

Making Shaper Knives

by Tommy Bargeron

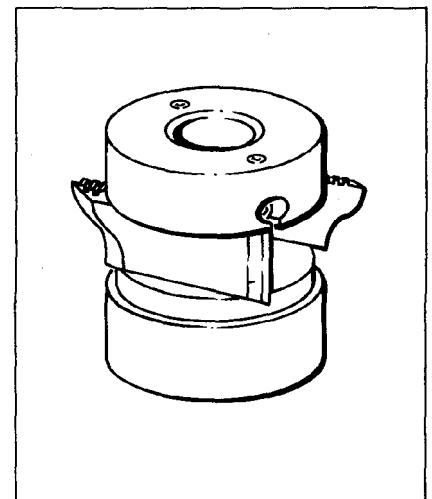
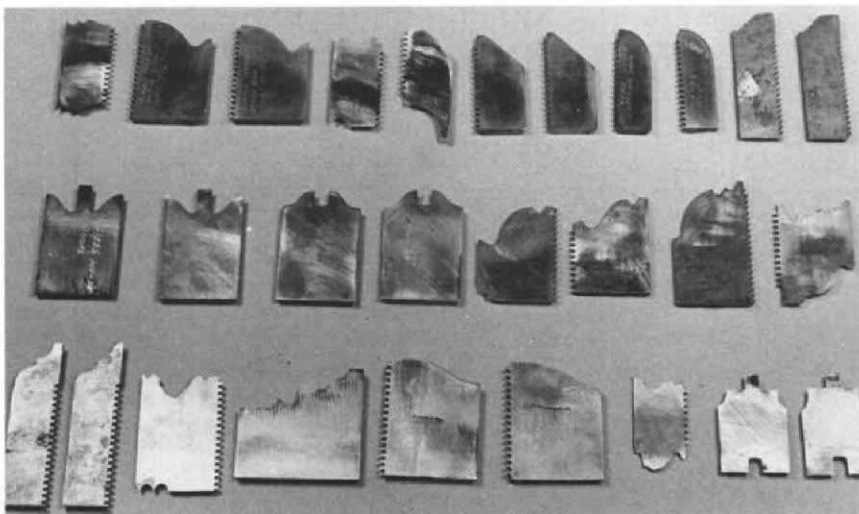
The shaper is one of the most useful machines to have in the serious workshop for machining edges, moldings and lippings. Only the router or a set of hand planes can even attempt to do the type of work the shaper can do, and they are no match for its speed, versatility and efficiency.

For most woodworkers and antique restorers, however, the shaper's usefulness is limited by the small selection of patterns available in the common three-wing cutters. Its range can be made infinite by using shaper collars to hold pairs of flat knives, which can easily be ground to almost any desired profile. The process is surprisingly simple and no elaborate grinding equipment is required.

Shaper collars are available in various diameters to fit most spindles. There are two basic types of collar, lock-edge and plain, and each comes with either solid or ball-bearing construction. I highly recommend the lock-edge collar because it is much safer. Knife steel for these collars is made with a serrated edge, which fits into grooves in the top of the collar and virtually eliminates the danger of throwing a knife. The lock-edge collar is approved by the federal Occupational Safety and Health Administration (OSHA). On light to medium-duty machines, a 2-1/2-inch diameter collar is adequate. If your shaper has a variety of spindles use the

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Knives can be ground to almost any profile. Some of these knives are ground at both ends, and some carry more than one profile on an edge. Drawing shows lock-edge knives in a ball-bearing cutter.



largest. An extra long spindle is helpful at times.

In a small shop where flexibility is vital, ball-bearing collars are best. They make shaping curved work safe and easy, because the stock can ride directly on the bearing. Ball-bearing collars cost about \$100; plain collars are available for \$60.

Knife blanks to fit the collars are made in a variety of widths and are usually sold in 24-inch bars. Shaper steel is available hardened or unhardened; I always use hardened because I do not have the knowledge and equipment for heat-treating. The depth of the cut determines bar thickness. It is advisable to make the knife at least one-third as thick as the cut is to be deep. Although this ratio can vary depending on spindle speed, wood density and so on, it is better to play it safe and not skimp. If you are trying this setup for the first time, buy several precut shaper blanks in various widths. Be sure to specify lock edge. Later, buy a 24-inch bar of the width you use the most. Note also that it is possible to grind both ends of a blank, and also to grind several narrow profiles on one wide blank.

To add this setup to your present shaper, you must adjust its spindle speed and add a spindle lock. Lock-edge cutters are designed to run about 4,000 r.p.m., but most shapers are set at the factory for about 10,000 r.p.m. Running too fast risks thrown knives. To compute your present spindle speed, use the formula:

$$\text{spindle speed} \times \text{spindle pulley size} = \text{motor speed} \times \text{motor pulley size}$$

Plug in all the knowns, which can be obtained by measuring the diameters of the pulleys and from the motor specification plate. Then use the formula to determine the proper pulley for 4,000 r.p.m. On most machines the motor pulley is easiest to change, and you will have to buy new vee-belts of the proper length.

The compression of the spindle nut is all that holds the knives in the collar. Therefore the machine must have a positive spindle lock against which to tighten the nut. To make one, weld a short piece of 1-1/2-inch pipe to the bottom of the spindle pulley and drill a 1/2-inch hole through the pipe. A Phillips screwdriver slipped into this hole will catch on other parts of the machine and prevent the

spindle from turning as it's being tightened.

The knives are ground to shape on a conventional bench grinder with a medium or coarse grit wheel, with delicate profiles worked on an abrasive cutoff wheel. Each profile requires two matched knives. The process is straightforward and, like anything else, becomes quicker and easier with experience.

First, know exactly what profile you want to cut and make a drawing or hand shape a wooden template. Paint or spray the knife blank with the blue layout dye that machinists use. It is inexpensive, a little goes a long way, and should be available at a local machine shop or mill supply house. After the dye has dried use an awl or scriber to mark the desired pattern on the knife. The dye makes possible a very fine but highly visible line.

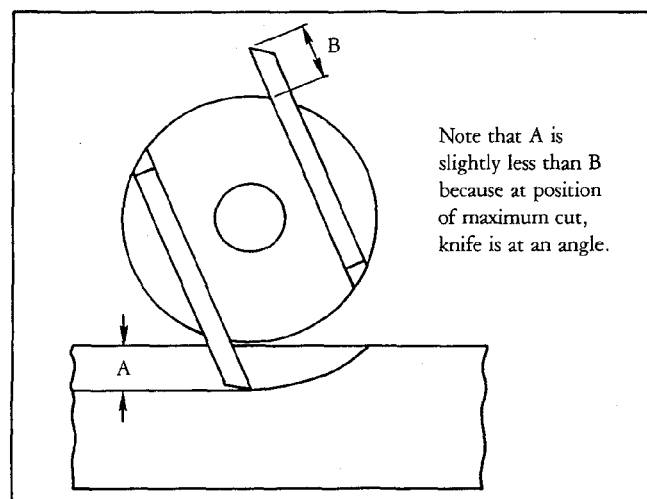
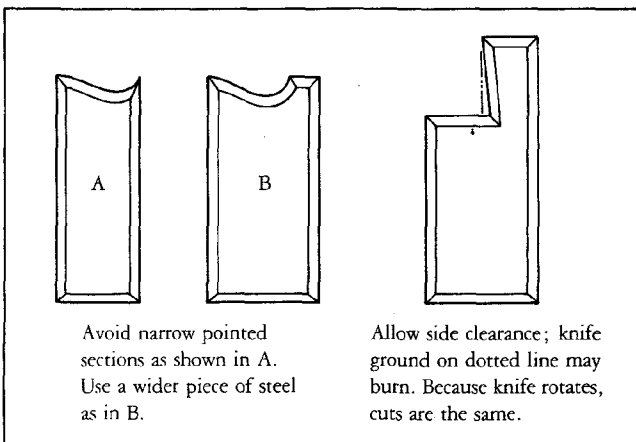
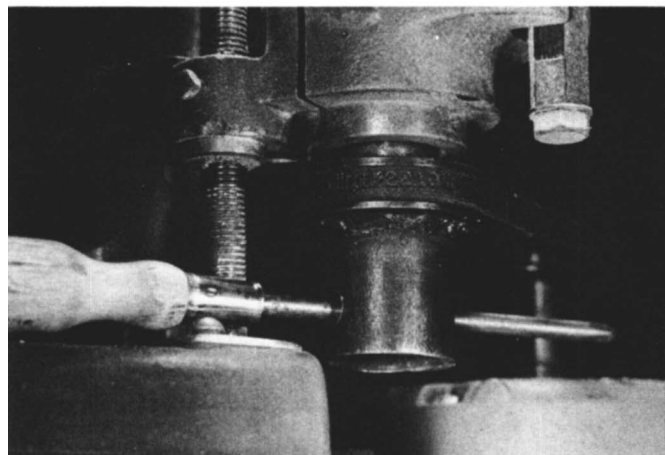
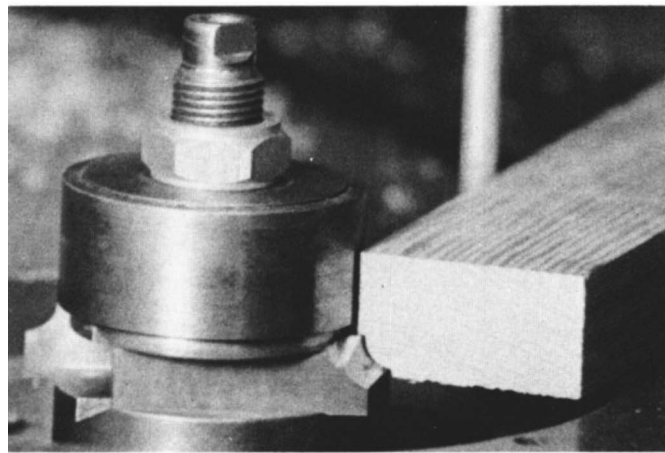
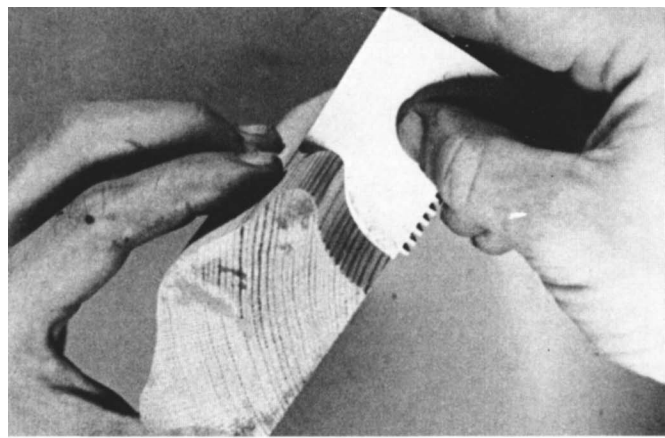
In designing knives, avoid long narrow sections and sharp points, which break easily. The cutting edge must have a side clearance of three to five degrees to prevent burning. And you should realize that the cut produced is not exactly the same as the pattern ground on the knife, because the knives are set on a chord, not radially, in the cutterhead. This affects the depth of the cut, not its width. Unless extreme accuracy is required this will not be significant. One way to overcome the problem when duplicating molding is to miter a piece of the original molding at the attack angle of the knife, and use this profile as a layout template.

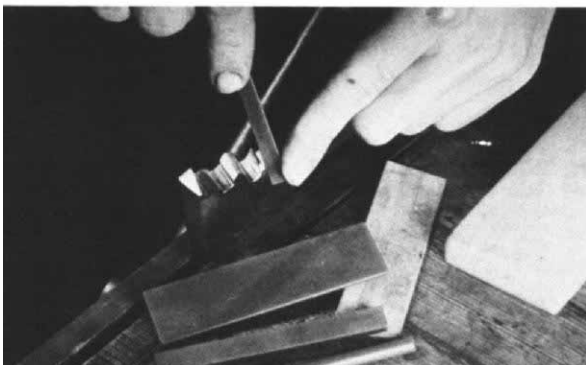
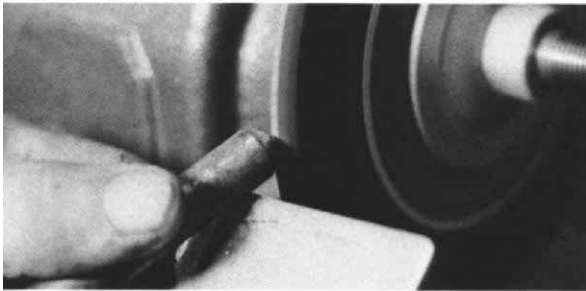
Begin rough grinding on a conventional bench grinder. The bevel depends on the size of the shaper collar, and must be steep enough to keep the heel of the cutting edge from bumping the stock. On a 2-1/2-inch collar, I use a 45 degree angle—about five degrees greater than absolutely necessary for clearance. The width of the wheel depends on the profile being ground; they are made in widths from 1/2 to 1 inch. Remember to keep the steel cool by dipping it frequently in water. When it gets uncomfortable to hold it is too hot, and overheating can ruin the temper.

After the knife is rough ground to within 1/16 inch of the desired profile, change to a fine grit wheel and finish very carefully to the line. Sometimes it is necessary to lay out the profile again as the dye may have burned away.

Delicate profiles and moldings with sharp corners or small

Top picture shows knife being checked for accuracy against an existing molding. At center a bead is cut using ball-bearing collars and a starting pin. At bottom a piece of pipe welded to spindle pulley provides positive lock against which to tighten spindle nut.





radii will require special grinding operations and here an abrasive cutoff wheel about 1/8 inch thick is most useful. Normally cutoff wheels are used on special industrial machinery with elaborate guards, but they do excellent work mounted on a bench grinder or on the arbor of a table saw. They cannot withstand lateral stress and you must be careful to cut directly into the wheel and avoid binding or pinching. Stay well under the maximum safe r.p.m. printed on the wheel, and guard it as much as possible, exposing only the cutting edge. On a table saw, simply raise the arbor until the wheel meets the table at the proper bevel angle, and carefully remove all sawdust to prevent a fire. I also use cutoff wheels on the table saw to cut knife blanks from 24-inch bars of shaper steel.

A jig to hold knives for grinding can be made from two pieces of scrap steel about 1/4 inch thick. Drill both pieces, tap the holes in the bottom one to accept bolts and sandwich the blank between them. A valuable aid is the diamond wheel-dressing tool. It looks like a Phillips screwdriver with diamond impregnated in the tip and can be used to shape and dress a grinding wheel to any profile.

High-speed rotary grinders, such as the Dremel, can be used with small diameter wheels to grind sharp curves. Mounted wheels for such tools can also be chucked in the drill press, with the table tilted to the correct bevel.

After the knife has been ground to the desired profile, it must be sharpened. First, remove the burrs by whetting the face of the knife on a fine stone such as hard Arkansas. Then whet the ground edge with a regular bench stone for straight or bevel cutters, and a slip stone, moon stick or Arkansas file set for curved cutters. When properly sharpened the knife should shave.

Before mounting the knives, make sure the collars are free of dirt, grease and chips. Set the bottom collar on the spindle and place the knives in its slots, allowing them to extend about the distance of the required cut. Be sure the knives are long enough to reach at least the centerline of the collar. Place the top collar over the knives, engaging the slots, and make sure the lock-edge notches fit properly. Adjust the knives to the desired cut by turning the Alien screws on the bottom collar, and hand tighten the spindle nut. Now lock the spindle and snug the nut. It is wise to place a heavy board in front of the knives when the machine is turned on, just in case.

Finally, a few cautions: Never run the spindle clockwise as this would loosen the spindle nut. Cut from the bottom whenever possible, as the knives are less exposed and there is no risk of binding. Avoid kickback by keeping the knives sharp and using hold-down fixtures. Keep the cutterhead well balanced and investigate any undue vibration.

[Author's note: Shaper collars and knives can be obtained from the following sources: Wisconsin Knife Works, Inc., 2710 Prairie Ave., Beloit, WI 53511; Forest City Tool Company, Box 788, Hickory, NC 28601; Charles G. G. Schmidt & Co., Inc., 301 West Grand Avenue, Montvale, NJ 07645; Woodworkers Tool Works, 222 S. Jefferson Street, Chicago, IL 60606].

At top, existing molding mitered to the attack angle of the knife can be used as layout template for an exact reproduction. Below, a cut-off wheel mounted on table saw arbor refines the contour that has been roughed out on a bench grinder. For safety, cut-off wheel should be used with a knife holder and guard. A diamond wheel dresser shapes grinding wheel to reverse profile of the desired cut. High-speed grinder sharpens difficult contour. At bottom Arkansas file set is used to hone knife.