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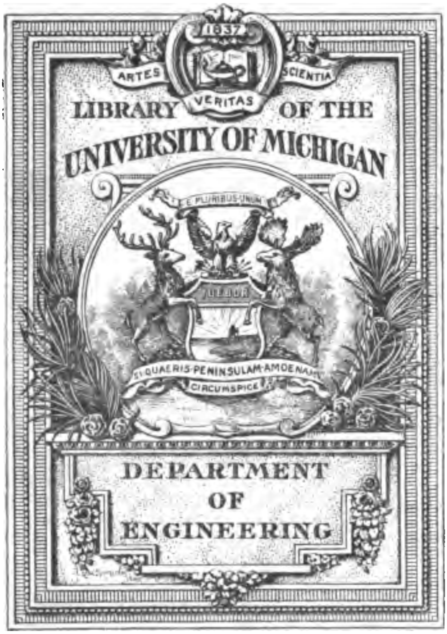
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THE

WOOD TURNER'S

HANDYBOOK

A Practical Manual

FOR

WORKERS AT THE LATHE:

EMBRACING INFORMATION ...
AND PROCE...

P.

AUTHOR OF "LATH...
"THE PATT...

WITH UPWARD...

LONDON:
CROSBY LOCKWOOD AND SON,
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1901.

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PREFACE.

THIS hand-book forms the second of a Series of HANDY-BOOKS FOR HANDICRAFTS. Some of the matter and illustrations may be identified as having been taken from various technical periodicals to which they were originally contributed by me. A few of the items originated from other sources, but have been re-written for publication in this hand-book.

The lathe, which is claimed to be the creator of mechanism, is a machine in which all mechanics should be interested. A knowledge of the art of turning finds useful application in all the mechanical arts. Not only is a large proportion of the community employed in these arts, but individuals interest themselves in their practice, as affording pleasurable and profitable recreation. Turnery occupies many workmen, and has special claims on amateurs. If this handybook tends to promote this fascinating and useful art my object will be attained.

THE METAL TURNER'S HANDYBOOK, which forms a companion volume, I would recommend to the notice of those who are interested in that branch of the Art of Turning.

LONDON, P. N. HASLUCK.
February, 1887.

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THE

WOOD TURNER'S HANDYBOOK.

CHAPTER I.

WOOD-TURNERS' LATHES.

THE lathes now commonly employed for general wood-turning are most simple and primitive. Some 3,500 years ago, the potter's wheel, which may be considered to be the primogenitor of modern lathes, was known and used. In some of the oldest Egyptian monuments the God Ptah is represented working at a potter's throw, or wheel. The modern throw possesses but slight modifications, and is substantially the same tool as that used for the production of antique pottery ware, some of which still remains unsurpassed for beauty and skilful execution.

The modern form of turning-lathe, in which the work is suspended on horizontal centres, was commonly used by the Greeks and Romans. Though none of the early writers have left anything like a graphic description of the lathe of their time, yet the tool is frequently mentioned by Herodotus, Cicero and Pliny—that is to say, at a date some centuries before the Christian era. Virgil, who lived from 70 to 19 B.C., gives particulars of the art of turning, from which it is evident that wood-turning was practised at that time. In his "Georgics" we learn not only that the ancients turned wood externally, but that they also hollowed it internally. Boxwood and lime tree, woods of very different natures, are spoken of as susceptible of being fashioned on the lathe.

Wind instruments were made of boxwood, and from Virgil's "Æneid" we may glean an idea of the degree of perfection attained in his time. The instruments were, it seems, all flutes, and of these there was no lack some 2,000 years ago. Pandean pipes are probably meant by the flute spoken of in the Bible; but the flutes made by the Greeks were formed of ass's bones, which, of course, did not require the use of a lathe in their preparation. It is difficult to decide with any degree of certainty the date at which wood-turning originated.

When turning between centres was first practised the work had an alternating rotary motion imparted to it. One method was by means of a cord, which encircled the work twice, having one end attached to an elastic pole, and the other formed into a stirrup for the foot. On pressing with the foot the work was rotated in the direction required for turning; it was similarly rotated in the opposite direction when the power was released, and the cord drawn back to its original position by the elastic force of the pole. During this latter movement the turning-tool had to be lifted from contact with the work. Another method was to pass a cord twice round the work, and an assistant, taking one end in each hand, would, by pulling alternately, produce the effect previously described. Both of these primitive methods of driving the work are still practised, the first by many workmen in their usual trade—for example, watch case makers—the second by the itinerant turners of India.

Before mandrels were employed, the work was suspended between centres only, then a portion of the article to be manipulated was utilised to form a pulley. The cord was passed round this part, which was generally hollowed out to receive it. When the work was finished, the superfluous pulley was severed from it and cast aside.

A bow having several strings, which were fastened to a roller at their middle, was next used to draw the cord to its original position, after applying the foot or other power. The roller had the cord coiled upon it, and when the treadle was pressed down the roller was rotated, thereby winding the several strings together, and bending the bow slightly. This bow was a considerable improvement on the pole. The power was more uniform, and could be adjusted to a great nicety, so that the influence of the spring would not be felt on delicate work. The bow could be fixed to the framework of the lathe, and from being more compact than the pole it rendered the whole machine more portable.

Bergeron's book, published nearly one hundred years ago, contains illustrations of lathes driven by means of the bow-motion last described. A German book, dated 1568, contains an illustration of a pole-lathe with a sphere between the centres. A quantity of turned objects are represented lying about the workshop. This illustration appears to be the earliest record of a lathe mounted on standards. The tool had been previously confined to the Oriental nations, and had been kept low down to suit their habitual squatting position.

The centre-lathe, that is to say the lathe which has merely plain centre-points on which the work is mounted, and the mandrel-lathe, which is provided with a mandrel headstock, were described as distinct tools by Bergeron. The former has since become obsolete except in the form of the turn-bench used by watch and clockmakers. Lathes with mandrels are now in common use throughout Europe, and it is with these that a modern turner executes his work.

Modern workshops, where wood-turnery is executed, are fitted up with apparatus of very primitive design. Steam power, of course a modern invention, commonly serves as the motor, but the lathes themselves are the same as those that were used a century ago. Timber is the principal material employed in constructing them. At the present time, when cast-iron has superseded wood in so many of the mechanical arts, this is a somewhat curious fact. Before the advent of planing machines for iron, the shaping of that material was difficult and costly, and principally for those reasons wood was employed. Now cast-iron can be fashioned to almost any form in the mould, and may be finished with the greatest accuracy afterwards. It is cheap, and possesses some important advantages over wood in the construction of machinery. It is, therefore, not easy to understand why wooden lathes are still employed by wood-turners.

The lathes commonly used for plain wood-turning are as simple and cheap as they can be. A plain bed, consisting of two strips of pine, as described below, supports the head-stocks. These are usually iron castings, made much lighter than the engineer's usual pattern. The mandrel has a neck for the front bearing, instead of the cone generally applied to single-speed metal-turners' lathes. The front head-stock bearing consists of a pair of brasses, to allow the mandrel to be put in the head-stock, not the usual steel collar driven into the head-stock casting. Gun-metal is most frequently used for these brasses, but no doubt phosphor bronze would prove more durable. This latter metal is now used extensively for the bearings of fast-running spindles in wood-working machinery, and apparently gives satisfaction.

The illustration, Fig. 1, shows a lathe of the type described above. It is intended to be driven by power from an overhead shaft. The bed is shown as capable of any extension towards the right. An extremely long bed would be further supported by additional standards placed between those at each end.

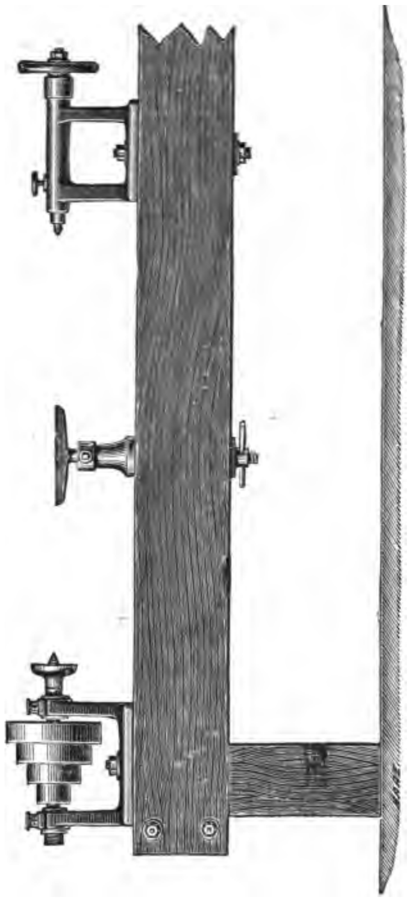


Fig 1. Plain Wood Turning Lathe.

Wooden beds are well suited to the requirements of the wood-turner. The work does not necessitate the use of a lathe possessing the solidity necessary for some classes of metal-turning, and hence the expensive planed iron bed may be dispensed with. Two strips of sound pine, two-and-half inches by five inches, form a convenient bed for an ordinary wood-turning lathe. The length is determined by circumstances; three feet six inches is about the shortest useful size, and frequently the bed is as long as the workshop will admit. The long bed will carry several head-stocks, and be more stable than several short ones. The two strips are usually bolted together parallel, with a space of from about one-and-half inches to two inches between; blocks of hard wood are used to separate them, and coach-bolts clamp them in position.

The bed is mounted on legs or struts, bolted to it, and firmly secured to the floor. The top surface of the bed should be at a height that will bring the lathe-centres level with the elbow of the turner when his arm is close to his side. This is the most convenient height for turning, and for men of average stature will be about three feet nine inches. A six-inch centre lathe, will require the top of the bed to be six inches below this; and the height of the bed is necessarily determined by the height of centres.

The rear side of the bed should be provided with a bench, or tray, on which various tools and appliances may be placed when temporarily out of use. This adjunct will be found very useful. It may consist of an inch board, a foot or so wide, secured to the bed by screws and supported at its outer edge by struts from the legs. The top of the bench should be placed about an inch below the top of the lathe-bed. The outer edge should have a fillet about an inch high fastened to it. This precaution will prevent the tools, &c., that may be laid on the tray from rolling off.

The head-stocks for a plain lathe may be made of beechwood. A strip, four-and-a-half inches wide and one-and-a-half inches thick, should be planed up straight and smooth. Square one end, and cut off a piece eight inches long; this is to form the bottom of the head-stock. The two upright pieces should be of about the same height; these must be cut off likewise, also a similar piece for the back centre poppit. These three pieces have to be carefully placed together, with one set of ends quite level. At six inches from this end a hole is bored straight through the three; it should be as near as possible midway of the width. A three-eighths of an inch hole will be about right for size. The pieces should be held together with cramps when boring.

One piece, to form the back centre, may now be fixed to a base, say four inches long, cut from the same strip. A holding-down bolt, consisting of a half inch coach bolt, long enough to go through the bed, with one-and-a-half inches to spare, is then fitted to it. A butterfly or winged nut is put on in place of the ordinary square or hexagon one, and a washer must be put over it to bear against the underside of the bed. The screw to form the back centre should measure half-an-inch to three-quarters of an inch in diameter, and be pointed. It can be obtained at an ironmonger's. This is forced into the hole bored through the wood, and will hold well without further precaution.

The mandrel head-stock is fixed together by means of one or two long bolts going quite through it lengthways. A nut on each end will draw the two end uprights into close contact with the bottom piece, and will prevent the head-stock from spreading open when the mandrel tail-pin is screwed up tight. It is essential that this wooden head-stock should be made as solid as possible, and one made of iron would be more serviceable. The former can be made by a wood-worker, whereas the latter entails engineers' work, and probably for this reason is not invariably met with in wood-turners' workshops. The wooden head-stock may be bolted on to the bed by the aid of coach-bolts.

The mandrel, usually made of iron, and its collar, which may be of steel, or of some softer metal suited for bearings, must be procured from an engineer. It would be impossible for a wood-turner to make these with his usual appliances, and not only will it be better, but cheaper, to buy the mandrel and collar. These will have to be fitted to the head-stock. A tail-pin screw is wanted to support the tail end of the mandrel, and should be obtained with it. The making of the mandrel head-stock is work altogether more fit for an engineer. A fast and a loose pulley have to be fitted on the mandrel to take the strap from the driving-shaft.

The hand-rest—or T rest as it is more properly called—consists of a casting which forms the socket, and of a second one, which is the T. These may be bought at many iron foundries. A holding-down bolt is wanted to secure the socket-sole. For convenience of shifting, a butterfly or bow-nut is preferable to a hexagon or square one.

A skeleton lathe of the most simple and inexpensive form has been briefly described above, so that an idea of the very primitive tools now employed may be formed.

Fig. 2 shows a wood-turning lathe of more substantial construction. It has the bed and standards made of iron. The mandrel projects on the left end, and has a threaded nose to receive chucks; by this arrangement discs of large diameter, say up to six feet, such as table-tops can be turned. When used in this manner, the mandrel nose must either have a left handed thread or be run the reverse way. The chucks would be unscrewed from an ordinary right-handed thread by the action of the tools.

Fig. 3 shows a lathe specially adapted for ornamental work. It will produce spirals of any size, pitch and form; shape prisms of any sectional form, parallel or tapering; and may also be used as an automatic lathe working to a template.

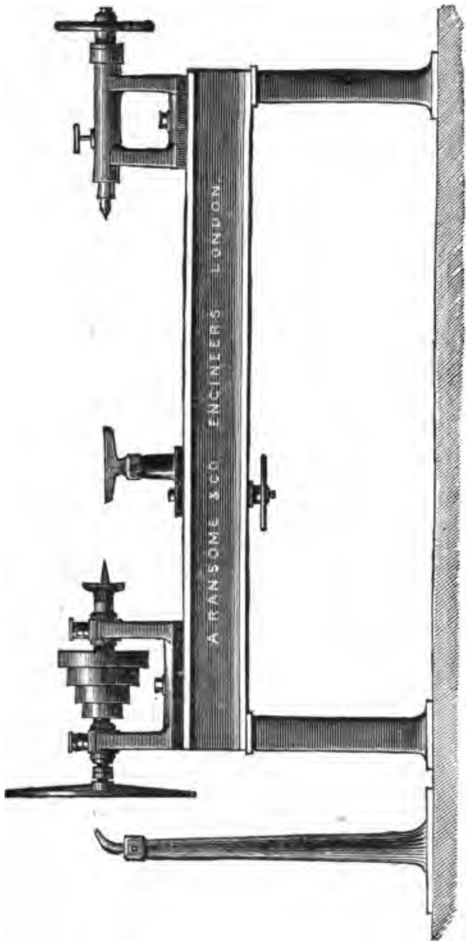


Fig. 2. Wood Turning Lathe on Iron Bed.

The slide-rest carries a revolving spindle, which is driven from an overhead countershaft, and cutters of any desired form can be fitted into this. When used for fluting, the cutter spindle is brought into action, and, if a spiral is desired, the mandrel is slowly rotated by means of gearing from the

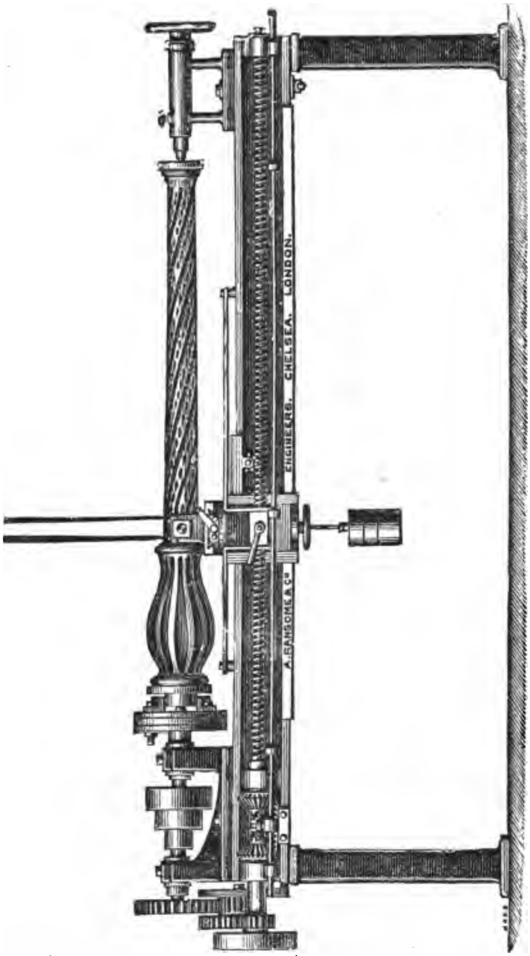


Fig. 3. Lathe for Straight and Spiral Fluting.

leading screw. Quick or slow twists are got by altering the wheels to suit. The chuck, shown on the mandrel-nose, serves the purpose of a division plate in spacing fluting. A template is shown in the illustration, and the upper slide of the rest is kept against it by the action of the weight, also shown.

In contrast with the lathe first sketched may be considered some of the automatic machines which are used in turnery. An American "Variety" lathe is illustrated in Fig. 4. This machine is constructed to produce large quantities of uniform articles at a minimum of cost, to effect which rapidity in working is most essential. An idea of the mode of operating this lathe may be inferred by reference to the illustration. The headstock to the left is fitted with a chuck, which receives the squared wood just as it comes from the saw mill; the right-hand end of the wood is supported by a collar, mounted on a carriage, which travels along the lathe-bed. This collar is fitted with a cutter, arranged to turn the square wood down to a parallel cylinder of definite diameter. The poppet-head is actuated by a lever handle, shown on the right, having its fulcrum about a pillar to the rear of the bed; the lever is jointed, and is attached to the barrel of the poppet. Suppose the rough wood is placed in position, ready for operating upon. By pulling the lever handle, the poppet-head is brought up towards the carriage, and as soon as the former touches certain regulating screws on the carriage the latter is also moved. The effect of this is to turn the wood to a certain diameter, the length being determined by regulating screws. Simultaneously with the operation, the wood may be bored to any diameter and depth required by means of a boring tool fixed in the poppet-barrel.

So far the process is merely to rough out the work. Any mouldings or shaping that may be wanted may then be made by a series of cutters fixed in the tool-box, shown just to the right of the collar. This tool-box is brought towards the work by pressing the knee-pad, shown near the centre, between the standards. The same operation also brings a parting tool into action, but this tool does not act till the last moment.

These operations, so difficult to describe clearly, are performed with such rapidity that about three seconds suffice for going through the whole series and producing a finished article from the rough material. The work that can be turned out in this machine is almost endless in variety and exact uniformity is assured.

Wooden boxes, bobbins, knobs, handles, egg-cups are amongst the many objects that can be successfully made on this machine at a speed of about 1,000 an hour. Turning,

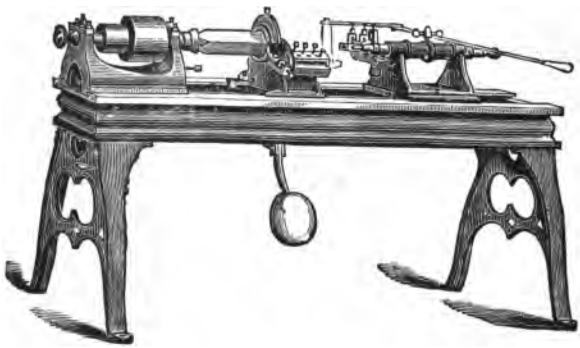


Fig. 4. American Variety Wood Turning Lathe.

boring, and beading being carried on at the same time, the lathe running at some 3,000 revolutions per minute. The

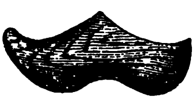


Fig. 5. Wooden Shoe.

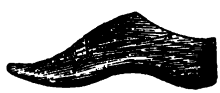


Fig. 6. Shoe Last.

Fig. 7. Pistol Stock.

price of this lathe is from £50 to £65, including freight from the United States.

Though turning is often considered as limited to the formation of circular work, yet lathes are constructed to produce ob-

Fig. 8. Tool Handle.

jects of a widely differing form, such as wheel spokes, gun stocks, boot lasts, curved handles, as used for axes, &c. Several speci-

Fig. 9. Axe Handle.

mens of this kind of turnery are illustrated in Figures 5 to 12. Such work is produced on copying lathes, and examples of these are shown and described in a subsequent chapter. The

Fig. 10. Hatchet Handle.

examples of work are introduced thus early in the book in

Fig. 11. Wheel Spoke.

order that the reader may not proceed with his ideas of turning limited to mere circular work.

Fig. 12. Gun Stock.

CHAPTER II.

HAND-TOOLS USED FOR TURNING WOOD.

THE wood-turner who works at the foot-lathe employs but few edged tools except chisels and gouges. By the aid of these alone nearly all external turning is done.

Economy of time is essential to the economic production of work, and it is, therefore, in some cases, advantageous to roughly round the material to be turned before putting it between the lathe centres, as there are ways of doing this at a less cost than by turning. In speaking of cost, it is here used in its abstract form, and means value of labour irrespective of the time employed; and if two unskilled hands can do more work than one skilled workman receiving double the wages, it would of course be cheaper to employ the two hands. Balks of wood may be trimmed up to a cylindrical shape with a hatchet, a paring knife, or a draw knife; and large chips of superfluous material are hewed off by these means quicker than could be done on the lathe, with a less expenditure of technical skill, and with appliances far less costly. Thus there are many reasons for getting material roughly to shape before mounting it in the lathe. For the same reasons the centres of such balks should be marked, and so obviate delay in finding the centre when chucked, though a general and very good plan is to finally centre the work as the turning progresses, for it is only when the rough, irregular figure is turned that its hollow places can be determined with certainty; and when the turning has reached the stage at which this shows itself, the work is driven, by blows of a mallet on its full side, to run so that the hollow will come up to the tool.

The cutting edges of tools used for turning soft wood are found to act best when ground to an angle of about twenty-five to thirty degrees. This gives a keen edge, capable of withstanding the ordinary usage of such work. To work with tools which are ground less acutely is like cutting wood with a cold chisel—and here it is as well to explain that a cold chisel is the name by which chisels used for cutting cold metal are known.

There is a great deal in keeping the tools in a proper condition for work; and the turner has to learn this, even before he begins to learn turning itself. New tools require to be ground and set before they can be used.

Cylindrical work, both plain and ornamental, is first roughly turned to shape with the gouge, and then the chisel is brought into requisition to smooth and finish the work. The same description of tools are employed for turning flat surfaces, both plankways and endways of the wood. Hollows and internal recesses are also turned with gouges and chisels whenever there is sufficient space for their introduction.

The correct position for the cutting edge of the tool is at a tangent to the circle which it is turning—that is, the circle left after the passage of the tool; and it is only necessary to thoroughly understand the meaning of this to be able to place the tool with precision and certainty in the best possible position for cutting. A tangent is a line which touches, but does not cut into the circumference of a circle, and the chamfer ground on the convex side of the gouge has to form a tangent to the circumference of the diameter being turned. It must be perfectly understood that a tangent may be formed at any point of the circumference, and equally well at the highest or lowest point. It is generally said that the height of a tool should be exactly of the same height as the lathe centres, and though this is perfectly correct in the case of slide-rest tools as usually ground, yet the axiom has no bearing if applied to hand tools, though in turning metal the same rule is advisable, as it affords a rigid rest at the most convenient place. No matter at what height the rest is fixed, the tool can be placed at a tangent to the work by elevating or depressing the handle as may be required.

To make the action of turning tools clear, so far as their cutting edges are concerned, I will borrow from "Lathework" a diagram which shows two tools correctly applied for cutting both soft and hard material. By this it is seen that the slide-rest tool, with a strong cutting edge suited for operating upon highly cohesive metal, such as steel, and the acute wood-turning chisel, suited for the softest material, have each the lower face-angle placed in the same position with regard to the work. The upper face, which wedges back the shavings, curling or breaking them according to the nature of the material operated upon, is the only one in which any difference is observable agreeable to this latter condition.

In Fig. 13 the line of centres is shown by *a*, *b*. It is precisely to this height that all slide-rest tools should be set. With hand tools it is of little importance whether they be applied above, below, or on the line of centres. The edge of the metal-turning tool is formed by the meeting of the faces *a*, *x*, and *d*, *x*; *d*, *x* is three degrees from the perpendicular, and this gives the angle of the edge as eighty-seven degrees. The edge of the soft wood chisel is formed by the meeting of the faces *c*, *x* and *d*, *x*, enclosing twenty-five degrees, still keeping the lower face in the same line, that is a tangent to the circle.

Suppose the tool is laid on to a true cylinder, so that its bevel forms a tangent to the cylinder, it cannot cut the material; but directly the handle is raised the cutting edge is depressed into the cylinder, and all that material lying outside of the diameter of the edge is removed. The position of the cutting edge is best determined by the sense of touch, the tool being laid on the T rest with its end overhanging the work considerably. The lathe being in motion, the tool is then drawn gradually towards the operator, all the while

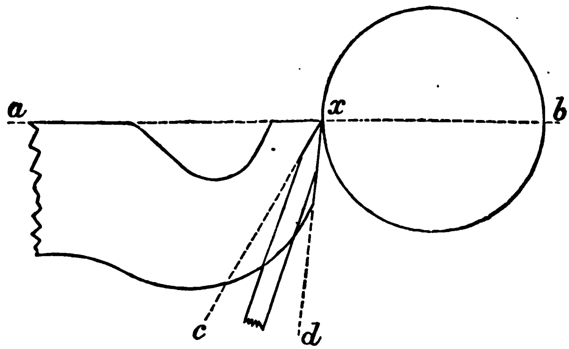


Fig. 13. CUTTING ANGLES OF TOOLS.

keeping it resting on the cylinder, till the edge reaches the point at which it forms the tangent, and then it commences to cut. By slightly tilting the tool, the edge is brought to act on a smaller diameter, and turnings are removed under the most advantageous circumstances.

Apertures which, in comparison with their depth, are of small diameter necessitate the use of tools of special form, which are, generally speaking, hook-shaped. Tangs of various forms and dimensions have the ends bent to form gouges and chisels, so as to be available for work where the ordinary straight gouge or chisel could not enter. To attain efficient mastery over these hook tools requires considerable practice.

In the hands of inexperienced persons their application frequently leads to mishaps. A strong wrist and, above all, practice in using the tool are required, in order to counteract the powerful leverage exerted by the work, which tends to twist the tool and wrench it from the grasp.

The length of handle is an item of importance in all hand tools, as reflection will show. They are all, when in use, governed by the laws which act on a lever, the fulcrum being the point of support on the rest, the cutting edge then terminates the short arm of the lever, and the power over it is proportionate to the length of the handle end as compared with the length of the short end. The control over the tool is therefore greatest when the rest, and fulcrum point, is nearest to the work, and the hand holding the handle is nearest to the end. When the handle is not sufficiently long, the edge of the tool is liable, when caught by the work, to be drawn into cutting too deeply, through the hand not having complete control over it, and, from the same cause, with greater force, the tool will be twisted out of the grasp, or the work forced from the chuck. In order to give greater freedom in the movement of the cutting edge, tools used for wood-turning, which are generally required to do a long range of surface, they are used with the rest placed at some distance from the work, and this, in giving longer motion to the cutting edge, gives a much greater power on the leverage: and it is for this reason that such tools require to have long handles.

Gouges for turning are made in all sizes, having cutting edges from one-eighth to two inches. The sectional form varies from crescent-shaped tools, with a thick back tapering to a thin edge, to circular ones, in which back and edge are of equal thickness. The curvature of the tools varies also greatly: from those in which it is so slight that they may almost be considered straight-edged to others having a semicircular edge.

The length of gouges is partly governed by their size, one inch gouges measuring generally from ten to fifteen inches long.

The ordinary gouge and chisel used by the wood-turner must not be confounded with those tools having the same names but used in cabinet making and joinery. The carpenter's and the turner's gouges are quite distinct tools, though they have a general similarity; and the same may be said of the chisels used in the respective trades. The turner's gouge is a much stronger tool, having more metal in it than its namesake; it is ground to a different shape, and has a handle from eight to sixteen inches in length, according to the size of the gouge. Fig. 14 illustrates a gouge handled complete. Both tools are ground on the outside of the curvature, but the turner's

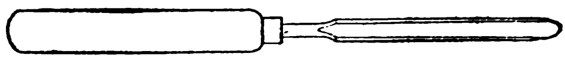


Fig. 14. A Turner's Gouge.

gouge terminates in a rounding edge, without corners, instead of being square with the shaft of the tool. This round form of edge is necessary in order to obliterate the sharp corners, which would be liable to catch in the work. It also allows the most prominent parts of the edge to be used in grooves which are comparatively narrow. Very small curves and mouldings can thus be easily operated upon by small gouges.

Several sizes are always provided for use, and whilst the larger ones take off large shavings and rough the material to shape quickly, the small ones are available for more minute work, and may be used for turning in shoulders to very nearly an acute angle.

Chisels for turning are made in sizes to correspond with the gouges, but larger ones can also be procured. They resemble ordinary paring chisels, but have no shoulder to the tang, the edge being also formed very differently. The blade of a turner's chisel is bevelled equally from each side, leaving the cutting edge in the centre of the thickness and at an oblique angle with the sides. This angle is usually about seventy degrees and one hundred and ten degrees, instead of being square across like a paring chisel. Turning chisels are ground obliquely, foi the sake of greater convenience in use. One of ordinary shape performs the work equally well, but, as that tool has to be applied at an angle to the work, which is often inconvenient, an oblique edge is preferable, allowing, as it does, a cylinder to be turned with the tool at right angles to the axis of rotation.

The method is the same for applying both gouges and chisels. The tool is grasped firmly near the cutting edge by the left hand, the knuckles being uppermost. The right hand holds the handle near the end, and, to afford greater steadiness, it usually rests against the side of the body. Thus held, the tool, if a gouge, is laid on the T-rest with its convex side downwards. The edge is brought sufficiently near to the revolving cylinder to touch it in the position of a tangent; that is to say, a straight line, drawn in continuation of the ground bevel of the tool, will touch, but not cut into, the cylinder. In this position the gouge will not cut, but by raising the end of the handle with the right hand, the edge of the tool is depressed, and it then comes in the position of a tangent to a smaller circle. When the work is rotated, all the material outside of that diameter will be shaved off by the tool. During this process the pressure on the edge of the gouge tends to force the tool deeper into the work; the right hand must, therefore, hold down the handle till the work has been reduced all round to the new diameter.

The first cut of the gouge is usually made at a short distance from the right-hand end of the rough balk, and when a groove is turned the tool is inclined towards the left, so as to remove the material between it and the end. A new cut is then made towards the left, and this is made continuous with the previous one by inclining the point of the gouge as before; thus by a continual shifting of the tool, and turning a small distance at a time, the entire cylinder is brought roughly to form. The size is gauged by means of callipers, and if much in excess of what is required a further application of the gouge is the best way of reducing it; and the cylinder is made as straight and even as possible by this tool before employing the chisel. In this levelling operation the gouge is slid along the top of the T rest, guided by the left hand, and tracing on the work a regular spiral path. An expert hand can by this means produce a very tolerable smooth surface to the work, the gouge being traversed from both ends alternately, and the parallelism is checked by callipering.

The chisel used for smoothing the work is applied similarly to the gouge, and all that has been said applies to both tools, subject to any modifications rendered necessary by their different forms. The chisel is always applied so that its edge lies obliquely across the surface of the cylinder, the handle being also slightly inclined to place the edge of the chisel—which is, as has been already stated, ground obliquely—at a slightly greater angle with the line of centres than that it makes with the chisel blade. The tool is laid on the rest, with the blade resting on one corner of the obtuse angle. The chisel is tilted up sufficiently to bring the central part of the cutting edge against the work. Only the central part touches, both corners being free, the edge lying obliquely across the cylinder. If either corner were allowed to act on the work it would be extremely difficult to guide the tool, which would have a tendency to "catch in." This tool is held with the left hand grasping the blade close to its cutting end, with the knuckles above; the right hand grasps the handle near to its end, holding it near to the right hip, and the chisel blade rests on the T, one of its lower corners only in contact. The tool is slid along with the obtuse angle leading, and may be used from either right or left. To reverse the direction it is only necessary to turn over the tool.

Through the tool being presented with its edge obliquely, only the central part cuts, the two corners not coming in contact with the work, and the extreme central part cuts deepest, the shaving cut by the chisel being thickest in the centre and tapering off on each side to a feather-edge. By carefully considering this, the necessity of correct tangential position will be better understood. If the chisel is laid on to cut with the entire breadth of its edge, the tool becomes unmanageable from the quantity of material it has to cut. The production of straight, level work will depend on maintaining, during the entire longitudinal traverse of the tool, a perfectly equal amount of tilting from the T, and the same relative position of the handle held in the right hand. It must be remembered that the chisel lying obliquely across the surface of the cylinder, and forming a tangent to it, will not cut at all, acting just as a gouge under the same conditions; but directly the handle is raised, and the edge penetrates the diameter, then the tool lies at a tangent to a circle of smaller diameter, and all material outside of that circle will be cut off. The cut is taken from either end, as most convenient, by simply turning over the tool. The principles which govern the cutting action of the gouge are equally applicable to the chisel, and it is by tilting up the handle that the tool is fed into the cut.

Fig. 15 represents a gouge of the form in general use; it measures nearly half-an-inch on the edge. The section shows much less metal than is embodied in Fig. 17, and this kind of gouge is much lighter and handier in many respects than the one shown at Fig. 17. The grinding is more easily accomplished. The substance of the tool is quite adequate to the requirements of all ordinary wood-turning, and it is with gouges of this form that most work is done. Larger sizes, from one inch to one-and-a-half inches, are used for roughing-down purposes. The section of this tool is crescent-shaped; the centres of the two circles, whose arcs form the concave and convex sides, are about one-sixteenth of an inch apart. The points of the horns are rounded off, so that all sharp corners are avoided. The convex surface has a radius of a quarter of an inch, the concave being only one-thirty-second less. From these measurements, taken from a gouge by the

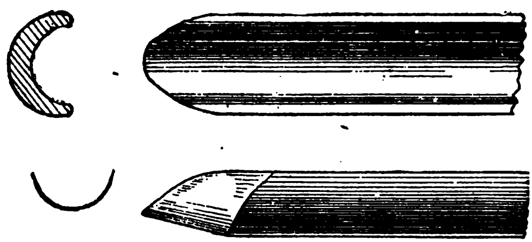
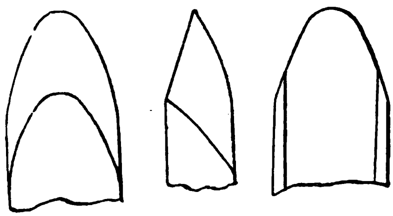


Fig. 15. A Half-inch Gouge.

aid of which I have made many a bushel of shavings, the precise form of the tool may be easily understood. The bevel ground around the convex part very much resembles that of the following figure. The elliptical form of the edge is more circular, owing to the larger channel in this tool. After what has been said in connection with the chisel, it is scarcely necessary to mention that the angle enclosed by the bevel and the inner surface should be about twenty-five degrees. Tools for soft wood turning are seldom more than thirty degrees on the edge.

The accompanying cut, Fig. 16, shows three views of the cutting end of a turner's gouge, and are intended to illustrate the method of grinding. C is the front, or concave side, of the gouge, and shows the parabolic curve of the cutting-edge B is the side, and shows the long sloping chamfer made by grinding the tool. The angle formed by this chamfer should be from twenty-five to thirty degrees. It is this chamfer that should form a tangent to the work when the gouge is in use. A shows the back, or convex side, of the gouge, and the chamfer will be seen to be of equal slope all round. In setting gouges, the turner has an ordinary oil-stone, with a number of different-sized, semi-circular groves worn into it. A groove the size of the gouge is selected, the back or chamfer



A BACK. B SIDE. C FRONT.

Fig. 16. GRINDING A GOUGE.

part rubbed along it, at the same time turning the tool slightly, as when grinding. Then with a slip of oil-stone having a rounded edge, the wire-edge, which will be found all round the cutting edge in the hollow side, is removed. In doing this great care must be taken to rub the burr down only level with the surface on the hollow side, because tilting up the back end of the slip would produce a slight chamfer on the hollow side of the tool, and this is not desirable. The operation, however, turns the wire-edge backwards, when the tool must again be lightly applied to the hollow set-stone; and, finally, one or two more rubs on the inside with the slip, after which it is wiped with a piece of soft leather, or on the palm of the hand, which removes any remaining wire-edge, and the tool is now ready for work. All the gouges, large and small, are ground and set as described above, different-sized slips being used.

Fig. 17 shows a quarter-inch gouge. Top, side, and sectional views being given, the small semi-circle shows the size and form of the cutting-edge. This kind of gouge is particularly strong, as can be seen from the sectional view, there is only a small channel as compared with the substance of the tool. The bevel formed by grinding is shown in the side view; and the form of the point, seen from the top, illustrates the correct form for grinding. There are no sharp angles, the point ends

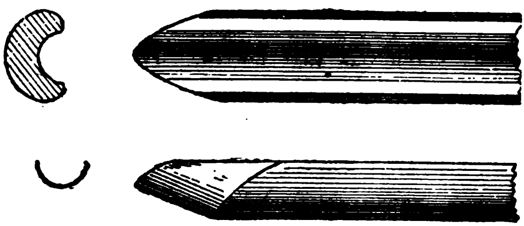


Fig. 17. A Quarter Inch Gouge.

in an elliptical edge, leaving the centre most prominent. The horns of the crescent-shaped section are thinned off on their outer sides, to save metal and leave less to be ground away. Both the inside and the outside curves are circular, excepting the part just alluded to; the centre of the smaller circle is, however, fully a sixteenth of an inch from the centre of the convex face.

Fig. 18 represents a three-quarter inch chisel; side, top and end views are given. The two bevels, which meet at the cutting-edge, enclose an angle of twenty-five degrees. This, as will be seen by the diagram, Fig. 13, is the angle suited for wood-turning tools. The oblique edge forms at each corner angles of seventy degrees and one hundred and ten degrees respectively, as has been mentioned previously. A chisel of the size illustrated will measure from about eighteen to twenty inches from end to end, when handled ready for use, the

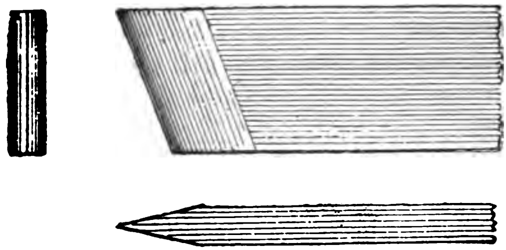


Fig. 18. A Three-quarter Inch Chisel.

blade being about half that length. The rectangular figure, facing the cutting-edge, is a view of the end.

Fig. 19 illustrates a hook-tool used for turning interior hollows. The steel shaft is forged out thin and wide at the

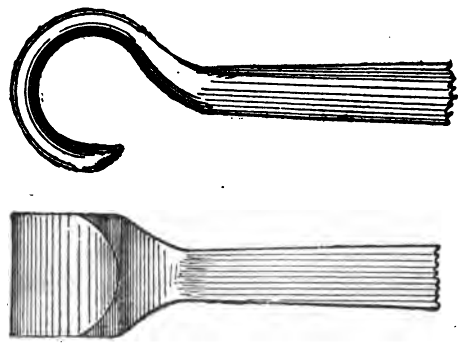


Fig. 19. A Hook Tool.

end, and curled into a circular form as shown. The outer part of the circle is ground square with the tang; the inner side is thick in the centre and bevelled towards both edges. This makes a sharp cutting-edge around the ring, as shown in the top view. The tang itself is square in section, with the corners bevelled off; near to where the hook commences it is nearly round. These hook-tools are carefully filed round the inside to form a smooth bevel; all the corners are rounded off, and the tool is then hardened and tempered for use. It may be applied to the work either side up, and considerable manual dexterity is required in its use to prevent accidents of a more or less serious nature.

The other necessary tools for ordinary wood-turning are but few, and consist of callipers, a pair of compasses, two or three slips of oil-stone for setting up the gouges, a side tool and a parting tool. Fig. 20 shows a large scale view of the side and edge of an ordinary parting tool. A grindstone and an oil-stone are also very useful, and, in practice, the use of these cannot well be dispensed with. There should be about half-a-dozen pairs of callipers of various sizes, the largest opening to about twelve inches to fourteen inches. Also one or two pairs of inside callipers, these being too well known to need illustration.

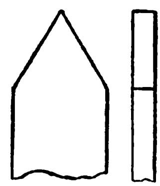


Fig. 20.
PARTING TOOL.

The parting tool is in shape like Fig. 20, about five-eighths of an inch broad and one-eighth of an inch thick. It is used for cutting off pieces of finished work from the block, held in the cup chuck, or on a face plate, such as bosses, patellas, draught-men, &c. It works best when the grain of the wood is running at right angles to the lathe centres, that is plank-ways.

The above tools are about sufficient for most purposes. There are, however, a variety of other tools of peculiar forms required by turners who do a great variety of work. The shape of these suggest themselves from the nature of the work to be done. Old files of various forms are often utilised by grinding into the required form. In the grinding of all tools, see that the ground part, or chamfer, is a straight line from the heel to the cutting-edge; and in setting on the stone this surface should lie nearly close on the stone, the heel only slightly raised, so that the cutting-edge comes in contact with the stone. If the handle end is held much higher, a new chamfer is immediately formed at a more obtuse angle than the ground part, and the tool will not work satisfactorily until it is re-ground.

The first actual turning is done with the gouge, and large ones are used for large rough work. The correct angle for grinding the gouge, and the proportion of handle have been previously mentioned. The rest is placed just clear of the revolving work, and the T adjusted to a convenient height, so that when the cutting-edge is performing properly, and the tool resting on the top of the T, the handle will come to a convenient place at the right-hand side. The height of the rest is therefore generally to a certain extent governed by the stature and habit of the workman.

CHAPTER III.

ROUNDING TOOLS AND MACHINES.

THIS chapter deals with the tools used for producing plain cylindrical work, such as curtain poles, broom-handles, dowel-pins, &c. A large quantity of cylindrical wood is used in many ways other than for the purposes named, but it would be of little use even to attempt to enumerate them all. Hard and soft woods are alike used in all sizes, from about a quarter inch diameter upwards.

Rounding machines are employed when the work has to be produced in large quantities. The wood, rough as it comes from the saw-mills, is fed by rollers into a hollow revolving mandrel, which carries an internal cutter. This reduces the material to a cylindrical form, and rollers with hollow grooves draw it out on the other side. It is not easy to say whether a rounding machine may be termed a lathe or not. The distinguishing characteristics of this latter tool have not been definitely determined.

Hollow planes are frequently employed for making cylindrical work; the accuracy of the result is not to be compared with that produced by rounding machines, or even by rounding planes or rounders, of which more hereafter. In a workshop where curtain-poles are the staple produce, I found the hollow plane holding the post of honour. The wood, having been sawn into rods of square section, is laid on a shooting-board, which is grooved to receive it, and the corners are taken off with a jack-plane, thus the material is reduced roughly to hexagonal form. A hollow plane is then used, and the wood is quickly shaved down to a circular section. A practised hand will make very good cylinders, but, of course, there is no means of ensuring perfect accuracy. The work is done quickly, and it is sufficiently true for the purpose for which it is intended; hence it is saleable, and the tools used for producing it are not costly. This latter consideration is probably the chief cause for adopting this primitive method, instead of using some of the modern machinery for the purpose. A few shillings will suffice to purchase the necessary hollow planes,

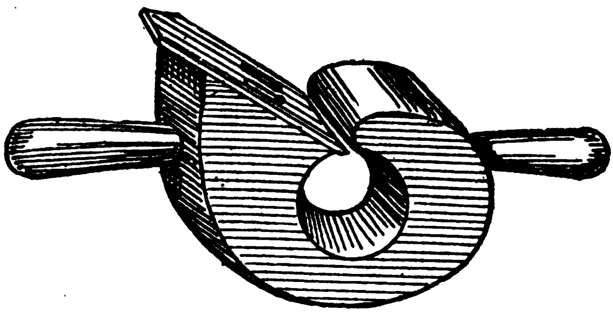


Fig. 21. ROUNDING TOOL.

but a rounding machine costs something like ten times as many pounds, and, moreover, involves the employment of steam power and other incidental expenses.

Rounding planes, or rounders, are used to make cylindrical rods. The tool consists of a wooden stock, or handle, with a round hole through it. See accompanying illustration, Fig. 21. A plane iron is fitted to the stock, and projects slightly inside the hole. The work has to be rotated, and the rounder is forced on to it, the rough wood entering the hole, which forms a guide for it. The plane iron reduces the irregular pole to a perfect cylinder as it passes through the tool. In many respects the rounder acts in a manner similar to the rounding machine. The chief difference is that in the latter the machine revolves, whilst in the former the work is rotated whilst the rounder is held stationary. This tool forms the connecting link between the implements used by turners and carpenters. The ordinary rounder is suited to round one size only, but adjustable tools are made with which any sized cylinder, within the limit of the tools' range, can be made.

Hollow augers, used for cutting tenons on wheel spokes and many other purposes, are very similar in construction to the rounder which has just been described. Universal hollow

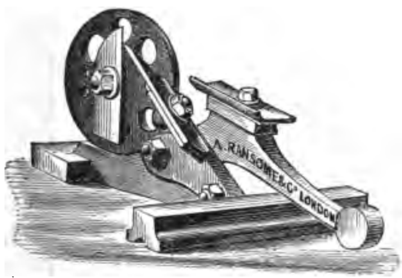


Fig. 22. CONCENTRIC SLIDE.

augers to cut all sizes, from three-eighths of an inch to one inch and a half are made, and very useful tools they are.

Fig. 22 shows an apparatus intended for use on a lathe, and adapted for turning cylindrical work straight, tapering, or any contour that has not abrupt alterations in its form. The apparatus is shown on the lathe illustrated on page 32, Fig. 23. It consists of an iron casting, fitted to slide along the lathe bed, to which several cutters are fixed. A circular plate, having a series of graduated holes, serves as a guide and steady for the work, which is turned to fit one hole by the knife shown slanting upwards. The knife placed vertically against the guide plate is placed at a slight angle, and serves as a self-acting feed, causing the apparatus to move automatically. The arm, which bears the name of the maker, rocks on the bolt, which is also shown, and carries the finishing tool. This arm rests

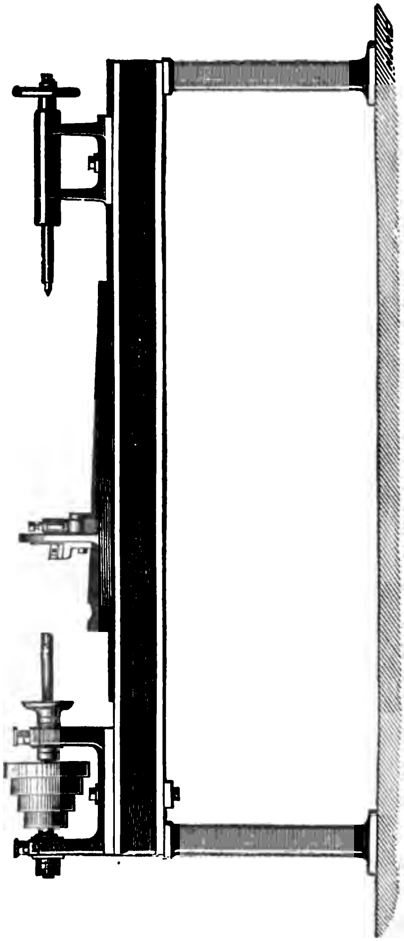


Fig. 23. LATHE FOR TURNING TAPER HANDLES, &c.

upon a template fixed to the front of the lathe bed, and thus shapes the work to any desired form. This apparatus will take work from half an inch to two-inches diameter, and turn out from eighty to one-hundred-and-fifty objects per hour.

Fig. 23 shows a lathe arranged for turning long tapering handles. The action is automatic, and from 1,200 to 1,400 handles, thirty inches long, can be produced in ten hours. Skilled labour not being required to work the machine. The action is obtained by means of the apparatus illustrated at Fig. 22, which is fitted to an ordinary wood-turning lathe, such as shown at Fig. 2. The wood is square when placed on the lathe, a cutter reduces it to fit a hole in the guide collar by which it is held steady. The finishing cutter is attached to an arm jointed to the sliding part, and this arm, by moving over a guide, causes the finishing cutter to produce work of any required form within not very wide limits. The advance of the apparatus is made self-acting by means of a knife placed at a slight angle. A glance at Fig. 22 will best explain the action.

The two forms of rounding machines next illustrated are manufactured by Messrs. W. Furness & Co., of Liverpool.

Fig. 24 shows a machine for turning pins and rods of all diameters, from one-quarter inch to three inches, and of any length. The hollow mandrel is mounted in bearings on a headstock, which is bolted to a substantial cast-iron stand. The mandrel is driven by a belt from a countershaft. The right-hand end of the mandrel carries a cutter-head, which is also shown separately in the engraving. This cutter-head carries two cutters, one a gouge and one a chisel; the former reduces the wood roughly to form, and the latter, acting on the part already made circular, makes it quite true and smooth. The wood is shown entering on the right hand end, square as it leaves the saw mill, and issuing on the left a true cylinder. On the right is a stop flange or holder, which prevents the wood from turning round by the motion of the mandrel. The stop rests against one of the faces of the square wood.

The material is fed into this machine by hand, while a second person is employed in withdrawing the finished cylinders. A hand-fed machine cannot be worked to its full

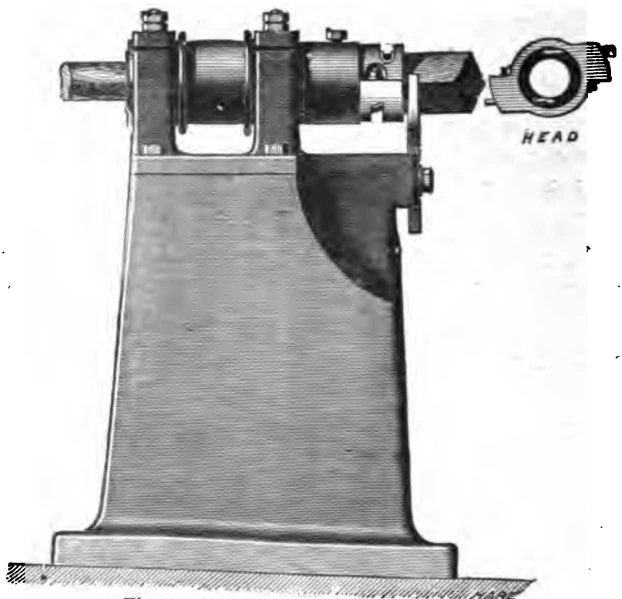


Fig. 24. SIMPLE ROUNDING MACHINE.

capacity, and is much less economical than an automatic machine. With self-acting motion the work is fed in at a speed of from ten to twenty feet per minute, the speed being regulated according to the size and hardness of the material. A hand-fed machine could not be supplied so fast. About one horse-power is necessary to drive the machine which has been described. A smaller machine, which will turn work from one-quarter inch to one-and-a-quarter inches in diameter, is made by the same firm. It is similar in all other respects, and only requires about half the before mentioned power to drive it.

Fig. 25 shows a rounding machine with automatic feed motion. It is similar in its general principles to Fig. 24.

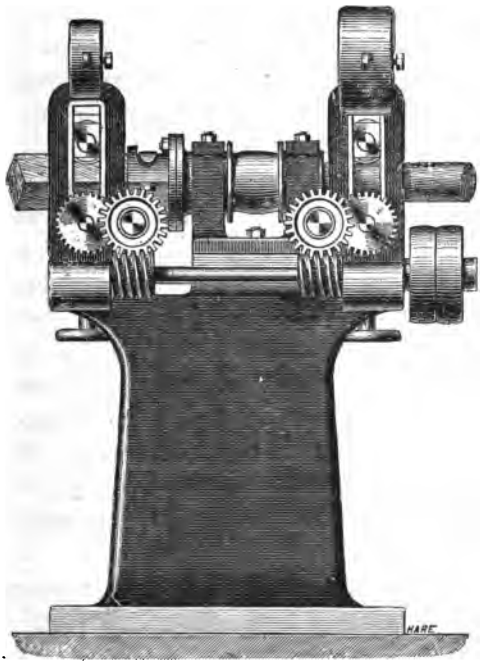


Fig. 25. AUTOMATIC ROUNDING MACHINE.

The square timber is fed in at the left-hand end between two rollers, which have V-shaped grooves. These rollers are made to grasp the wood by the pressure of the weight shown above. The lower wheel is revolved by means of the gear-wheels, shown driven by the tangent screw. A cutter-head comes next; this carries a chisel and a gouge, as previously described. By these tools the wood is shaped to a cylindrical form, and it then passes through the hollow mandrel to the rollers at the right-hand end. These rollers are covered with india-rubber, so that they do not indent or damage the smooth and finished cylinders. They are held in contact with the wood by the weight, shown above. The tangent screw turns the wheel which drives the lower roller. Thus both pairs of rollers are driven at the same speed from the screw-shaft, which carries at the right-hand end a fast and loose pulley for a driving-belt.

The hollow mandrel is mounted in bearings on a head-stock. The speed at which this should be driven is determined by the diameter of the work produced. For three-inch rods five to seven thousand revolutions per minute would be a fair rate, and the smaller the work the higher should be the speed. The lower rollers in the pairs are adjusted to a suitable height, according to the diameter of the work to be turned, by means of the hand-wheels, shown at both ends, below the bearings of the tangent screw shaft. The weights above bring the upper rollers in contact. The pressure is regulated by adjusting the weights along the lever arms to which they are fixed with set screws.

The necessity of driving revolving cutters at a high speed in wood-working machinery is now fully recognised. Not only does increased speed of the cutters allow the wood to be fed at a correspondingly faster rate, but increased velocity of the cutting edge produces a cleaner and better surface. It is only during recent times that wood-working machinery has been driven at the very high speeds named. Formerly it was considered to be impossible to manufacture bearings that would work satisfactorily under these high speeds. It has, however, now been ascertained that cutters will do more work of a better quality when driven at high velocities, and though the machines which carry them have to be constructed with extra caution, yet the consequent extra initial cost is inconsiderable when compared with the increased productive capacity.

Great attention must be paid to the correct balancing of cutter-heads which are driven at a high speed. Any deviation in the equipoise will impart a tremor, or spring, to the tool, and bad work will result. The bearings must be kept plentifully supplied with a suitable lubricant. A channel should be cut the whole length of the plummer-block bearing for the oil to flow in, and thus ensure a constant supply.

Spindles which have to be driven very fast should have their bearings as small in diameter as possible, consistent with the duty the spindle has to perform. The bearings are generally made very long in proportion to their diameters: twelve diameters long is perhaps a safe average. The greater the amount of bearing surface the longer it will wear. It is not superfluous to remind readers that to increase the length of a bearing does not increase the friction, and whether a spindle runs in bearings one inch or twelve inches long the same power will drive it, providing always that the diameters of the bearings are the same. An increase in the diameter will necessitate an increase in the power required to drive, and thus the necessity of keeping the diameters of bearings as small as possible is manifest.

The speed at which cylindrical work can be turned in a rounding machine of the construction illustrated may be judged by the figures given above. With cutter-heads running at over 5,000 revolutions per minute, the material may be turned at the rate of from thirty to forty feet length per minute. The enormous quantity of rod that can be turned out by a machine in constant work is surprising.

CHAPTER IV.

FITTING UP A LATHE.

AS distinguished from a metal-turning lathe, a wood-turning lathe usually has neither back gear nor slide-rest. It is termed a plain lathe, and consists of two headstocks, T rests, bed, standards, fly-wheel and treadle, the fly-wheel and treadle indicating that it is a foot-lathe, that is, driven by the foot of the operator.

A first-rate plain foot-lathe would have all the above parts made of iron and steel, with the exception of the treadle-board; but very many wood-turning lathes are mounted on a wooden bed and standards, and very many good wood-turners never use an iron-bed lathe. Plain lathes are made from two-and-a-quarter-inch up to seven-inch or eight-inch centres—meaning the height of the centre of the mandrel above the upper surface of the bed. The best plain lathe for all-round work is one about six-inch centres; it is not too large to drive by the foot, and while it does any work up to its capacity, it will also do small work equally well as a smaller lathe.

A lathe with wooden standards and bed is generally much cheaper than one all iron: indeed, a good plain lathe may be bought second-hand for a few pounds. By procuring two head-stocks, fly-wheel and crank-shaft, anyone handy with wood-working tools may make for himself the wooden parts.

In fitting up a lathe for ornamental as well as for plain turning a complication of parts is to be, so far as possible, avoided. Workmen should not be without proper tools, but in many instances elaborate and costly apparatus may be dispensed with and their purposes fulfilled by the use of simple tools. For example, a driving-wheel with V grooves, and an iron pulley with V grooves, for the mandrel, incurs an unnecessary expense, as, for light work, a driving-wheel with a flat rim and a wooden pulley on an iron mandrel will be found equally efficient. Again, where expense is a consideration, an iron bed may be dispensed with. A few hints on the fitting up of an inexpensive lathe may be useful.

The first thing to be considered is the lathe-bed. Either pine, teak, or mahogany may be used, according to the taste and means of the maker; teak is to be preferred on account of its stability. If required for wood-turning only, the space between the bearers should be two inches; if for metal-turning as well, it should be only one-and-a-half inches. The length of the bed should be about five feet and the depth six inches.

In purchasing the mandrel head-stock, select one that fits quite tight in the collar and tail-pin bearings, otherwise work cannot be properly turned. It may be here mentioned that a great evil in the manufacture of lathe-heads is that the holes for the tail-pin and the collar are not bored in truth with each other. In this case the collar fitting soon works loose, and the labour of driving the lathe is greatly increased.

Six-inch head-stocks will be found the most useful size for working both metal and wood, but the holding-down bolts should be long enough to allow of the head-stock being raised upon blocks for turning large articles. A further extension for turning large diameters may be arranged by cutting out pieces of the lathe bed, having first screwed a piece of iron on to the side of each bearer to strengthen the bed. A strip of veneer should be glued on the piece cut out to make it fit tight into its place. To refix the piece, procure a flat piece of iron, such as is used for making iron hoops and bands, cut off four lengths of about three inches more than the length of the opening, bore in each one say five holes, counter-sink them, and screw two pieces on to each piece cut out. Fit the pieces into their places and fix them there by means of a screw driven through the projecting ends of the iron strips into the bed of the lathe. When a large diameter is required to be turned, take out these end screws and remove the loose pieces of the bed. When neatness of appearance is studied, the iron strengthener and the four strips may be let into the wood so as to be flush with the surface.

The mandrel should, in all cases, be made of iron or steel, but a wooden pulley will be found to answer ordinary requirements. The pulley should have two speeds—about two-and-a-half and five-and-a-half inches diameter respectively.

For the driving-wheel, one about two feet eight inches in diameter and sixty to seventy pounds in weight will be found very useful. For wood-turning, flat rims to both driving-wheel and pulley will answer quite as well as the more expensive grooved rims. These so-called *flat* rims are turned slightly rounding; this prevents the band running off, no flanges will be required. The leather band should be three-quarters of an inch wide, secured by a buckle of the same width. Holes should be punched to suit the different speeds. The buckle need be no wider than the strap, if the latter be cut slightly narrower where the holes occur. When punching the holes, take care that the band shall fit sufficiently tight, as a loose band is a source of continual annoyance.

The crank should be countersunk at each end to receive the pointed centres. Do not have the crank itself pointed, as, in case of breakage, the driving-wheel would have to be taken off to have the crank re-pointed. The driving-wheel should be fixed by means of eight wedges. If the wheel becomes loose it can be tightened by means of the wedges. In doing this do not strike the wedges with a hammer, or the ends will be burred up, but hold a piece of iron against the wedges and strike the iron. The driving-wheel must run quite true upon the crank, otherwise it will shake and jar the work.

To connect the treadle and crank, a flat chain band attachment is the best. A small wheel should be made to rotate upon the treadle, with a groove round it to receive the chain, which is passed round the wheel and over the throw of the crank.

A mandrel suited to the peculiarities of wood-turning is shown by Fig. 26. It is drawn to scale, and the dimensions may be taken from the illustration. The nose, on the right-hand end, is cut to Whitworth's standard pitch, one inch in diameter. This gives a good stout screw, which will hold well in chucks made of wood. This quality is a most desirable one, and it should be rigorously insisted on. A small nose, or a fine thread, will speedily destroy the worm in wood chucks screwed on to it. A shoulder having sufficient bearing surface is also necessary; the chucks must have ample bearing against the shoulder, to ensure that they shall run true when replaced after removal. The large nose-thread and the wide shoulders, which have been mentioned as so necessary for wood-turners' lathes, cannot both be obtained with the usual conical front bearing to the mandrel.

In the drawing, Fig. 26, the front bearing is shown as a neck. Collars on the mandrel form this neck. The front collar forms the flange against which the chucks take their bearing. The back collar is the shoulder, which prevents end-play of the mandrel in working. The left hand end runs in a female centre, and this is screwed up to bring the back collar to a steady bearing against the brasses. By these means the end-play of the mandrel is confined. The front collar is not fitted to touch the brasses, though the neck should not be any longer than necessary to leave the collar just clear. This front collar, forming the flange against which the chucks screw, is only sufficiently wide to ensure adequate strength. The dimensions shown will suffice. The screw on the nose is kept short, a good rule being to make the length equal to the diameter.

Fig. 26.
MANDREL FOR WOOD-TURNING.

Every chuck, and all work mounted for turning without the back support, should be kept as close as possible to the mandrel bearings. It is easy to understand that by prolonging the mandrel, or the work, beyond its bearing, the liability to tremor is increased. This is readily proved by mounting a comparatively long piece of wood in a chuck and turning it with the end unsupported. The operation may be successful at that part near the mandrel, but as the turning tool is applied further from this support so will its action become less smooth and accurate, till, at a certain distance, only serrated cuttings, or "chatters," can be produced.

This simple result, which must have become apparent to every observant turner, should convince beyond question that all work, mounted without support from the poppit, should be fixed as near as possible to the mandrel bearings. So long as the mandrel nose contains enough threads to make a reliable hold for the chucks, the shorter it is the better. A length equal to the diameter is the rule adopted by the leading manufacturers of high-class lathes, and it is one that may be safely followed. The nose shown in the drawing has eight threads to the inch, which is the standard pitch for that diameter.

Steadiness is a characteristic of long mandrels, and as space is not specially restricted in wood-turners' lathes, it is advisable to have a mandrel about ten inches to twelve inches long. Iron that is good in quality answers every purpose for the body of the mandrel. The bearings must be of steel and properly hardened, to produce a good head-stock having lasting qualities. The collars and the neck part, if of steel, are welded on to the iron. The point at the rear end is a plug of steel, driven into a hole bored up the centre of the iron.

Pulleys are usually driven by straps from overhead shafting, set in motion by steam power. A single pulley, made of wood, driven on to the rough iron, often suffices. When a fast and loose pulley are put on the mandrel, some further work is involved. A single pulley is, however, better; also the stopping and starting can be better effected by means of some of the overhead gearing.

Before leaving the mandrel, Fig. 26, it may be mentioned that though the illustration is intended to convey an idea of a most useful pattern for mandrels, yet the many modified forms that are made have frequently special points in their favour.

A square hole is often made in the centre of the nose-screw, so that any of the various bits and boring tools made to fit the ordinary carpenter's brace may be used in the lathe. This is very convenient, and, when the diameter of the nose is sufficient to allow a hole of the standard size without injuriously depreciating the strength of the mandrel, this plan should be adopted. The hole should be central and tapering, to correspond with the shanks of the tools for which it is intended. A taper drift is used to form the hole, and this is best done before the thread is cut on the nose. Such a hole affords a very convenient means of chucking many small objects which may be shaped to fit. It is available for short lengths to be turned unsupported, but is more particularly useful in turning long, slender rods, the diameter of which does not greatly exceed that of the square hole measured diagonally.

All kinds of square rods are mounted for turning in an analogous manner. A block of wood is fitted on the lathe nose to form a chuck; a round hole is bored into it centrally, and this is afterwards squared with chisels, or other tools. This chuck serves to carry all square wood which will fit it, and which is mounted to run on the back centre-point. The hole may be about equal in depth and breadth; that is to say, a hole one inch square should be about one inch deep. The chuck last described is the one generally used when turning balusters, newels, and all other kinds of turnery, the wood for which is mounted on the lathe square as delivered from the saw-mills.

The accompanying drawing shows a lathe which has done long and good service. In Fig. 27, the two head-stocks, A and B, are mounted upon a wooden bed, C, of good red pine; it is made of two pieces four-and-a-half feet long, six inches deep and two inches thick. The two standards, D D, are six inches broad and two-and-a-half inches thick, they support the bed at a height from the floor of thirty-eight inches, they are cut away on both edges at the top, giving a rest for the bed, which has a space, or opening, exactly the width of the projecting parts on the soles of the head-stocks. The two parts of the bed are bolted to the standards, the bolts passing through the whole.

The secondary standards, E, are two-and-a-half inches square, as also the bottom pieces, which receive the standards by mortising, and serve to fix the whole to the floor. Two short rails are mortised to the top of the secondary standards to support a tool shelf, which is some fifteen inches broad.

In Fig. 27 will be seen a short standard supporting the end of the crank-shaft. This is only necessary when the shaft will not reach to the main standard.

The crank-shaft in this case is three feet six inches long, and is double-throw—that is, has two cranks, with rods suspending the treadle. The only benefit of the double crank is, it admits of a long, steady foot-board, so that the operator may travel along it with his foot in turning a lengthy piece of work.

Referring to the two head-stocks. That on the left, A carries the mandrel which rotates the work to be turned; two wooden pulleys, one three inches and one five inches in diameter, are fixed on it. The nose is screwed to receive various chucks, and it has a square hole to receive a square shank prong-chuck, or driver, sometimes called a swallow-tail, commonly used for turning wood between centres.

The head-stock, B, is made to slide along the bed, and to fix down at any desired part of it by the holding down bolt, a similar bolt fixes the T rest-socket in the same manner. The nuts of these bolts have bent lever handles, as shown. This headstock, B, is bored to receive a sliding cylinder carrying the cone-centre, and is actuated by a screw attached to the hand-wheel on the right-hand end.

The lathe under consideration has a driving or fly-wheel, with two speeds, as will be seen from Fig. 27. Two wheels are keyed to the shaft, their combined weight being over seventy pounds. A five-inch lathe should have its fly-wheel about seventy pounds weight, and, if a single wheel only, not less than thirty inches diameter. The two wheels in Fig. 27

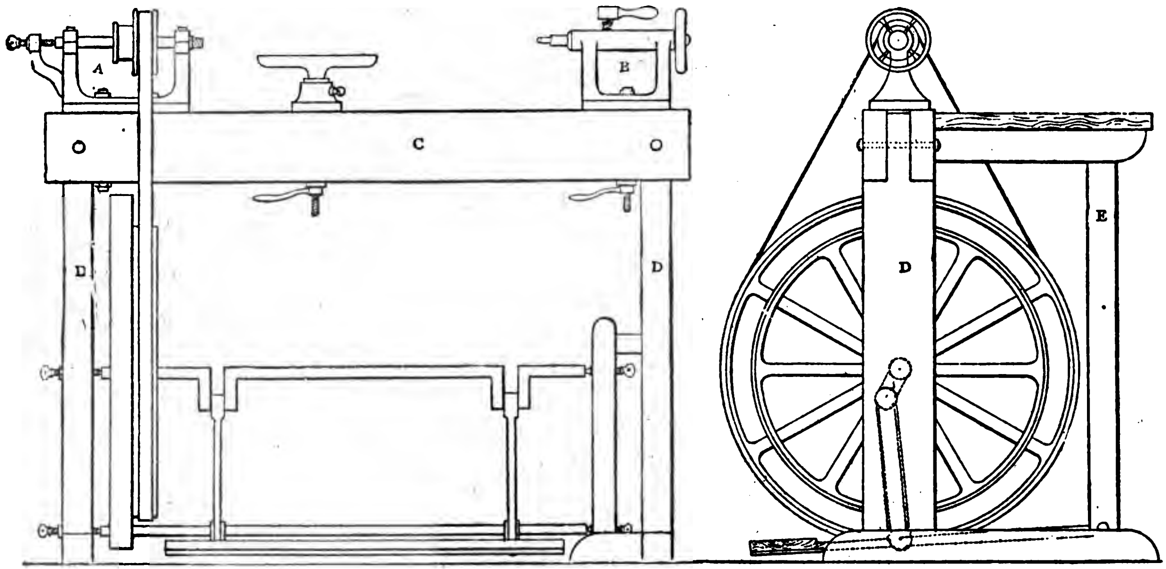


Fig. 27. A Home-made Lathe.

are thirty inches and twenty-five inches diameter, the belt used is one inch broad.

For turning work of small diameter, use the quick speed, having the belt on the thirty-inch fly-wheel and three-inch pulley. For discs or flanges of from twelve inches to six inches diameter, use the small fly-wheel and large pulley. In this case the mandrel is going at a slower speed, but the power is greatly increased.

This acquisition of power is a very great advantage even in a wood-turning lathe, from the fact that large discs, of say fifteen inches or eighteen inches, offer a greatly increased resistance to the motion of the lathe, as the further the cutting tool is removed from the centre, the greater is the leverage against the driving power. The disc, though running at a reduced number of revolutions, is really running at a very high speed towards its periphery; for example, a fifteen-inch disc travels some forty-five inches at its outer edge for every revolution, while the part of the same disc one inch from the centre only travels some six inches in the same time; that is, the outer edge of a fifteen-inch disc is running nearly eight times faster than that part an inch from the centre.

In a properly fitted up lathe, the cone point in the head-stock, B, should be exactly in line with the central point of the prong-chuck in the mandrel. This is called the line of centres, and is an imaginary line passing through the centre of the mandrel, and also through the centre of the poppet-barrel in head-stock, B. The two heads should be so placed that this line would pass exactly through their centres.

The socket that carries the T rests is made to slide, so that it may be readily adjusted to the work. The T has a shank to fit the socket; it may be turned angularly, raised or lowered as wanted, and is held firmly by a set screw. Two Ts, one six inches and one ten inches long, are about sufficient for ordinary purposes. For long jobs, such as pillars, mangle-rollers, broom-handles, &c., a long **T** is used; it has two shanks to fit into two sockets, thus enabling the turner to do a long length of work without shifting his **T**.

CHAPTER V.

CHUCKS.

THE appliances used for attaching the work to be turned to the lathe-mandrel are called chucks. They usually screw on to the mandrel nose, but sometimes this has an internal thread, and there are other means of attachment. Chucks are used in wood turning according to the kind of work to be performed, but the hollow chuck, the cone screw chuck, and the prong, or strut chuck, are almost indispensable to all turners. By the aid of these three chucks the bulk of ordinary turning is performed. They should be made of metal, this being greatly superior to wood, while the difference in cost is comparatively slight. Many turners use chucks of beech or box. It is the best plan to have the three chucks above mentioned made of cast-iron, and then prepare pieces of beech to fit the hollow and the screw chucks. If metal chucks are not used, boxwood should be used and not beech. It may be here mentioned that for iron chucks a male mandrel-thread is best, but for wood chucks a female mandrel is often preferable.

The prong chuck, Fig. 29, is used for every kind of wood turning, when the work is supported by the back centre. The most simple chuck of this description is made by driving a prong into a wood chuck. The prongs are sold at tool-shops ready forged to shape.

The ends usually terminate in a plain knife edge, which is diametrically across the prong. This form is wrong in principle, and generally unsatisfactory in use. The wedge-like edge, when forced into the end grain of the wood, tends to split it, and this usually results when the prong is applied incautiously. The illustration, Fig. 28, shows the prong made as it should be. A metal chuck is first prepared, and the steel prong, only roughly shaped, is driven into it. The central pip is turned up true on the lathe; it it shaped conically, as shown. Two opposite sides of the prong are then made flat by filing; they taper from about half an inch wide at the back to about three-sixteenths or one-eighth of an inch on the front edge. The two edges are bevelled from the back only, so as to resemble a

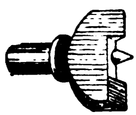


Fig. 28. PRONG.

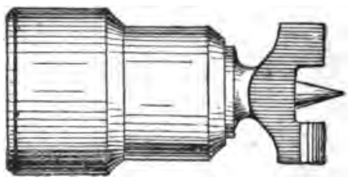


Fig. 29. PRONG CHUCK.

carpenter's chisel. Prongs of this shape hold the work more firmly, and are not so liable to split it as those having a straight wedged-shaped edge. Each prong holds at an independent place, and any tendency to split is distributed at two quite distinct points. The central pip is intended to keep the work central, and the prongs are to carry it round. It is necessary that the pip should run true, so that the work may be replaced true if removed from the lathe.

In use, the prong chuck is first imbedded in the work only so far as the pip extends beyond the edges of the prongs. The back centre is brought up to support the opposite end; the lathe is set in motion, and the work set true. The work is then driven on to the prong chuck by means of a mallet, sufficiently to firmly imbed the prongs, and the turning may then be proceeded with. All kinds of wood-turning done between centres are most frequently driven with the prong-chuck, and it is only in special cases that other chucks are used. When large numbers of square pieces are to be operated upon, a square-hole chuck, such as has been described, is better, because it saves time in chucking the work.

The next chuck illustrated is the conical screw-chuck, Fig. 30. This chuck is used for turning all kinds of wood plankways of the grain, when a central hole is allowable. The back centre is not used as a support for work mounted on this kind of chuck.

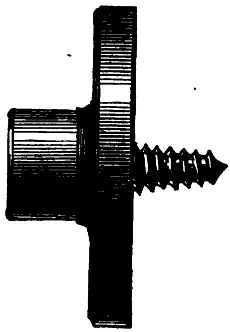


Fig. 30. Conical Screw Chuck.

The body is made usually of cast iron, but sometimes of brass, gun-metal, &c. It may be from two to four inches in diameter for a five-inch lathe. The front face must be turned quite flat and true. The conical-screw is of steel. The thread should be coarse and thin, similar to the thread of an ordinary wood-screw but conical. A special screw tool is necessary for cutting conical threads, in order to make them upright. If cut with the ordinary form of chaser, the thread would lean forward very much, and would have but comparatively slight hold on the wood into which it was screwed. The steel cone may be fixed into the casting by driving in from the back, or a fine thread will hold it very well, but it must be screwed very tight, and sometimes has to be riveted at the back to prevent the screw being removed when unchucking work.

Fig. 31 shows the form of comb-screw tool suited for cutting the thread of a taper-screw so that the thread is itself upright. The teeth are cut in a slanting direction, and those cutting the small part of the cone have their points ground off.

Different sizes are employed, according to the dimensions of the work to be turned; two or three are sufficient for most purposes. To mount work on this chuck a hole is bored centrally, and of a size and shape suited to the dimensions of the cone-screw. A conical, half-round bit, such as is commonly used in the carpenter's brace, is a useful tool for this purpose. The wood is screwed on to the cone screw direct, the chief consideration being to get it flat against the face of the chuck. When this is secured, the work may be taken off and replaced tolerably true. Discs of wood, which would be spoiled by having a hole in them, are frequently mounted on the cone-screw chuck by being first glued or cemented on to another piece of wood, which is bored and screwed on to the chuck. If the surface of a piece of wood fitting the chuck is turned true, and the work to be turned has one of its surfaces planed flat, the two may be fixed together by glueing, and when finished the separation is easily managed with care. It is, perhaps, the best plan to make the joint with a piece of paper glued on both sides. This allows easy separation.

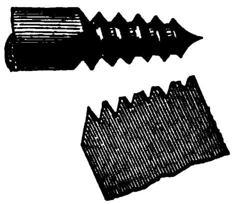


Fig. 31. SCREW TOOL FOR CUTTING THREAD ON CONE.

Work of large dimensions is sometimes further secured on the cone-screw chuck by putting wood screws through the flange into the work, holes being bored through the flange to receive such screws. An ordinary wood screw is sometimes used for the central screw, but it is not nearly so strong as the steel screw, illustrated. For some purposes, when the central screw is objectionable, a disc of wood may be held on a flange by three or four wood screws, the central screw being dispensed with.

The two chucks illustrated afford the means of dealing with wood in the form of both rods and discs, and they are those in most general request by the wood-turner.

The next illustration, Fig. 32, shows a spring-chuck which is employed to clamp small pieces of wood. This chuck is practically self-centring, and is the kind used by pipe-makers and others; it is suitable for chucking tobacco pipes, &c. The drawing shows a chuck with six grooves, but the number is immaterial. Some workmen use those with only one saw-cut, dividing the chuck into two parts, giving only two jaws. This is undesirable, as the work so chucked is not held firmly. Three jaws would act very well, but it is difficult to cut only three saw kerfs, and for that reason six is the number more generally made. Good sound boxwood is the best material from which to make such chucks, and at the termination of each saw-cut a hole should be drilled. This not only lessens the liability to split, but also, by decreasing the amount of material near the butt end, makes the chuck more flexible at that point—a desirable quality.

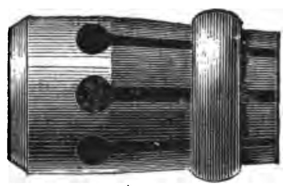


Fig. 32. BARREL CHUCK.

In order to ensure the jaws bending near to the butt end, the interior of the chuck should be hollowed out where the holes are bored. This method of reducing the substance of the wood is a better one than that of drilling large holes, because it reduces the strength in the right direction, and does not make the chuck weak, as is the case with large holes.

The outside of this chuck is turned slightly conical, so that the metal ring, shown in Fig. 32, when forced on it closes the points of the jaws, thereby gripping any work that may be placed within them. The range of motion in the jaws of this form of chuck is not very great, and hence it becomes neces sary to have several spring chucks in accordance with the various sizes of work to be executed. In order to prevent the wood from splitting, an iron ring is often put around it at the butt end.

It is important to see that the ring which binds the staves together runs true, as, if otherwise, the jaws are brought together unequally, and the work chucked in them will be eccentric. The inside of the ring should be rounded, so that its edge will not catch and cut into the surface of the chuck.

To use this chuck, the ring is first pressed on to the jaws moderately tight, so that it holds them firmly. A recess is then turned in the end very slightly smaller than the diameter of the object to be chucked; the ring is then pushed towards the front end, thereby allowing the jaws to open. The work is put into the previously turned recess, and there securely fixed by pushing the ring back till the jaws clip it firmly. The ring is often driven on by slight blows at various points of its circumference, always remembering to get it to run quite true.

This chuck is used principally for work which has already been turned true at some part, by which it may be conveniently chucked. When a large quantity of objects are to be turned, the dimensions of which are approximately the same, this chuck is the most useful in place of a solid wood chuck, in which it would be impossible to fix any but those of exactly one size. As an example, a set of men for draught playing would be chucked with the greatest ease in a spring-chuck, of the pattern illustrated, for the purpose of ornamenting one of their sides. Some objects with a projecting piece are most easily turned in this chuck. The bowl of an ordinary briar-root tobacco-pipe may be chucked for boring by merely cutting away a space to allow the stem to be free of the jaws.

In the next figure is illustrated a chuck specially designed for turning discs having central holes; or it may be used for mounting any work which has a true hole in its centre, the diameter of which is sufficient to allow the screw shown in Fig. 33 to pass. Numerous central screws of different lengths and diameters to suit various objects may be fitted to such a chuck as this. Plain steel spindles, with a thread at the extremity only, are stronger than those with a thread cut all their length; but they do not afford so great a range.

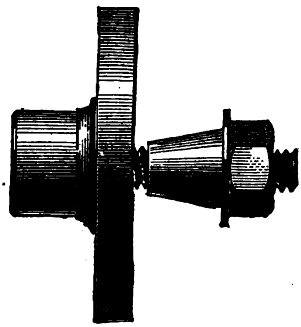


Fig. 33. CHUCK FOR TURNING DISCS.

The body-part of Fig. 33 is the same as the cone screw-chuck, Fig. 30. It must be faced up true to afford a bearing for any discs mounted on it; and in the centre it has a hole to receive the screw shown projecting with a cone and nut on it. This screw is an ordinary bolt-thread cut on steel, and must be quite straight. The length will be governed by the work it has to do; those from two to six inches are commonly employed. The diameter is restricted by the size of the hole in the work; otherwise it is well to have it large enough to be quite stiff under the heaviest cut to which it is likely to be subjected. The cone shown is bored to fit without shake on the thread, and must be turned quite true, as it is by its outside that the work is centred. Hard wood is frequently sufficiently durable for cones, used only for light wood work; but metal is better, and when the chuck is used for metal work, metal cones are necessary, and they are often made of steel. Any number of cones may be made to fit on one screw, and several are required to suit holes of different sizes.

An ordinary hexagon nut is used to force the cone up to its work, a plain washer being interposed between it and the outer edge of the cone. It will be understood that the disc mounted on this chuck is kept flat by the face of the flange, which also bears against the work with sufficient friction to carry it round with it, and will hold firm against any moderate cut.

The centrality of the disc is maintained by the cone, which bears against the inner edge of the hole in the work, and is kept there by the hexagon screw-nut. The cone itself penetrates the work till its diameter is greater than that of the hole; it then wedges the disc against the flange. This wedging force is liable to split wood which is not very tenacious, though it is not in any way detrimental to metal; and some hard woods will stand well under the pressure.

To secure wood that would be split by forcing the cone in far enough to wedge sufficiently tight for turning, another piece is fitted to this chuck. This may be thus described. The screw must be considerably longer for using this piece, which consists of a cup-like casting, the hollow of which is sufficiently large to contain the hexagon nut and projecting portion of the cone. The bottom of the cup is bored to accurately fit the screw, and the edge is turned flat and true; another nut has to be provided similar to the one shown, its purpose being to force the cup against the work on the chuck. To use this extra piece, the disc is first mounted in the manner already described, with the cone screwed up just sufficiently tight to keep the work central. The cup is put on next with its edge resting against the disc. A nut being screwed on behind the cup causes its edge to grip the work and wedge it against the face of the flange. By this arrangement a disc may be secured quite tightly, without in the least tending to split it. The broad surface of the flange will not indent any but very soft material, and even this can be protected with a disc of cardboard. The edge of the cup may also bear on the work through an interposed piece of wood, so that it will not mark finished work.

Fig. 34 shows a modified form of the chuck illustrated by Fig. 30. The conical screw is replaced by an ordinary wood screw, and a couple of other wood screws near the edge of the disc further secure the work.

Fig. 34. Modified Conical Screw-Chuck.

A fully-equipped lathe has a lot of accessories, but a wood-turner doing only plain work may get along comfortably with very few of these. A six inch and a nine inch face-plate, and one or two cup-chucks in addition to those already illustrated, are about sufficient. The face-plates are made to screw on to the nose of the mandrel. The six-inch face-plate should have a conical screw in the centre, with a coarse deep thread about five-eighths of an inch long; the plate has also a number of holes to admit screws to fix the work from the back; but discs up to the size of the plate, and even larger, do not need these screws, the central one being sufficient.

The nine-inch face-plate should have a very small, sharp conical stud in its centre and be truly central; the work is centred on this stud, and fixed with screws through the plate. This face-plate comes in frequently in pattern-making.

Two cup-chucks are necessary, one about two inches, the other about four inches diameter, and from one-and-a-half inch to two inches deep. They are used to hold pieces of wood that have to be manipulated on the end projecting from the chuck, and that could not be held on a face-plate. The smaller cup-chuck is often used as a drill-chuck. The turner fits a number of pieces of hard wood to this chuck: in the centre of each he drives a drill or boring bit firmly; all bits are thus provided with wooden blocks, and these all fit the cup-chuck. The turner selects the bit or drill he wants, inserts its block in the cup-chuck, gives the block a few taps with a hammer while the lathe is running, and the bit is immediately set true.

A few taps on the side of the block, which projects about an inch out of the cup, release it from the cup; or the lathe is run backwards, thus allowing the cup to screw off the nose; and the block with its bit are driven out with a round pin of wood through the screw-hole at the back.

CHAPTER VI.

TURNING THE CYLINDER, AND BALL FEET.

NOW for the operation of turning. Beginning with the very simplest work, a plain cylinder such as is shown at Fig. 35; say nine inches long and two inches diameter, for which a piece of pine-wood ten inches by two-and-a-quarter inches by two-and-a-quarter-inches, will be required. First

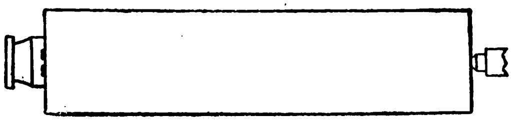


Fig. 35. PLAIN CYLINDER MOUNTED FOR TURNING.

it is centred; this may be done with a joiner's marking-gauge. The gauge is set by guess to reach to about the centre of the end of the block. The wood is now gauged from all four sides, on both ends; the scratches will, if exactly in the centre, form a cross, or they may show a very small square, in the middle of which an indentation is made showing the centre. In the absence of the gauge, and more frequently, the turner finds his centres with a pair of compasses.

The square block now centred, the corners are generally taken off with an axe or a draw-knife and one end of it is pressed against the central point of the prong-chuck; the other end is then struck with a hammer to make the prongs enter the wood. The poppet-head is now pushed along the lathe-bed till its centre enters the right-hand end of the wood, an inch or so of the sliding cylinder protruding from the barrel. The poppet is then firmly fixed, and the centre brought forward by turning the hand-wheel till it takes a good hold in the wood, and the clamp-screw, on the top or side of the head, is used to fix the sliding cylinder. A drop of oil is now applied to the centre, where it enters the wood, the working parts of the lathe being properly lubricated, and you are ready for work. In ordinary lathes, when the fly-wheel is not counter-balanced, the cranks are always hanging downwards, the treadle being at the bottom of its stroke. The lathe is usually started by catching the belt with the left hand, close up to the pulley, and giving it a pull downwards; when the cranks come over the top centre the foot is applied to the treadle, and the machine started at a good speed.

The hand rest is placed with the T inserted and pushed forward till the T will just clear the wood: there it is fixed to the bed; then the T is raised to about a quarter of an inch above the centre, and fixed firmly in the socket by the set-screw. A three-quarter-inch gouge may be used to rough down this work. Beginning at the right hand, the gouge is held with its round side on the rest, and pointing upwards, so that its chamfer forms a tangent with the surface of the revolving wood. The right hand grasps the end of the handle, while the left hand grasps the tool close to the rest, the thumb against the left edge, and the fingers passing over the upper side of the gouge. In roughing down, the turner begins by tilting the gouge over on its edge somewhat, the point being directed slightly to the right; he begins by making a series of cuts near the right end of the stuff, shifting the gouge for every fresh cut about a quarter of an inch, and working towards the left till he comes near the end of his T. These cuts are made in rapid succession, the cylinder presenting a series of grooves; without pausing, he works back again, this time sliding the gouge along and making a continuous cut the while, when the surface, though still grooved, is much smoother. The sides of the square wood will now have disappeared, or nearly so. A calliper is now set to fully two inches; the gouge reduces the cylinder at both ends to this size, and then with a sliding cut, removes all the intermediate wood—measuring with the eye to the diameter of the ends.

Assuming the cylinder to be one-sixteenth of an inch more than finishing size, a chisel about an inch broad is used. A beginner is safer to commence in the middle and work to both ends, right and left. In working to the left, place the chisel obliquely with its corner on the rest, the chamfer resting on the surface of the cylinder, so that only the centre of the edge will cut. The two corners, especially the upper acute one, must always be well clear of the work; for if it only gets a hold, it will make a frightful dig, and ruin the work.

The tool properly held, as described, is slidden along the rest, great care being necessary in keeping the handle always at the same elevation, so that a uniform shaving may be taken off all along. In working from the centre to the right, simply reverse the position of the chisel.

The callipers are now set to the finishing size, and the work reduced all along by careful shaving till it is considered to be parallel. Having worked the cylinder to a uniform diameter by callipering, it may be further tested by applying a straight-edge: the hand passed along the cylinder when revolving will detect very minute inequalities. The ends of the cylinder have now to be turned true. To get the exact length, a pair of compasses are set, their points brought against the work by resting the legs on the T, a very light mark is made while the work is revolving, marking off an equal portion at each end to be cut away. The ends are now cut in at the marks with a half-inch or five-eighth-inch chisel resting on edge with the acute corner down, and held slightly elevated at the point, raising the handle as the cut gets deeper. A three-eighth-inch or half-inch gouge is now used to cut away the ends to near the centre. In this operation the gouge is rested on one edge and has its back, or round side, towards the end of the cylinder, the extreme end doing the cutting. In this way the ends can be cut in very nearly square, that is, at right angles with the axis, leaving only a thin shaving to be taken off by the chisel. This last cut is the most difficult of the whole operation; and success depends entirely upon the way the chisel is held; as before stated, the acute corner is under. The danger is in its first contact with the surface of the cylinder. The chamfer side of the chisel next the body of the cylinder must be held exactly at right angles with the axis of the work, and with the top corner slightly inclined away from the work, for if allowed to touch it, the result is an ugly spiral, cut two or three inches along the finished surface of the cylinder, which effectually spoils the whole thing. To cut in these ends properly the chisel must be well ground, and very sharp.

Tool handles may be bought very cheaply; but they are excellent things for a beginner to practise on, and even the expert wood turner may find himself so placed that he can more readily produce them; moreover, he may have a fancy to turn his own handles, or to produce some for a neighbour who may not be the happy possessor of a lathe.

A medium-sized handle requires a piece of wood five inches long and one-and-half inch thick. Beech, elm, or hickory make very good handles. Ash is best as it does not blister the hands. The wood must be well seasoned or the ferrules will drop off.

Assuming the piece of wood to be square in section, it is first gauged on both ends to find the centres, as described in this chapter. These centres found, a mark is made on each end at the centre. The corners are now taken off with a small axe or a draw-knife, after which the wood is mounted in the lathe. It is then roughed down with a five-eighth-inch or three-quarter inch-gouge, till the flats disappear. A bradawl handle is shod with about half an inch of brass ferrule. These ferrules are made from brass tube, for some handles five-eighth-inch, and for smaller half-inch diameter. Take a piece of brass tube, say three inches long—this will make half a dozen—mount a piece of wood in the lathe, say four inches long, turn it down till the tube will fit on tight, mount again in the lathe, and cut the tube into lengths of from three-eighth-inch to half-inch, with a narrow parting-tool. When they are all cut

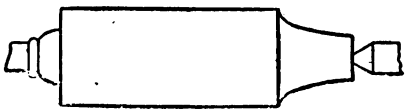


Fig. 36. Tool-Handle Roughed Out.

through to the wood-core, it may be driven out, then the burr must be scraped out of each ferrule.

Now to fit a ferrule to the cylinder of wood from which you purpose making your handle. Gauge the interior diameter of the ferrule with callipers; the double-ended male and female callipers are the proper tools for this. In their absence the ordinary callipers may be used. The expert never uses callipers for this kind of work; he simply places the ferrule on the projecting centre of his lathe, then mounts the wood; he roughs down the bit of wood, as already directed, then he reduces the right-hand end to a little over the outer diameter of the ferrule, as shown in Fig. 36. Then with a chisel he gauges off (with his eye) a little more than the length of the ferrule, cutting in a square shoulder, and reducing this part to fit the ferrule, see Figs. 36 and 37. He tries the fit by merely moving the ferrule forward from the cone centre on to the wood, and if too tight he reduces a little, but in almost every case it fits at the first trial; so accurate is the eye made by lengthened practice. The ferrule should be driven on pretty tightly home to the shoulder. To drive it home a second ferrule may be placed over the first and struck with a mallet, the second ferrule being necessary from the fact of the wood protruding about one eighth of an inch through the first. This over wood is finally cut away close to the edge of the brass.

The hole to receive the tang of the tool is bored, when the wood is revolving in the lathe, by means of a half round carpenter's bit, or better still, with a piece of a nose-bit fitted into a socket which fits in the back centre.

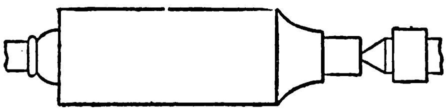


Fig. 37. TOOL-HANDLE WITH FERRULE FITTED.

Having got the ferrule on the wood, re-mount in the lathe and begin the operation of shaping the handle to the desired form. Here the eye must in a great measure be the guide. A well-shaped handle to copy from is best for a beginner, until the eye gets accustomed to forms and dimensions. Use callipers freely on the pattern and you will succeed in making your handle very near to match it. A practised turner will throw off perhaps two dozen of these handles in an hour, all formed and proportioned alike, with no gauge or calliper but his eye and hand. The beginner, however, need not be discouraged if he takes an hour to his first one, and finds it in the end not quite like the pattern.

In Fig. 38 we have the finished handle with the turning centres still attached. At *a*, it is the full size of the wood, namely, one-and-a-half inch. From the point *a* the wood is worked down right and left with five-eighth-inch or three-quarter-inch gouge. The projecting part at *b* shows two fillets and a bead between. The bead is one-eighth-inch, and the fillets each one-sixteenth-inch broad. On either side of the fillets the wood is reduced by a curve, that on the right sweeping down to exactly the outer diameter of the ferrule, and making with it an unbroken surface. The curve on the left sweeps away from the fillet to *c*, where the handle is of the same diameter as the ferrule. From *c* the curve swells towards the left to *a*, the part from *b* to *a* thus forming an ogee, and from *a* to left-end the form is semi-oval or semi-elliptic. The whole operation described is performed

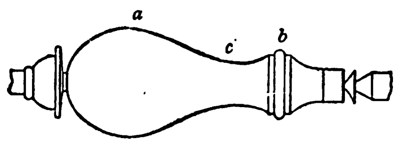


Fig. 38. BRADAWL HANDLE COMPLETE.

to nearly a finish with the gouge alone ; then the chisel cuts a shaving right and left from *a*, the cut to the left leaving about a quarter-inch uncut. To the right the cut stops at *c*, the chisel is then reversed, and cutting from the fillet finishes at *c*, always using the obtuse corner of the chisel. The two fillets and bead are also finished with a three-eighth-inch, or half-inch chisel, beginning at the crown of the bead and working down to the fillet on either side. The fillets are finished by placing the chisel flat side on the rest, and cutting sideways into the bead with the obtuse corner.

All this done, the handle is now glass-papered. The paper is held with the fingers, two grades being used. Care must be taken in papering the fillets and bead not to blunt them. Take a short piece of wood planed at right angles on the edges, wrap it in fine grade glass-paper, and hold it square on the fillets, turning it over on the bead—this will leave the fillets clean and sharp. When thus papered, take a handful of the turnings and allow the work to revolve through them; this gives a finishing gloss to the work. A dressing of linseed oil and yellow ochre, with alkanet root to give it a red tinge, should be smeared on and allowed to dry for a day or so before finally finishing off. The handle may now be cut off. First of all cut neatly in close to the end of the ferrule, nearly through—then cut in at the opposite end till it drops off.

When making a large number of such handles, it would be better to lay them aside with the turning centres still on till all are turned, then remount, and while running give a coating of raw linseed oil by means of a rag; wipe off the oil with clean rag, then, with a polishing rubber dipped in French polish and a drop of oil, coat the work while running slowly, moving the rubber lightly along the work, thus giving the rubber two motions, which will prevent sticking. Go over all your handles in this way, laying them aside for an hour or two. Again remount, and paper with finest flour-paper, and with a flat brush or a bit of fine sponge give a coat of spirit varnish. The previously applied polish will prevent the varnish sinking in; and handles thus treated will be found to have a good lasting finish, easily and quickly applied while the work is running in the lathe. The ends may now be cut in as previously described, but not until the varnish is quite dry.

All sorts of chisel, file, and other handles having ferrules, are manufactured in the way described above in the operation of fitting the ferrules. Chisel handles are of various forms, some of them being neither pretty to look at, nor pleasing to the grip. A very good form of cabinet-maker's chisel or gouge handle is shown in Fig. 39. It looks neat, and fits the grip exactly.

File handles are generally of the form shown in Fig. 40. They should be made of willow, or white home-grown birch is better.

Handles for bow-saws have the form shown in Fig. 41

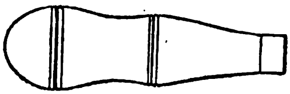


Fig. 39. CHISEL HANDLE.

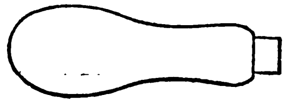


Fig. 40. FILE HANDLE.

They have a very short ferrule or plate attached to a spindle; the handle is bored right through to admit the spindle, which is firmly riveted on the outer end, the opposite end of the spindle being slit to receive the saw.

Handles for all sorts of small tools are made after the

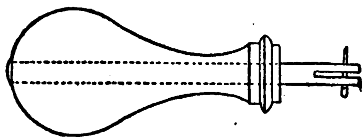


Fig. 41. BOW-SAW HANDLE.

pattern of Fig. 42. Handles for screwdrivers have much the form of those for bradawls. The ferrule is generally much thicker in the metal than ordinary ferrules, and after being

Fig. 42. SMALL TOOL HANDLE.

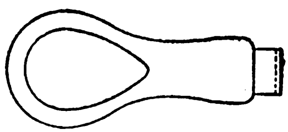


Fig. 43. SCREWDRIVER HANDLE.

fixed on the wood, is slit up about one-eighth of an inch to receive the blade. The blade, where it leaves the handle, should be of the same breadth as the diameter of the ferrule. The sides of the handle are planed off in the plane of the blade. This is to give the hand a better leverage in turning it while using (*see* Fig. 43). It also hinders the tool rolling about when laid down. Handles for choppers and very many knives such as curriers' and shoemakers', are made straight and reduced only at the ferrule, as in Fig. 44.

Fig. 44. STRAIGHT HANDLE.

Oval handles, as those of elliptical sections are called, are turned with the aid of a special head-stock or chuck; the largest end is placed in the chuck and the ferrule end supported by the back-centre. This gives a form merging from round at one end to elliptical at the other.

A pair of head-stocks that can be fixed on a bed at any required distance apart are shown at Fig. 36. With these a parallel piece of elliptical section can be turned, as both or either head can be set to any required amount of ellipticity.

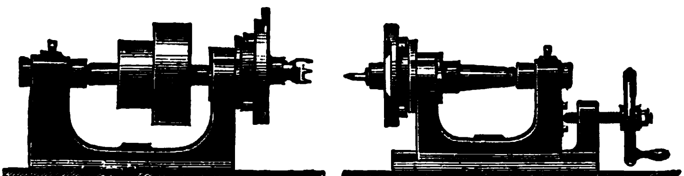


Fig. 45. HEAD-STOCKS FOR TURNING OVAL HANDLES.

The head on the left really acts as a poppet head, but the mandrel in it is revolved by the work, which is driven by the mandrel on the left in the usual way. With these head-stocks oval handles can be turned at the rate of one a minute.

Before concluding this chapter three different specimens of very simple-turned objects are shown. Fig. 46 shows several ball-feet, such as are used on numerous articles, as dressing-glasses, foot-stools, fern-cases, bird-cages, &c. A is the simplest of all ball-feet, and is found upon small boxes, caddies, and the like. It may be from an inch in diameter for a caddie, to two-and-a-half-inch to three inches for a dressing-glass. It is cut from the wood plankways with a bow-saw, a hole is bored in the centre, and it is fixed on a screw-chuck (*see* Fig. 30) for turning in the lathe. The wood-turner often makes his screw-chuck a very simple affair—using a small block of wood fixed to the ordinary face-plate, and turned up true. In the centre a common wood screw is inserted (*see* Fig. 34), having about half-an-inch of its point projecting. If this is properly done, the screw will run true. The face of the chuck may be reduced to about an inch diameter; on this the circular pieces for ball-feet are fixed; and as it is only

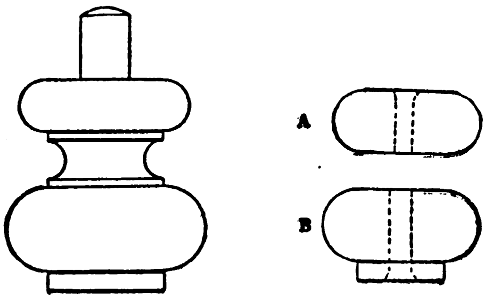


Fig. 46. BALL-FEET.

the edge that is turned, you get readily round it on the narrow-faced chuck. In turning ball-feet, the tools must be very sharp, as the wood running plankways presents, when rotating, two sides of side-wood and two of end-wood to every revolution. The rest is raised somewhat above the centre, and the chisel lies flat on the rest, with the handle somewhat lowered. With a blunt tool the wood, particularly on two sides, is only torn up, and will never paper smooth.

These ball-feet are fixed on to their destined places with screws passing through them. B is a ball-foot, with a fillet on the underside. This is an improvement when a somewhat high ball is wanted. C is another foot which is much used for chests of drawers, chests, and boxes. It is composed of a torus, an astragal, a hollow, and three fillets. It is hardly ever less than four inches or five inches diameter, and about the same height. It has a tenon for fixing by, and, unlike the ball-feet, its grain runs lengthways; consequently it is turned between centres. The tenon is usually an inch or more in diameter. To gauge the tenon, a centre-bit is selected, a hole bored with it in a bit of wood, the hole is callipered, and the

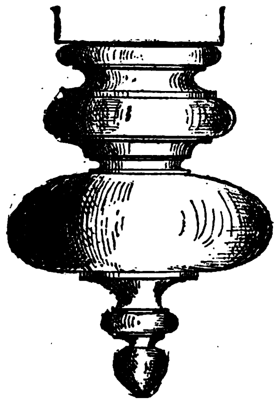


Fig. 47. FINIAL.

callipers used to gauge all the tenons of one diameter, so as they will make a good fit when glued in.

Fig. 47 shows a finial, which forms an ornamental finish to many various kinds of turned work.

CHAPTER VII.

TURNING BALUSTERS AND CLOTHES PEGS.

HAVING had some practice in producing the plain cylindrical form, a baluster may be the next object to be operated upon. Fig. 48 shows a common form of baluster of the Tuscan order. Commencing at the right and

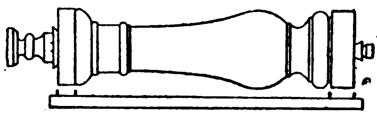


Fig. 48. TURNING A BALUSTER.

proceeding towards the left, the members are named as follows: the straight part, called the plinth; next a sunk fillet; next is a large bead, called a torus; then a fillet; and then the sunk member, called a scotia; over the scotia is a fillet, and these various parts collectively constitute the base of the baluster. Next is the body, which is the full thickness of the cylinder immediately above the scotia, and recedes to the thickness of the neck at the small bead, which is called an astragal. This astragal has a small square fillet underneath. Speaking of the baluster as if it stood on end, the part above the fillet is the neck; the neck expands abruptly into a fillet, which is surmounted by the spreading moulding, called an ovolo—in the cabinet trade called an inverted thumb. Over the ovolo is the abacus, which is straight, like the plinth. The abacus, ovolo, neck, and astragal constitute the cap, or capital, of the baluster. It is necessary to name the various divisions, so as to distinguish them in describing the process in turning. Now as to the manipulation in converting a cylinder into a baluster of this pattern. First mark off with a pair of spring dividers, the plinth three-quarters-of-an-inch at right-hand end, and the abacus half-an-inch at opposite end. The dividers are set to size, and the legs placed on the rest; the work is made to rotate, one leg of the dividers is placed against the end of the cylinder, the other allowed to touch the work, making a light scratch round it.

If a turner had large numbers of these balusters to do, he would get a lath of wood and insert small sharp spikes in its edge at the distances wanted to mark on the cylinder. This gauge is shown parallel with the baluster in Fig. 48. After turning the cylinder straight, he would hold this gauge against it, when each spike would make a light mark round it. Another way is to make small notches in the lath, and holding it in position on the rest and against the work, to place the point of a pencil in each notch, thus making a pencil circle in place of the scratch.

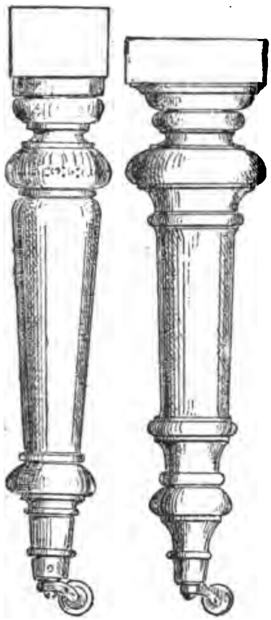
The form of baluster here shown, but more slender, is commonly used for making balustrades on the top of panelled partitions; such balusters usually have a tenon top and bottom let into the framing.

Having marked off the plinth and abacus, take a half-inch chisel, and resting it on edge on the rest and with the acute, or long corner, down, make a cut straight inwards, to a depth of about one-eighth of an inch. In doing this the chisel must be held exactly at right angles with the revolving work; for if held slanting either to the right or left, it will run off, making a spiral cut along the cylinder. Having made this cut, place the other edge of the chisel on the rest, having the long corner uppermost, cant it over to the right to an angle of about forty five degrees, cutting away the wood from the extreme top of the ovolo towards the previous cut, gradually turning the chisel over till it is once more upright on edge; another very light and clean finishing cut is made straight inwards, leaving a clean under-surface to the abacus. The loose wood is removed from the narrow angular hollow by making a very light cut to finish that part of the ovolo lying towards the abacus.

At three different places besides the plinth and abacus—namely, the torus, body, and ovolo—the baluster is of the full diameter of the original cylinder.

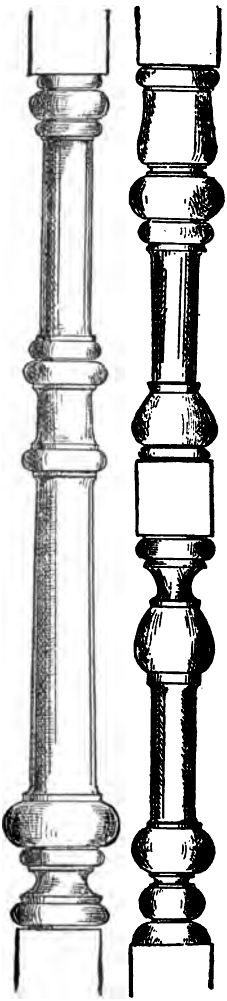
Beginning with a three-eighths-inch gouge at the top of the ovolo, work down towards the right, leaving as much thickness as forms the astragal. This astragal, including its fillet, is three-eighths of an inch broad and a quarter of an inch thick; the neck above the astragal being one-and-a-quarter inch thick, the other sizes may be readily determined. The diameter of the fillet is one-and-half inch. In turning the ovolo with the three-eighths-inch gouge, the tool is gradually canted over till, on reaching the fillet, it is resting on its side; a finishing cut is given to this part with a narrow chisel, and the fillet formed with the same tool. Now, the small gouge is used to form the curve away from the fillet, reducing the neck to near the finished size; a narrow chisel doing the finishing cut. The astragal is now formed with the same chisel, and the fillet behind it. The body may now be roughly shaped. The plinth is first of all cut in as directed for the abacus, then, with the chisel canted over nearly flat, with the short corner cutting, begin at top of torus-head and work towards plinth. A sunk fillet is here shown, one-eighth of an inch broad and one-quarter of an inch deep; this is cleaned out with a narrow parting tool. The upper side of the torus and the scotia may now be worked down roughly with the gouge, the torus finished with the chisel, and the fillet formed. The torus is the thickness or height of the plinth, and the scotia about the same; the fillets are three-sixteenths of an inch. The scotia is turned down and finished with the gouge. The gouge, in order to cut the wood and not scrape and tear it, must be turned on its side when starting the hollow away from the fillets; and here a difficulty presents itself.

In the attempt to cut square, making a sharp fillet, the gouge is held with its bevel at right angles with the line of centres. With a beginner, the first contact of the gouge with the wood results in running sideways, destroying the fillet entirely. This may be guarded against by making a cut with the chisel for some little depth close to each fillet. The gouge will remove the wood in the hollow between the cuts, and when turned on its side, with its point in the cut, it will not run into the fillet, having now a back to keep it in its place. The scotia, when finished, should calliper at least as thick as the neck of the baluster. It will be observed that the curve forming the scotia is much sharper towards the fillet; the fact being that the scotia is a reverse ovolo, or part of an ellipse.



Figs. 49, 50. TABLE LEGS.

The curve of the body is a kind of ogee; at its lower part the diameter is the full size of the plinth. A practical turner in working curves such as this depends mainly on the education of his eye. With an educated eye, he can at all times form graceful and pleasing curves. The body of this baluster might be finished in various forms of outline, all meeting at the centre, but some of them would be positively ugly. Apart from recognised rules for forming curves such as this, the hand and eye can produce them, without difficulty, to please cultivated taste.



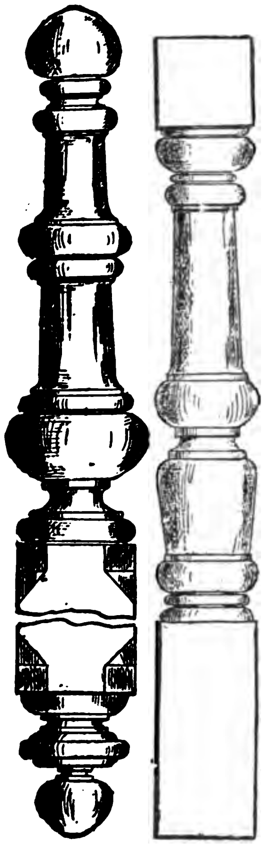
Figs. 52, 53.

Half-a-dozen specimens of turnery are illustrated on the adjoining pages by Figs. 49 to 54, to serve as samples for the young beginner.

If a turner were given a detailed drawing of a piece of work such as these, and told to work exactly to it, he would make a reverse or template from the drawing; he could then produce any number of exactly the same pattern. In like manner, the stone-cutter, making round balusters by hand, would work with a reverse mould, thus making them all alike in outline.

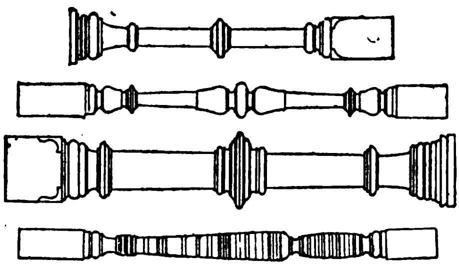
Practising on work of this kind will do much to train the eye. In working the body of the baluster, it is worked down to near the finishing size with the gouge, beginning at the largest diameter and working down on the right to the fillet and on the left to the astragal, where the body is finished same diameter as the neck.

It is a fixed rule that in order to cut the wood with the grain every projecting member must be cut away from its *centre* right and left, and every hollow or reversed member cut from its *sides* and finishing in its centre. To make this more clear refer to Fig. 46, page 69, showing a torus-bead on a plain cylinder. This would be formed by working from the crown towards the left, and from the crown again towards the right. Fig. 46 also shows a hollow in a cylinder, the cut is made from each side and finishing at the bottom. At the beginning of the cut the gouge is turned on its side, and is gradually turned till on reaching the bottom it has its hollow side up. To turn out a hollow like this, with the gouge always on its back, would be to tear out the wood, making a very rough job and leaving ragged edges at the top. There is all the difference between cutting and scraping—cutting is turning, scraping is not—and with the baluster, the more cutting in the process of manipulation the easier it will be to finish with glass-paper. A good turner should make it so smooth and clean cut with the tools that a very light papering would suffice to finish it. A bad turner would labour with various grades of paper, trying in vain to make a smooth job, and succeeding only in rubbing off the clean, sharp angles which always mark the best specimens of turned work.



Figs. 53, 54.

As examples of simple hand-turning, executed on the most economic principles, common balusters claim a place. Balustrades are found in every house, and very large quantities of balusters are required to supply the constant demand. Keen competition has lowered the price, and now the ordinary stair balusters, made from deal one-and-a-quarter inches square, are sold at about £1 4*s.* per gross, material included. They are about three feet long, and the sawn wood costs about 8*s.* per gross, so that the money left to pay for labour, cartage, and profit does not allow much refinement in the process of turning. Cheapness is of paramount consideration in this class of



Figs. 55 to 58. SPECIMEN BALUSTERS.

work, and some particulars of the tools used and the process adopted will be interesting. A few balusters are illustrated above, see Figs. 55 to 58.

The square wood to make a baluster is put on the lathe in the manner already described. A gouge is used to turn with, and the corners are speedily cut off, the whole being reduced to a rough cylinder. The T rest, for the tool, is a long board, extending from one head-stock to the other and generally fastened to each. The rest is seldom shifted, and if no new work of different calibre is brought to the lathe, the T rest may be practically a fixture. When turning near the middle of the baluster, it will be found too flexible to be operated upon successfully.

When long and slender pieces, such as balusters, are to be turned, a back-stay is required to steady the work somewhere near its middle. These back-stays are generally made by the turner from a small piece of board; a simple one is illustrated at Fig. 59. The notch near the top engages the work; the bottom is shown in the middle of the lathe bed, where a wooden wedge secures it sufficiently firm for ordinary requirements. This back-stay is shifted along the bed to any part, as may be necessary, and fixed instantly by the wedge, which is only pressed tight by the fingers. The notch in which the work is steadied is usually semicircular in form, though shown V-shaped in the sketch. For general purposes a V is best; but when a back-stay is used exclusively for one size of work, it is as well to cut the notch to fit as nearly as possible. This notch is all that supports the back-stay from falling through the bed.

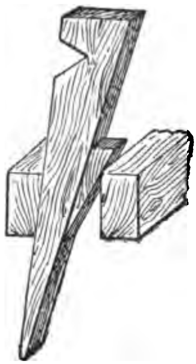


Fig. 59. BACK-STAY.

The speed of the work and the friction of the back-stay often generate heat enough to char the wood. Some soap, applied as a lubricant, is the best material to lessen friction. Many of the wood-bearings of machinery are successfully treated with soap as a lubricant.

When the back-stay is brought into use. First, a small portion of the baluster must be turned tolerably true. This is done by using the left hand as a steady, with the fingers encircling the work. A true part having been formed, the back-stay is brought up to it, the notch placed over it, and the apparatus fixed with the wedge. Thus an additional support is afforded, and the work is operated upon with ease and certainty. The back-stay may be moved to any part of the work as is required; all that is necessary is to turn a part for its bearing. These parts are afterwards turned true with the other parts, and all trace of them obliterated.

When the entire circular part of the baluster has been turned roughly true with the gouge, the chisel is used to smooth it, reducing the whole to a tolerably smooth and parallel cylinder. To mark the position of the various members used to ornament the work, a gauge is used. This is a piece of board with one edge planed straight, into which nails are inserted, at the desired places. Each one of these nails is filed to a wedge-shaped point, and thus serves to mark the places on the baluster, just as a carpenter's gauge is used on flat work. A gauge once made will last a very long time. It is applied to the work whilst revolving, and each member is represented by a scratch. The back-stay is fixed near the middle, so as to steady the whole during the finishing process. With a finished baluster lying on the bench, just in front of, and parallel with, the work, the turner can easily shape the revolving cylinder to correspond. The entire process of chucking, roughing out, fixing the back-stay, marking with the gauge and taking off the lathe, occupies but a few minutes.

Clothes-pegs are a sample of many articles that are produced on the lathe. Special machines are of course employed, and those who know but little of the process, scarcely realise the extent of the work in this connection. The following particulars of a New England clothes-peg factory are interesting :

The wood used is mainly white birch and beech. The logs are cut and hauled to the shores of a lake, or to the streams emptying into it, whence they are floated down to the mill. They are hauled into the mill by a windlass and chain worked by steam power, and sawed into lengths of sixteen or twenty-two inches—the former to be made into pegs, and the latter into boards for the boxes required in packing. The sixteen-inch lengths are next sawed by machinery into boards of the requisite thickness, then into bars of the proper size by a gang of twelve circular saws, and finally into five-inch lengths by a gang of three saws. By these processes the logs have been cut into blocks about five inches long and three-quarters of an inch square.

As these blocks leave the saws they are carried on an elevator belt into an upper story and are deposited in troughs, whence they are fed to the turning lathes, of which there are several—each being capable of turning eighty pegs per minute. The turned pegs are then passed to the slotting machines, in which a peculiar arrangement of knives, inserted in a circular saw, gives the slot its peculiar form; they are then automatically carried by elevator belts to the drying bins on the second floor, where they are subjected to a high temperature, generated by steam pipes, until thoroughly seasoned. There are several of these bins, the largest of which has a capacity of one hundred boxes, equal to 72,000 pegs, and the smaller ones fifty.

The pegs are now ready for polishing, which is accomplished by means of perforated drums, each capable of holding forty bushels, in which the pegs are placed, and kept constantly revolving until they become as smooth as if polished with the finest glass paper. A few minutes before this process is completed, a small amount of tallow is thrown in the drums with the pegs, after which a few more turns gives them a beautiful glossy appearance. These polishing drums are suspended directly over the packing counter on the first floor of the mill, and being thus immediately beneath the ceiling of the floor above, are readily filled through shoots from the drying bins on the second floor, and as easily emptied upon the counter below, where they are sorted into first and second grades, and packed in boxes of five gross each. The sorting and packing are done by girls. Two hundred and fifty boxes are packed per day. The market for these clothes-pegs is not confined to any special locality, but is found nearly all over the world. Ten firms in London have a stock of ten thousand boxes each. One thousand boxes constitute a load.

CHAPTER VIII.

FISHING ROD, DRAUGHTSMEN, SPITTOON AND MUSIC STOOL.

THE variety of objects coming under the heading of ornamental work in wood-turning are far too numerous to attempt to catalogue. It is almost safe to say that the quantity is infinite, being only limited by the time and tools at command. Of course, skill is equally requisite to fully develop the capabilities of appliances; but, possessed of a fair stock of tools and a thorough determination to work them to their utmost, the turner may safely contemplate a boundless scope in making articles, both useful and ornamental, in such a variety of sizes and designs, that there need be no fear of the work becoming monotonous, not to mention exhausted, for want of variety.

A Fishing Rod.—A great number of the common kinds of fishing rods are turned in the lathe. The most suitable woods are hickory, lancewood and yew, but a good rod may be turned out of ash. The best ash for this purpose is sold in bundles, at about 1*s.* 4*d.* to 1*s.* 8*d.* per bundle, containing from twenty-five to forty sticks, varying in number according to the thickness. For turning the rods, a boring-collar will be required; this has been described in connection with lathes in Chap. I. The seating for the boring-collar can be made of dry beech, and can be fastened with a wedge under the lathe-bed. The collar or plate should be secured to the seating by means of a bolt and nut, so as to admit of the plate being readily shifted round when requisite. It is necessary that the centre of each hole in the collar should come precisely opposite the centre of the mandrel-nose when adjusted, otherwise it will be difficult to turn truly. The parts of the rod may be fixed between the boring-collar and the chuck, and turned in succession. The size of the thickest joint will depend upon the taste of the angler, and the same applies to the length of the rod. The smallest joint should be made of lancewood; the joints, with the exception of the smallest, should be ferruled at both ends. If the joints are required to slide one within another, some long augers will be necessary. The cheapest plan is to buy a few ordinary augers, say half-inch, five-eighths of an inch, seven-eighths of an inch, and one-and-a-quarter inches, take them to a blacksmith, and tell him to cut them and "shut in" a piece, say eighteen inches. This will furnish a serviceable set of boring apparatus. In boring the rod joints the boring-collar should be used. Some turners use the hollow chuck and not the collar, but the latter will be found the more reliable tool. When the rod joint is ready for boring, fix it between the mandrel-nose and boring collar, turn out a slight hollow with the gouge, then use the auger. In boring up to one inch in diameter, only two augers are generally used; say a three-eighth of an inch first, and then the full size. Absolute dependence cannot be placed upon the hole being quite true, for the wood may vary in hardness, and the auger would incline to the soft parts, and this would throw the hole out of truth. This process of boring is also suitable for making hollow walking-sticks, the standards of loo-tables, and similar kinds of work.

Draughtsmen may be turned out of box, rosewood, ebony, sycamore, mahogany, tulipwood, satinwood, beech, ash, alder, birch, or deal. The ordinary turning tools will answer for soft woods, but for hard woods tools with a short bevel are requisite. Alder answers very well, it is very cheap, and can be obtained at most English timber-yards, or of toy-makers. Cut four lengths of about six inches, and pare or turn the ends to fit the hollow chuck; drive in a piece, and turn it down to the size required, say one-and-a-half inches, and smooth it with glass paper. Make the three other lengths the same. Set the compasses to half an inch, and with them mark the wood from end to end; this will give the thickness of the draughts. Cut down the front with a chisel, and turn a few grooves on the flat surface according to taste, say a hollow in the centre, a groove about one-quarter of an inch out, and another groove near the edge. The effect may be varied by cutting one groove deep and one shallow. When the front surface is turned, finish off with glass-paper, and, by means of a screver, cut off the piece at the first half-inch division. Then proceed to turn the front surface of the next piece, finish and cut it off as before, and when thirty-two pieces are thus finished on one side; the other side may be turned to match. To do this, fix a piece of wood in the hollow chuck, and turn out a hollow to fit the draught; this hollow should be slightly tapering.

Gently tap the draught in the chuck thus made, turn, and finish off as before. When all are finished, it will be necessary to dye sixteen of the draughts black. For any soft woods the following process will be found efficient: To half a pound of best logwood add two quarts of water, and boil in a saucepan for about two hours (it will not harm the saucepan). Meanwhile dissolve a teaspoonful of green copperas in half a pint of hot water. Then pour the whole into a pan, and, while the dye is hot, put in the draughts; let them remain in for ten minutes, and then lay them in the open air to dry. In dyeing large articles with this dye, the solution may be applied with a brush. When quite dry, fix the draughts again in the lathe, polish them with shoemaker's heel-ball, by pressing it on the draught while it revolves, finally finish off with a piece of black cloth. The white draughts may be polished with glazing wax. If turned out of box, or other hard woods, they may be polished as they are turned by applying the side of the tool

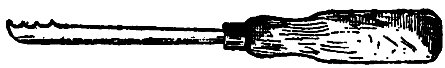


Fig. 60. Tool for Beading.

to the surface. A handy tool for turning a pattern on the face of the draughts at one stroke is illustrated by Fig. 60. Better results, however, can be obtained by a clever hand with ordinary tools.

Ottoman Spittoon Holder.—This forms a useful ornament for the parlour or smoking-room. The body of the article should be of pine, veneered with mahogany, and the ends turned from solid mahogany. The spittoon should be purchased first, so that the holder can be made to fit it. Select a piece of very dry pine, three inches thick and about thirty inches long by nine inches wide. Cut it in halves, plane two long edges quite true and join them together with glue (as in Fig. 61); do not use screws or nails. When quite dry strike a circle with the compasses thirteen-and-a-half inches in diameter, fixing the point of the compasses about one inch from the join, so that the joint may not be in the centre. Cut out the circular piece with a bow-saw, fix it in the lathe and turn the edge quite true (it can be easily tested with a

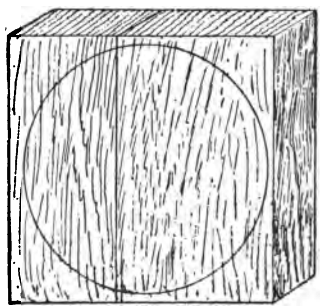


Fig. 61. Block for Spittoon.

square), and face each side with a firmer chisel. Do not use glass-paper, or the surface will be spoilt for veneering. The next thing is to cut out the centre to form a receptacle for the spittoon. Mark in pencil a circle, the diameter of the spittoon, turn out the centre until nearly through the wood, and then cut right through with a screver, which is a peculiar form of parting tool. To finish turning the inside surface, it is necessary to make a wood chuck to hold the circle; turn out a rabbet half an inch deep, fix in the circle, and finish off the inner surface with the long corner of a chisel. The circle is now ready for veneering. Cut a strip of mahogany veneer a trifle wider than the circle and the length of its circumference. Damp one side of the veneer with hot water, glue the other side with good and very hot glue, and lay the veneer on quickly and carefully. Press out the surplus glue quickly with the edge of a hammer, wind a quantity of string round the veneer, tie tightly, and leave the work to dry gradually in a warm place, but not too near the fire.

When quite dry, unwind the string, and fix the circle in the lathe on a chuck turned to fit inside the circle. Carefully cut off the overhanging edges of the veneer, and finish it off with coarse and then fine glass paper. To make the bottom of the spittoon holder and the top or lid, take two pieces of mahogany, about fifteen inches in diameter, and turn them with a moulding to project three-quarters of an inch all round beyond the circle. Turn another piece of pine about ten inches in diameter and one inch thick, and hollow it out like the inside of a saucer, so that it is one inch thick at the edge, and tapering to about one-quarter of an inch in the centre. Fix this upon the lid with screws, fix the bottom on with screws, and fix the lid on with a good brass hinge. Turn four flat balls, two inches in diameter and one inch thick, and screw them to the bottom near the edge of the moulding. The article may now be French-polished in the manner described further on. When this is done, proceed to stuff the top with hay, flock, or alva to a thickness of two inches, cover with a piece of coarse cloth or canvas tacked round the rim, and then a piece of carpet, and a piece of gimp over the tacks, fixed with very small-headed tacks or needle-points. When this is done, drive a brass-headed nail through the centre of the carpet into the wood beneath, this will hold the seat firm, and give the ottoman a finished appearance. Fig. 62 shows the spittoon-holder ready for stuffing and covering.

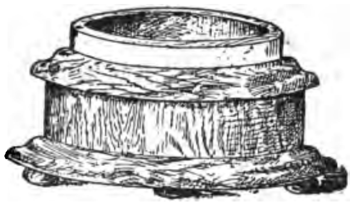


Fig. 62. SPITTOON COMPLETE.

Music Stool.—The materials required for this are a screw and socket for the elevator; a piece of wood, say walnut, about sixteen inches long by three-and-a-half inches square, for the centre column, Fig. 63; a piece, one inch thick and about six inches square, for the collar, Fig. 64; and three

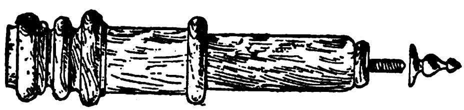
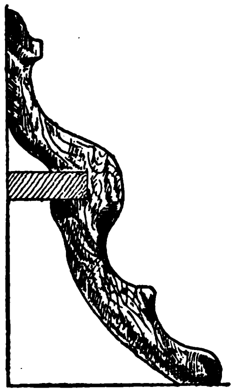


Fig. 63. COLUMN OF MUSIC STOOL.

Fig. 64. COLLAR.

pieces, one-and-a-half inches thick and about eight inches by six inches, for the legs, Fig. 65. The top should be made of beech in five pieces, mortised and glued together (as in fig. 66), or it can be turned from a solid piece of walnut, fourteen inches in diameter and one-and-a-half inches thick. First turn the centre column according to taste; the length should be twelve inches. At the lower end cut a pin, two inches long, to screw into the ornament. The latter must be bored one inch deep, and a thread cut to receive the end of the pin and secure the column to the collar, Fig. 64. The upper end of the column must be bored to receive the elevating screw, and the socket must be fitted into the mouth of this bore and fixed with screws. The collar, Fig. 64, should be turned six inches in diameter. To make the legs, take the three pieces and pin them together. They may then be cut out with a frame-saw to the desired pattern. The inner surface should be so shaped as to fit close to the column, to which it is to be



Fig, 65. LEG OF MUSIC STOOL.

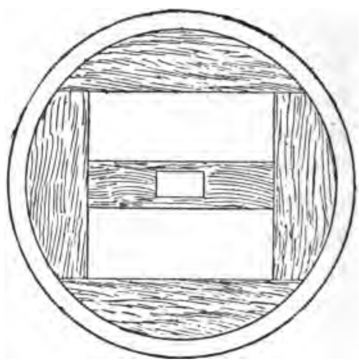


Fig. 66. TOP OF MUSIC STOOL.

glued, and to lock well on to the collar, to which it is to be screwed. This will impart strength and rigidity to the stool. The outer surface may be shaped and carved to harmonise with the column. When the legs are finished, the whole of the parts forming the stand of the stool should be nicely fitted into their places, and when this is done they may be glued and screwed together. The top of the stool should now be made. One turned from a solid piece of walnut, as mentioned above, will be the more convenient to make. A more elaborate top may be produced by constructing a beech foundation, cutting pieces of walnut to fit, and then gluing them upon the foundation. This walnut covering may be turned. This work, however, is rather too difficult for any but expert workmen to attempt. When the top is put together, a hole must be bored for the screw, which is put through and secured by a nut. The stool is now ready for polishing.

To do this properly, first brush the stool over with brown hard varnish, and let it stand for twenty-four hours or so, then rub down with flour glass-paper and linseed oil. The whole of the varnish must not be rubbed off, only the rough part. Next polish with French polish. Use a rubber of wadding, moistened with polish and covered with old linen rag, and gently rub all accessible parts. Give two or three coats, allowing one to dry before the next is applied. When quite dry, finish off with methylated spirits on the same rubber with clean rag; apply with a light, quick stroke. To stuff the top, a weed, called alva, is used by the trade, as it is very pliant and springy, but flock or hay can be used. Nail a piece of sackcloth on the top, lay and press on the alva, flock or hay to the required thickness. Cover with sackcloth, pressing in as much more stuffing as possible, taking care to preserve a good shape for the seat. Nail down firmly with short tacks, and cut off the edges. The seat may be covered with morocco leather, damask, rep, velvet, or American cloth, and the edges neatly trimmed and tacked down; the tacks are hidden by a piece of gimp being run round the edges. To complete the stool, procure a stuffing-needle with points at both ends, eighteen buttons, and some good twine. If the bottom of the seat is solid, nine-three-eighth inch holes should be bored. Thread the needle with double twine and string a button with it, pass the needle through the exact centre of the seat, from the top pass it through the hole beneath, through the shank of another button, and back again through the top; draw the twine tight, pass the needle again through the hole beneath, and secure the twine to the button. Proceed in the same manner with the other buttons, arranging them at regular distances apart. The height of the stool, when finished, should be eighteen inches, exclusive of the elevation (about four-and-a-half inches) to be derived from the screw.

CHAPTER IX.

LADY'S COMPANION, PIN-CUSHION, AND CHESSMEN.

THE illustrations accompanying the present chapter show a lady's companion. It will furnish a very nice exercise for the turner, and, when completed, makes a very pretty, as well as useful, present to a lady. It consists of three circular plates, or discs, supported on central pillars, and surmounted by a cushion-holder on a short pillar. Fig. 67 shows an elevation.

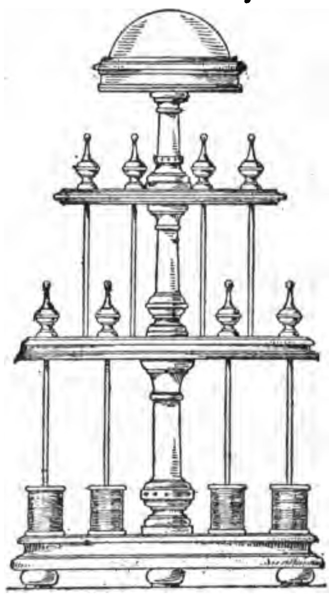


Fig. 67. LADY'S COMPANION.

These are made in walnut wood, as well as in mahogany and bird'seye maple, the latter looking very pretty, though Italian or American walnut are preferred, because they afford a better contrast to the white and coloured reels which the stand is intended to hold.

The three plates and the cushion-holder will afford a good exercise in face-plate turning. They are all, of course, cut from the wood plankways. The lower, or base-plate, is nine-and-a-half inches diameter and seven-eighths of an inch thick. Before these plates are cut from the plank with the bow saw, plane the back—that is, the under side of each—smooth and level, and place it next the chuck, or face-plate, as it needs no turning. The face and edges are then operated upon, being moulded with chisels and gouges as drawn; or the operator may adopt any other form of outline he may fancy.

The tools should be well ground, and have fine, keen edges, or they will tear the wood, showing, at two places in the circular edge, a roughness which no amount of glasspapering will remove. This is a difficulty that always presents itself in turning the edges of discs plankways, as at two places in the rotation the end grain of the wood is coming directly against the cutting edge of the tool, and it is only with the keenest of tools that these parts can be cut and not more or less torn.

When turning the face of the base-plate, and after the edge is moulded, a light mark is made with the corner of a chisel, or with a draw-point. This mark is fully half an inch from the edge, and indicates the line on which the holes are bored for the wires. Half an inch inside of this line a considerable hollow is commenced. It is about one-and-a-half inches broad, finishing near the base of the pillar, and is three-eighths of an inch deep in the centre, being an arc of a circle. Its purpose is to hold sundry ladies' requisites, such as pins, hooks, buttons, &c.; besides, it lightens and improves the appearance of the article. After the hollow is made, it will be seen that there is fully an inch of level space outside of it for the bobbins to rest upon.

The second plate, which rests upon a pillar five-and-a-half inches long, is nine inches in diameter in the rough, and five-eighths of an inch thick. It is moulded on the edge and turned on the face, as before described. A light mark is made with a draw-point while the plate is revolving, this mark making a circle exactly the same diameter as that on the base-plate, and again a hollow is made one-quartei of an inch deep, and finishing near the base of the second pillar. These hollows are worked to nearly a finish with a five-eighth-inch or three-quarter-inch gouge, and finished with a circular-ended chisel, made very keen and held flat on the rest. The hollow in this plate is necessarily narrower than that on the sole-plate, as level space is needed on this plate for the second tier of bobbins to rest within the line mentioned above, consequently a second line has to be marked, some three-quarters-of-an-inch within the first on this plate, for the second tier of wires, the third plate having a line or circle of the same diameter for the same wires. This third plate is somewhat less than half-an-inch in thickness, and is seven inches in diameter; it also has a hollow about an inch broad on its upper side.

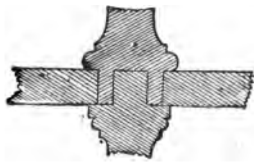
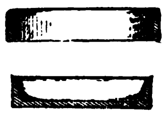


Fig. 67.
MORTISING PILLARS.

The lower pillar is five-and-a-half inches long and two inches diameter at its largest part. The second pillar four-and-a-quarter inches long and one-and-five-eighths inches diameter. That support ing the cushion is three inches long, and one-and-three-eighths inches thick. Each of three plates have a one-inch hole cut through them with gouge and side tool while running in the lathe, to receive the pillars. The manner of letting the pillars into each other is shown in section, Fig 67.

The bottom of the second pillar has a three-quarters-of-an inch tenon turned on it, and is let into the top of the first, which comes quite through the plate. The third pillar is treated in exactly the same fashion, and, when these are properly fitted and well glued in, they make a firm, substantial whole.

The cushion-holder is four-and-three-quarters inches diameter and one inch thick. It is moulded as shown, and hollowed out to a depth of three-quarters-of-an-inch, said hollow having a flat bottom. A ring, shown in section, Fig. 68, is fitted neatly into this recess, projecting above the surface one-eighth-of-an-inch, and formed into a quarter-round. Inside the ring, and fitting loosely, is the saucer, Fig. 69. It is a piece of pine three-quarters-of-an-inch thick, hollowed out to contain sawdust. The sawdust is heaped up and pressed into it; over the saw-dust is stretched a piece of calico, which is pulled tightly down and glued round the outer edge of the saucer. This cushion, if properly filled, should form a half ball above the ring. When the glue is dry, a piece of velvet or silk is laid over and the ring placed on from the upper side and pressed down, the covering being pulled tightly down at the same time. It will thus be seen that the purpose of the ring is to keep the covering neat and tight without wrinkles. The ring with its cushion will now fit into the holder, making a neat job. Of course the cushion is not put in until after the polishing.



Figs. 68, 69. RING AND SAUCER.

The next job is to turn three ball feet and twelve tops for the wires. The ball feet are one inch in diameter and half-an-inch thick.

Fig. 70. FINIAL IN HALF SECTION.

The top ornaments for the wires are shown, Fig. 70, half elevation. They are one-and-one-eighth inches long and five-eighths-of-an-inch thick. They have a one-eighth-of-an-inch hole bored in the centre of their bottoms to receive the wires, which are brass, No. 10. They should be nicely straightened and polished with fine emery cloth. They must be of a length to allow five-eighths-of-an-inch for the finials, then to pass through the plate and half-an-inch into the lower plate. The holes in the plates are fully one-eighth-of-an-inch, to allow the wires to pass through easily. The ends of the wires that enter the finials are roughened with a file and glued in. The lower ends are pointed, to enter the plates readily.

To mark off the wire holes for boring, take the radius with compasses from the centre of the plate to the circular mark. This radius will divide the circle into six equal parts. Mark the lower and second plate with this measure. Divide the third plate in the same way, also the upper side of the second plate. The holes may be in line with the first row, as in the plan, Fig. 71, or the upper tier may fall intermediately between the lower. In gluing the plates to the pillars, care must be taken to have the holes in each pair of plates vertical, the one above the other, else the wires will not stand upright but appear twisted.

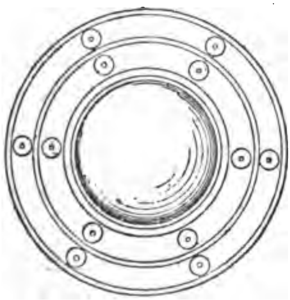


Fig. 71.
PLAN OF LADY'S COMPANION.

In the elevation, Fig. 66, the lower tier shows one bobbin on each wire. On this tier each wire will hold three or four bobbins. The upper tier will hold two or three, according to size. The finials on the tops of the wires are used for holding thimbles, &c. The ball feet may be put on with small screws. They are three in number, and are put on equidistant round the base. In making this job, the whole of the parts would be polished before putting together, after which it would get a finishing touch by the polisher.

We will now proceed with the construction of a pincushion and secretory. This article will be found to form a very good exercise for the wood-turner, and, when finished, it makes a very neat, useful ornament for the lady's work-table. If given as a present, the interior may be filled with needles, pins, thimbles, buttons, or any other of the many etceteras of ladies' use, or it may contain sweets or some absurdity, and the recipient left to find her way to the hiding-place. It is entirely of turned work, and may be made of walnut, mahogany or other wood. The design is taken from a circular temple erected on a platform of steps, the pillars supporting a cornice, and the roof represented by the cushion.

The cornice portion is made from wood eight-and-a-half

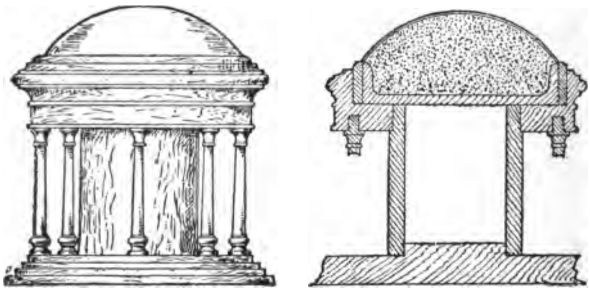


Fig. 72. ELEVATION. Fig. 73. VERTICAL SECTION.
PINCUSHION AND SECRETORY.

inches by one-and-one-eighth inches in the rough. One side may be planed quite true; and will be the under side when placed in position. This is chucked next the face-plate, and, if the latter is a little less in diameter than the finished work, the whole operation of turning may be done with the one chucking. The face of the disc may be trued up first; then the edge is moulded, as shown in the elevation, Fig. 72, taking care to make the diameter of the plate seven-and-a-half inches at the side towards the face-plate. The face has to be sunk to a depth of three-quarters-of-an-inch, making a level bottom, with the sides cut square down to it, so that the cushion with its ring may slip neatly into it. The making of the cushion saucer and ring is exactly as described in connection with the bobbin stand. This part of the sinking done and the work finished by glass-papering, it is to be further sunk, or cut quite through, to receive the body. This opening will be three-and-three-quarters inches in diameter, as the full diameter of the body is four inches. A shoulder of one-eighth-of-an-inch is cut to butt against the cornice plate and also the base. This body is four inches long, and the pillars are, of course, exactly the same length. The body is hollowed out, leaving about a three-eighths-of-an-inch thickness, thus forming a hollow cylinder which constitutes the secretory or hiding place, which is closed by the cushion when in its place.

In turning this body, a solid piece of wood would be fitted into a somewhat large cup-chuck, the outer face cut in straight, and the interior sunk with gouge and side tools to a sufficient depth (four inches); the sides would be parallel, of course, so that the finished body would have the same thickness of stuff throughout its whole length. The diameter of the inside will be about three-and-a-quarter inches. The outside of the piece is now turned parallel down to four inches, and cut in, or shouldered, to fit exactly the openings made for it in the two plates. It is well papered inside and out, then cut off.

The pillars are five-eighths-of-an-inch thick, top and bottom, and may be turned of the pattern shown in Fig. 72, or any other the maker may fancy. They are turned singly between centres, and have a three-eighths-of-an-inch pin on each end to fit into the plates. The upper plate, or under side of the cornice-piece, is bored for the pillars, exactly the same as the base-plate; and both are bored in circles of the same diameter.

The stepped platform is seven-and-half inches in diameter on its upper surface. The steps are each one-quarter-of-an-inch broad, and also rise one-quarter-of-an-inch. This base is turned from a piece of wood plankways, and requires about nine inches in the rough. While on the face-plate, the recess is made in the centre to receive the body, as shown in the section, Fig. 73. The turning of the steps on the edge of this disc is a very easy matter, being done for the most part with a five-eighths-of-an-inch chisel, in first-rate order. The only careful part of the work is to see that the steps are perfectly rectangular; that is, that the treads are level and the risers vertical. Some care is, of course, necessary in turning the face of the plate where the pillars and body are to stand: a straight edge should be used, and the face made perfectly flat.

Before removing from the face-plate, a light scratch should be made on the finished face, to mark the line of centres of the pillars. This circle is nearly half-an-inch from the edge of the upper step, and is divided with compasses into as many equal parts as there are pillars in the drawing of the plan (Fig. 74). Holes about half-an-inch deep are bored in these marks with a three-eighths-of-an-inch centre-bit.

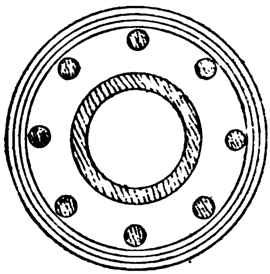


Fig. 74. PLAN SECTION.

The body may be made of good pine, boring out the interior, the exterior turned to the exact diameter; then, before cutting in the shoulders, and keeping the work still in the chuck, veneer the body all round. When this is quite hard, remount in the lathe, turn the veneer part with a fine chisel, cut in the shoulders, and finish as above described. As this process requires some knowledge of cabinet-maker's work, it could not well be adopted by turners who lack that knowledge. The ring which encircles the cushion may be made of plane-tree. It should fit the cushion, but not tightly, or it will break; then its outside should fit the recess made for it in the plate. The ring, however, is much better made in metal and nickel-plated, it cannot then be put on too tight. This article, like most others of like nature, is polished before fitting together, and, if the ring is of wood, it must be polished before fitting it on to the covered cushion.

A set of chessmen will form the subjects and boxwood and ebony (being inexpensive) the materials on which any amount of skill and ingenuity can be displayed, and there are very few things more appropriate and really more interesting to an amateur than the thirty-two pieces used in the game of chess. Having roughed out the whole lot to a general pattern, each separately becomes the special object to be particularly ornamented, and the skill can be taxed to its utmost in carrying out this principle. No rule is laid down as to the pattern to be adhered to in each piece; all can be turned in the lathe, with the exception of the upper portion of the knights, which is invariably fashioned to represent a horse's head and neck, and will require to be carved to pattern. Here is an opportunity of displaying skill in handling carving tools. The outlines should all be filed up, and the lines representing the mane, &c., engraved afterwards with a graver.

Each man should be designed and carefully drawn on a large scale—say three times its intended size; and in this process may be displayed any amount of skill as a designer, and the tasteful way in which this is done will go far to secure the beauty of, and admiration for, the complete set. Carefully cut out a template to the shape of each different piece, of course to the exact size of the proposed man. Thin, hard-rolled brass is very good material to make these templates of. Six will be required, viz:—for kings, queens, bishops, knights, castles and pawns.

In making the set, complete all of each sort before commencing any others; thus, for the pawns, rough out sixteen pieces to the exact same *length* and *diameter*; this will then be some guide to go by in the succeeding operations. Fix a tool in the slide-rest the correct shape for turning out any particular groove in the piece, and, using the template as a guide, set the tool to the exact place where the groove should be made, turn the lathe and take a cut right down to the full depth intended, then carefully set the slide-rest stops. Comparatively, no further care is needed when this is done. Take each rough piece successively and treat it in a precisely similar manner. When the sixteen are done, you may rely on their being exact counterparts of each other. Now, with a tool ground to fit another particular groove, take a cut in one piece in the exact place designed, using the template. Having got the correct depth, set slide stops, and turn each piece in the same manner; these processes of turning grooves are continued till all are finished, by which time the piece operated on will probably begin to look something like ship-shape.

Perhaps a little fluting may form part of the design; if so get the overhead gear and division peg in action, and flute out any pattern which may form part of the design decided on; do the first trip very carefully, gauging with the template, and, having set the slide stops, no especial care will be required in afterwards repeating the operation. It is no easy matter to minutely describe how to fashion each particular cut or flute, not knowing the exact pattern, but bear in mind the following: Turn each rough piece to uniform sizes, exactly to the largest diameter of the finished work; in removing the surplus material subsequently always turn off the greatest bulk first; never take the most weakening cut till last. These two last rules are difficult to reconcile, but a little thought will soon set matters right.

It is quite possible to turn the whole lot of pieces without the aid of templates, when one has a slide-rest with which to do the whole of the turning, but when any parts have to be shaped by hand it is better to use templates, to ensure each one being exactly the same size as its fellow. With templates to guide him, a fair hand can turn a very creditable set of chessmen entirely by hand, and, of course, all the more praise is merited by those who are able to dispense with elaborate chucks, slide-rests, cutting-frames, &c., &c., though it is impossible to imitate by hand the beautiful designs produced automatically by the aid of these intricate tools. There is one addition which many turners would be tempted to fit up to a simple lathe—*i.e.*, a division-plate and overhead motion—did they know the ease with which it could be done, and the immense additional facilities it gives in dealing with the usual work, besides affording the means of executing satisfactorily work which could not otherwise be attempted; and, indeed, a dividing apparatus becomes a necessity to anyone practising ornamental work on flat surfaces or longitudinally, by fluting or otherwise. The requisite addition to the ordinary lathe can be home-made, and the cost of the necessary materials is very small; but this is not the place to expatiate on the merits of this plan.

CHAPTER X.

TABLE, CHAIR AND TOWEL RAIL

A SMALL tripod table, Fig. 75, is adaptable to many purposes. For the garden or summer-house it should be constructed rustic pattern. If for the drawing-room, the legs should be turned ball pattern or twisted, and the materials and finish may be of a superior kind. Procure a piece of beech, oak or walnut, four inches square and four-and-a-half inches long, out of which turn a ball three-and-three-quarters inches in diameter, proceeding as described in Chapter XII.

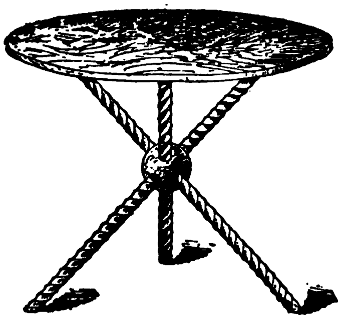


Fig. 75. TRIPOD TABLE.

It will now be necessary to make a cup-chuck to hold the ball in the lathe. For this purpose, screw a piece of wood tightly on the screw-chuck, and turn out a hollow to receive the ball. This hollow should be three-and-a-half inches in diameter inside the mouth. Now take the ball and knock it securely into the chuck (using French chalk to prevent slipping), and bore a five-eighths-of-an-inch hole through the centre of the ball. A nose-bit or augur is most suitable for this purpose, and to get a true bore it would be best to use first a three-eighths-of-an-inch bit, next a half-inch and then a five-eighths-of-an-inch. Do not use a centre-bit, as it is important that the hole should be quite true; indeed, upon this the successful workmanship of the table chiefly depends. When the five-eighths-of-an-inch hole is bored through, knock the ball out of the chuck, and re-fix in the chuck transversely, so that both ends of the hole are seen to be equidistant from the rim of the cup-chuck. You can now bore a hole similar to, and exactly at right angles with, the previous one. When this is done, knock out the ball again and re-fix, taking care that the *four* openings presented by the two holes are all equidistant from the rim of the cup-chuck. Now bore the third hole and the ball will present six holes to the view, all exactly equidisdant. The next thing required is a three-quarter-of-an-inch tap and screw box for wood-screws.

For the legs, if the table is to be a rustic one, procure a few ash sticks (in London they can be obtained at several of the English timber-yards); those sticks with a knotty surface should be preferred. Cut six lengths of eighteen inches, fix each one in the lathe, and cut on the end nearest the poppet a pin one inch long to fit the lid of the screw box. It matters not how untrue the centre of the stick runs in the lathe; but the pin must be turned true with the two ends. The next proceeding is to tap the pins with the box. This requires some care, and should be done as follows:—Put the lid on the box and grease the pins with tallow. Take one of the legs in the right hand, put the pin in the box, press hard, and, at the same time, turn the leg round to the right hand; follow on until the shoulder touches the lid, and then unscrew gently, taking care not to injure the thread. Proceed similarly with the rest. Take off the lid, re-insert the pin and cut the screw up to the shoulder. Now fix the ball in a vice or bench-screw, and fix the tap in a wood-handle. Press the tap carefully and firmly into the hole, turning at the same time in the right direction. When the tap is screwed in about half-way, unscrew and knock out the dust. Grease the tap, re-insert it and screw almost up to the shoulder. Now the legs and centre-ball are ready to be put together. Screw three legs into the ball to the shoulder, and, with a tenon-saw, cut a small piece off the bottom, at an angle, so as to present a flat surface to the floor. To screw in the other three legs, invert the tripod and proceed as before. The stand is now complete. With regard to the top, a circular is perhaps the best if it can be conveniently turned, but it may be oval, octagonal, square or otherwise, according to fancy. To prevent warping, make a triangular frame of wood and screw it underneath the top. The size of this frame should be such as to admit of the three legs being screwed to its three corners, this will give considerable stability to the table. The top may now be screwed on to the legs from beneath, and the table painted, varnished or polished, according to taste.

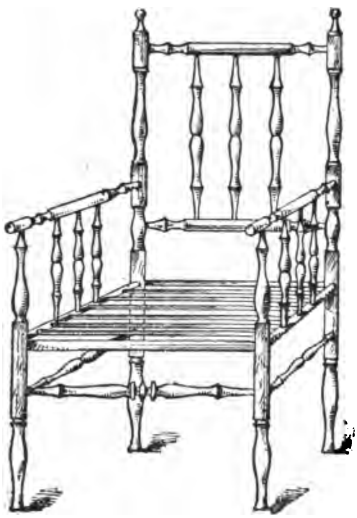


Fig. 76. ELEVATION OF CHAIR.

The accompanying illustrations show a child's chair composed entirely of turned work, no tools being necessary but the lathe and a boring bit. A chair of this sort is light and looks pretty. The back being straight with the lower back-legs is no objection in a child's chair, as it is not so liable to upset backwards as one with the back overhanging the legs. In Fig. 76, we have a perspective elevation ; the breadth of the side is twelve inches. It shows back legs and fore legs, the elbow or arm, with three short balusters, connecting the arm with the seat rail. These balusters are made from wood one inch square, and are five inches long between the rails; they are placed two inches apart, and equidistant from the back and front legs. The back and front legs are made from wood one-and-a-quarter inches square. The chair may be made from black birch, which is stronger than either mahogany or American walnut, though the latter woods are to be preferred for appearance.

The back is twelve inches broad, and the front fourteen-and-a-half inches. The height of the back is twenty-two inches, including the knobs on top; the centre of the upper back rail being twenty inches from the ground. The height of the seat is six-and-a-half inches, and that from floor to top of elbows twelve-and-a-half inches. The seat rails, which are turned plain or straight, and reduced where they enter the legs and also the two elbows are of one-and-a-quarter inches wood. The balusters and body of the seat are of one inch wood (see Fig. 77, plan of seat).

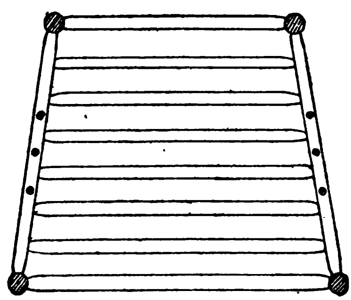
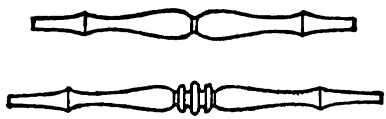


Fig. 77. PLAN OF SEAT.

It will be seen that the back legs, though turned throughout their whole length, have certain parts straight. That to receive the top back rail is two inches long. A similar piece is left to receive the lower back rail and elbows. Further down, a straight piece, four inches long, receives the seat rails and those below them. These two sets of rails are two-and-a-half inches apart, the lower set being made of one inch wood.

The elbows have each a straight part at their fore-ends to receive the ends of the upright fore legs. The upper and lower rails in the back are also made of one-and-a-quarter inches wood, and have the central part turned straight to receive the three balusters. These are seven-and-a-half inches long between the rails, and are placed two-and-a-half inches apart, from centre to centre.

In the seat, Fig. 77, it will be seen that the four seat rails, and those immediately under, are let into the centre of the legs, the rails being reduced to five-eighths-of-an-inch for that purpose Indeed, the whole structure consists of posts and rails, or bars, fitted together by round mortises and tenons, the mortises being simply holes bored fully half through the thickness of the stuff with a five-eighths-of-an-inch centre-bit, those for the



Figs. 80, 81. RAILS ENLARGED.

seat rails being bored through to meet. These holes may be bored when the wood is in a square state before turning, or they may be bored after being turned, a slight mark being made with the tool, while the work is revolving, to show the exact position of the holes to be bored.

Figs. 80 and 81 show enlarged views of some of the rails.

It is to be observed that in boring the uprights for the seat rails, the holes should not be exactly at right angles to each other, the angle for the back legs being slightly obtuse and that for the front legs slightly acute. The necessity for this will be readily seen when it is observed, from Fig. 77, that the front is two-and-a-half inches wider than the back, so the plain bars, forming the body of the seat, are all of different lengths, being gradually shorter as they approach the back. They are six in number, and are placed equidistant throughout the breadth of the seat. A seat of this description is always provided with a stuffed, movable cushion, as it would not be comfortable to sit upon.

In making this chair, all the turning may be done before the boring is commenced. In turning the ends of rails, balusters, &c., the tenons must be gauged carefully to fit the holes. With the five-eighths-of-an-inch centre-bit, bore a hole three-quarters-of-an-inch deep in a waste piece of hard wood; turn the first tenon to fit this hole tightly, but not so tight as to split the wood, and at the same time make sure that it is bottomed; set the callipers carefully to this tenon, and turn all the others to exactly the same dimensions.

In boring, fix the bit in the mandrel-nose, or in a chuck that will hold it; feed the wood to it by moving forward the sliding barrel of the poppet-head with the hand-wheel; when a depth of thrèe-quarters-of-an-inch is reached, mark the sliding barrel close against the face of the casting with chalk or slate-pencil. This mark will be a guide for all the other borings, as the proper depth will be reached when the mark appears outside the casting.

The chair may be fitted together, using good glue and a cramp, then varnished, or it may be French polished before putting together, using pieces of pine wrapped in cloth to protect the polished wood from injury from the cramp.

A towel-rail usually forms one of the articles of a bed-room suite: the present example is composed entirely of turned work, and forms a good subject for practice in turning.

The article, as shown in the illustration, Fig. 82, has four upright pillars set into two cross-pieces at the bottom. The pillars are coupled at the top by semi-circular pieces; each pair of pillars, with bottom piece and semi-circle, forming an end of the towel rail, and these two ends are joined together by seven rails let into them, thus forming a complete article of furniture.

First prepare the two horizontal pieces at bottom, which are made from wood one-and-a-quarter inches square. These, and the four posts, should be squared with a plane before turning. The primary object being to have the pieces quite straight and the four sides squared with each other. Holes are bored to receive the pillars eight inches apart, from centre to centre and the pillars of course rest upon a square part of the bottom-pieces. About six inches length in the centre of these bottom-pieces is turned. The ends project beyond the posts some four inches, to give the article stability, &c. Four feet (see Fig. 83) are inserted in the lower side of the extremities. These feet are one-and-a-half inches high, and turned from one-and-a-quarter inches wood; they are let into the cross-pieces by three-quarters-of-an-inch tenons, same as shown on end of rail. The outer ends of the cross-pieces are finished with a patera, or button.

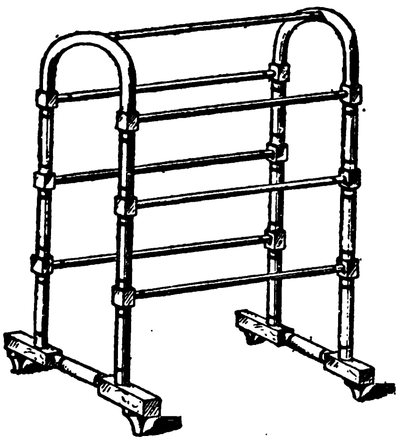


Fig. 82. TOWEL-RAIL.

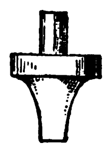


Fig 83. FOOT.

The circular tops are made from one ring cut in halves. The diameter of the ring is exactly the same, centre to centre, as the holes bored in the bottom cross-pieces, viz., eight inches. The section of this circle is exactly circular, like a curtain ring, and is of the same thickness as the turned parts of the pillars, viz. one-and-one-eighth inches.

The circle is made from the wood plankways, and cut in halves, with the grain of the wood running in the same direction as the saw. In the centre of the ends thus cut, a hole is bored some one-and-a-half inches deep, with a five-eighths centre-bit, care being taken to have each pair of holes parallel with each other. The holes cross the grain of the wood, and the tenons, being made long and filling the holes the full depth, greatly strengthen the semicircles at their weakest points.

The pillars may be thirty inches long, more or less, according to fancy or requirement. The rails for thirty-inch pillars should be three feet long. They are made from one inch wood, and are turned throughout their whole length, tenons being made on the ends as shown in Fig. 84.

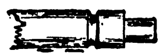


Fig. 84.
ENLARGED END OF RAIL.

A square groove is also made on the rails, some half-inch from the ends and one-sixteenth-of-an-inch deep. This is done with a one-eighth-of-an-inch parting tool. A similar groove is made on the turned parts of the pillars and bottom-pieces, in all cases half an inch from the termination of the turning. See perspective elevation.

The pillars have parts left square to receive the rails. These square parts are equi-distant from each other and from the bottom, so that each pillar has three turned parts of equal length. The squares are two inches long, and have the corners rounded off in the process of turning. In the centre of the squares, holes are bored about seven-eighths-of-an-inch deep to receive the rails. The top rail has its holes bored in the centre of the semi-circular head. This rail, instead of having a close-butting shoulder, as in the case of those entering the squares, should have the shoulder rounded off from near the incision to near the tenon, as it abuts against a curved surface.

The making of this article of furniture is very plain work, only it requires a lathe to admit three feet between centres, and the rails being long and slender are apt to vibrate a good deal. In turning slender rods, allow the work to run through the left hand, only the thumb coming over to the tool, and thus steady the work to the cut of the tool. The back steady, Fig. 59, is thus to an extent superseded.

CHAPTER XI.

EGG CUPS, TIMER AND WATCH STAND.

HALF-a-dozen egg-cups and a stand to hold them is a piece of work which I have found offers excellent practice to a young turner: every part, including the fitting together and polishing, being done on the lathe, the result being a nice shelf ornament, as well as a useful household requisite.

The accompanying illustrations show an egg-cup in process of conversion from the rough block, as in Fig. 65, to the finished cup, as in Fig. 69. Illustrations are also given of an egg-cup stand, and the whole may be found a useful breakfast-table adjunct, when eggs are in season and purchasable.

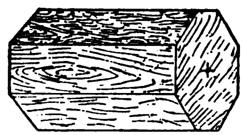


Fig. 85.
BLOCK FOR TURNING.

Egg-cups may be made from plain box, beech, mahogany, and almost any other hard woods. A block of wood, three inches long and two inches diameter, is sufficient to make an egg-cup, but, when turned in a cup-chuck, the block requires to be an inch or so longer.

The first operation is to prepare the block by chopping off the corners with an axe, as in Fig. 85, then to mount it between centres on the lathe, then turn one end down to fit the interior of the cup-chuck (see Fig. 86, also Fig. 87), into which it is driven firmly with a mallet. The poppet head-stock is moved away to the right-hand end of the lathe-bed, the fork-chuck removed, and the cup-chuck, containing the block, screwed on the mandrel-nose.

If on starting the lathe the block is not running true, it must be set true by tapping with the hammer. The process being observed by rotating the mandrel by turning it with the left hand. The block must have a tight hole in the chuck, so that it will not work loose, and get out of truth under the action of the cutting-tool. A tight fit is necessary, as in the event of the work shifting in the chuck, especially towards the finish, the job is very liable to be entirely spoiled.

The first operation is to reduce the block to a cylindrical form, as in Fig. 86, the diameter being nearly two inches. Having done this, cut in the face, or right-hand end, which is to form the mouth of the cup. This is done, as described in a former chapter, by placing, say, a five-eighths-of-an-inch chisel edgeways on the rest, long corner down, and cutting square into the centre.

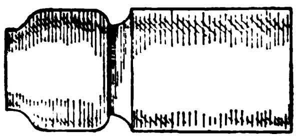


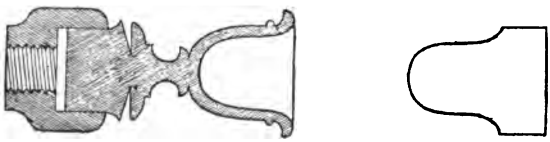
Fig. 86.
BLOCK TO FORM AN EGG-CUP.

This done, the rest is placed across the bed, at right angles to its former position, which will be parallel with the face just cut.

The rest may be placed a quarter-of-an-inch below the centre, and a quarter-of-an-inch distant from the work. The hollowing out of the end wood is next done with a three-eighths-of-an-inch or half-an-inch gouge. The most expeditious way is to enter the gouge exactly in the centre of the work, its back on the rest, holding it level, and exactly at right angles with the face of the work. By pressing it firmly, it will bore a hole, acting like a boring bit, very quickly to the required depth, that is, one-and-a-quarter inches. Then work out the mouth of the hole, slightly cant the hollow side of the gouge towards you, depress the handle, and cut away the wood on the near side, always working inwards to nearly the depth of the central hole. This operation is continued till the internal diameter is one-and-a-half inches, and the bottom having a somewhat hemispherical form.

In the hands of a beginner, the round-nosed tool, which has already been described, now comes into requisition, as the ordinary gouge, unless very sharp and very skilfully handled, makes a rough, torn surface. The round-nosed tool should be very sharp, and held quite level on the rest. It works cleanest by beginning a cut at the bottom and working carefully to the lip of the cup.

Fig. 88 is a thin slip of wood, shaped to fit the interior of



Figs. 87, 88. Section of Egg-Cup and Template.

the cup, and used as a template. The curved part is not circular, but somewhat oval in form. Most people probably consider that it doesn't matter how an egg-cup is shaped so long as it holds the egg, but the egg end is parabolic, or elliptic, and so the slip, Fig. 88, should be of that form, and applied when finishing the interior of the cup thus forming a mould or gauge for the depth and form. By using a sharp tool, the interior surface should be made tolerably smooth. It will be noticed by observing the section, Fig. 87, that the interior, just at the lip, is curved outwards. This part is shaped with the chisel. The diameter inside of this curve should measure one-and-five-eighths inches.

As to the exterior, Fig. 87 will be the best guide. It shows the cup in section not yet cut away from the chuck. The total length is three inches, and the foot or bottom should be cut in with chisel at that, but not deep enough to damage the stability of the work. The finished diameter of the foot is one-and-three-quarter inches; the extreme diameter at the mouth two inches. Beginning at the lip, the outside has first a hollow curve to the bead. This bead is one-eighth-of-an-inch broad, and one-quarter-of-an-inch from the lip. From the bead, the side curves down to the shank, the thickness of the substance of the cup gradually increasing towards the bottom, where it is one-quarter-of-an-inch thick. Feeling with the fingers will determine this thickness very nearly. To give the exterior of the cup a graceful contour, unaided by mechanical means, requires considerable practice and a good eye for forms, as this, like most work in wood-turnery, depends on the eye and hand alone for its beauty of form. The curve of this egg-cup is an out-and-in one from the lip to the stalk, the bead near the lip looking as if added. The bottom of the main curve is ended by a short curve running into it from the opposite direction, leaving the shank half-an-inch thick at this part. The short curve is followed by a scotia, sweeping downwards, then upwards to the fillet on the top of the foot. The narrowest part, at the bottom of the scotia, callipers a little over three-eighths-of-an-inch. The fillet callipers one inch; and the moulding from the fillet outwards, which forms the edge of the foot, is called an ovolo, or thumb.

In the operation of turning the exterior, a gouge is used for reducing to a rough outline. The bead is cut in with a chisel. From the lip to the bead, the hollow is finished with a small, say a quarter-of-an-inch gouge. The chisel does the large curve from the bead downwards, together with the small curve under it. The ovolo on the foot is turned with a chisel down to the fillet, and, lastly, the scotia with a small gouge. If all the turning is nicely cut with the proper tools, very little glasspaper is needed, two grades, No. 1 and No. 0, should be sufficient, not forgetting to paper the interior as carefully as the outside.

To polish the cups before cutting them away from the chuck, first of all wet the work out and in with a sponge and clean water, let it stand till dry, when it will be found to be rather rough, the fibre having risen considerably. Paper again with flour paper, and wipe off the dust with a clean rag; apply French polish with muslin rag and cotton in the usual way, holding it very lightly on the work and rotating the lathe very slowly. A few coats having been given in this way, and then allowed to dry, again paper lightly with flour paper. Now apply one or two coats of spirit varnish with a flat camel hair brush; this should be done in a warm place, as the varnish on getting chilled becomes milky-looking and very unsightly. If the cup thus varnished appears rough, give it a few turns of the polishing rubber, which will materially assist in giving it a smooth, glossy surface.

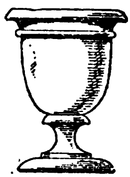


Fig. 89. COMPLETE EGG-CUP.

The cup may now be carefully cut from the chuck, the chuck taken from the lathe-nose, and the piece of wood driven out from the back with a wooden drift and mallet. Fig. 89 shows the complete egg-cup.

The difficulties of producing exact fac-similes offer very good practice. So, when turning half-a-dozen egg-cups, endeavour to have them all alike when placed upon a stand such as that shown in the annexed illustration. The base of this stand is eight inches in diameter on the upper side, around this the six cups are placed equidistant one from another. They are held in place by a pin, or dowel, placed firmly in the base, and a hole, to fit loosely, bored in the bottom of the cup. This base requires a circular piece of wood, nine inches in diameter, cut plankways and chucked on a face plate; it is seven-eighths-of-an-inch thick, and will be somewhat less when finished. The edge moulding is turned with gouge and chisel, both of small size.

As the revolving plate presents side-wood and end-wood alternately at every rotation, the operation is more scraping than cutting, the tools being held level on the rest. It will cut better, however, to have the rest an inch above the centre.

The moulding finished, the T rest is placed across the bed, in order to turn the face of the plate. This is trued by cutting lightly with the gouge, using the left side of the cutting edge, and depressing the handle. After it, the face is finished with a broad chisel, held square on and level, working from the edge to the centre. The face should be tested with a straight-edge, and it should be level. After the plate is nicely papered, it may receive a polish while running, in the same manner as the cups. Then a central hole has to be cut to receive the pillar; this hole is one inch diameter. It is sunk nearly through with a gouge—pretty much after the style of turning inside the cups. A pair of inside callipers are set. Then a side cutting-tool is used, making a parallel hole quite through, when the plate will drop off the face-chuck.

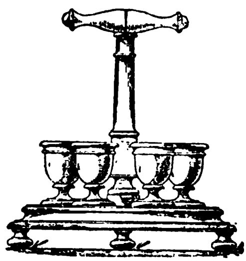
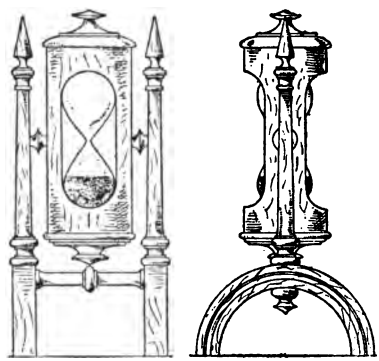


Fig. 90. Egg-Cups on Stand Complete.

The pillar is seven inches long and one-and-three-quarter inches diameter bottom; the thinnest part, near the top, being five-eighths-of-an-inch; its outline is sufficiently indicated by reference to the illustration, Fig. 90, the bottom having a one-inch tenon to fit the base. The cross handle is three inches long and three-quarters-of-an-inch diameter; in the centre it has a half inch round hole bored nearly through to receive a tenon, turned on the upper end of the pillar. The little pins, on which the cups fit, are also turned, they are one-quarter-of-an-inch in diameter, and stand out of the plate half an inch. The cups sit loosely on the pins, so that they may be lifted off without upsetting the stand.

Another useful article is the sand-glass, generally used to denote the time required to boil an egg. The glass itself, containing the sand, may be bought for two or three pence. The stand or holder for the glass is composed entirely of turned work, and, therefore, affords a very appropriate lesson to the young turner.



Figs. 91, 92. FRONT AND SIDE VIEW OF EGG-TIMER.

The wood may be mahogany, rosewood, maple, or other wood, according to fancy.

The piece of wood for the ring which, when cut in two, forms the feet, is cut from material a little over half-an-inch thick, with a bow-saw. It is then fixed on a coned screw-chuck. The circle is finished at two-and-three-quarter inches outside diameter, and half-an-inch square in section. In the centre of the face is a semi-circular hollow, one-eighth-of-an-inch broad. In turning this ring, it should be cut almost through inside, then nicely glass-papered out and in; then it may be cut quite through to the face-plate, when it will drop off. The arras on the inside may then be papered off, and the ring cut exactly in halves with a fine saw. A quarter-of-an-inch hole, to receive the pillar, is bored through the centre of the edge of each half, and also a similar hole on each inner face, to receive the tie-rod. This latter hole is only bored into the former one. The tie-rod is one-and-three-quarter inches long, and at ends and centre is nearly half-an-inch in diameter. It consists of a filleted shoulder at ends, two fillets and a torus bead in the centre. The ends are turned with tenons to fit into the feet. The pillars are four inches long, clear of the circles into which they are fitted. At the bottom and top, they are nearly half-an-inch in diameter, the plain central parts being a little less than three-eighths-of-an-inch in diameter. Their design will be clearly seen from the illustration. Two little drops are turned to fit in the centre of the semi-circles underneath. They have each a tenon to fit into the holes that have been bored through to receive them, and represent a continuation of the pillars, to which they help to give a neat finish.

The body, which is to contain the sand-glass, has the straight part three inches long, and one-and-a-quarter-inches outside diameter. This is a difficult part of the job. Take a piece of wood, fully three inches long, and, with a very sharp one-inch bit, bore a hole quite through the length. Turn a plain one-inch cylinder of pine wood, and fit in the bored piece. Turn down the body to one-and-a-quarter-inches diameter and cut off the ends, leaving a length of three inches, thus forming a wooden tube one-eighth-of-an-inch thick. The tube, removed from the wooden mandrel, has now to have its ends closed by two caps. These are shown somewhat different in design, but they may be alike. These caps are turned from wood running between centres in the lathe so that the grain runs in the same direction as the body piece, and, when fitted on, the whole looks as if turned from one piece. They are made to fit the interior of the tube, which they enter about one-quarter-of-an-inch. When finished, they should project from the body, showing one-eighth-of-an-inch bead, or, more properly an ovolo, all round.

The interior ends of the caps are hollowed to receive the globular ends of the sand-glass, thus holding it steadily and without shake.

The body has to be cut to expose the central part of the glass. This is done by boring holes opposite each other on both sides of the tube part, with a three-quarters-of-an-inch centre-bit; then a sharp penknife will cut away the stuff between the holes, thus making an oblong opening with circular ends. The edges of the opening should be papered. One cap may be glued in, and the glass dropped into the body; then the other cap (which should fit close round the edge, and at the same time hold the glass without shaking) may be glued in also.

Two pivots have to be made, as shown in the design. They are nearly three-eighths-of-an-inch in length, and have a round tenon on both ends, three-sixteenths-of-an-inch diameter, to fit into the body and into the pillars. The body is hung on these pivots exactly in its centre, so that it may have the same position in the frame when reversed. The pillars are bored nearly through to receive the pivots; the body is bored quite through and in the centre of the wood left between the openings. The pivots may be glued into the body, but they must be left to turn freely in the pillars.

This completes the construction of the egg-timer. It may be polished during the progress of turning, or French-polished.

The watch-stand, next illustrated is after the same character, being composed mainly of circles and pillars.

First of all we have the base, five-and-a-quarter inches in diameter, at the broadest part, and three-quarters-of-an-inch thick, supported on three ball feet. It is hollowed out on the upper side, to hold the watch-guard, coiled up. This piece is turned plankways on a face-plate.

Next turn a ring, two-and-three-quarters inches diameter and half-an-inch square in section. This is cut in halves, and has a hole bored through the centre of each half. A small piece is now turned exactly like the pivots above mentioned, and the semicircles are united, back to back, by gluing this piece between them. Two little buttons are now made and glued in, in continuation of the centre piece. Next make two short pillars and fit them into the sole. Then hollow the ends of the semi-circles to fit the straight turned part of the pillars.

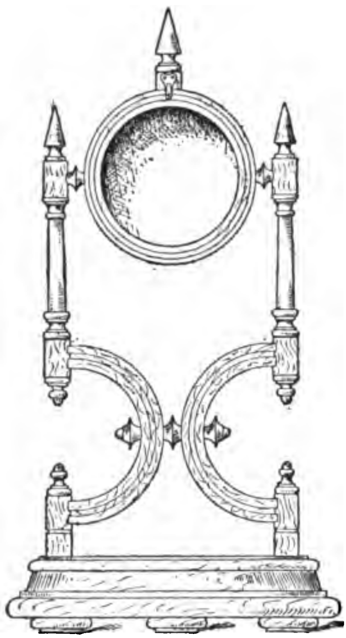


Fig. 93. ELEVATION OF WATCH-STAND.

The pillars have each a hole bored to receive a fine three-quarters-of-an-inch screw, which passes through and enters the end of the semi-circle. The screw-head should be sunk into the pillar and this plugged with a bit of the same wood. The upper pillars are four-and-three-quarters inches long and five-eighths-of-an-inch thick at the straight part, where they join the semi-circles and watch-holder. Their design is sufficiently clear to need no description.

Fig. 93 is the front elevation of the stand complete. Fig. 94 is a section of the watch-holder, which is two-and-three-quarters inches outside diameter, two-and-one-eighth inches inside, turned plankways, the thickness of the wood to make it being five-eighths-of-an-inch. In the operation of turning, it is fixed on face-plate without any central screw, being stuck on with turners' cement.

A piece of wood is fixed on the face-plate; the face of the wood is trued up, thus making a wooden face-plate. While the lathe is running, a lump of cement is held against the revolving face; the friction heats the cement, thus coating the wooden chuck-face. The bit of wood is now held against the still revolving chuck, with its coating of cement. Friction again heats it, and the wood immediately adheres to the chuck firmly. If it runs out of truth, it must be knocked off and tried again. This operation of cementing is only done when a screw hole would deface the job being turned, as in the case in hand. Having got the work cemented on, it must be roughed down with care, as it is apt to become detached, and, if this happens when the work is nearly reduced to a size, it is very difficult to fix it on again to run true.

Fig. 91. SECTION OF WATCH-HOLDER.

Having turned the edge and hollowed out the face, the watch-holder must be nicely papered, excepting the hollow part, which may be left somewhat rough, as it receives a circular piece of velvet, fixed in with glue. It is knocked off the chuck, and the back has to be turned. To do this, fix a piece of pine on the face-plate, true up its face, then hollow out until the finished side of the watch-holder fits in tightly. When made to run true, the back may be finished, as shown in section.

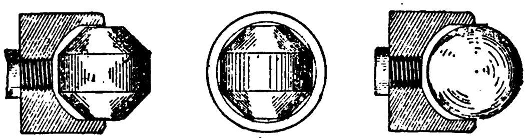
The central finial is made and fitted to the top of the watch-holder. Two pivots are made, same as for egg-timer, one end glued into the centre of each side of watch-holder and the other revolves in the pillars; or the holder may be tilted back to an angle of about seventy-five or eighty degrees and there fixed, by gluing in both ends of the pivots. A little hook is made and fastened to the base of the central pinnacle, for hanging the watch on. It will also be necessary to remove a portion of the beaded rim of the holder, immediately under the hook, to receive the ring or bow of the watch.

After polishing, a little bit of velvet is cut circular and fitted neatly into the holder, and, after fixing with glue or paste, the watch-stand is finished.

CHAPTER XII.

SPHERES AND SPIRALS.

IN turning billiard balls by hand, that is, in the usual way, without special appliances, as spherical slide-rests and such-like costly and complicated apparatus, the first operation is to select a piece of ivory large enough for the purpose. Of course any description of hard wood will serve almost



Figs. 95, 96, 97. TURNING A SPHERE.

equally well for experimental purposes — and, bearing in mind the cost of ivory, it would be as well to content oneself with good sound boxwood on which to make preliminary essays. The rough material is first turned up perfectly truly cylindrical, the diameter and length being equal and identical with that of the intended ball; practically, there is no absolute need to making a true geometrical cylinder, *i.e.*, a circular body of uniform diameter, its ends forming parallel circles. Figs. 95 and 96 show the face and side view of the partly fashioned ball chucked for further treatment. At this stage the work should gauge precisely the same across each diameter. The dotted line in Fig. 95 shows the form of the sphere—the callipers is the best tool to use for the purpose of ascertaining the truth of these various dimensions. It is necessary to mark a fine line round the circumference, exactly equidistant from the two ends; this line can best be made on the work with a hard blacklead pencil, but be sure that the line is *fine* and very distinct, as on this, to a great extent, depends the truth of your ball. Fig. 95 shows the wood chuck in which the work has now to be chucked. It will be seen how the chuck is hollowed out to receive the work, which is held by its eight angles very nearly (but not quite) half way in the chuck; the pencil line must be made to run perfectly true at the outer end, and the work is ready for finishing on the exterior half. With sharp gouges and chisels turn off all that material exceeding the pencil line, and you will have that half of the ball a perfect hemisphere. This is all that has to be done, and, though easily said, it will be found to involve a very considerable amount of manual address, and, in all probability, several blocks of material will be spoiled before a true sphere is turned.

Though the work is chucked firm enough for a careful hand to work at it with ease, yet a clumsy manipulator will be continually catching an angle on the edge of the tool, and knocking the work out of truth. If a "dig in" does occur, the central position of the pencil line must be verified, as its truth is essential to the production of a true sphere.

Every care must be taken to turn exactly to the gauge line and not to allow the tool to obliterate it—it should remain as a witness to testify to the truth of the sphere; it is not very difficult to go so close as to turn *a part* of the line from the surface, though this may appear to be drawing it a little too fine, though in practice it becomes a necessary process.

Having trued up the ball as far back as possible, knock it out of the chuck, and prepare another one to receive that part which has just been turned; that is, hollow out a wood-chuck in the form shown in Fig. 97, but of such a size that the half ball will go into it very nearly as far as it has been turned, and hold firm. This is ensured by making the outer part of the chuck " bite " on the hemisphere at very near its largest diameter only; it is a waste of time to try to fit the half ball into a hollow exactly corresponding with it, and trying to make them adhere by means of chalk, &c. Previous to turning off the angles from the outer half, carefully set the pencil line true, and then repeat the operations performed on the first half. When these instructions have been carried out, the resulting ball will be as spherical as it is possible to make it, though it often happens that, notwithstanding the care bestowed on it, the ball proves to be more or less unsymmetrical, and it is exceedingly difficult to assign a cause for the defects. They may arise from various causes, and amongst those most common may be noted—the want of truth in the chuck, defect in the fitting of the lathe-mandrel, want of exactitude in placing the work in the chuck so that the pencil line runs true, but, probably, the most fruitful cause of error is to be traced to a want of firmness in manipulating the tool.

Long and constant practice at turning spheres is requisite to ensure success. Billiard balls require to be fashioned with the greatest accuracy, not only spherically, but the three forming a set should be identical in size and weight; consequently an inexperienced ball-turner would do well to eradicate the qualifying adjective before trying his hand on costly ivory.

The truth of the ball may be tested by re-chucking it in any other position in the last used chuck, and using a blacklead pencil as the turning tool. Set the lathe going, and notice whether a continuous line is made, if so, it proves the truth of the sphere. A perfectly true ball may lose its symmetryand become somewhat orange-shaped in drying—that is, if the material from which it was made is not thoroughly seasoned; even ivory, though solid and compact in appearance, is liable to alter its form when exposed to the atmosphere. When a ball is proved to be untrue, the only course to adopt is to completely re-turn it, which operation, by diminishing the size, generally detracts much from the value of the ball, and often renders it useless.

An untrue ball may be re-chucked for turning in a wood chuck, made as shown in Fig. 97. The illustration will show the mode of constructing this chuck without any written explanation. A piece of boxwood is screwed on to the mandrel-nose and turned up true; the centre part is hollowed out to receive the ball, the back part being turned away to clear, allowing only the edge to grip the ball, as shown. A little chalk rubbed on the chuck where it touches the ball will often prevent its slipping, but too much must not be used, or it will throw the work out of truth.

A good test for the sphericity of a ball is to pass it through a round hole, of equivalent diameter, made in a piece of flat sheet metal (brass will do very well). Pass through in all directions and mark the protuberant places, which must be alternately exposed to the action of the tool when the ball is in the lathe. Considerable care is required in this latter process, as it is very easy to alter a protuberance into an indentation; and so keep on turning the sphere.

Spiral or twisted work is commonly done on an ordinary lathe. If the lathe has an iron-bed, the operator should lay a piece of wood upon it to prevent the tools being notched. The requisite tools are:—A ten-inch tenon saw (one nearly worn out is most suitable, as it is less springy), an eight-inch rat-tailed rasp, a one-inch paring chisel, a one-inch carving gouge, some fish-skin and glass-cloth.

The first thing to be decided upon is the style of twist that is to be cut. The beginner should not attempt two or three strand twists until he has had some experience in cutting one strand. Having fixed the plain cylinder in the lathe and thrown off the band, mark out the rod to be twisted.

The mode of marking for three strand twist is as follows:—Trisect the rod lengthwise by drawing three lines in pencil parallel to and equidistant from each other. The simplest way of doing this is to gauge the diameter with the callipers, set the compasses to the same scale, and prick the result on a piece of paper; bisect the space between the indentations, and this will give the radius. Set the compasses again, and it will be found that they will mark on the rod a space exactly equal to the sixth of its circumference (this may be proved by making six indentations in a circle round the rod, when it will be found that they make a complete circuit). It follows, then, that two of these sixth parts will be equal to the required third part. This is the simplest and most exact way of marking the trisections, and, when understood, it can be done very quickly.

The lines can be drawn with an ordinary straight-edge. There is no difficulty in getting them quite straight, as the edge will not touch the entire length of the rod (or, indeed, any appreciable part of it) unless it be exactly parallel with its surface. When the three lines are properly marked, set the compasses at about two-thirds the diameter of the column or rod to be twisted (that is to say, if the diameter is one-and-a half inches, set the compasses at one inch). Take the compasses and mark an indentation on one of the lines at the end where the twist is to commence; then, by shifting the points of the compasses, make similar indentations along the line to the end of it. Mark the other two lines in the same way. Next take a piece of chalk in the right hand, and, while turning the lathe-pulley with the left, draw a fine spiral line, commencing at the first indentation on the first line, and passing through the second indentation on the second line, the third on the third, the fourth on the first, and so on to the end of the rod. Then draw a similiar line, commencing at the first indentation on the second line, and another commencing at the first on the third. This completes the marking out.

Now for cutting. Take the tenon-saw in the right hand, and, while turning the pulley with the left, make a cut at a distance of one-third the diameter from the first *chalk* line and parallel to it. The saw must be held at an angle more or less acute, according to the required depth of the groove. Now make a similar cut at a distance of one-third the diameter from the same line, but on the other side of it. These two cuts, carefully made, will remove a small piece of wood. This process of cutting-out small pieces must be continued to the end of the rod, care being taken to keep the cuts as uniform as possible. This will leave an irregular groove, and the next process is to make it uniform. To do this, take the rat-tailed rasp, and rasp out the rough places until a hollow of equal depth is obtained—quite free from lumps—from end to end. Next pare off the edges of the twist; a spokeshave may be used for this purpose, but requires careful handling. A chisel or gauge will be found easier for beginners.

When the edges are as clean as they can be got with the tools, put the band on the lathe, and, while treading the lathe gently, apply a strip of fish-skin to the hollows, using both hands. Use the fish-skin till the rough edges have disappeared, and finish off with glass-paper or glass-cloth—the latter is best. In finishing off, the cloth or paper should be folded round a piece of cork, this will save the fingers. The operator should not attempt to use the tools while the lathe is in motion, or the spiral will be damaged, if not altogether spoiled. When marking out, the band should be thrown off the pulley, so that the action may be free. Fig. 98 shows the lines marked for a three strand twist.

Should any difficulty be found in marking out as described above, a very simple plan is as follows :—Cut a slip of paper (say one inch wide) as long as required, paste one side of the paper, and wind it round the rod or pillar to be twisted. You will now have a spiral. The paper must be laid on evenly, with a space left equal to the width of the paper. The space not covered should be cut out, and finished off in the same manner as above.

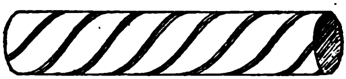


Fig. 98. A THREE STRAND TWIST.

Figs. 99 and 100 illustrate an instrument for marking out a spiral at any angle that may be required. It can be made as follows :—Cut a piece of mahogany, three inches in diameter and five-eighths-of-an-inch thick. Cut off a segment of the

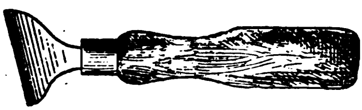


Fig. 99. CUTTER FOR MARKING SPIRALS.

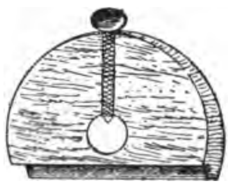


Fig. 100. GUIDE FOR MARKING SPIRALS.

circle, and cut a groove. The blade, Fig. 99, can be made from an old chisel or flat file. A hole must be bored large enough to admit the ferrule part of the handle. The thumb-screw is to fix the cutter at the desired angle. An ordinary tool-handle, to hold the cutter, completes the instrument. In order to use it, put on the T rest, and rest the groove upon it even with the wood to be marked. Having determined the angle you wish to twist, loosen the thumb-screw, turn the cutter round till the desired angle is obtained and tighten the screw. The edge of the cutter should now be touching the wood to be marked. Hold the handle in the hollow of the right hand, and press gently to the work; turn the pulley with the left hand, at the same time sliding the cutter along the T rest. Do not hold the instrument stiffly, but let it work freely at the same time that it marks

CHAPTER XIII.

COPYING-LATHES.

THOUGH turning is usually considered to be the art of producing circular forms, the same term is, however, also applied to the production of prismoidal and irregular forms, and polygon pillars, balusters, &c., among other forms are produced on the lathe. There are widely-different methods of turning these irregular and angular forms. Copying lathes have already been mentioned as employed in the production of such articles as were illustrated at the end of Chapter I. An iron pattern is first provided, and this forms a guide, former or template, which controls the action of the cutting-tool, and causes it to traverse a path precisely coincident. Some cutters act in the direction of the grain of the wood and others at right angles. This distinction forms two classes of machines. Polygon pillars are sometimes made by fastening the wood scantlings to the circumference of a drum, and turning the staves, which have to be re-chucked, in a new position to form each face of the polygon. Each side of the polygon so formed is slightly curved to correspond with the arc of the circles of which it formed part.

Lathes for shaping gun-stocks, boot-lasts and other irregular forms, such as are illustrated in this chapter, are divided into two classes as before mentioned, and a type of each are shown. Figs. 101 and 102 is a lathe manufactured by Messrs. Ransome and Co., of Chelsea, and in it the cutter acts on the wood across the grain. Machines of this class have the advantage of being capable of shaping articles having sudden curves. In machines working lengthwise of the grain, the pattern produced cannot have angular projections, or curves of less sweep

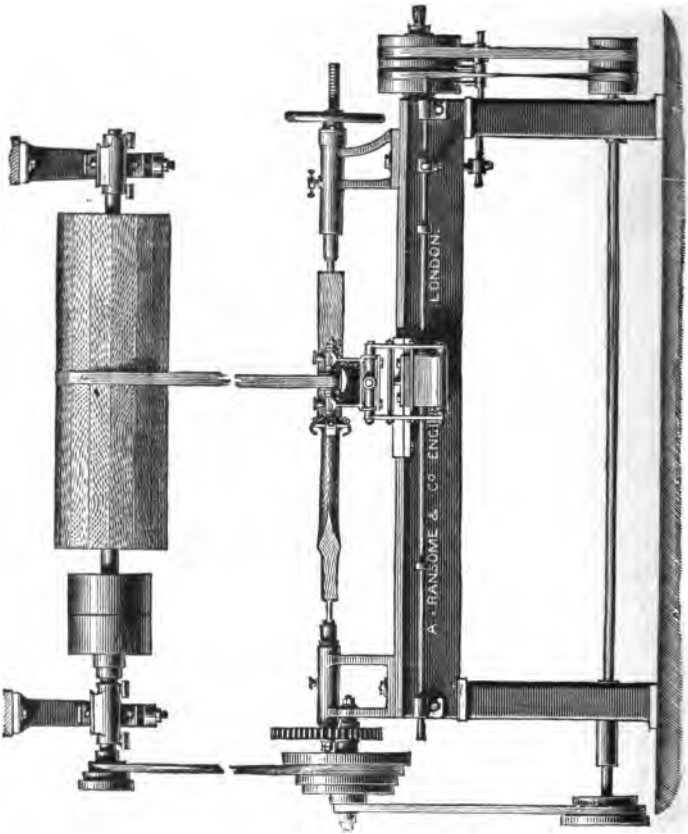


Fig. 101, Front View of Copying Lathe.

than that of the revolving cutter. For many objects this is no detriment, but for some it is an insuperable objection. When the timber being operated upon is knotty, cross-grained or shaky, cutters acting in the direction of the grain are more liable to tear and splinter than those working in the other direction. A superficial reflection might tend to the conviction that the former method would allow the work to proceed faster, and, by analogous comparison with the ordinary hand-plane, cleaner work might be anticipated. Practice, however, proves the contrary. Though the surface left from cutters working lengthwise may appear to be smoother than in the other case, yet the beautiful surface left by a sharp tool in plain turning is not to be surpassed.

The lathe illustrated is designed to turn such articles as are illustrated in the first chapter. Fig. 101 shows a front view, with the overhead-drum brought down towards the lathe-bed, so as to come within the limits of the page. Fig. 102 shows an end view, in which the relative position of the overhead-drum may be measured. The bed of this lathe carries a pair of head-stocks of peculiar construction. They have double centres. The fast-head carries two mandrels, designed to be revolved at a comparatively slow speed, about thirty revolutions per minute being the average. The back-centre has two points corresponding with the mandrels, but actuated independently. This allows any work to be placed between one pair of centres without disturbing that mounted between the other. Practically, the pattern article is mounted between the centres of the further heads, and there it remains till some new form of work is required and the pattern has to be changed. The rough material is mounted on the near head-stocks and removed when shaped.

The cutter which acts on the wood is shown driven by a belt from the overhead-gear. This cutter-spindle is mounted in gun-metal bearings. The cutter-head carries six detachable cutters, which are usually gouge-shaped, but may be formed to suit any especial purpose. This spindle is driven at a great speed, about 4,000 revolutions per minute. The cutters are fixed on the head, about six inches in diameter, giving a velocity of over 6,000 feet per minute at the cutting edge, the six cutters acting simultaneously. This high speed gives very clean work.

The two mandrels, carrying one the pattern, the other the work, are revolved by gear, which is actuated by the pinion on the shaft of the cone-pulley shown on the left of the head-stock. Both mandrels turn in the same direction, making about thirty revolutions per minute. The mandrels need not be fitted in such durable bearings as are required for the usual wood-turning lathe. The slow speed obviates the necessity. The form of head-stock is peculiar, it being a casting similar to the ordinary poppet-head. The barrel covers the mandrel and its bearings, and so protects them from dust and dirt.

The overhead-drum is a long parallel cylinder, which carries the belt to drive the cutter-spindle. As the cutter is traversed along the lathe-bed, the belt follows along the drum in a corresponding manner. The left-hand end of the overhead-shaft carries a small, stepped cone-pulley from which a strap descends to drive the pulley geared with the mandrel.

Fig. 102 shows the left-hand end of the same lathe, but with the belting from overhead unmutilated. It will be noticed that the speed is reduced very considerably in this transmission. The driving-band from the prime-motor takes effect on the pulleys—one fast, one loose—shown to the left of the drum. The handle for shifting the belt is shown on the right.

The shaft on the rear of the standards, near the ground, and extending the entire length of the lathe, is driven from a small pulley on the mandrel-cone. This shaft conveys motion to the leading screw, which actuates the traverse of the slide carrying the cutter-spindle. A pair of belts, one crossed, the other open, are shown on the right; these convey motion to the pulleys on the leading-screw, and give the means of moving the screw alternately in both directions. By a simple arrangement of the belt-shifter, shown on the front side of the

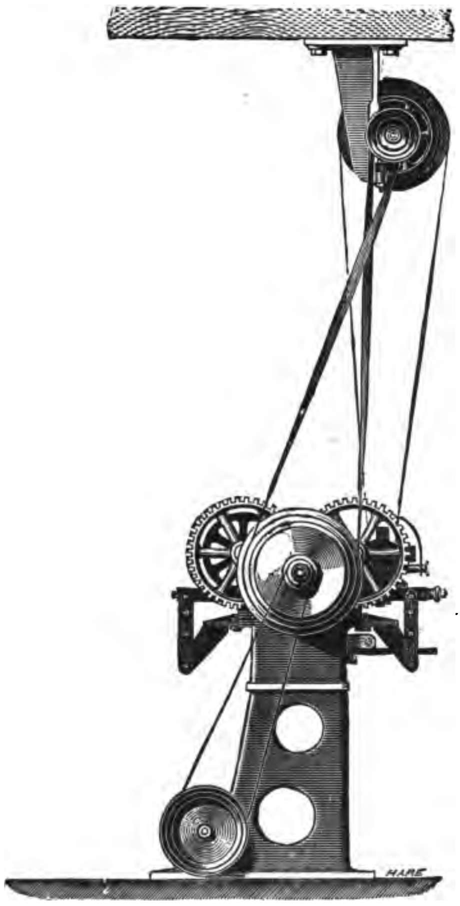


Fig. 102. End View of Copying Lathe.

lathe-bed, the bands are thrown on to loose pulleys and the action of the screw stopped when the slide has reached a certain pre-determined distance, that is, the end of its traverse. This action is automatic, and no time is lost by the operator in watching for the completion of the work. The cutter acts equally well in both directions, so no time is lost in bringing the slide back. In use, the operator puts a piece of rough wood between the centres, starts the lathe, and leaves the tool to do its work automatically. Meanwhile, a second piece of wood is selected in readiness for the time when the slide has completed its traverse, this is known by its stopping. The entire lathe is then stopped, by throwing the driving-belt out of gear. The finished article is taken from between the centres and replaced by a piece of rough material. The lathe is then restarted, and the slide traverses the work in the opposite direction.

The slide travels at the rate of from one to two feet per minute. From twenty to thirty articles can be turned in an hour. The work as left from the above described process is not sufficiently smooth for use. The action of the cutters, combined with the motion of the slide, makes a semicircular spiral groove along the work, leaving a small ridge between adjacent convolutions of the groove. The width and depth of the groove, and corresponding magnitude of the ridge, will be dependent on the form of the cutter and the rate of traverse.

The protuberant material is quickly and effectively removed by means of glass-paper. Machines are made for this purpose, specially provided with endless bands, covered with glass grains, and, with these, spokes, &c., as taken from the lathe, can be smoothed up ready for use at the rate of about sixty per minute.

The slide which carries the cutter-spindle consists of a saddle fitted to the bed and moved by the leading screw, previously described. A light frame, moving at right angles to the bed, is fitted on this saddle. This frame carries a friction-pulley having the same diameter and the same form of periphery as the cutters fixed to the spindle. The spindle-head, with its cutters, occupies precisely the same relative position to the front centres that the friction-pulley does to the back. An iron-pattern, mounted on the back centres, guides the friction-pulley, which is held in contact with a pattern by a spiral spring, shown on the left-hand side of the end view. The slide is moved out by protuberances on the pattern, and it is drawn back by the spring, thus the cutter is moved precisely in accordance with the form of the iron-pattern as traversed by the friction-pulley. The back-and-to motion of the slide is affected by means of a light framing hinged with a parallel-motion. This allows much lighter mechanism than could be used with a dove-tailed slide. The feed of the cutter is arranged by means of a screw attached to hand-wheel, shown on the front side of the frame in both end and front views of the lathe. A shield, to stop the chips from flying about to the annoyance of the workman, is fitted on the slide in front of the cutter.

The lathe illustrated has six-inch-centres, and allows three feet six inches length between centres. It weighs about 15 cwt. A double lathe is also made on which two articles are made at one operation. This lathe is similar in construction to the one illustrated.

A copying-lathe, arranged with the cutters to work in the direction of the grain of the wood, is shown in the full page illustration Fig. 103. It is made by Messrs. Worssam and Co., of Chelsea, who describe it as specially designed for shaping spokes, although it may with equal advantage be used for other kinds of work, such as that shown in Chapter I.

The construction of the machine is shown in the illustration. An iron template is used, and both it and the wood to be shaped are held between the centres; each is made to rotate

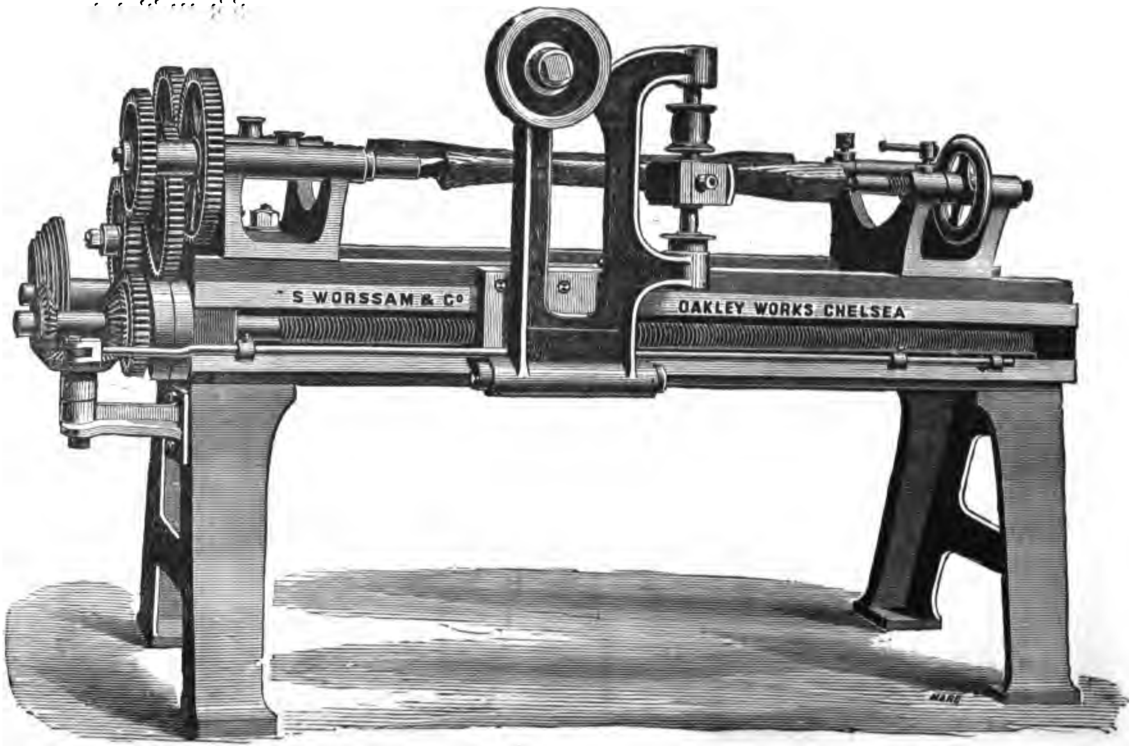


Fig. 103. COPYING LATHE.

at the same speed, and in the same direction, by suitable spur gearing. The cutters, which are fixed to a vertical spindle, revolve in a vibrating arm in front of the machine. This arm

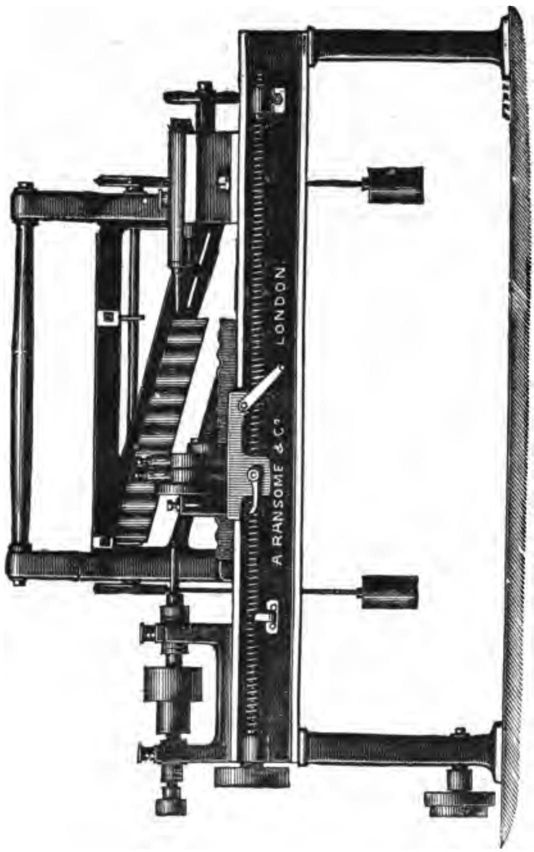


Fig. 104. AUTOMATIC GAUGE LATHE.

is connected with a similar one, which carries a friction roller, kept against the pattern by a weight. A screw, placed along the near-side of the bed, serves to traverse the carriage carrying the cutter and friction-roller. The traversing motion can be thrown in and out of gear automatically by means of the rod, shown running parallel with the screw. The cutter-spindle is driven by a belt from an overhead-drum, which extends the entire length of the working part of the lathe.

Fig. 103 shows an automatic gauge-lathe intended for turning articles, such as chair parts, having considerable and sudden changes of form, and required to be produced in large quantities. The slide-rest is traversed along the bed by means of a guide-screw, and carries a tool which reduces the wood to circular form and fits it to a hole in the guide-collar. Thus steadied, the shaping-cutters act upon the work being guided by a template corresponding to the form required.

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