WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

VOL. IV.—NO. 192.] SATURDAY, NOVEMBER 19, 1892. [PRICE ONE PENNY.

WORK WORLD.

JAPAN has twelve electric light stations supplying electricity for light and power.

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The total output of gold from the mines of the world for last year was 6,033,000 oz.

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The Yorkshire Miners' Association Council propose a general week's holiday at Christmas for all miners.

* *

The hours of work for women in French factories is henceforth limited to eleven hours a day.

* *

The Durham miners have voted against a legal compulsory eight hours' day, only 12,684 voting for eight hours, whilst 28,217 voted against it.

* *

A new use for paper pulp has been discovered in Germany. By a special process the pulp is compressed in moulds, and hardened to form artificial teeth.

* *

Earl Russell has commenced business as a general contracting electrical engineer. He has had considerable experience in electrical work whilst acting as business manager to a firm of electrical engineers.

* *

A new American reaping, thrashing, and bagging machine has been tried on most of the big farms in North Dacota with great success. Each machine will harvest over sixty acres of corn in one day.

* *

A new process of tanning by electricity is used on the skins of stray dogs in Paris. The skins are transformed into leather in a much shorter time by electricity than by the old-time tanning methods.

* *

The cost of the biggest firework display the world has yet seen, which took place recently at the inauguration of the exhibition buildings, Chicago, was £6,000. Over a million people witnessed the display, which was provided by a London firm.

* *

Workmen of a large Tyne shipyard recently requested to work three-quarter time in order that all the operatives might be employed, firmly resolved that 25 per cent. of them should be paid off so that the other 75 per cent. would be employed on full time.

Persons using an electric search-light cannot discover the approach of a boat painted dead black if the sea is calm. Calm water does not reflect the rays of an electric light, but appears almost black, and the black boat is lost in the surrounding blackness.

* *

The straw-plaiting industry of England is carried on principally in the counties of Bucks, Beds, and Herts, and gives employment to from 4,000 to 5,000 men, and about 500,000 women and children. As this is a home industry, the employment is but partial.

* *

American and Austrian newspaper proprietors are employing electro-motors for driving their printing machinery, and report complete success. The Vienna *Fremdenblatt* is printed by power derived through an electro-motor from the mains of the electric light company.

* *

At Aspen, Colorado, U.S.A., the electric light is maintained by water-power. The electric light company have recently erected plant to furnish power for mining operations in the district. The dynamos are to be driven by five 250-h.-p. Pelton water-wheels, worked by a 356 ft. head of water brought through 30 in. pipes.

* *

A German chemist has discovered that silver can be separated from copper and bismuth in a nitrate solution of these metals, and mercury in the mercurous state from copper, bismuth, and arsenic, dissolved in weak nitric acid, by electrolysis, using a weak current of electricity at a pressure of only 1·35 volts.

* *

In a Japanese invention, to enable members of the House of Representatives to vote without leaving their places, an electrical button is pressed by the voting member, and a corresponding ball is discharged into a receptacle behind the President's chair. After the balls have been counted they are electrically returned to a storage chamber, ready for the next division.

* *

A boat of novel construction has been recently built at Glasgow. Two thin sheets of Siemens-Martin steel were pressed to the exact shape and size required, and riveted together with a bulb steel between them, forming the stem, keel, and stern-post. The gunwale, streaths, and bottom bars are fitted in the usual manner, and a strong hook and ring-bolt is fixed at each end for mooring purposes.

* *

The diminution in lighting power of an electric incandescent lamp is partly due to the deposit of a carbon film on the interior of the bulb. This "age coating" is most pronounced in the early life of the lamp, and is greatest in lamps of high initial efficiency. The loss in transparency of the bulb, after a run of from 800 to 900 hours, varies from 15 to 20 per cent., being greatest in the most efficient lamps.

* *

A new alloy, resembling gold, remains unaltered even in colour after prolonged exposure to air, containing ammoniacal or acid vapours. It consists of 100 parts copper to 6 of antimony. When first mixed, the alloy would cool with a porous structure, but this is prevented by a flux of charcoal, magnesium, and calcspar put in the crucible; it can be cast, rolled, hammered, and soldered like gold, and is of greater solidity.

* *

If the bottles used in this country alone were made at home, it would find work for 20,000 people. From three to five thousand gross of bottles are said to be imported every week to the detriment of the English manufacturers and artisans. These bottles, by some curious oversight in the Merchandise Marks Act, are not compelled to be marked with their place of origin, and it is hard to distinguish whether they are English or foreign. It is time this was altered.

* *

The Balubans, in Central Africa, have a good local reputation as iron-workers. They find bog-iron ore on, or very little under, the surface of the ground. Their smelting furnaces are of clay, 6 ft. to 10 ft. high, conical in shape, and 40 in. to 60 in. diameter at the base. The ore is tipped in at the top, and charcoal fed in through basin-like side openings, which also receive a continuous air-blast; the iron and slag are removed from the bottom of the furnace every eight or twelve hours, according to the heat attained. The bellows supplying the blast consist of a block of wood about 20 in. long, hollowed out, and fitted with a funnel head of clay. At the lower end are two openings, over which skins are stretched. Motion is imparted through two small rods.

CHEMICAL APPARATUS: HOW TO MAKE AND USE IT.

BY H. B. STOCKS.

SUPPORT FOR CONDENSER—CLAMP AND BOSS—APPARATUS FOR CHLORINE, ETC.—APPARATUS FOR SHOWING SOLUBILITY OF GASES—METHOD OF SHOWING ACTION OF SULPHURETTED HYDROGEN UPON METALLIC SOLUTIONS—APPARATUS FOR SULPHURIC ACID, NITROGEN, AMMONIA, NITRIC ACID—TUBE RETORT AND RECEIVER—FILTRATION—METHODS—FILTER-PAPER—FILTER-CUTTERS—FILTER-STANDS—FUNNELS.

FOR supporting a condenser a special stand is not really necessary. It may be supported from a retort-stand by means of a copper wire or stout string, and may then be inclined in any direction (Fig. 1), or a clamp and boss may be attached to the retort-stand. These will be found very useful, not only for holding a condenser, but for retorts, flasks, etc.

The two articles above named are seen at Fig. 2, A being the boss and B the clamp. The boss will have to be cast in brass, and it has two thumb-screws and two slots at right angles to one another—one to grip the retort-stand, and the other to grip the rod of the clamp. A boss may be bought for about 1s. 6d.

The clamp may be made by anyone. The three portions, C, D, E, are made of hard wood, 3 in. × 2 in. × 1 in., two of them being slotted out to grip the article intended to be held.

Procure a 4 in. screw, and file off the head; make a hole for it in D, and screw it in firmly, taking care not to split the wood. Procure also a screw for window fastening, about $2\frac{1}{2}$ in. long, and a little thick copper wire. Place C, D, E together, and bore two holes one on each side of the slot, clear of the screw, right through the three pieces; also in the centre of A bore a hole for the thumb-screw, and let in the brass plate which accompanies it. Make the two holes in D a little larger, so that it will easily slip upon the copper wire. Push a piece of copper wire through all the holes, and flatten it at top and bottom, after leaving about $1\frac{1}{2}$ in. for the clamp to move. Turning the screw will then draw E towards D, thus gripping the object. A small piece of sheet brass let into D under the point of the screw will lessen the wear at that place.

Chlorine and hydrochloric acid may be made in the apparatus, which is seen at Fig. 4, and consists of a 20 oz. flask (costing 9d.), a safety funnel (costing 5d.), bent tube, and the wash-bottle from the hydrogen apparatus. The safety funnel is intended to prevent any of the gas entering the room; and the preparation of these gases would be much better carried out in the open air, as chlorine especially is dangerous when inhaled. The collection of the gases is somewhat different to those I have described. As they are so soluble in water they are collected by displacement; being heavier than air, they displace the air in the jar, and after a short time the glass plate may be placed over the jar. Take care to grease the mouths of the jars and the glass plates, to prevent leakage.

To show the solubility of hydrochloric acid in water, procure a large white glass bottle, a cork to fit, and a piece of glass tubing 2 ft. long. Draw the tube out to a point in the manner already described, bore a hole in the cork, and push the tube through, so that the point is just out of the cork. Fill the bottle with the dried gas, and for this purpose place a little strong sulphuric acid in the wash-bottle instead of water. When the jar is full of the gas, insert the cork, with the point of the tube inside the bottle; place a little plug on the open end of the tube (a short piece of rubber tube with a piece of glass rod in one end is suitable); suspend the bottle over a basin containing water coloured with a little blue litmus solution, into which the tube dips. Now take off the plug and shake the bottle a little. A fine fountain will play inside the bottle, owing to the vacuum produced by the gas dissolving, and the litmus will change to red, showing the acid nature of the gas.

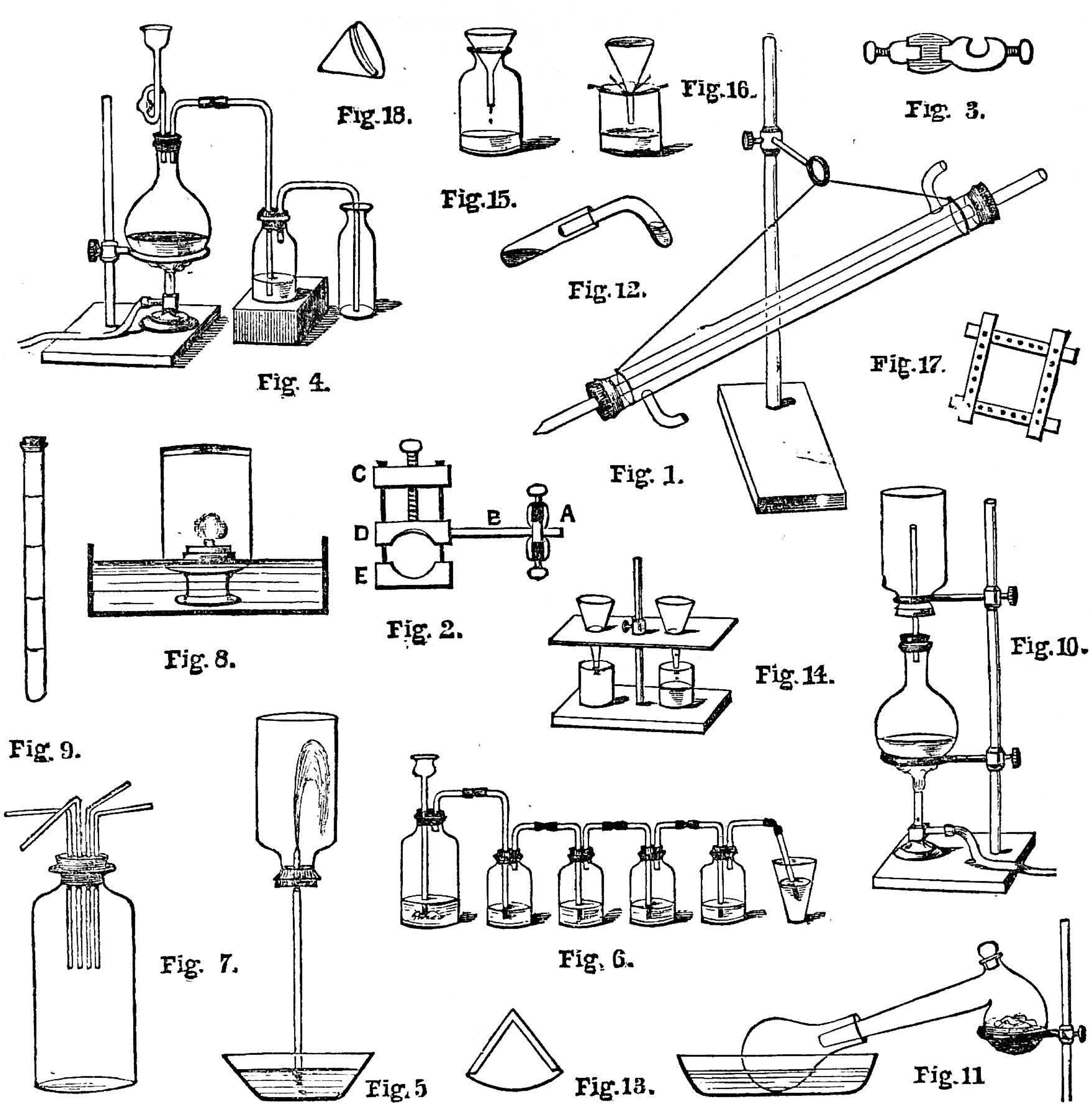
The same apparatus will do to show the solubility of ammonia gas. The litmus in the basin, being coloured red, will change to blue in the bottle, showing the alkaline nature of the gas.

The preparation of sulphuretted hydrogen should also be carried out in the open air, as its odour is not very pleasant, to say the least of it. The apparatus used is the same as that for hydrogen, or, for small quantities, the tube apparatus I have described. It is soluble in water, and therefore must be collected by displacement, in the same manner as chlorine.

The chief interest of sulphuretted hydrogen is its value as a test. As with many metallic solutions, it gives precipitates of various colours. To show this to the best advantage, fit up a number of small wash-bottles, similar to the one described, and connect them together by means of rubber tube—the first one to the gas generator and the last one to a glass of water.

Into the wash-bottles put solutions of (1) tartar emetic (antimony potassium tartrate), (2) lead acetate (sugar of lead), (3) stannous chloride (tin-salts), (4) zinc sulphate, made alkaline with ammonia; pass the gas, and notice the colours. Sulphurous acid is made in the same apparatus as chlorine, and collected in the same manner. Sulphuric acid is made on the large scale by bringing together sulphurous acid, nitric acid, and water in large leaden chambers. Now this process of manufacture may be imitated on a small scale, in a similar manner to that used some time ago, when the acid was 5s. or 6s. per pound. It is now only 2d. or 3d. per pound.

In place of the leaden chamber, we will have a half-gallon wide-mouthed bottle. A large cork is required, bored with four holes, each containing a bent glass tube. Connect one of these to the sulphurous acid apparatus, one to a flask containing nitre and sulphuric acid, and heated so as to give off nitric acid,



Chemical Apparatus. Fig. 1.—Condenser supported by String. Fig. 2.—Clamp and Boss. Fig. 3.—Boss. Fig. 4.—Apparatus for Chlorine, etc. Fig. 5.—Apparatus for showing Solubility of Gases. Fig. 6.—Apparatus for showing Action of Sulphuretted Hydrogen upon Solutions. Fig. 7.—Apparatus for Sulphuric Acid. Fig. 8.—Apparatus for Nitrogen. Fig. 9.—Tube for showing Composition of Air. Fig. 10.—Apparatus for Ammonia. Fig. 11.—Apparatus for Nitric Acid. Fig. 12.—Tube Retort and Receiver. Fig. 13.—Filter-cutter. Figs. 14, 15, 16.—Supports for Funnels. Fig. 17.—Wood Frame for Filtration. Fig. 18.—Filter-paper ready for Funnel.

and one to a flask containing water; the fourth tube is left open for air. If, now, sulphurous acid and nitric acid are allowed to pass into the bottle, the "chamber" crystals are seen; and on boiling the water in the flask these are dissolved, red fumes of nitric oxide are formed, and the liquid at the bottom of the bottle is dilute sulphuric acid, which may be shown by its redding litmus sol and by giving a white precipitate with barium chloride.

Nitrogen is usually prepared from air which consists of four-fifths of this element and one-fifth of oxygen. As phosphorus burns readily in oxygen, we may take the whole of the latter element away, leaving the nitrogen.

The apparatus is very simple, and consists of a bung or flat cork, on which is placed a small porcelain capsule or the lid of a porcelain crucible. This is floated upon the water in the pneumatic trough; a bit of phosphorus, dried by pressing (not rubbing) between blotting-paper, is dropped upon the capsule, set fire to, and a wide-mouthed jar placed over it in the trough. After the fumes have subsided, the residual gas is nitrogen.

To show the composition of the air, a tube, 18 in. long and ½ in. in diameter, is sealed at one end, as for a test-tube. It is then divided into five equal portions by rubber bands on the outside, and a good cork fitted to the open end. A small piece of phosphorus is dried, and placed about 2 in. from the open end of the tube. The cork is tightly inserted, and the phosphorus slightly warmed, and as soon as melted, shaken down to the bottom of the tube. It will take fire in its course, and when the flame has disappeared, place the corked end of the tube into water, withdraw the cork, and pour water on the tube to cool it. Again insert the cork under the water, so as to keep in the tube the water which has risen; then notice the height of the water in the tube. It will be at the first elastic band, showing that one-fifth of the air has disappeared. This one-fifth, as before stated, is oxygen.

Ammonia may be prepared in the apparatus shown at Fig. 10, which consists of the flask used for oxygen, a tube, and gas-jar. It will be noticed that ammonia is collected by displacement, being very soluble in water. Being also lighter than air, it displaces the air downwards in an inverted gas-jar.

Nitric acid is prepared in the apparatus shown at Fig. 11, and consists of a 10 oz. retort (costing 7d.) and a flask (that used for oxygen will do), the flask being kept cool by water in a basin. The nitric acid distils over from the materials in the retort, and is received in the flask, which is called the receiver.

When it is required to distil very small quantities of nitric acid or any other liquid, the tube retort and receiver (Fig. 12), made of hard glass tube ¾ in. in diameter, may be used. These may be made by anyone who has exercised himself in glass-blowing, in a similar manner to that I have described in former papers.

Having now gone over a little of the ground required by those studying elementary chemistry, and described the apparatus used in preparing, collecting, and testing gases, etc., I intend giving a few examples of apparatus which are in general use for many purposes in chemical laboratories.

Everyone knows what a filter is. It is usually a very unwieldy article, intended to filter and purify water, which it rarely does. Chemists never use these filters. If a coarse filtration is all that is necessary, a piece of cotton is spread upon a wood frame (Fig. 17), and held there by a number of pins fastened into the wood. The frame is supported over a dish, which catches the liquid.

The general method of filtration is by means of a funnel containing a filter-paper. Filter-paper is very similar in appearance to fine blotting-paper, and for qualitative work white blotting-paper will do quite as well. Filter-papers are cut to a circular shape, and for this purpose filter-cutters will be required. These are merely pieces of tin-plate cut to a triangle, with a rounded base, and having the sides turned up about ⅛ in. The filter-paper to be cut is folded twice and placed in the cutter, and, by means of scissors, the ends projecting beyond the tin-plate are cut off. The filter is then taken out, opened in the manner shown at Fig. 18, and placed in the funnel, which should be larger than the filter-paper—never *vice versâ*. Convenient-sized cutters will be 1½ in., 2 in., and 3 in., giving filter-papers double that diameter. The funnels required for these papers will be 2½ in., 3 in., and 4 in. in diameter, costing 2½d., 3d., and 4d. respectively.

A filter-stand is very useful (Fig. 14). It is made in wood, the base being 10 in. × 4 in., and the rod 12 in. high and about ½ in. in diameter. The sliding portion may be 3 in. wide, also 10 in. long. At each side a hole is bored, 2 in. in diameter, and in the centre a hole about 1 in. in diameter. Into this hole a cork is glued, and a hole is bored in the centre of the cork, and enlarged by means of the rat-tail file until it will just push on the rod. The sliding portion may then be adjusted at any height on the rod, and will take two funnels.

These stands are not absolutely necessary, as the funnel may be supported in the mouth of a bottle or over a beaker by means of a wire triangle.

METALLIC AND GLASS PIPES.

METALLIC pipes made of iron, cast iron, lead, etc., all have the disadvantage of rapidly oxidising, and consequently contaminating the water or liquids more or less. This is a demonstrated fact for which no genuine remedy has yet been found. In spite of this, we are compelled to employ them in all cases where glass is not sufficiently resisting—that is to say, for water-pipes, syphons, etc.

But is it not possible to make glass capable of supporting interior and exterior pressures such as those to which such conduits are subjected? Two Belgian engineers posed this problem and solved it in the following manner:—

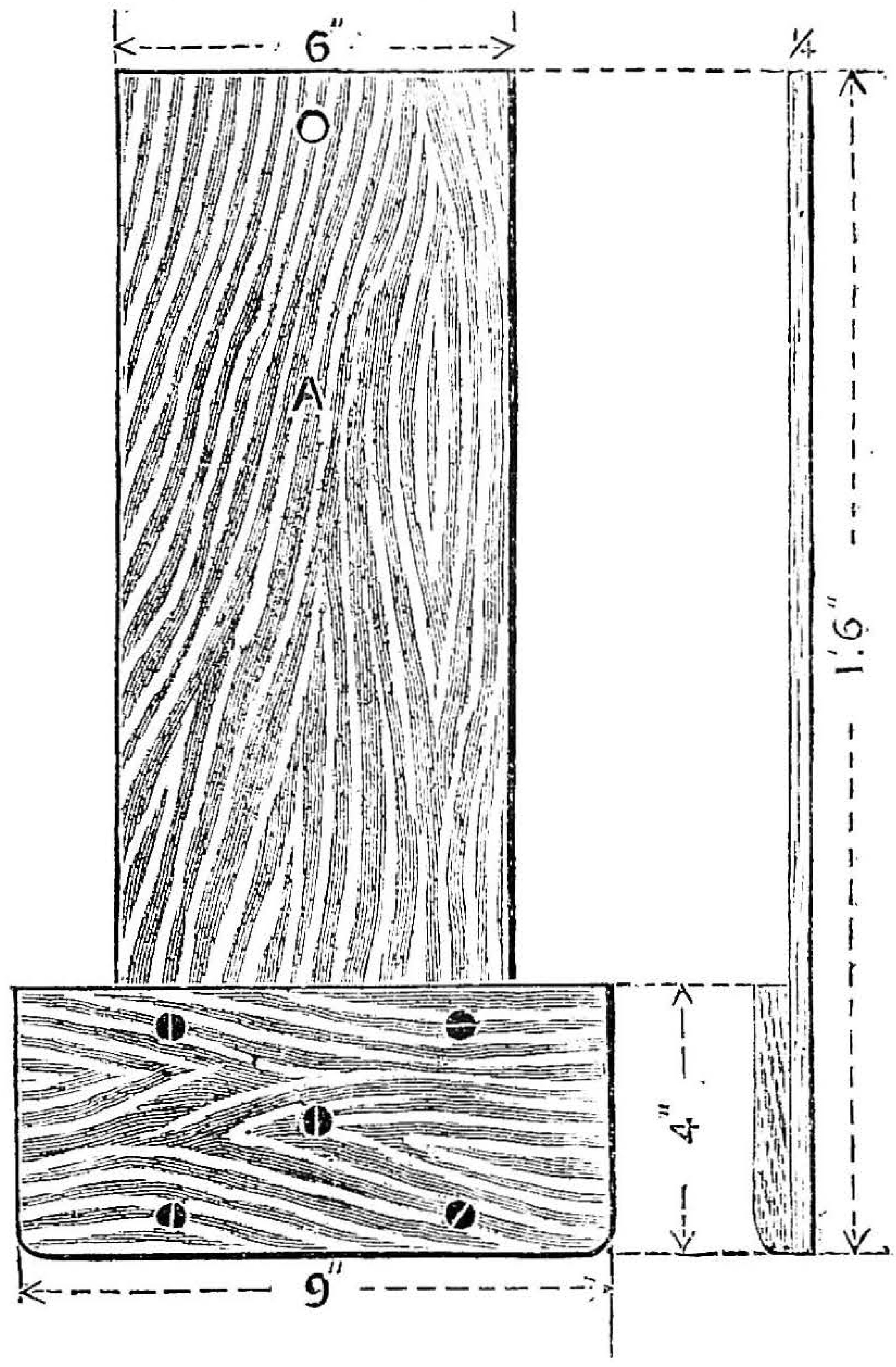
They cover the glass pipe with another made of metal, and between the two they pour special cement, which perfectly unites the pipe and covering, and at the same time protects the glass, and consequently the liquid running through, against the variations of temperature.

The method of manufacture is applied not only to straight pipes, but to every form of conduit used in trade. The ends of the pipes are wormed or fitted with flanges, so that they can be joined hermetically without expensive solder as with lead pipes.

Thanks to their lightness, and the non-conductibility of glass for electricity, the employment of these pipes is also presented to the electric industry; uncovered cables can then be used without fear of danger.—*Les Inventions Nouvelles.*

LEDGER-REST.

AMONGST the very many thousands of readers of WORK, there are doubtless many that have at least occasionally to enter various matters in large books or ledgers. To such as these I have no need to mention the difficulty experienced in writing as the bottom of the page is approached. Various expedients are employed to support the hand, such as placing the left hand or a large book under the hand holding the pen. These, at the best, are only to be regarded as makeshifts, and therefore will be used no longer than is necessary. The simple contrivance here



Ledger-rest, Front and Sectional Views.

placed at the service of readers may readily be constructed by the merest novice in the use of wood-working tools. It is formed of two pieces of wood screwed together at right angles as shown in sketch. The piece A may be about 18 in. long, 6 in. wide, and ¼ in. thick. The other should be, say, 9 in. long, 4 in wide, and ½ in. thick. The two pieces should be planed smooth, and screwed together with five ½ in. screws as seen. It may be made of any kind of wood, mahogany being preferred, as it can then be French polished, which will keep it clean, and by keeping the air away prevent it warping. In use, the thin blade is passed between the leaves of the ledger, the other piece thus forming the required support for the hand.—[This contrivance has been known to us for years. Nevertheless, being useful, insertion is willingly given to it.—ED.]

GRAPHITE, as a lubricant, is strongly recommended. To cool hot bearings, put it on as thick as it will mix with oil.

STEAM TRAPS, situated in any exposed position, should have a drain-cock, so that they can run dry when not in use. If left full, or nearly full, of water, a frost expanding the water will burst them.

BENT IRON WORK, AND HOW TO DO IT.

BY J. H.

Lanterns.

Lanterns — The Suspension Bracket — Ornamental Stars—Ball—Suspension Chains—The Lantern.

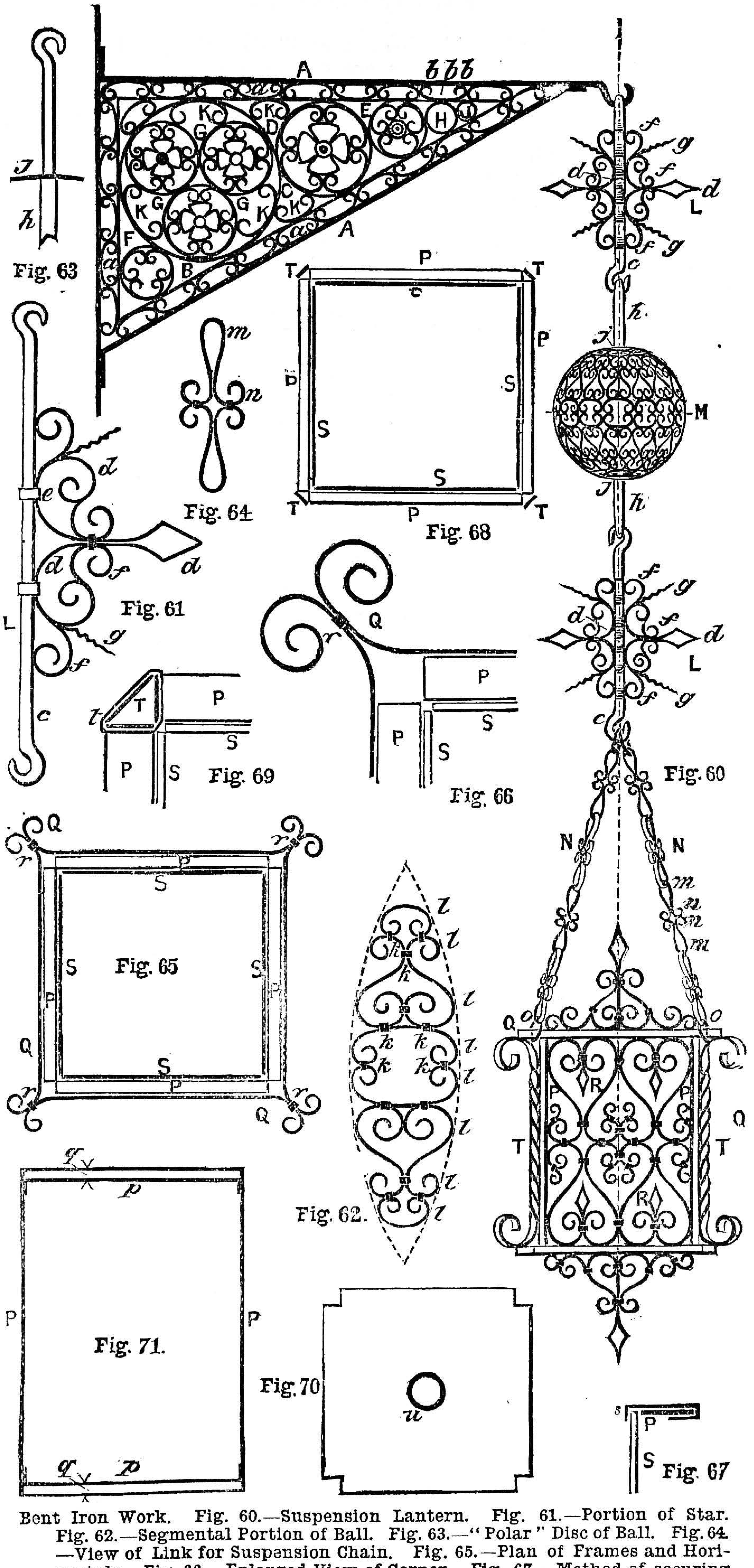
Lanterns.—Lanterns are articles that can be very prettily constructed in bent iron. They admit of many and varied designs, and their mode of suspension is generally made the vehicle of much ornamentation. In Fig. 60 I show a lantern with ornamental chains and attachments suspended from a bracket, formed mainly of scrolls and rosettes. Suppose we begin with the latter.

The Suspension Bracket.—There are two main frames, A and B, made by bending strips of iron of $\frac{1}{2}$ in. × $\frac{1}{16}$ in., or $\frac{3}{8}$ in. × $\frac{1}{16}$ in. section, into the triangular form shown in the figure. The joints may be made by lapping, or by scarfing and riveting, as already described in the description of the screen. The two frames are united with the double curves, *a*. These should be clipped at three points, *b*, *b*, *b*, to the frames. They need not be united to each other. Caution and care are requisite, as in the screen before described, to have these outer framings straight and free from winding. Then there are two large circles, C and D. These should be of the same heavy section as A and B, because a good deal of work has to be fastened to them, and they tie B together. They will be curved to lines struck on a board, or to wooden discs turned of the correct diameter. The end joints should be scarfed, and riveted or brazed. The circles should be riveted to B and to each other. The smaller circles, E, F, G, H, J, are made of the ordinary thin strips $\frac{3}{8}$ in. wide, and their ends may be united with soft solder. They need only be soft soldered to the other circles, or to B, or even fastened with the common clips. The centres of D and G are occupied with floral ornaments, fastened with double curves of bent iron to their respective circles. The flowers are cut from sheet copper, and hollowed out on a pitch block with a round-faced punch, and riveted in pairs *back to back*. The curves are clipped to their circumscribing circles and soldered to the edges of the flowers. Sundry curves, K, fill in open spaces, and serve by means of clips to render the union of the circles with the frames more complete.

Ornamental Stars.—Instead of suspending the lantern from a single long chain, the practice sometimes is to interpose several ornaments between it and the supporting bracket. In the figure there are two star-like designs, L, L, and a ball, M. The stars are easily made; the ball is rather difficult. For the stars, a central bar of iron, *c*, $\frac{3}{16}$ in., or, at the most, in. square, is used to carry the scroll-work. A hook is formed at each end of the bar by tapering down and turning round, according to the method described in p. 437, Fig. 44. Upon each bar there are four sets of scroll-work, identical in design and size. A single set is shown enlarged in Fig. 61. There is a main double curve, *d*, with a finial, one on each flat of the bar, *c*. These are united to the bar and to each other with clips at *e*, or with solder. The minor curves, *f*, are fastened to this with common clips. At *g* tendrils are brought out. These are made of the thin iron bent backwards and forwards with the round-nosed pliers. They are placed between their curves, *d* and *f*, and the clips are made to encircle the three thicknesses.

Ball. — The ball, M, is rather troublesome. It is made of several built-up pieces, which in general outline are like the surfaces of a segmented orange (Fig. 62). We proceed as follows:—First, prepare the centre-bar, *h* (Fig. 60), with hooks at each end, just as in the case of the stars, or large links, L. At the positions, *j*, *j*, on the bar corresponding with the diameter of the ball, thin circular discs are fastened. These discs are best secured by filing shallow shoulders on the bar for the discs to abut against, and securing them either with solder or with spelter (Fig. 63). The spherical curvature which is imparted to the discs will be the same as that of the ball. Now prepare a number of curves, as in Fig. 62, which represents one of the segments, of which there are fourteen, curved and united, required to complete the ball. These curves are united to each other with clips, as shown at *k*, and to their fellows on each side at *l*. The difficulty lies in imparting the spherical form to each of these segmental members and to the complete ball. Each of the members can be bent separately upon a templet ball of wood. Then during the process of union each to each, use may be made of the same templet to secure uniformity in the horizontal—or shall we say equatorial?—curves, and so on, until we have two separate hemispheres, each containing seven segmental members, and each bent by gentle pressure of the hand to the spherical form of the templet ball. These hemispheres will easily be united to each other with clips, so completing the ball.

Suspension Chains.—The suspension chains, N, for the lamp are made of bent iron. Two links are shown enlarged in Fig. 64. The links are made to engage each



Bent Iron Work. Fig. 60.—Suspension Lantern. Fig. 61.—Portion of Star. Fig. 62.—Segmental Portion of Ball. Fig. 63.—"Polar" Disc of Ball. Fig. 64.—View of Link for Suspension Chain. Fig. 65.—Plan of Frames and Horizontals. Fig. 66.—Enlarged View of Corner. Fig. 67.—Method of securing Glass to Frames. Fig. 68.—Plan of framing Glass, and Twisted Corners. Fig. 69.—Fastening of Corner. Fig. 70.—Bottom of Lantern.

with its fellow at m, before the scrolls, n, are secured to each other with clips. The rings, o, also are inserted before the adjacent curves are secured.

The Lantern.—The lantern, O, is made in one way out of several possible. I want, therefore, to make this the vehicle for remarks applicable to other types. In the figure the lantern is four-sided. It might, however, be triangular. It is glazed all over the sides, within the bent iron. It might be glazed with oblong slips, or with circular discs only. There is no door. It might be made with a hinged door. The chains come down to the top of the lantern, but the corners of the lantern frame could be carried up in neat curves to meet the chains. Instead of the way shown of putting the frame together, another way might be adopted.

As regards this particular example, first: There are four frames, made of $\frac{3}{8}$ in. iron (Figs. 60, 65, and 69). This may be the ordinary thin strips; but it is better to take a bit of $\frac{1}{8}$ in. square rod, heat it, and hammer it down until it is $\frac{1}{16}$ in. thick and $\frac{1}{4}$ in. wide. This will then make quite a substantial framing that can be manipulated with perfect freedom, without risk of distortion. Inside each frame, at top and bottom, and at a distance of $\frac{3}{8}$ in. along, a strip of thin iron, p, is fastened by turning down, and soldering in the ends. These receive the clips that attach the scroll-work at top and bottom, and the $\frac{3}{8}$ in. width is covered over by the strips, Q, that bind the frames, O, together.

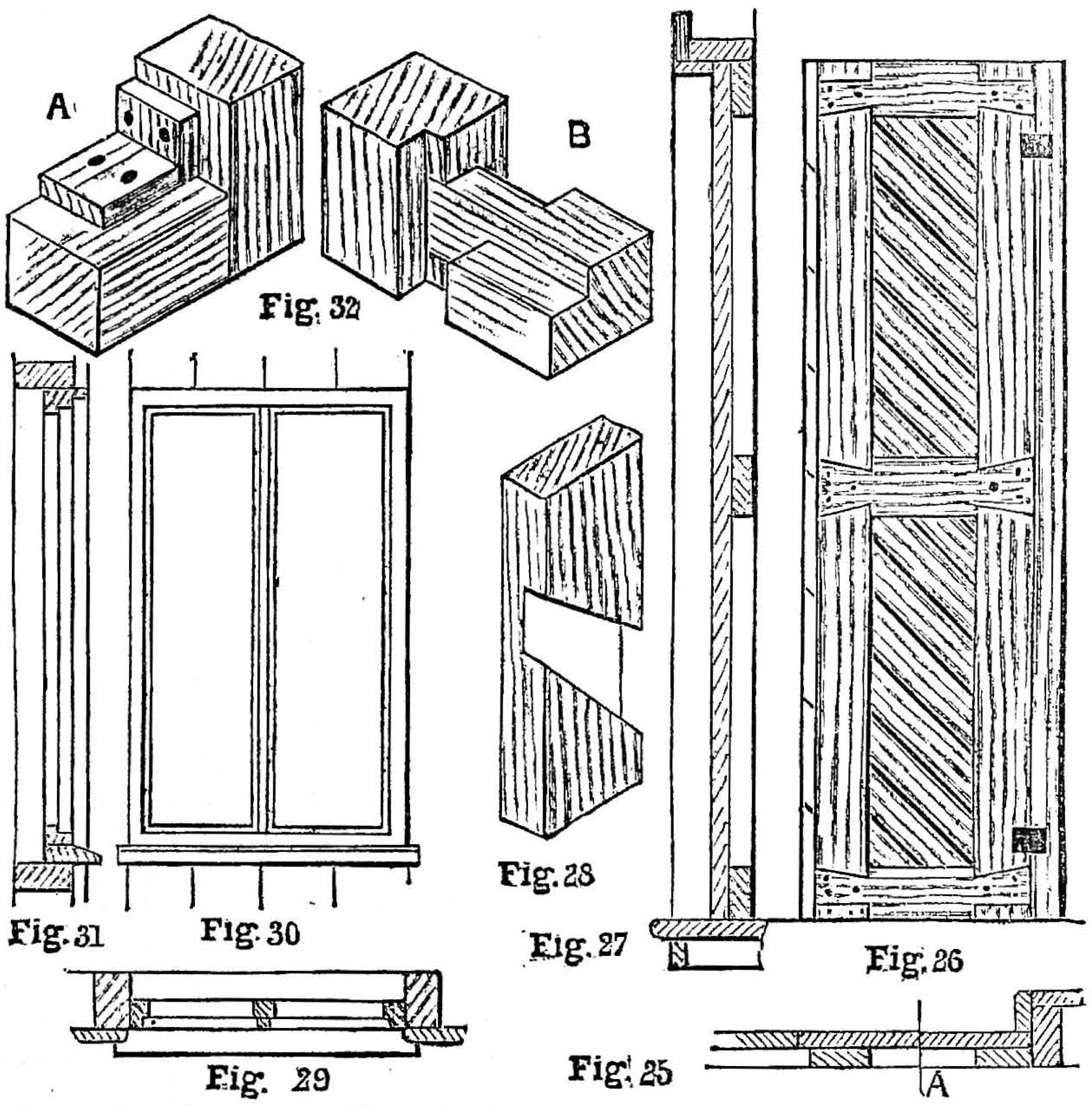
The frames are filled in with scroll-work, R. The main scrolls are fastened with clips to the frames at their points of mutual contact, and to each other also. The minor scrolls are united to the others with clips. These frames can be united to each other in several ways. In this example the horizontal strips, Q (see also the enlarged view, Figs. 65 and 66), act as binders, embracing the frames, being themselves held at the corners with clips, r. It will also prevent movement of the parts if a little solder is run between the faces at P. The horizontal strips must be secured to the frames with clips or with fine wire—the former looks more in keeping with the rest of the work.

Some finish is required at the corners formed by the meeting of the frames. That shown in Fig. 60 will look very well. It is simply a double-ended scroll, T, of $\frac{1}{4}$ in. iron, with its shaft twisted with the pliers. In Figs. 68 and 69 the scroll, T, is shown in the section of the thin iron near top and bottom, where it is clipped to P, P, with clips, t (Fig. 69). A little ornamentation at top and bottom completes the lantern framing. The scrolls at top and bottom are in harmony with those in the panels. They are fastened with clips similarly to the others.

Within the lantern frames oblong plates of coloured glass, S, are placed. They are secured with clips, as seen in Fig. 67, the ends, s, being turned down carefully after the insertion of the glass slips. Four clips—two at top and two at bottom—are sufficient to hold the glass securely.

In Figs. 65 and 66 the relative positions of these several parts are clearly seen, the outer frames, P, the horizontal binders, Q, and the glass, S. These parts are, of course, in contact, though in the figure they are shown separated a little. I have shown them like this in order to make the division between the separate parts quite clear.

I have not yet said anything about the bottom of the lantern. This should properly be cut to fit within the frames, P; in Fig. 70 the plan view of the bottom is shown. It rests on the inside of the bottom bars of the frames. It may be made of thin iron, brass, tin, zinc, or copper. No fastening is necessary, only it must be inserted previous to the fastening together of the frames with the top and bottom horizontals, Q. Upon it may be soldered a candle socket, u, or a small oil lamp be stood upon it. This completes the lantern. I will show an alternative method in my next and concluding paper.



Carpentry for Boys. Fig. 25.—Half Plan of Door. Fig. 26.—Back Half Elevation. Fig. 27.—Section at A. Fig. 28.—Joint of Rails and Stiles. Fig. 29.—Plan of Sash. Fig. 30.—Elevation. Fig. 31.—Section. Fig. 32.—A, B, Joints of Corner.

CARPENTRY FOR BOYS.

BY McDONALD.

CONSTRUCTION OF SHED DOOR—CONSTRUCTION OF WINDOWS—REMARKS ON OTHER CONSTRUCTIONS.

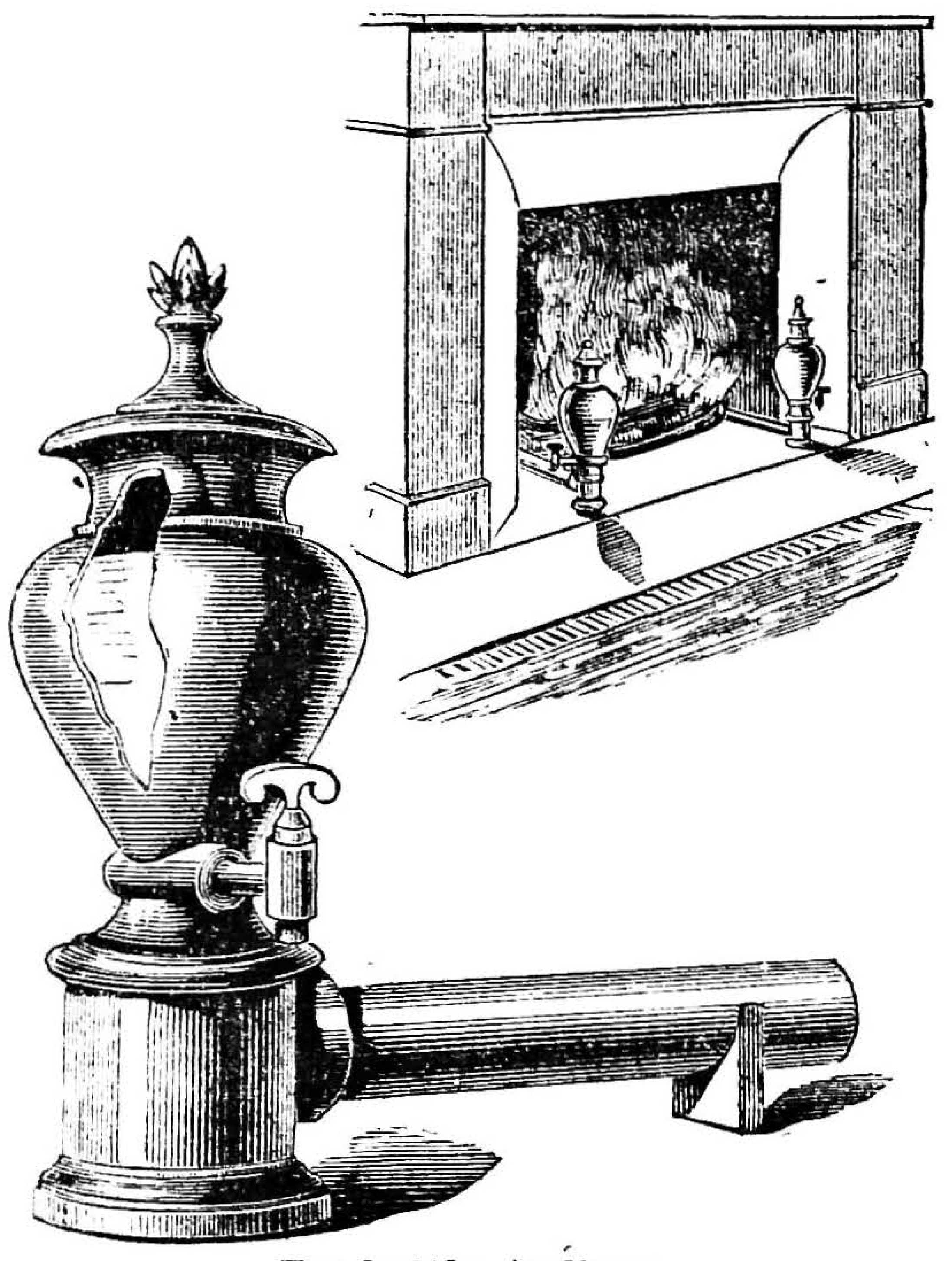
REFERRING to the sketches, it will be seen that the construction for our shed door is very simple, but quite substantial. It is in two leaves, or halves, one of which only is shown, the other being just the same. The back frame is made out of $3\frac{1}{2}$ in. $\times$ $1\frac{1}{4}$ in. stuff, dovetail-halved at the joints, and the boarding $\frac{7}{8}$ in. or so thick, laid diagonally, and nailed on the face. Dovetail-halving is not a difficult joint to make. The rails are gauged, shouldered, and cut out, as shown for square halving. They are then tapered or dovetailed, as at Fig. 26, laid on the stiles in position, and marked. The stiles are cut out, as in Fig. 28, to receive them. The frame is screwed together, and if necessary, flushed off on both sides by the jack-plane and trying-plane, after which the boarding is nailed on. The door is kept flush at the central joint when closed, by allowing the boarding to project $\frac{3}{4}$ in. or so over one leaf, and keeping it a corresponding distance back on the other. It is hung with strong back-fold hinges, flush with inside of door-post, and a piece of boarding, made flush with outer face of shed and chamfered, is nailed round on the posts and lintel to stop it. It will require a lock and a couple of slip bolts; but the fixing of these, especially the former, need not be detailed here, as our youth should get some assistance from a practical man with them. In fitting the door, care must be taken to give sufficient clearance all round.

Construction of Windows.—The windows, or rather the sashes, should be constructed, as at B (Fig. 32), with mortise and tenon joints, and the glass rebate or check taken out of the solid timber. This would necessitate the procuring of a back check—an expensive tool—with which the young worker can well enough dispense at this stage. Accordingly, the alternative construction in the same figure is given. This consists of a frame mortised and tenoned together, of sufficient dimensions to fill a window space, and pieces to form the glass check nailed on. The stuff for the frame may be 2 in. $\times$ $1\frac{1}{2}$ in., and that for the fillets $1\frac{1}{2}$ in. $\times$ $\frac{1}{2}$ in. or so; all to be dressed, squared, and gauged. The bars or divisions for the glass must be treated in the same manner. It should be noticed at B that when a mortise is at the end of a piece the tenon is rebated, so as not to come through the end. All mortised and tenoned frames, whenever practicable, ought to be cramped up, and pinned or wedged if the tenons go through. If pinned, these should go through the centres of the tenons; if wedged, allowance must be made in the backs of the mortises for wedge-grips. In inside work mortises and tenons should be glued; in exposed or outside work white-leaded. It will be observed from Fig. 31 that there is a small sill under each sash projecting, and weathered to take away the rain-water. There are also narrow stops nailed round the sides and lintels, finished flush with outside of shed boarding and chamfered similar to those for the door.

Remarks on other Constructions. — The youthful worker will now begin to perceive that there are many ways of doing work, all of which are employed as circumstances demand. Thus our sashes might have been checked or halved at the joints, and the door might have been mortised and tenoned. In fact, this is how they would have been made had it not been for the purpose of showing variety of construction. Also the bench and trestles could be fixed together by one or other of these methods, instead of being nailed only. But these are matters of judgment and discretion. Our young friend, when he gets a little more familiar with the craft, will see which method answers best for a certain job, and so on. We will only say here that for movable or portable work mortising and tenoning are best; for stationary work or fixtures, checking, halving, or even nailing only, is sufficiently substantial. Taste also plays a part. The joints should be hidden as much as possible. For instance, had it not been for the reason already stated, our door should have the board nailed on the side of the frame exposed to view, instead of as it is. But, whatever the method of construction may be, the worker should endeavour to make a sound and pleasing job of it; for anything worth doing at all is worth doing well.

TEA-KETTLE ANDIRON.

The apparatus represented herewith is, in America, replacing with advantage the tea-kettles that are usually placed before the fire in order that hot water may always be at one's disposal. This andiron is entirely hollow, so that it may be filled with water.



Tea-kettle Andiron.

A cock placed at the side permits of drawing off the water in measure as it is needed.

If it is desired to convert the apparatus into a hot-water bath, it is only necessary to remove the cover and to immerse in the boiling water the vessel containing the liquid to be heated. It is very easy to give the apparatus an artistic form that will permit of its being utilised in any fireplace.

HOW TO MAKE AND WORK THE SPECTROSCOPE.

BY CHARLES A. PARKER.

Supporting Stand of Spectroscope—Selection of Wood—Triangular Base of Stand—Table Top—Supporting Arms for Telescopes—Table for Prism—Supporting Pillar—Fitting Stand Together—Supporting Collars for Telescope Tubes—Clamping Plate and Nut for Movable Arm—Black Enamel for Stand—Polishing the Brasswork—Dead Black for Interior of Tubes—Lacquering the Brasswork.

We now come to the stand on which the collimator and telescope are supported. In the more expensive instruments this generally forms an important part of the apparatus, being one on which a considerable amount of care and ingenuity are usually expended. The stand illustrated in the accompanying diagrams, while being simple and easy to make, will be found to possess perfect rigidity combined with a good appearance. The most suitable wood to employ for the supporting pillar, the table top, and the triangular base, will be well-seasoned yellow pine for the former, and Honduras mahogany—sometimes called baywood—for the latter, each kind being straight grained and free from knots or shakes. With reference to the baywood, the pale description should be selected, as this is easy to work and not liable to warp or shrink. It should, however, be of a uniform colour, and not streaked with two different shades of red, the same remarks applying equally to the yellow pine. Beech or pine is unsuitable for our purpose, as this wood is liable to warp out of shape. If it is obtainable, nothing could be better than a leaf from a disused table or similar piece of furniture for the table top and the base, as a board of this description will sure to be thoroughly well seasoned, and will, moreover, require little or no preparation. Before proceeding further, make a full-size paper plan of the triangular base shown in Fig. 24. To do this with accuracy, first draw on a sheet of paper of suitable dimensions an exact triangle, the outside size of the base, which is 14 in., and then bring three lines to the centre, one from each angle, after which a 4 in. circle should be struck out from the centre with another smaller circle 1¾ in. in diameter at the apex of each of the angles. A line is now drawn at an equal distance from the central line on either side to join the outer and inner circles, tapering from 1 in. at the end to 2 in. in the middle, and finally a 1 in. circle is drawn exactly in the centre of the plan in order to indicate the position of the hole to receive the projecting pin of the supporting pillar.

Having selected a suitable board, which should be ¾ in. thick, proceed to carefully dress up the surfaces as true as possible, and, when quite ready, paste or gum the paper pattern on the best side of the wood, and afterwards saw the board to the exact outline by means of a fret or a bow saw, great care being taken not to splinter or otherwise damage the wood during the process of sawing. When the wood has been cut to the form of the pattern, the various sawn edges may be carefully smoothed by suitable paring tools, and then finished off by means of glass-paper, which should be glued on to a piece of cork or wood in order to preserve the edges of the wood.

For the table top we shall require a piece of ½ in. mahogany, which should be dressed up with the same amount of care as before; but this time we shall not require any paper plans, as it is of much more simple construction than the base. With a pair of compasses strike out an 8 in. circle on the surface of the wood to indicate the diameter of the table, and then, without removing the compass leg from the centre, strike out the quarter of a circle ½ in. inside the other, and then another at ¼ in. from the previous line in order to mark the position for the slot of the clamping screw, after which a final circle, 1 in. in diameter, is marked in the centre, as will be understood by reference to Fig. 25. Now, by means of a fret-saw, cut the wood to the form of the outer circle, and then cut the inner slot, and lastly remove the 1 in. circle in the centre, afterwards smoothing the sawn edges in the usual manner.

This done, we shall now be ready for the two supporting arms of the brass tubes, which are sawn from a piece of ⅜ in. wood to the form of Figs. 26 and 27, the measurements being 6 in. by 2 in., and 8 in. by 2 in., with one end of each rounded off carefully, and a 1 in. hole at the end of the 8 in. arm. We must also prepare a 2 in. circular disc of wood of the same thickness to form the table for the prism, as shown in Fig. 28, after which a couple of shaped supporting arms should be sawn to the plan of Fig. 29, the length being 5¼ in. and the width 1 in., which is gradually shaped off to ½ in. at the end, a piece of the wood from the straight-edge, measuring 2½ in. by ½ in., being removed to allow for the thickness of the table top.

The supporting pillar is now turned in a lathe according to the section shown in Fig. 30, the length being 12 in., with a pin 1 in. in diameter at the top, and a similar one 2 in. in diameter at the bottom. The base of the pillar may measure 4 in. in diameter, tapering to 3 in. at the top. As soon as this pillar has been finished, three knobs or supporting feet for the triangular base should be turned in a lathe to the form of Fig. 30, and then secured to the under side of each leg of the base. These feet should measure 2 in. in diameter, and may be turned from a piece of mahogany to ¾ in. thick.

Everything being ready, the stand may now be put together in the following manner. Having first affixed the three feet to the under side of the triangular legs of the base, proceed to fit the lower pin of the central pillar into the opening in the middle of the base, gluing, and afterwards securing it in position by means of three 2 in. screws driven in from the under side of the base into the broad part of the pillar, the wood being previously countersunk to take the heads of the screws. Now affix the table top to the upper end of the pillar in a like manner, and then slip the larger arm in position with the hole in the rounded end of the latter, put over the projecting pin of the pillar, after which the small supporting table for the prism is glued on to the top of the projecting pin previously accurately levelled to receive it. Screws or nails should not be driven through the table, otherwise they will spoil its appearance, and it must be so arranged as to come down quite close on to the movable arm, only just sufficient freedom being allowed to the latter. It will be found a good plan to glue a small curved strip of chamois leather to the under side of the movable arm in the position indicated by the dotted lines in Fig. 27, as this will enable it to be slid smoothly over the surface of the table. Another piece of leather cut to the form of a ring may also be glued to the under side of the prism table, which will enable the arm to move with greater ease and freedom. The other arm is now screwed to the table from the under side on the opposite side to the slot, as will be seen by referring back to Fig. 3, after which the two shaped supports are glued to the underneath of each of the arms, thus completing the stand.

We are now ready for the four collars which are attached to the wooden arms for the purpose of supporting the tubes. For each of these file up a moderately stout plate of brass to measure 1 in. by ⅝ in., drilling a hole in the centre and one on either side; then cut off a ⅞ in. length of ¼ in. brass rod, and having first filed a slight shoulder at either end, rivet this into the central hole of the plate just prepared, after which a ½ in. ring of brass tubing, 1¾ in. in diameter, is trued up in a lathe and provided with a couple of holes exactly opposite to each other, being afterwards riveted to the other end of the stem of the plate, thus completing the collar, as shown in plan and section in Fig. 32. A small brass screw, with a nut to fit, is now soldered over the hole in the top of the ring, and a narrow strip of chamois leather must be glued round the inside in order to form a soft bed on which the tube may rest, after which the four collars may be attached to the two wooden arms of the stands by means of short spherical-headed brass screws.

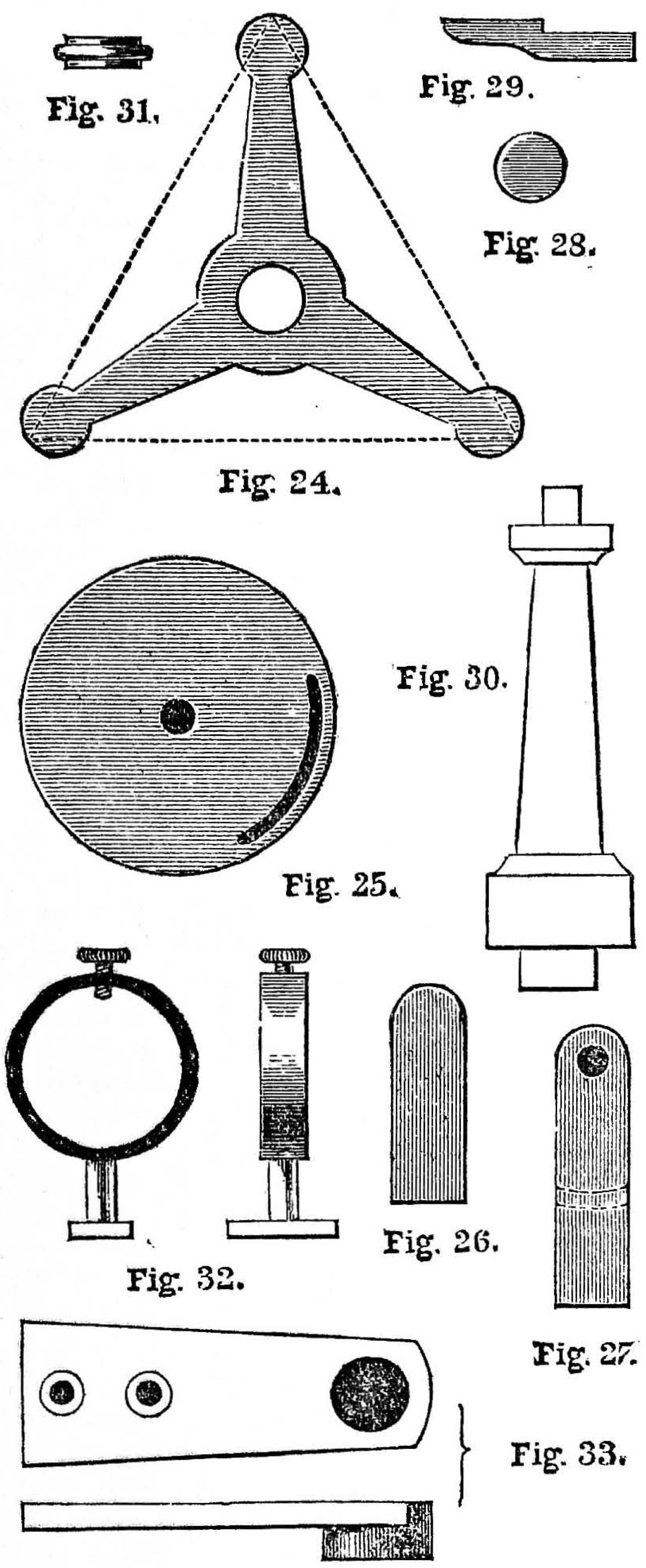
We must now prepare the clamping-plate and screw by which the adjustment of the movable arm is effected. For the plate, file up a piece of stout brass plate to the form of Fig. 33 until quite square and true to measure $1\frac{1}{2}$ in. by $\frac{1}{2}$ in., afterwards drilling three holes in the position shown in the cut. Now procure a clamping-screw and nut, which may be the same size and form to the regulating screw of the collimator. Solder the nut to the under side of the plate just made, and then screw this to the movable arm with the nut in position just over the slot in the table top, so that the clamping-screw can be passed through the latter and screwed into the clamping plate.

When completed, the stand may either be French polished or varnished, according to the taste or ability of the maker. In any case it will be found advisable to have the table top and the supporting arms carefully French polished, but the central pillar and the triangular base may, with advantage, be enamelled by "Palmer's black enamel varnish," which is a quick-drying spirit enamel. It is sold by Messrs. Palmer & Co., 78, Old Street, St. Luke's, London. A sixpenny bottle would be ample for the present work.

It will now be time to polish and lacquer all the brasswork, including the tubes, the collimator hood, the two clamping-screws, the clamping-plate, and the supporting collars of the two tubes. The brasswork should first be gone over with Oakey's emery paper in the following degrees of fineness—No. 1, F, FF, and O, after which a brilliant lustre is brought up by the use of crocus powder or one or other of the many excellent polishing pastes at present sold. The writer can personally recommend "the Universal metal polishing pomade," which will soon bring the surface up to a burnish-like brilliancy. It is sold in small tins at 1d. each, and can be had from ironmongers and oilmen, and some cyclists' emporiums. In polishing the work, the strokes should always be taken lengthwise, and it will be necessary to be particular and keep all the polishing materials distinct from one another.

When the polishing process is complete, the interior of all the tubes will require to be painted with a dead black varnish applied by means of a flat camel-hair brush. The dead black can be readily prepared by mixing ivory black with a small quantity of spirit varnish or French polish, and afterwards diluting it with methylated spirit until it dries with a good dull black surface, the exact proportion of spirit and black being ascertained by trial on waste pieces of wood. An excess of varnish will cause it to dry with a glossy surface, which may be remedied by the addition of a few drops of methylated spirit.

The various pieces of brasswork should be lacquered as soon as possible after having been polished, as they will soon lose their brilliancy by exposure to the air. It is also necessary to guard against handling the freshly polished surfaces, otherwise unsightly marks will appear on the surface of the metal. It is safest to handle the freshly polished work by means of pieces of wood. When ready to lacquer, about three-penny-worth—usually an ounce—of golden lacquer should be poured into a small pot or cup, across the top of which a string has been stretched for the purpose of wiping off any excess of lacquer from the brush. Now heat the article to be lacquered to about the temperature of boiling water, or until just too hot for the hand to bear, and then lightly draw a flat camel-hair brush—previously dipped in the lacquer—rapidly, and yet not hurriedly, lengthwise across the freshly polished surface of the work, care being taken not to stop once, otherwise an ugly mark will result. If the brush is laid on with a slightly curved motion at the beginning of the stroke, it will be possible to avoid the lacquer running over the sharp edges, and



Spectroscope. Fig. 24.—Plan of Base of Stand. Fig. 25.—Plan of Table. Figs. 26, 27, 28, and 29.—Plans of Table, Supporting Arms, Prism Table, and Shaped Supports for Arms. Fig. 30.—Supporting Pillar of Stand. Fig. 31.—Foot for Stand. Fig. 32.—Front and Side Elevation of Supporting Collar. Fig. 33.—Plan and Section of Clamping-plate.

it should always be taken over the surface in one uniformly steady sweep, and then raised the instant it reaches the opposite edge. Practice alone can make perfect, but it is, nevertheless, satisfactory to remember that a spoiled coat of lacquer can be removed by boiling the work in a lye composed of pearlash and water.

SMOKERS can mend their pipes with a paste made of plaster-of-Paris and water, and used immediately, as it hardens very quickly. But the best cement for the purpose is by dissolving ordinary glue with a little acetic acid.

TRADE: PRESENT AND FUTURE.

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

IRON AND STEEL TRADES. — The improvement recently noted in the Sheffield iron and steel industries is still shown. There is a good demand for railway wheels, tires, springs, and axles. There is, however, much hesitation on the part of customers, who still appear to be waiting for a fall in coal. This is not to be counted on, as until there are no signs of trouble in the coal trade, the market will not settle down. Hematites and Bessemer are unaltered in prices. Crucible steel is in small request, but file material and shear steel for cutlery shows a slight improvement. The first consignment of American pig iron, of 200 tons, for England, has been despatched from the "other side" for Liverpool. An *ad valorem* duty of fifty per centum would effectively stop this new business departure. Our Manchester correspondent writes:—The Lancashire steel trade remains in a very depressed state, and exceedingly low prices are quoted for orders of fairly large weight. Prices for best steel boiler plates range from £6 15s. to £6 17s. 6d. The volume of business being done in both raw and manufactured material is quite insignificant. In the latter branch, increasing competition by the German and Belgian makers renders orders for shipment difficult to obtain. Prices generally remain unchanged.

BOOT AND SHOE TRADE.—In Liverpool a fair amount of business is being done in the retail trade, but wholesale houses are in want of orders.

PLATE, CUTLERY, AND SCISSORS TRADES.—The silver plate and electro trades are not fully employed. The cutlery trade shows a slight improvement. There is a better feeling in the scissors trade. Messrs. Parkin & Sons, who have the Sheffield agency for Messrs. John Waine & Sons' new method of making scissors, are busy.

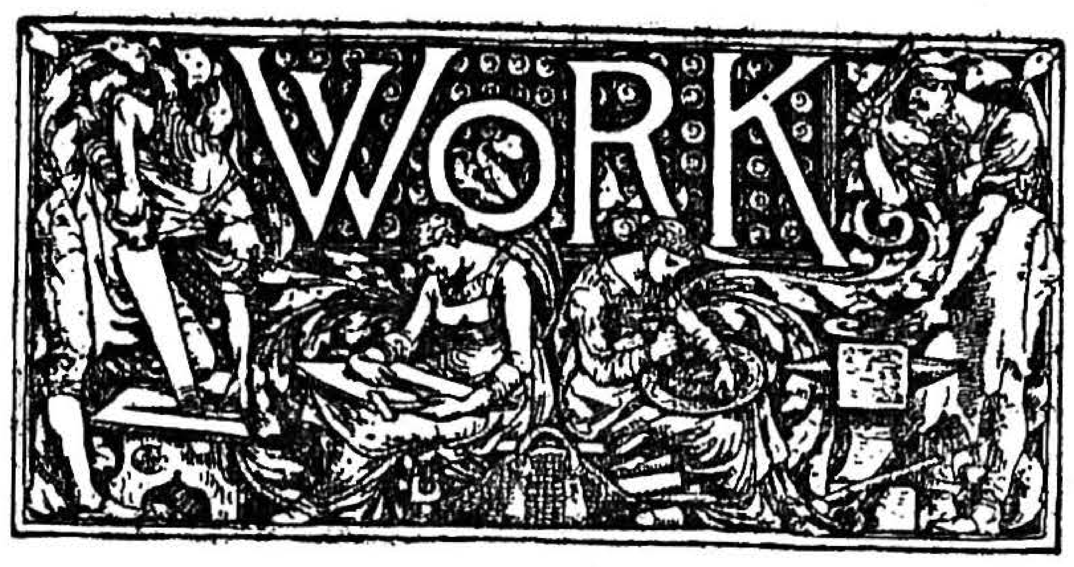
FLANNEL TRADE.—This holds its own very well.

CHEMICAL TRADE.—The price of bleaching powder has now fallen to its former value of £7 10s. per ton; owing to the cholera scare, large quantities of this commodity have been shipped to American and Continental ports. Caustic soda, 74 per cent. is sold at £11 5s.; 70 per cent., £10 5s.; 60 per cent., £9 2s. 6d., f.o.b. Recovered sulphur is steady and in fair request at £4 12s. 6d. Chlorate of potash, scarce, at $7\frac{1}{2}$d. per lb. Chlorate of soda, $8\frac{1}{2}$d. per lb. There is no improvement in the price of sulphate of copper, £14 15s. to £15 per ton being the figure. White arsenic is firm at £12 10s.

COTTON TRADE.—Our Rochdale and district correspondent writes:—The crisis has come to a head, and though the members of the Masters' Federation in this town have decided, without a single exception, to continue to run their mills and pay the fine ($\frac{1}{4}$d. a spindle, or £5,000 per week) for doing so, this is not the case in the surrounding district, and ere this is in print there will be from 50,000 to 60,000 operatives out on strike, the whole of whom will be drawing pay from the several societies. The proposal to decide the matter by arbitration, as proposed by the Mayors of Liverpool and Manchester, and agreed to by the Masters' Federation, was curtly rejected by the operatives, the letters sent being couched in most insulting language; so that if the working class suffer by the strike, it is their own, or rather their advisers', fault.

SHIPBUILDING TRADE.—Messrs. Laird & Co., of Birkenhead, have at the present time on the stocks three vessels for the Royal Navy, three vessels of war—two being powerful ironclads—for foreign Powers, and a despatch boat for the Indian Government. The Liverpool freight rates remain about the same, most business, at present, being between Black Sea and Baltic ports.

ARMOURPLATES AND WARSHIP MATERIAL TRADE.—In a speech of Lord Brassey at the "Banquet of the North," some passages occurred which will be interesting to armourplate manufacturers and others. He remarked: "Assuming the expenditure on naval construction will be maintained for the present, we may expect to find, in the forthcoming programme, ships of more moderate dimensions than those of the Hamilton programme, which included eight ships of no less than 14,159 tons. The larger vessels have their merits, but we have two ships building, of the *Barfleur* type, which combine the excellent qualities of speed, coal-carrying, armament, and armour within the limit of 10,500 tons. While adding to our strength in battle-ships, we must not neglect to supply an adequate number of cruisers, and the sea-going torpedo catchers and torpedo vessels."



is published at La Belle Sauvage, Ludgate Hill, London, at 9 o'clock every Wednesday morning, and should be obtainable everywhere throughout the United Kingdom on Friday at the latest.

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*** Advertisements should reach the Office fourteen days in advance of the date of issue.

*** All letters suggesting Articles, Designs, and MS. communications for insertion in this Journal will be welcomed, and should be addressed to the Editor of WORK, CASSELL and COMPANY, Limited, London, E.C.

NOTICE.
WORK correspondents are wanted in every Town.

EMIGRATION TO BRAZIL.—A contract has been signed between the Brazilian Government and a private company for the introduction of 1,000,000 emigrants from Europe and the colonial possessions of Spain and Portugal into Brazil. Under these circumstances, it is advisable to give a word of warning to such of our workers as might be tempted to try their fortune in South America. Under clause 10 of the contract, immigrants are to be taken to Pernambuco, Pahia, and Victoria, all three places being on the tropical part of the Brazilian coast. The climate in most, if not all, parts of the country is wholly unsuited to British emigrants, and the population, language, laws, habits, and modes of life and work are all alike strange to labourers from Great Britain and Ireland. However great may be the natural resources of Brazil, experience has abundantly proved that the country is wholly unsuited to the British workman; it is therefore sincerely to be hoped that our artisans will not be tempted by offers of free or assisted passages or grants of land to go out to that country.

WINTER DISTRESS.—There is little doubt that we are verging upon a winter when the pinch of poverty will be more than usually felt by those most concerned—so depressed already are many branches of trade upon which the working classes depend. Before the misery arising out of bad trade, depressed industries, and strikes is actually upon us, it behoves parish authorities and others responsible for the employment of labour generally to look ahead and prejudge, as far as possible, the probable danger looming in the near future in the cry of the unemployed, and to prepare for it. Distress arising from lowness of wages and no work is chiefly present in large towns and labour centres. Here local bodies might do much to ward off not a little of the immediate distress when it presents itself, provided they were forewarned and forearmed. As a rule, however, the reverse is the case. Vestries, local boards, and councils ought to face the question ere the troublous times set in. They would be doing some real good for those who, it is all but certain, will be requiring work this winter; and in addition be affording temporary satisfaction to peaceable citizens and shopkeepers, who are naturally concerned at the gloomy possibilities which threaten, and which every winter seem to intensify, from the great unemployed community. By planning out work ahead, the authorities might appreciably diminish much of the misery which is the portion of the lower classes during British winters, especially in towns. Streets, open spaces, roads, and the pavements could be sensibly improved and rendered safer by methodical cleaning during the winter, and this with little more cost to the ratepayers. Further, by arrangements with householders, much work such as window-cleaning, boots, messages, etc., might be found for poor people whose antecedents could be guaranteed by parish and police authorities. Much more might and ought to be done for the poor during our stern winters; much which so far has never been attempted is possible to ameliorate the distress of winter among the poor, and to stop the "We've-got-no-work-to-do" cry, only those in power must look forward and see where work will be needed. The call for energy and action in this winter distress question is sure to arise again this year, and those whose duty it is to cope with these social questions should now be preparing for the increasing rumblings from the comparatively dormant unemployed element, by providing against the lessening opportunities that the trade of this country provides for the hands and brains of its teeming working thousands.

COSTERS.—This question is one of great importance to the artisan population, inasmuch as it is from that population that the coster draws his customers. The reason is obvious—the coster's prices being always beneath the shopkeeper's; and where incomes are so slender that every penny has to be weighed before it is spent, this is a most important consideration. Of course, the shopkeeper will tell you that the coster has no rent to pay as he himself has, and that it is thus a very simple matter for the coster to undersell him. This is doubtful; still, as we are looking at this question from an entirely working-class point of view, we shall grant the shopkeeper's argument. "You have rent to pay," says the working-man's wife to the greengrocer; "and that is why you charge three ha'pence a pound for the same potatoes as Bill, the coster, serves me with at a penny. That extra ha'penny is for your rent? Now, why should I have to pay your rent? I have my own rent to pay, and that is as much as I and my husband can afford. If shopkeepers choose to take high-rented shops, why should we working-men and women have to pay it for them? We can't get a rise in our wages whenever we choose to move to a higher-rented house, or whenever our landlord raises our rent." That would be a very fair argument in the mouth of a working-man's wife, and one that the shopkeeper would have as much difficulty in answering as the authorities seem to have in clearing the costers from our streets. The fact is, the coster is as necessary as any other form of competition, and instead of driving him away, the authorities should seek rather to regulate him.

HOW TO MAKE AN EFFICIENT BATTERY FOR ELECTRICAL PURPOSES.

BY G. E. NEWLAND-SMITH.

INTRODUCTION—VARIOUS BATTERIES—DANIELL'S BATTERY—SMEE'S CELL—GROVE'S BATTERY—BUNSEN'S BATTERY—BICHROMATE BATTERY—LECLANCHÉ'S CELL—AMALGAMATING ZINCS—MATERIALS—SUPPORTING BEAMS AND PLATES—STAND AND JARS—LIFTING ARRANGEMENTS—CONNECTING-UP—OHM'S LAW—THE SOLUTION FOR CHARGING BATTERY—CONCLUSION.

JUDGING from the numerous queries in various scientific papers, it appears that a knowledge as to how to construct a battery suitable for the all-round purposes of the general experimenter in the science of electricity would be most welcome and useful to many. I therefore propose to describe how to make a four-cell chromic acid battery in a polished wood tray, and with a lifting arrangement for raising the plates when the battery is not in use.

The battery, when made, will be most useful for all kinds of electrical experiments—such as lighting small lamps, working coils, motors, electro-magnets, decomposing water, firing fuses, etc.; and anyone who carefully carries out my instructions will have the satisfaction of knowing that he possesses a really good and scientific piece of apparatus, and not a mere toy.

The battery will not cost more than 5s. or 6s. to make, although it would cost about a guinea to buy; also, it is one of those pieces of apparatus—unlike most—which is as good when home-made as it is when bought at a shop.

Before commencing the description of the battery itself, it would be as well to describe briefly some of the most general forms of battery now in use.

Daniell's Battery consists of a copper cylinder for the *negative* element, inside which is a cell of porous earthenware. A zinc rod inside the porous cell forms the *positive* element. Terminals are attached to the copper and zinc for convenience in connecting-up. No containing cell is necessary for this battery, the copper cylinder, being closed at one end, forming one. The outside cell is charged with a saturated solution of sulphate of copper, and the porous cell with dilute sulphuric acid. This cell is remarkably constant, and is used for electro-plating on a small scale.

Smee's Cell.—This cell consists of a plate of platinised silver for the *negative* element, and two plates of zinc for the *positive* element. These plates are suspended by a wood bar in an earthenware cell, which contains dilute sulphuric acid as the excitant. This battery is fairly constant, only requires one exciting fluid, and is easily managed. It is not, however, suitable for the general experimenter.

Grove's Battery has for its elements platinum for *negative* and zinc for *positive*. The outer cell is charged with sulphuric acid diluted with water, in which is the zinc. The porous cell containing the plate of platinum is filled with nitric acid 3 parts, and sulphuric acid 1 part. The zinc is usually in the form of a U, by which means the zinc plate is brought opposite each side of the platinum plate.

Bunsen's Battery.—The elements of this battery are zinc for the *positive* and carbon for the *negative* element. A porous cell is required, in which the exciting fluids and general arrangements are similar to that of Grove's.

Bichromate Battery.—Since this is the battery we are going to manufacture, nothing will be said of it here, except that it is the best battery for general use.

Leclanché's Cell is the one used for electric bells and telephones. It is admirably suited for such work, as it will give out a current at intervals—such as is used in making an electric bell ring or speaking through a telephone—for several years without attention; but it is not suited for general electrical experiments, on account of its high internal resistance, and consequently low current, besides its inability to give a *continuous* current. There are two cells employed for this battery. The outer one (of glass) contains a zinc rod, and is charged with a solution of sal-ammoniac; the inner (of porous earthenware) contains a carbon plate, and is filled up with a mixture of peroxide of manganese and broken gas carbon.

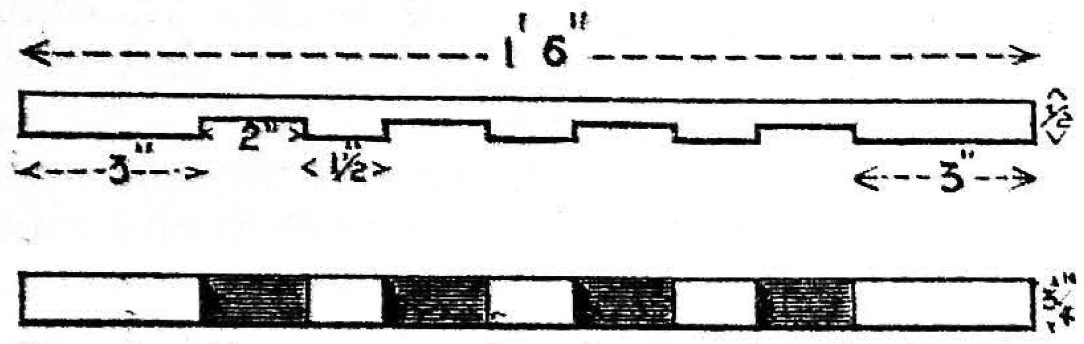


Fig. 1.—The Supporting Beams for the Plates.

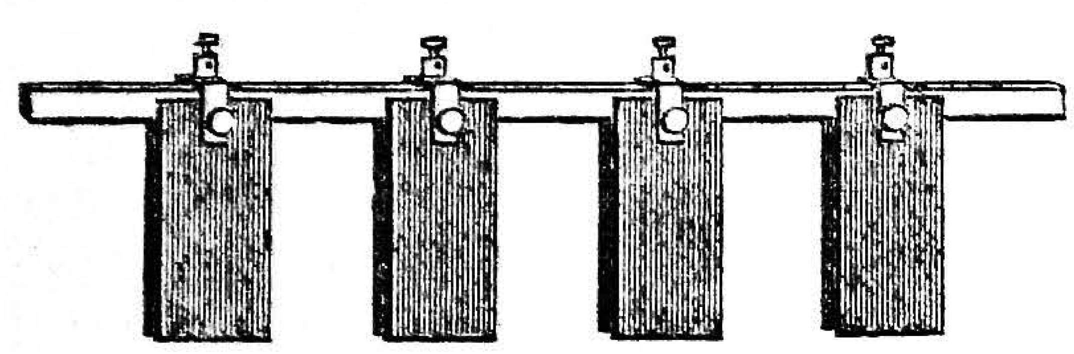


Fig. 2.—Supporting Beams with Plates fitted and clamped.

The zinc plates of the bichromate (or chromic acid), Smee's, and Bunsen's battery, etc., should be *amalgamated* with mercury previous to use, and will require re-amalgamating from time to time. The process is effected as follows: Place the plates (previously well cleaned) in a shallow dish, containing sulphuric acid 1 part, water 20 parts; pour upon the zincs a globule or two of mercury, and rub it over them with an old tooth-brush until they present a silvered appearance. They are then ready for use.

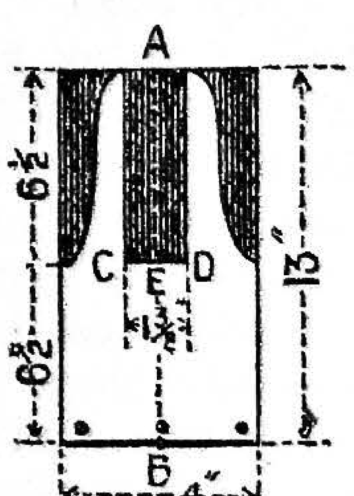


Fig. 3

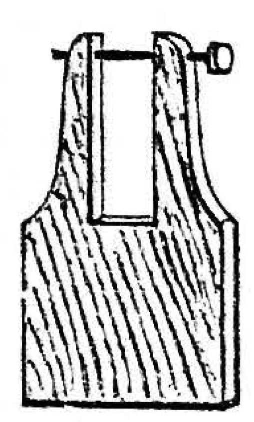
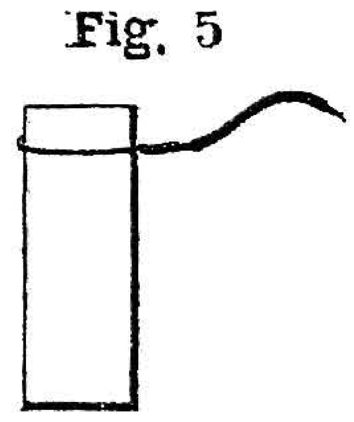


Fig. 4

Fig. 5



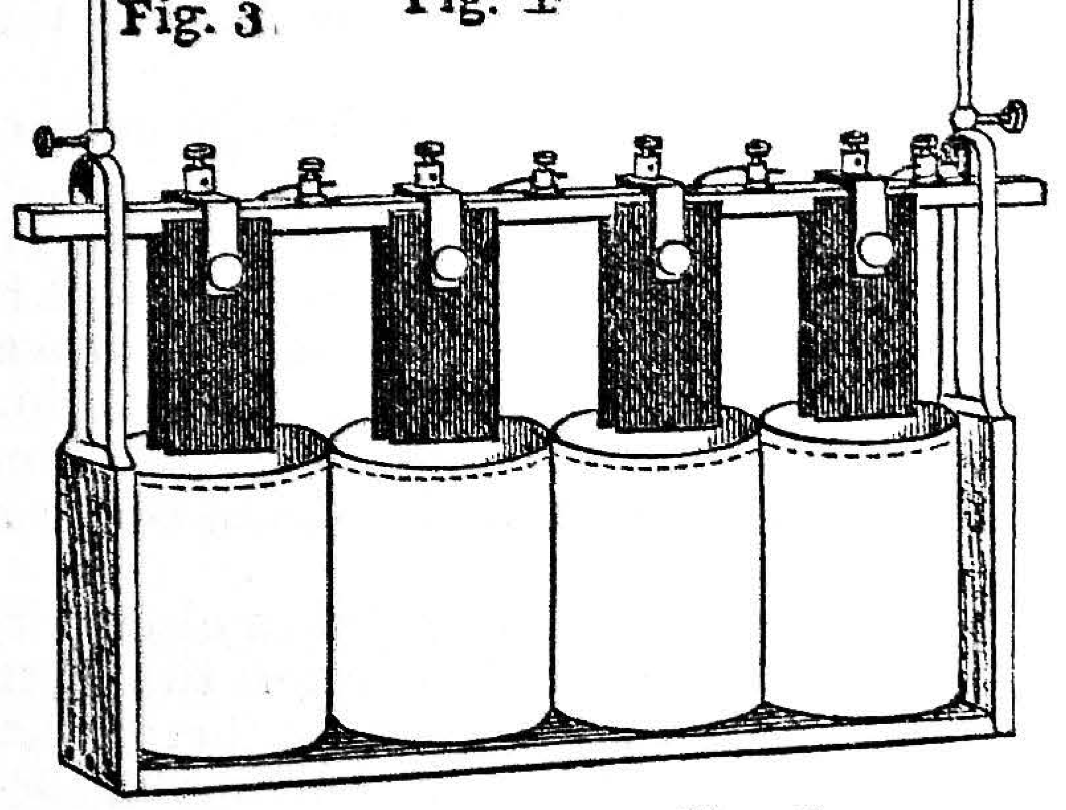


Fig. 6.

Fig. 3.—Plan of End Standard before cutting. Fig. 4.—Simple Method of suspending the Plates when out of the Solution. Fig. 5.—Zinc Plate with Wire attached ready for connecting-up. Fig. 6.—The Battery Complete.

The above are the most general forms of galvanic battery. There are also many other cells that have been invented and used, but in most cases have not been a success for useful work—except, perhaps, the E.S. dry cell, which is very good indeed for small plating, coil, and bell working.

Cells which are charged with one solution, and have no porous pot, are termed *single-fluid cells*, and cells with two solutions (and porous cells generally) are termed *double-fluid cells*. The double-fluid cells are more constant than the single-fluid, but are not so powerful.

Having given these preliminary details, I will commence on the battery which we are to manufacture.

Materials.—*8 carbon plates, 6 in. by 2 in. by $\frac{1}{4}$ in. thick; *4 zinc plates, 6 in. by 2 in. by $\frac{1}{8}$ in. thick; some $\frac{1}{2}$ in. planed deal board; *4 brass clamps; *3 small binding-screws; *1 large binding-screw; copper wire; $\frac{1}{8}$ in. brass rod, and steel wood screws.

All the above marked thus (*) are to be obtained at an electrical shop. Carbons can be got as cheap as 2s. a dozen, although many shops would ask 6d. each; zincs can be got for 2d. or 3d. each; clamps, 6d.; small binding-screws, 2d. each; large one, 6d.

While on the subject of prices, I will give the amateur electrician a hint—never deal with one shop only, unless you have unlimited cash. The reason is, that one shop can supply carbons twice as cheap as another, while the other's price for wire is as cheap again as the first's. Now to proceed.

Take two strips of wood, 18 in. long, $\frac{3}{4}$ in. wide, and $\frac{1}{2}$ in. thick, nicely planed and sand-papered. In each strip, on the $\frac{3}{4}$ in. side, cut four 2 in. slots. These slots are to be $\frac{1}{4}$ in. deep and $1\frac{1}{2}$ in. from each other, leaving 3 in. of wood at each end (see Fig. 1). The slots are for the carbon plates to fit into. Now place the supports, as the strips will now be called, back to back, with the slots outwards, and fit a carbon plate into each slot on both sides, a pair of carbons being opposite one another. Between each pair of carbons, and clipped in place by the two flat sides of the strips, is to be placed a zinc plate. There are now four sets of two carbons and one zinc, arranged sandwich-fashion, with the zinc in the middle. On the top of each set screw a brass clamp, to keep the whole together (Fig. 2).

The wood strips serve to keep the plates from contact; which has to be done, or else the battery would *short circuit*, and not work. The clamps, which are made with terminals or binding-screws on their upper surfaces, form a connection with the carbon plates. They should therefore be screwed up tight, taking care that the plates do not touch. They should be about $\frac{1}{8}$ in. to $\frac{1}{4}$ in. apart at the ends, and, of course, about $\frac{1}{4}$ in. at the top.

We will now put the supporting beams and plates aside, and turn our attention to the stand. To this end, we take a piece of deal 3 ft. 6 in. long by 4 in. wide, nicely planed and sand-papered, and from it cut two pieces 13 in. long. This leaves us a piece 16 in. long for the base of the stand, the two 13 in. pieces being for the standards at each end. Take one of these latter pieces, and rule a line lengthways down the middle (Fig. 3). From one end mark off along this line (A B) $6\frac{1}{2}$ in., as shown in the figure, and at right angles to the line draw a line $1\frac{3}{8}$ in. long (C D), equidistant from each side of point E ($6\frac{1}{2}$ in. from A).

Rule lines from each end of C D to top of standard. To make it look ornamental, draw curves as shown, and then cut away all the shaded parts of Fig. 3, leaving a flat standard with a $1\frac{3}{8}$ in. slot cut $6\frac{1}{2}$ in. down the middle of the top half, which is cut into an ornamental shape, as shown. Do the same with the other 13 in. strip, and make them exactly alike.

Now take the 16 in. piece, and screw these two standards to each end (upright), using three 2 in. steel screws at each end, as shown at Fig. 3, the standards being perfectly perpendicular to the base. This part of the stand is now finished, and may be stained and polished as desired, a walnut stain being very suitable.

Procure now four stoneware cells or jars, 6 in. high by 3 in. or 3½ in. in diameter. Put these next one another on the base of the stand. Now place the supports and plates—which latter go into the jars—into their places, the end of the beams resting in the slots of the standards, up and down which they are to slide. When the battery is working, the plates, of course, dip into the jars, which are full of solution; but when it is not being used, the plates are lifted out by means of the supporting beams, and allowed to drain into the jars.

Some arrangement must therefore be made for suspending, raising, and lowering the plates. I shall describe two methods of effecting this; one a simple, easily constructed way, and the other a trifle more complicated. The simplest way is effected as follows:—Drill a hole through the standards, ½ in. from the top, as Fig. 4. Drill a corresponding hole through the supports where they slide up and down, opposite these holes. A stout pin is now made of a piece of ⅛ in. steel knitting-needle about 3 in. long. A blob of solder or lead is cast on one end, to serve as a head. Make two such pins—one for each end—and put them through the holes in the standards and supports, which will suspend the plates when out of solution.

The second, and more finished, method is to take two pieces of ⅛ in. brass rod 8 in. long, and make an eye at one end of each like a skewer, and put a screw-thread on it all the way down. Make also a pair of small brass nuts to fit the rod, suitably tapped. It will be convenient to have a projection of brass rod in the side of the nuts, for convenience in turning them in screwing up. Now screw two pieces of brass, ½ in. wide, over and across the top of the standard at each end, with a hole drilled through the centre of it. Through this hole passes the brass rod, the eye being underneath, and hooking on to a small hook on the top of the supports immediately underneath it. On the top end of the rod is screwed the nut, with its projection. The same arrangement is fitted to both standards. Then, by turning the nuts above the brass strips attached to the standards, the supports and plate are screwed up to any required height. This method has, as will be seen, many advantages over the first method described.

The battery is now finished all except the connections, which may be proceeded with as follows:—

Take out all the zinc plates, and file a nick on each edge ½ in. from one end. Now take a piece of copper wire—preferably tinned—and remove the covering (if insulated) from one end for about 5 in., and put it round the zinc which is being operated upon, and twist it up tightly in the nicks, leaving about 2½ in. of covered wire for connecting-up. Be sure and twist the wire up tight, so as to ensure good contact (Fig. 5).

When all the zincs have been thus wired, they can be put back in their places, the wires coming up between the supports. Now put a small binding-screw on the front support, equidistant between each set of the plates, and between the last set and the right-hand standard put in a large size binding-screw. To this connect the wire coming from the zinc of the last cell, thus forming the zinc terminal of the four-cell battery. To each small screw connect the wire from the zinc of the cell before it, each one forming the zinc terminal of that cell, the screw-clamp being the carbon terminal of each set. Each cell has now its own connecting-screws from the carbon and zinc (positive and negative) elements.

The method of connecting the cells together entirely depends on what use the battery is to be put to. You can connect the cells *in series* or *in parallel*. To connect *in series* means connecting the zinc of one cell to the carbon of the next, and so on throughout the entire series. Batteries for electric lighting are thus connected. When the cells are connected in series, the E.M.F. (or electro-motive force) is equal to that of the four cells multiplied together; but the current is only equal to that produced by one cell.

To connect *in parallel* is to connect all the carbons to one wire, forming one carbon pole of battery, and all the zincs to another wire, forming one zinc pole. When the cells are connected in parallel, the E.M.F. is equal to that of one cell, but the current is equal to that of four cells.

This is easily explained on considering Ohm's law, which is: $C = \frac{E}{R}$, where C = current in *ampères*; E = electro-motive force in *volts*; and R = resistance opposed to the current in the circuit in *ohms*.

When the carbons are all connected together, and the zincs also, as in parallel, the resistance is only equal to one-fourth that of one cell, for this reason:—When the cells are thus connected, the four cells become, as it were, the *same as one large cell*, with plates four times as large as our one cell. Well, just in the same way that people in a crowd find it easier to get along if the road is wide, so does the electricity find it easier to get along a large-surfaced plate than a small one; and in pushing along the small plate, which offers resistance and makes heat, some of the current is lost in this way.

From this it will be seen that the manner of connecting-up your cells entirely depends upon what work they are required to do. If the battery is required to have a high E.M.F. and low current, connect in series. When, on the contrary, a high current and low E.M.F. is required (such as for working coils, electro-magnets, and motors), connect-up in parallel.

All those who are interested in electricity should study Ohm's law from the text-books, and thus they will see how to connect-up for any desired effect. Having finished this digression, I will return to the battery.

The battery is now finished, and the possessor may rely upon it to do any work that a four-cell battery of this description can be expected to do. If the battery is wanted occasionally to be easily carried about, handles of brass or nickel can be put on the side of each standard, and a strip of wood put across each side of the jars, and let in at each end to the side edge of the standards, about halfway up, to keep cells in place.

To charge the battery, make up a solution in the following proportions: Chromic acid, 3 oz.; water, 1 pint; sulphuric acid, 3 fluid oz. Dissolve the chromic acid in warm water, and slowly add the sulphuric acid, *gradually in a fine stream*. Let the solution cool, and it is ready for use. The amount required for the four cells will be about five to six pints. Fill the cells about three-quarters full. The solution will run about three hours, either at intervals or continuously. When you wish to work any piece of apparatus, connect up to the battery with insulated wire, lower the plates into the solution, and there you are!

I will finish by giving, in Fig. 6, a sketch of the complete battery, so that you will see what to make it like. When you have made it, you will have a really good and useful battery.

TAKING CASTS.

To take casts from carvings, wet some stout blotting-paper and a sheet of thin paper, say bank-post. Then damp the bank-post, and paste one or two sheets of the wet blotting-paper upon it, and then lay the paper, which must be damp enough to be soft. Now place the paper (the bank-post side) upon the carving you want a cast from, and hammer the paper into the carved surface with a hard brush (about as hard as a hard shoe-brush), driving the paper into all the interstices of the carving; and when this is done, paste a piece of brown paper on, and hammer again, and then remove the paper, and soak the face with oil, melted paraffin, or grease, when the mould is ready for casting. Then get some plaster-of-Paris, and mix it with some water to the consistency of thick paste, and place it on the mould, taking care that it goes carefully into the depression in the mould; and when it is dry, you will have a *fac-simile* of the carving.

GREENHOUSE HEATING.

In order to determine whether steam or hot water were the best for heating greenhouses, a series of experiments have been made at the Agricultural Experiment Station in connection with the Cornell University (New York City, U.S.A.), in which the following conclusions were arrived at: 1. The temperature of steam pipes average higher than those of hot-water pipes throughout the entire circuit for the entire period of test. 2. The higher the inside temperature in steam pipes the less is the proportionate warming power of the pipes at a given point. The heat is distributed over a greater length of pipe, and, as steam is ordinarily carried at a higher temperature than hot water, it has a distinct advantage for heating long runs. 3. When no pressure is indicated by the steam-gauge, the difference between the temperatures of the riser and the return is greater with steam than with hot water. 4. Under pressure the difference is less with steam than with hot water. 5. There is less loss of heat in the steam risers than in the hot-water risers, and this means that more heat in the steam system is carried to the farther end of the house and more is spent in the returns as bottom heat. 6. This relation is more uniform in the steam risers than in the hot-water risers, giving much more even results with steam than with hot water. 7. When the fires are operative the fluctuation in the temperature of the risers at any given point is much greater with hot water than with steam. 8. An increase in steam pressure raises the temperature in the entire circuit, but the temperature does not rise uniformly with the pressure. 9. The first application of the pressure increases the temperature of the returns much more than that of the risers. 10. Steam is better than hot water for long and crooked circuits. 11. Pressure is of greater utility in increasing the rapidity of circulation of steam and in forcing it through long circuits and over obstacles. 12. Unfavourable conditions can be more readily overcome with steam than with hot water. 13. Hot water consumed more coal than steam, and was at the same time less efficient. This result would probably be modified in a shorter and straighter circuit with greater fall. 14. Under the conditions here present steam is more economical than hot water and more satisfactory in every way, and this result is not modified to any extent by the style of heater used.—*The Surveyor.*

"USEFUL HOUSEHOLD ARTICLE" COMPETITION.

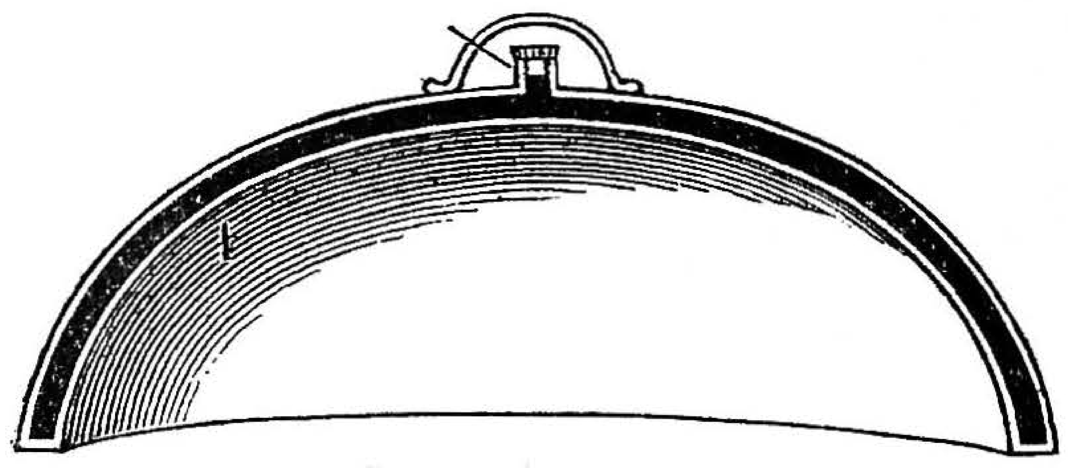
PRIZE SUGGESTIONS.

HOT-WATER DISH COVER.

By "Forkless" (Mervyn W. R. Bunbury, 15, *St. Mary's Terrace, Paddington, W.*).

A much needed invention is a hot-water dish cover.

The advantage of this cover is that it keeps the vapour of the food from condensing on the cover and bringing down on to the food any dirt there might be on the inside of the cover. It



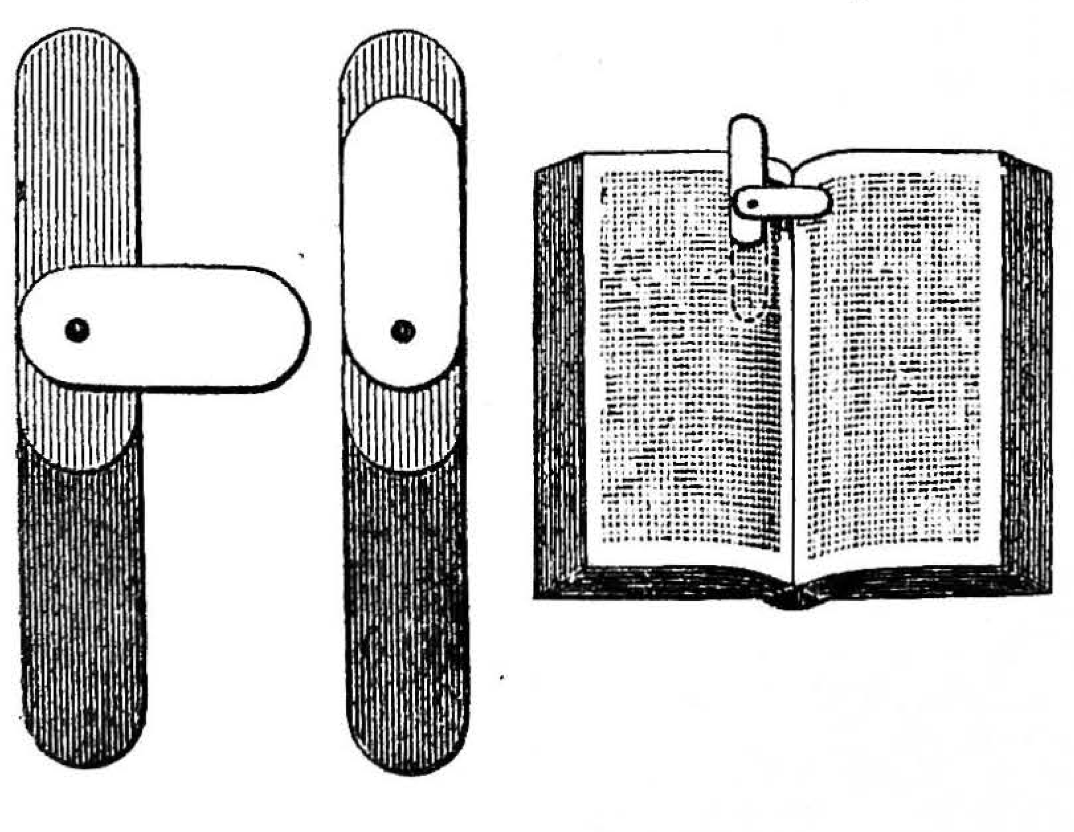
Hot-water Dish Cover.

also keeps the food from drying up. This suggestion is specially applicable for working men's homes, where ovens and such like facilities do not exist. Often a dinner has to be cut off and kept warm until some late comer has arrived, and in instances such as these the hot-water dish cover would prove of real service.

IMPROVED BOOKMARKER.

By "Bookmarker" (Sydney C. Smith, *Balliol House, Toynbee Hall, Commercial Street, E.*).

This bookmarker is designed to hold a book open whilst reading, so as to leave both hands free, also to avoid the spoiling of new books by breaking the binding in order to make them



Improved Bookmarker.

keep open. The back piece is sharpened for use as a paper knife. This article would be specially useful for reading at meals, or when smoking. The projecting arm might be made to close up over the other portion so as to make the bookmarker less bulky when the book is closed.

CLOTHES-HORSE.

By "Dhobia" (Harry T. Baker, 14, *Southgate Road, Kingsland, N.*).

I have examined every household article in my possession—perhaps I ought to say in my wife's possession—with a view to find some means of improvement; and after thinking upon everything, from the chimney-cowl to the doormat, and from the sugar-tongs to the coal-scuttle, I have decided upon the clothes-horse as an article requiring improvement as much as, if not more than, any other household article or domestic appliance. The ordinary clothes-horse, standing about 5 ft. high, and having three folds, has not more than 20 ft. of hanging accommodation. Now, I thought if the hanging accommodation could be doubled without increasing the size of the horse, it would be a decided improvement. I have worked upon that idea, and the result is a clothes-horse that will fold into a smaller compass than the ordinary clothes-horse, and yet when in use will give a hanging accommodation of 136 ft. If that is not enough, still more may be gained at the rate of 48 ft. for every foot added to its height; but I think 136 ft. enough for any ordinary household.

Fig. 1 shows the article when not in use. The first thing to be made is the frame. Get two pieces of ½ in. iron gas barrel, each about 3 ft. 9 in. in length, having a thread at each end extending about 2 in. up, with two back nuts on each end. These are the uprights. The top, bottom, and middle rails come next. These may be made of deal or any other wood, about 1 in. by 1½ in., and 2 ft. 4 in. in length. With a centre-bit bore a hole through at each end just large enough to admit the ½ in. iron barrel, taking care to have a clear 2 ft. 1 in. between the holes. Having taken one back nut off each upright, slip the bottom rail on the uprights, put the other back nuts on, and screw up tight. The dark lines at A, B, C (Fig. 1) show top, bottom, and middle rails. Two legs will be required. If iron barrel has been used for the uprights, you cannot do better than use iron barrel for the legs. For each leg procure one ¾ in. T-piece with ½ in. outlet, two 5 in. lengths of ¾ in. iron barrel, and two ¾ in. bends. Screw one of the 5 in. lengths into each end of the T-piece, and one bend on each end, and you have a strong leg (D, Fig. 1). Having made the two legs, screw them on the uprights below the bottom rail, their direction forming a right angle with the bottom rail. This is the position they will be in when the horse is in use. When the horse is not in use a quarter turn will bring them into the same direction as the bottom rail, as shown in Fig. 1, when the horse may be hung on the wall or stood close against the wall, taking up but little room. Measuring from the top of the bottom rail to the top of the upright, we have about 43 in. Allowing 2½ in. for the thickness of the middle and top rails and back nuts, we have 40½ in.—we will call it 40 in.—for swing rails.

Cut thirty-four rails of the same size as the bottom rail, and bore holes at each end the same as the bottom rail. Then cut them in two, as shown by dotted lines in Figs. 2 or 3, and we shall have sixty-eight 2 ft. swing rails. Having taken both back nuts off the top of each upright, place seventeen rails in such a manner as to allow each pair to fold in close, as shown in Figs. 2 and 3. Then place 6 in. of wooden washers on each upright; then the middle rail. Then place another seventeen swing rails on each upright, as before. Put one back nut on each upright, then the top rail, then the other back nut, and screw up tight, and you have the clothes-horse complete. By placing the 6 in. of wooden washers between the top half and the bottom half of the swing rails, we shall have 2 ft. space between each of the top swing rails and the corresponding swing rail of the bottom half. The top of the bottom fast rail and the bottom of the top fast rail should be countersunk, to let the back nuts in.

When the horse is in use, with all rails open, there being sixty-eight 2 ft. rails, it will give hanging accommodation equal to 136 ft. of clothes-line. When closed, with the legs turned in the same direction as the bottom rail, it will hang on a nail, with no part of it extending 2 in. from the wall.

When required for use, give the legs a quarter turn and stand it on the floor. It would be best to begin loading at the bottom of the top half. Swing the bottom pair of rails out to the front, hang the clothes on, and swing them round until their two ends meet behind. Pull out the next pair above, load them, and swing them back to within a few inches of the first pair. Continue in that manner until the top half are loaded; the ends of the top pair should meet in front, the points of the rails of each upright forming a spiral, the two spirals meeting in front at the top, and behind at the bottom. Having loaded the upper half of the swing rails, begin with the bottom pair of all; load and swing them back until they meet behind, and continue as before; and when the whole are loaded, the top pair of rails of the top half will be 2 ft. above the top pair of the bottom half, and so on. By those means you will have 136 ft. of hanging accommodation, with a free passage of air between each article, and the whole will be within a compass of 6 ft. wide, 4 ft. deep, and less than 5 ft. high.

On the same principle, it might be made with one upright standing on four spider legs; the upright to be of any height, and the arms, when in use, forming one continual spiral from top to bottom.

A very handy article may be made on the same principle to be fastened to the wall. Fig. 4 shows the article with half the rails in use, and the other half against the wall. Three or four pegs might be fastened to any one of those rails, which, when the article is not used as a clothes-hanger, would do for hat pegs, and when wanted for hanging clothes upon, such articles as stockings or socks could be hung upon those pegs.

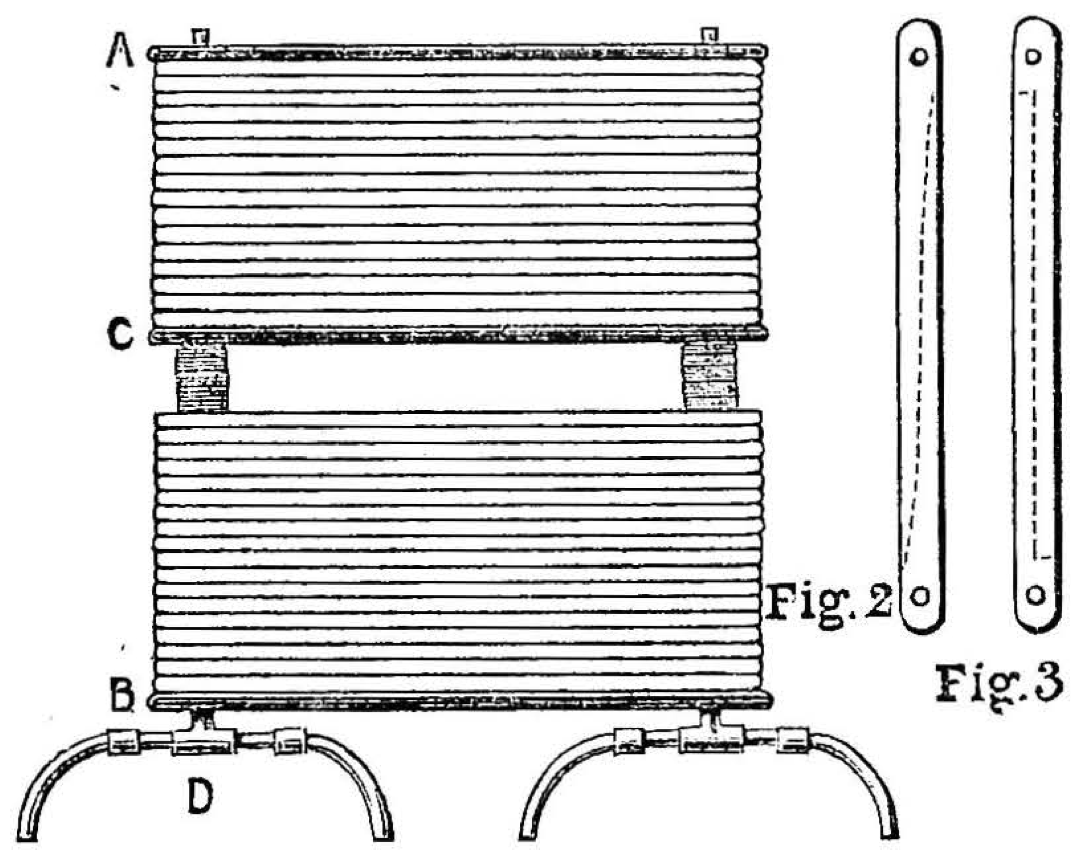


Fig. 1

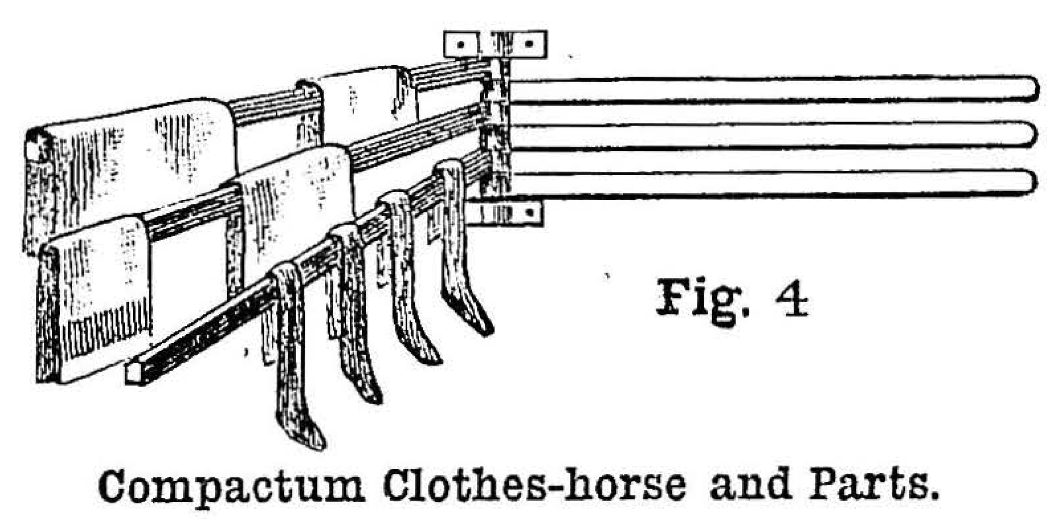


Fig. 4

Compactum Clothes-horse and Parts.

Many different forms of clothes-horse might be made on this principle, and any amateur could make them. All the tools required are a saw, a brace and centre-bit, a plane, and a wrench or spanner for tightening the back nuts.

This will certainly be considered a useful article by the ladies; and if ladies have aught to do with judging, a clothes-horse will get a place for once.

[*₊* £1 will be sent for each of the above prize suggestions; also, as opportunity offers, selections from the large number of designs which were sent in for this competition will be published in Work.]

Harrington bronze is composed of 55·73 per cent. copper, 42·67 zinc, 0·97 tin, and 0·68 lead, and has, after rolling, a tensile strength of 75,000 lbs. per square inch, and an elongation of 20 per cent. on a 2 in. section.

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.*

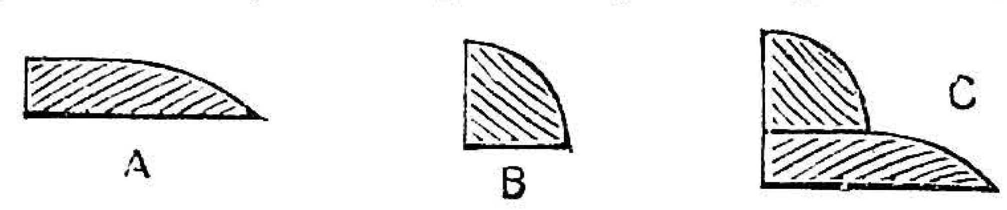
I.—Letters from Correspondents.

Sewage in Large Towns.—Chopstick writes:—"In regard to the necessity of providing a method of dealing with the sewage of large towns otherwise than by turning it into the rivers or canals, it may be of interest to some to know how it is dealt with in Rochdale; the method is, I believe, unique, as well as the manner of collecting. In the first place, every owner of property has to provide two tubs for each closet. These are about the size of a paraffin cask cut in two, but, for the sake of uniformity, they are supplied by the Corporation at the cost of 10s. 6d. each. One of these tubs is in use at the closet while the other is at the sanitary works, they being collected at certain periods by men in the employ of the sanitary department, who take away the full tubs in a long enclosed van, which is fitted with doors along the sides for convenience in loading. These men are also provided with lids for the tubs to keep in the smell, and, of course, on taking away the full tub, an empty one is left in its place. On arrival at the sanitary works, the tubs are emptied into a drying chamber, which revolves in contact with a heated chamber, and during the process the contents are turned over and over until the whole is formed into a dry powder, resembling guano, which is readily bought by farmers as manure. All the fumes are ejected into the air through a very high chimney, and anyone passing the works would scarcely know what process was carried on there, unless told. I believe the above method of dealing with sewage, etc., to be a very good one, but the manner of collecting I do not care for, as I think it could be managed better by means of water-closets, the water being drained off by means of gratings on arrival at the works. This would save the enormous expense of the men, horses, and vans, and would also render the system applicable to many towns without much expense; while it cannot be denied that it is decidedly unpleasant to meet one of the loaded vans in the streets. I shall be pleased to hear the opinions of some of our sanitary readers on the subject."

Soldiers' and Sailors' Handicraft Education.—Cam writes:—"I am much interested in the question you have started about teaching soldiers some trade which may be of use to them when their colour service expires. In most regiments workshops already exist, but only three or four men are employed in them."

Employment for Women.—N. M. (*Sheffield*) writes:—"It is bitterly complained from time to time that the labour market for women is sadly overstocked, and that competition daily becomes keener. This is so in some departments of labour; but one has only to take up a daily newspaper and scan the column of mistresses wanting servants, to see that at least one avenue is still left open for women. But domestic employment is not popular, as not being sufficiently 'genteel;' and it is in the ranks of those competitors for genteel employment that the greatest suffering is experienced. In America, where woman is nothing if not progressive, some persons have managed to strike out for themselves most original occupations. What is to prevent a woman from being an engraver, a chaser, an engine-turner, or an etcher?—all light trades, but requiring an artistic temperament and an artistic training—*i.e.*, an apprenticeship; for none can hope to acquire proficiency in these arts without giving time or money. Very good wages may be earned at these trades—except, perhaps, engine-turning, which is rather under a cloud; but employment is still to be had by competent female hands in the Coventry watch-making districts. As regards ornamental engraving, there are many light articles which might fairly be left to the delicate hands of women to enrich. The jewellery trade, in particular, offers a large field for the further employment of females; but they must be content to work in manufactories, and submit to a rather strict discipline in the matter of punctuality of attendance at work. And with chasing—which, by the way, is more nearly connected with the silver and electro-plated trades (tea and coffee services, etc.)—there is already a school for females established in Sheffield, where, for a moderate fee, a young person may be thoroughly trained, and where, if sufficient talent were shown, she would have no difficulty in obtaining work, which she would be able to execute at her own home. As a matter of fact, all these trades depend in a great measure on fashion, which is the one great drawback; but still, when trade is good plenty of work may be found. A preliminary essential to ornamental engraving and chasing is found in a preparatory education at a school of art, where she would learn to use her pencil deftly and quickly. This latter fact alone would be a sufficient inducement to a master to give the girl the preference over her less gifted sister applicants for a situation, as he could immediately employ her; and although she might feel rather awkward when called upon to trace a design upon a teapot, would very soon feel as much at home as though engaged in sketching with a pencil on a smooth sheet of paper pinned down to a drawing-board; and probably her employers, under the circumstances, would waive the apprenticeship, and give her a few shillings per week, together with instructions in his art. I have endeavoured to show that there are still occupations left for women. Let Englishwomen take a lesson from their sisters in America, and try to get rid of that bugbear, 'genteel employment,' all honest work being honourable; and if at first the labour should prove irksome, rest assured that, after the first plunge, all will become easier, and things will work more smoothly day by day. I have great sympathy with a delicately nurtured lady who, from any cause, finds herself compelled to seek a livelihood in a sphere quite outside that in which she has been reared, but venture to advise that a common-sense view of the situation in which she finds herself be at once taken, feeling sure that such a course will be productive of beneficial results."

Draught Excluder.—J. W. B. (*Huddersfield*) writes:—"This is the simplest way of making an excluder for both wind and rain at the bottom of doors, viz.: Take a piece of wood about 4 in. wide by 1 in. thick, and shaped as A, it being the length



Draught Excluder Pieces.

of outside, and fasten it on stepping flag; and then get another about 2 in. square and length of door, and formed as at B. Fasten this on door so that it will just fit on the other, as at C. It will be found to answer admirably. This has been tested, and I am using it myself."

II.—Questions Answered by Editor and Staff.

Lens Grinding.—S. B. (*Upton Park*) asks for "information as to the way lenses are ground ready for use," and "are there any books pertaining to the same?" Full information as to the method adopted, to be of much service, would require more space than "Shop" could supply. S. B. has not said whether the lens is for telescope or what. Two templets—one concave, the other convex—must be made, of a radius equal to the focal length of the lens. If of small size, they may be made of brass; if large, they are generally made of plate glass. The edges are ground together with emery, so as to be perfectly spherical. Two tools are now made of cast iron, concave and convex. These must be turned until they are as true as possible with the templets. When this is done, they must be ground together until they are both perfectly spherical. The disc of glass is now cemented to a bed; emery moistened with water is placed on the glass, and the tool is worked on it with a circular and swinging stroke. At the same time the worker gradually moves around the disc, and also keeps turning the tool around. From time to time the tool must be tried and ground with its own fellow to maintain a perfectly spherical curve. When every part is ground, and the disc presents a perfect form as tried by the templet, all the scratches are removed by finer emery, these by finer still, until, with a lens, no scratches can be seen, but there is simply a uniform granulated surface presented. A disc of wood must now be made of nearly the same curve, and covered with pitch or other adhesive substance. Whilst in a sticky and plastic condition, a piece of cloth is placed on it, and is worked with the iron tool until it becomes its exact counterpart. When hard, putty powder must be used wet, which will produce the necessary polish. This, in brief, is the method employed for grinding. When completed, it is centred—that is, it is ground on its edge into a circular form. When done, the lens may be said to be completed. With reference to the second question, I am not aware that any book has been published on the subject; there is, however, considerable information on lens grinding obtainable from articles that have appeared from time to time in magazines devoted to art and science. If S. B. has the opportunity, and will look up the *English Mechanic* for the last twenty years, he will find a great deal of valuable information on the subject. From the nature of the questions, my answers are, of necessity, vague; but if S. B. can state just exactly his needs, I have no doubt he will get the information required.—O. B.

Engineer.—T. B. (*Stourbridge*).—Inquiries have been made for the address of the inventor from engineers in Glasgow and elsewhere, but, so far, without success. When the address is found, it will be given in this column.—M.

Hand-power Saw Bench.—An Old Hand.—If you will read my article again, you will see that there is quite sufficient room for feeding purposes without coming into collision with the fly-wheel, and the cog-wheels are quite out of the way. In the case of tenon cutting it is usual, on benches of this kind, to use as small a saw as possible, and run the timber over the saw end up. This could easily be done from end of bench, if the latter is made 6 ft. long, as I recommended; but if made longer—say, 8 ft., as drawn—then it can be done from the side. I am perfectly aware that tenon cutting is done with a large saw on a steam-driven machine, but, of course, that would be impossible on a hand machine. If the fly-wheels were placed all on one side of bench, it would necessitate longer spindles, and the whole affair would also have a tendency to topple over, besides wearing the bearings unequally and causing friction, more or less: all of which would add to the labour of turning. As to the belt having to be very tight, it is not so in practice, the wood wheels causing it to bite more than iron ones. I do not mean to say that it would not be better with longer bearings, but we cannot have everything our own way on a small bench the same as we could on a large one. As to your so-called *complicated* arrangements for driving saw causing an undue amount of friction, and thus adding to the labour of turning the wheel, you will find that this is much more than overcome by the additional power given out by fly-wheel; and you must know that a small saw requires to be driven fast to cut easily; and did you ever see a *hand* bench, that was driven in the ordinary way, in which the saw would not be better if it was given more speed? I am sure I did not. We now come to your last question, as to why mill owners do not, or have not, adopted the same plan. My answer is: In benches where the saw is driven by steam, the fly-wheel is on the engine, so that none is required on the bench; and I know of one maker of hand benches who has adopted a very similar plan for increasing speed of saw. I hope I have answered your questions in a satisfactory manner, and I would ask you to bear in mind that, for those who can afford steam, I do not recommend hand labour; but those who cannot have one should surely make use of the other to the best advantage possible. I am thinking that you and I have had a few arguments before in the "Shop" columns, though, if so, you have adopted another *nom de plume*. Is this so? and if so, why?—Chopstick.

How to Bind Books.—J. B. (*Dalton-in-Furness*).—I do not know anything about the paper you mention. I get Work every week, but sometimes I have not an opportunity to read it through, and the paper must have escaped my notice. However, I do not think "gum tragacanth" would make a good paste. You will find flour paste suitable for all purposes for which paste is used, and it is very easily made. You can buy it at a shoemaker's furnishing shop. The colouring for edges may be any dry colour, to be obtained of either chemists or painters. For red edges, dry vermilion is the best. Grind it on a stone slab in water, and mix with a little white of egg to make it stick to the edge. Use a sponge, and apply very carefully, taking care that the colour does not run or form pools at the ends of the book.—G. C.—[The paint mentioned is an American speciality.—Ed.]

Work Index.—Axle can find out the number in which any article in Work appears as follows: Divide the number of page given in index by 16 (being the number of pages in each weekly number) and add 1 for the fraction; to this add 52 for each completed volume, and the total is the number required. Example: Find the number of Work in which the article on Construction of Kitchen Dresser appeared. Turn up the index for Vol. III., and we see Kitchen Dresser, p. 529. Now, $529 \div 16 = 33\frac{1}{16}$; add 1 for the fraction, and we have 34 as the result. As two volumes have been completed, we must add $52 \times 2 = 104$, and add 34 to this, and the total is 138, which is the number in which the article appears.—Ed.

Concertina.—H. H. (*No Address*).—The best steel for the reeds of concertinas is "spring steel." An old watch or clock spring answers the purpose admirably. The proper pitch of the reed can be obtained by *filing* it—at the *point* or free end of the reed to sharpen, and at the *heel* or fixed end to flatten. The steel may require tempering a little, and this may be done by heating in a gas-jet.—G.

Piano.—E. H. J. (*Bristol*).—I could have answered your query better if you had given a few particulars of your old piano, as to name of maker, etc., and a rough sketch of the action it already contains. If you intend to re-string it, do not alter the sizes of the wire. Put on the sizes, the numbers of which you will probably see marked on the wrest-plank, and when you have taken the strings off, see that the soundboard is secure in all the gluings. Also, I would advise you to place an extra bar at the back of the soundboard, and secure it with screws through the front of the soundboard, and glue a small block at the top and bottom of back for ends of bar to rest on. Then wash the soundboard carefully with soap and water, and when dry, varnish with white hard varnish; this will restore the tone. Your action probably only needs repairing. Send to Hallpike, 213A, Mare Street, Hackney, London, E. It makes no difference to your action, the compass of your keyboard.—T. E.

Staircasing.—Window Making.—J. O. (*Aston*).—Articles on Staircasing appeared in Work, Nos. 160, 164, 170, 177, and 184; on Window Making in Nos. 139, 147, and 153.

Six-inch Centre Lathe Mandrel.—Little Jim.—I do not know why you wish for parallel bearings, unless you want to have a traversing mandrel; but you say the lathe is to be "an ordinary one." I will suppose, then, you mean a foot lathe, non-traversing, and intended for wood, not metal. Well, then, you would do well to make the front neck $1\frac{1}{4}$ in. in diameter and $1\frac{1}{2}$ in. long, and the back one may be $\frac{3}{4}$ in. diameter and 1 in. long; this will run pretty easily. You might make the mandrel of tool steel and have the bearings in halves, of phosphor-bronze or bell-metal. I should have a hole bored right through the mandrel $\frac{3}{8}$ in. diameter. If you want to turn metal, or if you have a motor to turn your lathe, you might have the front neck $2\frac{1}{2}$ in. diameter, so, you see, "it all depends." It is difficult to explain the action of the oval chuck; get No. 1345 of the *English Mechanic*, where a very good one is described.—F. A. M.

Ferrotype Plates. — AMATEUR. — Ferrotype plates are usually coated with collodion, proceeding exactly in the same manner as in taking a glass positive. The only difference is that the ferrotype plate is opaque and the glass transparent. If AMATEUR does not understand wet plate work, he had better get instructions by word of mouth or by reading some work on the subject—orally, by preference—supplemented by seeing the whole process gone thoroughly into from first to last. Ferrotype plates are sold already prepared with emulsion, ready for exposure and development, but the collodion process gives rather the best results. A clearer and whiter image is obtained, the gelatine emulsion appearing muddy by comparison. To make the plates you have already procured sensitive, they must be first coated with a weak solution of albumen, dried, coated with iodised collodion, and sensitised in a solution of silver nitrate, immediately exposed, and developed by an acid solution of protosulphate of iron and barium nitrate, fixed with cyanide of potassium, washed and dried. But to make a success of it, you must be properly acquainted with the wet collodion process, of which the foregoing is an outline sketch.—D.

Fogging of Negative.—D. J. K. (*Roscommon*).—A friend of mine was troubled with fog on his negatives, and found the cause to be a lamp with orange-tinted glass used by him in the dark room. He at once discarded the orange for a ruby glass, and his trouble with foggy negatives ceased.—G. E. B.

Hammered Sheet Brass.—W. P. (*Widnes*).—Strip brass for the purpose required is to be obtained from Messrs. Smith & Sons, St. John's Square, Clerkenwell, London.—G.

Building Contracts.—W. R. (*Shrewsbury*).—The practice in London is to *include* the profit in pricing bills of quantities. We are pleased to find the articles on "Drawing Office Work" have been of help to you, and also to be able to state that they are not yet finished, as you have no doubt found out.—E. D.

Motor. — H. T. (*St. Helens*). — Your letter and many others have been sent to Simpson.

Looking-Glass.—H. H. (*London*).—Kindly say for what purpose you require the glass, I can then better advise you. In the meantime I may say the process is very difficult, and if you only want a small piece you had much better buy it, but if you simply want to have a try to see how it is done, I shall be glad to help you if you will write again.—W. E. D., jun.

Electric Current for Lamps.—H. B. McC. (*Spitalfields*).—As five 16 c.-p. lights should give a light equal to eighty candles, and each c.-p. will take $3\frac{1}{2}$ watts of current, we shall need a generator giving at the least 280 watts of current per minute. As primary batteries soon become exhausted when current is taken from them at a higher rate than three ampères per minute, we must choose a lamp offering a fairly high resistance—say, 50 volts. With five such lamps connected in parallel to a battery, we shall use $5\frac{1}{2}$ ampères of current per minute. We shall therefore require twenty-six cells, each of a gallon capacity, of the double fluid chromic acid type, and these will not run more than three hours with one charge of acid. It will therefore be seen that a primary battery will be a costly and impracticable generator of current for such a purpose. The least costly will be a 300 watt dynamo and a $\frac{1}{2}$ h.-p. gas engine to drive it; or, better still, power derived from a steam engine.—G. E. B.

Organ, Harmonium — Conversion. — W. D. (*Nuneaton*).—It is not possible to alter a harmonium, which has a pressure bellows, to an American organ, which has a suction bellows; or, if possible, the case and bellows possessed by W. D. would not be large enough for such additions as he contemplates. When spare time permits, a scheme for uniting the two instruments shall be thought out, and W. D. must abate his demands, for he cannot accommodate in his altered instrument so many extra reeds as he wishes. Why not sell the harmonium and make or buy an American organ? I believe some papers are in hand on the American organ, which will be published in due course.—B. A. B.

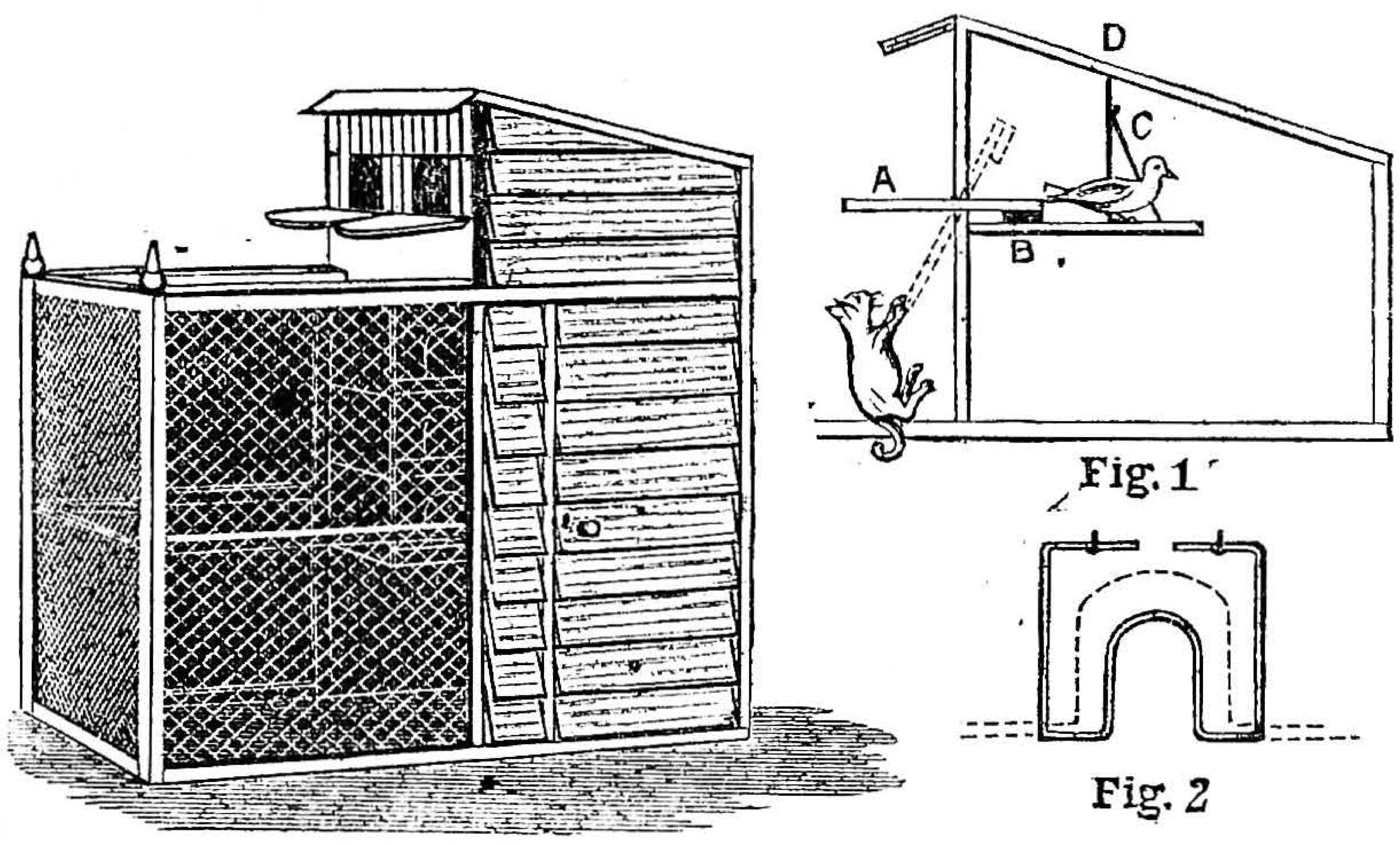
Drawing. — APPRENTICE ENGINEER. — Get "Linear Drawing and Projection" (Cassell & Company), 3s. 6d.

Chuck.—R. B. (*Galashiels*).—There is a self-centring chuck made with little levers, on the same principle as the one you sketch, you may see it in Churchill's catalogue. It is much more strongly made than you sketch it, far more compact, and without so much overhang as you show. The long screwed neck you show would be a most fatal objection, and would prevent any but the lightest cuts on small work.—F. A. M.

Phonograph.—D. E. P. (*Aston*).—Your question, "Whether the whole of this instrument is covered in?" is easily answered. It is not covered in, but should be exactly as described in the text and drawings referred to. The phonograms, or strips of foil, can be replaced by the strip of tissue, taking care that the indentations are exactly over the grooves in the cylinder. Great care and much patience are necessary to success. Most certainly a nut tapper would be much better than the piece of brass (Fig. 5). I am only an amateur at scientific instrument making, and have many a time to resort to a makeshift for the want of proper tools; so if you can conveniently make a better appliance by all means do so.—W. D.

Engineering Pupils.—F. W. (*Southampton*).—Whittaker & Co. now publish a 4s. 6d. book, "Electrical Engineering as a Profession, and how to Enter It," being a "Guide to the Electrical and *General* Engineering Profession." In it F. W. will find all information regarding premiumed pupils and firms.

Pigeon Loft.—L. M. (*Lee*).—I have sent a sketch of a dormer, with trap and balance board, to prevent the entrance of cats. Fig. 1: A, balance board; B, lead counter weight; C, stout wire trap, opening inwards. Fig. 2: Bent wire, dotted line; pigeon-hole cut in the partition, D, Fig. 1. The wire trap is fastened on the inside with two small staples, allowing it to work easy. The pigeons soon learn to push this and get in. When once in, they cannot get out, for the wire falls against the partition.—F. H.



Pigeon Loft. Fig. 1.—Section—A, Balance Board; B, Counter Weight; C, Wire Trap; D, Partition. Fig. 2.—Strong Wire Trap. Fig. 3.—Pigeon Dormer.

Geology and Chemistry.—C. R. (*Acton, W.*).—These subjects shall be treated when a thoroughly useful series of papers are submitted to me.—ED.

Tailors' Crayons.—A TAILOR.—Buy a penny square of pipeclay, scrape it to a fine powder with a knife, colour with red or yellow ochre, or any other earthy pigment that you may prefer, mix into a paste with milk, and dry in suitable lumps. This will generally be of about the right hardness, but if too soft a little starch may be added. This, however, must be used with caution, or the chalk may be too hard for use.—S. W.

Evening Classes.—P. F. A. (*Lewisham*).—As preliminary studies, you must take up mathematics and chemistry and elementary electricity and magnetism. Then your special studies will embrace the electric current, the laws of electro-magnetism and electro-magnetic induction, dynamos and motors, arc and incandescent lamps, accumulators, transformers, commercial distribution of electrical energy, and electric traction. Text books: Slingo & Brooker's "Electrical Engineering," Day's "Electric Lighting Arithmetic," Sylvanus Thompson's "Dynamo Electric Machinery."—J.

Measuring Cylindrical Vessel.—R. A. C. (*Poole*).—To measure any cylindrical vessel—by which I expect you mean to find out its capacity—proceed as follows: Multiply the diameter by itself in inches, and multiply this by ·7854; again multiply by the length in inches, and also by ·00360, and the answer will be in gallons. Or, in other words, diameter squared × ·7854 × length × ·00360 = answer in gallons. Another good rule: A cylinder 1 yard long holds as many *pounds* of water as the square of its diameter in inches. There are 10 lb. of water to the gallon.—T. R. B.

Bath-fitting for House.—R. B. T. (*Tyldesley*).—As you want to have the hot water quickly, you had best fix the cylinder in the kitchen. I have seen one fixed in the kitchen of a house similar in plan to yours, and they have a plentiful supply of hot water. A copper cylinder, though more expensive, will last a great deal longer than an iron one. They are sometimes fixed in the bath-room, the heat from them being utilised for heating the room; but in your case you would not get the hot water so quickly in kitchen. You might fix the hot-water cistern in the bath-room, and so get the benefit of the heat from it. With regard to your second question, you cannot heat the bedroom with pipes from the kitchen boiler.—M.

Driving Saw.—WARSAW will find his engine, if he drives direct from engine, and does not have too complicated driving gear, capable of driving a small circular saw (say, 6 in. or 8 in. diameter) in cutting wood $1\frac{1}{2}$ in. deep. It must be understood that for every countershaft or cog-wheel, as the case may be, if it is to increase speed, there is a loss of power. WARSAW should have given the diameter of fly-wheel and revolutions of engine, and my reply might have been more satisfactory. He will be careful in feeding his stuff, and not feed it too fast, or he may overcrowd his saw, causing belt to slip, and giving other trouble. If properly sharpened and worked, he will find that his engine has a great advantage over a saw driven by hand, the engine being rather more than the power of four ordinary men.—A. R.

Cutting Opals and Other Stones.—T. P. (*London*).—This matter has been dealt with at length in two replies. One is on p. 111, No. 59, Vol. II., and the other is on p. 473, No. 81, also Vol. II. If these do not give enough particulars, another letter to WORK will gain the desired information.—H. S. G.

Making a Felt Hat.—FELT.—The formation of felt is the result of a property which certain animal fibres have (when assisted by gentle friction and moisture) of so interlocking together as to become inseparable. They do this in consequence of their having, as is shown by the microscope, jagged or serrated edges. We believe that beer lees and size are used in hatting to bind the material more firmly together. But FELT is not advised to attempt a hat. Without personal instruction and proper appliances, he could not hope to produce anything presentable. A hatter would only laugh at his work. He will do far better to show his new shape to the trade in some other material.—M. M.

Cork Frame.—CONSTANT READER.—I have met with no such design as that which you mention, and cannot tell you where such could be procured. Why not get some friend who can draw to sketch what you want? The clasped hands should be repeated at each corner, and the word "Friendship" made to occur on each of the four sides, to make the idea decorative; but it is scarcely a happy one for the purpose. Why not use one of the admirable designs given by Mr. Yorke in Nos. 159 and 164, and place a neat inscription to the friend for whom it is intended on the back of the frame?—M. M.

Tools for Engraving Letters, etc.—J. S. (*Burton-on-Trent*).—The tools you want for engraving names on medals, etc., are called lozenge gravers and "spit-stickers." The graver sharpened to an acute angle is used for cutting V-shaped cuts, and for cuts of a parallelogram form the tool is first sharpened in the usual manner, and the cutting angle is rubbed down on the stone till it makes a flat-bottomed cut of the required width. For work such as the ferrules of walking-sticks and umbrellas a square graver is used, the "setting-off" being very slight, and the angle less acute than for lettering. As regards the names and prices, the ordinary term "graver" includes all cutting instruments used by the engraver; the names only being altered when the graver is whetted up to do certain work—as, for instance, a graver whetted to form a semicircular cutting face is termed a round-nosed or spotting tool, for the simple reason that, when used, it makes a round spot, or, if the cut be prolonged, a grooved cut. As to prices, you can go to almost any expense, always remembering that good tools are cheapest in the long run. Here are some fair prices: One dozen lozenge gravers, 3s.; one dozen square gravers, 3s.; Arkansas oilstone, 5s. to 15s.; tracing point, 1s.; spring dividers, 2s.; steel rule and straight-edge, 2s. 6d.; set of sandbags, 2s. 6d. to 5s.; one dozen handles for gravers, 3s.; oilcan, 6d. Sundries: Eyeglass mounted on stand, letterpress ink, oil, turpentine, indiarubber, foolscap paper for prints, lead pencils, white wax, German silver for practice, pitch block for mounting German silver. If you get the first volume of WORK you will find therein a series of papers on "Engraving on Metal," which, I daresay, will help you.—N. M.

Microscope and Telescope.—J. G. (*Shepherd's Bush*).—An article on the Microscope appeared in WORK, No. 22, and on the Telescope in No. 142.

Mail Cart.—S. W. (*Fitzroy Square*).—If you were a careful reader, as well as a "constant taker," of WORK, you would have seen innumerable sketches of mail carts; but as you have, perhaps, mislaid your back numbers, you cannot do better than send for No. 30, Vol. I., and I think you will find in it all you require. You can get wheels and springs, etc., from the Victor Cycle Co., Grimsby.—E. D.

Cast Steel. — NO NAME (*Sunderland*). — In reply to our correspondent, it is held in the law that the *substitution* of one material for another in a manufacture is *not* an "invention" that can be protected by a patent. A *mode* of manufacturing an article of the material named *may* be patented, and if properly set out in the specification, and the mode is novel, may be made to cover a great deal. We do not see what can be done in the circumstances he states, and he certainly runs a great risk in putting it before *any one* until he has lodged his application for the grant. We know of no trustworthy society, such as he mentions, in which he could have "full"—we say *any*—"confidence" in such matters, and should not advise him to be caught by any "professions" made with that object. If he stands well with his foreman, and he is a man he could trust, he might bring it to his notice, in *strict confidence*, to see if he would join him and find the means, on consideration of receiving a share in the right. Of course, our correspondent is in a better position to decide this than we are.—C. E.

Compound Engines.—Novice.—The object sought to be attained by the compound engine is the equalisation of the varying force of the expanding steam so as to produce and obtain a mean result of the pressure throughout the stroke of the engine. The first person to try and obtain it by the use of two cylinders of unequal sizes was Hornblower, who, in 1781, introduced the system. The steam at its full pressure is admitted to the smaller cylinder, and then allowed to pass into the larger one, which, by an increased diameter, allows the steam, at a diminished pressure, to produce or give off as much power as the smaller cylinder using the higher pressure, which result could not be attained by the use of two cylinders of the same size, supplied with a given quantity of steam at a given pressure. At the time of its introduction, and for a great many years after, the steam pressure used was too low to demonstrate the advantages of the system in a beneficial manner, and it is only in late years, when the use of steam at a pressure of from 50 lb. to 160 lb. and upwards on the square inch has been brought into use, that its advantages have been proved and made manifest; and now a given bulk of steam is expanded from ten to twenty times and upwards with great benefit to its users. The book mentioned contains some useful information, but, not being written by a practical engineer, is not, of course, more than a "popular" work on the subject. The great thing to be sought is a thorough practical acquaintance with the subject and a complete and thorough understanding of its principles and practice, which, it is needless to say, cannot be obtained from mere "popular" writings.—C. E.

Hartley's Catalogue.—J. G. L. (*Merthyr*).—Messrs. Hartley sent you their catalogue, but it has been returned. Your address was insufficient.

III.—Questions Submitted to Readers.

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

Printing Press.—Amateur Printer writes:—"Will some reader kindly give me instructions for making a small printing press, to be worked by hand, to print about 10 in. by 7 in.; also, how to make black printing ink and the roller for distributing it?"

Hot and Cold Service.—Improver writes:—"Will some reader kindly inform me how I should arrange pipes and connections and hot-water tank or cylinder and feed cistern, for circulating arch boiler of kitchener, 3 ft. long, small boiler to bathroom, which is on the second floor back, and range in back kitchen on the left, with one hot-water draw-off tap side of range? I should prefer the cold-feed cistern above bath, and hot-water tank in opposite corner and, of course, a little lower. What size tank shall I want for family of seven?"

Setting Bicycle Frames.—A. T. (*London, N.*) writes: "Can any reader inform me of the method used for the above? Also any hints on building tangent wheels."

Oxygen Gas.—Oxygen writes:—"Will some kind reader be good enough to inform inquirer of the various uses to which oxygen gas is put in the manufactures?"

Dark Oak Paint.—H. H. (*Sussex*) writes:—"Will any kind reader of Work inform me how to make up about 20 lbs. of dark oak paint?"

"H. W. R." Monogram and Design.—Leeds will thank any Work reader for a monogram, "H.W.R.," for a small box, and a neat design for its end panel.

"W. O." Monogram.—W. O. (*Newhall*) will thank any kind reader for a design for this monogram for fretwork.

Scroll Saw.—No Puff writes:—"I want a reliable scroll saw that will cut through ⅜ in. deal quickly. Would the 'Empire' be suitable? If not, could a reader name one?"

Moorish Frieze.—Alhambra writes:—"I shall be obliged if any contributor could give me a design for a frieze in the Moorish style, to be cut in thin wood; also design for a wall mirror in same style with the opening for glass about 16 in. by 14 in."

IV.—Questions Answered by Correspondents.

Folding Garden Seat.—J. Brown (*Cambridgeshire Asylum, Fulbourn, Cambridge*) writes:—"If T. W. (*Cardiff*) (see No. 172, p. 254) will write to me, I think I can give him what he wants, as I have made half a dozen for our doctor for his garden."

Fuller's Battery.—J. Brox writes to N. C. G. (*Islington*) (see Vol. IV., No. 184, p. 446):—"In charging a Fuller's cell there are two different charges that can be used. In one, the porous pot with the zinc plug is charged with a solution of chloride of sodium (*i.e.*, common salt: 1 oz. of salt to 1 pint of water. In the other a solution of 12 parts of water to 1 part of sulphuric acid is used. In using either of these solutions about 1 oz. of mercury should be placed at the bottom of the porous pot, which ensures constant amalgamation of the zinc, thereby preventing useless waste. The outer jar, containing the carbon plate, is charged with a solution made by dissolving 3 oz. of bichromate of potash to every pint of warm water, and then adding 3 oz. of sulphuric acid gradually, stirring with a stick. After the addition of the acid the solution will become scalding hot, so care should be taken to make the mixture in a suitable jar or vessel that has no chance of cracking. All the solutions should be quite cold when the cell is put up for use. Any size of porous pot will do; all depends on the shape and size of the outer one. It should stand up about 1 in. above the outer pot, and should comfortably take the zinc plug without taking up too much room in the other."

White Wood Articles.—M. (*Bishop Auckland*) writes to A. M. R. (*Golden Square*) (see No. 186, p. 478):—"I think you can procure these from J. H. Skinner & Co., Harger Brothers, or Booth Brothers, who advertise in Work."

Meerschaum.—M. (*Bishop Auckland*) writes to J. W. B. (*Castleford*) (see No. 186, p. 478):—"Make a cement of dry slaked lime, sifted through fine muslin and mixed with the white of an egg. Fix the tube with the screw on the end, with this, into the meerschaum, and, when set, screw on the amber."

Model House.—M. (*Bishop Auckland*) writes to T. B. (*Kirkbythore*) (see No. 187, p. 494):—"I do not think anyone supplies these articles. You might get a plumber to make the spouts and chimney-pot in sheet zinc, and use small brass or bone drawer knobs for door handles, which you can obtain from an ironmonger. If you cannot get them in your district, if you send me particulars and sizes, I will try to get them made for you."

Fuller's Battery.—Eddefra writes to H. C. G. (*Islington*) (see No. 184, p. 446):—"Fuller's battery consists of an outside stoneware pot or jar with an inner porous pot, the outer jar having a plate of carbon in chromic acid solution, with one-quarter of its bulk of sulphuric acid. The inner porous pot contains a rod of zinc, the bottom of which is covered with mercury, and remainder of cell filled with sulphuric acid and water. Electro-motive force, 1·50."

V.—Letters Received.

Questions have been received from the following correspondents, and answers only await space in Shop, upon which there is great pressure:—A. T., Junr. (*Birmingham*); Tom Doctor; J. S. (*No Address*); W. F. C. (*Coventry*); J. H. B. (*Pendleton*); W. K. (*Ditton*); C. M. (*Huddersfield*); C. D. (*Low Moor*); S. K. (*London, N.*); J. H. (*Stonehouse*); H. E. B. (*Newcastle*); A. A. (*Leeds*); E. S. (*H.M.S. "Victoria"*); Rev. W. H. N. (*Cambridge*); R. W. T. (*Newcastle-on-Tyne*); W. J. M. (*Dundalk*); Frame; Amateur Type; J. G. S. (*South Shields*); E. T. E. (*Summerhill*); W. S. (*Battersea*); Beginner; R. M. (*London, S.E.*); E. W. M. (*Redhill*); One Interested; Electric Light; Cyclostyle; D. C. (*Blackburn*); M. C. S. (*London, W.*); B. (*Wolverhampton*); A. W. C. (*Walthamstow*); Cylinder Plug; H. C. S. (*Wellingborough*); C. H. S. (*Midsomer Norton*); T. C. M. (*Haverhill*); P. W. (*Stockport*); C. J. (*Gloucester*); W. C. B. (*South Queensferry*); F. P. (*London, W.*); Follow Me; W. S. (*Newcastle*); E. S. (*Chelsea*); J. F. (*Selby*); J. F. M. (*Edinburgh*); H. V. T. (*Harrogate*); A. R. (*Scorrier*); J. W. (*London*); W. O. (*Carlisle*); C. L. (*Chorley, Lanc.*); S. A. L. (*Great Yarmouth*); T. B. (*King's Heath*); W. J. H. (*Market Harboro'*); A. R. M. (*Windsor*); T. D. (*Oldham*); J. W. (*Ashtead*); Robin Hood; E. R. (*Portsmouth*); R. L. (*Pentre, Ruabon*); A. H. (*Adwalton*); H. S. B. (*Tipton*); W. B. (*Penzance*); W. W. (*Southport*).

"WORK" PRIZE SCHEME.

FIFTH COMPETITION.

"Domestic, Commercial, or Scientific Application of Electricity" Competition.

Continuing our scheme of Prize Competitions of a useful and practical nature, we propose to devote the present one to the subject of Electricity, in which our readers and the world at large take so keen an interest. We invite competition for the following prizes—

First Prize, £3;

Second Prize, £2;

Third Prize, £1;

for the three best suggestions of an original and practical nature, involving the application of electricity to some domestic, commercial, or scientific use. This application may be on a large or small scale, to take effect on land, sea, or in air—the main conditions being the newness and practical possibilities of the suggestion.

Conditions and Rules of the "Electricity Suggestion" Competition.

All Descriptions to bear the Work Prize Coupon, cut from one of the numbers of Work in which the Prize Scheme is announced.

Each Description to be signed with an original *nom de plume*, and to have the writer's real name and address securely attached to the manuscript in a sealed envelope.

Each Suggestion should be fully described in respect to its purpose, construction, and working, and, where possible, should be illustrated with a drawing of the article itself and its various parts, to elucidate the description.

A Suggestion not illustrated will have an equal claim in the competition, provided the description be sufficiently in detail to convey a full idea of the article suggested.

In the work of judging regard will be had to the practical nature and utility of the suggestions, and their prospective popularity.

The Prize Suggestions and Drawings, and any others, to be published, if desired by the Editor, in Work, but the copyright thereof to remain with the authors.

Copies of MSS. and Drawings to be retained by the competitors, as in no case can the return of MSS. be undertaken.

The Editor of Work will supervise the judging of the Suggestions, and the selection, or decision, as determined upon by him is to be final.

All manuscripts intended for the "Electricity Suggestion" Competition must be addressed to the Editor of Work, c/o Cassell & Co., Ld., Ludgate Hill, London, E.C. They must reach him on or before Saturday, December 17th, endorsed, "Electricity Suggestion" Competition.