

## UNIT 12

# ROUTING AND SHAPING

In general, the tools and equipment that have been previously discussed are used to size stock. Even though this might be adequate for some products, many products are given a better appearance through the use of the shaper or router. After studying this unit, you will be able to identify shaping and routing bits. You will also be able to safely set-up and operate the hand-held router and the stationary shaper.

### PORTABLE ROUTER

The PORTABLE ROUTER, Fig. 12-1, is one of the most versatile pieces of woodworking equipment. It can be used to shape the edges of wood frames and paneling, rout grooves and mortises, and trim veneer and plastic laminates. The portable router can also be used with jigs and fixtures to plane edges, and for cutting specialized shapes using a template.

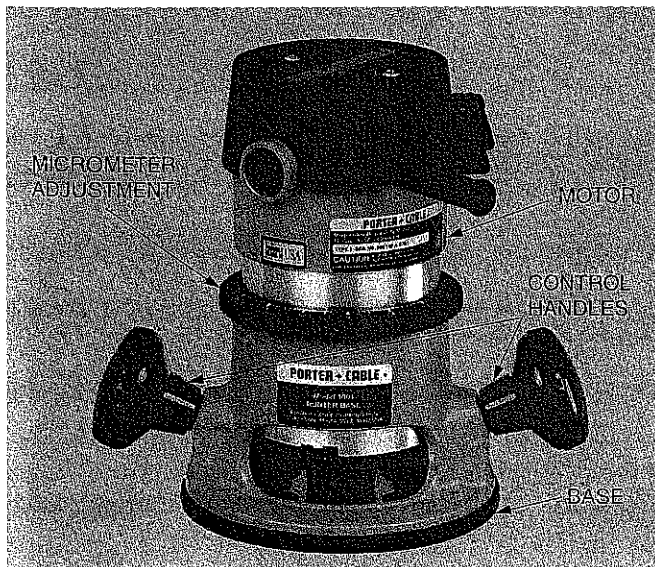


Fig. 12-1. Parts of a router. (Porter-Cable)

The size of a portable router is indicated by its horsepower rating and by the capacity of its chuck (bit shank diameter). The spindle of the router revolves at very high speeds, frequently 20,000 to 30,000 RPM (revolutions per minute).

### Router Bits

Router bits are made from high-speed steel with carbide cutting edges. Silicon carbide is an extremely hard material. This material allows the bit to stay sharp much longer than standard high-speed steel bits.

SHAPING BITS are used to form decorative edges. Inside curves are formed with cove bits. Outside curves are formed with round over or beading bits. See Fig. 12-2. Rabbits, chamfers, and combination curves can also be formed on edges using different bits. Shaping bits are guided along the edge of the stock by several methods. A fence can be attached to the base of the router, allowing the cutter to penetrate into the material the desired amount. Many bits have a pilot tip that extends below the cutter shape. The pilot tip follows the edge of the stock, producing the desired depth. A third method of

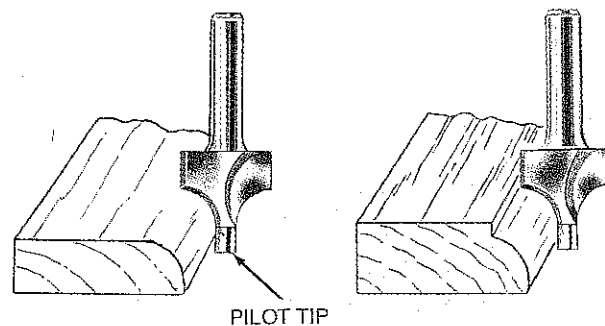


Fig. 12-2. Typical shaping bits. Left. Round over bit. Right. Beading bit.

control involves using a bushing and a template. The bushing is guided around the template while the cutter moves through the stock.

**ROUTING BITS** are used to cut dados, grooves, veins, coves, and mortises in the surfaces and edges of wood. Fig. 12-3 shows a straight bit that can be used for dados and grooves. These bits can be guided with a fence attached to the base, or with a template and guide. They are often used without the use of any type of guide. This is called **FREEHAND ROUTING** and requires a great deal of skill.

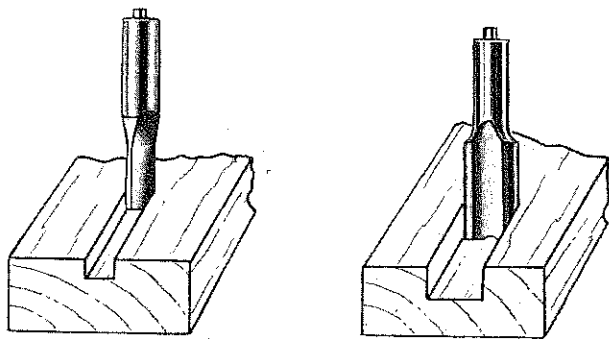


Fig. 12-3. Routing bits. Left. Single-flute, straight bit. Right. Double-flute, straight bit.

Special bits are available for trimming veneer and plastic laminates. Others are used to make dovetail joints, hinge and lock mortises, and special cuts.

### Installing Bits and Adjusting the Base

The router bit must be installed in the chuck before adjusting the base and cutting any stock. First, disconnect the power cord. Loosen the locking handle and base so that you have easy access to the chuck. Tighten the locking handle so that the router base does not move when inserting the bit. Then, insert the bit into the collet chuck. Position the bit so that the maximum amount of the bit shank is inside the chuck, but not touching the bottom of the chuck. If the shank touches the bottom of the chuck, it should be raised 1/32 to 1/16 inch to prevent its loosening while cutting. Firmly tighten the chuck. Loosen the router base and set the bit to the required depth with the depth adjustment. The depth adjustment is very useful when using routing bits, such as the straight bit. Tighten the base

locking handle and make any other necessary adjustments before starting the motor.

A fence may be used when using routing bits. Insert the fence adjustment bars into the router base and tighten the lock screws. Then, move the fence to the required width and tighten the lock nuts. When measuring the distance from the fence to the cutter, be sure to measure to the outside of the arc made by the cutter. It is easy to measure closer to the bit shank, resulting in an improper adjustment.

Plug in the router and test your adjustments on a piece of scrap stock. Make sure that the scrap stock is firmly secured in a vise or clamped to the table top.

### Router—Safety and Care

1. Turn off the router motor immediately after making each cut.
2. Disconnect the power cord before making any adjustments.
3. Grasp the router firmly, holding the cutter bit away from you, before turning on the motor.
4. Tighten screws and nuts securely when making adjustments. Since the router is a power tool, screws and nuts may have a tendency to vibrate loose during operation.
5. Handle the router carefully. Lay it on its side on a bench away from the work area to prevent accidentally knocking it on the floor. An alternative to laying it on its side is to place a block of wood under the base so that the bit does not contact the table top.
6. Use only sharp router bits. Protect the cutter bits from damage by returning them to their holder immediately after use.
7. Wear a face shield or goggles when using the router. Many types of safety glasses do not prevent wood chips from falling behind the lenses and into your eyes.
8. Wear ear protection when using a router due to the high noise level.

### Shaping an Edge

One of the shaping bits will be used to shape an edge of the stock. Choose a bit, install it in the router, and adjust the depth of cut. Clamp a practice piece of stock in a vise and firmly grasp both router handles as shown in Fig. 12-4. Turn on the motor and lightly push the router toward

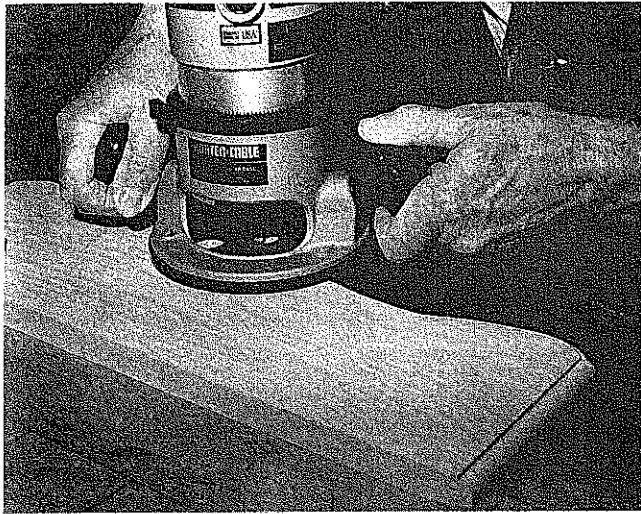


Fig. 12-4. Shaping an edge with a round over bit.

the edge of the stock, allowing the bit to make a short cut. Turn off the router and make any adjustments, if necessary.

Hold the router handles with both hands, turn on the router, and push or pull it around the edge of the stock. The feed direction of the router depends on whether an inside or outside cut is being made. Remember that the router bit rotates clockwise as viewed from above. The feed direction should be against the rotation of the bit as it contacts the surface of the stock. Therefore, the router should be fed in a counterclockwise direction for an outside cut and clockwise for an inside cut. See Fig. 12-5. Move the router with moderate speed, applying very light pressure against the stock with the tip of the bit.

Heavy pressure will result in excess friction, causing the bit to overheat. When this occurs the edge of the stock may be burned. Complete the edge and turn off the motor.

When routing the outside of a piece of stock, be sure to rout the end grain first and then the edges. Most of the splintering that may have occurred when routing the end grain will be removed as the edges are routed. An alternative to this method is to attach a scrap piece of stock to the edge and allow the router to complete its cut in the scrap. The set-up for this procedure is similar to an edge butt joint, except the scrap stock is clamped, not glued. This procedure should also be followed if all sides of a surface are not being routed, for example, the top of a night stand. The rear edge is usually not routed.

### Cutting a Groove

A straight bit is used to cut grooves. Select the correct size bit, install it in the router, and adjust the depth of cut. Attach the fence to the router base and adjust it to the desired width. Make sure that the router is unplugged when inserting the bit and adjusting the fence. Clamp a piece of scrap stock in a vise and turn on the router motor to make a trial cut. Grasp both router handles and make a short cut. Make adjustments to the depth of cut and fence setting, if necessary. Push or pull the router along the edge of the stock using pressure against the fence, Fig. 12-6. Complete the groove and then turn off the motor.

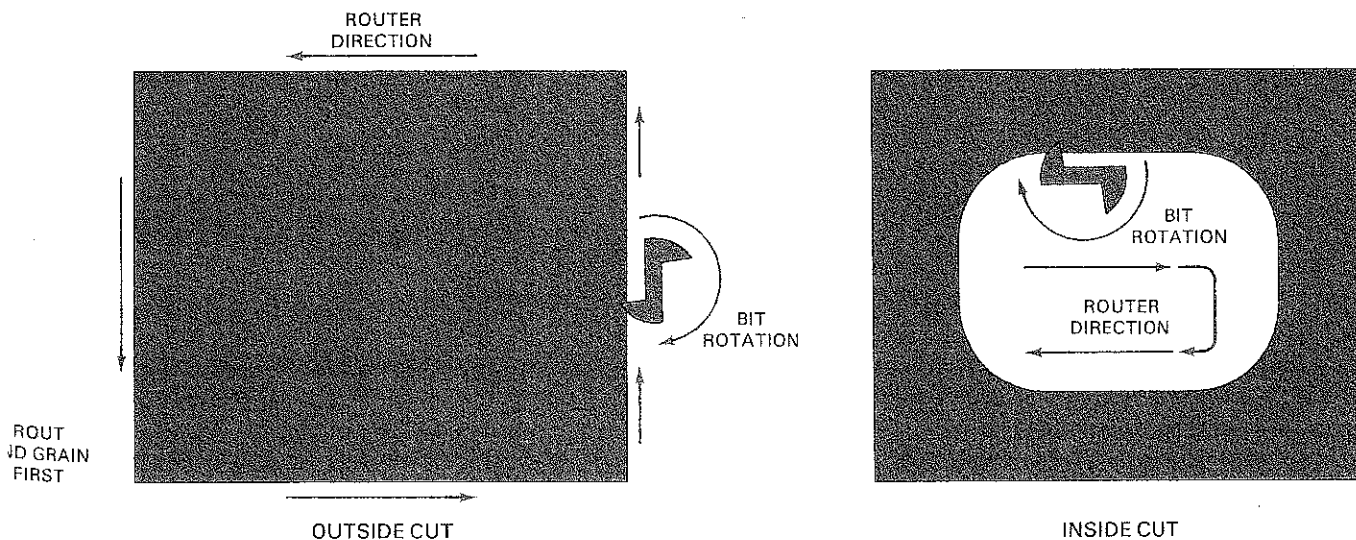


Fig. 12-5. When making an outside cut, rout the end grain first. Progress in a counterclockwise direction. Use a clockwise direction when routing an inside cut.

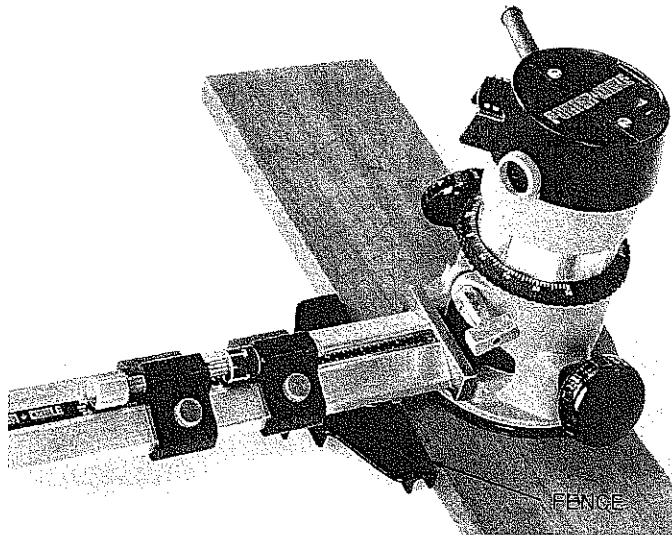


Fig. 12-6. Using a fence as a guide for cutting a groove with a straight bit.

### Using Templates

Irregular shapes can be cut with a router by using a **TEMPLATE** and template guide, called a **BUSHING**. The template is either attached to the stock to be cut, or the stock is secured in the template. Two templates that are commonly used are the dovetail template and the door hinge template. The bushing is attached to the bottom of the router base. A router bit with a pilot tip or a small bearing located above or below the cutter may also be used when using a template.

A template may be made by cutting the desired shape out of a piece of 1/8- or 1/4-inch hardboard or plywood. Clamp the stock to a bench and fasten the template to it. Attach the template guide to the router base. Insert the desired bit in the router chuck and tighten it securely. Adjust the bit to the required depth, plug in the power cord, and turn on the motor. Hold the bushing next to the template and push or pull the router around the template. Work from the outside of the template inward. Complete the cut, turn off the motor, and unplug the router.

### Trimming Plastic Laminates and Wood Veneer

A router or laminate trimmer can be used to trim plastic laminates and wood veneer. A **LAMINATE TRIMMER** is a special type of router used specifically for this purpose. See Fig. 12-7. It is similar to a router in both operation and appearance. When using a router or laminate trimmer to trim plastic laminate or veneer, either a special bit or guide must be used. Both of these devices control the side-to-side movement of the bit.

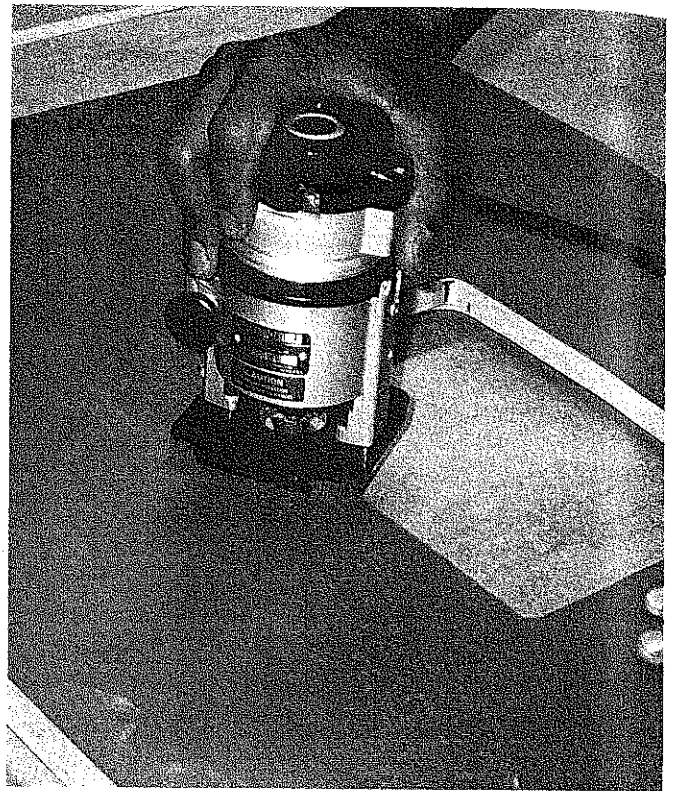


Fig. 12-7. A laminate trimmer is used to trim plastic laminates. (Porter-Cable)

When laminating plywood or other base material, the laminate should be cut about 1/2 inch larger than the base material. Adhere the plastic laminate or wood veneer to the plywood surface with the appropriate adhesive.

Insert a trimming bit in the chuck and tighten it securely. Adjust the bit. Clamp the stock to the bench or secure it in a vise. Firmly grasp the router, connect the power cord, and turn on the motor for a trial cut. Lightly push or pull the router toward the stock until the pilot tip or ball bearing guide touches the edge. Check the cut and make any necessary adjustments. Continue moving the router around the stock to complete the cut, turn off the motor, and disconnect the power cord.

### Overarm (Pin) Router

The **OVERARM ROUTER**, also called the **PIN ROUTER**, is a fast and efficient means of producing repetitive work, such as cut-outs, grooving, lettering, and edging. Other overarm routers are a stationary power tool that may use a portable router motor as its source of power. Some models of overarm routers have a built-in power source as shown in Fig. 12-8.



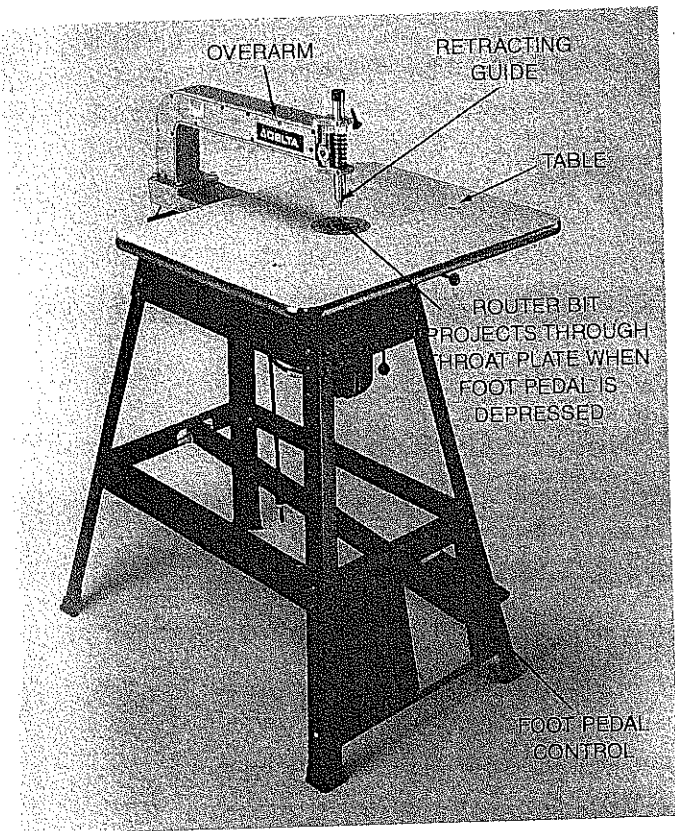


Fig. 12-8. Overarm inverted router.  
(Delta International Machinery Corp.)

A guide pin that matches the diameter of the router bit follows a groove previously cut into a template. This template is placed below the material to be routed. As the template moves along the pin, the overarm-mounted router bit shapes the stock. Fences and other accessories may be added to expand the capabilities of this machine.

## SHAPER

A SHAPER is used to shape the edges of both straight and irregular cuts. It is commonly used to form edges, make moldings, and cut grooves. Templates can be used when making duplicate parts. Fig. 12-9 shows a shaper with its parts identified.

The size of a shaper is specified by the diameter of the spindle that holds the cutters. Common spindle sizes are 1/2, 3/4, and 1 inch. Many machines allow the use of different sizes of spindles. The outside diameter of the shaper cutter knives vary a great deal, depending upon their use. Many cutters have larger spindle holes (center holes) as the outside diameter or overall thickness of the cutter increases. The height of

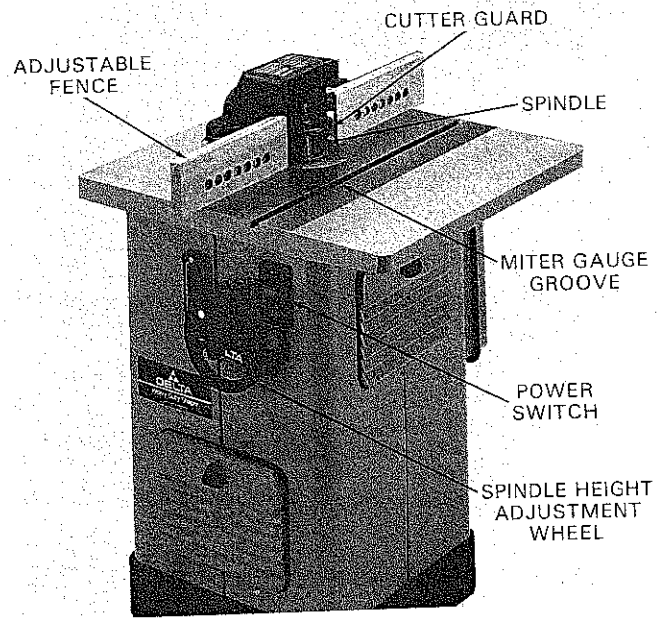


Fig. 12-9. Parts of a wood shaper.  
(Delta International Machinery Corp.)

the spindle is adjustable to allow for varying depths of cut. Once the desired height is determined, the spindle is locked into place.

The cutter and spindle are rotated by a motor-driven belt. Cutter speeds range from 5000 to 10,000 RPM. Some machines have variable speeds. They provide the best cutter speed for the type of material being cut, the thickness of the cut, and the size of the cutter. The cutter normally turns in a counterclockwise direction, but many machines are equipped with reversing switches.

Straight stock is usually held against the fence. The shaper fence is divided into two parts: the FRONT FENCE and the REAR FENCE. Both parts of the fence are separately adjustable. Curved stock is fed against a depth guide collar attached to the spindle, and one or two fulcrum pins.

## Shaper Cutters

Three-lip solid cutters are available in a variety of shapes, including straight, round over, cove, bead, combination, tongue and groove, flute, and door lip. See Fig. 12-10. Some cutters may be purchased for either left-hand or right-hand operation. Cutters are made of high-speed steel with carbide-tipped cutting edges to increase their durability.

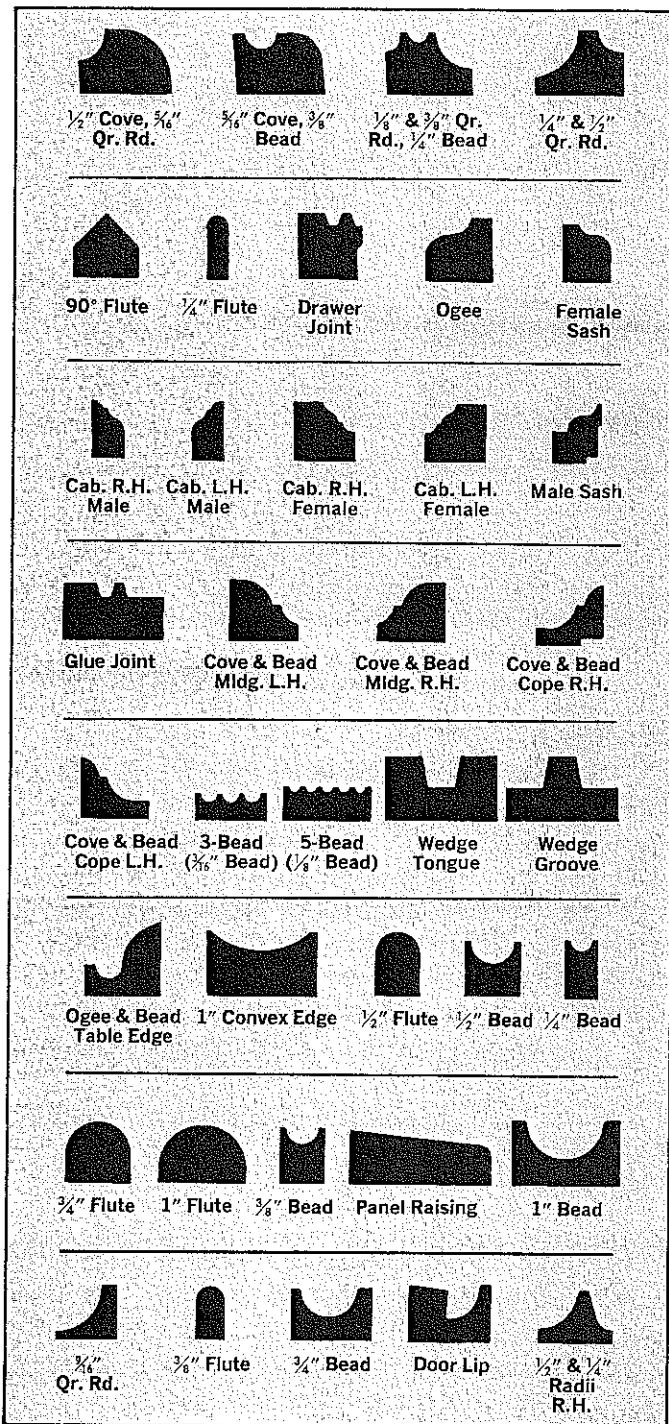


Fig. 12-10. Typical shapes, 3-lip shaper cutters. Cutters are shown half size. (Delta International Machinery Corp.)

### Installing Cutters

When possible, cutters should be installed so that they cut from the bottom of the stock. This allows the stock to act as a partial shield. Spacing collars may be used above or beneath the cutter to hold the assembly in the proper position. If irregular shapes are to be cut, a depth guide collar must be placed above or beneath the cutter. This regulates the depth of cut and guides

the stock as it is fed across the shaper, Fig. 12-11. When cutting irregular shapes, one or two fulcrum pins must be installed to aid in starting the cut.

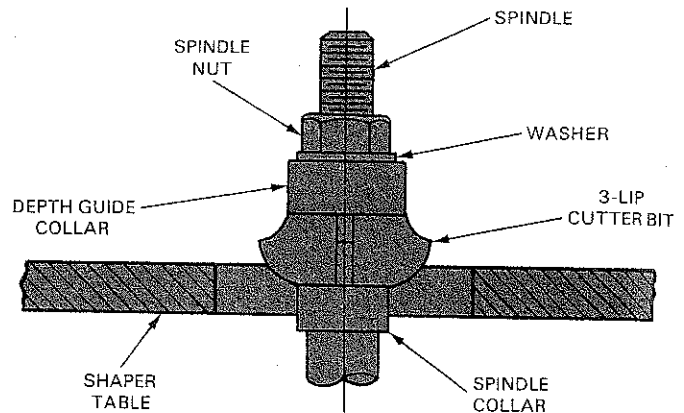


Fig. 12-11. Installing a bit on a shaper spindle.

When installing a cutter in a shaper, disconnect the power cord or turn off the disconnect switch. Remove the top spindle nut. Select the desired cutter and install it on the spindle. Spacers are generally necessary either above or below the cutter. These should be placed on the spindle prior to replacing the spindle nut.

### Shaper-Safety and Care

1. Know where to place your fingers and hands before turning on the motor. Always keep them well away from the cutters.
2. Use only stock that is free of warp, loose knots, and other defects. Make sure the stock is at least 16-inches long. Use a featherboard or other device to help hold stock less than 4-inches wide or 1-inch thick.
3. Be sure the cutter revolves toward the stock and in the direction of the grain.
4. Always use a fulcrum pin (guide pin) to help start stock against the depth collar. This will help prevent kickback of the stock.
5. Check adjustments carefully before you turn on the motor.
6. Feed stock at moderate speed. Use only sharp cutters.
7. Have your instructor check your set-up prior to operating the shaper.

### Forming Straight Edges

Best results when using a shaper are obtained after practicing on a piece of scrap stock. Select a defect-free piece of stock that is at least 16-inches long. Install a suitable cutter on the spin-

le. Set the fence in a position so the cutter is correctly aligned with the edge of the stock. Move the fence parallel to the miter gauge slot on the table and tighten it securely. Inspect the grain of the stock to determine its direction. Turn the stock so the *cutter knives cut toward the stock* and in the direction of the grain. See Fig. 12-12.

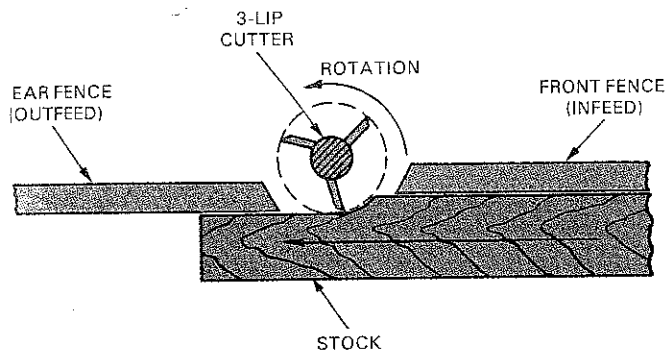


Fig. 12-12. Offset of the shaper fence as an entire edge is shaped (top view).

The process of forming a straight edge with a shaper is similar to that of jointing an edge with a jointer. Place the stock on the shaper table and turn on the motor. Hold the stock against the table and the fence and push it over the cutter. When about 2 inches of the stock passes the cutter, turn off the motor and adjust the second part of the fence to the formed edge. Turn on the motor and continue the cutting stroke. When about 8 inches of the stock passes the cutter, move one of your hands to the other side, then

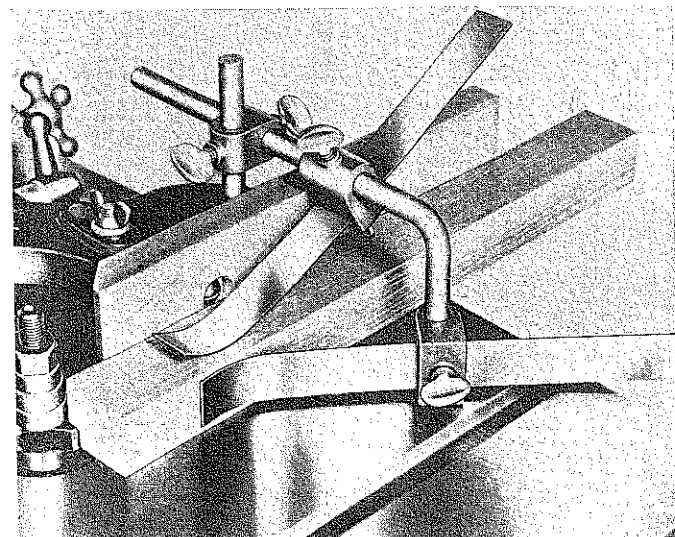


Fig. 12-13. Shaping a straight edge of wood against the fence of a wood shaper.

the other hand, and complete the cutting stroke with both hands pressing against the second part of the fence. This procedure ensures that your hands will not pass directly over or in front of the cutter. See Fig. 12-13.

### Forming Irregular Edges

Select a piece of scrap stock and saw a curve on one edge. Install a suitable cutter and a depth guide collar on the spindle. Fasten a fulcrum pin in the table. The **FULCRUM PIN** acts as a guide and support when starting the cut. Turn the stock so the cutter knives cut toward the stock and in the direction of the grain.

### Position Ring Guard

Place the stock on the shaper table and turn on the motor. Hold the stock firmly against the fulcrum pin and push it toward the depth guide collar into the cutter knives. Fig. 12-14. *Be sure the knives revolve toward the stock.* Continue to push the stock forward with light pressure against the depth guide collar. Complete the stroke by keeping light pressure against the depth guide collar while pushing the stock past the cutter. Turn off the motor after the cutting stroke has been completed.

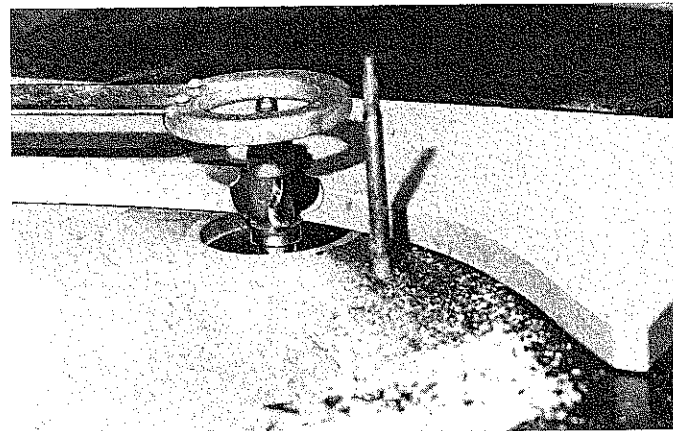


Fig. 12-14. Shaping a curved edge of wood against a depth guide collar on the spindle of a wood shaper. Note the fulcrum pin and the guard.

### TEST YOUR KNOWLEDGE, Unit 12

1. The size of a portable router is indicated by its \_\_\_\_\_ rating and by the \_\_\_\_\_.
2. Some router bits are \_\_\_\_\_-tipped, giving them greater durability than standard high-speed steel bits.

3. Irregular shapes can be cut using the portable router by using a \_\_\_\_\_ and a \_\_\_\_\_.
4. The size of a wood shaper is indicated by the diameter of the \_\_\_\_\_ which holds the cutter.
5. The wood shaper spindle is adjusted \_\_\_\_\_ for the depth of cut.
6. Speed of a shaper spindle is usually 5000 to 10,000 RPM. True or False?
7. When shaping straight stock, the stock is usually held \_\_\_\_\_.
8. When possible, shaper cutters should be installed from the \_\_\_\_\_ so the stock can act as a partial shield.
9. The \_\_\_\_\_ acts as a guide and support when starting irregular cuts on the shaper.

### ACTIVITIES

1. Inspect a router from your tool cabinet. What is the brand name? How many horsepower and amps? What is the size of the chuck? Does it have a standard base or a plunge base?
2. Remove the router bits from tool storage. Look at the various shapes. How many straight cutters are there? Sketch some of the shapes. Sketch profiles that can be obtained by combining different bits. Do some of the bits have pilot tips or ball bearing guides? Are any of the cutting edges carbide tipped?
3. Remove a router and a simple shaping bit from tool storage. Mount the bit in the chuck and tighten. Adjust the bit. Shape the outer edge using a scrap piece of softwood at least 3/4-inch thick x 6-inches wide.

- Make several light passes rather than one wide pass. Did the wood splinter on the ends? Did the router pull through the work? Are there any burn marks on the edges?
4. Identify the following parts on the shaper:
    - A. The ON/OFF switch. Is there a reversing switch?
    - B. The spindle adjustment wheel. How is the spindle locked into position?
    - C. Locate the spindle. What size is it?
    - D. Look at the fence. Are both sections in a straight line? If not, why not?
    - E. Where is the guard? How does it protect the operator?
  5. Identify the following parts that are used with the shaper.
    - A. A typical cutter. Sketch its profile. What direction does it rotate?
    - B. A spacing collar. How does this fit on the shaper? Does it fit above or below the cutter?
    - C. What other accessories are available in your laboratory for the shaper?
  6. Select a small diameter cutter and appropriate spacing collar. Mount them on the spindle. Adjust the fence to a straight line with the cutter in its proper position. Position the guard, hold downs, or featherboards. Select a clear scrap piece of stock measuring 2 x 4 x 36 inches. Determine the direction of the grain. Readjust the hold downs and guard to allow shaping the edge of the board. Adjust the spindle height to take a cut from the bottom of the board. Lock the spindle height. Have your instructor check your set-up. Make the cut. Answer the following questions:
    - A. Are there any burn marks? If so why?
    - B. Did the grain splinter?
    - C. Is the profile what you expected?