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May/June 1987, No. 64, \$3.75

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Gary Cernak's letter (*FWW* #63) about sacrificing a tree's life to build something beautiful struck a responsive chord in me. I sell forest products for a living. Whenever I am in a forest and see a magnificent tree, I say to myself, "Isn't that a beautiful tree? It would be too bad to cut it." Then I see the same tree, or one as nice or nicer, in the sawmill yard, and I say to myself, "Isn't that a beautiful log? Too bad to cut it into lumber." Then I see the boards from the log—wide, clear boards, lovingly crafted into beautiful furniture by any one of the hundreds of craftsmen that we are so fortunate to have in this country—and it's all worthwhile.

—Donald Bradley, Plainfield, N.H.

J. Schumacher's letter in *FWW* #59 missed the whole point of Graham Blackburn's article about old planes in *FWW* #57. The article was about finding, tuning and refurbishing old wooden planes to be *used*. Unless the tool is a rare or special example of its class, it is first and foremost a tool and should be maintained in as good condition as possible. I collect antique tools, but I also work over old tools so they can be a thing of beauty and still be used. With old, mass-produced planes, it's fun to see how close you can come to making them look like they did when new.

—Clyde J. Still, Grass Valley, Calif.

Even though I intensely dislike bandsaws, I found Jim Cummins' article in *FWW* #63 to be very good reading. In fact, it has encouraged me to use my bandsaw more.

My 14-in. Rockwell saw, purchased new in 1982, produced an awful thumping vibration whenever I ran it, which was not often. For whatever reason, I didn't complain about it until last Spring. My dealer sent the factory representative to my shop. He agreed with me that the hole for the bearing in the upper wheel was bored off-center. He promised to take care of it. Four days later, the UPS man delivered a complete upper-wheel assembly. I installed it, and that was the end of the problem. Had this saw come from Japan or Korea or Taiwan, I may have gotten equally good response, but I wouldn't count on it.

—Tom Potter, Tulsa, Okla.

I enjoyed your article on bandsaws. I never would have thought of strumming the saw to check the tension. I agree that poor tensioning arrangements seem to be a big problem.

I decided to spend the afternoon in determining how accurate my tension marks are since the spring has seen quite some service. I calculated that the force to tension a 6-tooth-per-inch, ¼-in. blade to 15,000 psi would be about 139 lb. It proved impractical to suspend 139 lb. from the top wheel, but with a ten-to-one leverage arrangement and a 14½-lb. weight, I exerted something near that. I assumed the spring was at zero when it could barely be turned. Surprise: the tension mark was reasonably close on my 14-in. Powermatic.

—John W. Wood, Tyler, Tex.

EDITOR'S NOTE: We just received a phone call from a reader who sheared off one of his bandsaw's wheels while bringing a blade up to full tension. According to the bandsaw manufacturers we checked with, such a thing *can* happen—but only if the shaft is fatigued and in a crystallized condition that might result, over time, from unbalanced or out-of-round wheels. Replacing the shaft and truing the wheels should result in a trouble-free saw.

I enjoyed Gregory Johnson's spray finishing article (*FWW* #62). The photo at the top of p. 74 leads me to make the following comment. Wet sanding as shown will lead to skips in the area between the fingers. The fingers should be at 90° to the direction of the grain and path of the sanding stroke. While this is initially an awkward motion, it does eliminate skips and reduces the amount of sanding and, in turn, the risk

of breaking through.

I also find that Murphy's Oil Soap and water is an excellent lubricant in the final rubout. It's available in grocery stores, and is probably cheaper than Flat Lube. On a large surface like a desktop, I count the number of strokes in a given area when steel wooling and try to duplicate this number in all areas to obtain a more uniform sheen.

—Alex Greene, Rutland, Vt.

Here's a lacquer-spraying technique borrowed from the auto-finishing trade: After the final coat of lacquer has been sprayed, empty the gun and refill it with straight lacquer thinner. Inspect the surface for any imperfections, and judiciously remove them with 600-grit paper lubricated with mineral spirits. Wipe the surface with a tack cloth, then spray with thinner. Leave the adjustments on the gun the same as when using the lacquer, but because of the lower viscosity of the thinner, keep the gun moving quickly and hold it slightly further from the work. This final coat will melt and level the previous finish coats, eliminating overspray marks. Using this technique will give a smooth surface with an attractive sheen. For some items, this may be just the elusive surface quality you've sought. If you decide to go on to a more highly polished finish, the time required for final sanding and polishing is considerably reduced.

—Robert J. Settich, Kansas City, Kans.

I have four Makita B04510 Sanders and three Porter Cable 330s, and I thoroughly enjoy all of them. If Ben Erickson (p. 4, *FWW* #62) puts some WD-40 on the Makita clamp-arm pin and simply loosens the arm by moving it back and forth with pliers, his troubles with clamps will be over. I do wish Makita had made the frame so it would accept a full ¼ sheet. But the size and weight make the Makita a good tool to use. And its well-sealed bearings do last.

—Rex Aman, Fort Worth, Tex.

I read with interest Mac Campbell's comments on apprenticeship in the January issue. The most important issue addressed by Campbell was the analysis of how much money the apprenticeship cost him. What struck me as significant is that shop orders were up only \$34 a month after the apprentice had been hired. The financial failure of this apprenticeship must rest squarely on Campbell's shoulders. He expanded his payroll with no appreciable increase in sales. Were there months of back orders waiting, or did Campbell expect the apprentice to bring in an extra \$1,000 worth of orders per month? Where, in his careful penny counting, did Campbell plan to generate new orders? After four months, something should have been happening.

If Campbell really wanted to take on an apprentice, his initial situation (a semi-trained, eager student and almost half his wages subsidized by the state) would seem ideal. However, an apprenticeship demands that the employer adapt to the new requirements of the situation—something that did not happen here.

—S. Simon Banistar, Bozeman, Mont.

I would like to respond to the Apollospray product review by Nancy Lindquist in *FWW* #62. When she conducted her test on the Apollo Model 500, she tested our hobbyist/homeowner unit which is not really meant for industrial use. Our smallest industrial machine is the Apollo 700, which delivers almost twice the air of the 500. We recommend the Model 700 as the one best-suited to commercial use.

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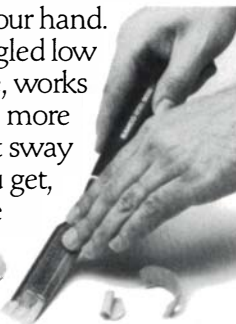
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It's true that the Apollo gun is different than a conventional gun. You need to spray closer to the job: about 6 in. to 8 in. is correct. You can tilt the spray gun in any direction—it won't drip, as the cup is pressurized and not syphon-fed as on a conventional gun. The gun is not slower—the spraying technique is different inasmuch as only one pass is required over the surface while several quick passes are used with a conventional gun.

If any of your readers have any technical questions regarding low-pressure spraying, I'll be happy to answer their queries. Just phone me at (714) 546-6217.

—John B. Darroch,
Apollo Sprayers Inc., Fountain Valley, Calif.

In *FWW* #61, Michael Podmaniczky states that light oils, such as kerosene, are acceptable for man-made stones. I disagree. My occupation as a molder operator depends on having sharp knives that *stay* sharp. I have a whole drawerful of ruined India stones as testimony that kerosene is not an effective lubricant for man-made stones. Norton impregnates their India stones at the factory with a heavier oil. Kerosene and other thin oils displace this oil and make the stone a virtual sponge that soaks up metal particles, ruining the stone.

—Brad Newcomer, Cincinnati, Ohio

A small but useful point to add to Eugene Landon's article on building a Chippendale chair (*FWW* #60): He mentions chopping out the top of the front leg posts to allow the seat-rail rabbet to continue into the corners. I find that chopping down through the endgrain is tedious, and that not exerting caution can too easily result in splitting.

I learned to take a marking gauge and scribe the inside faces of the front posts where the bottom of the seat-rail rabbet will hit. Then, I take a saw and cut across the inside corner of the post at that point. This is done prior to assembly. After the chair is assembled, it's much easier to remove the waste from the corner since you've already undercut most of it. The time saved is considerable when doing a set of chairs and, chances are, the corners will be cleaner.

—Dennis Young, Petaluma, Calif.

While I was laying out the mortises for the Chippendale chair (*FWW* #60), I discovered a mistake on p. 41. The measurements for the front post don't add up. The measurement from the tip of the side-stretcher mortise to the bottom of the side seat-rail mortise should probably be $9\frac{3}{16}$ —not $10\frac{1}{16}$, as in the article. Other than this, the plans work very well. I came up with another way to make the scratch stock. Using a chainsaw file, I cut the profile into a Stanley cabinet scraper.

—John Neubaum, Three Forks, Mont.

EDITOR'S NOTE: For the record, the correct dimension is $9\frac{3}{16}$ in.

As both an ardent *Fine Woodworking* reader and an amateur blacksmith, I'd like to offer a comment to the question in issue #62 re new life for an antique plane. Whenever we are dealing with edged tools of that vintage and earlier, we should recall that quality, heat-treatable steel was a relatively rare and expensive commodity. Consequently, tools were often "stepped" with a thin strip of high-carbon-steel forge welded to a much more readily available wrought iron body. Inevitably, of course, the steel would wear away, and the tool would be brought to the local blacksmith for resteeing.

Attempting to sharpen wrought iron produces the same conditions Mark Riffe (*Q&A*, *FWW* #62) described because wrought iron has significant quantities of ferrous silicate fibers physically comingled with the iron. There are tiny inclusions

throughout, and as they are encountered in the sharpening process, they simply drop away, leaving a nicked appearance.

A solution to Riffe's problem might be the same as would be undertaken by any woodworker of the period. Simply take the plane iron to the nearest blacksmith for resteeing. Today, there are many smiths capable of handling this job. In this particular instance, the new Andersen blacksmith shop in Old Williamsburg is staffed by several smiths who might be so induced.

—D.H. Plummer, Phoenixville, Penn.

I purchased one of those nice, expensive wood lathes recently. Right away, I needed a nice, expensive outboard stand to turn a project larger than the lathe's capacity. Because the lathe is in the middle of the garage, I couldn't use the wall, so I grabbed the next best thing. I took my floor-model drill press and moved it near the lathe. I bolted the tool rest to the table slot (you could also clamp it) and reversed the table to form a rest platform. The table is slotted, so the tool rest could also be moved horizontally to the project as needed. Surprisingly, it was pretty stable. Plus, I saved a hundred bucks on that new lathe stand I didn't buy.

—Elvin Perry, Manteca, Calif.

Re Barry Wallenstein's question about soundproofing the floor between his basement shop and the children's room (*Q&A*, *FWW* #61). He could do this more easily and cheaply by installing RC-1 resilient channel—a Z-shaped metal material that insulates Sheetrock from the noise of direct impact transmitted through studs and joists. Most gypsum suppliers and some lumberyards carry it. It's installed across the joists of the ceiling, and Sheetrock is screwed to it. Insulation can also be installed between the joists for almost complete sound transmission control.

—George Herrmann, Everett, Wash.

After seeing the comments on plastic spreaders in *Methods of Work* (*FWW* #61), I decided to write to suggest doctors' wooden tongue depressors for many similar uses and perhaps a few additional ones. In addition to spreading glue, they are ideal for stirring small cans of finish. Because they're wood, they give you a feel for how the stain is going to work. They also make good shims, and can be used for many craft projects. They're inexpensive and available in bulk at drugstores.

Speaking of finishes, I've also found that the best applicator is a piece of old pantyhose. It is lint-free, disposable, certainly cheap and—when held with surgical ring forceps—equivalent to a miniature brush.

—Ed Muldoon, Mt. Prospect, Ill.

The local fire marshall confirmed that having my basement shop close to a gas hot-water heater posed a hazard due to sawdust in the air. My solution was to form chicken wire around the bottom of the heater. Then, I took furnace filter material (Lennox furnaces, for one, use filter material on a roll, rather than cardboard-cased cartridges) and attached it to the frame with wire.

The fire marshall likes this solution, but warns to test the filter material to make sure it's not flammable itself.

—Dave Palmer, Royal Oak, Mich.

Concerning Peter Good's article "Free estimate" (*Notes and Comment*, *FWW* #62), I fully agree with the premise of not giving away time and talent. I do not give free estimates. I make it clear with the client that, along with a goodwill deposit, I require a set fee for consultation. It is also made clear that the fee for consultation and design will be subtracted from the final price should I receive a go-ahead on the job. I've found this an effective means of separating a serious buyer from someone who wants me to indulge his fantasy.

—L.R. Pastukiw, Eidson, Tenn.

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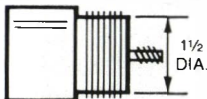
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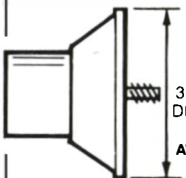
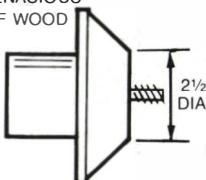
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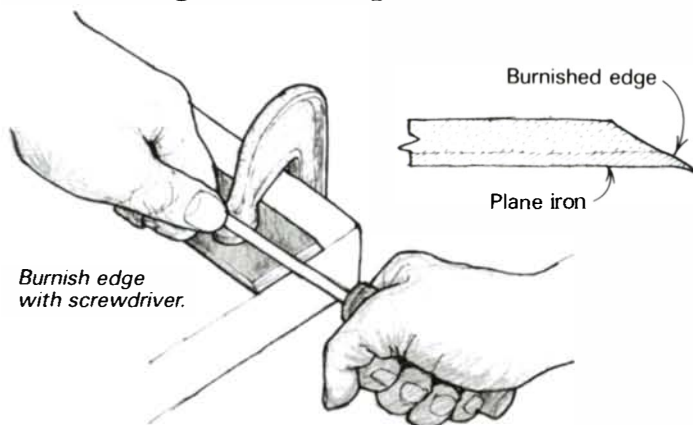
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Perfect edges on rust-pitted tools



I discovered this sharpening technique while working on an antique laminated-steel plane iron with a rust-pitted back. There just wasn't enough steel to chase those nasty pits to the core to obtain a flawless edge. This technique, which I now use on all my edge tools, burnishes the edge down to provide enough metal for a perfect, work-hardened edge while leaving the back of the tool in its original shape.

Before starting the edge procedure, I gently remove the rust from the old tool with emery cloth, a wire brush or green pot scrubbers. Then, I rough-grind the tool to the proper bevel angle using a hand-cranked grinder and a common silicon-carbide wheel. Next, with the tool clamped to the bench as shown in the sketch, I burnish the edge with a screwdriver shank to produce a curl about 1 mm tall. This burnishing operation isn't delicate; rather, it's a rough procedure requiring great pressure, determination, a tightly clamped workpiece and a safely dull edge. Burnish from the corners in to the center to avoid corner breaks. Western tool steel is tenacious, but it'll move if you press hard enough.

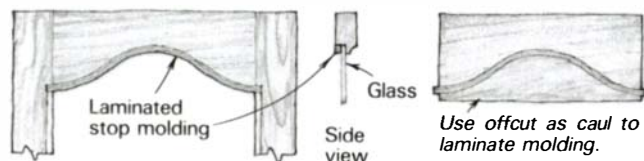
Next, I remove the burr and flatten the back of the edge by drawing the tool's back obliquely across a progression of flat stones. Since removing the burnished edge wears stones quickly, you may wish instead to use a sheet of emery cloth oiled or wetted to a sheet of glass. When the back of the edge is flat, you're ready to proceed with honing the edge in normal fashion.

—Generik Toolles, Madison, Wisc.

Quick tip: To keep my files from rubbing together and wearing each other out, I made a storage bin for them by gluing up a stack of various short lengths of PVC pipe in 1¼ in., ¾ in. and ½ in. diameters.

—Bob Boardman, Nevada City, Calif.

Stop molding for crowned frames



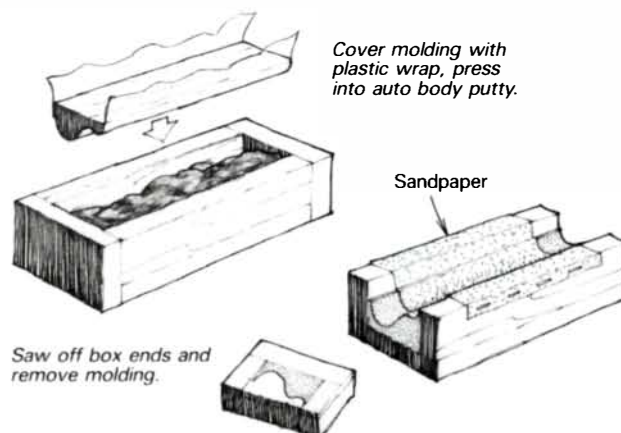
The usual procedure for making stop molding for glazed crowned frame doors is to handsaw the molding from solid stock. This approach presents two problems. First, it's difficult to fit the curved molding to the frame. Second, the inevitable endgrain of the handsawn piece is weak and prone to splitting when nailed in place. Both these problems can be eliminated by using laminated veneer strips to make the molding. I cut the strips slightly oversize in width, and use the actual door and its waste piece as a two-part form to shape the wetted and glue-coated veneer strips. After the glue has set, I plane and sand the molding to final thickness.

—Bob Plath, Delhi, N.Y.

Making contoured sanding blocks

When you use intricate molding in your work and insist on a perfect finish, the time invested in making a reverse-image, contoured sanding block is justified, even if you have to hand-carve the block. But when you can cast a perfectly accurate sanding block in minutes, using the workpiece as its own mold, there's no excuse not to have one.

To make the sanding block, use scrap wood to construct a small box that's as wide as the molding and about 6 in. long. Mix up a small quantity of polyester auto body filler (I used Bondo) and partially fill the box with the putty. Now, cut a



section of molding nearly as long as the box, cover it with thin plastic wrap and press the molding face-down into the body putty so that the air is expelled and the putty takes on the reverse shape of the molding. Hold the molding in place with C-clamps while the filler sets up. After the filler has hardened, bandsaw both ends of the box to free the molding and produce a U-shaped sanding block.

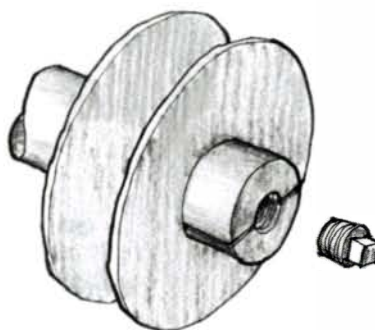
To complete the sanding block, tape sandpaper to a length of molding and sand the interior of the block until it is smooth. Then, staple sandpaper to the sanding block, carefully folding the paper where necessary to fit small corners and narrow beads.

—Earl J. Beck, Oak View, Calif.

Quick tip: For spot-oiling in tight places, use an inking pen from an old drafting set. The nibs are now obsolete for drawing, but will take a little oil exactly to the right spot and can be adjusted to dispense it at various speeds, as needed. This method has it all over trying to let little drops run down a fine wire, or similar old tricks.

—Robert M. Vaughan, Roanoke, Va.

Locking a pulley on its shaft



When all else fails, here's how to lock a pulley to a shaft. First, drill and tap the shaft with ⅜-in. pipe thread. Split the end of the shaft with a sawcut. Replace the pulley on the shaft and screw a tapered pipe plug in the tapped hole to expand the shaft.

—Douglas M. Ryan, Santa Clara, Calif.

Cheap faceplates

A bit of work will convert an inexpensive, common plumbing floor flange into a lathe faceplate for bowl turning. The biggest problem is that the threads on the floor flange are tapered. You'll have to use a tap in the appropriate size to open up the taper so the faceplate will screw on your lathe's spindle



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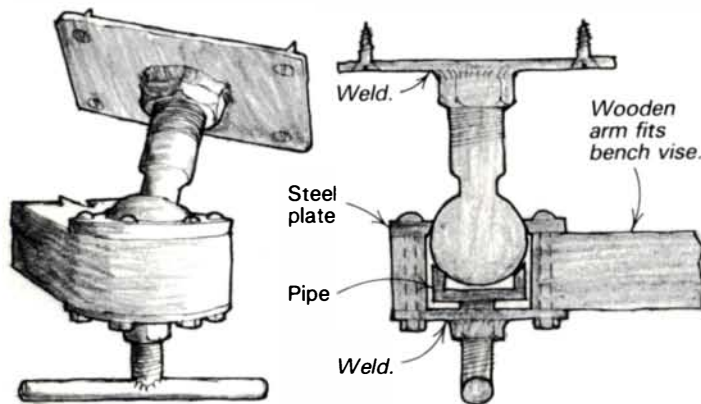
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without binding. After you've opened up the threads, screw the flange on the spindle and check the fit of the hub against the shoulder of the headstock. File the high spots on the hub until it fits flat up against the shoulder. Now, with your lathe running at its slowest speed, scrape the face of the faceplate true with a carbide scraper or an old file ground into a chisel shape. To finish the faceplate, scrape or file the edge. If you use a file, be sure to keep it moving so you won't wear out one spot.

—Robert Kelton, Saranac Lake, N.Y.

Trailer-ball power arm



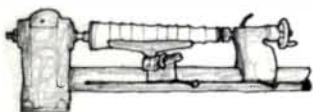
This "poor man's power arm" is invaluable for carvers and sculptors because it lets you swivel and lock a workpiece at any convenient angle. The heart of the fixture is an old trailer ball. Although it certainly isn't necessary, I cut away the shoulder and narrowed the neck of the ball to allow a little more articulation of the joint. The ball rotates in a socket made from steel plates bolted to a wooden arm. The inside of the top plate should be beveled as shown, so it doesn't score the ball. The locking "socket" that the ball fits into is a short piece of 2-in.-dia. pipe, beveled and capped with a disc. A twist on the screw handle will lock this thing up tighter than Dick's hatband.

—John Stockard, Milledgeville, Ga.

Quick tip: I use compressed air to blow out excess finishing oil from joint lines, knots and the like. Otherwise, the surplus oil can gradually bleed to the surface and mar the finish—something that can happen even after hours of wiping and that can be very difficult to remove.

—Joe Carter, Ames, Iowa

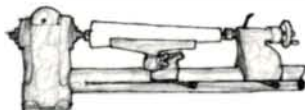
Turning accurate tapers



2. Connect ends with flat.



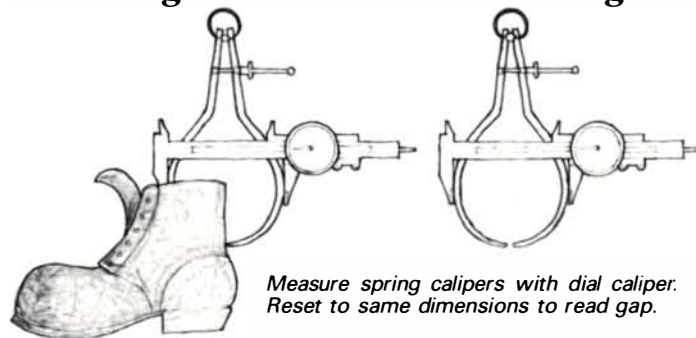
3. Remount and turn until planed flat just disappears.



A recent request for a tinsmiths' cone mandrel presented me with the problem of turning, freehand, an accurate taper. The technique I came up with is so simple and effective that I'd like to pass it on to other turners. First, rough out the stock slightly oversize and turn the ends to the final dimensions. Then, with the workpiece in a vise, plane a flat from the large to the small end until there is a straight taper all along. Now, re-center the turning in the lathe and turn the whole piece until the flat edge just barely disappears. The result will be an accurately tapered mandrel.

—Tom Ryder, Sturbridge, Mass.

Measuring wall thickness in carvings



While carving a wooden shoe, I wanted to measure the wall thickness near the ankle. Since none of the measuring tools I had would do the job directly, I used the two-step technique shown in the sketch above.

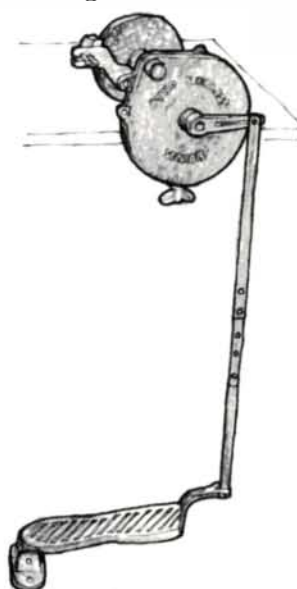
If you were measuring the thickness of several spots, it would pay to make up a table of wall thicknesses and blade-spread measurements beforehand, so you wouldn't have to reset the calipers each time. I suspect this method would be useful for measuring wall thicknesses on hollow turnings as well.

—Gilbert J. Warmbrodt, St. Louis, Mo.

Quick tip: For desktops and boxes, I get leftover leather from an auto upholstery shop. I use 3M's Spray Trim Adhesive for gluing it down.

—Jon Gullett, Washington, Ill.

Foot-powered hand sharpening



A few weeks back, I walked into a friend's shop and found his new hand grinder in disuse. His excuse was that he just couldn't crank the wheel with one hand and move the tool accurately enough with the other hand to achieve the sensitive, complex grinding required to shape a carving gouge, for example.

Ten minutes later, I'd tied a cord around the handle and to a 2-ft.-long board under my foot to produce a foot crank. Then, not more than a week later, I saw (in the San Joaquin Fine Woodworkers Association's newsletter) a reproduction of a turn-of-the-century advertisement featuring a foot-operated grinder. Bingo—woodworkers

were intelligent once! The old grinder featured a hinged treadle and a steel connecting rod that would certainly have worked smoother than my cord-and-board crank.

—Del Stubbs, Chico, Calif.

Quick tip: Try using cloth-backed belts from a belt sander as replacement abrasive on sanding drums. Cloth outlasts paper several times over.

—Jeffrey D. Walton, Arlington, Ohio

Gluing coopered panels

Here's a fast way to glue up staves for a coopered panel. Apply the glue to as many as a quarter-circle's worth of staves (if the panel is bigger than a quarter-circle, glue it up in sections). Then, lay the staves edge-to-edge, outside-up, on a clean flat surface. Apply several strips of strapping tape (the kind with fiberglass filaments running the length) across the staves, taking care to keep the stave edges in close contact. Now, using

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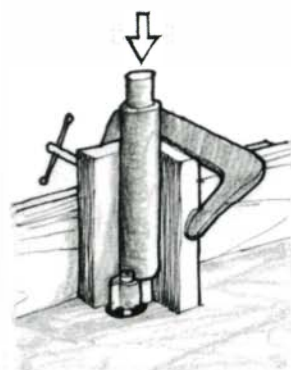
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two pipe clamps on the inside of the curve, apply light pressure to close the gaps and hold the panel in its curved shape until the glue sets. The procedure sounds too easy, but I've made strong panels with invisible glue lines inside and out using the method. —Gregory V. Tolman, Evergreen, Colo.

Quick tip: I use small magnets stuck on my drill press and various other tools to hold Allen wrenches, chuck keys and other small parts. Another method is to cut a short length of plastic tubing and tape it vertically to the tool—the wrench or chuck key can then be slipped into the tubing for on-hand storage. —Jack Rosenfield, Lakewood, Colo.

Making tenons on chair rungs

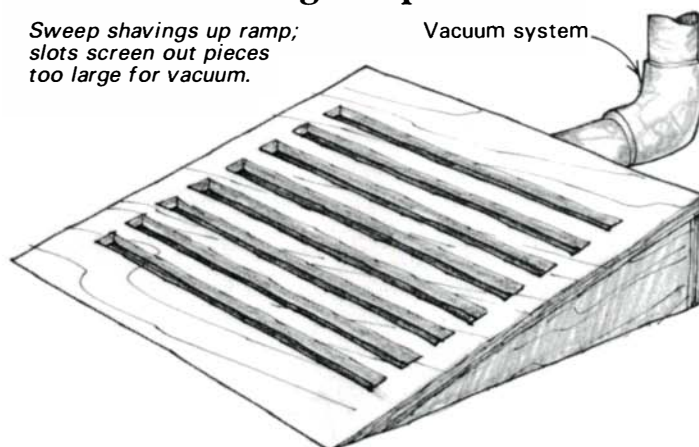


Here's how to use your router table to produce tenons on the end of chair rungs, quickly and accurately. First, chuck a rabbeting bit into the router and raise it until the bit's bottom is even with the top of the router table. Locate a V-block near the bit to produce the diameter desired, and clamp the V-block in place using the router table's fence. Then, holding the rung firmly with one hand, lower it into the rotating bit. Rotate the rung with the other hand in a counterclockwise direction. The result will be a clean and uniform reduction of the dowel diameter. To reduce splintering, take several small bites of $\frac{1}{8}$ in. or less. —David J. Langley, Corvallis, Ore.

Vacuum screening ramp

Sweep shavings up ramp; slots screen out pieces too large for vacuum.

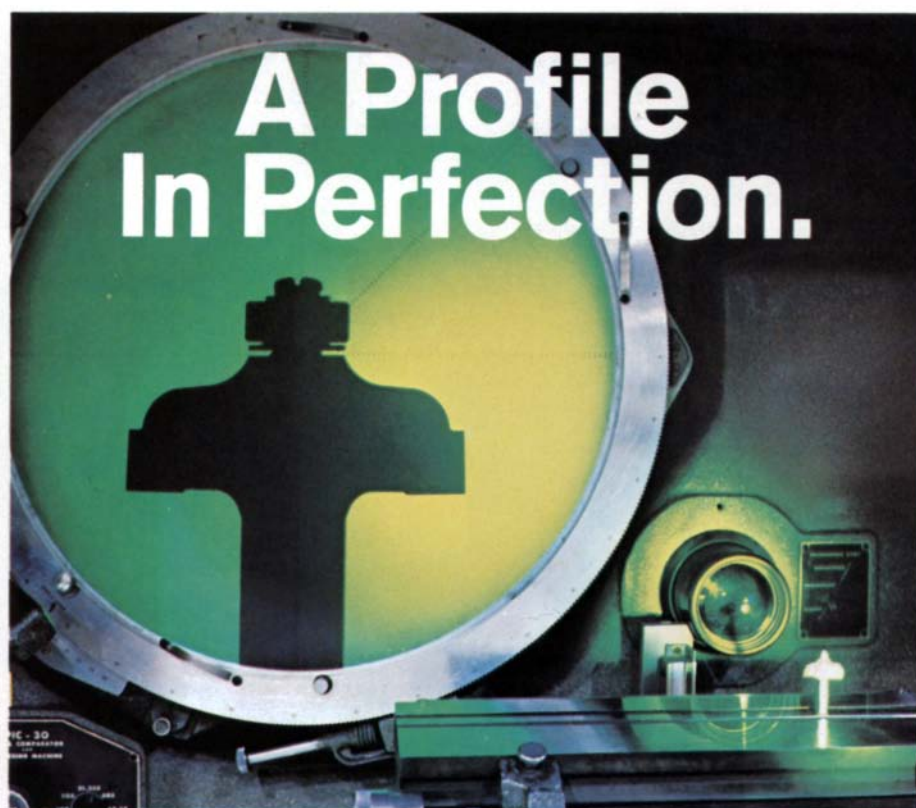
Vacuum system



Even in shops with efficient dust-collection systems, there are always piles of sawdust and shavings that must be swept up with a broom. Here's a handy screening ramp to speed up your cleanup. With $\frac{1}{2}$ -in. plywood, fabricate a wedge-shaped box with 1-in. slots cut into the top. Attach the ramp to your vacuum system through a hole in the back. Now, simply sweep your piles up the ramp. Any piece too large for your dust collector's digestive system will be filtered out by the slots.

—Ralph Bell, Ashford, Wash.

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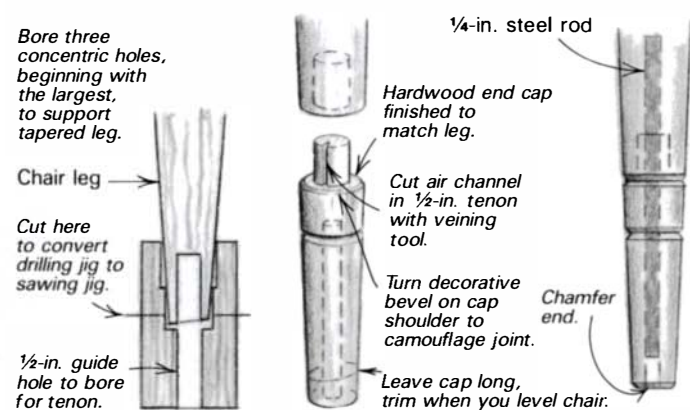
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Restoring cut-off chair legs

About 25 years ago, when lower tables and chairs were fashionable, I cut 2½ in. to 3 in. off the ⅝-in.-dia. legs of some bent oak and captain-type chairs. Can I restore the legs to their original lengths?

—Jack M. Oechsel, N. Hollywood, Calif.



Jeremy Singley replies: Short of turning new legs, I think the best way to raise chair height without making the job look like an obvious patch is to add an end cap to each leg. You can use this technique if the rungs are more than 2 in. above the floor.

Make a jig, as shown, for each style leg. If the individual legs vary in diameter, bore the block to fit the largest and wrap the others with tape until they fit the jig snugly. With the leg secured in the jig, use a brad-point twist drill to bore a ½-in. hole about 1½ in. deep into the leg ends (to accept the tenons you'll later turn on the new end caps). After you've bored all the ends, saw through the jig at the dotted line. Then, use the jig as a guide for sawing and sanding the legs square and smooth with an offset backsaw and sanding block.

Next, turn a set of caps from over-dry hardwood (I suspect your chairs are beech), leaving the tenons slightly oversize. Since your chair legs are so skinny, it might be a good idea to use your lathe to drill ¾ of the way through the end caps, starting from the bottom, so you can install a ¼-in. steel rod through the legs and end caps after you true up and join the two sections. The rods should run 2 in. to 3 in. into the legs and, if possible, the same distance into the end caps. Stain and finish the caps before sizing the tenons to a light hammer-tap fit. Kerf the tenons to prevent air-lock, and glue them in with Titebond or a similar glue. Loosely wrap a string around the joint to soak up the glue bead, then pull it away when the glue has dried.

If your legs are different lengths, stand the chair up when the glue is dry and place wedges under the short legs until the chair is level. Lay a pencil on a block of wood on the floor; slide the block around the leg to trace a line parallel to the floor. Saw the legs to final length and bevel them with a file.

The last step is to extend the holes bored on the lathe so that they run 2 in. to 3 in. into the legs. After the holes are bored, hammer in a length of steel rod; countersink the rod about ½ in.

[Jeremy Singley designs and builds furniture in East Middlebury, Vt.]

Splotchy finishes on light woods

When I apply stains or oil finishes on light woods (such as pine or maple), I often get splotchy, uneven results. How can I avoid this?

—Alanzo Schrendali, Bend, Ore.

George Mustoe replies: The fact that you're getting splotchy surfaces from stains and penetrating oils on both hardwoods and softwoods makes me think your application technique is the problem. Uneven staining most often results from applying a too-scanty amount of stain. Try using a saturated rag or wide

brush to stroke on a liberal coat. Work rapidly, but not at so hurried a pace that you create a flurry of splatters and dribbles. The coat should be heavy enough to flow into the grain patterns and exposed pores with very little rubbing. Allow several minutes for the stain to be absorbed, then pick up the excess with a clean rag. For a light tone, reduce the waiting time or select a lighter-colored stain, but don't skimp on the amount of the initial application.

Other possible causes of uneven staining include variations in surface permeability due to inadequate sanding; glue residue; or the ripple-like compression patterns produced by power planers. Planer marks are a real nuisance—they can only be eliminated by handplaning, scraping or sanding away the damaged surface layer. Unfortunately, light sanding may cause the marks to disappear temporarily, but then reappear as soon as you apply a coat of oil or stain.

Endgrain wood will soak up too much pigment if it isn't pre-treated with a wash coat of diluted shellac, linseed oil or commercial pre-stain sealer. Some workers apply these washes to the whole piece before staining, but I've found that the best results come from careful surface preparation and application techniques—not from the use of pre-stains or other tricks.

[George Mustoe is a geochemistry technician at Western Washington University in Bellingham, Wash.]

Health hazards of finish removers

I'm about to remove a shellac/varnish finish from a Winthrop secretary I built in 1948. I've read about using methylene chloride for a job like this, but I'm a little concerned about possible health hazards. This information is especially pertinent to me since I've suffered two coronaries, the last ending in bypass surgery. Is there a safe way to remove the finish without also removing the stain and filler on this piece?

—Calvin T. Burbage, Portsmouth, Va.

David Shaw replies: I assume the finish you're describing is several coats of shellac built up as a base for one or two coats of varnish. I bet the varnish has broken down enough over 40 years so that the finish can be removed by repeated washings with alcohol, which is the solvent for the shellac. This stripping method wouldn't remove the original stain or filler, and would produce fumes somewhat more benign than methylene chloride (although anyone who has had two coronaries should certainly take precautions in the use of any solvent).

Protection is the key. If you wear a high-quality respirator with organic vapor cartridges, use gloves and other skin protectors and have adequate ventilation, you should be okay—but why take chances? The best way to remove a finish without contacting harmful solvents is to let someone else do it. If you built a Winthrop secretary in 1948, I'll bet you're an accomplished woodworker who's paid his dues. Why not let the fragrance of walnut shavings fill your nostrils...and let someone else smell the chemicals.

[David Shaw is a writer and finisher in Kelly Corners, N.Y.]

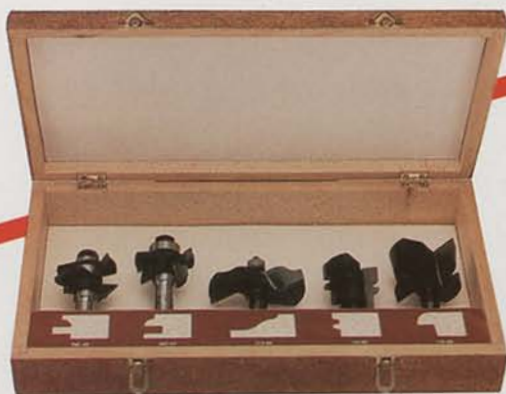
Saw burns on maple

We recently began importing and machining hard sugar maple, but our carbide-tipped blades burn the lumber. How do we eliminate the problem?

—John Sampson, San Juan, Puerto Rico

Rich Preiss replies: I experience more burning problems when ripping maple than when crosscutting. Best results can be achieved with either a 24-tooth carbide rip blade or a 40-tooth combination blade. Your saw must have sufficient power to sustain full-blade speed at a moderate feed rate. If the saw drags, burning can result. Carbide tips that have been ground too often can reduce kerf clearance and generate enough heat to burn hardwoods. Also, keep your blades clean, especially if you cut

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Freud's new 16 piece Forstner bit set comes in a box jointed wooden storage case. These bits, guided by their rim, will create a clean flat bottom hole in wood. A special heat treated steel is used in their production to assure long lasting edges.

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softwoods with the same saw. Soap, warm water and a toothbrush can remove the residue that accumulates behind carbide teeth or on the blade side, generating additional friction.

Very often when ripping maple—especially thick material that's not straight-grained or dry—the kerf tends to close back around the blade. The resulting pinch will cause enough friction to blacken one or both edges. The splitter that came with your saw will help keep the pieces separated, or you could wedge the kerf open. If you find the burning occurs more on the keeper piece next to the fence than on the cutoff, check the parallel alignment of the rip fence. A fence that toes toward the blade even slightly can cause the blade to burn hard material.

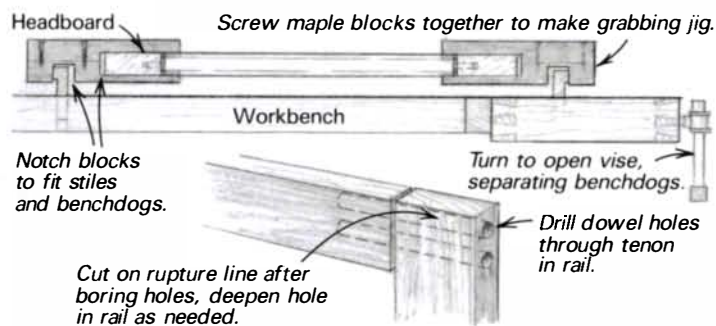
When cutting to length, I prefer a 50-tooth carbide combination blade, but I've had good luck with "fine" steel crosscut blades. Steer clear of hollow-ground blades that have no set—they overheat too quickly. Burn during crosscutting most often occurs for one of three reasons: dull or misshapen teeth; too slow a feed rate; or the fact that the rear section of the blade is rubbing against the hard endgrain after the cut is made. To prevent this kind of rubbing, keep straight-ahead pressure on the material as you cut.

[Rich Preiss is the head of the wood program at the University of North Carolina at Charlotte.]

Disassembling a mortise and tenon

I need a method for disassembling a mortise-and-tenoned headboard and footboard. Each has a 1½-in. by 3½-in. maple frame surrounding beveled-edge, tongue-and-groove maple strips. The strips are butted against one another and extend into dadoes in the rails. Some of the frame joints ruptured when the pieces were left unfinished during a rainy period.

—David M. Ronyak, Copley, Ohio



Michael Podmaniczky replies: The only way I know to disassemble a mortise and tenon glued up as you've described is to pull it apart. The best method would be to fabricate some type of jig to grab the inside edges of the stiles so you can use the dogs on your workbench and the tail vise (or a long bar clamp working in reverse) to pull the pieces apart. It might also help to shock the glue joints with several hard mallet raps on a wood block laid against the inside edge of the stile.

I think I'd try to repair the damage without pulling the joints apart. Mark out the ends of the tenons on the outside of the stiles, and drill two holes slightly larger than the thickness of the tenons squarely through the edge of the stile. Locate the holes at the extremes of the mortise, then bore through the length of the tenon and well into the body of the rail. Next, cut down through the ruptured joint with a very thin bandsaw, severing the tenon at the shoulder. Even though only one joint is ruptured, you must also cut the good joint to free the stile.

If needed, trim the tongue and groove to allow for future wood movement. Then, dress up the mating surfaces of the joint and reassemble the frame with dowels. The dowel holes will be perfectly aligned because of the way you bored them.

Don't chisel out the old tenon; it's now part of the dowel joint.

Assemble the frame so the dowels are about ¼ in. shy of the surface. Bung the holes on the outside with the same maple you used for the headboard. If you want something snappier, cover the holes with slightly proud rectangles of contrasting wood inlay, à la Greene and Greene. Remember that wood movement could cause the dowels to push against the bungs or inlay, so don't install them right up against the endgrain of the dowels.

[Michael S. Podmaniczky is an associate furniture conservator at Winterthur Museum, Wilmington, Del.]

Bentwood runners for sleds

I've built several dog sleds and have a few questions about techniques. Many sleds I see at races have one-piece, steam-bent handles and runners. I've found it more practical to rip ash stock into ¼-in. strips, bend the strips and laminate the wood with resorcinol waterproof glue. I usually orient the grain so the annual rings are parallel to the ground, but I'm not sure if that's important. Is ash the best wood to use?

—J. Kaita, Red Deer, Alberta, Canada

Henri Vaillancourt replies: The grain orientation on runners or other bent components shouldn't be critical, as long as the wood is straight-grained. The choice of grain orientation seems largely a matter of local tradition. Also, some woods are more easily split from the log in one direction. White cedar is split tangentially or parallel with the growth rings, while white spruce is split radially. This often dictates the orientation of the growth rings in the best pieces.

White ash is an excellent wood for sleds, as it is tough and pliable. Hickory is even stronger and more flexible than ash, but it's often not available. Northern white birch also bends readily and is good for sleds and snowshoes. It's technically not as strong as ash or hickory, but I've been told by the Cree Indians that it's less prone to break in extremely cold weather than ash or hickory.

[Henri Vaillancourt lives in Greenville, N.H. He is an authority on traditional crafts of Northern Woodland Indians.]

Hardwood tiles for tabletop

I plan to make a tabletop of ¾-in. plywood covered with different types of hardwoods, stained and fitted together in various patterns. Any advice on how thick the hardwood should be? And what's a durable finish to resist heat, cold, marking and dents?

—Scott B. French, Midland, Tex.

Simon Watts replies: When gluing solid wood to plywood, keep the solid wood as thin as possible—I'd say no more than ½ in. thick. If the hardwoods are more than ¼ in. thick, they'll be more susceptible to surface checking as the relative humidity of the environment changes. You should also veneer the underside of the plywood to keep the two sides in balance. I suggest a plastic resin glue (such as Weldwood) for the job.

Since you'll have to flush off the surface with a plane or sandpaper after all the pieces are in place, I'd be inclined to do all my staining after glue-up. Polyurethane finishes and clear epoxy paints would give you a hard, glassy surface with the durability you describe.

[Simon Watts is a cabinetmaker, teacher and boatbuilder in San Francisco and Nova Scotia.]

Glue up for dimensional stability

I plan to manufacture frame-and-panel doors. Softwoods are readily available in my area, but not in the form of ¾ vertical-grain stock. For dimensional stability, therefore, I plan to face-glue two ¾ plainsawn softwood boards with urea resin glue to make thick stock for rails, stiles and raised panels. Any recommendations?

—Dennis Keaster, Helena, Mont.

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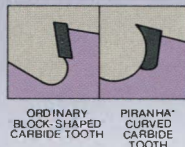
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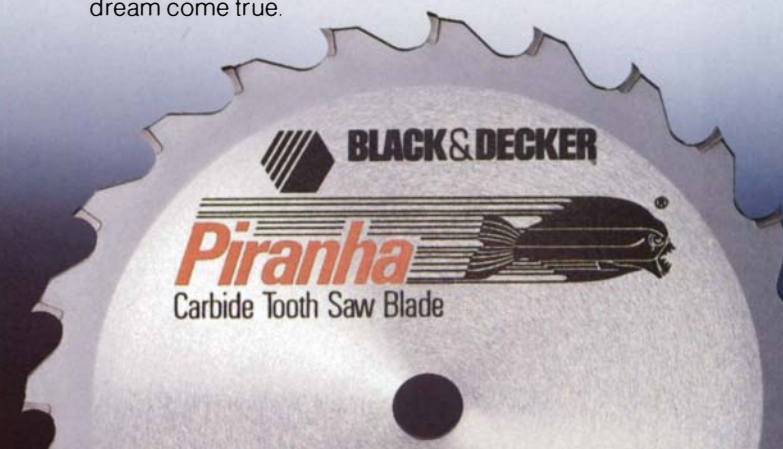
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John Birchard replies: While it's certainly possible to face-glue 4/4 stock to make 8/4 rails, stiles and panels for household doors, I think you're creating a lot of work for yourself. The process would be time-consuming, expensive and messy—not to mention hazardous to your health, thanks to all the glue fumes you'd be working in. Plus, the dried glue will be pretty hard on cutting edges. I also doubt whether you'll gain any dimensional stability with this method. Stability comes from many thin layers, as are found in plywoods. Two pieces of 4/4 will have enough strength left to break the glue joint if they're subjected to radical changes in temperature and moisture.

It's true that it's difficult to find 8/4 material in some woods—fir and pine, for instance. But if you're willing to buy 1,000 board feet or more, you can usually get it custom-milled to your specs. You avoid the glue-up hassle and use conventional frame-and-panel construction, which developed as a way to reduce wood movement problems. As long as the panels are less than 12 in. wide and you use good protective sealers, such as paints or oils, you shouldn't have any problems with 8/4 stock. If you want larger panels, that's the place to use lamination—but I'd use at least three layers.

[John Birchard is a professional woodworker in Mendocino, Calif. He wrote about building doors in *FWW* #49.]

Follow-up on lye and food

The article by Tom Dewey (FWW #61) about antiquing cherry with lye was good, but I'm concerned about his statement that the finish shouldn't be used on items that will contact food. I assume an oil or varnish finish on a table would protect food from the lye treatment, but it would be good to know for sure.

—Frederick Johnson, Andover, Mass.

Tom Dewey replies: There are three reasons why you don't have to suffer sleepless nights for putting the lye treatment on a dining table. First, I assume you'll seal the surface with either varnish or lacquer, and they form a good barrier. In fact, even an oil finish that's applied in multiple coats and rubbed sufficiently will remove any excess residue and provide a protective coat. Second, most of the caustic nature of the lye is exhausted when it reacts with the wood and is removed during subsequent cleanup operations—before the finish is applied. Finally, it's unlikely that a custom-made dining table would be used for casual dining, with food placed right on the wood. I hope your table is reserved for more formal repasts, complete with tablecloth and fine silver. But please, don't serve anything in lye-treated salad bowls.

[Tom Dewey has been designing and building furniture for ten years in Coudersport, Pa.]

Reader exchange

In *FWW* #63, an old address was mistakenly listed for DonJer Products Co., a supplier of spray-on suede lining for boxes and other projects. The correct address is Ilene Court, Bldg. 8, Belle Mead, N.J. 08502.

...For information on obtaining plans for the lightweight spruce, ash, Kevlar and Dacron canoe pictured in *FWW* #62, along with similar boats, contact Monfort Associates, Box 1490, Wiscasset, Me. 04578.

Send queries, comments and sources of supply to *Q&A*, Fine Woodworking, Box 355, Newtown, Conn. 06470. 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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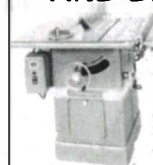
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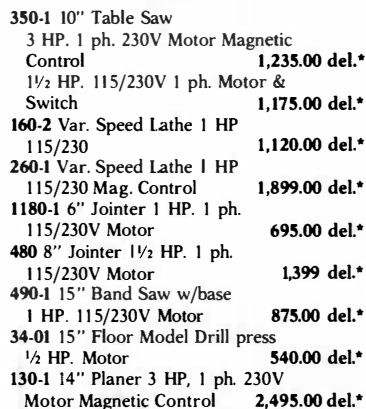
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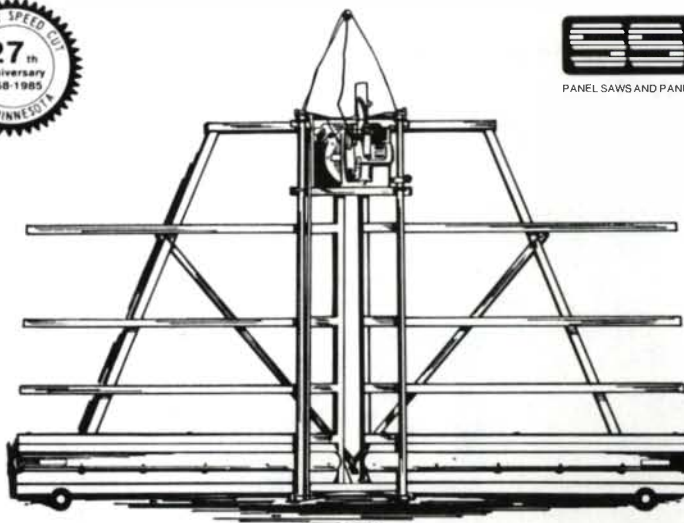
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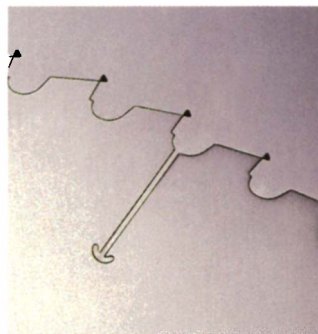
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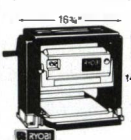


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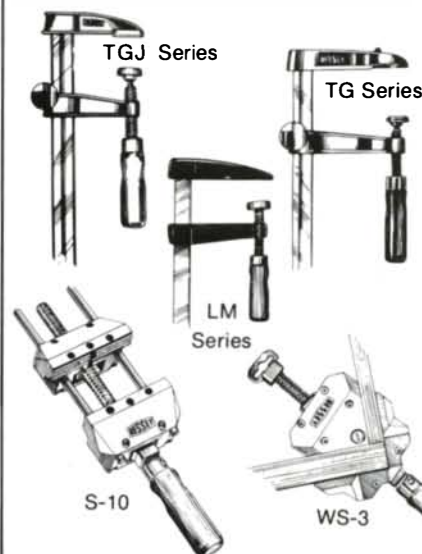


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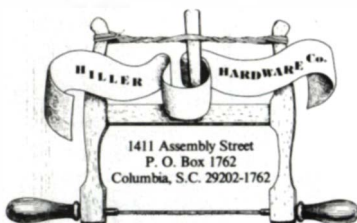
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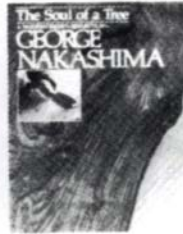
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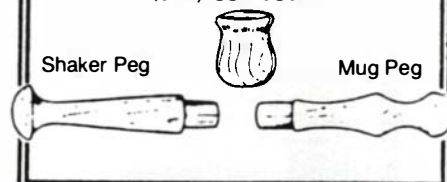
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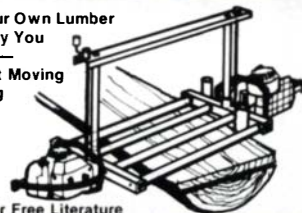
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7½HP 220V 3PH
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100	7/8 H.P. Router	92
128	Porta Plane	169
310	Laminate Trimmer	129
312	Offset Lam. Trimr.	134
330	Speed Bloc Sander	52
314	4 1/2" Trim Saw	124
381	3x24 Belt Sander	174
383	4x24 Belt Sander	189
504	3x24 Belt Sander	335
505	H D Finish Sander	99
518	3 HP 5 Spd Router	335
538	3 1/2 HP H D Router	195
686	3/8" H.D. VSR Drill	117
690	1 1/2 H.P. Router	129
7514	1/2" VSR Drill	119
7533	Adj. Clutch Driver	149
7548	VS Jig Saw w/case	139
9100	Classic (100) Router	119
9118	Porta Plane Kit	189
9882	Varia Plane Kit	295
99381	Hinge Temp Kit	149
99839	Hinge Temp Acc. Kit	89
304	7" Prof. Disc Sander	129
305	7" Prof. Polisher	129
315-1	7 1/4" Circ Saw	124
43263	Carbide Cutter for	59

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AM39-HC2	1.5 Gal. Single Tank	259
AM39-HC4	3.8 Gal. Twin Tank	279
AM39-HC4V	3.8 Gal. Twin Tank	279

1.5 H.P.	115 Volt	125 PSI
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AM77-HC4	3.8 Gal. Twin Tank	299
AM77-HC4V	3.8 Gal. Twin Tank	299

RYOBI POWER TOOLS

MOD #	DESCRIPTION	Sell
AP10	10" Surface Planer	345
E3800	0-4000 Drywall Dr.	79
E3810	0-2500 Drywall Dr.	79
JSE80	Jig Saw Var Spd	99
RJ100VK	VS Recipro Saw	99
S500A	Block Sander	37
SP180	7" Sander Polisher	109
TR30U	Laminate Trimmer	79
TS251U	10" Miter Saw	157
TS380	14" Miter Saw	339
W200S	16 1/4" Beam Saw	299
RA200	8" Portable Rad Arm Saw	247
BD101R	3/8" Cord Drill	47
RS01	Plunge Router	169
B7100	3x24 Belt Sander	129

Delta Carbide Blades and Cutters

35-400	9"x80T TC&F	59
35-425	10"x80T TC&F	76
35-434	9"x60ATB	49
35-423	10"x80T ATB	69
35-477	14"x108T ATB	69
35-447	12"x72T ATB	79
35-426	10"x60T ATB	49
35-560	8" Carb Dado Set	99

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43-921	Cabinet Set	165
43-922	Cabinet Set	169

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6811	2 Spd	HEAVY DUTY
0228-1	3/8" VSR Drill	79
0223-1	3/8" VSR Drill	98
0234-1	1/2" VSR Drill	105
0586-1	Drain Cleaner	179
1007-1	1/2" Drill SC	148
1250-1	1/2" Drill	148
1810-1	1/2" Spade Hnd Drill	139
1830-1	1/2" Compact Drill	148
1870-1	1/2" Hole Hawk	195
3002-1	Rt angl Electricians Drill	179
3107-1	Rt angl Drill Kit	199
3300-1	Rt angl Magnum Dr	195
5347	1 1/2" Rotary Hmr	399
5399	1 1/2" Hammer Drill	179
5455	7 1/2" Polisher	138
6012	Orbital Sander	118
6095	9" Sander/Grinder	104
6215	Chain Saw	143
6377	7 1/4" worm Drive Saw	169
6511	2 Spd Sawzall, case	119
6539	Cordless Screwdriver	69
6543-1	0-1000rpm Screwdriver	148
8975	Heat Gun	59

Thakita Power Tools

1100	3 1/4" Planer w/case	179
1900BW <td>3 1/4" Planer Kit</td> <td>109</td>	3 1/4" Planer Kit	109
2401B	10" Miter Saw	169
2708	8 1/4" Table Saw	199
3801B	1 3/8" HP Router	118
3612BR	3HP Plunge Router	169
4200N	4 3/8" Trim Saw	108
5081DW	3 3/8" Cordless Saw	102
5402A	18 6/16" Beam Saw	319
5600W	Cordl. Circ Saw 6 1/4"	155
6012WD	3/8" Cordl Scrudrill	94
6301LR	1/2" D Handle Drill	109
6510Lvr	3/8" VSR Drill	78
8801DBV	0-2500 Drywall Scrugun	89
8905B	1/2" Impact Wrench	149
8906	3/4" Impact Wrench	319
8419B2W	3/4" Hammer Drill	159
9030	1" Belt Sander	139
9207SPB	7" Polisher 2 Spd	135
9501BK	4" Mini Grinder	65
9820-2	Blade Sharpener	169
9924B	3x24" Belt Sander	129
804510	Block Sander	49
DP4700	1/2" VSR Drill	107
HP1020	3/8" Hammer Drill	69
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JR3000V	Var Spd Recipro Saw	119

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3103	2 Spd Cutsaw	89
4010-10	Palm Sander	39
3091	10" Miter Saw	179
8513-08	1/2" Dr. Impact Wrench	119
98003	Cord Drill Battery	38

Hitachi Power Tools

D10V	3/8" VSR Drill	69
D13	1/2" Spade Hnd Drill	99
DR10	3/8" Cordl Scrudrill	74
F20A	3 1/4" Planer	69
TR8	Laminate Trimmer	83
TR12	3HP Router	162
C75A	7 1/4" Circular Saw	65
W6VA	0-2500 Screwdriver	79
CR10V	Var Spd Recipro Saw	114
C8DA	6 1/4" Cordl Circ Saw	282
DH38VA	1 1/2" Roto Hammer	299
C10FA	10" Miter Saw	259

Bosch Power Tools

1581VS	Orbital Action Jig Saw	124
11202B	1 1/2" Roto Hammer	349
11203B	1 1/2" Roto Hammer	349
1601	1 HP Router	99
1804A	1 3/4 HP Router	119
3230	Jig Saw	49
11305	30lb Demo Hammer	565
1608T	Tilt Base Lam. Tr'mr	89
1609	Offset Laminate Tr'mr	115
1609K	Lam Tr'mr Inst. Kit	165
1651	7 1/4" Circ Saw	89

Skill Tools

77	7 1/4" Worm Dr Saw	134
471	1/2" Impact Wrench	139
492	VS Jig Saw	49
542	Spade Handle Drill	109
551	5 1/2" Circular Saw	72
587	3/8" VSR Drill	58
598	1/2" VSR Drill	69
7585	Palm Sander	39
2016-2	3/8" cordl var Drill	95
1400	4x24 3/4" Belt Sndr	139

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LU73M010	10x60T ATB	34
LU82M010	10x60T Tr Chip	38
LU84M011	10x60T Combo	38
LU84M012	12x60T Combo	69
DS308	8" Dado Set	109
FB100	16 Pc Forstner Bit Set	138
DB050	50 Piece Drill Bit Set	59
90-100	15Pc Router Bit Set	139

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EC260 3/4 Stile-Rail Shpr Bit 155
EC900 Complete Cabinet Set 166
EC091 Cove and Bead Set 166
EC900 Shaper Door System Set 237
99 034 Lock Miter Router Bit 59
99 032 Wedge tongue rt bit 48
99 033 Wedge groove rt bit 48
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T35-8	1" Crown Roofing Stplr	222
T35-40	16 Ga Brads 1 1/2-1 3/4"	282
T29-1	5/8"-1 1/4" Ga. Brad	159
T31-1	5/8"-1 1/4" Brads	129

Hitachi Power Tools

D10V	3/8" VSR Drill	69
D13	1/2" Spade Hnd Drill	99
DR10	3/8" Cordl Scrudrill	74
F20A	3 1/4" Planer	69
TR8	Laminate Trimmer	83
TR12	3HP Router	162
C75A	7 1/4" Circular Saw	65
W6VA	0-2500 Screwdriver	79
CR10V	Var Spd Recipro Saw	114
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11203B	1 1/2" Roto Hammer	349
1601	1 HP Router	99
1804A	1 3/4 HP Router	119
3230	Jig Saw	49
11305	30lb Demo Hammer	565
1608T	Tilt Base Lam. Tr'mr	89
1609	Offset Laminate Tr'mr	115
1609K	Lam Tr'mr Inst. Kit	165
1651	7 1/4" Circ Saw	89

Skill Tools

77	7 1/4" Worm Dr Saw	134
471	1/2" Impact Wrench	139
492	VS Jig Saw	49
542	Spade Handle Drill	109
551	5 1/2" Circular Saw	72
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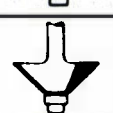
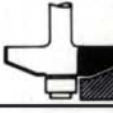
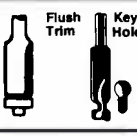
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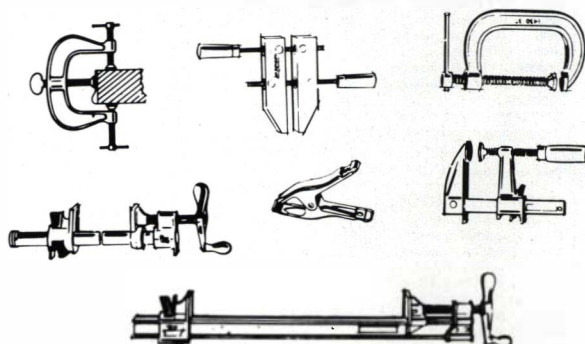
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	#26	3/8" Straight Bit	3/8"	1"	1"	7.00
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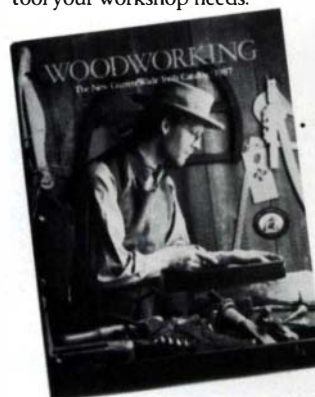
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S580A	3x5 1/2 Finish Sander	70	41
S58200	Finishing Sand, 1/2 Sheet	142	88
87075	3x21" dustless Belt Sand	179	116
87108	3x24" dustless Belt Sand	206	140
87208A	4x24" dustless Belt Sand	269	165
0160VR	3/4" VSR 0-1200 rpm drill	91	49
W640	7 1/4" 13 amp circular saw	158	99
W640	8 1/4" 13 amp circular saw	171	109
J560	Jig Saw-Single Speed	172	99
J560	Jig Saw-electronic v/speed	198	123
R150	1 H.P. Plunge Router	138	86
R330	2 H.P. Router	220	138
R500	3 H.P. Router	265	163
E3000	Drywall screwdriver 0-4000	126	79
L120U	3 1/2" Planer	142	89
80120R	2-sp. Cordless Drill		
	w/ free holster-Xtra special buy	148	95
TS251U	10" Miter Box	300	169
SG1150C	1/2" H.D. Mini-Grinder	99	59

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Model	Description	List	Sale
8224-1	3/4" drill 4.5A magnum	173	109
8224-1	1/2" drill 4.5A magnum	173	112
0234-1	1/2" drill 4.5A magnum	173	115
0222-1	3/4" drill 3.3A 0-1000 rpm	159	99
0228-1	3/4" drill 3.3A 0-1000 rpm	139	92
0375-1	3/4" close quarter drill		
	— NEW — 3.5 amp	191	118
0210-1	3/4" cordless drill		
	— NEW — 2 speed	189	95
6539-1	cordless screwdriver		
	— NEW — 190 RPM	99	59
1007-1	1/2" drill 4.5A D-Hole	217	145
1107-1	1/2" drill 4.5A D-Hole	222	145
3300-1	magnum rt angle drive kit	271	170
3102-1	Plumbers rt angle drill kit	267	180
1676-1	HD Hole Hawk w/cs-2 sp	363	235
5395	3/4" spig saw hammer drill kit	203	150
5397	3/4" var sp hammer drill kit	208	155
5371-1	HD mag. hammer drill 1/2"	313	207
5373	HD mag. ham drill 3/4"	262	175
6511	2 speed Sawzall w/case	197	122
6226	port band saw 2 sp w/case	416	280
6234	TSC band saw port w/case	416	280
6405	8 1/4" circ. saw 13 amp	191	127
6460	10 1/4" 15 amp w/case	380	245
6165	12" Chop saw 15 amp		
	4200 R.P.M.	311	189
6255	v/sp Jig Saw 3.8 amp	217	140
6245	sgle sp Jig Saw 3.8 amp	191	125
6012	1/2 sheet HD Orb. sander	173	110
6014	1/2 sheet HD orb. sander	184	112
5660	1 1/2 HP router 10 amp	289	175
5680	2 HP router 12 amp	342	220

DRYWALL SHOOTERS

Model	Description	List	Sale
6753-1	3.5 amp 0-4000 rpm new	125	79
6747-1	4.5 amp 2500 rpm	157	100
6750-1	4.5 amp 0-4000 rpm	141	90

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Item No	Description	Diam	Teeth	List	Sale
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PS303	Fine cutting 7 1/4"	40		32.97	20.50

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LU84M011	Combination 10"	50		74.51	37
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9900B	3" x 21" belt sander	234	119
9924B	3" x 24" belt sander	222	130
99240B	3" x 24" b/sand w/bag	248	130
9035	1/2 sheet finish sander	96	48
9045B	1/2 sheet finish sander	186	90
9045N	1/2 shi ltn sand w/bag	190	105
4200H	4 1/2" circ saw 75 amp	182	93
520HA	10 1/4" circ saw 12 amp	434	215
4300BV	v/sp jig saw 3.5 amp	234	120
4301BV	orb v/sp jig saw 3.5 amp	248	125
JP3000WL	2 sp recip saw w/case	198	120
JP3000V	w/recip saw w/case	208	120

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9820-2	Blade Sharpener	288	159
74074-9	60 (coarse) Grdg Whl	36	23
741070-7	1000 (med) Grdg Whl	34	22
741971-5	6000 (fine) Grdg Whl	45	30
19008W	3 1/4" planer w/case	198	92
1100HD	3 1/4" planer w/case	328	160
3608BK	3/4 hp router w/case	132	85
3601B	1 1/2 hp router	218	115
3700B	1 1/2 hp trimmer		
	28,000 rpm	162	82
804530	6" Round Sander	98	48
DA3000	3/4" angle drill	206	105
DP4700	1/2 v/sp w/rev 4.8 amp	178	92
HP1030W	3/8 v.s.r. hammer drill		
	w/case	168	98
6300L-R	1 1/2" angle drill w/rev	288	152
84198B-2W	1 1/2" s.p. hammer		
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GV5000	Disc Sander	108	53
68000B	2500 rpm 35 amp	146	79
68000BV	0-2500 rpm 35 amp	156	89
68010B	4000 rpm 35 amp	146	79
68010BV	0-4000 rpm 35	156	89
2030n	12" planer/jointer	2580	1475
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35-625	10" x 80 TC&F	123.05	
35-646	12" x 60 TC&F	110.65	

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Model	Description	List	Sale
35-615	10" x 48 TC&F	94.65	
35-601	9" x 60 TC&F	96.15	
35-618	10" x 60 TC&F	90.70	

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Model	Description	List	Sale
35-592	8" x 64 ATB	131.20	
35-604	9" x 64 ATB	88.00	
35-623	10" x 80 ATB	116.40	

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Model	Description	List	Sale
35-605	9" x 48 ATB	74.70	
35-610	10" x 60 ATB	83.65	
35-647	12" x 72 ATB	118.00	
35-620	10" x 72 ATB	99.00	
35-621	10" x 72 TC&F	110.50	
35-626	10" x 60 ATB	83.65	

Compositions And Veneers

Model	Description	List	Sale
35-622	10" x 80 ATB	111.20	
35-655	12" x 96 ATB	133.75	

Rip Blades

Model	Description	List	Sale
35-610	10" x 10 FT	54.75	
35-611	10" x 18 FT	66.60	
35-640	12" x 12 FT	76.80	
35-641	12" x 24 FT	78.65	

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35-614	10" x 48 ATB&R	87.60	
35-591	8" x 24 ATB	59.85	
35-603	9" x 24 ATB	59.20	
35-612	10" x 24 ATB	68.10	
35-602	9" x 34 ATB	68.05	
35-613	10" x 40 ATB	72.00	

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35-656	12" x 60 ATB	107.70	

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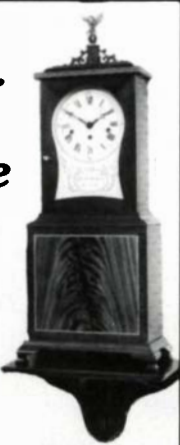
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Coping with Sash

Glazed cabinet doors on shaper and tablesaw

by David R. Pine

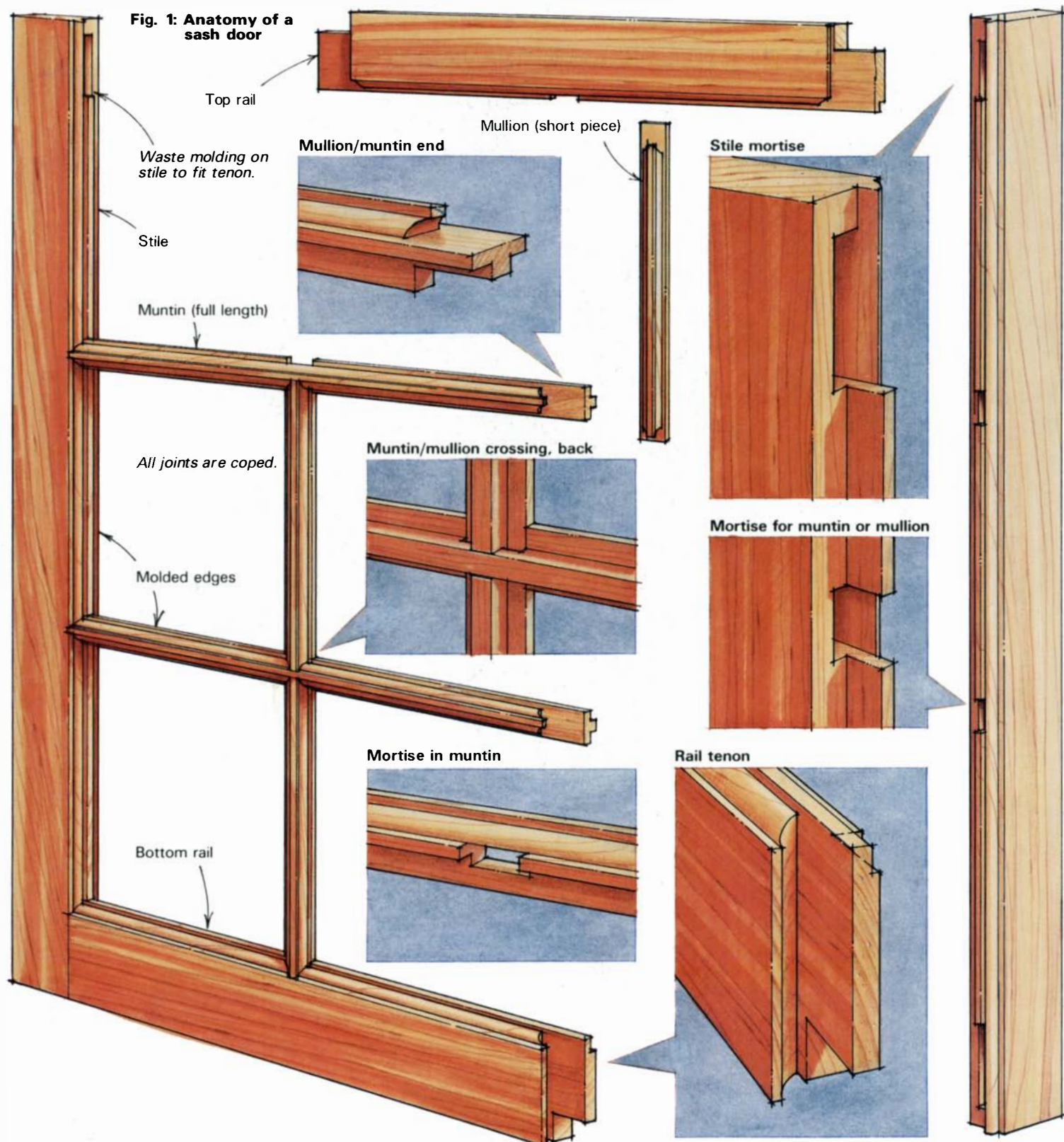
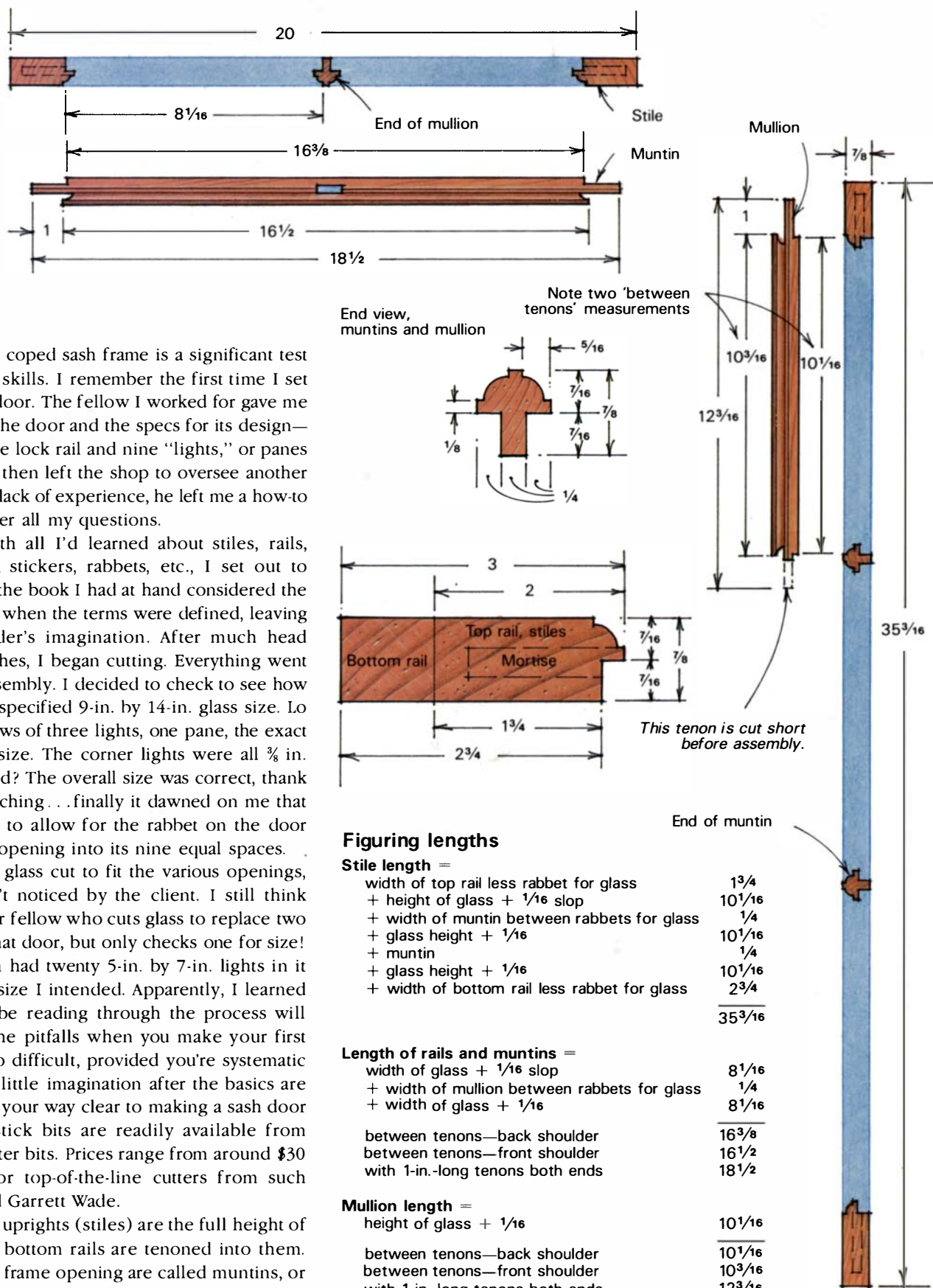


Fig. 2: Sash layout

Sash layout is made easy with just two scaled drawings: a side view through the stile and a top view through the rail.



Figuring lengths

Stile length =

width of top rail less rabbet for glass	13/4
+ height of glass + 1/16 slop	10 1/16
+ width of muntin between rabbets for glass	1/4
+ glass height + 1/16	10 1/16
+ muntin	1/4
+ glass height + 1/16	10 1/16
+ width of bottom rail less rabbet for glass	2 3/4
	35 3/16

Length of rails and muntins =

width of glass + 1/16 slop	8 1/16
+ width of mullion between rabbets for glass	1/4
+ width of glass + 1/16	8 1/16
between tenons—back shoulder	16 3/8
between tenons—front shoulder	16 1/2
with 1-in.-long tenons both ends	18 1/2

Mullion length =

height of glass + 1/16	10 1/16
between tenons—back shoulder	10 1/16
between tenons—front shoulder	10 3/16
with 1-in.-long tenons both ends	12 3/16

Cutting list

No.	Name	L x 2 x W x L	Comments
2	Stiles	35 3/16 x 2 x 7/8	Mold, mortise, rabbet
1	Top rail	18 1/2 x 2 x 7/8	16 1/2 between tenons
1	Bottom rail	18 1/2 x 3 x 7/8	at front, 16 3/8 at back.
1	Muntin	18 1/2 x 4 x 7/8	Muntin piece makes 4, need 2.
1	Mullion	12 3/16 x 4 x 7/8	10 3/16 between tenons at front, 10 1/16 at back. Makes 4, need 3.

The ability to build a coped sash frame is a significant test of a cabinetmaker's skills. I remember the first time I set out to make a sash door. The fellow I worked for gave me the overall dimensions of the door and the specs for its design—two raised panels below the lock rail and nine “lights,” or panes of glass, above it. My boss then left the shop to oversee another job. To compensate for my lack of experience, he left me a how-to book on millwork to answer all my questions.

With my mind agog with all I'd learned about stiles, rails, muntins, mullions, copes, stickers, rabbets, etc., I set out to make my door. Somehow, the book I had at hand considered the subject adequately covered when the terms were defined, leaving layout details to the reader's imagination. After much head scratching and a few sketches, I began cutting. Everything went well until after the final assembly. I decided to check to see how closely I had come to the specified 9-in. by 14-in. glass size. Lo and behold, of the three rows of three lights, one pane, the exact center one, was the right size. The corner lights were all 3/8 in. too big. What had happened? The overall size was correct, thank goodness. More head scratching. . . finally it dawned on me that somehow I had neglected to allow for the rabbet on the door frame when I divided the opening into its nine equal spaces.

We went ahead and had glass cut to fit the various openings, and the discrepancy wasn't noticed by the client. I still think occasionally about the poor fellow who cuts glass to replace two or three broken panes in that door, but only checks one for size!

My second piece of sash had twenty 5-in. by 7-in. lights in it and actually came out the size I intended. Apparently, I learned from my experience. Maybe reading through the process will help you avoid some of the pitfalls when you make your first door or window. It's not so difficult, provided you're systematic and accurate. By adding a little imagination after the basics are understood, you could see your way clear to making a sash door with a router—cope-and-stick bits are readily available from many manufacturers of router bits. Prices range from around \$30 at Sears to about \$130 for top-of-the-line cutters from such sources as Trend-Lines and Garrett Wade.

In most applications, the uprights (stiles) are the full height of the door, and the top and bottom rails are tenoned into them. The sash bars that cross the frame opening are called muntins, or munts. Muntins usually run horizontally, which makes them the same length as the rails. Shorter pieces at right angles to the muntins are called mullions. I realize that this is not the standard terminology found in dictionaries, but these are the names everyone I know uses. The advantage is that each part has its own clear name, which helps avoid confusion, so I'd like to stick with the system throughout this article.

Traditionally, the mold worked on sash bars and frame edges was a small (about 1/4 in.) quarter-round, worked directly onto the sash members—“stuck,” not applied. In the days before

Fig. 3: First sequence of cuts

A. Dimension the stock.

B. Mold the stiles.

C. Mortise stiles, muntins and rails.

D. Saw tenons at both ends of mullions, muntins and rails.

machines, muntins were sometimes full-length both ways, and crossed each other with coped lap joints (see facing page). When the machine age hit, however, it soon became clear that what I'm calling the mullions should be cut as separate pieces. This had several advantages. First, cutting the long and fragile muntins into pieces reduces the chance of breakage during machining and assembly. Second, short mullions could be made economically from scraps. Third, the hand-worked lap joint was avoided—all the undercut, or coped, joints in the door (including the rail joints) could be cut with the same machine setup.

The profile and measurements I prefer for sash bars are shown in figure 2. I think these proportions give a good sense of delicacy, yet still retain strength. My typical frame members for a cabinet door are 2 in. wide for stiles and top rails, 3 in. wide for bottom rails. Typical stock is $\frac{3}{8}$ in. thick, or sometimes $\frac{1}{4}$ in.

To lay out sash, you need a plan drawing (with experience, you can get by with a rough sketch). Before you can begin to draw, you need to determine how much room the sash molding takes up. Sash can be made to accommodate a stock glass size (5x7, 8x10, 10x12, etc.), in which case the glass determines the sizes of the door's parts. Or, a given door size can be divided into any number of openings. This is not too difficult to work out on paper. The best approach is to make a scale drawing of the top and side edges of the sash, as shown in figure 2. Notice that I've allowed $\frac{1}{16}$ -in. play for the glass.

I've seen a number of drawings of windows that show the muntins running full-length from top to bottom, with the mullions horizontal. Everybody I know runs muntins from side to side—probably for the reason that many doors and windows are vertical, and you want to avoid making fragile pieces any longer than they have to be.

To successfully make sash, one must work, from start to finish, to very close tolerances. (It even helps to pass all the pieces through the planer on the same side of the bed.) Sash components must all add up to the same total if the door is to be the correct size, with all joints tight. Sometimes slight discrepancies find their

way in, but these can usually be accommodated later by making the next series of cuts to suit. The drawings and photos show a clear, logical cutting order that helps this process.

In getting out stock, choose clear, straight-grained material for sash members. It's best to dimension all the muntins as one piece. That is, they are ripped apart after being cut to length, mortised, tenoned and coped. The same is done with mullions. This means you'll be handling fewer pieces of stock through the operations, ensuring greater uniformity. Get out enough stock for two or three extra munts and mullions, however. These will be invaluable for test cuts and insurance.

After the stock is dimensioned, I mold the stiles (but not the rails yet), then lay out the positions of the mortises. With a hollow-chisel mortiser on my drill press, I mortise the stiles to accept the rails and muntins. Then, I mortise the rails and muntins to accept the mullions. Since the muntins are all together, punching a mortise clear through that one piece of stock is actually doing four or five mortises at the same time, and aligning them as well.

Next, I cut the tenons on the rails, muntins and mullions. Note that while only those mullions that enter the door frame itself need a long tenon on one end, I cut a long tenon on *both* ends of *all* the mullions. It's easier to bob them off later than it is to keep track of them throughout and make the extra cutting setups.

Notice in figure 2 that the rails, mullions and muntins all have two "between tenons" measurements—one on the top of the tenon, another on the bottom. This requires two setups, but I haven't found a good way around it. Neither of the two alternatives is satisfying—if you make the sash bars with a wider flat down the center, the sash looks clumsy; if you enlarge the rabbet for the glass, the sash is weakened excessively and may split when the glaziers' points are driven. So, cut both these "between tenons" distances exactly. Remember that a discrepancy of as little as $\frac{1}{32}$ in. in the mullions can add up to $\frac{1}{8}$ in. or $\frac{1}{16}$ in. over the length of a door pretty quickly. That's a big gap to fill.

The next step is to cope the top sides of the tenons. I use Delta's cope cutter #09137 (which matches their quarter-round

18th-century sash methods

by Eugene E. Landon



Rails and stiles meet with just a short cope; face of mortise is chiseled square.

I plane all my moldings by hand, being fortunate enough to have a good collection of old molding planes. Several profiles were used in the 18th century, and a few are shown in the drawing. You can make the coped lap joint shown here to fit any of these profiles, even ones made with a router. You don't need a matching set of planes or bits.

Really old windows and glazed doors usually had wider muntins than the narrower ones that became popular after the Revolution. I'm not sure why—perhaps because large panes of glass were difficult to make (at least in reasonably light weights), perhaps because of a carry over in methods and taste from the time when such work was done to hold wooden panels, rather than glass.

At any rate, I like the look. Hefty muntins, with their wide rabbets and substantial puttying, add a look of sculptural dignity to a door.

The 18th-century coped lap joint looks a lot more complicated to cut than it is. Cutting the squared notches is obvious—make two cuts with a dovetail saw, then break out the waste with a chisel. The drawings show the rest of the method clearer than I could explain it in words.

The main strength of this joint comes from the contact of the straight faces. You can undercut the cope itself so the miter lines will draw up airtight. In fact, when testing the fit, don't press the joint fully home until glue-up. Then, with a clamp from front to back of the joint, the sharp cope line will cut into its matching molding, and the joint will practically weld itself together. □

Gene Landon builds period reproductions in Montoursville, Penn.



You don't need matching cope-and-stick bits to make this overlapping scribed joint. More complicated shapes, such as those shown below, can be coped similarly, with just a few more straight chisel cuts to fit the outside edges.

Some 18th-century molding shapes

Ogee



Reverse ogee



Chamfer



Ovolo

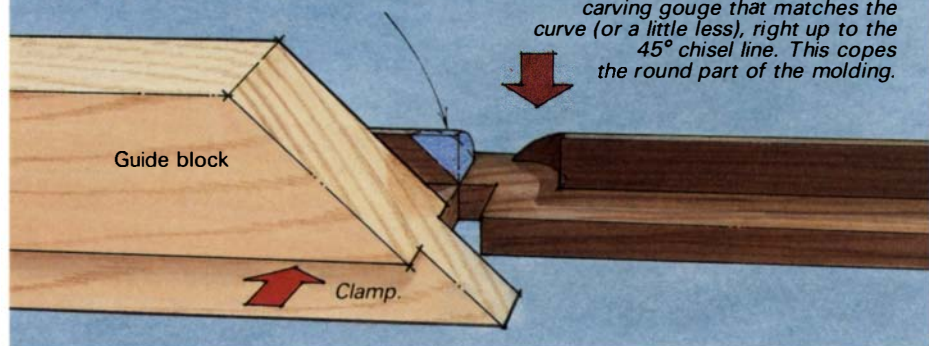


Coping by hand

The cope joint at the rails and stiles is similar, but you don't need to cope the full length of the joint, just where the miter meets the molding.

The first step for cutting the cope is to fit a 45° block to it. Use the block as a guide for a chisel to remove most of the waste.

Then come in straight down with a carving gouge that matches the curve (or a little less), right up to the 45° chisel line. This copes the round part of the molding.





Above, stock for muntins and mullions is tenoned and undercut, or coped, to the reverse profile of the moldings before the strips are ripped to width. This, in effect, tenons and copes six mullions at once. The shaper jig, which rides in the table slot, consists of a plywood panel to support the work, and a backup rail that prevents tearout. After ripping (left), the molding profile is shaped onto the stock one edge at a time, using a featherboard to press the work to the shaper fence (right). Rabbeting is done on the table saw (below). The first passes cut the surfaces the glass will rest on. The second saw setting cuts the rabbet shoulders.



Fig. 4: Beading and rabbeting

A. Molding.

First cut

Second cut

B. Rabbeting.

First cut

Second cut

C. Testing the fit.

Mold and rabbet one stile and one mullion, then test the fit. Adjustments in rabbet depth and height may be necessary.



#09136 cutter) fit on Delta's "stub" spindle, #43190. I made a small jig to slide in the shaper's table slot. This supports and backs up rails, etc., while coping tenons on their ends. Both the fence adjustment and the cutter-height adjustment are critical. Set the fence so that, with the tenons passing over the top of the spindle, the cutter just tips its flat against the shoulder you have already sawn. If the cut is too shallow, the joints won't pull up closed; if it's too deep, the distance between tenons will be altered. The other adjustment—the height of the cutter—is set to match the mold on the stiles; too high leaves a gap, too low splits the mold when the joint is closed. The flat top of the cutter should just brush the cheek of the tenon. The same setup copes rails, muntins and mullions, and you are coping the ends of a half-dozen munts and mullions at a time.

With this done, the mullions and muntins can be separated. I saw off both edges of the stock at $\frac{1}{16}$ in. wide, rejoin, saw off both edges and rejoin until I have enough, then pass the pieces through the planer, set at $\frac{3}{4}$ in., to remove the sawmarks.

Now all the remaining stock can be molded. Set up to match the stiles as closely as possible. You'll notice that the quarter-round mold will leave a feather edge around the cope if it's set up properly. Also, when the cutter crosses a mortise in rail or munt, it will leave a paper-thin slice of wood as it passes. The depth of cut should be set so that exactly $\frac{1}{8}$ in. is left after both sides of a muntin or mullion are cut. Keep in mind that the second pass in molding a muntin or mullion leaves only $\frac{1}{8}$ in. riding on the shaper table—the stock can easily tip if you aren't alert. Keep the stock held against the fence at the top where there's plenty of bearing surface, and keep your hands out of the line of the cutter. If a kickback occurs, you don't want to feed your fingertips across the cutter. You'll be glad there are no knots or snarly grained sections in your stock when doing this operation. Incidentally, it's not too hard to pass one of these pieces across the shaper on its side instead of its face, so be methodical.

The next operation is cutting the rabbet for the glass. I prefer to do this on the tablesaw. Each rabbet takes two passes. Of course, you could do it on the shaper in one, but it's a fairly deep cut ($\frac{1}{4}$ -in. by $\frac{1}{16}$ -in.) and likely to tear out or kick back. At this point, there isn't a whole lot of wood left on a mullion.

I use a wooden insert in the saw table that hugs the blade pretty closely. I prefer to use a smooth-cutting combination blade. Cut the face of the rabbet—the surface the glass will bear against—on all pieces first. Don't forget the stiles and rails.

Next, set up to cut the shoulders of the rabbets. This order of events leaves the widest bearing surface on the table after the second cut frees up the waste. Frankly, this is a scary operation; you won't want to be caught daydreaming should a kickback occur. The first two pieces cut will allow you to test the fit of the joints: cut one mullion, adjusting the fence setting so the center of the mullion is exactly $\frac{1}{4}$ in. Also, rabbet one rail or stile.

The most likely cause of an open joint is that the offset of the tenon shoulders isn't quite right. You can adjust this by making the rabbet deeper or shallower than $\frac{1}{4}$ in., but remember more than $\frac{1}{32}$ -in. adjustment here will either eliminate—or double—your $\frac{1}{16}$ -in. slop on the glass size. You may have to choose between tight joints or $7\frac{1}{16}$ -in. by $9\frac{1}{16}$ -in. lights. Shaving $\frac{1}{16}$ in. from glass isn't practical, so you'll end up paying for 9x12 lights.

To allow the joints to close, the mullion tenons must be trimmed back nearly to the cope where they abut one another in the muntins. This is a good time to cull out any pieces that are less than perfect. The other joinery work includes cutting a third shoulder on the tenons on the rails, and paring off the flat left

Coping by hand

If you don't have a shaper and want to make sash, the order of progression is a bit different. The muntins and mullions are still handled together during the mortising and tenoning operations. Then, they're ripped apart and molded and rabbeted *before* the copes are cut.

I've made a small 3-in.-long block to help lay out the copes for hand cutting. It's molded with a cove that's a reverse of the sash mold shape (this can be carved if you don't have a matching cutter). Both ends of this block are mitered off to the tip of the cove. This reveals the cope shape when the block is laid over the mold of the sash bar. Just trace it on, lay it on the other side (flipped end-for-end) and the cope is laid out.

The sash bars can be coped with—what else—a coping saw with a fine-toothed blade. Clean up with a small half-round file if necessary. Since it's not practical nor necessary to cope the whole end of a 3-in.-wide rail, common practice in hand work is to chop a cope pocket $\frac{1}{2}$ in. or so into the rails' ends with a gouge, leaving the rest of the tenon shoulder square, as shown in the small photo on p. 37. The stile molding has to be chopped off to accommodate the square shoulder, leaving the mold to run into the pocket, where it stops. This is also a good technique for paneled door frames.

—D.R.P.



The first step in hand coping a joint is to scribe the cope line with a 45° marking block (left). The second step is to saw to the line with a coping saw (right).

between the molding and the rabbet at the ends of the stiles.

Sand all the moldings and flats before final assembly. If you paint the tenons sparingly with glue, you'll minimize squeeze-out and save a world of cleanup time later on. Assuming good fits on your joints, you won't need to fill gaps with glue; there's already ample glue surface with all those mortises and tenons working together. Level the face and back sides of the joints with your favorite handplane, fit the door to the opening and hang. A sash door is heavy when glazed, so I allow room for the free side of a 28-in.-wide door to sag about $\frac{1}{8}$ in. from its own weight.

After you've applied your favorite finish (or primer to painted work), you can glaze—or put the glass in—the door. I've never seen old work that wasn't puttied, although I once used wooden strips to hold the glass instead. The project was a coffee table, and I thought the glass needed the extra support.

Putty looks much better, and isn't too difficult to learn to



A multi-paned glass door dresses up the author's walnut corner cabinet. Detail at left shows how crisp putty lines define inside surface of the glazing. The putty is tinted to match the wood.

install. Check the glass for defects or cracks, and drop each piece gently into place. Fix the glass with a glazing gun or by using glaziers' points. A piece of furniture requires that the glazing material get hard, while an exterior window or door will need glazing material that remains somewhat flexible—to allow for extremes of weather. DAP glazing compound is good for exterior work, and I use DAP Painters' Putty for furniture. The putty is white, and will need to be tinted (with earth colors ground in oil or painters' universal tinting colors) to agree with the wood of the piece. Use burnt umber and black for walnut, Venetian red and yellow ochre for cherry, raw sienna for maple, etc. The colors will make the putty too soft and gooey to use, so you'll need to stiffen it back up with ground whiting.

Getting the color right is a messy, often frustrating process, but it can be fun if you liked making mud pies as a child. Mixing is best done with a kneading action on a piece of scrap glass or Formica. Make up more than you need for a job—you'll never be able to match the color if you run out part way through. The consistency is right when a ball of the stuff will hold its shape without sagging and a putty knife pulled through it cuts cleanly

and doesn't drag. Make sure there aren't any lumps of hardened putty or areas of color variation.

To glaze a window, pull a hunk of putty off and work it into a rope shape between your palms. Use your fingers to work plenty of putty into the rabbet, then use a putty knife to force the putty into place. When you're sure it's in good and tight, wipe the knife clean on the leftover putty.

To bevel the putty, hold the putty knife diagonally, starting in one corner of the sash. In a smooth, firm motion, pull the knife toward you while holding the side of the blade against the corner of the rabbet, with the corner of the blade against the glass. Press hard. The putty should be squeezed into the space left between knife, glass and sash, with the excess pushed out and cut off by the corner of the knife and the edge of the rabbet. The angle of the blade is best determined by trial and error—you want the angle to be narrow enough so that no putty will be visible from the front of the door. Holding the handle of the knife too high above the sash tends to leave a rough surface behind the knife as it's pulled along. Finish each side by gently drawing the knife up out of the corner, then carefully remove the excess squeezed out by the knife. Go on to the next side of the light, beginning in the same corner you finished with last, and so on around the light. The corners may give you trouble at first, but they should finish up cleanly, looking as if the putty were mitered together, with a sharp crease right down the corner. You'll probably have to go over all of the corners several times to get them right.

It takes the putty several days to skin over. The sash should be left flat until then, at which point the glass can be carefully cleaned with a razor blade, and the wood with steel wool. You can wash the glass with window cleaner if you want; the spray doesn't hurt the fresh putty, only to the extent that the fresh skin will pucker and pull if you have to wipe it. It can take up to six months for putty to fully harden, but you can count on the glazing points to hold the glass in place until then. Leftover putty can be returned to the can and covered with a thin layer of raw linseed oil to prevent hardening. □

Ray Pine makes period reproductions in Mt. Crawford, Va.

Sash with matched planes

by Norman Vandal

The hardest part of making sash by hand is coping the molded pieces for a tight fit. Nineteenth-century joiners minimized this fussy cut-and-fit chore with matched planes, like the antique coping plane and mating stick-and-rabbet plane I bought years ago for \$80. Since the key to tight sash is making the fillet, mortises and tenons the same thickness, the joiner would also buy chisels and gouges sized to match the plane iron. Today, you'll probably have to make your own planes (*FWW* #37), then grind your own chisels to match.

My basic method for sash is to make a layout stick—for rails and horizontal bars on one side, stiles and vertical bars on the other—locating mortises, fillets and any



Vandal's coping plane shapes groups of muntins to fit molded sash rails.

other pertinent features. Using a marking gauge, I transfer this information to cut-to-size clear pine or spruce stock. I chop all the mortises—whether through or blind—while the stock is square, then cut the tenons on the rails.

To cope the muntins, I clamp the pieces together on a piece of plywood, and plane them all at once. Sticking is done with the pieces supported between two rails in a long track-like jig. If you've worked carefully, the sash will lay up tight and square without glue. Just pin the joints and plane the faces before installation. □

Norm Vandal is a consulting editor for Fine Woodworking.

Paring Chisel Basics

*Warm-up exercises
teach an essential skill*

by Michael Podmaniczky



The three paring chisels, center, are lightweight tools shaped for precise work in tight places. The firmer chisel, left, is heavier overall, without side bevels, to resist the shock of hammering. The Stanley chisel, right, is an intermediate design for general work.

One of my favorite, and often enjoyed, times is the first slice I take with a paring chisel after a good sharpening. This most basic and useful tool is also the most versatile, doubling as a plane, a drawknife, even a cabinet scraper. But like any tool, it only performs for the hands that understand its basic personality—quirks and all.

There are many types of chisels, from the brutal timber framers' mortiser down to the tiniest carver, each one requiring a different technique. Here, I'll limit myself to an examination of the parer and how it's used for fine cuts. You *can* pare with any chisel, so much of the advice here will apply to all chisels. But the parer is a special case in that it is a lightweight, specially shaped tool that can get into places other chisels can't. Paring chisels are thin and light, with beveled edges to reduce weight and increase maneuverability. They are not expected to take hammering or prying. The nature of this tool is to remove light shavings of wood, usually with a finished surface as the intended result: sides of dovetails, tenon shoulders, etc.

The plane finishes large surfaces, the paring chisel finishes small ones. Incorrect use of a tool that's not necessarily intended for finish cuts—a drawknife for example—results in temporary frustration and extra work. Incorrect use of a paring chisel results in poor joints and ten years of irritation from having to look at them across the living room.

Any discussion has got to begin with the usual enjoiner: buy the best. There's no point in trying to master a second-rate tool.

But don't fret, I'm not suggesting that you buy a drawerful of expensive chisels. You can get by with two or three good parers, say, $\frac{3}{8}$ in., $\frac{1}{2}$ in., and 1 in. or $1\frac{1}{4}$ in. You have many years to fill up that drawer. For rough-cut pounding, also pick up a couple of solid, inexpensive hooped socket or reinforced plastic-handled butt chisels. I like Stanley. There's no need to break the bank.

As I'll discuss further along, the action of paring—whatever sort of chisel you may be using—requires that the flat chisel back be used to “jig” the cutting edge in a straight line. It follows that the longer the blade, the longer the controlled cut. While this is true, it's also true that sometimes smaller areas need to be pared, and a long tool gets in the way. . . hmmm . . . what to do? Long-bladed patternmakers' chisels are really great for big work, and I go one step further and use cranked-handled ones—tools in which the shank of the chisel is bent so that the line of the handle is parallel with, but above, the line of the blade. With these, you can pare down a bung in the center of a sheet of plywood, if you really care to. But since these tools are extraordinarily expensive (not to mention hard to find), go for an average-length bench chisel, and it will take care of 90% of your needs.

It would be simple to describe some ideal working grip and, thence, the perfect handle for a paring chisel. You would then take it in hand, step up to the bench and find that the job you're doing is not ideal, and you'd end up with an entirely different grip and the shape of the handle would then be irrelevant, if it wasn't actually inconvenient. Better a plain handle that will give



A mortising chisel, top, cannot get into tight corners because of its square sides; the paring chisel, above, has no problem because of its side bevels, which can be ground to almost a knife edge. Taking this thought one step further, the author modified a small parer's cutting edge to form a double-skew chisel, right, for slicing into dovetail corners. In all these cases, the right hand powers the cut, while the left rests against the work and grips the tool for control.

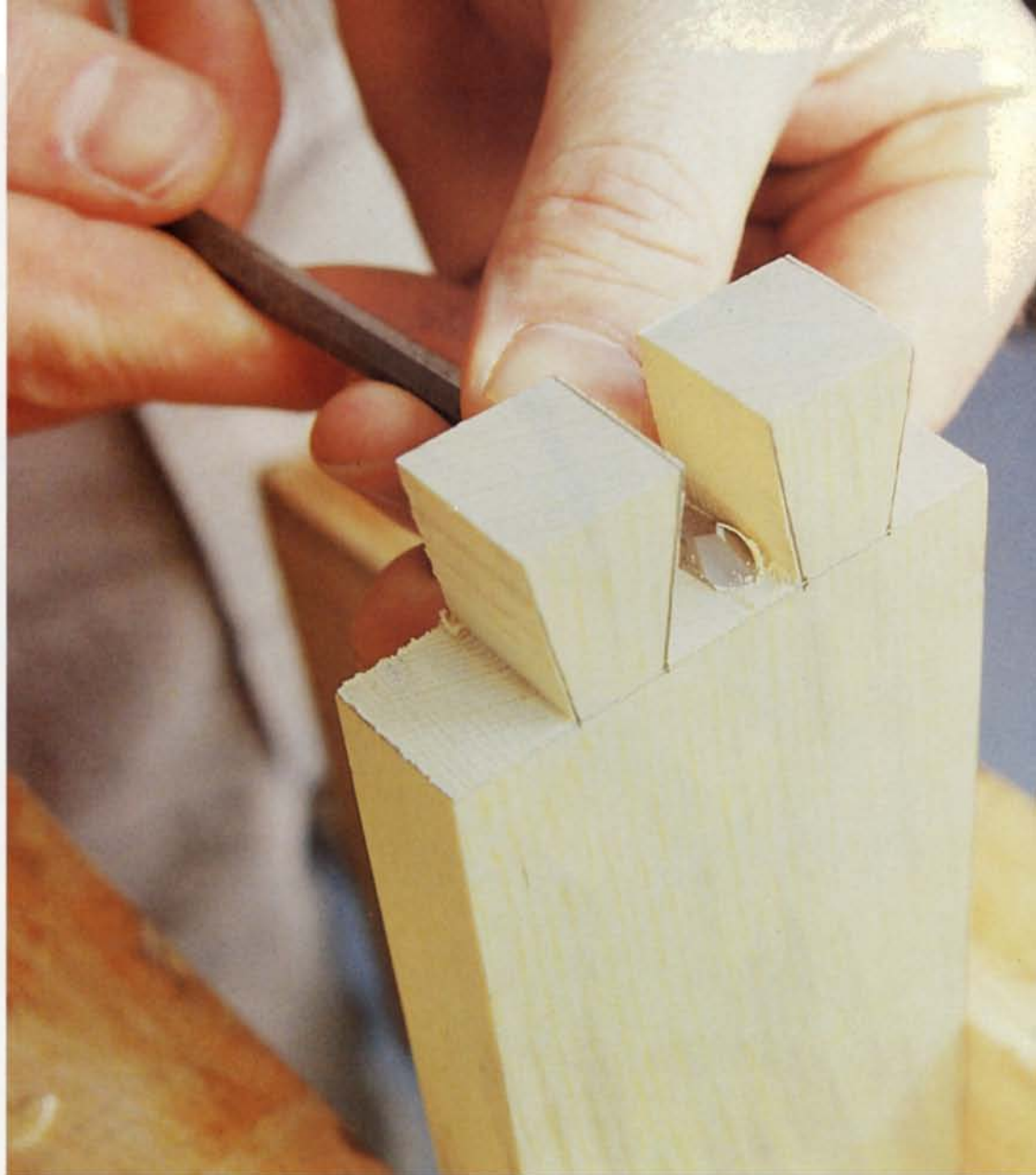
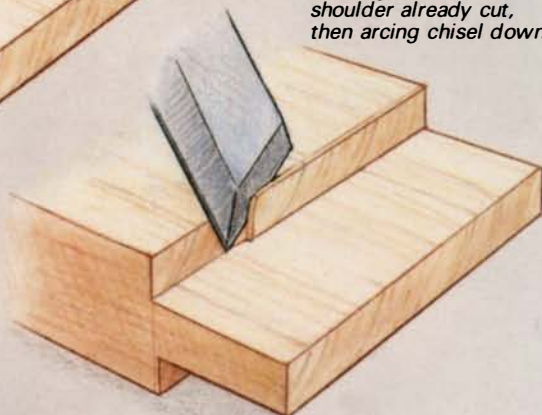
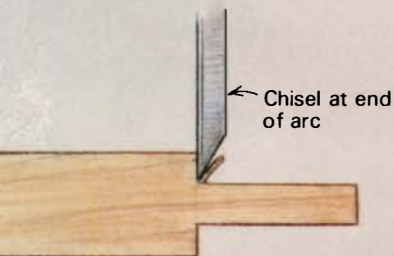


Fig. 1: Paring to a shoulder line

1. Start cut on line; slice down to tenon.

2. Proceed down line by jiggling corner of flat back against part of shoulder already cut, then arcing chisel down.

Detail: Side view



When paring a straight line, such as this tenon shoulder, the left hand backs up the tool for control, while the right hand pivots the cutting edge down. With a series of cuts (see drawing), the flat back of the chisel can jig itself along the length of the shoulder that has already been cut, as well as along the scribed shoulder line.

the versatility of grip so necessary to a proper job. The simple oval handles on Marples or Sorby tools are great, even though the smaller sizes may need a flat spot planed on one side of the handle to keep them from rolling off a not-so-level tabletop.

A very important detail is the finishing of the surfaces of the tool. It is imperative that the back of the chisel be ground flat, not belt sanded! This is easy to check if you're buying off the rack: just grab a steel ruler and hold it against the surface. You don't want to see light between the two. If you're catalog-buying and they send you a dud, send it back. It's the only way that manufacturers and distributors will ever get the picture.

As mentioned earlier, paring chisels have beveled side edges, and the care with which this is done is an indication of the overall concern the manufacturer has for the product. The maneuverability that side beveling gives you is apparent when working into an acute angle, such as next to a dovetail, as shown in the top photos on the facing page. You can re-grind this bevel almost to a knife-edge. To carry this idea a little further, I modified a ¼-in. bench chisel (shown in the large photo, p. 42) and made, in effect, a two-edged skew. Thus, I get a slicing cut (on either side), even when I push the blade in a straight line.

Now, I'm sure that you've already muttered something about my remarks that paring chisels are not for hammering on. I know, I know. . . I hammer on them, too, occasionally. But only

with a wooden mallet, and then only lightly. Besides, paring is, by definition, done just with the hands. Blasting away with a mallet on a heavy mortising chisel doesn't permit the intimacy that develops between your hands and a paring chisel during a long day of cutting joints. Like a tiny stone in your shoe, a sharp edge or protruding piece of hardware can become a real irritant to your hand in a short time—which is another reason for choosing smooth handles (i.e. no butt hoops).

Manufacturers usually leave sharp corners where the body of the blade tapers back to form the shank. I grind these trailing corners off the blade to avoid opening up a finger if my sweaty palm slips, and I file any proudness off the edge of the ferrule, which ideally should be flush with the wood of the handle. This wants to be as comfy as an old loafer.

Now, before you can really understand the proper use of a paring chisel, you have to appreciate a key concept.

Ask yourself what would happen if you stuck a coil spring on the handle and held it while trying to take a shaving off an important piece of work. Why, as soon as you got near the end of the cut, the spring would unload, the chisel would jump and make a mess of everything in its way. You would have no control. Unfortunately, this can happen any time you go to work. The muscles and tendons in your hands and arms will act just like the spring unless you develop proper paring technique. There are

Bahco's ergonomic chisel

by Sandor Nagyszalanczy

I always thought that chisels were all about the same: a little fancier handle here, a little harder tool steel there. But my nonchalance was put to the test recently when I tried a chisel created by design methods usually reserved for jet cockpits and auto interiors. Made by one of the world's leading tool manufacturers, Bahco of Sweden, the Ergo line of hand tools is inspired by modern methods of ergonomics, or "human factors engineering." Bahco's aim was a chisel that would reduce hand and wrist fatigue while minimizing the risk of injury, common in hand-labor-intensive work.

Conny Jansson, director of R&D at Bahco, and a team of consultants began by videotaping woodworkers on the job and analyzing their individual physical movements. They also used computerized measuring devices attached to both people and mannequin-type figures to study worker functions and measure stress.

The collected data provided design criteria for the improvements incorporated in the Ergo chisel: a longer, textured handle large enough to accommodate two hands; a gently rounded, knob-like end to reduce palm pressure and protect the fingers when struck by a mallet; a smooth blade-to-handle transition to allow a closer grip for delicate work; and a shorter, stiff blade—angled in relation to the handle—for a higher angle of relief when working in close on flat surfaces.

I was impressed by the scientific treatment, but wondered if all the high-tech was worth it. To find out if the Bahco performed like a European sports car, I gave it a road



Sleek as a Swedish Saab, the Ergo chisel is as much a product of science as it is art.

test around the shop. The overall heft and feel of the chisel was gratifying. There was no feeling of cheapness, and the oval shape of the molded polypropylene handle gave a good sense of blade position relative to grasp. Since I have large hands, I appreciated its generous size, although I could only use the palm of my other hand on the chisel's butt end. I used it with a mallet and the handle felt very positive when struck; evidently, it won't mushroom over time. The socket-style attachment and angle of the blade gave the tool a feel similar to Japanese chisels I've worked with. At a claimed Rockwell hardness of 58 to 60, the blade sharpened and honed well and held an edge even after being pounded into dense rosewood.

I didn't much like the surface of the Ergo's handle. Despite the groove-textured surface, the black plastic was just a little too slick for my taste. Also, an indented area on the chisel's handle where Bahco molds in its trademark was uncomfortable to grasp, nearly negating, for the sake of product identity, all the

effort that went into making the tool's hand fit revolutionary.

So, is ergonomics a gimmick or a giant step in the evolution of hand tools? Although I usually choose a tool for the way it performs, I'd be drawn to Ergo's high-tech modern appearance, even if I knew nothing about all the computer-aided effort that went into its design. Bahco has created a high-quality tool that's got more going for it than a trendy design, but I can't say I'm ready to throw out all my antiquated chisels just yet; I still prefer the feel of a wood handle over plastic. If you're comfortable with the tool, you may not be with the price—\$15 for the 1-in. model. But all that intelligent Swedish design—whether it's for hand tools or Saabs—doesn't come cheap. □

Sandor Nagyszalanczy is an assistant editor for Fine Woodworking. Bahco's Ergo chisels are available from Woodcraft Supply, Woodworker's Supply of New Mexico and Garrett Wade.



Successful paring demands forward pressure to make the cut and firm control to keep it in line. At top left, the controlling hand, the left, also acts as a brake so the chisel will not spring forward uncontrollably and chip out the wood at the far end of the workpiece. Below that is a practical one-handed grip—the heel of the hand acts as a fulcrum; the right thumb arcs the chis-

el like a lever through the wood, slicing through the wood fibers. Control in paring comes easily when large muscles of the body are used to drive the tool. Shown above is one of the most common techniques: Podmaniczky uses his chin against his fist and the end of the handle, with the left hand helping to keep the tool on line. Other strategies include pushing with hip or chest.

two ways to overcome this problem: dampen the spring action, or substitute inertia of body mass for muscle power.

In most cases where I use my right hand to power the cut, I use my left hand to help guide the cut and restrain the cutting action. By squeezing the blade and resting part of my left hand against the work—sometimes the forefinger, other times the heel of my hand or whatever is convenient—I have real control and can stop the cut whenever I want, right on a dime. As I mentioned earlier, the back/side edge of any chisel has to be kept in good condition—actually sharp—so that there is a slight danger with this grip that you’ll begin taking little slices off your finger. Try to apply the gripping pressure in the middle of the blade and you can avoid irritation.

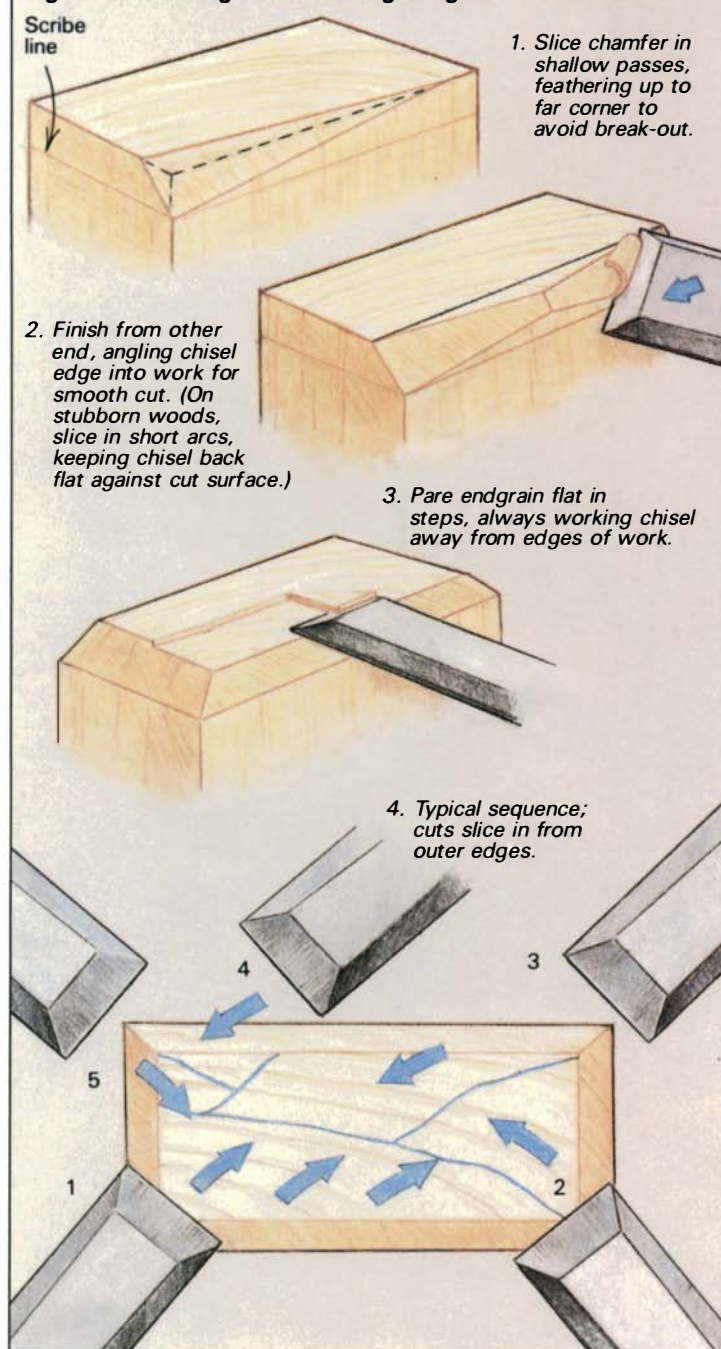
As shown above, when I’m at the bench cutting straight down, I use my head. Despite what my wife occasionally thinks my head is full of, it is quite heavy, and my chin can really move that chisel. The idea is to keep the butt inside the fist so that the chin

pushes against soft meat. In practice, the handle creeps out, but you put up with it because it gives a bit more control.

A variation on this theme is to grab the chisel anywhere along its length and use the chin to push against the side of the handle and forefinger. Both these strategies eliminate the problematic springiness of arm muscles. You can use your hip, chest or other parts of your body in this manner, depending on the circumstances. Once in a great while, you’ll look a bit foolish with one leg up on the bench in order to get the right angle, but you gotta do what you gotta do.

A plane is a jig that holds a “chisel” and forces it to cut in a straight line by virtue of a long flat sole. Without this jig, keeping the cutting edge going in a straight line is a bit harder, but as I mentioned earlier, you still have a way to partially jig the action. With the chisel flipped over on its back, start a paring cut. At first, the direction of cut is determined entirely by where you point the tool. As the cutting edge slices into the wood, it

Fig. 2: Chamfering and flattening endgrain



develops a flat surface behind the cut. The back of the chisel can begin to rest on this surface, which it has itself created, and use the purchase as a guide for ever-increasing accuracy of direction. The longer the cut, the more controllable it becomes. If you use this help, you can all but eliminate digging in.

To practice the various techniques we've been discussing, I would recommend a short piece of a 1-in. by 2-in. poplar or mahogany. Using your combination square and a sharp layout knife, scribe a line around the stick about $\frac{1}{4}$ in. from one end. Your task is to pare to this line so that you have a nice flat endgrain surface. Figure 2 shows the basic approach, but every piece of wood is different—I won't go so far as to say contrary—so apply the principles in whatever way necessary to suit the job.

Clamp the wood vertically in the vise, sticking up three or four inches above the benchtop. Chamfer the long right-hand edge at roughly 45°. Trying to do this all at once will just get you broken-out wood on the other end of the cut—so don't do it. With easy



Chamfering is the first step in paring a flat end (see drawing). Then bring the surface down in steps, working toward the center.

semi-circular slices, take $\frac{1}{16}$ -in. slices off the corner, aiming slightly up so that the cutting edge emerges from the wood before it gets to the other side. When you're down to your knife line at the corner, do the same on the other long edge, then finish the chamfers as shown in the drawing.

If you're right-handed, the first edge will be the easy one since you'll be able to rest your whole forefinger on the work. Moving to the left side will require a grip alteration, but a couple of tries will help you find a comfortable position. I half-heartedly try to do all operations with either hand. (I say half-heartedly because I'm not very good at it—but at least I try.) If you're paring or planing and run into reverse grain, you can flip the tool into the other direction a lot easier if you're a switch-hitter.

Now turn the work 90° and cut the two short edges. This will be easier since the following corners are cut down for this step, too. You now have a chamfer all around the end of the 1x2, right to your knife line. These can now be cut down flatter with the same grip and hand action. Slowly work two opposite chamfers down until you're almost on the flat. Turn the work 90° in the vise, and shoot across, square to the cuts you've just made, to finish off the flattening. If you're having trouble with break-out, rotate the work as many times as you need to, to be able to work "into" the surface. Finish off with a very light cleanup shave.

As you're working along an edge, keep in mind that the angle between the edge of the stock and the cutting edge of the chisel must be less than 90°, as shown in the drawing. Otherwise, the outside wood fibers will have a tendency to break away, being pushed by the chisel without anything backing them up. It can help if you imagine the cutting edge and the body of the stock as two scissor blades, shearing the fibers along the edge.

When you're satisfied with the flat end you've produced, scribe a new line, clamp the wood down horizontally on the bench and chamfer it again. You can either lay the work on a piece of plywood or directly on the surface of the bench, which will back up your cuts and prevent break-out, or you can hang the end out over the end of the bench, a position that more closely imitates situations you'll encounter in real life. This will be trickier, but better practice.

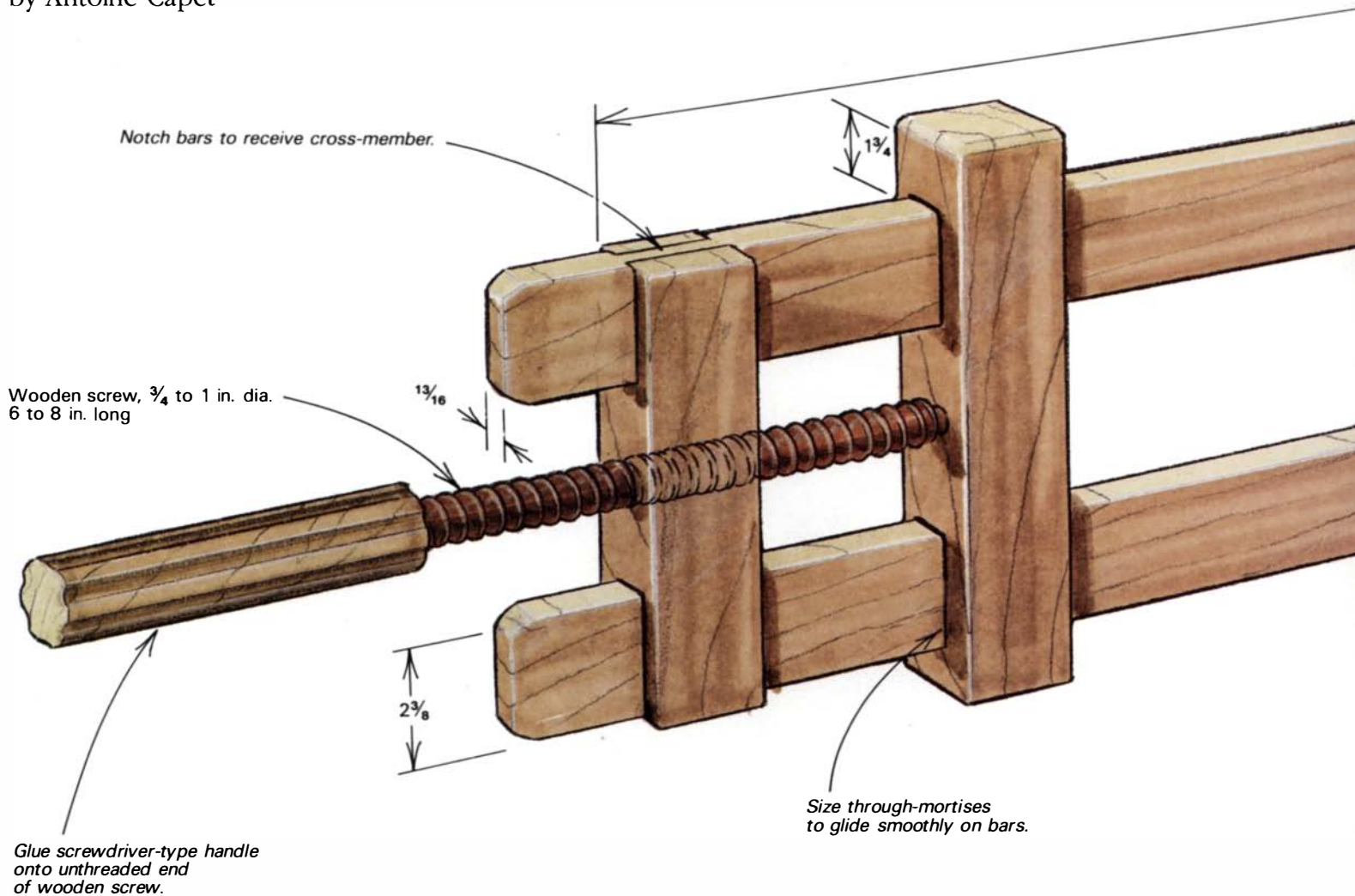
Try the other grips (including chin drive) that we've discussed, and cut the same way you did when the piece was vertical. The more you practice and the harder you make it for yourself (say, cut the end of the stock on a 120° bevel instead of square), the quicker and more accurate you'll be when it really counts. □

Michael Podmaniczky is a contributing editor to FWW.

Shopmade Sash Clamps

Two bars are better than one

by Antoine Capet



Clamping—an essential step in most woodworking jobs—just doesn't seem to get the same attention given to other major operations, such as sawing or planing. Yet the experienced woodworker will agree that faultless clamping equipment is a precondition for a businesslike approach to gluing, with no fiddling about and no frayed nerves.

Today, it seems that wooden sash clamps have been superseded by metal equipment. Steel-bar or pipe clamps, however, don't provide a complete answer. They are cumbersome, heavy and require a number of precautions to avoid denting the work being clamped. Moreover, they are quite expensive and cannot be made in the average woodworker's shop.

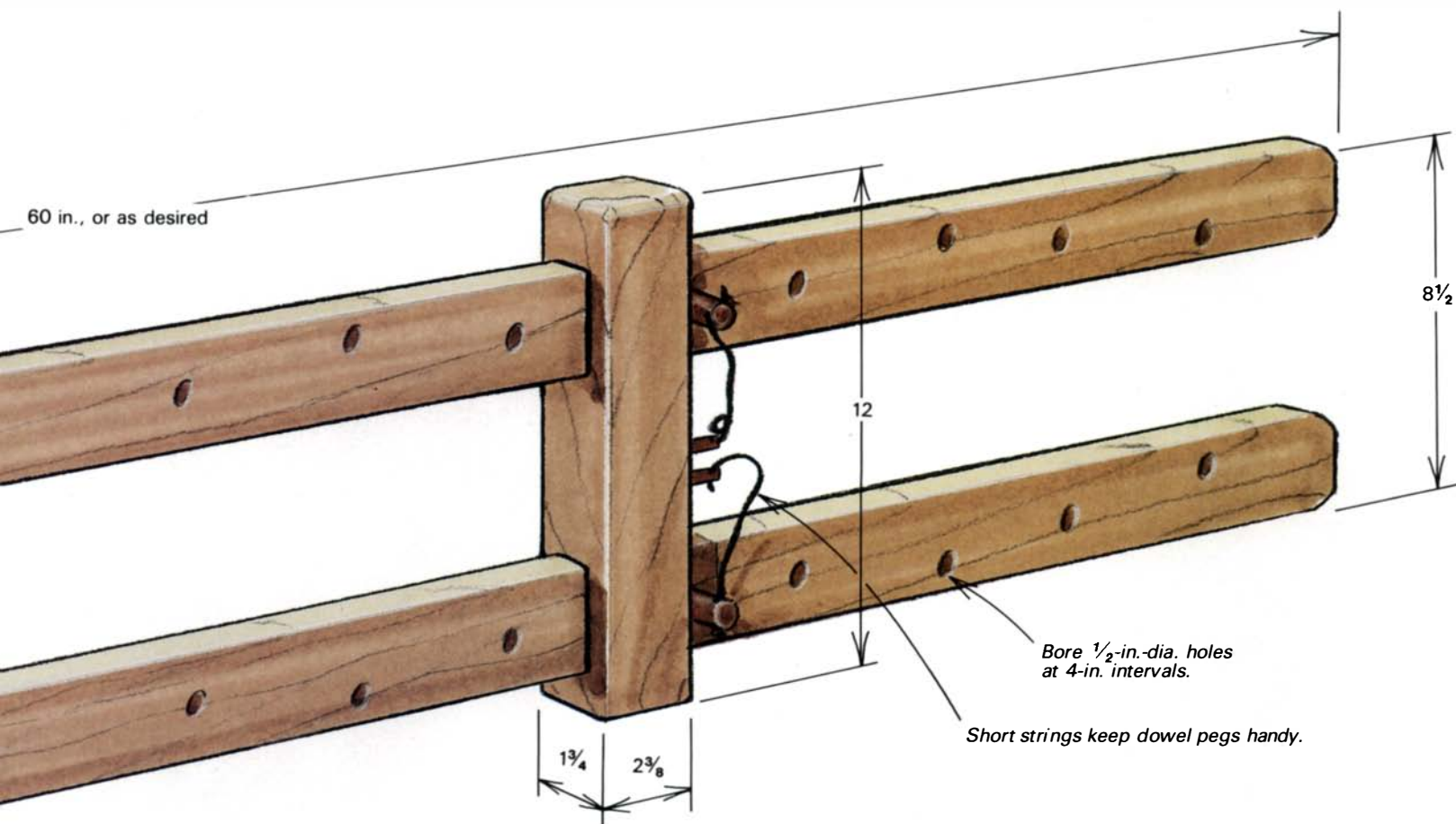
I've made several pairs of these wooden sash clamps and have found them to be extremely useful. There's no bending stress on the wooden bars whatsoever, since they're positioned on both sides of the press screw. And the bars won't break easily when clamping pressure is applied because they stretch slightly.

Wooden sash clamps can be made by even the inexperienced woodworker, and I strongly encourage readers new to the hobby to make at least one pair. Besides equipping themselves

for a lifetime of good clamping, the construction techniques required will give them good practice in performing basic, fundamental woodworking operations.

Before getting into the actual construction of the clamps, we must first decide on the species of wood to be used and the desired capacity of the clamp. In Europe, hornbeam has long established itself as the superlative species for clamps and presses, as it possesses the right combination of strength, elasticity and resistance to abrasion and splintering. Although hornbeam is sometimes available in America, ash, maple or beech would certainly be acceptable substitutes. The ideal wood for the screw would be a rather uncommon species called service wood (*Sorbus domestica*). However, any strong, dense hardwood will do.

I decided that my clamps should have a useful capacity of 50 in. in length and 4 in. in depth, although you may make them any size you wish. This size will accommodate the widest tabletop and the thickest benchtop I'm ever likely to make, not to mention doors, windows and other frame-type constructions. I made the bars from 60-in.-long 4/4 stock, and the fixed and sliding cross



members from 8/4 stock, with everything cut 2 $\frac{3}{8}$ in. wide.

After all the parts are planed to dimension, the ends of the fixed cross member are slot-mortised to receive the bars, which have been notched on both sides. The resulting bridle joint will later be held in place by glue alone, so a reasonably true fit between these parts is desirable.

Each of the sliding cross members is provided with two easy-fitting through mortises, cut approximately $\frac{1}{8}$ in. oversize so they can slide smoothly over the bars. Don't overdo it though—if the mortises are too big, the sliding cross members will not remain perpendicular to the bars and will tend to wedge themselves and bind.

The bars can now be drilled at 4-in. intervals with $\frac{1}{2}$ -in. holes (for the adjustable stop pegs), starting about 2 in. from the bottom end. The holes should not be aligned dead-on center, as any incipient split would be encouraged to travel the length of the bar. Instead, arrange them in a zig-zag pattern so that no two subsequent holes are in line. I didn't bore the bars all the way up, as it's unlikely that my clamps will ever be used for very small jobs.

It's now time to drill and thread a hole for the press screw in the fixed cross member, and to bore a shallow, flat-bottomed hole in the upper sliding cross member to receive the end of the screw. It's also prudent to cut the male part of the screw now, so that it can be tested in its "nut" before everything is glued up. You can use a $\frac{3}{4}$ -in. or 1-in. thread box and tap set to make a wooden screw as I did, or substitute a metal veneer-press screw. (Both the thread set and press screw are available from Garrett Wade, 161 Ave. of the Americas, New York, N.Y. 10013.) A screwdriver-type grooved handle is then fitted on the end of the shaft. It's very comfortable to use and easy to make on the

lathe—the grooves are cut with a small gouge or router jig.

The fixed cross member may now be glued to the two bars, with the sliding pieces left in position at the other end to ensure parallelism. While the glue is setting, cut two short stop pins from dowel scraps and tether them with short strings to the bottom sliding piece so that they will not be mislaid.

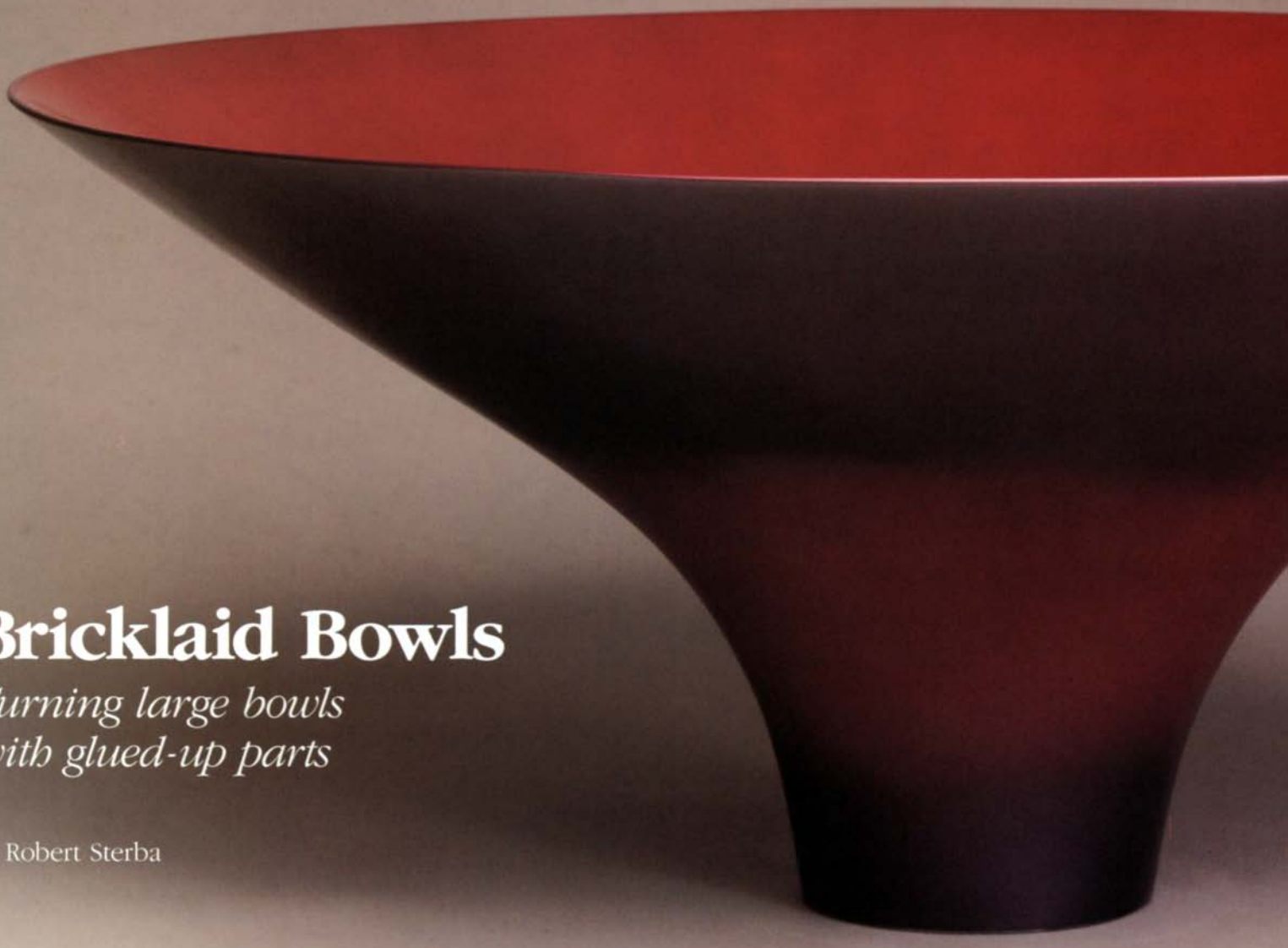
When completed, rub linseed oil or your favorite finish over the entire surface of the clamp, except the wooden screw. The screw can be finished by soaking it in hot tallow or a mixture of paraffin diluted in mineral spirits. A nice final touch is to permanently glue a thick layer of felt (off-cuts of carpet would do in a pinch) on the surfaces of the cross members that will contact the clamped work.

The finished clamps are extremely easy to use. The screw is first fully retracted so that the upper sliding cross member can rest against the fixed one. The pegs are then inserted in the appropriate holes, depending on the length of the workpiece. The bottom slider is positioned against these pegs and the clamp is ready to be tightened. You can also remove the end crossbar and thread the clamp through the work before reassembling and tightening the clamp.

The greatest advantage of this double-beam clamp becomes obvious when it's tightened. The more pressure you apply, the straighter the bars become. Plus, the clamping faces stay square—the complete opposite of conventional one-bar clamps.

Storage is always a problem for long clamps, but the flat nature of these clamps, combined with their relatively light weight, makes hanging them a breeze—two long nails driven in the shop wall will do nicely. □

Antoine Capet teaches at the University of Rouen in France.



Bricklaid Bowls

*Turning large bowls
with glued-up parts*

by Robert Sterba

The more woodturners I meet, the more I realize that most of us didn't start out as turners. We all got hooked somehow. I once made cabinets, built-ins and some furniture. My mistake was building a spindle lathe. From the beginning, I discovered a new awareness of shape—the most important and, often, most overlooked element in any three-dimensional object. Turning is a marvelous exercise in shape. Subtle variations in line can completely change the tone of a piece. You can get an idea of what I mean by taking a few same-size blocks and seeing how many different shapes you can cut. Variations on a theme like this are my favorite pastime.

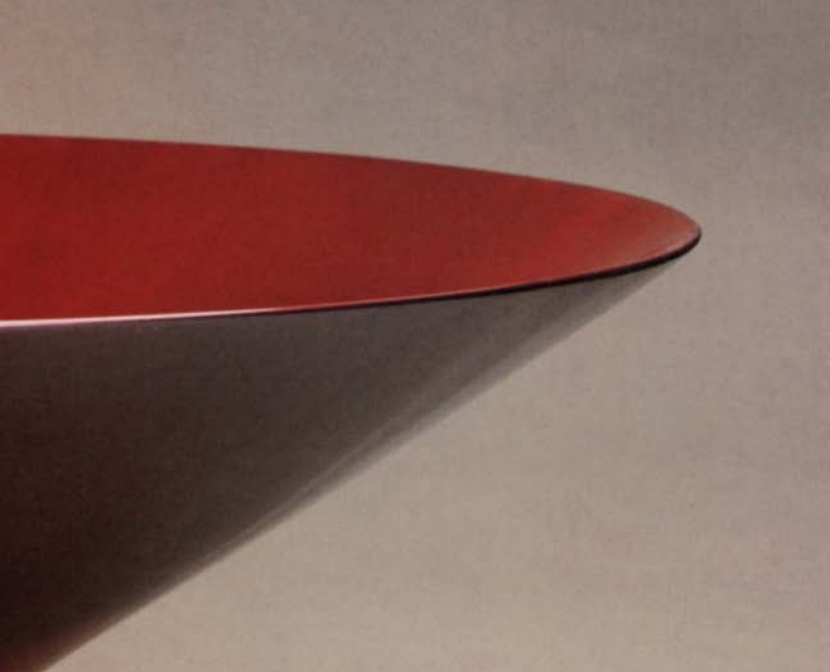
If, four years ago, someone had said, “Son, you could spend the rest of your life turning and exploring round shapes,” I might have choked. I certainly would have laughed, but here I am. The interplay of line and shape is really what my work is all about. For me, when a woodworker can bring color, grain and texture to enhance—almost caress—a shape, craft is well on its way to becoming art.

Since shape is my main concern, I don't find wood and wood-working tools all that fascinating. You may wonder why I even use wood, since its figure is hidden beneath layers of colored lacquer. I've never believed that *tools* and *how* you produce an

object are as important as the object itself. And, I reject those who proclaim, “Oh, look at that beautiful piece of wood!” as a way to avoid thinking and to excuse ugly designs. All that, to borrow a phrase from California woodworker Garry Knox Bennett, is “tech-no-wienie” woodworking—it's boring and it's time to grow out of it.

I like wood because it's immediate. I don't have to bake it, fire it or melt it. Wood is a material, just as clay is dirt and glass is sand. About seven years ago, I watched a friend, Scott Taylor, turn a maple dish, apply spray-can black lacquer, then polish it with rottenstone. The result was a low-tech, high-tech finish that didn't rely on expensive, highly figured wood. I had stumbled on a way to search for the perfect shape, and there would be no grain to get in the way.

My typical bowl has more than 100 small pieces of wood laminated into a bowl shape as large as three feet in diameter. The technique dates back to at least the 18th century, when it was used to prepare oval tabletops for gilding. Patternmakers also use these so-called bricklaid laminations to construct large shapes that resist warping when they absorb or give up moisture with the changing seasons. After I laminate the rough bowl, I mount the blank on a lathe and turn it to refine the form. I don't



The glistening lacquer finish on the author's 24-in.-dia. bowl makes it hard to believe there's wood beneath the 24 coats of finish. For him, wood as a material isn't as important as shape and color. To make a bowl blank, right, he glues together small wooden segments to form rings, which are laminated together.

use solid baulks of wood because I live in New Mexico, where 36-in.-dia. trees are pretty scarce. And, the few problems I've experienced with lacquer fracturing have been across the grain, so lamination techniques let me design that flaw out of the piece.

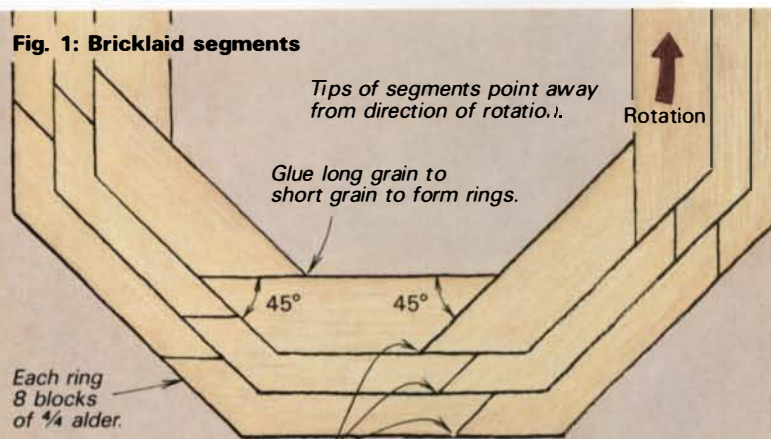
My basic materials are alder and medium-density fiberboard (MDF). Fiberboard is wonderful stuff. It's denser and finer-grained than industrial flakeboard, and can be turned with high-speed steel or carbide tools. I like alder because it's available, already milled, from a local hardwood distributor. All I have to do is saw the planks apart and glue the pieces together, using one of the construction techniques shown in figures 1 and 3. The simplest method is to glue small blocks together to make one larger block. Staved constructions resemble coopered barrels. It's an easy way to construct hollow, straight or tapered cylinders. Segmented, stacked laminations involve assembling many small blocks of wood, with 45° angles cut on both ends, into increasingly larger rings which are, in turn, laminated together to form a hollow bowl shape.

Segmented, stacked laminations are very stable and strong. I start by ripping 4/4 alder into 1¼-in.- to 2½-in.-wide strips, in ¼-in. increments. This sticking is then carefully surfaced and jointed. For accuracy, I cut the 45° bevels on the ends of each segment with a motorized miter box or chop saw. Eight blocks are needed for each ring (figure 1). These are glued together, endgrain to long grain, to form a ring. I usually use hot-melt glue to hold the segments together, but make sure the glue is hot enough to flow evenly and that it hardens to a good bond. An alternative method would be to join the segments together with yellow glue, clamping the pairs tightly with pinch dogs (available from Woodcraft Supply and Garrett Wade) and letting them dry on a flat surface. Handplane the surfaces, as needed, to ensure a good joint between rings.

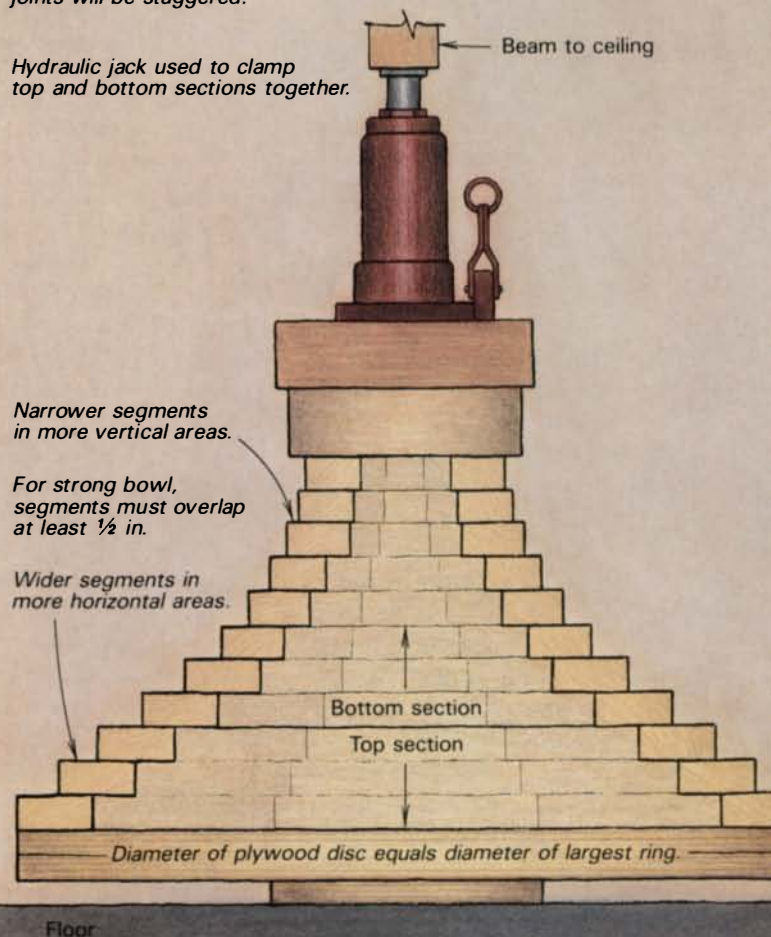
The rings are assembled in increasingly larger diameters. The more vertical the shape, the narrower the segments. The more horizontal the shape, the wider the segments. As with the staved cylinders, I make full-size drawings to work out the measurements. I like to make sure the rings overlap at least ½ in., as shown in figure 1, when I glue them together. The rings are

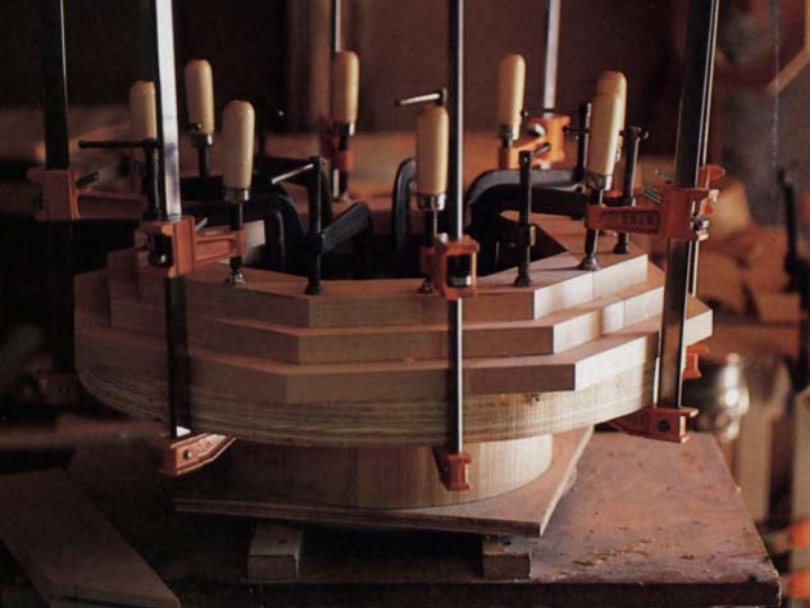


Fig. 1: Bricklaid segments



Because rings are different sizes, joints will be staggered.





Clamps set across each 45° joint secure the rings to each other and to a plywood faceplate. A shop-built cradle supports the rings and attached faceplate during glue-up.



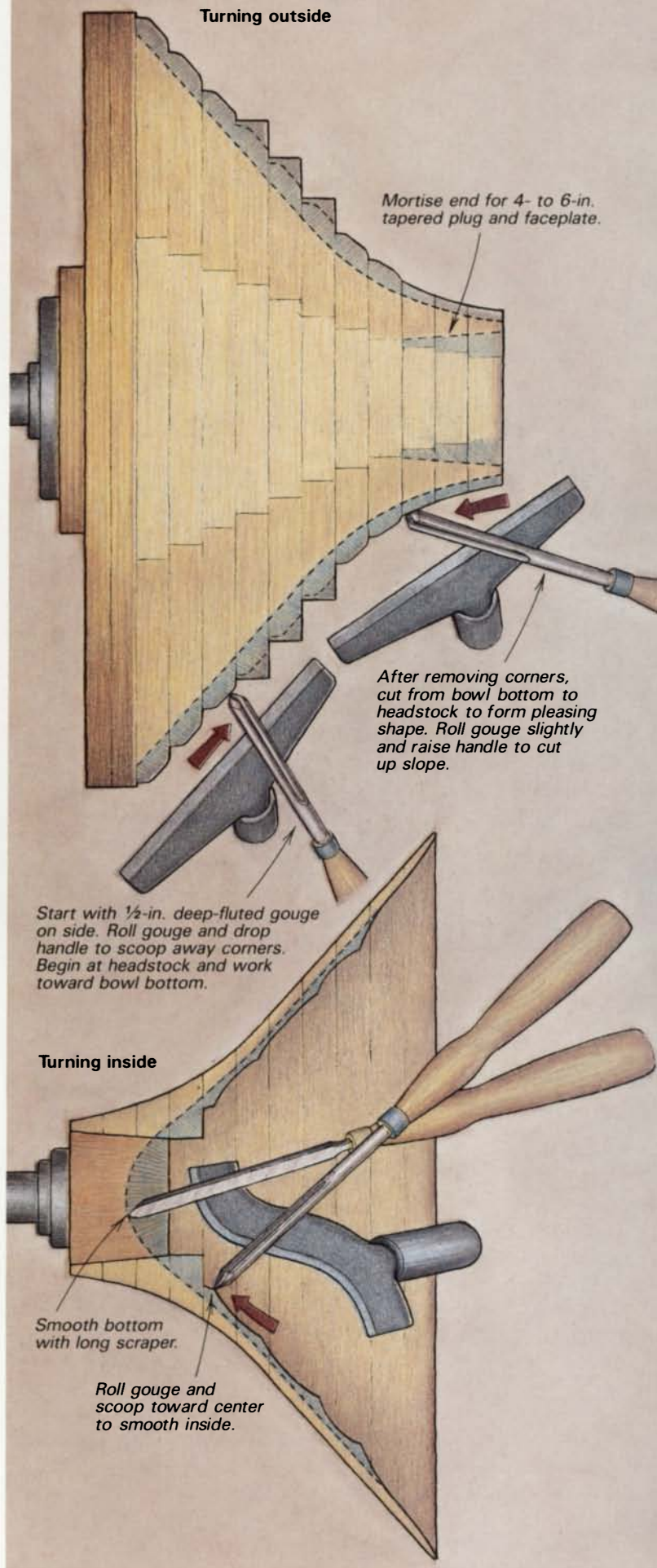
A faceplate screwed to a 3-in.-long tapered plug is glued into the bottom of the turning before the bowl is finish-turned.

quite fragile. The endgrain/long-grain joint is not, at this time, very strong, although it becomes stronger when the rings are bonded together because I rotate the rings slightly to stagger the joints. I dry assemble all the rings to make sure the form is right and everything fits. Direction is important in assembling the rings. Be certain that the rings are laid up in the same direction, so that the outside point of each facet points *away* from a counterclockwise rotation, if your lathe rotates in that direction.

Begin building the turning by gluing and screwing together plywood or MDF discs to make a 1½-in.-thick disc equal to the diameter of the largest ring. My turnings are 18 in. to 36 in. in diameter and 12 in. to 18 in. deep, so the backing disc must be strong. Bandsaw the disc somewhat round and mount it on your lathe. Start slowly and flatten the disc. (The pedestal lathe I use has a 1½-in.-dia. headstock shaft. I consider this the minimum size for this work.) Dismount the disc and lay the largest ring on it. Glue and clamp it in place. I spread yellow glue on one face, then clamp the pieces together as shown in the top photo, above. After about 20 minutes, remove the clamps and add another ring. A combination of 3- and 4-in. C-clamps and Jorgenson quick clamps works well. Clamp over each joint, being careful to keep the rings centered. An

Fig. 2: Turning a bricklaid blank

Turning outside





Sterba uses the shoulder of a deep-fluted gouge to shear the ridges from the lamination, left, and to shape the inside of the bowl. The bowl bottom is carefully finished with light scraper cuts, above.

Caution

A large bricklaid bowl blank is a rather imposing mass of wood and glue. Even though I have never had a blank shatter or tear loose from the lathe's faceplate, it could certainly happen. I don't think you can be too cautious. You should always start your lathe slowly, about 400 RPM to 600 RPM, and stand back. I let these things spin for a while before I get too close. If the bowl's going to come apart, I'd just as soon not be around. I also wear heavy leather gloves and a face shield when I'm roughing out.

off-center assembly will vibrate dangerously on the lathe.

While the glue is setting on the larger rings, I assemble the narrower-diameter rings to form the smaller part of the bowl. I glue the top and the bottom together using a one-ton hydraulic jack bearing against a post and a beam in my ceiling for pressure. I let the assembly dry for a day or two before turning, then screw on a 6-in. faceplate with #14 hex-head sheet-metal screws, which have impressive holding power.

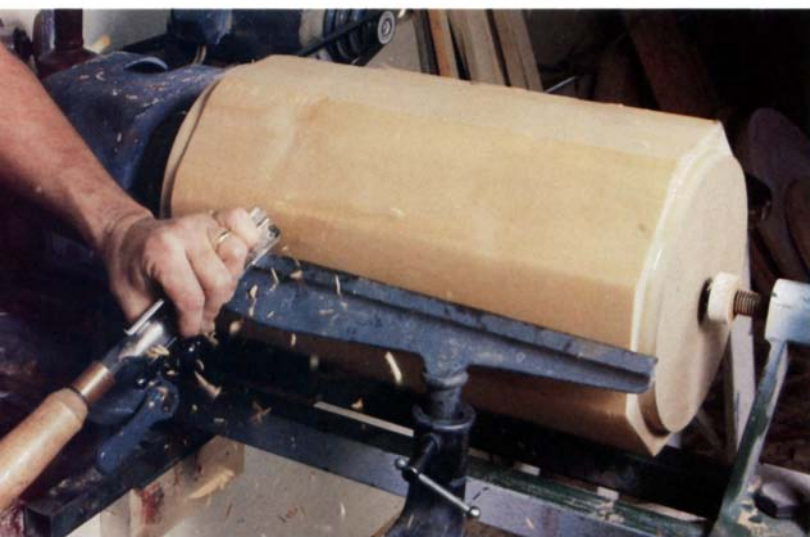
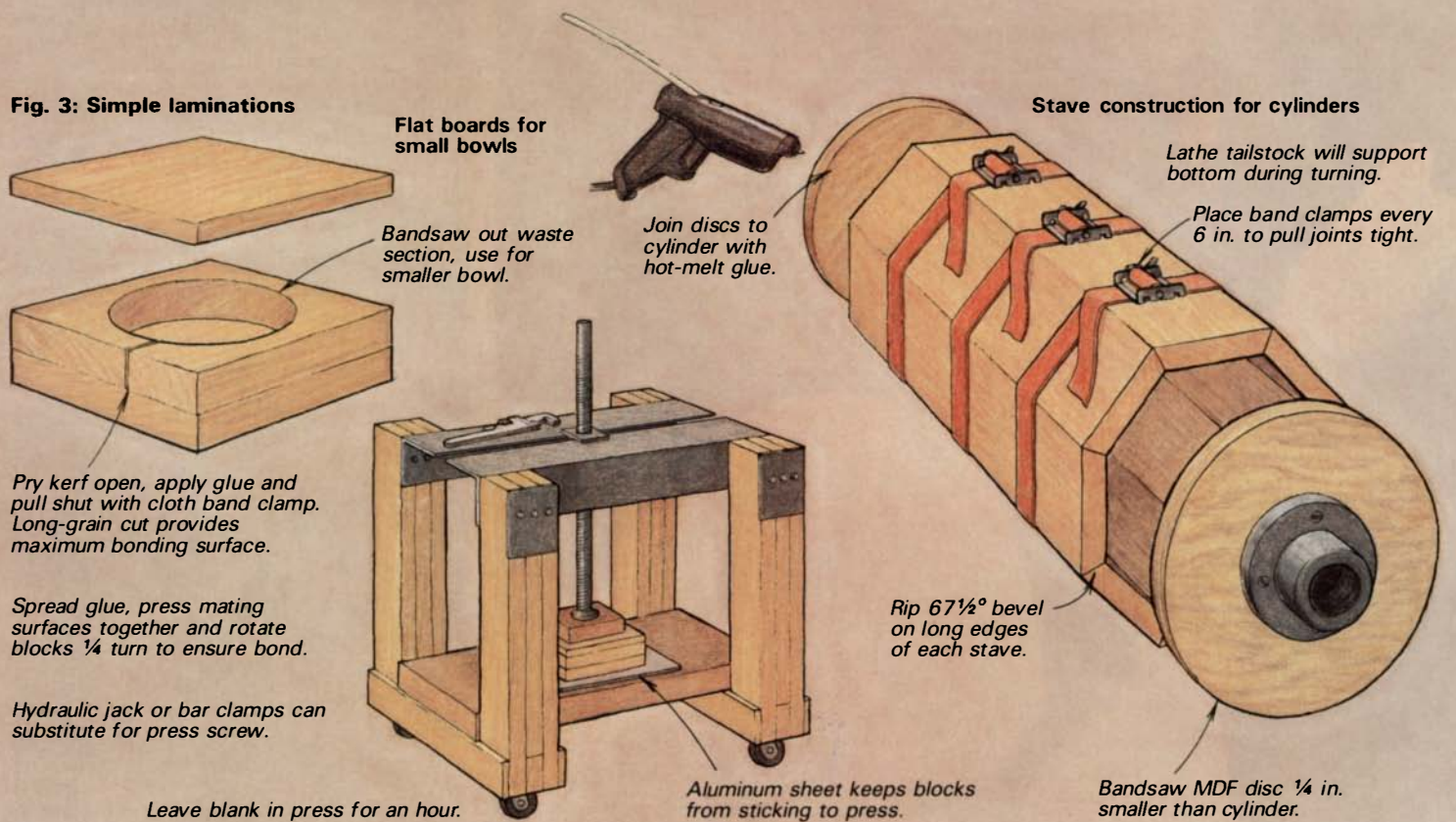
Turn the outside first, beginning at the end nearest the faceplate. Knock off all the edges with a ½-in. deep-fluted gouge. The open flute should face away from the headstock. Work your gouge almost horizontally, lowering the handle as needed to keep the cutting edge slightly above center. The cut resembles a dip-and-scoop motion. Hit it wrong and it sounds like a kettledrum vibrating. Take it easy, go slow and get the feel of the piece. It flows and so should you. After knocking off the corners, cut from the narrow end toward the headstock. Correct the shape to create a pleasant form. Here, cut with the flute facing the headstock and raise the tool handle as you cut up the slope. Don't forget that you have limited wall thickness. When you're satisfied with the shape, mortise the bottom for a tapered plug and begin

to part off the disc. Turn the plug, endgrain up-and-down, and seat it in the mortise with an even spread of glue. After the glue sets, remove the faceplate and turn the bottom flat.

The next day, mount a 3-in. to 4-in. faceplate on the plug with 2-in. to 3-in. lag screws. Mount the plug end on the lathe, remove the faceplate on the other end and cut off the disc. It will crash down and take off rolling, so watch out. True up the outside of the turning, as close to round and balanced as possible, with a deep-fluted gouge. Now you can begin shaping the inside of the bowl with a deep-fluted gouge, as shown above, left. Most of the cutting is done with the gouge's long shoulder. The flute should face the center of the bowl. As you cut, roll the gouge and scoop toward the center until you smooth the walls to the shape you want. Careful work with a scraper held slightly below the center of the turning, as shown above, right, is often needed near the bottom, where it can be difficult to maneuver the gouge.

If this bricklaid procedure seems too intimidating, you might try a simpler lamination for your first bowl. Cut several blocks slightly larger than the bowl you want, and make sure the stock is flat. Generally, a couple of passes through the planer or jointer will do it. I spread a thin layer of Titebond glue with plastic auto-

Fig. 3: Simple laminations



The stave-built cylinder is mounted on the lathe with a faceplate screwed to one MDF disc. The tailstock is snugged against a disc on the other end, then the piece is turned like a large spindle.

body putty paddles onto one or two sides of the mating pieces, depending on my mood. After pushing the blocks together, I twist them about $\frac{1}{4}$ turn to spread the glue and ensure good adhesion. This somewhat messy mass of glue and wood is placed in a press and screwed down tight for an hour. My press is very simple—basically, it's two pieces of heavy angle iron and a 1-in. veneer-press screw. You could use a hydraulic jack and a wooden frame.

To save wood and time, I often bandsaw the center from the middle or from the top of the piece (see figure 3); I later make this cutout the base for another turning. Bandsaw with the grain for maximum long-grain gluing surface. Force the kerf open with a screwdriver and inject glue into it. My favorite glue injector is a hog or horse syringe from the local vet supplier. Dull the point before using. Although it isn't necessary, you can insert veneer to help fill the kerf before snugging it up with a band clamp—an inexpensive

hardware store band clamp works well. Once the cloth band becomes stiff with glue, I leave it in a can of water overnight and wash it out the next day. Another tip is to do your gluing on an aluminum sheet. Dry glue won't stick and wet glue washes off.

Stave construction uses less wood, and also helps control the across-the-grain movement. Most of my staved constructions have eight segments. This calls for a $67\frac{1}{2}^\circ$ bevel cut on each long edge of the stave. To figure out the angles and widths of segments, I always draw a full-size plan of the top view of the cylinder. The method is described in *Tage Frid Teaches Woodworking: Shaping, Veneering, Finishing* (The Taunton Press, 1981). First, square and surface the staves and cut them to size. Set your tablesaw blade to cut the $67\frac{1}{2}^\circ$ bevel, and rip the bevel on both long edges (figure 3). Stand the eight pieces up and apply glue to both edges of every other piece. Place band clamps over the cylinder, every 6 in. or so, and dog them down. If the angles are not precisely right, the shape is somewhat self-correcting. Remove the clamps after the glue has set, but let the glue cure overnight before turning.

To turn the piece, bandsaw two discs from MDF, $\frac{1}{4}$ in. smaller than the intended final circumference. Place a disc on one end, and run a bead of hot-melt glue around it. Let the glue cool, then do the other end. Mount a faceplate and chuck it up, supporting the end with your tailstock as shown at left. After you turn the piece, pop off the discs with a putty knife or screwdriver. I rabbet the cylinder ends to receive a top and bottom, using a straight bit in a router and a standard V-shaped edge guide. For a cone shape, you could use the tapered staves discussed on the facing page.

My finishing procedures are basically the same for all my turnings. I sand from 100 grit to 180 grit, using a power-sanding disc. Then I apply three coats of catalyzed polyester primer, and set the form aside to stabilize for two to three weeks. Next, I sand the primed shape to 320 grit, removing the dust with a tack cloth. My primary finish is nitrocellulose lacquer (available from Sherwin Williams Co., 101 Prospect Ave., Cleveland, Ohio 44115, and its local distributors). Before spraying, the finishing room is cleaned,

Tapered staves on the tablesaw

by F. B. Woestemeyer



The author glues up bowls from staves tapered on the tablesaw. Angled blocks set the miter gauge and blade angle.

My tablesaw method for cutting tapered staves makes quick work of a task that can be very tedious. And, the speed of the method doesn't cost you anything in accuracy. The key to this technique is a master gauge block made from a scrap of 2x4—it preserves the setting angles for the sawblade and miter gauge.

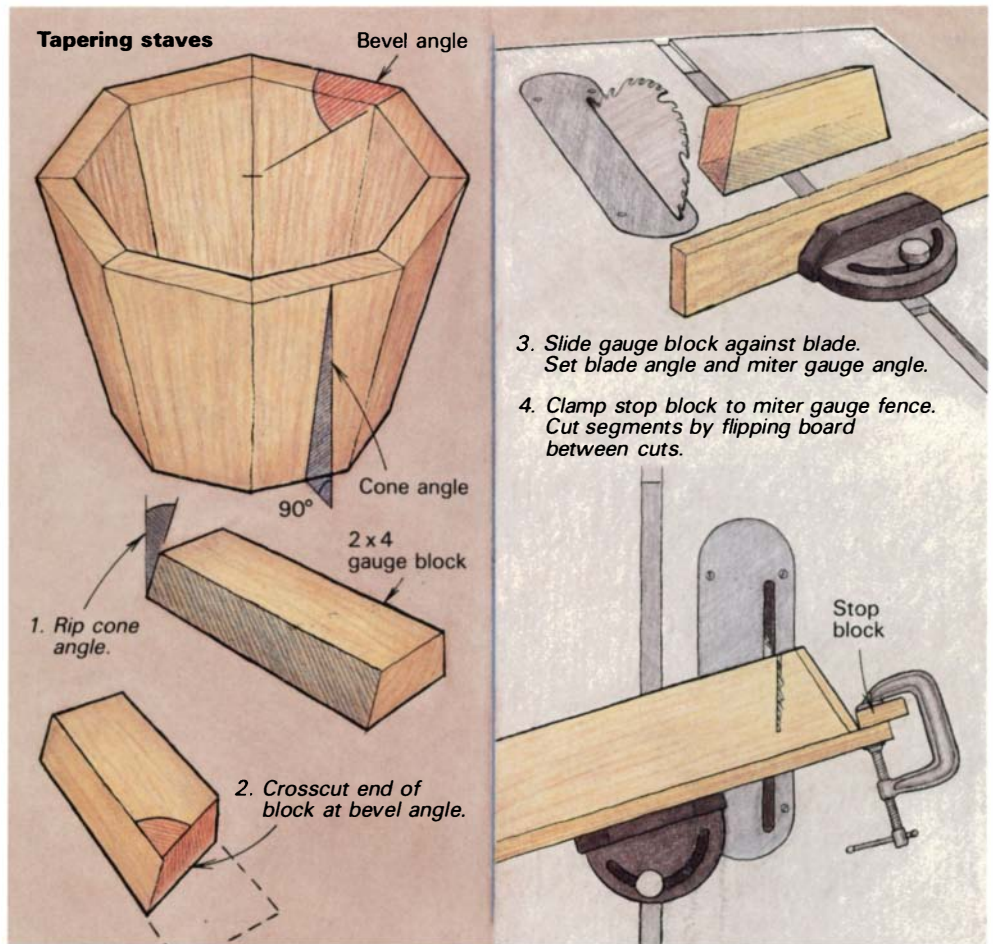
To make the gauge, first tilt the sawblade to the desired cone angle of each segment and rip one edge of the gauge block to this angle, as shown in the sketch. Return the blade to vertical and set the saw's miter gauge to the segment bevel angle. The bevel angle (B) can be calculated from the number of sides on the turning blank (N) with the following formula:

$$B = 90 - (180/N)$$

For example, where there are eight staves the bevel angle is 67.5°.

With the miter gauge set to the bevel angle, trim the end off the gauge block, as shown. Be aware that minor inaccuracies in the cone angle will simply flare the blank a little more or a little less. But inaccuracies in the bevel angle are more critical because they will result in gaps in the segment joints. Through trial and error, you may wish to recut and adjust the bevel angle until resulting segment joints are perfect.

To set up the saw, first place the gauge block against the blade and tilt the blade



flat against the end of the block. Then, leaving the block in position against the blade, set the miter gauge by matching the back edge of the block.

To cut the segments, first prepare a stock board whose width equals the height of the segments. After setting the saw as described above, clamp a stop to the miter gauge fence so all segments will be the same size. For the first cut, lop off the waste end of the stock board. Flip the stock board over, push it against the stop block and make the second cut. This second cut will form the second edge of segment one and the first edge of segment two. Flip the stock for each successive cut. Even-numbered segments get

their wide edges from one edge of the stock; odd-numbered segments from the other. If the stock is lighter on one side (or if you have laminated with contrasting woods), then the odd segments will be different from the evens. You may wish to use only odd segments for one glue-up and only evens for another.

Once made, a gauge block is good for all glue-ups of the same number of faces and cone angle. It takes only a few moments to set the blade and miter gauge to the angles of the block again for a later project. □

F.B. Woestemeyer is a woodworker in West Chester, Penn.

then cleaned again. The bowls, still attached to their faceplates, are screwed onto threaded wooden rods for spraying. The turning shown began with eight coats of red lacquer. After 48 hours, I sanded the lacquer with 600 grit and polished with pumice before applying eight more coats of lacquer. After 72 hours, I sanded again to 600 grit, polished with pumice and rottenstone, then applied four light coats of dyed, almost-transparent lacquer. After these coats dried, I applied two coats of clear lacquer containing a pale platinum pearl, then two clear coats. When the lacquer dried, I sanded to 1,000 grit and polished with rottenstone. The

turning was finally highlighted with sterling silver leaves, then glazed and polished to protect it from the environment. Finally, the faceplate was removed and the bottom covered with veneer.

By combining these methods of construction—cutting away, adding and subtracting—you open a whole new world of woodturning. Go slowly, have fun, and don't forget to consider the movement of the wood. □

Robert Sterba is a sculptural woodturner and lacquer artist in Albuquerque, N.M.

Power Primer

Electric motors in the woodshop

by Edward J. Cowern

Fig. 1: Induction Motor Anatomy

Capacitor start induction run motor (single phase, totally enclosed, fan cooled)

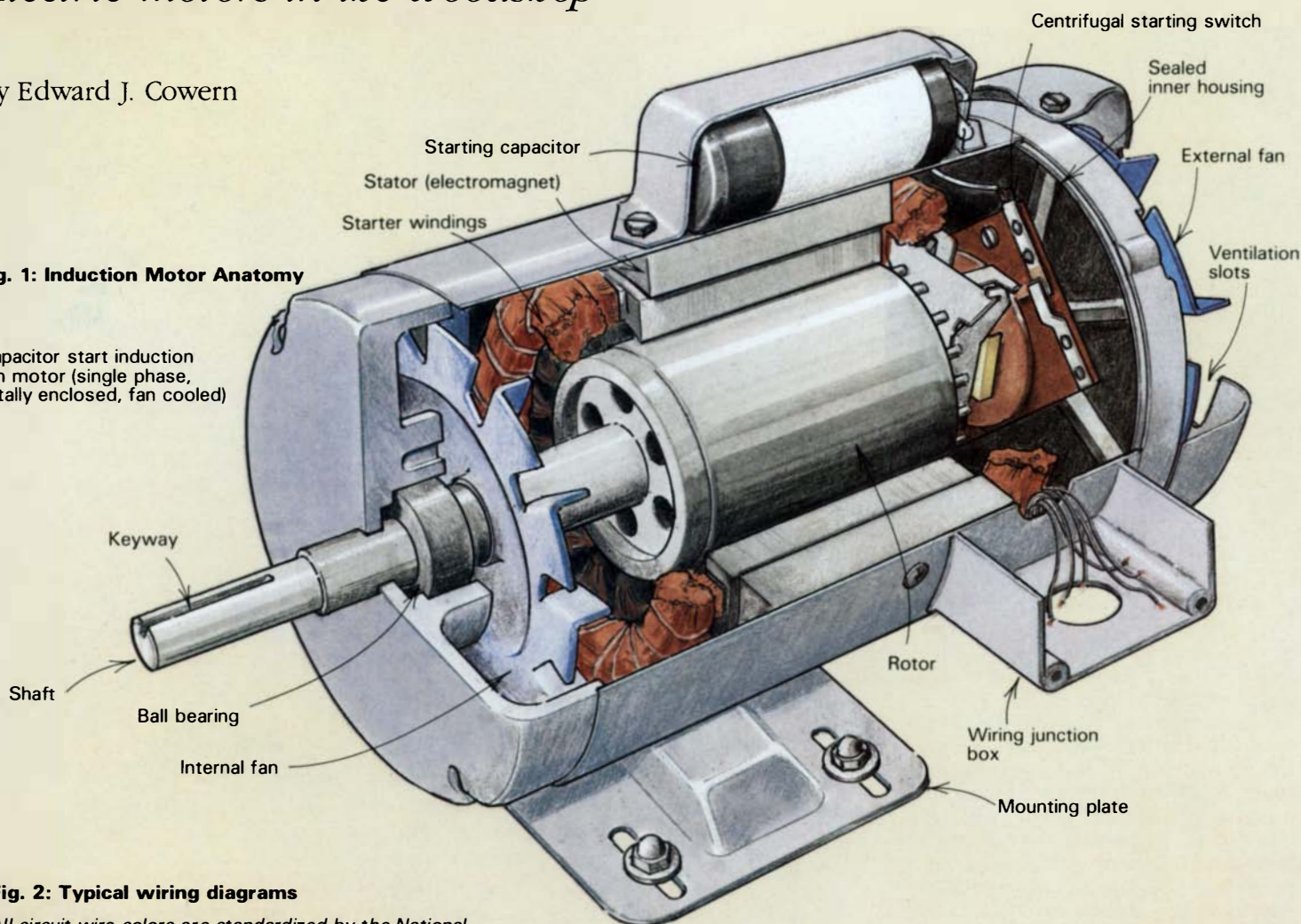
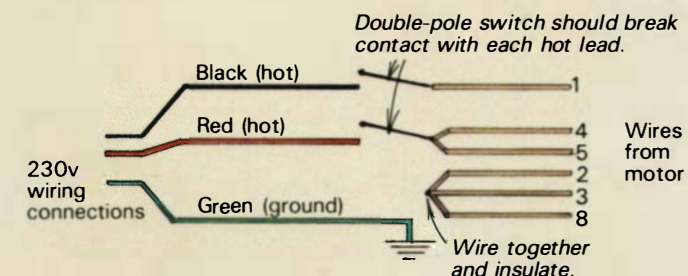
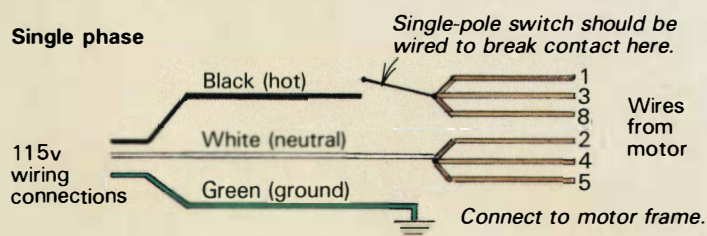


Fig. 2: Typical wiring diagrams

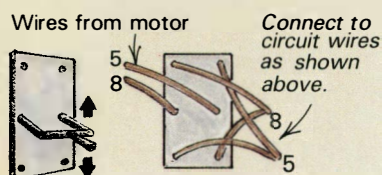
All circuit wire colors are standardized by the National Electrical Code. Induction motor lead numbering is standardized by the National Electrical Manufacturers Association (NEMA).

Single phase

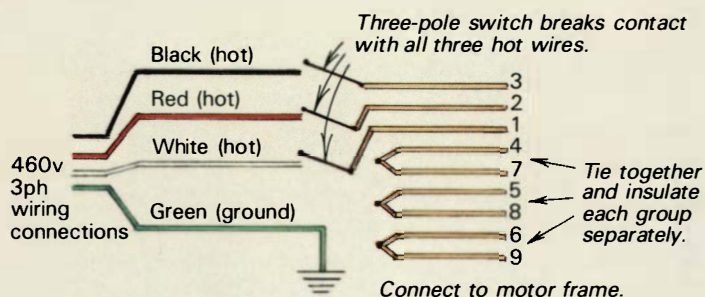
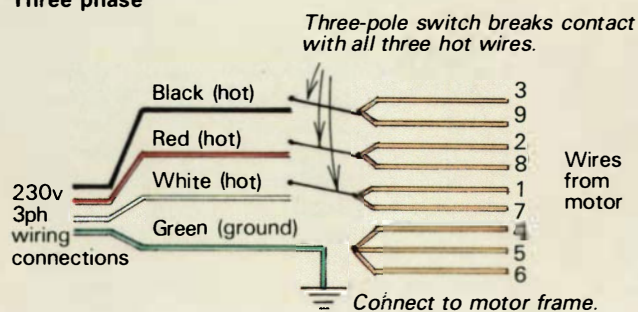


Rotation reversing switch

Double-pole, double-throw (DPDT) switch interchanges connection of wires 8 and 5 to reverse motor rotation.



Three phase



To reverse rotation of motor, interchange connection of any two motor leads.

There was a time not too long ago when a woodworker had to open a sluice gate to a waterwheel or stoke the fire beneath a steam engine's boiler before any powered machinery in the shop could be operated. Nowadays, the relative luxury of just flipping a switch makes electric motors an essential part of the woodshop.

In this article, I'll explain a bit about how electric motors work, why they might stop working and how you can intelligently choose new motors to use as replacements or incorporate in the machines you build. I won't attempt to entirely demystify motor theory, but I can convey enough knowledge to help you make sensible, safe decisions when choosing, connecting and operating electric motors in your workshop.

Motor types—Broadly speaking, two major types of motors are commonly used by woodworkers: induction motors for stationary power tools, and universal motors for portable tools. A third type, the direct-current permanent-magnet motor, is becoming popular for battery-operated cordless tools and in applications where controlled speed is important. However, I'll deal only with induction motors (see figure 1), the basic workhorse found on most stationary equipment—tablesaws, lathes, shapers, jointers, drill presses, etc.

This type of motor converts electricity into rotary motion by taking advantage of the fact that alternating current (AC) reverses its direction of flow 60 times per second. Inside the motor, these alternating electric impulses reverse the polarity of a fixed electromagnet, the stator, around a cylindrical drum called a rotor. These current reversals actually produce a rotating magnetic field inside the stator which, in turn, induces currents inside the rotor, producing a strong magnetic field in the rotor. The interaction of these two magnetic fields causes the rotor to spin as it attempts to match the speed of the stator's rotating field.

Since electrical power is available in either single or three phase, induction motors are designed specifically to operate on one or the other. "Phase" refers to the number of pulses of power delivered during one cycle ($\frac{1}{60}$ of a second for 60-cycle power). Therefore, three-phase electricity delivers six pulses of power in the same time that single-phase electricity produces only two.

Whether you choose single- or 3-phase induction motors may depend on what kind of power is available to your shop. When 3-phase power is available, usually in industrial areas, use 3-phase motors if you can. They are simpler and have longer service lives than their single-phase equivalents, and they are more efficient to operate. It's possible to use 3-phase motors on single-phase power, but you'll need to provide your own third phase. There are several ways of doing this. One is the type of phase converter described by Mac Campbell in *FWW on Woodworking Machines* (The Taunton Press, 1985).

The best all-around quick-starting single-phase induction motors are either capacitor start/induction run ($\frac{1}{4}$ HP through $1\frac{1}{2}$ HP) or capacitor start/capacitor run (2 HP through 10 HP). Both types depend on an electrolytic capacitor to energize a starter winding to get the motor spinning (see figure 1). Capacitor-start types use a centrifugal switch to disconnect the starter winding once the motor comes up to speed, while two-value capacitor motors have a separate, oil-filled capacitor that remains connected to the starter winding to provide useful power output after the motor has started. Split-phase motors—a third type—lack starting capacitors entirely and are found on machines that don't require much start-up torque, such as bench grinders.

Most capacitor-start induction motors can be wired to operate

on either 115v or 230v and can be made to rotate in either direction. Normally, 115v operation is adequate for motors through $\frac{3}{4}$ HP, but when possible, 230v should be used for motors 1 HP and larger. This is because amperage halves as voltage doubles, so a 2-HP motor requiring 13 amps at 220v would need 26 amps at 115v. Most household wiring is not capable of delivering that much current without a significant voltage drop at the motor terminals, a condition which substantially reduces motor performance.

Establishing the correct direction of rotation is simply a matter of wiring. Figure 2 shows standard wiring diagrams for both single- and 3-phase motors. If you wish to reverse a motor's rotation, say on a shaper or disc sander, you can wire in a reversing switch that reconnects the starter winding wires while leaving other connections intact. *Avoid using reversing switches on tools with threaded arbors, since the reversed direction could unscrew a blade's locknut or release the faceplate on a lathe.*

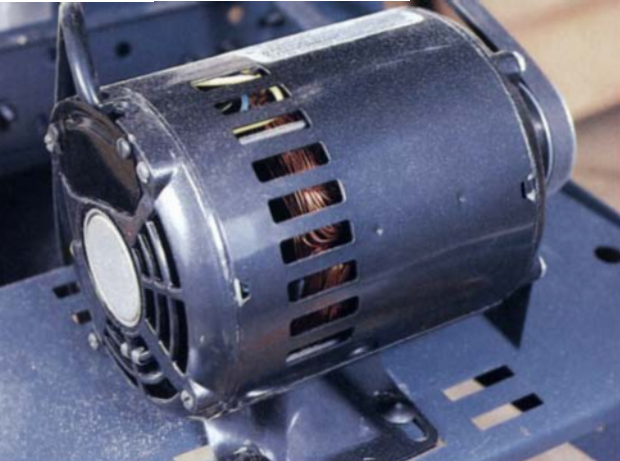
The major shortcoming of the induction motor—either single- or 3-phase—is its operating speed, which is fixed by the frequency of the power source and the number of magnetic poles designed into the motor. For example, on 60-cycle power, a two-pole motor will run at a maximum no-load speed of 3,600 RPM. As the load increases during operation, the motor will slow down to a full-load speed of approximately 3,450 RPM. Similarly, a motor with four poles will have a no-load speed of 1,800 RPM and a full-load speed of about 1,725 RPM.

Since most induction motors used in the shop are either 3,450 RPM or 1,725 RPM, speed adjustments must be made mechanically. By varying the diameters of the drive and driven pulleys, the speed of a blade or cutter can be made faster or slower than the speed of the motor. On certain machines where variable speeds are desirable, such as lathes, drill presses and shapers, multi-step pulleys offer a choice of a few preset speeds. Alternately, a mechanical adjustable-speed drive can provide a continuously adjustable range of speeds.

Enclosure types—Modern industrial-duty induction motors are available in three enclosure types. The open drip-proof motor (top left photo, next page) is the least expensive. Its louvered end brackets allow cooling air to freely circulate inside, while preventing water from dripping in directly. It's a fine motor for many applications where relatively clean and dry operating conditions exist, such as an air compressor located in an area of the shop unaffected by sawdust, or a drill press with its motor mounted high and away from the chips generated by the machine.

The second type, the totally enclosed fan-cooled (TEFC) motor, was originally developed for the metalworking industry where oil mist and metal chips are present. Its internal housing is completely closed (bottom left photo, next page) so that dirty air can't circulate through the inside of the motor. Since heat can be a problem for any motor, this type is cooled by both internal and external fans driven by the motor itself. The totally enclosed motor carries a slight price premium, but is an excellent choice for virtually all woodworking machines exposed to sawdust. Some debris will collect on the back of the fan cover, but routine housekeeping will keep this from causing trouble.

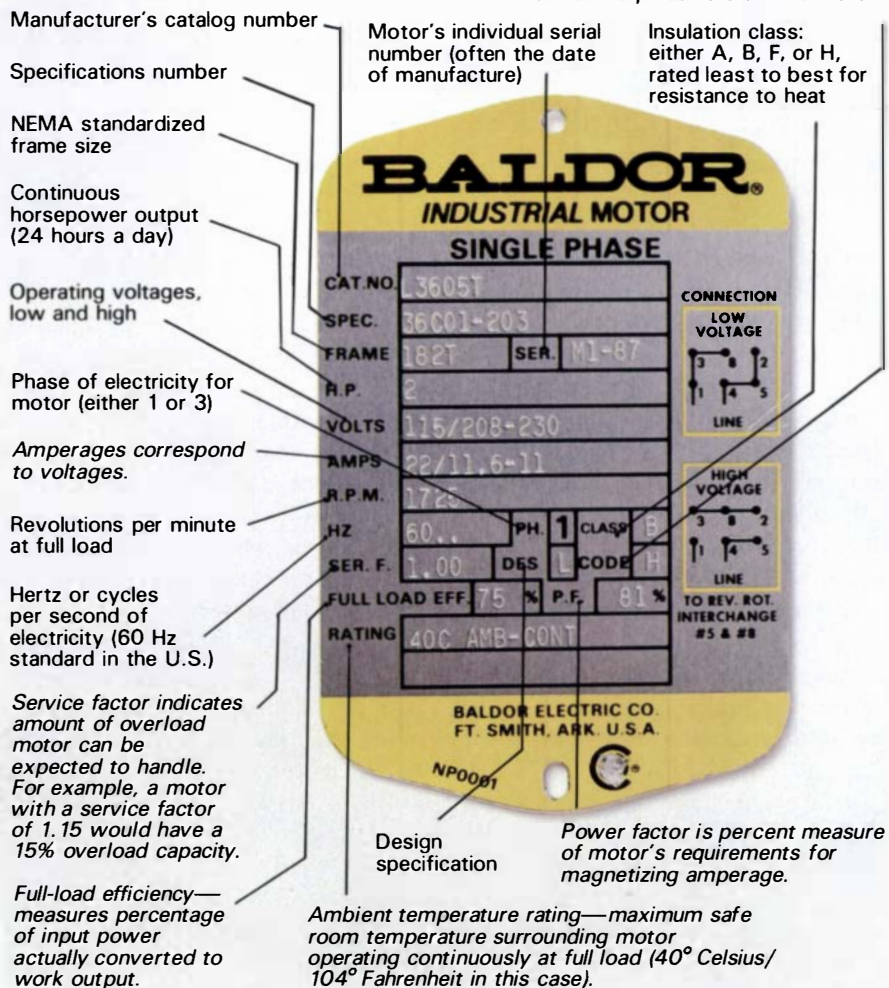
The third type of motor enclosure is the so-called hazardous location or explosion-proof. It looks like the TEFC type, but has tightly fitting seams and a rupture-proof casing to prevent internal explosions from igniting vapors or gases from combustible solvents or dusts outside the motor. Explosion-proof motors—UL-rated for Class 1, Group D applications—are the definitive choice for



You can see the wire windings in the open drip-proof motor frame on top, while the totally enclosed, fan-cooled (TEFC) motor above is sealed tight to prevent the invasion of dust and grime. The TEFC motor uses both an internal and an external fan to circulate cooling air and dissipate harmful heat buildup.

Fig. 3: Motor identification plate

Code letter indicates the amount of current required to start the motor.



spray-booth exhaust fans, where volatile fumes from woodworking finishes are encountered.

Frame size and mounting—When choosing a motor for a particular application, it's important that the physical characteristics of the motor fit the mounting situation. Fortunately, the frame sizes of modern electric motors have been standardized by the National Electrical Manufacturers Association (NEMA), so motors with the same size and power specifications made by different manufacturers are interchangeable. The frame number stamped on the information plate (see figure 3) is indexed to an extensive NEMA-compiled chart listing all motor dimensions and statistics, such as shaft diameter and housing size. Although the chart lists dozens of different frame sizes, most motors in the ½- to 5-HP range are either size number 56, 143, 145, 182 or 184.

The motor should be solidly attached to the stationary power tool's mounting plate to reduce any vibration a running motor and belt drive may produce. Better-quality machines have a cast iron, rather than pressed-steel, motor mount. A flimsy mounting plate can be reinforced with flat iron bars if necessary.

In addition to firm mounting, a motor needs well-aligned pulleys and the correct belts to deliver power effectively. Pulleys are made from either cast iron or zinc alloy, the former being more durable, the latter less expensive. These are almost always keyed to the motor shaft or arbor with a Woodruff or square key, then fixed with a setscrew. V-belts come in standard cross-sectional sizes. The most common are A-size and fractional horsepower

(FHP) belts, which are narrow, and wider B-size belts. Belts must be selected to match pulley width. The general rule is this: for low-torque, high-speed applications (such as jointers), smaller-section belts can be used; in high-torque applications—tablesaws, for instance—larger-section or multiple belts are required. If you're not sure about the length of the belt you need, an approximate length can be determined by adding twice the distance between the center of the motor and arbor shafts to half the sum of the circumference of the drive and driven pulleys (measured around the rims). Belt tensioning should strike a balance between too much, which places strain on the bearings, and too little, which allows belt slippage. Ideally, a belt should flex about ½ in. for every inch of span between pulleys when slight pressure is applied.

Motor controls—In addition to installing the motor correctly, single- and 3-phase motors 2 HP and larger should be protected with magnetic motor starters. Beside providing a regular on/off switch, this starter has a small heating element selected to match the amperage rating of the motor with which it's used. When heat generated from the current draw of the motor exceeds a certain threshold (lower than a temperature which would damage the motor), the element trips a thermal switch and shuts off the power. A magnetic starter has one additional safety advantage: if power in the shop suddenly quits, an electromagnet disconnects the starter in the switch; the motor stays off, even after the power is restored. To start the motor again, you have to deliberately

switch it on.

Many single-phase motors are equipped with a built-in manual overload device that can be used with a separate on/off switch. The device adds a small amount to the cost of the motor, but provides substantial burnout protection. The device is normally mounted on the side or end of the motor housing and is designed to sense the motor's current load and internal temperature, as well as ambient air temperature. After excess heat or an overload trips the device, the operator must wait for the motor to cool off before resetting the button and putting the motor back to work.

I *strongly* urge woodworkers to avoid, at all costs, motors with built-in thermal protectors that automatically reset after an overload shutdown. These motors, often found on pumps and air conditioners, can be bought used at tempting prices. They look and work just like any induction motor, but the automatic resetting feature can have potentially disastrous consequences.

For motors under one HP, a fractional-horsepower manual motor starter (simply an on/off switch with a heating element) can provide thermal protection for a fraction of the cost of the magnetic type. These must, however, be manually turned off in

the event of a power failure. Other small, low-amperage motors may be started with regular toggle switches as long as the voltage and amperage rating on the switch match the voltage and maximum current draw of the motor. Regardless of which type of motor or control you use, always make sure that the switch is connected to break continuity with the *hot* lead(s), not the neutral (see figure 2). Also, make sure the motor and switchbox are properly grounded.

Once you have your motor ready to plug in, consider what you're going to plug it into. An inadequate power supply will cause the voltage to drop and the wiring to heat up during heavy use. Sagging voltage dims the lights; more important, it causes motors to draw excessive current. Since voltage (the measure of electrical force or pressure) and amperage (the measure of electrical flow) are inversely related, a 10% voltage drop results in a 10% amperage increase. This diminishes motor performance, leading to overheating and a subsequent shortening of motor life. Even worse, overheated wires could ignite workshop sawdust and start a fire. It's fairly normal to see a slight flickering or momentary dimming of the lights when one of your larger machines is switched on. But if you notice this effect during routine operations, you probably need to consider upgrading

Understanding horsepower

Few shops these days employ the power of the hoof, but for the sake of evaluating electric motors, we've inherited the measure of horsepower established during the 1800s to compare the output of the steam engine to that of the horse. "Power" is defined as work per unit of time, and since the average workhorse can lift 33,000 pounds one foot in one minute, 33,000 foot-pounds per minute is the force equivalent to one horsepower.

Since induction motors run on electricity, it seems logical to determine their power output by figuring the amount of electricity they consume. If we calculate a motor's power consumption in terms of wattage—a measure of electrical power equal to voltage times amperage—the following formula should give us its horsepower:

$$\frac{\text{Amperage} \times \text{Voltage}}{746 \text{ (No. of watts in 1 HP)}} = \text{HP}$$

But, in practice, it doesn't work this way: a motor can't convert all of the electrical energy it uses into mechanical power. Some energy goes toward magnetizing the rotor and the windings. Power factor is a measure of this. Generally, the more powerful a motor, the higher its power factor. Also, a motor's full-load efficiency is the percentage of electrical input that's successfully converted into mechanical power. The rest is lost to friction, windage and electrical resistance. On new motors, efficiency and power factor are printed on the motor's nameplate (see figure 3).

As with motor design and construction, the National Electrical Manufacturers Asso-

ciation (NEMA) has standards for measuring and labeling motor output. These standards consider a motor's work capacity (stated as horsepower) and the allowable amount of temperature rise while performing at that capacity. A motor's output must be tested by connecting it to a dynamometer, a mechanical device that measures torque. The horsepower is then determined with the formula:

$$\text{Horsepower} = \frac{\text{Torque (in ft. lb.)} \times \text{RPM}}{5,252 \text{ (constant)}}$$

As the motor is forced to run under full load at its rated horsepower capacity, the rise in its internal temperature is carefully measured. The amount of allowable temperature rise depends on the type of insulation used in the motor's windings. A motor with Class B insulation, for instance, is allowed to heat to 80°C or less above the specified 40°C standard ambient temperature of the air surrounding the running motor. If it gets any hotter, its full-load nameplate horsepower rating must be lowered, or the motor must be redesigned for better cooling.

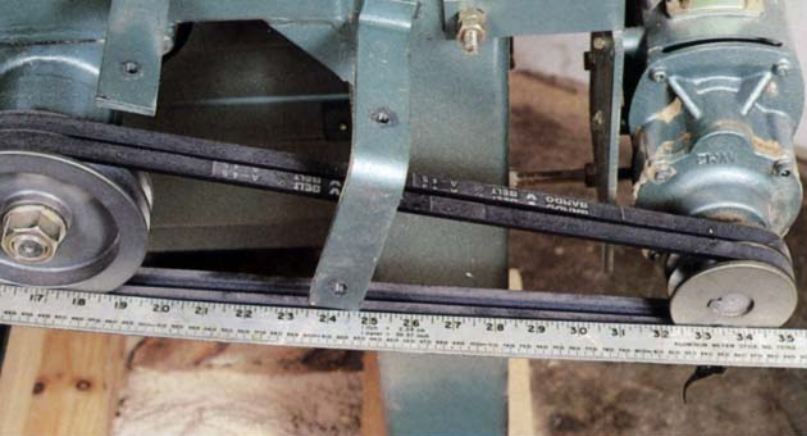
NEMA's standards for induction motor horsepower are based on a motor's ability to deliver its nameplate rated power continuously, 24 hours a day, under full load. But these standards can also be qualified by time-duty ratings of 15 minutes, 30 minutes and 1 hour, each representing the period of time the motor can deliver its rated horsepower without overheating. A duty-limited motor will always be marked accordingly on its nameplate. Continuous-duty motors are commonly used on stationary woodworking machinery.

This capability, however, is rarely needed for machines, such as saws, jointers, or planers, which are seldom operated at continuous full load.

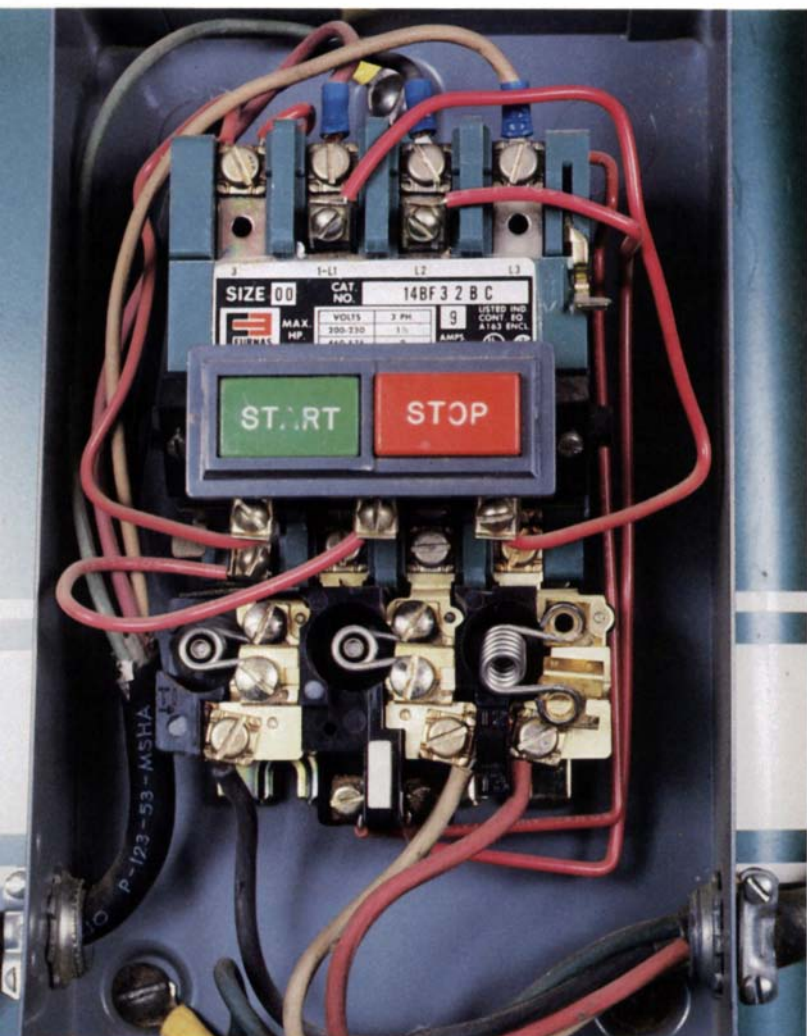
Machinery manufacturers aren't compelled to comply with NEMA's rating standards; they may devise their own methods for measuring the output of their motors. It's not unheard of for a tool manufacturer to take liberties with claimed horsepower ratings: the *same* motor design could be rated at its *continuous-duty horsepower* by one manufacturer and *peak power output* by another.

Any electric motor is capable of producing far greater than its continuous-rated power, if temperature rise is ignored. A 3-HP motor, for example, can generate up to 7 HP for short time periods. Beyond that, it reaches its pull-out or breakdown point and stalls, just like an airplane attempting an overly steep climb. If you don't cut the power or reduce the load, the motor will overheat and burn up.

On inexpensive tools that have induction motors of questionable pedigree, watch out for the words "maximum developed horsepower," which is advertising talk for a motor whose claimed output is right up near its pullout point. You can't operate the motor for very long at its maximum output without thermally damaging the motor. Some small induction motors rated at $2\frac{7}{8}$ maximum developed horsepower perform more like 1-HP continuous-duty motors. Furthermore, never mix apples with oranges and attempt to compare a machine rated in continuous-duty horsepower to a machine rated in maximum developed horsepower. *E.H.C.*



Proper alignment of pulleys, essential to good machine performance, can be checked with a straightedge. Multiple belts are used on this resaw bandsaw to handle high torque.



With the power off and cover plate removed, you can see the three coil-like heating elements inside this three-phase magnetic motor starter, located below the start and stop buttons. The element on the right has been partially removed to afford a better view.

Fig. 4: Table of wire gauges

		Length of circuit wiring or extension cord			
		25 ft.	50 ft.	100 ft.	150 ft.
Amperage rating of single-phase motor, 110v or 220v	5	14 ga.	14 ga.	12 ga.	10 ga.
	8	14 ga.	14 ga.	12 ga.	10 ga.
	10	14 ga.	14 ga.	12 ga.	10 ga.
	15	14 ga.	12 ga.	12 ga.	10 ga.
	20	12 ga.	10 ga.	8 ga.	8 ga.
	30	8 ga.	8 ga.	8 ga.	6 ga.

your shop power system. If the machine is a considerable distance from the power panel or plug, use heavier-gauge wire (see figure 4) to avoid voltage drop. This applies to extension cords for portable power tools as well.

Maintenance—Thanks to modern ball bearings, most electric motors require little maintenance. In fact, sealed bearings usually need to be replaced by the time they need lubrication. Too much well-intended maintenance can be damaging; motor bearings are more likely to fail from too much (or incompatible) lubrication than they are from lack of lubrication. If you're in doubt about whether or not to lubricate, *don't*. However, this advice doesn't apply to older motors with bronze sleeve bearings. The oil cups on these motors should be filled with high-grade SAE 10 to 20 non-detergent machine oil (don't substitute plain motor oil), always with the motor shut off. Over-lubrication won't hurt these bearings.

One regular maintenance habit will extend a motor's life: vacuuming the sawdust out of cooling passageways in the motor housing. To reduce the hazard of fire, clean out electrical junction boxes and switchboxes occasionally, cutting off the power first.

Troubleshooting—Unfortunately, there are no simple tests to determine the internal condition of a motor. In capacitor-start motors, centrifugal switch or capacitor failures are common faults. Switches wear out, burn or stick in one position. Capacitors can open, short out or change value. Whether a starter switch or capacitor fails, the result is the same: the motor hums but won't start. You can sometimes temporarily get the motor going with a quick hand turn of the pulley. But use extreme caution in doing so, and keep your hands clear of blades or cutters. When the starter switch fails to open, the motor will come up to speed but will draw excessive current (amperes) and overheat quickly. If the starting capacitor changes value as it becomes weak, the motor will be slow in starting and won't come up to speed as quickly as it should. Low line voltage caused by wire that's too small can produce the same symptoms.

Failure to react to any of these indications can lead to a complete motor meltdown, where the heat that builds up from an overload or component failure causes windings to overheat, burn off their insulation and short out. Do *not* continue to operate any motor on a machine or power tool when erratic performance or unusual noise is evident. Things will only get worse—and repairs more expensive—if problems are ignored, since capacitor or centrifugal switches can be replaced at a fraction of the cost of rebuilding or replacing the motor.

If you do burn out a standard-size single-phase or three-phase induction motor, it's usually quicker—and cheaper—to replace rather than rebuild it. But if the motor has a special mounting or isn't of a frame size or type carried by your local distributor, you may have no choice but to pay for a rebuild by a local motor repair shop. □

Ed Cowern is an electrical engineer and president of a company that distributes electric motors. For information on how electric motors are rated, contact the National Electrical Manufacturers Association, 2121 L St. N.W., Washington, D.C. 20037.

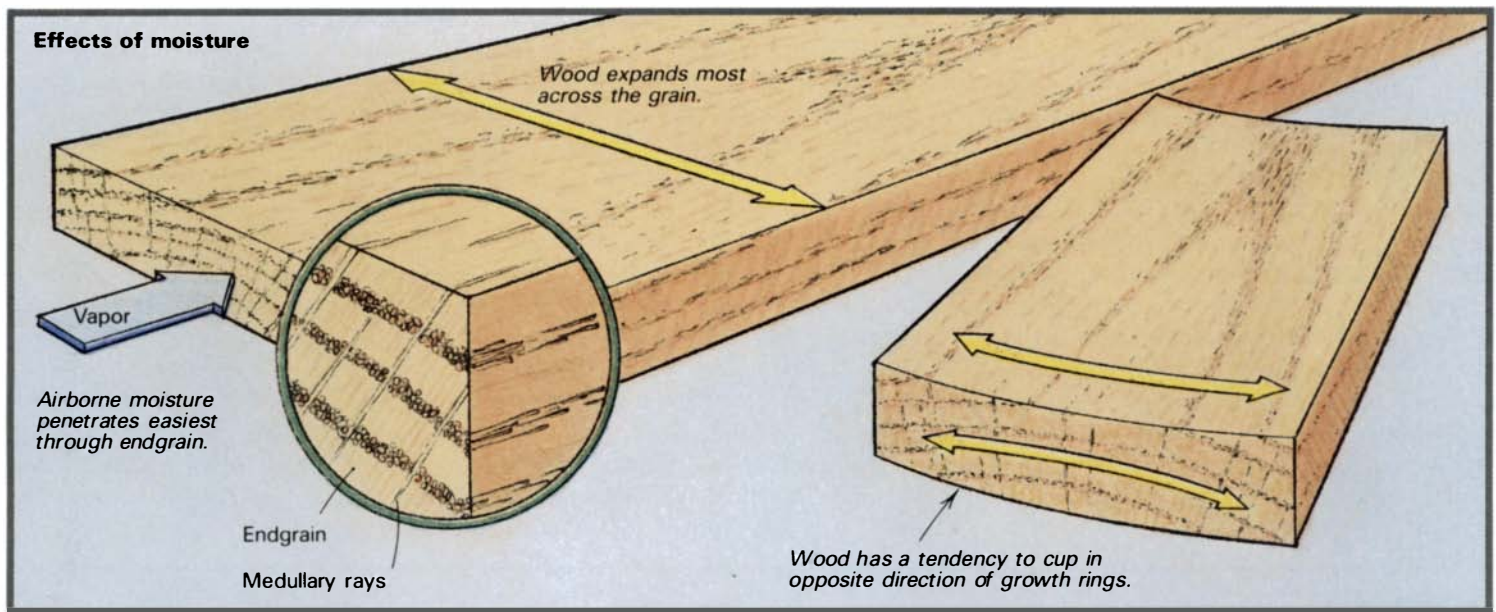
Further reading

How Electric Motors Start and Run by Harold Parady and Howard Turner and *Electric Motors* by James Allison are available from the American Association for Vocational Instructional Materials, 120 Engineering Center, Athens, GA 30602.

Protecting Wood from Humidity

Lab tests show which finishes work, which don't

by William Feist and Gary Peterson



Whether indoors and protected from weather, or outdoors and exposed to the elements, wood is always affected by moisture. It swells when it adsorbs liquid from rain, dew or moisture vapor in the air and shrinks as it dries.

Protecting wood from moisture is of no small importance. The more moisture that gets beyond the finish, the more grief you'll have with warped panels, joints that swell and break, drawers that stick and wood that discolors. Of course, the woodworker's dream finish would seal the wood entirely against moisture and protect the surface against dirt and abrasion, all without obscuring the appeal of the grain that makes us appreciate wood in the first place.

About a year and a half ago, the Forest Products Laboratory (FPL) completed a study that examined just how well finishes resist moisture vapor. And, while we didn't necessarily find that ideal finish, we did learn that wood coated with some types of finishes will be less affected than wood left completely unfinished. Our tests of 91 finishes showed that no coating entirely prevents wood from adsorbing moisture. We also found great differences in the effectiveness of many finishes. Some popular ones (linseed oil, tung oil and lacquer, for example) represent hardly any barrier to moisture vapor while other materials that aren't even considered to be finishes—paraffin wax, for instance—sealed the wood almost completely.

The problem with protecting wood from moisture vapor lies in the material itself: it's literally full of holes. In fact, when

seen under magnification, it would not be inaccurate to describe wood as mostly pores surrounded by smaller amounts of organic material. These pores provide lots of entry points for moisture vapor; and even the finish meant to seal them will be somewhat permeable. Ultimately, even the best moisture-resisting finishes only slow, but don't completely stop, the exchange of moisture vapor.

As wood takes on moisture vapor, it expands—which explains why a door that closes just so in the winter sticks annoyingly when humid summer weather arrives. As the drawing above shows, most of the expansion (and when the wood dries, contraction) occurs across a board's width rather than along its length. More shrinking and swelling will take place parallel to the growth rings than perpendicular to them. Thus, a board sawn so its growth rings are parallel to its face (plainsawn) will shrink and swell much more than a board sawn with rings perpendicular to its face (quartersawn).

This bit of wood lore is useful to know for two reasons. First of all, a quartersawn board will be less likely to warp because it expands less across its face. Secondly, to reduce warpage in any wood, moisture exchange must occur evenly on all sides and edges of the board. So, if you coat only one side with a finish, the face you skip will pick up or lose moisture faster than the coated side. This uneven exchange promotes warping. It's imperative, therefore, that the same number of finish coats be

applied to both sides of the board. And don't forget the end-grain, either. A great deal of moisture exchange occurs through the exposed pores of the endgrain.

In our tests, we refer to the effectiveness of a finish in terms of moisture-excluding effectiveness (MEE). To make it easier to understand the results, we used a numeric rating for each finish. This is a relative value, based on the number of coats applied to the clear Ponderosa pine samples we used in our tests. To get this rating, we took a piece of smooth pine, cut it in half and completely finished one half while the other half was left uncoated. To establish a reference point, we exposed both samples to 80°F temperatures at 30% humidity until both would adsorb no more water vapor. Then, both samples were exposed for one, seven and 14 days at 80°F and 90% relative humidity. (This exposure to controlled atmospheres of higher humidity imitated a "real world" situation, similar to going from low humidity in the winter to high humidity in the summer.) To arrive at the MEE, we simply weighed the pieces before and after exposing them to the higher humidity.

Perfect protection by the coating—or no gain of water vapor—would be represented by 100% effectiveness; complete lack of protection (as with unfinished wood) by 0%. Most of the coatings were brushed on; a few were dipped. We kept the more moisture-resistant finishes in the test longer (up to 150 days). Also, all test samples were completely coated with the finish.

As the chart shows, most clear and pigmented coatings that form some sort of film and are not latex-based will slow the rate at which water vapor enters wood. In general, solvent-based pigmented coatings, such as paints, are more effective in slowing moisture exchange than clear coatings, such as varnish or shellac, since pigments—the fine solid particles used to color finishes—increase the barrier against moisture

vapor. Within practical limits, the more coats applied, the greater the barrier to moisture vapor penetration and the slower the moisture level will change.

The finishes shown in the chart illustrate the range of our test results. Although not generally considered a finish, paraffin wax still proved to be the most effective, with an MEE rating of 95% after a dip-coated sample was exposed for 14 days. We had good results brushing it on as well: a one-coat, molten paraffin wax brush treatment topped the ratings for one-coat, brush-applied finishes, with an MEE of 69%.

Another unusual finish we tested was a two-part (resin and hardener) epoxy coating. It had a rating of 91% for three coats and 88% for two coats. Conventional two-part epoxy paints, often intended for marine use, were also very effective, especially with three coats.

The degree of moisture vapor protection afforded by a coating or finish depends on several factors. Among these are how thick a film the finish leaves; whether it contains pigments; the type of binder (the non-volatile, solid portion of the finish that holds the pigment particles together after the film is dry); the kind of resin (a film-forming solid or semi-solid organic substance, usually derived from chemical or natural products); and how long the wood is exposed to high or low humidity.

We found the wood samples adsorbed more water vapor as time went on. The longer the finished pieces were exposed to high humidity, the poorer their vapor retardance; eventually, moisture vapor finds its way in.

The chart shows that penetrating finishes like linseed oil, tung oil and furniture polishes are at the bottom of the scale, offering minimal or no protection even after three heavy brush coats. Because penetrating finishes don't form a film, they're usually not effective for controlling water vapor, even though they may be

Naming names

by Roy Berendsohn

Although 91 different finishes were tested by the Forest Products Laboratory (FPL), there wasn't enough space in this article to show the results for all of them. This is a list of some of the more unusual or hard-to-find products shown in the chart; in no way does this list or the chart represent an endorsement. When more than one brand of a type of finish was tested, the chart shows the one with the highest MEE. The FPL was reluctant to provide manufacturers' names and addresses out of concern that the test results are meant to show general characteristics of finishes—not the characteristics of individual brands. Nonetheless, I felt it useful to include this information when it was readily available.

Finishes are listed in the order they appear on the chart. Brand names and manufacturers of general finishes, such as linseed oil, have been excluded. However, we've listed this information for more unusual finishes.

—Two-part epoxy sheathing: Chem-tech Sheathing Epoxy L-26. Chem-Tech, 4669 Lander Rd., Chagrin Falls, Ohio 44022.
—Two-part epoxy polyamide gloss paint: Lindsay Epoxy Kote-Gloss. Lindsay Finishes, Inc. 1898 East Johnson St., Madison, Wisc. 53704.
—Aluminum-pigmented polyurethane gloss varnish: Mautz V-200 and Alcoa aluminum leafing pigment. Mautz Paint Co., Box 7068, Madison, Wisc. 53707.
—Soya-tung alkyd satin enamel: Mautz Deluxe Enamel Satin Finish, No. E-725, White.
—Two-part polyurethane gloss varnish: Brolite Z-spar Linear Polyurethane, Clear LP-300. Koppers Co., Att. Pam Keeler, 1850 Koppers Bldg., Pittsburgh, Penn. 15219.
—Epoxy gloss varnish: Mautz Deluxe Epon Varnish, V-100.
—Polyurethane gloss varnish: Old Masters Polyurethane, Gloss. Darworth Co. (Product no longer available).

Also tested were Mautz Exterior/Interior, Gloss V1-Ray Polyurethane, Clear, No. V-200; Flecto Varathane Liquid Plastic, Clear, Gloss; Gloss Zar Polyurethane Coating.)
—Alkyd satin wood finish: Mautz Satin Wood Finish, Clear, V-104.
—Nitrocellulose alkyd lacquer: Zynolyte Spee-E-Lac, Clear No. 0728.
—Phenolic tung floor sealer: Mautz Floor Seal, Tung Oil Base, V-55.
—Soya epoxy gloss and trim sealer: Valspar Val-Speed Epoxy Floor and Trim Sealer/Finish, No. 16, Clear Gloss. The Valspar Corp., 1101 Third St. S., Minneapolis, Minn. 55415.
—Soya alkyd phenolic/tung gloss spar varnish: Mautz Spar Varnish, No. V-11.
—Acrylic gloss latex varnish: Aquakleer, Water-based Clear Finish, Gloss. Benjamin Moore and Co.
—Tung Oil: Hope's Pure Tung Oil. □

Roy Berendsohn is an assistant editor of Fine Woodworking.

good at protecting against liquid water and staining from dirt. Latex- or water-based varnishes are also not very effective (although not shown, neither are latex paints). When these coatings dry, they leave small openings that allow water vapor to penetrate.

While penetrating oils, such as linseed and tung, are not very effective—even when three coats are applied—their effectiveness is greatly increased by blending them with other resins (making varnishes), or by adding both resins and pigments (paints). The more resin or pigment incorporated, within practical limits, the greater the effectiveness. As a rule, oil-based paints are more effective than varnishes; enamels (essentially paints with finer-ground pigments) are even more so.

The use of fillers to “plug” wood pores will indirectly contribute to improving the MEE and will also provide a smooth surface on which to build a uniform top coat. Woods with large pores, such as oak, will be more difficult to coat effectively than, say, cherry. Thinning a finish so it acts as a “sealer” may indirectly help in the same way, but it will probably do more to improve the appearance and durability of the final finish than to enhance the MEE.

The first coat of any finish may “seal” the wood, but it won’t provide a totally defect-free, uniform film coating. The second coat usually covers any defects of the first coat and doubles the film thickness. Each succeeding coat will increase the MEE, but when compared to the MEE produced by the first and second coats, the gains will be relatively small—even when up to six coats are applied. This is because the film thickness is doubled for the second coat, but is increased only by a third for the third coat, a fourth for the fourth coat, and so on.

A coating that is effective at keeping water vapor *out* is also effective at keeping it *in*. It took as long—or longer—for a coated specimen to lose water when the humidity was decreased. In fact, it took nearly a year for specimens with the most effective finishes to lose all their moisture after they were exposed at 90% relative humidity for six months.

The information in our studies relates to coatings that are only a few weeks old and not exposed to prolonged aging or severe conditions, such as outdoor weathering (which will quickly damage most coatings, causing them to lose effectiveness).

The moisture resistance of finishes also depends on the type of exposure. For example, water-repellent treatments are quite ineffective against water vapor but—because they cause water to bead on the surface—they’re fairly effective against liquid water. So, this type of sealer finish would protect your outdoor wood against rain and dew for some time, but not for very long against humidity.

Most of our studies dealt with brush-applied finishes, although we also compared the effectiveness of dipping. With a conventional finish like gloss polyurethane varnish, we found that one dip coat was equal in moisture-excluding effectiveness to two brush coats. One dip coat of a soya alkyd gloss enamel paint was equal to three brush coats. The better MEE from dipping occurs because more finish is applied over the wood surface and because dipping for some time (we used 30 seconds) increases penetration and provides greater sealing of the endgrain pores, where most moisture enters.

Protecting wood against humidity is important whether the wood will be outdoors or in. The information shown here should help you determine which finish to use. Perhaps, as well, we have dispelled a few old wives’ tales on how to control the effect water vapor has on wood. Among them, that penetrating oils are effective in reducing the adsorption of water vapor.

Moisture-excluding effectiveness

This chart shows the moisture-excluding effectiveness (MEE) of a variety of finishes and other materials. Of the 91 finishes tested, these figures are the best for each finish type. The chart is arranged from highest MEE to lowest. Ratings are given for one, two and three coats after 14 days of exposure at 80°F and 90% relative humidity. Negative numbers indicate that the finish itself adsorbed water. (N.A. = not applicable)

	1 Coat	2 Coats	3 Coats
Melted paraffin wax (dip coat) (brush coat)	95 69	N.A. N.A.	N.A. N.A.
Two-part epoxy sheathing	54	88	91
Two-part epoxy polyamide sheathing gloss (paint)	53	82	87
Aluminum-flake-pigmented polyurethane gloss varnish	41	77	84
Soya-tung alkyd satin enamel	50	70	80
Two-part polyurethane gloss varnish	0	46	66
Epoxy gloss varnish	3	34	50
Orange shellac	2	25	46
Polyurethane gloss varnish	11	36	44
Alkyd satin wood finish	8	29	43
Polyurethane satin varnish	8	27	41
Nitrocellulose alkyd lacquer	7	24	40
Phenolic tung floor sealer	-1	18	35
Soya epoxy gloss and trim sealer	1	13	31
Soya alkyd phenolic/tung gloss spar varnish	0	15	30
Acrylic gloss latex varnish	-1	6	10
Tung oil	-1	-1	2
Brazilian carnauba paste wax	0	0	1
Linseed oil	-5	-4	0
Spray furniture polish lemon oil/silicone	0	0	0

Similarly, thinning a finish so the first coat acts as a sealer may help improve the appearance and durability of the final finish, but it won’t do much to protect against humidity.

The most important criteria, then, for protecting against humidity are film thickness and impermeability. But no matter how effective your finish, some vapor still gets through and is adsorbed by the wood. Although it happens too slowly to watch, this means your wood (solid wood, anyway) is always on the move. □

William Feist is a wood finish researcher at the Forest Products Laboratory. Gary Peterson was formerly an information specialist at the lab.



Shaping and bending green wood is an attractive alternative to conventional dry-wood bending methods. After riving a blank from a log, the author pours near-boiling water on a green oak hayfork before bending it into its graceful and functional final form.

Bending Green Wood

Heating riven stock yields the best bends

by Drew Langsner

The wood for the things I make comes directly from the tree. I prefer to work the wood while it's still green, taking full advantage of its fibrous properties for splitting, shaping and, especially, bending. There's a simple elegance to this country way of working wet, unprocessed wood that might be considered primitive by some, but there's certainly nothing unrefined about the straightforward processes required to bend and shape green wood. Although the more-involved method of lamination adds to the woodworkers' repertoire, traditional green woodworking techniques are still the best way to make basket frames, sleds and canoe timbers, as well as a host of parts for chairs and furniture. A continuous-arm Windsor chair, for instance, has its back and arms bent from a single 5-ft. piece of green wood.

There are several good arguments for bending wood green. Wet wood bends easier and with less steaming time than dry wood because the fibers are more pliable and contain moisture that conducts heat more rapidly. Green bends are possible without difficulty and with less chance of failure. Equivalent bends using dry lumber would probably require more elaborate equipment, such as steel tension straps. Because it's rived rather than sawn from the log, the grain of a green-bent part follows the bend. So, for equivalent strength, the green part can be smaller in section and much lighter than dry bentwood.

In this article, I'll describe the basic principles of bending green wood. For demonstration purposes, I made a red oak hayfork, but the methods illustrated here are applicable to any bentwood project.

Getting started—The best wood to choose for bending green depends greatly on what's available in your area. Bending stock must be high-quality and free of all defects, such as large knots, insect holes, incipient decay and checking. The wood must also be capable of being rived, or split out along the grain. Riving is the best way to shape the wood for bending. Wood that has been sawn out of the log usually has grain that will run out of an edge or face, and these runouts are likely to splinter.

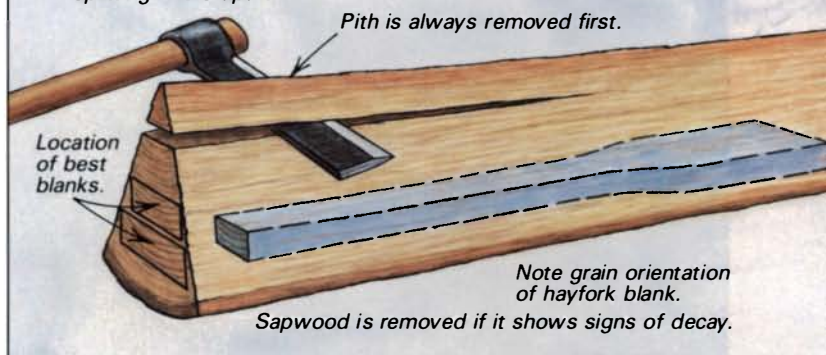
I've had the best success with hickory, ash and red and white oak, but birch, walnut, willow, white cedar and pecan can all be rived and are reliable bending woods. Many varieties—such as pine, yellow poplar and butternut—just aren't bendable, while some woods (beech and elm, for example) bend fine but are hard to shape because their irregular grain doesn't rive well. Among the ring-porous hardwoods, fast-growing trees with widely spaced growth rings are stronger and more likely to bend without problem than slow-growing trees which have characteristically brash wood that's prone to failure. Because of the variables, plan to experiment.

You can cut and split your own green wood, as I often do, get freshly cut logs from firewood suppliers or scrounge from road-maintenance crews. Occasionally, I also buy a high-quality saw-log from a mill, paying what the mill expects to get wholesale for finished lumber—about 50¢ per board foot. After splitting ½-section bolts from bucked logs, I store the wood in a pond (it usually sinks) to keep it from drying out before I get a chance to use it. You can also wrap the wood in plastic, paint the endgrain or even freeze small pieces.

To rive out a usable workpiece from a bolt, I use a froe and mallet to split away the pith and any part of the sapwood that shows signs of decay. Once you start a split, you must follow through, unless it starts to run out (divide unevenly). In that case, either restart the split from the other end and try to make the two splits meet in the middle, or lever the froe toward the thicker side and continue splitting in a straight line. Generally speaking, riving and

Fig. 1: Riving the blank

Froe is struck by club into endgrain and levered, splitting fibers apart.



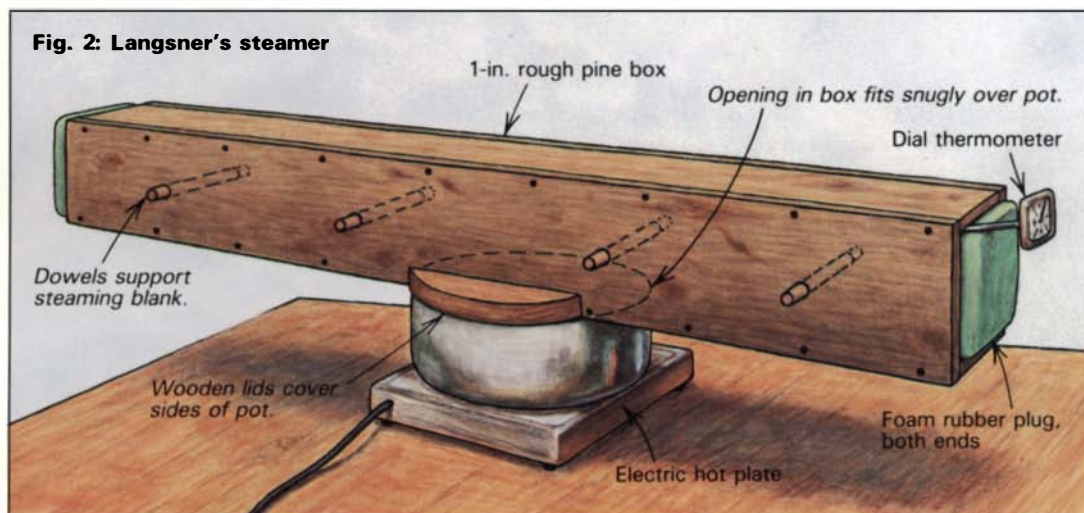
Using froe and club, Langsner rives a rough bending billet from a bolt that's just been fished out of his storage pond. He removes excess material with a hatchet before moving to the shaving horse, where the hayfork is shaped with a drawknife and spokeshave. The end will be sawn apart and bent into separate tines.



Hot water softens the tines prior to bending, and a clinched nail behind the sawkerfs keeps the wood from splitting as wedges are driven to separate the tines. After they're boiled, the dowels are bent and driven through the holes. Square shoemakers' nails hold them in place.



Fig. 2: Langsner's steamer



shaping billets so that their bends are either toward or away from the center of the tree will increase your chances of success. In the case of compound curves—such as the arm of a continuous-arm Windsor—growth rings should be oriented properly for the tighter bend. Also, the proportional dimensions of the piece should be oriented so that it's bent flat rather than on edge. Otherwise, it's apt to buckle on the flat sides and not bend evenly.

I usually shape the green piece to its basic form using a draw-knife and a spokeshave. Careful thickening is very important since bending forces tend to concentrate—and fail—at points of abrupt change in dimension. Also, if the thickness is not uniform, the bend will not be even since thick areas resist bending and thin areas tend to collapse. However, a purposefully made taper can be used to modify the radius of a bend, like the irregular curve of a snowshoe frame. Smooth surfacing will minimize failures, such as cross-grain splintering, and a slight chamfer on the edges also helps prevent the grain from tearing out. It's usually worthwhile

to shave and bend extra pieces, especially if you need matched parts (such as chair posts) because some wood will inevitably fail during bending, or will set and dry undesirably. After preliminary shaping, plan to do all other joinery after the piece is bent.

Bending the blanks—Green wood can sometimes be bent cold, even without jigs. With first-rate material and careful preparation, you can create some bends without heating the wood at all. Most heavier stock must be plasticized (made more bendable) by exposure to heat and moisture, which temporarily softens the cellular structure. Pouring hot water on the workpiece works just fine in many cases, and requires nothing more than a pot of boiling water and a ladle. It's the method I prefer for softening my hayfork blanks before bending the tines and handle (see photo, p. 64).

When the workpiece is thick or too long to heat evenly by ladling, it's usually best to steam it. The steambox I use was put together in about a half hour and works as well as any I've

Getting your steam up

by Simon Watts

As a boatbuilder who teaches workshops around the country, I'm always interested in finding new ways of steambending—boatbuilders bend a lot of wood. Here are a few of my favorites.

The safest and easiest way to generate steam is, undoubtedly, to use a wallpaper steamer. The electric immersion-style heater (right) makes a good volume of steam in about 45 minutes (starting with cold water), and its hose can be connected directly to your steambox. Rental is about \$15 per day, but if you're in a fire-hazard zone, it's well worth the money. You'll need a 15-amp, 220v outlet for most units. Incidentally, this steambox has an ingenious feature devised by Bill Neilson: a tight-fitting wooden plunger, gasketed with leather. Pushed up inside the box, the plunger adjusts the box's inside length to the size of the piece being steamed.



John Grew-Sheridan fabricated this setup, used by his furniture shop in the Mission District of San Francisco. It cost \$10 for the stove, a few hose clamps and some plastic hose. It gets up a full head of steam in about 40 minutes—less if you start with hot water. Sheridan bought the electric stovetop, framed it with wood and mounted it on casters. The two five-gallon containers, wrapped with insulating fiberglass, stand directly on the burners. The steam is vented through the plastic hoses into the steambox. This is a very effective rig, especially if you're in an area where open fires would attract undesirable attention. For a box this length, you'll need two burners in order to generate a sufficient volume of steam.



With the local fire truck right next door, this setup is a little more daring than it might be otherwise. All materials were scavenged, and the steamer is fueled by scrap wood, so cost is minimal. The holes punched around the bottom of the barrel give plenty of draft for the fire; the jerry can hung inside boils cold water in six minutes. Since the first version of the rig boiled dry too frequently, Hap Tallman connected a galvanized filler-pipe through a T-fitting. Now, water in the can can be replenished regularly. If you use plastic pipe to hook up the steambox, as we did, make sure it's far enough away from the barrel so the flames won't melt it. If you have a lot of open space, this is a good rig—especially for steaming large or thick workpieces—because the steam is abundant and can be maintained indefinitely. Still, always keep a garden hose handy in case the box catches fire. □



Simon Watts is a writer, boatbuilder and furnituremaker. He lives in San Francisco, Calif. Photos by author.

Fig. 3: Bending jigs

Slat bending

Simple frame holds back slats for ladderback chair in bent position.



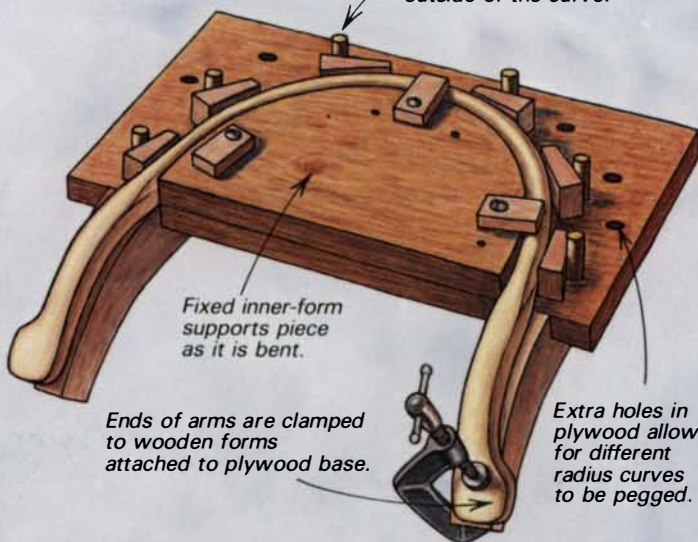
Continuous-arm Windsor

Removable pegs and wedges hold arm in place around the outside of the curve.

Fixed inner-form supports piece as it is bent.

Ends of arms are clamped to wooden forms attached to plywood base.

Extra holes in plywood allow for different radius curves to be pegged.



Hayfork jig

1 x 4 scrap

3/4-in. dowels

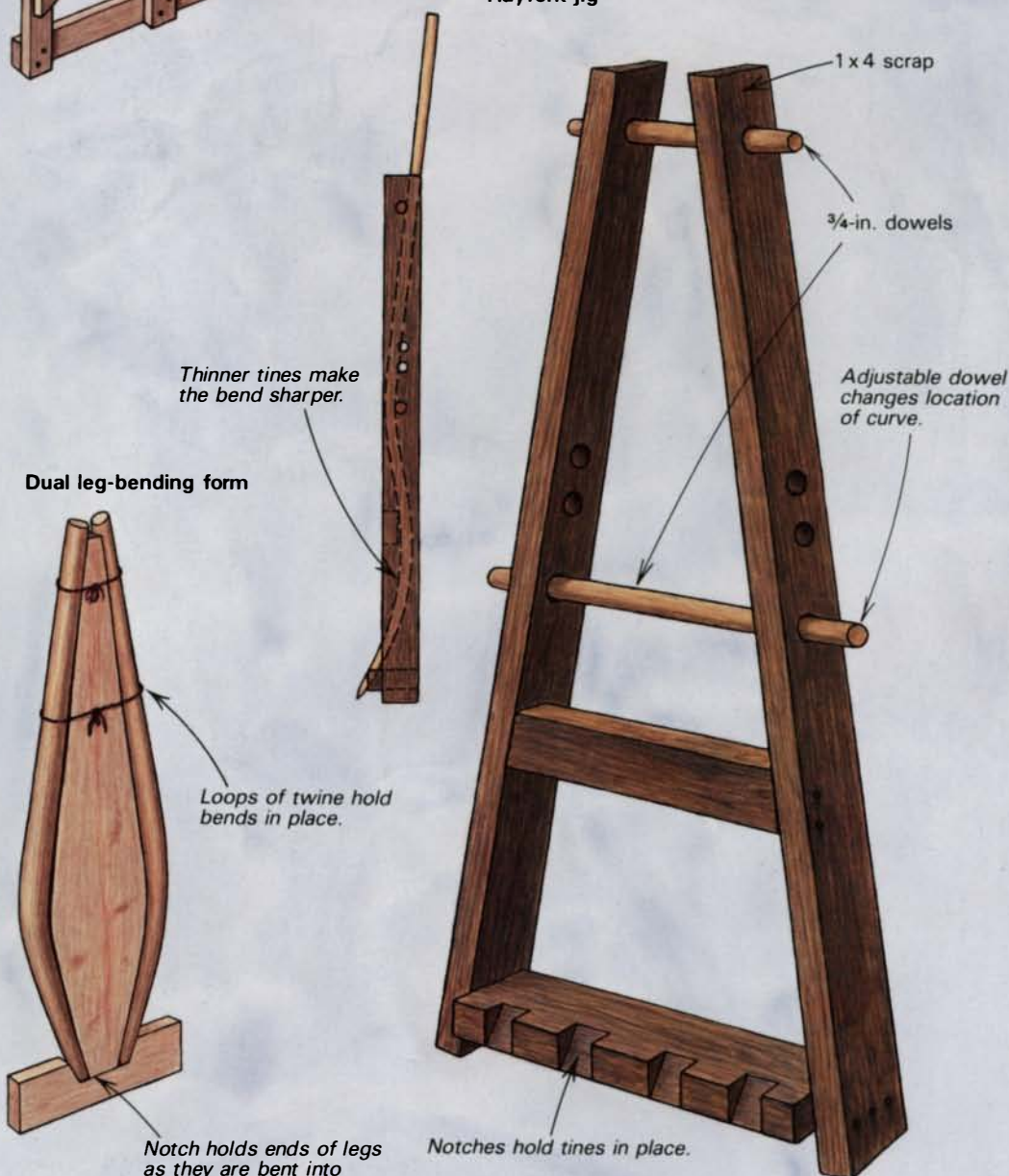
Adjustable dowel changes location of curve.

Thinner tines make the bend sharper.

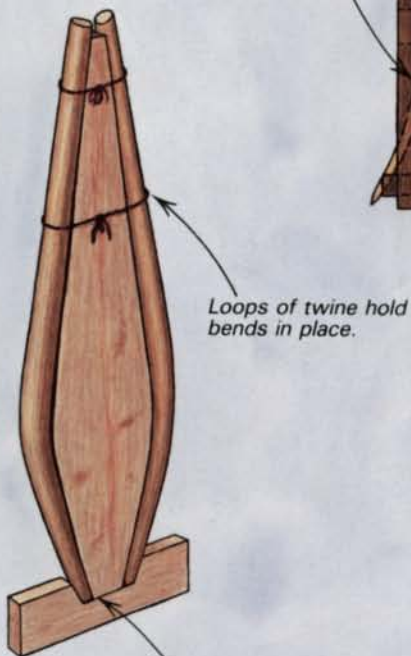
Loops of twine hold bends in place.

Notch holds ends of legs as they are bent into channel on edge of jig.

Notches hold tines in place.



Dual leg-bending form



After making the handle and tines pliable with boiling water, Langsner coaxes the hayfork to bend into a delicate S-curve, with the help of the jig frame shown above (and at lower right in figure 3). The fork must stay in the jig until the wood dries out a bit and sets—about a week or so.



Green-wood bending is practical for making all types of furniture—country-style or otherwise. The two back legs of the strong and elegant bent-back chair, above—made by the author for his daughter—were steam bent then tied to the dual-leg bending form shown at far left, bottom, until they set. The thin green oak for the crest rail was already steamed and limbered before being set in the slat-bending jig, top left.

seen. The chamber is a nailed wooden box made of rough pine lumber with the ends plugged with removable pieces of foam rubber. It actually works better than one made of metal pipe, since the wooden box holds heat well and doesn't cause much condensation. I made my box big enough for long chair parts, but you should dimension your steamer to suit your needs: the chamber shouldn't be larger than necessary. Inside, a rack of dowels keeps the work off the bottom so that steam can circulate freely around it.

The steamer rests directly on an old one-gallon pot heated by an electric hot plate. Steam enters the chamber through a pot-sized opening in the bottom of the box. Because the steamer is narrower than the pot, I cover the extra width of the pot top with two wooden lids, one on each side. Heating the box to about 195° seems adequate for most bends. To monitor the temperature, I insert a deep-fry dial thermometer into one end.

Softening the wood by boiling it in a tray of water works as well as steaming in most cases. This method can be used to advantage when only one end of a heavy piece requires bending, or if the workpiece is too big to fit into the steambox.

The length of time it takes to heat green wood for bending is about a half hour per inch of thickness—half the time it takes for dry wood. Heating it longer usually doesn't help; in fact, the wood may be structurally weakened.

Regardless of the method I use for heating the piece, I limber it a little before attempting a sharp bend. Limbering is a technique for gradually creating a curve by flexing the wood back and forth in the direction of the final bend. I often use the jaws of a bench vise as a limbering fixture, or sometimes pull the wood against my knee. If I've flexed the wood many times to limber it, I often re-heat it before making the final bend. It's important to work quickly, and to use a jig to hold the bend in place until it sets. Wear rubber gloves to protect your hands from the heat.

The bending jig—A typical jig for flat curves uses a form board (cut to match the interior curve of the bend) nailed to a plywood base, as shown in figure 3. The bending material is held in place against the form by wedges driven against protruding pegs that follow the outside curve. The drawback is that a separate jig is required for each curve. For more flexibility, you can screw on different forms and drill extra holes in the plywood base to accommodate removable pegs and wedges. For the continuous-arm Windsor, I use the basic flat-curve jig shown with additional forms attached to support the compound arm curves.

For the hayforks, I use a simple frame jig that forms several bends at once. The fork has a mild S-curve in the handle, and the tines are splayed apart and bent upwards. The jig consists of a 1x4 frame with holes in its sides, fitted with removable dowels. I've used it to bend hundreds of hayforks, and also the back posts of ladderback chairs. To change the curves, I just bore additional holes in the frame and set dowels at the desired bending points.

Another sort of jig I use for bending chair posts is made from a 1-in.-thick board with a channel gouged down each curved edge to hold the bent posts in place (see figure 3). The form holds two posts simultaneously, positioned back to back. I like these jigs because they stack flat and don't take up much space when you're making a lot of identical pieces.

The basic rule for designing and laying out any jig is this: the more thoroughly supported the workpiece, the better, as there will be less focus for failure at any one point along the bend. The curvature of the form board should be slightly exaggerated to



Examples of bending failures due to brash failure (left) and excess tension (right) illustrate what can go wrong when wood fibers don't cooperate with your bending efforts.

counteract springback, the exact degree of which can only be determined by trial and error. Changing from hickory to maple could require jig modifications. Springback makes it difficult to match paired components, such as the back legs of a chair, and unrestrained bends can change shape long after they're "permanently set" due to fluctuations in the wood's moisture content.

The time it takes for a bend to set depends on wood species, moisture content, wood thickness and bend radius. You can tell the bend is set when the wood rattles in the jig, or springs back just slightly when unclamped. It's often possible to remove the wood from its jig and tie the bend in place with twine about an hour after executing a bend. This practice is useful if you have to bend several pieces on a single form. Setting time is much shorter in a dry, warm environment—above a furnace or behind a wood stove, for instance. Very wet or green wood should be dried slowly at first, for at least a few days. Otherwise, you take a chance of getting end-checks or interior honeycombing.

The dried and set bend should be checked for signs of stress before the piece is finished by final scraping, sanding and the application of finish (I usually use tung oil). Bending failures are understandable when you consider the nature of the process. In a typical bend, the outer cells may stretch in tension only 2%, while the inner radius can compress as much as 30%. Thus, bending causes extensive, minute cellular compression deformations in the cell walls of the wood, creating a continuous zone of microscopic folds and wrinkles. Splintered areas of lifted grain on the outside of a bend indicate a tension failure (above, right). If the area is small, you can sometimes just cut away the jagged slivers and re-contour the surface slightly with sanding. Compression failures are more serious and can affect the strength of the entire piece. They usually appear as little humps or buckled sections of grain on the inside of a bend, and should only be sanded away or ignored if they're slight.

If you've been a kiln-dried-lumber woodworker all your life and the only curved work you've done has been laminated, green-wood bending might be an interesting change of pace. It's something to consider trying the next time a tree falls in your front yard and you're looking for an alternative to chainsawing it up for firewood. □

Drew Langsner is an author, farmer and woodworker. He and his wife, Louise, run County Workshops (90 Mill Creek Rd., Marshall, N.C. 28753), a summer program in green woodworking. Langsner's latest book, Green Woodworking (Rodale Press), will be available in June.

Plate Joinery

It's strong enough for chairs

by Graham Blackburn

Photo: Woody Packard



The plate joiner has been widely acclaimed in recent years as a quick way to make strong joints for frames and carcasses, but I never met anyone who thought it would be a good tool for chair-making. The relatively thin plates seem too fragile to form a really strong cantilevered joint, such as between a chair leg and a seat rail. When I was faced with building a run of 14 dining chairs recently, I couldn't help thinking about how fast a plate joiner can make a well-fitting joint, so I decided to experiment.

I used a Virutex model 0-81, which has a fixed-angle fence to control the location of the slot. This fixed-angle fence can be moved up and down, thereby allowing the blade to enter the work at varying points within the stock thickness. Bob Janitz, a cabinetmaker acquaintance of mine, fabricated a stand and a small table that's really an extension of the tool's fixed-angle fence. The table is made of particleboard covered with plastic laminate and is screwed right to the fence. The entire setup can be clamped to the benchtop, and the work can be brought to the tool, rather than the other way around. This simple adaptation makes it possible to plate-join pieces that otherwise would be too small to hold securely. All sorts of shapes and sizes can be accommodated by clamping stops and blocks to the table. When the work is fed into the cutter against the machine's spring-loaded mechanism, the entire 12-in. by 16-in. table moves.

The next step was to ensure a strong joint. I achieved this by using two plates per joint, positioning them side-by-side like twin tenons and thereby doubling the effective side-grain gluing surface. This, I reasoned, had to be at least as strong as the single-stub mortise-and-tenon joint normally employed. Since both surfaces of the plate-joined parts could be perfectly mated without having to worry about unequal tenon shoulders, and since the plates would fit perfectly in their machined slots, the chances of a weak joint due to a poor fit were virtually eliminated.

Almost all of the joints I made were offset, unlike the flush-surfaced joints typical of face-frame work. Adjusting the position of the table (and the fixed-angle fence to which it's attached) took time but, once done, the speed, accuracy and ease with which the joints were cut was truly wonderful. Although I glued and screwed corner blocks on the back legs as an insurance policy, I'm sure the joints are strong enough since I've yet to break the trial joints I made during my own period of initial skepticism.

One last tip: to make angled joints, simply add wedges to raise or lower the workpiece's angle of approach to the blade before you clamp the workpiece to the table. □

Graham Blackburn is a contributing editor to Fine Woodworking. He lives in Santa Cruz, Calif.



The rail-to-leg and crest rail joints in this high-backed dining chair, above left, would normally require stub tenons. Instead, Bob Janitz rigged up author Blackburn's plate joiner, left, to do the job. The Virutex 0-81 was mounted on a steel and wood stand, and a table was attached to its fixed-angle fence. The jigged plate joiner was then clamped to the benchtop, and the parts to be joined were oriented on the table with stop blocks, then plunged into the cutter.



Although externally similar to the Freud machine, the Lamello's power train (bottom of photo) is protected against impact loading by a spring clutch. Freud's ring gear (top of photo) is unyieldingly pressed to the cutter shaft.



Freud's made-in-Spain model JS100, above, makes plate joinery affordable for the amateur and small-shop professional woodworker. To plate-join miters, the fixed-angle front fence, adjustable via wing nuts on either side, is removed and reversed.

A low-priced machine from Freud

by Paul Bertorelli

Plate joinery has become such a habit for me that I've honestly pared down my list of must-have shop machines to just three: a tablesaw, a 6-in. joiner and a Lamello plate joiner. Unfortunately, at \$599 retail for the top model, the Lamello is not exactly an impulse purchase. Were it not a vestige from my days as a full-time woodworker when I could justify its cost, I'd probably have never owned one.

Evidently sensing a market bottled up by such steep prices, Freud—the Italian toolmaker well-known for sawblades and shaper cutters—has introduced a bargain plate joiner to compete with the Swiss-made Lamello, and a less expensive Spanish machine, the Virutex 0-81. At \$260 suggested retail (as little as \$175 from some deep-discounters), the Freud JS100—also made in Spain—costs about as much as a good router. Last winter, I borrowed and used one for a couple of weeks. Here's what I learned.

In principle, the Freud is identical to the other machines. It's really just a miniature circular saw whose blade can be accurately plunged into the work, milling a little semicircular slot into the parts being joined. Into these slots go the ½-in.-thick plates—also called “biscuits” and usually made of beech—that form the joint. To resist shearing loads, the grain of each plate is oriented about 30° to its length, and the wood is compressed slightly so it swells in contact with glue. Plate joiners are best-suited for plywood and particleboard carcass work, but they also work fine in solid wood.

The chief operating difference between the Freud and the Lamello is the way in which the slot's location in the wood thickness is controlled. The Lamello has a pivoting fence permanently attached to the front of the machine. Referenced against the work, it accurately orients the cutter so that mating slots will line up. The Freud has a front fence, too, but instead of pivoting, it slides up and down on a track and is locked in place with a pair of wing nuts. It's more awkward to set up than the Lamello but, once adjusted, the fence stays put. Otherwise,

Freud's sliding fence works well. It also has the advantage of allowing slots to be milled into the center of thicker stock—an operation the Lamello can't manage without a lot of fussing.

The Freud performed well during a weekend of making plywood carcasses and drawers and, externally, it looks very similar to the Lamello. So why the huge difference in price? Even the cheaper Lamello Jr., which also has a fixed-angle fence, costs twice as much as Freud's JS100. One answer lies inside the machines' innards. Both Freud and Lamello transmit motor power to the cutter through a ring-and-pinion gear. But where the Freud's ring gear is simply pressed onto the cutter shaft, the Lamello's is connected through a canny spring clutch mechanism that takes up the load gradually when the cutter is plunged. Thus protected against impact loading, the Lamello ought to last longer.

It's hard to imagine that a little extra aluminum and machining should add \$400 to the price of something as simple as a plate joiner. I still love my Lamello, but if I had the choice again, I'd go for the Freud. For an amateur, it's affordable and it's made well enough, even for moderate-duty work in a commercial shop. If durability is all that important, buy two. You'll still have enough change to buy a five-year supply of biscuits. □

Paul Bertorelli is editor of Fine Woodworking.

Sources

For information on Freud plate joiners, contact Freud directly at (800) 334-4107 or (919) 434-3171.

Lamello plate joiners are available through Colonial Saw, Box A, Kingston, MA 02364. Call (617) 585-4364 for a local distributor.

Virutex plate joiners can be purchased from Holz Machinery Corp., 45 Halladay St., Jersey City, NJ 07304, (800) 526-3003.

I grew up in Seattle, Wash., where anything accidentally left outside would be in no condition to return indoors after only a week. Memories of rusting little tractors and rotted Lincoln logs have kept my furniture designs strictly indoor affairs. Here in Southern California, the climate is more forgiving, although smog, humidity and temperature fluctuations can also be hard on outdoor furniture. So, when I was asked to create some work for a sculpture garden in the nearby Santa Monica mountains, I very hesitantly accepted. Well, a coffee table is hardly meant for a garden setting, so I took on the challenge of designing a piece of outdoor furniture that would be simple, straightforward and could stand up to the elements.

I decided to build a lounge chair that reflects the Southern California obsession with being trim and tan, so my design had to be physically light and visually lean. After doing a few sketches, I came up with a design that could best be described as an inclined tanning lounger, or what I came to call a “sun sled.” I wanted the top to have a look of lightness, so I tapered the ends of each slat, rounded the edges of the bottom frame and added wheels for mobility. I also designed the top so a standard 25-in. by 80-in. lounge pad could be used.

I chose maple for the project because it’s strong, takes a good finish and is relatively inexpensive. It took me about two hours of searching through the stack at the local hardwood store to locate the clear stock I needed. Most of the 4/4 boards had to be more than 10¼ in. wide to accommodate the radius of each crescent-shaped slat. When I got the wood back to the shop, I made a mat board template of a slat and laid out all the pieces for the top,

avoiding knotholes and splits. I marked out all the slats I needed, plus a few extra pieces for tests and mistakes, then trimmed all the slats to their finished length.

Since the project calls for a lot of repetitive operations, like cutting the curves for the top and sawing the spline joints in the frame, I designed several jigs that would allow me to get the work done quickly and accurately. The jig I used for bandsawing the top curves consists of a subbase attached to the bandsaw table, plus a pivoting carrier of ½-in. plywood (figure 1) cut to the overall width of the top and 1 in. longer than the 15-in. radius of the curve. A 3-in.-wide fence made of hardwood is screwed down to the plywood from the top, with its working edge 4⅞ in. from the pivot hole and parallel to the line of cut. With the fence in this position, the outside curves on the center slats are cut, then set aside. Before the remaining slats can be cut, the jig’s fence must be moved 1⅞ in. toward the blade. To hold down the slats, I used quick-action clamps made by De-Sta-Co (350 Midland Ave., Detroit, Mich. 48203, catalog #217-U).

Next, I taper all the curved slats on their bottom outer edges. By saving the inside radius cuts for later, a straight edge remains on each piece to align it to a wedge-shaped tapering jig (figure 2) that supports and guides it through bandsaw rough-cutting and planer trimming operations. The jig is basically a 9-in. by 24-in. plywood box with a 6° slope. Since the maximum thickness my bandsaw will cut is 6 in., the pieces must extend 5½ in. beyond the end of the jig to clear the blade guides (facing page, center). To grasp and register each piece on the wedge jig, I screw on a piece of the scrap from the outside radius cuts and a

stop strip. Using a hold-down clamp to secure the work, place the jig on edge, with the wider end nearest the blade so that the straight edge of the workpiece is down and the underside faces out. The bandsaw's fence is set to trim away a thin wedge from the end of each board.

After all tapers are rough-cut on one end, the bandsaw's fence is moved to the opposite side of the blade and the taper is sawn in the other end. Since the wedge jig must be flipped over to adapt to the new position of the fence, the stop assembly and clamp must also be repositioned (figure 2) to keep the straight edge of the workpiece down on the table. After first doing a test piece, I cut the second taper the same way I did the first.

I use the same wedge jig to trim the tapers with the stop and clamp setup moved down to the lower position, as shown in the

bottom photo. I lay the taper flat on the planer bed and trim the ends down, a little at a time, until it's $\frac{3}{8}$ in. thick and the taper runs in about $3\frac{3}{4}$ in. from the end. Make certain that the metal clamp clears the cutterhead before you begin, and keep the jig flat as you pull the jig through after it stops feeding forward. Also, if the rollers in your planer are set farther apart than the length of the taper, the work may have to be hand-fed, so be sure to do a test piece first. Several alternative methods for cutting the tapers are practical: you can use a panel-raising bit on a shaper, an angle jig with a router, or even a drawknife and block plane or belt sander.

After both ends have been tapered, the inside radii are cut on all but the two center pieces, using the same jig employed for the outsides. Simply move the fence toward the blade 3 in.



With work held securely by quick-action clamps, Tinius' radius jig bandsaws curves for the top slats quickly and accurately.

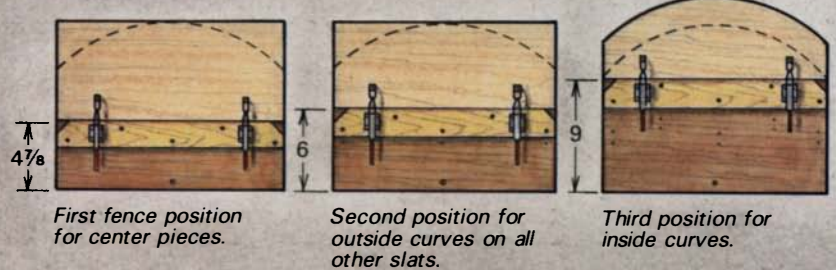


Tapering jig does double duty: author uses jig on edge to rough-cut taper on the bandsaw, then repositions fence and flips jig over.



Jig passes through the planer for final trimming. Be sure to shut off the planer and pull the jig through after it stops feeding forward.

Fig. 1: Bandsaw radius jig



First fence position for center pieces.

Second position for outside curves on all other slats.

Third position for inside curves.

Include blade width in all dimensions.

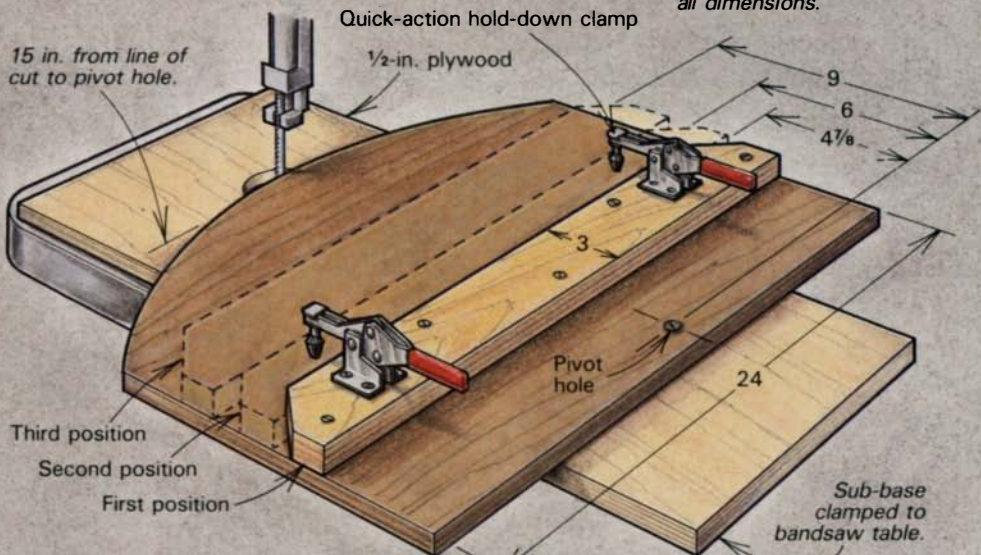


Fig. 2: Taper cutting/planing jig

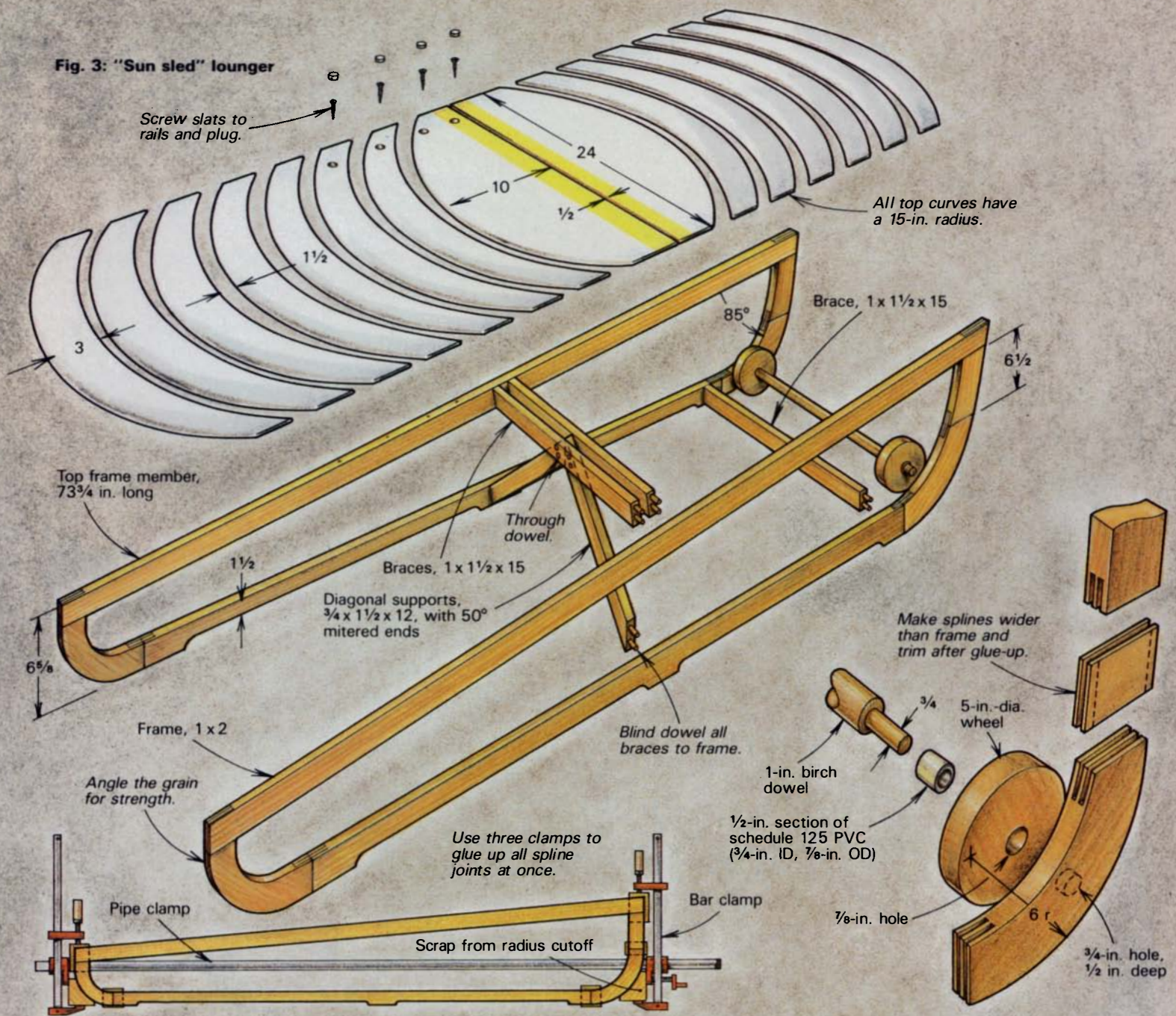
Position of stop for planer trimming

Position of stop for bandsaw cut.

Stop and clamp flipped over to this side for half the cuts.

$\frac{3}{4}$ -in. plywood, 24 in. long

$\frac{3}{4}$ -in. plywood, $18\frac{1}{2}$ -in. long



(plus the thickness of the blade), clamp down the work and proceed. I sand off the sawmarks with a rubber sanding block and 80- or 100-grit paper and, at the same time, ease the sharp arrises. The pieces are now ready to be finish-sanded and have their top edges routed with a $\frac{1}{16}$ -in. radius round-over bit set up on a router table.

Before the radius jig is stowed away, I cut one more piece in a $\frac{1}{2}$ -in.-wide arc. This will be used later as a spacer to keep the slat spacing consistent when the top is laid out on the frame.

The frame assembly (figure 3) consists of 1-in. legs and rails ripped 2 in. wide, joined by a 6-in. radius at each end cut from a separate square. First, I cross-cut the top and bottom rails and the short vertical legs to length. Both ends of the rails, the top ends of the front legs and one pair of radii are cut at a 5° angle to match the slope of the sun sled. I use double-spline joints to join the leg and rail assemblies together. They're strong, attractive, simple joints that can be a colorful accent if the splines are made from a contrasting wood. Best of all, I use the same jig setup (with very few adjustment changes) to cut

the spline slots in all the pieces—curved ones included.

The sliding jig for cutting the slots uses the radial-arm saw with its head turned sideways 90° (see photo, facing page). The jig consists of a $\frac{3}{4}$ -in. piece of plywood with a stout hardwood guide on the underside of the outer edge. The guide bears against the front edge of the saw's table, and the jig holding the workpiece is moved from right to left through the stationary sawblade. A $\frac{1}{8}$ -in.-high stop is attached on the top front edge, parallel to the back edge, and a 2-in.-wide fence with hold-down clamps is attached perpendicular to the stop. The blade must be set parallel to the top of the jig to obtain a true and clean cut. The top edge of the blade is set $\frac{13}{16}$ in. above the jig table, and the radial arm is locked down with the blade protruding $2\frac{1}{8}$ in. past the stop.

After making sure all the pieces are the exact same thickness, a test cut is made. *Be very careful*—if your saw is like mine, you'll have to remove the blade guard for this operation. All the frame ends, except the rails, are first slotted face-up, then flipped over and cut again face down. Since the top rail ends are cut at an angle, a 5° wedge must be slipped between the rail

and the fence. The slots at the foot end of the rail are slotted $\frac{5}{8}$ in. deeper than the rest to accommodate the added depth needed to meet the inward curve of the slot below it. After slotting, the curved pieces are completed by cutting both inside and outside radii. I make the splines (two for each joint) from scraps.

The wheels are bandsawn from 5-in. squares; a 1-in.-diameter birch dowel is used as an axle. An inch-and-a-half on each end of the axle is reduced to $\frac{3}{4}$ in. in diameter in order to slip through the wheel and fit into the leg assembly. To reduce wear and keep out moisture, I put a 1-in.-long collar cut from $\frac{1}{2}$ -in. Schedule 125 thinwall PVC pipe over the end of the dowel, up to the shoulder where the wheel will be (see figure 3).

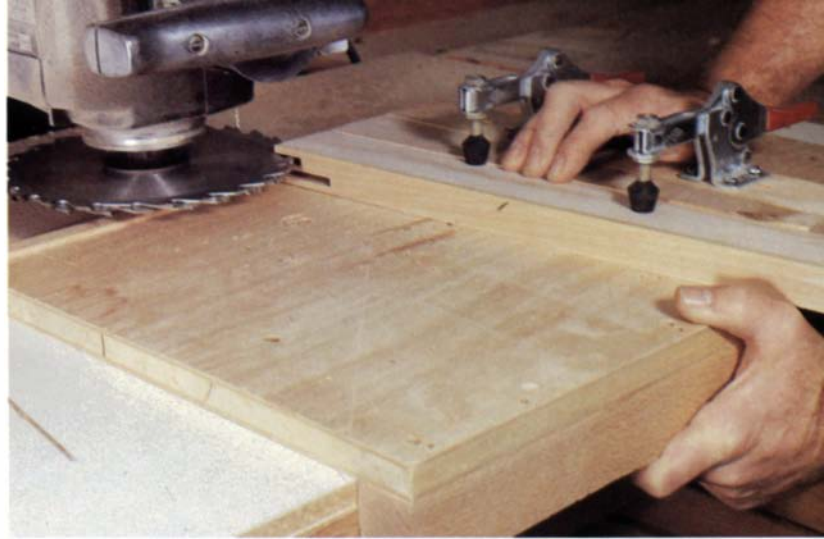
For the glue-up, I use Wilhold Plastic Resin, which has good water resistance and a set-up time that's long enough to allow me to do the assembly unassisted. I glued each leg assembly in two sessions, but it could be accomplished in one with help. The difficulty is that each joint must be clamped in both directions to obtain a nice tight joint (figure 3). After glue-up and trimming of the spines, all edges are ready to be routed with a $\frac{5}{16}$ -in.-radius round-over bit before finish sanding.

I finish-coat the frame before I do the final assembly and dowel the diagonal supports into place. The only clear finish I've found tough enough to stand up outdoors is varnish—either spar or polyurethane. Instead of the high-gloss spar varnish usually seen on a boat's brightwork, I like a satin luster to give the lounge the softer look of natural wood. I brush on four coats of McCloskey Man O'War spar varnish, sanding lightly between each. I use the dowel holes drilled in the frame (to join the cross braces) to hang the pieces up on a board with pins, like a hat rack. After allowing a week of drying time, I assemble the rest of the frame.

The proper finishing of the top is crucial because it receives the brunt of the sun and wear. After talking to several paint salespeople, I prefer a synthetic enamel called Sintec made by Sinclair Paints (available from any Sinclair dealer, white #7500; bright yellow #7513). It's an industrial-grade product that's used on farm implements and wears well outdoors. I also use Sinclair's "best" exterior-wood primer, knowing from experience that a top finish can only be as good as the preparation that goes into the surface below it. This primer has what's called a "controlled penetration" and takes a long time to dry (24 hours, if the weather is favorable). The first time I sprayed the stuff, I applied the first coat too heavily, and had to wait three days for it to dry. Also, the overspray from the enamel is different from anything I've ever used before—it floats through the air, still wet, and leaves a white film everywhere it lands. With that experience behind me, I return to my spray schedule, spraying two prime coats on both sides of each piece plus two enamel coats in about a week's time. I also spray a couple of sun-yellow stripes on the two middle pieces.

Once the top slats dry, I'm ready for final assembly. I start by carefully positioning the straight edge of one of the middle slats on top of the rails, clamping it down temporarily. Using a drill guide, I sink pilot holes through the top into the rails below. The top piece is then unclamped and moved to the drill press, where the holes are countersunk for $1\frac{3}{4}$ -in. #10 stainless steel screws. These steps are repeated as each top piece is positioned and screwed into place, one by one, using the $1\frac{1}{2}$ -in. crescent cut earlier as a spacer. The countersunk holes are later plugged and sanded, dabbed with primer and touched up with the synthetic enamel. You could also blind-dowel all the top pieces in place.

After I finished the sun sled, I realized that all the crescent-



After radial-arm saw's head is rotated 90° and locked in place on the rail, slotting jig slides workpiece through the $\frac{5}{16}$ -in.-wide dado blade. Stay clear of the exposed blade while cutting the joints.

shaped scraps that covered the floor of my shop could be used to make the top of a small sun table. The construction uses the same jigs and processes as the lounge, so the two pieces can be efficiently built at the same time with only a few setup changes.

The inner radii for the top slats are cut on the bandsaw jig with the fence moved 2 in. (plus blade thickness) closer to the blade. The underside tapers should be about $1\frac{1}{2}$ in. long, so you'll have to experiment to find a new position for the tapering jig's fence.

The table's lower frame is built essentially the same way as the sled's, except that the legs are mortised—not splined—into the top rails, and there's no need to angle-slot any of the pieces. The table has an extra stretcher in front but lacks the diagonal bracing of the lounge. When completed, it makes a fine companion piece to the sun sled. And, while lounging by the pool after a hard day at the racquet club, you'll need a place to set your drink between dips. □

Brian Tinius builds furniture of his own design in North Hollywood, Calif.



Canadian sculptor Joe Dampf specializes in portraits, such as this carving of his daughter, Rosanne, done in bleached mahogany. He begins each carving by working out proportions and other details with a clay model.

Carving in the Round

Roughing out with a clay model and a pointer

by Dick Burrows

I have always been fascinated by carvers who can transform a block of wood into a realistic likeness—be it a bird, a human or a leaf. Not that I expect carvers to be cameras with chisels, slavishly copying reality. For me, a realistic likeness does more than just look like an object; it reflects what the carver learned about the subject through careful observation, as well as any feelings and thoughts evoked. The model may provide the general form of an object, but the carver's heart, intellect and skill give life to that form. Whether or not the carving is an exact duplicate of the model is only incidental.

Creating this likeness can be an overwhelming task, especially if you're teaching yourself to carve. I began by copying patterns from various carving how-to books. My favorites were simple, smoothly flowing designs that suggested a person or an animal. Take a figured piece of wood, whittle it to shape, sand and finish it to a soft satin glow and presto—instant attractive gift or craft fair best-seller. And I was never embarrassed by anyone observing that I did sensitive or perceptive work.

It's easy to mire down in this copy-a-pattern rut. There's nothing wrong with patterns—many carvers start with them. But

the blind following of patterns can make carvings little more than shaped pieces of wood. Last summer, though, I learned a system that gave me enough freedom to enliven the most hackneyed pattern, and to capture the most complex real-life objects.

The key is to go to an art supply shop, buy 25 lb. of water-based clay, and carve in clay before you even think about wood. Clay is a 3-D sketchbook, every bit as versatile as you remember from your childhood. You can add to or subtract from it, twist or manipulate it with ease to create large masses or tiny details, and generally work it until you get the dimensions, shapes and expressions you want. Once the model suits you, you can transfer its dimensions to wood mechanically using the pointer system I'll describe. It's a method stone carvers have used for centuries. Though tedious, it roughs out your wood block to within a fraction of an inch of the desired final dimensions. Later, you add the final details freehand with a gouge or riffer, or by hand grinder. If this system seems too restrictive, you can carve from the model by eye, or transfer the dimensions with calipers and rule.

I was introduced to this system by Joe Dampf, a prize-winning Canadian carver who teaches in the Toronto area, at International

Woodcarving Convention seminars in Davenport, Iowa, and at the Haliburton, Ontario, School of Fine Arts, where I met him. A self-taught artist who's been carving for more than 15 years, Dampf describes his work as classical sculpture adapted to wood. He prefers wood to the more traditional stone or metal because he finds it warmer and more appealing to the touch. This warmth is essential to Dampf since he specializes in portraits, such as the bleached-mahogany carving of his daughter on the facing page.

Clay modeling is not as intimidating as I had imagined. The armature that appeared so unapproachable in sculpture handbooks turned out to be a simple wooden upright supported by corner brackets and fitted with copper tubing loops screwed to the top (see figure 1). If you're working on a relief carving, use the simple box frame shown at right. The clay itself is reusable, as long as you keep it moist. Tools are equally low-tech. Fingers are ideal. Add a couple of old knife blades, a few whittled wooden spatulas and some wire, and you're in business. And don't hesitate to check out the clay modeling tools at the local art supply store. Some of the pencil-like devices with tiny wire loops on the ends are perfect for forming eyes and other details.

You'll need at least three photos, 5x7 or larger, of the subject you want to sculpt. For a head, you'll need a full frontal view, a full profile and an oblique-angle shot. Take more pictures if you can. The more information you have, the better; a common mistake among beginners is the failure to thoroughly research the subject. Once you learn to note the little details, you're well on your way to mastering clay modeling.

To begin, build an armature like the one shown, line up the pictures in front of you, and start adding clay. You could check an anatomy or sculpture handbook, but the quickest way to learn is by doing. I found the best way to build the shape was to pinch off gobs of clay and smack them in areas that needed filling out. The head quickly began to take on the texture of a pinecone. When the form seemed right, I smoothed the surface with my fingers. When I couldn't figure out what to do next, Dampf suggested concentrating on one view. My best picture was a side profile, so I worked on that angle. When the side view looked right, I switched to the front, blending from the profile to improve the front view, and so on. When working on something as familiar as a head, you can use your own face to see how cheekbones or throat muscles are shaped. For refining lips, eyes and other details, hold the picture right up to the work, as shown at right. This way, you can see exactly what needs to be done. And eye your work from a distance once in a while. It really helps.

Don't be afraid to experiment with unconventional methods. A fine piece of fiberglass screen is perfect for smoothing cheeks and other broad areas. Put the screen on the clay and paint over it with a wet brush. The pattern left on the clay can be smoothed away with a sponge. Foam balled up on the end of a dowel is another effective smoothing tool. A tiny artists' brush is good for modeling lips, eyelids and other details. And if the head is out of shape, rap it enthusiastically with a board or a heavy ruler. It's a therapeutic exercise, although my wife didn't care much for the philosophical implications: she served as my model.

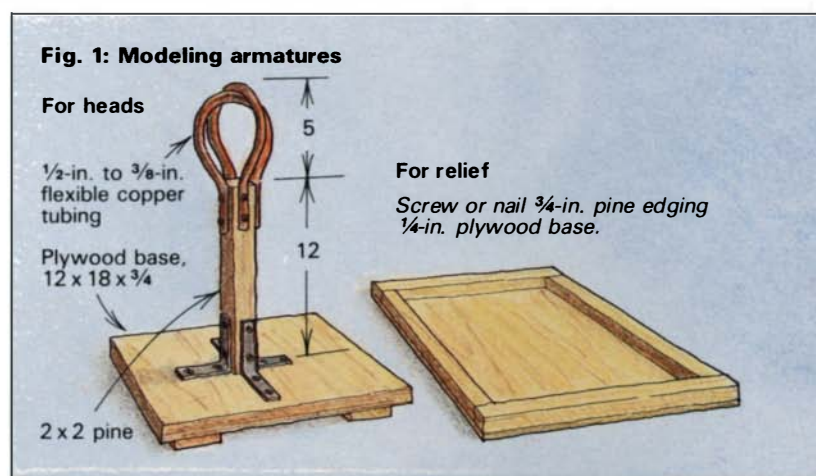
Don't rush. Just moisten the clay frequently with your sprayer. When you want to quit for the day, spray the clay liberally, cover it with a damp towel and wrap the whole thing in a plastic trash bag. Moisten any unused clay and seal it up in a plastic bag.

Once he's satisfied with the clay model, Dampf preserves it in plaster. The casting is more permanent than the clay model, which will shrink and crack if it isn't kept damp. Dampf's method for casting the piece is a two-step process (see figure 2). First, he

makes a plaster mold. Then, after removing the clay from the mold, he pours in plaster and lets it harden, forming a 3-D copy of the clay model. The process destroys both the mold and the clay model, but you can reuse the clay and the armature. Dump the used clay in a bucket with a tight lid (a plastic diaper pail or trash bucket works well), adding water to keep it moist.

The head is cast with quick-drying dental or molding plaster sold in art and building supply stores (so-called quick-set plaster won't set fast enough). Make sure you use clean water and clean tools; impurities could prevent the plaster from setting. To start, pour a small amount of water into a bowl. Sprinkle in plaster, which will sink to the bottom of the bowl. Continue adding plaster until a mound of plaster forms on top of the water. Blend the mixture until smooth, but be careful not to overmix or bubbles will form. They could be a problem later when you pour the cast.

The mold is worked in two sections: the front first, then the back. To separate the two halves, roll out a 1-in. strip of clay about ¼ in. thick and 2 ft. long. Lay this like a halo, narrow side up, around the head, slightly behind the ears (see figure 2). Make a key in the halo



Holding the model's photograph right up to his work, Dampf refines an eye with a shaped wooden stick. For finer details, he uses a wet artists' brush to manipulate the clay.

Fig. 2: Casting a head

Clay halo fence divides mold in half.

Make mold key by creating depression with coin.

Wet paper towels prevent plaster from seeping under fence.

1. Cover front half with thin layer of plaster colored with laundry bluing.

2. Add thin white layer.

3. Cover head with thick layer of plaster, reinforce with strips of plaster-soaked burlap.

Fence around base keeps plaster from running off.

Build shelf under clay to support plaster.

4. Remove clay halo and brush edge of mold with runny clay to keep front of mold from sticking to back half. Repeat plastering on rear of head after front hardens.

5. When back of mold has hardened, scrape seam with knife to expose clay brushed on between halves. Pour on water and pry halves apart. Dig clay out of molds. Wash surfaces with water and coat inside with dishwashing detergent as mold release agent.

6. Wire two halves together and pour mold.

Fig. 3: Roughing out head

Chop to saw kerfs with wide, flat chisel.

Locate glue lines at side of head.

Rough cut to lines with electric chain saw.

Orient block so have enough wood to carve all features.

Sight from wood block to cast. Draw rough outline, 1-in. oversize, on wood.

sculpture. When this first layer firms up in five to ten minutes, dab on a second, white layer, about $\frac{1}{4}$ in. to $\frac{1}{2}$ in. thick. The third coat of plaster should be the consistency of ice cream. Use a rubber kitchen spatula to spoon a $\frac{1}{2}$ -in.-thick layer on the front and bottom of the sculpture. When this heavy coat is firm, dip 3-in. by 12-in. strips of heavy burlap into liquid plaster, and pat these reinforcement strips snugly onto the front of the sculpture.

After the plaster hardens, remove the paper towels and clay fence "halo." Paint the plaster edge that's exposed when you remove the fence with a thick mixture of clay blended with water. Next, plaster the back of the sculpture in the same way you did the front—one tinted coat followed by two thicker layers plus reinforcement. After the sculpture is covered and the plaster has set for one or two hours, scrape the excess plaster from the seam between the mold halves with a knife. Continue scraping until you can see the entire joint. Soak the seam with water, then gently pry the mold apart. Start the two sections moving by pulling, pushing and pouring water into the seam. When you get both halves off, dig the clay out of the molds and remove the armature.

After washing any remaining clay from the mold, you're ready to begin casting. Brush the inside of the mold with two or three coats of liquid detergent—a great mold-release agent. Put the two halves together; secure them with wire. Turn the mold upside down, mix a large batch of plaster and pour about half of it into the mold. Roll the mold as the plaster sets. Repeat the process until you have a 1-in.-thick layer of plaster inside the mold. Next, soak burlap strips in plaster and place them around the inside of the mold. When the plaster is firm, carefully remove all reinforcements from outside the mold. Some of the blue plaster and parts of the actual cast will be visible. Carefully chip off the remaining bits of mold with a dull chisel. Use wet plaster to reattach broken parts or repair defects while the cast and parts are still wet.

Now carve the head in wood. To provide reference surfaces for the pointer, cut two identical squares of $\frac{3}{4}$ -in. plywood, slightly larger than the outside dimensions of the cast. Dampf tacks the pieces of plywood together, cuts them simultaneously, then sands their edges with a disc sander mounted on the tablesaw. Locate the cast in the center of one plywood square; trace its base. Run a bead of white glue inside this outline and set the cast on it.

The block you will be carving must be located in the center of the second plywood sheet. To make sure the block is oriented properly in relation to the model, and to ensure he has enough wood to carve out shoulders and other protrusions, Dampf sets

with a coin, as shown. You'll want to push out a good-sized dent to help align the two mold halves. Press wet paper towels against the halo's back side to prevent plaster leaks. You'll need to build a second clay fence about an inch from the base of the model to keep plaster from running off. If the clay model doesn't extend to the bottom of the armature, build a small wooden shelf under it.

Next, mix a small batch of plaster and color it with ordinary laundry bluing from the grocery store. The color will distinguish the mold wall from the actual casting, making it easier to chip away the mold without damaging the casting. When the tinted plaster mixture is as thick as heavy cream, use your best food-fight technique to flick a $\frac{1}{8}$ -in.-thick layer onto the front of the



The plaster head and the wood block are screwed to identically sized plywood bases. Student Jim Lewis butts the pointer base against the plywood, left, and sets the arm to an X marked on the cast. A bent metal rod controls the distance between the

pointer and the front plywood edge. Next, he moves the pointer to the wood block, center, and carves the wood to the dimension of the plaster cast, marking an X on the spot when done. Finally, the X-points are connected, right, by carving across the grain.

the cast and the wood together and sights from piece to piece. If the wood is laminated, Dampf also orients the block so that any glue lines will fall in less-apparent places—not down the middle of the face or in some other critical spot. When he's satisfied with the block location, Dampf temporarily nails it to the plywood, turns the whole assembly over and drills countersunk holes for 2-in. #12 woodscrews. He uses seven to twelve screws, depending on the size of the block.

During the roughing-out stage, Dampf bolts the block and its plywood base to a heavy worktable. The cast can be moved around, so he can roughly outline the head shape by sighting from block to cast. Working by eye and by pointer, an oversized head shape is sketched out on the block with a pencil or a crayon (see figure 3). When he's satisfied with the views, Dampf takes a small electric chainsaw and cuts perpendicularly into the head to the lines he marked on the block. Then, he chops off the excess wood with a small sledgehammer and a 1½-in. carpenter's chisel. This knocks off large chunks of wood, and turns the block into a rough head shape, about an inch oversize all around.

Before refining the head shape, Dampf points and marks Xs on all the high points of the face—nose, ears, point of the chin, and so on. Generally, you'll end up with Xs about 1 in. apart in delicate areas, and about 2 to 3 in. apart in broader areas. Dampf's pointer system uses two arms, as shown in the top left photo. (I made my pointer from a machinists' surface gauge purchased from Penn Tool Co., 1776 Springfield Ave., Maplewood, N.J. 07040.) The arm on the top of the upright is for transferring the X-points from cast to wood. The L-shaped arm on the base of the pointer block indicates the distance from the edge of the plywood square to the pointer base. To transfer X-points, set the pointer base against the plywood sheet under the plaster casting, secure the L-rod, and bring the top arm in until it touches the cast. Mark the spot with an X. Next, move the pointer over to the plywood square under the carving block, as shown above, center. The L-rod locates the base in the same place along the plywood, and you can tell from the distance between the pointer's base and the carving block how much wood you still need to remove. Carve the wood away until the pointer touches the wood exactly as it did on the plaster cast. This rough carving is done with a ¾-in.- or 1-in.-wide #8 gouge. Cut across the grain for maximum control, and to shear the fibers rather than split them off. When you're about ¼ in. from the desired depth, switch to a ½-in. #9 spoon gouge. Scoop out the wood from a ⅝-in. to ¾-in. circle, cutting across the grain once

more. When the pointer reaches the proper depth, mark the spot with another X. Repeat the process over the entire head.

The next step is to connect all the points and refine the shape by shaving the wood from X to X with shallow gouges, as shown above, right. Avoid gouging into the wood too deeply in any one spot. Otherwise, you'll be forced to reshape an entire section of the face to eliminate the pockmark. The final shaping is done with riffler files. Dampf finds commercial rifflers overpriced, so he makes his own from rat-tail and other small files. You can, too. Heat the end of a file to red hot with a propane torch, push it into a board, and bend the file to the desired curve. Then, reheat the file to red hot again and dip it in water to harden.

Dampf sands and polishes his carvings with heavy-duty Scotch-Brite abrasive pads (3M, St. Paul, Minn. 55144; call 612-733-0958 for local distributor information), starting with the coarse brown pads, then switching to the finer red pads (catalog #7447 and #7440, respectively). First, cut the pads into 1-in. circles and run them in a Dremel or Foreman flexible-shaft power grinder. Be careful—these pads can really grind away wood; in fact, you can actually sculpt with them. If you don't have a grinder, use rifflers and sandpaper to finish the surface.

At this point, Dampf recommends removing the cast and the carving from their bases. Put the two together and sight from one to another. You might also put both under a spotlight. The bright lights will help you see the curvature of each head, and you can use the highlights and shadows as guidelines.

Now, finish the carving with any clear flat finish rubbed down well with fine Scotch-Brite. Apply several light coats to seal the wood, rubbing off any excess immediately to avoid buildup on the surface. If the color of the carving is uneven due to sapwood or defects, color the wood with a matching stain. Dampf uses Varathane X-3D gelled wood stains (available from Flecto Co., 1000 45th St., Oakland, Calif. 94608; call 800-227-2944 for local distributor information). If you can't get the shade you want, mix two colors together. Let the stain sit on the surface for several minutes, then wipe it off. You may have to do this a couple of times. If a knot or other defect still shows, add thinned stain to the spot with a small brush. The last step is to cover the whole piece with a coat of clear flat finish. □

Dick Burrows is an associate editor of Fine Woodworking. Readers interested in classes conducted by Joe Dampf can write him at 66 Langhorne Place, Don Mills, Ontario, Canada M3B 1A9.

Wooden Hardware

Giving your furniture the right pull

by Jay McDougall

One challenging design problem for many furniture-makers is developing pulls and handles that enhance their designs. It's rare to find that elusive "perfect pull" in a catalog or at a local hardware store. You can't have too many options in this area, so here are three ideas to stuff into your burgeoning bag of tricks.

The coved pull shown below has been a real workhorse for me, since it can be modified for many different applications. It's made with a tablesaw and hand tools, then simply glued to the edge of a drawer front or door. A second option is to employ the same design on a smaller pull, which can be shaped with a router. The final example is an undercut crescent pull, ideal for contemporary "Deco revival-style" furniture. When painted black or some other accent color, the pulls, shown on p. 80, exude a classic look, much like shirt studs on a tuxedo.

The size of the pull always depends on the dimensions of the door or drawer on which it will be mounted. A typical blank for tablesawn coved pulls, like the ones shown in the photo series at right, is 2 in. wide and $\frac{3}{4}$ in. thick and long enough to span the door or drawer. For side-by-side drawers, you may want to cut the stock longer so you can have uninterrupted grain patterns in abutting drawers. This is a must if you have continuous grain in the drawer fronts themselves. Allow yourself extra length for waste,

experimentation and (don't kid yourself) mistakes.

To begin, I form the coves with a 6-in. dado head, set for a $\frac{1}{4}$ -in.-wide cut (see photos, top of facing page). The fence is set at an 18° angle to the blade. Next, I rip the coved pieces. Note that each piece is ripped twice—first with the blade set at 45° to remove the front corner of the pull, then with the blade set at 90° to remove the waste at the back of the pull. This step establishes a ridge that aligns the pull on the drawer or door edge. For a continuous pull, all that remains is to glue on the pieces and fair everything with spokeshave, chisel or scraper/sandpaper. For a contoured pull, make a template of the curve, trace it on the cove side and saw it out with a coping saw or bandsaw. Fine sandpaper makes a good non-slip template for small pieces.

The procedure for making smaller coved pulls is the same, except the coves are cut with a router fitted with a fence attachment and a core-box bit. Again, the size of the pull is determined by the dimensions of the door or drawer; I most often use 4-in. pulls cut from $\frac{5}{8}$ -in.-thick stock. To prevent the stock from flexing, and to provide an adequate bearing surface for the router, I usually rout the pulls in stock that's at least 3 in. wide, then rip off strips of pulls.

Routing is pretty straightforward. Make a template defining the profile of the pull and the length of the coves. The profile is marked only on the face of the stock, but the cove length must be transferred with a square to the back side of the board. Depending on your taste, you can cut through coves or stopped coves on each side of the pull. Set the router's fence (or guide strip) so the cove will be centered in the pull's width, $\frac{1}{8}$ in. from the front edge. The depth of the cove cut is a matter of taste. Just a hair (about $\frac{1}{64}$ in.) over $\frac{1}{8}$ in. works well for this size pull. Cut the coves between your layout lines with a $\frac{1}{16}$ -in. core-box bit. Flip the board over and cut the corresponding cove marked on the flip side. (Here's where a plunge router pays for itself.)

You can save yourself untold aggravation by sanding the coves and rounding off the front edges with a spokeshave and/or sander before you cut out the individual pulls with a bandsaw or coping saw. Coarse 80-grit paper rounds off the hard edges on the coves and produces a nice-feeling pull. When ripping the two $\frac{3}{4}$ -in. strips of pulls, keep the $\frac{3}{4}$ -in. strip on the side of the blade away from the rip fence to avoid kickback. Bandsawing the pulls apart and fairing all the surfaces completes the process.

To make a crescent pull like the ones shown on p. 80, cut out a wooden circle, undercut or chamfer its back edge, then cut off two sections, or arcs, to form crescents. For 4-in. diameter or larger pulls, I use $\frac{3}{4}$ -in.-thick stock; $\frac{5}{8}$ -in. or $\frac{1}{2}$ -in. stock is fine for smaller pulls. If the pulls will be painted, they should be cut from a dense, close-grained wood such as maple, birch or beech. You

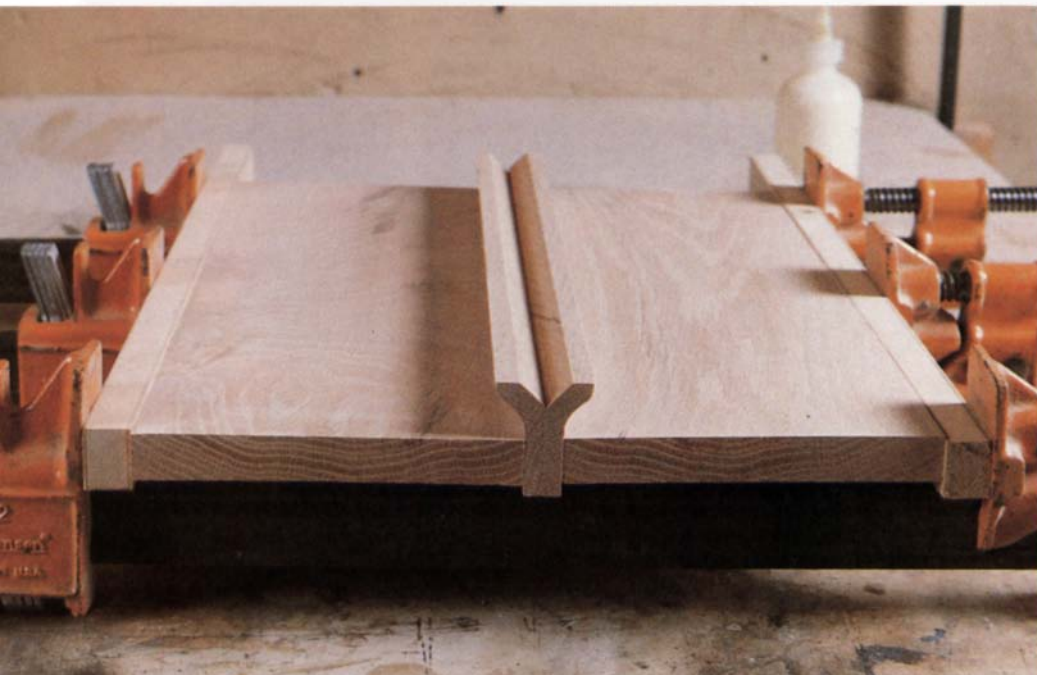


Handshaped hardwood pull adds a distinctive touch to drawers. The pulls are coved on a tablesaw, then shaped on a bandsaw.



After ripping out 2-in.-wide blanks, author McDougall coves the pulls on a tablesaw with a dado head set for a $\frac{1}{4}$ -in. cut, above left. The narrower the dado setting, the smaller the flat spot on the top of the cove. The fence angle is 18° . Several passes are needed to make a $\frac{3}{8}$ -in.-deep cove, with its edge about $\frac{1}{4}$ in. from the front of the blank. The cove blanks are then ripped twice with a sharp, preferably carbide-tipped, blade. McDougall sets

the blade at 45° to rip off the front corner of the blank, above center. The fence setting is $2\frac{1}{16}$ in. Next, he sets the blade at 90° with a 1-in. depth of cut and rips the waste from the back of the blade, above right. The fence is set slightly under $\frac{3}{8}$ in. from the blade, creating a small ridge that serves as a guide when gluing the pull to a door or drawer edge. The pull will be about $\frac{1}{4}$ in. proud at the back and must be planed or scraped.

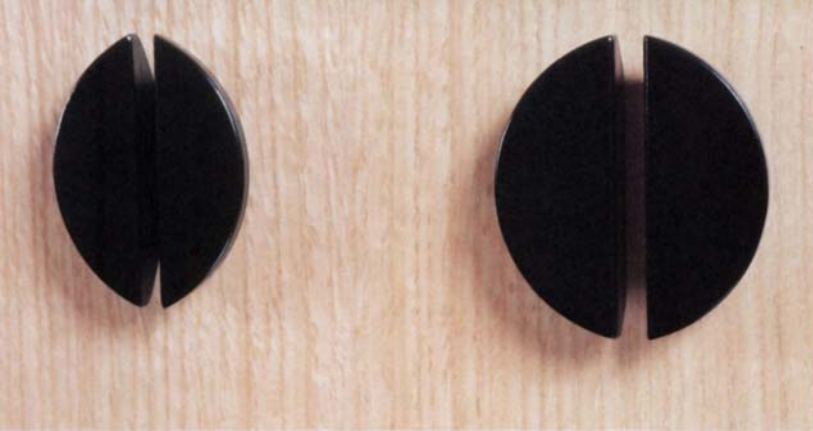


The pulls are glued and clamped to the drawer fronts in pairs, back-to-back, left. For a contoured pull, McDougall traces a template onto the cove, above, then band-saws the curve before finishing with spokeshave, chisel and sandpaper.



Small hardwood door pulls like the ones above are shaped with a router and a core-box bit. The 3-in.-wide stock resists flexing and provides a stable surface for the router and its fence attachment, right. Then, the strips of pulls are ripped apart.





The contemporary-looking crescent pulls above are two halves of a bandsawn disc, which is cut apart after being chamfered.

could also use the same wood as you used for the furniture, or some nicely contrasting species.

To speed up the process, make the jig shown at top right to bandsaw rough-cut squares into discs. Cut a sawkerf to the middle of a piece of plywood that can be clamped to the saw table. Then, install a pin and a pivoting arm to carry each disc into the blade as the discs are rotated and cut round, as shown. The same jig also holds the discs when you chamfer and sand them. To lay out the discs, cut several round Plexiglas or hardboard templates. Drill a center hole in each template, then a second hole 1 in. from the center for a stabilizer pin to lock the blanks when you don't want them to spin. I make the pins from $\frac{3}{32}$ -in.-diameter brazing rods. Use a template to mark the two holes on the blanks, aligning the holes with the grain, and drill the $\frac{1}{8}$ -in. center and stabilizer holes.

Next, mount the jig on the support table of a stationary bench sander set in its vertical position. Position the jig's long edge $\frac{1}{8}$ in. from the belt, as shown at right, and mark a new center pin hole so that $\frac{1}{16}$ in. to $\frac{3}{32}$ in. will be sanded off the discs when they are rotated against the belt. While you have the jig on the sander, you should also true and sand the template/shim discs, which will be needed in the next step. Once you've sanded true circles, you can rout around the blanks to chamfer their back edges to form the pulls' finger grips. Use the Plexiglas template to mark a $\frac{1}{8}$ -in. hole near the center pin so you can use the stabilizer pin to secure the disc. Shim the discs with the templates to raise them away from the jig (allowing clearance for the chamfer bit's bearing guide), and insert the center and stabilizer pins. With the shims and pull blank in place, back side up (see photo, far right), rout the chamfers. The chamfers are sanded much the same way as the edges were, except the sander table must be tilted 45°. I also mount the discs on the jig when I hand sand to soften the edges.

The final step is to cut the crescents. Use the template to mark the center and stabilizer holes about 2½ in. from the long edge of a 9-in. by 12-in. piece of plywood. Bore the holes parallel to the saw's line of cut. Mount the discs face down for a larger bearing surface. Set the tablesaw fence, as shown at right, to rip the size crescent you want from the disc, mounted on the plywood. Make the initial cut with the crescent on the side of the blade opposite the fence, then rotate the remaining piece 180° before mounting it on the pins for the second cut. If you dislike holding the pull this close to the blade, install a lever-action clamp on the jig.

After sanding, I attach the pulls with screws from the inside of the door or drawer front. The screws help position the pulls properly, but you could get away with just using glue. The end product will be a versatile pull that feels as great as it looks. □

Jay McDougall is a furniture designer and builder in Fergus Falls, Minn. Photos by the author.



Discs are cut from 3¼-in. squares on a jig mounted to a bandsaw table. A hole is bored in the center of each square, so it can be mounted on a swinging arm, which carries the blank into the blade as it's rotated through the cut. The pin on the arm is located so that the distance between it and the blade equals the radius of the disc and is tangential to the blade's line of cut. A stop pin secures the arm in cutting position.



Each disc is rotated on a pin and trued against a sanding belt, above left. Two pins secure the disc when its back edges are routed, above right. Plexiglas shims under the disc provide clearance for the chamfer bit's bearing guide.



A piece of plywood serves as a carrier for ripping crescents from the shaped discs. The discs are fastened to the plywood with two ⅛-in. brazing rod pins. Set the fence as shown, above, to cut the desired crescent size. After ripping off one crescent, rotate the remaining piece 180° and rip off the second.

Building an Art Nouveau Cabinet

Following the cold trail of the French masters

by Terrie Noll

My friend Page earned patron status when he referred me to a client who needed an Art Nouveau-style display case to house a collection of Gallé and other period glass. Armed with a portfolio of pictures gleaned from nearly two years of professional work and some borrowed books on the era, I approached the first meeting with my potential clients intending to assuage any anxieties about my skills and to ferret out their stylistic preferences.

After the portfolio, we started on the books, wending our way through the organic creepy-crawlies of the Nancy School and the sinuous Belgian lines that characterized turn-of-the-century Art Nouveau. From their comments, I could sense my clients' taste in art and get their ideas about the cabinet-to-be. As we turned a new page on the Parisian School's stylish grace, we found our aesthetic, done with finesse by Eugène Gaillard, a French master cabinetmaker whose work is prominent in the Art Nouveau School. Add a dash of interior lighting, a little carving here and there and voilà: the ingredients for a piece of fine furniture.

Back at the warehouse, putting magnifying glass to photo and eye to text yielded no clues about Art Nouveau construction. The single technical detail I unearthed—that pieces often were modeled in clay beforehand—only added to my confusion since you can't just glob on handfuls of wood to sculpt. The challenge was figuring out how to put material where I wanted it, take it away again and have a cabinet left over.

By scaling the agreed-upon dimensions—30 in. wide by “just a little taller” than my 6-ft. 4-in. client—I established my design territory. I immediately sectioned off the bottom third as too low for display, so it became a closed cupboard with paneled and relief-carved doors. The remaining space would be display area. With ballparked shelf spacing, I blocked in the carcass sides, flaring them all an inch forward and sideways. After adding an undulating profile, I had my basic cabinet.

There is no such thing as a square corner in Art Nouveau, so to my materials list I added a sheet of medium-density fiberboard for the curvy templates I'd need. Since the style didn't lend itself to visible joinery, and since I was more interested in representation than reproduction, I decided mortises with loose tenons throughout would be appropriate, affording me maneuverability while shaping. The cabinet elements could be glued up oversize, then

When Art Nouveau furniture was built in the shops of Paris around 1900, its sinuous lines were first modeled in clay, then sculpted by hand. Few clues about Art Nouveau construction have survived. For this Nouveau-style cabinet, Terrie Noll and Danielle Hanrahan followed template routing with hand carving.



Fig. 1: Carving a cabinet

Cabinet back held into rabbets with screws and finish washers.

Removable ventilated roof fits onto applied ledger strips.

High-intensity spotlights

78½

First, fit frame to opening then saw pattern.

Glass is let into rabbets routed in the profiled frames. Front frame is fixed in place, glass door is at left side of cabinet.

Brass grommets for shelf pins

Carve.

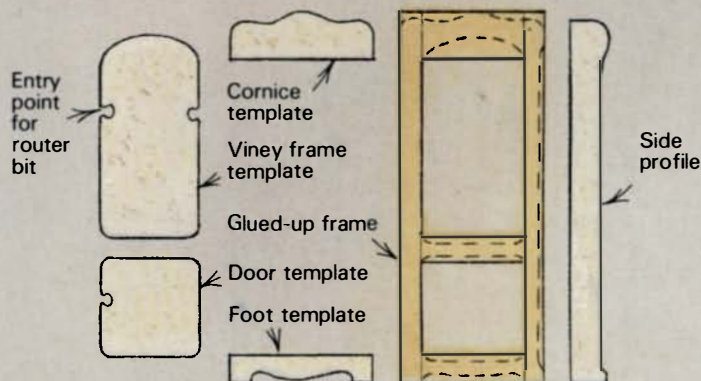
Veneered plywood corner moldings and solid wood straight moldings hold glass in place.

17

30

Loose tenons join rails and stiles.

The cabinet's profiles were first shaped with template-guided routers, one template for each elevation and for each inset part, such as doors, panels and the carved viney frame. Templates were bandsawn from ½-in. medium-density fiberboard. Face profiles were routed first, then side profile. Carving followed.



sculpted down to the final profile. My three routers and a drawer full of flush-trim bits went on standby alert.

It dawned on me that if this cabinet were ever to be completed within a reasonable budget, and be Art Nouveau you could live with, it would have to be done *sotto voce*. After all, it was *for* display, not *the* display. This eliminated carving the side panels and relieved any notion of pasta-like diversions into foliage on the carcass sides. Unsure at this point how to embellish the cornice and foot, or what design element would travel down in the name of unity, I approached some troublesome details.

For starters, the frame of a front-opening door would infringe on the precious 24 in. of face glass; without widening the cabinet, it was structurally impossible to house a front door. But, by increasing the width of the carcass sides, I lost no critical glass and actually gained enough structure to dig a hole and bury a door there. Flush doors with Soss hinges (see *FWW* #58, p. 40) fit both structure and design, and by making the carved reliefs double as door handles, I sidestepped the issue of finding period hardware.

Installing the glass was simple enough in the side door, but the big face glass could only go in diagonally through the top while the cabinet was face down. The glass was dropped into a rabbet, then held in place with a molding. With the glass set back fractions of an inch from the face of the 2-in.-thick wood, moldings to fill out the deep rabbets had to be very wide. For strength, the moldings transforming the curves into straightaways were of stacked ply, bandsawn to shape and veneered.

While synthesizing all these factors, a job at the San Diego Museum of Art led me to Danielle Hanrahan, the construction supervisor there. A discontented sculpture major, Danielle seemed karmically suited to moonlight on the display case. With this security blanket, I jumped into the abyss of living up to my famous last words: "Don't worry, I can build anything." I sent off a bid, then waited for a deposit to arrive. Magically, it did.

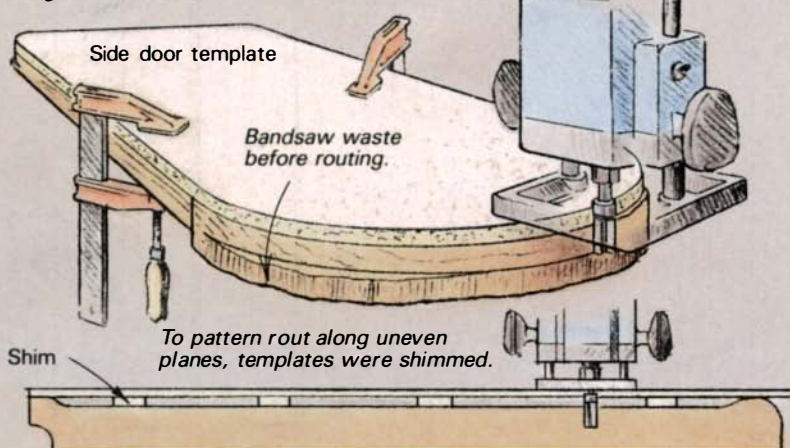
Using graph paper for layout, I realized I needed 12/4 lumber to accommodate the flared shapes, or else I'd have to glue up and tastelessly cut through a glue line. Considering the amount of carving and shaping to be done, and the species available in 3-in.-thick boards, I was fairly certain I'd choose the congenial workability of Honduras mahogany. Factoring in characteristics appropriate to the period—such as color, which had to be toward the light end so as not to lose the carving to massive darkness and subdued grain—mahogany won hands down.

While trying to sketch out tenon placement in several planes of cut-away material, I'm sure I suffered brain damage. I decided to follow the Krenovian approach: compose as you go and pray for divine guidance. By using loose tenons, I could cut all the parts to final length in basic chunks, then clamp the whole thing together into a full-size, three-dimensional worksheet. I could then see what would get cut away and what would not. With this decision, I felt safe to proceed, and began making full-size templates for every curve, outlining them in lumber crayon on my giant clamp-held box. Gaining the ability to look around corners and see what would become waste and where router bits would reach made deciding safe mortise placement a breeze.

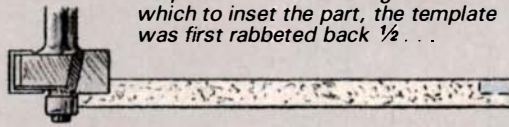
A maelstrom of router shavings in the corner meant that Danielle was hard at work, wasting the ground on the lower doors' relief panels to a depth of ¾ in. She then meditatively carved the now-raised design to final profile. Meanwhile—in the storm of my own router—the job of fashioning the carcass became, for me, a subtractive process of waste removal. Whoever invented Ocemco's ½-in. over-bearing flush-trim bit (Ocemco, 1251 51 Ave., Oakland, Calif. 94601) changed my life. Just slap

Fig. 2 Routing sequence

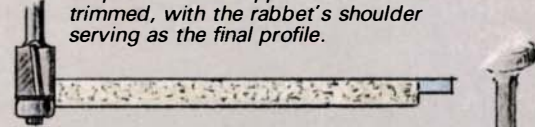
Step 1: To inset doors and viney frame, the part's outside profile was first template-routed with flush-trim bit. After an initial shallow cut, the template was removed and the bit was guided against the first cut.



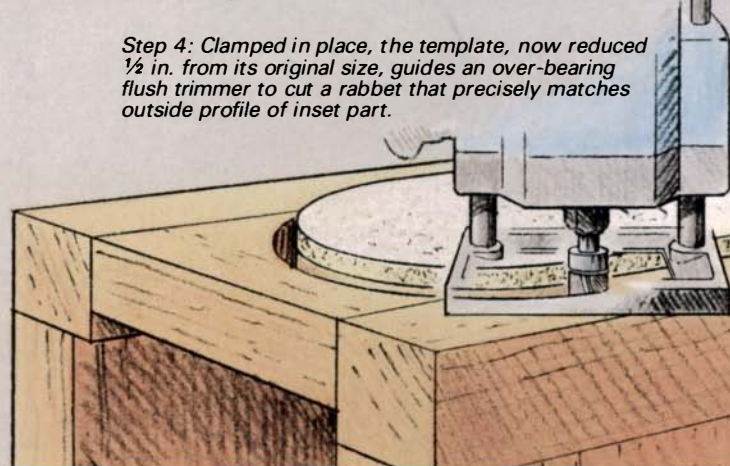
Step 2: To cut a matching rabbet in which to inset the part, the template was first rabbeted back 1/2 in.



Step 3: ... then flipped over and flush trimmed, with the rabbet's shoulder serving as the final profile.



Step 4: Clamped in place, the template, now reduced 1/2 in. from its original size, guides an over-bearing flush trimmer to cut a rabbet that precisely matches outside profile of inset part.



on a template, cut the next bearing surface with the first pass, pull out the template and work your way down. With this bit and some longer ones of my own live-dangerously manufacture, I cut most of the way through, then finished up from the other side with a conventional flush-trim bit guided by the new profile and, occasionally, with hand tools, drum sanders, or a 4-in. right-angle body grinder.

Slightly more complex were the three double-duty templates for the outside curves of the two cupboard doors, the side door, and a press-fit and glued-in frame at the face opening, which was later inscribed with the viney design around the face glass. First, the templates were used to flush trim the initial outside shapes of the doors and the viney frame. Then, the templates themselves were modified—reduced in size by 1/2 in. around their perimeters—to serve as guides to rout the openings into which the doors and frame would fit. I used the process shown in steps 2 and 3 of figure 2 to modify the templates. The first cuts of all inside curves were made with a 1/2-in. bit guided against the now-reduced template, with the outer edge of the cutters doing the work. On the carcase sides, the stiles had been spaced at glue-up to the final dimension, so the bit just grazed the wood there. All of the real cutting was confined to the inside sweep of the rails, and this method made it easier to fit corresponding parts to openings.

A watchful eye on the sequence ensured that nothing got cut away before its time, thus destroying a vital reference edge. To simplify the process, the paneled doors' center rail was half-lapped in from behind after glue-up. Like the horizontal pieces at the waist, the rail was set 1 in. back from the front plane, and eventually all planes were faired smoothly together. As shown in figure 2, this meant that some templates had to be shimmed up, and the bit hung down, to create a shoulder to guide subsequent cuts without the template.

After all the openings in the face and sides plus the profiles of the top and bottom had been routed, I cut a rabbet to hold the side door in flush. Prior to the vertical profile being put in the carcase, a slotting cutter was used from the still-flat face to waste rabbets for the side panels, face glass and side glass. The viney frame was glued into place, leaving a flush surface on the inside for the face glass to butt against. This step completed, all vertical profiles were cut using the same template. With the cabinet on its side or back, and with some of my homemade monster over-

bearing flush trimmers, I could still only rout so deeply. Thus, the forward flare of the cornice, as well as the side flares, had to be faired in with a 4-in. grinder and some serious-grit sandpaper.

By the time the doors were carved and the cabinet shaped, we had completed enough work to boost morale by sanding the door panels together. Meticulous tool marks had to be swallowed as "distractive," so I watched what I once considered a liberal sanding budget disappear on those two panels, along with my dreams of Nouveau riches.

With the cabinet now fully profiled and the cornice still open to suggestion, Danielle sputtered on the runway before launching herself into Krenovian mode. I finished carving around the face glass, fit moldings and hardware, and built a removable ventilated roof. Once the mounting of the light track inside the cornice and concealment of wires and transformer were all provided for, I had nothing left to do but follow Danielle's work with 80-grit sandpaper in my hand and tape on all my fingers.

As we edged over 500 hours, I was working alone when sanding mercifully came to an end—I had plasticized into character the cabinet's few remaining crisp edges. With help from the shop downstairs, we moved the cabinet to my living room where we discovered that it had become a roller coaster ride for the eye, with tension-filled climbs, exquisite agony over the top, swoops into energy and climbs back up again. We sank into postpartum depression, but the idea of getting paid swept us into the finishing stage. We intended nothing more than a premature aging until the mahogany could go its own natural way. This was accomplished in a round-about manner: the aniline-dye stain turned a panicky brick red and was brought back to gold by a wash of green-tinted sealer. A little brown Briwax toned it to an acceptable color, adding the shined-shoe patina I thought would fit the mood.

Into the windup, a smooth delivery and an honest pitch netted us some compensation for the hours we had surpassed the bid. The Gallè and Nancy glass glowed as never before under high-intensity spots. The cabinet emitted its own stately version of Art Nouveau liveliness. We glowed a little ourselves to know the Arts and Crafts movement was still alive and well in the 20th century, true to Walter Crane's aim of "turning our artists into craftsmen, and our craftsmen into artists." □

Terrie Noll builds one-of-a-kind furniture in San Francisco, Calif.

Art Nouveau Bing

Smithsonian show explores the birth of a style

by Gabriel Weisberg



Siegfried Bing's design movement attracted artisans from other European countries, not just France. His shop, *L'Art Nouveau*, engendered the decorative arts movement of the same name. At left, the Italian walnut buffet by French furnituremaker Eugène Gaillard is embellished with the carved foliage that came to typify the Art Nouveau style. It was made in 1900. The gilded wood étagère, right, was designed by Georges de Feure, a Dutch painter whose interests turned to furniture and ceramics, employed by Bing. The piece sold for 1,500 francs in 1900—then about \$288. Gaillard's walnut and leather dining room chair, facing page, is more restrained.



In France, the Industrial Revolution affected almost every level of manufacturing, from factories to cottage industries, creating in its wake a growing, prosperous middle class. Suddenly able to afford “luxury” items, members of this emerging group launched a search for *objets d’art* and other exotic items with which to adorn their homes. Their demand for something “new” in decorative arts opened the door to innovation in technique and design.

Yet design reform met intense resistance in France. Many saw the movement’s alliance of social and artistic reformers as a pernicious threat to the status quo, aided and abetted by such “unacceptable” elements as Jews, liberals and the *nouveaux riches*. At first, a stalemate prevented France from enjoying the florescence of arts occurring in other countries. In England, for example, William Morris and John Ruskin advocated a return to skilled workmanship. America, too, was experiencing an extensive arts-and-crafts movement. But it appeared that a powerful catalyst was needed to bring about change in France.

That catalyst took the form of an imaginative, German-born Parisian named Siegfried Bing—a man who firmly believed that a

new design aesthetic could be stimulated in France by applying the Japanese attitude that no distinction exists between major or minor, fine or applied, arts. Bing’s shop, *L’Art Nouveau*, eventually became identified not only with an innovative style that broke with past approaches, but also with the international decorative arts movement it engendered. This year, concurrent with revived interest in Art Nouveau, the Smithsonian Institution Traveling Exhibition Service has mounted an impressive exhibition of work produced by Bing’s shop. The photos on these pages show some of the furniture produced under his supervision.

After weathering the initially harsh criticism of his new aesthetic, Bing became successful enough to open his own atelier in 1899, hiring and directing craftsmen in the making of jewelry, furniture, carpets and ceramics. Some of the work was contracted out, but all of the furniture was produced on-premises. Bing’s atelier turned out both luxury objects for a select clientele and pieces that could be mass-produced for the less affluent. Bing claimed that his workshops aimed to create well-designed, utilitarian objects for the modest consumer, but his prices and level of perfection put his products out of the reach of any but the



rich and sophisticated. His best customers remained museums which—through public exhibitions—assisted Bing in exposing the public to the Art Nouveau style.

Changing tastes and a diminished demand closed Bing's atelier in 1904, but his efforts left a lasting mark. He had, after all, inspired design professionals of the day, proving that the applied arts in France could be the best in the world. Bing's belief that East and West shared aesthetic concepts placed him among the most significant design activists at the turn of the century. Only now, when Art Nouveau is judged more kindly, can the pioneering work of Bing and his artisans be assessed and appreciated for what it truly was—a revolution. □

*Gabriel Weisberg is a professor of art at the University of Minnesota. This article is adapted from his book, *Art Nouveau Bing, Paris Style 1900*, with permission from Harry N. Abrams, Inc. and the Smithsonian Institution. The exhibition can be seen at the Joslyn Art Museum in Omaha, Neb., until June 21, after which it will be at the Cooper-Hewitt Museum in New York City from July 21 to October 11.*



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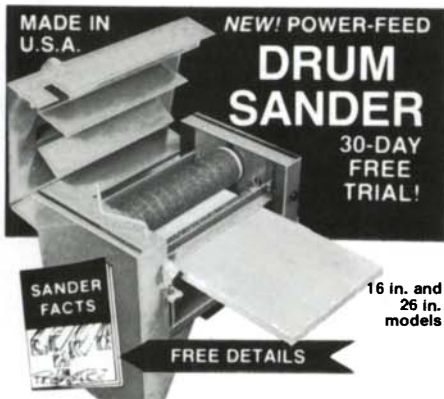


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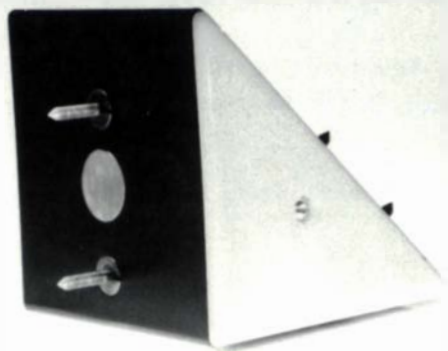
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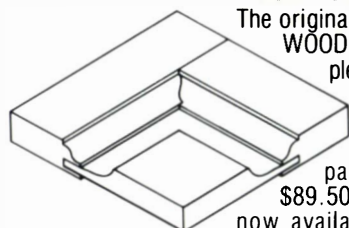
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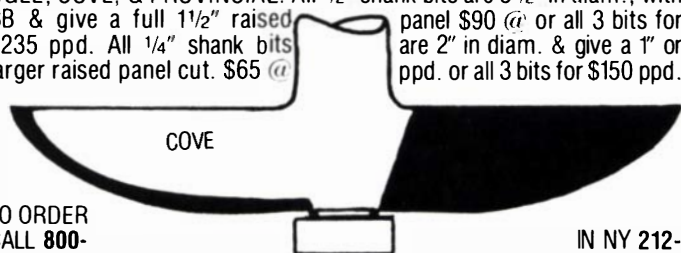
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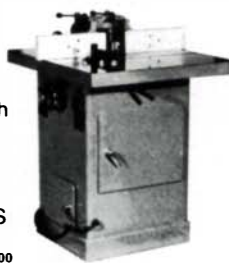


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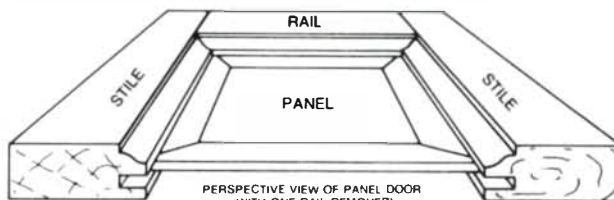
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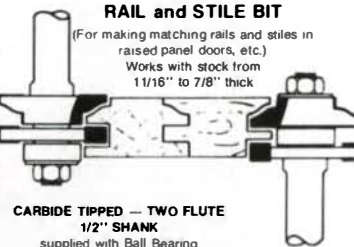


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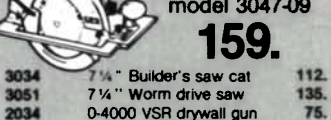
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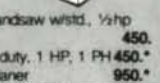


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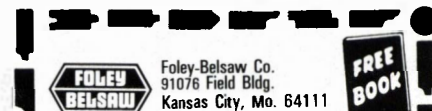
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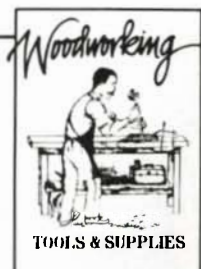
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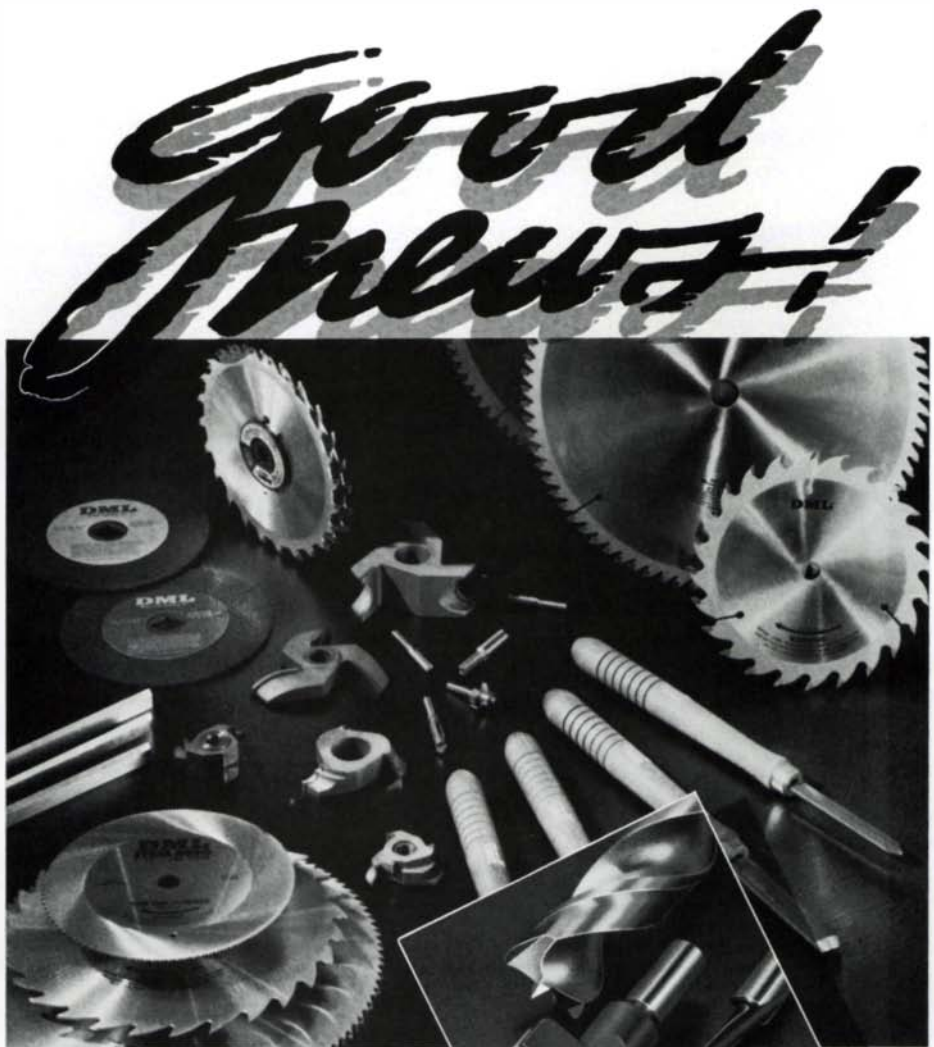
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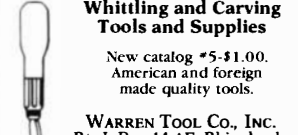
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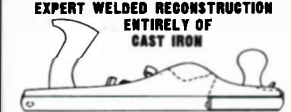


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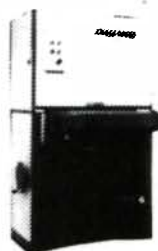
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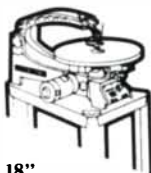


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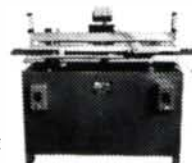
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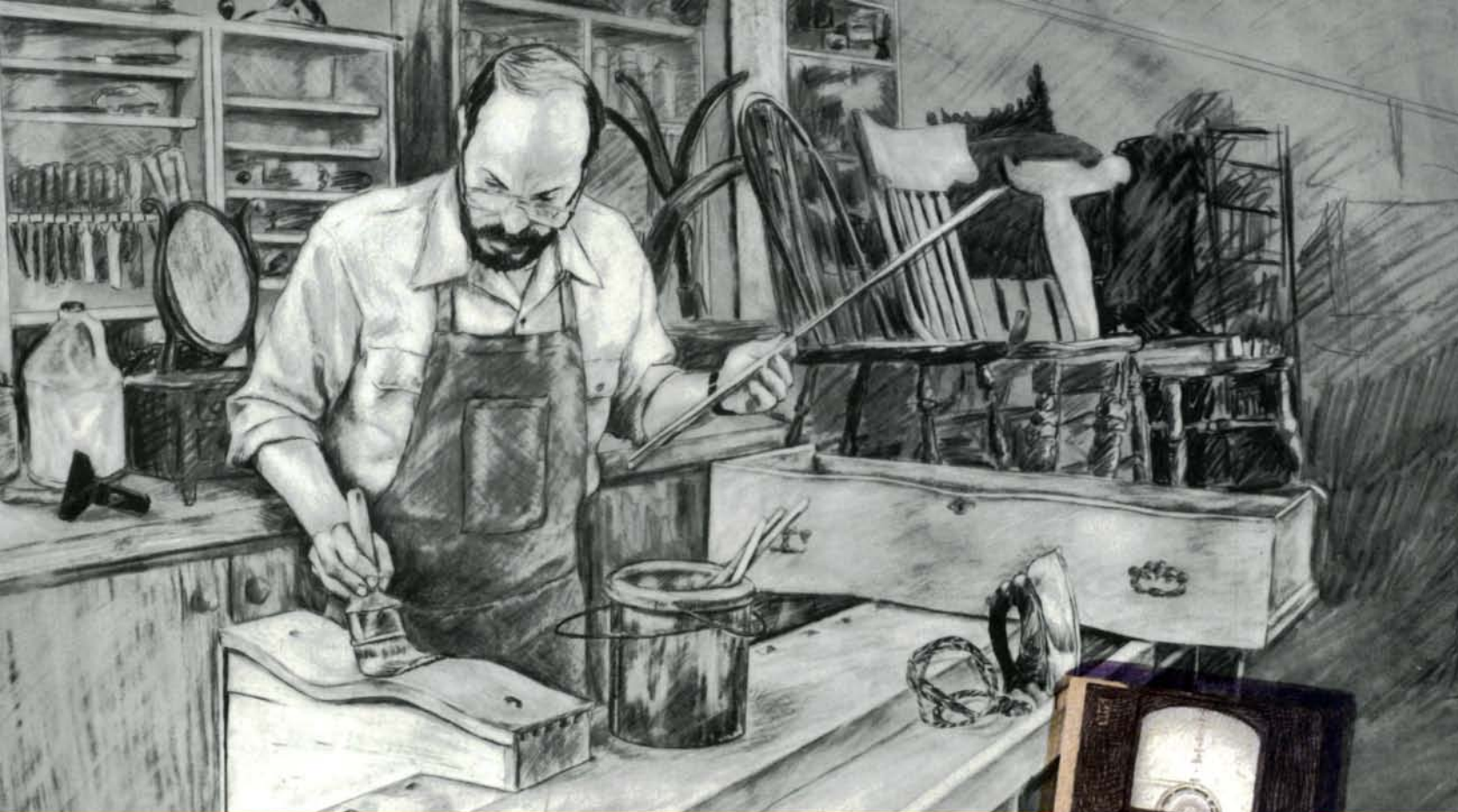
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You don't need extensive experience or an elaborate shop to repair your own furniture. You do need to understand glues and clamping techniques, and how to fix a piece so it won't suffer the same fate again. In our newest video workshop, furniture restoration expert Bob Flexner demonstrates a whole repertoire of straightforward techniques you can use to repair your furniture, and helps you decide which one is right for the job at hand. Flexner covers it all, from disassembling a piece safely and cleaning the surfaces for gluing, to clamping problem pieces, regluing or replacing damaged veneer, mending broken parts and matching missing moldings. With his instruction and the information in the accompanying booklet, those wobbly chairs and battered bureaus are as good as fixed.

70 minutes, \$29.95 postpaid (21-day rental: \$14.95)

VHS: Pub. #619 Beta: Pub. #620



To order from The Taunton Press, use the attached insert...

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In *Book 3: Furnituremaking*, Tage Frid shows you how to use the techniques from his earlier books to make some marvelous furniture of his own design. You'll find photos, instructions and working drawings for 18 different pieces—everything from Frid's distinctive three-legged stool to a grandmother clock. Frid also offers advice about designing furniture and a photo gallery of his work that will send you back to the shop with new ideas and enthusiasm.

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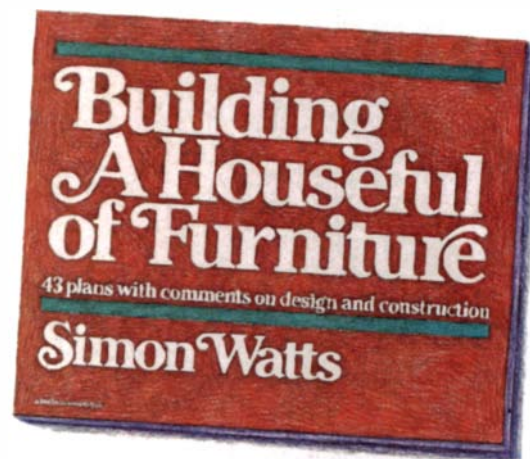
Three-book set: \$44.95 postpaid, Pub. #90



Simon Watts...

Cabinetmaker Simon Watts provides complete plans for 43 pieces he's designed—sturdy bed frames, handsome chests, tables, desks, bureaus, sofas and chairs. The pieces range in difficulty from turned stools that will develop a beginner's skills to an oval dining table that will challenge even an experienced furnituremaker. No matter what your own level of expertise, you'll appreciate the way Watts talks you through the tough spots in each project and explains the techniques he himself has used to do the work.

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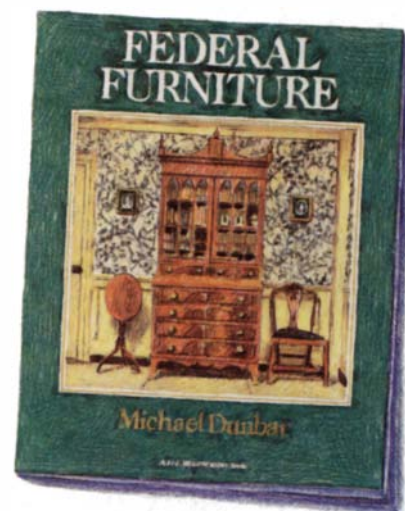


& Michael Dunbar

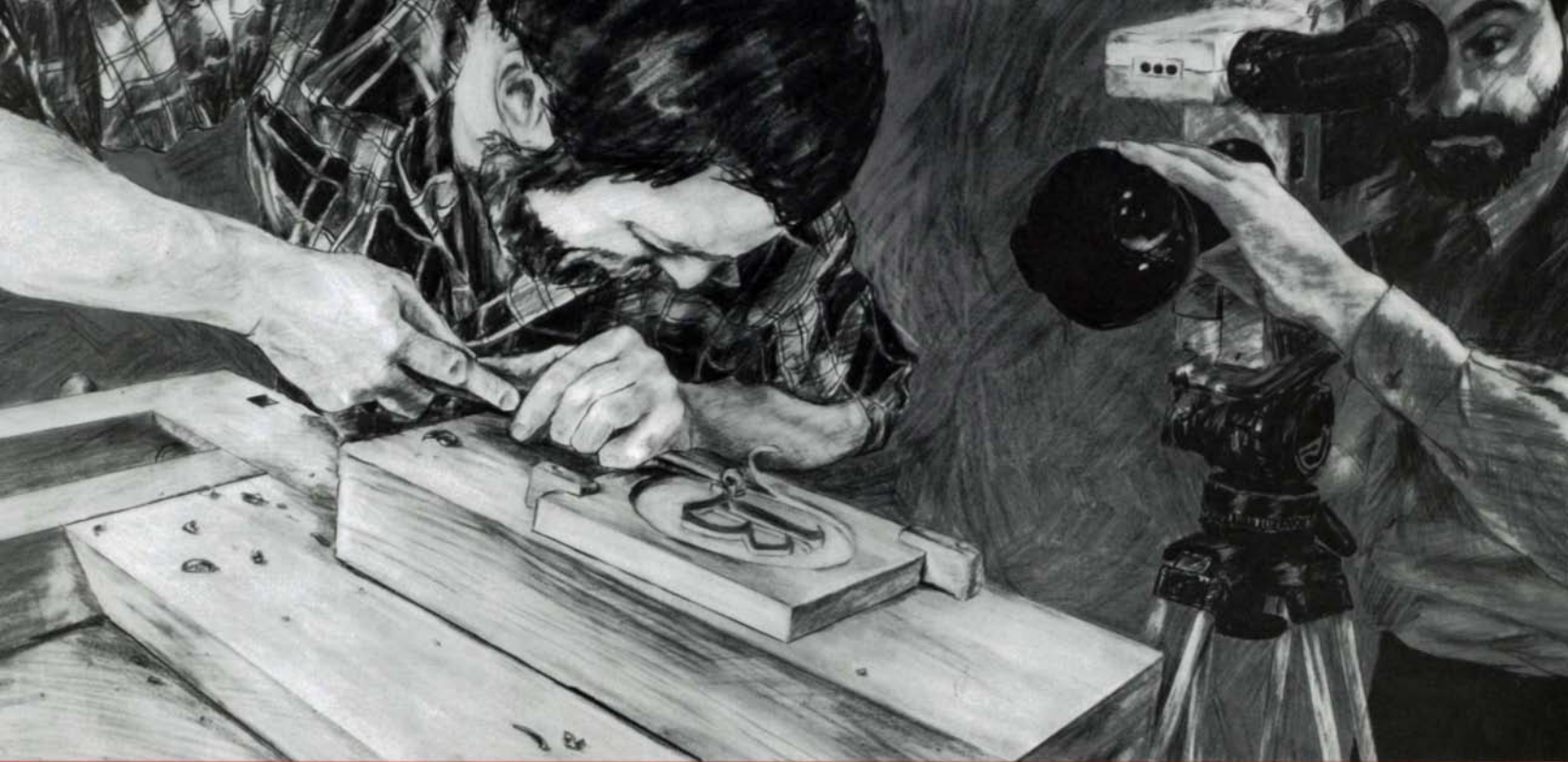
Period woodworker Michael Dunbar takes you into his home and workshop to show you how and why Federal furniture was made as it was, and how you can make it today. Among the 20 pieces he examines are a card table, candlestand, secretary, high-post bed and Hepplewhite and Windsor chairs. In each case, Dunbar provides measured drawings and construction tips, along with photos, drawings and step-by-step instructions for reproducing an aspect of the piece that is uniquely Federal.

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Dunbar's book on Windsor chairmaking is listed in the insert.



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60 minutes, \$29.95 postpaid (Rental: \$14.95)
VHS: Pub. #613 Beta: Pub. #614



Small Shop Tips and Techniques with Jim Cummins

Learn to use common machines to achieve uncommon results. Jim Cummins shares some of the tips and tricks he's discovered as associate editor of the *Methods of Work* column. (Booklet included)
60 minutes, \$29.95 postpaid (Rental: \$14.95)
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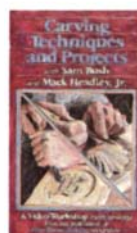
Making Mortise-and-Tenon Joints with Frank Klausz

Frank Klausz brings more than 20 years of cabinet-making experience before the camera to show you how to make haunched, through/wedged and angled mortise-and-tenon joints. (Booklet included)
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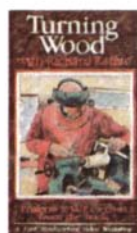
Router Jigs and Techniques with Bernie Maas and Michael Fortune

Bernie Maas demonstrates how to make the spline joint, the mortise-and-tenon and the sliding dovetail. Fortune shows you how to use a series of jigs to create a handsome hand mirror. (Booklet included)
60 minutes, \$29.95 postpaid (Rental: \$14.95)
VHS: Pub. #615 Beta: Pub. #616



Carving Techniques and Projects with Sam Bush and Mack Headley, Jr.

Sam Bush uses lettering to demonstrate gouge and chisel techniques. Mack Headley shows you how to carve that hallmark of 18th-century furniture, the classic scallop shell. (Booklet included)
90 minutes, \$29.95 postpaid (Rental: \$14.95)
VHS: Pub. #617 Beta: Pub. #618



Turning Wood with Richard Raffan

A companion to Richard Raffan's popular book, this video workshop covers tool sharpening, gouge and skew exercises and six complete projects—all keyed to pages in the book.
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Video/book set: \$49.95 postpaid, Pub. #99

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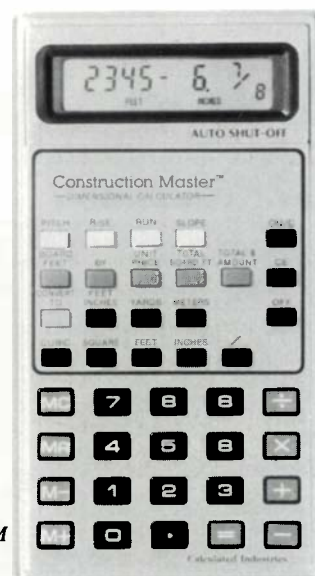
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Listings of gallery shows, major craft fairs, lectures, workshops and exhibitions are free, but restricted to happenings of direct interest to woodworkers. We'll list events (including entry deadlines for future juried shows) that are current with the months printed on the cover of the magazine, with a little overlap when space permits. We go to press two 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.

ARKANSAS: Show—Arkansas Ozarks arts, crafts and country antiques festival, May 1–3. Exhibitor space available. Contact Arkansas Ozarks Promotions, Box 1041, Bentonville, 72712.

CALIFORNIA: Workshops—Beginning & intermediate carving, Robert Fowler, June 15–26; tools & techniques, with James Krenov's staff, July 27–Aug. 21. Contact the fine woodworking program of the College of the Redwoods, 440 Alger St., Ft. Bragg, 95437. (707) 964-7056.

Workshops—Woodworking for women, beginners and advanced, traditional furnituremaking, focus on handtools. Contact Debey Zito, 103 Wool St., San Francisco, 94110. (415) 648-6861.

Show—Woodworking, machinery & furniture supply fair, June 16–19. Anaheim Convention Center. Contact Diane Stone, 1516 S. Pontius Ave., Los Angeles, 90025. (213) 477-8521.

Juried show—Sonoma County Woodworkers Assn. presents Artistry in Wood, May 3–31. Hand Goods Gallery, Main & First Sts., Occidental. Weekend demonstrations. Free. Contact John Shipstad, SCWA, Box 4124, Santa Rosa, 95402. (707) 874-2161.

Juried show—American Craft Council's Pacific States crafts fair, Aug. 5–9. Piers 2 & 3, Fort Mason Ctr., Bay & Laguna Sts., San Francisco. For trade only, Aug. 5–6; open to public, Aug. 7–9. General admission: \$4.

COLORADO: Workshops—Anderson Ranch Arts Center summer program. Frid, Hucker, Kopf, Maloof, Maruyama, Peters and more. Contact Peter Korn, A.R.A.C. Box 5598, Snowmass Village, 81615. (303) 923-3181. Juried show—4th annual "Art of Crafts" sale and juried exhibition, July 16–19. Denver Art Museum, 100 W. 14th Ave. Pkwy., Denver, 80204. Contact Lora Witt, (303) 575-5929.

CONNECTICUT: Exhibition—30th annual Guilford Handcrafts Expo, July 16–18. Guilford Green, Guilford. Hours: 12–9 daily. Admission: \$2. Children under 12 free. Contact Guilford Handcrafts Ctr., 411 Church St., Guilford, 06437. (203) 453-5948.

Show—Featuring the works of 100 artists and craftspeople, May 3–23. Mill Gallery, Guilford Handcrafts Ctr., 411 Church St., Guilford, 06437. In celebration of the Guilford Handcrafts Expo's 30th anniversary. (203) 453-5947.

Seminar—Wood finishing, Pat Devine, April 26. The Fine Tool Shops, 20 Backus Ave., Danbury, 06810. (203) 797-0772.

DELAWARE: Seminar—Inca demonstration, May 9. Holiday Inn, Dover. Contact Olde Mill Cabinet Shoppe, RD#3, Box 547-A, York, PA 17402. (717) 755-8884.

DISTRICT OF COLUMBIA: Juried exhibition—Washington craft show, Apr. 24–26. Departmental Auditorium, 1301 Constitution Ave. N.W., Washington, 20036. (202) 357-2700.

IDAHO: Juried show—19th annual "Art on the Green," July 30–Aug. 2; outdoor show. North Idaho College campus. Entry deadline: July 23. For entry blanks, contact Citizens Council for the Arts, Box 901, Coeur d'Alene, 83814.

ILLINOIS: Juried show—8th annual Fountain Square arts festival, June 27–28; outdoor show. Contact Evanston Chamber of Commerce, 807 Davis St., Evanston, 60201. (312) 328-1500.

Seminars—Routers, May 11–12; finishing, May 13–14; tablesaws, May 15–16; hand-tool woodworking, May 18–20; basic cabinetmaking, May 21–23. Write Program Registration, College of Continuing Education, Adams Hall, Rm. 131, Northern Illinois Univ., DeKalb, 60115. (815) 753-1454.

Expo—Woodland Expo, Oct. 2–3; forestry products, equipment and machinery. DuQuoin State Fair Grounds, DuQuoin. Exhibitors should apply by July 1. Contact Marie Malinauskas, Div. of Continuing Education, Southern Illinois University, Carbondale, 62901. (618) 536-7751.

Exhibition—"Tuning the Wood," a display of the works of Illinois luthiers. State of Illinois Art Gallery, Illinois Center, Chicago, May 26–July 3; Dickson Mounds Museum, Lewistown, Aug. 2–Sept. 13; University Museum, Carbondale, Sept. 28–Nov. 8; Illinois State Museum, Springfield, Nov. 21–Jan. 10. Contact Terry Suhre, Illinois State Museum, Springfield, 62706. (217) 782-7386.

EXHIBITION: Wood mosaic portraits by Tom Robinson, May 24–June 15. NAB Gallery, 331 S. Peoria, Chicago, 60607. (312) 733-0886.

Workshops—Furniture conservation, Mervin Martin, Aug. 3–7; conservation of gilt wood, Deborah Bigelow, July 7–10; conservation of transparent coatings, Gregory Landry, July 13–17; veneers, veneering & surface decoration, Robert Walker, July 6–10; furniture conservation & treatment, James Wermuth, July 6–10. \$75/course. Campbell Ctr. for Historic Preservation Studies, Box 66, Mount Carroll, 61053. (815) 244-1173.

INDIANA: Exhibition—Country Collections: A Gathering of Folk Artists and Craftsmen, May 30–31. The Breeding Farm (country roads 800 N. & 100 W.), north of Columbus. Sponsored by Bartholomew County Historical Society. Contact the Society at (812) 372-3541. Juried show—Madison Chautauqua of the Arts, Sept. 26–27. Slide deadline: June 15. Booth fee: \$55–\$100. For application, send SASE to Madison Chautauqua of the Arts, 1119 W. Main St., Madison, 47250.

IOWA: Exhibition—Holzfest '87, Aug. 15–16. Colony Village Restaurant, Amana. Demonstrations, wood exhibits, craft show, woodchoppers' ball, entertainment. Free. Contact Personalized Wood Products, Inc., Box 193, Amana, 52203.

KENTUCKY: Symposium—Woodturning, joinery, sharpening, Jim Hall, Ersal Kindel, Sanford Hill; June 11–13. Contact Sanford Hill, CPO 802, Berea College, Berea, 40404. (606) 986-9341, ext. 5504.

MAINE: Exhibition—2nd annual wildlife carving & art festival, Aug. 1–2. Samoset Resort, Rockport. Contact Dick Knotts, Maine Wildlife Woodcarvers Assn., 5 Hillcrest St., Waterville, 04901. (207) 873-2609.

MARYLAND: Juried shows—10th annual spring crafts festival, May 1–3, Maryland State Fairgrounds, Timonium. For information, send three stamps (66¢) for postage to Deann Verdier, Dir., Sugarloaf Mountain Works, Inc., 20251 Century Blvd., Germantown, 20874. (301) 540-0900.

Juried show—Artscape '87, July 17–19. For information, send SASE to Crafts—Artscape '87, c/o Mayor's Advisory Committee on Art and Culture (MACAC), 21 South Eutaw St., Baltimore, 21201. (301) 396-4575.

MASSACHUSETTS: Exhibition—Worcester Craft Center's 17th annual craft fair, May 15–17. Contact Craft Fair Registrar, Worcester Craft Center, 25 Sagamore Rd., Worcester, 01605. (617) 753-8183.

Exhibition—New England crafts, July 10–12. Hancock Shaker Village, Rte. 20, Box 898, Pittsfield, 01202. Admission to fair includes entrance to village; \$6 adults, \$2 children, \$5.50 students and seniors, \$15 family. Contact Joan Clemons, (413) 443-0188.

Exhibition—8th annual dollhouse and miniature show & sale, Aug. 16. Sheraton Hyannis Banquet Hall, Rte. 132, Hyannis. 10–5. Admission: \$2.50. Free parking. Contact Gordon Harris, Cape Cod Miniature Society, Box 1596, Orleans, 02653. (617) 255-3216.

Workshops/seminars—Numerous events. Contact The Woodworkers' Store, 2154 Massachusetts Ave., Cambridge. (617) 497-1136.

Workshops—Spring woodworking workshops at Horizons. Woodbending thru lamination, John Tierney, April 25; mask making, David Holzapfel, April 26. Contact Jane Sinauer, New England Craft Program, Snow Farm, Hyde Hill Rd., Williamsburg, 01096-9710.

Workshops—Finish carpentry, May 11–15. Heartwood Owner-Builder School, Johnson Rd., Washington, 01235. (413) 623-6677.

Workshops—Sponsored by the Cape Cod Miniature Society, Aug. 15. Reservations required. For info, send SASE to Box 691, Hyannis, 02601.

Summer classes—One- and three-week woodworking sessions for high school students. Contact Horizons, New England Craft Program, 374 Old Montague Rd., Amherst, 01002. (413) 549-4841.

MICHIGAN: Juried show—28th annual national fine arts and crafts fair, July 22–25. Contact Ann Arbor Street Art Fair, Box 1352, Ann Arbor, 48106.

MINNESOTA: Workshops/seminars—Numerous events. The Woodworkers' Store, 3025 Lyndale Ave. S., Minneapolis. (612) 822-3338.

Workshop/show—Woodturning workshop, Liam O'Neill, June 5–6. Also, woodturning show, June 1–July 5; Grand Avenue Frame & Gallery. Contact Minnesota Woodturners Assn., Box 26065, Shoreview, 55126.

Workshop/show—Relief carving, animal carving, caricatures, Aug. 9–15. Contact Villa Maria Wood Workshops, Box 37051, Minneapolis, 55437.

NEVADA: Exhibition/sale—3rd annual Miniature Clubs of Northern Nev. show & sale, May 30, 10–5; May 31, 11–5. Bally Grand Hotel, Reno. Contact Mary Shipp, (702) 826-2959.

NEW HAMPSHIRE: Seminars/workshops—14th annual violin craftsmanship summer institute, June 8–Aug. 21. University of New Hampshire, Durham. Bow

making, bow/violin maintenance & repair, violin building & varnishing. Karl Roy, Hans Nebel, William Salchow, Arnold Bone. Contact 1987 Violin Craftsmanship Institute at the University of New Hampshire, Div. of Continuing Education, 24 Rosemary Lane, Durham, 03824. (603) 862-1088.

NEW JERSEY: Exhibition—8th annual craft exhibition and sale, June 13–17, all media. Contact Craft Concepts, Jewish Community Center, 501 North Jerome Ave., Margate, 08402.

Workshops—1987 summer wood program, Peters Valley. Wood technology, Bruce Hoadley, June 13–14; gifts, Bob Matern, June 20–21; how to make a Shoji, Toshio Odate, June 27–28; Shaker oval boxes, John Wilson, July 3–8; decorative sign carving, Terry Wolff, July 11–13; creating in wood, John Hart, July 16–19; handcut dovetails, David van Hoff, Aug. 1; classic carving, Michael DeNike, Aug. 6–9; spindle turning, David van Hoff, Aug. 12; making bowls and vessel, Bob Matern, Aug. 15–16; post and rung chairmaking, Peter Touhey, Aug. 20–25; bending wood, James Hutchinson, Aug. 29–31. Limited live-in accommodations. Contact Peters Valley Craft Ctr., Layton, 07851. (201) 948-5200.

NEW MEXICO: Exhibition—Functional wood sculptures, Daniel Secor, July 12–25. Contemporary Craftsman Gallery, 100 W. San Francisco St., Santa Fe, 87501. (505) 988-1001.

NEW YORK: Workshops—Small projects, Japanese hand tools. The Lutherie, 2449 West Saugerties Rd., Saugerties, 12477. (914) 246-5207.

Workshops—Woodworking and furniture design, Michael Fortune, July 20–Aug. 5; wood, Michael Fortune, Aug. 6–21. Elective or 3 credits. RIT Summer Sessions, Rochester Institute of Technology, One Lomb Memorial Dr., Box 9887, Rochester, 14623-0887.

Workshop—Boatbuilding, Simon Watts, Aug. 8–15. Contact Laurie Rush, Thousand Islands Shipyard Museum, 750 Mary St., Clayton, 13624. (315) 686-4104.

Seminars—Product liability, contracts, legal aspects of copyrighting, trademarks & licensing, May 14; "homework" legislation with team from NYS Dept. of Labor, May 15; labeling laws, May 26. Contact Office of Continuing Education, North Country Comm. College, Box 89, Saranac Lake, 12983. (518) 891-2915.

Show/workshops—Woodworking machinery, supplies, tools, workshops and seminars, May 1–3. Rockland County Community College Field House, 145 College Rd., Suffern. Contact Marketing/Assoc. Services, (800) 826-8257; in Calif. (213) 477-8521.

Exhibition/sale—American crafts, May 1–3. 7th Regiment Armory, Park Ave., N.Y.C. Contact Carol Sedstrom, American Craft Enterprises, (914) 255-0039.

Exhibition—Southtowns Woodcarvers 10th annual, May 2–3. Erie County Fairgrounds, Hamburg. Contact Bernie Schenk, (716) 632-5149.

Exhibition—Sculptural wood, Garn Menapace/Frank Sabatino, thru May 11. The Gallery at 15 Steps, Clinton Hall, 114 N. Cayuga, Ithaca, 14850. (607) 272-4902.

Exhibition—11th annual American crafts festival, July 4, 5, 11, 12. Lincoln Center for the Performing Arts, N.Y.C. Contact American Concern for Artistry and Craftsmanship, Box 650, Montclair, NJ, 07042.

Exhibition—Selections from the permanent collection, thru Jan. 3, 1988. American Craft Museum, 40 W. 53rd St., N.Y.C. Sculptural and functional objects in wood, clay, metal, glass, fiber, mixed media dating from 1945. Tues. 10–8; Wed.–Sun., 10–5. Admission: \$3.50 adults; \$1.50 students & seniors. (212) 956-3535.

Juried shows—Woodstock-New Paltz spring arts & crafts show, May 23–25; fall show, Sept. 5–7. Ulster County Fairgrounds, New Paltz. Contact Scott & Neil Rubinstein, Quail Hollow Events, Box 825, Woodstock, 12498. (914) 679-8087 or 246-3414.

Juried show—Crafts, July 3–5; Aug. 7–9. Slide deadline: May 1. Entry fee: \$5. For application, send SASE to Gale Svenson, Chautauqua Crafts Festival, Box 89, Mayville, 14757.

Juried show—Crafts: National II, Sept. 9–Oct. 8. Buffalo State College. Sponsored by State University of New York. Faculty of Arts and Humanities. Entry fee: \$20 (maximum three entries). Deadline: June 1. Contact Chair, Design Department, Buffalo State College, 1300 Elmwood Ave., Buffalo, 14222; (716) 878-6032.

Juried show—Arts and crafts, Sept. 19. Rye Art Center. Contact Janet Levine, Rye Art Center, Box 582, Rye, 10580. (914) 967-0700.

Auction—To benefit Museum of Folk Art, May 27. Christ's, Park Ave. & 59th St., N.Y.C. Contact Carolyn Cohen Zelikovic, (212) 481-3080.

NORTH CAROLINA: Juried shows—Series of juried shows sponsored by High Country Crafters, Inc., 29 Haywood St., Asheville, 28801. 12th annual Highland Heritage Art & Craft Show, June 11–13, Asheville; 4th annual High Country Art & Craft Show, July 3–5, Scaly Mtn.; 8th annual Summerfest Art & Craft Show, Aug. 14–16, Asheville Civic Center. Send legal SASE for more information. (704) 254-0072.

Workshops—Greenwood chairmaking, Drew Langsner, July 27–31; Windsor chairmaking, Curtis Buchanan, Aug. 9–14; white oak basketry, Rachel Nash Law, Aug.

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OHIO: Juried show—Great Lakes woodcarving exhibition, June 13-14. Contact Kathy Holsopple, Parma Woodcarvers Guild, 90 Berwyn Dr., Bedford, 44146. (216) 232-0985.

Juried show—Indian Summer Festival; crafts, all media. Washington County Fairgrounds, Marietta, Sept. 18-20. Slide deadline: May 9. Contact Tanya Wilder, (614) 373-8027.

Workshop—Woodworking equipment maintenance & repair, June 8-13. College of Technology, Bowling Green State University, Bowling Green, 43403. Call (419) 372-8181.

Demonstrations—Traditional use of hand tools, July 18; Aug. 22. Richards' Cabinetry & Mill Co., 410 W. Harrison St., Lewisburg, 45338. (513) 962-4788.

OKLAHOMA: Juried show—11th annual national woodcarving show, July 10-12. Kensington Galleria, 71st & Lewis, Tulsa. Contact Charles Meeks, Eastern Oklahoma Woodcarvers Assn., 2676 S. Richmond, Tulsa, 74114. (918) 742-4284.

OREGON: Exhibitions—Numerous shows, exhibitions. The Gallery, World Forestry Center, 4033 S.W. Canyon Rd., Portland, 97221. (503) 228-1367.

Exhibition—Fine handcrafted furniture, July 12-Aug. 8. Contemporary Crafts Gallery, 3934 S.W. Corbett Ave., Portland, 97201. (503) 223-2654.

Workshops—Numerous classes, through June 6; register early. Oregon School of Arts and Crafts, 8245 S.W. Barnes Rd., Portland, 97225. (503) 297-5544.

PENNSYLVANIA: Juried show—9th annual Long's Park art & craft festival, Sept. 5-7. Deadline: June 1. Entry fee: \$10. Send SASE to Dick Faulkner, Long's Park Arts and Craft Festival, Box 5153, Lancaster, 17601.

Juried show—3rd annual woodcarving show, July 11-12. Sawmill Arts Ctr., Cook Forest State Park, Cooksburg, Open to all carvers. Contact Marilyn Karns, 315 Cowell Ave., Oil City, 16301; after June 15, contact Sawmill Arts Center, Box 6, Cooksburg, 16217.

Juried show—18th annual Fair in the Park, Sept. 11-13. Mellon Park, Pittsburgh. Slide deadline: June 22. Entry fee: \$5. Contact Craftsmen's Guild of Pittsburgh, Box 10128, Pittsburgh, 15232.

Juried show—Contemporary crafts, Oct. 3-Nov. 1. Luckenbach Mill Gallery, Bethlehem. Application deadline: June 5. Contact Janet Goloub, Historic Bethlehem Inc., 501 Main, Bethlehem, 18018. (215) 691-5300.

Juried show—Sponsored by Conestoga Valley Chapter of the PA Guild of Craftsmen, Oct. 4-25. Market House Craft Center Gallery. Slide deadline: Aug. 12. Entry fee: \$5. Send SASE to John Ground, Market House '87 Gallery, Box 552, Lancaster, 17603.

Classes—Woodcarving in relief, Larry Groninger, July 6-10; woodcarving in the round, Robert Butler, July 13-17; bird carving, Wayne Edmondson, Aug. 3-7. Sawmill Arts Ctr., Cook Forest State Park, Cooksburg. Thru June 15, contact Marilyn Karns, 315 Cowell Ave., Oil City, 16301. After June 15, contact Sawmill Arts Center, Box 6, Cooksburg, 16217.

Workshop—Basic woodturning, Dale Nish, May 14-16. Continuing Education Dept., Millersville University, Millersville, 17551. Contact Grace Evans, (717) 872-3030.

Workshops—Bird carving, Larry Barth, July 3-4; woodturning, Nick Cook, July 13-18; furniture design & construction, Mark Ragonese, July 20-Aug. 1; wood sculpture, Thad Mosley, Aug. 3-8. Contact Pioneer Crafts Council, Touchstone Crafts Ctr., Box 2141, Uniontown, 15401. (412) 438-2811.

Seminar—Japanese joinery with Toshio Odate, May 15-17. Olde Mill Cabinet Shoppe, RD 3, Box 547-A, York, 17402. (717) 755-8884.

Exhibition—Wharton Esherick Museum, sculpture, furniture, utensils from 1920-1970, daily. For reservations or directions, write or call The Wharton Esherick Museum, Box 595, Paoli, 19301. (215) 644-5822.

TENNESSEE: Show—Master furnituremakers' show, Apr. 24-26. Sponsored by Dogwood Arts Festival, 203 Fort Hill Building, Knoxville, 37915. Contact Carol Evans (615) 637-4561.

Juried show—Spotlight '87, Oct. 15-Dec. 12. American Craft Council Southeast Assembly. Slide deadline: July 14. Entry fee: \$15. Contact Spotlight '87, Arrowmont School of Arts & Crafts, Box 567, Gatlinburg, 37738.

Workshops—Summer courses at Arrowmont, many one- and two-week sessions. Woodturning, Liam O'Neill, June 8-12; turning hollow vessels, David Ellsworth, June 15-19; intermediate/advanced woodturning, Del Stubbs, June 22-26; basic woodturning, Nick Cook, June 29-July 10; laminated & staved wood ves-

sels, Ray Ferguson, July 13-17; woodworking, John McNaughton, July 20-31. Arrowmont School of Arts and Crafts, Box 567, Gatlinburg, 37738. (615) 436-5860.

VIRGINIA: Juried show—7th annual Virginia crafts festival, Sept. 18-20. Prince William County Fairgrounds. For information, send three stamps (66¢) to Deann Verdier, Sugarloaf Mtn. Works, Inc., 20251 Century Blvd., Germantown, MD 20874. (301) 540-0900.

Juried show—12th annual craft show, Nov. 20-22. Richmond Convention Centre. Slide deadline: June 1. Entry fee: \$10. Contact Hand Workshop, 1812 W. Main St., Richmond, 23220. (804) 353-0094.

WASHINGTON: Workshops/demonstrations—Tools-In-Action series, free, every Saturday, 10 A.M. Boatbuilding, woodcarving, sharpening, other woodworking topics. The Wooden Boat Shop, 1007 N.E. Boat St., Seattle, 98105. (206) 634-3600.

WEST VIRGINIA: Workshops—Augusta Heritage Arts Workshop, one- to three-week sessions, beginning to advanced, July 12-Aug. 14. Log construction, Peter Gott; white oak basketry, Bill Cook & Rachel Nash Law; guitar and mandolin construction, Wayne Henderson; Shaker oval boxes, John Wilson. Tuition \$160-\$170/week. Contact Augusta Heritage Center, Davis & Elkins College, Elkins, 26241. (304) 636-1903.

CANADA: Conference/workshop—1st Canadian national woodturning conference, Aug. 1-3. Francois Lambert, Wayne Hayes, Ron David, Michael Hosaluk, Leon Lacoursiere, Chris Scheffers, Giles Blais. Registration fee: \$100. Contact Saskatchewan Craft Council, Box 7408, Saskatoon, Sask., Canada, S7K 4J3. (306) 653-3616.

CHINA: Trip—Woodworkers' tour of China, June '87. Some openings still available. Contact George Frank, (813) 497-2503.

ENGLAND: Seminar—British seminar on woodturning, Aug. 14-16. David Ellsworth (USA), Ed Moulthrop (USA), Ray Key (England), Mick O'Donnell (Scotland), Jim Partridge (England). Loughborough College of Art & Design, Loughborough, Leicestershire. Contact American Association of Woodturners, Box 982, San Marcos, TX 78867, or Margaret Lester, Administrator, 5 Bridport Road, Beaminstor, Dorset DT8 3LU, England.

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The Practice of Woodturning by Mike Darlow. *The Mela-leuca Press, 20A City Road, Chippendale NSW, Australia, 2008; 1985. Available through Woodcraft, 41 Atlantic Ave., Woburn, MA 01888 and Craft Supplies USA, 1644 S. State St., Provo, Utah 84601; \$19.95 plus \$2.50 shipping and handling, hardcover; 353 pp.*

One problem with learning to turn from a book is the absence of motion on the printed page. Video tapes don't have this shortcoming, but they share with books the built-in limitations of representing a three-dimensional craft in two dimensions. Until someone publishes a pop-up turning book, we beginners and semi-experienced devotees will have to settle for lots of fancy arrows that almost, but never quite, reveal depth.

Mike Darlow's *The Practice of Woodturning* is an ambitious, well-organized attempt to pass on his considerable knowledge of the subject. While the book has its share of depth-defying arrows and in-depth explanations of technical matters, it also deals with practical considerations: "...efficient turning depends on using the minimum number of tools the minimum number of times." And: "to minimize sanding...a basically good surface with projections is preferred to an apparently smoother surface that has depressed damage. The distinction is a fine one, but it lies at the very heart of our turning process."

The technical drawings in this volume are, for the most part, very clear and to the point. Unfortunately, many of the photographs are less successful. They are poorly reproduced, mostly muddy and frequently enlarged to fill the page when a much smaller image would have served the purpose.

Darlow explores a variety of subjects. They include: wood, design, the lathe and its accessories, workshop procedures, plus spindle, faceplate and cupchuck turning. For those of us amateurs who can't seem to get enough cutting tool talk—especially grinding angle theories—Darlow may have come close to sating our appetites. As a bonus, there are several intriguing devices in the book, such as two adjustable rim-grabbing chucks and an unusual homemade driving center. In addition, the book includes photos of Darlow's work—some whimsical, some more conventional.

Despite some minor reservations, *The Practice of Woodturning* is a commendable book—an important addition to the rapidly expanding literature on turning. —**Ross Lowell**

The Wood Handbook for Craftsmen by David Johnston. *Arco Publishing, Inc., 215 Park Ave. S., New York, N.Y. 10003; 1983. \$19.95, hardcover; 168 pp.*

The Wood Handbook for Craftsmen might best be described as a very ambitious book. In this work, David Johnston presents the structure and properties of hardwoods and softwoods, offering detailed discussions of wood defects, seasoning and storage methods, sanding and finishing, preservatives, glues, processed wood products and veneers, and more. The author also explores why certain woods are preferred for certain purposes. And—just for good measure—Johnston goes on to provide technical descriptions of more than 100 cabinetwoods, complete with endgrain macrophotos to aid in species identification.

The fact that Johnston has done an intelligible, informative job at pulling this off—in a mere 168 pages—is a tribute to his command of the subject. No doubt about it, he tackles every wood-related topic factually and authoritatively. For instance, his description of the cellular anatomy of wood, along with the organic purpose of this structure, is the best I've seen. It is beautifully crisp and clear, requiring little or no technical background on the part of the reader.

If anything, this book suffers *because* of its unwavering

organization and precision. Johnston wastes no time entertaining the reader with anecdotes or suppositions. It is a no-nonsense treatment of a vast subject, with a certain textbook seriousness that makes it impossible to skim. But if you come to it with a serious desire to learn, Johnston's book is pleasantly readable—despite the fact that it was written for a British audience. Johnston is careful to provide both English and metric equivalents when discussing measurements, and has obviously tried to make the book useful to woodworkers worldwide.

However, American readers should be aware of one genuine drawback of Johnston's book: the author concentrates on species of wood more commonly available in Europe than in the States. Nonetheless, the author provides enough coverage of imported tropical woods available on both sides of the Atlantic to render the information useful, although not nearly as well-targeted to the American audience as is Bruce Hoadley's *Understanding Wood* (The Taunton Press, 1980).

Indeed, this book and Hoadley's cover essentially the same topics. If I could only own one, I'd opt for Hoadley. Happily, no such choice is necessary, and I would recommend both books to fellow woodworkers who have more than a passing interest in wood technology and species identification. —**Jon Arno**

Scroll Saw Handbook by Patrick Spielman. *Sterling Publishing Co., Inc., Two Park Ave., New York, N.Y. 10016; 1986. \$12.95, paperback; 256 pp.*

Spielman's latest book is terrific, everything a book of this sort should be. He begins by reviewing the types of scroll saws, comparing the good and bad points of rigid-frame saws, with their straight-up-and-down blade action, and the "walking-beam" type, with orbital blade travel. He then warns about a number of general things to watch out for, such as saws that tattoo your fingers when the blade breaks, and saws that have a 45° tilt scale but won't tilt more than 35°. This sort of advice is invaluable, and I only wish that Spielman had named names here—it's up to the reader to examine each saw described and to read between the lines in isolating the dogs.

In addition to a good section on blade selection, *Scroll Saw Handbook* provides a wonderful variety of cutting techniques and clever tips. If you own a scroll saw, I think you'll find Spielman's tips absorbing. If you're contemplating buying a saw, buy this book first. By the way, Spielman has also co-authored *Scroll Saw Pattern Book*, a companion volume that offers more than 450 easy-to-copy patterns and projects. —**Jim Cummins**

Making Whirligigs & Other Wind Toys by Sharon Pierce. *Sterling Publishing Co., Inc., Two Park Avenue, New York, N.Y. 10016; 1985. \$8.95 (\$11.95 Canada), paperback; 128 pp.*

What's a whirligig? It's a figure with paddle-type arms that spin in the wind. The harder the wind blows, the faster the figure paddles. But the real trick to making a whirligig work (other than the availability of a good, stiff breeze) is to get the paddles balanced and friction-free. Sharon Pierce tells how this essential balance is achieved, and discusses how to position the paddles so that the wind hits them just right. Instructions, material/tool lists and transferrable patterns are included. Beginning woodworkers should find this book a good source for some interesting and fun-to-make projects. —**Nancy Knapp**

Ross Lowell, an amateur woodworker, is a director and inventor/manufacturer of photographic lighting equipment. Jon Arno is an amateur wood technologist and woodworker in Brookfield, Wisc. Jim Cummins is an associate editor of FWW. Nancy Knapp is a system operator for The Taunton Press.

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Nakashima's peace altar

George Nakashima stands over the completed Altar for Peace at his shop in New Hope, Penn. After numerous logistical and technical difficulties were overcome, the altar was donated to the Cathedral of Saint John the Divine in New York City, and dedicated in a concert for peace on New Year's Eve.



Resting in the dim spaciousness of the Cathedral of St. John the Divine in New York City is an extraordinary wooden altar, dedicated to the idea of peace on Earth. Stationed at the foot of a huge stone pillar, the altar is an imposing presence: two huge walnut slabs astride a geometric base. With their natural edges left intact, each slab is joined by the butterfly keys that have become a signature of the altar's designer, George Nakashima.

For Nakashima, the altar is an embodiment of deeply held beliefs—in particular, an expression of concern for world peace. "The most telling concept of our age is what to do with the future," he says. He envisions the altar as a place to pray for peace, and hopes that someday it will serve as a terminus for peace marches like those held yearly in Nagasaki, Japan—the city devastated by an atomic bomb blast that ended World War II.

Several years ago, Nakashima acquired a huge black walnut log from Connecticut—a log which, eventually, yielded two huge slabs, each weighing in at about 1,400 lb. Nakashima had seen plenty of walnut in his day, but this was the best he'd encountered. "I felt [the log] had to be used for something quite special." Soon after, a dream Nakashima had while hospitalized inspired him to build the altar.

Giving trees a second life in furniture has been Nakashima's goal for half a century. "Each plank... can have only one ideal use. The woodworker must find this ideal use and create an object of utility to

man, and, if nature smiles, an object of lasting beauty," he writes in his book *The Soul of a Tree*.

But the decision to build an altar from the massive walnut log presented its difficulties. First, there was the problem of finding a sawmill large enough to handle the log. A mill in Virginia that had sawed large stock for Nakashima in the past didn't have the capacity. In fact, there wasn't a saw on the entire East Coast big enough for the job.

Undaunted, Nakashima flew west to speak with Scott Wineland, a sawyer in Chico, Calif. A specialist in salvaging figured walnut from huge Claro walnut stumps, Wineland had the tools it would take to tackle the massive task.

But it meant moving the mountain to Mohammed. Wineland had to disassemble his customized Alaskan Chainsaw Mill and ship it, piece by piece, to a lumberyard in Philadelphia where the log was to be sawn. Sawing commenced in mid-January and took a week to complete—much of it done during a blizzard. Furthermore, the log was frozen through, causing the chainsaw's teeth to dull rapidly.

Frozen wood, however, wasn't the worst of it. Nearing the center of the log, the saw blade hit a metal drainpipe installed by an arborist years before. Resharpening the chain, Wineland found many teeth had mushroomed on impact, causing considerable blade drift. He was forced to saw the log from both ends. With the aid of a forklift, the slabs were lifted clear and,

slowly, the cutting was accomplished—but not before 120 nails, part of another ancient repair, were removed.

The slabs were air-dried for two years, kiln-dried for three weeks, then shipped to the New Hope, Penn. shop where the woodworking would be done. Nakashima roughed out the design; his daughter, Mira, completed the working drawings.

As completion neared, Nakashima set out to find the ideal home for his altar-to-be. Bookmatched, the Connecticut walnut slabs formed a top 10½ ft. wide by 10½ ft. long. Indeed, the altar was the largest piece ever executed by Nakashima's shop. Obviously, it couldn't go "just anywhere:" even the doors at the U.N. weren't wide enough to allow the altar to pass.

Eventually, Nakashima selected St. John the Divine's as an appropriate home for the altar; it was, after all, the largest cathedral in the Western Hemisphere. Not unexpectedly, the Cathedral agreed to accept Nakashima's project.

Nakashima attributes a large portion of his success on this and other projects to his able crew, some of whom have been with him for 25 years. "If I didn't have them," Nakashima notes, "I couldn't have built this project."

From the start, Nakashima has wanted his altar to be seen and touched—not treated as a precious, hands-off object. "I don't like this museum sort of thing," he says. As such, he finished the piece's top to withstand wear and tear, protecting it with six spray coats of polyurethane, rather

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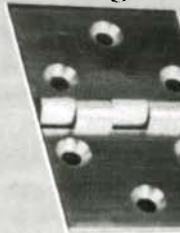
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than his usual oil finish. Well-rubbed, the top has an inviting low sheen.

With the altar installed, the energetic Nakashima, 81, can now turn to other plans. He hopes to see other peace altars installed in the Soviet Union and Nagasaki.

Hardly deterred by the obstacles cast in his way during the project, Nakashima concludes, "Each step in something like this is an adventure."

—Roy Berendsohn

Short shavings

When a mahogany Chippendale wing armchair, circa 1770, sold at a Southeby auction last October, the sale went straight into the history books: the \$1.1 million fetched by the chair represented the highest price ever paid for a piece of American furniture. Purchased by Eddy G. Nicholson, a private collector from New Hampshire, the piece was expected to sell for between \$350,000 and \$550,000. Mr. Nicholson also bought another rare Chippendale piece—a carved-mahogany chest of drawers—for \$660,000.

■ Are you nearing the end of a project and facing a confusing array of finishing options? Take heart: Sears recently launched a special service to answer your questions about paint and painting. Just call Sears' nationwide toll-free number—1-800-9-PAINTS—during regular business hours, Monday through Saturday. You'll find a staff of laboratory technicians on hand to provide information about interior, exterior and specialty paints, as well as primers, enamels and varnishes. The technicians are also ready to answer questions about application methods and accessories, and to try to help solve tricky finishing problems.

■ The new craft showcase catalogs are great-looking, but they're also expensive to list in. Now, however, there's a new hand-crafts catalog with a different twist: *Selections, a Designer's Catalogue*—a bimonthly publication that offers artists and craftspeople free listings. Targeted at the interior design industry, *Selections* will feature functional furnishings, seating, case goods, lighting and other one-of-a-kind items. And, to encourage direct contact by prospective clients, each craftsman will be represented with photographs and text, plus an address and phone number. A subscription to *Selections* costs \$17.95 for six issues, and includes a toll-free information line to help in locating sources. Artists and craftspeople interested in a free listing should call 1-800-624-6002, toll-free, or write *Selections*, Grant, Pardo & Associates, Suite 609, 25 SE Second Ave., Miami, Fla. 33131.



Linda Manzer's unusual guitar employs traditional techniques in an unorthodox manner.

While talking with jazz great Pat Metheny one day, Linda Manzer, who had already built several guitars for Metheny, caught a twinkle in his eye. "How many strings can you put on a guitar?" he asked. "How many do you want?" she replied. The subsequent collaboration resulted in this one-of-a-kind 42-string guitar. Built with Indian rosewood sides and back, a German spruce top, South American mahogany necks and ebony fretboards, the instrument's strings are divided into four sets: a 6-string guitar, a 12-string short-scale harp, a 12-string sympathetic string section and a 12-string full-scale set, with extra high and low notes. Besides the two sound holes on top, the guitar has two access doors to the internal electronics, which include an electronic synthesizer.

To employ or not to employ

Things were under control in your one-person shop for a while, but now business is picking up and you're spending more time answering phone calls and running for materials. The orders are starting to pile up. If you're already working six or seven days a week and spending evenings in the shop, it's time to face facts: you've got more work than you can handle alone.

But what does hiring an employee mean in terms of money and employer responsibilities? Let's assume that the employee is legally hired and paid at the rate of \$12 per hour. Using that figure, a full-time annual salary will be \$24,960.

But that's only the beginning—there are many additional costs and responsibilities required by law. Here's a partial outline of your duties as an employer:

You must purchase Worker's Compensation Insurance from a private insurance company or, in some states, directly from the state itself. Last year, Worker's Comp amounted to over \$3,000 for each \$12/hr. employee. (The price is set by law, so it's the same no matter where you buy it.) Most private insurance companies will allow you to pay the premium in equal monthly in-

stallments, plus a small administrative fee. However, you'll also be required to purchase liability insurance, the cost of which may exceed the Worker's Comp premium. And if you're late with three payments in a 12-month period, you'll be required to pay the entire year's premium in advance.

You must withhold federal income tax, state income tax, half of the employee's Social Security (FICA) tax, plus state disability insurance from the employee's salary. The amount withheld, based on the employee's W-4 form, is taken from Franchise Tax Board and IRS charts. Half of the employee's FICA amounted to 7.15% of gross salary in 1986. State disability was a bargain last year at .6%.

The federal income tax and FICA you withhold each month must be deposited on or before the 15th of the following month in a bank designated by the federal government. State income tax and disability insurance are paid quarterly by mail.

Federal income tax and FICA payments are reconciled on a quarterly report and mailed to the IRS. Another form is sent to the feds at the end of the year, together with your payment for federal unemployment insurance. Another annual summary goes to the state. And you're also responsible for state and federal unemployment

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insurance, along with retraining benefits.

Every pay period, you must give each employee a statement itemizing the amount withheld for taxes and insurance. At the end of the year, each employee also gets a W-2 form summarizing their salary and deductions for the year.

You must post evidence of Worker's Compensation insurance in the workplace, along with information about unemployment insurance and retraining benefits.

You must keep accurate and complete records of everything. At the end of each year, your books will be audited by your Worker's Comp insurance carrier and, possibly, the IRS and Franchise Tax Board, so it pays to keep good records.

As you can see, being an employer constitutes a trip into a deep bureaucratic forest. And this doesn't even count OSHA's stringent health and safety regula-

tions, or the other labor laws regulating workday and work-week length.

The way you unravel all the details and plug yourself into the state and federal computers is by making three phone calls: one to the IRS; another to your state's labor or employment department; and a third to the Franchise Tax Board. Thereafter, you'll get more mail from the government than you imagined possible—and they'll keep better track of you than your mother did.

All this is serious business, and failure to play by the rules can incur severe penalties. So why not just hire somebody under the table? Because the penalties are even greater if you're caught for illegal hiring practices. It just isn't worth the risk.

Approaching the bottom line, your \$12/hr. employee is now costing you around \$30,000 per year. If we add in the

salary of the employer, project materials and direct costs, and follow the assumption that you must realize an increased gross income of twice the cost of the employee, your business must now gross at least \$180,000 per year. If it doesn't, you can't afford the employee.

It's unfortunate that the costs and bureaucratic miasma make it so difficult for a small business to hire help. But that's the way it is, and not even a lifetime crusade will change it.

All in all, anyone thinking about hiring an employee should discuss their business finances with a good accountant first.

—Peter Good

Peter Good, a woodworker in Oakland, Calif., is editor of the Bay Area Woodworkers Association's newsletter, from which this article was adapted.

One-sided conversations

In my many years as a woodworking hobbyist, I've heard quite a few comments and questions from visitors to my workshop that have left me red-faced and slack-jawed. Here are a few of the best:

"Hey, I hear that woodworking is your hobby—you'd probably enjoy putting up some shelves in my closet."

"Why do anything by hand when you have all these machines?"

"This bandsaw should be able to cut up railroad ties. I have some that I'd like to make into benches."

"I'd like something made out of this dead tree that's standing in my yard."

"If you didn't spend so much time messing with your tools, you could make more stuff."

"You wouldn't have to go through all that trouble if you used a hot-glue gun."

"You could make a fortune as a woodworker. Like that jewelry box—you could get five bucks for it, easy."

"Wouldn't a nail hold it just as good?"

"That must have taken you all weekend to make."

"I bought a beat-up old rocking chair at a garage sale—you think you could cover it with that real skinny wood?"

"That's nice, but I'll have to show you the one I just bought for \$11.95."

"I used to make stuff like this in high school shop class."

"The best way to make a tight joint is to make the opening a little small, then whack it together with a hammer."

"What say I come over some night after supper and we'll make one of those."

"Gee, my wife sure would love one like that—her birthday's next Tuesday."

—Dario Biagiarelli, Kirkville, N.Y.

Photo: Courtesy of Ten Arrow Gallery



Tiger Swallow Tail

Leland Thomasset used his expertise with tinted clear lacquers over wood to obtain the rich colors in this desk and chair. Made of curly and plain maple, the pair was displayed at the Ten Arrow Gallery in Cambridge, Mass. last February and March.

My search for the perfect mortise

The trouble all started because I trained in a shop that was well-equipped. I was spoiled by cutting beautiful, clean mortises on a monstrous old Powermatic hollow-chisel mortiser, and I've been searching for a way to make them as well ever since.

My own first serious try at making machine mortises was to use a drill press. With it, I could drill a line of holes, then clean out the mess with a chisel. It wasn't

very satisfactory though, so I bought a hollow-chisel mortising set that attached to the drill press. On the face of it, you'd think this would be close enough to the Powermatic to be ideal: the same conformation of bit and chisel, a fairly high speed to eject the chips, and a moderately good hold-down system. Somehow, though, it didn't work out that way. The very first mistake I made was failing to allow enough clearance under the bit's tip. The result, predictably, was the prettiest pale blue on the first $\frac{3}{4}$ in. of the mortising chisel's tip.

Even after I replaced the chisel and

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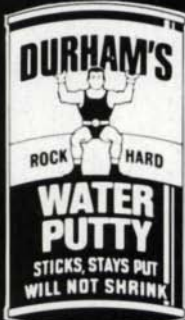


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learned to be more careful about bit clearance, I realized my troubles weren't over yet. Holding the wood firmly enough against the back fence so that the face-frame members are in the same plane when matched to a tenon is a lot easier said than done. Besides, in the time that it took to set up the arrangement on the drill press, I could have hired beavers to do the job—and the outcome would have been just about as good.

Any success I had with the drill press mortiser was always tempered with a sense of frustration. Whenever the chisel jammed in the wood and the workpiece shuddered, I'd think back to the smooth finesse of that old Powermatic.

Time passed. We were building a new house, and I had a whole kitchen to work on. I thought of cutting mortises and tenons on all the face frames, but the prospect was just too daunting. We were living in Dallas at the time, and my next-door neighbor was in the fastening business. He introduced me to bugle-headed drywall screws. I figured I could easily screw together the face frames for my kitchen cabinets with 3-in.-long screws. Here was

an answer to dealing with the complexities of mortise-and-tenon joinery... by not doing it.

The results were satisfactory—in fact, even my wife was pleased. But then there was the question of what to do about the cabinet doors. Rather than live with mortising and tenoning 36 doors of various sizes—not even counting the ones for bathroom cabinets—I chose to make bridle joints. These worked fairly well, but they really do lack the class of mortise-and-tenon joints.

A friend of mine who was visiting from California told me that he'd had success using plate-joinery biscuits combined with a slotting cutter on his router. This worked well enough, but it seemed as though every time I wanted to make a particular joint, the router table was tied up doing something else. Here I was, stuck again, scratching my head for some way to match the old Powermatic. I bought a Virutex biscuit-joiner machine, and it *did* make things better. But, confound it, my purist woodworking friends wrinkle up their noses whenever I mention biscuit joinery and say, "How about some *real*

mortise-and-tenon work?"

I read all the articles on router joinery—using floating tenons, turning square tenons into rounded-edge tenons with a rasp, and so on. Then, at a woodworking show in Houston about a year-and-a-half ago, I saw the Strong router machine and, shortly after that, the Wirth machine. Sturdily built and versatile, these machines seemed perfect for cutting mortises and tenons.

With the Holy Grail in sight, I built myself something quite similar to the Strong machine, along with a couple of tables to match. I successfully mortised out those 2¼-in.-square table legs with a ⅜-in.-dia. spiral-cut bit without any problems.

But along came a project that required a face frame only ¼ inch deep. The first time I impaled that thin and narrow stock into the bit was almost the last. The single-flute bit jarred the wood and vibrated so violently that it ripped the end out of the board. Subsequent cuts were made more carefully, but the fat was in the fire. I realized that I was running the risk of impaling my hand on the bit. Even two-flute bits didn't seem to really answer the question altogether, so I knew the mortise search was still on.

A woodworking show in Arlington, Texas presented me with yet another possibility: the overarm router. I reasoned that—with a plunge bit and a fence—this device could easily become my mortising machine. But the first tries were unconvincing, and I'm still not sure that the overarm router is the way to go.

Here I am, some twenty years later, still looking for a way to duplicate the virtues of that old hollow-chisel mortiser and find alternatives that are safe and accurate. I'm far too lazy to go the marking-gauge and mallet-and-chisel route, and I've found plenty of other uses for my plate joiner, drill press and Strong machine clone, plus all the other tricks and tools I've used to join wood together. But I'm still awfully close to where I started. And I suppose it's not out of the question that I'll end up with one of those blackened old Powermatic monsters after all. □

—W. Davis Smoot, Dallas, Tex.



Trimming waste on the wrong side of the layout line can lead to some strange dovetails.

Where did I go wrong?

Anyone who's passed initiation as a woodworker has, at one time or other, made a frustrating error, disastrous miscalculation, or at least a dumb mistake. Who can't relate to the angst and anguish of botching a cut on an expensive piece of lumber (measure twice, cut once—remember?), or wasting half a day making a part that turns out not to fit? And we've all screwed up a project by thinking at the

last moment, 'Just one last finishing touch.'

If it's true that you can learn from your errors, it's time to cut a slice of humble pie. Send us that woeful or ironic story about your most memorable mistake, along with what you did to remedy it. We'll be compiling a collection of these tumultuous tales in a future issue, so send your story and photos (color slides, preferably) to: Oops, c/o *Fine Woodworking*, Box 355, Newtown, Conn. 06470.

Notes and Comment

Do you know something we don't about the woodworking scene in your area? Please take a moment to fill us in. Notes and Comment pays for stories, tidbits, commentary and reports on exhibits and events. Send manuscripts and color slides (or, black and white photos—preferably with negatives) to Notes and Comment, Fine Woodworking, Box 355, Newtown, Conn. 06470.

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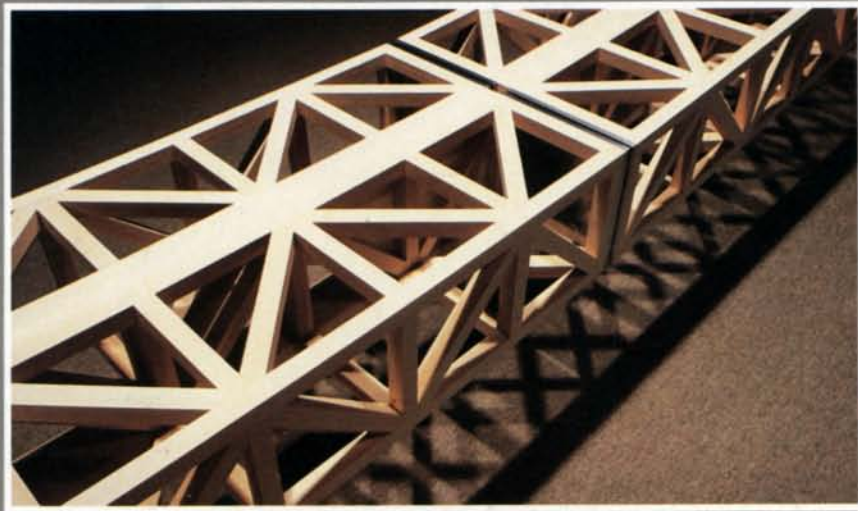
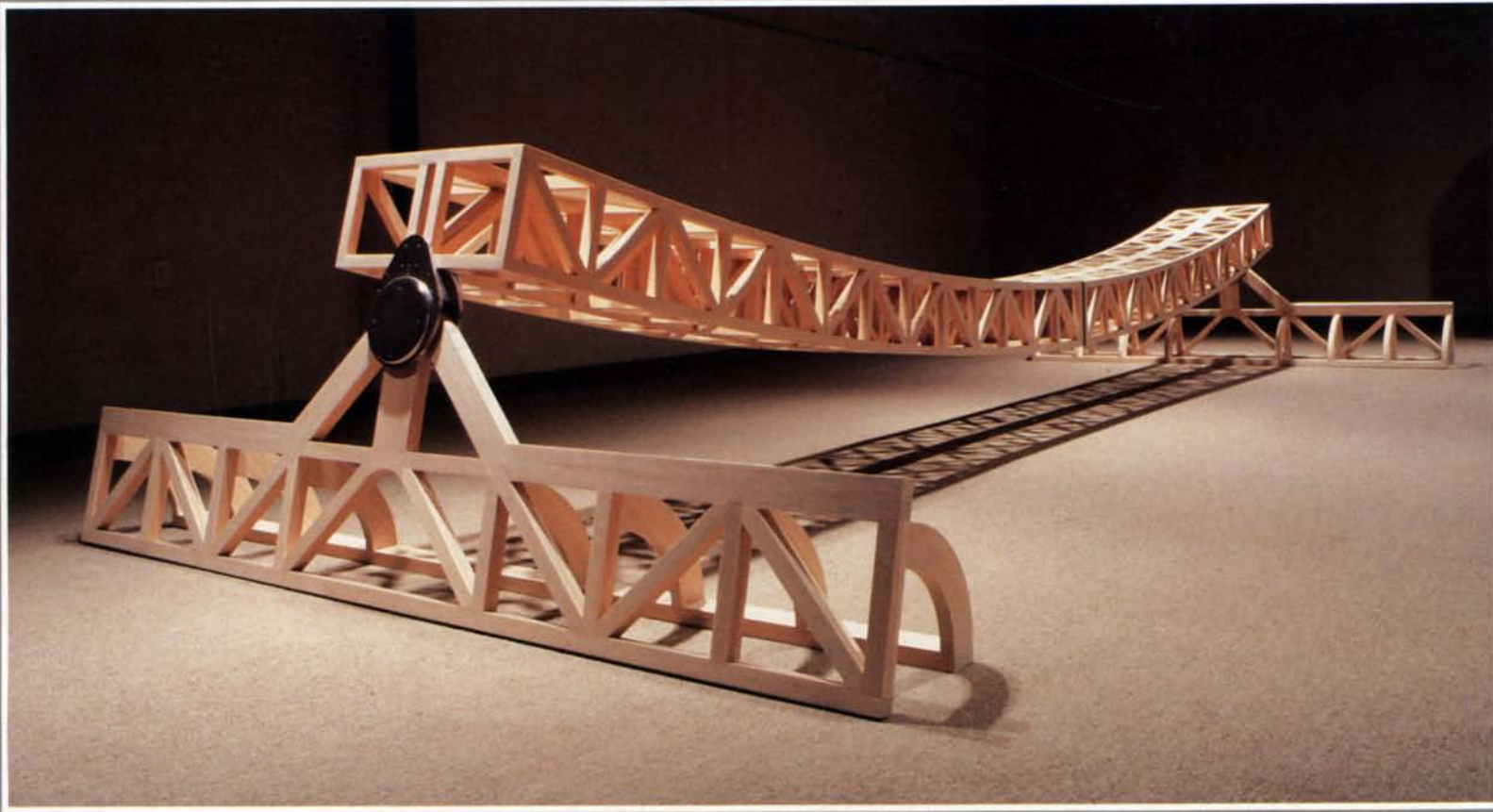
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For artist James Johnson, a steel truss bridge, with its regimented interplay of light and shadow, is as much sculpture as it is a way to cross a river. Johnson grew up in the watery Pacific Northwest, where dozens of truss bridges stand as monuments to the engineer's art. His fascination with these structures and the underpinnings of houses and other buildings inspired this 19-foot-long wooden sculpture, shown recently at Mankato State University in Minnesota, where Johnson teaches art.

Johnson's trusswork is made of sugar pine with cross members let into, then screwed into, the curved stringers. As with any truss, strength accrues not from the fasteners but from the diagonals, which stiffen the truss bays against racking. Concerned that his sculpture might appear too static, Johnson mounted the piece on a pair of aluminum axles so adventuresome gallery-goers can set it to swinging with a firm nudge. The truss weighs about 100 lb. and can be split into two sections for shipment. Photos by James Johnson.