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A Comprehensive Handbook on Uses and Applications of the BENCH SAW JOINTER and SHAPER

Containing over 100 photographic illustrations and line drawings

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PLAINFIELD, NEW JERSEY
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WHEN one looks at the very useful and ingenious power driven bench saws which are available today, and compares them with the somewhat “makeshift” affairs of only five or six years ago, it is small wonder that their popularity has increased so tremendously. With the many different types, most of them good, which are offered, one needs only to select the one that meets his particular fancy, or his pocket-book.

Bench saws, of course, are not all designed alike. One will carry its saw blade on a fixed arbor, with a table that raises and lowers. Another type will have a fixed table with a rising and falling arbor. Others will have some still different features intended to promote efficiency or practicability.

Since this treatise is not intended to deal with the merits of various power bench saws, but rather in their use and applications, the subject of design will not be discussed, other than to bring out the following points, which are important.

If the machine has an adjustable table or an adjustable arbor for regulating the depth of cut, assure yourself that the operation of adjusting the machine is not an arduous task, but may be accomplished with a minimum of exertion, and that such adjustment is accurate. The machine should be equipped with a gauge to show the extent of movement possible by such adjustment.

If the machine has a tilting table, the control of such tilting, in the larger and heavier machines, should be mechanical, preferably of the worm or screw operated type, which is positive and easy to operate. In the smaller machines this is not so necessary, due to the comparative lightness of the machine and the smaller sized table. It is rather unnecessary to have all kinds of “gadgets” on a small machine. If there is a gauge to indicate the angle to which the table is tilted, the indicating pin which is used in connection with the gauge should be slightly adjusted so that minor differences in position, when the blade is squared with the table (using a try square), can be corrected.
THE BENCH SAW

If the saw table has a metal insert, assure yourself that it fits flush with the table and may be easily removed.

Whether the saw arbor or the table rises and falls, make certain that provision has been made for adjusting the alignment of the saw with the table. Due to unusual strain, an accidental bump, or other cause, the saw may be knocked out of alignment and provision should be made to remedy it.

On a well designed saw, the arbor should not be threaded for a distance of at least \( \frac{1}{4} \)" from the collar to allow saws to ride on the arbor and not on the threads (dadoes excepted).

See that ample provision has been made for oiling the bearings, whether they be of the bronze sleeve type or of the ball bearing type. While most of the ball bearing types are dust-sealed, nevertheless, they will need oil or grease at some future date, and it is unwise to tear the machine apart to do so. If the machine is equipped with oil cups or grease cups a little injection of either can do no possible harm, no matter how frequently it is given.

See that the miter gauge and ripping guide are heavy enough to be in keeping with the rest of the machine, so as to maintain their accuracy.

Checking Up a New Bench Saw

After setting up your machine according to the instructions of the manufacturer, check it for these points. Regardless of what make machine you buy, or what price you pay for it, check it. Most machines are properly set and aligned when they leave the factory, but rough handling, climatic conditions and other uncontrollable causes are liable to change the alignment, so, make these tests.

Check the alignment of the saw blade with the grooves in the table, in which the miter gauge is guided. To do this accurately, a simple "home grown" test is the best. Attach a piece of scrap lumber \( 1\frac{3}{4} \times 1\frac{3}{4} \times 10" \) to the miter gauge. The miter gauge should be set at \( 90^\circ \). Raise the saw to its greatest cutting capacity. Start the saw blade running and move the miter gauge away from you toward the saw in the left hand groove, until the saw cuts half way through, on the under edge of the piece of wood. Now back the miter gauge away and lift it from the table. Place it on the rear end of the saw table and move it toward you, until the saw cuts the other half way through on the under side of the wood. Inspect the cuts made. If the two cuts meet exactly, the saw is lined up properly. Repeat the test in the right hand groove of the table. If the two grooves check up as being equidistant from the saw you can go to the next checking operation. If they don't, make adjustments of the saw arbor until they do, before attempting anything else. The miter gauge with one of the stop bars, may also be used to check the alignment of the saw with the slot.

Now, set the miter gauge at exactly \( 90^\circ \), and with a piece of wood at least 6" wide (8" is better) held tightly against the gauge, cut one end of it off, then check the squareness of the cut with an accurate try square. If it does not show up correct adjust the miter gauge slightly and make another cut, or yet another adjustment and cut until the cut is accurate. Then bend, file or adjust the indicating pointer to point to the \( 90^\circ \) mark.

The next thing to check is the alignment of the ripping guide with the saw. Now, since the saw is correctly aligned with the slots in the table, it is only necessary to align the ripping guide with the slots. This alignment should be checked periodically.

Now adjust the saw table to \( 90^\circ \) with the saw blade, then at \( 45^\circ \) with the saw blade, and adjust the stop screws which are provided for this purpose. The table may then be quickly set to either of these oft-used angles without the
add the labor of always getting these adjustments. See that the
 guard mechanism is properly adjusted so the guard will clear
 saw blade sufficiently. If saw is
equipped with a splitter be sure
that it is directly in line with
the blade.

The machine may now be con-
considered as being ready for use.

Squaring the saw blades with the table.

Best Location in Shop

When installing your saw, give its location in your shop seri-
ous consideration. The best possible place is in the exact center
of the working space. The size of material you can cut is limited
only by the size of the room. It is obvious, that if a saw is
mounted in front of a wall, the distance from the saw blade to
the wall is the longest piece you can cut. The practice of ripping
half way through a piece of board, reversing it and completing the
cut from the other end, is not good machine practice. Locate the
machine so that other machines or benches are not in the way
when ripping or cross-cutting large pieces. A little care in plan-
ing at installation saves considerable annoyance later, and it is
also productive of better and more satisfying work.

Speed, Power and Installation

Technical handbooks give as the safe speeds at which circular
saws for wood may be run, as follows:

7" diameter—5000 R.P.M.
8" diameter—4500 R.P.M.
10" diameter—3600 R.P.M.

Practically all present day bench saws are designed for lower
speeds than these. Most saw manufacturers recommend speeds
varying from 3000 to 4500 R.P.M. for any of the above.

To figure the size of pulleys necessary to obtain certain speeds
the formula is

\[
\frac{\text{Speed of motor} \times \text{diameter of motor pulley}}{\text{diameter of saw arbor pulley or speed of saw required}}
\]

Example. To obtain 3500 R.P.M. for the saw with a 1750
R.P.M. motor and a 4" pulley on the motor.

The formula then is stated as:

\[
\frac{1750 \times 4}{2} = \frac{3500 \times 3500}{7000}
\]

which works out to

\[
\frac{1750 \times 4}{2} = 3500 \times 2
\]

or 2 (which indicates that the other
pulley should be 2" in diameter.)

If we know the speed of the motor and the size of both motor
and saw arbor pulleys, the equation reads

\[
\frac{1750 \times 4}{2} = 3500 \times 2
\]

Theoretically it takes less power to keep a saw running and
doing the same work at 4000 R.P.M., than it does at 3000 R.P.M.,
but because of the comparatively small diameters of blades used
in present day bench saws, this factor is of little account. A more
important factor in the power of a saw, is the weight of the rotor
in the motor, its power and speed, and the correctness of the belt
tension.

It is usually good policy to follow the recommendations of
the manufacturers of the machine as to what motor should be
used with it. They are interested in your getting the greatest
possible service from the machine.

In order for a motor to transmit its power to the saw, it must de-
depend on friction. The modern "V" type endless belt has overcome
most of the difficulties of the old style flat belt. But to get the great-
est amount of service from "V" belts, they should be used on pul-
leys of ample diameter. Present day machines are too often equipped
with pulleys that are too small, in an effort to gain "capacity of cut." An 8" saw that has 3"
capacity, but will not cut over 1\(\frac{1}{2}\)" without the belt slipping is
not as serviceable as an 8" saw with 2\(\frac{1}{4}\)" capacity that will cut
2\(\frac{1}{4}\)".
Motor Must Have Ample Power

The machine should be equipped with a motor powerful enough to cut wood as thick as the capacity of the saw will allow, and the saw blade should be at its greatest height at all times when sawing completely through any thickness of wood, since less power is needed than if the saw is adjusted to just a little higher than the thickness of the wood.

Of all the machines in the shop the circular saw requires relatively the greatest amount of power. This being a fact, serious consideration should be given the type of electric equipment to be used—the horsepower of the motor and whether or not the electric wiring is heavy enough to supply sufficient current.

Except for very light work, with a small diameter saw, no motor of less than 1/2 H.P. should be used. With 7" or 8" blades when material up to 2" thick is to be cut, best results will be obtained with a 1/2 H.P. motor. If driven from a line shaft, allowance must be made for power loss in the hanger bearings, by using a heavier motor. The ideal set-up is with an individual motor. 10" saws almost invariably require a 3/4 H.P.

If Motor Does Not Pull Well
Check up on Your Wiring

The well-designed 1/2 H.P. motor will pull at least one and one half times its rated horsepower, which means that when pulling a capacity load with an 8" saw, the motor is drawing close to 10 amperes. If the motor is plugged in on a circuit already loaded with lamps or other appliances the line will not supply enough current for the additional load. The result is a drop in voltage and the motor, struggling to carry the load, becomes overheated. Very frequently perfect motors are condemned for not pulling properly when the trouble actually is in the house wiring.

If the shop is to be operated on the house circuit (it is always better to have a separate line direct from the meter) the line should be at least as large as No. 10 gauge wire.

Motor failures and loss of power due to motor defects are not at all common. If you think yours is defective have an electrician check your current with a volt meter, first with no load and then with a load. Without the load the reading should be approximately that shown on the motor plate. With a full load the line voltage should not fall more than 5%.

Individual Motor Bases

A recent development, the individual motor base, is very helpful in supplying full power to each machine. Extra mounting rods and brackets (part of the base illustrated) are mounted behind each machine and the motor with notched base moved from one machine to another as required. This prevents power loss caused by shafting and hangers.

Types of Saw Blades and Their Uses

The mainstays of the experienced machine saw operator are a good rip saw and a good cross-cut saw. For the operator who is alternately ripping, cross-cutting or mitering, one of the several good "combination" saws is satisfactory, since it saves considerable time, but it will neither rip as fast as a rip saw, nor cut as clean a cross grain as a cross-cut saw. There are also available, so called "planer saws," which are hollow ground to offset the teeth having no "set." This type of saw requires more power to operate than any of the other three types mentioned, but makes a very smooth cut that does not need "jointing" if the board is to be glued to another board. Using this saw, however, does not mean that it does away with the planing or jointing of the board for a finishing edge.

There are also available to the craftsman special "fast cut" saws, similar in action to the "combination" saw. It also is a good type of saw for the operator who is continually changing from one type of cut to another.

Then, there are also blades known as grooving saws and dado heads. Grooving saws form the two outside members of a dado, while the inside members or "chippers" are two tooth types, of different thicknesses, which may be added to make different widths of cut. These "chippers" are only used in conjunction with the grooving saws, never by themselves.
Among other special saws which have "specialized" uses, are lock-corner saws, and hollow-ground fine tooth miter saws, but since these are adapted to only the particular work for which they are designed, it is unwise for the craftsman to invest in them, unless he has considerable of the special work to do. For all general purposes, a good rip saw, a good cross-cut saw, and a good “combination” saw, together with a dado head that may be built up to 7/8” will give you a range that can handle practically all the work you may expect to do.

Mounting the Saw

When putting a saw blade on the machine, first wipe any sawdust from the arbor and collar. Then slide the saw on easily so as not to damage the threads. Teeth of the saw should point down at the point where they extend through the table (nearest the operator). Put on the retaining collar and nut and screw the nut up tight, so the saw will not come loose. Rotate the blade by hand to make certain that the saw clears the groove in the table.

Note—Before any sawing is done, take the time to attach to the ripping guide a piece of wood, at least 1/2” thick, about 3” wide and long enough to reach from the front of the table to the back edge of the saw blade. The ripping guides on some machines are provided with screw holes for this purpose. Should you accidentally run the ripping guide into the saw, no damage to the saw will result, while running a metal guide into the saw would result in ruining the blade.

Sharpening and Care of Saws

A dull saw is a constant source of annoyance, is hard on the machine and the motor. And it will not produce clean work.

The first operation in sharpening a circular saw, regardless of type, is to "joint" the saw. This is done by holding a hard emery stone, resting on the table, against the teeth and rotating the saw by hand, not by power, and rotating it backwards, until all the teeth have been "touched." Then remove the saw from the machine.

Make for yourself a saw clamp as illustrated. On the top of the back board put three guide marks, one at 90° from the face of the saw and two at 45°, for guidance in filing.

On a rip saw the front edge of all teeth are filed straight across, while the top of the tooth has a very slight angle, about 2° instead of flat, every alternate tooth having the bevel opposite to the preceding adjacent tooth. This type of filing tends to make the saw cut cleaner and easier.

When filing a rip saw, go all the way around the saw, filing the front edge only lightly. Then file alternate teeth on the top, with the end of the file nearest you lower than the farthest end. Reverse the saw in the clamp and file the other teeth the same way.

On a cross-cut saw, the teeth are filed at an angle of 45°, every alternate tooth being opposite to the preceding adjacent tooth. First go all the way around the saw, taking every other tooth and make about three strokes to each tooth, no more. Then reverse the saw in the clamp and repeat the operation, but filing by the other 45° angle mark from the first. If the saw is not sharpened sufficiently, repeat the operation on both sides, this time making only two strokes. If necessary, repeat around the saw, making only one stroke per tooth, until all teeth have been filed down to remove the "flat" left by the "jointing." By this method of filing a more satisfactory job will be obtained than if one attempted to file each tooth to the necessary depth to remove the "flat."

If the saw has to be filed considerably to remove the "flat" it will be necessary to "set" the teeth. This should be done just before the last "touch up" filing is done, not after the saw has been sharpened. One of the numerous saw sets (which may also be used on hand saws) should be purchased for this purpose.
THE BENCH SAW

On a “novelty” or combination saw and on dado outside saws, the teeth are arranged in groups of four or five teeth each. The first tooth which is usually a “chipper” or “raker” tooth, is filed straight across the saw, and is 1/32” lower than the cross-cut teeth. File all the raker teeth first. Then file all the cross-cut teeth, following the same routine as on a cross-cut saw. On a dado head, all the chippers or rakers should be filed to the same cutting diameter. After filing a dado head, mount the complete head on the saw arbor and try it out on some scrap wood. If properly sharpened, it should make a groove like “A” in sketch. (This has been slightly exaggerated to make it clear.) If the cut looks something like “B,” examine all the chipper teeth to find out which one or more are longer than the others and file it down slightly. Use this file-and-try method until the groove cut is smooth, with only four “scratch like” lines showing from the cross-cut teeth of the outside saws.

The same procedure is followed in sharpening a hollow ground “planer” saw, except that the teeth are not “set.”

Ripping

The bench saw is probably used more for ripping wide boards into narrower pieces, than any other operation. It is the simplest of the operations and at the same time it relieves one of the tedious task of hand ripping.

The setting of the ripping guide by measurement of the distance from the saw blade to the ripping guide, or by setting the ripping guide to a graduated bar on the table, is a simple matter. Obviously, the graduated bar should be checked frequently for accuracy in its relation to the saw.

The height of the saw above the table in relation to the thickness of stock being cut is an important point in ripping. The saw should always be high enough to have several full teeth projecting above the wood at the point above the arbor. This is necessary for the blade to free itself of sawdust. Unless the teeth project through dust will not be able to get out, resulting in binding and overheating the blade. You will note that when ripping without a saw guard, that the higher the saw is adjusted, the more sawdust it will throw up in your face. You will also find the higher the saw is adjusted, the more accurately the ripping guide must be aligned with the saw blade.

When ripping pieces where the distance between saw blade and ripping guide is less than 3”, use a pusher stick, which should be a specially made one, hanging always convenient to hand, rather than a “pick-up” scrap of wood. The “scrap of wood” is not always there when needed and the dangerous practice of pushing narrow pieces through with the fingers is resorted to.

After ripping a piece of wood, examine the surface of the cut on both pieces. If one appears considerably rougher and shows deeper saw grooves than the other this may be traced to two causes. Either the ripping fence is not properly aligned with the saw, or the wood warps as it passes the blade. The answer to the former is obvious, while the answer to the latter is to install and use a splitter, if procurable. On the best present day saws the splitter is incorporated into the saw guard.

Resawing

Resawing, or the cutting of boards into thinner boards, comes under the heading of ripping. When the piece to be resawed is less in width than twice the capacity of the saw, the blade should be set to just a little over half the width of the board, rather than do most of the ripping from one edge, and only a little from the other. For example, we have a board 4” wide x 3/4” thick, which we desire to resaw into two boards 4” x 5/16”. (Our blade will waste about an eighth of an inch.) The capacity of the saw is 23/4”, but we only set the blade to cut 23/8”. This leaves 1 3/8” for the second cut, which is sufficient stock to prevent squeezing together and binding the blade with the result of cutting a groove.
in the piece on the left side of the blade. Where the width of the board to be resawed is greater than twice the capacity of the machine, make cuts as deep as possible from each edge, then finish ripping by hand or by band saw. The important thing to remember when resawing is to keep the same surface of the board against the guide for both cuts; i.e., reverse the board end for end and not side for side.

The cutting of such items as tapered legs comes under the heading of ripping. If the operator will take the time to make for himself a taper cutting jig, this operation becomes as simple as ordinary ripping. The sketch shows such a jig and its construction.

In operation, the gauge block is set for the amount of the taper on one side of the leg. Two adjacent sides of each leg or piece to be cut are run through. The gauge block is then set for twice the amount it was first set, and all the pieces to be cut are run through, cutting the remaining two adjacent sides.

Ripping, with the table tilted to any desired angle, is accomplished just as easily as ordinary ripping.

Crosscutting

In cross-cutting, accuracy is dependent on several additional factors, not the least of which is the operator himself.

Since the miter gauge which is supplied with most bench saws does not exceed 7” in length, it is obvious that considerably more effort is required to hold a board several feet long against such a short surface with any degree of accuracy. One of the first things an operator should do, upon acquisition of a bench saw, is to attach a straight piece of wood, preferably laminated to prevent warpage, to the miter gauge. (Shown in use.) This piece should be at least 18” x ¾” x 2” high. Near the lower edge, to the left and right of the gauge, run a wood screw through, to project about 1/16”, then file the end of the screw to a point. The edge of a board pressed against these points will not readily slip, and the small indentations they make are not objectionable, in most work.

To do accurate work in cross-cutting it is essential that the miter gauge be checked and set to cut a right angle accurately first, after which it will automatically cut other angles to which it may be set. The indicating pointer may be filed to offset any slight inaccuracy or with some saws, may be adjusted to a perfect accuracy.

When holding boards against the miter gauge for cross-cutting or mitering, the pressure of the left hand should be directly across the board from the pivot of the gauge and not near one end of the face strip, so that no tendency to spring the face strip would be present, causing an inaccurate cut.

If the board which is to be cut off is wider than the distance from the front of the saw to the front of the table, reverse the miter gauge in its slot, as the illustration shows. The practice of holding a wide board against the gauge and letting its front edge come down on the saw is productive of pinched fingers and should be avoided. If the board is entirely too wide to be included in the capacity of the miter gauge, the ripping guide may be used, but do not under any circumstances, use the ripping guide as a gauge for cross-cutting narrow pieces, or for gauging the length of the piece cut off.

The right hand holds miter gauge, left holds stock firmly against it.

Reverse the miter gauge and use it against the leading edge of the board for wide stock.
There are usually furnished with a miter gauge, several metal rods, which are used to regulate the length of pieces being cut off. When the miter gauge is used in the left hand table groove no part of these rods should extend past the miter gauge on the right. When the miter gauge is used in the right hand table groove, the reverse is true. The illustration at the right shows the correct way of using these gauge rods, when cutting off a number of pieces to a given length.

Mitering, or cutting boards across the grain, at an angle to the edge is cross-cutting, and is done in the same manner. The most used angle is 45° to form a four-sided frame, 30° to form a six-sided frame and 22° 1/2° to form an eight-sided frame.

Table Extensions

Table extensions for enlarging the working space on the saw table are now available for most machines. They attach to both sides of the standard table and some attachments are provided for the part of the table to increase the table area in front of the saw blade. Extensions are very helpful and usually well worth the small extra investment required.

Moulding Making

The practice of making "makeshift" mouldings, by "forcing" a piece of wood diagonally across a circular saw blade, and "chewing" a section out of it, is not good circular saw practice. It is far better practice, if one is forced to make a moulding of this type, to remove as much stock as possible with successive cuts of a dado head and finish the shape with a hand moulding plane.

The use of moulding heads of the loose cutter type, in bench saws, unless the head is of a safety type approved by woodworking manufacturers, is not recommended. And again, the type of mouldings that would be beyond the capacity of a bench shaper,

necessitating their being made on a bench saw with a moulding head, come under the head of architectural mouldings and may be purchased for a small increase over the wood alone.

Further, a "coping head" or moulding head, for use on a bench saw must necessarily be at least 4" in diameter to be of any use and unless it is sufficiently heavy to withstand the strains imposed upon it, is more or less hazardous.

Dadoing and Rabbeting

First let us point out the fact that a bench saw is essentially a labor saving machine, and is not intended to produce finished work, as do the jointer and shaper. The very design of the cutting members or tools designed for use on the bench saw, such as dado heads and groovers show intention for rough work only; that is, there is no attempt made to eliminate tool cuts.

In a properly designed dado head, as explained in the chapter relating to the sharpening of saws, the cutting teeth (those shaped like cross-cut saw teeth) sever the fibers of the wood, and the chippers follow with a chisel-like action, chipping out the wood thus severed. If you will examine the illustration of the result of a correctly sharpened dado head, you will notice four distinct grooves, formed by the cutting teeth. These should always be present in a cut made by a dado head. If, on the other hand, there are other unevenesses present, they indicate incorrect sharpening of the dado head, and should be remedied. If the groove to be cut is on the outer surface of a piece of lumber, where it will show on the finished piece, don't use the dado, but do that work on a shaper. Dado heads usually include, in a set, two outside saws usually about 1/8" thick each. There is no set on any of the teeth on these saws, the idea being to make a smooth cut, with little or no tool marking on the sides of the cut. In some cases, these saws are hollow ground, particularly for deep grooving.

The inside chippers usually consist of one 1/4", two 1/8" and one 1/16", these dimensions indicating the thickness at the hub.
The actual cutting portion is widened out or “swaged” to a greater width, so as to lap over the adjacent cutter or saw. For this reason, the “swaged” portion of a chipper should always be so placed as to come in the “gullet” of the adjacent cutter or saw. Then too, the chipper teeth in a group should be staggered around the circumference, to distribute the cutting effort more evenly. This tends to give smoother running and cutting. The illustration of a correctly set up dado head shows clearly how this is done.

To set up a dado head on the bench saw, first clean off all sawdust that may have lodged itself on the saw arbor. In a dado head there is quite a mass of metal revolving at a good speed, and if it is not running true it can set up a terrific vibration.

Put on first an outside dado saw, then as many chippers as necessary, then the other outside saw to make the width of cut desired. Never use the chipper blades by themselves; always use the outside saws with the chippers between.

The regular stock dado head is usually furnished to cut a 13/16” width of cut, variable from 3/8” to 3/4” and then by sixteenths up to its capacity. Various widths of cuts are made by various combinations of saws and chippers. Example: to cut a 7/16” dado, the two outside saws—the 3/8” and 1/16” chippers would be used. Note that the thickness of a chipper is measured by that portion at the shaft—not the cutting edge.

If the total width of the finished cut is over 13/16” or beyond the capacity of the dado head, set up your dado head to a little more than half the total width, and make it in two cuts, lapping the cuts at the center. There is less tendency for the dado head to “creep” under a heavy cut than a light cut. If the total width is beyond twice the capacity, set up for a little over one-third of the total and make it in three cuts.

The design of the teeth of a dado head allows it to cut equally as well across the grain, with the grain or at an angle to the grain. (It is from a dado saw that the “combination” circular saw was developed.)
Tilted Table Operation

The advantage of a tiltable table on a power bench saw is not fully realized until one builds a piece of furniture, such as a Martha Washington sewing cabinet, the edges of which are beveled to odd angles. And then these beveled edges are grooved for slip tongues. The ease with which work of such type is handled, and the accuracy with which it is done, make one realize the real usefulness of the machine.

It is assumed that you have carefully checked the accuracy of the gauge which indicates the degree of tilt of the table, and that you found it o.k. But, even if it is perfect, there is always the human element to consider. When we take into consideration the fact that the spacing between the marks on the indicator are usually about 1/32" apart, and that a mis-setting of only 100th of an inch at the indicator may become, on some saws, as much an error as 1/16" in the actual cut (due to the difference in distance from the pivoting point) it behooves the operator to be careful. The best insurance against error is the cut-and-try method. After you have set the table to the desired angle by the gauge, cut a piece of scrap wood, and check the cut with a good bevel protractor. If there is any error, it can be corrected, and no good lumber has been ruined. This is one of the fundamental points of good machine operation — check and recheck all adjustments before cutting costly lumber.

The most widely used setting for tilted table work is the 45° angle. Triangular stripping, for use as glue blocks are run at this angle. The same type of stripping is used for fastening mirror plates into frames, but angles of from 30° to 60° are used instead.

The above mentioned angle of 45° is widely used for beveling the corners on large pieces of stock preliminary to turning. The usefulness of a bench saw as an adjunct to other machines is demonstrated here.

In using the tilted table, always try to work below the blade, whether ripping or cross-cutting. Any tendency of the wood to creep will then be away from the saw, and no jamming or binding of the blade may result. There are, of course, examples where some maneuvering is necessary to accomplish special cutting, such as the grooving of the beveled edge of a board, as illustrated. (This is a segment of the Martha Washington sewing cabinet.) If the ripping guide of your saw is not of the tilting type, tack a strip of wood on its face to form a surface to support the board.

Jigs and Fixtures

There are comparatively few users of the small power bench saw who realize the value of special jigs, and naturally, since the manufacturer has very few calls for them, there are none manufactured. The craftsman, however, can with a little effort, make some of these jigs or accessories for himself. Let it be pointed out that a jig worth making is worth making well, since it may be used again and again.

One of the first “jigs” which the craftsman should provide himself with is the one for cutting tapered pieces. This jig was described and illustrated in the section on ripping. The “pusher” or notched stick, while not really a jig, comes under the head of very necessary special equipment, and for that reason is mentioned again.
THE BENCH SAW

The ripping guide and the miter gauge should each be faced with "laminated" wood pieces, to increase their usefulness and accuracy. For the miter gauge provide strips of different lengths, which may be fastened to the miter gauge facing. To these strips, "stop blocks" may be attached for accurately cutting off duplicate pieces of the same length. If these strips are already made and close to hand they will be used considerably.

Two items that are important in conjunction with a bench saw (and a jointer) are stock rests. They are not jigs but their importance as an aid to good work compels their mention. Two types are suggested. One with a roller may be used in front and behind the saw to support the ends of long stock. The other is for supporting long stock while cross-cutting and should be as long as the depth of your table. It is wise to make their height adjustable, since numerous other uses will be found for them around the shop.

It is well worth while, when making any of the jigs described or any other special jig, to make them substantial, and keep them for future jobs. The satisfaction derived from producing good clean work more than repays for the small amount of time needed to make them.

Table Extension—Front

Increasing the distance (table area) between the front of the table and the front edge of the saw blade will prove an added convenience. It affords more room for resting wide boards when cross-cutting and facilitates handling of long stock when ripping. Several manufacturers are now supplying such attachments as extra equipment. A typical one is illustrated at the top of the next page. It is composed of two strips of steel clamped to the ripping guide bar. The section between the outer ends of the bars and the ripping guide control mechanism is filled in with wood strips. Some operators prefer to use two or three wooden rollers instead of the wood strips. Rollers will be of greater help in ripping long stock.

If your saw table is not equipped with a ripping guide bar it is not a difficult job to attach one to it. A piece of cold rolled steel of sufficient rigidity to bear the weight can easily be bolted or screwed to the table edge.

Production Work

That is, the making of a number of duplicate pieces or parts for a group of some particular article—is nothing more than setting up your machine, with gauges, jigs, stops or other necessary accessories to enable you to run through a succession of pieces, make identical cuts on each, with a minimum amount of exertion and loss of time. A definite routine or schedule of motion or handling should be thought out and adhered to for the full run of pieces. This makes for speed, ease of handling, for more certain accuracy and less possibility of error. Whenever you have a "run" of duplicate pieces, give a little thought to the routine you are going to follow before actually starting work.

Always square up one edge of a piece with an adjacent side as the first operation and then work from this edge or side only throughout all subsequent operations, as far as possible.

That's all there is to production. A machine, plus intelligent planning of operations, with consideration for as little handling of the piece as possible. And remember, working to pencil marks is all right for rough work, where variations of 1/16" or more are permissible, but for cabinet work, use jigs, stops, length gauges, etc., if you want the best possible service from your machine.
Special Uses for the Bench Saw

Among the special and very useful jobs to which the modern bench saw is put is the cutting of metal, tile, brick, composition material, gypsum slabs, marble, brake lining, and other similar substances.

For facing a large number of these materials on a sanding disc, various grades of abrasive paper may be obtained. For cutting metal, such as steel, brass, copper, etc., there are a number of different types of abrasive wheels available. For cutting tile, brick and other building materials, a different grade of abrasive wheel is used.

Other shop accessories such as wire scratch wheels, cloth buffers, grinding wheels and fiber brushes may be used on the bench saw in place of the blade providing their center holes are the same diameter as the saw spindle. Thus it is possible to sharpen tools, buff, polish, remove rust and paint, and do countless other jobs with the bench saw.

Sanding

Provision is made on most bench saws for attaching a sanding disc. Very accurate work can be done at various angles with the tilting saw table. The illustration shows a piece of wood being sanded to a perfect 45° angle. Coarse grit discs are used for fast cutting, fine for finishing.

Cutting Metal

By replacing the saw blade with an abrasive cut-off wheel you can cut hardened or unhardened steel, cast iron and many other metals. Operating speed should be the same as for sawing wood. No water or lubricant should be added, all metal sawing being done with the wheel dry.
BOOK TWO

The Jointer

Jointer or Planer

ITERALLY, the machine to be described is a planer, since it planes wood from a surface as the wood is passed over a revolving cutter head, but in woodworking plants and lumber mills this type of machine is known as a jointer. The stock, or wood is held on the table and fed by hand, and the machine is used mainly for surfacing narrow widths and edges of stock for making glued joints. The larger or heavier machine, where the wood is fed by power driven rollers and the capacity in width is 12" or more, is known as a planer. Since the home workshop owner does a wider variety of work either name will suffice, but for sake of coherence throughout this treatise, it will be called a jointer.

Mechanical Points of Importance

There are several points that are of utmost importance in a jointer, namely, the alignment and method of adjustment of the tables, the type of cutter head, the type of bearings in which the cutter head revolves, the design and accuracy of the "ways" on which the tables slide, the size and weight of the main casting or base, the design and size of the tables, and the design and construction of the fence or guide.

Testing Tables for Alignment

First in importance in a jointer is the alignment of the tables. A jointer may be of the finest design, with the best of bearings and materials available, but, if the tables are not on the same plane the machine is absolutely useless, as far as accurate work is concerned. If there is any doubt about alignment place a straight-edge on the tables, in each of the five positions indicated.
in the sketch. The straight-edge should be long enough to extend the full length of both tables. Place the straight-edge on the rear table, with the knives of the cutter head turned down out of the way, and then adjust the front table upwards until it just touches the straight-edge. With the straight-edge in any of the five positions indicated it will be easy to determine the degree of alignment.

Bearings and Lubrication

Examine the bearings. If the bearings are of the sleeve type, make sure that facilities have been provided for proper lubrication. If the bearings are of a high quality ball type, there is every possibility that they are packed with lubricant and dust sealed. If so, they are good for many months of operation without any attention, under continuous daily use. With the intermittent use that the home workshop owner gives a jointer, he will probably never need to worry about lubricating the bearings.

For the sleeve type of bearings, a good grade of medium engine oil should be used and the oil cups or reservoirs kept filled. Oil distribution and retention is usually accomplished by felt washers or wicks, so that it is necessary only to maintain a supply of oil in the cups, for proper distribution.

Cutter-Head and Knives

The design and type of material used in a cutter-head are both important considerations. The design is important, since it must insure safety in operation as well as balanced rotation. Most of the present day machines are equipped with an approved type round safety head. Metal alloy is used in the cutter-heads of some machines while the higher priced heads are made of solid machined steel. Both types have proved very practical. Ordinarily the three-knife head is preferred over the two-knife type due to the fact that three cuts are made per revolution of the head as against two with the two-knife type.
THE JOINTER

Guard

The modern jointer is also equipped with a guard, a swinging cover which covers the portion of the knives which are not being used. It is automatically moved out of the way by the piece of wood that is being pushed forward on to the knives. Although some cases necessitate using the jointer without the guard (to be discussed later) it will always be found advisable for the safety of the operator to keep the guard in position.

Installation and Power

A 1/2 H.P. motor is usually specified for driving the average 4" jointer although a 1/4 H.P. motor may carry a ball bearing jointer if not loaded too heavily. As the average user is concerned more with accuracy and smoothness of cut, than he is with working a large quantity of stock, the 1/2 H.P. motor will fill all ordinary requirements.

A sleeve bearing jointer may be run at speeds up to 5000 R.P.M., while the ball bearing type may be operated up to 8000 R.P.M. or even more. Nothing, however, is really gained by running it any faster than 8000, except in production work. The "whine" or high-pitched moan at higher speeds caused by the cutter-head is objectionable around the house.

To obtain the speed of 4000 to 5000 R.P.M. for the cutter-head, if the motor runs 1750 R.P.M. and the jointer head pulley is 1 3/4" in diameter, use a 4" pulley on the motor which will give you

\[
\text{1750 x 4 \over 1.75} = 4000 \text{ R.P.M.}
\]

while the use of a 5" pulley would give

\[
\text{1750 x 5 \over 1.75} = 5000 \text{ R.P.M.}
\]

so that, since the jointer usually is purchased with a pulley attached it is necessary only to change the formula around a bit to know what pulley is needed to obtain a desired speed. The formula then reads

\[
\text{5000 x 1.75 \over 1750} = 5" \text{ diameter}
\]

Detailed information as to installing a particular machine may be secured from the manufacturer. Most power tool manufacturers have service departments who will gladly assist you with any special problems of installation.

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Its Use and Application

When mounting the machine on a table or bench, make sure that the table is comparatively level. Of still greater importance is the need that the base rest solidly on all feet, before being bolted down, otherwise a strain will be induced into the base casting, possibly enough to throw the tables out of alignment. Remember that there is a terrific pulling power in a 3/8" bolt and when this power is applied, something has to give, and it may be something that sooner or later will cause trouble.

Alignment and Sharpening of Knives

Jointer blades must always be on a level with the tables, and kept sharp. Both these points are very important. To check the alignment of the blades with the table, first remove the fence, or guide, from the machine. Secure a piece of wood about 2 feet long, with one edge perfectly straight. Lay this along the center of the rear table, with one end projecting over the cutter blades, but not extending over the front table. Turn the cutter head by hand, in the regular cutting direction, that is, toward the front of the machine. Adjust the height of the rear table so that the blade touches the wood, but does not move it. All three blades should touch alike. Now, set the wood along one edge of the table and turn the cutter-head. All three blades should touch, as they did in the first position. If a blade does not touch it is low, while if a blade moves the wood, it is high. Mark the low or high blade. Then lay the wood along the other edge of the table and repeat, marking the low and high blades. A convenient marking is "L" and "H."

If a blade has "L" on one end and "H" on the other, loosen the two end lock studs only, and adjust by lightly tapping the high end with a piece of hard wood. If a blade is low on one end only, loosen that end and the middle stud and raise the knife by inserting a small punch under the bottom edge of the blade. If a blade is marked "H" on one end only, loosen the stud at that end and the middle, and drive it down with the hard wood block.

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Always level the knives properly before sharpening. When this is accomplished proceed as follows using either the front or rear table as a guide.

Drop the table about 1/16" below the knife or blade edge when the blade is at the top of its sweep or cut. A large flat oil stone of medium grade with a piece of paper wrapped around two-thirds of its length is laid on the table and knife. (The paper is to prevent scratching the table.) Rub the stone, with an even pressure, in a circular motion over the knife edge, which should be held motionless with one hand, until all nicks are taken out of the blade. Then take the next blade and finally the third.

Readjust the rear table until it is on a level with the blades at their topmost sweep. Use the piece of wood which you prepared for a straight-edge. When this rests on the rear table, the blades should just touch this wood when revolved, but not enough to move the wood. For all jointer work, the rear table is left in this position. It is made adjustable for one reason only, and that it to enable you to adjust it to knife cutting level, as the blades are worn down through continued sharpening.

**Blades Should Be Kept Sharp**

How often to sharpen the blades? The finest high speed steel will not hold its edge indefinitely and must be resharpened periodically. Contrary to general opinion, hard wood will not dull the blades any quicker than soft wood. The cause is usually dust particles which have settled on the wood. If you have wood that has laid around the cellar for several weeks, it is quite certain that there is a film of dust or grit on the surface. Dust each piece of wood off, before running it over the jointer. Blades will probably need sharpening every few months, the frequency, of course, depending on how much they are used. There is great satisfaction in a tool that is razor sharp and does not have to be coaxed.

When the jointer seems to require unusual power or the surface of the planed wood has a fuzzy look, sharpen the blades.

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**Alignment of Tables**

The method and adjustment of the rear table, in relation to the cutter head, has already been covered, and to make it still more positive, we repeat, that the rear table should be on a level with the cutting arc of the blades, and left there, for all jointer operations.

The front table, however, is adjustable for an entirely different reason. With it, the thickness of the cut to be taken is regulated. As the table is lowered it allows a thicker cut to be taken, until the maximum cut is reached. This maximum depth of cut, for all operations, is determined by the height of the knives above the housing of the bearings, and not the amount that the front table can be dropped.

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**Planing**

Under this heading, we will consider the surfacing of the faces of boards only. For boards or strips of wood under 1/2" in thickness it is wise to provide oneself with a block for use with the left hand to hold down the strips as they pass over the knives. Some jointers are equipped with spring hold-down clips, which serve the purpose of the block. For the right hand, a pusher block, such as shown in the sketch, should be made and kept handy to the machine. It is not alone a matter of safety, but accuracy of work, that necessitates the use of these blocks, since it is next to impossible to hold down thin strips with the fingers alone, and get a smooth even surface.

Wider pieces and more than 1/2" thick may be held down and fed with the hands only. As a matter of precaution don't let any of your fingers grasp the sides or edges of the wood as they pass over the knives, since there is always a chance that they may come in contact with the knives.
THE JOINTER

Planing Pieces Over 4" in Width

Pieces of wood up to 4" in width may be surfaced with the guard and guide in place. For wider boards it is necessary to remove them both. Boards 12" or more in width may be readily surfaced by the following method. Let us choose an 8" board as an example. The cutters will have a capacity of 4", but we do not utilize the full capacity. We take a cut about 2½" along one side, then a 2½" cut along the other side, leaving a 3" cut in the middle of the board for the last. On a 10" board we can make it in two 3½" and one 3" cut. This insures enough surface to form ample bearing on the tables, for each cut, so there will be little occasion or chance to "tilt" or wobble the board while cutting. With a little practice, and using a very shallow cut of not more than 1/32", one can surface boards that are quite wide. This removes a lot of the drudgery of woodworking, and after all that is the main purpose of power machinery.

There is a right and wrong way to plane wood; namely, with the grain and against the grain. Refer to the sketch which shows this clearly. If the knives cut against the grain they have a tendency to tear the wood out, rather than cut it off. There are some woods in which the grain direction changes several times in a piece and one has no choice but to cut against the grain. Cherry, beech, and more particularly birch, are examples of this.

When one is confronted with this problem, adjust the front table for a very shallow cut and feed the wood very slowly. It is doubly imperative that the knives have as keen an edge as you can put on them for this type of work.

For jointing, the fence is utilized. For flat work, where it is desired to have the edges square with the surface, the fence is set to a 90° angle. The board is laid on its edge on the table and, as it is fed across the knives care is taken to hold its whole surface against the fence. As much pressure must be exerted sideways as down. Here again the value of a block for the left hand, is advantageous, particularly when jointing such woods as fir, long leaf pine and others which splinter easily.

Its Use and Application

Strive to maintain a uniform pressure and feed. When planing or jointing long boards or strips, make use of the stock support illustrated on page 22.

For bevel jointing, the same procedure of operation is followed, except that the fence is adjusted at an angle to give the desired bevel. The fence may be adjusted either way from the vertical, whichever seems the most convenient for you to use. As in jointing square edges, due attention must be paid to holding the side of the board in contact with the fence, at the same time it is held down against the board and fed through.

Rabbeting

This is one of the special uses to which the modern jointer may be put and for that purpose a "rabbeting ledge" is incorporated in the front table, which is merely an extension of the table, to help support boards that are being rabbeted.

To make the following description more clear, when the width of a rabbet is mentioned it means the distance in from the edge of a board, as indicated by W in sketch, and the depth of a rabbet is the distance down from the face, as indicated by D.

The width of the rabbet is determined by the distance the fence is set from the left end of the knives, not the table, as shown by W. The depth of the rabbet is determined by the distance the front table is dropped below the cutting circle of the knives, as shown by D.

The rear table serves no other function than to support the wood after the rabbet has been cut, and no adjustment of it is necessary except as it should be for regular planing or jointing. The full depth of the rabbet, if not beyond the capacity of the machine, should be made in one cut. This, of course, in wide rabbeting, throws a considerable load on the machine and it should be fed slowly.

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Mouldings

Because a jointer planes, bevels and rabbets we can utilize it to make certain types of mouldings, in which the cuts are all flat or beveled surfaces. A few examples of such mouldings are shown in the accompanying sketch.

Work of this type usually is associated with the functions of other machines but, as these five examples indicate, creditable moulding work is done with the jointer. Many other designs can be worked out by experimenting.

Trouble Shooting

If the board gets thinner along one edge than it does at the other or wedge shaped after being planed off, one or more of the knives are too high on the side which planed thin. Adjustment of the knives is the remedy.

If the board is planed true for most of its length, but the latter portion of it shows up wedge shaped the tables are not in the same plane, that is, one of the two tables has a low corner, allowing the wood to drop before the cut is completed. Internal stresses in the table castings, usually beyond the control of the manufacturer generally causes this, and while it is not of frequent occurrence, it is cited as one of the things that do happen. The trouble in this case may sometimes be overcome by loosening the nut on the underside of the table and slipping a piece of thin shim brass under the low corner in the "ways."

If the surface planed is concave or low in the middle it is almost certain that one table is higher at the end nearest the knives. The remedy just mentioned above applies in this case, except that the shims are put under both sides of the table, in the "ways."

If the surface planed shows up convex, or high in the middle, one of the tables is low at its end nearest the knives. Again shims may remedy the trouble. If, in jointing the edge of a piece of wood, one end of it proves to have a square edge, but the other end does not, the fault may usually be found in a warped fence. If the fence is of the usual solid cast iron type, the only remedy is a new one unless you have access to a local machine shop that has a surface grinder or planer.

If the surface planed has a number of indentations in it, but is otherwise planed smooth, this is caused by chips coming up from beneath and getting between the knife edge and the surface. Provide ample outlet for the chips to fall from beneath, and this trouble will not occur.

If the surface shows a decided ripple, this may be caused by insufficient speed, feeding the wood too fast, or a loose belt. Sometimes it may be caused by taking a cut that is too heavy, and not exerting enough pressure with the hands to hold the wood down on the tables.

If the machine slows down considerably while a cut is in progress, it indicates insufficient power or a loose belt. Loose pulleys sometimes contribute to this trouble. There is always the possibility of low voltage in the house current. If the loss of power is more noticeable at night than in the daytime it is almost a sure indication that the trouble lies at this source. (A simple test is to start a 1/2 H. P. motor, with no load, and watch the lights. If they dim considerably when the motor starts, have the line voltage checked.)
BOOK THREE
The
Vertical Spindle Shaper

THE shaper is usually the last to be added of all the machines that are available for the home workshop. This is probably because the functions of a shaper are not understood as well as the other machines. While it may at first appear to be somewhat of a "luxury," once we have one we are surprised at the number of times we can fit it into our scheme of things and make the project under construction more beautiful and professional looking. There is a certain fascination about shaper work that takes hold of the operator, and before long he begins to plan ways and means of using it on almost all types of projects that he tackles.

While many "home-made" shapers are doing a creditable job, usually the amount of tinkering and time-wasting adjustments necessary to keep it in working condition is wasteful to the owner both in time and lumber spoilage. The improvement in the work, the saving in time and the elimination of annoyance afforded by better grade machines well justifies the modest investment ordinarily required for them. With a good shaper one can make adjustments with facility and turn out excellent work quickly. And, when the machine is not in use as a shaper primarily, it makes an ideal sanding machine with a vertical drum, working on projects that require sanding of curves both inside and outside; and it does a far better job and gives a smoother finish than could be accomplished by hand in a greater time.

Points of Construction

There are on the market at the present time many different types of shapers. Some have the table movable and the spindle stationary, the different depths of cuts being taken care of by the table being moved up or down in relation to the cutter. On others the table is stationary or fastened firmly to the base and the cutter is movable up or down, either by means of a rack and pinion, or by spiral gears, or by bevel gears and a screw mecha-
nism. Still others have the shaft of a motor mounted in such a way that the entire motor and shaft may be swung to various degrees to adapt the contours of cutters to the different contours and curvatures of the moulding under construction. Most kinds do the same type of work.

**Good Bearings Essential**

In any type of shaper the bearings and bearing support are the most important units of the machine, and it is wise to look over the bearings carefully before purchasing any shaper. In a machine where the bearings are of the sleeve type be sure and examine them closely to determine whether a suitable thrust bearing to take care of the up and down thrust of the spindle has been installed. This quite often is taken care of by putting the pulley operating the spindle between the two arms of the yoke which is perfectly suitable, but in time will develop end play and under heavy cuts there will be a definite variation of depth in the moulding being cut showing up in the form of a ripple on the moulding. In the other type of machine which has ball bearings as its spindle mounting, the bearing is usually of the pre-loaded thrust annular type ball bearing, in which the bearing has been pre-loaded with an initial thrust to take care of end play, and these bearings will, of course, with proper lubrication last almost indefinitely, at the speed at which a shaper is supposed to run. These bearings are usually packed with grease and sealed against dust at the factory where the machine is assembled, and with ordinary care should last five or more years without further attention. These bearings have been known to wear without any attention whatever, for over ten years.

**Reversible Spindle is an Asset**

Another important item in the design and construction of a shaper is the spindle itself. This should be of ample diameter to withstand constant hammering which is occasioned by the cutter striking the wood a terrific number of blows per minute, and it is obvious that a light spindle in a shaper using a cutter of fairly large diameter will soon cause the spindle to develop side play.

One of the very important items that is found in only one of the different types of shapers on the market is the reversible spindle, with a keyed washer and a keyed shaft to prevent the cutter coming loose under the impact of the cut being made. The operator will find that there are numerous cases where it will be necessary to reverse the cutter to prevent cutting into the grain and thereby tearing out the wood. In commercial work it is usual to have two spindle shapers setting side by side or a double spindle shaper, wherein the two spindles run in opposite directions and necessitate a pair of cutters or a reverse type cutter so that the same cut may be continued from one piece to the next. This, of course, is out of the question for the average home workshop user and also in small shops. Therefore the ability to reverse the spindle of a single spindle shaper and do this quickly with only a very slight loss of time is a boon to the man who has only a short time at his disposal.

The actual use of the reversible spindle will be taken up later on.

**Reversing Switch Helpful in Shaping**

The ability to reverse the direction of the spindle in a shaper is a decided help in doing good work. Frequently when shaping crosswise of the grain, the wood splits off at the end of the cut. While easing up on the feed will sometimes avoid this difficulty only by reversing the direction of rotation of the spindle and starting the cut from the other end, can one be sure that this trouble will not occur.

There is available a motor reversing switch which permits the direction of rotation of motor and shaper spindle to be reversed at will. This working in conjunction with a keyed spindle shaper will assure utmost in convenience.
Speed an Important Factor

Smooth, even shaping requires comparatively high spindle speed. While 4000 to 5000 R.P.M. will do fair work the best work requires speeds of from 7000 to 8000 R.P.M. This is especially true when cutters of small diameter (1½" or less) are used. Coping heads and larger diameter shaper cutters can be operated at relatively slower speeds.

The ideal power unit for the average shaper is a 3500 R.P.M. motor of around ½ H.P. With this type motor and a motor pulley twice the diameter of the spindle pulley a spindle speed of 7000 R.P.M. will be provided. If the motor is the 1750 R.P.M. type it will be necessary to use a motor pulley more than three times the diameter of the spindle pulley to obtain a speed of 6000 R.P.M. Naturally this step-up throws considerable load on the motor to start and it should be "favored" somewhat on this account.

The direct motor drive is recommended for all high speed machines and the shaper is no exception. If it is necessary to drive through a countershaft allowance should be made for loss of speed at hanger bearings.

Types of Cutters

There are two different type of cutters; namely, the loose cutter type, on a safety head and the small solid tool steel cutter which is milled from a solid piece.

The first or loose type of knife is in the nature of a cutterhead to which the cutters themselves are fastened by means of screws or lock studs and in the hands of an expert are fairly safe. But they are not recommended for the man who has had little experience with the shaper.

The second type, milled from a solid bar of tool steel and ground to the shape of the moulding, or a portion of the moulding for which the cutter is intended, is the type generally in use. It is, without doubt, the safest type to use.

As before stated, it is not at all necessary to have a large array of cutters of different shapes and contours in order to do a large variety of work with the spindle shaper. On the contrary it is surprising how many different types of mouldings can be made with only a very few cutters. A representative group of cutters with which quite a large array of mouldings may be made is shown on the page opposite.

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Guides and Guards

While the standard guards and guides which are usually found on the shaper table are really not part of the construction of the shaper, yet they claim a very important part in the operation of the machine. One can, of course, through the medium of jig sawed or band sawed strips of wood, clamped to the table with wood clamps or metal "C" clamps, do quite a variety of work, but if the shaper is equipped with a properly designed set of guides and guards, it is not necessary to stop in the middle of an operation to hunt around the workshop for small pieces of wood to strengthen the make-shift arrangement, but can continue with the cut once it is started with the assurance that the entire strip of molding will be the same through the positive action of the guide.

The quality of the work turned out with a machine that is fully equipped is in most respects of a superior nature to that turned out by a make-shift arrangement. In the hands of an expert a make-shift arrangement may turn out very creditable work, but with some of the small bench type shapers that are now on the market the expert can turn out no better work than the novice, once the novice has attained a little experience in the operation of the shaper. And most of these bench type shapers are priced low enough to be available to the novice and amateur as well as the expert.

There is one other very important point in the system of guides that is decidedly worth mentioning. In some types of moldings it is necessary to cut away the entire face of the wood that rests against the guide, and due to this type of cut it is necessary that the guide be made in two sections, so that one sec-

The Sharpening of Cutters

With shaper cutters as with hand tools it is absolutely necessary that they be kept as sharp as it is possible to have them. The actual sharpening of the knives is a simple matter, but it is necessary to have some special sharpening stones with which to reach into the curves and crevices of the cutting edge of the cutter. Suggested equipment for sharpening shaper knives comprises a small rat tail file or Arkansas oil stone, a slip stone type of the same material, whereon one edge is about 1/4" thick and tapers to about 3/8" thick on the other edge, the stone being about 4" long. Both edges of this stone are rounded.

Another stone is 1/4" square and about 4" long, while still another is 2" wide, 1/4" thick and about 4" long.

In addition, a small stone, triangular in section with each face 3/16" wide and 3" long is a very convenient stone to have. With this equipment one is able to sharpen almost any or all of the different cutters that he might have.

The action of cutting wood with the knife has a tendency to turn over the edge or wear it away and it is only necessary to renew the cutting edge in order to continue work so that a great amount of metal need not be removed from the cutting edge, and it is very important that the cutting angle of the cutting edge be not changed any more than is absolutely necessary.

The first procedure is to select a stone that will fit the shape or curve of the cutter and rub the stone lightly on the back of the cutting edge first, holding the stone almost flat on the back of the edge.
THE SPINDLE SHAPE

This will turn a wire edge over to the cutting face of the cutter and it is then necessary to remove this by laying the cutter flat on a flat stone and rubbing it with a back and forth motion until this wire edge has been removed. The cutter can then be considered as sharp.

Grinding Cutters to Various Shapes

The grinding of a cutter to a pre-determined shape is an entirely different proposition, and calls for some degree of skill. This skill, of course, can only be acquired through experience, and experience means grinding cutters. At first the new operator should only attempt the grinding of the simpler forms of cutters such as the quarter round, quarter cove, half round and simple concave or convex shapes, until he becomes proficient and gains confidence in his ability.

In order to grind cutters to special shapes, it is necessary to have a grinding head or an emery wheel stand. Or one may invest a little more money and obtain one of the motor grinders which are available at the present time, and mount it in a place that is convenient to the shaper, if one intends to do considerable cutter grinding. Grindstone equipment for this machine requires at least two stones which are $\frac{1}{4}$" thick, at least two stones $\frac{1}{6}$" thick and at least two stones $\frac{5}{4}$" thick, all of a medium soft grit. A hard stone glazes over quickly and burns the cutter. In addition one should have an emery wheel dresser which may be in the nature of the star wheel type, or of the carborundum stick type or the more expensive commercial black diamond type. The carborundum stick type of dresser is recommended for the average small shop, where it is necessary to shape a wheel closely to a given shape. One each of the three different types of stones mentioned should be kept faced with an absolutely square edge. The other three types or sizes may be used for various shapes by rounding off the corners or by tapering them to fit into the different types of cuts which you may desire to grind.

In addition to this is needed a small rat-tail file, a small square file, a half round file and a flat file for the making of templets to which to grind the cutters. For the actual making of the templets small scraps of zinc are usually the best material with which to work.

Its Use and Application

Forming a Sash Cutter

Probably the best and most convenient way of describing the grinding of a cutter would be to actually go through the procedure in a step by step description. Let us choose as our example a much used type of cutter which is known as a sash tool. One of the most popular of the sash tools consists of an ogee type on one side or one edge of the same, and, of course the rabbit for the glass on the other side. As shown by the sketch, we will assume that the finished moulding is to be 1" wide and the depth of cut is to be $\frac{3}{8}$". You will find in this type of cutter and in others of similar type that it is far easier to make the cutter of two separate cutters than to attempt to grind down into a deep recess and acquire sharp corners. For this reason we will choose as the cutter blanks, a 1" straight face type cutter and a $\frac{1}{2}$" straight face type of cutter. The $\frac{1}{2}$" straight face cutter will remain as is, that is, without any grinding. This cutter will take care of the rabbit on the underside of the moulding. We now have left the ogee shape and the flat face on the 1" straight face cutter to grind. Our next step is the making of the zinc templet, which is a means of gauging the grinding of the three legs of the cutter to the same shape.

The sketch opposite shows the shape that the templet should be made. You will note that there are two legs at the side of the templet, and these legs are the guiding or gauging edges by which to determine that the three cutting edges are being ground alike. Care should be taken to make the templet as accurate as possible.

THE ZINC TEMPLATE
Cutter Must Be Annealed Before Filing

It is now necessary to draw the temper of the cutter in order to allow for filing by hand at a later period. This is accomplished by putting the cutter on a piece of iron wire or by holding it with a pair of pliers in the flame of the kitchen gas range. Hold it so that the hole in the cutter is in a vertical position, and so that all three of the cutters may be in the flame at the same time and each receive the same degree of heat. Hold the cutter in the flame until it becomes a deep cherry red and then remove it and lay it to one side to cool. Do not plunge it in water or oil.

After the cutter has cooled we will now make use of the templet, the outline of the shape for grinding is marked on the leg of the cutters by holding the templet on the face of the cutter and scratching the line on the darkened face of the cutter itself. With the grindstone dresser round off the right hand edge of one of the 3/4" grinding wheels.

The first step which is taken in the grinding of this cutter is to grind away the portion as shown with a solid line in the drawing on the left, the grinding being taken down within about 1/32" of the scratch line, which is represented by the dotted line.

The next stage in grinding is to grind down the step as shown in the sketch below. This may be accomplished with either one of the 1/2" wheels or one of the 3/4" wheels with a straight face.

Since the accuracy of the cut to be made will depend to a great extent on how accurately the grinding wheel has been shaped it is of utmost importance that "dressing" the wheel be done carefully. If you expect to make various shaped cutters from time to time it may pay you to keep certain grinding wheels in stock particularly for this sort of work. The added convenience will warrant the small investment.

Then with one edge of the wheel grind away the remainder of the cutter as shown in the drawing to the right. After which a retouch of all the edges with the stone to bring it down to the scratch line, as necessary. As one gets nearer to the line, a lighter touch becomes necessary, and this is accomplished by holding it with much less pressure against the stone.

Back Clearance Must Be Provided

In a properly ground cutter there should be from two to four degrees of clearance on the back of the cutting edge. There is, however, considerable allowance for deviation permissible in this angle of clearance so that one need not worry about getting them exact. If you will examine a stock cutter, and by holding it against the face of the grinding wheel determine at just about what angle it is necessary to hold the cutter in order to attain the proper angle of clearance, you will have no difficulty in maintaining this angle. The angle should, of course, be maintained throughout the grinding of the entire face.

We have now ground our cutters roughly to the shape determined by the templet, and it is only necessary to clean up the edges and to sharpen the corners which were impossible to get with the grind stone itself. Clamp the cutter in a vise with the cutting edge towards you, and the back of the cutting edge on top, so that in filing you file against the cutting edge. In this particular cutter either the flat or the square file may be used for sharpening up the corners. Check the cutter with the zinc templet as you go and try carefully to get all three of the cutting legs of the cutter to the same shape. Should you inadvertently get one of the cutting legs a little out of line with the others, it is nothing to worry about since the other two cutters or cutting edges will maintain the proper contour. After you get the cutter to this stage of grinding it is wise to make a trial cut on a piece of wood on the shaper to determine how near you have come to the desired moulding shape.
Rehardening the Cutter

After making a trial piece of moulding you can determine which of the legs of the cutter are not according to the templet and make slight remedies here and there until you get exactly the proper contour which will check up with the templet. When the grinding and filing of the cutter have been completed it is necessary to reharden the cutter. Take the cutter back to the kitchen gas range and reheat it to a deep cherry red. When this point is reached and the cutter is plunged in and taken out of cold water as quickly as possible, and then three seconds later, plunged back into the water and held there until cool it will have just about the right amount of hardness, and a long wearing cutting edge. If the cutter is plunged into water right from the fire and held there until cool, there is a liability that the cutting edge will become too hard and brittle and break off under the action of cutting hard wood. If the cutter is allowed to become too cool before the second plunged, there will not be sufficient hardness in the cutting edge, and the wearing qualities of the cutting edge will be impaired. Ordinarily a cutter on which the temper has been drawn and then not rehardened, will give about ten hours of continued service before needing resharpening. This would tend to denote that considerable variation in the hardening of the cutting edge is permissible.

In the grinding of cutter shapes wherein it is not necessary to do any filing, it is not essential to draw the temper on the cutter. These may be ground on the grindstone as they are. While grinding a cutter on the stone, plunge it frequently into cold water to prevent drawing the temper.

An ideal set-up of a bench grinder with cooling cup for holding water, conveniently located, is shown at the left. Attention is also called to the non-shatterable glass shields which protect the operator.

As evidenced by the manner in which this particular cutter was made the reader will learn that in the more intricate types of cutters, it is easier to make the cutters of two or three individual cutters rather than to attempt to grind them from one solid cutter. The important point to remember in this grouping of cutters is to be sure that all the cutters are of the same outside diameter, or rather the same outside cutting diameter. This point can most readily be determined by grouping the bank cutters on the spindle shaper and running through a piece of wood.

If the reader will grind a cutter of this type and follow through the different operations in the grinding, step by step, as they have been described, he will find that the grinding of a cutter is not the terribly hard proposition that he has been led to believe. One can, of course, if he has a machine lathe, put the cutter on a mandrel in the lathe and turn it to the shape desired, and later grind off the cutting angle on the back of the cutter.

Straight Shaping

Shaper work which is in the form of long strips of moulding, the straight edges of table tops, bench tops, or other similar types of cabinet work, is considered as straight shaping. This type of shaper work is accomplished through the medium and help of the straight guide on the shaper table.

The best method possible of explaining just how straight shaping is done is to take a definite piece of moulding, and go through the operations just as they are done on the shaper. Let us choose for this explanation a piece of moulding which is to be used for a deep picture frame. This moulding is shown on the left.

The first step is the cutting of a rabbet on the face side of the piece of moulding. We find that the diameter of the cutter will not allow us to use the
face A against the guide while cutting, since the maximum depth which our cutter will cut is about $\frac{5}{8}''$, so that for the first cut it is necessary to rest face A on the table, and use face B against the guide. We use a 1'' straight face cutter for the first rabbet. The cutter is so adjusted that a portion of it sticks above the table which is equal to the distance X on the sketch to the right. After this has been accomplished the guide is so adjusted as to allow only a portion of the cutter to project beyond the guide and this distance would be equal to the distance Y on the sketch. Use a scrap piece of wood and make a trial cut, then take measurements and check to see that it is accurate to size desired.

**Keep Hand Pressure Constant**

We now adjust the cutter to a height above the table which is equal to the distance S in the sketch below. The guide is then readjusted so that a portion of the cutter projecting beyond the guide is equal to the distance R. In this case we will use face A against the guide, and face C resting on the table. The cut is then run through. You will note that in both of these cuts the cutter is below the piece of wood being cut. There is a definite purpose in cutting the wood this way rather than having the cutter above the piece of wood.

There might be a variable pressure of the hand on the piece of wood as it is being fed through, which would allow the wood to be raised or lowered during the operation, thus causing a variation in the cut. This variation sometimes shows up in the form of a decided ripple. There is also a possibility of the hand slipping and allowing the wood to jump, and in this case the piece of moulding would be practically ruined. By having the cutter below the wood, should an accident or release of pressure occur the piece of wood simply rises away from the cutter, and this can be recut at a later time, thus saving the piece of moulding.

**Spring Hold-Down Clips Helpful**

At this point it might be well to mention that a pair of spring hold-down clips attached to the guide are a very great help in this type of work, in that they maintain a constant uniform pressure on the wood, holding it against the table for the entire length of cut. One of these guides is installed in such a position as to be on the top of the wood. The other guide is bolted to the table in such a manner as to press against the side of the wood, holding it firmly against the guide.

The next step in the cutting of this moulding is the cove which is shown in the sketch to the right, and in this case we rest face A on the table and use face B against the guide. Again we so arrange our cutter that the wood will be above the cutter. The same system of adjustment is used as before in that the type of cutter above the table will regulate the width of the cut and the distance the cutter projects beyond the guide will regulate the depth of the cut.

The next step is the cutting of the quarter round as shown in the sketch to the left, and in this case we use face C, or face B resting on the table and face A resting against the guide. So arrange your cutter that the wood will again be above the cutter as it is being run through.
The Spindle Shaper

Always Make Trial Cut Before Proceeding

In making all the various cuts as described in the preceding paragraphs, after the cutter has been adjusted to what one imagines is the proper setting, it is wise to make a trial cut on the scrap piece of wood and check this cut before actually going ahead with the piece of good lumber. So far as is known there is no shaper on the market at the present time in which these adjustments of the cutter and guide are done by means of any sort of gauge, the setting being done by the trial and error method.

In the moulding just described we have kept one face, that is face A uncut, throughout the entire number of operations, and the guide therefore should be in an exactly straight line, and in the same plane, so that a bearing may be had on this surface before and after the cut is made.

It is sometimes possible to group a number of cuts on the spindle shaper at the same time, thus making a complete cut in one operation. Where this is impossible due to the length of the spindle of the shaper, and inability to get the complete group of cutters on, the group of cutters may be divided into two or more individual groups, and these run as successive cuts to make the completed moulding.

All straight shaper work is run along practically the same line of procedure as has just been described for the moulding just cut.

Drop Leaf Hinge Joint

One type of straight shaper work that seems to give considerable trouble to a great number of operators is the joint known as the rule joint, or the joint which is used on a drop leaf table. We feel that it would be advantageous to describe the operation in the making of the joint, and why the mouldings are made in the manner they are.

First examine the drawing of the hinged, and cut joint as shown in the sketch. We will assume that the table top thickness is \( \frac{3}{16} \)". You will note that a radius 7/16" is given on the male or table top portion of the joint. It is a usual procedure to allow a 1/2" drop from the top for a square face for the joint between the top and the leaf. You will also find that the hinge pin or rather the center of the hinge pin is exactly in a vertical line, below this joint of the table top. You will also note that due to the fact that a 7/16" radius has been used, that we have 3/16" left of the thickness of the top, that is we have used 1/8" for the straight edge drop, 7/16" for the radius, which leaves 3/16". This is the distance that the center of the hinge pin must be set in from the under surface of the table top. The table top is run through, cutting the moulding as shown by the dimensions. For the female portion of the joint we have a cutter which is ground to a 1/2" quarter round radius. The square shoulder on the upper face of the lead is in this case only 3/32" and with the 1/8" radius and the cut made so that the bottom surface of the table meets this radius at exactly 1/4" from its original square edge, we must maintain a 1/32" clearance between the top of the table and the leaf of the table to prevent the wood from rubbing together as the table leaf is dropped, thus wearing away the finish and leaving unsightly light wood showing.

Irregular Shaping

Oval shaped table tops, curved legs, stretchers and similar objects come under the head of irregular shaping, and in this case the guides of the shaper are dispensed with. In their place we use a varied assortment of depth collars; these collars being placed on the spindle above or below the cutter as required. The collar prevents the cutter from cutting beyond a certain depth, that is when the wood is cut in for a certain distance, until the edge of the wood strikes the collar, the collar prevents the wood from going any further, and, as will be seen, the difference in diameter between the cutter and the collar regulates the width of cut. It is true therefore that with a stock cutter of 1 3/4" diameter, cut from solid tool steel, it would be impossible to make any adjustment of the cutting edge, so that any variation in the depth of cut must be taken care of by the difference in diameter of the shaper collar, and it is necessary therefore to have an
assortment of different diameter shaper collars. The thickness of these shaper collars is unimportant and can vary from 1/4" up to 1". They must, however, have a square edge for the entire thickness.

As before, the simplest method of describing the use of a shaper collar in conjunction with the shaper cutter, is by going through an actual operation of shaping a curved piece of work. Let us choose for this description, an oval frame.

The first step in the making of this table top is to prepare the pattern and transfer it to wood. The edge is then bandsawed or jigsawed to the pattern and all parts of this edge are sanded to exactly the shape that they will assume for the finished piece. We will choose for the shaping of this edge a plain roll type such as is commonly found on frames of this kind.

Put the cutter on the shaper with the collar above the shaper cutter and adjust the cutter for the required width of cut. This adjustment and setting is shown in the photo to the left, and you will note that a shaper collar has been chosen, that is enough smaller than the diameter of the cutters to give the required depth of cut. It happens in this case that the shaper collar is exactly the same diameter as the smaller diameter of the cutter.

With a shaper running at 8000 R.P.M. or better it is unnecessary to reverse the direction of cut since clean cutting may be done, both against the grain as well as with the grain, provided, of course, the cutter is kept very sharp. It is well to keep in mind, however, that when cutting against the grain one should take the cutting much more slowly than when cutting with the grain in order to get a clean smooth surface. You will see that the cut is made on the bottom with the frame upside down, resting on the surface of the shaper table.

The foregoing description is what is known as irregular shaping to a finished edge. If one has a series or a number of these frames to run through at the same time, the operation is somewhat different, in that a templet is used to give the required shape instead of using the finished edge of the table top. In this case it would also be wise to provide oneself with a shaper cutter that will cut the entire moulding on the frame at one time. This cutter may be ground as you see fit.

There is one big advantage in irregular shaping from a templet in that you need not have a great array of different size shaper collars, since you can take up any discrepancy in the difference in size of collars by adding or subtracting from the size of the templet. Suppose, for example, we find that in order to make a certain cut we require a shaper collar which is 11/16" in diameter, and we find that the nearest collar we have is only 5/8" in diameter. We can use this 5/8" diameter collar by the simple expedient of making our templet 1/16" larger all around than it would be with the 11/16" diameter collar.

Using a Templet in Shaping

It is preferable that this templet be made of a hard wood such as maple or birch plywood or something of the sort, and it is very important that all edges be sanded perfectly smooth to exactly the finished shape desired. Any discrepancy or any mistakes or nicks that are left in the edge of the templet will be reproduced by the cutter in the finished work so you will see that it is very important that the edge of the templet be perfectly smooth if you wish to turn out very nice work. A little paraffin wax rubbed on the finished edge of the templet will greatly facilitate its functioning.

Let us take for our example an oval pie crust table top. In this particular case, that is, using a templet, the table top is placed upside down on the shaper table and the templet is placed on the upper side of this top. Several small nails driven through the templet to project about 1/32" or 11/16" on the face side, that
is the side to come in contact with the table top, will prevent the
template from slipping on the table top. The cutter and collar on
the shaper spindle are so adjusted that the cutter will make its
cuts at the desired points on the table top, and the shaper collar
will rest against the finished edge of the template. Thus you see
that the shaper cutter will cut in only so far as the template will
allow it to go before the template comes in contact with the shaper
collar. Moving the template around its entire circumference with
its edge in contact with the collar at all points, will therefore
reproduce the exact outside shape of the template on the table
top, through the medium of the cutter. It is therefore unneces-
sary to put a finished edge on the table top before shaping, it
being only necessary to band saw or jig saw the table top roughly
to its required shape, leaving a little excess stock on the table
which will be removed by the cutter, thus assuring a perfectly
smooth finish cut.

Use Fiber for Production Templates

If a template is required that will withstand long and hard
usage and stand up under this usage, the template had best be
made of ¼” fiber. A little paraffin wax rubbed on the edge of this
fiber template will cause it to attain a very hard and durable polish,
which seems to get harder as the friction of the collar rubbing
against it causes it to burn or glaze over.

All irregular shaping is done along the same line of operation;
that is, regardless of its peculiar shape or of its contour, so long
as it has a flat surface to rest on the table. Whether you do it
with the collar and the work alone, or whether it is done with
the aid of a template, is entirely up to the operator, and it is for
you to decide whether or not the making of a template is worth-
while. It is generally considered that the work turned out with
the aid of a template is superior to that turned out where the
work actually rubs against the shaper collar. It is difficult to see
any difference if the same amount of care is used in one method
as is used in the other. When using the shaper collar, with the
wood itself coming in contact with it, there will be a polished
line along the edge of the moulding, where the wood rubbed
against the collar, but this can easily be sanded away so that it
will not be noticeable. For such items as the curved leg of a
pedestal table or the curved leg of a chair and similar articles,
where there are at least four or more matched pieces in the
finished project, it would be advisable to make a template, the
template insuring that the four pieces will be exactly alike.

Matched Shaping—Tonguing and Grooving

Anyone who has torn apart a door such as is used in the
interior of a house or on a cabinet, will have noticed that there is
a male and female type of moulding which to the commercial
world is known as a coped joint. This type of shaper work
requires a pair of matched cutters; that is, a cutter to cut the
female portion of the moulding and another cutter to cut the
male portion of the moulding. In running this type of moulding
it is usually wise to cut the female portion of the moulding first,
and fit the male portion to it later on. This particular type of
shaping calls for a fair degree of skill and should not be attempted
by the novice until he is more conversant with the methods
of shaping.

For tongued and grooved jointing a pair of cutters is neces-
sary. The female portion of the joint or the board with the
female portion, is cut with a single cutter which ranges from
¼” to ⅜” or ½” in width of face, this width or thickness of
cutter is entirely a matter of choice with the operator and is
dependent mainly on the thickness of wood being jointed. There
are two methods of making the male portion of this joint. One
is to have a cutter in which is ground a square recess which will
cut a tongue; that is, a fairly close fit in the female portion of the
joint. Another method is to have two cutters of the same outside
diameter, and at least a ⅜” face on each one, and a collar or spacer
washer of such thickness as to separate these two cutters to a point
where they will cut a tongue which will be a close fit in the groove cut
in the female portion of the joint.
The latter method of cutting
the tongue on the male portion
THE SPINDLE SHAPER

of the joint is preferred to that of using the solid cutter, since the fit of the tongue into the groove may be controlled to some extent by varying the thickness of the spacer washer. This may be accomplished by inserting thin shim washers between the cutter and the spacer washer.

Grooving or dadoing such as is used in the side, front and back of a drawer into which the bottom of a drawer fits, comes under the head of straight shaping and is accomplished in the same manner as the groove cut in the tongue and groove joint.

Reeding and Fluting

For reeding or fluting straight or curved irregular work it is necessary only to have reeding or fluting cutters. A reeding cutter is a cutter in which the cutting edge consists of two coves coming together in the center of the cutting face; while a fluting cutter is just the reverse, being rounded off on its cutting edge. For reeding or fluting flat faces it is sometimes advisable to use more than one cutter ganged up on the spindle of the shaper, thus saving considerable time and also turning out more uniform work. The actual cutting, however, is done exactly the same as any other straight or irregular type of shaper work.

For the reeding or fluting of turnings it is necessary to supply oneself with a special jig, with which the turning may be held. A crude templet or jig which is used for this type of shaper work may be accomplished, consists of a piece of wood on which two blocks have been fastened, one at each end of the turning and a nail driven through each one of these blocks to act as a center on which to revolve the turning. The next step in this operation is to divide the turning into the number of flutes or reeds you desire to shape on it.

Two methods of gauging the depth of cut and guiding the turning against the cutter are open to the operator. One is the use of depth collars and the other the use of a templet. The templet in this case is the base board of the jig. Where the turning is tapered or curved such as is shown in the photograph to the right, it is necessary to curve or taper the edge of the base board to conform with this shape of the turning.

In using the depth collar with the cutter to determine the depth of the cut, be sure that the collars are of the proper diameters and are projecting far enough beyond the cutter to get bearing on the turning.

Ordinarily the templet type of work is preferred in reeding or fluting turnings since it may be more accurately gauged and better work is produced.

To facilitate the handling of the turning when it comes in contact with the cutter and to keep it from “running,” a pin should be installed in the shaper table. The exact location of this pin is immaterial so long as it is not directly in line, or close to the shaper spindle. In use this pin acts as a stop pin against which to rest the templet for a jig before it is brought in contact with the shaper cutter. To make clearer the use of this pin, let us assume that we are reeding or turning and we will feed the turning from right to left against the cutter, the cutter revolving in a counter-clockwise direction. The end of the templet nearest the left hand is placed on the table and brought against this stop pin. Then the right hand is moved toward the cutter bringing the turning in contact with it. This gives the right hand a certain amount of leverage to prevent the cutter from drawing the turning into it and causing a bad gash.

Where the reeding or fluting runs the entire length of the surface or a portion of the turning; that is, from a shoulder to another shoulder, it is immaterial whether the templet type of
shaping or the collar type of shaping is used. If, however, it is necessary or required that the fluting or reeding begin within a surface of the turning, and should end before it reaches another shoulder, the templet type of shaping is much to be desired. You will see that as the templet rides along on the shaper collar, the depression in the edge of the templet will allow the cutter to drop in and cut into the surface of the turning until a projection in the edge of the templet causes it to move away from the turning, thus preventing it from cutting.

Two typical examples of this type of reeding or fluting are shown in the two accompanying sketches on this page.

The diameter of turning that one is enabled to reed or flute on the shaper is, of course, entirely dependent on the height to which the shaper spindle may be adjusted. In all reeding and fluting operations the center of the cutter is exactly on a level with the center of the turning, and the cut is done from the side, not from the top or bottom.

Paneling

This is a type of shaper work which is advantageous in some cases, although it is not often used. For this purpose a special knife is used which may be up to 4” in diameter, so long as it may be put on the spindle and have sufficient clearance between the guides to revolve without striking them. A photo of this type of cutter is illustrated on the page opposite and its use is as follows. The cutter is so adjusted that its height above the table will give the required depth of cut and the panel is fed to the cutter in successive stages of cuts about ¼” in width. It will be understood that a cut made by a cutter of 4” or 3” in diameter, about ¼” in depth, and taking this cut all in one bite puts a terrific strain on the spindle and may possibly throw the spindle out of line or spring it out of shape.

This type of work is usually used where it is desired to install a panel of ½” in thickness, and use a groove in the frame of only ¼” in width, so that it is necessary to cut the thickness of the panel down to ¼” along its edges.

Sanding

One of the very useful purposes to which a shaper may be put is that of sanding with a sanding spindle or sanding drum. For this type of work the guides and guards of the shaper are removed and the sanding drum installed on the spindle. With this drum or spindle irregular shaped pieces of wood may be sanded with great facility, and give a machine-made look to the work turned out, which is almost impossible to attain by hand. For this purpose the sanding spindle or the machine should be run at a fairly slow speed, of not more than 1750 R.P.M. since the action or the heat generated by the sandpaper rubbing against the wood would cause a burning of the surface and a glazing of the sandpaper, thus using up considerable sand paper and not attaining a very good finish.

Surface Grinding

Another operation which may be performed with great nicety on the shaper is that of surface grinding. For this purpose a set of stones, possibly 2” to 3” in diameter and with faces of ¼” or ½” should be purchased with the hole of a size necessary to
go over the spindle. For this type of work it is necessary to use the straight guide. After installing the guides and adjusting them so that the edges or faces of the guides are practically flush with the periphery or circumference of the wheel, one should then clamp a board of about 1/2" to 3/4" thick on the surface of the shaper table with its edge resting against the guide. With a wheel of 2" or 3" in diameter it is impossible to drop the wheel below the surface of the table which is necessary in surface grinding. To begin the operation adjust the wheel so that its upper surface is just a slight amount above the surface of the board on the table. Then bring the piece of stock that is to be ground against the side and move it along until the grindstone grinds on its surface, then continue feeding until the entire length of the piece has been ground.

Then adjust the stone up from the table a fraction of an inch at a time and grind successively from one end to the other of the stock until the entire surface has been covered.

With a little practice it is surprising what very creditable surface grinding may be accomplished with the ordinary small bench type of shaper.

It is not necessary as is usually supposed to have a mechanical feed or a true feed to the work in order to do very nice surface grinding of this type.

WOODS COMMONLY USED

Hard Woods

Chestnut. Light in weight, of average strength, hardness and elasticity. Chestnut is sawed, planed, turned and shaped easily, although it splits readily and warps quite badly.

Maple. It is very hard, strong and elastic. Its close, crooked grain takes an excellent finish.

Oak. Used extensively for furniture and cabinet work. It is heavy, strong, hard and elastic. Very durable but warps and checks considerably.

Ash. Resembles oak somewhat, although ash is coarser grained and less attractive, but easier to work. Used for all kinds of furniture. Straight grained, heavy, hard, strong, stiff and tough, but becomes brittle with age.

Black Walnut. Because of its beautiful chocolate brown color, walnut is in popular demand for furniture, but rapidly becoming scarce. It is heavy, hard, strong, coarse grained and easily worked.

Birch. This wood is hard, tough, straight of grain and able to stand wear and tear. Widely used in cabinet making and for various kinds of furniture. An excellent wood for lathe turning.

Mahogany. There are several varieties, chief of which are Central American, African, Mexican and Philippine. They vary considerably in color, hardness and ease of working. Usual color is rich red. Very desirable if kept dry. Glues exceptionally well.

Soft Woods

Poplar. An excellent wood to work. Light, soft and stiff but not strong. Its fine texture and exceptional working qualities make it very desirable for furniture.

Gum. It has an even texture, is comparatively easy to work, takes a beautiful finish, is an ideal wood for carving, and with a little care can be nailed well.

Cypress. A soft, easily worked wood that does not warp easily, but is likely to contain many fine checks. Nails well and is very durable. Color is reddish brown. It makes beautiful furniture.

Basswood. A light, straight-grained wood which warps very little, is easily worked and nails well. Fairly durable but weak. Picture frames and mouldings are usually made from basswood.

White Pine. A very light wood of average strength and durability. It is used in large quantities for various carpentry purposes. Grain is straight and it is easily worked.
HOW JOINTS ARE MADE

1. Spliced or Halved Joint
2. End Lap or Halved Joint
3. Cross Lap Joint
4. Middle Lap Joint
5. Rabbee Joint
6. Dado Joint
7. Butt Joint
8. Glued and Blocked Butt Joint
9. Dowel Butt Joint
10. Edge to Edge Dowel Joint
11. End Dado or Box Joint
12. Dado Tongue and Rabbee Joint
13. Miter Joint
14. Miter with Spline Joint
15. Through Mortise and Tenon Joint
16. Blind Mortise and Tenon Joint
17. End Mortise and Tenon Joint
18. Stub Mortise and Tenon Joint
19. Panel Construction Joint
20. Half Lap Dovetail Joint
21. Half Dovetail Dado Joint
22. Through Single Dovetail Joint
23. Multiple End Dovetail Joint
24. Blind Miter or Secret Dovetail Joint

Even though you fasten with nail or screw, reinforce every joint with LePage's Glue

EXPLANATION OF COMMON TERMS

1. Ripping
2. Mitering
3. Grooving
4. Jointing
5. Cross-cutting
6. Rabbeeting
7. Dadoing
8. Setting

HINTS ON GLUING
(By Courtesy of LePage's)

The woodworker is concerned with three kinds of glue—animal, fish and casein. Animal glue, commonly known as "hot glue," is obtained from the hides, skin, bones and sinews of cattle. Fish glue, which we know as a ready-to-use, prepared liquid glue is made from a by-product of the salt fish industry. Casein glue, ordinarily called waterproof glue, is made from the curd of milk.

Good Joints Essential

No great skill is needed in using glue but there are a few important directions to follow regardless of what kind you use.

The most vital point is that the two pieces of wood to be joined together must be perfect joints and make perfect contact. The wood must be dry and free from grease, and the glue must be of the proper consistency, spread evenly—and be free from air bubbles. Use enough glue, do not starve the joints. The two pieces to be joined must be held together under pressure, while the glue sets. Always make a trial fitting without glue and mark the various pieces as they are to be put together as No. 1 and No. 1, No. 2 and No. 2, etc. Clean off the excess glue by throwing fine sawdust over that glue which has been squeezed out of the joint. This will facilitate its removal with a chisel.

If two pieces of wood are properly glued together, the glue will hold better than the wood itself. The illustration below clearly proves this.

No one kind of glue, whether animal, fish or casein, is the best for all uses. For average use, however, Le Page’s Liquid Glue is highly recommended. It requires no soaking, heating or mixing to certain proportions. It is fool proof. It has the advantage of setting slowly, giving the worker ample time to arrange and rearrange the clamps, or to square up the different parts being glued. For many needs, the slow set is indispensable.

Makies a joint stronger than the hardest wood.

LePage’s Held
Under 10,955
Pounds
Pressure

The first illustration above shows the side view of one of the blocks of wood used in testing the strength of LePage’s. The thin straight line indicates the lepaged joint. The irregular line indicates the line along which the wood finally gave way leaving the lepaged joint unbroken.

Under a pressure of 10,955 pounds, the block was finally broken. Note from the surface of the two halves that it was the wood itself which gave way under the strain and not the LePage’s.

REINFORCE EVERY JOINT WITH LePAGE’S GLUE