want something dry. Could you tell me also the pay per gross a workman gets in London for blocking cap B 8 in. mems. in gold leaf?"

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Glass Signs.—C. E. H. (*Tottenham*) writes in reply to W. McC's. query (see No. 84, page 522):—"We can undertake the class of sign which he requires."—[Messrs. H. and R. should advertise in our "Sale and Exchange" column.—ED.]

Graph.—F. A. J. (*Canonbury, N.*) writes in reply to W. W. (*Chelsea*) (see page 522, Vol. II.):—"Having tried every graph in the market, I strongly recommend the Simplex Hectograph. The composition may be bought in one pound jars for 3s. It must not be put into metal trays. I make my own trays of thin wood, and paint them with enamel paint. One pound of composition will make a graph foolscap size. The writing sinks in, and disappears after a few hours."

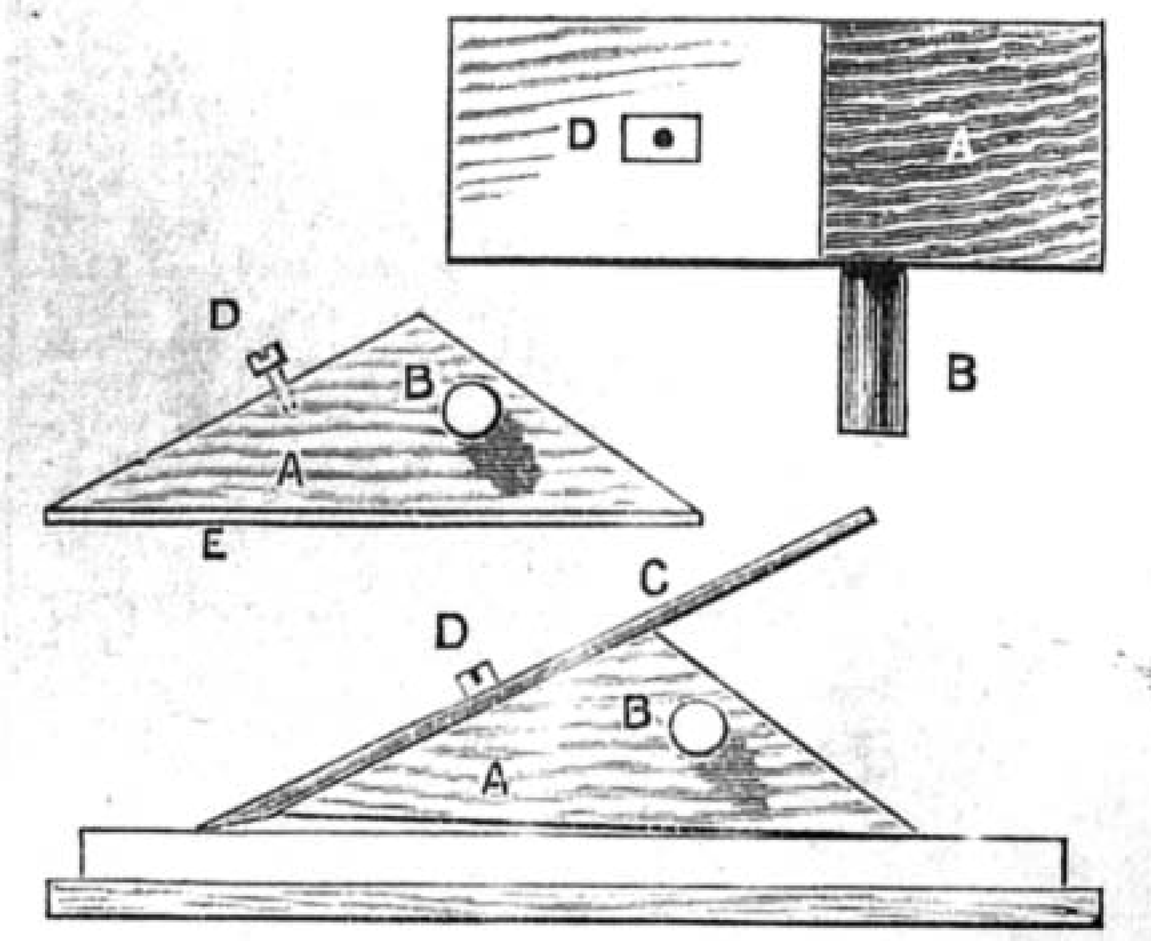
Patent.—F. A. J. (*Canonbury*) writes to T. H. (*Wandsworth*) (see page 521, Vol. II.):—"Why not go to the Free Library, Chancery Lane, where every specification may be seen easily?"

Artificial Water.—J. M. (*Manchester*) writes in reply to W. E. D. (*Hull*) (see page 522, Vol. II.):—"We have, in our Queen's Park Museum here (Harpurhey, Manchester), several models of vessels mounted on rough plate glass by cement (glue, I should presume), and which possess a very natural and power-like surface. As a matter of course the models are stopped off at the water line—*i.e.*, that below the water line is not constructed."

Coal Saver.—J. W. B. (36, *Railway Walk, Birkdale, near Southport*) writes in reply to J. S. (*Oldham*) (see page 535, Vol. II.), that he will be glad to answer any inquiries respecting "Coal Saver" (Vol. II., page 471).

Painting Venetian Blinds.—L. J. (*Huntingdon*) writes in reply to ASPIRANT (see No. 84, page 522):—"I have seen painters colouring these very quickly. They get a piece of guttering (half round, not O.G.), and lay the slat as in diagram, when it lies quite firm."

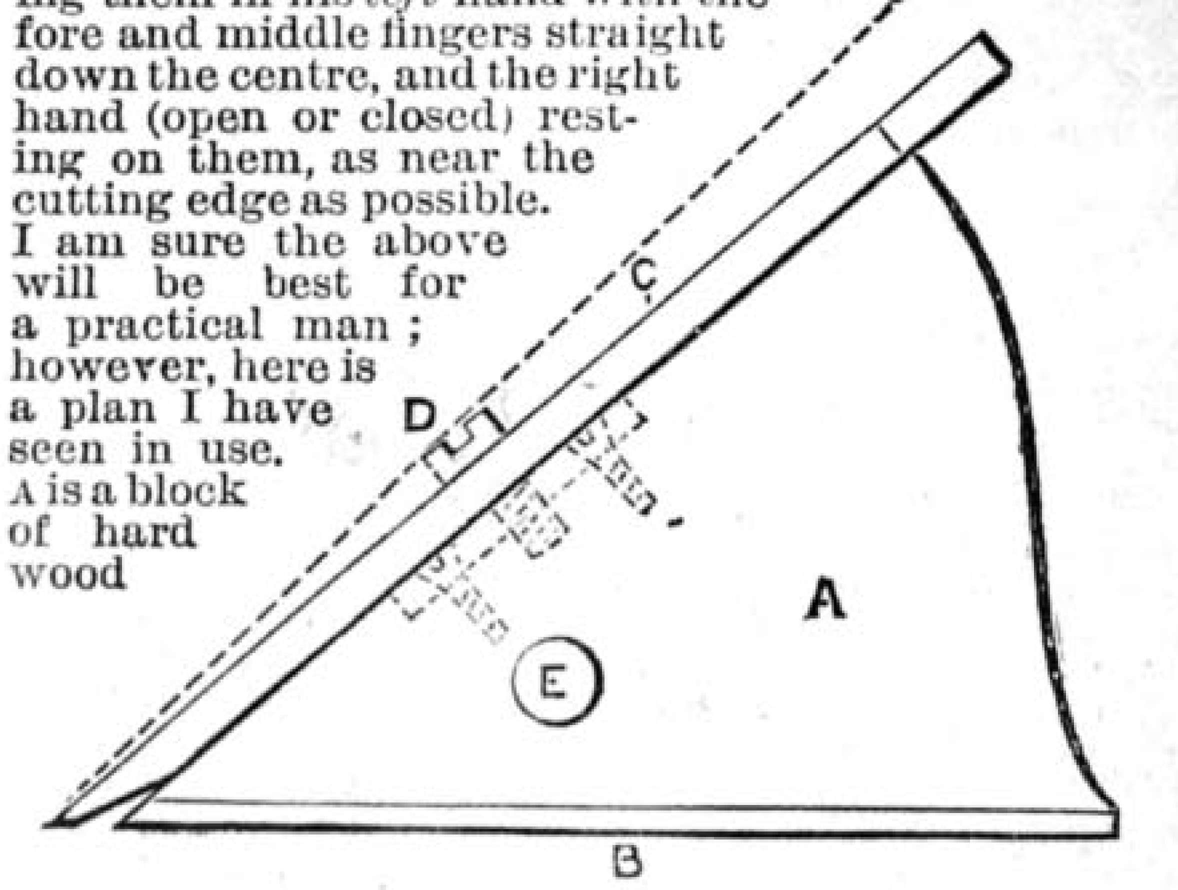
Plane Irons.—L. J. (*Huntingdon*) writes to ONE IN DISTRESS (see page 522, No. 84):—"I never saw a plane iron that did not want sharpening, but this may help ONE IN DISTRESS. A is a piece of ash about 8 in. by 2½ in. by 3 in. deep, cut to an



Plane Sharpener.

angle a little quicker than the bevel of the plane iron is ground; B the handle, about 2 in. long, ¾ in. round; D, the screw to fix iron to block, is an old back iron cut and let in flush. To use, screw the plane iron on the block, and rub the whole length of the oilstone. Sharpened thus, I find the edge lasts longer."

Plane Sharpening.—CHIPS writes:—"I think ONE IN DISTRESS (see Vol. II., page 522) should try sharpening his plane irons by holding them in his *left* hand with the fore and middle fingers straight down the centre, and the right hand (open or closed) resting on them, as near the cutting edge as possible. I am sure the above will be best for a practical man; however, here is a plan I have seen in use. A is a block of hard wood



Plane Iron.

2¼ in. thick, with a piece of hoop iron; B, same width screwed to bottom; C is the plane iron held by screw D tapped in iron plate let in flush, or a wood screw with a washer would do; E is the handle which projects about 4 in. each side of block. The slope of block should be about 5 in. less than the iron when fixed in plane, which is shown by dotted line. This mode has the advantage of always sharpening to the same angle, also of wearing the stone even. The edge can be rounded by pressing harder with one hand alternately. All irons should have edges which are arcs of circles, although in the case of a smoothing plane it would be one of immense radius."

V.—BRIEF ACKNOWLEDGMENTS.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—O. H. O. (*East Dulwich*); CEDAR; A. E. J. (*London, W.*); JOURNALIST; NOVICE; SIDEBOARD; A. T. M. (*Lichfield*); LINENS; W. G. J. (*Portsmouth*); T. H. (*Glasgow*); OBED; G. H. (*Liverpool*); W. B. (*Maidstone*); H. W. (*Peckham*); GLUE CO.; G. R. R.; C. T. C. (*London, S.E.*); ARGENT; ESPERANZA; T. B. (*Northampton*); A. H. F. (*Cheltenham*); ORNAMENTAL; J. G. W.; S. F. W. (*Kidderminster*; J. S. K. & Co. (*Coventry*); J. F. (*Cornwall*); J. A. G. (*Sunderland*); J. E. H. (*Southampton*); EXPERIMENT; AMATEUR; W. H. (*Bolton*); J. H. B. (*Manchester*); A. F. W. (*Oldham*); D. D. (*Aberdeen*); L. S. L. (*Kirkcaldy, N.B.*); J. H. B. (*Pendleton*); J. B. (*Glasgow*); F. A. (*Portsmouth*); MIST; A. H. (*Birmingham*); S. F. C. (*Workington*); CELT; F. F. F. (*London, E.C.*); T. S. & Co. (*Herstmonceaux*); SCHEMER; S. R. (*Newry*); W. S. (*Preston*); J. H. H. (*Belfast*); W. H.; CONSTANT READER; A. T. (*Eastbourne*); S. B. C. (*Trowbridge*); BANJOIST (*Sussex*); STATIONER'S ASSISTANT; LOCO.; FRANKLIN; WATER GAUGE; JEAN.

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