GETTING THE MOST OUT OF YOUR LATHE

- WOOD TURNING
- METAL TURNING
- METAL SPINNING

Published by
DELTA

GETTING THE MOST OUT OF YOUR LATHE

WOOD TURNING — METAL TURNING — METAL SPINNING

Edited by
SAM BROWN

A Complete Handbook Describing all Branches of Lathe Operation in the Home Workshop with Over Two Hundred Photographic Illustrations and Line Drawings.

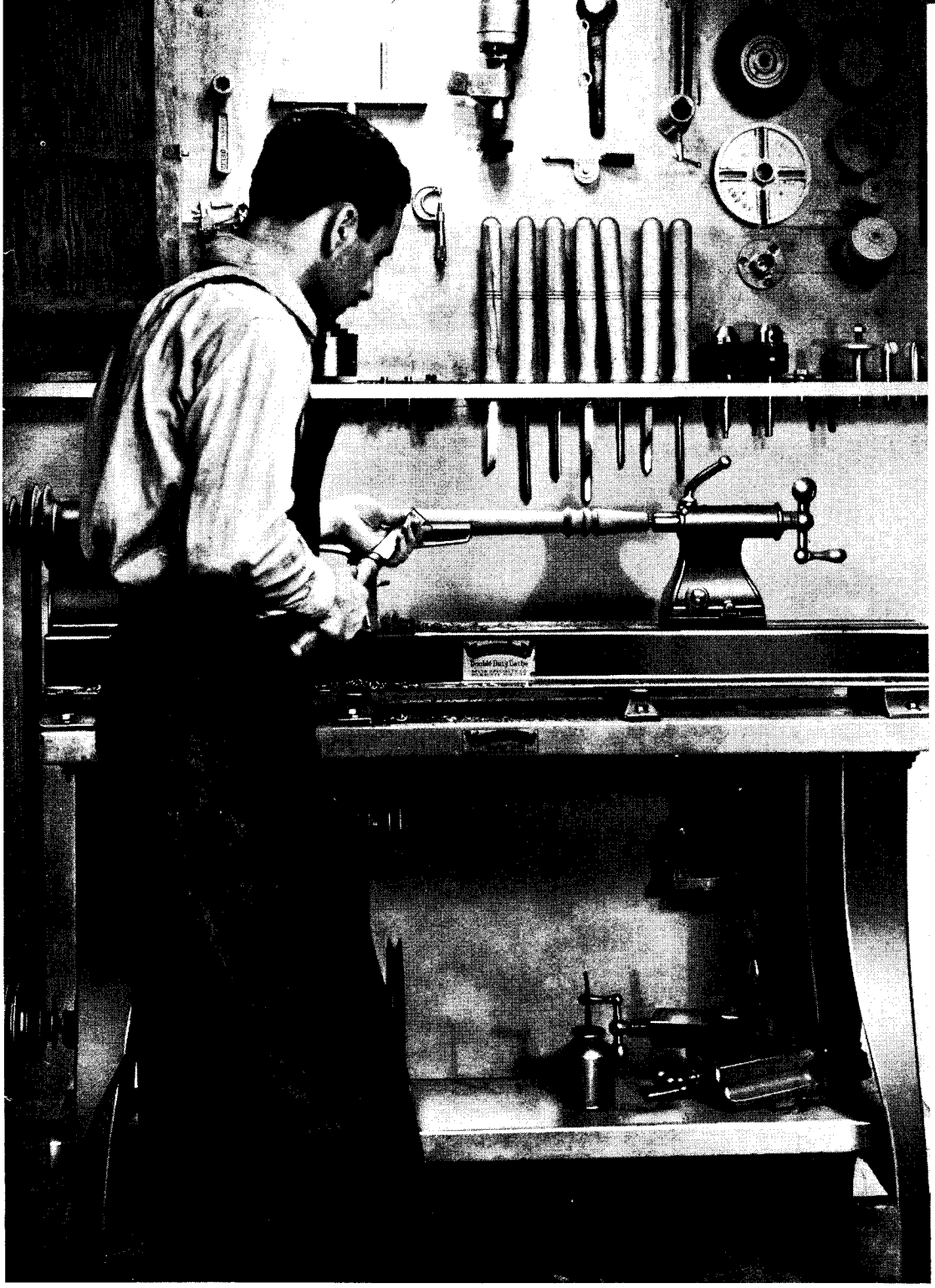
DELTA MANUFACTURING CO.

Milwaukee Wisconsin

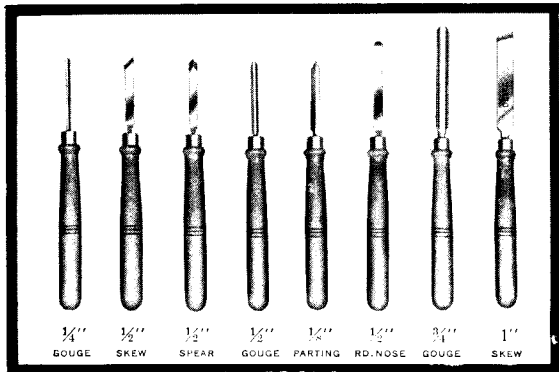
Printed in U. S. A.

Form LB-1135

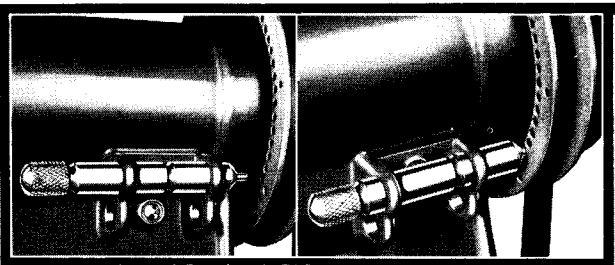
MAIN CONTENTS



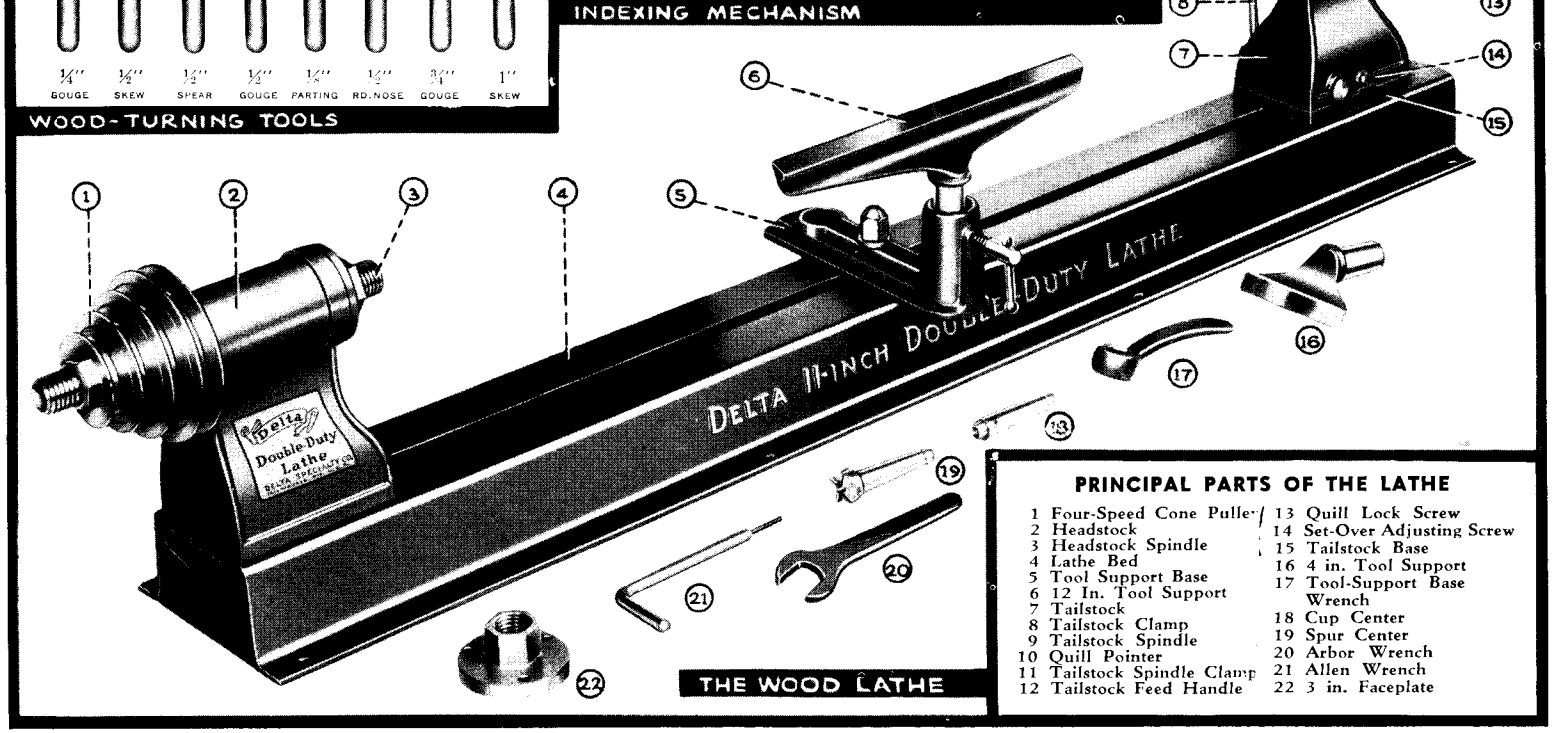
An Important Corner in the Home Shop . . . The Photo Shows the General Working Position of the Operator. Lighting Should Be Overhead. Tools Should be Arranged on a Convenient Panel or Shelves So That Each Piece Is Easily Located as Required



WOOD-TURNING TOOLS



INDEXING MECHANISM



THE WOOD LATHE

PRINCIPAL PARTS OF THE LATHE

1 Four-Speed Cone Pulley
2 Headstock
3 Headstock Spindle
4 Lathe Bed
5 Tool Support Base
6 12 In. Tool Support
7 Tailstock
8 Tailstock Clamp
9 Tailstock Spindle
10 Quill Pointer
11 Tailstock Spindle Clamp
12 Tailstock Feed Handle
13 Quill Lock Screw
14 Set-Over Adjusting Screw
15 Tailstock Base
16 4 in. Tool Support
17 Tool-Support Base Wrench
18 Cup Center
19 Spur Center
20 Arbor Wrench
21 Allen Wrench
22 3 in. Faceplate

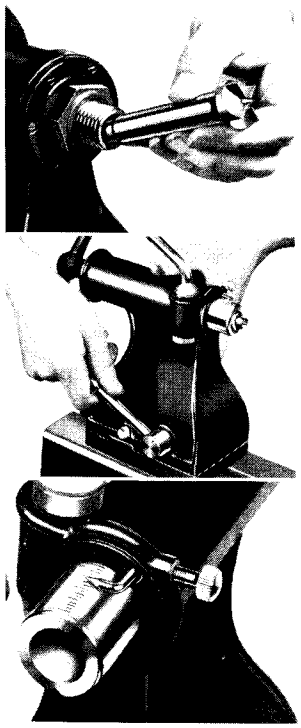
BOOK ONE
WOOD TURNING

CHAPTER ONE
THE LATHE and its EQUIPMENT

WOOD TURNING is a fascinating art, and the lathe, more than any other tool in the shop, is in itself a complete unit capable of producing finished work. The operation of the machine is not difficult, indeed, any beginner can make a creditable turning on the very first try by using scraping methods. True wood turning, however, is a cutting operation, and the acquisition of the necessary skill to fashion turnings quickly and well in this manner demands some knowledge of methods and considerable practice in their application.

The Wood Lathe.—A typical wood-turning lathe with its principal parts named is shown in the photograph on the opposite page. The essential major parts comprise the *lathe bed*, the *headstock*, the *tailstock*, and the *tool rest*. The headstock carries the live or power-driven spindle, and is firmly fixed to the left end of the lathe bed. The tailstock carries the dead or fixed spindle, and this unit is arranged so that it can be clamped anywhere along the bed of the lathe to suit different-length turnings. The tool rest consists of two major parts—the base and the tool rest itself. Different types of rests are interchangeable in the same base, and the whole unit is readily clamped at any position along the lathe bed.

There are two general types of lathe spindles. The one shown in the illustration has a hollow spindle in both headstock and tailstock. The second type has a suitable-diameter arbor on which are clamped or threaded the various lathe attachments. All operations in this book are shown on the hollow spindle lathe, yet it must be understood that these operations can be done just as well on the solid arbor spindle. Both headstock and tailstock spindles have a No. 2 Morse taper hole to take attachments with tapered shanks of the same size. The two main attachments of this nature are the *spur center*, No. 19, which fits the headstock spindle, and is consequently known as the live center, and the *cup center*, No. 18, which fits the tailstock spindle, and is known as the dead center. In operation, the work is mounted between these two centers for turning, the spurs of the live center serving as the driving member.

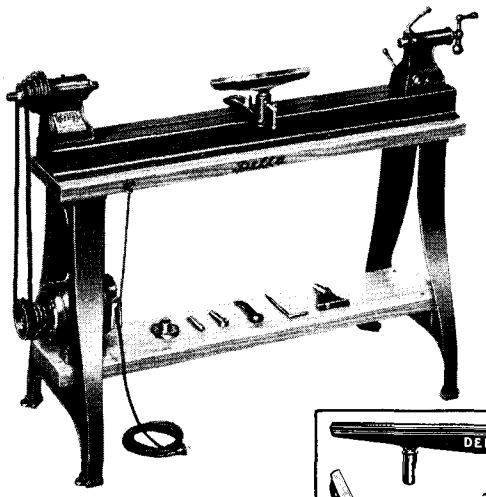


Top, inserting the spur center in the hollow headstock spindle. Center, releasing the tailstock clamp. Bottom, the tailstock spindle is graduated as an aid in taking dimensions.

The headstock spindle is also threaded at either end for mounting faceplates, a right-hand thread being used on the inner end of the spindle and a left-hand thread on the outer end. The most common type of faceplate is about 3 in. in diameter, and has a center hole and three outer holes for use in screw-fastening the work to the faceplate.

The tailstock of the lathe has three different adjustments. First of all, it can be moved bodily along the lathe bed and can be clamped at any position by means of the *tailstock clamp* (No. 8). Secondly, it can be moved within slight limits across the bed of the lathe by means of the *set-over screws* (No. 14). Thirdly, the spindle can be projected or retracted inside the body of the tailstock by manipulating the *feed handle* (12). Any desired position can be fixed by clamping the spindle with the *tailstock spindle clamp* (No. 11).

Indexing Mechanism. — The indexing mechanism consists of two rows of holes, accurately spaced around the rim of the drive pulley. There are 60 holes in the inside row, spaced 6 degrees apart, and 8 holes in the outer row, spaced 45 degrees apart. The sliding pin on the side of the headstock has two positions so that the point can engage any hole in either inner or outer row. The indexing mechanism is used for dividing faceplate work, and for spacing cuts in fluting, reeding or any similar work de-

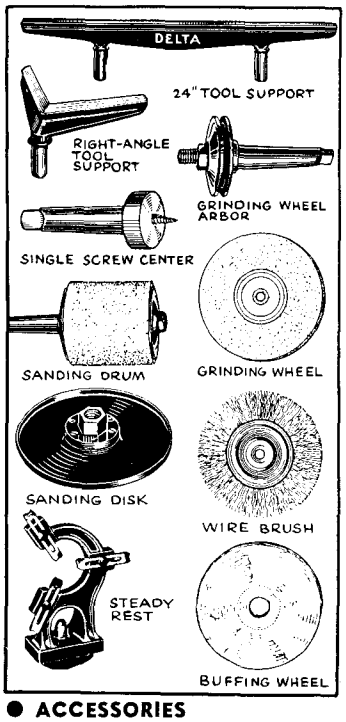


● INSTALLATION

manding equal divisions of space around the turning.

Tools. — The standard set of tools used in wood turning comprises five different shapes. Most important of these is the *gouge*, a round-nose, hollow chisel which is used for roughing cuts, cove cutting and other operations. Next in important is the *skew chisel*, a double-ground, flat chisel, with the end ground to an angle instead of being square across. This tool is used for smoothing cylinders, for cutting shoulders, beads, vee-grooves, etc. The *spear* or *diamond-point chisel* and the *round-nose chisel* are scraping tools which are used where their shape fits the contour of the work. The *parting* tool is a double-ground tool, and is used for cutting-off and for make straight incisions to any required diameter.

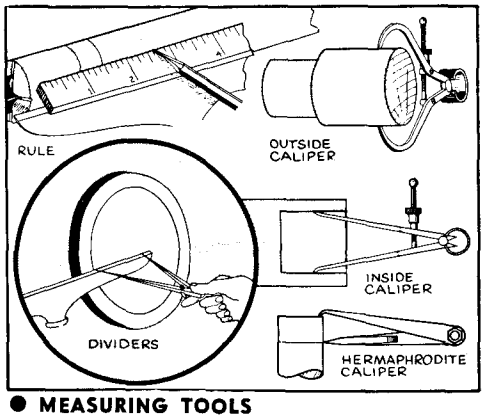
Installation.—The lathe can be mounted on any work bench or on a special bench with steel legs, as shown in the upper photo. The motor can be mounted below or to the rear of the lathe, depending on the method of installation. The motor should be ⅓ H.P., 1750 R.P.M., and should be fitted with a 4-speed cone pulley to match the pulley on tthe headstock spindle. Substantial fastenings are essential. The lathe should be securely fastened by bolts or lag screws to the bench, and the bench itself should be anchored to the floor wherever possible. Raising blocks are often used between the lathe bed and the bench top so that shavings can be easily cleared away.



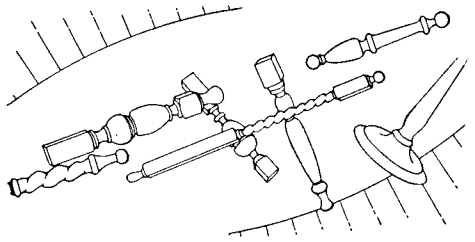
● ACCESSORIES

Accessories.—The drawing in the center of the page pictures various accessories which are frequently used in wood turning. The *24 in. tool support* is invaluable when doing turnings which cannot be covered from end to end with the shorter tool rest. The *right-angle support* is used for faceplate work, and permits operations on both the rim and face of the turning. The *screw center* furnishes a quick and satisfactory method of mounting small faceplate turnings. The *grinding wheel arbor* is valuable as a means of mounting a *grinding wheel, wire brush* or *buffing wheel* in the lathe. Sanding accessories are worthwhile aids, the two most common types being the *sanding drum* and the *sanding disk*. The drum is fitted with a tapered shank to fit inside the headstock spindle, while the disk is threaded to fit the threaded nose of the spindle. The *steady rest* is used as a support for long, slender turnings, or as an end support for shorter work.

Measuring Tools. — Lathe work demands certain measuring tools, namely, the *rule* and *calipers*. The rule is used for taking dimensions along the turning, while the various calipers are used in measuring diameters. Calipers are best of the spring type since they are often applied directly to the revolving stock, and must be depended upon to hold a set dimension when in this position. The dividers are used mainly in faceplate work where they are useful in setting off diameters.



● MEASURING TOOLS



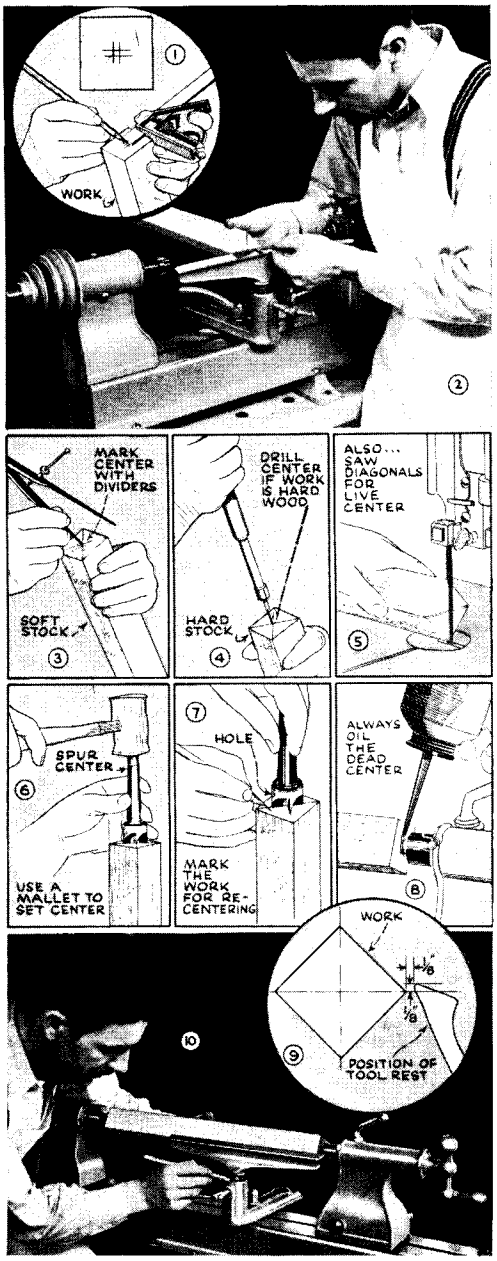
CHAPTER TWO

SPINDLE TURNING

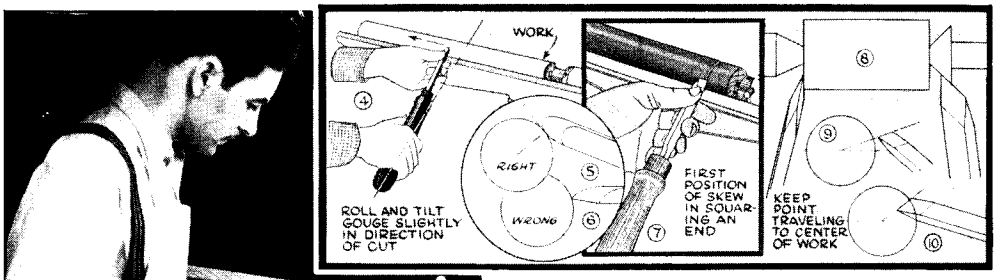
Centering the Work.—Wood stock for any turning which is to be worked between centers must be properly marked before it can be placed in the lathe. The stock should be approximately square, and the ends should be square with the sides. Two common methods of determining the center are shown in Figs. 1 and 2. In the first of these, a distance a little more or a little less than one-half the width of the stock is set off from each of the four sides. The small square thus set off in the center can then be accurately used in marking the true center. The diagonal method, as shown in Fig. 2, consists of drawing lines from corner to corner, the intersection marking the center of the work. The top of the tool rest or any other straight edge can be used in running in the marks.

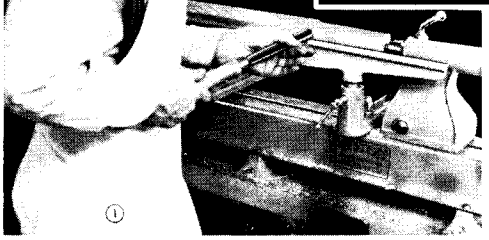
After marking each end, the true center should be definitely marked with a punch awl or with dividers, as shown in Fig. 3. If the stock is hardwood, the centers should be drilled to a depth of about ⅛ in. The spur or live center is then placed against one end of the work and seated by striking with a mallet, as shown in Fig. 6. In hardwood, it is necessary to make a starting seat for the spur center, this being done by sawing on the diagonal lines, as in Fig. 5, and drilling a small hole at the intersection of the cuts. After setting the center, a mark should be made on one of the diagonals in line with the adjusting screw centerhole, as shown in Fig. 7. This permits perfect re-centering of the work at any time. The end of the work which is to take the tailstock center should be oiled, placing the lubricant on the wood either before or after it is put in the lathe, Fig. 8.

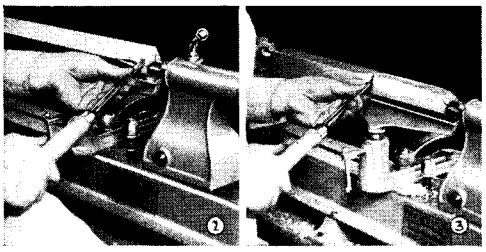
After marking each end of the stock, the work can be mounted in the lathe. The stock is first pressed against the live center so that the spurs enter the grooves previously marked. Next, move the tailstock up to a position about 1 or 1½-in. from the end of the stock, and lock it in this position. Advance the tailstock center by turning the feed handle until the center makes contact with the work. Continue to advance the center while slowly rotating the work by hand. After it becomes difficult to turn the work, slack off on the feed about one-quarter turn and lock the quill spindle. The work is now ready for turning.



Photographs and Diagrams Above Show Various Operations in Centering Lathe Work.







Left, Photos Show Right and Wrong Methods of Making Roughing Cut. The Diagram Shows Points in Handling the Gouge and Skew Chisels.

Tool Rest Position.—The tool rest is now mounted in place, about ⅛ in. away from the work and ⅛ in. above the work centerline, as shown in Fig. 9. This position may be varied to suit the work and the operator, but the rest should never be below the center of the work. A guide mark to show the most suitable working position can be placed on the tool rest shank, as shown in Fig. 10 on the previous page, as an aid to quick and accurate re-setting. Once some experience has been obtained in turning, the proper setting of the tool rest will become almost second-nature.

The Roughing-Off Cut.—The large gouge is used in the first turning operation of roughing-off the sharp corners of the work. Run the lathe at low speed, and hold the gouge in the manner shown in Fig. 1. The cut starts about 2 inches from the tailstock end, and continues from this point towards and off the tailstock end. A second bite is then taken about 2 or 3-in. to the left of the first cut, advancing again towards the tailstock to merge with the cut previously made. This procedure continues until a point about 2 in. from the live center is reached where the gouge is rolled in the opposite direction to carry the final cut off the live center end of the work. The roughing cut should not be carried out with one continuous movement, as shown in Fig 3, as this tends to tear long slivers from the corners of the work; neither should the cut be started directly at the end of the stock, Fig. 2, for the same reason. The cut can be safely carried from the center of the stock towards and off either end once the first roughing cut has been made in the manner previously described.

The position of the gouge in relation to the work involves two or three important angles. First of all, the tool may be advanced along the work either from right to left or from left to right. From left to right or from headstock towards tailstock is preferable, since this throws the chips clear of the operator. The gouge is rolled slightly in the direction in which it is advancing; also, the cutting point should be a trifle in advance of the handle, as shown in Fig. 4. The tool is held well up on the work, with the bevel or grind tangent to the revolving surface, as shown in Fig. 5. It should not be pushed squarely into the work, as at 6, since this position will cause the tool to scrape instead of cut. Once a cylinder has been formed, the proper location of the gouge can be determined by placing the tool with its bevel rubbing the wood, then gently lifting the right or handle hand until the edge begins to cut. The roughing cut is carried out until the work approaches ⅛ in. of its required diameter, stepping up to second low speed once a barely cylindrical form has been attained. The position and handling of the gouge, as described, applies to finish surface cuts as well as roughing-off.

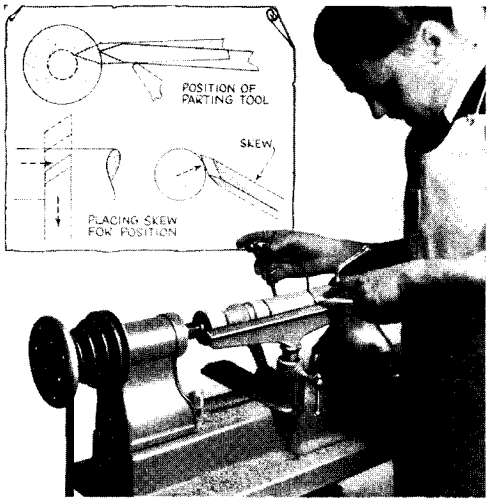
Squaring the Ends.—After the work has been reduced to a cylinder, the ends may be set off or squared to mark the length of the turning. This can be done by using the parting tool, as shown in the sketch at the top of the opposite page; it can also be done entirely with the skew chisel. In the skew method, a light nicking cut is made with the toe of the chisel, as shown in Fig. 7, above, pushing the point directly into the work a trifle outside the required dimension. This cut cannot be made very deeply without danger of burning the chisel, so it becomes necessary to make a "clearance" cut by inclining the skew away from the first cut and again pushing the tool into the stock. This procedure of side cut and clearance cut is continued until as much of the stock is removed as is desired.

At the left end of Fig. 8 on the opposite page is shown the proper position when making the side cut in squaring an end. The essential point is that the grind of the skew adjacent to the end being cut must be nearly parallel with the end surface of the work. There should be just a fractional variation from this plane—enough to allow the toe only to cut while the heel of the grind serves as a fulcrum. The right end of Fig. 8 shows the tool being advanced for the clearance cut. Here, the tool is inclined so that the grind farthest away from the end surface being cut will parallel the intended surface of the V-cut. Here, again, the toe does the cutting, the grind or bevel being parallel with the cut surface but with enough variation to prevent the heel from catching. The heel of the grind again serves as a fulcrum. In both cuts, the cutting edge of the chisel should be advanced in a line towards the center of the work, as shown in Figs. 9 and 10.

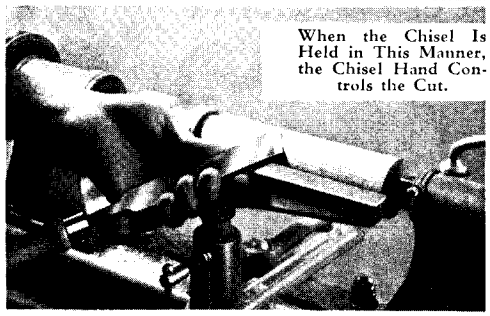
Smoothing a Cylinder.—This operation is done with the large skew chisel. The manner of placing the tool is shown in the sketch above, the chisel being placed well above the work and then brought down until the center portion of the cutting edge makes contact with the work. The handle is then gently raised to enter the cutting edge to the proper depth, after which the tool is advanced evenly along the work. As with the gouge, the skew can be advanced in either direction; also, the cutting point should be slightly in advance of the handle. The heel of the grind serves as a fulcrum, and the handle hand controls the depth of cut by rocking the chisel on this pivot point. The point of contact with the work should be in the approximate center of the cutting edge, although some workers prefer a point a little closer to the heel of the chisel. The two center photographs on this page show the skew chisel in the proper working position, the cut being made from headstock to tailstock. For cutting in the opposite direction, the chisel is simply turned over, as can be seen in the upper diagram.

Using the Parting Tool.—The parting tool is perhaps the easiest turning tool to handle. In use, it is simply placed with its narrow edge against the tool rest and pushed into the work, keeping the lower bevel approximately tangent with the surface of the cylinder being cut, as can be seen in the upper diagram and also in the lower photo. The tool is frequently used with one hand, as pictured in the upper photo, the cut progressing until the calipers slip over the work to indicate the completion of the cut.

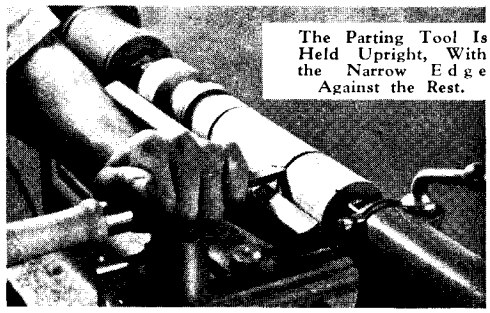
Position of Hands.—In all tool handling, the handle hand takes a natural position, being nearer or farther from the end depending on the amount of leverage required. The position of the tool rest hand is more a matter of individual liking rather than any set or "proper" position. The hand may be held palm down, fingers encircling the tool, and with the wrist dropped so that the heel of the hand below



Freehand Manner of Holding Chisel. The Handle Hand is the Control Hand.



When the Chisel Is Held in This Manner, the Chisel Hand Controls the Cut.



The Parting Tool Is Held Upright, With the Narrow Edge Against the Rest.

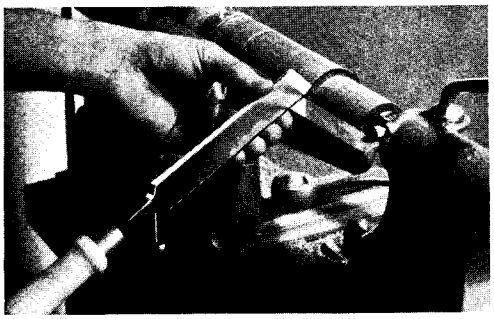
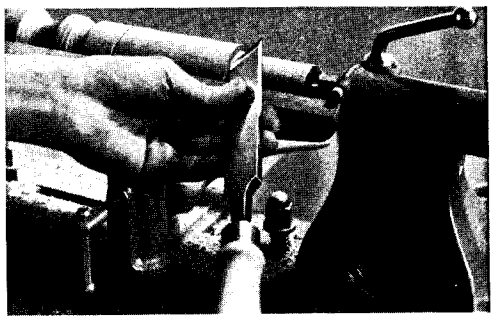


Photo Above Shows How the Skew Chisel Is Held when Making the Side Cut in Squaring a Shoulder.



The Heel of the Skew Chisel Is Used in Making the Horizontal Cut Where It Joins With the Side Cut.

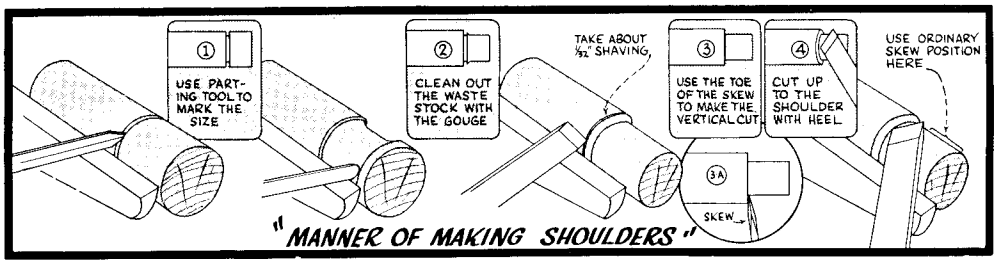
the little fingers acts as a sliding guide along the rest. Again, the hand may be held palm up, in which position the side of the index finger supplies the guide along the rest. In still another position, the wrist is not dropped, but held quite high, the small finger serving as the guide. All of these positions are shown in the various photographs; and the proper one to use is the one which you find most to your liking. Generally speaking: Palm down and a heel guide for heavy roughing; palm up and a finger guide for control and accuracy.

Cutting Shoulders. — This cut is quite similar to squaring an end. The parting tool is first used to reduce the wood to within about one-sixteenth inch of the required shoulder and finished diameter, as shown in Fig. 1. The waste stock is then cleaned out with the gouge, as shown in Fig. 2. You are now ready to actually cut the shoulder. Ordinarily, the small skew is used, holding it in the manner shown in the photograph to the left above. The most important thing here is that the bevel of the chisel next to the cut should be very nearly parallel to the cut, as shown in Fig. 3-A. There should be just a little inclination away from this plane—enough to allow the toe of the chisel to cut and the heel of the grind to pivot on the surface of the cylinder. The exact position demands a careful study with the work directly in hand. The cut taken is about $\frac{1}{32}$ in., and the handle of the skew is gradually raised as the cut deepens to keep the toe towards the center of the cylinder.

The horizontal cut is also made with the skew, but in a little different manner from that used in doing plain cylinder work. If the shoulder is long, the ordinary skew position can be used for the outer portion of the cut, but at the angle between the horizontal and vertical cuts, the heel of the chisel moves into a position tangent between the skew and the cylinder, as shown in the photo to the right and in Fig. 4. In this position, the handle of the chisel is raised slightly to allow it to cut as the tool moves along the rest. A very light cut should be taken in order to produce smooth work. The heel of the skew can be used for making the entire cut, if desired, but the cut, whether in this position or any other position, should not be picked up directly at the end of the stock. It is quite evident that any horizontal cut started directly from the end of the work will have a tendency to bite into the wood, often ruining the entire piece. Always run *off* the end and not *into* it. Where special occasions arise making this procedure impossible, make certain that the chisel is securely held and set for a light cut before touching the tool to the end grain.

If you are simply squaring the ends of a cylinder, you would use the first operation—the vertical cut—until the diameter of the cylinder is reduced to a little less than the size of a lead pencil, as described on page 8. The work can then be removed and completed with saw or knife. Experienced lathe men insert the chisel with the left hand while holding the cylinder loosely with the right, and cut away the work at the live end while the lathe

Diagram Below Pictures Successive Operations in Roughing-out and Finishing a Shoulder.

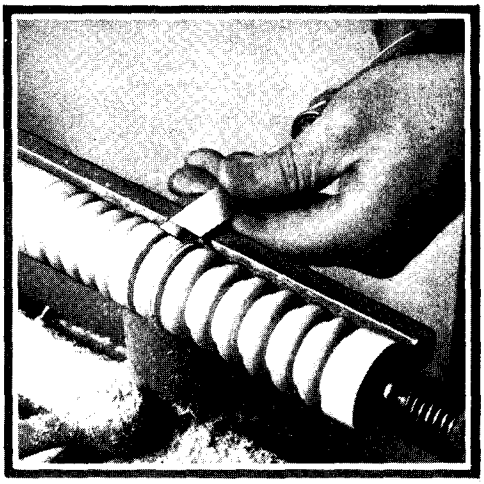


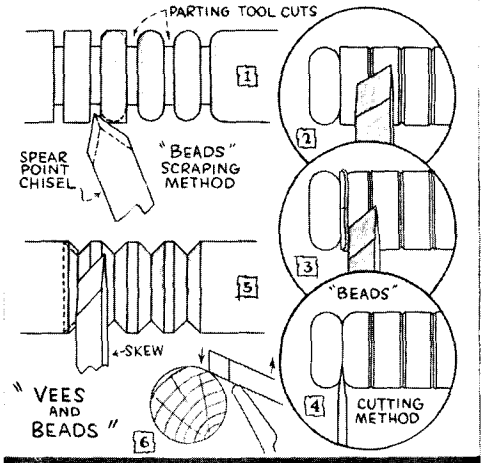
is running. Beginners should simply reduce the work to small diameter and then remove for finishing.

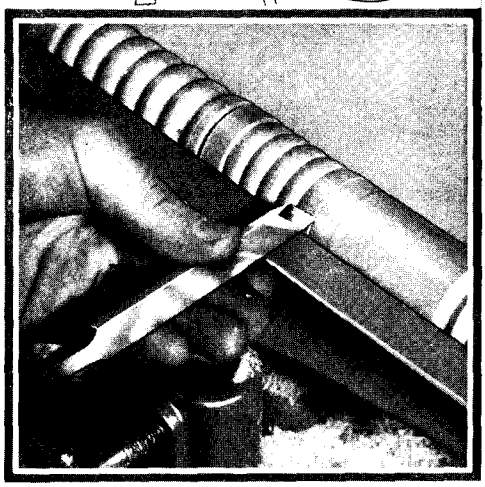
Vees and Beads.—Two methods are used in making beads—scraping and cutting. The scraping method uses the spear or diamond-point chisel, and works to best advantage on beads which are separated by a parting tool cut. This manner of forming beads is very simple—it demands only a scooping action to properly round off the corner, as shown in Fig. 1. This method is also useful in working in tight corners, where the use of the skew chisel might result in a run or bite. Scraping, as a whole, is slower, harder on chisels, and less productive of smooth, clean work than cutting methods.

Cutting beads quickly and accurately is one of the most difficult lathe operations, and craftsmen differ largely on what is proper technique. The usual method is as follows: A deep vertical cut is made at the point where the two curved surfaces will eventually come together. This cut can be made with either the heel or the toe of the skew chisel, the lower photo showing the toe being used. Care must be exercised in making this cut not to burn the chisel by too continuous a pressure. Now, place the small skew at right angles to the work and well up on the cylinder. The chisel is flat on its side at the start, and is evenly rotated through the successive stages of the cut, as shown in Figs. 2, 3 and 4. At the same time, the chisel is drawn slightly backwards so that it will be at all times tangent to the curve. The upper photo shows the cut at the halfway stage. The cut is entirely with the heel of the chisel. The opposite side of the bead is then cut in the same manner.

Cutting full V-grooves demands much the same technique as the cutting of beads. Here, again, a deep vertical cut is made to indicate the proposed bottom of the depression. The chisel is started well up on the work, and the handle is raised to enter the heel of the chisel to the required depth. Only one-half of the V should be cut at a time, then the chisel is reversed to cut the other half. As in all cutting with the skew, the bevel next to the cut must be used as a fulcrum, without, at the same time, allowing the full edge of the







Photos Above Show Cutting of Vees and Beads. The Diagram Below Shows Manner of Making Long Cuts.