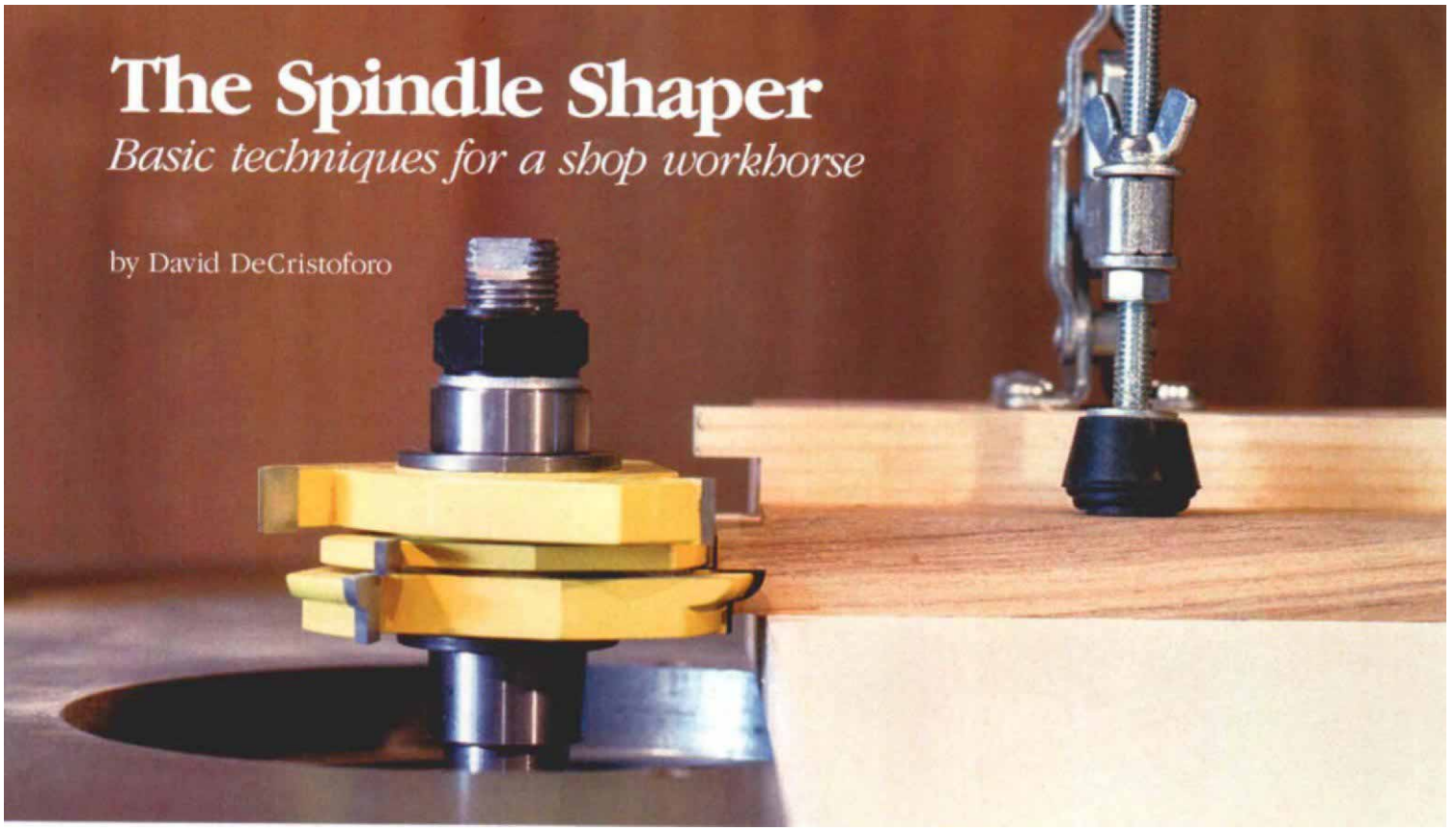
The Spindle Shaper

Basic techniques for a shop workhorse

by David DeCristoforo



A cope-and-pattern cutter shapes the end of a cabinet rail, held in the sliding-table jig shown in figure 2. Table inserts normally under the cutter head and guards have been removed for clarity in this article, but guards must always be used for actual cuts.

In years gone by, a woodworker's tool chest contained a large selection of wooden handplanes. With skill and enormous labor, the craftsman could cut rabbets, grooves and moldings. Contemporary craftsmen still must perform the same operations, but they're more likely to switch on a spindle shaper than reach for a handplane for raised panel work or large moldings. Again, skill is essential for a good job, but the shaper drastically reduces the labor and time involved.

The shaper is a simple machine—a large horizontal worktable with a vertical spindle projecting through a circular opening. The spindle height is generally controlled by a handwheel on the front of the machine. Cutters are mounted on the spindle, which is driven by a powerful motor, either direct drive or belt driven. At first glance, the shaper may look like a glorified router table, but even the largest router can't match its power or continuous cutting ability.

In times past, you'd grind a steel knife to the shape you wanted and bolt it into a cutter head. In recent years, a broad range of sophisticated cutter systems have become readily available, making the shaper even more versatile than ever. These cutters, which have knives permanently brazed to a heavy steel body, can be arranged in various ways on the shaper's spindle to cut a wide variety of molding profiles, do basic mortise-and-tenon joinery, cope-and-stick moldings for doors and windows, and numerous other tasks. Once you've learned to use collars, templates and hold-downs, the shaper is ideal for rapidly producing odd-shaped parts in large numbers.

Shaper sizes—Shapers are most often classified by spindle size, which, to a large extent, determines the horsepower of the motor; as spindle size increases, so does motor size. I don't think any serious craftsman should consider a machine with a spindle smaller than ¾ in. and with less than a 2-HP or 3-HP motor. A ½-in. spindle with a 1 HP motor may be sufficient initially for lightweight molding work for furniture, but most workers quickly outgrow these machines. Also, small shapers can handle only small cutters, which generally aren't available in as many patterns as larger cutters. Heavy-duty machines—those with at least ¾-in. spindles—often have interchangeable spindles, which offer greater flexibility in mounting cutters and router bits. My heavy-duty Delta shaper (Model 43-822), for example, has ½-in., ¾-in. and 1-in. spindles, an extra-long ¾-in. spindle and a router collet, all driven by a 3-HP reversible motor with a two-speed (7,000 RPM and 10,000 RPM) pulley setup. The smaller spindle accepts cutters with smaller bores, which usually have smaller outside diameters and can shape tighter curves than large cutters.

Most shapers come from the factory equipped with a split fence. Both halves can be adjusted independently so the fences can be offset, as shown on the next page, in much the same way that jointer tables are offset. If the outfeed fence (fence halves are designated infeed or outfeed according to feed direction) is offset about 1/32 in., it can support the stock if the entire edge is removed, as when shaping a half round. If only part of the edge is removed, the fences are set flush or replaced with a one-piece fence that spans the opening in the cutter shroud, as shown in figure 1. Factory fences are very limiting; in fact, you may feel they're provided as a token gesture. This is especially apparent with large cutters that won't fit inside the cutter shroud. Also, large cutters often produce enough waste to clog factory-made shrouds and any dust collector attachments. (You'll really need a dust collector if you use many large cutters.)

Shaper safety—Consider safety before using a shaper. It is an extremely dangerous machine and over the years I've developed

Fence halves can be adjusted independently, just as you would set jointer tables so that a wide straight cutter can be used to true edges of stock. The offset shown above is about 1/32 in.

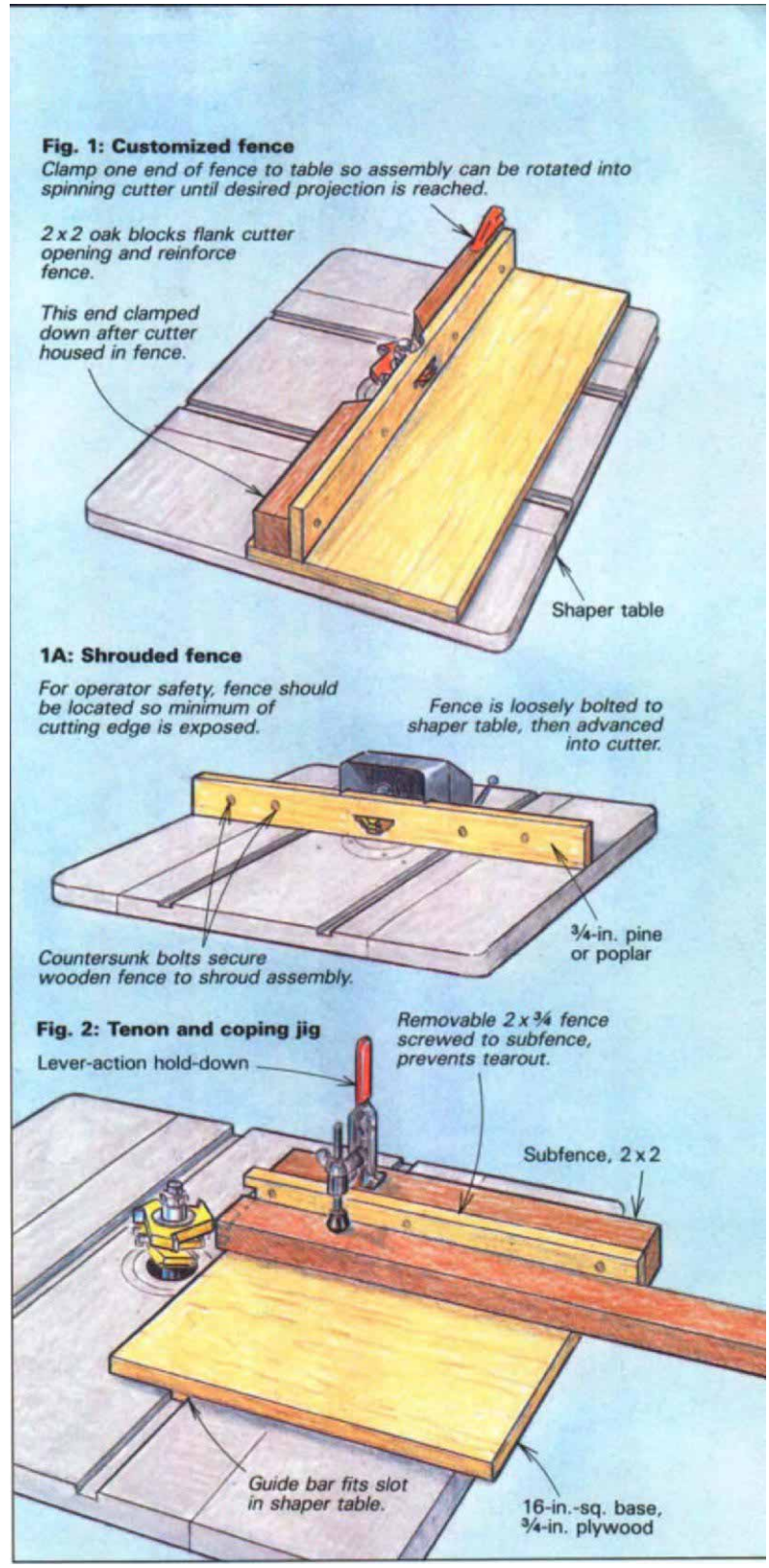
a very healthy respect for it. Read the owner's manual carefully. Some of the safety rules are cut and dry, others enter gray zones where common sense is crucial. Unplug the machine before mounting cutters. Check the speed rating marked on each cutter and don't exceed the recommendation. Never shape narrow stock that would bring your hands within 3 in. to 4 in. of the cutter. Rather, shape the edge of a wider piece and then rip it to size. Push sticks aren't recommended, as they might be with a tablesaw, because of the danger of the stick contacting the cutter. A 2-lb. chunk of steel spinning at 7,000 RPM under 2 HP or 3 HP can tear a push stick out of your hand with ease, exposing you to serious injury. The push blocks with non-slip rubber faces often used to move stock facedown over a jointer are useful for some cuts. If you must shape narrow stock, use featherboards or hold-downs, or better yet, a power feed, which can mechanically guide the stock past the cutter and let you keep your hands well out of the way. Be equally careful with short pieces or when shaping the endgrain of boards. Never attempt to shape a piece that's less than five times as long as the width of the fence opening. For endgrain work, such as tenoning, where the danger of the cutter suddenly grabbing the piece is high, I use a sliding table to hold the stock.

Never stand directly behind the stock or allow anyone to stand in its path in case it's kicked back and ejected. Don't leave the machine with a cutter loose on the spindle—it's too easy to start the motor, forgetting that the nut is not tightened. If you've never been seriously frightened, this will do it. Last but not least, always lock the spindle elevation mechanism and make sure the cutter clears all fences and guards before starting the machine.

Spindle size versus horsepower—It's unwise to mount a cutter more than 2½ in. in diameter and 1 in. in height on a ½-in. spindle, and even using those sizes on spindles this small can be risky. I have seen a ½-in. spindle with a 5-in.-dia. panel cutter bend enough to jam the cutter into the table. On a 3-HP machine, a ½-in. spindle is seriously overpowered, even with a smaller cutter. For this reason, I rarely use the ½-in. spindle, relying instead on the more substantial ¾-in. or 1-in. spindles.

Shaper work can be divided into two broad categories: straight-line work and curved work. With either category, the workpiece must be securely supported at all times—before it reaches the cutter, continually during the cut and until the piece is safely away from the cutting edge. Straight-line work usually involves a fence and a combination of hold-downs, featherboards or factory-supplied tensioning devices to snug the workpiece against the fence and table without endangering fingers.

Fences and associated jigs also can do double duty as guards. I have several panel-raising cutters, for example, which don't clear

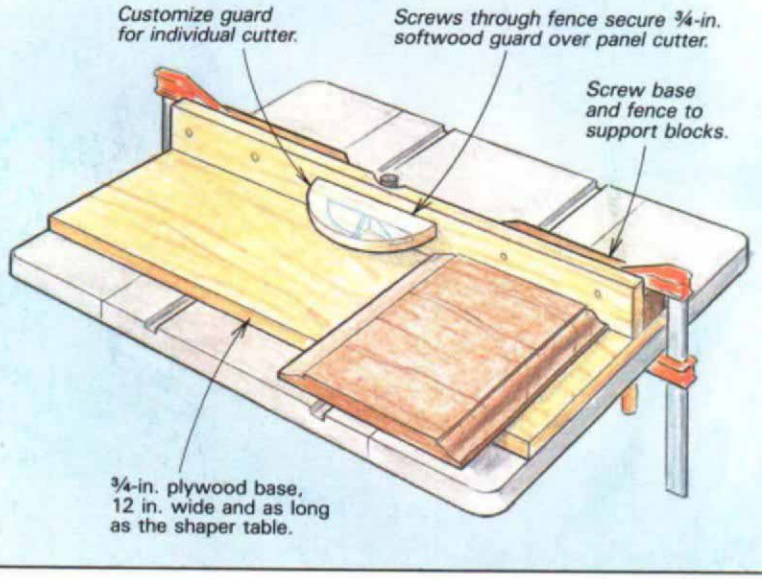


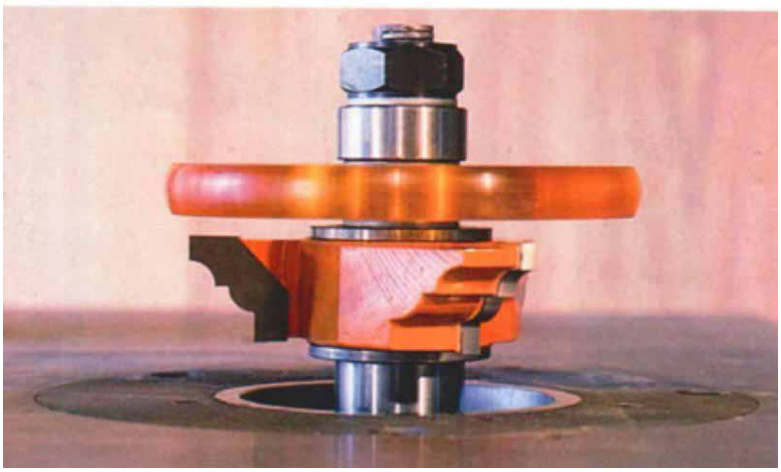
the shroud on my Delta shaper, so I built the panel-raising jig shown on the next page for each cutter. One approach to designing these setups is to draw out the cross section and the stock as it will have to pass the cutter to produce the shape you want. Then, simply construct an appropriate stock-support system that can be mounted on the machine—fences don't necessarily have to be mounted square or parallel to the table. To achieve the desired shape, the stock may have to pass the cutter at an angle or vertically, so some of your jigs may be complex and involve considerable time and effort. The time needed to come up with a safe and reliable system is well spent; the consequences of a jig

Photos by author except where noted

Shopmade fence and guard assembly shields large-diameter panel-raising cutter. Even though these large cutters won't fit within factory-made shrouds and fences, they should never be used without guards. Make a separate guard for each cutter.

Fig. 3: Auxiliary table for panels





A typical shaper cutter setup includes, from top to bottom—lock nut, lock washer, collar, thin spacer, cutter guard, thin spacer, bushing, cutter, bushing and collar. When the cutter is mounted above the stock, the concentric inserts, shown below, should be installed in the table to provide maximum stock support.

failing could be horrible. These jigs are important, so store them carefully. It's helpful to make notes on the jig itself explaining how it is used and tape on samples of the shaped stock.

Mounting cutters—The exact sequence for mounting cutters and accessories on the spindle depends on the requirements of the cut. A typical setup is shown in the second photo at left. You must always consider the limitations of the machine when determining setups—the major adjustments involve changing the cutter height, either with shims or by raising or lowering the spindle, and changing the distance between the cutter and the fence and/or any template being used to guide the workpiece. Some workers also build tilting fences to support the stock at various angles for specialty cuts; some manufacturers offer tilting arbors for the same purpose.

As an example of the setup adjustments, here's how to shape a cove and bead on a table edge. My cutter has been designed for stock facedown (submerged), counterclockwise rotation, as discussed in the accompanying article on cutter selection. We must first remove enough table-insert rings to provide cutter clearance; the remaining concentric rings help support the stock from below. I usually place a thin ¼-in. collar on the spindle first so the cutter body is not stressed against the spindle-bearing housing. Then the cutter is placed on the spindle with the profile facing up. If the spindle cannot be raised enough for the cutter to project sufficiently, a thicker collar must be placed under the cutter. Several more collars are placed on top of the cutter. I leave at least 1½ times the nut thickness of thread above the last collar so I can get a good grip with the spindle wrench when I tighten the locking washer and nut. Now set the spindle at the approximate elevation needed for the cut. Mount the fence on the machine and set it for the approximate cutter projection. After the fence is locked down and any necessary guards and hold-downs attached, a test cut can be made. Then the elevation and projection can be fine-tuned as needed by adjusting the spindle height and fence location.

I generally feed the stock manually past the cutter, against the direction of cutter rotation. A smooth, steady feed is best. If you feed too fast or the spindle speed is too slow, the cutter will take off bigger chunks of wood, making tearout likely. Shapers are powerful enough to make most cuts in a single pass, but on tough woods or with large cutters, you might get a smoother finish by making a couple of passes. If the grain is really contrary, I'll sometimes feed the wood in the same direction as the cutter rotation, an operation called climb cutting. This is dangerous without a power-stock feed, so don't attempt it freehand. If you get hooked on shaper work, you'll eventually want a power feed anyway, because it gives much more uniform results with less effort and greater safety than hand-feeding allows.

Shaping curves—I generally support curved workpieces with templates, used in conjunction with fences, guide pins inserted in the shaper table itself and guide collars over the cutters. The starting pin supports a curved piece until it can bear on guide collars on the spindle, as shown on the next page. Most shapers have several holes bored into the table for optimal positioning of these tapered pins. Never move a curved piece into the cutter without using the pin. The safest method is to maintain contact with both the pin and the collar, however, it's sometimes necessary to move the work away from the pin to turn a tight curve. Keep in mind that you cannot shape an inside radius or an inside angle smaller than the radius of the cutter. Finish these areas by hand.

Spindle-mounted guide collars can be either fixed or ball bearing and can be mounted either under or over the cutter. A

ball-bearing collar functions just like a ball-bearing pilot on a router bit and works more smoothly than a fixed collar. If only a portion of the stock is to be shaped and the uncut edge is at least ⅛ in. thick, that edge can ride directly on the bearing. Otherwise, a template must be used. I usually make my templates out of ¼-in. tempered hardboard and fasten them to the workpiece with small brads. If I'm shaping many duplicates, say legs for a run of chairs, I make a heavier template, commonly called a carrier, out of ¾-in. plywood. The carrier can be fitted with handholds for extra security and several hold-downs to secure the stock as the carrier runs against the guide collar to move the stock past the cutter. Regular straight fences can sometimes also be used for curved work, as when shaping the face of a curved piece like the one shown at right. Templates can also increase the versatility of the guide collars, which are generally sized to a specific cutter. Rather than spending $35 to $45 for a separate collar for each cutter, you can customize templates so one collar can be used with different-size cutters. It is helpful to visualize a line tangent to the ball bearing. If this tangent were the face of a fence, the distance from this face to the outer edge of the cutter would equal the cutter projection. The size of the template can now be adjusted to move the stock closer to or further from the cutter.

I always tell beginners that the best way to understand cutters is to actually make some test cuts. After just a short time, most people begin to understand the toolmakers' logic and have little difficulty setting up cutters to produce the patterns they need. □

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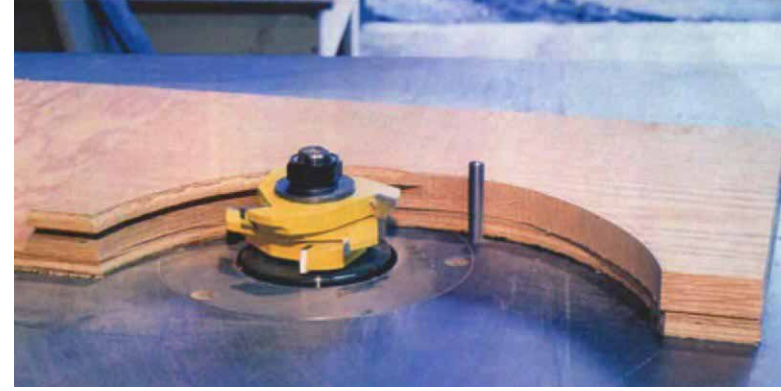
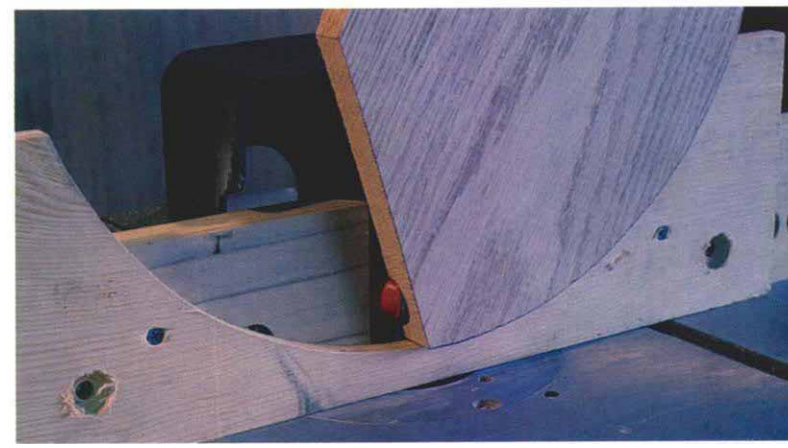


A starting pin and a ball-bearing rub collar are needed to shape a radiused edge. The pin supports the template until it securely bears against the collar.



A shopmade high fence supports the workpiece while it is rotated past the cutter, shaping a relief into the radiused face.