WORK

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FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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Patterns A, B, C, D, all full size. A, Half Arch, Top Tier; B, Central Arches, Second Tier; C, End Arches, Second Tier; D, Half Arch, Third Tier.

AN OVERMANTEL IN THE ARABIAN STYLE.

BY E. BONNEY STEYNE.

The motive whence this overmantel is derived will be found in a number of the *Furniture Gazette* for June, 1888, containing a drawing of a cabinet said to be now in the possession of a gentleman at Bayswater. But although for the sake of preserving the symmetry of the genuine Arabic work the proportions of the shelves have been faithfully followed, both details and size have been freely adapted to befit it for its new purpose.

Most people are beginning to grow weary of the hackneyed type of overmantel—the style illustrated *ad nauseam* in art-furnishing hand-books and catalogues—with its prim little mirrors and trim little spindles, its rigidly accurate symmetry, and unsympathetic concord with its environment.

The original cabinet is described as decorated with gold in colours, and the many objects of Saracenic and Moorish art at South Kensington Museum show the style of such ornament, and show also how unlikely it is that any northern craftsman could catch the spirit of that southern extravagance with its prodigal use of gold and colour. The decoration lavished upon a square yard of Arabian work is enormous, and the apparent roughness of its detail a huge factor in its pleasant effect. When English workmen learn that the neatness of finish is not art, but dead mechanism; and when their employers and the public recognise that the personality of the craftsman, the very flaws of his handiwork, excel in their human interest all geometrical exactness, then, and not until then, may we look for living art in our country. Fancy a tangled country hedge or a landscape executed with the same precision: nay, take an exhibition rose-tree grown with an absence of all grace, and made artificial in its wooden regularity, and then see if Nature's great law of individual expression be not one of her most widespread and unalterable.

In place of a somewhat elaborate cornice and railing I have suggested a frieze worked in fretwork—a painted decoration with a motto that if trite is certainly apt for its position.

The carcase is made so simply that words may be saved in describing it. The arched pieces are intended to be cut out of thin wood (several layers at a time) by an ordinary fret saw, with an applied decoration of paint, or made of plain polished wood with fret-cut ornaments. The halved pillars at either side of the arches are of turned wood to the pattern given.

The difficulty in giving full-sized working drawings of the parts that specially need them must be pleaded in excuse for the rather involved page of sketches. I only wish it had been possible to have included full-sized studies of possible decoration, but the attempt had to be abandoned, as black and white is unequal to convey an effect of colours in a space so crowded.

Neither was it feasible to give working patterns for the cornice nor for the lower arches and their turned pillars, which, it will be noted, are in the round, not halved and applied to each side of a partition, as in these upper storeys.

The arch openings for the first or top tier, the second with its narrower ends, and the third are all indicated. The size is governed by the thickness of the shelving, the average opening being 8 in. wide and 7 in. high.

If painted, naturalistic presentation of flowers or birds must be avoided. In the Arabic, above all styles, conventional ornament is alone fit. To employ Japanese mottoes, for example, would be a hideous anachronism. Mediæval detail would be far less so, and Indian, although it differs from Persian and from true Arabic, is yet near enough to be possible.

In these days of illustrated papers, when fine-art volumes like Messrs. Liberty's catalogues and the advertisements of our papers bring representations of genuine Oriental Art to every home, the whereabouts of designs for painted pattern to embellish this should not be hard to discover.

If any one attempts to carry this out, and yet sticks fast for want of instructions, let him write to "Shop," and in due time he shall have all the information he desires that it is in my power to impart.

MODEL ELECTRIC LIGHTS.

BY GEORGE EDWINSON BONNEY.

INTRODUCTION—ELECTRIC LAMPS—HOW THE LIGHT IS OBTAINED—COST OF ELECTRIC LIGHTING.

Introduction.—The subject of electric lighting is one of great interest to every householder throughout the civilised world. Old methods of lighting the houses in which we live have all some uncomfortable or inconvenient drawback to make us all desire some better method of illuminating our homes when the long dark nights of winter creep in upon us. Rushlight candles, with their dim uncertain light and guttering propensities, have had to give way to the cotton-wicked tallow candle of larger dimensions; and its flaring, yellow, smoking flame has had to yield its position in the household to the whiter light of the cleaner-burning composite candle. But the light from this has been found inadequate to the wants of even humble country cottagers when evening work has had to be done in the home, or it has been sought to beguile the long evening hours of winter with reading, drawing, and similar intellectual pastimes. Hence, paraffin and other oil lamps have superseded the use of composite candles as a light for the family table, because the volume of white light from one lamp is much greater, and more agreeable to the eye, than an equal volume from several candles; and also, because one such light entails less labour in its maintenance. Some of the best oil lamps give out a splendid light, and are free from noxious fumes arising from vaporisation of the oil and combustion of the vapour; but common lamps in unskilled hands are dreadful nuisances, making their presence felt in a most unpleasant manner. Dwellers in towns and cities are able to choose between lighting their homes by means of oil lamps or by coal-gas, but the use of gas in a house as a means of lighting has its inconveniences, among the most prominent being the bad effect of the products of its combustion on the bindings of books, the frames of pictures, the upholstery of the furniture, and the decorations of the room generally in which gas is burnt. Electric lighting by means of incandescent lamps is entirely free from all these faults (although it has others peculiarly its own, which we shall notice in their place), for the light is pure, white, soft, and agreeable to the eye, and cannot by any means vitiate the atmosphere of a room; whilst, at the same time, it does not sensibly raise its temperature. We may therefore safely say that the desire of the people for a pure artificial light has been fairly met in the invention of electric lighting by means of incandescent lamps: that is, those small lamps enclosed in glass globes in sizes varying from a pigeon's up to a goose's egg, and some of them having the ovoid contour of an egg. Electric lighting by means of arc lamps is quite another branch of the subject, and this is not so entirely free from objection as that of incandescent lighting.

The lighting arrangements of public exhibitions, and the special exhibitions of electric lighting appliances during the last ten years, have done much to educate people's minds with a desire for this form of illumination. It is quite natural to suppose that the sight of a building, and rooms in that building, lit up by means of a number of small lamps fed by current from a machine of moderate dimensions, should suggest that a few lamps (sufficient to light the rooms of a cottage) could be fed from a machine of corresponding small dimensions. This suggestion has led many persons to attempt electric lighting on a small scale by means of model dynamos (constructed by themselves), and also by means of primary electric batteries. The demand for these model machines has led to quite a respectable trade in iron castings suitable to the required field magnets, brass castings for the bearings, and iron punchings for the armature of small dynamos. It has also led to the invention of special forms of primary batteries, and improvements of some old forms, on which we may have something to say as we proceed.

The result of all those amateur experiments in electric lighting has been satisfactory to the experimenters in proportion to their expectations. Where a man has taken up the work of trying to make a dynamo and light up a lamp, solely as a hobby to fill up spare time, improve his education, and let his friends see that he can get a light by this means, the result has been to him most satisfactory. The same may be said of the results obtained by those who have constructed dynamos and batteries for a given purpose: as, for instance, to light up a lamp sufficiently powerful to illuminate the interior of some small instrument, to furnish a small temporary night-light, to throw light on an object under the microscope, or to furnish a light for a photographic dark room. All these, having moderate expectations, and setting about the work in a proper manner, have generally succeeded to their own satisfaction. The men who have not been satisfied are those who have been led by interested advertisers or by their own imagination to expect too much from a model machine. In the following pages I hope to clearly show what may be reasonably expected from a model electric light plant, and how to set to work to realise those expectations.

Electric Lamps.—Before we go further into the subject, it will be well to inquire into the nature of an electric light, and to examine the lamp by which it is produced. The lamp itself differs in every particular from the oil lamps and gas lamps we have been accustomed to use. Some of the more prominent points of difference are here enumerated. An incandescent electric lamp has no wick as in an oil lamp, nor perforated burner as in a gas lamp. It has no reservoir for oil, nor pipe for gas, nor any substitute for these parts, since the light it gives out is not produced by the combustion of any oil, or gas, or liquid of any kind in the lamp. The light-giving part does not consume away at all, neither does it require any air—in fact, the smallest admission of air to the globe would cause at once a total destruction of the light-giver. As there is no combustion, there are no products of combustion, and the light will burn as well under water or in a sealed chamber (such as an air-tight glass case) as in the open air. As there is no flame to flicker, it may be used in an open space with impunity, however the stormy winds may blow.

The manufacture of incandescent electric lamps is a special trade, carried on by skilled workmen, with tools and appliances suitable to the work in hand. The lamps cannot be successfully made by an amateur in his own workshop, unless he is provided with all the costly tools and appliances employed in their manufacture. It will be well, however, to know how these lamps are made. On examining an incandescent electric lamp, it will be seen that it is composed of a sealed glass globe, enclosing a loop of thin wire with its two ends fused into the neck of the bulb. The thin wire inside the lamp is made of carbon, and is variously prepared by the several makers of lamps. The form of the loop, the size of the carbon wire, and the length employed in the lamp, also varies in lamps of differing makers. For instance, the carbon in a Swan lamp is of cotton, first made into a kind of parchment, and then converted into carbon by strongly heating the parchmentised filaments in an air-tight retort. The filament in an Edison lamp is made of carbonised bamboo. That in the Lane-Fox lamp is prepared from broom fibre. Others have used carbonised cardboard, platinum wires coated with carbon, and tubes of carbon. The Edison carbon is bent to the form of a horseshoe, and the makers of some other lamps have adopted the horseshoe or arch form in their lamps. Some of the Swan lamps have a spiral turn of half an inch in diameter put in the arch, thus giving an additional loop. The carbon in the Maxim lamp is bent into the form of an M or a gridiron. The small lamps generally used in model electric lights have only the arch form of carbon, varying in size with the resistance of the lamp or its candle power. The carbon filament is firmly clipped in the ends of two platinum wires, and these are fused in the neck of the globe, leaving two looped ends outside for convenience in connecting to the conducting wires from the battery or dynamo.

The glass globe or bulb of the lamp is blown from a piece of clear glass tube, the carbon loop is inserted in the bulb, and its conducting wires fused into the neck on the bottom of the bulb. On the other side, or at the top, is left a piece of the tube from which the bulb was blown. This tube is attached to a pipe leading to the exhaust chamber of a Sprengel air pump. The pump is set to work, and all the air is pumped out of the lamp bulb, thereby producing therein a perfect vacuum. When this has been satisfactorily obtained, a blowpipe flame is made to play on the connecting glass tube close to the bulb; this melts the glass, and (as the bulb is being drawn off) perfectly seals the exhausted lamp. This, briefly, is an outline of the methods adopted in the manufacture of the lamps employed in model electric lighting.

How the Light is obtained.—The question may now be asked—how can the carbon filament in an exhausted bulb be made to give out light? An answer to this question takes us into the mysterious domain of electricity. I say "mysterious," because to the many its workings are a mystery, although to the well-informed student they may be perfectly clear. To clearly understand what happens in an incandescent electric lamp when its carbon filament is heated to a glowing white temperature, we must dismiss from our minds all preconceived notions respecting the necessity of the combustion of a substance to render it incandescent. When iron and carbon are made white hot in air, they abstract oxygen from the air, and this combines with either of those elements to form new compound substances. In the first case the white hot iron combines with oxygen to form a black dust entirely different from metallic iron. In the second case the white hot carbon unites with two atoms of oxygen to form a gas named carbon dioxide, which passes away in a state imperceptible to our sense of sight. But the white hot condition in both substances—the iron and the carbon—did not in itself ensure the combustion of those substances. This condition was brought about in both by the particles of which they were composed being made to vibrate in a very rapid manner by means of energy imparted to them from the burning fuel in which they were placed. Therefore, if now we can produce in these substances the same vibratory motion whilst they are protected from the action of oxygen, they will attain a glowing white, or (in other words) an incandescent condition, without being consumed thereby. This actually happens when a strong current of electricity is sent through a filament of carbon sealed in a glass bulb exhausted of air. The current of electricity itself, being only a form of rapid motion in the particles of its conductors, causes a sufficiently vibratory motion in the carbon to make it white hot; but as there is no oxygen present in the bulb to combine with the white hot carbon, it is not consumed by the heat.

It will be well here to note that the carbon gets white hot only when motion of a sufficiently rapid character is imparted to it. This can only be attained by the employment of enough energy to produce this condition: that is to say, unless we send through the carbon filament enough electric energy to produce the necessary rate of vibration, we shall not succeed in raising it to a white heat. This fact should be remembered when we are planning the dynamo or battery to be used in lighting a given number of lamps, and rules for this purpose will be given further on.

Cost of Electric Lighting.—The expenditure of energy necessary to raise a filament of carbon to a glowing white heat in a vacuum, must depend upon its capabilities of conduction and absorption. Take, for instance, an ordinary electric lamp requiring one-and-a-half ampères of current to render its carbon filament incandescent. This will represent its capabilities of absorption: that is to say, it will continue to absorb the energy of the electric current until the volume of this reaches 1·5 ampères. A less volume will not raise it to the required incandescent condition, whilst a larger volume will strain its capabilities of absorption and endanger its existence, because it will be liable to rupture from excess of strain upon its particles. But the above figures alone will not, in themselves, represent the expenditure of energy necessary to light up such a lamp; for we must also take into consideration the capabilities of conduction in the carbon filament. If the carbon bridge or loop is a short and thick one, it will conduct the required volume of current freely, and thus offer a low resistance to its passage. If the loop is a long and thin one, it will offer a greater resistance to the passage of the current, and require a correspondingly higher rate of energy to overcome that resistance. Whatever length or size of carbon wire there may be in the lamp, we must employ a sufficiently large volume of current to render it incandescent throughout, and we must employ enough pushing force to send that quantity of current through the lamp. The cost of producing the amount of energy necessary to light up a lamp, or a number of lamps, must be governed to a large extent by the above considerations.

Some idea of the required energy may be obtained by noting the light obtained from one-horse-power. This power may be generated in a steam-engine, in a gas-engine, in a horse, in a number of men, or by a fall of water, or by a falling weight, or by a current of air, or by the consumption of zinc in a galvanic battery. However generated, or however derived, it is a horse-power of energy: that is, energy sufficient to lift 33,000 lbs. one foot high in one minute. It may be applied to a dynamo-electric machine constructed to generate a current of electricity, or it may be used direct from a battery. In either way, its results are the same, and it is represented by 746 watts of electric current. Now, the theoretical quantity of light obtainable from one H.-P. through incandescent lamps is put down as 300 candles, but the actual and practical outcome, with some of the best lamps, falls far short of the theoretical data. Mr. Sprague, in his latest edition of his book on "Electricity: its Theory, Sources, and Applications," puts down 200 candles as the light obtainable per H.-P. through incandescent lamps. But the Edison-Swan United Electric Light Company only claim an efficiency of 3·5 watts per candle-power for their lamps. Now, as we get 746 watts of electric current per indicated H.-P. of energy, and fully 10 per cent. of this is absorbed by the resistances in the machine and conducting wires, it follows that we can only get 671 watts of current for the lamps per I.-H.-P., and this, divided by 3·5, the number of watts consumed per candle-power, only gives us an efficiency of 191 candles per I.-H.-P. This may be accepted as the efficiency of incandescent electric lighting by small installations. If we can lay down a large installation, demanding several thousand C.-P., and can use large incandescent lamps, such as the large Maxim lamps, the efficiency of the lamps will be much higher.

An answer to the question of cost is, therefore, simplified by knowing how much light can be got from one H.-P. of energy. If we can now arrive at the cost per H.-P. to generate the required energy, and add to it the cost of lamps, holders, and conducting wires, we can get a fair idea of the cost of an installation. In calculating the cost per H.-P., some persons only start from the motor itself, and reckon the cost of maintaining the energy from the motor, such as the cost of so much coal or gas consumed per hour: this is fallacious. The cost of everything must be put down, and must include all that goes to produce the light: the prime cost of the motor, the cost of labour in putting it down, the cost of all fittings and appliances, the prime cost of the dynamo and all pertaining to this, as well as the cost of lamps, conducting wires, and fittings. This ascertained, a certain percentage should be allowed for capital sunk in the undertaking, and a rate of depreciation fixed to cover probable cost of renewals at all future time. When this has been added to the cost of fuel and attendance, we may get at the actual cost of the light per C.-P. hour.

It has been generally conceded that water-power is the least costly method of generating electricity when this power is obtained from a fall of water in a natural stream. Next to this we may take the power of steam, and the cost of this will vary as the cost of coal in certain districts. The cost of power for a gas-engine, according to Mr. Sprague, may be taken as being 75 per cent. higher than that for a steam-engine, minus the cost of attendance, which is, of course, much less in a gas-engine. The cost of man-power may be put down as 8d. per hour, and in this time he will develop at the most only one-sixth of a H.-P. The cost of battery-power as compared with steam may be easily seen by the following quotation from Mr. Sprague's remarks on the subject:—"Now, the oxidation of 1 lb. of coal gives the same energy as that of about 7 lbs. of zinc, which costs some twenty-four times as much per pound, so that the energy of the source is in one case 150 times as costly as the other, and no amount of efficiency can make the cost of energy produced comparable in cost." This part of the subject will come up again for more detailed treatment further on, when considering the actual cost of generating power by batteries to furnish current for electric lights.

A SIMPLE SILK WINDER.

BY APIS.

MANY of the readers of WORK are interested more or less in the breeding of silkworms, and many others are interested in those who are interested in that pursuit. I am one of the latter. A mania for rearing silkworms and making huge fortunes with their produce breaks out betimes in every neighbourhood. Many of my young friends were seized with the affection. They purchased eggs, the grubs appeared, and, after having eaten enormously, began to spin their golden cocoons. These, in due time, were relegated to the warm water basin, and the process of winding the silk begun.

It was during this last process that I happened to call on one of my little friends. The work appeared tedious and unpleasant. He was winding round a lady's visiting card, revolving the card between his two hands, first half a turn with the right, then the other half with the left, and so on. It took him three hours to wind one cocoon by this means.

I wished to lighten his labour, but it took me some time to design the little winder shown in the annexed engravings. I did not want to go to much trouble about it. It should be very small, capable of being fastened on to a table, and, at the same time, efficient.

The body, or pillar, which supports the entire thing, is a piece of hard wood about 8 in. long and 1½ in. square. Near the lower end a deep recess is cut, wide enough to embrace the top of any ordinary small table—say, 1½ in. wide. A wheel, turned from hard wood, 4½ in. in diameter and ⅜ in. thick, is secured to the opposite side with an ordinary brass wood screw, a washer being placed between wheel and body. A little ivory handle is affixed to the wheel with a long thin screw. Within half an inch of the top a hole is bored right through the body, somewhat more than ⅛ in. in diameter; and brass washers are fastened with little screws to each side, having holes concentric with the hole through body, but smaller. A straight piece of wire acts as an axle above, having a little pulley at one end, and the frame on which the silk is wound at the other. This wire is about ⅛ in. thick, and fits the holes in the brass washers nicely.

Between the frame and washer I have a little bit of brass tubing about ¼ in. long, and a tight fit for the wire, which is thus prevented from moving endways.

The frame is a nice piece of work, and should be carefully made. The inside cross-piece is fixed to the wire simply by being pushed in tightly. The parallel bars B, B are pivoted to the inner cross-piece, but merely fit into the recesses in the front one.

Fig. 1.—Front Elevation of Silk Winder.

A, Frame.
B, B, Bars of Frame.
C, Wire on which Frame revolves.
D, D, Brass Washers.
E, Pulley.
F, Wheel.
G, Washer.
H, Screw forming Axis of Wheel.
K, Space to Embrace Table Top.
L, Body.

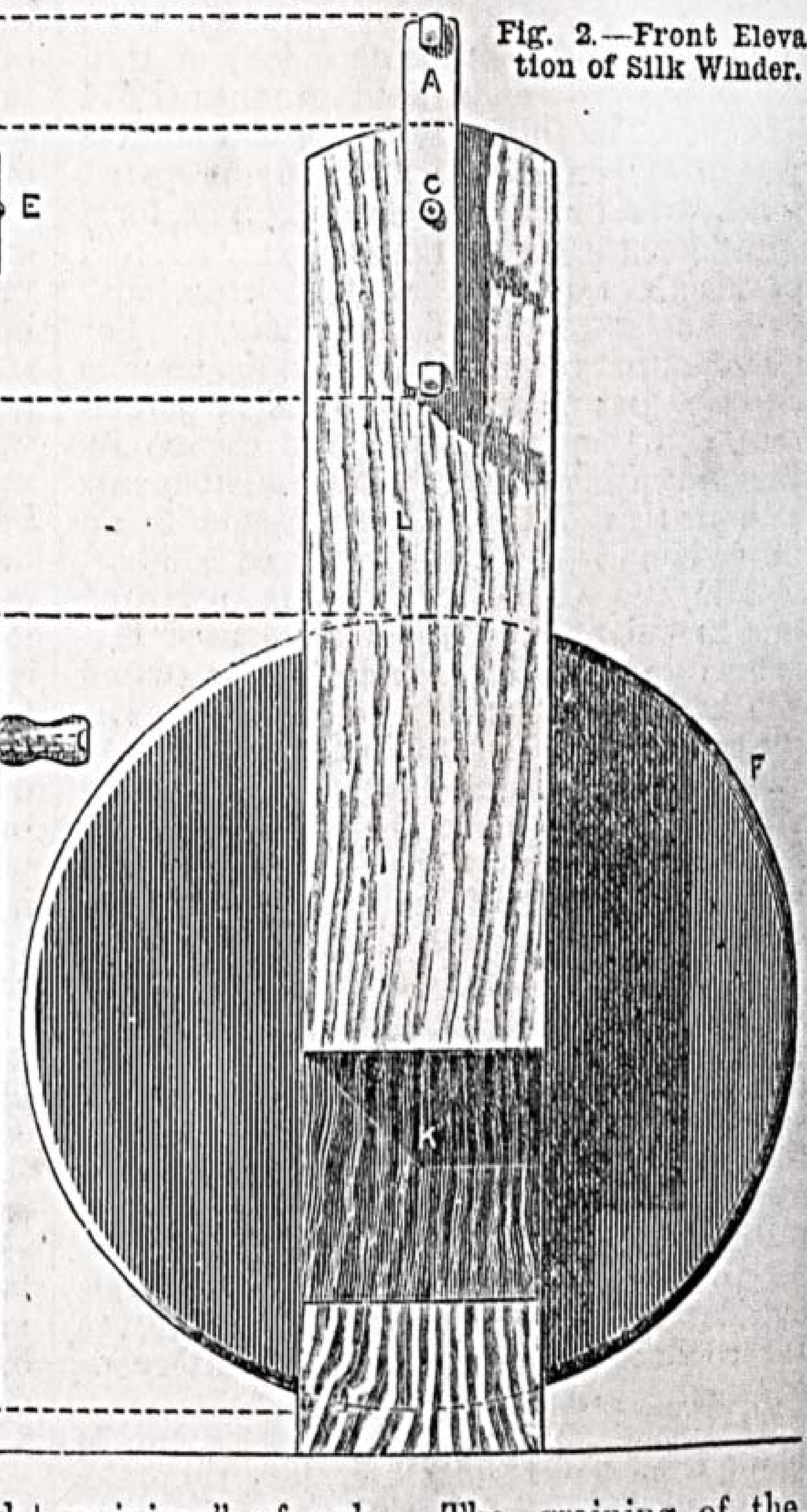


Fig. 2.—Front Elevation of Silk Winder.

The object is that when the silk is wound the outer cross-piece can be slipped off, the bars B, B pressed together slightly, and the skein taken off; otherwise it would require to be cut before it could come off. I made all my frame of lancewood, which did very nicely.

The entire apparatus is fastened to a table by means of a long thin wedge put between the under surface of the table top and the lower face of the recess. This is cut to a slight angle—as seen, much exaggerated, by the dotted line in Fig. 2—to suit the slope of the wedge. A little band of silk connects the wheel and pulley, and the apparatus is an ornament to any drawing-room.

Although this will not make my *protégé's* fortune, yet I am sure it has saved him many a weary hour's winding, and has made the silkworm *furore* less short-lived than it otherwise would have been.

In conclusion, I would advise any one who thinks of going in for the interesting work of silkworm-rearing to make one of these winders. I will always be glad to help such through the pages of "Shop."

THE ART OF GRAINING.

BY A LONDON DECORATOR.

GRAINING POLLARD OAK AND KNOTTED OAK.

THE subject of my present paper marks a distinct step forward in the path of progress for the student of graining, since we shall now take in hand the imitation of a beautiful variety of oak wood, and which is obtained by the *distemper*, or "water-graining" process. So far, these lessons have dealt with the latter merely as an *accessory* to oil colour graining—as in the "over-graining" of oak. The graining of the "Pollard" variety, however, opens up a new sphere of study and practice for the learner, which will prove even more interesting than the work appertaining to imitations of the ordinary, or "maiden" oak. It is a fact fully recognised by all "imitators" of experience that facility in wiping out the "lights" of oak is acquired by some workers far more rapidly than others; whilst, on the other hand, we repeatedly find the grainers who "shine" in oil imitations often outstripped in speed and beauty of results—when it comes to distemper graining—by the same slow workers who were previously outshone. Such, certainly, has been the results of the writer's observation and experience; my purpose, however, is not merely to notice the fact herein, but to prepare the student who puts these papers to a practical use for an entirely different method of working, in which, according to his individual faculties, his previous rate of progress may be somewhat reversed. No learner must take upon himself, from these few general remarks, to deduce an excuse for neglecting the painstaking study of and practice from real specimens of *veined* oak; for proficiency in any branch can only be acquired through the medium of correct knowledge and continuous practice.

Pollard Oak is a variety that may here with advantage be briefly considered, both with respect to its nature and appearance, and the cause of its beauty and markings. The meaning of the word "pollard" is easily discovered by reference to a simple dictionary, and, although at first glance the connection between "poll"—the head—and "pollard"—a tree lopped—with "the art of graining" may appear rather remote, their meaning gives the key-note of the explanation. Pollard, or rather "pollarded," oak belongs to the same natural class of oak as the ordinary figured variety, the striking appearance of which, however, is brought

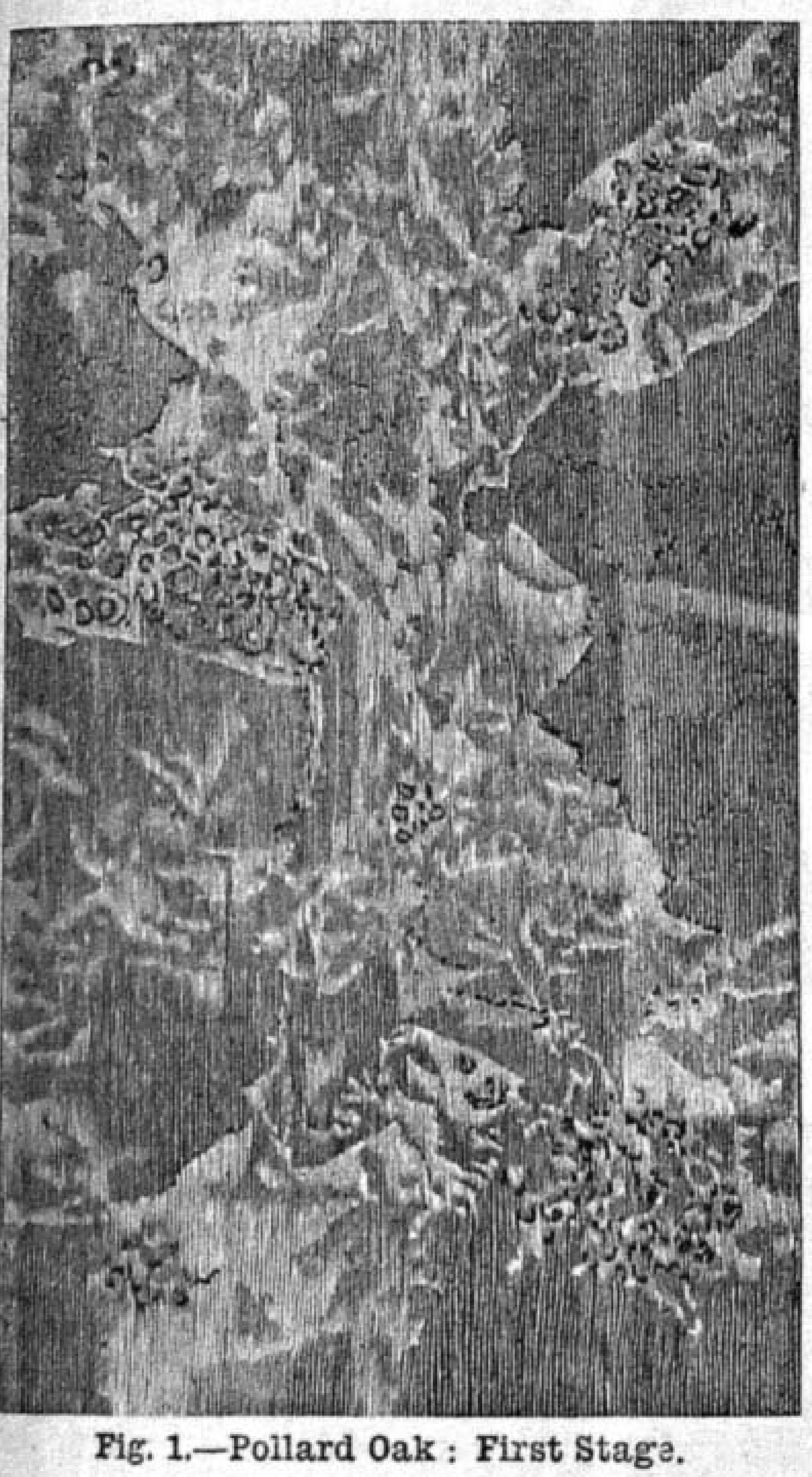


Fig. 1.—Pollard Oak: First Stage.

about by combined artificial and natural means. In most parts of the country there is a sufficiency of fuel without cutting or lopping off the branches of the trees; but when, by accident or design, an oak tree is so treated during its growth, then the trunk will display the results of this "pollarding." We are unable here to examine into the botanical cause and effect of such matters, but it must be understood that the junction of a branch with the parent trunk of the oak tree is characterised by a growth of knots and irregular twisted grain. When, therefore, these "arms" are lopped off, the knots and roots of the branch still remain connected with the heart of the tree; so that, provided the pollarding be executed at intervals of a few years, as the tree grows, the parent stem, when cut into long planks, will eventually display these clusters of knots, this gnarled and twisted grain, with intervening spaces of plainer grain, and which condition we know as Pollard Oak.

The brushes required for this imitation are a large thick mottler (Fig. 5, page 40, Vol. II.); a large sash tool, such as that advised for

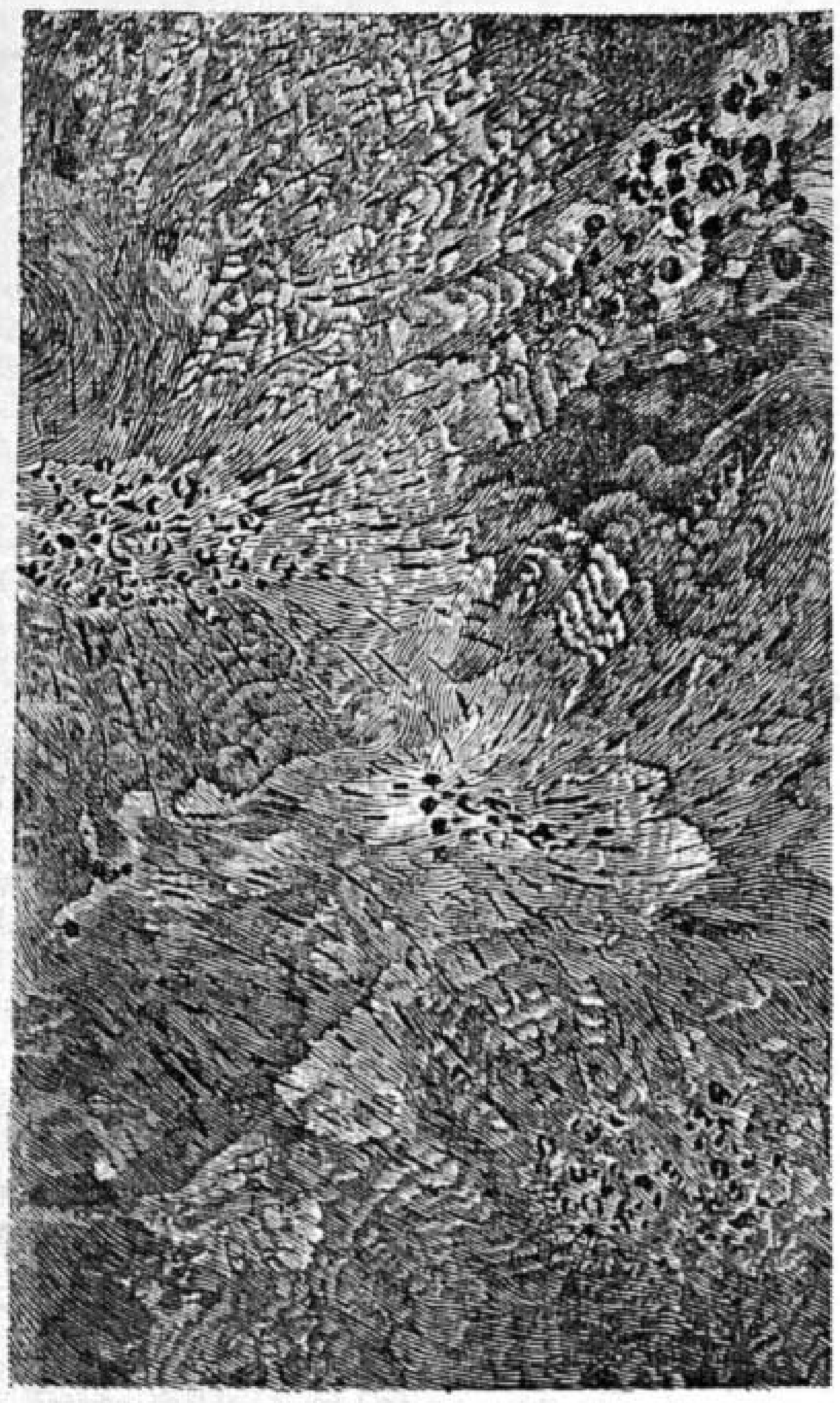


Fig. 2.—Pollard Oak: Second Stage.

overgraining ordinary oak; the "indispensable" badger (Fig. 16, page 40, Vol. II.), a piece of old open sponge, a wash-leather, a couple of round fitches, medium and small sizes (Fig. 7, page 820, Vol. I.), and, later on, the sable pencil and overgrainer, depicted as Figs. 21 and 8, respectively, upon page 40, Vol. II.

The ground colour for Pollard Oak should be a warm buff, very similar to the ground advised in the chapter on oak grounds for medium oak, but slightly richer. This is best made from white lead, Oxford ochre, a little Venetian red, and, when the imitation is required to be of a "quiet" nature, a little burnt umber will improve the

Fig. 3.—Pollard Oak: Final Stage.

colour. Occasionally we may come across directions and instructions upon this subject, which advise the ground to be made from "chrome, vermilion, and white lead." The brightness of such a combination would spoil the natural effect of any graining, however "woody" the figure may be.

The importance of working and studying from natural specimens I have repeatedly drawn attention to; and the young grainer will find a piece of real "pollard oak" one of the best investments he can make. A good specimen of this wood is somewhat difficult to obtain, and I, therefore, for the time being, will aim to make the student acquainted with the appearance and method of imitating the figure—until he is able to secure the coveted sample—by the poor, but useful, substitutes of pen and pencil. With respect to the grounding colours and the above directions for mixing, I may state that most grainers err on the side of brightness. The appearance of two real specimens

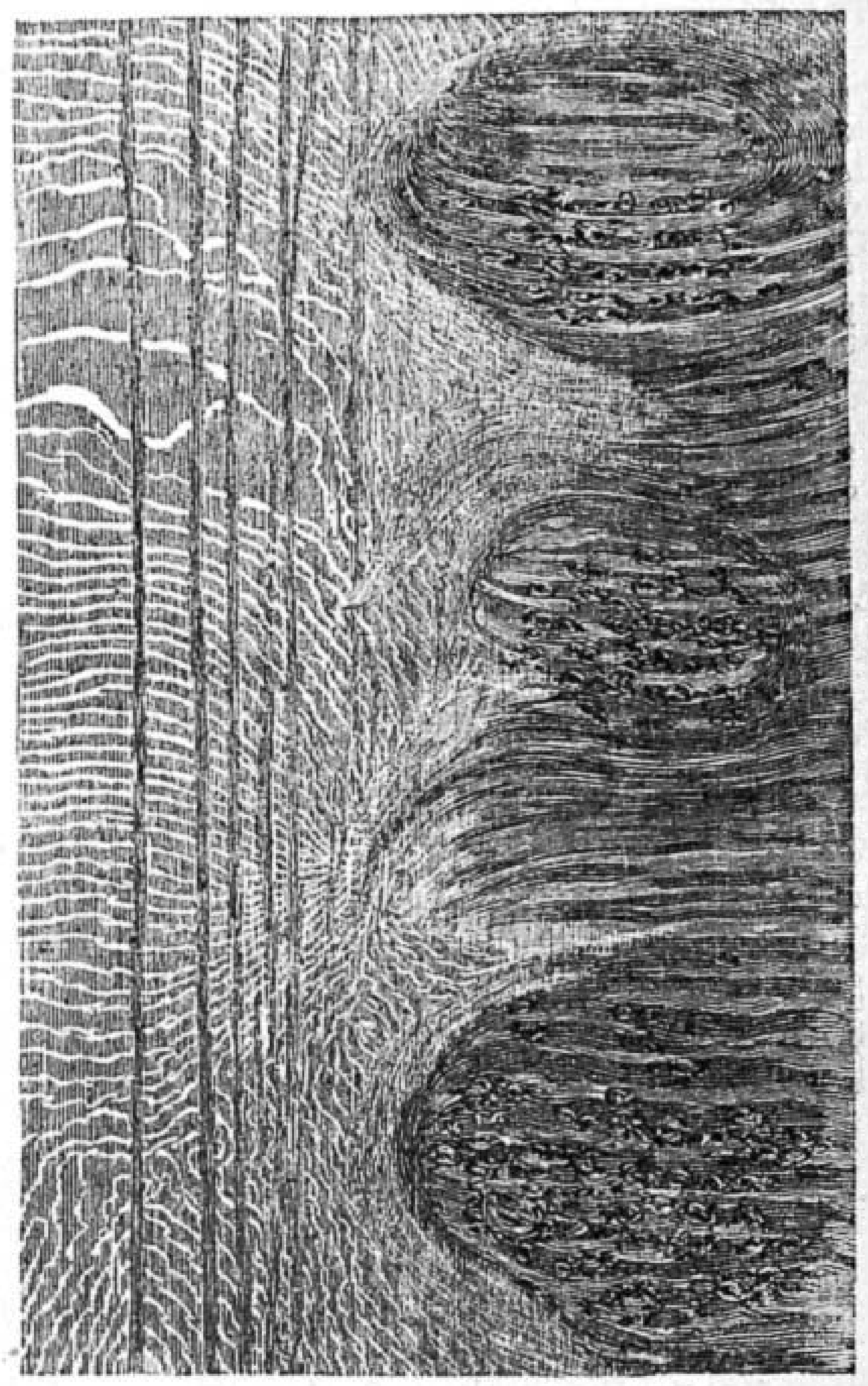


Fig. 4.—Knotted Oak in Oil.

I have in front of my table as I write may be given in support of this. Piece No. 1 has been French polished, and kept under fair conditions in my possession for many years; its colour is decidedly warm, and very rich; but even this could not be well copied without a slight dash of umber in the ground. The other sample has been merely well oiled, and in no way artificially coloured. To match this latter piece the ground would have to be that for an ordinary medium oak: viz., a slightly warm buff; the idea of graining it upon a "vermilion and chrome" tinted ground would be an absurd one.

In imitating pollard oak, there are two commendable but slightly different treatments, the working of which I will now explain. The first of these aims at reproducing the *general effect* of the wood in a broad and natural manner, and upon the ordinary buff oak ground, with complete results akin to the real uncoloured wood. The other style of imitation is worked on more, if I may so term it, *conventional* lines; the ground is made for a warm and very rich final tone, such as the real thing would acquire from coloured polishing and age; whilst the plain and knotty features of the grain are more distinctly separated, and the detail of which is more minutely and painstakingly rendered. Both of these treatments are worth studying. That first mentioned is mostly practised in the West of England, but in the northern counties the more conventional "pollard" is chiefly favoured and practised.

The illustrations of graining Pollard Oak accompanying this description refer to the broad, and, to coin a term, "naturalistic" imitation; and as this is the most simple for the student to follow, we will give our first attention thereto. Having the tools before-mentioned conveniently to hand, and also a vessel with a little beer, some water, and a little each of Vandyke brown, blue-black, and burnt sienna (all finely ground in water), we dilute the former with beer to a fluid form, in old plates or basins, and the sienna to a thin wash in a third vessel. With the large sash tool the panel is rubbed over with the sienna wash, and then taking up a damp wash-leather, we "dab" and roll it over portions of the surface, which gives an irregular but connected "mottle." (Fig. 1.) This mottle is at once badgered and "softened" into stronger but softer masses. With a stiff round fitch dipped into the Vandyke and black, we at once put in the clusters of knots of innumerable sizes and shapes, but giving them an open appearance, and not as if put on with the finger tips. This part must now stand for a few minutes until dry, when we pass the mottler, dipped in clean cold water, over the work, and with the pencil overgrainer (Fig. 8, page 40, Vol. II.), charged with a wash of Vandyke, put in the fine grain which crosses more or less regularly the plain spaces between the knots. As we do each few lines of grain we soften each individual one to a dark edge by the aid of the badger; when all are so treated, we take our sable pencil, and with a little black we paint in the numberless fine dark veins which cross in an opposite direction the fainter cross grain, and which work from one set of knots to another set. (Fig. 2.) The work must now be varnished once, or if time and cost must be considered, we give it a coat of Japan gold size and turps in equal parts. It is then ready for the final glazing or overshading, which is also done in beer.

The final glazing of the Pollard Oak imitation I am now describing is a similar process to the first mottling, shown in Fig. 1, but instead of using burnt sienna, we employ a wash of fine blue-black. With the latter pigment we must use a fluid strong in beer, as black is a very bad binder, and this is one of those exceptions in which the grainer—however strong may be his abhorrence to it as a beverage—will find beer to be necessary. If Vandyke brown is mixed with black, the strong binding powers of the former are sufficient for the two; but as nothing is more annoying or disastrous than to find our glazing colour working up with the final varnishing, even in the latter case it is best to use weak beer. Having therefore brushed over our panel with the blue-black wash, we take the wash-leather, and after wiping out a few sharp and small reflective lights amongst the knots, we roll the leather over the panel in such a manner as to get more depth and transparency to the whole previous work. (Fig. 3.) If these methods have been carefully followed the panel will give a rich and natural woody effect, and will make an admirable foil to the maiden oak stiles when used on doors. Where possible, all water-grained imitations should be worked upon the best and finest "brush work," and after having one finishing coat of copal varnish, it should stand a few days to harden. It will then be fit for "flatting" or felting down with finest pulverised pumice-stone rubbed with felt and water, and finally a good flowing coat of copal (painters' "carriage" or "copal oak") will give a finish, fit to last, with occasional re-varnishing, for twenty years.

Another imitation of Pollard Oak, which I have previously alluded to, is obtained with slightly different means, but on the same principle as that already described. The ground being of a richer and warmer cast, we commence with a full wash of burnt sienna; then with the sponge dipped into the Vandyke, and also slightly into the blue-black, we dab in the dark masses of knots, and put in a few connecting touches of dark colour where it appears desirable. With the large mottler we now work the colour surrounding the knots into one sweeping direction, using the brush at right angles to the board, and thus get one natural lead across the plain spaces from one "nest" to another. With the round, stiff fitch we further work the grain surrounding and amongst the individual knots in the same natural flowing curves as the mottler has indicated, and also "open" any knots which may appear too "spotty" or "set." The plainer spaces may also be mottled after the appearance of Fig. 1 in the previous process, but scarcely to an equal extent. The work can now all dry, and should then be wetted over, which our beer allows us to do without moving the colours, and then overgrained. Instead of the pencil overgrainer before used, we take the thin overgrainer (Fig. 13, page 40, Vol. II.), and, separating it into fine divisions, we work in the overgrain with a thin wash of Vandyke. While still wet, as before directed, the grain is softened to a dark edge, and then the fine dark markings which cross the latter are put in with the pencil and blue-black. The varnishing or "binding down" coating is now given, and then the work is glazed with Vandyke, if desired full and rich in complete effect, or with the blue-black or a mixture, if we wish to tone down the warmth. Providing we use beer with our pigments, we can, with care, always wet our work over, and thus see the colour when varnished. In the first process of such imitations we are therefore able to make little alterations or additions by re-wetting the work which may have dried too quickly for us.

In offering these directions to the learner of graining, the writer's chief desire is to make the *modus operandi* and the reason thereof plain and apparent to those readers of WORK who have no better way open to them for obtaining instructions upon imitating woods. The few black and white illustrations which we have attempted in these papers are in no way given as examples or "copies," but solely as pictorial aids to the letterpress. The advice given in my opening paper of procuring either good natural samples of woods, or imitations grained by a good professional worker, must be applied to all these varieties; and when the student has obtained all the assistance he is able to gather from this present aid, his best plan would be to take practical lessons, directly or by intelligent observation, from those experienced workers whose imitations are their best recommendations. As in all arts and crafts, practice will and must beget experience and knowledge, and the young grainer will often produce more masterly effects after a few lessons by actually watching the manipulation of tools and pigments by a proficient man than he would from a long study of real specimens alone, without instructions.

Pollard Oak in Oil may be grained in a similar manner as in water. The pigments, previously ground in oil, should have a little of the best terebine rubbed up with them, and the bright graining colour, or first wash, should be made as the ordinary oil-graining mixtures are. The sponge, mottler, and stiff fitches are used as in water colour, and, to take the place of water, and keep our work moist and amenable to mottler and fitch, we substitute turpentine. The brushes are dipped into clean turps, and then the superfluity pressed out before using them on our panel. The final glazing is worked as in the distemper process; but we have no occasion here to varnish or bind down the earlier process, in consequence of it being oil-grained.

Root of Oak is an imitation much akin to the pollard I first described. The grain of the wood, however, instead of "flowing" from each set of knots, more in the one direction of the length of plank, is found to encircle the masses of knots in irregular rings of overgrain, and is marked by the more decided presence of the dark pencil veins. It may be of interest to notice that one contemporary, an experienced writer and grainer, classes *all* such specimens, with which my first method is identified, as necessarily all "root of oak," and not genuine pollard. My own real specimen, upon which natural appearance the process and imitation is based, was cut directly off a 14 ft. plank, and, therefore, could not possibly be genuine *root*. It is very easy to understand how, when a specimen is cut from a large oak, that an old junction with a branch may be displayed of so large a size as to give it the appearance of a piece of root cut across the stump of the tree. With respect to this same specimen, it will scarcely be credited that, for want of a purchaser, or, perhaps, through ignorance of its value, the plank in question was being used by a country carpenter for *making common coffins*. Surely the want of trade and technical education was never better exemplified.

Knotted Oak—so called—is a useful and effective imitation of combined knotted and figured portions of the wood. It is commonly used, when graining oak in oil, for the panels, with ordinary oak stiles. It is a cheap attempt at the richness and variety of root of oak grained in oil, and although it is often as "nasty" as cheap, there are many grainers who make a good door with the panels so varied. I append a brief description of the working, and a black and white "suggestion" of its appearance. (Fig. 4.)

The colour for Knotted Oak is a warm, rich buff ground with a dash of umber therein, and the graining-colour the best burnt Turkey umber. A little of the pigment having been made to ordinary working consistency the panel is rubbed in evenly, and then one side slightly combed. With a stiff, scrubby, round fitch we now take up a little pure umber, only slightly thinned with terebine, and put in the dark knots; then, with another larger fitch, work round these, and give them and the surrounding space a growing motion towards the other half of panel. We now put in the fine neat lights across the slightly combed half, and with a lead towards the knots; and then with a pencil and rag we work up—adding to or taking from—the knotted half according to the circumstances, "time and cost," of the job. When dry, we overgrain in distemper with a wash of Vandyke. The combined treatment of figure and knots gives full scope for display in the last process, and a creditable and natural effect may thus be obtained without much more cost than of a panel of *maiden oak*.

CONSTRUCTIVE STRENGTH IN WOODWORK.

BY JOHN WHITFIELD HARLAND.

FRAMING—NATURE OF WOOD—BREAKING AND CRUSHING STRAINS—STRAIN OF CONTRACTION —SIMPLE FRAMES — COMPOUND FRAMES — HOUSE DOORS — DIAGONAL STRUTTING — SWEDISH JOINERY—CUBIC FRAMING.

IN my first paper on this subject (see page 165), I disposed of the different modes of jointing boards together, and alluded to mortise and tenon joints for framing, and now propose to take framing as my present subject. Before attempting to show how strength of construction can be best attained in framing, let me first point out the conditions to be ascertained. Firstly, it is evident that wood being fibrous, that is, composed of fibres closely packed together, familiarly termed the grain, can be much more readily broken transversely than in a longitudinal direction, whilst it is much more easily split longitudinally than transversely; in fact, it is very nearly true to say that wood cannot be split or cleft across the gain. There is, however, another sort of strain to which wood may be subjected other than a breaking strain, which is called the crushing strain, that is to say, that with the grain upright a superimposed weight will, if heavy enough, ultimately crush the fibrous tissue of which the wood consists, whilst experiment proves that this crushing strain will much more easily destroy the tissue if applied on side grain wood. The reason for this is not far to seek. The fibres being laid alongside each other, and cohering by attraction in laminæ or layers, are, so long as the piece of wood is straight, of equal length; but so soon as a sufficient weight is applied to bend the wood, some of the layers of the grain are deflected (*i.e.*, the under side ones) more than others; and as a straight line is the shortest distance between two points, it follows that to some degree, no matter how slight, a movement takes place between the layers where they lie contiguous, which necessarily introduces a split or cleft, and the weight superimposed breaks up their union, and deals with them as separate pieces laid one upon the other, instead of as it they were one united whole. Hitherto, I have been talking of weight acting in the direction of gravitation only, which, to keep a clear ideal of, we designate as perpendicular strain. The science of mechanics teaches us that there are other strains, such as side thrust, *i.e.*, lateral strain; and, going further still, proves to us that where two forces, or strains, act in different directions, these forces neutralise each other in an ascertainable degree, and enable us to predicate with absolute certainty where and in what direction the line of fracture resulting from these combined strains, equal or unequal, will be sure to take. For instance, where a force acts perpendicularly and an equal force acts horizontally, the line of fracture will be in a diagonal direction, equidistant between the two, viz., at an angle of 45°; but if the piece of wood be upright, the resistance to the downward force being greater—let us say, three times that of the resistance of the wood to side thrusts—the diagonal of equal forces will no longer be at an angle of 45°, because either force, if sufficient to fracture at all, would fracture the lesser resistance, in this supposed case, in one-third of the time that would be required to fracture and overcome the greater resistance. Or, what comes to the same thing, one-third the side thrust and the same downward thrust would give the diagonal of the forces at an angle of 45°. This reasoning shows that, given the resisting power of the same wood laterally and perpendicularly—we can predicate the diagonal, in this case evidently, on the former assumption of one-third the former equals the whole of the latter in breaking power—the angle would be altered from 45° to that of one-third to one, viz., 30° (one equalling 90°, *i.e.*, a right angle, because we premise a perpendicular and a horizontal force). Tables are published giving the coefficient strains of all sorts of wood and metals—calculated upon the base of square inch sections—and also giving a third class of strain, which I am about to explain; and these tables give us the power of accurately ascertaining the exact diagonal of both equal and unequal forces acting either against each other, partly or entirely, or in different directions altogether. I do not mean to say that in woodwork it is absolutely necessary that the carpenter or cabinet maker should go into such calculations as those indicated, but I do say, and mean it, that he should have a thoroughly clear understanding in his own mind of these facts, so as to know beforehand where his work is likely to break if strain sufficient were put upon it, so that he may avoid in his construction leaving weak points. He should know how to put his work together so that it shall be strongest wherever the forces are likely to have their strongest tendency to destroy it. He will then be able to avoid heaviness, clumsiness, and waste of material and strength in the wrong place, where the forces actually counteract each other by neutralising each others' effect.

The third kind of strain is the opposite to the foregoing in every way. Crushing strains and side thrusts are pushing strains, not pulling strains. They do not destroy cohesion of particles as do pulling strains, and the latter are, therefore, termed tensile, that is, stretching strains. A familiar example of tensile strains is noticeable in a drawer front, where the self-evident tendency is to pull it away from the dovetail joints with the two sides, which in this case, it should be noticed, is perpendicular to the grain of the sides, which explains why the "pins" are on the drawer front and the "tails" on the sides; if they were reversed the tensile strain of opening the drawer would inevitably draw the "pins" out. Another instance of tensile strains is in the roof principal, where it is very important, though not perhaps so evident at first sight. The beam, usually called a tie-beam, is subject to a tensile strain, caused by the weight of the roof having a tendency to force out the walls which carry it. It is also subject to a perpendicular side thrust (by this I mean a perpendicular strain on the side grain, which, of course, runs horizontally), and evidently this force is greatest half-way between the supports at each end, that is, in the exact middle. Now, although it is almost universally done, a mortise to take the foot of a king-post at this, the very weakest point of the tie-beam, still more weakens it, and must be admitted to be bad construction. Better far to leave the tie-beam its full strength, and plant on it two blocks to maintain the foot of the post in position lengthwise, and bolt to the two side-pieces saddling it, as it were, athwart ships, or even bolting the side-pieces only to the post, as even a hole bored through the tie-beam sadly weakens it. The principal thus constructed may be of considerably lighter dimensions than the former method permits, without loss of strength, but should have an iron tie-strap.

Every one is aware that wood varies considerably in the direction of the grain, which frequently, owing to the more or less exposed situation of the trunk of the tree whence it has been cut, and the angles at which branches have forked from it, runs out, and is termed "cross" or "short" grained stuff in consequence. Such stuff is better able to resist crushing strains than either side thrusts or tensile strains, and to use this for tie-beams would be considered by me as bad construction. It would be usefully employed as a post, for blocking, or any portion of the work where the only strain was a crushing one. Hence I would urge workmen to exercise their judgment in selecting timbers for certain purposes, more with a view to their fitness than their accidental convenience of size, which, even if it entails a little more trouble and labour, is of considerably more importance in good work. This is the more important when we remember that an architect designs a roof on the general lines of habitual calculation, allowing, of course, a margin above and beyond what is termed the breaking strain, but does not, and cannot, make allowance for any improper use of a weaker piece of timber than his usual averages.

There is yet another strain to which wood is inherently susceptible, namely, the internal strain of contraction; and as this is, invariably, unlike metal, in width or thickness, or both, only never in length, no construction which ignores this strain, or does not compensate for it in some way or other, can be considered good. Thus any large surface of wood, either framed together or not, as the case may be, which experience teaches us will shrink in time, should be so put together as not to involve any necessity for the joints to be forced open or the grain to split in shrinking. In other words, table tops, panels, and other surfaces, should never be held by their sides, or in such a manner as to disallow their shrinkage from taking place naturally and without restraint. Something must give way if such restraint be imposed in their construction: joints will open or the wood will split, and no matter how good the general workmanship may be, the result of bad construction will ruin everything, bringing its own disgrace with it. It is no excuse to plead that wood will shrink, do what you will; this only aggravates matters. Your knowledge of the fact ought all the more to have made you careful to obviate its effect by such expedients as have been found to answer the purpose. In tables and drawing-boards this may be overcome by "buttoning" at the ends, or by screwing to battens underneath from the back through slots instead of round holes, so that in contraction the buttons or the screws can move inwards instead of remaining fixed, whilst panels should be left, of course, loose in the grooves, and not glued or held rigid by any means. Having thus, perhaps, too briefly sketched the various strains to which all construction in wood, as a material, must or may be subjected and their difference in degree, it must not be assumed that I mean that these forces will be by any means constant, nor that any one force alone will invariably act in a given direction. To make this perfectly clear, such member of any construction designed to resist, say, a crushing strain, may instead, or, in some cases, even simultaneously, be also subjected to a tensile strain, or a side thrust, or both, a contingency that in all good construction should be foreseen and provided for so as to eliminate every possible source of weakness. With a view to this, framing is resorted to. By framing, I mean so putting together component parts of any construction that they may hold together under ordinary strains —hence we have simple and compound frames. The simple frame (Fig. 1) consists of four pieces of wood united at the corners, *a*, *b*, *c*, and *d*, in such wise as to be almost as strong and very much lighter than a solid piece of timber of the same outside dimensions. The corners may be halved together (as in Fig. 2), *e* being side view and *f* plan, in which the portion shaded shows where the half of the one piece underlies half the other piece. This is not by any means good construction, as it depends either on the glue or nailing or screwing of the halved portions together; it is therefore seldom resorted to in permanent work. A simple frame may be also mitred together (see Fig. 3) or halved and mitred (as in Figs. 4 and 5). There is very little strength—which in both cases is sacrificed to appearance—in these methods of uniting a frame together, and it is used almost exclusively for picture frames or mirrors, or other similar articles. Then again, framing may be dovetailed together (as in Fig. 6); but this again is weak, because the "pins" may be drawn out of the tails. By far the best means of framing-up is that of mortising and tenoning the corners together (see Fig. 7), where the shaded portion, *g h j i*, shows the tenon passing through the mortise, so that when glued it may be firmly wedged home to the shoulder at *g* and *i*. If the tenon be made as described in my first paper and illustrated in Figs. 13 and 13*a*, page 165, no stronger simple frame can be devised. All simple frames, if of sufficient size to permit of the sides being bent or deflected by strains, are to some extent weak on this very account, and therefore various means are resorted to to strengthen them, and they then become what I have termed above, compound. The cross-bar *k l* in Fig. 8 exhibits one method of stiffening a frame; it prevents the points *k* and *l* from being brought nearer together by a crushing strain or being forced apart by tensile strain, always provided the cross-bar is tenoned into the frame at *k* and *l*, and wedged either from outside or by fox-wedges in a concealed mortise. Sometimes, where the frame is to be filled in either with panels, or, in the case of window sashes, with glass, which (both being square) would add to its rigidity, the former must be only in the lengthwise direction, as we have seen that the width is always liable to shrinkage. Although in the case of glass it acts in both directions, being brittle it ought not to be too much relied upon. The cross-bar may be sufficient to prevent breakage; but in other cases, the size of the frame and the amount and variety of strains to which it may be destined by its purpose to be subjected necessitate changing its character, and it becomes a cross-rail *n*, Fig. 9, tenoned into the frame at each end, and at its centre in its turn mortised to receive muntings *m*, *m*, their other extremities being tenoned into the opposite members of the frame, technically termed top and bottom rails.

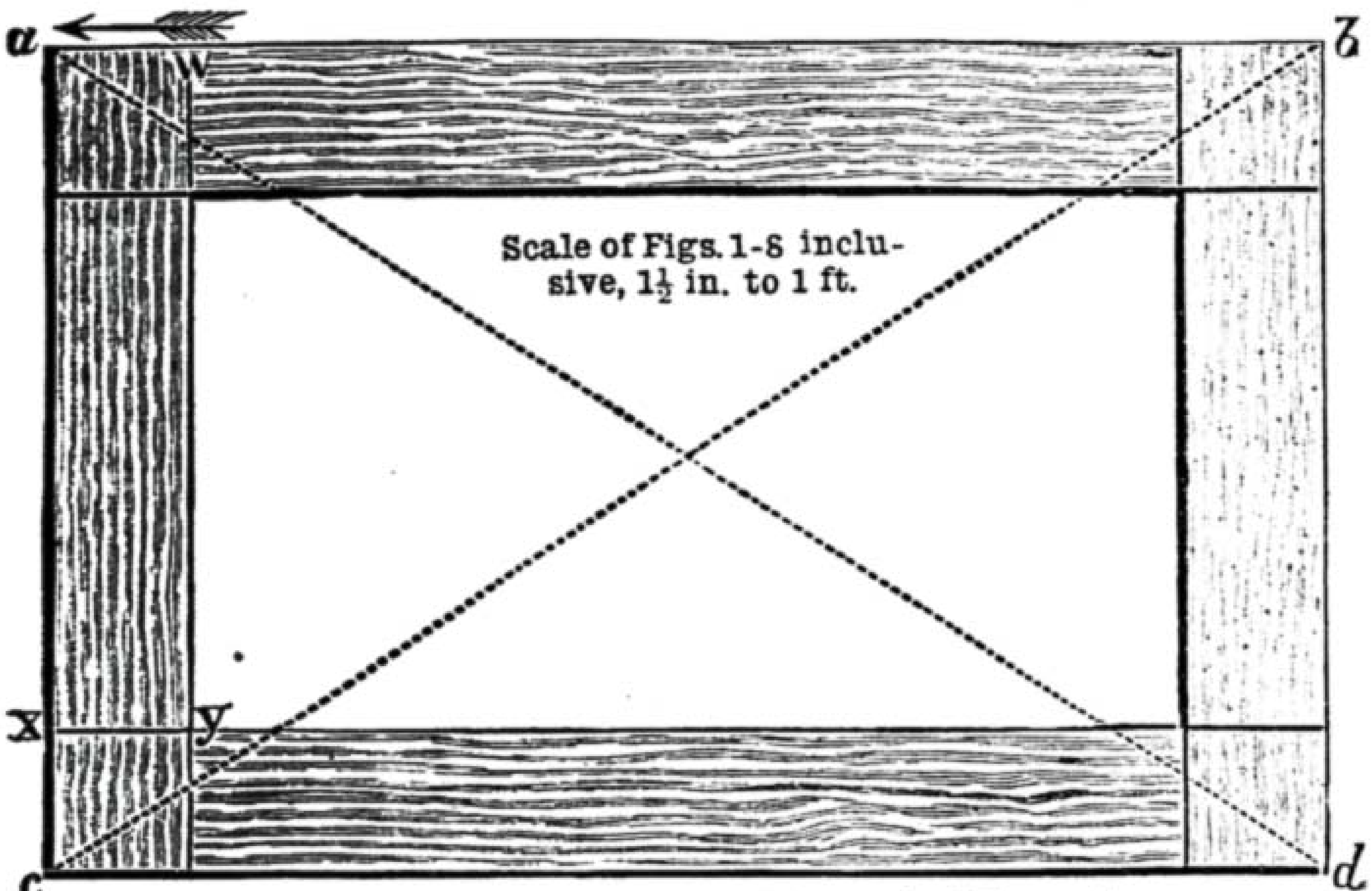


Fig. 1.—Diagram showing "Diagonal of Forces."

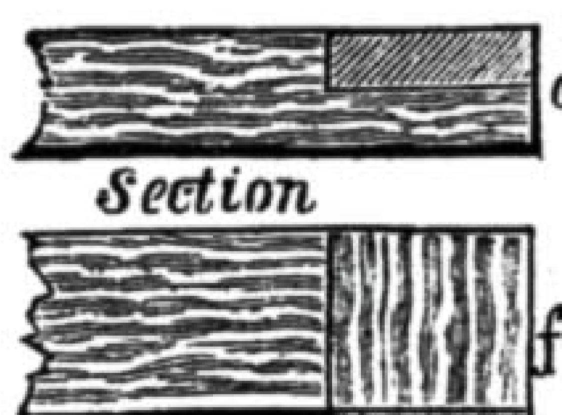


Fig. 2.—Halved Joint of Frame.

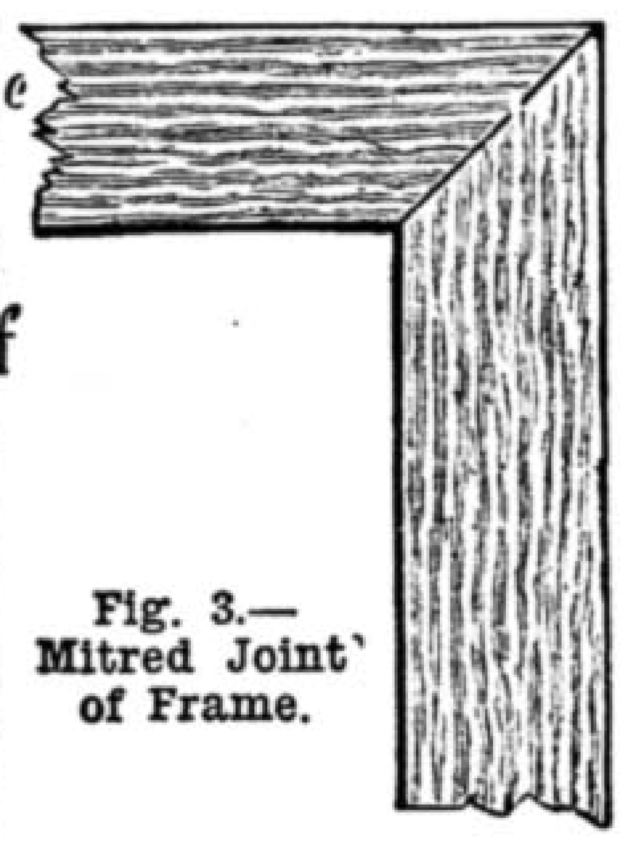


Fig. 3.—Mitred Joint of Frame.

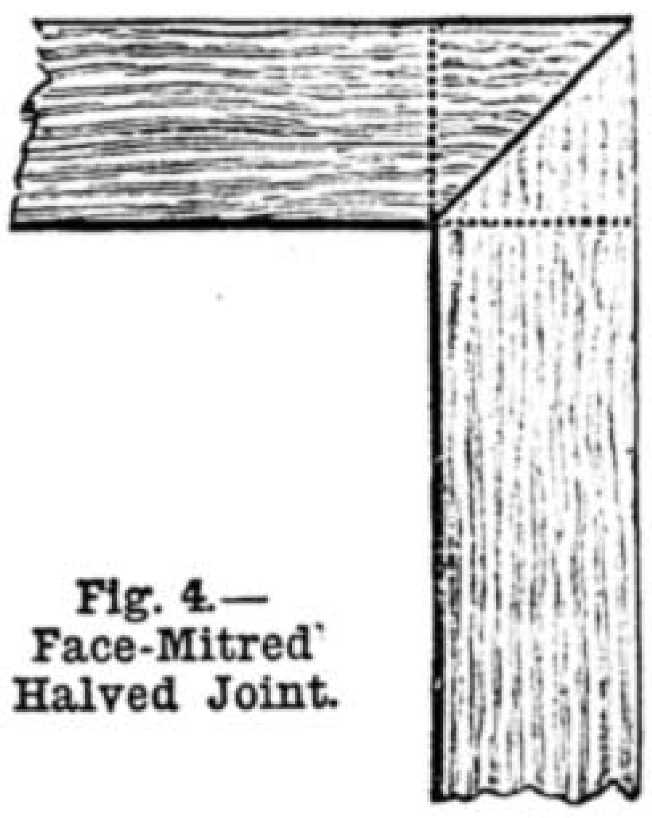


Fig. 4.—Face-Mitred Halved Joint.

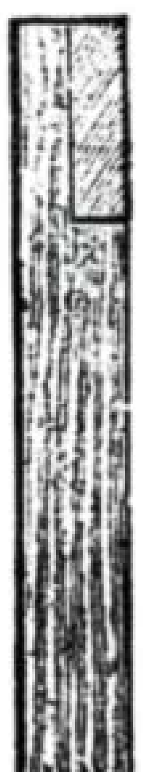


Fig. 5.—End View of Fig. 4.

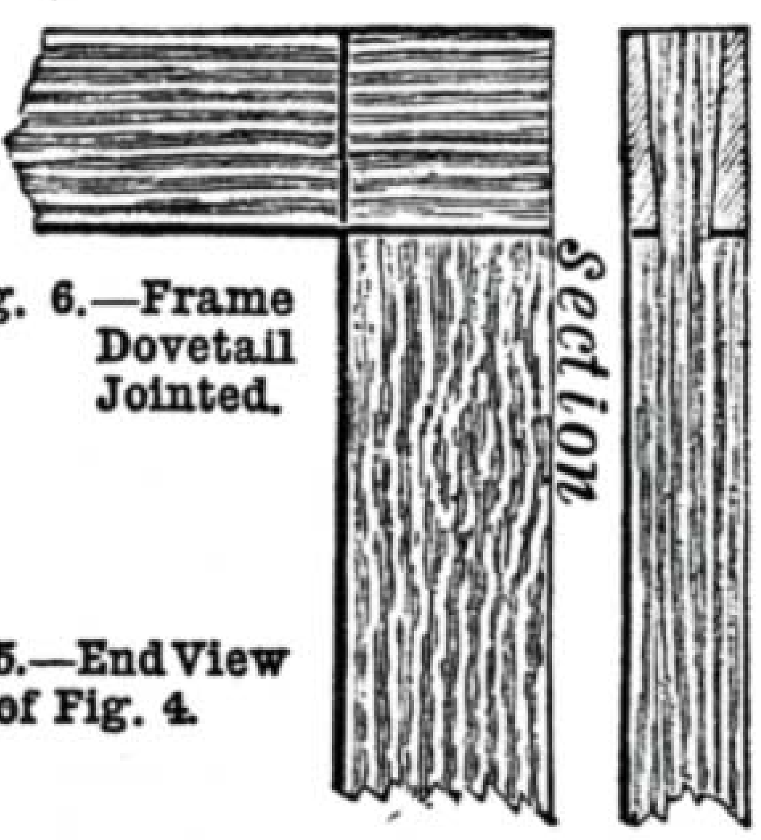


Fig. 6.—Frame Dovetail Jointed.

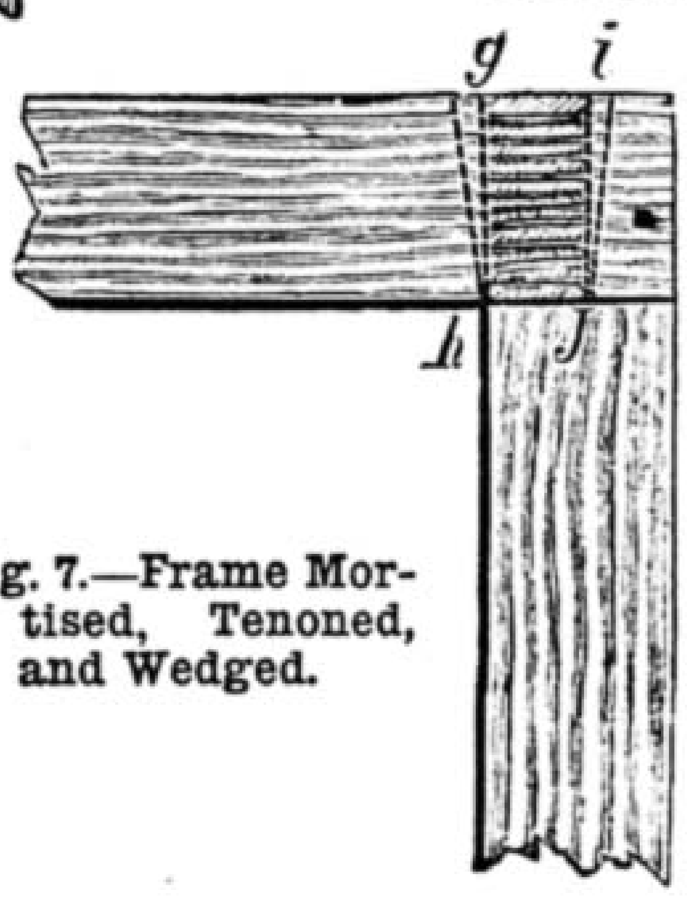


Fig. 7.—Frame Mortised, Tenoned, and Wedged.

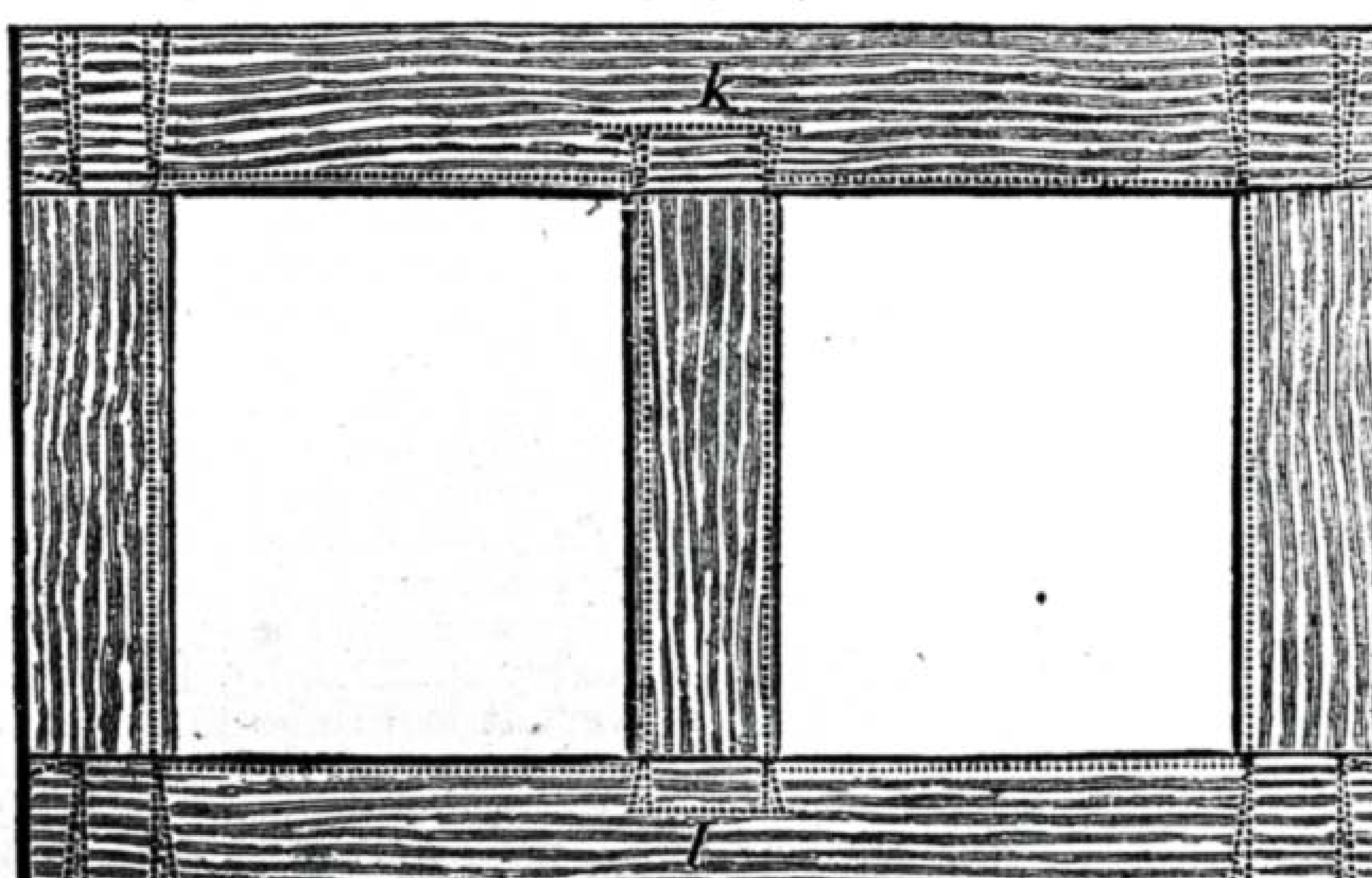


Fig. 8.—Frame strengthened by Cross-bar or Munting *k l*.

Without going into derivations of the term "muntings," it is much more to a useful purpose to consider their functions, and the strains they are designed to counteract. By the squareness of their shoulders, if also fox-wedged, which alas, too often, is neglected, they help to make the framing more rigid; they also serve as struts against compressive strains and as tie-bars against tensile ones, thus holding in and keeping out at one and the same time the top and bottom rails, whilst they also add to the strength of the cross-rail in like manner by maintaining it in its designed position and deriving from it and the other rails, in return for services thus rendered, so to speak, a power of keeping itself in position. It may partake of the character of a fairy tale, or fable, thus to endue what we may call dead or inert matter with any power to resist, even passively, strains from within and without; but in the infinitely lesser degree that man, by studying the laws that the Great Architect of the Universe has designed to govern matter, can command, if not create, combinations of strength and beauty, by thoughtful study, and bright and cheerful labour as a means to an end, is it not possible for the moment to accredit matter directed by man's mind with fanciful powers such as these? At any rate, it will not fog any practical mind thus to play at work, but may tend to true pleasure thus to endow soulless matter with the intelligence breathed into it by man. "It amuses me and does not hurt you," as the man said when he made a harmless joke.

This sort of frame is that used in the ordinary household door, the inner edges of the styles, rails, cross-rail, and muntings being rebated to receive the panels which are more or less well (chiefly *less* be it whispered) fitted into the rebates before being glued and wedged up. Verily, workmen who can and who would prefer to do their work to their own satisfaction and credit are tempted by the competition of foreign labour and foreign machine-made joinery to slur the details of craftsmanship and produce inferior work far below their capabilities because the public, who are ignorant technically of the wants and demands of constructive strength, never ask the question raised by the old conundrum, "When is a door not a door?"

I have shown that strains act in the diagonal of two forces which may have been and probably was the reason why the "monks of old" adopted in Gothic doors and other framing the principle of diagonal struts and diagonal panelling. Refer to Fig. 1, where you will see a shoulder *x y*. If a force acted in the direction of the arrow at *a*, or the contrary, the result would be, either that *x* or *y* would become the fulcrum of a bent lever, one arm of which would equal *a x* and the other *x y*, or *w y* would be one arm and *y x* the other—a leverage of eight or ten to one. It follows used for the panels. It has been shown that panels shrink in width, but not in length; therefore it follows that panels diagonally put in will not shrink so much in one direction as perpendicular ones, but will shrink slightly more in the other direction, because the diagonal is the mean of their shrinkage (*i.e.*, is between the shrinking in width and the non-shrinkage in length); but as this shrinkage is at an angle it becomes much less than if it were on the square; in fact, it is virtually imperceptible, so that tensile and compressive strains destroy each other if coincident in time and side thrusts through loss of fulcrum for leverage can only exert an infinitesimal portion of their force, the latent remainder being carried down and vitiated in what I have called the simple frame, by absorption in the directions where the material employed, *viz.*, wood, is strongest and most powerful in its resistance. Another consideration that will emphatically assert its existence in used until the width of the board was reduced beyond the point to which it could ever contract before placing it in position. Thus floorboards, matched lining, and other large surfaces, the joints of which notoriously open in time, and in contracting weaken the framing in which they are set, might be compressed sufficiently to take all tendency to contract out of them. In doors, panelled partitions, and similar constructions the framing of which is wood, I do not see why the filling should also be of wood; it would, in painted work, be better to employ sheet metal, paper boards, or millboards, vulcanite, or other non-contracting substance which would always remain of the same size, and thus afford a constant support by close fitting at the bottom of the grooves to maintain the styles square with the cross-rail and top and bottom rails. A filling which by contraction goes away from its work and leaves room for backlash ceases to fulfil the object of good construction, but

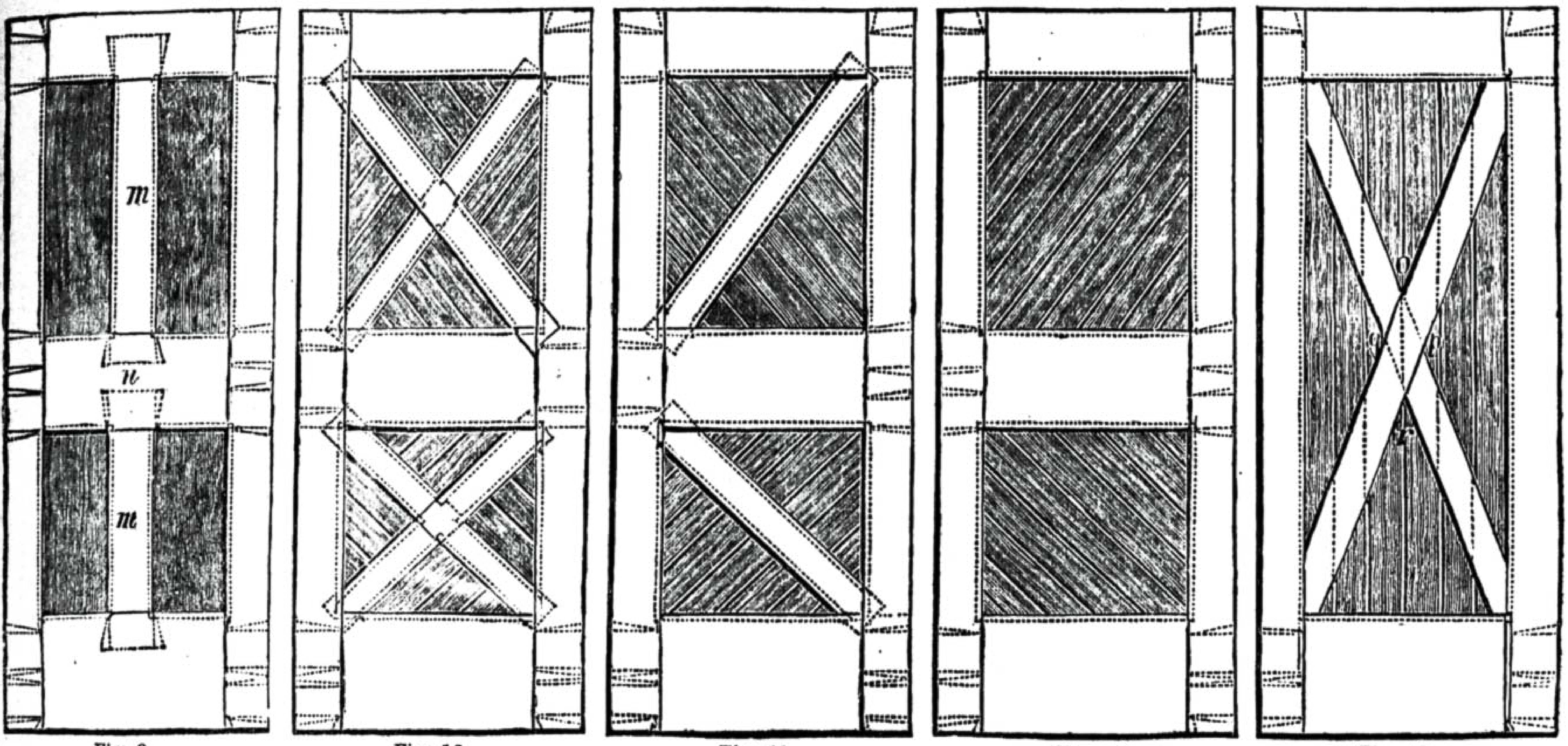


Fig. 9. Fig. 10. Fig. 11. Fig. 12. Fig. 13.

Fig. 9.—Ordinary Door. Fig. 10.—Door Cross Panelled with Diagonal Filling. Fig. 11.—Door with Diagonal Struts and Panelling Parallel. Fig. 12.—Door with Diagonal Matched Panelling. Fig. 13.—"Cross Buttock" Door Ledge boarded flush on one Side. (Scale of Figs. 9–13 inclusive, $\frac{1}{2}$ in. to 1 ft.)

that the frame could not withstand the force however moderate in either direction at *a*. Therefore the point *b* would be moved, or, what is equally fatal, would have a tendency to be moved to the right or left. Supposing that the forces were pretty near equal, the result, as before shown, would give the diagonal of the forces, as the dotted line *a d* would show. Now a strut with *a d* as its central line would absorb the forces competing for mastery, *i.e.*, the force acting from right to left, that acting downwards, that acting from left to right on the fulcrum of the said bent lever, and that acting in a tensile manner from *b* to *c*, as this would be negatived by being exerted at right angles to the strut whose centre line would be *a d*. If instead of framing, as in the ordinary door, a cross-rail and muntings as previously described we substitute on *a d* a diagonal rail, and tenon into it diagonal muntings, also tenoned into the corners *b*, *c* of the simple frame (provided the mortises do not interfere with and weaken those of the style and rail at *b* and *c*), the very acme of strength of construction is reached, especially if diagonal matched boarding be door-framing is that the strain imposed on it in opening it and closing it develops a twisting motion or tendency to some extent counteracted by the fixed points or fulcrums supplied by the attachment to the posts by hinges, but which also re-acts in the twisting.

Other developments of this thesis of diagonal strutting in framing are shown in Figs. 10, 11, 12, and 13, which explain themselves and call for no special description, except that it should be noted in Fig. 13 that the cross-rail is dispensed with and the filling in, instead of panelling, is here matched boarding flush on one side, battened by diagonal battens which are tenoned into the simple frame, the enclosed part *o p q r* showing where the battens are halved. When I come to consider and explain constructive strength in metal, I shall have to allude to casting under compression, a most powerful factor, and here let me apply the same principle in a modified form to the material now under consideration—wood—which is as compressible at ordinary temperatures as metal when raised to melting point. Now I suggest that to overcome contraction of side grain wood, a sufficient crushing strain or pressure might be readily by substitution of wood which has been deprived of its power of contracting and is therefore to be relied upon not to work mischief, or of some other material which does not contract at all, we can afford to use for framing wood of slighter dimensions and thus effect economy of material. Let me instance a door of what I consider the best construction, say Fig. 10, which, if made out of $1\frac{1}{2}$ in. stuff with diagonal $\frac{1}{2}$ in. panelling, would be subject to a minimum contraction, yet would contract enough to nullify the support it ought to afford to the maintenance of perpendicularity of styles and squareness of rails, and would be still pretty strong. It could, by substitution of non-contractive filling, be made even stronger when made out of $1\frac{1}{4}$ in. stuff, with $\frac{3}{8}$ in. panelling, thus effecting an all round saving of material, weight, and labour, enhancing, rather than detracting from, strength of construction.

WORK readers will perceive that I am thus going a little beyond the recognised boundaries in these remarks, but they need not fear that I shall take them "beyond their depth," even if they strike out in new departures. Those master builders who now buy American and Swedish, or Norwegian doors, instead of using English labour, have the excuse that they are cheaper. But they simply buy "a pig in a poke," taking sufficient care, however, of "number one" to sell it again before the "poke" is removed. But this sort of thing can be foreseen to have a not far distant ending. Timber takes longer to grow than to cut down, and demand will fetch up prices; exhaustion of supply (as in the case of our own coalfields) will again enhance prices. Courted labour will demand in the increasingly enlightened condition of workmen all over the world, better pay, and foreign joinery cannot therefore for any lengthened period dominate the market. To shorten that period I suggest superiority of strength of construction, applied to English work: the substitution of sheet iron panels for doors, enabling the maker of the frame to reduce thicknesses, without sacrificing strength, securing rigidity and extra lightness, at lower cost. But all slovenly work, such as bad mortising and tenoning, too often passed in the case of muntings, which under these conditions only seemingly are of any structural strength at all, should be put down with firmness by all English builders. If the muntings be properly tenoned and mortises be cut deep and square and fox-wedged till they are held home, afterwards pinned with good dowels, they add to the strength of the framing as much or more than the members of what I call the simple framing (or, as the French call it, the *entourage*, that is the surroundings). Then if the panels, non-contractive, fit all round they may be glued in place, thus adding to the strength by holding to the sides of the grooves in which they are set, whereby tensile and side thrust strains are neutralised. If sheet iron be used for panels instead of glue, the iron should be warmed and hot shellac used to fix them in the grooves, which instead of being ploughed can be cheaply cut by circular saws, as is now done in floor-boarding with hoop iron tongues, which ought also to be warmed and cemented in place with hot shellac to ensure good work, and all contraction first compressed out of the boards. Having thus treated of framing, I must defer to another chapter the consideration of what may be termed *cubic* framing, as this subject demands too much space for the present. By cubic framing I mean where the third dimension comes in, as for instance in a table. The top of a table may be a frame, or laid upon a frame, such as I have just treated of, but the third dimension, inclusive of fixing the legs to a frame perpendicularly, which itself is horizontal, involves several intricate questions of strains and strength, which perforce I must defer.

MEANS, MODES, AND METHODS.

FIREBRICKS.

IT may not be generally known that firebrick in the shape of cheeks and backs for open or closed stoves and ranges can be manufactured easily, and broken ones repaired, at home, by any one who may have the time and the inclination to do so, and with a comparatively small outlay of money. Of course, the shops advise folk to buy a new set when a brick is broken, but with a view to helping those who wish to help themselves, I will explain the mode of setting to work.

Now, whether the object in view is to repair a broken brick or to put in an entirely new set, the first thing is to mix the fire-clay (sold by most ironmongers in the dry form as Stourbridge clay) into a stiff paste with water, and to do satisfactory work, this paste must be stiff enough to stand by itself when cut into slabs about $1\frac{1}{2}$ in. in thickness. Next, having cleaned out the grate, and, in case of repairs to a broken brick, picked out any loose fragments, thoroughly wet with a brush or the hand all the parts where the new brick is to touch the grate. There is no need to flood the grate, but just give as much water as can be absorbed, and no more. Most grates have some firebrick in them, and the amount of water that can be absorbed will be very easily seen.

Next, without any hurry—for the clay does not set instantaneously, like plaster of Paris—lay the cement into the place it is to occupy in the grate, using a trowel or spatula of wood, and pressing it equally in its place. For my own part, I prefer to use my fingers first, and finish the surface off with a piece of wood.

Where cheeks and a back are required in a grate (and this helps to keep down the coal merchant's bill), I put them in all in one piece, and am inclined to think that the brick lasts longer when in one piece than when composed of three pieces, as usually sold in the shops; and the reasons are these:—that the brick in one piece has greater solidity; there is less chance of fine ashes and dust getting behind or underneath; thus the risk of breakage is considerably diminished, and the brick cools more equally when the fire goes out.

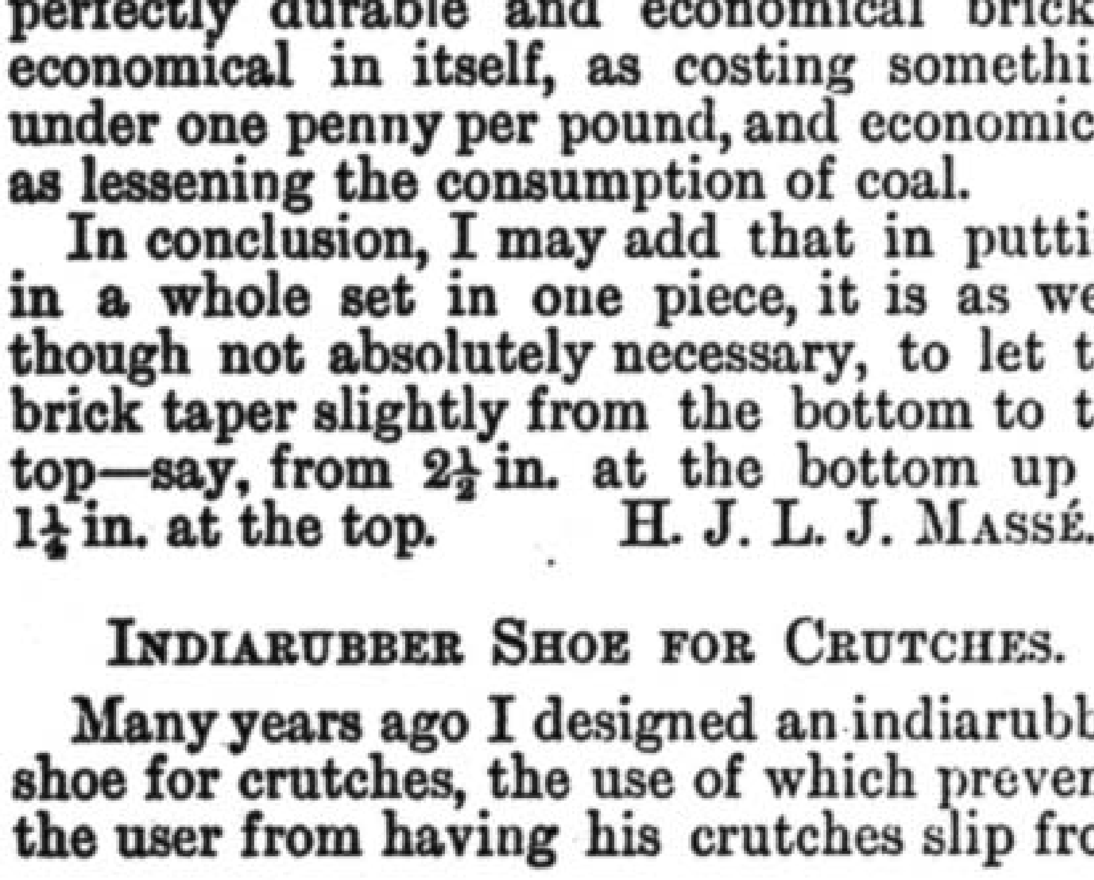
When the fire-clay is firmly in its place, a fire may be lighted at once, or if the work be done overnight, the clay may be left to dry until the morning.

There is no need to go into the chemical details of the action of the fire on the clay, but the result, in my own experience, is a perfectly durable and economical brick—economical in itself, as costing something under one penny per pound, and economical, as lessening the consumption of coal.

In conclusion, I may add that in putting in a whole set in one piece, it is as well, though not absolutely necessary, to let the brick taper slightly from the bottom to the top—say, from $2\frac{1}{2}$ in. at the bottom up to $1\frac{1}{4}$ in. at the top. H. J. L. J. MASSÉ.

INDIARUBBER SHOE FOR CRUTCHES.

Many years ago I designed an indiarubber shoe for crutches, the use of which prevents the user from having his crutches slip from



Indiarubber Shoe for Crutches.

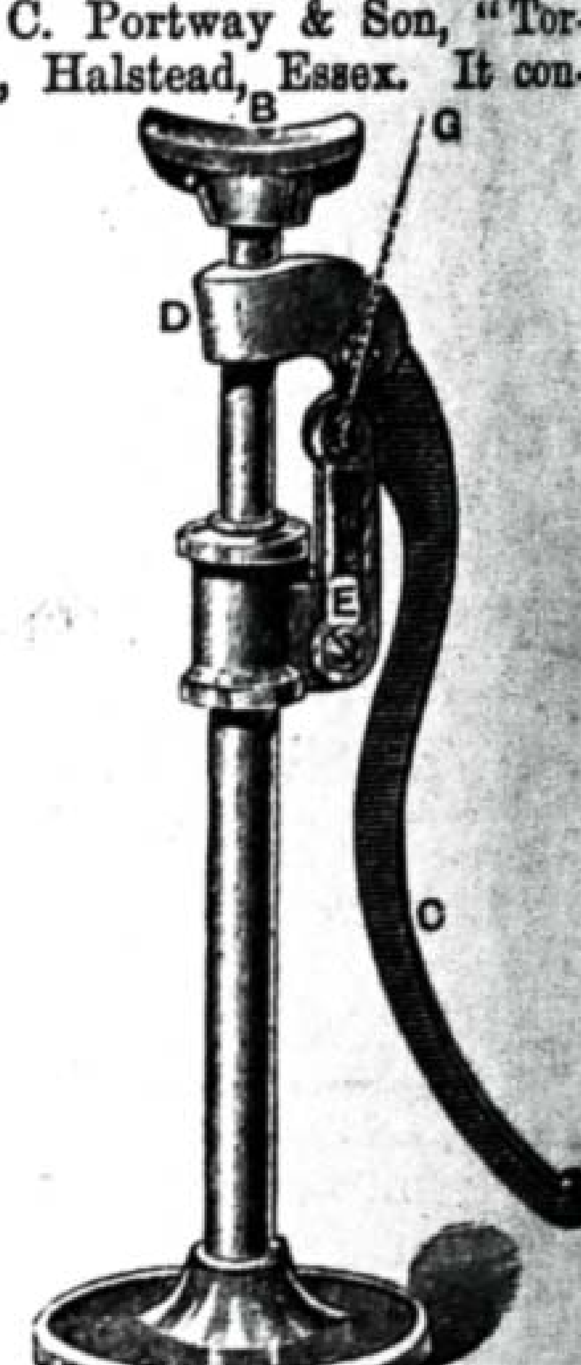
under him, even upon ice or polished marble or oak flooring. It was made by Messrs. Macintosh & Co., but never having been advertised, never got into general use. I enclose sketch of it, also a section, thinking that, as it answered perfectly well, it might be taken up as an article for sale, especially by the hospital surgeons, civil as well as military. It consists of a tube of vulcanised rubber, $\frac{1}{8}$ in. thick, let into a piece of the same material moulded to the section shown, and cemented to it with a solution of rubber in benzine or naphtha. The foot of the crutch should be reduced to $\frac{3}{4}$ in., and then inserted into the tube, a small piece of wood or iron wire being inserted with it, to allow the air to escape, which, when removed, the tube collapses tight to the foot of the crutch, and it will then never come off. These shoes last much longer than leather ones. J. W. H.

OUR GUIDE TO GOOD THINGS.

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

61.—A NEW CARRIAGE JACK.

A SIMPLE and effective carriage jack or setter for lifting carriages by the axle from the ground is shown by the accompanying illustration of this appliance, which is known as "Little Jack," and is made by Messrs. C. Portway & Son, "Tortoise" Stove Works, Halstead, Essex. It consists of an upright cylinder on a base A about 20 in. high; into this cylinder is a rod with a crutch top B, which works freely up and down, to suit the height of axles from the ground; a handle C is fitted to the cylinder and crutch-rod sliding piece D. The jack is put under the axle of a carriage, the handle raised horizontally, and the crutch lifted to the axle to be raised, the downward pressure of the handle acting by pressing the connecting rod E to a vertical line, and the fulcrum bearing beyond a vertical line—as shown by the dotted line G—raises the crutch 2 in., and secures it from sinking till the handle is raised again to the horizontal line. It is made in three sizes, Nos. 1, 2, and 3. The height of these is 14 in., 18 in., and 21 in. respectively. No. 1 will lift the axle of a carriage weighing 5 cwt. 20 in. from the ground; No. 2, the axle of a carriage weighing 10 cwt. 25 in. from the ground; and No. 3, the axle of a carriage weighing a ton, 29 in. from the ground. They are sold at 5s., 7s. 6d., and 10s. respectively.



Portway's Carriage Jack.

62.—THE DECORATOR'S AND ARTISAN'S HANDBOOK.

I can cordially recommend this book, which comprises from five to six hundred recipes and instructions for mixing and using cements, paints, stains, varnishes, etc., with much useful information with regard to exterior and interior work. It must have cost its compiler and publisher, Mr. W. McQuhae, Cockermouth, much time and research. Its price is 1s., or 1s. 1d. post free. There is no workman, professional or amateur, who will not find something useful to him in its sixty-four pages. THE EDITOR.

SHOP:

A Corner for Those who Want to Talk It.

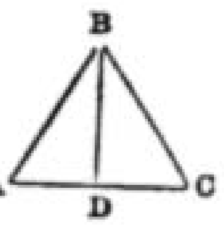
NOTICE TO CORRESPONDENTS.

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

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

I.—Letters from Correspondents.

Mitre Cramp.—Kildonan (*Inverness*) writes:—"I was spending a hard-earned and all too brief holiday in a remote Highland glen when Work (No. 69) reached me a week behind time, and as I adhered to my fixed determination to avoid all correspondence, *pro tem.*, hence my delay in replying to the strictures of Codgeto (see page 275). I confess I do not understand what he is driving at. In the mitre cramp described by me and H. B. (*Chatham*), the central triangular piece must have its apex a perfect right angle thus: A B C is a right angle. The saw cut B D equally bisects this angle, making the angles A B D and C B D equal to one another, each being therefore equal to 45°. Now a piece of moulding laid along A B and another along B C and cut in the direction of B D are practically coincident with these lines, and when brought together must necessarily form a perfect right angle. How Codgeto managed to produce a figure such as he has done, I cannot imagine. Does he mean to say that the *lengths* of any two straight lines containing an angle affect the value of the said angle? If so, the correspondence may as well cease. Perhaps he has fallen into the mistake of having the sides A B and B C of *unequal* length, and of bisecting the base A C. This would, of course, throw his mitre out of truth."



Oil Polishing.—Kildonan writes:—"I am pleased to see Mr. Denning's article on this subject in the current number of Work. I made a small fancy table, described in No. 1, Vol. I., from an old Indian tea chest, making the legs of light-coloured oak. I don't know what kind of wood was in the chest; it is not unlike oak in colour, while in texture it is more like mahogany—anyway, it works like cheese, and takes a fine skin. Two practical painters—one a house painter and the other a coach painter—advised me to polish with oil, the one advocating raw linseed, the other boiled oil. I tried the raw oil, but, rub as I liked, I never could get it dry. The wood was porous and took in the oil easily, and perhaps this caused me to use more than I should; but for weeks and months afterwards it would sweat and have a greasy appearance. I always took a clean rubber and went over it till the sweat came over my nose, but in a day or two it was as bad as ever. Eventually I rubbed in some methylated spirit, and that cooked it. I cannot say that it spoiled the polish, but it has since continued dry."

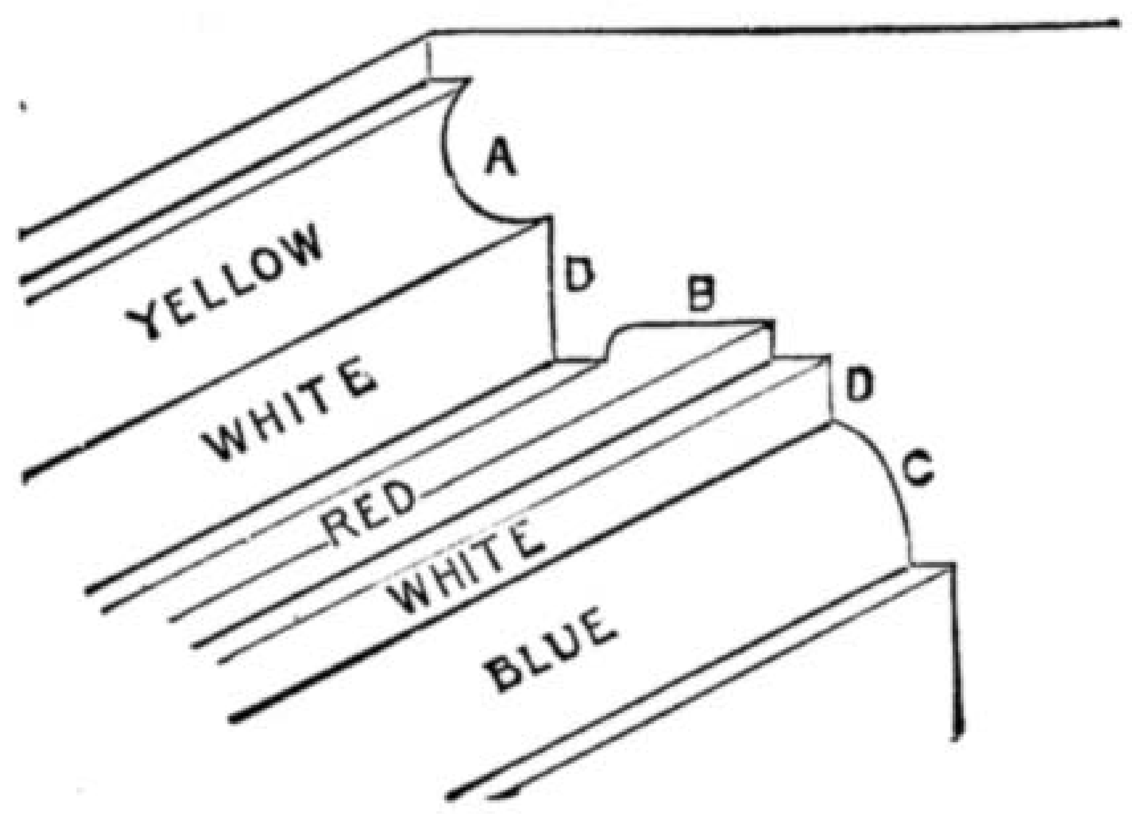
Erratum.—J. S. (*London, N.*) writes:—"I hasten to correct a mistake in Work, No. 73, page 341, in my reply *re* 'Shut-up Stool.' The word 'bottom,' relating to Fig. 7, should be 'top.'"

Sheet Metal Book.—R. A. (*Salisbury*) writes:—"The price of the 'Sheet Metal Worker's Pattern Book' should be 9s., not 2s., as stated."

Winter Classes.—Pater writes:—"All my knowledge of carpentering and kindred subjects I gained at Polytechnic, and similar classes. Intending dabblers with wood and metals this coming winter cannot do better than look up classes of the kind in their neighbourhoods."

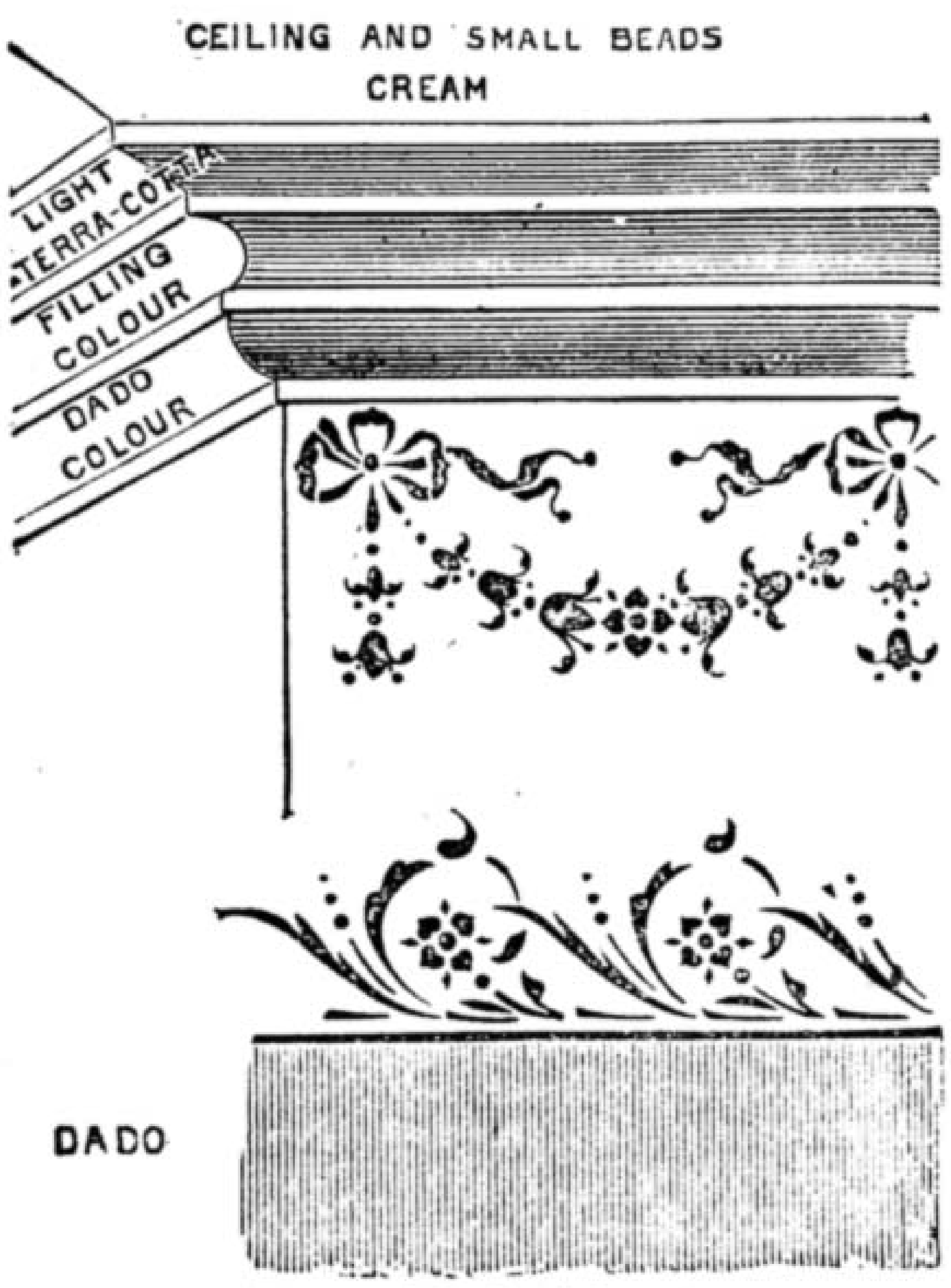
II.—Questions Answered by Editor and Staff.

Colour.—Boathook.—Turning to your suggestion of giving "sketches of the cornice, doors, ceiling, etc., and the sketches lettered and numbered for the colours to go with the others without having any guess work," this will, I hope, duly be carried out, as much as can be thoroughly useful. You will notice my expedient of advising earnest students to get "Aspinall's" colour card, and which will enable me to make a definite attempt to teach colour harmony. It is quite useless to give instructions on "colour" without colour samples; this has been the weak point of all periodicals and trade literature hitherto, which have "tackled" the subject of practical colouring. Red, blue, green, yellow, mauve, terra-cotta, and such like words, do not represent definite colours in their ordinary use; they are only comparative terms, since that which appears a green hue may, by juxtaposition with a bright yellow, be made to appear decidedly blue. Again, that which I would call a brown, you might term dark red; hence you will see the impossibility of practical lessons on colour without specimens, and the invaluable help we may obtain later on by both writer and student working with the colour card. With reference to the ordinary training (?) of house painters, the introduction with which my papers were commenced will show you to what extent I am familiar with the state of affairs. No book could possibly teach you all you suggest, or make a person, by literary knowledge alone, a colourist. The faculty for colour, like that for music, is to a very definite extent born in us. The same sensitiveness to hard and harsh effects, discords, and want of balance in colours, comes naturally to a born colourist, just as similar arrangements of sound strike the hearing of a musically-gifted person. Granted that almost any faculty can be cultivated by study and perseverance to a very



Cornice Colourings.

successful degree, yet but very few persons have any idea of the immense amount of study and patience demanded to originate colour harmonies. Women, whose senses are usually more sensitive to sight and sound, instinctively, so to term it, avoid decidedly bad colouring; whilst their periodicals and wearing apparel further help to teach them what *not* to select. Beyond this, not one woman in a hundred is a colourist, in the true sense of the word. Where the faculty exists, the idea of studying the scientific aspect, and the mathematical equations and works of Brewster, Chevreul, Young, Rood, or Church, is usually scouted and seldom undertaken. If such is desirable, in due time useful papers on the theories of colour alone will be given; but it shall be my special effort to very much assist you when purely decorative house painting is in hand. A few lines of foundation for practice for you I here append; their author was the late Owen Jones:—"It is evident that, as the object must be to cause A to advance, it is here we must put the yellow, both from its position and from its form. On the contrary, we place blue at C as the retiring colour, and assisting the concavity of the moulding. Red, the most positive of all colours, looks best in



Ceiling and Dado Colourings.

shadow—we, therefore, place it at B. The fillets or vertical planes at D we make white, as useful in separating the colours from harsh contrast. The positions of the colours are subject to modification, according to circumstance. Red never looks well when seen in a strong light, it is too positive and painful to the eye; on the contrary, in soffits, in hollows, or depths of any kind, it looks most brilliant." Beyond this, use a faint tint instead of white for all but simple bedroom ceiling flats. Avoid pure or bright colours, especially when they contrast, like blue and yellow, red and green. Mix your tints similar in colour to the wall paper, then place them somewhat as shown. Avoid much contrast of tone—depth.—London Decorator.

Tool for Dowels.—Constant Reader (*Perth*).—The only way to make dowels across the grain of the wood for stopping screw holes so as to clean off neatly, is to have the dowels turned in the lathe. I have used many of oak and elm for coffin making, and other people that I know do the same. I do not say that Constant Reader cannot cut the dowels with a sharp gouge, but the best and cheapest plan is to turn them, or get a wood turner to do so. If you want the plugs 1 in. in diameter, saw 1¼ in. off the end of 1¼ in. board, take off the corners, and send to the turner. Undertakers keep these plugs in stock for their cases, and they are made as above.—B. A. B.

Scissor Grinding.—Lectio.—Separate the two blades by taking out the rivet, and grind them on the flat surface—not the bevelled edge—slightly hollow; then take off the edge from the outside. The only book on cutlery I know of is, "Cutting Tools Worked by Hand and Machine," published at 3s. 6d. by Messrs. Cassell & Co.—T. W.

Nickel-plating.—Fritz (*Holloway*).—(1) All articles to be nickel-plated must first be scoured clean and bright with a surface free from blemishes as in a finished article. To do this it is necessary to use acid dips to clear off oxides, and potash dips to clean off grease and animal impurities. See article on "Brass and Brassing," pp. 597—599, Vol. I., for information on cleaning the articles. When well rinsed, give them a dip in cyanide of potassium solution before placing in the metal plating solution. (2) Iron and brass articles may be plated in the same solution, but it is not advisable to plate them together at the same time. (3) Polish on a proper polishing lathe by means of revolving rag dollies and mops charged with Sheffield lime.—G. E. B.

Magnesium Wire.—Inquirer (*Walton-on-Thames*).—The wire you inquire about, "which, when lit, burns like electric light," is probably magnesium wire. It is used in some of the more costly firework experiments, and in furnishing a light for photographic experiments by night. You cannot make it yourself, but can get it from any dealer in photographic materials. The price is somewhere about 15s. an ounce.—G. E. B.

Coppering Solution gone Wrong.—Woodcut (*Edinburgh*).—I think your solution is deficient in metal, although you think it has been supplied with copper as fast as you have taken copper from it. Hang a muslin bag filled with sulphate of copper crystals in the solution, and add a little dilute sulphuric acid to it from time to time until it is restored to its proper condition. If this does not speedily cure it, use a lower battery power, and adjust this to meet the altered conditions of the solution.—G. E. B.

Black Bronze for Brass.—J. M. (*Bootle*).—The process is described in the article on "Bronze and Bronzing," page 643, No. 41, Vol. I., of Work.—G. E. B.

Electro-plating.—Amateur Plater (*Devonport*).—Full instructions on how to electro-plate with silver, nickel, gold, platinum, and other metals, will be given in Work as soon as room can be spared for their publication.—G. E. B.

Electric Bells.—A. W. (*Wakefield*).—I am glad to hear of your success with electric bells made from my instructions, and will gladly help you out of your present difficulty. In altering the connections, you have connected up both bells to one battery, and have shut out one battery with its switch, hence you can ring both bells from one end, but cannot ring them from the other end of the line. Make a sketch on paper of your telephones, bells, and batteries, then arrange lines between them so as to make a complete circuit of one battery, one bell, and one telephone. Also arrange a switch to put the bell out of circuit whilst the telephone is in use, unless this is furnished with an automatic switch. Call this first arrangement the home station, and arrange the connections to ring the home station bell with a push at the distant station. Then sketch the distant station appliances in a similar manner. When you have got it right on paper put your ideas into practice. Of course the terminal carbon of the battery must be connected to the bell and the zinc terminal to the earth wire. You may not need the whole battery for the telephone, but should take in all the cells to ring the bell.—G. E. B.

Battery for Coil.—A. R. (*Fulham*).—Either the Bunsen battery described and illustrated at pages 3—22 and 42, Vol. I., or the bichromate battery described at page 442, Vol. I., will be found most suitable for working a coil. Use one, two, or more cells until the full powers of the coil have been developed.—G. E. B.

Patenting Instruments of Warfare.—R. B. (*Highbury*).—Under the 26 and 27 Vict., the Crown had the power of using any patented invention on payment to the inventor of a compensation, to be fixed by agreement, or, failing that, by valuation; also of insisting that the invention should be kept secret, if such a course were considered desirable for the public service; more recent legislation, however, would seem to have somewhat limited the powers of the Crown in these respects. The colonies have their own patent laws, and protection has to be sought in them separately.—C. C. C.

Brazing Lathe Head.—H. N. C. (*South Norwood*).—It is possible to stick cast iron together by means of brazing, but as to making a good job, that is out of the question with such a thing as a lathe head. If I were going to mend it I should drill and tap a stout plate on each side, and screw it on with countersunk-headed screws; this will be far stronger.—R. A.

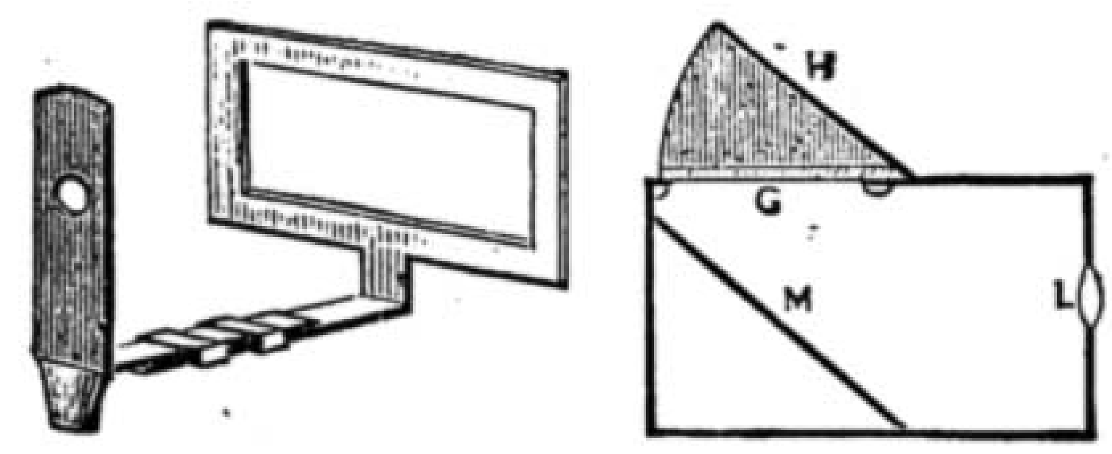
Home-made Camera.—FOCUS.—(1) The circular front is better rebated; the rebate is conveniently made by making the front of two thicknesses of wood, the circular opening in one being a little less than that in the other, thus together making a rebate. (2) Yes, ½ in. rebate is sufficient. Velvet or cloth is good. (3) Hinge the focussing screen. (4) Strong, close-textured buckram is preferable to leather for hinge to dark slide; use glue to fix. (5) Refer to previous number of WORK, in which will be found drawings and the information desired both as to swing back and reversing frame. (6) Brass fittings can be had of H. Park, 1, Orchard Buildings, Acton Street, Kingsland Road, London, N.—D.

Steel Points, etc.—C. E. S. (*Kingsland*).—I think that this querist has very little idea of the wonderful mechanism of the perfected phonograph if he thinks that he has got sufficient details to enable him to make one from a lecture view, which lasted a few minutes as he says. I am just a trifle curious to know what details he has got, for those which he has *not* got and asks me to supply seem to me the most important; in fact, they are the embodiment of the whole thing. I have promised to give an article on the phonograph, and it is in the Editor's hands awaiting space and other necessaries before it can be published, but I hope that you and others interested in this subject are not expecting the instrument described to be anything like Edison's instrument; let me say here, and once for all, that it is very much unlike the perfected phonograph. It bears somewhat the same resemblance to that instrument, as the single needle telegraph bears to Sir W. Thomson's siphon recorder. I am not possessed of all the details of this wonderful machine, and cannot therefore supply them to the querist. I have a copy of the specification by me and could easily copy from that, but I do not feel at liberty to do so, it savours so much of the plagiarist. The number of the specification is 16,212, and its price is 11d., to be had from the Patent Office, Cursitor Street, Chancery Lane. I may say, however, that the points are not of steel, but of sapphire. The shape of the reproducing point is round, perfectly smooth, and polished. The recording point is cup-shaped and has a very keen edge. The diaphragms are variously described as being of glass, mica, thin sheet metal, gold-beaters' skin, etc. I hope C. E. S. will not think me ungracious if I have not satisfied him in this answer. He must remember that the perfected phonograph is a very much patented article, that it is not yet on sale in this country, and that its interests are jealously watched by those whose business it is to do so. I would strongly advise you to wait until the Editor can publish the above-mentioned article before you begin to make a phonograph.—W. D.

Map and Plan Drawing.—BOTCH.—With our Editor's permission I shall be glad to give you detailed information on the construction of a plane table and other instruments for use in plotting to scale land surveys, alluded to in the "Popular Educator," but such a paper would far exceed the space in "Shop."—J. W. H.

Post Office Adhesive.—J. P. O. M. (*Milford Morpeth*) asks for a receipt for making the adhesive matter used by the Post Office. It is only burnt starch, *i.e.*, dextrine dissolved in water (see D. A.'s answer to E. M. (*Ashton*), No. 49, page 780), which evidently J. P. O. M. has *not* read. In the same letter the writer asks for a composition harder than plaster of Paris with the appearance of ivory. I suppose he means a very common imitation of ivory which is produced by saturating plaster of Paris casts with linseed oil, and then letting them thoroughly harden for a couple of weeks when they may be surface polished with a dry, hard brush, care being used not to damage them by violent brushing. Another plan is to take a soft, broad, camel-hair brush or a piece of soft sponge and cover the surface of the plaster cast with solution of silicate of soda or silicate of potash (water glass), which changes the pure white of the plaster to an ivory colour and dries instantly, being very careful not to go twice over the same part until it is quite dry or you will get it lumpy. Try on something first that is of little value, and when you have got the knack you can proceed to work on the article you have in view. The plaster must be quite dry, not fresh from the mould—at least three days should elapse; when its suction is perfect it will absorb the silicate with avidity to some depth, and it will be found to be case-hardened by this means and quite impervious to damp. This is far better than painting casts or busts if properly done. The linseed oil process, though much longer, is much easier to a tyro. In future write each query separately.—J. W. H. [Questions upon divergent subjects are answered by separate specialists. Hence the necessity of writing each one on separate sheets of paper.—ED.]

View Finder.—P. F. W. (*Dover*).—The most simple contrivance as a view finder is a small rectangular frame made of sheet metal and blacked, the opening being of the same proportionate dimensions as the plates to be used. This is fixed on a sliding bar, marked with the foci of the different lenses to be used. Opposite, and at the other end of the bar, is a small upright strip of metal, with a hole through it to form an eye-piece. This apparatus is fixed centrally on the top of the back of the camera, and the subject examined by placing the eye to the opening. The amount of subject included by the frame will be found on the plate. The sliding bar must, of course, be marked by actual comparison with the image on the focussing glass. This arrangement is generally called a view matter when used, and the hand unattached to the camera. Two small studs fixed on the upper part of the front of the camera and one stud in the centre of the back are sometimes found useful for the same purpose. The eye being placed against the central back stud, a good idea may be gained of the amount of subject that will fall on the plate—



View Finder.

or rather the position of it. The view finder proper is neither more nor less than a small camera fixed on the top or side of the larger one, being used with a lens of fixed focus, giving a small image approximate in proportion to the image on the focussing screen. In detective cameras, these small finders are inside the case. Their construction is very simple: a small box with a lens L fixed at one end projects the image on to a small mirror M, which again reflects it on to a piece of ground glass G, the contrivance being shielded by a small hood H; or the image can be seen direct in the mirror without the intervention of the ground glass. The advantage of the ground glass is that it permits the image to be seen more inverted.—D.

Dulcimer Tuning.—IAGO.—There are several ways of tuning the dulcimer with twenty-five sets of strings (38 notes), but the most useful (at least, I have found it so) is that shown in the accompanying diagram. You will observe that several of the notes are duplicate, and in rapid passages these duplicates are very useful, as by their means long jumps from one part of the instrument to another

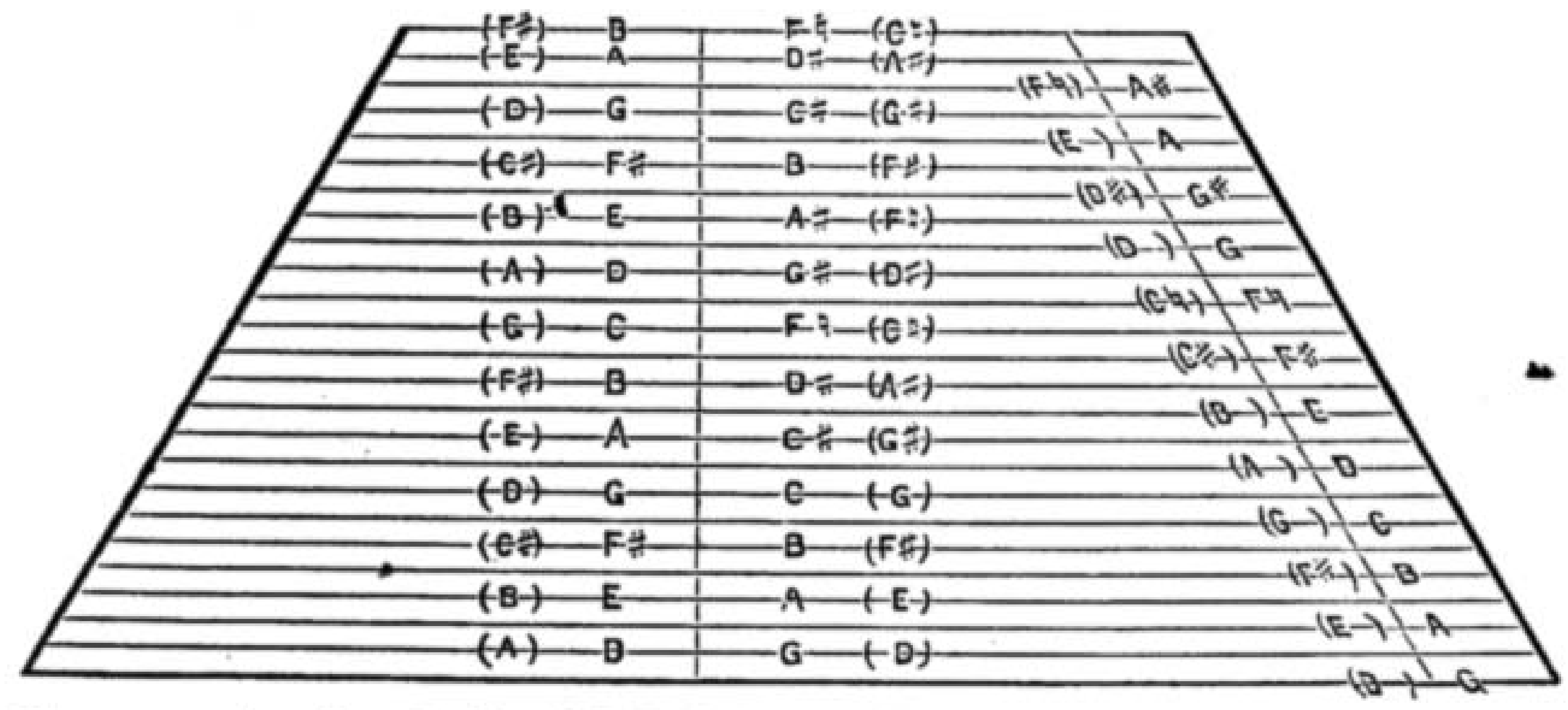


Diagram showing Scale of D Dulcimer with 38 Notes, with actual sounds produced (in brackets).

are avoided, and such passages may be played with greater ease and smoothness. The pitch of the instrument would be D, and the letters in brackets show the actual sounds as they would be produced on a piano, while the other letters show the notes of the dulcimer scale.—R. F.

Gold and Silver Solders.—H. H. W. (*Pimlico*).—These solders, as well as gold and silver in wire or sheet, can be bought in small quantities from refiners, of whom there are plenty in Soho and Clerkenwell; or from jewellers' material shops, which are very numerous about Clerkenwell Road, Jerusalem Passage, or Clerkenwell Green. There are two in Poland Street, Oxford Street, Calipe, Dettmar & Co., and Plucknett & Co.; these are the nearest to the address you give, and at nearly all of them you will be able to obtain a variety of brooch tongues and other fittings. If one firm has not got what you desire, then try another. I do not suppose any of them keep all kinds. Your query as to cost and the way in which gold and silver are sold admits of but a general answer. First, the weight used is troy weight. Secondly, the intrinsic value of each quality varies; but that you will be able to judge from what follows; silver solder about 3d. per dwt.; gold from 2s. per dwt. upwards; 9 ct. gold, in flat or wire, cut to size, would be about 40s. per oz.; 18 ct., about 72s. The intermediate qualities, 12 ct., 15 ct., etc., will be charged at a proportionate rate per oz.—H. S. G.

Rain-Water Tank.—SOMERSET.—From your description your tank seems to be constantly dark, and the cause of the water going bad and smelling foul is due partly to the absence of light. Rain-water, you must remember, is almost free from carbonate of lime: unlike spring water, which becomes impregnated with it and also absorbs carbonic acid gas (carbonic anhydrate), which keeps its atoms constantly in motion: *i.e.*, ventilates it by slight effervescence. If SOMERSET will force air down to the bottom of his tank every day for half an hour altogether, say ten minutes twice or thrice, he will, I think, get rid of the difficulty. An ordinary garden pump or a large syringe should be quite sufficient if the outlet tubing be let down quite to the bottom. Water, like foul air, requires ventilating. If this plan does not succeed, or succeeds only partially, write again, and very explicitly tell how you collect the water, and of what material your tank is constructed, how and what with it is lined, and the material, etc., of your pump. Charcoal, I think, would scarcely deodorise it, as you could not immerse it; or if you did, it would require to be supplied with oxygen or air to act fully. I should be glad if this succeeds to hear again, as many of the readers of WORK will, no doubt, be interested.—J. W. H.

Sticking Iron to Wood, etc.—H. S. M. (*Birmingham*) writes to ask for an effective receipt for sticking iron to wood, but does not explain if he wants to stick a ton of metal to a wooden bed or merely wants to fasten a light thin bit of iron to wood—he does not even say what wood! If there is no great stress, iron, or metal of any kind, may be stuck on to wood by using shellac, the metal being warmed and pressed on until cool, but the surfaces should be as true as a glue joint, and the air well pressed out. It is really, however, only a question of atmospheric pressure, and such a joint cannot be relied upon. If any stress or strain is likely to be brought to bear upon it, it would be far better to fix the iron to the wood with screws. Your second question (which by our rules ought to have been on a separate sheet of paper) as to moulds for vulcanised rubber made of half lead and half zinc, I should say yes, as sulphur melts at 114°, lead at 334°, and zinc at 500° Fahr., although I never tried the experiment; there seems sufficient margin.—J. W. H.

Lead Mining.—ROCK FERRY.—Lead is generally obtained from "galena" (Pb.S.), sulphide of lead. There are several methods of extraction from the ore; the most general is by roasting the ore, when a part is transformed into sulphate of lead, whilst a second part forms oxide of lead and sulphurous anhydride, and a third remains unattacked. When the process has been carried far enough, the ingress of air is stopped, and a much greater heat is applied until the sulphate and oxide re-act on the third portion: *i.e.*, the sulphide disengaging, sulphurous anhydride and metallic lead remain. The lead may be got by roasting, and thus converting the whole of the sulphide—*i.e.*, the ore—into the oxide, and then reducing the oxide with charcoal; or again, by heating the ore with iron, which absorbs the whole of the sulphur and liberates lead more or less pure. Sheet lead consists of the metal rolled from the ingots into sheets at the ordinary temperature, as it is very ductile.—J. W. H.

Tubing for Pencil Cases.—W. L. C. (*Aberdeen*).—I cannot glean from W. L. C.'s letter the purpose for which he wants the tubing. Write to Mr. Charles Whitfield, Factor, 19, Charlotte Street, Birmingham, stating your wants, mentioning WORK. It is almost a certainty that he will be able to give you the information and prices of the various tubings you require.—J. W. H.

Screw Cutting.—E. C. (*Brierley Hill*).—You wish for the change wheels to cut a thread of $7\frac{1}{4}$ pitch with a lead screw of 2 threads. Putting 2 for the numerator, and $7\frac{1}{4}$ for the denominator, you get the ratio $\frac{2}{7\frac{1}{4}}$; multiplying by four, we have $\frac{8}{29}$: that is, teeth of wheel on mandrel are to number of teeth of wheel on screw as 8 is to 29. You will require a wheel of 29 teeth, or of twice 29, or three times or four times 29: that is, because 29 is a prime number, it cannot be divided by any other number.

$$\frac{8}{29}=\frac{40}{29\times5}=\frac{40\times20}{29\times5\times20}=\frac{40\times20}{29\times100}$$

that is, put 40 on mandrel to drive 29 on intermediate along with a 20 to drive 100 on screw; or you can of course double or treble the 20 and 29, provided only you treat them both alike. You will, of course, have read the article on page 438, Vol. I., and understand that it is the *proportion* between the numbers of teeth that matters, not the numbers themselves, as of course a 40 on the mandrel driving a 40 on the screw would produce the same result as an 80 on mandrel driving 80 on screw, etc. So your speed ratio being $\frac{8}{29}$, the number of teeth in the driving wheels multiplied together must bear to the number of teeth in the driven wheels multiplied together the proportion of 8 to 29. A casting of a 29 wheel of 12 pitch (=¼ in. full) costs, from R. Lloyd & Co., Steelhouse Lane, Birmingham, only sixpence; and you can, of course, easily fit it yourself. Messrs. Crosby Lockwood & Co.'s address is Ludgate Hill, London. "The Metal Turner's Handbook" is now 2s.—F. A. M.

Polishing.—G. T. (*Oswestry*).—If the surface got by enamel painting is not sufficiently smooth and brilliant you may paper it down and then finish in the ordinary way with French polish. As you say you are well up in polishing, I need not go into details. Instead of using enamel paint you will find the following very suitable for the kind of work you describe. Mix some of the colour required with polish. Coat the wood with it and finish as before. Have you tried the Foochow enamel paint? It gives excellent results, and I much prefer it to the one you name. It dries hard in a very few minutes.—D. A.

Glass Blowing.—H. H. (*Battersea, S.W.*).—You can get proper burners and blowpipes of Messrs. Townson & Mercer, 89, Bishopsgate Street Within, E.C., and also anything else you may require for glass blowing; get one of their catalogues (3s.), it is one of the best I have ever seen.—W. E. D., JUN.

Portable Bath.—A. H. B. (*Birmingham*).—The water for the portable bath you inquire about is usually heated by means of an oil lamp; these can be had specially constructed for the purpose, although an ordinary oil stove would doubtless answer your purpose. I am rather at a loss as to what you infer from your second question; of course it is a vapour bath. I shall be pleased to give you any further particulars if you should require them.—T. W.

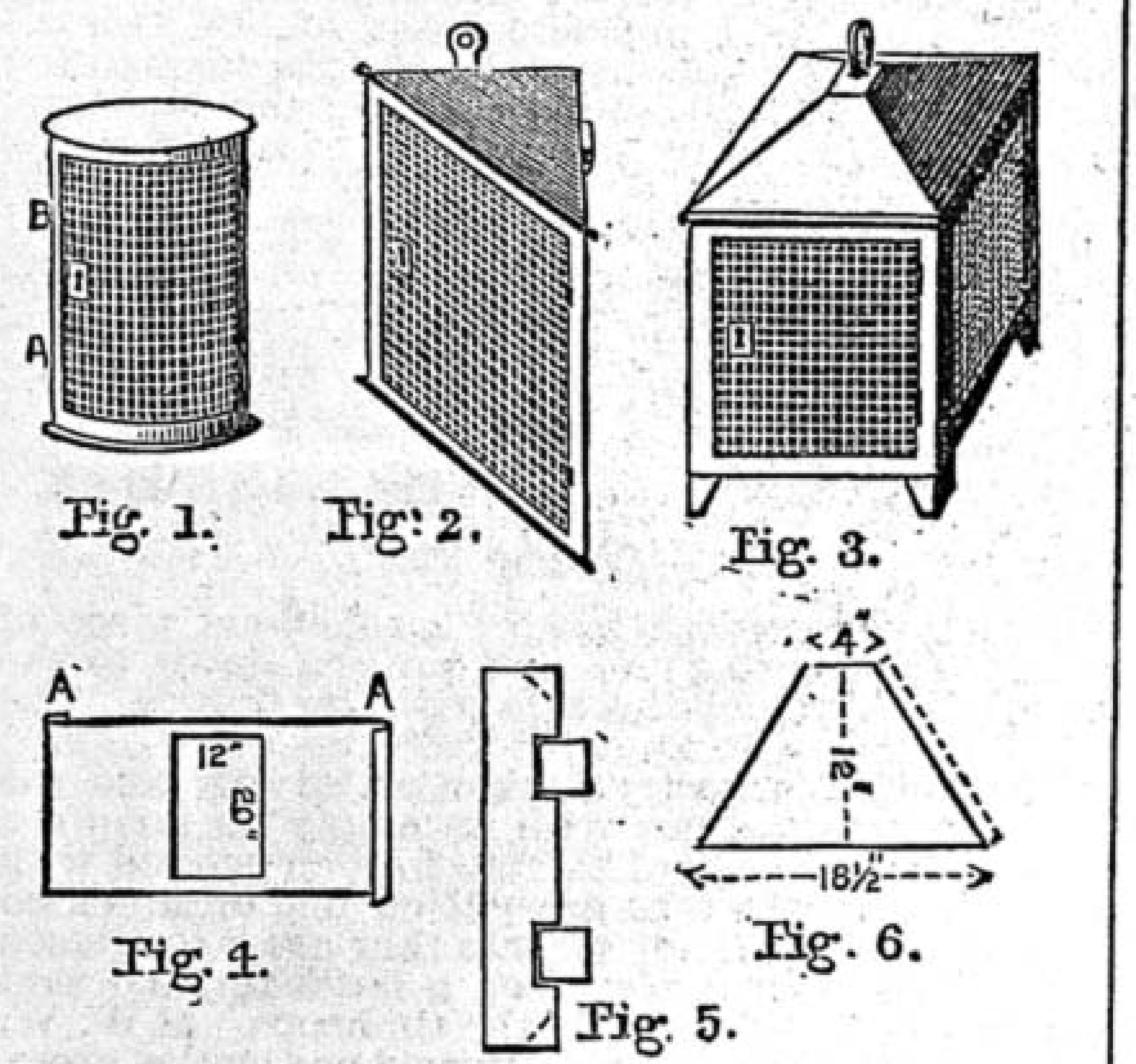
Papier-Mâché.—S. T. (*Newcastle*).—No special paper is necessary. Any porous paper of medium thickness will suffice. The quantity and cost must depend on circumstances, we cannot give an opinion on them. The cost, however, will probably be very small.—S. W.

Work on Lithography.—G. W. R., JUN. (*Camberwell*).—The book best suited to you, so far as I can judge from your letter, is "Richmond's Grammar of Lithography" (Wyman's Technical Series), 5s., 65, Chancery Lane. If G. W. R. can draw in pen and ink on ordinary paper, all he has to do is to obtain from any dealer a sheet of writing transfer paper and a stick of litho ink. The ink should be rubbed in a saucer—dry first (in cold weather warm the saucer slightly until about as warm as the body)—and then rub with the fingers and a little clean water until quite smooth and thin enough to run freely through the pen; then pour off into a small bottle. Fresh ink should be made every day; even if corked it does not go down so sharp to the stone as fresh made ink. Take a perfectly clean new pen (never one that has been used with ordinary writing-ink) and proceed to draw very lightly upon the paper, avoiding going twice over a line, as, when the composition is soft, it rubs up, mixes with the ink, and makes a very rotten line. Let every line dry first before either going over it again or crossing it with other lines. All solids should be painted in with a fine sable brush; indeed, much better work is done by using very fine brushes instead of pens. Litho writers use fine quill pens made by themselves to their own nicety, and steel pens which they cut out of sheet pen steel with fine scissors; but no verbal description would be of any use to G. W. R., he would have to be repeatedly shown, and to spend much time in daily practice; nor could he use such pens in the ordinary way, as they are only just kept in the merest contact with the paper. If any mistakes are made, never scratch out with a knife or you remove the composition; instead, paint over the lines rather thickly with ordinary gamboge and water or gum and water, and when dry make your correction over it with litho ink. To draw upon stone there are two methods: 1st, Line work or "stipple" work; and 2nd, chalk work. The former is done on a polished stone, the latter upon a grained stone; in both the work is done the reverse way it is intended to be printed, that is, as it appears when opposite a mirror, when it will print right way about. Litho ink, rather thicker than for paper work, is used mostly with brushes for line, and pens for stippling, but technical showing how would certainly be necessary to ensure success (as in all technique) and considerable practice.—J. W. H.

Printing Ink for Copying Pad.—R. W. B. (*Poplar*).—I can scarcely say what you require, as you do not explain sufficiently the purpose of the pad. Ordinary printers' ink will not do, you want type-writing ink; you can readily obtain a small bottle of that or violet indiarubber stamping ink of most large stationers—the pads are also sold for a few pence. Second question: write to the Publishing Department, as to the "World of Adventure," Messrs. Cassell & Co., Limited, La Belle Sauvage, E.C.—J. W. H.

Drawing for WORK.—"MIEUX QUE ÇA."—Your query is very kindly meant, but, thanks to photography, even if you send your drawings full size, they can be reduced exactly to scale to suit our columns direct on to the wood upon which they are to be engraved. All that is necessary is for correspondents to make clear drawings that any one can read, to any scale they prefer, provided they state what the scale is. The drawings best suited for our purpose are those made on dull white enamel paper in Indian ink or "*mieux que ça*;" better still, in Stephens' jet black ebony stain, which photographs splendidly.—J. W. H.

Meat Safes.—J. D. (*Manchester*).—I have much pleasure in sending you instructions and sketches of three meat safes, to be made in zinc.: viz., circular, triangular, and square. The circular one is very easy to make: it simply consists of a cylinder of zinc 24 in. high by 14 in. diameter, or any size required, with plain top and bottom, and a perforated door. To make it, take a piece of No. 11 zinc, 44 in. by 24 in.; in the middle of it cut a rectangular opening 20 in. by 12 in. (Fig. 4); fold these edges over, and knock down so as to present a smooth edge, so as not to scratch the hands when putting in or taking out things; notch the corners and fold the edges, turn round and seam together, or if not possessed of the appliances for seaming, soldering will do as well. Next throw off an edge, top and bottom, cut two circles of zinc, $\frac{3}{16}$ in. larger all round than the edge, turn up an edge, and fit one on the top and one on the bottom, and pane them down; solder at A, 6 in. from the bottom, three brackets for a shelf and the same at B, 10 in. from A; this gives three compartments: two narrow ones for cheese, butter, etc., and the centre one for meat or poultry. To make the door, cut a piece of perforated zinc 19 in. by 10 in., cut two pieces of plain zinc 13 in. by 2 in., and two pieces 22 in. by 2 in.; in one of the long pieces cut two notches $1\frac{1}{2}$ in. by $\frac{1}{4}$ in. (Fig. 5); solder these four pieces together to form a frame, and solder the perforated piece on to it, notch the four corners as per dotted lines (Fig. 5) and wire all round; after wiring, the hinges are formed by slipping pieces of zinc through the spaces left by the notches and bending and hammering them together; the door can now be bent to the shape of the safe and a piece of plain zinc soldered where the lock is to come, a keyhole cut in it, and a small brass lock soldered on so that it will lock under the

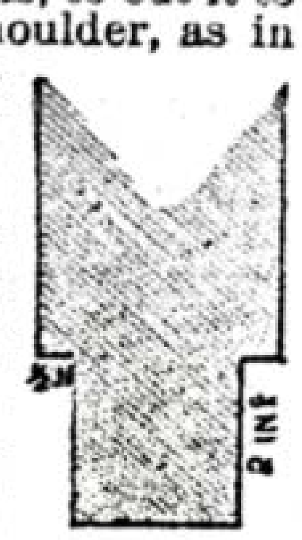


Meat Safes. Fig. 1.—Circular Meat Safe. Fig. 2.—Triangular ditto. Fig. 3.—Square ditto. Fig. 4.—Plan of Circular Body. Fig. 5.—Detail of Door Hinge. Fig. 6.—Plan of Top of Square Safe.

edge of the safe. The door can then be soldered on by the hinges, and the safe is complete. If wanted to hang, a strengthening piece must be soldered in the centre of the top and a hook affixed. If more air is desired than is admitted by the door, a piece of perforated zinc could be put in the back. With respect to the triangular one, it is obvious that it can be made on similar lines, so no details are necessary. The square one is rather more difficult to make. It consists of a framework of angle zinc of any size required; the best shape is the form of a cube, plain flat bottom, plain sloping top, and the sides and door of perforated zinc or wire gauge; 18 in. square and 18 in. high, before the top is put on, is a good size. The frame should be of stout zinc (No. 12). The bottom and top pieces, eight in number, will be cut $18\frac{1}{2}$ in. by $1\frac{1}{4}$ in., and a notch cut in them $\frac{1}{2}$ in. by $\frac{1}{4}$ in. The $\frac{1}{2}$ in. lap is for soldering the frame together; before soldering, the edge can be folded at a right angle for the bottom and top. This is better than throwing off the edge after the frames are soldered, as that puts them out of shape. Make the four angle pieces for the uprights by cutting them 2 in. wide and bending in the centre; this ought to be done in a folding machine; by any other method the pieces will get more or less bow-shaped. If no machine is available, the next best way is to put them between a pair of clams of sufficient length, squeeze the clams in the vice, and knock over with a mallet. These pieces have then to be soldered upright in the bottom frame and also to the top frame; the eight sides of perforated zinc can be soldered in and the bottom put on. The top is next; cut four pieces, give a lap of $\frac{1}{4}$ in., and solder together; if it is wanted to hang up, a hook must be affixed to a strong piece of stuff that will form the top for the 4 in. hole at the top of the safe. The top is put on the same as a bottle top: viz., a flange thrown off and then an edge turned on that, the body sprung in, and the top paned down, after which it should be strongly tacked with solder at the corners and middles. Four brackets must be soldered on the inside half-way up for the shelf; the details of the door will be similar to the others already described; four little angle feet or four brass knobs soldered to the bottom for feet will complete it. Perforated zinc can be got at any good ironmonger's at from 4d. to 5d. per square foot.—R. A.

Restoring Discoloured Boot Tops.—E. C. B. —(*Leytonstone*).—I am not acquainted with any approved method of restoring to their original whiteness the tops of grooms' boots which have turned brown. For merely cleaning and preserving a good colour, washing with new milk and soft soap is recommended. Pipe-clay would doubtless have some effect in removing discoloration, but hardly to the extent desired. One of the most powerful bleaching agents is chlorine; possibly this, applied in its common and cheap form of chloride of lime, might remove the objectionable colour; but I cannot say certainly what its effect on the leather might be.—M. M.

Fixing Upright Memorial Stones on Bases. —MARBLE JOINT.—In fixing memorial stones there is choice of ways. Perhaps the best is to "shoulder" the bottom of the upright stone—that is, to cut it to a tenon some 2 in. long, leaving a shoulder, as in the annexed section. If the upright stone is, as in one of the cases submitted by our correspondent, a 3 in. slab, the stone should be cut away all round to a depth of $\frac{1}{2}$ in. The hole cut in the base to receive this tenon must be about $\frac{1}{4}$ inch larger each way than the tenon itself, and $\frac{1}{4}$ in. deeper (to allow for the settling of cement). The hole is wetted and half filled with best Portland cement, mixed to the consistency of cream, and into this the upright, also previously wetted, is lowered. The overflow of cement should be cleaned off as soon as possible. To save the trouble of shouldering, the mortise hole is sometimes cut large enough to receive the whole width of the slab: but this is a less workmanlike method, since the shoulder covers and hides the ragged edges of the hole. The second way is by dowelling. Say we are fixing the 3 in. slab: take slips of slate, say, 3 in. by 1 in., and 4 in. long, let them for half their length into the bottom of the slab, and there cement them. Corresponding holes are then made in the base to receive them; cement is put in, and the upright is lowered on the base as before. In all cases care must be taken to make the holes large enough to allow for the cement. In the instance adduced by MARBLE JOINT of a cross with stem 6 in. square, shouldering is to be preferred; but if the length of the stem will not allow of the loss of 2 in. for tenon, it should be dowelled with slate $2\frac{1}{4}$ in. square and 6 in. long. The above methods apply equally to fixing memorials of marble or of stone.—M. M.



Cartridge Ejector.—MACHINE GUN.—Of the many contrivances for ejectors of empty cartridge cases, all effective, it is hard to tell you which is best suited for your purpose. One of the latest patented is excellent, as it is made to serve as a support for the next cartridge to be used. It would be rather difficult to illustrate the action without a long technical description. The number of the patent is 7,915; date of patent, 1889; inventors, Edward Smith Higgins, 6, Thorburn Square, Southwark Park Road, Surrey. There are thirty-four separate drawings with this specification; price 1s. 10d.—J. C. K.

Glass Lamps.—JUBY MACRAE.—An amateur would find it exceedingly difficult to manufacture coloured glass lamps, and the expense would greatly exceed what they could be bought for; I could not advise you to attempt it.—W. E. D., JUN.

Bookbinding.—A. W. S. (*Wheatley*).—I am afraid you have spoiled the cover of your Family Bible, and the best remedy for it would be to have it re-covered. I fancy you have used the white of egg in its thick clammy state without beating it up so as to make it thin. Two coats of the above would spoil any leather cover, and you have made the spoliation complete by using the paper varnish. I have already indicated the best remedy, but you may want to try something yourself to improve the old cover. Well, try washing it carefully over with methylated spirit until not a trace of varnish is left; afterwards wash with water in which a little flour paste has been mixed. If this has been done aright, the natural surface of the leather should show and have a clean appearance. If it is now coated with glaire, that is, the white of an egg beaten to a thick white froth and allowed to settle, and allowed to dry, it may be all right; a coat of thin shellac varnish might also improve it after the above operations have been completed. Shellac varnish is simply shellac dissolved in spirits of wine, and is the varnish used by bookbinders. Great care will be necessary in the above operations, as the gold on the cover, if any, is liable to be washed out.—G. C.

Transfers for China.—CARBON.—If you are referring to the ordinary picture transfers which are used by wetting them on the back, you should have no difficulty in getting them in Birmingham. Try the artists' colourmen.—D. D.

Drapery Book for Upholsterers.—J. M. B. (*London, W.*).—Several books on the subject have been published, but I do not know of any which would assist you unless you are already proficient at the work. If you are, and wish to improve yourself, get into some first-class upholsterer's. Cutting is more an art than a mechanical following of rules. If you want books on the subject, call in at Batsford's, High Holborn, and see what he has; but as they are mostly costly, you may prefer to study them in the library at South Kensington Museum or the British Museum.—D. D.

Gutta Percha for Barbetine Work.—PHILIPPA.—The required material can doubtless be obtained at any of the following places:—In London: Gutta Percha Co., Wharf Road, City Road, N.; Messrs. Anderson, Abbot, & Anderson, 37, Queen Victoria Street, E.C.: J. Smith & Co., 87, Blackman Street, S.E.; J. Winter & Co., 1, Parkside, Knightsbridge, S.W.; or, in Birmingham (wholesale), Birmingham Indiarubber Co., 124, New Street; Messrs. Binney & Son, Broad Street Mill; (retail) T. F. Pedley, 68, Bull Ring; or, T. F. Pett, 3, Bull Ring.—S. W.

Hot Sand Shading for Inlay.—W. B. (*Glasgow*).—To shade pieces of veneer for inlaying by hot sand, all that is necessary, beyond skill, is a shallow pan filled with sand. This is then heated over a fire or stove sufficiently to brown a piece of veneer. The veneer is inserted edgeways, and gradations of shade are got by careful management. The wood must not be burnt or charred. Try with a few pieces of waste wood till you get into the way of shading evenly.—D. D.

Locomotive Book.—C. G. W. (*Jubbelpore, India*).—The following book should suit you, Roper's "Handbook of the Locomotive," 12s. 6d., Trübner & Co., Ludgate Hill, London, E.C.

Fern Case.—GLESCA YOKEL.—A design for a Wardian case, with illustrated instructions, is in the hands of the Editor, and will appear in due course. The amateur is just the man to be most likely to proceed with a new design, and succeed too; hence the desirability of complete instructions. Our worthy Editor knows nothing of racial distinction between his correspondents, and all share alike.—C. M. W.

Aquarium.—AQUARIUM.—In No. 31, Vol. I., of WORK, you will gather a general idea of how to make rockwork for the aquarium, which you can adapt to the measurements you require. A design is hardly needed, especially as you have a clear idea of what you want; and by following the directions given you cannot fail in producing a pleasing result.—C. M. W.

Aquarium.—A. L. H. (*Liverpool*).—See No. 31, Vol. I., of WORK, for aquarium. Use what part will best suit your purpose. I do not recommend the use of wood.—C. M. W.

Cement for Tank.—J. K. (*Oldham*).—Presuming you want to cover the inside of a wooden tank, to make it waterproof, you can paint it over with two or more coats of cement consisting of one part of gutta percha to two parts of pitch, melted by a gentle heat in sufficient turpentine to make it thin enough to be easy of application; put it on hot, and increase the thickness of the final coat. In tendering you this advice, permit me to add that woodwork is not at all suitable for self-acting fountain. Why not use zinc, which is easily worked? Fretwork designs get a fair share of the space of WORK.—C. M. W.

Solid Glossy Black from Stone.—STONE HOGGER.—Are you perfectly sure that the specimen you allude to was not printed from type or block? It is much easier to get a full solid colour, black or otherwise, by surface printing than from stone, as the moisture interferes with solidity, and the coat of colour is much thinner in the latter case. I think, however, if S. H. takes equal portions of Japan gold size and best copal varnish and mixes his ink (any colour he prefers) with this, instead of ordinary litho. varnish, he will obtain a slight gloss. But, as we all know, it is impossible to get a brilliant gloss on a rough surface; therefore the card or paper should first be rolled until the surface itself is glossy. After printing, the work being thoroughly dry and hard, a final rolling will still improve the gloss. For black, the addition of about one-fifth bronze-blue ink enriches the colour, and will assist to gloss it also.—J. W. H.

Analysing Metals.—CAMANALIST.—For learning to analyse metals you should obtain Thorpe's "Quantitative Chemical Analysis," and Fresenius's "Quantitative Analysis." Nos. 36 and 39, Vol. I., of WORK contained articles on "Iron and Steel: its Analysis;" and an article on "Brass: its Analysis," appeared in No. 75. The analysis of some of the metals mentioned is attended with considerable difficulty, on account of the small amount of impurities present. Refined lead, for instance, frequently contains as little as 0·10 per cent. of impurities, made up of copper, iron, silver, zinc, bismuth, antimony, etc.—CHEMICUS.

Dyeing.—CROQULICOT.—I know of no periodical on dyeing. There is the "Dyeing of Textile Fabrics," by Hummel, price 5s.; and this can be had by order of any bookseller, or free by post of the publishers, Messrs. Cassell & Co., London, E.C., for 5s. 4d.

WORK Exhibition Competitive Designs.—T. H. S. (*Bradford*).—As to competitive designs for medal and certificates—WORK Exhibition, 1890-91—intending competitors should write for full particulars to the Secretary, WORK Exhibition, La Belle Sauvage, Ludgate Hill, E.C., enclosing stamped envelope for reply, stating which competition they are desirous of entering for.—J. W. H.

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Pie-Making Machine.—W. E. D., JR. (*King's Lynn*) writes:—"In replying to W. W. (*Sunderland*) (see page 309, No. 71, Vol. II.), R. A. says he does not know of any such machine; will you allow me to say that if it is a pork pie machine for business purposes that is asked for, they can be bought of Mr. John Hunt, Baldwin Iron Works, Bolton, Lancs. Two machines, one for blocking the pies and the other for putting the lids on, cost with tins £15; or one machine can be had to perform both operations at £10. Larger machines can be had, and also, according to his catalogue, 'A great variety of sizes in both round, taper, oval, and dish-pie shapes; particulars on stating requirements. I would advise W. N. to write to him for one of his catalogues, and which also contains particulars of other machines—meat-cutters, paste-rolling machines, egg whisks and mixers, etc. etc."

Fretwork Frame.—W. B. (*Wigan*) writes in reply to A NOVICE (see page 191, Vol. II.), *re* above:—"You will notice that on the top and bottom of design there are small dotted lines running through; these are where the pieces marked M 0·01 to 10 for top, and D 0·01 to 10 for bottom are put in—that is, if you desire to enlarge the design in breadth, you would trace it and insert the size of pieces, M and D, you wished at the dotted lines. This is the purpose they are for, and if you will measure the pieces marked M, and those marked D, you will find that they correspond in lengths, which is from ½ in. to 4 in. Of course you would also have to enlarge the overlays. I made mine from the design, without enlarging, of walnut, overlaid (the four side pieces) with white holly, and it looks very well. I hope A NOVICE will now understand."

Drills.—W. J. B. (*Sidbury*) writes:—"In reply to SPOKES and A. S. P. (see page 210, No. 65), I can supply a drill, nearly as described, with six drills, assorted sizes, for 35s."—[W. J. B. should advertise in our Sale and Exchange Column.]

Pie-Making Machine.—F. H. (*Streatham*) writes in reply to W. W. (*Sunderland*) (see page 309, Vol. II.):—"I presume what W. W. means by a pie-making machine to be the tin hoops used for making such pies as we see in the ham and beef shops and refreshment bars. The tin hoops

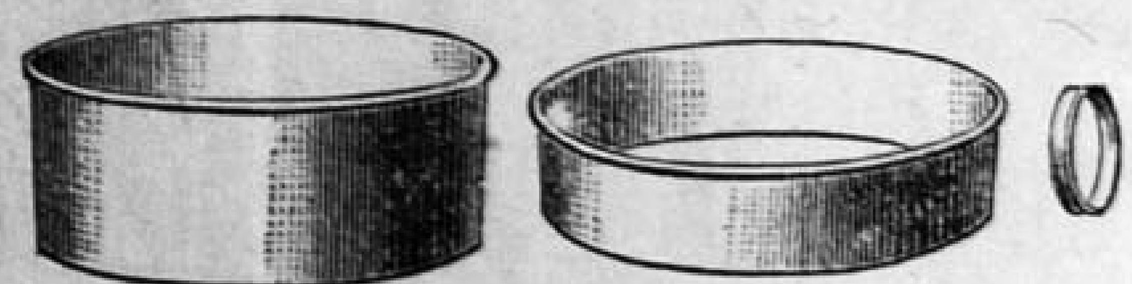


Fig. 1. Fig. 2. Fig. 3.

Pie-Making Tins.

are first well greased inside; a rolled-out piece of pastry is put into them and pressed down to the bottom and round the side with the fingers. The meat is then put in, with the proper seasoning; a large piece of pastry is then rolled out, and the tops are stamped out with an empty tin hoop the same size; the edge of the pie is then wetted with a little water, the tops are put on and ornamented with a fork or a fancy wheel; they are now glazed with whisked eggs, placed on a large tin, and sent to the oven to be baked in the tin hoops. If W. W. were to see the pork pies turned out by the gross, he would think they were made by a machine."

Steel Bronzing.—F. S. (*Exeter*) writes in reply to NEMO (see page 324, Vol. II.):—"NEMO must say if he wants a steel bronze for brass work, if so I can give it him. I suppose him to be a brass worker, who wants a bronze similar to gas chandeliers, etc. These are terms given by the trade to some of the bronzes in use: black bronze, steel bronze, copper bronze, floratine bronze, etc. Fancy iron work is cleaned and scratched, brushed with steel wire brushes, and lacquered pale; it looks and wears well. To do any of the above well requires lathe power to drive the scratch brushes."

Copper Bronzing.—F. S. (*Exeter*) writes in reply to H. T. (*Wolverhampton*) (see page 226, Vol. II.):—"I understand H. T. to be a brass worker, who wants to copper brass bronze work. To do this in a very old-fashioned, but simple way, clean the brass from grease and dip in aquafortis, and dry in sawdust; then lie around the brass some fine iron wire and immerse in the pickle, which is water with some aquafortis mixed with it; this will turn the brass work red wherever the iron wire touches the brass work. Wash off in clean water, and dry out in sawdust; next process is to obtain some Spanish brown and mix with water thickness of cream, adding about a thimbleful of pickle to half a pint of above; allow to dry, and brush well with a black-lead brush; if this is required a darker shade, add a little black lead to the brown. If a brass wire scratch brush is comeatable, use it by all means."

V.—BRIEF ACKNOWLEDGMENTS.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—T. W. V. (*Leicester*); FRET CUTTER; A. M. (*Brighton*); A. G. (*St. Albans*); M. P. S. (*Kingstown*); S. P. (*London, W.*); FOUR AMATEURS; AN OLD SUBSCRIBER; W. D. (*London, N.W.*); GLASS PAINTER; A. P. (*London, E.C.*); R. H. W. (*Hackney*); W. P. (*Nottingham*); R. C. H. (*London, W.*); GRUPH PRAWNE; L. Q. P. (*Airdrie*); A. A. (*Lincoln*); A. M. (*London, W.C.*); EXHIBITOR; J. T. J. (*Manchester*); W. P. (*Enfield Wash*); K. M. D. (*Norfolk*); W. B. (*Birmingham*); J. W. B. (*Birkdale*); D. G. (*London, E.C.*); AMATEUR; S. S. (*Salford*); SMADA; E. B. (*Bristol*); W. W. D. (*Leeds*); G. H. M. (*Lower Clapton*); H. W. (*Surrey*); J. F. P. (*Rotherham*); W. K. R. (*Nottingham*); A. C. (*London, E.*); F. M. (*Finsbury, E.C.*); G. E. (*Northwich*); E. C. (*Derby*); C. B. (*Islington*); G. G. (*London, S.E.*); C. E. H. (*London, N.*); I. Mc F. S. (*Govan*); J. W. (*London, E.*); G. W. (*Lancaster*); C. B. (*Islington*); F. B. (*Blackburn*); COUPLER; J. E. G. (*South Norwood*); C. B. (*Guildford*); W. E. W. (*London, W.C.*); G. F. (*Sheffield*); SECOND HAND; C. L. (*Glasgow*); F. C. B. (*Battle*); AQUA; S. R. (*Newry*); HOBBY; J. S.; E. G. W. (*Westminster*); N. F. L. (*Battersea*); R. L. (*Dundee*); E. M. (*London, S.E.*); A. M. and W. P. (*London, E.C.*); M. M. (*Poplar*); R. F. C. (*Walworth*); S. F. W. (*Lancashire*); T. T. (*Leeds*); W. D. L. (*South Shields*); W. M. (*Shepherd's Bush*); HOPEFUL; J. C. (*Birmingham*); W. V. (*Birmingham*); E. J. S. (*Maidstone*); DISTIL; H. T. (*Scarborough*); H. A. (*Birmingham*); C. M. (*Brighton*); W. P. (*Wishaw*); J. W. (*Hereford*); W. J. (*Laurencekirk*); J. S. (*London, W.*); J. W. T. E. (*Brighton*); J. F. (*Boston*); R. B. (*Sheffield*); W. H. C. (*Birmingham*); SUBSCRIBER (*Birmingham*); T. D. (*Nottingham*); CONSTANT READER; J. R. (*Newton Stewart*); W. C. (*Hulme*); E. D. (*Birmingham*).

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(1890-91).

For Classification, Prize List, etc., see WORK No. 70.

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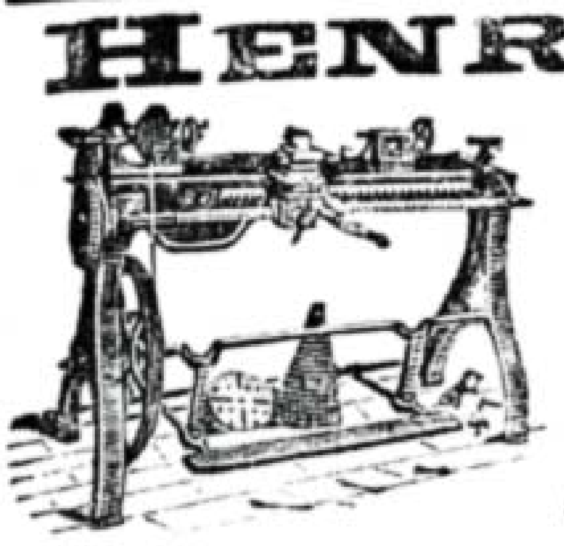

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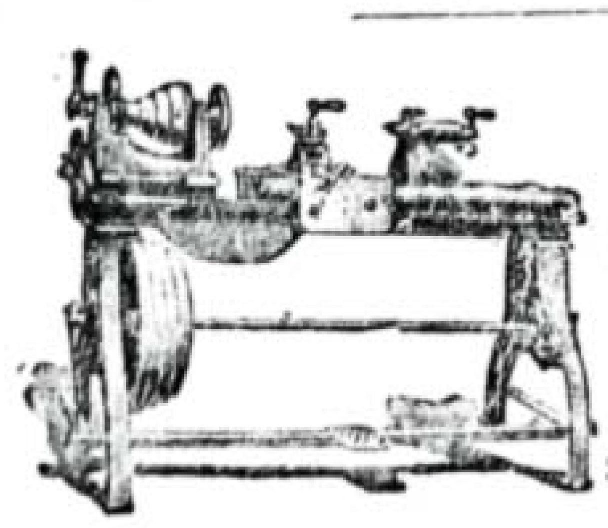

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