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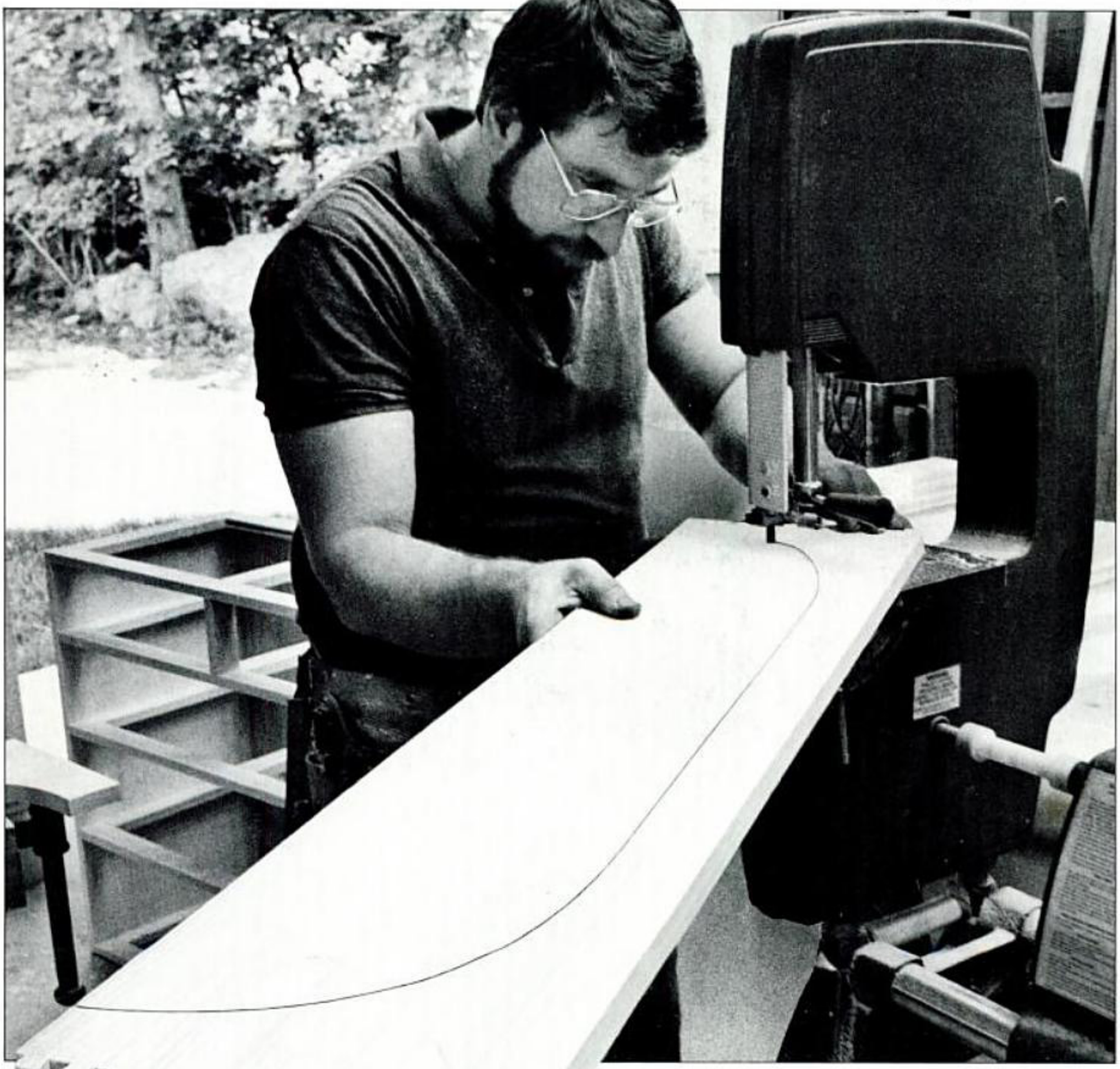
March/April 1989, Volume V, No. 2

# AMERICAN WOODWORKER



*Build Norm Abram's Chest of Drawers*
*The Gentle Art of French Polishing*
*Mike Dunbar's Shooting Board*
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# A WORD FROM THE EDITOR

## PUSHING THE ENVELOPE

A couple of weeks ago one of our editors used the expression, "pushing the envelope." I thought I was pretty much up on things language wise, but that one had me stumped. I didn't have the slightest idea what it meant. The fellow who used the phrase filled me in. When test pilots push a plane's performance to its absolute limits, they call it "pushing the envelope." The "envelope" being the speed, altitude, or maneuverability limits imposed by the plane's design. The editor in question (a pilot, I should add) thought the phrase filled a gap in the language and used it in a non-aeronautical context. That's how language grows and evolves.

Now that I know what to call it, I realize that most of us are always "pushing the envelope" in one way or another. We could get real metaphysical about all this but let's stick to woodworking, the thing we all have in common.

Sometimes we push the limits of our equipment. (Ever try ripping 3-in. maple on a bench-top tablesaw?) Other times it's the limits of our skills—trying a new technique, a new design, a new finish, a tricky joint; something we never attempted before and which just *might* not work.

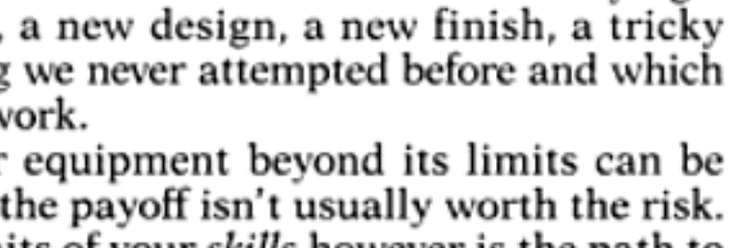
Pushing your equipment beyond its limits can be dangerous and the payoff isn't usually worth the risk. Pushing the limits of your *skills* however is the path to improvement and the key to becoming a better woodworker. Start with the things you *know* you know and build on that knowledge by taking risks.

We're always "pushing the envelope" here at AMERICAN WOODWORKER—trying new things and changing old things. We've chosen master carpenter Norm Abram for our first ever "people" cover. Norm's got a great new woodworking series called THE NEW YANKEE WORKSHOP and a companion book by the same title, and we wanted to let you know.

This issue also contains our very first centerfold (no it's not what you think). We thought many of you would appreciate having full-size patterns for projects with complex shapes. If you like it, we'll do more.

And finally, we've added a new department, "Final Pass," a forum for woodworking news and nonsense.

We're taking some risks to bring you a better magazine. Let us know what you think.



DAVID SLOAN
Editor

# LETTERS

*Sir:*

The Tech Tip for sanding wooden wheels (November/December 1988 AW) has major problems. First, the hardness of the file teeth will destroy the drill chuck. Second, the brittleness of the file can lead to breaking and possible injuries. Third, the tang of the file is softer and often bent. The runout of a skewered wheel could fling it off as a missle. The suggestion to limit the speed is absolutely mandatory.

A hardwood dowel could be used instead of a file with provision for retaining the wheel. A split end and a wedge could be used or the end of the dowel could be threaded and lock nuts used.

ED STRONG
Elk Grove, CA

*Sir:*

I made the High-wire cyclist exactly as shown in the November/December 1988 issue, but I can't keep the cyclist on the nylon fishing line. I even placed the lead weights on a metric scale, so I'm sure the weights on each side are equal.

The cyclist will ride momentarily but we spent more time picking him up from the floor than we did watching him ride the high wire. Could I get an explanation from John Fisher on what I did wrong?

ELMER STUHLMILLER
Harlem, MT

**JOHN FISHER REPLIES:**

*Chances are you didn't make the balancing poles long enough to balance the cyclist properly. If you look at the photo in the article, you'll see that the weights extend well below the wire. On my original cyclist the poles measure 14 1/2 in. long.*

*Sir:*

Yesterday, I took off early and flew to Detroit to see a woodworking show listed in Woodworker's Calendar. After renting a car, I proceeded to the Michigan State Fairgrounds, where the show was to be held October 7-9. When I arrived at the fairgrounds, I was told that over 100 people had already come to the show but there was no show at the fairgrounds. I checked newspaper ads and other arenas and no show. I spent over $300 to see a show that didn't exist. Why do you publish information that misleads people?

For your information, I went to another woodworking show recently and it was poorly attended and didn't have many exhibitors.

Last year I attended no fewer than 13 woodworking shows from coast to coast. If you and the promoters are interested in promoting the woodworking profession and hobby, someone is going to have to take the lead and put on better programs or the shows are going to fold for lack of interest. You can't charge the exhibitors an exorbitant fee and expect them to come back when you have nothing to offer the public with limited booths and publicity.

RICHARD F. VAN ANTWERP, SR.
Batavia, IL

# LETTERS

**EDITOR'S NOTE:**
*We make every effort to ensure the accuracy of Woodworker's Calendar listings at the time they go to press. Schedules can change, however, so we always include a phone number with each Calendar listing. It's a good idea to call to confirm the date and the time of the event before traveling. As for your comments about the quality of woodworking shows these days, how about it readers? Let's hear what you think about the shows you've attended recently. Address your comments to the Editor.*

*Sir:*

We encourage you to avoid recommending the use of tropical woods. The plans for the "Red Mower Push Toy" (September/October 1988 AW) call for the use of padauk. As evident from the article, Mr. Armstrong came to its use only after a great many trials. It was not his first choice. Nonetheless, we cringe at the use of tropical woods with the knowledge that rain forests, a most fragile ecosystem, are meeting their demise more and more every day.

Perhaps with your help, and that of other woodworking publications in concert with environmental watch groups, you could make woodworkers aware of which tropical woods not to use and encourage woodworkers to use woods which can be easily replenished without destroying fragile ecosystems.

It is our opinion that woodworkers are very special people. Thoughtful woodworkers create works that are often heirlooms, deserving the utmost care. Perhaps woodworkers could be leaders of those who are careful with the fragile "heirloom," the Planet Earth, upon which we live.

LEON and MARILYN LIENKE
Beaver Dam, WI

*Sir:*

When I first set up my woodworking shop, I was very concerned about my grandchildren and other youngsters wandering into my shop and turning on one of my machines. Of course, there are safety switches, keys, unplugging the plugs, etc. This didn't satisfy me so I put in a central switch out of reach on the ceiling where only an adult could reach it. The switch controlled only the circuits for my stationary machines so I could still operate the lights and other accessories.

This system had a flaw in that I would forget to turn off the switch. Then the idea hit me. I wired in a light that was operated *only* by the central switch. That way I would never leave my work area without forgetting to throw the central switch killing the power to my machines. I entertain my grandchildren now without worrying where they have wandered.

JAMES P. HOWARD
Eau Claire, WI

*Send your comments, compliments, complaints and corrections to: Editor,* AMERICAN WOODWORKER, *33 E. Minor St., Emmaus, PA 18098.*

# Q&A

## Chair of a Different Color

**Q.** *I plan to make a chair and dye different parts of it different colors. For example, the arms will be red, one leg blue, another green. I want to color them with aniline dye. Would it be best to dye the pieces before or after I glue the chair together?*

MARY POLK
Lexington, KY

**A.** I would dye all the parts first and then glue them together. This will give you very sharp divisions between adjoining colors without having to protect one color from another with masking tape while staining. Since you've put the color in the wood before gluing up, you will avoid the common problem of light spots around the joints where glue seepage has prevented stain penetration.

To know when a dye or stain can be applied before assembly without weakening the glue bonds, you must know how that dye or stain is made. If it is dissolved in a solvent such as water, alcohol or lacquer thinner, it won't have any effect on the glue bond—even if some of it inadvertently gets into the mortises or onto the tenons.

On the other hand, if the dye or stain has a binder such as linseed oil added to it to help the color adhere to the wood, take great care and avoid getting any of the stain on the glue surfaces. The binder partially seals the pores and keeps glue from penetrating and bonding.

If you are using a water-base dye and some glue does squeeze out, don't wash the glue off with water since water also will remove some of the dye. Wait until the glue is dry and carefully chisel off the excess glue. Then apply the finish.

BOB FLEXNER
Furniture Restorer and Author
Norman, OK

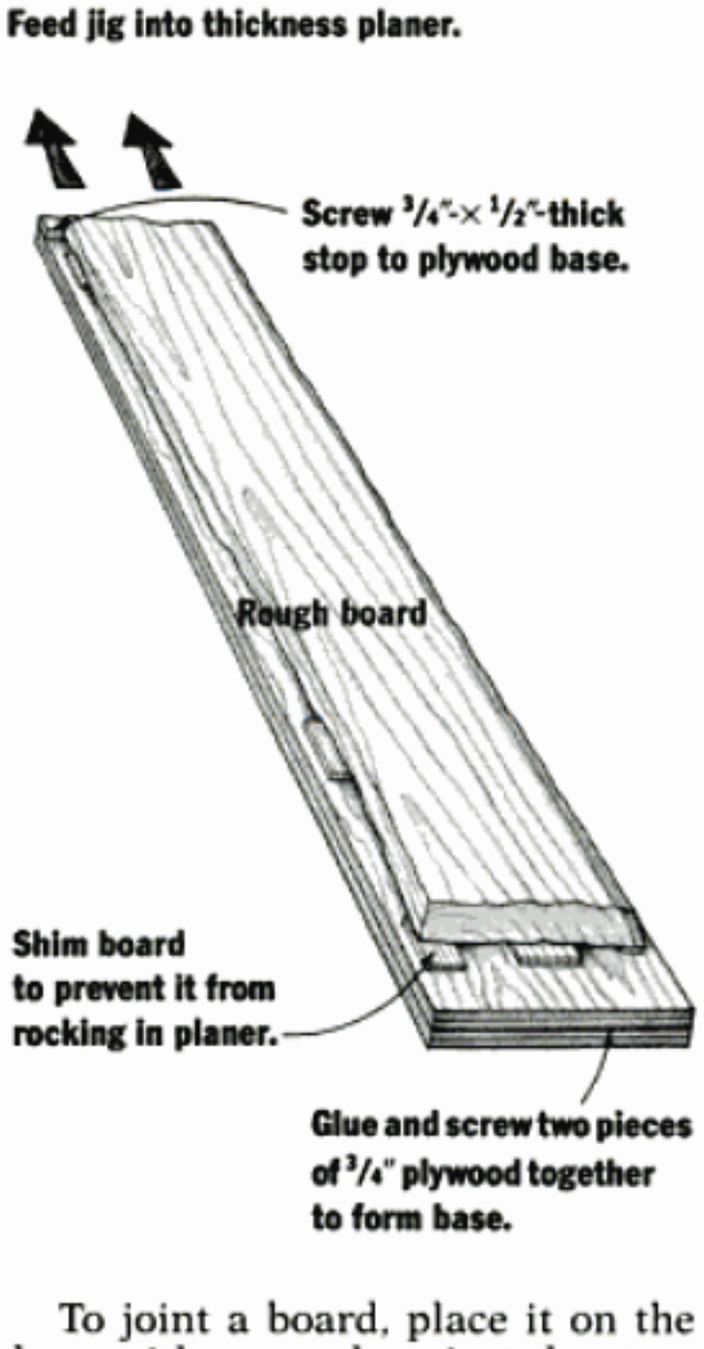
## Big Boards, Small Jointers

**Q.** *I have a 6-inch Powermatic jointer. When I want to joint wide boards, I have to rip them down to 6 in. first, which gets frustrating after a while. Is there a better solution?*

THOMAS RELLER
Columbus, OH

**A.** At one time or another, we all have the same problem. No matter how big your jointer, there is always a board just a little wider.

I solved this problem with a simple jig that, if necessary, trues up the first face on the thickness planer instead of the jointer. I glued and screwed 2 pieces of ¾- × 12- × 60-in. plywood together to form a very stable, flat base. Along one end, I glued and screwed a stop, countersinking *all* the screws.




To joint a board, place it on the base with one end against the stop. Shim the board to keep it from rocking and send the whole thing through the thickness planer, stop end first. The stop will keep the infeed rollers from pushing the board through ahead of the jig. I've never had the jig kick back out of the jointer, but I always stand to the side of the machine just in case.

Take several light passes. Once the first side is flat, you can put aside the jig, turn the board over and continue milling.

GREG JOHNSON
Custom Wood Finisher
Newton, MA

## Scroll-Saw Puzzle

**Q.** *I'd like to make some jigsaw picture puzzles for presents with my scroll saw. Can you suggest the best wood to use as a base, the best glue and best finish?*

C. GRANT LUCKHARDT
Atlanta, GA

**A.** For a quality jigsaw puzzle, the base should be ⅛-, 3/16-, or ¼-in. cabinet-grade plywood. Avoid the construction grades as they often have uneven surfaces, internal voids, and tend not to cut cleanly. Plywood with a poplar facing is my favorite; birch and maple facings are also good. For pieces of 1 or 2 square in., 3/16-in. plywood is the best thickness.

Sand the plywood lightly before attaching the paper. Wallpaper paste powder is a good adhesive. I buy my paste from a paint or wallpaper supplier and apply it with a brush. There is such a variety of papers, pastes, and sizing requirements that I would experiment before gluing down a valuable print. Keep everything clean and dust free; press the print down with a hard-rubber roller.

Some adhesives may cause the plywood to warp. This probably won't be a problem in the finished puzzle but may prove to be a nuisance while cutting out the pieces. This distortion often can be avoided by gluing a sheet of similar, plain paper to the backside of the wood with the same paste.

Once the adhesive is thoroughly dry, protect the picture with several spray coats of artist's fixative. If rough handling is anticipated, follow by spraying on a coat or two of urethane varnish. Apply the same protective coating to the back.

When cutting out the parts, have a clear plan of each cut in your mind but don't draw the pattern of cuts

on the picture—it's difficult to saw right on the lines and even more difficult to completely remove any visible lines. Saw with a new, thin blade and use a backing board to minimize backside whiskering.

If the puzzle is for small children, be cautious about the chemical content of all selected products and don't make the pieces small enough to fit in the mouth.

ALLAN J. BOARDMAN
Aerospace Engineer and Woodworker
Woodland Hills, CA

## *Shake, Rattle & Roll*

**Q.** *I want to turn ovals on my Delta heavy-duty lathe. I'm afraid that even at the slowest speed (340 rpm) the ovals could shake the lathe off its mounts. Should I put in a D.C. motor with a speed control?*

ROLAND CORTELYOU
Elwood, NY

**A.** Whenever turning a large diameter or out-of-round piece, a slow speed and secure lathe are of utmost importance. Some of the new "custom" lathes have a variable speed that goes down to 1 rpm. This may sound like overkill, but even at this speed, the surface speed on the rim of a large piece is quite high.

You can do several things to steady the lathe. Bolt it to the floor. If the lower portion of the lathe has an empty, enclosed cavity, fill it with sand or put sandbags on the bed. If the lathe is located under a beam, wedge a 4×6 board from the beam to the bed sandwiching the bed between the floor and ceiling.

You may find that steadying the lathe is all you need to do. If not, you will have to slow down the speed at which you turn. Instead of changing the motor, change the pulley on either the motor or the lathe. To cut lathe-speed in half, put a pulley half the diameter of the original on the motor, or double the size of the pulley on the lathe.

Save the old pulley for doing smaller-diameter spindle work, which necessitates higher speeds.

MARK SFIRRI
Cabinetmaker and Instructor
New Hope, PA

## Where to Find It

Leaded glass inserts for doors and windows are available in eight different patterns from The Cabinet Door Co., 15750 Concord Circle, Morgan Hill, CA 95037.

Small-scale wood-drying kilns are available from EBAC Lumber Dryers, 5789 Parkplaza Ct., Indianapolis, IN 46220.

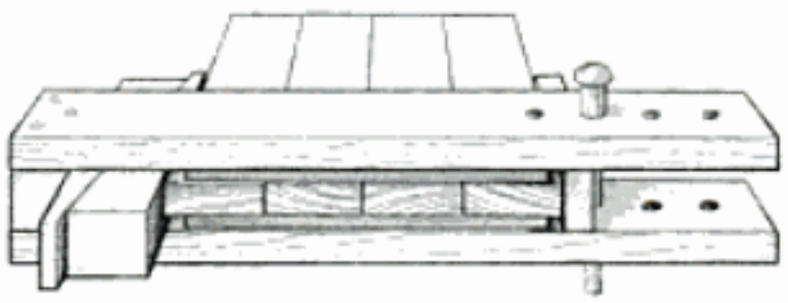
*Got a woodworking question for the experts? Send it to Q&A,* AMERICAN WOODWORKER, *33 E. Minor St., Emmaus, PA 18098.*

# TECH TIPS

## *Wooden Wedge Clamp*

If you're like me, there never seems to be enough clamps during assembly of a piece of furniture.

Here's a device I often use when boards have to be joined edge to edge or tenons pulled tight in a flat frame. Two long 1-×2-in. strips are firmly fixed at one end to each side of a 2-in. block. At the other end, I've drilled holes to take a ½-in. bolt.



In use, the assembly goes over the job, then a flat piece of wood goes against the bolt to prevent marking the wood. Two opposing, identical wedges with slopes about 1 in 6, hammered opposite ways, exert as much force as any screw clamp. An added bonus of this device is that you can keep the glued boards flat by inserting spacers under the strips —something you can't do with an ordinary bar clamp.

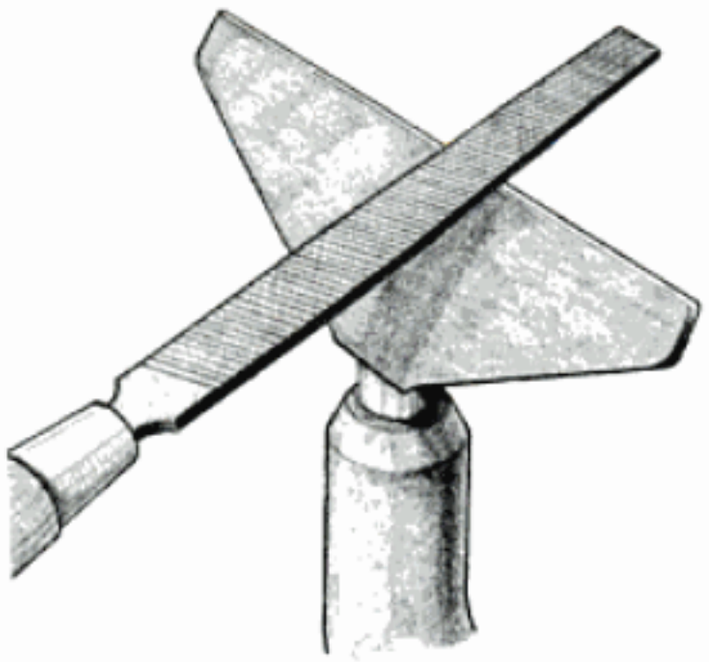
PERCY BLANDFORD
Stratford-upon-Avon, England

## *Jointer Plane Jointer*

Here's a way to joint pieces of wood that are too short to be run safely over the jointer. Flip your hand-jointer plane upside down and clamp it in your bench vise. Now you can pass the wood over the plane to joint the edge. It's a good idea to use a push stick so that you don't nip your fingers on the blade.

ALAN McMASTER
Brighton, MI

DRAWINGS BY HEATHER BERNE LAMBERT



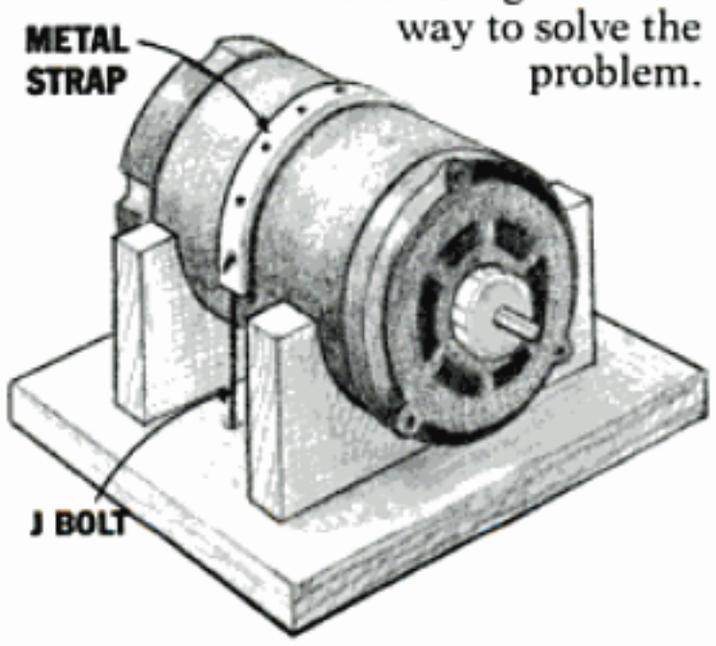
## *Filing Tool Rests*

File the top edge of your lathe tool rest occasionally to remove any nicks. Nicks on the tool rest hinder smooth movement of the tools.

BILL BIGELOW
Surry, NH

## *Low-Tech Motor Mount*

Electric motors from old washers and dryers can be useful in the shop but they often lack a base plate for mounting. Here's a way to solve the problem.




I make a base from ¾-in. plywood, two "J" bolts and a length of perforated iron strapping. If you can't find J bolts, you can open up the loops of eyebolts.

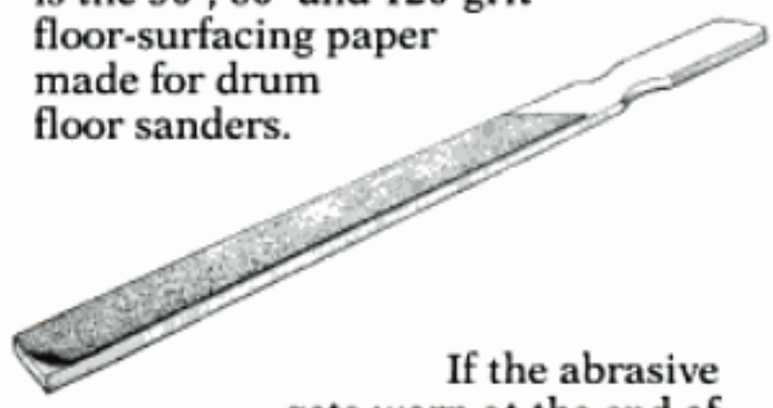
I find that one strap is sufficient to hold the motor in the cradle. However, you could install two straps—one at each end—if necessary to hold the motor.

DEAN ST. CLAIR
Salesville, OH

*Know a better way of doing something? Designed a clever jig? Send your woodworking tips, along with a sketch or a snapshot to: Tech Tips,* AMERICAN WOODWORKER, *33 E. Minor St., Emmaus, PA 18098. We'll pay you $25 if we publish your tip.*

## *"Files" for Wood*

Files come in handy for certain woodworking jobs, but files meant for metal will clog quickly if you use them on wood. I make my own woodworking "files" by gluing sandpaper to a wooden paint-stirring paddle with white or yellow glue. The longest-lasting abrasive is the 50-, 80- and 120-grit floor-surfacing paper made for drum floor sanders.



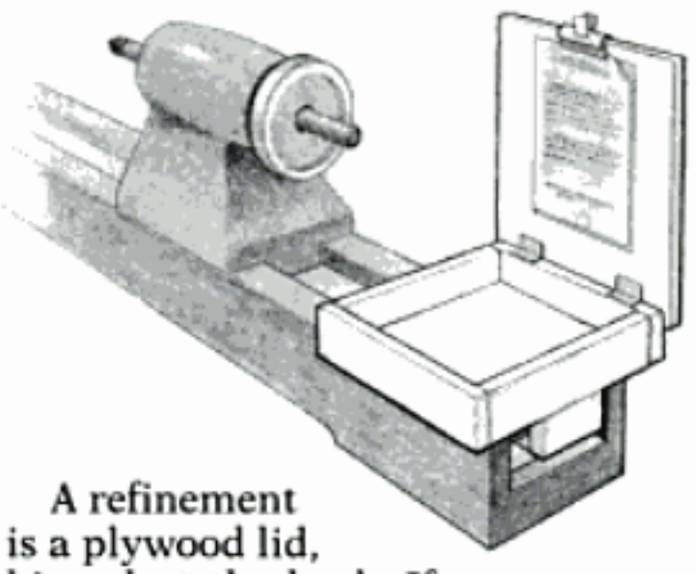
If the abrasive gets worn at the end of the stick, you can saw the end off to reach better abrasive. If you thin down an edge of the stick you can sand in narrow grooves.

NELSON H. RITTENHOUSE
Wayne, NJ

## *Lathe Tray*

Woodturning produces a considerable amount of waste shavings and chips, causing things you put on the lathe bed to disappear. A plywood tray at the right-hand end of the lathe bed will hold calipers, gauges and tools away from most of the clutter.

How the tray is attached to the bed depends on the design of the lathe, but it should be removable in the event you need to move the tailstock to the far end of the bed.



A refinement is a plywood lid, hinged at the back. If you arrange the hinges so the lid tilts back slightly when open, it becomes a place to clip drawings or notes so you can see them while turning.

PERCY BLANDFORD
Stratford-upon-Avon, England

## Two-fer ▲ Panel Bit

Until now, raising a panel with a router was a two step process: first you had to rout the bevel, then rabbet the back edge to bring the panel flush with the frame. Now there's a router bit that does both steps at once. The new ⅜ 3-in. o.d. panel-raising bit from Cascade Tool Co. cuts the bevel and the rabbet at the same time leaving a ¼-in. tongue to fit the panel frame. These carbide-tipped bits come with top-mounted template bearings. Also available as a shaper cutter. (Price: $49.95)

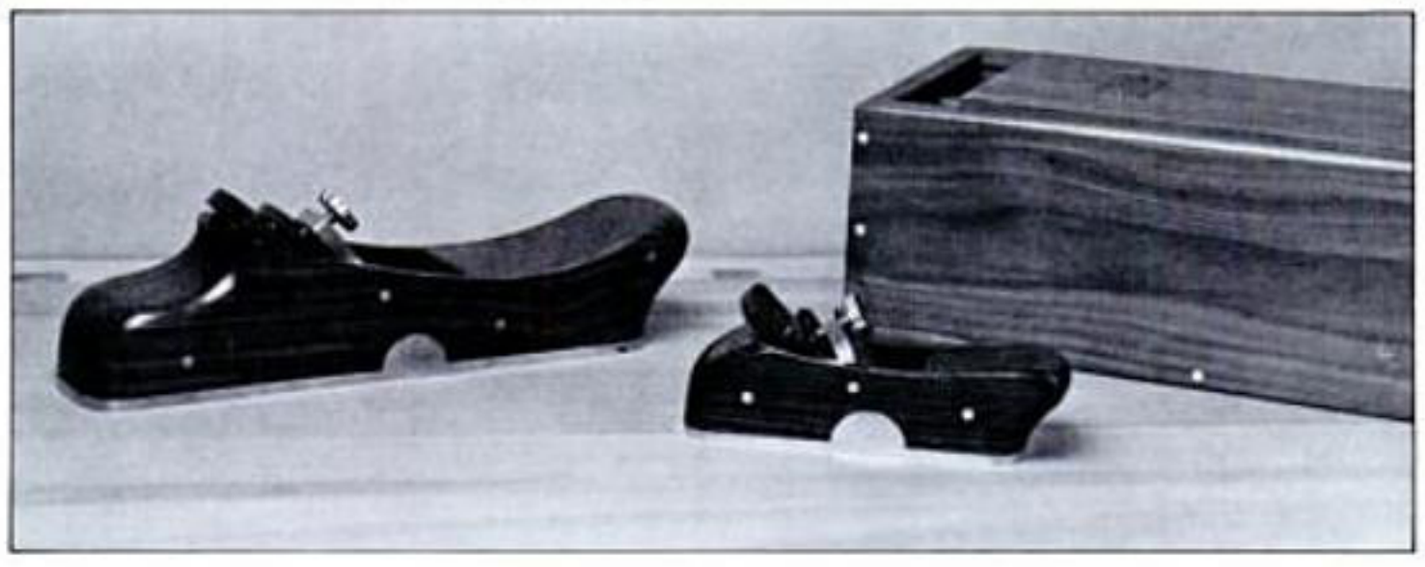
■ *Cascade Tool Co., Dept. AWT, Box 848, Mercer Island, WA 98040*

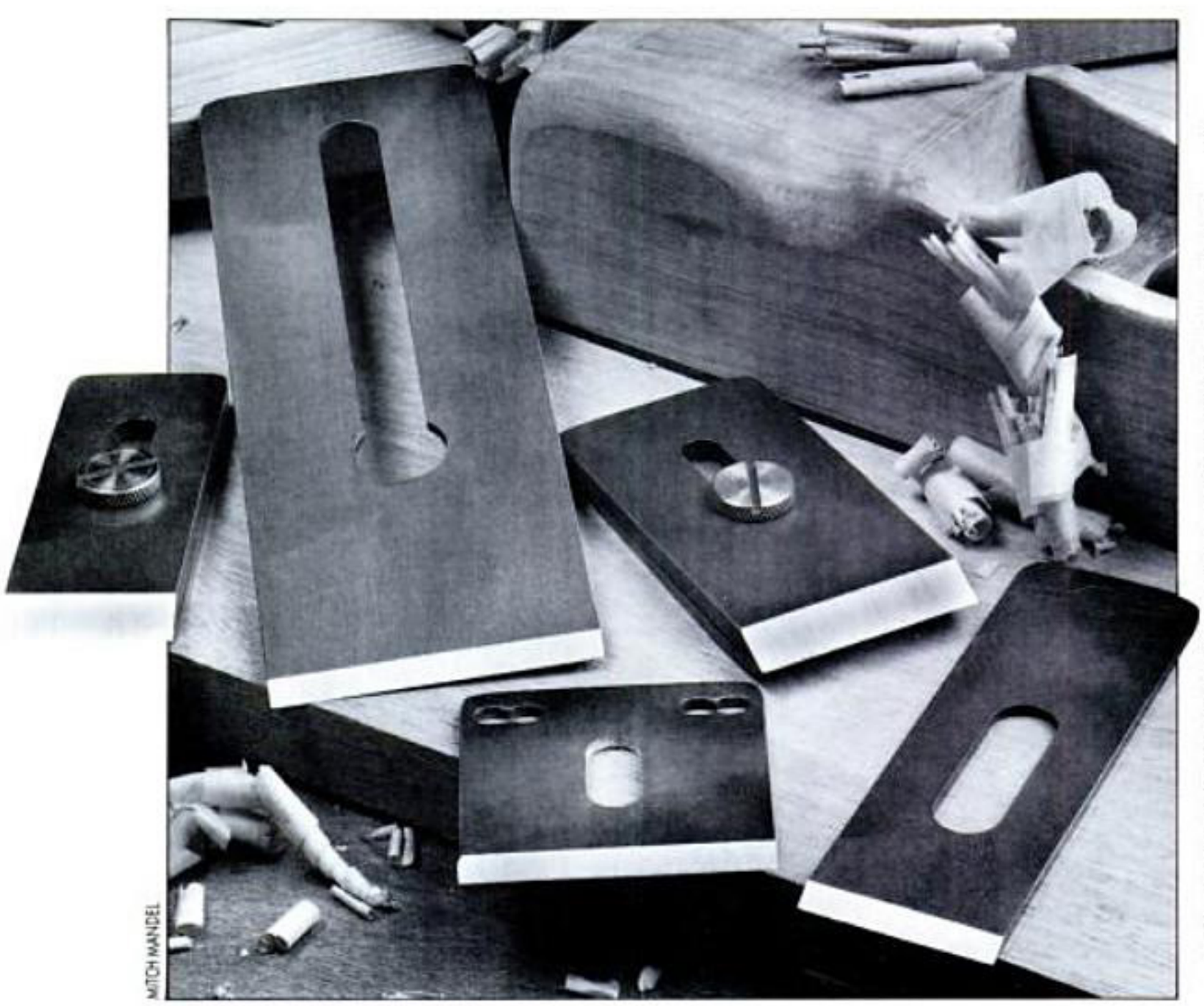
## First-Class Planes

Dragonsong has put the art back into the planemaking craft. Dragonsong planes are made by an American craftsman out of laminated Macassar ebony, with rivets running through the body for extra stability. The durable, low-friction phosphor-bronze sole comes tuned up and ready to go. The blade and back iron—made of a special high-carbon steel for easy sharpening—are held in place by a pivoting brass Norris-type mechanism. Dragonsong planes come in two sizes: 11 in. and 6 in., with blade widths of 2 in. and 1½ in. respectively. Each plane comes in its own custom-made walnut box and cloth bag. (Price: 11 in., $325; 6 in., $250; set, $550)

■ *Garrett Wade, Dept. AWT, 161 Ave. of the Americas, New York, NY 10013*

▼





MITCH MANDEL

## ◄ Hefty Plane Irons

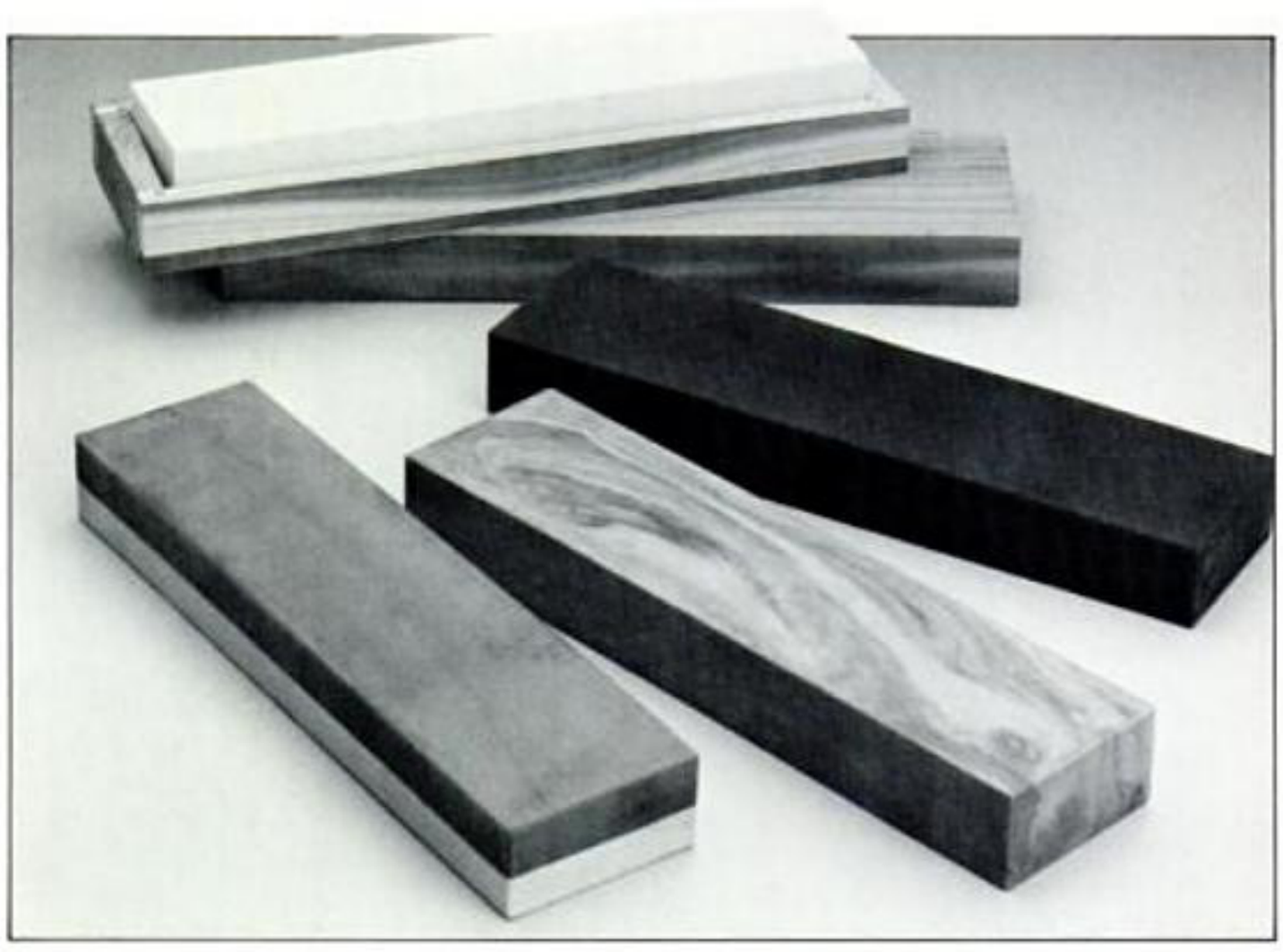
If your old plane iron has a bad case of the chatters, maybe it's time to Hock it. Whether it's a replacement blade for your metal plane or spokeshave or an iron and chipbreaker assembly for your handmade plane, Hock makes it. Made of high-carbon steel and hardened to Rc62, these irons are easily honed to a long-lasting, razor-sharp edge. Hock irons resist chattering and deflecting because they're thicker than standard irons; replacement irons are 3/32 in. thick, and irons for handmade planes are 3/16 in. thick. By the way, Hock makes plane kits, too. (Price: replacement blades, $15.95-$21.50; for spokeshaves, $9.50-$11.95; plane iron and chipbreaker assemblies, $19.95-$26.95)

■ *Hock Handmade Knives, Dept. AWT, 16650 Mitchell Creek Drive, Fort Bragg, CA 95437*

## *Tape Holster* ▼

Ever find yourself riding the crest of a productive work wave only to be beached by a misplaced tape measure? The "Gripper" can rescue you from the frustration of lost-tape limbo. Dubbed the "quick draw of tape holders," the "Gripper" holds any size tape measure right on your belt. The tape is held in place by Aplix-brand fastening pads—a durable hook-and-eye system similar to Velcro. You stick one pad on the back of your tape; its mate is already fastened to the leather and plastic holster. Aplix pads are good for more than 10,000 grips, and should you wear them out, replaceable pads are available. The "Gripper" comes in three sizes to accommodate any size tape from 8 in. to 30 in. (Price: $9.95)

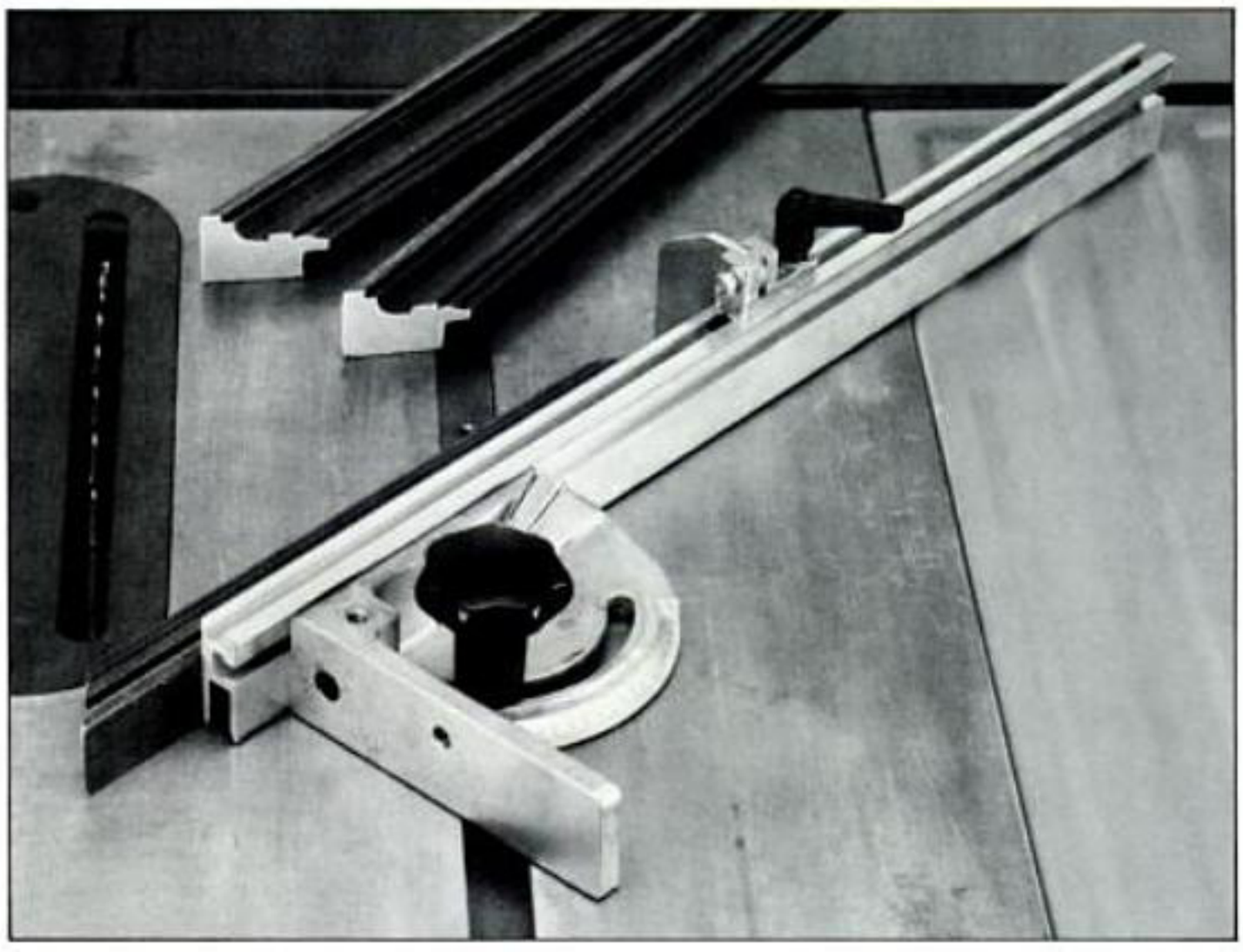
■ *Guildwood, Dept. AWT, P.O. Box 372, St. Marys, OH 45885*



## *"Perfect" Stones* ▲

Here's everything you always wanted in an Arkansas stone for a lot less money. Woodcraft's new Arkansas "Perfect" sharpening stones are made of ground and screened novaculite particles from natural Arkansas stones. These particles are bonded together to create stones of controlled uniformity. Slightly coarser than natural Arkansas stones, these stones are "perfect" in grain and shape, so they cut a sharp edge quickly and more effectively. Stones measure 8×2×1 in., and you have a choice of three grits: coarse (600), medium (700) and fine (900). (Price: coarse, $16.50; medium, $18.50; fine, $29.95; combination medium/fine, $24.95)

■ *Woodcraft Supply Corp., Dept. AWT, 41 Atlantic Ave., P.O. Box 4000, Woburn, MA 01888*



## ◄ *Gap-Free Miters*

Do you shy away from miters for fear of gaps and inaccuracies? Because of its two-faced design, Woodcraft's new, right-angle miter gauge makes miters clean and accurate every time. Each face is ground a precise 90° to the other. Instead of interrupting your work to reset the gauge, you simply slide your stock to the gauge's other face—making inaccuracies disappear. This miter gauge comes with a 20-in. support fence and an adjustable flip stop for precise length cuts. You can buy a longer support fence for larger jobs and additional flip stops for varied length cuts. (Price: $84.95; extra flip stop, $13.50; 39-in. support fence, $24.50)

■ *Woodcraft Supply Corp., Dept. AWT, 41 Atlantic Ave., P.O. Box 4000, Woburn, MA 10888*

*From the PBS series:*
THE NEW YANKEE WORKSHOP

# CHEST OF DRAWERS

## *A Basic Bureau With a Shaker Flair*

BY NORM ABRAM

Of the many examples of Shaker-style furniture, this chest of drawers is one of the best known. Imitations abound, some of them high-priced versions made from walnut or other expensive hardwoods. On the low end, chests like this one can be made almost entirely of veneered plywood or particleboard. In most respects, the chest of drawers I've made is faithful to the antique pine chests found in furniture museums and fine antique shops.

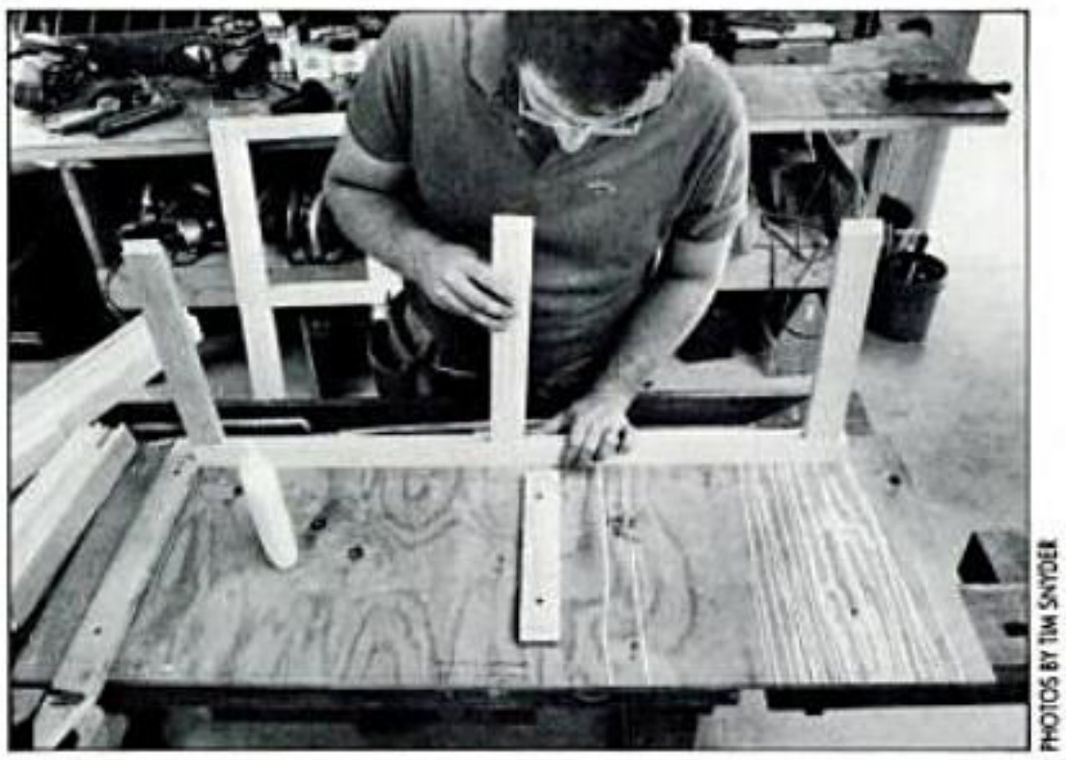
In the old days, cabinetmakers might have chosen to cut the top and sides of the chest from a single wide board instead of gluing up several boards as I've done here. And undoubtably, early cabinetmakers would have cut all the dovetail joints in this piece by hand. Luckily, we're able to use power tools to speed these and other operations.

### *Sides and Frames*

The first step in building the chest is to glue up the sides and top. I use clear, 3/4-in. thick pine boards to make these panels. The finished dimensions of the sides are 17 7/8 in. × 32 3/4 in. The top finishes out to 41 1/2 in. × 18 7/8 in. The panels you glue up should be about 1/2 in. larger than these measurements, so that you've got room to cut edges square and smooth.

While the glue on the panels is curing, you can make the five frames that hold the sides, top and back together. These frames also support the drawers, so they need to be strong, square, straight, and identical in size. Each frame has a pair of sides, a center piece and matching front and back pieces. All pieces are 2 in. wide. The sides and center pieces are 14 1/2 in. long; the front and back pieces are 38 3/4 in. long.

I assemble the frames using simple tongue-and-groove joints cut on the tablesaw with a dado cutter. First I groove the ten front and back pieces. The dado head should be adjusted to make a 1/4-in. wide cut. Raise the cutter 1/2 in. above the table, and set the rip fence 1/4 in. away from the cutter. Turn the saw on and mill a sample groove in scrap stock that's the same thickness as your frame members. Measure the groove to make sure it's centered exactly. When you're sure of the position of the rip fence, go ahead and mill the



PHOTOS BY TIM SNYDER

**Assemble the frames one at a time using a jig made from plywood and scrap boards. After gluing the side and center frame members to a front or back piece, set the assembly face down on the jig to align and square the frame.**

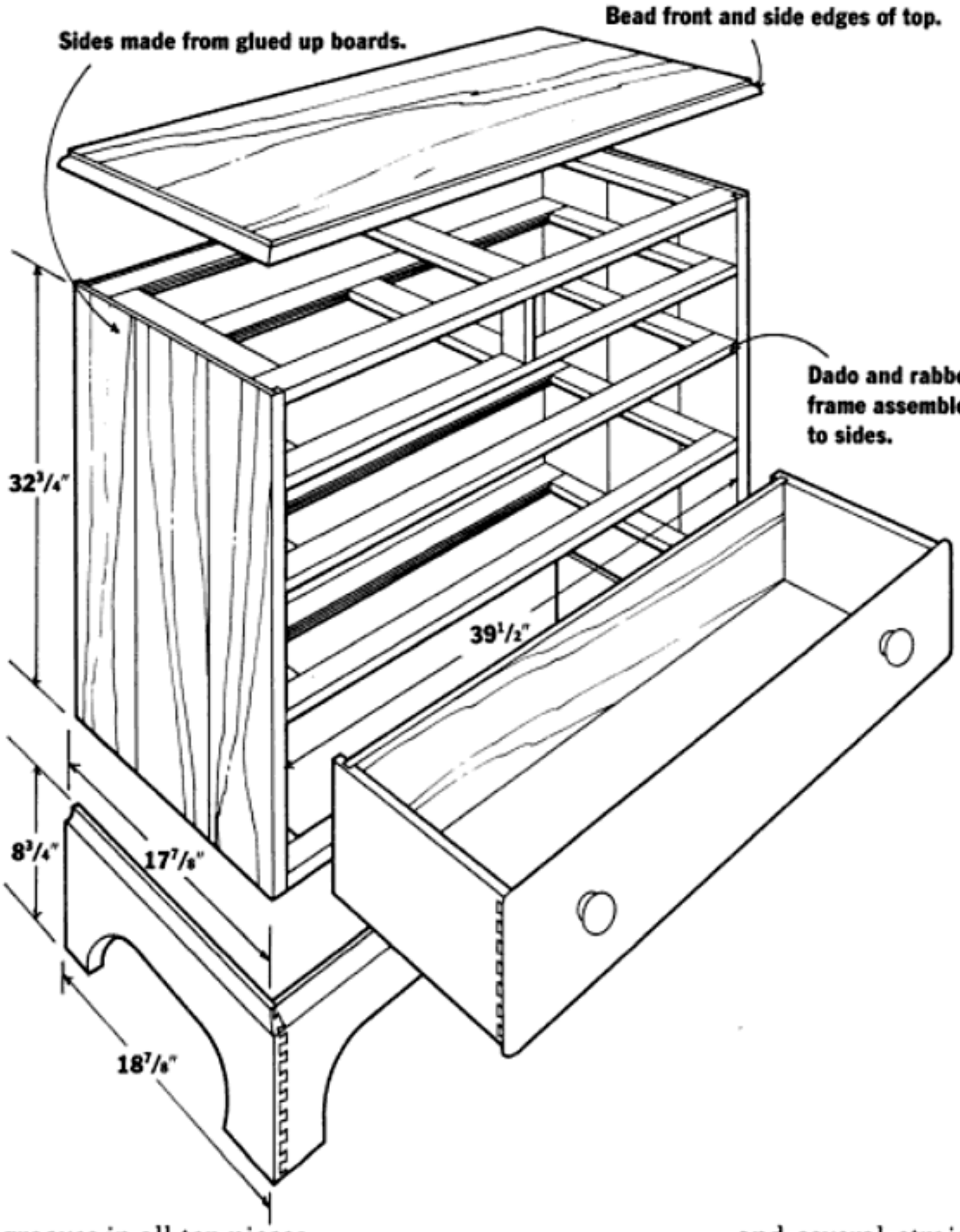
### THE NEW YANKEE WORKSHOP

Master carpenter Norm Abram is a familiar face to the millions of loyal viewers who tune in to television's popular home-renovation series, THIS OLD HOUSE. In his new 13-part TV series, THE NEW YANKEE WORKSHOP, Norm moves from the job site to the workshop. Each week, Norm shows home woodworkers how to build an entire piece of furniture from start to finish—a different piece of furniture each week.

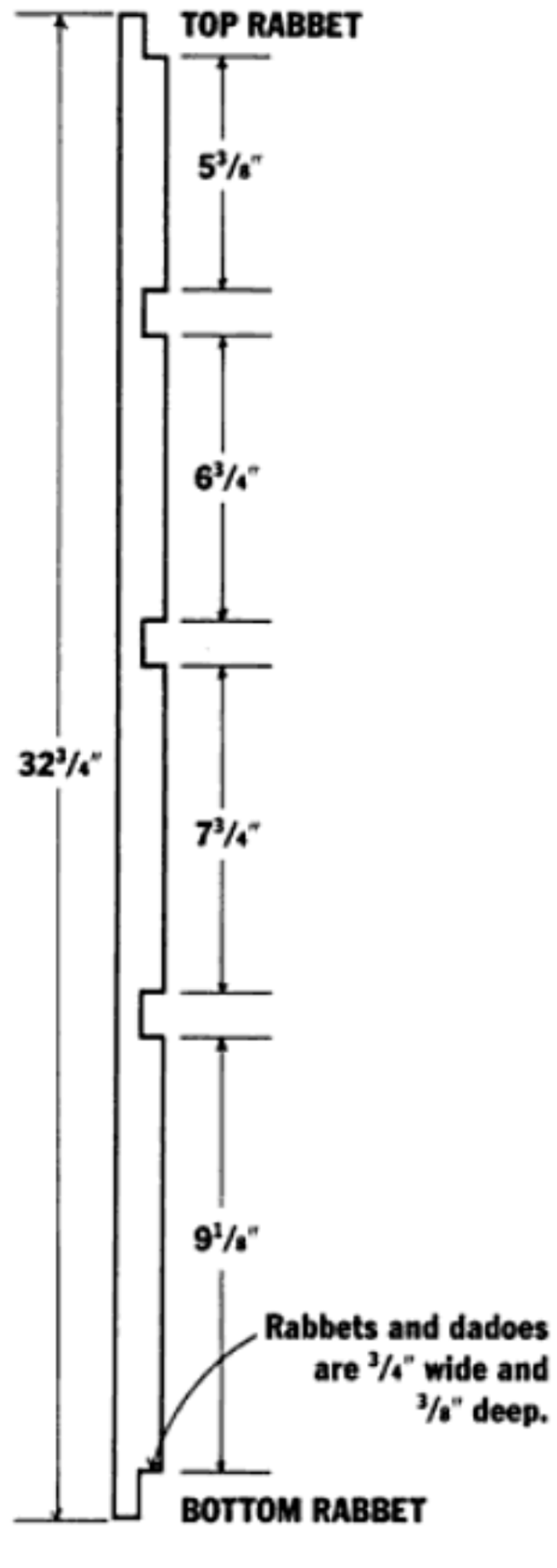
Norm's furniture projects are inspired by Shaker designs and built with modern tools and materials. "We've tried to design it so that someone who has a decent tablesaw, a router table and a few shop tools can build these furniture projects," comments Abram.

The "Chest of Drawers" project will air Saturday, March 18, 1989 at 2 p.m. (EST) on PBS. Check listings for your local station.

## FIG. 1: CHEST OF DRAWERS




## FIG. 2: LAYOUT FOR SIDE DADOES AND RABBETS




DRAWINGS BY DAVID DANN

grooves in all ten pieces.

Both the dado head and the rip fence have to be adjusted to mill the tongues in side and center frame members. The dado should be set to ½-in. width or greater, and lowered so that just ¼ in. shows above the table. Clamp an auxiliary fence against the rip fence and on your side of the cutter. Adjust its location so that the fence aligns side and center pieces for a ½-in deep tongue or tenon. To make the cut, hold the long edge of the stock against the miter gauge. A pair of cuts completes each tongue.

Before milling the sides and center pieces, test the setup by milling a tongue in scrap stock. This tongue should mate snugly with the grooves you've milled in front and back frame members. If your test tongue is too thin, lower the dado cutter. If it's too thick, raise the cutter and make another test joint. Once the fit is right, you'll be able to mill side and center pieces (15 in all) fairly quickly.

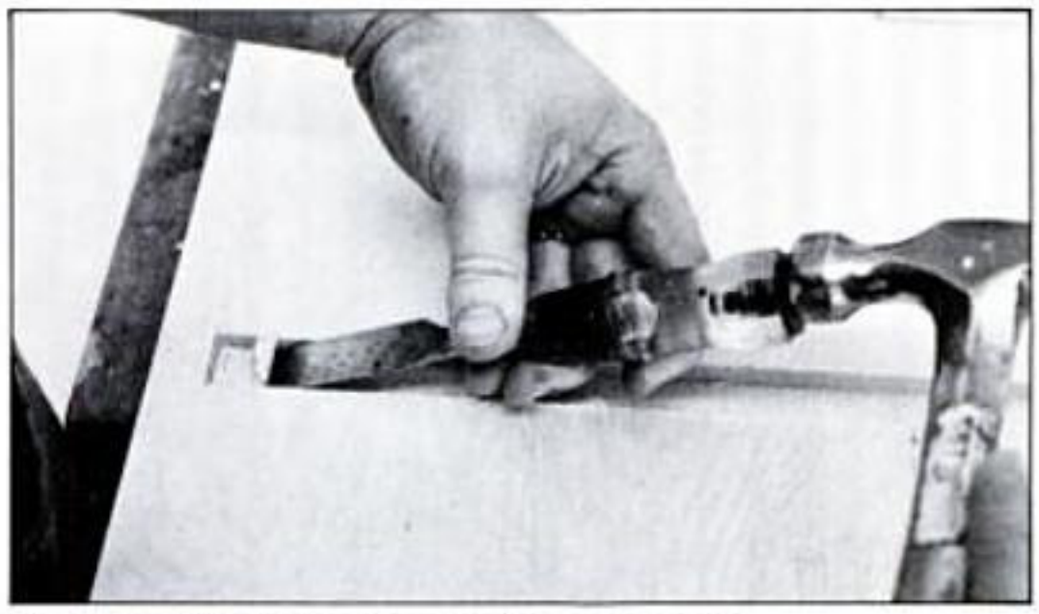
The next step is to assemble the frames. This is repetitive work, but it has to be done accurately or the case won't fit together well. One way to make the process go quickly without sacrificing precision is to use a jig. I built mine from a small sheet of ½-in plywood and several straight 1×2s that keep corners square and aligned while you nail the joints (see photo page 20). Using a framing square, lay out the locations of the frame members. Then screw straightedge 1×2 guide pieces to the plywood so that the frame, when assembled and square, will butt against the guide pieces. After gluing and joining a frame together, hold it against the jig's guide pieces while nailing the joints together with ½-in. long wire brads. Drive several nails into each joint from both sides of the frame. The brads should keep the joints square until the glue cures.

After the sides have been cut to finished size, rabbet their back edges to receive the back of the chest. The back is just ¼ in. thick, but I make the rabbet ⅜ in. deep and ⅜ in. wide to recess the back slightly.

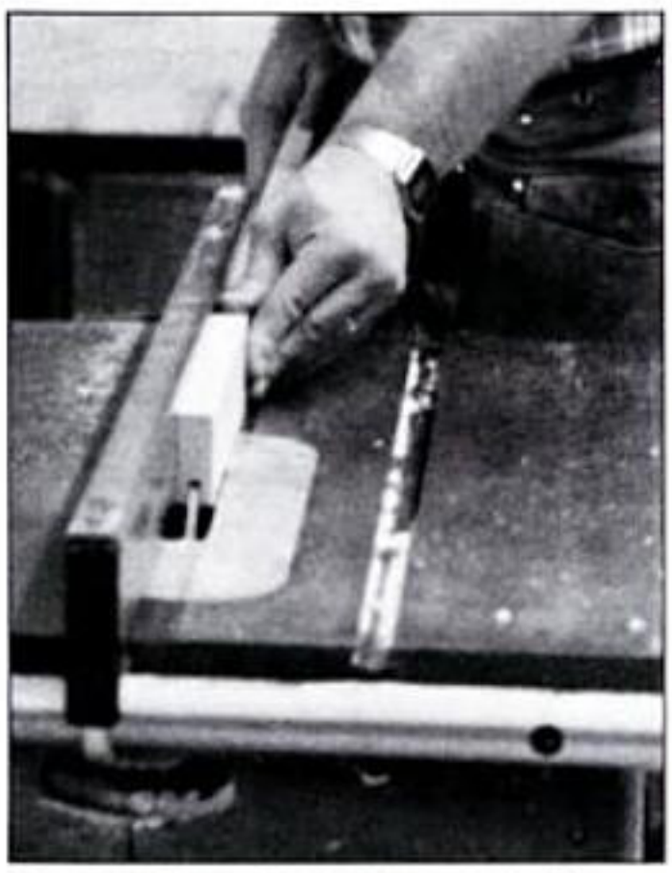
Now the sides can be dadoed to receive the frames. These dados are called "stopped dados" because they stop ¾ in. short of each side's front edge. I use a tablesaw and dado head to cut these dados. Adjust the dado's width to match the thickness of your frame members, and set the cutter height at ⅜ in.

Stopped dados are a bit trickier to mill than regular dados. I use the rip fence as a guide, adjusting its location to match the layout of the dados (see Fig.2). At

**Stopped dadoes are cut in two steps (photo above and right). First dado the sides on the tablesaw (above). Use the rip fence as a guide and lower the side over the cutter.**



**The second step is to square up the end of each dado with a chisel. The square edge should stop 3/4 in. from the front edge.**



**Use the tablesaw's rip fence as a guide when milling grooves in frame members. Adjust dado width to 1/4 in. and cutter height to 1/2 in.**

**Mill tongues with the dado head raised 1/4 in. above the table and adjusted for a 1/2-in. wide cut. Two passes complete each tongue.**

**Glue and nail sides and frames together: Install the three center frames first. Glue and nail each joint with 1 1/4-in. finishing nails at an angle, through the frame edges and into the sides of the dadoes.**

each of five rip-fence settings, you'll cut matching dados in both sides. The sides that are run through front edge first will have to be lowered over the dado head as shown in the photo. Those that are run through back edge first will have to be lifted free just before the dado cuts to within 3/4 in. of the front edge.

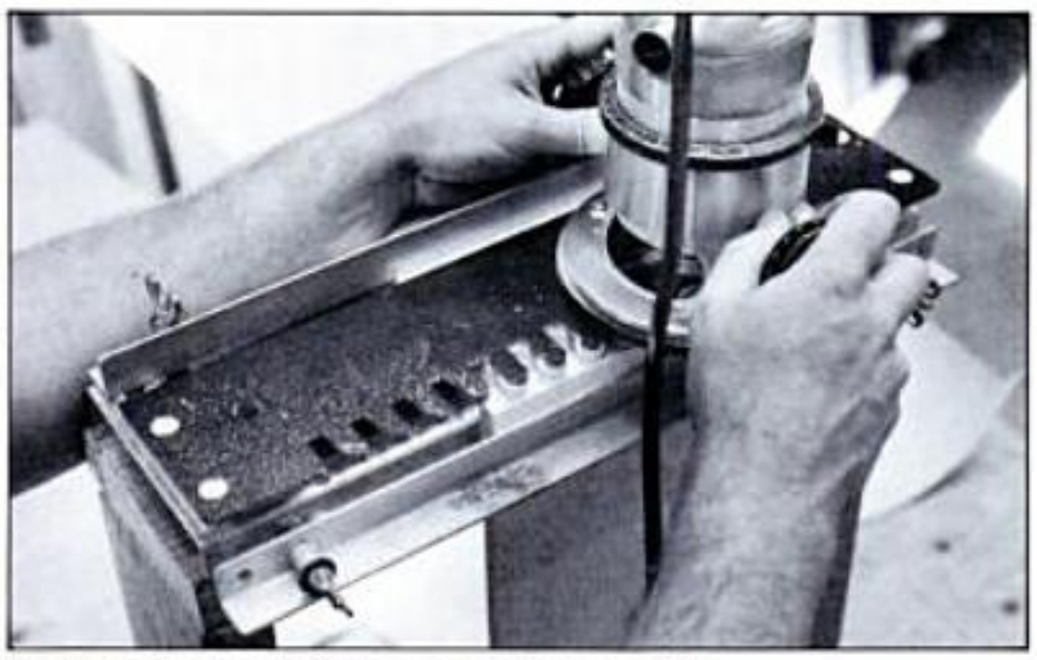
The stopped dados aren't complete until you chisel the "stopped" ends square. Use a sharp pencil and a combination square to lay out the stopped ends. Then switch to a sharp chisel—either 3/4-in. or 1/2-in. width. Using a hammer, drive the sharp edge down just inside your layout lines; then chisel from inside the dado toward the front edge. Repeat this technique until you've reached the full 3/8-in. depth of the dado and squared the end. If you're not used to chiseling, this work can take some time. The key is to remove large chips while working inside the layout lines, and then carefully pare to the layout lines, removing delicate shavings only as the final step. With each dado, your technique will get better.

There's one small step left before sides and frames can be assembled. The front corners of every frame have to be trimmed just slightly to lap over the stopped dados. As shown in Fig. 3, this small cutout is 3/8 in. wide and 3/4 in. deep. I make these on the tablesaw, raising the dado head 3/4 in. above the saw table and adjusting it to make a 3/8-in. wide cut.

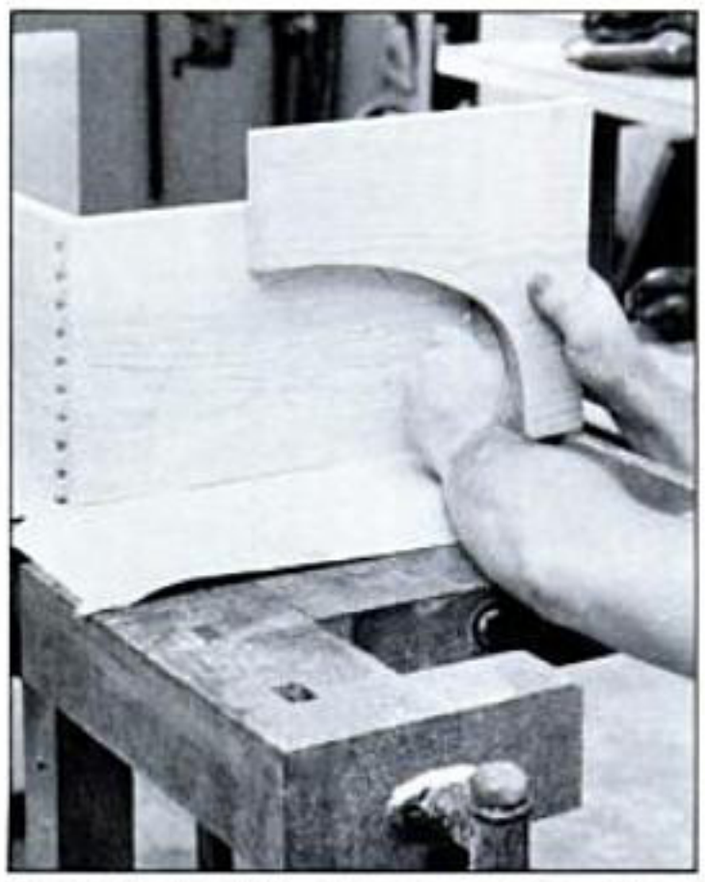
Now the frames and sides are complete, so the next step is to assemble the chest. With one side resting on the workbench, I glue and nail the three center frames into their respective dados. Be sure that the front edge of each frame is flush with the front edge of the side. Fasten the frames to the sides by driving 1 1/4-in. finishing nails through the frame edges and into the sides of the dados. Attach the opposite side the same way. After the three center frames and sides are together, you can glue and nail the top and bottom frames in place. These frames can be nailed down with 5d box nails.

As soon as frames and sides are together and before the glue sets, it's important to square up the chest and install the back. I run a bead of glue along the back edges of the frames and in the rabbets that run along the back edges of both sides. Then I position the 1/4-in. thick back and drive 5d box nails through the back and into the top frame only. Working quickly, turn the chest upright and check the front for square by comparing diagonal measurements. If you need to, rack the chest carefully until diagonals match. Check the

Nail the back to the top frame only then check diagonal measurements at the front of the chest to make sure it's square. Rack the chest until diagonals match then finish nailing the back to the sides and frame members.



The base has dovetailed corners that are made using a router, a 3/8-in. dovetail bit and a dovetail jig.



Dry fit the dovetailed base corners together and trace the curved leg pattern onto the sides and front of the base.

Cut the curved legs out on the bandsaw.


Set up the router table with a 1/2-in. cove bit to mill a cove in the top edge of the base.

three center frames to make sure they're straight, then finish attaching the back by driving 5d box nails into rabbets and frames.

Now cut and install the short vertical frame member that will separate the pair of small drawers at the top of the chest. Like the other frame members, the piece is 3/4 in. thick and 2 in. wide. Center it between the two upper frames, glue and screw it in place.

## *Building the Base*

The chest base has a front and two sides and is made with dovetailed corners, curved legs and a molded top edge (see Fig. 5). Sides and front start out as eight 3/4-in. wide boards. If you're milling 3/8-in. deep dados like I do, then the finished length of the front is 3/4 in. longer that the width of the chest (side-to-side measurement). Likewise, the finished length of the base sides will be 3/4 in. more than the chest depth.

It's best to mill the dovetails in the base sides and front before cutting the curves for the legs. This way, if your dovetails don't come out right, you won't have wasted time cutting the legs. The dovetail jig that I use is similar to many jigs on the market. It consists of a template that's built into a right-angle clamping mechanism, which allows you to mill the tails and the pins in joining pieces in a single operation. The template requires a 3/8-in. dovetail bit and guide bushing to be used in the router.

Jigs like this cost between $75 and $150, and they're well-worth the investment if you're planning to do any amount of cabinetry work. In terms of strength and stability, dovetail joints are far superior to any other type of joint. Properly made, a dovetail joint doesn't need to rely on glue, nails or screws to stay together; that's why you'll find dovetails on antique furniture. After a little practice with a dovetail jig, you'll be surprised at how quickly you can produce those intricate, traditional joints.

If you haven't used a jig before, be sure to read the manufacturer's instructions carefully, and mill some practice joints in scrap stock. This way, you'll learn how to clamp the stock in place and fine-tune the jig before cutting into good material. I set up my jig so that the tails are milled in the base front; the pins are milled in the sides. This lets the dovetailed corners show from the front of the chest. When you're using the jig, it's important to move the router and bushing

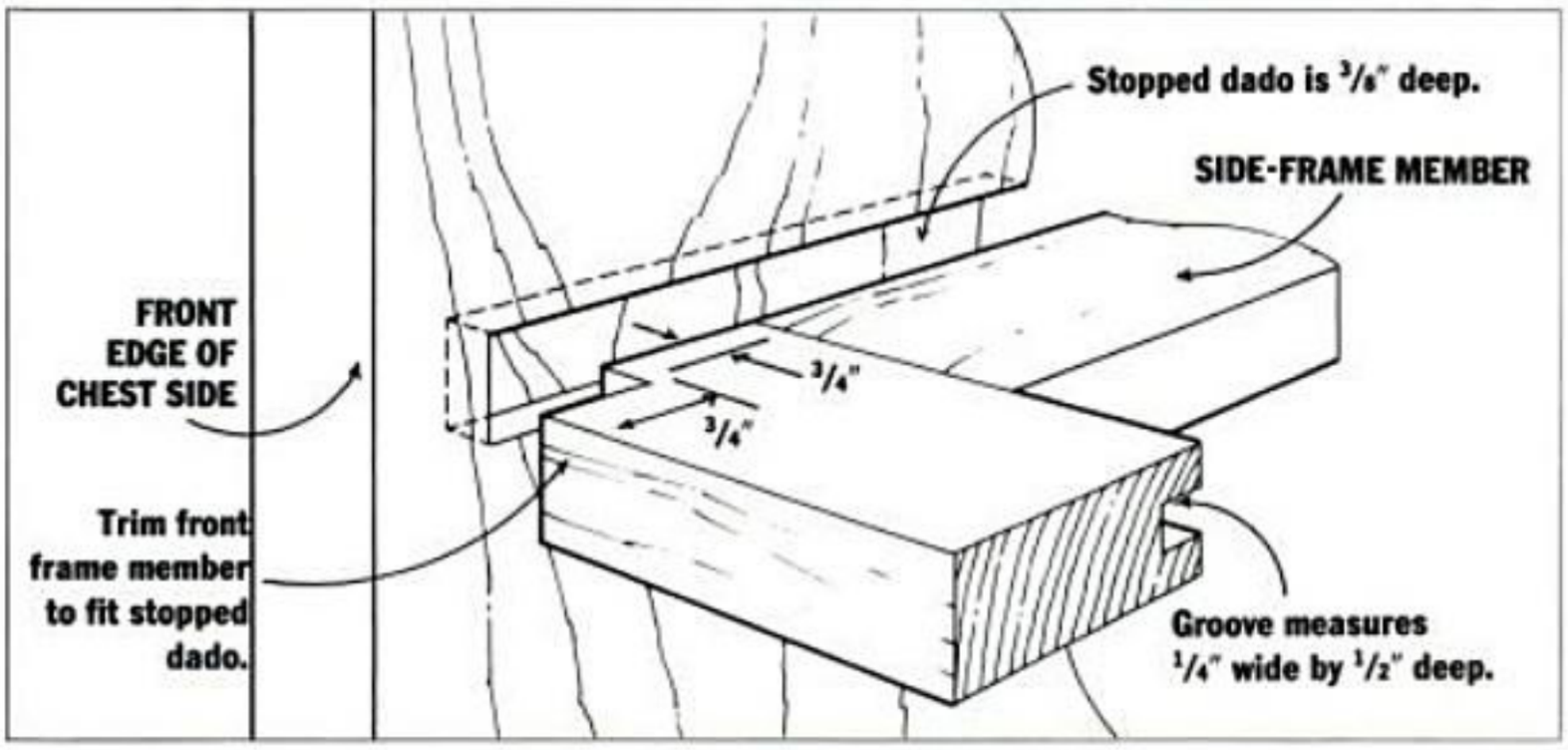
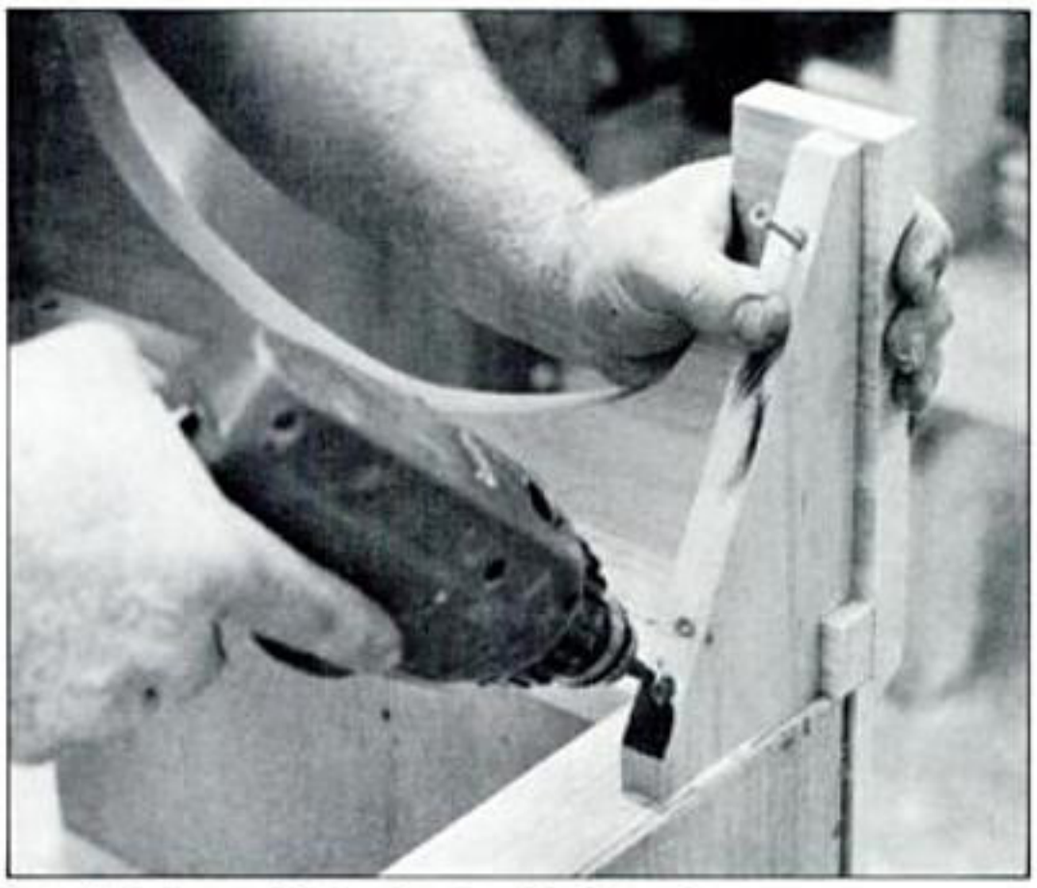
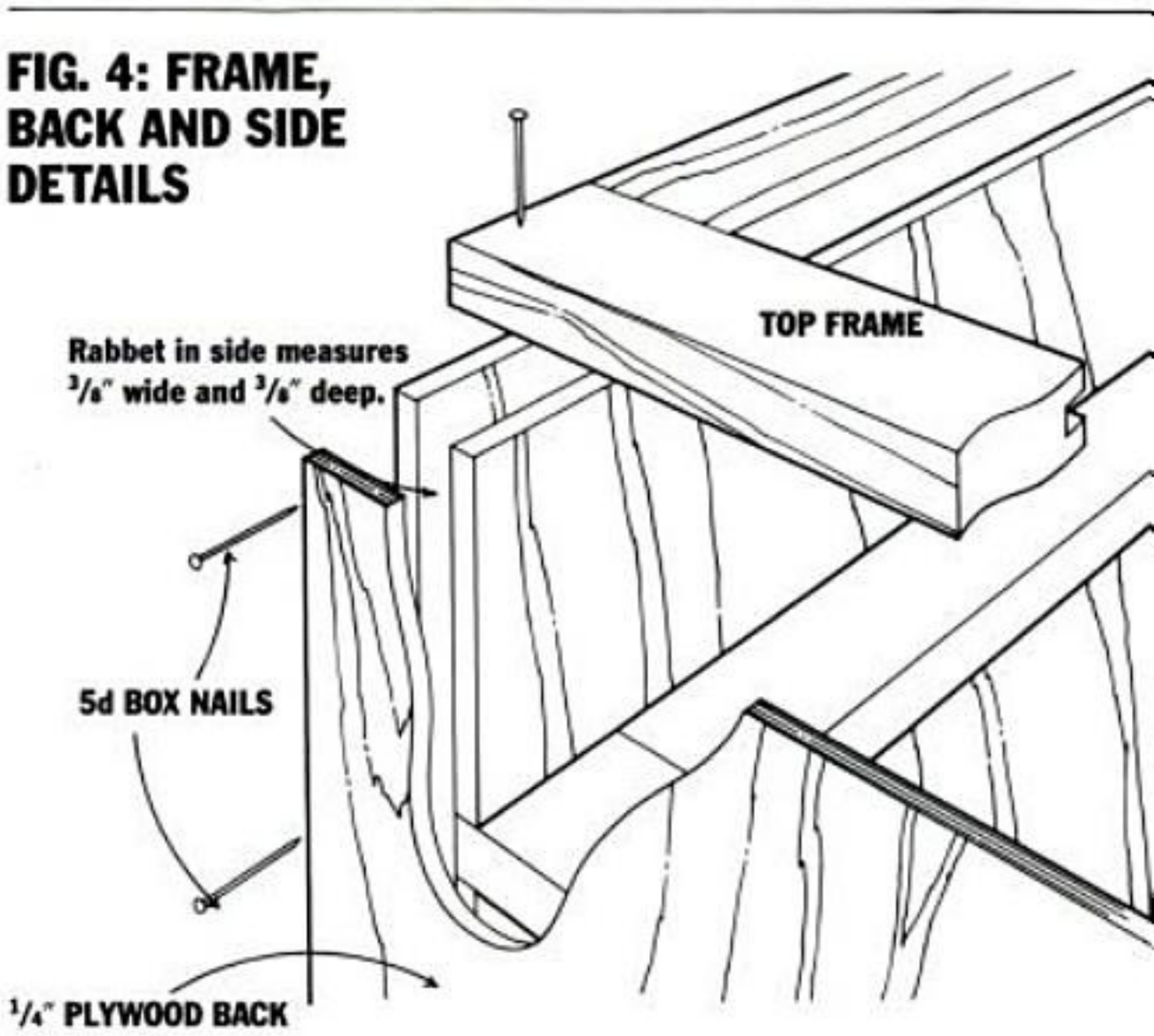



**FIG. 3: STOPPED DADOES AT FRONT OF CHEST**



**Install the base with the chest upside down. For extra strength, glue and screw triangular braces at the back corners, joining the base sides to the bottom frame of the chest.**

**FIG. 4: FRAME, BACK AND SIDE DETAILS**




carefully into the template's fingers. If the router base isn't flat against the template top, the dovetail bit can cut into the template instead of the wood.

After the dovetails are milled in base front and sides, I temporarily assemble the base and trace the curves for the legs on all three pieces. The pins and tails are delicate, so treat them carefully until the joints are glued up. Once the curves are traced on front and sides, I cut them out, one at a time, on the bandsaw. If you don't have a bandsaw, it's not difficult to cut these curves with a portable jigsaw.

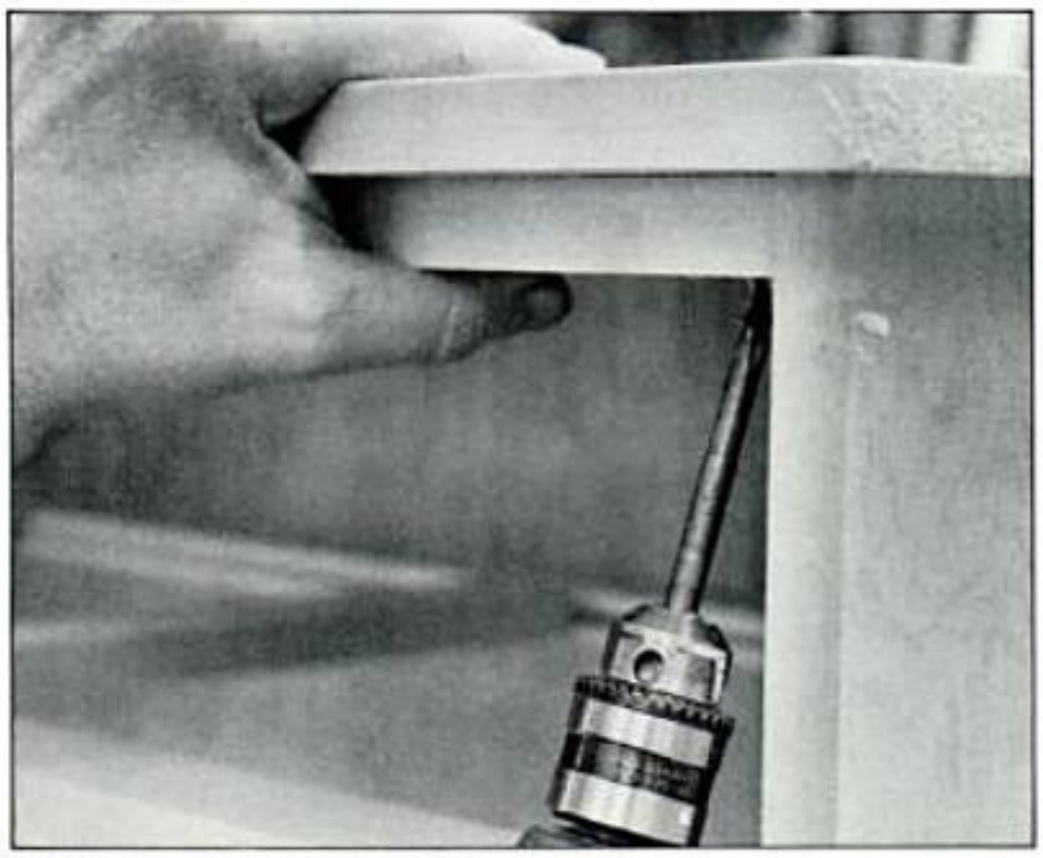
The next step is to glue the base together. Because there's so much surface area to cover, I use a small brush to spread the glue between pins and tails. Fit the corners together carefully. If the joints are snug, as they should be, you may have to hammer them together. Be sure to use a wood mallet or a shot-filled mallet, instead of a regular hammer, which might damage the joint and mar the wood.

Now glue and screw 1×1 cleats inside the assembled base, 5/8 in. down from the top edges of sides and front. About every 8 in. or so, drive 1 1/4-in. drywall screws through the cleat and into the base. This cleat forms a ledge for the chest to rest on as shown in Fig. 5. It also stiffens the base slightly, a feature you'll appreciate during the next operation.

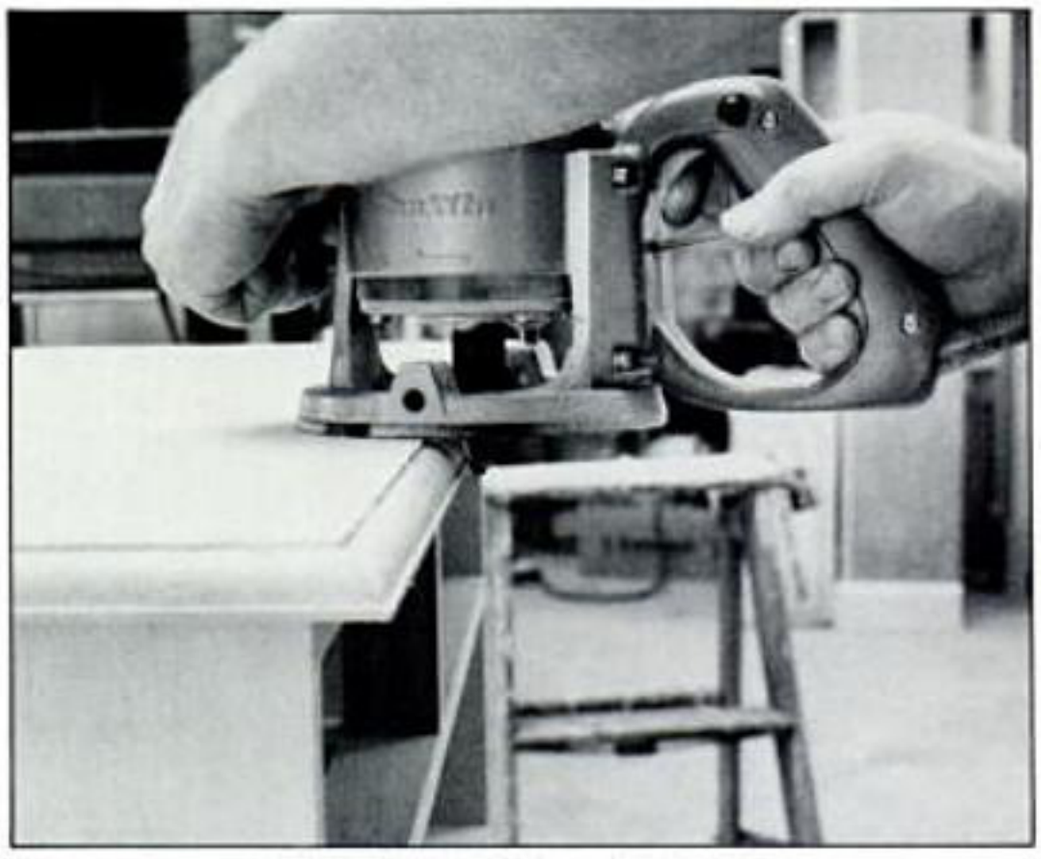
Instead of leaving a square edge along the top of the base, I mill a coved edge, using a 1/2-in. radius-cove bit chucked in a router-table setup. The coved edge doesn't hold dust like a square edge will, and it also looks better. Adjust the height of the bit and the router-table's fence so that at least 1/8 in. of flat shows at the top of the cove. Test your setup on some scrap stock first, then readjust the bit and fence if necessary. When you're ready to mill the base, run the sides through first, then the front. This will leave the cleanest edge where it's most visible.

Before joining the chest to the base, give both a thorough sanding. You'll be able to do a better sanding job before these parts are assembled. I smooth out the curves in the base using a drum sander chucked in my electric drill.

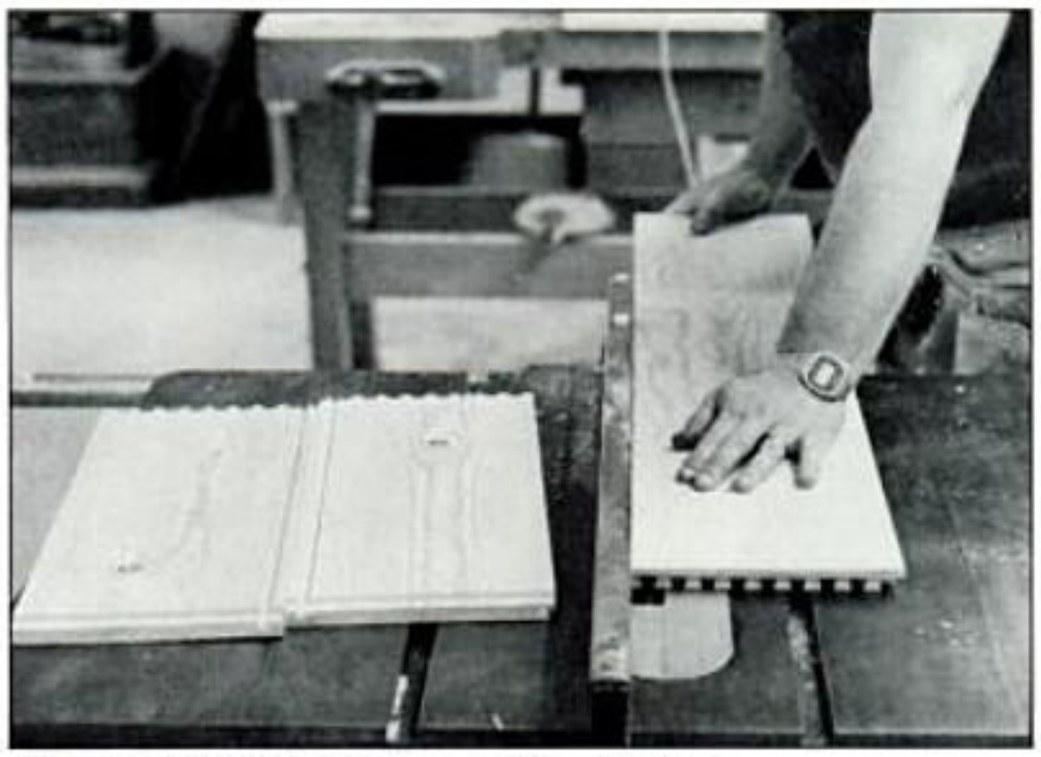
Join base to chest with the chest positioned upside down. The chest should nest snugly in the base, resting against the cleats. Spread glue along the joining surfaces, and attach the cleats to the bottom frame of the chest with 1 5/8-in. drywall screws. For an extra measure of stability, I screw a pair of triangular



Attach the top by driving 1¼-in. drywall screws through the top frame from inside the chest.



Use a router and a ½-in. beading bit to mill a bead around the edge of the top.



After dovetailing the drawers, dado each side to hold the bottom and back. Set the dado blade ¼-in. above the table surface.

The drawer fronts have been rabbeted along top and side edges and dovetailed for the sides. The final step is to round over the front edges with a ¼-in. round-over bit in the router table.

braces bridge between the back edges of the base sides and the back rail of the bottom frame as shown in the photo on page 22.

## *Attaching the Top*

The top overhangs the sides and front of the chest by 1 in. I fasten it from underneath, screwing through the top frame with 1¼-in. drywall screws. In order to give the top room to expand and contract without pulling loose, I don't glue it down. Instead, I use only nine screws: one screw in each corner, and a screw at or near the midpoint of each frame member. The corner screws are driven in slots, rather than holes. Working the drill bit back and forth, I make these slots about ⅜ in. long and parallel with the sides of the chest (see Fig. 6). This configuration takes into consideration that the top's movement will be greatest across the grain, rather than with it.

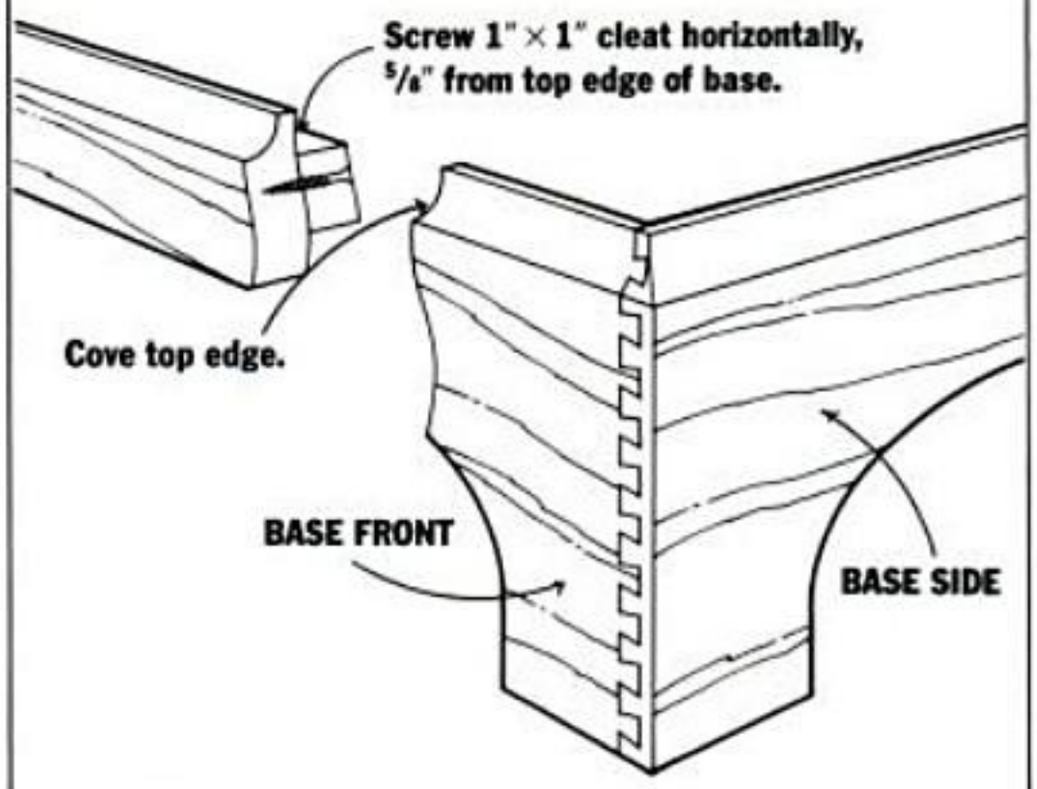
With the top in place, you've now got to mill a bead on its side and front edges. I use a ½-in. beading bit in my router. Adjust the bit's position to center the bead on the ¾-in. thick edge. Working from left to right, mill the side edges first, then the front. Feed the bit slowly, and take care to keep the router base flat against the top.

## *Drawer Construction*

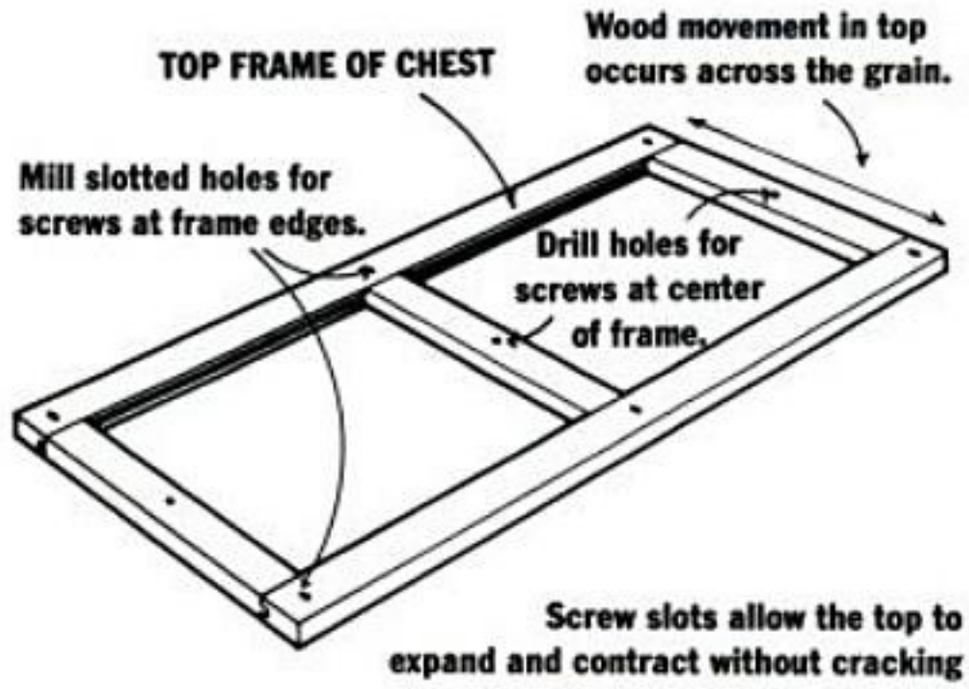
The drawers for this chest are designed for heavy use. Drawer sides, made with ½-in. thick pine, are dovetailed into ¾-in. thick drawer fronts, and the fronts overlap their openings on three sides with a rounded-over lip (see Fig. 7). The first step in constructing the drawers is to cut all the parts to their finished size. On this chest, the large drawer fronts are all 38¾ in. long. Sides for all drawers are 17¼ in. long, allowing ¼-in. clearance at the back of the chest when a drawer is closed. To calculate side widths, subtract ⅛ in. from the height of each drawer opening.

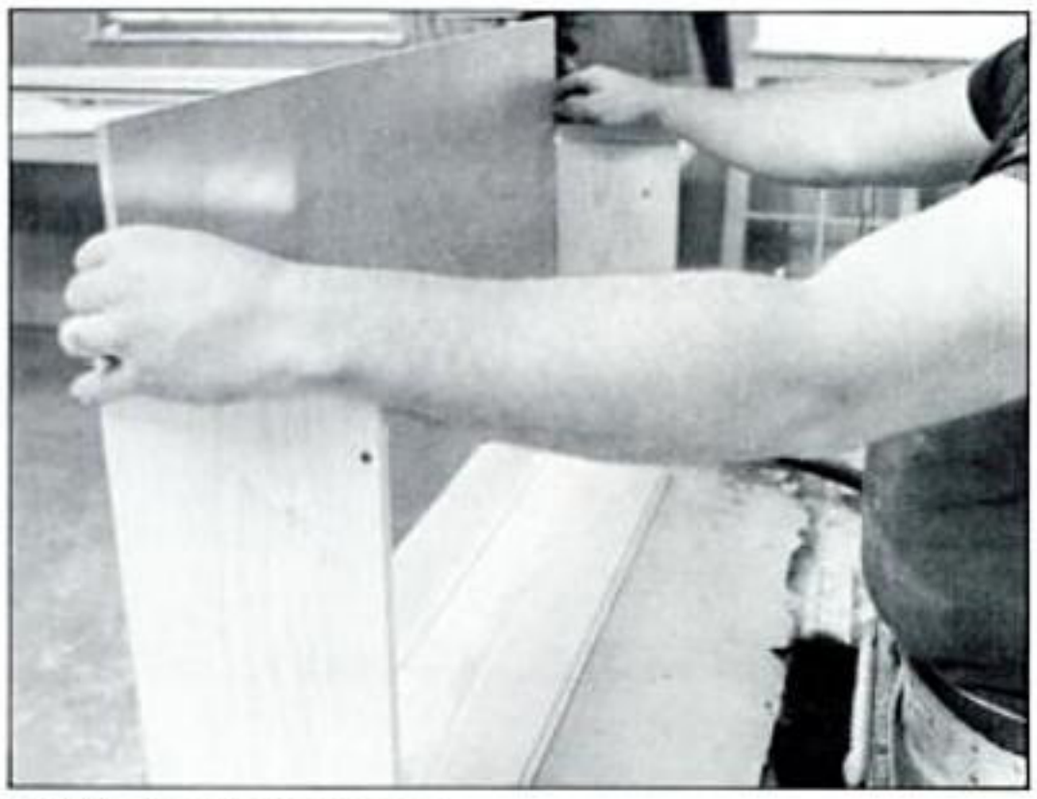
After cutting all the drawer parts to size, I rabbet the drawer fronts on their tip and side edges. This rabbet is ¼ in. wide and ½ in. deep, and I mill it on the tablesaw, with the dado head set up against a wood auxiliary fence. When all the rabbets are done, it's time to use the dovetail jig again to make the joints where drawer sides meet their fronts. In my jig, the drawer front must be clamped horizontally, under the template with the rabbet facing up. The side is

## FIG. 5: BASE CONSTRUCTION



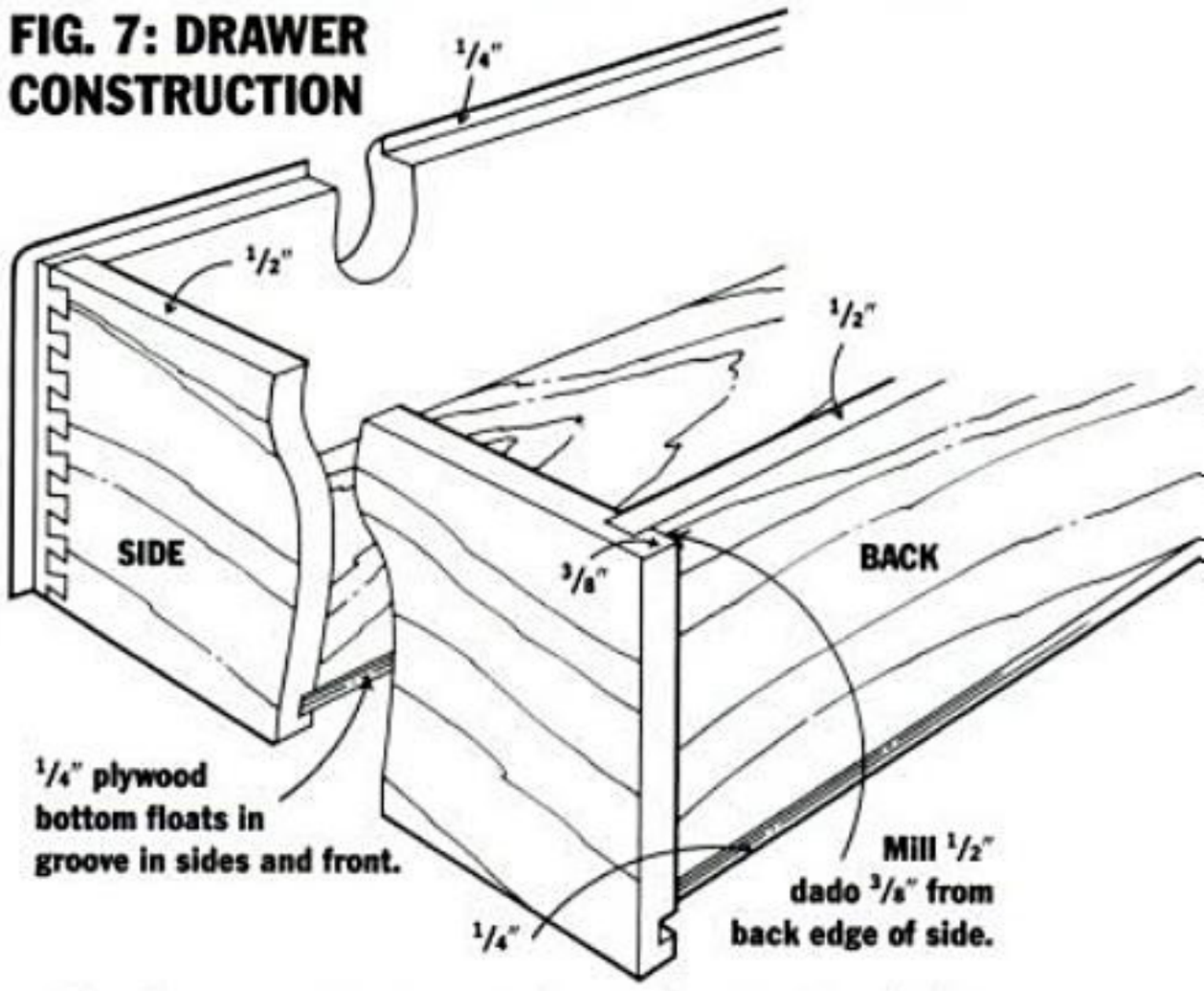

## FIG. 6: ATTACHING THE TOP



Installing the drawer bottom.

## FIG. 7: DRAWER CONSTRUCTION




clamped vertically. With this setup, you'll mill through the side and 1/2 in. into the shoulder of the rabbet.

Once milled, the sides fit the drawer fronts only one way, so mark each side to distinguish right from left and inside face from outside face. Now set up the dado head in the tablesaw to mill a groove 1/2 in. wide and 1/4 in. deep. Position the rip fence 3/8 in. away from the cutter. First, dado all the sides to receive the drawer backs. Then adjust the dado's width of cut to 1/4 in., and mill the grooves in sides and drawer fronts to receive the bottoms. Check the label on each side piece to make sure its dados are milled in the right locations.

Assuming that you've cut the backs and bottoms to size, there's one more operation to complete before you can assemble the drawers. The front edges of the drawers have to be rounded over. The lip created by the rabbeted edges is just 1/4 in. thick, so I use a 1/4-in. round-over bit to give the edges a slight curve. I set up the bit in the router table and mill the drawer edges as shown in the photo on page 22. Mill a sample edge in scrap stock first to make sure the bit and fence are set up correctly. When milling the drawer edges, always mill across the grain first so that you can finish up with the grain.

The drawers are now ready to glue up. Brush the dovetail joints with glue and assemble them first. If they need some coaxing, tap side into fronts with a shot-filled hammer or wood mallet. Install the bottoms next and finally the backs. I let the bottom float in the dadoed sides and front, nailing it only into the back with 5d box nails. Backs should be glued and nailed in place.

This completes the chest of drawers, except for installing the drawer knobs. Simple turned wood knobs are traditional on this style of chest, but ceramic knobs also look nice, depending on the type of finish you use on the chest. To make the drawers slide smoothly, rub the bottom edges of the drawer sides with some wax. ▲

*Norm Abram is host of the PBS TV series, "The New Yankee Workshop," produced by WGBH-TV in Boston and co-host of the series, "This Old House." From* The New Yankee Workshop *by Norm Abram. (1989 by WGBH Educational Foundation, Norm Abram and Russell Morash. Reprinted by permission of Little, Brown and Co., Inc.) The mail-order edition is available from Rodale Press, Inc., 33 E. Minor St., Emmaus, PA 18098.*

# WINE RACK

## *Display Your Handiwork and Your Wine at the Same Time*

BY SIMON WATTS

Here's a versatile wine rack that you can hang on the wall or lay on a counter. Guests will swear your wines are from the choicest grapes when you nonchalantly select your bottles from this handsome rack. You'll find it's quick and easy to make—a fine idea for an elegant gift on short order.

PHOTOS BY MITCH MANDEL

**You have the option of hanging this wine rack on a wall or laying it on a counter.**

### *Materials and Dimensions*

I made the original wine rack in walnut, but you could use any reasonably strong hardwood including oak, ash, maple, cherry or teak. Better not use a softwood (except possibly Douglas fir) because the weight of the 11 bottles and their contents is close to 30 lbs.

Choose the stock—grain running lengthwise—and plane it to a hair over $^{3}/_{4}$ in., $^{13}/_{16}$ in. will do, $^{7}/_{8}$ in. if possible. When cleaned up, stock for the two sides should measure $6^{1}/_{2}$ in. wide and $38^{1}/_{8}$ in. long. Make sure there are no checks or shakes that may weaken the wood. It will be easier to do the finish sanding before you make any cuts.

With $^{1}/_{8}$-in. hardboard, thin plywood or cardboard, make a full-size template of one side in the dimensions shown on the drawing (see Fig. 1). I always keep templates such as these for future use, especially if your first rack is a gift—because once you see it on your friend's wall, you're bound to want one yourself. On this template, you'll want to cut out the half circles with a coping saw or bandsaw, but you needn't cut out the full circles. Instead, mark their centers accurately with a hole using a drill or an awl. Lay the template down on the wood, mark out the half circles and then the centers of the full circles. I suggest cutting the full circles first because the stock is less fragile that way and easier to clamp.

There are a number of ways to cut out these holes. I used a circle or fly-cutter attachment on my drill press. Despite its humorous name, (no, it doesn't come wrapped in flypaper) it is a dangerous tool. Be extremely wary. The rotating bar can catch long hair or a loose sleeve much faster than I can write about it. Another possibility for cutting these circles is a $3^{1}/_{4}$-in. hole cutter (available from Tool City, 14136 E. Firestone Blvd., Santa Fe Springs, CA 90670). You could just as easily remove this waste by drilling a hole inside and near the perimeter of the circle, inserting a coping-saw blade and sawing it out.

When using a fly cutter to cut the circles, begin by clamping or screwing a flat piece of $^{3}/_{4}$-in. hardwood, plywood or particle board to the table of your drill press. Leave this in place for the entire drilling operation. Now set the arm of the fly cutter to $1^{5}/_{8}$ in., and slow the speed of the drill down to 300 rpm or less.

**A fly cutter will cut out circles in a flash, but watch your fingers.**

Bring the cutter down so it just grazes the surface. Turn the drill press off and measure the diameter. Adjust the arm of the cutter if necessary and keep on trying until the diameter of the hole is 3¼ in.

Now, set the depth stop on the drill press so there's no danger of hitting the iron table, and try cutting a circle in a piece of scrap, preferably the same wood you are using for the rack. Be sure to clamp it firmly. Examine the underside for tearout where the cutter exits. If necessary, sharpen the cutter or try drilling only part way through and then turning the work over and completing the cut from the other side.

It saves time cutting the circles on both sides of the wine rack with these sides fastened together. Instead of using clamps—they tend to get in the way—screw the two pieces together before drilling. Just make sure you put the screws through the half-circle waste because these parts will be cut away later. Now, clamp the two sides to the table, center the twist bit of the fly cutter over one of the circles and drill.

After you've cut the full circles, but before separating the two sides, mark out the three notches for the hangers. These are conspicuous joints so they should be cut out with care. Scribe a line with a marking gauge ½ in. from the edge. Saw across the grain just inside the line and chisel out the waste. You're ready to bandsaw the top and bottom edges and the half circles using an ⅛-in. or ¼-in. blade or coping saw.

Cleaning up these circular cuts is quite a chore. You might want to get a 2-in. or 2½-in. drum sander that will fit in the drill press or improvise something.

Cut out the three hangers, measuring 7¾ in. long, 1½ in. wide and ½ in. thick. Fit them to the notches and secure each joint with glue and a single 1¾-in. #10 flat head steel screw. If you plan to hang the rack on a wall, it's best to drill and countersink the hangers before final assembly. Make sure you go through the Sheetrock or plaster into something solid—like a stud—or you'll end up with a horrid mess of broken glass and wine.

If you put off gluing the hangers until later, the rack can easily be taken apart and boxed if you choose to bestow one on some needy friend. Though, if offered the choice, I might take the wine instead… ▲

*Simon Watts teaches wooden boatbuilding in California and around the country. He lives in San Francisco.*

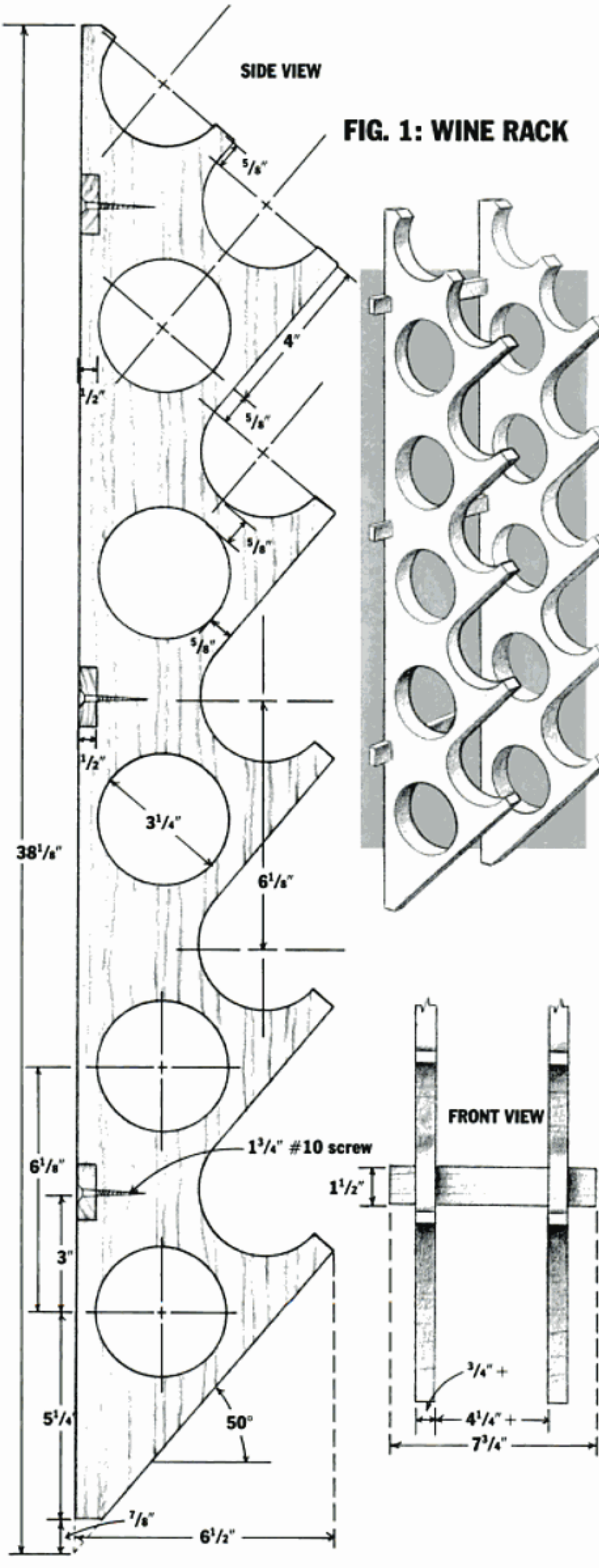



**FIG. 1: WINE RACK**

DRAWINGS BY SALLY ONOPA

# CUTTING INLAYS WITH A ROUTER

*Rout the Insert and the Hole With Just One Template*

BY BLAIR HUBBARD

**Decorative shapes or practical patches, a router makes inlay work fast and accurate. The right bit and guide-bushing combination lets you rout the hole and the insert with the same template.**

PHOTOS BY DAVID SLOAN

When the need arises to inlay one piece of wood into another, there are a great many methods and tools that will work. When I'm faced with an inlay job—especially one that involves multiples of the same shape—I reach for a router. With a template the shape of your inlay and the right combination of router bits and guide bushings, it's possible to rout both the inlay and the hole into which it fits with the same template. Once you've made the template, you can cut the same shape again and again. Best of all, the inlay is always a perfect fit.

My template technique has all sorts of applications, both practical and decorative. I use it most often for inlaying patches to cover defects in boards. And I also find it handy for setting decorative ceramic inserts into furniture surfaces. It's also possible to produce inlays in geometric shapes like circles, squares and stars or most any random shape. The primary restriction is that, without some hand work, the inlay can't have a smaller radius than the radius of the router bit.

While the technique is quite simple, some of the

concepts aren't easy to visualize until you've actually tried them. If you find yourself getting confused as you read, the drawings and photos will make things clear.

## *Guide Bushings and Bits*

A guide bushing guides the router around the template. In case you aren't familiar with them, a guide bushing is a small cylinder of steel that fits into the base of a router. The cylinder part surrounds the router bit and protrudes slightly below the router base as shown in the photo and Fig. 1. The guide bushing rubs against the edge of a template to guide the router through the cut. Guide bushings come as standard items with some routers and are available as optional accessories for most routers.

Guide bushings come in different sizes and you'll need two—a large bushing to rout the hole and a small bushing to rout the inlay. Not just any two guide bushings will do, however. The sizes are important.

Guide-bushing specifications in tool catalogs normally list two diameters. The smaller diameter indicates the largest bit that will pass through the opening. The larger diameter is the outside diameter (o.d.) of the cylinder—the part that rubs the template. The *offset* between the outside of the bushing and the cutting edge of the bit is a crucial factor in template routing as shown in Fig. 2. The offset is measured differently depending on whether you are routing the insert or the hole.

When routing the insert, you measure the offset from the outside of the bushing to the *farthest* cutting edge. When cutting the hole, you measure the offset from the outside of the bushing to the *nearest* cutting edge. Keeping the offset the same for the insert and the hole allows you to cut both with the same template.

You need to select a combination of guide bushings that give you the right offset. This isn't easy to visualize, but the drawing in Fig. 2 should make it clear. The chart in Fig. 2 lists practical combinations of router bits and guide bushings and the offset that results. If you want to experiment with other combinations, here's the rule of thumb: To rout both the hole and the insert with the same bit, the outside *radius* of the large guide bushing must equal the *radius* of the small bushing plus the *diameter* of the bit. (Note that guide-bushing dimensions are usually given as diameters, while most computations for template routing are made using a radius. Beware.)

While I'm on the subject of guide bushings, I want to mention that some router manufacturers offer a wider selection of guide bushings than others. Porter-Cable, Ryobi, Makita and Hitachi all have a large selection of sizes. I like to use my Ryobi plunge routers for inlay work because there are nine different guide-bushing sizes to fit these routers and the guide bushings can be changed without removing the bit. Another advantage is that the Ryobi guide bushings protrude only 1/8 in. below the router base, which allows me to make my templates from 1/4-in. thick stock. If your

**FIG. 1: GUIDE-BUSHING NOMENCLATURE**

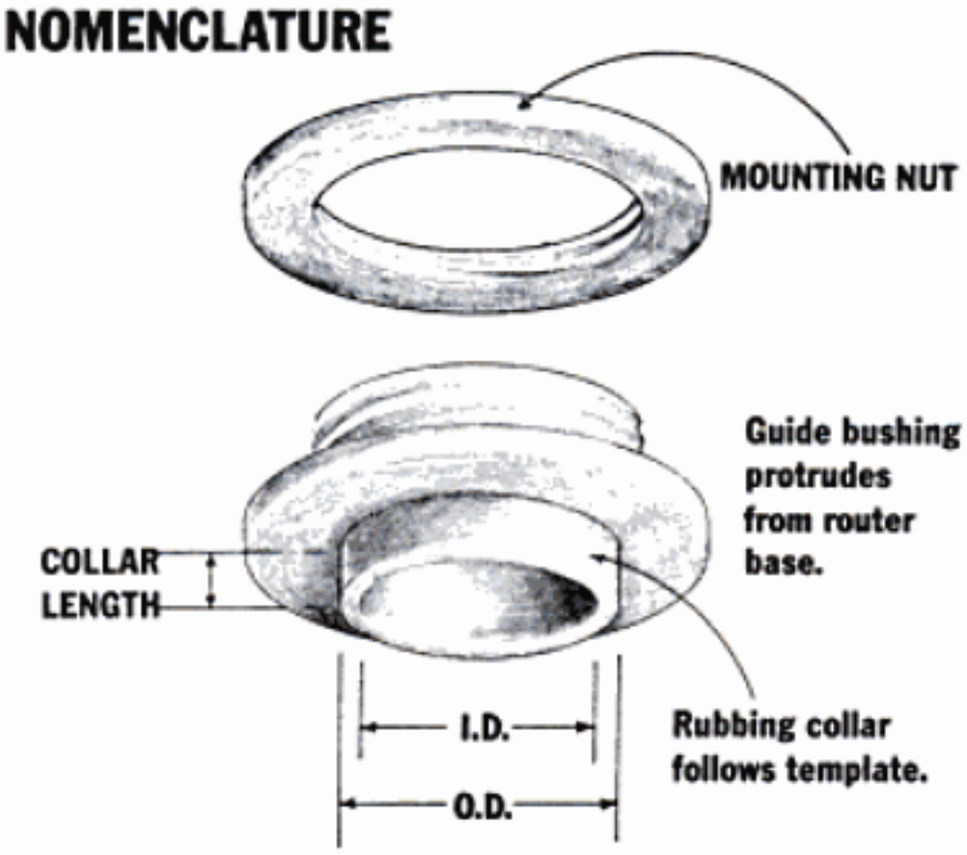
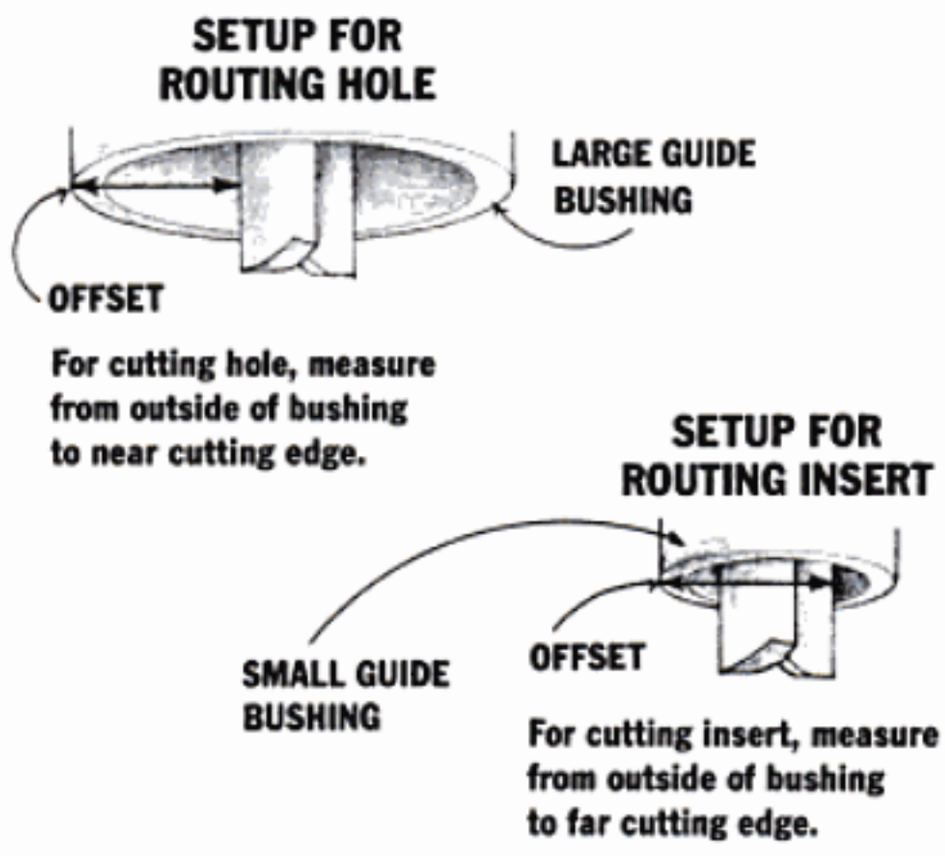



**FIG. 2: BUSHING/BIT COMBINATIONS**

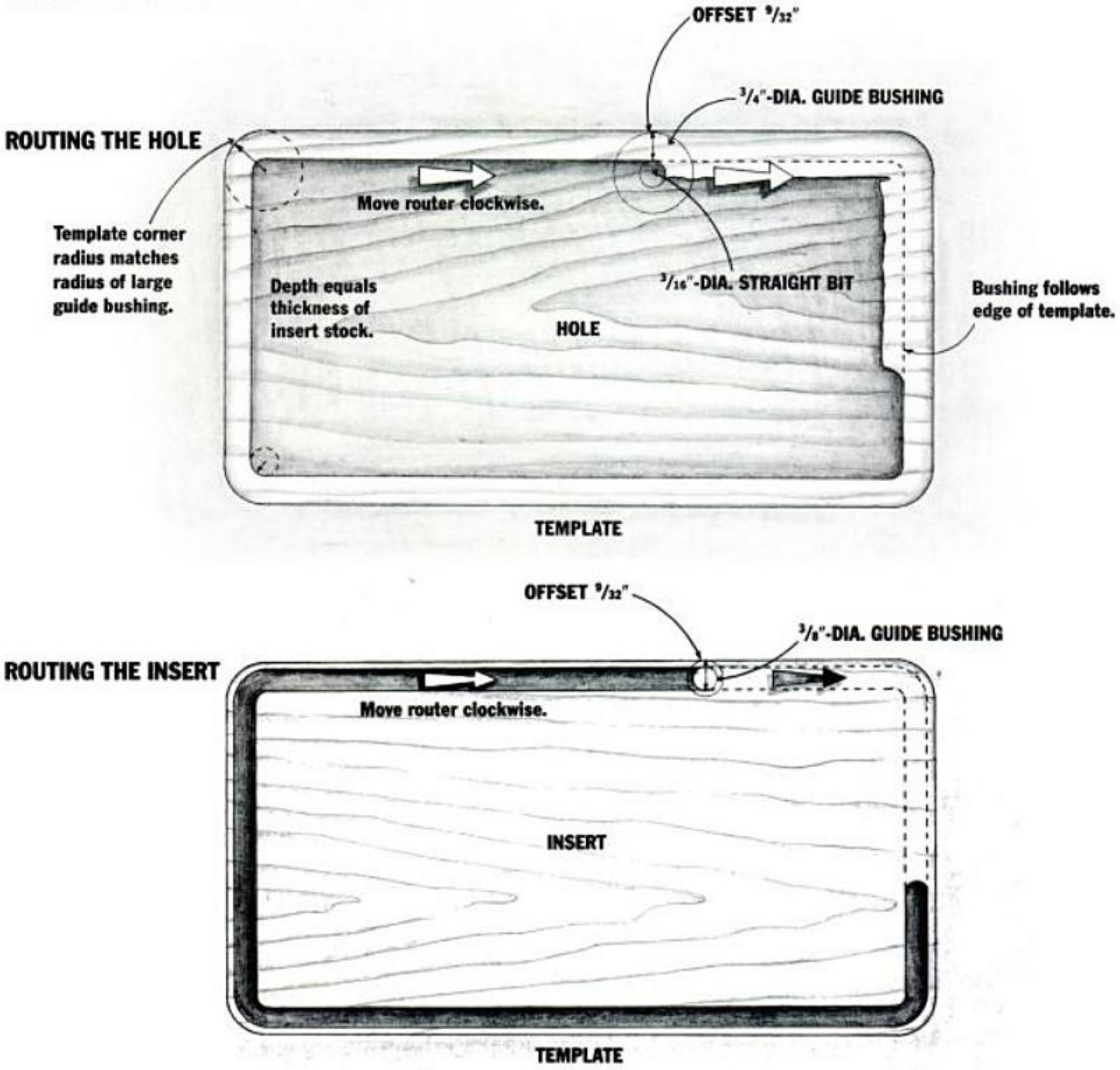


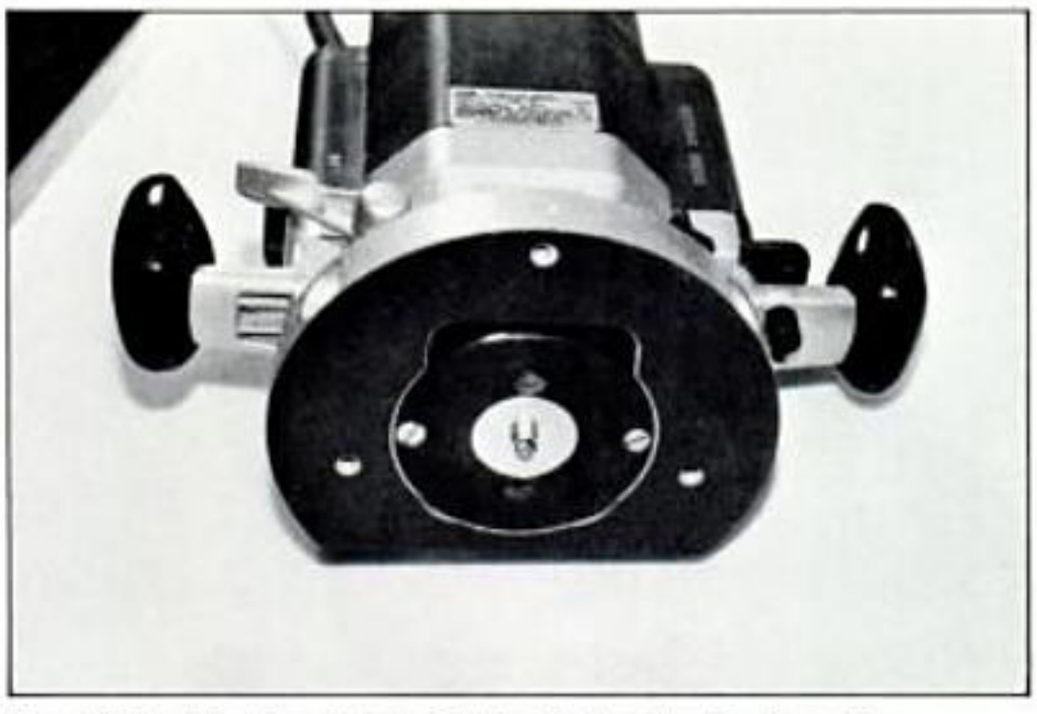

DRAWINGS BY KATHY BRAY

**ROUTER BIT/GUIDE BUSHING COMBINATIONS**

| ROUTER BIT DIA. | SMALL GUIDE BUSHING | LARGE GUIDE BUSHING | OFFSET |
|---|---|---|---|
| 1/8" | 7/16" | 11/16" | 9/32" |
| 3/16" | 9/16" | 11/16" | 1/4" |
| 3/16" | 3/8" | 3/4" | 9/32" |
| 1/4" | 5/16" | 13/16" | 9/32" |
| 1/4" | 3/8" | 7/8" | 5/16" |

## FIG. 3: ROUTING A RECTANGULAR INLAY



**A guide bushing is a steel cylinder that protrudes from the router base. It rubs against the edge of the template to guide the router through the cut.**

guide bushings are longer, you have the option of using thicker template stock or shimming the base of your router. One significant disadvantage of long guide bushings or thick templates is that they effectively shorten the usable portion of your bit.

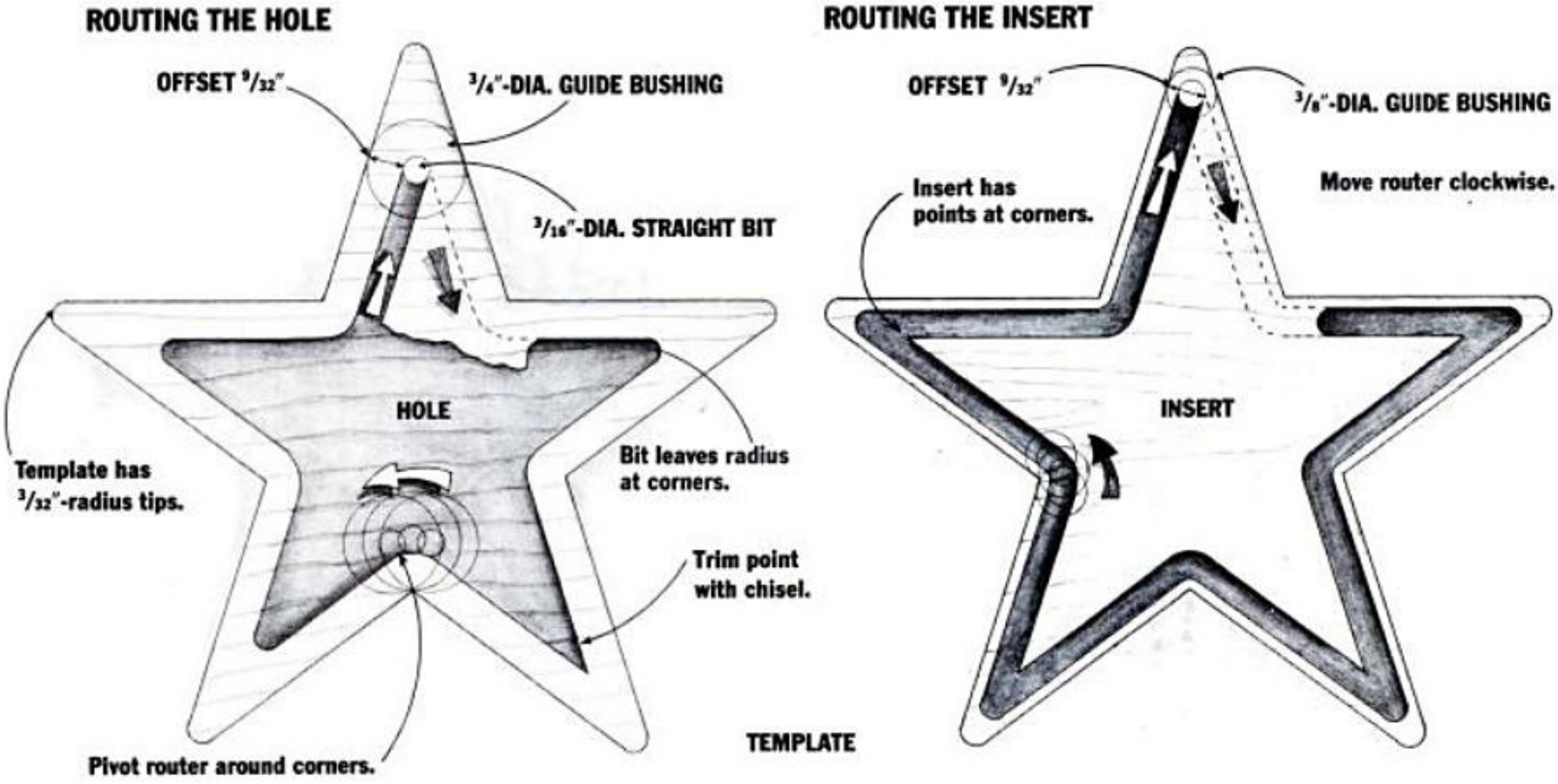
Next, I'll walk you through the process of making a simple, rectangular inlay. I suggest that you start with a simple shape like this before tackling a more complicated pattern.

### *Routing a Rectangle*

Start by sketching the shape of the hole full size on paper. Keep in mind that any points or sharp corners will be rounded to the radius of the router bit.

Next, decide on a combination of bit and guide bushings, taking into account the minimum radius you want on your inlay. I normally use either a 3/16-in. bit or 1/4-in. bit for cutting the hole and the insert. In

## FIG. 4: ROUTING A STAR INLAY




this case, let's use a 3/16-in. bit, and a guide-bushing combination from the chart in Fig. 2—a 3/8-in. o.d. bushing and a 3/4-in. o.d. bushing. As shown in the chart, this combination of bushings, together with a 3/16-in. dia. bit, gives an offset of 9/32 in.

**Making the template** is the next step. Phenolics, plastics and metal are all acceptable template materials, but I prefer to make my templates from 1/4-in. tempered hardboard. Whatever you choose, the template must be larger than the hole to provide support for the router base and room for clamps to fasten it to the work piece.

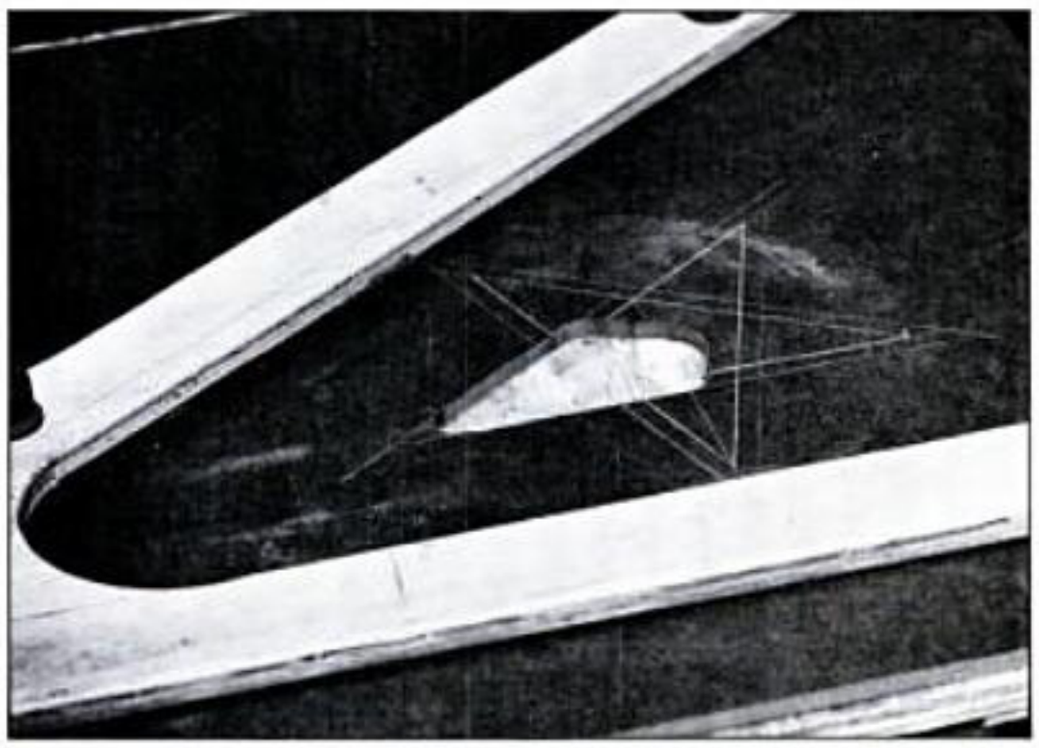
The template opening must be larger than the hole on all sides by the offset measurement—in this case 9/32 in. Lay out the template opening on a sheet of 1/4-in. hardboard. I set a drawing compass to the offset and use it to draw around the outside of my original hole drawing. While I'm at it, I write the bit and guide-bushing sizes on the template for future reference.

When laying out a template, carefully think through what will happen as the router is guided around it. What happens at the corners will often surprise you. The results will be different depending on the radius of the template corners and whether the corners of the template are rounded or square. When you've got the hang of the technique, you may want to do some experimenting. For now, however, make the radius of your template corners the same as the *radius* of the large bushing (in this case, 3/8 in.), as shown in Fig. 3, or you'll end up with an insert that won't fit the hole.

While sketching the template on paper, I consider the need for attaching a fence or a guide to the template to orient it on the work piece later. I'll leave extra material on the template for this, if necessary. If a locating block or two is needed to accurately place the template on the work, I plan for that as well, including any mounting screws.

Once the template is layed out on the hardboard, you can cut out the template with a jigsaw or a router. To get an accurate geometrical shape I normally rout out the template opening with a bit the same *diameter* as the o.d. of the large guide bushing I plan to use (in this case, 3/4 in.). I clamp guides to the template stock and follow them with the router base. It's important for the guiding surface to be smooth.

**Routing the hole** for the inlay comes next. Mount the large guide bushing in the router base and insert the bit. To set the depth-of-cut for the hole, place the insert stock on a piece of flat scrap and place the template on the insert stock. Place the router on the tem-



**To make the points of the star-inlay template symmetrical, guide the router base against a plywood template.**

plate and lower the bit until it touches the scrap. If you want the insert to fit flush with the surface, lock the setting when the bit touches the scrap. I usually prefer to have the insert protrude slightly above the surface and then plane it flush later so I raise the bit a little before I lock the depth setting. This makes a hole that's slightly shallower than the thickness of the insert.

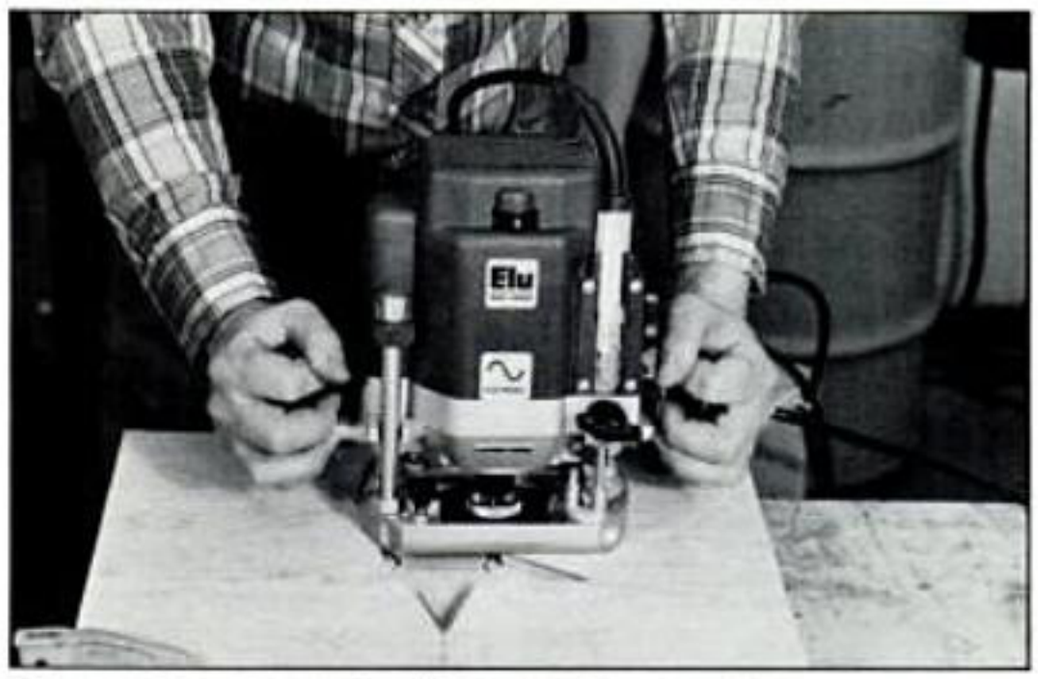
Locate the template on the stock exactly where you want it (keeping in mind that the hole will be smaller than the template opening) and firmly clamp it in place. It's important that this assembly be very steady while routing. I clamp everything firmly to a bench.

If the hole is large and you're routing several inlays, it might be worth setting up a second router with a larger-diameter bit to remove stock quickly from the center of the hole. Don't get too close to the edges.

Remove the bulk of the waste from the center of the hole with a wide bit, if you choose, then use the 3/16-in. bit and 3/4-in. guide bushing to accurately follow the template for your finish cut. Hold the bushing firmly against the template to be sure of an accurate cut. I go around the template two times, in a clockwise direction, vacuuming and checking for chips against the template between passes.

Routing the hole is a much more forgiving process than routing the insert. If the guide bushing loses contact with the template, it simply moves into the waste area and you can go back and do that portion again. You don't have that luxury when you rout the insert.

**The points of the star-shaped hole are rounded to the radius of the router bit. Trim point with chisel or knife.**




**Guide bushings longer than 1/4 in. require a template made from 3/8-in. or 1/2-in. material.**

**Rout the insert** after you've routed the hole. Compare the figure and grain of the inlay stock with that around the hole, and orient the template to give a complementary match. Clamp the template firmly over the stock.

Because you'll be cutting completely around the insert, it will break free at the end of the cut. To keep the insert from shifting (and being chewed up by the router) set the depth-of-cut 1/64 to 1/100 in. less than the insert stock thickness. This thin layer of wood at the bottom of the cut will keep the insert in place, and it's easy to cut the insert out by hand. If your plunge router has multiple depth-stops, you could set one stop to leave about 1/32 in. at the bottom of the cut and another stop to just cut through the insert stock. Then, after routing around the template at the higher setting, lower the router to the full depth, and cut the insert free except at the corners. You can trim these later by hand.

Insert the small guide bushing (in this case, 3/8 in. o.d.) in the router and set your depth-of-cut. I recommend placing the guide bushing in a corner of the template at the beginning of the cut. It is vital to maintain constant pressure against the template at all times—there's no room for error here. One hand should always be pulling the router firmly against the template, being especially careful around the corners. Move the template in a clockwise direction so that the bit pushes the guide bushing against the template.

When you've cut the insert free, it should fit right into the hole with little, if any trimming.

## *Routing a Star*

Let's look at a more complicated shape—a five-pointed star. All four corners of the rectangle template were concave—the guide bushing nestles into them. A star-shaped template has concave and convex corners. As the guide bushing swings around these points, it always produces a radius equal to the offset as shown in Fig. 4.

You can make a star *insert* with sharp points if the radius of the template corners is less than the radius of the small guide bushing (see Fig. 4). The *hole*, however, will have rounded corners and you'll have to trim them to a point with a chisel so the inlay fits. I don't know of any way to get sharp points on the hole without moving the template or making multiple templates.

If the template is perfectly symmetrical, the star insert should fit into the hole in any orientation. However, the fit is always best when the template is oriented the same way for both the hole and the insert.

## *Other Possibilities*

I use the router-inlay method a lot, and I've developed more complicated variations on the techniques described here. For example, sometimes I use different bits for the insert and the hole. The relationships and calculations can get pretty complicated and I won't go into them here. I encourage you to experiment with different combinations of bits and guide bushings and explore the possibilities yourself. ▲

*Blair Hubbard lives in Knoxville, Maryland and works for the National Parks Service. He's been a woodworker for 25 years.*

# WHIRLIGIGS

*A Marriage of Whimsy and Precision*

BY NICK ENGLER AND
MARY JANE FAVORITE

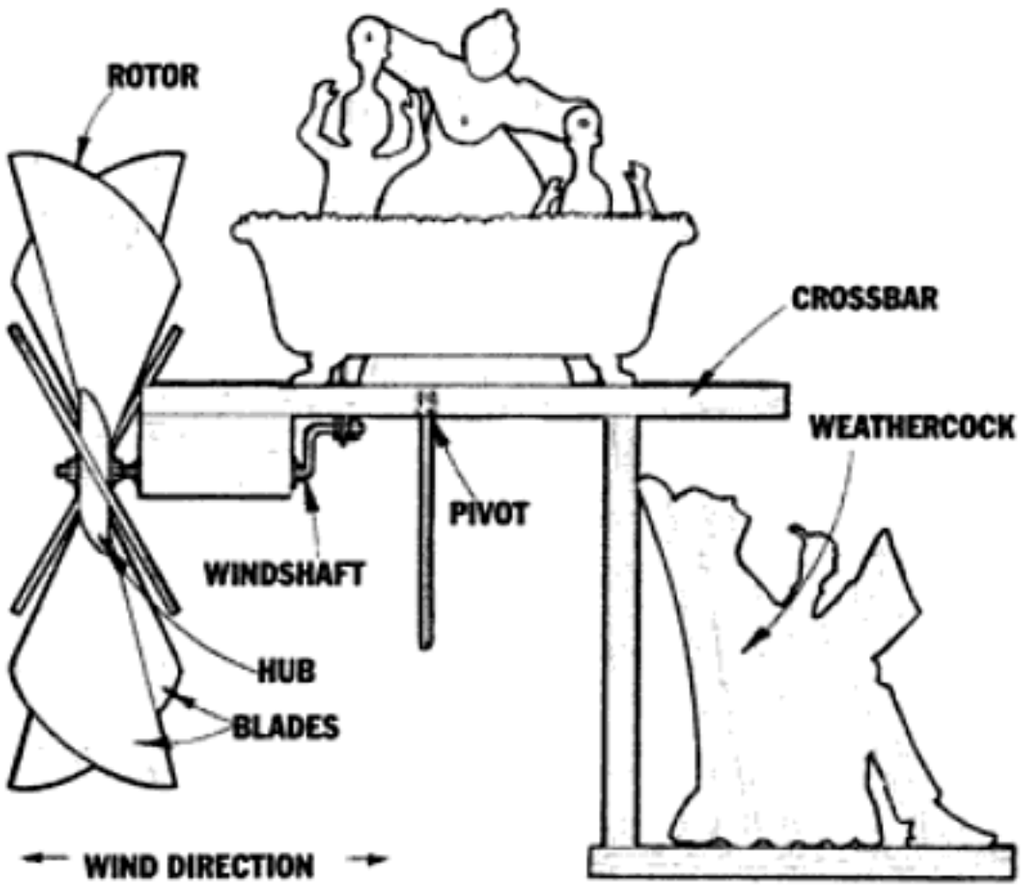
There is, perhaps, no other form of folk art quite so typically American as the whirligig. This simple wind toy evolved long before the discovery of the New World—you can find references to "whirlyegigs" in medieval manuscripts. But nowhere were they quite as popular as in America. From our beginnings, we were a nation of tinkerers and inventors and these miniature wind-driven machines struck a chord in our collective soul. Just as the intricate lines of a Philadelphia Highboy and austere grace of a Shaker chair expressed the poetry in an American craftsman's spirit, the whirligig echoed his humor and whimsy.

A few American whirligigs were built with serious intentions. Some served as agricultural aids—scarecrows or "mole thumpers." For example, the traditional woodchopper whirligig produces a clicking

**Wooden whirligigs are an American folk-art tradition. Simple or complicated, these wind-powered mechanisms will amuse and delight. The whirligigs shown here, "Saturday Night" and "Close Shave," are just two examples.**

PHOTOS BY NICK ENGLER

**FIG. 1: PARTS OF A WHIRLIGIG**




DRAWINGS BY MARY JANE FAVORITE

noise as the little woodsman flails away with his ax. This noise travels down the mounting pole and into the ground, where it scares away the moles. Others helped encourage good, moral character— they were given to children as "Sunday toys." Just as good Christian adults refrained from physical labor on the Sabbath, their children were not allowed boisterous play. Wind toys helped keep the kids quietly occupied.

But most whirligigs were built simply because they're fun to build. Certainly, the two wind toys that I'll discuss, "Saturday Night" and "Close Shave," serve no practical purpose. But when you get all the elements of these contraptions adjusted just right, so that the slightest breeze starts Ma dunking her prodigy or the maniacal barber shaving his terrified customer, you can't help but smile.

## *How a Whirligig Works*

Before you build a whirligig—for whatever reason—you'll find it helps to know how the device works. Anyone with a little mechanical aptitude can trace the connections, but it takes some know-how to *make* these connections. This understanding is important, even though you may be working from plans. Wind toys are intricate machines, and they rarely work smoothly on the first try. The mechanism *always* requires some refinement. Knowing what to look for when the parts freeze up will save endless frustration.

Let's start by introducing a few terms. Refer to Fig. 1 for clarity. A whirligig is designed so that as the wind blows, it presses against the *weathercock*; this turns the *crossbar* on its *pivot* so that the *rotor* faces into the wind and spins. The rotor is usually mounted to one end of the crossbar and at the other end is the weathercock. On "Saturday Night," the weathercock is Pa in his chair, on "Close Shave," it's the barber's pole. The *blades* of the rotor catch the wind. On some whirligigs, the rotor is incorporated in the figures. For example, in "Close Shave," the rotor is the arms of the barber. These arms are connected by a *windshaft*. On other whirligigs, like "Saturday Night," the rotor protrudes from the front of the whirligig and as it spins it turns a central *hub*. This hub is fastened to a windshaft and crank, which also turn, thereby moving the figures. The entire assembly—rotor, crossbar, and weathercock—is mounted on a single pivot. The proper coordination of all the parts causes the whirligig to operate.

It takes a bit of high school physics to get all of these parts to work together properly—two important physical principles, in particular. The first is the relationship between mass and motion. The second is the effect of friction on the moving parts of a machine.

Isaac Newton summed up mass and motion in his classic equation, $F = ma$—the force (F) required to move an object is equal to the mass (m) of that object times the acceleration (a) you want to achieve. Or, in other words, the larger the mass (the moving parts of the whirligig), the more force required to move it. On any wind toy, the size or "sail area" of the blades determines the amount of wind force available. Bigger blades catch more wind and exert more force. The rotor blades on "Saturday Night" are fairly large because they have to set a lot of parts in motion. On "Close Shave," the blades are small because they have only to move themselves. If you build a whirligig that won't move, chances are the blades aren't big enough, or there's too much friction between the moving parts.

## *Whirligig Materials*

In addition to physics, it helps to know a little engineering when you build a whirligig. These wind toys are mechanical devices, and as such, the moving parts tend to wear out quickly. Also, they sit outside in the weather. If you build a whirligig from improper materials it will fall apart or freeze up after the first rainstorm no matter *how* smoothly it operated in your workshop.

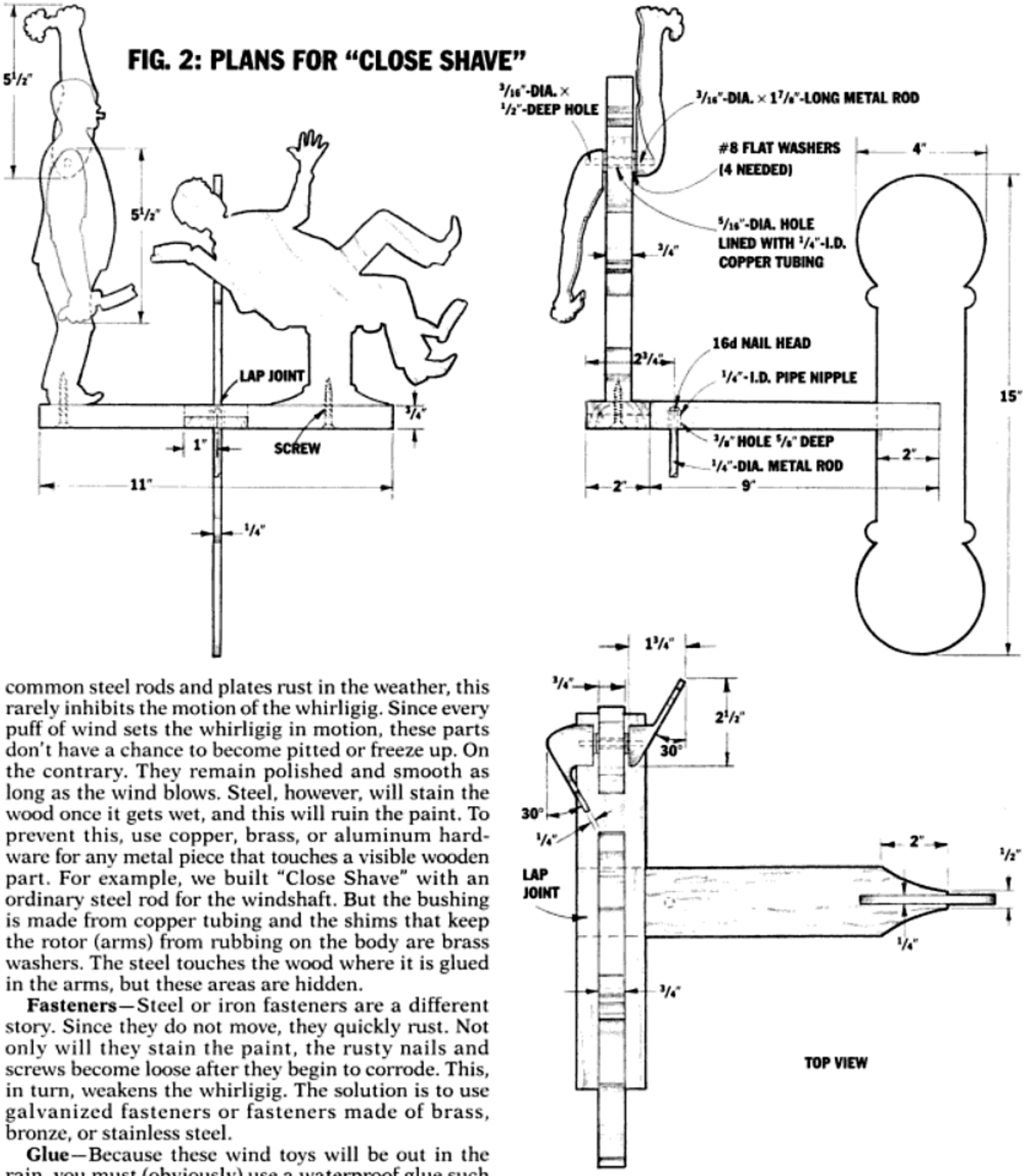
There are five different materials in most whirligigs—wood, metal, fasteners, glue, and paint:

**Wood**—Most of the whirligig is made from wood—the rotor, crossbar, weathercock, and the figures. For these parts, select a wood that weathers well but is strong enough to stand up to constant motion. The traditional choices for outdoor projects—cedar, redwood, and cypress—are too soft and break easily. Pressure-treated wood often warps and splits when cut into small pieces. Early American craftsmen traditionally made their whirligigs from Eastern white pine, but this stock was cut from virgin timber. The annual rings were close together and evenly spaced, and this helped keep the wood from distorting or decaying while it was outside. Contemporary white pine is cut from fast-growing trees—the rings are far apart —and it doesn't stand up to the weather as well.

Poplar is a good choice if you use domestic woods. It will do well in the weather if it's coated with a water seal (I recommend Thompson's Water Seal) before you paint it. However, I chose to use an import: mahogany. It is strong, fairly weather resistant and can be easily worked. It's expensive, but you need so little wood for a whirligig that it doesn't add much to the overall cost of the project.

**Metals**—The windshaft, bushings, keepers, shims, and any other parts that rub or may wear quickly should be made from metal. Your choice of metal is less critical than your choice of woods. Even though

## FIG. 2: PLANS FOR "CLOSE SHAVE"




common steel rods and plates rust in the weather, this rarely inhibits the motion of the whirligig. Since every puff of wind sets the whirligig in motion, these parts don't have a chance to become pitted or freeze up. On the contrary. They remain polished and smooth as long as the wind blows. Steel, however, will stain the wood once it gets wet, and this will ruin the paint. To prevent this, use copper, brass, or aluminum hardware for any metal piece that touches a visible wooden part. For example, we built "Close Shave" with an ordinary steel rod for the windshaft. But the bushing is made from copper tubing and the shims that keep the rotor (arms) from rubbing on the body are brass washers. The steel touches the wood where it is glued in the arms, but these areas are hidden.

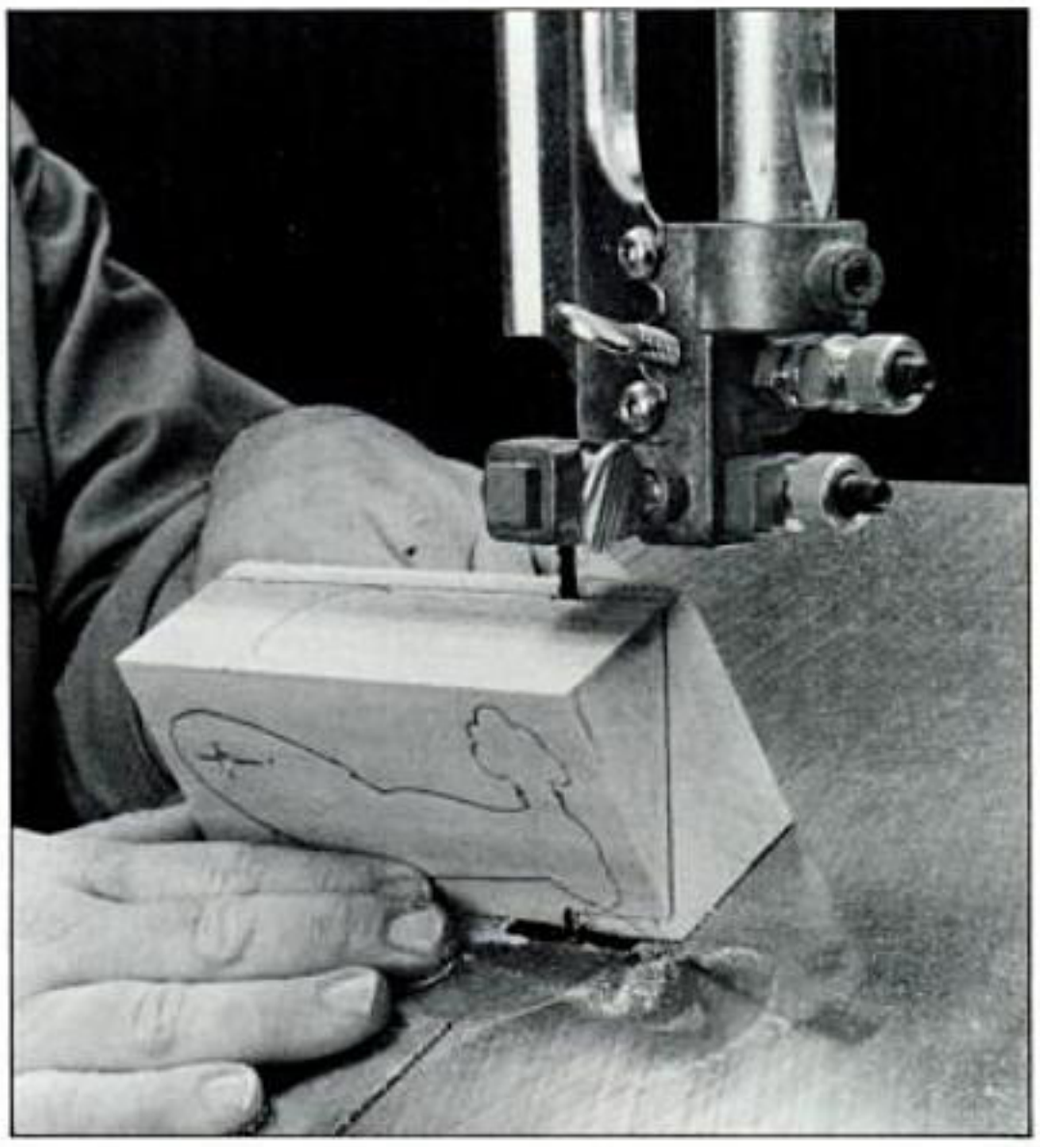
**Fasteners**—Steel or iron fasteners are a different story. Since they do not move, they quickly rust. Not only will they stain the paint, the rusty nails and screws become loose after they begin to corrode. This, in turn, weakens the whirligig. The solution is to use galvanized fasteners or fasteners made of brass, bronze, or stainless steel.

**Glue**—Because these wind toys will be out in the rain, you must (obviously) use a waterproof glue such as epoxy or resorcinol. When gluing metal to wood—for instance, when attaching the arms of the barber to the windshaft—we found that an epoxy product called "PC-7" (made by the Protective Coating Co., 1341 N. Van Buren St., Allentown, PA 18103) works best. This epoxy putty is especially formulated to bond dissimilar materials. Most good hardware stores carry this, but if you can't find it, ordinary epoxy will do just fine.

Whenever you can, reinforce a glue joint with a fastener. Wood shrinks and swells with changes in the weather and puts a terrific strain on the bond. To hide the hardware, use a resin-based wood dough High Performance Wood Filler (by Minwax) that is manufactured for use outdoors. You'll never see where you applied the wood dough once you paint the project.

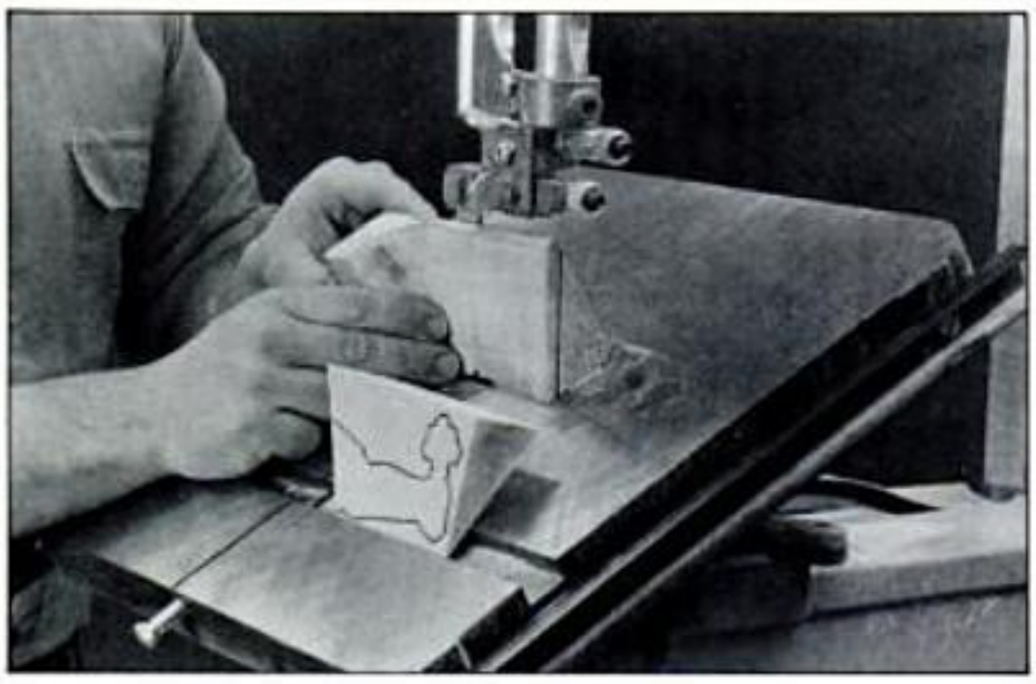
**Paint**—You can use a variety of exterior colors to paint the project. Perhaps the easiest to use—and the most flexible—are artist's colors (that come in a tube). Both artist's oils and acrylics stand up well in the weather and can be blended to create infinite shades. The only drawback is that once you've mixed up a color for, say, a flesh tone, you may have a problem mixing up exactly the same flesh color again. For this reason, make up large batches of the colors you think you'll need *before* you start to paint.

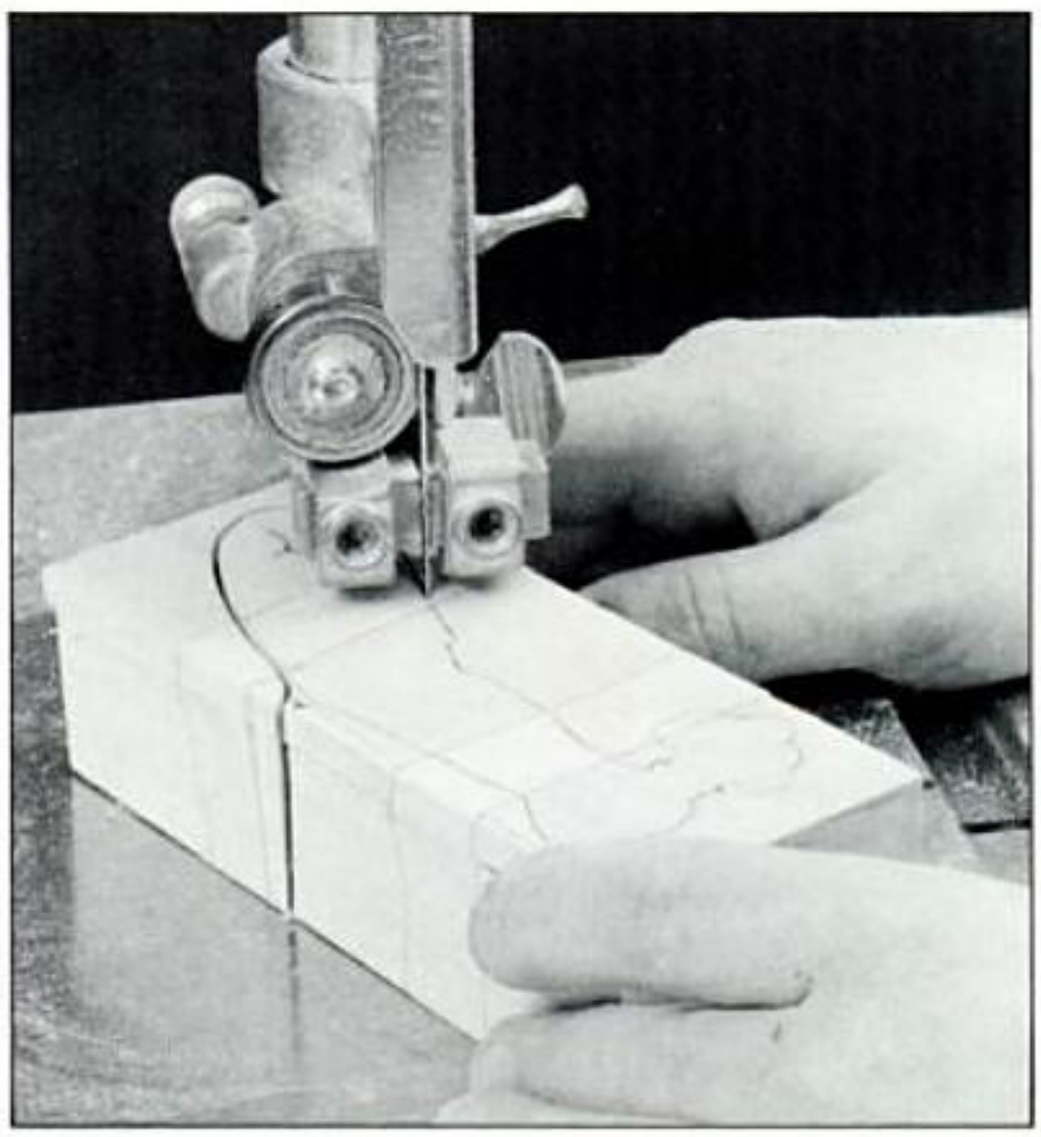
You can paint the wooden surfaces without priming them. But if you need to paint a metal surface, prime it first with spray-on zinc chromate or "yellow" pri-



To cut the barber's left arm, first tilt the tablesaw to 30°. Then make a curved L-shape cut as drawn on the stock in the photo.

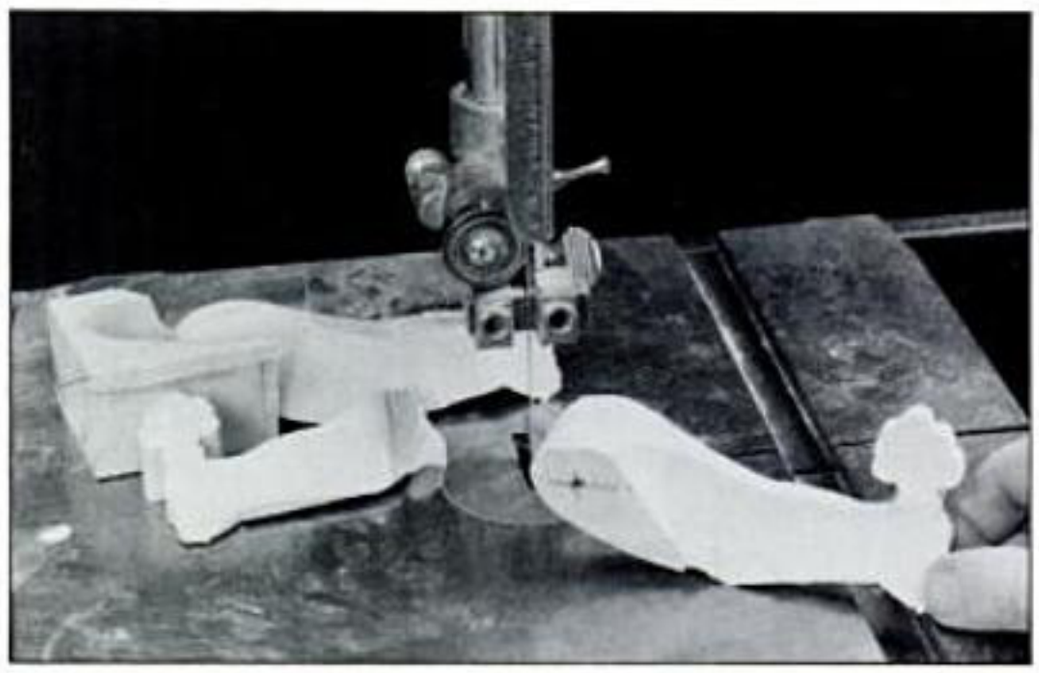
Keeping the table at 30°, rip cut the outside edge of the arm. Start this cut 1/4 in. from the first cut, but this time don't curve—this is a simple, straight cut.





Tape the pieces you have cut away back together. With the bandsaw back at 90°, cut out the arm shape.

When you finish cutting out the shape, you will end up with a piece that looks like an arm.



mer, (zinc chromate is the best choice for priming aluminum and other non-ferrous metals.) When painting over wood dough, first coat it with paint sealer.

## *Building Whirligigs*

You'll find that building a whirligig is unlike other woodworking projects you've ever attempted. It is precise work, but there is a great deal of room for creativity. The parts must work together just so, but the mechanism is very forgiving. Most mistakes can easily be corrected with a judicious tap of a hammer or the patient application of a file.

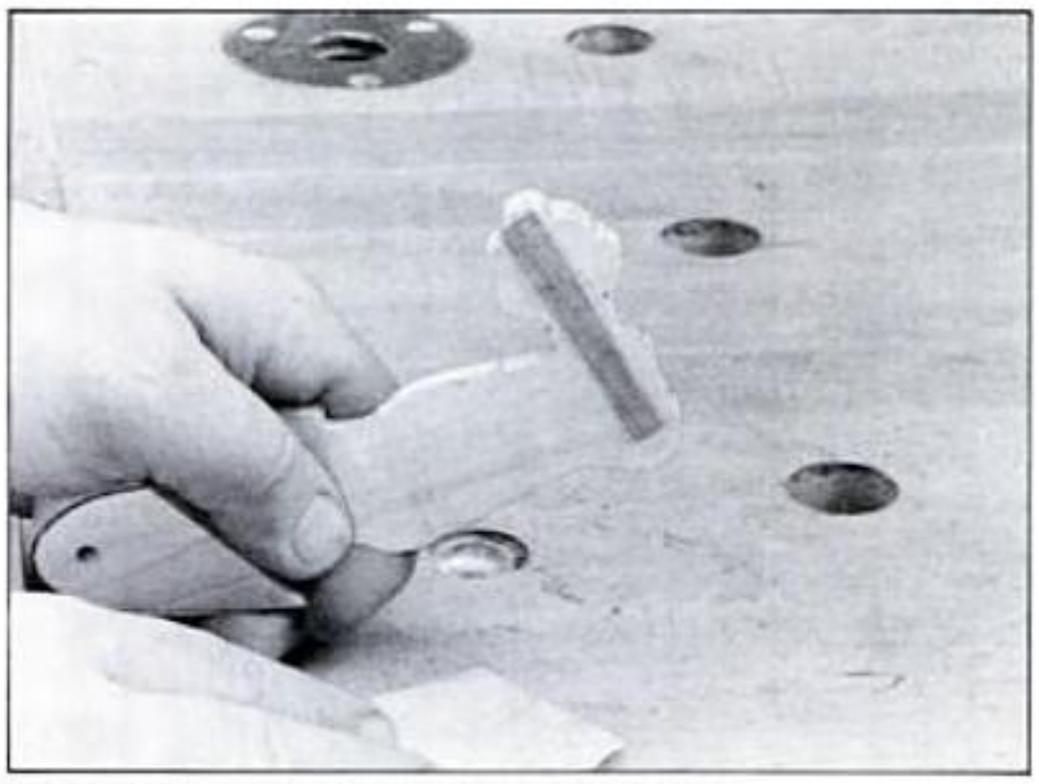
No two whirligigs are ever the same, even two that are built from the same plans. To a great extent, you must put each one together as you go. There are some methods and techniques, however, that apply to all whirligigs. We've collected a few of these general tips to give you a head start. The general tips below combined with the information shown in the drawings will tell you all you need to know to build "Saturday Night" and "Close Shave."

**Cutting the figures**—Many of the shapes in a whirligig are quite intricate and have all sorts of appendages (see pullout). No matter how you orient the grain, some part of the figure will be weak. Consider the barber's customer, for example. If you run the grain vertically making the pedestal of the chair strong, then the legs and the neck of the customer will be fragile. The solution to this problem is to make your own plywood.

Using waterproof glue, bond at least two equal thicknesses of solid wood with the grain directions perpendicular to each other. The final thicknesses of this plywood will depend on what part you are making—refer to drawings for exact thicknesses. Cut your figures from this plywood.

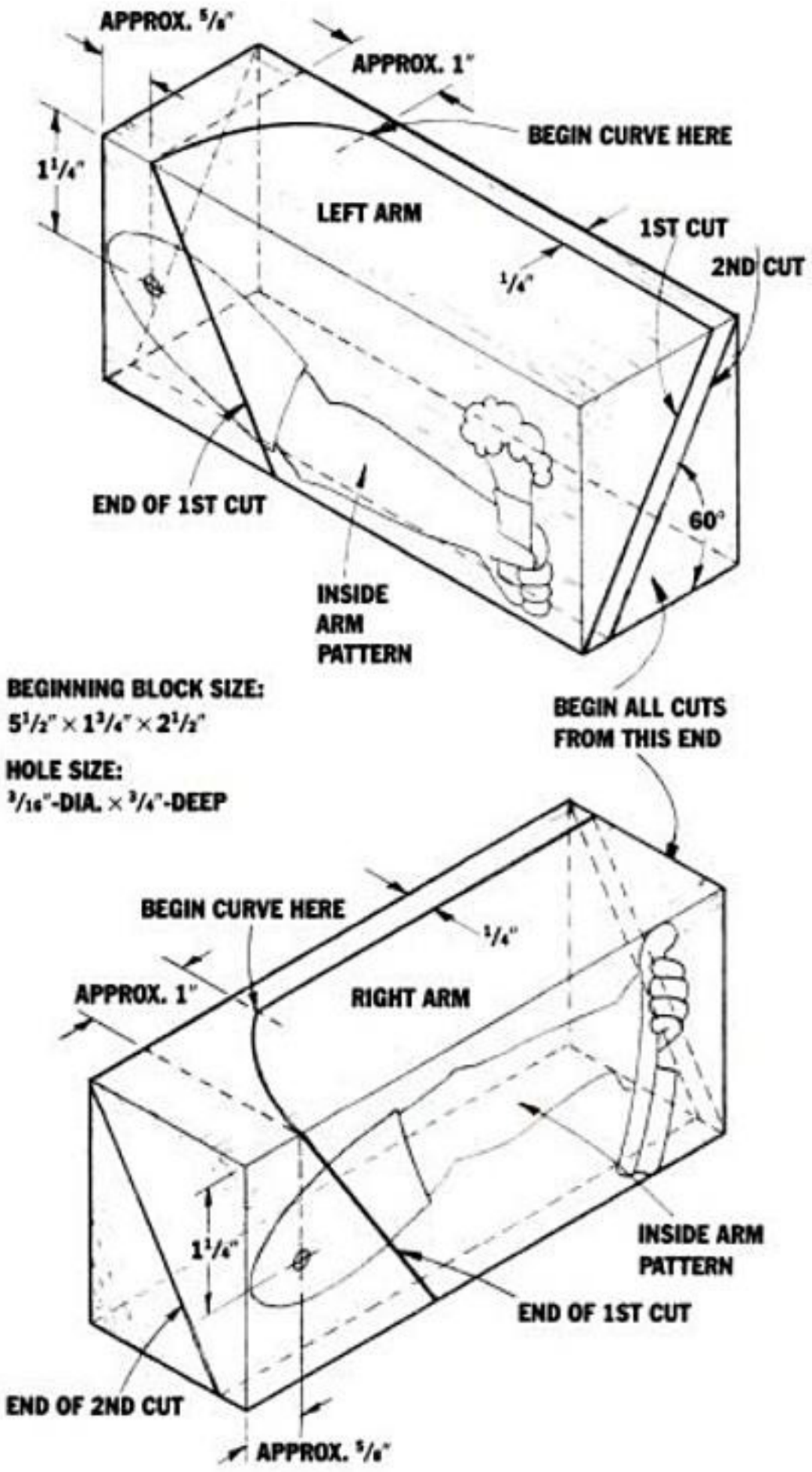
**Making a small rotor**—There is no rotor hub, as such, on "Close Shave." Instead, the blades are connected directly to the windshaft. The twist in the blades and the shape of the arms is formed by some clever compound-cutting on a bandsaw or scroll saw (see Fig. 3). This is one of the more complicated steps in making a whirligig. You may end up tossing your first few tries into the scrap bin. Don't be discouraged—patience and practice will pay off in the end.

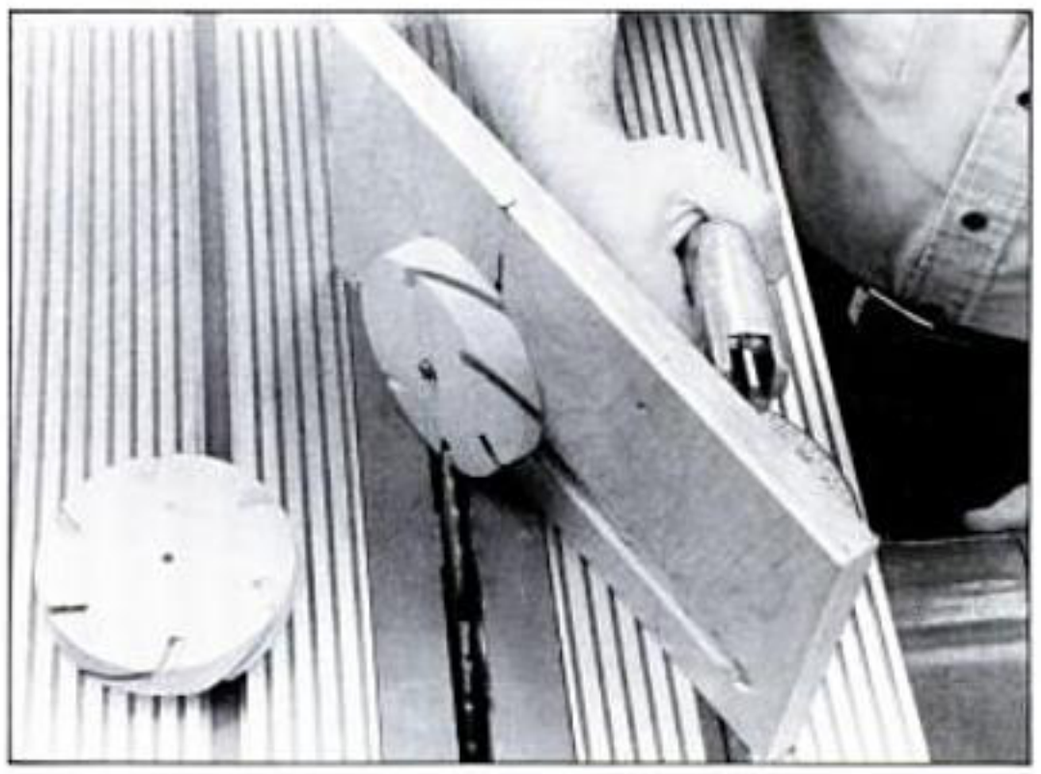
To make these arms/blades (see photo sequence), first trace the shapes onto the *inside* face of the stock, then drill the windshaft shaft holes at 90°. Tilt the table of your bandsaw 30°. Hold the left-arm stock (the arm that grasps the brush) so that the end with the hole is closest to you and the brush is pointing up. (The traced-arm pattern will face right or *downhill* on



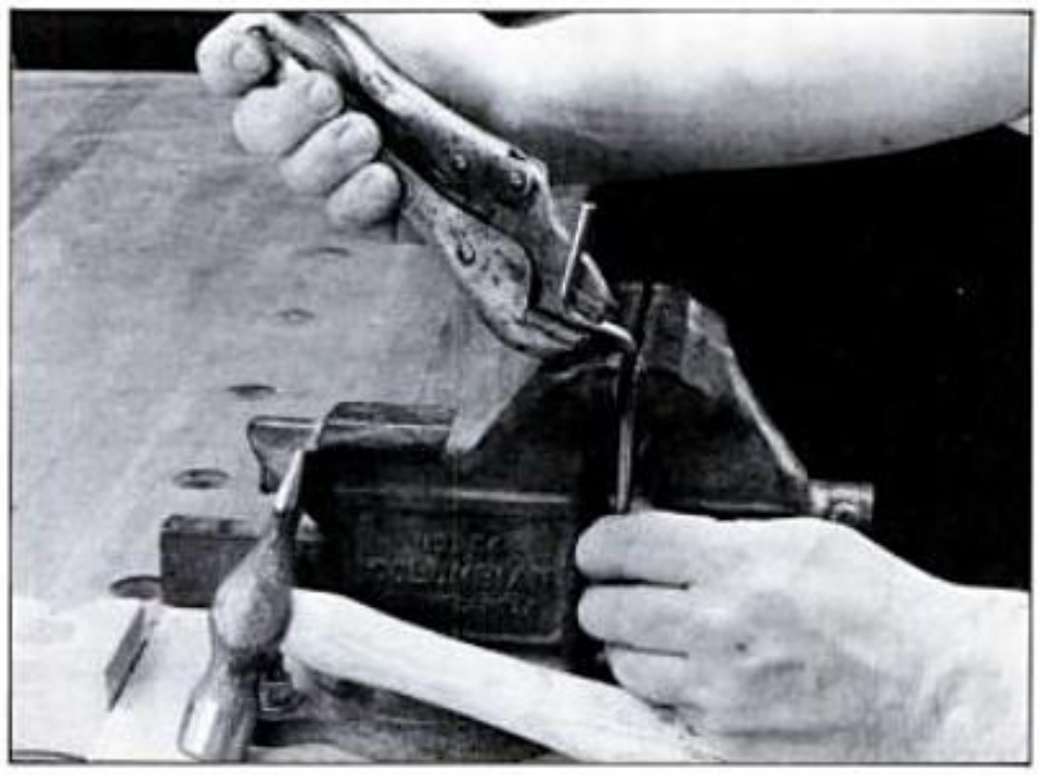
**Make a "bandage" from veneer to strengthen the delicate razor and brush on the barber's arms. The grain of the veneer should be perpendicular to that of the arms.**

## FIG. 3: CUTTING OUT THE BARBER'S ARMS



**To make the hub for a large rotor, attach round stock to a wooden miter-gauge extension. Cut six evenly-spaced kerfs around the perimeter of the hub to hold the rotor blades. These kerfs should be angled at 30°.**



**To make the second bend in the crank, grasp the rod with a pair of vise-grip pliers *below* the first bend. This will keep the first bend from unbending.**

the bandsaw table.) Bevel-rip the inside face of the arm/blade as shown in Fig. 3, feeding the stock into the blade. About 1 in. before cutting through the windshaft hole, make a turn with the saw blade and exit the inside face of the stock. Then bevel-rip the outside face, cutting the blade portion of the arm about 1/4-in. thick. This second cut is straight; you don't have to make any turns.

Cutting the right arm stock (the arm that grasps the razor) is almost exactly the same, except that you hold the stock with the razor pointing *down*. IMPORTANT: Remember, the blade portions of the arms are angles in the same direction when you cut them. But when you mount them to the barber, they will seem to twist in opposite directions. The hand with the razor will twist in toward the body, while the other will twist out.

Save the scraps and tape them back together to make the stock square again. Then cut out the arm shape with the saw. When you remove the tape and the scraps, you'll have a blade that looks remarkably like an arm.

One more consideration: The razor and the brush will likely be very fragile. This will be true even if you make the blades from plywood because of the bevel of the cuts. To keep these shapes from snapping off, glue narrow strips of veneer to both sides of the stock (see photo). The grain direction of the veneer should be perpendicular to the grain direction of the blades. When you finish sand the blades, blend the edges of the veneer into the surface of the wood. After you paint the whirligig, there will be nothing but a slight hump on the razor and the brush to show where you applied the veneer "bandages."

**Making a large rotor hub**—On "Saturday Night," the six rotor blades are set in 1/8-in. wide grooves in the hub. These grooves can be cut easily on a tablesaw using a miter gauge and a wooden miter-gauge extension as shown in the photo. Divide the circular hub into six pie-shaped sections and bolt it to the miter-gauge extension. Angle the miter gauge at 30° and adjust the height of the saw blade to cut 1/2-in. deep. Put an index mark on the extension next to one of the section marks on the hub. Pass the hub across the saw, cutting a kerf. Loosen the hub, turn it so that the next section mark lines up with the index mark, and cut another kerf. Repeat until you've cut all six grooves. Once you've done this, remove the hub from the miter-gauge extension. Cut out your blades and glue them in these grooves.

**Bending a windshaft**—The windshaft of "Saturday Night" is made of metal and bent to form a crank. Bending a rod is not hard to do, but making two precise bends is a little tricky. To create the first bend, simply clamp the rod in a metal vise and bend it over slowly. Tap the rod with a hammer to "flatten" the bend and make it square. Reposition the rod in the vise to make the second bend. Grasp it with vise-grip pliers just above the jaw face but *below* the first bend (see photo). (This way, you won't undo the first bend.) Bend the rod as far as you can with the pliers. Then, complete the second bend by tapping the rod with a hammer.

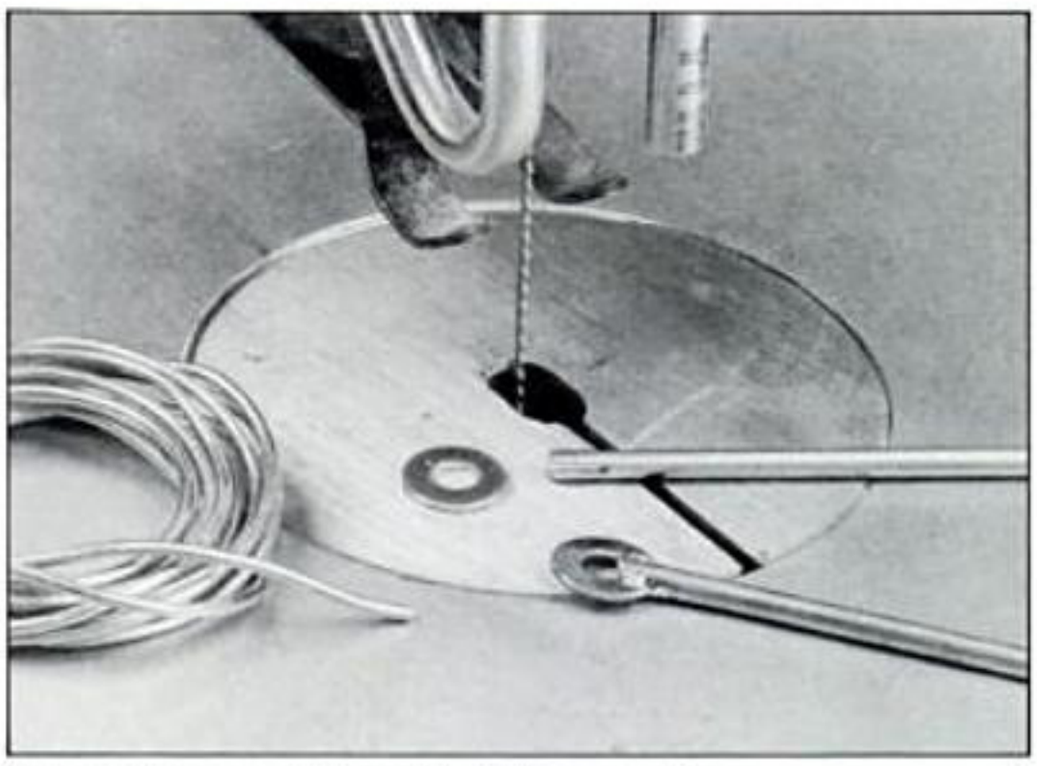
Don't be disappointed if your first try at making a crank is slightly off from the drawings. Even experienced whirligig-makers rarely get it right the first try. Just remember to purchase twice as much 3/16-in. rod as you think you need so that you'll have enough material to do it over.

**Connecting a rotor to a windshaft**—There are several ways to mount the hub on the windshaft. For a small rotor, such as the one on "Close Shave," simply epoxy it in place. Flatten or "peen" the ends of the shaft with a hammer to give the glue a rough surface to adhere to. Then, fill the hole in the hub with glue and press the rotor onto the shaft.

For large "Saturday Night"-style rotors, thread the end of the windshaft and sandwich the hub between two stop nuts. There are two reasons for this: The nuts will hold the mass of a large rotor more securely than glue and allow you to remove the rotor for storage or repair. Use a 12-24 die to cut the threads.

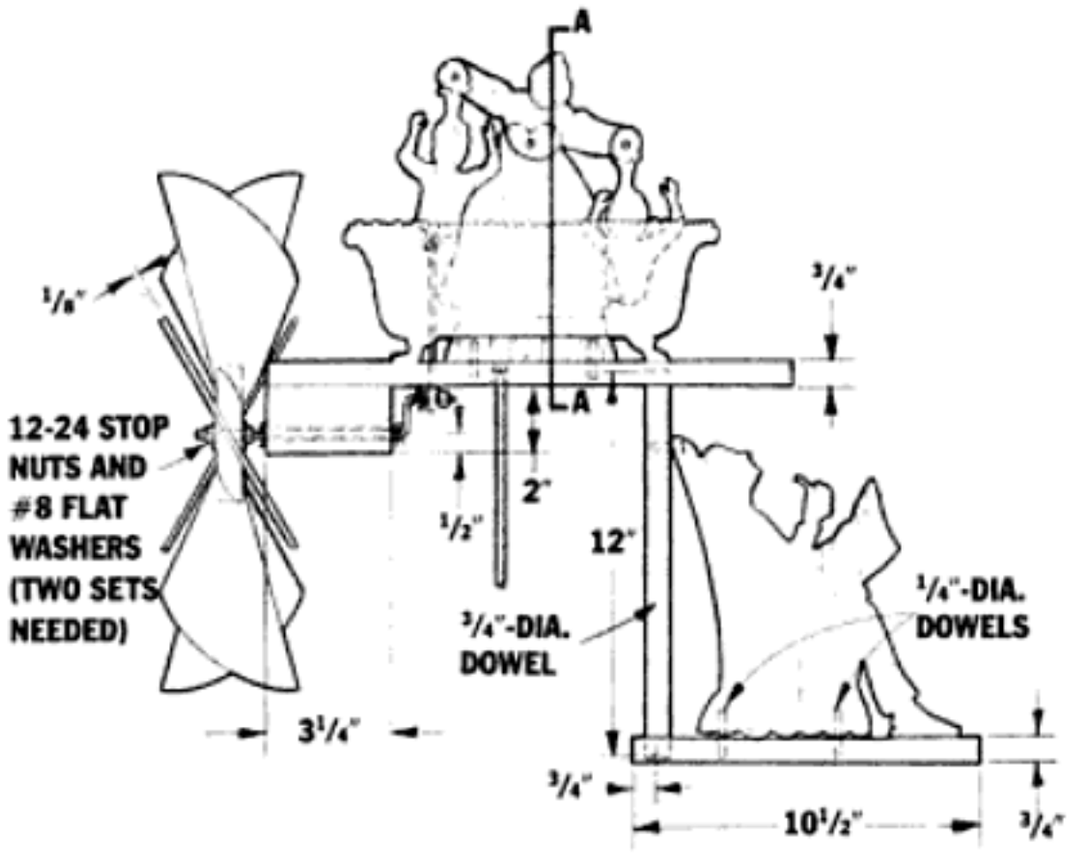
**Making a connecting rod**—On "Saturday Night," the windshaft crank is linked to the figures by a connecting rod (see Fig. 4.) At the upper end of this rod, a washer hooks over an eye screw. At the lower end, a slotted metal plate fits over the crank wrist to make a sliding joint.

Fashion the parts of this connecting rod from copper or brass, so that you can easily solder them to-

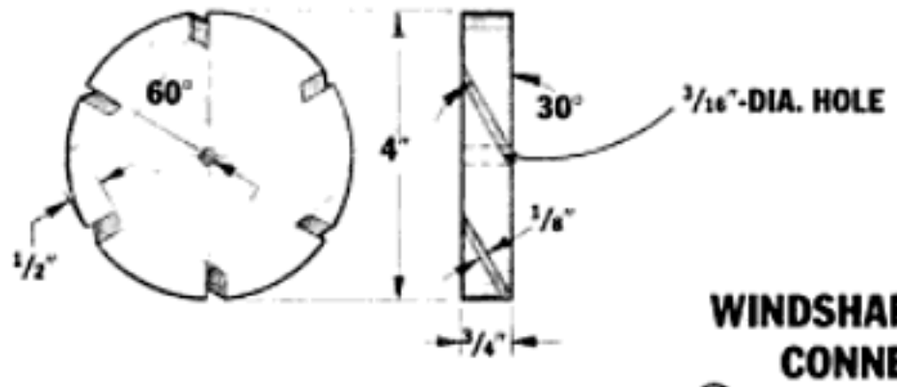


**Cut small grooves in the ends of the connecting rod before you solder the washer to it (the same holds for the lower plate). If the rod is made from soft metal, cut these grooves with an ordinary scroll-saw or fretsaw blade.**

**To add weight to a part, drill a hole in it and fill the hole with molten lead.**

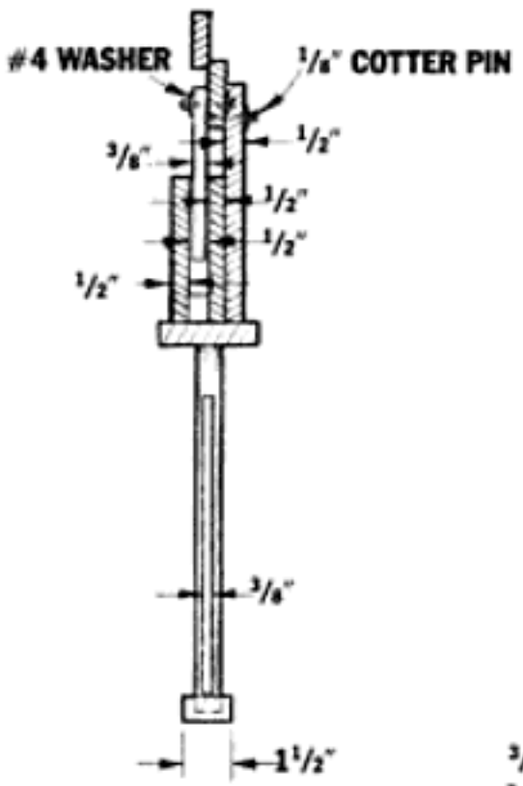



## FIG. 4: PLANS FOR "SATURDAY NIGHT"

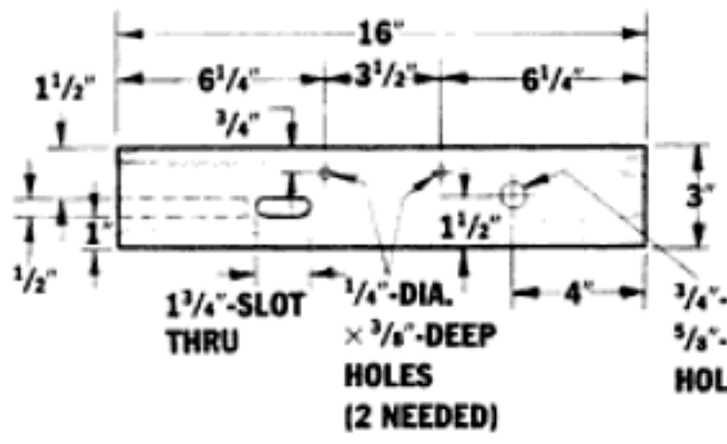


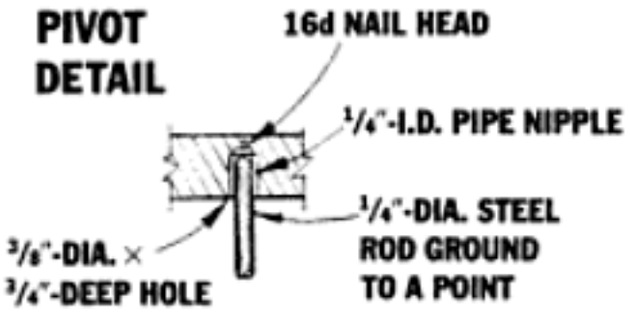

ROTOR-HUB LAYOUT

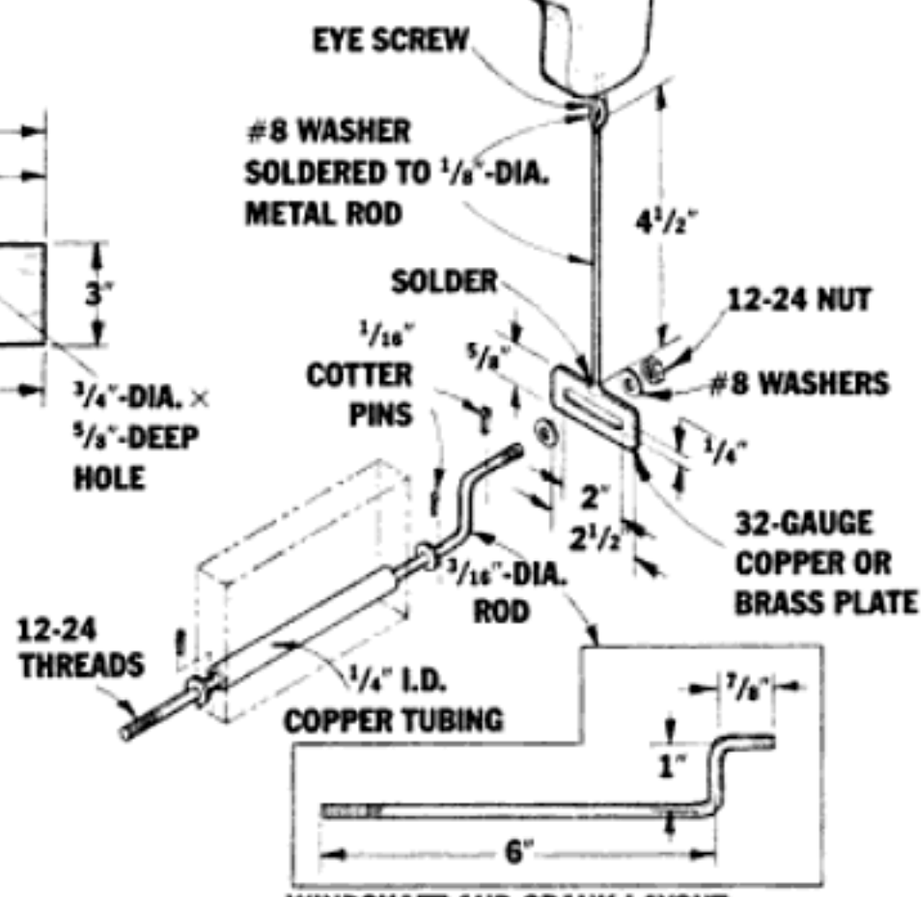
WINDSHAFT AND CONNECTING ROD DETAILS




SECTION AA




WINDSHAFT AND CRANK LAYOUT

gether. (You can buy copper or brass plates and rods at welding-supply shops, hobby stores or from Small Parts Inc., 6891 N.E. Third Ave., P.O. Box 381736, Miami, FL 33238.) To make the slot in the plate, drill two 1/4-in. dia. holes and remove the waste between them with a fretsaw or scroll saw. Cut tiny grooves in the upper and lower ends of the rod to hold the washer and plate, and solder the parts together (see photo).

**Adding weight to the whirligig**—While you usually try to make the moving parts of the whirligig as light as possible, (to keep the mass at a minimum) you sometimes need to add weight to a particular part. This is done to either balance the part or take the play out of the mechanical system. For example, the last piece in the "Saturday Night" mechanism, the boy furthest from the crank, is weighted slightly. This puts a little tension on all the connections and helps the whirligig operate more smoothly, especially when the rotor turns at a high speed.

To add weight to a wooden part, first drill a hole or two in it. On your stove, melt down some lead fishing sinkers or plumber's wool (also known as lead wool) in an old pan—lead melts at 620° F. Carefully pour the molten lead into the holes and let it cool (see photo).

**Making a pivot**—As mentioned before, the whirligig turns on a pivot causing the rotor to always face into the wind. This pivot, like many other moving parts, should be made of metal. Make the pivot socket from a 16d nail and a short piece of 1/4-in. I.D. steel pipe. Drill a 3/8-in. dia., 5/8-in. deep hole in the crossbar at the point where the whirligig balances best. Cut the head off the nail and drop it into the bottom of the hole. Then tap the pipe into the hole on top of the nail (see side view, Fig. 2).

Make the pivot point from a 1/4-in. dia. metal rod. Mount the rod in a hand-held drill, turn the drill on, and hold it against a moving belt sander or disc sander. This will grind a point. Insert the rod in the socket with the point resting on the head of the nail.

## *Parting Thoughts*

As mentioned before, don't get discouraged if your whirligig doesn't work smoothly when you first assemble it. This is especially common in whirligigs with complex mechanisms, such as "Saturday Night." More often than not, the moving parts need to be refined, balanced, and adjusted—like any machine. Sit back, study the situation, and patiently rework the pieces that need attention. Before too long, you'll get the payoff, as your whirligig begins to whirl. ▲

*Nick Engler and Mary Jane Favorite are currently working on a book called* Whirligigs and Wind Toys, *coming soon from Rodale Press.*

# SHOP BUILT STROKE

*A Low-cost Version of an Industrial Machine*

**The long, wide belt of this shop-made stroke sander makes quick work of sanding large surfaces.**

# SANDER

BY GLENN BOSTOCK

When I opened the doors of my cabinet shop for business, I was well-equipped except for one thing—a stroke sander. It's not the sort of thing the average craftsman longs for—a good tablesaw or jointer is probably higher on the wish list. But I'd used stroke sanders in school and in shops where I'd worked and fell in love with them. These large, stationary, belt sanders are incredibly efficient for sanding everything from tabletops to cabinet frames.

Stroke sanders have a wide abrasive belt, about 20-25 feet long, running above a sliding table that holds whatever it is you're sanding. You sand the piece by pushing the belt down onto it with a pad, and sliding the table back and forth. You can sand a tabletop in minutes and a set of kitchen cabinets in a morning.

Stroke sanders may be efficient, but they are also expensive. When I was looking for a stroke sander five years ago, the cheapest one I could find cost $2,000—used. (Editors Note: Stroke sanders in the $1000 to $1,600 range have been marketed since, including several models made by Woodmaster Tools, 2908 Oak, Kansas City, MO 64108, and a model by Wilke Machinery Co., 120 Derry Court, York, PA 17042.) I built my stroke sander for $400, half of which went for the motor. For about $10 each, I make my own sanding belts. After five years of regular use in my shop, the sander still runs like a dream.

## *Basic Construction*

I designed this machine as I went along. Until I wrote this article, the only drawings of it were some sketches on a piece of scrap wood which, like all scrap in my shop, eventually ended up in the wood stove. I encourage you to design a little as you go, too. If you make your own belts, as I do, you can make the sander as large or small as you like, so consider your needs before you start. I underestimated mine, and had to enlarge my machine by cantilevering it off to one side as shown in the photo. Unless you do real big work, the sander in the drawings will probably meet your needs.

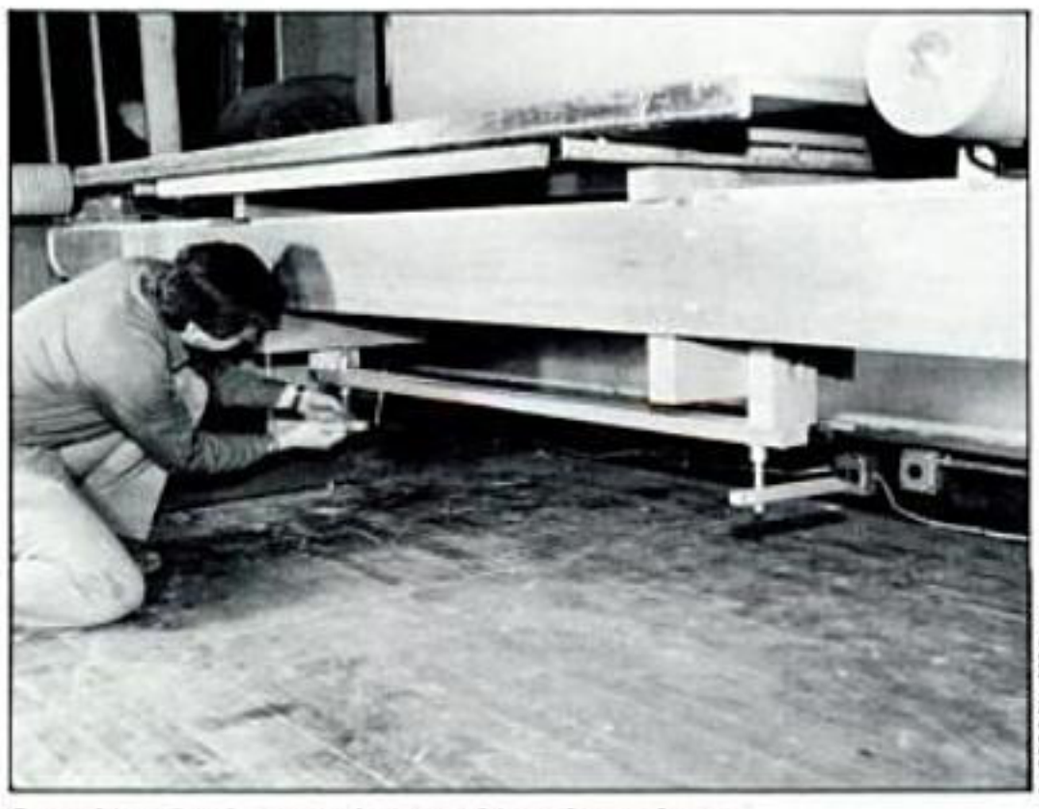
There are three subassemblies to my sander as shown in the drawing. The *bench assembly* supports the machine. The *sander assembly* is a 6-in. wide sanding belt, looped around two drums made of medium density fiberboard. One of the drums is mounted directly on the shaft of a 1700 rpm-, 1-H.P. motor, which powers the machine. The *table assembly* holds the piece being sanded and slides back and forth on garage-door tracks. The table adjusts up and down on two lead screws to accommodate different thicknesses of wood.

An important difference between my machine and those made commercially is that the sanding table lies *within* the loop of the belt, instead of underneath the loop. The abrasive is on the inside surface of the belt. This setup lets me push the belt down onto the piece I'm sanding without reaching inside the loop of the belt as with many commercial stroke sanders.

## *The Bench Assembly*

The bench assembly shown in Fig. 2 is patterned after my workbench. I've added a couple of cross stretchers and some other supports to hold the sliding table. My trip to get wood for the bench resulted in my first design change: The lumberyard was out of poplar, which is cheap and serviceable, so I built the bench out of 8/4 Philippine mahogany instead. I bought the wood pre-milled and designed the bench around the wood's width of $1\frac{1}{2} \times 7$ in. A few of the supports are made of oak for its strength, as shown in the drawing, because they directly carry the weight of the table. I made them from $2 \times 4$s I milled from 10/4 oak.

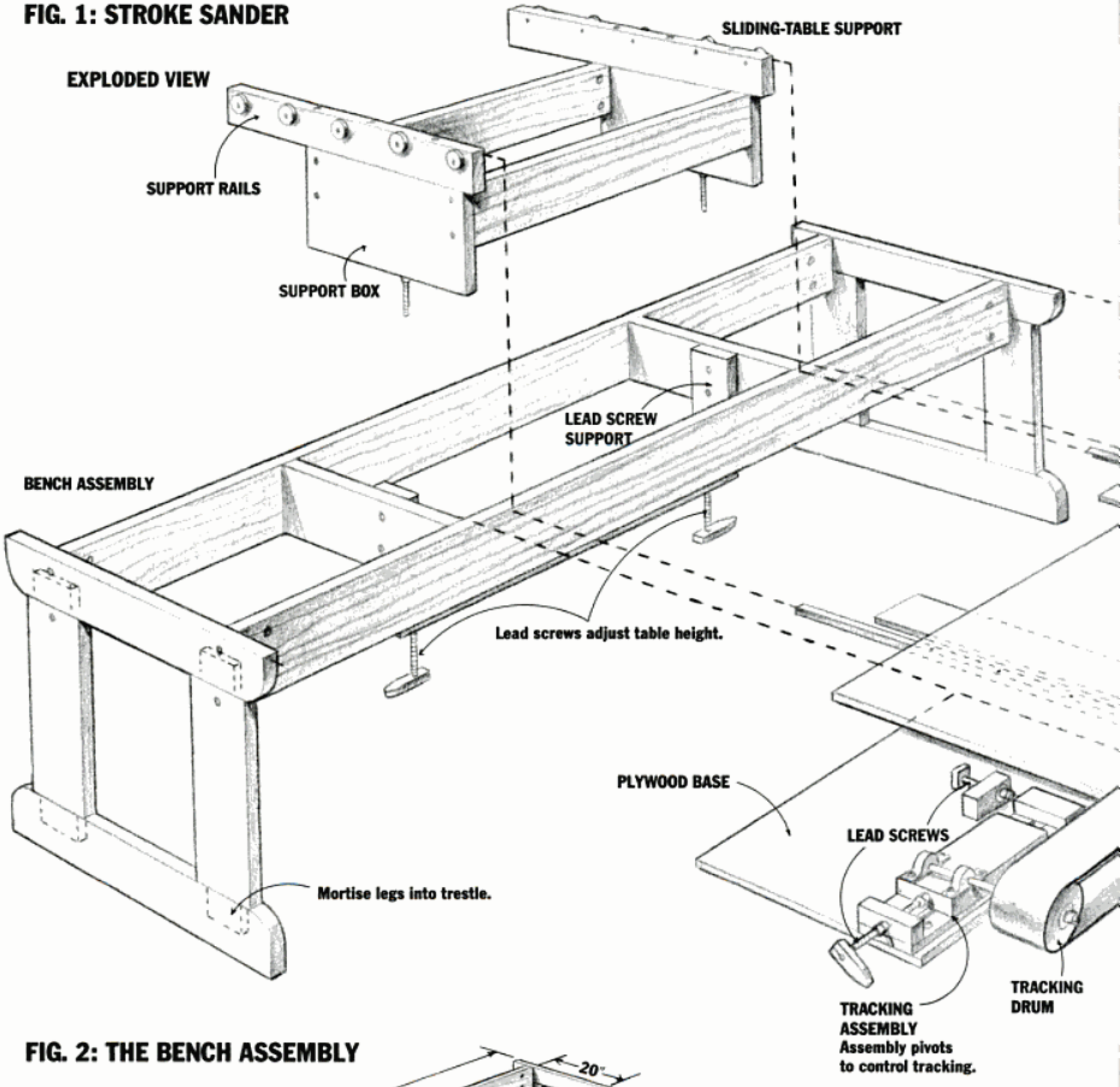
Note that I simply bolted the stretchers in place. I've taken a lot of heat from my artsy-craftsy friends about this. In my defense, I can say that after five years and lots of abuse, the bench is still solid as a rock.



PHOTOS BY JEFF DAY

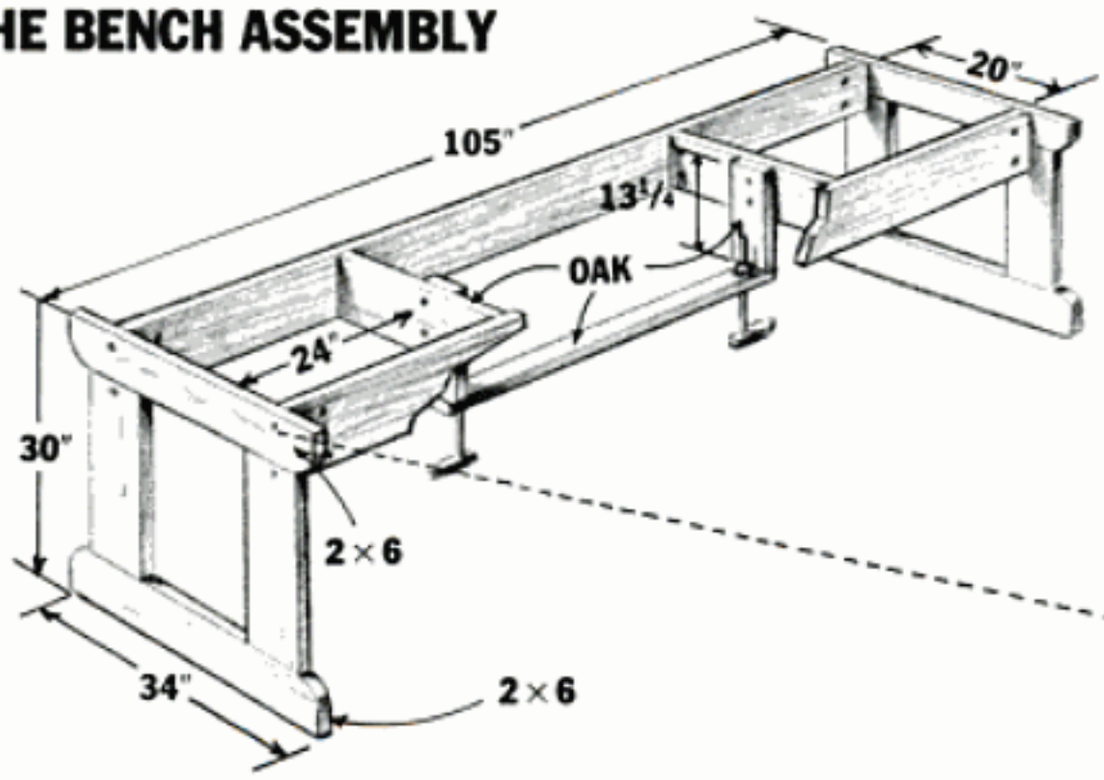
**One of two lead screws is turned to raise or lower the sanding table.**

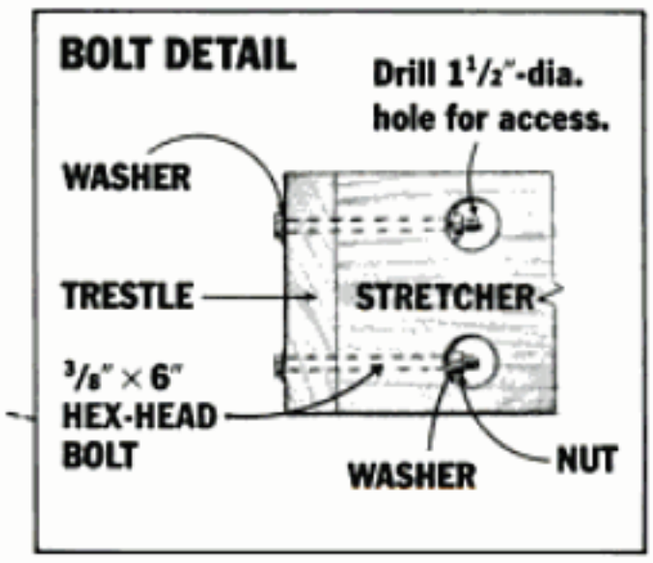
## FIG. 1: STROKE SANDER




## FIG. 2: THE BENCH ASSEMBLY

All stock nominal 2 × 8 except where noted.



## *The Sliding-table Assembly*

Once the bench was complete, I built the sliding-table assembly shown in the drawing. This assembly consists of the table and the table support. The table travels on two garage-door tracks mounted on a wooden support. The support adjusts up and down on two lead screws so I can bring varying thicknesses of wood up to the belt.

Build the support first. I built my support—which is really just an open-ended box—from 10/4 oak that I milled to 2 in. thick. Build the box to fit the opening in your bench—there should be about $^{1}/_{16}$ in. gap between the box and the stretchers on all sides, so the box can move freely up and down.

When the support box is complete, bolt two oak rails to the sides to support the garage tracks as shown. The rails overhang what will be the back of the machine more than they overhang the front. The extra length in back provides additional support.

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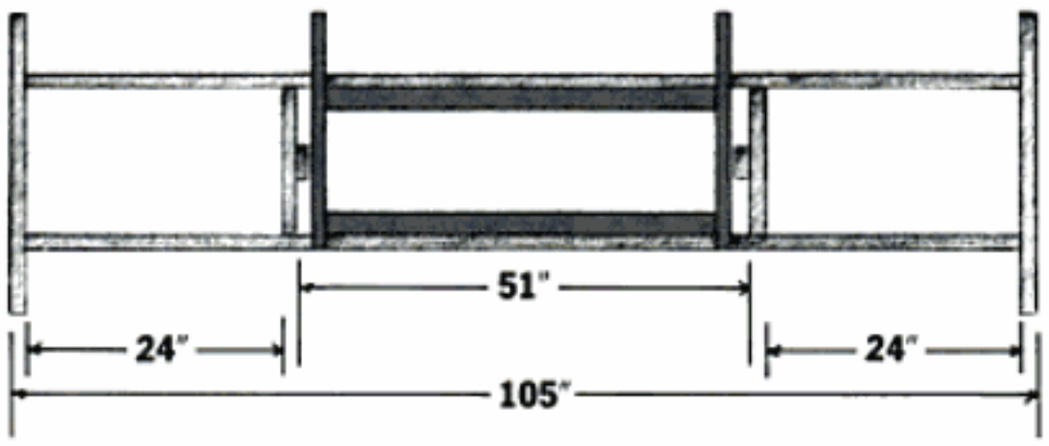
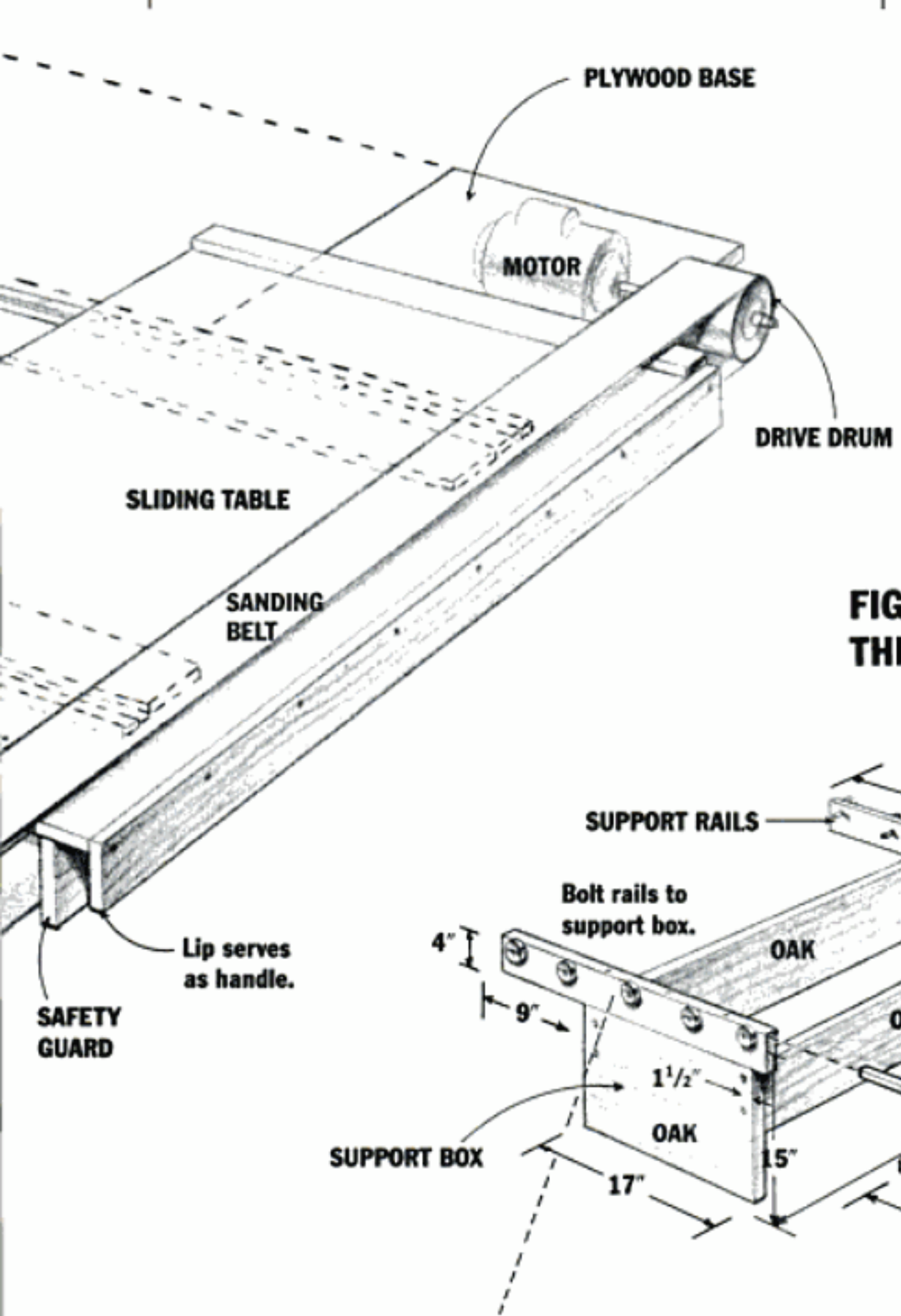


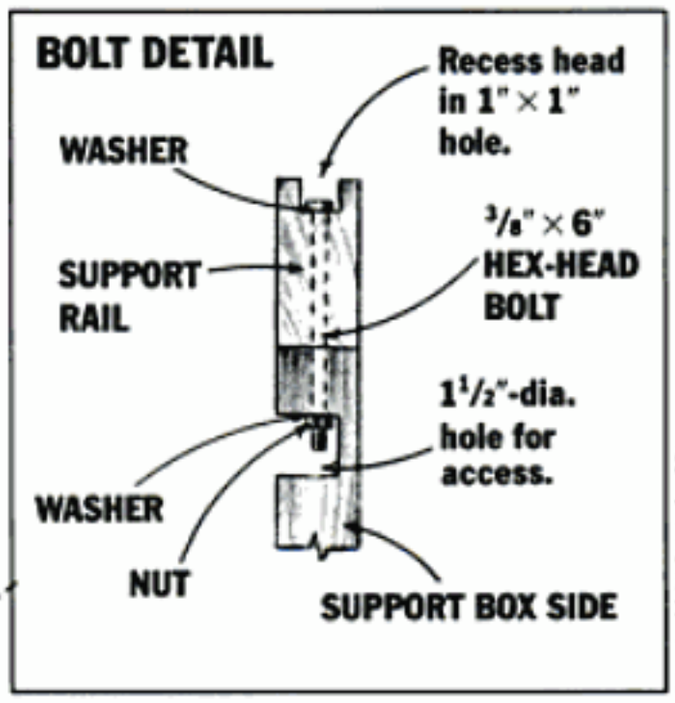
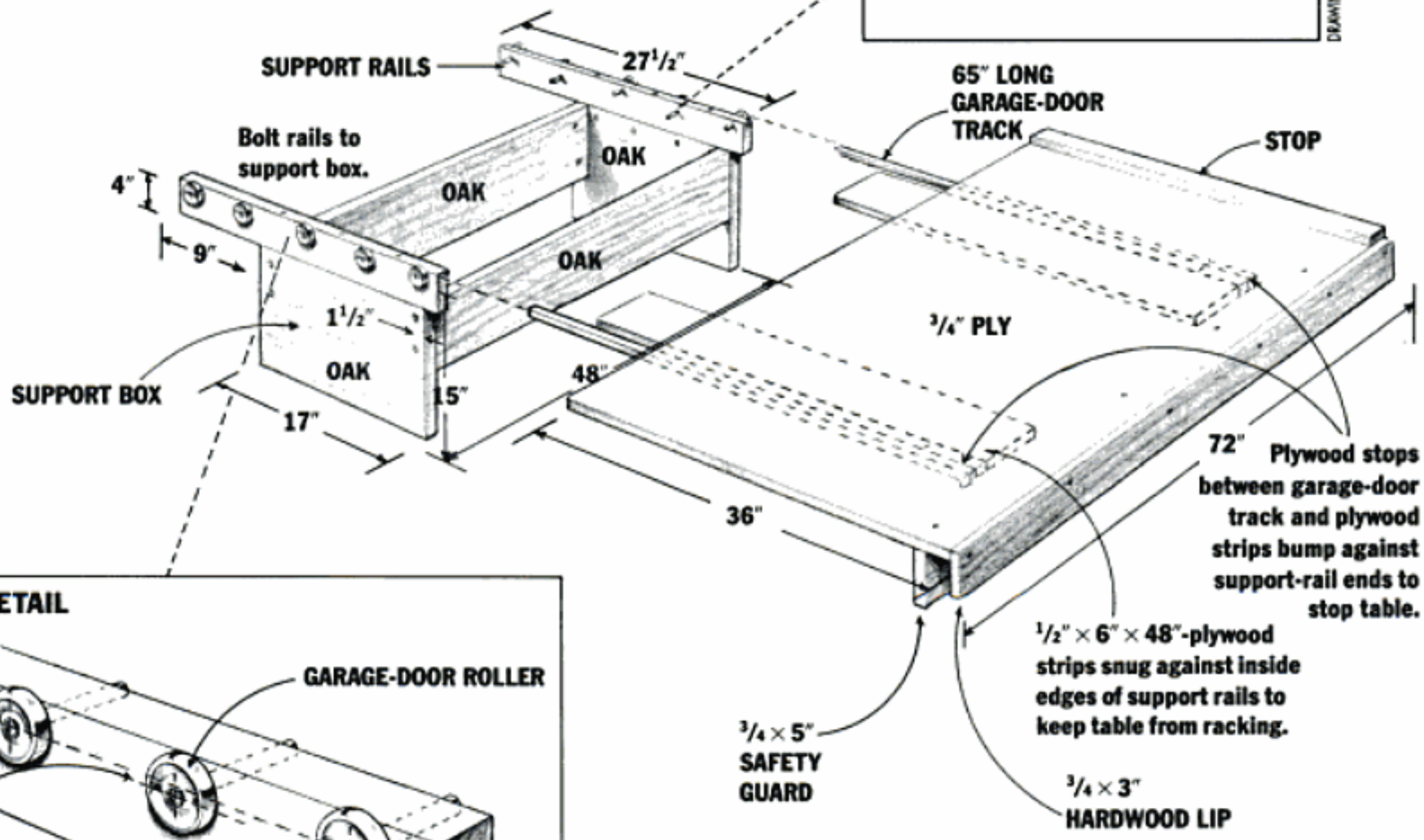
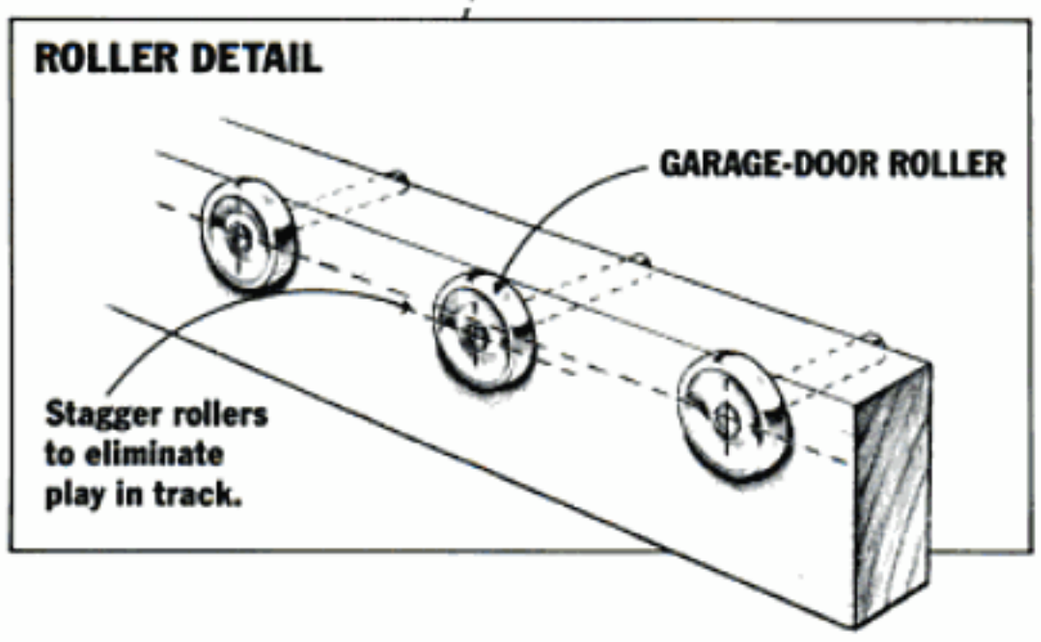
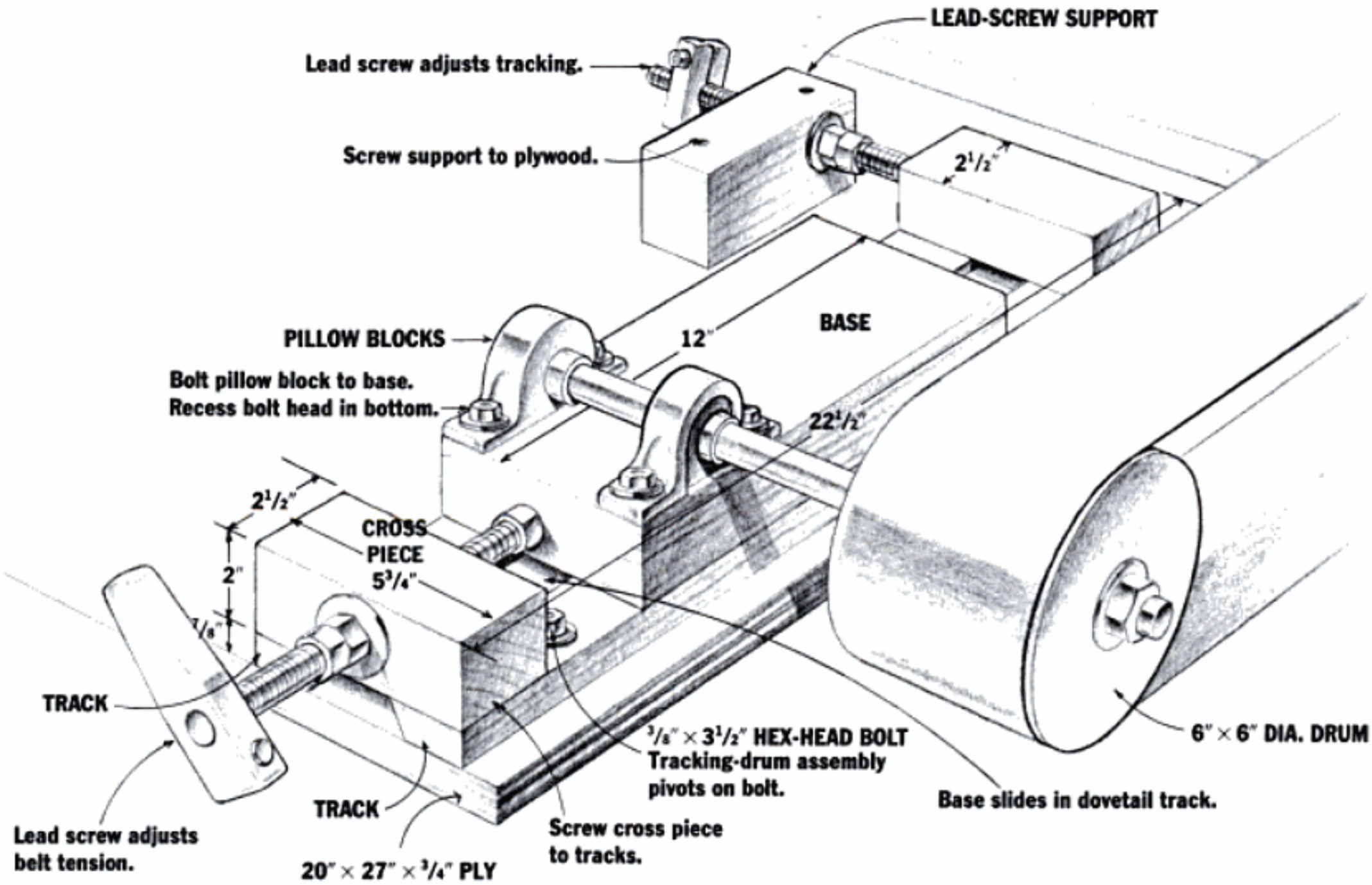



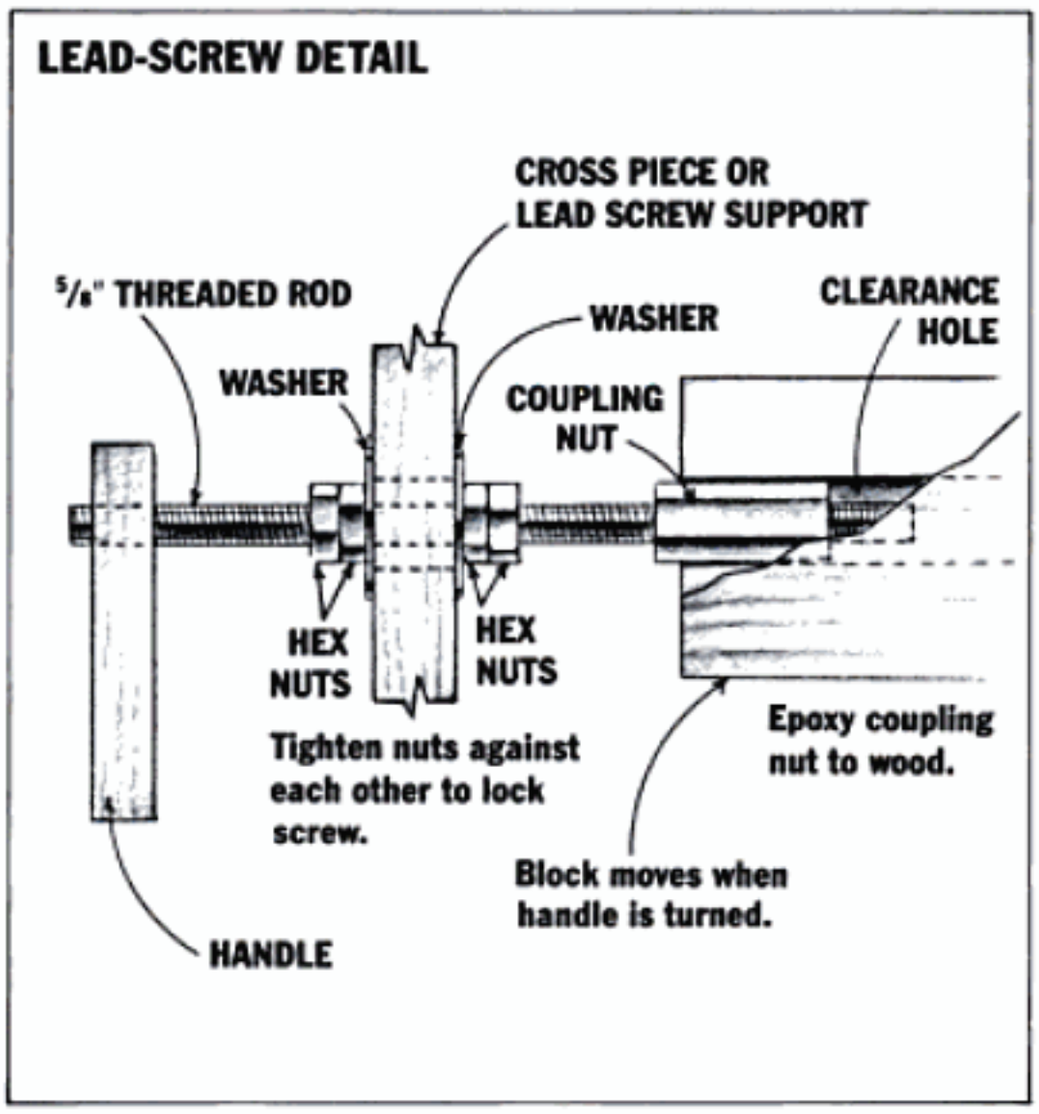

**FIG. 3: THE SLIDING TABLE**

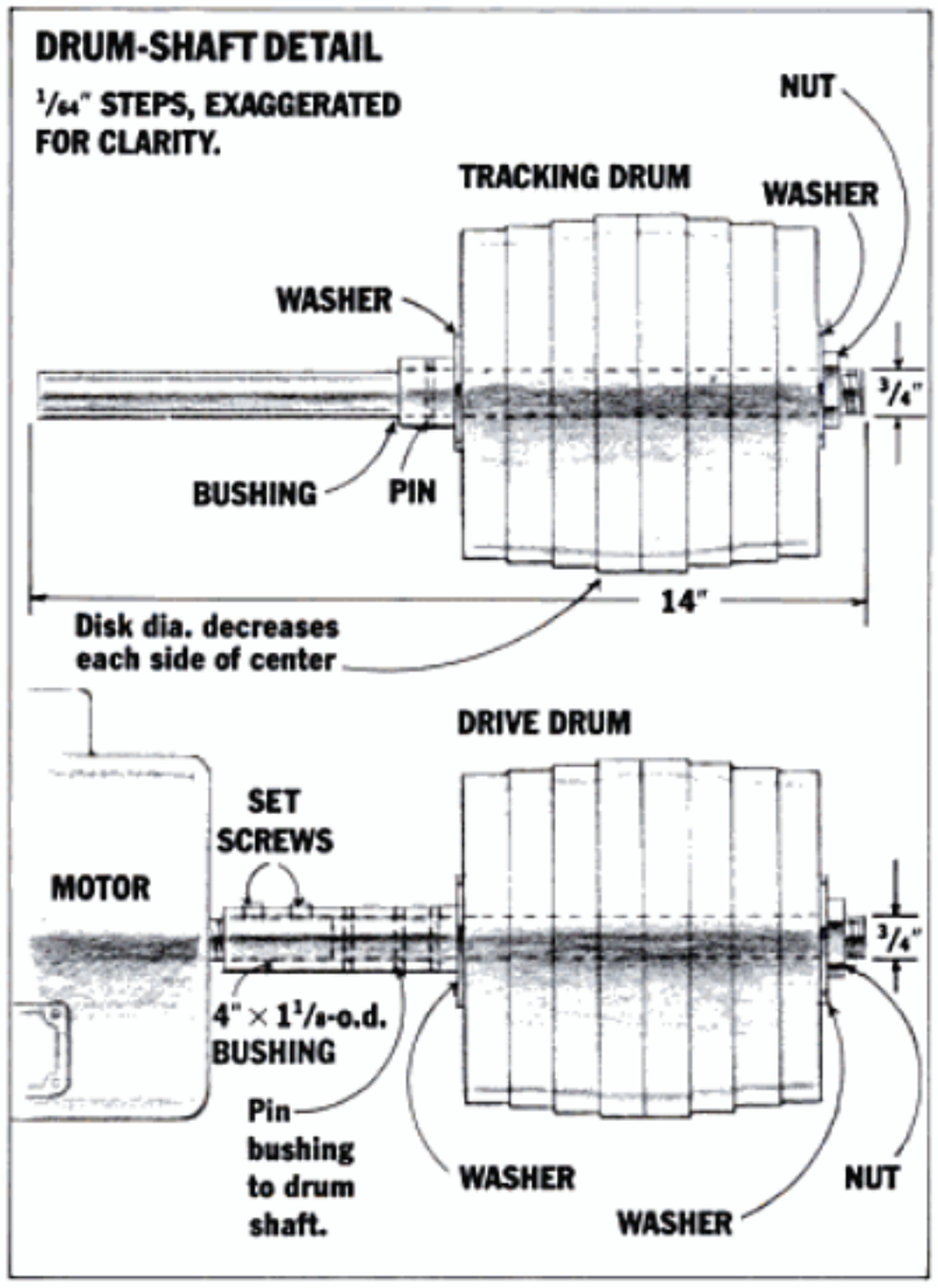


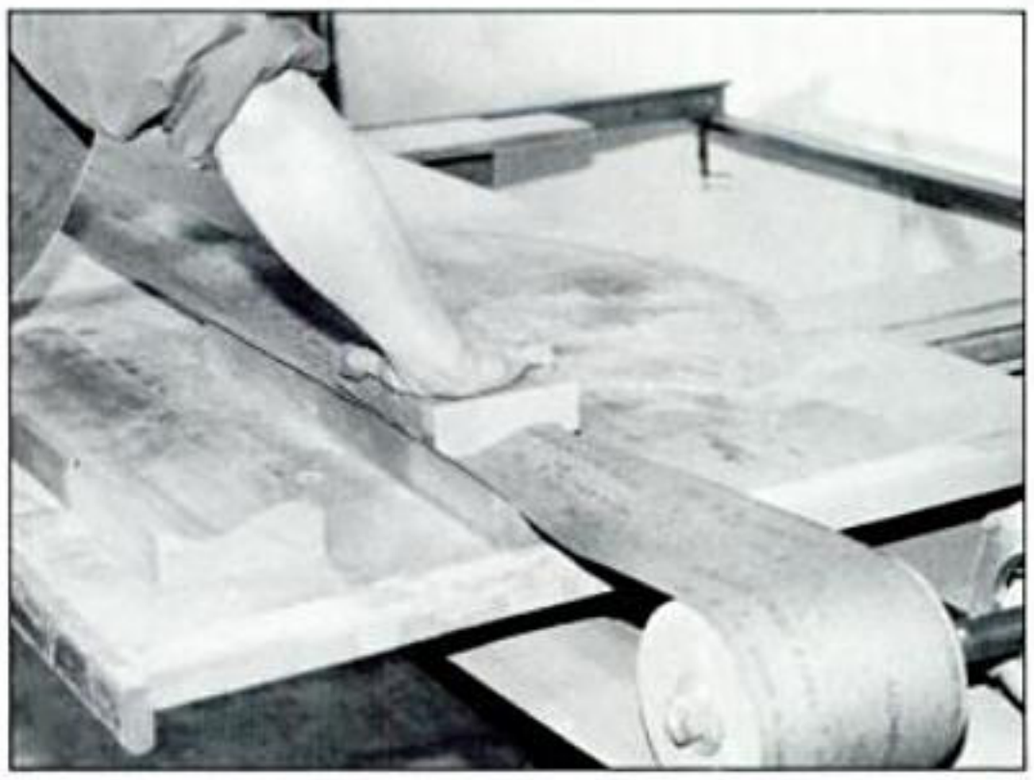



## FIG. 4: TRACKING-DRUM ASSEMBLY





**The stroke sander works well on moldings as well as flat surfaces if you make a pad that matches the contour.**

Garage-door rollers are mounted on the oak support rails as shown. I got my rollers from a local garage-door dealer. When I was picking them up, he gave me some leftover track. I wouldn't count on having the same luck again, but I'd sure try.

There are five door rollers on each side. The shaft of each roller fits into a hole drilled in the rail. Drill the holes 1/64 in. oversize. The shafts should slide end for end in the holes just a bit so that the wheels will automatically align with the track.

Garage-door tracks are notoriously sloppy when operating, so I staggered the wheels to eliminate play (see Roller Detail, Fig. 3). One roller runs against the bottom of the track, the next runs against the top of the track and so on. Determine the amount of stagger by mounting the end rollers first. Slip the track over them. Stagger the wheels by the amount of vertical play in the track.

## *Controlling the Table Height*

The sliding table adjusts up and down by means of two lead screws as shown in the photo. I made my lead screws from standard 5/8-in. threaded rod, a handful of nuts and some washers as shown in the drawing. The lead screws thread into coupling nuts, which I epoxied to the bottom of the support box as shown in Fig. 4. Coupling nuts look like regular nuts except they're about five times as long (available from MSC Industrial Supply Co., 151 Sunnyside Blvd., Plainview, NY 11803). The extra length gave me more glue surface for the epoxy.

The table—a piece of plywood bolted to the garage door tracks—is pretty straightforward. Determine the holes for the bolts by sliding the tracks over the rollers, and setting the table on top of the tracks. I used carriage bolts and recessed the heads in the plywood.

I glued and screwed a 3-in. wide lip on the front edge of the plywood, as shown, that I grab to slide the table when I'm sanding. The 5-in. wide board, glued and screwed to the bottom of the table just behind the lip, is equally important—it is a safety guard to prevent you from inadvertently reaching into the moving sanding belt. It's a lesson I learned the hard way. I added it after a friend got a nasty cut.

When I'm operating the sander, I often pull on the table from one of the corners. To prevent it from racking in the tracks, I glued and screwed two strips of plywood to the underside of the table so that they snug up against the oak rails as shown in the drawing.

## *The Drum Assemblies*

This is the part of the machine that takes its inspiration from a belt sander. The belt is looped around two drums. One drum is driven directly by a motor. The second drum, which I call the tracking drum, is shown in the photo. One lead-screw assembly keeps the belt taut; another makes it track correctly.

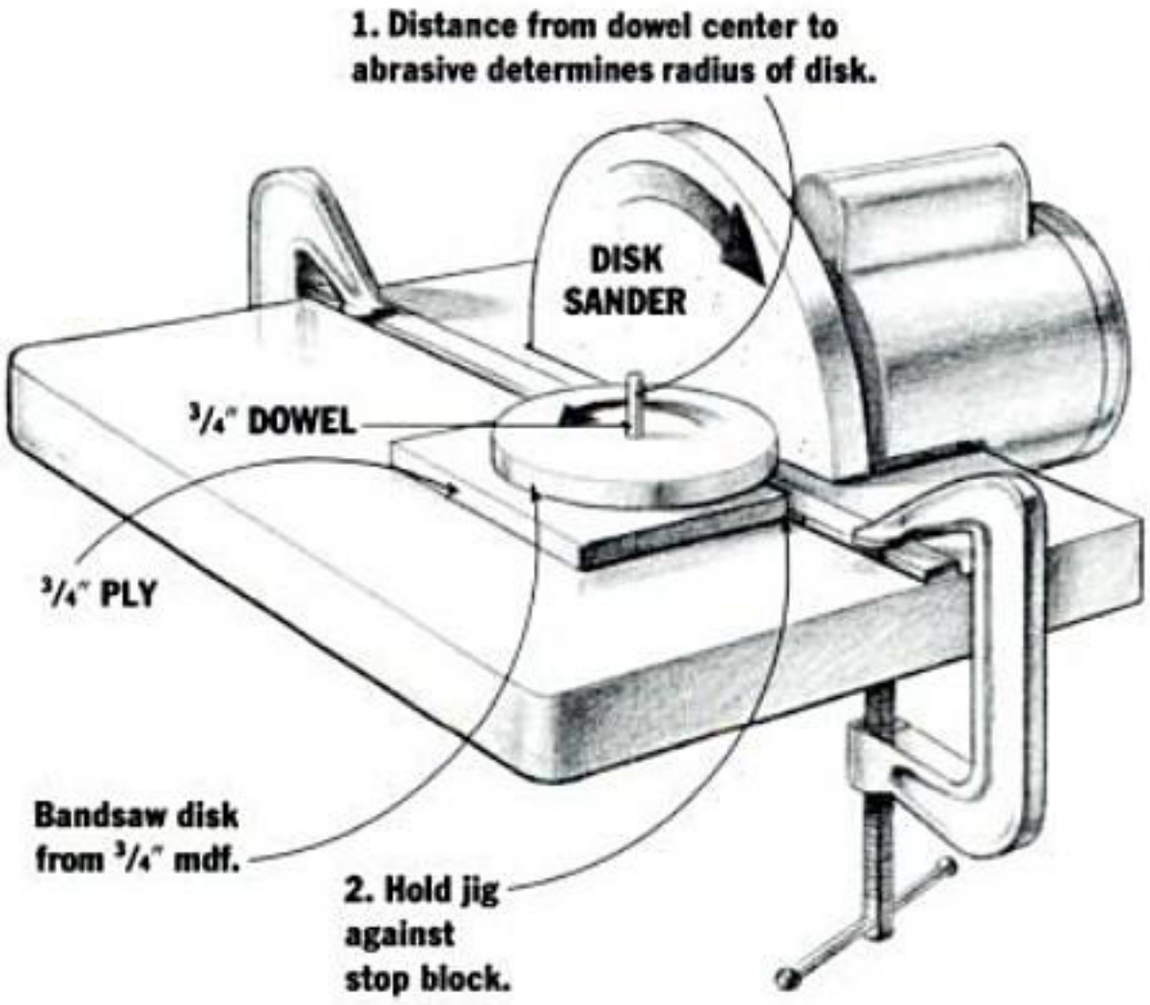
I built the drums first. Each drum is really a stack of eight disks of 3/4-in. medium density fiberboard. The disks are friction fit on the shaft, and sandwiched between a nut and a stop on the machine shaft as shown. The disks fit quite tightly on the shaft. I found it easier to mount the disks on the shaft one at a time.

Belts track best on a slightly barrel-shaped drum. I made my drums barrel shaped by making the disks slightly different diameters. The center two disks are a full 6 inches; the two on either side of them are 1/32 in. smaller and next two are 1/32 in. smaller yet. The two outermost disks are the smallest and measure 5 29/32 in. You can turn the disks on the lathe or bandsaw them and true them up with a disk-sander jig as shown in Fig. 5.

Cut the drum shafts from 3/4-in. dia. bar stock to the dimensions shown and thread the ends (I had a machinist make mine). Drill 3/4-in. dia. holes in the disks, but don't mount the disks on the shafts until after the shafts are mounted on the machine. Until then, the drums make the shafts awkward to handle.

My sander is direct drive—a bushing on one of the

**FIG 5: MAKING DRUMS ON THE DISK SANDER**

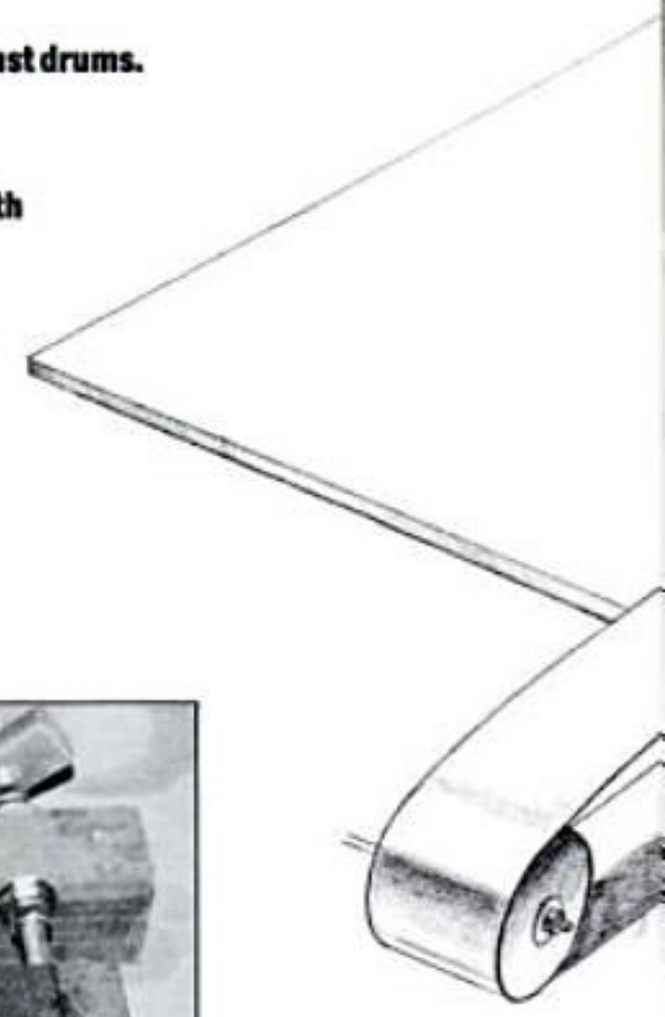


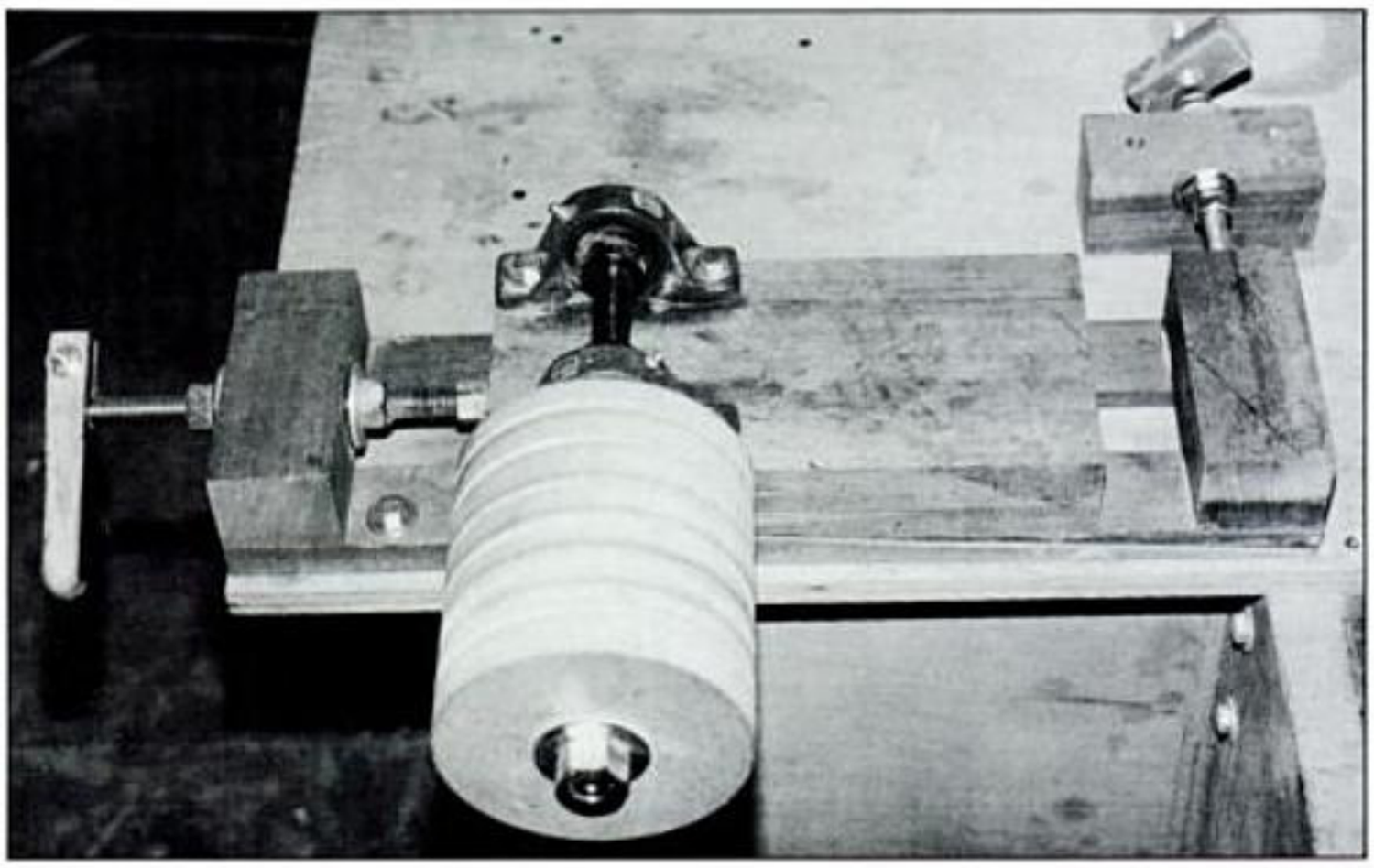
drum shafts slips over the shaft of the motor. Two set screws fasten the bushing to the shaft as shown in the Shaft Detail of Fig. 4. I haven't had any trouble with this arrangement, but direct drive puts a lot of stress on the motor bearings. If I had it to do over again, I'd mount the drum shaft in pillow blocks, mount a pulley on the end and drive the shaft with a belt.

However you choose to connect your motor, I recommend 1-HP, 1700-rpm, totally enclosed fan cooled (TEFC) motor. (Electric motors are available from Surplus Center, P.O. Box 82209, Lincoln, NE 68501.) TEFC motors are sealed to protect them from dust, and one thing this machine generates is dust. There's often enough dust to clog an unsealed motor and keep it from working—another lesson I learned the hard way.

Screw a piece of plywood to the bench, as shown in Fig. 1, and mount the motor on the plywood. To determine the exact location of the motor, push the sliding table back until the safety guard bumps against the

## FIG. 6: MAKING BELTS



**The tracking-drum assembly controls the belt. The lead screw to the left adjusts belt tension and the screw to the right adjusts tracking.**

ends of the support rails. The front edge of the belt should travel directly above this point as indicated in Fig. 1, so you don't accidentally flay your fingers while sanding. Screw two plywood stops to the underside of the table as shown in the drawing. The stops will bump into the support rails and keep the table from going back too far.

## *The Tracking-drum Assembly*

The tracking-drum assembly, shown in Fig. 4, controls the belt tension and tracking. The drum is adjustable in two directions by means of lead screws: It moves back and forth in line with the belt to keep it taut. To control tracking, the entire tracking-drum assembly pivots on a bolt. (The length of even the best sanding belt varies from one edge to the other. Pivoting the drum compensates for this.)

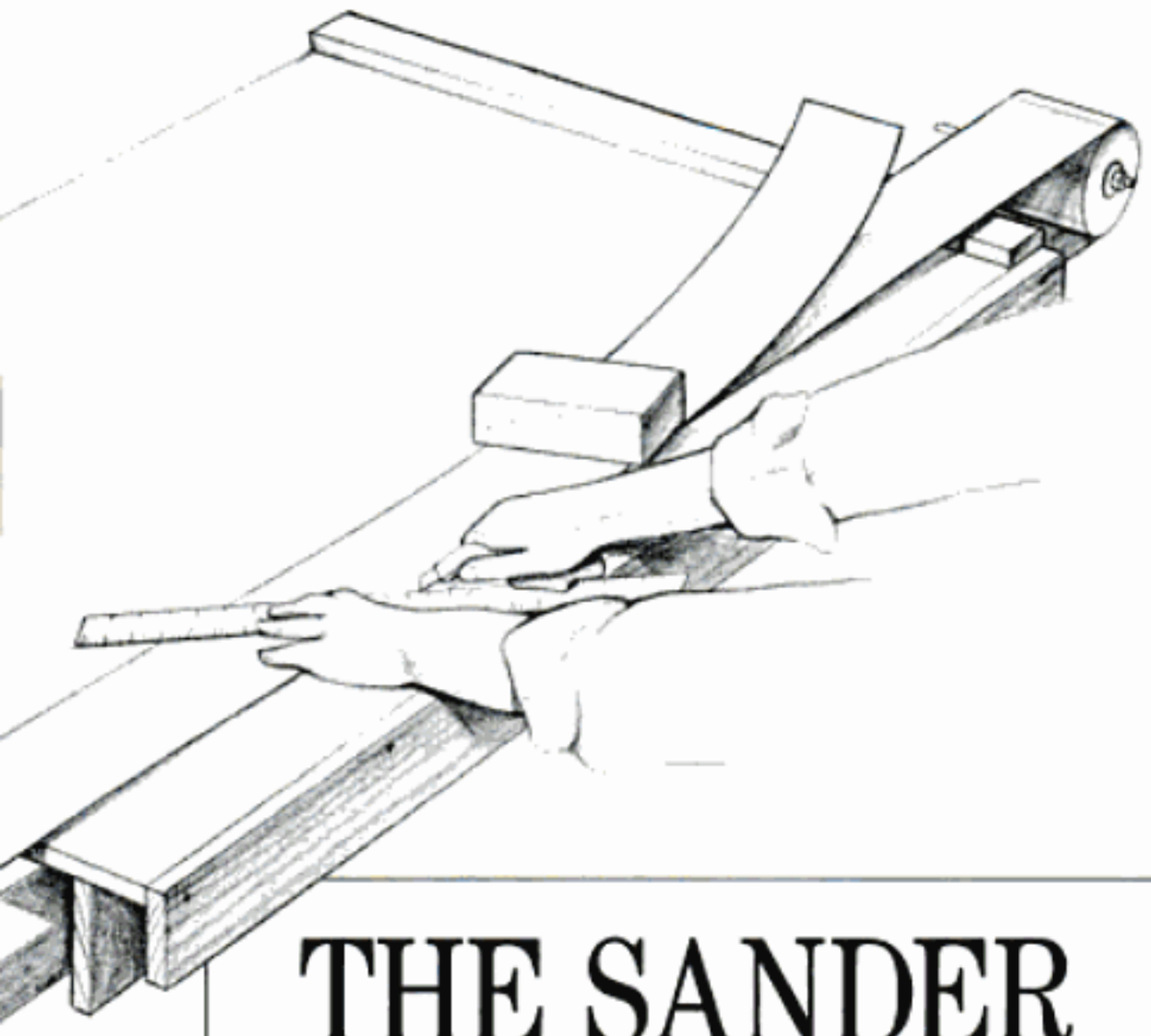
A drum that can be adjusted in two directions is not as complicated as it may sound. The drum and its shaft are mounted in Browning VPLE 212pillow-block bearings. The pillow blocks are mounted on a base with a dovetailed strip on the bottom that slides between two dovetailed tracks. A single bolt holds the entire tracking-drum assembly to a piece of plywood screwed to the bench. To tighten the belt, a lead screw moves the base on the dovetailed track. A second lead screw pivots the track around the mounting bolt to control tracking.

## *Making the Belts*

I make the belts from a 6-in. wide roll of aluminum oxide paper (available from Econ-Abrasives, P.O. Box B865021, Plano, TX 75086 and from Kuster Mfg., P.O. Box 34, Skillman, NJ 08558). I have a collection of grits that ranges from 80 to 220, but I find I do almost all my sanding with 120- or 150-grit.

To cut the abrasive to the right length, I put one end of the roll on the sliding table and loop the roll around both drums with the grit facing the drums as shown in the drawing. Where the paper overlaps, I cut it with a knife and a straightedge. Turn the straightedge at a slight angle, cut a line through one layer and then through the next. This makes a perfect seam, which I splice together with plastic packing tape. ("Sand Aid," a belt-splicing kit, is available from Kuster Mfg.)

Tape along and across the seam, and slip the belt over the drums with the grit facing the drums. Adjust the tension until the belt is snug, and rotate the drums



slowly by hand to check the tracking. You may have to fine-tune both the tracking and the tension while the machine is running.

Unlike a belt sander, a stroke sander has no sole. As a result it operates a little differently. Instead of pushing the machine onto the work, you raise the table until the work is 1/2 to 1/4 in. below the belt. You then push the belt down onto the work with a special pad. My pad is nothing more than a piece of plywood with a handle on one side, and a piece of plastic laminate glued to the other side. Sand the edges of the laminate slightly so you don't have a sharp edge meeting the belt. Lubricate a new belt slightly by holding a chunk of paraffin against the back of the belt while the machine is running. Repeat when you feel the pad dragging on the belt. ▲

*Glenn Bostock makes period furniture and does custom millwork in Rushland, Bucks County, PA.*

# THE SANDER IN ACTION

The stroke sander won't eliminate *all* your hand sanding. On fine pieces, I still sand lightly with 180-grit in an orbital sander and follow that up with a light hand sanding of either 180 or 220. But the stroke sander does end all that grueling 80- and 120-grit work that accounts for probably 80 percent of your sanding. The sander is very good at removing machine marks and scratches.

Sanding a flat piece, like a tabletop, is pretty straightforward. Put a 150-grit belt on your machine. You will use this throughout the entire operation. Put the tabletop on the sander's sliding table with the grain running parallel to the belt. Raise the sliding table so the top of the work piece is within 1/2 in. of the belt. The exact distance will depend on the tension you've put on the belt, but I like to set up the machine so that when running, the belt just skims above the surface of whatever I'm sanding.

Start the sander. Slide the table back and forth with one hand. With the other hand, gently push the belt down onto the tabletop with the pad. Travel with the pad along the length of the belt to get to each end of the table, and as you move, slide the table back and forth to sand each side. Keep pushing with the pad. It's an awkward motion at first, but you'll soon master it.

When you've stroke sanded the entire surface, turn off the machine, and remove the tabletop. Sand with 180-grit in an orbital sander and finish sand by hand with either 180- or 220-grit.

You'll quickly discover stroke sanders have a disconcerting tendency to grab whatever you're sanding and throw it in the direction of the belt's travel—to the right on this machine. Make sure you snug your piece against the stop at the right-hand end of the table to avoid this.

I find the stroke sander especially handy when I'm doing kitchen cabinets or bookcases. I can sand the disassembled plywood carcases on the stroke sander. When I'm done with the plywood, I sand the frames of the door, too. I glue up the door, sand with the grain along the rails, and then turn the door 90° to sand the stiles.

I also use the stroke sander to sand moldings. This doesn't work well on intricate shapes, but if I've got a large cove that I've built up in the shop, it's perfect.

Sanding moldings requires a pad that is the inverse of your molding profile—the two must mate perfectly while the belt runs between them. First, I rough out both the molding and pad on the tablesaw. To make a pad that precisely matches the molding, I take the stroke-sander belt off and put it back on with the grit facing *away* from the drum. I place the molding on the table and carefully push the belt into the molding with the roughed out pad. The paper side of the sanding belt conforms to the shape of the molding, and the grit side of the belt is running against the pad. In no time, the belt sands the block into the correct shape. (It will do the same thing to your fingers, so *be extremely careful to keep your fingers away from the belt.*)

I reverse the belt again to sand the molding, and when I push it into the molding with my newly made block, the two mate perfectly.

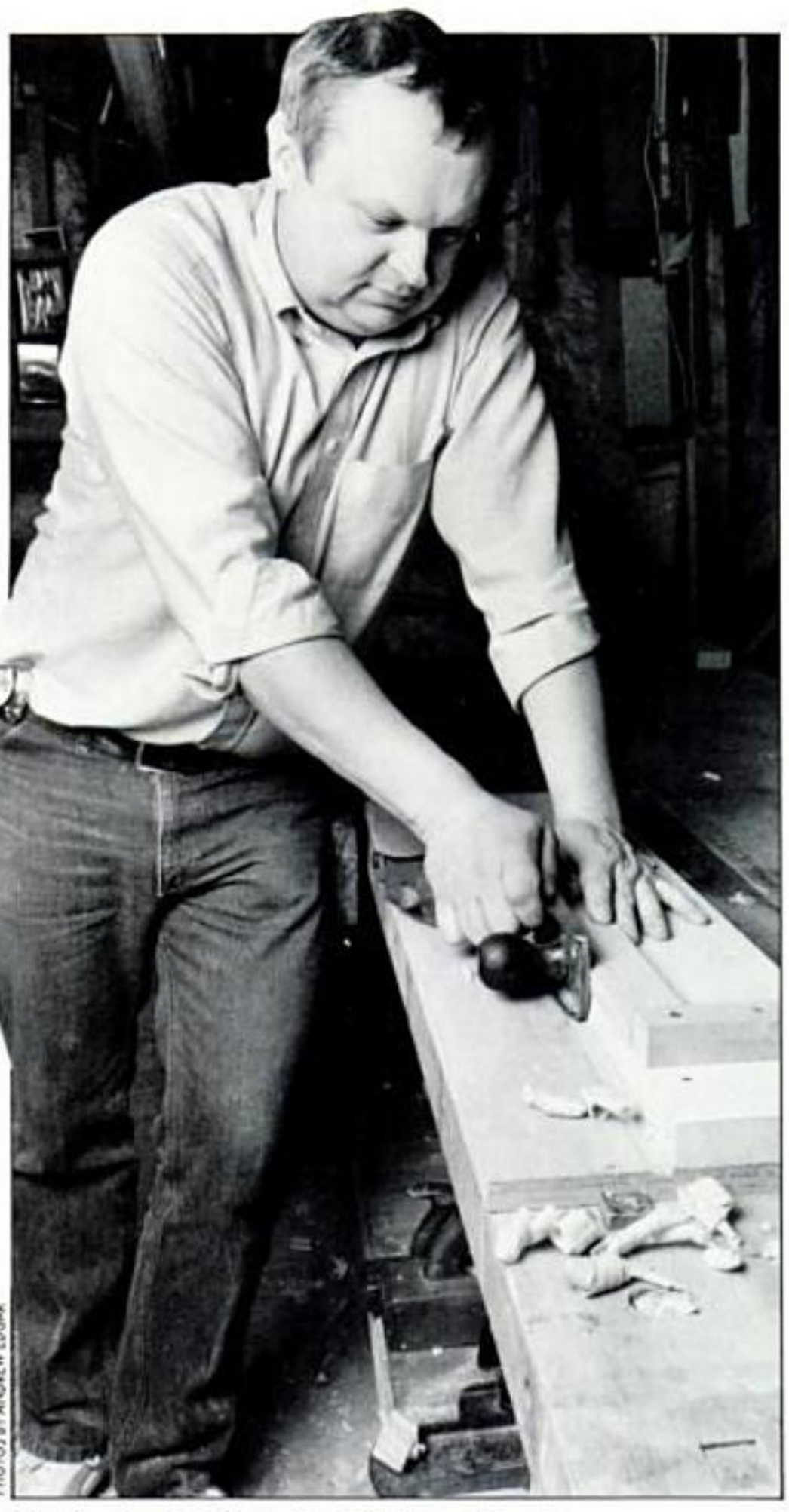
Incidentally, the machine is an excellent belt sander when the grit faces away from the drum. You can sand flat surfaces on the table and contours on either drum.

The stroke sander looks like a gentle enough machine, but it can be dangerous. Belts may break while you're sanding. Always wear safety glasses to protect yourself from the belt and from random flying grit. Wear a dust mask to protect your nose and lungs.—*G.B.*

*An Age-old Jig for Planing Straight, Square Edges*

# THE SHOOTING BOARD

BY MIKE DUNBAR



PHOTOS BY ANDREW EDGAR

**The shooting board is a simple jig that guides the plane to ensure straight, square cuts.**

Don't feel bad if you can't saw the end of a board perfectly square or cut a perfect miter. And you are not a klutz if you can't plane an edge that is both straight and square. I have met few people who can.

For precision jointing, many woodworkers rely on jointers and sanding disks. For these basic jobs I prefer shooting boards. When combined with a sharp, well-tuned bench plane the results are equally precise and you obtain an extremely smooth surface.

Shooting boards have other advantages as well. You can make them quickly and inexpensively. They are safer than machines when you are working with small pieces, and they don't create dust.

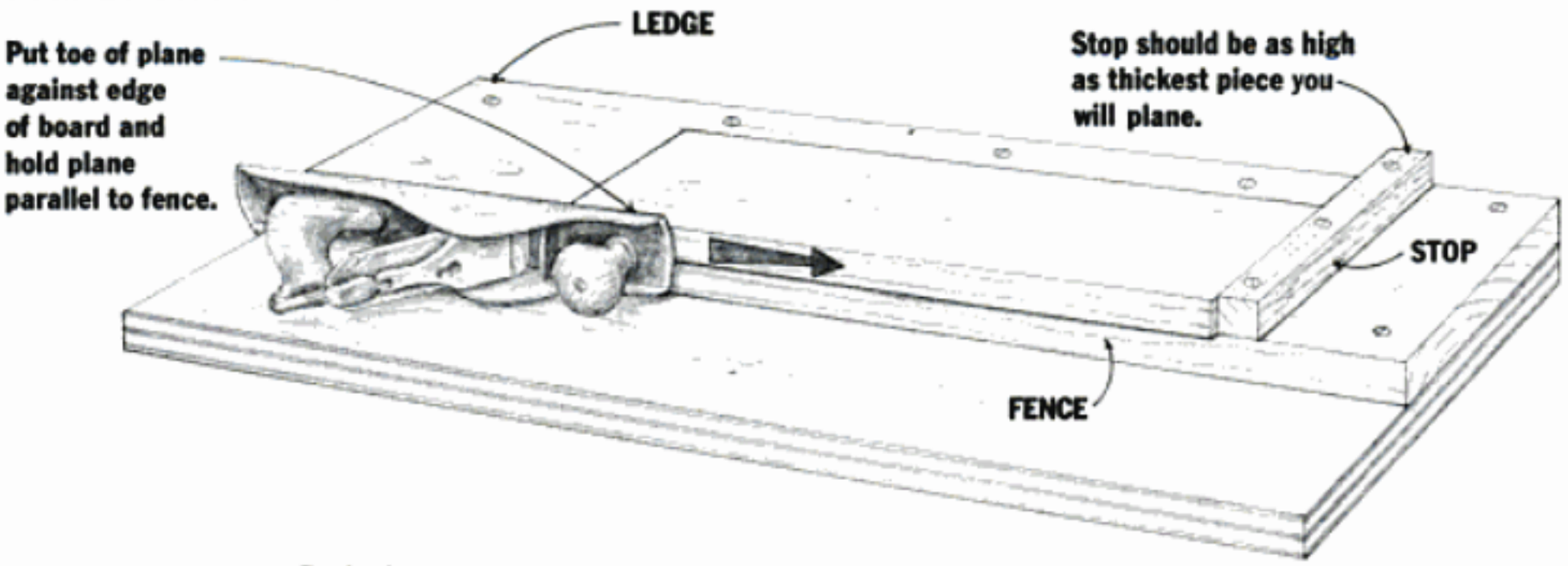
There are three types of shooting boards. The one that joints edges and squares ends is discussed here. Two others, the miter shooting board and the "donkey's ear," both used in trimming miters, will be subjects of future articles. The work done on any of these is called shooting and when done, the surface of the board is said to have been "shot."

The joint-and-square shooting board is very simple. It consists of three wooden parts: A base, a raised ledge, and a stop as shown in the drawing. The edge of the ledge serves as a fence to guide the plane.

When shooting, the plane is placed on its side as shown in the photo. The work is laid on the ledge with one edge projecting slightly over the fence and one end pressing securely against the stop. (To square off the end of a board, you place a side against the stop and shoot the end grain.)

The plane's toe (the area of the sole in front of the mouth) is held against the corner of the work farthest from the stop as shown in the drawing. The rear of the plane is held parallel to the fence. Pushing the plane toward the stop trims the projecting surface. When the plane takes a shaving that is continuous in length and width, you have made a perfectly straight and square edge (or end). A basic joint-and-square shooting board can be made with a handful of screws and a few pieces of wood and is very practical if used only occasionally. However, I need mine nearly every day. When used this regularly, the basic design has a problem: One area on the iron does all the cutting and the blade wears in just that spot.

## FIG. 1: SHOOTING BOARD




DRAWINGS BY KATHY BRAY

A shooting board with an inclined edge, as shown in Fig. 2, solves this problem. An inclined ledge distributes the cutting action over the entire width of the plane blade, keeping it sharper longer. Also, an incline holds the work at an angle to the cutting edge. The blade is said to be "askew" and results in a cleaner surface than when cutting straight on. (This is a tip to remember when you are using a plane.)

I will explain how I made my shooting board. However, there are many alternatives and no set dimensions, so make yours to meet your needs. While working on it, remember that a shooting board makes straight and square edges and ends. So, you must be continuously aware of two concepts: flat and square.

The base has to be perfectly flat. Should it warp, it will throw the shooting board out of square. For stability, I made my base out of 3/4-in. interior-grade luan plywood because the luan has a smooth, even grain.

My base is 10×30 in. This is fairly large, but I use my shooting board to make architectural elements as well as furniture. If you do very fine work, your base could be as short as one foot. When laying out the base be sure the grain in the face ply runs in the same direction as the plane.

The ledge is made of 5/4 (1 1/4-in.) Eastern white pine. Mine is 6×30 in. which exposes 4 in. of the base to support the plane. The ledge tapers in thickness from 1/8 to 1 1/8 in. Since my plane's mouth is 1/8 inch from the edge of the sole and it has a 2-in. wide blade, I can shoot work up to 1 in. thick. I seldom shoot anything thicker, but when I do, I use a jointer plane with a wider blade.

I tapered my ledge on a jig, shown in the drawing, which I ran through the thickness planer. I began with the ledge itself—a piece of 5/4 (1 1/4-in.) pine a couple of inches longer than the finished length. I used a jointer plane to joint the edge that became the fence.

Next, I built a carriage to hold the ledge on its trip through the planer. The carriage held one end of the board higher than the other, so that the planer cut a taper. To make the carriage, I laid the ledge on my work bench and placed a strip of 1-in. thick pine under one end. At several points along its length, I measured the gap between the bench and the bottom of the ledge as shown in the photo. I planed pine strips to these thicknesses and glued them underneath the ledge.

When the glue dried I attached a 10×33×1/2 in. pine board to the spacers with 1-in. drywall screws, which I countersunk. The result was a carriage that held the ledge at the desired incline for planing as shown in the photo.

I measured the combined thickness of the carriage and ledge at its highest end and set the planer to remove about 1/16 in. of that. I made repeated light passes. Each successive pass created more and more of an incline.

When the taper was finished, I gripped the carriage between bench dogs and hand planed the chatter marks from the ledge's surface. I removed the ledge from the carriage, chiseled away the pine spacers and planed off any residue. Then I cut the ledge to length.

When a shooting board is in use, small particles of shavings collect along the fence and can lift the plane out of square. A dust groove in the base prevents this. To locate the groove, I positioned the ledge on the base and traced a line using the fence as a guide. I made the groove along the line with a Stanley #10 bench rabbet plane held on its right edge as shown in the photo. The first pass was slow but scored a track that the plane could follow. I continued cutting until the groove was about 3/8 in. wide by 1/4 in. deep.

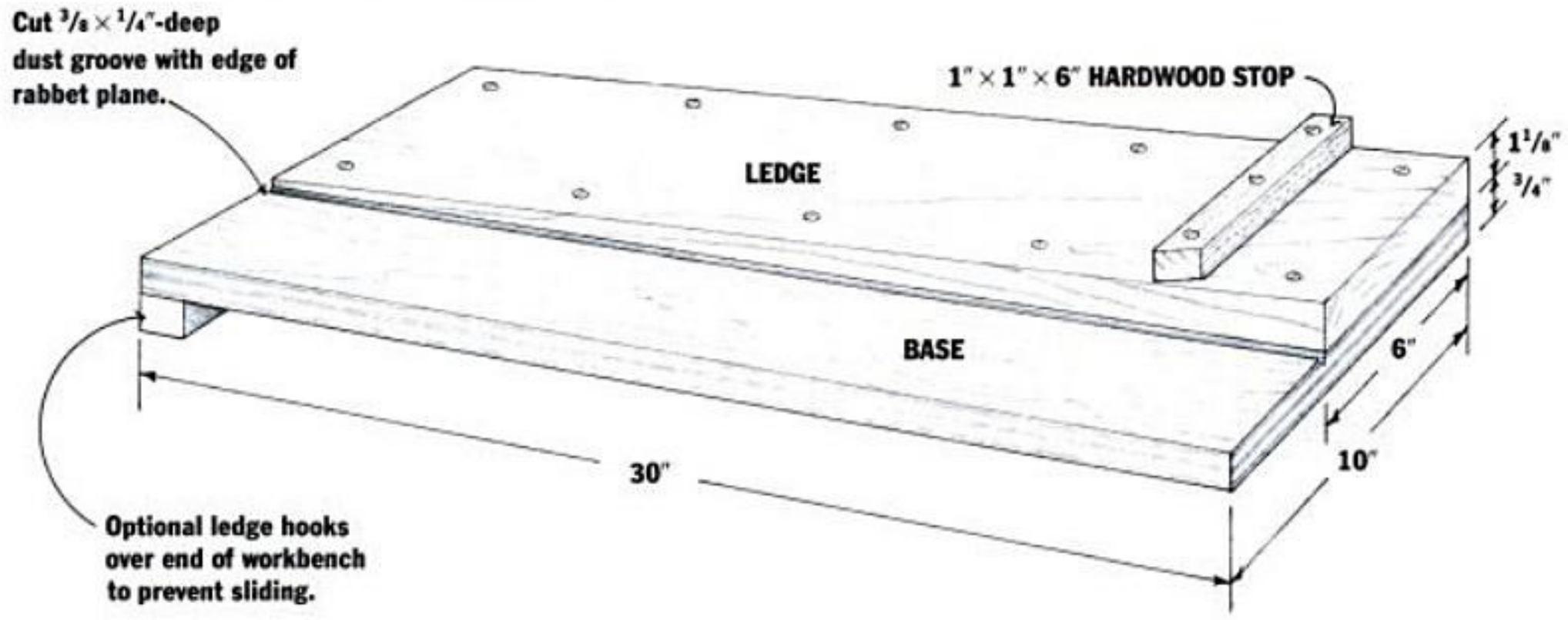
Next, I attached the ledge to the base with drywall screws and countersunk their heads.

The two surfaces created by the tops of the base and ledge have to be perfectly parallel across their widths. If not, the finished edge will be out of square. I tested the two surfaces by standing two squares back to back, one on the ledge, the other on the base as shown. When butted together, the blades should be parallel. If not, adjust the ledge by planing the high spots with a hand plane.

The stop is 1×1×6 in. and made of a scrap of hardwood. The only critical dimension is the height. It should be as high as the thickest piece you will have to shoot. Otherwise, when squaring the end of a board, the work's upper corner will not be supported and will chip. Note that the front end of the stop is angled slightly backward, as shown in the drawing, so the plane can't chip the far edge of the stop.

The stop cannot be placed at the very end of the ledge because the plane tends to rock as it passes over

## FIG. 2: IMPROVED SHOOTING BOARD




the end of the fence. I positioned the stop 2½ in. from the end of the ledge as shown in the drawing. To make sure it was square, I laid a square against the fence and traced a line against which the stop was screwed.

When the shooting board was complete I applied a layer of paste wax to the base. That reduces friction making the plane easier to push.

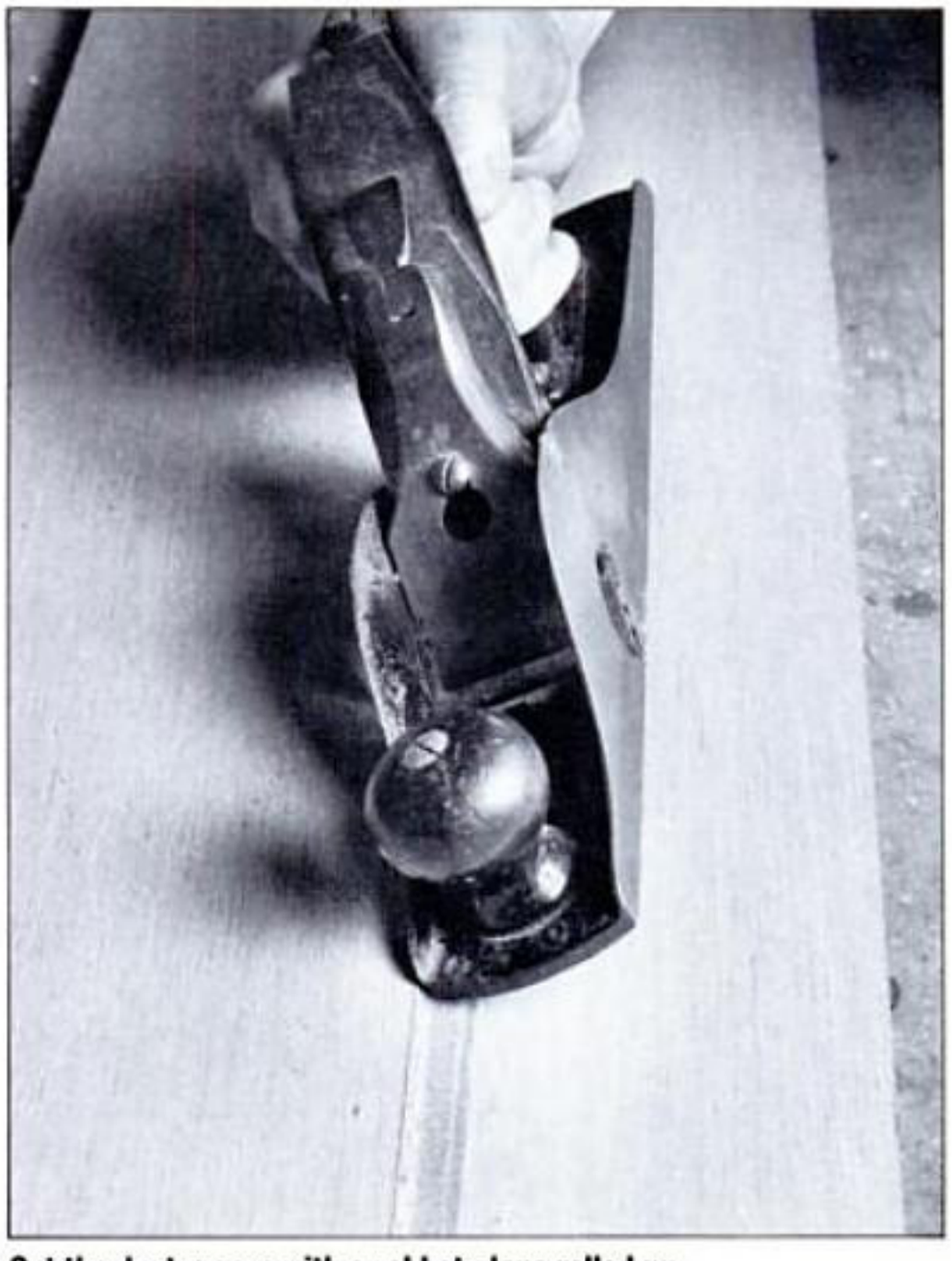
The plane has to be razor sharp and well-tuned. It also has to fit your shooting board. My shooting board is fairly large so I use a Stanley #5 jack and sometimes a #7 jointer. On a very small board you might even use a block plane.

It is critical that the plane's sole be square with its right side. Normally, a bench plane's cutting edge is slightly curved to prevent the corners from digging. For shooting, the cutting edge has to be straight. I ensure this by first spraying the flat side of the cutter with machinist's layout fluid, a fast-drying colored dye (available from MSC Industrial Supply, 151 Sunnyside Blvd., Plainview, NY 11803). When the dye is dry, I lay a square on the blade and trace a line with a scratch awl. I grind the edge to this line. It is imperative that you hone the cutter so it is razor sharp.

Finally, advance the frog so the mouth is literally paper thin. To do this, loosen the two screws that hold the frog to the body, and turn the adjustment screw as shown in the photo. Adjust the cutter to take a very fine shaving, being sure that the edge is perfectly parallel to the sole.

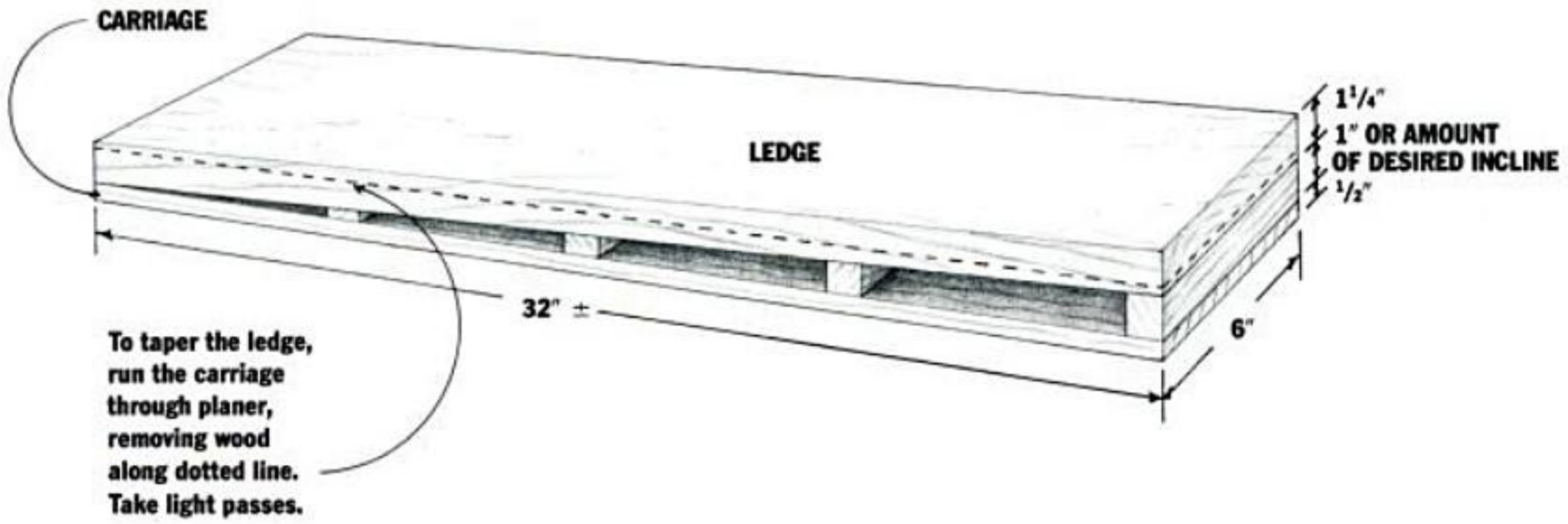
Unfortunately, a plane with a straight cutting edge on the blade will not work well on the bench, so I have

**To make the planer jig that tapers the ledge, shim up one end of the ledge, and cut other shims to fill the gap. Screw the shims to the ledge and to a base and run the entire assembly through the planer.**



**Cut the dust groove with a rabbet plane rolled up on edge; a two-handed grip provides better control.**

## FIG. 3: PLANER JIG FOR MAKING INCLINED LEDGE




designated one plane specifically for shooting. A less expensive alternative (but more work) is to buy a replacement cutter that you put in the plane when using your shooting board.

### *Shooting a Board*

In use, a shooting board will slide all over the workbench unless secured. I grip my shooting board between the bench dogs; other cabinetmakers secure their shooting board by screwing a strip of wood underneath it as shown in the drawing. The strip hooks over the end of the workbench and holds the shooting board in place.

Hold the work tightly against the stop. The edge (or end) should slightly overhang the ledge—no more than a whisker. Put the toe of the plane on the work and push the plane with conviction. Take several thin shavings rather than a single heavy one.

Cutting into the fence affects the accuracy of the jig so keep an eye on the plane blade. If it gets too close to the fence, push the board out so it hangs over a bit more and continue planing.

When the plane takes a shaving that is continuous in length and width, you have made a perfectly straight and square-edge surface. Test the shot surface with a square and it will be perfect. ▲

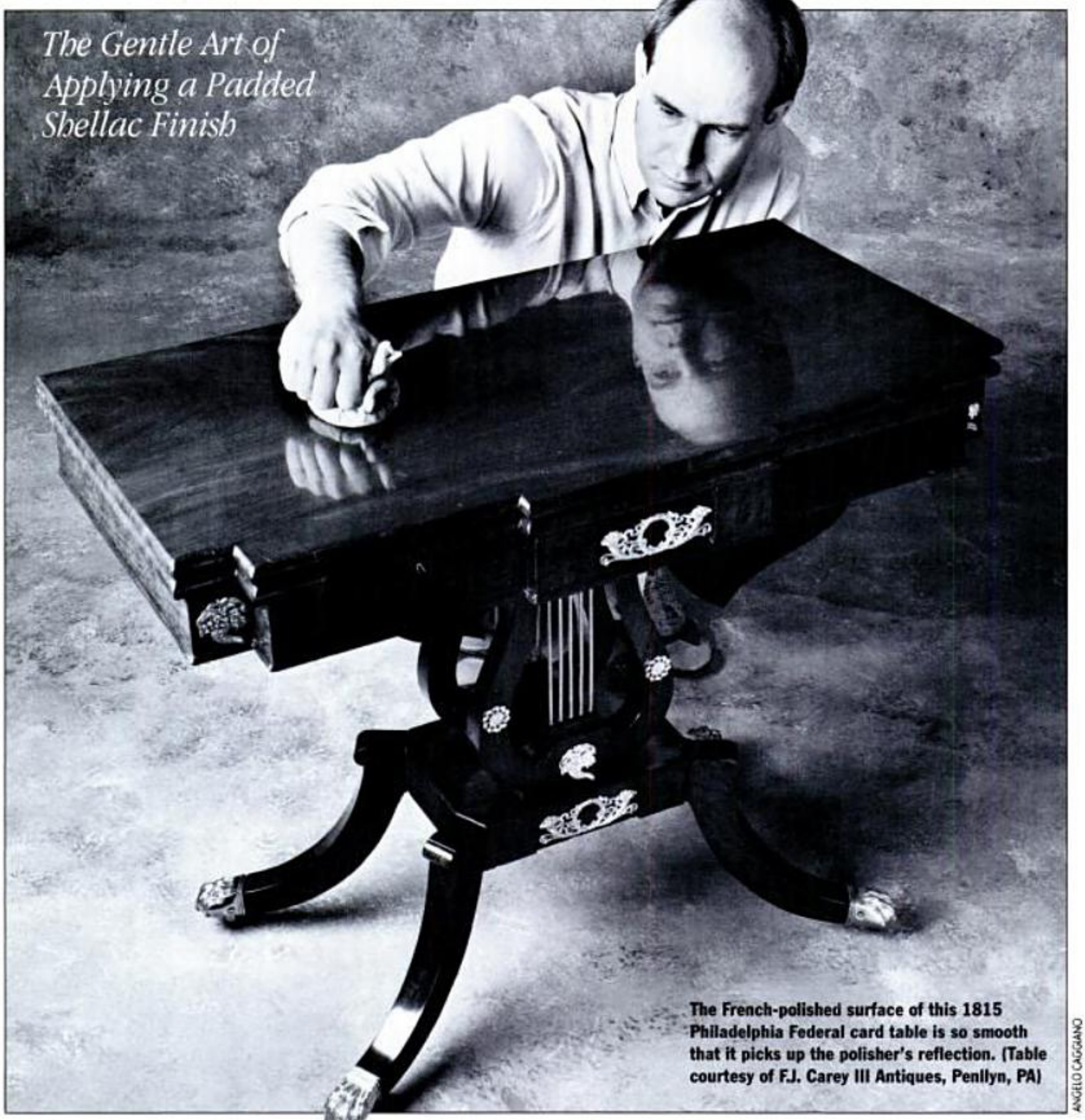
*Mike Dunbar is a furniture maker, author of several books, and a contributing editor of* AMERICAN WOODWORKER.

**The surfaces of the ledge and base are parallel if the blades of squares set on each surface are also parallel.**

**Adjust the mouth of your shooting plane for a paper-thin cut by turning a screw on the plane's frog.**

# FRENCH POLISHING

## *The Gentle Art of Applying a Padded Shellac Finish*



**The French-polished surface of this 1815 Philadelphia Federal card table is so smooth that it picks up the polisher's reflection. (Table courtesy of F.J. Carey III Antiques, Penllyn, PA)**

ANGELO CAGGIANO

BY ROBERT ENTWISTLE

Mention French polishing to a French woodworker, and he will probably give you a puzzled look. Our name for this lustrous shellac finish makes little sense in France, where this venerable finishing method originated. Instead, the French call it *"vernis au tampon,"* varnishing with a pad, and I think this term describes the finish best. No matter what you call it, French polishing is the art of applying shellac with a cloth pad.

There are many variations of French polishing but the process I'm about to describe is the one used in France today as taught in the *Ecole Boulle*, a cabinet school run by the French government. Although I

make chairs in Florida for a living, I travel frequently to Paris and have periodically audited some classes at *Boulle,* as it is called. I'm also indebted to my good friend Stephan Sauve, an American who studied finishing at Boulle and practices French polishing for a living. His extensive notes on the subject contributed vastly to my knowledge and in a very real sense he shares authorship of this article.

French polishing is done in three stages: filling, rubbing and clearing. Filling is the process of filling the pores of the wood; rubbing is the process of applying the shellac, and clearing refines the finish with a light rubbing of alcohol. During each stage the finisher rubs the surface with a special cloth pad; the pad is charged with a different medium—pumice, shellac or alcohol—depending on the stage in the process. Mineral oil is sometimes applied as a lubricant.

In the second stage, the finish is built up as the polisher moves the pad constantly across the wood, laying down an incredibly thin layer of shellac with each pass. The shellac dries instantly. Without lifting the pad from the surface, the polisher lays another layer on top of the first and another layer on top of that, and so on. The layers fuse into one and the surface builds until it shines like no other finish. A well-padded shellac finish will reflect a soft mirror image.

To be honest, French polishing is somewhat tedious and time-consuming. In addition, it isn't appropriate for all applications. It's a poor choice for bar tops, for example, because alcohol dissolves the finish and water turns it white. But on other furniture, it is extremely durable. I've seen 200-year-old furniture with a shellac finish in better condition than the wood under it. The luster of French polishing is unsurpassed by any modern finish, and if damaged, it is repaired easily by repolishing.

## *Materials for French Polishing*

The materials used in French polishing date back to the 16th century, and some bear explaining before I describe exactly what I have on hand when I polish.

**SHELLAC**. Liquid shellac has a limited shelf life. It is best to mix your own from flakes to ensure freshness.

Shellac is available in various grades. The more refined grades are lighter in color. The almost clear Super Blonde grade is excellent for French polishing. Bleached shellac is water-clear but has been chemically refined. It is difficult to pad and has an extremely short shelf life. Less refined, darker-colored grades of shellac are good for matching antique colors, and some do a great job of bringing out an antique red tone in mahogany.

A pound of shellac dissolved in a gallon of alcohol is said to have a 1-lb. cut. I recommend a 2-lb. cut solution for French polishing—two pounds of shellac in a gallon of alcohol. Of course a gallon of shellac will probably go bad before you can use it all; mix your 2-lb. cut a quart at a time.

Put a half-pound of flakes in a jar and pour 3 cups of alcohol over it. Cap the jar and give it a good shake. The alcohol dissolves the shellac slowly so shake the jar periodically and let it sit overnight. Stir in a fourth cup of alcohol in the morning. Date the mixture so that you will know its age. I've successfully used year-old shellac, but shellac that old is always a gamble.

**ALCOHOL**. Shellac dissolves in alcohol. Ethyl alcohol, the grain alcohol in liquor, works best for finishing. In fact 190-proof grain alcohol works quite well in the early stages of French polishing. In my experience however, the 5 percent water content can create troubles in the last stages of the process by causing some cloudiness in the final finish.

In my opinion, the denatured alcohol sold in hardware stores usually is not the best choice for French polishing. Denaturing is the process of poisoning ethyl alcohol to make it undrinkable and avoiding liquor taxes. The exact proportions vary, but the denaturing agent is usually methanol, a poisonous wood alcohol. The problem with hardware-store denatured alcohol is that it often contains some water, making the finish softer and less transparent.

I prefer Behkol, a denatured alcohol made by Behlen Brothers (see Sources). Behkol has been denatured with solvents that appear to have little effect on the shellac.

A word of caution. Alcohol absorbs water from the atmosphere easily. Leave a bottle uncapped for an hour and the water content may rise by as much as 5 percent. I avoid this by keeping my alcohol in small bottles as shown in the photograph. Cap the bottles tightly. When polishing, replace the caps with corks. I cut a $^{3}/_{16}$-in. notch in the side of the cork and dispense my alcohol by pouring it through the notch. I keep my 2-lb. cut shellac in a similar dispenser.

**PADS.** Pads consist of an inner core and an outer cover. Depending on the stage, the pad is charged with different materials and rubbed over the wood.

Some French polishers use one pad through the entire process. It's easier to learn with three pads—one for each stage—so that the materials from one stage don't mix with the materials from another. The pads for the first two stages can be used again and again, each kept in a jar with a tight-fitting lid. I make my clearing pad fresh each time.

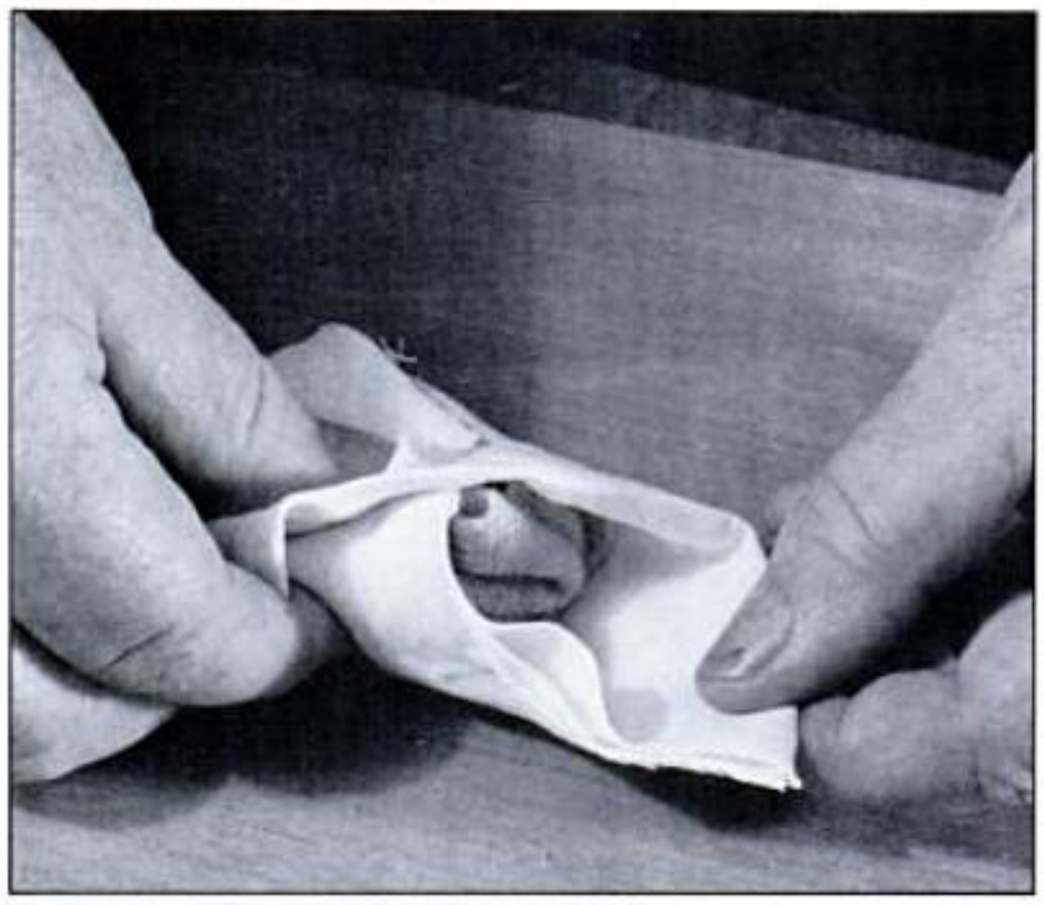
Wool makes the best core because it holds a greater quantity of shellac and releases it with better control. Well-washed linen is best for the cover because it has the least tendency to break and release short threads into the finish. The "well-washed" cotton frequently recommended often wears out and gives off threads in disastrous amounts.

To make the cover, cut a 5-× 15-in. strip from a piece of linen and fold the linen so it's a 5-in. square. To make the core, cut a 7-× 7-in. piece of wool from an old light-colored sweater. Fold the core, as shown in the photo, and place it on the linen square. Fold the corners of the linen across the core as shown, to form a pad roughly the size and shape of a mouse.

The pad should fit comfortably between the inside of your thumb and your fingertips as shown. A small fold of the pad under your index fingertip will help get into corners.

**PUMICE.** Pumice is a very fine, abrasive powder made from a crushed volcanic stone and is applied in

To make a rubbing pad, place a piece of wool from an old sweater inside a linen cover.



Fold the corners of the linen over the core.

PHOTOS BY ROBERT ENTWISTLE

Hold the pad between the thumb and the fingers.

the first stage of polishing to fill the pores of the wood. Buy the finest grit, sold as 4F. I keep my pumice in a saltshaker.

**OIL**. Mineral oil lubricates the pad during polishing to keep it from sticking to the shellac already put down. Linseed oil also will work, although it darkens the finish.

## *French Polishing Kit*

The materials I have on hand when I polish are shown in the photo and consist of:

Shellac, 2-lb. cut in a corked dispenser bottle.
Behkol alcohol in a corked dispenser bottle.
Filling pad in a closed container.
Shellac pad in a closed container.
Clearing pad, freshly made.
Pumice, 4F, in saltshaker.
Sandpaper, 600-grit.
Small bottle of mineral oil.

## *Preparing the Surface*

To obtain the traditional mirror-like finish, the surface of the wood must be perfectly flat and smooth. I sand with an electric sander, beginning with 100-grit, continuing with 120, 150, 180, 220, 280, and finishing with 320. I sand a second time with 320-grit, this time by hand. I wrap the paper around a cork block, to cut down on stray grain fibers. Dust carefully with a tack cloth between grits so loose grains from the previous grit don't scratch the surface.

If you wish to dye or stain the surface, do it after sanding. You may need to resand with 320-grit paper after staining, especially if you apply a water-base aniline dye, which will raise the grain.

Many polishers apply oil to the wood at this point to give it a deeper color. Some spread oil on with a cloth and immediately wipe off the excess. I rarely use oil, but when I do, I put a drop or two on a rag and rub the oil in with a nearly dry rag. This gives depth and shine to the wood. Beware, too much oil will make filling, the next stage of the process, very difficult.

## *Step One: Filling the Grain*

Even a well-sanded piece is seldom ready to finish. For a truly mirror-like finish, you must fill the pores of the wood. The amount of filling required varies depending on the species. On close-grained woods, such as cherry, you can skip this step altogether. On open-grained woods, such as walnut, mahogany and rosewood, filling is essential for a top-quality finish.

To fill the pores, rub the wood with pumice and alcohol. This creates a sawdust and pumice paste that fills the pores. I suspect Americans haven't heard much about this filling technique.

To begin filling, take your filling pad, remove the linen cover and charge the core of the pad lightly with alcohol as shown in the photo. There should be just enough alcohol so that if you hit the pad on a piece of wood, it creates a little dampness. If you can squeeze or shake any liquid from the pad, it's too wet.

Now put some pumice on the board as shown. I find about a ¼ teaspoon dusted over a square foot is the right amount—that's two or three shakes from my saltshaker. A good rule of thumb when in doubt about

how much pumice you need is use less. Pumice left on the wood causes problems later.

Now rub the pumice into the wood with a circular motion. In a moment you'll develop a light paste of sawdust and pumice. Work the pumice into the pores of the wood. After about a minute, the paste disappears. Continue rubbing. As you look across the wood, it begins to pick up a shine. Underneath the pumice, the surface feels glassy. The pad is picking up the color of the wood from the sawdust. As the pad dries, apply more pressure, eventually using both hands.

You'll know the wood is filled when the pores are bluish and even with the surface when examined in a slanting light. If the surface loses its gritty feel before the pores are filled, give it a quick shake of pumice and give the pad a quick shake of alcohol.

Continue rubbing until you fill the pores. On a coarser-grained wood, a second filling is usually necessary after the first dries.

## *Step Two: Padding Shellac*

In the padding stage, you are putting shellac on the wood for the first time. Padding takes place over two days. At the end of the first day there are minor imperfections and a short stint with the pad removes them on the second day.

Because you can pad only large, flat areas effectively, you'll need to finish moldings, carvings and other small details before you can pad. The traditional technique is called glazing and is nothing more than applying shellac with a brush.

Apply two or three coats of 1-lb. cut shellac to the hard-to-reach places. Don't worry if you brush shellac on the flat surfaces; as you pad later, let the pad slide onto the glazed areas to build up the shine.

Instead of brushing, I prefer to spray hard-to-reach places with three coats of shellac in a small touch-up gun. I spray a 1-lb. cut shellac at 25 psi. Shellac dries more slowly than lacquer so spray slowly and give it time to dry before going over it again.

This is it. Everything else was just preparation. From here on in, you are building the actual finish. There is shellac in the pad, and you are rubbing, rubbing, rubbing, to build the shine.

My technique differs from others in a couple of respects. I don't apply pumice at this point because pumice trapped in the finish can ruin it, and I apply oil very sparingly. I also change the ratio of shellac to alcohol in the pad as I work. I find the finish builds faster if I gradually increase the proportion of shellac in the pad. There are as many different techniques as there are French polishers. This one works for me.

Take your shellac pad and remove the linen wrapping. Charge the wool core with three times as much alcohol as shellac. I find that a quick shake from my shellac bottle, followed by three quick shakes from my alcohol bottle gives me the right amount. The amount is right if you can squeeze about a half teaspoon of moisture from the pad. Learn to judge by eye because once you've squeezed out the liquid, the pad is too dry.

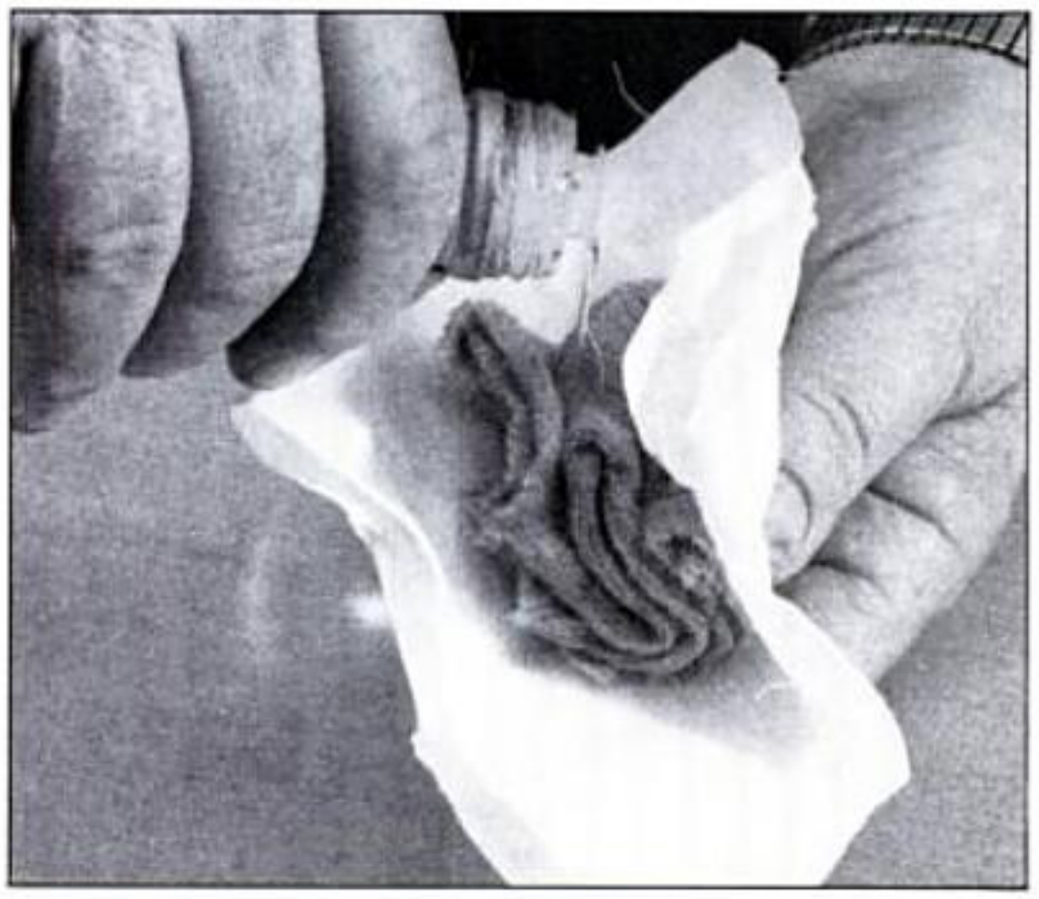
Hit the pad on a board or on the heel of your hand a few times to mix and distribute the shellac and alcohol. Now glide the pad onto the surface of the work, much like an airplane making a landing. Wipe across the surface of the work, and as you approach the edge of the wood, let the airplane take off again. Do the entire surface in this way, strip by strip. When you begin to get the faintest shine of shellac, you'll find it's easier to move in figure eights or circles.

If your surface is much bigger than 10 × 15 in., you'll need to polish in sections of roughly 8 to 10 in. square at this point. Overlap the sections so the finish flows from one section to another. You can overlap as much or as little as you like.

When padding, make sure that the pressure is the same on the curves as on the straight stretches, and never, never stop the pad in the middle of the surface or make an abrupt change of direction. Remove the pad by gliding it off.

As the pad glides over the surface, it may leave a blush that disappears almost immediately. This is caused by the alcohol evaporating. On a humid day, the cloud or blush might not disappear as fast. If not, stop, have a cup of coffee, and when you return, rub more slowly, giving the shellac time to dry.

If you find dust motes, pumice or other particles beginning to build in the finish, stop rubbing. Gently



**Charge the core of the pad by pouring alcohol onto it.**

**To fill the pores of the wood, sprinkle on pumice and rub with an alcohol-charged pad.**

**Bottles with notched corks make excellent dispensers, and help keep alcohol from absorbing moisture in the air.**

scrape off the imperfection with a chisel and clean off the surface with a blast of air or tack cloth. Repad the area for about 3-5 minutes to remove any flaws.

The great beauty of padded shellac is developed most effectively when you pad with what appears to be a nearly dry pad. You are using the rag to dissolve and redistribute the shellac, to smooth it out. When you sense you're no longer accomplishing anything by rubbing, recharge the core of the pad. Apply about half as much liquid as initially, and equal amounts of shellac and alcohol.

As you polish, increase the pressure on the pad as it dries. This sometimes causes the pad to stick. If this happens, stop rubbing, and put a drop or two of oil on the pad to lubricate it. Let the alcohol and shellac in the pad dry out until it seems as if there is nothing but vapor in it. The best polish comes from a rag that seems bone dry.

It will seem that nothing happens at first, but soon the finish begins to build very rapidly and suddenly. At this point, the French say the polish is "fat"—once you see it, you'll understand what they mean. The finish appears to have a certain thickness, as opposed to the initial stages, and a good shine.

How do you know you're there? Experience. But one of the tricks is to watch the grain. Despite your best efforts, you will have missed a few pores in the filling process. They will leave pinholes in the surface. Don't try to fill them all the first day. Instead, stop when most of them are gone. On a 4-×4-ft. table, it might take 30 minutes to get to this point.

Put the pad in its jar. Let the finish rest for 24 hours.

## *Step Three: Day Two*

Day two is basically devoted to touch-up. If all goes well, we could bring our fictional 4-×4-ft. table to the right stage in 15 minutes.

First sand the surface *lightly* with 600-grit paper. Clean the surface with a tack cloth or air.

Take your rubbing pad from its jar and charge the core. Apply one shake of alcohol and three shakes of shellac; the pad should be half as moist as it was at the beginning of the process. You should barely see moisture when you pound the pad.

Rub the wood with the same circular or figure-eight pattern. Use a lot of pressure—eventually you'll rub with two hands. Let the pad get very dry. Add a drop of oil if it sticks.

Get every last bit of shine onto that piece of wood and don't stop until you do. The closer you can come to a mirror, the more successful the finish. When the pinholes left by yesterday's rubbing are gone, you are done with the second stage.

Let the finish rest for 24 hours.

## *Step Four: Clearing*

This step is intended to remove any water that might have gotten in the finish from the air. It is done entirely with alcohol. Polishers who use a lot of oil in their finish remove it at this point with much the same technique, but since I don't use much oil, I am concerned only with moisture.

Make up a clearing pad, and charge it lightly with alcohol. *Do not add either shellac or oil at this point.* On a scale of 1 to 10, with 10 being the wettest and 1 being bone dry, the pad now should be a 2 or 3.

Glide the pad on and rub as before. Rub gently. You'll become fascinated with making things smoother and smoother. If you get *too* fascinated, the pad begins to pick up some of the shellac you have put down. You haven't ruined anything, but you are starting to go backward so stop. You've finished clearing when nothing more happens—10 minutes or so on our fictional table.

Now you are done. The finish has a soft glow. You can see the reflection of your face in it and you should be smiling. You have begun to master the most elegant of finishes. ▲

*Robert Entwistle is a cabinetmaker in Florida.*

# SOURCES

Materials for French polishing are available from:

CONSTANTINE'S
2050 Eastchester Rd.
Bronx, NY 10461

GARRETT WADE
161 Ave. of the Americas
New York, NY 10013

MOHAWK FINISHING PRODUCTS INC.
Rt. 30 North
Amsterdam, NY 12010

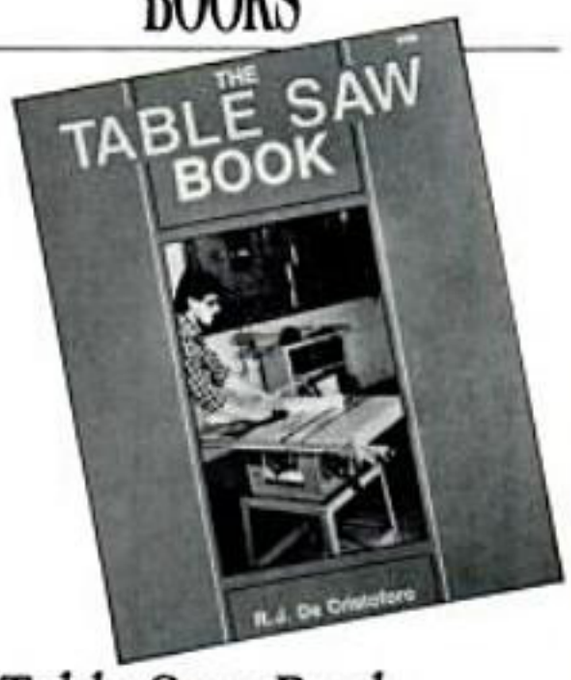
WOOD FINISHING SUPPLY CO. INC.
1267 Mary Drive
Macedon, NY 14502

WOODCRAFT SUPPLY
41 Atlantic Ave.
P.O. Box 4000
Woburn, MA 01888

THE WOODWORKERS STORE
21801 Industrial Blvd.
Rogers, MN 55374

# BOOKS & VIDEOS

## BOOKS




### *The Table Saw Book*

*by R.J. De Cristoforo*
*(1988, Tab Books, Inc., Blue Ridge Summit, PA 17294) paperback; 342 pp; $15.95*

Time was when books about the tablesaw were hard to find. These days, it seems you can't fall down without landing on one. R.J. De Cristoforo has just added his contribution to the field and by-and-large it's a good one.

This book is packed with illustrations and photos showing that the tablesaw can do more than just rip and crosscut. Topics range from blades and basic saw setup to joinery, molding heads and cove cuts.

The book covers everything I can imagine doing on the saw and improves upon techniques I've used.

But like life, the book is not without its faults. The illustrations are so ample that there often isn't room for them anywhere near the appropriate text. Occasionally, I take issue with the techniques. For example, De Cristoforo's jig for crosscutting looks flimsy and would work better if it were built on a plywood platform. I'd be happier if his tenoning jig had some sort of clamp attachment and so on.

But in general, De Cristoforo offers good advice about the tablesaw. I will refer to his book often.

JEFF DAY

### *24 Table Saw Projects*

*by Percy W. Blandford*
*(1988, Tab Books Inc., Blue Ridge Summit, PA 17294) paperback; 120 pp; $6.95*

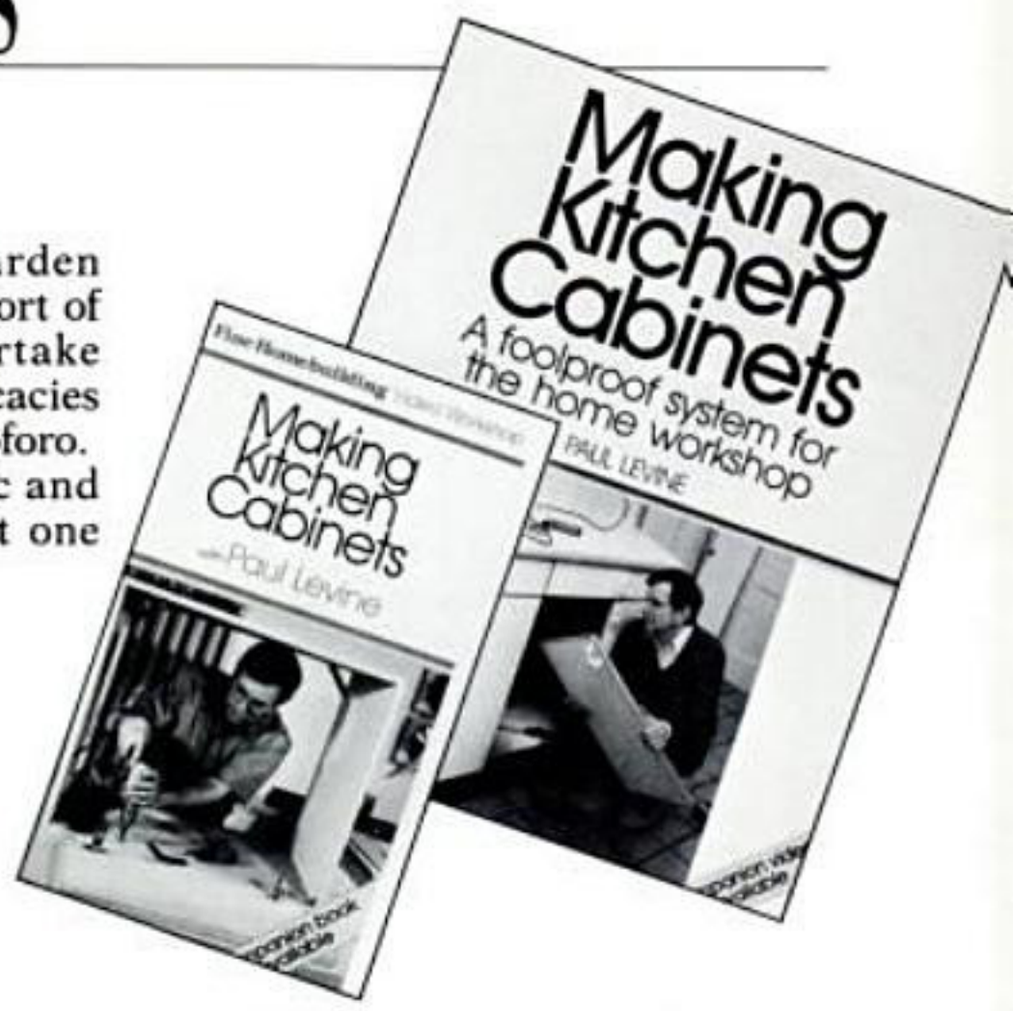

Written as a companion to *Table Saw Book* by R.J. De Cristoforo, *24 Table Saw Projects* just doesn't measure up. Sawhorses, garden gates and fences are not the sort of things you'll want to undertake once you've learned the intricacies of the tablesaw from De Cristoforo.

The projects are simplistic and often poorly thought out. At one point, Blandford suggests making a shelf from veneered particleboard. At best, the particleboard will sag, more likely snap, when loaded with books.

If you're interested in doing wonderful things with your saw, buy De Cristoforo's book. From there, Blandford's book is nothing but a step backward.

JEFF DAY

## VIDEOS




### *Making Kitchen Cabinets*

*with Paul Levine*
*(1988, The Taunton Press, Box 355, Newtown, CT 06470) Length: 60 min.; VHS and BETA; $29.95. Book/Video set; $39.95*

If you've thought of building your own Euro-style kitchen cabinets but lacked familiarity with that type of construction, this book/video set is for you.

Cabinetmaker Paul Levine has developed a customized approach to building cabinets based on the European, 32-millimeter system. Through years of trial and error, he's simplified and streamlined the process, without sacrificing quality or strength.

European cabinets have no face frame to obstruct access. They have elegant, uncluttered lines, concealed hinges, and unlimited decorative possibilities with plastic-laminate surfaces and natural-wood trim. The cabinets are constructed with simple materials and joinery. A tablesaw, router and basic hand tools are sufficient.

In the video, Levine takes you through the construction of a typical cabinet, step-by-step. His technique is so well engineered that the camera easily captures every nuance. There's nothing too complicated here, just careful attention to detail.

Materials and hardware are previewed first. Then, applying laminate, building the cases, and drawers, and mounting and adjusting the hardware are covered. Levine's system anticipates mistakes so that later steps can compensate without missing a beat.

The video production is first-rate. The workshop setting is bright, clean and uncluttered, and Levine is a capable on-camera teacher. He offers valuable tips borne of experience, and demonstrates the use of simple jigs and templates.

The companion book complements the video perfectly but can stand on its own as well. It covers the subject with exceptional thoroughness. The illustrations and color photos showcase the author's technique with excellent clarity.

In addition to the how-to material covered in the video, the book features detailed sections on planning a kitchen layout and designing cabinets for your specific needs. It also offers much more detail on finishing and installing the cabinets, as well as fabricating countertops and backsplashes.

DAVE SELLERS

PHOTOS BY ROBERT WALCH

# GALLERY

*CURRENT WORK BY OUR READERS*

PHOTOS BY SUSAN DELONG

**"Chippendale Roundabout Chair," by W. Mickey Callahan, Cambridge, Massachusetts. Mahogany, shellac and linseed oil/varnish, Philadelphia-style carving. Dimensions: H: 31½ in., W: 27½ in., D: 26 in.**

**No, this isn't an ad for an antique showroom. These pieces are the recent work of students at the North Bennet Street School in Boston, Massachusetts. Under the leadership of Lance Patterson, the North Bennet Street cabinet and furniture-making program provides its students—over the course of two years of full-time training—with a thorough education in the craft. The program is based, in part, on the old apprenticeship system. Students develop their skills by making pieces from 18th- and 19th-century American and English traditions. The pieces shown here are from an exhibit in downtown Boston entitled The North Bennet Street School: an Education in Craftsmanship.**

**"William and Mary Gateleg Table," by Jay Doster, Somerville, Massachusetts. Maple, curly maple, shellac and tung oil/varnish finish. Dimensions: H: 29¾ in., W: 12 in., Dia: 41 in.**

**"Federal Tambour Desk," by Rick Etre, Worcester, Massachusetts. Mahogany, mahogany-crotch veneer, satinwood, French polish. Dimensions: H: 42 in., W: 40 in., D: 24 in.**

# GALLERY

*CURRENT WORK BY OUR READERS*

**"Comb-back Windsor Armchair," by Tim Morgan, Somerville, Massachusetts. Red oak, pine, cherry, soft maple, black milk paint with linseed oil. Dimensions: H: 41 in., W: 26 in.**

**"Chippendale Piecrust Tea Table," by Michael J. Waldrep, North Andover, Massachusetts. Honduran mahogany, shellac. Dimensions: H: 29 in., Dia: 24 in.**

LANCE PATTERSON

**"Bombé Chest of Drawers," by John McCormack, Cambridge, Massachusetts. Brazilian mahogany, mahogany-crotch veneer, French polish. Dimensions: H: 34¾ in., W: 42½ in., Dia: 21 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 (4×5 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.*

## Token Totem

Last November, Woodcraft Supply Corp. sponsored a totem-pole carving to celebrate the opening of its new retail store in Minnesota's Twin Cities area.

Carvers from the local Viking Chapter of the National Woodcarvers Association gathered at the Bloomington store where they spent the day chipping away with both hand tools and power tools to carve the 8-ft. sculpture.

The token totem carries on it the mythical figures of an eagle, a raven and a bear with a salmon. It stands at the entrance of the store with the hope that it will bring good luck to the business.

In addition to the Bloomington store and the original one in Woburn, MA, Woodcraft opened retail stores in Denver, Seattle and Detroit.

**Carvers put hands to wood to celebrate Woodcraft's newest store by chiseling out a traditional Indian totem pole.**

## One Good Turn Deserves Another

If woodturning had a patron saint, it would have to be Albert LeCoff. Ever since he and his brother Alan organized the first Woodturning Conference back in 1976, Albert's given selflessly of his time and energy to promote woodturning.

Back in September, a group of woodturning luminaries met in secret to scheme up some way to thank Albert for his latest coup—the wonderful International Turned Objects Exhibition last September in Philadelphia (see September/October 1988 AW). The turners hit on a plan to present Albert, who walks with a cane, with a collection of turned walking sticks, each done by a different artist. Wendy Michelson, who coordinated the project, explained the symbolism behind the idea. "Albert's helped so many turners 'walk' from the craft field into the art field. The canes were our way of returning the favor—our way of helping Albert walk."

The plan called for installing a handrail on the staircase in Albert's home with the canes as removable balusters. This idea lost out in favor of a ceremonial stand to hold and display the canes.

The canes were presented to Albert at a surprise party on a snowy Philadelphia night last January. There were 35 in all, as well as a collection of miniature canes beneath a glass dome on top of the spalted-maple stand. The stand itself was a collaborative effort by artists Giles Gilson, Wendy Michelson and Johannes Michelson.

Each cane was unique. Workmanship, without exception, was outstanding. Concepts ranged from functional to far out; the handle on Johannes Michelson's cane, for instance, was a miniature, battery-powered bowl lathe. Albert, needless to say, was bowled over.

DAVID SLOAN

DAVID SLOAN

**Albert LeCoff and Wendy Michelson look over the 35 canes presented to Albert for his tireless efforts to promote woodturning.**

## Ryobi Recall

Ryobi America Corp. has announced that certain Ryobi RA-200 radial arm saws and Ryobi AP-10 portable planers have design problems that can present a safety hazard.

It appears that the radial arm saw's carriage center, which attaches the motor and blade assembly to the overarm, could break under certain conditions. Ryobi is voluntarily retrofitting all RA-200 radial arm saws sold since December 1986 with a modified carriage center at no cost.

An upgrade kit is being offered for the 1985 Model AP-10 planer. It closes the space between the main body of the planer and the rear outfeed support roller, lessening the possibility of fingers getting crushed between a board and the rear roller.

The Ryobi AP-10 units in question carry serial numbers 064155 and lower. Some AP-10 planers were sold as the Sears/Craftsman Portable 10-in. Thickness Planer, Model No. 35123372. Owners of this model can contact the nearest Sears Service Center or order the upgrade kit from Ryobi.

For more information call 1-800-525-2579 or an authorized Ryobi service center. For the nearest service center write, Ryobi America Corp., 1433 Hamilton Parkway, Itasca, IL 60143.