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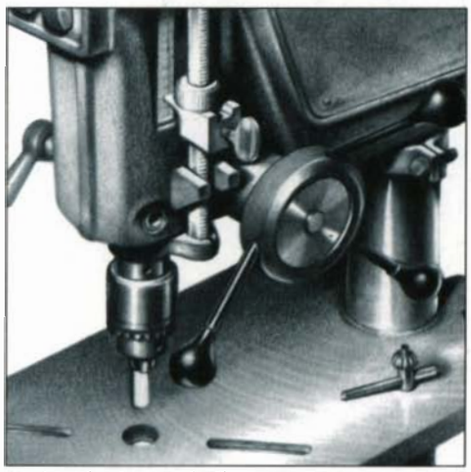
Fine WoodWorking

May/June 1992 No. 94

DEPARTMENTS

ARTICLES

Making raised panels, p. 65



A close look at a drill press, p. 55

Building a solid-wood chest, p. 38

On the Cover: *A tight shot of the mechanism for a butterfly-leaf table. How to design and install one of these self-storing table leaves on p.50. Photo: Sandor Nagyszalanczy.*

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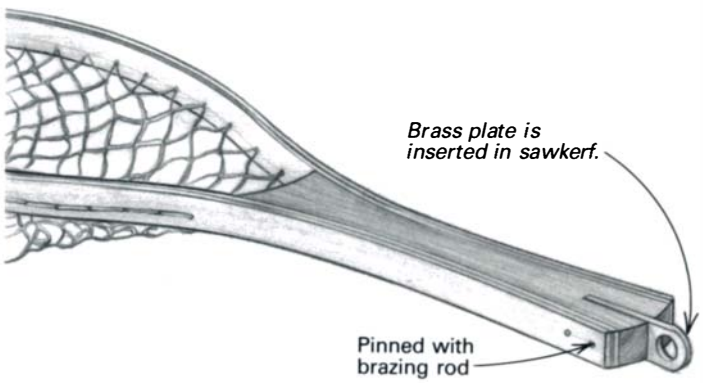
A tip on random orbit sanders from the auto shop—As an auto-body-repair instructor and an old car restorer, I enjoyed the article on random-orbit sanders in *FWW* #92. Random orbit sanders, powered with compressed air, have been used for years in body repair. The article failed to mention that 5-in. or 6-in.-dia. sandpaper can be purchased without adhesive. Disc adhesive comes in either tubes or spray, although I prefer the spray. The back of the sandpaper can be sprayed and set aside for use later that day. It's good to also apply a little adhesive to the sander's pad occasionally. This system is more economical than using pre-glued discs, and the discs come off the pad much easier. Auto-parts stores that carry body supplies will have both the discs and the adhesive. *—Will Boksa, Adams, Wisc.*

An improved landing net



I read the article by Geoffrey Carson on laminating a landing net in the February 1992 issue of *FWW*. I made a similar net several years ago, and since then I have made several more for fishing friends. It concerns me, however, that the author chose to "install a brass screw eye" to complete his net. I suggest that this is tantamount to going to the store to buy a trout for the lead photo.

I think the method I use, as shown in the drawing above produces a sturdier attachment and a more aesthetic look appropriate to a fine woodworking project. I made a plate from 20-gauge brass, drilled a ¼-in.-dia. hole near one end and inserted the plate in a kerf in the end of the handle. The plate is pinned in place with brass brazing rod. *—Renzo Gervasoni, Ridgewood, N.J.*

Justice is done—Jon Arno's and Rudi Wolf's articles about chestnut in the February 1992 issue of *Fine Woodworking,* reminded me of a true story related to me during my apprenticeship, regarding the similarities of our native Sweet Chestnut with English Oak (Quercus *robur*).

When the proprietor of the local timber yard died, his elder son called upon an undertaker who had purchased wood for coffins from his father for many years and asked him to carry out the funeral arrangements.

The arrangements were made, the coffin was built and the son went to the undertaker to pay him for his services. The son stated that the only fault he could find with the oak coffin he had ordered was that it was made of chestnut. To this the chagrined undertaker replied that the father had sold him the chestnut as oak.

—C. B. Reedman, Market Harborough, Leics., England

Surface-jointing convex side down—The article, "Stock Preparation" by Mark Duginske (*FWW* #92), thoroughly covered an often-neglected subject. But, in my experience, face jointing a bowed board with its concave side down is self-defeating.

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 those we can't publish. Send your contributions to *Fine Woodworking,* PO Box 5506, Newtown, Conn. 06470-5506.

When jointing or planing a board, the ends will usually bow toward the side being machined. Therefore, by jointing the convex side, the bow will lessen considerably after a couple of passes. This is most evident in longer boards and enables you to get the maximum usable length from a bowed board.

To joint a face convex side down, start with one end on the outfeed table, and feed as normal. The difference in height between the two tables will help keep the board from rocking. If necessary, support the near end with your fingers to hold the gap between board and table about equal at both ends. Make a pass or two, removing wood from the middle of the board. (Since only the midsection is being jointed, the pass will be completed before your hands get too near the cutterhead.) When there's enough flat area to make a complete pass, use a push block to feed the last foot or two over the cutterhead. Remember, while jointing, to note the feed direction that gives the least amount of tear out.

When you move to the planer, feed the opposite end through first, and check for a bow after each pass. If it reoccurs, planing a little more off the convex side should straighten it without having to rejoint.

I have had good results with this method and have saved myself from digging through the woodpile for straight boards.

–Thomas J. Loizeaux, Youngsville, Pa.

An alternative to steam-bending a dowel–In the "Q&A" section of *FWW* #93, Mr. Jim Ward inquired about bending a 1-in.-dia. dowel into a U-shape. I would like to offer a change in tactics that might make the project a little easier.

Although people have been bending walking-cane handles for a long time, it is easy to underestimate the forces at work when steam-bending a piece like this. Mr. Ward's project uses a 6-in. inside radius with a 180° arc. Once bent, the outer surface of the 1-in. thick piece will measure over 3 in. longer than its inner surface. To visualize this, take a 1-in.-thick bundle of thin strips that are 1 in. wide and all the same length. Hold one end of the strips even, and bend the bundle around a 6-in. radius until it forms a U-shape. To make the bend, the inner layer will slide past the outer layer by more than 3 in.

This graphically illustrates how much the fibers on the outer surface of a steam-bent piece of wood must stretch, and how much those on the inner surface must compress.

An easier way to make the bent piece would be to laminate together a bundle of thin strips like the ones I used to illustrate the principle of stretching and compressing. Depending on the thickness of the strips, they may have to be softened by steaming for about 15 minutes before bending, so they won't break. When the strips are pliable, clamp the bundle over a form with a 6-in. radius. After the bundle has cooled, remove it from the form, spread glue on both surfaces of each strip (except the inner and outer surfaces) and once again clamp the bundle to the form. Wait overnight for the glue to set, and then sand the edges smooth and make a router pass on each corner with a ½-in.-radius roundover bit to make the square stock into round stock. With this method, there should be little if any spring back.

–Lon Schleining, Belmont Shore, Cal.

Beware of methylene chloride–As a professional furniture restorer/refinisher, I look forward to receiving *Fine Woodworking* each month as both a source of knowledge and inspiration. Michael Dresdner's article "Removing an Old Finish" in the April, 1992 issue of *FWW* was very informative, but there are a couple of points I'd like to add.

First, when stripping furniture indoors, which is at best a risky activity, it is important to understand that the methylene chloride fumes are heavier than air. These fumes will sink to the floor and accumulate there. Ventilation should be provided by an explosion-proof fan mounted or vented low to the floor. Second, readers should know that wearing a standard organic mist/lacquer type respirator will not provide protection against methylene chloride fumes.

Some time ago I read that methylene chloride is a suspected carcinogen. Soon thereafter I started bringing my projects to a professional stripper who is equipped to hand strip each piece in a relatively safe environment.

We need to use common sense in handling some aspects of working wood. Some precautions are obvious, like using the safety guards on tools, but others, like those needed when working with solvents, finishes and adhesives, require more education and knowledge. *–Robert S. Judd, Canton, Mass.*

Chlorine bleaching compounds can cause rust–I'm writing in response to Michael Dresdner's article, "Removing an Old Finish" in *FWW* #93. Near the end of the article, Dresdner recommends using either chlorine laundry detergent or swimming-pool chlorine to wash pieces after stripping. I wish to warn your readers that this activity should *not* be performed in the workshop because chlorine is very corrosive to iron and steel. Chlorine that evaporates into the air will attack any unprotected iron or steel surface if the concentration of chlorine ions is high enough.

Last summer I thoughtlessly stored an open container of swimming-pool chlorine in my semi-damp basement workshop. My bar clamps, hand screws and the guide rails on my record vise all rusted overnight. Fortunately, all of my hand tools were put away in cabinets, and my tabelsaw and jointer were covered.

–Carl Dorsch, Pittsburgh, Pa.

Troubled by "Troubled by current trends"–After reading Jeremy Singley's letter, "Troubled by current trends" in the April 1992 issue of *Fine Woodworking*, I became disturbed by Mr. Singley's observation that "woodworking isn't art and never will be." Perhaps *his* woodworking isn't art and never will be, but to say all woodworking isn't art is unjust and indicative of a very narrow vision of working wood.

The medium does not determine whether or not a piece is art. Wood is a very viable medium for art. An art piece in wood can exhibit all the finer points of furnituremaking that Mr. Singley holds dear–elegance, warmth, finesse–and it *can* be enjoyed long term just like his rocker. I have several "art pieces" I made years ago and I never tire of admiring their lines or touching the warmth of the various woods I used. The mark of any good work, whether "art" or furniture, is to hold one's interest without wane for a lifetime.

While I, like Mr. Singley, don't particularly care for "purple boxes with spikes and orange beads," I do respect someone's desire to make such expressions and will defend his right to do so. Certainly carbon-copy art is very tiring but so is carbon-copy furniture and craft projects.

The public and woodworkers/artists alike should realize that there is a need for both wood furniture and wood art. Wood is too wonderful a material to be limited to only one use. To say we should all be making the same things is a travesty. Mr. Singley would not be happy producing art–I would not be happy just making furniture. *–Steven M. Krause, Goshen, Ind.*

A key to safety with power tools–I just finished reading the fine article "Wiring a Home Shop" by Grant Beck in the March/April 1992 issue and have a suggestion that may appeal to readers planning a home shop.

For the safety of my grandchildren, I have all my shop's power-tool and workbench outlets wired through a key switch in the shop. This type of switch (available from large electrical suppliers) is turned on and off by inserting a special double-

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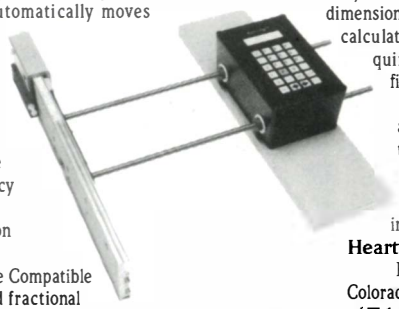

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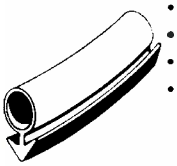

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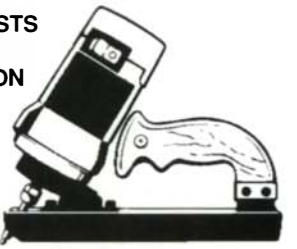

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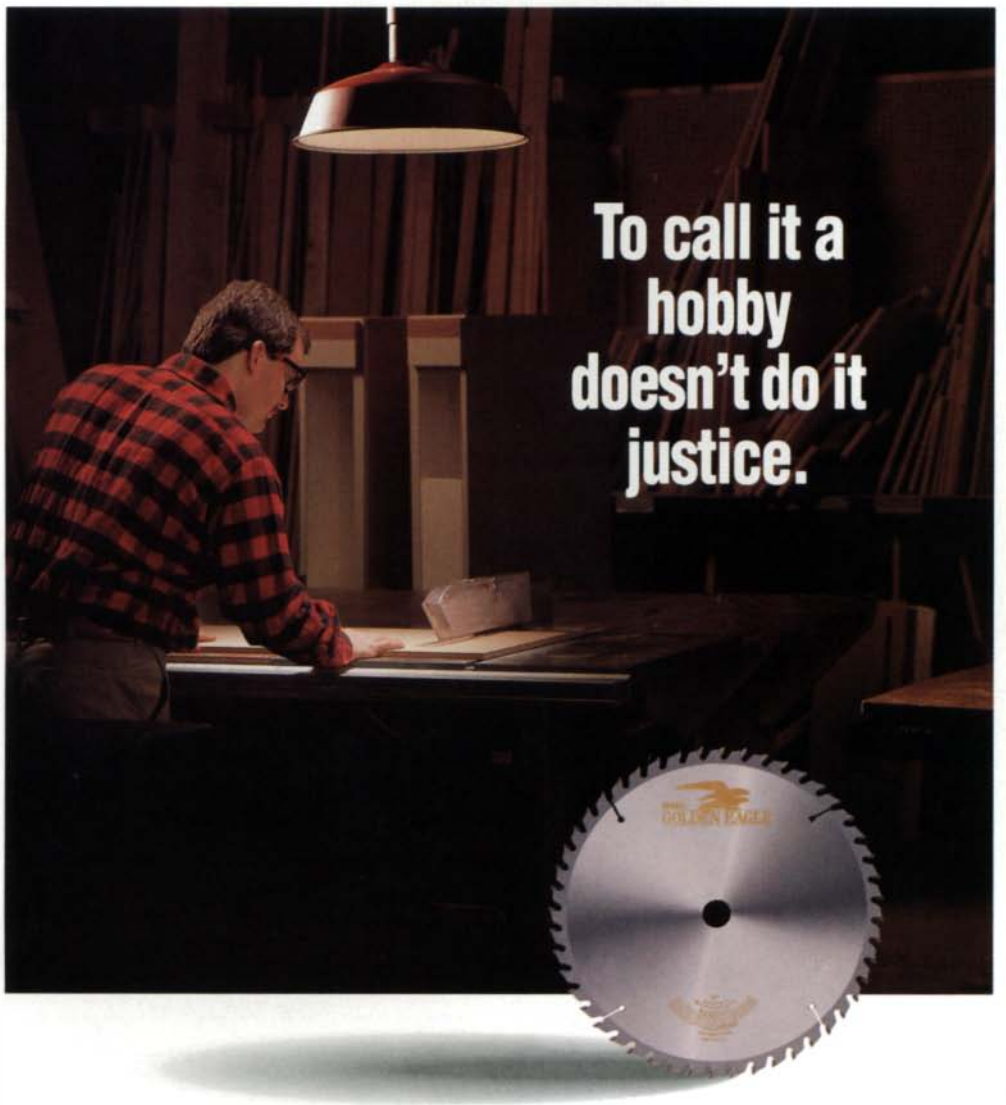

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wishbone shaped key, which I keep hidden from the children. When the switch is turned off, no tools can be turned on by curious young fingers—or stupid old fingers for that matter. The lights are on a separate circuit and, therefore, are unaffected by the key-switch position. As a matter of habit, I also turn the key switch off whenever I leave the house for extended periods so that a crafty housebreaker who might want to construct something from the pieces of low-grade lumber lying around in my shop will not dull my blades or bits.

—G.E. Adams, Green Valley, Ariz.

Refer to Material Safety Data Sheets—The article "Workshop Solvents" (*Fine Woodworking* #92, pp. 80-83) was a fine treatment of the subject; however, I was surprised that the author did not direct readers to the manufacturer's Material Safety Data Sheets (MSDS).

Every manufacturer must prepare a MSDS For each product. It lists the contents of the product, the potential hazards and the precautions to be taken in its use. Contractor's are required by law to maintain a file of these sheets for every product used, so their employees can refer to them. These sheets are readily available from all manufacturers, if not from your local supplier.

—William B. Fink, Jr., Mechanicville, N.Y.

Not a hydrocarbon—In George Mustoe's article "Workshop Solvents" in the January/February 1992 issue of *Fine Woodworking*, carbon tetrachloride is incorrectly identified as a halogenated hydrocarbon. Carbon tetrachloride is not a hydrocarbon because no hydrogen is present.

A glaring error such as this tends to cast doubt on the technical accuracy of an otherwise informative article. Certainly, more information on this important topic is needed by those of us who expose ourselves to these chemicals. Keep trying.

—Charles G. Berendsen, New York, N.Y.

George Mustoe replies: While other common halogenated shop solvents are all hydrocarbons, carbon tetrachloride technically is not a member of this group. Although its molecular structure lacks hydrogen, as Mr. Berendsen points out, the chemical and physical properties closely resemble the halogenated hydrocarbons (perchloretylene, methylene chloride, etc.). For this reason, in non-scientific articles, carbon tetrachloride is often lumped into the same group, a classification scheme that makes sense to woodworkers but offends the sensibilities of organic chemists. Perhaps it would be better to call all of these substances halogenated organic solvents, using a more general level of chemical taxonomy.

—George Mustoe, Bellingham, Wash.

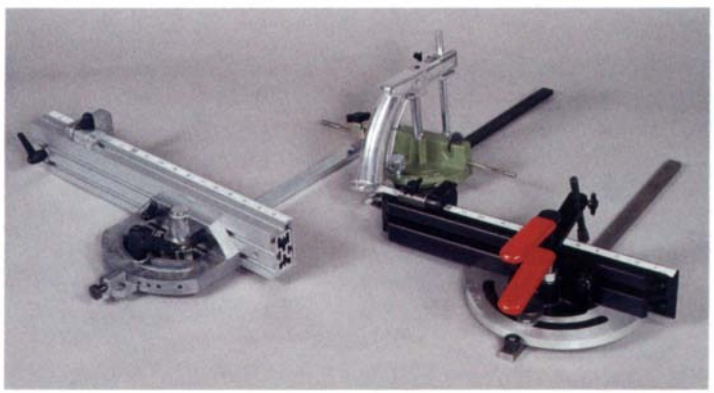
Follow up

Problems with Kuster Manufacturing—We have received several complaints from readers about a former advertiser, Kuster Manufacturing, of Belle Mead, N.J., makers of large wide-belt and drum sanders. Readers report that machines are ordered and paid for but often not delivered. If the machine is delivered, it usually does not run as it should. When buyers attempt to contact the manufacturer, their calls are not returned.

Our advertising sales manager, Dick West, phoned the Somerset County, N.J. consumer complaint division and learned that there is a case pending against the company. He was encouraged to direct all complaints against Kuster Manufacturing to their consumer complaint division (908-231-7000, Ext. 7400).

Flopped photo leads to confusion—Several readers have written in to point out that the lead photo of "Wiring a Home Shop" in *FWW* #93, p. 58 contains incorrect and dangerous information. Because the transparency was flopped, the receptacle appears to be incorrectly wired. The black wires are attached to the gold screws as they should be, but because the photo presents a mirror image of a correctly wired receptacle, the gold screws are on the wrong side. In addition, the wires appear to be wrapped around the screws in the wrong direction. The wire should be wrapped in a clockwise direction so that when the screw is tightened, the wire will be forced more securely beneath the screw's head.

Miter gauges are incorrectly identified



The caption for the photo above, which ran on p.74 of *FWW* #93 in Daniel Westberg's article "After-Market Miter Accessories," was incorrect. The names of the miter gauges on the left and right were swapped. The caption should have read: From left to right, Accu-Miter, Multi-purpose Mitre Gauge and Performance Mitre Gauge. Sincere apologies to the manufacturers and the readers.

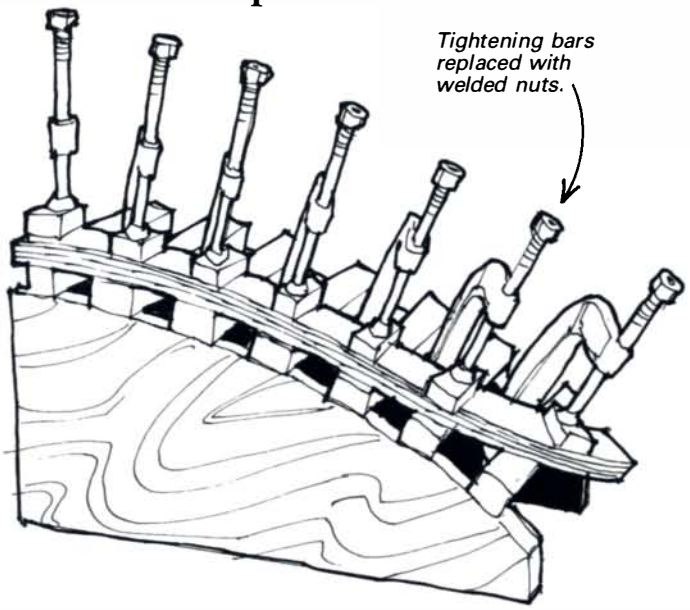
In the chart included in the miter-gauge article, Rib Mountain Tool Works is correctly listed as the manufacturer of the FasT-Trak miter gauge. However, the FasTTrak is available only from Garret Wade, (161 Avenue of the Americas, New York, N.Y. 10013; 800-221-2942), not from the manufacturer.

The Incra Miter Slider, an 18-in.-long aluminum bar with two adjustment screws that expand the bar for a tight fit in the miter-gauge slot, is discussed in Westberg's article on p.77. The author states that when crosscutting a board more than 10 in. wide, one of the adjustment points will be withdrawn from the slot, thereby compromising the squareness of the cut. The manufacturer contacted us to clarify this point. The Miter Slider is designed to be used as a runner on a sliding tablesaw crosscut jig (as shown in the plans included with the bar). When used this way, the bar is mounted at the back of the jig so that on a standard 27-in.-wide saw table, the jig can be made to handle a crosscut of up to 18 in.

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

edited and drawn by Jim Richey

Modified C-clamps

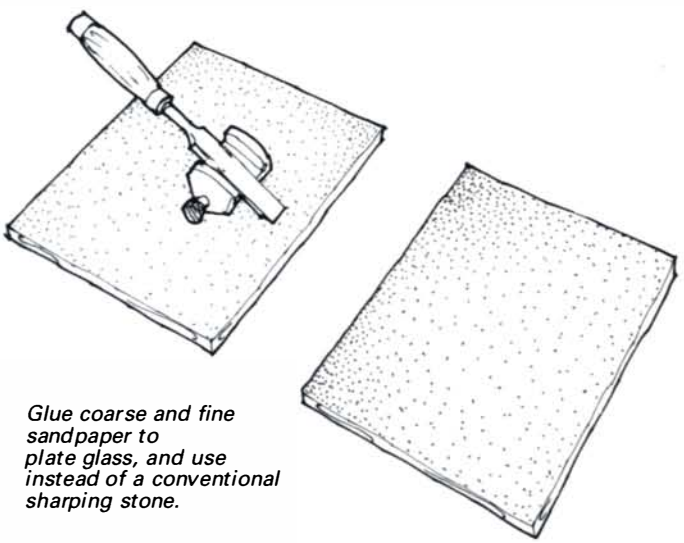


Almost all C-clamps have sliding bars through the end of the screw for tightening. But when you have to use several clamps close together, as you do when gluing laminations to a curved form, for example, these bars get in the way. On a recent project, I finally got annoyed with the interfering handles, so I removed the tightening bars and welded nuts to the ends of the clamp's screws. Now I can easily take up the slack by twisting the screws with my thumb and forefinger and then give each a final tightening with a short-handled socket wrench. As an added bonus, the clamps stack up neatly on a storage post.

–Jack Jerome, Nokomis, Fla.

Quick tip: Apply a thin coat of nail polish to the cutting edge of chisels and plane irons before sharpening. The wear pattern in the color will give you direct feedback about the sharpening angle and honing progress. *–Howard E. Moody, Upper Jay, N.Y.*

Chisel sharpening

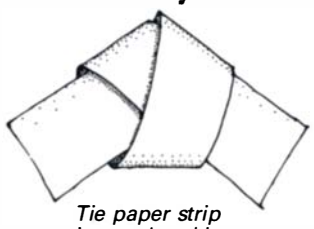


Glue coarse and fine sandpaper to plate glass, and use instead of a conventional sharping stone.

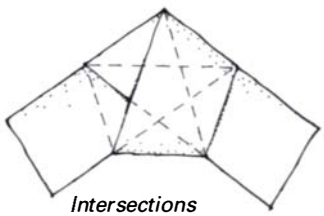
Here's how to produce a really sharp edge on a chisel or plane iron quickly and without the typical problems of holding the tool by hand on a grinder, such as overheating an edge or dealing with unevenly worn sharpening stones. Attach full sheets of 150-grit and 600-grit sandpaper to ¼-in.-thick plate glass with spray adhesive. Place your chisel in a wheeled sharpening guide, and begin with the 150-grit. Spray a little water as a lubricant, and go to work. You will quickly produce a flat bevel, even on the widest chisel. Now go to the 600-grit, again with water. The sharpening guide ensures that you will get exactly the same angle on the subsequent, finer honing, and in no time, you'll have a sharpened edge that almost looks polished. Finer paper up to 2000-grit is available if you want to polish further.

This method also works for truing the bottom of a plane or the flat side of a chisel. *–Thomas R. Schrunk, Minneapolis, Minn.*

Another way to make a five-pointed star



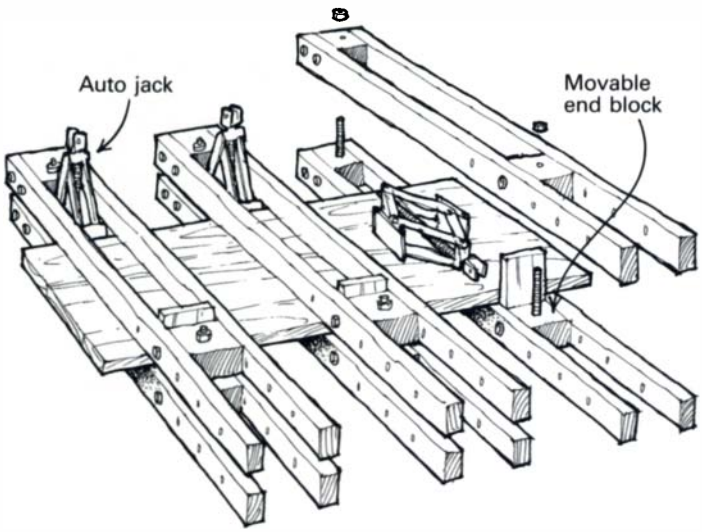
Tie paper strip in overhand knot.



Intersections establish points of star.

I've read about several methods for laying out pentagons or five-pointed stars based on algebra or trigonometry, like the one put forth by Daniel Bass in *FWW* #89. My method for laying out a five-pointed star requires neither calculator, compass, protractor, formulas nor hard-to-remember constructions. Take a strip of paper as wide as the distance between star points, and carefully tie a simple overhand knot. Thin but strong paper works best. Resist the temptation to flatten and crease the paper until you have removed all the slack. When the strip knot is tight and flattened, you have created a perfect pentagon pattern, as shown in the sketch above. You can scale the pattern up or down to whatever size pentagon you need or connect the intersections of your paper knot to draw a star. *–Ralph Koebke, Fremont, Ind.*

Auto-jack bar clamps



Here's a way to make low-tech wooden bar clamps for gluing up panels, tabletops and the like. The inexpensive clamps, which utilize salvaged scissor-style auto jacks for the main component, adjust to any thickness of stock and automatically align the stock being glued. Also, the parts are bolted instead of glued together, so you can easily replace any damaged component.

To build the clamps, select 1-in. or thicker dense hardwood, and make the various parts as shown in the sketch. To use the clamps, first bolt the movable end blocks into the appropriate hole that correlates to the size panel you're gluing up. Then place the work on the lower tier of clamps and apply glue to the edges. Next slide on the upper parts of the clamps and hand-tighten the nuts to align the boards being glued up. Last of all, insert and tighten the car jacks to put edge pressure on the glued lumber. *–Koji Katsuragi, Kumamoto, Japan*

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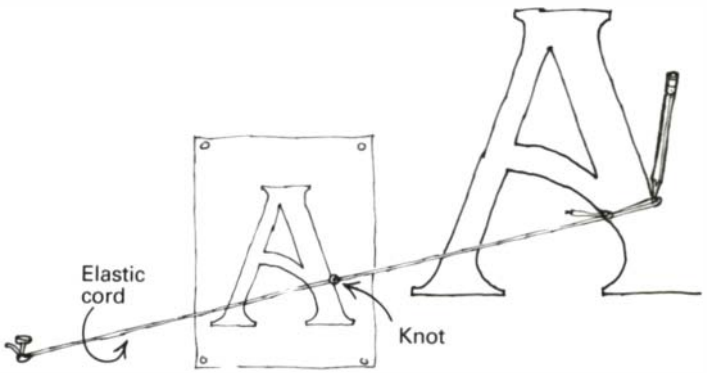
Elastic pantograph



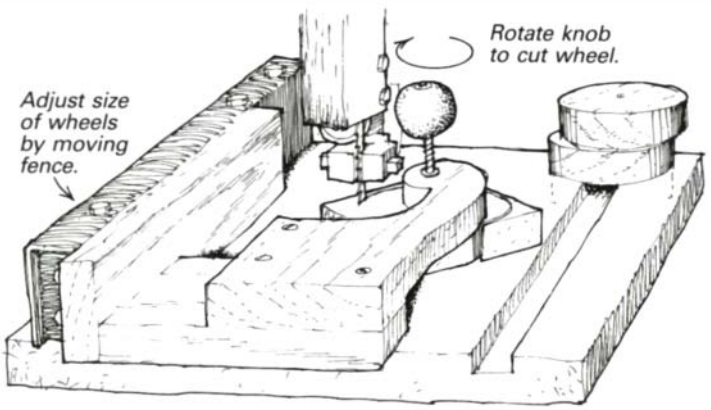
I use this elastic-cord pantograph to transfer designs from paper to wood for carving. You can buy small diameter elastic cord at mountaineering shops, or rob the shock cord from the inside of hollow tent poles. Set up the cord, nail, wood, paper and pencil as shown in the diagram. Keep tension on the cord at all times, and move the pencil so the knot in the cord follows the design on the paper to trace an enlarged version of the design.

The degree of enlargement can be varied by changing the position of the knot. The closer the knot is to the nail, the bigger the proportion of enlargement.

—Bob Cromwell, Royalston, Mass.

Quick tip: To ensure your suddenly acquired stock of free green wood doesn't crack or check before you get it on the lathe, keep it submerged in a tub of water. Wood can be preserved in this manner almost indefinitely. *—Earl R. Rice, Augusta, Ga.*

Cutting toy wheels on the bandsaw



The toy wheel cutting fixture I made for my Craftsman 12-in. bandsaw, attaches to the saw's fence with two screws. The fixture will cut out wheels ranging in diameter from 2 in. to 6 in. from ¾-in. stock. You can cut wheels from thicker stock by adding a spacer. Bandsawn wheels have advantages over those produced by a hole-saw: The diameter selection is infinite, and because there is no hole through the wheel, there's more flexibility in mounting.

To use the fixture, I first precut the wheel blanks about ½-in. larger than the finished wheel. Then I slide the blank into the fixture with the center of one edge pressed lightly against the blade. I insert the pivot-knob screw into the spacer hole and screw the knob into the blank about one or two turns. The spacer hole is lined with a piece of tubing, so it won't become enlarged. Then I turn on the saw and rotate the block into the blade by turning the knob. *—E. T. McCord, Tucson, Ariz.*

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Tablesawn coves

I've seen several articles lately describing how to cut coves by pushing the workpiece across the tablesaw at an angle using temporary guide fences. The trouble is they're all doing it the same way it was done 50 years ago—scratching rough coves 1/16-in. at a time with sawblades that were designed to cut kerfs.

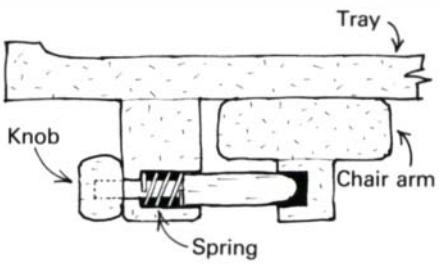
To cut smooth coves to full depth in one pass, simply replace the sawblade with a molding head fitted with radiused cutters. The molding head removes fluffy shavings—evidence that it is cutting, as opposed to whatever a sawblade does when the work is fed into it from the side. A second cut of 1/32-in. will produce a finish comparable to that of a commercially milled molding. Of course, for a very deep cove, you can remove the waste in more than one pass.

Cove-cutting is not for unsupervised beginners. Beyond the generally accepted safe work habits, I recommend a few special measures. First, use a snug-fitting insert, making sure it is flush to the saw's surface. Make sure the angled fence is held securely in place, and the cutters are sharp and clean. Apply wax to both table and guides so that the work will slide easily. Do not use push sticks—push blocks of the type available from Sears are much better for this operation. You can make your own push blocks from the rubber-padded floats used for finishing concrete. Last, feed the stock at a slow, steady rate. You will be delighted with the results. *—Tom Rose, Los Angeles, Cal.*

Quick tip: Storage boxes used to hold 5¼-in. computer diskettes (also available in 3½- and 8-in. sizes) make great organizers for 5-in. sanding discs. Just label the boxes' dividers for different grits, backings and coatings.

—Andrew J. Lenhart, Royal Oak, Mich.

High-chair-latching mechanism



After my son, Corey, was born, I wanted to build a high chair for him, but I didn't like the hardware that was available for attaching the removable tray to the chair.

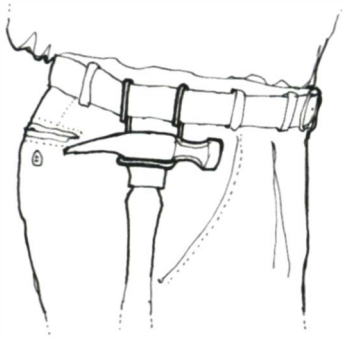
The replacement I designed is basically a modified bullet catch. But instead of installing the bullet pin in a blind hole, I turned the shank of the bullet longer and thinner, extended it out the back through a smaller hole and glued on a small knob. The spring-loaded bullet pin engages a small block, which is permanently attached to the chair under the arm. The block is all that's visible when the tray is removed. This design has lasted through three children without any problems.

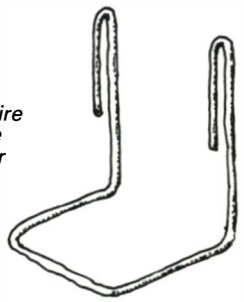
—Ben Troxell, San Jose, Cal.

Quick tip: When sanding small parts that can't be gripped with the fingers take a technique from the lapidary. Put a dollop of hot-melt glue on the back of the part and stick it on the end of a dowel. To remove the dowel, place the assembly in the freezer for a few minutes—the part will pop right off. This technique also works well for polishing small metal parts on a buffing wheel.

—Paul Marshall, Apache Junction, Ariz.

Hammer hanger





Bend wire to make hammer hanger.

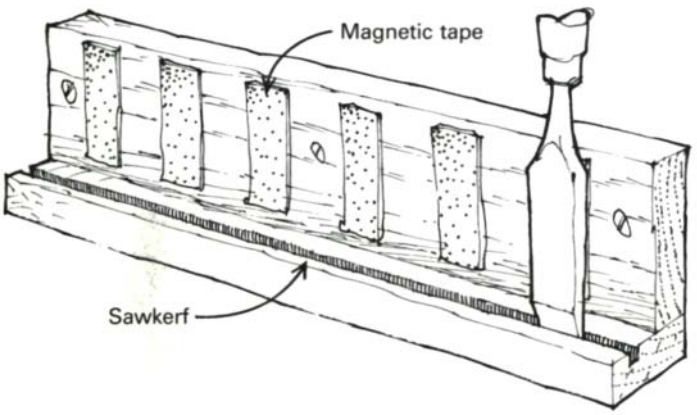
Forty-plus years ago, when I was an apprentice, all tradesmen wore overalls. An old-timer showed me the trick of inserting the hammer's handle into the side opening at the hip below the buttons. Always handy, the hammer's handle hangs along your leg without interfering with movement. Years later, after the overall's era had passed and leather aprons appeared, I found the hammer loops on the aprons were often in the wrong place for me. So I bent up a piece of 3/16-in. wire into a hammer hanger like the one shown above. The hanger slides over your belt to any position you prefer—in my case to the spot where I carried my hammer years ago. Most importantly, you can drop the hammer in the hanger without looking and retrieve it just as easily.

—Jerome Jahnke, Milwaukee, Wisc.

Quick tip: This simple idea has saved me hours of work when trying to trim dowel plugs flush with the surface. Simply tape a double layer of masking tape along the length of each side of the sole of a low-angled block plane. Now take a fine cut with a sharp blade. The plane rides just off the surface of the wood and neatly cuts the plug flush. A quick sanding finishes the job.

—Bob Gleason, Hilo, Hawaii.

Magnetic chisel-storage rack



I have found this simple-to-make storage rack extremely useful for chisels and turning tools. The sawkerf in the ledge both secures the blade of the tool and protects the finely honed cutting edge. Make the back board thick enough so that the handles won't hit the wall and prevent the blades from resting against the magnetic tape.

The self-adhesive magnetic tape is generally available at hardware and novelty stores. The tools can be removed and replaced easily but won't fall off by themselves; mine even stayed in place through a small earthquake.

—Roger Walker, Orleans, Ont. Canada

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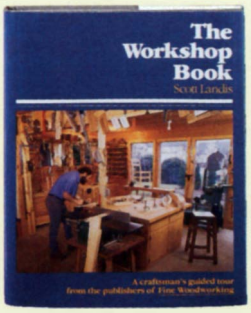

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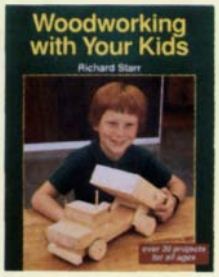

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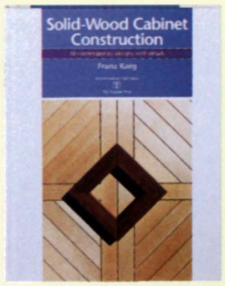

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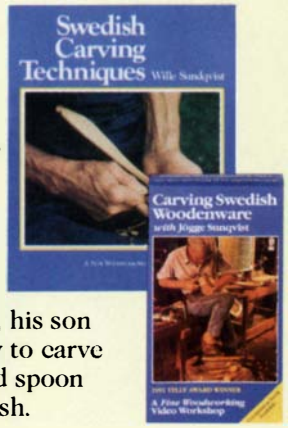

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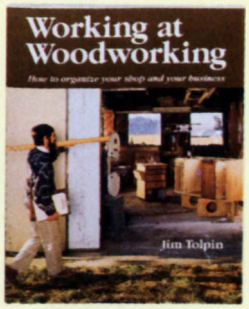

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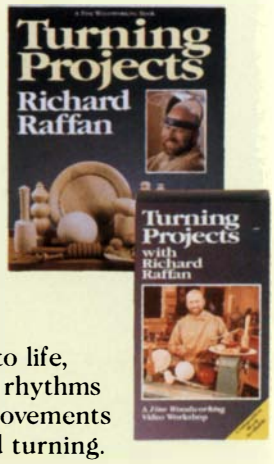

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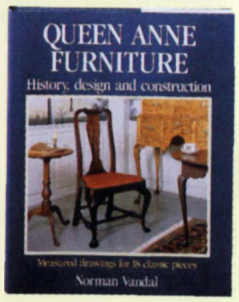

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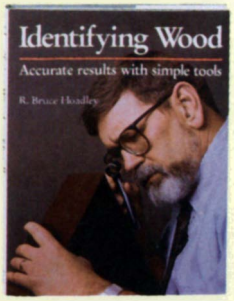

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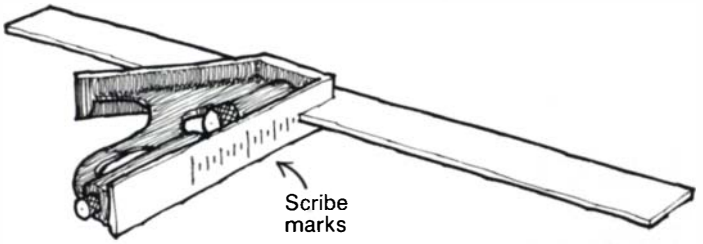
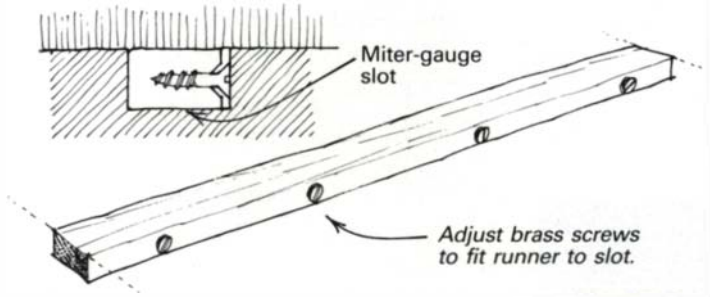


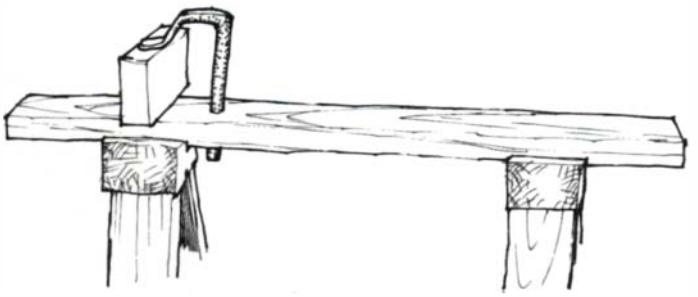
I scribed marks at ⅛-in. increments on the body of my combination square to help in transferring measurements. The marks are especially useful when laying out story sticks for cabinets. I didn't scribe the numbers, and 1/16-in. increments are easy enough to eyeball when needed. *—Tom Rodriguez, Westfield, Mass.*

Improved miter gauge runner



Over the years, I've seen many plans for homemade jigs that utilize a hardwood runner that fits in the miter-gauge slot. But, because wood shrinks and expands depending on the humidity, the runner's fit and, hence, the jig's accuracy will vary. To correct the problem, cut the runner a bit undersize so that it is loose in the slot. Then install four ½-in.-long brass screws in countersunk holes along one edge of the runner. You can adjust the screws to get a perfect fit, regardless of the humidity. The brass screws won't wear the sides of the slot and are easily replaced if they wear out. *—Larry Loo, M.D., Clovis, Cal.*

Sawhorse holdfast



Holdfast clamps are simple, inexpensive, quick to apply and just as quick to release. I keep one in my toolbox for use with my sawhorse in which I've drilled a few strategically placed holes. The clamp is especially valuable when I have to use both hands in a cutting operation and can't let the workpiece slip around. *—Don Rosati, Easton, Conn.*

Methods of Work buys readers' tips, jigs and tricks. Send details, sketches (we'll redraw them) and photos to Methods, Fine Woodworking, *PO Box 5506, Newtown, Conn. 06470-5506. We'll return only those contributions that include an SASE.*

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	CV213	1/2	5/8	1/4	13.00
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Stanley #29 handplane

I would appreciate any information you can give me about the Stanley #29 plane I own. When was it manufactured? Is it a collector's item, and what does the 29 stand for?

—George Erickson, Two Harbors, Minn.

Richard Starr replies: Your Stanley #29 is a metal-and-wood bench plane that's 20 in. long with a 2⅜-in.-wide cutter. It is called a *transitional plane* by collectors because it has the mechanism of an all-metal bench plane grafted to a hardwood sole, typically made of beech. Stanley offered these planes in a variety of sizes and shapes, apparently to satisfy workers who were not willing to give up the advantages of a wooden sole (i.e. lighter weight and less friction sliding over the stock). They were slightly cheaper than all-metal planes.

Handplane designs changed in the second half of the 19th century because lots of clever people sought efficient ways to replace the cutter and wedge of the traditional wooden plane. Eventually, one design rose to the top of the heap and has survived as the familiar metal bench plane. This plane, developed by Leonard Bailey and others at the Stanley Company, was copied by many other manufacturers even back then. These are the features that made the new concept so successful: a thin blade that's cheap to replace and easy to sharpen; a cap iron for stiffening the blade and to act as a chip breaker; a cam-actuated lever cap to apply rigid pressure to the cap iron yet release quickly for disassembly; a screw adjustment for setting the thickness of cut and a lateral-adjustment lever for squaring the blade to the sole.

Although your #29 was probably manufactured between 1870 and 1918, Alvin Sellens in his book *The Stanley Plane* (available from Early American Industries Association Book Sales, John A. Watson, PO Box 2128, Empire State Plaza Station, Albany, N.Y. 12220-0128.) suggests several ways to date your plane more accurately. If the name *Bailey* appears forward of the front knob, the tool was probably made after 1909. The frogs on planes made earlier were secured to the stock by wood screws, but after 1912, these were replaced by machine screws, which threaded into metal bushings inserted in the wood (In my experience, I've had the earlier-style frogs loosen repeatedly, so I consider the metal bushings a big improvement).

What does the number *29* stand for? More than a century ago, the Stanley Company evolved a numbering system arcane enough to mystify a cryptographer. The top-of-the-line series of transitional planes, like yours, were numbered from 21 to 37. As far as I can tell, *#29* means that your plane is slightly larger than #28 and a bit smaller than #30. However, a Stanley #34 is 30 in. long, but a #35 is only 9 in. long. Go figure. Perusing Sellens' book on Stanley planes will yield lots of additional, interesting history, but will produce no more information about Stanley's numbering system.

[Richard Starr is a teacher and the author of *Woodworking with Your Kids*, published by The Taunton Press]

Getting the make on mahoe

When I was in Jamaica some years ago, I saw a striking local wood called mahoe. I managed to get some shipped to this country and made a stack-laminated table from it. The mahoe turned out to have good working qualities, except it seemed a little too unstable for stack construction. I have never seen this wood in commerce in this country. What can you tell me about it? —William V. Dorwart, Jr., Bala Cynwyd, Pa.

Jon Arno replies: Mahoe is a member of the mallow family, Malvaceae, as are cotton and okra. In fact, mahoe belongs to the same genus as okra, *Hibiscus esculentus*. The two species logged for mahoe lumber are *H. tiliaceus* and *H. elatus,* found on some of the larger islands of the Caribbean and in extreme southern Florida. This diffuse-porous wood has a very fine texture and is similar in appearance to yellow poplar *(Liriodendron tulipifera)*. Mahoe's sapwood is stark white while the heartwood is often tinted with dark, olive-green or black highlights. The wood tends to have a higher surface luster than yellow poplar and the highlights in the heartwood occasionally vary from their normal green to a strikingly vivid, grayish blue. Unlike yellow poplar, mahoe has considerable resistance to attack by fungi and is suitable for exterior use. Also, with an average specific gravity of 0.62 (ovendry weight/green volume), mahoe tends to be a heavier and harder wood than yellow poplar.

Mahoe, especially the mountain variety *H. elatus,* which may attain a height of 70 feet and produce logs of up to 18 in. dia., is a much prized cabinetwood in Cuba. But owing to our government's poor relationship with the current Cuban government, very little of this wood finds its way to the American market. As you've been fortunate to discover, the mountain species also grows in Jamaica, however supplies there are limited. And what little mahoe is to be found growing in Florida is stunted and too shrubby to produce much more than an occasional bowl blank (Florida represents the northern extreme of mahoe's range).

Despite the negative experience you seem to have had with the wood's shrinkage, mahoe is not known for its lack of stability. I suspect the wood you had shipped from Jamaica, being air dried in the humid climate, simply arrived with too much remaining moisture to allow it to be safely put to immediate use. When importing tropical lumber of any kind, it's wise to sticker the boards for a few months and let the wood acclimate to our generally drier climate.

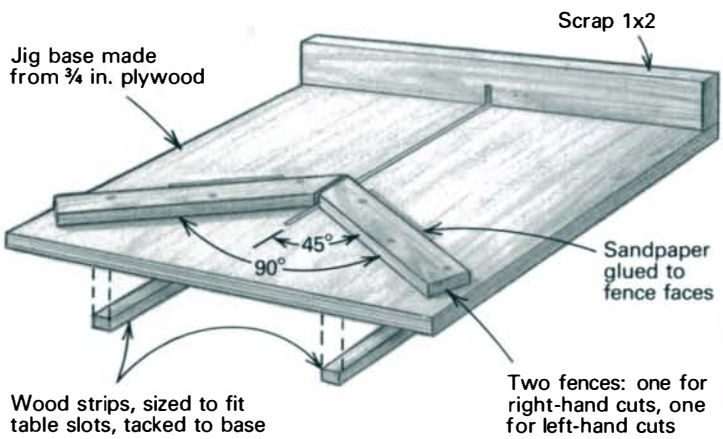
[Jon Arno is a wood technologist and consultant in Schaumburg, Ill.]

Perfect tablesaw miters

I am gearing up for a project that requires numerous precise 45° miter joints. I can use all the help I can get in creating a jig for these cuts, to get my project off to a good start.

—Fletcher K. Wood, Kanab, Utah

Sandor Nagyszalanczy replies: The best method I've seen for cutting dead-on 45° miters uses a simple plywood jig on the tablesaw. The device, as shown in the drawing below, has two fences, one for left-hand miters, and one for right-hand miters. These fences are precisely oriented and fixed to a plywood base with runners that fit a tablesaw's miter slots. The workpiece is held against one of the fences and the jig pushed forward to make the cut.



To make the jig, start with a piece of ⅝-in.- or ¾-in.-thick plywood (particleboard is okay, but it's much heavier and not as strong) about the same size and shape as your saw table. If you are planning to cut some really wide or long pieces, you might want to make the base even larger. Now make two strips, sized to fit your miter slots exactly, and glue and tack them to the bottom of the base. Glue and screw a scrap 1x2 to the top back edge of the base. With the blade set to cut all the way through the plywood, slide the jig into the blade so that it cuts about halfway into the base.

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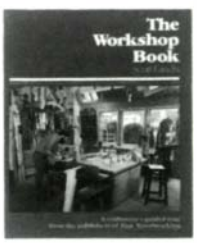

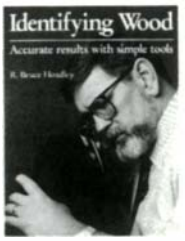

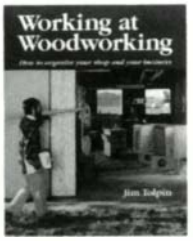

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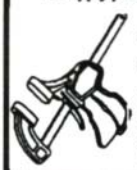

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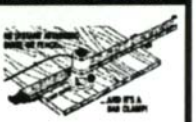

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To make the fences, cut two strips, each about 2½ in. wide, with 45° miters on the ends. Glue narrow strips of 120-grit sandpaper to the edges of the strips that end in the miter points. (The sandpaper will help keep the workpiece from slipping along the fence later). Now butt the ends of the miter together, and use an accurate framing square to keep the strips square to one another. Place the miter over the sawkerf in the jig base and carefully orient the fence assembly to a 45° angle to the line of cut (see the drawing). Glue and screw the fences down; then slide the jig into the running sawblade just far enough to cut through the end of the fence miter.

To use the jig, first cut your frame parts to approximate length, and hold the parts firmly against one fence or the other while pushing the jig through the miter cut. By making sure all pairs of frame members are exactly the same length and by making right and left hand cuts using the two fences, you can be assured of always getting a perfectly square frame.

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

Moving your power tools to Europe

I am planning to return to Norway and wish to take my power tools with me. Will I be able to run my tools that are designed to run on regular U.S. household current? If not, can I buy a converter that'll allow me to use them in Europe?

—Bard Schive, Houston, Tex.

Ed Cowern replies: If you want to use tools made to run on standard 110 volt (v), 60-cycle U.S. household power in a country that uses 220v, 50-cycle current (the standard power in Europe), you must first consider the type of motor in the tool or machine. Most portable power tools, such as drills, routers and belt sanders, are driven by universal motors. As their name implies, universal motors will run at their designated voltage regardless of the number of cycles in the AC current (most will also run on DC current). The only catch to using your portable power tools in Europe is that you'll still have to buy a transformer that steps down the 220v power to 110v. Such transformers are generally available in ready-made power converters, but these are usually designed to handle only very low power requirements, such as a traveler's hairdryer or electric shaver. To handle your power tools, you'll probably have to buy a transformer from an electrical supply house. You'll need to buy one that is nameplated for 50/60 cycles and will handle the power requirements of the tool. Different sized transformers are distinguished by their volt-ampere rating or kilovolt-ampere rating. To determine the size of transformer you'll need, multiply the number of amps your most powerful tool uses (check its nameplate) by the tool's voltage. The result is the volt-ampere requirement of the tool (to get the kilovolt-ampere rating, divide this number by 1000). Buying a transformer slightly larger than this will allow you to run any of your portable power tools.

Usually transformers do not come with power cords or outlets, so it will be necessary for you to have a competent electrical technician wire the input and output of the transformer for your use. An on/off switch or circuit breaker and a pilot light on the input side of the transformer would be desirable so that it could be turned off when not in use. The pilot light reminds you that the transformer is turned on.

Stationary machines such as tablesaws, jointers and drill presses are typically run by induction motors, though some smaller "homeshop" models employ universal motors. If your motors are nameplated for 50/60 cycles (many are) and will run on either 110v or 220v, all you have to do is rewire the motor for the higher voltage. Then the motor will run directly on 220v, 50-cycle power.

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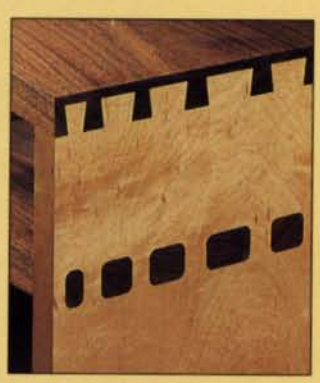

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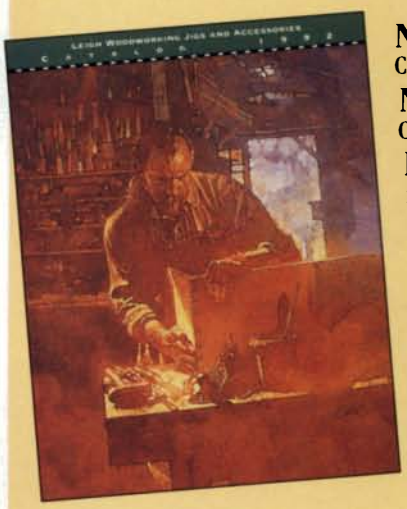

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If your motors are nameplated for 60 cycles only, the complications of converting them to run on 50 cycles are difficult enough to warrant buying new 50 cycle motors when you get to Europe. Converters that change 50 cycles to 60 cycles are expensive and not readily available for handling single-phase power.
[Ed Cowern is an electrical engineer and president of EMS, a company that distributes Baldor electric motors.]

Problems with slow-drying tung oil

I recently rented Frank Klausz's video on wood finishing, and was particularly interested in his use of tung oil. But when I purchased a can of Pure Tung Oil from Liberon and tried to follow his method, the finish was extremely slow to dry. What am I doing wrong? *—Antony Porter, Lorpoint, Cornwall, England*

Chris Minick replies: Oil finishes are popular with woodworkers because they are easy to apply, give consistent, predictable results and are easy to repair. They do have two major drawbacks though: long drying times and marginal protection qualities.

As you have already found, thick coats of oil are very slow to dry. There are two reasons for the slow drying. First, all vegetable oils, such as tung oil, contain naturally occurring antioxidants which prevent the oil from hardening while still in the plant. These antioxidants must evaporate from the oil before any drying can take place. Hence, applying a too-thick coat of oil will retard the release of the antioxidants, resulting in a long drying time.

Second, oils dry by a process called oxidative polymerization. Oxygen is absorbed from the air and causes the oil molecules to crosslink, forming the finish film. As you would expect, the surface of a heavy coat of oil dries first, skins over and forms an effective oxygen barrier. Oxygen must now diffuse through the cured surface film to polymerize the oil that's uncured below, which is a very slow process. Metallic driers can be added to most drying oils to speed up the drying process. This fix doesn't work with all oils though, tung oil being the most famous exception. Tung oil polymerizes by a unique mechanism different from other common oils and will not respond to metallic drier treatment.

Two things can be done to overcome the drying problems. If you prefer to use conventional oil finishes, such as raw tung or linseed, apply *very* thin coats and wait at least 24 hours. between coats. The better solution though, is to use a modified drying oil, like polymerized tung oil or one of the Danish-oil products. Regardless of brand, traditional Danish-oil finishes are mixtures of alkyd resins, drying oils, and solvents. These products look, act and apply like conventional oils but eliminate the lengthy drying time. This added benefit provided by the alkyd modification provides a harder, more durable finish that still retains the easy repairability feature of conventional oils.

As with conventional oils, the key to success when using any any drying oil as a finish is to apply multiple *thin* coats. Eight-to-ten coats may be necessary to provide sufficient protection for heavily used furniture, such as dining room tables. A sufficiently thin coat can be applied by using a wipe-on/wipe-off technique. Saturate a cloth with oil and wipe a liberal coat on your project. Apply enough oil to visually wet the surface. Then allow the oil to soak into the wood for 20 to 30 minutes and wipe off the excess. Let the remaining thin oil film dry for at least 24 hours, and repeat the process until you are satisfied with the appearance.
[Chris Minick is a product development chemist and amateur woodworker in Stillwater, Minn.]

Send queries, comments and sources of supply to Q & A, Fine Woodworking, *PO Box 5506, Newtown, Conn. 06470-5506.*


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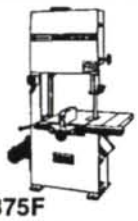
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503	3"x24" HD Belt Sander w/ Bag	550	345
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9345	6" Saw Boss w/Case	220	124
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0375-1	3/8" Close Quarter Drill	219	129
0379-1	1/2" Close Quarter Drill	249	147
0395-1	3/8" 9.6v Cordless Drill Kit	279	166
1676-1	HD Hole Hawg w/ case	449	244
3107-1	1/2" V/S Right Angle Drill w/case	360	195
5192	2" HD Die Grinder	289	171
5371-1	1/2" V/S Hammer Drill Kit	335	188
5397-1	3/8" V/S Hammer Drill Kit	239	139
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5680	2 Hp Router 12 amp	355	205
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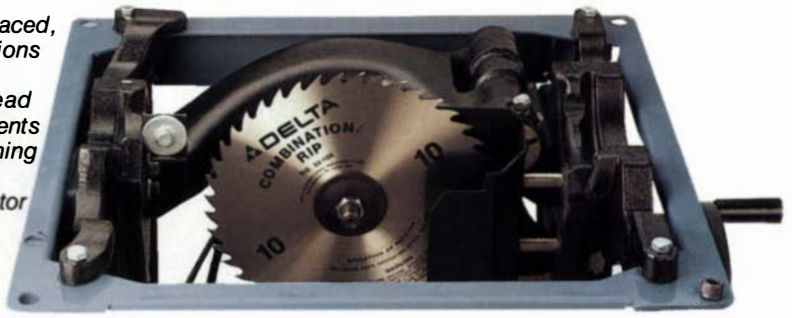

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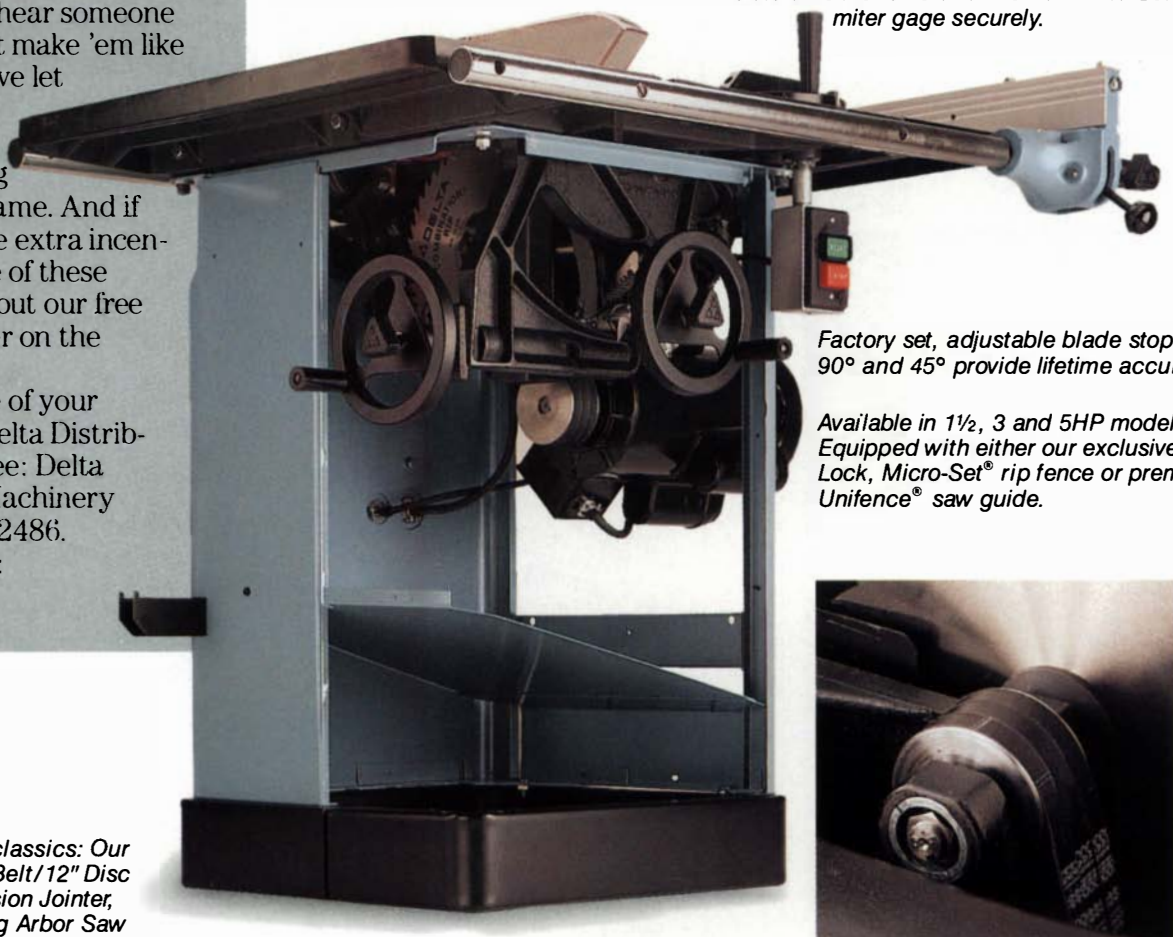

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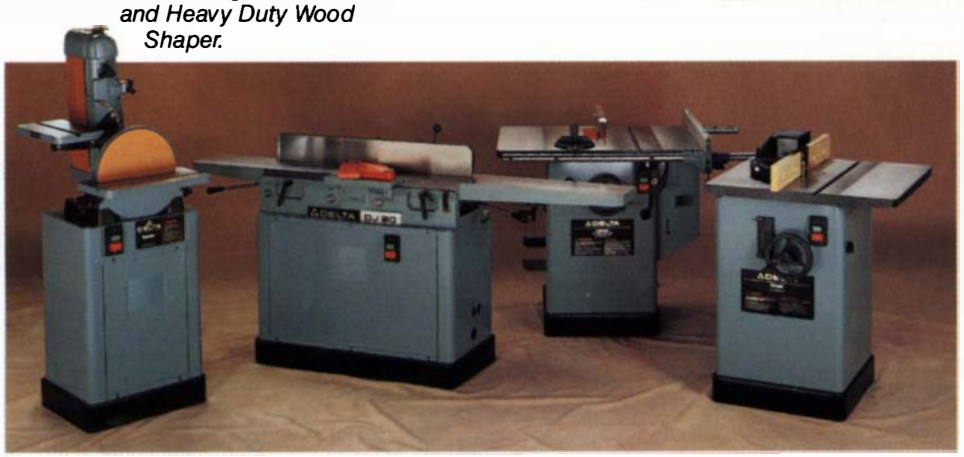

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A Chest for All Seasons

Wood movement is part of the plan for solid construction

by Christian Becksvoort

Wood movement is too powerful a force to ignore in furniture construction. It can break apart joints, wedge drawers closed and split carcase sides. Wood movement cannot be avoided; as humidity levels rise, wood expands, and, as humidity drops, wood shrinks. Although movement occurs in all three dimensions, it is relatively insignificant along the length of a board, about one-tenth of a percent or 3/32 in. for an 8-ft.-long board. And because the thickness is usually such a nominal amount, movement in this direction can generally be ignored. A flatsawn board, however, can move significantly across its width. One of my favorite woods, black cherry, is slightly more stable than most woods, but even it will cause a carcase to self-destruct if natural wood movement is ignored. For example, a 50-percent change in relative humidity, not uncommon with seasonal changes in many parts of the country, will cause the 19-in.-deep chest, shown in the photo at right, to change by 1/2 in.—expanding front to back during periods of dampness and shrinking back during dry weather. Any cross-grain constraints that interfere with this movement will cause cracked sides or popped joints.

Because I wanted to build pieces of lasting quality, I re-evaluated the entire process of case assembly, with special emphasis on avoiding cross-grain restrictions to the seasonal movement of the case parts. I examined antiques, reread books and talked to craftsmen who were restoring old pieces and creating new ones. My research showed the most frequent problem areas in chests of drawers are applied moldings, web frames for drawers, solid-wood backs, drawer construction and fitting drawers to their openings.

I try to design my cases and drawers for the most extreme conditions they are likely to encounter because I never know where one of my pieces might end up. I've shipped furniture throughout the Eastern seaboard and as far west as California. In fact, the chest of drawers in the photo at right was built in the middle of a Maine winter and shipped to Germany in the hold of a ship in August's heat and humidity. Since I began applying the construction techniques shown in the drawing at right, many of which have been around for centuries, I haven't had any problems with inadequate allowance for wood movement.

Photo: Christian Becksvoort

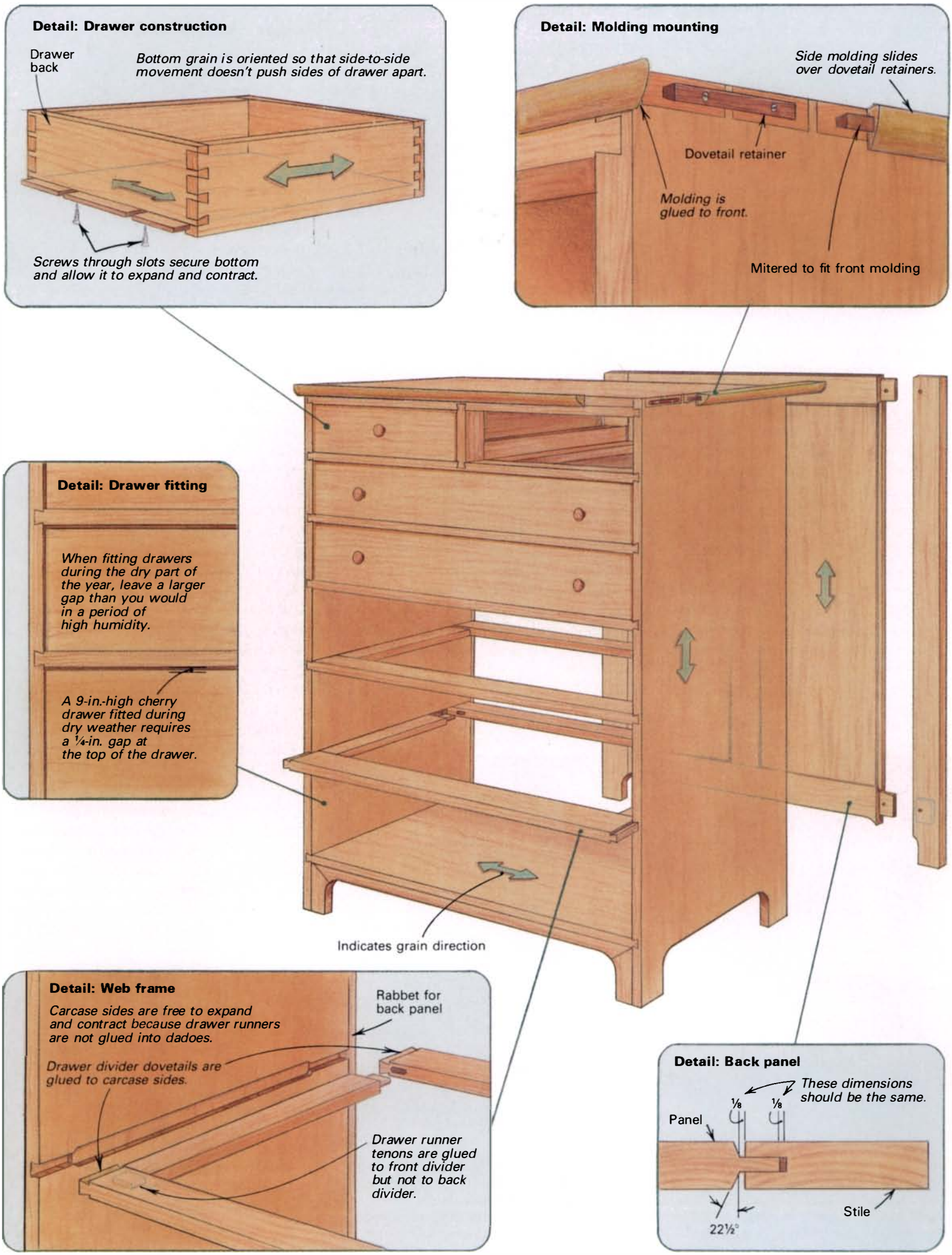
***The unadorned appearance of this seven-drawer chest** hides many techniques that accommodate the natural movement of wood and ensure the piece's longevity.*

Building the web-frame drawer supports

A major difficulty when making a chest of drawers with solid sides is installing the drawer runners so they'll provide adequate support for the weight of a fully loaded drawer and yet still allow the carcase sides to expand and contract front to back. My web-frame system, as shown in the drawing detail, consists of a front and back drawer divider glued into the carcase sides and drawer runners that also act as kickers to keep the drawer below from tipping when it's pulled out. The key to this system is that the tenons on the ends of the runners are glued only to the front dividers and not to the back dividers. Also, the runners are not glued into the dadoes in the case sides that locate and support them. And because I allow space between the runners' tenon shoulders and the back dividers, the case sides are free to expand and contract.

To lay out the dadoes in the case sides that house the drawer runners, I butt the front edges of the sides together and clamp them. This method ensures perfect alignment of the web frames. Then I unclamp the sides and use the jig shown in the photo on p. 40 and a pair of routers with identical-size bases to cut the stopped dovetail slots at the front and back edges of the sides for the drawer dividers and the dado for the runner all with one setup. I first rout the 2 1/4-in.-long dovetail slots for the drawer dividers with a 3/4-in.-dia. dovetail bit. Then I remove the stop from the center of the jig and switch to the second router, which is fitted with a 3/4-in.-dia. straight mortising bit, to cut the 3/16-in.-deep dado that connects the slots.

This technique can be used with only one router, but it's more difficult and time-consuming because either the router or the jig



Photos except where noted: Charley Robinson; drawing: Gary Yarrish

must be reset for each cut. Before I had two routers, I'd dado the grooves with the jig and router and then handcut the dovetails.

A word of warning here: I found that the baseplates on both of my Bosch routers were 1/32 in. off center. Thus, if I had the routers turned the wrong way in the jig, the cuts were 1/16 in. off. I corrected the problem by enlarging the countersunk screw holes in the routers' baseplates and shifting them slightly to center them.

When routing the dovetails for the top web frame, you'll have to provide support for the side of the jig that hangs off of the case side, and take care to preserve the fragile piece left when the routed dovetail undercuts the handcut carcase dovetails. Because the top frame serves only as a kicker, I eliminate the dadoes for the runners.

Making and installing the web frames

After routing the sides for the dividers and runners, I assemble the carcase and begin making and installing the components of the web frames. First, I cut all the drawer dividers to length and then dovetail their ends on the router table using a tall auxiliary fence and fingerboard for support. Next, I dry fit a front and a back divider to determine the exact length of the runners. I measure the distance between the dividers, add the length of the tenons and then subtract the desired clearance between the runner's tenon shoulder and the back dividers. This clearance depends on the moisture content of the case. During the dry period of the year, I leave about 1/8 in., but when the humidity is high, I allow as much as 1/2 in. to avoid problems when the case sides contract. All the clearance in the world won't help a bit though, if you forget to allow the same clearance between the end of the tenon and the bottom of the mortise in the divider.

After cutting stock to length, I mark and cut the tenons on the runners and the mortises in the dividers. If you use two small top drawers, as I did on the chest shown on p. 38, you'll need to add a wide runner at the center of the two top frames and fit a vertical drawer divider between them.

I assemble the web frames by first gluing all the front drawer dividers into place flush with the face of the carcase. (The top dividers are glued and clamped to the top of the case.) Then I turn the case over and glue a wide runner (kicker) into the center mortise and two regular-width runners into the mortises at the ends of the top divider. When installing all the other web frames, the runners must be inserted into the dadoes in the carcase sides as well. Next, I glue the back dividers into position flush with the rabbet for the back, as shown in the photo on the facing page. Remember that in the back, only the dovetailed dividers are glued to the case sides; the runners' tenons are *not* glued into the mortises. And make sure you have the appropriate gap between the shoulder of the runners and the back dividers.

Making and installing a frame-and-panel back

The back of my chest is almost 31 in. wide. A glued-up, flatsawn panel of that width might expand and contract as much as 3/4 in. with normal swings in humidity. But by using frame-and-panel construction, as shown in the drawing on p. 39, the only parts of the back that will move and affect its width are the 3-in.-wide vertical side stiles. And, by selecting quartersawn wood for the stiles and rails, I reduce the normal movement of that 6 in. of wood by almost 50 percent so that the 31-in.-wide back will move only a total of about 1/16 in. Because the movement of the back is insignificant, the frame-and-panel assembly can be glued and nailed solidly into its rabbets in the case sides and top and along the back edge of the solid bottom piece. The glued-in back not only squares up the carcase, but also greatly increases its strength.

When building a frame-and-panel assembly, you must allow for wood movement of the solid panels within the grooves in the frame. Because the grain of the panels runs vertically, I rip them undersized to allow at least 1/4 in. overall side-to-side movement. Because of the minimal longitudinal movement of wood, I allow only 1/16 in. for top-to-bottom clearance to keep the panels from being loose in the groove. While the clearance between the tongue and the bottom of the groove is important, it is equally important to leave the same gap between the edge of the frame and the shoulder of the tongue, as shown in the drawing detail on p. 39.

When making the tongues on my panels, I use a bearing-guided rabbeting bit that I had custom ground to a 22 1/2° bevel to create the slightly sloping shoulder. The appearance of this panel is in keeping with the traditional Shaker-style furniture that is my speciality, yet it increases the visual gap between the rail and the panel. It would be very easy to see any variation from one side to the other if the gap were only 1/8 in. wide. But with the wider gap afforded by the beveled panel shoulder, slight variances are not noticed.

***Becksvoort routs the dovetail slots** for the drawer dividers with a jig that traps the router base. After routing both dovetail slots, he removes the jig's center stop, changes to a router with a straight bit and cuts the dado between the slots for the drawer runners.*

Attaching moldings

Although moldings on Shaker-style furniture are minimal, they have the same potential for disaster as any other cross-grain construction. The sliding dovetail mounts that I use for the top end moldings, as shown in the drawing, allow free cross-grain movement and will also work for the wider cornice-type moldings found on more traditional furniture. This technique is applicable for moldings applied at the top, waist or base of cabinets as well. The dovetail retainers are made and installed in

a long strip and then sections are cut from the strip to leave a row of perfectly aligned individual retainers that won't restrict movement. A dovetail slot in the back of the molding slides over the retainers to hold the moldings in position. This method allows unlimited wood movement, keeps the molding tight against the case year round, looks good from the back and does not require nails.

Because the grain of the front molding is parallel to the grain of the carcase, it can be glued directly to the top front of the case. But to attach the side moldings, I begin by routing the dovetail slot in the molding, and then I make the dovetail retainer to fit the slot. A fingerboard holds the molding securely against the fence of my router table while I rout the slot. I use a ⅜-in.-dia. dovetail router bit exposed ¼ in. above the table and adjust the fence to cut near the center or the heaviest part of the molding. When completed, I cut the molding in half and miter the front ends to fit the mitered molding glued to the face of the chest.

***After installing the front drawer dividers and runners,** the back dividers are slipped onto the runners' back tenons and glued into dovetail slots in the carcase. The runners' front tenons are glued, but not the back, to allow for movement of the carcase sides.*

I make the retainer from a piece of scrapwood 3 in. wide to 5 in. wide and a little longer than the depth of the case. I plane the piece to just over ⅜ in. thick, readjust the router table fence so that the stock is not trapped between the fence and bit, and then run the edge of the retainer stock past the dovetail cutter. I cut both sides of the long edges, adjusting the fence as necessary, until the retainer is a snug fit in the molding slot. Then I rip the dovetail retainers off the scrap stock on the bandsaw and plane them until they are 0.002 in. to 0.005 in. thinner than the depth of the groove in the molding. A dial caliper or micrometer is very helpful for measurements this fine. I use a smooth piece of plywood secured to the planer bed when planing pieces this thin to prevent them from being broken as they pass over the bed rollers.

To align the retainer on the chest, I hold the slotted molding in position on each side and make knife marks at the front and rear of the case to locate the dovetail slot. Guided by a steel rule, I connect these marks, making two parallel scribe lines across the case. Next, I crosscut the dovetail retainers as long as the case is wide and mark off five or six sections, allowing about ½ in. waste between each section to be removed after the retainers are installed. I predrill two holes in each marked-off section for wood screws, apply a dab of glue between each pair of screw holes and temporarily tack the retainer in place between the two scribe lines. After drilling pilot holes into the carcase, I screw the retainer in place and remove the temporary brads. Then I chisel out the ½-in.-long waste chunks to leave perfectly aligned, individual retainers.

I install the moldings, by tapping them on with a mallet from the back of the case until they are within 2 in. of the front molding. Then I apply glue to both miters and to the first retainer on each side before tapping the moldings home. To get a tight miter, I clamp the glued end of the moldings across the carcase. After the glue dries, I trim the back ends of the moldings flush with the back of the cabinet.

Making and fitting drawers

I make my drawers with half-blind dovetails at the front and through-dovetails at the back. The drawer bottoms slide into grooves in the drawer sides and front from the rear, and the bottoms are secured with two screws through slots into the drawer back, as shown in drawing detail on p. 39. I don't glue the bottom into the groove in the drawer front because this can make repairs difficult, but a ½-in.-deep, tight-fitting groove in the drawer front is usually enough to hold the bottom in place. The bottom is solid cherry, with the grain running side to side. If the grain were oriented the other direction, the bottom could expand in humid weather, pushing the drawer sides out and jamming the drawer between the carcase sides. The bottom extends beyond the back of the drawer and, with leather bumpers attached to its back edge, acts as a stop. Since the drawer bottoms and the case sides will all expand front to back and at approximately the same rate, the drawers will stay flush with the front of the carcase.

Fitting drawers is always iffy: A good fit depends on the height of the drawer, current moisture content of the wood, time of year and other unknown conditions. The species of wood also will have an effect. Some woods, such as redwood, cedar and teak, are very stable while others, such as beech, madrone and certain oaks, will require larger gaps.

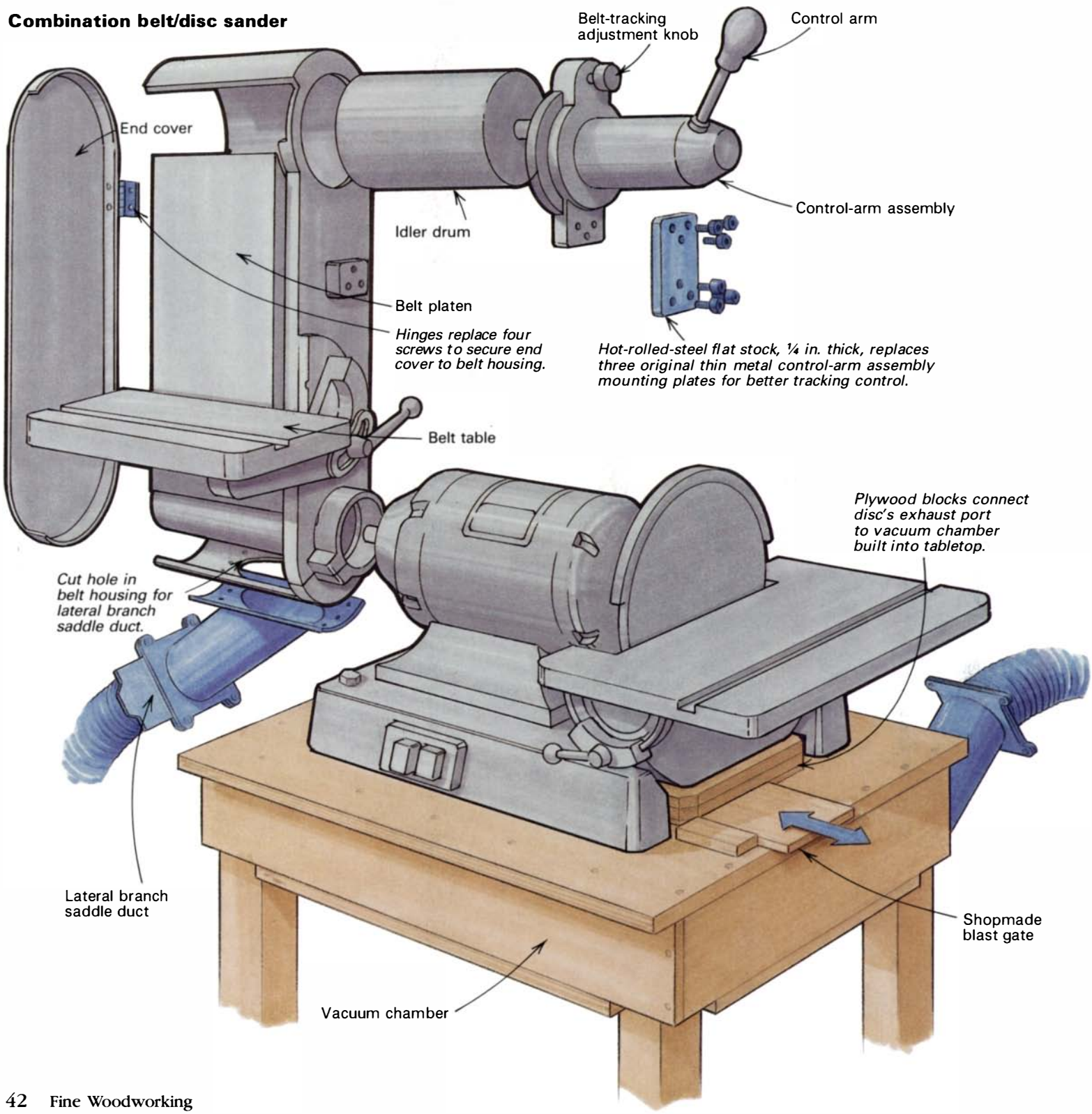
Because a tight-fitting drawer can be a source of considerable irritation, I always err on the safe side: I'd rather have a larger gap than a stuck drawer. For example, the 9-in.-high bottom drawer of this chest (the tallest drawer I'll use) can expand ¼ in., enough to seal it closed for the duration of a humid summer until cold, dry winter weather shrinks it back down. With a drawer of that size and a moisture content of 7 percent, I leave ¼ in. above the drawer. This gap can be decreased if the moisture content is closer to 10 percent or 11 percent and should be increased when working with woods such as maple. If I know the piece will be shipped to a dry location, such as Tucson, Ariz., I leave only a 1/16-in. gap for my largest drawer. Smaller drawers will require correspondingly smaller gaps, as shown in the photo on p. 38, where the top drawer has a gap about one-half that of the bottom drawer. □

Christian Becksvoort is a contributing editor to FWW *and a custom furnituremaker in New Gloucester, Maine.*

Belt/Disc Sander Upgrade

Minor modifications improve belt tracking and dust collection

by William Tandy Young



The combination belt/disc sander is a tool that is probably not on many peoples' list of basic essentials. But the combination sander in our shop has grown to be a necessity that can help move work along in unrivaled fashion. The possibility of owning one of these versatile machines has in recent years been enhanced by the appearance of several modestly priced Taiwanese brands that have the potential for top performance.

The word *potential* is key because, like many inexpensive light-industrial tools, the Taiwanese sander shown in the photo at right, did not arrive at my doorstep perfectly designed and manufactured. However, because the machine had sound, basic components, such as castings, bearings and controls, I was able to get it to perform quite well with a certain amount of remedial upgrading. But be aware that any of these changes may void your warranty. I've taken a generic approach in my discussion of these upgrades because they apply to similar sanders offered by other importers.

Compensating for high speed

The first thing I noticed about the sander after setting it up was that the belt ran too fast for optimal woodworking. Indeed, both belt and disc functions can professionally burn endgrain on short notice. Because the unit is driven directly by an AC-induction motor, the only remedy for the excessive speed is to use sharp (fresh), high-quality abrasives and a light touch with the workpiece (both are good habits to develop anyway). There are advantages to mounting a direct-drive motor between the disc and belt sanders, however. This arrangement allows room for using the belt sander without interference from the disc cowling, as on some belt-driven machines, and the direct drive provides a disc sander that runs remarkably true and needs no further modification.

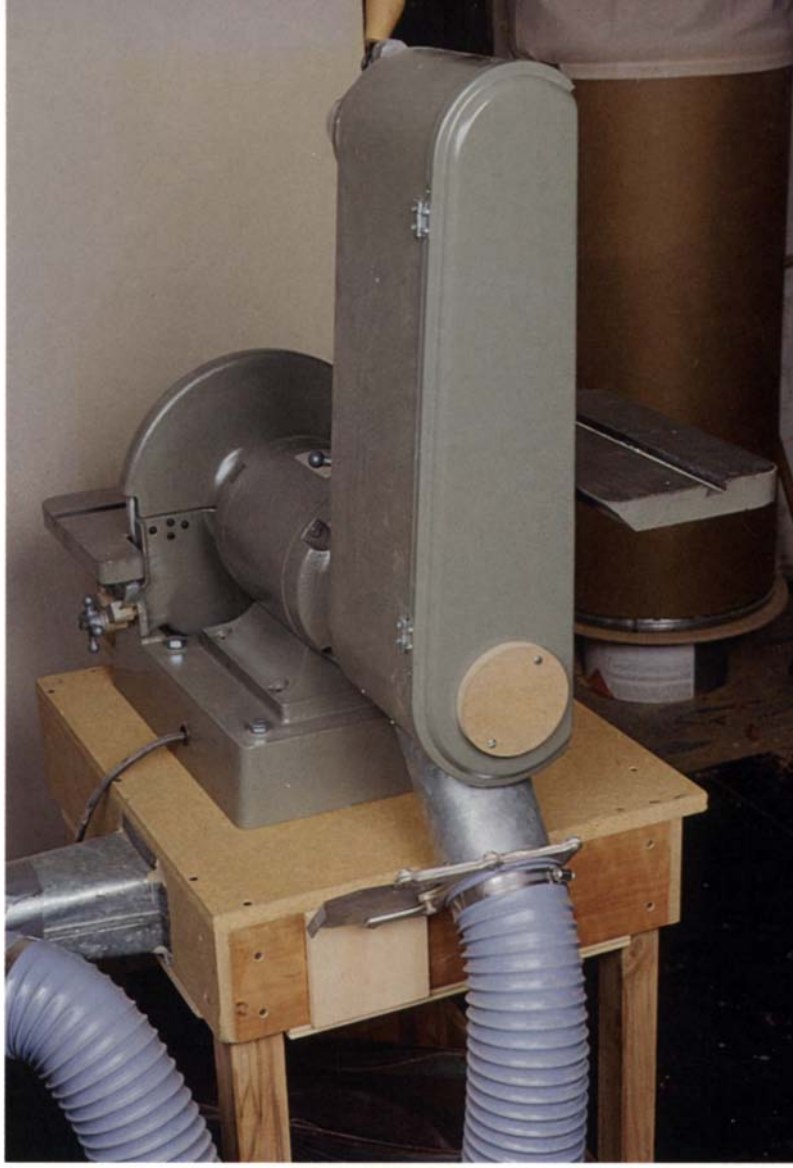
Belt-tracking modifications

Belt-sander tracking was the next issue I had to deal with. Lateral belt tracking on this machine is controlled with the spring-loaded control-arm assembly at the top of the belt housing, which is fitted with an adjustment knob for fine tuning. But the sandwich of thin metal plates that link the control-arm assembly (including the idler drum) to the belt housing are not stiff enough to ensure continuously true belt tracking. At the suggestion of a smart, neighborly machinist, I replaced these plates with a solid piece of ¼-in.-thick hot-rolled-steel flat stock that's 2 in. wide by 3¼ in. long (see the drawing at left). The plates and the control-arm assembly are easily removed from the belt-housing body by backing out six Allen bolts. Using one of the original thin plates as a template, I drilled slightly oversized bolt holes in the new ¼-in.-thick plate. The oversized holes allowed some front-to-back adjustment so that the idler drum could be aligned with the platen and the drive drum.

Although tracking improved dramatically with these upgrades, I still found the belt-tracking adjustment knob to be extremely sensitive as a consequence of the basic system design. However, there are advantages to this design that more than outweigh the inconvenience of having to monitor the position of the belt during use. The main advantage is the ease with which the belts can be changed. You simply pull down the control arm (which relaxes the idler-drum tension) and slip the belt off the drums.

Hinging the end cover for easier belt changes

The only real hitch in the belt-changing process is the end cover of the belt housing. As shipped from the factory, the end cover was screwed to the belt-housing casting in four places and was rather laborious to remove for belt changes. So I simply hinged the cover to the housing, as shown in the photo above. I placed shims between the hinge leaves and the belt housing to compensate for the thickness of the cover lip, and I ground off the excess length of the sheet-metal screws (used to mount the hinges) inside the cover in deference to the well-being of the belt. I found that bending the lip of the cover a bit here and there created a friction fit to the housing that would hold the cover closed without a latch.



***To adapt his belt sander for dust collection,** the author cut a hole in the bottom of the belt housing. He also connected the disc sander's exhaust port to the table, which acts as a vacuum chamber.*

Because belt changes are speedy with the hinged cover, I don't hesitate to change grits or use dedicated belts for different materials. The belt drums on this sander are manufactured with ample crowns to aid in positive, steady belt tracking, but the crowns can distort the belt's flatness across its width after a period of time. Additionally, since belt tension is not adjustable with this system, the belt continually takes the maximum amount of spring tension manufactured into the control-arm assembly. I think of this as a graphic depiction of job stress and give the belt a rest every evening by removing it from the sander.

Belt-platen tricks for longer belt life

Removing the belt overnight will help increase its life, but no belt would last very long while cascading over the sharp leading edge on the belt platen of this machine. I carefully relieved the leading and trailing edges with a mill file. And, while I was at it, I eased all the unnecessary sharp edges throughout the machine.

Another trick to increase belt life and performance is to reduce friction between belt and platen by using graphite (commonly sold in pad and stick form.) Rather than attaching pads to the platen, I

Photos except where noted: Charley Robinson; drawing: Bob La Pointe

***The author built two sliding tables:** one with a 90° fence and one with a pair of 45° fences for accurate end sanding. The tables ride in the miter-gauge slots.*

sparingly rub a graphite stick (Process Engineering Corp., Crystal Lake, Ill. 60039-0279; 815-459-1734) on the platen as needed. Graphite should not be applied to the belt or to the drums because any buildup will reduce drive friction, affect tracking and over-stress the belt. After removing the belt and unplugging the sander, I periodically remove any excess graphite from the drums with paint thinner.

Adding dust collection

Once I had fine-tuned the sander, I used it more often, and, consequently, I discovered what a dust generator it is. Although my sander had an exhaust port under the disc, it had no port for the belt. Since I needed a stand for the machine, I built one with an enclosed box beneath its top that acts as a collection chamber for the disc sander. The main dust collection line enters the box from the rear, as shown in the photo on p. 43. A hole in the stand's top lines up with the exhaust port for the disc sander, and a stack of plywood blocks, with holes in their centers, slip over the exhaust port and connect to the stand. Included in the plywood blocks is a shopmade, plywood blast gate to control the vacuum.

To provide dust collection for the belt sander, I ran a branch off the main line into a lateral branch saddle duct fit to a hole that I cut in the bottom of the belt housing. The branch saddle is a dust-collection-system fitting available in various sizes. This one is designed to fit a 7-in.-dia. duct pipe and reduces to a 4-in.-dia. opening for a blast gate and hose. To cut the hole in the belt housing, I first removed the control-arm assembly, the belt table and the belt platen, as shown in the drawing on p. 42. Then by loosening two bolts, I removed the entire belt housing. I traced the branch-saddle opening and cut the hole in the belt housing with a metal cutting blade in a variable-speed sabersaw. I screwed the saddle on with self-tapping sheet-metal screws, and I used just enough flex hose to allow the belt housing to be rotated to its horizontal position. This fitting does a superb job of collecting dust and replaces my earlier inadequate attempt of connecting the vacuum to the end cover. The wooden plug on the end cover in the photo on p. 43 shows you where *not* to attach a vacuum hose.

Auxiliary tables for accurate sanding

The modifications described here have greatly increased the performance of my machine, but various jigs have contributed to really accurate sanding. For example, I made plywood tables like the one shown in the top photo at left that have strips screwed to their bottoms that ride in the tables' miter-gauge slots. One table has a fence that's 90° to the belt, and the other has a pair of 45° angled fences. Unfortunately, because of variations in the two miter-gauge slot locations, I need a different set of tables for the belt and disc functions, but when end sanding pieces for a precise fit, these tables are indispensable. □

William Tandy Young is a professional cabinetmaker and conservator in Stow, Mass.

Shopmade sanding belts

Epoxied butt joint

by Bill Skinnner

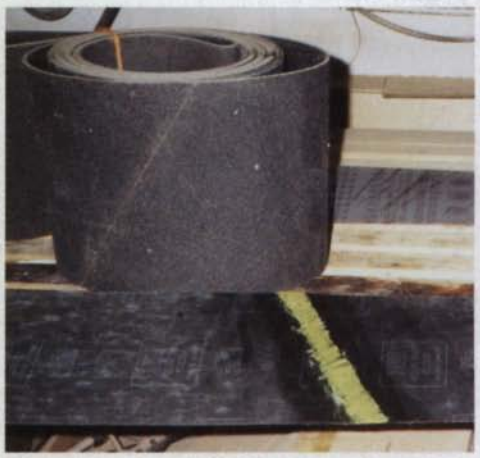
I've been making sanding belts for my stroke sander and smaller machines for more than 40 years. I use an angled butt joint reinforced with a strip of Kevlar cloth (similar to fiberglass but much stronger) glued to the back of the belt with Hexcel Epolite 2461 epoxy resin (see the photo at right). The belts joined with this system are plenty strong (I haven't broken one yet), and the butt joint allows me to run the belt in either direction. Kevlar cloth and Hexcel Epolite resin, which are commonly used by boatbuilders, are available from the Fiberglass Mart (12619 Highway 99 S., Everett, Wash. 98204; 206-743-0332). One quart of resin and hardener and ⅓ yd. of Kevlar cost about $40, which should do all the belts you'll ever use.

I cut the belt stock (cloth-backed only) about 4 in. longer than required for the finished belt and clamp it along a straight edge with the ends overlapped to yield a belt of the exact length needed. With a sharp knife guided by a straightedge, I cut through both layers of abrasive to create a perfect butt joint. An angled joint reduces bumping as the joint passes over the platen.

I reinforce the joint with a 1-in.-wide strip of Kevlar glued with a spoonful of resin/hardener. I put a piece of waxed paper under the belt and over the Kevlar strip and then clamp a short piece of 2x2 over the joint and let it set overnight. □

Bill Skinner is a retired cabinetmaker in Everett, Wash.

Photo: Bill Skinner



***Butt-joined sanding belts are easy to make,** and they can be run in either direction. The author glues a strip of Kevlar cloth across the back side of the joint with Hexcel Epolite epoxy resin.*

Glued lap joint

by Robert M. Vaughan

I first started making my own sanding belts about 10 years ago when I came across several boxes of industrial abrasive cutoffs from a furniture factory. I made a variety of sizes (from 1-in. to 6-in. wide and from 24-in. to 48-in. long) because I could save a fair amount of money by buying bulk abrasive at salvage prices. Now I can get the 3-in.- and 4-in.-wide by 24-in.-long belts for my portable machines for about $1, so I no longer make these, but I still glue up my own 1-in.- and 6-in.-wide belts.

In the years that I've been making these belts, I've made a lot of mistakes, so the techniques I offer have been gleaned from the school of hard knocks. My method involves grinding the abrasive from the overlapping ends of the belt and gluing the ends together with polyvinyl acetate (PVA) glue (I prefer Titebond, manufactured by Franklin International, 2020 Bruck St., Columbus, Ohio 43207). A special fixture aligns the belts and clamps them securely. These methods have worked for belts up to 6 in. wide and will probably work for wider belts, although I've never needed anything bigger. There is a special tape adhesive available, but it is very sensitive and requires precise preparation of the belt and strict control of temperature and clamping pressure, so it's better suited to commercial operations.

Selecting and cutting the abrasive: I recommend high-quality, cloth-backed abrasives over paper-backed abrasives when making belts. I find that cloth holds up better to the grinding process, and the more durable backing provides a longer lasting, better performing belt.

To cut the abrasive to size, I first make a wood pattern stick, with its ends cut at a 30° angle to reduce the bump when the lapped belt joint passes over the material being sanded. The length should be ½ in. longer than the nominal belt size to allow for the lap joint. I write the word *up* on one side of the pattern stick so that I can keep the angle going the same way when I move from cutting to clamping. It doesn't matter which way the angle goes, but it's important to be consistent throughout the belt-making process.

Cloth-backed abrasive is easily ripped to the appropriate width, and a test tear or two will quickly reveal which direction tears more predictably.

To cut the strips to length, I first secure them to the edge of a bench or table with spring clamps to hold them straight. Then I lay the pattern stick over the abrasive and mark where the end cuts are to be made, as shown in the top photo on this page. I use old scissors to cut the lengths while the paper is still clamped to the bench, and I also trim any strings that are hanging off the sides of the strips at this time, otherwise they become a real nuisance later.

Grinding the lap joints: After trying all sorts of grinding fixtures, I have gravitated to a ½-in.-dia. metal rod located about the thickness of a business card away from the face of the grinding wheel. It takes a bit of adjusting to get the rod the proper distance from the wheel, but with all the end cutoffs lying around, experimental stock is rarely lacking. I slip the end of a 6-in.-wide belt between the rod and the grinding wheel at an angle, as shown in the center photo. If the grinder has side guards, these must be removed so that the full width of the belt can pass smoothly past the grinding wheel's face. For 1-in.-wide belts, I drop the end of the abrasive strip straight down between the rod and the grinding wheel and then quickly withdraw it. I try to grind about ¾ in. of abrasive off to allow for a comfortable lap. Grinding the abrasive takes about a full second; if you keep the abrasive on the grindstone too long, the cloth will be ground away. Grinding abrasive is a dusty, dirty task, and a respirator is a necessity.

Gluing the lap joint: The fixture I made for gluing the abrasive holds the belt ends parallel and secures the joint between steel clamping pads with a C-clamp, as shown in the bottom photo.

The pads I use are made from ⅜-in.-thick by ¾-in.-wide bar stock. I mounted two steel dowel pins on the ends of one pad and drilled matching holes in the other to keep the pads aligned when the rotary screw pressure of the C-clamp is applied.

I used to be concerned about the durability of the glue joint, but I have 10-year-old belts held together with PVA glue that are still quite usable. Try a plastic resin glue if moisture or heat is a particular problem.

To glue up a belt, I put the clamp pad with the pins in the fixture and secure the belt in position with spring clamps. After gluing the lapped ends of the belt, I drop the other clamp pad in position and fasten it with a C-clamp. I've made five sets of clamp pads for each belt size, so I can remove the clamped-up belt from the fixture to let it dry and proceed to glue up another belt.

Once the glue is dry, I scrape off any squeeze-out to avoid bumps in the belt or the possibility of the belt separating if the glue catches on the work.

When using these shopmade belts, I always run them so that the open edge of the lap won't catch on the edge of the work and rip the belt apart. □

Robert Vaughan is a contributing editor to FWW *and a professional woodworker in Roanoke, Va.*

***A pattern stick** makes it easy to consistently cut abrasive strips to the correct length with uniformly angled ends. Angling the ends reduces bumping when the glued joint contacts the workpiece.*

***Grinding away the abrasive** cleans up the belt for gluing the lap joint and makes for a thinner glueline and smoother running belt.*

***The gluing fixture** aligns the belt while the lap joint is being clamped. Multiple steel pads permit the removal of one belt from the fixture to glue up others.*

Photos this page: Robert Vaughan

Its finish all but destroyed, *this barrister's bookcase top is about to be reborn. The author fills large holes and gouges with auto-body filler and then presses shellac into the smaller cracks with an electric burn-in knife.*

To darken a high spot *(below), the author dabs a bit of powdered stain onto the surface of the finish and then quickly polishes over it.*

Though not the most practical finish *for a surface subject to wear or possible contact with liquids, a French polish is a beautiful, authentic antique finish (right).*

French Polishing for Restoration Work

Modern padding finishes update an age-old technique

by Scott Lawrence

The subject of French polishing almost always provokes strong opinions among finishers—some swear by it and some swear at it. This disparity of opinion is due to the finish's great beauty coupled with its fragility. Possessing little durability and having almost no resistance to common household spills, heat or solvents, it is not a practical finish for most new furniture or cabinetry. It is unsurpassed, however, for repairing and restoring antiques because it captures and preserves the age marks and patina, rather than obliterating them as is typically the case when an antique is stripped and refinished.

Even a severely degraded finish can be brought back with a French polish through the use of powdered aniline stains and a shellac stick of the appropriate color. I keep a full range of both on hand whenever I'm working on a restoration. The shellac stick allows me to fill any nicks, gouges or checks, and the powdered stains allow me to restore color to a worn or faded finish and even to match a replaced part to the rest of the piece. A word of caution: The technique I describe is legitimate for most antique restoration work, but if you are asked to restore a museum-quality antique, you should consult a conservator before taking any action.

French polishing is the building up of a shellac film that's applied with a cloth pad soaked in either a shellac/alcohol mixture or a modern, premixed formula consisting of shellac and some other solvent (such as ethyl acetate or methyl isobutyl ketone). Lubricated with a few drops of oil, the dissolved shellac builds quickly and dries as it's applied, allowing a finish to be built in one session. Although simple in theory, mastering the technique requires a fair amount of practice. If the pad is too wet, it will tend to dissolve the finish you've already put down; if too dry, the pad will stick to the finish and leave cloth prints. Even when modern, premixed formulas are used, the beginner is advised to develop the technique on an expendable piece or two. For more on the basics of French polishing, see the sidebar on the following page.

Materials

Traditionally, French polish consisted of various formulations of shellac, alcohol and a tiny amount of oil to lubricate the pad. Although traditional finishers always have delighted in discovering ever more obscure and exotic variations on this basic formula, the modern, premixed padding finishes will give virtually the same results with much less hassle (see the sidebar at right). The techniques discussed in this article were developed for use with the modern finishes, but they can be adapted for use with traditional French-polishing materials.

Modern padding finishes can be roughly categorized as high-build, general-purpose or topcoat formulas. High-build padding finishes, such as Mohawk's Lacover or Star's Lac-French, are the best choice for filling and smoothing a cracked, worn or scratched surface (see the Sources of supply box on p. 48 for addresses). This high-build formula will fill and level all but the most severely degraded finish. I use this type of padding finish for all steps of a restoration except the final one and sometimes even then.

General-purpose padding finishes can be used where less build-up is required. I carry a small bottle of this formula in my touch-up kit for on-site finish repairs that don't require a high degree of stain resistance (such as table legs and the sides of case goods). Behlen's Qualasole, Star's Wil-Pro and Mohawk's Rapid-Pad are all good general-purpose padding finishes, although each possesses slightly different characteristics.

Topcoat finishes such as Mohawk's Golden Rapid-Pad or Star's Starlite are formulated to flow out smoothly with a minimum of streaking, which makes them the best choice for final topcoating of large surfaces such as tabletops or desktops.

Cleaning and preparing the old finish

I've never followed the common practice of cleaning an antique with water and detergents. Naphtha does a fine job of cleaning the finish's surface of old wax, dirt and polish, without harming either the wood or the finish as water and harsh alkaline detergents often do. I simply sponge on naphtha and blot up the crud with paper towels. When the paper towels come off the surface clean, I'm done. In severe cases, I'll gently scrub the piece first using 3M's Scotch-Brite pads and naphtha. Another advantage of using naphtha to clean antiques is that it evaporates within minutes, so restoration work can begin almost immediately. But if you clean with detergents and water, you have to let the piece dry overnight.

Right after cleaning is generally the best time to repair any gouges, chips or dents. I do this with an electric hot knife and the appropriate color of shellac stick (available from Mohawk, Behlen or Star). I prefer the electric hot knife over other types because it's more convenient when I have to make on-site repairs, and the heat it generates is most consistent. I slice a bit of shellac off of the stick, smear it into the damaged area and smooth it as best I can (see the top left photo on the facing page). Then I sand the repair smooth with #320 or #400 wet/dry sandpaper moistened with naphtha. Any graining or blending of the repair will be done later.

Next, I usually stain and seal any bare or badly worn areas with a glazing stain made up of either powdered aniline stains or artists' oil colors mixed into clear Watco oil finish. This oil-base stain penetrates and stains worn and bare areas and wipes off the darker, already-finished sections, without obscuring the grain. If the area to be stained is large, I wipe the stain on with a rag, but for smaller areas and when blending in details, I use an artist's brush. If you have rebuilt any missing parts, you can also use this same oil-stain mix to begin matching the new wood to the existing finish. Try to match the color to the lightest color in the old finish. You will darken and "age" the new part in subsequent steps.

Once the oil stain has dried thoroughly (48 hours or so), you can distress the new section to match the general condition of the piece. Observation is the key to realistic distressing. Rounding

Padding finishes vs. shellac and alcohol

Modern padding finishes are virtually identical in appearance to the traditional shellac-and-alcohol finish, but they're more versatile, faster and easier to use than the traditional mixtures. Because the modern padding formulas are premixed, there's no need to experiment to find the proper consistency and build. And since there are a number of formulas with varying degrees of build available, you don't have to alter the ratio of solids to solvents toward the end of the finish, as you do with the traditional method. Finally, in my subjective experience (although I haven't done any quantitative research), the premixed finishes are somewhat more durable and stain resistant than a traditional polish.

So what's the controversy? Beats me. I get just as much personal satisfaction from using a premixed padding finish as I would (and have) from using shellac and alcohol, without any of the hassle. I'm quite satisfied with the quality of the results (as are my customers), and that's the bottom line as far as I'm concerned. *—S.L.*

Photos: Vincent Laurence.

over of exposed edges, bump marks on legs and little dings where silverware and plate rims might have left slight impressions on a tabletop create a truer feel than wholesale abuse. Don't overdo it—excessive flyspecking, chain marks and rasping look phony. Think about how the piece was used, and distress accordingly. Reapply the oil stain to distressed areas, if necessary; then let the piece dry.

Building a new finish

Except in the rare instance an antique needs only a new topcoat, you must first rebuild the finish, filling in the countless scratches and scuff marks that have accumulated over the years. I rebuild the finish with high-build padding formula, adding a touch of powdered stain if I need to further doctor the color. I like to use a clear glass ashtray (available at the finest hotels and bars) to mix padding formula and powdered stain; I look for both a proper color match and the right degree of transparency given the piece I'm working on.

I apply the padding finish in circular or figure-eight strokes to the damaged area until I've built up a new layer of finish about as thick as the old one. With a very thick finish that has been severely degraded (cracked, peeled or crazed, for example), it will be necessary sometimes to build up a new film on the repaired area, sand down the adjacent old finish until the two surfaces are roughly level, and then apply a coat of the padding finish to both sides. This coat can be lightly sanded to remove any padding marks, and a final coat can be applied with the grain to blend the two areas.

With open-pored woods, such as oak, walnut or mahogany, I like to "grain" any repairs that I've burned in using a shellac stick and a hot knife. I score the repair slightly with the edge of a chisel or a glass cutter and try to connect these lines with grain lines on either side of the repaired area to create the effect of grain running uninterruptedly through the repair. Then I rub a little dark oil stain into these grain marks until they match the color of the surrounding wood grain. Done carefully, this faux graining will make your repairs disappear. Let the piece dry overnight before proceeding.

Next, I do any final color glazing or streaking to blend in areas that have been patched extensively. I lightly brush the freshly padded surface of the repair with a dab of powdered stain on a fingertip of my left hand; then I quickly pad over it to dissolve the touch-up powder into the finish and to seal it (see the bottom photo on p. 46). This process will leave a subtle streak of color in the surface, simulating a contrasting streak in the wood or completely disguising a repair under the predominant wood color.

If the restored area still looks too light or new, now is the time to darken it, using layers of glazing made up of powdered stain and padding formula mixed in your "souvenir" ashtray. Pad on the mix using long, straight strokes running with the grain. The ability to match for color and for a realistic degree of opacity is a skill that will come only with experience. But I can tell you that a finish that is too clear will make an area stand out as new and that a finish that is too opaque will render your efforts muddy and lifeless. Remember that you are trying to recreate many years of aging—don't try to reproduce this in one quick application of glazing.

When you have blended in the restored area to your satisfaction, the entire surface (preferably the entire piece) should be topcoated with one of the light-bodied padding finishes (see the large photo on p. 46). Use a fairly dry pad at first so you don't smear your previous work. Once you've sealed the surface, you can work with a slightly wetter pad, using long, straight strokes. When you're first experimenting with the finish, play with variables such as the moistness of the pad and the pressure and/or speed of your strokes. The only hard-and-fast rule is *not* to let your pad come to a stop while on the finish surface; always keep the pad moving until it's completely removed from the surface.

Should your restored finish be too glossy for your (or your client's) liking, it can be rubbed down with #0000 steel wool after a few days. You can also put a coat of high-quality wax over a French-polish finish to give it a bit more protection. Don't use a liquid wax, however, since they often contain solvents or water, which could damage the French-polish finish. Should your newly restored piece become scuffed or scratched, don't worry. It can be easily repaired using the same materials and techniques as described above but in much less time than a full restoration. □

Scott Lawrence is a professional furniture finisher and restorer in Colorado Springs, Colo.

French polishing: the short course

Here are the basics of French polishing in a nutshell: Make an egg-sized ball of clean cotton cloth. Saturate with finish compound—either the traditional shellac-and-alcohol mixture or one of the modern, premixed formulas. The pad should be damp but not wet. Squeeze out the excess. Then wrap the pad tightly with another clean, lint-free cotton cloth. Make sure this cover cloth is free of wrinkles on its bottom surface, or it'll streak the finished surface.

If you're using the traditional shellac-and-alcohol mixture, sprinkle a few drops of linseed or mineral oil onto the surface to be polished. This will lubricate the pad, allowing it to move freely without sticking. (This step is not necessary with the premixed padding finishes.)

Apply pad to wood with circular strokes. Start this circular motion in the air before the pad comes into contact with the surface. Gradually pad out the entire surface, using slightly overlapping strokes. Repeat this process until the desired film thickness is achieved; then finish with overlapping straight strokes running with the grain.

When using the shellac-and-alcohol mixture, you must wipe the entire finished surface with a fresh pad that's been slightly dampened with alcohol. This will remove any remaining oil from the surface and burnish the shellac film to a smooth, glossy sheen.

For more on French polishing, see *Fine Woodworking on Finishing and Refinishing* and George Frank's article from *Fine Woodworking* #58 in *The Best of Fine Woodworking—Finishes and Finishing Techniques.* —*S.L.*

Sources of supply

Modern padding finishes, shellac (in many forms), alcohol and other solvents, and powdered stains are all available from the following manufacturers and distributors.

Mohawk Finishing Products Inc. (also manufactures the Behlen line*), Route 30 N., Amsterdam, NY 12010; (518) 843-1380

Star Finishing Products Inc., 360 Shore Drive, Hinsdale, IL 60521; (708) 654-8650

Wood Finishing Supply Co., Inc., 100 Throop St., Palmyra, NY 14522; (315) 597-3743

* H. Behlen and Bros. finishing supplies are available through retailers only.

Flip-Stop Fence for a Radial-Arm Saw

The track-mounted stop is always handy

by Art Duser

"You can't buy any more tools," my wife told me in no uncertain terms, and she added, "the accessories cost too much!" Though she wasn't entirely serious, her wake-up call helped me to rank my woodworking tool needs; I began to think seriously about what I could do without and what I could build myself. Since then I've built a number of power-tool accessories, including the radial-arm saw fence with flip stop that's discussed in this article. Building my own accessories not only saves me money (allowing me to buy more lumber and essential tools) but also provides real satisfaction, borne of self-reliance and successful problem solving.

My fence consists of two 5 ft. lengths of mahogany—a main fence and an extension fence—that I spliced together, as shown in the drawing. A dado in the top of both pieces of mahogany houses a piece of extruded aluminum shelf standard (manufactured by Dorfile, a division of Newell Home Hardware Co., 4533 Old Lamar, Memphis, Tenn. 38118; 901-365-0479). The lips of the shelf standard capture a toilet-flange bolt that extends through a piece of polyethylene (generally available as scrap from a plastics supply house). A knurled thumbnut atop the block permits me to lock it in place. The flip stop is screwed into a hole that I drilled and tapped on the side of the polyethylene block.

The main fence is pinched between the front and rear portions of the saw's table (in the same manner as the stock fence) and is made more rigid near the blade with a piece of aluminum angle that I screwed to the main fence's downward-extending lip (see the drawing). The extension fence can be connected to the main fence either with a pan-head machine screw and a T-nut set into the extension fence (as I did) or with a wood screw through both members into the table below. Both extension and main fences are carefully aligned and then screwed to the extension table.

Stop block and flip stop

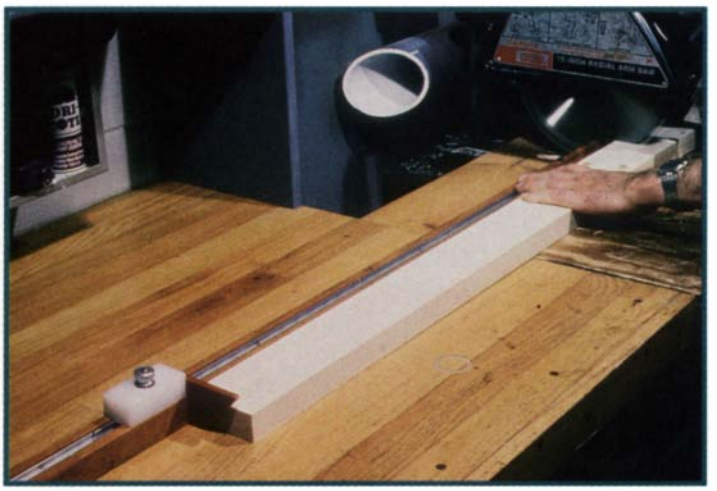
The first stop block I made was of hardwood and required a mortise on its back side to capture the locking nut for the flip stop's pivot screw. Since then I've made a few of these fences for friends, and I've used polyethylene for all my stop blocks. The polyethylene permits drilling and tapping of the hole for the pivot screw and will hold the screw snug with just enough play.

I've used knurled thumb nuts on the toilet-flange bolt for all my stop blocks (though I'm sure a wing nut would do the job as well), and I embed a flat washer in the top of the block to prevent the thumb nut from wearing into the polyethylene. To minimize friction in the track when the stop block is moved, I file the flat sides of the flange bolt's head slightly. I also set a rubber tack bumper into the main fence near the blade to discourage the stop-block assembly from getting too close to the blade.

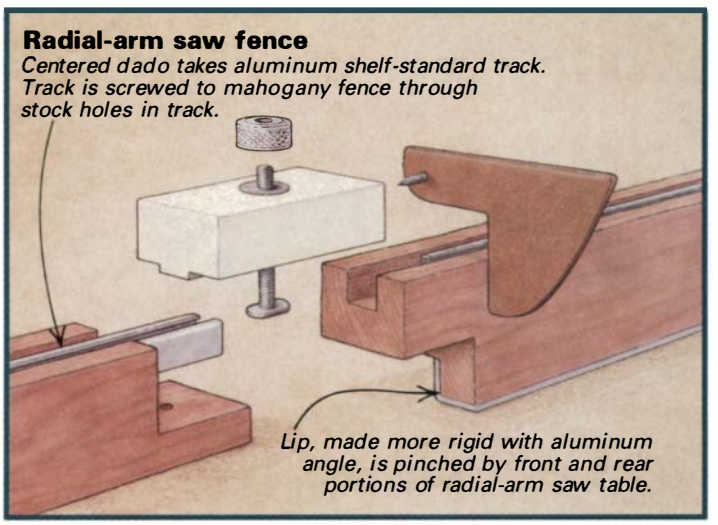
I've used both aluminum and phenolic-resin board for flip stops, but plywood would probably work as well. The front edge of the stop curves upward so that it will flip back when a long piece of stock is pushed into it. This makes it easy to trim one end of a board before flipping it end for end to cut it to length.

I use my radial-arm saw almost exclusively for 90° crosscutting, so I've tuned it up to cut dead on. When I need to cut a 45° miter or any other angle, I position the piece I'm cutting with one of a number of precut plywood angles I've made for this purpose. I find this method to be more accurate and a lot quicker than having to reset my saw every time I want a different angle. If you cut angles other than 90° on your saw, you'll want to keep the aluminum back farther from the blade, and you may have to use a block against the flip stop if you are cutting fairly short pieces.

I've only made these fences for radial-arm saws, but I'm sure some ingenious woodworker could modify the design to accommodate a miter saw or even a sliding compound-miter saw. □



***Quick, accurate multiple cuts** are all but assured with a good fence setup. The flip stop is angled up in the front to allow the user to push a piece of stock into the fence for a square cut and then flip the stop back down for the cut to length.*



Art Duser is a woodworker and a member of The Triangle Area Woodworkers' Club, which meets in Raleigh, N.C. He's also a data communications specialist.

Photo: Ed Walker; drawing: Heather Lambert

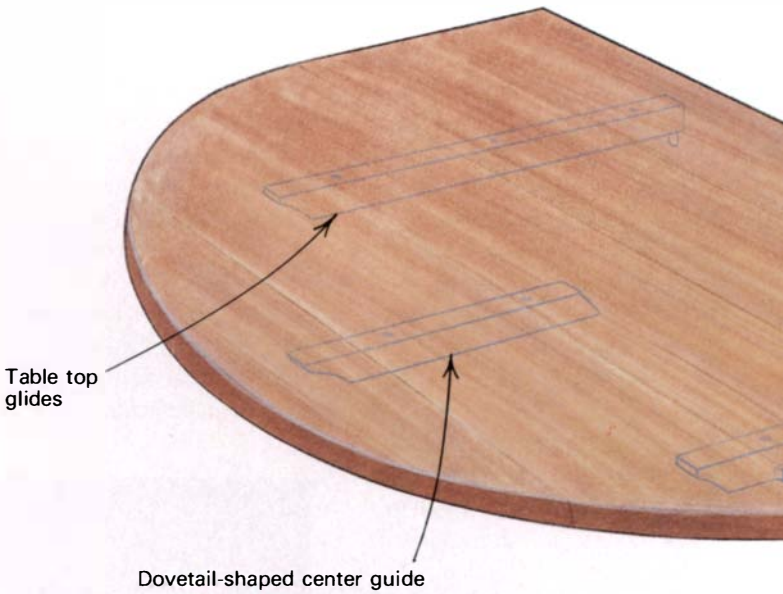
A Butterfly Expansion Table

Self-storing leaf hides under the top

by Paul Schürch

In a butterfly-leaf table, a hinged leaf stored under the top pivots up and unfolds to extend the table. This leaf-storage system eliminates the need to handle the heavy, bulky leaves normally used in an extension table and also avoids the possibility that forgotten leaves will be left behind in the excitement of loading up the moving van. Just this past year, I've had two jobs making and matching table leaves to replace ones that had been lost. So when commissioned to design and build an extension table, I decided on the butterfly-leaf table for its practicality, aesthetics and absolute ease of operation.

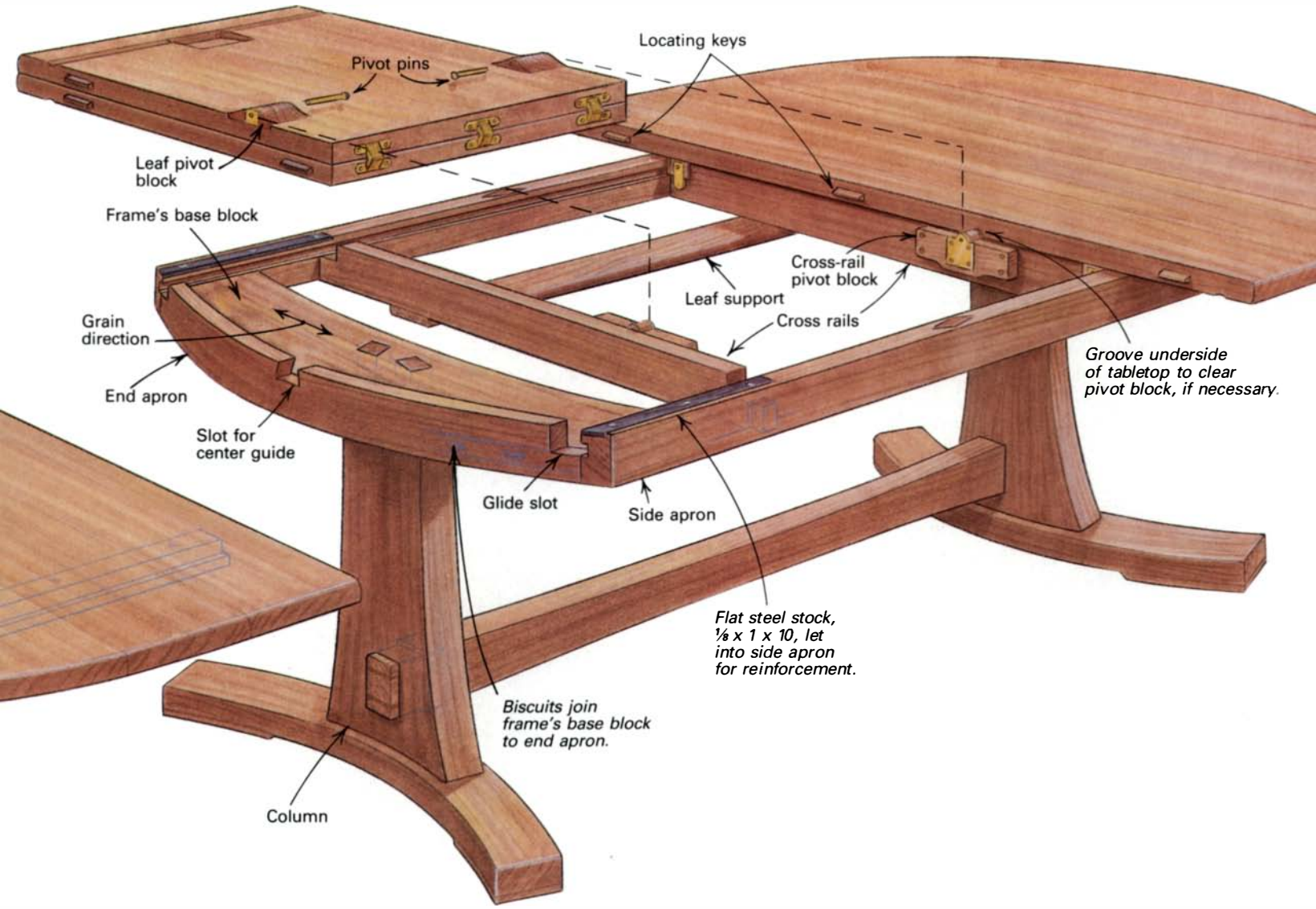
The butterfly mechanism is not as complicated as it may appear, and once the basic geometry is understood, the mechanism can be built easily. The hinged-leaf sections counterbalance each other, as shown in the photo below, and move almost effortlessly. The key



***The butterfly-leaf table derives its name** from the motion of its folding leaf as it is moved from the stored position between the rails to the open position in the extended table.*

Photo this page: Paul Schürch; drawings: Bob La Pointe

Fig. 1: Butterfly-leaf table construction



to laying out the mechanics of the leaf is to build a full-scale mock-up based on the cross-sectional view of the butterfly leaf and aprons shown in figure 2 on p. 52. You must take into consideration that the leaves need space to swing freely under the table and that the aprons are an important structural part of the table. With the exception of these restrictions, there is considerable flexibility in designing a butterfly-leaf table. The top can be just about any shape or size and can be supported by a trestle base like the one shown in the photo at left or with a more traditional four-legged base. The table's base-and-apron assembly are stationary, and the ends of the tabletop are screwed to glides that ride in grooves cut into the side aprons. For greater extension capabilities, the table could include multiple butterfly leaves.

In addition to the mechanics of the folding leaf, there are some other key areas that this article will touch on. The material from which the table is made will not only affect the appearance but also can have an impact on the function of the mechanism. For example, woods with excessive seasonal movement may interfere with the operation of the leaf. The hardware for the folding leaf is surprisingly simple, and much of it is easily shopmade, as are the guides and glides that the table ends slide on. And, finally, I'll discuss the pivot blocks, which ensure smooth operation and the locating keys, which position the leaf in relation to the tabletop. In the sidebar on p. 54, I'll describe the simple templates I use to rout the mortises and tenons that connect the top to the base.

Making a mock-up of the butterfly mechanism

A full-scale drawing of the leaf in both the open and closed position and a working mock-up of the table-leaf mechanism are essential for planning and laying out a butterfly leaf that opens easily, aligns properly with the tabletop and stores without interference below the top. To make the mock-up, draw a cross-sectional view, as shown in figure 2 on p. 52, on a smooth piece of plywood. Two thin strips of plywood, fastened together with a fabric hinge at one end, represent the hinged table leaf. Drive a nail through the mock leaf at the approximate pivot point, as shown in figure 2. Put another nail into the plywood drawing to represent the edge of the leaf support. Now you can move the mock leaf through its entire range of motion and experiment with the location of the pivot point and the leaf support. As the top half of the leaf is lifted, the bottom half should ride on the leaf support and just barely clear the apron. To gain more clearance, you could move the aprons farther apart, but having the aprons as close to the folded leaf as possible provides the best balance and support for the open leaf.

To make the mock leaf, rip two strips of ½-in.-thick plywood as wide as the tabletop is thick (1¼ in. for the tabletop shown in this

article). A piece of fabric glued onto the ends of the plywood strips simulates the action of the Soss hinges used in the actual leaf. The location of the folded leaf between the side aprons of the table is not critical, although I positioned my folded leaf so that it is centrally located between the aprons and parallel to the top. The space between the folded leaf and the underside of the tabletop must accommodate the pivot block without interfering with the top as it slides open and closed. As this space becomes larger, however, the side aprons must become wider to conceal the leaf below the table. About ⅝ in. clearance is ideal, but because I wanted narrow aprons, I left only ⅜ in., and, consequently, had to groove the underside of the top to pass over the protruding cross-rail pivot blocks, as shown in the bottom photo on the facing page.

Pivot-point placement is very critical and needs to be carefully laid out. After positioning the folded mock leaf on the drawing in the closed position, outline the leaf's exact location on the plywood and remove the leaf mock-up. Then draw a line from the closed leaf-joint center (point A in figure 2 below) to the open leaf-joint center (point B, which must fall at the table's center). The pivot point lies at the middle of this line.

Now, reposition the mock leaf on the drawing and glue a semicircular block with a small hole drilled through it onto the leaf, so the hole aligns with the pivot point. A finishing nail, driven through the hole serves as the pivot point while a second nail driven into the plywood drawing simulates the contact point between the leaf and the edge of the leaf support. Clamp the plywood drawing in a vertical position so that the leaf hangs on the pivot nail and gravity holds the bottom half of the leaf against the leaf-support nail. Pull the top half of the leaf up, over and into the open position, while checking that the lower half of the leaf slides properly on the leaf support and clears the side apron by at least ¼ in. Also, be sure the trestle or other substructure does not interfere with leaf movement. Although the leaf is balanced and moves with very little effort, it should not open on its own. If the leaf does not stay in the closed position, the pivot point needs to be moved toward the hinged edge of the leaf, which in turn necessitates repositioning the leaf and possibly the leaf support. It takes some experimenting, but once this mock-up functions properly, you are assured that the actual tabletop will operate flawlessly.

Choosing the right wood for the top and leaf

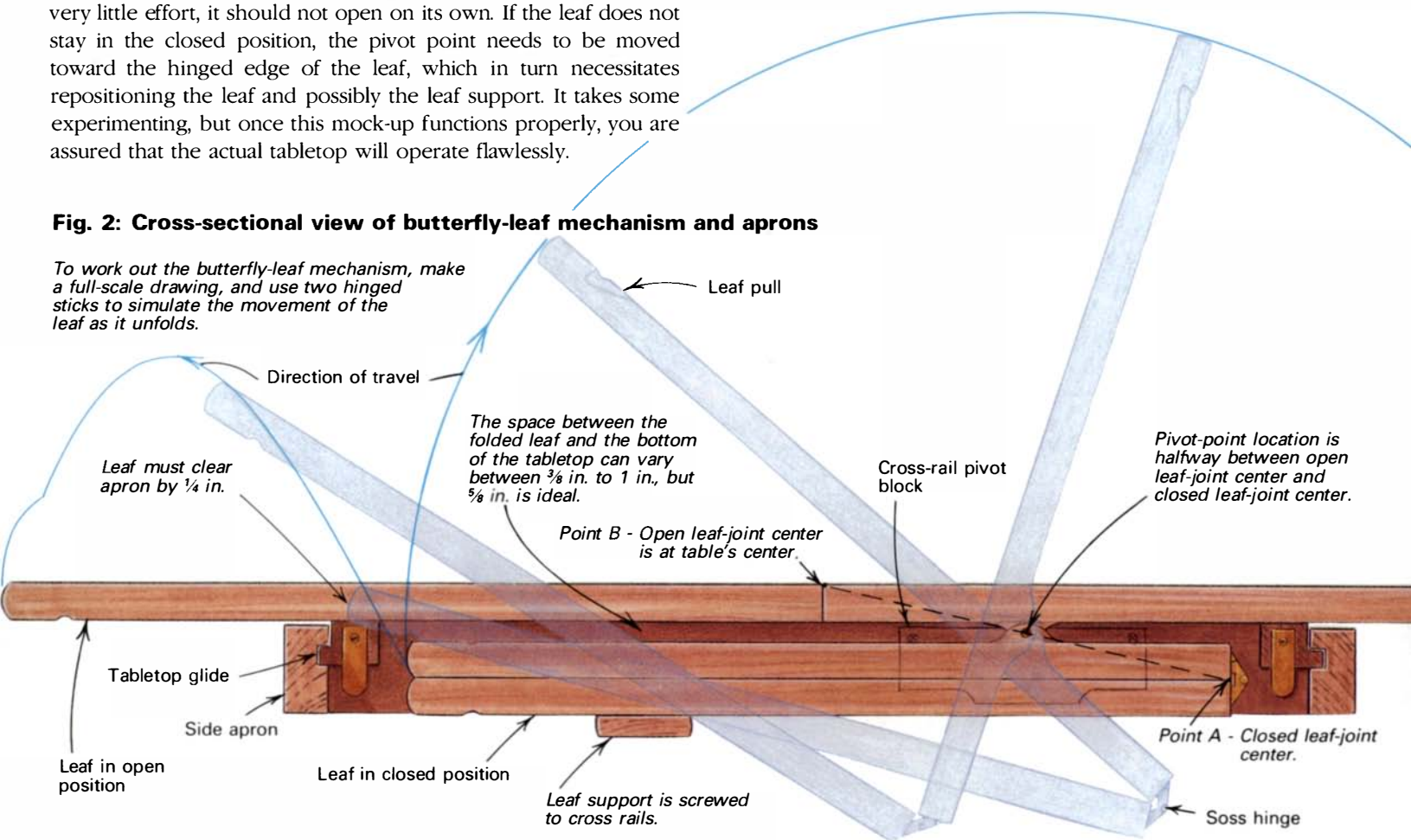
Most of the references I found on making butterfly-leaf tables recommended against using solid wood because seasonal movement or warping can cause the mechanism to bind or cause a mismatch between the leaf and the tabletop ends. My solid-wood table, now six years old, was built with wood movement in mind. Even though the table is subjected to humidity swings of 25 percent to 55 percent, it still works very well.

Wood selection is very important. I used teak for this table, but mahogany, oak or even pine will do, if it is high-quality, stabilized wood. The wood must be properly air- or kiln-dried (with no internal tension) and stabilized to the shop's environment. Boards with a wild and undulating grain pattern or those that bind or warp when ripped are sure to have internal tension and should be avoided. The grain of the tabletop should run across its width, and to equalize or minimize warping, I recommend using the opposed-heart method when gluing up the top, as shown on the table's edge in figure 1 on p. 51. To allow for seasonal movement of the leaf, I left ¼ in. between the leaf and each pivot block. And because the aprons are the main structural support and form the glide system for the tabletop, quarter-sawn defect-free wood, with its grain oriented as shown in figure 2 below, is preferred.

Selecting and making the hardware

I joined the leaf halves with three heavy-duty Soss hinges (see the Sources of supply box on p. 54) that permit the halves to fold back on themselves yet are completely invisible when the leaf is open. The pivot pins that hold the leaf in the table are two ¼-in.-dia. by 3½-in.-long solid-brass hinge pins. I had to scavenge them from a set of brass butts after I found out that I couldn't just buy the pins. I might have been able to use the butt hinge leaves to make the

Fig. 2: Cross-sectional view of butterfly-leaf mechanism and aprons



pivot plates or table stops if I hadn't already cut them from some ⅛-in.-thick by 1½-in.-wide flat, brass bar stock. I also made a table lock from the brass stock. I cut the brass with a coarse metal-cutting blade mounted in a sabersaw and used drops of water as a cooling lubricant. I recommend wearing safety glasses to protect your eyes from flying brass chips. After roughing out, the brass is easily filed to shape, buffed to a bright shine with a felt buffing wheel and soft-metal rouge compound, and, finally, sprayed with Agateen 2-B cellulose-nitrate lacquer. Because these brass pieces are rarely handled, the lacquer provides a durable shine and prevents tarnishing.

To facilitate the removal and reinstallation of the tabletop, I screwed a threaded insert into the end of the tabletop glide, so the brass end stop could be fastened with an easily removed machine screw, as shown in figure 3 below. A hook-and-screw table lock, which holds the table ends together when the leaf is not in use, is mounted about 3 in. from the perimeter and across the joint on the underside of the table ends. When the table is fully extended, the weight of the leaf on the locating keys prevents the table ends from being accidentally pulled apart. But if you prefer, locks also could be installed on the leaf.

To strengthen the aprons against the leverage exerted by the extended tabletop, I reinforced the top ends of the side aprons with 1-in.-wide strips of ⅛-in.-thick by 10-in.-long flat, steel bar stock, as shown in figure 1 on p. 51. I screwed the steel to the side aprons with three #12 by 2½-in.-long flat-head screws, positioned to avoid the slide groove on the aprons' inside edges. The steel, located under the table ends, is not visible even when the table is fully extended on its glides.

Guides and glides

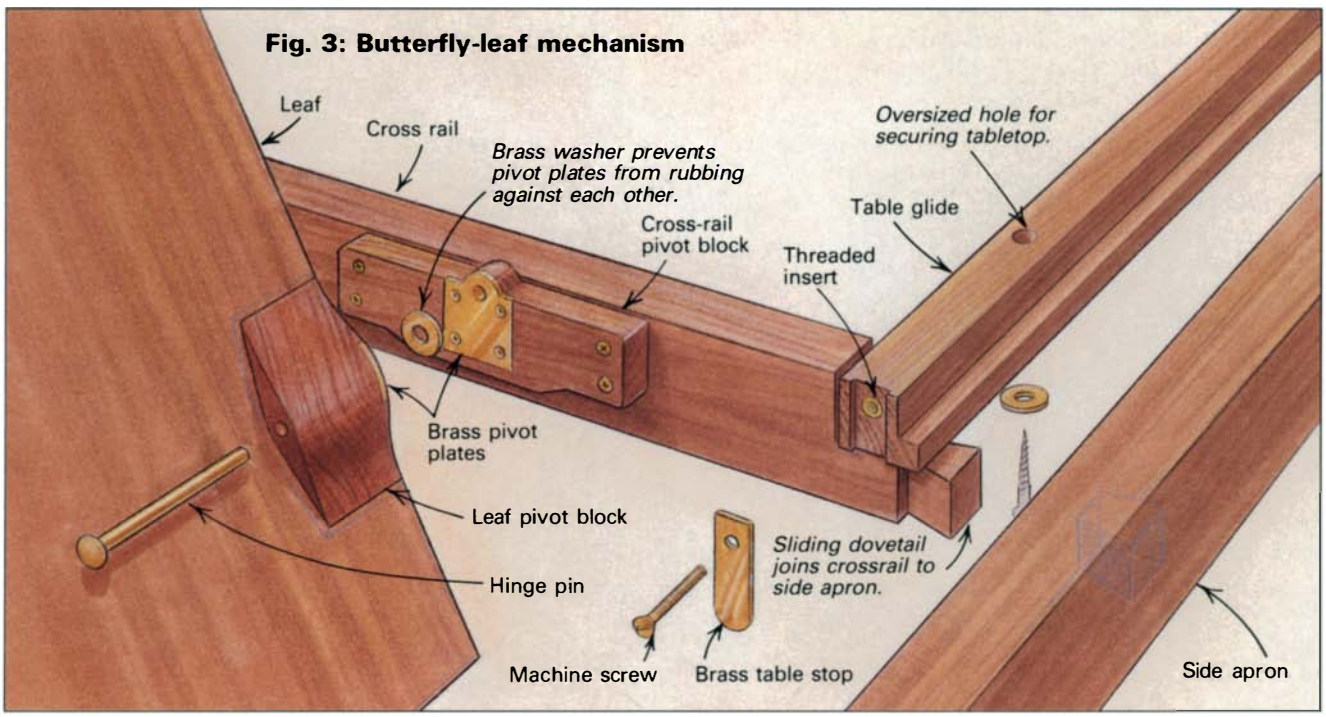
For each table end, there are two tabletop glides and one center guide, as shown in figure 1 on p. 51. The guides and glides should be made from a dense wood with the grain angling across the stock at 45° when viewed from the end (as shown in figure 2 on the facing page), which offers more lateral and shear strength. The end aprons and the cross rails are notched to allow passage of the tabletop glides, as shown in the top photo at right, and the end aprons are also notched for the center guides. The dovetail-shaped

The table glide extends through the end apron, *which is dovetailed to the side apron. Also shown are the dovetail joints that connect the frame's base block and the cross rail to the side apron.*

The butterfly-leaf mechanism *includes the cross-rail pivot block, the leaf pivot block and pin, and the Soss hinges that join the two halves of the leaf. The author grooved the underside of the tabletop to accommodate the pivot blocks' knuckles, but this could be avoided by lowering the pivot point slightly.*

Photo: Paul Schürch

Fig. 3: Butterfly-leaf mechanism



Photos except where noted: Sandor Nagyszalanczy

center guides provide additional support and prevent undue stress on the glides if the table is picked up by the top. The guides also prevent racking when the top sections are slid in and out and even can serve as stops if positioned to hit the cross rails when the top is fully closed.

The guides and glides are screwed to the underside of the tabletop with round-head screws and flat washers through oversized holes. The oversized holes permit adjusting the glides and guides to their respective slots and allow for normal wood movement with seasonal changes in humidity.

Locating keys

Although locating keys and their corresponding mortises along the mating edges of the leaf and table ends, shown in figure 1 on p. 51, may be optional on other types of extension tables, they are necessary on a butterfly-leaf to secure the folding leaf in the open position. The locating keys also align the leaf with the table ends and when the leaf is folded, align the table ends to each other. I have found that three keys across the width of the table are sufficient. The key located near the leaf joint is positioned on the lower half of the leaf (when the leaf is closed), so it will clear the pivot block on the cross rails when opening or closing the leaf. The 1-in.-thick cross-rail pivot block automatically provides ample clearance between the locating keys (which should protrude about ⅝ in.) and the table's ends. I've found that it's best to wait until the leaf is ready to be installed in the table before cutting the mortises and setting the locating keys into the edges of the table ends and leaf. Then I can make last minute adjustments to be sure everything is perfectly aligned.

Mounting the pivot blocks

Because the leaf pivot blocks bear considerable weight and are subjected to some abuse as the leaf swings in and out of the table, I dovetail them into the leaf. Each of these joints is further reinforced with a brass pivot plate mortised into the side of the leaf, as shown in figure 3 on the previous page, and screwed to both the leaf and the block.

Before installing the cross-rail pivot block, make sure that the table ends slide freely together and apart in a smooth, predictable fashion, and then mortise for and install the locating keys. To locate the cross-rail pivot blocks, clamp the tabletop ends and leaf together in the full extension position, and from under the table, screw the pivot blocks to the cross rails with a single screw. Gently swinging the leaf open and closed will reveal if any final adjustments are needed before securing the pivot blocks with three more screws. □

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Sources of supply

Soss hinges and threaded brass inserts are available from Woodcraft Supply, 210 Wood County Industrial Park, PO Box 1686, Parkersburg, WV 26102; (800) 225-1153.

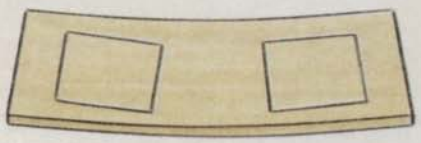
Brass bar stock for making pivot plates, stops and table locks is available from Industrial Metal Supply Co., 3303 N. San Fernando Blvd., Burbank, CA 91504; (213) 849-3184.

Agateen 2-B lacquer for coating brass is available from Agate Lacquer Manufacturing Co., Inc., 11-13 43rd. Road, Long Island City, NY 11101; (718) 784-0660.

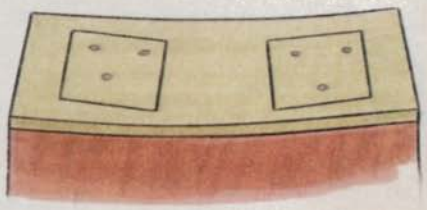
Templates for through-mortises and tenons

I connect the trestle base of my butterfly-leaf table to the upper assembly with a through wedged mortise-and-tenon joint, as shown in the photo below. It's a challenge to lay out and cut this joint exactly where I want it, with tenons that fit tightly into their mortises. However, the simple templates shown in the drawings at right make lay out easy and ensure perfect-fitting joints every time. *—P.S.*

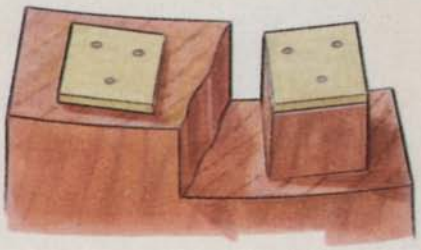
Trestle mortise-and-tenon templates



Step 1: Cut a piece of ¼-in.-thick Masonite to match the top of the trestle column. Cut the mortise openings; then scribe, cut and fit the tenon templates to the opening.



Step 2: Position the mortise template on the column end, drop the tenon templates into place and, after predrilling the Masonite, nail the tenon templates onto the column with brads. Remove the mortise template.



Step 3: Rout away the waste, taking about ⅛ in. per pass with a flush-trimming bit with the bearing mounted above the cutter. Be careful not to contact the template until you've cut deep enough for the bearing to ride along the template.

Step 4: Position the mortise template on the frame's base block and rout away waste in the center of the mortises. Again, keep the router bit away from the template until the bearing will ride on it. Square up the mortise corners with a chisel.

Drill Press Primer

Anatomy and use of a woodworker's standby

by Bernie Maas

***Using a metal rule,** Maas double checks each hole's edge distance for the series he bored with a machine-spur bit chucked in his drill press. A fence, clamped to the table with a hold-down, keeps the workpiece aligned while the machine's depth gauge (next to the feed lever) ensures that the holes are uniformly deep.*

If your solutions to boring holes have been a wrist-cracking brace and bit and an ear-straining electric drill, then you'll break into a smile when you crank up a drill press. Originally devised for metalworking, the drill press offers the same professional results for woodworking: consistently accurate holes. While the press is a premier hole maker, its name belies its ability to do other work, such as mortising. In contrast to most stationary machines, the press is a quick study, and it's quiet and fairly safe to use.

Basically, there are two types of drill presses: benchtop and floor standing. Bench models range in height from 22 in. to 46 in., while floor models can be anywhere from 52-in. to 76-in. tall. Drill-press capacity or throat size—the largest circular workpiece you can bore a central hole through and not hit the column with—is often expressed as *swing* or *diameter*. Bench models usually have a swing from 8 in. to 12 in. Floor models range from 10-in.-dia. machines up to 21-in.-dia. monster presses. I prefer the floor-standing models in the 11-in. to 16-in. range because they can be positioned in tight spots without occupying valuable bench space, and this size is ideal for most woodworking jobs.

Drill-press parts and their purposes

The drill press is made up of four basic parts (see the drawing on p. 57), which are clamped to a polished steel column. From the bottom up, there's a base (foot), a movable table, a safety collar, and a head. Both the table and base are usually cast iron and ribbed for strength and rigidity. The base is big enough to stabilize the machine, and usually features bolt-down holes. The table, adjustable up and down, has a smoothly machined flat top that's either square or circular. Commonly, there's a split ring and a screw handle to lock the table to the column. Some tables have slots to clamp fixtures; some tilt for angle work, but all have a central hole so that you won't easily run a bit into the metal top. The safety collar is locked to the column just beneath the head to support the head in case it accidentally slips. Finally, there's the head itself, a cast unit that houses the most important parts: the motor, pulleys, pinion shaft, quill and electricals. Most drill presses have sealed-bearing motors ranging from ¼ HP to ¾ HP. The drive belt is tensioned by shifting the motor on its bracket. When properly tensioned, the belt should flex about an inch midway between the motor and spindle pulleys.

The quill assembly—The heart of the head is the quill, which is the sleeve that contains the spindle. The quill allows the spindle shaft both to revolve (drill) and to reciprocate (press) simultaneously (see the drawing detail on p. 57). Ball bearings at each end retain the spindle within the quill and keep it centered and free to rotate. Rack-and-pinion gearing, controlled by the quill handle (feed lever), moves the quill up and down. Quills usually have a vertical stroke of 3 in. to 4 in., although some travel 6 in. An adjustable clock spring returns the quill

Selecting spindle speed

Heat is the enemy of bits; you need to get your bit in and out of a workpiece before friction heats it up. To do this, your drill press has to generate the correct number of RPMs. Most presses will run between 400 RPM and 5500 RPM. Speeds are adjusted by altering the position of the drive belt. The press will run fastest when the belt couples the smallest spindle pulley with the largest motor pulley. To help determine the best speed to use for the bit you've chosen, refer to the chart below. *–B.M.*

Bit type/size☆	Recommended speed (RPM)*
Machine spur	
⅛ - ⅝	3,600
over ⅝	1,800
Multi-Spur	
½ - 2	1,200
2 - 3	900
over 3	600
Forstner	
⅜ - ⅝	1,800 - 2,400
11/16 - 1	1,400 - 1,800
1 1/16 - 1 7/16	900 - 1,200
1½ - 3	250 - 600
Spade†	
¼ - 1½	1,000 - 2,000
Powerbore†	
⅜ - ⅝	1,800 - 2,500
¾ - 1	1,200 - 2,000
Twist	
1/16 - 3/16	2,400 - 4,700
¼ - 7/16	1,250 - 2,400
½ - ¾	700 - 1,250
Plug cutter	
Under ½	2,400
½ - 1	1,800

☆ Don't use long (over 6 in.) thin-shank bits over 1,000 RPM

* Slower RPMs (when range is given) are for hardwoods. Actual spindle speed will be influenced by step-pulley sizes and density variations within the wood. Generally, the larger the bit and the harder the material, the slower the speed.

† Speeds over 2,500 RPM will likely burn workpiece.

to its up position. From time to time, the spring and quill should be lubricated through their oil holes, but unless you're desperate for entertainment, don't try to take apart the spring assembly.

You can lock the quill or preset the depth to which it can advance. On the left of the head is the quill-lock handle. On the right is the depth gauge, usually a simple rod-and-nut arrangement. To set the depth gauge, lower and lock the quill at the desired depth, and snug the gauge's bottom stop nut against the lug on the head. Then unlock the quill, return it to the starting position, and lock the gauge's top nut against the bottom one.

The chuck—Fixed to the lower end of the quill is a three-jaw chuck, sometimes called a Jacob's chuck (after its inventor). While ¾-in. and ⅜-in. chucks are not uncommon, most presses have ½-in. or ⅝-in. chucks. A chuck's size designates the maximum diameter shank that it will take; minimum capacity is usually 1/16 in. Some chucks have springs that automatically eject the key, so it can't be left it in the chuck accidentally. For the best grip possible, tighten all three of your chuck's key holes, especially when boring large holes (over 1½ in.). Large bits exert considerable torque, sometimes stalling while the chuck continues to spin. This chews up the chuck and galls the bit shank so that it won't run true.

Drill-press safety

The drill press is not inherently dangerous, but it deserves respect and warrants some precautions. The greatest hazard is spinning work. Large bits muster enough torque to rip work from your grip, smacking it into your knuckles or worse—launching it at bystanders. Besides causing injury, a whirling piece of wood can bend a bit or the spindle. Boring a hole off center can also whip work around. Misalignment occurs when the bit grabs a hole's edge or when small or unwieldy stock dances out of line or becomes cocked due to vibration or table tilt. Chips and debris left on the table also can allow a piece to drift dangerously off center.

In order to avoid these hazards, always keep the floor around the press clear and the table clean and well lit. To prevent work from spinning when boring small holes, brace it against a clamped block or fence, and when using bits over ½ in., clamp the work down. In addition, you can use a hold-down (available from Enco Manufacturing Co., 5000 W. Bloomingdale, Chicago, Ill. 60639) to prevent work from lifting when you withdraw bits (see the photo on p. 55). Through the following good shop practices, you'll avoid other hazards, such as flying pieces, entanglement and cutter contact: Never leave the key in the chuck; wear eye protection; tie back long hair and don't wear jewelry or loosely hanging clothing. Remember that the chuck and bits revolve clockwise—keep your hands and body clear of them and anything else that might spin.

Feed rate, pressure and speed

When boring wood with a drill press, the spindle speed, feed rate and the pressure you apply determine the quality of the hole. Too much pressure on the feed lever causes rough cuts or jammed and broken bits. Too slow a feed rate can burn the work and overheat the bit. Feed steadily and evenly. A fast or choppy stroke can cause drift, thus elongating a hole. Boring at the correct rate and pressure produces uniform shavings, about .040-in.-thick. If you're coming up with dust, either the feed is too slow or the bit is dull. If your bit is advancing slowly but is requiring a lot of pressure, then your speed is too fast or your bit is dull. Refer to the chart at left for recommended speeds for bits. With a little practice, you'll know when you've found the best combination of feed rate, pressure and speed.

Boring with a drill press

Before you do any boring, cover the drill-press table with an auxiliary table of ¾-in. plywood. The auxiliary table supports the fibers on the underside of your work and may save you from running an expensive bit into the cast-iron table. Additionally, if a bit slips as you're chucking it, it'll only drop a few inches onto plywood instead of diving 4 ft., point first, into the cast-iron base. A fence is another drill-press helper. I clamp a fence to the table to help keep the work from spinning and to align a series of holes, such as bracket holes for shelving. My fences are made from straight lengths of 1x2 hardwood with a 3/16-in. chamfer on the bottom edge. The chamfer acts as an escape hatch for chips, which otherwise will pack against the fence, throwing off its registration.

To bore a hole, put your auxiliary table down first, and then adjust the table to a comfortable height. After selecting the right bit for the job (see the sidebar on p. 59), mount it in the chuck and set the spindle speed for the size and type of bit you are using (see the sidebar at left). If the bit has a center lead point, ding a center hole in your work with an awl or punch. For plug cutters and Forstner bits, which don't have lead points, lay out the circumference of the hole with a circle template (found in most art-supply stores). If you're boring an angled hole, lay out the hole's upper limit (where the boring will begin). And remember, the perimeter of an angled hole is an ellipse.

Most holes will be shallower than your press's stroke, but if the hole depth exceeds the stroke of the machine, you can use a bit extension shaft or drill as deep as you can, and then raise the table or block up the work until you get to the depth you need. If the hole depth is less than the stroke and shallower than the thickness of the workpiece, adjust and lock your quill travel. Keep in mind that the chip ejectors for both Forstner and Multi-Spur bits work best in shallow holes. In deep holes, the chips wad up, making it tough to back out the bit. Avoid wadding by raising these bits periodically to evacuate the waste. But don't retract a Multi-Spur bit completely from the hole, and then feed the spinning bit back in again because the teeth will likely grab the hole's edge and ruin the face of your work. Instead, stop the machine and feed the bit back into the hole. Restart the motor and continue boring.

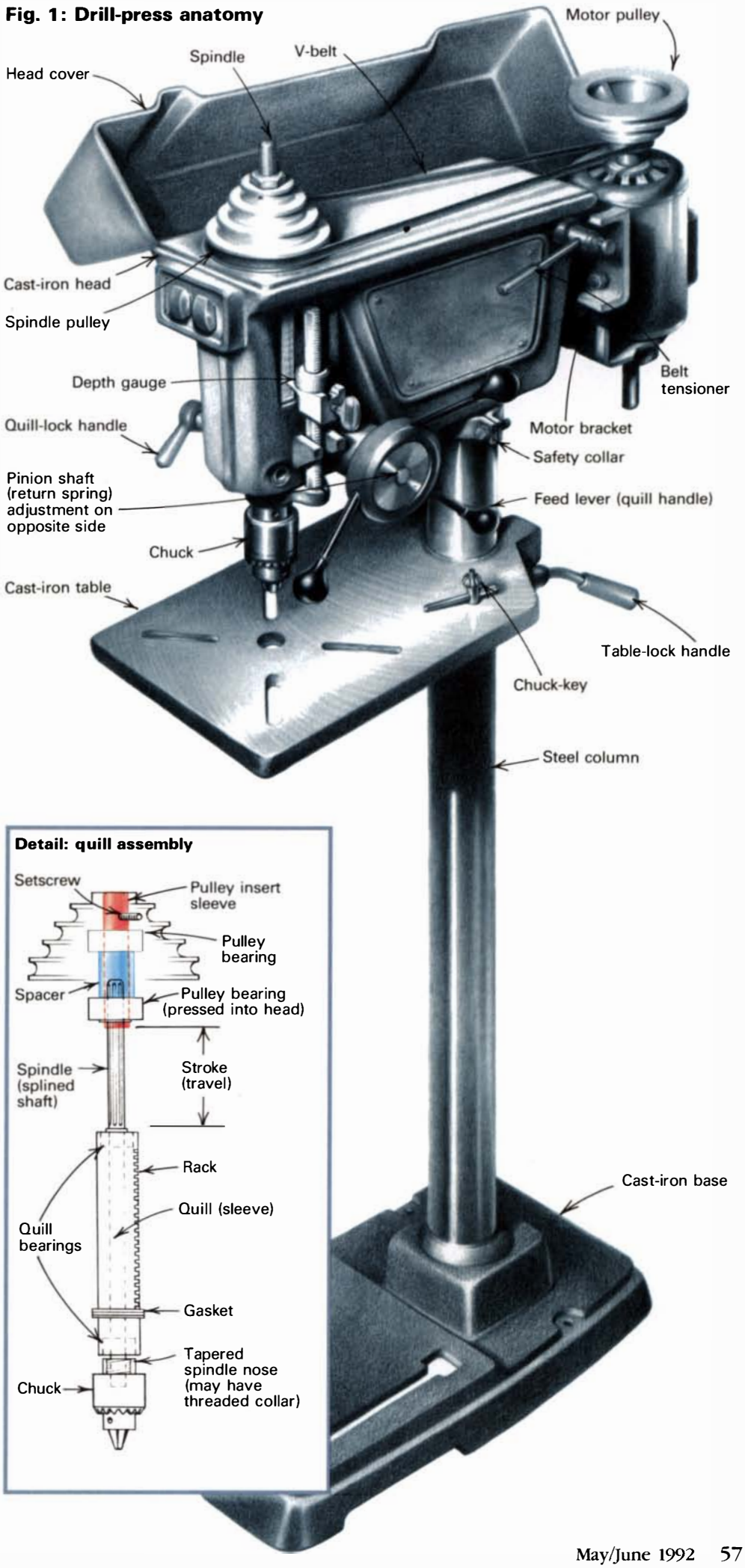
If you have to bore completely through the workpiece, there's a good chance you'll split the underside. You can avoid this by drilling only deep enough for the lead point to come through and then back drilling from the other side. To do this, first, lower the bit (with the motor off) and sink just the point into the auxiliary table. Lock the quill at this position and set the depth gauge to bore only this deep. Release the quill lock and fire up the machine. Get a good grip on your work or clamp it down, and bore until the depth stop bottoms out. Then turn the work over and look for the tiny pilot hole made by the point. If you back drill carefully, you'll wind up with a splinter-free hole. This method won't work with a Forstner bit because it doesn't have a lead point. So instead, set the depth stop to where the bit's rim barely brushes the underlayment. Then carefully bore down from the topside. Lower the bit gently until you feel the bit just break through.

To use a fence when boring a series of holes, first set the workpiece on the table. With the motor off, lightly tack your bit's point into a hole's center and lock the quill. You don't have to align the fence parallel to the table's edge because only one point—the bit's center—must be the correct distance from the fence. Snug the fence against the work (chamfered edge down and toward the bit), and clamp the fence to the table. Make sure the clamp pads are on a flat spot under the table, not against a rib where they might vibrate loose. Release the quill lock, start the motor and bore the first hole. Slide the work along the fence to bore the rest of the holes in a row, as shown in the photo on p. 55.

Fixtures and table vises

There are dozens of drill-press fixtures that you can make. A few that I like are a V-block

Fig. 1: Drill-press anatomy



Photos: Alec Waters

When boring angled holes *for splayed legs, Maas uses ramps like the pair in the foreground (above). A pocket-hole fixture (left, background) makes sloped (75°) holes for recessed screws. The steel vise (right, background) serves as a tilting table, which can precisely hold small pieces.*

A V-block cradles a dowel *being bored with a Forstner bit (left). To make the cradle, the author cut 45° chamfers on two edges of a foot-long 2x4, ripped the 2x4 in half and glued the halves together.*

(cradle), a pocket-hole fixture and a riser block (ramp). A V-block (see the photo above left) allows you to bore almost any cylindrical workpiece. If you try to bore a hole in a dowel freehand, the dowel will roll, and you will have a devil of a time getting the hole where you want it. But you can stabilize the dowel by cradling it in a V-block. To make a V-block, simply cut a 45° chamfer along two edges of a 1-ft. length of 2x4; then rip the piece in half, and glue the halves together to form a 90° cradle.

A pocket-hole fixture comes in handy when you need to make angled holes for screws that fasten an apron to a tabletop's underside or screws that join stiles to rails in a cabinet face frame. The fixture is L-shaped and like the V-block, forms a 90° cradle (see the photo above right). But a pocket holer tilts the workpiece at about a 75° angle. When using a pocket holer, always bore the large hole (land) that recesses the screw head first. Then bore the hole for the screw shank most of the way through before turning the work over to back drill. If you want your pocket holes in a neat line, add a fence to the setup.

You'll also need holes that are angled to the work surface when socketing splayed legs for a stool. If your press has a tilting table, you can bore the angled holes directly. Whenever I do this, however, my lumber, clamps and ruler end up on the floor. A good solution is to build a riser block or ramp, which is simply an inclined auxiliary table. To make a project-specific ramp, just cobble together some plywood scraps to form the table angle you need as well as a base with a clamping ear. A variation of this has a hinged table, so you can bore at almost any angle, much like a tilting table. The photo above right shows a couple of ramps that my students have made over the years.

A steel drill-press vise (see the photo above right), sometimes called a milling vise or an angle vise (also available from Enco), mimics a tilting table. But, because they have machined jaws with intersecting grooves to improve their grip, these vises let you precisely hold small objects, such as tubing and rods. They're also great finger savers. The more sophisticated vises have swiveling bases and cross slides, which allow you to hold odd-shaped pieces at very precise alignments to your drill-press spindle. Although some vises can be expensive, their accuracy and durability justifies the cost.

Other functions and accessories

The press can perform many secondary functions that are variations on boring, such as countersinking screw holes. You also can counterbore (superimpose a large hole over a smaller one) by clamping the work and using a Forstner or Multi-Spur bit. With a set of plug cutters (see the sidebar on the facing page) you can make cross-grain plugs for hiding counterbored screws, instead of using end-grain dowels. With a fence and a Forstner or Multi-Spur bit, you've got a basic mortiser; just bore interlocking holes and chisel the resulting slot square. A hollow-chisel mortising bit and a drill-press yoke will let you do both operations at once (see *FWW* #83, pp. 52-56).

For some drill-press users, a set of drum sanders for smoothing curved edges is also a must. But because drum sanding exerts substantial side pressure, you're likely to cause premature wear on the chuck, spindle or bearings. This is true for drill-press grinding and routing, too. Furthermore, drill-press routing isn't very effective because the press can generate only about one-fifth of the necessary speed. And without a guard and anti-kickback pawls, the procedure is dangerous. For these reasons, I leave sanding, grinding and routing to the tools designed specifically for those functions and save the drill press for the boring operations that it does so well. □

Bernie Maas is an associate professor of woodworking at Edinboro University of Pennsylvania.

Sources of supply

Information on sharpening methods and recommended speeds for bits is furnished by the following bit manufacturers.

Machine spur and Multi-Spur:
Forrest City Tool Co. (a division of Textron Corp), 620 23rd St. N. W., Hickory, NC 28601.

Forstner:
CONVALCO, 102 Washington St., PO Box 1957, New Britain, CT 06050

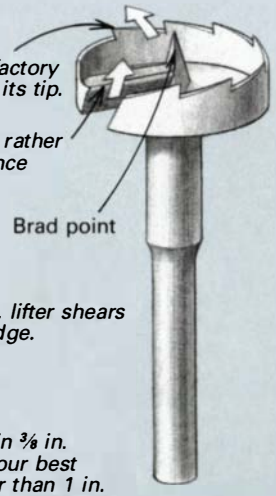
Spade:
Irwin Co., 92 Grant St., Wilmington, OH 45177

Powerbore:
Stanley Tools (a division of Stanley Works), 600 Myrtle St., New Britain, CT 06050

Twist drills and plug cutters:
Vermont American Tool Co., PO Box 340, Lincolnton, NC 28093.

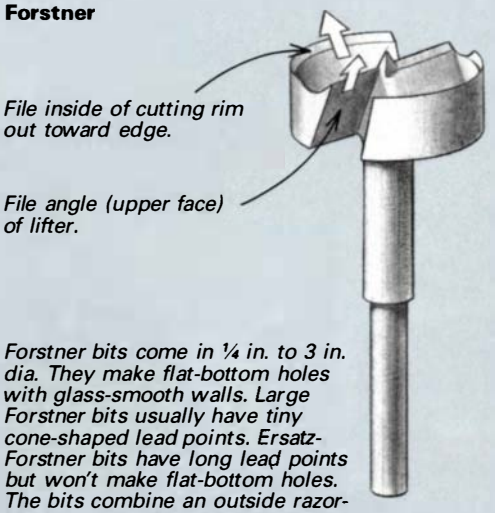
Common woodworking bits

Multi-Spur



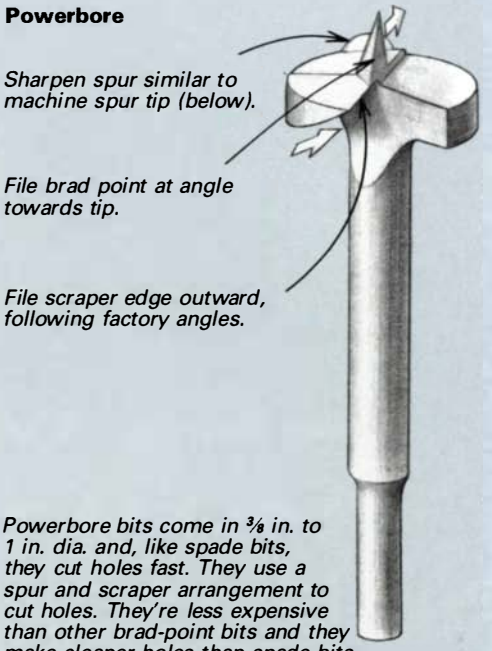
Multi-spur bits come in ⅜ in. to 4 in. dia. and are your best choice for holes larger than 1 in. They have brad points to seat and lead them into wood. They use saw-like teeth arranged in a circle to cut the outside of the hole and recessed lifter tips, which shear off and eject the wood chips. Bits can start holes at almost any angle, bore overlapping holes (good for mortises and rabbets) and start holes on curved surfaces or cylindrical workpieces.

Forstner



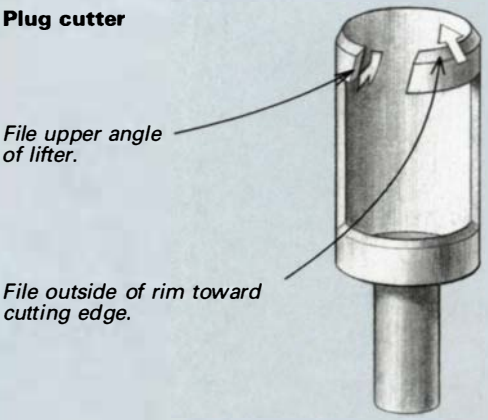
Forstner bits come in ¼ in. to 3 in. dia. They make flat-bottom holes with glass-smooth walls. Large Forstner bits usually have tiny cone-shaped lead points. Ersatz-Forstner bits have long lead points but won't make flat-bottom holes. The bits combine an outside razor-edged circular band, which cuts wood fibers with an interior pair of lifters that hog out material. Because lifters and cutters act on the same plane, these bits are increasingly grabby with size. Bits can bore angled holes, overlapping holes and holes on curved surfaces.

Powerbore



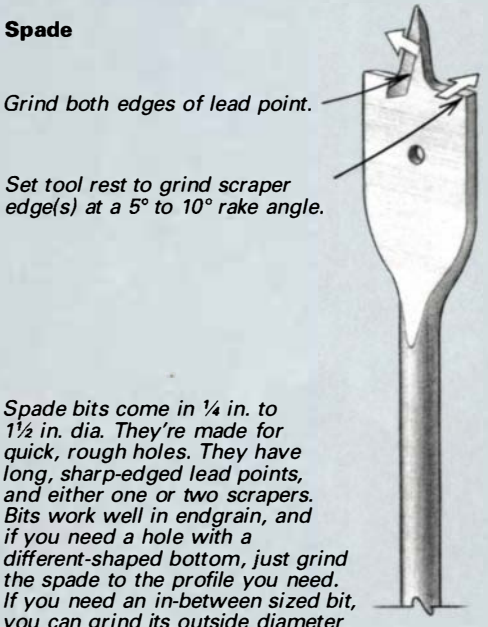
Powerbore bits come in ⅜ in. to 1 in. dia. and, like spade bits, they cut holes fast. They use a spur and scraper arrangement to cut holes. They're less expensive than other brad-point bits and they make cleaner holes than spade bits.

Plug cutter



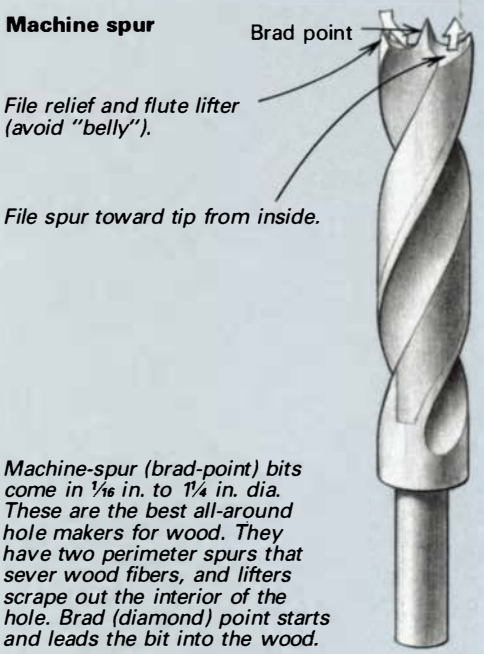
Plug cutters come in sizes from ¼ in. dia. to 2 in. dia., and come in lengths from under an inch to over 3 in. They use a cutting rim to scribe a hole's edge and a lifter to remove chips. Plug cutters can make a custom plug for almost any counterbored hole, whether to cover a screw head or to inlay some decoration.

Spade



Spade bits come in ¼ in. to 1½ in. dia. They're made for quick, rough holes. They have long, sharp-edged lead points, and either one or two scrapers. Bits work well in endgrain, and if you need a hole with a different-shaped bottom, just grind the spade to the profile you need. If you need an in-between sized bit, you can grind its outside diameter down to size.

Machine spur



Machine-spur (brad-point) bits come in 1/16 in. to 1¼ in. dia. These are the best all-around hole makers for wood. They have two perimeter spurs that sever wood fibers, and lifters scrape out the interior of the hole. Brad (diamond) point starts and leads the bit into the wood.

Choose the right bit and keep it sharp

Many of us have chucked twist bits in a drill press because they're cheap and handy. While twist drills can make holes in wood, they're really designed to cut metal. In contrast, screw-tipped bits, although made for wood (like augers designed for slow hand-boring), should never be used in a drill press. An auger in a press feeds itself too aggressively. The result is a torn-up hole or an unclamped workpiece whipping out of control. Luckily, there are better bit alternatives for boring crisp, precise holes in wood.

When I'm boring holes with a drill press, I usually use one of three bit types: machine spur (or brad point), Multi-Spur or Forstner. And although I don't use them as often—spade, Powerbore and plug-cutting—are three other bits that come in handy. All six types (shown in the drawing above) are designed to cut wood, so they are available from most woodworking-supply stores.

Basic bit care: Only run bits at their recommended speed, and don't toss them in a drawer. Instead, store them in an index, a cloth pouch, a rack or a compartmented wooden case. Also, douse bits with WD-40 every so often to discourage rust, and polish the bit's flutes and spirals with steel wool to keep them running cool. To keep carbon steel bits surgically sharp, touch up their edges with auger-bit files. Don't worry about wire burrs left from filing; they'll be stropped away as you bore holes. For hardened-steel edges, like those on most spade bits, use a grindstone. If you want to sharpen your twist drills, see Ken Donnell's article in *Fine Woodworking* #82, pp. 72-74. Finally, if you think a bit has been used or honed beyond reason, don't despair, and don't toss it out. For a nominal fee, most bit makers will restore bits to their factory specs. *–B.M.*

Drawing this page: Bob La Pointe

Tuning Your Drill Press

How to find and eliminate vibration, play and wobble

by Robert M. Vaughan

***To check for wobble** in a chuck, place a dial indicator on the table with its plunger perpendicular to the chuck. Unplug the machine and turn the spindle pulley; the gauge will read any eccentricity.*

Whether you buy a new drill press, a used one or you inherit one from granddad, you should periodically check its precision. Provided you've chucked in a straight, sharp bit, your press should run steadily, and it should bore clean holes. But there are basically three things that can prevent top performance in your press: vibration, play and wobble (runout).

Taking out vibration

Vibration usually originates at a press's drive system. If you feel vibration, open the head cover, turn the machine on and see if the pulleys idle smoothly and without noise, beyond the humming of the belt. If they don't, kill the power, remove the belt and check its condition. If the belt is brittle or has bumps or cuts, replace it. Next, hand spin the pulleys to see if they have any cracks or are out of round. Before replacing a pulley that wobbles, try retightening its setscrew. If there's a rumble or growl when the pulleys are spinning, dirty or worn bearings are likely the problem and should be replaced (for more on this, see *FWW* #90, pp. 49-51).

Removing quill side play and spindle end play

A press can develop side play between the head casting and the quill. To check for this, lower the quill and then shake it (not the chuck) from side to side to see how much slack there is. If the head casting is split at the front, there should be a bolt and locknut that will allow you to snug the halves together to take some of the play out. If your press has a solid head, then a remedy for side play is unlikely.

To check spindle end play, lock the quill, and try to move the chuck up and down. If there's end play, then the slack is probably between the quill and the collar above the upper quill bearing. To fix this, loosen the collar's setscrew, and slide the collar back to its original position. If you're lucky, a plate will be on the front of the head to access the collar. If not, the feed lever and the pinion will have to be removed along with releasing tension off the quill's return spring. This procedure is tricky and somewhat dangerous, so if your machine's instruction manual doesn't cover how to disassemble the spring assembly, have a professional do the work.

Wobble and how to find it

A wobbly chuck usually results from poor techniques. For example, you get a bit hung up in a workpiece and it swings around and bangs the column; or you let a workpiece dance around on the table while you're drum sanding the inside of a tight curve.

To detect and measure wobble, you'll need a dial indicator mounted on a magnetic base. First, chuck in a precision rod of known straightness. I use a ½-in.-dia. by 2-in.-long hardened, ground-steel dowel. Next, put the indicator's base on the table or column, so the plunger is touching the end of the rod. With the press unplugged and the head cover open, hand turn the spindle pulley and watch the indicator to pinpoint maximum fluctuation. Stop turning when the rod is at its farthest from the plunger. Wrap a piece of masking tape around the chuck, and mark a reference point above the plunger with a felt-tip marker. You can also check the outside of the chuck in this way (see the photo on the facing page). If I get more than .003-in. at the tip of the rod or more than .002-in. on the chuck, I feel it's time for some corrective action.

Correcting wobble with a smack

Rather than replacing your machine's most expensive parts (quill, spindle and chuck), you may be able to smack wobble out (see the bottom photo). Since a shock force knocked things out of alignment, an equal-and-opposite blow (within reason) can line things up again. Move the arm of the indicator out of the way, and then mount a hefty steel rod in the chuck and put on your safety glasses. Position the chuck so you can smack the rod directly opposite your mark. Your first tap should be a light one—similar to driving a ⅝-in. brad into soft pine. Chuck your precision rod, reposition the plunger and rotate the spindle to observe any change. Repeat until you've got less than .002-in. wobble.

Chuck removal

Occasionally, you'll have to remove a chuck to install a mortising yoke or to clean and repair the chuck. The backs of most chucks (including the key-and-scroll Jacob's type and the hand-tightening Albreicht type) have a tapered hole, which mounts either onto a matching tapered stud on the spindle nose or onto an adaptor that connects to the spindle. Chucks that mount directly to the spindle nose are usually held on either by a plain friction-fit or by a combination of friction and a threaded collar with snap ring.

If there's a ring with holes around the top of the chuck, you can unscrew this collar to force the chuck down off the spindle. To turn the collar, most press manufacturers provide a spanner (similar to an open-end wrench). Stick the spanner's pin into a hole in the lock ring, and insert the handle of the chuck-key into a chuck hole. Grip the key for leverage and loosen the collar by turning the spanner clockwise (see the center photo). Keep turning, even though it'll feel like the collar is tightening again as it bears against the top of the chuck. If it doesn't break free, wrap a cloth around the chuck, and clamp it in a drill-press table vise. Then try to unscrew the collar.

Chucks without collars can often be popped off with an ordinary open-end wrench. First, lower the quill to expose the top of the chuck, and lock the quill. Then take a wrench that fits over the shaft between the chuck and the quill, and dislodge the chuck by snapping the wrench upward, as shown in the top photo. If the chuck doesn't come off, rotate the spindle a half turn, add some Liquid Wrench and try again. Your next options are to try either prying the chuck off with a set of Jacob's-brand removal wedges or taking the quill assembly out of the head and bringing it to a machinist or service center to have the chuck removed.

To remove a chuck from an adaptor, first use a drift wedge to dislodge the adaptor (with chuck). Then drill a hole in a block of wood to accept the Morse-taper end of the adaptor. Split the block in two, and clamp it around the adaptor in a vise. Twist the chuck off with the key or a pipe wrench.

There are two ways to remove most chucks. *For chucks without a collar (above), lower and lock the quill and insert an open-end wrench above the chuck. Snap the wrench upward to pop the chuck off. To remove chucks with threaded collars (right), grip a chuck hole by inserting the handle of the chuck-key, and turn the collar clockwise with a spanner.*

The author uses a hammer *to remove wobble (below). He taps a chucked steel rod and then rechecks for runout with a dial indicator and a precision rod.*

Photo: author

Chuck remounting

To remount taper-fit chucks, first clean the mating surfaces with a dry rag and press the chuck onto the spindle by hand. Next, retract the chuck's jaws and strike the bottom of the chuck squarely with a wooden mallet. Or reseat the chuck by lowering it evenly against a piece of plywood laid on the press's table. If the spindle's nose is worn, a couple of drops of cyanoacrylate (super glue) can often hold it in place, and the resulting bond still can be broken easily when needed. Finally, check concentricity with the indicator and the straight rod again, and, if needed, fine-tune things with a few hammer taps on the heavier rod. You'll be amazed how light a blow it takes to align things. □

Robert Vaughan is a contributing editor to FWW.

Photos except where noted: Alec Waters

The Marquetry of Vadim Aksyeonov

An artist creates wooden renderings of Russian landmarks

by Jon Humboldt Gates

Despite the recent breakup of the Soviet Union and a declining economy in the region, the wealth of Russian art never diminishes. The marquetry of Vadim Aksyeonov is an impressive example of this wealth. Aksyeonov's wooden mosaics may be the most accomplished work of their kind to come from Russia. His proficiency as a painter is apparent; all his panels exhibit a remarkable three-dimensional quality (see the top photo on the facing page). In addition, Aksyeonov's work is of historical significance because some of the panels offer accurate representation of destroyed Russian landmarks.

Aksyeonov's formative years

Vadim Aksyeonov was born in the town of Menzelinsk, near the Ural mountains; from an early age, he dreamed of becoming a landscape oil painter. During World War II, while stationed in Lvov in the Ukraine, he sketched memorials and churchyards—scenes that would later inspire his marquetry. In 1955, Aksyeonov entered Moscow's Pedagogical Institute to study art and painting, and upon graduating, he became an art instructor. During this time, he often traveled to small villages to paint his favorite subjects: old churches and abandoned monasteries. In his free time, Aksyeonov taught himself the techniques of marquetry, and because his early works were translated directly from paintings, they displayed his characteristic treatments of perspective, light and shadow (see the bottom right photo on p. 64). In the 1980s, Aksyeonov began creating detailed architectural marquetry in tribute to Russian Orthodox and Islamic churches that were destroyed under Soviet authority. He also inlaid panels of old cityscapes, like the 18th-century Moscow Kremlin, shown in the bottom photo on the facing page. Working from photos and sketches, Aksyeonov recreated images of lost buildings by inlaying scores of native woods, like *beriozka* (birch), *kashtan* (walnut), and *klyoan* (maple).

Images preserved in wood

Aksyeonov begins his panels by drawing a subject (scaled by eye) with a pencil and a plastic straightedge. Then he transfers the drawing onto tracing paper so that he can reverse the tracing and copy it with carbon paper onto the back side of the veneers. Veneer samples are chosen for hue and grain pattern because Aksyeonov does not paint or dye any of them. He orients the veneer's grain and scribes the major elements of the scene onto them, such as the sky, foreground and buildings. After cutting out these large pieces with a knife that he crafted from a circular-sawblade tooth, he marks and cuts out the medium-sized elements from the larger pieces (see the photo above). Then he slides another wood variety under the hole and scribes the piece that will fit into the opening. He works from larger to smaller shapes, until all the pieces are cut.

Before mounting the veneers on a backboard of ¾-in.-thick particleboard or plywood, Aksyeonov uses sticky brown-paper tape to hold all the pieces together. He assembles the whole scene face up, and then cuts strips of tape, wets the glue side and presses the tape firmly over the whole surface of the scene. He smooths the taped joints with the butt of his knife's wooden handle. Next, he turns the taped-together sketch face down, spreads a thin, even coat of yellow glue onto the veneer back and the plywood backboard and places the glued surfaces together. To keep the assembly flat and the pressure uniform, Aksyeonov uses a 4-ft. by 6-ft. veneer press that's heated to about 150° by two ⅛-in.-thick zinc electric plates. The panel is sandwiched between two layers of newspaper, the zinc plates and two heavy wooden platens. The platens, which are larger than the panel and the plates, are pressed together, and the assembly is left to dry from 4 to 12 hours. After removing the panel from the press, Aksyeonov peels the brown tape from the surface, and scrapes off any dried glue. Next, he levels the veneers with a portable electric sander and hand-sands the surface to remove any scratches. Then he frames the panel and seals it with two coats of lacquer.

Current work

Vadim Aksyeonov, now 65 years old, continues to teach art and do marquetry during the evenings and weekends in the living room of his Moscow home. The panel he's working on in the photo above is his second attempt. When he was completing the scene the first time, his dog *Taiga* (Tundra) "ate it while his master wasn't looking." Every summer, Aksyeonov returns to Menzelinsk where he visits old friends, hunts in the forest, paints in the countryside and renews his creative energy for marquetry. □

Jon Humboldt Gates is a hobbyist woodworker, musician, and author of a collection of travel stories and photos titled Soviet Passage *(Moonstone Publishing, PO Box 911, Trinidad, Cal. 95570). Anyone wishing to arrange a gallery of Aksyeonov's marquetry, should contact Moonstone Publishing. Special thanks to journalist Oxana Khomenko for her research and translation help.*

Photo this page: author; all other photos: Giorgey Spiridonov

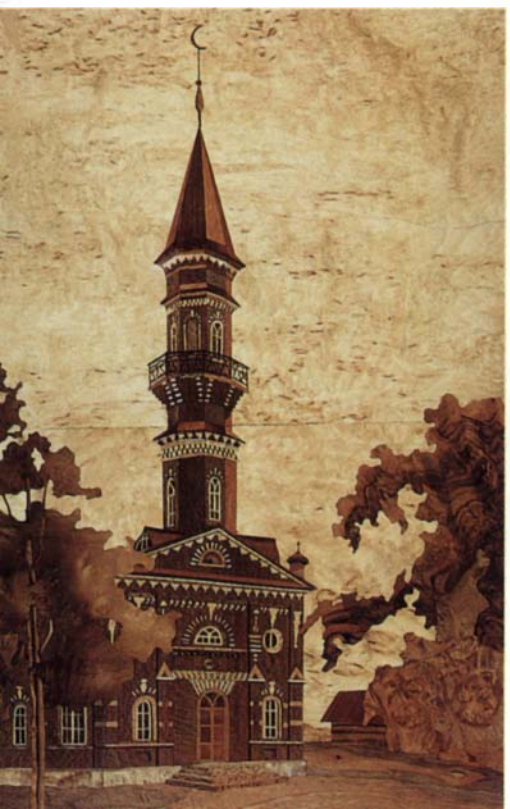
Russian landscape painter and marquetarian, Vadim Aksyeonov, *chooses highly figured woods for large elements, like the sky and foreground shown in this scene of the Church of Assumption at Pokrovka in Moscow. But he does most of the inlaying within the panel's building mass. This church was built from 1696 to 1699 and later demolished by the Soviets.*

To create this image of Moscow's 18th-century Kremlin, *Aksyeonov based every inlaid detail, including shadows, trees and reflections, on old sketches and photographs. The scene is an excellent example of the way Aksyeonov combines bold and subtle colors and grain.*

This panel of Temple of Christ the Saviour *(at left) contains hundreds of pieces cut from over a dozen varieties of wood from around the world. Built in Moscow in 1839 to 1880, the temple was razed in 1931. Church groups are now collecting funds to reconstruct the building at its former location across from the Kremlin.*

Aksyeonov began his Myechet Church panel (below left) during an annual return trip *to Menzelinsk. After its tower was destroyed in the 1930s, the building became a library until 1991 when it was returned to the Islamic faith, which is still popular in that region. The church, constructed in 1910, is currently having its tower rebuilt.*

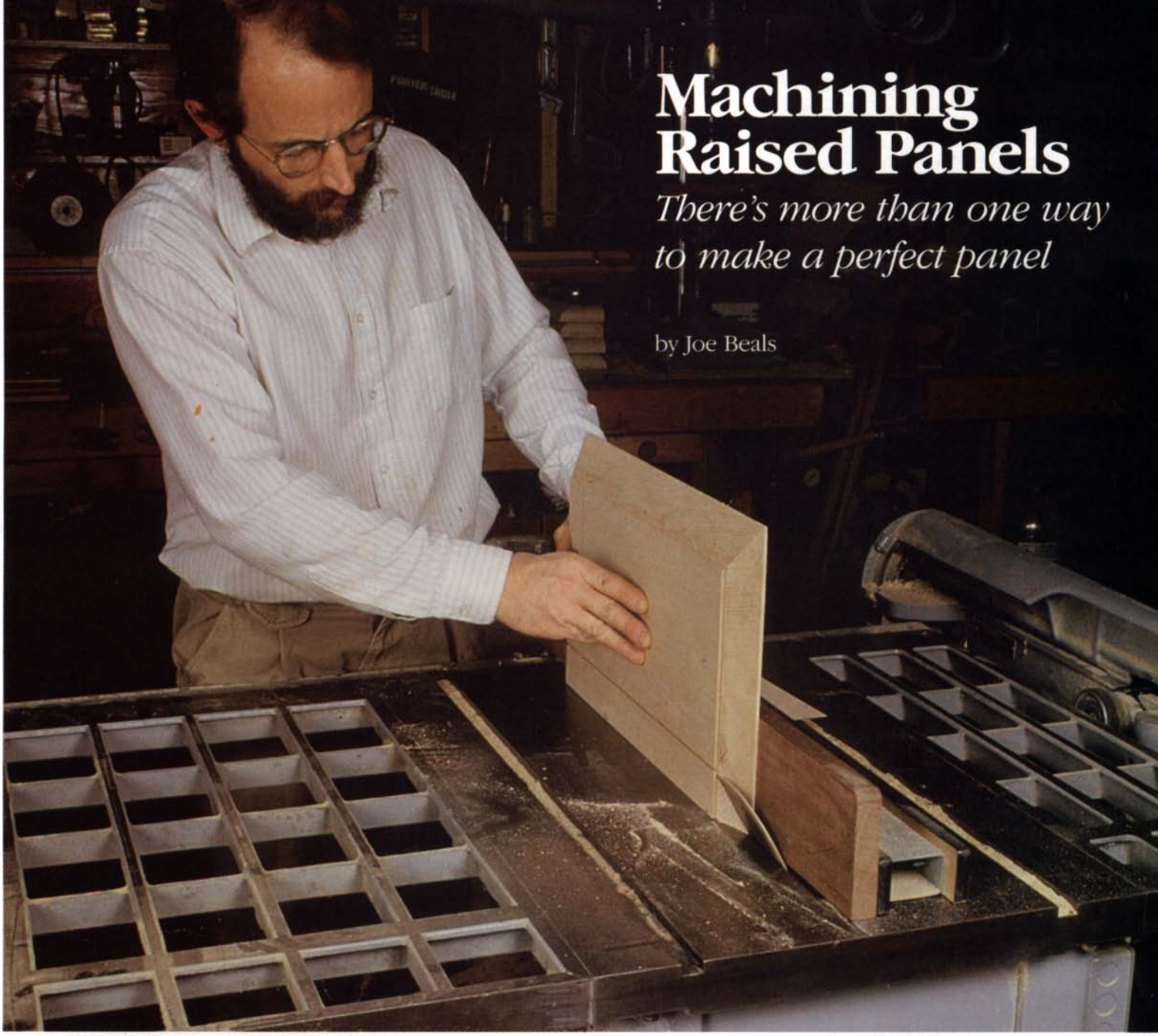
Exotic veneers are becoming increasingly difficult to locate in Russia. *When he can, Aksyeonov uses native maple, walnut and birch, as in the panel (below right), completed in 1976, of Karilia's Peter and Paul Chapel near St. Petersburg.*



Machining Raised Panels

There's more than one way to make a perfect panel

by Joe Beals



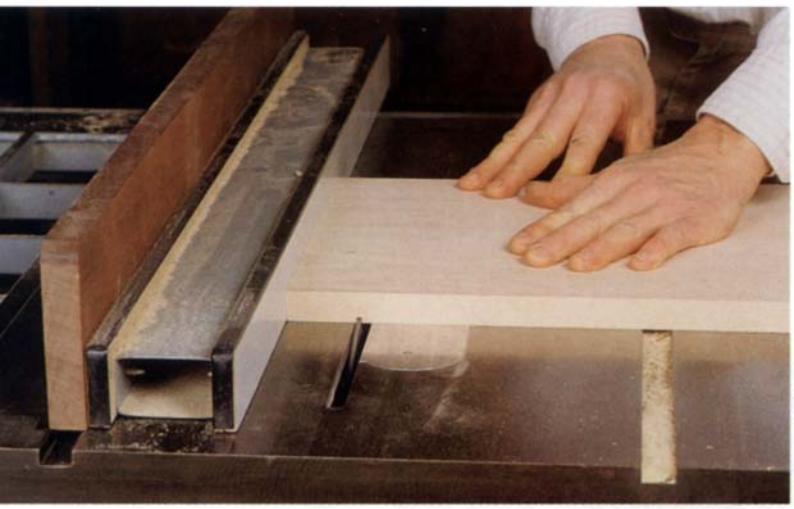
***A traditional raised panel is easily cut on the tablesaw** with the aid of a tall auxiliary fence to help stabilize the panel. A zero-clearance throat plate supports the edge of the panel on the table. The square shoulders of the panel's field are cut first.*

Despite their apparent simplicity, the panels used in framed cabinet doors demand a thoughtful approach to ensure good results with machine techniques. The door frame bears the load, but a poorly made panel can distort or break the frame that surrounds it. In addition, because panels are most of what we see, their construction requires as much attention to design detail as does the frame. (See my article, "Cabinet Door Frames," in *FWW* #86, pp. 76-79.)

The origin of the raised panel is a classic case of form following function. The problem is how to build a dimensionally stable, solid-wood door. The solution is a frame built from narrow stock that moves very little with seasonal changes of humidity. The wide beveled-edge panels are free to expand and contract within the frame grooves that capture them.

Early colonial panels reveal this method of construction in its most basic form. Panel edges are beveled without much finesse, and the panel is often left rough on the back side. Dedicated panel-raising planes evolved that could produce a smooth, accurate bevel worked to a shoulder, giving a crisp, pleasing outline to the panel field. Panel-raising planes also allowed the bevel to be varied from narrow and steep for small doors to broad and shallow for large doors. In addition, the shoulder depth could be varied to accommodate a range of stock thicknesses, and the face of the panel could be made recessed, flush or proud of the frame.

In straightgrain, easily worked woods, such as walnut, mahogany or clear pine, raising an occasional panel by hand is very satisfying. (See the sidebar on p. 69). But for production runs or for panels made of dense woods, such as oak, maple or cherry, a machine method is more practical. Although I prefer a heavy-duty shaper, excellent panels can be raised on the tablesaw, as shown in the photo above. Panels can also be raised with a table-mounted router, but it's potentially dangerous. When beveling a panel, a good deal of stock must be removed, which puts a heavy load on the router bit. Also, typical panel-raising bits are massive chunks of steel, which can test the bearings and durability of a router. To reduce these stresses, I recommend removing most of the waste



***The shoulders that define the field** of the panel are cut by adjusting the rip fence the appropriate distance from the blade and setting the blade about ⅛ in. above the table.*

with the tablesaw and then making a finishing cut on the shaper or router table. Vertical panel bits for routers are a fairly recent advancement in router-panel-raising technology (see the sidebar on p. 68). Because these bits cut in the vertical plane, they're smaller and safer. Before I get into panel-raising techniques, however, I'll first talk about preparing the panel stock.

Gluing up and sizing panels

Careful selection of stock for panels is very important. All panel stock for a single piece of furniture or for a set of cabinets to be installed in the same room should be similar in grain pattern and color. Since it's likely you will have to glue up stock for wide panels, matching these panels is equally important. Many authors advise alternating heart and sap faces to produce a more stable panel. They reason that because plainsawn stock tends to cup toward the sap or bark side, stock that's glued up with heart or sap sides all on the same surface will develop a large cumulative bow. In contrast, stock glued with alternating heart and sap faces up will produce a less-troublesome, wave-like distortion. I like the theory, but in actual practice, too slavish a devotion to principle can produce results that are technically correct and aesthetically lousy. Remember that the goal is a glued-up panel that looks like a single piece of wood: if two heart faces match perfectly, put them together.

I set glued-up panel stock aside for a day or two to let the glue dry and to allow the wood to relax from clamping pressure, before cleaning the glue joints and dressing the surfaces with a sharp bench or jack plane. Raking off glue squeeze-out with a scraper can cause tearout, which telegraphs the glueline. Although I prefer a handplane, a surface planer or wide-belt sander can also be used to dress the panels. Whichever method is used, make sure all panels are the same thickness so that when the bevels are machined, the panels will have uniform edges to fit to the frames' grooves. The fielded surface should require only a light finish sanding after beveling to minimize the risk that the shoulders will be rounded over.

Tablesawn panels

I will discuss my method for raising panels on the tablesaw first because I use the saw to remove most of the waste even when raising panels on a shaper or router table. Sawn panels require two cuts: one for the shoulder and one for the bevel. To avoid trapping the cutoff scrap between the blade and the fence, I cut the shoulder first and then saw the bevel with the blade tilted away from the fence. I always use scrap stock to test my setups. To cut the shoulders, I set the fence and blade height to my layout lines on the test piece and then cut all four shoulders, as shown in the photo at left. A sharp carbide blade leaves a crisp, clean edge, especially across the endgrain.

To saw the bevels, hold the panels vertically on the saw table, and tilt the blade to the bevel's angle. Start sawing one end, and rotate around the panel from end to side. A high auxiliary fence stabilizes the panel, as shown in the photo on p. 65. A carbide blade will tend to burn the endgrain bevel, but a razor-sharp steel combination blade won't. A hollow-ground steel planer blade might be even better, but the setup must be perfect to avoid scorch marks. In addition to cutting cleaner and faster, a steel blade also can be filed sharp halfway through a run of panels.

No matter how carefully you saw, the panels will still need to be cleaned up. I dress the bevels with a skew-iron rabbet plane that will cut to the shoulders. If the sawing went well, the planing is quick. Sanding is a less satisfactory alternative: It does not produce the wonderful sheen of sliced fibers that a plane does and can be terribly time-consuming on a production run of panels.

Router- or shaper-cut panels

Panel raising on the spindle shaper or router table is accurate and convenient, though not to the degree you might expect. Because the bevel profile is fixed by the cutter pattern, you can obtain a range of profiles only by stocking an assortment of cutters—at $100 or more per cutter. For that reason, I suggest starting with a traditional flat bevel and square shoulder profile, a time-tested, classic pattern that always looks good. Discount carbide cutters are available, but they often sacrifice quality of material and accurate grinding. You'll be happier with good cutters, such as those manufactured by Freud (PO Box 7187, 218 Feld Avenue, High Point, N.C. 27264; 919-434-3171) or Freeborn Tool Co., Inc. (PO Box 3403, Spokane, Wash. 99220-3403; 800-523-8988 or 509-535-3075).

A panel-raising cutter produces a specific profile that only can be varied by a small range of adjustment in the shoulder depth. Most cutters are for ¾-in. stock, which leaves a ¼-in.-thick tongue at the panel perimeter. Thicker stock can be accommodated by rabbeting the back side of the panel to produce an appropriate tongue.

Cutting the waste from around the panel field requires removing a surprisingly large volume of wood. While it is possible to shape an edge in a single, full-depth pass, it's hard on the cutter and demands tremendous power. Furthermore, producing an acceptable finish in one cut is almost impossible. Of course, you could make multiple passes, but it's better to waste the bulk of material by beveling the panel's edges on the tablesaw. This may seem like a step backward, but the work will go faster, there will be less dust and the bulk of stock removal is done with an easily sharpened sawblade rather than by a very expensive cutter.

Before beveling the panel on the tablesaw, I set up the shaper first, adjusting the fence for a full profile cut and setting the cutter height to the appropriate shoulder depth or tongue thickness. A full-depth pass in a piece of pine lets me preview the profile and creates a pattern for setting the tablesaw fence and blade angle. Because the sawcut will waste only the excess material, I don't bother with the shoulder cut. With the sawing done, I can cut the finished profile on the shaper with a single, full-depth pass, as shown in the top photo on p. 68. If I were using a table-mounted router instead of a shaper, I would cut the final profile in two light passes.

Although I prefer a shaper for panel raising, the table-mounted router offers one distinct advantage. The router runs with the cutter below the work, while standard shaper practice has the cutter mounted above the work, rotating counter-clockwise. I have two objections to this shaper setup: first, the cutter is entirely exposed and

Photos except where noted: Charley Robinson; drawings: Lee Hov

Fig. 1: Fitting the panel to the frame

Take panel dimensions from a door frame assembled dry, and always allow clearance so an expanding panel will not push the frame apart. Allow 1/16 in. per foot of panel width when building during high humidity and 1/8 in. in low humidity. Panels with flat shoulders or concave bevels provide the best fit with no interference between the face of the bevel and the groove. Wedge-shaped bevels must have clearance between the face of the bevel and the frame, or the bevel will bind with the frame before the panel's edge bottoms in the frame's groove. If the bevel binds, either the frame joints will break apart (especially if the frame is built with stub tenons common to cope-and-stick shaper cutters) or the stiles will split above the groove. Long bevels fit the groove better and are less likely to bind with the frame.

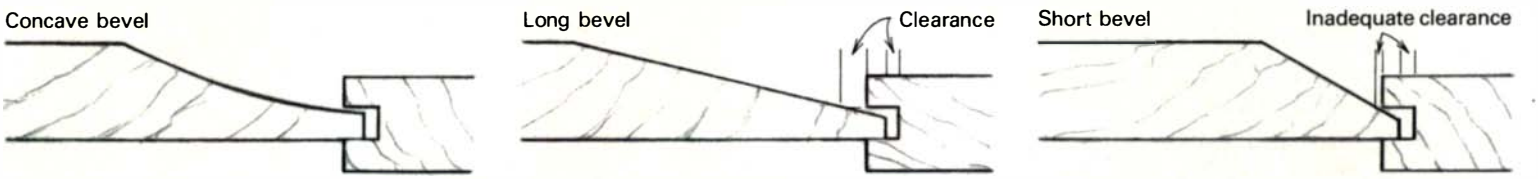
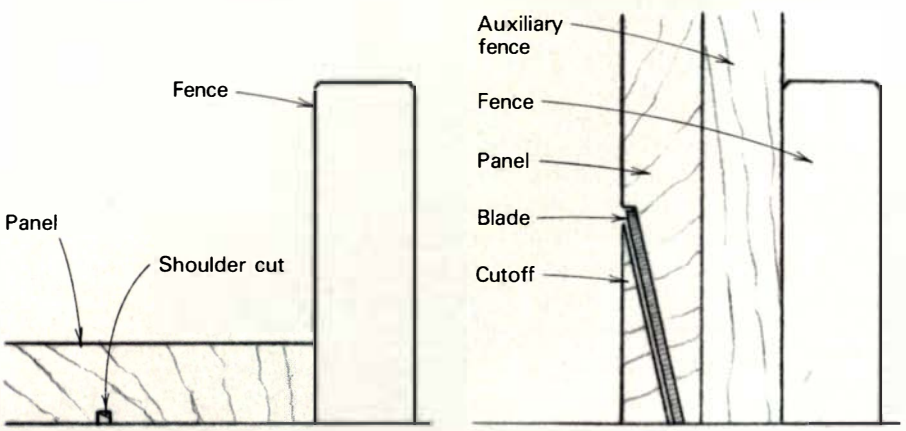


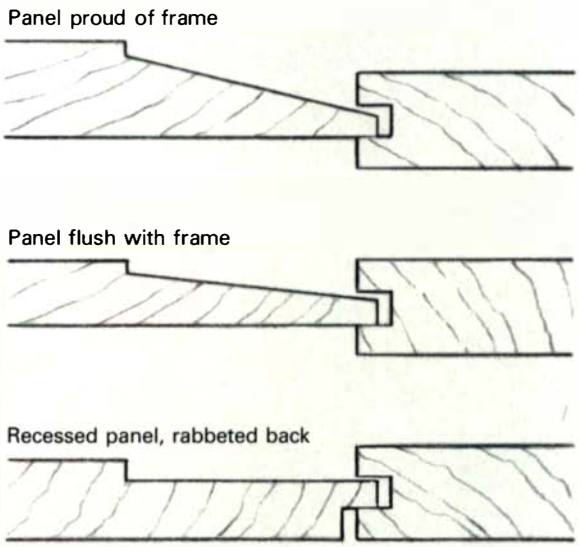
Fig. 2: Raising wood panels

Tablesawn panels

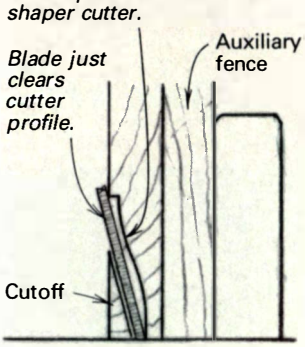
Raising a panel on the tablesawn requires a shoulder cut and a bevel cut as shown below. Position the fence so cutoff is not trapped between blade and fence. Tablesawn panels can have a variety of bevel widths and angles, but remember to size the bevel's edge so that it doesn't bind with the frame.



Design variations

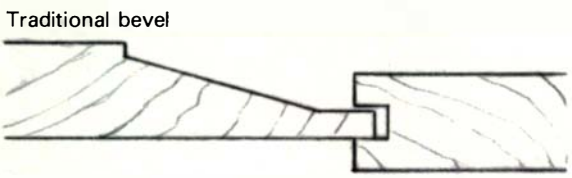


Actual profile of router or shaper cutter.

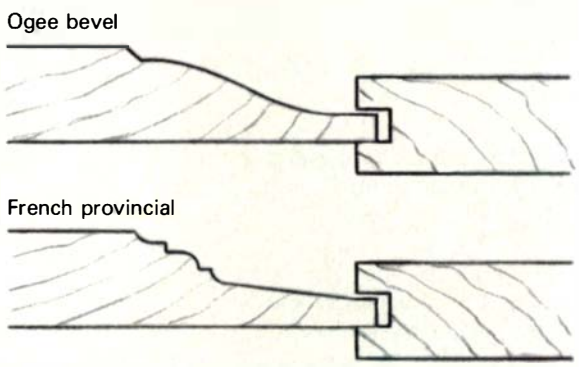


Router- or shaper-made panels

Beveling panel stock on the tablesaw before shaping or routing reduces wear on cutters and allows a smooth finish cut in just one or two passes. Shown here are a few of the profiles available for shaper and router cutters. Note the flat shoulder that fits snugly in the frame's groove and eliminates the wedging action of a tablesawn or hand-raised bevel.



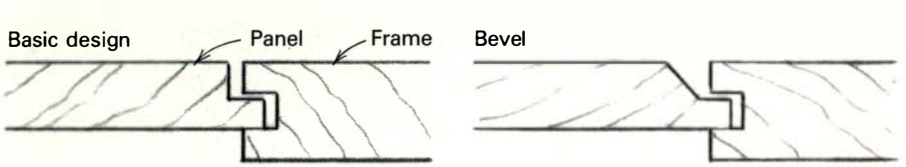
Design variations

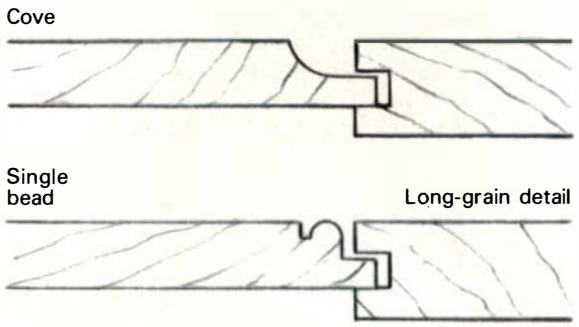


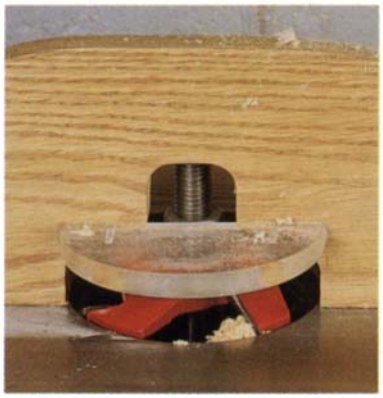
Rabbeted panels

Panels can also be raised by cutting a rabbet around the perimeter. Leave the same clearance between the edge of the field and the frame as between the panel's edge and the groove's bottom.

Details worked on the edge of the panel's field can soften the edge and reduce the visual effect of panel movement. Beading and its variants, such as V-grooves, are typically worked only on the two long-grain edges to avoid a fragile condition across the endgrain.







***By reversing his shaper** to run with a clockwise rotation, the author was able to mount the cutter below the table, thus reducing the hazards of an exposed overhead cutter and minimizing the chances of damaging the panel. A second spindle nut, tightened to the first nut, ensures the cutter won't come loose. Because this mounting can restrict chip ejection (left), the machine should be turned off and the chips cleared often.*

however well-guarded, a hazard to your hands, and second, if you jog or bump the panel, it will be damaged instantly and possibly kicked back. Large or heavy panels are particularly hard to control, even on a big shaper table. Table extensions and hold-downs can reduce the chance of damaged panels, but your fingers are still at risk.

The solution to both problems is to run the shaper cutter submerged, in clockwise rotation. Because the stock is above the cutter, any inadvertent movement off the table simply leaves a crown that can be removed with another pass. With the stock shielding the cutter, there is far less danger of trimming your hands to the bevel profile. However, there is one potential hazard when using this method. Panel-raising cutters are typically very large and virtually will fill the table opening through which they protrude. Depending on your shaper's design, there may not be enough room to eject the chips, as shown in the bottom left photo. Trapped chips can bog down the motor, so I stop the machine after every few panels to blow out the waste with compressed air.

Not all shapers have a reversing option, which means running a submerged cutter may not be possible. If you retrofit a reversing switch to your shaper, as I did to mine, remember that the clockwise rotation will tend to loosen the spindle nut. To prevent this, I screw on a jam nut and tighten it hard against the spindle nut.

Finishing

A discussion about raised panels would be incomplete without the finishing argument. Many woodworkers finish the panels before assembling the frame, so shrinkage won't expose an unfinished edge. This approach may work for a panel or two, but for production runs, it doubles or triples my completion time. I've found that when the panel and frame are finished together after assembly, enough stain will seep into the groove along the bevel to accommodate any panel shrinkage. If the panel's fit precludes this, then the panel is too tight in its grooves. □

Joe Beals is a designer, builder and custom woodworker who lives in Marshfield, Mass.

Vertical router bits raise panels safely

by Charley Robinson

Because I don't have a shaper, I rely on my table-mounted router for my shaping operations. But I've never felt comfortable running the 3½-in.-dia. bits that are designed for raising panels. The noise and breeze created by this whirring mass, whose rim speed exceeds 225 MPH at a typical router speed of 22,000 RPM, is a warning of the potential dangers. The large cutter exerts considerable leverage, requires more feed pressure than usual and makes the workpiece hard to control. At best, this size bit should be run in the 11,000 RPM to 13,000 RPM range, which means you would need a large, variable-speed router or a separate speed controller.

Because of these problems, I avoided raising panels on my router table until I came across panel-raising bits designed to work in the vertical plane, as shown in the photo at right. The rim speed of these 1-in.-dia. bits is only a fraction of the larger bits, and, therefore, they don't require reduced speeds. The smaller diameter also reduces the leverage and makes it safer and easier to feed stock.

I use a 10-in.-tall auxiliary fence to support the panel, as shown in the photo. The bit is recessed into the fence, so the panel is not trapped between the bit and the fence. To save wear and tear on the bit and router, and to reduce the dust, I bevel the panel on the tablesaw first to remove most of the waste. Then I make two passes on the router table, adjusting the fence so the last pass cuts away only about 1/16 in., which produces a clean, smooth bevel. Vertical panel-raising bits are available from the inventor, Brad Witt of Woodhaven (5323 W. Kimberly Road, Davenport, Ia. 52806; 800-344-6657) and most mail-order tool catalogs. □

Charley Robinson is an assistant editor at FWW.

Photo: Vincent Laurence

Beveling panels by hand

by Tom Wisshack

The beveled panel is the humble antecedent of the raised panel. It was most likely introduced as a practical necessity at a time when thin boards were either impractical or unobtainable. By beveling the edges of a relatively thick board, the craftsman could fit it into a frame and avoid the tedious resawing of boards. As a general rule, the flat side of the panel was placed outward, and the bevel was inside or on the back where it wouldn't show. A distinct advantage of this construction was that boards of uneven thickness could be used for the panels by simply adjusting the amount of bevel.

The decorative merit of beveled panels was recognized by the 17th century when beveled panels with molding applied around the field were used on drawer fronts and cabinet ends. The beveled panel remained an important structural element in furniture during the 18th and 19th centuries. In America, the bottoms of drawers almost invariably were beveled to fit unglued into grooves in the fronts and sides of drawers so that movement could occur. This basic technique is as sound today as it was in the 18th century.

When beveling the back of a panel, the width of the groove in the frame and the thickness of the panel are the main considerations. In general, a long bevel will allow the panel to more properly fill its corresponding groove (see figure 1 on p. 67). Beveled panels that were not meant to be seen were often worked without specific dimensions. For an exposed beveled panel, the aesthetic appeal of the panel plays a large role, and the surface of the panel should be divided into attractive, well-proportioned parts. But the panels still must fit the frame properly.

I join my frames with pegged mortise-and-tenon joints, cutting haunched tenons on the tablesaw to fit mortises roughed out on a drill press and cleaned up with a chisel. To make the panel, I glue up stock ½ in. oversized and, after the glue dries, trim the panel to fit exactly within the frame's grooves. Later, I plane a little off the panel's edge to allow for normal wood movement.

I rough plane both sides of the panel but leave the face to be polished with a block plane, after the panel has been beveled. After determining the appropriate proportions for the bevels and field, I use a marking gauge to draw a shoulder line around the perimeter of the panel, as shown in the drawing below.

I bevel the endgrain first, after chiseling away one corner of the panel, as shown in the drawing, so that when I plane toward that corner, I won't splinter the edge of the panel. For a panel in the 10-in. to 15-in.-wide range, a 14-in. jack plane is ideal for making the initial cuts to establish the angle. Then I switch to a sharp block plane for the final trimming. I get the cleanest cuts on the endgrain by holding the plane slightly diagonal to the bevel. Cuts should be made with long, smooth strokes, parallel to the panel's edge. I test the fit of the panel to the frame with a mullet, as shown in the drawing. I stop planing when the mullet fits snugly onto the bevel without allowing the panel to quite reach the full depth of the groove.

Once the first bevel is planed, I use a marking gauge to transfer the edge thickness around the panel as a guide for planing the other bevels. However, I always use the mullet to gauge the bevels as I make my finishing cuts. With a freshly sharpened plane blade, I make the final cuts to allow the panel to bottom out in the groove. After all four bevels have been planed, I trial-fit the frame and panel together.

At this time, I also trim a small amount off each long-grain edge to allow for seasonal movement. For most of my panels, which tend to be 10-in. to 15-in. wide, I allow a ⅛-in.-wide gap on each side and about 1/16-in. on top and bottom. To keep the panel from rattling in the frame, I put a small wooden pin through the center of the top and bottom rails to hold the panel centered in its opening yet allow it to shrink and expand as needed. I prefer to paint, stain or apply a coat of sealer to panels before assembly to avoid a white line along the panel's edge. I allow extra clearance for the thickness of the finish.

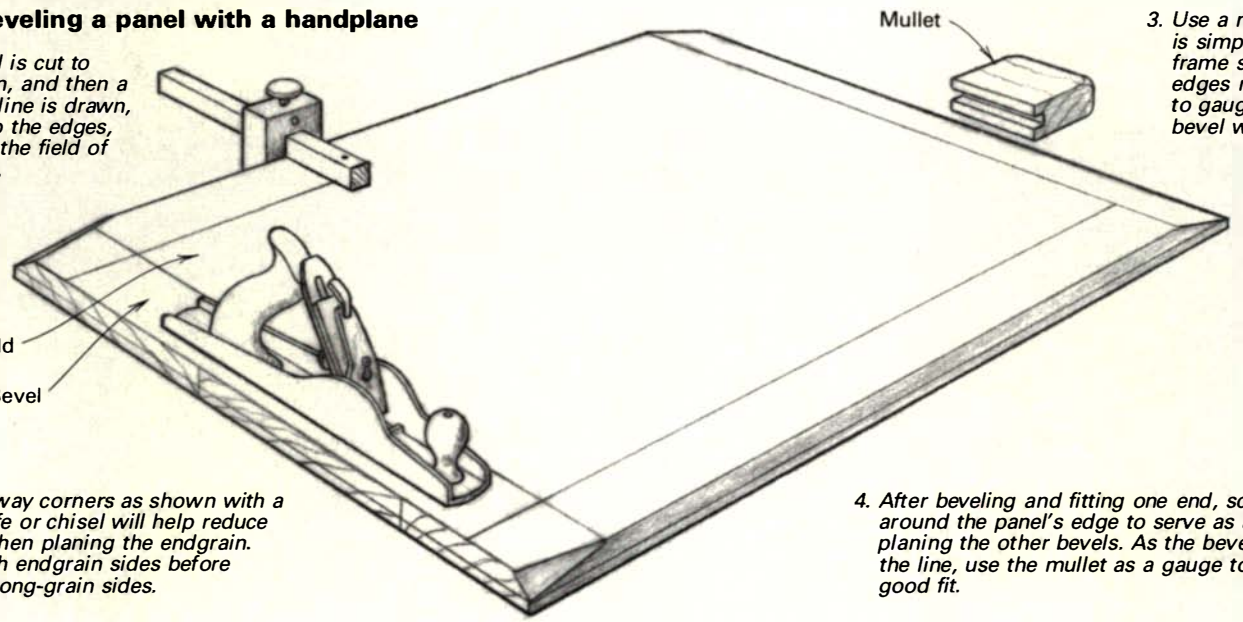
When gluing up a frame and panel, I've learned to have absolutely everything ready and handy, including a work list. When gluing the mortise and tenon, I'm careful to avoid getting even the smallest amount of glue near either the panel or its groove. I assemble the frame and panel, checking my work list at each step, and then attach the bar clamps, positioning them so that I have room to install the pegs. After removing any surplus glue, I drill holes for and install two square pegs through each joint.

A work list for such a simple job might seem ridiculous, yet I once glued a frame together and drove the pegs home before realizing I had forgotten to install the panel. With great care, I was able to get the frame apart and prepare it for reassembly. Proud of this effort, I applied glue to the various parts and reassembled them. Only when I reached for the clamps did I realize I had again left out the panel. Fortunately, I was able to wiggle the frame apart enough to slide the panel in place. That's why I always make a work list that includes the reminder, in large, red letters, "INSTALL PANEL." □

Tom Wisshack makes and restores fine furniture and is a wood-finishing consultant in Galesburg, Ill.

Fig. 3: Beveling a panel with a handplane

1. *The panel is cut to dimension, and then a shoulder line is drawn, parallel to the edges, to define the field of the panel.*



3. *Use a mullet, which is simply a scrap of frame stock with the edges rounded over, to gauge the panel bevel while planing.*

2. *Cutting away corners as shown with a sharp knife or chisel will help reduce tearout when planing the endgrain. Bevel both endgrain sides before beveling long-grain sides.*

4. *After beveling and fitting one end, scribe a line around the panel's edge to serve as a guide for planing the other bevels. As the bevel approaches the line, use the mullet as a gauge to ensure a good fit.*

Warner's glue-block method for mounting a blank on the lathe *starts with turning the bottom flat using a scraping tool (top inset), which leaves a small stub tenon. A shallow mortise for the tenon is then cut with a 3/8-in.-wide scraper into the glue block, which is screwed to a faceplate (center inset). After the blank has been glued to the block with gap-filling cyanoacrylate adhesive and turned, it is parted off (above) with a narrow parting tool. Finally, the bowl is remounted between the tailstock and a foam-covered plywood disc secured to the headstock, and the foot is cleaned up (bottom inset).*

Bowl Turning with a Glue Block

Fast-setting glue and a stub tenon secure and center the blank

by Jack Warner

Photos this page: Dick Burrows

Securing a workpiece on the lathe for faceplate turning is a problem with which every beginner must wrestle. The old standbys—faceplates, screw chucks, expansive chucks and spigot chucks—all have distinct disadvantages. Faceplates and screw chucks require that the piece have a heavy base to take screws big enough to keep the piece on the lathe, and then you're left with holes to fill. As an alternative, the section of the base that contains the screw (or screws) can be turned away when finishing the foot, but that's a waste of material. When using expansive chucks or spigot chucks, you must make the size and shape of the workpiece's foot fit the chuck, which can put a crimp in your design.

About four years ago, North Carolina turner Knud Oland (now deceased) showed me a method of mounting a turning blank on the lathe via a glue block. This method has served me flawlessly and also is now in very common use among turners. The blank is mated to the glue block with a small mortise-and-tenon joint and glued in place with a quick-setting cyanoacrylate (CA) adhesive. After turning, the work is parted off by cutting into the glue block—not the workpiece. There is virtually no waste and the method never intrudes upon the design.

The method depends on using cyanoacrylate glue, which is super strong and seems to work equally well with either wet or dry wood. Further, the glue sets in a matter of seconds. This means that the glue block and turning blank can be held together instead of clamped. There are at least half a dozen brands of CA that are suitable for turning purposes and that can be purchased through most woodworking supply houses and practically all hobby shops (see the sidebar at right).

Fitting the glue block to the workpiece

I've stumbled upon a simple way of making a small mortise-and-tenon joint that creates a mechanical connection between the workpiece and the glue block. The joint provides little mechanical strength because the tenon is usually cross-grain, but it provides an exact reference for recentering the piece. This is especially helpful when it comes time to finish the bottom of the bowl.

To make the tenon on the bottom of the workpiece, I mount the blank between lathe centers, with the top of the blank at the headstock and a cup center in the tailstock. After turning the wood round, I flatten the bottom with a gouge to get it close and then use a heavy-skewed scraper to get it as flat as possible (see the top inset photo on the facing page). I use the straight edge of the scraper's shank to check for flatness so that I don't have to take the work off the lathe. Using the scraper to work right up to the lathe's ½-in. cup center, I leave a ½-in.-dia. nipple of wood, which creates a tenon exactly in the center of the foot. Usually this tenon is no more than ⅛ in. long, but if I had to waste a lot of wood getting the foot flat, it could be a good deal longer.

After the workpiece is removed from the lathe, I make the glue block and secure it to a small faceplate. The wood used for the glue block is important and deserves careful consideration. Obviously, you don't want to pay a bundle for wood to be used this way. Poplar and oak seem to crack too easily. In the Southeast, hard maple is relatively cheap, and it works well. I generally use 8/4 stock, so the same block can be used several times. But if I'm going to turn something especially hairy—unusually large or unbalanced—I'll use 4/4 stock and hold it to the faceplate with screws that leave just enough room to part the work off right below the glueline after turning. I roughcut each glue block to size on the bandsaw first, and secure it to the faceplate with 2-in.-long square-drive screws. Then I turn the face of the block flat (just as I did with the workpiece) and turn the block to the same diameter as the faceplate. With a narrow scraper, I cut a ½-in.-dia.

Cyanoacrylates are super glues

Although it has become virtually a generic name among woodturners, Hot Stuff no longer has the market to itself. I've found at least three other lines of cyanoacrylate (CA) intended for similar purposes. Perhaps the most commonly available is the Pronto line of adhesives made by 3M, chiefly CA-100, a fairly high-viscosity, gap-filling liquid, and CA-50, a gel that comes in a tube. There's also a product called Zap, which is a low-viscosity liquid that's available from Oland Craft (Route 1, PO Box 75, Brasstown, N.C. 28902; 704-837-2273). And just coming on the market is Wood-Pro glue, available in ultra-thin, medium and maximum viscosities and a gel. This glue was originally formulated for wood and has a particularly interesting property: If the accelerator isn't used, it has a 90-minute work time before setting. Colorants also will be available for the Wood-Pro glue. For information on this product, call Woodcare Products at (800) 676-4583.

Because all my experience is with Hot Stuff, that's what I'll talk about from here on. Hot Stuff comes in three mixtures—regular, gap filling and super gap filling. The regular formula is too thin to be of any use for holding work onto the lathe, but the gap-filling formula—the bottle with the yellow label—is generally just right. Although CAs are not cheap, a 2 oz. bottle, which costs about $10, goes a long way: Generally I can mount several dozen bowls (to glue blocks) out of a single bottle. For best results, an accelerator should be used with the glue. Satellite City makes an accelerator called Hot Shot, which can be found in most hobby shops or ordered from Satellite City (PO Box 836, Simi Valley, Cal. 93062; 805-522-0062).

Bob Hunter, a representative of Satellite City, told me the trick to storing an opened bottle of Hot Stuff for up to one year: squeeze it until a little bead of glue appears at the end of the nozzle; then cap it and store it upside down.

Cyanoacrylate safety: There are a few caveats when using CA adhesives. First, there is a pungent odor and fumes that can irritate your eyes when your tools cut through a layer of glue during turning. Satellite City makes a special odorless version, called UFO (short for User-Friendly Odorless) in the very thin and very thick versions.

Second, and most importantly, you must be careful when applying CA because it will glue your skin just as quickly and firmly as anything else. I know this from experience. Once, while using Hot Stuff to seal a crack, I absent-mindedly kept rubbing sawdust into the fissure and didn't get my finger out quickly enough. I stood there by the lathe, with a large bowl hanging off my index finger, feeling equal parts of fear and embarrassment. I tried using the solvent that's marketed with Hot Stuff, but it didn't help me get that bowl off my finger; in the end, I left some skin on the bowl, which is a rather unpleasant experience. Hunter insists I wasn't patient enough—that the solvent, given a few minutes, will dissolve the bond. (He said it will also get Hot Stuff out of your clothes.) If only a little glue gets between your fingers, carefully peel them apart under a stream of warm water.

One final caution: Don't squeeze a CA bottle hard to get glue to come out when the tip is clogged. I have heard of several cases where the glue squirted sideways and into an eye. None of these accidents resulted in permanent damage, but the experience can be painful and frightening. Hence, I examine the tip of the bottle, and if the fluid won't come out normally, I clear it by rapping the bottom of the bottle sharply on the table. Of course, the best insurance when using CAs is care. If you'll take a few simple precautions, I think you'll find that CAs are good stuff. *J.W.*

Quick fixes on the lathe

by Giles Gilson

I first encountered cyanoacrylate (CA) adhesive during the 1960s when I worked as a prototype assembler at an engineering firm. By the early '70s, model-airplane builders caught on to CA, and it began to appear in hobby shops. But, these early varieties had very thin viscosity and didn't fill gaps well, so joints had to fit together perfectly (modelers soon discovered that baking soda worked very well as a glue thickener).

CA manufacturers today offer a whole range of different glues that are designed for wood (see the sidebar on p. 71), and woodturners especially have found CAs useful. I've found many applications for CAs in my turning work. For example, I glue wood to other materials, such as fiberglass and aluminum, which I often incorporate in my pieces. CA is also great for strengthening areas of soft or punky wood in damaged or spalted turning blanks (use the low-viscosity type of glue and let it soak in).

But one area where CAs are indispensible is repair work. The glue's transparency coupled with its strength and nearly instantaneous drying time make it possible for a woodturner to fix a mistake, in most cases, without having to remove the turning from the lathe. Two common turning situations in which CAs excel are fixing breakage and small surface repairs. The processes for handling these problems are shown and described in the photos and captions below. With a little experimentation, I'm sure you'll find your own uses for these versatile adhesives. □

Giles Gilson is a woodturner, sculptor and product-design specialist living in Schenectady, N.Y.

***Cyanoacrylate glue is great for quick repairs,** such as mending the broken rim of a bowl (top left). After the piece is refitted, thin cyanoacrylate (CA) is wicked into the joint (top right). Minor defects in a bowl's surface are restored by packing the area with sawdust and applying thin CA (bottom left). After the CA cures for a few minutes, the spinning workpiece is sanded with a small sanding disc chucked in an electric drill (bottom right).*

recess in the center of the glue block to provide a snug fit for the workpiece's tenon, as shown in the center photo on p. 70.

Gluing up

Now, the faceplate comes off the lathe, and the glue block and workpiece are checked for a good fit. To glue them together, I apply accelerator to the foot of the workpiece, and a gap-filling CA on the glue block. According to Satellite City, the makers of Hot Stuff (which is the brand of CA I use), applying too much glue can weaken the bond. A product pamphlet that comes with the glue suggests that one drop of glue is sufficient for 1 sq. in. But remember that you may be cutting past some of the outer edge of the original foot when you finish it, so apply the glue in a spiral—liberally near the center and sparingly toward the outer edge. But don't get any glue in the mortise because you don't want the tenon glued down. Then the turning blank and glue block are mated and held under pressure for about 15 to 20 seconds, until the glue sets. If glue oozes out from under the block, I also spray that with a little accelerator to make sure the glue isn't so liquid that it will fly around when I start the lathe.

Now the workpiece is ready to go on the lathe and become a bowl. The mortise-and-tenon method automatically centers the rough workpiece on the lathe. Also, the whole assembly can be removed and later remounted on the lathe with no re-turning necessary to get the workpiece back into round (the bigger benefits, however, come when I reverse the bowl on the lathe to clean up the foot, as described below). I'm confident with my glue-block method, but I've never been an optimist. So when I turn a particularly large piece, I keep the tailstock in place while rough shaping the outside of the piece.

Parting off and finishing the foot

When the piece is sanded and ready for removal, I use a parting tool to cut through the glue block, as shown in the large photo on p. 70. After my nerve runs out, I use a thin-blade Japanese ryoba saw to finish the cut. For cleaning up the foot, my procedure varies depending on whether the piece has a formal or a natural lip. Formal-lipped pieces are mounted on a plywood disc with a groove to accept the lip. Natural-lipped pieces are mounted over a disc of plywood that's held onto a ½-in.-dia. threaded rod and covered with foam carpet padding (see the bottom inset photo on p. 70). The tailstock, still fitted with the cup center, is brought up to hold the piece in place. This is when I realize the final benefit of the little tenon cut on the back of the piece. When I saw through the glue block, I'm careful to leave the tenon on the foot of the piece, and it still bears the dimple left by the pin in the cup center. This dimple marks the exact center of the foot. I orient the piece so that the cup center falls right back into place, and the bowl is exactly centered. I shape up the foot if necessary, cut away the remains of the glue block and all but a nubbin that holds the live center. Then when the piece is off the lathe, I remove the nub with a sharp carver's gouge, sand the spot clean and it's done.

If you rough turn your pieces wet and set them aside to dry, be sure you orient the grain of the glue block to run parallel to the workpiece. Even then, the movement of the wet piece is likely to pop off the block. If this does happen, all you need to do is mount the bowl between centers, using the tenon once again to find the exact center of the bottom; reflatten the foot of the piece; clean up the glue block and reglue. □

Jack Warner is a journalist who writes a nationally distributed newspaper column on woodworking and furnituremaking. He's also a woodturner who lives in Atlanta, Ga.

Photos this page: Sandor Nagyszalanczy

A Kerf-Bent Mirror Frame

Sawcuts turn the corners and epoxy fills the voids

by Ken Picou

Woodworkers have traditionally used multiple sawkerfs to bend wood smoothly and gracefully. A series of closely spaced cuts are made almost through the strip or panel, leaving a thin layer of undisturbed material beneath. When the panel is bent, the kerfs close, and the thin, uncut surface is shaped into a smooth radius with a pattern of triangular voids on the edge of the material. Although these voids are usually concealed, I discovered that with a bit of strategy and a little epoxy, these kerfs can become an integral component of design. I make continuous mirror frames from a single strip of wood by planning the arrangement of the cuts, making my cuts carefully and then filling the kerfs with colored epoxy. The result is a frame that is both decorative and structurally sound. I have incorporated this joinery in the design of a series of uniquely shaped wall mirrors, such as the one that's shown in the photo on this page, and my method works equally well with picture frames, table aprons, top frames and decorative railings.

The process

Making a segmented-joint frame is quite simple: A single strip of frame stock is partially sawn through along the edge and is bent to form a series of radiused corners. The wedge-shaped voids are covered on the face side with duct tape to form a mold and then are filled with colored epoxy. Once the epoxy has cured, the remaining thin ribbon of wood along the frame's outer edge is sand-

***By filling kerfs in a bent strip** with epoxy resin, you can make decorative wooden frames of all shapes and sizes. Picou carefully planned the spacing of the cuts to create these geometric patterns of colored-epoxy wedges.*

ed away, completely separating the components of the joint. The result is shiny, colored wedges separated by thin, rectangular strips of wood, which align radially around the curve. This creates a geometric pattern with sharp contrasts in shape, texture and color, as shown in the photo on the previous page.

One of the most interesting aspects of this technique is that once you figure out how many kerfs are required to create a rectangular frame, you can use the same number of cuts to form any closed-shape frame, provided you use the same width stock. Various shapes can be developed by changing the number of kerfs per joint and the distance between the joints.

Counting the kerfs

The first step in creating a segmented-joint frame is determining the number of kerfs it will take to allow the frame stock to be bent to form a complete frame (360°). Although this could be calculated, I find it simpler to rip a strip of scrapwood that's the same width as the frame I wish to make. With the blade of my radial-arm saw raised to cut within 1/16 in. of the saw table, I start making kerfs along the length of the test piece. I continue to cut until the strip can be bent to form a right angle with all the kerfs completely closed along the inside edge. I confirm this by checking it with a framing square, as shown in the top photo on this page. If you find, for example, that 15 kerfs result in a bend that's more than 90° yet 16 kerfs let the strip bend past 90°, you can fine-tune the angle by varying the width of the kerf or the wood strip or by simply adjusting the depth of cut just a bit. A wider kerf, narrower strip or slightly lowered blade means fewer kerfs are needed for 90°. A thinner kerf, wider strip or raised blade means that more kerfs are needed. Once you have determined the number of kerfs required for a perfect 90° angle, multiply by four to get the total number required to complete a closed frame. When designing the frame, any corner angle can be figured based on the total number of kerfs: if 64 cuts equal 360°, then 8 would equal 45° and 4 would equal 22.5°. Once you have developed a feel for this system, the combinations are limitless.

Kerfing the frame

After you've worked out a full-scale frame design on paper, select and thickness your frame stock and rip it to the same width as your test piece. Check your design to determine the length of stock you need. For the wall mirror shown in the photo on the previous page. I used 3/4-in. thick by 1 5/8-in. wide stock that was 96-in. long. Make sure your radial-arm saw adjustments are set the same as during the test cut, and begin kerfing the strip according to your plan. Position the back side of the frame stock against the fence, so any splintering that results will end up on the back of the frame. I have found that spacing the kerfs 1/4 in. apart at the corners yields a pleasing radius and creates an interesting visual interplay between the colored epoxy wedges and the small rectangles of wood. To keep the spacing between the kerfs uniform, make a pencil mark on the fence as a guide to show you how far to advance the stock after each cut. After completing the kerfing, trim the ends of the strip as necessary and carefully roll the frame into shape (see the bottom photo). The frame should lock rigidly into shape as the kerfs close up. If the ends don't meet, widen a kerf or two very slightly. If the ends are too long, trim them. And if the strip accidentally breaks, repair it by gluing the outer ribbon with cyanoacrylate (super glue).

Kerfing a mirror frame: *a test strip (above) is cut to determine the number of kerfs needed for the piece to bend into a right angle. This number, multiplied by four, yields the kerfs needed for a closed frame. After kerfing on the radial-arm saw (below), the frame is rolled up to check its shape.*

Gluing up

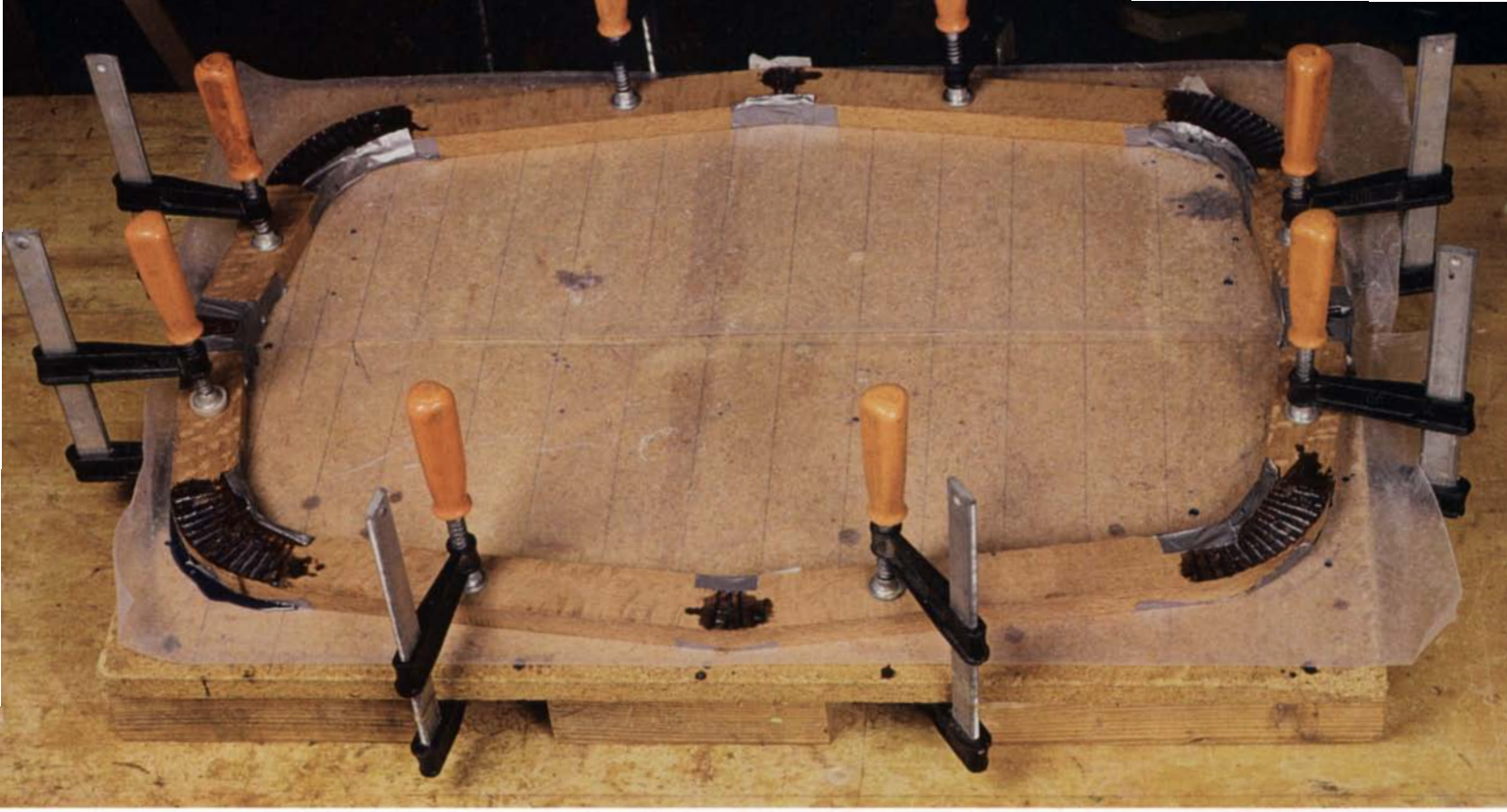
A flat piece of particleboard or plywood serves as a platform for pouring the resin. To help you align the frame, draw a line lengthwise down the center of the board and several evenly spaced perpendicular lines across the width. Clamp the frame to the platform, face side up, and cover the face and inside edges of all kerfed areas with duct tape to retain the resin during the pour. Now unclamp the frame and flip it over. Clamp it to the platform face down with a piece of waxed paper between the frame and the platform (see the top photo at right).

I use West System epoxy (available from Gougeon Brothers Inc., 100 Patterson Ave., Bay City, Mich. 48706; 517-684-7286) and tempera powders or artist's acrylic paint for a colorant. When using epoxy, always work in a well-ventilated area, and make sure the room temperature and the humidity during the pouring and curing period are in the range prescribed by the manufacturer. As you mix the epoxy and colorant, stir slowly to avoid bubbles, and pour the mixture into the kerf voids slowly and carefully. Segments can be refilled as the epoxy soaks into the wood. Let the resin cure overnight.

After unclamping the frame the next morning, carefully peel off the duct tape. If there are any voids in the face of the frame, fill them now. The epoxy on the back of the frame will have sunk a bit as the epoxy penetrated the pores of the wood. You will have a chance to refill this area in the next step.

Reinforcing the frame

Even after the outer ribbon of wood is removed later, segmented joints are surprisingly strong. You can, however, greatly increase the strength of the frame and its ability to withstand impact by routing a narrow 3/8-in.-deep channel around each corner on the back of the frame and pouring a liquid spline (see the center photo on the facing page). Mount a 1/4-in. straight bit in a table-mounted router, and set the fence so the bit will rout at the center of the frame.



***The kerfs are filled with colored epoxy** using artist's acrylic paint to tint the resin. After the face and edges of each joint are covered with duct tape to create a mold, the frame is clamped to a flat panel and epoxy is poured into the kerfs (top photo). After the epoxy has hardened, a narrow channel is routed across the back of each joint on the router table (left photo), and then epoxy is poured in to form a liquid spline to reinforce the frame (center photo). Finally, the ribbon of wood that's left on the outside edge of the frame is sanded away (right photo), creating the illusion that the frame was assembled out of many separate segments.*

Carefully lower the frame, back side down, onto the spinning bit and maneuver around the radius of each corner to rout a channel (see the photo at left above). You can further reinforce each joint by placing a length of heavy-gauge wire in the channel before pouring.

Sanding and finishing

Once the epoxy cures, you can sand away the outer ribbon of wood that initially held the frame together. I do this on a stationary belt sander (see the photo at right above), but you could also secure the frame in a bench vise and use a portable sander. The edges of the frame can then be routed to suit your taste. I generally use a roundover or chamfering (45°) bit. To prepare your frame to accept a mirror or artwork with glass, rout a rabbet on the inside back edge with a piloted rabbeting bit. You are now ready for the final sanding (I sand to 600-grit) and finishing. I usually hand-rub a tung-oil finish on my frames but lacquer also will work well. I generally use a ¼-in. plate-glass mirror to avoid the distortion common in thinner glass and back it up with ⅛-in. plywood to secure and protect the mirror. I finish the job with a sawtooth-style wall hanger screwed securely to the frame.

Once you're comfortable thinking and working with kerf-bent joints, you might want to develop your own style. New shapes can be designed with simple math or by trial and error using scrap stock. You can also vary the width of the sawkerfs within a frame to add a different design element to your work. You can even make sculptural pieces by kerfing different faces of thicker stock and working in three dimensions. Regardless of application, the basic techniques remain the same. □

Ken Picou is a designer/woodworker living in Austin, Tex.

Photos: Sandor Nagyszalanczy

Scavenging through junkyards for used electrical motors *can provide cheap power for shop tools. You'll need protective clothing (a beekeeper's hat thwarts angry insects), a three-pronged cultivator for probing through tall grass and a cart to carry the heavy booty.*

Confessions of a Junkyard-Motor Junkie

Finding, cleaning and wiring cheap machine power

by Ted Myers

I was once a decent person just like you. When I bought a new machine, I bought a motor, too. Though I might be able to afford a cheap machine or kit, the cost of the motor would often put it out of reach. If only a cheap source of motors could be found, I would be able to equip my woodshop at poverty prices. But where?

And then it happened. I was on a junkyard safari in search of the elusive full-chromed car bumper. Pushing my way through the dense weeds and grass, I suddenly found myself at the bottom of a crushed-car canyon. But neither the flattened Fords nor Chevies caught my attention. There, at the far end of the canyon, shining in the sunlight, stood a veritable mountain of electric motors. There were quarter-, third-, half- and three-quarter horse motors. Some were blue, some gray, some black, some red with rust, some burnished satin and some blistered. But were any still good? Are not all junkyard motors bad? For a few dollars each, I bought three that looked good. Two worked, and the other was sold back for scrap at only a small loss.

For the past 20 years, when the need arose, I have resolutely beaten the brush in junkyards and landfills to find good electric motors. There are many to be found, and with your indulgence, I would like to share a few hard-earned tips on both how to tell a good motor from a junker and how to decipher the wiring to get your cheap motor up and running.

The equipment

The successful junkyard motor safari demands preparation but little specialized equipment. As you can see in the photo at left, the proper outfit includes: high boots (to protect the feet and ankles), sturdy coveralls, leather gloves and topping it all off, a beekeeper's hat or mosquito netting (in case you stumble upon a nest of yellow jackets). The three-pronged cultivator is essential for poking through high grass and brush and also hooking motors off piles. It also encourages more respect from junkyard dogs and smart alecks who might laugh at your beekeeper's hat. A sturdy garden cart is crucial because electric motors are heavy, and carrying even one can slow you down. Be sure to show the junkyard operator what you bring into the yard. One fellow tried to charge me for the cart even though my name was stenciled on it!

All the other equipment can be held in a small toolbox. Grip-lock pliers and side cutters are for handling wires and cords. If the motor is still in the appliance, a socket set, wrenches and screwdrivers are needed for removal. A utility knife cuts off old V-belts. You'll need two meters to test a motor's wiring: a small, inexpensive multimeter and a large precision meter that's capable of taking accurate, low-range ohm readings. I carry the small one in my pocket and leave the larger more sensitive meter in the car. Be sure to use old-style meters with needles because the types with an LED readout don't show up well in bright sunlight. Also, bring along a host of rags to clean dirt and grease from prospective treasures.

Stalking electric motors

Before you start out, be sure to call the junkyard to see if motors are available. The demand for copper has been way down, and many yards have gotten rid of their motors at a loss. Others will love to see you and currently will charge about $5 a motor. You may have to talk your way into the landfill, but it helps if you bring in a load of trash. And, as you hand over your dumping fee, ask if you might look for a motor in the appliance section of the yard. Motors are usually loose and piled in one area, but don't be surprised to find some scattered here and there. Landfills usually have appliance sections where motors are still in the appliances.

Once you've located a motor, approach it from the connector end. It's now time to put that cheap multimeter to work. Motors always have at least two and sometimes as many as nine connectors. For simplicity, let's start with a two-connector motor. With the meter set to read ohms, touch the two leads to the connectors. If the needle does not move, the windings are burnt-out. If the needle jumps to zero (indicating continuity), then probably both windings are good, and you have a possible candidate. (On motors with more leads, check each pair.) Next, read between each connector and the motor case. If any continuity is read, leave that motor because one of the windings is shorted to the case. If the motor has passed the meter test, spin the shaft. Do not be put off by a hard-to-spin shaft. Quite often, the motor's grease simply has hardened or the oil reserves are dry. Sometimes, the bearings will be bad but, in my experience, not as often as you might expect.

The three-pronged cultivator is essential for hooking motors off piles. It also encourages more respect from junkyard dogs and smart alecks who might laugh at your beekeeper's hat.

If the motor is still in an appliance, it will have to be removed. I cut all the lead wires and the power cord, leaving them as long as possible. Each manufacturer mounts its motors in a different manner, and some are really difficult to unbolt. Do not be shocked if you must walk away from a good motor simply because it cannot be removed. Do not, however, be put off by a motor you find in the dirt. Also, there are more bad motors piled loosely than in machines or appliances. Usually an appliance is discarded when its transmission goes bad, though the motor is probably still good.

Different kinds of motors

Knowing the various types of motors and what they can do will help to provide a focus to your junkyard-motor quest. The top photo on p. 78 shows some of the types of motors you're apt to find in a junkyard or landfill. Though hard to find, repulsion motors are worth scrounging for because these offer the highest starting torque for the smallest starting current, and there's nothing better for running a pump or an air compressor. Split-phase motors are the standard junkyard fare. These need time to come up to speed and are most usable in tools that require low starting torque, such as jointers and bench grinders. Capacitor-start motors use a capacitor on the starting windings to provide high starting torque, which is good for tablesaws and bandsaws. Once up to speed, a centrifugal switch cuts the capacitor out, and the motor runs like a split-phase. A capacitor-start/capacitor-run motor keeps the capacitor on-line for high torque and instant reversing. Usually found in garage-door openers, these motors overheat badly if operated continuously.

To find out valuable information about a motor, look for either a nameplate or stampings on the case. The horsepower (HP) rating is the main concern: Is the motor powerful enough to do the required job? Motor phase also is important, because only single-phase motors run on regular household power. Three-phase motors must be run either on special three-phase power or require a phase converter. Some motors will only run on either 110v or 220v while some can be wired to run on either voltage. The amps rating shows how much current the motor draws. Also, check the number of cycles on the plate: You want 60 Hertz (Hz), the standard in the United States. Many motors have one or more speeds. Standard motor speeds, which are stated in revolutions per minute (RPM), are 3450, 1725 and 1140 for two-, four- and six-pole motors. The plate will also tell you whether the motor is continuous duty, which means it can be run for long periods of time.

The final check

After selecting a motor (or motors) that meets your needs and before putting your money

The different types of motors you're apt to find *include (from left to right): the repulsion motor, a high-starting-torque AC motor with brushes; the slow-starting split-phase motor, commonly used to run fans; the versatile capacitor-start motor, identified by its protruding capacitor housing; and the small-capacitor start/capacitor-run motor, rescued from a garage-door opener.*

down, you can perform one more test by using the sensitive ohmmeter. Because every wire that carries current has a little electrical resistance, the resistance of both a motor's start and run windings can be checked with an ohmmeter. Normal resistance in run windings ranges from 3 to 6 ohms; start windings range from 4 to 8 ohms. You can read these directly on a four-connector motor by testing the two pairs of winding leads (see the hookup section on the facing page to help indentify the pairs). If the motor has only two leads, it means the start and run windings are wired in parallel. In this case, since parallel wiring reduces the overall resistance, a reading of about 1 to 2 ohms is correct. If the meter reads zero or between 4 and 5 ohms, then one winding or the other is bad. When testing a capacitor-start motor, it's normal for the meter to read zero at first and then come up to an ohm reading. This is because the capacitor draws all the voltage from the meter while it is testing. The capacitor is probably bad if the windings still read zero after a few seconds.

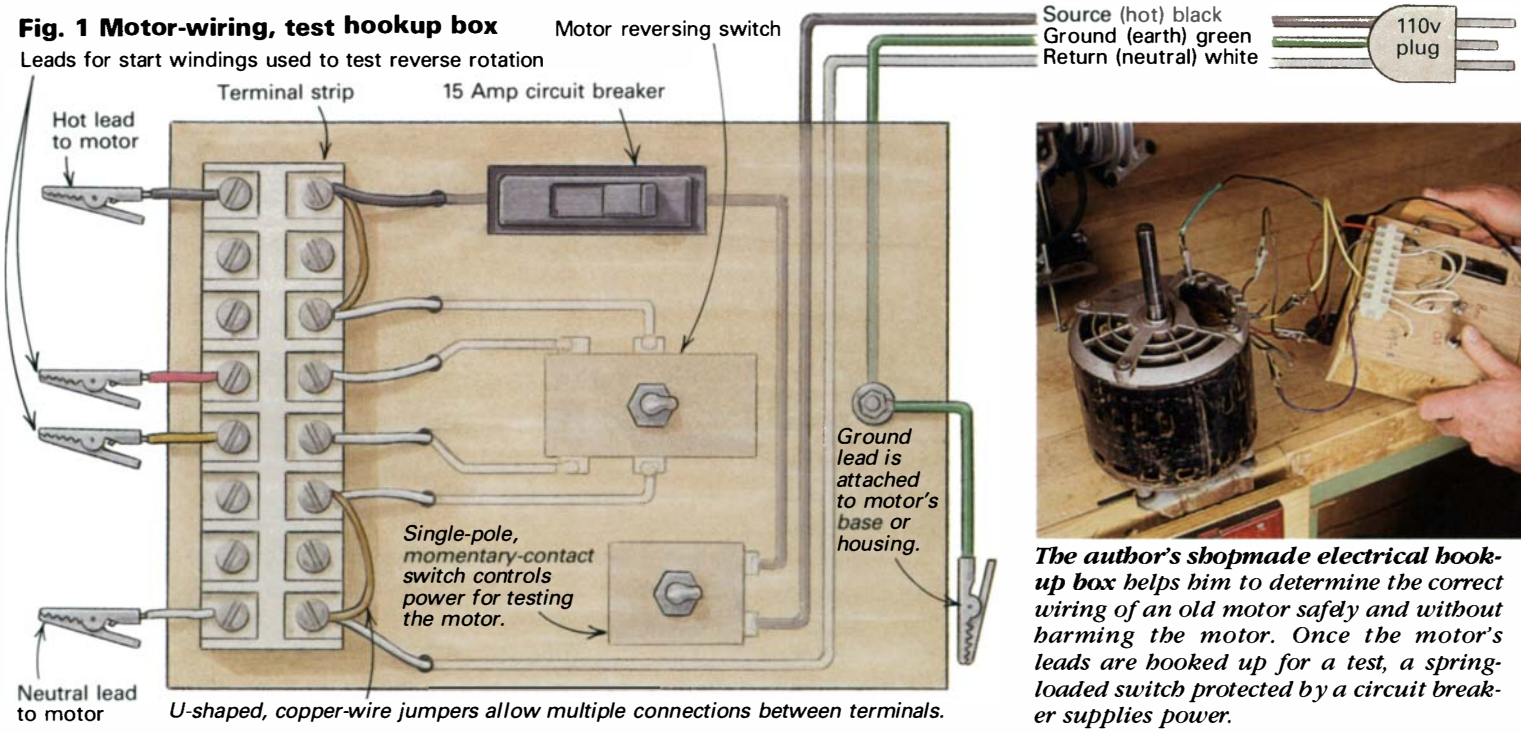
If all the tests outlined above are positive, you must still make an intuitive leap. Will the motor's bearings last? Will the starting switch work? You must trust your intuition just as you do when you play the stock market or get married. Here are a few rules of thumb to help you make your decision: Surface rust on a motor is okay, but blistered paint is not, since it probably indicates that the motor overheated at one time or another. Also, beware of that otherwise nice motor with sawdust packed inside its housing; it may have been well-cooked by a lazy woodworker who used a dull sawblade to cut oak.

Motor cleaning

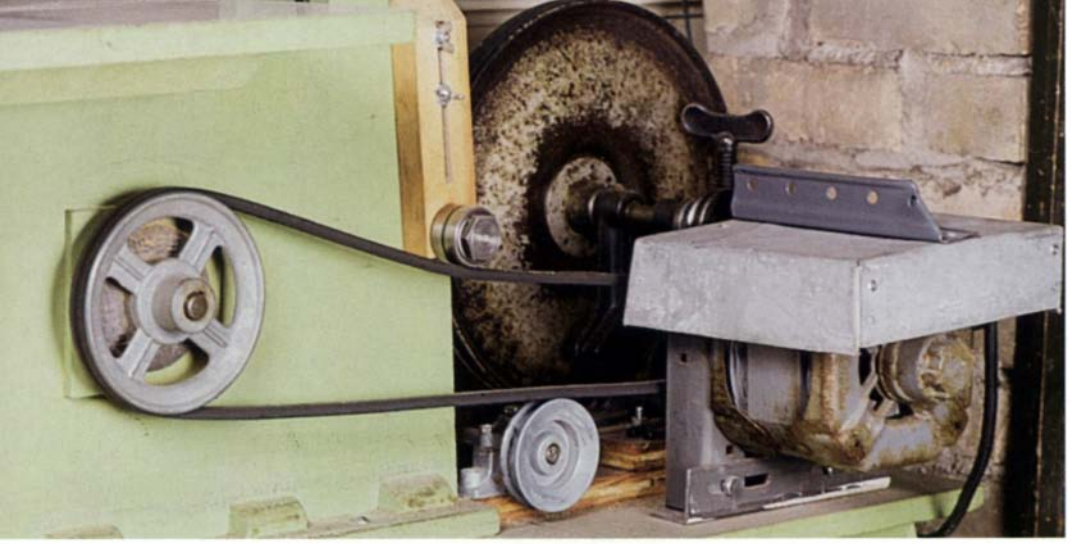
Cleaning is the first order of business when you get your motor (or motors) home. Many are sufficiently cleaned with just a shop vacuum and a small artist's brush to get the lint and crud out of the end bells. A wire brush and wax will remove rust, and heavy grease and grime will yield to a small amount of mineral spirits. Some people recommend cleaning with carbon tetrachloride, but I avoid it because it's too dangerous. In extreme cases, the universal solvents of soap and water are quite safe and effective so long as everything is dried well afterward.

I found the repulsion motor shown in the photo above buried to its rear end bell in sand and dirt. I cleaned it by removing the end bells, pulling the rotor out and blasting away with a garden hose. When the water ran clear, I used the exhaust on a shop vacuum to dry everything thoroughly. Once the oil wicking was fully saturated at each bearing, this repulsion motor ran just fine. And at $5, it turned out to be a real bargain.

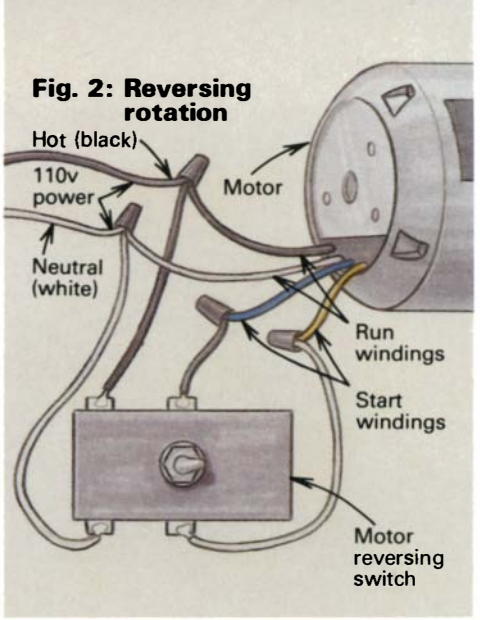
Fig. 1 Motor-wiring, test hookup box



The author's shopmade electrical hookup box *helps him to determine the correct wiring of an old motor safely and without harming the motor. Once the motor's leads are hooked up for a test, a spring-loaded switch protected by a circuit breaker supplies power.*



***A motor recovered from an old washing machine** powers the author's shopmade bandsaw. Because the ½-HP split-phase motor had no base, angle-iron brackets were built to mount the motor to the saw.*



Hooking up your junkyard motor

Sometimes a motor's nameplate includes a diagram of how the motor should be wired. But in most cases, you are left to figure this out on your own. To facilitate this experimentation, I built a simple hookup box, as shown in the bottom photo on the facing page and in figure 1. The hookup box allows you to try out different wiring arrangements on motors with more than two leads (to determine which wires change RPM or direction) without burning out the motor or, more importantly, risking electrocution. Power is supplied through a spring-loaded on/off switch, backed up by a 15-amp circuit breaker. At the first sign of trouble, you only need to release the switch to cut off power. A 10-amp motor-reversing switch provides a way to test for rotation reversal on motors with four or more leads. All motor leads connect to the hookup box by way of a terminal strip with hookup leads that end with alligator clips. Small U-shaped jumpers, bent from solid copper wire, are used to connect terminals together for routing one connection to several terminals when necessary.

Before testing, the motor must be bolted down to the workbench. Motors without bases should be held securely in a vise. The ground-wire clamp from the hookup box is attached to the motor's base or case. I leave the hookup box unplugged, until after I've made all connections; then I plug the box into a 110v outlet. (My box only tests 110v motors). If you suspect your motor is 220v or 110/220v, check the nameplate for a wiring diagram. If there isn't one, play it safe and take the unit to a motor-repair shop for wiring.) Remember that all exposed connections on the box are hot. How you hook up each motor will depend on the number of leads it has: Each situation must be dealt with separately.

Two leads—Two connections are the minimum needed to run a motor, as a motor's wiring must form a closed loop with the power company's transformer. Connect the two leads to the hot and neutral connections on the hookup box, and then try it out. If the motor has a white wire, this is almost always the neutral wire, while the hot wire might be black, red, blue or orange (green is always ground).

Three leads—Motors capable of running at two speeds (1725/1140 RPM) have three connectors. One wire will probably be white, for the neutral. By hooking up one of the other two (hot) leads, the motor will run at one speed or another. *Do not* connect both wires to hot at once. Also, remember that if one of the hot leads is connected, the free one will also be hot, so take care.

Four Leads—A four-connector motor, unless it is a three-speed with one neutral wire, will have separate pairs of connectors (each with a hot and a neutral wire) for both start and run windings. You can identify the start pair because it has the highest resistance (yields the higher ohm reading when you test the pair). The rotation of these motors is easily reversed by intercepting the hot and neutral wires with a motor reversing switch and then passing them on to the start connectors, as shown in figure 2 above.

Five or more leads—We are now entering the *Twilight Zone* of junkyard motors and things can get rather confusing when you're trying to decipher their wiring. First, try to find the motor's start and run windings by checking the ohm readings, as described above. Next, label each of the motor's leads with a different letter. Then proceed to test each lead to another with the sensitive ohmmeter. Pairs that test 0 ohms would short out if connected to hot and neutral as a pair; lead pairs that yield low ohm readings (3 ohms to 4 ohms) are much more promising. Using the hookup box, you can experiment by connecting these leads to power in various combinations. They are likely to change the motor's speed or reverse the direction of rotation.

Once the motor-wiring riddle is solved, you're ready to wire up your motor. To switch small motors on and off and change speed and reverse rotation, I have found that common 15-amp household light switches work very well. In cases where I need a motor reversing switch for a fractional-horsepower motor, I buy mine from Burden Surplus Center (1015 West O St., PO Box 82209, Lincoln, Neb. 68501-2209; 800-488-3407). They cost about $2.

Once your motor is all wired up, you're ready to put it to work. If the motor has a base, all that's required is to bolt the base to the machine, tighten the appropriate sheave or pulley on the shaft, install a V-belt and let her rip. If the motor doesn't have a base, you can buy a universal base (shown on the far right motor in the top photo on the facing page) for $6.75 from AMT (Fourth Ave. and Spring St., Royersford, Pa. 19468; 215-948-0400). Or you can engineer your own secure mounting brackets. The ½-HP split-phase motor shown on my homemade bandsaw in the photo above is attached to angle-iron brackets secured to the tool's base through the bolt holes in the motor.

As you might now suspect, junkyard motors are quite a test of knowledge, logic and intuition. The more knowledge we have, the more our logic works for us, so you might want to read more about electric motors at your local library. But experience creates one major concern. It's been my misfortune to witness one too many electrical accidents. When I catch myself operating in the dumb to stupid range, I shut off switches, pull plugs and walk away until another day. Please do the same. Happy hunting and may the Electromotive Force be with you! □

Ted Myers is an English teacher, amateur woodworker and machinist in Cambridge, Minn. This material was adapted from Myers' article in the January/February 1991 issue of Home Shop Machinist.

Photos: Sandor Nagyszalanczy; drawings: Bob La Pointe

Perhaps the largest tree ever felled by a human being, *this Douglas-fir was brought down by George Carey (on the ladder) and his crew in 1895. The tree, reputed to be 417 ft. tall., grew on Vancouver Island, British Columbia.*

Douglas-Fir: It's Not Just for Studs Anymore

A tough softwood makes a great furniture wood

by Jon Arno

If you're like me, the first images conjured up by the words *Douglas-fir* are of 2x4 studs, 2x12 joists and racy-grained plywood. There's plenty of validity to that stereotype, but there's more to the story. While its strength-to-weight ratio makes it the ideal construction timber, Douglas-fir is a remarkably diverse species, which will also yield plenty of furniture-grade wood.

What is Douglas-fir?

Douglas-fir has been (and sometimes still is) called Oregon pine, Columbian or British Columbian pine, Douglas spruce and red fir. Regardless of what it's called colloquially, there's little question that Douglas-fir is a member of the pine family (Pinaceae) along with spruce, larch, (true) fir and hemlock (see the photos at right). On the genus level, though, it's something of an anomaly. Despite its vernacular name, Douglas-fir is not a true fir (genus *Abies*). First classified in 1803 as a pine, *Pinus taxifolia*, it was switched to the fir genus as *Abies taxifolia* in 1805. Later in the 19th century, the great naturalist John Muir referred to it as Douglas spruce, but it was never formally placed in the spruce genus, *Picea*. In 1889 it was given its own genus, *Pseudotsuga*, which translates as "false hemlock," and named *Pseudotsuga taxifolia*. Most recently, in 1950, its name was changed to the present designation, *P. menziesii*, honoring its discoverer, Archibald Menzie, a surgeon and naturalist who collected the first samples for scientific study in 1793.

There are only five species worldwide recognized as *Pseudotsuga*, and only two of these are native to North America. One of

Photo above: Courtesy of the British Columbia Archives and Records Service

our domestic species, big-cone Douglas-fir (*P. macrocarpa*), is a small tree occupying a rather limited range in Southern California. It's not a significant timber species. The other, *P. menziesii*, is North America's most plentiful species of softwood and accounts for about one-fifth of our total reserve of softwood timber: Over 120 billion cubic feet of Douglas-fir is growing in the United States and Canada today.

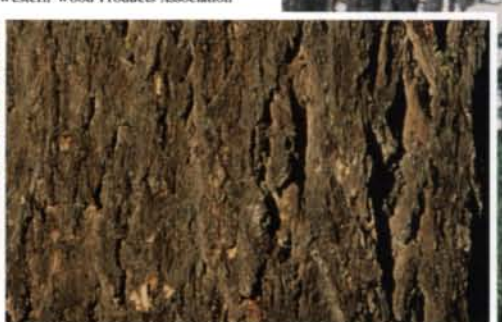
The wood of Douglas-fir varies considerably throughout its vast growing range. Extending from Canada to Mexico and from the Rockies to the Pacific coast, Douglas-fir has successfully adapted to diverse growing conditions. In the mild, perpetually moist climate of the coastal Pacific northwest, second-growth plantings of Douglas-fir attain sawlog size very rapidly, producing a rather stringy and harshly figured wood. One tree recently cut on Washington state's Olympic Peninsula was 170 ft. tall and 3 ft. dia., but only 72 years old! While examples of this kind of growth certainly support the argument that Douglas-fir is a renewable natural resource, the wood produced by these rapidly grown trees just isn't the same. Bright orange in color, with wide annual rings and a rather coarse texture, it's an inferior construction or furniture wood.

The wood from old-growth trees, however, has a mellow brownish color with yellow to pale-orange highlights and a pleasant, pinstripe grain pattern on radially cut surfaces. Trees a thousand years and older, 8 ft. to 10 ft. across and well over 300 ft. tall, can still be found on good growing sites in Oregon and Washington. The unofficial record—substantiated only by the photograph on the facing page—is of a colossal specimen felled by lumberjack George Carey on Vancouver Island in 1895. This tree is reported to have measured 417 ft. tall and 25 ft. dia. If true, this would have been the tallest tree known to man, surpassing the loftiest living redwood by more than 50 ft.

There is yet another variety (botanically speaking, the same species, but with morphological differences) of *P. menziesii* indigenous to North America. A somewhat stunted variety that's native to the interior of the continent, its range extends from Alberta southward through the Rocky Mountains into Mexico. Because of the extent to which it has adapted to the more arid conditions of this region, some botanists suggest that this Rocky-Mountain variety should be considered a separate species, *P. glauca*. The two varieties cross-pollinate (or intergrade), however, and this has prevented the interior variety from attaining separate-species status. It is, nonetheless, a noticeably different tree. Seldom exceeding 100 ft. tall, its foliage is a lighter, bluish-green color.

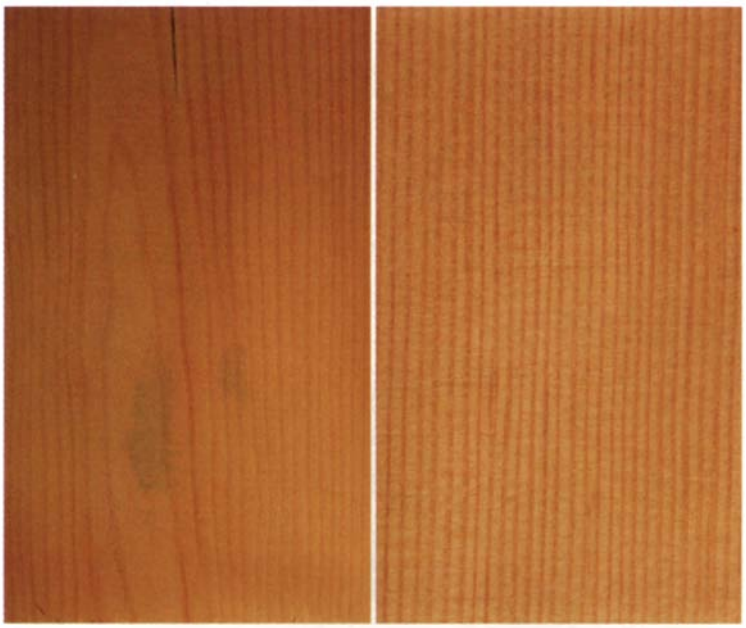
The wood of this variety—often peppered with small knots—exhibits considerable variation in both texture and density. In the

Inset photo at right: Courtesy of Western Wood Products Association



***Douglas-fir can be a renewable resource,** as this 65-year-old stand (far right) shows, but the quality of second-growth timber pales beside old-growth. The bark of young Doug-fir is smooth, gray and thin, but turns brownish red, thick and deeply fissured as the tree ages (above right). The three-pronged bracts that protrude between cone scales (above left) are unique to Douglas-fir.*

Photos this page except where noted: Ed Jensen



***Flatsawn (left) and quartersawn (right) Douglas-fir** exhibit very different characters. The proximity of the growth rings on quartersawn stock makes the extreme density between earlywood and latewood much less troublesome to work.*

north, where the trees grow slowly but receive periodic moisture throughout the year, the wood tends to be dark red, fine textured, hard and exceptionally stable. Toward the southern end of its range, however, in Arizona and New Mexico, where less-frequent rains cause spurts of rapid growth punctuated by periods of relative dormancy, the wood tends to have proportionately wider bands of earlywood, which make it, overall, much softer, weaker and somewhat pinkish-yellow in color.

Beyond the stereotype: fir for furniture

But what about the wood of typical first-rate Douglas-fir? By this I'm referring to the old-growth wood from the Pacific Northwest. As softwoods go, Douglas-fir is downright tough. It's heavier and stronger than either yellow poplar or butternut, two hardwoods commonly used in the furniture industry, and it is nearly as dense as cherry. Also, like cherry, it is a very stable wood with a naturally warm, pinkish-brown color when freshly cut, shifting to a rich, subtle orange as it ages. Its resistance to abrasion, while not on par with maple or oak, is among the best of the softwoods, and this trait, along with its color, strength, stability and affordability, make it our most popular softwood for interior flooring.

The character of any wood greatly depends on how the tree has been cut. This is especially true for Douglas-fir because of the dra-

Working Doug-fir

by Curtis Erpelding

My first crude attempts at furniture were made with construction-grade Douglas-fir. I liked to think that those pieces resembled the modern pine Scandinavian furniture I admired in books and magazines. Still, I remember looking at my rough pieces and imagining my peers' skepticism, "When are you going to start working with real wood?" Fir was for building houses, supporting weight, easy to cut and nail. At best it found its way into floors, door jambs, window casings and trim moldings. It performs these jobs admirably, but, as I've gradually come to appreciate, it's capable of so much more (see the photo on the facing page). As with any hardwood, though, getting to know Doug-fir's particular idiosyncrasies will make working it less frustrating and more rewarding.

Machining properties: Douglas-fir generally machine-joints and planes well, although the face of flatsawn lumber is susceptible to tearout. Dampening suspected problem areas with a sponge prior to machining can help, as will using sharp blades, a light cut and a slow but steady feed rate.

When cutting profiles with a shaper or router, it's always better to climb cut (or back cut) if possible. *Climb cutting* means feeding the work in the direction of the cutter's rotation. This is a potentially dangerous operation, though, because the workpiece will want to fly forward—out of your hands—if you're using a shaper or router table. On a shaper, it would be foolhardy even to attempt this operation without a power feed; on a router table, you still need to use great care (a power feed would be preferable here also). If you are using a hand-held router, the router will try to self feed; you have to restrain it. When you're climb cutting with a hand-held router, you should take a number of light passes rather than one pass to finished profile to avoid having the bit catch and pull your router across your work.

Handplaning vs. sanding: When preparing a surface for finishing, I prefer to handplane vertical grain and to sand flatsawn boards. Vertical grain can certainly be sanded too, but the plane is faster and gives a superior surface. The disadvantage of sanding Douglas-fir (whether flatsawn or quartersawn) is that you're likely to get a bumpy effect because of the difference in hardness between earlywood and latewood. It's extremely difficult, however, to plane flat grain cleanly and without tearout because of the constantly changing grain direction. Wetting the surface of the wood, as when using a power planer, will help some. A well-tuned plane with a finely honed blade is a must, but it's still not an easy go.

A handplane with a blade angle of 45° to the work is normally recommended for softwoods, including Douglas-fir. In contrast to its positive effect on planing hardwoods, increasing the blade angle to 50° or 55° (as you might if you make your own planes) actually has a slightly negative effect on controlling tearout in Doug-fir. Doug-fir also responds poorly to a scraper, although areas can be leveled out somewhat in preparation for sanding.

Douglas-fir has a propensity to lift and splinter when the grain runs out to an edge. Handplaning rather than sanding an edge can help to control splintering. When sanding an edge, wrap the sandpaper around a block so that the edge of the paper can't catch on a point of dark latewood and pull up a splinter. For the same reason, if you're using a palm sander, orient it so the turned-up edges of the sandpaper held by the sander are in line with the edge you're sanding.

Despite all precautions, though, edges still seem to splinter and usually when least expected. Perversely, they always seem to surprise me on my last pass with sandpaper prior to finishing. Luckily, splinters are easy to repair. If a splinter is still intact (and hasn't lodged under your fingernail or in your palm) it can easily be glued back into place and clamped with masking tape. When the splinter is missing or so damaged that it can't be replaced, the edge can still be built back up with five-minute epoxy. Run masking tape along one face to form a dam, and work the epoxy into the damaged area. When the epoxy has cured, file and sand it to match the contour. The clear repair will become practically invisible.

Photos: Courtesy of Oregon State University—Department of Forest Products

matic contrast in density (and color) between its earlywood and latewood. The garish appearance of Doug-fir plywood is a result of the exaggeration of this contrast, which occurs when the log is rotary cut. When flatsawn, this fluid, meandering pattern is far subtler and more attractive—though still bold—resembling figured oak.

At the opposite end of the spectrum from rotary cut is quartersawn Douglas-fir, or VG (vertical-grain) fir as it's called in the Pacific Northwest (see the photos on the facing page). When it's quartersawn, the radial surface of the wood shows, displaying neatly parallel lines of light and dark grain (earlywood and latewood). The effect is so dramatically different from either flatsawn or rotary cut that the wood seems to have undergone a complete metamorphosis, having changed quickly from a splashy madras sportcoat into a formal, pinstripe suit.

The contrast between earlywood and latewood gives the woodworker a number of design possibilities, but it also poses some pragmatic problems both in machining and finishing the wood. In machining, the varying degrees of drag on bit or blade (due to the differing density of the wood) sometimes causes chatter or tearout. Also, blades must be kept especially sharp or crosscut edges may fray, creating a ridge of needle-sharp splinters. And being stabbed by a Douglas-fir splinter can be a prolonged, unpleasant experience, because even a minute sliver will cause a wound that will fester and heal exceptionally slowly. Although the exact cause of this reaction is unknown, it's suspected that a terpene in the wood is a histamine sensitizer. (See the sidebar below for an in-depth look at working and finishing Douglas-fir.)

From practical and economic perspectives, Douglas-fir has a lot to offer the furnituremaker, which is something those in the Northwest have known for awhile. It's time woodworkers in other parts of the country added it to their palette of furniture woods. Until recently, it's been readily available in virtually any width, length and thickness, and at a relatively moderate cost. Old-growth Douglas-fir has become a bit scarcer and pricier in the last few years, due to both log exports and logging bans, but there are still vast forests of the timber. Woodworkers should embrace rather than deny the fact that the old-growth forests are a finite resource and should treat this great wood with the same veneration furnituremakers of old had for Cuban mahogany and Brazilian rosewood. As long as it's thought of as merely a construction timber, high-volume appetites will continue to devour the remaining stands of these centuries-old giants. Conversely, if woodworkers give Douglas-fir its due, elevating its status in the hierarchy of woods, it should be around for many years to come. □

Jon Arno is a wood technologist and consultant in Troy, Mich.

Finishing: Most softwoods have either a pale-yellow to white color, like pine, hemlock and spruce, or a reddish-brown color like red cedar and redwood. Douglas-fir is unique among the softwoods for its orangish color, and in my finishing, this is the color I try to preserve and enhance. Staining Doug-fir is completely out of the question as far as I'm concerned. I can't imagine what I'd possibly try to make it look like, and it seems an insult to try to make something that's fine in its own right look like something it's not.

To my eye, oil is the definitive finish for fir. Yet a straight oil finish on fir tends to take too long to build and looks too dark and dry. To avoid these shortcomings, I use several coats of dilute shellac or lacquer first, which seals the wood and allows the subsequent oil coats to build faster without overly darkening the wood. The object is for the sealer to penetrate the wood rather than build on the surface. A sealer and three coats of oil will give the same surface luster as six or more coats of oil alone. I prefer lacquer to shellac as a sealer because of shellac's tendency to remain sticky if contaminated with water. I dilute one part regular lacquer with three parts thinner and brush on two coats, sanding with 320-grit or 400-grit sandpaper between coats. Allowing the sealer to dry for one day before oiling is sufficient.

I prefer a light-bodied oil like Watco to tung oil, which dries and builds too quickly for my taste. The first coat is brushed on and allowed to sit about half an hour—long enough to penetrate but not to become tacky—before wiping off. A day later, a second coat is rubbed on with steel wool and wiped off immediately. Subsequent coats are applied in the same way at one day intervals. Try not to wipe off the oil too thoroughly because you want to leave a very thin film that will polymerize. Polymerization is responsible for the low luster and depth that are the hallmarks of a good oil finish. Using a clean, dry rag may defeat your purpose by removing all the oil. A moderately (not saturated) oily rag is better. Make sure you dispose of the rags properly to prevent spontaneous combustion.

After three coats of oil, the wood starts to acquire a glow; the color deepens rather than darkens, and its signature orange color and graphic grain pattern start to give this most utilitarian of softwoods an exotic panache. For a soft, pale, ethereal effect, skip the oil and apply several coats of wax over the sealer instead.

In the real world of budgets and deadlines, it's not always possible to use our favorite, perfect finish, and humbler alternatives must be substituted. Several coats of sealer alone can provide an adequate finish that's resistant to dirt and fingerprints and kind to the natural color of the wood. Lacquers, varnishes and polyurethanes can all be used on fir, though I don't like the coated, superficial look they impart. There are other finishes for floor and marine applications, but I've chosen to ignore these, both out of prejudice and ignorance. After all, we're talking about fir and furniture, and it's about time we invite this neglected orphan into the family of fine furniture woods. □

Curtis Erpelding is a professional woodworker and designer in Port Orchard, Wash.

Photo: Steven Young

***Clean design and crisp joinery** distinguish Curtis Erpelding's work in Doug-fir. To enhance its orange color, he sealed this piece with dilute varnish sealer, and then finished it with four coats of Danish oil.*

Photo: M. Van S.

A veritable tableau of Northwestern woods, *Tom Conroy's blanket chest is an elegant and articulate (though silent) case for the use of softwoods in furniture. The legs and frame for the lid are black-lacquered alder; the rails and the top panels are Doug-fir rescued from a stack headed for a door factory. The side panels, (the front one featuring Tracy Powell's fish carving) are planks of western red cedar that Conroy found at a shingle mill. The handle is made of Pacific yew.*

Douglas-fir...niture

by Vincent Laurence

It's always seemed a travesty to me that trees of great beauty and stature, such as old-growth Douglas-fir, should be reduced to such prosaic and merely utilitarian objects as sheets of plywood or 2x4 studs. These centuries-old (and in some cases, millenia-old) giants deserve a better fate.

The late George Nakashima spoke of giving trees a "second life" as dignified as their first, of honoring the *kodama*, or the spirit of the tree. Creating fine furniture was his way of doing that, and although much of his work was in temperate hardwoods from the Pennsylvania woods near where he worked, he grew up in the Pacific Northwest and revered the Douglas-firs that, in his words, "punctured the heavens."

The furnituremakers whose work is featured on these two pages have honored the Douglas-fir. A common thread ran through the conversations I had with each of them, a conviction that Douglas-fir is a fine furniture wood, a material precious both for its innate beauty and for its increasing scarcity. □

The calm character and muted color *of Douglas-fir gave Marie Hoepfl's bookcase/hutch the quiet grace and warmth she was looking for. Hoepfl used solid wood throughout, except for the door panels and top, which were laminated like plywood; the curved top consists of 11 plys. Woods used in the marquetry include satinwood, poplar, holly and orangewood.*

Vincent Laurence is an assistant editor at FWW.

Inspired by the rich texture and patina *of a 40-yr.-old Douglas-fir cabinet made by James Krenov, Austin Meinert resolved to build something very fine from what's normally considered a cheap, construction-grade wood. The sides and top are constructed of laminated plys, with bookmatched Doug-fir on the outside and Alaskan yellow cedar on the inside. The writing surface, drawer sides and web frame are maple. Carving the stylized flowers and foliage (detail, right) required patience and very sharp tools.*

His great-grandfather's violin needed a home, *and Mark Minor wanted the cabinet to harmonize with its contents. Minor chose Douglas-fir for its similarity to the violin's spruce top and rosewood for the drawer front as a counterpoint to the instrument's chin rest, fingerboard and tuning pegs. The redwood door panels were chosen for their color and for the textural similarity to the Doug-fir.*

Photo: Sean Sprague

Photos except where noted: Courtesy of College of the Redwoods' archives

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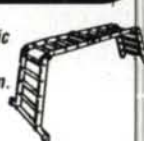

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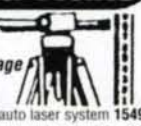

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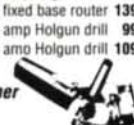

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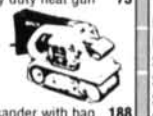

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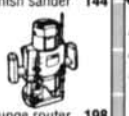

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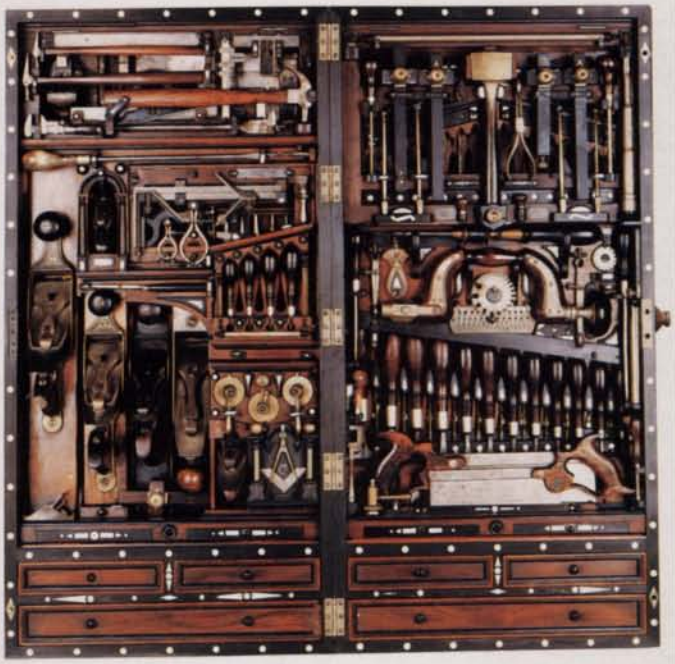

TOOL CHEST LEGACY

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Now available from *Fine Woodworking* magazine

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

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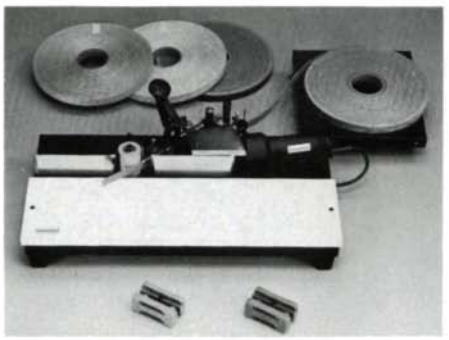

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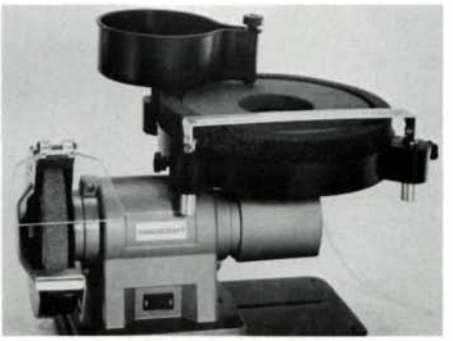

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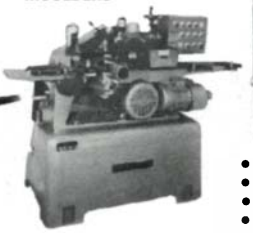

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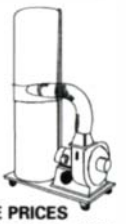

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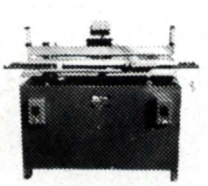

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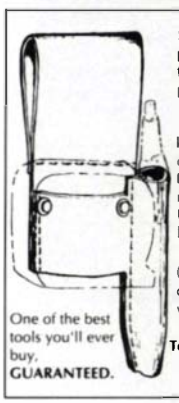

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6095DW	3/8" VSR Cordless Driver/Drill w/Keyless Chuck	145.
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RE600	3 HP VS Plunge Router	205.
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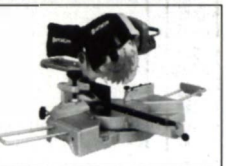

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C7BD	7-1/4" Circular Saw, Elect. Brake	135.
W6V2	VSR Quiet Drywall Screwdriver	89.
CB75F	Bandsaw/Resaw	1575.*
F1000A	12" Planer/6" Jointer Combo	1475.*
P12RA	Portable 12" Planer/ 6" Jointer Combo	839.

HITACHI NAIL GUNS

NR83A	Clipped Head Stick Nailer	419.
NV83A	Full Head Coil Nailer	429.
N5008AA	1/2" Crown Stapler, 5/8" - 2"	319.
N3824AR	1" Crown Roofing Stapler	329.
NT65A	16 Ga. Finish Nailer	319.

SKIL

2735-04	8" VSR 12v Cordless Drill Kit, w/2 Bat.	135.
77	7-1/4" Wormdrive Saw	145.
5860	8-1/4" 60° Wormdrive Saw Wormdrive Saw	169.
3810	10" Miter Saw	225.
1605-02	Plate Joiner Kit	119.

READER SERVICE NO. 4

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

NATIONAL & INTERNATIONAL: **Seminar**–Finishing and Sanding Solutions for the '90s, May 11–13. Amway Plaza, Grand Rapids, Michigan. For info, contact Daniel Cassens, Department of Forestry and Natural Resources, Purdue University, West Lafayette, IN 47907-1200. (317) 494-3644.
Symposium–American Association of Woodturners, June 18–20. Brigham Young University, Provo, Utah. Contact American Association of Woodturners, 667 Harriet Ave., Shoreview, MN 55126. (612) 484-9094.
Convention and exhibition–Guild of American Luthiers, June 24–28. Shrine to Music Museum, Vermillion, South Dakota. Contact Guild of American Luthiers, 8222 S. Park Ave., Tacoma, WA 98408-5226. (206) 472-7853.
Convention and show–Unfinished Furniture Association, June 27–29, Nashville Convention Center, Nashville, Tennessee. Contact Sandi Soellner at (800) 487-8321.
Conference–World Turning Conference, April 21–25, 1993. Wilmington, Delaware. Application deadline: Aug. 1. Contact Albert LeCoff, Wood Turning Center, PO Box 25706, Philadelphia, PA 19144. (215) 844-2188.
Juried exhibition–Redefining the Lathe-Turned Object. Call for entries. Slide deadline: October 1. For prospectus, send SASE to Arizona State University Art Museum, Nelson Fine Arts Center, Tempe, AZ 85287-2911. (602) 965-2787.

ARKANSAS: **Open House**–North Scenic 7 Spring Open House, May 1–3. For more info, contact Mert Parsons, President, Highway 7 Artists and Crafters Co-op, PO Box 326, Jasper, 72641. (501) 428-5224 or (501) 428-5501.

CALIFORNIA: **Exhibition**–International Lathe-Turned Objects: Challenge IV, thru May 31. Craft & Folk Art Museum, fourth floor of the May Co., corner of Wilshire and Fairfax, Los Angeles. Exhibition of 80 objects by more than 60 artists. Contact the museum at (213) 937-5576.
Shows–San Bernardino Woodworking Show, May 1–3. Maruko Convention Center, 295 North E St., San Bernardino; Southern California Woodworking Show, May 15–17. Long Beach Convention Center, Exhibit Hall 3, 300 Ocean Blvd., Long Beach. For more info. contact The Woodworking Shows, 1516 S. Pontius Ave., Los Angeles, 90025. (800) 826-8257.
Festival–9th annual California Strawberry Festival, May 16–17. Fine arts and crafts show. College Park, Oxnard. For more info, call Pacific Arts Festivals at (805) 831-1972.
Workshop–Building the Norwegian Pram with Simon Watts, June 6–12. San Francisco Maritime. For info, contact Crissy Field, National Maritime Museum Association, Bldg. 275, San Francisco, 94129. (415) 929-0202.
Competition and exhibition–Designs in Wood, June 16–July 5. Sponsored by San Diego Fine Woodworkers Association. Deadline: June 1. For entry forms, contact Southern California Expo, Entry Office, Del Mar, 92014-2216.
Workshops–Woodworking for women. Furnituremaking with hand tools using traditional joinery, weekends. Call for schedule: Debey Zito, (415) 648-6861.
Solicitation–New artists wanted for the Los Angeles Craft & Folk Art Museum Research Library. Used by collectors, curators, architects, designers. For info, contact Craft & Folk Art Museum Library, c/o the May Co., 6067 Wilshire Blvd., Los Angeles, 90036. (213) 934-7239.
Workshops–Various workshops incl. Japanese woodworking, joinery and sharpening. Contact Hida Tool Co., 1333 San Pablo, Berkeley, 94702. (415) 524-3700.

COLORADO: **Classes**–Woodworking and related classes, year-round. Red Rocks Community College, 13300 W. 6th Ave., Lakewood, 80401. (303) 988-6160.
Seminars–Woodworking seminars thru May. Contact Woodcraft Supply, 4403 South Tamarac Parkway, Denver, 80237. (303) 290-0007.
Workshops–Summer woodworking and furniture design workshops, June thru Aug. Instructors include: Silas Kopf, James Krenov and Sam Maloof. For a free catalog, contact Anderson Ranch Arts Center, PO Box 5598, Snowmass Village, 81615. (303) 923-3181.
Seminar–Beginning Woodworking for Youngsters, May 9. Woodcraft Supply, 4403 S. Tamarac Parkway, Denver. For more info, call (303) 290-6764.
Seminars–Woodworking seminars, Sept. thru April. Contact Schlosser Tool and Manufacturing Co., 301 Bryant St., Denver, 80219. (303) 922-8244.

CONNECTICUT: **Exhibition**–Containers, thru May 10. Lyman Allyn Art Museum, New London. For info, call (203) 443-2545.
Juried exhibition–24th annual Celebration of American Crafts, Nov. 9–Dec. 23. Deadline: July 1. For prospectus, send SASE to Celebration of American Crafts, Creative Arts Workshop, 80 Audubon St., New Haven, 06510.
Juried show–SoNo Arts Celebration, Aug. 1–2. Waterfront district of South Norwalk. For an application, send SASE to SoNo Arts Celebration, Exhibiting Arts Committee, PO Box 2222, South Norwalk, 06852. (203) 849-9366.
Juried expositon–35th annual Guilford Handcrafts Exposition, July 16–18. Town Green, Guilford. For more info, call (203) 453-5947.
Exhibition–Windsor Chairs by James Rendi, June 6–July 19. Brookfield Craft Center, 127 Washington St., South Norwalk. For more information, call (203) 853-6155.
Exhibition–Colorful Carvings and Bird Houses by Raintree Carving (Barry Leader), June 14–Aug. 2. Brookfield Craft Center, Route 25, Brookfield. Call (203) 775-4526.

FLORIDA: **Meetings**–Central Florida Woodworkers Guild, second Thursday of every month, Winter Park. For information, contact Ed Harte (407) 862-3338.
Meetings–Sarasota Woodworking Club. Second Thurs. of every month. For info, contact Tom Clark, 3544 Oak Grove Drive, Sarasota, 34243. (813) 351-9059.

GEORGIA: **Fair**–Prater's Mill Country Fair 1992, May 9–10. This rural festival takes place on the grounds of an 1855 water-powered mill. Contact Prater's Mill Foundation, 101 Timberland Dr, Dalton, 30721. (404) 259-5765 or (404) 259-3420.
Competition–Design Emphasis '92 furniture design competition, call for entries. Sponsored by and held in conjunction with the International Woodworking Machinery & Furniture Supply Fair '92, Aug. 21–24, Georgia World Congress Center, Atlanta. For info on the competition, contact Shirley Byron, IWF, 8931 Shady Grove Court, Gaithersburg, MD 20877. (301) 948-5730.
Workshops–Japanese woodworking by Toshihiro Sahara. One Saturday each month, year-round. Contact Sahara Japanese Architectural Woodworks, 1716 Defoor Place N.W., Atlanta, 30018. (404) 355-1976.
Courses–Various woodworking courses, Feb. thru May. For info, contact Chris Bagby, Highland Hardware, 1045 N. Highland Ave., N.E., Atlanta, 30306. (404) 872-4466.

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

INDIANA: **Classes**–Various woodworking classes and workshops including general woodworking, lathe and router seminars. Woodworking Unlimited, 6038 E. 82nd St., Indianapolis, 46250. (317) 849-0193.
Juried show–Works in Wood. Deadline: July. For more info, contact Marsha Demkovich, Chesterton Art Gallery, PO Box 783, Chesterton, 46304. (219) 926-3041.

IOWA: **Juried fair**–22nd annual Art in the Park, May 16–17. Four Square Park, Main Ave., Clinton. Fine arts and crafts. For more info, contact Carol Glahn, Clinton Art Association, Box 132, Clinton, 52733. (319) 259-8308.

KANSAS: **Juried show**–8th Annual Lenexa's National Art Show, June 12–14. Sar-Ko-Par Trails Park, Lenexa. For more information, contact Lenexa's National Art Show, 13420 Oak, Lenexa, 66215-3652. (913) 541-8592.

KENTUCKY: **Show**–Kentucky Lake Arts and Crafts Show, May 23–24. Land Between the Lakes, Aurora. For more information, contact Cindy Lawson, PO Box 1332, Murray, 42071. (502) 753-1460.
Workshops–Woodturning and joinery instruction. One-day to one-week courses. Contact Jim Hall, Adventure in Woods, 415 Center St., Berea, 40403. (606) 986-8083.
Meetings–Kyana Woodcrafters Inc., first Thursday of each month. Bethel United Church of Christ, 4004 Shelbyville Road, Louisville, 40207. (502) 426-2991.
Workshops–Traditional Windsor chairmaking instruction. One-week courses. Contact David Wright, 503 Prospect, Berea, 40403. (606) 986-7962.

MAINE: **Show**–Woodworking World Show, May 1–3. Portland Exposition Bldg., 239 Park Ave., Portland. For more information, call (800) 521-7623.
Classes–Haystack Mountain School of Crafts, summer program. For info, contact 1992 Haystack Mountain School of Crafts, PO Box 518, Deer Isle, 04627. (207) 348-2306.
Classes–Woodworking for adults and children in daytime, evenings and on weekends. Portland School of Art, 97 Spring St., Portland, 04101. (207) 775-3052.

MARYLAND: **Juried show**–15th annual Spring Arts and Crafts Fair, May 1–3, Maryland State Fairgrounds, Timonium. For more info, contact Deann Verdier, Director, Sugarloaf Mountain Works, Inc., 200 Orchard Ridge Drive, Suite 215, Gaithersburg, 20878. (301) 990-1400.
Show–20th biennial Crafts Collection, June 3–July 13. Strathmore Hall Arts Center, Rockville. For more info, contact Mac Ehrlich, 6540 Bradley Blvd., Bethesda, 20817. (301) 365-1133.
Exhibition–10th annual Artscape '92, July 17–19. Crafts exhibition and market, Baltimore. For more info, call (410) 396-4575.
Juried show–29th annual Havre de Grace Art Show, Aug. 15–16. Tydings Memorial Park, Havre de Grace. Deadline: June 15. For an application, send SASE to Art Show, PO Box 174, Havre de Grace, 21078. (410) 879-4404 or (410) 939-3303.
Juried festival–Maryland Country Music & Craft Festival, Aug. 15–16. Fair Hill. For more info, contact Carl Hyden, Governor's Office of Art & Culture, (410) 333-4793.

MASSACHUSETTS: **Exhibition**–Garden Treasures, May 9–July 11 at 175 Newbury St., Boston; May 18–July 11 at 101 Arch St., Boston. For info, contact The Society of Arts and Crafts at (617) 266-1810.
Exhibitions–Kimberly Kelzer and Jay Stanger, thru May 22. Clark Gallery, Lincoln Station, Lincoln; Stephen Whittlesey and selections from Peter Joseph Gallery, May 1–30. Gallery NAGA, 67 Newbury St. Boston. For more info, call (617) 259-8303.
Seminars–Various woodworking seminars thru May 16. For further info, contact Woodcraft Supply, 313 Montvale Ave., Woburn, MA 01801 (617) 935-6414.
Workshops–Painted Surfaces and Faux Finishes with Demetra Andreadis, May 8–10; Carpentry: Design and Build with Lance Hodes, June 20–22. For more info, contact Horizons, 374 Old Montague Road, Amherst, 01002. (413) 549-4841.
Show–7th annual Crafts at the Castle, Dec. 4–6. Deadline: May 18. For an application, contact Crafts at the Castle, Family Service of Greater Boston, 34 1/2 Beacon St., Boston, 02108. (617) 523-6400.
Fair–American Craft Council Fair, June 26–28. Eastern States Exposition, West Springfield. For more info, contact American Craft Enterprises at (800) 836-3470.
Workshops–Summer workshops at The Heartwood School, Johnson Road, Washington, 01235. (413) 623-6677.
Workshops–Fundamentals in Fine Woodworking, June 1–12, July 13–24 and Aug. 10–21; Shaker Nightstand, July 13–24 and Aug. 10–21; Bow Repair and Restoration, July 20–31; Violin Repair, Aug. 3–14. For info, contact North Bennet Street School, 39 N. Bennet St., Boston, 02113. (617) 227-0155.
Classes–Woodworking classes, throughout most of the year. Boston Center for Adult Education, 5 Commonwealth Ave., Boston, 02116. (617) 267-4430.

MICHIGAN: **Seminar**–Basic Wood Technology-Advanced Applications, May 21. Holiday Inn, Kalamazoo. For info, contact Dr. Otto Suchsland: (517) 355-7562 or Dr. Huber: (517) 355-6544.
Seminars–Various woodworking seminars thru May 24. For more information, contact Woodcraft Supply , Heritage Plaza, 14695 Telegraph Road, Redford, 48239 (313) 537-9377.

MINNESOTA: **Fair**–American Craft Council Fair, May 2–3. Minneapolis Convention Center. For more info, contact American Craft Enterprises at (800) 836-3470.
Courses–Log building, graduate session (furniture, railings, finishing), May 11–17. For more information, contact Great Lakes School of Log Building, 3544 1/2 Grand Ave., Minneapolis, 55408. (612) 822-5955.
Juried show–10th annual Upper Midwest Woodcarvers' Exhibition, July 25–31. Blue Earth. For more information, contact Harley Schmitgen, 311 E. 14th St., Blue Earth, 56013. (507) 526-2777.
Seminars–Various woodworking seminars thru May. Contact Woodcraft Supply, Plaza at Oxboro, 9741 Lyndale Ave. S., Bloomington, MN 55420. (612) 884-3634.
Juried festival–Minnesota Crafts Festival, June 27–28. College of St. Catherine, St. Paul. For info, contact MCC-Festival, Suite 308, 528 Hennepin Ave., Minneapolis 55403. (612) 333-7789.
Classes–Woodcarving classes year-round. Also, seminars on woodturning, chair caning and whittling. Special one-week summer session Aug.10–14. For info, contact the Wood Carving School, 3056 Excelsior Blvd., Minneapolis, 55416. (612) 927-7491.

MISSOURI: **Seminars**–Various woodworking seminars thru May 9. For info, contact Woodcraft Supply, Dierberg's Heritage Place, 12511 Olive Blvd., Creve Coeur, 63141.
Juried exhibit–Turned Visions, May 8 thru June 27. A portion of the sales' commission will benefit the Woodworkers' Alliance for Rainforest Protection. Contact Craft Alliance, 6640 Delmar Blvd., St. Louis, 63130. (314) 725-1177.

MONTANA: **Exhibition**–Good Wood III, Oct. 2–4. Ramada Inn, Billings. Contact Montana Woodcarvers Association, 2919 Lynn Ave., Billings, 59102. (406) 656-2051.

NEBRASKA: **Classes**–Carving a Standing Bear with Desiree Hajny, May 16–17; Carving a Big-Horned Sheep, Sept. 18–20. Midwest Woodworkers Supply, Omaha. For more info, contact Midwest Woodworkers Supply, 13209 I St., Omaha, 68137. (402) 330-5444.

NEW HAMPSHIRE: **Classes**–19th summer Violin Craftsmanship Institute. University of New Hampshire. For more information, contact Violin Institute, UNH Continuing Education, Brook House, 24 Rosemary Lane, Durham, 03824. (603) 862-1088.
Demonstrations–2nd annual Wood Day, May 9. Canterbury Shaker Village. For info, contact Shaker Village, 288 Shaker Road, Canterbury, 03224. (603) 783-9511.
Demonstration–Techniques on making chairs and benches with Jim Becker, May 16. Guild of New Hamp-

shire Woodworkers, Kensington. For info, contact John Skewes (603) 778-7360.
Juried exhibition–Guild of New Hampshire Woodworkers, Oct. 19. Killian Gallery at the Sharon Arts Center, Sharon. Deadline June 19. Contact John Skewes, 132 Drinkwater Road, Kensington, 03833. (603) 778-7360.
Classes–Fine arts and studio arts. Manchester Institute of Arts and Sciences, 114 Concord St., Manchester, 03104.
Classes–Various woodworking classes, year-round. Including antique repairs, carving canes & walking sticks, small boxes, kitchen utensils, lathe-turning, hand-carving, more. Contact The Hand & I, PO Box 264, Rte. 25, Moultonboro, 03254. (603) 476-5121.
Auctions–Antique and craftsman's tool auctions, year-round. Contact Richard A. Crane, Your Country Auctioneer, 63 Poor Farm Road, Hillsboro, 03244. (603) 478-5723.

NEW JERSEY: **Show**–13th annual South Jersey Wood Carvers Show, June 6–7. New Jersey National Guard Armory, Cherry Hill. Contact Pat DeAngelis: (609) 227-1969.
Juried festival–Waterloo Arts and Crafts Festival, Sept. 26–27. Deadline: June 15. Waterloo Concert Field, Stanhope. For more info, call Stella Show Management Co. at (201) 384-0010.
Juried show–22nd annual Peters Valley Craft Fair, July 25–26. For more info, contact Peters Valley Craft Fair, 19 Kuhn Rd., Layton, 07851. (201) 948-5200.
Workshops–Summer woodworking program. June thru Aug. For brochure, write to Peters Valley Craft Center, 19 Kuhn Road, Layton 07851 or call (201) 948-5200.

NEW MEXICO: **Seminar and juried exhibition**–Seminar with master cabinetmaker James Krenov and an exhibition of fine woodworking, July 10–11. For more info, contact Santa Fe Community College, Community Services, PO Box 4187, Santa Fe, 87502-4187.
Classes–Woodworking classes. Northern New Mexico Community College, El Rito, 87520. (505) 581-4501.

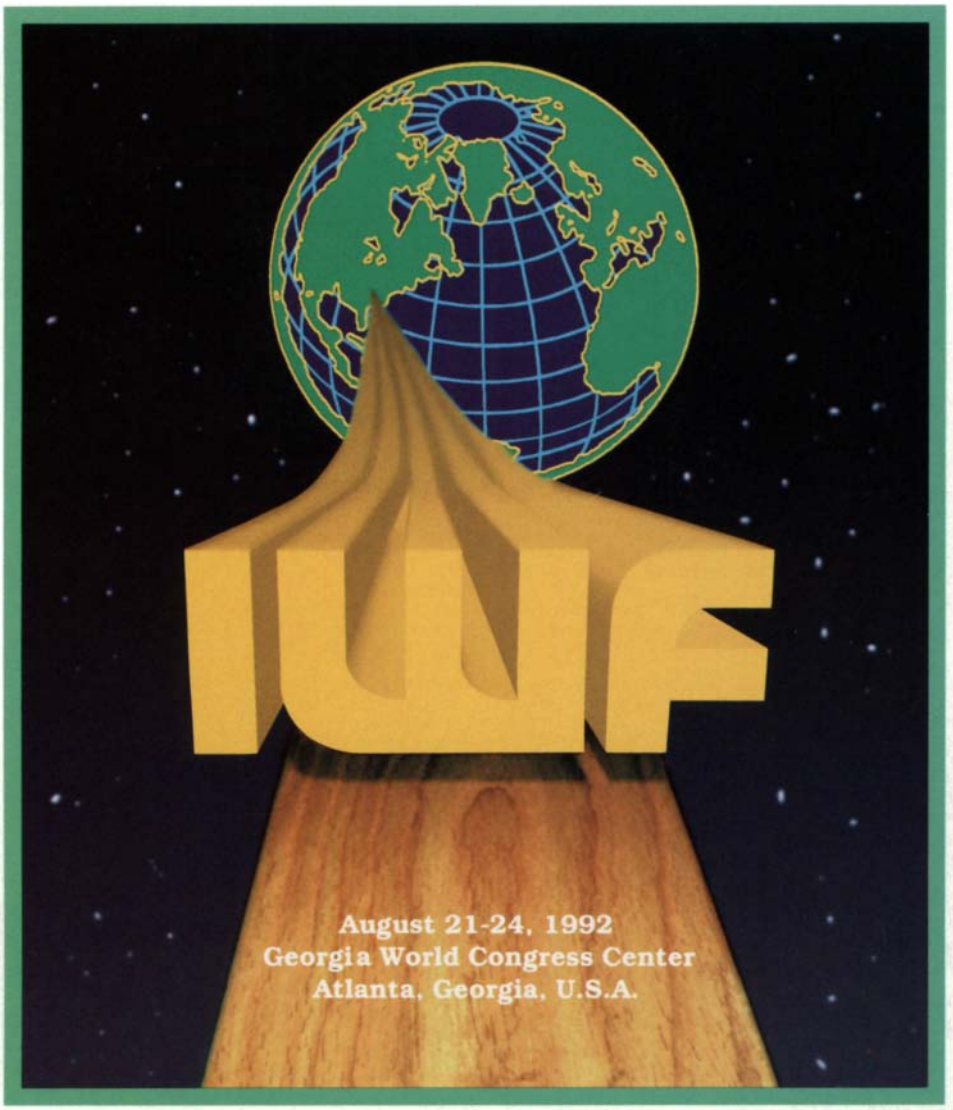
NEW YORK: **Exhibitions**–Timothy Philbrick, thru May 2; Rosanne Somerson, James Carpenter, thru May 15. Peter Joseph Gallery, 745 Fifth Ave., New York City. (212) 751-5500.
Show–14th annual Great Neck Celebrates Crafts, May 3. Old Village, Great Neck, Long Island. For more information, contact Creative Faires Ltd., PO Box 1688, Westhampton Beach, 11978. (516) 288-2004.
Exhibition–Japanese Folk Art: The Triumph of Simplicity, May 14–July 2. Japan Society Gallery, 333 E. 47th St., New York. Contact Aimee Gautreau at (212) 715-1216.
Fair–International Contemporary Furniture Fair, May 17–20. Jacob K. Javits Convention Center. Contact George Little Management, Inc., 2 Park Ave., Suite 1100, New York, 10016-5748. (212) 686-6070.
Workshops–Japanese Hand Tools, May 23–24 and June 13–14. 2449 W. Saugerties Road, Saugerties, 12477. (914) 246-5207.
Juried show–Woodstock-New Paltz Arts & Crafts Fair, Spring Show, May 23–25, Ulster County Fairgrounds. Contact Scott or Neil Rubinstein, Quail Hollow Events, PO Box 825, Woodstock, 12498. (914) 679-8087.
Exhibition–Constructed Sculpture in Wood, thru June 7. The Brooklyn Museum, 200 Eastern Parkway, Brooklyn. For more info, call (718) 638-5000, ext. 330.
Classes–Boatbuilding classes, June thru Sept. Contact The Antique Boat Museum, 750 Mary St., Clayton, 13624. (315) 686-4104.
Exhibition–Step Lively: The Art of the Folk Cane, June 4–Sept. 7. Museum of American Folk Art, 2 Lincoln Square, New York. Contact Susan Flamm at (212) 977-7170.
Juried show–Spring Crafts at Rhinebeck, June 26–28. For info, contact Crafts at Rhinebeck, PO Box 389, Rhinebeck, 12572. (914) 876-4001.
Festival–Chautauqua Crafts Festival, July 3–5 and Aug 7–9. Bestor Plaza, Chautauqua Institution. For info, contact Gale Svenson, Director, Chautauqua Crafts Festival '92, PO Box 89, Mayville, 14757. (716) 386-6043.
Juried festival–16th annual American Crafts Festival, July 4–5 and July 11–12. Lincoln Center, New York City. For more info, contact Brenda Brigham, American Concern for Artistry and Craftsmanship, PO Box 650, Montclair, NJ 07042. (201) 746-0091.
Classes–Various beginning and advanced woodworking classes. Constantine, 2050 Eastchester Road, Bronx, 10461. (212) 792-1600.
Meetings and classes–New York Woodturners Association, first Tuesday of each month. Woodturning techniques exhibits, more. Also, Woodworking with Maurice Fraser. Sessions begin June 1. The Craft Student League, YWCA, 610 Lexington Ave., New York City.

NORTH CAROLINA: **Fair**–Guild May Fair, May 23–24. Folk Art Center, Milepost 382 on Blue Ridge Parkway, Asheville. For more info, call (704) 298-7928.
Shows–17th annual Highland Heritage Art and Craft Show, June 11–14. Asheville Mall, Asheville; 2nd annual Heritage Art and Craft Show, July 1–5. Old Threshers' Reunion, Denton; 4th annual Mountain Magic Art and Craft Show, July 10–12. Carolina Day School, Asheville. For more info, contact High Country Crafters, 46 Haywood St., Asheville, 28801. (704) 254-2787.
Workshops–Summer woodworking workshops, June thru Aug. Penland School, Penland. For a catalog, write to Penland School, Penland, 28765 or call (704) 765-2359.
Show–North Carolina Piedmont Woodcarvers annual show, Oct. 3. For info, contact Bob Williams, Route 7, Box 234, Mooresville, 28115. (704) 663-3736.
Video course–Wood Technology, six-lesson correspondence course on the wood industry. For info, contact Ms. Vann Moore, Dept. of Wood & Paper Science, North Carolina State Univ., PO Box 8005, Raleigh, 27695-8005. (919) 737-3181.
Workshops–Woodworking and woodcarving workshops, year-round. For info, contact John Campbell Folk School, Route 1, Box 14-A, Brasstown, 28902. (800) 562-2440 or (704) 837-2775.
Meetings–North Carolina Woodturners, second Saturday of every month. Also, woodturning workshops for all levels. For info, contact Eric Hughes, Rte. 3, PO Box 300, Conover, 28613. (704) 464-5611.

OHIO: **Workshop**–Spray Finishing Technology, May 11–14. Classes to be held at Technical Training Centers at DeVilbiss Ransburg in the Toledo area. Contact Dr. Richard Kruppa at Bowling Green State University: (419) 372-7560.

OREGON: **Show**–About Beds, May 9–June 14. Made in Jefferson Gallery, 3259 Jefferson Scio Drive, Jefferson. For info, contact Toni Gilbert at (503) 327-2543.
Show–Summer Show of Fine Woodworking, June 25–28. Presented by the Siskiyou Woodcraft Guild. Pioneer Hall, Winburn Way, Ashland. (503) 482-4829
Design Competion–5th annual Table, Lamp and Chair. Deadline: June 30. For more information, contact Table, Lamp and Chair '92, PO Box 69352, Portland, 97201. (503) 246-7314.
Workshops–Special English Finishing Techniques, July 13–17; Conservation and Restoration, July 20–24. Instructor: Bruce Luckhurst. Oregon School of Arts and Crafts, 8245 S.W. Barnes Road, Portland, 97225. (503) 297-5544.
Juried show–Nehalem Fine Woodworking Show, Aug. 1–31. Artisans's Gallery, 12870 H St. (Highway 101). Slide deadline: June 1. Contact Deborah Kerner, Artisan's Gallery, PO Box 367, Nehalem, 97131. (503) 368-7301.
Meetings–Guild of Oregon Woodworkers, third Friday of every month. For location, contact the Guild at PO Box 1866, Portland, 97207. (503) 293-5711.

Think IWF '92—Atlanta



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READER SERVICE NO. 124

PENNSYLVANIA: **Juried exhibitions**–Re-Awakening: A Celebration of Spring, May 2–June 7; Stories: The Narrative Art in Contemporary Crafts, Aug. 8–Sept. 20. For more info, contact Luckenbach Mill Gallery, 459 Old York Road, Bethlehem, 18018. (215) 691-0603.
Festival–9th annual Penn's Colony Festival, Sept. 19–20 and Sept. 26–27. Application deadline: May 31. For info, contact Penn's Colony Festival, 603 E. End Ave., Pittsburgh, 15221. (412) 241-8006.
Market–20th Lancaster designer spring art and craft market, June 6–7. For info, call Pegge Shannon (717) 291-1173 or Lancaster Designer Craftsmen (717) 295-1500.
Show–Market Square Traditional Wholesale Show, June 13–15. Valley Forge Convention Center, King of Prussia. For more info, call (717) 776-6989.
Classes–Woodcarving at Sawmill Center for the Arts, June 22 thru Aug. For more info, contact Cook Forest Sawmill Center for the Arts, PO Box 180, Cooksburg, 16217.
Juried festival–Central Pennsylvania Festival of the Arts, July 9–12. For info, contact Katherine Talcott, Assistant Director, Central Pennsylvania Festival of the Arts, PO Box 1023, State College, 16804. (814) 237-3682.
Classes–Windsor chairmaking, all levels, weekly and weekends. Contact Jim Rendi, Philadelphia Windsor Chair Shop, PO Box 67, Earlville, 19519. (215) 689-4717.
Classes and demonstrations–Carve a Cabriole Leg with Gene Landon, May 2–3; Sharpening with Prew Savoy, May 16–17; Mike Dunbar Builds a Sack Windsor Chair, May 30–31; Build a Chippendale Chair with Gene Landon, June 13–17. Olde Mill Cabinet Shoppe, 1660 Camp Betty Washington Road, York, 17402. (717) 755-8884.

SOUTH CAROLINA: **Festival**–Mayfest Arts and Crafts Showcase, May 2–3. Sidney Park, Columbia. For info, contact Columbia Action Council, 817 Calhoun St., Columbia, 29210. (803) 254-0253.

TENNESSEE: **Workshops**–Windsor Chairmaking with David Wright, June 8–12; Art of Woodturning with Giles Gilson, June 8–12; Timber Framing with David Hickman and Joe MacDonald, June 8–12; Woodcarving with Jess Betschart, July 20–24; Woodturning with John Jordan, July 20–24. For more information, contact Ilene Quall, Appalachian Center for Crafts, PO Box 430, Route 3, Smithville, 37166. (615) 597-6801.
Workshops–Summer workshop program at Arrowmont School of Arts and Crafts, June thru Aug. For more information, contact Registrar, Arrowmont School, PO Box 567, Gatlinburg, 37738. (615) 436-5860.

VERMONT: **Classes**–Shop courses, May 31–Aug 1. For more info, contact Yestermorrow, PO Box 344, Warren, 05674. (802) 496-5545.
Classes–Cedar/Canvas Canoe Construction, July 5–10 and Sept. 6–11. For more information, contact Sterling College, Craftsbury Common, 05827. Or call Horace Strong at (802) 586-2575.

VIRGINIA: **Exhibition**–Spotlight '92, May 8–July 31. Sponsored by Southeast Region of the American Craft Council and Hand Workshop, Virginia Center for the Craft Arts. For more information, contact Spotlight '92, Hand Workshop, 1812 W. Main St., Richmond, 23220. (804) 353-0094.
Show–17th annual Richmond Craft and Design Show, Nov. 20–22. Richmond Centre for Conventions and Exhibition. Slide deadline: June 1. For an application, contact Hand Workshop, 1812 W. Main St., Richmond, 23220. (804) 353-0094.

WASHINGTON: **Seminars**–Various woodworking seminars thru May. For info, contact Woodcraft Supply, Georgetown Center, 5963 Corson Ave. S. Seattle, 98101. (206) 767-6394.
Juried show–6th annual show and sale, Kitsap County Woodcarvers Club, June 13–14. Kitsap Mall, Silverdale. For more info, contact Chuck Malven, 6015 Osprey Cr., Bremerton, 98312.
Meetings–Northwest Woodworkers Guild, last Wednesday of each month. Contact John Gruenewald 622 9th Ave., Kirkland, 98033. (206) 827-8012.
Workshops–Boatbuilding workshops and seminars year round. For more information, contact Northwest School of Wooden Boatbuilding, 251 Otto St., Port Townsend, 98368. (206) 385-4948.

WEST VIRGINIA: **Workshops**–Workshops include Windsor chairmaking and Basic Cabinetry, May 17–Aug. 17. For info, contact Crafts Center, Cedar Lakes, Ripley, 25271. (304) 372-7005.
Workshops–Workshops include Banjo Construction, Log House Construction and Chip Carving, July and August. For more info, contact Augusta Heritage Center, PO Box CN, Davis and Elkins College, Elkins, 26241-3996. (304) 636-1903.

WISCONSIN: **Exposition**–The Masters Wildlife Art Exposition and Ducks Unlimited Carving Competition, May 16–17. City of Racine Festival Hall, 5 Fifth St. Racine.

AUSTRALIA: **Festival and meeting**–Battle of the Coral Sea, May 1–12; meeting May 11. The Townsville Area Woodturners Association, PO Box 692, Aitkenvale, 4814, Queensland. Contact Neville Hines (077) 73-556 or Mac Goodwin (077) 79-1932.

CANADA: **Juried exhibition**–Southern Alberta Woodworkers Society. Call for entries. For entry forms, write Southern Alberta Woodworkers Society, PO Box 6753, Station D, Calgary, Alberta, T2P 2E6. For info contact, Doug Haslam: (403) 270-3195.
Show–Woodturnings by Bob Gonzales, July 4–5 and July 11–12. Arnold Mikelson Mind and Matter Gallery, 13743 16th Ave., White Rock, Surrey, B.C. (604) 536-6460.
Juried exhibition and show–9th annual Wood Show, Aug. 7–9. Durham Community Centre, Grey County. For brochure or info, contact The Wood Show, PO Box 920, Durham, Ont., N0G-1R0. (519) 369-6902.
Workshops–Furniture workshops, June 15 thru Aug. 8. Sheridan College Summer School of the Arts, 1430 Trafalgar Road, Oakville, Ont., L6H 2L1. (416) 845-9430.
Seminar–Woodturning Design and Technique III, Aug. 1–3, Kelsey Campus, Saskatoon. Instructors: Del Stubbs, Richard Raffan, Giles Gilson, Mark Sfirri. For more information, contact Saskatchewan Craft Council, 813 Broadway Ave., Saskatoon, Sask. S7N 1B5 (306) 653-3616.
Classes–Furnituremaking, carving, lathe turning, router and more. Tools 'n Space Woodworking, 338 Catherine St., Victoria, B.C., V9A 3S8. (604) 383-9600.
Meetings–Canadian Woodturners Association meetings, throughout the year. Second Tuesday of each month. Contact Patrick Chen, PO Box 8812, Ottawa, Ont., K1G 3J1. (613) 739-7746.
Meetings–Blue Mountain Woodworking Club meetings, throughout the year. Third Wednesday of each month. Contact Glenn Carruthers, PO Box 795, Stayner, Ont., L0M 1S0. (705) 444-1752.
Meetings–West Island Woodturners Club meetings, second Tuesday of each month. Also, woodturning courses. Contact Eric Webb, 61 Devon Road, Beaconsfield, Que., H9W 4K7. (514) 630-3629.
Meetings–Northern Alberta Woodcrafters Guild meetings, third Thursday, Sept. thru June. Contact Douglas Lobb, 121 Healy Road, Edmonton, Alberta, T6R 1W3. (403) 430-7391.

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

***The grain of the silver-ash veneer top** (above) on David Upfill-Brown's demilune table radiates perfectly from the center of the table and contrasts with the jarrah detailing.*

***The William-and-Mary style cabinet,** (at left) made by Geoff Hannah, is exquisitely inlaid with accurate depictions of Australian flora and fauna. The piece has 64 drawers, including several secret ones.*

***The subtle curves of Richard Vaughan's** cheval mirror (far left) are executed in lightly fiddle-backed silver ash. The 70-in.-high mirror tilts to accommodate the height of any viewer.*

Australian woodworkers excited by response to Sydney show

Public reaction to the biennial show of The Woodworkers' Association of New South Wales (WANSW), held for four weeks last fall, was overwhelmingly positive. The Sydney, Australia, exhibition, titled "Hands On," focused on native talent and native timbers. The goal was to increase awareness of the group's work. The title not only reflected the woodworkers' approach to their work, but it was also an invitation to the public to get their "hands" on the exhibits—an invitation that most of the visitors weren't able to resist.

And there were lots of visitors; some 2,000 people a day marveled over the intricate work of more than 30 of the countries finest woodworkers. The huge success of the exhibition, in terms of both attendance and sales, can be attributed to the sponsorship of The Forestry Commission of New South Wales. With this financial backing, WANSW was able to promote and produce a first-class exhibition that addressed the misconception that in Australia, quality woodworking doesn't exist.

The marquetry masterpiece that's shown in the bottom right photo was created by Geoff Hannah. The high chest took more than 2,000 hours to complete and has 64 drawers with an individual Australian animal or plant motif on each drawer. The chest sold for approximately $76,000 (U.S.) and is now in the Government House, which is Australia's equivalent of the White House.

Some observers felt that David Upfill-Brown's demilune table shown in the top right photo exhibited the finest craftsmanship of the show. But all of the 150 entries were excellent, from small, well-crafted wooden toys to Hannah's magnificent cabinet.

It's hard to believe that just 10 years ago the driving force behind such a successful show, Richard Vaughan, wasn't even a woodworker. After attending a WANSW exhibition, Vaughan enrolled in the two-year program in advanced cabinetmaking at Sydney Technical College. Following this training, he es-

Photos this page: Scott Donkin

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tablished his own studio. Not only has Vaughan become a serious woodworker, as indicated by his cheval mirror shown in the photo at left on p. 104, but he's also the chairman of WANSW.

The next "Hands On" exhibition is scheduled for September 1993 in Sydney, Australia. For more information, contact Woodworkers' Association of New South Wales at 14 Fred Lane, Lilyfield, NSW, Australia 2040.

–Charley Robinson

A touch of crass

Out of earshot, we called him "Jimmy the Hacker." Although he was the senior finisher in the shop, he had a reputation for requiring two or three attempts to get a finish right. Still, when he was sober, he did some beautiful work, and the neophytes like myself enjoyed learning from this profane ex-marine in spite of his rather short temper.

One Friday, Jimmy was putting the finishing touches on a tabletop that had been keeping him busy all week. The finish was a fake-grain lacquer job with at least three separate color glazes used to mimic red oak. It was a bear of a finish, and this was Jimmy's second shot at it already. His first effort was undone by an inconsiderate flying insect. After the final coat of lacquer was applied, a palmetto bug flew into the still-wet finish, and its death throes undid all of his fine efforts. Each coat of a lacquer finish dissolves all of the previously applied coats. The last coat melts all others into a thick layer cake of translucent colors. As it flopped around, that bug ruined the finish right down to the raw wood. There was nothing to do but strip the finish off and start over.

Now in its second incarnation, the table received its final coat. Just as Jimmy wheeled the top out into the drying room, the shop's owner came by with two potential customers in tow. They were the sort of Southern matrons who still wore socially correct white gloves despite the eroding etiquette of the 1970s. The look of the still-wet lacquer under bright lights must have been too much to resist, for as she walked past, one of the women gently ran her fingers across the glistening top. To her surprise, the lacquer moved aside leaving a furrow down to the wood. It looked like the icing on a two-year-old's birthday cake after an unofficial tasting.

Those of us who saw the incident let out a collective gasp, and stood stock still, convinced that we were about to witness a justifiable homicide. Jimmy turned beet red and barely containing his fury, blurted out "That finish is *wet!*"

"Oh, it's quite all right," replied the offender, holding up a clean, but now gloveless finger, "I had my gloves on."

–Adapted from Michael Dresdner's forthcoming book, The Woodfinishing Book, *to be published in the fall by The Taunton Press.*

Wood collectors announce international fest

"Get this bunch of people together in a wheat field in Kansas, and we'll have a good time." That's what Rex Vaught, an Indiana member of the International Wood Collector's Society (IWCS), thinks of the forthcoming Woodfest International slated for June 7 to 11 in Blacksburg, Va. Vaught says "You'll never find a friendlier, more helpful or more generous group."

This year's meeting features more than 40 programs, including lectures on the nature of wood, demonstrations of turning, carving, cabinetry, and other wood pursuits, a gallery where members can display their best work, an auction of hundreds of species of wood and an auction of members' work. Other programs, including weaving, pottery, guided walks and other craft workshops, are being offered for the less-fanatical wood collectors and their families.

The IWCS is a non-profit organization dedicated to the exchange of wood and information about wood. Founded in 1947, the IWCS, has 1400 members in 25 countries. For more information, contact Lloyd Sumner, 5900 Chestnut Ridge Road, Riner, Va. 24149; (703) 382-1974 (before 9:00 PM EST).

–Lloyd Sumner, Riner, Va.

Real woodworking

I lived in Nepal for almost a year before I had time to closely examine their woodworking. But when I found the time, I went to the Mecca of Nepalese woodworking, Baktapur, an ancient city located in the Kathmandu valley.

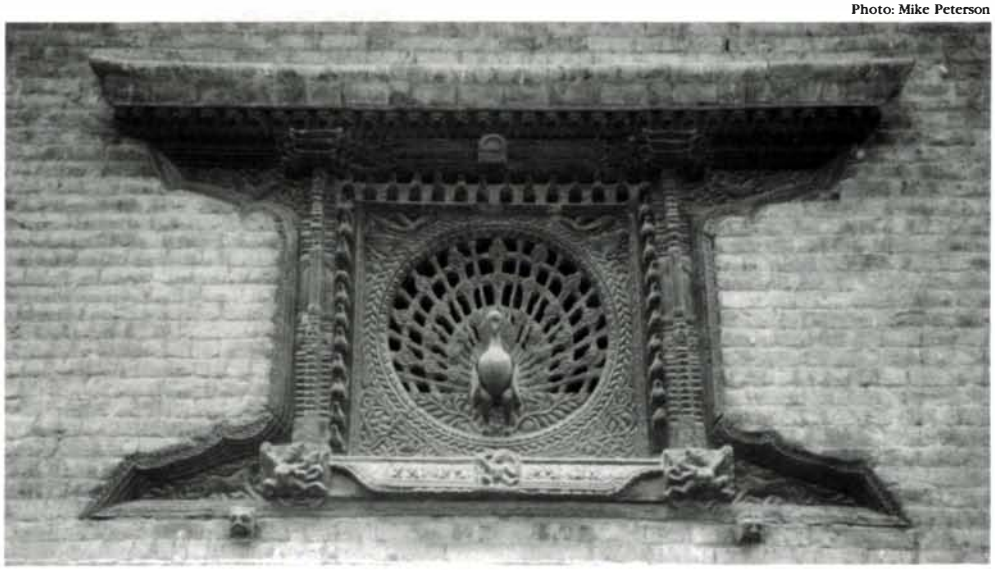
As I jerked and jimmied my four-wheel drive through the narrow, brick streets, I was immediately enveloped in and impressed with the antiquity of Baktapur. I felt as though I was driving back into time, complete with goats, chickens and an occasional water buffalo placed here and there for effect. The brick homes and shops pushed at me from either side stretching from three-to-five stories into the clear, blue sky.

There was much to absorb. The Nepalese are a very spiritual people and all about me were carvings in wood and stone depicting Hindu gods and Buddha. Over many of the doorways I could see the ancient toranas—elaborate carvings on the lintels—in fact woodcarvings were everywhere. I was amazed at the number of carvings on each home. The doors were intricately carved, as were the door frames, and each home was adorned with a number of windows known as *tiki jhaya,* or eye windows, impressive both as carvings and in their complex joinery.

I found Baktapur's most famous woodcarving, the *Peacock Window.* The window was down a narrow walkway and was completely unprotected. It was a very impressive carving, but not being a woodcarver, I was more interested in the joinery, which, I must confess, was a little disappointing. On all the carvings in the area, the joints looked sloppy, and on most, the wood had pulled back and twisted out of shape. I began to chalk up all the hoopla about Baktapur's woodworking to a pretentious guidebook—just another gimmick to grab the tourists.

I wandered around a few more streets and found myself in front of the Baktapur Wood Carvers Conservation Society. I went in and met Mr. B. K. Adhikary, the manager of the society, who told me that the organization was formed in 1977 to provide a program to preserve the traditional woodcarving skills that were rapidly dying out. Because of the poor joinery I had just seen, I wondered why anyone would want to preserve these skills. However, I kept my thoughts to myself and

Photo: Mike Peterson



***The 550-year-old peacock window** in Baktapur, Nepal is considered the masterpiece in a city overflowing with intricate architectural carvings.*

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12" x 30T x 1"	162	**109**	8" x 40T 3/32	136	**89**
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9" x 60T x 5/8"	156	**109**
8" x 60T x 5/8"	150	**99**
New 8-1/4" x 40T x 5/8"	136	**89**

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Note: *Fine Woodworking Editorial Nov./Dec. 1988 No. 73 pg. 65 S. N. recommends high alternating top bevel (ATB) thin kerfs and large blade stiffeners for smoothest cuts on RADIAL SAW, etc.*

Jim Forrest, President and designer microscoping cutting edge.

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Ryobi-Makita		14"	x 100T x 1"	266	**169**
Hitachi		15"	x 100T x 1"	277	**179**

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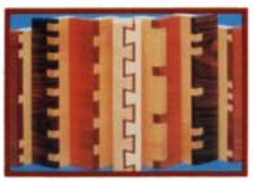

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asked him how old the peacock window and the surrounding carvings were. He said the peacock window was 550 years old and most of the other pieces around 500 years old. I almost fell over. Suddenly I realized the carvings I had seen were masterpieces, works of art, invaluable pieces of true craftsmanship. It seemed inconceivable that something made of wood and exposed to the elements for more than 500 years could still be here.

He took me on a tour of the society's workshop where craftsmen, some as young as 15 years old, were busy at various tasks. There was Mr. Shilpakar (his name means *master artisan*), an 85-year-old man working side by side with his son and grandson. I asked what kind of wages they were paid, and Mr. Adhikary said that they earned from 30-to-85 rupees per day, ($.33 - $.78) depending on their skill level. Right about then I was distracted by the whine of what they call a tablesaw—a loose imitation of the real thing. Other than this saw and a power hand planer, all the work was being done by hand.

He then showed me an extensive renovation program for preserving some of the carvings that are beginning to decay. Because of the remarkable condition of the carvings (considering the years of exposure and abuse), I asked what craftsmen had originally used for sealing the wood.

"Oh, you know, a little wax and suet and local medicine," Mr. Adhikary replied.

"Local medicine? What's that?"

"Well, you know, local medicine."

I wasn't sure if he didn't think it that important or if he was trying to hide a trade secret, so I pushed on.

"No, I don't know, what do you mean, *local medicine*?"

"Well, clay and sand and dried leaves . . . . "

I thanked Mr. Adhikary and wandered over to the society's store. I purchased a large tiki jhaya for $7.80, stowed it safely in the jeep and bumped my way back to Kathmandu.

I've often heard woodworkers described as *expert* and *master* craftsmen. And I've heard comments like "Now, he's a real woodworker!" dropped by those who are in the know or who are at least pretending to be, and I've wondered what it takes to be labeled in such a way. Perhaps real woodworkers, like the Nepalese woodcarvers, are committed to a standard of craftsmanship described in a frontispiece quote by John Ruskin in a 1943 edition of *Audels Carpenters and Builders Guide*: "When we build, let us think that we build forever. Let it not be for present delight nor for present use alone. Let it be such work as our descendants will thank us for; and let us think, as we lay stone on stone, that a time is to come when those stones will be held sacred because our hands have touched them, and that men will say, as they look upon the labor and wrought substance of them, 'See! This our father did for us.' "

—Mike Peterson, Sacramento, Cal.

Photo above: Dwight F. Brooks, photo below: James F. Liles

The biggest l ttle boat in the bay

When Dwight Brooks saw the *Gulfstreamer* pull into a Los Angeles area marina, he was immediately taken by the magnificent 114-ft. yacht. As luck would have it, the yacht belonged to an old friend whom he hadn't seen for years, so Brooks decided to track the owner down and got permission to go aboard and take photographs of the interior. He also managed to obtain the plans originally used by Bennetti Yachts in Viareggio, Italy to build the boat. Although the plans were entirely in Italian and had no dimensions, Brooks photographed the drawings and used them to build the 1/12 scale, 10-ft.-long model of *Gulfstreamer* that's shown in the photo below.

The hull is standard plank-on-frame construction with 1/8-in. by 3/4-in. balsa planks glued and nailed to a 1/2-in. plywood framework. The curved aft section was molded out of foam, and the hull was covered with fiberglass—inside and out—for maximum strength. All three decks were made by gluing 1/8-in. by 3/8-in. teak strips to an aircraft plywood base. To match the real yacht's decks, Brooks left 1/8-in. spaces between each strip of teak decking and filled these gaps

***Dwight Brooks thinks big** when he scales things down. His 1/12-scale, radio-controlled model of a 114-ft.-long Italian-made yacht (below), causes a lot of doubletakes when he runs it on the lake near his cabin in Minnesota. A large model allows total attention to detail, as revealed by the cabin's completely furnished interior (left).*

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with black Bondo caulking. Cabin structures are mahogany aircraft plywood assembled with cyanoacrylate. Brooks reproduced all the furniture in the real *Gulfstreamer*, as shown in the top photo on p. 108, by working from his photographs, and he purchased additional furnishings, such as working lamps, fire extinguishers, dishes and TV sets from doll-house suppliers.

The radio-controlled model is completely operable thanks to two 12v and two 6v batteries that power twin electric flap motors, complete navigation and interior lights and a built-in AM/FM tape-deck system. After spending around 3000 hours in his California shop to complete the boat, Brooks crated it up, had it flown to Minnesota on a commercial DC-10, and then trucked it 150 miles to Brainerd, Minnesota where he has a cabin on a lake. Other than stopping the 300-lb. yacht once it has momentum, the biggest problem Brooks has when running the boat on the lake is avoiding curious boaters who want to get a closer look. *—Jim Boesel*

Photo below and back cover photo: Giorgey Spiridonov

Back cover key

Vadim Aksyeonov's marquetry tabletop, *Vortex of Dancers* (back cover), depicts the traditional folk dress of women living in the Commonwealth of Independent States (formerly the Soviet Union). The following is a list of the 15 republics (at the time of this printing). Start at the top with the woman in the dark-striped skirt, and proceed clockwise.

1. Lithuania
2. Turkmenistan
3. Estonia
4. Georgia
5. Russia
6. Ukraine
7. Moldavia
8. Byelorussia
9. Uzbekistan
10. Azerbaijan
11. Kirgizia
12. Armenia
13. Latvia
14. Kazakhstan
15. Tajikistan

Product review

Scraper system: Variable Burnisher, Jointer/Edger and Super-Hard Milled Scrapers, *Veritas Tools Inc., 12 E. River St., PO Box 1720, Ogdensburg, N.Y. 13669-1720; (800) 667-2986.*

A good part of woodworking's allure for me has always been the skill and handwork of the craft. In an age dominated by automated precision and repetition, it's all the more satisfying to cut dovetails by hand or to finish a surface with a cabinet scraper. And with dovetails and scraping at least, not only do I create less dust and noise, but I can get the job done almost as quickly as I could with power tools.

The lowly scraper has long been one of the most heavily used tools in my shop. After a little initial experimentation, keeping it cutting properly was no problem. I made a quick pass with a file, a couple more passes on a stone, and a quick burnishing with the back of a chisel or an old hydraulic piston rod, and I was off and running. I tried to get the hardest scrapers on the market, but I was still frustrated at how often they needed to be resharpened.

Then I ordered Lee Valley Tools' Super-Hard Milled Scrapers. The four scrapers in the set, varying from 0.4mm thick (very flexible) to 1mm (very stiff), are much harder than any others I have used (Rc 48-52 vs. Rc 38-42). Because they're so hard, they stay sharp much longer than my old scrapers. Unfortunately, their hardness also makes them more difficult to sharpen.

I must not have been the only one with that problem. Veritas, which is Lee Valley Tools' manufacturing arm, recently introduced the Variable Burnisher, a rather complex-looking device that actually performs a simple function and does it well. In a moment of weakness, flush with the proceeds of a recent sale and frustrated with trying to sharpen the extra-hard scrapers, I ordered not only the burnisher but also Lee Valley's Jointer/Edger, a metal jig that holds a file at exactly 90° to the face of the scraper. The investment very quickly paid for itself.

A dull scraper has two features: the edge is highly polished and slightly crowned (from passing over the wood), and the hook is gone. Sharpening starts with re-squaring the edge; using the Jointer/Edger, this takes about 30 seconds per edge. Because the file leaves a slightly striated surface, it's easy to tell when the edge is square again by watching the light reflecting off of it. I haven't found it necessary to stone the scraper after filing. I use a very fine file and light pressure, which give me an edge ready for burnishing. I've not found it necessary to flatten the face of the scraper either. Any bell or mushroom shape at the edge will only beef up the new hook.

Photo: Vincent Laurence

***Veritas's scraper system** includes a new adjustable-angle burnisher, a file-holding jig that squares the scrapers edge and a set of four ultra-hard scrapers of varying thickness. Big shavings curled right off the lip of the scraper (foreground) leaving a glassy smooth finish on this mahogany crotch.*

Once I've squared the edge, three or four passes with the burnisher complete the job. Since the actual burnishing rod within the tool is made of carbide, which is much harder than any scraper, a few passes are all that's needed. What makes Lee Valley's burnisher unique is its adjustability. The burnisher can be set to any angle between 0° to 15°, quickly and accurately. I take a couple of passes at 0° (to "mushroom" the edge slightly); then finish the burnishing at my desired angle. I set the burnisher at 2° to 3° for very fine work and up to the full 15° for rough glue removal.

A complete overhaul of a scraper's edge takes less time than reading this review, and the results are wonderfully predictable. This scraper system belongs in every shop in which hardwoods are worked.

You can order Veritas' Variable Burnisher ($34.95), Jointer/Edger ($12.95) and the Lee Valley scrapers (set of four, $12.95) from Veritas Tool Inc., or from Lee Valley Tools, Ltd., 1080 Morrison Drive, Ottawa, Ont., Canada K2H 8K7; (613) 596-0350.

—Mac Campbell, Harvey Station, N.B., Canada.

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,** ***PO Box 5506, Newtown, Conn. 06470-5506.***

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DANCING TOGETHER

While visiting Moscow several years ago, author Jon Humboldt Gates happened upon the extraordinary marquetry of Vadim Aksyeonov. Aksyeonov, who was trained as a painter, creates refined marquetry like the 38-in.-dia. tabletop, *Vortex of Dancers,* shown here. Aksyeonov designed the table for a Moscow drawing room in 1982 as a statement of friendship between the various cultures of the republics, which at the time comprised the now dissolved U.S.S.R. Each of the 15 women dancing together on the tabletop is wearing the traditional costume of her republic. For a list of the 15 republics, see page 110 and for more about Aksyeonov's marquetry, see page 62.