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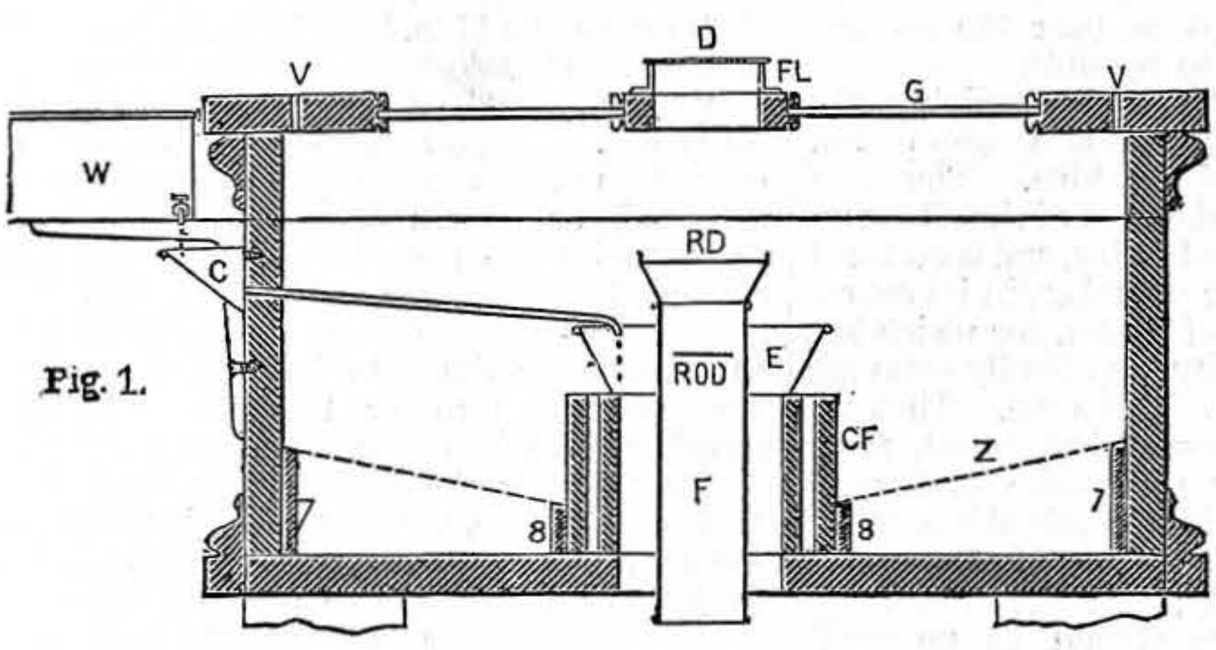


Fig. 1.

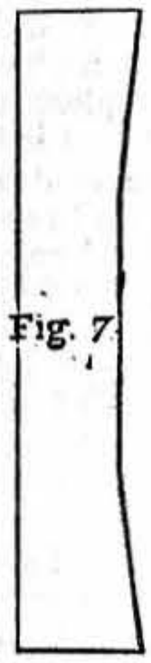
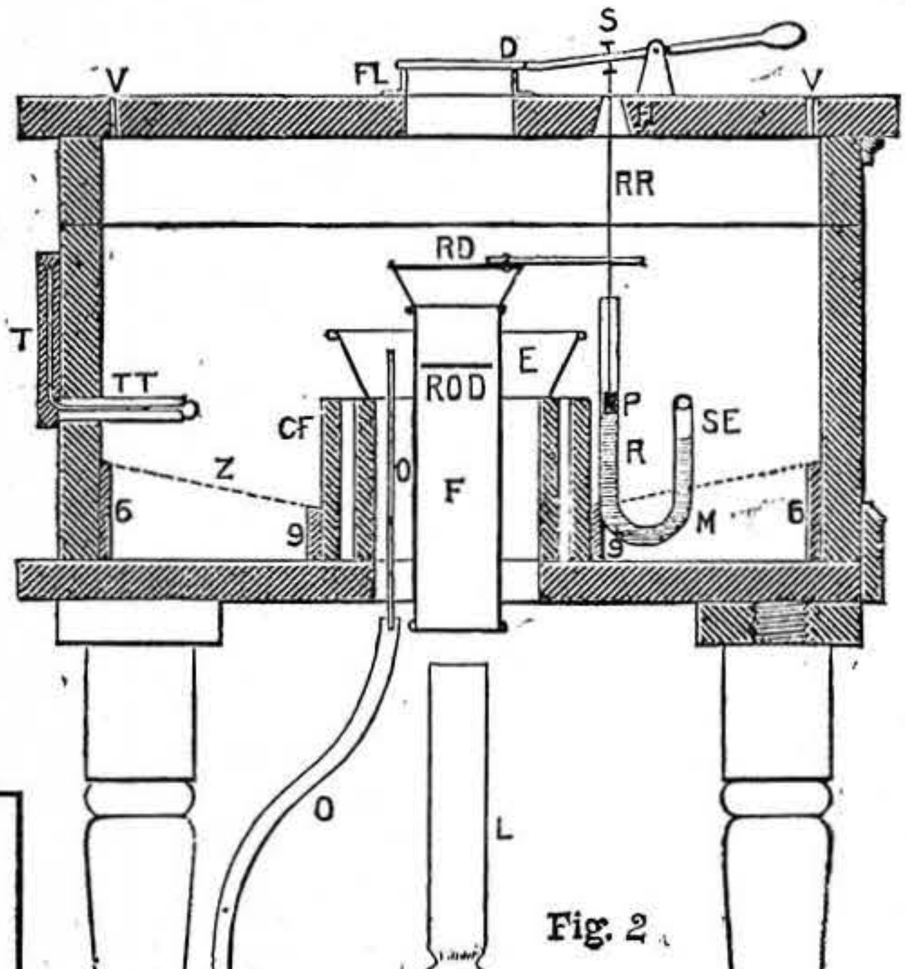


Fig. 7



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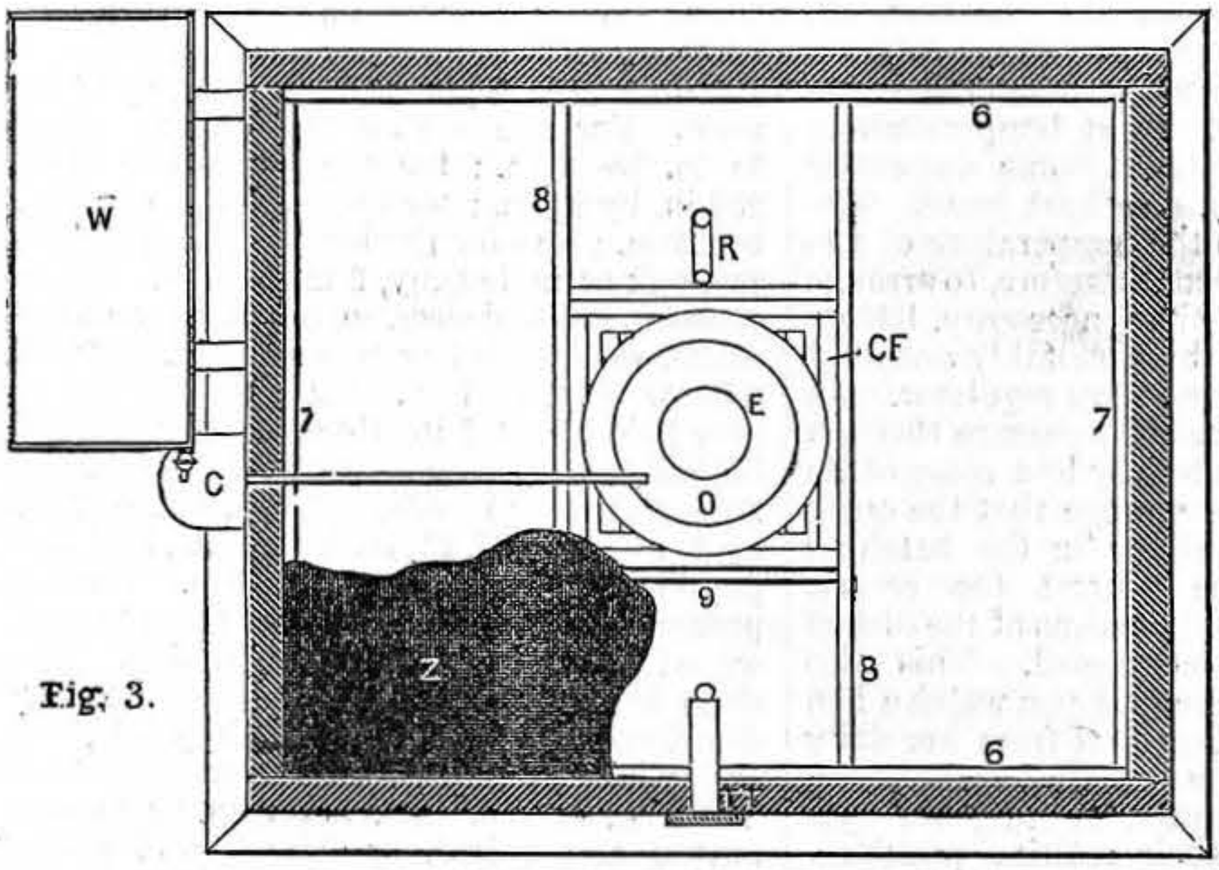

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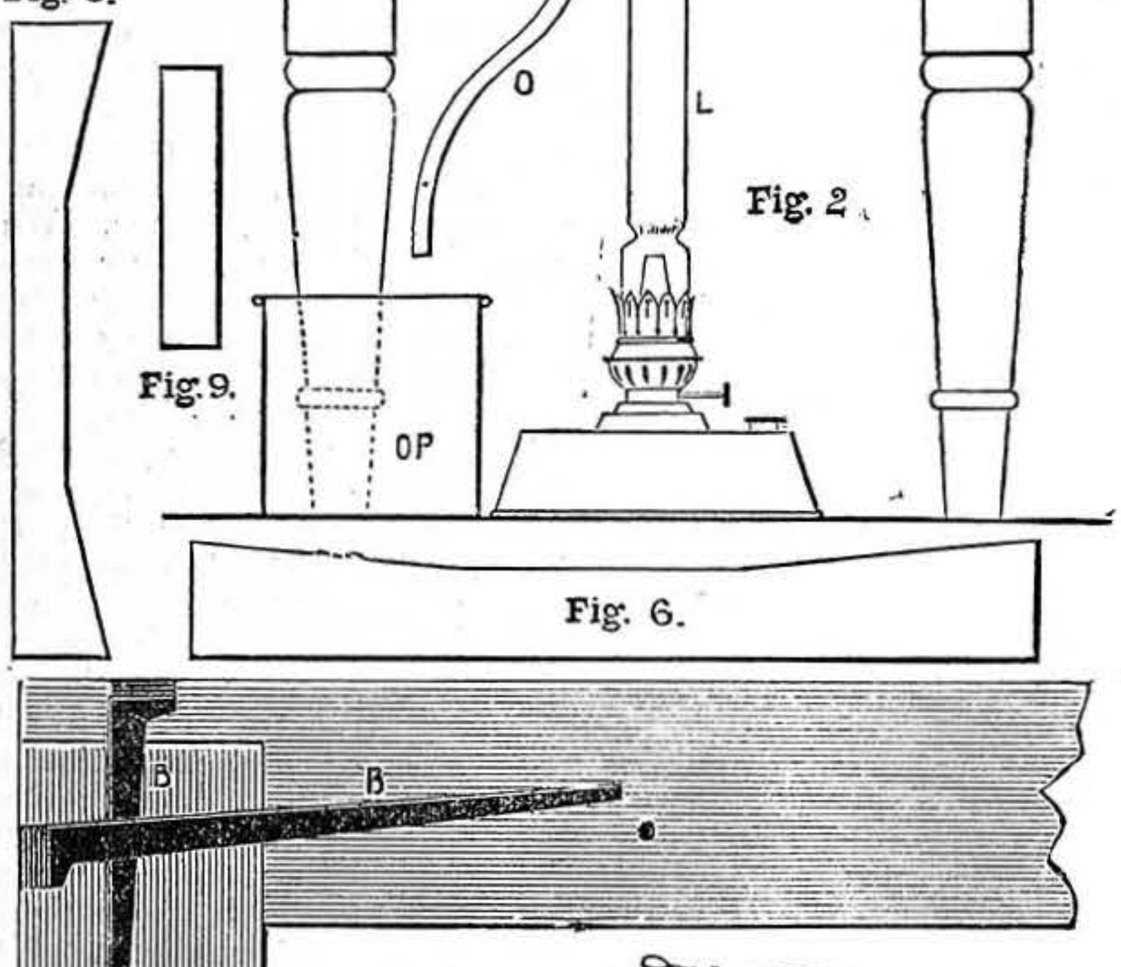


Fig. 2.

Fig. 9.

Fig. 6.

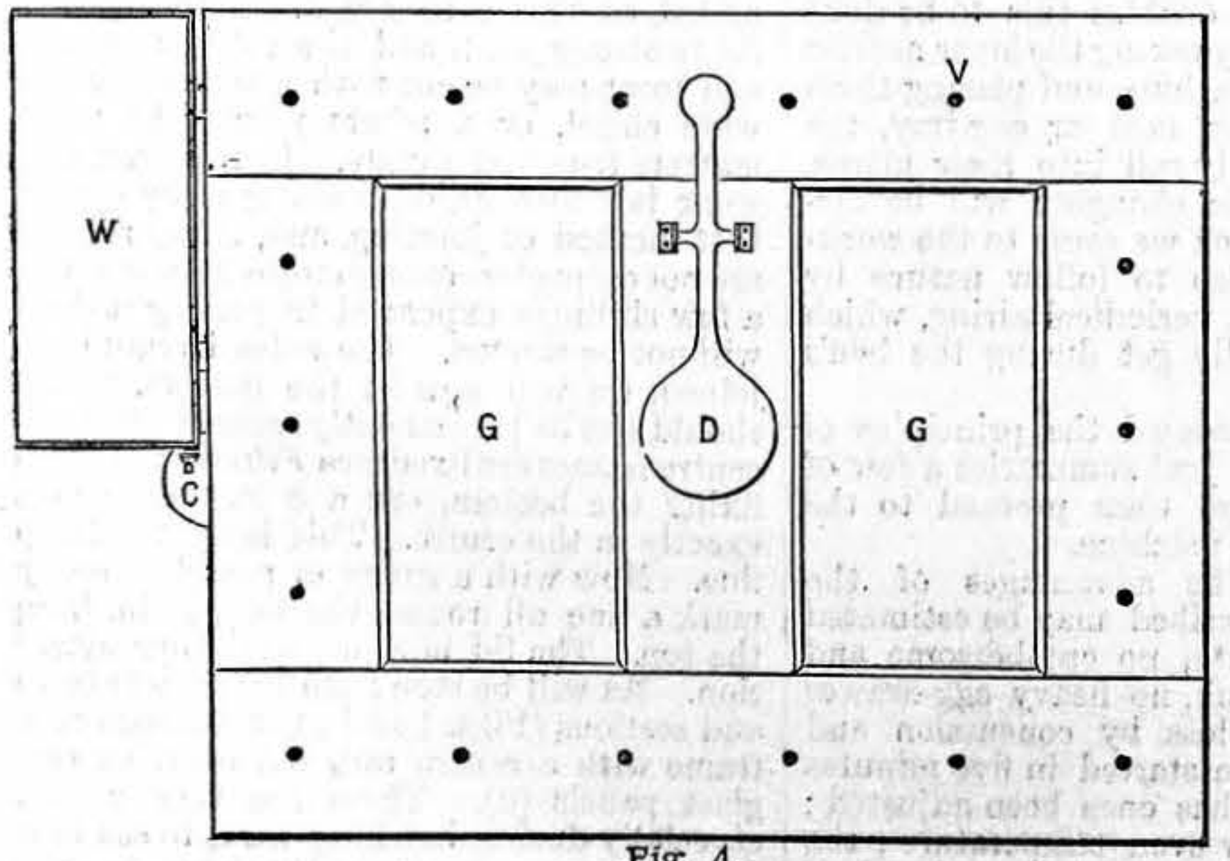


Fig. 4.

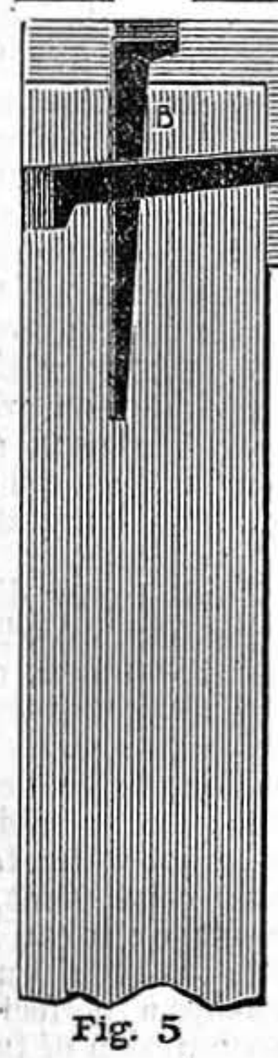


Fig. 5

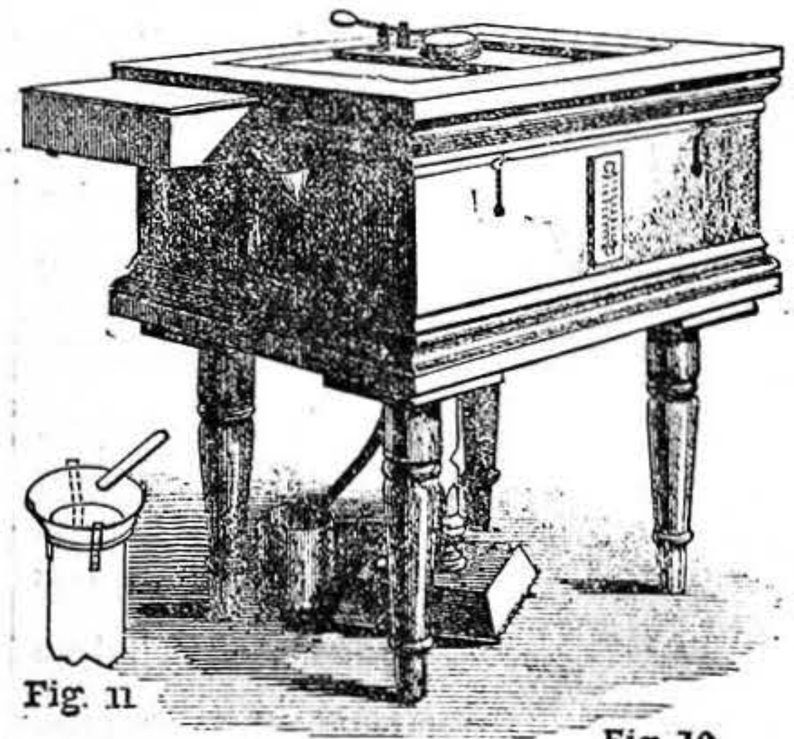


Fig. 11

Fig. 10

AN ATMOSPHERIC INCUBATOR: HOW TO MAKE AND WORK IT.

Fig. 1.—Longitudinal Section. Fig. 2.—Cross Section. Fig. 3.—Plan. Fig. 4.—Plan of Top. Fig. 5.—Alternative Method of Jointing Corners. Figs. 6, 7, 8, 9. —Fillets for Egg Trays. Fig. 10.—Machine complete, from Photograph. Fig. 11.—Top of Lamp Flue, with Tripod and Regulator Rod Guide. Scale, 2 in. to 1 ft., except Figs. 5, 10, and 11.

AN ATMOSPHERIC INCUBATOR: HOW TO MAKE AND WORK IT.

BY LEGHORN.

INTRODUCTION — GENERAL PRINCIPLES — ADVANTAGES — CASE — FITTINGS — REGULATOR — LAMP — WORKING — CONCLUSION.

Introduction.—My object in writing this paper (in fulfilment of my promise in No. 99, Vol. II., to describe a simple and reliable atmospheric incubator) is to help those who help themselves.

The ancient Egyptians, we are told, hatched chickens artificially, so that we may presume incubating machinery is no new thing; but the varying success following its use, together with its somewhat prohibitive price, has not had the effect of bringing the artificial method into general use until quite recently. Since, however, the introduction of the "hot-air" variety, an impetus has been given to poultry raising generally, and machines are now to be had, the results from which make "poor Biddy" take quite a back seat.

Whatever your object in poultry keeping—eggs or table birds—the grand secret of success is to hatch your chickens at the right time, so as to ensure a steady and constant supply all the year round. Those who keep only non-sitting varieties or, having limited accommodation, can keep but few birds, generally have a difficulty in finding a hen willing to undertake maternal duties in the early months of the year—a necessity if winter eggs are wished for—so that, for raising early chicks and ducks for laying purposes, the show pen, or for market, the possession of a reliable incubator must necessarily prove a great boon. Now a good machine with a pedigree costs money, and the average amateur poultry keeper, as well as some of his professional brethren, does not care to lay out much money in the purchase of such, and consequently gets only late-hatched birds, which do not make the return they should. "Poultry don't pay," used to be, and still is with some, a familiar croak; but I am glad to say we are beginning to find out that poultry *does* pay, and pay well, IF—put this in big type, please, Mr. Printer—they have proper attention; in fact, no stock pays better if *intelligently* managed.

In this paper it is my intention to place within the reach of all who possess but a small amount of mechanical skill the outcome of a long period of study of the principles and practice of artificial incubation. From the amount of correspondence I have received, I feel sure the subject will be a pleasing one to many readers of WORK, and if I can help any lame dog over a stile I shall not have put pen to paper in vain.

I purpose giving instructions for a machine nicely made and properly fitted—my motto always being, "What is worth doing at all is worth doing well;" but, of course, details of finish and materials must be left entirely to the individual worker.

General Principles.—Josh Billings says: "The principal bizzness for an abel-boddyed hen iz tew lay eggs, and when she haz laid thirty-six ov them, then she iz ordained tew set still on them until they are born; this iz the way young hens fust see life."

This is evidently something of it, but we must look a little farther into the subject. Let us for a moment inquire into the principles of incubation. At first sight it would seem that all a hen does to the eggs is to keep them warm during a certain period. However, this is not all. In the natural order of things, the bird would make her nest on the ground, and the heat of her body would draw moisture from it; also, during her morning ramble, her breast feathers would get saturated with dew, thus providing more moisture: and as a hen selecting her own nest thus, rarely fails to bring off a chick for every egg, it follows that moisture plays a very important part in the process of incubation, natural or artificial. In building a machine to discharge these functions, the nearer we copy nature the better results we may expect. We need, therefore, to have the bottom of our machine in the form of a nest—the reason for this will be seen later on—and to supply a moist heat centrally and from *above* the eggs, kept as near the natural heat of a hen's body as possible.

The simplest method of supplying the necessary heat is by means of a lamp placed under the centre of machine. The heat arising from the combustion of the oil enters the machine by a suitable flue, and is radiated all over the hatching chamber, in its course passing over a tray of water, for which hot air has a great affinity, and finally escaping by a series of holes in the lid. Thus we have a continual flow of hot, moist, fresh air. "But," I hear someone say, "won't the fumes from the lamps kill the germ of the chick?" I answer, "No; if the lamp is kept burning properly, with the wick regularly trimmed, there should be no smell whatever, burning even the cheapest oil, which, however, I do not recommend."

In this variable climate of ours, it is impossible to keep a constant temperature in the egg chamber without some automatic means of regulation, the heat inside fluctuating according to the temperature of the atmosphere. We need, therefore, to arrange for a larger supply than necessary, letting off the surplus heat by a suitably arranged valve, actuated by a sensitive regulator. As the heat, in the course of its passage through the machine, will naturally lose some of its intensity, we need to arrange that the outer layers of eggs are higher in the hatching chamber than those nearest the centre. This is accomplished by means of the dished bottom previously mentioned. This also serves another purpose. If you watch a hen after returning to her nest from her daily feed, etc., you will notice that she is very busy for a few minutes, turning her eggs over and altering their relative positions. The dished bottom enables this to be done easily, for, by simply taking the layer nearest the centre of the machine and placing them at the edge of the nest or egg-tray, the others will naturally roll into their places. The reason for this changing will be discussed later on, when we come to the working. We need also to follow nature by allowing the eggs a periodical airing, which they would naturally get during the hen's daily absence.

Having now discussed the principles of incubation, we will just summarise a few of the advantages, and then proceed to the construction of the machine.

Advantages. — The advantages of the machine to be described may be estimated thus: Its portability, no cumbersome and leaky hot-water tank, no heavy egg-drawer with consequent loss by concussion and breakage; it can be started in five minutes after the regulator has once been adjusted; it keeps a perfectly even temperature; the consumption of fuel is small—less than half what a hot-water machine of same capacity would require; and with proper attention—all other things being equal—it will hatch every fertile egg. I hope the work of construction and the after operations may be the source of much pleasure to such of our readers who keep poultry for pleasure, prizes, or profit.

Construction: The Case.—On reference to the diagrams on the front page of this number, it will be seen that the apparatus consists essentially of a box with a hinged lid, standing on four legs. Fig. 10 gives a view of the finished machine (from a photograph); Fig. 2, a complete cross section—that is, as if the machine were cut in halves through the centre from back to front; whilst Fig. 1 gives a section of the upper portion only, cut lengthways.

For this incubator, thirty-six egg size, we shall want a box 17 in. long, 14 in. wide, and 9 in. deep, all outside measurements. The wood may be pine, deal, or any harder wood the fancy of the maker may direct; but whatever is used, it *must* be dry and well seasoned, or it will probably shrink and crack under the heat to which it will be subjected. For this reason it will be advisable to select one of the softer woods as being more likely to be well seasoned. The material forming the sides and lid should not be less than $\frac{3}{4}$ in. in thickness, whilst that for the bottom may be $\frac{1}{2}$ in. It would be well, perhaps, if I give here a list of wood required. For the front and back we shall require two pieces 17 in., and for the ends, two pieces 14 in. long by $7\frac{1}{2}$ in. wide; for the bottom, one piece 17 in. by 14 in.; for the top (if framed), two pieces $18\frac{1}{2}$ in., and two pieces $15\frac{1}{2}$ in. long by $3\frac{1}{2}$ in. wide. For the centre frames, one piece 31 in. by 3 in.; for the fillets, one piece $25\frac{1}{2}$ in. by $2\frac{1}{4}$ in.; for the legs, 4 ft. of $2\frac{1}{2}$ in. by $2\frac{1}{2}$ in.; and for the leg blocks, a piece of, say, oak or mahogany, 6 in. by 6 in. These are neat, finished sizes, so, to allow for a little waste, we had better procure, say, 12 ft. of 8 in. or 9 in. by 1 in. (Inch boards really only hold about $\frac{7}{8}$ in. thick, so by the time both sides are planed it will be about the right thickness.) Also get, say, 4 ft. of 7 in. by $\frac{5}{8}$ in., 4 ft. of $2\frac{1}{2}$ in. by $2\frac{1}{2}$ in., and the piece of hard wood $6\frac{1}{2}$ in. by $6\frac{1}{2}$ in. Having procured these, planed and cut them to size, we will now proceed to the joining. The sides should preferably be dovetailed (for description of various dovetail joints, see an article by Fred. Crocker in page 389, Vol. III., or No. 129), but may be merely butted and nailed, or jointed and cross-nailed, as shown in Fig. 5. This makes a fairly strong joint, and the rebates in back and front may be cut with a tenon saw and wide chisel, or a rebate plane will make matters true and square. If, however, nice work is aimed at, dovetailing is by far the best method of jointing, and, if my readers are not carpenters enough to do it themselves, a few shillings expended in getting it done will not be wasted. The sides having been joined, we will now fit the bottom, which should not be permanently secured until the centre frames are fixed (see *Fittings*). Before fixing the bottom, cut a 3 in. square hole exactly in the centre. This is for the lamp flue. Now with a gauge or pencil correctly mark a line all round the box, $1\frac{3}{4}$ in. from the top. The lid now demands our attention. As will be seen from the plan (Fig. 4) and sections (Figs. 1 and 2), it consists of a frame with a centre rail, and contains two glass panels (G). These are very useful, especially during hatching time, to see how matters are progressing without opening the lid. This glass should not be less in substance than what is known in the trade as 32 oz. sheet or pieces of plate glass, which

is about ¼ in. thick, would be still better. The frame should be mortised and tenoned to make a nice strong job, but a simpler plan, though not nearly so good, would be to halve the joints and secure them with brass screws from the under side. It may, of course, be solid, but, if this plan is adopted, it should have a lining of felt and sheet zinc, or it would, in all probability, crack with the heat. The top now being ready, nail it to the sides of the box, and fixing the case, if possible, in the vice of a carpenter's bench, proceed to divide the lid from the body by sawing round the line previously marked. Now take out the saw marks with a smoothing plane, and hang the lid with a pair of 1¼ in. or 1½ in. brass butt hinges, using brass screws (iron would rust).

Now mitre a 2 in. architrave moulding round the bottom, and a 1¼ in. panel moulding of similar section round the lid under the projecting top, or a plain plinth may be affixed to the bottom and a small hollow run round the top, as shown on the right-hand side of Fig. 2, or the top and bottom may be rounded off or left square, as on left-hand side of same figure. In this latter case the bottom should project ¾ in. over the sides instead of being flush, as previously described. Before fixing the top, a hole 2 in. in diameter should be cut in centre of middle rail (see D, Fig. 4, also sections), and round the framing of lid a series of ⅜ in. holes (V) equidistant from each other, and midway between the edge and the glass, should be bored with a centre-bit—boring from both sides in order to cut the holes clean. These are for ventilation. Now procure two squares of glass 9¼ in. by 4¾ in., and fix in place with small beads secured with needle-points or fine brads. Now, having prepared your blocks of hard wood, take them, with the four pieces for the legs, to a wood-turner, and get him to turn the legs to pattern, and cut a thread on the top stud and a corresponding thread to fit in the blocks. This will cost about 1s. or 1s. 6d., according to the conscience of the turner. Now fix the blocks in position as shown, screw in the legs, punch in all nail heads, stop the holes with putty, and give all a good glass-papering. It can now be painted or stained and varnished to taste, when it will be quite an ornament in any room of the house. A pair of brass side hooks fixed to the front for fastenings completes the case, and we will now proceed to the fitting up.

Fittings.—On reference to the sectional drawings (Figs. 1 and 2), also to plan (Fig. 3), there will be noticed an arrangement of double frames (C F) fixed in the centre of the machine, to which is affixed the lamp flue and evaporating tray. To be more explicit, the arrangement consists of two lidless and bottomless boxes made of ⅜ in. wood, 3 in. high, the outer one 5 in. square, and the inner one 3¾ in. square—both outside measurements. The smaller of the two is fixed, by means of fine brass screws, exactly over the square hole in the centre of the bottom; the larger one is fixed outside the other, leaving a ¼ in. air space all round. The object of this is to prevent the heat from striking through direct to the eggs nearest the centre of machine. These having been fixed, secure the bottom of case to the sides permanently by means of brass screws. Now take the remainder of the ⅛ in. wood, which we have already planed up, and cut to shape eight fillets, two to each pattern (see Figs. 6, 7, 8, and 9). When prepared, they are to be fixed with brass pins or brads all round the bottom of case and centre frames, and in the positions indicated by the corresponding numbers on plan (Fig. 3). These complete the wood fittings. We now require a sheet of perforated zinc a little larger than the inside measurement of the case). Cut out a portion corresponding in size to the centre frames, and then cut and shape the zinc to fit on the fillets, thereby forming the dished bottom, egg-tray, or nest (Z, Figs. 1, 2, and 3) previously mentioned. Fix this bottom down with brass escutcheon pins to the fillets, first boring the holes with a suitable bradawl, and then forcing the pins home with a piece of wood, so as to be easily withdrawn when required for cleaning purposes. Out of sheet metal—copper recommended—make the lamp flue (F) and the evaporating tray (E). Through the bottom of the latter solder a piece of small brass tube (O, Fig. 2) to act as overflow pipe. Over the bottom of this slip a piece of rubber gas tubing to convey the waste water to a suitable receptacle (O P, Fig. 2). To the top of lamp flue fix, by means of rivets, three narrow strips of copper, forming a tripod, shaped to hold the radiating disc (R D, Figs. 1, 2). In order to make this quite clear, I have, in Fig. 11, sketched the top of flue, showing tripod and disc. This disc should be made of a piece of stout steel metal, and have affixed to it tightly by a single rivet a short arm as shown, with a small hole drilled in its extremity to serve as a guide for the regulator rod (R R), of which more anon. A second disc (R O D), but smaller, should also be provided, and hung by cross straps from the top of flue, in order to throw the heat passing upwards against the sides of evaporating tray, thus heating the water contained therein. A metal cup (C, Figs. 1, 3, and 4) must now be provided, and a piece of brass tube soldered into the bottom at the back to convey the water into the evaporating tray. These two fittings should be made of copper, and it will repay the worker in the end to have them made by a coppersmith, as there must be no soft soldering about them. They are also the parts subjected to the most wear and tear. Tinplate will not do on any account, as sooner or later it would only lead to trouble; therefore avoid it. The next fitting to claim our attention is the water tray (W). This may be made of zinc, and needs no special description beyond saying that it is a rectangular vessel, supported on two brackets of iron or wood secured to the side of case. A small brass tap, costing about 1s., should be soldered near the bottom at the right-hand side of front, and serves to regulate the supply of water dropping into cup (C).

The next item on the programme is the damper (D). This may be built up of sheet metal, but is better as a brass casting. It consists of a bent bar, say, ⅜ in. wide and ⅛ in. thick, with a circular enlargement at one end 2½ in. in diameter, and a smaller but thicker enlargement at the other. This should be hollowed out and filled with lead as required to adjust the balance, so that the widest end is just slightly the heavier of the two. A cross-bar occupies a central position in its length, the ends being reduced and filed to a knife edge. Two brackets, with a round hole in each, are fixed on either side to the top of the case, forming the fulcrum on which the knife edges work. A small flange, ½ in. deep, is now to be fixed over the circular hole in cross-rail of lid, and the damper adjusted until it covers the opening in the flange. After the regulator is fixed, carefully note where the lifting-rod (R R) engages with the bar of damper, and at this point drill a hole and fit a small milled-headed screw (S). When fitted, a small disc should be soldered to its point, in order to catch the end of the lifting-rod of the regulator. By means of this screw the final exact adjustments are to be made. A simpler arrangement, though not nearly so good, would be to make the damper lever of wood. The cross-bar could be of wood also, having a couple of needle-points driven in, one at each end, which might work in the slots of screw heads, screwed in the lid.

Regulator.—This, as will be seen by reference to Fig. 2, consists of a bent glass tube (R) of about ½ in. calibre, bent in the form of the letter J. The shorter limb is sealed over with the blowpipe, and in the sealed end, imprisoned by a column of mercury (M), is contained a volatile fluid (S E); preferably dilute sulphuric ether in the proportion of 3 parts of ether to 1 of alcohol. (N.B.—Water will not mix with ether, so do not try it). This fluid, boiling at a low temperature, gives off a vapour in proportion to the amount of heat present, and, being imprisoned, forces the mercury column round into the longer limb. This in turn engages with a small float or plunger (P) resting on its surface, carrying a rod (R R), which in its turn actuates the damper (D), impinging on the small disc at the end of adjusting screw (S), and allows a portion of the heat to escape. As the temperature falls, the damper resumes its normal position, rising and falling according to the variations in the temperature. In practice, however, it will be nearly always open, and should be adjusted so that the damper stands about ⅛ in. clear of the flange, thus allowing for decrease as well as increase of heat. Now, to get the ether and mercury into their proper positions is rather a troublesome job to the tyro, but to the initiated it is as easy as "eating pie," and is easier shown than described. However, having procured your tube, pour into it sufficient mercury to fill not quite half its length. By gently tilting the tube thus, ⟍, force out all the air, so that the mercury entirely fills up the short arm. Now pour about three-quarters of an inch of ether on the mercury, and by gently tilting in this direction, ⊂, lodge about half the fluid above mercury at the sealed end. Ether being of lighter specific gravity than mercury, will assume the uppermost position. Bring the tube to an upright position, and with a small piece of rag or sponge soak up the surplus liquid now remaining in the open end. Slip the rod through the hole in the guide-arm attached to radiating disc, and adjust as necessary, so that the plunger slides easily and freely in the tube, and at the same time engages, when rising, with the small disc of adjusting screw. To know the exact temperature the machine is working at a thermometer will be necessary, and should have a bent tube in the form of the letter L (see T, Fig. 2), the bulb being inside on a level with the upper side of eggs, and the scale from about 90° to 120° Fahr., reading outside. To protect the thermometer it must be encased, as shown, with a piece of brass tube fixed in the front.

Lamp.—Now we come to the heat supply. It is not absolutely essential that a lamp should be used. Gas may be employed if more convenient, only it needs carefully watching to note when pressure in the main is increased, as it always is towards night, or you may get more heat than the regulator can master. Watch should also be kept

that the supply is not shut off for repair of mains, etc., without being noticed. If a lamp is used, these precautions are unnecessary, and can, after the first day or two, be left to take care of itself for twenty-four hours at a stretch. The best form of lamp to use is one of the round burner variety, known as "kosmos," taking an inch wick. The burner and screw collar can be purchased at most respectable oil shops for about 1s., and should be fitted to a square tin reservoir as shown in Fig. 2, a screw cap being also provided for filling. If made to size, as drawn, it will hold enough oil for two days' supply in the coldest weather.

All the sketches—with the exception of Figs. 5, 10, and 11—are drawn to a scale of 2 in. to the foot, or one-sixth full size, so that if any measurement is multiplied by 6, the exact size will be obtained.

Working.—We will now suppose the machine finished, and ready for a trial run. It will be well to run it empty for a few days in order to understand its working and to get the temperature set and regulator adjusted. The machine should stand, if possible, in a room with a fairly even temperature (the bedroom is a capital place, if the lady members of the household do not object), out of the way of draughts, and as far from the reach of loud noises and jarrings as possible. The quieter its surroundings the better. The situation having been selected, fill the lamp with oil of good quality, costing about 1s. per gallon. Avoid cheap oil; for our purpose it will be the dearest in the end, being very deficient and variable in heating power. Trim the wick squarely with the top of the burner, light, and turn up until the flame is about level with, or but slightly above, the constriction in the chimney. Fill the water tray with tap water (warm in cold weather), and turn the tap so that it supplies a full drop per second, remembering that, as the water gets lower in the tray, the slower will it drop from the tap. A piece of muslin placed over the tray and water-cup will keep out dust, etc., which might choke the tap and pipes. Take out the regulator rod, and watch the thermometer until it registers from 104° to 106°. Now note the position of the mercury column in the regulator tube, and cut the rod to its approximate proper length, insert in place, and make final adjustments with adjusting screw (s). As regards the proper heat to work the machine at, a little difference of opinion exists, but it is pretty generally conceded that it lays between 104° and 106°. I have had good results with the latter, but if eggs at various stages of incubation are in the machine together, the former figures will be preferable. Having mastered the details of working, *and not before*, place a few ordinary eggs in the machine, and proceed to business.

One word of caution: Do not put a batch of valuable eggs in for the trial run, as incubators, like everything else, want understanding before the best results can be obtained, and it is considerably within the range of possibilities that the first lot may not prove an unqualified success, although the experience gained should stand you in good stead. Josh Billings says, "The hen is a darn phool;" but this remark does not apply to this "tin hen," as incubators have been called, and any failure should not be rashly laid to its account. The eggs being in, and all working satisfactorily, we shall need to trim the lamp once every twelve hours by carefully removing the charred portion of the wick with a duster, also replenish oil and water as may be necessary. Once a day, morning preferably (when the lamp is trimmed will be a seasonable time), open the lid of machine for a short time according to the state of the weather—say fifteen minutes in cold weather, and twenty in warm—to give the eggs an airing; and also turn them and alter their position as before described. The reason for this is that the germ always floats on the top of the egg, and if kept in one position would probably stick to the shell, and thus cause the death of the embryo chick. No notice need be taken of the temperature in the egg-chamber for an hour after the daily airing, after which time, with the lamp burning properly, it should have resumed its normal temperature. Provided the eggs were fresh—and I may as well say here they *must* be as fresh as possible (if taken direct from the nest to the machine, all the better), as stale eggs cannot but produce unsatisfactory results — we may, towards the end of the twentieth day, look for signs of the eggs chipping, and may possibly hear the chirp of the chicks some hours before the shells are "starred." Avoid opening the lid of machine at all times, any more than is necessary, and especially at hatching times. If no shells are "starred," the eggs may with advantage be placed in a basin of water heated to 100° Fahr., placing them in gently, so that they are not entirely submerged. The live chicks can now be easily distinguished by the capers they cut, the struggles of the chick trying to extricate itself giving the motion. After a few minutes' soaking—being careful not to chill the eggs—replace them, *without wiping*, in the machine, and await developments. Help at hatching time should not be too freely rendered; but, if a shell has been chipped for twenty-four hours, and the chick seems unable to kick its covering off, a little help may be beneficial. Begin at the beak, and gently remove the shell in small portions by the help of warm water, if necessary, but, should blood flow, desist at once, and replace in machine, as the blood-vessels attached to the membrane of the shell are not dried up, and the chick would probably die if removed. Our trial run having proved satisfactory, we may now proceed to business in earnest; but in order to economise space, we will examine the eggs after they have been in a few days, replacing the clear or unfertile ones with fresh. In adding fresh eggs to those in an advanced state of incubation, care must be taken that the cold eggs are not placed in contact with the warm ones. If possible, it will be advisable to thoroughly warm them through, in front of the fire or otherwise, before placing them in the machine.

Conclusion.—In finishing this paper, I may say it will be followed by another, in which I shall hope to make clear the testing of eggs at different stages, give instructions for making simple rearers or artificial mothers of two or three different patterns, and conclude with a few remarks on chicken rearing. I hope all who attempt to follow my instructions may be successful. I have endeavoured to make everything clear; but if not, I shall be pleased to help and advise any who may be in difficulty through "Shop." Let me impress upon each worker the necessity of quiet, regular daily attention, patience, fresh eggs, good oil, sufficient water supply, and last, but not least, cleanliness. This is ever and always an important item in the keeping and management of everything that has life, but which, unfortunately, is too often neglected.

SHORT LESSONS IN WOOD-WORKING FOR AMATEURS.

BY B. A. BAXTER.

THE SAW.

I HAVE, in these lessons, treated on the saw used merely to divide pieces of any size into parts, but before any real progress can be made in the more advanced use of the saw, the learner must know the difference between sawing *on* a line and sawing *up to* a line. In the first case a line may be made, and the saw not only wastes the wood on which the line is drawn, but some wood on each side of the line; but in the second case the saw is to be used so that the line is just glanced by the saw, and the whole of the wood wasted by the saw-cut must be taken from the part not wanted.

In making the various joints in which sawing forms part of the operation there is, of course, waste, and if the lines are accurately drawn, as boundary lines, clearly the saw must be made to move on the waste side of the line, outside the marked boundaries, or the finished work will be too small. Nor is this an unnecessary refinement. For instance, if a tenon is to be cut, both surfaces are generally formed by the saw, and therefore if the saw is allowed to encroach upon the tenon the fit will be materially affected.

The learner must practise with the saw until it is his obedient servant, but some advice may be given tending to that result.

The hint given to keep the eye in a plane with the cut will be slightly modified in favour of any position, differing but *little* from it, in which you can see the line.

In cases where special accuracy is needed, such as cutting shoulders to tenons, a knife-cut instead of a pencil-mark is to be recommended.

In that case, using care, the actual joint is the cut-line, rather than the sawn edge. Very little reflection will convince the worker that the whole of the wood removed by the saw must be on the waste side of the line, and that the blade of the saw should move along the line in *close* contact with it.

I am aware that the word line in this connection scarcely bears its mathematical meaning, although, even in that respect, a line made with a sharp cutting edge is much nearer the ideal line than a pencil-mark.

As to the proper saws to be used for cutting the parts of joinery, there can be no hard-and-fast rules laid down. A tenon may be so large that it may be formed by cutting with the grain with the rip saw, and across the grain with a panel saw, or so small that a dovetail saw is of ample size for both purposes. Again, a dovetail may easily be large enough to warrant the use of a tenon saw, and yet not be as large as dovetails are sometimes required.

It is of importance to learn to use the saw so as to require the aid of chisels to pare the tenons, etc., as little as possible. It is far better and economical of time to cut the work properly at first than to trust to the use of chisels to reduce tenons too stout, dovetails too big, sockets too small, or mortises too narrow.

Of course, this advice is to be applied to sawing for *joinery*; in the use of the saw as an adjunct to wood carving it is a time-saving tool, and these considerations do not apply. It may be as well, however, to add that when I speak of the saw as a tool used in wood carving, it is in the production of wrought forms from the solid in cabinet making and not to wood carving in bas-relief.

KNOTTING, SPLICING, AND WORKING CORDAGE.

BY LANCELOT L. HASLOPE.

SPLICING.

SHORT SPLICE—MARLINESPIKE—PRICKER—LONG SPLICE—CUT SPLICE—EYE SPLICE—CABLE SPLICE.

SPLICING is a method of joining ropes by interweaving together the strands of which they are composed. When ropes that are required to run through blocks have to be joined it is evident that knotting them together will not serve our purpose, as the knot would prevent their passing through the block. In this case splicing is always used to unite them.

The splice most generally used is the short splice.

The ends of the two ropes are unlaid for a sufficient distance; they are then placed together, as shown in Fig. 112, the strands of one rope going alternately between the strands of the other. The two ropes are then jammed closely together. The end of one rope with the strands of the other rope is now held firmly in the left hand. Sometimes a lashing is put round the strands to keep them down to the rope on which they lie. Pass the middle strand, A, over the strand of the other rope, which goes down to the left of it, which is B, then bring it under C, and haul taut. Do the same to each of the other strands in succession, putting them over the next strand to them and under the next beyond. Turn the rope round and do the same to the other set of strands; this may be repeated on both ropes. Care must be taken not to bring two strands up through one interval in the rope. Each strand should come up separately between two strands of the rope they are passed into. If it is desired to taper the splice for the purpose of making it neater after the ends have been interwoven, divide the yarns of which the strands are composed, pass one-half as before, and cut off the other half. For the purpose of bringing the rope into shape again after the splice is finished, it is usual to roll it, if the rope be large, with the foot on the deck; if small cord has been used, a piece of flat wood is substituted. As the strands of a rope are tightly twisted together it requires some force to open a passage for the parts of one rope through the other. For this purpose, in the case of large ropes, a marlinespike (Fig. 113) is used. They are made of iron, copper, and hard wood. I like copper best myself, as it does not rust like iron, or break like wood. With small stuff we use a pricker (Fig. 114), which should be made of steel. Messrs. Thomas Turner & Sons, of Sheffield, make an excellent knife, with one large blade, and a good-sized pricker; the whole is nickel-plated to avoid rust. At the end of the handle is a shackle for a lanyard. It is as useful a tool as any sea-going person could desire. For very large ropes a fid is used, which is merely a wooden pin, tapered, generally made of lignum vitæ.

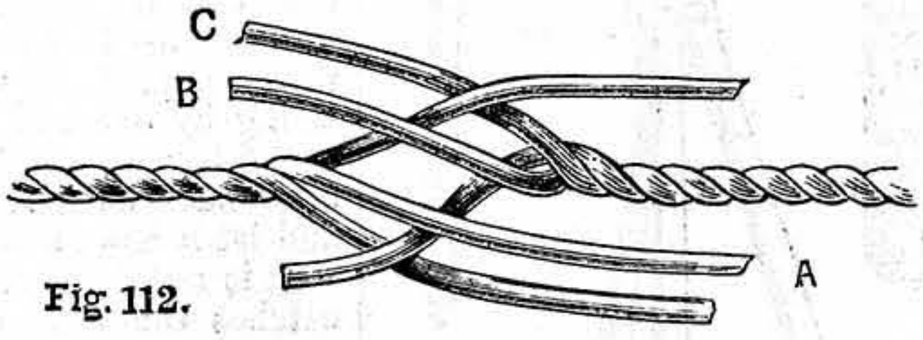


Fig. 112.

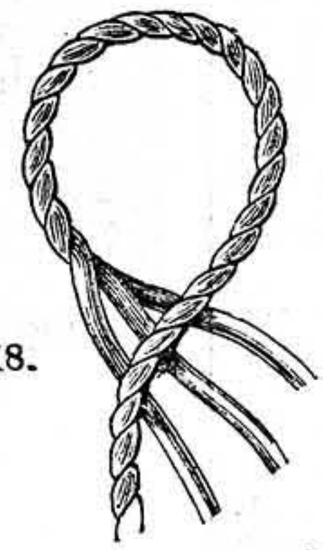


Fig. 118.

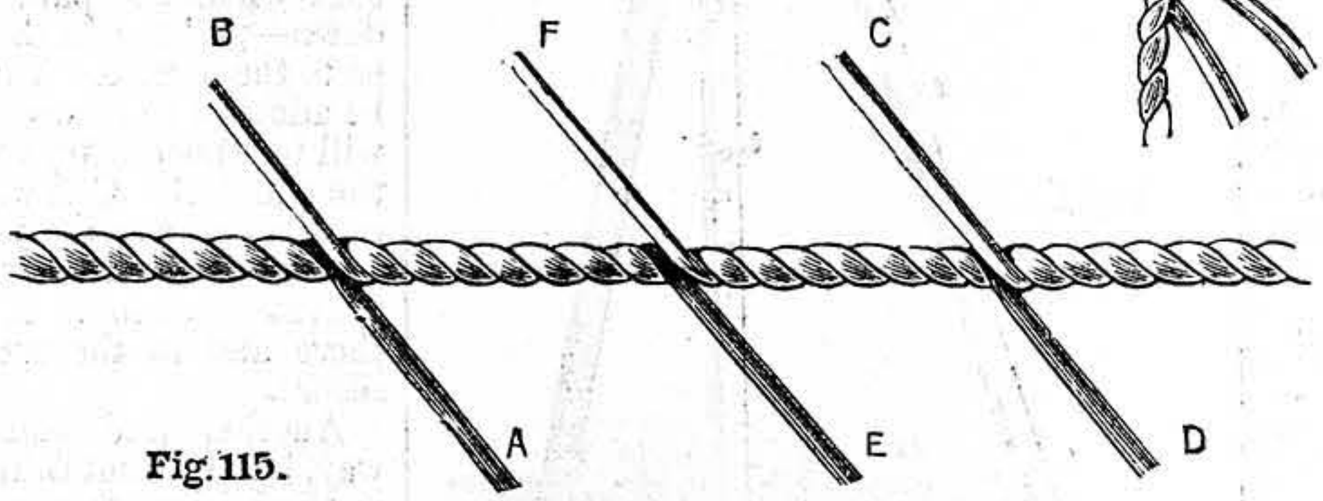


Fig. 115.

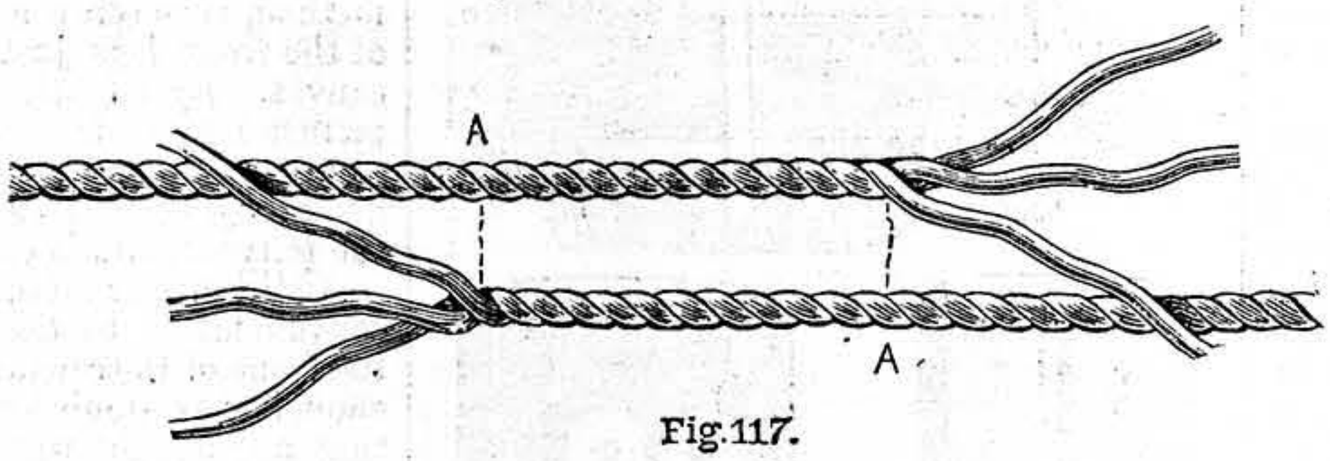
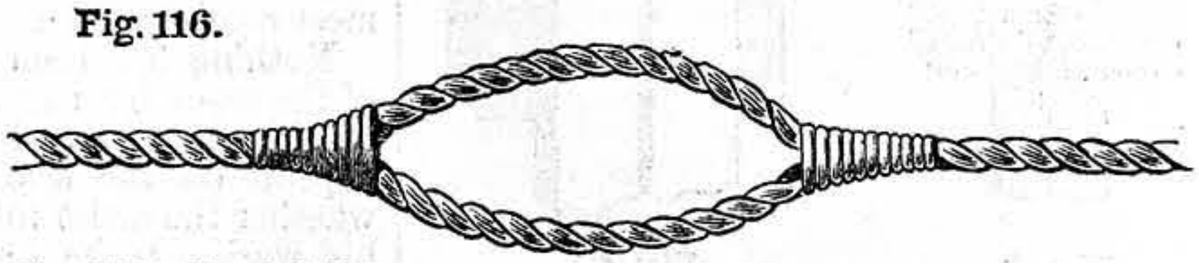


Fig. 117.

Fig. 116.



Long Splice (Fig. 115).—This is in some respects a better splice than the short splice. Unlay the ends of two ropes for a much greater distance than for a short splice and put the ends together as before. Unlay one strand (A) for some length, and fill up the space left by its removal with the opposite strand from the other rope, as B. Do the same with two more strands (C, D), C being the one unlaid, and D the one laid up in its place. Now make an overhand knot with the two remaining strands (E and F), taking care that the ends follow the lay of the rope and not across them. Divide both strands in halves and pass one-half over the next strand, and under the following one; do this two or three times and cut all the ends off close. Work the remaining two pairs of strands the same way and the splice is finished. The rope should be well stretched before the ends of the strands are cut off.

Fig. 116 is a cut splice forming an oblong loop in the middle of a rope. It is made by splicing the end of one rope into the standing part of another, as at A, A, Fig. 117, so as to form an eye of any size you wish. The end of the other rope is then spliced into the standing part of the first rope, and the spliced parts served over. A neat way of forming an eye at the end of a rope is by unlaying the strands and placing them on the standing part so as to form an eye, then put one strand under the strand next to it, and pass the next over this strand and under the second; the last strand must go through the third strand on the other side of the rope. Taper them as before by halving the strands and sticking them again. This is called an eye splice (Fig. 118).

Cable Splice.—Unlay the ends of the ropes to be joined for some distance, then place them together and make a short splice, leave some length, and from thence reduce each strand to a long taper by gradually cutting away as many yarns as necessary; neatly point over the taper and lay the ends in the intervals of the rope. Clap on a seizing at each end of the splice, an end seizing at the beginning of the pointing and a stop at the end of the tails. This is the best splice for cables, as it may readily be taken asunder.


Fig. 113.

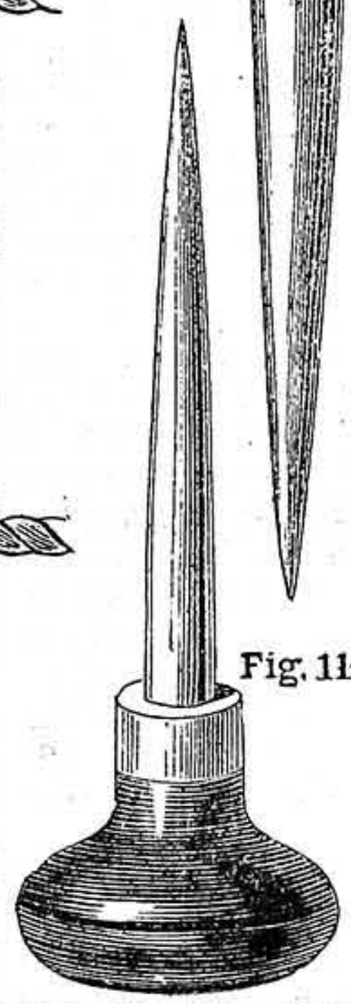


Fig. 114.

Fig. 112.—Short Splice commenced. Fig. 113.—Marlinespike. Fig. 114.—Pricker. Fig. 115.—Long Splice. Fig. 116.—Cut Splice. Fig. 117.—Cut Splice commenced. Fig. 118.—Eye Splice.

Another method of making a cable splice is to splice the ends in twice each way, then to pick out the strands, worm part of them round the cable, and taper away the rest, which should be marled close down; then clap on a throat and two end seizings of ratline.

I am now approaching the termination of the subject on which I have been writing, and in two papers more I shall bring my remarks on it to a conclusion. Readers will have noticed that it divides itself into three parts, of which the first, namely knotting, was by far the longest. Splicing, which has been dealt with here, is short, but its importance must not be underrated on that account. Working Cordage now remains for our consideration, and this, as I have said, will be comprised in two papers.

AN ARTIST'S SKETCHING EASEL.

BY A. CONWAY.

NECESSARY FEATURES — DIMENSIONS — HINGE-BLOCK — ATTACHMENT OF LEGS — SUPPORTS FOR CANVAS — ENDS OF LEGS — FASTENING EASEL AND CANVAS—HEIGHT—UTILITY.

AN easel adapted for out-of-door use or sketching purposes differs in many respects from its counterpart of the studio. Its primary qualifications should be lightness and portability, in order that it may be easily carried even, as sometimes happens, for a considerable distance to a good "subject." The conveniences for raising and lowering the canvas, adjusting it to different angles, etc., which are found in a first-class

studio easel are not expected in it; indeed, they are not necessary, as the canvases painted out of doors are seldom of large size. Therefore all that is required in the way of adjustment can be done by simpler means than are adopted in a heavy studio easel. In addition to the essentials of portability and lightness, the sketching easel must be sufficiently rigid to bear the canvas being painted.

The easel I am about to describe is of a type which, rightly or wrongly, is generally attributed to the late David Cox, whose pictures, done direct from Nature, are in such high and increasing repute. Whether he actually invented this simple form of easel or not, there is no doubt that he used it and largely popularised it among artists; and the probability is that much of his work was done on no other. I do not think that I need say any more to show that this kind of easel is thoroughly useful and serviceable, though its popularity with artists of the present day might be adduced as an additional evidence of its utility.

Of course, I am far from saying that the construction of the one I am about to describe has not been elaborated or, if the reader likes to consider it so, even improved. A glance at those in an artists' colourman's shop will show that. At the same time, it is open to question if these alterations are always improvements. Extreme lightness may be got at the sacrifice of strength, and the other modifications may rather be regarded as luxuries than as actual necessities. However, I have not to do with the nicely finished arrangements of the artists' colourman so much as with a good, practical easel which can be made in the simplest manner with materials which can be found anywhere. The constructive work, also, is so trifling and of such an easy character that even the novice at wood-working can manage it, and in the event of his not being inclined to do it himself, the most unskilled and thickest-headed country carpenter cannot have the slightest difficulty in grasping the main features and carrying them out in a satisfactory manner. From this it will be gathered that the cost is small. As some guide to those who want to get one of these easels made, I may say that the one from which this description is taken cost me 1s. 6d. complete from the village joiner who made it for me.

By referring to the illustration (Fig. 1), it will be seen that the easel is formed of three legs, the back one being merely a support for the other two, on which the canvas rests. Now what may be called the actual making is of the very slightest, as, beyond smoothing and cleaning up the three long pieces, it consists almost entirely in the formation of the block at the top, to which they are attached. This block is shown on an enlarged scale in Fig. 2, and may as well be of some comparatively hard wood, such as beech—anything, in fact, that is harder than common pine, which, however, will do very well for the other parts, and may be used even for this one.

The dimensions of the various parts can best be regulated by individual requirements, so that I cannot say much about them, and beyond determining the substance of the three long pieces, we have little to do with them at present. I may, however, say that in the easel referred to the parts are all of 1 in. stuff. The only reason for making any remark about this now is that the size of the opening of the block may be made to correspond with the width of the top of the back leg, which is fitted within it. If it corresponds in thickness, so much the better for appearance, but not for any other reason. Let us suppose the width to be 1 in.

Hinge the end of the back leg by means of a piece of wire—a French nail will do very well—driven through as shown by dotted line in Fig. 3.

The front pieces now have to be fastened to the block, and this may be done easily by means of a screw-nail through each. The plain parts of the screw-nails will allow of the legs moving sufficiently easily on them; and to allow of the legs opening outwards, the holes should be placed near their ends, which should be rounded as in Fig. 4.

It will now be seen that the front legs can

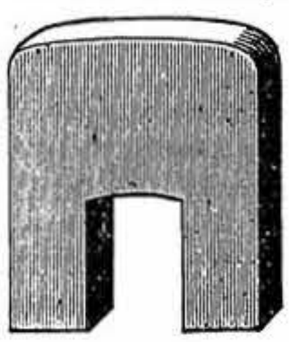


Fig. 2

Fig. 5

Fig. 1

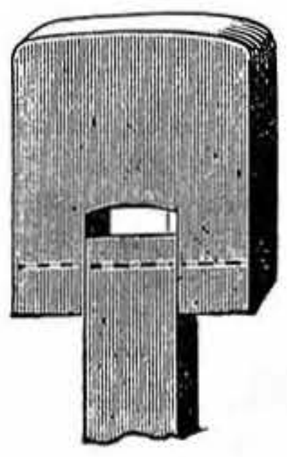


Fig. 3

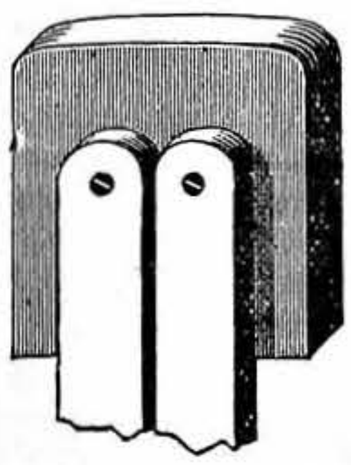


Fig. 4

Fig. 1.—Easel. Fig. 2.—Block for Top. Fig. 3.—Back Support fastened to Top. Fig. 4.—Front Supports fastened to Block. Fig. 5.—Screw-Hook.

be spread open sideways, and that the back one will support them at any desired slope, while, when the easel is folded, they lie close together, and form as compact a bundle as possible.

To complete the easel, it is only necessary to bore holes at intervals through the two front pieces, so that pegs may be inserted in them for the canvas to rest on. For the pegs themselves almost any short pieces of stick will do. My own are nothing but bits of twig cut off with a piece of a projecting branch left on at the outer end, thus forming a kind of rough hook within which the bottom of the canvas lies, so that it is prevented from accidentally slipping off.

The ends of the legs may be left as they are, but it will be better to fix a piece of stout wire or thin iron rod into each to prevent them slipping, and to allow of their being firmly fixed. If wire is not handy, they may be simply sharpened to a point, so that when sketching in fields or on soft ground they can be driven into the earth. Of course, the points will want sharpening occasionally, as they will, under ordinary circumstances, soon get worn away. As everyone who has painted in the open air knows, it is necessary often to fasten both canvas and easel so that they may not be blown over; but novices may not quite see how it can be managed, as it may be, very easily. So far as the easel itself is concerned, there is no difficulty when the ground is sufficiently soft to allow of its points being driven in. It is not always, however, that this can be done, and then some other means must be adopted. The simplest is to fasten a piece of rope or sufficiently thick string by one end to the top block, and to the other end fasten a stone or anything else—such as a rod—that may be handy, and let it hang near the ground.

It is not, however, the easel itself which catches the wind as much as the canvas; and everyone knows how awkward it is for this, when the paint is wet, to be blown down—perhaps, in the effort to save it, right on to the palette. Various contrivances may be adopted to secure it to the easel, but it will be unnecessary to do more than suggest the simplest. One way, which will no doubt readily occur to the young artist, is to fasten a small nail or two into the top edge of the canvas stretcher. A piece of string tied there and to the easel will then make all secure.

Another and somewhat neater-looking way, but I do not think any more serviceable method, is to screw a hook into one or both of the front legs just above the top of the canvas. By slightly turning the hook, the picture may be fastened or released as occasion may require. The ordinary brass screw-hook (Fig. 5) does as well as anything for the purpose, and is easily obtainable.

A still cruder method, but one not always convenient, is to tie a piece of string over the front of the canvas and round the easel; enough has doubtless been said to show that any simple way which may be found satisfactory will do equally as well as the most complicated arrangement of clips.

Nothing has been said about the height of the easel, for naturally this must depend on circumstances. For instance, much will depend on the size of the paintings and whether the artist intends to sit or stand to his work. If he habitually sits, a much shorter one will do than for a standing position, but I may name what I consider a fair average size—viz., about 5 ft.; while for a sitter, probably 4 ft. will be found sufficient in the majority of cases. It will easily be understood that it is not advisable to have the easel too long, not so much on account of inconvenience while painting as of its being cumbersome for transport; nor, on the other hand, too short and, consequently, awkward to paint at.

For small and, consequently, light paintings, even slighter substance than 1 in. square will do very well; and those who want to make the easel still more portable than as described, can do so by cutting each leg in half and bringing the parts together by means of a screw, or other suitable tie. A piece of stout wire or French nail passed through holes will prevent the legs collapsing, and render them sufficiently rigid when the easel is in use.

Of course, it must not be understood that a more highly finished easel might not have

been described, but to have done so would have been to increase the difficulty and cost of making without in any material degree increasing what I may call its workable capacity. The maker might, for instance, have been advised to make it of mahogany, and carefully French-polish it; but *cui bono?*

I have spent many pleasant hours in company with such an easel and its accompaniments of paints, brushes, palette, canvas, etc., out of doors when sketching, and have not disdained to use it in the house. I think any readers of WORK will not regret adopting the pattern if they are on the look-out for a cheap, serviceable, and handy easel, whether for in- or out-door use.

THE WINTER CARE OF CYCLES.

BY "CYCLOPS."

AT this time of the year cyclists are thinking of stowing away their machines, and it may interest many readers of WORK to know that a cycle, when stored for the winter, may be doing itself as much harm, and wearing itself away almost as much, as when in active service in the rider's use. This may seem, on the face of it, ridiculous, but a closer examination of the question will show that there is more truth in the seemingly sweeping assertion just made than is at first apparent.

I say "*may* be wearing itself away" advisedly, because there are many experienced cyclists who take care to put their machines away in good condition, and thus prevent this wear.

It must not be supposed that I am in favour of thus banishing for the winter a friend who has stood us in good stead during the summer. I myself am of opinion that almost as much pleasure can be had out of the constant use of the bicycle during the winter as during the summer; and any cyclist who has sallied forth on his machine on a clear frosty day, with a good hard macadamised road under his wheels, will testify to the exhilarating effects of such exercise—an enjoyment not to be compared with that of going forth on a hot day, with the rider's temperature almost at boiling point.

There is a distinct difference between the two feelings, and I am inclined to give the preference to the winter ride. But to return to our subject: There are no doubt many riders of cycles whose interest in their machines ceases with the advent of winter, and who take up some other hobby or pastime, and leave cycles and cycling to take care of themselves until summer comes round again. To these cyclists I would say: Take care, in putting away your machines, to make them thoroughly comfortable, as a coachman would his horses after a hard day's work.

It is often the case that a cyclist, going to his machine to get it into condition for use again, is surprised to find that it is looking very bad indeed. The enamel is, perhaps, cracked in many places; there are marked signs of the plating stripping; the spokes are rusty at the points where they enter the hubs and rims; the wheels, on being turned round, are found to be very stiff, and the pedals refuse to revolve when tried. All this may be avoided by carefully observing the following directions:

On deciding to put the machine away for the season, the first thing is to thoroughly clean it in every part. First remove all the dust and dirt with a cloth and stiff brush, then thoroughly clean all the bright parts as follows: Procure some very fine flour of emery, and mix into a thick paste with common paraffin oil; with a soft cloth and a small quantity of the paste thus formed rub all the bright parts carefully over, and dry with a clean rag; then polish with a soft duster and a little dry whiting, and finally, rub all over with a soft leather. This will take all the moisture out of the plating which may have got into it by exposure to rain, etc., and help to keep it from rusting and stripping off.

The enamelled parts next require our attention. They should be rubbed all over with a cloth dipped in benzoline, and afterwards carefully polished.

The machine, unless very much used and worn, will now have the appearance, almost, of a new one, and the worker will be surprised at the effect his labours have had on his old friend.

Before proceeding further, the bearings should be thoroughly run out with paraffin oil—or, better still, this could be done before the final polishing process.

The running out of the bearings may be effected as follows:—Support the wheel so that it is free to revolve, and underneath each side of it set a can to catch the paraffin which will drop out from each side of the bearing; then open the oil-cup, fill with paraffin, and revolve the wheel.

This should be continued until the paraffin, which at first runs out thick and black, has assumed its proper density, and runs through the bearings perfectly clear. This should be done with all the wheels, bearings, and pedals, and when they are all quite clear they should be carefully oiled with best machine oil.

Here let me caution the reader against the use of common oils, which only eat into the bearings, and eventually prevent that free movement they are intended to assist. Good oil may be procured from any sewing-machine shop, and, for the trifle of extra cost, it is far and away superior.

The next consideration is the chain. This should be taken off the machine by unscrewing the movable link, and soaked in paraffin oil until all dirt and grit are thoroughly removed. It should then be dried and well black-leaded, or rubbed with one of the many chain lubricants advertised in cycling journals, and afterwards fitted on the machine again.

We must now procure some vaseline, or, as it is known in the trade, petroleum jelly. This may be got by the half-pound of any chemist, and should any be left over, it will come in useful for putting on the hands in frosty weather, to prevent them getting chapped.

But this by the way. We must now thoroughly grease the whole of the machine over with vaseline, even including the saddle, as it will keep it from becoming hard and cracking.

Our machine is now ready to put away. The vaseline will keep the plated and enamelled parts from cracking, and the new oil in the clean bearings will prevent them clogging, so that when summer comes, all we have to do is to wipe the grease from our "iron horse," oil up, and set off for a run, without all the trouble and bother of first overhauling it. "Safe bind, safe find," is advice which holds good for cycles as well as other things, as will be found by all who follow the instructions given above. If the cycle is put away clean, it will be found clean when the time comes to use it again.

TRAMMELS: THEIR USES, AND HOW TO MAKE THEM.

BY J. H.

THEIR PURPOSE—DESCRIPTION OF COMMON FORM—PATTERN WORK—FITTING UP—WOODEN TRAMMEL—DITTO—FINE ADJUSTMENT—DRAWING TRAMMEL.

Their Purpose.—Trammels, or beam compasses, are used for striking circles and radii larger than can be embraced by dividers and ordinary compasses. They are used by fitters, pattern-makers, boiler-makers, and draughtsmen, and are more or less slightly modified according to their special uses.

Fig. 1 shows the common form used by fitters, pattern-makers, and boiler-makers. The only essential difference that need be made in these trammels is that when used on wood the points are ground off at a more acute angle than when used for metal.

Description of Common Form.—In Fig. 1, A is the body of the trammel, made of brass, sliding along the beam or bar, B, and pinched in any position with the screw, C. To avoid bruising the beam, there is a thin washer, D, interposed, with shouldered ends, to prevent it from slipping out endwise when the trammel head is being slid along. The pin E is formed of a bit of steel, either screwed into the boss on the body or driven into a drilled hole.

Pattern Work.—To make such a trammel, a pattern like Fig. 2 is necessary, where A is the pattern itself, and B, B, prints for carrying the core for taking out the holes. Leave extra metal—say $\frac{1}{16}$ in. in diameter—upon the bosses for turning, and a very little—say $\frac{1}{64}$ in.—on the finished sizes of the hole and the outside of the body for filing. Centre the bosses very truly to scribed centre lines, and see that the prints are cut quite central also. Attention to these minute details saves a deal of after trouble in filing up.

Fig. 3 is the core-box for taking out the interior of the body. It is a perfectly plain rectangular box, put together as shown. Be precise as to thickness, for if thicker or thinner than its prints there will be unequal thicknesses of metal in top and bottom sides.

On receipt of the castings, it does not much matter whether the turning or filing is done first. But I should proceed thus:—

Fitting up.—Plane up a short strip of hard wood, 6 in. or 8 in. in length, very accurately to the section of the trammel rod intended to be used. Have its faces quite parallel, and its edges at right angles. This, being smeared with red lead, is the gauge to which the holes in the trammel bodies will be filed out until they will just slide over it freely—neither head fitting tighter or slacker than the other. This will give some little trouble; and it will be as well to make another gauge strip just a shade smaller than the actual templet, and fit the heads roughly over that first.

To save the trouble of filing over the entire flat surface, those who make their own trammels often core them out concave, as shown in Fig. 4. Then, only about $\frac{1}{8}$ in. or $\frac{1}{4}$ in. at each end has to be actually filed instead of the entire surface. The outside of the casting is made convex, to retain a sufficiency of metal. Then the core-box is made like Fig. 5, the box sides taking the place of the open top and bottom of Fig. 3, and the concave portions are cut in the sides.

Having the inner faces true, slide both heads upon the gauge piece, and mark the centres of all the bosses with scriber block central with the strip, and squared over at

right angles with it. The holes in the bosses can then be drilled to these centres, and the bosses turned concentric with them. Each of these operations can be performed in one of two methods. The holes can be drilled by hand, holding the heads in the vice. But as they are liable to become out of perpendicular, the better plan is to drill them in the lathe, pinching the head on an angle-plate the while, and holding the drill in the slide-rest. Or the head may be clamped on the slide-rest, and the drill run in a drill-chuck. The bosses also may be turned while the head is held in an angle-plate; or the head may be clamped between dogs; or it may be held between centres with a small carrier at one end, and pivoted on the poppet centre at the other. In either case the boss nearest the poppet will have to be turned first, and then the head reversed to bring the other boss next the poppet for turning.

The flat faces, A, A, of the heads (Fig. 1) will be also skimmed over in the lathe. A quick speed will be used, and either hand or slide-rest tools will be employed for turning the bosses and facing the ends, and a file and emery-cloth will be used for polishing. After the turning is finished, the outside faces of the heads will be filed and polished.

It gives less trouble to cast a bit of brass for the screw than to turn it down out of steel or iron. It will be turned and milled, and then screwed.

The washer, D, is made from a pattern, or filed out of a bit of solid brass. Another form of washer answering equally well is shown in Fig. 6, where the ends, instead of being turned upwards, are spread at the sides.

The pin, E, is a bit of steel, which should be turned taper for good appearance, and driven into the body.

Wooden Trammel Head.—A cheap wooden trammel head is shown in Fig. 7. It is turned in hard wood, box being preferable, and bonded with small brass ferrules, A, at each end. The screw, B, is made of brass or steel, and its nut, C, consists simply of a square bit of brass or steel sunk into the trammel head within the slot cut through for the trammel rod. This plate will be about $\frac{1}{8}$ in. thick, to take three or four threads, and will wear an indefinite time. The washer, D, is of the form shown in Fig. 6. Such a trammel is very easily made, and yet for wood-work answers as well, or nearly as well, as a more elaborate one of metal.

Wooden Trammel.—Figs. 8, 9, 10 give three views of a trammel head made in hard wood. It is very easily made, very simple in action, involves no metal work except the fitting on of the brass ferrule, and requires no screw cutting. Yet for wood-workers it is quite as serviceable as the trammels made entirely in metal.

Fig. 8 shows the trammel in outside elevation, and Figs. 9 and 10 in transverse and longitudinal sections respectively.

In these figures, A is the body of the trammel, turned of hard wood, and bonded with a small ferrule, B, to prevent the wood from becoming split on the driving in of the leg, C. Through the head passes the washer-piece, D, and the tightening-pin, or cam, E. The cam-like form is given to the pin, E, by simply cutting out a narrow portion at the centre (see Fig. 9) eccentrically. When, therefore, the pin is in the position shown in Fig. 9, there is no pressure on the washer; but when the pin is turned round to bring the opposite or full portion lowermost, it presses upon the washer, D, and tightens the head.

The rounding of the bottom edge of the rod, F, is thought by some to be a slight advantage, as tending to increase the stability of the head upon the rod, giving a more wedge-like grip than a flat face would afford.

Fine Adjustment.—The pinching of the top screw of the trammel head does not alone furnish that precision of adjustment which is desirable for the most accurate kinds of work, such as the pitching out of centres of wheels, the striking of pitch circles, and other lines and centres where adjustments of $\frac{1}{50}$ in. or $\frac{1}{100}$ in. are required. A fine adjustment, like the screw adjusted leg of a spring divider or of wing compasses, is then desirable. There are two or three ways of effecting this. I think the method shown in Fig. 11 is as good as any that I have seen, and I therefore illustrate it.

Of the two trammels used, only one is like that shown in Fig. 11, and it always remains near the end of the rod, A. The other is made without the extension, B, and slides anywhere on the rod. The narrowing of the upper part of the head where the washer, C, and screw, D, come is simply a fanciful form that one often sees, and is no essential part of the design; so that as regards the shape of the head in Fig. 11, it is simply a common trammel head, extended at the end, B, to form a boss through which passes the fine adjusting screw, E.

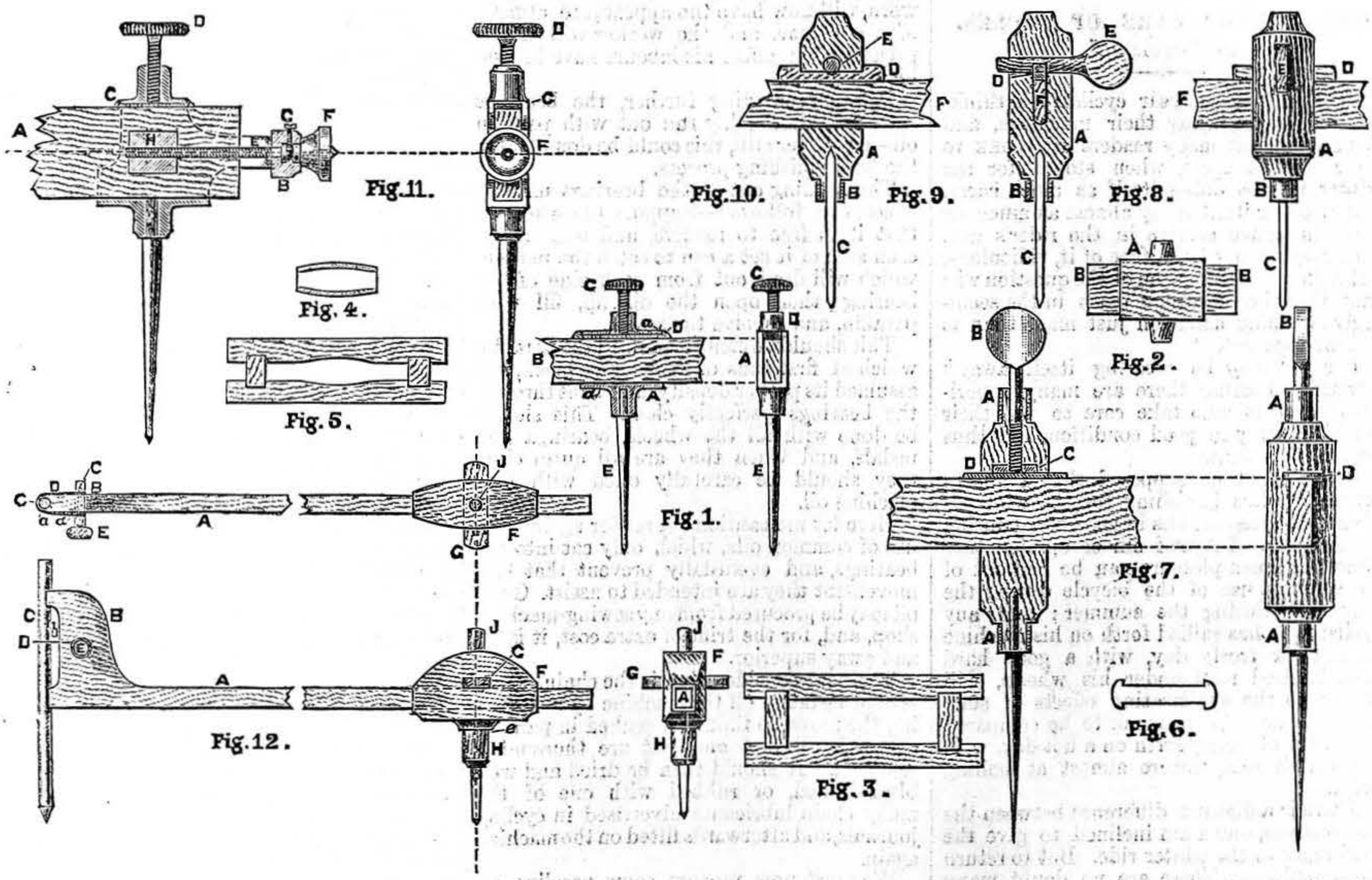


Fig. 1.—Brass Trammel Head. Fig. 2.—Pattern for same. Fig. 3.—Core-Box. Fig. 4.—Section of Concave and Convex Head. Fig. 5.—Core-Box for same. Fig. 6.—Form of Washer, alternative with that at D in Fig. 1. Fig. 7.—Wooden Trammel Head with Screw. Fig. 8.—Wooden Trammel Head with Cam. Fig. 9.—Ditto: Transverse Section. Fig. 10.—Ditto: Longitudinal Section. Fig. 11.—Brass Trammel Head with Fine Adjustment. Fig. 12.—Draughtsman's Pencil Trammels.

The mechanism of the screw, E, is seen in section in the figure. There is a turned and grooved portion next the milled head, F, which fits into a hole bored in the boss, B, of circular form. The purpose of this groove is to prevent the endlong movement of the screw, E, for the small pin, G, being tapped into the boss, and fitting into the groove, prevents any endlong movements, while allowing it to be turned freely by the fingers.

The screw is tapped into the gun-metal nut, H, which is a cubical block of brass let right through the trammel rod near the end, and drilled and tapped throughout longitudinally to receive the screw, E. Consequently, when the trammel head is set approximately, with the pinching screw, O, slackened, the turning of the milled head, F, of the fine adjusting screw, E, causes the screw to travel endlong in the nut, H, and so carries the trammel head along with it. When the correct adjustment is made, then the pinching screw is tightened.

Drawing Trammel.—A drawing trammel, useful to both draughtsmen and pattern-makers, is shown in Fig. 12. It is made of mahogany. The length of the staff, A, may be anything—say, from 2 ft. to 3 ft. long—2 ft. 6 in. being a useful average for ordinary drawings. Make it as follows :—

Plane up a piece of straight-grained mahogany to ½ in. thick, and of the full width of the head, B, at one end, which will then be cut out of the solid ; or plane a strip of mahogany to ½ in. square, and glue and screw the piece for the head upon one edge of it. The head is hollowed at *a* to receive the pencil, C, and is recessed at *b*, so that the pencil only bears at two points, and the tightening of the string, D, around it tightens it very firmly. The tightening is effected with the tapered button, E, which passes through a hole in the head. The string, D, is passed through a hole bored at C, and is turned once or twice round the pin at *d*. When, therefore, the button is turned in the proper direction, it tightens the string around the pencil, and a slight thrusting forward of the tapered pin, E, at the same time into its hole tightens it so that it will not slacken back of its own accord. The pencil is released as easily by the turning back of the button in the opposite direction.

The sliding head, F, is cut in a solid piece of mahogany. The hole is cut through first—not a difficult matter with centre-bit and chisel—and then the outer portions are shaped. The head is made deep in the middle, so that the pressure of the wedge, G—which is, however, only tightened with the fingers, not with the hammer—shall not be likely to split it off.

There are two turned portions fitted to the head into holes bored with a small centre-bit. One is the boss, H, into which the steel point is driven ; the other is the pin, J, upon which the finger is placed to steady the trammel when in use. The boss, H, terminates at *e*, the hollow which comes to meet it being cut out of the solid head. The wedge, G, bears directly upon the rod, and being broad, and only gentle pressure being exerted, it does not bruise it.

Of course, the details of such a tool as this are very much a matter of taste ; so, too, the dimensions can be varied. I simply copy from trammels of my own, and have seen a good many similarly made.

Provision is often made in brass trammels for the use of a pencil, by casting a boss upon the side of one head, and drilling a hole through it to receive the pencil, which may either be tightened with a screw or be a tight sliding fit only. This I need not illustrate.

MAKING THE BEST OF A BAD HOUSE.

BY MARK MALLETT.

THE STUDY: DEALING WITH AN OBJECTIONABLE WINDOW—MULLIONS—GLAZING WITHOUT THE GLAZIER—PANELLING OF WINDOW—GLAZING DOOR ON NOVEL PLAN.

The Study: Dealing with an Objectionable Window.—The only window to my study (as I found it) was a mean affair. It had a wooden frame divided into three lights by clumsy square wooden "uprights"—for of the name of "mullions" they were in no way deserving. Its glazing was of small square panes, set in broad lead-work, which by no means admitted a proper proportion of light ; in the middle compartment was also the further obstruction of a clumsy iron casement. This window was as inefficient for lighting purposes as it was unsightly ; and as its size was full small for the room, something had to be done with regard to it. To have made a larger opening would have been too serious an undertaking for me, so I had to do the best I could with the existing space.

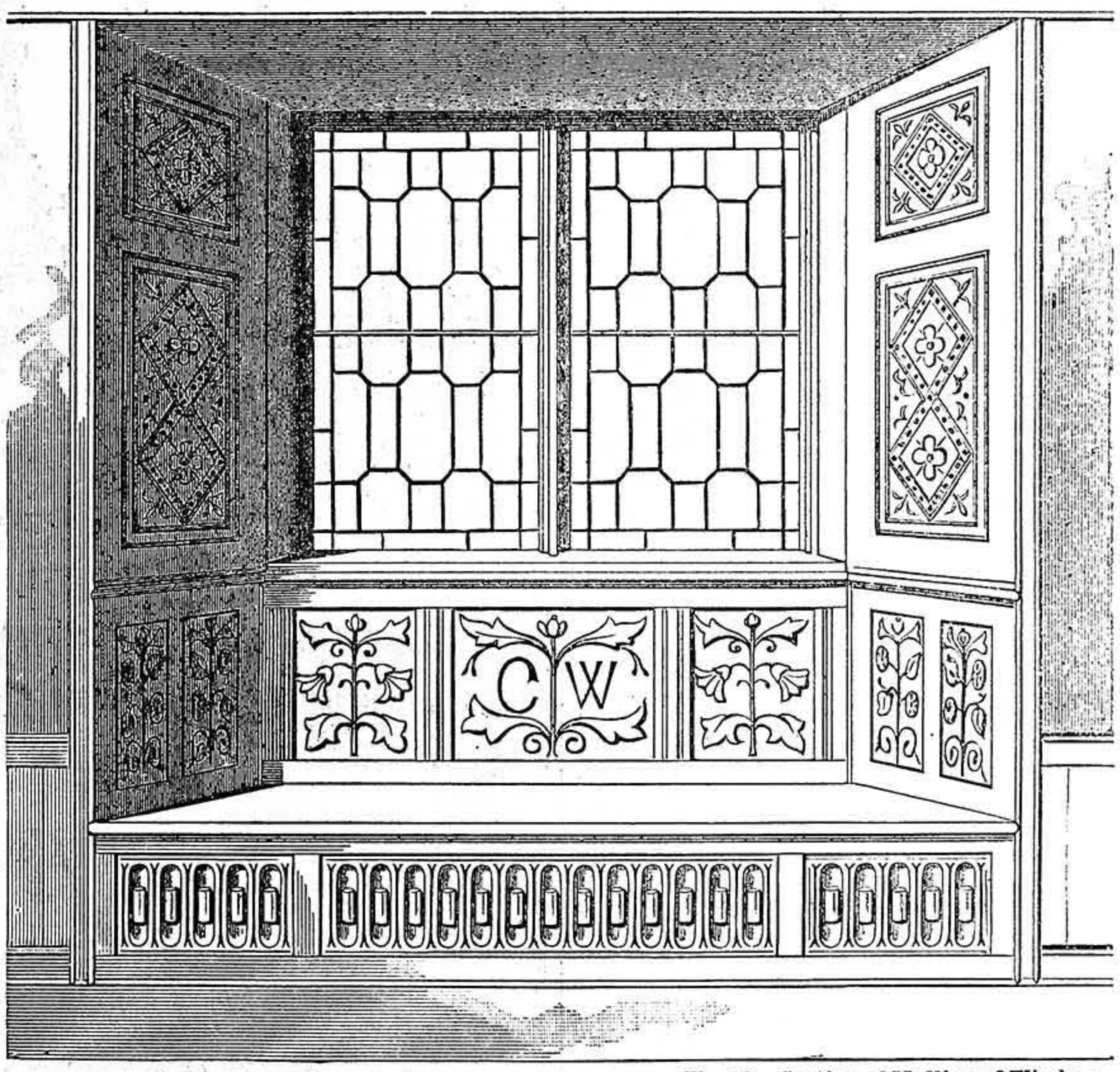


Fig. 11.—Study Window as improved.

As the room had a door to the open garden, I concluded that I should have abundant ventilation without the casement, which would make one difficulty the less. Accordingly I cleared out the leaded lights and the casement with them. The wooden "uprights" I sawed out, and in their stead inserted a single mullion. How this was constructed (and since it other mullions) must be more particularly described, as a useful wrinkle may thus be imparted.

Mullions.—Fig. 12 gives a section of the special mullion in question. Its body, A, is a piece of squared oak (the top, in fact, of one of the head-posts of an old-fashioned bedstead, other parts of which came in handy in other parts of my house). This I dowelled into the frame at top and bottom. On its four faces are screwed four strips of deal ; B is the outside strip, and this is so much longer than the mullion as to admit of its being screwed to the outside of the frame at top and bottom ; this, with the dowels, renders the mullion as firm as if it had been mortised in. The other three strips are of the same length as the body.

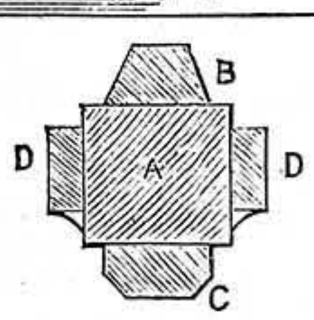


Fig. 12.—Section of Mullion of Window.

The strip C is screwed to the inner face ; the two strips, D, D, to the sides so as to form rebates to hold the leaded lights. To finish my mullion and to prevent any air from drawing through it, I laid putty up the angle at back of D, smoothing it down with a gouge, and thus making a round hollow moulding. The result was a firm, strong, boldly moulded mullion, fully equal for its purpose to one worked from the solid.

Glazing without the Glazier.—It will be seen from Fig. 11 that the reconstructed window was again fitted with leaded lights ; but these are both more decorative and less obstructive than the old ones. They are put together with thin string lead, which keeps out very little light. I might, of course, at less cost, have fitted each light

with a single sheet of glass, but this would not have suited the style of the room; besides which, as a general matter of taste, I consider moderately small panes to be far better in effect. Large panes have a cold and comfortless look, as they do not (in appearance) sufficiently cut off the room from the outside world.

The actual leading of the glass together was not done by myself, nor did I call in the glazier to help me. I found that the best and most economical way was to draw out on paper a full-sized cartoon of one of the lights, marking, of course, all the lead lines, and to send this to a wholesale Birmingham glass warehouse, from which the lights all already for fixing, with the necessary saddle-bars and ties, were promptly forwarded to me. These lights, 35 by 19 in., cost about 8s. or 9s. each. I fixed them in place myself, which was a very simple matter.

Panelling of Window.—The window had clumsy shutters of painted board. I removed them, and substituted some of my old oak panelling, as shown in Fig. 11. The carving upon it is my own, and its style is in keeping with some of the old carving round the fireplace and elsewhere. Below is a window-seat. This I also panelled round, the wood used being the front and ends of a small oak chest of, say, Cromwell's time, which I picked up at a sale for 2s. 6d. The initials C. W. on the central panel were there originally; the other ornamentation is incised work like that above the fireplace, and of my own doing. The pieces of gouge work below the seat are part of the wreckage of an old bedstead. The edge of this oak-work, on the side towards the room, was finished, as shown in the illustration, by an ebonised moulding.

Glazing Door on Novel Plan.—I have mentioned that this room had a door leading to the open air. As my only window was so small, I proposed to make this a passage for a little additional light. Had it been a panelled door I should simply have taken out the upper panels and filled their places with British plate glass; but it was not panelled, it was a plain ledger door, yet a strong well-fitting door of its kind, and gave me no excuse for going to the extravagance of a new one.

Now I had made a collection of things of a kind which, perhaps, no one else, of all the thousands who read WORK, has ever thought worth the collecting—namely, the feet of broken wine-glasses. But the reader must by this time have seen that I am an enthusiastic utiliser of odds and ends. I hold that by the judicious employment of such "unconsidered trifles," wonders can be worked at little cost; and that there are very few things which cannot be made of use if you only know how to use them; indeed, great part of the object of these articles is to indicate how odds and ends may be utilised to good purpose.

My small discs of glass—my wine-glass bottoms—I had thought might come in useful for ornamental (plain pattern) lead glazing; I now, instead, arranged them for my door in such a geometrical design as would best admit light without seriously interfering with strength; I then pierced my round holes through the wood, and puttied them in.

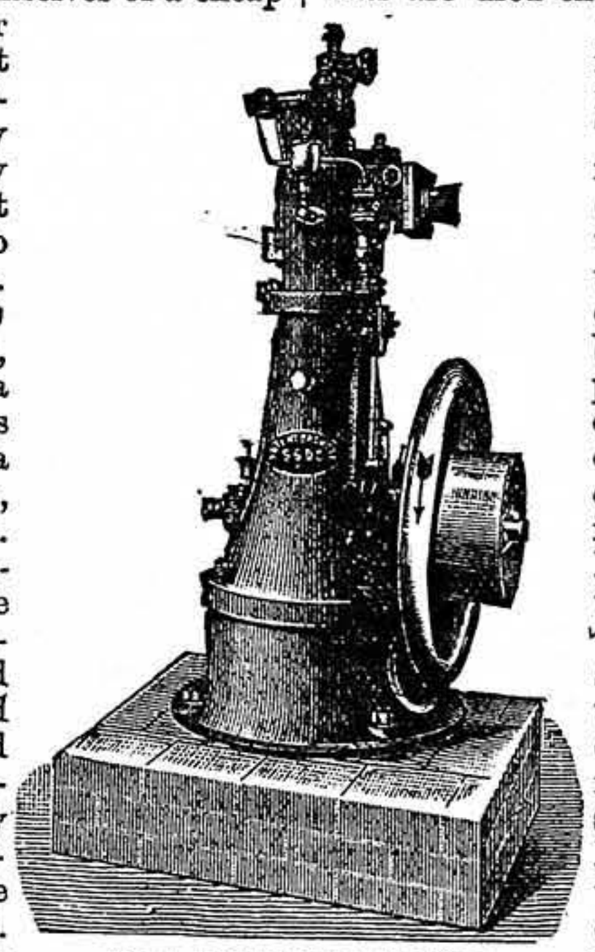
And in this situation they have *one* especial advantage over larger sheets of glass—namely, that no slamming of the door will ever be likely to crack them. At all events, there has been no breakage since they were first put in, and, possibly, there never will be.

OUR GUIDE TO GOOD THINGS.

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

92.—CAPITAINE'S NEW PETROLEUM ENGINE.

I HAVE been asked to call the attention of readers of WORK, and especially those who are interested in motors and wish to avail themselves of a cheap machine, worked by oil, for generating motive power, that a new petroleum engine (Capitaine's patent) has been recently introduced into this country and, I am informed, has met with the approval of all who have, as yet, seen it at work. The engine, as may be seen from the accompanying illustration, is of vertical type, and has a crank shaft at the bottom. Its construction is such as gives a noiseless and steady motion, without any vibration whatever. Owing to the vertical arrangement the cylinder is not liable to get oval. A simple and ingenious driving-gear is acted upon by the governor placed within the driving pulley, and the introduction of oil is therefore regulated automatically by the work done. The space required for, and occupied by, the engine itself is very small. After having been started, the engine does not require any attendance until the oil tank is emptied. Ordinary lamp oil is used as fuel. No electric spark is required for effecting the ignition, as *one* lamp fed with petroleum is used for vaporising the oil and igniting the gas mixture. The consumption of oil is about from seven-tenths of a pint to one pint per actual horse-power per hour, according to the size of the engine. I am told that an extensive use of this high speed engine is being made for agricultural purposes, as well as for electric lighting, driving ventilators, propelling small launches, for working cranes and hoists and capstans on board sailing vessels, etc. The cost of Capitaine's New Petroleum Engine is but little more than one-half that of any other oil engine. The agent in the United Kingdom is Mr. Leopold Tolch. These new engines are now to be seen working in Liverpool.



New Petroleum Engine, Capitaine's Patent.

93.—MINNITT'S PATENT DOUBLE GRIP LOCK NUT.

This new and ingenious invention by Mr. H. Minnitt, which has been recently patented and described at length in Specification No. 17,799, is, as will be readily recognised from the illustrations, given in elevation, section, and plan of one of the nuts in Figs. 1, 2, and 3, especially suitable for railway fish plates, agricultural machinery, and in all cases where there is much vibration. There are two forms of nuts employed, the parts of which are lettered respectively B, C, and B′, C′, in Figs. 1 and 2; and these nuts are used in the following manner, the two parts being called respectively in each form the cap nut (B and B′) and the cone nut (C and C′). The cap nut (B or B′), whichever form may be used, is first slipped on or over the bolt A against the plate which it is desired to tigthen up, and the cone nut (C or C′) is then screwed on the bolt and *into* the cap nut. Being provided with a saw-cut which entirely severs the cone nut on one side, the pressure of the cap nut, as the cone nut enters it, causes compression on the latter, and thus forces it to grip the bolt after it has been drawn up tight. This prevents it shaking loose through vibration. The cone nut, and the cap nut as well, are made in two forms, as already said, and as shown in the illustrations as No. 1 and No. 2. No. 1 is shown with the cone screwed and the cap nut threaded inside to take it. No. 2 shows only a plain cone, and in this case, as the nut C is screwed on the bolt, it forces itself into B, and is thus subjected to compression. In Fig. 3 another form of C′ is shown, as seen in plan from below, C″ being the plan of C′ as seen from above. As made in the manner shown in Fig. 3, the cone cap, instead of being provided with only one saw-cut by which it is entirely cut through from the outer to the inner surface, has three or four cuts extending only the length of the cone, and stopping when the hexagonal portion is reached. It is, however, used in the same manner, being screwed on the bolt after the cap nut is put on, and forced into the latter, thus causing the wings to tighten on the bolt. The nut shown in Fig. 3 can be made with screwed or plain cone. THE EDITOR.

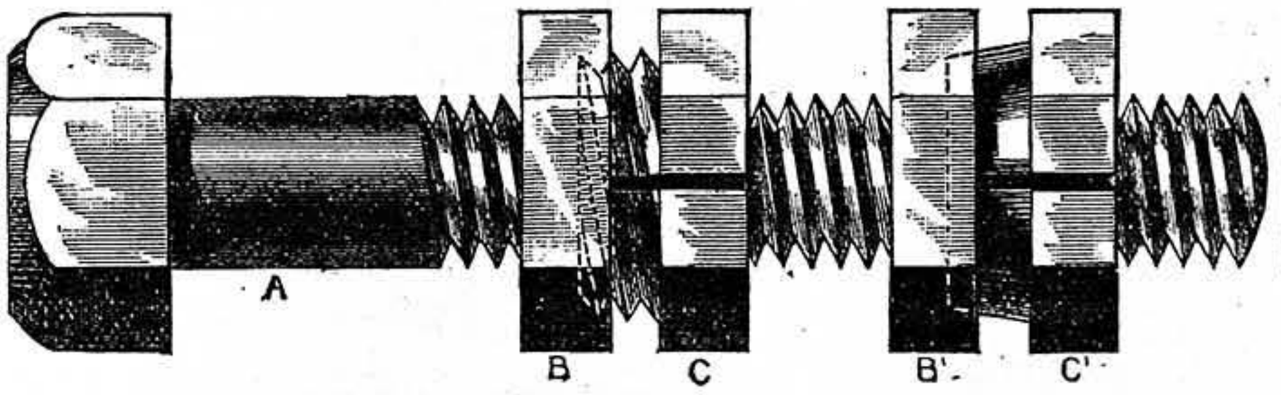


Fig. 1.

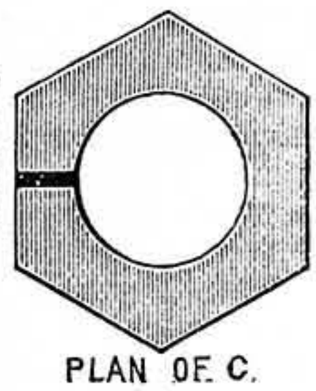


Fig. 3.

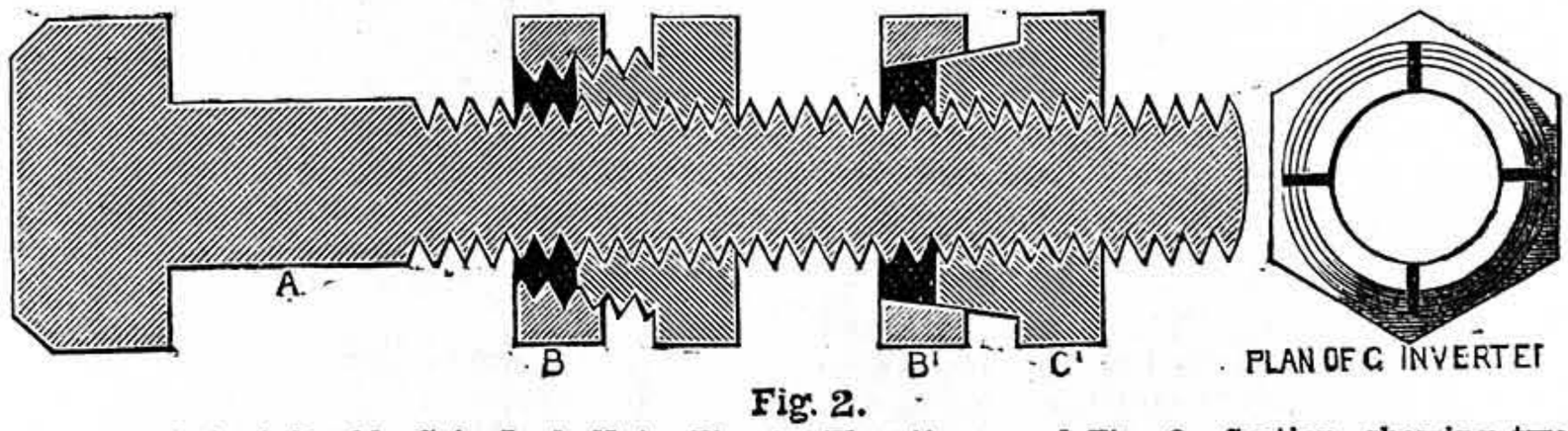


Fig. 2.

Minnitt's Patent Double Grip Lock Nut. Fig. 1.—Elevation; and Fig. 2.—Section, showing two Forms of Nuts—A, Bolt; B, Cap Nut; C, Cone Nut; C″, Nut C′ in Plan seen from above. Fig. 3.—Another Form of C′ as seen from below (C″).

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.

Sussex "Trug" Baskets.—The Redonda Phosphate Co. (*Montserrat, West Indies*) write:—"There is some demand here for baskets of the following measurements (inside): Length, 20 in.; width, 16 in.; depth, 8 in. This is the size of the 'oak-spelk hand coal-baskets' imported from England. They are identical with those used by coal-porters, except the iron hooping. Those we have, the iron hoop is riveted to the rim and crosses on the bottom. They need be *very* strong to stand the rough usage here. I will explain the use we make of them. The phosphate—a hard, very *sharp*, compact rock—is quarried by the men in places where it is very difficult to erect any kind of machine. Boys are employed to fill the baskets with the rock and carry it from the quarry to the shipping place—a distance of about half a mile. The load is about 70 lbs."—[Clog and Trug Basket manufacturers will probably follow Captain Cuttle's practice, and make a note of this.—Ed.]

Diamond Chips.—F. W. (*De Beauvoir Town*) writes:—"The answer given concerning diamond chips by Damon (see Work, No. 138, p. 541) might be clearer. He says that bort is almost, if not quite, as hard as diamond. Now, bort *is diamond*. Technically, real bort is somewhat harder than ordinary diamond. It cannot be cut and polished like ordinary diamond; but what is known to the trade as bort are diamonds which are too flawy or off-coloured to cut for jewellery purposes, and is, when crushed, used for slitting crystal, pebbles, etc.; made into powder for polishing hard stones, such as rubies, sapphires; and also used, when broken into small pieces, for drilling glass and china. They are the pieces known to china-riveters as 'diamond sparks,' or, as your correspondent puts it, 'diamond chips.' I might also mention that the material black diamond is known to the trade as carbonate, or carbon. It is black, and it cannot be cut or polished: used principally for turning emery wheels. It is better than diamond for glass and china drilling, for it never wears smooth, like the diamond: it maintains its rough surface to the last. Both diamond or carbon sparks can be obtained from firm mentioned by Damon—viz., Woods & Toussaint. I might mention that carbon is double the price of diamond."

Wire-Work.—Erratum.—J. S. (*London*) writes: "On p. 534, No. 138, line 18, column 1, 'right hand' should be substituted for 'left hand.'"

Mechanical Voting.—J. S. (*London*) writes:—"*Re* your remarks on Mechanical Voting in No. 138, contained in 'Hints to Inventors,' I take the following from a journal I read weekly: In the Italian Parliament the voting is said to be done by electricity. Three buttons, marked 'Aye,' 'No,' and 'Abstain,' on each member's desk, are connected with a central printing apparatus, which records the votes automatically as the members touch the buttons. Doubtless, something similar would answer for the voting alluded to."

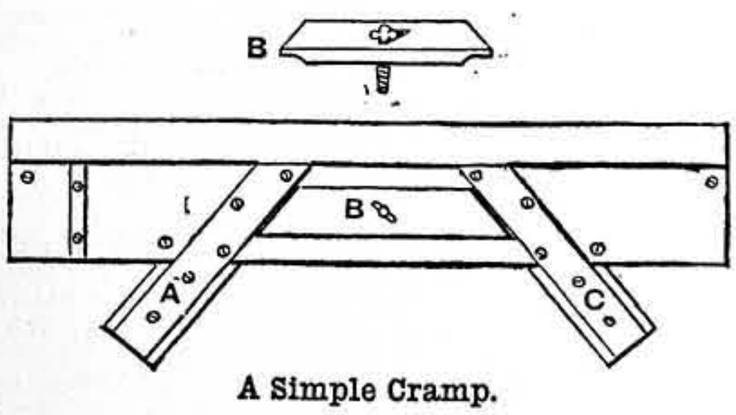
To Restore a Damaged Mirror.—G. A. S. (*Edinburgh*) writes:—"Judging by the number of inquiries in the columns of 'Shop' as to how damaged mirrors may be re-silvered, I think that some easier way than re-silvering may be very welcome to many readers of Work. As has been already pointed out in 'Shop,' the process of re-silvering is too difficult a job for most amateurs; and it will be found more profitable, where the plate is worth the expense, to send it to the professional. But the object of the present paper is to show whereby a small plate—say, 15 in. by 12 in.—on which the silvering is run or has been scratched, and in its present state is generally unsightly, may be made, with a very little expense, a thing of beauty and (to the owner, at least) a joy for ever. As mirrors don't all get damaged in the same place, it would be useless and out of place to lay down any hard-and-fast rule to go by, so we must leave a great deal to individual taste: the intention being to make, by the use of scraps, an imitation of a hand-painted mirror. I suggest a lake or river scene; but that is on the supposition, as well as for the sake of example, that the mirror is damaged round the sides only. For material, we require the mirror, which may be some old dressing mirror, or one which may have seen better days in the back of a case, but, having been exposed to damp, or carelessly laid past, has had its silver back partially destroyed. Then we will require some scraps, such as foliage, water-lilies, flying birds, swans, and boats (these should be in duplicate), a little starch-paste, and a dip of varnish or paint. Laying the mirror on its face, we select the scraps which we think will best suit. For the sides we take the foliage: this may take the form of a tree, or hanging ivy, or a clump of tongue fern; with a little weak paste we stick the scrap, face down, so that it covers the damaged parts; in the same way, stick on the top the flying birds, and on the bottom the water-lilies, swans, or boats, or whatever you may think will suit best. The proper placing must, of course, be left entirely to the taste of the worker or the needs of the mirror. Next paint over the scraps, going particularly into the edges, with a little lamp-black, or some dark colour, mixed with a little paste or size; or with a sharp instrument cut close round the margin of the scraps: the object being, when the scrap is removed, to leave a clear outline. Now with a sharp penknife scrape off the silver which has been covered by the scraps, keeping as sharp an outline as possible, and getting the glass quite clean. The scraps we have taken off will probably be destroyed; at any rate, they should not be used again, as the second coating of paste on the painted surface might cause them to peel off. Therefore, we take duplicate copies, and, pasting them on the face with starch-paste, or any transparent paste or gum, we place them in the spaces scraped out for them. Give the whole of the back a coat of size or starch-paste, and when dry, a coat of varnish or oil-paint. Should the scraped-out spaces be too large for the scraps, use oil-varnish; and when it has set—which will be in about three or four hours—dust some silver-bronze over the bare parts; and if your scraps have been laid on with taste, you have a good imitation of a hand-painted mirror."

A Simple Hair Curler and Crimper.—F. H. (*Battersea*) writes:—"Perhaps some readers of Work will think anything appertaining to hair curling out of place, but I am describing an appliance which, as it is very useful, and is very simple to make, will be none the less welcome for being first made public through the pages of Work. A is a

Hair Curling and Crimping Appliance.

piece of ¼ in. iron gas-pipe about 12 in. long, bent to form a handle: it is filed and burnished; B is 18 in. of ¼ in. iron rod, used as the heater. It is placed in the fire and made red hot, and then inserted into the tube A for a few minutes. By this means there is no fear of the iron being hot enough to singe the hair, and it is always kept bright. The female figure explains how the appliance is used."

A Simple Cramp.—Markwell writes:—"One of the first things I made, soon after Work first appeared, was a mitre shooting board and cramp combined. By its aid, sundry frames which I made have been comfortably tapped together. In the illustration below, A, B, and C are made of hard wood. I think J. W. would like it better than his. The angle-piece is rabbeted, and the rabbet lined with



A Simple Cramp.

leather. When screwed strongly down, English gilt moulding is not injured, and brads may be used; but I must say I like the idea of screws. A little chalk on the back of moulding, and also on board, is useful. I put my shaded lamp a few inches from the mitre points, and can at once see if the joint is quite close front and rear. By unshipping A, B, and C (often done), an ordinary shooting board is available."

II.—Questions Answered by Editor and Staff.

Rubber Types.—E. M. (*London*).—Climax date bands may be made by forming a sufficiently deep mould, the surface of which should be carefully levelled, and using two or three thicknesses of raw sheet rubber compo, backed with one thickness of linen, the die being cut into suitable strips, and the strips cemented end to end with rubber cement after vulcanisation. Solid rubber type may be made in a similar manner (omitting the linen), and cut with a keen knife-blade, wetted with water, to the desired length. Rubber-faced type cannot be made with appliances available to an ordinary amateur. —Qui Vive.

Fretwork Enlarged.—R. M. (*Penicuik*).—The designs drawn full size have often to be reduced to fit the space available in Work, when so many conflicting tastes must be represented. To enlarge patterns there is a simple mechanical contrivance known as the pantograph, which any cyclopædia will explain. Unfortunately, it would take up too much room to do it here. "Letts's sectional tracing paper" provides another way. You trace the design on a sheet ruled in tiny squares of red lines, and then, by a mechanical process of counting squares, you copy it on one of much larger scale. This is easier to do than to describe; but if you have seen anyone working the old-fashioned Berlin wool work from a small pattern, you will gather the ruling motive of the process. For your kindly words anent Work, and the censure of dilatory agents, compressed thanks in a few words, but none the less real.—G. W.

Panel.—Cartridge.—The basket-work or dotted effect of background in patterns in low-relief carving is gained by hammering the ground with punches sold for that purpose at any tool-maker's. The commonest one of simple lines in a square produces the wicker-work pattern.—J. G. W.

Patent Agents.—W. G. S. (*Bristol*) is strongly advised to place himself in the hands of a patent agent in his own city. It is important that the patentee should be near his agent. We are unable to recommend anyone at Bristol, and it would not be safe to take a name from a directory merely. W. G. S. might place himself in communication with two or three local patentees (whose names he could get from advertisements, or from their articles), and take their opinions as to the best agent. Among London agents, we may mention Rayner and Cassell, 37, Chancery Lane, W.C., and Messrs. Carpmael & Co., Southampton Buildings, Chancery Lane, as of high professional reputation. Judging from our own experience, as well as from common sense, we incline to think that Mr. Eustace Smith's remarks are calculated to give too low an idea of the value of provisional protection.—C. C. C.

Blue Prints.—Cosmos.—The following formulæ will answer well:—

Ferricyanide of potassium	70 grs.	No. 1.
Water	1 oz.	
Ammonio-citrate of iron	100 grs.	No. 2.
Water	1 oz.	

Mix equal parts of 1 and 2 just before use, and apply evenly with a brush or sponge, and dry in the dark.—D.

Toy Wheels.—J. M. C. (*Greenwich*).—You would, I think, be able to buy your toy bassinette wheels of The Victor Cycle Co., Grimsby, Yorkshire, who advertise in Work, and who would be able to get them for you if ordered. The price of a set of wheels 11 in. by 7 in. would be about four shillings, or a little over, as I am able to procure a small-sized set 18 in. by 12 in., for an ordinary bassinette, at five shillings and sixpence the set, wholesale price, in Manchester.—W. P.

Wheels.—G. H. A. (*Sheffield*).—The proper address is The Victor Cycle Co., Grimsby. I know of other makers, but as they do not (unlike the Victor Cycle Co.) advertise in Work, I do not think it fair to mention them, but by writing to the above address you will receive every attention.—W. P.

Ice-Cream Freezer.—J. C. (*Belfast*).—Glad to give you any information in my power; but I do not see the point of your terming yourself a "man of wood," as these freezers are made out of a very different material. They are, or ought to be, made of pewter, and, as a rule, are about twice as deep as the diameter of them. The sizes vary according to the quantity required. You say you want to make a sufficient quantity to dispose of in your shop. I think, when you look at it, that seems rather vague. I cannot tell whether your shop is a large or small one, or whether the Belfast folk are fond of ice or not. But to return to the subject. If you can use a soldering iron, it is not a very difficult job to make an ice pot. Get a piece of sheet pewter, 15 × 10; turn it round on a wooden mandrel; let the edges "butt"—that is, just meet—and, with a hatchet soldering iron, solder down the seam on the mandrel, using resin and oil as a flux, and pure solder. Do not try to make the solder flow after the iron, and never mind if it looks rough. After you have soldered the seam down, rasp off all superfluous solder till it is level with the metal, and then scrape smooth with a knife or piece of steel. Then cut out a bottom that will just slip in, and solder that round in the same way. Turn a piece for the rim of the cover, 1½ in. deep, and solder this, and make it smooth at the seam inside and out, so that it will fit well. Put a cover on this, the same as you did the bottom. The shop ones are hollowed up; but that is not essential. Lastly, bend a piece of ¾ in. tin pipe across the cover, and solder it to each side,

for a handle, and the affair is complete. For instructions in soldering, see Nos. 19 and 23.—R. A.

Furniture Restoring.—PAPYRUS.—I am afraid you will not be able to improve the appearance of your mahogany chairs by ebonising them; or, perhaps, it should rather be said that such chairs as I gather yours are would not look well ebonised. I make these remarks, as you ask for any suggestions; but it is certainly possible to ebonise your mahogany chairs. If they are good wood—*i.e.*, finely figured, and of a good colour—it would be a great pity to blacken them; for, though you object strongly to mahogany colour, the probability is that most of your friends will object more to the black. Of course, if your chairs are the fiery red so often considered to be the true mahogany colour, do anything you like to them; you can't make them more unsightly than they are. This may be a consolation to you, and you may adopt several different courses. If you want to ebonise them thoroughly, all the existing polish must be removed, either by washing off, or scraping, or papering, or perhaps a little of all three. Then stain, and re-polish in the usual way. If this seems too tedious, polish them with blackened polish, which you may make by mixing gas-black in ordinary French polish. This, of course, is not such a satisfactory way as the other, as the stain does not enter the wood, but is merely on the surface, from which wear will remove it. If you want an easy way of darkening the wood, not blacking it, use French polish with some brown in it. It is quite impossible to restore faded and worn leather chair coverings to their pristine appearance; but if not too far gone, and you are skilful enough, it is possible to improve and, to a certain extent, to obliterate the marks of wear and tear. Unless you are careful, though, you are more likely to do harm than good. The only way is to go lightly over the leather with a rubber just moistened with thin French polish or white of egg. Without seeing the things, it is impossible to answer your further query as to the desirability and economy of re-covering the furniture. Your own judgment, or the decision of an experienced upholsterer, after he has seen the coverings, will be more reliable; but your idea of covering things which have leather seats—and are, therefore, probably dining-room chairs—in cretonne, is peculiar. Why not use something which will not be so *outré?* There is leather-cloth, which so closely resembles leather that at a very short distance the difference could hardly be detected. Be careful, though, to get only the very best quality. It wears for years, and is cheap enough for anything.—D. D.

Plush on Brackets.—F. C. (*Belfast*).—As I have not seen the frame to which you refer, I cannot say whether the plush was glued or backed on, though you might have noticed for yourself. The plush having been put on well is only owing to the skill of the worker. We cannot give you this; and I very much fear that what hints I can give you will not avail you much. However, that is your look-out. Plush may be put on frames by gluing the wood either all over or just at the back, so as to fix the edges on behind. At the bends and angles on the inner edges of the frame cut the plush neatly. Do not apply the glue to the plush, which should not be pressed down too hard: only enough to cause adherence. If you ask at any good cabinet-maker's, you will be able to get suitable plush. Ask for silk plush, and at the same time ask the price, which depends on quality. You might get the sconces (the brasses to which you allude) at the same place, or from any shop dealing in cabinet-makers' brasswork. If you do not know any, write to Grew and Bridge. How can I tell you the price of the brasses you saw? You might as well ask how big a piece of stone is.—D. D.

Wood-Wool Making Machine, and Folding Furniture Designs.—G. D. (*Oldham*).—You must forgive me if I create disappointment by saying that I am entirely ignorant of the article you are in quest of: viz., wood-wool making machine. I have made inquiries among my friends and relatives, but fail to elicit any information likely to be of use to you. Perhaps some reader may peruse this somewhat "queery" reply who, perchance, is fully acquainted with the above article. If so, I shall personally thank him if he will be so good as to forward the fullest particulars, for the benefit of yourself and others. There is one query, however, which I am glad to say I can reply to. Several designs of folding furniture have been given by various contributors, including myself, in the volumes of WORK so far published. You will, doubtless, have seen the announcement that Indexes to WORK are obtainable, at the cost of 1d. My advice is: get one at once. Therein you will find specified several folding furniture designs. You will find two folding arm-chairs and three folding tables, by me, in Nos. 41 and 37 respectively; and in No. 23 are also three designs of folding chairs. I must inform you, however, that it came to light, after the publication of the latter, that Fig. 3 design represented an article which is patented in this country (see p. 476, No. 30). My fellow contributor was unaware of this fact when he sent the designs in. I mention all this that you may not infringe the patentee's rights by making this particular chair. You need not fear to progress with any of those (folding or otherwise) which I have given, as I make a point of giving original designs. The price of volumes of WORK, bound, is 7s. 6d. If you possess any skill, however, I should advise you to endeavour to bind back numbers yourself by reading the articles on Bookbinding, commencing in No. 57.—J. S.

Portable Photographic Studio.—R. H. (*Bishop Auckland*).—It is impossible, in the space at our disposal in these columns, to do more than give a mere sketch of how to build a studio. In the first place, much depends on the site and the surroundings; and, secondly, the amount of money to be expended. A "portable studio" is a very elastic term, and may mean anything between lath and canvas and brick and glass—in fact, anything else. "Portability" is a term signifying not *permanently attached to the ground* or *adjoining buildings*, and may cost, so to say, anything according to size, material, and decoration employed. A home-built small studio—say, 20 ft. by 12 ft.—might be made for £8 to £10; but it could only be roughly finished. Supposing the site available is an open space, not shaded with buildings, make eight or ten piers of bricks, about a foot high, as a support for the superstructure, and to provide ventilation under the floor for dryness' sake; and on these piers lay a frame that will enclose a space 20 ft. by 12 ft. of 4 in. battens. Lighter wood will do for the uprights and roof. The walls may be made of match-boarding, and the roof of the same, covered with roofing felt. One side, that towards the north, may be glazed, and also the north side of the roof; one corner inside to be partitioned off for a dark room; backgrounds to be fixed at each end; the whole of the framework to be *screwed* firmly together, not nailed; provision for a door on the unglazed side to be made where

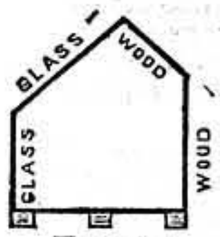


Fig. 1.

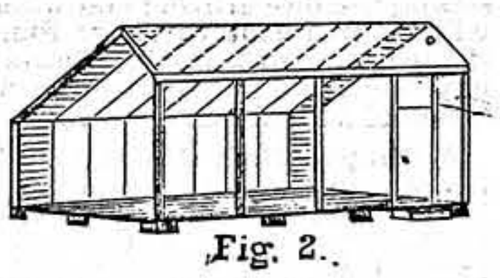
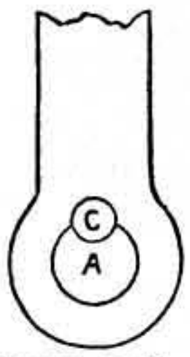


Fig. 2.

Portable Photographic Studio.

most convenient. The floor should be made of good stout planks, tarred on the lower side. *Any* kind of picture can be taken in such a studio, the kind being regulated by *the lighting*, which is controlled by blinds, that should be contrived to cover the whole of the glass, and easily opened and closed, according to circumstances. The woodwork of the walls may be made more sightly by stretching canvas over them, and papering; and the floor should be covered with floorcloth, and a few curtains disposed here and there, to give an air of comfort otherwise absent. A few coats of paint on the outside will be a useful protection. The subjoined diagrams will show the shape and general design of the place. Fig. 1 is a sectional end view, showing the slope of the roof; and Fig. 2 showing door and arrangement of the glass, the wooden side being towards the spectator. Ventilators should be placed near the ridge at each end, and of course, in a slight sketch like this, many details are, perforce, omitted. The above gives a general idea of one of the most useful forms. Many little matters will suggest themselves, when the place is set up, as conveniences or improvements, according to the taste or funds of the proprietor. Reflectors, furniture, head-rests, etc., are necessary accessories. The dark room should be lighted from the outside, and extra ventilation provided for it. A deep wooden sink, covered with sheet lead, is practically best, there being less danger of breakages to bottles, measures, etc., than if stoneware is used. There should be plenty of shelf room, and space to lay down the dark slides for filling and emptying; and, it goes without saying, total exclusion of daylight.—D.

Safety Bicycle.—H. W. (*No Address*).—I rather think H. W. will find that the crank is not *screwed* on to the shaft A. The screw that appears behind the crank is for the nut to adjust the bearing. Neither is it usual to have the key C round as shown, as that sort of key works loose much sooner than a rectangular one. If this crank is really screwed on, the other will do so, and they would be screwed right and left screws. The pin C may possibly be screwed as well; in that case a *nick* would have to be made in the end of it to unscrew with a screwdriver, then the crank would screw off. If the crank is on plain it may be wrenched off with a crank-puller, used by repairers. The best thing to do is to give the job to a repairer.—A. S. P.



Crank and Shaft.

Patenting an Invention.—H. W. (*Nottingham*).—If the machine is to be worked by downward pressure of the hand (a succession of blows), and not by a wheel, the idea, so far, is not new. We have been shown such an apparatus, its price being, I believe, 1s. 6d. Before incurring expense, H. W. would do well to ascertain that nothing with which his own machine would clash has been protected. Perhaps he could not do better than make a model, and submit it to Mr. Clarence S. Newton, General Business Agent, Royal Courts Chambers, 70, Chancery Lane, W.C. From him he will get information on the above point on what the commercial chances of his invention may be worth, and so forth. Communications with such an agent would, of course, be considered confidential; but if the inventor fears piracy, he can first get provisional protection. As to the third query: till H. W.'s orders become large, we do not see that he can do better than buy his spools of cotton in such a cotton-consuming place as his own town. For needles, he might go to F. G. Heath & Co., Crabb's Cross, Redditch; and for light brass tubing to Stone & Benton, Birmingham.—C. C. C.

Stain for Blackboard.—A WELL-WISHER.—Much information upon this subject appears in the following back numbers of WORK: 39, 44, 98, 102, 103, 104, which may be obtained through any bookseller, price 1d. each.

Globe.—EQUATOR.—I doubt whether you can get what you require; but you might inquire of some map publishers, as Philips & Son, Fleet Street; Stanford, of Charing Cross; or W. & A. K. Johnston, 5, White Hart Street, Warwick Lane, E.C.—F. B. C.

Concert Flute.—NORTHAMPTON.—There are about a dozen different bores, and as many systems of key arrangement in flutes, in each of which the holes are differently laid out, so that it is impossible to help you. Your only plan would be to get a flute of the pattern you wanted and work to it. We may tell you, however, that the arrangement of the holes on the conical-bore flute is altogether different from that on the cylinder-bore instrument.—G.

Makers of Copying Apparatus.—W. O. J. (*No Address*).—A reference to Kelly's "London Directory" will give the information wanted.

Bois-Duré.—J. S. (*No Address*).—If this is the material we take it to be, it is wood fibre condensed by heavy pressure, and has been patented. We believe that Mr. T. Remus, Tabernacle Street and Castle Street, Finsbury Square, London, supplies it in combination with his patent angle-brasses. Possibly, J. S. might do well to apply to him.—S. W.

Making Small Still.—DEVON.—In WORK, Vol. II., pp. 490 and 651, Nos. 82 and 92, you will find a full description and particulars of a small still that, I think, will answer your requirements. The answers are at full length, and I think you would have no trouble in making one from these instructions.—R. A.

Brazing Bicycle Tubes.—BRASSY.—If BRASSY will provide himself with the numbers of WORK containing papers on the "Construction of the Safety Bicycle," he will get all the information as to brazing he can possibly desire.—A. S. P.

Affixing Glass Letters.—GLASS.—If I had this to do I should simply use the best varnish, covering the letters well, and when nearly set, giving another coat round the edges to fill up all holes, so as to keep out damp and moisture. There is a very good cement in the market, called "Coagiline," also Le Page's liquid glue. If you use either of these I should still put a coat of varnish round the edges. If it does not matter to have it transparent, you will find red lead thinned with varnish answer well; or the following: Litharge, two parts; white lead, one part: boiled linseed oil, three parts; gum copal, one part; mix just before using; or you could use red lead thinned with varnish.—W. E. D.

Eidograph.—NIL DESPERANDUM.—I am unable to give the required directions, but NIL DESPERANDUM will find the instrument (which is an improvement on the pantograph) illustrated and described in Knight's "Practical Dictionary of Mechanics," p. 775, published by Cassell & Co., London, E.C.—S. W.

Waterproofing Cloth.—J. B. (*Hastings*).—Our correspondent does not tell us what material it is he desires to waterproof, therefore we cannot give him any satisfactory information. If it is woollen cloth, then one kind of treatment has to be adopted; if it is flax, cotton, or other vegetable material, then another plan has to be adopted. What will be correct for one material will be quite inapplicable to the others. If he will state specifically what he wants to do, we may then possibly be in the position to give him the required information.—C. E.

Quarter Horse-Power Engine.—G. M. L. (*Selborne*).—You are quite right, it would be most convenient to have full-size drawings of the engine to put up on the workshop wall, or on a board, to go to for measurements. In fact, it is almost necessary. Whether such drawings will be supplied, I cannot say as yet, but the very best preparation for making the engine would be to make full-size drawings from the scale drawings in WORK, taking the *written* dimensions wherever possible. Before very long, I think, the castings will be advertised; you will then be able to make the drawings well and carefully: the time will not be wasted, even if drawings are eventually supplied, since it is sure to give the workman a better knowledge of what he has to do, and will save him from making mistakes.—F. A. M.

Mechanical Office Work.—F. H. B. (*Manchester*).—You should advertise your requirements in WORK. Any writings you care to send, on approval, will be considered, if suitable for WORK. London is already overcrowded with workers, and, as you are in a manufactory much in your own line, the best thing you can do is to stop there, and make such headway as you can in business and out of it; but don't come to London.

Photo Frame in Fretwork.—NO NAME.—Your large design, as you have made it up, looks well, and shall be published if I can make room for it, but you have sent your letter and large sketch without name, initials, or *nom-de-plume*, so

I am unable to follow the above side-heading with one or the other of these in the usual way. Kindly send your name and address.

Battery for Electric Night Light.—LUX IN TENEBRIS.—I cannot advise the use of a chromic acid or bichromate battery in a bedroom for supplying current to a small electric lamp used on electric night light. Although the fumes from such batteries are said to be non-injurious, the odour from them is to me objectionable, and is highly injurious to my brother, causing sore throat and constriction of the bronchial tubes. The large agglomerate tin block Leclanché is very suitable for a night-light battery; so is the Gassner dry battery of large cells. It would take six such cells to light an 8-volt lamp. The cost of the Leclanché battery at 10s. 6d. each cell will be three guineas; the cost of the Gassner at 5s. per cell will be 30s. Mr. K. Schall, Wigmore Street, London, W., supplies a 6-cell chloride of silver battery, specially made for small electric lights, at a cost of £2 9s. These, although costly, are clean and portable. A correspondent at Ipswich has made his own Leclanché battery for an electric night light. The agglomerate Leclanché and the Gassner can be obtained from Messrs. T. Gent & Co., Faraday Works, Leicester, who also supply lamps and other electric light appliances. You can also, as you suggest, get everything from Mr. Bottone, who is agent for a very good portable dry battery. Replying to your questions as they stand in your letter: (1) Large cells, carbons, zincs, etc., in a battery, lessen the internal resistance and furnish a larger volume of current, lasting for a longer time than the current from small cells. (2) Amalgamating the zinc with mercury means coating the cleaned zinc with this metal to prevent waste by excessive or local action. (3) Either of the firms mentioned can supply carbons, zincs, clamps, switches, wire, and lamps, and will quote you prices for the same. I do not know a firm in Dublin. (4) A sickly odour, to me, proceeds from a bichromate battery, so I would not have one in *my* bedroom. This objectionable feature does not exist in the Leclanché, Gassner, and chloride of silver batteries. The Lithanode battery of Messrs. Cathcart & Peto, Hatton Garden, E.C., is also free from objectionable fumes. A battery may, however, be left outside, and the conducting wires only led into the room. (5) A battery would need recharging about once a week, if you use the light for from ten to twenty minutes at a time, about a dozen times in the night, as this would mean at the least two hours per night. I thank you for your kindly appreciative words respecting WORK and members of the editorial staff. We endeavour to couch our instructions in "good Anglo-Saxon language," and hope you may long enjoy, as a subscriber, some more half hours with us.—G. E. B.

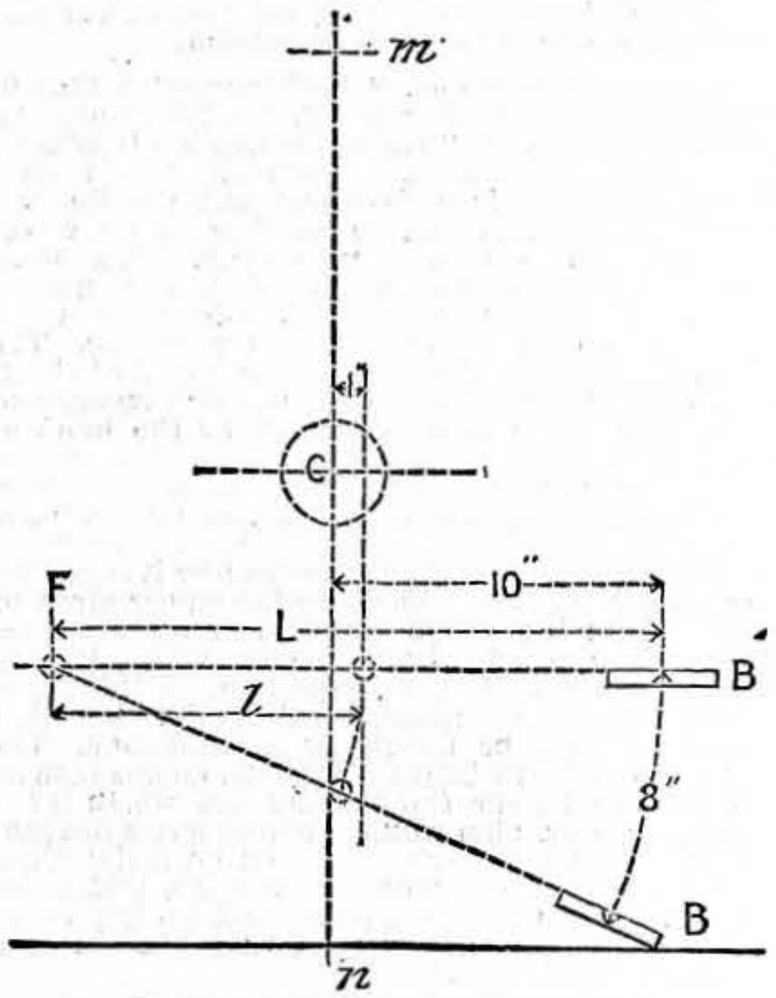
How to Make a Dynamo.—J. G. (*Edinburgh*).—Articles giving illustrated instructions on making small dynamos appeared in Nos. 92, 94, 97, and 99, published December 20th, 1890; January 3rd, January 24th, and February 7th, 1891. An article on accumulators appeared in No. 101, published on February 21st, 1891. "The Dynamo: How Made and Used," by Mr. Bottone, Wallington, Surrey; and "How to Make a Dynamo," by Mr. A. Crofts, Dover, are both good books on the subject, well suited to the wants and knowledge of amateur dynamo makers.—G. E. B.

Battery for Medical Coil.—T. A. (*Shotley Bridge*).—Yes, a Leclanché battery can be, and is, used for working medical coils, but special large cells should be employed. The large 6-block agglomerate cells are suitable to this work, but their cost (10s. 6d. each) is rather high. The Gassner dry battery has also been employed for this purpose. Messrs. T. Gent & Co., Leicester, supply these and other suitable batteries. The new chloride of silver cells made by Mr. K. Schall, Wigmore Street, W., will give a strong constant current for several hours whilst working a medical coil. If the coil has to be used for from 1 to 1½ hours each day it will be necessary to frequently charge the battery—say at least once a week.—G. E. B.

Battery for Firing Fuses.—W. K. S. (*Whaley Bridge*).—If you know anything about the construction of electric batteries, and can make them yourself, you may get all the materials and instructions from Mr. Bottone. You will have to tell him just what you wish to do, the kind of fuse you wish to fire the shot with, the distance of the battery from the fuse, and size of the conducting wire to the battery. He will then tell you what things to get and how much they will cost. Messrs. King, Mendham, & Co., Western Electric Works, Bristol, make a special battery of 8 cells for this purpose at a cost of £4.—G. E. B.

Incandescent Gas Light.—R. C. B. writes respecting the address of the Incandescent Gas Light Co., given in No. 134, p. 475, Vol. III., of WORK, in reply to C. N. V. (*Aldershot*) He says the address is not the one C. N. V. wants, but he shall be very pleased to let C. N. V. know the address or anything else about the light. I should have been better pleased if R. C. B. had given me the proper address, and the information offered, so that it could have been published for the benefit of all readers of WORK.—G. E. B.

Lathe Proportions.—WALLACE.—The dip or throw of a crank is not measured over all, but from centre of shaft to centre of pin. Assuming your square crank-shaft to be 1 in. square, then the throw of your crank would be 4 in. and the stroke would be 8 in. Now 8 in. is just about the proper stroke for the footboard to move up and down; for a small 3½ lathe, 7 in. will do, but for a 5 in. you require a little more power; a greater rise of the footboard is more fatiguing for the leg. You could not with this crank use the ordinary kind of treadle, as it must nearly double the stroke of the crank, and I think you should give it up. The proper throw for the crank is determined by the movement it is desired to give to the foot (say 8 in.), and the proportions of the lever arm of the treadle. In the sketch sent herewith, *m* is the centre of the mandrel; *m n* a perpendicular dropped from *m* and passing through the centre of crank-shaft at C; F is the fulcrum of the treadle; B B the footboard, the centre of which should be 10 in. in front of the perpendicular centre line; L is the full length of the treadle lever, and *l* is the short length measured from fulcrum to the point of attachment of pitman or crank-hook; this point of attachment is rather better placed 1 in. in front of the perpendicular, as it lengthens the down stroke when the lathe runs forwards. F is rather better placed 6 or 8 in. high, because then, in descending, the foot moves a little forward, which is somewhat easier. Now if L be twice as long as *l*, then it is evident the throw of the crank will have to be 2 in. and the stroke 4 in. If the crank had a throw of 2¼ in. and a stroke of 4½ in., then the fulcrum would be moved back 2⅛ in., or more exactly 2⅞ in., so as to make L = 20⅞ in. and *l*



Sketch of Treadle Arrangement.

=11⅞, in order that L may bear the same proportion to *l* that 8 does to 4½. You will see from all this that 2¼ is a proper throw for a crank if the other parts are made in proportion. With regard to your second question, I have never seen a weaver's shuttle tip, and cannot tell whether it would do to insert one in each end of the crank-shaft to form a point on which it would turn. To do this the pin must be at least $\frac{5}{16}$ in. diam., or it might break right off; also the angle of the cone should not be more obtuse than 60 degrees. I should prefer to bore a ¼ in. hole up each end of the shaft, and insert a hard steel plug 1 in. long, having a $\frac{1}{8}$ in. hole bored right through the centre and countersunk to 60 degrees at the outer end; plug to be driven in tightly, and the hole in the centre to form a reservoir for oil. The screws on which the crank-shaft turns may be $\frac{1}{8}$ in. diam., screwed with a Whitworth thread and pointed to exactly 60 degrees so as to fit well into the holes in the crank-shaft; these screws can be tapped into the beech wood standards so as to fit pretty tightly, and they will hold very well without any metal plate or backnut. If you are 5 ft. 6 in. in height, your lathe centres, from the floor, should be about 3 ft. 6 in.; if higher you will get too many chips in your face; if lower you will not see so well. The top of your lathe bed will, therefore, be 3 ft. 1 in. high. It would not do to incline the connecting rod or pitman 30 degrees, as you propose, but it may be inclined a little, as shown in the Fig. I send; the effect is to lengthen the down stroke and make the foot rise rather faster, which is an advantage in running forwards, but a disadvantage when running backwards, as you want to do in sand papering.—F. A. M.

Electric Detector.—MINING DETECTOR.—You evidently have an ordinary linesman's current detector or galvanometer with the dial marked in degrees of the arc of a circle, numbered from 1 to 60 on each side of zero. When you send the current from one cell of a battery through the instrument, the needle is deflected to 30 degrees; with two cells you get a deflection of 50 degrees; and with three cells you get a deflection of 60 degrees. Now you wish to know the value of those degrees. I fear that I shall not make the value clear to your mind by stating that it is "as the tangent of the angles of deflection," so will try to simplify this statement by saying that the value of the deflection increases disproportionately with the distance of the needle point from the zero mark. From 1 to 20 the degrees will indicate proportional strength of current passing through the instrument—that is to say, a deflection of 20 will indicate a strength twice that of 10. But, from this upward, we may put down 30 as 15 × 2 + 3·076; 40 as 20 × 2 + 8·066; 50 as 25 × 2 + 18·275; and 60 as 30 × 2 + 39·220. You will not be safe in taking even these figures as being absolutely correct, since the grading on the dials of these instruments is not made to a standard, nor are the needles all made of the same weight. This short table will, however, give you some idea of the value of the deflections, and enable you to make rough approximations of the strength of the current from your cells. The use of this instrument in the hands of a linesman or electric bell fitter is to test lines for leakage of current, and to give a rough idea of the strength of a battery. For instance, he knows that the current from a cell in good condition should deflect the needle to 30 degrees. If it fails to do this, he knows that the battery is getting weak. The value of the deflections is not given in volts or ampères, but there are instruments made which are so graded as to indicate the strength of the current in volts and ampères by the deflections of the needle. Volts represent the pressure of the current; ampères show its volume, or bulk, so to speak. Thus, a current of 1 volt will represent the pressure (E.M.F.) of that obtained from one cell of a Daniell battery; whilst a current of 1 ampère will represent the volume of electricity obtained through a resistance of the ohm when the pressure or E.M.F. is 1 volt. Taking water as an analogy, the ohm may be said to represent the dimensions of a pipe, and the volt the pressure or head of water, whilst the ampère will show the volume of water obtained through the pipe. This is the nearest I can do for you in the way of simplifying these terms.—G. E. B.

Telescope.—T. H. (*Spennymoor*) wants to know first, "The proper method of mounting the various glasses that they may be correctly fixed in their places." From a former remark made it is evident he wishes to work with as little cost as possible, and has mentioned a paper tube. I thus take for granted he does not use a lathe. Make a cell for the object-glass thus:—Procure a piece of brass tubing large enough to take the object-glass, and cut off 2 in.: cut the ends perpendicular to the length. Anyone who has a lathe would be pleased to do this. In the next place cut a disc of sheet brass 4 in. diameter, to which solder the tube, leaving ½ in. all round. Cut out the centre, leaving the opening ¼ in. less than the tube; this will form a bed for the lens to rest on. This opening can be cut with an ordinary hand fret saw. I have sawn stout sheet brass repeatedly thus. Take another piece of tube and cut a slit in it, so that it may be sprung into the cell now made. Place the lens in its cell and spring in the slit tube and the lens will be held firmly: it may be further secured by means of a bayonet joint. Four small holes must be made in the flange to take screws. Now get a turner to turn a wooden ring 2 in. wide, ¾ in thick, and of a diameter large enough to admit the paper tube made. When the object-glass is secured by the spring in its place, it can be attached to the tube with four screws. Of course, this is rather a clumsy way, but it will be efficient and not costly. Secondly, the probable cost of an ordinary object-glass of 3 in. diameter and about 36 in. focus, also price of an achromatic of similar dimensions. An ordinary object-glass 3 in. diameter and 50 in. focus may be procured from 5s. 6d. with lenses for eye-piece; achromatic, 3 in. diameter, about 45 in. focus, from £4 to £6, according to maker and quality. Thirdly, eye-pieces. The optician supplying the object-glass would send the lenses required; they will cost about 2s. An article is in the hands of the Editor on the construction of eye-pieces, which will supply every particular needed; that being the case, I will save space here. Lastly, the best house to purchase from. Without undertaking to say which house is the best, I would say that repeatedly have I done business with Lancaster, Birmingham, and have always found satisfaction. Should T. H. not like the primitive plan suggested, and can command a screw-cutting lathe, then he will find in another answer over my initials the proper method of making and mounting cells.—G. B.

III.—QUESTIONS SUBMITTED TO READERS.

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

Flower-Pot Cases.—INQUIRER writes:—"Could any of your numerous readers oblige by giving the name and address of a firm or firms where ornamental flower-pot expandible envelopes (wood) can be had?"

Darning Weavers.—MART writes:—"Will any reader of WORK please give me address of firm that make the Patent Darning Weaver, with price of same?"

Wool Winder.—MART writes:—"Will some kind reader of WORK please give me a design and the construction of a wool winder—one to stand on the table and wind the wool into balls?"

Canoe Building.—CENTRE-BOARD CANOE writes:—"Will some practical hand kindly answer the following?—(1) How is a canoe keel built to take a centre-board? Please give rough sketch. (2) Does the special form of keel cause any difficulty, or necessitate a different method in fitting on the first plank (or garboard streak, as I believe it is called)? If so, please give sketch, and say how difficulty is to

be overcome. (3) What thickness of wood should be used for centre-board well? How is it put together, and how is it attached to keel? Sketch would much oblige. (4) Please give the special advantages of mahogany or cedar, as compared with pine, for canoe building, and say if oak (best white English) would make much difference in the weight of the craft, or be more difficult to mould to shape. This question refers to the planking. I have no steam killer, and wish to do without one."

Invisible Printing. — TULIP writes:—"Could any reader tell me what kind of stuff is used to print with on cardboard, etc., that is invisible in the daytime, but can be seen in the dark?"

Pipe Mouthpieces.—C. H. C. (*Manningham*) writes:—"Will any reader kindly tell me how vulcanite pipe mouthpieces are polished?"

White Metal.—L. S. L. (*Kirkcaldy*) writes:—"Would some correspondent kindly give me some information about white metal? I am constantly coming across articles made from it, and it appears to me to be such a useful and cheap substitute for silver for many purposes, that information as to its precise composition, properties, and applications would be acceptable to many of the readers of WORK."

Pins.—A. W. B. (*Bristol*) writes:—"Can any reader kindly give me some particulars as to the manufacture of pins, the district where principally made, and names of two or three firms engaged in the business."

Saw Bench.—WOODWORKER writes:—"I have read CHOPSTICK'S note on Hand Sawbench in WORK, No. 135, p. 491, and I wish to know whether he or any of our readers can instruct me as to the making of one such as he describes."

Taps.—D. G. C. (*Bradford*) asks for "the address of any firm where I can buy taps made of iron exclusively."

Handles for Driving Whips.—E.E. S. (*Newton Abbot*) writes:—"Can any reader give me the address of a shop where I can get handles for driving whips?"

Modelling Wax.—CARVER writes:—"Can any reader inform me how to make modelling wax, and what articles to make it with?"

Razor Case.—J. A. (*Gristhorpe*) writes:—"Could anyone give me a design for a razor case?"

Markets for Wood Carving.—F. G. W. (*Kettering*) writes:—"I would like to know of some exhibition where I could enter a carved oak mantelpiece recently designed and executed by myself. If any of your correspondents can tell me of any such exhibition, I shall be much obliged."

Colour Matching.—CONSTANT READER wants to know the best book on matching colours, with colours in book, and how to make them.

Gum.—GUM writes:—"Will anyone please give me a good recipe for making gum liquid—something that will keep so, and without becoming musty?"

Re-transfer Ink.—W. E. (*Bristol*) writes:—"Can any reader of WORK tell me the way to make re-transfer ink from plate to stone?"

WORK Exhibitions.—YENNIL writes:—"Will you kindly say if there will be any sort of exhibition this year, or early next, where small inventions may be exhibited? I have taken out a provisional protection for an improved mangle and wringer, and should like to get it, or the improved part, exhibited."—[There will be no WORK Exhibition again for the present, but local workmen's industrial exhibitions are constantly being held all over the country. You should watch the public announcements in the daily newspapers. In the meanwhile, I shall always be glad to receive from secretaries and projectors of such exhibitions early intimation of plans and intentions in this respect, in order to give them prominence in WORK.—ED.]

Model Yacht Fittings.—T. H. S. (*Newport, Mon.*) writes:—"Not having seen an answer in the columns of WORK for deck fittings and rigging of model yacht, 4 ft. long, I would be glad if one of the readers would give an insight of same."

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Colouring Bright Steel Surfaces.—H. B. S. (*Liverpool*) writes:—"BARIUM asks for a method of colouring steel articles (see p. 542, No. 138). Why not colour them in the usual way, which really means tempering them by heat? The heat required for tempering watch-springs, etc., which gives a bright blue to the articles, is only 288° C., and cannot be considered high. The method used for small flat objects is to heat them upon an iron plate until the colour is attained; then throw them into water. Mercury would cool them quicker, but would be much more expensive. A neat way of proceeding is to have an iron pan filled with fusible metal, and to heat it up to the required temperature, which may be noted on a chemical thermometer, just dipping in the metal. The articles are strung on a wire and placed in the bath, and allowed to remain in the melted metal till they have acquired the temperature of the bath, then taken out and rapidly quenched. I do not know that the latter plan has been used on a large scale—it has on a small scale—but it is worth trying. Keeping the bath at the proper temperature is the chief thing. I may say that pens are coloured by heating to the required temperature in a revolving cylinder. Perhaps the latter plan might suit you. I need hardly say that the articles must be clean and bright."

Drilling Grindstones.—STONEMASON writes, in reply to T. A. D. (*Royton*) (see p. 510, No. 136):—"Holes are not drilled in grindstones, but are cut by hand with a mallet and small chisels. The chisels must be kept sharp. It is a stonemasons' job, and I should never attempt to drill holes in grit-stone. Before cutting holes in thin stones, they should be fastened down on another stone with plaster of Paris."

Measurement of Paraffin Barrels.—H. B. S. (*Liverpool*) writes, in reply to PARAFFIN (see p. 526, No. 137):—"I think you will find that the '120 tests,' marked on the barrels, has nothing to do with the measurements of the barrels. It evidently alludes to what is known as the 'flame test,' which is conducted in the following manner: A small quantity of the oil, contained in a metal cup, is heated in a suitable manner in a water bath. In the oil is immersed the bulb of a thermometer. At short intervals a lighted taper is passed over the surface of the oil, and when a flash of light is noticed, the oil is giving off inflammable vapour, and the temperature is noted. In your particular case the oil gives off an inflammable vapour at 120° F. This test is necessary, as some of the oils give off an inflammable vapour at little above the ordinary temperature, and these oils are very dangerous. It is required by Act of Parliament that oils of this description should be called petroleum."

Lapidary Work.—H. B. S. (*Liverpool*) writes, in reply to SPES MEA (see p. 542, No. 138), upon the cutting of pebbles:—"The apparatus is a lapidary's table, consisting of a small bench with raised sides. Under the table is a fly-wheel and treadle, and the wheel is geared on to another small wheel revolving on a shaft horizontally. The shaft passes through a hole in the table, and upon it small thin wheels of lead, sheet-iron, or wood, may be fixed for the cutting and polishing. The cutting is done by the edge of the wheel of sheet-iron, which is kept moistened with fine emery and water—the stone held against it by the hand or some mechanical contrivance. After the stone is cut, it is rubbed down on the face of a lead wheel with fine emery; it is then polished upon a wood wheel, using rotten-stone and water. The stone must be frequently looked at to see how it is getting on; all the scratches made by the emery must be rubbed out: the polish will appear after a time. Finish on a wood wheel covered with cloth or leather, using a little putty-powder. I think you might make the lapidary's table. All the other appliances may be bought at a paint-shop. The cost of a lapidary's bench, complete, means money. Do you think your few pebbles are worth it? I think your best plan would be to choose a flat face on the pebble, and to rub it down on a flat stone with emery, smooth with rotten-stone, and finish off on a piece of smooth slate with putty-powder and oil; finally, with putty-powder and oil on a piece of smooth glass."

Drilling Grindstone.—M. (*Bishop Auckland*) writes to T. A. D. (*Royton*) (see p. 510, No. 136):—"You might try a hollow drill in the form of a tube, fed by coarse sand and water. Unless the stones are very soft, you need not have any notches or teeth on the end of the tube. But why not have the holes made the right size at the quarry? In the Newcastle district the square holes are cut by a mallet and chisel; the grindstone is then mounted on a mandrel driven by steam, and the faces and edge turned with a steel tool. If you get the holes made 1½ in. square at the quarry, you can mount them in your machine as well as having a circular hole, unless you have some other reason for having a circular hole. To the best of my remembrance, the mandrels on which they are turned are circular, the stones being fixed by a plate and screw."

Model Steam Launch.—M. (*Bishop Auckland*) writes, in reply to A. M. C. (*Holywood*) (see p. 494, No. 135):—"If you refer to No. 71, Vol. II., of WORK, you will find a plan of steam launch. You can make it of yellow pine, free from knots or shakes, and hollow the inside out, leaving the sides ¼ in. thick. You can get engines from Mr. Lee, of Holborn, who advertises in WORK. If you will send me the size, I will tell you what size of engine you will require, and any other particulars you may require."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—S. (*Bristol*); A. M. L. (*Nuneaton*); F. W. C. (*Dublin*); H. A. W. (*Holt*); H. M. M. (*Bootle*); C. B. (*Regent's Park*); R. A. DE P. (*South Kensington*); W. F. (*Leeds*); W. H. E. (*Crewe*); J. W. (*Plumstead*); P. B. (*Clapham*); J. B. (*Dundee*); GAMMA; H. R. (*Blackpool*); G. G. (*St. Blazey*); P. M. (*Shields*); W. M. (*Heigham*); CHURCH OF ENGLAND TEMPERANCE SOCIETY; E. E. S. (*Bickington*); S. E. (*Camberwell*); W. H. (*Edinburgh*); R. A. R. B. (*Oxford*); C. S. (*Wigan*); E. R. D. (*Sherborne*); NED; J. E. J. (*West Witton*); W. H. B. (*Leicester*); NO NAME; READER FROM THE BEGINNING; W. (*Glasgow*); A. D. (*Dunfermline*); T. G. P. (*Plumstead*); J. D. (*London, E.*); E. W. S. (*Surrey*); WING; A. W. B. (*Glasgow*); F. M. (*Hollesley Bay*); CHROMA; W. S. (*Harrow Road*); F. E. D. (*Bridgend*); R. S. (*Manchester*); J. P. (*Edinburgh*); M. & J. W. (*Conway*); E. P. (*London, S.E.*); H. B. (*Dewsbury*); G. R. E. (*Wakefield*); SCHEMER; T. A. (*Little Bolton*); D. W. K. (*Dumfries*); E. H. (*South Bermondsey*); AMATEUR ELECTRICIAN; W. M., JUNR. (*Norwich*); J. H. M. (*Liverpool*); CONSTANT READER; G. J. (*Didsbury*); J. M. S. (*Hull*); J. R. (*Dalton*); W. R. (*Brixton*); BOOKBINDER; BAROMETER; J. F. (*Paddington*); E. O (*Folkestone*); AXLE; A. & H. (*London*); A. E. C. (*West Bromwich*); EVER WILLING; W. P. (*Aberdeen*); TRANSMITTER; W. F. H. (*Islington*); INQUIRER; WHITTAKER; W. H. (*West Bromwich*); DOBRA; EVENING.

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