WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

VOL. IV.—No. 170.] SATURDAY, JUNE 18, 1892. [PRICE ONE PENNY.

WORK WORLD.

A NEW tire protector has been brought out. It is composed of very thin compressed raw hide, in $1\frac{1}{2}$ in. sections, which overlap each other. It is very light, is puncture-proof, and shaped to fit closely over the tread of the tire. Cyclists will note.

* *

The finest Persian carpet in the world—the Holy Carpet of the Mosque of Ardebil—is on view in London. It measures 34 ft. 6 in. by 17 ft. 6 in. The maker's signature is accompanied by the date 942, which is 1535 of our era.

* *

Sheffield is largely interested in the new Admiralty battleship—the *Resolution*. 2,500 tons of her armour plating were turned out at the Atlas Works. Sir John Brown & Company, Limited, are furnishing the armour for a sister ship—the *Revenge*.

* *

A submarine boat recently tested attained a speed of ten miles per hour under water, turned round, and rose and sank under perfect control. When on the surface it is driven by steam, and when below by a storage battery charged by the propeller engines. Saving life at sea ought to be possible with this.

* *

The economy of heating feed water by steam direct from the boiler—commonly called "live" steam—has been shown by experiment, and is now beginning to be recognised by the Whitehead Torpedo Company, who have ordered a second apparatus on this principle.

* *

An optical pyrometer has been designed, based upon Cornu's photometer; it is a much simpler instrument than the thermo-junction electric pyrometer, and therefore more suitable for everyday use. The methods of measuring very high temperatures yet calls for investigation on the part of practical men.

The number of gun barrels proved during 1891 in the Birmingham Proof-house was 561,631, an increase of 40,691 over those in 1890. Failures in proof were much smaller in number than might have been expected, considering the great increase in the common class of work and the falling off in the best work. The common class of barrels are very much exported abroad for foreign guns, and are not likely to favourably impress foreigners with the quality of English workmanship.

* *

Although the electric light may be put anywhere and used without the adventitious aid of match or fire, yet Mr. Preece, F.R.S., maintains it is not always absolutely safe. Security is to be obtained only by good design, perfect materials, first-class workmanship, and rigid inspection. Imperfect materials erected by cheap contractors lead to many disasters. Everything ought, as much as possible, to be kept in view, and the conductors ought not to be hidden under wainscots or floors, or above ceilings. All this is worth knowing.

* *

A Labour Exchange has been opened in Paris. The building has been erected by the municipality, which paid 1,000,000 francs for the site. It contains a hall accommodating 1,600 persons, and has 150 rooms, which will be used by 230 trade unions, the building being left entirely to the management of the unions. It is hoped it will contribute to social pacification, to the success of the just claims of labour, and to international relations, resulting one day in universal peace! Where is London?

* *

Many German engineers prefer masonry to iron for bridges, and they have revived the practice of building masonry bridges with lead joints at the key and points of rupture near the spring lines. The Romans used sheets of lead between cut stones, and in bridges built in England in 1833 bands of lead were placed in the joints for two-thirds of the distance above the spring line. The use of lead is for maintaining the proper interval of joint, and for uniformly distributing the pressures.

Milling machines are doing away with much of the vice work of the practical engineer. Double eyes, and other fitting parts of engines and machinery that were formerly carefully filed up at the vice, are now turned out at the machine by skilled labourers at about four-sevenths of the wage of mechanics. Work that was done a year or two ago at the slotting and planing machines, and afterwards fitted, is now designed so that it can be finished by milling cutters alone, afterwards being highly polished by the aid of buffing wheels and belts.

* *

The street music joys of the metropolis are likely to be increased. Mr. J. Charles King, the writer and worker upon the technics of coachmaking, has patented some carriage musical gear, which he proposes to apply at first to children's mail carts and perambulators in the shape of chimes and simple tunes. When the idea is extended, and every vehicle gives off a tune to the revolution of its wheels, the reputation of England as a musical country will be materially strengthened. Whether the general result will be a matter for national rejoicing or a cause for profound despair lies in the future. But England is so musical!

* *

An oppressive shop-tax exists on all coachmakers, with the added indignity of Excise espionage at all hours of the day, and the annoyance of having to keep books of accounts to suit this humiliating official action of the Government—under the risk of severe penalties for any contravention of the Excise dictum. Every carriage repaired must be entered, and owner's name and address submitted to the exciseman. Every carriage sold must in like manner be entered. Carriages bought of private users must be entered in the trade books. Forms supplied by Government have to be accurately filled in. The particulars of all carriages sold must be precise as to number of wheels, and if with a pole-socket on the bed for a pair of horses or not; and the coachmaker must answer any question of sales or repairs to the exciseman, or submit to be "Star-chambered" at Somerset House, which authority is despotic in its judgments.

THE ART OF STAIRCASING.

BY GEORGE F. CHILD.

Close String Stairs with Winders.

Introduction — Working Drawings — Position of Winders in Newel—Drawing Plan and Elevation—Full-size Drawings — Setting Out the Wall-Strings—Gluing up the Wall-Strings—Easements on the Strings —Mould or Template for Winders—Gluing up the Winders—Cutting Winders to Size—Housing Winders in Newel—Placing Stairs in Position—Models.

Introduction.—In all staircases that we have previously examined the "going" has required nothing special beyond careful attention in setting out the number of steps, so that they should not project beyond a given point.

The plan, however, we now propose working upon being strictly limited, the space for the "going" will require careful study, to enable us to reach the floor above in a reasonably easy manner. This it will be found can only be achieved by introducing at the bottom a series of graduated steps, called *winders.* Winders are placed in various positions, according to circumstances; hence we often find them at the top of a flight of stairs, again at both top and bottom, and finally the whole of the landing (as in the drawing) is converted into winders, in which case they are called a *half-space of winders.*

As I have before mentioned, winders should always be avoided where possible; but as they are so often indispensable, we must make them as easy as circumstances will allow. The following examples have been taken as representative of the various forms of winding stairs in common use, and will fully answer our present purpose.

Working Drawings.—The present flight of stairs is arranged to be placed between two walls, with entrance at right angles to the staircase at the bottom. There being a room on each side at the top, a landing becomes a necessity. At first sight it might appear that the winders could have been dispensed with, by leaving a space at the bottom similar to the landing at top, thus making a straight flight do. But upon examination it will at once be seen that this will not answer, the "going" being so little that the number of *risers* necessary to carry us up would only allow of a very narrow "tread" indeed, therefore we bring in the *winders.*

Position of Winders in Newel.—As the most dangerous position on the winders is of course round the newel, we must make them as large as possible at this point.

Many people strike out the winders from the centre of the newel (as at Fig. 7); but this is not desirable, the better plan being to keep the *fliers* back (straight steps are called fliers), so that the winder may be a short distance behind the newel (as at A, Fig. 8). At times it is also possible to have the *first* winder in *front* of the newel (as at B). This is the case where there are steps in two directions—that is, with a quarter-space of winders.

Drawing Plan and Elevation.—To set out the plan, first draw the enclosing walls, with landing and doorways in their respective position; then place the newel as seen at N, and draw the riser, No. 4, at a distance of 2 in. beyond. Now draw riser No. 1, then with a radius of 15 in. strike an arc from the centre of newel, and divide into three equal parts. Divide the two sides of the newel into as many portions as this line, when lines drawn through these points give us the necessary risers. Now, by measuring off the space (*a* to *b*) occupied by the winders, it will at once be seen that the distance *b* to *c* is all that we have at our disposal for the *fliers.*

Having decided upon the number of risers —viz., twelve—this will, as we know, give us eleven "treads." We therefore deduct the three winders from this number, which leaves eight *fliers*; so of course the space *b* to *c* must be divided into eight equal parts.

The elevation must now be drawn as previously described, the only difference being the winders. The winders can also be projected from the plan, and the easement on string drawn as seen.

Full-size Drawings.—As the winders require careful handling to make a satisfactory job, it is necessary that a full-size drawing of them be made. This can be done by fixing a few boards together by ledgers for a drawing-board and marking them on its surface (as at Fig. 10), the method being described in setting out the plan.

Setting Out the Wall-Strings.—Having found the necessary length for our wall-strings (from Fig. 1), we proceed to set it out with the pitch-board, starting at the *top* and working *downwards* until riser No. 4 is reached (as seen in Fig. 6). At right angles to this riser draw a line *a b*, equal in length to *a b*, Fig. 10. This gives winder No. 3. Next draw riser No. 3, *b*, and again draw a line square off this the length from *b* to *c* on Fig. 10, thus obtaining *one* side of winder 2. Draw the line *d* 1 in. beyond *c*, this being the thickness of return-string (Fig. 5), which enters a groove (as shown at Fig. 4).

Fig. 5 represents the wall-string that takes the winder No. 1 and part of No. 2. The part A corresponds in plan and elevation. To set this string out, set a *bevel*, B, to any convenient angle, and apply it to string (as seen in Fig. 5), making *i e* the same as *i e*, Fig. 1. Make *e d* equal *e d* (Fig. 10); draw riser *d d*, at right angles to which draw winder No. 1, making *d e* the same as *d e*, also on Fig. 10.

Gluing up the Wall-Strings.—As it is obvious from Fig. 6 that a 9 in. board would not be nearly wide enough for the winders, pieces must be glued on the string (with a tongue in the joint) as at *e f g*, the dotted line representing the joint-line.

Easements on the Strings.—The easement on the string in Fig. 6 should be made as shown, keeping the line as close as convenient to *b*, or otherwise the depth of string above the second winder will be unsightly. This depth must, of course, be the same on the string (Fig. 5), forming an easement to meet one at the bottom of string from the skirting.

Mould or Template for Winders.—This mould is very useful indeed, as by its use both time and material are saved. It can be made from any odd strips of deal, about 1 in. wide and ⅜ in. thick, and is screwed together at the angles (as seen in Fig. 11). To apply the mould, lay the strips upon the lines *f*, *b*, *c*, *d*, in our full-size drawing (represented by Fig. 10), and screw them together. Be sure to allow about 1 in. *beyond* the lines for the nosing, etc. Now place the mould upon the board (see Fig. 11), and mark round the outside, and cut it out to the shape. This will leave the board with a long angle, *f h.* Now, by turning the mould over, the angle can be brought into use for the piece that is required to make out the winder at S, thus saving a good piece of stuff.

The mould must be fitted to the other winders in the same manner, but these will only require three strips, as reference to the drawing will show.

Gluing up the Winders.—Having cut off all the stuff, the winders must be glued up with a tongue in the joint, as it makes them stronger and less liable to part company in a damp position.

Cutting Winders to Size.—When the glue is dry, the winders should be placed upon the full-size plan and marked for cutting to proper size.

It must be remembered that the lines on the board represent the *risers*, therefore 1 in. must be allowed beyond at front for nosing; the same at the back, to pass under the riser above; ⅜ in. must also be added at the parts that enter the strings and newel. Fig. 3 shows one of the winders cut to its proper size, the dotted lines representing the edge of strings, riser, and newel respectively.

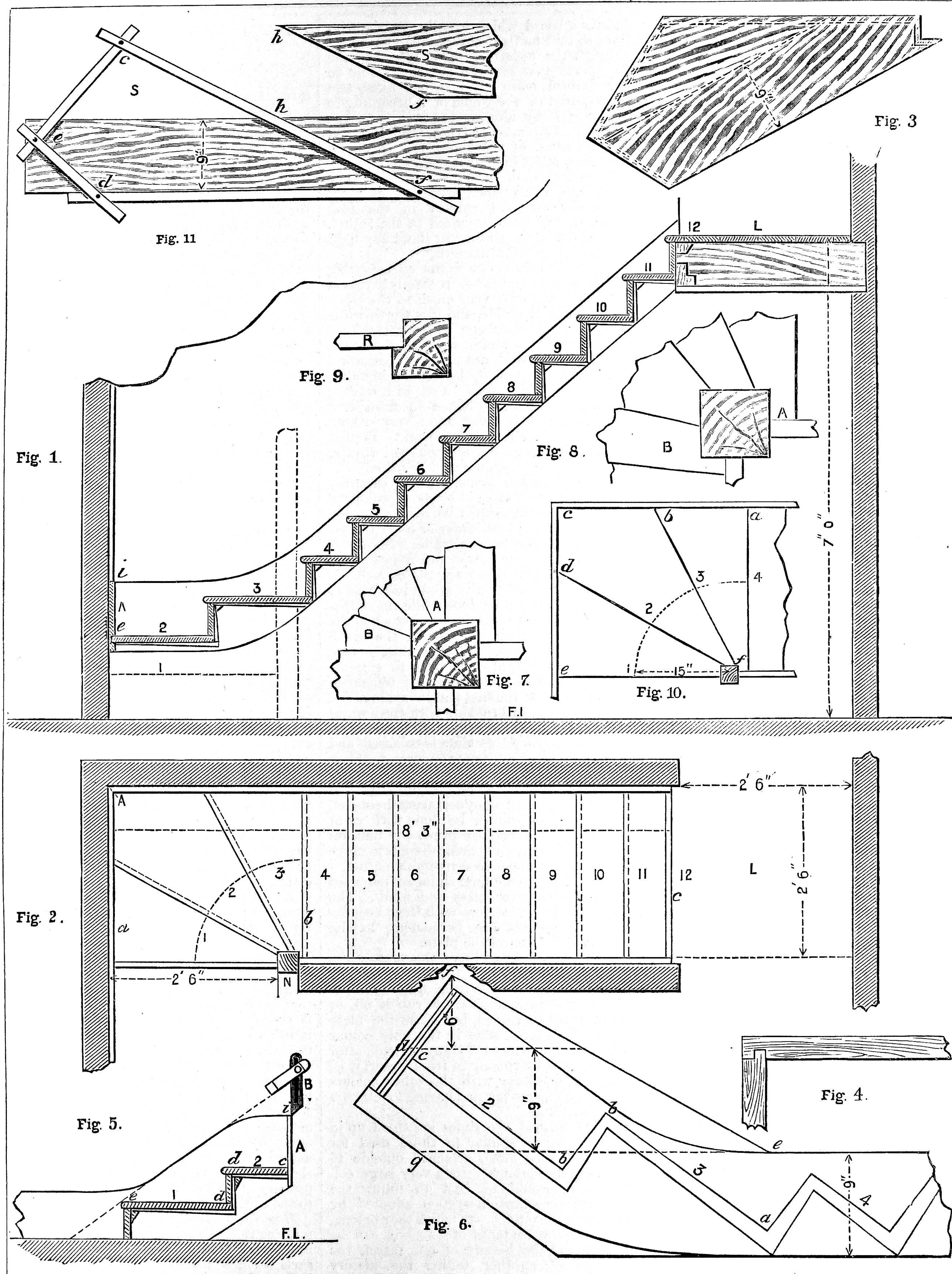
Housing Winders in Newel.—To house the steps and risers into the newel, start at the bottom riser, R (Fig. 9), and cut out ⅜ in. from the newel. Now mark up the other steps, placing each in its proper position, which is obtained from the full-size drawing. Then fit the steps in the same manner; and all that remains is to fit the outside string to the newel at the height seen in Fig. 1, the dotted line being the newel.

Placing Stairs in Position.—A point of great importance to the staircase hand lies in the query, Can our stairs be placed in their position if put together in the shop? It is *always* better that they should, if possible, as it saves a deal of time and temper in the building. This can often be arranged with care. In the present instance, if it were possible to drop in the stairs from above, the newel should be placed with its edge, N, fair with the outside of the string, thus affording no impediment to its passage downwards.

Failing this, the tenon should not be fixed, and the wall-string cut in a line with riser No. 4, then continuing the cut in the form of a *bird's mouth.* If this is done, the stairs can be put together in two parts —the winders in one, and the fliers in the other.

Models.—Should any doubt exist in the mind of the student as to his ability to successfully make a winding staircase over a given plan, I should strongly advise him to prepare a set of *working drawings*, as here described, and make a model to them, working upon a scale of, say, 1½ in. to the foot, as by this means confidence will be assured. The wall-strings would be sufficient, as the other string presents nothing special beyond that which we have attempted before. It might be marked out on a piece of stiff cardboard, as there is no occasion to cut it out for steps, but only the level lines at top and bottom, with the proper easements. Should he do this, he will be astonished at the progress made, as it is very convincing.

Staircasing. Fig. 1.—Sectional Elevation. Fig. 2.—Plan. Fig. 3.—Step. Fig. 4.—Joint between Strings. Fig. 5.—String—B, Bevel; F L, Floor Line; A, Tongue. Fig. 6.—Enlargement of String for Winders. Figs. 7 and 8.—Alternative Method of placing Winders. Fig. 9.—Housing Risers (R) in Newel. Fig. 10.—Sketch for Full-size Drawings. Fig. 11.—Sketch of Template for Winders, showing its Application to Board in Practice.



Staircasing. For Inscriptions to Figures see previous page.

MICRO-PHOTOGRAPHY WORK.

BY ARTHUR RENAUD (B.A. OXON.).

METHOD OF MAKING THE LANTERN SLIDES (1) BY CONTACT; (2) BY REDUCTION—COLOURING SLIDES—FINISHING SLIDES—STORING SLIDES —CONCLUSION.

We now come to the last stage of our subject: viz., the conversion of the negatives into lantern slides. The thing to aim at is the production of negatives free from stains, and the field should be so dense that all round the object may be clear glass in the lantern slide printed from it, and yet not so dense but that the details of the object itself may have every chance of making their appearance on the slide. The actual manipulation is simple enough. The negative is placed film side upwards in a printing frame, and on the top of it is placed the lantern plate, film to film; the printing frame is now shut up, and the exposure takes place, either to artificial light or daylight, the former being the most easily controlled. The red shade taken off the lamp or candle, when the latter has been placed before the printing frame, and replaced after a few seconds, is enough.

In developing the lantern plate, we want as fine a deposit and gradation of tone as we can possibly get. It is a rule that quick development produces a coarse deposit, and a slow development a fine deposit: consequently, the greater time given to development the better. But a too protracted development is liable to give stains and other evils of its own, and is therefore to be avoided. From a quarter to half an hour will probably be about the time taken if the exposure was correct. Some say that great diversity of tone can be made by adding substances to the developer, such as honey, raspberry-syrup, etc.; I should never dream of utilising any such messes.

There is nothing for removing yellow stains like a solution of perchloride of iron —not too strong; I think the actual strength does not much signify—to which a few drops of hydrochloric acid have been added. If the plate is placed in this after fixing, the yellow stain will at once depart. After it has gone, place the plate in the fixing bath again for a few minutes, and wash well. This is a reducing agent, and too dense negatives can easily be reduced to the right depth by its use, but the operator must remember that the full effect is not produced until the plate is in the hypo bath, and he, therefore, must not allow it to remain too long in the iron solution, or it will become too weak when in the hypo.

If the photographs have been made on quarter or half-plates, they can be reduced to lantern-slide size by means of a special instrument made for that purpose. It goes by the name of the "lantern-slide making camera," and is a perfectly indispensable instrument to those who wish to make lantern slides from larger negatives without using their own camera. The cost is not excessive (12s. 6d. for half-plate size), and they are sold by all dealers of any note. But it is as well to have one so made as to take in the *whole* of the negative on the slide, and not merely part of it; this costs 2s. more, but is worth the price. It also necessitates the use of masks, which are, however, generally used in any case, though these have to be of a special shape. The dealer will supply these too. The large negative can also be reduced to lantern-slide size by merely photographing it with the camera in the ordinary way, using a lantern plate instead of a dry plate of ordinary make. The negative is fixed in a hole in a board which exactly fits the window, so that no light enters the room except through the negative. This plan has the advantage that one can get the picture on the lantern plate any size one likes, and take in part or the whole of it according to the subject by altering the position of the camera. The mask having been fastened on, the name of the object is written on the black paper in Chinese white.

The question of lanterns is too deep a one to go into in this paper, especially as there is plenty on that subject in the past numbers, and more promised in the future. If well made, the slides will stand any light —even the limelight lantern.

In conclusion, a few words on colouring the slides may be useful. It stands to reason that colouring adds very much to the effect produced by the slide, and it is worth while to attempt it when you have mastered the manufacture of slides without colouring. Aniline dye colours are used for this work, and it must be done by daylight, or blunders of colouring will ensue. You will want a broad camel's-hair brush, a medium-sized fine-pointed sable brush, and a very minute sable brush for very small work. Besides these and the colours, all you will require will be a bottle of gum arabic solution.

The slide, when made, must be carefully freed from every trace of hypo by prolonged washing, and there must be no incrustation on the film from hard water or other causes. When about to colour the slide, a few drops of colour from one bottle and a few drops of gum from the other are placed side by side on a plate. If the groundwork is to be coloured, it can be done while the slide is wet, and it must be kept very wet while the tinting is going on, by keeping the brush moist with water. The operator's own taste must tell him what tints to employ, and how deep they are to be. If too much colour is put on the first part, while the slide is wet, soaking or brushing with fresh water will remove it, but this cannot be done so easily when the whole slide is coloured, and it is therefore necessary to be careful. When the groundwork is finished, let the slide dry for a little while. Before it is quite dry is the best time to finish it off by colouring the object, which must, of course, be done with great care, using the smallest brush for delicate details. Of course, the great thing is to make the picture on the screen resemble nature.

When dry, the coloured slides are mounted as usual with cover glass and mask. The colours will not interfere with their keeping qualities, as they are permanent, having sunk into the film of the plate.

If it is necessary to leave the plate while at work, put it under a bell-jar, or similar protection, to keep it from dust. If any dust settles on it, don't try to rub it off, or the film will be ruined, but rinse the plate well under a tap. Blue is the only colour that can be reduced to any extent after putting it on by rinsing in fresh water; it is, therefore, necessary with the other colours to avoid going too far, and having to retrench one's footsteps.

When finished, the slides are stood up in grooved boxes similar to those used for negatives, with labels attached outside to denote their contents. In a very large collection it would be best to follow the ordinary classification system adopted by experts in the branches to which they belong, or the whole contents of one box can be made to tell the history of one insect, the contents of another telling the history of another, or of some different subject altogether.

INDUCTION COILS: HOW TO MAKE AND WORK THEM.

BY G. E. BONNEY.

SMALL SPARK COILS — HOW TO LENGTHEN THE SPARK FROM A COIL—THE CONDENSER: ITS ACTION AND PRINCIPLES OF CONSTRUCTION—HOW TO MAKE THE CONDENSER—THE DISCHARGERS: HOW MADE AND HOW USED.

ON starting the small coil (made as directed in my last paper), and connecting the two terminals of the secondary coil by bridging the two with a piece of No. 8 copper wire, a short thin spark will be seen to play between the end of the stout wire and the screw of the terminal. This spark will not satisfy the maker of the coil, who will expect to see one quite ¼ in. in length—that is to say, on first connecting the wire with the terminal, and then gradually slipping the end of it off, he will expect to see a spark follow the end of the wire when this is quite ¼ in. off from the terminal. The shortness of the spark may be due to bad insulation of the wire (there may be no spark at all if there is any defect in the wire), or the break may not work right, or the battery may not be in good order. If one pint cell does not work the coil, try two such cells in series, but no more for such a small coil. If too many cells are employed in trying to lengthen the spark of a defective coil, the defect will be intensified, because the tension of the induced current will then be raised, and it will break down the already defective insulation of the coil.

But suppose the insulation and continuity of the wire coils to be perfect, and the right battery power employed, and the break or interrupter in working order, why is the spark shorter than we anticipated? The cause lies in the fact that the primary current passing through the primary coil is subject to a serious hindrance, arising out of the self-induction of the current. At the instant when the current is interrupted, it charges the primary coil with electric energy, and this is discharged against the current when the primary circuit is restored. In this battle much energy is lost which might be transmitted to the secondary coil. We therefore need some addition to the coil: something to absorb the back-lash of the current: something to act as a thrust-block or buffer to this opposing force. This addition is named a condenser.

The Condenser of a Coil.—This is a storage chamber for the extra current set up in the primary coil by self-induction. The inductive charge of the coil is sent into this chamber instead of being allowed to rush back on the primary current, and from this is discharged in the same direction as the primary current when the circuit is restored. The baseboard of spark coils is either made in the form of a shallow box, to form a condensing chamber beneath the coil, or a space is hollowed out in the baseboard to receive the condenser. The chamber itself is only a receptacle for the condenser, which is made up of a number of sheets of tinfoil, insulated from each other by sheets of waxed paper, but connected alternately at the ends. These sheets receive the extra current from the primary coil, and then give it back again to the primary circuit.

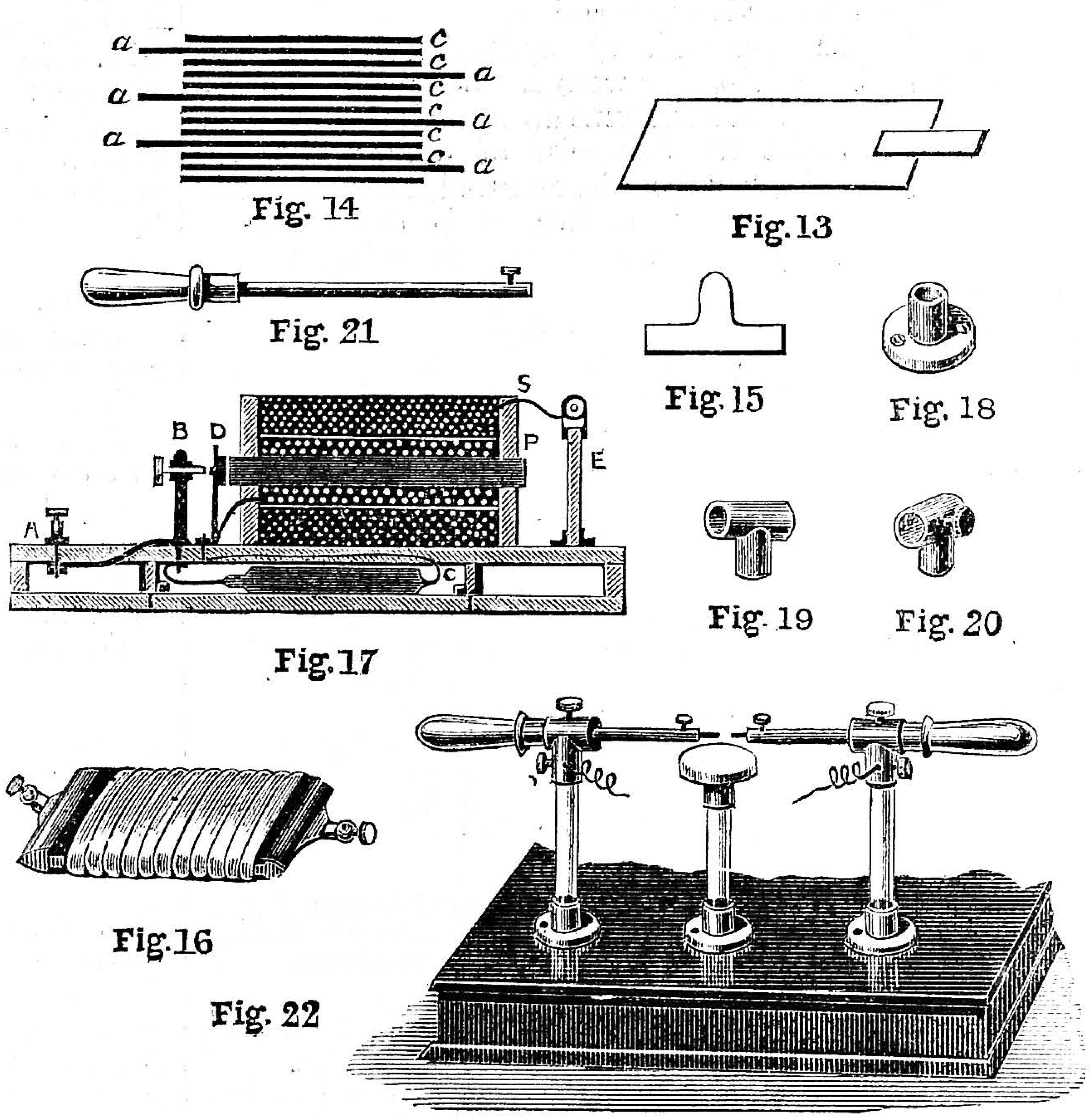
How to Make the Condenser.—First determine the area of the condenser and the number of sheets to be employed in it, such being arranged to suit the size of coil. For small coils to give ⅛ in. spark, we shall require 25 sheets of tinfoil, 2 in. in length by 1 in. in width; for a $\frac{1}{4}$ in. spark, use 40 sheets of tinfoil, having an area of 2 in. by $1\frac{1}{2}$ in.; for a $\frac{1}{2}$ in. spark, use 50 sheets, 2 in. by 2 in.; for a $\frac{3}{4}$ in. spark, use 60 sheets of 4 in. by 4 in. The dimensions for larger coils will be given later on, when we deal with those coils. The tinfoil must be quite smooth, and free from holes and cracks. It will cost about 3d. per lb., and can be obtained from any dealer in electrical apparatus, or from a chemist. Cut the tinfoil in strips of the required size (using a sharp knife and a straight-edge on a smooth board or sheet of glass), and lay them aside as cut. If the condenser is to be used for a large coil, it will also be advisable to cut a number of small strips of tinfoil, $\frac{3}{4}$ in. in width by 2 in. in length (an equal number to that of the sheets of tinfoil), to be laid on the ends of the sheets (as shown at Fig. 13) to form connecting lugs. The same arrangement may be made for the condenser of a small coil; but this is not usually done, connection being made with the overlapping ends of tinfoil.

The sheets of tinfoil will have to be built up into the form of a block or book, with sheets of waxed paper between each sheet of tinfoil. We must, therefore, prepare the paper for the purpose. The paper selected for this purpose must be thin and tough, and free from glaze, size, or salt of any kind. It must be smooth, and quite free from cracks, flaws, and pinholes. As each sheet is cut, it should be held up to a strong light, and thus examined for flaws. In making the condenser for a small coil with overlapping sheets of tinfoil, cut the sheets of paper 1 in. wider than the sheets of tinfoil, so as to have $\frac{1}{2}$ in. of paper on each side of the foil; but in cutting the paper for larger condensers with connecting lugs, give 1 in. of paper all around each sheet of tinfoil. When all the sheets have been cut, examined, and selected, put the perfect sheets in a shallow dish (such as a baking-dish) one at a time, with a few shavings of paraffin wax on each sheet; then put the dish in a moderately heated oven until the paper floats in melted paraffin. Paraffin wax may be obtained of any dealer in electrical sundries, or through any chemist and druggist. The price is about 1s. per pound. It varies in quality. The best for this purpose is a hard, dense white substance, resembling white wax of best quality. If a choice can be had, choose this in preference to that having a yellowish tint, and a soft, crumbly appearance.

When the paper has been well soaked in the melted paraffin, take up each sheet with a pair of forceps by one corner, allow the hot paraffin to drain off, then place each sheet separately on a clean board to get hard. This will only take a few minutes, as the wax will harden almost immediately. The tinfoil and sheets of insulating paper are now ready to be built up in the form of a book.

The covers of this book will be of wood. We must therefore get two pieces of thin mahogany or similar hard wood, $\frac{1}{4}$ in. less in length and breadth than the paper insulators of the condenser. These must be well smoothed and varnished on both sides. Lay two sheets of paraffined paper on one of these boards, then a sheet of tinfoil, with one end overlapping one end of the paper to the length of $\frac{1}{2}$ in. On this lay another sheet of paper, exactly coincident with the lower sheets; then lay another sheet of tinfoil on this, with the opposite end overlapping the paper to the length of $\frac{1}{2}$ in. Thus go on building up the pile with alternate sheets of paper and tinfoil, each alternate sheet of tinfoil overlapping the paper to the left, and each other sheet overlapping the paper to the right (as shown in annexed sketch, Fig. 14). If the condenser is for a large coil, this arrangement may be modified by placing all the sheets of tinfoil coincident with each other, and placing on each sheet alternately, right and left, the small strips of tinfoil cut for the purpose to form lugs.

When the pile is complete, put on the top board or cover, and apply pressure to the whole pile to the extent of several hundredweights, applied gradually, so as to compress the whole firmly together. This done, bind the whole bundle tightly together with broad tape, wound around across its breadth. All the projecting pieces of tinfoil at one end must now be soldered together, and those at the other end of the pile must be similarly connected to form connecting lugs for the wires from the coils. The best method of doing this is as follows. Get a thin piece of sheet brass or thin copper sheet, and cut out two pieces of the form of Fig. 15. Clean and tin both sides of the widest parts, place them in between the projecting pieces of tinfoil, so as to have half on one side and half on the other, then lightly solder them on both sides to the connecting strips. Binding screws may now be soldered to the strips for convenience in connecting these to the coil wires (as shown at Fig. 16). The condenser will be placed in the cavity beneath the coil, and its two ends will be connected by short wires to the contact pillar and break-spring of the coil, so as to form a connecting link between them. Thus, a wire will go from the foot of the contact pillar to one of the terminals on the condenser, and another wire will go from the opposite end of the condenser to the foot of the break-spring (as shown in the diagram, Fig. 17). The extra current of the primary (which gives a smart spark at the tip of the contact screw) will now pass into the condenser, and the length of spark will be lessened at the point of contact.



Induction Coils. Fig. 13.—Shape of Tinfoil Sheet and Lug for Condenser. Fig. 14.—How to build the Condenser—*a*, Tinfoil; *c*, Paper. Fig. 15.—Brass Lug for End Connection. Fig. 16.—Condenser Complete, bound with Tape. Fig. 17.—Section of Coil showing Position and Connections of Condenser—A, Binding-Post Terminal; B, Contact Pillar; D, Break-Spring; C, Condenser; P, Primary Wire and Core; S, Secondary Wire; E, Discharger Pillar. Fig. 18.—Socket for Foot of Discharger Pillar. Fig. 19.—Brass T for Head of Pillar. Fig. 20.—T fitted with Set-Screw. Fig. 21.—Discharger Handle and Rod. Fig. 22.—Discharger Complete, with Ebonite Table.

The Discharger.—In making a small spark coil with moderately thick bobbin ends, we may mount a small binding post on the ends, and connect the ends of the secondary coil to these. In the holes on the upper part of the posts we may insert two stout brass wires, and slide these in the holes until the tips are near enough for the sparks to pass. If the brass wires of this improvised discharger are furnished with small handles of hard wood or of ebonite, they may be worked without feeling a shock; but if not thus protected by an insulating medium, the operator will get a twofold result from his coil, one of which will be unpleasantly felt. If square ends are employed to the bobbins, both ends of the secondary wire may be brought to small posts at one end of the coil. Such an arrangement would be manifestly inconvenient for use with a large coil, and might also be dangerous to coil and operator alike. It is therefore desirable to have the discharger as a separate piece of apparatus.

How to Make the Discharger.—Get or make brass sockets, with foot flanges (shaped as shown at Fig. 18), and large enough to hold a $\frac{3}{8}$ in. or $\frac{1}{2}$ in. glass rod. Fix the sockets 3 in. apart on the baseboard of the coil, at the opposite end to that of the contact breaker, and cement into each a 3 in. length of glass rod or ebonite rod. Next get two T-sockets (shaped as shown at Fig. 19), the upright branch of each to fit the tops of the glass pillars, and the horizontal tube on top to fit the sliding bars of the dischargers. These may therefore be $\frac{3}{8}$ in. or $\frac{1}{4}$ in. Each tube should also be furnished with a set-screw in the side (as shown, Fig. 20) to hold the discharger in position, and another set-screw and hole to receive the ends of the secondary wires. Cement these T's to the tops of the pillars, taking care to have the tubes on top in line with each other. Now get two 4 in. lengths of brass or copper rod to exactly fit the tubes. At one end of each, fit a small handle of ebonite, or baked hard wood soaked in melted paraffin. In the opposite end of each rod drill a $\frac{1}{16}$ in. hole to the depth of $\frac{3}{4}$ in., and drill a $\frac{1}{8}$ in. hole to intersect this hole half-way. Tap this hole for a screw, and fit to it a small short set-screw with a milled head. These holes will be employed to hold bits of wire used in experiments with the coil. Midway between the pillars of the discharger we may fix another insulated pillar, capped with a small table of ebonite. This will be found useful to hold substances subjected to experiments with the coil, as the chosen substance can be placed on the small table whilst the sparks are sent through it.

How to Use the Discharger.—Connect the secondary wires to the T-sockets on the discharger pillars, or, if the ends of the secondary wires are already connected to brass terminals, lead wires from these to the T's on the pillars. Hold one of the discharging rods by the insulated handle, and slide it through one of the T's half-way, then fix it there. Take the other rod by the insulated handle, and slide this through the other T until the tips of the two rods are near enough to allow the charge of the secondary to discharge itself between them. If one of the sliding-rods is graduated in parts of an inch, the exact length of the spark can be ascertained at once. The tips of the rods should be first fitted with bits of platinum wire—these are the permanent discharging points—but may afterwards be replaced with bits of other wire with varying and pleasing results.

In making a discharger for a large coil, the various parts should be enlarged to match the coil, and a ball and socket T will be found to be a convenience instead of a fixed T on top of the discharger pillar. In this all joints must be well fitted, to prevent corrosion by sparking. This accessory to a spark coil is known by the name of Henley's discharger, and is sold by dealers in electrical apparatus at prices varying from 13s. 6d. to 25s.

LADIES' SADDLES, AND RECENT IMPROVEMENTS

BY J. CHARLES KING.

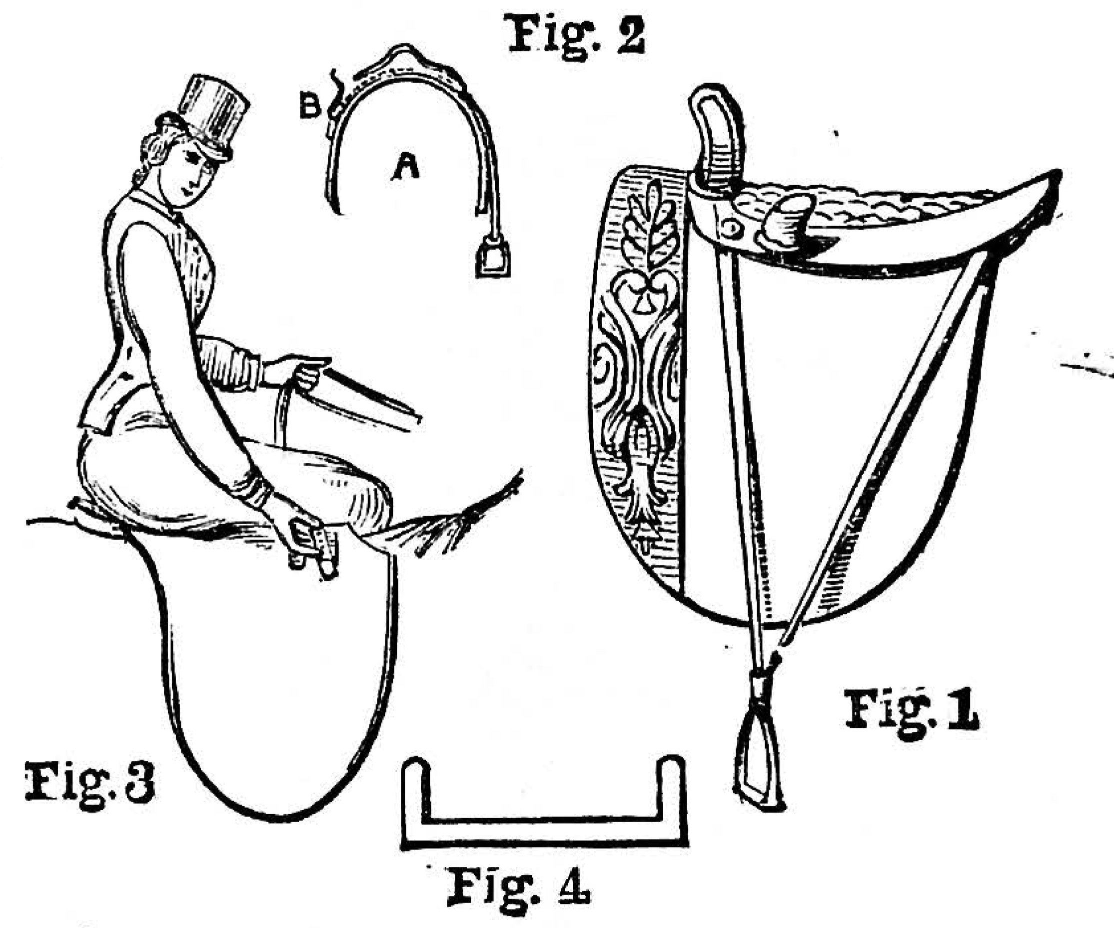
In England the large makers of saddles know more than their sewers, but it is chiefly the technical names of saddles and their prices. Whether a saddle is a good one for a horse or rider they know little, and care less, so long as it sells—that is their business, and they stick to it like men of business.

If you want to see any improvement in saddlery, do not look for it in a saddle-making town till it has had the run of England and the Colonies. One or two trading exceptions might be named; but it is with the lady's riding-saddle we are concerned, and to point out the distinct merits of pommel-fitting, and a stirrup-leather which has been tested now for some time with increasing satisfaction by users. A lady's seat on horseback is not so secure as a gentleman's, and therefore should have every improvement made prominent for trial by women riders.

Formerly there were only two pommels to a side-saddle, to hold one leg in a sort of crutch. It was to decide a wager made by two sporting men—of an aged rider with a side-saddle and a young man with a cross-saddle—that the third pommel, to go over the other leg that was in the stirrup, was suggested by Mr. F. Oldaker, of London, and by its aid the old rider beat his competitor in a race.

This extra pommel was so good that it was adopted, and the off-pommel removed as useless. This was a great advance, and a gain to women riders. The next improvement was to cut off to a level the high pommel-head of the seat; this is becoming quite general everywhere. The next improvement was the stirrup-strap girth that a lady could alter by pulling up the flap on the off side and drawing up or letting out the end of the stirrup-strap to suit the rider. This was found not safe or easy to do, so the stirrup-strap was carried obliquely to the "cantle-point" just at the off side of the seat of saddle. All these inventions were English, but called French, though not seen at French saddlers' for years till quite common in England. The side-saddle had remained as described, but still far from satisfactory, several ladies having been killed and lamed for life from these latest-improved saddles; hence the further improvement by the gentleman, not a saddler, who made the first level-top saddle for his daughter's riding.

The principle of equitation for men is "knee-grip," for women "balance." To aid the balance the stirrup is of immense help if under the equipoise of weight of rider, but if away from it, as usual, even with the best saddlers' saddles, it is deceptive in security and causes painful riding to the horsewomen and tender backs to the horses by side-wrench and rocking of saddles.



Ladies' Saddles. Fig. 1.—Improved Saddle. Fig. 2.—Section. Fig. 3.—Stirrup-Leather Buckle Position. Fig. 4.—Culvert-Plate Bridge.

The illustration (Fig. 1) shows the improved saddle with the stirrup hung so that the foot is back under the rider's weight, and cannot dangle forward. The projecting edge of seat, which is built out about 3 in. from the horse's back in most saddles, is quite removed here, so that the rider's stirrup-leg and near half-seating is quite close to the animal, and low down on his back, so that the rider is not decentralised, as by an ill-made saddle, which causes the side-wriggle of a woman when riding a trotting horse. It will be seen that the stirrup-leg pommel is about 3 in. back more than in ordinary side-saddles, and lower down on the side of the saddle. This gives the requisite power for the stirrup-leg—even when nearly straight, as it should be—an unfailing leverage to support the rider's equilibrium, forward or sideways. The front pommel checks the backward sway of the rider in the saddle by the clutch of the seat-leg.

The girth stirrup-leather is ordinarily made of great length; it hangs the stirrup from a fixed loop in the saddle, and has a double fold of leather under the stirrup-leg, then goes under the horse as a girth, up to off-side cantle; so that it is about 7½ ft. long from stirrup to altering buckle, with an indirect action. It is not easy to alter, by its complication and oblique pull through the girth-loop, and it often sets fast, and is useless; and being fixed to a loop in the saddle that gives no release in case of a dragging fall—the usual one with women riders—the stirrup-leather has no release, which is a serious matter.

It will be seen by examination of Fig. 1 that the front hanging of the stirrup-leather passes over to the off side of saddle to a buckle. This is shown in Fig. 2, a sectional view of it; and in Fig. 3 is a rider in the act of altering the length of the stirrup-leather while riding. By the illustration (Fig. 2), it will be seen that, from the stirrup, half the length of leather goes direct to the buckle near to the rider's hand for easy altering, and that the stirrup-leather is not under the rider's knee to bruise and chafe it. The improved saddle has a releasing latch at the back-hanging of stirrup-leather.

The opening at the front of saddle-seat, now common with best saddles, is covered by a thin flap of leather only, so as to keep the seat level in front. In the improved saddle the tree is strengthened by a bridge forming a culvert-plate (Fig. 4). This serves as the channel for the stirrup-leather to slide in; a roller at each end of this culvert-plate makes the strap move freely through the channel.

With such a saddle, riding is both safe and pleasant for horse and horsewoman, however long the day; and the added ease and grace of pose on horseback is material to enjoyment, as a lady is always critically scanned by fellow-riders, and feels proud of admiring glances.

The saddles being so much lower in price, by a sovereign or two, though of the best make, may be something else in their favour.

A NEW MAP OR GUIDE-BOOK REST FOR CYCLES.

BY PERCY C. RUSHEN.

The following is chiefly written for the benefit of cyclists, and consists in a few designs for a clip or appliance for holding map-books or tourist-books (to be affixed to the handle-bar) while riding a bicycle. I submit several designs, because out of ten bicycles which would be seen on a country road hardly two would be alike.

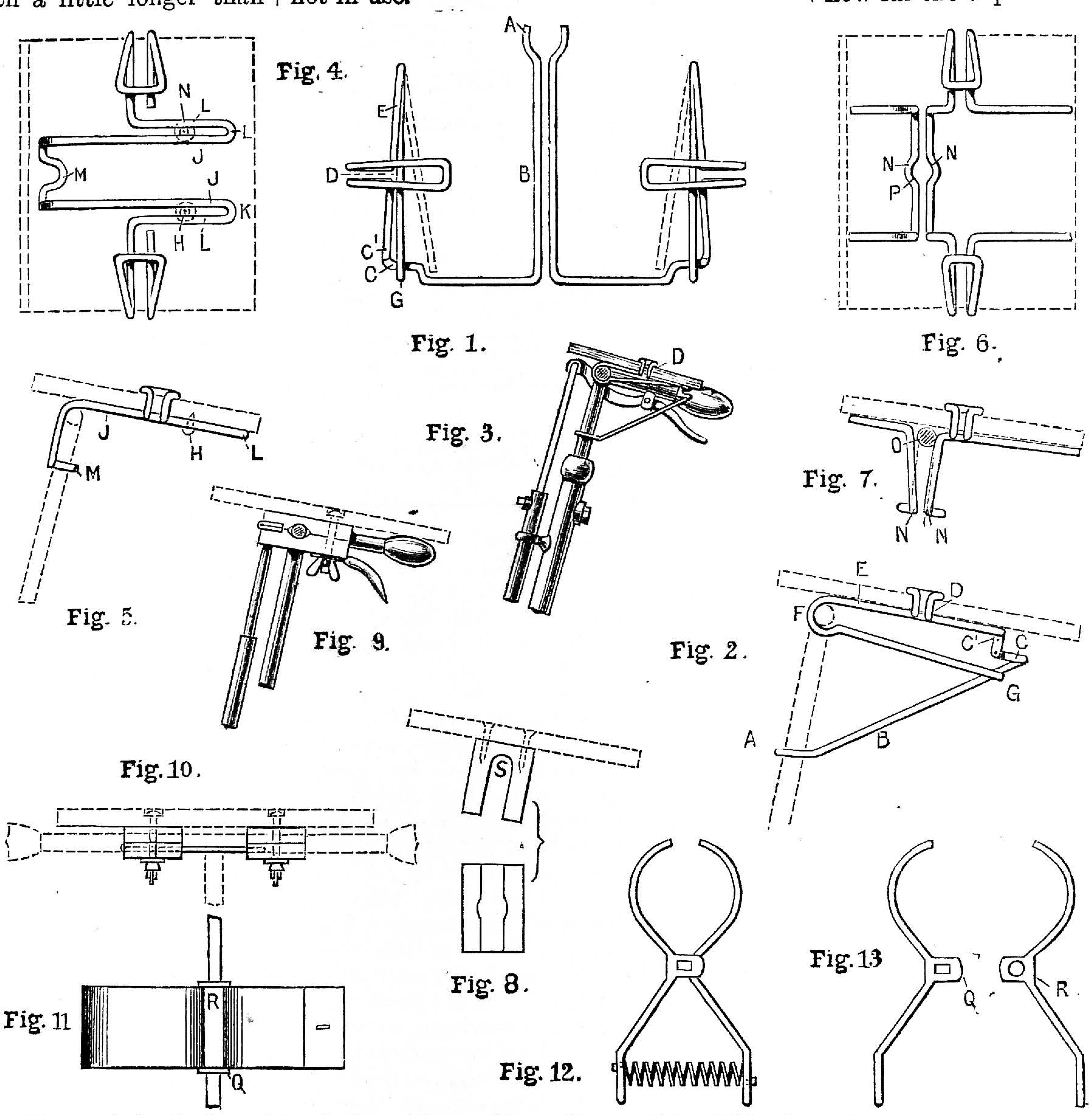
The first device, illustrated in Figs. 1, 2, and 3 of the accompanying drawings, is made out of strong wire of about ⅛ in. or $\frac{3}{16}$ in. diameter, and a piece of board of any size, preferably the size of the books you mostly study while riding. It consists of two pieces of wire bent to the shape represented in the said figures, and attached to the piece of board by staples.

Fig. 1 is a plan and Fig. 2 a side elevation of this design. Fig 3 is a side view of the same fixed on the handle-bar of a safety bicycle. Taking the end, A, of a piece of wire, it is bent in a semicircular figure as represented in Fig. 1, and for a distance of about 5 in. or 6 in. after this curve it is bent at a slight angle from the plane of the flat side of the said curve as seen in Fig. 2 and marked B. It is then bent at right angles to this length, and continued straight for about 3 in. or 4 in. Then, keeping in the same horizontal plane, it is turned inwards, that is, towards the end, for about ½ in. at right angles to the last length, and then bent back to the same straight line again as seen at C. This only continues for about ½ in. or ¾ in., when it is bent upwards for about ½ in., at the same time bending it towards the steering-post in its subsequent position on the handle-bar nearly parallel to the length, B, as seen at C¹ in the said figures. This continues for about 4 in., having preferably in its middle the clip for holding the pages of the book down when placed on the board.

This little clip, I think, needs no description, not forgetting when bending it that the parts D had better project as far as the length of the board you are going to use, no further, as it will then help to keep it in place. At the end of this length, which is marked E in the accompanying drawings, it is bent into nearly a circular figure, as seen at F in Fig. 2, and continued for a length a little longer than the length, E, as represented in the said figure, and cut off, which end is marked G. When this length of wire has been bent as described, another must be bent exactly like it, excepting that it will be bent the reverse of the one you have just bent, and after being placed in the position represented in Fig. 1, fastened permanently on the board by staples passing over the length or side, E.

When placing on the handle-bar, it must be placed a little to one side of the steering-post, to allow of the passing between the end, G, and the bent-down end of the length or side, E, attached to the board of the handle-bars. It is then slid along to the centre, and the fork composed of the ends, A, dropped on to the steering-post. The ends, G, are then slightly bent to one side, that is, towards the bent-back pieces, as illustrated in Fig. 1 in dotted lines, and then pushed back on to the inner pieces, E, and the circular piece, F, then partially grips the handle-bars. The thicker the board the better, as it is less likely to warp, and if its ends are mortised it is better still. You will find this appliance pretty firm, owing to the fork bearing against the steering-post, and when not in use it can be let down after removing the fork and let swing. If the edge of the board is found to be inconvenient to the working of the treadle, it may be fastened more towards the front of the machine still.

Another form is shown in Figs. 4 and 5, showing a plan and side elevation respectively. It is formed of one piece of wire, and the manner in which it is bent will, I think, be seen from the said figures. The board in this case is adjustable, and can be slid either towards or away from you by the screws, H, working between the parallel lengths, I, J. The screws do not require turning when first driven in just tightly enough. In placing upon the handle-bar, the wire part must be placed upside down, and the steering-post placed between the ends, K and L, and the ends then carried over the handle-bars, when it will be found to drop in its place right side up, the socket, M, receiving the steering-post. The board is then slid on from the front. Two hooks may be placed in the board wherewith to hang it on the frame of the velocipede when not in use.



Map or Guide-Book Rest for Cycles. Fig. 1.—Plan of Upper Side of Wire Rest of two Lengths of Wire. Fig. 2.—Enlarged Side Elevation of above, showing Clip before final fastening. Fig. 3.—Side Elevation of above, showing its Position upon Handle-bar. Fig. 4.—Rest made from one Piece of Wire in Plan of Upper Side. Fig. 5.—Side Elevation of Rest, shown in Fig. 4, in Position. Fig. 6.—Modified Form of Rest of two Pieces of Wire in Plan of Upper Side having a Spring Action. Fig. 7.—Side Elevation of Rest (Fig. 6) in Position. Fig. 8.—Simple Form of Rest. Fig. 9.—Clamp Rest in Side Elevation in Position. Fig. 10.—Back Elevation of Clamp Rest (Fig. 9). Fig. 11.—Side Elevation of simple kind of Clip for position upon Steering-Post. Fig. 12.—Plan of Spring Clip. Fig. 13.—Parts of Spring Clip (Figs. 11 and 12) separated.

The appliance represented in Figs. 6 and 7, which represent a plan and side elevation respectively, is perhaps more simple still. After the foregoing descriptions I think it needless to describe how this is bent, as it will be readily seen from the drawings. It is very simple to put in position, only requiring to be pushed on to the head of the velocipede, the spring ends, N, bending out to admit of the passing between them of the handle-bars into the position O, when the said ends, N, spring back again and clasp lightly the steering-post in the circular space, P.

Fig. 8 represents, in plan of underside and side elevation, a modification of the last form made out of wood, and more suited to those handle-bars which are connected to the steering-post by direct welding—that is, without the addition of a piece of angle tubing or an enlargement. A depression with a semicircular end, S, is cut in a block of wood, and the said block attached to the board by screws. To place it in position, it is only dropped on to the handle-bars.

Two pins attached to chains, placed through holes in the block on each side of the steering-post, and directly underneath the bottom of the handle-bars, prevent the uplifting and sliding of the appliance. Of course, the height of the board depends on how far the depression is cut in the wood. This appliance is very rigid.

In Figs. 9 and 10 still another convenient form is illustrated in side and back elevation respectively. It is formed of two clips, each clip consisting of two pieces of wood joined together at the front by a hinge, which clips clasp the handle-bar between semicircular depressions cut in each piece of wood, by means of bolts having washers and fly-nuts working in holes through the board and each clip. A pin passed through one bottom block of one clip, and partly through the bottom piece of the other clip, prevents the slipping away of the board downwards if the nuts are not tightened quite enough, or a wire fork may be attached to the board to rest against the steering-post.

A handy clip is illustrated in Figs. 11, 12, and 13, which may be used for many purposes. It consists of two pieces of sheet brass bent or fashioned as seen in Fig. 12, which is a plan of the same. The length and breadth are seen in Fig. 11, which is a side elevation. Fig. 13 represents the two arms separately. It will be seen that the bent-over pieces, Q and R, have holes made in them, the hole in the bent pieces, Q, which overlap those marked R, being square, and the hole in the bent piece, R, being circular to such an extent as to rotate on a square wire of the size of the square hole, Q, being placed through the holes. This wire is bent at one of its ends and attached at the other end to the board, and a strong spring placed between the two ends of the arms in the manner shown. This is adjustable, and can be used by itself for many purposes; or one arm may be made flat and screwed on to the bottom of the board.

WORK

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.

TERMS OF SUBSCRIPTION.
(*Sent post free to any part of the world.*)

3 months, free by post	1s. 8d.
6 months, "	3s. 3d.
12 months, "	6s. 6d.

Postal Orders or Post Office Orders payable at the General Post Office, London, to CASSELL and COMPANY, Limited.

TERMS FOR THE INSERTION OF ADVERTISEMENTS IN EACH WEEKLY ISSUE.

	£	s.	d.
One Page	12	0	0
Half Page	6	10	0
Quarter Page	3	12	6
Eighth of a Page	1	17	6
One-Sixteenth of a Page	1	0	0
In Column, per inch	0	10	0

Small prepaid Advertisements, such as Situations Wanted and Exchange, Twenty Words or less, One Shilling, and One Penny per Word extra if over Twenty. ALL OTHER Advertisements in Sale and Exchange Column are charged One Shilling per Line (averaging eight words).

Prominent Positions, or a series of insertions, by special arrangement.

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

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

ELECTRICITY FOR HORSES.—The uses of lightning are endless; one of the very recent ones is to stop runaway horses in pleasure carriages. There are few families of eminence in England but what have suffered from carriage accidents or bolting saddle-horses. The invention of the use of an electric discharge into the nostrils of a horse is known to cause him to stop instantly. Why, we cannot stop to inquire. Horsemen know what a nervous animal is the horse, and that fear is the prime cause of bolting. The shocks to the brain of the horse at the inner part of the nostril seem to paralyse its impulse to run. Two metal balls are fixed on copper wire which branches from a stem applied to the front of the nose-band; within the nose-band, the connecting wire is carried to the sides of the nose-band, and from thence to the carriage, as extra reins would be. A push-button connects them with a dry battery in the carriage, so that it is somewhat like the operation of an electric bell arrangement. A button for the coachman may be supplemented by one for a rider in a close carriage in case of an accident to the coachman. Trials recently by an American gentleman proved effective; a runaway pair of horses was stopped instantly and began to "back" till pacified by one of the party going to their heads. Coach-makers, harness-makers, riders, and drivers, will have to study their respective parts, and operate with critical accuracy what each has to do to ensure efficiency without added risks. Harness-making is in a low state just now, both as to its efficient make for restraining horses, and its fitness to prevent backing, rearing, or kicking—we refer to the machine and slop-made harness—so that the work and the workers may be bettered by this new fitting. Nose-bands will have to be made rightly, and held by the check-pieces properly; now only a few are so; with the general run of riding and driving bridles they are defective. It is proposed to apply the electric wires under the girth for stimulating shocks to make the horse go; this is not desirable. The poor animal has enough stimulating persuasion from the whip and voice. The electric current had better be applied to act as a motor to move the wheels of the carriage, and help the horse.

FREE TECHNICAL SCHOOLS.—This large and important question seems likely to receive a share of the attention it deserves at the hands of the London County Council. We need scarcely say that this should be so, and as it is a matter which we have much at heart, we shall watch it with the greatest possible interest, and give any well-devised measures our full support. With our many thousands of technical readers throughout London and the country, we know something of the wants and requirements of the professional worker as well as the amateur. The existing provisions for technical education in London are lamentably inadequate, and what exists in the way of necessary machinery for technical education of youths and workmen is surrounded with deterrent conditions, which render it useless for the very people who most need it. We maintain that if there is a need in the London parishes of a free public library, a free technical school is a still greater want; and these should, if possible, be worked in conjunction with the Board schools. In these latter we are educating the children of the masses up to a fine point, only to leave them at the moment when they most need opportunity to enable them to become dexterous workmen instead of clerks and kid-gloved gentlemen. The ratepayer would do well to face an increase in the rates for the establishment of free technical schools rather than make a rod for his own back by slowly eliminating the British craftsman as is now being done under the system of educating him in everything else but his craft. Mr. Sidney Webb, the Chairman of the Special Committee on Technical Education, sees the importance of the situation, and has urged it upon the Council. We trust that the £500 which is asked for to defray the necessary expenses of suitable inquiries into the existing provisions for technical education is but the prelude to some such grant as £500,000 for the cause of craft instruction in London alone—a sum of money which the country, and not poor ratepayers, should pay, saving it in some of the many directions where it is uselessly and wastefully thrown away for mere bauble purposes. Parliamentary candidates should take note.

CARPENTRY AND JOINERY.—An exhibition of works in wood has just been held at Carpenters' Hall under the auspices of the Worshipful Company of Carpenters and Joiners. The carving exhibits were very good, but looked at from a joiner's point of view, were very meagre indeed. It is a difficult thing to get a thorough exhibition of joiners' work, because joiners' work proper is of no practical use except for the particular purpose for which it is designed; yet surely such an influential body as the Company of Carpenters and Joiners could prevail upon the leading firms of builders and joiners to lend, for the purpose of exhibition, various pieces of work that are from time to time in hand. Such examples might be left unpolished and sent in, and then taken away and polished as they are required; this would give joiners and the public generally a very good idea of what work in wood really means. The work shown by the students of various technical classes, though commendable enough, was a long way behind that of the continental schools.

A COLLAPSIBLE TENT FOR RIVER OR SEASIDE BATHING, ETC.

BY ONE WHO MADE IT.

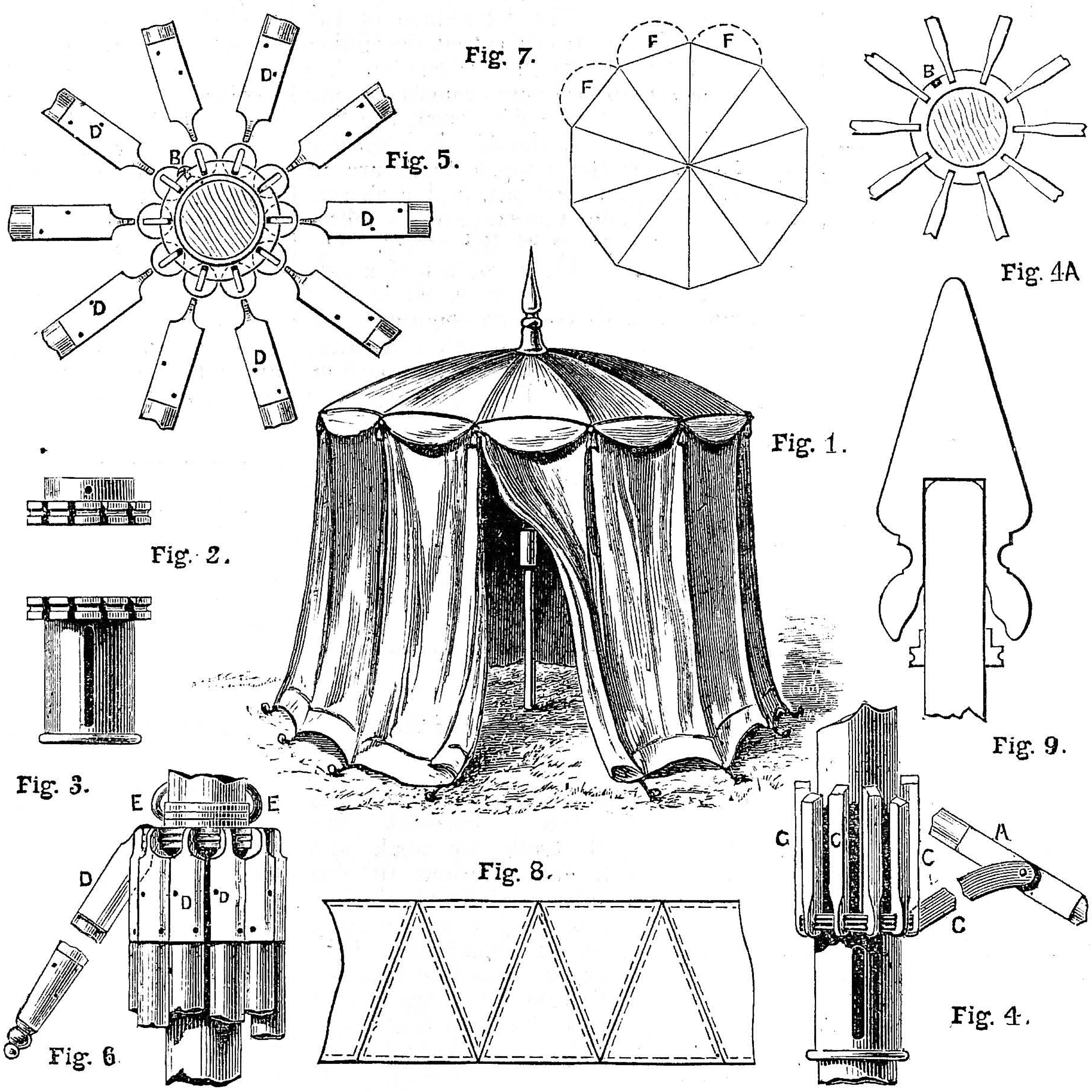
THE collapsible and portable travelling tent which I am about to describe will, I think, supply a long-felt want—viz., a tent that can be easily and cheaply constructed, adapted for use on the sea-shore, river bank, garden, or elsewhere.

There must be a great number of people who have got stowed away in some corner or lumber-room an old-fashioned "gingham," or gig umbrella. For certain, a great many must be scattered all over the country somewhere.

Anyone who possesses one of the above has an excellent foundation for a "portable tent"; and even if there is not one in the house, a few inquiries would be almost sure to bring one to light in that of a friend's; and failing this, there would be very little trouble in buying one at an umbrella maker's for a shilling or two; but one should be selected (if there is a selection) with the ribs as stiff as possible.

Those readers who desire a tent of the above description (see Fig. 1), and who have not got, and cannot readily purchase, an old gingham frame, can buy all the fittings through an umbrella maker at a very reasonable figure, and by following the method I shall now proceed to explain, can easily make the thing complete themselves. Those who are fortunate enough to have a frame by them need not trouble themselves with that part of the description relating to it.

We first require two strong 1 in. hardwood sticks, about 3 ft. 6 in. long each. An agricultural tool handle will do if you cannot get what you want at the place you buy the other fittings. Joint these together by means of a piece of brass tube about 7 in. long, about 3 in. of which should be fitted and driven on one end of what is going to be the top piece, and secured firmly to it with screws, and the end of the other, or bottom stick, should be made to fit nicely into that part of the socket left, so that these two sticks form one. The bottom part should be pointed, to enter the ground or sand, like a cricketing-stump, but, of course, a little further. These two sticks make the pole of the tent when complete.



A Collapsible Tent. Fig. 1.—The Tent complete. Fig. 2.—Notch. Fig. 3.—Runner. Fig. 4.—Elevation showing connections of Stretchers, Ribs, and Runners. Fig. 4 A.—Plan of Runners, showing Stretchers connected and open. Fig. 5.—Plan of Notch and Ribs, also Ribs detached and opposite their respective Grooves. Fig. 6.—Elevation of Ribs shut and connected to Notch, with one Rib partly open. Fig. 7.—Plan of Roof. Fig. 8.—Width of Fabric, showing Method of cutting Segments. Fig. 9.—Finial. A, Thin Tube; B, Grooves for finishing off Wires; C, Stretchers; D, Ferrules; E, Wire securing Notch to Stick; F, Lappels.

We now require the notch (see Fig. 2), runner (Fig. 3), stretchers (Fig. 4), ribs (Fig. 5), ends for ribs (Figs. 5 and 6), and springs.

First get your ribs (which should be of cane, about ½ in. in diameter) all to exactly the same length—say 3 ft. 2 in.—and fit and fix the top and bottom ends, or ferrules, on, either by rivets or by making several indents in them with a sharp tool. Now measure down from the eye of the top ferrule the exact length of the stretchers, which will be about 1 ft. 4 in. long, and this will give you the position for the holes for the rivets for the top of stretchers (Fig. 4). Split pieces of very thin brass tube, about 2 in. long, and pass it round the ribs (as shown at A, Fig. 4), and secured by indenting it as described for ferrules; keep the joints on the outside of ribs, and then drill the holes for rivets, and rivet the tops of stretchers to them, allowing the stretchers to hinge freely.

Now secure the top of the ribs to the notch. To do this, pass a piece of stout wire through the eyes of top ferrules, and, holding the notch in position, with the ribs in their respective grooves, by means of a pair of pliers, turn the two ends of the wire round and round until you tighten it into the hollow of the notch, and fasten the wire off opposite the cut (shown at B, Fig. 5). This wire forms the centre on which the ribs work or open, and when shut should appear as Fig. 6.

The bottom ends of the stretchers should now be secured to the runner in the same manner, and when so secured, should appear as Fig. 4.

If the stick is next passed through the runner and notch, and the latter temporarily fastened in its place, you can, by raising and lowering the runner, see where to put the springs. Now take out the stick, and let in and fix the springs, after which the stick should be replaced, and the notch properly secured to it by passing a piece of stout wire through both and fastening off the ends (as shown at E, Fig. 6).

The frame is now ready for covering. I have purposely made the above explanation very brief, because everyone possesses such an excellent example in an ordinary umbrella of what I mean.

Now for covering. The material, of course, depends on the amount of money one wishes to spend; and as one of the greatest recommendations of this tent is its extreme cheapness, I should suggest unbleached calico. This material is not water-proof, neither is it as suitable in many respects as others I could mention, but it is very cheap. A great many people think that it is a very difficult matter to cover an umbrella; but it is not so, as the following description will show.

There are ten spaces between the ribs of the frame in question, each of which form an isosceles triangle, their bases being the sides of a ten-sided figure, or "decagon" (see Fig. 7). Now, all that is necessary to do is to cut ten equal triangles, with their two long sides the exact length of the ribs, from the hole at the points to the centre of the stick, allowing for the seams. These segments should be cut on the "cross," as it is termed—that is to say, the height of the triangle should be the width of the stuff (see Fig. 8). Then sewing these segments or triangles together, we have a complete decagon. Now pass the top of the stick through the centre, and firmly bind the ends of the various pieces to the stick, just on top of the notch, with strong waxed thread, with the frame unopened. Next firmly stitch with strong thread the other ends to the holes at the points of each rib, and just above and below where the stretchers hinge to the ribs.

Now carefully open the frame, and you will see that the stuff will give to the bending of the ribs, and a nice tight cover will be the result.

The stuff being cut on the cross at the seams allows of its being drawn up to the necessary curve, and not being cut curved, as is generally supposed, this draws the bottoms up ; so I should advise anyone who has not done this sort of thing before to allow sufficient material on the bottom of segments to form the flaps or lappels (as shown at Fig. 7), and cut and bind them afterwards.

The walls are formed by sewing ten pieces of the same material together, their widths being the same as the length of the bases of the triangles. The heights or lengths are, of course, determined by the length from the bottom of roof when the pole is stuck in the ground or sand. There is no necessity to make a joint at each corner if the material is wide enough to make two or more sides; but the narrower the material used the cheaper it is, as a rule.

To secure the walls to the roof, firmly sew by the middle a piece of strong tape, about 15 in. long, to the joint of each side, about 1½ in. down from the top on the inside, and by passing each end over its respective rib, just above where the covering is secured to the point of the rib from the inside, and tying them, the walls or sides are secured to the top, and the lappels hide the joints. The opening, or doorway, can be secured with large hooks and eyes or tapes.

If the tent is proposed to be used for the sands, pockets should be formed all round the bottom of the sides on the outside, and by filling these pockets with sand or stones, the tent is held securely in its position. By sewing cords at the bottom joints of the sides, they can be secured to tent-pegs driven in, in the ordinary manner, on any sort of ground.

The ends of the fabric above the notch should be covered with a turned finial (as Fig. 9).

The approximate prices for the various fittings are as follows :—Notch, 7d.; runner, 9d.; stretchers, 2½d. each ; ribs, 3d. each ; ends for ribs, 1½d. each ; sticks, 6d. each.

HELICAL GEARS.

BY J. H.

Principles of Formation.

Proposed Treatment—Sense in which the Term "Helical" is Used—The Principle of the Helical Tooth — Definitions — Method of Contact—Helical Bevels—Development of a Helix upon a Cone—Principle *v.* Practice.

Proposed Treatment. — This paper is written in response to a request from a correspondent. The querist, being a pattern-maker, asks specially for information relative to the making of core-boxes. In order to render my reply useful to pattern-makers in general—and especially to those who may have to make helical tooth blocks for wheel-moulding machines—and also to engineering readers, I propose to give a condensed account of the principles, as well as the practice involved in the construction of helical gears.

Sense in which the Term "Helical" is Used. — At the commencement I must, in order to guard against possible hostile criticism, say that whenever I use the term "helical teeth," the *double* helical type is always meant. Single helical teeth are seldom used, because of the unbalanced diagonal pressure transmitted through them to their shafts.

The Principle of the Helical Tooth.—A helical tooth is, in principle, a very short section of a screw of very long axial pitch. By axial pitch is meant the total longitudinal distance traversed by a helix in making one complete revolution. Thus, in Fig. 1, A is the axial pitch. The parent of the helical tooth was the old stepped gear (Fig. 2), the invention of Dr. Hooke, which may be seen even now in the racks of many planing machines. The advantage of the stepped gear consists in this: that the sliding and rubbing of the teeth over one another which occurs in ordinary wheels during approach to, and recession from, the line joining the centres of the wheels, is greatly minimised ; for the stepped teeth are in effect cut into short sections, and each section is set a little in advance of its fellow around the periphery of the wheel. The total rolling and sliding contact of a pair of ordinary teeth is, therefore, divided and apportioned equally between the number of slices into which the stepped teeth are divided, and are reduced exactly in that proportion. A given pair of stepped teeth, during their total contact from one side of the wheels to the other, make as many distinct contacts as there are steps, and these contacts take place approximately, though not entirely, on the line of centres, and back lash is lessened. But then, the stepped teeth are weak and difficult to make, and injurious rubbing and sliding are only partially eliminated. Their advantages scarcely counterbalance their disadvantages, and hence they have never been popular, or come into common use. But now obliterate the sharp angles, merge the steps into a smooth continuous helix, and we have the typical helical tooth.

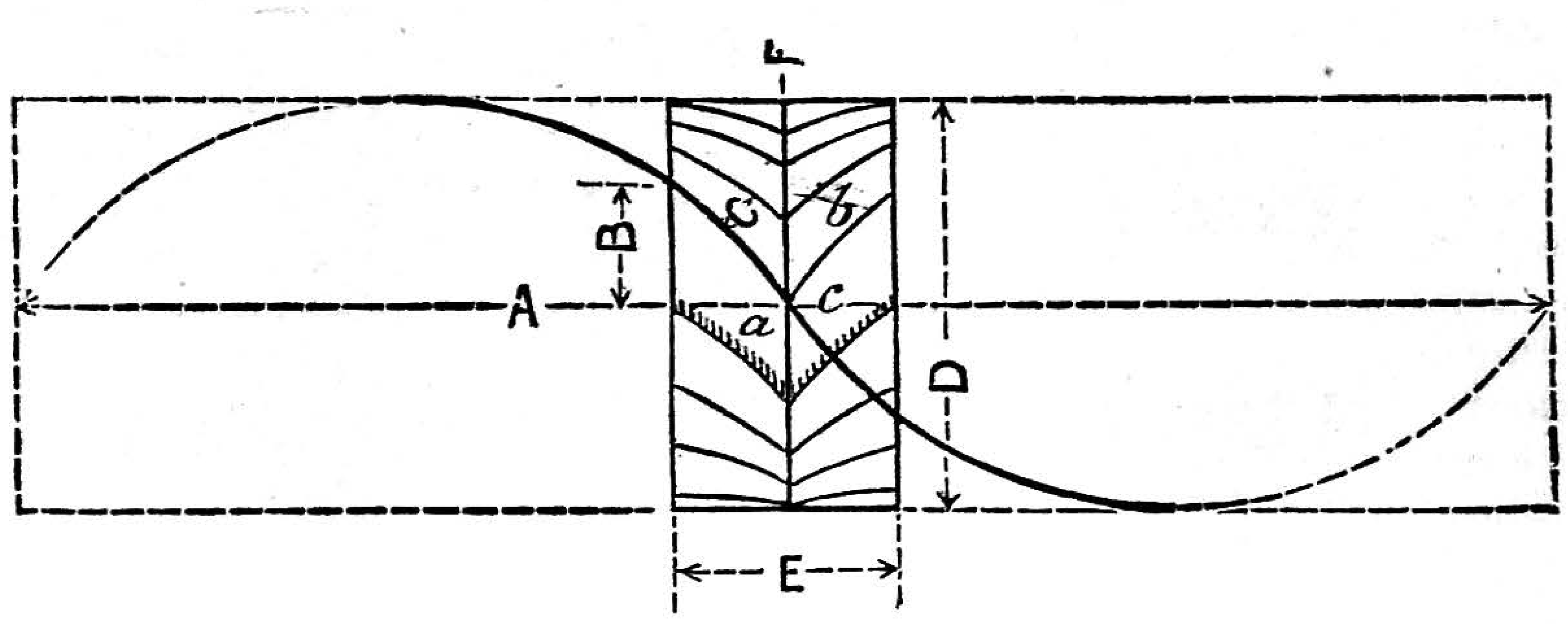


Fig. 1.—Diagram to illustrate the Relation of the Helical Tooth to the Screw.

Definitions.—In Fig. 1, A is axial pitch, B circumferential pitch, and C normal pitch ; B is the only pitch which is required to be known ; D will represent the pitch diameter of the wheel, and E its breadth ; F is its middle plane. We have, therefore, single helical teeth, *a*, *b*, to right and left of F, each tooth forming a short portion of a long helix of axial pitch A, developed on a cylinder of diameter D.

Method of Contact.—In the teeth of a pair of such wheels gearing together, mutual contact continually occurs exactly upon the line of centres passing through the wheels. The path of contact travels across the wheels from side to side, as at A (Fig. 1). For an instant, and only for an instant, each successive section of a pair of teeth is in gear, and the total action is the same, and as devoid of injurious rubbing and sliding as that of two smooth screw threads rolling in contact.

Helical Bevels.—In helical bevel wheels the action and the principle are exactly the same as in helical spurs. A bevel wheel is in principle a frustrum of a cone. The tooth of a helical spur wheel is a section of a helix developed upon a *cylinder*. The tooth of a helical bevel wheel is a section of a helix described on a *cone*. A helix can be developed upon a cone as well as upon a cylinder. Into the primary methods of describing these helices we cannot enter much here. They can be drawn upon a revolving cylinder, or upon a cone, with a marker held in the slide-rest ; or they can be drawn by dividing the axial pitch and the circumference of cylinder or cone into the same number of equal parts, and delineating the helix through successive points of intersection.

Development of a Helix upon a Cone.—Fig. 3 represents the development of a helix upon a cone. The base, A, of the cone, and the height, B, are divided out as shown, and right and left-handed helical curves, C, D, drawn through successive points of intersection. Substitute teeth for these curves, and we have a helical bevel wheel, in which A is the major pitch diameter, E the minor, F the middle plane, and G the breadth of rim. A little examination of the figure will render the relationship of the lines clear. A number of horizontal lines are omitted in the elevation of the cone.

Principle v. Practice.—Yet these fundamental principles and methods, which it is necessary to know in some kinds of work, are not actually applied in the practice of helical wheel construction. We do not even want to know the axial pitch of the segmental teeth of helical wheels. But, then, it is obvious that the amount of *slope* or *twist* given to the teeth is of importance. If it is too little in amount, one pair of teeth will be quitting gear before the succeeding pair touch each other, and the action will be jerky ; if it is too much, there will be prolonged contact of the first pair during the early portion of the engagement of the second, with consequent undue friction and liability to fracture. The slope of the teeth is, therefore, settled, not with reference to axial pitch, but with reference to the circumferential pitch (Fig. 1, B) and the width of the wheel—the condition being that the engagement of one pair of teeth shall terminate simultaneously with the commencement of the engagement of the next pair. This relation is shown in Figs. 1 and 3 by the lines *c* in each figure touching the apex and the base of contiguous teeth. Hence the coarser the pitch and the narrower the wheel, the greater will be the slope of the teeth, and *vice versâ.* The slope will vary in different wheels by as much as 40 or 50 degrees.

When large wheels—and even those of moderate diameter — are concerned, the screw-formation of the gear may be practically ignored, and straight teeth—*i.e.*, teeth without any twist whatever—be fixed diagonally on the pattern block. The reason is, that in these wheels the length of the teeth bears so small a relative proportion to the axial pitch of the fundamental screw and the diameter of the primitive cylinder, that the twist upon them is quite imperceptible. In these, therefore, straight teeth are used. But as wheels diminish in diameter, or are increased in breadth, the fundamental screw-formation must be adhered to, in order to correct working.

MEANS, MODES, AND METHODS.

NEW PLANES.—New planes are often a source of trouble to an amateur, and very often professional workmen are troubled with new planes choking up—the shavings get fast in the mouth, and the plane refuses to take any more until the wedge and iron have been removed, and all cleared out. The reason of all this difficulty is that the "eye" or "mouth" of the plane is too small. Sometimes workmen cut a little out with a chisel, but it is a practice to be strongly condemned, for in many instances it results in spoiling the tool. In a short time the bottom of the plane wears away, and consequently the mouth gets larger; and in course of time it gets so large as to require a piece planting in to enable it to work clean. What we want, then, is something that will open the "eye" of the plane as long as needed, and when the plane bottom is sufficiently worn it can be placed back in the original position. This can be effected by cutting a strip of soft leather, about ¾ in. wide, and gluing it down in the mouth of the plane under the top end of the iron; this will cause the iron to be more upright, and consequently a larger opening in the mouth (two thicknesses can be put under, if necessary). It will then be found that the plane will clear itself and work nicely. When the plane bottom has worn a little, the leather may be removed; and after the plane has worn away so much that the "eye" becomes too wide to work nicely—especially with smoothing planes—a piece of leather may be glued in the mouth under the bottom end of the iron, which will cause the iron to come nearer to the wood and closer in the "eye." The leather forms a bed for the iron, and the plane will be found to work much sweeter, and to clean up cross-grained wood better.—H. H.

ABOUT THE CAISSON WORK OF THE FORTH BRIDGE.

FEW persons, besides those technically acquainted with this stupendous monument of modern engineering, can intelligently grasp the details of it. They hear, in a general way, of the Forth Bridge (or the Tay Bridge) being a mile and a half long, and that it contains so many tons of steel. They admire the fine structure, but perhaps they do not think that the wind may, and can, exercise a pressure on it of twenty pounds to the square foot; but a resistance of fifty-six pounds per square foot has to be provided for—an impossible pressure!

The Forth Viaduct is 1½ miles long; the total length of the bridge and approaches is upwards of 1¾ miles. The actual lengths of the respective approaches and the spans are as follows:—

From Queensferry side to span, 1,979 ft. 11 in., ten spans of 168 ft. each being included in this approach. The first span from that side measures 689 ft. 9 in.; the two great centre spans are 1,710 ft. each, and either would comfortably hold the Eiffel Tower within its length. The Fife span is, again, 689 ft. 9 in.; and the length of its approach, including five small spans of 168 ft. each, is 966 ft. 7 in.

A few more plain facts ere we describe the work. The foundations are carried 88 ft. below the surface. The weight on the base of a single circular pier is 16,000 tons!

The total height of the Cantilever Masonry Pier above *high-water* mark is 209 ft., while it measures 240 ft. in girth. There are twelve circular piers, of which half were constructed by pneumatic caissons, the men working in compressed air.

There are steel plates of 1¼ in. thick in this structure, and tubes 38 ft. in circumference, while upwards of 40 miles of steel plates have been employed in these tubes alone! The channel is more than 200 ft. deep; and with these data before us we may form some opinion, and gain some impression, of the Forth Bridge and the work it demanded.

Besides some 55,000 tons of steel, there are 140,000 cubic yards of masonry. The strength of the structure is made to equal a tension of 30 tons to the square inch. The rolling load, or weight of traffic, was tested up to 1 ton per foot, or "two long coal trains, two engines and tenders, and sixty waggons each on both lines, at once on the bridge."

These were some of the questions or, rather, problems which had to be solved before the bridge could be pronounced secure.

Yet a great deal had to be done before the engineers reached such a stage, and of all the many interesting portions of the work, perhaps the foundations of the piers were the most

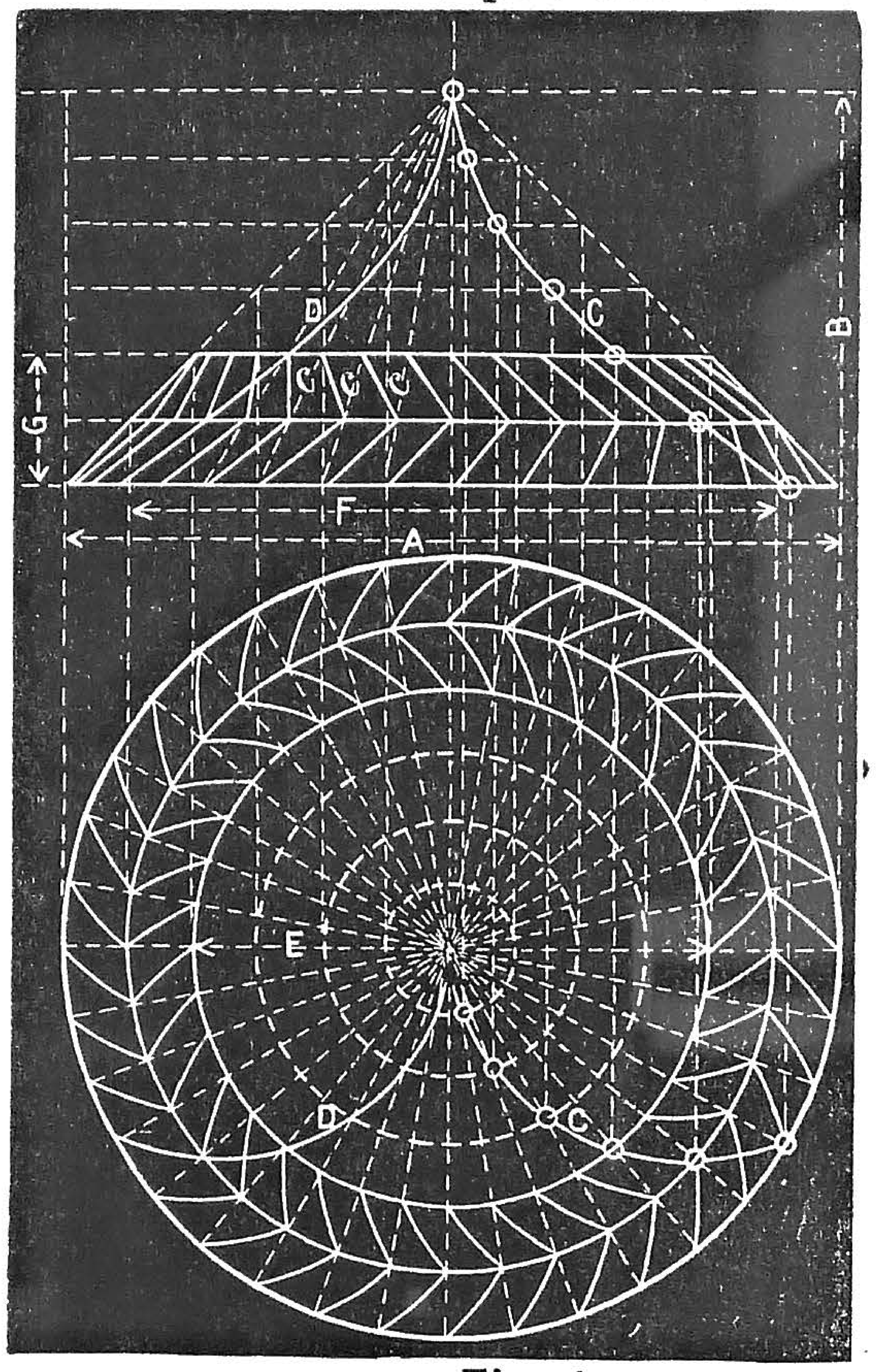


Fig. 3

Fig. 2

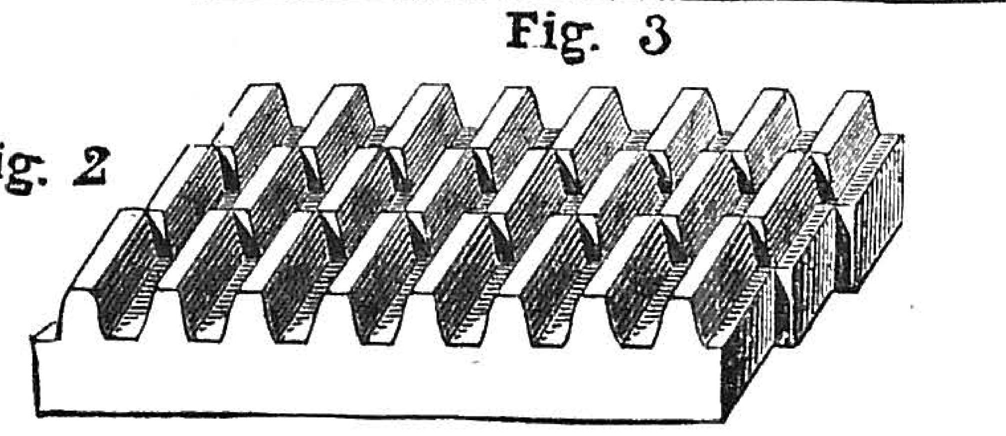


Fig. 2.—Hooke's Stepped Gear. Fig. 3.—Development of a Helix upon a Cone.

striking. These foundations, upon which the cantilevers were to rest, were sunk in the bedrock and boulder-clay of the estuary. Of course, the work was done under the water, and we will just describe how it was done.

Take the South Queensferry pier. The caissons in which these foundations were laid had to be specially constructed. They were immense coffer dams, 70 ft. in diameter, and were sunk by air-pressure. These immense cylinders have the concrete built within them, and four piers were thus built.

The caissons were sunk about 83 ft. into the estuary after having been carried out on iron cradles These permanent caissons consist of an inner and an outer shell. In the base is a space denominated the "working chamber." Above was an *air-tight* roof supported by girders. The air inside the caisson was compressed, and of much higher pressure than the water outside it. Consequently, as this great chamber was slowly pressed down, the water and the silt and sand, diluted, were ejected by pipes. Men "liquefied" the more solid mud, and sent the stiff clay up to an outer platform to be thrown away.

The rim of the cylinder cut down lower and lower; and as fast as the soil and water were thus forced into the space it was discharged by the occupants working in the air-chamber, and secured by air-locks. If you stick a roll of stiff paper endways into some yielding material, and pick the inside of the roll clean continually, you will understand the situation.

At length, after much effort and hard work, the caisson or cylinder rested upright and firmly at the bottom of the Firth. The water, mud, and silt had all been sent out and sent up. In the immense, hollow, air-tight chamber, or compressed-air chamber, the men worked under unnatural conditions of pressure. They had now to fill in the caisson to the top (low-water mark) with concrete for the foundation.

How could they get the concrete into the air-tight caisson? Very easily, as it proved. Above, of course, the air was at its usual pressure; a kind of passage with two doors, air-tight, was made, and when the upper door was shut the passage or "lock," as in a canal, was full of air of the ordinary kind. But by opening a tap into this air-lock, compressed air of the same pressure as the lower and working chamber was admitted. The lower door was then opened, the concrete shot down, and the men at once began to lay it on the floor, etc. The lower door was then shut, the upper air admitted, pressure with the outside world equalised, and so *da capo*—filling above, and emptying below. Thus the caisson was packed and rammed full of concrete, the level rising gradually. Working in these chambers is unpleasant at first, and there is much singing in the ears. It is hard to work in such pressure of air; speaking and hearing are difficult, and one cannot whistle! Sickness sometimes supervenes, and on emerging there were cases of paralysis. Our own experience was confined to bleeding of the nose and much discomfort in the head, with a dazed sensation for a couple of days.

Nevertheless, the work was continued. Electricity restored the afflicted, but new hands were continually required. At length the foundation reached to one foot of the top—low-water mark; and here the granite-faced superstructure was commenced. Timber stages were erected, cranes fixed, plates and beams, etc., hoisted up. The steel work was fixed on these platforms, and fastened; the stages were gradually raised as the work proceeded. No scaffolding was employed. The bridge was commenced outwards from the piers on the cantilever system—a kind of mutual bracket support, the structure being gradually added to as each portion was fixed; each piece supporting a successor, and being braced by opposing stresses. Thus the structure is rigid.

Sir B. Baker described the principle so well and so simply at the Royal Institution, that we cannot do better than quote him:—

"Two men seated on chairs extend their arms, supporting them by grasping sticks resting ('butting') against the chairs. This represents two double cantilevers. The central beam was, in this case, represented by a short stick slung from the near hands of the two men, and from the anchorages of the cantilevers by ropes extending from the other hands of the men to a pile of bricks. When stresses were brought to bear by a load on the central beam, the arms and the anchorage ropes came into tension, the sticks and chairs into compression." So rigidity and compensation of structures is the result.

This is, briefly, the idea of the cantilever system. On the Forth Bridge the superstructure of the main spans is composed of three great double cantilevers, which rest on the piers. The centre one is 1,620 ft. in length, the shorter pair being 1,505 ft. each. The centres of the wide spans are formed of girders 350 ft. long and 50 ft. deep in the middle.

From these details we may form some notion of the immense mass of material with which the engineers had to deal, and the tremendous difficulties to be surmounted. All these were happily overcome, and when the railways get into thorough working agreement, and the stations are equal to the autumn traffic, the real advantages of this splendid viaduct will be perceived, and the expenditure (£1,600,000) will not be unproductive.

TRADE: PRESENT AND FUTURE.

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

Iron, Steel, and Coal Trades.—The collapse of the Durham strike has restored tone to a somewhat weak market. Hematite stocks have been all but exhausted, and will rise slightly. In coal, appearances seem to point to an early reduction in prices. In railway material, orders are still coming in freely. There is also an increased call for material to be used in the staple trades. The stove-grate industry has improved slightly, and brass-workers are busier.

File, Saw, and Tool Trades.—For files, saws, shipbuilding and other tools, there is but little wanted. The engineering trades are brisk, and the wire trade is firmer. Rolling mills are not doing average work.

Cycle Trade.—Trade is at its height, extending even to Malta, where the Crypto Cycle Company have filled three orders for geared ordinaries. The North-Western Cycle Company, Manchester, have been awarded the gold medal at the Sportsman's Exhibition. Mr. R. A. Vogt, one of Scotland's foremost path racers, is pushing the sale of the Elswick cycle, a machine which has taken immensely with Scotch riders.

Jute Trade.—In Dundee business is confined within the narrowest possible limits. In the linen trade a moderate degree of activity prevails, and values are maintained. The reports from France and Belgium regarding the new crop of flax are not favourable.

Plumbing Trade.—What promises to be a somewhat serious labour dispute is in progress at Bolton, where the master plumbers and glaziers have decided to lock out the men pending settlement of a dispute which has occurred as to the non-union hands who have been lately imported into the town.

Building Trade.—This trade is in fair condition in the West of England. More bricklayers, etc., are required. There is no sign at present of an end to the strike at Cardiff. In Rochdale and district all branches are busy. The stonemasons are still out on strike. At Stockport a strike of bricklayers' labourers has taken place, the men standing out for an increase of from 5½d. to 6d. per hour. It is stated that 6d. per hour is the rate prevailing in most of the towns round Manchester, while in the latter city 6½d. per hour is paid.

Engineering Trade.—Business remains in a dull state. Locomotive builders are somewhat better situated for work than they have been during the past month, and one or two large orders have been booked for cotton machinery, intended chiefly for abroad. Boiler makers continue to be fairly well employed, but there is little doing in the stationary engine branch; while machine tool makers have great difficulty in finding new work of any kind. The Whitsuntide holidays have unsettled the iron market, but the prices of outside brands of pig iron have fluctuated considerably of late. The demand for steel boiler plates has remained fairly steady. The shipbuilding and marine engineering industries continue in the same depressed state, with the exception of Barrow, where work is still plentiful.

Silver and Cutlery Trades.—There is not much alteration in the volume of trade in the silver and allied branches of trade. The cutlery trade is inactive, excepting in the more valuable departments.

Tin and Sheet Metal Trades.—Manufacturers in the London district are fairly well engaged. Country reports also indicate increased activity. Dairy appliance makers are doing a brisk trade. The London tin-plate market shows a slight improvement. South Wales and Monmouthshire are doing a heavy export trade. The galvanised sheet trade is in a very low condition.

SHOP:

A Corner for Those who Want to Talk It.

I.—Letters from Correspondents.

Maori Ornament.—J. W. P. (*Holborn, W.C.*) writes:—"Referring to the article on 'Design and Decoration of all Ages' in Work, No. 163, it may not be generally known that the Maories, or natives of New Zealand, derived the motive of much of their ornament from the convolutions seen in a transverse section of the tree-fern. I may add that in the early days of the settlement lengths of this tree-fern were used extensively for drain tiles, the soft inner pulp speedily decaying, and the outer fibre also becoming readily disintegrated, leaving a horn-like structure of generally annular form, which answered the purpose admirably."

5-oz. Egg.—G. W. (*Monmouth*) writes:—"On April 30 a Minorca hen presented us with an egg, 5 oz. in weight, 8¾ in. girth long way, 8 in. girth small way. On examination, I found it contained a usual sized egg in centre, shell and all complete, and was filled up between shells with white. I have damaged the outer shell a little in trying to blow it, as it was my intention to have kept the shell."

Horse-Power.—F. B. C. (*Liverpool*) writes to H. B. P. (*Stockport*):—"Thanks for letter. Watt's experiment has been doubted by some, and it has even been published in 'The Manufacturer's Gazette' that the figures actually obtained by Watt were 22,000 foot-pounds; but to encourage his business, he offered to sell engines reckoning 33,000 foot-pounds to a horse-power. Whether this be true or not I cannot say, but many think that very few horses could do 33,000 foot-pounds per minute continuously for eight hours. This is, however, a matter of small moment, and it is sufficient that the unit called a 'horse-power' is equivalent to 33,000 foot-pounds per minute. It is an 'arbitrary' unit, because no unit based on such variable conditions as a horse's state of health, treatment, and capability of work can ever be absolute; and, further, because a 'foot' is an arbitrary unit of length, and a 'pound' an arbitrary unit of weight."

II.—Questions Answered by Editor and Staff.

Scene Painting.—G. A. S. (*Old Trafford*).—A series of papers on Scene Painting appeared in the following numbers of Work: 92, 95, 97, 101, and 103.

Brass Handles.—W. B. (*Northumberland*).—You had better consult the hardware fittings dealers in your own town, and, failing these, get one of them to send your sample to Birmingham. If it can be matched anywhere, Birmingham is the place.

Tinman's Tools.—W. S. (*Barking*).—The machine you speak about is called a "jenny," and you could not make one yourself, or anything simpler, that would answer the purpose, except a half-moon stake, and that will only do one of the numerous things that can be done with a jenny. The price of a jenny, small size, is about 30s. Consult the articles in Vol. II. of Work for description of this and other tools.—R. A.

Green Stain.—H. E. T. (*Harrow Weald*).—The usual staining medium is verdigris steeped in hot vinegar, though I have found the aniline dyes, such as Tomlinson's, very good. The olive-green colour to which you refer is much in vogue in America for small tables, etc., and is gained by giving two coats of green stain and one of black; or the work might be stained green, then use a black filling-in previous to polishing, which latter, by the way, should be done by the white or transparent polish. H. C. Stephens' stains can be procured in most large towns either in liquid or powder form; they include two shades of green.—Lifeboat.

Sheet-Metal Workers' Guide.—Resin.—The best book I know of on the subject is C. T. Millis' "Sheet-Metal Work," published by F. & N. Spon (9s.); and for electric bell work, I can recommend F. C. Allsop's book, published by the same firm, (3s. 6d.). The articles that have appeared in Work from the pen of Mr. G. E. Bonney are also thoroughly practical and reliable, and contain all necessary information.—R. A.

Battery for Silver-Plating.—J. K. (*Cathcart Road*).—Illustrated articles on Silver-Plating and Gilding, specially written for jewellers, were given in Nos. 107, 110, and 112, pp. 35, 82, and 118, Vol. II. of Work. In these you will find full instructions for making a suitable battery. I may add, in passing, that I have found the dry battery sold by the Electric Stores Co. very handy for doing such little jobs as gilding or plating a few rings, pins, brooches, alberts, etc. It is always ready and clean. The E. S. Co. supply it with a "plating set" for amateurs, and it is giving much satisfaction.—G. E. B.

Resolution of Forces.—Corkscrew.—*Erratum.* No. 162, page 93, second column, seventh line from the bottom, for "$R^2 = P^2 + 2\,PQ \cos a$," read "$R^2 = P^2 + Q^2 + 2\,PQ \cos a$."

American Chuck.—Taylor.—I do not think you can buy the chuck used on American braces separately. It is extremely cheap, but not good enough for holding work in a lathe; also it would look too big, and have too much overhang to do well on such a little lathe as you could drive with the treadle of a sewing-machine. Remember, the foot-power you can exert on a sewing-machine treadle is not sufficient for any but the smallest work, and it would be useless to put a lathe of more than 2½ in. centres upon it. On such a small affair, with, say, a ⅜ in. mandrel, a chuck 3 in. long and an inch in diameter would look awkward. I would not have a self-centring chuck, but a simple one with ¼ in. hole, and a set-screw for the larger drills, to be made from ¼ in. round steel, and another with ⅛ in. hole for smaller drills to be made of ⅛ in. round steel. There is a handle made hollow for about a dozen tools, and at one end a chuck something like those on American braces. It costs 4s. at the tool shops. A friend of mine used this in his 3½ in. centre lathe, and also in its proper handle. I think it screwed into its handle, so he could make a chuck with a similar screw to hold it in the lathe.—F. A. M.

Souvenir Play Books.—G. S. (*Lambeth*).—I know nothing of the book. Write to Hawes Craven, scenic artist. The Lyceum Theatre, W.C., would find him.

Reliable Patent Agents.—J. B. (*Huddersfield*).—It is beyond our province to name any firm in particular to whom you might entrust your invention, but the names of several respectable firms have appeared in the advertisement pages of Work.

Painting Letters on Roller Blinds.—K. M. D. (*Harling*).—There is no medium mixed with the colours that I am aware of. Coat the fabric with some rather strong parchment size. The colours should not "ciss" or "run" on this prepared ground.—H. L. B.

Agglomerate Blocks.—F. W. P. (*Clapham*).—To make agglomerate blocks for Leclanché batteries, you will require a very powerful press for compressing the agglomerate mixture whilst hot into an iron mould. The mixture of granular carbon and manganese peroxide and shellac is then made hot—to melt the latter ingredient—and the whole subjected to very heavy pressure in a heated iron mould. No other cement is used.—G. E. B.

Dynamo.—H. S. (*Birkenhead*).—Laminated sheet iron fields are of no use whatever in a dynamo. Your machine may give fair results as a motor, but will not be satisfactory as a dynamo. The fields of a motor are best when easily and readily magnetised and demagnetised. The fields of a dynamo should retain a magnetic charge. With only 12 oz. of No. 20 wire on a 2¼ in. armature, and 6 lbs. of No. 16 wire on the fields, you would not get much current shown on your small galvanometer when connected in series, because the galvanometer has a high resistance. When the armature coil is connected in shunt with the field magnet's coil, and driven at a speed of 1,500 revolutions per minute, you should get a current of two ampères at a pressure of 20 volts from the machine. If you put a drum armature in your machine, you will get poor results, since with an armature 2¼ in. × 4 in. there will be as much dead as active wire. It will be the same with a ring armature. The ends of each coil must be connected to two neighbouring sections of the commutator, and there should be as many sections as there are coils.—G. E. B.

Incubator.—C. O. P. (*Bacup*).—The cause of your regulator not acting may be: (1) tube too small; (2) either too strong, or too much of it; (3) damper not properly balanced. Read over the instructions again, carefully noting these points, and you will probably then find where the mischief lies. I think from your letter No. 2 is the wrong one.—Leghorn.

Lathe Attachment.—T. B. B. (*Stoke Newington*).—Any tool merchant will get the attachment you want to your order. We cannot insert the petroleum engine address.

Keltic Ornament.—H. C. K. (*Liverpool*).—There is no error in the design to which you refer.

Magic Lanterns.—A City of London School-boy.—Much upon this subject and optics generally will be given in the present volume of Work, which commenced with No. 157.

Current for Electric Lamp.—H. McM. (*Bootle*).—It is quite true, as you suppose, that it is the current volume, expressed by the term ampère, "that gives the heat and, consequently, light to the lamp"; and your friend the electrician was quite right when he described the lamp as a ½ ampère lamp. But (and this is a large "but" of great consequence) the description of the lamp, as given by your friend, leaves you in a fog, unable to determine how you are to get half an ampère of current through the lamp, for electric current must have potential or pushing power (named E.M.F.) behind it to push it through the resistance of the lamp filament, and this is just the important factor lost sight of when only stating the ampèrage of current needed to light the filament. On the other hand, if a lamp is described as an 8-volt or a 16-volt lamp, we know that it takes a current with a potential of 8 volts or 16 volts to push the requisite ampèrage of current through the filament. There may be 100 ampères of current in the generator, but we shall not get enough of it through a 16-volt lamp unless the E.M.F. of the current is 16 volts.—G. E. B.

Battery for Coils.—Amateur.—Instructions for making a Leclanché battery were given in No. 27 of Work. Instructions on batteries for coils, and illustrated details of a medical coil, will be given in the series of articles on coils about to be published in Work. You will also find much of interest on the same subject in my book on "Induction Coils." We have not yet published an article on Magnetic Electric Machines, but may possibly do so at some future time. Room cannot be found for a description of one in "Shop."—G. E. B.

Corrosion in Steam Boilers.—J. M. (*Dawley*).—Scaling in steam boilers has always been a source of trouble, and the experience of two generations does not show us any cure—really reliable—for it; prevention is better, and easily effected. Heat your feed water with live steam direct from the boiler in a suitable feed water heater; the scale, if any, will then be precipitated before the water enters the boiler, and, moreover, some economy ensues.

There is no waste of heat in this process, and in practice a gain of about six per cent. has been proved in marine work. —F. C.

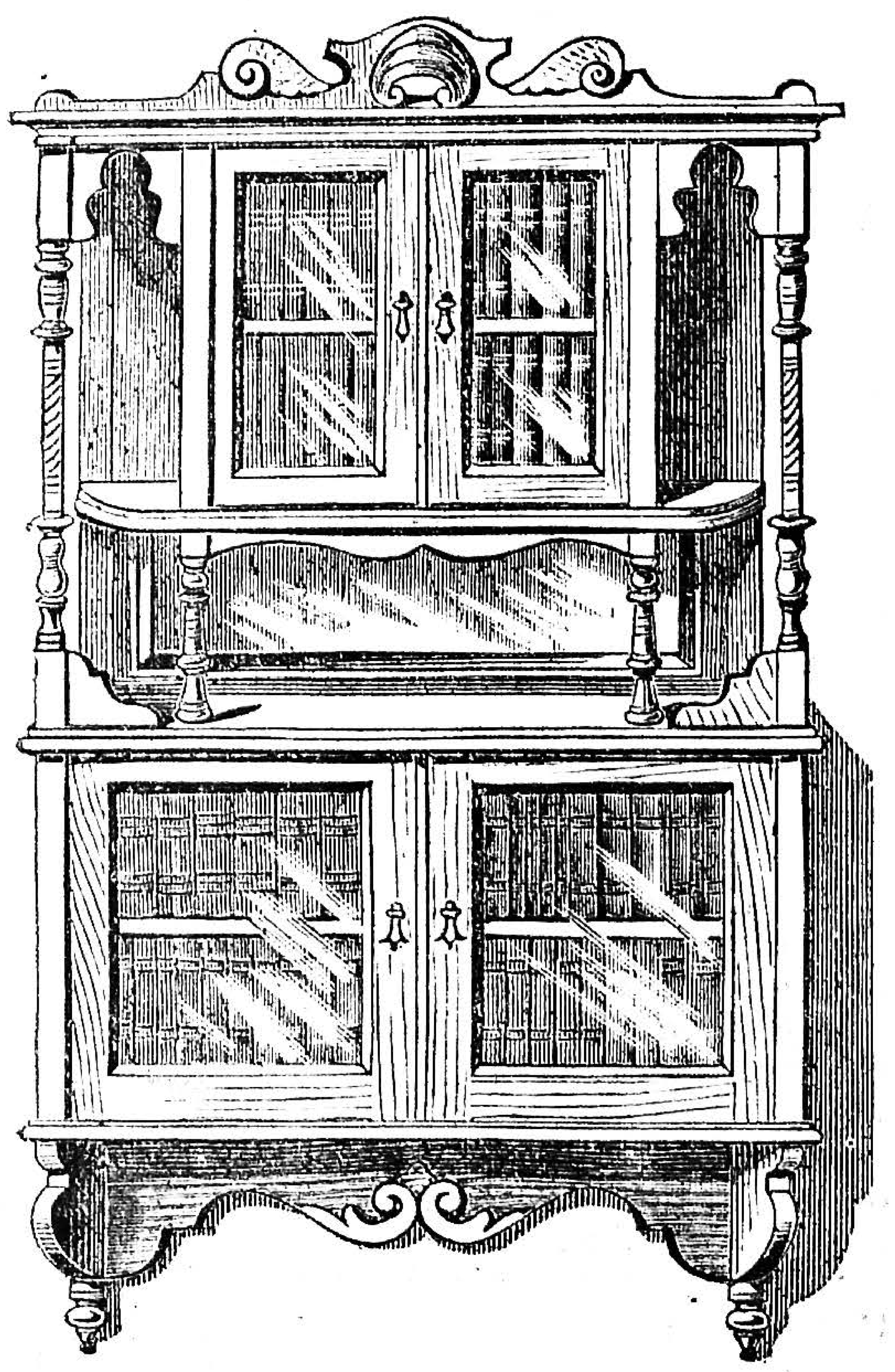
Jewel-Case Making.—FITTER.—These articles are in preparation by a first-rate hand, and we hope to include them in Vol. IV. of WORK.

Upholstery. — MAPLE. — This subject shall be given in WORK as soon as we are suited with a thoroughly good man capable of writing about this branch of work. There is an Upholsterers' Club in the neighbourhood of Tottenham Court Road. Consult the London Directory.

Zinc and Copper.—OLD READER.—If you have the ingots by you, you may send them to be rolled to gauge by the Old Park Rolling Mills Co., Sheffield. Failing this, write to Messrs. Tucker, York Street, Sheffield, stating your requirements, who will, no doubt, be able to suit you, being agents for all the best houses in the trade.—N. M.

Examinations.—ENGINEER.—There is no official examination which the drivers of stationary engines are required to pass. A very excellent book to study is "Stationary Engine Driving," by Michael Reynolds, price 4s. 6d., published by Crosby Lockwood & Co., Stationers' Hall Court, E.C.—J.

Hanging Bookcase.—R. T. C. (*Newcastle*).—According to your wish, I have designed you a hanging bookcase. As you are perhaps aware, considerations of space prevent a printed description of



Hanging Bookcase Design.

details: but if you are doubtful on any particular point, and cannot satisfy yourself by references to back numbers, write again explaining your difficulty.—J. S.

Hard Stopping.—T. H. R. (*York*).—The address where this can be bought ready made is W. H. Palmer & Co., Old Street, London, E.C.; it can also be bought from Mr. Kingston, veneer merchant, Pershore Street, Birmingham.—LIFEBOAT.

Plant Propagator. — BARRA. — An illustrated answer appeared in No. 167.

Sheet Vulcanite.—A. D. (*Birmingham*).—A hand fret-saw and a little patience will enable you to accomplish your task with ease.—QUI VIVE.

Small Spark Coil.—KALLITYPE.—A coil of the following dimensions will give a $\frac{3}{16}$ in. spark when worked with current from one pint bichromate or chromic acid cell: Soft iron core, $\frac{3}{8}$ in. diameter by $3\frac{1}{2}$ in. in length; bobbin ends of ebonite or hard wood, $\frac{1}{4}$ in. in thickness by 2 in. in diameter; primary wire, two layers of No. 24 silk-covered copper wire; secondary wire, 4 oz. of No. 40 silk-covered copper wire; condenser, 40 sheets of tinfoil 2 in. by $1\frac{1}{2}$ in. Run all wire through hot paraffin wax to thoroughly insulate it; have two folds of paraffined paper between core and primary, and three folds of the same between primary and secondary. Baste each layer with hot paraffin wax before winding on the next.—G. E. B.

Mastic Paints.—J. A. (*Glasgow*).—Messrs. Tolhurst's address is King William Street, E.C., *not* Tooley Street.

Chick Rearer.—D. C. (*No Address*).—This, as you will have seen, appeared in No. 151 of WORK, so that you need no longer keep your chicks in an "old hat." That you have got the chicks proves the value of LEGHORN's articles in WORK.—ED.

Window Frames, etc.—APPRENTICE LAD.—Articles on the above appeared in Nos. 135, 139, 147, and 153 of WORK.

Child's Mail Cart.—A. N. (*Uxbridge*).—"How to Make a Mail Cart" appeared in WORK, No. 30.

Lacquering.—CONSTANT READER.—The reply to H. J. (*Oxford*) appeared in WORK, No. 161.

Sycamore for Violin.—E. H. (*Rock Ferry*).—As you have not got the irons, the only way I can suggest is to try and bend the sycamore wood by the aid of steam, bending it gently, so as not to snap it.—A. J. H.

Model Yacht.—A. H. D. (*Marylebone*).—The gentleman who is our model boat specialist has kindly promised to give you an interview with your model. Please send your full name and address, that this may be arranged.—ED.

Decorations of Organ Pipes, and Alphabets for Sign Writing.—R. G. (*Grantham*).—I am unable to point out any published set of coloured designs for church organ pipes; possibly some reader of WORK can and will do so. There are hints on the subject in WORK, Vol. II., p. 160, No. 62, which may perhaps be useful. As regards alphabets, there is Mr. F. Coulthard's advertisement in the "Sale and Exchange" column of WORK weekly, which looks as if it might be the very thing to suit R. G., but I have not seen his letters.—S. W.

Fret Market.—S. W. (*Chesham*), AMATEUR, ARDROSSAN, and OTHERS.—For selling fretwork apply to S. P., 26, High Street, Bromsgrove, who should advertise in WORK.

Etching on Bone.—A. E. S. (*Glasgow*).—Use sulphuric acid.—S. W.

Engine.—J. S. (*Glasgow*).—No book specially on a *horizontal* engine, but plenty on engines in general. There is Holmes's, published by Longmans at 6s., and Jamieson's, published by Griffin at 7s. 6d. If you want to know *how to make* such an engine, you cannot do better than read F. A. M.'s papers, just completed in WORK. A small vertical engine will be described in the present volume of WORK.—J.

Turbine.—J. B. (*Keighley*).—Gunther, of Oldham, can supply such a turbine.—J.

Striking Medals.—J. E. (*Liverpool*).—Any engraver can get these dies made for you.—J.

Castings.—W. H. H. (*Colne*).—Do you mean stoving the moulds in which castings are made, or the process of varnishing or japanning the castings themselves? Say which.—J.

"Statuary Ware."—J. E. L. (*Middlesbrough*).—The chief London makers of figures, etc., in plaster and similar materials (which, and not objects of high art, are, we presume, the "statuary ware" required) are D. Brucciani & Co., Russell Street, Covent Garden, W.C. Try them.—M. M.

Bamboo.—W. W. (*Liverpool*) will find an article on this material—method of working, tools, etc.—in Vol. I., page 318 (No. 33). There are also many useful hints on the subject scattered up and down the columns of "Shop" in the three vols. of WORK, which are too numerous to be specified.—M. M.

Cabinet-Makers' Journals. — K. M. D. (*Harling*).—In addition to the *Furniture Gazette*, price 4d. monthly, there are *The Cabinet-Maker*, 6d. monthly, and *Furniture and Decoration*, 6d. monthly. Fuller particulars will be supplied upon inquiry at any newsagent's. If you purchase "The Directory of Technical Literature," price 2s., you will find therein named many good American magazines, which, if you can afford their purchase, would assuredly prove of great service to you.—J. S.

Banjo Making.—G. H. H. (*Leeds*).—Much has been said on Banjo Making in "Shop." You should purchase the indexes to Vols. I., II., and III.

Brass Fittings.—W. H. (*Liverpool*).—Your best plan is to keep your address before our readers in the "Sale and Exchange" column.

Æolian Harp.—J. U. (*Bournemouth*).—"How to Make an Æolian Harp" appeared in WORK, No. 55.

WORK, Volume I.—H. W. H. (*Bath*) and other correspondents write to F. C. J. (*King's Cross*), offering Volume I. of WORK for sale.—[These correspondents would do well to advertise in our "Sale and Exchange" column.]

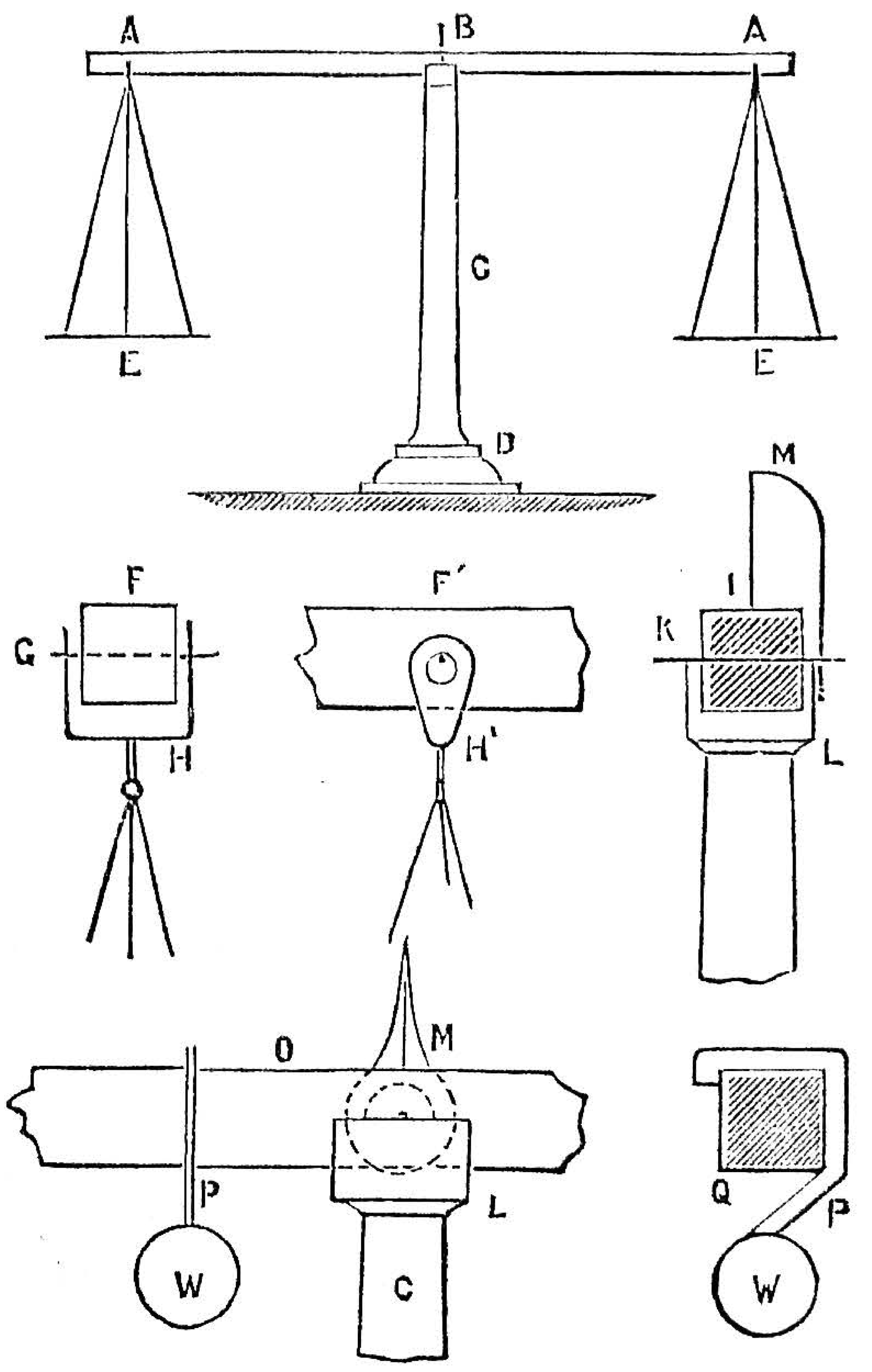
Photographs on Tin.—BAPTISTA.—The tintype or ferrotype plates are procurable at Fallowfield's in Charing Cross Road. They are usually worked with wet collodion, and as such are quite unsuitable for your detective camera, which requires plates as rapid as possible. They are also sold coated with emulsion, but the price would not be very much lower than glass. A shilling a dozen is not a very high figure; the wonder is they can be made good so cheaply. The specula lens, although working very well, is scarcely quick enough for hand-camera work.—D.

Domestic Oil Motor.—A. G. (*Lhanbryde*).—Benzoline is too dangerous. You should go to Priestman Bros., Holderness Foundry, Hull, and 73, Queen Victoria Street, London; they make engines actuated by common petroleum oil free from all the danger connected with the lighter oils, and no extra insurance is charged. A launch 28 ft. long has been fitted with a 5 h.-p. oil engine for exhibition purposes, and can be seen at Hull; it can be put in motion in a few minutes. This engine has been adopted by the Elder Brethren of the Trinity House, the Irish Lights, and the Northern Lighthouse Board.—F. A. M.

Enamelled Hollow Ware. — WILLM. — For enamelled ware, try the following: Baumann Brothers' agents, Oscar Mœnich & Co., Coleman Street, London (the production of this firm is twenty tons daily); or the Thale Ironworks, Thale-a-Hasy, Germany, who employ 2,500 hands, with a daily output of 35,000 pieces—English agent, James Slack, Bishopsgate Street Within, London. There is also The Patent Process Enamel Company, Bradford, England, for sign-plates, etc.—R. A.

Litho. Press.—CHIPS.—I do not think that you would find the friction of the roller fixed to the handle sufficient to carry the bed of the machine backwards and forwards underneath the scraper. You at least want two or three, two being underneath, one on each side of the handle; and, if it is a large machine, an extra one at the back.—A. J. A.

Analytical Scales and Balances.—T. W. M. (*Bolton*).—Scales and balances, as supplied by good makers, always involve very exact work, and demand long experience in the workmen; in respect to analytical and chemical balances, the nicety of the work is incalculably increased, and the expense very great. It would be hardly possible for an amateur to turn out such a balance on the lines of those made in the trade, but in other ways a very serviceable and reliable one (illustrated herewith) may be produced. I have made and used such myself with much success. In the side elevation C is a pillar, which may be of mahogany or cedar wood well seasoned; there is a cavity in its base (D) filled with lead, to give stability, and on the top is a bearing for the beam at B. The beam may be of



Analytical Scales and Balances.

ebony or mahogany thoroughly seasoned, and about $\frac{1}{4}$ in. square by 18 in. long between the points A and A, from which the scales (E, E) are hung, exactly equidistant from the centre (B). The scales are cut out of thin mica, and supported by fine silk threads. The lower sketches show details. Some sewing-needles are selected, and the central cylindrical parts used as described below. At A and A needles (G) are passed through the centre of the beam (shown in end view at F), to carry thin steel straps (H) through holes in which the needles pass, as shown. A side elevation of this detail is shown at F′, H′. These details are about full size. I shows a cross section of the beam at B. A needle (K) is passed through it *a little above its centre*, and rests upon the turned-up edges of a thin steel strip (L). The edges of this strip must be ground so as to be in exactly the same plane, and should be rounded rather than sharpened. An index needle (N) may be fixed in the beam, and a gauge point (M) to the strip (L), to indicate when the beam is horizontal, but I prefer to let into the centre of the length of the beam a very small spirit-level for that purpose, as that will act whether the column is on a horizontal base or not. A side elevation is shown at O. The gauge point (M) has a wide opening—shown in dotted lines—to allow free play to the needle (K). This balance may be used with weights in the ordinary way, or—and this is very convenient for analysis in which percentages are to be ascertained—by graduating the beam and using a weight (W) carried by a hook (P) made of very thin steel or brass, of which another view is shown at Q. To graduate the beam, a strip of fine note paper should be fixed along the top with thin glue, and thoroughly dried. The holes for the needles being made, the paper is to be carefully divided into 100 parts from B to A in each direction, marked with fine lines in Indian ink, and then covered with a coating of thin shellac spirit varnish. When not in actual use, the balance should be kept in a glass case, in which is a small basin containing pieces of pumice-stone soaked with sulphuric acid, to absorb any moisture in the air. This balance will, if carefully made, turn with a quarter of an inch of sewing-cotton in one scale.—F. C.

Cementing Tiles to Wood.—A. E. S. (*Maidstone*) wishes to fix tiles on board for the top of a washstand, there being no overlapping wood to hold them in place. The fact that the two materials will not shrink and expand alike with the changes of temperature renders it difficult to unite them, and the cement must needs be an elastic one. The following has been recommended: To 4 parts good glue (prepared in the usual way for the carpenter) add, and boil in, 1 part Venice turpentine. This, it is said, will also hold stone or metal to wood.—M. M.

The Hot-Air Engine.—J. J. (*Newcastle Emlyn*). —There is no patent on the Seal hot-air engine, nor on a regenerating displacer, though there may be on some particular form of one.—F. A. M.

Piano.—J. K. (*Glasgow*).—Articles on "How to Make a Piano" appeared in WORK, Nos. 29, 32, 36, 41, 43, 46, 50, 51.

Dyeing Grasses.—J. K. (*Bolton*).—Grasses for the mounting of stuffed animals are most simply and easily dyed with the *aniline* dyes, which you can get as "Judson's Dyes," or otherwise, in all colours. If, as is sometimes the case, the hard, flinty casing of the stems resists the dye, soak them for some hours, and you will then find them take the colour properly.—S. W.

Covering Hand-Rings with Leather.—E. H. M. (*Birmingham*).—As no seam is permissible lest the hands should be blistered, your plan would seem to be to bind the rings with a long narrow strip, the edges pared thin, so that they may neatly overlap each other. I should first bind dry, to make sure that all was right, and then bind permanently, fixing the edges as I went on with Le Page's glue. I could show you work thus done in which you would find it hard to detect the joinings.—S. W.

Concertina Reeds.—J. O. G. (*Wellington*).—Our correspondent will find spring steel the best for concertina reeds. We are told that old watch springs answer the purpose admirably.—G.

Steel Reeds.—SUFFOLK LAD can procure the steel reeds he requires for his accordion from Messrs. Wallis & Co., Euston Road, London, N.W. —G.

Batteries.—ELDRID.—The thing which has happened to the porous pots of your Bunsen battery is, I am afraid, what comes to pass in most batteries where porous pots are used after a time. Of course, it all depends how much work they have to do, as to that time being longer or shorter in coming. A porous pot is, in fact, like a sponge, all full of little holes: these are, however, so minute that you cannot see them. During the working metallic salts, and in some batteries a metal itself, separate out and bung up all these little holes; when these salts crystallise, the same thing happens as in a lead pipe when the water freezes: the porous pot, in time, can no longer withstand the strain, and so crumbles to pieces. In your case the white and scaly substances you mention are the salts of zinc, which have been formed by the electric current. Now, in asking how to prevent this, you are asking a very hard thing; but I shall try and help you all I can. In the first place, I gather from your letter that you give your battery its full share of work, if you are working it often from the runs you mention; so you must expect it at some time or other to wear out. I am afraid your pots are used up. Get new ones, and then, after working, rinse them *well* in, say, half a gallon of warm water with about a small wine glass of spirits of salts in it; then give them a *good* soaking in clean water before putting them away. If they are to be used again soon—say in two days' time—let them remain in clean water until you want them; by this means you will, I think, lengthen their lives a good deal, but I do not know of any absolute cure.—J. B.

Workbox.—C. T. (*Edinburgh*).—A tenon saw will do nicely to cut open a workbox. Any finely-set sharp plane will do to plane edges of lid and box, giving preference to a trying-plane, and taking care of the corners to avoid injuring them. The tools, of course, may be bought at any tool-shop, but I do not know any Edinburgh maker. For mitring boxes, etc., you should make yourself a "donkey's ear" (see WORK, p. 136, where you will find a sketch of that and several other useful appliances). I will submit to our Editor a list of tools of greatest utility shortly, in answer to you and some others.—B. A. B.

Wood-Carving.—U. K. (*Watford*).—I should leave the wood-carving to tell its own tale without the brass inlay. Being in lime wood, brass would not give much contrast of colour or richness of effect. If the carving had been ebony or rosewood, bright metal does light up the work. However, if you wish to inlay brass into the initials, cut brass exactly to shape, using a jeweller's piercing-saw, which is like a fret-saw, but has a smaller frame and a blade more suited to metal. With a fine drill make holes at suitable places, and use fine pins to fix brass, bedding the brass in thick glue or bicycle cement. All this, however, presumes that the surface of metal is flat, and can be polished *in situ*. The practical way would be to do inlaying first, afterwards the carving.—B. A. B.

Overmantel.—SHOPMAN.—So many designs for overmantels have appeared in WORK that, rather than select a particular one for you, I prefer to advise you to scan the Indexes (1d. each) to Vols. I., II., and III. "Shop" has been devoted to the reception of several designs of a simple and effective character.—J. S.

Incubator.—J. J. (*Walthamstow*).—Articles appeared in WORK, Nos. 89 and 143.

Varnish for Violin.—JOHN.—See No. 108 of WORK.

Coach and Carriage Painting.—VARNISH.—These articles are in hand, and will appear shortly.

Steam-Engine Working Models.—A. W. McC. (*Holywood*).—Many makers of these advertise in WORK. Consult our advertisement pages.

III.—QUESTIONS SUBMITTED TO READERS.

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

Glass Bending.—TAXIDERMIST writes:—"Will some fellow worker kindly tell me the method taken to bend sheet glass; the furnace, if any, used; and also a description of the annealing, if required, of sheets up to 5 ft. by 2 ft.?"

Monograms.—H. T. W. (*Cardiff*) writes:—"I would thank our correspondent R. T. D. (*Marylebone*) for a monogram for the letters, 'S. S. G. C.'; also 'H. T. W.' If he would oblige, I should be very thankful to have a monogram from such a competent hand as his."

Fern-Case Designs.—D. B. (*Glasgow*) would feel obliged for a few designs and descriptions in fern cases.

Inlay Monogram.—M. E. (*Renfrew*) writes:—"Will some kind reader give me a circular monogram of 'M. E.,' to go inside a shield for inlaying?"

Magnesium Lamp.—H. W. (*Smethwick*) will thank any reader to inform him as to the makers of such.

Division Plate.—DRILL writes:—"Will any lathe-worker give me some help in the direction of division plates?"

Violin Tone Lines.—ROYAL COLLEGE writes:—"Will some reader learned in the science of sound waves explain the theory of, and illustrate the travelling currents of tone from stringed instruments—notably the violin?"

Public Clocks.—HOROLOGIST writes:—"I should be glad of the opinion of practical clock makers and experts as to the best form of lettering for dials at a great height."

Black Ink.—W. T. P. (*Bilston*) writes:—"Would a fellow reader kindly inform me how to make good black ink for writing purposes?"

Carriage Whip.—A. H. (*Manchester, Jamaica, B.W.I.*) writes:—"I should be obliged to any reader of WORK for information as to how to finish a carriage whip, with information of white metal mounting; cost of machinery for a full working plant, varnish, brushes, etc. I am sending a choice exhibit of the various kinds of our Jamaica woods to the Imperial Institute shortly, and would solicit an inspection from whip manufacturers and other wood-workers."

Coffins.—W. P. W. A. (*Aylesbury*) writes:—"Will some kind reader give me full instructions how to panel a coffin; how wide and thick the panelling ought to be; and how the lid is done? What is about the right width of the head and feet of a coffin—say, 18 in. at the shoulder? Is it in character to put a bit of flourishing on the breast-plate? If so, kindly give me a design for these and letters."

Picture Restoring.—J. H. (*Edinburgh*) writes:—"I have an oil painting which seems to have been coated with a dark-coloured varnish, making a view in bright sunshine appear as if it were a thunderstorm. Can any reader of WORK inform me how to get off the varnish without injuring the painting?"

Formula.—W. A. C. J. (*Newcastle*) writes:—"Will some of our engineering correspondents supply formula for finding the diameters of cylinders for compound, triple, and quadruple expansion engines?"

Fly-making.—F. E. T. (*Maidstone*) writes:—"Can any reader inform me if there is a book published giving instructions in the above? If so, the price, and where to be obtained; if not, where I should be most likely to get lessons."

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Lessons in Engraving—Tools for Engraving.—N. M. (*Sheffield*) writes to ENGRAVER (*Wales*) (see No. 165, page 142):—"For the former send a letter through the Editor of WORK to N. M.; and for the latter consult the first volume of WORK, which contains a series of articles dealing with engraving in its ordinary form."

Armour.—C. J. F. (*Eastbourne*).—Please write to Wetherilt, 10, West Chapel Street, W.

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—OSTEOLOGIST; H. F. (*New Cross*); S. M. L. (*Goderich, Canada*); FLASHING DYNAMO; J. J. H. (*Cardiff*); SILEX; CARINO; T. W. S. (*Hulme*); BRASS LACQUER; R. M. (*No Address*); F. J. (*West Bromwich*); F. E. (*Kerry, Wales*); AMATEUR; J. M. & CO. (*London, E.C.*); C. S. L. (*Manchester*); R. A. L. (*No Address*); AJAX; FRED; J. McC. (*Lochwinnoch*); J. F. N. (*Dundee*); A. W. E. (*Lynmouth*); C. K. (*Fitzroy Square*); J. A. M. (*Stamford Hill*); E. U. (*Wimbledon*); CYCLIST; B. N. (*North Seaton*); H. S. T. B. (*Godalming*); W. E. (*Herts*); C. S. L. (*Kirkcaldy*); W. P. (*Bermondsey*); N'OUBLIEZ PAS; E. W. L. (*Newcastle-on-Tyne*); J. B. (*St. Helens*); GUMMAN; A. F. (*New Ross*).

NOTICE TO READERS.

Next Week's WORK (*No.* 171) *will contain an illustrated article on* POWER HAMMERS; *and also the first of a series of articles on* SIMPLE UTENSILS FOR THE GARDEN.

"WORK" PRIZE COMPETITIONS.

A general subject has been considered best with which to commence; and as most of the readers of WORK and thousands of the outside public know something of bicycles and tricycles, competition is invited for the best essay upon

"The Cycle: Its Worth to the Nation."

For the three best essays the following prizes will be awarded—

First Prize, £3;
Second Prize, £2;
Third Prize, £1.

ALL Essays to bear the WORK Prize Coupon cut from one of the numbers of WORK in which the prize scheme is announced.

Each Essay 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.

No Essay to exceed more than two pages of WORK in extent, including any diagrams that may be necessary to elucidate the text.

In the work of judging regard will be had to original suggestions of value affecting the improvement of bicycles and tricycles, especially where such improvements are shown by diagrams.

All Prize Essays and Drawings 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 Essays, and the selection as determined upon is to be final.

All manuscripts intended for the Cycle Essay Competition must be addressed to the Editor of WORK, c/o Cassell & Co., Ld., Ludgate Hill, London, E.C. They must reach him not later than Saturday, June 25, endorsed, "WORK Cycle Essay Competition."