

Mortising Machine

A shop-built combination of router and precision sliding table

by Samuel Butler



A mortising machine can be an economical, precise alternative to hand work in any custom furniture shop. Sam Butler built his machine, above, with a stock router and an Inca sliding table. The rack on the base is for storing bits and cutters.

The speed and accuracy of a horizontal milling machine make it an important mortising tool for anyone who builds a lot of furniture. Commercially available machines can cost more than \$2,000, but, for about \$270, I combined my Bosch 2¼-HP router and a stock Inca mortising table to come up with the sturdy home-built model shown above. Equipped with a standard double-fluted cutter (see p. 79) the router is fast and powerful enough to make short work of most mortises, unlike many moderately priced mortisers, which are notoriously slow.

The key to my machine's versatility is the Inca table, which can move back and forth enough to make a 4-in.-long mortise. A handwheel and threaded-rod system also lets me move the table up and down enough to cut a 2½-in.-wide mortise without unclamping or shimming the wood in any way. The two nylon cam clamps supplied with the table are capable of gripping wood up to 4 in. thick. The table also has several precisely scored lines running perpendicular to its long edges. These marks are ideal for lining up workpieces or cutter bits. If the score marks aren't in the right position for lining up a cut, it's very easy to make temporary pencil marks on the aluminum table. As an added bonus, the sliding table tilts up to 90°, making it handy for cutting angled mortises for chair parts.

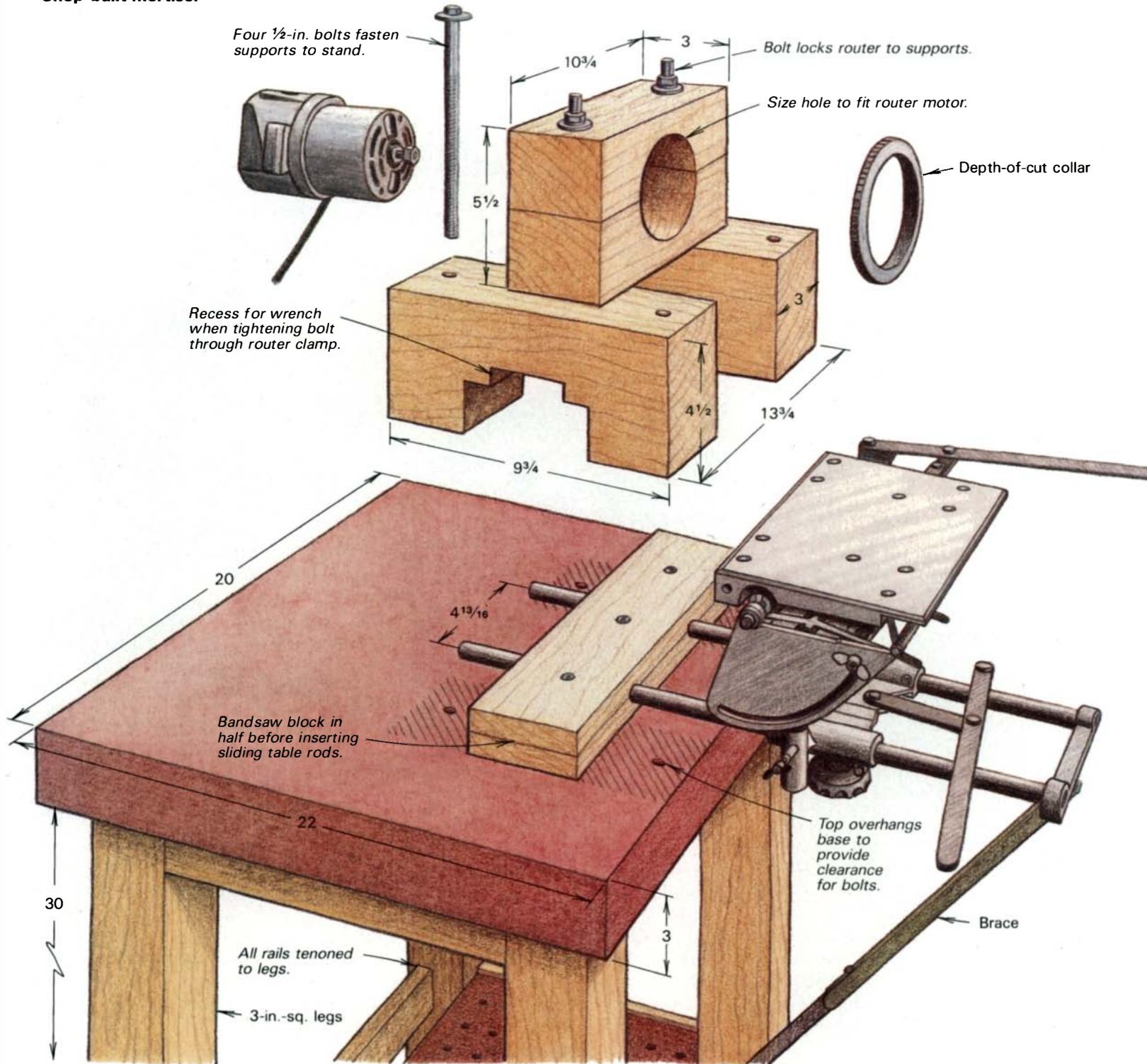
Despite the router's power, I don't hog large cuts in one pass. I seldom cut more than ¼ in. deep in a single pass, although I'm

sure the machine could handle heavier cuts. I think this produces a neater mortise without straining the router or excessively heating the cutter. Actually, the lighter cuts don't take very long. Once the wood is clamped in place, you can adjust the Inca's horizontal stops, which work very much like the margin tabs on a manual typewriter, to control the length of the mortise. The depth of cut is set with a simple stop and setscrew arrangement. By working the machine's two control levers, one to move the table from side to side and one to slide the table in, you can make gradually deepening passes from horizontal stop to horizontal stop until you hit the depth stop. To widen the cut, you use the handwheel to raise or lower the table. Each turn of the handwheel moves the table about ⅙ in.

The cutters I use most often for mortising are Onsrud ⅜-in. and ½-in. double-fluted bits (part number 48-150 348 and 40-139 ½ AAK, available from C.R. Onsrud Inc., P.O. Box 416, Highway 21 South, Troutman, N.C. 28166). Because these cutters are shaped just like drill bits, the machine cuts mortises with round corners. Instead of squaring the corners with a chisel, I prefer to leave them round and shape the mating tenons. The machine could be rigged to cut tenons, but I find it easier to cut them on a tablesaw, then round the edges with a rasp and sandpaper. A jig for cutting the tenons with a hand-held router is shown on p. 81.

To hold the router assembly at a comfortable work height, I

Shop-built mortiser



built a stand with 3-in.-square hardwood legs and a 3-in.-thick top made by laminating four pieces of particleboard. I covered the top with a piece of wear-resistant, easily cleaned Formica. The design of the stand shown in the drawing is not important, as long as it's sturdy and heavy enough to minimize vibration, and to allow large pieces (like bed frames) to be mortised without tipping the machine over. I made my stand about 30 in. high, which puts the sliding table slightly above the level of my wrists when my arms are hanging by my sides. This height is especially important when working with long pieces. For a bed rail, for example, I clamp the end to be mortised on the table, reach over and support the wood with one hand while operating the table levers with my other hand.

After building the stand (using mortise-and-tenon joints), I cut two pairs of mahogany blocks, as shown, to secure the router to the laminated top. The Bosch router is ideal for horizontal mounting because the cylindrical motor unit can be removed from its housing and clamped in a bandsawn block of wood. Since the electrical cord is independent of the housing, the router doesn't have to be rewired. Just plug it into a switch-controlled receptacle after the motor is clamped to the table. You could use any router with a removable housing, but I'd recommend you pick one with at least a 1 1/2-HP motor.

To bolt the sliding table to the stand, I improvised a simple wooden clamp to accept the two metal support rods that come with the Inca table. Once the rods are sandwiched between the

two halves of the wooden clamp, the whole assembly is bolted directly to the table. You must be very careful when making this clamp. Since the clamp also provides tracks for sliding the table in and out, the two rod holes must be parallel to each other. Otherwise, the rods will twist when they are forced into the blocks and the table assembly won't move freely back and forth, making it difficult to vary the depth of cut or align the machine. I made the clamp from a piece of hardwood 1¼ in. by 3¾ in. by 13¾ in. long. Accurately square up the block before you bore two ¾-in. holes centered 4⁹/₁₆ in. apart. Again, accuracy is important, so make sure you bore the holes with a properly aligned

drill press. Next, resaw the drilled block in half and clamp it around the rods. The bandsaw kerf removes enough wood to allow the two halves to clamp the table supports snugly when the block is bolted to the table. Before tightening the bolts all the way, square up the wooden block with the front of the table and position the table so that 14 in. of each rod hangs over the front edge of the stand. This will give you enough room to vary the depth of cut from a fraction of an inch up to about 3 in. without extending the table precariously from the stand. Inca also provides a metal table brace that goes from the end of the rods to the base of the stand. I think the rods and wooden clamp system

Bits for horizontal milling

by Rich Preiss

To get the best results from horizontal mortising or milling equipment, you need high-quality, well-designed bits. I've found two basic types of cutters, shown in the photo below, to be suitable: the mortise drill, which is patterned for wood, and the machinists' end mill, which is designed for metalworking but has many advantages for the woodworker.

Mortise drills resemble extra-long router bits. They are available in at least three types. The simplest one has a single, straight flute with occasional serrations on the long cutting edges to help chip clearance. The second type, the mortise miller, has a straight cutting edge and an additional row of deeply cut teeth that promote quick chip ejection, which leads to faster and cleaner mortises. The double-edge spiral cutter looks like an end mill but is designed for routing wood. Its flat cutting nose and spiral flute make for quick, smooth plunges and rapid chip

ejection. These short cutters are ideal for mortising with a plunge router.

Two types of metal-cutting end mills work extremely well for mortising wood. Two-flute, center-cutting spiral mills provide the best combination for plunging and clean cutting. They leave smooth-walled mortises and eject waste rapidly. If you select double-ended cutters, you'll have twice as long between sharpenings for less than the cost of two separate cutters. For you carbide fanatics, end mills are available in carbide, including straight-flute router mills designed for metal. The carbide greatly extends cutter life in hardwoods or abrasive materials.

Over time, end mills have greatly outnumbered my mortising-style drills for many reasons. For one thing, end mills are more readily available in a greater variety of sizes at a significantly lower cost. The performance of end mills versus even the specialized mortise miller bits is virtually

the same, although plunges are not quite as smooth due to the lesser rake angle of the nose's cutting edges. When sharpening is needed, end mills don't require the more exotic specialty grinding needed for the toothed-type or carbide cutters. In Charlotte, N.C., where I live, sharpening an undamaged, dull end mill costs \$3. Carbide sharpening normally costs about twice as much. End mills, especially the smaller diameters, tend to come in shorter lengths than comparable diameter mortising drills, but this hasn't been a problem because narrow mortises are generally shallow. Because end mills are available in larger sizes, your ability to cut wider mortises in one pass is limited more by the chuck size of your machine than by the cutter selection. □

Rich Preiss supervises the architectural woodworking shop at the University of North Carolina at Charlotte.

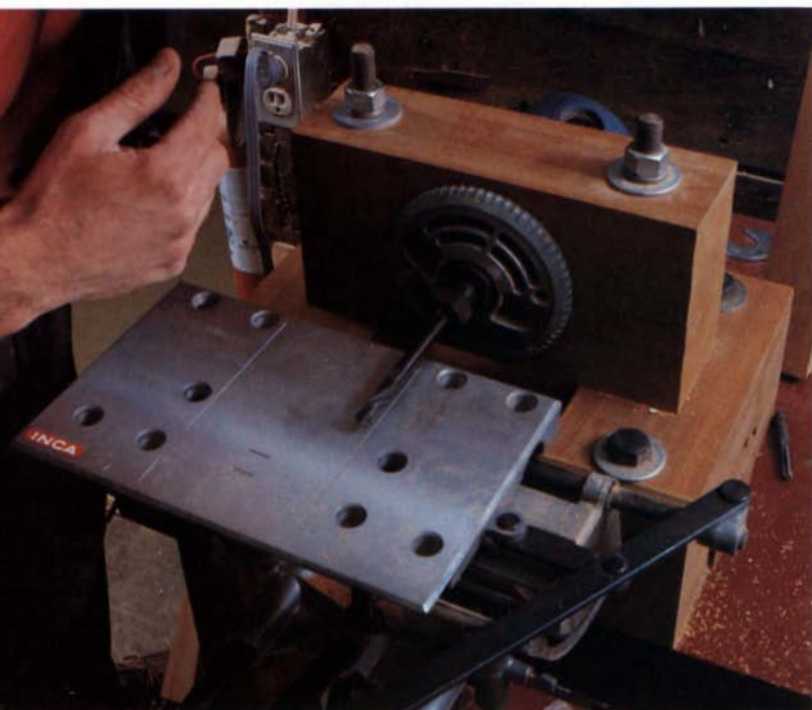
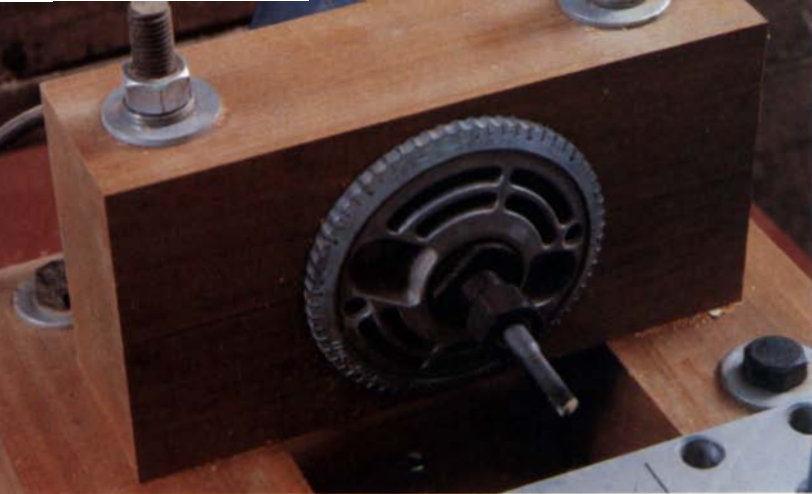


A mortising drill (1) resembles a router bit with one or two notches in its long cutting edges for chip clearance. The mortise miller (2) has a long cutting edge and a row of chip-clearing teeth. The double-edge spiral cutter (3) has a flat nose and deep flutes for quick plunging and clearing. Two-flute spiral mills, flat (4) or round nose (7), plunge well and cut smoothly. Double-end cutters extend time between sharpening. Four-flute end mills (5) produce the smoothest cuts, but feed more hesitantly. Bits for aluminum (6) work well with abrasive hardwoods.

Sources of supply

Double-edge spiral cutters are available from Woodworker's Supply of New Mexico, 5604 Alameda, N.E., Albuquerque, NM 87113 and Garrett Wade, 161 Ave. of the Americas, New York, NY 10013. Mortise drills and miller bits are available from Garrett Wade.

Double-flute end mills and solid-carbide mills are available from Manhattan Industrial Supply, 151 Sunnyside Blvd., Plainview, NY 11803 and C.R. Onsrud, P.O. Box 416, Troutman, N.C. 28166.



Butler reversed the base on his Bosch router to make a flange that prevents the router from being pushed through its support blocks. To align the mortiser, he loosens the clamp bolts and twists the blocks until a long drill bit lines up with the scribe marks on the table (not safe for actual mortising).

are adequately strong without the brace, but since it came with the table I figured I might as well install it.

The dimensions of the blocks used to clamp the router motor to the stand are shown in the diagram. These dimensions allow for the 4 in. height adjustment of the table. Size the router hole to fit the motor of the machine you will be using. Again, band-sawing the block in half will give you enough clearance for snug clamping when the router is bolted to the table. When you remove the motor from its housing, also remove the depth-of-cut collar from the router. Flip the collar over so that the flat side, the side the router usually rides on, faces the motor. After inserting the motor in the wood clamping blocks, thread the collar back onto the base of the motor, as shown in the top left photo. The flat side of the collar makes a strong flange that prevents the router motor from being pushed back through the blocks under the strain of mortising.

You will notice from the drawing that 1/2-in. bolts secure the table clamp and the two router supports to the table. Another set of 1/2-in. bolts secure the router and hold it to the two supports. I bored 5/8-in. holes for all these bolts. The oversize holes allow enough free play to shift the router assembly slightly to align the motor shaft perpendicular to the table. When making this alignment, place a long bit in the router collet, move the table forward on its tracks and pivot the router/block assembly so that the router bit is exactly parallel to the lines Inca has scribed into the table surface, as shown in the photo at left. Caution: the bit is for alignment only. Don't use a drill bit in a router; the bits can't withstand a router's high RPMs. Since these lines are exactly perpendicular to the edge of the table, the router and the table will be aligned. Tighten the bolts and begin cutting mortises.

I like the speed and quality of this mortiser, and I'm also pleased that I did not have to give up a router to get a mortising machine. Once the mortising is done, the router can easily be removed from the blocks and used in its own housing for standard router work. □

Samuel Butler builds custom furniture in Kennebunkport, Maine. Inca mortising tables are available from Garrett Wade, 161 Avenue of the Americas, New York, NY 10013.

A commercial mortiser for small shops

If you don't want to build a mortising machine, a new tool called the Easy Mortise might be a low-cost solution for your shop. The machine shown on the facing page is a router stand married to a sliding table. Mount any 1-HP or larger router to the \$398 stand, and you're ready to work.

Without the router, the Easy Mortise weighs 40 lb., hefty enough to operate without being clamped down. The 22-in.-long by 19-in.-wide by 16-in.-high machine is constructed of 1/8-in.-thick sheet metal, which is rigid enough to support the router and the workpiece without twisting. The router is bolted to a vertical plate that is raised or lowered with a threaded rod controlled by an easy-to-use palm-size plastic knob. After setting

the router height, you tighten two more plastic knobs to lock the plate and the router in position.

Wood to be mortised is clamped on the machine's sliding table, which is large enough to easily accommodate a large board. My favorite aspect of the Easy Mortise is the 20-in. universal-joint control arm, which moves the table both into and across the router bit in one motion. The table moves on ball-bearing wheels that track on sheet metal ways beneath the table. Stop washers for the table movement are tightened onto a 1/8-in. steel rod with a thumbscrew. The rod is attached to the machine at only one end, making a wobbly, but adequate mechanism. Initially, I thought the wobble might be a problem,

but all the joints I cut were true and accurate. Even so, a manufacturer's representative told me that new models will have attachments at both ends of the rod.

I didn't find much use for the pointer gauge and ruler mounted on the table front. The pointer didn't logically line up with the router bit, so I found myself referencing the cuts from marks I drew on the stock. This was somewhat awkward because the vertical router mounting plate makes it difficult to see where the router bit actually contacts the stock.

A lever-action mechanism holds the stock to the table and can be adjusted for different thicknesses by moving a series of nuts up or down on a threaded rod. At the end of the hold-down arm is a heavy rub-

Router tenoning jig

by David Marshall

I have developed a simple router jig that will cut "perfect" tenons at the rate of around 60 an hour. All you need are two pieces of plywood, three offcuts from the stock to be tenoned, and about 15 minutes assembly time.

Two offcuts are used to support the router base during the cut and form a channel to align your workpiece, as shown. A third piece is a stop to set the length of the tenon. When you build the jig, put paper between the workpiece and the two offcuts, so you'll be able to move the tenon stock easily. Clamp the three pieces together and nail the offcuts to the baseboard from underneath.

Cut the tenon with any sharp, parallel-sided, straight router cutter $\frac{3}{8}$ in. or $\frac{1}{2}$ in. in diameter. Insert the bit and adjust the router's depth-of-cut mechanism until the bit just begins to cut. Insert the workpiece in the guides, put the router on the jig and rotate the cutter by hand until it grazes the shoulder line. Then place a square against the edge of the guide and the router base and mark across the guides with a knife.

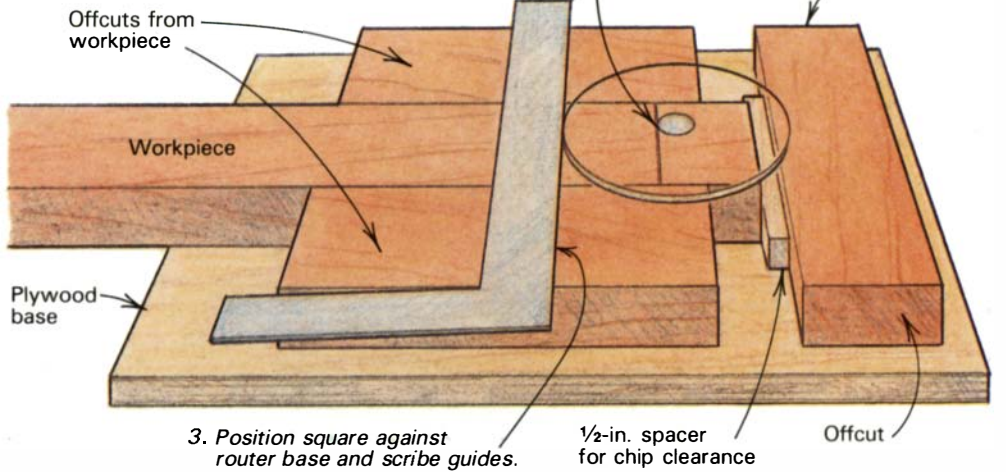
Step on the clamp cord to back the fence down, push the router across the jig and adjust the depth of cut. On the return cut, remove the waste at the end of the tenon. From there, work toward the fence as you cut away the waste. If the shoulder cut isn't exactly right, shim the stop block with paper or veneer, or pare the block thinner. To complete the tenon, flip the stock over and repeat the process. □

David Marshall is a woodworker in Gwynedd, North Wales.

Making the jig

1. Nail offcuts in position on plywood base.

2. Position router so bit grazes tenon scribe line.



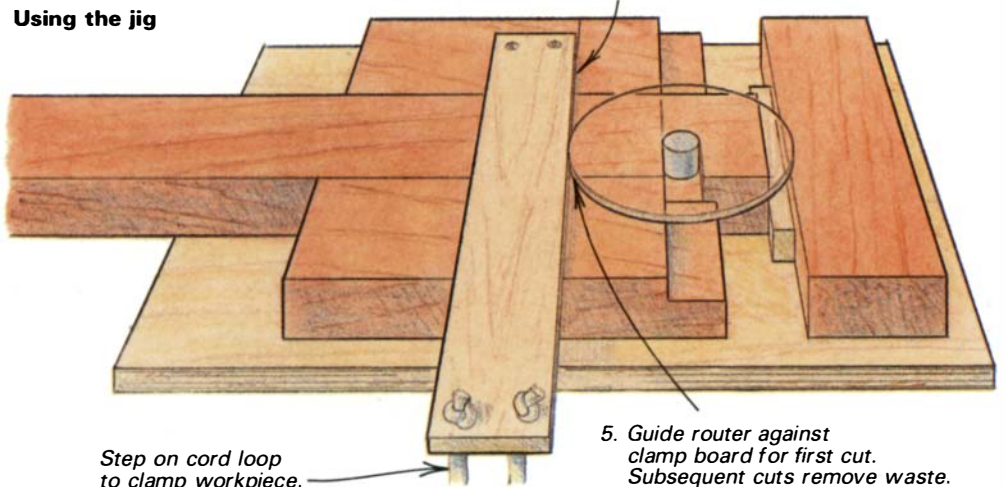
3. Position square against router base and scribe guides.

1/2-in. spacer for chip clearance

Offcut

Using the jig

4. Align clamp board with scribe lines and nail in place.



Step on cord loop to clamp workpiece.

5. Guide router against clamp board for first cut. Subsequent cuts remove waste.

ber stop (like an industrial doorstop) that deflects onto the stock when the handle is lowered. Flanges protrude at the front of the table and on one side of the rear. When the stock is butted against these flanges, it's referenced either parallel to the router plate for mortising, or perpendicular for tenoning. You can cut accurate tenons if you set up a jig and stop block to cut the shoulders at the same depth. The mortise is the guide for setting the bit to cut the tenon cheek to be just above the height of the lower mortise wall, then the stock is set to overhang the table and the bottom cheek is shaved off with the cutter. The piece can be flipped over, realigned against the stop jig you built and the other side cut, or the bit can be raised and realigned against the mortise for the top cut.

I found the Easy Mortise to be a reasonable value. Unlike some inexpensive machines, the control knobs on the Easy Mor-



On the Easy Mortise machine, a single lever moves the sliding table in and out, as well as from side to side.

tise are large enough to grab hold of. The rubber pads the machine sits on keep vibration to a minimum, though I would bolt the machine to the table so long stock won't cause it to tilt. A heavier-gauge sheet metal would beef-up the machine, but if you're willing to take light passes and not bang the bit into the end of the mortise, the Easy Mortise won't flex excessively. On the negative side, I thought the hold-down mechanism was fickle when adjusting for thickness and it won't accept stock thicker than $2\frac{1}{2}$ in.

All in all, the Easy Mortise, which is distributed by N.J. Cote Enterprises, P.O. Box 182, Cooper's Mills, Maine 04341, can do good work once you align it and devise stop references to suit your needs. The manual provided with the machine also showed some interesting ways to cut reeds and flutes and make shutters, but I didn't try any of those operations. —S.R.B.