Fine WoodWorking

March/April 1988, No. 69, $3.75

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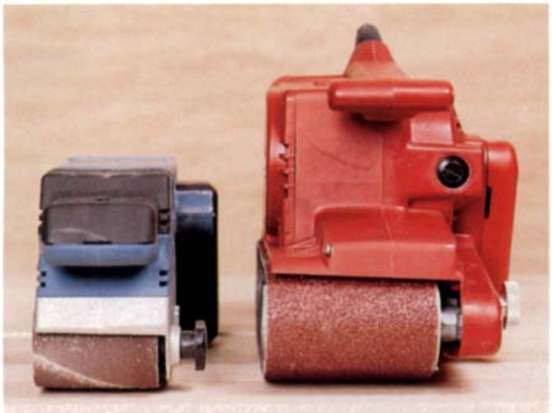

New-generation, lightweight, streamlined belt sanders are paying their way in many cabinet shops. To find out the advantages of these new workhorses, turn to p. 70. Cover: The shaper has long proved itself one of the most versatile woodworking machines. For the story, turn to p. 48.

Fine Woodworking is a reader-written magazine. We welcome proposals, manuscripts, photographs and ideas from our readers, amateur or professional. We'll acknowledge all submissions and return within six weeks those we can't publish. Send your contributions to *Fine Woodworking*, Box 355, Newtown, Conn. 06470.

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DEPARTMENTS

ARTICLES

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Go home, 32mm—I make my living doing trim work in custom homes and, in my opinion, the 32mm cabinets (*FWW* #67) belong back in Europe where they seem to have come from. They do not lend themselves into our American ways, nor do they fit our materials. They also take away from our own very capable craftsmen who turn out a quality wood (not particleboard and plastic) cabinet at a lower price. Problems, such as not enough room for the sink, to not enough room for the electrical outlets (sometimes requested by customers), make the need to jury-rig all too common. The flood of import tools from Japan is bad enough, but at least *our* craftsmen use them to earn a living. Keep the pseudo-woodwork in Europe.
—William Hopkins, Edgewater, Md.

Delusions of a woodworker—While sitting in my booth at a recent craft fair, listening to the hundredth person tell me how satisfying it must be to work wood, my thoughts wandered to all the frustrations of being a furnituremaker. Along the way, I came up with this list of the 10 greatest self-deceptions of woodworking.

1. It doesn't matter if I don't sell anything at this craft fair; it's good exposure.
2. I'll figure out how to make the piece if I get a commission for it.
3. If I can sell this piece for $500, I'm doing fine, because I can make it in a week. (That means working 12 hours a day for six days, not counting design time, time spent with the client, finishing time, the cost of the wood and shop overhead.)
4. This scratch will come out when I switch to the next finer sanding grit. (Or, the finish will fill this dent.)
5. Passing a sheet of plywood on edge over my jointer won't hurt the knives. (Or, flakeboard won't hurt my best sawblade.)
6. I don't need to laminate; 8/4 stock should mill out about 2 in. thick.
7. Buying the most expensive machinery will pay off.
8. Buying the cheapest machinery will pay off.
9. There isn't enough sawdust in the air to cause any long-term damage to my lungs. (Or, noise from this machine won't hurt my hearing.)
10. I've only got one cut to make, so I don't have to bother with a push stick or goggles. *—Josh Markel, Philadelphia, Pa.*

Safety concerns—I read your article on shopmade sanding drums (*FWW* #67) with interest. I love shopmade gadgets, but a person can't make a new eye or hand. I ducked when I saw the drawing that shows a short blank pushed into a tablesaw blade. An experienced woodworker would never saw such a short piece, especially with the blade set at a 45° angle. I tell people who visit my shop, "If you aren't afraid of these tools, you're a fool." My hands don't shake, but I remain constantly aware of what these tools are capable of doing. The proper procedure for ripping a square to an octagon is to start with a blank at least 2 ft. long and cut it to length afterwards. That way you have more control over the wood and will have stock for making plenty of drums.
—Dana H. Hart, Miami, Fla.

Turning controversy—I can't wait to see the fallout from Richard Raffan's "Current Work in Turning" article (*FWW* #67)—he certainly made some gouging remarks. If you're tallying "Yeas!" and "Who does he think he is?" responses, count me as a "Yea!" (I would, however, like to be able to turn my stunning, visually balanced, perfectly finished lidded bowls in under an hour. How does he do it?) *—Betty J. Scarpino, Indianapolis, Ind.*

I can't believe you would print an article as naive as Raffan's piece on turning. I would say the chip on Raffan's shoulder weighs more than David Ellsworth's extra-large walnut burl vessel. If Ellsworth had wanted to put salad in it, he would have plugged the hole. If all the woodturnings in the two exhibits Raffan saw were overpriced, why did most of them sell? Maybe the customers at a gallery exhibition are looking for art, not salad bowls. *—Robyn Horn, Little Rock, Ark.*

Thanks for Raffan's article. His incisively admonishing appraisal was long overdue; his focus on the importance of shape (form) seems eminently correct. However, his last paragraph prompted me to quibble a little. Low-cost, rapid production on a lathe is one thing; the making of a one-of-a-kind object is another. The latter process is, usually, neither rapid nor low-cost. Many of the pieces discussed and/or photographed for the article represent makers primarily concerned with making an object, while the lathe is merely a tool to produce the object. As Raffan himself says, this is ". . .as it should be: appreciation of the object first, then the skills that executed it." And in describing Giles Gilson's and Robert Sterba's pieces as "a technical achievement of both turning and finishing," surely the emphasis should be on finishing. As to whether any of these objects is art, especially "fine art," is extremely argumentative in any circle, but I would prefer having Gilson's Sunset Place or Ellsworth's spalted Norwegian burl bowl to hanging a Hockney or Warhol on my wall. *—Hilliard Booth, Annapolis, Md.*

Clearing out old dowels—Re: Bob Flexner's article on failing joints (*FWW* #67). After drilling out an old dowel with an undersized bit, he peeled off the last shell of the dowel with a 1/8-in.-wide chisel. I prefer to use a steel rod with its end ground at a 35° to 45° angle. I use a 5/16-in. rod; most of the dowels I find are 3/8 in. The drill rod makes a sharp-edge tool with a round back that damages the hole less than a chisel. Old glue also can be hard enough to damage a good chisel. The steel rod can be quickly reground if it's damaged.
—Thomas H. Kestel, Hicksville, N.Y.

The forester's son—A friend who is a land agent and county surveyor in Norfolk, England, told me a little story I thought other woodworkers would enjoy. In the days when the forests of Norfolk were part of large estates, there was an unwritten law that the resident foresters who managed the lands were entitled to go out into the woods and fell a mature oak tree whenever their wives gave birth to a son. When the child was 10 years old, the tree was cut up and the lumber stickered to dry. When the child was 21, he was entitled to select a house site

and use the wood to construct his home. Needless to say, foresters always knew in advance where the largest sound oak was.

—*John G. Holyoak, Norfolk, England*

Feedback on dust collectors—Roy Berendsohn is to be complimented on his well-researched article on dust collectors (*FWW* #67). There are two points, however, that we at the Cincinnati Fan and Ventilator Co. Inc., would like to clarify.

While many good woodworking ideas and tools originated overseas, the portable dust collector is not among them. The first truly portable, two-stage dust collector was manufactured by our company more than 30 years ago. Since then, several hundred thousand Dustmasters have been sold around the world.

We also think a further word of caution is needed on CFM and static pressure. These test values may vary greatly for a given blower simply by changing the inlet and outlet diameters; the data used to design a system should be obtained in a test using the same diameter duct as the one to be installed. To avoid this complexity, Delta has developed a simplified graphical method to design a central dust collection system (available from Delta, 246 Alpha Drive, Pittsburgh, Penn. 15234 for a $2 handling charge).

—*D. Thomas Retford, Cincinnati, Ohio*

Woodworker burned out—A relief fund has been established for nationally known woodworker Dan Rodriquez, who lost his shop, work-in-progress and tools in a fire last November in Comer, Ga. The loss is estimated at $150,000. Contributions can be made to the Dan Rodriquez special account, Farmers & Merchants Bank, Comer, Ga. 30629. For more information, call me at (404) 769-5896 or Paul Cassilly at (404) 743-5157.

—*George McCauley, Watkinsville, Ga.*

Why Warrington hammers—I don't know enough about tool history to join the melee over Warrington hammers recently being waged in "Letters." Whatever that pattern hammer was originally designed for, I do know this: A 6-oz. Bahco/Record/Marples Warrington hammer is not only a nicely made tool, but also a boss veneer hammer when it's time to stick down edging, banding, repairs and small turnings with hot hide glue. Use it one-handed or two, buff away the rust between jobs and don't be proud—use either face when you need to.

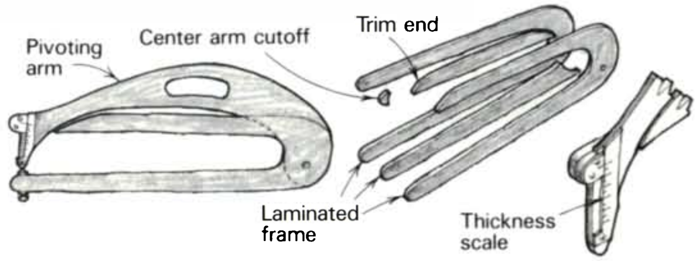
—*William Tandy Young, Stow, Mass.*

No-profit wood drying—I've had some experience with wood drying as described by Todd Scholl in his article, "Buying and Drying" (*FWW* #68). My efforts weren't too successful. I purchased about 1,000 bd. ft. of oak and cherry from a local mill, air dried it for two years, and took it to a local kiln for drying. During the air drying, I had the boards stickered and covered with tin roofing. Apparently there were nail holes in the roofing, because when I picked up the wood from the kiln, there were a lot of water stains on the wood. Also, I discovered most of the wood was ash instead of oak. The mill apparently either sold me ash as oak or the kiln made the switch from oak to ash. It's hard to tell one from the other at the mill.

As a result of this experience, I've decided to buy my material from a dealer. Oak down here is selling for $1.50 a bd. ft., kiln dried and surfaced three sides. From an economic standpoint, the cost of the material represents only one-fifth of an article's selling price, so saving one-half on wood cost doesn't represent much of a saving for the trouble involved.

—*L.C. Marsh, Joplin, Mo.*

Two wall-thickness calipers



I believe this thickness caliper is simpler and less prone to error than Gilbert Warmbrodt's technique ("Methods of Work," *FWW* #64), which involves using both a dial caliper and a spring caliper. I made mine from plans carried in a 1950s British woodworking magazine.

The calipers consist of a 3-piece laminated frame and a pivoting arm. Make it by screwing together three pieces of 3/16-in. Baltic birch plywood (sold in model and hobby shops). Next, cut the three pieces into the U-shaped caliper frame. Cut the pivoting arm from Baltic birch to the shape shown in the sketch. Disassemble the three frame pieces and cut apart the middle piece as shown to allow clearance for the pivoting arm at the back and front of the caliper. Save the cutoff from the center piece; the pointer plate is screwed to it and then attached to the left frame piece. Trim the front of the right frame piece so you can read the measured thickness.

Glue the three frame pieces together, bore a hole through them and bolt the pivoting arm in place with a wing nut on its end to adjust the pressure on the arm. For the scale, mark off a strip of 1/16-in.-thick aluminum or brass in 1/32-in. increments. Screw or glue the plate to the pivoting arm as shown. Sharpen the end of a small bolt and center it on the bottom of the frame so the tip of the pivoting arm meets it. With the caliper closed, mark a fine line from the thickness scale to the pointer plate to indicate zero. *—John Bickel, Ossining, N.Y.*

These shopmade calipers are made from two 3-in.-dia. plywood discs, a bolt and wing nut and four pieces of heavy, stiff wire. Accuracy depends on two conditions. First, the distance from the pivot to both ends must be exactly the same. Second, when the caliper jaws are closed, the two chisel faces at the other end must also touch. To use, bring the curved ends together on the workpiece and measure the thickness as the distance between the two chisel faces on the other end.

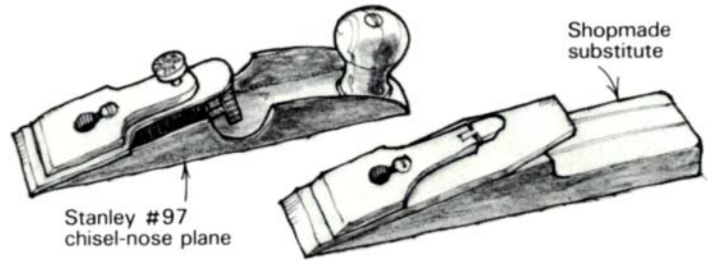
—Ralph S. Mason, Portland, Ore.

Quick tip: For color-matching in small spots, try Maybelline eyebrow pencils. *—Jim Buell, West Covina, Calif.*

Shopmade chisel-nose plane

The Stanley #97 chisel-nose plane, originally made for trimming and fitting piano parts, is also useful for trimming off plugs and planing into corners. Its iron is mounted on the front of the plane at a very low 16°.

Unfortunately, the Stanley #97 is hard to find and collectors often shell out $300 for them. The alternative is to make your own from a plane iron, lever cap, T-nut, 1/4-in.-dia. round-head machine screw and a piece of dense 2-in.-thick hardwood, 3 in. wide by 10 in. long. Don't use a regular bench-plane iron, as it's not heavy enough; I used an inlaid tapered iron from an old wooden jointer plane. These heavy old irons are fairly common at flea markets and antique tool sales.



Shape the wooden blank as shown and set the iron and cap on the blank, align the screw holes in each and mark the location of the hole. Bore a through hole on the mark perpendicular to the blank's angled face. Enlarge the hole on the plane's sole and install a T-nut. Add a knob if you wish.

—Philip Whitby, Englewood, Colo.

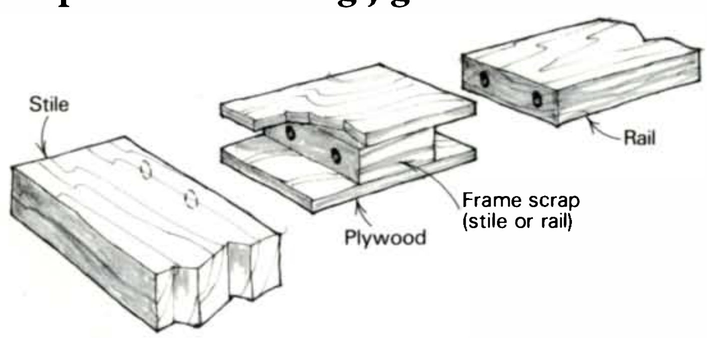
Quick tip: It is important to flatten plane and scraper blades, but they are hard to hold while hand-lapping. I solved the problem by using suction cups as handles. A little soapy water ensures good suction. *—B.A. Cartwright, Cedarburg, Wisc.*

Canned lubricant

Lightly oiling a handsaw's blade or a plane's sole makes the tool easier to use by reducing friction. Just tightly roll up a 2-in.-wide band of upholsterers' hessian webbing, tuck it into a tuna-fish can and soak with thin machine oil. Then wipe the tool over it, or it over the tool. Resoak the block if it dries out.

—H.G. Durbin, Porthcawl, Eng.

Disposable doweling jig



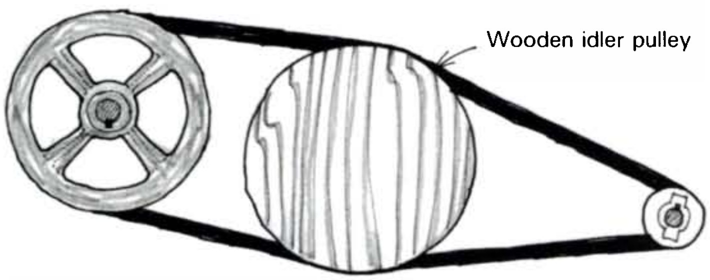
When joining face frames, make this doweling jig from 1½-in.-long scraps from the frame's rail or stile and a piece of plywood. Bore the two guide holes in the block on a drill press, then glue the block between two pieces of 1/4-in. plywood that extend 1 in. from each end of the block. Mark one face and one edge of the jig as reference surfaces to ensure consistency when drilling dowel holes.

—Ronald F. Seto, San Rafael, Calif.

Quick tip: Rip an old undershirt off just below the armholes. Double up the lower part and wear it as a headband while you work. There is plenty of absorbancy, and I've found that if this headband ever gets saturated, it's probably time to quit work anyway. *—Lawton E. Reid, Kansas City, Mo.*

Belt tightener

Often a power tool belt will slip just when it's needed most. You can keep the old stretched belt tight (until it can be replaced) by installing a wooden idler pulley similar to the one

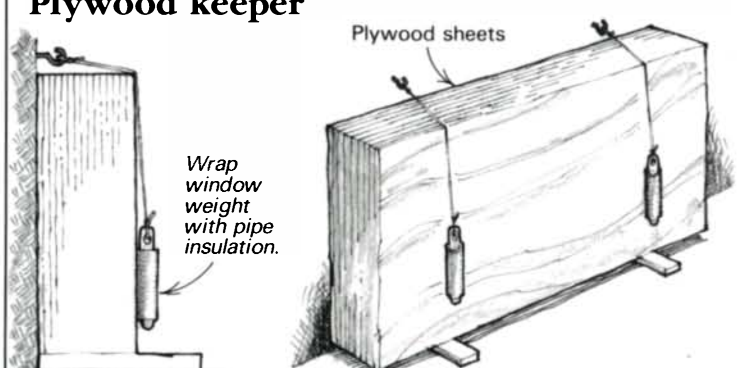


shown in the drawing above. Turn the wooden disc on a lathe so its diameter is larger than either pulley on your equipment. Use a skew chisel to cut a V-groove in the edge to fit the profile of the belt. Pull the belt apart slightly and insert the pulley. In operation, the free-running idler pulley will move up and down seeking its own invisible center.

—Donald F. Kinnaman, Phoenix, Ariz.

Quick tip: Instead of using sawdust and glue as a wood filler, use sawdust and sanding sealer. It dries quickly and will never leave a white spot, as the glue mixture will if not sanded off completely. *—Myron Mykiwka, Guatemala, Guat.*

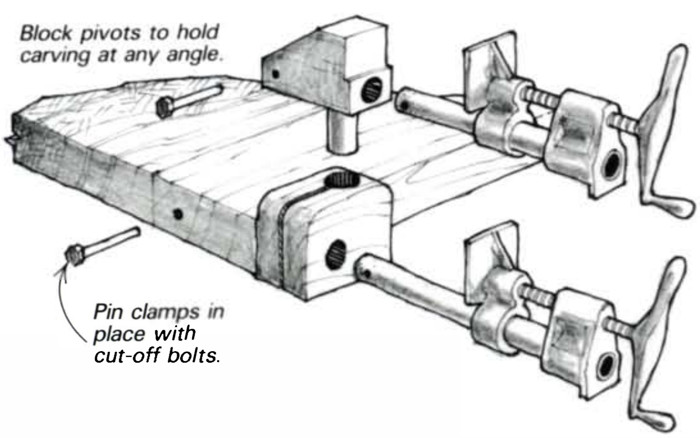
Plywood keeper



I've used this method on stacks of plywood up to 30 sheets thick. Sink two eyescrews into the wall about 51 in. off the floor. Tie two sash weights to a piece of string and suspend each weight from an eyescrew. Cover the weights with foam pipe insulation to keep them from marring the plywood.

—John R. Thiesen, Cheektowaga, N.Y.

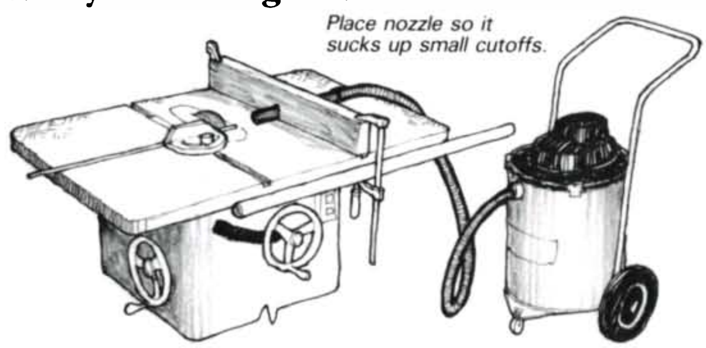
Woodcarver's vise



The pipe-clamp vise shown above makes my woodcarver's clamping system ("Methods of Work," *FWW* #55) even more versatile. Work can be clamped in virtually any position in the top vise, which pivots around 360°. The bottom clamp locks the top vise at the desired angle.

—Wallace C. Auger, Fairfield, Conn.

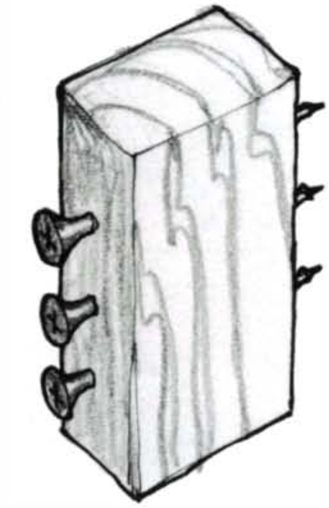
Safely removing small cutoffs



A good way to remove small cutoffs (such as chunks sliced off a dowel) from your tablesaw or bandsaw is to suck them in with your shop vacuum. Fit the vacuum's nozzle through a 2x4 notched to fit its hose diameter. Clamp this setup on the tabletop with the nozzle mounted as close to the cut-off point as possible. When you're done, the parts are neatly collected in the barrel. *—David Shaffer, Grand Rapids, Mich.*

Quick tip: Old tire pieces clean sanding discs and belts. Interstates are full of them. *—Myrl G. Brooks, Cleveland, Tenn.*

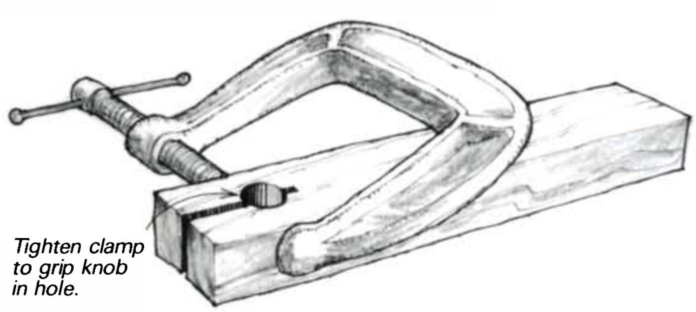
Lathe layout tool



More convenient than a marking stick and pencil, this scribing gauge speeds spindle turning by scoring several layout lines at once. I use drywall screws as marking pins. Made from hardened steel, their tips stay sharp for making clean, thin lines. Space the screws to correspond to key measuring points on the workpiece. The gauge shown here might be used to mark divisions on a short honey dipper, but there is no reason you can't make it the full length of long work.

—Galen Miller, Vestal, N.Y.

Installing small brass knobs



Small brass knobs with threaded shanks can be difficult to install without marring their finish, especially in very hard woods. I solved the problem with this grip made from scrapwood. Use a small C-clamp to squeeze the knob in the hole, but take care that the clamp doesn't drag on the wood and scratch it. The wood scrap acts as a non-marring handle, allowing easy installation of the knob.

—Mac Campbell, Harvey Station, N.B.

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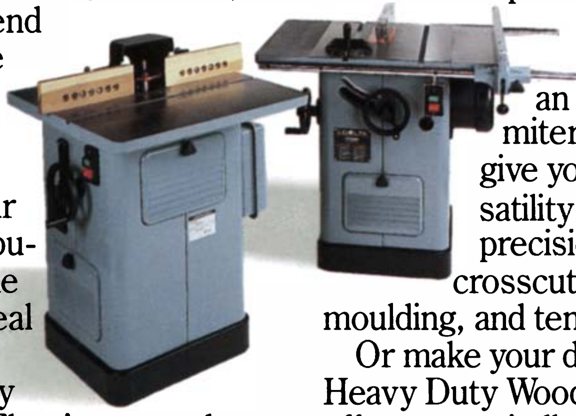

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Pigment bleeding ruins finish

I'm working with a polychromatic lamination of thin padauk and cypress strips. When the pieces are finished, the reddish color of the padauk spreads into the lighter woods. How can I prevent this? —*Dr. F.K. Anan, Tokyo, Japan*

Dick Boak replies: It's common for the pigments of certain hardwoods to bleed across laminate lines and contaminate lighter-colored woods and other materials. Guitarmakers often experience the problem when pigment from rosewood guitar backs or sides bleeds into purfling strips or inlays. In addition to the true rosewoods (*Dalbergias*) and padauk, the bleeding is common with cocobolo, pernambuco and East Indian rosewoods. These species contain pigments that are soluble in the natural oils of these resinous woods. Many of these pigments are water soluble as well, so they readily dissolve in the solvents in most finishes.

If you can, you might substitute species that are less prone to bleeding, although you may sacrifice some of the brilliance of the original woods. Bubinga (African rosewood) and bloodwood or sapele may be suitable substitutes for padauk. Morado (Santos or Bolivian rosewood) is a fairly close substitute for East Indian rosewood.

If you can't substitute woods, brush the wood with 0000 steel wool, working with the grain, to remove any pigmented sawdust from the wood pores and surface before applying the finish. Sometimes, however, the anti-rust oil in steel wool can cause problems in subsequent lacquer coats. To prevent wood resin from migrating to the surface, spray on several extremely light mist coats of vinyl sealer, which is available from any good finishing supply shop and from The Woodworkers' Store, 21801 Industrial Blvd., Rogers, Minn. 55374. These mist coats effectively lock in the pigments by protecting them from the solvents in subsequent coats. A wet coat will cause instantaneous bleeding that can be corrected only with tedious scraping of the lighter woods or by resanding and starting over from scratch. Once you have an effective coat of vinyl sealer, you can apply a compatible lacquer sealer and lacquer. Be careful not to sand much until you've built up a good lacquer layer, else you risk sanding through the sealer coats. From my experience, oil-base or hand-rubbed finishes will not work on woods where pigment bleeding is a problem.

[Dick Boak manages the Sawmill, the exotic-wood sales division of The Martin Guitar Co. in Nazareth, Pa.]

Battens and wood movement

I recently built some battened doors for pine kitchen cabinets. The battens are fit into dadoes on the top and bottom of the inside surfaces. Screws fit into slots hold the battens to the door, which is assembled from four vertical pieces tongued and grooved together. I have to make several more of these doors, and was wondering if I could dispense with the slots and just glue and/or screw the battens to the doors. —*Steve Lambert, Jackson, N.J.*

Norman Vandal replies: The way you made the first doors, with a dado to house the batten and slotted holes for the screws, is adequate. The dado provides mechanical strength against racking, and the screw slots allow the width of the door to expand and contract with seasonal changes in humidity. Your proposed shortcut is asking for trouble, however.

You don't make it clear whether you have glued the boards together or not. If you have, then the four boards together will expand and contract as if they were one wide piece of wood. You can expect movement of up to ¼ in. from summer to winter, and if the batten is glued or screwed solidly, then bowing and cracking will be inevitable.

If the four boards are not glued together, then each will expand and contract only about ⅟₁₆ in. It would be safe, I feel, to secure the batten by driving two screws through it into each board, spacing the screws about half the width of the board apart. This will reduce the wood movement between screws to about ⅓₂ in., and the wood around the screws should be able to give enough to avoid problems. But I'd still advise you to house the batten in a dado; otherwise, all resistance to racking depends on the screws, and the doors will eventually sag.

For the strongest door, I'd glue the boards together, then slot the holes in the battens for the screws. This need not be a tedious process. I suggest first boring the hole with a drill or drill press. Then, use a router table and a bit the same size as the hole to create the slot. Put the batten on the table so the bit fits in the hole, turn on the router and move the wood back and forth along the router fence until the hole is as long as you need. Be careful to hold the batten down firmly, because you must turn the router on and off while the bit is in the bored hole.

Another method is to cut a sliding dovetail across the back of the door and fit the batten into it tightly, fastening it with a single screw located at the center of the door. This is probably the most sophisticated system, but requires set-up time to make the proper router jigs (*FWW* #62). Once you have everything worked out, making several joints should be quick and accurate. In the future, you may want to graduate to making frame-and-panel doors, which are much more dimensionally stable and well worth the extra time involved.

[Norman Vandal makes period furniture and architectural furnishings in Roxbury, Vt.]

Dissolving hide glue with alcohol

I've read that injecting alcohol into hide-glue joints will crystallize the glue, making it easy to disassemble the joint. But alcohol isn't a single compound. There's methyl, propyl, isopropyl, butyl and others. Would you please clairfy which one to use? —*Alfred J. Coulombre, West Bethesda, Md.*

Bob Flexner replies: Any alcohol from the aliphatic group, which includes the commonly available methyl (wood), ethyl (denatured, grain) and isopropyl (rubbing), will dehydrate the crystalline structure of hide glue, causing it to fracture. This is not the same as melting, so the joints won't just fall apart. Pressure must be applied to separate the fractures in the same way that pressure will break the connection of plastic pop beads children use to make bracelets and necklaces. I find a small crack in an edge-to-edge joint where I can insert the alcohol with a syringe. Then I force a wedge, such as an old chisel or screwdriver, into the crack to pop the joint apart. For mortise-and-tenon joints, I use a plastic or leather mallet to tap the joint apart. The glue will still be good if rehydrated with hot water or more hot hide glue.

[Bob Flexner restores furniture in Norman, Okla. His videotape, "Repairing Furniture," is available from The Taunton Press, Box 355, Newtown, Conn. 06470]

Sticky ooze on cedar

Several years ago, I built a chest out of aromatic red cedar. I finished the outside with a penetrating oil and wax, but left the inside unfinished. I thought the chest came out pretty well, but this year the customer called to say that a sticky substance was oozing from an interior wall. How can I remedy the problem? —*Duncan R. Warren, Mandan, N. Dak.*

Jim Cummins replies: Cedar chests are usually left unfinished on the inside so the aroma can escape, discouraging moths. Apparently, the oils in your chest's wood are working their way to the surface. I suppose it would be possible to wash out these oils using clean rags and solvent, but that would eliminate the cedar smell. Instead, a light sanding might remove the stickiness as well as rejuvenate the aroma. It's recommended in

BOSCH

TOP HANDLE JIG SAW
ITEM #1581VS

SALE **$125**

ITEM #	DESCRIPTION	LIST	SALE
1581VS	TOP HANDLE JIG SAW	$235	$125
1582VS	BARREL GRIP JIG SAW	220	118
3270D	3 x 21 DUSTLESS BELT SANDER	219	108
1272D	3 x 24 DUSTLESS BELT SANDER	295	159
1273D	4 x 24 DUSTLESS BELT SANDER	315	175
3258	3¼ PLANER W/CARBIDE BLADE	205	98
1347	4½ MINI GRINDER	145	77
1604	1¾ HP ROUTER	219	115
1606	1¾ D HANDLE ROUTER	243	138
1608	TRIM ROUTER	135	78
1608L	LAMINATE TRIMMER	139	82
1608T	TILT BASE LAM. TRIMMER	155	89
1609	OFFSET BASE LAM. TRIMMER	199	114
1609K	TRIMMER INSTALLERS KIT	285	158
1158VSR	3/8 VAR. SPEED REV. DRILL	99	56
11212VSR	3/4 SDS ROTARY HAMMER W/CASE	339	186
11202B	1½ ROTARY HAMMER	599	349
11203B	1½ ROTARY HAMMER	639	373
1198VSR	1/2 VSR HAMMER DRILL	219	122
1632VSK	RECIPROCATING SAW KIT W/CASE	215	134
1920RK	3/8 CORDLESS DRILL	199	78
1942	HEAVY DUTY HEAT GUN	99	57

Hitachi

ITEM TR12

SALE **$164**

1/2" PLUNGE ROUTER
3 H.P. WITH ACCESSORIES

ITEM #	DESCRIPTION	LIST	SALE
C6DA	6¼ CORDLESS CIRC. SAW	$284	$ 106
CB10V	4" ELECTRONIC BAND SAW	482	279
C7SA	7¼ CIRC. SAW 5,500 RPM	121	74
TR12	3 H.P. PLUNGE ROUTER W/ACC.	338	184
P100F	12" PLANER	1,970	999 *
F1000A	12" PLANER JOINTER	2,500	1,329 *
CB75F	BAND SAW ACCEPTS 1/4" TO 3" BLADES	2,880	1,489 *
C12Y	12" TABLE SAW W/3HP MOTOR	2,569	1,329 *
R100	DUST COLLECTOR	875	479 *
C10FA	DELUXE 10" MITER SAW	487	264
C15FB	DELUXE 15" MITER SAW	630	364 *
15-80AL	15" CARBIDE BLADE 80T ALUM.		84
15-110W	15" CARBIDE BLADE 110T WOOD		106
15-120P	15" CARBIDE BLADE 120T PLASTIC		106

* FREIGHT COLLECT

Makita

ITEM #6093DW

3/8 CORDLESS DRILL VARIABLE SPEED REVERSIBLE

SALE **$119**

ITEM #	DESCRIPTION	LIST	SALE
2414	14" CUT-OFF SAW	$338	$175
4200N	4⅜ CIRCULAR SAW	190	106
6010 DWK	3/8 CORDLESS DRILL KIT 7.2V	174	85
6093 DW	3/8 CORDLESS DRILL KIT 9.8V	232	119
B04550	DUSTLESS SANDER	92	44
DA 3000	3/8 ANGLE DRILL	206	77
GE0600	DIE GRINDER	104	62
632007-4	9.6V BATTERY	48	29
632002-4	7.2V BATTERY	40	27

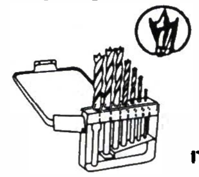
5" ALUMINUM WOODWORKING VISE

PORTABLE, LIGHT WEIGHT. THE "L" SHAPED FACE HOLDS YOUR WORK EQUALLY WELL IN A HORIZONTAL OR VERTICAL POSITION. CLAMPS TO ANY SAW HORSE OR BENCH TOP UP TO 2" THICK. 4" OPENING.

ITEM #5ALVI

SALE **$19.00**

7 PC. PREMIUM BRAD POINT DRILL BIT SET



SALE **$18**

ITEM # 7PBPD

SET OF 7

DOUBLE SPUR BITS PREFFERRED BY CABINETMAKERS. EXTRA LONG SPURS WHICH CUT WOOD FIBERS CLEAN AND FAST. FAR SUPERIOR AND LAST 10 TIMES LONGER THAN ORDINARY BRAD POINT BITS. SET INCLUDES SIZES: 1/8", 3/16", 1/4", 5/16", 3/8", 7/16" AND 1/2".

Johnson

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ADJUST-A-SQUARE

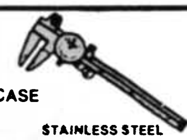
COMPLETELY ADJUSTABLE, CUT ANY ANGLE YOU WANT, TEMPERED ALUMINUM BLADE IS 1/4" THICK BY 2" x 48".

ITEM #ADS48

SALE **$24.98**

ITEM # 06DC

6" DIAL CALIPER IN WOOOEN CASE



SALE **$32**

0-6"x0.001" STAINLESS STEEL

- OUTSIDE, INSIDE & DEPTH MEASUREMENTS
- DIAL READS DIRECTLY TO .001"
- LOCK FOR REPETITIVE SETTINGS
- CONVENIENT THUMB ROLL MAKES MEASURING QUICK & EASY
- SATIN CHROME FINISHED

ITEM #	DESCRIPTION	SALE
12DC	12" DIAL CALIPER 0-12"x0.001"	$78
06VC	6" VENIER CALIPER STAINLESS STEEL .001"	16
12VC	12" VENIER CALIPER 0-12"x0.001"	48

7 PC. AUGER BIT SET

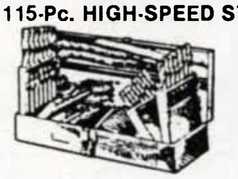
FOR USE WITH RATCHET BIT BRACE EXTENSION LIP, SOLID CENTER PATTERN CAREFULLY FORGED FROM HIGH CARBON STEEL. ACCURATELY CENTERED SCREW. HAND FILED LIP AND SPUR.

1/4" 3/8" 1/2" 5/8" 3/4" 7/8" AND 1"

ITEM #7ABS

SALE **$22.00**

115-Pc. HIGH-SPEED STEEL DRILL BIT SET



THE TOTAL DRILL BIT SET OF THE FINEST HIGH-SPEED STEEL, HEAT-TREATED AND CAREFULLY SHARPENED. CONVENIENT ALL-STEEL INDEX CASE SHOWS DECIMAL EQUIVALENTS FOR EACH SIZE. EACH HOLDER IS HINGED SO ALL BITS ARE READILY ACCESSIBLE. INCLUDES 29 FRACTIONAL SIZES 1/16 THRU 1/2" BY 64THS, 26 LETTER SIZES A THRU Z, 60 WIRE GAGE NUMBER SIZES #1 THRU #60. 2¼ x 4½ x 13".

SALE **$58.95**

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Emglo

SALE **$295**

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- COMES WITH PRESSURE SWITCH, ON/OFF SWITCH & AIR LINE REGULATOR

Milwaukee

ITEM #6511

2 SPEED SAWZALL

SALE **$118**

ITEM #	DESCRIPTION	LIST	SALE
0228-1	3/8" DRILL 3.3A 0-1,000RPM	$145	$ 84
0234-1	1/2" DRILL 4.5A MAGNUM 0-850RPM	179	105
0235-1	1/2" 4.5A 0-850RPM KEYLESS MAGNUM DRILL	184	112
0244-1	1/2" DRILL 4.5A MAGNUM 0-600RPM	179	110
1660-1	1/2" COMPACT DRILL 450RPM	239	148
1675-1	2 SP. HOLE HANG 1,200 & 300RPM	349	218
1676-1	SAME AS ABOVE W/STEEL CASE	375	232
3002-1	ELECTRICIAN'S RIGHT ANGLE DRILL KIT	290	174
3102-1	PLUMBER'S RIGHT ANGLE DRILL KIT	295	177
3107-1	RIGHT ANGLE DRILL KIT VARIABLE SPEED	305	192
5455	POLISHER 1750RPM	199	122
5535	POLISHER 2800RPM	209	128
6012	1/3 SHEET ORBITAL SANDER	179	112
6014	1/2 SHEET ORBITAL SANDER	189	115
6016	1/4 SHEET ORB. FINISH. SANDER	65	39
6226	2 SP. BANDSAW W/CASE	416	258
6366	7¼ CIRC. SAW W/ACCESSORIES	187	108
6508	VAR. SP. SAWZALL W/CASE & 7 BLADES	214	125
6511	2 SP. SAWZALL W/CASE & 7 BLADES	207	118
6539-1	CORDLESS SCREWDRIVER KIT	103	59
6750-1	DRYWALL DRIVER 4.5A 0-4,000RPM	141	87
6753-1	DRYWALL DRIVER 3.5A 0-4,000RPM	125	77
8975	HEAVY DUTY HEAT GUN	81	49

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HARDENED AND GROUND MEASURING FACES, FORGED WITH ENAMEL FINISH. ONE-STEP ZERO ADJUSTMENT. GRADUATED .0005", ACCURATE TO .00025". SPINDLE LOCK AND RATCHET STOP.

SALE **$27.95**

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ITEM #330

SPEED BLOCK FINISHING SANDER

SALE **$54**

ITEM #	DESCRIPTION	LIST	SALE
314	4½" TRIM SAW	$165	$119
330	SPEED-BLOC FINISHING SANDER	97	54
345	6" SAW BOSS	154	95
352	3 x 21 DUSTLESS BELT SANDER	212	123
360	3 x 24 DUSTLESS BELT SANDER	297	179
362	4 x 24 DUSTLESS BELT SANDER	312	189
505	1/2 SHEET PAD SANDER	187	104
555	PLATE JOINER W/CASE	269	165
690	1½ HP ROUTER	205	123

32 PC. COMBINATION FILE SET

SET INCLUDES: **10 JUMBO NEEDLE FILES.** WHEN YOUR WORK IS HIGHLY DETAILED, AND SPACE IS TIGHT, OUR LARGE NEEDLE FILES ALLOW YOU PRECISE FILING CONTROL IN AND AROUND YOUR CARVING THE FILES ARE LARGER AND HEAVIER THAN STANDARD NEEDLE FILES.

12 NEEDLE FILES. MADE OF HARDENED ALLOY FILE STEEL AND INCLUDES DEEP CAREFULLY MILLED GULLETS FOR RAPID AND CLEAN CUTTING. SET WILL GIVE SMOOTH SHAPING RESULTS ON ALL WOODS, METALS, AND PLASTICS.

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any case that the owners of cedar chests sand the insides every few seasons to get the aroma going again.

The oil-bleeding will be much more noticeable if the chest has been stored in a hot attic or in direct sunlight, which would heat the wood. The bleeding has nothing to do with faulty workmanship or materials—it's just the way cedar is. Similar problems can occur in pine or other softwoods, particularly when the lumber has not been kiln dried at a temperature high enough to permanently set the resins.

If you'd rather seal the inside of the chest, I'd recommend three coats of thinned shellac. If the problem is limited to a few bad resin pockets, just spot-shellac them. If that doesn't work, one last resort is to rout out the bleeding areas about ½ in. deep and fill them with an inlay of clear wood.

[Jim Cummins is an associate editor of *Fine Woodworking*.]

Reader Exchange:

Several years ago, I designed a music stand very similar to the one discussed by Lance Patterson in *FWW* #63. Copies of these full-size drawings are available for $18 Canadian funds (includes postage and handling) from Frank L. Gallo, 47 Terrence Park Drive, Ancaster, Ont., Canada L9G 3Z8.

Los Amigos del Mesquite is an international organization of individuals interested in mesquite. For more information, write Ken Rogers, P.O. Box 2303, Lufkin, Tex. 75901.

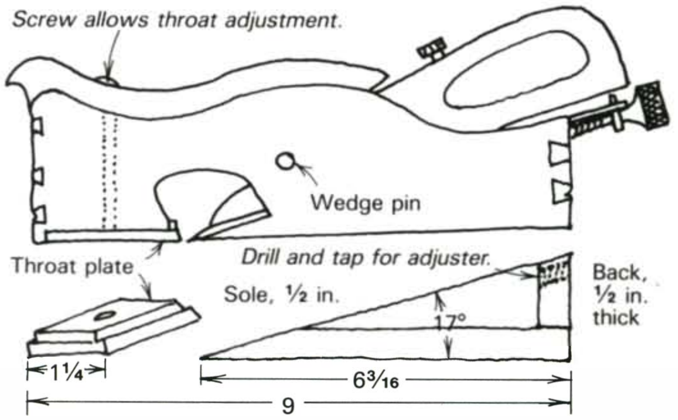
Send queries, comments and sources of supply to Q&A,* Fine Woodworking, *Box 355, Newtown, Conn. 06470. We attempt to answer all questions but, due to the great number of requests received, the process can take several months.

by Jim Cummins

A brass shoulder plane—This handsome shoulder plane was made by Ian Wilkie of Guelph, Ont., who wrote us to say he'd always hankered for a shoulder plane, but always balked at spending a lot for a tool he thought would be seldom used. Finally, inspired by a piece of ⅛-in.-thick, 2½-in.-wide brass he chanced upon in a local hardware store, he decided to make one for himself. That first plane proved functional and handier than he'd expected it to be, but photos of superb planes in old-tool catalogs made him think his first effort was a little dowdy-looking. So, he went on to make this second one.

Photo: Tim P. Sullivan

Ian Wilke's brass shoulder plane with rosewood infill weighs a little more than 3½ lbs. It was made to fit a Record iron.



Wilkie says his small plane was not difficult to make, and he encourages other readers to try their hand at one, using Charles Dolan's brass panel plane from *FWW* #55 for reference. The body is assembled with dovetails, although finger joints would suffice, then silver-soldered. The sole piece is butt-joined inside the sides. The infill is rosewood, epoxied in place. The throat plate is simply two pieces of brass, with the top piece drilled and tapped before soldering them together. The wedge-adjustment screw goes through a T-nut in the bottom of the wedge and contacts the top of the iron; tightening this screw pivots the back of the wedge up, forcing the front down against the iron near the cutting edge. Wilkie says he turned the brass knob on the iron-adjustment screw using a friend's small metal lathe, but adds that this adjustment mechanism is not used much and could be dispensed with.

Sawing black locust—In "Q & A" last issue, Tim Southworth wondered why he was breaking teeth sawing black locust with a portable bandsaw mill. I responded that it was a tough wood to cut and that I'd dulled out my own chainsaw once cutting just a few feet of the stuff. I suggested double-checking the saw tension and sharpening frequently, and added that maybe he should cut the tree into turning chunks or firewood.

That prompted Jean Sumner of Riner, Va., to write in to say she had sawn more than 20,000 bd. ft. of both green and seasoned black locust over the past three years on a Wood-Mizer portable bandsaw mill (Wood-Mizer, 8180 W. 10th St., Indianapolis, Ind. 46214; 317-271-1542). Sumner reports using only three or four blades per 1,000 bd. ft. and recommends sharpening at a 12½° hook angle with about a ½-tooth-width set, the same as you would for oak.

When sawing green locust, it may be necessary to lubricate the blade with water to prevent sap buildup, she says, and adds that the surest way to dull a blade is to saw through dirt or gravel embedded in the bark. She's never broken a tooth unless it hit metal or a rock. "Are you sure these trees weren't in an old fencerow?" she asks. Good question. The tree I gave up on is still standing on the hillside. Maybe I'll take another whack at it; locust *is* beautiful stuff.

Rietveld refelt—Mail about designer Gerrit Rietveld's work (*FWW* #65) has been sharply divided; one camp loves it, the other thinks it's worse than junk. At any rate, Rudi Wolf of Les Plantiers, France, wrote to say that there is a recent bilingual (Dutch/English) book entitled *How to Construct Rietveld Furniture*. It contains measured drawings of 23 projects, including lamps, cabinets and both the red-and-blue and zigzag chairs ($25 ppd. from Architectural Book Center, Colony Square Mall, 1197 Peachtree St. N.E., Atlanta, GA 30361; 404-873-3207). Please note that the designs in the book are copyrighted and may not be used to produce furniture for sale.

Mini news—The article about miniaturist William Robertson in *FWW* #66 has prompted some letters from woodworkers who want to know more about the craft. There is a guild, devoted to excellence, that in addition to newsletters, a directory and other usual guild pursuits also has a summer school: IGMA (the International Guild of Miniature Artisans), P.O. Box 71, Bridgeport, N.Y. 13030. There's also a how-to magazine suitable for anyone from beginners on up: *The Scale Cabinetmaker*, P.O. Box 2038, 1426 Cambria St., Christiansburg, Va. 24073.

The dust settles—Recent articles about choosing a dust collector (*FWW* #67) and about making an electronic switch for turning one off and on automatically (*FWW* #68) have brought some interesting mail. Lloyd D. Uber of El Cajon, Calif., who is a lawyer when he isn't woodworking, adapted the radio control and relay from an old garage-door opener to turn his dust collector on from anywhere in the shop. This seems like a great idea if you have the parts.

Coincidentally, the author of the switch article, Robert Terry, sent us a letter from a woodworker who had been puzzling how to adapt a garage-door switch and who opted for Terry's switch instead. Terry, who offered a kit of parts for the switch, has received so many requests for help in assembling it that he decided he'd better sell complete units as well. Ready-to-install, the switch and sensor sells for $87.75 (Techaid, P.O. Box 3272, Palm Beach, Fla. 33480-3272).

Finally, Dick Goldman of Little Falls, N.J., who also coincidentally is both lawyer and woodworker, wears out about 20 sanding discs per week, so he bought a new Grizzly to clear the dust from his tiny 10-ft. by 12-ft. sculpture studio. Because the room is completely enclosed by the other rooms in the house, he must share his workspace with the screaming machine, necessitating hearing protection to save his ears while the dust collector saves his lungs. Goldman now feels secure enough about his own health, but jokes that he has concerns for other members of the household—he swears the Grizzly has enough pull to suck up his cats. □

Jim Cummins is an associate editor at Fine Woodworking.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SOLID WOOD	4-6
VENEER	3-5
CHIP BOARD	5-6
PLASTICS	3-5
STEEL	3-6
PAINT REMOVAL	3-6

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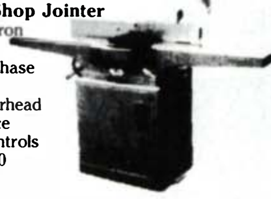

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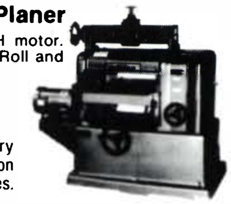

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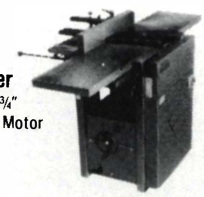

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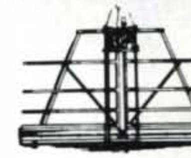

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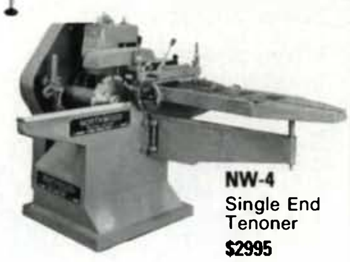

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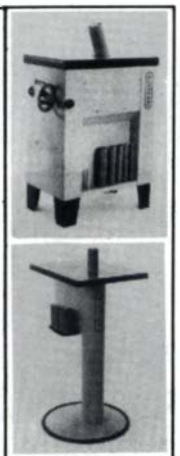

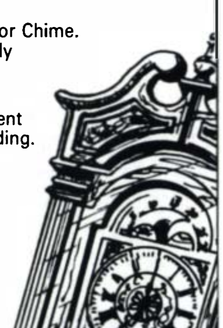

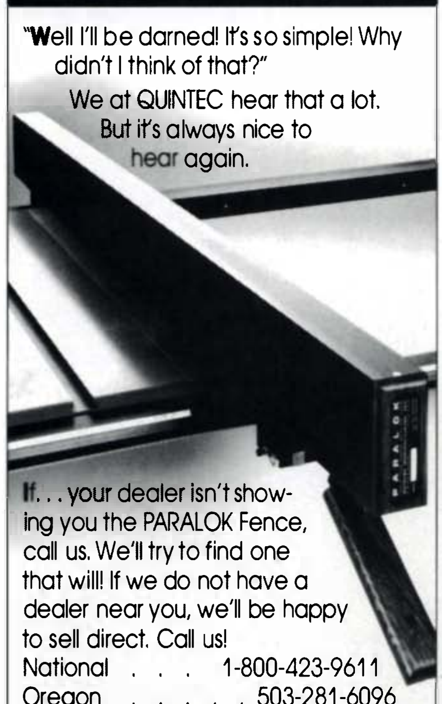

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First and foremost, *Fine Gardening* is going to be a practical magazine about creating beautiful gardens. We'll concentrate on the broad subject of landscape and ornamental gardening—how to make your garden a pleasure to the eye, and nose. But we won't neglect the palate, either. We'll provide serious, if more selective, coverage of food gardening as well.

In our first issue alone, you'll find in-depth articles about building your own lily pond; growing primroses, foxgloves, and French beans; controlling Japanese beetles; and the nearly magical transformation of a very ordinary yard. We'll also answer your gardening questions, tell you where to find the equipment you need, and use ground-breaking, full-color graphics to show you what's going on every step of the way.

Best of all, this information will come directly from experienced, successful gardeners—amateurs and professionals—who take you into their gardens (and confidence) to show you exactly what they do and how they do it.

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Paul Roman

Paul Roman, Publisher

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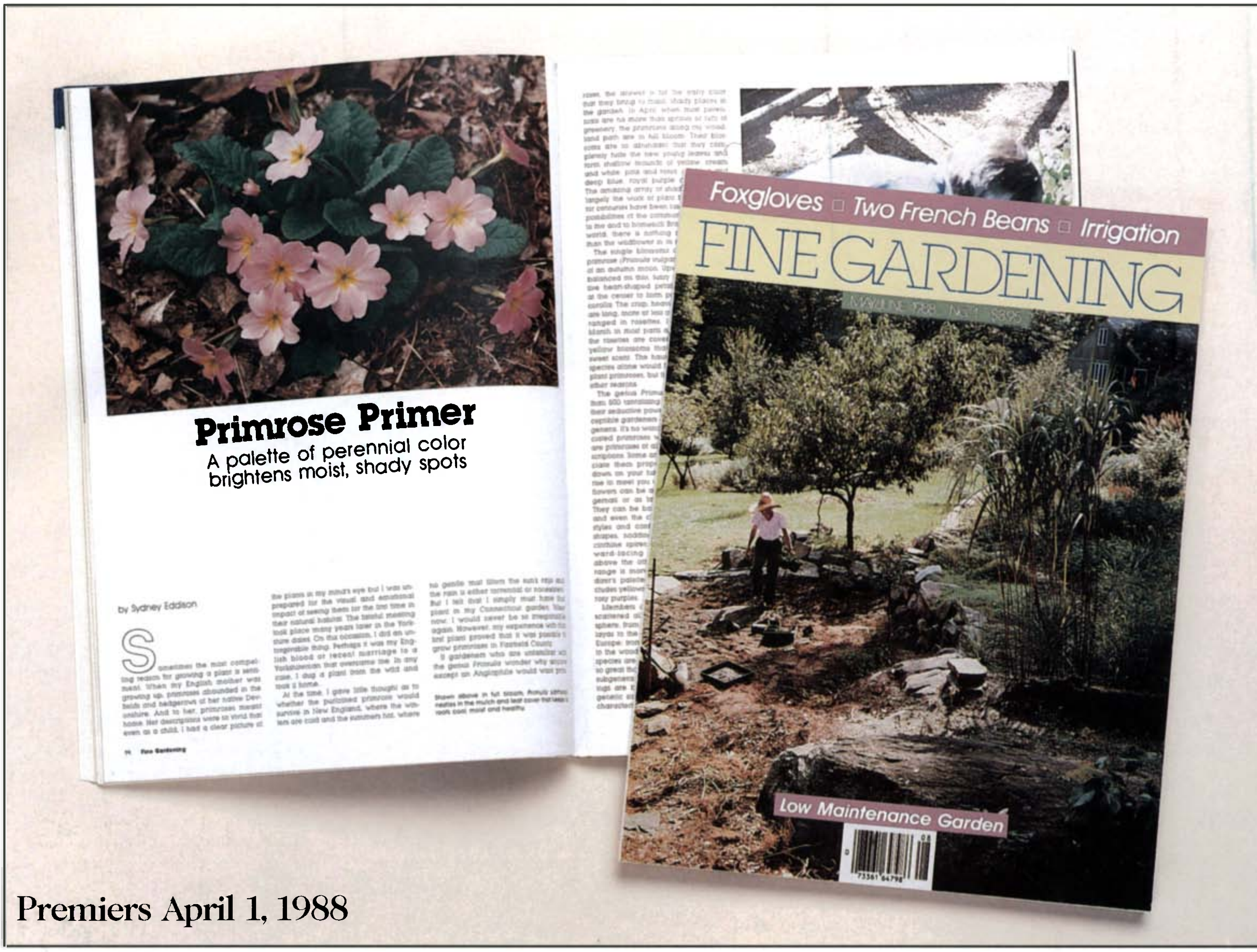

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Garden Design

The design articles in *Fine Gardening* won't be effusive strolls through expensive landscapes. To be sure, there will be inspiring photographs, but they will be accompanied by down-to-earth talk about how the lovely scene you're looking at came to be. You'll come away with practical design ideas you can use in your own garden, whether you're grappling with a troublesome little area or an entire home landscape.

Specific Plants

Experienced gardeners will tell you how to select, propagate, and nurture a wide variety of plants: annuals, perennials, shrubs, trees—old standbys and new introductions. You'll find out about hardy ivies, trillium, new bulbs from Africa, ornamental grasses, specimen trees, French beans, table grapes, and wild rice, to name just a few.

National Coverage

Fine Gardening will go everywhere there is something to be learned—a New Hampshire garden with more than 700 varieties of wildflower, a California backyard with an ingenious home-built irrigation system, a rooftop garden in Chicago, a marvelously landscaped hillside in Arkansas. And whenever it's appropriate, we'll go the extra mile to show you how you can use the ideas and information from other regions in your own neck of the woods. The result: a wealth of ideas and information to improve and enrich your own gardening—wherever you live.

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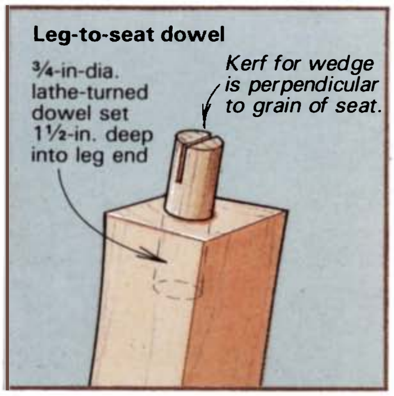
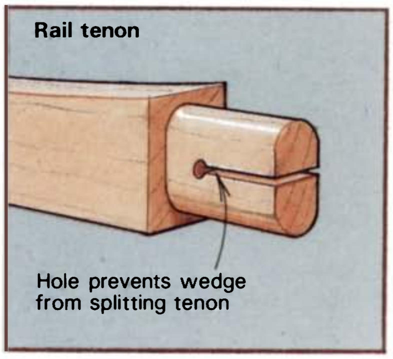
Building a Stool

Compound angled joints on drill press and tablesaw

by Gary Rogowski

Fig. 1: Rogowski's stool





It was not in the sometimes-a-great-notion category that I decided to build a stool a few years ago. I needed something sturdy to sit on. "How hard could it be to knock out a stool?" I asked myself. My first attempt ended in a three-legged triumph of material over maker. It was astonishingly ugly and so precarious that you could sit on it only with great caution. It did hold a plant very nicely though.

In the process of building my first stool, I learned a basic lesson. Effort, not luck, and planning, not good intentions, are required to successfully build a piece of furniture. This involves a thoughtful approach to design, accurate drawings and careful construction. Gone is the innocent notion that one relaxing weekend of humming and puttering is enough to concoct a piece with style, grace and strength. So, I started over.

Designing a chair or stool is a deceptive task, like setting up a model train. Kind thoughts blessed with the vision of an innocent invariably produce some degree of frustration. It only looks simple. You soon find the job involves more work than you expected. The process is a lot like designing other types of furniture in that it involves solving a series of problems, both aesthetically and structurally. Stools do present unique design difficulties, however. A stool's parts must strike a delicate balance between looks and weight. Stools look jaunty compared to chairs, are comparatively lighter and easier to move. Yet, looks can't come at the expense of strength. Thus, a stool is built with the strength of a timber-frame house even though its airiness gives the impression it is built of matchsticks.

As if this didn't present enough of a challenge, recall that, by design, stools are meant to put you high off the floor or close to it. Generally, the former design is more popular because there are more reasons in this world for sitting at workbenches, counters and bars than there are for sitting a few inches off the ground. Thus, stools are generally higher than chairs and narrower in front and side profile. This makes for a weight distribution problem. Chairs are comparatively wider and more stable, so their legs can be perpendicular to or angled from the seat. Stools need all the stability they can get, are more stable and look best if their legs are splayed (i.e. they slope at a compound angle). A stool with splayed legs distributes a person's weight over a greater area than one with legs perpendicular to the seat. Thus, a person sitting on a stool with splayed legs must tip through a greater arc before falling over.

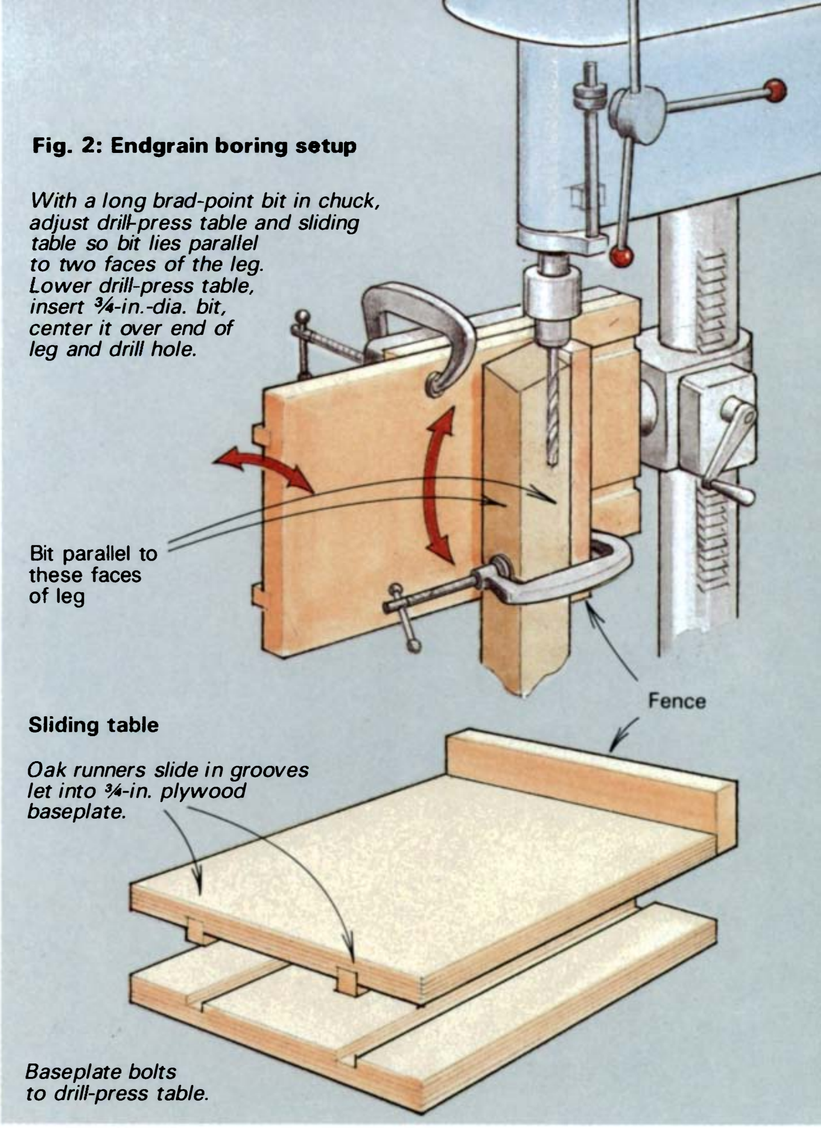
Splayed legs help, but don't entirely solve the stability problem. A stool's stability and attractiveness rely heavily on its proportions. In my case, these were quickly arrived at through an empirical method. I wanted to sit comfortably at my workbench and knew that chair height, about 17 in. or 18 in., would be too low. I put a chair on top of bricks, placed phone books on its seat and finally, sat myself on top of the phone books. I discovered the correct seat height was about 25 in. With the stool's height established, I went to the drawing board and made a series of drawings at ¼ in. scale, experimenting with various leg angles and spacing arrangements. I finally decided to locate the legs so they were 12 in. apart at the base and sloping 82°. Given the stool's height, the slope of the legs looked just right. I used a sliding protractor to copy the angle of the legs off the drawing.

Angled joinery—It soon occurred to me that although the sloping legs add to a stool's attractiveness and stability, they presented quite a challenge in joining together its parts—both in terms of rung-to-leg and leg-to-seat joinery. This was particularly troublesome in my case because, being influenced by James Krenov's work, I wanted to use exposed mortise-and-tenon joinery throughout. This meant the eight rung mortises would have to be cut to compensate for the slope of the legs, and the tenons on the ends of the rungs would need sloping shoulders. Furthermore, the compound angle does funny things to the geometry of the legs. The footprint seen in figure 3 shows an exaggerated view of what happens. Fortunately, the gentle curve I added to the legs had no effect on the joinery, because the legs curve only on their outside surfaces and were shaped after the joints were cut.

Joining the seat to the legs seemed similarly tricky, but after some head scratching, this problem was easily solved by letting a lathe-turned dowel into the top of each leg (I explain how to do this below). A dowel joint eliminated the need to cut a tenon with compound-angled shoulders on the end of the leg.

I started work on the stool by milling up my stock for the legs, rungs and seat. Cutting the compound angles on the ends of the legs seemed the trickiest job, so I started with them. I cut an accurate 8° compound angle on the ends of each leg on the tablesaw. With an extra-long fence on the miter gauge, I tilted the

Fig. 2: Endgrain boring setup



blade over 8°, made a test cut and then checked it with the protractor. I repeated and tested the cuts until the saw cut a perfect 8° slope. To complete the compound angle, I set the miter gauge to 8°, make another test cut and check as before. When I can produce a perfect compound miter, I clamp a stop to the miter-gauge fence. Then, I cut one end, tip the miter gauge to 8° in the other direction, flip the leg over and cut the leg to finished length. Be sure to check that the top and bottom of the leg are parallel after it is cut to length.

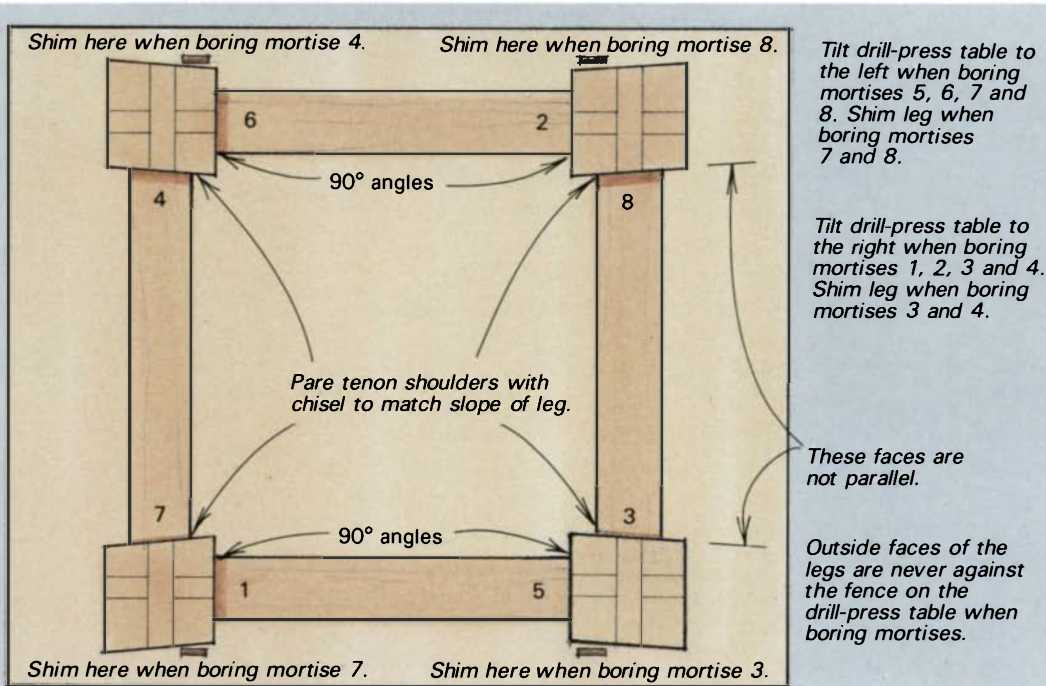
To bore the dowel hole in the end of each leg, I clamp the leg to a vertical sliding table bolted to the drill-press table. The sliding table moves toward or away from the drill-press column (see figure 2, above). To ensure the leg is plumb to the bit, I swivel the drill-press table around until the leg butts up to a long brad-point bit chucked into the press, adjusting the drill-press table so the leg lies along the bit's length. I then reposition the sliding table so a second face on the leg lies along the bit's length (referencing off a face perpendicular to the first face). Once I'm sure the leg is plumb to the drill bit, I switch to a ¾-in.-dia. bit, center the leg's end under it and bore a 1½-in.-deep hole.

Next, I crosscut the rungs on the tablesaw with a plywood crosscutting jig with an 82° wedge tacked to its fence. With the wedge to the right of the blade and its narrow end pointed toward the left, I cut one end of each rung. Then I positioned the stop block, flipped each rung over and cut it to length. Next, I lowered the blade and repositioned the stop block to cut the tenon shoulders. On each rung, I cut one shoulder, flipped the rung end for end and cut the shoulder on the opposite face. I then switched the wedge and stop block to the other side of

Tenons are cut square and then rounded with a file to fit the mortise, above. Their shape is checked with a template with a slot cut by the same end mill that bored the mortises. With addition of a shopmade sliding table, right, the author's drill press does double duty as a slot mortiser. Clamps under the table hold stop blocks to set length of mortises, which are first bored with a brad-point bit, then finished with an end mill. The sliding table is sloped to the left or right to angle the mortises, accounting for the legs' slope. A test leg to establish table angle and locate stops is shown in place.

Fig. 3: Boring mortises

This diagram of the legs and rungs, viewed from above, shows the geometric relationship between them. Since the legs lean in at a compound angle, they're diamond shaped in cross section. The rails are parallel to the seat and floor. The tenons on the rails and mortises in the legs must accommodate the diamond-shaped section of the legs. Rogowski put shims under the legs when boring four of the mortises and shaved the shoulders on the matching tenons.



the blade and repeated the procedure to cut the remaining two shoulders.

Next, I roughed out each tenon cheek on the bandsaw to prevent the offcut from flying back at me and finished sawing the tenon with a tenon jig on the tablesaw. Back at the bandsaw, each tenon was trimmed on its top and bottom edge to give it a shoulder on all four sides. Shoulders of two rungs must be pared, as described in figure 3, to compensate for the slight diamond shape of the legs. The tenons were rounded with a file to match the curve of the mortise and each was slotted on the bandsaw to receive a wedge. A $\frac{3}{16}$-in. hole was bored at the bottom of the slot to prevent the wedge from splitting the tenon.

Drill-press mortising—I moved on to cutting the leg mortises. I don't own a slot mortiser, but have the next best thing—a horizontal sliding table for my drill press (see photo above, right). I set the table's angle for the sloping mortises using the angle on a rung end as a guide. I chucked a long drill bit into the drill press to serve as a positioning guide, stood the rung up on the table, tipping the table until the rung laid flat against the drill bit.

Without changing the drill-press alignment, I removed the drill bit and chucked a four-flute end mill into the drill press. The end mill badly mauled a test leg at every speed I tried. The remedy was to bore out the bulk of the mortises with a brad-point bit. The mortises were cleaned up taking shallow passes with the end mill, running the drill press at 1,600 RPM. In boring with both the brad-point bit and the end mill, I prefer to stop $\frac{1}{16}$ in. or so shy of boring out the other side of the mortise. The leg's outside is shaped after the mortises are cut, so the remaining wood is cut away, leaving a clean opening. If you bore through the other side, you will have to put a piece of scrap under the leg to keep from cutting into your sliding table; you also risk tearing out the exit hole. The final shaping may not be able to remove the tearout if it's too severe. Mortises 1, 2, 3 and 4 are cut with the table sloping to the right; mortises 5, 6, 7 and 8 are cut with the table sloping to the left, as shown above. Remember to mark the table for two different sets of stops for boring the upper and lower rung mortises. When boring for mortises 3, 4, 7 and 8, I had to

Fitting rungs

by Jeremy Singley

I wish I had an extra 10 minutes for every time my mother told me not to tip back in my chair. I could retire. Mothers know a chair or stool's rungs are its weakest link; to the woodworker, rungs are a pain in the neck.

Not only do rungs have to fit tightly to the leg, in some cases they have to fit tightly to each other—double jeopardy. This requires rung holes be bored in the leg at the correct angles and cut to an accurate length. If these requirements aren't met, the assembled stool or chair will have legs sloping at different angles.

Fortunately, I've developed a bunch of techniques and jigs to make the job of fitting rungs to legs easier. For example, when I have just one or two stools to build, I bore the leg holes in the seat with a hand drill sighting along a sliding bevel gauge set to a leg axis line as a guide. I dry assemble the legs to the seat, then eyeball the alignment of the rung holes. The rungs are bored from inside the legs with an electric drill. If the room between the legs isn't enough to accommodate the drill and a full-length bit, I use a ground-off Powerbore, spade or twist bit.

The tricky part here is getting the rung holes centered. I solve this problem with a marking tool or a try square and straightedge, shown in figure 7. I bore on the marks and measure for rung length. I check that the legs are the correct distance between their ends, use an extension rule with a sliding tongue to measure the distance from the shoulder of one hole to the bottom of another, then add the depth of the second hole. If you find reading the ruler in this situation awkward, you can simply measure the depth of each hole and then measure the span between them. The rung stock is cut to this length, and its ends are shrunk to a snug fit with a heat lamp just prior to turning and reshrunk just before the stool is assembled. The tenons swell from the moisture in the glue, locking them firmly in their holes.

The eyeball rung-boring method works if you have only a few stools to build; if you have a large batch, it pays to set up a jig.

It's crucial to keep the legs organized as you bore. A box of 50 unmarked legs with two rung holes in each makes a fine solution to the leisure-time problem—you can spend your day off sorting legs. To avoid this, before each leg leaves the jig, I mark its end with a number from one to four, corresponding to the four clockwise designations of leg positions: 1—front left; 2—front right; 3—rear left; and 4—rear right. This system assumes the stool is flipped over (the position it will be assembled in) so its left, front leg becomes the leg sticking up at the left rear. I use a color code to keep track of rungs. I crosscut boards and paint their ends a color to match rung length. No further coding is necessary, because turned rungs are not handed—a top rung that fits on the right side of the stool would also fit the left side. Then I rip the boards into rung blanks.

A final question: What do you do if you botch a rung hole? First, act innocent. Why bother the world with more bad news than it has already? Usually, turning a new leg is more work than the following alternatives. If the hole location is wrong and you plan to paint the stool, simply fill the hole with a plug and sand it flush. If the angle is wrong, turn a rung and then whittle the oversized tenon at an angle by eye to fit the hole (see figure 8, below). You can also glue a lathe-turned dowel into the hole and rebore. Since you have to bore the new hole exactly on the center of the dowel, position the plug with the tail center mark facing up and bore into the center mark with a brad-point bit. □

Jeremy Singley makes chairs and stools in East Middlebury, Vt.

Fig. 7: Marking legs for boring

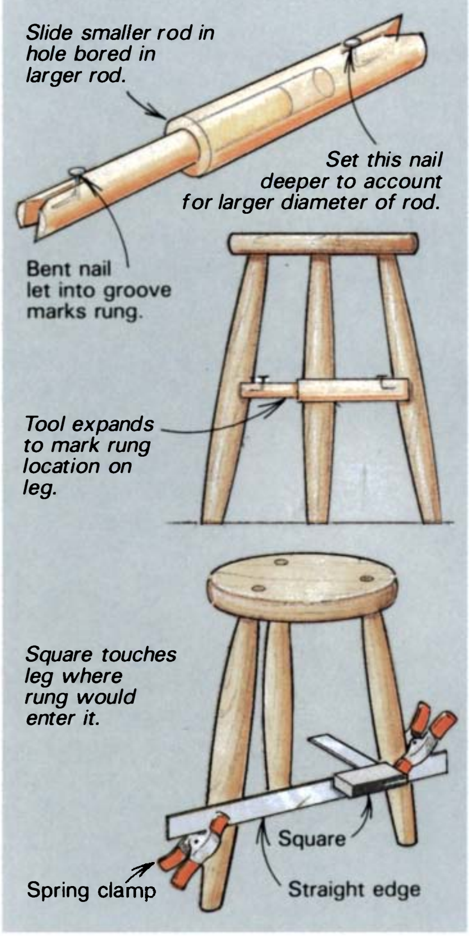


Fig. 8: Leg-boring jig

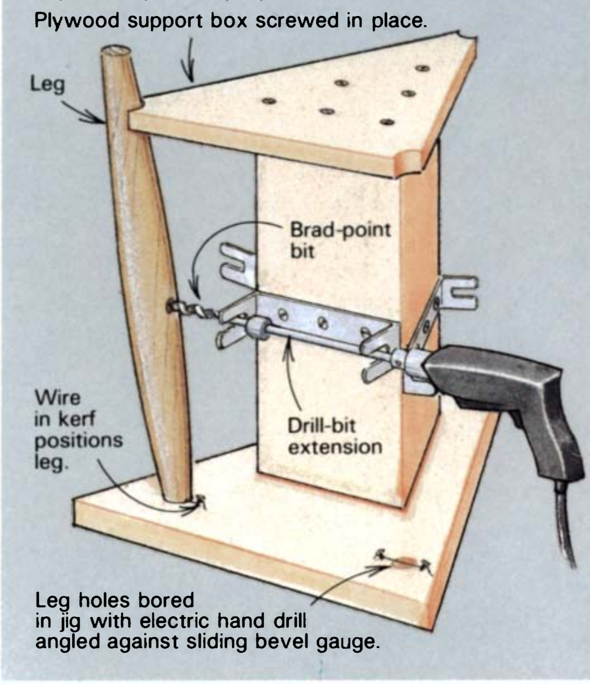
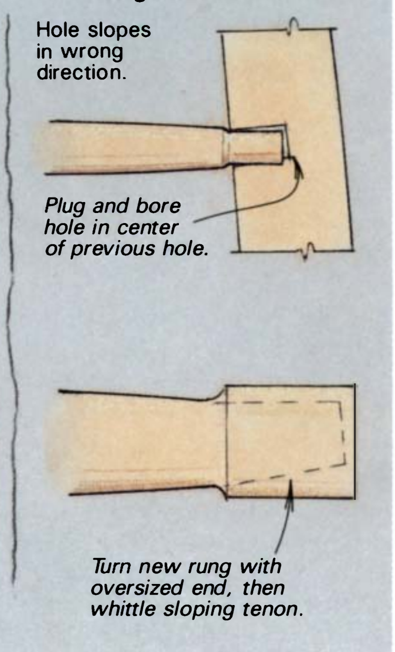
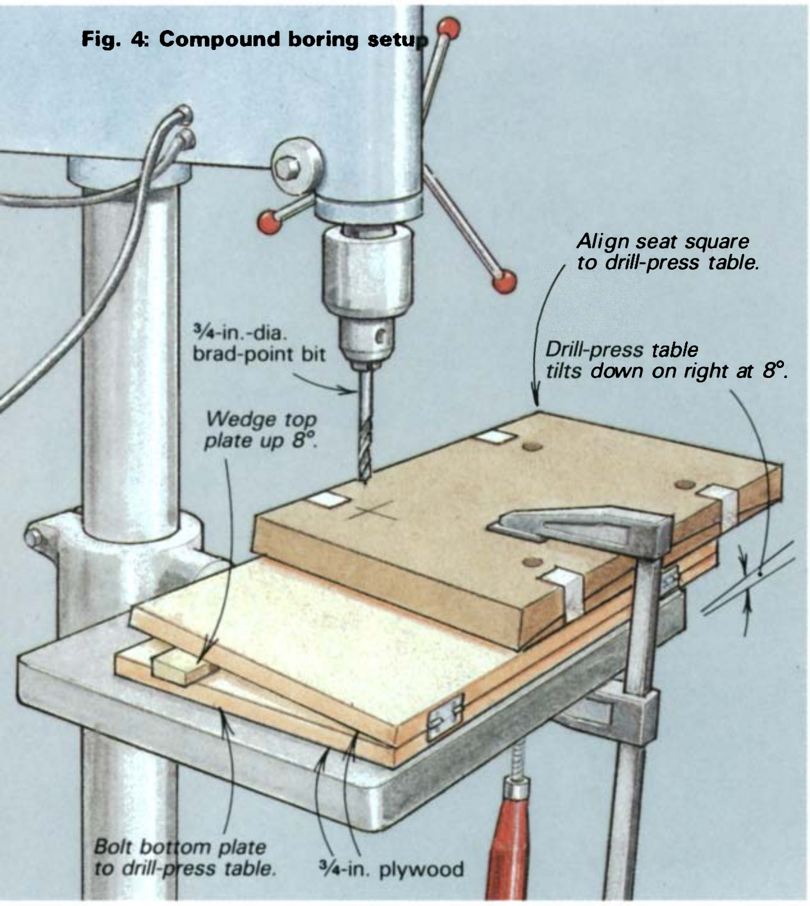


Fig. 9: Fixing a botched rung hole



The curves on the outside of the legs are roughed out on the bandsaw and then cleaned up with a straight bit and template on the router table. Note that the template curves in two planes to accommodate the curve routed during the first pass. Always test such a setup before trying an actual leg.

Fig. 4: Compound boring setup



shim the legs with a slip of paper under the rear, back edge to compensate for the compound slope of the legs.

With the setup fine-tuned, I cut the mortises and moved on to shaping the legs. Working from a full-size drawing of the stool, I made Masonite templates shaped to the curve of the legs and seat. I transfered the marks from the Masonite leg template to one made of alder, which I curved in depth and plan view (see photo, above) to match the curve of the legs. I marked the legs out, rough sawed them on the bandsaw, then taped the template on top of one leg and finish shaped it on the router table with a straight bit and ball-bearing pilot bearing against the template. I then flipped the leg over 90° and used the alder template to guide the straight bit while cutting the second curve. As can be seen in the photo, the curve in the template's depth accommodates the first curve cut in the leg.

I sand the legs and rungs before assembly because it's impossible to do a quick and neat job after the legs are assembled. There is no way of simultaneously assembling all four legs and rungs on a stool single-handedly. Because I work by myself, I had to glue and clamp the stool in subassemblies. I glued up the front and back pairs of legs and rungs (the legs perpendicular to the long axis of the seat) and hammered the wedges into the tenons. When the glue was dry, I inserted the remaining two rungs and then glued and clamped the two pairs together.

Seat shaping—I was moving into the homestretch and started work on the seat. To save time shaping, I wanted to saw out the curve in the seat, but my bandsaw wasn't large enough to accept the seat blank turned up on edge. I solved this by making the seat from two narrower halves; I sawed the curve in each half then glued them together. I don't cut to the curved line, but leave a slight amount of wood to allow for tearout when boring the leg holes. Save the curved offcuts, you'll need them later to back up the seat when you bore the holes through it.

To mark for boring, I set dowel centers into the top of each leg, placed the seat top down on the bench and set the legs with dowel centers against the seat's bottom. After checking that the seat was positioned correctly relative to the leg, I tapped on top of each leg to mark the seat bottom and then returned to the drill press.

I use a hinged jig that bolts to the drill-press table to bore the leg holes (see figure 4). This is simply two pieces of plywood connected by a piano or butt hinges. The jig is placed with the hinge knuckle opposite the drill-press column and the jig's edge parallel to the drill-press table. The top plate is wedged up from underneath until it's at an 8° slope, then clamped in place so the wedges can't move. Next, I tilt the table 8° to the left or right, using a rung, as before, to align the table relative to the bit. I rest the seat top down on the table with the offcuts taped together underneath the seat. The brad-point bit enters the offcuts as it exits the seat, reducing tearout on the top of the seat. The seat is parallel to the edge of the jig.

Assembly is relatively easy compared to the rest of the project, but it takes considerable clamping force to bring the stool parts together. I set concrete blocks on the shop floor and then put a piece of plywood that is slightly larger than the area covered by the stool's base on top of the blocks. I set the legs on top of the plywood and the seat on top of the legs, then rest cauls on the seat's long axis (the cauls are notched to allow the leg dowels to project through the seat). I bring the seat and legs together with bar clamps running from the plywood to the cauls. I have to flex the legs a few degrees to get them into the holes; this requires a fair amount of force. Once the legs fit in the holes, a generous amount of clamping pressure is required to bring the legs and seat together. Once the legs butt up to the seat, I take the clamps off, spread some glue on the wedges and bang them in place.

After the glue has dried, I file down the seat dowels and spokeshave and sand the seat to its final curve. I file down any remaining projecting tenons. I lightly sand any areas that require it and then finish the stool with Watco or a similar oil. I prefer oil finishes because stools are prone to being roughly handled, and oil finishes are easy to retouch.

Through the years, I have made a number of variations of these stools to suit the customer's needs. Their heights have ranged from 24 in. to 27 in. and with different rung heights, but I haven't changed the basic design; neither have I changed my attitude toward building them—another relaxing, uncomplicated weekend project. I'll get started after brunch. □

Gary Rogowski builds stools and other intriguing projects in his Portland, Ore. shop.

Turning chair and stool spindles

by Mac Campbell

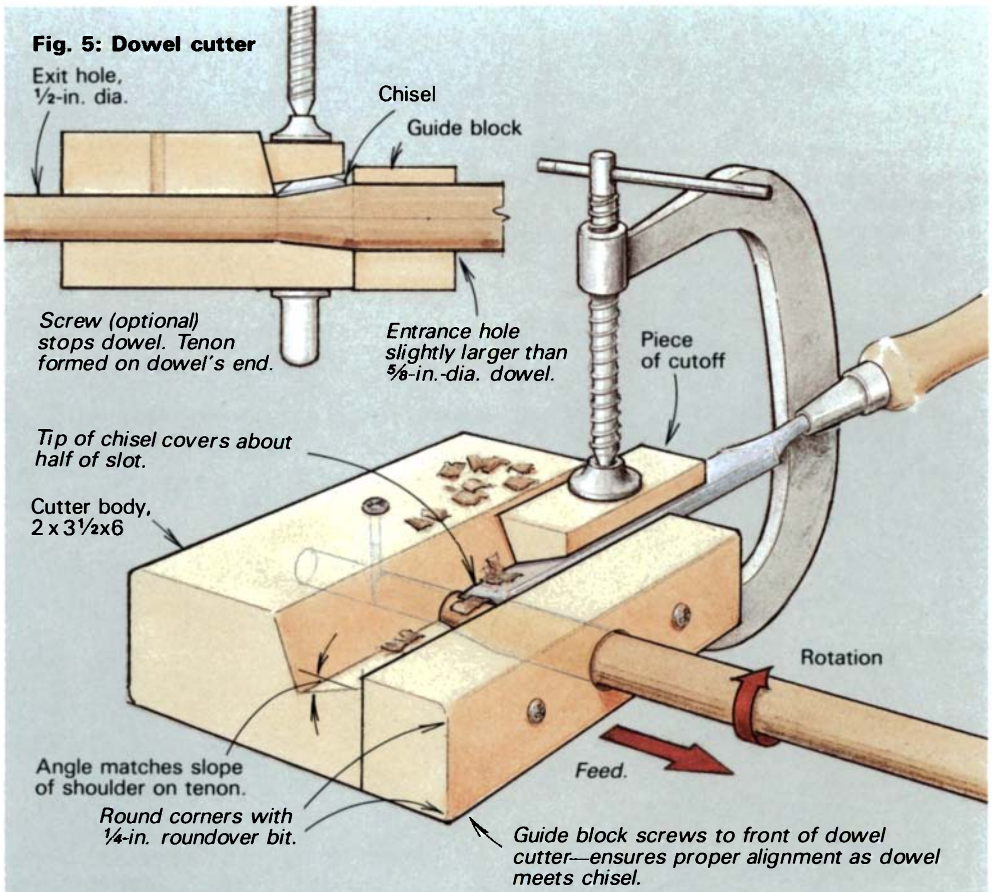
Turning spindles and rungs between centers is difficult because their thin diameter makes them whip badly. Furthermore, they have to be virtually identical, otherwise you'll get bogged down in a nightmare of tedious fitting on each chair or stool at assembly.

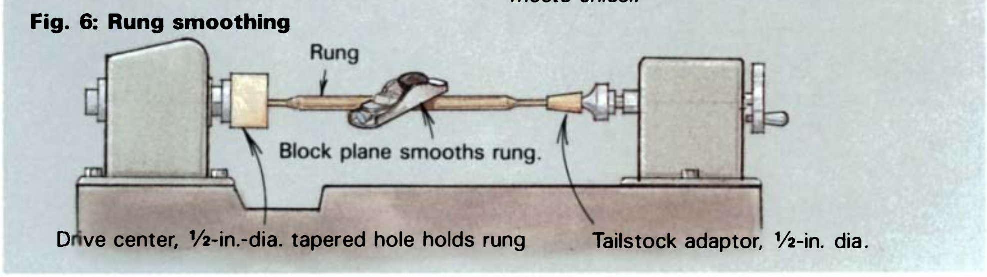
I avoid this problem and speed up the process by using shopmade dowel cutters to rough the spindles or rungs to a consistent size, then finish turn them with a block plane followed by sanding. My dowel cutters are simply rectangular wooden blocks with a hole bored through one edge to allow the dowel blank to be fed through. An angled rabbet cut into one face of the block opens up a slot, allowing the cutting edge (a bench chisel clamped to the jig) to do its work. The dowel cutter can be hand-fed or guided along the lathe's tool rest.

To bore the hole, I mount the block on a faceplate and bore with a bit equal to the diameter of the finished dowel. Then, I use a square-edge scraper to enlarge the opening, creating a cone-shaped entrance hole slightly larger than the diameter of the turning blank I'll be using. The angled rabbet, shown at right, is cut on the tablesaw with the blade tipped at an angle equal to the slope of the cone.

I made one dowel cutter that accepts a square ¾-in. blank on one end and reduces it to an $^{11}/_{16}$-in. dia. To produce the ½-in.-dia. tenons on the end of these turnings, I made another dowel cutter that has an alignment block mounted to it with an $^{11}/_{16}$-in.-dia. hole bored through it (see figure 5). This hole is centered over the ½-in.-dia. exit hole to ensure proper alignment as the tenon is cut. To help align the exit hole with the hole in the block, turn a spindle ½-in.-dia. on one end and $^{11}/_{16}$-in.-dia. on the other. Slip the spindle into the dowel cutter, then slip the alignment block over it. A screw that runs through the top of the dowel cutter stops.the dowel's passage through the cutter, forming the tenon on its end. A third dowel cutter reduces $^{11}/_{16}$-in.-dia. turnings to ⅝ in. dia. for tapering chair spindles or dowels on stool rungs.

To turn the dowel blank as the cutter is fed along its length, I've built some drive centers that attach to the lathe's headstock. These are basically simple wooden chucks. Each consists of a wooden block screwed to a faceplate. For the largest one, I chop a square hole to accept a square dowel blank. A smaller drive center has a stepped hole made by first boring a ½-in. hole followed by a $^{15}/_{32}$-in. hole. To keep the blank





firmly on the tailstock, I made a tailstock adaptor from a 2-in.-long wood plug, with a ½-in.-dia. hole bored in one end.

This is how the setup works. I prefer to split turning blanks from the tree, but if I can't use split stock, I mill the blanks to ¾-in. square and cut them to length. A C-clamp holds the chisel to the cutter and should be set to cover about half the slot. With the lathe set at about 1,350 RPM, I insert a blank into the square drive center and hold up the blank's other end with the dowel cutter. I turn the lathe on and, reaching over the turning with my right hand, feed the cutter down the turning. This isn't as risky as it sounds; I've found that after some practice, I could turn the spindle down freehand, that is without supporting the dowel cutter on the tool rest. Feed the cutter down the blank until it hits the drive center. If the cutter is supported, you can go just about up to the drive center. If the turning jams in the cutter's exit hole, knock the chisel in a little deeper. If that doesn't work, slice off a little more of the cone on the tablesaw or shave it down with a rabbet plane and try the setup again.

Stop the lathe, remove the dowel cutter and, using the same procedure, cut the ½-in. tenon on the end of the turning. Work up a batch of these turnings and then clamp the $^{11}/_{16}$-in. cutter to the workbench with the exit hole facing you, and clamp down the ½-in. cutter. Feed the turning through the cutter, grip its tenon in a portable drill, reverse the drill and draw the remaining length of the turning through the cutter. Only a very short length of the dowel should remain to be turned—the portion of the dowel inside the drive center and the length of dowel

Photo: Mac Campbell

For boring rung holes, Campbell uses a 2x4 with a hole bored through it as a guide for his drill. Demonstrated here on a Windsor chair, the technique works on stools too. To avoid splintering, the auger bit (extended by a pipe welded to it) is retracted when the pilot screw breaks through. The holes are then finished by boring from the other side.

inside the cutter that the chisel could not reach.

I reverse the drill and feed the far end of each turning into the cutter to produce the ½-in. tenon on the other end. Next, using the ½-in. tailstock adaptor, and the lathe running at 2,200 RPM, I smooth the turning with a block plane and finish surfacing it with a belt sander and 120-grit paper.

You can also use this method to produce spindles that taper from their midpoint to the tenons by cutting ⅜-in. tenons on the ends of the $^{11}/_{16}$-in. turnings, then tapering the turnings with the block plane.

When I have to bore the holes for rungs,

Gallery of stools

The dictionary describes a stool as a seat, usually without back or arms, supported by a pedestal or three or four legs. But in reality, stools come in all shapes and sizes and can be built for any purpose using almost any kind of joinery and finish. Once you've abandoned a preconceived idea of what a stool should look like (it has three or four skinny legs and a round seat), the design possibilities broaden considerably. The photos here show some of the stools we've encountered recently and are a good cross section of recent stool design.

Photo: James Hutchinson

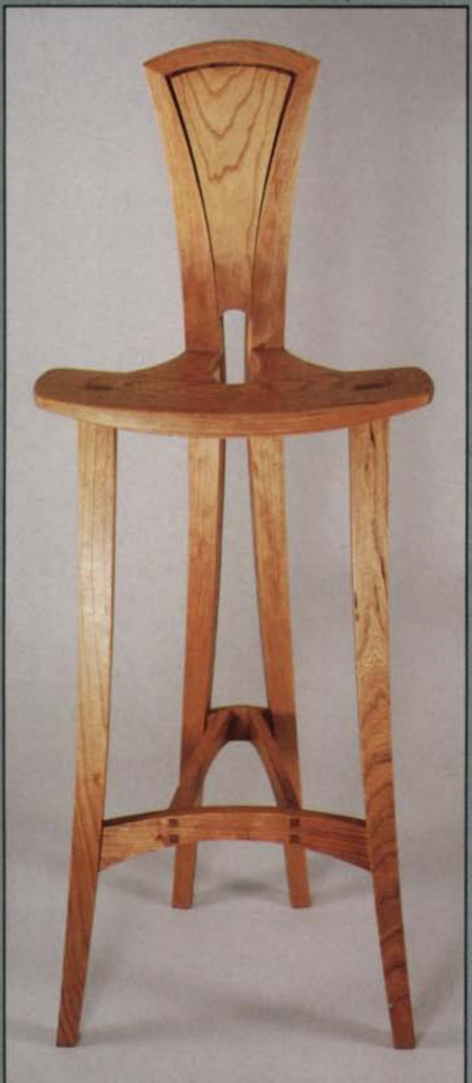


Photo: Fred Puksta

Built for sitting at a 42-in.-tall counter, the cherry stool at left was built by James Hutchinson of Mohnton, Penn. Its back legs are bent from tapered laminations, while its front legs are bandsawn from 8/4 stock. The crown rail is splined and mitered, and the stretchers are bandsawn and assembled with mortise-and-tenon joints. Its seat is 18 in. wide and 10 in. deep. "Seating Planes" is the title of these stools, above, built by Fred Puksta of Rochester, N.Y. The stool on the left is made of white ash with ebony inlay. Puksta built the stool on the right with ebonized cherry, then inlaid the legs with a line of multi-colored telephone wire. Both are 30 in. tall, with 24-in. by 24-in. bases. The rungs are ash covered with rubber tubing, and the stools are assembled with bridle and mortise-and-tenon joints.

I revert to a tool I last used for log-cabin building. It is a ½-in. auger bit welded onto the end of a ⅜-in. OD steel rod. The whole setup, about 20 in. long, is chucked into my drill.

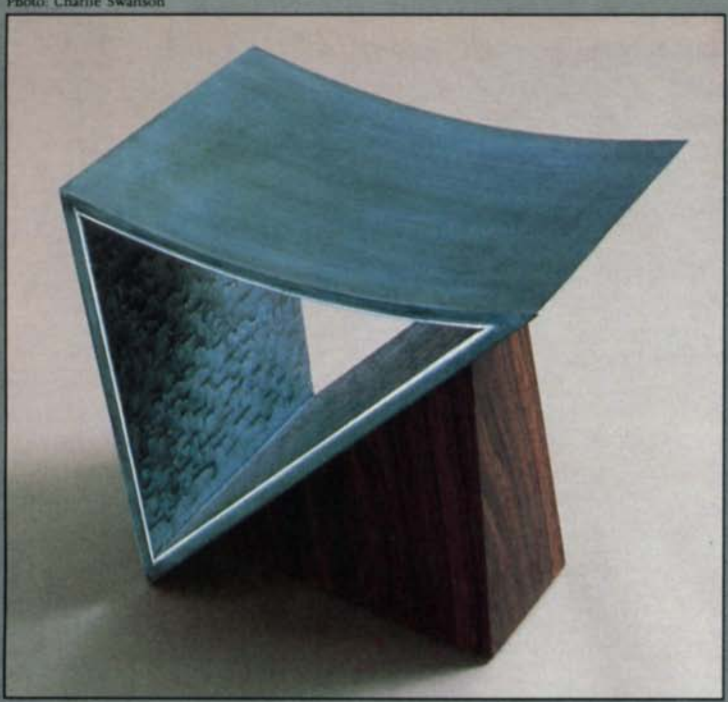
Here's how I use it. I dry assemble the chair or stool right-side-up on my bench. With a pair of dividers, I measure the rung's hole positions relative to the benchtop and then poke a mark at the correct location. I turn a 2x4 scrap into a boring guide by boring through its wide face with the extended auger bit. With the guide block clamped in my vise, I line up the bit—sighting along the shaft for the right angle—and begin boring the rung hole. I stop boring just as the auger's leadscrew breaks through the leg. I turn the piece around and bore through the other three legs, stopping each time as the pilot breaks through. I go back and finish boring the holes from the other side. The difference in angle when you approach the hole from the other side makes no difference if you put the auger's leadscrew in the exit hole.

After all the rung holes are bored, I remove the front or back legs, insert the rungs and reassemble. I then turn the chair 90° and bore for the center rung. This system is for through-wedged joints; if you prefer a blind or fox-wedged joint, set a depth stop on the auger bit.

The setup is very accurate and nearly foolproof. One caution, however: Because the leg you are boring into is at an angle, file back the auger bit's cutting lip. Otherwise, the cutting lip will contact the downhill side of the leg first and start cutting before the spurs have a chance to score ahead of it, tearing out the hole instead of cutting cleanly. □

Mac Campbell builds custom furniture in Harvey Station, N.B., Canada.

Photo: Charlie Swanson



Robert Sonday of Free Union, Va., made this traditional Shaker weaver's stool from untraditional Wenge and then gave it an oil finish. The stool is 38 in. high, 19½ in. wide and 14¾ in. deep with a 26-in.-high seat woven with cotton tape.

Photo: D'Wayne Blackdog

Charlie Swanson of Providence, R.I., used a bent lamination for the seat of his 17-in.-tall stool, above. He covered the seat with gesso and then textured it with a rubber stamp. To create the luminescent-band edge treatment, Swanson wiped away the Japan-color surface paint, revealing the gesso beneath. Bill Sloane's stool, below left, took 200 hours to build; it was the first piece of furniture he built. It's 20 in. tall and has legs tenoned into the slats of its 14-in. by 14-in. seat. The stool's seat and legs are maple; the stretchers, cherry. It's finished with linseed oil and turpentine. The 4-legged cherry stool, below right, was built as a one-day project by Stephen Proctor, dean of woodworking at the Wendell Castle School in Scottsville, N.Y. Proctor used it to demonstrate shaper techniques to his students. The legs were profiled on the shaper using a flush trim bit guided by a template and then tapered on the planer. With a felt-tipped pen, Proctor sketched in the ballet slippers on the legs.

The Spindle Shaper

Basic techniques for a shop workhorse

by David DeCristoforo

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

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

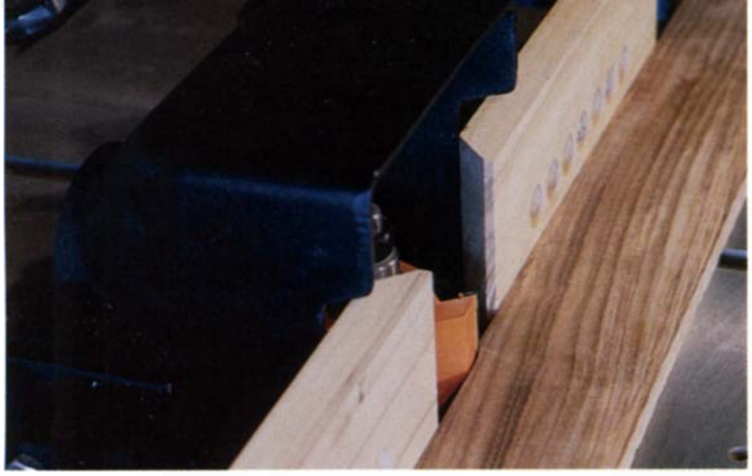
The shaper is a simple machine—a large horizontal worktable with a vertical spindle projecting through a circular opening. The spindle height is generally controlled by a handwheel on the front of the machine. Cutters are mounted on the spindle, which is driven by a powerful motor, either direct drive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

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

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

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

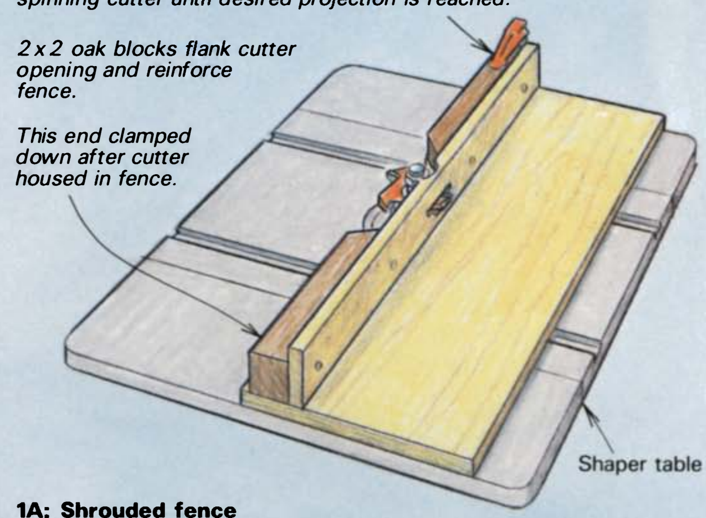
Shaper safety—Consider safety before using a shaper. It is an extremely dangerous machine and over the years I've developed



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

Fig. 1: Customized fence

Clamp one end of fence to table so assembly can be rotated into spinning cutter until desired projection is reached.



1A: Shrouded fence

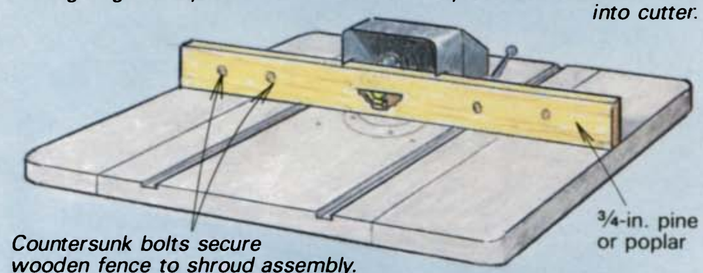
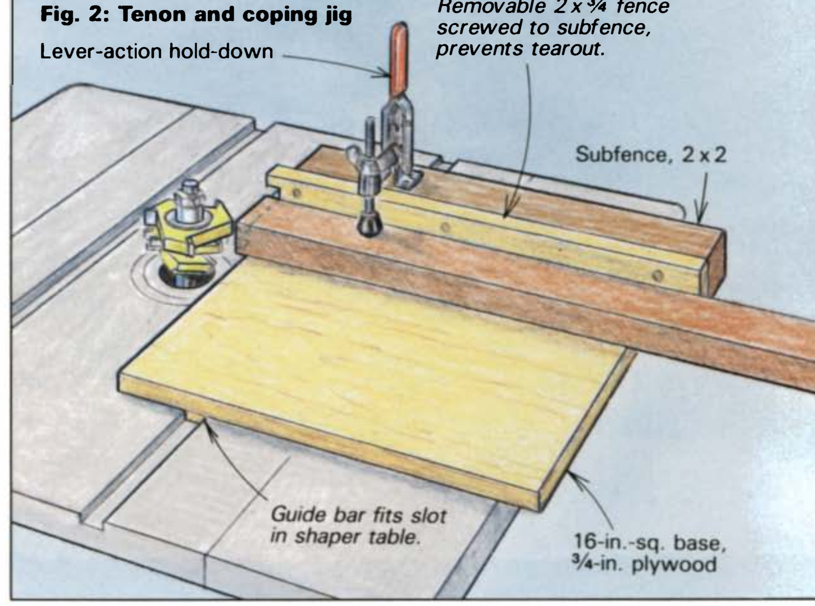


Fig. 2: Tenon and coping jig



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

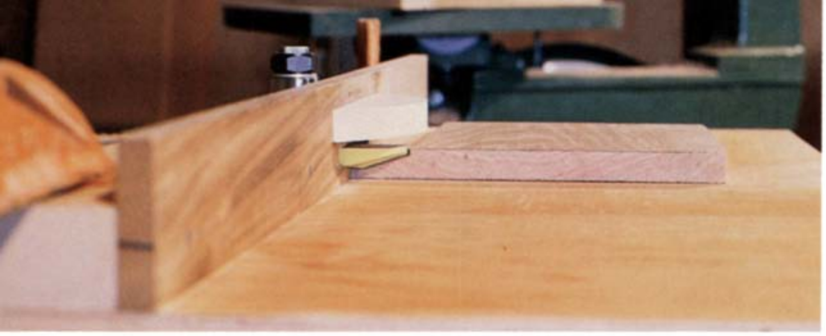
Never stand directly behind the stock or allow anyone to stand in its path in case it's kicked back and ejected. Don't leave the machine with a cutter loose on the spindle—it's too easy to start the motor, forgetting that the nut is not tightened. If you've never been seriously frightened, this will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

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

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

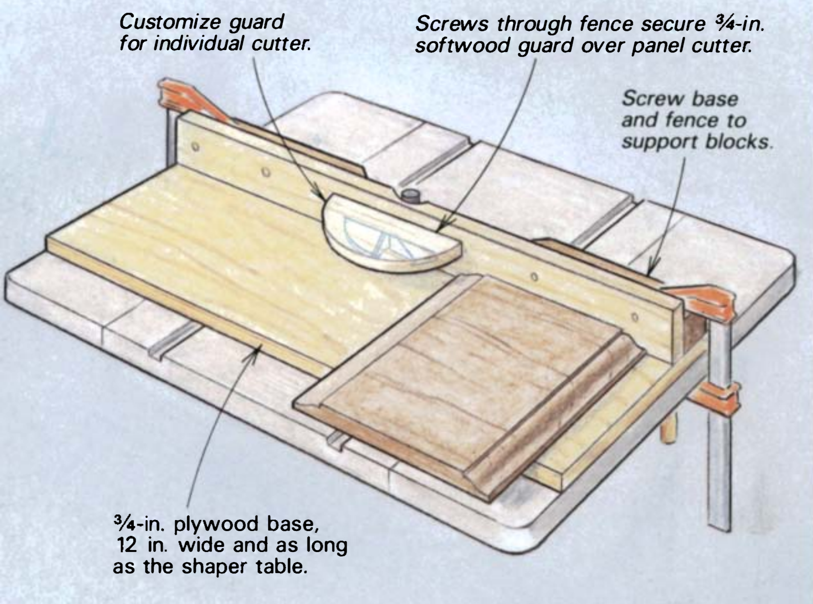
Fences and associated jigs also can do double duty as guards. I have several panel-raising cutters, for example, which don't clear the shroud on my Delta shaper, so I built the panel-raising jig shown on the next page for each cutter. One approach to designing these setups is to draw out the cross section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

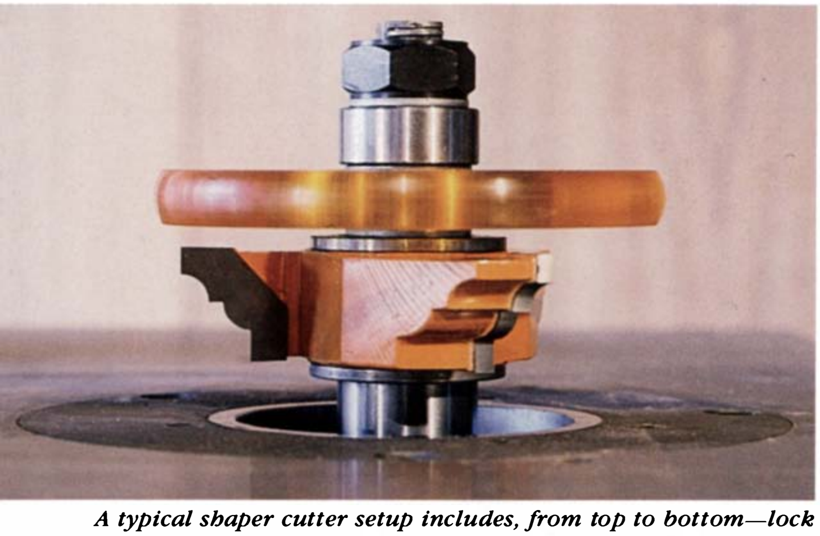
Photos by author except where noted



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

Fig. 3: Auxiliary table for panels





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

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

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

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

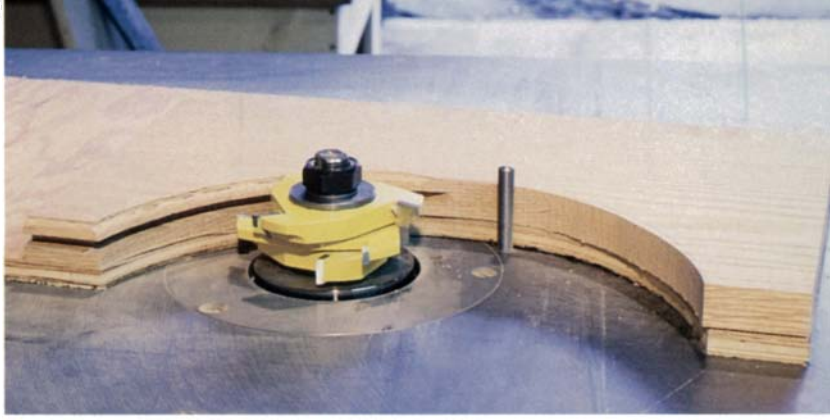
I generally feed the stock manually past the cutter, against the direction of cutter rotation. A smooth, steady feed is best. If you feed too fast or the spindle speed is too slow, the cutter will take off bigger chunks of wood, making tearout likely. Shapers are powerful enough to make most cuts in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

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

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

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

David DeCristoforo is a designer/craftsman and writer. He lives in Davis, Calif.



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

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

Shaper cutters: infinite varieties, endless possibilities

In the past, every woodworker had to make his own shaper cutters by grinding down steel knives and mounting them in specially designed heads, which had a bad reputation for launching knives from time to time. Now, good-quality shaper cutters are available in a great variety of shapes and styles, and most workers opt for the convenience and greater safety offered by commercial cutters. I don't recommend shopmade knives, especially for inexperienced workers, because of difficulties in shaping, balancing and aligning the knives. Some companies do, however, manufacture cutter heads with improved locks for securing the knives and a variety of useful interchangeable knives.

The other types of commercial cutters range from single-profile cutters to elaborate combination systems that offer a relatively low-cost way to acquire the cutting capability of scores of individual cutters. All the major manufacturers also give the buyer the option of specifying how the cutter will run—clockwise or counterclockwise with the stock facedown (submerged) or counterclockwise with the stock faceup (cutter over). Submerging the cutter is advisable when shaping long or large workpieces unassisted. Should the stock lift off the table during the cut, it won't be forced into the cutter. If you need to observe the progress of

Cutter components: top—ball-bearing rub collars; center, left to right—bushings, spacers, collars and shims; and bottom—Delta's spindle-mounted cutter guard.

the cut, the cutter must be over the stock. Actually, any cutter can be run either facedown or faceup by flipping it over and reversing the spindle rotation, assuming your shaper motor is reversible. This won't cause problems as long as you securely tighten the nut when running the spindle clockwise.

In addition to the basic cutter shape, you'll need a variety of spacers, collars, shims and guide collars, as shown above, for mounting cutters. Spacers are sometimes needed between cutters when more than one cutter is mounted on the spindle at one time to cut multiple patterns. Shims come in sets of varying thicknesses, generally from 0.003 in. to 0.03 in., and are useful for fine-tuning cutter spacing. Collars take up empty space on the spindle, so you don't have to run the nut all the way down the spindle to secure a single cutter. Guide collars are used for shaping curved edges.

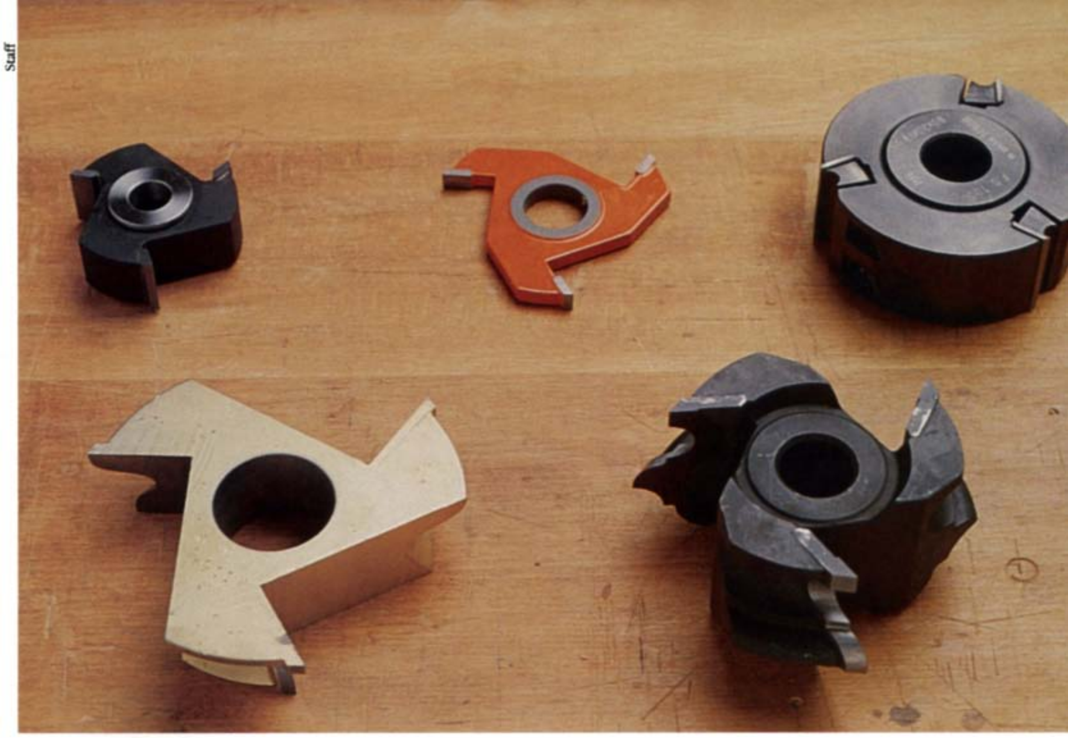
Here is a rundown on common cutters:

Straight cutters: Straight cutters are available in thicknesses from ¼ in. to 3 in. for grooving, rabbeting, dadoing and slotting, and can be stacked with spacers to form tongues. Several narrow cutters can be stacked to make wider cuts, too. For the smoothest and quietest cut, always stagger cutters when stacking them. I've also found that a 2-in. straight cutter gives the shaper several advantages over a jointer. Jointing the edges of wide stock is easier because the wood lies flat on the broad shaper table. Also, using a power feed and climb cutting against the grain, I can joint difficult grain without chipping. On the minus side, stock thickness is limited by the cutter height, and face planing is not practical. Since the face-grinding operation used in sharpening carbide cutters reduces their diameter slightly, it is a good idea to have all your straight cutters sharpened at the same time. This will ensure that all the cutters maintain the same diameter so they can be stacked for tongue cutting. Also, remember that as sharpening changes the cutter diameter, it also changes the relationship between the cutting edge and any ball-bearing collar that might be used with it. You may eventually need to adjust your templates or get smaller collars.

Detail cutters: Detail cutters, available in a multitude of profiles, are used for general molding work. These profiles include ogees, ¼ and ½ rounds, fluting, various cove-and-bead combinations and numerous others. While it is nice to have a good selection of cutters, it is difficult to say which could be considered as "basic." My approach has been to buy cutters as I need them, including their cost in my job estimate. As my inventory of profiles builds, I offer clients designs that incorporate molding profiles already paid for by previous jobs, returning the savings to them in the form of a reduced bid.

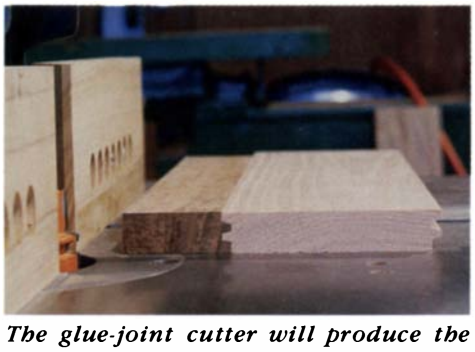
Reversible cutters: These cutter profiles interlock when reversed and joined. They can be molding profiles or special cutters like the glue-joint cutter shown below. The rule of thumb with all reversible cutters is that their centerline must line up with the stock's centerline. Some trial and error is necessary to get the cutter elevation just right, so it is a good idea to save a correct stock sample for future setups. The lock-miter cutter is the most difficult reversible cutter to set up because cutter elevation and fence depth both affect its fit. Adjusting this cutter for the first time is a lot like the old rub-your-tummy-and-pat-your-head bit. I like to leave a slight flat at the long point of the miter rather than cut right down to a sharp point. I plane away the flat after the pieces are joined.

Staff



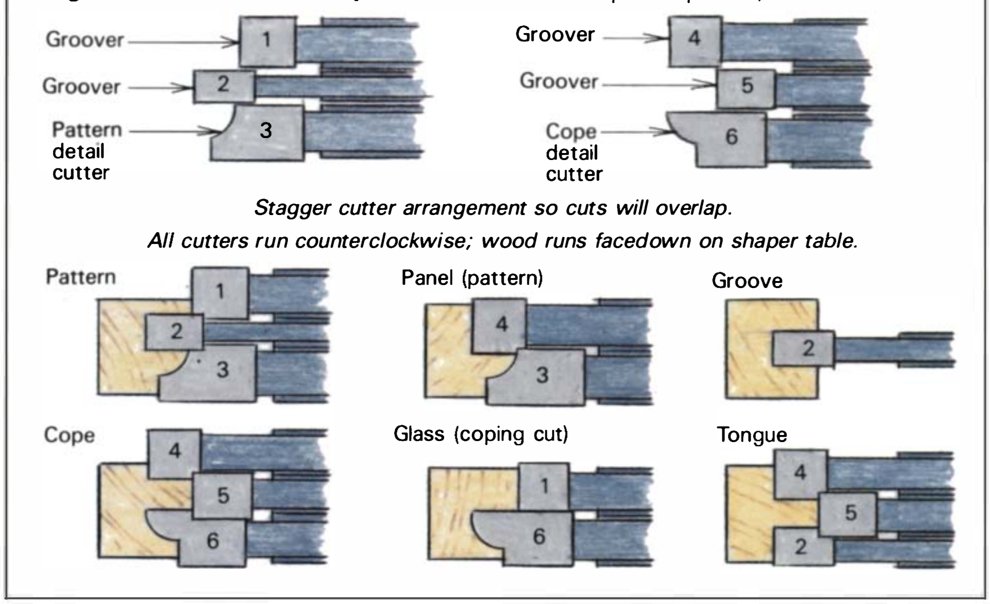
Shaper cutters range from straight cutters to elaborate molding patterns. Shown above, clockwise from top left, are a Delta ¾-in. straight cutter, a Freeborn straight-top groover, a 3-knife jointing cutter from F.S. Tool Corp., a door lip cutter from I.RH Enterprises and a Freud Perfecta combination cutter, which can cut 39 molding shapes.

A narrow straight cutter cuts a ¼-in. groove in the edge of a board. Both halves of the split fence are aligned with each other to support the stock before, during and after the cut.



The glue-joint cutter will produce the joint shown by simply flipping the stock over for every other pass. This joint has about 2½ times more glue surface than a simple butt joint.

Fig. 4: Freeborn cutter setup

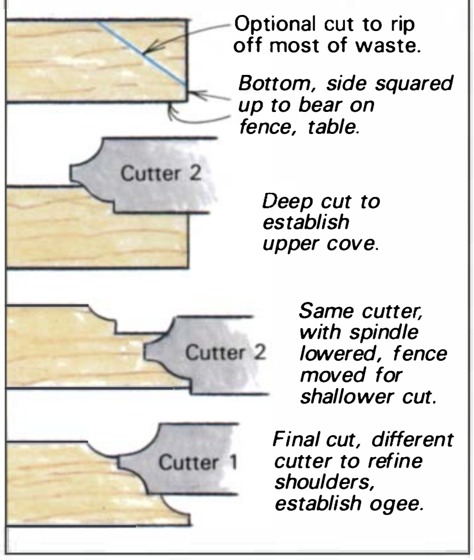


Combination cutters: Many inexperienced workers find combination cutters too intimidating to use, especially since they often don't come with clear-cut directions. Freud's line of combination cutters, for example, come only with diagrams showing the cut and the numbers of the cutters in the set needed to produce it. A Freud spokesman said these are purchased by experienced woodworkers who don't need detailed instructions. Freud cutter kits aimed at furnituremakers and small shops come with detailed instruction booklets. The Freeborn Tool Co. also provides instruction sheets with its cutters. The guide for the company's double-sided cope-and-pattern cutters (1¼-in. bore) is shown in figure 4. These patterns can be stacked though, and it's fairly clear how the individual shapes are formed and where the spacers and shims must be used.

For more-complex patterns, cutters sometimes can be stacked together to produce the pattern shown, but often multiple passes must be made, as shown in figure 5. Begin with accurately milled stock and unless you retain a square surface to run against the fence and the table, you will have to build a special support system to hold the piece as it passes by the cutter. If you must remove a great deal of material, you might remove much of the waste with a tablesaw cut before starting the shaper. I usually start with the deepest pattern cut first, reasoning that the setup required would call for the cutter to extend the most, and that the guard devised for it would offer protection for the remain-

Specialty cuts range from interlocking patterns to wide beveled fields. Above, clockwise from top left: a carbide-tipped glue-joint cutter from Delta; a set of Tantung-tipped cope-and-pattern cutters from Freeborn; and two styles of panel raisers—one from DML that cuts a flat field and a second from F.S. Tool that creates a gently curved field.

Fig. 5: Freud Cassette 65
Pattern #20



ing cuts. Also the deeper cuts would be made while the stock is thickest and most resistant to flexing. The shallower cuts are made last.

Cope-and-pattern cutters: The cope-and-pattern cutters are sold in sets for the construction of doors and other frame-and-panel work. They go by a number of aliases, among which are cope-and-stick, stile-and-rail and male-and-female cabinet door sets. These cutters can be confusing to the novice, but a few practice cuts will clear everything up. The sets consist of two stacks of three cutters each. One stack is used to shape the inside edges of stiles and rails, forming a molded edge and a groove for a panel insert. The second stack is used to cope the ends of the rails, forming an exact mating joint. These sets are available in different thicknesses from 3/4 in. to 1 3/4 in. I usually make the cope cuts first, using the tenon-and-coping jig shown in figure 2. Endgrain is likely to tear out, but the long-grain pattern cuts usually remove most of the damage. Once all the stock ends are coped, use one of the pieces as a gauge to set the correct height for the pattern cutter. These cutters are factory ground for a correct fit, but sharpening will loosen the fit. Usually, a thin shim under the molding cutter in the cope stack will tighten the joint sufficiently. In any event, cutters in these sets should all be sharpened at the same time. One other hint: Always make more than you need when making interlocking parts—it's easier than setting everything up again to make another matching piece.

Custom cutters: If you or your client want something unique, most manufacturers will custom-make carbide or composite-alloy cutters. You must send an accurate, full-size drawing of the desired profile and your configuration requirements to the manufacturer for bid. These cutters will be expensive. I once paid more than $700 for two cutters to shape a large edge banding. However, I ended up with a one-of-a-kind molding profile I could use over and over.

Panel-raising cutters: Panel raisers can be hair-raisers. They are generally quite large in diameter, often making you feel that you're using a helicopter rather than a woodworking tool. Panel raisers are sized for a specific stock thickness, usually 5/8 in. or 3/4 in. They are designed to cut a full profile in the specified thickness, leaving a 1/4-in.-thick tongue. A 3/4-in. panel raiser cannot be used on material of less than 3/4-in. thickness without sacrificing part of the molding profile or part of the tongue thickness. If this same cutter is used to shape 7/8-in.-thick material, you will end up with a 3/8-in.-thick tongue. However, you could rabbet the back of the panel to reduce the tongue thickness. Many manufacturers offer a panel-back cutter that can be mounted on the spindle with the panel raiser to simultaneously shape the back of a thicker panel.

Due to their extreme size and cutter projection, panel raisers require extreme caution and should never be mounted on a spindle of less than 3/4 in. dia. Never mount them any higher on the spindle than necessary, and guards should always be used. —*D.D.*

Sources of supply

Additional information on shapers is available from the following companies:

Andreou Industries Inc., 22-69 23rd St., Astoria, NY 11105.
Cascade Precision Tool Co., P.O. Box 848, Mercer Island, WA 98040.
Chang Iron, U.S. distributor, Woodworker's Supply of New Mexico, 5604 Alameda N.E., Albuquerque, NM 87113.
Delta International, 246 Alpha Drive, Pittsburg, PA 15238.
Farris Machinery (Kitty tools), 2315 Keystone Drive, Blue Springs, MO 64015.
Grizzly Imports, Inc., P.O. Box 2069, Bellingham, WA 98227.
J. Philip Humphrey International Inc., 210 Eighth St. S., Lewiston, NY 14092.
Jet Equipment and Tools, P.O. Box 1477, Tacoma, WA 98401.
Kölle, U.S. distributor, Woodworking Specialties, Quality Lane, P.O. Box 70, Rutland, VT 05701.
Mini Max, 5933 Peachtree Industrial Blvd., Norcross, GA 30092.
Northwood Industrial Machinery, 11400 Decimal Drive, Louisville, KY 40299.
Parks Woodworking Machine Co., 1501 Knowlton St., P.O. Box 23057, Cincinnati, OH 45223.
Powermatic, Morrison Road, McMinnville, TN 37110.
Scheppach America, P.O. Box 135, North Miami Beach, FL 33163.
Sunhill, 1000 Andover Park E., Seattle, WA 98188.
Total Shop, P.O. Box 25429, Greenville, SC 29616.
Transpower, 11000 E. Rush St., #18, S. El Monte, CA 91733.
TWS Machinery, P.O. Box 55545, Seattle, WA 98155.
Wilke Machinery Co., 120 Derry Court, York, PA 17402.

Shaper cutters are available from these manufacturers and their distributors:

Cascade Precision Tool Co., (see above).
Delta International, (see above).
DML, a division of Vermont American Corp., 1350 S. 15th St., Louisville, KY 40201.
Freeborn Tool Co. Inc., 3355 E. Trent Ave., Spokane, WA 99202-4459.
Freud Inc., 218 Feld Ave., High Point, NC 27264.
F.S. Tool Corp., P.O. Box 530, 210 Eighth St., Lewiston, NY 14092.
LRH Enterprises, 6961 Valjean Ave., Van Nuys, CA 91406.
Reliable Grinding, 145 W. Hillcrest Ave., San Bernardino, CA 92408.
TWS Machinery, (see above).

Walnut lap desk features a durable, lacquered writing surface and storage for every correspondent's necessities. The decorative corners are tablesawn finger joints. Beneath the hinged top, right, are compartments for legal-size paper, envelopes and pencils.

Walnut Lap Desk

Cutting corners with finger joints

by Kelly Mehler

When my partner and I went into business about ten years ago, we found that most people at craft fairs couldn't afford a trestle table or chest of drawers. If we were going to survive, we knew we had to offer accessories—affordable and easily transported items like quilt racks and boxes. My partner, Peter Blunt, designed and built the prototype of the lap desk described here and shown above. This functional object, made of nicely finished, highly figured hardwoods, was very successful. People called them Shaker desks because of the simple design, but Peter wasn't copying any style. These desks are an old idea, with many variations.

Lap desks are ideal for small-shop production runs. They don't require much wood, so you can afford good walnut or cherry. The distinctive finger joints can be cut efficiently on the tablesaw, and the grooves for the bottom and shelves are all routed. In addition to being easy to cut, the fingers and slots in the joints interlock so snugly that the box virtually squares itself up during assembly. And the large glue-surface area offered by the interlocking components makes the joints incredibly strong. We usually made runs of 10 desks at a time. Leftover parts from one run became guides for setting the jigs for the next run. Now, I build two basic desks: the large one shown in figure 2 and a smaller one, just large enough for writing paper and envelopes.

Because grain is such an important design feature of a small object like this, I cut the stock for each desk body from a single 1½-in.-thick, 4-in.-wide plank for continuity of grain and color all the way around. The grain leads your eye around the piece, something that won't happen if a dark piece butts with a light piece or straight-grain patterns run into wild grain. I begin by crosscutting a 36-in.-long section for the body parts. I resaw the 1½-in.-thick stock into full-width, ½-in.-thick slices, plane the pieces to ⅜ in. thick and then cut out the back, front, two sides,

Drawings: David Dann; photos this page: Michele Russell Slavinsky

two dividers and shelf. Before continuing with the body, I resaw the stock for the top from a 2x5½x18½-in. plank and edge-glue the three pieces, each nearly ¾ in. thick, so the glue will have time to cure. Grain patterns are critical because the top is the most closely scrutinized surface. Quartersawn lumber is better than plainsawn, both for figure and to avoid warping. Whenever possible, I arrange the boards so all the grain patterns run in the same direction to avoid tearout when the top is surfaced.

Cutting finger joints—Large lap desks are joined by finger joints, which are made by cutting a series of equally spaced interlocking slots and fingers into the ends of mating pieces. For the pieces to interlock, the joint of one piece must begin with a finger; the joint of the mating piece must begin with a slot. Smaller desks can be made with a tongue-and-rabbet joint, shown in figure 3. To ensure accuracy and consistency from batch to batch, I've made a series of jigs for crosscutting the pieces to length, cutting the joint itself and tapering the sides.

I begin by ripping the pieces to the proper width, then crosscut them to length with the L-shaped stop jig shown in figure 1. Because the jig is attached to the saw table at an angle behind the miter fence, I have room to cut one end of the board square, move the miter gauge back, flip the piece over and butt the squared-off end against the stop, then cut again. You can adjust the jig to accommodate larger or smaller pieces.

My jig for cutting the finger joints is a simple, shop-built, fence-and-spline arrangement, shown in the photos on the next page. Basically, the jig provides a guide for stepping off the fingers and slots as you move the stock through the blade. I square up a piece of stock, fit it with a spline that's exactly the width of my sawblade and screw or clamp the assembly to my tablesaw's miter gauge. Jig height isn't critical—2 in. to 4 in. is adequate for supporting the side, front and back pieces when they are held upright for the endgrain cuts. Adjust the blade so it protrudes from the table slightly more than the thickness of the stock being joined. Then, cut a slot through the miter gauge board and insert the spline.

The trick is to locate the fence so the spline is exactly one sawkerf away from the blade. You may have to do some fiddling to get it right. Sometimes the setup goes very fast, other times it seems an impossible task. The adjustment is a matter of micromillimeters. Even a slight error compounds across the width of a

Fig. 1: Crosscutting jig

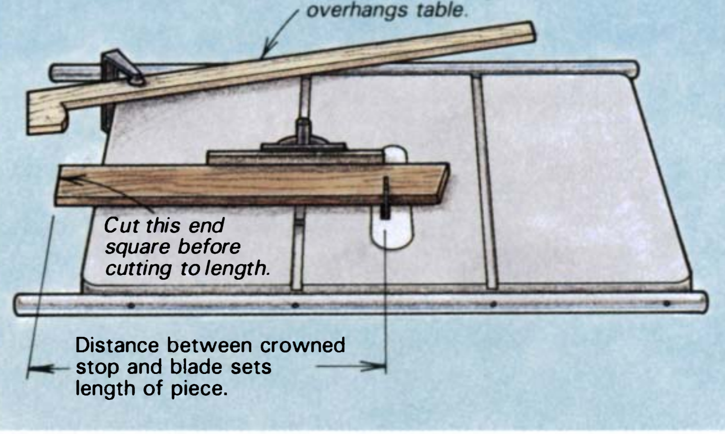
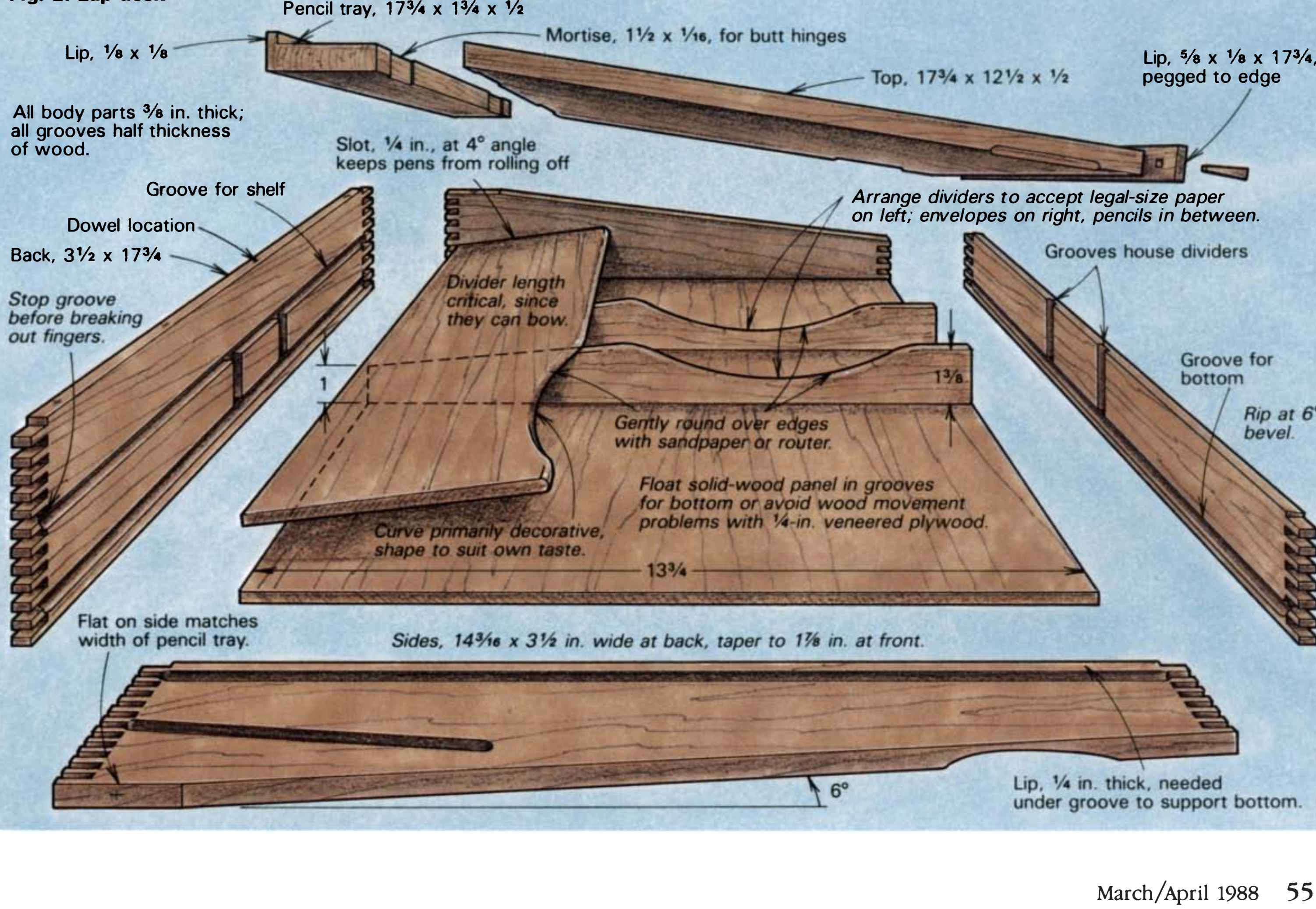
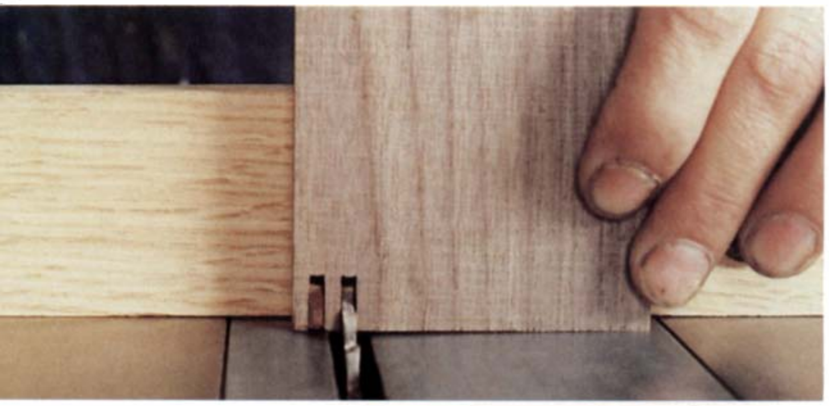


Fig. 2: Lap desk

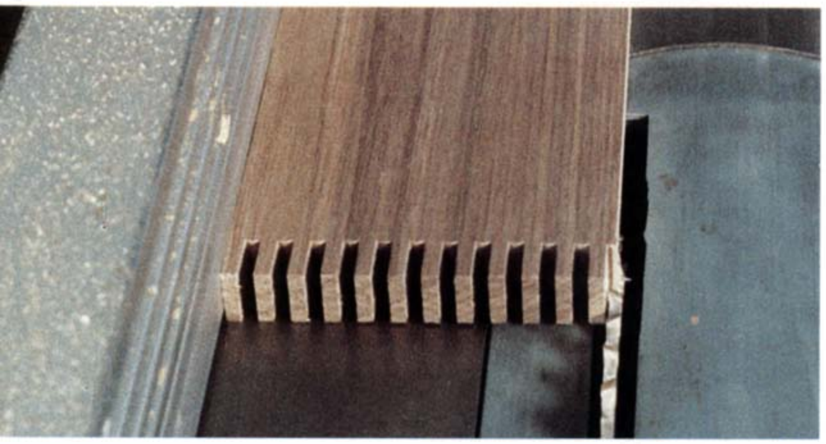


The finger-joint jig locates the spline one sawkerf from the blade so each cut leaves a finger equal to the blade width.



Before the next slot is cut, the board is moved so the previous slot fits over the spline. The process is repeated until fingers and slots are cut across the width of the board.

The first half of the joint begins with a finger, so the mating piece must begin with a slot. The initial finger on the first piece becomes a stop for cutting the first slot on the mating piece. After the slot is cut, the sequence is the same as described above.



Minor miscalculations can be rectified by ripping the pieces narrower so each joint ends with the same element it began with—a full-width slot or finger. This makes the ends interchangeable, and pieces can be flipped to hide a defect or pitch pocket.

board to create a no-go situation. Here is where your test pieces come in. Cut a few fingers on ends of scrap and see if they fit together. If not, move the jig one way or the other.

Because the fit is so precise, I remove the piece after each cut before retracting the miter gauge for the next cut. Blade choice varies, too. I use a regular 50-tooth combination blade, which leaves slight crown at the top of the slots. A 30-tooth rip blade or specially sharpened blade would probably leave a flatter surface, but I don't think the crown detracts from the joint's visual appeal.

Ideally, each joint should start and end with the same element, either a slot or a finger. This isn't absolutely necessary, but it lets you flip each piece end-for-end and cut both sides at the same time with the same setup. I always cut the first piece so the joint begins with a finger. That way you can butt the piece against the spline, as shown in the top photo at left, and the positive stop of the spline eliminates having to align the stock with the kerf in the support board the first time the jig is used. After cutting the first slot, which simultaneously creates the first finger, I move the board so the new slot can be slid down on the spline and the next slot-finger pair can be cut. The process is repeated until the fingers and slots extend across the width of the board. After completing the joint half that began with a finger, I use the first finger on the piece as a stop, as shown in the third photo at left, to cut the first slot on the mating piece.

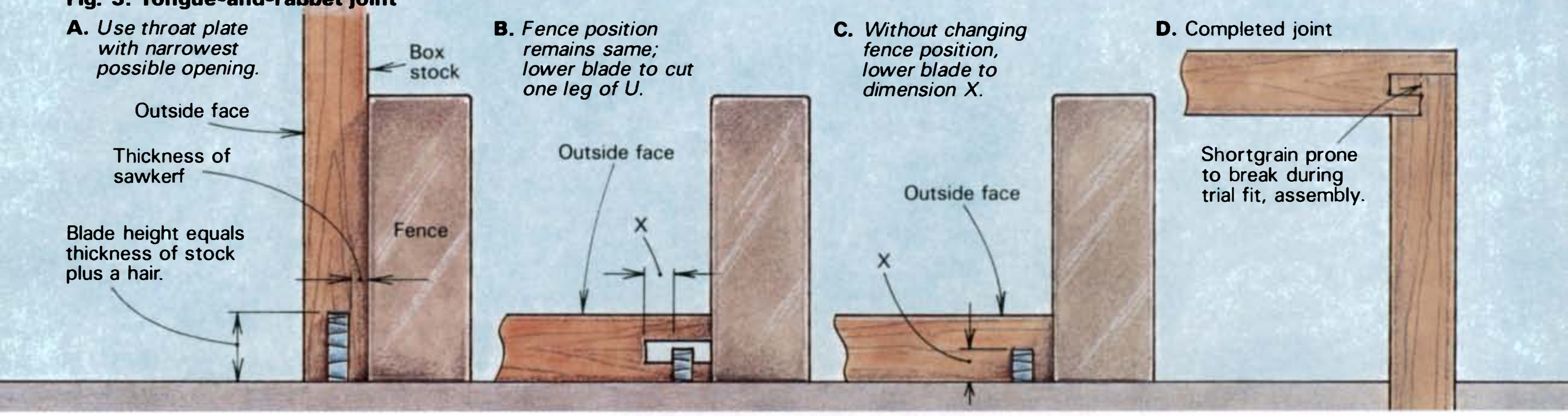
You should size your stock to get full-width fingers or slots across the board, especially with fingers only a kerf wide. You can check the dimensions before you begin by dividing the board's width by the sawkerf's width. With larger joints cut with a dado setup instead of a sawblade, you can adjust the width of the cutter before you begin so the slots and fingers will cover the whole board. With a project like this, where the dimensions aren't critical, you have a little more flexibility if the setup is a little off and leaves a partial slot or partial finger—just rip again to remove the partial element.

After I cut all the joints, I dry assemble the basic frame to check the fit and mark the sides as left and right, to avoid cutting the taper the wrong way. Initially, we experimented with different taper angles before deciding the 6° angle looked best. I cut the taper with the jig shown in figure 4. The length of the jig isn't important as long as it doesn't interfere with the fence. What is important is adjusting the fence so the rip cut leaves the proper flat at the top and the height of the sides matches the width of the front, as shown in the drawing. I always test the setup with scrap pieces.

I cut the grooves for the bottom, shelf and dividers with an overarm router, but a table-mounted router fitted with a fence and stops would work. I dislike cutting stopped grooves on the tablesaw, because I've never felt comfortable dropping stock on a spinning blade. And even with a router, it is easy to break off the fingers at the end of the cut. When a finger does pop off, I often cut one of the scraps used for test cutting and glue it in place. Finger joints are so strong that the joint won't be significantly weakened by the patch.

I cut the angled grooves for the shelf with a pin router, again using a taper jig as I did for the sides, but this time with a 4° angle. The angle isn't critical, as long as it's the same on both sides, but the slope should be great enough to keep pencils from rolling off. The 5¼-in.-wide shelf is large enough to be functional, yet still allows a clear view of what's in the desk. The cutout also allows more hand room for picking up paper, as do the cutouts in the dividers. Before shaping the dividers, I taper them on the jig used to cut the shelf groove to ensure all the angles match.

Fig. 3: Tongue-and-rabbet joint



Assembly—I assemble the finger joints with Franklin Liquid Hide Glue. It's easy to clean up and its slow setup time is welcome with all the little pieces that must be tapped into place. The sequence for assembly is to sand or scrape the inside faces of all the components, join a side and back to form a corner, then insert the bottom and shelf. The other side and the dividers are next. The front goes on last. Excess glue is wiped off with a damp cloth as soon as it appears. Between the bottom and the tight-fitting finger joints, the box just about pulls itself square, but I do check it with a framing square and adjust if necessary. I generally don't clamp the piece unless I have a problem squaring it.

As shown in the photo on page 54, a section of the top is cut to form a pencil tray. To provide enough stock for the tray, I plane the glued-up top to ⅝ in. thick, then rip off a 1¾-in.-wide section before planing the remaining part to about ½ in. thick. Then I rabbet the thicker section with a single tablesaw cut, as shown at right, and pop off the waste to create the ⅛-in. ledge. The pencil groove is cut with a router and cove bit. The groove, which is a little longer than a new pencil, is usually located slightly above the midsection of the tray.

Before hinging the tray and top together, I take a bevel gauge and set the sawblade to the same angle as the side taper and rip a slight bevel on the upper edge of the top. This bevel allows the hinges between the tray and top to close properly. I mortise for the hinges and attach them so I can fit the tray and top to the box as a unit. Before attaching the top, however, the handholds visible on the edges of the top are routed with a 60° chamfer bit. Each handhold is about four fingers wide.

The first step in fitting the tray-and-top unit is to drive a series of brads into the top edge of the back and the flats of the sides, leaving the brads proud of the surface. Next, I clip off their heads, center the assembly on the box and force it down to mark locations of ⅛-in. dowels. After removing the brads, I bore the holes, insert the dowels, spread white glue onto the mating edges and clamp the tray down so the joint will fit tightly. The final step is to sketch out a gently chamfered recess on each side, directly under the handholds on the top, and shape them with chisels and sandpaper. Finally, the pencil catcher can be attached to the front edge with glue and little pegs.

After scraping and sanding the exterior, I spray it with one coat of sealer and two coats of lacquer. The inside gets one coat of sealer and one coat of lacquer. People like lacquer—it's durable, doesn't need to be maintained and really sets off the grain patterns of the broad writing surface. □

Kelly Mehler builds custom furniture and operates the Treefinery Gallery in Berea, Ky.

Fig. 4: Taper jig

The ledge on the pencil tray is formed by rabbeting the tray on the tablesaw. A single cut, ⅛-in.-deep, into the face of the board establishes the ledge, above; any remaining waste can be broken off. Push sticks are essential on such a small piece. The pencil tray, below, is joined to the body with glue and ⅛-in. dowels, then clamped together.

Purfling is bound tightly into its rabbets by windings of awning rope, one side at a time. Any areas where the joint is not tight can be snugged up with additional windings. This body shape, called a cutaway, allows the musician to reach farther up the fretboard.

Guitar Body Construction

Bending and purfling the frame

by William "Grit" Laskin

A guitar body is a hollow box that epitomizes balance: The precise symmetry of the curves, the compromises between strength and lightness, the artful fitting of minimal glue joints; all these elements combine in what at first glance seems to be half woodworking and half magic. Yet, taken step by step, making a guitar body is fairly straightforward.

Briefly, the process is as follows: The thin sides are bent to the shape of a mold, a plywood or particleboard form that surrounds the instrument in the early stages and acts as a template to ensure symmetry and accuracy (see photo, next page). With the sides inserted in the mold, mahogany endblocks are glued in place at the top and bottom of the body to span the joints where the two sides butt together. The glued-up rim, or frame, is removed from the mold and the top endblock, or heel block, is dovetailed to receive the neck of the instrument.

Next, linings—wooden strips that both stabilize the frame and increase glueline area—are glued around the inside edges at the top and bottom of the frame. The guitar's soundboard, or top, and its back are braced with supporting strips of wood on the inside to make them stiffer, then glued to the instrument. Finally, narrow strips called binding and purfling are let into rabbets cut on the top and bottom edges of the body. This completes the basic "box," the body.

In a magazine, I can't possibly hope to give you a complete how-to for making an instrument—for that, I referenced a number of books in my first article (*FWW* #67), which covered body shape, the woods used and stock preparation. Here then is another brief look at how an instrumentmaker relates himself to the structural, the visual, and eventually auditory, beauty that is a guitar.

Bending sides—The most convenient way to bend guitar sides is to heat them until the wood plasticizes, apply pressure by hand to form the curve, then let the wood cool to set the bend. Once bent, the sides are immediately in a workable, glueable state.

You'll need to rig up what I call a bending iron—a hollow metal tube clamped or bolted in place with a heat source inside. For this project, I suggest supporting a propane torch so it flames into one opening of a piece of tubing or pipe. A few other accessible ways of making bending irons are shown in William Cumpiano and Jon Natelson's new book *Guitar Making: Tradition and Technology,* which was listed in the bibliography in part one. I've only just seen this book—since writing the first part of the series—and it turns out that I can recommend it very highly. I feel it is the most thorough guitarmaking manual in print.

Leave your book-matched side pieces slightly oversize in length, but cut their width down to the final size of 105mm (the thickness of the top and the back will bring the eventual full measurement of the instrument to 110mm, as shown in the drawing in part one). Run one edge across your jointer, then slice down to size with a tablesaw. Thickness the sides to 2.5mm or bending will be tough going. Final sanding and scraping will bring the sides down to the 2.3mm thickness shown in the plans.

Match the grain symmetrically where the bottom endblock joint will come, and mark with a pencil the top edge of both pieces. For reasons I will clarify later, have the grain run down to the back edge as it travels toward the neck block.

You may want to bend a trial piece or two, because skills come from discovering the correct feel. The balance of pressure and movement will come in short order if you work at it.

With your mold as reference nearby on the bench, you will start your shaping at the lower bout endblock joint. Allow the side about a 2.5cm excess overlap of the joint line. Here are some hints to get you bending: First, your bending iron is hot enough when your spit will ball up and bounce off. Second, run your wood under the tap just to wet the surface. (You may want to do this occasionally throughout the process.) This lessens surface burn marks. Third, never hold your wood stationary on the iron, always keep it in either a side-to-side rocking motion or a slow slide across the iron combined with a constant jiggling action. This is the only way to achieve smooth, unkinked curves.

Both hands must exert a small amount of downward pressure to bend the wood into the desired position. Do not worry if you overbend a section of the curve too tightly. You can correct it by simply bending the curve out from the opposite side.

When bending the lower bout, work in 6-in.- to 8-in.-long sections. I match the first section to the curve of the mold, then shift to the adjacent section. I slightly bend the section to the left of the one I am concentrating on as well, so the gradually emerging curve will blend smoothly. If you work solely on one area, with no thought to the adjacent sections, you can cause kinking at the transition points. Test the lower bout bend by holding it against the inside of the mold. Correct any underbent, flattened spots on the bending iron while the section is warm.

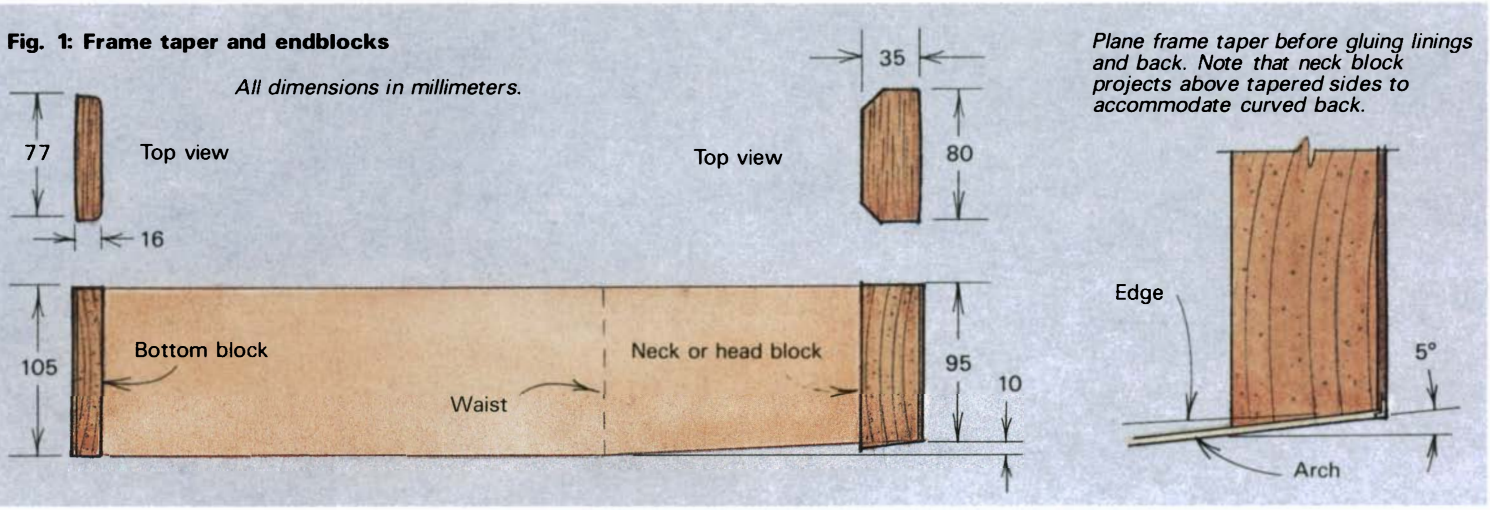
The waist is next. Hold the partially bent side in position in the mold, then rock it until it is pressing against the very center of the waist curve (for reference, mark the center on your form). Pencil this point on the side and center it on the bending iron's circumference. Lean alternately to the right, partially bending that side of the waist, then to the left and back, across the whole curve of the waist until it is completed.

Bend the upper bout curve in 3-in. to 4-in. sections. When the side is finally shaped enough so it can slip down into the mold, refine and fair all the bends as necessary. Being slightly overbent

Guitarmakers shape the sides to conform to the guitar mold by bending the dampened wood over a heated pipe, moving the wood constantly to avoid kinks and scorching. With a little practice, the mold can be matched exactly.

Guitar sides and blocks are clamped and glued in the mold. Shaped blocks at the waist, wedged apart by a stick, hold the pre-bent sides tight in place. Next the body will be tapered, as shown below, the neck block dovetailed, and linings added, as shown on p. 63.

Fig. 1: Frame taper and endblocks



is fine. Just be sure that when you hold the side at its waist and push in each end against the mold, the curves fall into proper place. Be sure to check the bottom edge of the side as well. Should one edge differ from the other, correct it by concentrating hand pressure on the problem edge only as you press against the iron.

Repeat the above procedures with the second side, working with the mold turned upside down and the bottom edge of the side facing up. Double check that the grain direction is symmetrical with the first piece.

Immediately after bending, the sides are able to be joined together with the mahogany endblocks to form the rough frame. If it will be more than a week before you can move on to this next step, clamp the sides in your mold to prevent any springback.

Frame assembly—The frame will be glued up in the mold, as shown in the photo above. Regular woodworking clamps hold the endblocks, while the waist is pressed tight to the mold by two shaped blocks wedged into place with a loose stick.

The first step is to trim the sides to length. Hold one side at a time into the mold using one of your waist wedge blocks and a clamp. Separately press each bout section flush to the mold and mark the location of the joint at the centerline. Unclamp the side and squarely cut off the excess. Confirm the fit by placing both sides in the mold, ends butting against each other, and wedge the waist blocks tight. If the waist will not make contact with the mold, one or both of the sides are too long—trim one end of one side 0.5mm at a time until both sides fit snugly. If the fit is loose, insert a small strip of rosewood in the joint at the neck end.

The endblocks that reinforce both joints should be cut and sanded to the dimensions shown in figure 1. Be sure their grain runs as shown. The surfaces that clamp against the rosewood sides must be matched to the curves of the mold. I do this by rocking them across my stationary belt sander.

When the blocks and sides are prepared, rest the mold flat, top down on the bench, waist-wedge the sides into position and insert wax paper between the rosewood and the mold at the joints. Dry clamp the blocks in place on the top side, then lift the mold onto its edge to finish clamping from the back. If all is well, apply white or yellow glue and clamp for real. These and all other glue joints should be well cleaned immediately after clamping. Allow the frame to remain clamped overnight.

Tapering the sides—This guitar back curves in two directions: across its width, because of the curved back struts; and up its length, because of the tapered sides of the frame, as shown in figure 1. Looking from the side, the taper can be seen to be straight, neither concave nor convex. I chisel, then hand plane the side taper, working from the waist toward the neck block. If the grain direction of the sides is as I instructed earlier, the sides will plane smoothly while completing this stage, and not chip out.

The frame edge should be even with the top of the heel block for approximately 10cm on both sides then rise upward to the waist. To confirm that the slant is correct, do two things: One, place a straightedge on the edge of the block and allow it to extend over the sides, as shown in the photo on the next page. There should be a clearance of approximately 2.5mm. Two, lay a small flat board along the tapered edge—it should lie flat, touching all along. If either condition is incorrect, you will have flat and/or concave sections in the back.

Now that you have the frame tapered, go ahead and glue in the linings, shape and sand them, and sand level the outsides of the

Bending with an electric blanket

by Wade Hampton Miller

While bending instrument sides with a hot pipe is a time-tested and proven method, today many luthiers are taking a more modern approach using a high-tech heating blanket as a heat source. As Bob Baker of Blue Lion Musical Instruments (4665 Parkhill Road, Santa Margarita, Calif. 93453) explains: "Bending a guitar side with a hot pipe used to take me about 25–30 minutes, and I'm pretty good at it. But by using forms with this heating blanket, I can do a set of sides in less than half the time, and the result is even more accurate."

The heating blanket is manufactured by Watlow Electric (12001 Lackland Road, St. Louis, Mo., 63146, 314-878-4600). Designed originally to keep satellites warm enough to function in the ultrafreeze of deep space, the Watlow heater is a silicon rubber blanket imbedded with a grid work of fine wire that can generate a constant heat of up to 500°F. Very light and very flexible, the Watlow heaters are now used for purposes as diverse as thermoplastics manufacture and the heating of oil pans on automobiles in Arctic Alaska.

Baker makes no claim to have originated the use of the Watlow heater in luthiery. He first read about blanket bending in *Frets Magazine,* a publication that specializes in acoustic instrument performance and construction. The advantage of the Watlow heater in woodbending, Baker says, is that "you can design just about any shape and stick this heating blanket on there."

To build a heating form for an instrument side, Baker begins by cutting the shape he wants out of dense particleboard or ¾-in. plywood. "I cut out the basic shape in however many pieces I need to make up the width of the side . . . for a guitar side I'll use seven or eight pieces of plywood." These pieces are then glued with either Titebond or a heat-setting epoxy, then bolted together (to prevent the heating action of the blanket from loosening the glue). Once the pieces are glued and bolted, Baker trims the edges flush with a bandsaw and then scrapes them to get the surface as smooth as possible.

Baker then cuts a piece of sheet aluminum to size and screws it to the face of the form. This prevents the wood from scorching and also makes a smoother surface for the heating blanket to stick to. Next comes a mastic that's unaffected by heat, (available with the Watlow heater) and the blanket is attached.

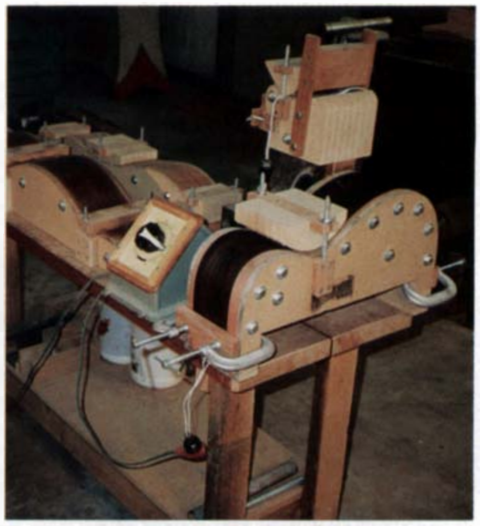
The Watlow heaters are available in widths of 1 in. to 6 in., and in lengths ranging from 5 in. to 40 in., in 5-in. increments. Baker uses the 5-in. by 35-in. size for the main heating element, and a 4-in. by 5-in. heater for a formed block that he clamps at the waist. "The waist block isn't strictly necessary," Baker says, "but it cuts the bending time about in half."

What's needed now is a control element to regulate the electricity going into the blanket. "You can get thermostats," says Baker, "but I use a high-capacity Variac I salvaged from a hotel ballroom that was being demolished. Basically you need something that can handle the high wattage of the blanket."

The sidebender is now ready. The instrument sides are prepared as they would be for hand bending—cut to size, thinned to 0.085 in. and moistened. Baker heats the waist block first to bend the middle, then unplugs that heater and clamps the ends of the instrument side down with C-clamps cushioned with scrapwood. Then the main heating element is turned on.

"How long the side stays in and how high the setting on the Variac goes," Baker explains, "is a matter of experimentation." In general Baker finds that a koa guitar side needs about 10 minutes in the form, and a rosewood side needs about 12 to 13 minutes.

A problem that can occur as the wood heats up and dries out is that the edges of the side can begin to curl. Currently Baker counters this by clamping additional blocks of wood across the problem spot. But this can be time-consuming, and he intends to prevent it from coming up at all by fabricating two flexible pieces of stainless steel cut to the size of a guitar side. The guitar side will be sandwiched between the two sheets of steel when it is placed in the form, and the edges will be unable to curl.



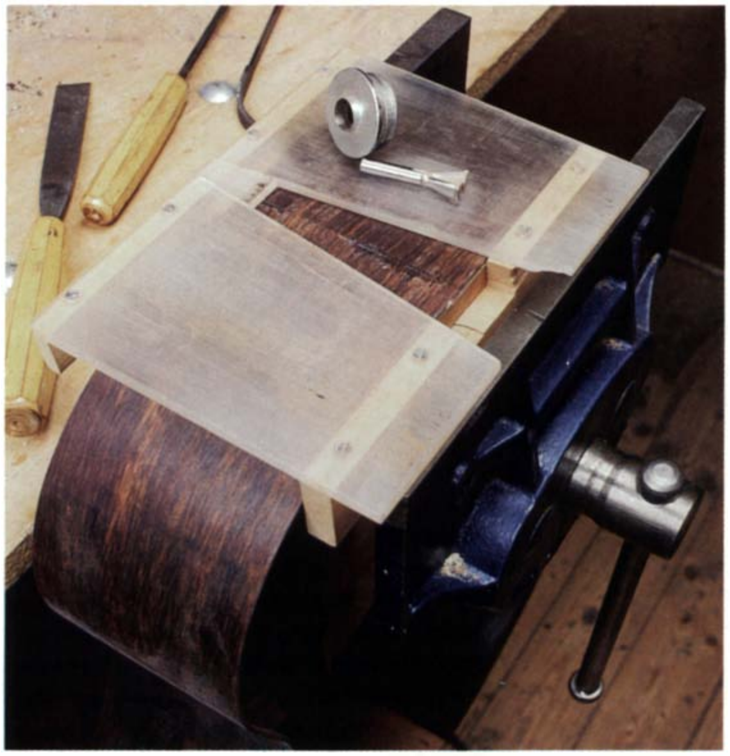
For production work, sides can be bent in forms heated by blankets of silicon rubber. Forms for a guitar's waist and bout curves are in the foreground. In the background are a pair of dulcimer forms.

Since most of his guitars are built on a custom basis, Baker will usually let guitar sides cool in the form. But Blue Lion is one of the leading dulcimer manufacturers in the country, and so Baker's dulcimer production is geared toward maximum efficiency.

"I have a form that will bend two dulcimer sides at once, and another mold to put them in to cool so they'll retain that shape. In the meantime, I've put another pair of sides in the form to bend. Both bending and cooling of the dulcimer sides take about six to seven minutes each, so this way I maintain a steady stream of parts." □

Wade Hampton Miller is a writer and musician living in Anchorage, Alaska. His playing won the U.S. Mountain Dulcimer Championship in 1980.

Checking the relationship of the high end of the heel block to the tapered sides. Also see figure 1, for measurements.



To rout the dovetail socket for the neck, the author uses a standard dovetail bit with a plastic template and a guide bushing.

frame. Any of the texts will see you through these steps. The next step after that is to machine the neck dovetail socket.

I use a router and two template-guide jigs to rough out both parts of the dovetail, then do the final fitting by hand. The jig for the dovetail socket is shown in the photo above. The collar on the guide bushing follows the edge of the Plexiglas during the cut, which is made to a depth of 13mm.

The last thing I do, relating to the female cut, happens after the back and top are glued to the frame but before purfling. I want the area of the frame around the dovetail slot, on which the neck will rest, to be perfectly flat. You'll see the reasons for this when we look at adjusting the neck angles, in part three. The tapering flattened area is as wide at the top and as narrow at the bottom as the finished neck will be—refer to the plans drawing in part one. Though I do this flattening with a belt sander, I suggest you take the safer route of a large flat block and sandpaper.

As I stated at the beginning of this series, this is not a step-by-step guide to guitar construction. Hence, I once again shall scoot you past some stages. For example, I spend two full days preparing, bracing and gluing the top and back to the frame, and there is simply no way to get the necessary information into a magazine article. So, once more, I refer you to the outside texts for guidance: David Russell Young's book, *The Steel String Guitar: Construction and Repair,* shows a method very like my own.

Binding and purfling—On this guitar, as with most of good quality, there are at least three different types of decorative strips comprising the purfling, the wooden bindings around the body's edges. These are shown in detail in figure 2.

We have to cut steps of three different depths around the edge of the body to accommodate all the purfling. There are hand methods and a variety of machine methods to accomplish this. I do it with my router, held stationary in a jig, the idea for which came from my teacher's teacher, Edgar Mönch. The photo on the facing page shows the idea. I use this jig by gently pushing the body along, resting the sides on the turned aluminum cylinder, while at the same time pressing snugly against the router's baseplate. The smaller the diameter of the rod, the more the bit projects beyond it, which fixes the depth of cut.

I grant you this is a fairly complicated jig to construct if you don't intend to make a number of guitars. I suggest first of all, that you make this jig out of hardwood. That would be faster and easier than metal. If that doesn't suit, many of the texts, even those dealing with classical guitars, will take you through some other hand or machine method. Allow me to say though, that the time required to make my jig plus the resulting cutting time is only about one and a half times as long as cutting the purfling grooves by hand, plus it leaves cleaner, more accurate cuts. The bit I use is a Rockwell #43706, a carbide, straight, three-flute rabbeting bit with an overall diameter of about 1⅛ in., though the diameters of the turned rods can be adapted so that any similar bit can be used. The bit's pilot bearing should be removed.

Regardless of the method chosen, finished edges must be as smooth and clean as possible. After routing, I go around the top and back edges with fine files to smooth out any irregularities.

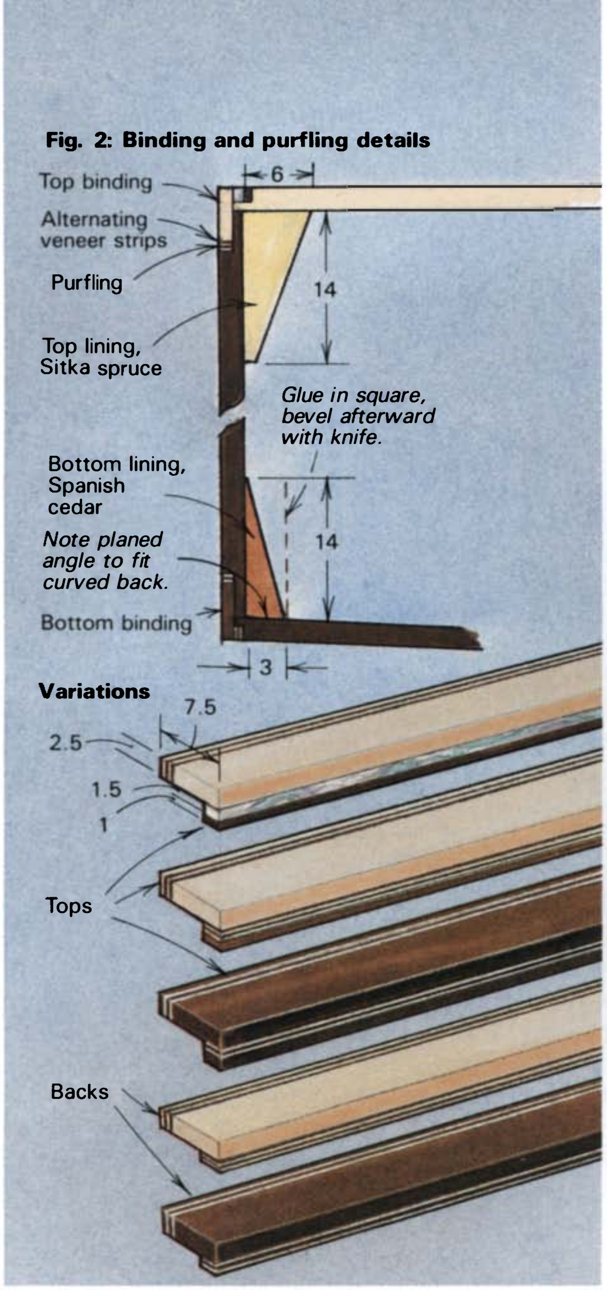
When you have the purfling grooves prepared, you must prebend only the outermost strips for the front and the back. Temporarily join all four strips—the two front strips and the two back strips—together with masking tape at both ends making sure that two strips are bottom edge down and two up. The bending procedure is the same as for the sides except that a little less pressure will be needed. Do not rush. However, try not to work too long in any given area as you may start to melt the glue joints holding the veneers to the strips.

The purflings are glued to the body in four separate stages, one front side, then the other front side, then repeating with the back strips. This allows you the freedom to adjust and fit most of the joints without the time pressure of setting glue. You must protect the edges not yet purfled nor being worked on with other scrap wooden strips bent and temporarily masking-taped in place. These protective strips are necessary to guard against the pressure of clamping, which in our case, is done with 150 ft. of awning rope.

Clamping all along the guitar's irregular curved surface has traditionally been done with rope or, more recently, different styles of strong cloth tape. I have found awning rope to be ideally strong and to offer a slight stretching that helps tighten its pressure. Also, its comparatively narrow diameter leaves more of the purfling joint visible for inspection while gluing. A 15cm-long piece of doweling is tied to one end of the rope to anchor the rope to the guitar through the soundhole.

To begin the gluing process, first trim your main purfling strip to match the centerline of your top. You will be starting the gluing of each strip at this endblock area.

Apply glue along approximately 5 in. of the routed grooves, then do the same to the outer side of the unbent, inner strip. Place this strip in position with its end slightly proud of the



To rout the different-size grooves around the edges of the guitar for inlaying binding and purfling strips, Laskin made this router jig. The side of the guitar bears on the turned aluminum rod as the instrument is moved through the cutter, while the front or the back of the instrument is pressed against the router base. Various rods control the width of the cuts; the depth is controlled by the router's own depth-setting adjustment. The tapered top edge of the small pad in the center of the base allows clearance for the curved back of the guitar. A duct-tape shield directs dust down and away from the operator.

centerline (you'll trim it later). The main strip is then held in place and the rope, its dowel gripping the inner edges of the soundhole, is pulled snug across the purfling pieces 2mm or 3mm from the trimmed edge and around the body to grip at a point directly opposite where you're working. The first pull must be gentle to ease the dowel's pull on the soundhole edges. Your next pulls, with the rope crossing the purflings at about 2cm divisions, can be hefty.

Once the first 5 in. are clamped, keep the tension by wedging the free end of the rope under and around one of the taut winds. Now apply glue to the remainder of the purfling, tape the strips in place at two or three spots, wipe off the excess glue, trim the purflings' superfluous length at the neck joint (I quickly clip them with wire cutters) and continue winding the rope.

Wedge the rope again and inspect your work for gaps. If you're suspicious of a slight gap, press the purfling strip home by hand, looking for evidence of glue squeeze. If you do find any gaps, you should have enough rope to wind back to the spots and pull them in. Another choice is to use lightweight clamps and minimal pressure.

I let each section dry for at least one hour. I then unclamp the rope, letting it fall loosely onto a clean section of the floor ready for the next section.

The purfling strips around the top have a visible joint only at the bottom of the instrument; but the two sections of the back purfling have a second joint at the neck-block end. Leave the last few inches at the neck glue-free and unclamped, allowing you to fit the joint. Cut the strips one at a time just slightly overlong, and use a sharp chisel and/or fine file to trim them until, with hand pressure, they fall accurately into place. Apply glue, finish your clamping and finally, give your hands a deserved break.

Though I remove the rope after an hour, I don't clean down the purfling until the next day when the crystalized glue won't clog sandpaper.

Using a good sturdy scraper is the simplest way to level the purfling edges with the body. (I use my belt sander to even off the top and back edges, but that method can be dangerous to the guitar if you're not practiced at it.) My router jig, fit with a ¾-in., straight-fluted cutter and ¾-in.-dia. bar, can be used to remove most of the excess purfling off the side edges, but even with that method, hand scraping finishes the job.

Let me close with a reminder that you'll not regret working carefully and taking your time. Purfling work is often the first visible clue to an instrumentmaker's work standards. Doing it well shows respect for the entire tradition, and future, of the craft. □

Grit Laskin makes and regularly plays guitars in Toronto, Canada. Photos by Brian Pickell.

Turned Pens and Pencils

A retractable ballpoint

by Richard Elderton

After my second ballpoint pen broke in half, I noticed the flimsy plastic joint between the metal top and the plastic bottom. The thin plastic joint doomed the pen to a short life. To avoid this fate, I decided to clothe my two naked Parker refills with suits of wood.

The design is simple and functional—a wooden cap and barrel, shaped on the lathe and bored out for the refill and the trigger mechanism that advances the pen point for writing. The cap slides onto a sleeve turned on the barrel, and the two pieces are held together by a pin in the cap, which twists and locks in an L-shaped groove routed in the barrel. So far, I've resisted suggestions to add inlays or other adornment, partly out of laziness and partly to retain the basic quality of the rosewood and other exotics I use.

The first step is to rip blanks about 3/4-in. square for barrels, 3/8-in. square for triggers and 5/16-in. square for pins, then crosscut the cap and barrel blanks as shown in the drawing, or to fit your refill, plus an extra 3/16 in. I don't cut off the trigger and pin blanks until after these tiny pieces are shaped.

Turning techniques—I use a 3-jaw chuck for the turning and boring operations. By inserting the blank deeply into the chuck and gripping it tightly, I can do all the boring and end-grain shaping without the piece vibrating or whipping. First, I turn the 3/4-in. blanks to cylinders that can be gripped in the 3-jaw chuck without being damaged. After chucking each cylinder in the 3-jaw, I square both ends with a skew chisel.

The cap and barrel must be bored in stages. I mount a Jacobs chuck in the tailstock to advance different-diameter bits into the spinning cylinders. To hollow the cap, I begin with a 3/8-in. brad-point bit to bore the main hole to about 1/2 in. from the top of the piece, then complete the bore with a 7/32-in. sleeve drill. The sleeve drill, which centers the second hole in the first, is made with a drill rod and twist drill. I bore a deep axial hole in the center of the drill rod, again using the 3-jaw and Jacobs chucks, and epoxy in the twist drill. The barrel is hollowed in the same way as the cap, but this time I bore with a 1/4-in. brad-point bit, followed by a 7/64-in. sleeve drill.

I rechuck the barrel with about 1 3/4 in. of the open end protruding from the jaws and turn down a shaft, 3/8 in. dia. and 1 1/8 in. long. This shaft slides into the hole bored in the cap, which I deburr by sanding with 220-grit paper rolled into a cylinder. Then I gently push the cap onto the slightly oversize rotating barrel just enough for the burnishing action to indicate high spots to be removed with light skew cuts. Once the cap goes halfway on under power, test fittings are done with the lathe stopped, and the surfaces are sanded with 320-grit paper until everything fits.

To avoid breaking the barrel when it's shaped, a short section of 1/4-in.-dia. rod is inserted in the sleeve before the piece is clamped in the 3-jaw. A ball-bearing tailstock center is also snugged up into the small hole at the end of the barrel to steady and center it precisely as I turn the shape with a roughing gouge and skew. The next step is to mount the cap on a 3/8-in.-dia. rod. A piece of rubber tubing wrapped around the cap end prevents slippage in the jaws. Again, a live center provides end pressure for stability. Shape the cap, then try it on the barrel and adjust the pieces as needed. Do final sanding with the grain while the lathe is stopped.

A spring about 5/8 in. long makes the pen retractable. If you can't find a 3/32-in. OD spring, you can make one by wrapping 0.014-in.-dia. piano wire tightly around a piece of 7/64-in. drill rod clamped in a vise. Remove the spring from the rod and stretch it until it has about 14 turns per inch, then cut it to size. Once the spring is made, I can put it on the refill, assemble the parts I've made so far and calculate the dimensions of the trigger mechanism in the cap.

Calculating part sizes—The math here may seem a nuisance, but it avoids the wasted time and frustration of trial-and-error methods. To begin the calculation, I insert the depth gauge of a vernier caliper through the hole in the cap and use it like a trigger to depress the refill until it protrudes the correct amount from the barrel. I record this reading to the nearest 1/32 in., then proceed as shown in figure 3.

The oversized, square trigger stock can now be mounted in the 3-jaw, with just enough for one trigger protruding. I turn the whole section to 5/16 in. dia., then cut the steps shown, taking care to make the length of each step correct. The 7/32-in.-dia. section is

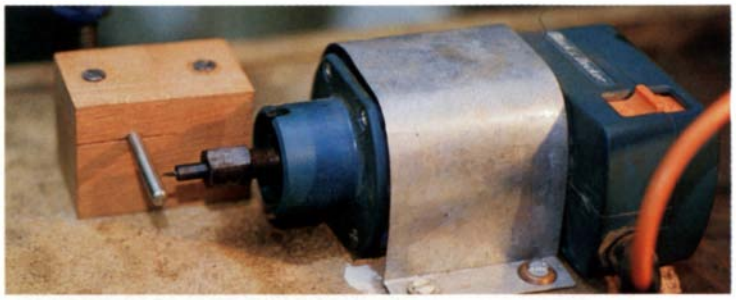
Tired of plastic pens breaking, the author made a two-piece rosewood housing for his ballpoint refills. The tiny trigger on the top makes the pen retractable. A boxwood pin fit into the top locks into a groove in the barrel to hold the pieces together.

Photos this page: Michele Russell Slavinsky crucial—if it's too slack, the trigger will slip; too tight will make it difficult to retract the refill.

After parting off the trigger from the square blank, I remount it with the chuck gripping the 7/32-in. section and turn a rounded point. I'm now ready to put the trigger in the pen and test the mechanism. If it doesn't work, I recheck the dimensions and adjust as needed.

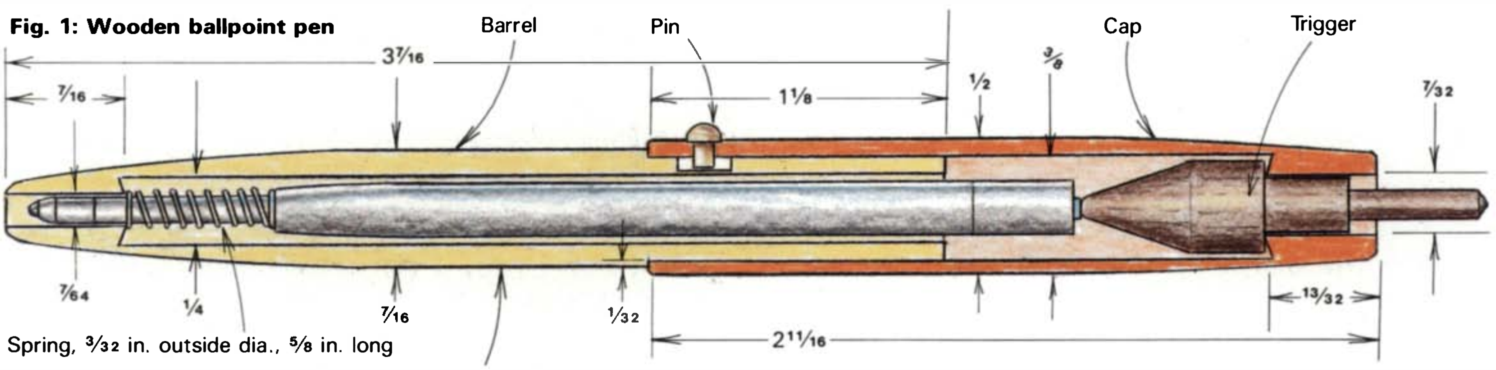
Routing grooves—I used to hand-carve the twist lock, but the simple router jig shown at right simplifies the process greatly. First, I drill a 5/64-in. hole about 3/16 in. from the open end of the cap, perpendicular to the pen's long axis. I like to recess the hole with an 1/8-in. counterbore to make a flat-bottomed socket for the pinhead. I made my counterbore from 1/8-in. rod, just as I did the sleeve drill, but filed in the tiny teeth before epoxying in the 5/64-in. pilot. The next step is to mount the 3/16-in.-square stock in the chuck with about 1 in. protruding. I turn it down to 1/8 in. dia., then reduce the diameter of the first 1/8 in. to create a square shoulder and 5/64-in.-dia. shaft. A small 1/4-in. skew made from an old screwdriver or drill rod works well here. After test fitting the pin, I adjust its length to fit the thickness of the cap, form the rounded head and part the piece off. The pin must protrude about 3/64 in. into the cavity to lock into the routed groove.

To cut the groove, I take out the pin, assemble the cap and barrel, then rotate the pieces until there's a good grain pattern



Cutting the groove for the locking pin is simple with this router arrangement. The pen barrel is pushed onto a guide rod, which fits snugly inside the barrel, as the bit cuts the groove. Twisting the barrel creates the final skewed section of the groove.

Fig. 1: Wooden ballpoint pen



Case shape determined by personal taste, pen refill size.

Fig. 2: Turning sequence

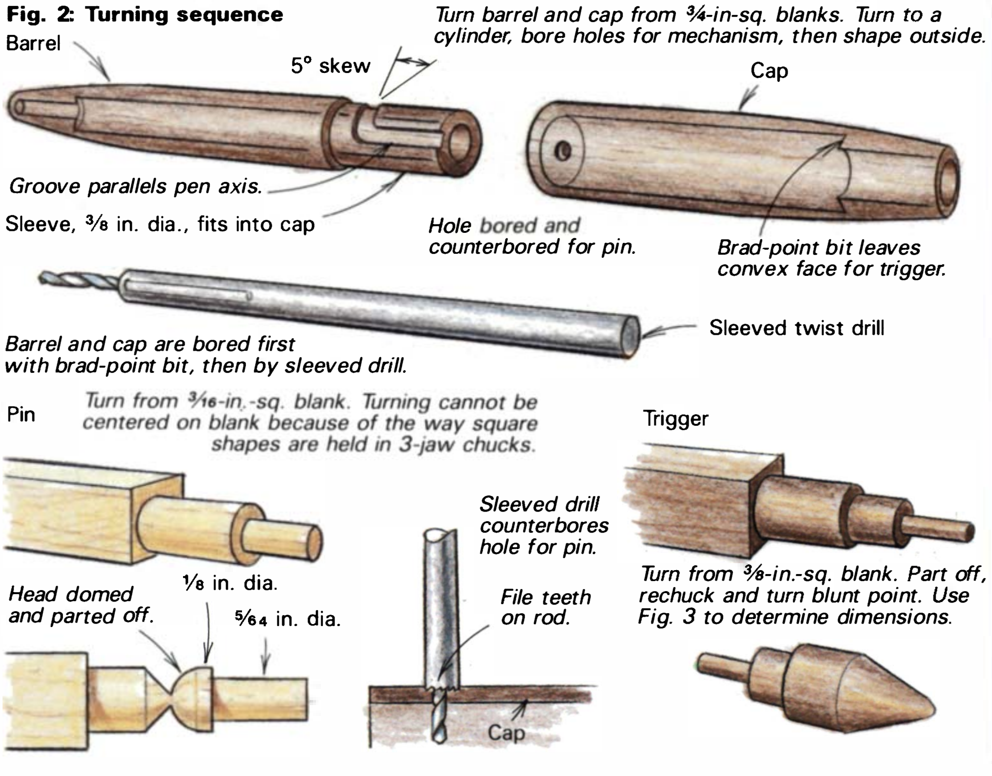
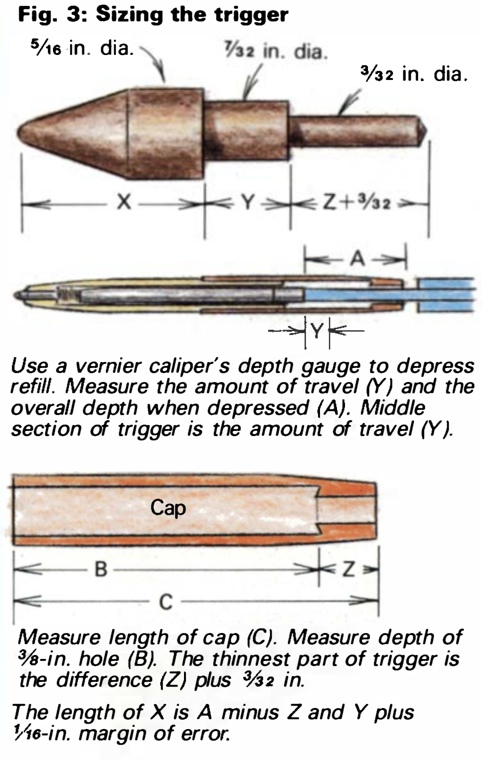


Fig. 3: Sizing the trigger



down the length of the pen. After marking the hole location with a pencil dot, I remove the cap and sketch a pair of lines about 3/32 in. apart and flank the dot at a 5° angle, skewing away from the joint. After drawing a line parallel to the axis from the top of the skewed lines to the top of the barrel, I switch on the router, mount the barrel on the rod as shown and push the barrel forward, cutting down to the skewed lines. At the skew, I twist the barrel and push it to follow the angle. My 5/64-in.-dia. router bit is ground from a 1/4-in. drill rod; I set the depth of cut with a feeler gauge inserted between the mounting rod and bit. After refitting the pin and filing it down so it doesn't bottom out in the groove, I secure it with a spot of white glue. I finish the pen with wax or shellac after the glue dries.

After wrestling with making the pen, you may be disappointed to discover that few people will see beyond the pen's pleasant shape and glistening finish to realize it is actually made of wood. Perhaps my wife has a case when she says the pens need a little embellishment. □

Richard Elderton is a cabinetmaker in Hawkley, England.

A mechanical pencil

by Earl C. Kimball and Cynthia A. Kimball

Turned wooden casings let you customize mechanical pencils to your hand and show off your turning skills. The pen, above, is turned from walnut and maple.

We enjoy the clarity of line produced by 0.5mm mechanical pencils, but dislike the plastic models sold in art and department stores. Wooden pencils feel better in the hand, so we decided to fit the self-contained lead cartridge of a mechanical pencil into an all-wood housing.

Any good hardwood can be used for the casing. We usually begin with a walnut, ebony, mahogany or maple blank, bore a hole lengthwise through the center, then slide the blank on a mandrel that can be mounted in a Jacobs chuck and turned on the lathe. We prefer Pentel 0.5mm and Pilot 0.5mm pencils, but other brands might work; adapt the measurements shown in the drawing to fit your pencil. The first step is to remove the innards from the plastic, usually by unscrewing the tapered tip from the lead cartridge.

The original plastic sleeve becomes a rough model for determining the size and shape of the wooden case. For our pencils, we started out with a 3/4-in.-square hardwood block, about 2 in. longer than the desired pencil. The excess length is used to hold the blank on the mandrel and will be discarded after turning. We make sure our original blocks are square in section, then draw diagonal lines from corner to corner. We drill through this mark with a 7/32-in., brad-point drill, which isn't deflected by slanting grain as much as a high-speed steel bit. I use the horizontal boring feature on my Shopsmith Mark V multipurpose machine to drill the blanks. You could also clamp the blank upright in a vise or against a high fence on a drill-press table. To bore through the 6-in. to 8-in. blanks, we generally drill in from one end with an extra-long bit. If you can't find long bits, you can drill in from both ends with regular-length bits. It's fine to have a hole at each end, because the top hole will be plugged with the eraser.

The pencil point must be reinforced so that pressure from writing won't split the wood. We use soft aluminum tubing (available from model airplane stores) with a 7/32-in. OD as a sleeve. Bore out the inside diameter to accept the lead cartridge. The tube should be inserted about 3/32 in. into the blank, then epoxied in place before being cut off about 1/8 in. longer than the wood blank.

Our turning mandrel is a custom-shaped, mild-steel mandrel with shoulders to fit the inner shape of the pencil. It can be turned on the lathe or mounted in a drill chuck and filed to shape as it is rotated. We epoxy the block to the rod at both ends to prevent spinning, so it's not necessary to make a tight-fitting mandrel.

The blank is mounted on the lathe by fitting the mandrel at the pencil's top into a Jacobs chuck and the other end into a drilled wooden plug in the tailstock. Turn to any desired shape. Note the pocket clips (salvaged from old felt-tipped pens) fit in shallow rabbets turned on the pencils. After sanding the pencils, we finish with tung oil. Finally, we carefully cut the pencil from the block with a skew. We saw through the excess tubing with a jewelers' saw, then remove the mandrel. If the reinforcing ring isn't securely fastened, we reglue before inserting the pencil mechanism. □

Earl C. Kimball is a forester in McCall, Ida. His daughter, Cynthia Kimball, is a graduate student at the University of Idaho at Moscow.

Fig. 4: Turning a wooden pen

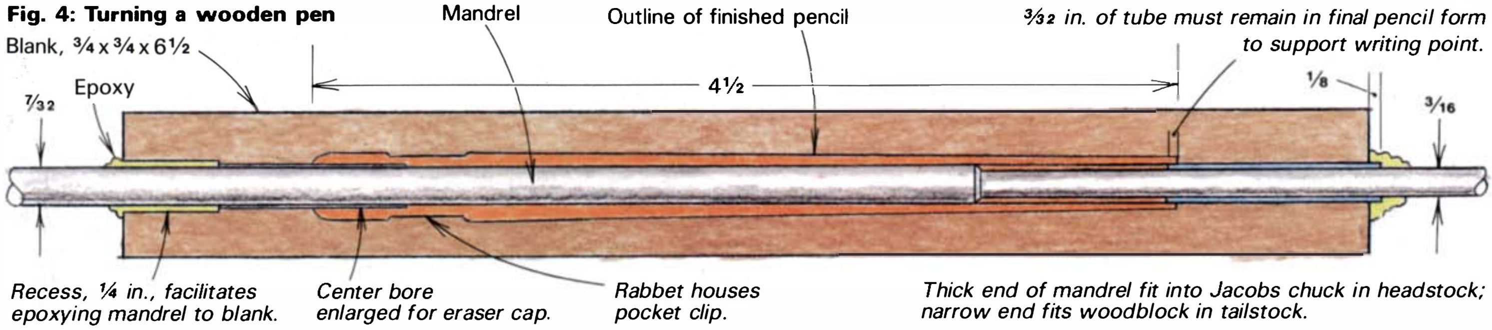


Photo: Michele Russell Slavinsky

Shop Insurance

Taking the splinters out of buying the right coverage

by Gary B. Savelli

If you're a self-employed woodworker, you should consider liability, business and personal property insurance as important as your shop equipment. Even if you're an amateur woodworker, it's wise to check your homeowner's insurance policy to make sure that your home and shop equipment are adequately covered and that having a shop in your house doesn't jeopardize your home coverage. This is especially true for hobbyist woodworkers who earn money on the side by selling products made in the shop, because a homeowner's policy might not cover commercial operations.

Insurance can be expensive, but it could determine whether your business survives should you incur losses through lawsuits, fire or theft (to name a few potential catastrophes). Although I feel a woodworker should be adequately insured across the board (no pun intended), you have to balance the total amount you spend on insurance against the risks you are facing. For instance, if you specialize in restoration work and installing architectural elements, your equipment and tools may be minimal, so fire insurance might not be terribly important to you. Instead, you might prefer to spend your money to insure your health and income in case a fall off a scaffold leaves you unable to work. On the other hand, if you located your cabinet business in a bad neighborhood to take advantage of low rents, you might concentrate on insuring your tools against fire and theft.

"As a manufacturer, a woodworker might be liable for injuries caused by a product, even if the customer abused it."

Liability insurance—I advise my woodworking clients that business liability coverage is essential. This insurance covers you if a judge finds you liable for losses or damage incurred by another person (or corporation). The settlements and the legal expenses here can be so large that were you *not* insured, you might be forced into bankruptcy. I recommend Comprehensive General Liability insurance. This broad liability policy covers court settlements, the cost of legal defense and medical expenses that arise from the operation of your shop. If your business is in your home, you still need a separate CGL policy—homeowner's insurance will not cover losses from running a business. The CGL policy does not deal with lawsuits brought by employees, however. These are generally covered by worker's compensation.

As a product-liability insurance, CGL also pays claims resulting from property damage or injury that your product causes. It does not cover loss to property in your care. For instance, suppose you're in the process of delivering a cabinet and accidentally drop it on my car. The car damage amounts to $200; the cabinet damage is $450. Your insurance may pay for car damage, but the cabinet is not covered. If the cabinet tipped over and hurt someone, the insurance would pay the court costs and any settlement against you to the full extent of the policy.

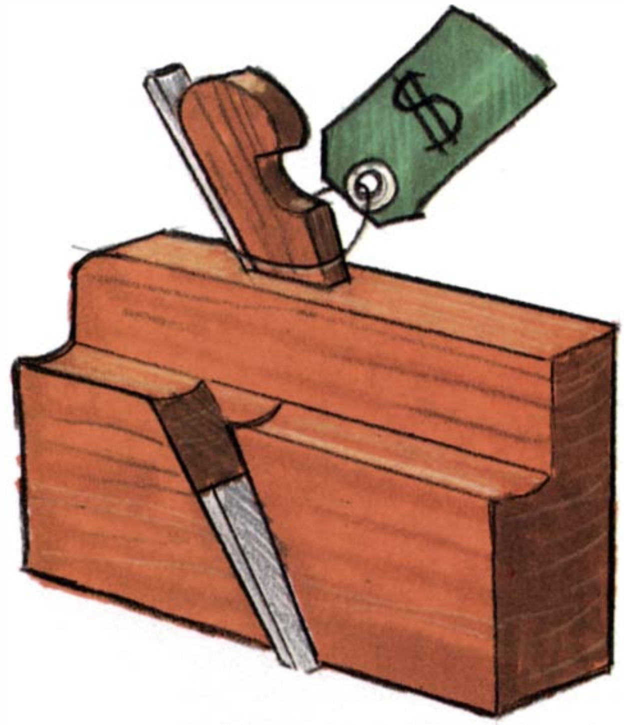
CGL costs vary widely, depending on the state and the situation, so it's impossible for me to give specific costs, but here's a typical case based on rates in California. The premiums are usually determined with a formula based on your gross annual receipts, employees' annual payroll and, sometimes, the square footage of your shop. If you have a sole-proprietor shop with no employees and a gross income of $40,000, you would pay between $500 and $800 for $300,000 of liability coverage. A two-worker shop with 3,000 sq. ft. and gross annual receipts of $100,000 would pay between $2,000 and $3,000 for $300,000 of liability coverage. One caution: The policy is auditable, meaning that your agent will base the initial premium on payroll and income figures you supply. Then, at the end of the year he'll require audited figures, which will be used to calculate the actual cost of the policy. Should the audited figures vary from your original estimates, your insurance company will either bill you extra or pay you a refund. When shopping for a CGL policy, be wary of very low rates—the agent may have deliberately lowered the figures to offer you a deceptively lower initial premium, but will make up the difference at the end of the year. Also, many agents offer low prices because their policies are not true CGL policies, but actually owners, landlords and tenants policies that cover only your premises, not products or business operations outside your shop.

If you cannot find a CGL policy, the next best policy is one that contains "manufacturers and contractors" and "products and completed operations" coverage. A policy that contains these coverages protects the same major elements of a CGL policy.

In addition to your CGL policy, you may want to cover your business personal property, such as machines, inventory, raw materials and office equipment. Two basic types of policies apply. The least expensive is Named Perils Coverage, which covers losses from fire, windstorms, water, smoke, vandalism and other specified problems. The other, more expensive, coverage is called All Risk, which covers theft, as well as damage from fire, windstorm, water, smoke and vandalism. These policies can cost anywhere from a couple of hundred dollars to more than a thousand dollars, depending on the company and the state where you live. Some companies also combine business personal property and liability coverages into a single package often called Multi-Peril Package, Artisan Package or Manufacturers and Contractors Package.

Worker's compensation—This insurance, which covers employees for occupational diseases and injuries, is mandatory in most states. In addition to covering injuries while on the job, this insurance will pay employees' salaries while they are recovering from a disease or injury. The policy also includes employer's liability insurance, which generally protects an employer found liable for the employee's injury. Usually the premiums are set by the state and will not vary from company to company.

A type of worker's compensation you should look for is a "participating" policy. This kind of policy pays back a dividend (though usually small) if your insurance company remains profitable. The dividends are not guaranteed, but at least it's good to know you may be able to recoup some of the insurance costs. Many states also have a state compensation fund, making compensation coverage available to those who cannot afford or qualify to purchase from a private company.



"If you have antique hand tools, their value should be listed on your homeowner's insurance."

Homeowner's insurance—This insurance generally excludes most damages involved with operating a business in your home. For instance, if a professional woodworker working at home has a fire in his basement shop, homeowner's insurance would cover only the losses to the home, not the business losses. Similarly, a homeowner's insurance policy won't cover court costs stemming from a product-liability suit.

Hobbyist woodworkers (those who don't sell their product) generally are covered by their homeowner's policy, but you should check with your agent to be sure. Generally, a fire that originates in a hobbyist's shop is covered under homeowner's insurance because insurance companies recognize that virtually every house has a shop or work area of some kind.

Homeowner's insurance usually deals with the cost of replacing your personal property in one of two ways. One type of policy will reimburse you for the cost of your tools and machinery (or any other household item) minus the depreciation. The other type pays you the current replacement cost. This type is slightly more expensive, but is worth it because you'll have to replace an item at current costs. If you have many machines and hand tools, they should be listed on your insurance policy. This could result in higher premiums, depending on the limits set in your policy. Your agent may require copies of the receipts from the tool purchases to determine their value. If you have antique hand tools, their value should be listed on your homeowner's insurance. Once again, your agent may want them appraised.

Whether you are a hobbyist or a professional, read your policy. I can't overemphasize this. You should find out what you are insured for *before* a catastrophe happens. Your policy may not exactly qualify as light reading, so if you have any questions, contact your agent. You should shop for insurance in the same aggressive manner you would shop for a tablesaw—prices and policies will vary significantly. A good way to shop for insurance is to join your local woodworker's trade association. Ask members what company they use, then go with a proven specialist. Also, the American Craft Council makes group medical insurance and an all-risk property policy available to its members. For more information, write: American Craft Council, 40 W. 53rd St., New York, N.Y. 10019.

Finally, if you're dealing with an independent agent, ask what company the agent is offering and if the company has an "A" rating by the A.M. Best Co.'s rating method, which gauges the financial health of insurance and other companies. And again, trying to save money by not buying insurance is false economy, especially if you're an incorporated business and the premiums are tax deductible. □

Gary Savelli is vice president of Basic West Insurance Co. located in San Francisco, Calif.

Limiting your liability

by Peter A. Lee

Woodworkers selling their products risk the same kinds of product liability and personal injury suits as do industrial giants. The cash amounts involved may be more modest, but any woodworker can be held legally liable if an employee or customer is injured in the shop or if an employee injures someone or damages their property. As a manufacturer, a woodworker might be liable for injuries caused by a product, even if the customer abused it.

Liability laws are complex and vary from state to state, so in a short article, I can give only general advice on limiting liability. There are prudent, common sense steps you can take to reduce risks, and you can organize your business in ways that will reduce your personal financial liability if you are sued.

Suits arising from shop accidents may be the most serious risk faced by a woodworking business. You have an ethical and legal obligation to the public and your employees to run a safe shop.

Housekeeping is important. Keep your shop clean and in a good state of repair. Safety hazards, like piles of dust and scrapwood, should be corrected immediately.

Equip all your machines with necessary safety devices, such as guards for blades, cutters, belts and other moving parts, even though it sometimes seems easier to work without them. Post clearly visible safety procedures around the shop and near machines. Provide and require all employees to wear eye, hearing and breathing protection. Other safety gear such as push sticks, featherboards and hold-downs should be available in abundance so there's never an excuse for not having them handy. Be sure each employee is properly trained to handle the assigned jobs and machines, and if you can, keep written records of how and when the training was conducted. By practicing rigorous safety procedures, you reduce the likelihood of an accident; if one does occur, you have documented your concern for safety and reduced your chances of being found negligent.

Keeping the public at large out of the shop is also important. Posting a prominent warning sign at your shop entrance is not enough. Locate your office in the front of the shop to discourage walk-throughs. At a job site, stand sawhorses to block traffic through dangerous areas.

Fellow woodworkers may want to trade their labor for shop time and the use of your machinery. This can be especially risky. A newcomer might not be familiar with the safe operation of your machines or tools, putting themselves or others at risk. Don't enter into such an arrangement unless you're sure they can safely operate your machinery. Have them sign a "release in indemnity" agreement—if the person is injured, you are not liable. These agreements, however, don't afford protection in all states, so check with your attorney.

The major product liability risks come from poorly thought-out designs that in normal use can injure a person; defectively made items that could break easily or operate improperly, injuring someone; or items sold without warnings advising the customer of hazards relating to their use or misuse.

You must ensure that someone using your product won't be easily injured by it (the same holds true for your premises). Furniture should be proportioned so it won't tip unexpectedly and so it's strong enough to stand up to the use it's reasonably expected to see. Take extra steps to ensure safety, like fastening a tall cabinet securely to the wall, instead of just letting it stand on its own. Take the trouble to gently round sharp edges on furniture. If you're making toys, make sure there are no small parts that a child could break off and swallow and that the finish you're using is non-toxic. Establish your concern for safety by documenting any specific actions you take to ensure product safety.

In instances where safety is still a concern, provide the customer with a written explanation—a tag, label, letter or card—explaining any precautions that might be appropriate. None of these precautions can be overemphasized when designing children's furniture or toys. For more information on this, write the Consumer Product Safety Commission, whose address is given at the end of this article.

You must insure yourself within economically realistic bounds—without going broke. Your insurance should be comprehensive enough to cover your business premises and products (see main article). If you have employees, you must carry state-mandated insurance, such as worker's compensation. Contact your state labor board to find out any additional obligations.

In spite of all your precautions, you could find yourself the loser in a business-related civil suit. Therefore, in addition to insurance coverage, one of the simplest and most economical methods to protect your personal assets is incorporation. The beauty of the corporate structure is that, as long as you are operating under the legal formalities of the corporation and holding yourself out to the public as a corporation, only corporate property and assets (bank accounts) can be used to settle a claim. In rare cases, the so-called corporate veil can be pierced and personal assets reached, but the corporation still affords effective protection. If you wish to incorporate, you should seek the advice of your attorney and public accountant.

In most states, you can also protect your assets by holding personal property jointly with a spouse. Spousal-protection laws (and homestead acts) allow that judgements (including those judgements initiated by trade creditors) against one spouse cannot reach assets that are held jointly by both spouses—a spouse who is an innocent bystander should not have to act as the insurer for the other spouse's business misfortunes. One can debate the complexities in considering this tactic for asset protection, but in most cases the benefits outweigh the detriments.

Many corporations, woodworking businesses included, involve partners. While there are benefits to partnership, an "innocent" partner may still be liable if the other partner injures someone in the course of business. If that partner has no assets, the injured party can satisfy his claims against the assets of the solvent partner, even though the solvent partner may not have had any direct part in causing the damage to the injured party. Once again, a corporation would afford some protection in this case.

Discussion of insurance and liability may sound like a doomsday approach to craft, but it simply amounts to good business, and this ultimately benefits you and your customers. □

Peter A. Lee is an attorney and woodworker in Honolulu, Hawaii.

Further reading

Additional material for this article came from:

The Law (In Plain English) For Craftspeople by Leonard D. DuBoff. Madrona Publishers, Inc., P.O. Box 22667, Seattle, WA 98122; $7.95 plus postage.

DuBoff has written two other books useful for the small craft business:

The Law (In Plain English) For Small Businesses ($8.95 plus postage) and *Business Forms and Contracts (In Plain English) For Craftspeople* ($14.95 plus postage).

For information on federal regulations for toys and children's articles, write:

U.S. Consumer Product Safety Commission, Washington, DC 20207.

Porter Cable 504 Milwaukee 5935 Hitachi SB8T

Belt Sanders Survey

New models and features kick up some dust

by Hugh Foster

A belt sander is a portable surfacing tool. Unlike a handplane, it uses a continuous belt of abrasive instead of a blade to remove material. Although many purists consider belt sanders quick and dirty tools suited only for rough carpentry, I think they're indispensable for many surfacing jobs for high-quality woodworking. After a board with roey or curly grain is handplaned or run through the planer, the pecks and mill marks still need to be cleaned up, and scraping or sanding them can be a substantial task. A belt sander can run with or across the grain without tearing it and will prepare a relatively rough surface for finish sanding quickly and painlessly. Depending on the coarseness or fineness of the grit, a rapidly running sanding belt can quickly level and smooth anything from a small piece of molding to a huge panel glued up from a dozen boards or do very sensitive work, such as smoothing out the joint between a face frame and plywood carcase. A belt sander will also sand materials besides wood, including plastics, ferrous and non-ferrous metals and even stone.

Belt sanders come in several different sizes, specified by the size of their sanding belts. The three most common sizes on the market are 3 in. by 21 in., 3 in. by 24 in. and 4 in. by 24 in. But at least two companies, Sears and Skil, make sanders that use non-standard-size belts. Since you're likely to have only one belt sander, choosing a larger or smaller size involves a trade-off. A 4x24 sander can remove more material to sand large surfaces more quickly, and so is excellent for panel sanding. But, it is heavy, and wide belts are more expensive than narrower ones. The 3-in.-wide models, on the other hand, are lighter and less fatiguing to use, more maneuverable for jobs like face-frame sanding, and cheaper. But, in most cases, they won't work as quickly or flatten a panel as readily as a 4-in.-wide belt will.

To find out more about the belt sanders currently on the market, I shop-tested 39 different models made by 11 manufacturers. I compiled their specifications, and significant features are outlined in a chart on page 75. I found the innovative design and abundance of new features on seven of the sanders warranted more extensive review, which will appear further along in the article. First, let's look at what basic attributes constitute a good belt sander: good balance and comfortable handles; a motor powerful enough to sand without bogging down; light and sturdy construction that protects the user from electrical shock; a tracking mechanism that keeps the belt uniformly aligned on the rollers; and efficient dust collection. While I found all the belt sanders I tried to be serviceable (there wasn't an absolute turkey in the bunch), there are many subtle distinctions worth noting. Once you understand the qualities described below, you'll be able to use the chart to compare various models against one another.

Basic belt sander attributes—***Handle placement and weight distribution*** are important to a belt sander because it's mostly used hand-held and needs to be easily controlled and kept flat on the workpiece to do the best job. An unevenly balanced sander can tip and gouge the wood; one that's uncomfortable to hold increases the chances of the operator losing his grip and making a mistake. But how a sander "feels" to the user can be highly subjective. Nearly 10 years ago, my friend and I both bought 3x24 belt sanders, his made by Milwaukee and mine by Makita. We'd swapped sanders on numerous occasions and, although many of the basic features of the two machines are about the same, we wouldn't trade machines under any circumstances. His sander felt out of balance, with handles awkwardly placed, and he felt the same way about mine. The point may be that prefer-

Sears 11791 **Makita 9924DB** **Skil 7845**

ences are a matter of habit, but it's still good advice to try a machine out before you buy it. Just the location or shape of a handle might rule out a particular model for you. For instance, the front handle on the Elu 4023 is placed too far back for my taste, and even though I like the Ryobi 7200's solid construction, nice balance and competitive price, its large-size front handle is just too big for my hand. Freud makes its handle arrangement more adaptable by allowing the front knob to be mounted either on the top or front of the body.

The balance of a belt sander is affected both by the machine's distribution of weight and center of gravity. Most sanders have a transversely mounted motor, which puts a lot of the weight on one side of the sanding belt instead of directly over it. It's best for a sander to have a low center of gravity and its handles centered with the sanding belt; otherwise, the sander can require a lot of effort to keep flat on the workpiece.

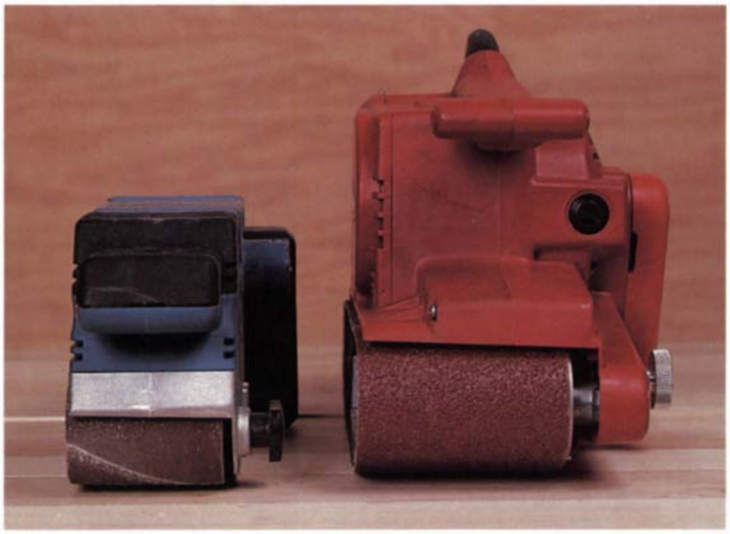
Universal electric motors are used by all belt sanders to drive the sanding belt, the cooling fan and an optional dust collector. While motor power obviously affects sanding capacity, figuring out which model sands the fastest isn't as easy as picking the sander with the highest horsepower rating. Since it takes more energy to run a sanding belt faster and sand more surface area at a time, you have to consider the rate at which the belt rotates (measured in surface feet per minute, SFPM) and the size of the sander's platen (the part that presses the belt against the work) when estimating how effective sanding action will be. For instance, wider-belt sanders don't always sand faster than narrow ones. The Sears model 11791 and the Makita 9924DB have almost identical power ratings, SFPM, and platen size, yet the 4-in.-wide Sears doesn't sand any faster than the 3-in.-wide Makita.

When considering the motor power of any sander, remember manufacturers use different methods of rating horsepower, and many stretch the truth by inflating horsepower claims. This is why, in the chart, I've stated motor power as an amperage rating. You can calculate approximate horsepower by multiplying motor amperage by 110, (the voltage all U.S. models use), dividing by 746 (the number of watts required to produce one horsepower) and subtracting 15% for friction losses.

The motor housings and bodies on almost all current belt sander models are made from a mixture of high-strength plastic and cast-alloy parts. While this may not appeal to those who prefer solid-metal castings, it makes for a lighter belt sander that's a lot less tiring to use. One exception, the all-metal-bodied Porter Cable "locomotive" model 504 may outlast your grandchildren, but they may need to help you lift it when you retire to your shop. For those who suppose that plastics are used in modern power hand tools to cut manufacture costs, there's an irony: The plastic fiberglass-filled tool bodies that many companies make for their sanders are more expensive to manufacture than the original all-metal bodies they made years ago.

Besides helping to keep the weight down, the use of nonconductive plastic parts helps provide electrical protection. All the manufacturers, except for Porter Cable, double-insulate their sanders, which means neither the motor's armature or body can conduct electricity to the user. The longer cords that come on some machines eliminate the need for an extension cord. This is more than just a convenience. If you're working with a short cord or extension cord that comes unplugged, chances are you'll forget to release the trigger lock (all the sanders have trigger locks so you don't have to hold them on while sanding), and when you replug the cord, the sander will suddenly leap from the workbench, probably with untoward results. Also, the cords on some sanders connect to the body above the rear handle; the sander is meant to be used with the cord draped over your shoulder so it's out of the way and won't get sanded over or, worse yet, caught up between the belt and the body of the sander.

Tracking the sanding belt to keep it from either coming off the sander on the open side or scraping against the inside of the housing is accomplished on most belt sanders by turning a knob. The knob changes the cant of the crowned front roller (or idler) slightly, coaxing the belt to ride dead center. Skil and Sears belt sanders feature an automatic tracking mechanism that monitors the belt's position and adjusts the angle of the idler accordingly. Once the



The Ryobi BE321, left, has an in-line motor design and low center of gravity that make it a lot easier to handle than the larger, more powerful Milwaukee 5935.

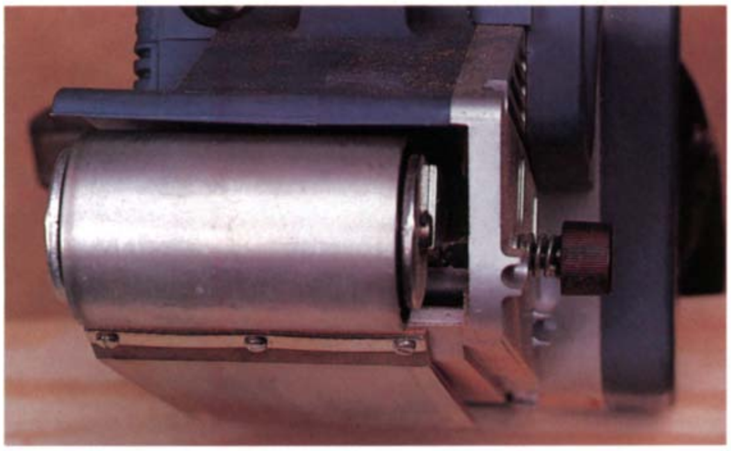
Besides their modern, low-profile body styles, the new model sanders host a variety of features and accessories, like sanding frames, variable-speed control, vacuum hookup and bench-mounting stands with fence attachments that give state-of-the-art performance.

range of tracking is adjusted by a setscrew, the mechanism seems to be responsive and works without a hitch. While all the sanders I tried tracked very well and didn't need much fooling with, the tracking adjustment was more responsive on some machines—especially the Japanese sanders.

The tracking mechanism can be ruined by rough handling or a sudden impact that dings the idler or tweaks the yoke that holds it. Most sanders are susceptible to this because the body doesn't provide the idler much protection. Tracking can also suffer from damage to the rear drive shaft, which is supported from one side only. Excessive wear to the rubber-covered rear roller or drive-shaft bearing will also make tracking erratic.

Dust collection was once something of a novelty on belt sanders; now it comes either as standard equipment or is available as an option on every sander model I tested. Considering the amount of dust a sander kicks out and all the discomfort and health problems airborne wood dust can create, I think it's foolish even to consider buying a belt sander without at least a dust bag on it—even the sander will operate more efficiently.

Belt sanders with built-in dust collection use more or less the same motor as non-dust models, but employ two fans—one for motor cooling and another for dust ejection into a canvas bag. A crucial difference between Japanese sanders and their American and European counterparts is the placement of the dust bag. As I look down on the tool with the handle in hand, Japanese sanders have dust bags attached on the upper right, making the tools definitely right-handed. The others have the bag mounted on the left and farther from the handle so the machines can be run either left- or right-handed. While most dust bags readily slip on or off and have a zipper or slide-off clip to make emptying painless, some do not. My old Makita, for instance, has a dust bag that's so hard to remove, I usually empty it by taking the whole sander to the trash can, opening the bag and shaking the sawdust out.


With its sanding belt removed, you can see where the tracking adjustment screw contacts the front-roller yoke assembly, in this case, on a Bosch 1273DVS. Turning the screw in or out changes the cant of the roller and sets the tracking of the belt.

Noise control, unfortunately, is something hardly any belt sanders are good at. Nearly all the sanders measure loud enough to where I wouldn't consider using any of them for very long without wearing hearing protectors. I used a Radio Shack sound-level meter and measured each sander from two feet away, about the distance the machine is from your ears when you're using it. The levels listed in the chart are stated in decibels (50 Db = a normal speaking voice—an increase of 10 Db anywhere in the scale indicates a doubling in volume). Curiously, a few of the sanders, like the Freuds and the Bosch 1270 series, ***seem*** quieter than they actually measure, probably because of the subjective nature of how we perceive sound. Since the motor accounts for most of a sander's noise level, reducing the motor speed will reduce the sound level. This is possible on a few of the new sanders because of built-in variable-speed control.

New features—Some new features that haven't been available in the United States until recently are now being offered on many belt sander models. Many are only on the new model sanders described below, although some are available for conventional models as well. At least three of these new features—sanding frames, variable-speed controls and stationary sanding stands—improve a belt sander's performance and expand its repertoire and thus, are worth some description.

The sanding frame is the most significant of these new features. Developed in Europe for high-production, veneered-panel sanding, a sanding frame is an auxiliary sole that clips to the bottom of a sander and extends around its sanding belt, like the baseplate of a router around the bit. The frame prevents the sander from tilting and allowing the edges of the belt to gouge the work. This is particularly useful on 3x21 machines that don't have a very large platen size (footprint) and don't produce as flat a sanded surface as a machine with a bigger footprint. To assist good surfacing further, an adjustment screw on the frame regulates how deep the belt will sand and can be set so the sander will remove as much or as little material as desired.

Variable-speed control allows you to change the speed of the motor, and hence the sanding belt. This is useful either for adjusting the belt speed to the correct SPFM for sanding different materials or for reducing the rate at which the belt removes material for delicate work. By adjusting a knob, you can select any of several speeds: full speed for solid wood; slower for ply-

AEG HBSE75S Ryobi BE321 Bosch 3270D

woods; and slower still for plastic, aluminum or gummy woods prone to end-grain burning.

An auxiliary stand allows a belt sander, which is mostly hand-held, to be flipped over and used as a small stationary sander without having to clamp its irregular-shaped body to the bench or hold it in a vise. In addition, a metal angle gauge that bolts to the sander or the stand allows you to sand small pieces with great precision and safety.

State-of-the-art—While I liked many of the 39 belt sanders I shop-tested, there are seven new models that represent the new generation of state-of-the-art machines. The first of these belt sander models came from Germany where they were developed for high-production, flat-panel processing used in 32mm cabinetry. Now they're manufactured in Japan as well. These sanders incorporate designs and features that distinguish them from more conventional models, and they're offered at attractive prices for both the professional and the hobbyist.

The most obvious distinction between the new model belt sanders and their traditional counterparts is the new models' in-line motor design featuring even-weight distribution and a low center of gravity. This lends them a sleek, modern appearance and makes them easy to use; there's less effort needed to keep the sanders flat on the workpiece and moving evenly. Their low profile also allows them to work in more cramped spaces than sanders with taller, more bulky body styles. But despite their similar appearances, not all the new models are the same in terms of construction or features, so let's examine them individually to compare their strengths and weaknesses.

The AEG HBSE75S is a light and powerful unit with good balance and a well-made feel to it. AEG's attention to detail is really apparent on this machine. For instance, the dust bag mounts to the body via a gasket fitting that has an internal baffle to make it more efficient by directing the air flow within the bag. Also, the machine's heavy-cast belt platen has a graphite-impregnated pad on it to reduce friction. The AEG's sanding frame has a very large 7¾-in. by 14-in. footprint, and the precise depth-adjusting mechanism can be set to remove as little as a couple of thousandths of material at a time. The bottom of the frame is covered with dozens of short brushes that help it glide over all but the roughest surfaces, making it a pleasure to use. However, the bristles tended to hang up on some fir plywood I tried it on. The sanding frame clips to a couple of rather large brackets that unfortunately must be bolted to the sander before the frame can be used. The electronic variable-speed control allows the AEG's belt speed to be adjusted anywhere from 660 SFPM to 1250 SFPM—a healthy range. There's also an attachment for edge and angle sanding that's well worth the $6.95 additional cost. Inverted on the standard cast feet and with the sander's belt speed slowed to around 800 SFPM, the edge guide can be used successfully for tool grinding.

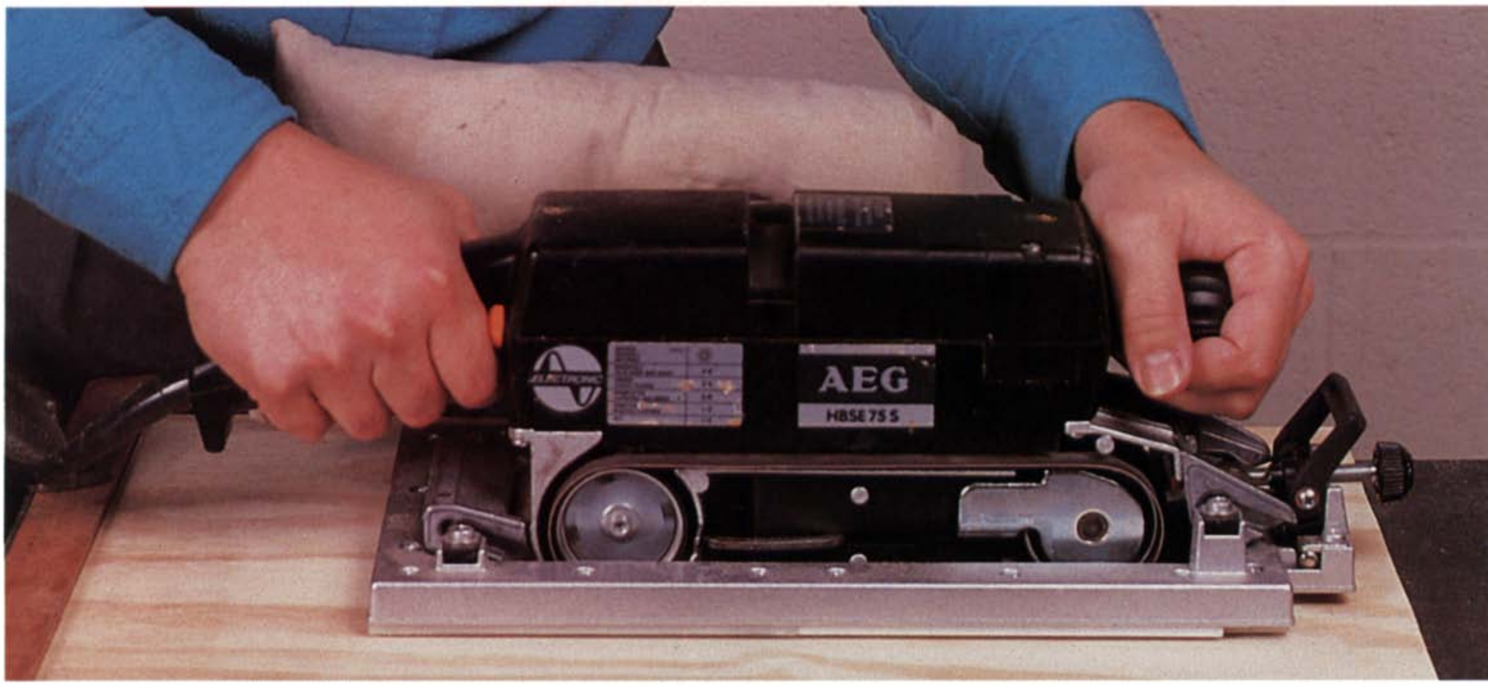
The Ryobi BE321 is quite similar to the AEG in looks and overall feel, and its lighter weight and compact size make it easy to heft. The tracking mechanism on the Ryobi is very responsive, with only a slight twist of the knob needed to get the belt tracking perfectly. The belt release has a molded plastic handle (as does the Bosch 3270D) that's comfortable to operate. The dust-collection fan is adequately powerful, but the bag is rather small and needs to be emptied frequently. Also easy to use, is the BE321's variable-speed control. Unlike most models that put the control knob on the body, Ryobi has mounted it on the front handle so you can change the speed of the belt without taking your hands off the machine. Optional accessories for the Ryobi include a bench stand that clamps the sander down, a variable-angle jig and a sanding frame. Unlike the AEG, the Ryobi's sanding frame is covered with slippery phenolic-like plastic often used for router baseplates. The frame clips on the bottom of the Ryobi body, making it very easy to pop on and off and leaving no protruding brackets when it's not in use.

The Freud LC75 looks very similar in body design to the AEG, but its cast-alloy lower body doesn't look as well finished. There are two threaded inserts atop the Freud—just like those the AEG uses to mount its cast feet—but Freud uses them instead as alternative mounting points for the movable front handle. The unit has great power and a strong dust fan, with a cloth bag that's easy to remove and empty.

The Freud LC110 is the LC75's big brother and the only new model 4x24 currently being manufactured. This sander seems to be the 3x21 model with the addition of wider rollers and a metal protective belt guard. The LC110 doesn't feel underpowered at all, considering it employs the same 9.6-amp motor as the LC75, making the latter the most powerful 3x21 belt sander on the market. The handles are mounted in the same position on the body of both Freud models, but are off center with the belt on the wider LC110, which makes it more difficult to control. Also unfortunate is that two of the most important features among the new models—variable-speed control and a sanding frame—aren't available at this time for either Freud model.

The Bosch 3270D is a beautiful machine with a design that looks as if it belongs in New York's Museum of Modern Art. It has an

Held rigidly in its stand and fitted with its angle guide, the Elu 4023, above, can be used as a small stationary sander. Fitted with its optional air-vac attachment—a hose connecting from the sander's dust port to a vacuum cleaner—the Bosch 3270D, left, undoubtedly becomes the cleanest-to-use belt sander on the market.



Fitted with a sanding frame, a belt sander can become a very precise, portable surfacing tool. Here the brush-bottomed sanding frame on the AEG HBSE75S gives the sander tremendous stability, although it prevents the sander from sanding flush to a corner.

overall heft and feel like the Ryobi BE321, and both machines have similar weight and power. Its molded handles are extremely comfortable, although the front knob extends a little too far forward for my tastes; I tended to tip the machine that way. The dust collection fan is a bit weak, but Bosch has compensated for this by offering an accessory vacuum attachment called the Air Sweep Dust Extractor System that makes the sander's dust collection efficient enough to use without a dust mask. The hose and couplings retail for $16.30 and are also available for the Bosch 4x24 models. If I owned the Bosch, I would tape the vacuum's hose to the power cord to keep it from getting in the way. Like the Freud models, the 3270D doesn't have variable-speed control or an optional sanding frame.

The Elu 4023 and 4024 are Swiss-made machines imported by the Black and Decker Corp. These machines are unique looking compared to the other new model belt sanders, because their motors are transversely mounted and they have their dust bags clipped right on at the front. Despite the non-in-line motor position, they are still light and low centered. The location of the dust bag puts the position of the front handle on top and very near the rear handle. While this may be all right for some people, it may feel a bit cramped for persons with large hands. The Elu's 5-amp motor feels a little skimpy on the power, and hence the dust collection is also weak. With their smaller platen size that puts less demands on the motor and, at 6.2 lb., these Elus are among the lightest sanders available. There's also a feeling of quality to these machines, from the finish on the cast-alloy parts to the smoothly-operating belt-tension release mechanism. The Elu's phenolic-bottom sanding frames quickly snap on and off the body without bulky brackets, although the front mounts prevent sanding flush to the outboard edge of the belt. The variable speed that's featured on the 4024 has a larger range than the AEG or Ryobi, with a very slow 492 SFPM minimum speed. Although the Elu's elaborate accessory metal stand has a detachable bracket that quickly screws to the edge of a tabletop, it's a hassle to attach the sander to the stand because the top handle must be unscrewed and the machine bolted on in two places. There's also an accessory bevel guide for stationary use, similar to the one for the Ryobi sander.

If I had to select only one belt sander, I would choose different machines for different reasons. The stability and smooth feeling of the AEG's sanding frame combined with the machine's solid overall construction make it a top contender, especially for someone who does a lot of panel sanding. The Ryobi's comfortable handles and light weight make it a fine choice for someone that needs to spend a lot of time using a sander in the shop or requires a maneuverable machine for jobs like face-frame sanding. The high-amperage motor of the Freud LC75 gives it power to spare for demanding jobs, and I might consider either Freud model if the company included variable speed and offered a sanding frame. The Elus' small size and super-light weight would make them a good choice if you have trouble hefting a heavier machine, and their stands adapt them for some precise stationary work on small parts. Although the Bosch's Air Sweep Dust Extractor System makes it clean enough to be just the ticket for someone who abhors the dustiness of belt sanding, the belt sander's small motor probably wouldn't qualify it for production-level work.

It's worth mentioning that a number of the conventionally designed sanders offer features like variable speed and sanding frames. Elu and Hitachi both offer optional sanding frames for their 4x24 models, and Skil has two models that use sanding frames. The Bosch 1273DVS has variable speed and fittings for a sanding frame, not offered as yet in the United States.

Though they're not a replacement for the big, powerful 4x24 bruisers, any of the new model belt sanders are worth considering if you're in the market for a reasonable-price machine that's good for all-around use. Once you've played with one of these new sanders, it will make using your old sander seem a lot like driving an old car without air conditioning on a hot August day in Alabama—with the windows up. Any belt sander will get the job done, but so will hand sanding. □

Hugh Foster is an English teacher, furnituremaker and author. He lives in Manitowoc, Wis.

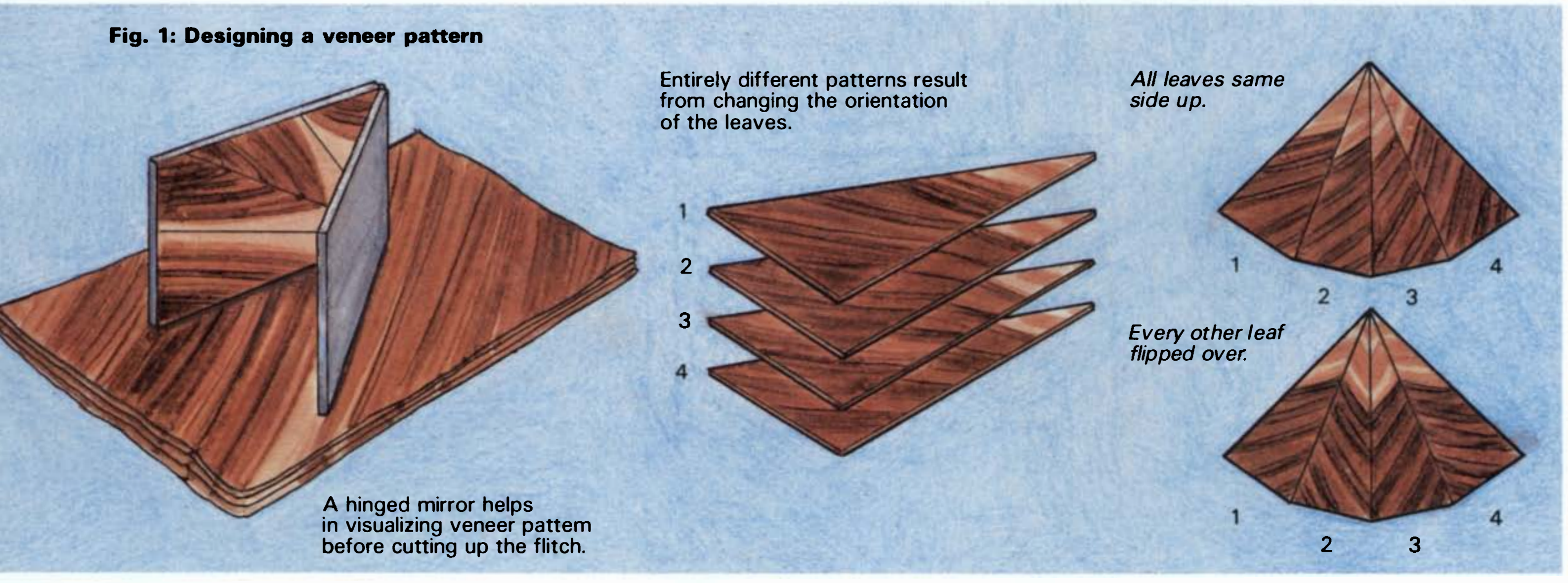
Belt Sander Chart

Company	Model number	List* price	Weight (lb.)	Belt size	Sfpm**	Amps	Noise in decibels	Dust bag	Cord length	Country origin	Accessories
AEG	HBSE75S	224	8.4	3x21	660-1250	7.8	98-103	Yes	12'	W. Germany	S-BS, O-SF, AF
Bosch	3270D	219	7.9	3x21	1080	5	104	Yes	10'	Switzerland	O-VS
	1272D	295	14	3x24	1550	10.5		Yes	10'	USA	O-VS
	1273D	315	14.8	4x24	1550	10.5	98	Yes	10'	USA	O-VS
	1273DVS	339	14.8	4x24	1150-1550	10.5	88-98	Yes	10'	USA	O-VS
ELU/Black & Decker	4023	261	6.2	3x21	1148	5.2	96	Yes	10'	Switzerland	O-BS, SF, AF
	4024	289	6.2	3x21	492-1148	5.2	86-96	Yes	10'	Switzerland	O-BS, SF, AF
	4029	469	13.9	4x24	1148	9.2	107	Yes	10'	Switzerland	O-SF
Freud	LC110	290	10.75	4x24	1475	9.6		Yes	7.5'	Spain	
	LC75	217	11.625	3x21	1475	9.6	102	Yes	7.5'	Spain	
Hitachi	SB75	218	10.8	3x21	1180/1475	8.7	104/102	Yes	8'	Japan	O-BS
	SB8T	234	11.4	3x24	1180/1475	8.7	104/100	Yes	8'	Japan	
	SB10T	268	11.7	4x24	1150/1380	8.7		Yes	8'	Japan	O-SF, BS
Makita	9924B	222	10.2	3x24	1300	7.8		No	8'	Japan	
	9924DB	248	10.5	3x24	1300	7.8	102	Yes	8'	Japan	
	9900B	234	10	3x21	1180	7.8		Yes	8'	Japan	
	9401	288	16	4x24	1148	8.5		Yes	8'	Japan	O-BS
Milwaukee	5920	315	13.5	3x24	1400	10		No	8'	USA	
	5925	337	13.75	3x24	1400	10		Yes	8'	USA	
	5930	326	14.25	4x24	1400	10		No	8'	USA	
	5935	348	14.5	4x24	1400	10	98	Yes	8'	USA	
Porter Cable	351	202	9.5	3x21	1300	7		No	7'	USA	
	352	212	10	3x21	1300	7	105	Yes	7'	USA	
	360	297	16	3x24	1500	10.5	101	Yes	7'	USA	
	361	277	14	3x24	1550	10.5		No	7'	USA	
	362	312	15.25	4x24	1500	10.5	103	Yes	7'	USA	
	363	297	14.5	4x24	1550	10.5		No	7'	USA	
	503	515	15	3x24	1500	9		Yes	7'	USA	
	504	500	14	3x24	1600	9	101	No	7'	USA	
Ryobi	7075	219	9.6	3x21	1181	8.4	102	Yes	7'	Japan	
	7100	279	9.7	3x24	1500	8.4	102	Yes	7'	Japan	
	B7200A	326	16.7	4x24	1148	8.7	100	Yes	14'	Japan	O-BS
	BE321	259	7.9	3x21	755-1148	5.4	84-96	Yes	7'	Japan	O-SF, BS, AF
Sears	11791	120		4x21	1300	7.5	98	Yes	8'	USA	O-BS
	11715	95	12	3x21	1300	7.5		Yes	6'	USA	O-BS, VS
	11713	85	11	3x21	1300	7.0		No	6'	USA	O-BS
Skil	7313	80	5.5	3x18	700	4.5	98	Yes	8'	USA	O-BS, SF
	7845	227	10.625	4x22	1400	9	97	Yes	8'	Netherlands	O-BS, SF
	595	197	7.75	3x21	1000	5.5		Yes	8'	USA	

S = Standard Equipment O = Optional Accessory
BS = Bench Stand SF = Sanding Frame AF = Adjustable Fence VS = Vacuum System

* Actual selling prices from dealers are typically 25% to 45% less than list price.
** Sfpm = Surface feet per minute

The author created the radiating pattern on his tabletop by cutting wedge-shaped pieces from consecutive leaves of a walnut flitch and hammer veneering them to the plywood top. The underside is also veneered to prevent warping.



Pattern Veneering

Fanned flitch decorates a tabletop

by Christopher Faulkner

Often the natural figure of wood can be enhanced by repetition of a pattern. Modern veneers are sliced thin enough so that the same figure traveling through the leaves of a flitch can be spread out and arranged to form a pleasing repetitive pattern. But veneer patterns can be difficult to arrange. Wild-grained veneers are hard to cut accurately and don't flatten easily. Also, positioning and gluing down lots of individual pieces in a press can be a nightmare, because you can't see the final fit until the glue is dry and then it's too late to fix misalignments.

In this article, I'll show you how I do pattern veneering and take you through the steps of applying a design to a round tabletop, using hammer veneering to glue the pattern pieces in place. Hammer veneering uses hot hide glue and a special hammer to press veneer pieces flat, one at a time. It's an excellent alternative to press veneering, because you can see what you're doing and fix problems as you proceed. I won't go into the details of hammer veneering here but will refer you instead to my article in *FWW* #61.

Controlling pattern—Most pattern veneer designs take advantage of the pattern created by repeating features, such as streaks, knots and areas of sapwood, in the consecutive leaves of a veneer flitch. Pattern pieces are cut with a knife and are mostly straight-edged, as opposed to marquetry designs where curved parts are sawn and fitted together like a jigsaw puzzle. Initially cut oversized, veneer pieces are first glued down and trimmed to size.

The pattern you choose should fit the shape and scale of the object, as well as the character of the veneer. Beginners have a tendency to design complex patterns and select flamboyant veneers that are hard to work with and visually overwhelming. I prefer patterns that reflect nature and the beauty of the veneer rather than elaborate geometry, so I chose a simple radial design for the central pattern on my round tabletop. It's made of 16 wedge-shaped pieces and surrounded by a line inlay and octagonal border. The wedges are laid around the top in the same order they were cut from the flitch, and every other leaf is flipped over, creating a book-match between adjacent leaves. The dark streaks on the walnut veneer I used form a series of lines that travel all the way around the top, resulting in an undulating, circular pattern, like an open flower.

After choosing the design and veneer, you must mark and cut out the wedge pieces and press them flat. I first make a cardboard template the exact size of a wedge, then I position it in various places on the veneer to locate the figure that works best with the design. I use a hinged mirror set to a narrow angle to preview what the pattern in adjacent leaves will look like (see figure 1). I orient the template so the grain of the veneer runs roughly perpendicular to the circumference of the table. If the grain is parallel, gaps will form at the seams of adjacent leaves as the wedges expand and shrink over time. Also, be wary of endgrain or flakiness in the veneer near the tips of the wedges, as the tips might crumble during gluing.

To sense how the pattern will finally look, flip through the flitch and observe how the grain pattern changes as it travels through the 16 separate leaves. Since I want prominent features, like dark streaks, to align in adjacent leaves all the way around the top, I cut the leaves oversized to allow the individual wedges to be shifted to precise positions before being trimmed to their exact size after gluing.

When I'm ready to cut the veneer, I place the wedge template on the top leaf of the flitch and mark a line about ½ in. oversize on the sides and 1 in. at the narrow end. I then number the leaves with chalk, taking care not to upset their order. Next, I take the entire flitch to the bandsaw and holding the bundle together tightly at the edges, I cut all the wedges out at the same time.

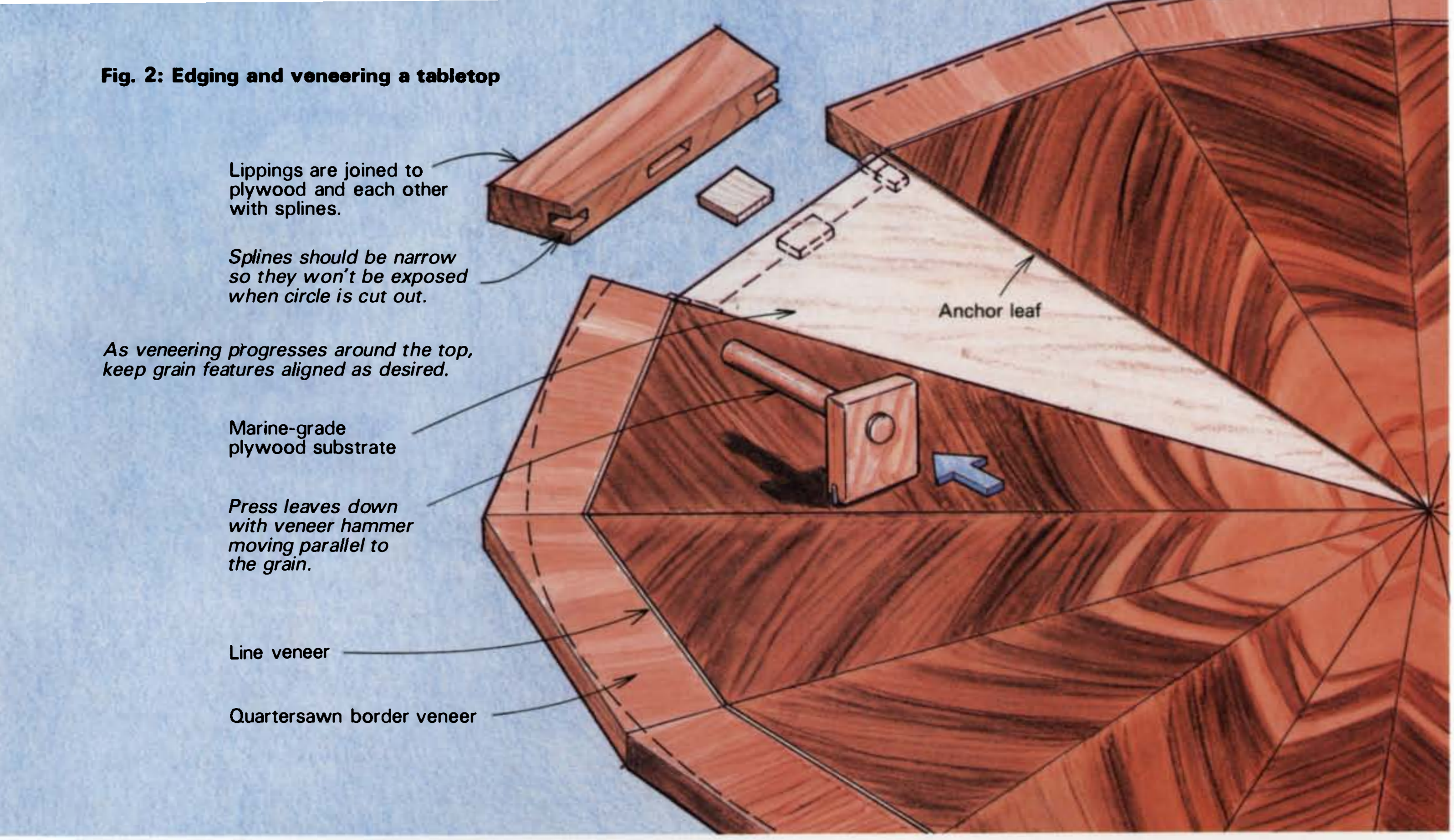
It's best to do the steps I've described sometime before you veneer the top to allow time for the leaves to be pressed. This is especially important with burled or curly-grained veneers that must be tamed before they'll lay flat. Alternate pieces of damp newsprint (not newspaper, as the ink will stain) with the leaves and press between plywood sheets for two days. Remove and repeat with dry paper, leaving it in the press for several days or weeks if possible.

Preparing a substrate—While the veneer is pressing, prepare the substrate. For a 25-in. round top, I start with a 24-in. square of AA grade ⅝-in. marine plywood. I glue a straight-grained balancing veneer to the underside to equalize the movement of the top veneer and prevent warping. It's best to lay this veneer perpendicular to the grain of the plywood, but you might choose a four-square pattern instead, especially if the table's underside will be seen. After I cut the square substrate into an equal-sided octagon, I apply eight solid-wood lipping pieces to the edges, using splines to join the lippings to the plywood as shown in figure 2. Next, I plane the lippings flush with the top of the plywood, then bandsaw the octagon into a circle. Finally, I scribe eight lines diagonally across the top to mark the position of the 16 pattern pieces. Don't use a pencil, because the lead will repel the glue where it needs it most at the edges.

Applying the veneer—I use basic hammer-veneering techniques and glue the veneer pattern to the top, but some exceptions are worth noting. Use the same hammer motions as you might on a larger piece of veneer, but take special care not to

The 16 wedges needed for the tabletop's pattern are cut at one time on the bandsaw from walnut crotch veneer.

Fig. 2: Edging and veneering a tabletop



After laying the first or anchor leaf (above), trim the excess with a knife and straightedge, using the layout line scribed on the substrate as a guide. As the pattern progresses around the top (above, right), keep an eye on the position of prominent grain features. Position leaves as necessary so the pattern matches up with the anchor when the last leaf is pressed. After the pattern veneering's done and been allowed to dry for a few days, scrape off the excess glue (right) and level the veneer in preparation for sanding and final finishing.

draw the hammer across the grain (head parallel to the grain), which could easily break off the point or corners of the wedge. Remember that one hammer stroke in the wrong direction can spell disaster as there probably won't be any spare leaves with matching grain patterns. Also, try not to overwork the veneer by excessive hammering. This stretches it out, and can cause casting (small cracks) weeks or even years later.

The first leaf, called the anchor, is laid so its edges overhang the layout lines by equal amounts on both sides. Once the anchor leaf has set—preferably overnight—the excess must be trimmed off. For this I use a razor knife and straightedge, taking several light cuts instead of one heavy one to get through the veneer. To get a square cut, keep the bevel of the blade against the straightedge at 90°. Next, cut the edge of the next leaf that will butt up against the anchor. The new leaf will be glued as close as possible to the anchor, and whatever distortion is caused by the glue's moisture or the hammer action stretching the veneer will be trimmed off on the remaining overhanging edge. This is another difference between pattern and regular hammer veneering. If no delicate leaves are involved, you can overlap adjacent veneers, cut through both sheets at the same time, then carefully pry up the waste beneath the joint. Wedge-shaped patterns are too delicate to lift up, so adjacent leaves must be trimmed to butt together.

Glue and trim each leaf as described above, working your way around the top counterclockwise from the anchor if you're right-handed, as I am. Make sure to clean out the excess glue at the edge of each leaf after you've trimmed it—a scraper or sharp chisel works well for this. If you encounter any problems, like a burst or a split in the veneer, mark it with tape and repair it later. When you've completed half the pattern, stop and let the veneer dry overnight so the hammering will not disturb the delicate points of wedges opposite the ones you're gluing.

At this point, check how the pattern is moving around the top, keeping in mind that you'll want certain grain lines to come around and line up with the anchor at the end. Measure from the center of the pattern to the grain feature, and if it's slowly traveling outwards (they rarely seem to move inwards), reposition the following wedges slightly, distributing the error over several pieces so it won't show.

When I come to the final wedge, I trim the remaining side of the anchor leaf and measure the remaining space carefully. Trim both sides of the last leaf for a tight fit: If it shrinks even slightly as it dries, it will leave unsightly gaps at the seams.

With the central pattern done, I trim the outside edges of the wedges and apply the line veneer and octagonal border. I like to use a quartersawn veneer for the border pieces, because it's least likely to cause movement problems and its plainer grain doesn't compete visually with the central pattern. I alternate gluing border pieces to one side of the circle and then the other to allow the pieces to cool before adjacent ones are laid.

Once the entire top has had a chance to cure for several days, scrape off the glue and sand the veneers smooth and flat, feathering out the thickness of the border near the edge. Finally, I round over the solid-wood edge with a spokeshave and apply a durable, water-repellent varnish. I never use oil on a tabletop, as someone sooner or later is bound to leave a glass on it, and it's a shame to water-spot the top after so much hard work. □

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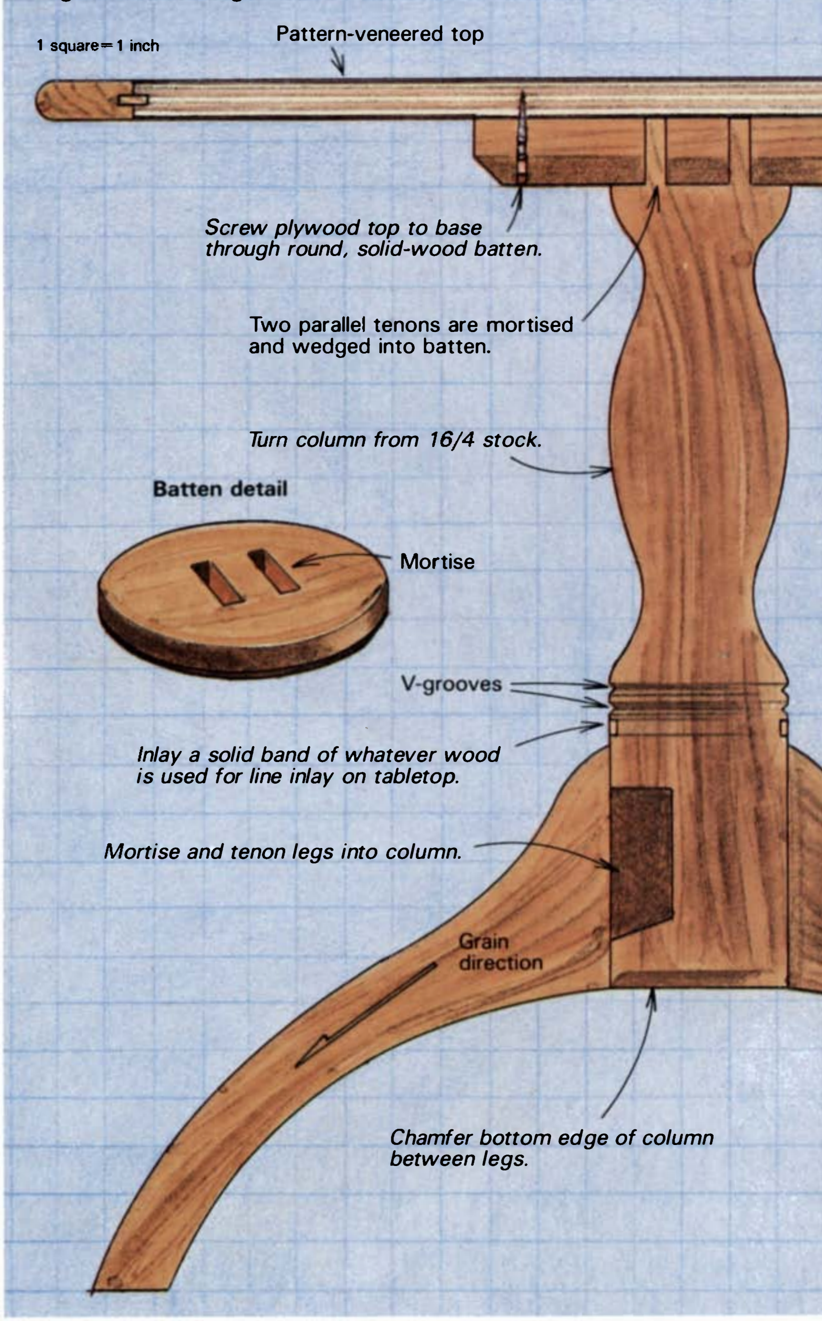
Fig. 3: Table design



Tripod table

The author mounts his veneered top to a small tripod he built from the same wood that's used for the pattern veneering—walnut in this case (see the photo at right). The tripod table consists of a single, central turned column with three curved legs mortised and tenoned to it (see the drawing above). A round batten is attached to the top of the turned column. The plywood top is then screwed to the round batten from underneath.

Photo: David Sherwill

Drawings: Robert La Pointe

Hydrocote: A Water-Base Lacquer

by Michael Dresdner

Although water-base lacquer has been around for years, all the brands I've tried suffer from the same generally poor finish qualities. They're characteristically soft, lack clarity and have inadequate layer-to-layer adhesion. Many wood finishers accustomed to the versatility of nitrocellulose and acrylic lacquer have given up on water-base substitutes. The need for a viable water-base lacquer is increased by the fact that the EPA Volatile Organic Components (VOC) emissions guidelines impose restrictions on the use of solvent-base finishes.

Recently, I discovered a finish called "Hydrocote" that's renewed my faith in water-base lacquers. Its impressive list of qualities sounds as if it was dreamed up by an old-time huckster selling snake oil. Because it's water-base, it is noncombustible and nonflammable; it also exceeds EPA guidelines for VOC emissions. What's surprising is that this nontoxic finish has film characteristics better than most nitrocellulose and acrylic lacquers. A dried film of Hydrocote is harder than that of typical solvent-base lacquers and surpasses them in alcohol, chemical, water and heat resistance. Even though liquid Hydrocote is milky white, a thinly-sprayed coat is as transparent as nitrocellulose and doesn't yellow with age. Hydrocote's adhesion to clean wood is excellent, as is layer-to-layer adhesion. Hydrocote can be sprayed directly over nitrocellulose lacquer, and nitrocellulose will adhere to a dried film of Hydrocote, as will most polyurethanes.

Hydrocote comes in 1-gal. and 5-gal. plastic containers as both a sanding sealer, and as gloss, satin and tabletop (extra-hard) lacquer. It's available from Hood Products, Inc., Box 163, Freehold, N.J. 07728; (800) 223-0934. Hydrocote costs a bit more than a typical nitrocellulose lacquer, but it's cheaper to use because it has more than twice the solids content of nitrocellulose—so fewer coats are needed—and it uses tap water instead of expensive solvents for thinning and cleaning the spray equipment. Hydrocote's extremely neutral color keeps blonde woods from turning amber, and it can be tinted with various water-soluble dyes and universal tints to give it a transparent or opaque color.

Hydrocote's milky-white color belies the fact that it dries to be as transparent as nitrocellulose lacquer. Since Hydrocote is nontoxic, the author sprays a sample without a respirator on.

Hydrocote comes ready to spray from the can, but needs to be strained thoroughly as it tends to coagulate. Hood suggests spraying several thin coats in rapid succession prior to the first wet coat for better adhesion and to minimize grain raising. Hydrocote sands easily and each coat must be sanded smooth with an open-coat sandpaper before respraying. The high-solids coats build so quickly that on nonporous woods like maple, I don't use a sanding sealer at all—something I'd never do with nitrocellulose lacquer. Hydrocote sets quicker and dries almost as fast as nitrocellulose lacquer, and the final finish can be rubbed out as little as 30 minutes after spraying. It will never blush due to humidity, but spraying it on too thick will reduce finish clarity.

Spraying Hydrocote will take some getting used to for those accustomed to the "feel" of spraying a solvent-base lacquer, but the novice will appreciate its excellent flow-out characteristics that seem to compensate for poor gun technique and uneven spraying. It does, however, tend to flow out better on horizontal surfaces than on vertical ones, so it's best to spray these coats a bit lighter to avoid sags or curtaining.

Aside from a small amount of grain raising, the only problem you're likely to encounter with Hydrocote is from surface contamination. Like nitrocellulose, it develops fish-eye-like craters when exposed to oil or wax. Fortunately, Hood makes a special fish-eye-eliminating additive that alleviates the problem. Hood also publishes a guide for troubleshooting Hydrocote problems.

I've had excellent success spraying Hydrocote with conventional equipment at pressures between 25 psi and 55 psi. Hydrocote also works well in a low-pressure spray system, such as the Apollo sprayer reviewed in *FWW* #62, p. 110. The only catch is that since Hydrocote doesn't redissolve itself, you'll have to flush out your gun with clean water to keep it from clogging if you let it stand for more than 15 minutes. Also, the gun must be made of stainless steel or aluminum, or lined with Teflon, otherwise contact with water will rust it. But these guns aren't prohibitively expensive, even for a small shop. Something you'll not be needing if you decide to spray only Hydrocote (or other water-base lacquers) is an explosion-proof exhaust system. Hydrocote doesn't burn, so its fumes can be expelled from your finishing room with a regular window fan. As a bonus, eliminating the spraying of flammable materials in your shop can put you in a cheaper insurance bracket.

I know of quite a few woodworkers who use Hydrocote exclusively, including both those who don't do much finishing and can't justify the expense of a spray booth and those who want to graduate from "wipe-on/wipe-off," one-step finishes. Advanced finishers may find Hydrocote somewhat less versatile than the nitrocellulose lacquers they're used to. However, with its impressive list of virtues and very few shortcomings, Hydrocote can fulfill many of the finishing needs of novices and professionals. I suggest that anyone who thinks all water-base lacquer is worthless give Hydrocote a try. □

Michael Dresdner is an instrumentmaker in Zionhill, Penn.

Hollows and Rounds

Making the most of a common pair of planes

by Graham Blackburn

A few of the author's hollows and rounds, a mixed bag bought over the years—some so recently that they have yet to be reconditioned. At far left is a pair of English planes with skewed irons; at far right is a pair of side-cutting rounds. Unlike most molding planes, which are named for the shapes they cut, hollows and rounds are named just the opposite, for their profiles.

Of all the wooden molding planes that are still to be found in antique shops, at flea markets and at the back of many workshops, the hollow plane, and its mate the round plane, are among the commonest. They hardly appear at first glance to be among the most useful of tools, but their relative abundance is an indication of the important position they once held in many woodworkers' tool kits. I well remember, as a boy in England, seeing rows of them in my school workshop and watching with fascination as they were used for all manner of work. Today, more than 30 of them have a place in my own workshop and find frequent employment in my custom-furniture business. The photo above shows a good range of sizes, from a variety of makers here and abroad. While these are by no means a complete set of graduations, these are typical of what you might easily find for sale, and a selection such as this is sufficient to accomplish most of the purposes I will discuss in this article.

Hollows and rounds are often represented as being the poor relations in the family of molding planes. While other molding planes—the ogees, the cavettos, the astragals and the beading planes, for example—all cut a distinct molding, the hollows and rounds are said to be used only in lieu of a more particular plane, in a makeshift effort to reproduce the desired molding. While it is true that hollows and rounds can duplicate moldings made by specialized molding planes, this is by no means their only job. They are also invaluable for completing and trimming moldings begun by more specific planes, for sculptural shaping, and for working hollow and round shapes in their own right—of which perhaps the crowning example is linenfold paneling (see *FWW* #36 or *FWW on Carving*).

Old books written at the time when machines were increasingly

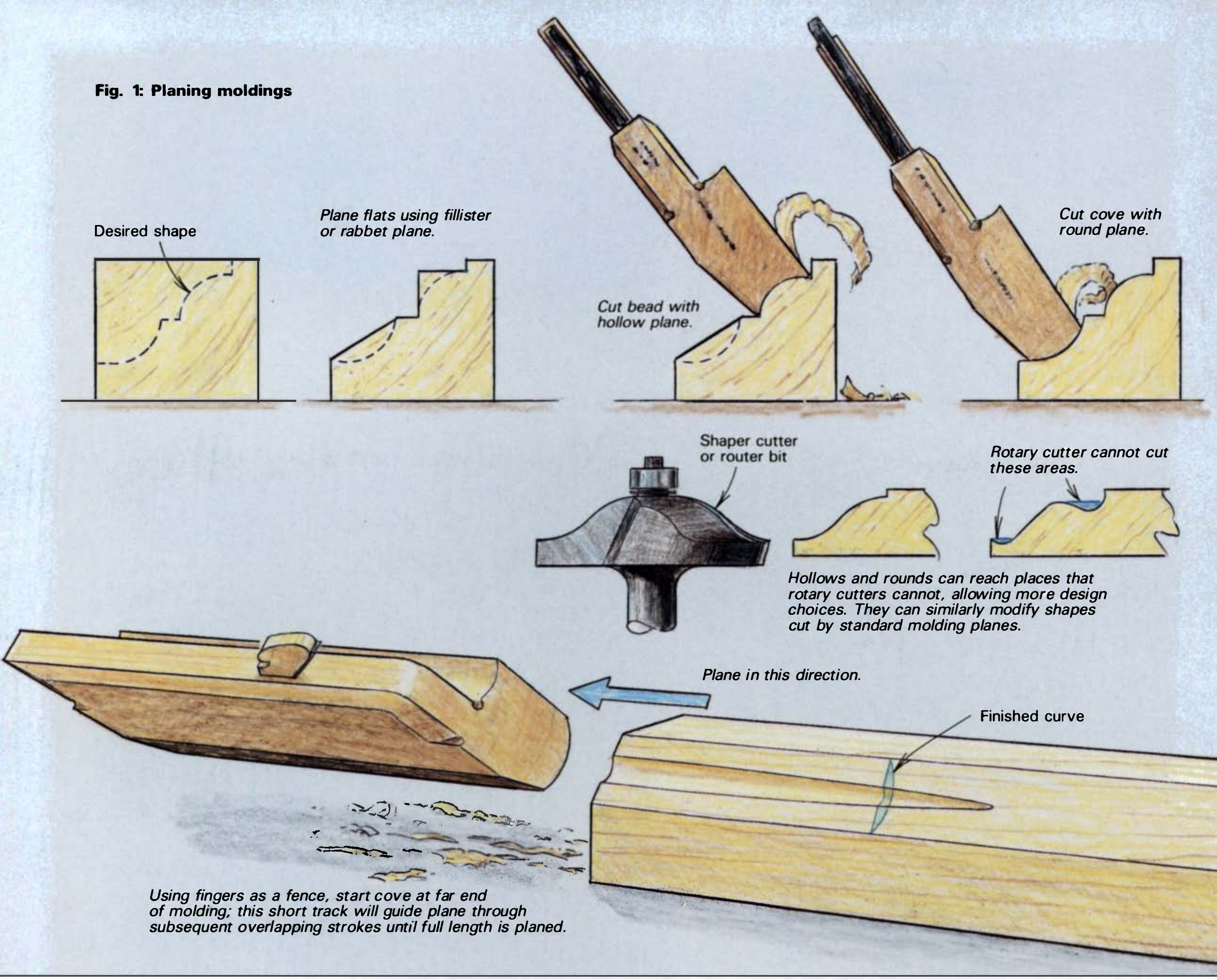


Fig. 1: Planing moldings

replacing planes in the production of commercial molding, and when the fashion for moldings was decreasing anyway, often advise the beginner that hollows can be dispensed with by substituting flat-soled planes and sandpaper. This is roughly the equivalent, in today's terms, of suggesting that you don't really need to learn joinery, because everything ought to be put together with dowels or metal fasteners. In fact, a hollow plane could be your most useful tool when, for example, you need to round over edges. Rather than setting up a router, or being limited by the size of available roundover bits, reach for the nearest-size hollow plane. Draw the exact profile you desire on the stock and plane to the lines. You will find the hollow plane does not have to match the required profile exactly, as does the router bit; neither is it limited to a perfect quarter round.

Of course, if you have any kind of footage to prepare, a router is the method of choice. Yet even in this case, hollows and rounds can lend a hand, refining machine-made moldings and allowing the benefits of quick production without unduly limiting design choices.

Before we examine exactly what these planes can do, and how they do it, let's take a closer look at the variety of hollow and round planes you might find.

Varieties—The planes were originally sold in pairs of matching hollows and rounds, and numbered according to the width of the iron. Markings are not always consistent, but one of the most common systems in America was to number planes using even numbers only, from 2 through 30, for planes starting at ¼ in. and increasing by increments of about ⅛ in. up to 2 in. In Britain, a frequent method was to sell sets of 18 pairs, ranging from ⅛ in. to 1½ in., rising by ¹⁄₁₆ths, and using both odd and even numbers—which also made possible the selling of so-called half-sets of nine pairs consisting of only the odd or the even numbers. You might also find the size stated as a fractional number, such as 4/8, denoting a width of four-eighths, or ½ in. Other numbers may refer to the manufacturer's catalog listing or a store code. Most planes are stamped with the manufacturer's name and address, and many are stamped with the owner's name, an obvious effort to keep the tools from wandering.

The most common arc for hollows and rounds is about one-sixth of a circle (60° of arc), but this will vary somewhat from one manufacturer to another. Therefore, you can't assume that by collecting a group of planes, made by different firms, stamped from 1 through 15, for example, you will have a graduated, fully matched set. Various manufacturers indicated the exact shapes by charts of measurements, diagrams and printed tables. One manufacturer, the Ohio Tool Co., found it necessary, after having merged with another plane manufacturer, to publish two tables: one for their own planes and another for those of the company they had absorbed.

To complicate matters further, there are different kinds of hollows and rounds. The commonest sort by far have straight irons bedded at various pitches between 45° and 50°. (In general, the 45° planes are designed for softwoods and hence are carpenters' tools, while the 50° planes are for cabinetmakers working in hardwoods.) Then, less common, are planes with skewed irons, which are usually set at a higher pitch, around 55°. In addition, the overall family of hollows and rounds includes a number of specialty planes. I'll describe some of these briefly.

Planes with arcs comprising virtually one-quarter of a circle (90° of arc) are called table hollows and rounds, and are used specifically for cutting the two halves of a rule joint—by means of which drop leaves are joined to drop-leaf tables. The better quality table hollows and rounds were made with fences—unlike regular hollows and rounds—and this kind is the easiest to use when cutting rule joints. The lower grade, unfenced, table hollows are less easy to recognize—the clue is that both sides of the plane body, or stock, are beveled instead of just one. If you chance upon a pair (or even one) of table hollows and rounds, seize them, for they can be very useful in conjunction with regular hollows and rounds.

Yet another variety is the side round. This type can have a profile consisting of a quarter round or a half round and was made in mirror-image pairs, as shown in the photo on p. 81.

Lastly, there is a group of planes that, while not strictly hollows and rounds, nevertheless cut these shapes and so deserve mention. These planes, which often have wide bodies like bench planes, include such exotics as ship hollows and ship rounds, gutter planes, forkstaffs and nosing planes. For those interested, all these tools are shown in R. A. Salaman's *Dictionary of Tools* (Charles Scribner's Sons, Front & Brown Sts., Riverside, N.J. 08075; 800-257-5755).

Plane shopping—Now that you know what to look for, what are you likely to find? There is a good chance of coming across matched pairs of planes, especially if you buy from knowledgeable dealers, who are unlikely to split pairs up. Occasionally a set of hollows and rounds will turn up, often in some purpose-made box or chest, and such a find would be a great pleasure. But do not think that a single plane is useless without the "rest of the set" or even its mate. It is up to you how many you collect, and use, just as it was to the original purchasers. Cabinetmakers, and those joiners who worked in shops rather than on-site, kept many more sizes and types than a carpenter would have carried around with him, and indeed manufacturers themselves were by no means in agreement as to how many planes properly constituted a "complete set."

I keep a list in my wallet of the particular sizes and arcs that are missing from my collection. But my main strategy is simply to pick up all that appear on the horizon and trade any duplicates with other woodworkers or interested dealers or collectors. I find it astounding that these tools can be bought for as little as $7 to $10 in the open marketplace, for surely they represent much more intrinsic value. For the price of a router bit, I can buy a tool whose working life is longer than my own.

When you look for a plane to use, I'd suggest that something from the middle of the size range will be best to start with; leave the extremes until later. How to judge the serviceability, and if necessary how to effect some basic restoration, was dealt with in my earlier article, "Old Wooden Planes" in *FWW* #57, so I shall mention here just a few correctible, yet critical, points.

The profile of the edge *must* match the profile of the plane's sole, otherwise one of two things will happen: Either the high area of the iron will take a coarse shaving, leading to tearout in the cut, or, if the iron is lowered to take a finer shaving, the plane will bottom out after a few strokes and be unable to cut the full profile. In the days when hand tools were the mainstay, planes were properly maintained by their owners; but in the days since, inept sharpening by bunglers is likely to have changed the profile of the iron. When examining a plane, you should assess how much work it will take to grind and hone the iron to match the sole, until the iron can be made to project through the mouth of the stock the same amount across its entire profile.

If the wedge is warped, bent or split, you may have to refit or remake it so it supports the iron evenly against its bed. If the wedge is blunted, it may be necessary to angle and repoint the tip so shavings exit cleanly.

Secret weapons—It should be obvious that hollows and rounds can cut independent rounded-over profiles and coves of various sections. It follows that they can finish up and trim similar sections of other profiles. This use is extremely valuable because of the main inherent weakness of most molding planes—they can work in only one direction. Thus, they cannot be reversed if grain direction changes in the middle of the workpiece.

To minimize tearout due to changes of grain direction, molding planes are tuned to take extremely thin shavings, which requires many passes of the plane to finish the job. When possible, the bulk of the material is removed with other planes, such as a rabbet plane or a fillister. Aside from speeding the work, this has the added advantage of doing most of the job with a plane whose iron is easily resharpened. Yet despite paying the best attention to stock selection, some tearout may occur. The hollows and rounds are the secret weapons that can step in and clean up the work by going in the opposite direction. Without these, no set of molding planes is truly complete.

The side hollows and rounds have tight arcs and the fact that they are made in pairs makes them reversible. They will be found to be of great use, as will certain auxiliary planes designed for cleaning up quirks and fillets, such as side snipes and snipesbills, and various shaped side- and V-rabbet planes—but these planes take us beyond the present discussion. A little experimentation will amaze you with the possibilities that hollows and rounds offer in the realm of molding adaptation and duplication—try skewing them to alter the cut, for example.

As to which sizes work best for any given profile, preferences will vary with experience. To start with, the planes you own will dictate the shapes you can attempt, but improved skill will seem to make each plane capable of an increased range. At this stage, hollows and rounds can become an extension of your eye and your intent. They will then compete with the Surform and rasp for rough shaping of sculptural forms as well as being always to hand for delicate trimming of a variety of shapes. Last, but not least, the sound they make when properly tuned and used is infinitely preferable to the threatening whine of any machine. □

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Bentwood boxes have been used in Norway for centuries. These two variations are known as "tine" or "laup." The larger one is made of ash; the smaller one, pine.

Norwegian Bentwood Boxes

A leisurely soak eliminates steaming

by Johann Hopstad

Hopstad's boxes are bent around a wooden form bandsawn from a laminated blank. To anchor the box sides during bending, the ends are tucked into a notch cut in the side of the form and are held fast by a metal plate. A block nailed to the bottom of the form allows it to be held in a vise.

The soaked box side is bent around the form freehand and then pulled tight with a quick-action clamp. A curved block distributes clamping pressure across the face of the overlap. A heavy black line is marked on the form to designate the center of the long side that will become the box's front.

Bentwood boxes have a long and illustrious history in Europe, spanning at least 3,000 years. In Norway, examples dating from A.D. 840 were unearthed in a Viking ship found in Oseberg. These boxes were used by rich and poor alike for storing anything from their most valuable possessions to cargo as humble as a day's lunch.

The boxes came in a variety of sizes and shapes—oval, round, triangular or heart-shaped. Some resembled baskets with solid-wood sides, while the sturdier versions had handles lashed to their lids and were used as suitcases. The box discussed here is known as a "tine" or "laup." It's about 9 in. long, 6⅜ in. wide and 3½ in. deep. The ³⁄₃₂-in.-thick sides, as well as the lid, handle, bottom and clasps are ash. These small, decorative boxes hold delicate objects such as needle and thread, but in years past, larger versions displayed farm produce in markets.

The engineering of these boxes is marvelous in its simplicity. The bentwood body doesn't even require steam bending; soaking the wood in water makes it pliable enough to bend around a form. Then, the two ends are fastened together with a little glue, birch-root lacing and wood pegs.

Building a box—Norwegian bentwood boxes are shaped around a solid-wood form, in this case an oval, as shown on the opposite page. To build the form, I make a paper pattern of the shape and trace it onto a block of wood a couple of inches thicker than the height of the box. The block can be solid wood or a plywood or solid-wood lamination. After bandsawing the oval shape, I hollow the form with a large auger bit or a router. The hollow allows room for a clamp head. The block nailed to the form's bottom is for clamping the form in a vise when the wood is bent around it. The center of one long side of the oval is marked to designate where the center of the overlap should fall when the body is clamped around the form. To accommodate the thickness of the overlapping ends, the form must be notched and fitted with a piece of sheet metal to form a lip, as shown in the left photo below. One end of the body is tucked under the sheet-metal lip and held in place as the body is bent around the form.

I resaw the ³⁄₃₂-in. ash for the body on a bandsaw, but you can do it on a tablesaw, making two rips on each edge of the board and then finishing the cut with a handsaw. Either quartersawn or flatsawn stock can be used, but I prefer flatsawn because it's less likely to break when bent. Straight-grain boards bend better and are less likely to split than figured wood. After crosscutting the resawn stock into sections equal to the circumference of the box plus a 3-in.-long overlap on each end, I plane or belt sand the sections. It's not necessary to make the pieces perfectly smooth at this point, though, because soaking will raise the wood grain, which will necessitate further sanding.

Bending sides—I soak the wood for 24 hours in cold water, then just before I bend it, I dunk each piece in warm, not hot, water for five minutes to increase its pliability. Steam bending would make the wood pliable much faster, but the steam-bent wood must be clamped within seconds of being removed from the steam box or its pliability is greatly reduced. My method, however, doesn't require an elaborate steam setup and allows me to work at a more leisurely pace.

I clamp the wood to the form with fast-action clamps, as shown in the center photo below. A piece of scrapwood caul cut to the outside curvature of the box distributes the clamping pressure on the overlap. I put the box aside for four or five days to let it dry before removing it from the form. Next, I sketch the heart and decorative fingers on the face of the outside overlap. I suspend the box from a piece of scrap clamped to the workbench top and drill out the perimeter of the heart and the circles between the bases of the decorative fingers (see right photo below). The waste is cut out with a sturdy sheath knife. Cutting out the fingers and the heart this way looks difficult, but the knife quickly splits off the waste and it's the only way to accurately align these decorative touches on the side of the box. If the heart and fingers are sawn before the box is bent, they may end up being incorrectly positioned, because it's impossible to predict exactly how much the wood will spring back once the box is removed from the form. You can't use a saw to shape the body after bending because there isn't enough room to work it.

I lightly chamfer the outside of each decorative finger with a file or knife, smooth the heart with the knife tip and then slip a peacock feather between the mating surfaces of the overlap so

The outlines of the decorative fingers and the heart are drilled out and then finished with a sturdy woodworking knife. The box's body is suspended from a board clamped to the workbench.

Photos of finished boxes: Michele Russell Slavinsky

To cut the rabbet in the bottom, the author first marks the back of the rabbet by tracing along the body from inside the box. He then marks the bottom of the rabbet by drawing a line on the outside edge using his hand as a marking gauge. He saws on this line around the box's edge with a dovetail saw, then pares along the kerf, working down to the first line.

With the lid of the box notched to fit over the clasps, the lid's profile is traced from the body. The pencil is wrapped in tape, thus creating space for an overhang around the box.

it's framed by the heart cutout. Peacock feathers have been used as decorations in Scandinavia for hundreds of years (available from Aardvark Adventures, Box 2449, Livermore, Calif. 94550). If you don't want to use a peacock feather, you can use red fabric or carve some sort of decoration into the overlap behind the heart. The next step is to spread a thin film of glue over the mating overlapping surfaces and squeeze them together. A single quick-action clamp and the curved caul are all that's needed to secure the box while the glue dries.

Attaching the bottom—The ⅜-in.-thick bottom is rabbeted to fit inside the box body. I prefer cutting the rabbet freehand, but you can use a router fitted with a rabbeting bit and ball-bearing pilot. To cut a rabbet freehand, trace the outside and inside perimeters of the box onto the bottom, being sure to mark the overlap. Then, bandsaw the outside perimeter. Stand the bottom edge up in the vise and using your hand and a pencil as a marking gauge, trace a line around the center of the edge. Cut down ³⁄₃₂ in. to the inside perimeter mark with a dovetail saw. Saw around the perimeter of the bottom, turning the board after each cut. Next, with a chisel, pare down to the bottom of the kerf, as shown in the photo at left, and chisel out the notch to seat the overlap. Test fit the bottom to the body and pare accordingly. Do not peg the bottom in place until it has been mortised to accept the clasps for the lid and the lacing is completed.

I draw the profiles of the box clasps on a piece of cardboard, cut them out and transfer the marks to the wood blocks, which are about ⁹⁄₁₆ in. thick. The clasps' shapes aren't critical as long as they have a slight curve along the edge to make them attractive and are notched to fit the lid. The clasps are slotted, slid over the edge of the box body and pinned in place. The pin and the thinness of the body allows them to flex slightly when the lid is removed or pressed in place. When shaped, as shown in the drawing at right, the lid should fit with a satisfying snap. With the clasps pegged and glued in place, trace their outline on the box bottom, then chop mortises for the clasp ends.

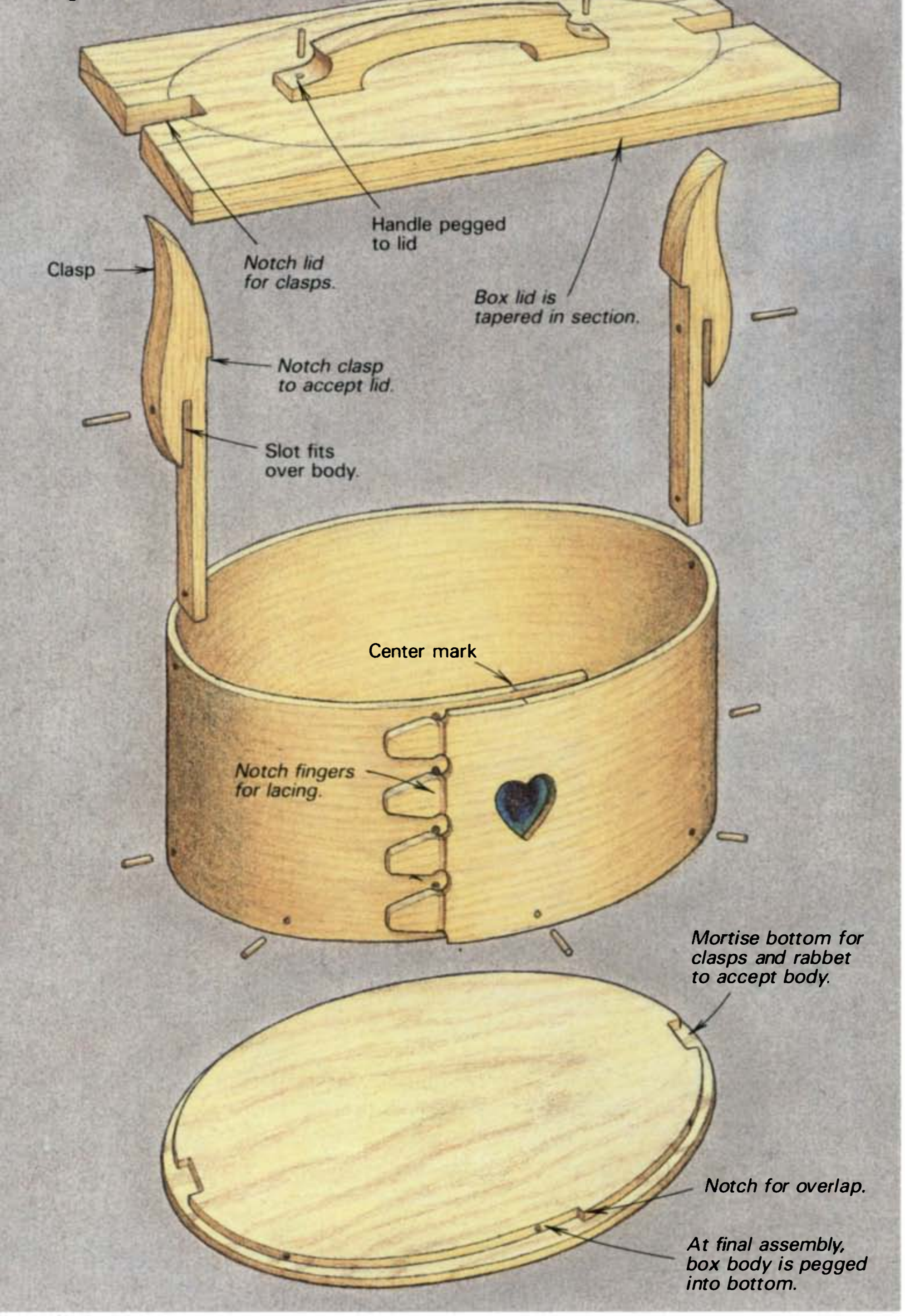
Fitting the lid—The box lid is cut from a blank that's about ¾ in. thick, ½ in. wider than the box's width (the narrow length) and long enough to accommodate the length of the box and clasps, plus a ¾-in. overhang beyond the clasps. Locate the center of the blank's width and mark a line along its length, then slot the blank evenly on each side of the centerline to accommodate the clasps. Test fit the lid and trim the clasp slots as necessary. Wrap a pencil with tape and trace the outline of the box on the lid blank. The tape holds the pencil away from the box side so the lid will have an even amount of overhang. I freehand draw the bevel of the lid on the endgrain of the lid blank and plane down to the line with a jack plane. The lid is hollowed slightly from underneath. This can be done quickly with a scrub plane and then faired down with gouges and sandpaper. The oval lid is sawn out and its edges sanded smooth. Finally, I cut the handle from a ½-in.-thick piece of wood and peg it to the lid.

Since the overlap has been glued, the lacing is purely decorative, adding charm and character to the box. The lacing is gathered from the roots of young birch trees about 6 ft. high growing on high ground. The location of the tree makes a difference. Trees from high ground send out an extensive root system to gather moisture and are thus more likely to produce a plentiful supply of the small-diameter (about ⅛ in.) roots necessary for lacing. Trees that grow in damp areas produce thick, stubby roots. Gather the roots when they are most pliable, from May through September, and don't take too many from one tree, lest you kill it. I've taken lacing from just about every variety of birch (white, black and yellow) and find they all work fairly well. If there aren't birch trees where you live, you can easily substitute cane for lacing.

After rinsing off the roots, I store them bent in a ring. Soaking them in cold water for about five hours will make them pliable again. Once they're pliable, I wipe off the excess moisture with a rag, bend them around a wood block and work them back and forth in a buffing motion. This removes the roots' skin and polishes them. Next, I split each root in half along its length with a pocket knife and sharpen the tips so I can poke the roots through the holes more easily.

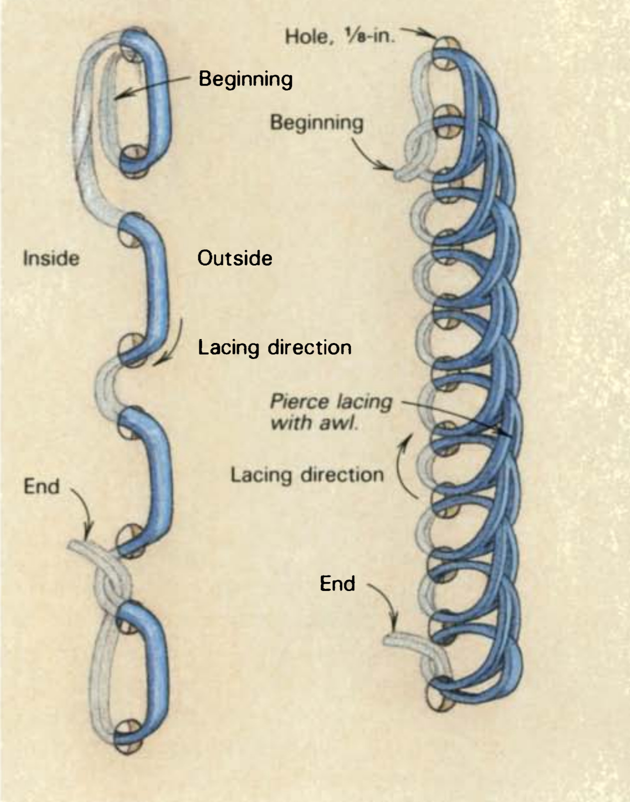
The lacing pattern is more easily illustrated than described (see figures 2 and 3). The two rows of lacing, on both sides of

Fig. 1: Bentwood box and lid



Each loop of birch-root lacing is pierced with an awl to allow the lacing coming from the inside of the box to be passed through it. Note that the lacing has been sharpened to ease its passage through the holes.

Fig. 2: Decorative lacing around fingers **Fig. 3: Decorative lacing around heart**



the heart, are started inside the box. If you start from the outside, the decorative pattern will be formed inside the box. The lacing around the fingers is also started inside the box. Mark a reference line for the lacing by butting a try square against the top edge of the box and drawing two lines, square to the top edge on either side of the heart. Bore 11 ⅛-in. holes evenly spaced along the two lines for this lacing. No layout line is necessary to bore the holes for the lacing on either side of the fingers, just bore eight holes, two at the base of each of the four fingers. Use an awl to poke the lacing through when coming from the inside of the box. To make the knots at the ends of the rows, and to snug up loose areas, use the awl as a lever, sliding it under the lacing and pulling up with lacing between the awl and your thumb.

When the lacing is finished, secure the box's bottom with several round whittled pegs. Drive the pegs into evenly spaced holes bored through the outside of the box into the rabbet in the box bottom. Be careful not to tip the drill while boring these holes; you could easily pierce the top surface of the bottom.

The box can be left plain, given a light coat of wax or finished with a 50/50 coat of linseed oil and turpentine. The latter gives the box a golden, mellow hue as it ages, making it hard to distinguish from boxes of antiquity. □

Johann Hopstad builds traditional bentwood and staved boxes in Bodo, Norway. He also teaches summer classes in the United States. For information, contact the Norwegian American Museum in Decorah, Ia., (319) 382-9681, or Augustana College in Sioux Falls, S.D., (605) 336-0770.

Drawings: Lee Hov

Backyard Exotics

World-class figure from neighborhood trees

by Jon Arno

In a previous issue, ***Fine Woodworking*** asked readers to share their experiences with unusual woods they had harvested right in their own backyards or in wooded areas near their homes. The topic seemed offbeat, so it was a little surprising when scores of readers wrote, identifying more than 80 different species. Most of the respondents were carvers or turners, who thrive on small chunks of wood. You just don't find long 1x2 FAS, or even No. 2 common boards when scavenging windfalls and orchard thinnings.

The obvious explanation for this pursuit is frugality—finding a cheaper way to feed our tablesaws, planers and other cast-iron pets. Many readers indeed confessed that their first foraging attempts were aimed at acquiring cheap supplies of the more prestigious timbers: walnut, cherry, oak and maple. However, they quickly found the project to be almost addictive, despite the backbreaking chainsaw and ax work, the hauling and storage problems and the sloppy chore of end coating each piece, sticker-stacking the pile and babysitting the project for months to ensure the wood is drying quickly enough to prevent mildew, but slowly enough to prevent checking or warping. No wonder commercial dealers don't mess with offbeat species.

Finding woods to harvest is easy. Mother Nature quickly fills in virtually any patch of land in a temperate or tropical climate with all varieties of native woody species. In the upper Midwest where I live, elm, cottonwood, ash, box elder and other species with wind-borne or bird-transported seed will soon establish themselves. The letters we received indicate nature is more generous to some parts of the country. Woodworkers in the Deep South, especially in semi-tropical Florida and in the east-central hardwood belt, enjoy a bewildering array of species much greater than those of us in the North. Even in the arid Southwest, however, beautiful species like mesquite ***(Prosopis juliflora)*** and desert willow ***(Chilopsis linearis)*** rival the finest commercial timbers.

My truly memorable finds have been in the backyards of suburban America, a virtual mother lode of exotic woods. Over the decades, no expense has been spared to landscape our neighborhoods with jewels of the botanical world. Orchard owners thinning or replacing their stock frequently dispose of walnut, olive, pecan, apple and cherry. One reader surprised me by turning up an unbelievable variety of exotics in Milton, Mass. Bill Nesto went foraging at what he called "the tree zoo," the nearby Arnold Arboretum, after a hurricane hit the area and found a cork tree, Kentucky coffee tree, pagoda tree, smoketree, Japanese snowball and several other species. Now I'd like to share some of my favorite comments from the wood foragers who wrote to us.

Jon Arno is an amateur woodworker and wood technologist in Schaumburg, Ill.

Blackjack Oak: One local wood that I've enjoyed using is known as blackjack oak *(Quercus marilandica)*. It's usually used for fence posts or firewood, because it checks and cracks badly and warps in unbelievable positions. Its grain is interlocked, somewhat like elm, but its color is a beautiful reddish orange with brilliant black streaks.

—Rick Parker, Gentry, Ark.

Photo: Rick Parker

Many large, blackjack oaks are destined to become firewood or fence posts despite their reddish-orange colors and black highlights, because the wood tends to crack and warp.

Chaparral Woods: The plants of the Southern California Chaparral make national news nearly every fall, as they fuel the brush fires pushed down the coastal canyons by the dry Santa Anna winds. During the rest of the year, these plants are largely overlooked, even though the plant community includes numerous members of the **rose, sumac, heath, sunflower, buckthorn, oak** and **pine** families. The only harvesting equipment needed is a bowsaw (you won't find anything big enough to warrant the chainsaw noise) and a good botanical guide for the region. The wood is qenerally dense due to slow growth in a rather arid environment. The main trunks seldom exceed 4 in. to 5 in. in diameter, making them ideal for woodcarving, turning and other small projects. One of my personal favorites is **laurel sumac** *(Rhus laurina)*, which grows up to 8 in. in diameter. The wood is tan with occasional green and red hues. Although moderately soft, it carves well and holds fine detail.

—Joe N. Smith Jr., Del Mar, Calif.

Laurel sumac

Chinaberry: My most unexpected pleasure was obtaining a Chinaberry tree almost 30 in. in diameter. This tree *(Melia azedarach)* was introduced into the United States many years ago, and is, I believe, one of the few mahogany species growing in this country. The wood has a reddish color with marked grain. It dries without checking and is easy to work for small projects. Bandsawn boxes are especially showy because of radial changes in grain across short spans. Chinaberry trees grow very fast, but are short-lived. About 30% of my tree had rotted, but drying appears to stop the rotting. I've set aside a 6-in.-thick plank that I'll make into a tabletop if it doesn't happen to rot in the next five years.

—John M. Wilson, Aiken, S.C.

Fruitwood: Thanks to the generosity of my friends, I've decided that fruitwoods are the prettiest wood for the spoons and other tableware I make. Collecting is easy and fun; friends prune their trees or know someone who's cut down a fruit tree. I put a classified ad in my husband's farm newsletter and found ranchers pruning old orchards planted by homesteaders. I've harvested usable flitches of **apricot, apple, pear** and **greengage plum**. I can't decide if I like the fruitwoods because the grain is so pretty, they finish so well or they smell so good when you work them.

—Rosemary Rupp, Pendleton, Ore.

Peach: About 18 months ago, I harvested some peach trees from an old orchard and ended up with 50 small logs, about 2 ft. long and 4 in. in diameter. These were air dried under the house for eight months, sawn into ¼-in.-thick planks and stickered in the house. When I planed the pieces, I ended up with a lot of chips because the figured grain chipped so badly. Eventually, I built an abrasive planer that dependably produces ⅛-in.-thick stock. The wood is very stable. There's been no checking or splitting during the drying process, but the planks have bent longitudinally along the heart axis, probably the result of flatsawing. I suspect quartersawn boards would be more stable. The wood seems somewhat brittle, but nonetheless works well with either hand or power tools. The color is golden brown and nicely figured.

—Jerry Spady, Oak Ridge, Tenn.

Los Angeles Trees: When I started to investigate local woods, I was astounded by the incredible variety available in the city of Los Angeles. The best for me is **bluegum**, *(Eucalyptus globulus)*. I do lose a lot of it in the drying, but what's left is wonderful timber. It has a

Eucalyptus

Photos of wood samples: Michele Russell Slavinsky

Indian laurel

Mesquite

cool, yet friendly feeling. The pink color fades rapidly, but some sections retain a nice, reddish-brown color. Another marvelous street tree, although it shrinks and warps badly, is **Chinese elm** *(Ulmus parvifolia)*. The wide sapwood is similar in color and pattern to American elm or ash. The heartwood is a reddish brown with slightly darker stripes. It's also very hard and tough. Another wood I like is **indian laurel** *(Terminalia alata)*, which is lighter and softer and much easier to season. The wood finishes to a high luster and exhibits a nicely variegated pattern of light and dark browns.

—Alden Smith, Los Angeles, Calif.

Manzanita: I located a large manzanita *(Arctostaphylos)* stump while searching for firewood in a burned-over section of Los Padres National Forest near Santa Barbara, Calif. The hard, dense, reddish-colored manzanita intrigued me, so my father-in-law and I cut it off at ground level and hauled it home. From the start I realized that making useful boards from the stump would be difficult. The chainsaw dulled almost instantly—apparently the combination of natural drying and the very hot fire had actually hardened the wood. The wood was extremely hard and brittle to machine. I was able to obtain some small, very thin boards from which I built a jewelry box. The wood is a brilliant red-brown color with a nice contrasting maple-colored sapwood. It polished up brilliantly. One caution: The wood is a protected species in California, however, due to its graceful form and relative scarcity.

—Lyle Erman, Redmond, Wash.

Mesquite: This species has a beautiful brownish-red color. With tangential cuts, the yellow sapwood often produces a pleasant variegated effect. If you leave the bark on and seal the ends, you can usually obtain air-dried boards with few cracks. The wood is hard and somewhat brittle. Mesquite *(Prosopis spp.)* grows mainly as a shrub in the more arid parts of west Texas. Even though ranchers are usually glad to get rid of it, harvesting it is still hard work. It is very difficult to find limbs long and straight enough to make boards. If the shrub lives long enough and ample water is available, trees 10 in. or larger in diameter develop. I know of a firm in San Antonio that harvests trees nourished by the San Antonio River and its tributaries and kiln dries the wood to produce beautiful flooring.

—Martin E. Riley, Arlington, Tex.

Osage-Orange: If osage-orange *(Maclura pomifera)* grew in an isolated region of the Amazon, I'm convinced it would sell for $10 a bd. ft. Although most experts call it osage, in the southeastern and lower southwestern parts of the United States where it grows in abundance, it's known as bois-d'arc, pronounced "bowdock." Seldom tall, and almost never straight, the trees grow in profusion along creeks and ditches, competing with other moisture-loving trees for sunlight. It sports vicious thorns, especially in fast, new growth. Mature trees produce a green fruit about the size of an orange, with a quilted surface. The wood is heavy, hard and tough, and the heartwood, which makes up most of the log, is virtually immune to insects and rot. The wood's across-the-grain strength, even when green, may be the highest of any domestic wood. Its bright yellow color darkens over time to a golden orange shade. Contrast between winter and summer growth is a positive feature, enhanced by rather wide bands of fast-growing rings. The wood dries with little shape change.

—James P. Rozelle, Marietta, Ga.

Russian Olive: This species is planted as an ornamental tree in some parts of North Dakota, mainly in government-sponsored shelterbelts. The wood is almost as dense as black walnut, has about the same working characteristics when sawn, planed or turned, is often

Russian olive

heavily grained and polishes well. The Russian olive *(Elaeagnus angustifolia)* tree is fairly large. I've collected some beautiful burl sections up to 18 in. in diameter from roots. When finished with a penetrating oil, it becomes deep tan with dark, chocolate-colored grain.

—Dr. Lloyd Best, Wahpeton, N.D.

Toyon burl

Toyon: One of my favorite woods, toyon *(Heteromeles arbutifolia)* is usually just a shrub, but I've obtained trees as large as 24 in. in diameter. The wood is very beautiful and hard, sometimes curly and marbled with blacks and tans. I've also obtained small burls. Toyon seems to end-check very little and dries well without much shrinkage. Another beautiful tree in this area is **Monterey cypress** *(Cupressus macrocarpa)*. My friend Earl Bushey uses it for musical instrument soundboards and furniture. Occasionally you find curly sections, but they can be hard to plane without tearout.

—Jerry Blanchard
Pebble Beach, Calif.

Oysterwood: Cuban oysterwood *(Gymnanthes lucida)* is very hard, about 78 lbs. per cubic ft., and in the Florida Keys, at least, it doesn't grow very large—10-in. dia. is the largest I've found. I put white glue on the endgrain after cutting the pieces and it cures very well. The pith, however, always cracks, so getting a board for something larger than a jewelry box is close to impossible. *—Charles W. Waggener*
Lake Worth, Fla.

There is no limit to the possibilities. A successful forager can pluck and nibble, at will, from nature's larder. I'm convinced the native woods ignored by the commercial lumber industry offer some of the most beautiful, wildly figured woods in the world. And, as Jerry Blanchard wrote, "The point is wood isn't something we need to find in cuboid pieces on hyped-up store shelves, replete with sticky tags and high prices," it's growing all around us. □

Oysterwood

Osage-orange

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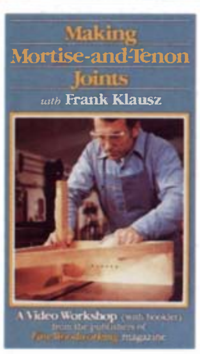
Joinery



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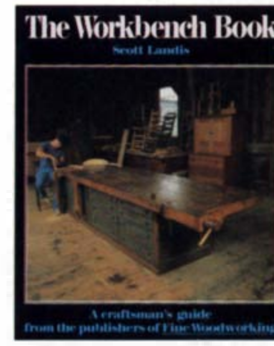
Small Shop



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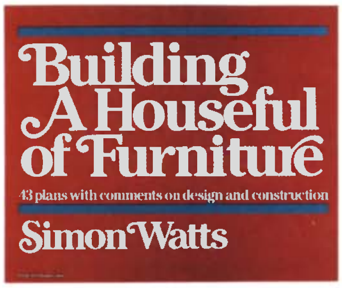
Furnituremaking



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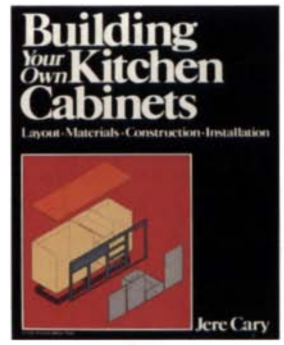

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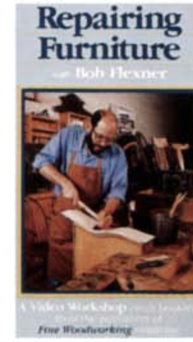

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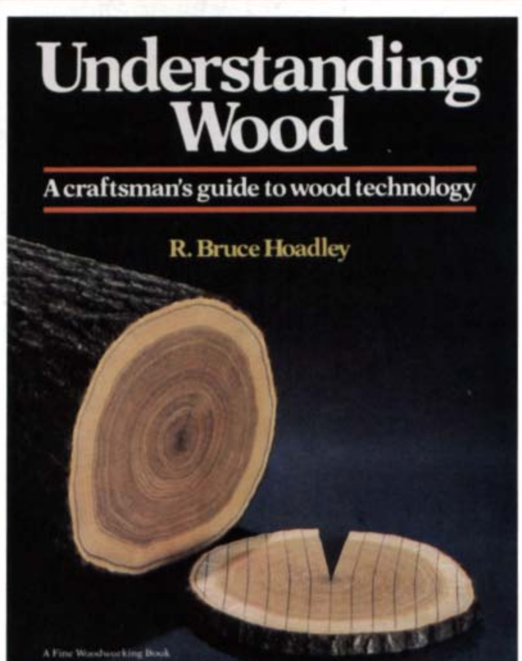

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B7200	4"x24" Belt Sand w/bag	351	182
W640	7¼" 13 amp Circular Saw	210	114
TS380	14" Mitre Box	773	385
RA200	8¼" Radial Saw	515	285
TS251U	10" Mitre Saw	392	205
JSE60	Electronic V/Speed Jig Saw	234	128
TR30U	Laminate Trimmer	163	88
R150K	1 H.P. Plng Router w/cse	206	119
R230	1½ H.P. Router	257	165
R331	2 H.P. D-Handle Router	304	189
R500	2¼ H.P. Plunge Router	326	198
L120UK	3⅛" Planer w/cse	206	119
L580A	6⅛" Planer 10.5 amp	548	298
S600A	¼ Sheet Finish Sander	88	59

YOUR ATTENTION PLEASE!
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Take Additional 10% OFF Sale Prices

NEW FROM RYOBI

TS200—8¼" Compound Mitre Saw
List 299 Special Sale 149
RE600—3 H.P. V/Spd. Plunge Router
List 398 Special Sale 209
BE321—3"x21" V/Spd. Belt Sander
List 259 Special Sale 129

MILWAUKEE TOOLS

PRICE BUSTERS $

Model	Description	List	Sale
0224-1	⅜" drill 4.5A magnum	179	109
0234-1	½" drill 4.5A magnum	179	109
0244-1	½" drill 4.5A magnum	179	109
0222-1	⅜" drill 3.3A 0-1000 rpm	165	100
0228-1	⅜" drill 3.3A 0-1000 rpm	145	100
0375-1	⅜" close quarter drill	195	118
0210-1	⅜" cordless drill 2 spd	195	115
0212-1	⅜" cordless drill v/spd.	229	129
6539-1	Cordless screwdriver 190 rpm	103	59
3102-1	Ptmbrs rt angle drill kit	295	175
3002-1	Electricians rt angle kit	290	175
5399	½" D-hdle ham drill kit	284	165
1676-1	H.D. Hole Hawg w/cs	375	230
6511	2 sp sazsall w/cs	207	119
6405	8¼" circle saw	199	122
6750-1	Drywall driver 0-4000	141	89
6798-1	Tek screwdriver	173	105
6226	2 sp bandsaw w/case	416	250
6234	TSC bandsaw w/case	416	250
6507	TSC sazsall w/case	219	129
6170	14" chop saw	349	209
6012	Orbital sander 3⅝"x7⅜"	179	100
6014	Orbital sander 4½"x9¼"	189	108
6305	6¼" cordless circle saw	239	134
6753-1	Drywall driver 3.5A	125	73
8977	Var temp heat gun	108	70
0214-1	⅜" v. spd. cordless drill	195	125
5397-1	⅜" v. spd. hammer drill kit	227	145
0211-1	⅜" cordless driver drill	205	120
5371-1	½" v. spd. hammer drill kit	313	199
3107-1	½" v. spd. rt angle drill kit	305	189
1854-1	Super hole shooter-10A	530	350
6232	4¾" bandsaw w/case	452	275
6747-1	Drywall driver-0-2500	141	85
0230-1	⅜" drill 0-1700 rpm	165	103
3300-1	½" v. spd. magnum rt angle kit	279	180
5620	Router 1 H.P.—8 amp	289	175
5660	Router 1½ H.P.—10 amp	299	180
5680	Router 2 H.P.—12 amp	350	220
5455	⅞" polisher 1750 rpm	199	130
5535	7" polisher 2800 rmp	209	140
6215	16" chain saw	229	140
8975	Heat gun	81	55
6366	7¼" circular saw	187	106
6368	7¼" circular saw	216	125
0216-1	2 spd cordless drill Hi-torque	215	139
2035-1	½" drill keyless chuck mag	184	125
6016	¼ sheet pad sander	65	40
6147	4½" sander/grinder w/cse	182	110
8950	8 gal wet/dry vac	189	130
8955	10 gal wet/dry vac	279	189
0239-1	½" drill keyless chuck	174	115
6377	7¼" worm drive saw	275	155

FREUD SAW BLADES

⅝" Bore—Industrial Grade
CARBIDE TIPPED SAW BLADES

Item No.	Description	Diam.	Teeth	List	Sale
LU72M010	Gen'l Purp	10"	40	78.49	36
LU82M010	Cut-off	10"	60	98.89	42
LU84M011	Combination	10"	50	85.25	37
LU85M010	Super Cut-off	10"	80	126.90	62
LM72M010	Ripping	10"	24	74.22	36
LU73M010	Cut off	10"	60	91.16	38
PS203	Gen'l Purp		24	31.42	19
PS303	Plywood		40	37.74	22
DS306	6" Dado - Carbide			168.13	92
DS308	8" Dado - Carbide			205.89	108
F0	1¾"x⅝" Biscuits 1000-Qty				25
F10	2⅛"x¾" Biscuits 1000-Qty				25
F20	2⅜"x1" Biscuits 1000-Qty				25
FA	Assorts Biscuits 1000-Qty				28

MAKITA CORDLESS

Model	Description	List	Sale
6070DW	⅜" var spd rev 7.2v	108	61
6071DWK	⅜" var spd rev w/removable batt	180	105
5081DW	3⅜" saw kit	222	130
5600DW	6¼" circular saw	284	167
6010DWK	⅜" cordless drill kit	174	102
6010SDW	⅜" cordless drill	94	55
DA3000DW	⅜" angle drill	228	133
6010DL	⅜" drill w/flashlight	188	113
6012HDW	2 spd driver drill w/clutch & case*	210	113
6710DW	Cordless screwdvr kit	176	103
6092DW	V/spd & case*	218	115
6093DW	V/spd w/clutch & case*	232	123
6891DW	Drywall gun 0-1400	204	120
5007NBA	7¼" saw w/elec brake	208	127
5008NBA	8¼" saw w/elec. brake	232	145
B04510	Sander	92	52
9900B	3"x21" belt sander	234	145
9924DB	3"x24" belt sander w/bag	248	138
9035	⅓ sheet finish sander	96	53
9045B	½ sheet finish sander	194	109
9045N	¼ sht fin sand w/bag	196	110
4200N	4⅜" circ saw 7.5 amp	190	112
5201NA	10¼" circ saw 12 amp	480	300
4301BV	Orb v/sp jig saw 3.5 amp	248	145
JR3000WL	2 sp recip saw w/cse	198	122
JR3000V	Vs recip saw w/case	208	125
LS1020	New 10" mitre saw	396	210
9820-2	Blade sharpener	302	190
410	Dust collection unit	410	269
3705	Offset trimmer	228	125
1900BW	3¼" planer w/case	198	116
1100HD	3¼" planer w/case	344	199
9207SPC	7" sander-polisher	250	139
3601B	1⅜ H.P. router	218	120
3700B	½ H.P. trimmer	162	90
9501B	4" grinder	146	65
BO4530	6" round sander	98	55
BO4550	¼" pad sander w/bag	92	46
DA3000R	⅜" angle drill	222	130
DP4700	½" v/sp w/rev 48 amp	178	110
HP1030W	⅜" v.s.r. hammer drill w/cs	176	102
6300LR	½" angle drill w/rev	302	176
2708W	8¼" table saw	396	250
2711	10" table saw w/brake	698	465
GV5000	Disc sander	108	67
6800DB	2500 rpm 3.5 amp	146	80
6800DBV	0-2500 rpm 3.5 amp	156	88
6801DB	4000 rpm 3.5 amp	146	80
6801DBV	0-4000 rpm 3.5 amp	156	85
2030N	12" planer/jointer	2580	1495
2040	15⅝" planer	2180	1240
1805B	6⅛" planer kit w/case	548	340
JV1600	var speed jig saw	186	125
JV2000	var speed orb jig saw	206	135
5005BA	5½" circular saw	192	113
9503BH	4½" sander-grinder kit	166	83
DP3720	⅜" drill rev 0-1800 rpm	99	55
6510LVR	⅜" drill rev 0-1500 rpm	144	77
6013BR	½" drill rev 6 amp	208	125
5402A	16" circular saw - 12 amp	542	325
3612BR	3 H.P. plunge router	338	187
9401	4"x24" belt sander w/bag	288	165
3620	1¼ H.P. plunge router w/cse	166	92
4302C	V/spd orb jig saw	256	155
5077B	7¼" Hypoid saw	250	145
LS1430	14" Mitre saw	630	365
2414	14" cut-off saw AC/DC	338	222
5007NB	7¼" circ saw 13 amp	194	114

SKIL SIZZLERS

Model	Description	List	Sale
5510	(551) 5½" circ saw	130	82
5625	(552) 6½" circ saw	164	108
5650	(553) 7¼" circ saw	164	108
5665	(554) 8¼" circ saw	185	118
5750	(807) 7¼" circ - drop foot	175	115
5765	(808) 8¼" circ - drop foot	204	130
5790	(810) 10¼" circ - drop foot	350	225
5825	(367) 6½" worm saw	257	139
5865	(825) 8¼" worm saw	283	149
4575	Vari - orbit jig saw	120	82
3810	10" Mitre saw	349	179
595	3"x21" sander w/bag 5.5A	197	125
7565	¼" palm sander	62	41
2535-04	7.2V drill w/x-tra batt	142	97
2735-04	12V drill w/x-tra batt	210	118
77	7¼" worm drive	261	135

BOSTITCH PNEUMATIC TOOLS

Model	Description	List	Sale
N80C	Utility coil nailer framing, decking, sheathing - 1½"-3¼" nails	725	470
N80S	Stick Nailer framing, decking, sheathing - 2"-3½" nails	725	470
T36-50	Sheathing and decking stapler	525	340
N128-1	Coil roofing nailer - ⅞"-1¾" nails	725	470
T35	Roofing staplers applic. of asphalt strip shingles	425	275
T31	Brad nailer and stapler	229	119

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DELTA TOOLS

34-410	Saw Complete w/1½ H.P. motor & stand	679.00
33-150	Saw Buck	509.00
28-2435	14" Band Saw w/open stand, light attach ½ H.P. motor	499.00
28-283F	14" Band Saw w/enclosed stand & ¾ H.P. motor	599.00
43-122	Lt. Duty Shaper w/stand & 1 H.P. motor	499.00
17-900	16½" Floor Drill Press	285.00
23-700	Wet/Dry Grinder	125.00

DELTA #34-080
10" MITRE BOX
XTRA SPECIAL
179.00
LIST 279.00

TOOLS ON SALE™
AMERICA'S LOWEST PRICED TOOLS
★ **PLUS — FREE FREIGHT** ★
ON EVERY ITEM

PIRANHA By Black & Decker

CARBIDE TOOTH SAW BLADE

- Advanced saw blade technology Exclusive design out-performs regular carbide blades
- An excellent all-purpose blade

Model #	Size	# Teeth	List	Sale
73-756	6-1/2	36	27.75	15.20
73-717	7-1/4	18	12.30	7.50
73-737	7-1/4	24	15.68	8.90
73-757	7-1/4	40	28.78	16.20
73-758	8	40	40.70	22.60
73-759	8-1/4	40	41.48	23.00
73-739	9	30	30.40	17.10
73-769	9	60	65.05	18.00
73-740	10	32	31.95	35.70
73-770	10	60	65.55	36.25

"NEW" BULLET DRILL BIT SETS

Model	Description	List	Sale
14347	8 piece 1/16 to ¼ HSS	18.45	11.95
14350	11 piece 1/16 to ¼ HSS	27.18	14.95
14353	14 piece 1/16 to ½ HSS	49.03	28.95
14356	21 piece 1/16 to ⅜ HSS	86.50	49
14359	29 piece 1/16 to ½ HSS	162.75	89

ADJUSTABLE HANDSCREWS

Item No.	Jaw Length	Open Cap	List	Sale	Box of 6
#5/0	4"	2"	12.05	7.75	41.85
#4/0	5"	2½"	12.95	8.80	47.50
#3/0	6"	3"	13.88	9.35	50.50
#2/0	7"	3½"	14.92	9.90	53.50
#0	8"	4½"	16.61	10.95	59.10
#1	10"	6"	18.98	12.60	68.00
#2	12"	8½"	21.78	14.95	80.75
#3	14"	10"	27.62	18.35	99.00
#4	16"	12"	35.93	26.25	141.75

STYLE 37 2½" Throat ¼"x¾"

Item No.	Jaw Length	List	Sale	Box of 6
3706	6"	8.27	5.80	31.35
3712	12"	9.17	6.25	33.75
3718	18"	10.12	7.30	39.45
3724	24"	11.07	7.75	41.85
3730	30"	12.35	8.70	47.00
3736	36"	13.49	9.40	50.75

PONY CLAMP FIXTURES

Model	Description	List	Sale	Lots of 12
50	¾" black pipe clamps	11.68	8.25	90
52	½" black pipe clamps	9.73	6.75	73

STYLE J. ADJUSTABLE HANDSCREW KITS

Model	Open Cap	List	Sale
J04	4	6.47	4.00
J06	6	7.38	4.50
J08	8	8.31	5.10
J10	10	9.69	5.95
J12	12	12	7.40

BOSCH

Model	Description	List	Sale
1581VS	Top hdle jig saw	235	129
1582VS	Barrel grip	220	119
1942	Heat gun 650°-900°	99	69
1272D	3"x24" BS w/bag	295	195
1273D	4"x24" BS w/bag	315	219
11-212	Bulldog ¾" SDS rotary	339	189
1196VSRK	⅜" vs hammer drill	205	119
1198VSR	½" vs hammer drill	219	129
1608	5.6 amp lam trimmer	135	75
1608L	Same as above w/trimguide	139	79
1608T	5.6 amp tilt base trim	155	89
1609	5.6 amp offset base trim	199	119
1609K	Lam installers kit w/1609	285	169

Offset base, trimmer tilt base, trimguide, ¼" collet, collet nut, wrenches, hex keys and case

Model	Description	List	Sale
1601	1 H.P. 790 watt motor 25,500 rpm	159	95
1602	1½ H.P. 1000 watt motor 25,000 rpm	195	109
1603	1½ H.P. D handle 1000 watt	219	119
1604	1¾ H.P. 10 amp 25,000 rpm	219	119
1606	1¾ H.P. D handle 1120 watt	243	129
3258	3¼" planer w/blade guard 57 amp	205	139
3270D	3"x21" dustless belt sander 5 amp	219	145
1273DVS	Var spd 4"x24" 6 speed range sander 10.5 amp	339	219
1611	3 H.P. trigger hdle, plunge base slo start	339	219

HITACHI 15" MITRE SAW
#C-15FB List 630.00 Sale 389.00

FREUD 15" BLADE
108 Tooth LU85M015
List 181.00 Sale 118.00

BLACK & DECKER!!!

Black & Decker Cordless

Model	Description	List	Sale
1950	Hi-torque drill kit w/case	190	115
1980	Clutch scrudrill kit w/case	193	115
1987	V/spd scrudrill kit w/case	209	125
1947	V/spd hi-torque kit w/case	201	117

Black & Decker Deals

Model	Description	List	Sale
2054	Versa clutch screwgun - teks & wd screws	232	140
2037	0-4000 5 amp drywall gun	160	92
1175	⅜" 0-2000 3.5 amp drill	96	54
2034	0-4000 4.5 amp drywall gun	138	87
4015	½ sheet sander 3 amp	190	109
2600	⅜" 0-1200 4.5 amp drill	119	73
4018	½ sheet sander 2.3 amp	122	74

Black & Decker Saw-A-Thon

Model	Description	List	Sale
3051	7¼" worm drive 13 amp	246	142
3103	2 spd recip w/case	190	127
3028	7¼" circ w/18 tooth carb blade	125	78
1703	10" mitre w/60 tooth carb blade	313	186
3047-09	7¼" super saw cat w/brake	270	164
3048-09	8¼" super saw cat w/brake	285	174
3157	Orb v/spd jig saw	212	126
3153	V/spd jig saw	205	123

NEW FROM BLACK & DECKER
1707 8½" Compound Crosscut Saw
automatic brake—cuts
2x10 at 90° 2x6 at 45°
List 770.00 Sale 469.00

PORTER CABLE

Model	Description	List	Sale
630	1 H.P. router 6.8 amp	165	115
690	1½ H.P. router 8 amp	205	142
691	1½ H.P. router D hdle	225	156
536	1½ H.P. speedmatic router	300	207
518	3 H.P. 5 speed router	520	357
520	3 H.P. 15 amp router	490	340
309	3.8 amp lam trimmer	135	93
310	3.8 amp H.D. lam trimmer	190	132
312	Offset base lam trimmer	205	142
319	Tilt base lam trimmer	221	152
695	1½ H.P. router/shaper	283	197
696	H.D. shaper table	155	108
351	3"x21" belt sander w/o bag	202	140
352	3"x21" belt sander w/bag	212	148
360	3"x24" belt sander w/bag	297	205
361	3"x24" belt sander w/o bag	277	192
362	4"x24" belt sander w/bag	312	215
363	4"x24" belt sander w/o bag	297	205
587	7¼" speedtronic 145 amp circ saw	220	152
315-1	7¼" top handle 13 amp circ saw	178	109
3617	7¼" pushhandle 13 amp	178	109
346-1	6½" top handle 12 amp	166.50	115
368-1	8¼" top handle 13 amp	188	131
314	4½" trim saw 4.5 amp	185	128
548	X HD bayonet saw	245	170
9548	X HD bayonet saw w/case	265	185
9629	Recip saw v/sp 8 amp	225	139
9627	Recip saw 2 speed 8 amp	215	133
666	⅜" H.D. vsp drill - Hdl	176	122
620	⅜" H.D. 4 amp 1000 rpm	132	92
621	⅜" H.D. v spd 0-1000 rpm	140	98
320	Abrasive plane 3 amp	140	98
126	Porta plane 7 amp	280	193
9118	Porta plane 7 amp kit	315	218
653	Versa plane 10 amp	399	278
9652	Versa plane 10 amp kit	419	288
7545	0-2500 v spd drywall gun 5.2 amp	163	114
505	½ sheet pad sander	187	116
7511	⅜" v spd drill 5.2 amp	175	122
7514	½" v spd drill 0-750	180	125
303	Paint remover	220	150
304	7" disc sander 4000 rpm	187	130
305	7" disc polisher 2000 rpm	187	130
367	3¼" planer 65 amp	210	145
537	1½ H.P. D hdle router	315	220
7548	Top hdl jig saw 4.8 amp	205	142
7648	Barrel grip jig saw 4.8 amp	205	142
330	Speed block sander ¼ sheet	97	60
555	Plate biscuit joiner 5 amp w/case	269.95	162
345	6" saw boss 9 amp	154.50	107
5060	"Stair Ease" stair templet	194	135
5061	"Stair Ease" hard wood stair templet	204	142
655	0-4000 drywall gun 4 amp	125	87
7540	0-4000 5.2 amp gun	158	110
100	⅞ H.P. router	155	107
59381	Door hanging kit	219	152
399	Drywall cutout unit	104.50	73
43218	Drywall cutout unit replacement bit	6.75	5.50
5008	Dovetail template kit	95	69
97650	½" v/spd hammer drill w/case	211	149
5009	Mortise & Tenon jig	49.95	38

STICK IT PAPER

Model	Description	List	Sale
13599	Dispenser	21.95	13
	80 grit paper 10 yd roll	13	10
	100, 120, 180, 220 10 yd roll	11.50	9

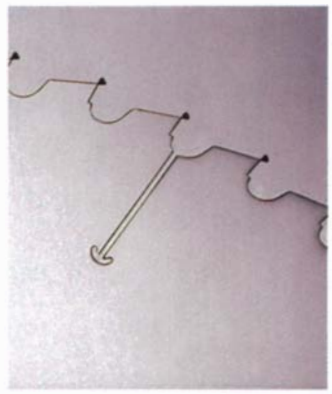
★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

Start with the job to be done—the material being cut, the feed rate, the speed and power of blade rotation. Engineer it all on our computer. Mix well with our thirty years of experience making carbide tipped blades from 6 to 30 inches in diameter for virtually every sawing application on earth—from logs to laminates. Result? A blade design that's precisely designed to give the smoothest possible cuts and the longest possible life.

How to make a Systi Matic saw blade.

Feed the digital description of the blade to SYSTI MATIC'S laser press and cut the blanks out with absolute mathematical accuracy from the finest grade of high alloy saw steel. Using just 1000 watts of light, the laser can cut steel plate up to a quarter of an inch thick. Unlike mechanical shearing and milling, the laser cut does not transmit stress to the edge of the blank—the secret of SYSTI MATIC smoothness starts right here.

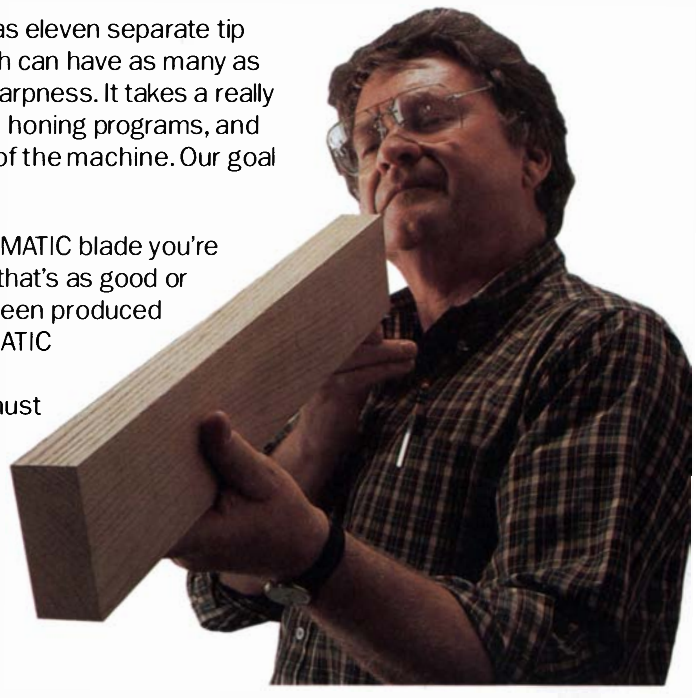
The actual laser cut is less than 6 one-thousandths of an inch wide—about the same as a fine pencil stroke. The fineness and precision of the cut enabled us to innovate our exclusive Anchor™ expansion slot. Made right on the laser, it gives you a blade that runs so quiet that you can scarcely hear it. (Ordinary expansion slots are milled and punched. And then plugged with a copper slug to quiet them down.)



After heat treating and tempering, we chuck each blade up on this microprocessor-controlled surface grinder for flattening. The machine makes up to 20 separate passes across the surface of the spinning blank. The first "rough" pass may take up to 2 thousandths of an inch. Final passes are automatically gauged to less than one TEN thousandth! Result? A blade that's absolutely and completely FLAT!

We used to make our own precision tip grinding machines. Then we went to Germany and found incredibly accurate three axis automated grinders that give us even sharper results. The diamond sharpening wheel can hone an individual tooth facet in as little as four seconds. But we set our machines for an average facet cycle of TEN seconds. Extra pains on our part. Extra smooth cuts for you.

Today's sophisticated saws may have as many as eleven separate tip paths in an individual tooth group. And an individual tooth can have as many as six separate surfaces that must be honed to absolute sharpness. It takes a really remarkable machine to keep track of these complicated honing programs, and a superbly skillful and dedicated operator to keep track of the machine. Our goal is simple: perfection.



When you cut with a SYSTI MATIC blade you're using an American-made product that's as good or better than any blade that's ever been produced *anywhere!* And yes, every SYSTI MATIC carbide-tipped saw blade is unconditionally guaranteed. You must be happy or your money back!

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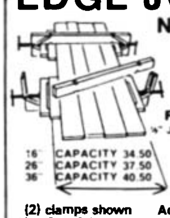

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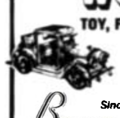

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Tannewitz bandsaws 24-in. and 30-in.; Crescent 12-in. 4kn jointer; Oliver 20-in and 24-in. D.D. jointers; Powermatic drill press; Dewalt radial arm saw; Oliver pattern lathe; pattern vise; Watkin pin router; Sandmaster 36-in wide belt sander; 3PH converter. (412) 593-7038.

Kuster 36-in. double drum sander with Grizzly 4-bag dust collector. $3,900. or B.O. New $4,600. Dove-tail Omnijig 24-in., $495. or B.O. New $750. (913) 437-2964.

Dewalt radial arm saw 5HP 3PH. Excellent condition. $1,150. Carb, router bits 1/4-in dia. 2 flt. sharp slightly used ⅜ flt. ln. 6/15. ⅜ felt ln. 6/10. Richard Smith, 1128 Michael Sean, Bedford, TX 76021.

Boise Craine 60-in. belt stroke sander. 2HP 3PH mag. st. Seldon used. $800. Call Jim. S.C. (803) 984-7124 day; 682-5628 PM.

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.

ALASKA: **Workshops**—Wilderness workshops; scribe-fit log construction, Mark Fritch, May 4–15, tuition $325; building a sailing pram, Simon Watts, May 18–27, tuition $375; $25 reduction if registered by Mar. 1. Harmony Point Wilderness Lodge. Contact Harmony Point Lodge, Box 110, Seldovia, 99663. (907) 234-7858.
Seminars—A number of seminars and workshops offered by the Alaska Creative Woodworkers Association for its members. For more information, write 2136 Alder Drive, Anchorage, 99508; or call (907) 278-2455.

ARIZONA: **Seminars**—Realistic pronghorn antelope carving, Tony Weaver, Mar. 17–19. Church of the Holy Cross Lutheran, 3110 N. Hayden Rd. Contact Dave Rushlo-Woodcarvers Supply, 2530 N. 80 Place, Scottsdale, 85257. (602) 994-1233.

ARKANSAS: **Exhibition/workshop**—Works in wood, exhibition and sale, April 9–May 8; furniture design and construction workshop by Frank Ferraro. For more info., contact at Gallery B., 11121 N. Rodney Parham Rd., Little Rock, 72212; or call (501) 221-0266.

CALIFORNIA: **Class**—Simon Watts' building the sailing pram, Apr. 2–9. Contact Nat'l Maritime Museum Assoc., Crissy Field, San Francisco, 94129. (415) 929-0202.
Seminar—Joinery and tools, Apr. 11–22. Japanese masters seminar by Fujieda Hiro Aki. Mahogany West, Sacramento, 95826. For more info., call (916) 731-5489.
Juried show—West Coast Woodworking open juried furniture show, July. Highlight Gallery. Send SASE for prospectus to Highlight Gallery, Box 1515, Mendocino, 95460; or call (707) 937-3132.
Juried show—1st annual nat'l "Site Specific Lobby/Landscape/Architectural Arts and Public Space" competition. Slide deadline Apr. 29; fee $7.50/slide (no limit to the number of slides). Distinguished jurors of top nat'l firms; tour planned to nat'l trade conventions 1988-1989. For application, write Daveen Fine Arts, 4111 Lincoln Blvd., #358, Marina del Ray, CA 90292. (213) 398-0151.

CONNECTICUT: **Exhibition**—"Container Exhibit," May 4–24. Nat'l juried craft exhibition. The Mill Gallery. Applications due April 1. Send SASE to: Container Exhibit, Guilford Handcrafts, Inc., Box 589, Guilford, 06437.

DISTRICT OF COLUMBIA: **Juried show**—1988 Washington Craft Show, Apr. 22–24. Departmental Auditorium, 1301 Constitution Ave., N.W. Featuring more than 100 artists; general admission $5. Contact Smithsonian Visitor Information and Associates' Reception Center at (202) 357-2700.

FLORIDA: **Show**—"Wood," Mar. 4–Apr. 15. A duo exhibition featuring Perry Allen and Bob Kopec. New Day Gallery, Pine Castle Center of the Arts, 6015 Randolph St., Orlando, 32809. For info., call (305) 855-7461.

GEORGIA: **Workshops**—Various 1- & 2-day workshops, Feb. 27–May 7, and a 3-day workshop by Tage Frid, Mar. 25–27. Contact Highland Hardware, 1045 N. Highland Ave., Dept. F, Atlanta, 30306. (404) 872-4466.

ILLINOIS: **Class**—Simon Watts' building the Herreschoff pram, Apr. 23–30. Contact Bruce Helmreich, RR#3, Quincy, 62301. (217) 434-8742.
Juried show—9th annual Fountain Square arts festival, Jun. 25–26. Outdoor show. Application deadline Apr. 8. Contact Evanston Chamber of Commerce, 807 Davis St., Evanston, 60201. (312) 328-1500.

INDIANA: **Exhibition**—"American Folk Art: Expressions of a New Spirit," Apr. 30–Jul. 5. Conner Prairie, Noblesville. Exhibition from the Museum of American Folk Art permanent collection. Contact Susan Flamm, 444 Park Ave. S., NYC, NY 10016. (212) 481-3080.
Show—Hand-crafted wood furniture, Sept.'88. Chesterton Art Gallery. Slide deadline Jun. 30. Send SASE for more info. to Marsha Demkovich, Chesterton Art Gallery, Box 783, Chesterton, 46304. (219) 926-3041.
Exhibition—Turned bowls by Betty J. Scarpino, April. Center for Creative Arts Gallery, 6263 N. Carrollton Ave., (Broad Ripple Village), Indianapolis, 46220.

KANSAS: **Exhibition**—Topeka crafts competition 12, Apr. 2–May 2. Contact Gallery of Fine Arts, Topeka Public Library, 1515 W. 10th St., Topeka, 66604-1374. (913) 233-2040.
Juried show—Dimensions '88, May 13–5. 4th annual nat'l 3-dimensional art show. Outdoor show—Lenexa's Sar-Ko-Par Park. For info. and entry forms, contact William H. Nicks, Jr., Show Director, City of Lenexa, 12350 W. 87th St. Parkway, Lenexa, 66215.

LOUISIANA: **Convention**—2nd Nat'l Convention of Craftspeople, Apr. 16–20. Featuring seminars and workshops on advertising, publicity, law, creative displays and other craft-related topics. New Orleans. For brochures and registration info., contact The Nat'l Convention of Craftspeople, 111 Liberty St., Petaluma, CA 94952. (800) 321-1213.
Show—FestForAll'88 and FestForAll Gallery Show, May 20–23. FestForAll will be held downtown, North Blvd.; gallery show at Baton Rouge Gallery in City Park; opening reception 7–9 P.M., May 21. For more info., contact Gina Castle, River City Festival Assoc., at (504) 344-3328.

MAINE: **Classes**—Post & beam building, Apr. 10–15, Sept. 18–23; and 2- & 3-week design and build classes beginning in Mar. through Nov. For specific class dates and more information, contact Shelter Institute, 38 Centre St., Bath, 04530. (207) 442-7938.

MARYLAND: **Juried shows**—13th Annual Spring Arts & Crafts Fair, Apr. 15–17. Montgomery County Fairgrounds, Gaithersburg. 11th Annual Spring Crafts Festival, Apr. 29–30 & May 1. Maryland State Fairgrounds, Timonium. For detailed info., send 66¢ in postage stamps to Deann Verdier, Director, Sugarloaf Mountain Works, Inc., 20251 Century Blvd., Germantown, 20874. (301) 540-0900.

MASSACHUSETTS: **Juried show**—Art at Work, handmade furniture for the office. Slides due May 15; entry fee $15. Send up to 6 slides, fee and SASE to: The Society of Arts and Crafts, 175 Newbury Street, Boston, 02116. (617) 266-1810.
Workshops—Cabinetmaking, Apr. 25–29; finish carpentry, May 9–13, June 13–17; comprehensive housebuilding, May 16–June 3, June 20–July 8; timber framing, July 11–15, Aug. 15–19. Contact Heartwood Owner-Builder School, Johnson Road, Washington, 01235. (413) 623-6677.
Exhibition/Workshop—Exhibition of work by Tage Frid, Mary Lee Hu, Susan and Steven Kemenyffy and Warren Seeling, Mar. 1–Apr. 10; reception and gallery talk, Apr. 9; and weekend workshop series, Apr. 9–10. The Gallery at the Worcester Center For Crafts. For more info./brochure, contact: Worcester Center For Crafts, 25 Sagamore Road, Worcester, 01605. (617) 753-8183.
Show—"Woodworking World 1988," Apr. 29–May 1. The Boston Show, Bayside Expo Center, Boston. Admission $6. For more info., contact Christine Murphy at (603) 536-3768, CDI Productions, Box 796, Rt. 3 & Cummings Hill Rd., Plymouth, NH 03264.

MINNESOTA: **Exhibition**—The Turned Message II, April 1–29. Grand Avenue Frame and Gallery, 964 Grand Ave., St. Paul, 55105. For information, call (612) 224-9716.
Craft fair—1988 American Craft Council (ACC) Craft Fair for wholesale buyers, Apr. 6–7. St. Paul Civic Center. For more info., buyers may call the buyers-only phone (800) 527-3844; in NY and outside the U.S., call (914) 255-0039 between 9 A.M. and 5 P.M. EST.
Demonstration—MN Woodturners Assoc. demonstration by woodturner Rude Osolnik, Mar. 26. Contact: MN Woodturners Assoc., 667 Harriet Ave., St. Paul, 55126. (612) 483-3489.

NEW JERSEY: **Auction**—Annual antique and user tool auction, Apr. 9. Begins at 10 A.M., free, approx. 450 lots. Holiday Inn, Clinton. For info., write CRAFTS of New Jersey, 85 Brunswick Ave., Lebanon, 08833.

NEW YORK: **Exposition**—The Pratt creative arts therapy annual expo; transitions and transformations, Mar. 19; annual creative arts spring institute, Mar. 14–19. For information, contact Leslie Abrams, Chairperson, Creative Arts Therapy Dept., 200 Willoughby Ave., Brooklyn, 11205. (718) 636-3428.
Exhibition—11th Annual Wood Carving Exhibition, May 7–8. Creative Arts Building, Erie County Fair Grounds, Hamburg. Free admission, non-juried; sponsored by the Southtowns Wood Carvers of Western NY.
Juried show—International Art and Craft Competition 1988. Slide submission deadline May 16. For application, write to I.A.C., Dept. FW, Box 245, Eastchester, 10709; or call (914) 699-0969.

NORTH CAROLINA: **Juried show**—"NC Showcase of Visual Art," May 20–22. Raleigh Civic Center. Contact Gail Gomez, High Country Crafters, 19 Haywood St., Asheville, 28801. (704) 254-7547 or 254-0070.

OHIO: **Show**—The Great Lakes wood carving exhibit, May 14–15. Brooklyn Recreational Center. For exhibition information, contact Ed Katzenmeyer, 116 Goodhue Drive, Akron, 44313. (216) 864-0784.
Show/seminar—"Woodworking World," Mar. 11–13. The Columbus Show, Veterans Memorial Hall, Columbus. Machines, tools, supplies, demos, seminars, door prizes. Admission: $6. Contact CDI Productions, Box 796, Plymouth, NH 03264. (603) 536-3768.

PENNSYLVANIA: **Show**—1988 Mid-Atlantic Woodcarving Show & Competition, Apr. 9–10. Open 10 A.M. to 5 P.M.; $3 donation, children under 12 (w/ adult) free. Penn State (Ogontz) Abington Campus Gym, Abington. For more information, contact: The PA Delaware Valley Wood Carvers Assoc., Box 69, Willow Grove, 19090.
Juried show—6th annual PA Nat'l Arts & Crafts, Mar. 25–27. PA state farm show complex. For information, send SASE to: PA National Arts & Crafts Show, Box 11469, Harrisburg, 17108-1469; or call Lew Kishbaugh at (717) 763-1254.

TENNESSEE: **Juried show**—Master furnituremakers show, Dogwood Arts Festival, April 22–24. Open to individuals and those representing woodworking schools. Contact Dogwood Arts Festival, 203 Fort Hill Bldg., Knoxville, 37915. (615) 637-4561.
Workshops—Bowl and plate turning and carving—technique and design, Alan Stirt, Mar. 6–11; woodturning, Del Stubbs, Mar. 13–18, Mar. 20–25; woodturning and design, Leo Doyle, Mar. 27–Apr. 1. For more information and/or a spring brochure, write: Arrowmont School of Arts and Crafts, Box 567, Gatlinburg, 37738; or call (615) 436-5860.

TEXAS: **Juried fair**—Annual Crafts & Arts Exposition, Houston Int'l Festival, April 9–17. Contact Barbara Metyko, Houston Int'l Festival, 2 Houston Center, 909 Fannin, Suite 890, Houston, 77010. (713) 654-8808.
Show—21st annual Winedale Spring Festival and 13th TX Crafts Exhibition, April 9–10. Winedale Historical Center, Univ. of Texas, Austin. Gates open at 10:30 A.M.; festival admission $2 (adults), $.50 (students). For further information, call (409) 278-3530.

UTAH: **Juried show**—Celebration '47, Apr. 14–May 6. 47th annual multi-media art exhibition. Braithwaite Gallery, S. Utah State Coll. Cedar City Art Committee, Iron County School District, Box 879, Cedar City, 84720.

VIRGINIA: **Auction**—7th Annual Tool Auction for collectors and users, Mar. 12. A "club" auction sponsored by PATINA (Potomac Antique Tools and Industry Assoc.), Alexandria (near D.C. and nat'l airport). For a complete list of over 500 quality tools, send a SASE to Karl Sanger, 14516 Carona Drive, Silver Spring, MD 20904; or call (301) 384-4377.
Show—8th annual Herndon Antiques Show and Sale, Apr. 8–10. Herndon Community Center, 813 Ferndale Ave., Herndon, 22070; (703) 435-6870. For info., contact the Herndon Woman's Club, Box 334, Herndon, 22070.

WASHINGTON: **Workshops/seminars**—Various classes, seminars & workshops ranging from plywood pram construction to building a tool box, March. Center for Wooden Boats, 1010 Valley St., Seattle, 98109. For more info., call the center at (206) 382-2628.
Workshops—Sailmaking & repair, Mar. 5; caulking, Mar. 12; planking, Mar. 19; interior joinery, Apr. 9; oar making, Apr. 16; and repair & maintenance, Apr. 23. Contact: Northwest School of Wooden Boatbuilding, 251 Otto St., Port Townsend, 98368. (206) 385-4948.
Show—"Small Tables," Mar. 3–27. Featuring tables for telephones to tables for tea by gallery members and other NW woodworkers. Northwest Gallery, 202 1st Ave., S., Seattle, 98104. (206) 625-0542.

WEST VIRGINIA: **Exhibition**—Craftsmen in Wood: Eastern Panhandle, Mar. 20–Apr. 24. The Admiral Boarman House, 208 S. Queen St., Martinsburg, 25401. (304) 263-0224.

AUSTRALIA: **Competition/exhibition**—International exhibition of woodcrafts and wooden artifacts, Apr. 25–May 1. Includes woodturning, cabinetmaking, carving and more. Objects must use Australian-grown timber. Contact Australian Forest Development Institute, Box 802, Albury NSW 2640. (060) 411266.

CANADA: **Show**—Belleville's 1st annual Quinte Wood Show, Mar. 18–20. Ben Bleecker Auditorium, Fairgrounds, Belleville. Featuring exhibits, seminars, juried competition, sales, prizes and demos. For info., write to: The Quinte Wood Show, Box 973, Belleville, Ontario K8N 5B6.

CHINA: **Study tour**—George Frank woodworker's 1988 study trip to China, June 3–19. Visits to traditional Chinese furniture factories, lacquering shops, the restoration centers of the forbidden city in Beijing, etc. Reservations close Mar. 15. For details write Eva Frank, 3504 Beneva Rd., Sarasota, FL 34232; or call (813) 923-3377.

EUROPE: **Trip**—Timber-framers' tour, sponsored by Mafell N. America Inc., tentatively scheduled for June. For information, contact Mafell N.A., Inc., Box 363, Lockport, NY 14094. (716) 434-5574.

ITALY: **Study tour**—Seminar on Italian furniture with George Frank, Oct. 12–26. Visits to craft, art and restoration centers of Milan, Verona, Florence and Rome; and seminars on the artistic Renaissance furniture made in the Tuscany craft centers. For details write Eva Frank, 3504 Beneva Rd., Sarasota, FL 34232. (813) 923-3377.

Carving Large Birds by Bill Dehos and Patrick Spielman. ***Sterling Publishing Co., Inc., 2 Park Ave., New York, N.Y. 10016; 1986. $17.95, paperback; 224 pp.***

It was once stated by one of the leading bird carvers that we are tending to get away from true carving when we add such non-wood properties as ribbon epoxy, glass eyes, brass leaves, acrylic water, wire feet, acrylic paint and steel supports to our carved birds. If you feel the same about these "advances" in bird carving, you might find *Carving Large Birds* up your alley.

The direction the authors wish to develop is a bridge between the realistic bird carver and the rough stylism of the chainsaw carver. They give the reader ideas and patterns for more than 30 finely finished, stylized birds. They make good use of laminations of contrasting woods to accentuate various sections of many of the subjects. The visible grains running through each piece bring the viewer closer to the feeling of wood. This is something that is lost in the realistic bird carver's artwork.

The format of this book is divided into two main sections. The first gives the reader some general advice on selecting tools and woods. The second explains the use of wood-burning tools for accentuating certain areas on the birds and their bases.

After going over this book several times, I began to feel the text was written around the photos, rather than the text being reinforced by the photos. The sequence of photos also tended to wander. One very impressive feature of the book, however, was the beautiful color photos of Dehos' carvings. The composition and placement of the birds was well done. Each carving was placed in a setting typical for that bird and complimentary to it.

Although the authors have given many patterns to follow, it's obvious that anatomical accuracy was not one of their main concerns. The most impressive birds in the collection for me seemed to be the eagles and hawks in the standing positions. The birds with open wings tend to illustrate the difficulty of wing placement when limited to the natural dimensions of the tree. As with most pattern books, the finished subject is the product of the pattern. The opposite is true in this case, for the patterns were drawn from the original carvings done by Dehos.

—Bruce Chidester

Making Country Furniture by Alex Webb. ***B.T. Batsford Ltd., London; distributed by David & Charles, Inc., North Pomfret, Vt. 05053; 1986. $24.95, hardcover; 144 pp.***

In *FWW* #65, we reviewed two strikingly different books, both entitled *Making Country Furniture*. Here, now, is yet a third.

Webb approaches the topic more from the how-to perspective. His is a handsomely bound, 7x10 hardcover book, but it only deals with eight project plans in its 140 pages. All of the pieces are traditional English country pieces: a paneled chest, cricket table (sort of a three-legged plant stand), side table, refectory table (we might call it a heavy-duty dormitory dining-room table), box stool, dresser, open-bottom china cupboard and joint stool.

Since the number of pieces presented is somewhat limited, Webb is afforded the luxury of providing thorough, step-by-step construction details and a battery of very complete line-art illustrations for each piece. The plans are thoroughly readable, and the average woodworker would have no difficulty following them. However, the book's central theme relates more to the faithful reproduction of time-honored joinery, and the projects are, by and large, used as examples of how the joints were employed. In fact, the book dedicates five of its 13 sections to describing joinery and cabinetry methods for cutting moldings, dovetails and mortise and tenons, plus edge-gluing and turning.

What I found especially appealing in this work is that no attempt is made to carry these topics out to any level of frivolous sophistication beyond what is functionally important and practical. Webb attempts to present only the basics and, by holding to that limited objective, he does it very well.

As far as I'm concerned, however, the world still needs a really good book on making country furniture—this one didn't fill the derth. Maybe someday when I no longer have to earn a living, I'll take a shot at it myself.

—Jon Arno

Guitarmaking: Tradition and Technology by William R. Cumpiano and Jonathan D. Natelson. ***Rosewood Press, 85 N. Whitney, Amherst, Mass. 01002; 1987. $48 introductory price, hardcover; 392 pp.***

I've waited a long time for this book to be written. I searched for it during the years I was learning about instrumentmaking and bemoaned its absence when my various apprentices and employees asked for direction. It is a great pleasure to find the book emerged in a form I can review with unabashed praise.

Cumpiano and Natelson have given us that "rara avis" among texts; one that maintains scrupulous accuracy in spite of an astonishingly broad scope. They have managed to include the most sophisticated and esoteric luthier techniques, yet still anticipate virtually every possible beginner's error.

Starting with absolutely no assumed knowledge on the reader's part, the book takes you through the design and building of two guitars simultaneously—a steel-string acoustic and a traditional nylon-strung classical. The classical is made entirely with hand tools and could literally be made on one's kitchen table, while the steel-string guitar instructions bow to the efficiency available to the typically equipped home woodshop. The instructions cover the most rudimentary operations, replete with necessary admonitions about common pitfalls, but also delve into such advanced operations as making the mosaic "tiles" for a soundhole rosette (classical) or cutting and shaping abalone shell for an elaborately inlaid steel-string guitar. A variety of possible techniques and options is offered for each operation, followed by the authors' opinions of the best course of action.

In true textbook fashion, the upper right-hand corner of each page spread contains "running heads"—those terse one-line descriptions that indicate the contents of that page so as to facilitate easy reference. The chapters are laid out in recipe fashion: A discussion of historical perspective along with an overview of the coming operation is followed by a list of necessary tools, materials and supplies, thence by a detailed description of the procedure. Where special tools and jigs need to be fabricated, complete instructions for doing so appear at the beginning of the appropriate chapter. Additionally, the text is sprinkled with boxed "sidebars" offering history, techniques, or toolmaking ideas that go beyond the scope of the regular text.

The entire book is profusely illustrated (500 photographs and line drawings illuminating 400 pages of text), with the description of each operation juxtaposed to the applicable visuals. The drawings are consistently outstanding—better in fact than the photos, which are at times a bit dark and cluttered.

The book is available through a number of luthiers' supply outlets and can be purchased directly from the authors themselves.

Price notwithstanding, *Guitarmaking: Tradition and Technology* is an unparalleled treasure and a true bargain—an oasis in a desert of mediocrity. One can only hope it is the catalyst to spawn a new generation of competitive quality.

—Michael M. Dresdner

Bruce Chidester, a professor of music at the Univ. of Northern Iowa, is also an avid sportsman, photographer and wildlife artist. Jon Arno is an amateur woodworker and wood technologist in Schaumburg, Ill. Michael Dresdner is an instrumentmaker in Zionhill, Pa.

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Colorado guild show: A juror explains his verdict

Over the years I've subjected my furniture to the scrutiny of numerous craft show and museum juries and have had my share of rejections. Each left me wondering just what sort of misguided knuckleheads were on the jury. Last fall, I got a taste of the juror's difficult job when architect John Nelson and I were asked to judge the annual exhibition of the Woodworkers Guild of Colorado Springs.

I accepted the invitation with some apprehension. Simply picking pieces for a show is tricky enough, but the guild had an even more difficult goal: As a means of encouraging and improving woodworking in Colorado, we were asked to deliver a two-hour critique, explaining our decisions to both winners and losers. I suspect the critique was as illuminating for the jurors as for the guild members.

Nelson and I spent Sunday morning looking over the 70 entries. All had been brought to the Pioneers' Museum in Colorado Springs. After much discussion, we settled on 35 pieces for the show. Although we agreed completely on our final choices, we had the most difficulty in drawing the line between those pieces that were neither outstanding nor terrible. We knew that explaining our reasons for rejecting nondescript work would not be easy. We worried that those who were rejected wouldn't stay for our critique, but were pleased to find the desire for feedback outweighed any pain from wounded egos, and everyone did remain for the discussion.

From my point of view, criticism must begin with an understanding of the designer's intent. How can you judge the success of a design without knowing what the mak-

er hoped to accomplish? Often, especially in sculpture, a maker's intentions are more clearly expressed in the work itself than in any verbal explanation. Carved from a gnarly cedar limb, Sophie Cowman's sculpture of a woman carrying a bundle of logs, for example, is not accomplished carving. But the very roughness of the work expresses the image of women living in the natural world, inseparably bonded with nature. Cowman has produced a vivid picture of herself and the self she aspires to become.

Another sculpture, a superbly made pair of crutches by Harv Mastalir, delivered a muddled message. The crutches were carefully made of laminated walnut, giving a great sense of strength and perhaps respect for the person meant to use them. At least, that's what I felt until I saw the wooden wheels attached to the crutch tips. Now, they rendered the crutches useless, provoking an uncertain, discomforting reaction. Is this a joke and we've missed the punch line? Is there a message hidden here? Is someone making fun of cripples? It's impossible to tell.

Craftsmen are often angered by the argument that function separates craft from fine art, but I believe the distinction is real and that it illuminates the different criteria used by craftspeople. This isn't to say that craftspeople aren't as self-expressive as artists. In fact, self-expression is what art and contemporary craft have most in common.

C. Scott Taylor's box, which won first prize in the exhibit, is one example of how function can give meaning and depth to a craft object. Through his fine craftsmanship and choice of precious materials—ebony, cocobolo, silver and ivory—Taylor communicates a strong sense of integrity and love of quality. This container affects us in three ways: We want to approach and handle it, we want to open it, and it creates both attraction and reverence for what lies within—a pair of hairpins, perhaps intended for someone close to Taylor.

One of the nicest pieces in the show, a chest of drawers by Terry Blanchard, offers another opportunity to explore a craftsman's intent. Made of mahogany with ebony pulls and an ebonized reveal at the base, the chest has clean, simple lines, reminiscent of Art Deco. The only disquieting note comes from the top, which looks like a board set on the chest, destroying the design's harmony. I wondered why Blanchard made the top this way when a cleaner solution would have been a flush, inset veneered panel.

Examining the drawer bottoms and chest back gave me the answer. If Blanchard had used frame-and-panel construction and inset the top panel as he had done on the sides and back, the top would have been a dust collector. To avoid this, he lipped over the edge, creating the board-stuck-on-the-top effect.

The real message I sensed from Blanchard's chest came from his commitment to solid wood and involved joinery, even at the expense of harmonious design. Most of us who choose to be designer/craftsmen do so because our struggle for uncompromised excellence promises great satisfaction, even if the economic rewards aren't great. Adherence to solid-wood construction and traditional joinery speaks of integrity and quality many believe our culture is forgetting. The problem with Blanchard's piece, I finally concluded, was not in the rules he set for himself, but in the way he applied them.

Another piece by Mastalir, a shedua table, won second prize. I thought its message—a devotion to high-level craftsmanship in solid wood—was similar to that of Blanchard's chest. But overall, Mastalir's table succeeds better as a design. And unlike much contemporary furniture, the table projects modesty—it doesn't scream for attention through bright colors or bold decoration, but instead waits patiently to be noticed.

Not all of the pieces in the Colorado show elicited such extensive response. Some were rejected out of hand because of poor construction. We turned away one perfectly executed cabinet because its flawless, machined joints and standard porcelain pulls lacked even a hint of the kind of self-expression we thought the exhibition should showcase. Where a number of turned or carved objects were submitted by the same maker, we picked the best of the lot. On balance, our views as jurors were accepted with equanimity, although I'm sure some of the rejected makers will still consider us knuckleheads. At least now they know why. *—Peter Korn*

Peter Korn is director of the Woodworking/Furniture Design Program, Anderson Ranch, Snowmass Village, Colo.

How much can a free saw cost?

"Ever hear of an Oliver?" I looked up from my desk in response to the familiar voice. "Yeah, heavy-duty industrial woodworking equipment, quality stuff. I'm not sure whether they're still in business though," I replied. The question came from Wayne, a fellow engineer and avid woodworker, who had just been offered a free bandsaw.

It so happens that I have a 20-in. saw built about 50 years ago that Wayne has always admired and more than once offered to buy. Although I had suggested one of those bargain Taiwan bandsaws, Wayne wanted something more substantial. After months of pouring over the classifieds in search of used tools, he heard of an old bandsaw stored in an outbuilding. It had been there for many years and was going to be scrapped. Wayne could have it free if he'd just haul it away.

One Saturday we got together with the saw's owner, who took us to the outbuilding. There, in the shadows of a far corner, was a hulking old machine. A quick check with a tape confirmed it was a 30-in. Oliver! With its gracefully curved column, flared feet and huge tables, the old machine was a masterpiece of the patternmaker's and foundryman's art. The castings were sound beneath the rust and peeling paint, and except for a missing tire, the bandsaw appeared complete.

"It would look beautiful with a fresh coat of enamel and pinstriping," I mused as Wayne and I discussed the saw over a couple of beers. "Besides," I added, "even if it has some major flaw, you could always sell it to a boat owner as an anchor." Since it was free and needed only a phase converter to run on household current, a new tire and a few hours of cleaning, the saw was a steal. As we discussed what was required to put the saw in working order, Wayne's wife, Pam, happened into the kitchen. Upon hearing our enthusiastic description of the saw, she smiled and asked, "How much is this free saw going to cost?"

The following Monday I found that Oliver is not only still in business in Grand Rapids, Mich., but that they also have a toll-free phone number. Wayne phoned to find out the age of the saw, whether it had ball or journal bearings and if parts were still available. He also casually asked how much the machine weighed. Came the reply: "1929, ball, yes and 1,500 lbs." I remember moving my 20-in. bandsaw required three men and a boy and it was only half the weight of this saw.

The Yellow Pages listed several riggers who estimated it would cost about $600 to move the monster. Through a friend, we learned of a "discount rigger" who would do the job for $250. We abandoned our half-baked plans to move the thing ourselves and hired the rigger. His equipment was almost as old as the saw. His truck broke down and the job took all day, but he knew how to handle heavy machinery and moved the saw with little difficulty.

With the saw in Wayne's garage, we checked into buying a phase converter. The estimated cost—$300. But we're talking about a saw you couldn't even buy for $3,000, so this expense was justified. Since the saw is direct drive, the lower wheel had to be removed before the motor could

be unbolted from the frame. The only problem was that the wheel probably hadn't been removed since the saw was built, and this proved to be the next of many unforeseen challenges. It seemed that a gear puller would do the job, but after deforming the screw of a heavy-duty puller (mine), we rented an even larger puller that still didn't budge the wheel. The final solution: We paid a machine shop $100 to remove the wheel with a 30-ton hydraulic puller. By this time, I had accepted a new job some 3,000 miles away, so now our progress reports and head-scratching sessions were carried on via telephone.

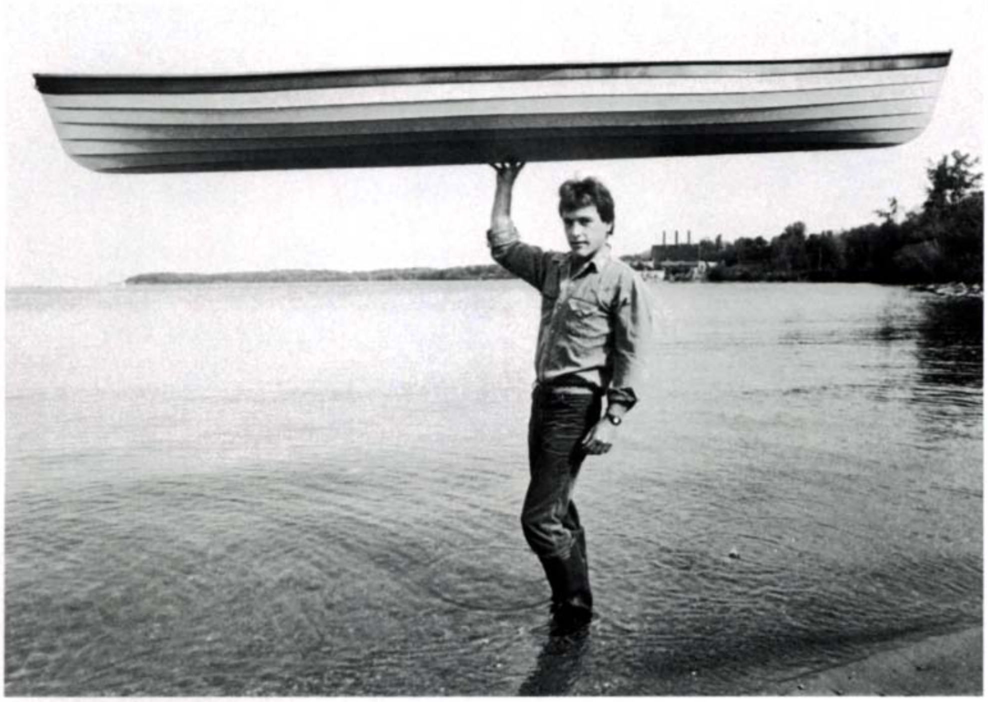
While the motor was being inspected, other items kept up Wayne's flow of sweat and cash. First, the tables (there are two) were sent to the machine shop for resurfacing ($75). Next, the old paint was removed to bare metal and the castings sanded smooth and repainted. The upper blade guides were chewed up and had to be replaced ($60). Finally, Wayne purchased two new tires locally and stretched them onto the wheels ($40).

Now back to the motor, which wouldn't run. The shop wanted to rewind it, at a cost of $600. The repairman must have sensed the panic at the other end of the phone and offered one other possibility. The rotor and stator could be cleaned and relacquered—cost, $50. At this point it seemed to be the only choice. The next problem to surface was whether the house would have to be rewired to accommodate the current draw of the 5-HP phase converter. Some careful trials showed that the house wiring was up to the job. When motor, starter and phase converter were united with the now brightly enameled saw, the machine ran quietly and vibration-free. But the blade didn't track well and the centrifugal force caused the lower tire to fly off the wheel in pieces. For $300, Oliver would mold on new tires, turn them true, grind a crown and balance the wheels.

Now, $1,300 and six months later, the saw runs beautifully. There's a lesson worth passing on here to anyone entertaining a similar enterprise: Rebuilding industrial equipment causes industrial-sized headaches and requires an industrial-sized budget. It take perseverance and a thorough understanding of Murphy's law. On the positive side though, Wayne truly has a magnificent piece of machinery that would certainly be out of the financial reach of most amateurs and small professional shops (about $12,000 new). It has as much power as anyone could want, and the thing runs so smoothly it's difficult to tell it's on. But if any of you are lucky enough to be offered a free saw, remember first to ask yourself: "How much can a free saw cost?"

—Dennis Preston, Torrance, Calif.

Rob Swanson



Tom Hill's ultra-light lapstrake canoes are a wilderness backpacker's dream. At 11 ft., 6 in., this monocoque canoe weighs only 25 lbs.

Tom Hill's ultra-light canoes

Many boatbuilders make canoes and small boats by fastening planks to bent oak ribs with clenched nails or screws. Others patiently build up the hull with dozens of cedar strips, wrapping the completed shell in a layer of watertight fiberglass. Tom Hill has another way. He builds monocoque canoes with thin but durable marine plywood imported from Europe. As in monocoque aircraft and racing cars, the outer skin of a Hill ultra-light canoe carries all the stress, instead of a rigid, heavy inner frame. Each boat's shell is made of 4mm-thick plywood planks glued together with marine epoxy, making the canoes watertight right from the start, without relying on a bulky wrap of fiberglass cloth. Because they lack both framing and fiberglass, Hill's canoes are incredibly light. A 9-ft., 6-in. monocoque, for example, weighs only 19 lbs. With one hand, Hill can lift it easily overhead.

At first, a 19-lb. plywood boat might seem akin to a waterborne eggshell. That's not the case here. Although unsuited for white water, Hill's canoes are tough—perfect for wilderness backpacking to remote rivers and lakes. Hill has been a boatbuilder for 16 years and has refined ultra-light building techniques he learned from Vermont canoe builder, Carl Bausch of Charlotte.

Hill's ultra-light techniques are appropriate at a time when builders of cedar-strip canoes find it increasingly difficult to obtain good quality material. A traditionally built cedar stripper usually requires 40 to 50 individual strips for a 16-ft. canoe, but designs built with narrow strips may require as many as 100. To ensure strength, each plank must be relatively straight-grained and knot-free. Often, boatbuilders purchase rough cedar in large quantities, sawing and surface planing the wood before ripping it into strips. Under the best of circumstances, building a stripper can be very tedious.

Hill, on the other hand, takes mahogany plywood from a package in 8-ft. or 10-ft. lengths, rips it into 2-ft.-wide panels, scarfs the panels together and starts planking immediately. He buys plywood in the exact thickness he needs so there is no need for hours of tedious sawing and surface planing.

As with a stripper, Hill's boats are built upside down on a boat-shaped jig. At various points along its length, station molds that duplicate the hull's cross section are firmly fastened to the jig. By wrapping strips around the molds, the hull's shape is built up plank by plank. To edge-join each strip, a traditional builder planes a bevel on each edge or forms a joint called a "bead and cove." Either method requires countless trips between the jig and workbench.

Hill works differently. To the station molds of his jig, he fastens longitudinal strips called "ribbands," each of which represents an actual hull plank. Using the ribbands as a guide, he positions a plywood-plank panel, marks it and then cuts it with a jigsaw. This ingenious method vastly reduces time-consuming sawing and fitting. There are far fewer planks, too. Hill's 16-footers have only 14 planks, seven on each side. Moreover, once the hull is planked, it's essentially finished, except for

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minor detailing. There's no need to apply canvas, fiberglass or epoxy to seal the hull.

The hull's great strength is derived from the fact that the planks are lapstrake—they overlap about ½ in. at each joint. At each overlap, the hull's thickness is effectively doubled or, expressed another way, there are six boat-length chines running from stem to stern. One of the planks forming each lap is beveled, using a cleverly jigged block plane Hill learned about from Bausch. The plane is fitted with a wooden guide that follows the contour of the ribbands, planing a perfect winding bevel on each plank. Once the planks are cut and fit, the laps are glued with epoxy, not nailed as in traditional lapstrake boats. During glue-up, the ribbands provide clamping surfaces along the length of the joints.

Exclusive of drying time for the epoxy (approximately two and a half to three hours), Hill says he can hang a pair of planks—from start to finish—in about an hour. It takes Hill about three working days to plank a 12-ft. canoe.

Professional boatbuilders, shop instructors, doctors, lawyers and others, even two naval architects, have traveled from Australia, Canada and across the United States to attend Hill's summer workshops at the Brookfield, Conn. Craft Center, the WoodenBoat School in Brooklin, Maine, or the Appalachian Center for the Crafts in Smithville, Tenn. And, about 100 outdoor enthusiasts have ordered Hill's wooden canoes or skiffs, 9 ft. to 18 ft. long. He charges $120 a foot, plus freight.

If you're interested in trying ultra-light canoe building, Hill has written an excellent book entitled *Ultra-light Boatbuilding*. It's available for $17.95 from International Marine Publishing Co., 21 Elm St., Camden, Maine 04843. Hill also sells plans. You can write him at the following address: RR594-16, Huntington, Vt. 05462.

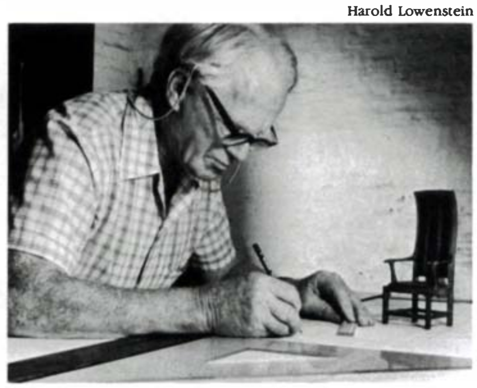
—Fred Stetson, Winooski, Vt.

Craftsmanship

My slickly polished plane
slips along the edge,
releasing
a delicate ribbon of wood.
It drifts soundlessly to the floor
to join an airy cushion of redolent curls.
With particular patience the plane
addresses the inconstant wood,
dancing with elastic pine,
balking at an obstinate knurl,
and running off the edge
in a moment of careless distraction.
Adjusting the pressure,
she cuts cleanly through crisp mahogany,
her zipper-song heralding
the smart face she has revealed.
Stroking the coconut satinwood,
summer scent fills the rhythm
again and again and again
of his softly sliding back under my hands.

—Nancy Heaton, Baltimore, Md. ©1987

Harold Lowenstein



Edward Barnsley at the drawing board in his Froxfield workshop.

Edward Barnsley: 1900-1987

Early last December, at the age of 87, Edward Barnsley died, leaving a great legacy to furniture design and fond memories to his students, employees and customers. Barnsley's lifelong work was the continuation and growth of the English Cotswold tradition and of the Arts and Crafts Movement begun by William Morris and John Ruskin in the late 19th century.

I first knew Barnsley simply as Uncle Edward. He was a close friend to my parents, sharing with them a common commitment to craftsmanship. Barnsley had always been around furniture, having played in the shop of his father, Sidney Barnsley, and handling the tools as soon as he could pick them up.

When, at the age of 18, I decided to learn how to make furniture, there was simply no comparable place to go other than Barnsley's Froxfield workshops, just 60 miles southwest of London. Before I actually became a full-time pupil, Edward would send me lumber and detailed drawings along with instructions explaining what to do. I finally joined his workshop as a formal pupil in 1946. I was ready. I knew this was what I wanted to learn and I was in awe of Edward. This man represented a quality of craftsmanship that one just didn't see anywhere but in his workshops.

The atmosphere was of a working shop rather than a teaching institution. We learned by doing, by being productive, working always with hand tools on pieces intended to sell. We worked in solid timber, seasoned on the premises. Always, nothing less than perfection would do. Even parts that wouldn't show in the end had to be given complete and careful attention to satisfy Edward.

I will always remember listening to him as he sat in his corner settee, teacup or glass in hand, discoursing on design and craftsmanship. His spirit was contagious and he succeeded in passing on to his pupils and apprentices a kind of idealism, a sensitivity and feeling for wood not easily taught or put into words. His influence, generosity and love for his craft will not be forgotten. □

—David Powell
Leeds Design Workshops
Easthampton, Mass.

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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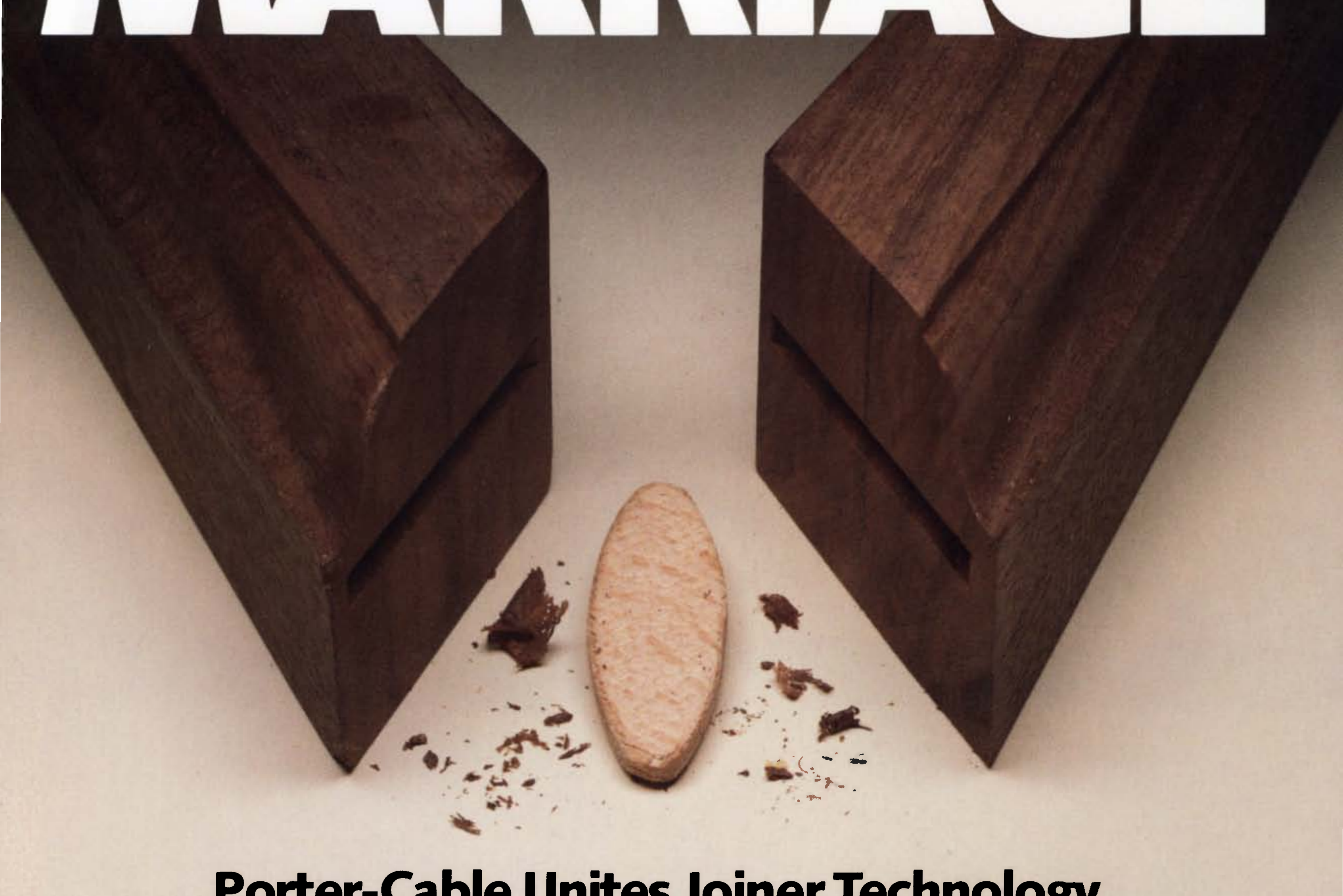

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CAROUSEL ANIMALS

The splendor of old-time carnivals and carousels lives again in this regal 60-in.-high charger and the rest of Joe Leonard's carved menagerie. The charger, a basswood reproduction of a 1917 classic by Daniel Muller, shimmers with the anatomical accuracy, sense of movement and rousing spirit that have entranced children and adults for decades. Left, is his 68-in.-tall basswood hippocampus, half horse and half sea monster, and right, his 48-in.-tall mahogany rocking rabbit, based on a carousel original. The bodies are laminated boxes, to save weight and allow for seasonal wood movement, but the heads are solid. Prices go from $2,500 for the rabbit to $15,000 for the horse. In addition to restorations and reproductions, he also designs originals in his shop, Custom Woodcarving Co., Burton, Ohio.

Photos: Andrew Russetti, above; Joe Leonard, left; Ed Naro, below