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DEPARTMENTS

ARTICLES

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On the Cover: *Cutting tenons with a double-blade setup increases accuracy and production. Mac Campbell tells how to cut tenons safely with his unique auxiliary fence on p. 72. Photo: Alec Waters*

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Source for paulownia seeds—Hurray to *Fine Woodworking* for publishing the articles by John Melhuish and Warren May (*FWW* #93) about paulownia trees as a source for high-quality hardwood. John and I have worked together for over 13 years researching and experimenting with paulownia. We had a vision that blossomed into a mission—a global mission. We have endeavored to introduce this incredible tree to the public for its ecological, economical and wood-utilization virtues. We asked Warren to help shape the direction of the mission by working with the wood to demonstrate that the raw material does have a confirmed use. The excellent photos in the article of the finished products only touch on the real beauty of these items.

John left his job with the U.S. Forest Service, and I left my professorship at the University of Maryland, and we set up the National Paulownia Center. We have provided information, starter kits, seeds, growing instructions and economic data to over 9,500 tree growers, woodworkers, industries, conservation groups, the Peace Corps, Native American tribes, and state, federal and private agencies in the United States and 66 other countries. If you are interested in receiving high-quality seeds, growing instructions and other information about paulownia, send $1 and a SASE to National Paulownia Center, 4303 Kenny Street, Beltsville, MD 20705; or call (301) 937-4635.

—Peter Beckjord, Ph.D., Beltsville, Md.

Where there's smoke...—I'm writing to relay an experience that occurred in my woodshop recently. I was cutting an open mortise and tenon for an end vise on a maple workbench using my tenoning jig on the tablesaw. Because the tenoning jig held the workpiece vertically, I had to cut a full 2¾ in. into the end-grain of the workpiece. When I made the first cut, the wood smoked a little, but I wasn't too surprised because I knew this was a very deep cut to make, especially in hard maple. After the cut, I checked the cheeks of the tenon—and they weren't burned—so I set up for the next cut.

But when I made the final check of my setup, much to my dismay, I noticed a red glow inside my tablesaw. Since I had left my dust-collection system running, I had not noticed the smoke coming from the fire developing in the sawdust below the blade. A spark, fanned by the dust collector, had now developed into quite a blaze.

I quickly shut the blast gate to the tablesaw and grabbed for the fire extinguisher that I keep near the entrance of my shop. Luckily, the saw was not damaged and the burning sawdust had not been sucked into the dust-collection system, but if the fire extinguisher had not been close at hand, a minor mishap could have cost me my tablesaw, if not my house. I had never expected to use that fire extinguisher on a fire ignited by my tablesaw.

Since then, I have changed my work habits to include a cooling off period after I am done working, and I always check my workshop before I go to bed. I hesitate to think what might have happened if the spark had ignited on the last cut of an evenings' work.

—David Christianson, Brighton, Mich.

Securing a loose dust bag—I've come up with a tool modification inspired by Sven Hanson's article in *FWW* #92 on orbital sanders. When I used my Bosch orbital sander (model #3283DVS), I ran into the same problem that Hanson described in the article—the dust bag came loose. Hanson had also remarked that Bosch's right-angle model (#1370DEVS) uses an O-ring to hold its dust bag in place. This gave me the idea to modify my sander. I filed two slots on opposite sides of the dust

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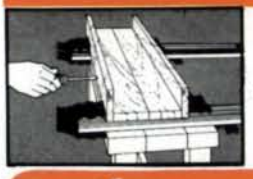

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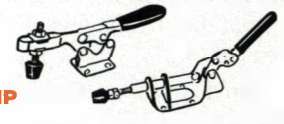

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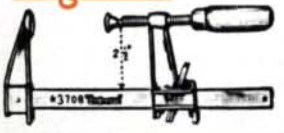

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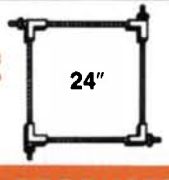

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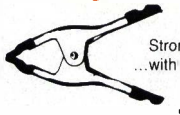

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chute to receive an O-ring that would secure the dust bag. I used a 1¼-in. by 1-in. O-ring with a ⅛-in. cross section (a standard size available at most hardware stores), and filed the slots about ⅛ in. wide by ½ in. long and about ⅜ in. in from the edge of the chute. The O-ring provides a cheap tension clamp to hold the dust bag in place. *—Callan A. Campbell, Chicago, Ill.*

Misplaced T-nuts—I found the article by Lyle Kruger about his shopbuilt tenoning jig *(FWW #93, p. 66)* both interesting and disconcerting. I would like to direct your attention to the placement of the T-nuts in the drawing that accompanies the article. The T-nut on the lower half of the sliding portion of the jig should be installed on the bottom of the piece, not on top, as shown. When the threaded shaft of the locking knob is tightened, the T-nut should be captured, so the two parts of the sliding jig are clamped together. As drawn, the four small prongs of the T-nut's flange are all that are holding the parts together. The same goes for the four T-nuts on the jig's face that hold the clamping assembly. *—Kenn Van-Dieren, Rochester, N.Y.*

EDITOR'S NOTE: Good catch, Mr. Van-Dieren. You're right about the misplacement of the T-nut that receives the locking knob. In fairness to Lyle Kruger, whose jig the article describes, I should point out that the error was only in the drawing, not on the actual jig. However, the T-nuts on the jig's face (which Mr. Van-Dieren also mentions) are located correctly on the drawing. These T-nuts are installed in the back side of the jig's face, and then walnut caps are inlaid over their flanges.

Although no one would ever put a regular hex nut on the wrong side of two parts when bolting them together, it is not uncommon for people to mislocate T-nuts. This error can be avoided if you remember that even though the T-nut happens to fit into a hole, it still functions like any other nut—it must be on the far side of the parts to be bolted together.

If you're self-employed, don't forget to work for yourself—Occasionally, you print articles and letters about the pros and cons of running your own business, and I have something to add to that discussion.

For the past five years, I have been designing and building furniture and restoring antiques in my own shop. I learned this craft from my father, and I can understand a person's trepidation and frustration with the craftsman vs. businessman dilemma. Although you probably won't get rich as a craftsman, there is something else to consider. When I go home, I open the door to a house full of furniture that I made. I would have to make three to four times more money than I currently make to be able to purchase this furniture.

When you work in wood, you can't judge your wealth by your checkbook, so don't try. Some months you will make money, some you won't. But if you don't build for yourself, you'll always be in the red! *—Paul Saporito, Orange, N.J.*

Keep an eye on tool cords—Almost every woodworker knows, and is continually being reminded, to use saw guards and hold-down fixtures and to wear face shields, respiratory masks and proper clothing. The old-timers know about safety from experience, and the neophytes read about it in owner's manuals and woodworking magazines. The warnings are well-indicated and constantly repeated.

However, the silent, sneaky, unobtrusive danger I have run into in my shop is multiple electric cord rots in the original cord furnished by the manufacturer. My Makita router developed 7 separate splits in a 15 month period even though it was not used very often. In fact, it was mounted in a homemade router table, not dragged around from job to job. The cord on my Skil 5½ in. heavy-duty trim saw rotted out in almost the same amount of time—13 months.

Interestingly, my cheaper orbital sanders and electric drills are over 12 years old and have shown no signs of cord deterioration. All the tools are in my small backyard workshop and are exposed to the same humid, Florida weather conditions.

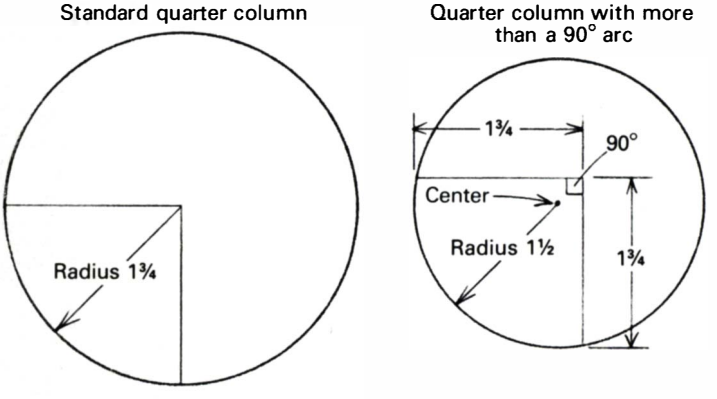
None of the tool distributors or electric-tool repair shops seemed to know if neoprene was better than rubber wire, or if there was a specification code to evaluate the best material for the jacket covering. I suggest that woodworkers periodically give all the cords in their shop a close inspection.

By the way, would you call it superior engineering when a product fails right after the warranty expires?

—Daniel Angert, Orlando, Fla.

A-bit-more-than-a-quarter columns—Thanks for Mac Campbell's excellent article on quarter columns in *FWW #93*. Inset quarter columns are a handsome, classic alternative to square corners on all sorts of case goods and allow for considerable variety of design. But after using quarter columns on a number of commissioned pieces, the results began to look flat, as if the column curvature was too shallow, and the case corners above and below stuck out too far.

An alternative is to use partial columns with greater than a 90° arc, cut to a right angle behind the axis of rotation. This isn't as preposterous as it seems at first glance. For example, if the plan calls for a quarter column of 1¾ in. radius, I can turn a column of 1½ in. radius and then lay out a right-angle section whose maximum width is 1¾ in., as shown in the drawing below. The included arc in this case is about 110°, giving the column a much rounder, fuller appearance.



I turn the column from a square section long enough to leave a few inches of the square intact at each end. After turning, I screw a straight edge across the square ends and rip the corner section on the tablesaw. After removing the straight edge, I trim the column to length.

This method is inconvenient to the extent that only one quarter column can be obtained from a single turning. But turning visually identical columns is not particularly difficult, and because the corners on most case goods are separated by a fairly large distance, small variations, even on highly detailed classic columns, are of little consequence.

—Joseph Beals, Marshfield, Mass.

Familiar finishes may become hard to find—There's more to the issue of regulating volatile organic compounds (VOCs) than first meets the eye. In his sidebar "Will new VOC regulations affect you?" (*FWW #92, p. 82*), Michael Dresdner speculates that they won't. Compliance, he tells us, will be voluntary for small shop owners. And while he urges us to be environmentally responsible, he leads us to believe that we can go on using our old, familiar varnishes and lacquers if we so choose.

I have just completed a finishing book and, after interviewing several finishing manufacturers, I find that Michael Dresdner is only partly right. While compliance for small shops may be voluntary in theory, eventually, we'll all be dragged into a brave, new low-VOC world, whether we want to be or not. Con-

sider the following facts: The EPA and other regulatory agencies have not outlawed just finishing substances but also many *manufacturing processes* that were found to be polluting. For example, the high temperature reactions needed to create certain hard resins are forbidden, and manufacturers have to fill the gaps with more benign processes. These regulations have changed, and they will continue to change, the chemistry of off-the-shelf finishes.

Medical research continues to identify health risks associated with certain widely used finishing materials. Several years ago, the use of benzene was prohibited because it was shown to cause cancer. Soon, the availability of toluol, turpentine and aniline dyes may be restricted for this same reason.

As VOC regulations force industrial users (shops that use more than 1 gal. of finish per day) to buy less-organic, solvent-based finishes, the demand will drop. And sooner or later, so will the supply. Although the regulations don't directly affect small shops and individual craftsmen, the familiar finishes will become increasingly scarce. One finishing manufacturer I talked to estimated small users to be less than 10 percent of the market—not nearly enough for him to keep stirring his lacquer and varnish pots. *—Nick Engler, West Milton, Ohio*

Loose clothing does not belong near machinery—I was appalled by the pictures from the Anaheim Woodworking Show on p. 93 of your April 1992 edition (*FWW* #93). There were three people in the area of rotating machines with loose neckties, which is about as dangerous as you can get. I have seen what can happen when loose sleeves are worn around these machines and have had near nightmares about a loose tie getting caught in a circular saw. Michele Letendre, who is demonstrating a table-saw blade with his tie hanging loose, literally would have his face cut in two if the tie moved into the rotating sawblade.

—F. Reed Estabrook, Jr., Dedham, Mass.

Which came first?—How come it seems that all of the woodworkers pictured in your magazine have a slightly stupid expression, a bit of a pot belly and wear terribly tasteless clothes? Since this description fits me somewhat, I would like to know—does the craft make people like this, or do people like this do the craft?

—An Anxious Reader (John Kennaugh), San Francisco, Calif.

EDITOR'S NOTE: I circulated this letter around the office, and the consensus was that if the tasteless clothes fit, you should wear them, John. As for the "chicken and egg" question, perhaps other readers have an opinion about which came first—the board that was cut too short, or the stupid expression.

What do wedges and opera have in common?—I'm not sure which adage is appropriate, "necessity is the mother of invention" or "poor folks have poor ways," but after reading Percy Blandford's article "Clamping with Wedges" (*FWW* #93, pp. 63-65), I was immediately reminded of my early days of woodworking. I have friends with thousands of dollars invested in clamps—a situation I'm sure that we would all prefer. However, economics sometimes disallows this approach, and we fall back on cost-saving measures learned through years of trials and tribulations practicing our craft.

My first encounter with field expediency was some 15 years ago, when I found myself in charge of four Mexican brothers. These *braceros* had learned their skills from their father and grandfather. They sang opera as they worked and carved

wooden roses while on break. Although I was "in charge," there was never any doubt about who was the student in this association. They shared many tricks of the trade with me including how to make scrapers from a discarded handsaw and how to make jigs that would turn a cheap tablesaw into a precision instrument.

One day, when we needed to glue up some frames, we found ourselves short of clamps. One of the brothers picked up an extension cord, sized it to one of the frames, tied a knot in the cord so that the cord stretched as it was forced around the frame and then inserted wedges from the center outward on both sides of each corner. As the gluelines formed on the joints, we knew that the corners were in solid contact. (I recommend substituting rope to extend the life of your extension cords.)

I still use variations of the tricks I learned from this brotherhood, and the sounds of their arias will forever resound in my memory. *—Kennan Bowden, Cleveland, Texas*

Polycarbonate vs. acrylic—I've noticed that a lot of woodworkers use polycarbonate (such as Lexan) for router bases. I've had the opportunity to work with both polycarbonate and acrylic materials since the mid 1960s, and I avoid using polycarbonate if I can use acrylic instead. Acrylic is cheaper and more forgiving, and polycarbonate's biggest advantage—it *will not* creep—is also its downfall. Because polycarbonates are so stable and creep resistant, they are susceptible to cracking or crazing when stress is applied, such as around attachment hardware. It is possible to buy polycarbonate that has been properly stress relieved, but not all of it has been, so crazing could be a problem.

When using screws to hold polycarbonate in place, you should play it safe and not use excessive torque. The easy solution to this problem is to always use a nylon washer under the screw head. I've found that for flat-head screws you can cut a flat washer out of a plastic milk carton and countersink a little deeper to accommodate the added thickness. After tightening the screw, use a chisel to pare the washer flush with the screw head. The plastic from the milk bottle will creep enough to absorb the stress (the thicker the washer the better).

Also, it's important to keep hydrocarbon-base materials away from polycarbonates. This includes Loctite, oils, cleaners and even soaps. About the only cleaner that can be used on polycarbonates is alcohol. Otherwise, solvent attack will cause crazing or cracking at points of stress. *—F. J. Germanowski, Pittsfield, Mass.*

Correct phone number for Anaheim Woodworking Fair—In your April issue, Charley Robinson wrote a great piece on the Woodworking, Machinery & Furniture Supply Fair in Anaheim, Calif. Thanks. Unfortunately, the article listed our phone number incorrectly. Our correct phone number is (310) 477-8521.

—Ellen Schwartz, Los Angeles, Calif.

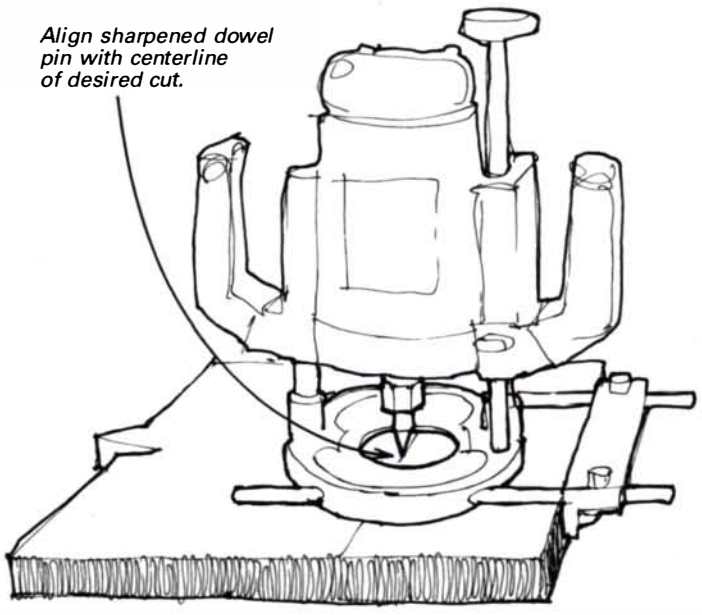
About your safety:

Working wood is inherently dangerous. Using hand or power tools improperly or neglecting standard safety practices can lead to permanent injury or death. So don't try to perform operations you learn about here (or elsewhere) *until you're certain that they are safe for you and your shop situation.* We want you to enjoy your craft and to find satisfaction in the doing, as well as in the finished work. So please keep safety foremost in your mind whenever you're in the shop.

—John Lively, publisher

edited and drawn by Jim Richey

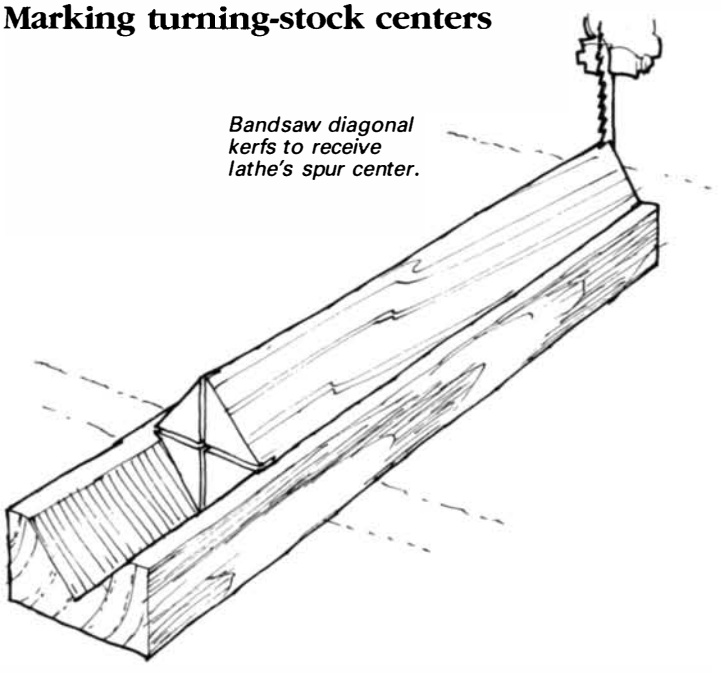
Quick router setup



Here is a quick procedure for setting the fence on your router. Grind a center point on the end of a steel dowel pin that fits the chuck of your router. You can grind the point by chucking the pin in an electric hand drill, turning on the drill and holding it against a running bench grinder. To use the pointed pin, insert it in the router collet, and place the pin right on the centerline of the cut. Then set the fence, replace the pin with the bit, and you're ready to go. *—Jeff Trentini, La Mirada, Calif.*

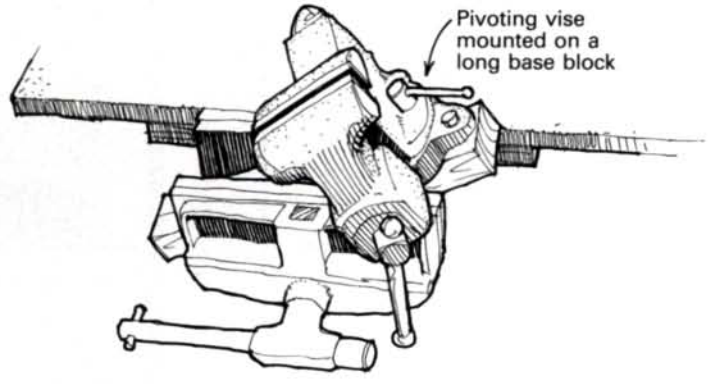
Quick tip: When you need a precision temporary shim or feeler gauge, try the non-fluted end of a twist drill. My set ranges from 1/16 in. to 1/4 in. in increments of 1/64 in. I recently used a pair of 3/32-in. bits to align a flush-mount drawer during its installation. *—Tom Hazelleaf, Seal Beach, Calif.*

Marking turning-stock centers



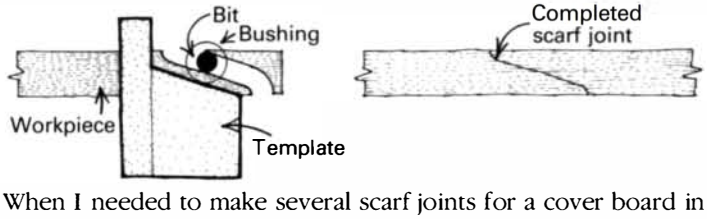
The fixture above marks the centers of turning stock and, at the same time, notches the stock to receive the spurs of your lathe's live center. To make the fixture, cut a 90° V into a scrap 2x4, place the squared workpiece in the V and feed it into your bandsaw, so the blade cuts from corner to corner, about 1/4-in. deep. Turn the piece 90° and repeat. You can also use the jig to find the center of round stock. Just make sure the second cut is at a right angle to the first. *—Dean C. Westervelt, Acme, Pa.*

Universal vise



It's common for woodworkers to mount an engineer's vise on a block of wood, so it can be clamped in a woodworking vise and used to hold a piece of metal. To extend the clamping range of the vise-in-a-vise concept, choose a small engineering vise with a pivoting base, and bolt it to a 2-in.-square hardwood post that extends about 5 in. beyond the vise. This allows you to vary the position of the post in the carpenter's vise to obtain an almost unlimited number of clamping angles. *—A. D. Goode, Sapphire, NSW, Australia*

Routed scarf joint

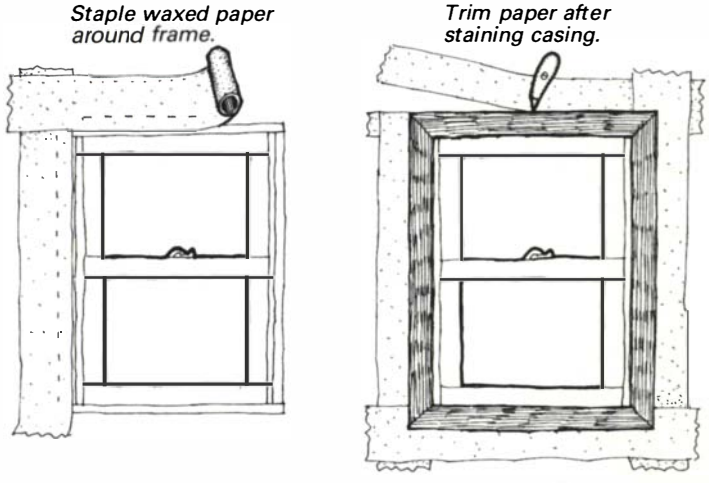


When I needed to make several scarf joints for a cover board in a boatbuilding project, I used a router and template to cut the

joint's profile. The challenge was to shape the template so that the inside curve would be identical to the outside curve. Finally, I hit on the idea of using a router bit with the same radius as the joint's curve and a template bushing with twice the radius. With my router set up this way, all I needed for a template was a simple glued-up block with three straight line edges.

—Robert L. Thompson, New Hampton, N.H.

Masking for window trim



Here's a simple masking procedure that dramatically speeds the process of finishing door and window trim. Cut a roll of regular waxed paper into thirds, and, before installing the casing, staple lengths of the narrow waxed paper around the frame. Now install the trim and stain away. The paper will protect the surrounding sheetrock, and if you also have to paint the walls, just fold the waxed paper down to mask the stained casing from the wet paint. When the paint is dry, simply trim off the exposed waxed paper with a razor knife.

—Richard H. Larsen, Racine, Wisc.

Sawblade indexing head

When an impromptu indexing head is needed for fluting or other routing on the lathe, use a circular sawblade. Divide 360° by the number of teeth to determine how many degrees each tooth represents. A 48-tooth blade, for example, represents 7.5° per tooth, which is particularly useful because you can easily find common settings like 30°, 45° and 90°. To use the indexing blade, fasten it to the workpiece and mount the assembly between centers. Then you can rotate the assembly the desired number of degrees, and place a pin in the appropriate tooth gullet to lock the workpiece in position.

—Boyd K. Ferrell, Blackduck, Minn.

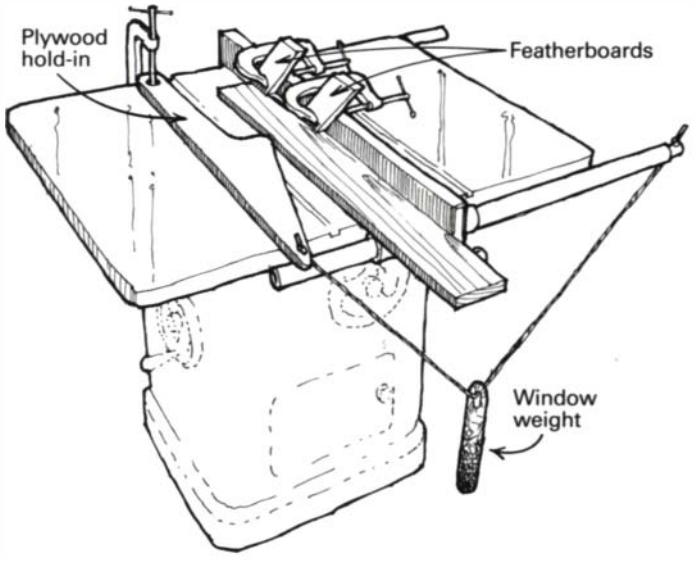
Shop uses for adhesive transfer tape

I discovered the Scotch adhesive-transfer tape I use to mount papers and mat boards is also handy in the shop. This tape has a paper backing that peels off, leaving only a layer of adhesive. Available in ½-in. and ¾-in. widths, it is designed to be used in a trigger-operated gun but can also be used straight off the roll. I find this tape useful for tacking wood together for sawing, routing or sanding, and the adhesive doesn't affect any of those operations. Used in the gun, transfer tape is much faster than double-faced tape, and you can put the right amount exactly where you want it. The adhesive can be removed by rubbing it with your finger

or by laying masking tape over it and lifting. The gun (Scotch ATG-752) and the transfer tape (#942) are available at art- and framing-supply stores. —*Frank Valenchis, Hollywood, Fla.*

Quick tip: Keep the sticky side of the masking tape out when wrapping folded bandsaw blades to avoid any glue residue on the blades later. —*Robert M. Vaughan, Roanoke, Va.*

Constant-pressure hold-in

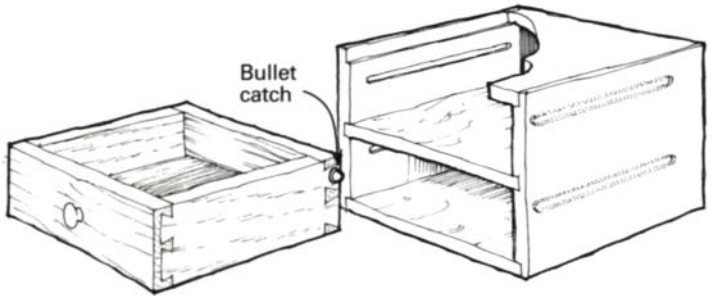


One day, while working in the shop alone, I found I needed an extra hand to rip random-width ¾-in. stock into square molding blanks. To rip these long pieces safely, I built a hold-in from a scrap piece of plywood and an old window weight, as shown in the sketch below left. In operation, the hold-in pivots open and applies pressure just in front of the blade as I push the workpiece into it. The window weight, which hangs on twine tied to the hold-in and the end of the rip-fence bar, provides the constant pressure needed to keep the workpiece against the fence. While ripping, I also add two featherboards, one clamped to the rip fence in front of the blade and one clamped behind it. Using this method, I have ripped many linear feet of irregular-sized pieces by myself and still have all 10 of my fingers.

—*John Spurlock, Houston, Texas*

Quick tip: For starting screws in tight corners and other hard-to-reach locations, attach the screw to the screwdriver blade with a dab of rubber cement. —*Howard E. Moody, Upper Jay, N.Y.*

Stops for small drawers



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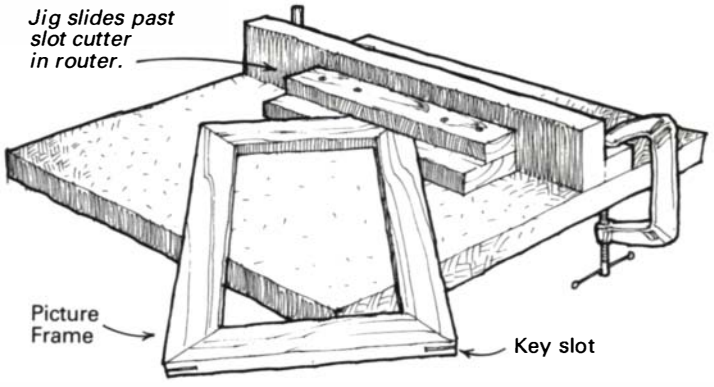
side of the drawer frame. The spring-loaded bullet catch will stop the drawer at the end of its normal travel. But when needed, an extra tug will remove the drawer from the frame.

—Mark Stebbins, Palm Bay, Fla.

Keyed miter joints



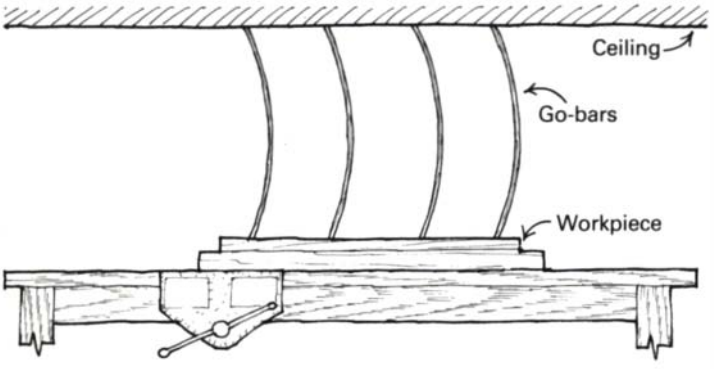
I like to reinforce the miter joints in my picture frames by adding a contrasting key after the glue in the joint has set. The usual method of cutting the key slot is with a tablesaw and a vertical 45° jig riding on the fence, but I find it easier and safer to make the cut on the router table with a slot-cutting bit. The jig, shown in the sketch above, can be made in just a few minutes and has the advantage of enclosing the spinning bit throughout the operation. The resulting slot has a flat bottom and is uniform in width. Inexpensive bits are available to cut slots as narrow as 1/16-in., which looks better on a small frame than the 1/8-in. slot produced by a tablesaw's blade. On larger frames, I cut two slots by setting the bit a little below the centerline, cutting the first slot and then flipping the frame over for a second pass.

—Paul Davis, Lake Stevens, Wash.

Quick Tip: If you have to use an edge tool for a final detail after a piece has been sanded, give the wood a good blast of compressed air. The air removes most residual abrasive granules that would otherwise quickly dull a scraper or lathe tool.

—Robert M. Vaughan, Roanoke, Va.

Go-bars for clamping



I first learned about go-bars during a visit to the shop of William Dowd, a harpsichord builder. A go-bar is simply a thin strip of wood flexed by hand into a bow shape and inserted between a fixed surface, such as a ceiling, and the surface of a workpiece to be clamped. Harpsichord makers use go-bars for gluing the soundboard of their instrument into the carcase because no or-

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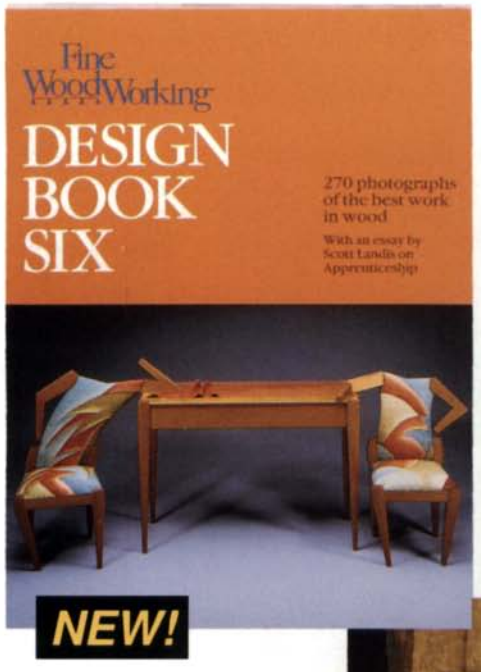

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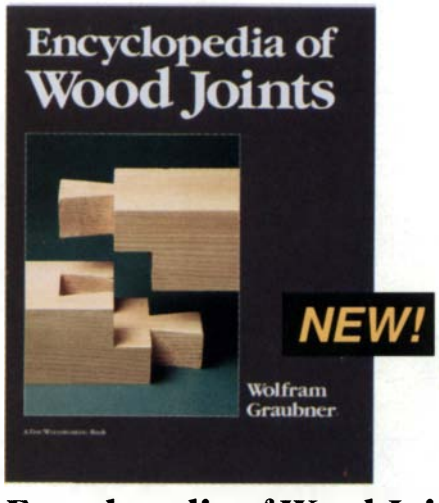

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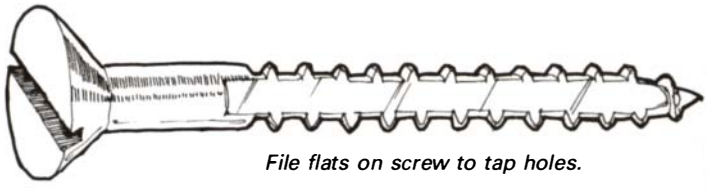
dinary kind of clamp can be brought easily to bear on the work. But go-bars can be applied to a much broader range of clamping problems. They are not only simpler and less expensive than other clamps but also much easier and faster to set.

To make go-bars, start with straight-grain wood. I've used ¾-in.-thick fir flooring sawn into ½-in.-wide strips for 39-in.-long go-bars. Experiment with your own wood-and-clamping conditions to get the dimensions right. Cut the bars about 2 or 3 percent longer than the distance between the work surface and the fixed surface. This will cause the bars to bow out about a fifth of their length, which should feel about right.

—Abijah Reed, Newton Centre, Mass.

Tapping screw holes



File flats on screw to tap holes.

When driving screws into hardwood, it is easy to snap off the screw in the hole or gall up the screw slot. To reduce these problems, tap the hole prior to driving the screw. Make a tap by filing or grinding two opposing flats down the length of a screw, as shown in the sketch above.

—Don Clemens, The Colony, Texas

Two ways to clean spray-can nozzles

You can clean a clogged nozzle from an aerosol paint can by temporarily moving the nozzle to a can of engine starting fluid and squirting some of the fluid through it. The ether and solvent in the starting fluid will thoroughly clean the nozzle.

—Vic Hulley, Penticton, B.C. Canada

Rather than wasting propellant gas to clear the nozzle jets of spray-paint cans, remove the nozzle head and store it in an appropriate solvent, like acetone. I find a plastic 35mm film container ideal for the purpose. *—James Sterling, Concord, Mass.*

Quick tip: When machine-sanding with fine grades of sandpaper, apply masking tape to the exposed edges on the back of the paper to protect them from tearing. This allows much longer use of the thinner, more delicately backed sandpapers.

—Dan Morgan, El Sobrante, Calif.

Truing up a router base

Many router bases are almost, but not quite, concentric with the collet center. This has the undesirable effect of varying the distance between the fence and the bit or slightly changing the depth of cut when the router is rotated. You can true up a base by first mounting a short length of straight steel rod in the router. Then drill a rod-sized hole in a flat block of wood, so you can pivot the router in the block with the router base's edge against a disc sander. Clamp the block to the disk-sander table (set at 90°); then rotate the router to sand the base round.

—Bill Webster, Chillicothe, Ill.

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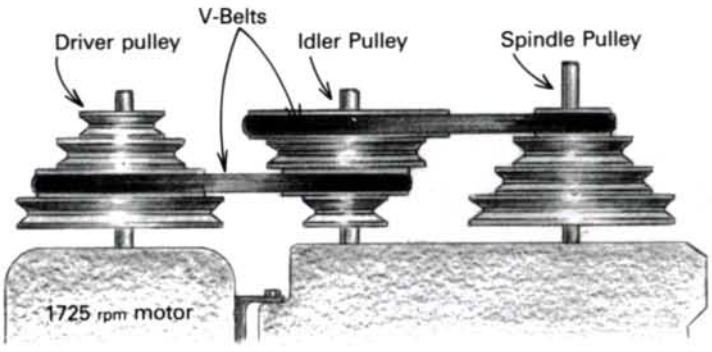
Craftsman 15-in. drill press

Awhile ago, I was given a large floor-model Craftsman 15-in. drill press equipped with a 1725 RPM motor. To allow a wide range of boring speeds, my drill press has three, four-step pulleys configured as illustrated below. I have been unable to locate a manual, and a pulley-speed chart is not included on the machine. Can anyone tell me the formula for ascertaining the spindle speed for various pulley and V-belt combinations?

—Henry M. Coxe, Alpine, N.J.



Sandor Nagyszalanczy replies: Here's a way to calculate spindle speed in two easy steps. In step one, take the motor RPM and multiply it by the driver-pulley diameter (all diameters should be in inches), and then divide this product by the idler-pulley diameter. This quotient equals the RPM of the idler pulley. In step two, multiply the idler-pulley RPM by the second idler-pulley diameter (driver and spindle V-belts can't be on the same step of the idler pulley at the same time), and divide the product by the spindle-pulley diameter. This number is the RPM of the spindle pulley and the rate of rotation of whatever bit you have chucked in the drill press. The reason you want to know spindle speed is that all bits have ideal speeds they should be run at (see Bernie Maas' article in *FWW* #94). As an example, let's say you're using the 4-in. and 3-in. driver- and idler-pulley steps and the 5-in. and 2-in. second idler- and spindle-pulley steps. If you plug in these values for a drill press with a 1725 RPM motor, you get: (1725 x 4) ÷ 3 = 2300, which is the idler-pulley RPM. In the second equation, (2300 x 5) ÷ 2 = 5750 provides the final spindle speed in RPMs.

Using these formulas, you can calculate all the different spindle speeds for each pulley combination and make up your own reference chart. By keeping the chart posted near your drill press, you can always determine the configuration you need for any drilling job.

[Sandor Nagyszalanczy is managing editor of *Fine Woodworking*]

Chemicals in cedar ruin nitrocellulose lacquer

I've built a number of blanket chests of red oak, lined with 3/8-in.-thick tongue-and-groove aromatic cedar (commercially sold for closet lining). The cedar lining is attached to the oak carcase with Liquid Nails construction adhesive and is trimmed with oak at the opening. The oak is stained and finished with three coats of Deft lacquer and the cedar is left unfinished. Several months later, two of the chests have developed a sticky substance where the oak trim overlaps the cedar lining. Could fumes from the aromatic cedar be spoiling the lacquer?

—Timothy B. Fields, Colorado Springs, Colo.

Chris Minick replies: Your assumption that the gooey-finish problem was caused by gasses emitted from the cedar lining of the blanket chest is entirely correct. Aromatic cedar contains several chemicals that are harmful to nitrocellulose-lacquer finishes. Two of these, limonene and bornyl acetate, are solvents for nitrocellulose resin but are only present in freshly cut cedar boards. However, 2-hydroxycamphene (the chemical that makes cedar smell like cedar) continues to be present in high concentrations, easily volatilizes out of the wood and will damage nitrocellulose lacquer finishes.

Ironically, chemicals like 2-hydroxycamphene and camphor (a close relative) were used commercially as plasticizers in nitrocellulose resin in the early part of this century. A plasticizer can be thought of as a slowly evaporating solvent. They are added to lacquer formulations to increase the flexibility of the finish so that a hard resin (like nitrocellulose) is suitable for use on wood. As you might expect, adding too much plasticizer causes a finish film to become sticky.

This same phenomenon happened on your blanket chests. The 2-hydroxycamphene in the cedar vaporized and was absorbed into the lacquer film. Then the chemical dissolved into the nitrocellulose resin, which over-plasticized the system and turned the finish film into a sticky mess. Therefore, nitrocellulose lacquer is not a good choice for finishing a piece that comes in contact with aromatic cedar. The gooey-finish problem is most severe when nitrocellulose-finished parts come into direct contact with the cedar liner. Hence, I think you should redesign your chests so that there's no direct contact between the exterior wood and the cedar lining.

As far as choosing another finish for your chests, most other common finishes will not create problems. Drying oils like tung oil or linseed oil, alkyd varnishes, and standard oil-modified polyurethane varnishes (such as Flecto's Varathane products) are not affected by the chemicals in cedar. However, acrylic lacquers offer what I feel is the best alternative to nitrocellulose. They can be applied with conventional spray equipment, will not yellow and are generally not affected by the plasticizers found in cedar. Finishes composed entirely of acrylic resins are usually designed for coating metal or as all-purpose lacquers, but they'll work equally well on wood. High-quality acrylic lacquers can be purchased at stores specializing in automotive refinishing products or from your local Sherwin Williams dealer.

[Chris Minick is a product development chemist and amateur woodworker in Stillwater, Minn.]

Drying white oak rounds

I have about a dozen freshly cut, white oak rounds that are roughly 5 in. thick by 3-4 ft. dia. I want to dry them, attach legs and use them for butcher blocks. Currently, they are stored outside under a sheet of plastic that allows some ventilation. Should I sticker the rounds and protect them from the sun? About how long should these rounds take to dry?

—Tucker Hill, Etters, Pa.

Bruce Hoadley replies: The best drying rate for any wood is really a compromise: It must be fast enough to prevent the development of fungal deterioration but slow enough to minimize drying defects resulting from differential shrinkage stresses. In the case of your large oak discs, keep them well-elevated above the ground and separated with stickers to allow air circulation across their endgrain surfaces. Generally, white oaks are much less apt to develop stain than red oaks. Protect the stack, if left outdoors, from direct sun and rain by stacking the oak in a shed, garage or under a roof.

Monitor drying progress by keeping a record of the weight of one or more of the discs with a bathroom scale. When weight loss ceases, you'll know the pieces have attained an equilibrium moisture content with the surrounding atmosphere. Then you might move the rounds to an indoor location, and once again, monitor their weight loss until an indoor equilibrium is reached.

Sorry I don't have a solution to drying discs defect-free. Haven't figured that one out yet! I cannot be optimistic that you will be successful in drying the discs without seeing some severe defects. Because tangential shrinkage is greater than radial, extreme circumferential stress will develop. If the discs are dried slowly, a single radial check will initially occur and then will gradually develop into a gaping crack that will split part of the disc;

the remainder of the disc's surface may come through in reasonably good shape. If the drying is rapid, a large number of small checks will initially develop somewhat uniformly over the surfaces, but sizable cracks may or may not develop from these smaller surface checks. Either way, defects are likely to be significant.

An alternative might be to consider stabilization treatment with polyethylene glycol-1000 (PEG-1000) before drying. This would require a major investment of time and materials and, with 5-in.-thick discs, might not be very successful, particularly with white oak. Such large discs would not be a good choice for your first attempt at using the PEG treatment. (For more information about using PEG-1000, read my article in *FWW* #19; also reprinted in the *FWW* book *Techniques 3*).

[Bruce Hoadley is professor of wood technology at the University of Massachusetts at Amherst and a contributing editor to *FWW*]

How much sawblade runout can you live with?

After reading Robert Vaughan's article "Using Dial Indicators and Calipers" in* FWW *#87, I used a dial indicator to check the runout of the blade on my tablesaw; the blade had .008 in. runout. If this much runout is too much, how do I correct it?

—Graham Laird, Ashstead, Surrey, England

Robert Vaughan replies: The fact that you took the time and effort to write this letter leads me to believe that you are having cutting problems, and I suspect that blade runout is the cause. It's hard to say how much sawblade runout is acceptable: Almost every one of my blades has at least a small amount of runout. The .008-in. runout that you mention could have a small, but noticeably negative effect on the smoothness of cut your saw produces. The runout may also increase the pressure required to feed stock through the blade.

Even the bodies of new sawblades are rarely flat, and hard use will quickly increase the amount of runout. Radial-arm saws can bend and buckle blades when cutoffs accidentally get wedged against the fence and bind the blade. And on tablesaws, pinched stock between the table opening and the blade can cause blade warpage as can binding and kickback

There might be a chance of reducing your runout. Start by rechecking the blade. Observe the dial indicator's needle as the sawblade is rotated. If the extremes of the reading are 180° apart, then the cause of the runout may be the arbor flange. Try changing the position of the blade on the arbor to see if it decreases the runout. If the variation goes in and out all around the blade, then the body of the blade is most likely warped, which is the probable source of your runout.

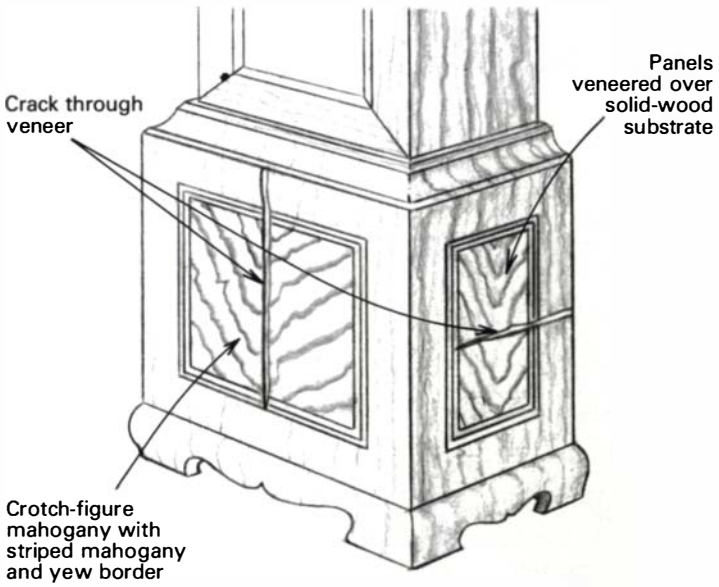
My experience with blade problems over the years has ultimately revealed one common denominator—age. I have found that no matter how well the blade has been sharpened, older sawblades (some of mine are 8 to 15 years old) just won't cut the way they used to. The only consistent solution that I have found is to replace the blade. Even though an old blade may look great as it hangs on the wall and has plenty of resharpenable carbide remaining on the tips, it still isn't worth keeping if it's seen years of hard use and is not cutting satisfactorily after sharpening. The skill and technology required to make an old blade flat again is not worth the expense to me when compared to the cost of a new blade.

[Bob Vaughan is a contributing editor to *Fine Woodworking* and a woodworking machinery rehabilitation specialist in Roanoke, Va.]

Veneering a grandfather clock

I am interested in reproducing a Chippendale grandfather clock by Thomas Raper (circa 1765) that I saw in an antique

shop. The base appears to be made of solid wood covered with crotch mahogany veneer surrounded by a border of plain mahogany and narrow bands of yew. I'm concerned about the ability of these rather delicate veneers to withstand the seasonal movement of the solid-wood substrate. On Raper's clock, a vertical crack on the front and a horizontal crack on each of the sides (as shown in the drawing below) make me wonder how the grain of the substrate should be oriented to prevent problems. I'd rather not, but should I use plywood for the base? —Frank Del Greco, Munson Township, Ohio



Norman Vandal replies: Careful veneer work spoiled by an inadequate substrate is a real heartbreaker even when seen on period work. There is really no way that lumber can be safely used as a substrate for veneer over such broad surfaces. As a result, period clocks with veneered or marquetry surfaces are perhaps some of the most frequently restored pieces of furniture. The size of a tall clock is also a factor in that the base is near the colder, damper floor while the pediment hugs the ceiling—the hottest part of the room.

Technically speaking, there is no proper convention for grain orientation of veneer over a solid-wood substrate: Either vertical or horizontal orientation present the same potential problems. The most important factor is the structural integrity of the clock. If you must use lumber substrate, then try to keep the grain oriented parallel to that of the largest pieces of veneer to be applied while keeping the construction consistent with case strength.

Another factor to consider is the substrate cupping or warping. I have seen clocks whose bases have cupped so much as to prevent their doors from closing properly. In addition, the doors themselves are frequently warped or cupped. You can prevent these problems by carefully gluing up your panels from narrower boards and orienting the boards so that heartwood faces and sapwood faces alternate all the way across.

If you can bring yourself to part from strict tradition, make your own panels for the base using ⅝- or ¾-in. plywood as a core. Then veneer a secondary wood, typically either pine or poplar, to the inside surfaces of the panels. The primary figured veneers can then be glued on the panels' outside surface. The edges of the plywood will be hidden by moldings on the clock case, and the plywood ensures that these moldings, which often come off due to the movement of solid-wood cases,

will stay put. These panels will remain stable, particularly if you use a multiple-core furniture plywood for the substrate.
[Norm Vandal is a consulting editor to *FWW* and makes period furniture and architectural furnishings in Roxbury, Vt.]

Using homemade veneer

I am planning to build kitchen cabinets using the methods detailed by Paul Levine in his book and video. However, I want the cabinet and drawer fronts to be hardwood rather than plastic laminate. Further, I want to make my own veneer from locally grown spalted maple. After resawing, I can thickness the maple down to 1/8 in. thick, but no less. Is this thin enough to apply as a veneer? —Paul Glasser, Sherwood, Ore.

Monroe Robinson replies: Your plans to saw your own veneer for cabinet doors and drawer fronts will give you the clean European look you're desiring. You'll retain the harmony that comes from a matched flitch of sawn veneers without the monotony of commercial veneers.

I would recommend a maximum veneer thickness of 1/8 in., although thinner—3/32 in.—is better for very hard or resinous woods to keep the veneer from pulling loose or splitting. The method of bandsawing veneers I describe in *FWW* #58, using a fence adjusted for the drift of the blade, allows you to saw veneers of consistent thickness down to 1/16 in. with no need to plane or sand to thickness. Bandsawing is economical, too; the only waste is the thin, .029-in. to .035-in. blade kerf. A 1/2-in. blade with a skip-tooth pattern and 4 teeth per inch (t.p.i.) is probably the proper blade for the spalted maple.

Veneered panels are least likely to warp if both surfaces are covered with the same veneer. If you wish to veneer only one side, I'd recommend using an adhesive that has no water in it, such as epoxy, to reduce the risk of your thin veneer panels warping. The doors should have edge strips glued to the core and trimmed prior to gluing on the face veneers.

You can glue the face veneer onto your doors using a vacuum press (see *FWW* #84), or, in lieu of that, you can clamp the panels using a 1-in.-thick layer of particleboard as a caul above and below the panel backed up with 2x4 struts clamped on the ends with bar clamps. Clamping in the middle of the panel with one or more deep throat clamps is a good idea. If you use an adhesive with a long open time (the amount of time it takes the glue to initially set), you can veneer a whole stack of panels of the same size at the same time; place clean butcher paper or newsprint between them before clamp up.
[Monroe Robinson is a woodworker in Little River, Calif.]

Restoring cocobolo's color

Frequently, the color of newly sawn cocobolo is an unattractive purplish-brown yellow whereas it turns a beautiful red-orange color after aging awhile. I assume that this occurs because of the wood's exposure to the air over a period of time. Can something be done to accelerate the development of this red-orange coloring? —Charles Conyers, Toledo, Ohio

Jon Arno replies: Cocobolo is a member of the rosewood genus, *Dalbergia,* and this genus produces some of the most brilliantly colored woods in the world. Often, however, these woods are not particularly vivid when first cut but tend to develop a richer, warmer color over time. The reason for this is that the wood contains organically produced volatiles that oxidize upon exposure to the air. While these volatiles are not particularly complex in chemical structure intitially, the oxygen in the air causes them to polymerize, forming more complex molecules,

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and, in turn, these polymers are often pigments. Although this explanation describes the general process, it is overly simplified in that many woods react to other stimuli in the environment as they develop their unique patinas. For example, American black cherry, *Prunus serotina*, darkens when exposed to light, but light alone does not appear to be the only factor in creating the rich color cherry ultimately develops.

A wood's natural patina is the product of rather complicated chemical reactions, which are neither thoroughly understood nor easily controlled. Rubbing the freshly cut surface of some woods with one of several solvents, such as alcohol, acetone or naphtha will often cause an immediate change in the wood's color, but this interference in the natural process can lead to long-term disappointment. Rosewoods have such an outstanding potential for natural patina it is a shame to adulterate it. With this in mind, I recommend working the wood down to where all surfaces are the uniform color of the fresh wood, and then letting it develop its patina naturally. In only a few weeks, the wood will mellow enough in color to be very attractive, and it will go on to attain its full range of warm highlights, which it might never achieve if you attempt to hasten the process with harsh chemicals. [Jon Arno is a wood technologist and consultant in Schaumburg, Ill.]

A ceramic top for a wooden table

I am interested in making some tabletops with ceramic tile inserts. How thick a base should the table have to properly support the tile, and what type of adhesive should be used to glue the tiles down? Also, what kind of grout should I use?

–Lawrence J. Raleigh, East Sebago, Maine

Michael Schweit replies: Start by designing your tabletop to be as rigid as possible, without making it too heavy to be practical. This is important because any flexing can weaken the tile bond and cause cracking in the grout joints. As a tile substrate, I'd recommend ¾-in.-thick plywood, which further prevents flexing or warping of the top. If you want the tile surface flush with the surround wood frame, measure the thickness of your tile and add about 1/16 in., for the layer of tile adhesive, before building the frame. Also, when sizing the opening for the inlay, leave the same amount of space between the tile and the frame as between adjacent tiles for the grout joints. To protect the wood, finish the top before gluing and grouting.

For a tile adhesive, use either a type I or type II organic mastic (both are available from your local ceramic tile dealer). Type I mastic is slightly more water resistant, but I'm assuming your table is for indoor use and won't be exposed to more moisture than the occasional spilled drink, so either type mastic should work fine. Follow the manufacturer's instructions, and observe the glue's open time and curing time for best results.

Epoxy grout would be the ideal choice for your tiled top. However, it is very costly and difficult to use for anyone inexperienced with tile installation. Instead, use a standard tile grout with a latex additive mixed in to greatly improve the grout's bond strength and flexibility. If your grout joints are 1/8 in. wide or more, use a sanded grout; with narrower joints, use unsanded grout. Colorants in grout have a tendency to stain softer woods, so mask off the wood frame as necessary before grouting. [Michael Schweit is a professional tile contractor in Northridge, Calif.]

Send queries, comments and sources of supply to Q&A, Fine Woodworking, *PO Box 5506, Newtown, Conn. 06470-5506. We attempt to answer all questions, but due to the great number of requests received, the process can take several months.*

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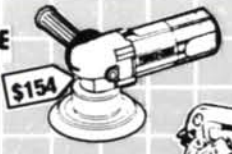

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Fine Woodworking
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With its surface at 20 in., Chuck Davis' assembly table puts the work at a comfortable height and also allows him to put a foot up to rest and stretch his back.

Cabinetmaker's Assembly Table

Torsion-box construction and a wooden brake make this mobile work surface strong and stable

by Charles Davis

There's never enough bench space in a shop. At one time or another, almost every horizontal surface in a shop will get pressed into service as an ersatz assembly table. Through the years, I've had to improvise to come up with assembly space: at times using my workbench, a solid-core door placed over two sawhorses, my tablesaw and extension tables and (all too often) the shop floor. All the projects assembled on these makeshift assembly tables were completed, but there were always compromises and inconveniences.

My workbench is too narrow for many projects, solid-core doors aren't as stable as I would like and I hated to tie up the tablesaw from glue-up until I removed the clamps—usually the next morning. Clamping around the casting on the bottom of the tablesaw is a pain, too, and extension tables just aren't meant to take the weight or the pounding that assemblies often entail.

I wanted a table that was large enough to stack standard sheet goods on and flat enough to screw face frames together on. I wanted it stationary most of the time (and able to be locked in place) but capable of being moved around the shop when needed elsewhere. I also wanted the table to support relatively large loads (I figured up to 3,000 lbs. or so), such as for stacking sheet goods at the infeed side of the tablesaw. Through a process of trial and error, I found that a surface height of 20 in. provided comfortable access to my work and allowed me to set one foot comfortably onto the table, which makes it easier to reach the middle of the table and also relaxes my back. I mulled over the design for several months; then, during a lull between jobs, I did some serious design work and began construction. The result (with a few modifications) is shown in the photo at left and in the drawing on p. 40.

A torsion box for a flat, strong surface

Torsion-box construction was really the only solution to my design dilemma. A torsion box consists of a core grid with a skin on both sides. The resulting box is stronger (especially in resisting bending or twisting forces), more stable and far lighter than a block of solid wood of equivalent size. I decided on ¾-in. birch plywood for the torsion box's core members and for the two full sheets that would sandwich the core. I wanted a flat surface on which to build the table, so I put a sheet of Kortron (an acrylic-faced pine particleboard) on—you guessed it—the floor to smooth out any slight irregularities in the concrete. Kortron is more rigid than plywood, so it's ideal for this application. Also, my floor is very nearly flat to begin with, but if yours is not, you may need to shim beneath the Kortron to eliminate any tendency for the sheet to rock.

I cut the box's sides, ends and all core members and then marked the long core members where the short pieces would butt against them. I stapled together the perimeter of the box first and then proceeded from one side of the box to the other. Because I didn't have a giant, industrial milling machine handy to surface the core and perimeter, I didn't glue the core members to each other. The core members must be able to move slightly to come flush with the box's top and bottom when the whole is assembled. I stapled across each joint line to provide sufficient hold till the box was glued up and made sure all the staples were set below the surface of the core members.

After checking corner to corner for square, I marked the box's perimeter where the core members were stapled to it. I then applied glue to the top edge of all core members and, with my wife's help, carefully laid the box's top in place. Working quickly, I snapped chalklines to define the core's grid on the top, using the marks I'd made around the perimeter for guidance. I nailed off the perimeter first, placing a nail every 6 in. and did the same in the interior of the grid. I was careful to avoid intersections of the core members because I didn't want to hit staples or split the core members' ends.

***Shopmade cam brakes** hold the table immobile. A little wax on the fulcrum screw keeps the cam working smoothly.*

I wanted even pressure over the entire surface until the glue set, so I placed six sheets of Kortron on top of my now half-finished tabletop. I calculated this would provide approximately 140 lbs. per square inch of "clamping" pressure on the glue joints. By now it was late afternoon, so I left the "clamps" on overnight. The next morning, I removed the sheets of Kortron, flipped the assembly over and attached the box's bottom in the same way.

To provide a means of attaching the leg assembly, I glued and screwed pairs of leg-attachment plates to the bottom of the torsion box, one over the other, at the four corners. I positioned the outside edges of the plates directly beneath two core spacers. Besides transferring the load more directly (than if the leg were positioned over a void), this placement provides plenty of stability to the table as a whole and keeps the brake-cam lever under the table and out of the way. Although I used two pieces of plywood for the leg-attachment plates, in retrospect, using one good piece of Douglas-fir 2x4 would have been adequate and would have saved me some time and effort.

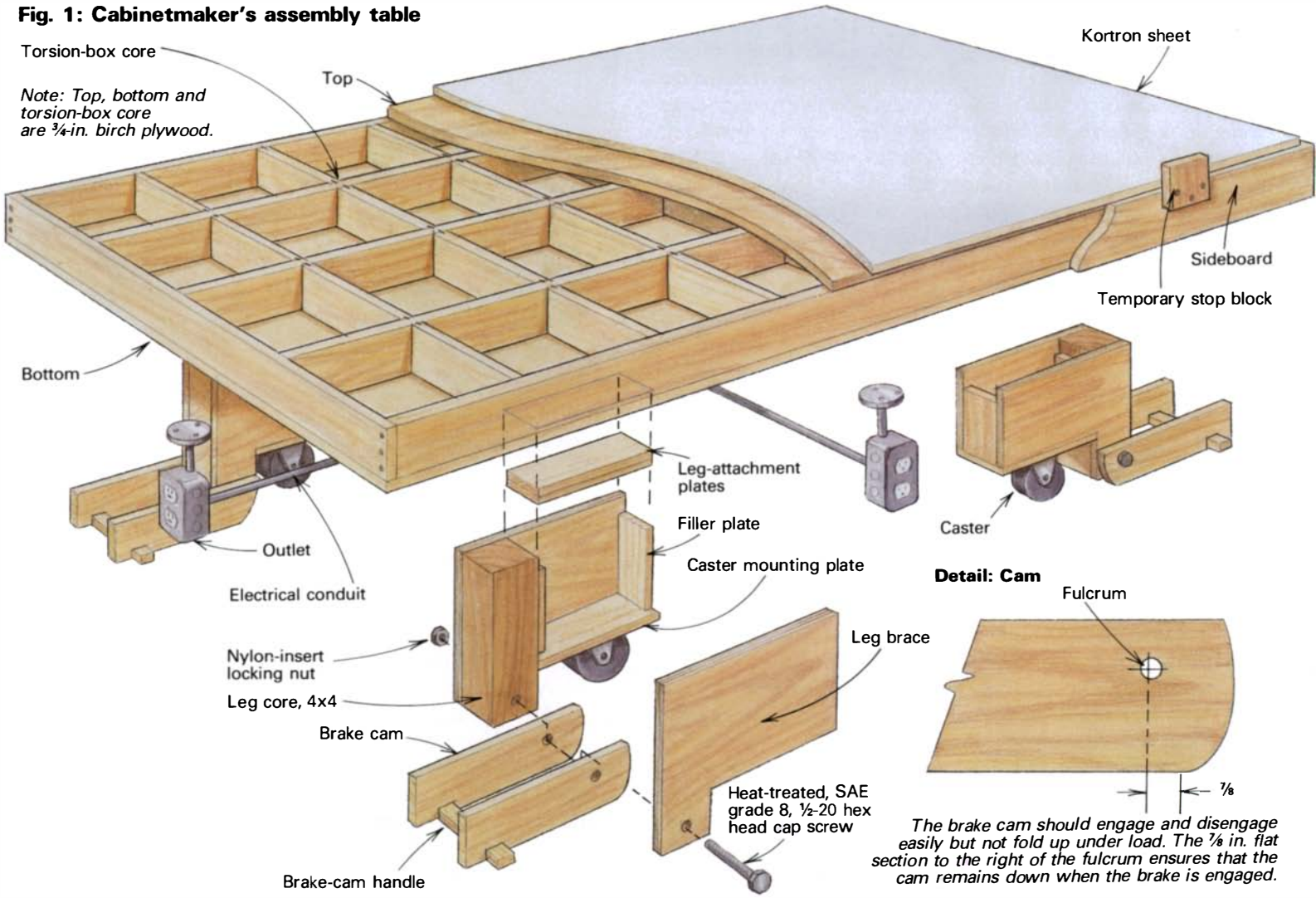
Designing the legs and brake system

I'd already determined the overall height for the table, so I had a rough idea of the size of the leg assembly. I also knew about how much weight I wanted the table to be able to support. I had since revised my original goal of having the table support 3000 lbs., figuring instead on a maximum of 19 sheets of ¾-in. stock, which would stack level with the height of my Unisaw's tabletop. At just over 98 lbs. a sheet, 19 sheets of Kortron weigh almost 1900 lbs., and the table itself would weigh over 300 lbs. complete. Even with my reduced-load requirement, I needed a set of casters with a load rating of more than 500 lbs. each! After an extensive (but ultimately futile) search for rubber casters with brakes that could accommodate this load, I realized I'd have to compromise a bit. I decided I could do without the mobility when the table was fully loaded. I settled on some 4-in. casters, load-rated at 200 lbs., which had been kicking around in a dark corner of my shop ever since I'd salvaged them from a defunct dolly. They had no brakes, so I redesigned the leg assembly to incorporate a shopmade, cam-operated brake, separate from the swivel casters (see the drawing on the following page and the photo above).

The legs on my table consist of a core of 4x4 Douglas-fir, two L-shaped leg braces, the caster mounting plate and two filler plates that help support the caster mounting plate (see the drawing on p. 40). The cores, braces and filler pieces are glued and nailed together with 1½-in. finish nails, and the caster mounting plates are glued and screwed to the leg braces. I bored a ½-in. hole in each of

Photo facing page: Sandor Nagyszalanczy; photo this page: Vickie Davis

Fig. 1: Cabinetmaker's assembly table



The brake cam should engage and disengage easily but not fold up under load. The ⅞ in. flat section to the right of the fulcrum ensures that the cam remains down when the brake is engaged.

Would you believe, a saw pony?

by Pat Paterson

A sawhorse is a sawhorse is a sawhorse. Right? Well, not exactly. Occasionally, I need a low-assembly table when I'm working on a set of cabinets, but I don't want to monopolize a lot of space in my shop on a permanent basis. So I simply throw some 2x4 ribs and a sheet of plywood over four of these low sawhorses. Problem solved.

These little horses have come in handy on more occasions than I can count. I've used them, stacked two high (they nest perfectly), as supports for an auxiliary bench of normal height. They're great step stools for working on crown molding, installing a ceiling light fixture or for poking around in some long-forgotten wood you stashed in the rafters. Someone 6-ft.-tall standing on one of these horses will have 4 in. of clearance to an 8-ft. ceiling. They also provide a comfortable seat for lunch, for a cup of coffee or for looking at plans. When you're not using the horses, stack them four high, out of the way; they take up almost no space.

If you build one set of sawhorses, you'll never stop building them. Because they're so versatile, people want them as soon as they see them. A gardener friend wanted only one horse. She put all her hand tools inside and placed her seedlings on the open lid while she worked her garden. The bottom of the legs were wide enough to keep the sawhorse from sinking into the soft soil. My brother uses one for stepping into and out of his truck camper. Others have used the horses as picnic tables at the beach and as extra chairs at a backyard barbecue.

Back in prehistory—before the existence of chop boxes, or power miter saws—I used a manual miter box. My backsaw had very little set, and the saw occasionally bound in the kerf. I'd clamp the miter box to the top of one of these horses, and it never tipped, even during one of those binding thrusts. The stability of the horses will also keep them upright in the back of a pickup no matter how sudden the stop.

One of the best things about these horses is that you can build them for next to nothing. I use 2x4 cutoffs and any plywood scraps that are big enough. I cut pieces to size as I get them, and I set them aside. When I have some slack time, I put together a set of sawhorses. Old horses can be reconditioned quite easily, too, by replacing the lid, which takes all of the abuse. If you're starting from scratch, you can make five horses from a standard sheet of plywood (lids excepted).

I gave two horses from the first set I made to a friend. He immediately bemoaned the fact that the narrow opening made access to bulkier tools, like the router, jigsaw and hammer drill, a bit difficult. He was happy to use them nonetheless but only until he got around to building something better. That day never arrived, though. So he's still using the same two horses—23 years later. □

Pat Paterson is a retired steam engineer. He works wood as a hobby in Victoria, B.C.

the leg assemblies for the brake-cam fulcrum, and glued and nailed the leg assemblies to the attachment plates on the table's bottom.

I used heat-treated, SAE grade 8, 1/2-20 hex head cap screws as fulcrums for the brake cam (a screw with a smaller diameter may not have been strong enough under full load, and a lower-grade steel probably would have bent). To secure the screws, I used aviation-style, nylon-insert locking nuts. These nuts permit me to keep the brake cam in the upright "off" position by just snugging the nuts against the leg braces, yet they don't interfere with the cam's operation.

Getting the brake to work properly required a good deal of trial and error. Setting the brake cam has to cause the caster to rise off the ground, but only slightly; the greater the distance, the more stress on the cam and the more difficult the brake will be to operate. I settled on a design whereby the wheel rises ⅛ in. off the ground when the brake is engaged. Ensuring the stability of the leg assembly under load required that I design the cam with a flat section on both sides of the fulcrum. Arriving at an optimal length for the flat at the end of the cam (⅞ in.) and an optimal curve for the cam end, required some experimentation and several trips to the bandsaw. The drawing detail on the facing page shows the final shape I arrived at.

A couple of oversights rectified

I used my table for a couple of weeks, very contentedly, but soon discovered, as often happens, that I'd overlooked a thing or two in my design. I noticed that I was always just beyond the reach of an electrical outlet. I remedied this situation by adding four outlets below the torsion box, one at the midpoint of each side and one at each end. I used metal handy-outlet boxes because both boxes and cover plates have round corners to prevent snags or cuts. I installed Leviton #5014 special-service duplex outlets into these boxes. These outlets were considerably more expensive ($2.99) than standard-service outlets ($0.39), but they're designed to stand up better to rough conditions, such as those found in a woodworking shop. I connected a 14-gauge, Type SJ electrical-cable supply line with a nylon grounding plug to one of the boxes at the end of the table.

All 115-volt outlets in my shop are protected with Ground Fault Circuit Interrupter (GFCI) breakers. If yours aren't, you may wish to install one instead of a duplex outlet in the handy box where you have attached the supply line, and feed the power through it to the other three boxes. Select a receptacle-type GFCI device with a rating of at least 15 amperes at the receptacle and 20 amperes feed-through to the other three outlets. My shop outlets are protected with the Leviton #6599. (For more on GFCI breakers, see *FWW* #93, pp. 58-62.)

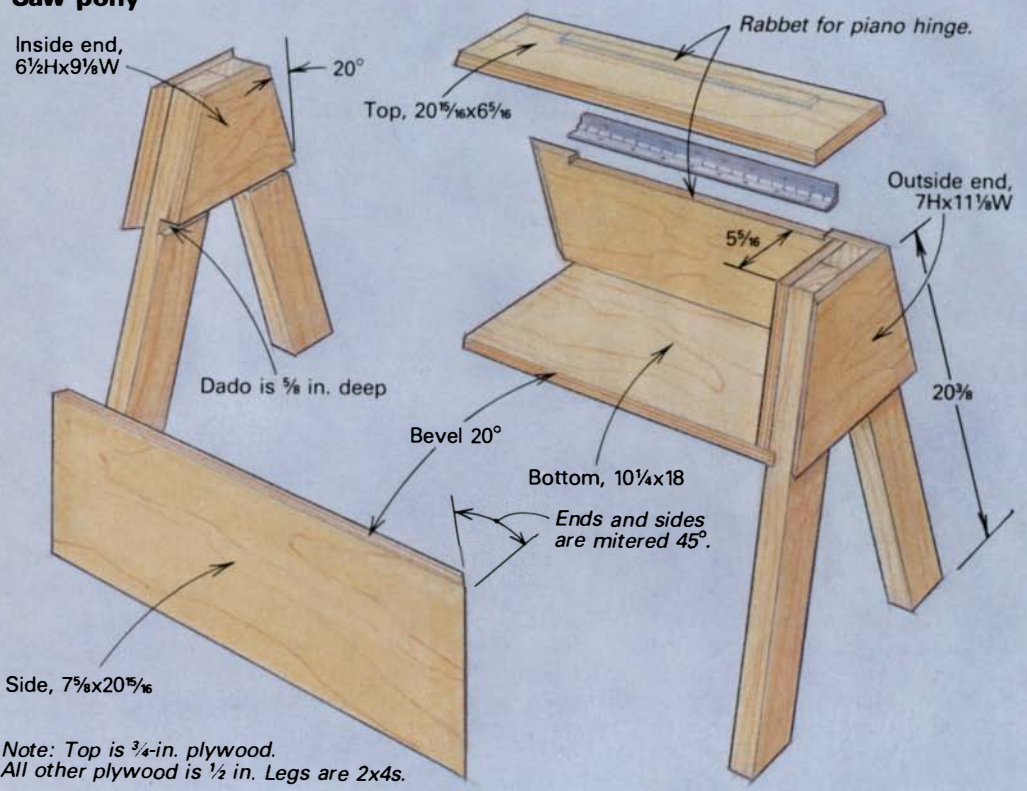
Working on my new assembly table was infinitely better than working on any of the previous surfaces I'd used, but I did notice that some of my face-frame joints were slightly offset. The only thing I could attribute this to, since I was using the table as reference, was a slight deflection in the tabletop. I'd screwed a sheet of ¼-in. hardboard to the top of the birch plywood after I'd finished the table (intending it to be a replaceable, smooth work surface), but, evidently, it wasn't stiff enough. I replaced it with a ¾-in. sheet of Kortron, and that solved the problem. I'd also noticed—especially with the Kortron—that whenever I really bore down on a face frame, it would tend to slip. I fixed this by installing side and edge boards all around (to get the sides out beyond the 49x97 sheet of Kortron) and using temporary stop blocks whenever I'm assembling cabinets.

Since completing the assembly table, over 100 sets of cabinets have moved across it on their way through my shop. The table's low height has saved my back (as has being able to use the table at the tablesaw's infeed side); the flat, stiff reference surface has saved me untold hours of sanding; and the convenience of electrical outlets—where I need them, when I need them—has eliminated many snake-like tangles and saved me plenty of time as well. □

Chuck Davis is a cabinetmaker and licensed contractor in Watsonville, Calif.

***A combination mini-sawhorse and toolbox,** these saw ponies are extremely versatile. Their rugged construction and low stature make them very stable.*

Saw pony



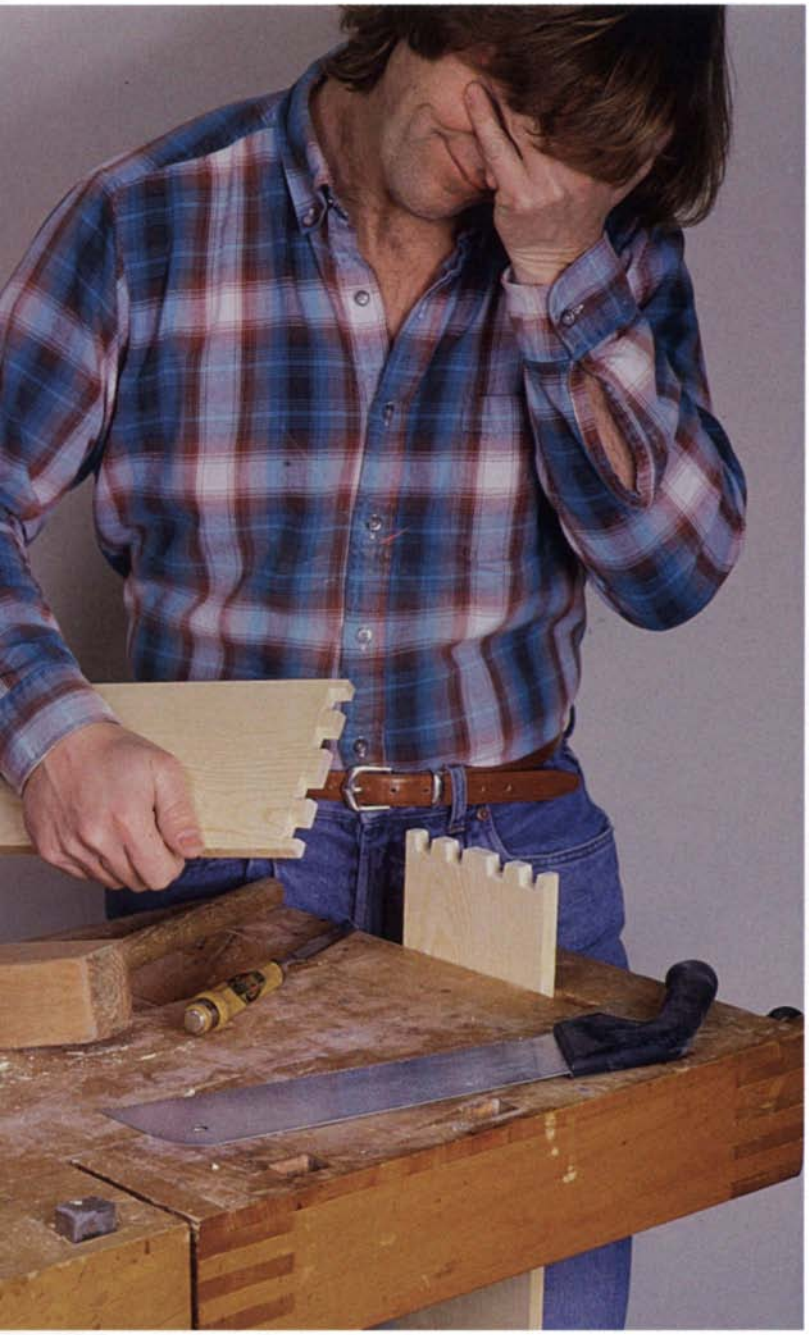
Note: Top is ¾-in. plywood. All other plywood is ½ in. Legs are 2x4s.

Photo: author; drawings: staff

Dealing with Woodworking Mistakes

To err is human, but clever repairs are divine

by Sandor Nagyszalanczy



***Silly mistakes, like accidentally cutting away the wrong parts** of a dovetail joint, can cost you time or spoil your project (the author's mistake shown above was made only for illustration purposes). But you can sidestep frustrating setbacks by keeping your concentration and following good construction practices, such as marking the waste sections of a joint before cutting it out.*

There was scarcely a whisper in the room as we watched Japanese temple carpenter Makoto Imai demonstrate how to mark out a scarf joint that seemed to have the complexity of a Rubic's cube. The silence was broken by one Santa Cruz Woodworking Association member who had paid to see the traditionally trained craftsman perform: "Since all your layout work is in ink, how do you erase a mark if you make a mistake?" Brushing back his jet-black ponytail, Imai replied simply, "*Don't make a mistake.*"

But all woodworkers occasionally make mistakes. We make them for various reasons: bad luck, lack of skill, not approaching the task logically enough, fatigue or distractions. Little foul-ups, like sawing a part too short, are inconvenient at best and can disrupt work flow. More serious errors, like ruining a pair of book-matched panels, can take the wind out of our sails and make woodworking tedious instead of fun. For professionals, blunders and slipups can lead to overtime and drain the profit from the job. Because the universe of possible foul-ups is limitless, it's just as important to learn to deal with mistakes as it is to learn to sharpen a chisel or adjust a tablesaw. As Japanese craftsman Toshio Odate says, "Accept human error, but be prepared for it so it doesn't inconvenience you."

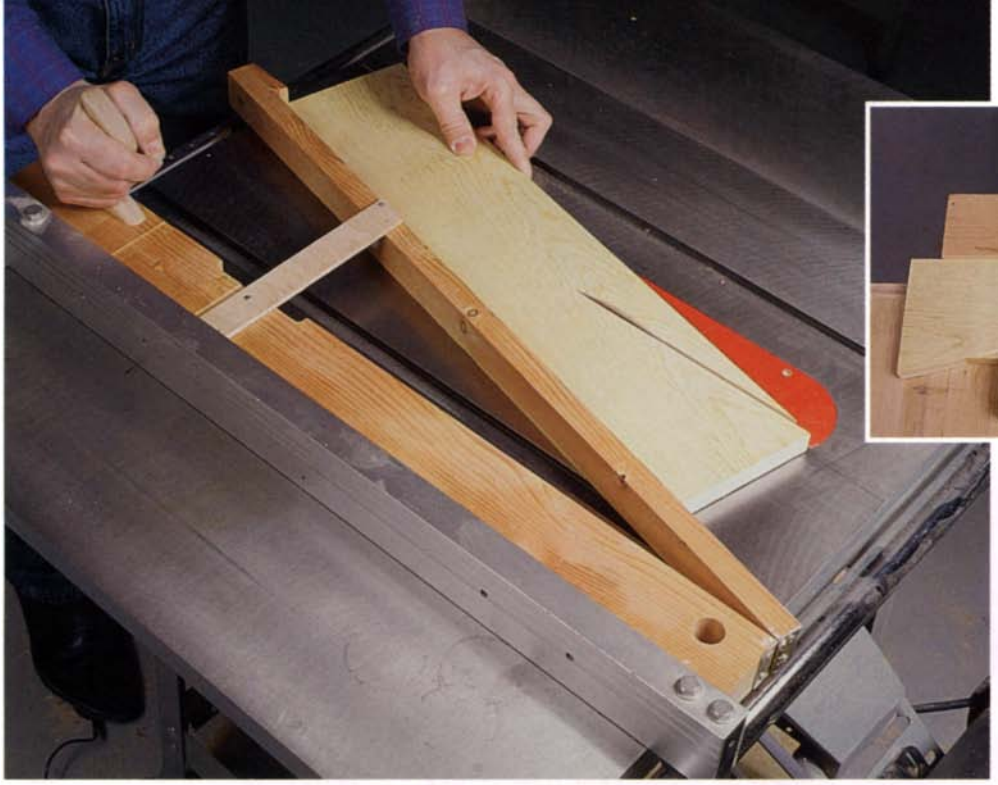
To repair or to remake

After the drained feeling that comes from having erred has passed, you must ask yourself a question that renowned cabinetmaker and teacher James Krenov told me is at the heart of what to do next: "Can I correct the mistake in a way that I feel good about and that won't interfere with my or the viewer's enjoyment of the finished piece?" A negative response might mean that you'll sleep better if you remake the part. But if you're up to the challenge, it's time to find the right remedy for the error—a task that can take as much cleverness as designing your project in the first place.

I've assembled a collection of methods for dealing with some of the most common mistakes woodworkers are likely to face. In addition to my own ideas, I've picked the brains of more than a dozen professional woodworkers. Some of these error antidotes are from the repairman's bag of tricks; others are the inventions of desperate men trying to save their assets in a pinch. You'll also find a collection of strategies designed to help you *avoid* many basic woodshop blunders in the sidebar on p. 45.

Shortcuts for short cuts

Need a board stretcher? There are many ways to add length to parts that have accidentally been cut too short. A straight part can be made longer by sawing it apart diagonally, thickness or edgewise, using a taper jig on the tablesaw, offsetting the halves and regluing them along a scarf joint (see the photos on the facing page). This works best with wood that has few grain lines (such as



***Stretching the length of a board that's been cut too short** can save the day when you've miscut a piece that's irreplaceable.* FWW *contributing editor Christian Beckssvoort's method starts by sawing the board in half diagonally using a taper jig on the tablesaw (left). Then he slides the halves along the diagonal to yield the desired length and glues them back together (top right). Plate-joinery biscuits keep the halves from sliding during clamping. Finally, he bandsaws off the small triangles left at the corners (right). After the surface has been planed and sanded, the seam becomes practically invisible.*

maple) or straight, parallel grain (such as vertical-grain Douglas-fir) because the glueline will be less noticeable. To lengthen turned parts, you can add capitals, pommels or collars turned separately and then doweled or mortised and tenoned onto the ends. If you've forgotten to figure in length for the joints on frame members, you often can get away with it by switching joinery methods. Not enough length for tenons on face-frame rails? Switch to dowels or loose tenons that fit into mortises in both parts. Didn't add that extra ⅜ in. to make a tongue on a plywood cabinet bulkhead? Get out the plate joiner, and use biscuits to put that carcase together.

If you can't easily add length to a part, try the next best thing: Cover up the gap where parts meet with a strip of molding or trim. This could be done, say, to salvage a slew of balusters that were cut too short for a stairway railing. Moldings can also reduce the size of a jamb (no pun intended) to accommodate an undersized door.

Occasionally, miscutting parts can lead you to design innovations. Portland, Ore., woodworker Jeff Hilber once salvaged a pair of too-narrow door panels for a walnut cabinet by sawing each panel apart and laminating in strips of padauk as a design element to echo the decorative inlays in the cabinet's top. (See the photos on p. 44 for another creative remedy for parts cut too short). Woodshop teacher and author Richie Starr says that when his students make a major mistake, he encourages them to reset their sights. "If a kid accidentally cuts all the shelves for a bookcase too short, I try to talk him into making a narrower bookcase." Whatever strategy you implement, there's no turning back; be consistent with the fix, so it appears to the uninformed eye that you meant to make it that way in the first place.

Repairing and covering up defects

When an edge or corner splinters or breaks off during a machining operation, such as planing or routing, it's best to repair the damage as soon as possible before the splinters get lost or the split advances. Cyanoacrylate adhesives (super glues) are terrific for this because they dry very quickly and don't leave a visible glueline. The thin varieties are great for gluing down torn and lifted grain; the glue wicks into small fissures via capillary action.

If you accidentally drop a clamp or hand tool on a surface, the resulting dent can often be steamed out with a damp cloth and a household iron (see the top left photo on p. 45). Indonesia-based furniture designer Stewart Welch says steaming works best on open-grain hardwoods, like mahogany, butternut and walnut. It will also work on dents in veneered surfaces, but care must be taken not to destroy the glue bond between the veneer and the substrate.

Store-bought wood putty may be a good choice for filling small cracks on work that will be painted, but you won't get a good color match on wood that will be clear finished. You'll achieve much better results by mixing your own filler. For darker woods, mix fine sanding dust with epoxy or cyanoacrylate glue (see Giles Gilson's sidebar in *FWW* #94). Because glue/sawdust fillers usually dry too dark for lighter woods, *FWW* Executive Editor Jim Boesel recommends mixing epoxy with a small amount of acrylic paint or powdered pigment to accurately match the color of the wood. This is easier than the professional finisher's method of filling with shellac burn-in sticks, which is most effective but difficult to master.

Areas with more serious defects will require larger patches. San Rafael, Calif., craftsman Griffin Okie, who teaches a class in mistake repairing for the Baulinas Craft Guild, says that for seamless repairs, you should always make patches from a saved cutoff scrap with the closest color match. And inlay patches should run the full length of the part whenever possible because patch seams that run parallel to the grain are harder to detect. When full-length patches aren't possible, apply a sizing coat of shellac to the endgrain of the patch and inlay area to prevent stain or finish from taking darker there, and pre-finish the patch before gluing it in place. If you damage the edge of a part, say, a frame member, you can cover it up with a veneer edgeband. To fix deep gouges on the face of a panel or frame, *FWW* contributing editor Mark Duginske advises

Photos except where noted: Sandor Nagyszalanczy

Sometimes a mistake can lead to a design innovation. *Roger Heitzman discovered this when he was building a set of 10 curvaceous dining chairs, each with five gracefully laminated back slats. Just as he had finished gluing up all 50 slats, he discovered that they were all ½ in. too short. After some head scratching, Heitzman realized he could add a short riser at the back of each chair's seat (see the inset detail), mortised to accept the slats. He coved the ends of each riser to flow into the seat, to keep it from looking "added on." Heitzman was so happy with the look of the finished chair that he decided to include this riser on all his subsequent chairs with similar slatted backs.*

thickness planing ⅛ in. off its face and gluing on a matching ⅛-in.-thick piece. I discovered a sneaky way to patch a bad dent in a highly visible part of a koa top on a custom stereo cabinet I once built: I inlaid a knot (as shown in the bottom photo on the facing page). By replacing an artificial defect with a natural defect, you can fool the viewer's eye.

One of the most painful mistakes a woodworker can make, and one that is practically impossible to patch, is to sand through the face veneer on a plywood panel—always a hazard when beltsanding a face frame flush to a cabinet side. Santa Cruz, Calif., furnituremaker Roger Heitzman's solution is to finish the piece with lacquer and then spray tinted lacquer over just the defect to match the surrounding wood's color. To make the fix seamless, he lightly etches in grain lines with an Exacto knife after the lacquer is dry.

If you can't hide a defect, as a last-ditch effort, try accentuating it instead. If you've misdrilled holes for cabinet pulls, try inlaying a design element over them. Woodworking luminary Art Carpenter inlayed little ebony seagulls to cover up nail and bullet holes in a slab of orchard-grown walnut. To fill the natural voids often present in redwood burl, try using a contrasting-color filler like black epoxy.

Tightening up a loose fit

Not everyone's joinery has that perfect "piston" fit. To tighten up a loose-fitting joint (for example, a mortise and tenon) glue a plane shaving or a thin piece of veneer, as thick as necessary, to the tenon's cheek or edge. You can tighten through-tenons with a diagonal wedge, as shown in the top right photo on the facing page. To clean up the look of poorly cut dovetails, veteran woodworker, author and retired instructor Tage Frid recommends gluing up the joint and then carefully sawing down any ragged joint lines at an angle to make a clean kerf. Next, take a piece that's slightly thicker than will fit into the sawed gap, cut it at a 45° angle and hammer it flat; then apply glue and force it into the kerf. The glue causes the shim to swell, filling the gap perfectly. A gap at the tip of a miter that's shrunk open can be closed by rubbing the corner with a burnishing tool or the shaft of a screwdriver. Work down both sides of the corner, holding the tool at a slight angle to crush the wood fibers.

Instead of struggling for a perfect fit between difficult-to-mate parts, like compound-curved legs attached to a bent-laminated carcase, it's better to chamfer or to roundover the mating parts or to create a reveal at each juncture. Another strategy used at Roger Heitzman's shop is to initially try for only a rough fit between parts; then rout a shallow channel over the seam and glue in a line inlay.

Warped panels and parts

One of the most common methods to remove a cup from a panel or wide solid-wood part is to wet the concave side of it, and lay it in the sun, wet side down. Tage Frid recommends covering the panel, concave side up, with a clean, wet rag and going over it with a household iron set on steam and high heat. To flatten badly warped doors, John Kriegshauser, shop director at Chicago's IIT College of Architecture, lays them on a benchtop, blocks under the corners that touch and clamps the other two corners down until the frame takes a tension set and straightens.

Occasionally, you will encounter improperly dried stock, 6/4 and up, with honeycombs (internal voids) that don't show on the surface. I once built the base for a podium from 8/4 oak and didn't discover that one of the pieces was cracked and falling apart until I had finished the base. To save the project, I injected glue into the fissures and carefully reclamped the pieces; then I cleaned off the excess glue and re-topcoated it. If you are having a tough time finish-sanding woods with fuzzy grain, such as soft maple or lauan, Tage Frid recommends flooding the affected areas with a thin mixture of hide glue and then rubbing it into the

Photos this page: Roger Heitzman

surface. The glue firms up the fuzzy grain so that it will sand cleanly, and the glue won't show when the wood is stained or finished.

Assembly and finishing failures

If you're using a water-base glue—white or yellow—and you get drips on a surface that'll show, *don't* mop off the gooey adhesive with a wet rag. This is especially important on porous-grain hardwoods, like oak, where diluted glue will be absorbed into the wood's pores and cause blotches in the finish. Allow the drips to dry rubbery hard, and pop them off with a cabinet scraper or a sharp chisel.

In case you've forgotten to square up carcases or drawers during glue-up, Griffin Okie says that they can often be squared by applying bar or pipe clamps diagonally and "popping them" back, even after the glue has set. If the case weakens from the belated clamping, add glue blocks. If stool, chair or table legs are glued up unevenly, true them up by setting them on a flat surface and scribing the feet with a pencil taped to a thin block that's riding on the surface. Trim to the line with a fine saw, plane or rasp.

Unfortunately, there are few easy remedies for a bad finishing job—you usually must strip off the offending finish and start over. There are a few exceptions: If your lacquer finish has blushed (become cloudy), spray on a retarder, which is a slow-drying solvent, or a thin coat of lacquer with retarder in it to redissolve the lacquer and to allow the trapped moisture to leave, clearing the blush. If your brushed-on finish ends up with hairs in it, Minneapolis, Minn., finish chemist Chris Minick advises to pick them out immediately and to switch to a better brush. Surface tension around each hair will form a little rim that you can flatten later with very fine (400- or 600-grit) sandpaper.

Learning from your mistakes

Keep track of your hard-earned solutions to avoid repeated blunders. One way to log successful solutions is to do what Petaluma, Calif., furnituremaker Jeff Dale does—write down all the pertinent information about how a particular job is done, including what bits were used and the order of operations, directly on the jigs used to make the parts (see *FWW* #93, p. 48). Keeping a shop journal is another great way to retain a record of your work progress and mistake-mending maneuvers. Besides, you'll salt away some great stories to share with your grandkids someday. □

Sandor Nagyszalanczy is managing editor of Fine Woodworking.

***Steaming out a dent in a panel** (left) isn't difficult. First, dampen the dented area with distilled water, and let it soak in for a while. Then, cover the area with a clean, damp, cotton cloth, and apply heat with a household iron or a soldering iron. Repeat this a few times to swell the crushed fibers back near their original size.*

***Tighten up loose-fitting through-tenons with wedges** (right). Saw down the length of the tenon diagonally; glue and assemble the joint; then drive a thin wedge into the kerf for a perfect fit.*

***Inlaying a knot is a tricky way of covering up a large defect** in a highly visible spot, such as in the middle of a tabletop (below). After locating a tight knot in a piece of scrap, mark around the knot's perimeter and rout to the line with a straight bit set to cut about 5/16 in. deep. Using the bandsaw's rip fence, resaw the scrap so that the knot is about 1/4 in. thick. Using the knot as a template, mark and then rout for the inlay, and glue it in place.*

Strategies for avoiding slipups

You'd have to be a fortune-teller to predict and prevent all the possible mistakes that can take place in the shop (or anywhere else, for that matter). But as furnituremaker Roger Heitzman advises, "Nothing is foolproof, so try to make each workshop task *fool resistant*." Here are a few tricks for striving toward that goal.

Good design: Careful design is the foundation for glitch-free construction. When building a cabinet that must be attached to a wall or fitted into an existing space, design the piece with plenty of clearance; don't try for a perfect fit unless absolutely necessary. Complete the installation with a scribe or a piece of trim or molding. If the cabinet must accommodate objects such as books, appliances, stereo equipment or bedding, never assume that there are standard sizes. Measure the actual objects whenever possible. If you're uncertain, make the drawer, shelf or divider slightly larger than you think you'll need. Also, consider the path the assembled cabinet must travel to its final destination. Professional cabinetmaker Cliff Friedlander warns that kitchen corner cabinets, which are often almost 3 ft. sq., are notorious for not fitting through household doorways.

Because it's a natural material, the behavior of wood isn't entirely predictable. But you can avoid most wood-related problems, such as warped or cracked tops and doors or drawers that won't close, by always designing to accommodate wood's seasonal movement. For example, never join wide, solid-wood parts cross-grain, such as breadboarding a tabletop, and never veneer and finish only one side of a panel.

Measurement problems: Many of our most painful mistakes come from incorrect measurements, which can creep in at several stages of building. Sizing parts by calculating their lengths from a sketch can

lead to tragedy if your math is off. It's much safer to create a full-size drawing so that details, such as joint connections, can be worked out. Part dimensions can then be taken directly from the drawing. Whenever possible, size doors or drawers by measuring their openings directly.

When using a tape measure to mark a known dimension on a part to be cut, it's common to measure from the 1-in. mark (ostensibly for better accuracy). Unfortunately, it's also all too common to forget to add an inch to the overall dimension. The result is a part 1 in. short. Avoid this by using a tape measure with a properly adjusted end, or switch to a ruler or yardstick. The clearest path to correct measurements is to eliminate numerical measuring entirely. Instead, use the story stick method to record and transfer measurements in analog fashion, as shown in the photo below.

Cutting out and machining parts: While it's imperative to work safely with power tools to avoid the grizzliest kinds of mistakes, the best insurance is practice. Don't try cutting an intricate joint until you've made a few trial attempts in scrapwood. Always keep parts to be machined in organized stacks, with faces, edges and ends oriented the way they should be fed through the machine. When crosscutting, start with the longest parts and work toward the shorter ones; if you miscut a part, you can recut it for a shorter part. Always cut extras, and keep all your scraps until the project is completed in case you need to make patches or replacements. When craftsman Toshio Odate cuts the delicate dividers for his shoji screens (called *kumikos*), he always cuts one more than is needed as it's not uncommon to break a kumiko during assembly. "Cutting 11 rather than just 10 is no big deal, but if you must make an individual replacement from scratch, it takes ten times as long. Plus, it won't be absolutely identical as it would have if it were cut with the others."

To prevent hidden checks from becoming cracks in a panel, Odate makes what he calls a "nose cut" on the end of each board before cutting out parts. While crosscutting about ½ in. from the end, he watches the scrap to see if it stays together. If it doesn't, he repeats the nose cut until he's past any checks in the board's end.

When making complicated joints, like dovetails, marking the waste sections before sawing will help you to avoid cutting away the wrong sections, such as the tails themselves (see the photo on p. 42). Also, mark the waste side of crosscuts to prevent ending up with parts one sawkerf too short. To ensure that frame or panel components are machined and assembled correctly, dry-fit and mark them with a cabinetmakers' pyramid (a triangle drawn across the face of a frame or across boards to be edge-glued to show part orientation and which face is up) or label parts sequentially.

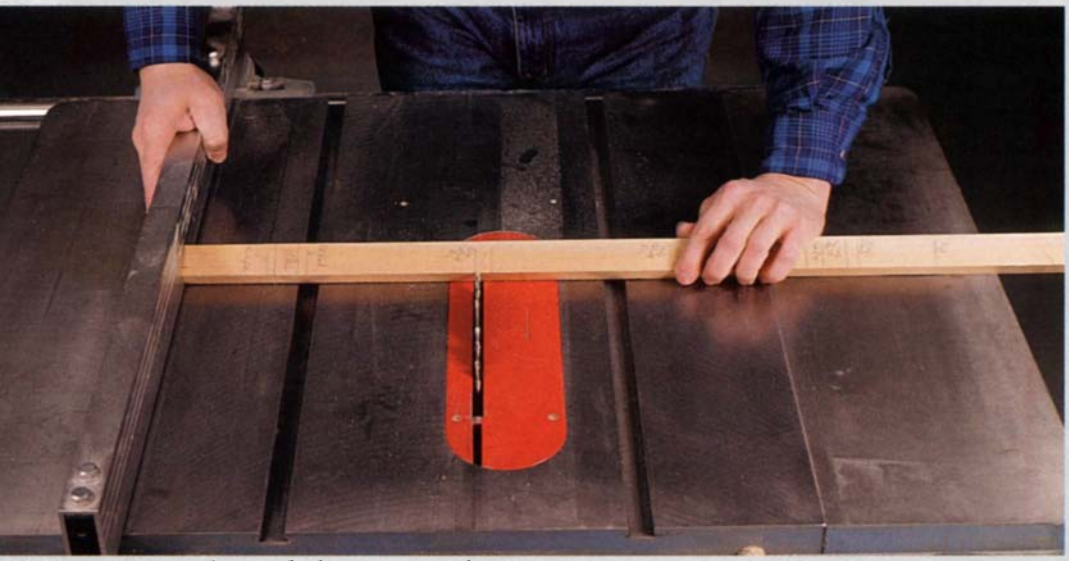
Incidentally, many woodworkers blame themselves or the wood when they don't get a good cut when, in fact, it's the tool that needs proper setup or sharpening. Always test a tool or machine with scrapwood before using it on a project—especially if someone else has been using it. If it's misaligned or dull, it could leave a gouge or tear that you can't fix easily.

Assembly and glue-up: While it's a natural impulse to rush the assembly of your project when you're in the homestretch, patience pays many dividends: Pre-sanding parts will prevent messy inside corners that often result from trying to sand after assembly. And by doing a trial dry-assembly, you will confirm that all joints fit properly and that clamping will go smoothly at glue-up. To prevent glue squeeze-out from ruining pre-sanded parts or hard-to-clean areas, rout or scratch a small groove into one of the mating surfaces just inside the finished face. The groove will act as a small reservoir and keep excess glue from bleeding out of the joint. When building multiples, such as doors or drawers, Cliff Friedlander says it's prudent to make and assemble all the parts for one before starting on the rest. If you've made an error, this will keep you from repeating the mistake many times.

Flawless finishing: Before committing your satin-smooth tabletop to a finish, always do a test on a scrap of the wood or woods you've used (sanded to the same degree). Before applying the finish, daubing wood surfaces with a little naphtha (it won't raise the grain) will reveal hidden defects, such as smears of glue and scratches left over from final sanding, before finishing makes them difficult to fix.

If you choose to brush on your finish, author and finishing consultant Michael Dresdner offers these suggestions: Never stick a brush into a can of finish without first stirring it thoroughly. Substances that rise to the top of the mix can coat the brush and prevent the finish from laying out smoothly. After mixing, load the brush first with solvent; then dip only ⅓ to ½ of the brush into the finish when applying. The finish flows on better and the brushes are easier to clean. Also, avoid using any finishes that have been around the shop more than six months—especially shellacs.

Keeping time on your side: If there's such a thing as a universal mistake preventative, it is time: Leave plenty of it for any project and you'll stay further from the frustrating grip of misfortune. Interruptions can also cause costly foul-ups. Woodworker Art Carpenter remembers getting a phone call just after hanging the tall glass doors on a large cabinet. "While chatting, I watched one of the doors slowly open, which threw the balance of the partially completed carcase off, bringing it crashing to the floor." Leave your answering machine on while working to prevent such a disaster. Also, schedule sensitive jobs, like cutting up a $300 sheet of rosewood plywood, for when you're most alert and *never* when you're fatigued (for safety's sake). If you do make a mistake, don't rush to fix it; you might end up making the problem worse. Take five and consider your alternatives. —*S.N.*



A story stick can help you avoid measuring errors *by eliminating confusing numbers from the layout process. Lengths and widths of cabinet or furniture parts are marked directly on the story stick and can be used to lay out cuts and joinery, to compare alignment of adjacent parts (face frames and drawer fronts, for example) or to set up machine operations (such as setting a tablesaw fence for ripping carcase parts, as shown). Veteran cabinetmaker Frank Klausz uses story sticks to work out all cabinet measurements, layout schemes and proportions. And the stick provides a lasting record of each job.*

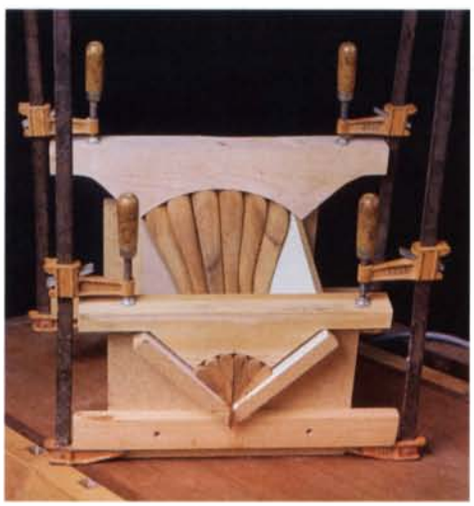
Reeded Columns from Shaped Staves

Bandsawn and routed segments simulate carving

by Tim Carr

A vase-shaped reeded column, hand-carved from a single piece of wood, is a traditional base for Hawaiian pedestal tables. But, these days, finding a large enough block of dry, unchecked koa is nearly impossible. And besides, carving and sanding the deep veins between the reeds in curly koa take long hours of concentrated attention and would probably eliminate any chance of making a profit on the table.

Still, the first time I saw a photograph of an Hawaiian, reeded pedestal table, I knew I had to build one. But, instead of turning and carving the column from a single piece of wood, I glued up 24 wedge-shaped koa segments to form the central column. I created the column's turned shape by bandsawing the outside edge of each segment and formed the reeds by rounding over the bandsawn edges on a router table. When I glued the segments together (see the photo above), it appeared that I had turned the column and carved the reeds. The rest of the pedestal's parts—the column's base and capital, the four-legged stand and the table mount—were each stack laminated as separate units and then bolted together with a threaded rod that runs through the center of each piece (see the drawing on p. 49).



***Carr assembled the reeded column** on the table above from 24 separate wedge-shaped segments. The segments are bandsawn to shape and rounded over with a router before they are glued into quarter columns in a simple jig.*

Using this method of construction, I have built three pedestal tables for the same client: a 9-ft.-long banquet table, a smaller breakfast table and the 5½-ft. by 6-ft.-oval dining table that's shown in the photo above. The same methods used to make these vase-shaped, reeded columns could also be applied to columns with other shapes and exterior detailing.

Roughing out the segments

The segments that I use for my vase-shaped columns are much larger than the stave-like

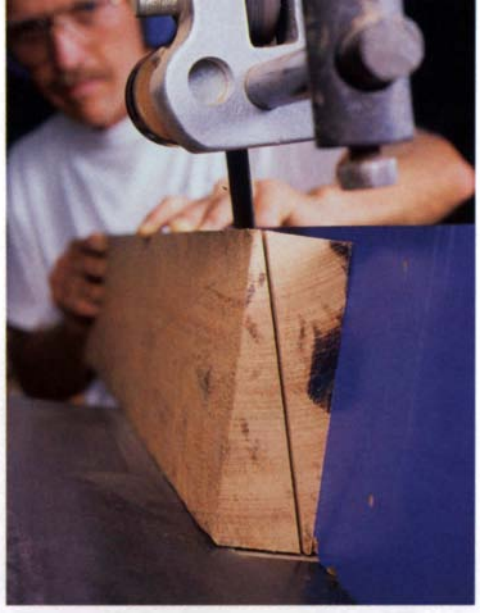
pieces you might have seen on other laminated cylinders. Because of the column's bulbous shape and deep curves, each beveled segment must be 7½ in. wide. Columns with less-undulating curves will require narrower segments. To ensure the best possible matching of grain and figure, I rough out segments for the column from two 10-ft.-long 2x8s all sawn from the same tree. This gives me plenty of stock for the column, plus several extra pieces just in case one is ruined during the routing operations. I crosscut each board into 34-in.-long pieces. Later, I rough crosscut the pieces to 17 in.—2 in. longer than needed for the finished column. The extra length gives me enough flexibility to align the pieces for the best vertical figure match and is worth the waste, even at $9 a board foot for koa. After flattening both sides of the stock on a jointer, I plane the pieces to 1⅞ in. thick. Then I resaw the individual pieces on the bandsaw with the table tilted 15°, as shown in the top photo.

To true up the bandsawn faces, I made a carrier (see the center photo) to run each beveled segment at an angle through the thickness planer. In addition to ensuring a good glue joint, this operation also makes the inner edge of each segment 1/16 in. thick. The uniformity of these edges is important for aligning the templates used to shape the outside curves on each segment. Ragged or paper-thin edges would make lay out much more difficult. I also use the 1/16-in. edge to guide my drill bit when I bore out the column to accept the threaded rod that runs through the center of the pedestal.

Shaping the segments

After rough crosscutting the pieces and aligning them side by side to get the best grain and figure match, I crosscut the planed segments to their final 15-in. lengths. Then I lay out the lines that will give the column its turned and carved look. Two plywood or fiberboard templates are needed. The first template defines the outside curve to be roughed out on the bandsaw. The second outlines the carved edge that will create the reed shape when the segments are edge-glued together. Bandsawing the outside curve is fairly straightforward, except the saw table must be tilted 7½° to compensate for the bevel on each segment. Sawing at an angle produces an edge tangent with the outside of the column for the router bit's guide bearing to run against.

I shape the curved edge on the router table with two different bits. First, I make a pass with a ⅜-in.-dia. roundover bit, shaping from the top to the bottom of both long edges of each segment. Then, I repeat the operation, using a ¾-in.-dia. roundover bit and cutting only the bulbous area to create a wider shaped area in this larger-radius section (see the bottom photo).



***The author resaws a 2x8 with his bandsaw table tilted 15°** to rough out the wedge-shaped segments that form the column. To ensure a good grain match, all 24 segments are cut from two long boards milled from a single tree.*

***To clean up the bandsaw marks and to provide a good surface for gluing,** Carr runs the segments through the planer on a carrier. The carrier holds the beveled segment's surface parallel with the planer table.*

***After bandsawing the outer edge to the pedestal's profile,** the author rounds over each segment's edge on a router table. He uses two different bits: a ⅜-in. radius bit for the narrow upper portion and a ¾-in. radius bit for the wide lower portion (above). Masking tape designates where to stop each cut.*

Next, I further refine the routed shape with a medium-cut rasp, a wood file and a hand scraper before sanding everything to a fine finish. This is the most tedious part of the operation. After 24 pieces, I really appreciated my flapper-style sanding wheel (available from most woodworking supply houses) for removing rasp and scraper marks. I finish up by hand-sanding each piece with 180-grit and 220-grit paper.

Gluing up the column

Instead of trying to glue up all 24 segments simultaneously, which would be an invitation to disaster, I assemble six segments at a time and then glue the four assemblies together after each has cured. My glue-up jig for six segments, as shown in the bottom photo on the previous page, is a simple 90° channel of particleboard; the ends are left open for cleaning up any glue squeeze-out. I fit the jig with two saddles—one at the top of the neck and one at the crown of the bulb—shaped to clamp the segments together. The saddles also help align the segments, although the ends of the quarter columns still have to be trimmed square after glue-up. To avoid marring the wood, I line each saddle with a very thin layer of foam (Naugahyde or poster board works, too). All the segments must be in contact with the saddles as the clamps are tightened to ensure a perfect radius. I rout a narrow groove just behind the line created by the reed shaping to collect excess glue so that I don't have to clean up the glue squeeze-out from between the reeds. I let each glue-up cure in the jig for 24 hours.

When all the quarter columns are glued up and cured, I make a couple of light jointer passes to ensure that the 90° angles are perfect. To stabilize the pieces during the glue-up and clamping stages, I use two round, plywood collars. I saw a hole in the middle of the collars, so they will fit over the column the way a metal band fits over a wooden barrel. One collar fits just above the widest part of the bulge, and the other collar fits where the neck starts to bell. The collars hold everything steady while I tighten down padded, ratchet-tensioned nylon strap clamps around the top and middle bulge of the column.

After the glue is dry, I drill the ½-in.-dia. hole through the column's center on a drill press with a 10-in.-long bit. I drill down 10 in. from the top, turn the column over and drill into the bottom until I pass the other hole by about 4 in. The small opening between the 1/16-in. edges of the segments

Photos: Rob Ratkowski; drawing: Lee Hov

helps guide the bit because the cutter takes the path of least resistance. The boring could be eliminated altogether by shaving about ¼ in. off the inside corner of each quarter column before assembly and then reaming out any glue squeeze-out after the column has dried. Or the planer carrier could be adjusted to leave a wider inside edge on each segment, which will create a larger opening in the column's center.

Making the capital, base and stand

When dimensioning the lumber for the stack-laminated base and capital, I size the pieces so the joints fall at a bead or detail line (see the drawing). The finished parts thus appear to be a solid piece of wood, and the joint lines provide a reference when refining the shapes on the lathe. To ensure that the joint between the column and base is tight, I turn a slight 1/32-in.-deep dish on top of the base so that only the outer edges of the column contact the base. The capital has a 3/16-in.-deep recess, which fits over the pedestal and hides any glue excess or alignment irregularities. I make the square top mount from two laminations of ¾-in.-thick koa plywood, edgebanded with ⅜-in.-thick solid koa.

The stand for my pedestal is four laminations of ½-in.-thick plywood, shaped with a template and router and glued and screwed together. Rather than relying on the screws to pull the plywood tightly together along the edges, I also apply C-clamps. And even though I try to keep the edges as free of glue as possible, I usually still have to scrape them before gluing on the edgebanding. The guys in the shop always razz me when I pull out my double-bladed Red Devil paint scraper to clean up glue squeeze-out, but it's really invaluable for removing dried glue or a few microns of koa without tearing the grain. A conventional scraper blade just doesn't give me the control or pressure needed to remove the material.

The laminated stand is edgebanded with 3/64-in.-thick koa veneer. To help hide the joints in the edgebanding, I keep the veneer pieces in sequence and avoid locating joints on convex curves. The top surface of the stand is covered with ⅜-in.-thick book-matched koa, and the bottom surface is trimmed with ⅜-in.-thick molding. Both the top pieces and the bottom molding overhang the edgebanding by about ⅜ in. I roundover the overhang with a ⅛-in. radius bit, and then I use a rasp to slightly blunt the edge. Blunting the radius may seem like a minor detail, but it makes the stand less prone to dents from chairs or vacuum cleaners.

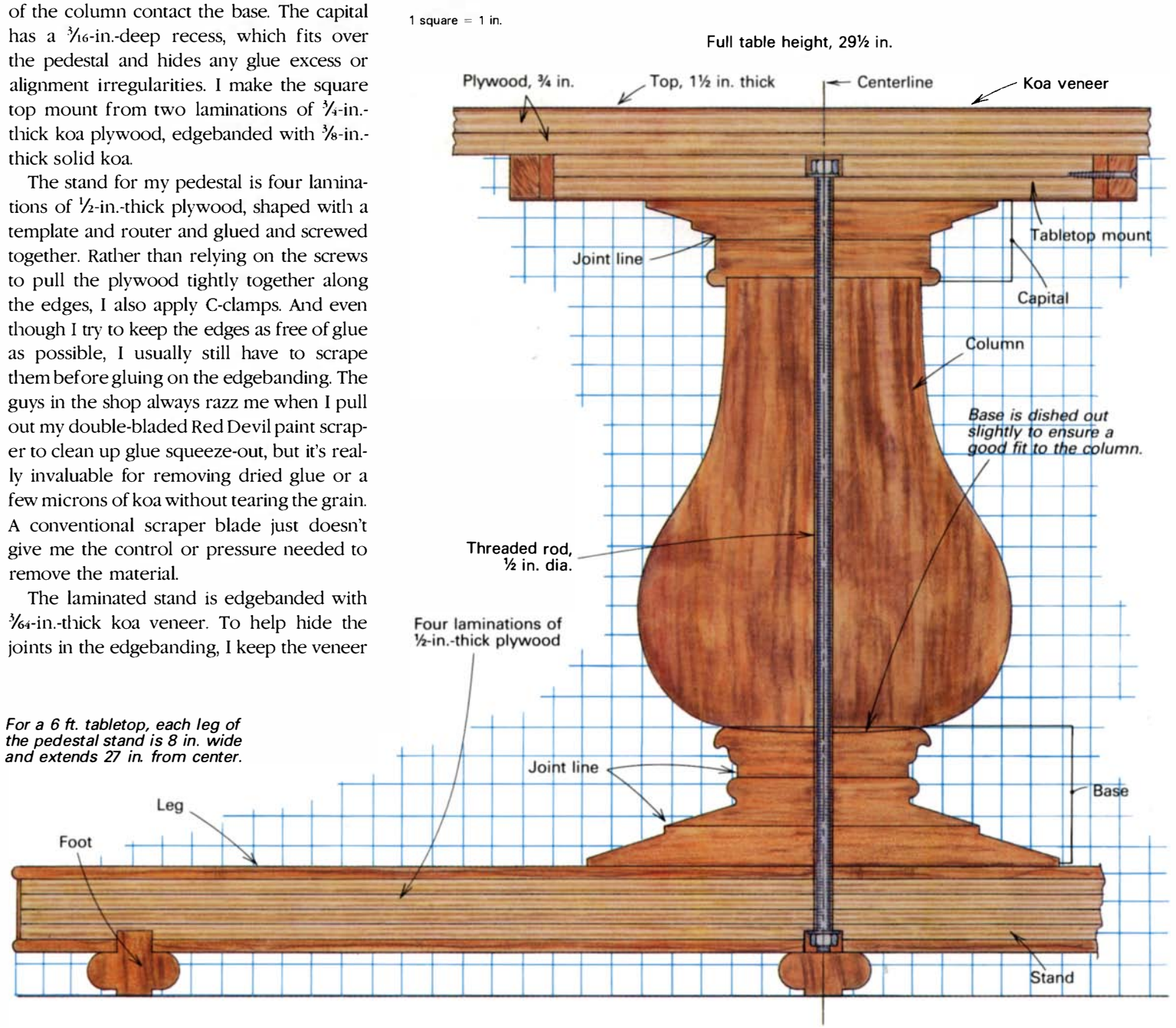
Assembling the pedestal

Before assembling the pedestal, the top mount, capital, base and stand must each be bored out individually for the threaded rod. To recess the nuts and washers, I drill a larger hole about ¾ in. deep in the top of the table mount and the bottom of the stand before I drill the ½-in.-dia. hole for the threaded rod.

After turning the short legs and gluing them into the stand, I dry-assemble all the parts on the threaded rod and make any necessary alignment or leveling adjustments. I index each section with a chalk mark so that everything can be reassembled without head scratching with gluey fingers. After tightening the top and bottom nuts securely (I want them to stay snug for the next 300 years), I use a wet rag to remove all the glue from the veining near the base and from under the capital—sanding a little raised grain beats picking at hard glue 10 to 1. □

Tim Carr is a professional furnituremaker and architect in Haiku, Hawaii.

Pedestal Construction



For a 6 ft. tabletop, each leg of the pedestal stand is 8 in. wide and extends 27 in. from center.

How to Install Bandsaw Tires

Getting them on is only part of the job

by Robert M. Vaughan

***Stretching a new bandsaw tire over the rim of the wheel** is a tough task made easier by the author's method, which employs both wheels as stretching forms. After pulling a loop of tire from between the pair of wheels, Vaughan inserts dowels one by one around the perimeter. The new tire can be slipped down over the wheel's rim after dowels have been inserted at each spoke.*

Bad tires are the number one cause of poor bandsaw performance. I'm often asked to repair or adjust bandsaws as part of my machine-restoration business. Often, the tires on old machines are brittle or full of grooves caused by the tooth set of narrow blades, or they have deep cracks and missing chunks. Sometimes, the tires have been replaced but haven't been properly trimmed and recrowned, resulting in a bandsaw that vibrates and won't track blades correctly. No matter how much attention is paid to alignment and adjustment, a machine with bad tires simply won't perform well.

The way to restore an older bandsaw's smooth and accurate performance is to replace the tires. Although each bandsaw is a little different (some types of bandsaw wheels require factory-made tires that need special installation), fitting new tires usually can be done right in the shop by following the steps outlined in this article. The process includes removing the old tires, cleaning the rims and then stretching the new tires on and gluing them in place. Then the new tires should be equalized, trimmed and crowned and, finally, the wheels should be rebalanced.

Removing old tires and cleaning the rims

Getting off the old tires is sometimes easily done with two fingers. Other times, the cement tenaciously sticks to both the tire and the wheel. In either case, the process is simple enough, but a few extra steps can effectively reduce some of the wheel cleanup later. In the toughest instances, insert a razor knife between the wheel and the tire and pour in a slight amount of lacquer thinner, which will partially dissolve the contact adhesive that holds the tire to the wheel. Wait about 30 seconds, and then pry with a screwdriver to enlarge the opening. After inserting a small wooden wedge, pour in a little more thinner, and wedge the tire farther off the wheel. Continue this process until the tire comes off entirely.

Next, all of the old contact cement has to be removed from the wheel; otherwise, it will cause lumps and gaps in the bonding of the new tire. First, remove the wheels from the saw, a process that's usually only slightly more complicated than taking a V-belt pulley off a motor shaft. Typically, this involves just removing a single nut on the end of each axle and pulling the wheel off (if you're in doubt, consult your saw's manual). Clamp one of the wheels in a vise with padded jaws. Working in a well-ventilated area, lay a strip of old sock on top of the wheel and pour on lacquer thinner. Let the soaked sock set for a couple of minutes and the thinner will soften the old contact cement, so it can be scraped off. After using this technique all around the perimeter of the wheel, go around it again with a solvent-coated, stiff-wire brush to remove any dry and crumbly cement. A wire wheel in an arbor or chucked in an electric drill works quickly on cast-iron wheels but can ruin the tire-bonding surface on aluminum or plastic wheels.

Stretching on new tires

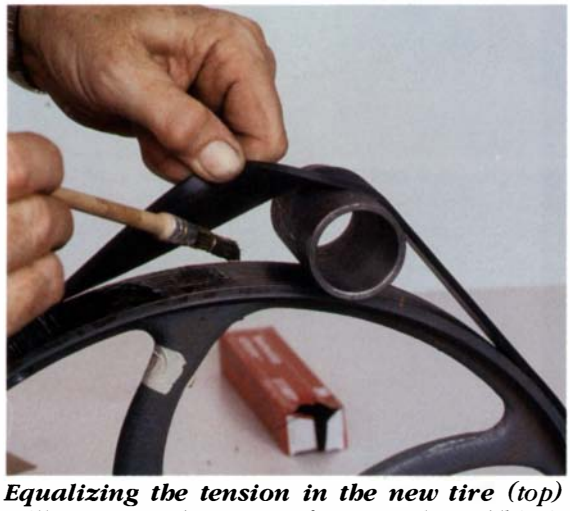
Solid-band tires, which are most commonly found on woodshop bandsaws, cost about $1 per inch based on the diameter of the wheel (up to 38 in. dia). I purchase mine from the Pennsylvania Saw Co. Inc. (PO Box 533, Emigsville, Pa. 17318-0533; 800-233-9381). Often, the tires on many small-wheeled bandsaws—12 in. dia. or less—can be manhandled onto the wheel without much difficulty. Just C-clamp the tire to the wheel at one point, and work your way around the rim. However, installing new tires on bandsaws with 14 in. or larger wheels is like trying to stretch your lips around a bowling ball. To fit correctly, most new tires are about 15 percent to 20 percent shorter than the circumference of wheel they're made for.

To install tires on large-spoked bandsaw wheels (the most common design) with relative ease, I've developed a method whereby the wheels themselves are used as a form for stretching the tires, so they can be slipped on. With both wheels removed and cleaned, as described above, lay them down on the bench, one on top of

the other. Next, insert a ring-shaped spacer (I use an old ball bearing, but you could easily turn one from wood) between the wheel hubs so that the rims of the wheels are separated slightly more than the width of the new bandsaw tire. Now, sandwich the new tire loosely between the two wheels, and, as a temporary axle, insert a dowel or rod through the wheel hubs and spacer. Finally, put another spacer under the bottom wheel to raise the assembly about ½ in. or more off the bench.

Before the stretching begins, you'll need to cut some short, sturdy dowels (the same number as the number of spokes on one wheel). I use old broom handles and cut them about 2 in. longer than the total height of the wheel sandwich. You'll also need three 12-in. lengths of mason's twine or strong cord to tie the dowels in place during stretching. Cut a fourth length of twine about 24 in. long; thread it through the new tire, and tie the ends into a loop for use later to stretch the tire.

To begin the tire stretching, fish out a loop of the tire from between the wheels, insert a dowel down through the loop and tie it to the wheel's rim (over one of the spokes) with a length of twine (see the photo on the facing page). Securing the dowel this way prevents it from rolling around the perimeter of the wheel each time the tire is stretched at a different spot. Repeat the stretching and dowel-insertion process about a third of the way around the wheel to form the second side of an equilateral triangle. For the third leg, pull on the string that's looped through the tire to help you stretch the tire so another dowel can be inserted (see the photo on the facing page). Repeat this pulling ceremony with the remaining dowels. I've found it unnecessary to tie the last few dowels to the rim because the first three dowels hold things pretty much in place. Once all the dowels are in place, you should be able to work the tire down over the bottom wheel without much trouble. Then, working carefully, one dowel at a time, remove the untied dowels first, and then cut the strings, and remove the tied dowels. Finally, turn the assembly upside down and repeat the procedure to mount a new tire on the other wheel.



***Equalizing the tension in the new tire** (top) will prevent a bumpy performance later. This is done by rolling a short length of pipe around the wheel several times.*

***To cement a tire in place** (bottom), lift the tire off the rim with a pipe, and apply weatherstrip adhesive in one small area at a time, gradually working your way around the wheel.*

Equalizing the tire and cementing it on

Once in place, the new tires need to be equalized to even up unequal thickness in the rubber that may have resulted from stretching. With a wheel on its edge on the bench, carefully lift the tire in one spot and insert a short piece of pipe (about 2 in. dia.) with a dowel slipped through the center (see the top photo). Now roll the pipe around the perimeter of the wheel at least three revolutions to equalize the tension of the rubber tire. Keep track of the revolutions by marking a starting point on one of the spokes with masking tape.

For cementing the new tires on, I use 3M's weatherstrip adhesive because it's convenient to apply right out of the tube, and I find it much stronger than the other adhesives I've tried. Starting near your masking-tape mark, lift the tire with your fingers, and insert the short pipe you used to equalize tire tension. Brush some cement on the exposed area of the wheel and the tire on one side of the pipe, as shown in the photo below. In the time it takes to apply the adhesive to both surfaces, the glue will get tacky, and the pipe can be rolled a short distance, so the cemented areas can bond (the tension of the tire should flatten any globs of cement that result from uneven application). Continue to apply the cement, working all the way around the wheel. When you get near where you started, there'll be a small area where you won't be able to apply cement, but don't worry about it; this small, unglued area won't be a problem. Now, let the glued tire dry for about 24 hours to be sure of a good bond.

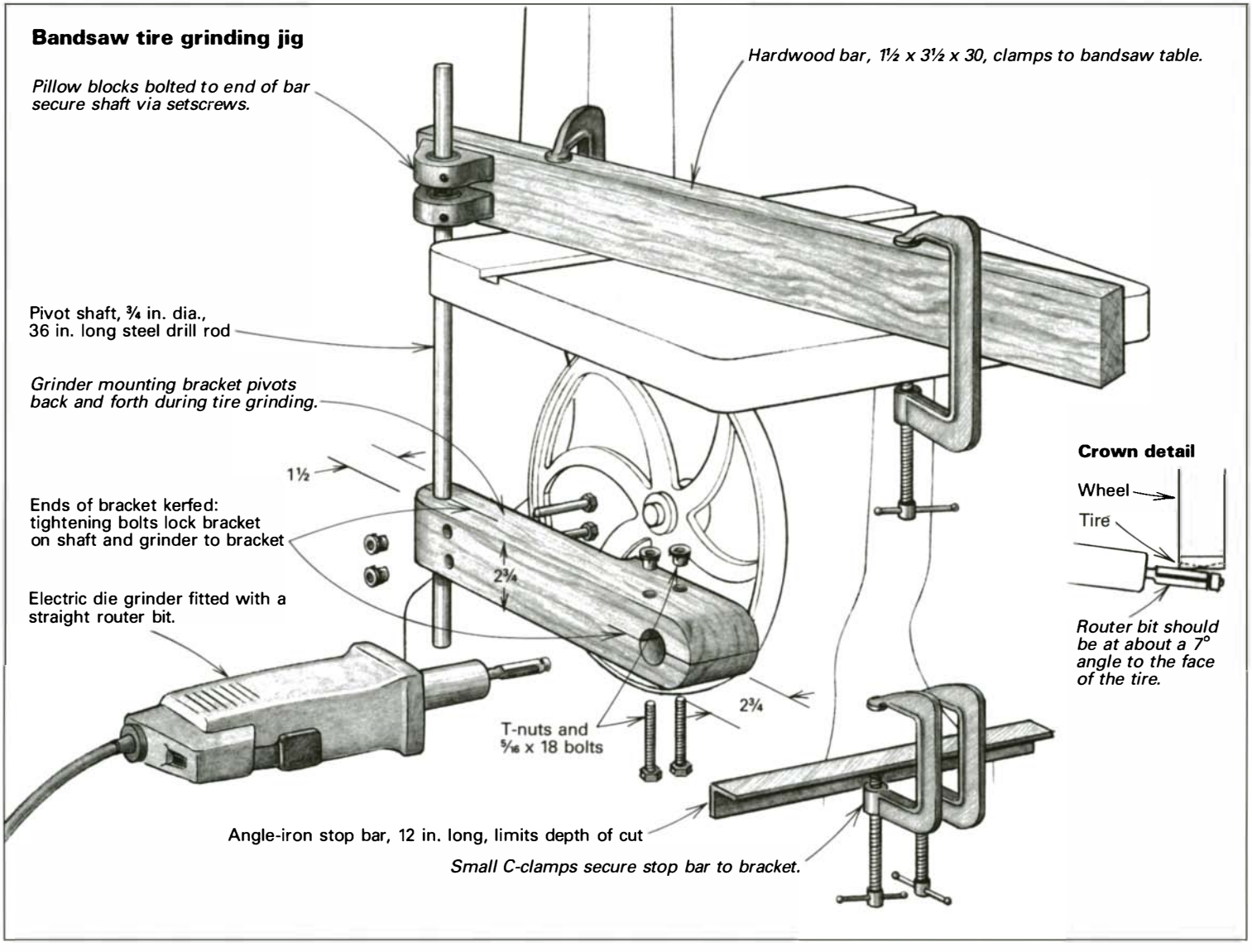
Trimming and crowning

Now you're ready for the most important steps of this job: trimming the tires concentrically and shaping a crown on them, which are necessary for good blade tracking. First, remount the wheels on the bandsaw, and tighten the axle nut firmly. Make sure there is no slop or looseness in either wheel on the saw; otherwise, the crowning will give lumpy and bumpy results.

For trimming and crowning, I use a shopmade jig, shown in the drawing on p. 52. I've used this setup on bandsaws with 12 in. to 36 in. wheels. The jig, which is temporarily clamped to the saw, allows an electric die grinder fitted with a router bit to be pivoted into the tire. I use my Black & Decker die grinder because it runs at the same speed as a router, and it has a long, straight neck that's easy to mount. For a cutter, I use a ½-in.-dia. laminate trimmer bit with a ball-bearing pilot. I trim a V-shaped crown on all the bandsaw tires I install rather than the round crown typically seen on new tires. This V-angle is about 7°, which I find works well with any bandsaw blade but especially well on narrow (1/16-in. to ¼-in.) blades. I can't imagine ever going back to the more-difficult-to-grind round crown.

To make the trimming jig, start by bolting a pair of pillow blocks to one end of a hardwood bar. The pillow blocks hold a ¾-in.-dia. drill-rod pivot shaft, locked to the blocks with setscrews (some styles use locking collars). This allows the shaft to pivot but keeps it from sliding out. Bandsaw the grinder-mounting bracket to the shape shown in the drawing, and bore holes at each end—one for the shaft and one for the neck of the grinder. Kerfs sawn through these holes and bolts installed in T-nuts provide a means for locking the bracket to the shaft and the die grinder to the bracket. A length of stop rod, cut from flat or angle iron, completes the setup.

Vaughan's jig for trimming and crowning *the tire holds an electric die grinder fitted with a flush-trimming router bit clamped in a pivoting bracket. He clamps the jig to the bandsaw with the pivot shaft extending up for working on the top wheel (left) or down for the bottom wheel (right). Each tire is trimmed twice at a slight angle from each outer edge to form a V-shaped crown.*

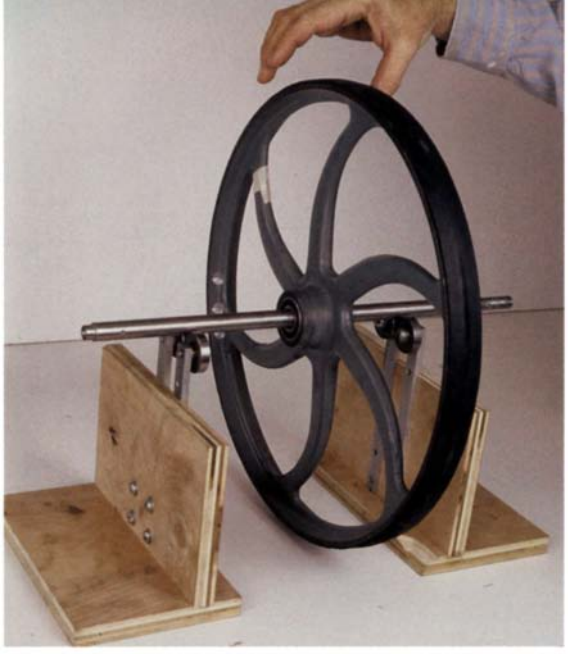


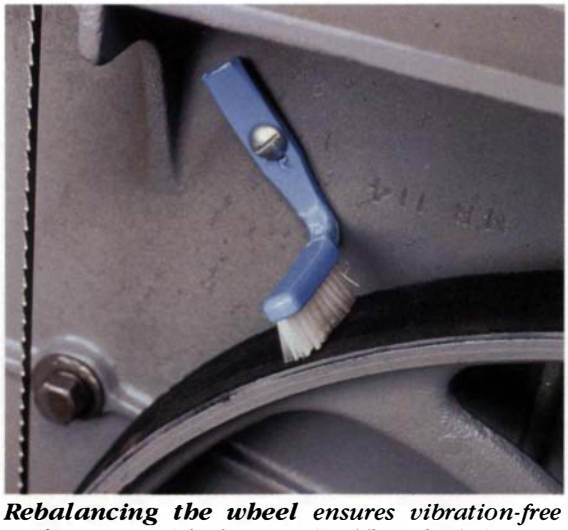
Photos: Robert Vaughan; drawings: Lee Hov

Before mounting the jig on the bandsaw, make darn sure that the power cord to both the die grinder and the saw are disconnected. Lightly clamp the hardwood bar to the saw table with the pivot shaft extending up for trimming the upper tire or down for the lower tire (see the photos on the facing page). Secure the die grinder in its bracket; then attach the bracket to the shaft with the T-nuts and bolts. Use a pair of small C-clamps to secure the stop rod to the bracket below the grinder. These C-clamps also make good operating handles for pivoting the bracket during trimming because they keep your hands away from the spinning bit.

Trimming each tire is done in stages: Three increasingly deeper passes cut one side of the V-shaped crown, and three cut the other. Trimming involves the somewhat tedious process of adjusting various parts of the jig to different positions, clamping and unclamping them to change the angle at which the bit contacts the tire and the depth of cut. It'll take time to get things right, especially on your first attempt, but the gratifying results outweigh the effort required.

You need to locate the axis of the jig's pivot shaft so that the axis of the bit relative to the surface of the tire is about 7° off. For a saw with 1¼-in.-wide wheels, this angle will allow the bit to trim about 1/16 in. more at the edge of the tire than at the center. Once you've set the correct angle, clamp the stop rod so that the first cut lightly trims the tire just at the edge. The stop rod is a crucial component of this rig. Without it, precision trimming is nearly impossible, not to mention dangerous.





***Rebalancing the wheel** ensures vibration-free performance with the new tire. The wheel rides on pairs of ball bearings screwed to this simple jig. A heavy spot will consistently end up at the bottom, indicating where weight needs to be removed.*

***Keeping the wheel clean of sawdust and debris** makes tires last longer. An old toothbrush bent and screwed into place serves that purpose.*

Now, plug in the grinder (*not* the saw), and don a face shield and dust mask—this process sprays little black specks of rubber all over the place. Double check all clamps and setscrews (you need to be very sure that they are tight). Next, turn on the grinder, and then lock its switch on. Use one hand to turn the bandsaw wheel—very slowly—in the direction opposite the rotaton of the bit at a perimeter speed of about 1 in. per second. With your other hand, slowly pivot the cutter into the tire. If the wheel isn't turning when the bit enters the rubber, a jolting kickback will occur, and the tire might be gouged. Until you get used to this setup, start with a *very* light cut to prevent this accidental gouging, which can ruin the tire.

It takes about three full revolutions of the wheel to trim one side of the crown smoothly. The first pass will have little dips where the bit went in and out when the wheel-turning hand changed positions; the second pass cleans up most of these dips. The third pass should be very slow and smooth to take a light shaving and clean up more of the little dips (resist the temptation to turn the wheel fast). Don't let any tiny dips that remain disturb you. They don't affect blade-tracking performance, and I can't completely avoid them either. When one side of the crown is finished, shift the pivot shaft's axis point to set the angle to trim the other crown, and repeat the process. I overlap the cuts slightly at the center of the tire, taking care that the apex of the tire crown is centered after the second cut. In theory, this should leave a point, but because the rubber is so soft, the crown is actually slightly rounded. After trimming both sides of the tire, flip the hardwood bar and pivot shaft over. Remount the grinder bracket on the shaft, and then trim the other wheel.

Rebalancing the wheel

The new rubber tire can and usually does change the balance of the wheel. Therefore, you should remove each wheel from the saw after trimming to check the balance. My balancing rig shown in the top photo is crude compared to most static balancers, but the results are most satisfactory. I mounted pairs of ball bearings on the ends of some upright steel strips and then screwed these strips to a couple of bookend-style plywood platforms. Although it surely would be quicker to balance the wheels on the machine, usually there is too much natural resistance from the bearing seals and lubricant for sensitive results.

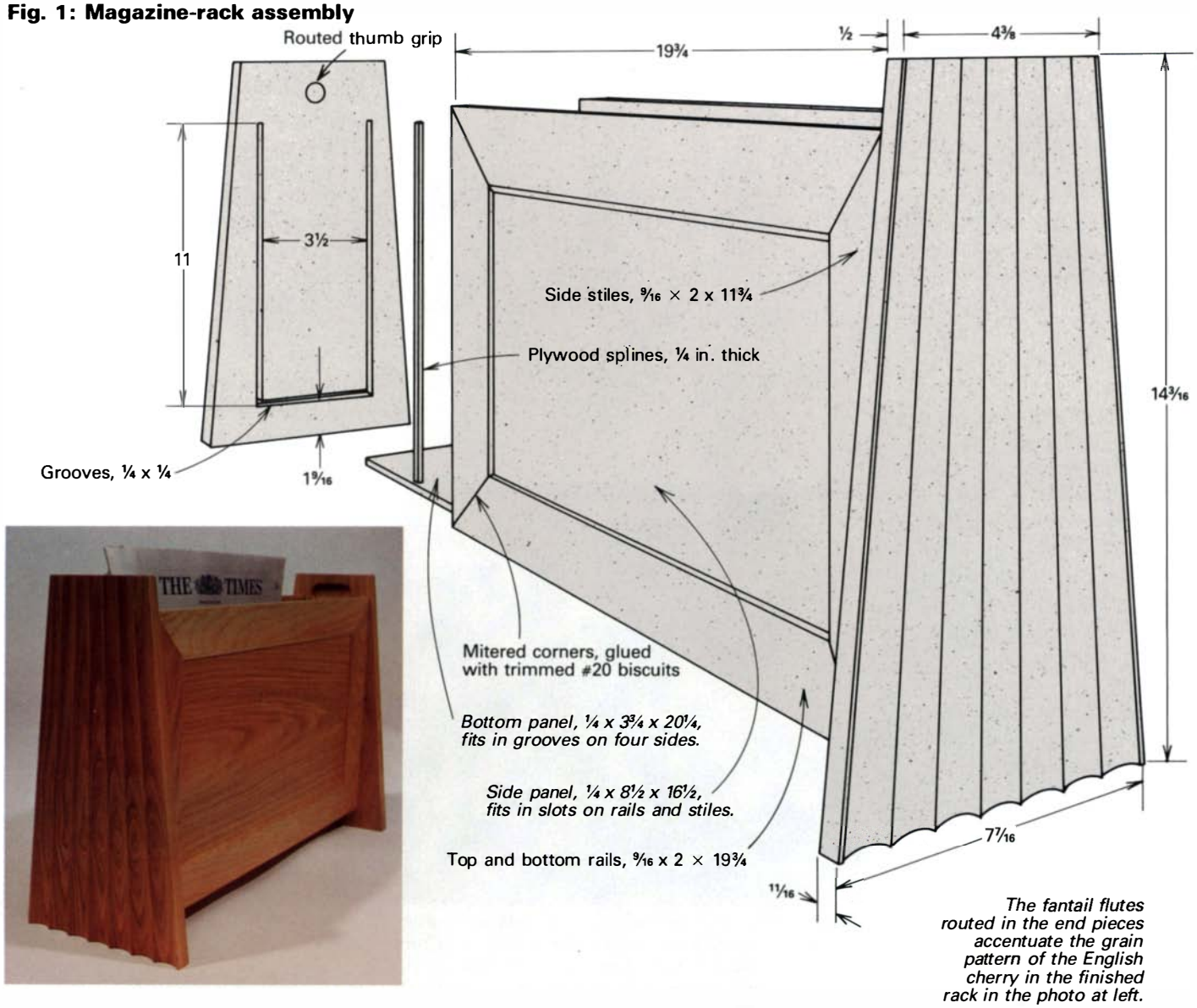
To use the jig, insert a very smooth shaft, like a drill rod, through the wheel's hub, and then set it between the bearings, as shown in the top photo. The principle is simple—the heaviest part of the wheel rolls to the bottom. Experimenting with different wheel orientations will soon tell you exactly where the heaviest spot is. If the same spot repeatedly ends up at the bottom, take the wheel to the drill press and bore one or more shallow holes at the heavy spot on the inside rim of the wheel with a ½-in. twist bit. Conservative drilling is in order here. If you're afraid to drill into your wheel, then wrap and tape pieces of electrical solder around the spokes or screw on weights directly opposite the heavy spot. Recheck and drill/weight each wheel until it can be spun on the balancing jig without the same spot settling to the bottom each time.

Brushing after every wheel

After all of this work, it's a good idea to install some sort of brush on the lower wheel of your saw to clean and protect your new tires. A brush that contacts the lower wheel sweeps away dust, pitch and other debris, which can build up and change the shape of the tire's crown and thus alter tracking. To make the brush, simply heat and bend a dogleg into the handle of an old toothbrush, as shown in the bottom photo, and screw it to the inside of the bottom wheel guard. □

Bob Vaughan is a contributing editor to Fine Woodworking *and a woodworking machinery rehabilitation specialist in Roanoke, Va.*

Fig. 1: Magazine-rack assembly



The fantail flutes routed in the end pieces accentuate the grain pattern of the English cherry in the finished rack in the photo at left.

Routing Tapered Flutes in Flat Panels

Jigs make short work of a magazine rack's fan-shaped ends

by Malcolm Vaughan

One of my first furnituremaking commissions was a corner display cabinet in English cherry for my mother, who added: "If there's any wood left over, perhaps you could knock together a Christmas gift to replace my aging magazine rack." So I built a magazine rack, like the one in the photo above, as a bonus to her display case. After coming up with a fluted, fan-shaped design for the ends of her rack, I came up with a few jigs, so I could make the racks in small batches to sell through craft galleries. By first using a thickness-tapering jig and a width-tapering jig on the ends, I discovered that I could cut the fantail flutes in a simple router jig. And by building similar jigs, I can vary the width and depth of tapers when fluting other furniture as well.

Design, construction and materials

I used frame and panels for the rack's sides. The panels show off the rich grain patterns of the native hardwoods I use, such as elm, ash, oak, cherry or chestnut. Because of their neat appearance, I chose miter joints reinforced with biscuit splines for the frames' corners. I tapered the ends of the rack to make it stable when loaded with newspapers and magazines, and I fluted the ends to emphasize the inverted-fantail shape. Slots routed on the inside of the ends, as shown in the drawing above, receive the bottom panel and the splines that attach the sides.

Photo this page: author; all other photos: Jim Boesel

Because I prefer the natural figure in wood rather than applied decoration and ornate detailing, I dig out the most interesting boards when I go to the lumberyard. This is particularly true when I'm making small pieces like the magazine stand. The grain of the ends, for instance, can dramatically improve the contoured effect (for more on this, see the article by Peter Tischler on p. 58). Of course, no matter how dry the timber is or how long it's been sitting, most woods misbehave when I start to cut them up. Therefore, I cut all the rack's components to rough length first and then machine them a bit oversized and leave them for a week or two, so the wood can relieve any inherent stresses. When resawing the stock for the thinner parts—the bottom and the pair of matching side panels—I use a sharp, 4 teeth per inch (t.p.i) skip-tooth blade in my bandsaw, so I can cleanly split the 1-in. stock down the middle.

Using jigs to shape the ends

I use jigs to cut and contour the ends: one for thicknessing the stock at a shallow taper, a second for ripping the ends into trapezoid shapes and a third for routing tapered flutes. The tapers of both the width and thickness of the endpieces are based upon proportions I chose for the fan-shaped flutes. Tapering the end pieces first allows me to use a simple carriage-like router jig that automatically narrows the flutes toward the top of the ends.

Because I wanted to use a 1¼-in.-dia. core box router bit, I designed the taper of the flutes and the flair of the ends around the bit's capacity. To work out the depths and widths of the flutes, I drew a 1¼-in.-dia. circle on paper to represent the router bit, as shown in figure 4 on the following page. Then I drew parallel chords through the circle to give me a visual representation of the width and depth of the flutes. As I had planned, seven flutes tapering from 1 1/16 in. wide at the bottom to ⅝ in. wide at the top fit nicely within the basic proportions of the end pieces. To accommodate these flutes, the ends would taper from 7 7/16 in. wide at the bottom to 4⅜ in. wide at the top. From the drawing, I determined that each flute would be 5/16 in. deep at the bottom and ⅛ in. deep at the top. This meant that I needed to taper the thickness of the end pieces 3/16 in. over their 14 3/16-in. length.

Taper thicknessing with a planer jig— After ripping and crosscutting the two ends to 7½ in. wide by 14¼ in. long, I plane them to 13/16 in. thick. I then taper the end's thickness using the planer jig shown in figure 2, which holds an end at an angle as it passes under the cutterhead. Rather than tapering the thickness in one hit, I take several passes

Fig. 2: Taper-thicknessing jig

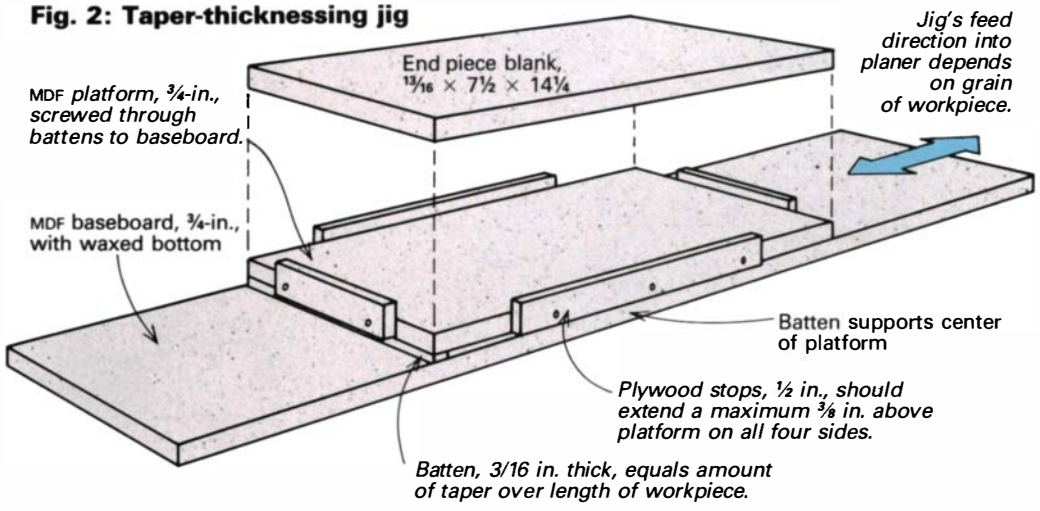
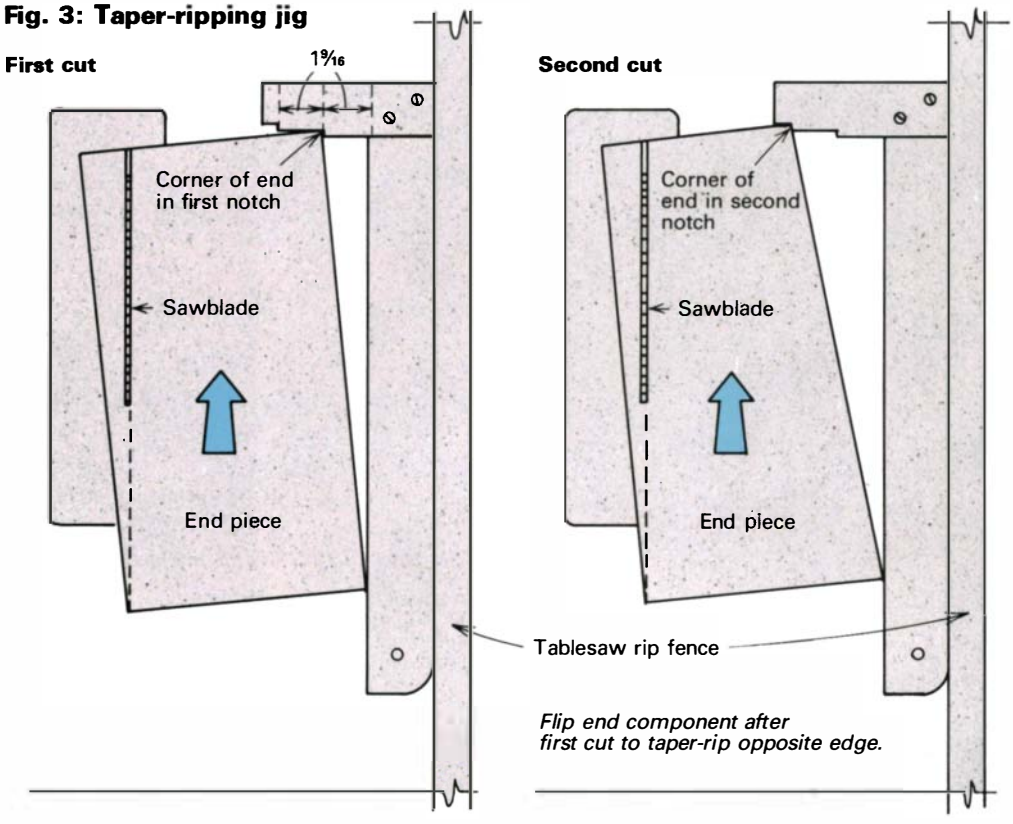
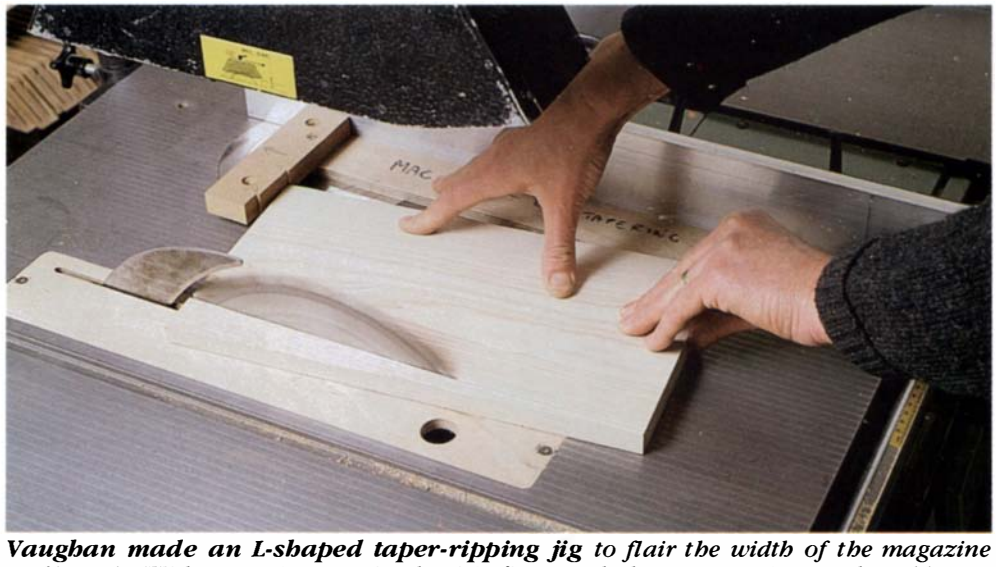


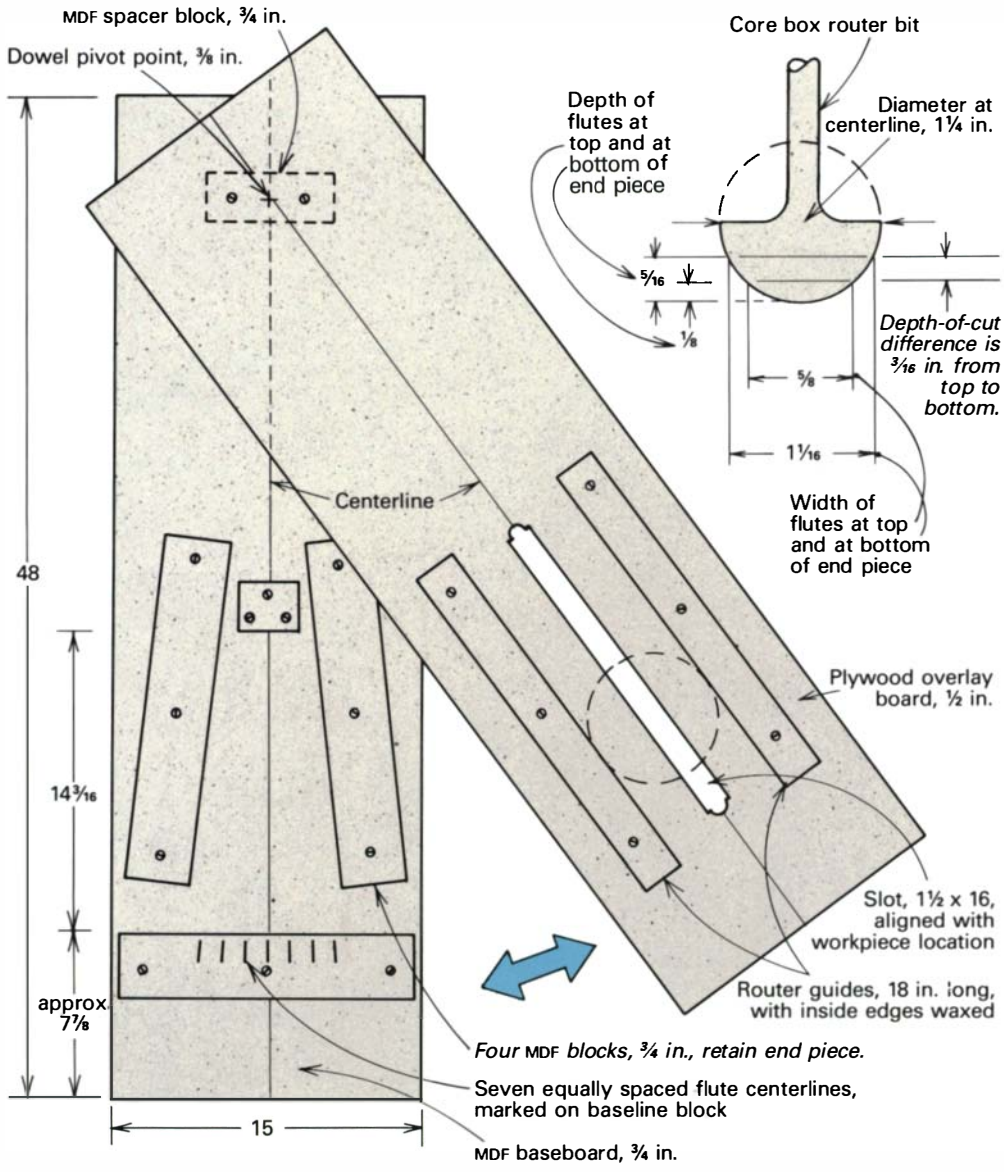
Fig. 3: Taper-ripping jig





Vaughan made an L-shaped taper-ripping jig *to flair the width of the magazine rack's ends. With an end corner in the jig's first notch, he rips an edge on the tablesaw. Then he flips the end over, aligns it in the jig's second notch and tapers the other edge.*

Fig. 4: Router jig for taper fluting



Detail: Determining flute depths

until the ends taper from 1¹⁄₁₆ in. at the bottom to ½ in. at the top. This ³⁄₁₆-in. taper ensures that the flutes' width and depth will narrow in a corresponding fashion when I'm running the router over the workpiece in the fluting jig. (You should taper plane a spare end because you'll need it for testing the other jigs later.)

After the taper thicknessing is done, I select and mark each end's outer face and square up the top and bottom of the ends to their inside faces. I also clean up the inside faces with a scraper, plane or sander while checking for flatness (cupping will prevent the side frames from gluing up flush). Then, before I taper rip the long edges of the end pieces, I rout the ¼-in.-wide by ¼-in.-deep slots on their inside faces for the splines that join the sides to the ends and that house the bottom panel. I make U-shaped slots by guiding my router's fence along the edges of the end and then along its bottom (to locate the slot, see figure 1).

Taper ripping with a tablesaw jig—To taper the width of the ends, I use a simple jig (see figure 3) that runs along my tablesaw's rip fence. I rip the first taper with an end corner set in the first notch. Then I flip the end piece over, align the corner in the second notch and rip the taper on the opposite side, as shown in the photo on p. 55. The finished end should taper from 7⁷⁄₁₆ in. at the base to 4⅜ in. at the top.

Making a fluting jig—The router jig that I use to make tapered flutes is shown in the photos below and figure 4 at left. The jig

The author routs fantails on his end pieces *using a fluting jig (left). To use the jig, he places an end component within the blocks on the baseboard and lines up the pivoting overlay board on one of the flute centerlines marked on the baseline block (above). Then he clamps the boards together, and, with a 1¼-in. core box bit extending through the overlay slot, he guides a router in the top tracks. Because he taper thicknesses the ends in another jig beforehand, the flutes narrow in width and depth toward the top of each end.*

Drawings: Bill Jurgens

consists of a ¾-in.-thick medium-density fiberboard (MDF) baseboard and a ½-in.-thick plywood overlay board each with a centerline marked down its length. I center one of the trapezoid end pieces on the line near one end of the baseboard and outline the end shape with a pencil. After removing the end, I subdivide the trapezoid's base and top into seven equal spaces. I mark the center of each space and then connect base points to top points to indicate the centerline of each flute on the baseboard (see figure 4). I extend the converging lines to their point of intersection and mark the spot. Then I drill a ⅜-in.-dia. hole at this point on the baseboard and drill a corresponding hole on the centerline in the underside of the overlay board. A dowel glued into the overlay board becomes the swivel point of the pivoting router guide.

After screwing ¾-in.-thick MDF blocks (labeled in figure 4 on the facing page) to the baseboard to hold an end piece securely along all four edges (the gaps between the blocks are for chip clearance), I use a sharp pencil to transfer the flute centerlines squarely up the front and back edges of the baseline block. Then I join the block's edge marks across the top of the block to form the alignment lines for the overlay board. Next, I rout a 1½-in.-wide by 16-in.-long slot down the middle of the overlay board at a place that corresponds to the location of the end piece when the jig is in use. I screw two 18-in.-long straight sticks to the top of the overlay board, parallel to the slot and wide enough apart to act as a snug guide for my router base. I wax the sticks and overlay surfaces, so the router will track smoothly.

Routing tapered flutes—With the fluting jig's baseboard clamped to my bench, I lay the spare end piece in the jig and place the overlay on top (see the photo at left). I stick the overlay dowel in the baseboard pivot hole, line up the centerline of the overlay with a flute line on the baseline block and clamp the boards with a C-clamp. With the 1¼-in. core box bit in my router and the router in its channel on the overlay, I adjust the depth of cut and make test passes until I get the correct flute depth. Then I remove the spare end and mount an actual end in the jig and rout away, successively lining up the overlay centerline with each flute line (see the far left photo).

One half of each flute is cut against the grain, so sometimes the wood tears out no matter how sharp my cutter is or how slow my speed (elm and chestnut are more difficult than oak, ash or cherry). An energetic burst of hand-sanding with a shaped cork block usually is needed to clean up the flutes. I begin with 80- or 120-grit to get rid of any pits, and then I quickly work down through the sandpaper grades. Once I've cleaned up the flutes on both ends, I increase the router depth about 1/16 in., put an end back in the jig upside down and clamp the overlay on the baseboard centerline. Then I plunge a thumb grip on the inside face of each end, 1¼ in. from the top.

Frame-and-panel sides

After I joint and plane the frame stock to width and thickness, I plough a ⅜-in.-deep groove for the panels and shape a 3/16-in.-wide molding along the inside edges. I do the grooving and molding before I cut the miter because it's all too easy to damage the point of the miter if you cut them first. Then I cut the frame's miters and fit the frames together to check their 90° corners.

To cut the biscuit slots for the frame corners, I clamp my biscuit jointer to the bench on its side and either mark some lines or clamp a stop to center the biscuit slots in the miters. I use #20 biscuits, which means that I need to trim about 9/16 in. off their length first. You could use smaller biscuits, but I prefer the larger surface area that the #20 biscuits provide.

To thickness the side-panels and bottom to ¼ in., I usually tuck the pieces under my arm and go to a friend's shop and use his thickness sander. To clean up the thicknesser's machining marks, I either handplane or belt-sand the parts. I sand the panels to 400-grit, and then I finish them (usually with oil) before gluing the frames around them. If you finish the panels after you glue them into the frames, the panel could shrink, thus revealing an unfinished border.

I apply polyvinyl acetate (PVA) to the biscuits and frame-member ends and knock each frame together with a nylon-faced mallet. Next, I clamp the frame in two pairs of bar clamps; one pair clamps the frame lengthwise while the other pair clamps the frame perpendicular to the longitudinal ones. I snug up all four clamps evenly so that the miters are lined up and the frame is square (see the photo at right). You could use a miter clamp or a bar clamp with corner pads to assemble the frame and panel, but the bar-clamp setup lets you view the miters just as easily. After the glue is dry, I clean up the frames with a handplane, scraper and orbital sander and recheck that the frames are square; otherwise, when I glue them to the ends, I'll either have unsightly gaps or the rack will be cocked. I true up the frames with a plane, if necessary.

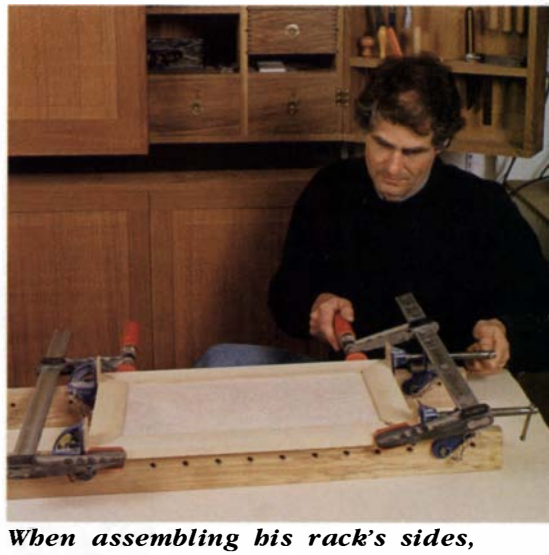
Finally, I rout full-length grooves along the inside face of the bottom frame members to house the bottom panel, and the stopped spline grooves in the edges of the frames where they join the end pieces.

Final assembly and finish

To assemble the two sides, two ends and the bottom, I rely on six bar clamps and some MDF pads about the size and shape of the ends and faced with a thin layer of cork. But first I assemble the parts in a dry run to measure the finished length of the bottom. Then, I disassemble the rack, cut the bottom to length and apply finish to the edges and faces of the bottom. Next, I smooth all flat surfaces with an orbital sander, and then I usually hand-sand to 400-grit. For the actual glue-up, I glue the plywood splines into the frames, fit both frames to one end, slide the bottom panel (without glue) into its slot and push the other end on before placing and tightening the six clamps.

After I remove the rack from the clamps, I check for twist by standing it on a flat surface. If it rocks, I handplane the base of the ends until the rack stands flat and steady. To finish the ends and remaining parts, I usually apply two or three coats of Danish oil, rubbing them in slightly between coats. On lighter-colored woods, like ash, I first apply a thin coat of cellulose lacquer as a sealer. After lightly sanding the lacquer with 400-grit, I buff the finish to a satin sheen with white petroleum jelly and a fine, white Scotch-Brite nylon pad. Finally, I buff off the surplus with a rag to make the wood's figure come alive again. □

Malcolm Vaughan is a furnituremaker living in Devon, England.



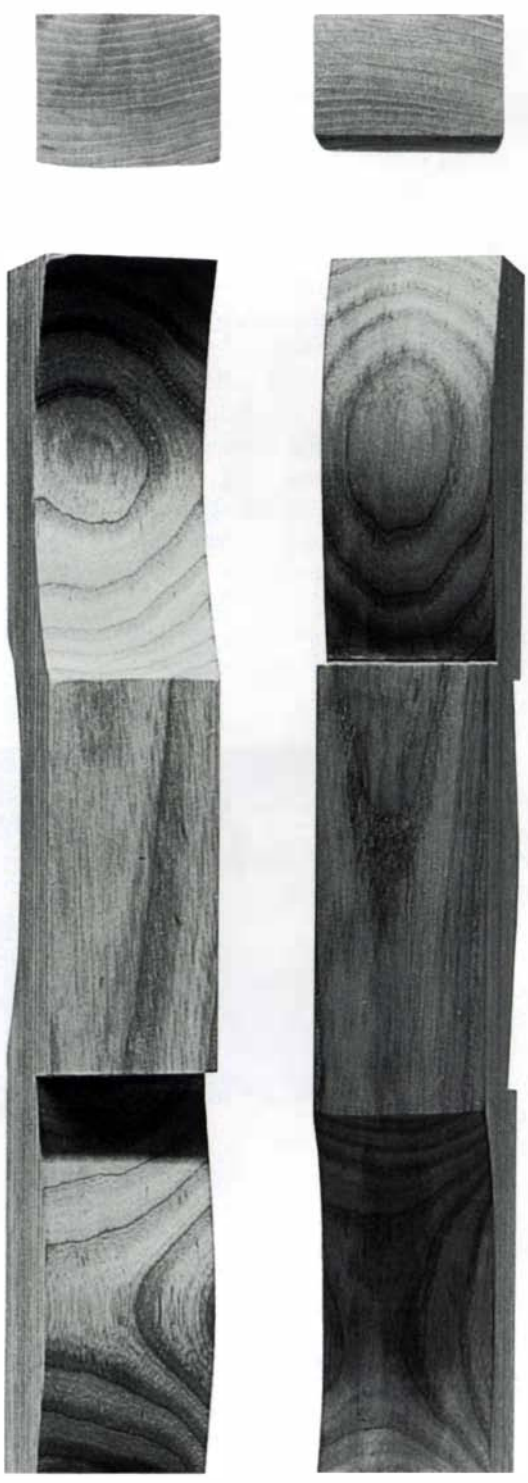
When assembling his rack's sides, *Vaughan uses two pairs of clamps situated perpendicularly to each other across the frame. This clamping arrangement lets him observe the frame and panel as he evenly snugs up the four clamps, making sure that the miter joints are aligned and that the frame is square.*

Choosing the Grain Pattern for Curved Parts

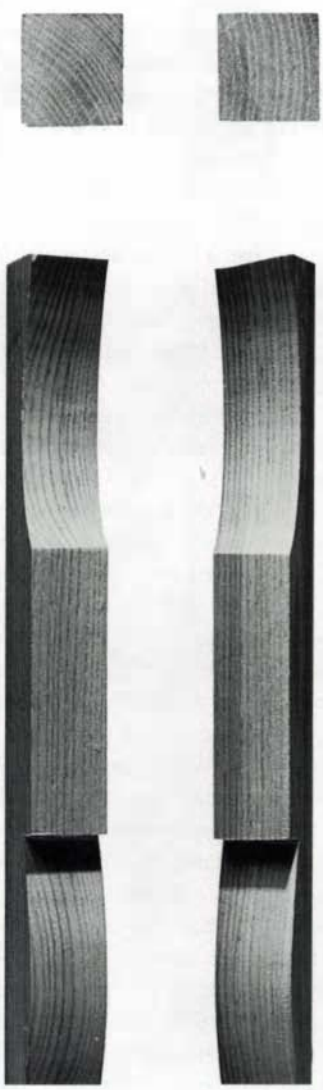
Endgrain orientation determines surface pattern

by Peter Tischler

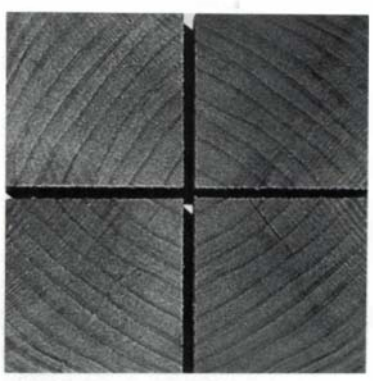
Convex and concave shaping on tangential surfaces



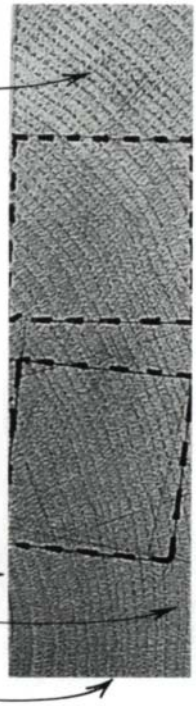
Convex and concave shaping on biased-grain and radial surfaces



Arranging quartersawn stock for four shaped legs or posts



Laying out stock on the endgrain of a board



When the bark-side tangential face of a wood sample is shaped ***(far left)****, the grain pattern of its concave surface is an elliptical bullseye; its convex surface displays converging parabolas. When the sample's heart-side face is shaped* ***(near left)****, the grain configurations are reversed. The ash sample near left also shows that when the growth rings are parallel to the shaped surface, the ellipse and parabola patterns are centered.*

When the growth rings on the endgrain are diagonal or perpendicular to the shaped surface ***(as in the two ash samples above)*** *the grain patterns are not pronounced. The biased-grain sample on the left produces a slightly curved pattern when shaped, and the radial grain on the right remains straight.*

Note: *The shaped surface faces the bottom of the page in all endgrain photos.*

I've always liked chairmaking because it involves my two favorite aspects of woodworking: joinery and shaping. All my chairs, whether they have a traditional, contemporary or custom design, rely on shaped components I sculpt from solid wood. Although I first became aware of the importance grain patterns have in relation to shaped work (and vice versa) in a lecture at trade school, I've since refined the ways I select and orient grain direction for curved parts.

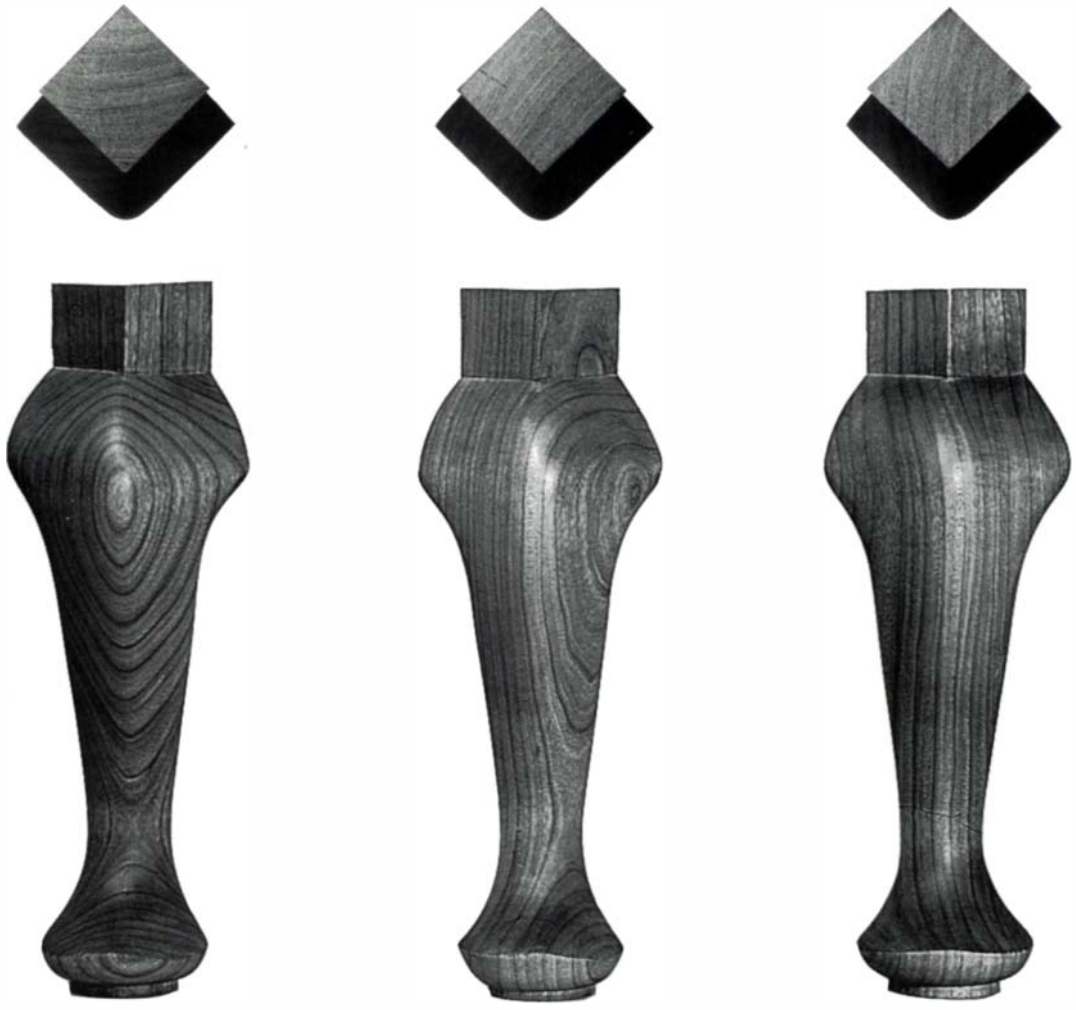
Due to seasonal changes and climatic variations, almost every tree forms contrasting growth layers. The wood in these layers is usually of differing cell structure and density. Appearing as light and dark rings, the layers are referred to as earlywood and latewood, which woodworkers term *grain* (not to be confused with figure). If you pay careful attention to the direction and type of grain when laying out a part before you bandsaw or shape a curved surface on it, you can achieve patterns that add cohesiveness to a design. There are basically three considerations to make when selecting wood for a particular grain pattern: first, the way in which the lumber was sawn into boards; second, how the growth rings are oriented with respect to the plane being shaped; and third, the shape you desire, whether it be concave or convex.

Plainsawn vs. quartersawn—Trees are most commonly sawn parallel to their growth rings to produce plainsawn or flatsawn lumber, which has tangential grain. The wide face of a plainsawn board usually has marked V-patterns. When wood is milled perpendicular to the growth rings, quartersawn lumber is produced (also called radial- or edge-grain wood). Quartersawn boards, made by quartering and slabbing a log, usually display diminished patterns on their faces. But when shaped, these boards can generate some highly interesting patterns. Boards that are cut completely across a tree, may exhibit both plainsawn and quartersawn characteristics. Boards that have growth rings oriented between 30° and 60° to their wide surface are said to have biased or bastard grain.

Orienting endgrain—To obtain a grain pattern that's consistent with a design, I often make adjustments during stock layout. The wide face of a plainsawn board can be oriented either bark side (outside of the tree) up, or heart side up. In addition, a component's cross section can be adjusted to achieve symmetry or asymmetry in the overall patterns (see the bottom right photo on the facing page). Since grain configuration can change dramatically across the width of a plainsawn board, it's best to cut all like components from the same section of a long board. Also, a board whose grain is veering off the wide face's edge can be bandsawn parallel to the runout, jointed and then tablesawn to make the opposite edge parallel.

Shaping with the grain—Because the right and left sides of a chair are mirror images, legs and posts are best laid out from above (looking down on the endgrain), rather than from the front. I prefer quartersawn stock when shaping the corners of cabriole legs (see the photos below). In addition, whether the shape is concave or convex greatly influences the patterns. For instance, a chair's crest rail usually has a concave shape, but you may decide to face the heart side or bark side toward the sitter in order to get either a parabolic or elliptical pattern. I keep several labeled, bandsawn samples as visual references of patterns displayed on concave and convex surfaces (see the shaped samples on the facing page). □

Peter Tischler is a North Bennet Street School graduate who operates a chairmaking and cabinetmaking shop in Caldwell, N.J.



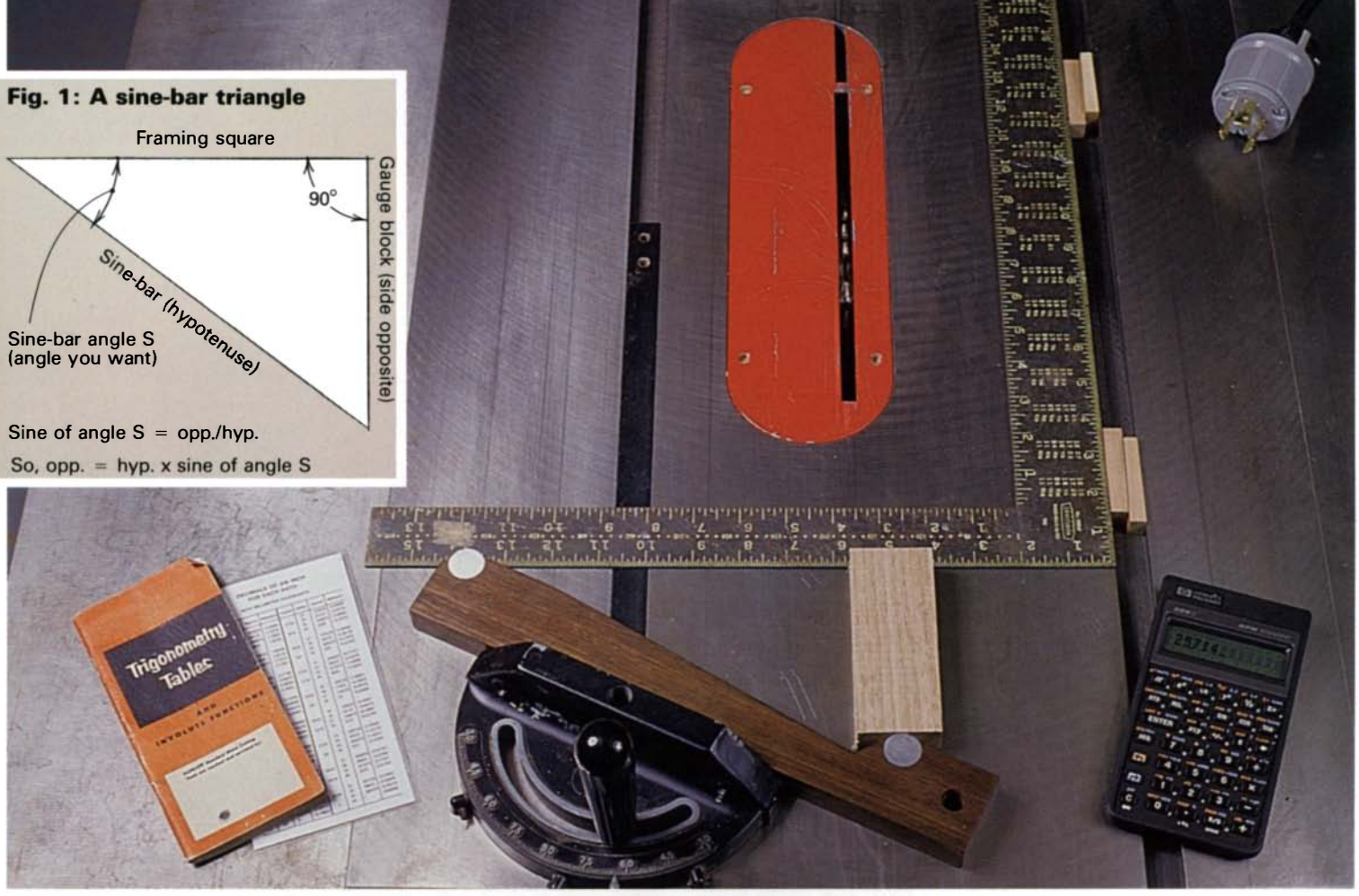
To lay out a leg for a desired grain effect, *Tischler adjusts cross sections on his stock's endgrain (see the two squares dotted on the rectangle at left). By rotating sections within a thick board, he can situate the grain as needed.*

For the cabriole leg at the far right, *Tischler jointed and planed quartersawn cherry stock to orient the growth rings diagonally. The resulting grain patterns are symmetrical and visually pleasing since they flow with the profile.*

Although the patterns in the left leg are symmetrical, *the grain direction produces a totally different look—a bullseye at the knee. When viewed from above, the stock for four legs or posts with this grain orientation would be arranged as shown in the upper right photo on the facing page.*

Asymmetrical grain patterns make the center leg less appealing; *its plainsawn stock was randomly selected (see the endgrain right center).*

Photos: Susan Kahn



***The author's walnut sine-bar provides** an hypotenuse of known length (10 in.) for a right triangle formed by a gauge block and a framing square (aligned with the miter groove). Trigonometry tables reveal how long the gauge block should be to create a given angle.*

Simple Instrument Sets Precise Angles

A shopmade sine-bar and basic math yield accurate miters and bevels

by Tom Rose

Cutting exact angles can be time- and wood-consuming. But I've found by adapting a traditional machinists' method for my home shop, I can establish precise angles on my woodworking machines. Rather than relying on the inexact angular graduations of most miter gauges and protractors, I use a shopmade instrument, called a *sine-bar*, and gauge blocks to set accurate angles on my table- and radial-arm saw. Because a sine-bar solves the dilemma of how to split a degree, I don't have to make multiple trial cuts and adjustments.

What's a sine-bar?

Although the name implies trigonometry, sine-bars needn't be intimidating to non-mathematicians. Using a sine-bar requires only one simple computation and some proficiency at cutting a block of wood to precise length. As shown in the drawing above, a sine-bar represents the hypotenuse of a right triangle while a custom gauge block acts as one of the triangle's legs. All you need to remember is that in any right triangle, the sine of either of the two acute angles is the ratio of the length of the side opposite the angle to the length of the hypotenuse. Since you know the length of the hypotenuse (sine-bar) and the angle you want, it's easy to figure the length of the triangle's "side-opposite" leg (gauge block). To find the block length, simply multiply the sine of the desired angle (obtained from tables or a calculator) by the sine-bar's length. Then, to set the angle (on a miter gauge, for example), just form a

Photo: Alec Waters

right triangle on your tablesaw with the sine-bar, framing square and gauge block, as shown in the photo on the facing page, and set the face of your miter gauge against the sine-bar and lock the angle.

My sine-bar consists of a wooden straight edge (body) and two metal cylinders (anvils). I attach the anvils to the body at exactly 10 in. on centers along a plane that's parallel to the straight edge. The anvil's center-to-center spacing can be any distance, but 10 in. is commonly used to simplify calculations. A 10-in. sine-bar is also a convenient size for setting any angle on a power saw—in any of its cutting planes: mitering, beveling or taper ripping. Because the sine-bar length (10) is a multiplier, once you've obtained an angle's sine value, you can move the decimal point one digit to the right to get the gauge block length. If you're setting an angle that is less than 45°, your gauge block will never be longer than 7.07 in. (sine of 45° x 10), and when setting an angle over 45°, use the angle's complement (90° minus the angle)—again your gauge block won't exceed 7.07 in.

A few prerequisites to using a sine-bar

To use a sine-bar, you'll need a good framing square and a table of sines, like those in the backs of most high school trigonometry text books. (Sine tables are also available for $1.50 from Illinois Tool Works, 3601 Touhi Ave., Lincolnwood, Ill. 60645). Most engineering and scientific calculators will also give you sines. To make gauge blocks and to transfer angles, you'll need a bevel gauge with a 12-in. blade, a set of feeler gauges and a 12-in.-long flexible scale that is graduated in 64ths and 100ths. (I've found 1/64-in.-thick scales can be read more accurately than thicker ones). In addition, a chart of decimal equivalents will help you convert fractions, and a 4x magnifying lens can make reading the scale easier.

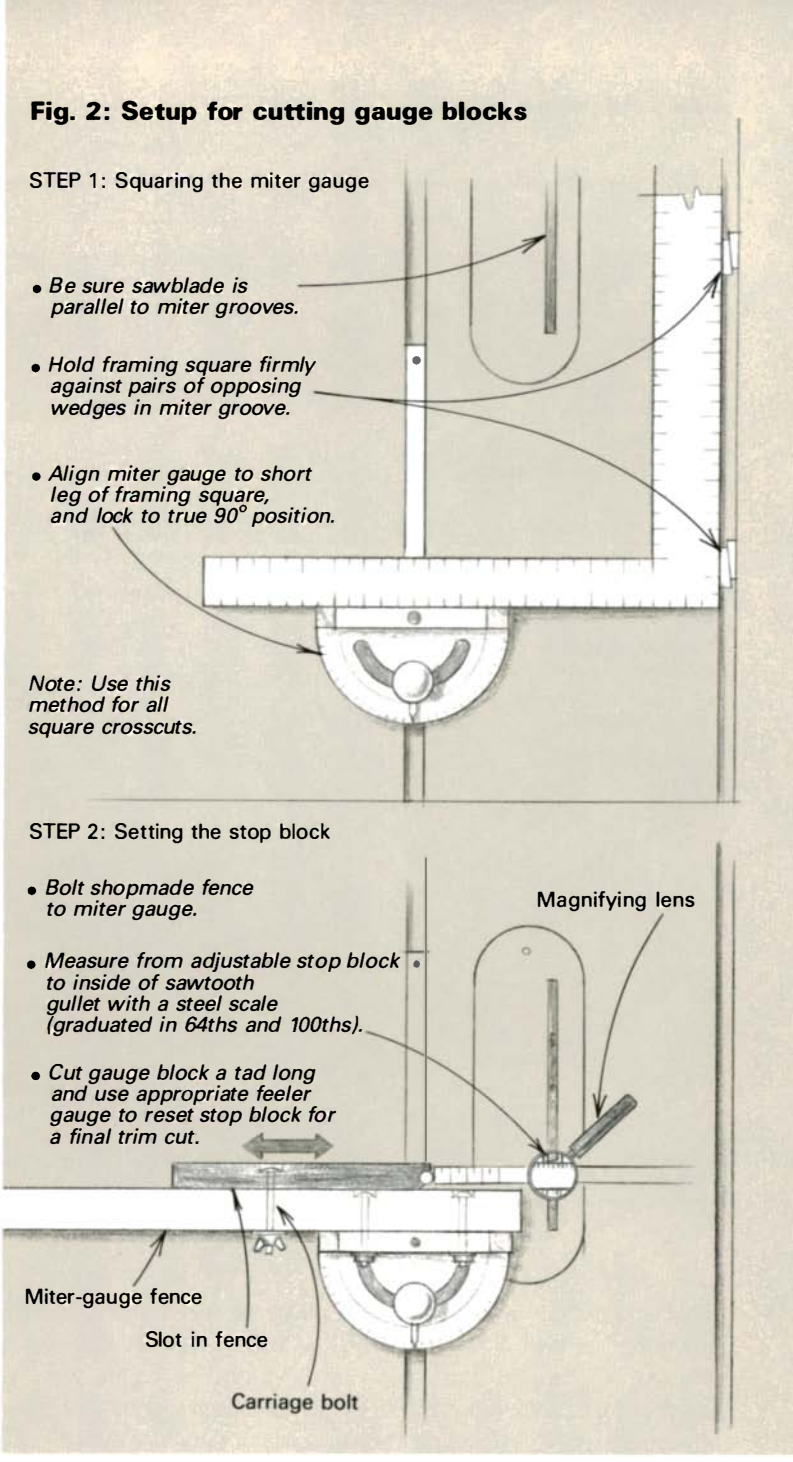
The sine-bar's accuracy is limited by the accuracy of the distance between the anvils, by the exactness of gauge block lengths, and by the condition of your measuring tools as well as the device you're setting. The framing square must be perfectly square, and its two legs must have parallel edges. Although it doesn't matter if your miter gauge's graduations are off, you should inspect the face of the gauge's casting for flatness and squareness to the saw table. (Remove any protrusions with a flat mill file.) Imperfections in your saw also will be reflected in finished cuts, so verify that your machine is tuned and properly adjusted. For example, your tablesaw's table should be flat and its blade set exactly parallel to the miter grooves. If you're using a fence as an angle-setting reference, make sure it is parallel to the miter grooves and blade as well. Because you'll be using a drill press when making a sine-bar, you should square its table to the spindle.

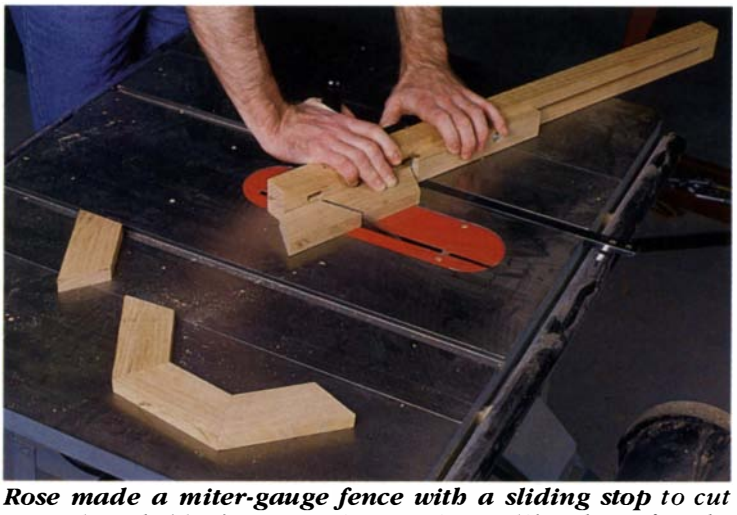
Cutting exact-length gauge blocks

I've found that using a miter-gauge fence with an adjustable stop block is the best way to cut gauge blocks. I borrowed the design for my fence from a friend but modified the stop block to include a cylindrical anvil similar to those used on the sine-bar (see the photo at right). The anvil stop is ideal for mitered surfaces because it will not damage the point on the mitered ends as a typical hinged drop-stop can.

Figure 2 describes how I square the fence to the tablesaw's miter groove and how I set the stop block. I fine-tune block lengths by micro-adjusting the stop either with a dial indicator or with a feeler gauge as follows: I square one end of the block, set the miter-fence stop to 1/32-in. longer than the block length I need and then cut the block's other end. Next, I butt one end of the block against a true vertical surface, carefully measure its length with a scale and magnifying lens, and return the block to the miter fence. I then select a feeler equal to the amount to be trimmed,

Fig. 2: Setup for cutting gauge blocks

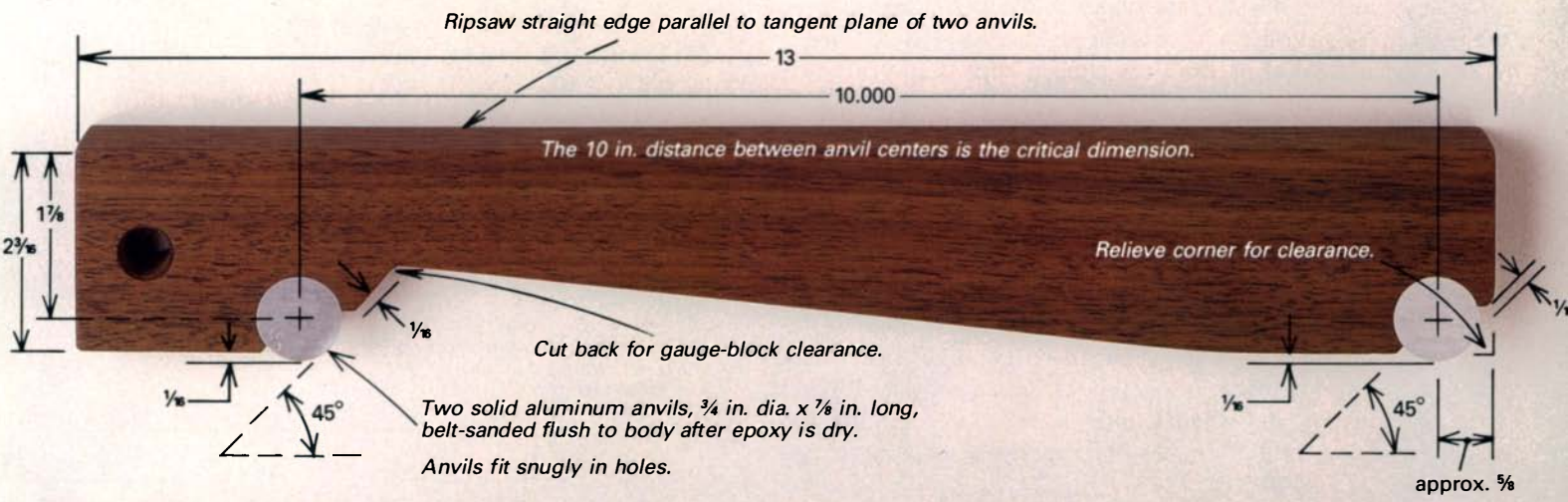




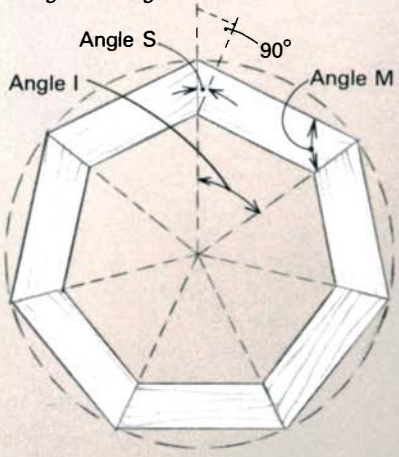
***Rose made a miter-gauge fence with a sliding stop** to cut exact-length blocks and mitered pieces, like those for the seven-sided frame shown in process here. To use the fence, he first sets the miter angle with a sine-bar, and then he sets the stop by measuring between the blade and the stop's anvil.*

Photo: Sandor Nagyszalanczy

Making and using a sine bar



Example of heptagonal frame. See chart at right for angle values.



Angle I (interior angle) is 360° ÷ number of sides. Angle M (workpiece miter) is complement of angle S (sine-bar angle).

Miter angle, sine-bar angle & gauge block length for cutting regular polygon frames

No. of Sides (N)	Interior Angle, I (360 ÷ N)°	Workpiece Miter, M [(180-I) ÷ 2]°	Sine-bar Angle, S # (90-M)°	Sine value, V of Angle S (from tables)	*Length of Gauge Block (Vx10)in. @
3	120.000	30.000	60.000	0.866	8 21/32+
4	90.000	45.000	45.000	0.707	7 5/64-
5	72.000	54.000	36.000	0.588	5 7/8+
6	60.000	60.000	30.000	0.500	5
7	51.429	64.286	25.714	0.434	4 11/32-
8	45.000	67.500	22.500	0.383	3 53/64+
9	40.000	70.000	20.000	0.342	3 27/64-
10	36.000	72.000	18.000	0.309	3 3/32-
11	32.727	73.636	16.364	0.282	2 13/16+
12	30.000	75.000	15.000	0.259	2 19/32-

NOTES:
- This is also the angle to set the miter gauge from a 90° position. To get the sine-bar angle without figuring the interior or workpiece angles, just divide 360° by twice the number of sides in the frame.
* - Based on a 10-in.-long sine-bar.
@ - Fraction to nearest 1/64 in. (+ or -).

place it between the stop and the end of the block and clamp the block to the fence. Last, I remove the feeler, reposition the stop against the clamped block and cut the block to length. Keep in mind that if a block length is off by 1/64 in. (when that block is used to set a sine-bar), the angular error is quite small—only 0.09 of a degree at a 10° angle; only 0.12 of a degree at a 40° angle.

Making a sine-bar

You can make a sine-bar body from any straight-grain, dimensionally stable hardwood. I made the one shown in the photo above from 4/4 walnut. To minimize dimensional changes in my wooden sine-bar bodies, I seal them with oil. I've compared the anvil spacing of several oiled sine-bars against a 10-in.-long steel rod in a workshop environment and found the difference was less than 0.0002 per inch over a range of 30° F. Your anvils can be any diameter, but both must be the same size, and you will need the correct-sized bit to bore their holes in the body. A good anvil material is round bar stock, such as cold-roll steel, or aluminum (I used a piece of ¾-in.-dia. 2024-T351 aluminum alloy rod for the anvils shown here). Pipe can be used as long as it is uniformly round (within 0.003 in.) and its walls are at least 1/16 in. thick. To make hollow anvils more decorative, you can plug them with wood.

The sine-bar blank should be 13/16 in. thick, 2¼ in. wide and 13 in. long and have mutually perpendicular surfaces. To control the critical 10 in. spacing of the anvil holes, make a spacer from a straight stick of hardwood to use with your drill press. Square one end of the stick and then squarely trim its other end so the spacer is exactly 10 in. long. Before boring the anvil holes, place a piece of plywood under the body to prevent chip-out, clamp a 30-in.-long fence to the press table 1⅞ in. behind the center of the spindle, and then clamp a stop block to the fence 12⅜ in. left of the spindle. With a Forstner bit in the chuck and the depth stop set, hold the workpiece against the fence and the stop and bore the first hole. Next, slide the work to the right, clamp the 10-in. spacer between the stop and the left end of the body, and bore the second hole. If you want to hang your sine-bar, bore a ⅜-in.-dia. hole slightly off center in the left end of the body and countersink both sides of the hole. Finally, mark out the anvil-edge profile (see the photo above) onto a side of the body. Bandsaw to your lines and sand the shape smooth.

Hacksaw two ⅞-in.-long anvils, deburr their edges and square the ends on a disc sander. To grip the anvils when sanding them, I bore a ¾-in.-dia. hole through a small scrap of 1x3, make a kerf through the hole, and clamp the anvil by driving a #8 wood screw across the kerf. Before epoxying the anvils into the body holes, clean the anvils with a degreasing solvent. Five-minute epoxy will adhere tenaciously to smooth surfaces, so you don't have to rough up the anvils. If you're using aluminum, though, sand off the anodizing. Blow the dust out of the body holes, and then sparingly spread epoxy inside each. Insert the anvils and twist them around

Photo: Susan Kahn; drawings: staff

to coat their sides before positioning them so they overhang evenly from the holes. Wipe off excess epoxy and set the assembly aside for about a half hour. When the epoxy is cured, beltsand both sides of the bar, so the anvils are flush to the body. Next, clamp a straight extension fence on your tablesaw's rip fence, so you can guide the anvils against it (completely past the blade) while ripping a skin-cut off the long edge of the sine-bar. This cut ensures that the bar's straight edge is parallel to the anvils' contact plane. Finally, finish-sand the body's surfaces, and apply several coats of your favorite oil finish.

Precision mitering with the sine-bar

A sine-bar easily accommodates odd angles, such as the miters for a heptagonal (seven-sided) frame. The chart on the facing page shows workpiece angles, miter-gauge angles, sines and gauge block lengths for 3-sided to 12-sided polygon frames. You can make blocks for the miter angles you commonly cut, label what each is for and seal them with a clear finish. You won't have to look up those angles or crank through their calculations again. To obtain the gauge block length for an unlisted angle, first find your miter angle (the angle to rotate the miter gauge from the 90° position) by dividing 360° by twice the number of sides in your polygon. For the heptagon frame illustrated next to the chart, 360 divided by 14 equals 25.7143°. If you're obtaining sine values from tables, first convert the 0.7143° into minutes by multiplying by 60 and rounding off to 43'. Then look up the sine of 25°-43'—you'll get 0.4339. The gauge block's length is simply 0.4339 x 10, which equals 4.339 (0.005 in. less than $4\frac{11}{32}$ in.) If you're using a calculator, divide 360° by twice the number of sides to get the miter angle; then punch the sine key and multiply that value by 10. Next, prepare seven blanks for the frame, attach the miter fence and set the gauge's angle with the sine-bar and gauge block. Then set the adjustable stop, and cut the miter on one end of each piece. Reset the stop to miter the pieces to proper length, as shown in the photo on p. 61.

Setting bevels with the sine-bar

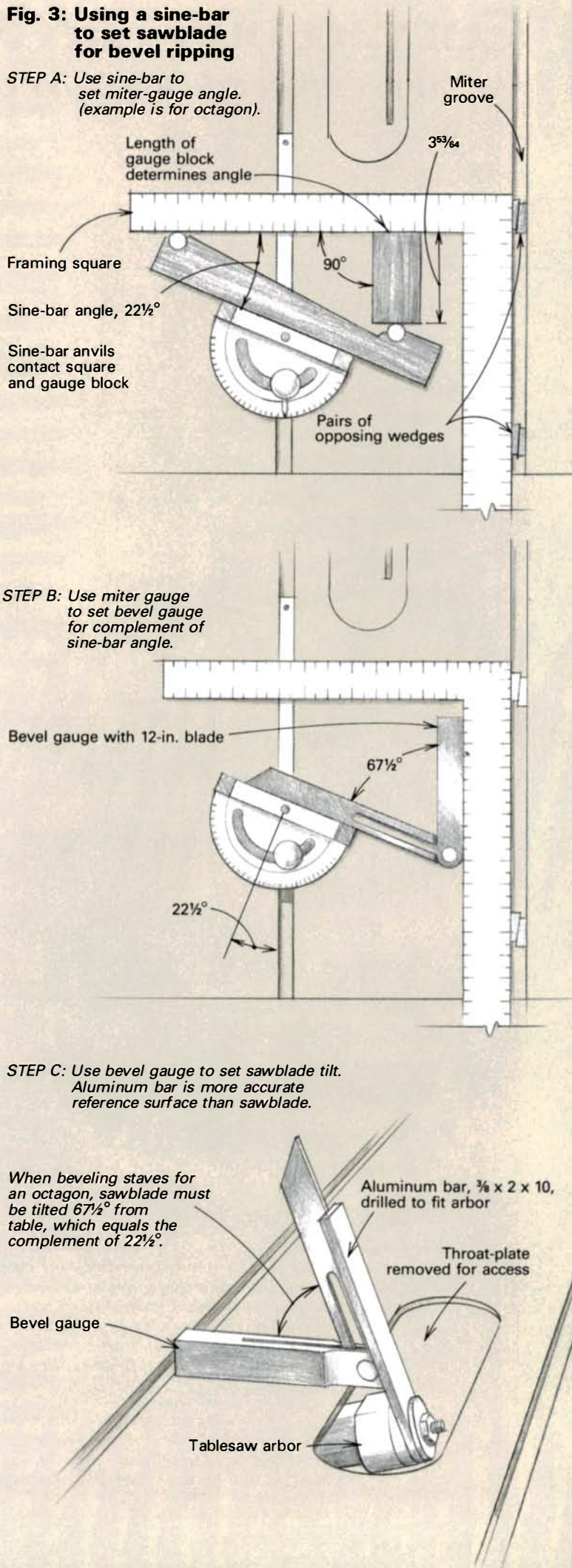
You can set the tilt angle of a tablesaw blade using a bevel gauge that's been calibrated with a sine-bar (see figure 3 at right). To ensure accuracy, use a rigid metal bar in lieu of the blade. I use a 2-in. by 10-in. flat of ⅜-in.-thick aluminum with a ⅝-in.-dia. clearance hole that loosely fits my saw's arbor. Like the miters in polygon frames, the bevels in stave construction are critical because angular error is cumulative. When ripping staves for an octagonal drum, for example, I make sure the blade's angle is exactly 67½° to the table. To do this, I set my miter gauge to 22½° using a sine-bar, a framing square and a $3\frac{53}{64}$-in.-long gauge block (sine of 22½° x 10). I then use the miter gauge to set a bevel gauge to the complementary angle of 67½°, as shown in step B in figure 3.

Sine-bars for ripping tapers and drilling angled holes

I built a fence-guided taper-ripping jig, which has an integral sine-bar. The bar hinges with a straight edge that slides along my rip fence. I also built a 10-in. sine-plate for boring angled holes with my drill press. The sine-plate is a hinged ramp made from two 12 in. sq. pieces of plywood. The top plate (hypotenuse) tilts to form a triangle with the bottom plate, which I clamp to the press table. The device works like a sine-bar: the upper plate has two rods that are 10 in. apart; the lower rod serves as a hinge, the upper as an anvil. To complete the triangle, I insert a gauge block for the angle I need between the upper anvil and the lower plate. □

Tom Rose, a retired project engineer for Hughes Aircraft, enjoys woodworking in his Los Angeles, Calif., shop.

Fig. 3: Using a sine-bar to set sawblade for bevel ripping

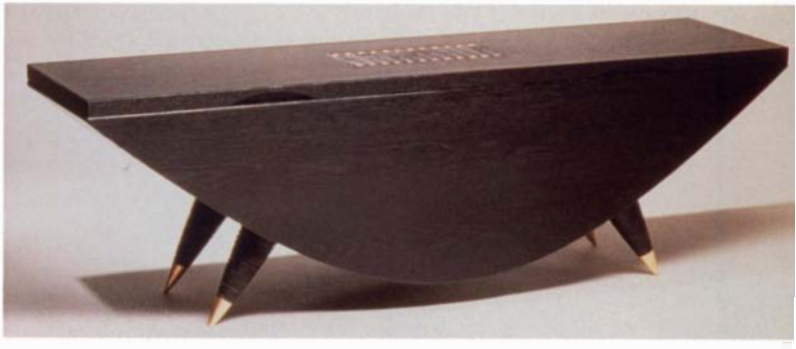


Curvaceous Carcase Construction

Slats dress up bendable-plywood sides

by John Eric Byers

Thelma and Louise ***(above left and right)*** *owe their shapely figures to the author's method for building curved-sided carcases. Byers applies layers of bending plywood over an inner plywood structure; then he covers the curved sides with decorative slats.*



Byers' bending-plywood carcase construction *lends itself to a wide range of furniture, including* Temptation Chest, *the ebonized-oak blanket chest shown at right.*

Photos this page: Thomas Brummett; drawing: Vince Babak

Turned, curvy forms have always influenced my work. My first lathe-turned-wood forms emulated fine glass and ceramic vessels. However, I found turning to be too limiting in terms of the kinds of objects I wanted to create, so I attended the Wendell Castle School to learn furnituremaking. After leaving school, I developed a construction technique to produce curved forms on a large scale. Pieces like *Thelma and Louise,* the two chests of drawers shown on the facing page, allow me to create functional furniture with voluptuous curves that invite interaction and have a strong physical, even anthropomorphic presence. I like to think that when I hear a noise downstairs at night, it might be one of my furniture pieces dancing around.

Besides allowing me to create the kinds of pieces I like, my curved carcase construction, as illustrated in the drawing, is really quite simple: An internal frame of plywood dividers provides housings for drawers and an armature for two layers of bending plywood, which make up the curved sides. After I add a plywood back and laminated strips on the curved edges, I dress up the bent sides with tambour-like slats. Finally, I build standard, box-like drawers with solid-wood drawer fronts with their ends sawn to match the curvature of the piece. This way, the drawers don't have to be made to fit curved, irregular spaces. Usually, the width of the drawer varies to suit the space between the curves, but these standard, box-like drawers are as easy and quick to make for any standard, rectangular carcase.

My construction method is very flexible, so I can create many different types of curved-sided furniture pieces besides chests of drawers, such as small cabinets, night tables and the blanket chest shown in the bottom photo on the facing page. These pieces employ some variations, such as hinged doors on one of my cabinets and the solid-wood front, back and lift-up lid on the blanket chest.

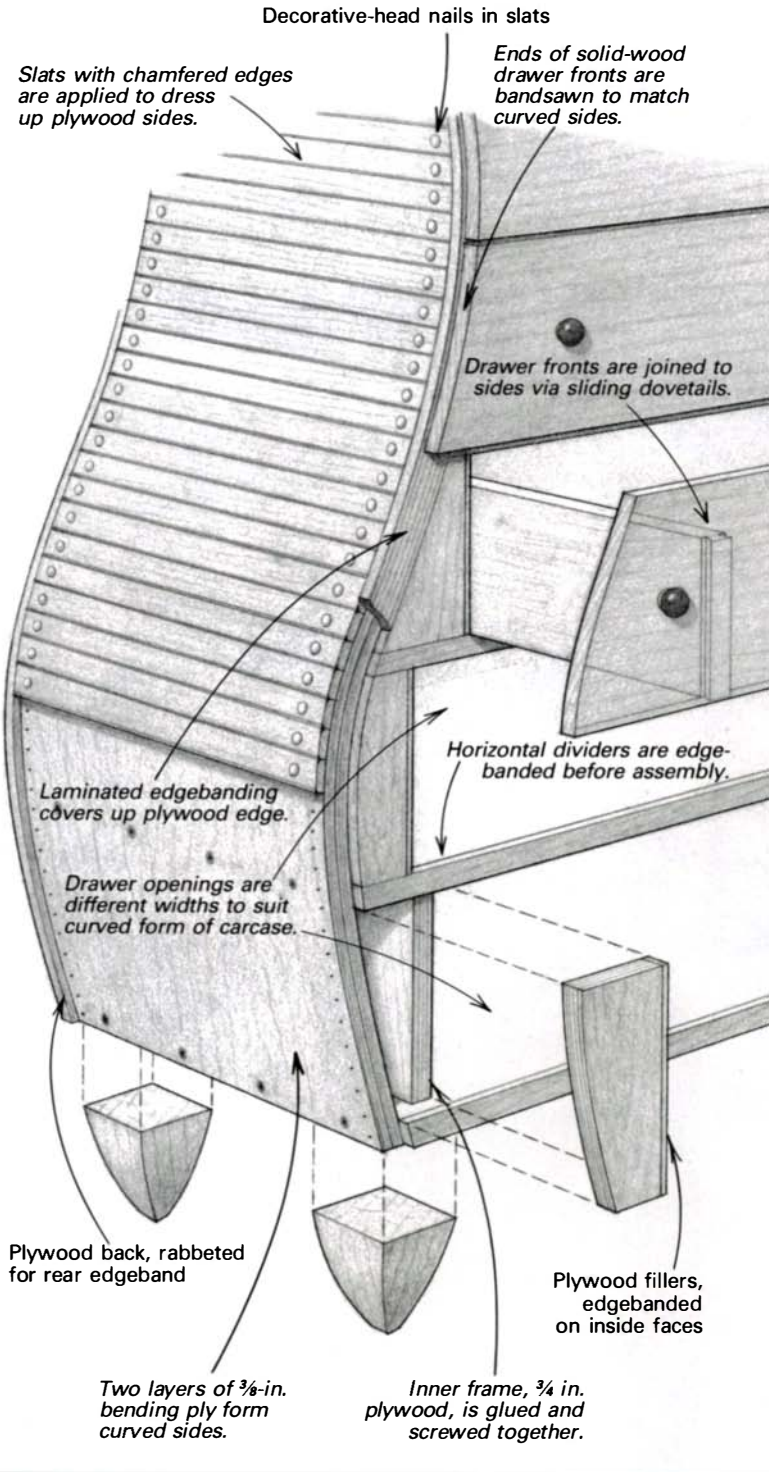
Designing a curvy carcase

I view the design of my furniture pieces as basically a subtractive process; I draw a square and "carve" away the negative space until I end up with a form that looks right. I start with gesture drawing, small thumbnail sketches that allow me to try out different ideas on paper. Then I turn a promising sketch into a full-scale elevation on a sheet of ⅛-in. door-skin plywood. With symmetrical carcases, I refine the curve on one half of the elevation, cut out this half profile and use it as a template to draw both halves of the case. This full-size drawing helps me visualize the final form of the piece. I draw the position of all plywood dividers that will separate and contain the drawers and work out the scheme of how tall and wide the drawers will be in the irregular spaces as I go along. Because each irregularly shaped drawer front will attach to a standard drawer, I can make the drawers different dimensions to keep things interesting and still end up with drawers that are standard construction.

The ends of the inner frame's horizontal dividers (the equivalent of dust panels) provide points of attachment for the plywood skin that will be bent over them. Therefore, I miter these ends, as well as the ends of the top and bottom panels, to best contact the curved plywood. I measure these angles directly from the full-size drawing with a bevel gauge. After cutting out and mitering the panels, I apply a ⅜-in.-thick edgeband to the front of each and sand the surfaces. Next, I cut the vertical dividers to create the rectangular boxes that contain the drawers. Then I glue and screw (sometimes I use biscuit joinery instead) the panels together to assemble the inner frame.

To make the surface of the curved sides, I apply the ⅜-in. bending plywood, which consists of three plys; two thicker outside plys with their grain running parallel and a thinner inside ply that runs perpendicular to the other two. Two layers of this flexible plywood, which is sold by lumber dealers under many names including "wacky wood," are bent onto each carcase side. After cutting two pieces to size for each carcase side, I simply bend the first layer directly over the horizontal dividers and screw it into their ends. As I work around the carcase side, I adjust the curvature of the bending plywood before screwing it to each divider to get a smooth curve and avoid flat spots. A second layer of bending ply is glued on over the first layer, initially held with spring-action clamps and then screwed and nailed in place. Pneumatically driven ¾-in. or ⅝-in.-long brads, liberally applied over the surface (as shown in the top photo on the following page), ensure that the two plywood layers will glue tightly together without voids, mak-

Curved carcase construction



The author glues and nails a second layer *of thin bending plywood over the first, which was screwed to the end of each divider as the ply was bent into place. Byers uses spring clamps temporarily to keep the ply in place while a pneumatic nail gun drives dozens of brads to secure the layer.*

Solid-wood edgebanding *that's laminated together from thin strips covers the edges of the bent-plywood carcase. The carcase itself acts as the bending form, and spring clamps hold the glued laminae in place.*

Chamfered slats, *glued and nailed over bent sides, provide a decorative covering for the carcase. A strip of scrap plastic laminate acts as a spacer to allow room for solid-wood slats to expand and contract.*

ing the curved sides strong. For very tight curved sides, I apply a few curved plywood ribs between dividers on the inner carcase to help fair out the tight bend.

Laminated edgebanding

After the sides are glued, screwed and nailed on, I use a rabbet plane to trim both front and back edges of the plywood in preparation for an edgeband that finishes off these sides. Many 1/16-in.-thick strips of hardwood laminated together comprise this band. On the front of the piece, this strip is formed directly to the front edge of the carcase. I use enough strips to make the edgeband about 1⅛ wide. This thickness equals two bending plys (¾ in.) plus ⅜ in., which is the thickness of the slats that will cover the sides. A few scraps of plywood temporarily nailed to the inside surfaces of the bent sides provide the form for the edgeband as it's clamped in place with spring-action clamps (as shown in the center photo). Tape masks the edge of the side, so the strip won't stick to it as the laminae are glued together. After the laminated strip dries, I scrape off the excess adhesive and glue it in place on the edge after removing the tape.

At the rear of the carcase, a ½-in. plywood back is cut out and glued and screwed onto the inner frame and curved sides. The back is flush trimmed all around, and the curved edges are rabbeted about ⅜ in. deep and 1⅛ in. wide. A rear edgeband is then laminated and glued into this rabbet—same as the front edgeband.

Gluing on the slats

The individual slats that cover up the bending ply and dress up the curved carcase sides are machined and applied next. After they're thickness planed to ⅜ in. thick and ripped to 1½ in. wide, I chamfer all the edges and ends on one side of each slat with a 45° bit in my router. Then I apply the slats, gluing them on with yellow glue and using spring clamps to anchor them while the glue dries. In cases where the carcase will be painted, I nail the slats on with the brad gun and fill the holes with putty. The brad holes are also covered by decorative-head nails. To ensure that the solid-wood slats have room to expand and contract, I leave a slight gap between adjacent slats. I set the gap by using a scrap of plastic countertop laminate as a spacer (see the bottom photo on this page). Once all the slats have been mounted, I drive two decorative-head nails into each slat. I do this as much for the dressy effect as for strength. The nails I use most often are made of copper and several styles are available from Faering Design Inc., Route 1, PO Box 223, Sutton's Bay, Mich. 49682; (616) 271-6729. To complete the casework, I cut and edgeband the plywood fillers to fit the irregular spaces between the drawer housings and the curved sides and glue and screw them in place. Also, I veneer the plywood top.

I build the drawers with solid-wood sides and ¼ in. plywood bottoms. Using standard construction, I join the sides to the back with through-dovetails. A groove near the bottom edge of the sides and back houses the drawer bottom. The drawer faces are ripped to width from solid-wood stock, and the ends are bandsawn to match the side curvatures. I attach the fronts to the drawer sides with sliding dovetails made with the router.

Sometimes a case's design creates built-in feet for the piece, but I often add shaped or turned feet, as on my blanket chest, or bandsawn feet, as I used on *Thelma and Louise* (see the photos on p. 64). I use a variety of finishes, including clear lacquer and pickled finishes, but most often I finish my work with milk paints. The colorful finish further enhances the animated quality of my pieces. □

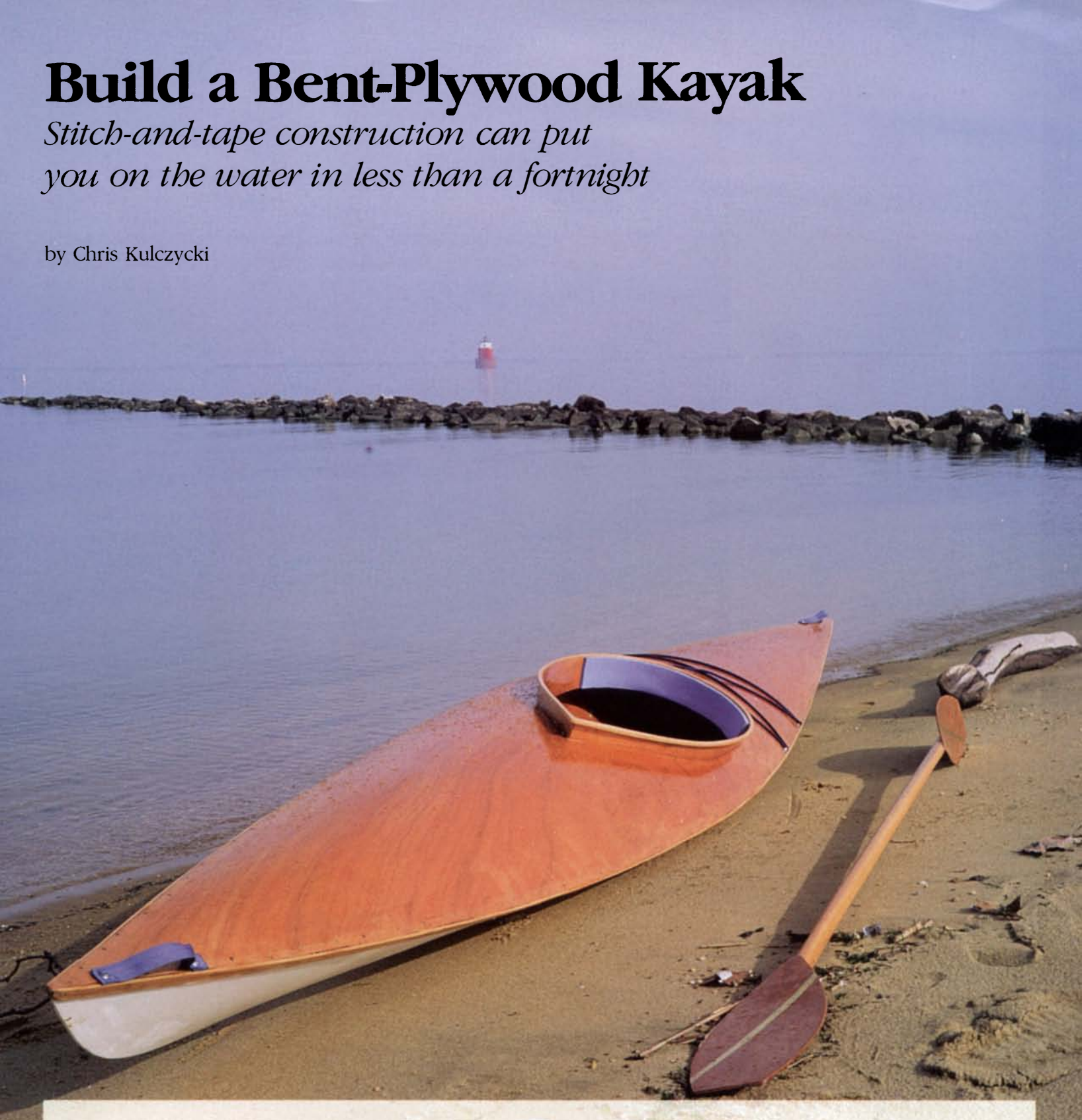
John Eric Byers is a furniture designer/craftsman who works in Philadelphia, Pa.

Photos this page: Sandor Nagyszalanczy

Build a Bent-Plywood Kayak

Stitch-and-tape construction can put you on the water in less than a fortnight

by Chris Kulczycki



Building a boat is something many woodworkers have thought about but often dismiss. It takes too much time, money and specialized skills to build a boat, right? Not necessarily. With the technique I describe, you'll be able to build the sleek, handsome kayak shown above for less than $200, in less than two weeks and with little more than a jigsaw, block plane, hand drill and a pair of pliers.

In the early 1960s, a technique known variously as compounded plywood, stressed plywood, developed plywood, and, most descriptively, tortured plywood was developed for building multi-hull sailboats. Soon thereafter, an Englishman named Dennis Davis developed several kayaks using this method; all of today's compounded-plywood kayak designs are based on Davis' early work.

Compounded-plywood construction consists of taking a two-dimensional sheet and forming it into a three-dimensional shape with compound curves by bending it in two planes simultaneously. On my boat, this is done by stitching together pieces of thin plywood to form halves of the hull. Wood screws, staples and copper wire ties are all used to hold pieces in place while epoxied joints cure. As the piece is stitched up along the keel line (see the glossary on p. 71 for

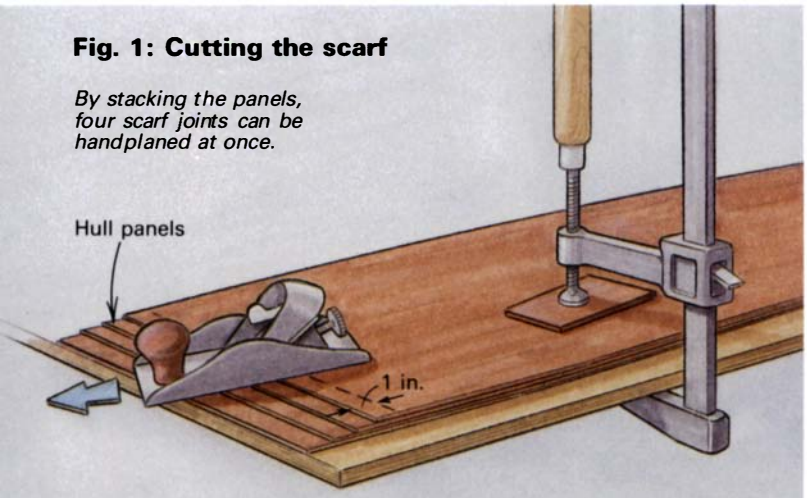


Fig. 1: Cutting the scarf

By stacking the panels, four scarf joints can be handplaned at once.

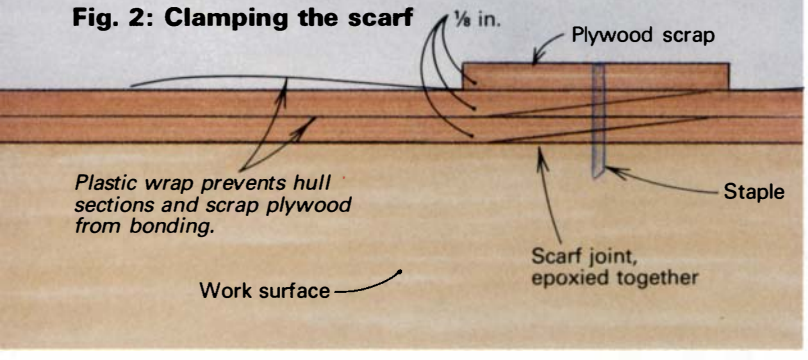


Fig. 2: Clamping the scarf

Plastic wrap prevents hull sections and scrap plywood from bonding.

definitions of this and other boatbuilding terms), the plywood begins to rise off the work surface, forming a compound curve. A form or frames can be used to help develop the final shape or, as in this kayak, the plywood simply can be held in shape by the deck and deck beams. This type of hull, in which the skin is the primary stressed member, is called a monocoque structure. It results in a rigid, very light boat (about 25 lbs. for this model). This kayak is designed for use on ponds, lakes and slow-moving rivers and streams. As light as it is, it's quite fast on the water. It's also easy to transport, load and unload and can be stored by hanging it from the garage or shop rafters.

Materials: Marine plywood and expoxy resin

Plywood can be bent nearly to its breaking point when building compounded-plywood boats, so it must be of very high quality. Plywood containing voids will not bend evenly and could very possibly crack at the void. The best marine plywoods are from European manufacturers, such as Bruynzeel, Lydney and Shelman; they are expensive–as much as $60 for a 3mm sheet–but their quality is remarkable and you only need two sheets for this kayak. I buy my plywood from Harbor Sails, 1401 Russell St., Baltimore, Md. 21230 (they ship throughout the country). Marine plywood is also available at many large commercial lumberyards.

The thickness of the plywood used is important in creating the desired hull shape. If it's too thin, it will not bend into a smooth curve; if it's too thick, it will break before reaching the intended shape. Generally, the thickest plywood that can be bent to shape produces the best results. I prefer okoumé (a type of mahogany) marine plywood because it's light, easy to work, bends smoothly and takes epoxy well. For this kayak, 3mm okoumé marine plywood is ideal, but, if you can't justify the expense, 3mm okoumé bending panels (an exterior-grade panel) will work nearly as well. Bending panels are virtually indistinguishable from marine plywood and cost between a third and a half as much. The sheer clamps, deck beams and carlins are made from clear straight-grain spruce or fir.

Epoxy-resin adhesive makes the construction of this boat possible. It is used in several capacities here. Unthickened it's used to bond fiberglass tape (along the exterior seam of the hull) and as a strengthening and waterproofing agent in a process known as epoxy saturation. This process involves coating the hull with the epoxy resin, usually both inside and out, rendering the boat absolutely watertight. This prevents rot and delamination and adds strength to the hull by filling the grain that's opened from the plywood's being contorted into shape. The epoxy also soaks deep into porous woods–such as okoumé–leaving a tough, protective exterior skin and a smooth base for a varnish finish.

The expoxy resin is thickened with chopped cotton or silica fibers to slow the epoxy's flow and to increase its strength when used as an adhesive or a gap filler. I prefer the cotton fibers, so that's what I've used on this boat. You should be able to find epoxy and epoxy thickeners at marine-supply stores. About 2 quarts are needed for this boat.

Making the hull panels

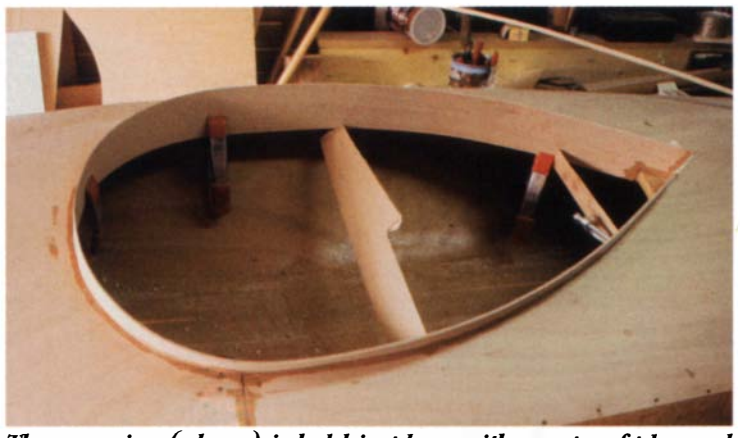
I cut the hull panels in pairs to ensure that they're identical, so the hull will be symmetrical. I lay out the panels on half of the plywood sheet; then, holding a wooden batten against brads driven at the measurement points (see the hull-panel layout on p. 71), I draw the curved lines. Next, I cut the sheet in half lengthwise, stack the halves and cut out the hull panels together. I always cut the panels a bit proud and trim to the layout lines with a block plane.

Bow and stern panels are joined with an 8:1 scarf to make the two full-length hull panels. With 3mm plywood–about ⅛ in. thick–the scarfs are 1 in. wide. I mark my scarf line on each panel and then stack all four panels with the midships' edge of each on the scarf line of the panel below (see figure 1). The scarves should be planed on the insides of the bow panels and on the outsides of the stern panels. The bottom panel is just flush with the edge of my work surface. I plane a ramp from the top line to the edge of the bottom panel. The individual plys will appear as bands as you plane. By keeping the bands parallel and of consistent width, you can cut a flat scarf surface that will result in a clean joint.

There are basically two ways of clamping the scarf joint: You can use pressure (weight or clamps), or you can tack it. I prefer to tack the joint. I position the two pieces I'm joining at the scarf as best I can; then I check their alignment by running a string line along the bottom edge of the panels. When the string just touches at the scarf, the tips of the bow and stern should be exactly 9 in. from the string line. Once the joint is lined up, I clamp the panels to the workbench, far enough back from the joint so that I can apply the epoxy. I smear epoxy (thickened with chopped cotton fibers) onto both sides of the joint and cover it with plastic wrap. Then I lay the second set of panels on the first and again cover the joint with plastic wrap and a strip of scrap plywood. I staple every couple of inches along the joint, right through the joints into the bench or a piece of scrapwood below (see figure 2). I then tap each staple with a hammer to ensure even clamping pressure. When the epoxy has cured, the scrap plywood can be pulled up along with most of the staples. I fill the tiny holes left by the staples with a mixture of epoxy and sawdust.

The last step before joining the two hull halves is to glue on the sheer clamps. The sheer clamps–full-length ¾-in. square strips of spruce or fir–are glued to the top inside edge of the hull to stiffen it and to provide a gluing surface for the deck. I lay the hull panels back to back (outside faces of the boat facing each other) and then position the sheer clamps in as fair a curve as possible. I glue and clamp both sheer clamps into place at once, trying to produce

***Once the epoxy that holds the sheer clamps to the hull** has set, small holes are drilled all along the keel line 4 in. apart and ¼ in. from the edge. Then the center portion of the two halves of the hull are sewn together with copper wire.*



***The coaming (above) is held in place with scraps of plywood** until the epoxy cures. Then thin strips of ash are bent around the top of the plywood to provide a lip on which to mount a spray skirt.*

***After the epoxy on the inside seam has dried,** the hull is flipped over. A single length of epoxy-soaked fiberglass tape strengthens and seals the center of the keel, and then the bow and stern sections can be stitched to complete the hull joint (below left).*

***Epoxy holds the carlins to the deck beams** and the deck beams to the sheer clamps (below right). Stainless-steel screws provide clamping pressure and can be left in or removed. Once the sheer clamps and carlins have been planed so their top surfaces match the radii of the deck beams, the deck can be scribed to the hull.*

mirror images from one side of the boat to the other. Any plywood that's extending above the sheer clamps can be trimmed off later.

Joining the hull

The two hull panels are temporarily held together with short twists of copper wire and then joined permanently with epoxy-saturated fiberglass tape. Taped joints are strong, light and waterproof and, when carefully laid, the epoxy-saturated tape becomes quite clear, leaving a joint that's all but invisible.

I drill 1/16-in.-dia. holes every 4 in., ¼ in. from the edge of the hull's center seam and stitch the panels together for 42 in. on each side of the scarf (see the photo above). The wire should be twisted on the outside of the hull and flattened against the seam inside. As the hull is stitched, I raise and support the bow and stern to keep the hull close to flat across the boat (athwartships). In boatbuilding, more than other crafts, fair curves are essential, both aesthetically and for reasons of fluid dynamics. Any bumps or hollows created on the flat will be greatly magnified when the boat is rolled up.

I begin taping the panels by spreading a bead of thickened epoxy so that it just covers the wires inside the boat. I lay a 90 in. length of 3-in.-wide fiberglass tape over the joint and wet the tape with unthickened epoxy resin. This process is repeated twice more, each length of tape a few inches shorter than the previous one, to avoid creating stress points. I work the epoxy into the tape with a disposable brush to eliminate any air bubbles or dry spots.

Once the epoxy inside the hull has cured, the boat can be (carefully) flipped over. I cut off the wire ties flush with the outside of the boat, sand off any epoxy that has dripped through the joint and apply a single layer of tape and epoxy to the center 7½ ft. of the hull. To keep the tape clear, only unthickened epoxy should be used on the outside of the hull (see the photo at left above).

I begin stitching the bow and stern sections of the boat together; when the sheer clamps touch, I cut bevels on each with a handsaw and then plane the bevels, so they'll meet neatly. A bead of thickened epoxy and two layers of tape complete the joint on the inside of the bow and stern sections of the hull. This new tape overlaps the tape applied earlier by a few inches; the new tape should be soaked as before with unthickened epoxy and brushed out to eliminate any bubbles or dry spots. Running a single layer of tape the full length of the outside hull and epoxying it finishes joining the hull.

Fitting the deck

Two deck beams hold the hull at the proper width (or beam), add rigidity around the cockpit and hold the deck at the proper arch. I

laminated my deck beams from three strips of 1-in. by ¼-in. spruce using a simple arc-shaped laminating jig and a few C-clamps. The radius of the aft-deck beam is 25 in., and the forward-deck beam's radius is 18 in. The tighter radius creates a higher arc, which provides more knee room.

To install the deck beams, I use either a pipe clamp or string to hold the hull at 26½ in. (outside dimension at the scarf). I bevel the ends of the deck beams, so they'll fit neatly at 16 in. from the scarf, fore and aft. I then epoxy the deck beams to the sheer clamps, using 1½-in.-long #8 stainless-steel screws to hold the deck beams in place until the epoxy cures. The screws may be left in or removed, as desired.

The two carlins (see the drawing) provide a gluing surface for the deck and the cockpit coaming, and they stiffen the cockpit area. I glue and screw the carlins to the deck beams so that the carlins' sides are vertical, and then I plane their tops and the tops of the sheer clamps to match the radius of the deck beams, as shown in the bottom right photo on p. 69.

I transfer the shape of the deck to the second sheet of plywood by holding it on top of the hull and tracing the hull's shape onto it. The deck is cut about an inch oversized and then trimmed later after fastening. Notice that the two deck sections meet at the widest part of the cockpit, not at the hull's scarf.

I coat the underside of the deck and the inside of the hull with unthickened epoxy just before installing the deck. I use thickened epoxy to glue the deck to the carlins, deck beams and sheer clamps. To avoid the hassle of having to clamp the whole arrangement, I tack ¾-in. bronze ring-shank nails every 3 in. along the sheer clamp. The bronze nails also provide a nice traditional touch. I lay out and cut the cockpit opening next and then reinforce the butt joint between the two deck halves with fiberglass tape epoxied to the underside.

The coaming, seat and trim

The coaming helps to keep the paddler dry by preventing water from sloshing into the cockpit. Its lip can also hold a spray skirt, a welcome feature in rough water. The coaming is formed with a 3¼-in. band of plywood glued to the carlins, deck beams and deck (see the top photo on p. 69). In addition to epoxying between the coaming and the deck beams and carlins, I also add a fillet, or bead, of thickened epoxy under the deck to strengthen the coaming-to-deck joint. I glue two thin strips of ash or another easily bent wood to the top of the coaming to form the lip. (See the drawing on the facing page for coaming details.)

The plywood seat rests on two cleats, so any bilge water can wash under it. The seat and cleats are both saturated with unthickened epoxy before they're installed. I glue the cleats to the hull and the seat to the cleats. Adjustable foot braces are available at kayak shops, and I've used them, but a simple wooden block glued in place will suffice. Positioning of the foot brace will vary according to the height of the paddler. I trim the boat with a ¾-in. by ¼-in. ash rub rail to protect the gunwale and to hide the deck-to-hull joint. I epoxy it on and tack it with ¾-in. brass escutcheon pins.

Finishing with varnish or paint

I saturate the outside of the hull with epoxy, applying it with a foam roller—it's difficult to get a smooth epoxy finish with a brush. If you take your time and use a foam roller, sanding should take less than an hour. Unfinished epoxy is not a sufficient finish, though, in spite of its being waterproof. Left unprotected, it will react to ultraviolet (UV) light, turning milky and unattractive; therefore, it must be covered with varnish or paint. Marine varnish contains UV filters, is long lasting and is fairly abrasion-resistant. I varnish the inside of the boat as far as I can reach into it. I stick with established marine brands such as Z-Spar, Woolsey, Interlux and Epifanes. Z-Spar's Captain's Varnish is particularly easy to apply over epoxy.

If the kayak is going to see many rocky beaches, though, painting the bottom with marine enamel might be a better idea. Enamel's greater degree of resistance to abrasion will reduce maintenance substantially. Whether you paint or varnish, it's necessary to wash the boat with soap and water before proceeding because the epoxy releases a soap-like film as it cures that will prevent varnish or paint from drying. After the varnish or paint has dried, I screw nylon-webbing grab handles to both ends of the deck, grab the kayak and head for the nearest body of water. □

Chris Kulczycki is a boatbuilder and freelance writer living in Arlington, Va. Plans and kits for this and other compounded-plywood kayaks are available from the author's company, Chesapeake Light Craft, 34 S. Pershing Drive, Arlington, Va. 22204. For Dennis Davis' plans, contact him at 9 Great Burrow Rise, Northam, Bideford, Devon EX39 1TB, England.

Further reading

The Gougeon Brothers on Boat Construction **by the Gougeon Brothers, Gougeon Bros., Inc., PO Box 908, Bay City, MI 48707.**

Sea Kayaking: A Manual for Long-Distance Touring **by John Dowd, University of Washington Press; 1988.**

Sea Kayaker **(a quarterly magazine), 6327 Seaview Ave. N.W., Seattle, WA 98107.**

Fig. 2: Touring kayak

Photos: author; drawings: Bob La Pointe

Glossary

Beam - The vessel's width.

Bilge - The lowest portion of the inside of the hull.

Bow - Extreme forward end of the boat.

Carlin - A beam running fore and aft that supports the deck.

Coaming - A raised lip around the cockpit designed to deflect water.

Deck - A rigid covering that prevents water from entering the boat.

Deck beam - A structural member running across a boat's width to support the deck.

Fair - Smooth, lacking bumps or hollows.

Gunwale - The upper edge of the boat's sides.

Hull - Outer shell of a boat.

Keel line - The lowest continuous longitudinal centerline of a boat.

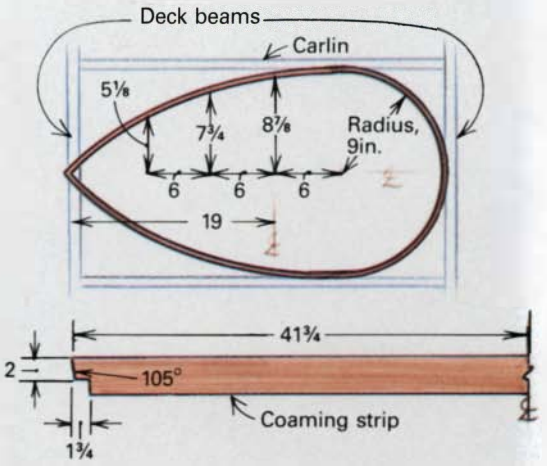
Midships - The central portion of a vessel.

Rub rail - A strip of wood near the hull-to-deck joint designed to protect the hull.

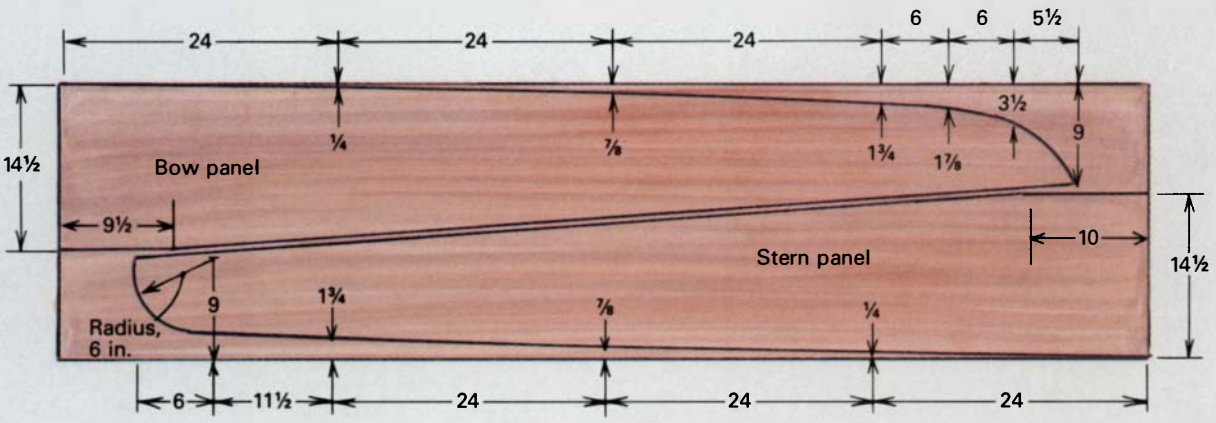
Sheer clamp - A wooden member to which the hull and deck are fastened.

Stern - Extreme back or aft end of the boat.

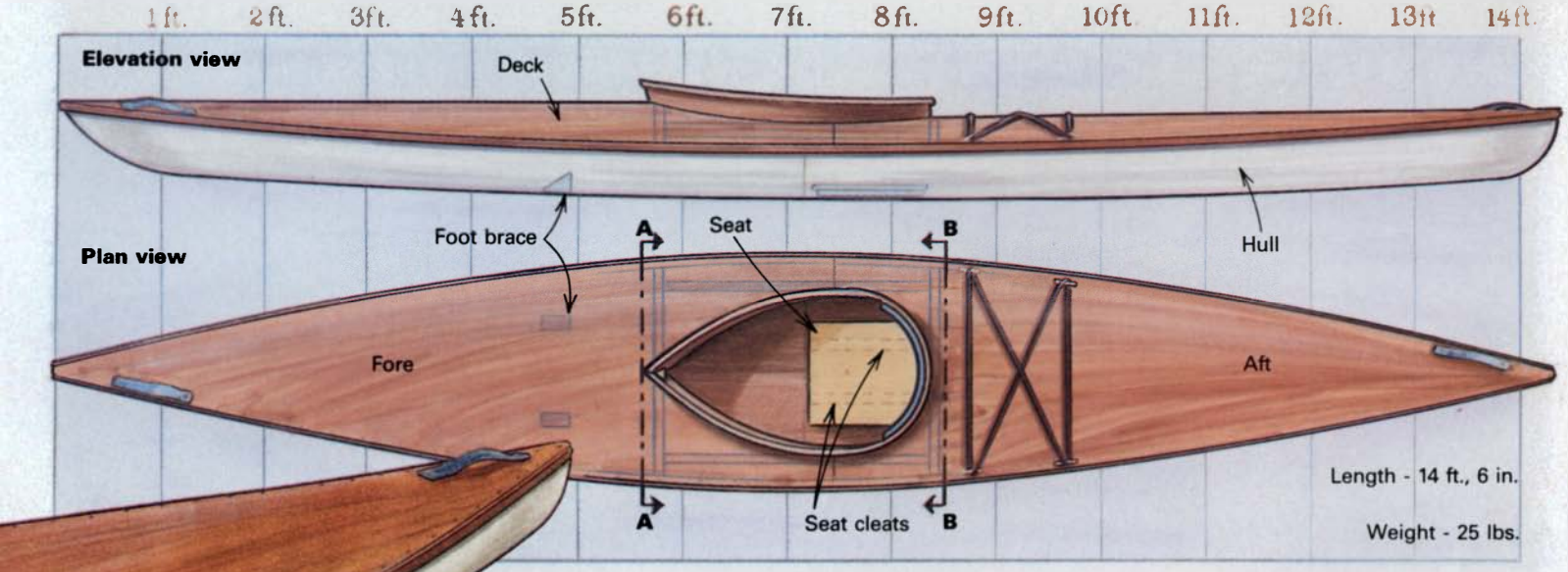
Coaming detail



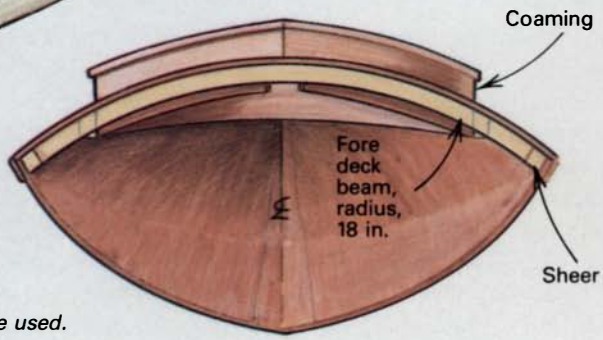
Hull panel layout



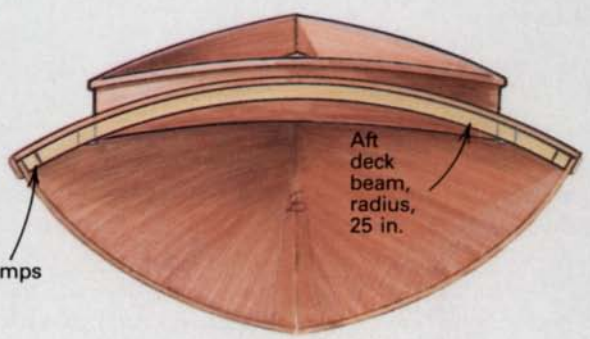
Rip one sheet of plywood in half and layout bow and stern panels on one half. Stack the two half sheets when cutting out the panels.



Section A-A



Section B-B



Optional hold-down rig consists of padeyes and bungee cords.

Use only marine epoxy adhesive.

Flotation bags should be used.

***A double-blade tablesaw setup cuts tenons quickly** and accurately because both tenon cheeks are cut simultaneously. A tall, shop-made auxiliary fence, fitted with a regular miter gauge, supports and steadies the work. An upright backup board minimizes tearout.*

Double-Blade Tablesaw Tenoning

Spacers and shims between blades make setup fast and accurate

by Mac Campbell

I operate a custom woodworking shop, making pieces individually designed for each client, so I can't take advantage of the profitable, repetitive operations that are the bread and butter of many production shops. Profits are important, though, and I wanted to apply assembly-line efficiency to my custom work. This lead me to standardize and streamline many common furnituremaking operations.

Joinery was an ideal first candidate for this standardization. Like many furnituremakers, I rely heavily on mortise-and-tenon joints. The components' sizes and the members to be joined may change, but the joints are all pretty much the same. After a little experimenting, I came up with an efficient, no-fuss system for cutting the tenons on the tablesaw using two blades separated by shims and spacers to cut both cheeks at once, as shown in the photo above. The precisely machined shims and spacers can be arranged in various combinations to produce tenons to fit any of the mortises I commonly use in my furniture. Once the blades are set, cutting the tenons is simply a matter of running the stock on end through the saw. An auxiliary fence and a miter gauge with a backup board increase the stability and safety of the cut and reduce tearout. Tenon shoulders are also cut on the tablesaw using a sliding crosscut box.

This system can quickly produce most tenons, even angled or stub tenons; plus, it offers several other advantages. First, it is predictable: Follow a series of easily repeatable steps, and the result is the same every time. Second, the resulting joints are structurally sound. And, finally, the system works despite the gremlins that inhabit a woodworking shop—the inevitable variations in stock thicknesses and working characteristics of different species don't alter the results.

Because the size of the mortise determines the exact tenon thickness, I cut the mortises first and then adjust my tenoning system to produce the proper tenons. Theoretically, you could calcu-

late the mortise-and-tenon dimensions by measuring from the blades and bits you use, but in practice, the final settings are more easily determined by trial fitting the tenon to the mortise. It's also easier to set up for cutting the tenons if you have a mortise to help you align the blades and fence. The method for cutting the mortise—drill press, overarm router, plunge router or mortising chisel and mallet—is immaterial. What's most important is cutting the mortise the same way every time, using the same tool and the same setup.

Anatomy of the standardized tenon

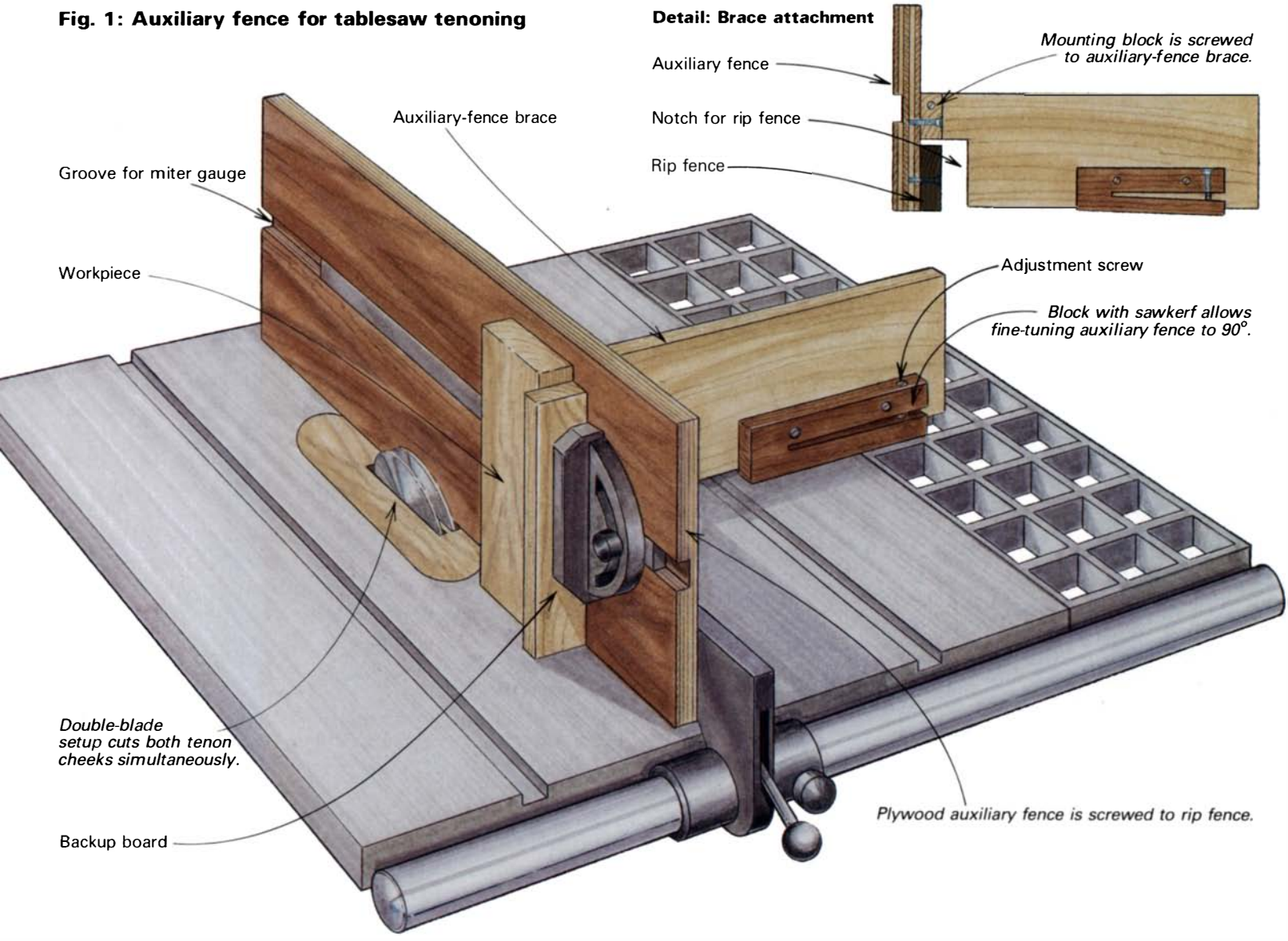
Before cutting the mortise and tenon, let's look at the joint itself. For my standard, four-shouldered tenon, the ideal thickness equals half the thickness of the stock. Thus, for ¾-in.-thick stock, the tenon should be ⅜ in. thick. This half-the-thickness rule is not carved in stone but rather is a guideline. For an open mortise and tenon, or bridle joint, the tenon should be one-third of the stock thickness. Because most of my tenon work is in ⅝-in. to 1-in.-thick stock, I decided on a standard tenon thickness of ⅜ in. (As long as it is equal to or greater than that of the tenoned piece, the thickness of the mortised piece makes no difference.) There's no comparable rule of thumb for the width of the tenon, so I decided to make it 1 in. narrower than the stock it is cut from, leaving a ½-in. shoulder on each side. The length of the tenon is more difficult to standardize because it depends on the width of the mortised part. I rarely use a tenon more than 1½ in. long and almost never more than 2 in. long, which is my mortising bit's maximum-cutting depth.

Blades for cutting tenons

The sawblades I use for tenoning are steel, hollow-ground planer blades. These blades are thin because their teeth have no set, so it doesn't take an extraordinary amount of motor power to cut the tenons. Since the stock is run vertically over the saw to cut the tenons and these endgrain cuts are extremely hard on sawteeth, it is important to keep the sawblades sharp. My solution is to keep two sets of blades; I use one set while the other is being sharpened. I also have all the teeth ground straight across, as many rip blades are ground, rather than the usual alternate top bevel. This helps extend the life of the blades. I have tried carbide blades (they stay sharper longer) but couldn't eliminate the severe flutter in the blades, which destroyed the accuracy of the system. If I get any vibration with the hollow-gound blades, I rotate the blades slightly and retighten them on the arbor; this usually fixes the problem. Blade life can be maximized by feeding the stock as smoothly and as quickly as possible without bogging down the blade speed.

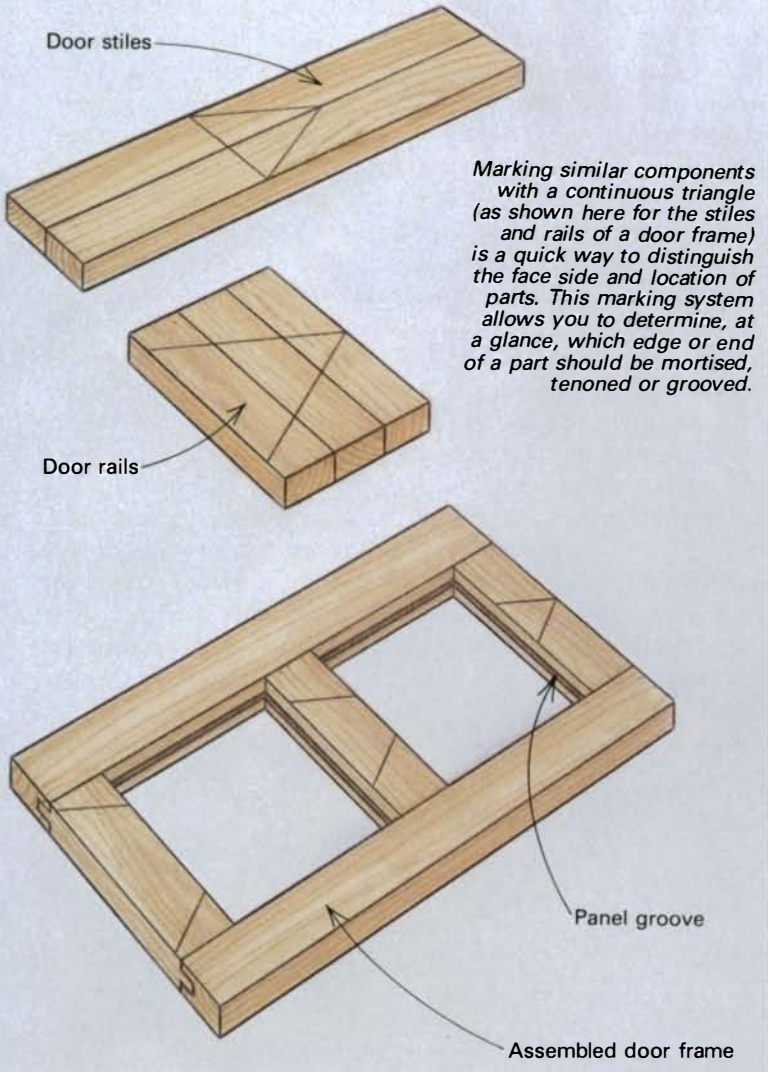
The distance between the blades, which determines the thickness of the tenon, is controlled by the combination of spacers and shims installed on the saw arbor between the blades. A local machine shop made my spacers: Each is the same diameter as the flange on my saw arbor and has a ⅝-in. hole in the center. The spacers are ¼ in., ⅛ in. and 1/16 in. thick. For fine-tuning the thickness of tenons, I have several small squares of hard-brass shim stock in thickness of .005 in., .010 in., .015 in. and .025 in. A ⅜-in. tenon, for

Fig. 1: Auxiliary fence for tablesaw tenoning



Photos: Alec Waters; drawings: Mark Sant'Angelo

Fig. 2: Triangle marking



Marking similar components with a continuous triangle (as shown here for the stiles and rails of a door frame) is a quick way to distinguish the face side and location of parts. This marking system allows you to determine, at a glance, which edge or end of a part should be mortised, tenoned or grooved.

***The auxiliary fence can be adjusted so it's exactly 90°** to the saw table by means of a spring-like block screwed to the fence's brace. A kerf partially across the block provides enough flexibility to tip the fence by driving a single screw in or out.*

example, requires a ¼-in. and a ⅛-in. spacer between the two blades.

Using two blades at once requires a new table insert for the saw. I made one from ½-in.-thick birch plywood, with four ⅜-in.-long #5 screws in the bottom side to level it exactly to the saw table. To install the table insert, retract the blades completely below the surface of the table, and then place the plywood in the opening and level it by adjusting the four screws. Now place the rip fence over the edge of the insert to hold it down. Turn on the saw, and raise the blades to maximum tenon-cutting height.

Auxiliary fence for endgrain cuts

You can buy tablesaw tenoning jigs for cutting stock held on end, but I prefer a shop-built auxiliary fence, as shown in the photo on p. 72, because the workpiece doesn't have to be clamped in place during each pass over the saw. As you can see in the photo, the fence has a slot running parallel to the saw table to accept a standard miter gauge. With the blade fully raised, the fence must be tall enough so that the lower edge of the miter gauge clears the blade by a couple of inches and still has its base fully supported by the fence. The fence pictured here is 13 in. high, with the slot 7 in. from the bottom. Because it is absolutely essential that the cheeks of the tenon are parallel to the face of the stock, I made my fence adjustable for squareness with the table. This adjustment is simply a brace on the back of the fence set at just under 90°. The brace shown in the photo below has a kerf partially across it, making it flexible enough to be moved by an adjustment screw until it's square to the table. This adjustment should be checked every time the fence is used.

Once the fence is screwed to the rip fence and squared to the table, place the miter gauge in the slot and hold it there. Next, screw a piece of scrap to the miter gauge to serve as a backup board to minimize tearout. The backup board should be long enough to seat firmly against the miter gauge and sit solidly on the saw table. Any wood will do as long as it's flat and accurately dressed. I hold the gauge in the slot as I push it and the workpiece past the blade.

After setting up the auxiliary fence and miter gauge, you are ready to adjust the blade spacing. This only needs to be done once for each set of blades, spacers and bits, although you should recheck the system each time the sawblades or the router bit used for mortising is sharpened. Trial and error is the most efficient method here. Cut a few mortises in several pieces of scrapwood; then insert spacers and shims between the two blades until they'll cut a tenon to match the mortises. In my setup for ⅜-in.-thick tenons, this would mean installing the two sawblades with a ¼-in. and ⅛-in. spacer in between (because the teeth have no set, spacing the blade bodies ⅜ in. apart makes the teeth ⅜ in. apart). With the blades set to produce the desired tenon length, cut the cheeks on a piece of scrap. For convenience, this scrap should not be wider than the desired tenon. At this point, I usually just bandsaw the shoulders to remove the waste because shoulder alignment is not important for a test piece. Then I check the tenon thickness in the mortise. You'll probably have to adjust blade spacing with shims to get a good fit. Keep playing with the setup until the tenon fits smoothly and snugly; you shouldn't have to hammer it in place. (Remember that a fit that is too tight will wipe away all the glue during assembly and leave you with a wonderfully machined joint that doesn't last.) Once you have found the right combination of spacers and shims, mark them clearly in case you want to cut the same tenons in the future.

Once everything is aligned and tested, you are ready to put this whole process to work. All of your stock should be marked for correct joinery orientation. The triangle marking system shown in figure 2 above does this quickly and clearly (for more on triangle

***Trim tenon shoulders** on the tablesaw with a sliding, plywood crosscut box. A stop block clamped to the fence ensures that all the shoulders will be cut identically.*

***Tenons can be trimmed to width** on the bandsaw (below left). A piece of wood clamped to the saw table behind the blade stops the tenon stock before the blade reaches the shoulder. The plywood fence clamped to the saw table sets the tenon width and guides the workpiece as it's pushed into the blade.*

***If tenons are to mate** with routed mortises, you should roundover the tenon's corners to ensure a snug fit.*

marking see *FWW on Boxes, Carcases, and Drawers,* pp. 30-31). To ensure uniform placement, mortises and tenons must be referenced from the face side. Mark and cut all the mortises first; then cut all the tenons. If you have tenons of varying lengths, cut the shortest ones first so that the backup board will block the tearout on all tenons. Before changing the saw setup, double check that all tenons have been cut because it's easy to miss one in a large job. The best way to prevent problems is to keep all pieces neatly stacked; an uncut tenon stands out clearly.

Crosscutting tenon shoulders

With all tenons cut, remove the tenoning blades and install a fine-tooth cutoff blade on the saw. Using a sliding crosscut box (see *FWW* #89, pp. 72-75), clamp a stop block to regulate the shoulder cuts, as shown in the top photo above. This stop should be raised above the base of the crosscut box, allowing the waste to slide underneath, thus reducing the danger of any scraps binding against the blade. Once the tenon cheeks are cut free (again, stack all the pieces neatly and make sure that all cuts have been made), raise the blade, and, without changing the stop block, make the remaining two shoulder cuts on the edges of each tenon.

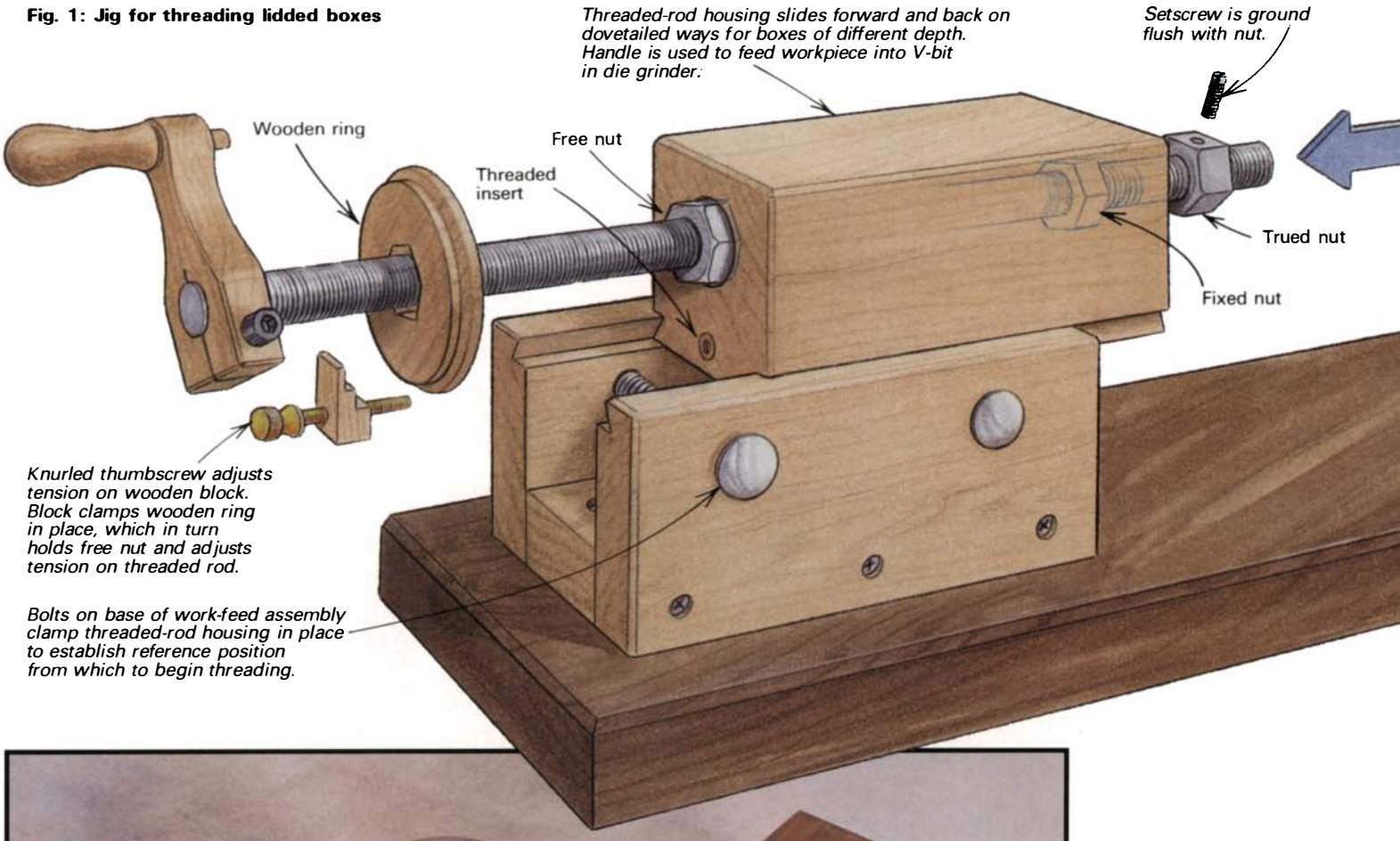
The quickest and safest way to trim the tenons to width is with the bandsaw. My auxiliary fence for this job is a square of ¾-in. plywood sized to extend just to the front of the sawteeth, as shown in the photo at left above. A stop glued to the bottom of the plywood fits against the front edge of the saw table when the assembly is clamped down. Adjust the fence so that the combined waste piece and the sawkerf equals the desired shoulder size. Clamp a scrap to the rear of the table to stop the cut just short of the tenon's shoulder. Make two very shallow cuts, one on each edge, and check the resulting tenon width; adjust the fence if necessary. Once the fence is properly set, trim all tenons to width.

If you routed the mortises, the next step is to round the tenon corners to fit. If you cut the mortises with a hollow chisel or regular chisel, this step is not necessary. I round the corners with a carpenter's coarse wood file (see the photo at right above) after clamping the stock upright in a bench vise. Alternately, I've tried squaring the mortises with a mortising chisel, but I found it a slower process. Whichever method you prefer, perform the necessary trimming, and your joinery is completed.

Once this system is set up, it can be expanded to a variety of applications. The angled tenons common in chair work, for instance, are easily handled by simply tilting the arbor of the saw to the desired angle. Even compound-angle tenons can be cut by tilting the arbor and resetting the miter gauge. This system ensures that the tenon and the mortise will be well matched; the applications are limited only by your imagination.

Mac Campbell builds custom and reproduction furniture in Harvey Station, N.B., Canada, and is a regular contributor to FWW.

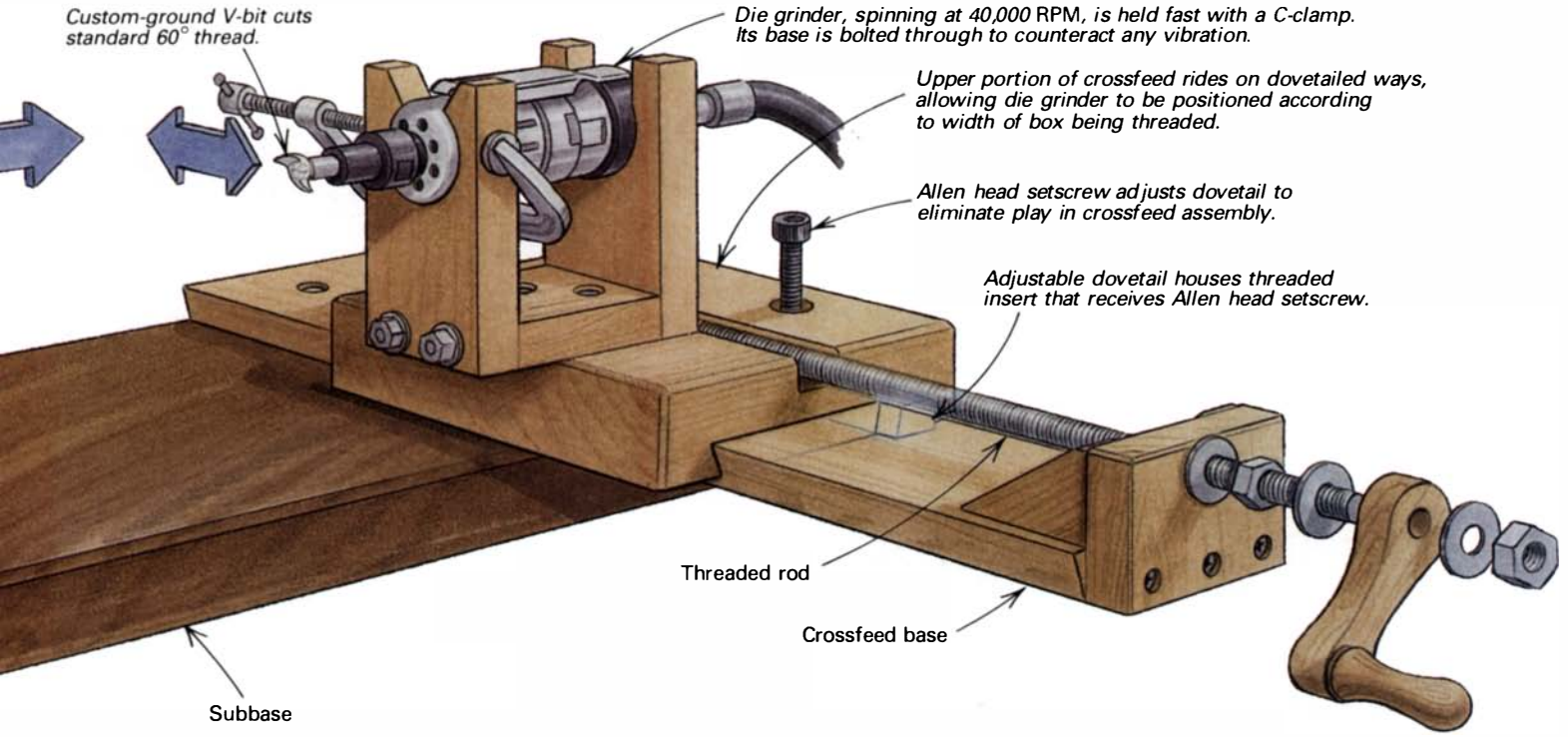
Fig. 1: Jig for threading lidded boxes



Threaded-Lid Boxes

Shop-built device simplifies threading wooden containers

by Steven Gray



The mainstay of my business for years has been the production of kaleidoscopes and small boxes (see *FWW* #86, pp. 47-49 and the photo on the facing page). At some point in the evolution of my kaleidoscope designs, I realized that by threading some of the wooden parts, I could add another level of interest to the finished product. Threads allow a viewer to interact with the object, which increased my sales. Threading also made the scopes more fun to construct. Thus began my fascination with wooden threads. Since then, I've experimented with many different threading techniques. The jig I describe in this article makes short work of threading small boxes.

Used in conjunction with a wood lathe (for turning jam chucks and the workpiece itself, as well as for truing up parts for the jig), this jig is the next best thing to having a very expensive metalworking lathe (see figure 1 above). In fact, the jig functions very much like a metalworking lathe, relying on a crossfeed to move a die grinder perpendicular to the axis of the box, to adjust for different width boxes and depths of thread (see figure 2 on p. 78). Hand rotating a wooden handle at the end of the work-feed-assembly threaded rod moves the workpiece parallel to and into the die grinder.

Box and lid are mounted in jam chucks, which are screwed to metal faceplates that are in turn mounted onto the threaded rod. The threaded rod is held captive in a wooden housing that slides forward or backward in its base according to the depth of the box being threaded. The housing can also slide right off its base and be replaced with another housing with a threaded rod of a different pitch (number of threads per inch). Because the number of threads per inch on the threaded rod determines the number on the work, having several housings, each with a rod of a different pitch, greatly increases the jig's versatility. Of course, you'll need a different faceplate for each rod, and you'll also need to have adapters made, with female ends that mount onto your lathe's spindle thread and male ends that accept the faceplate with a different pitch. Removing the workpiece from one faceplate (on your lathe) and remounting it on another (on the threading jig) to forego the adapter might seem a cheaper and simpler solution, but having to re-center the workpiece every time you transfer it is not worth the hassle.

This jig has a number of advantages over most other systems for threading small boxes. With a sharp bit and the benefit of the die grinder's speed (mine turns at 40,000 RPM—about twice the speed of a router), almost any kind of wood can be threaded. Also, because of the shape of the cutter, the threads can be cut very close to the shoulder of the box. This jig is also one of the fastest ways of putting threads on a wooden jar or box. On production runs, only one pass is needed once bit position has been determined. Another plus is the cost: my whole jig would have cost me less than $200, die grinder included. Die grinders run from as little as $29 to over $200. (Die grinders are available from mail-order companies, such as Grizzly Imports, PO Box 2069, Bellingham, Wash. 98227.) I had most of the materials on hand, so out-of-pocket expenses were negligible.

Making the threading jig

To make the threading jig, I first cut a 16 in. length of threaded rod having the same pitch as the headstock spindle on my wood lathe. By using threaded rod with the same pitch, I'm able to use my faceplates and other accessories on the jig. Check your lathe or manual to determine the pitch on your lathe's spindle.

I fastened a nut near one end of the rod (allowing enough room on the end of the thread for the faceplate), using Loctite machinist's adhesive and a setscrew. I bored the nut with a standard drill press and tapped the threads for the setscrew by hand. After fastening the nut, I marked the center of the end of the rod closest to the nut and bored a dimple there for the tailstock.

The next step was to true the face of the nut so that the box and lid will thread true. Either take the threaded rod and nut to a machinist or do it yourself. To save time and money, I did it myself. I secured the end of the threaded rod farthest from the nut in a three-jaw chuck on my wood lathe's drive end, and brought the tailstock up to the other end of the threaded rod. I used a tailstock with a ball bearing at its tip to eliminate any friction. Turning the lathe by hand, I checked to see if the threaded rod was centered. It was slightly off, so I located the high spot and rebored the dimple and checked the threaded rod until it was centered. Once I'd centered the threaded rod, I trued the nuts' outboard face (toward the tailstock) using a cobalt cutter, hand held in a shopmade holder.

I next had to house the threaded rod and provide for its travel toward and away from the cutter. Figure 1 shows the details of the

Photo: Susan Kahn; drawings: Bob La Pointe

Fig. 2: Threading a wooden box

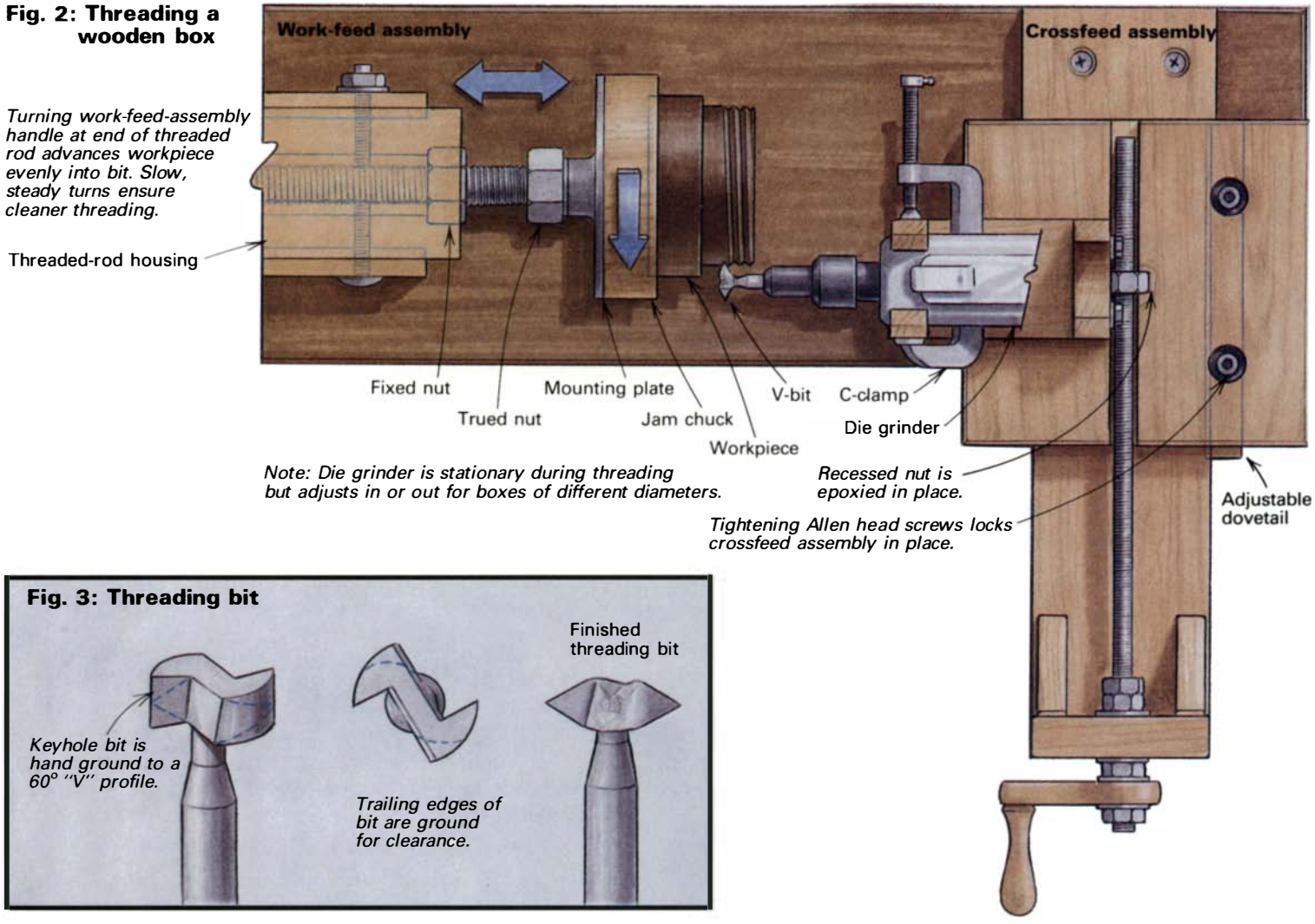


Fig. 3: Threading bit

arrangement I worked out. A solid wooden block, bored through on my drill press and dovetailed on both sides at the bottom, acts as a sliding carriage. A fixed nut at the end of the block closest to the workpiece is epoxied into place. I bored the hole for that nut slightly small and hammered the nut into place. At the other end of the block, I bored a hole large enough to accommodate both a nut and a wooden ring that I fashioned to fit around it. This nut is free to turn, but I wanted some means of locking the nut at the proper tension (snug but not hard to turn) on the threaded rod. To accomplish this, I screwed a threaded insert into the threaded-rod housing and used a knurled thumbscrew to exert pressure on a small piece of wood over the wooden ring. The small piece, in turn, exerts pressure on the wooden ring round the free nut and keeps the pressure constant. I find I have to tweak it whenever the humidity swings widely.

I still needed a cross slide for the die grinder. My first thought was to buy an inexpensive one from a mail-order company, but I didn't want to wait. Instead, I built the slide shown in figure 1 on p. 76. A wide carriage travels on dovetail ways (cut into both base and carriage) over a fixed base, which is screwed to the overall base of the jig. I made one side of the carriage dovetail separate from the carriage, drilled and tapped the dovetail piece, and installed a screw to provide a means of adjusting tension on the crossfeed.

The bit for this jig must be custom ground. You can do it yourself or have a machinist do it for you (at a reasonable cost). People who thread wooden boxes generally use one of three commonly available bits as a blank—a two-flute core box, a keyhole or a Woodruff keyseat bit. I prefer the two-flute core box or the keyhole because a bit with two flutes allows me to turn the bit out of the way, so I can back the piece I'm working on away from the bit to check its fit with its mate. The bit needs to be ground to a centered 60° profile (see figure 3 above). I ground it freehand, taking just a little off of each side at a time and checking the profile often.

Making the box and lid

There are two important things to know about threading wood before you even get started: Harder woods thread better, and you'll experience far less wood movement if you orient the grain along the axis of the box rather than across it. That said, the first step in making a threaded-lid box is making the box. I turn the blank round between centers on my wood lathe. It's essential to face off (make square to the sides of the cylinder you've just turned) both ends of the box so that when you transfer the box and lid to their respective jam chucks, they'll run true.

Then, if box and lid are going to be made from the same blank, I cut a groove to separate the lid from the box, using a 1/16-in.-wide parting tool that I made from a short piece of a power hacksaw blade. This narrow groove allows me—if I'm careful—to create the illusion of unbroken grain in the finished lidded box. I cut the groove nearly all the way through the rough-turned box, shut off the lathe and then handsaw the lid from the box.

Blocks of scrap are then mounted on the metal faceplates and turned for use as jam chucks. I turn a flat, shallow hole in both blocks, just wide enough to accept the box and the lid. The fit should be snug. Both box blank and lid blank are then mounted in the jam chucks with a bit of yellow glue—just a dab on the end of

my finger in three spots—to help secure the work in the chuck.

Starting with the base, I turn a lip for the male threads. I usually cut the lip between ¼ in. and ½ in. long (better longer than shorter at first, in case there's a problem). The lip should be parallel to the sides of the box and the shoulder should be square.

I hollow out the inside of the box next, and then I check the lip again for round. I never seem to have the luxury of letting my wood adjust after working it, but I haven't had any problems with warpage. Hollowing the box can relieve latent stress in the wood, however. On the few occasions when I've had a box warp a bit at this stage, just a couple of passes with the parting tool around the lip got it back to round. Don't sand anything until after you've cut the threads, though. Abrasive residue will dull your cutter in no time.

Once you've cut the lip on the box, you're committed. Now you have to size the lid to the box. But here's the kicker—before it's threaded, you can't test fit. You need to know, with a fair degree of accuracy, the relationship between the exterior diameter of the lip on the box and the interior diameter of the lid. How do you do this? Well, fortunately, I've already made enough of these lidded boxes, with threads of various pitch, that I've determined approximate differences in diameter (see figure 4 at right). These numbers take into account the approximate depth of thread on rods with different numbers of threads per inch and tell you how much larger the exterior diameter of your box's lip should be than the interior diameter of your lid. This figure is slightly less than the depth of the threads.

After removing the box from the lathe and mounting the lid, I mark the interior diameter of the lid with a divider. Then I start to hollow—carefully, approaching my mark with ever lighter passes. I check the inside diameter for square just before reaching the line and again after I've made any necessary adjustments and finished up.

The shape of the cutter makes it impossible to cut threads all the way to the shoulder of the box. But there are a couple of ways to make the top screw all the way down to the shoulder. You can carve the remaining male thread by hand from where the cutter leaves off all the way to the base. Or you can turn a rabbet on the inside lip of the lid. I prefer the latter. I think it looks better, and I find that the top centers easier when its being screwed on. After rabbeting the lid, both parts are ready for threads.

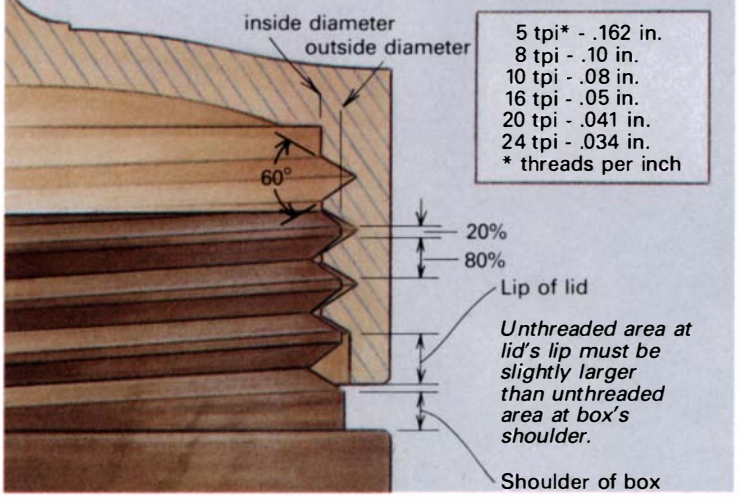
Threading

I take the faceplate with the box on it and mount it on the threading jig. Then I turn the workpiece slowly and steadily into the cutter, taking the first cut about halfway to finished depth. It's better to underestimate than to overestimate. If you cut too much, you'll end up with a sloppy-fitting box, and it will be too late to do anything about it. I cut to a depth that leaves a plateau at the peak of each thread (about 20 percent of total thread—see figure 4). This not only looks better, but also makes the peaks less prone to chipping. Getting to know precisely when to stop is simply a matter of experience. It usually takes two or three seconds per revolution, on average (for a small box), but it varies according to the size of the box.

When the box is done, I remove it from the jig and mount the lid, without moving the crossfeed. Then, because I know my jig so well, I crank the crossfeed in 6⅛ turns and cut my thread. The fit is perfect every time, with enough play to allow for any slight seasonal movement in the wood. After a little initial experimentation, I found that six turns was a bit looser than I liked and that 6¼ turns was a tad tight. After your first few boxes, you'll know how far to turn the crank to advance the crossfeed. The size and pitch of the threaded rod for both crossfeed and workfeed, as well as the diameter of the cutter, affect this distance, so it will vary from jig to jig. Until you become familiar with your jig, take small bites, and check your fit after every pass. Be sure to lubricate the threads with wax or paraffin every time you test fit to prevent the box and lid from becoming stuck. Before I thought to wax the threads, I had to use a pipe wrench to separate the two on a few occasions.

Fig. 4: Fitting lid to box

Before threading, a shoulder must be turned on box, and lid must be hollowed. Figures below give approximate differences between lid's inside diameter and outside diameter of the box's lip when 20% of thread is left flat at peak. Leaving 20% flat, makes for a better fit and stronger thread.



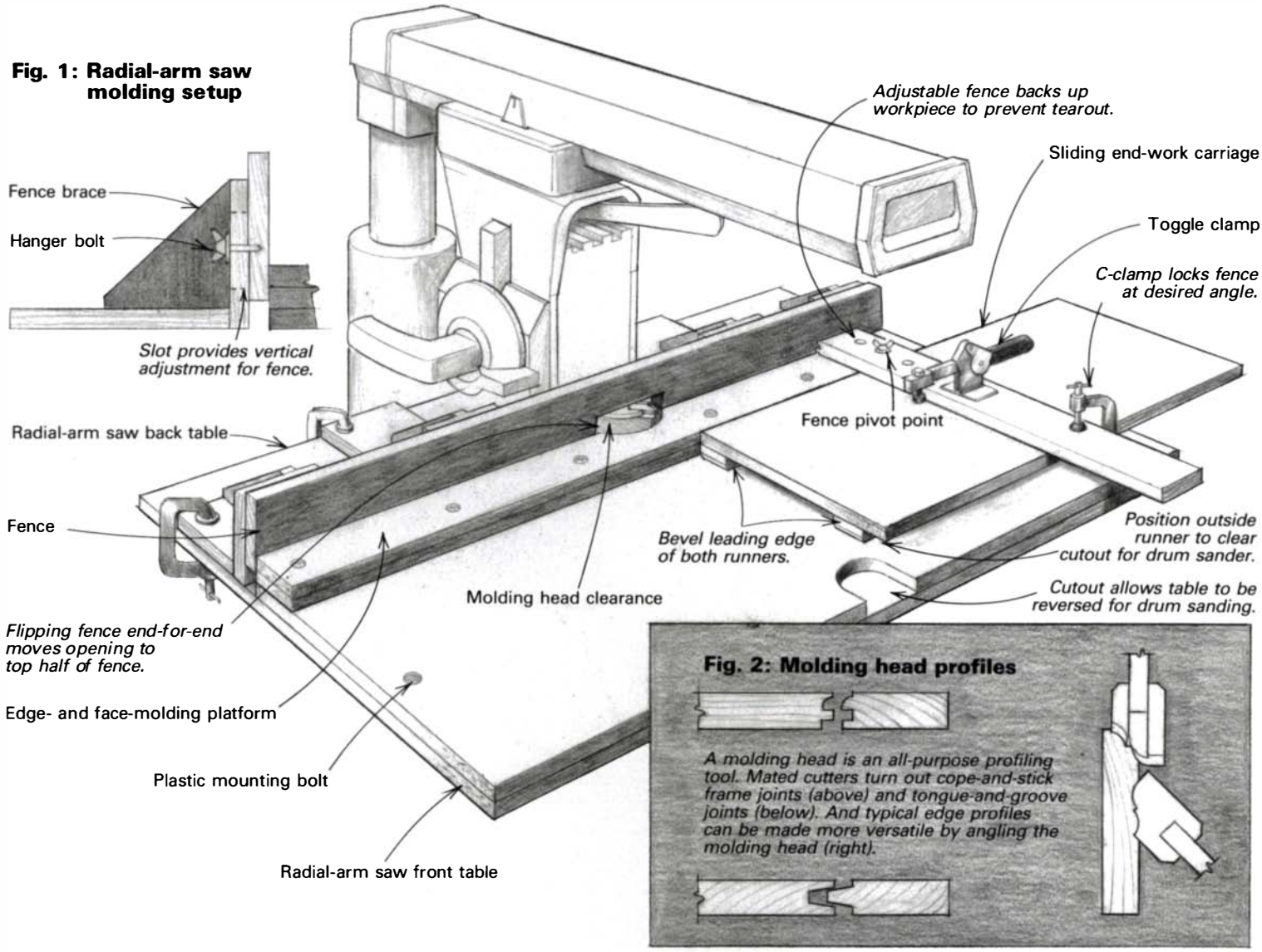
When the parts screw together and apart with ease, I put the lid back on the lathe and sand the inside of the lid and its lip. Then I run a piece of 220- or 320-grit sandpaper over the threads, taking care not to oversand them; one quick pass will clean up the fuzz quite adequately. I then cut the lid from its jam chuck. Next, I mount the box on the lathe and sand its inside. I don't sand the shoulder yet, and I leave the box mounted. Then I screw the lid onto the box to see how the grain lines up. Ninety-nine percent of the time, it doesn't.

Aligning the grain isn't difficult, but you've got to do it *very* gradually. It's done by removing wood from the shoulder of the box, so the lid will screw down farther. You can determine about how much you'll need to take off by figuring from the pitch of the threaded rod you used. For example, if you used a rod with 8 threads per inch, one full turn will advance the lid ⅛ in. If the lid needs to advance one half turn on the box, then removing 1/16 in. from the shoulder will get the grain nearly aligned.

I use a parting tool to remove the bulk of what needs to be removed, but I've learned to stop just short. A light sanding of the shoulder removes just enough wood to get the top and bottom to match, but if you take off too much, then you've got to go all the way around again. Once I've got the grain lined up, I leave the lid on the box and finish-turn and sand them together.

All that's left, at this point, is to finish-turn the bottom of the box. I do this in one of two ways. If I'm only making one or two boxes of that size, I make another jam chuck to hold the lid end of the screwed-together box; there's usually enough stock left on one of the jam chucks I've just used. If I'm doing a production run, I can save a lot of time by threading a waste block to fit the threads on the box. Then I can just screw the box to the block and turn the bottom. I finish my boxes with a couple of light coats of oil and then sign and date them. □

Steve Gray owns and operates a woodworking studio in Bozeman, Mont., where he makes kaleidoscopes.



Molding on a Radial-Arm Saw

Auxiliary fence and table provide safety and versatility

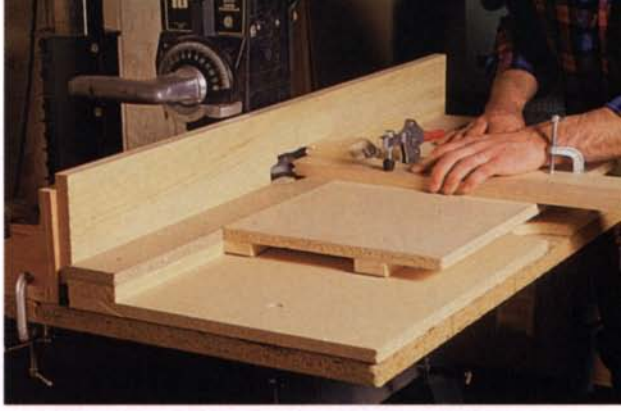
by Dick Willford

The radial-arm saw, equipped with a molding head and a standard set of knives, can be an effective substitute for a shaper. However, anyone who has ever tried to feed hardwood into one of these whirling molding heads with the radial-arm saw motor in the rip position, as recommended by some books, knows what a scary proposition this can be. Molding in the rip position (with the blade vertical, but rotated 90° from its normal crosscutting position), effectively traps the work between the cutter and the table and will cause a violent kickback and a flawed piece of molding. Because of these problems, many woodworkers only use their molding head on a tablesaw or retire it to the bin of things that don't work right.

Because I was not satisfied with stock moldings and had no other alternative for shaping the custom moldings I need for my projects, I developed the basic fence system shown in the photos and in the drawing. This setup doesn't trap the work between the cutter and the table, so it practically eliminates kickback when shaping the edge or face of a board. And, by using the auxiliary sliding carriage, I can easily and safely shape endgrain for cope-and-stick door and window frames (see the top right photo).

In addition to the wide range of stock cutters available for molding heads, custom shapes can be easily ground into straight cutters usually used for rabbeting. Also, the radial-arm saw's adjustability allows the molding head to be set at a variety of angles to increase

***An auxiliary table and fence** make shaping on the radial-arm saw a safe process. Because the motor can be tilted to almost any position, an infinite variety of shapes can be cut using just a molding head and a basic set of knives.*



***A sliding carriage,** with an adjustable fence and a toggle clamp to secure the stock, makes shaping ends for cope-and-stick frames simple and safe.*

***By changing the angle of the motor head,** you can cut cove moldings of almost any shape and size with a regular sawblade. Note how the fence is cut away to provide motor clearance.*

the number of profiles from each cutter or from the sawblade, as shown in the bottom photo at right. Now I can crank out almost any shape molding in whatever species I need.

Making the fence and end-work carriage

My fence system includes a new table that I bolt to the standard radial-arm saw table, a high fence with a molding-head opening and four braces to support the fence. The sliding end-work carriage has a fence that can be adjusted to almost any angle and a toggle clamp to hold the workpiece.

The new table serves two purposes: It provides a smooth surface for the end-work carriage to glide across, and it has a narrow platform along the fence that raises the workpiece enough to allow the molding head full access to the stock for edge and face shaping. I moved the new fence forward 2 in. to allow more room for the motor to be swung to different angles and to make knife changes easier.

I screwed the two strips together for the edge- and face-molding platform before cutting the notch for the molding-head clearance, and then I glued the bottom strip to the table. The top strip can then be reversed to provide a smooth work surface right up to the fence when molding-head clearance is not required, as shown in the photo at left above. The 4¾-in.-wide rear fence is adjustable vertically to accommodate varying widths of moldings and can be flipped end for end, moving the opening to the upper half of the fence for cutting even taller moldings. I usually cut a 1⅛-in.-high by 4-in.-wide opening in the fence to start and then modify the opening for different cutters and blades at varying angles. Additional fences can also be made with the opening customized for a specific cutter to provide maximum support.

The fence braces are merely clamped to the rear radial-arm saw table, but the two middle braces have longer bases, so they can easily be clamped at the back edge of the saw table. The middle braces are not bolted to the fence; they simply butt against the fence to prevent it from deflecting as work is fed past the cutter.

The sliding end-work carriage is made from the same material as the edge- and face-molding platform so that they are of equal thickness. One end of the adjustable fence pivots on a hanger bolt, so the other end can be positioned and locked in place with a C-clamp. I set the fence to 90° by holding a square against the face of the carriage that rides along the edge- and face-molding platform. The fence provides a backup when I'm end milling stock to help prevent tearout. I make the fence extra long and drill a number of pivot holes along its length, so it can be crosscut and advanced to a new position as the end becomes worn.

Molding on the radial-arm saw

While this setup makes it much safer to cut moldings on a radial-arm saw, there are still a few considerations to bear in mind. To ensure the cutters will clear everything before starting the saw, rotate the molding head by hand with the saw unplugged. Keep fence openings as small as possible to fully support stock and to keep your fingers away from the cutters. When cutting moldings that require multiple passes, plan your sequence of cuts so you always have a bearing surface against the fence. Use push sticks and featherboards to protect your hands, and don't try to shape small pieces. To reduce tearout make light cuts—1/16 in. to 1/32 in. deep per pass. When shaping the edge or face of stock, make depth adjustments by moving the motor head. When shaping endgrain, set the cutterhead for a full depth cut, and then gradually advance the stock, securing it each time with the toggle clamp on the sliding carriage. Although the radial-arm saw can't replace a shaper, with this setup and a molding head, you can produce a surprising variety of moldings. □

Dick Willford is a woodworker in Welland, Ont., Canada.

Photos: Charley Robinson

Cutting Sheet Goods Down to Size

Alternative rigs for sawing and routing large panels

by Charley Robinson

***The challenging job of cutting full sheets of plywood** into manageable pieces is made easier by circular-saw accessories that guide a straight cut. Exac-T-Guide above uses a T-square (to which the saw is attached) guided in a U-channel to produce accurate results.*

I hate plywood, but I've used a lot of it. And I've used plenty of medium-density fiberboard (MDF) in my time, too. The inherent stability of sheet goods makes them very convenient for cabinet carcases, built-in units and other remodeling projects. But trying to horse the heavy sheets through a tablesaw can be difficult, particularly if you work alone. And even with a helper, you still need almost 20 ft. of floor space to rip a full sheet.

Large commercial shops and lumberyards have used panel saws for years, but I couldn't justify $800 to $1,000 for such a specialized tool. My low-tech solution was to use a circular saw and the cutting guide shown in the sidebar on p. 84. The system works great for occasional use but can be cumbersome and time-consuming; the guide needs to be realigned and clamped for each cut.

At recent trade shows, three guide systems for cutting plywood with a circular saw caught my eye. Exac-T-Guide, Glide-Easy Saw and Blade Runner II (see the photo above and the photos on the facing page) all use a carriage to mount the saw and a fence or rail system to guide the carriage. Each manufacturer claims their guide system will rip and crosscut full 4x8 sheets, and two say they will replace the tablesaw for cutting sheet goods. The cost for these units, including the extras you will need to set them up for cutting plywood, ranges from $215 to $235. In addition, the systems all have router capabilities or will in the near future.

I wanted to try out these systems, so I designed and built some closet organizers and several sets of bookshelves to put the units through their paces. Typical of most sheet-good work, these projects required ripping panels to width, crosscutting them to length and routing dadoes and grooves. If you're used to working sheet goods on a tablesaw, it will take an open mind to see how versatile these tools can be. For example, when making a bookcase, shelf dadoes must align. With one of these units, I was able to rout dadoes across the panel before ripping it into individual bookshelf sides, thereby ensuring alignment. I'll describe how each system is set up and how they performed these basic functions.

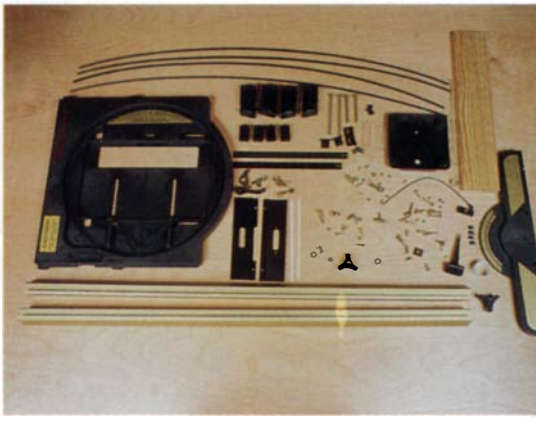
Glide-Easy Saw

The Glide-Easy system suspends a circular saw above the workpiece on a pair of aluminum brackets. Nylon rollers ride along some 2-in.-dia., electrical conduit to guide the saw, as shown in the top left photo on the facing page. For $185, Intelligent Product Designs (see the sources of supply box on p. 85) includes the aluminum brackets that clamp to the saw's baseplate, a pair of plywood glide-rail supports and plywood height-adjustment blocks, as shown in the top right photo on the facing page. To this you need to add about $30 worth of materials: four 10-ft.-long 2x4s and two 10-ft.-long pieces of 2-in. inside diameter (ID) electrical conduit.

Once you have all the parts on hand, Glide-Easy can be put together in about a half hour. Fortunately, this system is simple because the instruction sheet that accompanies it is rather cryptic. The glide-rail supports clamp to the conduit, and the height-adjust-

The contents of the Glide-Easy kit *(above) are rather basic. A circular saw rides smoothly along 2-in.-dia. electrical-conduit guide rails (left) to make straight cuts. This unit can also crosscut and rip dimensional stock. Convenience and accuracy could be improved with such refinements as stops or a fence for making duplicate cuts.*

Blade Runner II's strong suit *is crosscutting and mitering dimensional stock, but with the addition of 60-in.-long optional rails (left), it can also rip and crosscut a 4x8 panel. An optional drop-in router mounting plate is available for quick changes from sawing to routing. The array of hardware and components (below) required several hours to assemble.*



ment blocks, which are already attached to the glide-rail supports, are screwed to the four 2x4s. A 36-in.-long plywood crosscut gauge is screwed to the 2x4 base at one end of the unit perpendicular to the line of cut. Glide-Easy will rip and crosscut a full 4x8 sheet and will handle stock up to 2-in. thick.

Ripping and crosscutting—Glide-Easy is designed to be used on the ground with the workpiece supported by the 2x4 base and your body weight holding the workpiece in place. Before you can use the system, you must saw a kerf the length of the base 2x4 that is directly under the saw. This kerf serves as the reference for lining up the workpiece. Then slide the panel in from the side, and align cut marks at each end with the sawkerf. Once the piece is positioned and held down with your body weight, push the saw carriage along the guide rails to make a straight cut. You can make crosscuts in the same manner but with the panel oriented perpendicular to the rails instead of parallel to them. Because of this configuration, Glide-Easy requires at least 10 ft. by 10 ft. of floor space.

Routing—The Glide-Easy system doesn't have a router carriage at this time, but the manufacturer plans to have one available soon.

Blade Runner II

When I unpacked Blade Runner II, I was reminded of the kid's toys labeled "some assembly required" that take several hours on Christmas eve to put together. There were seven different bags of hardware and 14 components, as shown in the bottom right photo, which took over three hours to assemble. Fortunately, the owner's manual gave detailed instructions.

Blade Runner II, as shown in the bottom left photo, is similar in function to Glide-Easy in that a tool carriage is guided above the work by a pair of rails that are screwed to a shopmade worktable. When properly set up, the plastic carriage glides smoothly on the extruded aluminum rails that include a rip gauge for the saw on one rail and a gauge for setting the router on the other rail.

In its standard form, Blade Runner II is designed for crosscutting, ripping, mitering and routing standard lumber up to 2 in. thick and 27 in. wide and sells for $135. I added the optional 60-in.-long rails ($80) to extend the length of cut to a full 48 in., so I could crosscut and rip full sheets of plywood. Including the plywood base, out-of-pocket costs will run about $235 to get this unit ready.

Ripping and crosscutting—The manufacturer suggests making a wider worktable for better support if you are going to be doing a lot of ripping. To rip on Blade Runner, rotate the saw plate in the carriage so that the blade is parallel to the adjustable fence. The saw is positioned using the rip scale on the guide rail and clamped in place with the carriage locking knob. The hairline pointer on the carriage makes accurate setups easy. The workpiece is then fed through the saw as if you were using a tablesaw, so you'll need

Photos: Vincent Laurence

To rout dadoes across panels with Exac-T-Guide, *clamp the T-square in place at both ends, and slide the router on the mounting plate along its long arm, as shown. Exac-T-Guide is the only unit that has a stock mounting plate that accepts a wide variety of tools.*

about 20 ft. of floor space to push the panel through the saw.

Blade Runner II's carriage has a removable plate that holds the circular saw. The plate can be rotated in the carriage to position the saw perpendicular to the rails for rip cuts or parallel to the rails for crosscuts. For crosscutting, slide the workpiece under the rails and against the adjustable fence. A kerf in the lead board attached to the fence serves as a reference for aligning the cut. If the fence is accurately set, pushing the saw through the piece will result in a square crosscut. Sliding a large piece of plywood into position, however, can exert sufficient leverage to affect the accuracy of the fence. I found it best to mark the workpiece on both edges and then align one cutting mark with the kerf in the lead board and the other edge with the sawblade.

Routing—An optional drop-in router mounting plate ($36) is available for fairly easy tool changes. To rout dadoes, position the stock under the rails and against the fence, and then push the carriage-mounted router along the rails (the same as crosscutting). To rout grooves the length of the panel, follow the ripcutting-setup procedure, and then push the panel past the bit.

Exac-T-Guide

Exac-T-Guide shown in the photo on p. 82 takes a different approach to guiding the cutting tool. The saw (router, biscuit joiner, jigsaw or laminate trimmer) mounts on an easily detached glass-filled plastic mounting plate. The mounting plate slides on the extruded-aluminum long arm of a large T-square. The stamped-steel short arm of the T-square, in turn, rides in a U-channel screwed to the edge of a 4x8 plywood work surface. (The $224 it took to set up Exact-T-Guide includes $199 for the tool and $25 for the plywood.) In addition to the U-channel, I screwed a perpendicular end stop to the work surface and completed the setup by assembling and truing the T-square.

When I was setting up Exac-T-Guide, I thought I could skip the cut-and-adjust procedure described in the instruction sheet by instead using the factory edge of another panel to align the U-channel. But I found that factory edges may not be as perfect as I had thought. My first cut bowed 3/32 in. from the ends to the middle of a 7-ft.-long piece. By readjusting the fence as prescribed, I eliminated all of the bow. The entire setup is a simple procedure that shouldn't take more than about an hour, including setting the U-channel.

Ripping and crosscutting—Sheet goods up to 7/8 in. thick are ripped on the work platform with the T-square guided by the U-channel, as shown in the photo on p. 82. The panel is placed on the work platform and butted against the U-channel. Any width ripcut up to 4 ft. can be accommodated by sliding the saw mounting plate along the long arm of the T-square and then tightening a knob to lock it in place. The scale on the T-square's long arm and the hairline indicator on the mounting plate make accurate adjustments a snap. The short arm of the T-square rides in the channel and guides the saw parallel to it.

Other materials, such as doors, that are too thick for the U-channel can be ripped or crosscut by guiding the short arm of the T-square along an edge parallel to the cut while pushing the saw forward.

Although panels can be crosscut as described above for doors, I found it easier just to swing the panel 90° and, like a ripcut, use the

Double-edged cutting guide and sturdy worktable

Before I had a shop that could handle full sheets of plywood, I used a couple of simple cutting guides that relied on the factory edges of a sheet of medium-density fiberboard (MDF) to make accurate cuts. At first, I had an 8-ft.-long and a 4-ft.-long guide for both my router and my circular saw. But for easier handling and to cut down on shop clutter, I modified the design so that one guide would work for both the router and saw, as shown in the drawing on the facing page.

I used to cut sheet goods with a couple of 2x4s stretched between some wobbly, old sawhorses and invariably had to try to catch one side or the other as I was finishing my cut. I've found that the knockdown worktable shown in the drawing allows me to concentrate on cutting, instead of catching, by fully supporting the entire sheet of plywood. And the folding sawhorses (Pack Horses by Davalco Products, see the sources of supply box), are stable and strong. I found their height to be just right, and they fold into self-storing packages that can be latched together and lugged around by their carrying straps with just one hand. Also, Pack Horses' sawhorses fit easily into a trunk.

Making the cutting guide: The dual-purpose cutting guide is made by cutting two strips from the edge of a sheet of ½-in.-thick MDF. The first strip is the 5-in. or 6-in.-wide center guide, and the second strip, about 14 in. wide, serves as the cutting-guide base. The actual width of the base will depend on the circular saw and router that you will be using with the guide (see the drawing detail at right). If you are making a dual-purpose guide, the center-guide strip will need to be run through a tablesaw, with the factory edge against the fence, to true up the edge that's cut and make it parallel to the factory edge.

Measure the baseplates on your saw and router to determine the position of the center guide on the cutting-guide base, and then glue and screw the center guide to the base. Now a pass with the circular saw on one side and with the router on the other side will trim the edges of the guide so that they coincide with the sawblade and the router bit. Be sure to trim the guide with the same router bit that you will be using with the guide. I used a special 18mm-dia. (23/32-in.), down-shear straight bit (available from Woodhaven, see the sources of supply box), so I can rout dadoes that fit tightly to the metric plywood I use. The appropriate edge of the cutting guide is now easily lined up with the layout marks on the plywood. Don't forget to mark each side of the guide, so you'll know which side is for the saw and which is for the router. *C.R.*

U-channel to guide the T-square. However, swinging the panel will require at least 10 sq. ft. of floor space. The manufacturer indicates an accessory mount is being developed that allows the mounting plate to be rotated 90° yet still slide along the long arm of the T-square. With this mounting, you could cut perpendicular to the U-channel for crosscuts without having to turn the panel.

Routing—Exac-T-Guide provides very controlled router movement, both across the panel and along its length. Grooves are easily routed in the same fashion as ripcuts: Clamp the mounting plate at the desired position along the long arm of the T-square, and push the T-square, guided by the U-channel, the length of the panel. Rout dadoes by clamping both ends of the T-square in place and then sliding the router on the mounting plate along the long arm of the T-square (see the photo on the facing page). By using a set of four accessory stops ($40) to control router movement, it's easy to rout stopped grooves, dadoes or even a square opening anywhere in the panel.

The bottom line

Although all these tools can cut a straight line, there is a considerable difference in their ease of use. Lining up cuts on the Blade Runner II is a little fussy, and repetitive cuts are a real irritation because there is no provision for setting a stop. Ripping sheet goods on Blade Runner II has the same problems as ripping on a tablesaw: It needs 20 ft. of floor space to push the heavy, awkward panels through the saw. And the overhead rails make it difficult to use a push stick to feed panels through the saw. I also found it difficult to rout a straight groove the length of an 8-ft. piece by pushing the stock past the bit. In addition, the router mounting plate flexes enough to create uneven depths when trying to plunge cut for a stopped dado.

Glide-Easy can cut sheet goods or dimensional lumber as well, but it's a pain to line up the workpiece with the sawkerf in the 2x4. I'd get one mark lined up only to have it move while aligning the other end. Also, Glide-Easy has no fence or stops for making repetitive cuts. Glide-Easy's ground-level working arrangement means you don't have to lift heavy panels to a raised table, but bending over the work and crawling along a panel can be hard on your back and knees. And, finding a flat place to set up could be a challenge on a job site.

My favorite tool for working with plywood is Exac-T-Guide. It produces ripcuts and crosscuts that are more accurate than possible with my tablesaw and with a lot less stress and strain. The built-in carriage locks and accessory stops make it easy to set the saw for repeat cuts that yield exactly the same size panels. This tool would also be useful for straightening the bowed edge of a board up to 8-ft. long, which is something that can't be easily done on a tablesaw.

Exac-T-Guide is equally adept at controlling a router. But I discovered that both ends of the T-square must be clamped when routing dadoes; otherwise, there's enough play in the free end of the T-square to allow the dado to drift off course by ⅛ in.

Exac-T-Guide can also be used for taper cuts and routing or cutting circles. Although Exac-T-Guide's mounting plate is the only one that will accept a variety of tools, I would opt for an extra mounting plate (about $50). Then, with just the twist of a knob, I could switch from the saw to a router in a matter of seconds to conveniently and easily handle most of the work I need to do on sheet goods. □

Charley Robinson is an assistant editor for FWW.

Sources of supply

Exac-T-Guide, BradPark Industries, Inc., 91 Niagara St., Toronto, Ont. Canada M5V 1C3; (416) 594-9455, (416) 461-1601.

Glide-Easy Saw, Intelligent Product Designs, 1556 Halford Ave. #363, Santa Clara, CA 95051; (408) 296-4066.

Blade Runner II, Professional Tools, Inc., PO Box 672525, Houston, TX 77267-2525; (713) 872-1885.

Pack Horse sawhorses, Davalco Products, 301 West 53rd St., Suite 3D, New York, NY 10019; (800) 945-9545.

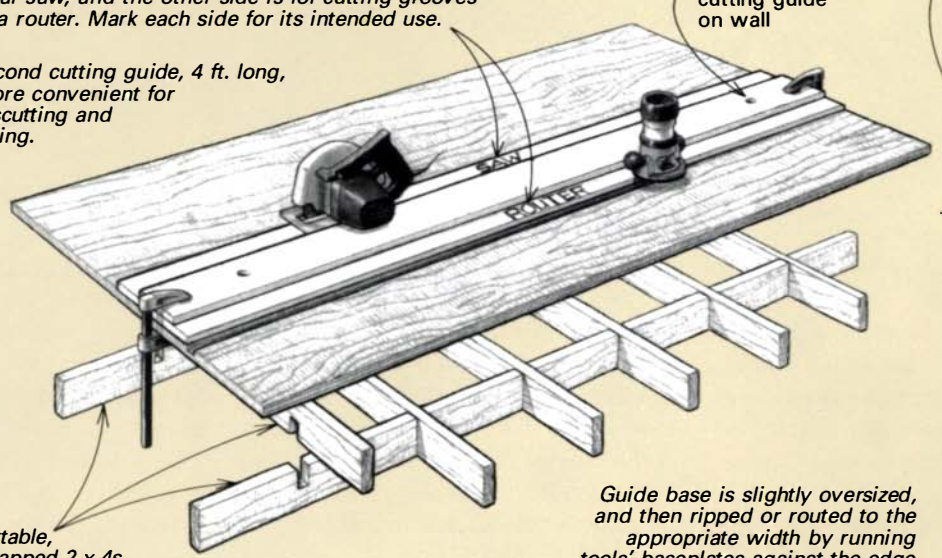
Carbide-tipped, shear-dado router bits (metric and standard diameter), Woodhaven, 5323 W. Kimberly Road, Davenport, IA 52806; (800) 344-6657.

Shopmade cutting guide and worktable

One side of this cutting guide is for ripping plywood with a circular saw, and the other side is for cutting grooves with a router. Mark each side for its intended use.

Hole for hanging cutting guide on wall

A second cutting guide, 4 ft. long, is more convenient for crosscutting and dadoing.



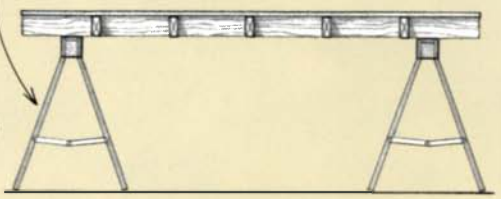
Worktable, half-lapped 2 x 4s, dry-assembled is sturdy and easily stored or transported.

Guide base is slightly oversized, and then ripped or routed to the appropriate width by running tools' baseplates against the edge of the center guide.

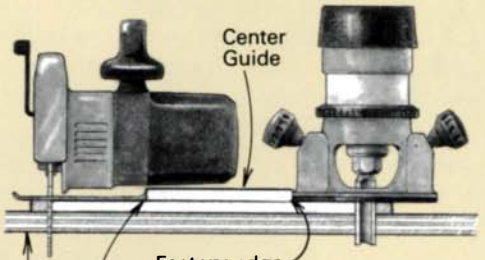
Waste

Portable worktable setup

Pack Horse folding sawhorses fit neatly into a car trunk yet support very heavy loads.



Detail: Cutting guide



Rip this edge on a tablesaw so that it is parallel to the factory edge.

Drawing: Heather Lambert

***Flocking provides an easy, quick and inexpensive way** to line the interiors of small boxes, presentation cases and chests with a durable covering that's plush as velvet. After the interior of the marquetry box shown above (made by Johnson and his wife as a production item) has been routed out, flocking is applied to neatly cover the unsanded, slightly irregular surface.*

Flocking a Box

Simple, inexpensive method for adding a velvety lining

by Spider Johnson

Aside from large marquetry murals and one-of-a-kind art furniture pieces, my wife Lora Hunt and I produce a line of small boxes with marquetry tops, like the one shown above. Because these boxes are production items to be sold at wholesale prices, our construction methods need to be as efficient as possible. Therefore, we finish the inside of each box with flocking, which provides a quick, simple and inexpensive way of lining them with a durable, velvet-like covering.

A long-time favorite of taxidermists for decorating antler wall mounts, fiber flocking also is commonly used to make raised, fuzzy letters and designs on T-shirts and baseball caps as well as to upholster parts of automobile interiors. The flocking process is straightforward: An adhesive is applied to the surface, and the flocking is sprinkled or sprayed onto the adhesive. Flock is made from very thin nylon or rayon fibers cut extremely short—from .020 in. to .060 in. long. The tiny fibers come in many colors and can be applied to almost any surface. It's available in small amounts (a little bit goes a long way) from many mail-order outfits, including Woodcraft, 210 Wood County Industrial Park, PO Box 1686, Parkersburg, W.Va. 26102-1686; (800) 225-1153. A good wholesale source is Cellusuede Products, Inc., PO Box 716, Rockford, Ill. 61105; (815) 964-8619.

One of the greatest advantages of flocking is that it's easy to perfectly line the interior of irregularly shaped cavities, such as a sil-

ver chest or presentation case routed out to fit the contours of its contents. Also, flocking covers up most irregularities, so the box or case interior doesn't have to be perfectly smooth. With a good application, even complex contours will be well-covered, giving the appearance that you accomplished an impossible fabric-upholstery job.

The flocking process

To prepare a surface for flocking, seal the raw wood with shellac or lacquer. After the sealer coat is dry, coat the surface with an even layer of enamel-oil paint, which acts as the flocking adhesive (see the photo at right). I've had good luck with Rust-Oleum enamel paint, but companies that sell flocking usually sell colored-flocking adhesives, which also work well. Choose the same color paint as the flock to make the flocking look denser and more opaque and to even out areas where the flocking doesn't take as heavily as it should. Be careful to get the paint only where you want the flock to stick.

To flock small items, like the marquetry box shown in the photo on the facing page, you need to use a thin-walled box to contain the excess flock and a hand-held orbital sander to supply the vibration that causes the flock fibers to stand on end and produce the desired velvet effect. The box should have an open top and should be big enough to contain the flocking item and your hand (see the center photo at right). I made my box from thin-acrylic sheet material, but thin plywood also works. Clamp the box into your bench vise or secure it in whatever way will leave the underside accessible. Hold the item in the box, and sprinkle the flock on the item until its painted surfaces are thickly covered. The paint must be wet when flocking; if even a slight film forms on its surface, the flock will not adhere properly. Now, while forcing the item against the bottom of the box, press the edge of the running orbital sander's platen against the outside bottom of the box so that the whole assembly vibrates vigorously. The flock will dance across the adhesive-coated surface evenly with a tumbling pattern. Then, carefully lift the item out without touching the flocked surface. Empty the loose flock from the box, and set the item aside for four to six hours. After it's dry, shake or blow off the remaining loose flock, and the item is ready to use.

For flocking larger surfaces, it's best to use a flocking gun (available from the flock sources previously cited). Prepare the item as before, and then shoot the flocking onto the surface with the gun (see the bottom photo). Pump the gun's plunger in short bursts, and keep the gun upright. Ideally, the flock fibers will fly out and adhere end first, like little spears, into the layer of paint.

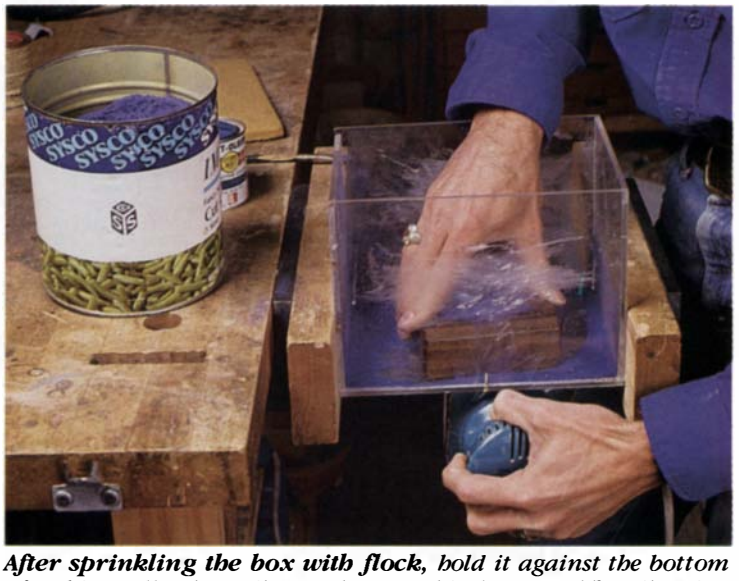
If you make a mistake while flocking, you have several options. You can wash off the whole surface with lacquer thinner and a rag and start over. If you accidentally scrape the flocked surface while it's still wet, wait until it dries; carefully, paint the bare area by dabbing it with a small touch-up brush, and then re-flock. Be careful not to saturate the surrounding dry flock.

Because flock sticks only to surfaces with adhesive, interesting effects can result from painting selected areas and applying various flock colors. You can make flock stripes, for example, by applying paint in narrow bands. Also, to get a specific shade, mix the flock like paint; shake red flock and blue flock together to get purple flock. Black flock will darken any color and white will create pastel tones.

When applied properly, flock is very durable, wearing well through many years of use, and the process is much quicker and easier than other methods of small-box upholstery. □

Spider Johnson is a professional artist from Mason, Texas. He collaborates with his wife, Lora Hunt, on functional and non-functional sculptured-wood artwork that's sold worldwide.

***Seal the routed-out interior of a box** with a coat of lacquer, and then apply an enamel paint to act as an adhesive for the flock. Using the same color paint as flock produces a rich, uniform appearance, even on irregular surfaces.*



***After sprinkling the box with flock,** hold it against the bottom of a thin-walled box vibrated by an orbital sander. The vibration causes the flock fibers to stand on end, producing an evenly coated, plush surface. Pour out the loose flock, and set the box aside to dry.*

Photo: Jim Bocsel

***The best way to flock larger surfaces** is with a pump-action flocking gun. The author shoots an even coat onto a painted drawer bottom. A cardboard box traps the overblown flock, allowing it to be scooped up and reused.*

Photos except where noted: Sandor Nagyszalanczy

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23-880	8" Bench Grinder 1/2 HP	151	115
11-950	8" Drill Press	199	144
28-160	10" Hobby Band Saw	210	145
31-050	1" Belt Sander 2.0 amp	104	78
31-460	4" Belt\6" Disc Sander	198	145
31-340	NEW 1" Belt/8" Disc Sander	268	188
31-080	NEW 1" Belt/5" Disc Sander	134	94

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40-560	16" 2 speed Scroll Saw	266	184
11-990	12" Bench Drill Press	276	219
11-090	32" Radial Bench Drill Press	399	309
43-355	3/4" Shaper 1-1/2 HP	964	705
43-505	1/2" Bench Router/Shaper	399	279
22-540	12" Bench Top Planer	595	398
36-220	10" Compound Mitre Saw	350	238
28-180	Bench Band Saw	232	167
40-640	NEW 20" Bench Scroll Saw	466	325
23-675	NEW 6" Grinder / 3x24 Belt Sander	141	105
14-600	Hollow Chisel Mortiser	668	465
46-700	12" Wood Lathe	548	419

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34-444	Table Saw complete w/1-1/2 HP motor & stand	812	615
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34-446	34-444 Table Saw complete w/30" Unifence and 32-010 EMS system	Sale	839
28-283	14" Band Saw w/enclosed stand and 50-274 mobile base	910	729
22-662	13" Planer with 2 HP motor, stand, and 32-011 EMS system	1436	1169
17-900	16-1/2" Floor Drill Press	441	389
40-601	18" Scroll Saw w/stand and blades	942	729
34-080	10" Mitre Box	Xtra Special	198
34-761	10" Unisaw 1-1/2 HP	1715	1325
33-990	10" Radial Arm Saw	818	585
37-280	6" Motorized Jointer	488	395
50-179	3/4 HP 2 stage Dust Collector	483	335
50-181	2 HP Dust Collector	885	615
70-200	20" Floor Drill Press	1049	798
37-154	DJ15 6"Jointer with 3/4 HP motor	1420	1079
33-055	8-1/4" Sawbuck comp with legs	865	579
34-330	8-1/4" Table Saw 13 amp	343	229
34-670	10" Motorized Table Saw	511	385
32-100	Station Plate Jointer	645	275
36-040	8-1/4" Compound Mitre Saw	224	165
34-915	30" Unifence	385	239
34-897	50" Delta Unifence	525	279
36-755	10" Tilt Arbor Saw	1264	895

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Item	Throat	Opening	Jaw Length	List	Sale
K3.512	3-1/2"	12"	5"	44.35	30.99
K3.524	3-1/2"	24"	5"	48.65	33.99
K3.531	3-1/2"	31"	5"	52.85	36.99
K3.540	3-1/2"	40"	5"	56.95	39.79
K3.550	3-1/2"	50"	5"	60.65	42.39
K3.560	3-1/2"	60"	5"	64.50	45.09

NEW DEWALT TOOLS

DW364	7-1/4" Circ. Saw w/brake, 13 amp	245	148
DW946K	12 volt cordless 3/8" Hammer Drill Kit	312	179
DW306K	8.0 amp Recip Saw w/case var. speed	254	159
DW610	1-1/2 HP 2 handle Router	250	139
DW411	1/4 sheet Palm Sander, 1.7 amp	87	54
DW705	12" Compound Mitre Saw	555	339
DW704	12" Mitre Saw	480	289
DW100	3/8" Drill, 4 amp, 0-2500 rpm, rev	110	65
DW250	4.5 amp Drywall Gun, 0-4000 rpm, rev	146	89
DW254	4.5 amp Drywall Gun, 0-2500 rpm, rev	146	89
DW124K	1/2" joist & stud Drill w/case, rev	504	295
DW102	3/8" Drill, 4.5 amp, 0-1200 rpm, rev	154	92
DW103	3/8" Drill, 5.0 amp, 0-1200 rpm, rev	189	115
1707	8-1/2" Slide Compound Mitre Saw	815	439

SKIL SIZZLERS

3810	10" Mitre Saw	263	199
3810K	3810 with 60 tooth carbide blade		229
77	7-1/4" Worm Drive Saw	230	144
5825	6-1/2" Worm Drive Saw	255	159
2735-04	12 volt cordless Drilt Kit	210	135
2735-04X	2735-04 with keyless chuck	235	137
1605-02	NEW Biscuit Jointer with case	200	123
7584	NEW 5" Random Orbit Sander	160	104
5510	5-1/2" Circular Saw	165	114
5660	NEW 8-1/4" 60° Circular Saw	225	145
5860	NEW 8-1/4" 60° Worm Saw	275	179
5625	6-1/2" Circular Saw	210	139

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3330	16" Scroll Saw	200	135
3380	8" Drill Press	200	135
3370	4" Belt\6" Disc Sander	200	135

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HBSE75S	3 x 21 variable speed Belt Sander	299	169
ABSE15S	1/2" cordless 12V Drill complete w/case	389	235
FSPE100	Barrell Grip variable speed Jig Saw	265	149
BSPE100K	Top Handle variable speed with case	275	159

HITACHI TOOLS

Model	Description	List	Sale
C7SB	7-1/4" Circular Saw	214	109
DTC10	3/8" 7.2 volt cordless Drill	138	78
C7BD	7-1/4" Circular Saw with brake	230	127
M12V	NEW 3 HP variable speed Router	447	225
TR12	Plunge Router 3 HP	354	169
F1000A	12" Planer/6" Jointer	2835	1535
C10FA	10" Deluxe Mitre Saw	538	274
C12FA	NEW 12" Mitre Saw	632	299
C8FB	8-1/2" Slide Compound Saw	899	449
FREUD	LU91M0088-1/2" carbide blade 48 tooth	68	43
C15FB	15" Mitre Saw	745	384
FREUD	LU85M01515" carbide blade 108 tooth	180	105
F20A	3-1/4" Planer 3.4 amp	172	99
G12SA	4-1/2" Grinder 6.9 amp	147	79
M8V	Var. speed Router 1/4" collet	278	155
DS10DVAK	NEW 12V Cordless Drill Kit with 2 batteries	385	199

JORGENSEN ADJUSTABLE HANDSCREWS

Item#	Jaw Length	Opening Capacity	List	Sale	Box of 6
#5/0	4"	2"	13.80	8.35	48.59
#4/0	5"	2-1/2"	14.80	8.95	51.99
#3/0	6"	3"	15.90	9.59	55.75
#2/0	7"	3-1/2"	17.10	10.35	58.95
#0	8"	4-1/2"	19.00	11.95	64.95
#1	10"	6"	21.76	12.99	73.49
#2	12"	8-1/2"	24.95	14.95	83.45
#3	14"	10"	31.61	18.95	104.95
#4	16"	12"	42.30	24.95	143.95

JORGENSEN STYLE 37 2-1/2"Throat 1/4"x3/4"

Item#	Jaw Length	List	Sale	Box of 6
3706	6"	9.86	6.49	36.55
3712	12"	10.92	6.99	39.75
3718	18"	12.05	7.75	42.99
3724	24"	13.16	8.39	47.75
3730	30"	14.70	9.55	54.45
3736	36"	16.05	10.39	57.95

JORGENSEN STYLE 45 5" Throat 1-3/8" x 5/16"

Item	Jaw Length	List	Sale	Lot of 6
4512	12"	30.07	19.39	109.99
4518	18"	31.73	20.45	116.99
4524	24"	33.55	21.75	123.99

PONY CLAMP FIXTURES

Model	Description	List	Sale	Lots of 12
50	3/4" Black Pipe Clamps	13.61	7.99	84.99
52	1/2" Black Pipe Clamps	11.37	6.50	69.50
56	Double 3/4" Pipe Clamps	38.50	24.45	274.00

JORGENSEN STEEL "I" BAR CLAMPS

Model	Size	List	Sale	Lots of 6
7224	24"	31.46	18.45	107.00
7236	36"	33.77	20.19	115.45
7248	48"	37.12	22.19	126.95
7272	72"	42.71	26.79	149.95

ELU BY BLACK & DECKER

3338	2-1/4 HP variable speed Plunge Router	427	249
3304	1 HP variable speed Plunge Router	292	164
3375	3-1/8" Univ. planer 7.2 amp	313	155
3380	Biscuit jointer with case	542	249
4024	3 x 21 variable speed Belt Sander	322	184

BLACK & DECKER

1166	3/8" Drill 0-2500 rpm 4 amp	100	65
2600	3/8" Drill 0-1200 rpm 4.5 amp	142	89
1703-1	10" Mitre Saw with 73-770 blade	313	179
4011	1/4 sheet Palm Sander	82	59
79-034	Workmate 400	175	105
1349-09	1/2" Timberwolf Drill 2 speed	489	279
1180	3/8" Drill rev. 0-1200 rpm 5 amp	182	104
2037	Drywall Gun 0-4000 5.0 amp	175	97
2038	Drywall Gun 0-2500 rpm 5 amp	175	99
3157	Orbital var spd Jig Saw 4.5 amp	220	145
2665K	NEW 3/8" cdls 12V Cyclone Drill	280	165
5045K	MACHO Rotary Hammer Drill	742	409
5071	3/8" Hammer Drill w/case	239	144
5073	1/2" Hammer Drill w/case	282	163
2054	TekGun 0-2500 5.0 amp	269	152
2660	Drywall Gun 0-4000 4.5 amp	142	88
2700	7-1/4" Worm drive Saw 13 amp	250	149
1321	1/2" Spade hdle Drill 450 rpm 7 amp	292	165
2750	4-1/2"Grinder 10,000 rpm 6 amp	149	83
2694	7-1/4" Super Sawcat Circular Saw	248	142
2695	8-1/4" Super Sawcat Cricular Saw	271	153

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73-716	6-1/2	18	13.70	7.55
73-717	7-1/4	18	13.90	7.99
73-737	7-1/4	24	17.20	9.29
73-757	7-1/4	40	31.30	16.89
73-759	8-1/4	40	44.65	24.99
73-719	8-1/4	22	19.65	11.95
73-769	9	60	72.75	39.89
73-715	5-1/2	16	13.70	7.99
73-704	7-1/4	18	21.00	11.59
73-740*	10	32	32.98	17.95
73-770*	10	60	67.02	33.95
73-711	10	50	65.08	33.95

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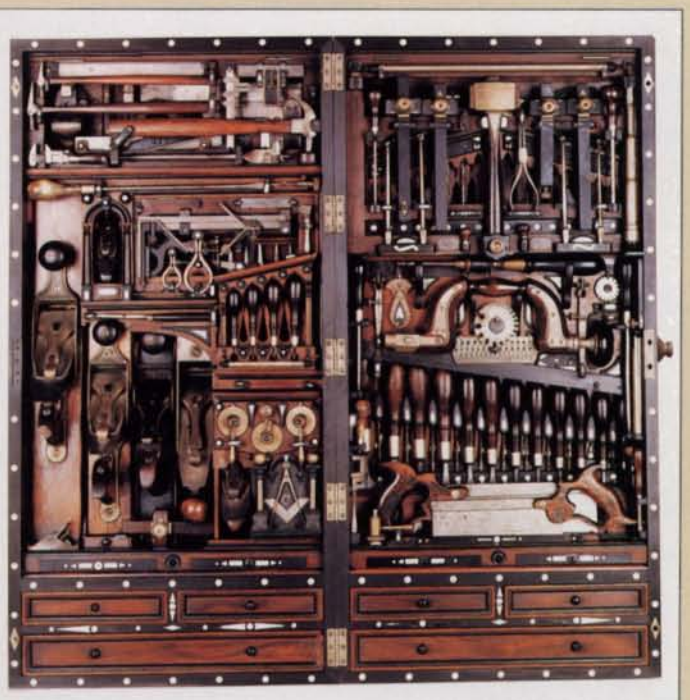

TOOL CHEST LEGACY

If the workmanship in a tool chest is any indication of the maker's talent, then the craftsmanship of master carpenter and stonemason H.O. Studley must have been awe-inspiring. In an oak clamshell box adorned with rosewood, ebony, pearl and ivory, Studley kept both tools he made and a collection of the finest hand tools made prior to 1900, including a complete set of woodworking tools as well as machinist and stonemasonry tools. To pack the 300-plus tools into a case only 19½ in. wide, 39 in. long and 9½ in. deep, Studley devised a jigsaw-puzzle arrangement of flip-up trays, fold-out layers and hidden compartments. Maine native Pete Hardwick now owns the chest, which has been in his family since it was bequeathed to his grandfather by Studley. Hardwick acquired the chest from his brother by trading a 1934 Ford sedan for it. A good trade? It would seem so. Just one tool—the Stanley #1 plane housed in the ebony archway in the upper-left part of the chest—was appraised at $700. Hardwick, a nonwoodworker, plans to sell the chest.

Now available from *Fine Woodworking* magazine

The response to *Fine Woodworking*'s July/August back cover was overwhelming. So many of you called or wrote asking for a poster reproduction of the exquisite tool chest by H.O. Studley, that we decided to go ahead and print one up.

We rephotographed the chest and enlarged the photo to fill the 18" x 26" poster shown above. Seen at this size, Studley's ingenuity and workmanship is even more apparent.

The poster is printed in full color on the same book-quality stock as the *Fine Woodworking* covers. And we'll mail it to you carefully rolled to keep it suitable for framing.

It makes a great gift for you or a friend.
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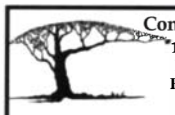
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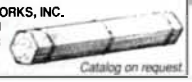

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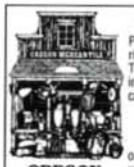

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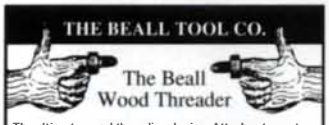

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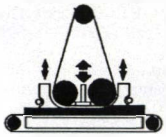
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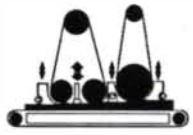
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1000VSR	3/8" Var. Spd. Rev. Drill	$131	$85
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1273D	4" x 24" Belt Sander w/D. Coll.	$345	$190
1290D	Fin. Sander, 1/2 Sheet Dustless	$232	$135
3258	3-1/4" Power Planer	$239	$145
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1290	1/2 Sheet Finishing Sander	$217	$95
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3283DVSK	Kit, (same as above)	$199	$139

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1601	1 hp. Router	$184	$105
1604	1-3/4 hp. Router	$236	$145
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1614EVS	1-1/4 hp. Var. Spd. Plng. Router	$255	$160
1615EVS	3-1/4 hp. Var. Spd. Plng. Router	$460	$265
1611	Plunge Router, 3-1/2 hp., 220 v.	$435	$269
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READER SERVICE NO. 48

Listings of gallery shows, major craft fairs, lectures, workshops and exhibitions are free, but restricted to happenings of direct interest to woodworkers. We list events (including entry deadlines for future juried shows) that are current with the time period indicated on the cover of the magazine, with overlap when space permits. We go to press three months before the issue date of the magazine and must be notified well in advance. For example, the deadline for events to be held in March or April is January 1; for July and August, it's May 1, and so on.

***NATIONAL & INTERNATIONAL:* Conference**–World Turning Conference, April 21–25, 1993. Wilmington, Delaware. Application deadline: Aug. 1. Contact Albert LeCoff, Wood Turning Center, PO Box 25706, Philadelphia, PA 19144. (215) 844-2188.
Juried exhibition–Redefining the Lathe-Turned Object. Call for entries. Slide deadline: Oct. 1. For prospectus, send SASE to Arizona State University Art Museum, Nelson Fine Arts Center, Tempe, AZ 85287-2911. (602) 965-2787.
Festival–International Craft Festival '92 Toyama, Sept.8–17. Toyama Prefecture, Japan. Contact Mr. Yamashita, Mr. Kuyo, Ms. Gen, Toyama Industrial Technique Center 150 Futakami-machi, Takaoka-City, Toyama Pref., Japan 933. 81-(0)766-28-1838.
Student competition–Design Emphasis '92, Aug. 21–24. Georgia World Congress Center, Atlanta, GA. For further information on the competition, contact Shirley Byron, Competition Coordinator, Design Emphasis '92, IWF, 8931 Shady Grove Ct., Gaithersburg, MD 20877. (301) 948-5730.
Show–1992 National Hardware Show, Aug. 17. 3M, 530 Fifth Ave., New York, NY 10036. (212) 536-7930. For more info, contact Michael R. Virgintino (212) 536-7921.

***CALIFORNIA:* Competition and exhibition**–Designs in Wood, thru July 5. Sponsored by San Diego Fine Woodworkers Association. For info, contact Southern California Expo, Entry Office, Del Mar, 92014-2216.
Workshops–Woodworking for women. Furnituremaking with hand tools using traditional joinery, weekends. Call for schedule: Debey Zito, (415) 648-6861.
Solicitation–New artists wanted for the Los Angeles Craft & Folk Art Museum Research Library. Used by collectors, curators, architects, designers. For info, contact Craft & Folk Art Museum Library, c/o the May Co., 6067 Wilshire Blvd., Los Angeles, 90036. (213) 934-7239.
Workshops–Various workshops including Japanese woodworking, joinery and sharpening. Contact Hida Tool Co., 1333 San Pablo, Berkeley, 94702. (415) 524-3700.
Proposals–The National Museum of Women in the Arts, Pennsylvania Guild of Craftsmen and the Virginia Center of the Craft Arts invite submissions of proposals for the conference Women and The Craft Arts, scheduled for Oct. 1993 in Washington, DC Proposal abstracts should be no longer than one typewritten page and sent to The National Museum of Women in the Arts, 1250 New York Ave., N.W., Washington, DC 20005-3920, Attn. Angela A. Adamas. Deadline: Sept. 30. For info, contact Paula Owen, Executive Director, The Hand Workshop, 1812 West Main St., Richmond, Va. 23220. (804) 353-0094.
Festival–The Best of the Arts & Crafts World, Sept. 18–20, Fort Mason Center, San Francisco. Contact Lori Loan (707) 778-6300
Exhibit–The Art of Function through Aug. 23, Baulines Crafts Guild, UC Museums at Blackhawk, Danville. Contact Baulines Crafts Guild, Schoonmaker Point, Sausalito 94965. (415) 331-8520.
Exhibition–California State Fair Fine Arts, Aug. 21–Sept. 7, California Works/California State Fair, Box 15649, Sacramento 95852. (916) 924-2282.
Fair–Pacific States Craft Fair, Fort Mason Center, San Francisco. For information contact American Craft Enterprises (800) 836-3470.
Classes–Various woodworking programs through Aug. 7. 440 Alger St., Fort Bragg 95437. (707) 964-7056.
Fair–A celebration of the California Northcoast's woodworking tradition, July 10–12. College of the Redwoods, 7351 Tompkins Hill Rd., Eureka. For general wood fair info, call (707) 445-6915 or (707) 445-6966; for gallery exhibition details call (707) 445-6915.

***COLORADO:* Classes**–Woodworking and related classes, year-round. Red Rocks Community College, 13300 W. 6th Ave., Lakewood, 80401. (303) 988-6160.
Workshops–Summer woodworking and furniture design workshops, thru Aug. Instructors include: Silas Kopf, James Krenov and Sam Maloof. For a free catalog, contact Anderson Ranch Arts Center, PO Box 5598, Snowmass Village, 81615. (303) 923-3181.
Seminars–Woodworking seminars, Sept. thru April. Contact Schlosser Tool and Manufacturing Co., 301 Bryant St., Denver, 80219. (303) 922-8244.

***CONNECTICUT:* Juried show**–SoNo Arts Celebration, Aug. 1–2. Waterfront district of South Norwalk. For an application, send SASE to SoNo Arts Celebration, Exhibiting Arts Committee, PO Box 2222, South Norwalk, 06852. (203) 849-9366
Juried show–New Views–A show for emerging artists, Sept. 26–Oct. 17. Application deadline Aug. 8. For application send SASE to New Views, Guilford Handcrafts Center, PO Box 589, Guilford 06437. (203) 453-5947.
Exhibition–Colorful Carvings and Bird Houses by Raintree Carving (Barry Leader), thru Aug. 2. Brookfield Craft Center, Route 25, Brookfield. (203) 775-4526.
Juried exposition–35th annual Guilford Handcrafts, July 16–18. Town Green, Guilford. (203) 453-5947.
Workshops–Bandsaw boxes, July 19–20; Shaker Oval Boxes, Aug. 1–2; Advanced Bowl Turning, Aug. 15–16; Building an Adirondack Guideboat, Aug. 17–22. Brookfield Craft Center, PO Box, Brookfield, 06804. (203) 775-4526.
Exhibition–57th annual Society of Connecticut Craftsmen, July 18–Aug. 9. New Canaan. For prospectus send SASE to Society of Connecticut Craftsmen, PO Box 615, Hartford 06142.

***FLORIDA:* Meetings**–Central Florida Woodworkers Guild, second Thursday of every month, Winter Park. For information, contact Ed Harte (407) 862-3338.
Meetings–Sarasota Woodworking Club. Second Thursday of every month. For info, contact Tom Clark, 3544 Oak Grove Drive, Sarasota, 34243. (813) 351-9059.
Show–Riverside Art Festival, Sept. 12–13. Riverside Avondale Preservation, 2623 Herschel St., Jacksonville 32204. (904) 389-2449.
Festival–30th annual Coconut Grove Arts Festival, Feb. 13–15, 1993. Deadline Sept. 15. For an application, write Coconut Grove Arts Festival, PO Box 330757, Miami 33233-0757. (305) 447-0401.

***GEORGIA:* Competition**–Design Emphasis '92 furniture design competition, call for entries. Sponsored by and held in conjunction with the International Woodworking Machinery & Furniture Supply Fair '92, Aug. 21–24, Georgia World Congress Center, Atlanta. For info on the competition, contact Shirley Byron, IWF, 8931 Shady Grove Court, Gaithersburg, MD 20877. (301) 948-5730.
Workshops–Japanese woodworking by Toshihiro Sahara. One Saturday each month, year-round. Contact Sahara Japanese Architectural Woodworks, 1716 Defoor Place N.W., Atlanta, 30018. (404) 355-1976.
Courses–Various woodworking courses, Feb. thru May. For info, contact Chris Bagby, Highland Hardware, 1045 N. Highland Ave., N.E., Atlanta, 30306. (404) 872-4466.

***IDAHO:* Festival**–24th annual Art on the Green festival, July 31–Aug. 2. Fort Sherman area of North Idaho College campus, Coeur d'Alene. For more info, contact Citizens Council for the Arts, PO Box 901, Coeur d'Alene, 83814. (208) 667-9346.

***ILLINOIS:* Exposition**–8th annual American Craft Exposition, Sept. 9–12. The Henry Crown Sports Pavilion, Evanston Lincoln St. Contact Shelly K. Robinson, Winger & Associates, 320 N. Michigan Ave. Suite 1901, Chicago 60601; (312) 263-4313, or Wendy Loeser, Evanston Hospital Public Relations Office, 1301 Central St., Evanston 60201; (708) 570-5105.

***INDIANA:* Classes**–Various woodworking classes and workshops including general woodworking, lathe and router seminars. Woodworking Unlimited, 6038 E. 82nd St., Indianapolis, 46250. (317) 849-0193.
Juried show–Works in Wood. For more info, contact Marsha Demkovich, Chesterton Art Gallery, PO Box 783, Chesterton, 46304 (219) 926-3041.
Classes Various log building classes thru Nov. 14. William M. Lasko School of Log Building, PO Box 274, Camby 46113-0274. (317) 856-6868.

***KENTUCKY:* Workshops**–Woodturning and joinery instruction. One-day to one-week courses. Contact Jim Hall, Adventure in Woods, 415 Center St., Berea, 40403. (606) 986-8083.
Meetings–Kyana Woodcrafters Inc., first Thursday of each month. Bethel United Church of Christ, 4004 Shelbyville Road, Louisville, 40207. (502) 426-2991.
Workshops–Traditional Windsor chairmaking instruction. One-week courses. Contact David Wright, 503 Prospect, Berea, 40403. (606) 986-7962.

***MAINE:* Classes**–Haystack Mountain School of Crafts, summer program. Contact 1992 Haystack Mountain School of Crafts, PO Box 518, Deer Isle, 04627. (207) 348-2306.
Exhibition–Guild of Maine Woodworkers, July 11–Aug. 22. Thomas Moser Galleries, 415 Cumberland Ave., Portland. (207) 774-3791. Contact Jack Vesery (207) 829-6650.
Classes–Boatbuilding and woodworking, thru Aug. WoodenBoat School, PO Box 78, Naskeag Rd., Brooklin 04616. (207) 359-4651.
Classes–Woodworking for adults and children in daytime, evenings and on weekends. Portland School of Art, 97 Spring St., Portland, 04101. (207) 775-3052.

***MARYLAND:* Show**–20th biennial Crafts Collection, thru July 13. Strathmore Hall Arts Center, Rockville. For more info, contact Mac Ehrlich, 6540 Bradley Blvd., Bethesda, 20817. (301) 365-1133.
Exhibition–10th annual Artscape '92, July 17–19. Crafts exhibition and market, Baltimore. For more info, call (410) 396-4575.
Juried show–29th annual Havre de Grace Art Show, Aug. 15–16. Tydings Memorial Park, Havre de Grace. For more information, contact Art Show, PO Box 174, Havre de Grace, 21078. (410) 879-4404 or (410) 939-3303.

***MASSACHUSETTS:* Workshops**–Summer workshops at The Heartwood School, Johnson Road, Washington, 01235. (413) 623-6677.
Workshops–Fundamentals in Fine Woodworking, July 13–24 and Aug. 10–21; Shaker Nightstand, July 13–24 and Aug. 10–21; Bow Repair and Restoration, July 20–31; Violin Repair, Aug. 3–14. For info, contact North Bennet Street School, 39 N. Bennet St., Boston, 02113. (617) 227-0155.
Classes–Woodworking classes, throughout most of the year. Boston Center for Adult Education, 5 Commonwealth Ave., Boston, 02116. (617) 267-4430.
Workshops–Summer woodworking classes. Contact Roy Nielsen, Dir. of Admissions, North Bennet Street School, 39 North Bennet St., Boston 02113. (617) 227-0155.
Classes–Sculpture, Expressions in Wood, Aug. 13–16. For more information, contact Horizons, 374 Old Montague Road, Amherst. 1002 (413) 549-4841.
Fair–10th annual Artisans' Fair of Crafts, Sept. 13. Codman House, Lincoln. For more info, contact Millie O'Connell or Gretel Smith, (617) 227-3956 or (617) 259-0076.

***MICHIGAN:* Classes**– Stiles Education Center, July 15–Sept. 30. For more info, contact the Center 3965 44th St., S.E. Grand Rapids 49512. (616) 698-7500.

***MINNESOTA:* Juried show**–10th annual Upper Midwest Woodcarvers' Exhibition, July 25–31. Blue Earth. For more information, contact Harley Schmitgen, 311 E. 14th St., Blue Earth, 56013. (507) 526-2777.
Classes–Woodcarving classes year-round. Also, seminars on woodturning, chair caning and whittling. Special one-week summer session Aug. 10–14. For info, contact the Wood Carving School, 3056 Excelsior Blvd., Minneapolis, 55416. (612) 927-7491.
Workshops–9th annual villa Maria Woodcarver's workshop, Aug. 9–15, Old Frontenac. For info write Villa Maria Woodcarvers Workshop, Box 37051, Minneapolis 55431 or call (612) 827-6590.

***MISSISSIPPI:* Classes**–Various classes. Allison Wells School of Arts & Crafts, Inc., PO Box 950, Canton (800) 489-2787 or (601) 859-5826.

***MISSOURI:* Show**–Third annual Wonders of Wood, Sept. 12–13. St. Peters Cultural Art Center, 3960 Mexico Road, St. Peters. For more info, call (314) 928-8571.

***NEBRASKA:* Classes**–Carving a Big-Horned Sheep, Sept. 18–20. Midwest Woodworkers Supply, Omaha. For more info, contact Midwest Woodworkers Supply, 13209 I St., Omaha, 68137. (402) 330-5444.

***NEW HAMPSHIRE:* Classes**–19th summer Violin Craftsmanship Institute. University of New Hampshire. For more information, contact Violin Institute, UNH Continuing Education, Brook House, 24 Rosemary Lane, Durham, 03824. (603) 862-1088.
Classes–Fine arts and studio arts. Manchester Institute of Arts and Sciences, 114 Concord St., Manchester, 03104.
Classes–Various woodworking classes, year-round. Including antique repairs, carving canes & walking sticks, small boxes, kitchen utensils, lathe-turning, hand-carving, more. Contact The Hand & I, PO Box 264, Route 25, Moultonboro, 03254. (603) 476-5121.
Auctions–Antique and craftsman's tool auctions, year-round. Contact Richard A. Crane, Your Country Auctioneer, 63 Poor Farm Road, Hillsboro, 03244. (603) 478-5723.
Fair–59th Annual Craftsmen's Fair, Aug. 1–9. Mt. Sunapee State Park, Newbury. For more info, contact League of New Hampshire Craftsmen Foundation (603) 224-1471.

***NEW JERSEY:* Juried show**–22nd annual Peters Valley Craft Fair, July 25–26. For more info, contact Peters Valley Craft Fair, 19 Kuhn Rd., Layton, 07851. (201) 948-5200.
Juried festival–Waterloo Arts and Crafts Festival, Sept. 26–27. Waterloo Concert Field, Stanhope. For info, call the Stella Show Management Co. at (201) 384-0010.
Workshops–Summer woodworking program, thru Aug. For brochure, write to Peters Valley Craft Center, 19 Kuhn Road, Layton 07851, or call (201) 948-5200.

***NEW MEXICO:* Exhibition**–1992 New Mexico Woodworkers, July 11–Aug. 9. Santa Fe Community College, PO Box 4187, Santa Fe 87502-4187. For more information, call Marilyn Batts (505) 438-1230.
Seminar and juried exhibition–Seminar with master cabinetmaker James Krenov and an exhibition of fine woodworking, July 10–11. For more info, contact Santa Fe Community College, Community Services, PO Box 4187, Santa Fe, 87502-4187.
Classes–Woodworking classes. Northern New Mexico Community College, El Rito, 87520. (505) 581-4501.
Classes–Fine woodworking classes, Santa Fe Community College, Santa Fe 87502 (505) 438-1361.

***NEW YORK:* Classes**–Boatbuilding, thru Sept. Antique Boat Museum, 750 Mary St., Clayton, 13624. (315) 686-4104.
Workshops– Japanese Hand Tool workshops by Robert Meadow, July 11–12. The Luthierie, 2449 West Saugerties Rd., Saugerties 12477. (914) 246-5207.
Exhibition–Step Lively: The Art of the Folk Cane, thru Sept. 7. Museum of American Folk Art, 2 Lincoln Square, New York. Contact Susan Flamm at (212) 977-7170.
Festival–Chautauqua Crafts Festival, July 3–5 and Aug 7–9. Bestor Plaza, Chautauqua Institution. For info, con-

tact Gale Svenson, Director, Chautauqua Crafts Festival '92, PO Box 89, Mayville, 14757. (716) 386-6043.
Juried festival–16th annual American Crafts Festival, July 4–5 and July 11–12. Lincoln Center, New York City. For more info, contact Brenda Brigham, American Concern for Artistry and Craftsmanship, PO Box 650, Montclair, NJ 07042. (201) 746-0091.
Classes–Various beginning and advanced woodworking classes. Constantine, 2050 Eastchester Road, Bronx, 10461. (212) 792-1600.
Meetings and classes–New York Woodturners Association, first Tuesday of each month. Woodturning techniques, exhibits, more. Also, Woodworking with Maurice Fraser. The Craft Student League, YWCA, 610 Lexington Ave., New York City.
Festival–Southampton Fine Craft Festival, Aug. 7–9. Long Island Univ., Southampton. Contact Linda Faulkner (518) 584-1819.
Fair–New York International Gift Fair, including Accent on Design and American & International Crafts. Aug. 9–13. Jacob K. Javits Convention Center, New York.
Festival–15th annual New York Renaissance Festival, Aug. 1–Sept. 20 (weekends). Sterling Forest, Tuxedo. For more info, call (516) 288-2004.
Exhibition–More Than One: Contemporary Studio Production. Aug. 13–Nov. 8, featuring Skip Abelson. American Craft Museum, 40 West 53rd St., New York 10019. (212) 956-3535.
Festival–Market Street '92–A Festival of the Arts, Aug. 22–23. Historic Market Street, Corning. Contact Linda Faulkner (518) 584-1819.
Fair–Woodstock–New Paltz Art & Crafts Fair, Sept. 5–7, Ulster County Fairgrounds, New Paltz. For more info, contact Scott Rubinstein/Neil Rubinstein, Quail Hollow Events, PO Box 825, Woodstock, 12498. (914) 679-8087 or (914) 246-3414.
Festival–8th annual Autumn Crafts Festival, Aug. 29–30, Sept. 5–7. Lincoln Center, Fordham University Plaza, New York City. Contact Brenda Brigham, American Concern for Artistry and Craftsmanship, PO Box 650, Montclair, NJ 07042. (201) 746-0091.
Exhibition–Craft Art: Western New York, 1992, Sept. 19–Nov. 29. Burchfield Art Center, Rockwell Hall, SUNY College at Buffalo, 1300 Elmwood Avenue, Buffalo. For more info, contact the Center at (716) 878-6012.
Show–28th annual antique boat show, July 30–Aug. 2. The Antique Boat Museum, 750 Mary St., Clayton 13624. (315) 686-4104.
Seminars/Workshops–Tools of the Woodworking Trades, July 5–8; Shaker oval boxes, whirligigs, July 5–8; faux finishes, coopers trade workshop, July 8–11. For more info contact Seminars on American Culture, New York State Historical Association, PO Box 800, Cooperstown, 13326 (607) 547-2534.

NORTH CAROLINA: **Shows**–2nd annual Heritage Art and Craft Show, July 1–5. Old Threshers' Reunion, Denton; 4th annual Mountain Magic Art and Craft Show, July 10–12. Carolina Day School, Asheville. High Country Crafters, 46 Haywood St., Asheville, 28801. (704) 254-2787.
Workshops–Summer woodworking workshops, thru Aug. Penland School, Penland. For a catalog, write to Penland School, Penland, 28765 or call (704) 765-2359.
Video course–Wood Technology, 6-lesson correspondence course on the wood industry. Contact Ms. Vann Moore, Dept. of Wood & Paper Science, N. C. State Univ., PO Box 8005, Raleigh, 27695-8005. (919) 737-3181.
Workshops–Woodworking and woodcarving workshops, year-round. For info, contact John Campbell Folk School, Route 1, Box 14-A, Brasstown, 28902. (800) 562-2440 or (704) 837-2775.
Meetings–North Carolina Woodturners, second Saturday of every month. Also, woodturning workshops for all levels. For info, contact Eric Hughes, Route 3, PO Box 300, Conover, 28613. (704) 464-5611.
Classes–Woodworking, design business marketing, associates degree program. Haywood Community College, Freedlander Dr., Clyde 28721 (704) 627-2821. For more info, contact Wayne Raab.
Show–8th annual Woodworking World Carolina Show, Sept. 25–27. Omni Durham Hotel, Durham. For more info, call (800) 521-7623 or (603) 536-3768.
Juried shows–13th annual Summerfest Art & Craft show, Aug. 21–23. Asheville Civic Center. Juried by slides/photos. Legal SASE. Fee; 15th annual Indian Summer Art & Craft Show Oct. 8–11. Asheville Mall. Juried by slides/photos. Legal SASE. Fee. Contact Gail Gomez, High Country Crafters, 46 Haywood St., Asheville 28801. (704) 254-7547.
Workshops–17th century joinery, July 6–11; toolmaking for woodworkers, July 20–24; Windsor chairmaking, Aug. 3–8; ladderback chairmaking, Aug. 17–22; Japanese woodworking, Aug. 31–Sept. 4; crafts and chalet tour of Switzerland, Sept. 29–Oct. 8. Country Workshops, 90 Mill Creek Rd., Marshall 28753. (704) 656-2280.
Fair–45th annual Guild Fair, July 16–19. Asheville Civic Center, Asheville. Contact Folk Art Center (704) 298-7928

OHIO: **Seminar**–Traditional Windsor Chairmaking, David Wright, July 25. Carriage Hill Farm, 7860 Shull Rd., Dayton 45424. For info, call (606) 986-7962.

OKLAHOMA: **Show**–16th annual woodcarving, July 10–12. Tulsa Promenade Shopping Mall, 4107 S. Yale Ave., Tulsa, 74135. For info, contact Henry and Sally Moreland, 803 Comet St., Claremore 74017. (918) 341-3809.

OREGON: **Show**–About Beds, thru June 14. Made in Jefferson Gallery, 3259 Jefferson Scio Drive, Jefferson. For info, contact Toni Gilbert at (503) 327-2543.
Workshops–Special English Finishing Techniques, July 13–17; Conservation and Restoration, July 20–24. Instructor: Bruce Luckhurst. Oregon School of Arts and Crafts, 8245 S.W. Barnes Road, Portland, 97225. (503) 297-5544.
Juried show–Nehalem Fine Woodworking Show, Aug. 1–31. Artisans's Gallery, 12870 H St. (Highway 101). Contact Deborah Kerner, Artisan's Gallery, PO Box 367, Nehalem, 97131. (503) 368-7301.
Meetings–Guild of Oregon Woodworkers, third Friday of every month. For location, contact the Guild at PO Box 1866, Portland, 97207. (503) 293-5711.
Exhibition–Hugh E. McKay, July 4–Aug. 8, sculpted turned wood vessels. Earthworks Gallery, 2222 Hwy. 101 N., Yachats 97498. (503) 547-4300.
Workshops–English and French Wood Finishing Techniques, July 13-17; Conservation and Restoration of Period Furniture, July 20-24. Oregon School of Arts & Crafts, 8245 Southwest Barnes Road, Portland 97225. (503) 297-5544.
Meetings–Cascade Woodturner's Association, third Thursday of each month. For location, contact Cascade Woodturners, PO Box 91486, Portland 97291.

PENNSYLVANIA: **Juried exhibitions**–The Narrative Art in Contemporary Crafts, Aug. 8–Sept. 20. For more info, contact Luckenbach Mill Gallery, 459 Old York Road, Bethlehem, 18018. (215) 691-0603.
Festival–9th annual Penn's Colony Festival, Sept. 19–20 and Sept. 26–27. For info, contact Penn's Colony Festival, 603 E. End Ave., Pittsburgh, 15221. (412) 241-8006.
Classes–Woodcarving at Sawmill Center for the Arts, thru Aug. For more info, contact Cook Forest Sawmill Center for the Arts, PO Box 180, Cooksburg, 16217.
Juried festival–Central Pennsylvania Festival of the Arts, July 9–12. For info, contact Katherine Talcott, Assistant Director, Central Pennsylvania Festival of the Arts, PO Box 1023, State College, 16804. (814) 237-3682.
Classes–Windsor chairmaking, all levels, weekly and weekends. Contact Jim Rendi, Philadelphia Windsor Chair Shop, PO Box 67, Earlville, 19519. (215) 689-4717.
Classes– Woodturning with David Ellsworth. Three-day weekend workshops in private studio. Limit 4 students. July 17–19, 24–26; July 31–Aug 2. For information, contact David Ellsworth, Fox Creek, 1378 Cobbler Rd., Quakertown 18951. (215) 536-5298.
Seminars–Spindle turning, Palmer Sharpless, Aug. 22–26; natural and chemical coloring, color bleaching and difficult stain removal, Prew Savoy, Sept. 19–20; build a sack back Windsor, Mike Dunbar, Sept. 26–30; woodfinish and antiques, George Frank, Oct. 10–11; period restoration and touch-up, Eli Rios, Oct. 17–18; traditional Shaker oval boxes, John Wilson, Oct. 25; chip carving, Wayne Barton, Nov. 14–15. For registration info contact Olde Mill Cabinet Shoppe, 1660 Camp Betty Washington Rd., York, 17402. (717) 755-8884.
Exhibition–Guild of Maine Woodworkers, Thos. Moser Galleries, 210 West Washington Square, Philadelphia (215) 922-6440. For info, contact Jack Vesery, (207) 829-6650.

RHODE ISLAND: **Exhibition**–Nine Rhode Island Masters of Furniture Design, July 3–Sept. 14. Newport Art Museum, Newport. Contact Ms. Sharp, (401) 848-8200.
Call for entries–Call for entries for major woodworking exhibition at the Museum of Art at Rhode Island School of Design (Providence). Entry deadline April 1, 1993. For further information, send SASE with two 29-cent stamps to: Seth Stem, Box 4-14, Rhode Island School of Design, 2 College St., Providence 02903-2784.

TENNESSEE: **Workshops**–Woodcarving with Jess Betschart, July 20–24; Woodturning with John Jordan, July 20–24. For more info, contact Ilene Quall, Appalachian Center for Crafts, PO Box 430, Route 3, Smithville, 37166. (615) 597-6801.
Workshops–Summer workshops at Arrowmont School of Arts and Crafts, thru Aug. For information, contact Registrar, Arrowmont School, PO Box 567, Gatlinburg, 37738. (615) 436-5860.
Exhibition–Summer Faculty and Staff, thru Aug. 14. Arrowmont School of Arts and Crafts, PO Box 567, 556 Parkway, Gatlinburg 37738-0567. (615) 436-5860.

TEXAS: **Convention**–Los Amigos del Mesquite annual convention, competition and trade show, Sept. 24-27. Wyndham Hotel, Austin. For more info, contact Herb Nordmeyer, Los amigos del Mesquite, PO Box 68, Knippa 78870 (512) 934-2616.

VERMONT: **Classes**–Shop courses, thru Aug 1. For more info, contact Yestermorrow, PO Box 344, Warren, 05674. (802) 496-5545.
Classes–Cedar/Canvas Canoe Construction, July 5–10 and Sept. 6–11. For more information, contact Sterling College, Craftsbury Common, 05827 or call Horace Strong at (802) 586-2575.
Classes–Woodcarving: Ornamental and three-dimensional. July 6–Aug. 21. Fletcher Farm School for the Arts and Crafts, Route 1, PO Box 1041, Ludlow 05149. (802) 228-8770. For more information, contact Alma Rounds, 77 Chestnut Street, Brattleboro 05301.
VIRGINIA: **Exhibition**–Spotlight '92, thru July 31. Sponsored by Southeast Region of the American Craft Council and Hand Workshop, Virginia Center for the Craft Arts. For info, contact Spotlight '92, Hand Workshop, 1812 W. Main St., Richmond, 23220. (804) 353-0094.
Show–14th annual Claytor Lake Arts & Crafts, Sept. 5–7. Claytor Lake State Park, Dublin. Contact Kathy Firebaugh, Virginia Mountain Crafts Guild. (703) 977-4686.
Nominations–Lifetime Achievement Awards. Nominations should be no longer than one type written page and sent to The National Museum of Women in the Arts, 1250 New York Ave., N.W., Washington, DC 20005-3920, Attn: Harriet McNamee. For more info, contact Paula Owen, The Hand Workshop, 1812 West Main St., Richmond 23220. (804) 353-0094.
Competition–Call for entries, toys and games, Target Gallery at the Torpedo Factory Art Center, Alexandria. Deadline Sept. 1. Exhibition Dec. 6–Jan. 30, 1993. Fee. For prospectus, send a #10 SASE to The Game Show, Torpedo Factory Artists' Association, 105 N. Union St., Alexandria 22314 (703) 549-5543.

WASHINGTON: **Meetings**–Northwest Woodworkers Guild, last Wednesday of each month. For more info, contact John Gruenewald 622 9th Ave., Kirkland, 98033. (206) 827-8012.
Workshops–Various boatbuilding workshops thru Aug. The Center for Wooden Boats, 1010 Valley St., Seattle 98109. (206) 382-BOAT.
Workshops–Boatbuilding workshops and seminars year-round. For more information, contact Northwest School of Wooden Boatbuilding, 251 Otto St., Port Townsend, 98368. (206) 385-4948.

WEST VIRGINIA: **Workshops**–Workshops include Windsor chairmaking and basic cabinetry, thru Aug. 17. For more information, contact Crafts Center, Cedar Lakes, Ripley, 25271. (304) 372-7005.
Workshops–Workshops include Banjo Construction, Log House Construction and Chip Carving, July and August. Contact Augusta Heritage Center, PO Box CN, Davis and Elkins College, Elkins, 26241-3996. (304) 636-1903.
Festival–16th annual Lake Union wooden boat festival, July 3-5. The Center for Wooden Boats, 1010 Valley St., Seattle 98109. (206) 382-BOAT.

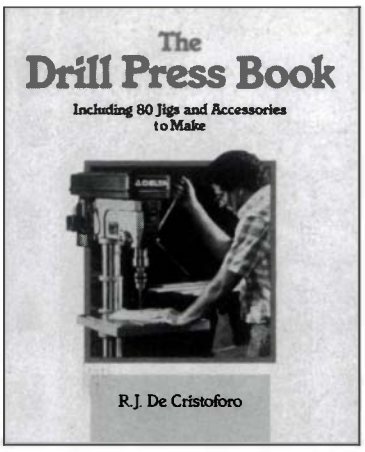
WISCONSIN: **Seminars**–Wood technics training, July, Sept., Nov., Jan., Mar., May 1993. Fox Valley Technical College, Oshkosh. For more information, contact Karen Schallhorn, Fox Valley Technical College, Oshkosh campus, 150 North Campbell Rd., PO Box 2217, Oshkosh 54903-2217. (414) 236-6110.

CANADA: **Juried exhibition**–Southern Alberta Woodworkers Society. Call for entries. For more information, write Southern Alberta Woodworkers Society, PO Box 6753, Station D, Calgary, Alberta, T2P 2E6. Contact, Doug Haslam: (403) 270-3195.
Show–Woodturnings by Bob Gonzales, July 4–5 and July 11–12. Arnold Mikelson Mind and Matter Gallery, 13743 16th Ave., White Rock, Surrey, B.C. (604) 536-6460.
Juried exhibition and show–9th annual Wood Show, Aug. 7–9. Durham Community Centre, Grey County. For brochure or info, contact The Wood Show, PO Box 920, Durham, Ont., N0G-1R0. (519) 369-6902.
Workshops–Furniture workshops, thru Aug. 8. Sheridan College Summer School of the Arts, 1430 Trafalgar Road, Oakville, Ont., L6H 2L1. (416) 845-9430.
Seminar–Woodturning Design and Technique III, Aug. 1–3, Kelsey Campus, Saskatoon. Instructors: Del Stubbs, Richard Raffan, Giles Gilson, Mark Sfirri. For more information, contact Saskatchewan Craft Council, 813 Broadway Ave., Saskatoon, Sask. S7N 1B5 (306) 653-3616.
Classes–Furnituremaking, carving, lathe turning, router and more. Tools 'n Space Woodworking, 338 Catherine St., Victoria, B.C., V9A 3S8. (604) 383-9600.
Meetings–Canadian Woodturners Association meetings, throughout the year. Second Tuesday of each month. Contact Patrick Chen, PO Box 8812, Ottawa, Ont., K1G 3J1. (613) 739-7746.
Meetings–Blue Mountain Woodworking Club meetings, throughout the year. Third Wednesday of each month. Contact Glenn Carruthers, PO Box 795, Stayner, Ont., L0M 1S0. (705) 444-1752.
Meetings–West Island Woodturners Club meetings, second Tuesday of each month. Also, woodturning courses. Contact Eric Webb, 61 Devon Road, Beaconsfield, Que., H9W 4K7. (514) 630-3629.
Meetings–Northern Alberta Woodcrafters Guild meetings, third Thursday, Sept. thru June. Contact Douglas Lobb, 121 Healy Road, Edmonton, Alberta, T6R 1W3. (403) 430-7391.
Exhibition–A treasury of Canadian craft, thru Sept. 7. The Canadian Craft Museum, 639 Hornby St., Vancouver, B.C. V6C 2G3 (604) 687-8266.
Classes–Various summer classes and workshops thru Aug. 14. Haliburton School of Fine Arts, PO Box 839, Haliburton, Ont. K0M 1S0 (705) 457-1680.

ENGLAND: **Classes**–Woodworking classes. Smith's Gallery, 56 Earlham St., WC2. Contact Laetitia Powell, Parnham, Beaminster, Dorset, DT8 3NA. (0308) 862204.

MEXICO: **Show**–Tecno Mueble Internacional (International Woodworking & Furniture Supply Show), July 10-12. Expo Guadalajara Center, Guadalajara, Jalisco, Mexico. For more information, contact Trade Shows, Inc., PO Box 796, Conover, NC 28613 (704) 459-9894.

The Drill Press Book by R. J. De Cristoforo. *TAB Books, Blue Ridge Summit, Pa. 17294-0850; 1991. $16.95, paperback; 290 pp.*



The Drill Press Book covers a lot of information in a well-thought-out-manner that's useful for a woodworker of any skill level. It serves as a reference manual or as a replacement owner's manual. The photographs and drawings are clear and convey as much as the text does.

When I first opened this book, I had to look at the copyright date because it looks and feels like a book published 20 years ago. The black-and-white photographs, many of which depict old machines, add to the impression that you might expect to find this book in a used book store.

This isn't the kind of book most people would read from cover to cover. Instead, it's more of a reference book and as such I feel the index and the table of contents are the most important parts. The table of contents is four pages long and covers all of the main points as well as the usual chapter listings. To evaluate the index, I went through the book, page after page, looking for key words to see if they were in the index; the index came through for me about 80 percent of the time—which is not a bad percentage.

I don't think any woodworker ever has enough jigs and fixtures. They allow us to do in minutes what would have taken hours. This book has a fixture for almost any use. Most of them are fairly simple to make and will allow the drill press to be used more often. Fixtures also allow the drill press to be used on smaller or odd-shaped pieces more safely.

One of the many ways the author uses the drill press is as a router, and though he covers this method in great detail and includes a discussion of the safety considerations, I would go a step further and advise novices to avoid this practice.

The Drill Press Book would be a great addition to any tool-book collection. It's written by a professional for both professional and non-professional woodworkers. Woodworkers will have to let their instincts guide which techniques to try, but this book offers many new options for an underutilized tool. —***Benjamin Wild***

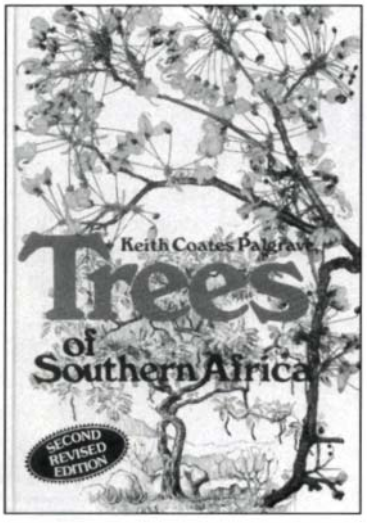
Outdoor Structures by Nick Engler. *Rodale Press, 33 E. Minor St., Emmaus, Pa. 18098; 1990. $19.95, hardback; 123 pp.*

Have you ever wanted to build a gazebo, but were afraid to tackle the tricky, angled joinery and complex, decorative details? If so, this book could be what you're looking for. In fact, it could prove to be a handy reference if you are planning to build any of a number of outdoor, yard and garden structures ranging from bird houses to a two-story storage barn. The plans are clearly illustrated, well detailed and cover a diverse array of outdoor projects.

Aside from the gazebo, bird houses and barn, Engler delves into five different styles of fencing and other can't-do-without items such as a "user-friendly" doghouse, picnic shelter, country deck, sheltered firewood rack, trash can corral and a lattice-work affair he calls a sunshade, which looks a little like something you might find in a tobacco field in the South.

Having read most of Engler's books in this Build-it-Better-Yourself series, I must confess this one provides only a few projects that I would have any interest in building. But it's probably his best work to date when it comes to providing construction insights that can readily apply to other projects of the reader's own design. The tips and techniques scattered throughout the book do an excellent job of describing the structural essentials for pier-and-beam foundations, pouring concrete slabs, setting poles so they don't heave, installing windows and doors, building sturdy and functionally proportioned stairs, installing shingles correctly, and using fasteners and brackets to keep joints snug. Regardless of how skilled a woodworker might be in cabinetmaking and joinery, outdoor projects can be a very different kind of challenge. This book helps provide an understanding of the special requirements exposure to the elements brings to the design process. —***Jon Arno***

Trees of Southern Africa, second revised edition by Keith Coates Palgrave. *Struik Publishers, Cape Town, South Africa 8001; 1990. $37.50, hardback; 959 pp.*



Trees of Southern Africa is a comprehensive guide to the trees of South Africa, Rhodesia, South West Africa, Botswana, Lesotho, Swaziland and southern Mozambique. The book describes and illustrates all the indigenous and many of the naturalized trees occurring in this region. But this is a book not just for those interested in the identification of southern African trees. Users of wood products from these species will find the properties and uses of the wood described here and those interested in the ecology of these species will be able to use this book to inform themselves about a fascinating flora.

The format of the book is essentially that of a field guide. Species identification is based on characteristics that can be easily observed through most of the year in combination with geographical information, e.g., vegetative characteristics with an occasional reference to fruits. Species descriptions are accompanied by range maps and illustrations of the most useful identification features. In a separate and very attractive section, drawings of each tree are accompanied by close-up detail and color photographs to give a field impression of the tree and its flowers and fruits.

This is not a book to sit down to read cover to cover on a long winter's evening. However, with its 900 plus pages of keys, species descriptions and illustrations, it is a goldmine of interesting facts about this fascinating flora. Following the botanical description of each species is information and comments on the uses and ecology of the plant. There is a wealth of information concerning African medicinal uses of these plants, and if the tree is of economic value, its uses are described. For example, the entry for Khaya nyasica (red mahogany) runs the gamut: the bark is bitter, resembling quinine and an infusion is used by Africans to relieve colds; the stems are used for dugout canoes; it is one of the most important timber woods over large areas of Mozambique, Malawi and Zambia; it is reddish, hard, works easily, takes a fine polish and is suitable for furniture.

A visit to a university biological library turned up no single volume as complete as this one for this particular flora. That it is an extremely attractive and easy-to-use publication is a bonus.

—***Hilary Woodcock***

Benjamin Wild teaches high school vocational training and runs an apprenticeship program in Rochester, N.Y. Jon Arno is a wood technologist and consultant in Schaumburg, Ill. Hilary Woodcock has a degree in botany from London University and is a graduate student at the University of Massachusetts at Amherst.

From left to right, *Tim Philbrick's nightstands, Hank Gilpin's chest of drawers and Tage Frid's three-legged stool illustrate the range of furniture styles and types shown at the Virginia Lynch Gallery in Tiverton, R.I., last November. A coffee table, recently designed by Frid (left), features a skin of rosewood veneer over a maple substrate. Its curved legs and apron lend it a sprightly, energetic appearance.*

Rhode Island's embarrassment of riches

It's the smallest state in the nation (there are glaciers in Alaska that are bigger), but there's no shortage of woodworking talent in the Ocean State. From colonial times, Rhode Island furnituremakers have crafted meticulously detailed, sturdy furniture intended to weather the years.

That tradition continues today, as evidenced by a show at the Virginia Lynch Gallery in Tiverton, R. I., which took place last November. The show featured the works of six Rhode Island furnituremakers, including Tage Frid, professor emeritus of woodworking at the Rhode Island School of Design (RISD). Two of the furnituremakers, Hank Gilpin and John Dunnigan, are former students of Frid, from his days at RISD, and Dunnigan teaches there now. John Marcoux, Timothy Philbrick and Stephen Turino were the other three furnituremakers represented.

Styles varied from Arts and Crafts to Postmodern, but the emphasis was decidedly non-traditional. The furniture ranged from Frid's signature stool shown in the top photo above to a massive granite-topped bubinga sideboard by John Dunnigan. Chairs and tables made up the majority of the work, but there were also a few pieces of casework to round things out (see the photos above). The response to the exhibition was so positive that another show has been scheduled at the gallery from July 3 through Sept. 14 of this year. The show will include all of the furnituremakers featured in last fall's show as well as current RISD faculty members Roseanne Somerson, Alphonse Mattia and Seth Stem (author of the book *Designing Furniture*).

—Vincent Laurence

Photos: Jonathan Percy

Product reviews

CMT Tools router bits, *CMT Tools, 5425 Beaumont Center Blvd., Suite 900, Tampa, Fla. 33634; (813) 886-1819.*
CMT Tools has been making router bits for 30 years but has only been selling bits under their own name in this country since January. CMT used to supply several major international tool manufacturers who did business in the United States, but cheaper sources of supply eventually supplanted CMT. In marketing their bits for the first time in this country, CMT is betting that there are enough woodworkers willing to pay a fair price for premium goods.

The first thing that struck me about the CMT bits (besides their color—Safety Orange) was the anti-kickback design; the profile bits look different from their conventional counterparts. CMT's literature explains that by milling the bodies of the bits so they're just fractionally smaller than the cutters, the bit can only take a small bite with each revolution. The result: Kickback is all but eliminated, and neither feed rate nor performance are affected.

As much attention seems to have gone into materials as design. According to Carlo Venditto, CMT's U.S. chief, the fatigue-proof steel used for the bits (and by Ferrari and Porsche for their engine and transmission parts) has excellent uniformity in hardness from the center to the surface, and it is electromagnetically tested for cracks before it's ground to shape.

Other features that set CMT's bits apart, according to Venditto, are the quality of the carbide and the process for applying the Teflon. Because the Teflon coating is baked on, not painted on, as with other Teflon-coated bits, it's there to stay.

Ultimately, though, a bit must be measured by how well it performs. These bits met the challenge. They cut coves on the edges of the mahogany shelves I was working on as though they were butter. I expected as much. But when another editor used a straight bit to rout dadoes for drawer bottoms in rock maple sides, I expected he'd encounter more resistance. Instead, the maple boards cruised effortlessly over the bit (see the top photo at left), leaving a clean, smooth surface, free of burn marks. I can't say how they'll hold up after a few hundred hours of use, but I suspect they'll still be going strong. These are among the finest bits I've used.

Prices vary according to the bit but range from $12 to $29 a piece. Savings are available when buying them in sets.
—Vincent Laurence, assistant editor of FWW.

***Even in rock maple,** CMT bits met little resistance. Proprietary micrograin carbide provides a fine cutting edge, and baked-on Teflon all but eliminates drag. The bits are available individually or in sets.*

TS-Aligner consists of a dial indicator mounted on an arm that travels vertically on linear bearings. The cam-follower bearings that fit in the miter-gauge slot allow horizontal movement.

TS-Aligner, *1016 Morse Ave., Fair Oaks Industrial Park, Suite 21, Sunnyvale, Calif. 94089; (800) 333-4994.*
The Edward J. Bennett Co. recently introduced TS-Aligner, which is designed to make tuning up a tablesaw "a simple step-by-step procedure." According to the pamphlet that comes with the tool, TS-Aligner will check a blade for flatness, angle to the saw table and parallel alignment to the miter-gauge slots; it checks the fence for flatness, squareness to the table and alignment to the miter-gauge slots. TS-Aligner also determines the amount of miter-gauge play in the slots, the accuracy of the miter-gauge scale and the condition of the arbor bearings.

TS-Aligner consists of a dial indicator mounted on a base that slides in the miter-gauge slots. This basic setup costs $190 plus shipping. There are numerous extras, including angle-plate sets, a precision square, a set of parallel blocks and an oak storage case. The complete package costs more than $400.

I sent the Aligner to a couple of our machinery experts for evaluation. They felt that the product as a whole was poorly designed. One of the reviewers stated that the Aligner seems to be "designed to withstand wear that will never occur while it's susceptible to dust that's always around." And, as if to acknowledge this shortcoming, the warranty states that "damage due to dirt, sawdust, any other foreign matter or to neglect is not covered."

Both reviewers also noted that when checking blade flatness with TS-Aligner, all you can really determine is that *something* is wrong: It could be the blade, the flange, the arbor or the arbor bearings. Without a more specific diagnosis, you don't know. The owner's manual provides minimal guidance, but for nearly $200, I'd expect more information on tablesaw tuneup.

When I tried TS-Aligner on a Delta contractor's saw, I found the Aligner's play in the miter-gauge slots excessive. The owner's manual instructs one to "put a small rotational force on the entire unit," placing "the cam-follower bearings against opposite sides of the slot [to] eliminate any play." But it's hard enough to rotate the blade by pulling on the drive belt while holding the Aligner still, without also having to rotate it in the slot.

Specific criticisms aside, though, I don't think that the TS-Aligner is worth $190. For perhaps half of the cost, you can buy a quality combination square, a set of feeler gauges and a book on setting up your tablesaw. If you decide you need .001-in. accuracy when checking your saw's alignment, you can buy a good quality dial indicator with a magnetic base for around $80. *—V. L.*

Bandsaw tires, guides and blades

Parts for tuning up your bandsaw can be hard to find. Although large, general woodworking catalogs offer a little bit of everything, they can't—by their very nature—be all things to all woodworkers. That's where smaller, specialty companies come in. In conjunction with Bob Vaughan's article on installing bandsaw tires (see p. 50), we thought we'd provide information on a couple of small companies that specialize in bandsaw items.

Tires are available from G. C. Peterson Machinery Co. (3125 S. 108th St., West Allis, Wis. 53227; 414-543-5522) and from Carter Products Co., Inc. (437 Spring St., N.E., Grand Rapids, Mich. 49503; 616-451-2928). Carter also specializes in precision guides for most bandsaws. And, finally, Suffolk Machinery Corp. (12 Waverly Ave., Patchogue, N.Y. 11772; 800-234-7297) manufactures and sells Swedish silicon-steel bandsaw blades for every purpose. They have been in business for 16 years, and it's all they do. *V.L.*

Notes and Comment

Got an idea you'd like to get off your chest? Know about any woodworking shows, events or craftsmen of note? Just finished a great project? If so, we'd like to hear about them. How about writing to us? And, if possible, send photos (preferably with negatives) to Notes and Comment, Fine Woodworking, ***PO Box 5506, Newtown, Conn. 06470-5506.***

Photos: Vincent Laurence

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260-1
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w/1 HP motor

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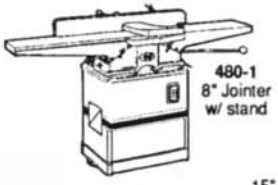
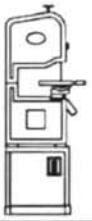
GENERAL



480-1
8" Jointer
w/ stand



490-1
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695	1-1/2 Hp Router-Shaper Table	335	203
696	Router-Shaper Table	185	122
693	1-1/2 Hp Plunge Router	295	165
6931	Plunge Router Base	120	75
7518	3-1/4 Hp 5 Speed Router	475	265
7519	3-1/4 Hp Router	410	224
7536	2-1/2 Hp Router	355	199
7537	2-1/2 Hp D. Handle Router	375	209
7538	3-1/4 Hp Plunge Router	410	224
7539	3-1/4 Hp V/S Plunge Router	475	264
5060	Stair Ease Template	200	139
5061	Stair Ease Template Hardwood	210	145
59381	Door Hinge Butt Template Kit	240	159
5116	Omni-Jig 16" Dovetail Jig	400	259
7310	5.6A Laminate Trimmer	150	89
7312	5.6A Offset Base Lam. Trimmer	215	122
7319	5.6A Tilt Base Lam. Trimmer	170	105
7399	5.6A Drywall Cutout Unit	145	85
97310	Laminate Trimmer Kit	345	188

SANDERS

303	Paint Remover	270	170
304	7" Disc Sander	235	139
305	7" Polisher	235	137
351	3"x21" Belt Sander w/o Bag	245	137
352	3"x21" Belt Sander w/ Bag	255	142
360	3"x24" Belt Sander w/ Bag	330	182
361	3"x24" Belt Sander w/o Bag	310	174
362	4"x24" Belt Sander w/ Bag	345	189
363	4"x24" Belt Sander w/o Bag	330	184
503	3"x24" HD Belt Sander w/ Bag	550	345
504	3"x24" HD Belt Sander w/o Bag	535	335
330	Speed Bloc Sander 1/4" Pad	102	57
505	1/2 Sheet Pad Sander	210	117
9505	1/2 Sheet Commem. Sander	240	129
7334	5" Random Orbit Sander	210	119
7335	5" V/S Random Orbit Sander	230	129
7336	6" V/S Random Orbit Sander	235	134

CORDLESS DRILLS

9852	12V Drill w/ Case 0-1000 RPM	275	159
9853	9852 w/ Keyless Chuck	275	159
9854	12V 1/2" Drill w/Case 0-360 RPM	280	165
8500	12 V Battery For The Above Drills	62	39

DRILLS

621	3/8" HD V/S Drill 0-1000 RPM	170	99
666	3/8" HD V/S Drill 0-1200 RPM	200	125
7514	1/2" HD V/S Drill 0-750 RPM	210	119
7515	1/2" HD V/S Drill 750 RPM	215	124
7540	0-4000 Drywall Screwdriver 5,2A	185	112
7545	0-2500 Drywall Screwdriver	185	112

SAWS

315-1	7-1/4" Top Handle Circular Saw	210	118
9315-1	315-1 w/Case & Carb. Blade	240	135
617	7-1/4" Push Handle Circular Saw	210	118
9617	7-1/4" Push Hdle w/Case & Carb. Blade	210	135
314	4-1/2" Trim Saw	240	138
9314	4-1/2" Trim Saw w/ Case	265	149
345	6" Saw Boss 9A	180	103
9345	6" Saw Boss w/Case	220	124
9647	Tiger Cub Recip Saw w/Case	195	119
9637	Recip. Saw V/S w/Case 8A	250	138
7549	Top Handle Jig Saw	250	149
7649	Barrel Grip Jig Saw 4.8A	250	159

PLANERS

320	Abrasive Plane 3A	190	116
367	3-1/4 6.5A Planer	250	149
9118	Porta Plane Kit	360	199
9652	Versa Plane Kit	460	299
102	Door Hanging Kit	490	315

PLATE JOINERS

555	Plate Biscuit Joiner w/Case	315	169
9555	Plate Joiner w/Case & Asst. Biscuits	345	189
5556	Adjustable Tilt Fence	67	49

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22-540	12" Bench Top Planer	595	399
23-680	6" Bench Grinder 1/4" Hp	86	75
23-700	Wet/Dry Grinder	234	159
23-880	8" Bench Grinder 1/2"	151	115
28-180	NEW Bench Band Saw	232	169
31-050	1" Belt Sander	104	78
31-080	1" Belt/5" Disc Sander	134	94
31-340	1" Belt/8" Disc Sander	268	184
31-460	4" Belt/Disc Sander	198	145
32-100	Plate Joiner	422	259
32-200	Boring Machine w/ 13" Spindle	1595	1179
34-080	10" Miter Saw	308	195
34-330	Deluxe 8-1/4" Bench Saw	343	235
36-220	10" Compound Miter Saw	350	235
40-150	15" Scroll Saw	179	119
40-560	16" 2 Speed Scroll Saw	266	184
43-505	1/2" Bench Router/Shaper	399	279
34-897	50" Delta Unifence	525	295
34-915	30" Delta Unifence	385	239
50-179	3/4 Hp Dust Collector	483	329

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17-900	16-1/2" Drill Press	478	329
20-330	4" x 6" Horizontal Band Saw	410	275
22-661	13" Planer 2Hp, Stand, EMS	1633	1075
28-245	14" Band Saw Open Stand	779	525
28-283	14" Band Saw w/ Enclosed Stand w/ mobile base. While Qty Last	965	659
31-730	6" Belt / 12" Disc Sander	1393	1049
33-055	Deluxe Sawbuck w/ Legs	854	529
33-890	Deluxe 12" Radial Arm Saw	1908	1259
33-990	Deluxe 10" Radial Arm Saw	818	539
34-444	10" Contractor's Saw	923	575
34-445	10" Contractor's Saw w/ 30" Unifence	1203	759
34-782	10" Unisaw w/ 52" Unifence and motor cover.	2206	1625
36-751	10" Cab. Saw w/ 30" Unifence	1487	999
36-752	10" Cab. w/52" Unifence	1702	1099
37-154	6" Precision Jointer w/ stand	1420	999
37-280	6" Motorized Jointer w/ stand	498	339
37-350	8" Precision Jointer w/ stand	1870	1439
40-601	18" Variable Speed Scroll Saw	1025	689
43-275	Onsrude #2003 Inv. Rtr.	3335	2500
43-355	1-1/2 Hp Wood Shaper	964	639
43-375	3 Hp HD Two Speed Shaper	2086	1589
46-700	12" Variable Speed Wood Lathe	548	375
50-180	1 Hp Dust Collector	611	399
50-181	2 Hp Dust Collector	885	579

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LU87MO10	10" Thin Kerf	24	70	39
LU88MO10	10" Thin Kerf	60	86	45
LU98MO10	10 Ultimate 10"	80	125	69
SD306	6" Dado-Carbide		215	109
SD308	8" Dado-Carbide		229	117
F0	1-2/4" x 5/8" Biscuit 1000 qty		32	27
F10	2-1/8"x3/4" Biscuit 1000 qty		32	27
F20	2-3/4"x1" Biscuit 1000 qty		34	28
FA	Assorted Biscuits		34	28
FB107	7 Pc. Forstner Bit Set		86	54
FB100	16 Pc. Forstner Bit Set		331	179
WC106	6 Pc. Chisel Set		86	52
WC110	10 Pc. Chisel Set		140	84
90-100	15 Pc. 1/4" Router Bit Set		324	169
91-100	13 Pc. 1/2" Router Bit Set		324	169
94-100	5 Pc. Cabinet Door Set		319	165
JS-100	Biscuit Joiner		333	169
JS-100	Biscuit Joiner w/ 1000 asst. Bisc.		369	189
FT2000E	3-1/4 Hp Plunge Router		410	219

BOSCH

1194VSR	1/2" V/S/R Hammer Drill	264	141
11202	1-1/2" Rotary Hammer	720	399
11212VSR	3/4" SDS Bulldog Rotary Hammer	370	195
1272	3"x24" Belt Sander	308	177
1272D	3"x24" Dustless Belt Sander	329	184
1273DVS	4"x24" V/S Belt Sander	370	199
1347	4-1/2" Mini Grinder	160	95
1581VS	Top Handle Jig Saw	265	136
1582VSC	New Clic Barrel Jig Saw	265	136
Bosch	Metal Case for above Jig Saws	34	30
Bosch	30 Blade Asst. For Jig Saws		30
1604	1-3/4 Hp Router	236	122
1604K	1-3/4 Hp Router Kit	287	167
1606	1-3/4 Hp D-Hdle Router	273	148
1608	Lam. Trim Router	149	88
1609K	Lam. Installers Kit	309	173
1609KX	Lam. Installers Kit w/Underscribe	361	202
1611	3 Hp Plunge Router	386	199
1611EVS	3-1/4 Hp V/S Plunge Router	448	231
1632VSK	V/S Orbital Recip. Saw Kit	247	145
1654	7-1/4" 13 amp Circular Saw	205	89
1942	Heat Gun	111	69
3050VSRK	3/8" V/S/R Cordless Drill Kit w/2 battery packs	256	133
3258K	3-1/4" HD Planer Kit	265	148
3272	3-1/4" Planer	147	95
3283DVS	5" Random Orbit Sander	169	105
90300	3-1/4 Hp Router	556	349

Milwaukee

0222-1	3/8" Drill 3.5 amp, 0-1000 RPM	185	105
0228-1	3/8" Drill 3.5 amp, 0-1000 RPM	179	102
0234-1	1/2" Drill 5.4 amp, 0-850 RPM	219	118
0375-1	3/8" Close Quarter Drill	219	129
0379-1	1/2" Close Quarter Drill	249	147
0395-1	3/8" 9.6v Cordless Drill Kit.	279	166
1676-1	HD Hole Hawg w/ case	449	244
3107-1	1/2" V/S Right Angle Drill w/case	360	195
5192	2" HD Die Grinder	289	171
5371-1	1/2" V/S Hammer Drill Kit	335	188
5397-1	3/8" V/S Hammer Drill Kit	239	139
5660	1 1/2 Hp Router 10 amp	325	185
5680	2 Hp Router 12 amp	355	205
5925	3 x 24 Belt Sander w/ Bag	419	228
5936	4 x 24 Belt Sander w/Bag	419	228
6014	1/2 Sheet Orbital Finish Sander	209	116
6368	7-1/4" Saw, fence carb. blade and case	239	139
6508	2 Speed/V/S Sawzall w/case	249	135
6528	VS Super Sawzall 8A w/case	295	164
8975	Heat Gun 570° & 1000°	89	65
8977	Var. Temp. Heat Gun 212-1000°	114	75
6754-1	0-4000 Drywall Screwdriver 4.5A	189	114
6748-1	0-2500 Drywall Screwdriver	209	117

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SFN-1	Finish Nailer 1"-2"	419	259
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SN325+	Framer 1-7/8" - 3-1/4"	639	399
SN4	Framer 2"-3-1/2"	713	469

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AM39 HC4V-	3/4" Hp Compressor	499	279
AM78 HC4V-	1-1/2" Hp Compressor	514	299

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AP10	10" Portable Planer	794	355
BE321	3"x21" Belt Sander	272	135
JM100K	Plate Joiner Kit	431	209
JP155	Jointer/Planer	611	299
RA200	8-1/4" Portable Radial Arm Saw	520	245
RE600	3Hp V/S Plunge Router	444	219
S550	1/6 Sheet Finishing Sander	79	45
TS251U	10" Miter Saw	397	166
TS380	14"/15" Miter Saw	840	369

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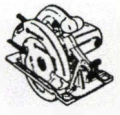

TR12
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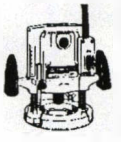

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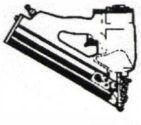

C7BD	7-1/4" Circular Saw w/ Brake	230	119
C7SB	7-1/4" Circular Saw	214	99
C8FB	8-1/2" Slide Compound Saw	899	434
C10FA	10" Miter Saw	538	269
C12FA	12" Miter Saw	632	295
C15FB	15" Miter Saw	745	369
M8	7.3 amp, 1/4" Router	215	114
TR-12	3 Hp 1/2" Router	347	166
M-12V	3-1/4" Hp V/S Router	447	224
SV-12SA	4-3/8" Orbital Sander	80	49
D10-DFK	3/8" Cordless Driver Drill 9.6 V	280	135
D10-DFKBE	Same W/ Extra Battery.	300	149
D10-V1	3/8" V/S Reversible Drill	148	89
D13V	1/2" VS Reversible Drill	198	99
W6VA2	0-2600 Drywall Screwdriver 5.5A	161	85
W6V2	0-4000 Drywall Screwdriver 5.5A	149	79
DV20V2	3/4" VS Hammer Drill w/case	257	135
DH38YE	1-1/2" Rotary Hammer w/case	753	379
G12SA	4-1/2" Disc Grinder	145	79
PDL180A	7" Disc Grinder	212	109
SP18V	7" Disc Sander/Polisher EVS	274	145
F-20A	3-1/4" Planer	172	99
F30	3-5/8" Planer 8.3 amp	319	179
P-50	6-5/8" Planer 11 amp	563	299
CR-10V	V/S, Orbital Recip. Saw	241	125
CC14	14" HD Cutoff Saw	358	189

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CB75F	14-1/2" Band Saw	3070	1499
F1000A	12" Planer/6" Jointer	2835	1425
P12R	12" Portable Planer	1185	610
P12RA	12" Planer/Jointer	1555	810

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H. O. Studley's tool chest revisited

An old saw holds that you can judge the quality of a man's work by his tool chest. Steve Knight, of Santa Rosa, Calif., hopes that potential customers will judge his workmanship by the quality of his marquetry reproduction of H. O. Studley's tool chest. The chest first appeared on the back cover of *FWW* #71 and subsequently was published as a poster. Knight was so inspired by Studley's masterpiece that he spent more than 400 hours completing his marquetry rendition. He concentrated on completing one element of the poster at a time and then finished up by filling in around the sides with the background. The marquetry includes more than 1,000 pieces of about 25 different species of wood.

—*Charley Robinson*

Photo: Jean Von Trende

***This marquetry rendition** was inspired by one of* FWW*'s most popular back covers.*

Photo: Richard G. Johnson

Photo: Gary Weisenberger

***The double bandsaw** and the coopered shop vacuum, shown in the photos above, are just two examples of the extremes that woodworkers will go to. If you think you have a good example of craftsmanship taken to (beyond?) the limits, send us a photo, and we'll select a few of the best for a feature in a future issue.*

Could it be overkill?

Some woodworkers have been known to go overboard when it comes to outfitting and designing their shops. But what might be considered wretched excess by some is merely shop enhancement for others.

Richard Johnson of Scituate, Mass., always seemed to have the wrong blade on his bandsaw, so he was faced with either using an inappropriate blade or making a lengthy blade change with all the attendant guide adjustments. Out of frustration, he designed and built the duplex bandsaw (see the photo above left), powered by one motor on a sliding mount that enables shifting from one unit to the other in less than a minute. Now he's ready for almost any bandsawing situation.

Steve Gray of Bozeman, Mont., has found the onerous task of shop cleaning more enjoyable using his coopered vacuum (see the photo above right). Although this project might seem a bit impractical, the wood shroud does help lower the decibels of the screeching motor, and it looks a lot better than the typical plastic vacuums found in most shops.

If there's enough interest, we will run a collection of your favorite examples of woodworking run amok in a future issue. Any woodworking project could qualify, but it should embody good craftsmanship and sound technique. Send well-focused, original color slides to *FWW*, Notes and Comment, PO Box 5506, Newtown Conn. 06470. —*C.R.*

My new workbench

Another Scott Landis book, *The Workshop Book*, has just been published. That scares me. It was about two years ago that I read *The Workbench Book*. I got it for Christmas and couldn't put it down for the next two months. After reading several chapters, I was struck by the fact that a lot of these beautiful, extremely functional benches were made in just a couple of weekends.

Inspired by this captivating book, I became convinced that I should build my own dream bench. I fantasized about how I would make the mother of all workbenches, incorporating all the clever ideas in Landis' book as well as adding a few of my own. With my woodworking experience, I could probably knock out a bench in a month or so. I forgot, however, to take into account my personal rule of time management: Estimate the number of weeks the task will take, convert

Photo: John D. Wilson

***Inspired by Scott Landis'* Workbench Book,** *John Wilson's "four-week project" took over a year to complete. No wonder Landis' new* Workshop Book *strikes fear in Wilson's heart.*

INDEX TO ADVERTISERS

the weeks to months and multiply by three.

I think I inherited from my father the need to overbuild everything, because, like him, even my smallest projects seem to require three strong men to move. I showed my design to my buddy, Floyd, who builds dainty dulcimers. He laughed at the 30-in.-wide by 7-ft.-long top of 4-in.-thick laminated maple. Of course, I ignored his advice to make it smaller, but I did take the precaution of making the top removable from the two cabinets that spanned the 7 ft. length, just in case the bench was too heavy to move in one piece.

I began building the top, working on it over a period of months. The bench even helped build itself: As I completed the vises, I used them to help make other parts. It wasn't until the top was finally completed and moved to a pair of out-of-the-way sawhorses that I noticed I had built in a pronounced twist.

Three months later, as I was coming out of my depression, I devised a scheme to flatten the top, which involved buying a $300 router and $50 bit and making a 6-ft.-wide router base. The router, guided by a set of poplar rails, flattened the top in a matter of hours. The silver lining in this cloud was that I did end up with an excellent router.

Keeping in mind "the only difference between an expert and an amateur is an expert fixes his mistakes better," I made new ends for the top and patched the hole in the top made when the router inexplicably jumped out of my hands during the flattening process.

The rest of the project went smoothly, except for making the drawers an inch too short. But I persuaded myself that I really wanted them that way. From the first drawing to the last coat of oil, the workbench took a year and a half to complete. I went over budget by only about $1000 (including the router, bit, extra pipe clamps and belt sander that I really needed anyway).

I'm between projects now and have been reading about the "dream shop" in *The Workshop Book*. It's given me some ideas about things that I'd like to do with my shop. Let's see, I'm sure I'll be able to put in the dust collection system and convert to three-phase power in just a couple of weekends ... .

—John D. Wilson, Matthews, N.C.

***Rob Anderson's interpretation** of an 18th-century French dining table has all the traditional ingredients: undulating curves, ormolu and beautiful veneers (detail at right).*

Ormolu daydreams

You've quit your lucrative job as an accountant and taken a 60 percent paycut to become an apprentice in a woodshop specializing in French antique reproductions. You were promised after-hours access to the shop for personal use and instruction in fine furnituremaking. Then, after little more than a month on the job, everything changes: All of a sudden, you're relegated to sweeping floors and rough-milling lumber. If you want to use the shop, the foreman has to be there, and you need to provide prior written notice of the machines you'll be using and how long you'll be using them. Sounds like a Dickensian nightmare or a scene from somewhere behind the old Iron Curtain, doesn't it?

Rob Anderson thought so too when he found himself in this situation, but times are tough in Los Angeles, and he needs the job. Fortunately, he's been able to use friends' shops and to pay to have panels veneered to complete projects for himself. He built the table shown in the photos above last year, working nights and weekends over a period of three months. The legs and the solid edging are koa, and the table and aprons are 1-in. medium-density fiberboard (MDF) over which Anderson veneered pommele sapele, satinwood and purpleheart.

The ornate metalwork on the knees and ankles of Anderson's table, known as ormolu, is gilt bronze. Ormolu was common on mid-18th century French (and some derivative English) furniture. It was used both as a decorative element and as added protection for delicate parts of the furniture. Anderson saw the ormolu on a desk featured in a furniture catalog and saved the catalog for 10 years, dreaming of building a similar table. It took a while but he did.

Anderson, whose self-professed goal is "to create a few pieces of furniture that will be admired after I'm gone," is sticking it out with his employer for now. He'd eventually like to go to school to learn furnituremaking, though.

—Vincent Laurence

Register now for IWF '92

The International Woodworking Machinery and Furniture Supply Fair (IWF), scheduled for Aug. 21-24 at the Georgia World Congress Center in Atlanta, is nearly upon us. A gigantic smorgasbord of woodworking tools and materials, IWF bills itself as "the largest show of its kind in the Western Hemisphere."

If you're planning to attend IWF, you can pre-register any time before Aug. 5 and pay only $5 for a ticket instead of $20 at the door. Pre-registration also gets you a list of exhibitors and a visitor's guide to Atlanta. To receive a pre-registration form, call IWF '92 at (708) 390-2420. For special convention rates on hotel and airline reservations, contact Destination, Inc., 240 Peachtree Street, Suite 13A11, Atlanta, Ga. 30303, or call toll free from the United States (including Georgia) or Canada: (800) 243-4018. And if you make it to the show, be sure to stop by the Fine Woodworking booth and say hello.

—Jim Boesel

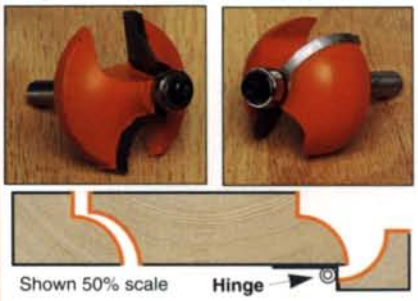
Photos: Vincent Laurence

"Only Premium Quality Tools For Professionals"

CMT Tools

5425 Beaumont Center Blvd., Suite 900, Tampa, FL 33634 1-813-886-1819, FAX 1-813-888-6614

1/2" Radius Rule Joints



Produce perfect drop leaves with a matched set of 1/2" radius Cove and Roundover bits. Use the Roundover bit to produce a radius with inset bead on the table and the Cove to cut a matching concave cut on the leaf. The result is a beautiful joint whether the leaf is up or down.

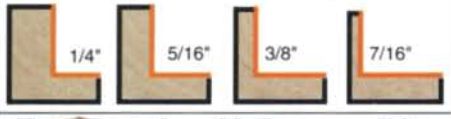
838-3801/4" ShankRoundover	Sale:	$25.00
837-350 1/4" Shank Cove	Sale:	$24.00
838-880 1/2" Shank Roundover	Sale:	$31.00
837-850 1/2" Shank Cove	Sale:	$26.00

Rabbeting Kit

With a single bit and 4 bearings, you can cut precise, clean rabbets at four convenient depths. Choose a 1/4" or 1/2" shank set, either way you'll get a carbide-tipped, Teflon®-coated bit, an allen wrench and bearings to produce 1/4", 5/16", 3/8" & 7/16" deep rabbets (cuts shown full-size below). Bits deliver cutting heights of up to 3/8".

800-607
1/4" Shank Set
Sale: $29.90

800-608
1/2"Shank Set
Sale: $32.90



Solid Brass Inlay Set

Simplify inlay work and increase accuracy with CMT's new inlay set. The solid brass template guide will follow any 1/4" thick pattern, allowing you to produce perfectly-fit inlays in any shape. Fits Porter•Cable, Black & Decker and similar bases and any other router with a manufacturer-supplied adapter for Porter•Cable template guides. Includes solid carbide spiral bit, template guides and complete instructions.

880-002K Sale: $34.90

Top-Bearing Pattern Bits

See the pattern *and* the workpiece, with CMT's top-bearing bits. Top bearings make pattern work easier and safer. Use the allen wrench to remove the bearing, and you have a fine carbide-tipped straight bit.

Item	Cut Dia.	Cut Lgth	Sale
811-127B	1/2"	3/4"	$21.60
811-158B	5/8"	3/4"	$21.10
811-191B	3/4"	3/4"	$21.70
811-690B*	3/4"	1"	$26.00

*1/2" Shank

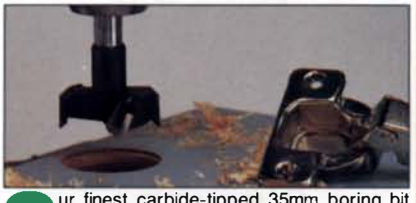
Top-Bearing V-Groove Bits

CMT's V-groove bits give you lots of choices: veins, 45º chamfers, even eye-catching sign lettering. With the top-bearing you can follow any pattern you choose to create dramatic decorative effects.

Item	Cut Dia.	Cut Lgth	Sale
815-127B	1/2"	1/2"	$27.70
815-690B*	3/4"	5/8"	$34.00

*1/2" Shank

European Hinge Bit



Our finest carbide-tipped 35mm boring bit cuts clean holes for European hinges. Recommended for drill press w/1/2" or larger chuck. Right Hand rotation. Other sizes available.

317-350-11 Sale: $26.40

What's In The Box?

CMT offers nine premium router bit sets. Six sets include the beautiful Italian hardwood case shown at right, and every set features bits with CMX-4 Micrograin carbide, Teflon® coating, anti-kickback design and the engineering expertise of CMT! All bits carbide-tipped or solid carbide.

Sets With Hardwood Case:

800-500	1/4" Shank Set For Incra, 6 Dovetail & 2 Straight	Sale: $ 99.00
800-501	1/2" Shank Set For Incra, 6 Dovetail & 2 Straight	Sale: $109.00
800-502	1/4" & 1/2" Shank Set for Leigh w/ 7 Dovetail & 3 Straight	Sale: $129.00
800-503	12-Pc. 1/4" Shank Set, w/ Chamfer, Rabbet, Radius, Flush Trim, Cove, Ogee, Dovetail, V-Groove, Mortising, Round Nose & 2 Straight	Sale: $159.00
800-504	6-Piece 1/2" Shank Set, w/ Round Nose, Cove, Rabbeting, Roundover, Ogee & Chamfer Bits	Sale: $119.00
800-505	13-Pc. 1/2" Shank Set, w/ Cove, Rabbeting, Ogee, Chamfer, Roundover, Dovetail, Round Nose, V-Groove, Flush Trim, Mortising and 3 Straight	Sale: $199.00

Brand New Sets carefully packed in sturdy cartons:

800-611	1/4" Shank Set for Porter•Cable OmniJig, w/ 3 Dovetail, 2 Straight & 1 Top Bearing Bit	Sale: $89.00
800-609	1/4" Shank Set for JoinTECH Jig, w/ 3 Dovetail & 2 Str.	Sale: $62.00
800-610	1/2" Shank Set for JoinTECH Jig, w/ 3 Dovetail & 2 Str.	Sale: $69.00

Why should CMT bits be in your shop?

To find out, take the CMT "self test" below:

	CMT Yes	CMT No	Your Bits Yes	Your Bits No
1) Do your bit bodies have ***Anti-kickback Design*** for safety (3/4" diameter or larger)?	☒	☐	☐	☐
2) Are your bits ***Teflon®*** coated to help reduce pitch and gum buildup?	☒	☐	☐	☐
3) Are your bits machined from a ***Solid Block of Steel*** instead of investment castings?	☒	☐	☐	☐
4) Does every bit feature ***Micrograin Carbide*** for sharper edges and longer life?	☒	☐	☐	☐
5) Do your straight bits have ***Radially-relieved Cutting Edges*** for faster feed rates?	☒	☐	☐	☐
6) Are both the face & outside diameter of the carbide ***Precision Ground*** for better cutting?	☒	☐	☐	☐
7) Do your bits have a ***Mirror Finish*** on the carbide for long-lasting sharpness?	☒	☐	☐	☐
8) Do all profile bits have ***Shear Angles*** that allow the cutters to slice rather than "chop"?	☒	☐	☐	☐
9) Does your router bit supplier offer a lifetime warranty?	☒	☐	☐	☐

Now, check your score. If there is even one "No" in your present bits' column, then you need CMT bits.

Send $2.00 For Our Catalog. In Canada call 1-416-663-8665

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CELEBRATING TURTLE ISLAND

Turtle Shaman **is dollmaker Michael Langton's offering to commemorate the quincentennial of the discovery of the New World by Europeans. The myth of Turtle Island, shared by several Native American tribes, describes the creation of North America. Briefly, the myth says that first there was only water. A great tortoise then rose up and his shell became dry land, which brought forth a tree, which, in turn, brought forth humanity. Langton found the turtle skull the shaman is holding before he made the doll or knew the story of Turtle Island. But, as the Indian doll was taking shape, he was delighted to learn that there were North American turtles large enough that the found skull could conceivably be in scale with the 24-in.-tall doll. The bodies of Langton's dolls (he's made 75 in six years) are assembled from about 65 parts, which enable the figures to hold a multitude of realistic positions (below). The shaman's head and hands are carved basswood, and the pipe is red marble with a burnt ash stem. The clothes were sewn by BJ. Itchkawich, Alton, N.H.**

Photos: Susan Kahn