AMERICAN WOODWORKER

October 1991, Issue No. 22

Drawers: An Illustrated Guide for the Furniture Maker

Hot New Tool! Random-Orbit Sanders Reviewed

Shaker Wall Clock: Build a Timeless Timepiece

Plus Jigs, Techniques and Workshop Wisdom

$3.95

0 09281 01507 9 10

CONTENTS

Issue No. 22
September/October 1991
COVER PHOTO: JOSEPH KUGIELSKY

PROJECTS AND FEATURES

DEPARTMENTS

AMERICAN WOODWORKER

EDITOR/PUBLISHER
David Sloan

ART DIRECTOR
Michael Mandarano

ASSISTANT MANAGING EDITOR
Fiona Wilson

ASSISTANT EDITORS
Robert Moran
Dave Sellers

COPY EDITOR
Nancy Wallace Humes

TECHNICAL ART ASSISTANT
Glenn Hughes

ART ASSISTANT
Suzanne Burke

SEC./PRODUCTION COORDINATOR
M.N. Lhuillery-Peischl

DESIGN SHOP
Philip Gehret
Fred Matlack

CONTRIBUTING EDITORS
Ernie Conover
Mike Dunbar
Roger Holmes
W. Curtis Johnson
Simon Watts

PRESIDENT/MAGAZINE DIVISION
John Griffin

ADVERTISING SALES MANAGER
James Owens

SALES SERVICE/PRODUCTION COORDINATOR
Sheila Bauder

CLASSIFIED SALES REPRESENTATIVE
Diane Moore

ADVERTISING SALES OFFICE
33 E. Minor St., Emmaus, PA 18098
(215) 967-5171

East
Renée James

West
Doreen Brill

CIRCULATION MANAGER
JoyceAnn Sokol

SUBSCRIPTION SERVICE MANAGER
Bob Nichter

PRODUCTION DIRECTOR
Harry Ardoline

CUSTOMER COMMUNICATIONS
(800) 441-7761

AMERICAN WOODWORKER (ISSN 8750-9318) is published six times a year in January, March, May, July, September and November by Rodale Press Inc., 33 E. Minor St., Emmaus, PA 18098. (215) 967-5171.

SUBSCRIPTION RATES: U.S. one-year $28, two-year $56. Single-copy $4.50. Canada one-year $35, two-year $70 (Canadian funds) GST #-R122988611. Foreign, one-year $35, two-year $70 (U.S. funds). U.S newsstand distribution by Eastern News Distributors, Inc., 1130 Cleveland Rd., Sandusky, OH 44870. **SECOND-CLASS POSTAGE:** paid at Emmaus, PA and additional mailing offices. POSTMASTER: Send address changes to AMERICAN WOODWORKER, 33 E. Minor St., Emmaus, PA 18098. **CONTRIBUTOR GUIDELINES:** available upon request. We treat unsolicited material with care, but can't assume responsibility for loss or damage. Send a stamped, self-addressed envelope for return of material.

BOOMERS HIT THE BOARDS

A few months ago, *Time* magazine ran a cover story entitled, "The Simple Life: Americans Get Back to Basics." Monitoring the pulse of the people as they do, the pundits at *Time* were the first to note a trend in the making. Fast-track baby boomers, who pushed it flat-out through the high-rolling '80s, are hitting the brakes in a panic as the S curves of midlife loom dead ahead. Burnt out from their high-paying, high-stress careers, these one-time workaholics are rejecting the rat-race and rediscovering the basic values of family, home and hearth.

If the trend-spotters at *Time* are correct, these baby boomers should be showing up in the ranks of *AW* readers. After all, if it's basic values you're looking for, you can't find a more down-to-earth pastime than woodworking—a venerable craft that's just steeped in tradition.

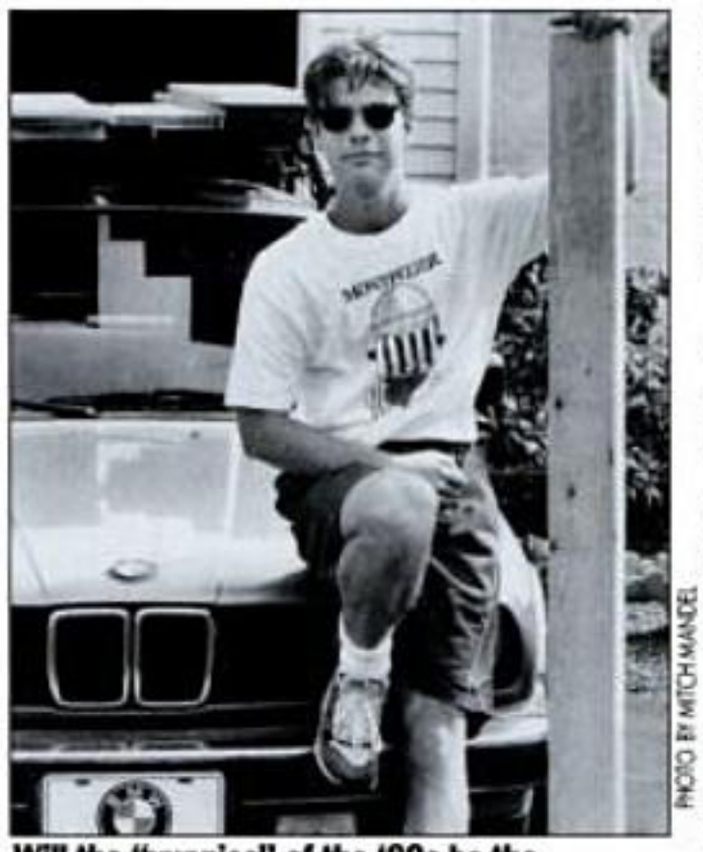


PHOTO BY MITCH MANDEL

Will the "yuppies" of the '80s be the woodworkers of the '90s? Trend-spotters say that they will.

Sure enough, our reader surveys confirm that it's true. The "yuppies" of the '80s are becoming woodworkers in the '90s. The average *AW* reader is younger, wealthier, and better educated in 1991 than the average reader in 1989—a trend we expect to continue for the next few years.

So, to all you newcomers out there, welcome to the club. If you're searching for basic values, you've come to the right place. Woodworking is a rewarding and satisfying endeavor—a craft you can practice for the rest of your life. Nothing beats the great feeling of making something by hand. Tell all your friends. (And if you haven't already sold the BMW, there's no need to rush. It can haul lots of lumber if you buy the right roof rack.)

DAVID SLOAN
Editor and Publisher

LETTERS

Cutoff Box Comments

I enjoyed your article on the tablesaw cutoff box (*AW*, #14), but there is another way to mount the two fences that does not require trial and error.

Once the base is made and mounted to the runners, raise the blade sufficiently to cut through the base and cut about half the length of the base. Lower the blade and treat the kerf as a line segment. Remember your plane geometry? [With a compass,] construct a perpendicular bisector to the line segment. This bisector is an absolute 90° to the kerf. Project this line to within 1 in. of the [front and back] edges [of the cutoff box] and affix the two fences.

Another matter of choice is the use of two runners. I use only one, but I extend it both to the front and back [of the cutoff box] so that the miter-gauge slot is completely covered by a runner at the beginning and end of the cut. I find that this lends far more stability to the box than two runners.

DON BROWN
Friendswood, TX

Stone Cold

Re: Q&A on Storing Water Stones (*AW*, #16). I have had a set of water stones for the last ten years. For six of those years I've lived in Michigan. I, too, was concerned about storing the stones [to protect them from freezing], as my workshop was not constantly heated.

I wrote to the Japan Woodworker Co. and asked about storing them in windshield-washer antifreeze, as it is good for 25° below zero. They said that they had never heard of this but that it wouldn't hurt the stones.

I used a plastic "Rubber Maid" rectangular container with a cover and put in 1 gal. of the windshield-washer antifreeze. I keep the lid on all the time and have had no trouble with evaporation.

The wooden base on the 8000-grit stone did fall apart because of the moisture. I just made another, and I hang it near the stones.

TOM BURNHAM
Rogersville, TN

More Outdoor Woodworking

Rick Mastelli's article on spoon carving (*AW*, #20) was welcome information. I intend to try his techniques as soon as the weather is nice enough to work outside. I'd like to see more articles on this kind of woodworking... carving and such that you can do outdoors in the summer.

ROGER A. BONDSMAN
Rockford, IL

Happy With Hand Tools

I enjoy receiving *AW*. I find the articles and format to be inspirational and beneficial. *AMERICAN WOODWORKER* is not cluttered by excessive fluff, such as advertisements and gimmicks. This simple, clean approach is refreshing and appeals to the utilitarian side of my personality. The attribute I find most appealing about *AW* is the lack of emphasis on power equipment. Yes, your articles use power tools, but they don't emphasize them as the only way to do the job. Power tools are great for getting work done quickly and sometimes more accurately. However, I'm not in a hurry, and I happen to like the small deviations from perfection which occur when I work with hand tools. Thank you for producing an ideal magazine.

In response to change and adding color, I like black and white. Please don't change too rapidly. You can't please everyone, but you already please at least one person. Over the years, I have subscribed to almost every woodworking magazine. Today, I receive only one.

GEORGE R. FRENCH
South Berwick, ME

Big on Biscuits

Why doesn't biscuit joinery get more recognition as a woodworking procedure? I've found it to be a relatively simple process that is a fast and effective way of joining two pieces of wood. A big plus is that it is a forgiving system in that if you are not "right on the money" it's not a disaster. I use the process almost exclusively for joining cross members to legs. Undoubtedly, the mortise-and-tenon joint is a proven process, but the biscuit system, in my opinion, is an alternative that provides a strong joint without the additional time, work and skills. What do you think?

WALLY WUNSCH
Sparta, WI

Biscuit joiners are enormously popular in cabinet shops, because biscuits beat dowels hands down for fast, strong, no-frills joinery in plywood, MDF, or solid wood. A leg-to-apron biscuit joint should be plenty strong on a table. (Use two biscuits in each joint if there's room.) You're better off with a mortise and tenon on a chair-leg joint, though, because it's stronger and more resistant to racking.

More on "Winging It"

I feel that woodworkers are akin to artists and have active imaginations. We aren't likely to sit around wishing we had such-and-such a tool so that we could then make a franistat [sic]. We make the franistat with the tools that we have. We are constantly pushing our designs up to and beyond the capabilities of the tools that we happen to have. If prehistoric woodworkers had let themselves be limited by the tools at hand, we would still be using stone axes, I suppose.

I enjoy reading about projects that require tools that I don't have ... it excites my imagination. Besides, if you don't go just a little beyond us occasionally, how will we ever be exposed to new tools, new machinery, and new techniques?

RENO W. KUEHNEL JR.
Newton, WI

Tell us what you think. *Send your comments, complaints and corrections to: Editor,* AMERICAN WOODWORKER, *33 E. Minor St., Emmaus, PA 18098.*

COMING NEXT ISSUE:

SILVERWARE CHEST

ALL ABOUT DRAWERS Part II

DRUM SANDERS

BANDSAWN BLOCK PUZZLE

Shop-Wiring Tips

Q. *I'm planning to set up shop in my basement. The wiring is a hodgepodge of old knob-and-tube circuits from the 1920s, with some newer Romex lines run in the 1960s. All the wiring is overhead in the floor joists. I'd like some general tips on how I should rewire for my lights and machinery. I have a tablesaw, radial arm saw, bandsaw, jointer and planer.*

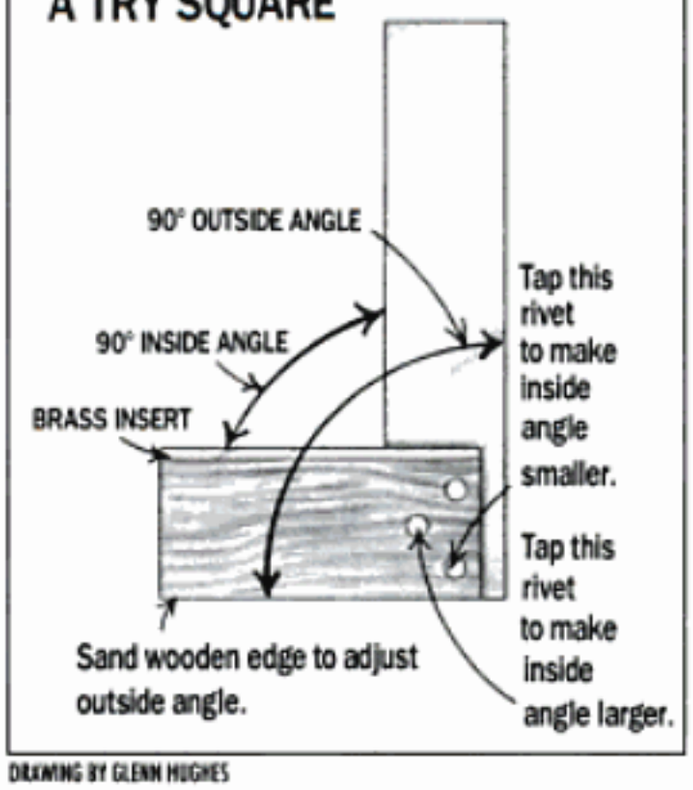
RICHARD HIRSCHMAN
Binghamton, NY

A. First, think very carefully about present and future needs for your shop, then work out a logical plan for the wiring and sketch the layout. Take into account the location of machines, workbenches, lights and the possible future expansion to your shop. I'd tear out the ancient knob-and-tube wiring. You can reuse the newer wiring only if it meets the criteria below and if its location fits the new plan. Here's a list of suggestions to help you.

- Run separate circuits for lights and machines. You can operate as many as a dozen twin-bulb, 40-watt fluorescent light fixtures on one light circuit using 14-gauge wire and a 15-amp, 115-volt circuit breaker.
- The circuit for machinery requires 12-gauge wire and 20-amp, 115-volt circuit breakers. Wire a generous number of 20-amp outlets on this circuit. Space them around the shop to suit your layout. Outlets mounted above, on the joists, could save the expense of conduits for wall-mounted outlets (though, they may not be handy for portable power tools). For a workbench located away from any walls, try mounting a hanging outlet or two on flexible drop cords made from rubber-insulated 12-gauge cable.
- Wire the motors on larger, stationary power tools (1 HP or more) for 230 volts if possible. Supply them with a separate 230-volt circuit with 12-gauge wire, a 20-amp breaker and outlets with a different plug-pin pattern. Equipment like big dust-collection systems or electric welders should each have a separate 230-volt circuit.
- The electrical entrance box in your house should have at least 35 amps of spare capacity and room for the new circuit breakers you'll need. If the box is near the shop, wire the new circuits directly to it. If the entrance box is remote, run a 230-volt branch line from the entrance box to a small distribution box at the shop. Connect the shop's new circuits (with circuit breakers) in the distribution box. If the branch circuit runs long (50 ft. or more) use 10-gauge wire.
- Pick up a DIY wiring handbook to select appropriate wiring methods. Review a copy of the local electrical code, available at a library, and secure local building permits.

JOE RANSIL
Electrical engineer
Saratoga, CA

SQUARING UP A TRY SQUARE



DRAWING BY GLENN HUGHES

Unsquare Square?

Q. *I have a 9-in. try square with a rosewood handle. I've just discovered the tool is out of square by about .010 in., which isn't acceptable in my opinion. Is it possible to have the square trued up, and where would I send it to have this done?*

GERALD R. HUNT
Rochelle, IL

A. Try squares of this type are meant to be perfectly square only on the inside (between the brass insert on the inside edge of the rosewood handle and the blade). If it's out of square on the inside, you can try to adjust it by tapping the rivets, which hold the handle to the blade. This is a trial-and-error adjustment, so proceed slowly. Tap the outside rivet (nearest the outside edge of the handle) to make the angle smaller; tap the inside rivet to make the angle larger. Use a punch to tap the rivets, and back them up with a heavy-metal block.

The wooden outside edge of the handle is machined square at the factory but can become inaccurate from natural expansion and contraction of the rosewood handle. This movement throws off the 90° outside angle. You can resaw or sand the back edge of the handle to make it square again, but it will change with further wood movement as the weather changes.

DAVID DRAVES
Woodcraft Supply
Woburn, MA

If you can't adjust it, I'd just go out and buy a new square. Your particular square isn't an expensive tool and can be replaced for about $15. For permanent, exact inside and outside measurements get an all-metal engineer's square, or a top-of-the-line rosewood-handled square with brass ribs on both the inside and outside edges of the handle.

MIKE DUNBAR
Contributing editor
Portsmouth, NH

Finish Won't Dry

Q. *I recently made a music box of oak and cocobolo, and applied polyurethane varnish as a finish. The*

varnish dried alright on the oak, but it wouldn't dry on the cocobolo. Is there something different about cocobolo that prevents the varnish from drying? Is there another varnish or oil finish that I can apply to bring out the color and grain of cocobolo?

VERN CHEFF III
Ronan, MT

A. Your drying problem is caused by the interaction of the polyurethane varnish with the cocobolo. All varnishes and oil finishes cure by oxidation (absorbing oxygen from the air). Many oily woods, including cocobolo, teak, rosewood, ebony and cordia contain chemicals in the oil that retard oxidation, preventing a finish from curing. No native-American hardwood I know of contains oil or these chemicals.

Your varnish (or oil finish) will cure normally on oily woods if you remove the natural oil from the surface of the wood before applying the finish. To do this, wipe the wood several times with a cloth well-dampened with a fast-evaporating solvent such as naphtha, lacquer thinner or denatured alcohol. When the wood is dry and no longer feels oily to the touch, you can apply the finish.

It's usually wise to follow this same oil-removal procedure before applying other finishes such as lacquer or water-based finishes. The natural oils in exotic woods won't prevent these finishes from curing, but the oils may cause a weak bond between the wood and the finish.

BOB FLEXNER
Finishing consultant
Norman, OK

Where To Find It

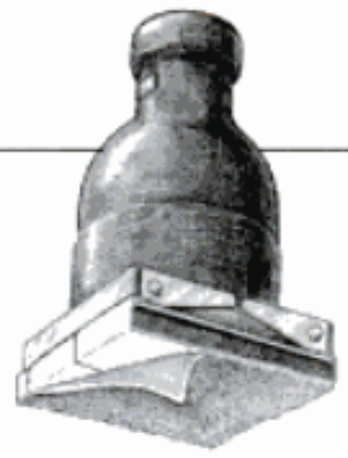
Lamp parts and wiring kits are available from Lamp Specialties, Box 240, Westville, NJ 08093.

Chemical-resistant gloves, respirators and other safety equipment is available from Direct Safety Co., 7815 S. 46th St., Phoenix, AZ 85044.

Miniature power tools and other tiny tools for modelbuilding, crafts, and marquetry are available from Micro-Mark, Small Tool Specialists, 340 Snyder Ave., Berkeley Heights, NJ 07922.

Got a woodworking question for the experts? Send it to Q&A, AMERICAN WOODWORKER, *33 E. Minor St., Emmaus, PA 18098.*

TECH TIPS



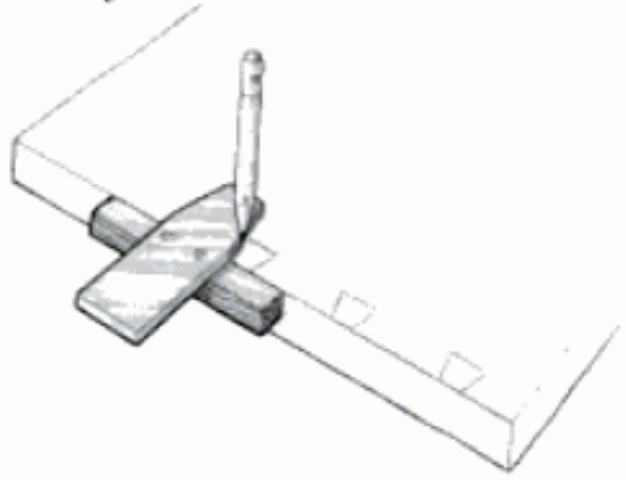
Update Your Sander

If the pad on your orbital sander wasn't made for adhesive-backed sandpaper, stick duct tape edge to edge over the pad and around the edges. The sandpaper will adhere to the duct tape and will peel from the tape without tearing up the pad.

WALTER J. MARTIN
Buffalo, NY

Hand-cut Dovetail Gauge

If you cut a lot of dovetails by hand, make your own layout gauge. Use hardwood for the fence and Plexiglas, phenolic, aluminum, brass or even thin hardwood or hardwood plywood for the blade. Cut both sides of one end of the blade to the angle you prefer for your dovetails. Leave the other

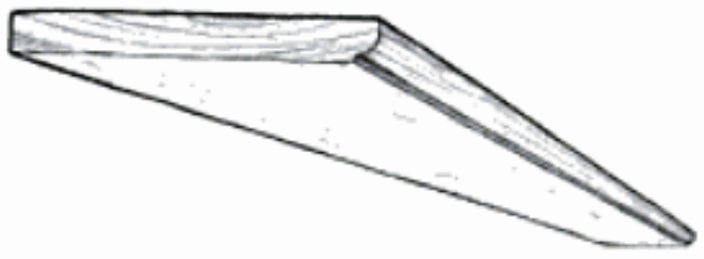


end straight for use as a square. Glue and/or screw the fence to the blade, and make it all as precise and square as you can.

FRANK WRIGHT
HOLLAND, MI

Painting Stilts

Plaques and other flat pieces need a finish on every side to prevent cupping. Painting stilts let you finish all sides at once. To make the stilts, sharpen three or four six-penny finish nails, and drive them all the way



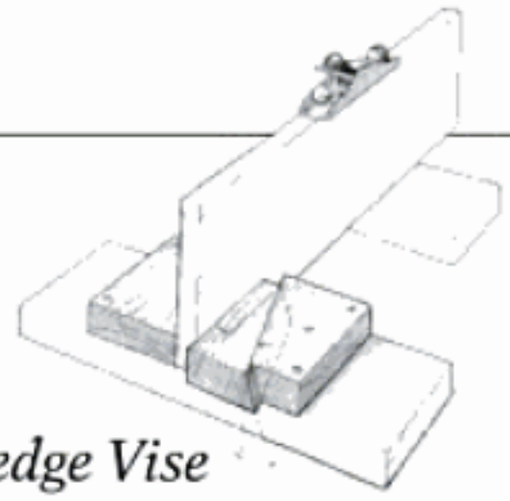
through a piece of ¾ in. plywood. To use the stilts, finish the bottom of the piece first, then lay it bottom down on the stilts to finish the top and edges. Styrofoam stuck on the nail points will protect you from the pointed stilts when not in use.

DAVID BLACK
BARNWELL, SC

Better Filtering

If your shop-vac has a foam filter that clogs quickly with wood chips, try covering the filter with old pantyhose. This allows the larger, heavier chips to fall off into the canister when you turn the vacuum off.

WILBER GOEKE
CLEVELAND, WI



Wedge Vise

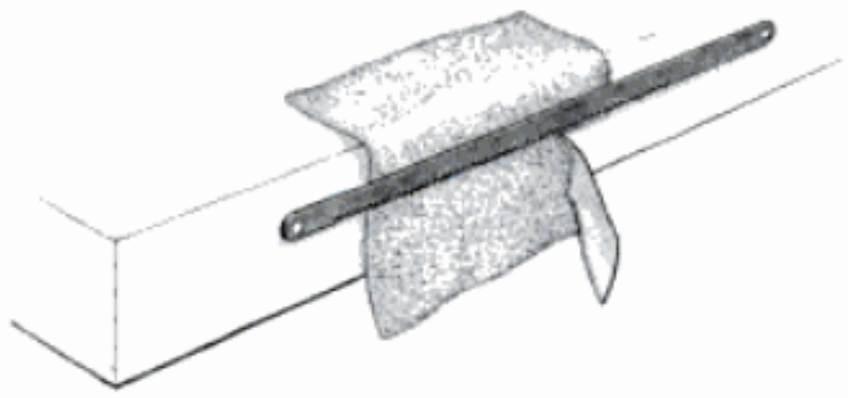
This simple holding device is best suited for gripping a board (or door or similar assembly) by its edge. It can be installed on a plank, sawhorse or on the workbench. I make mine out of 2 x 8 stock, but yours should suit the work you do. I use a wedge angle of about 15° and a bevel angle on the wedge of about 35°. A tap on the wedge secures or releases the workpiece.

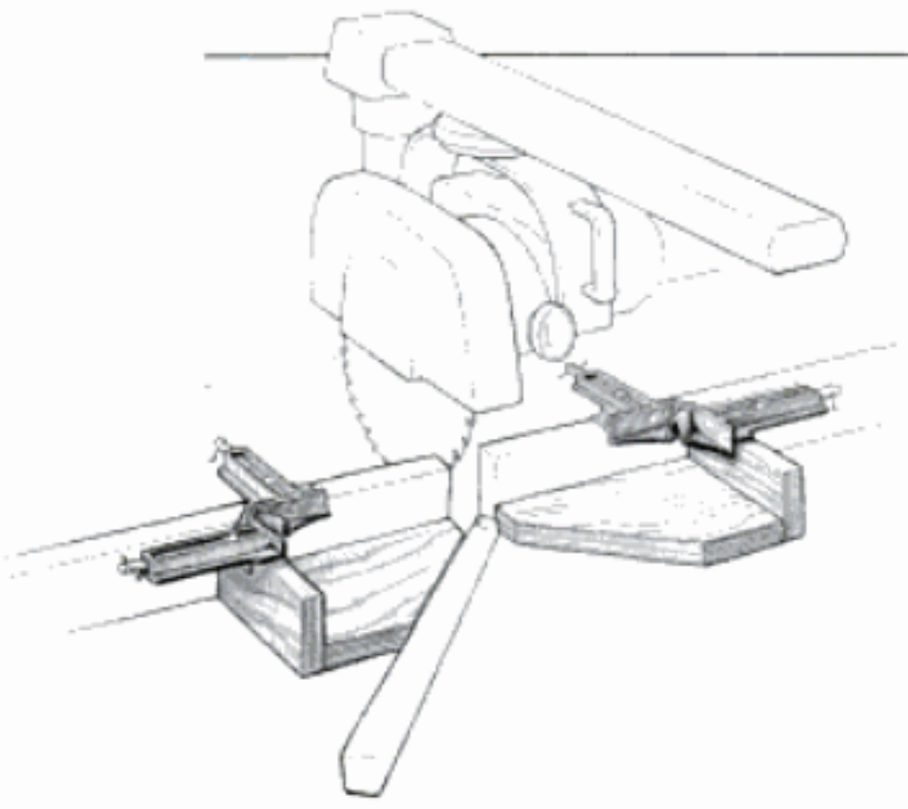
JOHN HAGEN
EAST JORDAN, MI

Sandpaper Cutter

To tear sandpaper to size, loosely tack or screw a hacksaw blade to the edge of your workbench, teeth down. Slip the paper behind the hacksaw blade with the desired amount below the teeth and tear it toward you.

BRIAN A. GREEN
FOAM LAKE, SK, CANADA

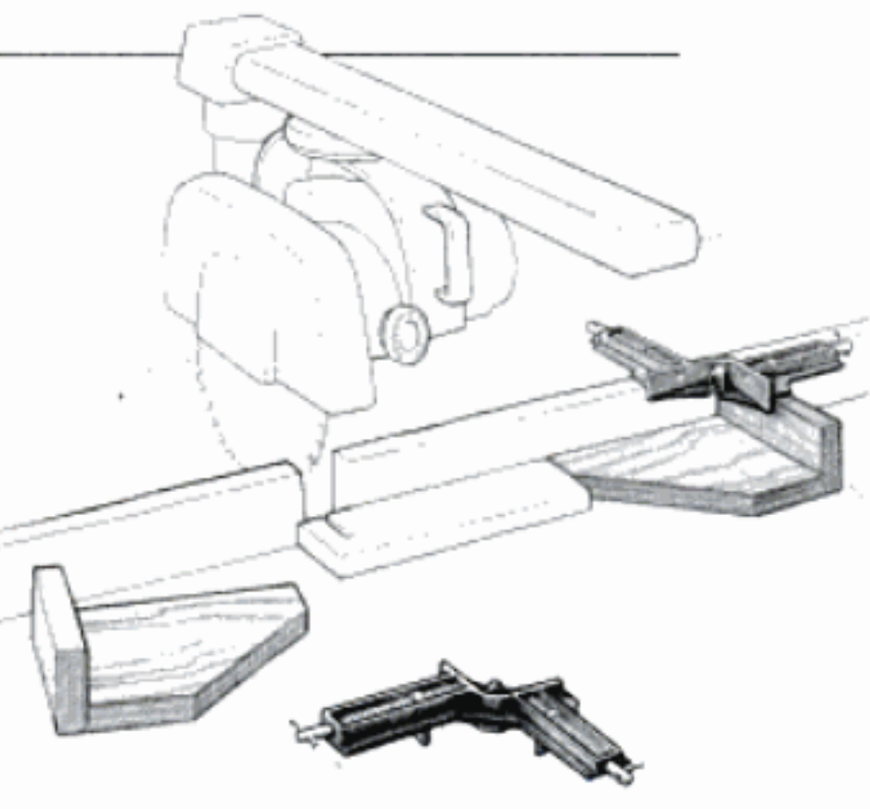




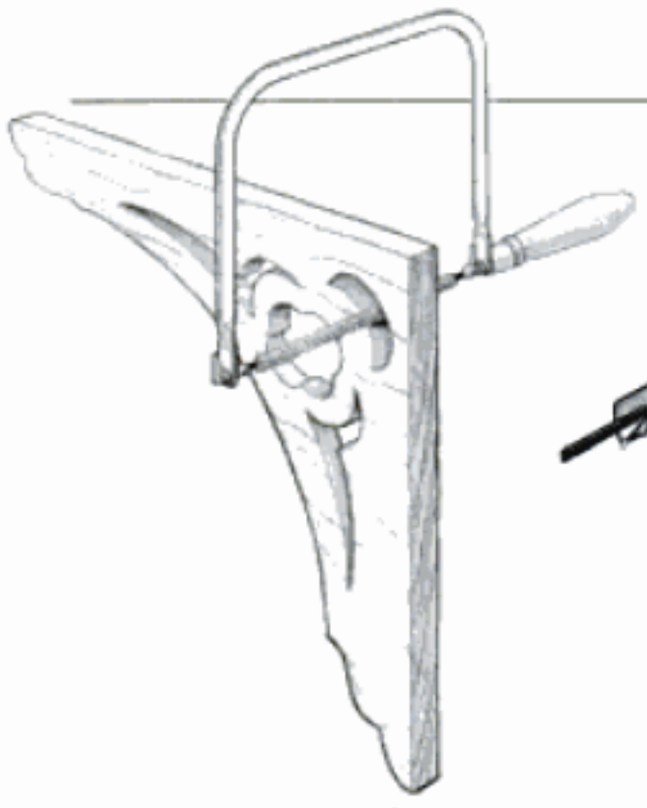
Radial Arm Stop and Miter Jig

A pair of Stanley #404 Corner Clamps holds a combination cutoff stop and miter fence to the fence of my radial arm saw as shown in the drawing. The stop/fence is made of stable plywood. Be accurate so your miters will fit well. When you need the corner clamps for holding a miter, just borrow them back.

WAYNE ASPEN
STROUDSBURG, PA



TECH TIPS



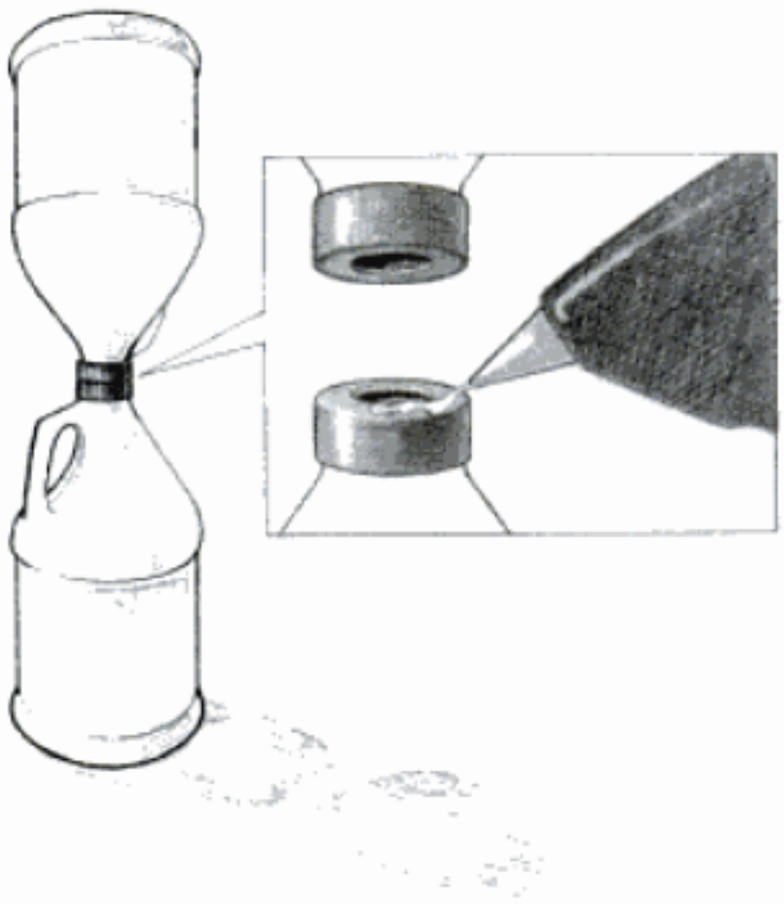
Coping Sander

To sand small, inside holes on a project, I glue the broken end of a coping saw blade to a strip of cloth-backed abrasive. When the glue dries, I insert the strip through the project and mount it in the coping saw.

JOHN TEEHEE
HILO, HI

Waste Not

Epoxy resins and hardeners are thick stuff, and expensive. To empty the last bit into another container, I connect the two containers, one above the other, with their caps glued together and

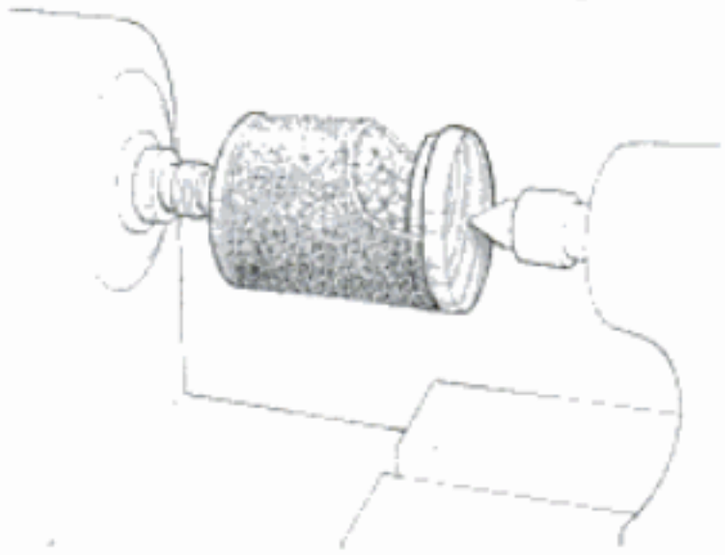


a hole drilled through the caps. I let the upper one drain into the other container for as long as it takes. Hot-melt glue works for joining the caps.

ALLEN L. RIGGS
HILL CITY, KS

Homemade Lathe Sanding Drum

You can make your own sanding drum for your lathe. Turn two wooden plugs with a shoulder on the edge, sized to fit standard sanding-drum



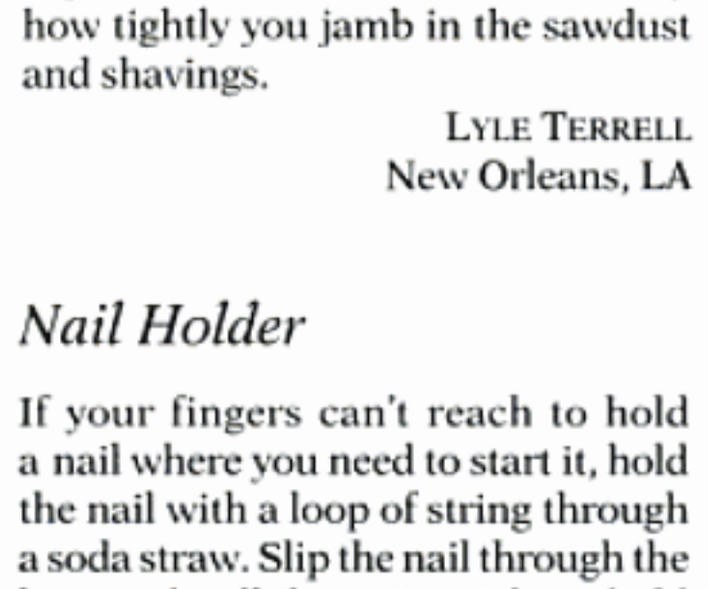
sleeves as shown in the drawing. Slip a sleeve on one plug, jamb the sleeve full of sawdust and/or shavings, fit the second plug, and hold it all together between the head stock and tail stock. Turn on the lathe and go to it. You can adjust the firmness of the drum by how tightly you jamb in the sawdust and shavings.

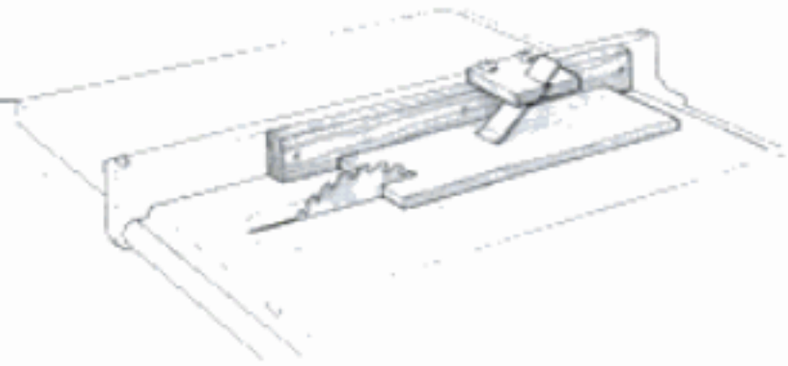
LYLE TERRELL
New Orleans, LA

Nail Holder

If your fingers can't reach to hold a nail where you need to start it, hold the nail with a loop of string through a soda straw. Slip the nail through the loop and pull the string tight to hold the nail.

ALICE AND ROBERT TUPPER
CANTON, SD





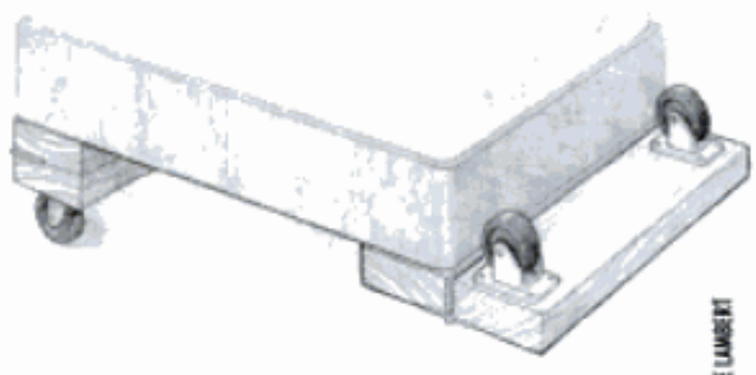
Anti-Kickback Hold-Down

I made a combination hold-down and anti-kickback device from a ¼ in. thick piece of hardwood 4 in. x 4 in. On one end, I made a 2-in. long slot cut at 45°. It holds a piece of lucite, phenolic or similar flexible material as shown in the drawing. You can shim it with layers of tape to get the fit that you want. I install it as needed on the top edge of my auxiliary fence with hanger bolts and wing nuts.

PAUL FERTELL
CHESTER SPRINGS, PA

Machine Casters

I often need to move my stationary machines around my small shop to make room for projects. To simplify the process, I've fitted them with casters mounted on hinged 2 x 4s that can



DRAWING BY HEATHER BRINK LAMBERT

be flipped under the base by lifting one end of the machine at a time. I used ordinary door hinges and casters with a load rating of at least a quarter of the weight of the machine for each caster.

DAVID R. JOHNSON
APPLE VALLEY, MN

Know a better way to do things? Designed a clever jig? Send your woodworking tips, along with a sketch or snap-shot to : Tech Tips
AMERICAN WOODWORKER
33 E. MINOR ST., EMMAUS, PA 18098. WE'LL PAY YOU $35 IF WE PUBLISH YOUR TIP.

The Tucker vise rotates and tilts to hold odd shapes. PHOTOS COURTESY OF VERITAS TOOLS, INC.

The Tucker Vise

Tested by Michael Fortune

Most of my woodworking involves curves and tapered shapes. My standard, fixed-jaw woodworking vise has its limitations, and I've cursed it more than once when I just couldn't get a grip on an odd-shaped piece.

There once was an alternative that oldtimers might remember—the Emmert Patternmaker's Vise, which could swivel and tilt to accommodate odd workpieces. That vise was legendary for its versatility, but it went out of production decades ago. Used Emmert vises command a high price (if you can find one), and they're often damaged or are missing a few parts.

I'd resigned myself to using my standard vise until something better (and affordable) came along. That's why I was immediately intrigued when I saw the new Tucker Vise from Veritas Tools. It's an update of the Emmert vise, designed with modern materials and improved features. I ordered one right away.

Putting a Tucker Vise through its paces is a little like watching a carnival pitchman demonstrate one of those all-purpose kitchen gadgets that slices and dices a dozen different ways. Except, the Tucker Vise is more than a novelty—it's arguably the finest woodworking vise made today.

The body of the vise is cast from a zinc and aluminum alloy that's stronger and less brittle than cast iron but only 80 percent of the weight. The cast-alloy parts are covered with a baked-on polyurethane finish. Moving parts are made of steel, stainless steel and anodized aluminum. It's a beautiful tool just to look at.

But it's the operation of the vise that's most impressive. The whole body of the vise rotates 360°, and it can be locked in any position. This feature gives you access to three different sets of vise jaws with widths of 13 in, 5 ½ and 2 ½ in. The body also tilts 90° so the jaws can be used horizontally or vertically. The front vise jaw pivots up to 10° in either direction to hold tapered work.

Using the Tucker vise is a dream. The smooth, snag-free rotation and tilt actions move very easily. The spring-loaded locking knobs (one for tilt, one for rotation) operate positively with light pressure. The pivoting jaw can be left to float free or it can be locked at a given angle by tightening two allen-head bolts. I found that the free-floating jaw automatically conforms to the shape of tapered pieces, so I don't bother to lock it often. When locked, however, it remains in place regardless of clamping load or vibration from tools such as orbital sanders. (This was a problem with the old Emmert vise.)

Another feature is the four round dog pins (two in each jaw) that extend 6 in. upward to grip irregular objects. The pins are especially versatile when used in combination with the pivoting front jaw. I covered the pins on my vise with pieces of old rubber hose to protect delicate workpieces. The vise jaws themselves come already protected with a composite cork/rubber lining that grips stock very firmly without marring. I haven't noticed any chipping or permanent compression marks in this lining on my vise.

Like many other woodworking vises, the Tucker has a quick-release feature that enables you to open or close the movable jaw directly (without having to turn the screw). The quick-release is actuated by pressing a flat bar on top of the fixed jaw or by pressing a foot pedal, then moving the jaw in or out with your hand. What's more, the quick-release bar or foot pedal can open the jaws to a preset width automatically. This automatic opening is powered by an elastic cord that you can adjust to open the jaws from about 1 in. to 7 in. When I'm holding a large or awkward workpiece in both hands, it's a real treat to open the jaws to receive it just by pressing the foot pedal.

The vise is installed by bolting a mounting plate to your bench, then fastening the vise body to the plate with a pin. I found the mounting instructions slightly cumbersome in their thoroughness—something I can easily forgive, having experienced too little information with other tools. Installation took me an hour. You can get additional mounting plates for other benches in your shop and move the vise from one bench to another.

Drawbacks? There's only one in my shop. With three full-time and four part-time woodworkers, I have to line up to use the Tucker. (Price: $495)

Veritas Tools, Inc., Dept. AWT, 12 E. River St., Ogdensburg, NY 13669, (315) 393-1967.

CIRCLE NO. 39 ON PRODUCT LITERATURE CARD

Breath of Fresh Air

Wood dust is dangerous to your health. Cheap paper filter masks may keep out some of the big dust particles, but it's the tiny particles (less than a micron) that are a problem because they get trapped in your lungs. And if you're allergic to the dust of certain wood species, a good filter mask is essential. 3M's new Woodworking and Welding Respirator #8660 traps particles down to about 0.4 microns in size (that's 10 times better than cheap masks), yet it's lightweight and adjustable for comfort. An exhalation valve allows moisture from your breath to pass out unimpeded for easier breathing. A built-in chemical adsorbent protects against ozone from welding fumes and low levels of organic vapors—it's *not* designed for use as a respirator for spraying paints or finishes. It's U.S. government approved for dust or mist with a TLV (threshold limit value) not less than 0.05 milligrams per cubic meter. (Price: $16) CIRCLE NO. 47 ON PRODUCT LITERATURE CARD

Consumer Relations, Dept. AWT, 3M DIY Division, 3M Center, 515-3N-02, St. Paul, MN 55144, (612) 731-6681.

Pocket-Hole Jig

Pocket screws are a simple and effective alternative to dowels or biscuits on face frames and other butted joinery. The Kreg Jig is a one-piece cast-aluminum jig for drilling slanted pilot holes for the pocket screws. The jig has an adjustable toggle clamp to hold the wood and a hardened-steel drill guide (Optional model has two drill guides.) The jig includes a stepped drill bit that makes a flat-bottom hole for the screw head and a pilot hole for the screw shank in one operation. A stop collar on the bit determines the depth of the pilot hole. The clamp will accommodate wood from ⅜ in. to 1 ¼ in. thick. (Price: $94.95, one drill guide; $114.95, two drill guides) CIRCLE NO. 48 ON PRODUCT LITERATURE CARD

CAS Enterprises, Dept. AWT, RR 1, Box 101B, Kelley, IA 50134, (515) 769-2234.

This hanging corner cupboard is typical of those built by "Pennsylvania Dutch" craftsmen—German immigrants who settled southeastern Pennsylvania in the 1700s and early 1800s.

PHOTOS BY MITCH MANDEL

PENNSYLVANIA HANGING CUPBOARD

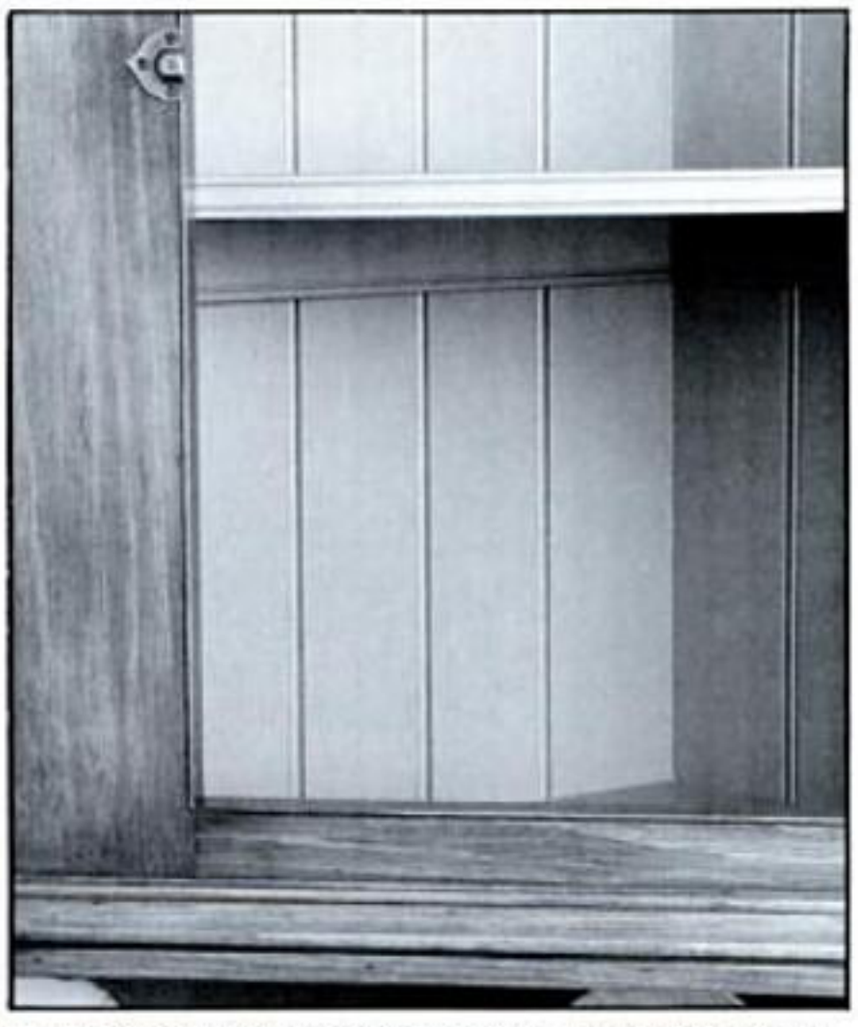
BY CRAIG W. BENTZLEY

Of all of the cupboards that have been built through the ages, I find that those built in rural southeastern Pennsylvania, circa 1750 to 1850, are the most charming. These cupboards were made by German immigrant farmers—part-time furniture makers with a simple, practical approach to cabinetmaking. These "Pennsylvania Dutch" craftsmen turned out furniture of pleasing proportion, with quality design and joinery.

The cupboard you see here was inspired by a hanging corner cupboard I saw in the Landis Valley Museum near Lancaster, Pennsylvania. I had just returned from a day trip to the museum when I received a call from a client who was interested in a hanging corner cupboard. We looked over some photos I'd taken of the museum's cupboard as well as photos of other corner cupboards. After quite a few sketches, we arrived at the design for the cupboard you see here that blends features from three different antique cupboards.

When I combine features from different pieces, I make sure they are from the same time period and geographic location. This approach allows me to design a piece with an authentic feel without plagiarizing someone else's design.

The cupboard shown here is made of clear pine, finished in a mellow pine-color stain with painted interior.



The tongue-and-groove backboards are beaded along one edge as are the cleats that support the shelves.

I built the cupboard using mostly traditional methods—mortise-and-tenon joints for the face frame and door frame; a raised-panel door; tongue-and-groove backboards, and moldings to decorate the cabinet's top and bottom. The most striking feature of this cupboard is the curved tailpiece that extends under the cabinet and provides two small, open shelves.

Building the Cabinet

The front of the cabinet consists of a frame-and-panel door mounted flush within a face frame. The face frame is flanked on both sides by vertical boards called "returns," which are edge glued at a 45° angle. The return pieces link the face frame to the backboards.

Start by building the face frame for the front of the cabinet from 1-in. thick stock as shown in the section views in Fig. 1. The face frame is put together with haunched mortise-and-tenon joints.

I cut the stiles about 2 in longer than finished length and cut them to length after completing the mortises. This eliminates any chance of breaking out the ends of the stiles while mortising.

Lay out and cut the mortises in the face-frame stiles. I do this by hand with a chisel, though a hollow mortising chisel in a drill press would work nicely. Cut the face-frame rails to length, then lay out and cut the tenons on the ends of the rails.

The face frame has a ⅛-in. bead running around the perimeter of its inside edge. Before I assemble the face frame, I cut this bead with a simple jig consisting of a sharpened wood screw in a block of wood. (See sidebar.) It's much easier to control this tool where two beads meet at a corner than it is to control a molding plane or router.

Cut the rail beads first. Mark the stiles at the point where the rail beads meet them. Now cut a ⅛-in. bead on the edge of the stiles, stopping just short of the point where the beads will intersect. Finish off the junction of

the beads with a veining tool. (The bead is butted at the corners, not mitered.) Now glue up the face frame, making sure it's square.

The angled "return" pieces on each side of the face frame come next. Rip two pieces of ¾-in. stock to rough width. (See Fig. 1.) Joint or plane one edge of each return piece, and cut the ⅜-in. deep rabbets in this edge for the backboards. I used a rabbet plane to make the rabbets, though you could also use a router or a tablesaw with a dado head.

To cut the bevel on the other edge of each return piece, set the blade of your tablesaw at 45°. Set the saw's fence so this bevel cut also rips the return pieces to their final 3¼-in. width. Cut these return pieces to final length and attach them to the face frame with glue and cut nails. I like to use reproduction "antique" cut nails. (See Sources.) Drill pilot holes for the cut nails to prevent splitting.

Next, cut out the top and bottom of the cabinet from glued-up 1-in. stock. Also, glue up some ¾-in. stock for the two interior shelves. Cut the top and bottom pieces to size as shown in Fig. 1. Fasten the top and bottom to the face frame/return assembly with glue and cut nails, making sure they're perpendicular to the assembly.

Making the Tailpiece Assembly

I wasn't able to examine the inside of the original cupboard in the museum, so I couldn't tell how the original maker had attached the tailpiece. I worked out a design that includes the two rear-most backboards (I'll call them rear-corner boards) and the tailpiece in a whole separate subassembly. (See Fig. 2.)

The subassembly consists of two rear-corner boards that run the entire 60-in. height of the cupboard. They form the rear-corner backboards for the cabinet and extend down to form the rear corner of the tailpiece as well. (See Fig. 2.) To make the tailpiece wide enough to cut the decorative curved shape on its front edges, I edge glued shorter boards along the bottom of the two rear-corner boards. This solved the problem of how to attach the tailpiece, but I can't say that the original cupboard is built this way.

To make the rear corner/tailpiece subassembly, first prepare the rear-corner boards. Start with two pieces of ¾-in. stock 60 in. long—rip one piece 3 ¾ in. wide and the other piece 4 in. wide. You'll rabbet the inside edge of the 4-in. wide piece after the shorter tailpiece boards are glued on. First, it's necessary to plow a stopped groove down one edge of each rear-corner board to accept the tongues of the other backboards as shown in Fig. 2. I used an antique tongue-and-groove hand plane (like a Stanley #48) to cut the ¼-in. wide x ⅜-in. deep groove. (See photo.) Cut the groove only ⅔ of the way down the boards because the lower boards of the tailpiece are edge glued on instead of tongued and grooved. A tablesaw or router would work just as well to cut the grooves.

After preparing the rear-corner boards, edge glue the extra stock on the bottom of the long corner boards to form the tailpiece as shown in Fig. 2. When the glue has dried, rout ½-in. wide x ½-in. deep dadoes for the tailpiece shelves. Lay out and cut the decorative curved profile on the tailpieces with a bandsaw or saber saw, and smooth the edges. Cut a small slot on the front, top corner of each tailpiece where a wood screw will fasten it to the bottom of the cabinet. (See Fig. 1 and 2, and photo on page 23.) I used a drill and a small round file to make the slot about ⅜ in. long. The slot will allow for wood movement between the tailpiece and the cabinet.

Now that you've shaped the two rear-corner pieces and tailpieces, it's time to cut the back-edge rabbet and assemble them as shown in Fig. 2. Cut a rabbet down the entire long rear edge of the 4-in. wide corner board. Glue the other 3¼-in. wide corner board in the rabbet, and with a few cut finishing nails, secure the joint. Before the glue dries, place the completed rear-corner/tailpiece assembly on the cabinet and align it with the top and bottom of the cabinet. (You'll add the other backboards later.) Fasten the assembly to the cabinet with cut nails driven into the top and bottom. Also, run a flat head wood screw through each slot in the tailpiece into the edge of the cabinet bottom as shown in the photo.

To make the small shelves for the tailpiece, measure the length of the dadoes you've cut in the tailpiece from the inner corner of the shelf out to the curved edge. Cut the shelves to these radii (see Fig. 2) and attach them with glue and cut finishing nails. Next, shape the front edges

BEAD-SCRATCHING JIG

I didn't have a molding plane small enough to cut the ¼-in. bead around the inside edge of the cupboard's face frame, so I made a simple jig to do the job. The jig is described by Michael Dunbar in his book *Federal Furniture* (1986, Taunton Press, 63 S. Main St., Newtown, CT 06470). The jig consists of a sharpened #12 flat head wood screw in a small block of wood. (See photo and drawing.) It's really the sharp point at the end of the screw slot that does the cutting. Sharpen this point by rubbing a soft sharpening stone on the flat surface of the head and the beveled underside of the head.

You can adjust the width of the bead by turning the screw into or out of the wood block. When using the scratch tool, angle the screw slot as shown in the drawing so the sharp edge, where the slot meets the rim, will cut the wood.—*C.B.*

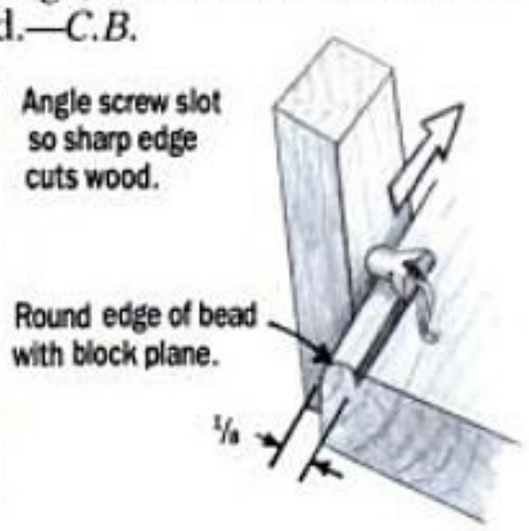
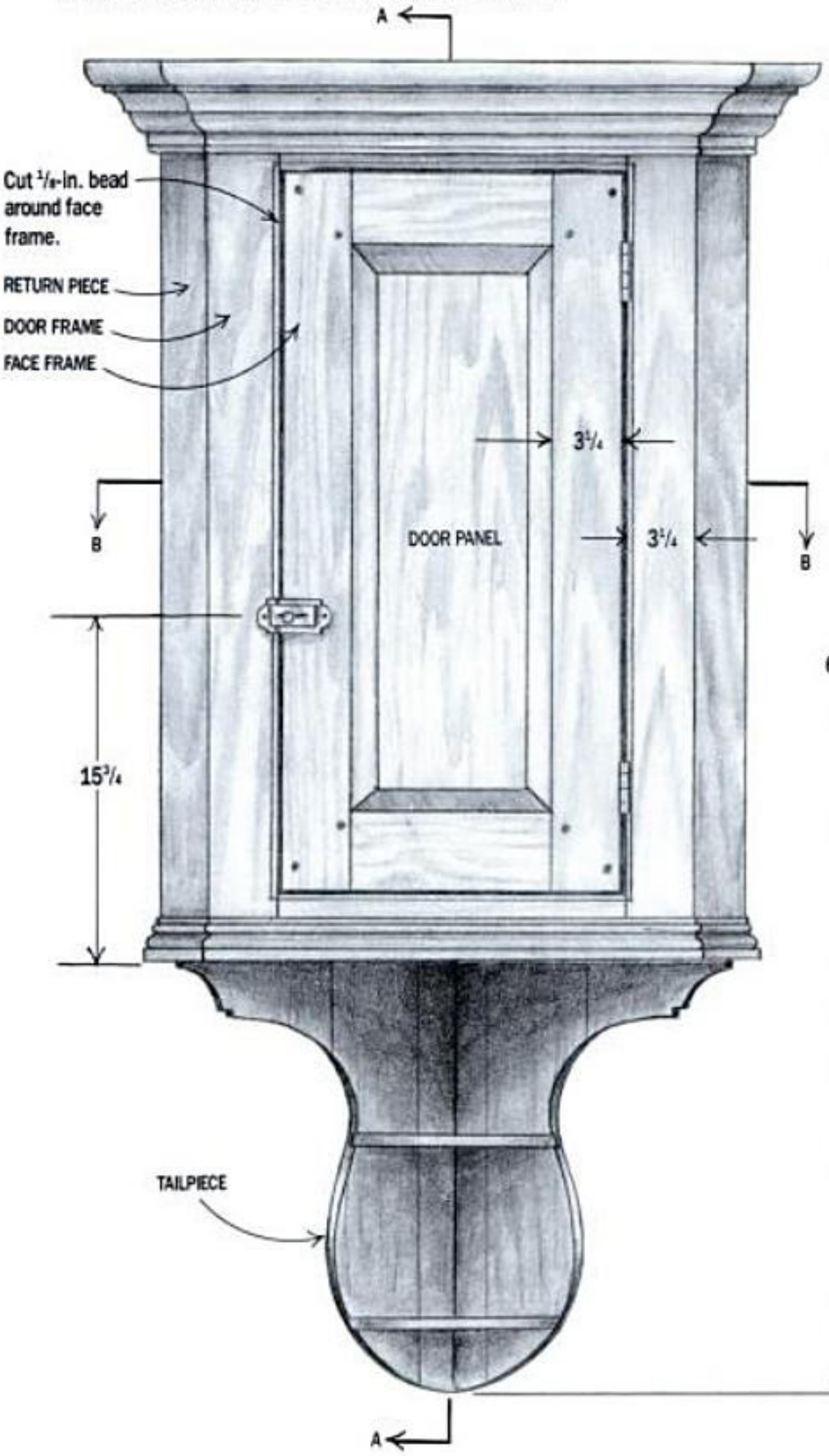
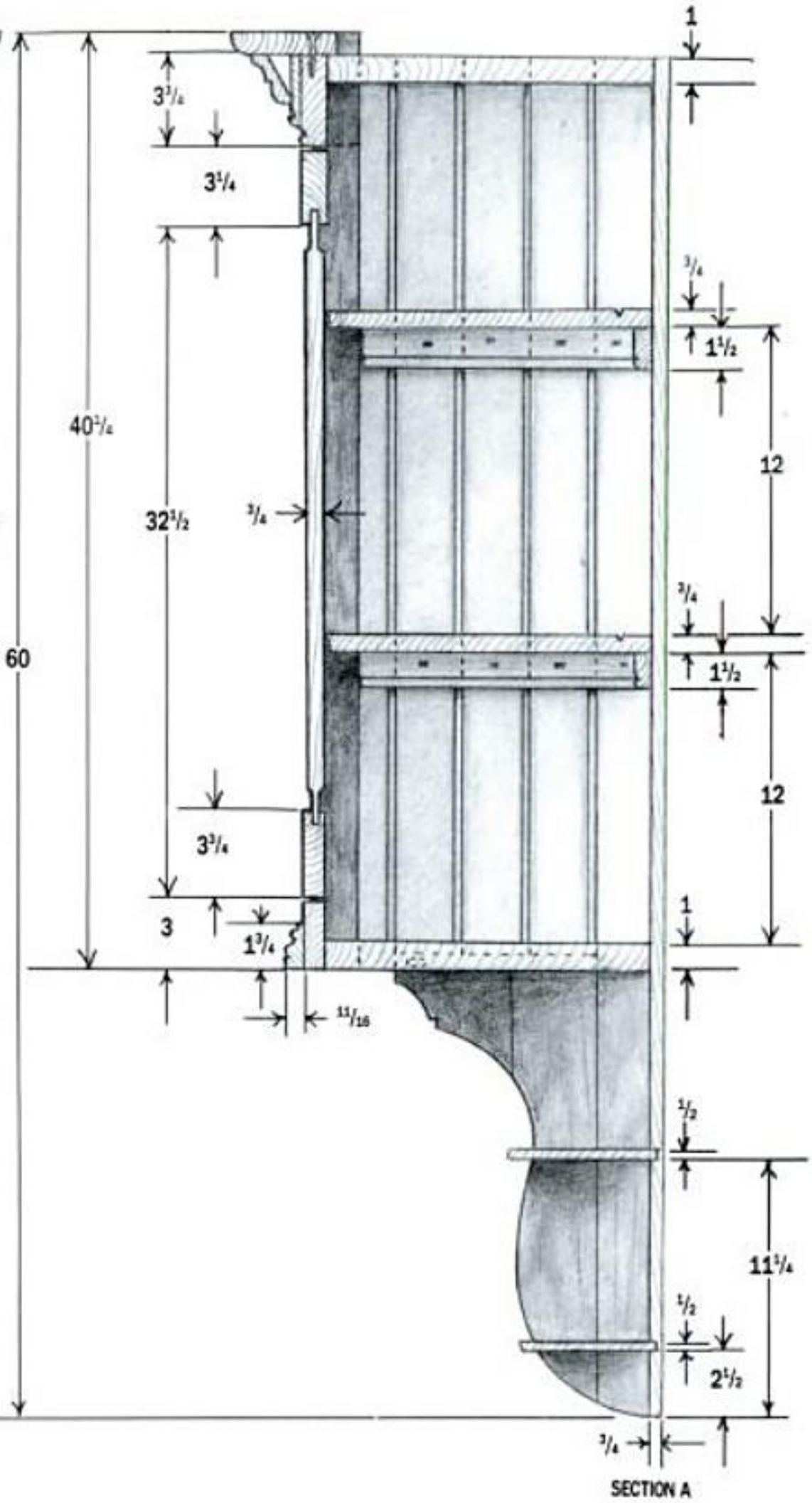
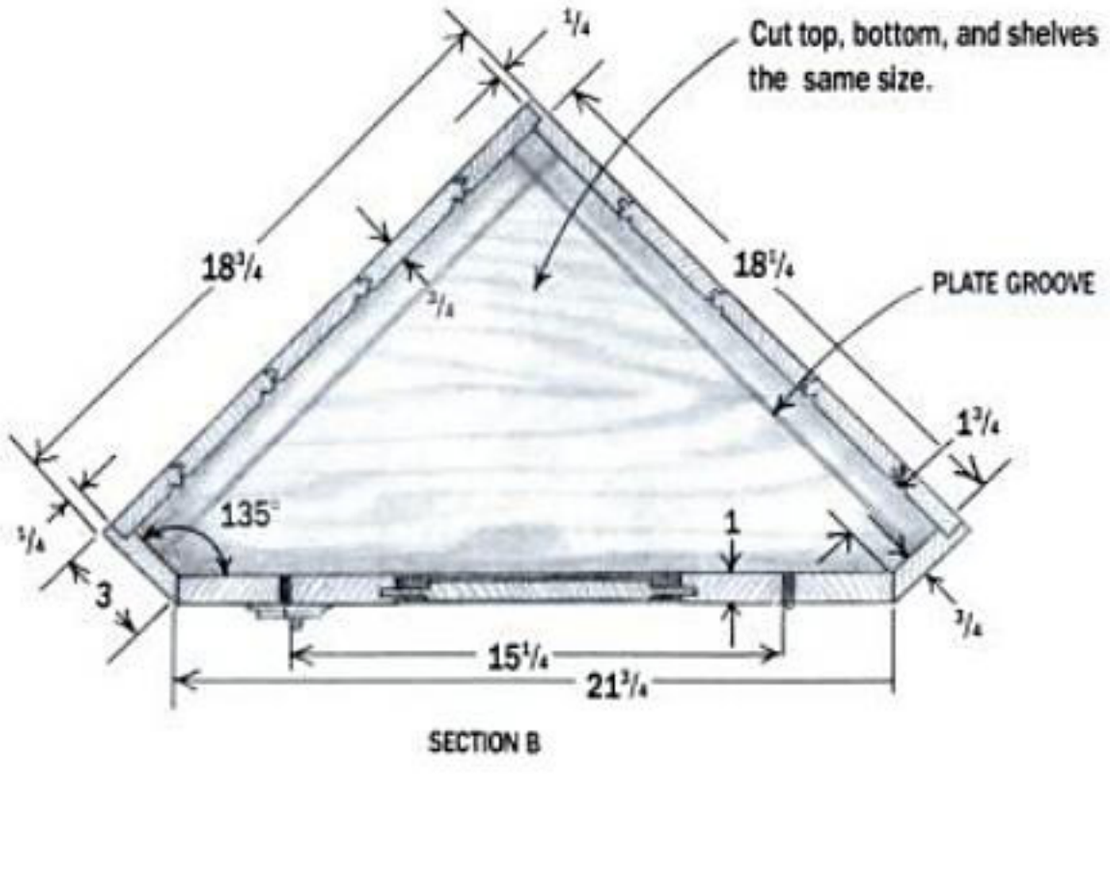


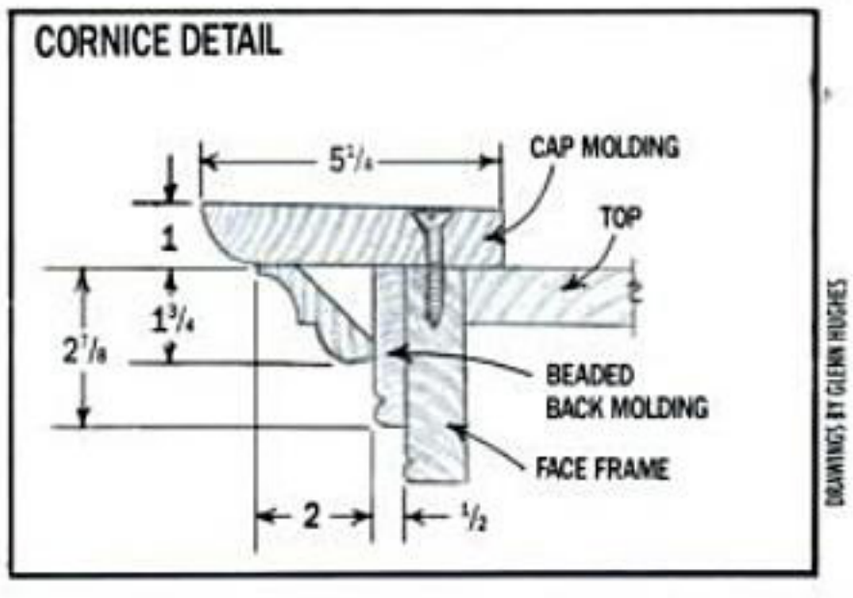
FIG. 1: HANGING CORNER CUPBOARD







SECTION B



DRAWINGS BY GLENN HUGHES

of the shelves with a file to match the curved profile.

Now make the eight remaining tongue-and-groove backboards. I don't spend a lot of time getting them to exact width. I just work my way from the back to the front corners by approximating widths, then cut the last backboards to fit the remaining space. With a Stanley #50 combination plane and a beading cutter, I cut a ¼-in. bead on the inside tongue edge to add some detail to the inside of the cabinet. A beading bit in a router would also work. Before nailing the backboards, I put a coat of the interior paint on the inside of the backboards so the tongues won't show raw wood when the backboards shrink.

Making the Frame-and-Panel Door

The door is fairly simple and straightforward. The mortise-and-tenon joints at the corners are made with through tenons. After dimensioning the stiles and rails, plow a ¼-in. x ½-in. deep groove down the inside center edge of the door rails and stiles to accept the door panel. I chop the through mortises by hand with a mortising chisel, working in from both sides to avoid any breakout. I cut the tenons on the tablesaw. (See *AW*, #8 May/June, 1989, page 32.)

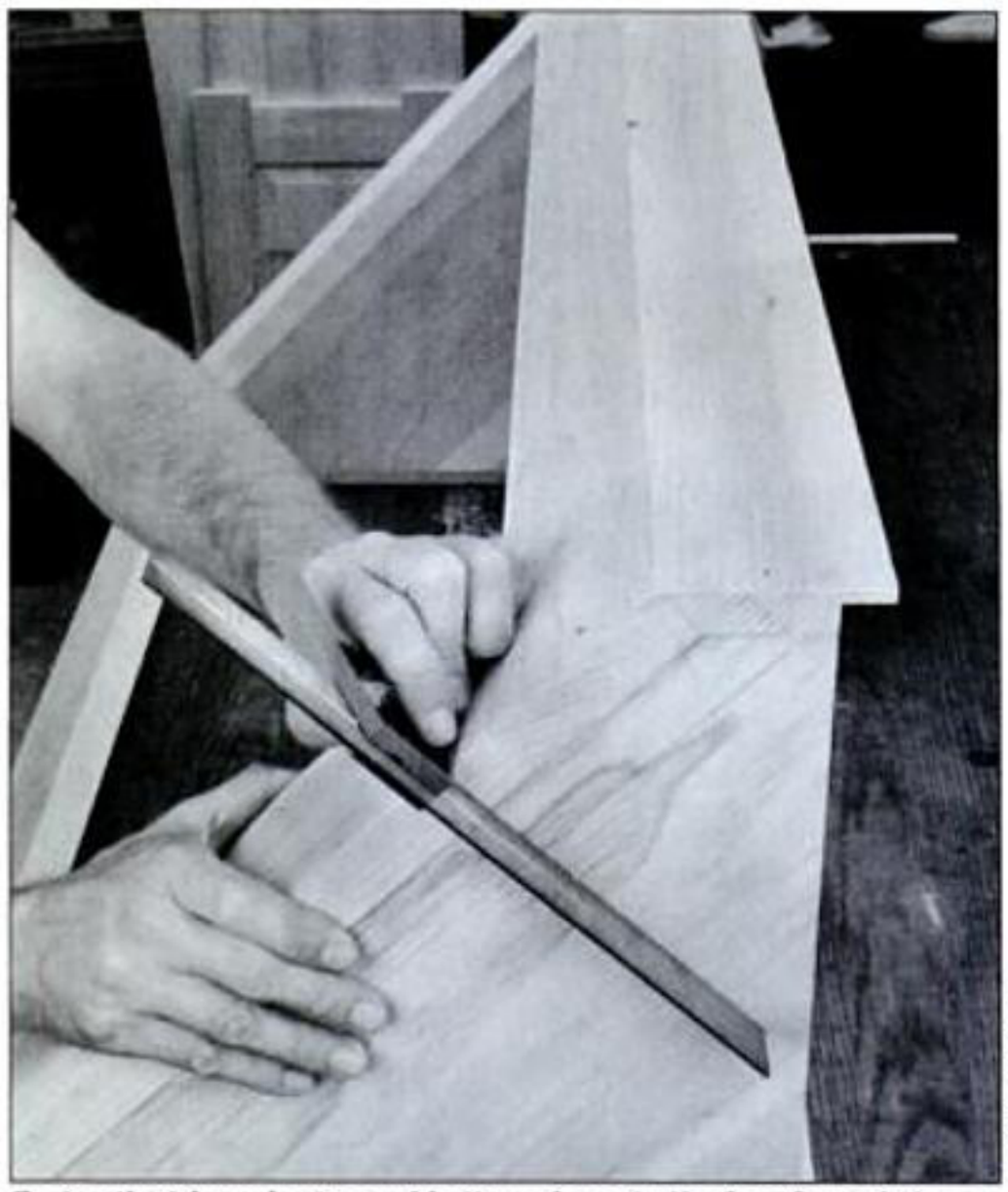
Dry assemble the door frame and measure inside the grooves to determine the dimensions for the door panel. Be sure to size the width of the panel to account for the season of the year and moisture content of the wood. For summer (high humidity) construction, I allow 1/16 in. clearance all around the panel because I know the panel will shrink in the winter. In the winter (low humidity), I allow more room, up to 3/16 in., because the panel will expand when humidity goes up.

Raise the door panel on the tablesaw (see *AW*, #8 May/June, 1989, page 33) and removed the saw marks with a finely set rabbet plane. I recommend finishing the panel before assembling the door, then glue up the door with the panel in place. Don't glue the panel—it should float in the groove. After clamping the door, drill and peg the mortise-and-tenon joints with octagonal pegs. I make the pegs from square stock with a simple shop-made jig and a block plane. (See *AW*, #19, page 34.)

I make my doors slightly oversized and hand plane the finished door to fit the opening. Fit the door to the opening and slightly bevel the inside edge opposite the hinges—this will provide a bit of clearance for the door to close without rubbing on the catch side.

Moldings, Cleats and Shelves

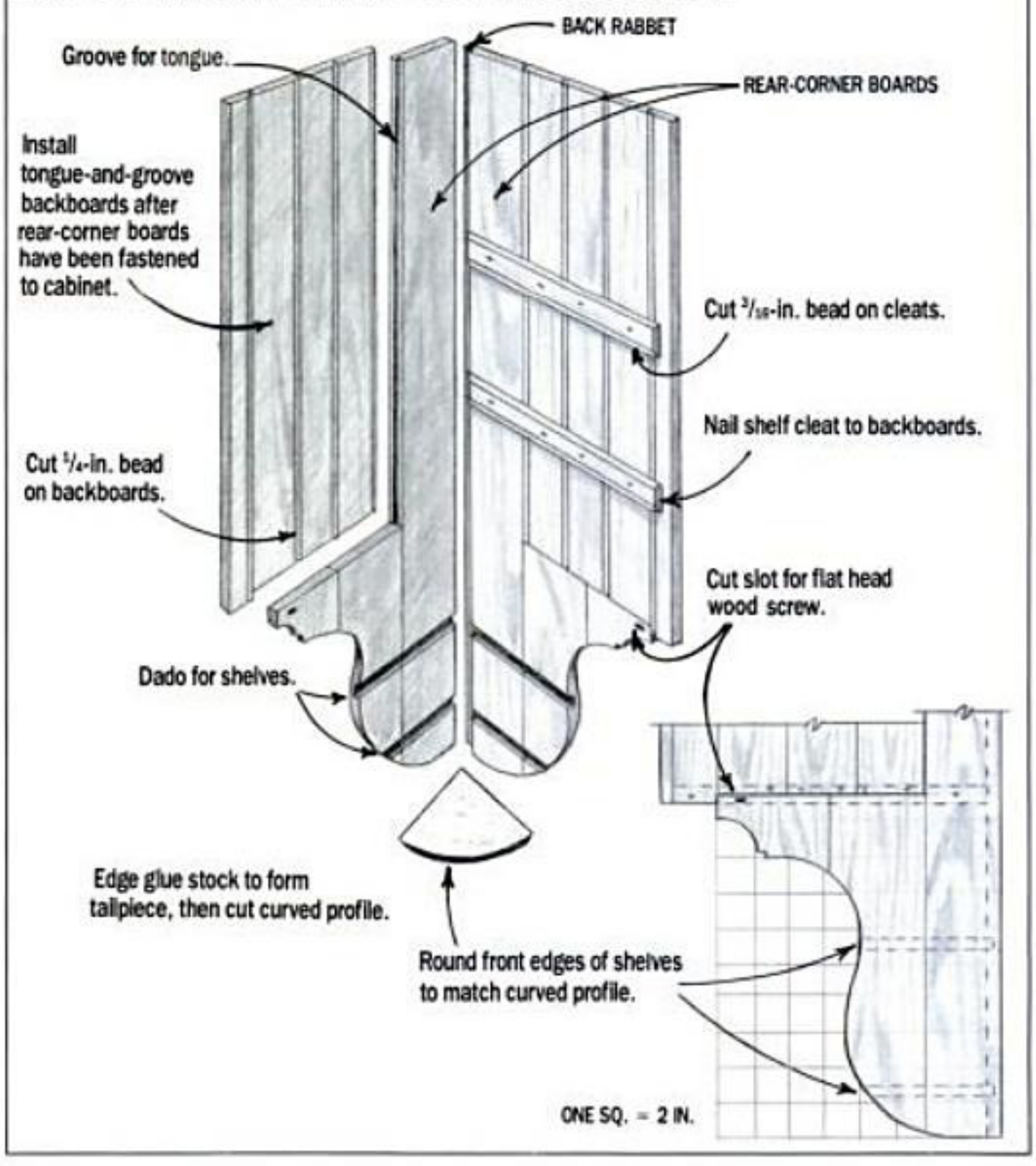
The waist molding around the bottom of the cabinet is a stock pine molding I bought at my local lumberyard. It's an ogee with a bead on the top, and



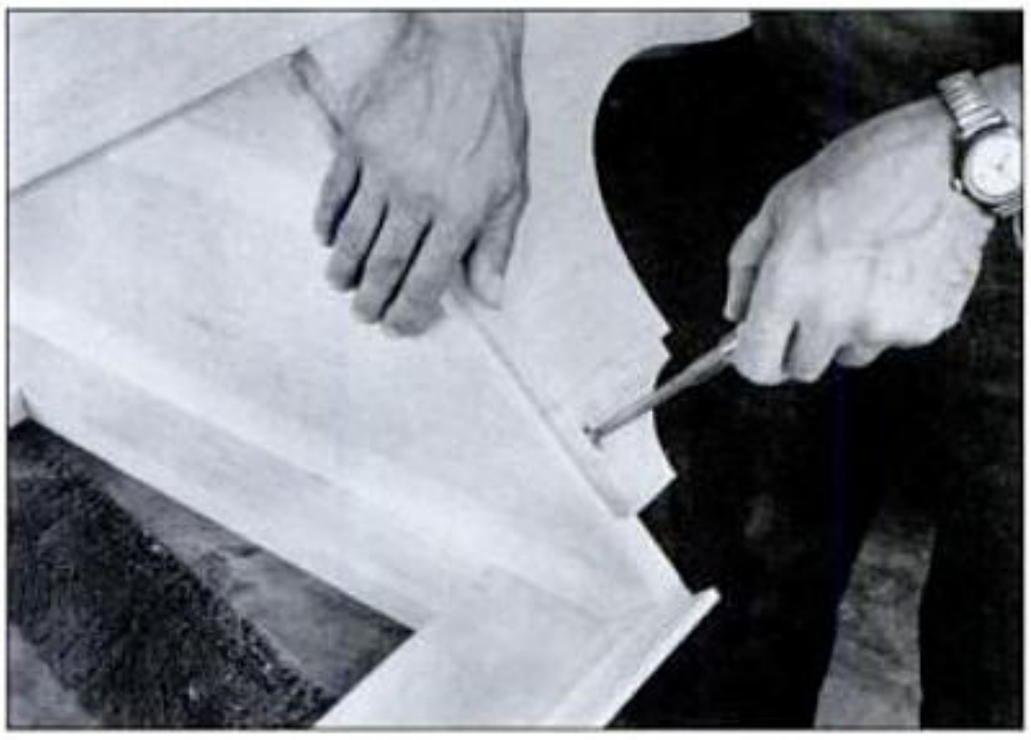
PHOTOS BY GLENN HUGHES

Fasten the triangular top and bottom pieces to the face frame/return assembly with cut nails and glue. Be sure to keep the parts perpendicular to the face frame.

FIG. 2: REAR-CORNER AND TAILPIECE ASSEMBLY



This Stanley #50 hand plane cuts the tongues and grooves in the backboards in less time than it would take to set up power tools to do the job.



Fasten the front corners of the tailpiece to the cabinet by driving a wood screw through a slotted hole into the edge of the bottom piece.

is an old version of architectural base molding. (See Fig. 1.) You should be able to find it at specialty mill-work shops, but don't worry if you can't find the exact profile—any molding that pleases your eye is fine. The crown molding at the top of the cupboard is built up from three separate pieces—a stock 2-in. bed molding attached to two shop-made pieces of molding. I make the cap (top-most) piece of molding first, with a 1-in. radius molding cutter on my tablesaw. I screw the cap to the top of the cabinet with 1½-in. #10 wood screws. Next, I use my Stanley #50 combination plane with a ¼-in. bead cutter to make the beaded back molding and attach it to the front of the cabinet with glue and fine-cut brads. The store-bought, angled bed molding goes on last with glue and fine-cut brads.

Make the cleats to support the interior shelves from ½-in. stock, and cut a ¼-in. bead on their bottom edge for decoration. Position the cleats where you want the shelves and nail them in place as shown in Fig. 2. Cut the interior shelves to size (it's best to measure the inside of the cabinet to determine the size) and mill a plate groove near the back edges of the shelves if you wish. I use an antique plane that cuts a shallow V-groove, perfect for plates. Cut a 3/16-in. bead along the top and bottom front edges of the shelves. The shelves can be installed through the open door of the cupboard after it's mounted on a wall.

Finishing Touches

Before I apply the finish to the cupboard, I cut the mortises for the door hinges and trial-hang the door. I also install the cabinet hardware to adjust the fit of parts, but remove it before finishing. Also, I remove any mill marks on the store-bought moldings. Eighteenth-century furniture would never have machine mill marks, and they look unsightly on reproductions. I sink the cut nail heads slightly below the surface with a countersink. On the surfaces that will be painted, I fill the nail holes with Durham's "Rock-Hard" Water Putty (available at hardware stores). Nail holes in areas that are to be stained are filled with colored putty from a stick after finishing.

I choose my finishing materials carefully to simulate the aged and worn finish you'd find on a 200-year-old cupboard. First, I stain the exterior of the cupboard with Zar #114 Provincial Wood Stain (oil based). When dry, I rub it down with a fine 3M Scotch-brite pad, followed by a tack cloth to remove the dust. Next, I apply a coat of Stulb's Old Village #1232 Graining Liquid (see Sources), a thick translucent oil stain. To help achieve an "aged" effect, I wipe most of the graining liquid off with a lint-free cloth but leave some in grooves, crevices, and areas where dirt and dust would normally collect. Finally, I apply two coats of Zar Satin Tung Oil finish. I prime the inside of the cabinet and the interior shelves with an oil-based primer, followed by two coats of Stulb's Old Village #1204 Antique Pewter oil-based paint.

After finishing, all that's left to do is to install the hardware and place the interior shelves in position. The door catch and hinges are antique reproductions available from mail-order suppliers. (See Sources.) To hang the cupboard, I use four 3/16-in. x 3-in. lag bolts with washers, that go through the back of the cabinet into studs in the wall. I paint the bolt heads and washers the same color as the inside of the cupboard. ▲

SOURCES

The hanging corner cupboard was built with the following hardware and supplies:

Reproduction cut nails: Tremont Nail Co., P.O. Box 111 Wareham, MA 02571, (508) 295-0038.

Door catch, part #SL-3: Horton Brasses, P.O. Box 95, Cromwell, CT 06416, (203) 635-4400.

Door hinges, part #H207-022: Ball & Ball, 463 W. Lincoln Hwy., Exton, PA 19341, (215) 363-7330.

Stulb's Old Village #1232 Graining Liquid, and Stulb's Old Village #1204 Antique Pewter oil-based paint: The Stulb Co., P.O. Box 597, Allentown, PA 18105, (215) 433 - 4273.

Craig Bentzley lives in southeastern Pennsylvania where he restores and conserves antique furniture and builds period reproductions. His tavern table appeared in AW, *# 19.*

TURNING

BY MICHAEL DUNBAR

Sit down in a straight-backed chair and chances are that you'll stand right up, again. Chairs with an angled back are far more comfortable. However, angling the back shifts the sitter's weight to the rear, making the chair tippy if the sitter leans back. To prevent this, the rear legs must also be angled backward to extend beyond the back edge of the seat.

On some chairs, a single, one-piece upright forms both the stile and the leg. This upright must bend at an angle to form the proper relationship between leg, seat and stile. (See Fig. 1.) It's an easy matter to *saw* angled uprights from a thick plank of wood. If you want to make *turned* uprights, however, you've got a problem. Every turner knows that the lathe makes only *straight* spindles.

Doing the impossible—The trick is to box one end in a plywood bracket that provides an "off-center" centerpoint for the drive center.

Some chairmakers solve the problem by steam bending the uprights after turning. This approach works only if the uprights are plain and unadorned. Any decorative beads or coves will cause the wood to break during the bending process where the turned decoration cuts through the layers of grain. Because of these limitations, turners who make chairs usually use straight, one-piece uprights and just learn to live with uncomfortable chairs.

Here's a little-known technique for doing the impossible—turning a "bent" upright on the lathe. It was developed about the turn of the 17th century and used to make Flemish chairs—cane-backed chairs of the William-and-Mary period. (See photo, page 26.) On this type of chair, the stile and leg sections of the upright are angled and this "bend" was turned directly on the lathe.

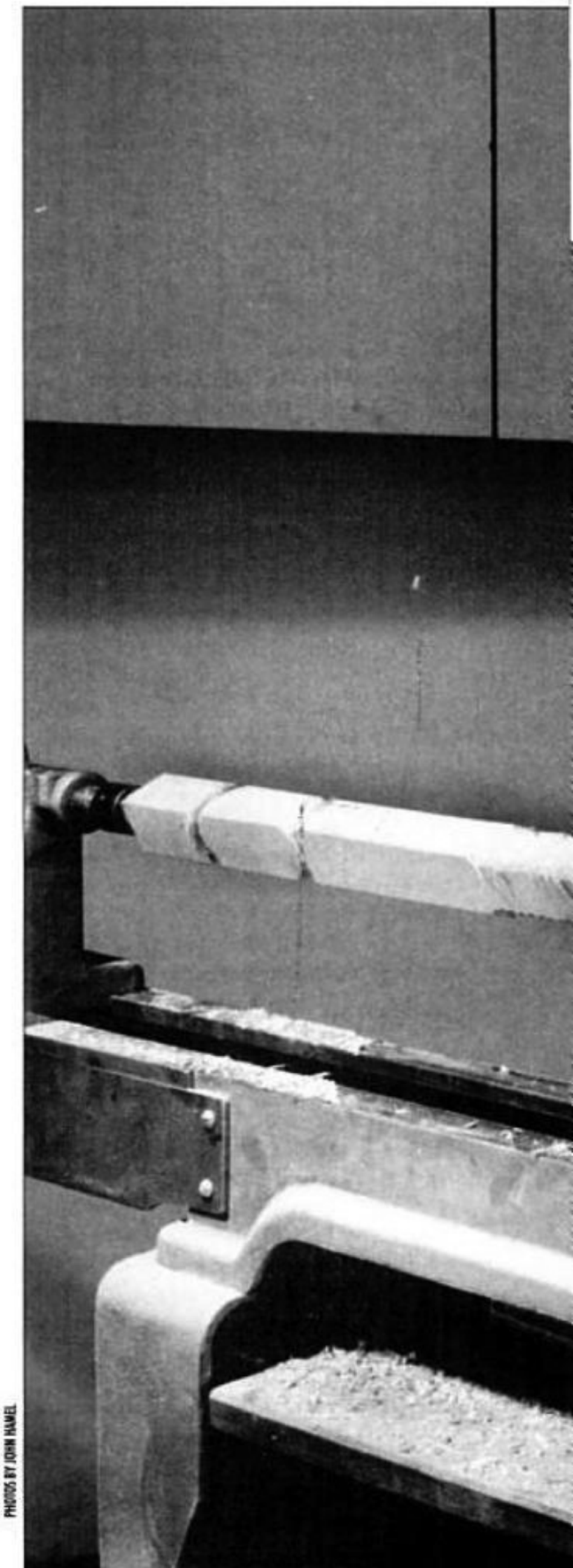
Obviously, there's a trick. The trick is to encase the leg section of the turning blank in a box, or "bracket," that provides an "off-center" centerpoint for turning the stile section. (See Fig. 1.) After turning the stile, you enclose the stile section in a bracket so you can turn the leg section to shape.

Once you know this trick, turning angled chair uprights (or any other "bent" spindle, for that matter) is actually quite simple. Off-center turning can be dangerous, however, and is not for beginners. Only experienced turners should try this technique.

Design Considerations

The bracket consists of two pieces of ¼-in. plywood and two wooden blocks that form a channel to hold the turning blank. (See Fig. 2.) You saw the turning blank to shape and place it in the channel. When you assemble the bracket, it holds the blank securely.

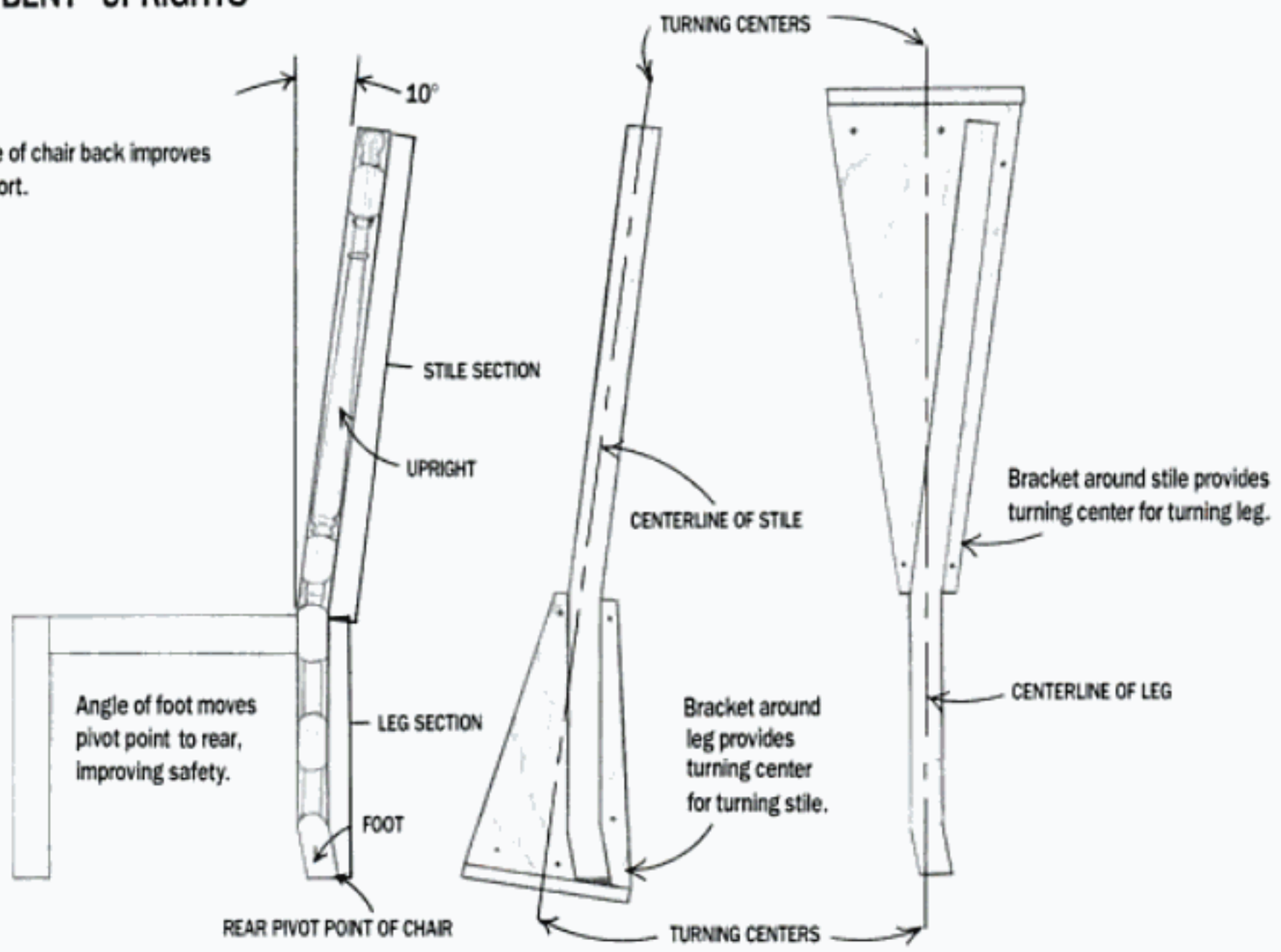
There is a limitation with this kind of bracket that you



PHOTOS BY JOHN HAMEL

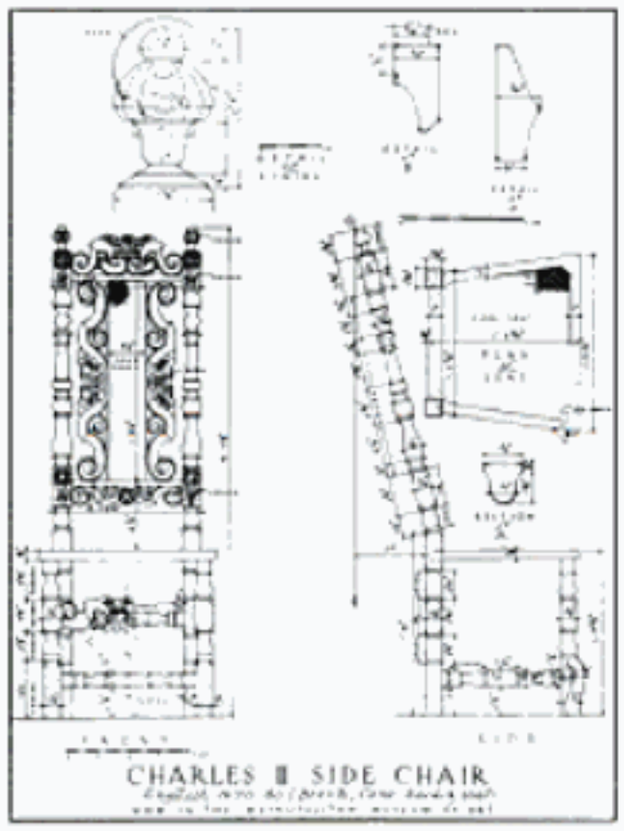
"BENT" CHAIR POSTS

FIG. 1: TURNING "BENT" UPRIGHTS



DRAWINGS BY GLENN HUGHES

The ornate "bent" uprights on 17th-century Flemish chairs were turned in one piece on the lathe.



DRAWING COURTESY OF DOVER PUBLICATIONS FROM *MASTERPIECES OF FURNITURE* BY VERNA COOK SALOMONSKY

must keep in mind when designing a chair. Only a square section will fit securely in the bracket. At least one of the turned sections (stile or leg) must have two or more square portions. (See Fig. 1.) By turning this section first, the square portions will fit into the bracket for turning the other section. Since a chair stile often has square portions where the crest rail and bottom rails join, this limitation is not usually a design problem.

The assembled bracket and projecting leg or stile look like a Russian balalaika, a banjo-like instrument with a triangular body. (See photo, page 24.) This symmetrical shape is important because it balances the combined weight of the bracket and turning blank around the centerline of the spindle, minimizing vibration and any tendency of the lathe to "walk" around.

Fig. 1 shows the two brackets needed for turning the upright for a typical Flemish chair. If your chair design calls for turning only one section (stile or leg), one bracket is all you need.

Making the Brackets

Make a plywood template in the shape of the turning blank. Use this template to lay out the shape of the blocks.

Glue the blocks to the plywood bottom. Because you have to assemble and disassemble the bracket every time you turn an upright, use carriage bolts rather than screws to fasten the bracket together. Aim the bolts in the direction shown in Fig. 2 so the carriage-bolt head is on the side coming toward you when the bracket is spinning on the lathe. If you should let a hand or tool stray into the spinning bracket, the bolt head will do less damage than the nut and exposed bolt end. Round all the corners and edges of the bracket, making it safer to use.

Turning the Upright

Trace the turning blank from your plywood template. Saw out the blanks on the bandsaw and plane them to remove the saw marks. It's easier to do this finish work before you do the turning.

If you're turning both the stile and the leg, first turn the section with the most square sections. The square sections that remain after turning make it possible to fit the blank into the bracket for turning the second section.

Put the blank in the bracket for turning the first section. The blanks should fit tightly in the bracket to avoid wobbling on the lathe. If you're making several chairs, you can shim an occasional loose fit, but change either the bracket or the template if many of the blanks fit loosely.

With the blank in the bracket, locate the center on the exposed end of the upright. Pull a chalk line down the centerline of the exposed section of the blank and snap a line onto the bracket as shown in Fig. 3. Square down across the bottom of the bracket from the end of the chalk line and mark the second center.

FIG. 2: ASSEMBLING THE BRACKET

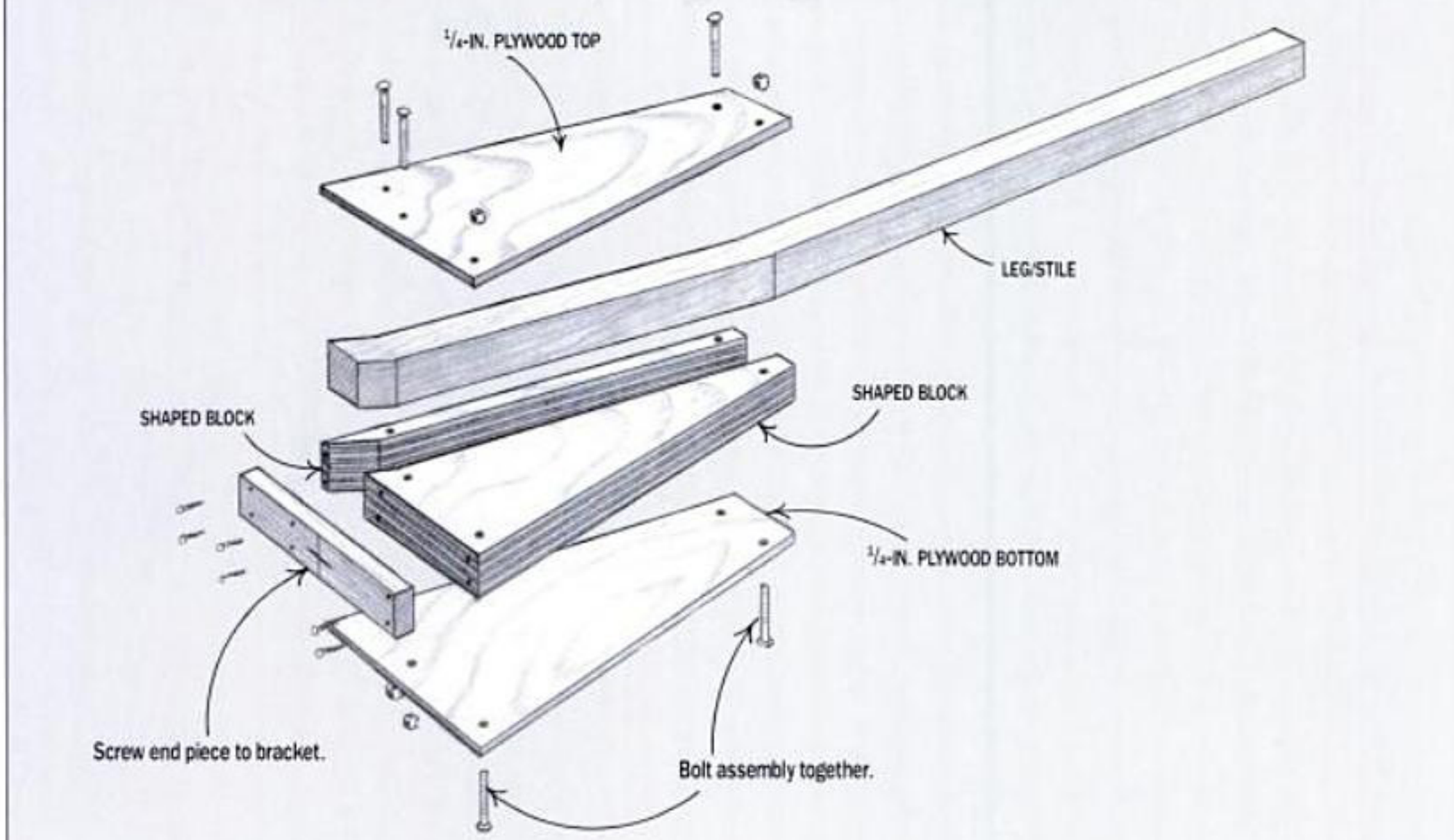
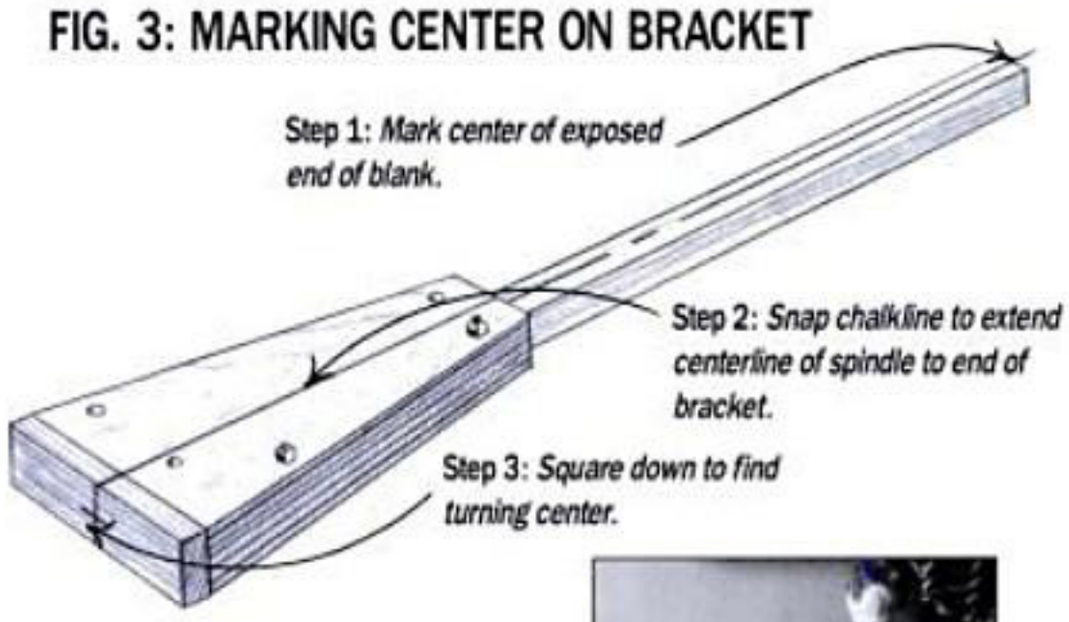
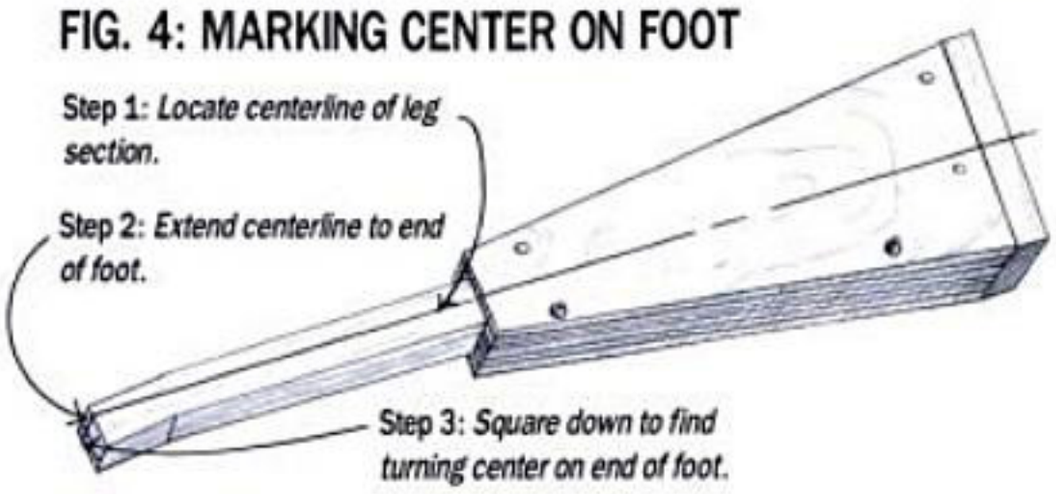


FIG. 3: MARKING CENTER ON BRACKET



To find the turning center on the end of the bracket, pull a chalk line down the centerline of the exposed part of the turning blank.

FIG. 4: MARKING CENTER ON FOOT



Mount the blank and bracket between centers on the lathe with the bracket at the head-stock end. Rotate the assembly by hand to check that it clears the bed. Check that it's accurately centered, and make certain that the lathe is set at its slowest speed before switching it on. I don't exceed 600 rpm.

The large spinning bracket is dangerous. If you get in the way with a hand or a tool you'll get swatted, hard. Be extremely careful, and turn the lathe off immediately after you're no longer turning. With the exception of the extra caution, the actual turning is straightforward spindle turning.

When you're finished turning the first section, remove the blank from the bracket and mount it in the second bracket. The only real difference between turning the stile and turning the leg is in marking the centers. If the bottom of the leg is canted, extend the centerline of the leg to the end of the foot as shown in Fig. 4 and square down across the end to find the turning center.

One of the drawbacks of this technique is that each bracket fits a blank of only one shape. You can't change the angle between the leg and the stile. You can change the design of the turning, and you can definitely make a lot of other turners scratch their heads in wonder. ▲

Mike Dunbar is a contributing editor of AW. *He's well-known for his Windsor chairs and has written several books on furniture and antique tools. This article is based on a technique from his recent book* Woodturning For Cabinetmakers *(1990, Sterling Publishing Co., Inc., 387 Park Ave. S., New York, NY 10016).*

PHOTOS BY MITCH MANDEL

CHINESE PLANT STAND

From Peking to Your Parlor

BY RALPH WILKES

While I was walking through the lobby of a hotel in Beijing, China, my eye was attracted to three plant stands. They were identical except for their heights, and together they displayed luxuriant foliage at three levels.

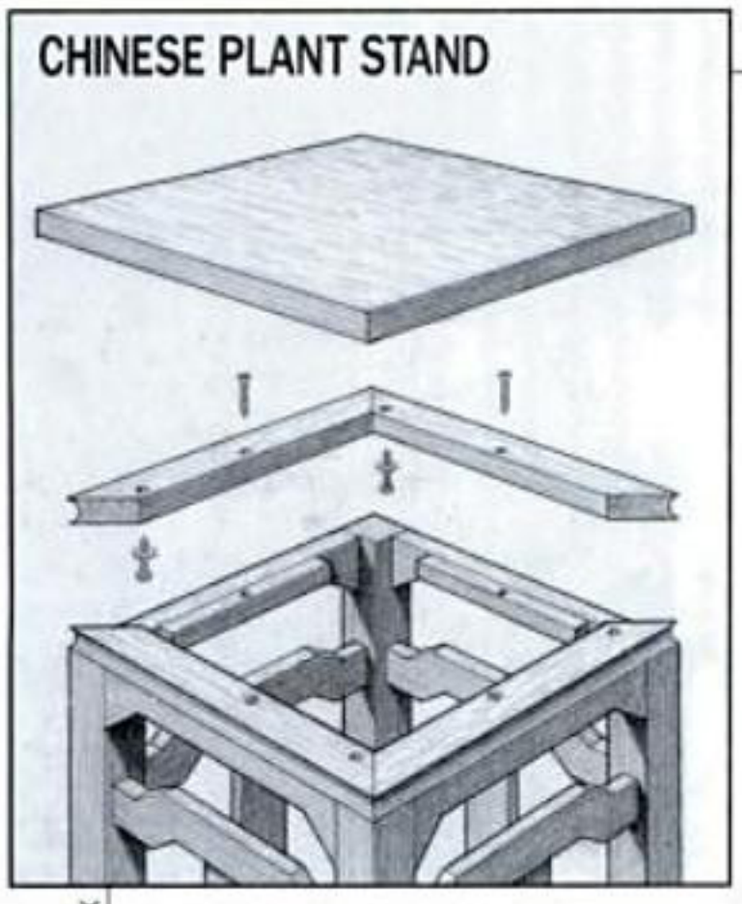
Here was a distinctly Chinese project that I felt I had to build. I sketched the 3-ft. tall stand, changing the top a little by borrowing the coved edge of a Chinese coffee table that I had seen. The drawing shows the dimensions for the stand. If you want to make a set of three in graduated sizes, you need to adjust only the length of the legs and the vertical slats. Sketch them to scale to make sure you'll get the look you want.

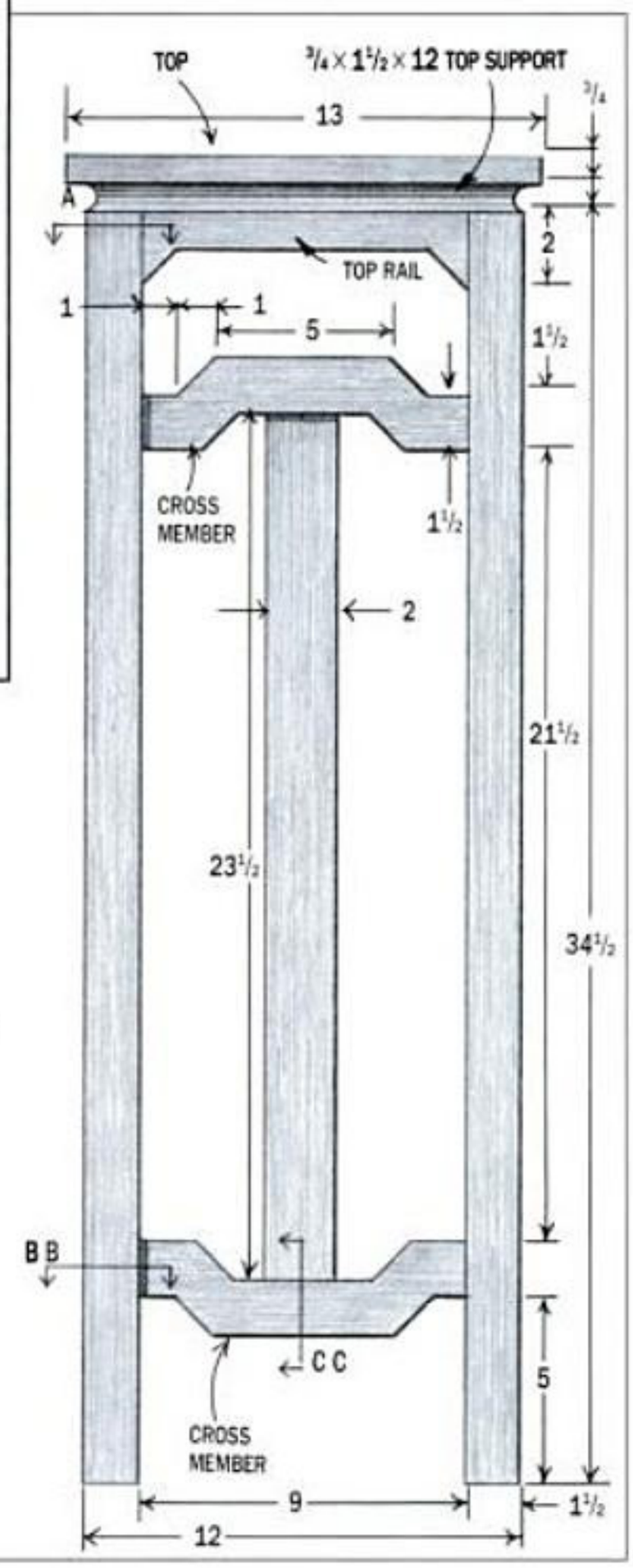
The original stands were probably mahogany, and the finish was quite dark. I decided on cherry. If you glue up the legs, the entire stand can be made from 4/4 stock.

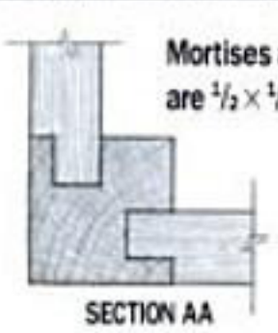
Mark the best adjoining sides of the glued up legs for the outsides, then lay out and cut the mortises on the other two sides. I cut them with a router bit in a drill press running at its highest speed as shown in the photo. Notice in the drawing that the cross-member mortises are centered on the legs but the top-rail mortises are not. (See *AW*, #18 for more on mortise-and-tenon joinery.)

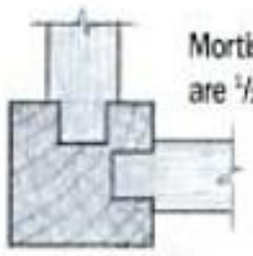
I cut out the top rails and the cross members on the bandsaw. Removing the saw marks on these edges can be tricky because the inside corners prevent a long, clean sweep with a plane or sanding block. To keep the edges flat, straight and square, and to keep the inside corners sharp and crisp, I used a square-edged hardwood sanding block. A hand-held cabinet scraper would also work

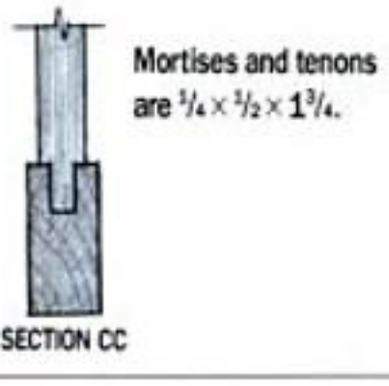
CHINESE PLANT STAND











DRAWINGS BY VINCE BABAK

well.

Cut the tenons to fit the mortises, and if your mortises have round ends, round the corners of the tenons with a wood rasp.

Cut the vertical slats to the proper length, including an inch for the two tenons. Dry assemble each side, and scribe the shoulders for the tenons on the slats directly from the assembly to get a good, snug fit.

I assembled the stand in two stages. First, I assembled two opposite sides, then I joined the two sides. I checked for twist by laying an assembled side on a flat surface. You can use weights to eliminate twist. If an assembly is out of square, I correct it with a diagonal clamp or tourniquet. You must make both of these corrections before the glue begins to set.

When the glue is dry, join the two opposite sides. Place the stand on a flat surface, check for square, and correct as necessary. Check the top as well as the sides for square.

Once the four sides are assembled, you can turn your attention to the top and its support. I cut the cove in the edge of the top support pieces with a ¼-in. dia. round-nose router bit (also called a core box bit). I found it easiest to shape one long piece on the router table and cut it into four pieces with mitered ends.

I used pine for the ¼-in. square cleats that hold the top rails to the top supports. Note that the cleats are only 6 in. long; you need an exposed area at the end of the top supports for the screws that hold the top as shown in the drawing.

Make the top (but do not attach it yet), and you're ready for finishing.

I finished the stand with a cherry stain mixed with dark walnut stain, followed by three coats of satin-finish polyurethane. If you prefer, black lacquer would give the stand a more traditional Chinese appearance. Be sure to finish the top on both sides to minimize cupping from uneven moisture changes.

When your finish has dried, attach the top with four 1¼-in. #8 round head wood screws with flat washers under the heads. The holes through the top supports should be larger than the diameter of the screws to allow for movement from seasonal moisture changes.

Your last task is to find a plant that will properly complement this elegant stand from the Far East.▲

When routing mortises on a drill press, begin with a series of closely spaced holes and clean up the mortise by moving the stock sideways against the router bit.

Ralph Wilkes is an amateur woodworker and retired business manager of Keuka College in New York.

BUYER'S GUIDE TO RANDOM ORBIT SANDERS

I've always thought it would be great to have a sander that could do both rough sanding and finish sanding. A sander that could remove stock quickly when equipped with coarse-grit paper, yet, with fine-grit paper, leave a surface smooth enough for staining and finishing. For the first time, power-tool companies are offering such a tool to woodworkers—it's called a *random-orbit sander*. It works like a disc sander, except the disc's axis of rotation moves around in a little eccentric orbit, which means the abrasive particles on the sanding disc move in a *random* path.

What does this mean for wo

sanders and a couple of ¼-in. sheet orbital finishing sanders with 120-grit paper, and used each to sand pine and ash boards. I then repeated the test with 240-grit and 320-grit papers. In each case, the random-orbit sanders left a smoother finish and removed material three to four times faster than the finishing sanders.

Of course, random-orbit sanders are larger, heavier, more expensive tools that won't squeak into small spaces or corners the way finishing sanders will. When equipped with coarse-grit papers, you can use random-orbit sanders for rough stock removal on many projects, eliminating the need for a belt sander.

Performance Features

When shopping for a random-orbit sander, you'll want to compare specifications to help you find a machine that meets your needs. The first consideration should be performance—the capacity for the sander to remove stock. This capacity depends on several factors you can compare from the chart on page 33.

No-load speed: The rotational speed (rpm) of the sander's spindle affects sanding speed. Because the random-orbit sanding head is connected directly to the spindle, the speed of the small orbiting motion will be equal to the spindle speed—one revolution = one orbit. Higher spindle speeds mean faster stock removal.

The rotational speed of the sanding pad varies, depending on how much pressure you exert when sanding—more pressure, less speed. Bearing down on the tool won't increase the speed of stock removal. Light to moderate pressure produces the best results, both in stock- removal rate and smoothness.

Motor power: Sanders with more powerful motors are able to maintain higher spindle speeds under load. This means they can remove stock faster when cutting aggressively. If you'll be doing a lot of rough sanding—removing a lot of stock—choose a sander with higher motor power. The best indicator of power is the "amp" rating.

Eccentric throw: Stock-removal rate also depends on the amount of offset between the sander's spindle axis and the sanding pad's axis. This offset determines the diameter of the tiny orbital motion called the "eccentric throw." In general, larger orbit diameters means faster stock removal.

Sanding-pad diameter: All other things being equal, a 6-in. dia. sanding disc will remove stock more quickly than a 5-in. one, simply because the surface area of the abrasive disc is larger.

Variable speed: Sanders with variable motor speed are more versatile than those without, but this feature is not too critical in most woodworking applications. Variable speed is handy for rough sanding to help control the rate of stock removal. When using the tools for finish sanding, I got the smoothest results by sticking with the highest speed and changing the pressure slightly to control stock removal. Lower speeds are good for final buffing or for polishing clear finishes and wax coats with a lambs-wool bonnet or felt pad, and for rubbing out penetrating-oil finishes to a high sheen. On the chart, the variable-speed models are indicated by two sets of figures in the "No-Load Speed" column.

Most right-angle random-orbit sanders come with side handles (AEG VSR 600 shown). These sanders convert to angle grinders by mounting a grinding wheel and guard in place of the sanding head.

Ergonomic Features

Power and speed aren't everything on random-orbit sanders. The fit of the tool in your hand, its balance, switch and handle locations, and how it handles sandpaper and dust are as important as brute performance.

Body designs: Random-orbit sanders come in two basic motor configurations—right-angle and in-line. Most are a right-angle design, which is laid out just like a small angle grinder. The spindle that drives the sanding head is connected at a right angle to the motor shaft by a set of bevel gears.

The other configuration is what I call an in-line motor design. On these, the sanding head runs directly off the motor shaft, so the weight of the tool is balanced directly over the sanding pad. Generally, I found the in-line sanders a bit easier to control on horizontal surfaces, whereas the right-angle tools were easier for vertical sanding. Each type takes some getting used to.

Handles: The sander handles should be comfortable to grip without having to put your hands or arms in an awkward position. All of the right-angle sanders require two hands to operate. Most of the right-angle sanders come with detachable side handles that can be mounted on either side of the tool for left-hand or right-hand use. The Skil has an adjustable bail handle on the front of the tool, which made it less tipsy from side to side when sanding and generally easier to control. (See photo.) Skil offers the side handle as an option; AEG plans to offer an optional bail-type handle for its sanders.

This bail-type front handle is standard equipment on the Skil #7584. The author found that it provided more stability than side handles did when sanding horizontal surfaces.

PHOTOS BY TOM BARRETT

The in-line Bosch 3283 DVS and Ryobi have D-type rear handles; the Metabo, a similar barrel-type handle. The bail-type handle on the Bosch 3283 is adjustable. (See photo.) I found the saddle-horn front handle on the Ryobi comfortable, though a top-mounted saddle-horn grip on the Metabo didn't fit my hand as well. The body-grip style of the Wen was the least comfortable to use—it was too large and transmitted a lot of vibration, which was tiring after an extended period. Though it's designed for one-

hand use, a two-handed grip on the tool, as shown in the photo, provides better control. A company spokesman at Wen told me that a planned design change to reduce vibration should make it less tiring to use.

Switches: The Fein and Porter-Cable have simple OFF/ON slide switches located on the top of the tool. The other right-angle sanders (AEG, Bosch 1370 DVS and Skil) have "momentary-on" slide switches located on the left side of the tool body. These switches have a built-in switch lock, which you engage by rocking the front of the switch forward while in the ON position. The in-line Bosch 3283 DVS, Metabo and Ryobi have finger-operated trigger switches with a switch lock button under the rear handle. The Wen has an ON/OFF slide switch on the front of the saddle-horn top grip. The Milwaukee sander has a comfortable rectangular paddle switch located underneath the tool body.

I thought the switches on all the sanders were conveniently located, though the switch lock buttons aren't made for lefties like me. My only complaint is that the variable-speed control knobs on the in-line Bosch, Metabo and Ryobi sanders are too small and hard to get to—the switch has to be locked ON to adjust the speed while the tool is running.

Sandpaper attachment: Most of the sanders have a Velcro-type paper attachment system (optional on Skil). The Velcro discs are expensive, but you can remove them and use them again and again until the abrasive is worn out. The AEG, Porter-Cable, Skil and Wen sanders use pressure-sensitive adhesive-backed (PSA) sandpaper

RANDOM-ORBIT SANDERS FEATURES AT A GLANCE

MAKE	MODEL	LIST PRICE (1)	PAD DIAMETER (in.)	TYPE (2)	NO-LOAD SPEED (rpm)	ORBIT DIAMETER (3)	AMPS @ 120 V.	DUST PICKUP (4)	SWITCH TYPE (5)	PAPER ATTACH. (6)	CORD LENGTH (ft.)	NET WT. (lbs.)	ACCESSORIES (7)
AEG	VSR 500	$220	5	R	10,000	5/16	5.7	N	S	A	10	5.0	sd, mc, fh, *
	VSR 600	$230	6	R	10,000	5/16	5.7	N	S	A	10	5.0	sd, mc, fh, *
	VSRE 500	$240	5	R	900-9000	5/16	4.6	N	S	A	10	5.0	sd, mc, fh
	VSRE 600	$250	6	R	900-9000	5/16	4.6	N	S	A	10	5.0	sd, mc, fh
BOSCH	3283 DVS	$169	5	I	6000-12,000	5/16	2.3	B, v	T	V	7	4.0	SD, p
	1370 DEVS	$391	6	R	4800-12,000	5/16	5.0	B, v	S	V	7	5.0	SD, p
FEIN	MSf 636-1	$610	6	R	7500	5/16	3.3	V	S	V	9½	3.7	sd
METABO	SXE 125	$213	5	I	5000-12,000	3/16	1.8	B	T	V	8½	4.75	SD, p
MILWAUKEE	6125	$200	5	R	10,000	19/64	5.5	N	P	A	8	5.1	SD, p
	6126	$205	6	R	10,000	3/8	5.5	N	P	A	8	5.1	SD, p
PORTER-CABLE	7334	$210	5	R	6000	11/32	3.7	v	S	A	10	5.5	SD, p, mc
	7335	$230	5	R	2500-6000	11/32	3.7	v	S	A	10	5.5	SD, p, mc
	7336	$235	6	R	2500-6000	11/32	3.7	v	S	A	10	5.75	SD, p, mc
RYOBI	RS-115	$134	4½	I	11,000	5/32	2.0	B	T	V	6	3.0	SD, p
SKIL	7584	$160	5	R	10,000	3/16	6.0	B	S	A	8	5.2	SD, p, FH
WEN	15	$60	6	I	3000	3/8	2.5	N	S	A	6	3.9	SD

KEY TO CHART

1. Mfr's. sugg. list price includes standard accessories: listed as uppercase letters in "DUST PICKUP" and "ACCESSORIES" columns. (Prices often discounted 10 percent to 40 percent.)
2. I = In-line; R = Right angle
3. Also called "Eccentric Throw."
4. B = Bag; V = Vacuum; N = None (Uppercase = Standard; Lowercase = Optional)
5. S = Slide; T = Trigger; P = Paddle
6. A = Pressure-sensitive adhesive; V = Velcro.
7. Accessories: Uppercase = Standard
   Lowercase = Optional
   SD = Sanding Disks
   MC = Metal Case
   P = Optional backing pads with different flexibility (Skil: optional Velcro pad)
   FH = Bail-type Front Handles
   * = AEG VSR 500 and VSR 600 also available in kit form; includes metal carrying case, side handle, front bail-type handle:
   VSR 500K $242
   VSR 600K $252

discs. With PSA discs, the adhesive backing can get contaminated with sawdust when you remove the pad, and it won't restick. The adhesive also loses its tack when exposed to air for more than a few hours. In addition, you must remove the disc shortly after use or the adhesive will set up, making removal difficult.

On the plus side, PSA sanding discs are readily available in a wide variety of grits at hardware stores, home centers and by mail. They're also less expensive than Velcro discs, especially if you buy them in bulk. However, the cheaper price is somewhat offset by the shorter life of the pads. Personally, I prefer the convenience of the Velcro discs and don't mind paying a bit extra for them. They're readily available from dealers who sell sanders that use them. The discs come in 5-in. and 6-in. sizes with

The front bail-type handle on Bosch 3283 DVS adjusts to different positions, though it's a bit small for large hands to grip comfortably.

the standard eight-hole pattern for sanders equipped for dust pickup.

Dust Collection

All the sanders have some means of dust collection except the AEG models, the Milwaukee models and the Wen. Porter-Cable offers an optional vacuum-attachment system, which consists of a dust hood and adaptor fitting that can be attached directly to a 1¼-in. vacuum hose or the standard 1½-in. hose found on most shop vacs. (See photo.) While the Porter-Cable sanders don't have through-the-pad dust pickup, they plan to offer an accessory sanding pad with this feature to make the vac attachment work better, though I thought the attachment picked up dust quite well even without it.

The Fein comes standard with a dust-collection hood and hose adaptor that fits a powerful Fein-built shop vacuum (see photo) and other vacs that use 1½-in. hoses. According to Fein representative Bob Hillard, the vac traps dust particles down to 1 micron in size and operates at a noise level of 59 decibels—quieter than your average shop vac. Another nifty feature of this setup is that in "auto" mode, the vacuum and sander operate simultaneously, controlled by the sander switch. Hillard

You can use a one-hand grip on the Wen sander, but the author prefers the two-hand grip (shown) to prevent fatigue when sanding for long periods.

Optional dust-pickup hood on the Porter-Cable sander does a good job of dust collecting when connected to a standard shop vac.

tells me that while the sander and vacuum are sold separately, they're intended to be used as a system to take full advantage of the dust-collection capability. He suggests that the system is ideal for shops where strict dust-control measures must be taken (when sanding and finishing are done in the same area or to meet OSHA dust-control requirements). As much as I would like this industrial-quality German import, it's a bit pricey for this weekend woodworker ($610 for the sander and $625 for the vac), so I'll use it only in my dreams. However, if I were sanding several hours a day in a production shop, the Fein's superior dust-collection system would be worth the hefty price.

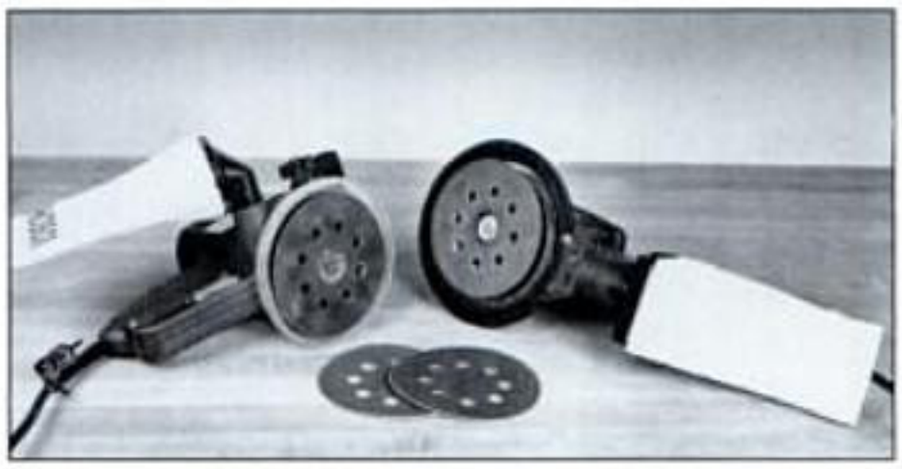
The rest of the sanders (Bosch, Metabo, Ryobi and Skil) use on-board dust bags and through-the-pad dust pickup.

Clean machine! The Fein sander/vacuum system ranked best in dust-pickup tests. The powerful accessory vacuum traps particles down to 1 micron, giving virtually dust-free performance.

A fan in the sander pulls dust through generous holes in the sanding pad that align with holes in the sanding discs, and shoots the dust into a bag. The Bosch 3283 DVS has an optional suction hood to catch dust that escapes around the sanding pad. (See photo.) Both Bosch sanders can also be hooked up to 1¼-in. vac hoses. The Metabo comes with a brush ring that's good for dislodging dust from the pores of open-grained woods.

In my tests, the Fein had the cleanest dust-pickup system of all the sanders when coupled with its vacuum. Next best was the Porter-Cable, which worked well when its hood was hooked up to my Black & Decker shop vac. Of course, vacuum attachments usually work better than dust bags, but are less convenient.

Of the tools with dust bags, the Bosch 3283 DVS and Metabo did the best job of dust pickup when fitted with their respective suction-cup and brush-ring attachments. Without them, these models rated about the same as the Bosch 1370 DEVS and Skil 7584. The Metabo unit shown in the group photo on page 31 is a prototype—its paper bag will be replaced with a cloth bag on production mod-



Sanders with bag attachments have "through-the-pad" dust pickup. Bosch 3283 DVS has an optional plastic hood to improve dust pickup (left); Metabo SXE 125 comes standard with a dust-brush ring to help clean out open-grained woods (right).

els. Bosch, on the other hand, will offer a paper-bag attachment and bags as an option. Chris Carlson at Bosch tells me that some woodworkers prefer the paper bags because they trap finer dust particles than do cloth bags. This makes them more desirable for such operations as sanding between finish coats or using micron (super-fine) abrasives that produce extremely fine dust.

On the Ryobi, a plastic box mounted under the handle takes the place of a dust bag as shown in the photo. This dust box is located neatly out of the way during sanding, but it must be emptied frequently. When it does fill up, dust tends to back up in the tool and blow out through the fan-housing vents above the pad. ▲

Detachable dust box on Ryobi fits neatly under the rear handle. The box slips on and off easily, but fills up with dust faster than bags do.

Jim Barrett writes about woodworking tools and finishes from his home and shop in California. He has written about doweling jigs, honing guides, carbide saw blades, belt sanders and cordless drills in prior issues of AW.

AMERICAN WOODWORKER BEST BUY

Picking a winner is tough. Different sanders have different combinations of the features that I like, but none has them all. Also, features like variable speed might be a high priority for one woodworker but not another. Of course, your wallet usually has a say in the matter. I do favor the D-handle, in-line random-orbit sanders over the right-angle models—but that's just a personal preference based on how they feel in my hand.

Bosch 3283 DVS

With these caveats in mind, I picked two "Best Buy" winners: First is the Bosch 3283 DVS in-line sander. It's sturdy, light weight, has good balance, an efficient internal dust-pickup system and variable speed. It isn't as powerful as some of the right-angle machines, but it sands plenty fast for me. The front handle fits my hand well, and at $169, it's reasonably priced.

Among the right-angle sanders my, choice is the Skil 7584. Also reasonably priced ($160), it's one of the most powerful sanders I tested (6 amps), has good dust pickup and appears to be a sturdy, well-built tool. The deciding factor, though, is Skil's bail-type front handle. (I like to be on top of a tool.) Both best-buy sanders offer the Velcro sanding discs I favor.—*J.B*

Skil 7584

SOURCES

Random-orbit sanders are available from most mail-order tool companies. For information about a specific brand, contact the manufacturer listed below:

AEG POWER TOOL CORP.
Three Shaw's Cove
New London, CT 06320, (800) 243-0870,
(203) 447-4600
ROBERT BOSCH POWER TOOL CORP.
100 Bosch Blvd.
New Bern, NC 28562, (800) 334-5730
FEIN POWER TOOLS, INC.
3019 W. Carson St.
Pittsburgh, PA 15204, (412) 331-2325
METABO CORP.
P.O. Box 2287
West Chester, PA 19380, (215) 436-5900
MILWAUKEE ELECTRIC TOOL CORP.
13135 W. Lisbon Rd.
Brookfield, WI 53005, (414) 781-3600
PORTER-CABLE
P.O. Box 2468
Jackson, TN 38302, (901) 668-8600
RYOBI AMERICA CORP.
1424 Pearman Dairy Rd.
Anderson, SC 29625, (800) 323-4615
SKIL CORP.
4300 West Peterson Ave.
Chicago, IL 60646, (312) 794-7495
WEN PRODUCTS
5810 Northwest Hwy.
Chicago, IL 60631, (800) 462-3630

Two

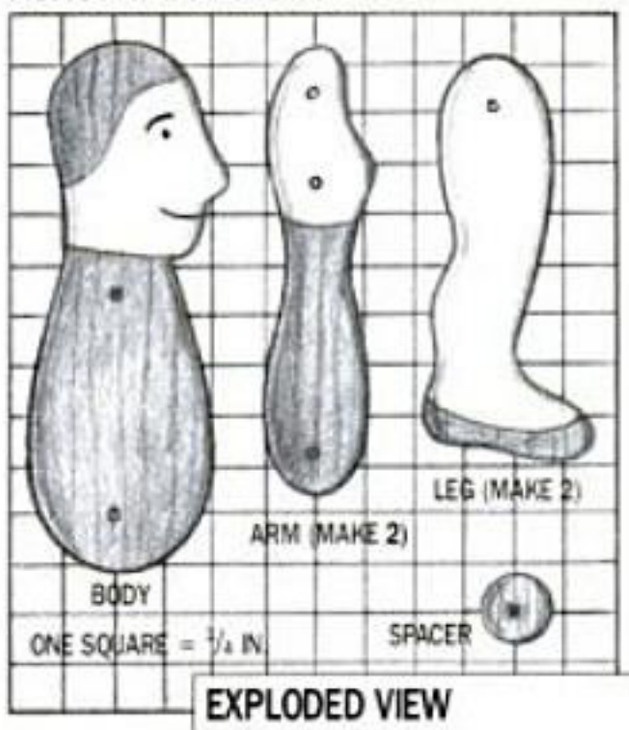
Caution: These Gifts Come With Strings Attached

PHOTOS BY MITCH MANDEL

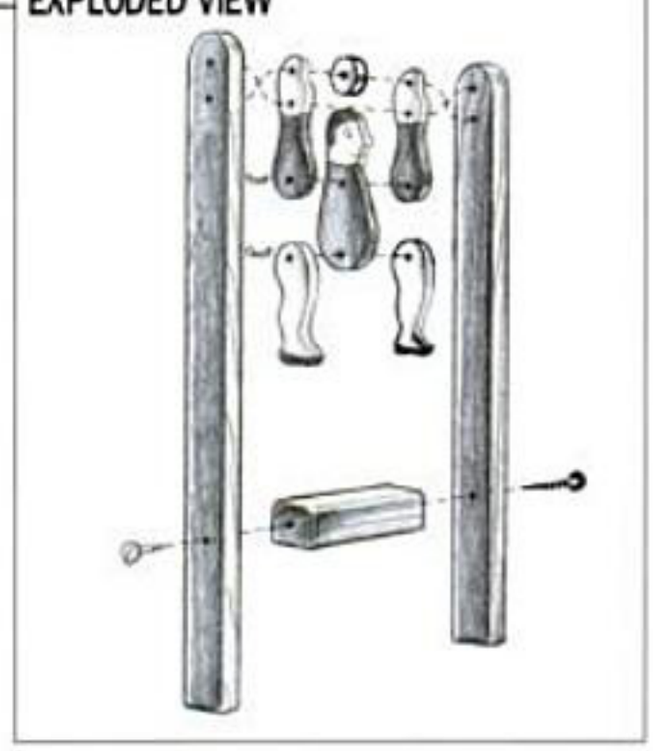
The acrobat flips over the string bar and back when you squeeze and release the ends of the poles. When not in use, prop the toy in a base that has two holes drilled out for the poles. ACROBAT BY JULIUS FRITZ

EDITOR'S NOTE: Wooden string toys have been around for centuries, but they never seem to lose their novelty. Here are two string toys—the Climbing Lizard and the Tumbling Acrobat—that will have your little ones giggling for hours. String toys are captivating because of the way they move when you play with them: the lizard crawls up the strings it hangs on when you pull down on each string alternately; the acrobat flips over the string "bars," back and forth, when you squeeze and release the ends of the poles. There's nothing much to making these toys. The drawings tell it all. We recommend you give these toys to children 3 years and older, but there's no law that says they're only for kids... these toys make wonderful distractions at the office.

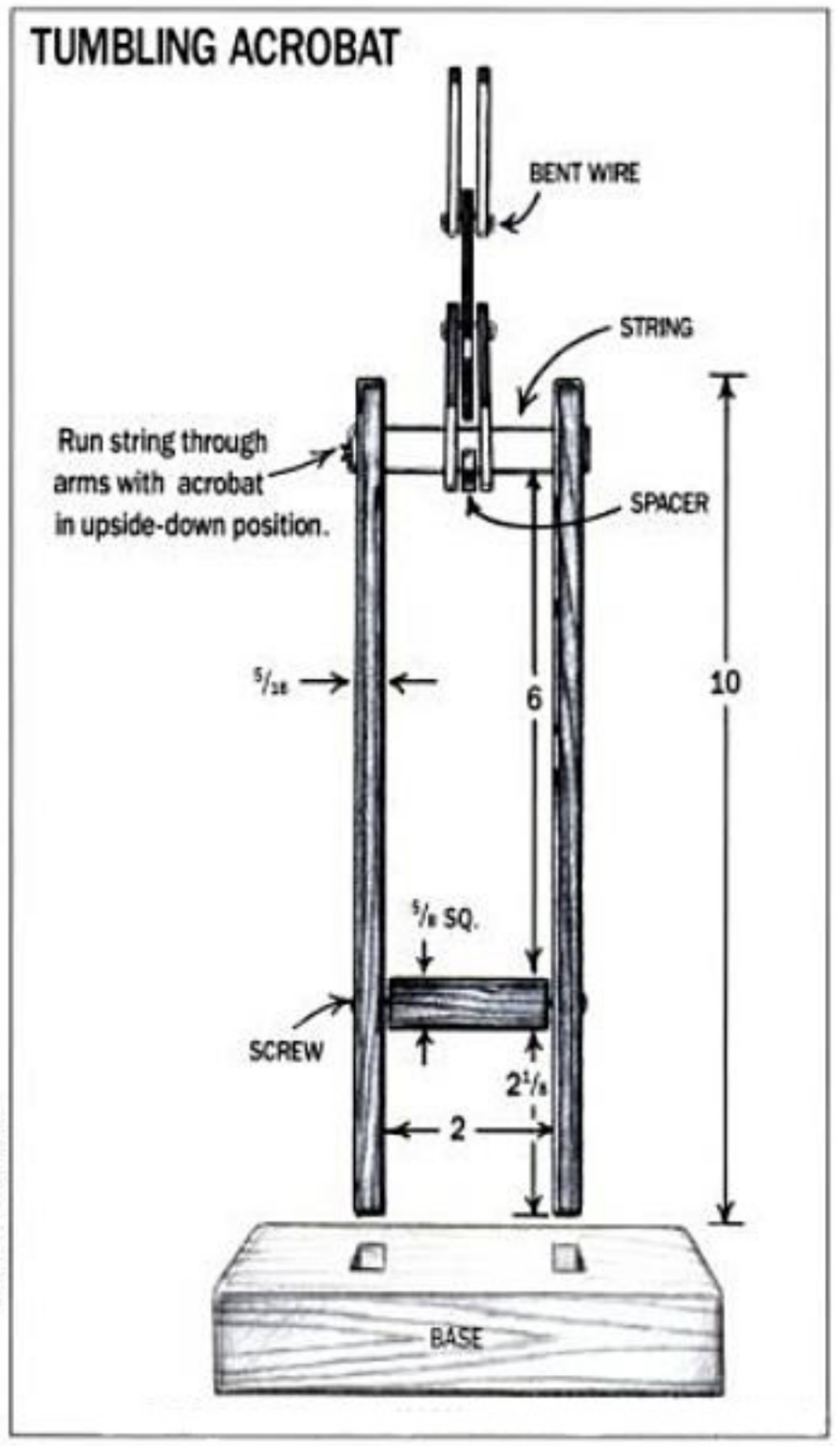
ACROBAT BODY PATTERNS



EXPLODED VIEW

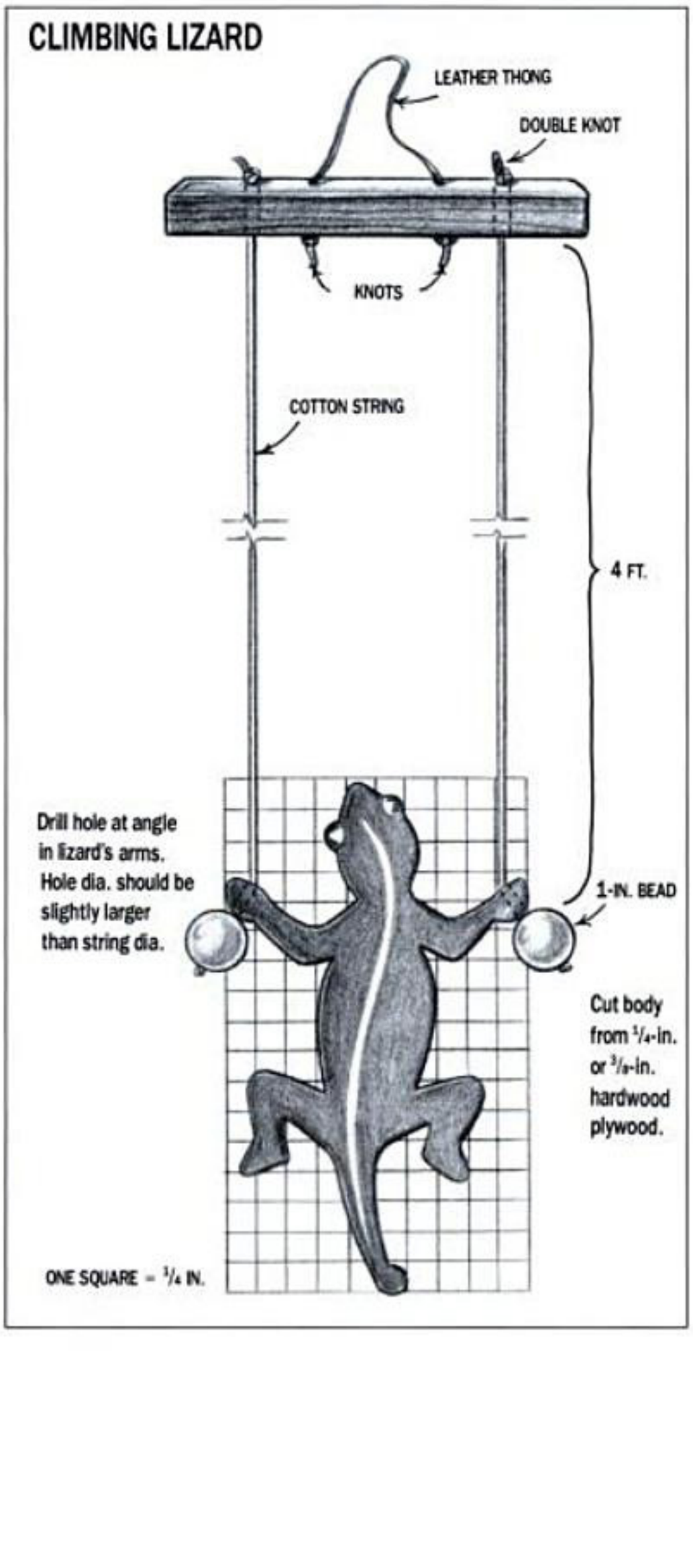


TUMBLING ACROBAT



DRAWINGS BY SALLY ORDOÑA

STRING TOYS



This painted lizard scrambles up the ropes when you pull down and slightly out on one string, and then the other. To get the critter down, simply bring the strings together.

LIZARD BY ANN MICHAEL

ALL ABOUT DRAWERS

Part 1: Housing and Mounting the Drawer

BY ROGER HOLMES

Drawers have always fascinated me. They're the main attraction of many of my favorite pieces of furniture, and even some of my favorite places. For me, the charm of an old hardware store, pharmacy or printer's shop increases with each row of little drawers lining its walls.

I've noticed, particularly at yard sales and auctions, that I'm not alone in my fascination. The temptation to open a drawer seems as universal as it is irresistible. What, we wonder, might Mr. Jones have left in here? It's easy to spot the woodworkers at these gatherings—before they look in the drawer they check its construction.

At its simplest, drawermaking is merely the making and fitting of one box inside another. If you're not terribly concerned about how snug the boxes fit together, drawermaking can be done quickly, even haphazardly. I've seen drawers so loose in their cabinets that they probably could have been tossed in from across the room. If you want sturdy, durable drawers that slide smoothly with little play, drawermaking can be one of the most challenging tasks in woodworking—and one of the most rewarding.

For a novice, making and fitting even a single drawer, not to mention a chest full of them, may appear more daunting than rewarding. What joints should you use? How do you support it in the carcase? What woods are best? In this two-part article, I'll examine these and other questions. There are many design options with drawers. Because these options are affected by the carcase in which a drawer fits, I'll examine in this first part, the more general issues of carcases and drawer-mounting choices; then in Part 2 (to appear next issue), I'll cover the more specific issue of making and fitting a drawer.

Making informed choices will help you balance your abilities and aspirations. The examples I'll discuss are by no means comprehensive, but they represent a range of options accessible to anyone with basic equipment. Give these a try, and if you, too, become fascinated by drawers, you can have a lot of fun dreaming up other possibilities.

Desires and Designs

Before you start worrying about dovetails and drawer runners, think about the nature and purpose of your project. Is this chest of drawers to be an heirloom—a showcase for your woodworking skills worthy of fine materials, painstaking attention to detail and a lot of time? Or do you need some drawers quick, to stem terminal clutter in a kid's room? You'll probably want to pull out all the stops for the heirloom, but simple drawers, loosely fitted in the chest, will do fine for the kids. When I build a chest, table or cabinet, I usually think first about how the entire piece is going to look and work before thinking about drawer construction.

First, consider the carcase itself. The drawing shows four common types of carcase construction that house drawers: solid, frame and panel, face frame, and tables and simple desks. (Wardrobes and most other drawer-bearing furniture fit into one of these four carcase types.)

Then decide how you want to mount the drawers. (See drawing.) Do you want them to slide on runners underneath the drawer sides or on one central runner in the center of the drawer? If space is at a premium, do you want to hang the drawers by their sides on narrow strips of wood called fillets, or even from the drawer bottoms themselves? Perhaps commercially made drawer slides suit your purposes best.

As you can see, there are numerous ways to hang drawers. However, some methods of hanging drawers are more appropriate than others, depending on the type of carcase. Fig.1 shows the options for each carcase type.

Solid Carcases

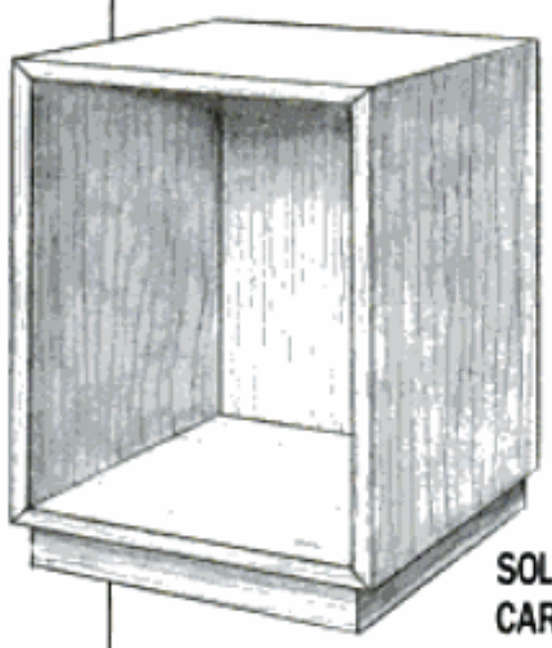
Solid carcases are in some ways the easiest carcases for drawers. Rails and runners, and side-hung fillets (see drawing) can be readily fastened to the carcase sides, and the flat surface of the carcase sides can guide the drawer, permitting little movement side to side.

If your solid carcase is made of sol-

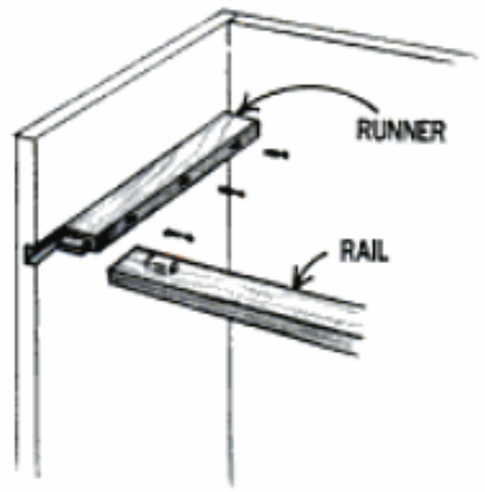
The type of carcase determines your options for hanging a drawer. On this solid carcase, the drawers ride on runners, which are slot-screwed to the carcase sides to allow the sides to expand and contract.

PHOTOS BY JOSEPH KUSHELSKY

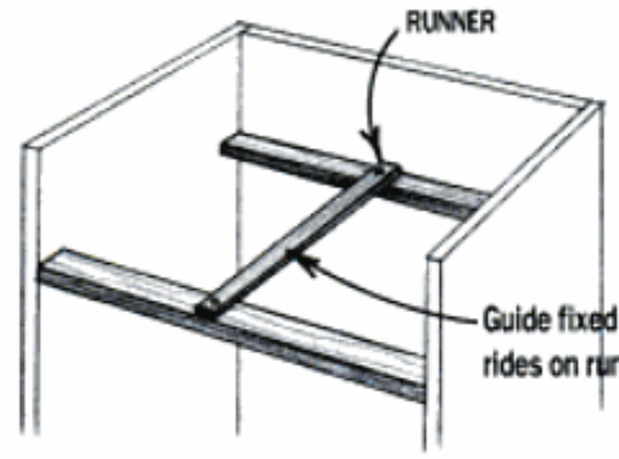
DRAWER HANGING OPTIONS FOR THE FOUR BASIC CARCASE TYPES



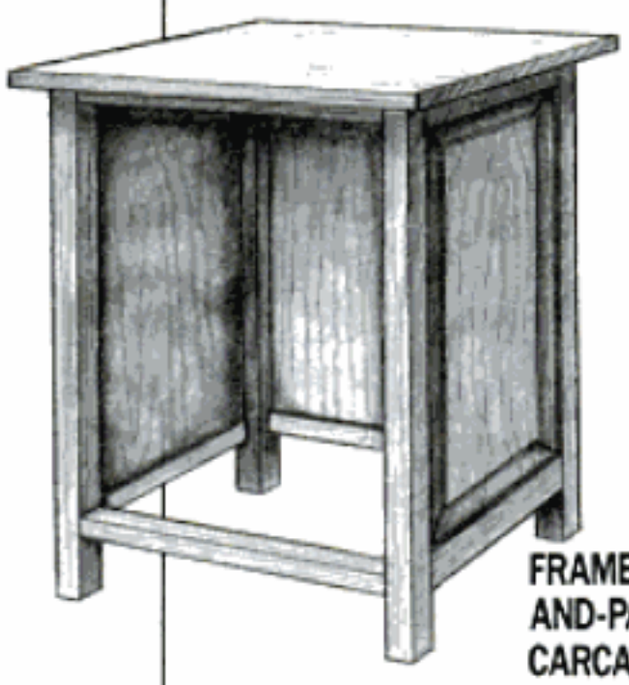
SOLID CARCASE



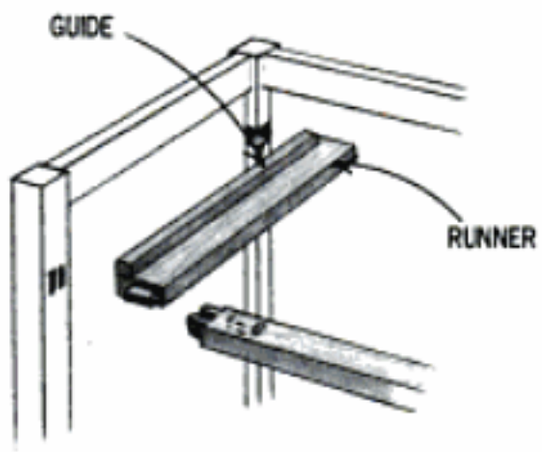
RAIL AND RUNNER



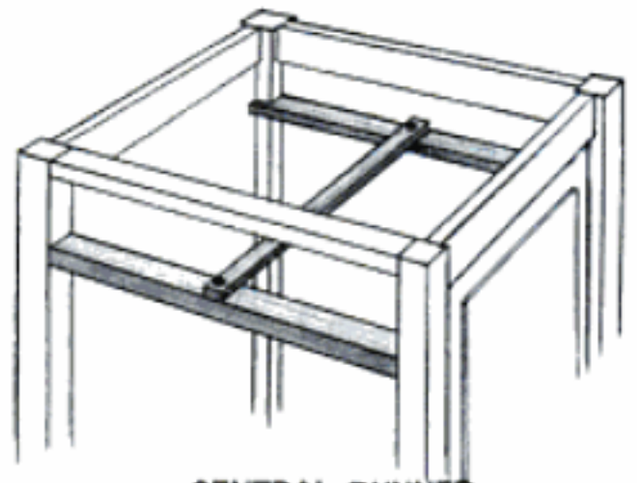
CENTRAL RUNNER



FRAME-AND-PANEL CARCASE

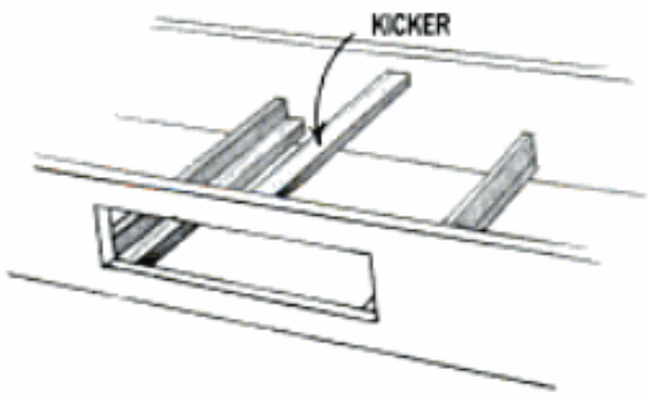


RAIL AND RUNNER

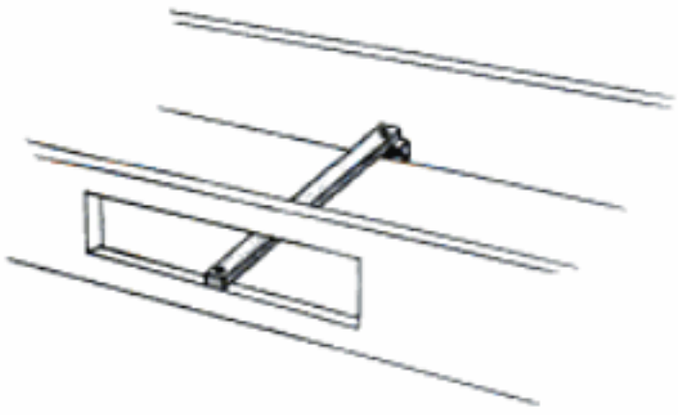


CENTRAL RUNNER

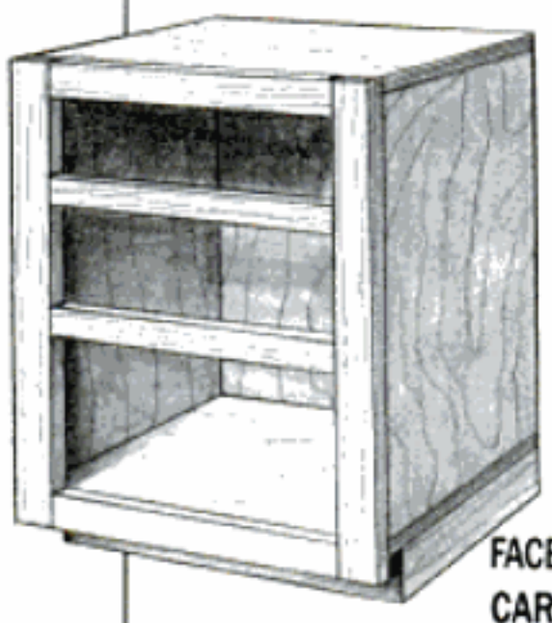
TABLE/DESK CARCASE



RAIL AND RUNNER



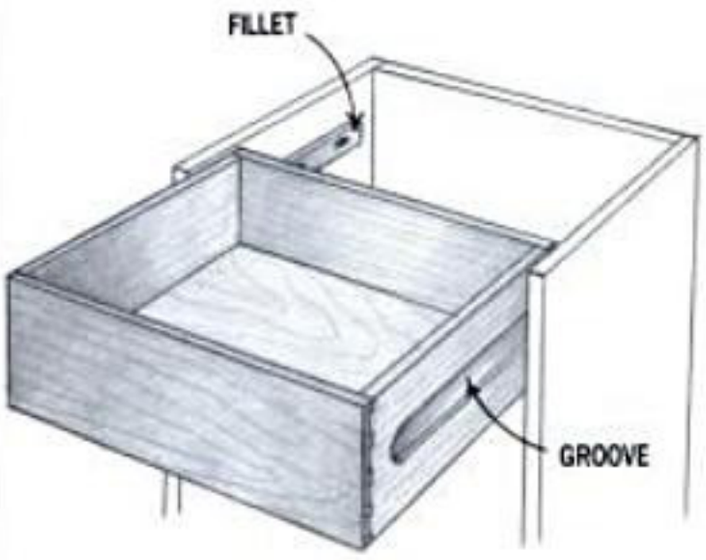
CENTRAL RUNNER



FACE-FRAME CARCASE

RAIL AND RUNNER

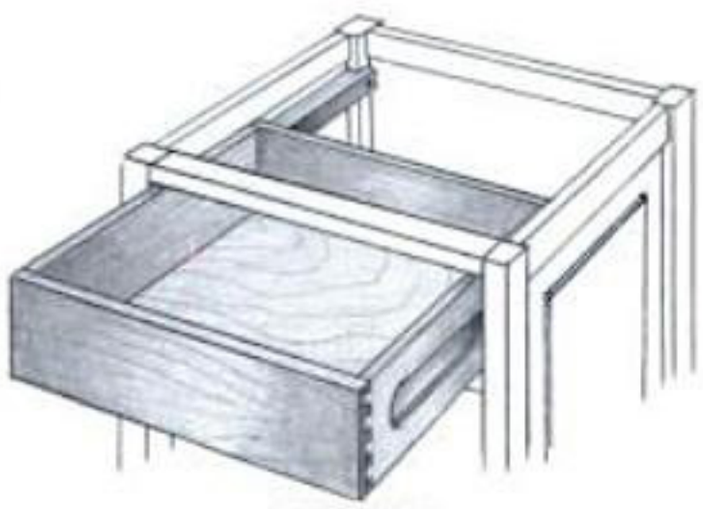
CENTRAL RUNNER



SIDE HUNG

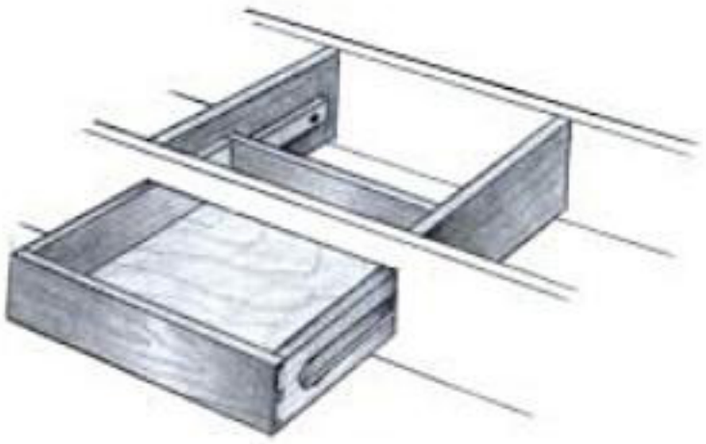
COMMERCIAL DRAWER SLIDES

BOTTOM HUNG

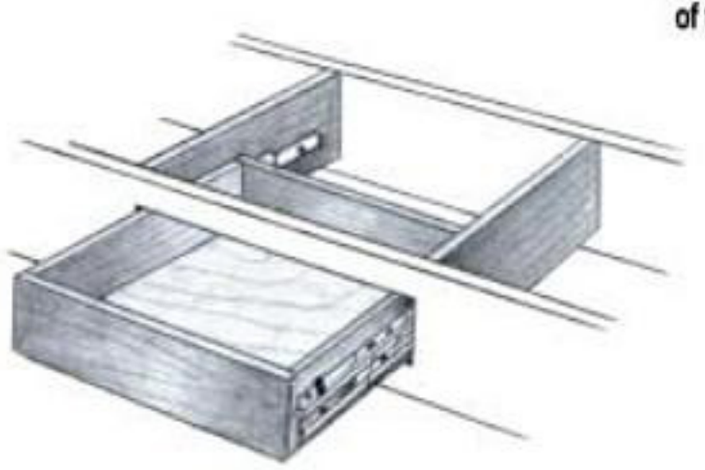


SIDE HUNG

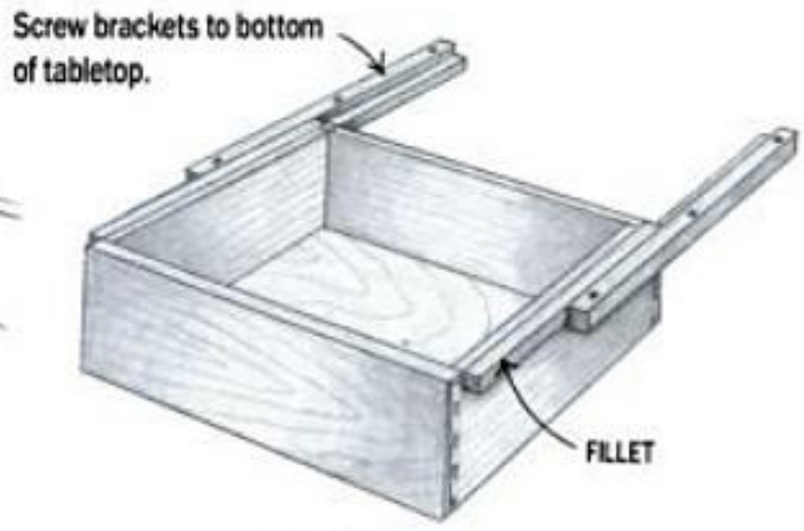
COMMERCIAL SINGLE-TRACK SLIDE



SIDE HUNG



COMMERCIAL DRAWER SLIDE



TOP HUNG

SIDE HUNG

COMMERCIAL SINGLE-TRACK SLIDE

DRAWINGS BY GLENN HUGHES

id wood (and not MDF or plywood), the sides of the carcase will expand and contract with changes in humidity. For this reason, anything you attach to them (like drawer runners or fillets) needs to allow for this movement. Whether you join runners to rails (the horizontal divider between drawers) with stub tenons and glue or simply butt the runner to the rail, runners (and side-hung fillets) should be slot-screwed to the cabinet side to allow for movement. The drawing shows some solutions for attaching rails, runners and fillets to the carcase. Screwing them to the inside of the carcase sides is easiest, but housing them in dadoes is a more durable solution—the runners or fillets won't move out of alignment.

More problematic are solid-wood cabinet sides that cup across their width or bow along their length, clamping snug-fitting drawers like a vise. Because boards cup away from the heart, you can orient the sides so they'll cup outward (heart-side out) rather than inward. Drawers may rattle around a bit, but they'll open. Sometimes, wide runners can pull a slightly cupped side flat. A solid, horizontal divider between drawers may remedy more pronounced cupping, and it's about the only way to deal with bowing.

Side-hung drawers (see drawing) allow for more or deeper drawers in a given space because they don't need rails. However, with no rails or dividers to check cupping or twisting, the carcase sides must be stable. In England, I once worked on a chest-on-stand filled with a stack of shallow side-hung drawers. Made of an exotic wood we didn't know much about, the sides of the chest bowed drastically after placement in a dry, centrally heated house, and the drawers couldn't be budged. The only solution, short of rebuilding the whole thing, was to make the center drawer into a "divider" by fixing it permanently to the sides, then refit the other drawers. It worked, but subsequent versions of the same cabinet were made of veneered plywood.

Frame and Panel

Frame-and-panel construction minimizes the effects of wood movement and affords a distinctive look. When both the frames and panels are the same thickness, you can handle drawer runners much as you would for a solid carcase. But frequently, the panels aren't flush with the frame on the inside of the carcase. This makes attaching runners to the inner walls of the carcase a fussier task. You'll need to fix guides to the runners to keep the drawer from shifting side to side. (See drawing.) I've never tried hanging a drawer from wooden fillets in a frame-and-panel carcase. Without dadoes or screws to fix the fillets along their length, I'm concerned they'd move and bind in the groove in the drawer side. Bottom-hung drawers also make little sense in a frame-and-panel carcase.

Tables and Simple Desks

Drawers are useful additions to many tables—cutlery, games, bedtime reading material, desk paraphernalia and so on can be stored right at hand. A drawer or set of drawers that span the length between the front table legs can be mounted on runners with guides, as for a frame-and-panel carcase. (See drawing.)

Installing a drawer in the middle of a long apron rail (under a dining table, for example) can be a little trickier. You can construct what amounts to a small carcase behind the apron as shown in the drawing. The drawer slides on runners. Two guides tenoned to the front and back aprons keep it from shifting from side to side. A strip of wood called a top kicker (also tenoned to the front and back aprons) keeps the drawer from tipping as it is opened. A simpler solution would be to slide the drawer on a central runner.

If the table has no apron rail, you can hang a drawer from the tabletop itself by attaching fillets to the drawer sides and mounting brackets to the tabletop as shown in the drawing. You might even attach the brackets and fillets inside the drawer to hide them from view—the drawer would appear to be defying gravity.

Face-Frame Carcases

Face frames are commonly used for kitchen cabinets and built-ins. (See drawing.) The face frame is usually fastened to the front of a solid carcase. To hang a drawer in a face-frame carcase, you must install wooden guides or even false, inner sides on either side of the drawer opening to account for the width of the face frame. A central runner is the simplest solution.

Carcase Tips

The most important thing to remember when building a carcase for drawers is that it has to be square—in every direction. If the face of the carcase is out of square, the drawer fronts will bind. If the carcase is narrower at the back than the front, the drawer sides will bind. If the carcase is twisted, everything will bind. Likewise, all drawer rails, runners and fillets must be square with the carcase and parallel to each other.

That, of course, is the ideal. Don't despair if your efforts fall short. I've never made a perfectly square carcase, and my first attempts were well off the mark. If the problems are small, you can usually solve them when you fit the drawers. Larger problems may require adjustments in your plans—make the drawers smaller, hang them differently or settle for a rattling fit.

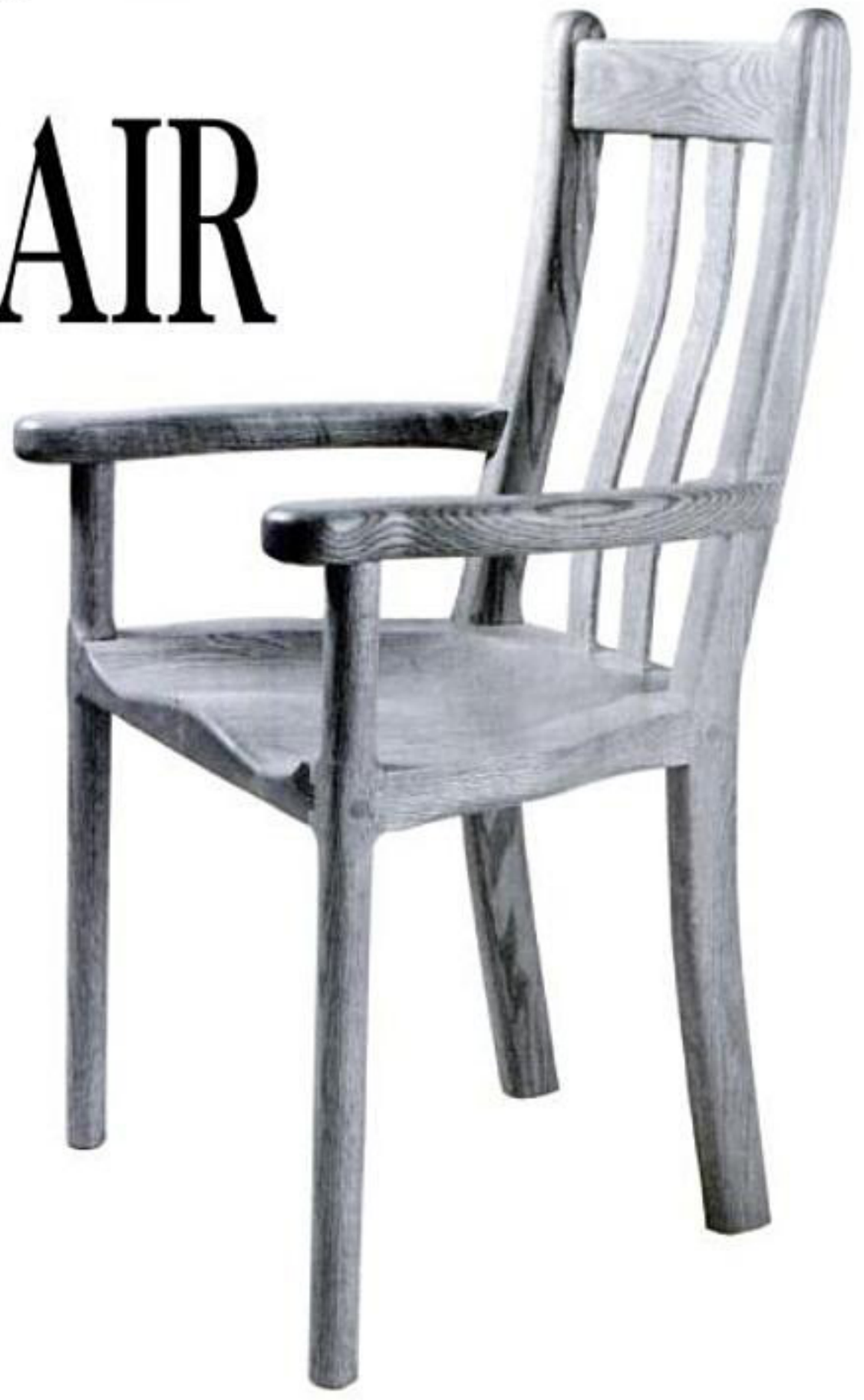
Rails and runners can be made as an assembly and fitted in the carcase after the carcase is glued up. This approach can make glue-up a lot easier. In very fine work, rails and runners are often joined as a frame and grooved to hold loose horizontal panels. (A back rail is added when this is done.) These "dust panels" protect the contents of the drawers from dust and debris. English furniture makers sometimes use aromatic cedar panels to moth-proof a chest of drawers. You can install this frame-and-dust-panel as a unit when the carcase goes together, or you can assemble them piece by piece inside the glued-up carcase from the back. ▲

Roger Holmes studied furniture making with Alan Peters in England. He is a contributing editor of AW *and has written about planing, box-making, hinges, sharpening and edge joining in prior issues.*

OAK ARMCHAIR

Wrap-Around Dado Joints Make It Easier to Build Than You Might Think

BY DAVID DONNELLY



Building your first chair can be an exhilarating experience. It's quite a change from casework and cabinet making. Unfortunately, many woodworkers shy away from making chairs because the joinery is rarely at right angles. If you're one of those people, here's a chair that may change your mind. It may look complicated, but the joinery is all at 90°. You cut the joints before you shape the members while the wood is still square. It's really quite simple. Of course, you don't have to tell anyone how simple it was to build.

This chair has several unique features. (See Fig. 1.) The seat-to-leg joint is a wrap-around dado-rabbet joint, a variation on a joint designed by California furniture maker Sam Maloof. Unlike most chairs with solid seats, the front and back legs continue uninterrupted above the seat to become the arm supports and back. The front legs are turned on a lathe, and the seat is sculpted and deeply contoured for comfort. The splats are also contoured to conform to the shape of the human back for good lower-back support. There's no need for stretchers or seat rails because the arms serve the function of stretchers.

Sculpting the Seat

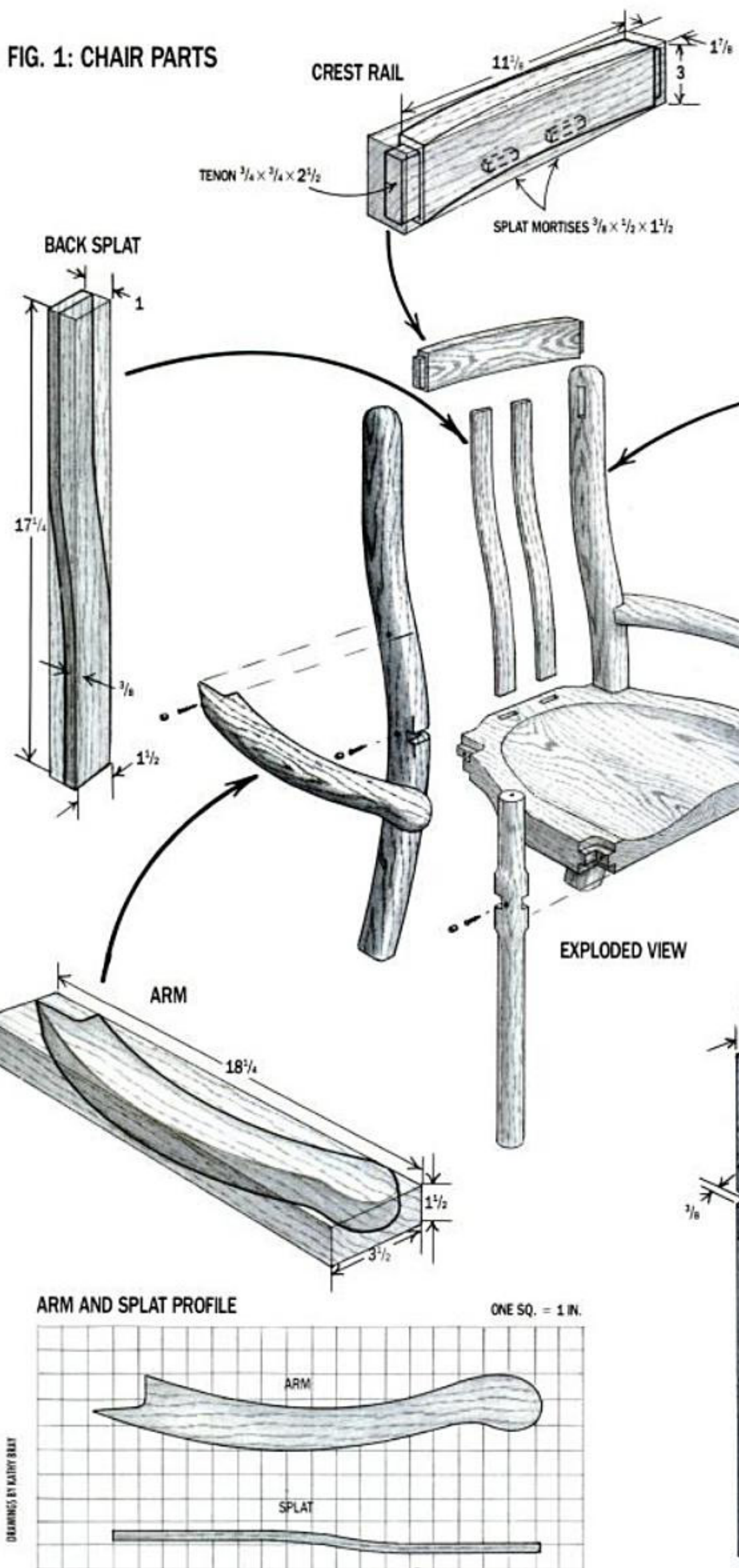
Begin by shaping the seat. Traditionally, a seat of this kind would be glued up and hollowed out with a scorp or an inshave. I decided to use a more modern method pioneered by Sam Maloof. I contoured the four boards that make up the seat on a bandsaw *before* gluing them together. After gluing them up, I smoothed up the contours with a sander. This method of shaping wood on the bandsaw is a bit unusual, but it will reduce your overall labor and result in a deeper seat. Here's how it works. (See Fig. 3.)

Start with four pieces, each 1⅛ in. x 4¼ in. x 16 in. (If you can't find 8/4 wood that will surface to 1⅛ in. thick, 1½ in. will suffice.) Put the pieces together in the order you want them for glue-up. Next, using the seat outline pattern in Fig. 4, make a template and draw the outline onto the top of the seat. On each of the four pieces, draw out the waste lines using the template patterns shown in Fig. 4.

Before you saw these curved profiles, mark and bore holes for the ⅜-in. dia. dowels that will reinforce the edge joints. (See Fig. 3.) Make sure to bore these holes in the solid portion of each piece, not in the areas that will be sculpted out. To reduce the stress created by

PHOTO BY CHUCK SHEALY

FIG. 1: CHAIR PARTS



ARM AND SPLAT PROFILE

ONE SQ. = 1 IN.

DRAWINGS BY KATHY BRAY

gluing dowels across the grain, I use short dowels about 1 in. long. Biscuits would also be satisfactory. With the dowel holes drilled, you're ready to sculpt the pieces on the bandsaw.

Tilt the bandsaw table to the angle necessary to cut the contour on the seat pieces. You'll need to tilt the table a few times per piece to account for the constantly changing planes of the surface. You'll find it difficult to cut exactly to the layout lines. Try to get close—the more wood you remove on the bandsaw, the less you'll have to sand off later. Make small cuts, and stop from time to time to check the layout line on the bottom of the piece as well. If you aren't comfortable bandsawing the seat in this way, shape it by hand after glue-up with a scorp or inshave.

After bandsawing the pieces for the seat, glue them together. The result is hardly pretty (see photo, page 46), but you've already removed 90 percent of the waste for contouring. Now it's just a matter of smoothing it.

I recommend a disc sander for shaping the seat. Start with an extremely coarse 24-grit or 36-grit abrasive. Hold the sander at an angle and sculpt the waste away. Sandpaper this coarse removes wood very rapidly; it does *not* make wood smooth. However, the coarse grit is exactly what you need to clean up the bandsaw cuts and round everything out. If you want to know how you're doing, give the seat the fanny test: Sit on it and see how it feels. After the rough edges are off, proceed to a 100-grit abrasive, by which time the seat should be quite smooth. Finish sanding by hand with finer-grit paper.

Joining the Seat and Legs

Now to tackle the wrap-around dado-rabbet joint that connects the seat and legs. Start with the seat while the sides are still square. Mark out and bandsaw notches in the front and back seat corners *before* cutting the outer seat outline. Rout the rabbets in the seat with a ⅜-in. rabbeting bit as shown in Fig. 2.

Now for the legs. The rabbeting bit leaves a rounded corner on the inside of each seat notch. The strength of this joint requires a snug fit between the seat and the leg, so you'll need to rout a round-over on the inner corner of each leg where it fits into the notch in the seat. (See Fig. 2.) My ⅜-in. rabbeting bit cuts a radius of ⅜ in., so I rounded the legs with a ⅜-in. radius round-over bit (available from Cascade Tools, Inc., Box 3110, Bellingham, WA 98227, 800-235-0272). You can simply rout this round-over along the full length of each leg. On the two front legs, rout the round-over on both the inner corner and the outer corner as shown in Fig. 1.

Next, mark out the ¾-in. deep x ¾-in. wide dadoes on the inner corners of the legs. (See Fig. 1.) I cut the dadoes with a dado blade on my tablesaw with the miter gauge supporting the stock.

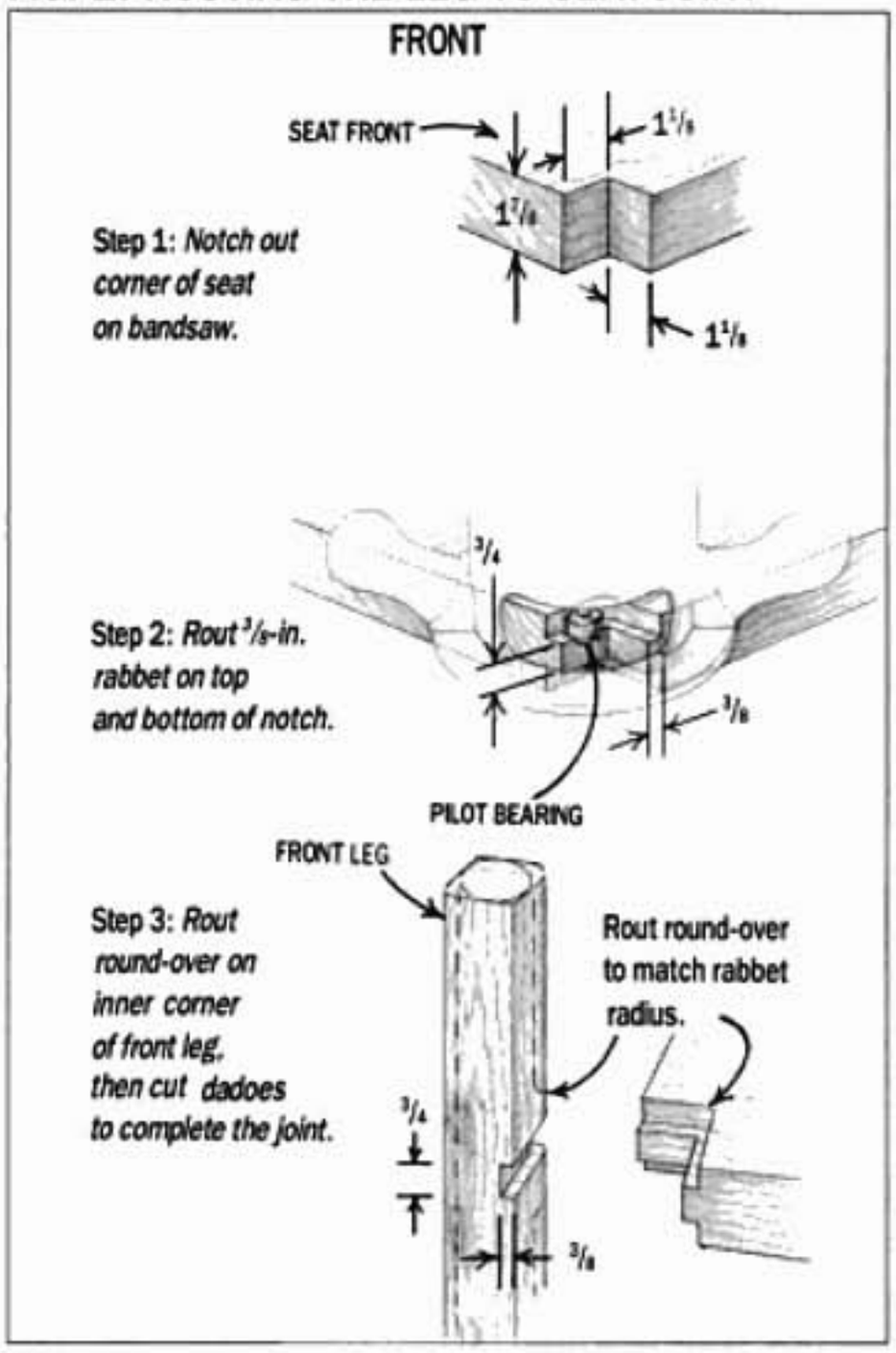
Once you've cut the dadoes, assemble the joints to see how they fit. If they don't fit tight, round the corners of the leg with a carving gouge or file until you have a perfect fit.

Shaping the Back Legs

Before bandsawing out the shape of the back legs, mark and chisel out the mortises for the crest rail while the wood is still square. (See Fig. 1 for dimensions.)

Now you're ready to shape the back legs on the bandsaw. To keep the joints square, don't cut any closer than 1 in. above and below the dadoes. After sawing, sand the sides of the back legs smooth to

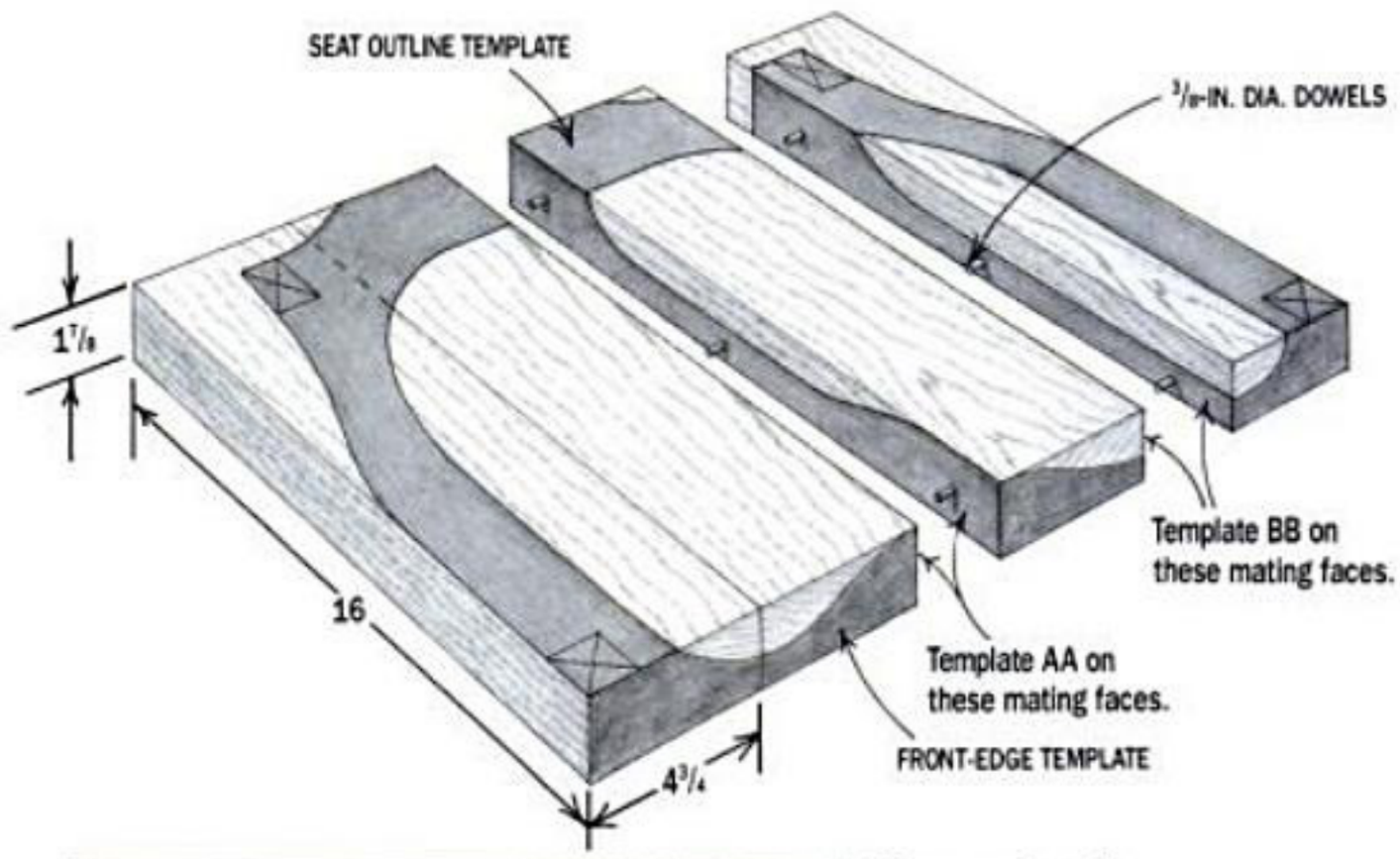
FIG. 2: ROUTING THE LEG TO SEAT JOINT

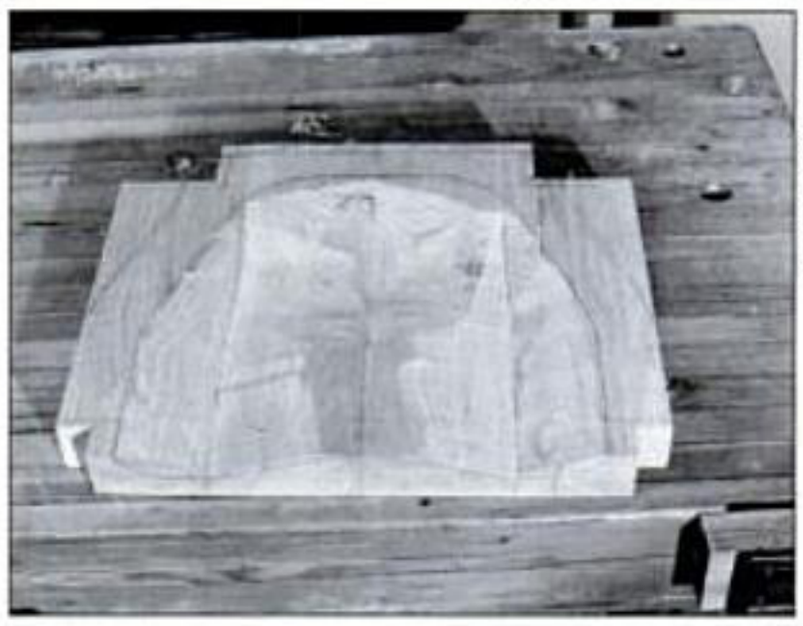


PHOTOS BY DAVID DONNELLY

To reduce the time it takes to carve a contoured seat, bandsaw the contours in the seat-blank boards before you glue the seat blank together. Mark the contour curves on both sides of the board and tilt the table so the blade cuts to both lines—top and bottom. Stop the saw and reset the table when the angle of the contour changes. Don't worry if the cuts are rough. You'll fine-tune the shape with a disk sander.

FIG. 3: SCULPTING THE SEAT





After you shape the boards on the bandsaw, glue them together with dowels or biscuits. The seat will look rough but nothing that sanding won't fix.

remove the bandsaw marks. I did this with a belt sander. Round over the edges of the back legs with a ½-in. round-over bit. Stop the round-over 1 in. above and below the dado. (See Fig. 1.) You'll blend these areas together later with a file.

Turning the Front Legs

Now on to the front legs. Dry fit the legs into the seat joints and mark the legs where they meet the seat. Leave the legs square between these marks. Mount each front leg on your lathe and turn it round above and below the seat joint.

Completing the Back

The crest rail is curved as shown in Fig. 1. While the wood is still square, cut tenons on the ends of the crest rail to fit into the mortises on the top of the back legs. Offset your tenons toward the front of the crest rail.

The ends of the back splats fit into mortises on the crest rail and seat. Lay out the curve on the crest-rail blank and mark out the splat mortises on the bottom of the crest rail as shown in Fig. 1. Next, mark out corresponding mortises on the back edge of the seat blank. Cut out the mortises—I did this with a chisel.

After completing the mortises, saw the crest rail to shape on the bandsaw, maintaining an even thickness of 1⅛ in. along the length of the curve. Round over the top and bottom edges with a ⅛-in. round-over bit. Be careful not to rout into the mortises for the splats.

The splats may appear to be bent, but I cut them to shape on the bandsaw. Lay out the curve for the splats on the wood, and bandsaw the splats to shape. Round the edges with a ¼-in. round-over bit, but leave the ends square where the splats fit into the mortises.

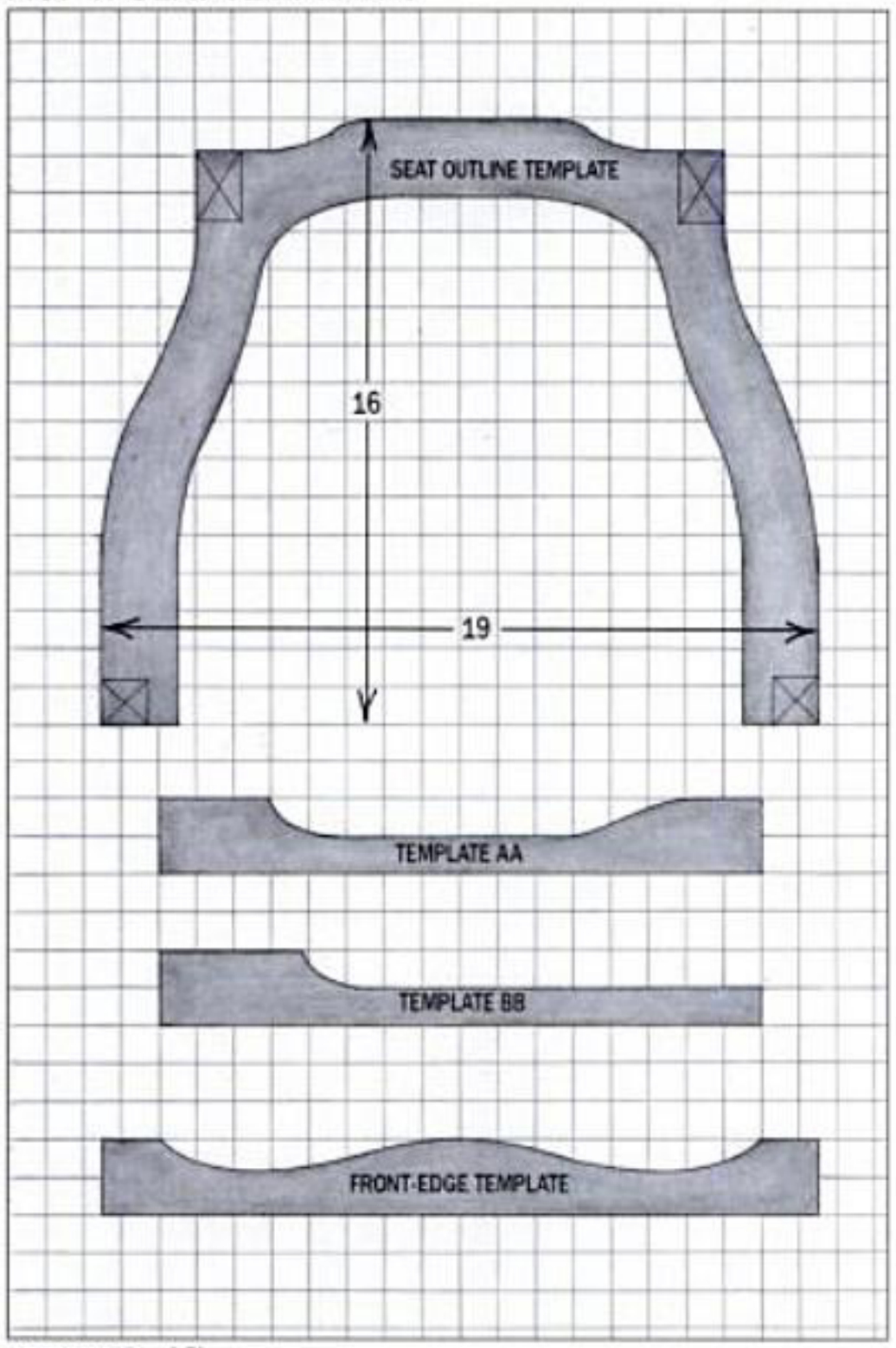
Now that most of the chair parts are finished, try a test assembly. Check the outline you drew on the top of the seat to be sure it lines up with the outside edge of the back legs. If not, redraw the seat outline. Disassemble the chair and bandsaw the seat to shape.

Shaping With a Rasp

To continue the rounded theme of the chair, round over the bottom edges of the seat with a rasp for a gradual curve. Again, stay away from the joints.

Rasps are wonderful tools when used properly. I've found that the #49 and #50 cabinetmaker's rasps are the best ones for cutting smoothly and reliably. Smaller riffler rasps and files are good for getting into the tight areas and blending the joinery together. (Rasps and files are available from Woodcraft Supply,

FIG. 4: SEAT TEMPLATES



210 Wood County Industrial Park, P.O. Box 1686, Parkersburg, WV 26102, 800-225-1153).

Assembling the Chair

With every piece except the arms cut to size, it's time to glue up the chair. The rest of the work that remains—making the arms and fine-tuning the joinery—can be done only after the chair is assembled.

Glue and assemble the legs, seat and crest rail. There's no need to glue the splats in their mortises—they'll stay put without glue.

Clamps are especially important on the seat joinery because the structural soundness depends on these joints being tight. Be sure all four legs are on the ground when you glue it up or the chair won't sit flat. If it rocks, check that the legs are square to the seat. Adjust the clamps to square things up. You can also run a few clamps from the seat to your benchtop to force the chair to sit flat while the glue dries.

Making and Fitting the Arms

Fit the arms to the chair after the rest of the chair is assembled. You'll need to do a bit of eyeballing here to get a good fit. The measurements provided for the arm are only *rough* sizes. Cut out the arm blank as shown in Fig. 1. On a bandsaw, notch the back end of the arm to fit the curve of the back leg, and with chisels and gouges, bevel the underside of this notch to fit against the back leg when you hold the arm level.

When the back of the arm fits the leg, round the upper and lower edges of the arms with a ½-in. roundover bit. Don't rout the area around the joint (at the back of each arm).

Attach the arms by screwing the front ends to the front legs and the back ends to the back legs. I used 3-in. drywall screws in front and 2-in. screws in back. The screws will be covered with ½-in. oak plugs, so drill pilot holes for the screws and counterbore for the plugs before screwing.

Also, for additional support at the leg-to-seat joints, add 3-in. screws to the joints on the sides of the chair legs (one screw per leg, see Fig. 1). Plug these screw holes like you did those on the arm rests.

Rasping and Sanding Smooth

Okay, your chair is finally together. Now you're ready to fine-tune the joinery with rasps, rifflers, files, and sandpaper.

Start at the back of the arms where they meet the back legs. Because of the irregular shapes involved, this requires hand shaping with a file or coarse sandpaper. File and sand these joints to make a smooth transition between the back legs and arms. Watch your grain direction as you file to avoid tearing the fibers.

The front and back legs should flow smoothly into the seat. File or sand any hard corners or edges on the leg joints that you didn't round with the router or on the lathe. At the points where the splats enter their mortises, round off any extra square corners that may be exposed.

Sand the seat all the way around on the edges—front, sides, and back. A palm sander should do the trick. Pay particular attention to the sculpted look of the joinery. The legs and seat should blend smoothly at every corner.

Finishing the Chair

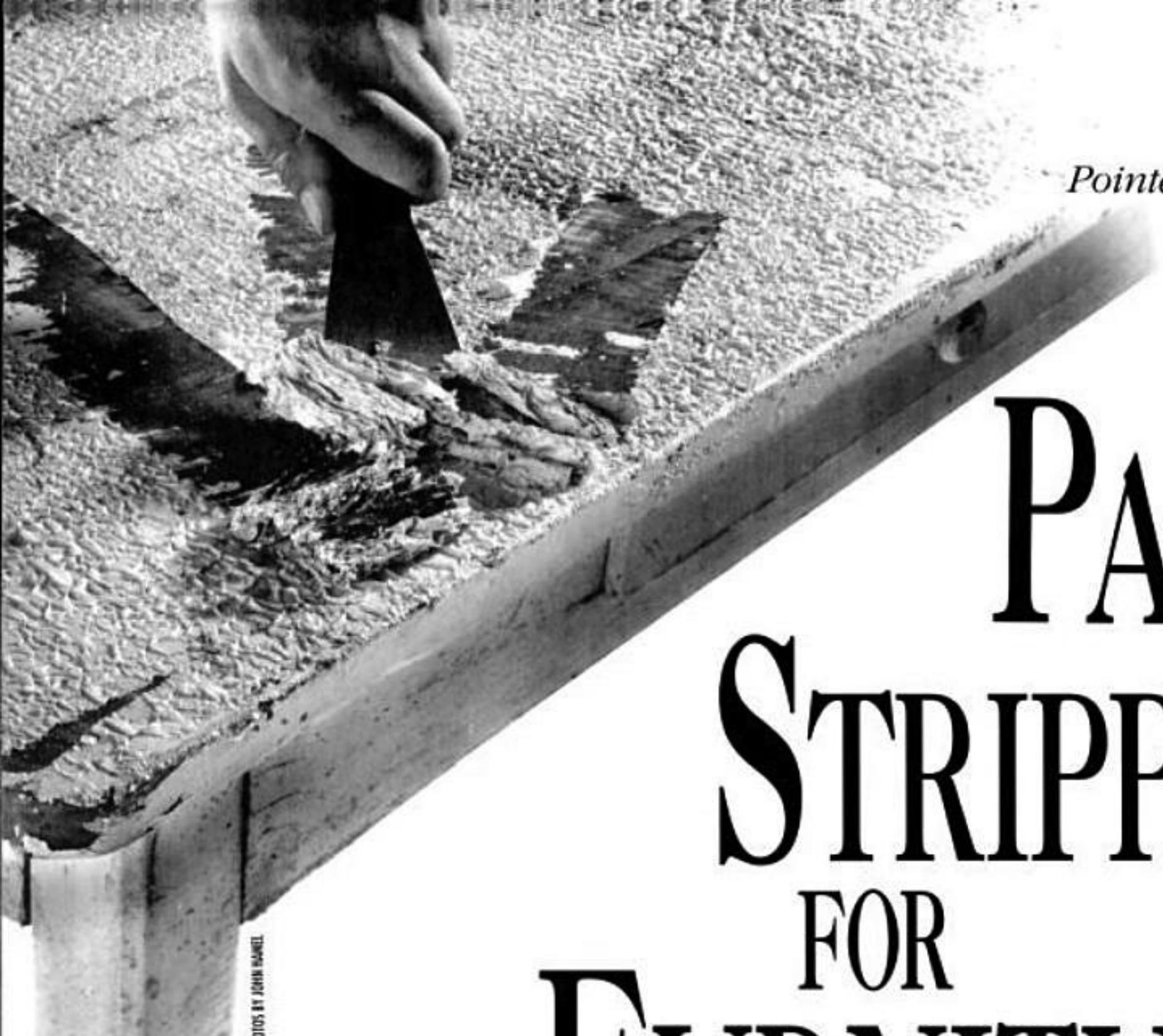
Before applying a finish, your chair needs to be sanded smooth. Sand all the way down to 220-grit. Next, wet the wood lightly with a damp sponge to raise the fibers, and after it dries, sand the fibers off.

Each species of wood has unique qualities that affect how it should be finished. Because oak is so porous, I always fill the pores with a paste filler before I put on the final finish. Paste filler mixes very nicely with oil-based stain, so I usually mix the paste filler with a little stain to fill and stain in one step. (See *AW*, #13 for more on paste filler.)

To finish my chair, I used a 50-50 mixture of tung oil and polyurethane. I mixed the two together in equal proportions and wiped on three coats by hand, letting the finish dry between coats. Rubbing it in and wiping it off creates thin layers that do not drip or run. Since chairs take a lot of abuse, I believe the polyurethane is necessary for its added hardness.

I made four of these chairs (all armchairs) and use them around my breakfast table. I hope they bring you as much pleasure as they've brought me. ▲

David Donnelly is a teleproductions manager at Boise State University. He also teaches woodworking to adults in the Boise Schools Community Education Program.



Pointers from a Pro for Taking It All Off

PAINT STRIPPERS FOR FURNITURE

BY BOB FLEXNER

Refinishing furniture means stripping off the old finish and starting from scratch. Unfortunately, stripping isn't much fun. I don't know a way to eliminate the drudgery, but stripping will be a lot easier if you understand how different strippers work and learn a few tricks and precautions about how to use them. That's what this article's all about.

Why use chemical strippers in the first place? Mechanical paint-removal methods such as sanding, scraping or heating with a heat gun are effective for removing paint from house siding or interior woodwork, but these methods are generally too harsh for furniture.

How Strippers Work

Paint strippers are composed of a solvent or combination of solvents strong enough to penetrate a paint or finish film. They act on that film in one of three ways, depending on how the particular solvents in the stripper react with the film being stripped. They either *dissolve* the film into a gunk that can be wiped off; they *swell* the film so it blisters and can be scraped off; or they *break the bond* of the film to the wood so the film lifts off in sheets when you scrape it with a putty knife. Generally speaking, shellac and lacquer dissolve, varnish and enamel paint blister, latex paint dissolves *and* blisters, and polyurethane and catalyzed lacquer lift off in sheets.

Until recently, almost any off-the-shelf stripper would remove nearly every paint and finish you'd find on old furniture and woodwork. This all changed with the development of more solvent-resistant paints and finishes during the last 30 years, along with the recent introduction of safer-to-use (but less-powerful) solvents in paint strippers. Now it's much more common to buy a stripper at the paint store that won't remove the paint or finish on your furniture. It's becoming increasingly necessary to understand the differences between paint strippers to use them successfully.

With the information provided here, you'll know what you can expect from every paint stripper available simply by reading the ingredients on the can.

The Solvent's the Key

There are four solvents, or groups of solvents, that are commonly used in strippers: 1. Methylene chloride 2. A mixture of acetone, toluene, and methanol (ATM) 3. N-methyl pyrrolidone (NMP) and 4. Dibasic esters (DBE). You'll find one or more of these solvents listed somewhere on every container of paint stripper.

Methylene Chloride-Based Strippers—Methylene chloride has been the primary active ingredient used in most paint and varnish removers for the past three or four decades. It's the most effective stripping solvent available to the general public. Unfortunately, methylene chloride is also a suspected carcinogen, and exposure may trigger heart attacks in people with existing heart conditions. (See sidebar on safety, page 53.)

You can buy methylene chloride-based strippers in liquid or semi-paste consistency. The consistency of the stripper is important to consider if you're working on vertical surfaces—liquid will run off, semi-paste will cling. The consistency has very little to do with the strength of the stripper.

The strength of methylene chloride-based strippers primarily depends on the formulation. There are three classes of formula strength. All three contain methanol (methyl or "wood" alcohol) as an "activator" to increase the effectiveness of the methylene chloride.

The weakest of the three formula classes dilutes the methylene chloride/methanol combination with two other solvents—acetone and toluene—to reduce the cost. The middle-strength formula class relies on the methylene chloride/methanol combination alone. The third, and strongest, formula class contains an alkali or an acid to increase the strength of the stripper. Each formulation has advantages and disadvantages.

The most common strippers are those in the middle-strength formula class: combinations of methylene chloride and methanol. (Other alcohols may also be added.) These strippers are strong enough to rapidly remove all but the most solvent-resistant paints and finishes such as epoxy and polyester coatings. These strippers are also non-flammable. The primary disadvantages of this formula class of stripper are its high cost (methylene chloride is a relatively expensive solvent) and the health risks associated with all methylene chloride-based strippers.

The strongest class of methylene chloride-based strippers are alkali-fortified or acid-fortified. Adding an alkali or an acid increases the strength of the stripper. The alkali is usually ammonium hydroxide (common ammonia), and it's usually, but not always, listed on the container. The acid is usually oxalic acid. Because acid is not very stable in the mixture, acid-fortified strippers are sold only to commercial stripping shops.

Alkali-fortified strippers are available in paint stores and boat and auto-body supply stores. They are often sold as "marine" strippers. The advantage of these strippers is their increased effectiveness on exceptionally tough coatings such as epoxy, polyester, catalyzed lacquer, and baked-on boat and car finishes. The drawbacks are their high price, the health hazards associated with methylene chloride, and a tendency to stain hardwoods such as oak, mahogany, cherry, and walnut. The staining is cause by the ammonia, which reacts with the tannic acid naturally contained in these woods. (See sidebar on solutions to common stripper problems, page 52.)

The third, and weakest, class of methylene chloride-based strippers contains methylene chloride and methanol diluted with acetone and toluene (toluol).

STRONG
Methylene chloride, acetone, toluene and methanol

PHOTOS BY JAMES D. BIGGS UNLESS NOTED

STRONGER
Methylene chloride and methanol

The most powerful strippers you can buy contain methylene chloride, a potent and controversial solvent. The strippers shown here all contain methylene chloride. There are three formula strengths, all of which are quite effective. The strongest of all are those that contain methylene chloride and an alkali (ammonium hydroxide).

STRONGEST
Alkali-fortified methylene chloride and methanol

Sometimes methyl ethyl ketone (MEK) is substituted for the acetone, and xylene (xylol) for the toluene. The addition of these cheaper solvents lowers the cost, which is a plus. However, it also reduces the strength of the stripper, and it introduces potential air pollutants and flammability. Though weaker than simple methylene chloride/methanol blends, this class of paint stripper is still strong enough to remove most old paints and finishes used on furniture before the 1960s.

The solvents in both liquid and semi-paste strippers evaporate very rapidly, so paraffin wax is usually added to retard the evaporation. The wax operates by rising to the top of the stripper and forming a skin that holds the solvents in. Every time you disturb this wax skin you allow the release of some of the solvents. After stripping, the wax residue must be removed from the wood by washing it off with a solvent such as paint thinner, nap-

ATM strippers do not contain methylene chloride. The solvents are acetone, toluene and methanol (ATM), (the basic ingredients in lacquer thinner). These solvents are considered to be less hazardous than methylene chloride.

ATM refinishers contain the same solvents as ATM strippers, but they're thinner in body because they don't contain any wax or thickeners. They soften the finish so you can scrub it off with steel wool.

tha, etc. Some strippers are made to be water-washable by the addition of a detergent to the formula.

All methylene chloride-based strippers work well. However, because of the health risks associated with methylene chloride, manufacturers have developed paint strippers based on some alternative solvents.

ATM-Based Strippers and "Refinishers"—The solvents in this type of stripper are acetone, toluene and methanol (ATM). These solvents are three of the basic ingredients in lacquer thinner.

There are two types of ATM-based product. One type contains wax to retard evaporation, and thickeners to make it a semi-paste. It's sold as a stripper and used in the same way as the methylene chloride-based strippers. The other type is a thinner formulation that contains neither wax nor thickeners and is sold as "refinisher."

ATM-based "strippers" (formulas containing wax or thickeners) work quite well on almost all old paints and finishes. They perform as well, in fact, as many of the methylene chloride-based strippers. ATM-based strippers are effective because the wax holds the solvents in contact with the coating long enough for them to penetrate. Their advantages are that they are cheap and perform well without the health risks of methylene chloride. Their disadvantages are that they're highly flammable, and some brands contain an alkali that will stain some hardwoods.

Because ATM-based "refinishers" don't contain any wax, the solvents evaporate before they can really penetrate and blister the finish. This makes them relatively ineffective for removing varnish, paint and any of the tough new finishes. ATM-based refinishers work well for removing lacquer and shellac, however. The solvents soften the finish enough to be scrubbed off the wood with steel wool. (See A Tale of Two Finishes, *AW*, #11 November/December, 1989 for the reasons shellac and lacquer respond differently to strippers than varnish does.) Because refinishers leave no wax residue on the wood to interfere with refinishing, there's no need to wash the wood with a solvent or water after stripping.

The vapors of all three ATM solvents—acetone, toluene, and methanol—are toxic in high concentrations. Toxic fumes in concentrated amounts can impair your central nervous system, cause illness and, in extreme cases, cause death. You should take the same safety precautions when using ATM-based strippers and refinishers as you do with methylene chloride-based strippers. (See sidebar on safety, page 53.)

NMP and DBE-Based Strippers—N-methyl pyrrolidone (NMP) and dibasic esters (DBE) are not new solvents, but they're new to furniture strippers. Both solvents are being tried as "safe" replacements for methylene chloride, acetone, toluene, and methanol in strippers because they're less toxic and low in flammability. They also evaporate slowly, which means there's no need for wax and the extra washing step to remove it. That's where the similarity between the two strippers ends.

NMP-based strippers perform much like methylene chloride-based and ATM-based strippers. They're a little slower than these strippers and a little weaker, but on all but the toughest coatings you won't notice much difference. The reason NMP hasn't been used in furniture strippers until now is its cost. NMP-based strippers cost about twice as much as methylene chloride-based strippers. It has taken an increased awareness of the potential dangers of working with methylene chloride and the ATM solvents to make people willing to pay the extra amount to get a safer stripper.

DBE is also a safer solvent than methylene chloride or ATM, and it's not as expensive as NMP. However, it penetrates films more slowly than NMP and takes much longer to dissolve or blister finish and paint. The extra time is especially noticeable on shellac and lacquer. Depending on the brand, it takes anywhere from an hour to overnight to thoroughly penetrate and dissolve lacquer and shellac. The instructions promised faster results.

The biggest problem with DBE-based strippers is not the time they take to work. Instead, it's the length of time that the water in these strippers is in contact with the wood. In my experience with DBE-based strippers, the water almost always roughens the surface of the wood

DBE

NMP

The new crop of "safe strippers" contains either NMP or DBE—two solvents considered relatively safe to use. While not as fast as the other types of stripper, they offer a lower-risk alternative to consumers who want to minimize their exposure to toxic solvents.

enough to require fairly heavy sanding before refinishing. Worse, the water is in contact with the wood for so long that it can warp thin parts and blister veneer that has been glued down with water-based glue. (All old furniture was glued with water-based animal-hide glue.)

The problem with water is made still worse if you follow manufacturers' instructions, which direct you to scrub the dissolved or blistered film with more water and a coarse pad or strong detergent. (Steel wool will cause rust spotting in the wood.) The hard scrubbing further increases the damage to the wood.

New technologies often take awhile to be perfected and understood. In my opinion, the current generation of DBE-based strippers leaves a lot to be desired. In order to make DBE strippers into a viable alternative, something will have to be done to reduce the time the wood is in contact with water.

Lye—Lye (sodium hydroxide or caustic soda) is probably the oldest chemical paint stripper. It's also the most effective, most dangerous to use, and most damaging to the wood.

Lye is often used by commercial strippers. They dip furniture into a vat of a heated solution of lye and water. The lye dissolves all the paint or finish, but it also dissolves most of the glue that holds the piece together. If the furniture is not removed from the lye quickly enough, the lye begins to turn the surface of the wood to pulp. A great deal of furniture has been ruined when dipped into a lye bath, and strip shops have gotten a bad reputation because of their often indiscriminant use of lye for stripping.

Lye is not all bad, however. It can be used sparingly to dissolve stubborn paint out of pores without doing too much damage to the wood. It can effectively strip paint from metal objects (except aluminum) without damaging the metal. Also, it's a cheap, effective stripper for large surfaces and for outdoor siding, masonry, concrete, and on

STRIPPING TIPS:

11-POINT PLAN FOR SUCCESS

Stripping is easier if you follow these tips. The following information applies to all chemical strippers except "refinishers" and lye.

1. Read the instructions on the container. Following directions will increase your chance of success.

2. Work outdoors in the shade or in a room where you have arranged cross ventilation. Don't work near an open flame or source of sparks if you're using a flammable stripper.

3. Remove hardware and difficult-to-get-to wood parts that can be disassembled easily. If the hardware requires stripping, soak it in a can filled with stripper.

4. Wear a long-sleeved shirt, chemical-resistant gloves (butyl or neoprene) and safety goggles.

5. Shake the container of stripper. Cover it with a cloth and open the cap slowly to allow for a gradual release of pressure. Pour the stripper into a wide-mouth jar or can.

6. Brush the stripper onto the wood, preferably in one direction, with an old or inexpensive paint brush. Brushing in one direction helps lay on a thick coat and reduce solvent evaporation. Some synthetic-bristle brushes will dissolve in methylene chloride-based strippers.

7. Allow the stripper time to work on the paint or finish. Test the film now and then to see if it can be lifted from the wood. Add more stripper if the original has mostly evaporated. All strippers will lift many layers of paint at one time if kept wet and allowed time to penetrate.

8. Remove the dissolved, blistered, or softened film in one of the following ways, depending on the situation.

- Scrape the film off flat surfaces into a bucket or cardboard box with a plastic scraper or a wide, dull putty knife. The putty knife should be clean and smooth, and have its corners rounded with a file so it won't scratch the wood.
- Soak up and wipe off dissolved film with paper towels.
- Soak up dissolved or blistered film into wood shavings (from a jointer or planer), and then brush them off with a stiff bristle brush.
- Break blistered or softened film loose from moldings, turnings and carvings with #1 steel wool or a fiber stripping pad.
- Pull a coarse string or rope around the recesses of turnings to work out blistered paint or finish.
- Pick the softened paint or finish out of cracks and recesses with sharpened sticks or dowel rods, which won't damage the wood the way sharp metal picks will.

9. Coat the wood with more stripper, and scrub out any paint or stain left in the wood pores with a soft brass-wire bristle brush. Scrub with the grain of the wood.

10. Wash the wood with paint thinner, naphtha, lacquer thinner or alcohol to remove wax residue left from strippers containing wax.

11. Let the solvent evaporate out of the stripping sludge, then dispose of it in the trash unless local laws forbid this. (The dried sludge is the same thing that was on the furniture before you stripped it. Sending dried paint sludge to the landfill is no more polluting then tossing the entire painted object into the landfill.)—*B.F.*

Break blistered or softened film loose from moldings, turnings and carvings with #1 steel wool or a fiber stripping pad.

Pull a coarse string or rope around the recesses of turnings to work out blistered paint or finish.

Scrub out any paint or stain that remains in the wood pores with a soft brass-wire bristle brush. Scrub with the grain of the wood.

PHOTOS BY JOHN HAWEL

STRIPPING FURNITURE:

PROBLEMS AND SOLUTIONS

PHOTO BY JOHN HAMEL

Basic instructions for using strippers are outlined in the sidebar, Stripping Tips, but if you've ever done any stripping, you know it's seldom this easy. Here are some of the most common problems and their solutions.

PROBLEM: The stripper doesn't work.

If the stripper you're using doesn't dissolve, blister, or break the bond between the finish and the wood, there are two possible explanations. 1. You're either not allowing enough time for the stripper to work or 2. You need to use a stronger stripper. (See accompanying article.)

First, allow more time for the stripper to work. If the temperature is below 65° F, any stripper will work slowly. (Chemical reactions in general are slower in cold weather.) If the temperature is above 85° F, the stripper may be evaporating before it has had time to work. Keep the surface wet with more coats of stripper or cover the surface with plastic wrap to prevent the stripper from evaporating. If you still have problems, try a stronger stripper. (See accompanying article.)

You may find that layers of paint and finish respond differently. Your stripper may remove three coats of paint, for example, but not have any effect on the coat below. If this happens, switch to a stronger stripper. If all else fails, use lye or remove the finish by sanding or scraping.

With clear finishes, it's sometimes difficult to tell when you've removed all of the finish. Don't be misled by the presence of stain in the wood. Stain can remain even though all the finish is off. When the finish is off and the wood is dry, there won't be any sheen or shiny places on the wood or in the pores. The wood will look and feel like raw wood, though it may not have the original color.

PROBLEM: You can't get the paint out of the pores.

Enamel paint doesn't dissolve—it swells and blisters. The same is often true for latex paint. In the pores of wood, the paint doesn't have any place to swell to. It softens, but it just sits there in the pores until something jars it loose. Therefore, you need to combine some mechanical force with the chemical action of the stripper to knock the softened paint out of the pores.

The best technique I've found is to scrub the stripper-wet wood in the direction of the grain with a soft brass-wire bristle brush available from most paint stores. Remove the gunk with rags or paper towels, which you may want to wet with more stripper. It's usually necessary to repeat this procedure several times.

You may find situations where this procedure doesn't work, especially on softer woods like pine and poplar. Try using a solution of lye before you resort to sanding.

If nothing you do will get all the paint out of the pores, you can try masking the paint with a stain, paste wood filler or a glaze applied between coats of finish. If the problem is severe, you may be forced to repaint.

PROBLEM: You can't get the stain out of the wood.

If there's a stain under the finish, you can strip the finish and still have color in the wood. There are several types of stain, and whether a stripper will remove the stain or not depends on how that particular stain is affected by the stripper. There are no strippers or refinishers that consistently remove all types of stain.

You don't have to remove the stain to restain or refinish. You can stay with the original color left in the wood or stain over it with any type of stain you want to change its shade or darken it. You can't lighten the color without removing most or all of the stain first.

Water-dye stains, the most common stains used on old furniture, can be partially removed by water and totally removed by chlorine-type wood bleach. Solvent-based dye stains will be partially removed by the same solvent they were originally dissolved in (try different solvents to see which one works) or by bleaching. Pigment stains act like thin paint lodged in the pores and can be removed with the procedure described above for paint.

PROBLEM: The stripper streaks and darkens the wood.

Lye and stripper that contains an alkali may darken the wood. This often shows up as ugly streaks. You can bleach out the dark stains the same way you bleach out dark water rings.

Dilute some oxalic-acid crystals (available at paint stores and pharmacies) in warm water. I usually make a saturated solution, though this degree of strength is not always needed. Brush the solution over the entire surface, not just over the stains. If you don't, the solution may create lighter spots in these areas, and you'll have to recoat the entire surface anyway to even the color. Let the oxalic acid dry. Wash the crystals off the wood with a hose or well-soaked sponge or cloth and wash the surface well with water. Add a mild alkali such as borax or a small amount of household ammonia to some clean water and wash again to neutralize the acid. Oxalic acid will seldom bleach the wood itself to any noticeable degree, but it will take out the stain. (See *AW*, #4 September/October, 1988 for more on bleaching wood).

PROBLEM: Stain won't take evenly after the wood has been stripped.

It could be that you didn't remove all the old finish. If so, continue stripping until all the finish is off the wood or out of the pores. Uneven stain penetration could also be caused by uneven density or swirling grain in the wood itself.

PROBLEM: The new finish won't dry or it peels after it's cured.

Many strippers contain wax and may cause these problems when you don't wash off the wax after stripping. Wash the wood thoroughly with a solvent, refolding and turning your wet cloth a number of times, lifting the wax off the wood instead of smearing it around. Mineral spirits and naphtha are the best solvents to use. Lacquer thinner and alcohol will also work.—*B.F.*

indoor plaster and soft-wood trim.

(WARNING: Lye causes severe chemical burns. Wear eye protection, gloves and protective clothing to shield yourself from splashes.) To make a lye stripper, dissolve about ¼ lb. of lye to a gallon of warm water. Don't use an aluminum or plastic container. Be sure to pour the lye into the water, not the other way around because the sudden chemical reaction may "boil over" and burn you. The lye and water mixture will get *hot* from the chemical reaction, so don't hold the container.

Brush the stripper onto the wood, using just enough to dissolve the finish but not damage the wood. After stripping the finish, you'll need to brush the wood with vinegar to neutralize the lye. If you don't neutralize the lye, it will continue its chemical activity and slowly destroy the wood and the new finish you apply.

Slaked lime (calcium hydroxide) is another stripper much like lye but safer because it's less caustic. Slaked lime is sold as Behlen's PDE Powder Paint Remover (available from Garrett Wade, 161 Ave. of the Americas, New York, NY 10013, 800-221-2942).

Which Stripper to Use?

So how do you choose from among all of these types of strippers? First, decide whether you're willing to accept the health risks of a methylene chloride-based stripper. If the answer is yes, choose the cheapest brand that will do the job. The weakest formula class—methylene chloride and methanol reduced with acetone or toluene—is the cheapest and strips most old paints or finishes.

Tougher finishes such as polyurethane will require stronger strippers made with only methylene chloride and methanol. The toughest coatings such as catalyzed lacquer and melamine finishes will require an alkali-fortified, methylene-chloride stripper—the strongest type of off-the-shelf stripper you can buy.

If you don't want to expose yourself to methylene chloride, go with an ATM-based stripper. While not quite as strong as the methylene-chloride strippers, ATM-based strippers will remove most common finishes.

If you want to limit your exposure to toxic solvents and are willing to pay more, your best choice is an NMP-based stripper. If you don't mind waiting longer for the stripper to work, and if the piece you're stripping won't be harmed by extended contact with water, you could choose a DBE-based stripper. Both NMP and DBE strippers are marketed as "safe strippers."

You should be able to remove any paint or finish with one of the solvent-based strippers mentioned in this article. The exception is milk paint. Milk paint has milk (casein) as the binder instead of varnish or latex. It was used fairly often in the 18th century and in rural areas of the U.S. in the 19th century. You can remove milk paint with lye or slaked lime (calcium hydroxide).

New strippers are constantly being developed. I've received word of new strippers in the works that contain solvent alternatives to methylene chloride. More on these new products in a future update. ▲

Bob Flexner is a professional furniture refinisher and finishing consultant in Oklahoma. He wrote about aniline dyes in AW, *#5, shellac and varnish in* AW, *#11 and stains in* AW, *#17. Flexner has also produced videotapes on furniture refinishing and furniture repair (available from Taunton Press, Box 5506-AW, Newtown, CT 06470.)*

SAFETY
AND THE POLITICS OF STRIPPERS

Methylene chloride—the active ingredient in many paint strippers—has become a controversial solvent. Evidence shows that it may cause cancer. It was already known that excessive exposure to methylene chloride could cause headaches, dizziness, impaired mental alertness, reduced physical coordination and even heart attacks in those with existing heart problems. (Methylene chloride metabolizes into carbon monoxide in the blood stream, causing the heart to pump harder to get enough oxygen around the body. **If you have a heart condition, don't use methylene chloride strippers.)**

When researchers in the mid-1980s induced cancer in mice and benign tumors in rats, methylene chloride was quickly bumped up to a class B2, "probable human carcinogen" by the Environmental Protection Agency (EPA). If methylene chloride could be clearly shown to cause cancer in humans, no one would object to its being regulated and possibly removed from the consumer market. Unfortunately, the evidence is not at all clear.

With such ambiguity, it's only natural that politics should enter the debate on whether or not methylene chloride should be regulated. Last February, I attended a conference on paint strippers organized by the EPA. Before the conference was an hour old, an employee of a major manufacturer of one of the alternative solvents asked, not so subtly, "When is the Consumer Products Safety Commission (CPSC) going to require that warnings on containers of methylene chloride-based strippers be made larger and clearer?" A spokesman for makers of methylene chloride-based strippers replied, "Consumers aren't so dumb. They know that warnings just mean the stuff works."

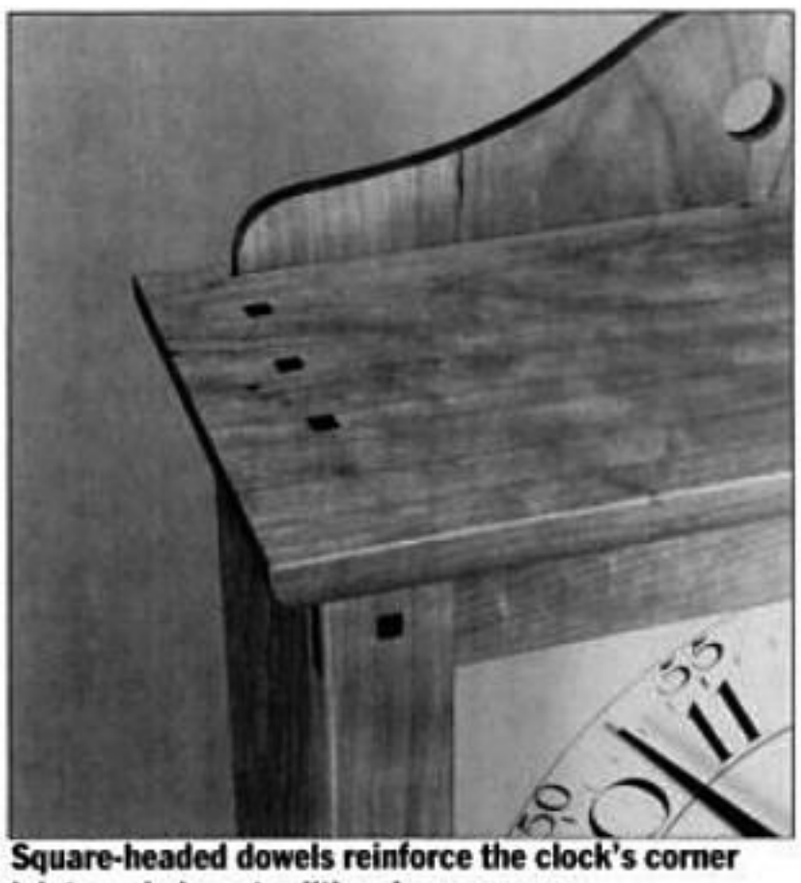
Thus began the debate, with the manufacturers of of methylene chloride-based strippers on one side, and manufacturers of alternative solvents and strippers on the other. The CPSC and EPA played neutral, but it's hard to believe that in our increasingly regulated society, they will be neutral for long. Sooner or later they will feel the pressure to "play it safe" and begin regulating the use of methylene chloride.

So how should you, the consumer, "play it safe" in the meantime? First, decide if you're willing to risk using methylene chloride, keeping in mind that the history of solvents demonstrates that the more we learn about them the more we discover problems with *all* of them. Second, you should limit exposure to the fumes of *any* solvent by working outside or in a well-ventilated room. "Well-ventilated" means arranging an air flow through the room with fans blowing air in one side and out the other. It means *cross ventilation*. Cross ventilation is more important, even, than wearing a respirator mask. Respirators have been shown to have very limited effectiveness against methylene chloride fumes. Though the use of a respirator mask is a good idea in combination with air flow, used alone, a mask can give you a false sense of safety. Cross ventilation is the only way to keep the concentrations of solvent vapors to a minimum.—*B.F.*

The design looks as fresh today as it did back in 1840—proof that the Shakers were correct in their belief that "beauty rests on utility."

PHOTOS BY JOHN HAMEL

Shaker Wall Clock



Square-headed dowels reinforce the clock's corner joints and give a traditional appearance.

BY W. CURTIS JOHNSON

A century and a half ago, Shaker furniture maker Isaac N. Youngs built six wall clocks. Three of them are in the collection at the Hancock Shaker Village near Pittsfield, Massachusetts. The design looks as fresh today as it did in 1840—proof that the Shakers were correct in their belief that "beauty rests on utility."

The clock in the photo is based on Youngs' design. While similar to the original, my clock is not an exact reproduction. I made my clock from cherry instead of pine, and I simplified the construction by standardizing the thickness and width of a few of the parts. If you want to make an exact reproduction, you can find measured drawings of Youngs' original clock in the book *Shop Drawings of Shaker Furniture and Woodenware, Vol. II*, by Ejner Handberg (1975, The Berkshire Traveller Press, Pine St., Stockbridge, MA 01262).

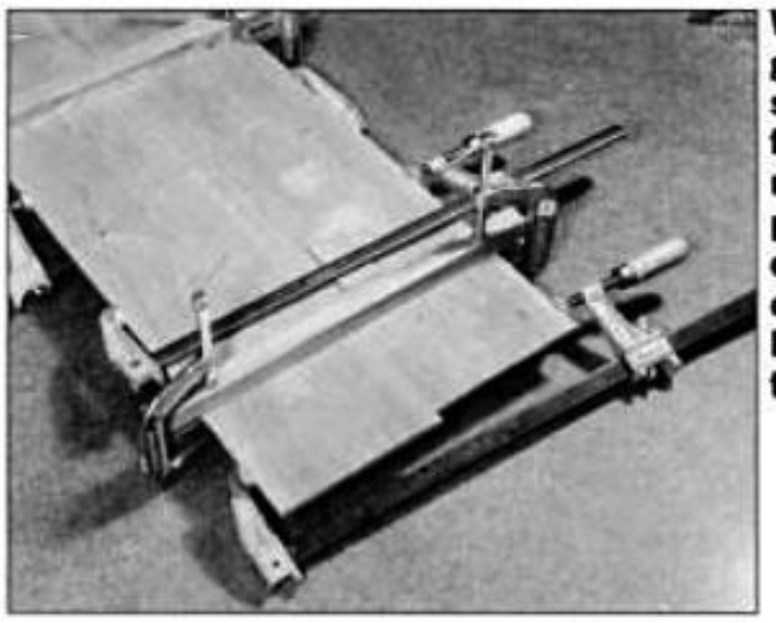
It's wise to purchase the clock movement, the dial and the case hardware before you begin building the clock case. (See Sources, page 57.) The case is designed to house either of two Mason and Sullivan clock movements. One movement strikes the hour and the half hour with a pleasant "bim-bam" sound. The other movement has Westminster chimes that strike the quarter hours as well. I prefer the gentler bim-bam chimes, which remind me only twice an hour that time is passing.

You also have a choice between two dials: one with Arabic numerals, or if you want a more faithful reproduction, a dial with Roman numerals.

Building the Clock Case

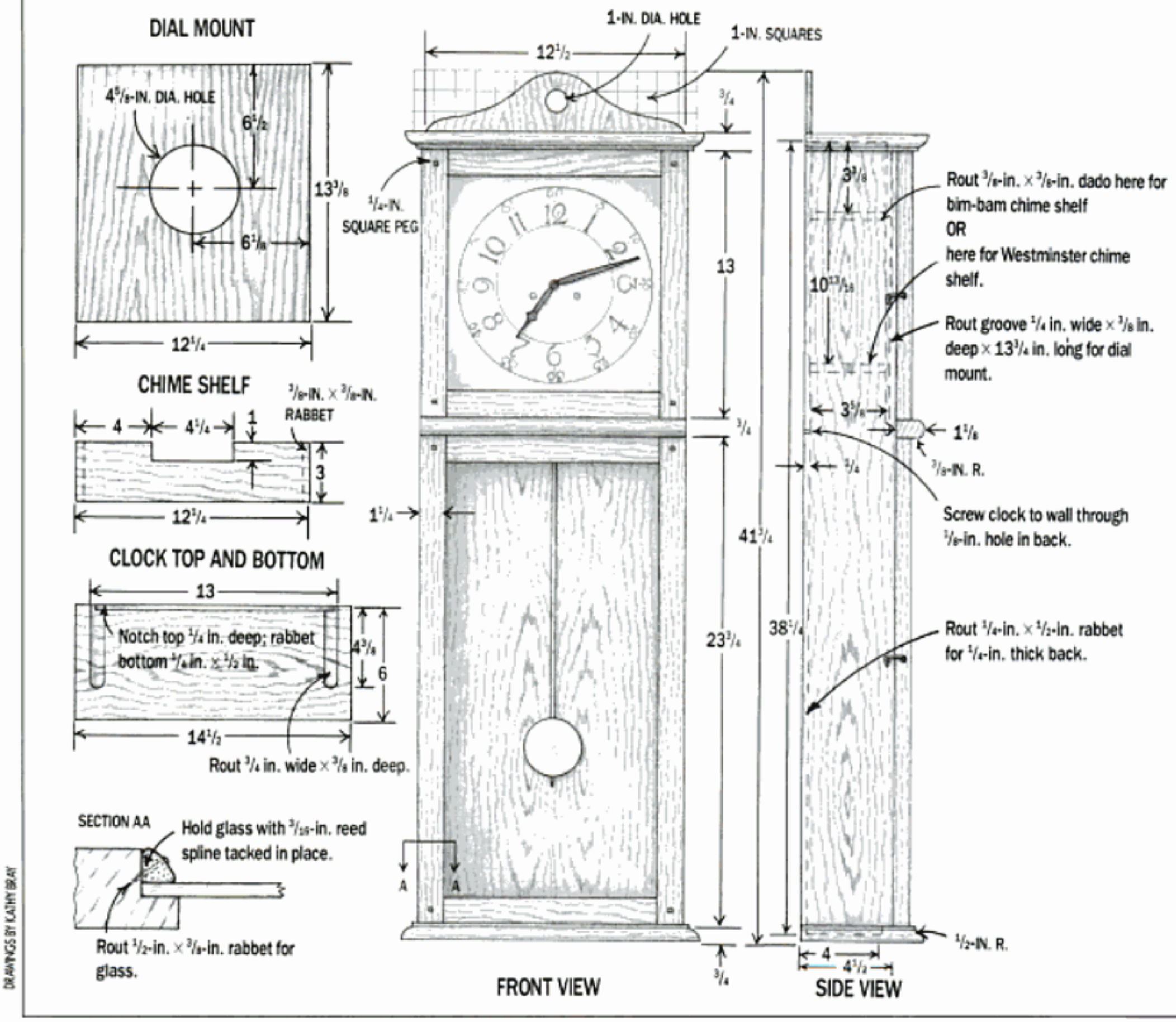
I began building the clock by making the ¼-in. thick back. (See Fig. 1.) I resawed a 7-in. wide piece of 4/4 stock and allowed the resawn boards to sit for a week before I planed them to final thickness. Resawn boards tend to cup. By waiting a week before planing, the boards are flattened *after* they've cupped. Next, I glued the two pieces edge to edge to form a book-matched panel.

Edge clamping such thin wood can cause the boards to buckle. You can prevent the buckling by clamping the boards between pairs of battens as shown in the photo. Position a pair of battens about 8 in. from either end and a third pair near the center. Waxing the battens with a candle will keep the glue from sticking. Slight cupping of



When edge gluing thin stock, prevent it from buckling under the pressure of clamps by clamping pairs of battens across the stock.

FIG. 1: SHAKER WALL CLOCK



This dowel former is designed to put grooves in regular dowels when the dowels are pounded through. It will also form square stock into round dowels. Here, a square head is left on the dowel for decoration.

the panel won't matter because it will flatten out when screwed to the case. Don't cut the back to size and shape until you fit it to the assembled clock case.

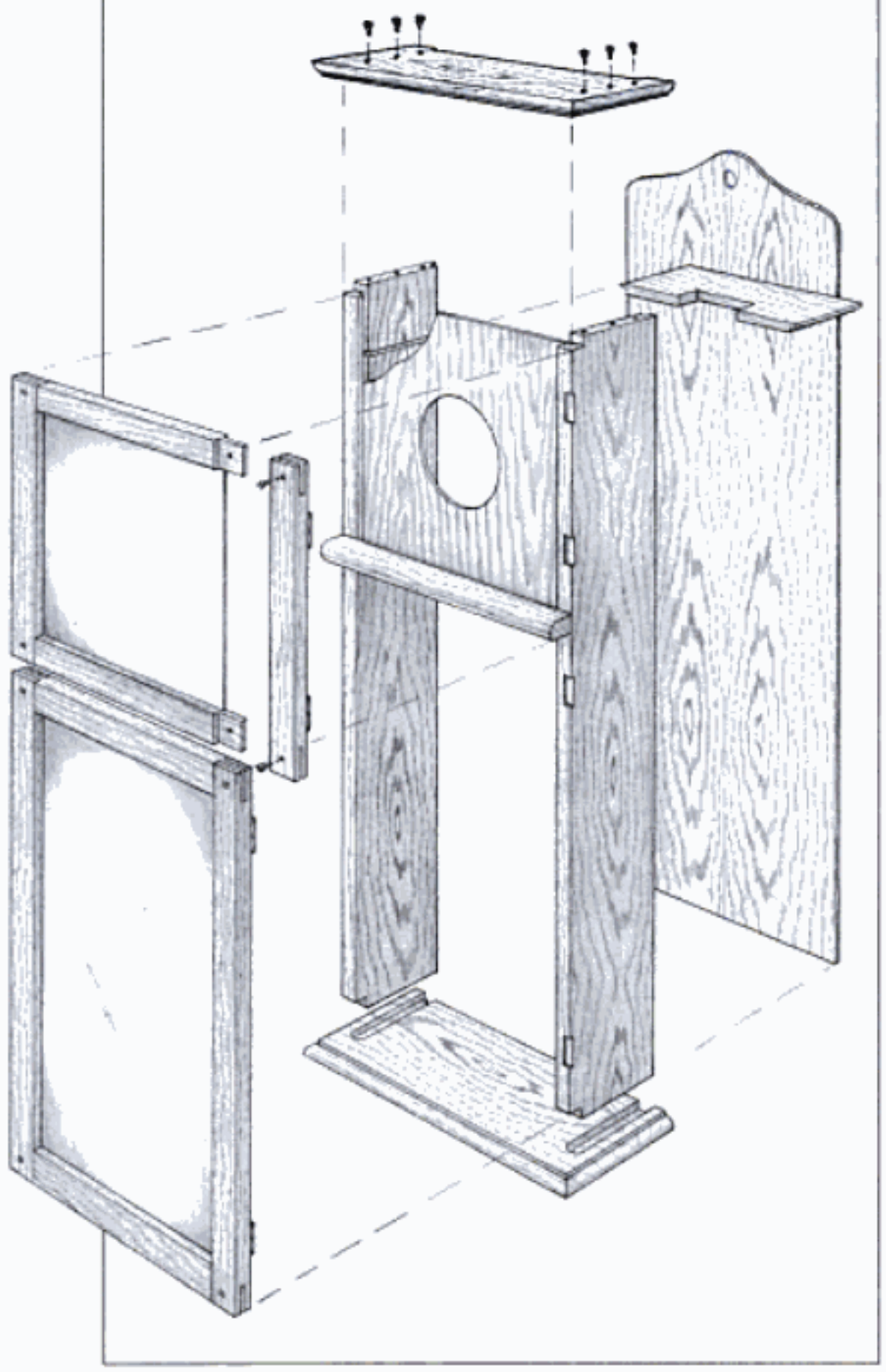
All the joinery for the clock case consists of dadoes, grooves and rabbets. I cut the joints with a router. I began by routing the ¼-in. wide groove for the dial mount in the case sides as shown in the drawing. Remember, the sides of the case must be mirror images. I made the dial mount from ¼-in. birch plywood.

The chimes for the clock mount on a shelf either above or below the movement, depending on which of the two movements you choose. Dadoes are routed in the case sides for the chime shelf as shown in the drawing. Note that the dadoes stop at the dial-mount groove.

The sides of the clock case fit into dadoes in the top and the bottom. These dadoes are ⅛ in. shorter than the width of the sides. The sides are notched to make up the difference. Make the notches ½ in. long so you won't have to square the round ends of the dadoes.

Rout rabbets in the case sides and bottom for the back of the clock. The top of the clock is notched to allow the

FIG. 2: EXPLODED VIEW



back to extend up through the top to become the hanger.

Shaping the edges of the top, the bottom and the rail between the two doors comes next. I put the bull nose on the rail with a ⅜-in. radius round-over bit, and I shaped the edges of the top and bottom with a ½-in. radius round-over bit.

The last step before assembling the case is to saw the 4¾-in. dia. hole in the dial mount with a coping saw.

Assembling the case requires gluing end grain where the sides of the case join the top and bottom. End grain has a reputation for gluing poorly, but there's a technique that greatly increases strength. Put a fair amount of white or yellow glue on the end grain, wait about 5 minutes until it's tacky, then wipe off the excess. This fills the end grain, preventing it from sucking up additional glue. Now put more glue on the end grain and assemble the joint.

Assemble the clock case by fitting the dial mount in its grooves, then glue and clamp the top and bottom to the two sides. Lay the case on a flat surface, check that it's square and let it dry.

When the glue is dry, I pin the joints with dowels. I make my own dowels by pounding ¼-in. square stock part way through a dowel former (available from Woodcraft, P.O. Box 1686, Parkersburg, WV 26102, 800-225-1153). Leave one end of the dowel square for ½ in. so it shows as a square peg on the finished clock. Drill holes for the dowels, then square up the entrance to the holes with a small chisel. Put a little glue in the hole and drive in the dowel until about ¼ in. of the square head enters the wood. Later you can saw the dowel flush with the case.

To complete the assembly of the case, glue on the rail that separates the upper and lower doors.

SOURCES

The Shaker Wall Clock can be built with either of the two mechanical clock movements listed below. Movements, dials and hardware are available from Mason and Sullivan, 586 Higgins Crowell Rd., West Yarmouth, MA 02673, (508) 778-1056. Mason and Sullivan will punch the correct key holes in the dial when you buy the dial with a movement.

Movements: (choose one)
Two-spring bim-bam #3301X ($85)
Three-spring Westminster chime #3331X ($129)
Dials: (choose one)
Arabic numerals #7416S ($14.95)
Roman numerals #7415S ($14.95)
Hardware:
Hinges #2450B, two pair needed ($7.95 pair)
Hook-and-eye latch #2548B ($4.95 set of six)
Miscellaneous:
1/16-in. reed spline: The Woodworkers' Store, 21801 Industrial Blvd., Rogers, MN 55374, (612) 428-2199).

Making the Doors

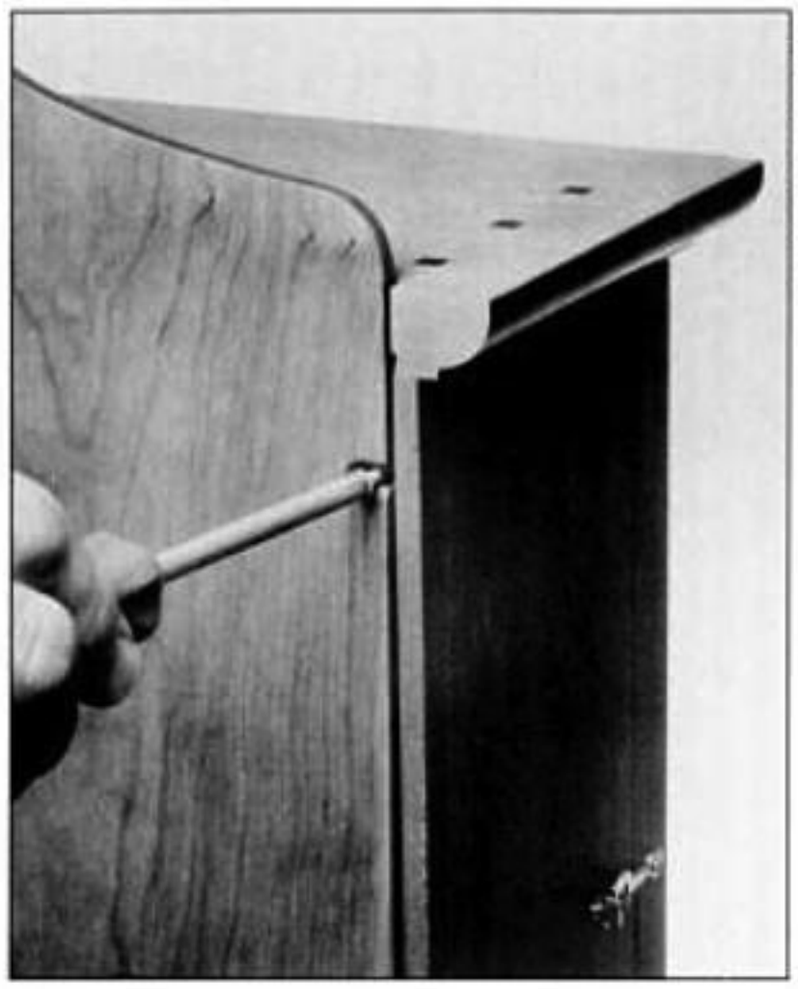
The stiles and rails for the doors will look best if you make them from plain, straight-grained wood. Cut these parts ½ in. wider than the dimensions in the drawing so the doors can be planed to fit the case.

I joined the door frames with bridle joints. I cut the joints on my bandsaw and removed the waste with a chisel. You could cut them on the tablesaw if you prefer. Check the fit of your joints, and trim the shoulders if necessary to get them to fit tightly. Apply glue sparingly to the cheeks of the tenons, making sure not to get glue on the shoulders, and assemble the door frames. Clamp them with light pressure to close the joints at the shoulders, then square up the assembly and clamp each corner joint.

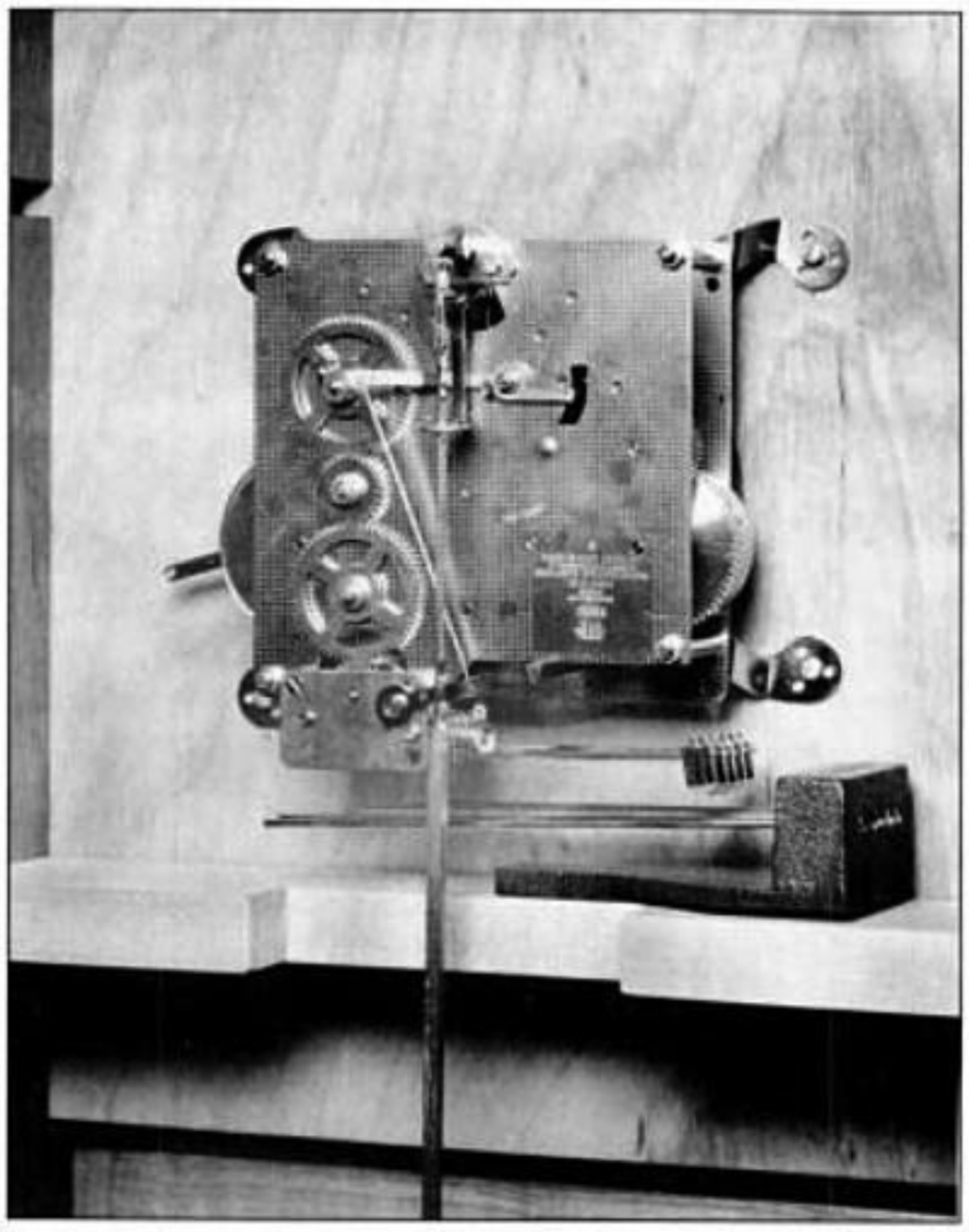
With the glue dry and the clamps removed, I add a square-headed dowel at the center of each bridle joint. The holes for these "pegs" go all the way through the frame, so back up the frame with a piece of scrap stock to prevent tear-out when the drill breaks through.

After the glue on the door frame is dry, rout the rabbet for the glass on the back side of the door and square up the rounded corners with a chisel. Measure the recess for the glass and order the glass 1/16 in. smaller in both length and width.

Install the hinges (see *AW*, #15), then trim the doors to size. I strive for an even ¼ to ½ in. gap at the top and bot-



Allow the solid wood back to expand and contract by installing the screws in slotted holes.



The Westminster chime block (shown) or the bim-bam gong rods mount on a shelf separate from the clock movement.

tom and about ¼ in. overlap on each side. I installed hook-and-eye catches to fasten the doors.

Completing the Back

Once the case is assembled, you can complete the clock back. Cut the back ⅛ in. narrower than the distance between the rabbets in the sides of the case to allow for expansion and contraction. Saw out the top profile of the back and drill the 1-in. dia. hanger hole.

The back of the case is screwed to the sides, top and bottom. The screws in the sides are installed in slots. (See photo.) The slots allow the back to expand and contract in width with seasonal changes in humidity. Drill the holes and cut the slots for these screws. Next, drill a hole as shown in the drawing for the screw that prevents the clock from moving when it's hung on the wall. Install the back to check the fit, then remove it for finishing and installing the movement.

Finishing

I put an oil finish on my clock case. When you finish the case, also finish about 13 ft. of ⅛-in. reed spline of the sort used in caning chairs. (See Sources.) The reed serves to hold the glass in the doors. Once the finish is thoroughly dry, cut the reed spline with a knife to fit in the rabbets for the glass. Miter it at the corners. Set the glass into the doors and tack in the reed spline with small brass brads. I drill a tiny pilot hole for the brad and tap it home with a hammer and a nail set.

Installing the Movement

The fumes from finishing materials can contaminate the lubricating oil of a clock movement, so the finish should dry for at least a week before you mount the movement. When your finish is thoroughly dry, screw the dial to the dial mount, centering it in the opening in the upper door. From the back of the clock, position the movement with the arbor centered in the hole in the dial. Mark the screw holes for attaching the movement to the dial mount, but remove the dial before you drill the holes. After that, install the movement and reinstall the dial.

Cut the notch for the pendulum in the chime shelf and rout the rabbets at each end of it so it slides snugly into the case. You don't need to glue the chime shelf in place. Following the instructions that came with your movement, mount the chimes on the chime shelf. Bend the hammers so they rest about 1/32 in. from the rods. When chiming, a hammer should just tap the rod and not hit it again on the bounce. The installed Westminster chimes and movement are shown in the photo above.

Refer to the instructions that came with your movement when adjusting the clock and its chimes. The instructions describe how to hang the pendulum, set the time and adjust the beat.

To avoid damaging the movement, you should never move the clock with the pendulum attached, not even to mount the clock on the wall. Before you screw on the back, study how the pendulum connects, and practice attaching it from the front of the clock. Also, study how the beat adjustment is made. Screw on the back and hang the clock on the wall. Level the case and secure it in place with the screw through the back. Hang the pendulum, adjust the beat, set the time and enjoy your new old-fashioned timekeeper. ▲

W. Curtis Johnson is a biophysicist at Oregon State University. He is also a part-time professional woodworker and contributing editor of AW.

BUYING TOOLS BY MAIL

BY DAVID SLOAN

The Pleasures and Pitfalls of Catalog Shopping

Mail-order shopping is an American tradition. Richard Warren Sears started it all back in 1887 when he decided to quit his railroad job to sell watches by mail. You know the rest of that story. The wonderful Sears, Roebuck & Co. catalog brought the goods of the world to the doorstep of rural America. Its 1900 catalog sold everything from horse-drawn farm wagons to pills for curing your opium habit. Compared to today's, the prices are laughable: Its top-of-the-line "Acme Carpenter Chest of Tools," with four Stanley planes and all the chisels, saws and hand tools a strong man could carry, sold for $14.58. (Don't forget, the average worker in 1900 earned about 22 cents an hour.)

Sears is still a contender in the mail-order tool business, but it's no longer the only game in town. There are dozens of mail-order companies that cater to the needs of the woodworking enthusiast—amateur or professional. You can buy just about anything you need for your shop, day or night, without ever leaving the house... if you know where to look.

So you'll *know* where to look, we've put together a chart that lists most of the major mail-order woodworking-supply companies we know and the categories of merchandise they sell. Each company prints a catalog, which you can order by calling the phone number on the chart. Conspicuously absent from our chart are companies

AMERICAN WOODWORKER'S MAIL-ORDER SOURCES FOR TOOLS AND SUPPLIES

COMPANY NAME	HAND TOOLS	POWER TOOLS & ACCESS.	STATIONARY MACHINES	FINISHING SUPPLIES	HARDWARE	TURNING SUPPLIES	CARVING SUPPLIES	WOOD & VENEER
AMT—215-948-0400	●		●			●		
Baldwin Hardware—215-777-7811					▲			
Ball & Ball—215-363-7330					▲			
Biesemeyer—800-782-1831			● 1					
Bridge City Tool Works—800-253-3332	▲							
Cascade Tools, Inc.—800-235-0272		▲ 2						
Conover Woodcraft Specialties—216-285-2341	●					▲		
Constantine's—800-223-8087	●	● 3		●	●	●	●	▲
Craft Supplies USA—801-373-0917						▲		
CraftWoods—800-468-7070							▲	
Eagle America—800-872-2511		▲ 2						
Econ Abrasives—800-367-4101				● 4				
Foley Belsaw—800-468-4449		●	●					
Frog Tool Co., Ltd.—312-648-1270	▲			●		●	●	
Garrett Wade Co.—800-221-2942	▲	●	●	▲	▲	▲	▲	
Grizzly Imports, Inc.—East 800-523-4777 West 800-541-5537	●	●	▲		●			
Hida Tool Co.—415-524-3700	▲ 5							
Highland Hardware—800-241-6748	▲	▲	▲	▲		▲	▲	
Horton Brasses—203-635-4400					▲			
HTC Products, Inc.—800-624-2027			●					
Industrial Abrasives Co.—800-428-2222 in PA 800-222-2292				▲ 4				
Laguna Tools—800-234-1976			● 8					
Lee Valley Tools, Ltd.—613-596-0350	▲	●	●	▲	▲	▲	▲	
Leichtung Workshops—800-321-6840	●	● 3		●	●			
Lie Nielsen Tool Works—207-273-2520	▲							
Lobo Power Tools—213-949-3747			▲					
MLCS Ltd.—800-533-9298		▲ 2						
National Hardware Co.—800-334-9582					▲			
Olde Mill Cabinet Shop—717-755-8884				▲				
Paxton Hardware, Ltd.—301-592-8505					▲			
Penn State Industries—800-288-7297			▲					
R. A. Ness & Co.—800-368-6377 708-824-0565 in 312 or 718	●	▲	●					
The Sanding Catalog—800-228-0000				▲ 4				
Santa Rosa Tool & Supply, Inc.—800-346-0387		●	▲					
Seven Corners Ace Hardware—800-328-0457	●	▲	▲	●	●	●	●	
Shopsmith—800-543-7586	●	●	▲	●		●	●	
The Source—800-452-9999	●	▲	▲	●	●	●	●	●
Sunhill Machinery—206-575-4131			▲					
Tepper Discount Tools—800-626-0566		●	●					
Tool Crib of the North—800-358-3096	●	▲	▲					
Tool Force—800-553-4177	●	▲	●	●	●			
Transpower—800-654-7702			▲					
Trend-Lines—800-767-9999	●	▲	▲	●	▲	●	●	
Whitechapel Brasses—307-739-9478					▲			
Whole Earth Access—800-829-6300	●	▲	▲					
Wholesale Division—800-736-6586		▲	●					
Wilke Machinery Co.—717-764-5000			▲					
Williams & Hussey—800-258-1380			▲					
Williams Tool & Hardware Supply—800-338-6668	●	▲	●	●	●	●		●
Wood Carver's Supply, Inc.—800-284-6229							▲	
Wood Finishing Supply Co., Inc.—315-597-3743				▲				
Woodcraft—800-225-1153	▲	●		▲	▲	▲	▲	
Woodline, The Japan Woodworker—800-537-7820	▲ 5							
Woodpecker's—505-438-3885	●	●		▲ 6			▲	
Woodstock International, Inc.—206-734-3482	●	● 7						
Woodworker's Emporium—702-871-0722					▲			
The Woodworkers' Store—612-428-2199	●	●		●	▲	●	●	▲
Woodworker's Supply, Inc.—800-645-9292	●	▲	▲	●	●	●	●	

KEY: ● Means the company carries this product category. ▲ Means the company specializes, or carries a wide selection in this product category.

KEY TO FOOTNOTES:
1. Machine fences and accessories
2. Router bits and cutters
3. Power-tool accessories only
4. Sanding supplies only
5. Japanese hand tools
6. Specialize in non-toxic finishes
7. Dust-collection accessories
8. Combination machines

that sell only one product. We just don't have room to list them all. Also, missing from the chart are mail-order outfits that sell only wood. We'll look at the mail-order wood business in a future issue.

Three Big Advantages

Mail-order shopping has three big advantages: convenience, selection and price. The convenience factor is obvious—you save time, gas and money when the tools come to you. Selection? No store I know of can afford to stock the wide range of tools, supplies and machinery you can access by mail. In fact, specialty items such as high-quality hand tools and reproduction hardware are often available *only* by mail order.

The biggest advantage for me is the price break available on brand-name equipment. You can save lots of money if you buy your big-ticket power tools and machines by mail. (See sidebar.) Large, mail-order discounters—Trend-Lines, Seven Corners, Grizzly, Tool Force, Whole-Earth Access and others—sell brand-name power tools, machinery and accessories at prices your local dealer just can't beat.

The trick to getting the best deal is to know what you want. Do your homework. Learn the brand, size and model number of the equipment you want, then shop for the best price. I scan the fine-print ads in woodworking magazines (I call them "laundry-list" ads) until I find the lowest price for the equipment I want. I also check to make sure that the price includes shipping. I call up and order from the company that gives me the best price—it's as simple as that.

You never get something for nothing, and the trade-off in this case is service. Your local dealer is conveniently nearby when you need parts and service. A mail-order company could be thousands of miles away.

If You Run Into Problems

In all the years I've been buying tools by mail, I've never once had a problem with a mail-order company, but Murphy's Law states that things sometimes go wrong. Items can be back ordered, and equipment can get damaged in shipping. It's prudent to hang on to credit-card slips, canceled checks and shipping bills in case you should ever need to return an item or make a claim.

If you need to return an item, call the company first for instructions before sending it back. You'll need to repack the item and pay for the shipping. (United Parcel Service will pick up a package at your home for a $5 service charge).

If a problem comes up, you can almost always resolve it by phone. In those rare cases when you can't straighten things out with a phone call, state your problem clearly in a letter and enclose copies of any documentation (canceled checks, credit-card statements, etc.) you need to support your claim. Send the letter by certified mail, "return receipt requested," and keep a copy for your files. If the letter doesn't get results and you feel you've been victimized by an unscrupulous mail-order company, report the incident to your local postmaster. Be sure to bring copies of all relevant documents. The U.S. Postal Service has stringent regulations that govern the conduct of mail-order businesses, and the postal authorities will investigate your claim.

David Sloan is editor of AW.

SPECIALTY CATALOGS FOR THE SHOP

Here are three of my all-time favorite specialty mail-order catalogs. They're great fun to look through and you won't find this kind of oddball shop-related stuff anywhere else—*D.S.*

Small Parts Inc. (305-759-5143): A tinkerer's dream come true. This catalog specializes in all the small, mechanical parts and components you've always been looking for to make jigs, machinery or Rube Goldberg contraptions. Metal and plastic rods and tubing, miniature gears, bearings and sprockets, stainless-steel screws... the list goes on and on. The catalog is free.

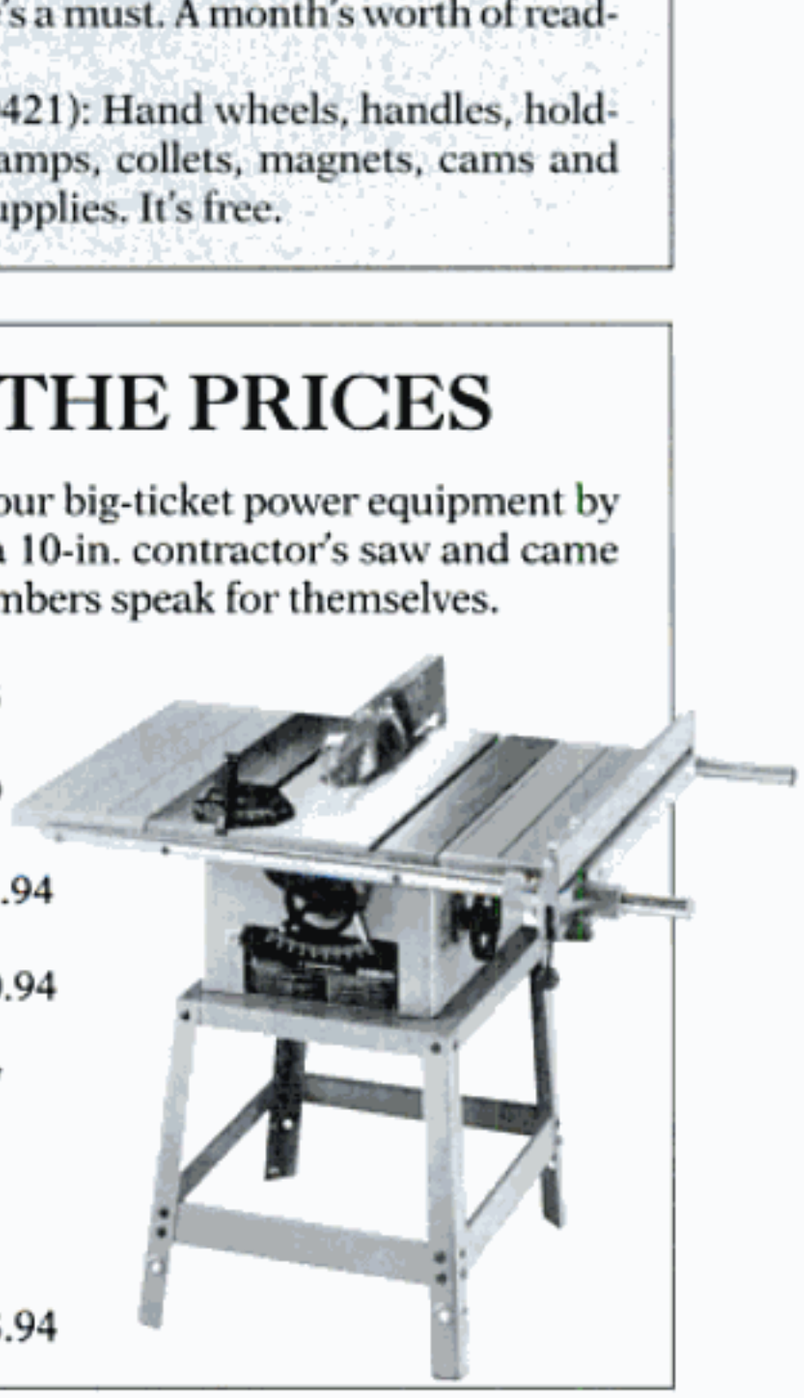
Dixie Gun Works, Inc. (800-238-6785): Catering to black-powder shooters, this wacky, wonderful 640-page catalog contains thousands of unusual items of interest to anyone who tinkers with wood and/or metal. If you're into old firearms, this one's a must. A month's worth of reading for a paltry $4.

Reid Tool Supply Co. (800-253-0421): Hand wheels, handles, hold-downs, leveling mounts, unusual clamps, collets, magnets, cams and cranks, and all sorts of machinist's supplies. It's free.

COMPARING THE PRICES

You can save big money if you buy your big-ticket power equipment by mail. We shopped around for a Delta 10-in. contractor's saw and came up with the following prices. The numbers speak for themselves.

Mfrs. Suggested List Price:	$923
Discount Price at Local Dealer	$699
6% State Sales Tax	$41.94
Total Dealer Price	$740.94
Mail-Order Discount Price (Shipping included. No sales tax to out-of-state buyer)	$597
Mail-Order Savings	$143.94



BOOKS

Wood Joiner's Handbook

by Sam Allen
(1990, Sterling Publishing Co., Inc., 387 Park Ave. S., New York, NY 10016) 288 pp; paperback, $14.95

Woodworking Joints—An Illustrated Handbook

by Percy Blandford
(1990, TAB Books, Blue Ridge Summit, PA 17294) 370 pp; paperback, $17.95

Do you know what a hammerhead joint is? Or how to determine the correct compound angle for a hopper joint? How about the best angle for a scarf joint? Whether you are a professional working on a tight schedule or an amateur with only a few hours a week to devote to a project, getting quick, accurate answers to these kinds of questions is important. Two books, Sam Allen's *Wood Joiner's Handbook* and Percy Blandford's *Woodworking Joints—An Illustrated Handbook*, intend to make the search for the answers a little bit easier.

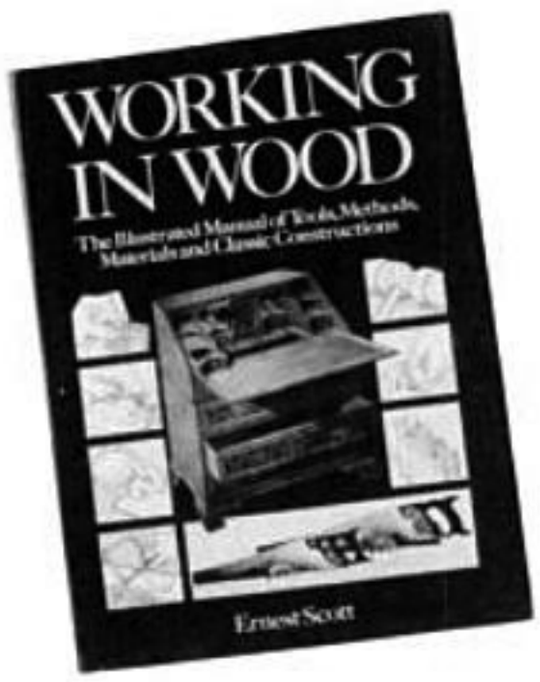
In his introduction, Allen explains that much of his knowledge about woodworking joints came from working in a furniture-repair shop, which gave him first-hand experience with a wide variety of joinery techniques. His well-organized book draws on this background and is exceptionally well-written. It contains plenty of useful photographs and clear illustrations of joints in solid wood and man-made materials.

The text is divided into three logical sections. The first covers basic elements of joinery, including hand techniques and a brief discussion of the forces that act on a joint. The second section covers more advanced joints and machine techniques, while the third gives guidelines for using the joints. Throughout the book, he lists "rules of thumb" that simplify the laying out and cutting of joints.

The Blandford book presents a wide selection of joinery techniques. From screws to Bermuda dovetails, Blandford includes "all variations known to the author," as he writes in the introduction. Despite the large volume of information, the text is not in any apparent order, so finding specific information isn't always easy. The emphasis seems to be on exposing the reader to as many different joints as possible rather than on instruction in their construction. The most disappointing aspect of this book, especially considering its title, is the poor quality of the illustrations and the total absence of photographs.

Although I think that the Allen book is much better, either of these books would make a useful addition to a woodworking reference library.

SCOTT COOPER



BOOK

Working in Wood

by Ernest Scott
(1980, Michael Beazley Publishers, Ltd., Mill House, 87 Shaftesbury Ave., London, WIV 7AD. Published in the United States by G.P. Putnam's Sons, 200 Madison Ave., New York, NY 10016) 272 pp; hardcover, $25

Working In Wood is a reference book that never collects dust on my shelf. I always seem to use this book, whether to look up information such as the proper angle for a seat back, or to make a decision about what hinge to use.

Working in Wood begins with a brief, well-illustrated overview of major furniture forms, from the evolution of the raised-panel chest to the ballon-back chair. The text continues with a basic design section, a good place to check for the right height for a cabinet or length for a bed. A well-illustrated section on woodworking tools follows. Make note, however, this section is dated because power tools have evolved so much in the past decade. It's not the best source if you're preparing to buy a new tablesaw or router.

The chapter called "Methods" claims to be "a comprehensive demonstration of all the essential techniques in woodworking." This section covers numerous joints, but beware, the emphasis is very heavy on hand-tool techniques. You'll learn how to chop a dado with a chisel, but if you want a jig for zipping through dadoes with a router, you'll need to look to another source. Of course, it's interesting to read the proper way to rip a long board with a hand saw, if only to make you wax your tablesaw in a show of appreciation.

Because this book is British, the terminology can sometimes make it challenging to find what you want. The other day I decided to see what *Working in Wood* says about finger joints. Finding nothing about finger or box joints in the index, I thumbed through the book and found an extremely useful entry on " comb joints." I didn't mind the search. This smorgasbord of woodworking information is always fun to browse through. All the dimensions are given conveniently in inches and centimeters.

Working in Wood is a fine reference book that will prove useful to woodworkers of every skill level.

DAVID SCHIFF

VIDEO

Repairing Furniture
by Bob Flexner

(1987, Taunton Press, Inc., 63 S. Main St., Box 355, Newtown, CT 06470) 70 min.; VHS, $29.95

I have a secret delight in the repairs people make with stuff like toothpicks, Bondo, Magic Markers, and Liquid Nails. But for every clever, make-do solution, there are hundreds of botched repairs. The irony is that the correct repairs are often faster and easier and less time consuming to make than the makeshift ones.

For a practical guide to fine-furniture repair problems, I recommend Bob Flexner's video, *Repairing Furniture*. Even the experienced woodworker will find a tip or two in this well-produced tape.

Although chairs are the most common repair problems that Flexner deals with, he demonstrates disassembly, repair and regluing on a variety of pieces, from sewing tables to grandfather clocks.

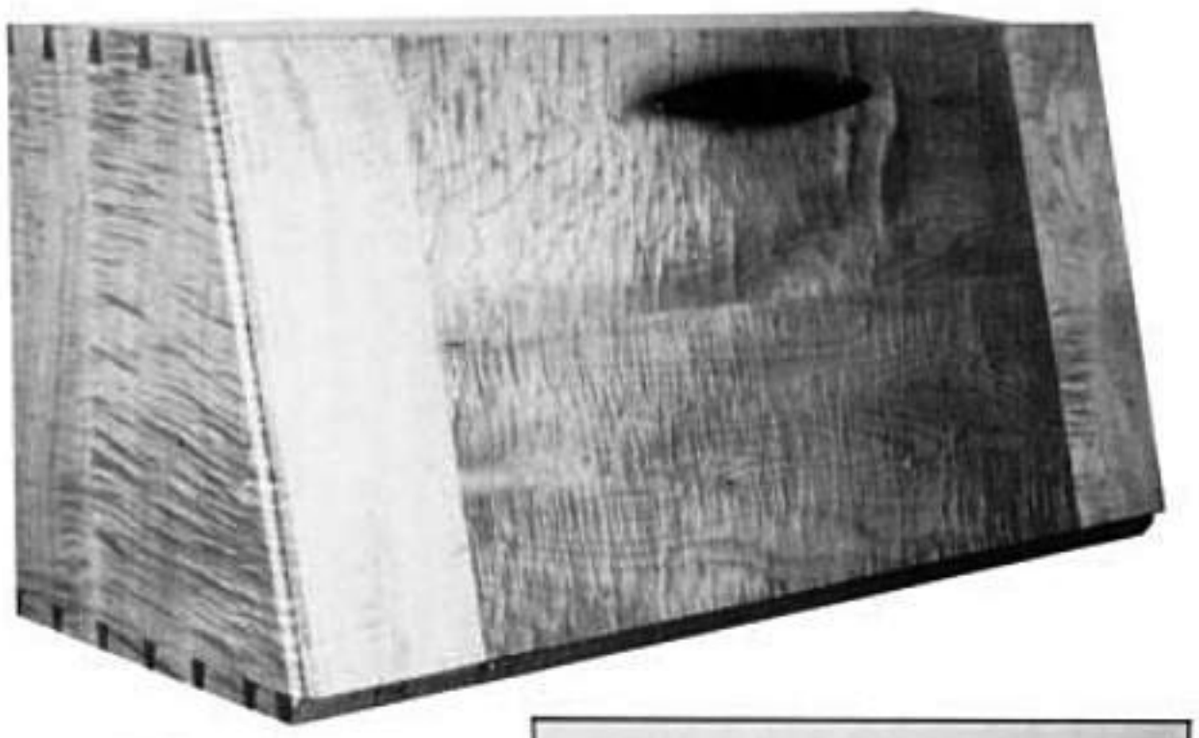
If you've never tried working with hot hide glue, Flexner will give you a great argument for getting a glue pot and dipping into it. Hide glue liquifies with the addition of water or alcohol. To disassemble a joint, squirt alcohol on it and give a good blow with a mallet. Flexner also demonstrates hammer veneering on a curved-face, oak-veneered drawer.

Whatever glue you prefer, the no-nonsense clamping jigs and fitting techniques he mentions will make your repair work more effective. Most of Flexner's repair tools are familiar to the average woodworker. He also suggests methods to help you get by with what you have. This videotape was a hit with my woodworker's guild for showing how a scratch stock can reproduce small pieces of molding. Everyone made one to add to their tool chests.

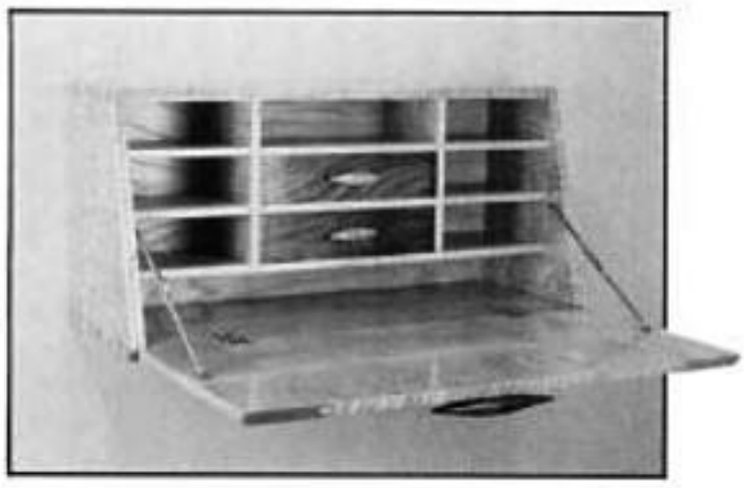
Although the video covers wood repairs and not finish repairs, there is a strong emphasis on minimizing the damage to the finished surfaces. Flexner's philosophy about repairs is simple—make a sound repair and you'll only have to fix it once. Bad repairs with metal brackets and nails just lead to further damage. Because repair work is primarily good gluing work, he suggests two basic rules; "clean wood," and "tight wood-to-wood contact." I can't argue with these suggestions.

NANCY LINDQUIST

GALLERY



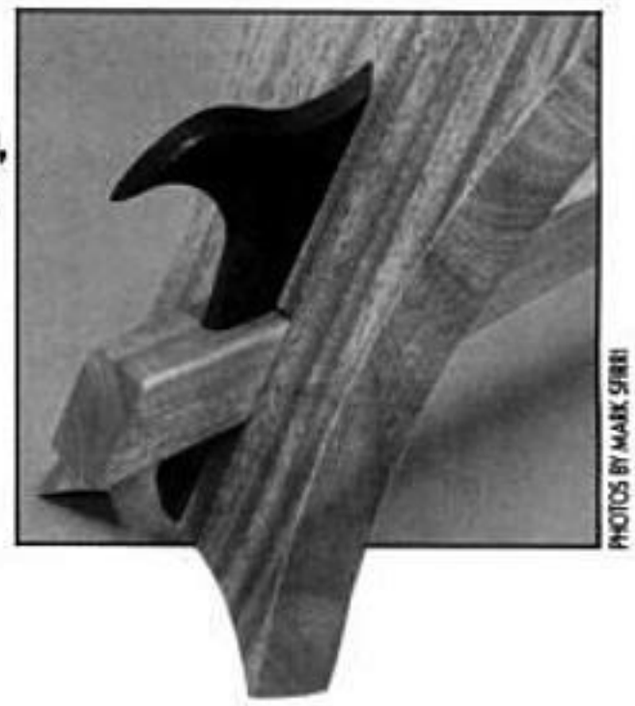
Wall-hung Desk,
by Chris Preston,
Pipersville, Pennsylvania.
Figured maple, walnut.
Dimensions:
H: 16 in., W: 14 in., L: 36 in.



The Fine Woodworking Program at Bucks County Community College is a full-time, two-year program with an emphasis on furniture design and construction. The work you see here was built by students during the 1990-91 school year. For more information about the program, contact Mark Sfirri, Fine Woodworking Program, Bucks County Community College, Swamp Road, Newtown, PA 18940, (215) 968-8425.

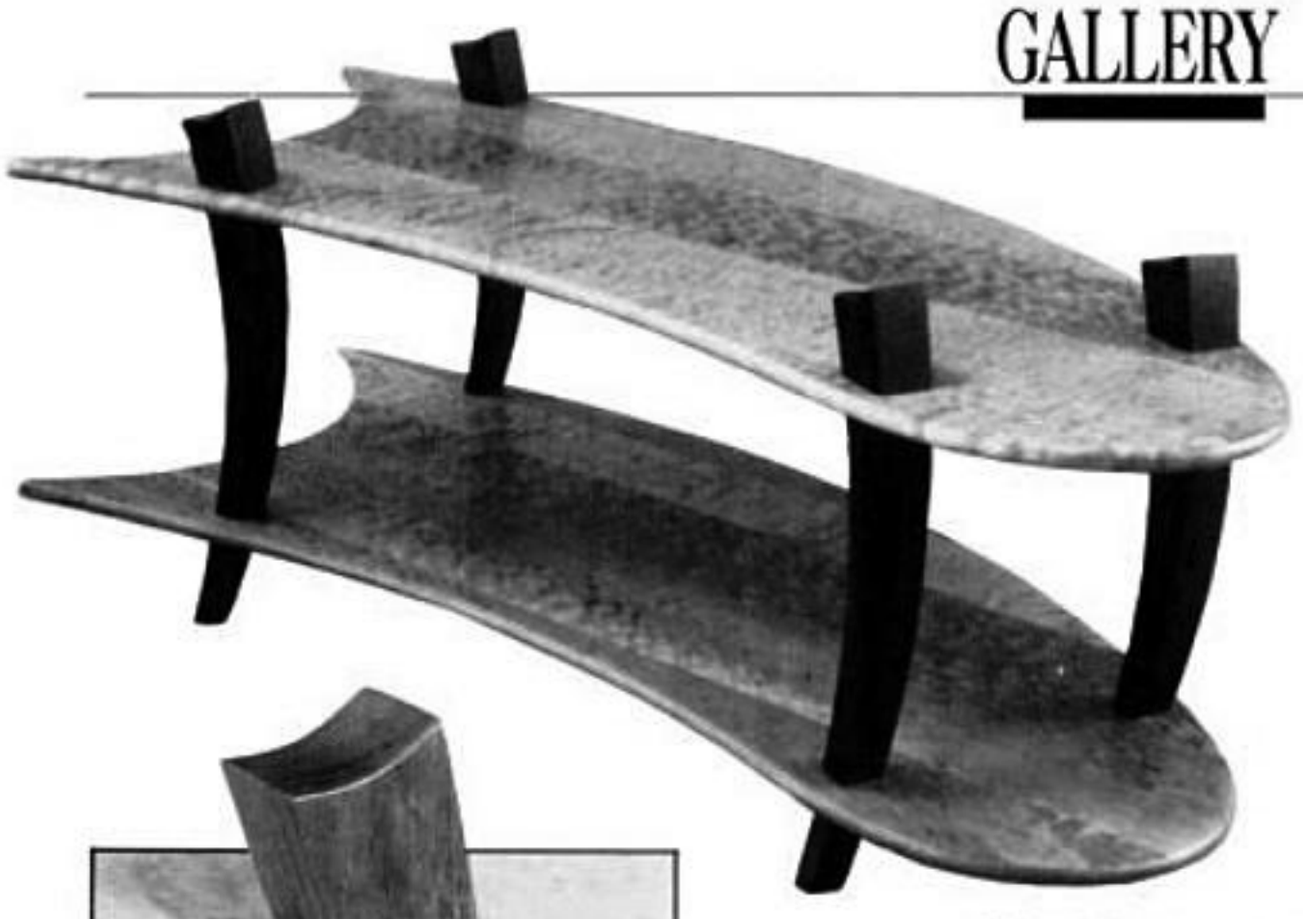
Large Sculpture,
by John Seiffert,
Wilmington, Delaware. Mahogany.
Dimensions:
H: 16 in., W: 12½ in., D: 4 in.

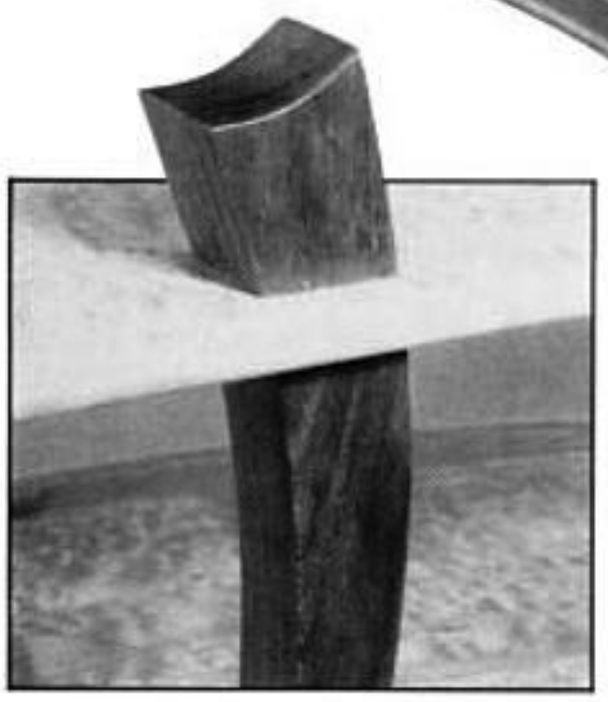
Coffee Table, by Douglas Finkel,
Trevose, Pennsylvania. Sapele,
wenge, mahogany.
Dimensions:
H: 20 in., W: 16 in., L: 52 in.



PHOTOS BY MARK SFIRRI

GALLERY





Coffee Table, by Bill Quigley, Philadelphia, Pennsylvania. Curly western maple, purpleheart. Dimensions: H: 18 in., W: 16 in., L: 48 in.

Want to see your work in Gallery? Send photographs and a description of the piece to: AMERICAN WOODWORKER, *33 E. Minor St., Emmaus, PA 18098. Only black-and-white prints (4 in. × 5 in. or larger) or color slides will be accepted. Please do not send color prints or snapshots. Enclose a self-addressed envelope for return of photos.*

Chest of Drawers, by Aris Paganakis, Easton, Pennsylvania. Maple, Baltic birch ply, aniline dye. Dimensions: H: 60 in., W: 12 in., D: 15 in.

Writing Desk, by Estella Cruz, Holland, Pennsylvania. Curly maple, maple, acrylic paint. Dimensions: H: 30 in., W: 20 in., L: 36 in.

FINAL PASS

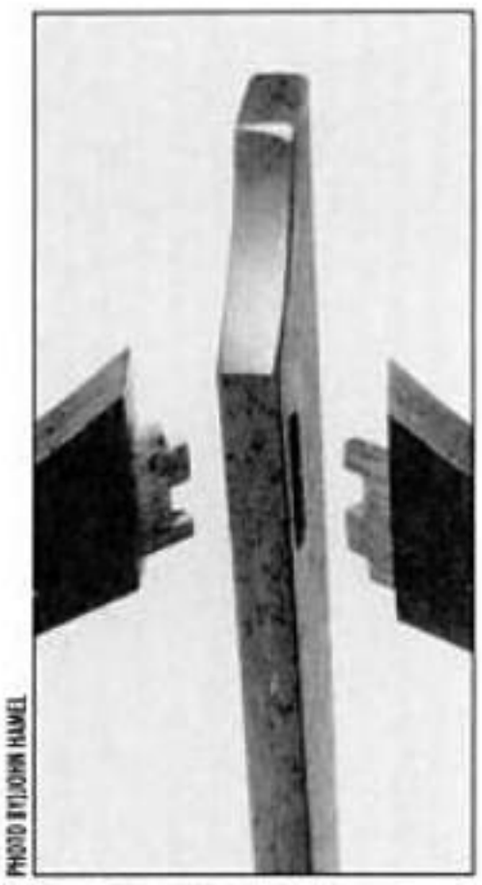


PHOTO BY JOHN HAWEL

Here's the solution to the display-stand "Mystery Joint" in last issue's Final Pass. The tenons interlock inside the mortise to form a strong "box joint" inside the leg.

Mystery Joint Revealed

Solving the joinery puzzler we ran in Final Pass last issue, (*AW*, #21) was a piece of cake for a dozen or so of our readers. The first person to correctly identify the rail-to-leg joint on Bob Moran's display stand was Gary Mathias of Bettendorf, Iowa. He won $100 for being the first to get it right.

The photo shows the solution for those of you who haven't yet figured it out. The tenons interlock inside the mortises to make a strong "box joint" inside the leg.

Just for Turners

Woodturning is a new magazine that covers the international wood-turning scene with emphasis on activities in the United Kingdom, the U.S. and Australia. Articles cover tools, techniques, current work, and profiles of turners all written in a chatty, personal style.

Woodturning is published four times a year, and a one-year subscription costs $27.50. For information contact: *Woodturning*, 166 High St., Lewes, East Sussex BN7 1XU, England, U.K. Phone (from the U.S.) 011-44-273-477374.

A Career in Conservation

Woodworkers interested in furniture restoration take note: Applications are now being accepted for The Smithsonian Institution's Furniture Conservation Training Program. This three-year graduate-level program explores the preservation, stabilization and restoration of historic furniture and wooden artifacts.

Classes begin in August of 1992 and are intended for experienced woodworkers who want to pursue a career in furniture conservation.

The deadline for application is November 30, 1991. Applicants are selected on a competitive basis. Prerequisites are woodworking skill and a bachelor's degree that includes courses in chemistry, drawing and art history.

For information contact: Training Secretary, CAL/MSC, Smithsonian Institution, Washington, D.C. 20560, (301) 238-3700.

Guide to Politically Correct Wood

To use or not to use exotic hardwoods. That is a question many woodworkers face as tropical deforestation continues at an alarming rate.

To help you see the forest for the trees, The Rainforest Action Network has prepared *The Wood Users Guide*, a handy book that covers more than 300 species of tropical wood, describing their color, principal use, country of origin and scientific name. Most important, the guide offers domestic-wood alternatives to tropical woods with similar characteristics.

The Wood Users Guide explains the relationship of tropical timbering to rain-forest depletion and examines some acceptable tropical logging operations based on RAN standards.

The Wood Users Guide costs $7.50 plus $2.50 for postage, and is available by calling (800) 989-RAIN.

Designer Ralph Lauren is pushing plaid in his new line of home furnishings. This Queen Anne dresser proves the point.

Period Plaids?

Mad for plaid? Smartin' for tartan? You're in luck. Designer Ralph Lauren has gone Highland happy, putting red and green plaid on everything from coffee mugs to Queen Anne-style mahogany furniture. That's right, mahogany furniture. Just picture this pattern on the front of your bedroom chest of drawers...

The effect comes from a silk-screen process that imparts a plaid surface on the wood. The furniture, from the Ralph Lauren Home Collection, became available this month. The price of the nine-piece set ranges from about $2,000 to close to $10,000 per piece. A bit rich for my Scottish blood.

NANCY HUMES