

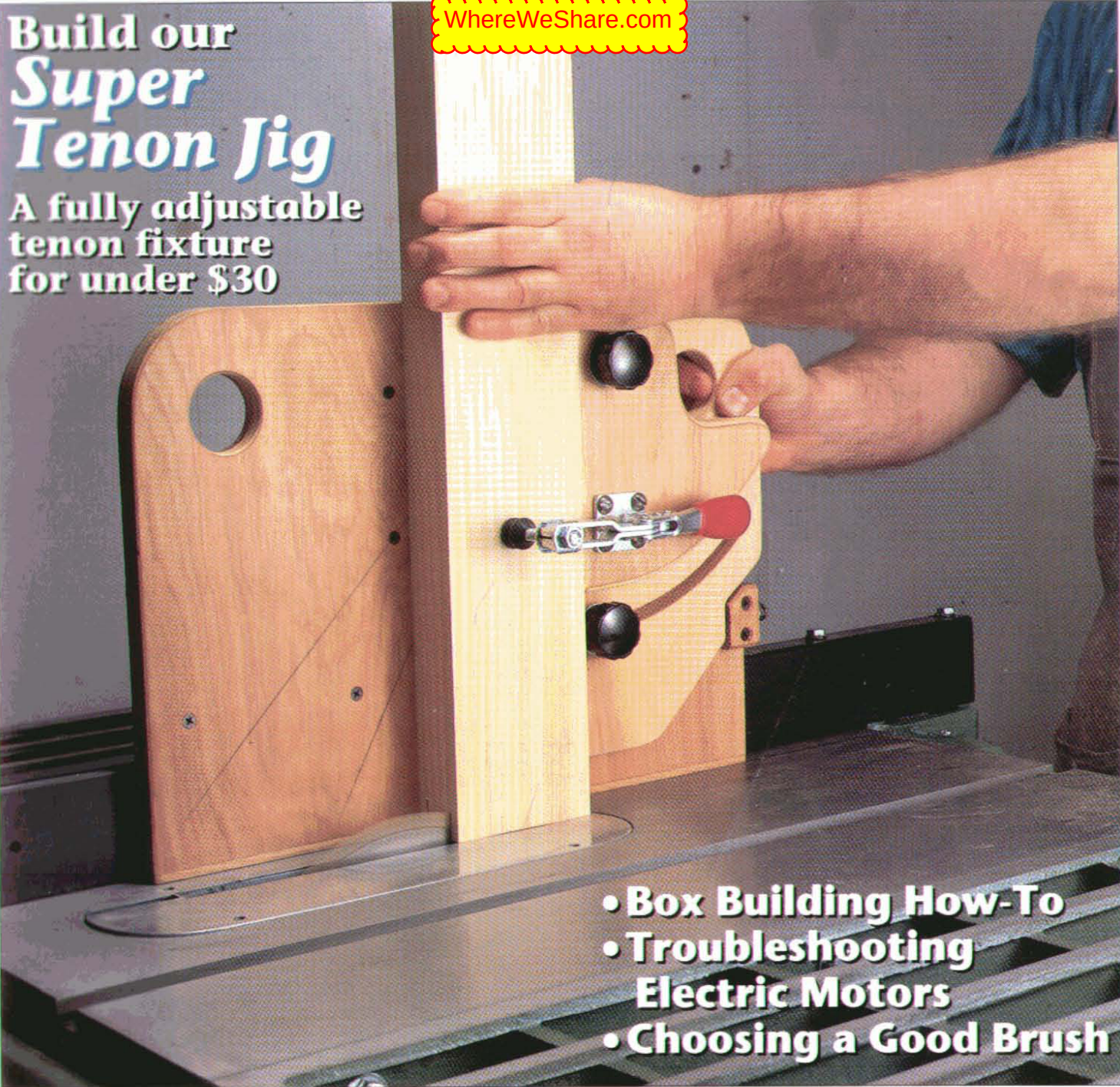
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The Woodworker's Journal

MARCH/APRIL 1993 VOLUME 17, NUMBER 2

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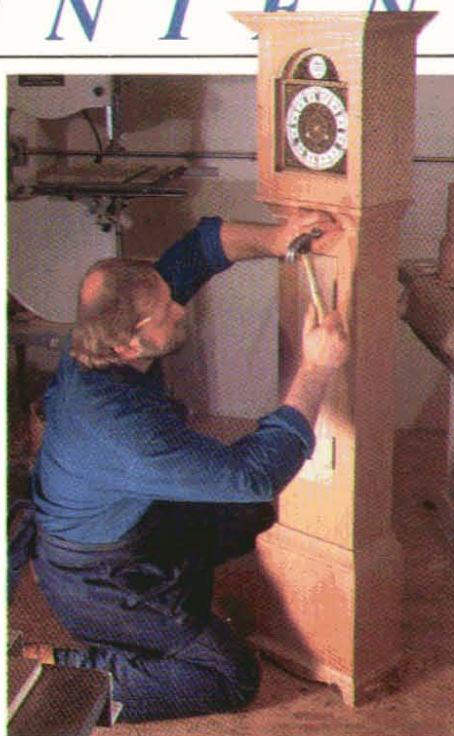
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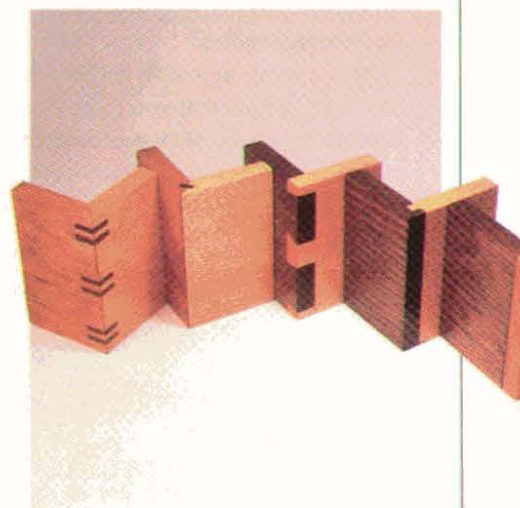
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New Sears Router Table

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Shoptalk

A Super Jig

We've found that the most popular jigs and fixtures are often geared to making your table saw easier and safer to use. And one of the most valuable is a good, versatile tenon jig.

Our featured project this issue is a super time-saving tenon jig, designed by master jig builder Dennis Preston. Dennis has used the prototype of this jig for years to safely secure stock at the most common 90-degree orientation . . . and for cuts at any angle down to 45 degrees. Best of all, this jig is fully adjustable to compensate for any built-in inaccuracy.

We've arranged for a low-cost hardware kit that includes everything you need if you don't have easy access to a hardware supplier.

In The Looking Glass

Periodically, we survey you about your woodworking activities, and about your level of satisfaction with *The Woodworker's Journal*. This, and a steady flow of mail from you, keeps us looking at ourselves from your perspective, and helps us fine-tune our magazine to better serve your needs and interests.

Our recent survey yielded very gratifying comments (Thanks, guys and gals!) and a few surprises, one of which is a growing interest in doll furniture and miniatures. This particularly delighted both our designer/craftsman Mark Ziobro, and our regular contributor, Dave Moretti.

For years, Mark has used hardwood scraps to build doll-sized chest of drawers similar to his Sample Chest in this issue. Designed to accompany the doll bed featured in the November/December 1992 issue, this also serves as a spacious jewelry chest or elegant storage for sewing accessories. Dave likes to build miniature furniture and when he showed us his display box designed to show off his handiwork, we knew we had a winner. If you're not into miniatures, the display box is perfect for housing a prized collectible.

Over the Transom

No matter how happy you may be with us today, we know that we're only as good as our next project. Some of our best ideas arrive unsolicited or "over the transom." For example, the handsome Grandchild's Clock in this issue was inspired by a photo submitted by a reader of a clock built for his granddaughter.

If you've designed an original project you'd like to share, or have a new tip or technique that you think other woodworkers would be interested in, send us a picture, sketch or description. We're always open to great ideas!

James J. McQuillan

The Woodworker's Journal

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Letters

We welcome opinions and comments (both pro and con) from our readers. Address correspondence to: Letters Department, *The Woodworker's Journal*, P.O. Box 1629, New Milford, CT 06776.

I liked the CD Carousel project in your January/February 1993 issue, but the \$44.80 cost for all the plastic inserts was too rich for my blood. My solution was to change a few dimensions, which enabled me to cut dadoes in the partitions to accept the CD's. It worked just fine.

Duane C. Hawk, Rush, NY

For years I have been trying to find plans for block-front furniture. Any chance you will include plans for a block-front project in the future?

Richard M. Dale, Fort Washington, Md.

We are pleased to report that our September/October 1993 issue will feature plans for a block-front chest from the Wallace Nutting Collection at Berea College. It's a beautiful design that we think many of our readers will enjoy building.

I am refinishing an antique painted pie safe and, like most old pie safes, it has tin panels. Unfortunately, all the tin panels are covered with several coats of old paint, and the panels can't be removed from the pie safe. Can you tell me a way to clean the paint off the panels while they are still secured to the pie

safe? Also, since I want to repaint the panels once I get the old paint off, can you suggest a brand name and color that will work well?

Frank Denton, Danville, Ill.

We passed along your letter to Marie Palotas at Country Accents, a Montoursville, Pennsylvania company that sells pie safe tin. Here's what Marie had to say: "Remove all the loose paint with a wire brush, but be careful not to scrape the metal too much or it may damage the panel. Lightly sand the surface, then paint with a base primer sold by Rustoleum. Let it dry thoroughly. As a finish coat, use Rustoleum in a color determined by the wood of the surrounding cabinet. A satin finish is preferred as it is more pleasing to the eye."

Your January/February 1993 issue had a nice article about working green wood. Your readers may be interested to know that Country Workshop, 90 Mill Creek Road, Marshall, NC 28753 is an excellent source for further information on green woodworking. They carry a selection of tools and books, and regularly hold workshops throughout the year.

Joe DesLauriers, East Jordan, Mich.

Odds and Ends

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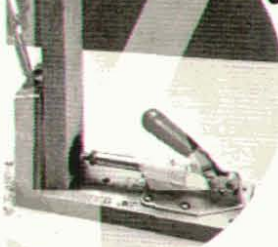
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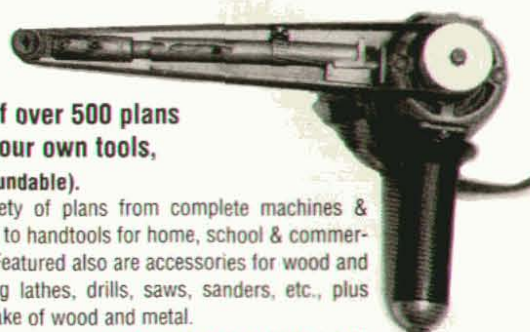
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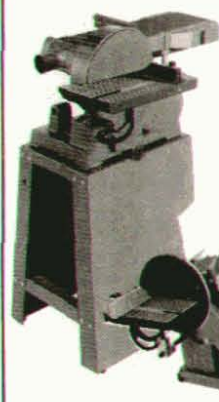
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Letters Continued

have also included Freud, Inc., 218 Feld Avenue, High Point, NC 27264; tel. 1-800-334-4107.

In the article on high end scroll saws in our November/December 1992 issue, the Excaliber phone number listed on page 77 is incorrect. The correct number is 1-800-387-9789.

Readers in Western Pennsylvania and the panhandle of West Virginia will be interested to learn that the Western Pennsylvania Woodworker's Club meets monthly except for the Christmas season and the summer months. Woodworkers of all skill levels are welcome. For information on membership write to the club at P.O. Box 135, Delmont, PA 15626.

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—The Editors

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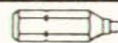
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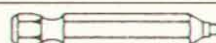
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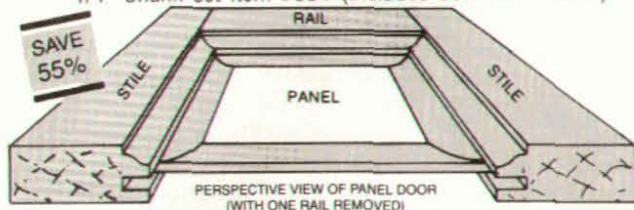
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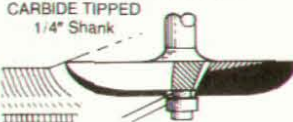
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#903		1/4" Spiral Cutter		1/4"	3/4"	1/2"	\$12.00
#904		3/8" Spiral Cutter		3/8"	1"	1/2"	\$24.00
#905		1/2" Spiral Cutter		1/2"	1 1/2"	1/2"	\$29.00
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#531		5/16" Edge Beading	5/16" Dia. of Circle		1/2"	1/4"	\$15.50
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#351		3/16" Round Over	3/16" R	7/8"	1/2"	1/4"	\$11.00
#230		1/4" Round Over	1/4" R	1"	1/2"	1/4"	\$12.00
#353		5/16" Round Over	5/16" R	1 1/8"	1/2"	1/4"	\$14.00
#209		3/8" Round Over	3/8" R	1 1/4"	5/8"	1/4"	\$15.00
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#204		3/8" Rabbeting	3/8" Deep	1 1/4"	1/2"	1/4"	\$13.00
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#418		3/4" Core Box	round nose	3/4"	5/8"	1/4"	\$15.00
#213		1" Core Box	round nose	1"	3/4"	1/2"	\$17.00
#548		Lockmitre		2"	7/8"	1/4"	\$32.00
#214		1/4" Straight	plunge cutting	1/4"	3/4"	1/4"	\$ 6.50
#216		3/8" Straight	plunge cutting	3/8"	1"	1/4"	\$ 6.50
#474		1/2" Straight	plunge cutting	1/2"	1"	1/4"	\$ 7.00
#219		3/4" Straight	plunge cutting	3/4"	1"	1/4"	\$ 9.50
#779		1" Straight	plunge cutting	1"	1 1/2"	1/2"	\$10.00
#462		1/2" Bull Nose	1/2" Dia. of Circle		3/4"	1/4"	\$18.00
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#450		1/8" Beading	1/8" R	3/4"	3/8"	1/4"	\$11.00
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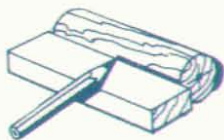
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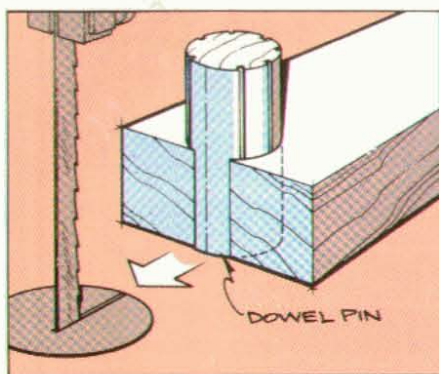
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Shop Tips

Dowel pins are fluted (grooved) to allow air and excess glue to escape from the dowel hole when a pin is inserted. Most commercially-made dowel pins, in sizes up to 1/2 in. diameter, are sold with flutes already formed in them. However, in sizes above 1/2 in., which I sometimes use, fluted dowel pins are hard to find.

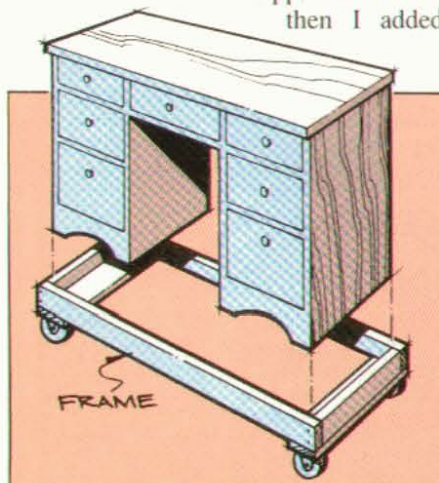
I solved that problem with this little jig. It's made from a scrap piece of stock that's thick enough to support the pin length. The hole diameter equals the dowel diameter, and it's bored so that part of the hole is exposed on the end as



shown. To use it, place the dowel pin in the hole, then use the band saw to cut each flute. Six or eight flutes will do the job for most pins.

Dale A. Doerr, Traverse City, Mich.

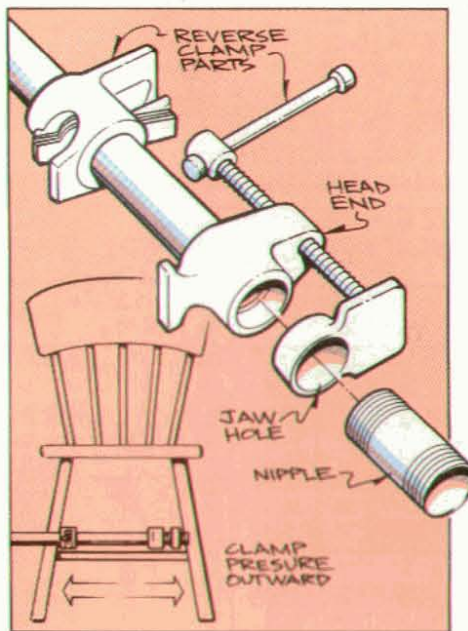
Small kids' desks seem to be pretty common at garage sales these days. When my wife bought one for five bucks recently, I built a frame from 2 by 4's to support the base, then I added



four casters. In little time I had a sturdy, portable shop work surface complete with several drawers for storage.

Mike Steffen, Wurtsmith A.F.B., Mich.

Most woodworkers have an occasional need to spread, or separate, parts of a project. For example, it's usually necessary to spread apart chair



legs in order to remove a broken rung.

Several types of woodworking spreaders are sold, but if you have a pipe clamp with a sliding-pin handle, here's an easy way to convert it into a spreader at very little cost. (Fixed crank-style handles won't work because the pipe prevents the handle from turning.) Reverse the direction of the two clamp ends, and only partially screw the "head" end onto the pipe as shown. Then, to support the loose jaw, insert a short (2 to 3 in. long) pipe nipple through the jaw hole and thread it into the head. You'll find pipe nipples in the plumbing section of your hardware store.

David W. Peterson, Jacksonville, Fla.

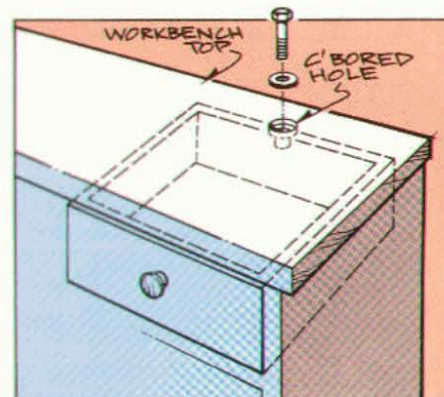
Even in their original boxes, which are not airtight, dust masks are susceptible to an accumulation of shop dust. And you won't help your lungs by putting on a mask that's already coated inside and out with dust. To prevent this, be sure to always keep your masks where they will be well protected from dust. I've found that those disposable paper dust masks store nicely in plastic Zip-Lock bags. The bags are just the right size and the Zip-Lock seal makes them impervious to dust.

Mike Carroll, Sacramento, Calif.

Don't toss out your old socks quite yet—even if they may have a hole or two. Instead, wash them one more time and put them to use in the shop. I find that when worn on the hand, like a mitten, an old sock is great for rubbing down or polishing a finish, or wiping off excess stain. Throw them out when the job is over.

Al Westbrook, Bellmore, NY

If the top drawer of your workbench doesn't have a lock, and you want to discourage young children from opening it, consider this idea. On the surface of the bench, mark a point just inside the drawer back. At the marked point, drill a counterbored hole to accept a 5/16 in. or 3/8 in. diameter bolt. Make the counterbore just deep enough to allow the bolt head to rest slightly below the surface of



the bench (a washer under the bolt head is also a good idea). To secure the drawer, just close it up and drop the bolt into the counterbored hole. To release it, use a pair of needle-nose pliers (or a magnet) to remove the bolt.

Howard E. Moody, Upper Jay, NY

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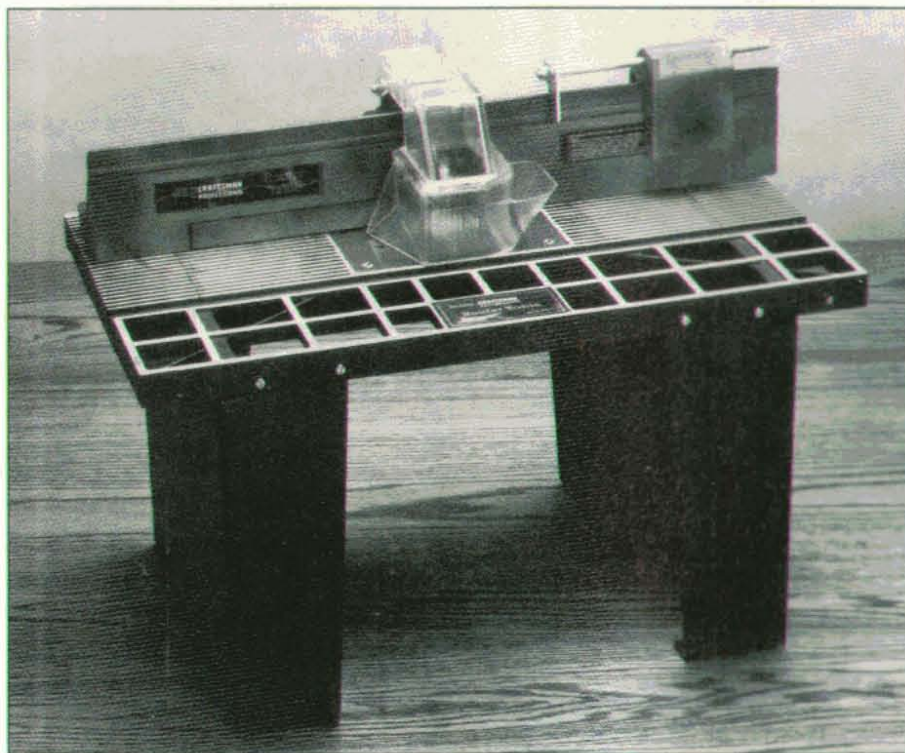
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Shoptest

Craftsman Industrial Router Table



Sears has a new larger router table. Marketed as their Industrial Router Table, this model has several improvements over previous Sears tables—most notably a removable “throat plate” table insert. With other Sears router tables, the machine is fastened directly to the underside of the table. This is okay, but if you change often from the stationary setup to handheld use, you soon tire of unscrewing the router from the underside of the table and reattaching its sub-base. Do this several times during a work session and you’re ready to buy a second router so that one could be left permanently attached to the table.

The throat plate on this new table is a $7\frac{3}{8}$ in. square steel plate that replaces the factory-supplied sub-base on your router. This permits the router base to be lifted through the top opening without a lot of hassle. Sears provides screws to secure the throat plate to the table top, but I found the router weight sufficient to hold the machine in place. Six snap-in plastic inserts of various sizes are provided for filling the gap between the bit and the center hole in the throat plate.

Routers up to 13 in. high and having a base within the size of the throat plate can be used on this table. The mounting holes on the Sears routers align without any modifications; other

brands may require drilling and countersinking the appropriately spaced holes. The unit was shipped knocked-down and took about one-half hour to assemble. Assembly was primarily attaching the folded steel legs to the top and attaching the throat plate to the router. The instructions were clear and well illustrated.

The top is a ribbed die casting that measures 14 in. by 24 in. (33 percent larger than its predecessors). The throat plate rests in a recess on the table. Leveling screws allow the plate to be adjusted to sit perfectly flush with the top. A miter gauge is provided and fits in the $\frac{3}{4}$ in. by $\frac{1}{8}$ in. groove in the top.

Molded Fence Assembly

The adjustable fence assembly is molded from rigid, glass-filled plastic and has several features; a groove to guide a pushblock, a bit guard, a dust collection hookup and a pocket fence for jointing. The fence assembly has two mounting locations (depending on desired proximity to the bit) or it can be easily removed for free routing. A fulcrum pin (or starting pin) is provided to make free routing a safer operation.

The supplied pushblock is a molded unit that incorporates a stock clamp. It slides along the fence and has a clamp capacity of $4\frac{3}{8}$ in. I found this to be a convenient feature for cutting joints on end-grain.

The dust chute is molded into the fence and can be used in conjunction with a shop vacuum. It did a great job minimizing airborne dust.

The bit guard is a simple flip-up clear plastic guard. It provides adequate protection and also assists the dust collection by enclosing the bit.

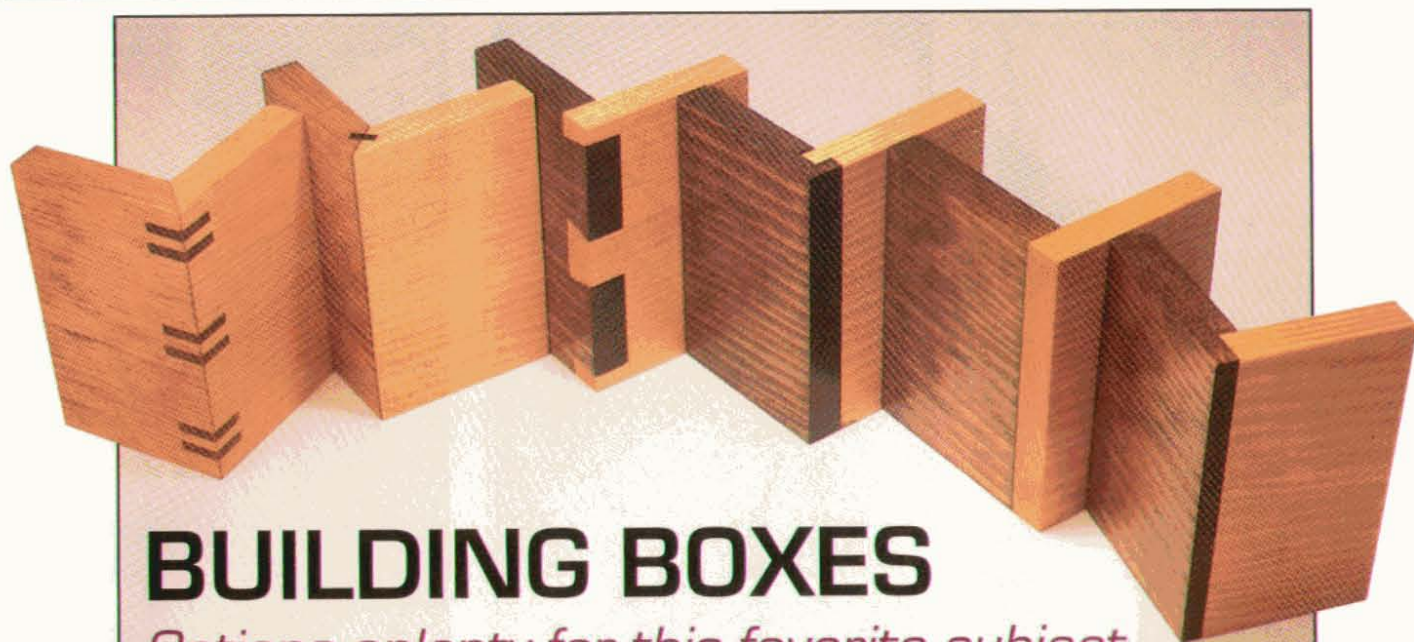
The pocket fence is a small adjustable fence that resides within the outfeed side of the main fence. It allows you to use the router as a jointer by adjusting the pocket fence to support the outfeed (the fences act like tables on a jointer). While it sounds good in theory, I could not get very satisfactory results. It may be a reasonable approach for short stock, but longer work needs more support and guidance.

Conclusions

The new Industrial Router Table offers some real improvements over the previous Sears models. The larger table with the removable throat plate is a big plus for convenience. The pushblock, bit guard and dust collection are good features that worked. The pocket fence for jointing produced poor results, so I would limit its use to short stock. The miter gauge was adequate, but it would have been nice if Sears made the groove $\frac{3}{8}$ in. deep so that most of the other gauges could also be used.

Craftsman Industrial Router Table, model no. 171.25490, Sears Roebuck and Co., Chicago, IL 60684. The current price is \$99.





BUILDING BOXES

Options aplenty for this favorite subject

by Roger Holmes

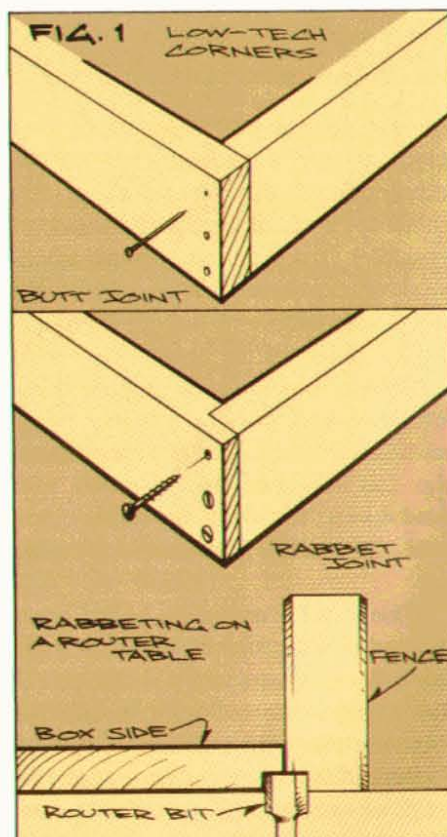
I can think of few workshop projects as satisfying as making wooden boxes. Although I've been building boxes for years, I still can't quite put my finger on the attraction. When I'm making a little jewelry box, I think it's the challenge of precise joinery on a small scale. But then I make a rough-and-ready tool box or toy chest, and I get a charge out of that, too. Maybe the appeal resides in the small mystery that seems to hover around any box—who can resist the urge to open the thing and see what's inside?

Whatever the attraction, boxes are a lot of fun to make. Although there are a great many things to consider when making a box—purpose, size, material, embellishment—two practical considerations stand out: How are you going to join the corners, and what should you do about the lid? Between them, the treatment of corners and lids establishes much of a box's character and the ease or difficulty of constructing it. What follows is a sort of corner-joint and box-lid sampler, covering options I've tried over the years, and what I've learned about them. I'll start with corner joints.

Low-tech Corners

The simplest box corners are the butt joint and its slightly more sophisticated

cousin, the rabbet joint (Fig. 1). Glued and pinned with nails or screws, these are serviceable joints for making boxes



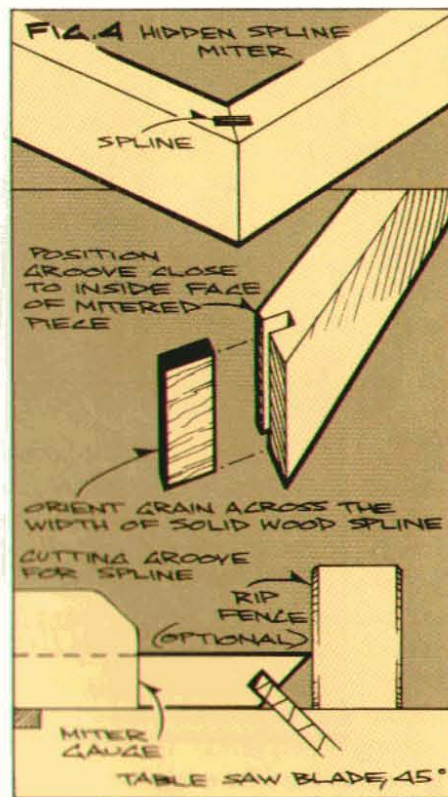
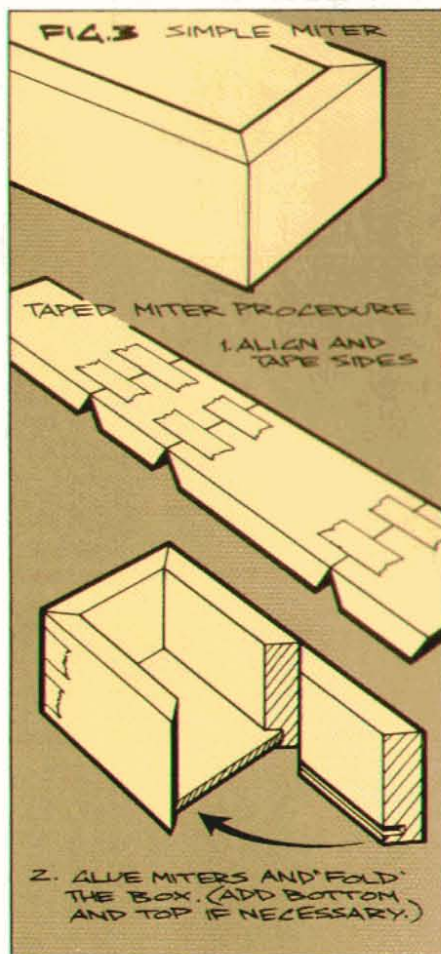
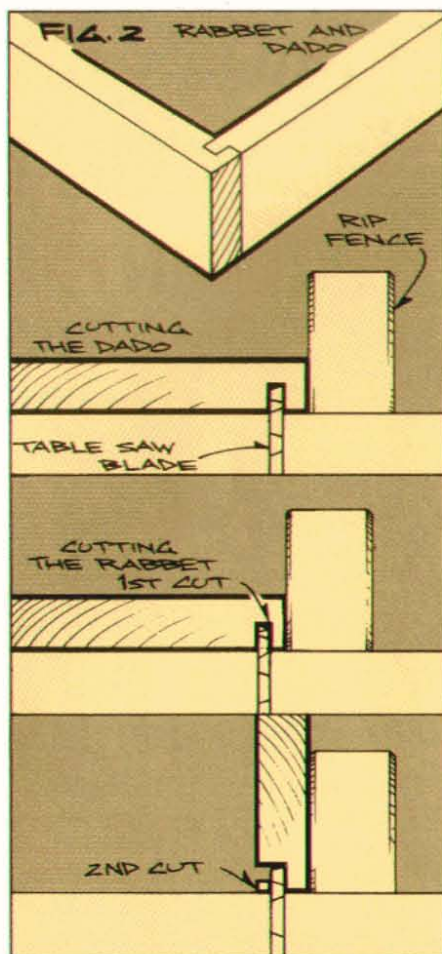
fast. A rabbeted corner is easier to position during assembly and the shoulder provides some resistance to racking

forces (pressure applied diagonally across the box). Even when stuck together only with glue, small rabbeted boxes can be surprisingly durable, despite the inherent weakness of the end-grain gluing surfaces. If you don't want to devote effort to joinery, and the primary attraction of the small box is a painted or carved surface, you might consider rabbeted corners. Larger butt-jointed or rabbeted boxes, however, won't withstand much knocking about unless their corners are strengthened with angle brackets, metal straps or some other mechanical reinforcement.

Rabbet-and-Dado

This joint isn't a great deal more difficult to produce than a simple rabbet (Fig. 2), but it is much stronger. You can make the joint by hand (with a plow plane) or with a shaper, a router, a radial-arm saw or a table saw. I usually use the table saw, cutting the dados first, then rabbeting the mating pieces to make snug-fitting tongues. A few clamps pull the joints tight; if the joints fit well, glue alone is enough to make durable, long-lasting corners that stand up well to racking stresses.

Viewed from the ends of the box, this joint is indistinguishable from a butt joint. Because it shows so much end



grain, I don't think it's a good choice for boxes whose attraction is beautifully figured wood or subtle details. But its strength and relative ease of making put it among the best for "working" boxes, such as tool, toy or blanket chests, as well as for decorative painted or carved boxes of any size.

Miters

Perhaps no box joint shows off handsome wood better than the miter (Fig. 3). Uninterrupted by end grain or joint lines, a beautiful wood surface flows like a ribbon around a mitered box. Unfortunately, the price of this "invisible" joint in time and frustration is often very high. Miters can be difficult to cut accurately and a real pain to glue up. And, without reinforcement, the end-grain gluing surfaces that are most common for box-corner miters provide little more strength than a butt or simple rabbit joint.

I have never mitered the four corners of a box on a table saw without having to

spend time truing the joints with a hand plane to get them to fit just right. Admittedly, I don't miter every day (indeed, I avoid mitered joints whenever possible), but I suspect many woodworkers experience the same difficulties. Every additional inch of width and any deviation of the board's face from dead flat compounds the problem. Nevertheless, with practice, patience, well-tuned machinery and the help of a few jigs (an accurate table saw sled with hold-downs for wide or springy box sides, for example), decent miters can be cut.

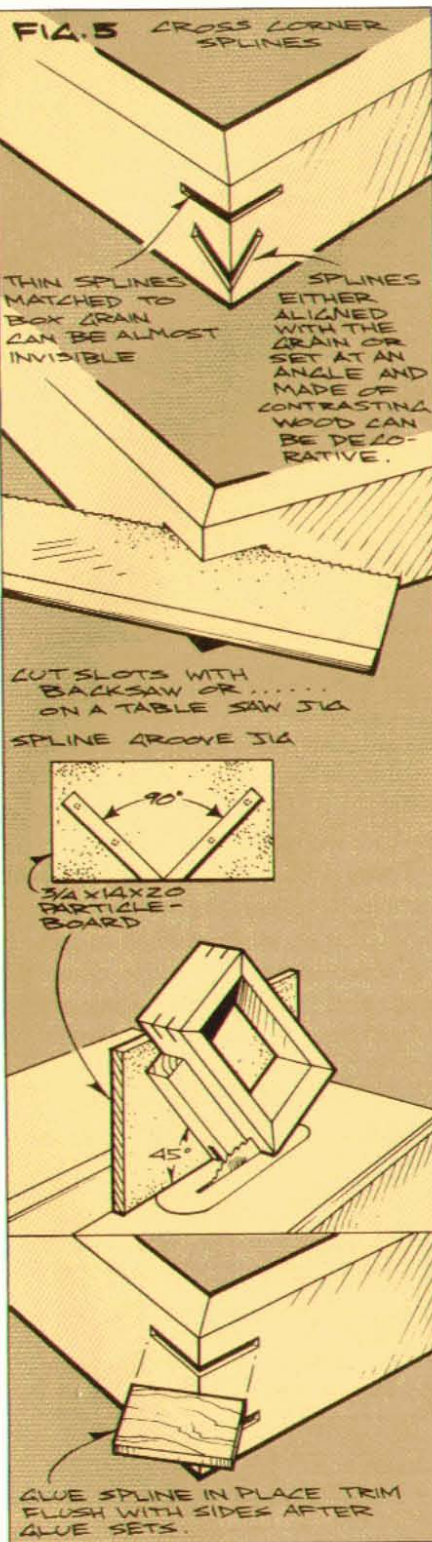
Glue alone is enough to hold a small mitered box together. A friend of mine has been successful with a simple procedure, also shown in Fig. 3. He cuts the joints on the table saw, lays the pieces end to end (outside faces up) and applies strips of masking tape across the joints. Then he spreads glue on the mitered surfaces and folds the sides on their tape hinges to form the box. The tape both aligns the joints and holds them fairly

tightly while the glue dries.

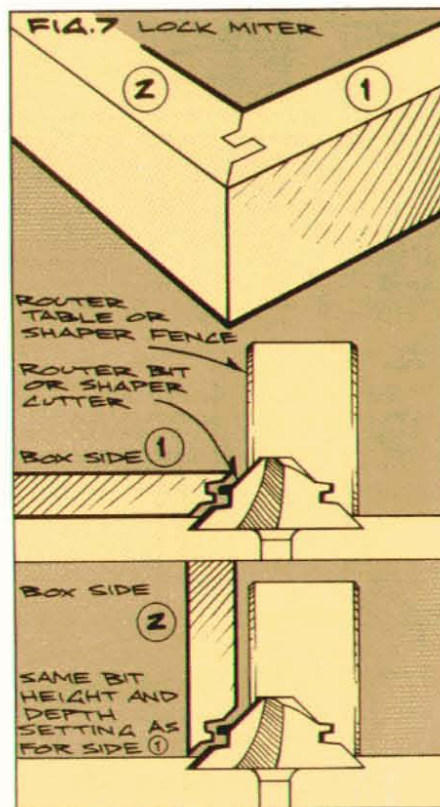
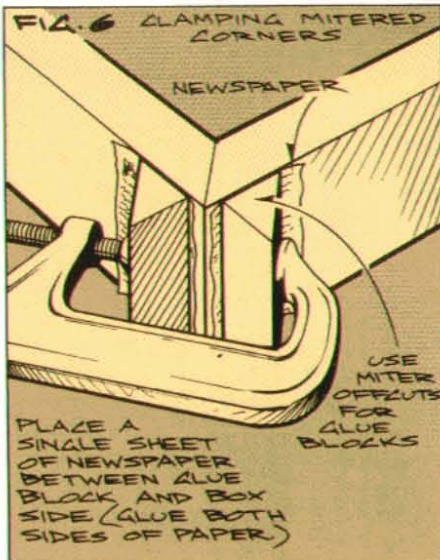
Mitered corners for larger boxes require reinforcement. Fitting loose splines in grooves cut along the length of the miters, as shown in Fig. 4, provides hidden strength, but the procedure can be tough to do accurately. An alternative is to miter and assemble the box, then slip splines into kerfs cut across the corners (Fig. 5). Thin splines matched to the sides can be almost invisible; thicker splines of contrasting wood, perhaps inserted into kerfs cut at various angles, add decoration as well as strength.

I struggled for years gluing up mitered boxes before I finally tried what all the old books suggest—temporary glue blocks. I glued the miter offcuts to the box sides as shown in Fig. 6, placing a piece of newspaper between the block and side. (Put glue on both sides of the newspaper.) A series of C-clamps on each corner draws the joints nice and tight. The technique works for boxes of any size; a sharp rap from a hammer severs the blocks (the newspaper splits in half) when you're ready to clean up.

If you have a router table or a shaper, you might want to try cutting lock miters with a special router bit (Fig. 7). The joint has a great deal of mechanical



strength, increased gluing surface and is self-aligning, which is a big help at assembly. It is not easy to maneuver pieces of much size through this set up—only a feather edge contacts the table or outfeed fence beyond the cutter, and the vertical cut of every pair can be tricky for large box sides. I don't believe



cutters are available for box sides less than 1/2 in. thick.

Finger Joints and Dovetails

These interlocking joints, easily the strongest of the box-corner options, are frequently the major decorative element on a box as well (Fig. 8). Both types of joint can be cut by hand or machine. Most woodworkers have tried their hand at making homemade jigs for cutting these joints on a table saw (one is shown in the drawing), and in recent years a

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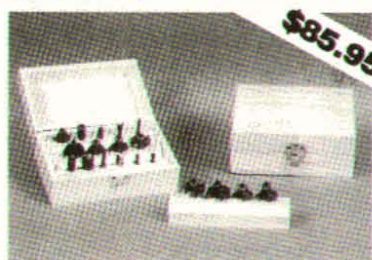
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Woodworking Basics

Continued

**FIG. 8 FINGER JOINTS
AND DOVETAILES**

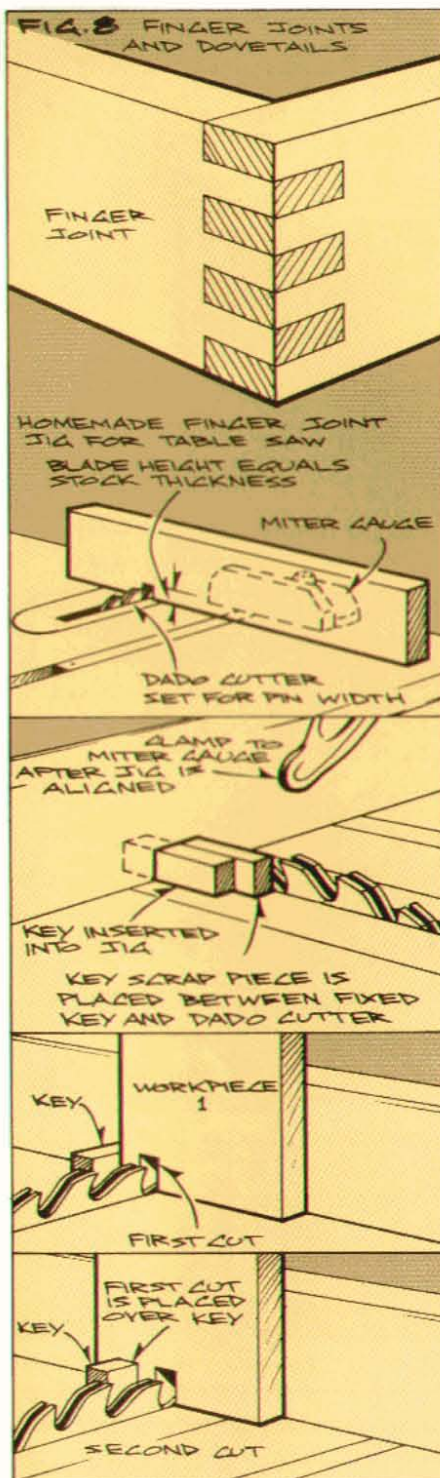
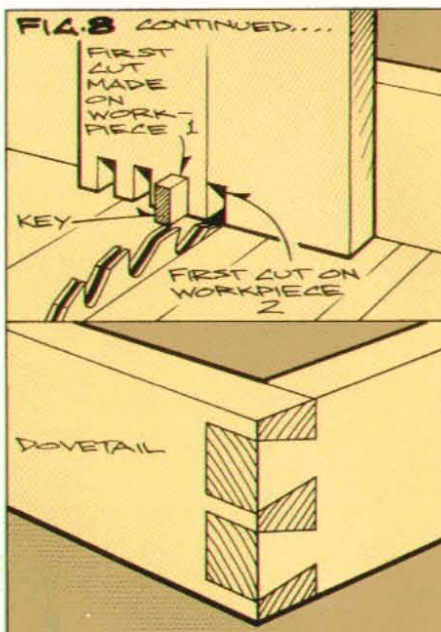


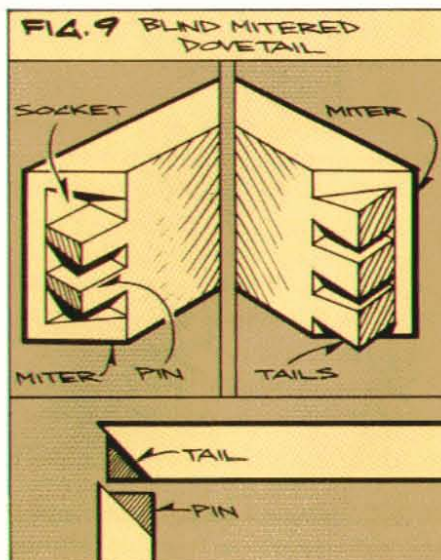
FIG. 8 CONTINUED...



most machine jigs, there is little difference in the time or skill needed to make either joint. Because of this, the only reason to choose finger joints instead of dovetails is if you want their particular look for the box.

If you want to combine elegance with technical virtuosity, try the blind mitered dovetail (Fig. 9). In addition to providing a virtually indestructible miter, the joint tests your humility—unless you call all your friends over to admire the

**FIG. 9 BLIND MITERED
DOVETAIL**



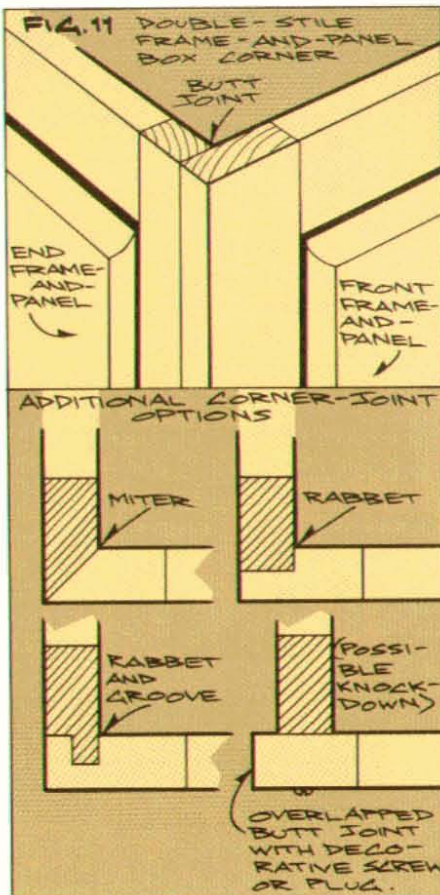
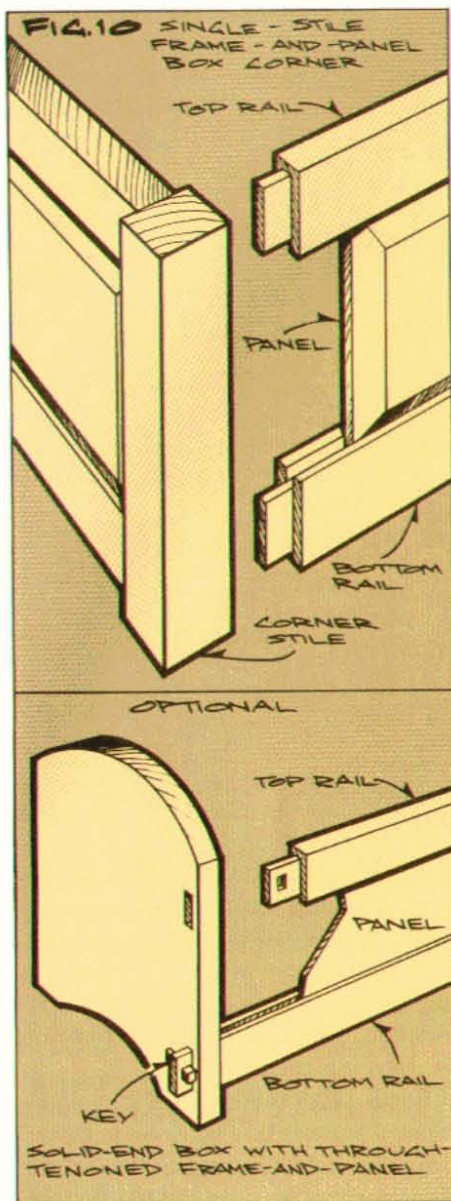
small industry has sprung up supplying ever-more ingenious jigs for routing dovetails.

Both joints have great mechanical strength and provide large areas of long-grain gluing surface. Because of their tapered fit, dovetails are mechanically stronger, but modern glues make snug-fitting finger joints every bit as durable. Whether cut by hand or with

joints before assembly, you're the only one who'll know they're there.

Mortise-and-Tenoned Boxes

Boxes, like other carcasses, can be assem-



bled of framed-and-paneled sides. The corners can be single stiles into which are mortised rails from a side and an end, as shown in Fig. 10. (A variation of this, where front and back rails are through-mortised into thick solid ends, is a favorite of mine.) Or two stiles can be butted, mitered, or rabbeted together at a corner, the mating long-grain surfaces making very strong glue joints (Fig. 11). These types of construction are most commonly used in larger boxes, but it's not impossible to use them on the scale of a silver chest or jewelry box.

Box Lids

I divide box lids into two basic types. One is a single panel, usually flat, added

after the body of the box has been assembled. The other, consisting of a top panel and the upper portion of the box sides, is cut from the box after assembly. There are numerous versions of both types, but they all must address, in some fashion, the problem of wood movement. With few exceptions, every box lid will shrink or expand along the unchangeable length of two of the four box sides (Fig. 12). If the design doesn't address this, the lid will stick in humid weather and rattle in dry.

Fig. 12 shows a variety of single-panel lids and how they accommodate or overcome wood movement. A solid-wood panel resting on top of the box front will be able to expand and contract without restriction. (To mask the movement, make the top overhang the front side.) A solid-wood "pencil-box" lid is cut to allow movement side-to-side within the grooves. A frame-and-panel lid minimizes movement—the loose center panel accounts for most of it. Providing a small allowance for movement of the stiles, you can enclose a

5"
or
6"

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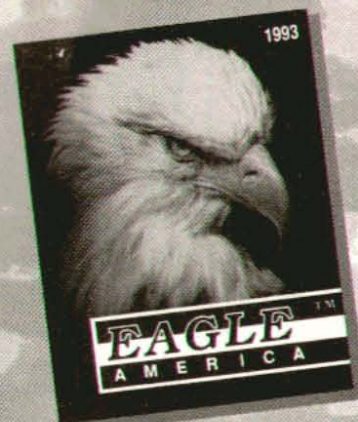
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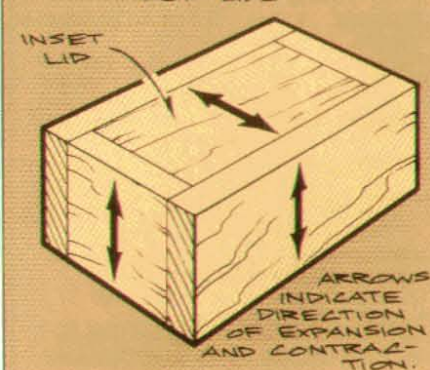


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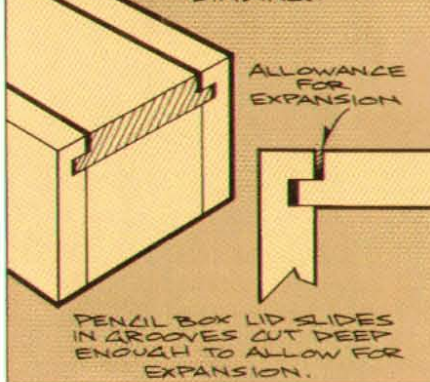
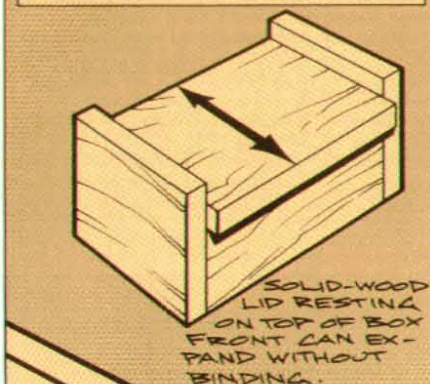
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FIG. 12 SINGLE-PANEL BOX LIDS



WOODMOVEMENT DILEMMA
THIS SOLID-WOOD LID WILL EXPAND ACROSS ITS WIDTH. THE ENDS OF THE BOX ARE STABLE ALONG THEIR LENGTH. RESULT—STUCK LID.

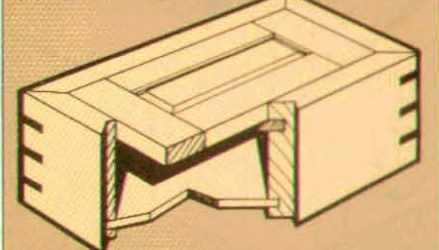


frame-and-panel lid within the sides of a box. A veneered lid eliminates movement altogether, and can stand very close tolerances between box sides.

Cut-off lids (Fig. 13) are, in effect, frame-and-panel construction. The attached box sides form the frame and the box top forms the panel. The top may be solid-wood, a veneered panel or a frame-and-panel itself. Setting solid-wood tops into the thin sides of small boxes can be tricky—there's not a lot of room for movement. But I've used the overlapping construction shown in the drawing

FIG. 12 (CONTINUED)

FRAME-AND-PANEL LID
GREATLY REDUCES MOVEMENT, ALLOWING FOR SOME EXPANSION IN THE FRAME MEMBERS. YOU CAN USE IT AS A FULLY INSET LID.



A VENEERED SINGLE PANEL LID WON'T MOVE AT ALL, CAN BE INSET TO VERY CLOSE TOLERANCE.

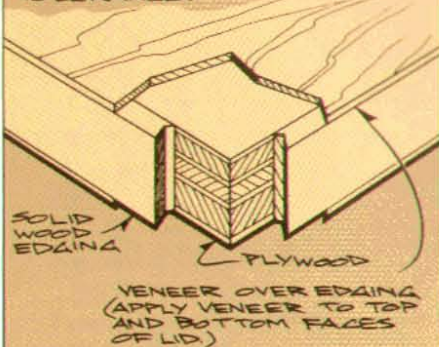


FIG. 13 CUT-OFF BOX LIDS

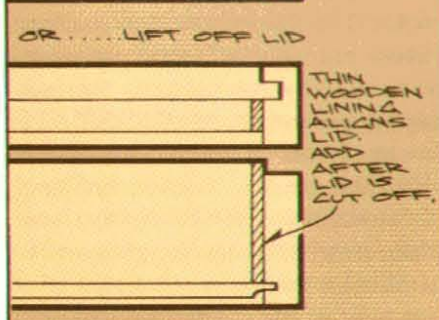
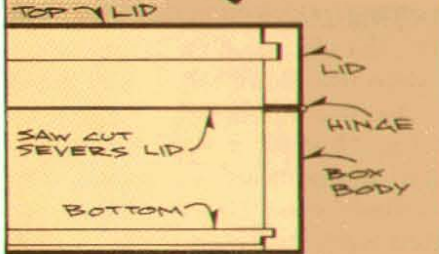
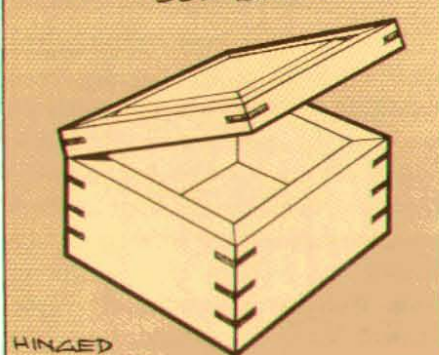
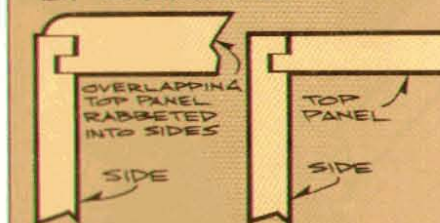
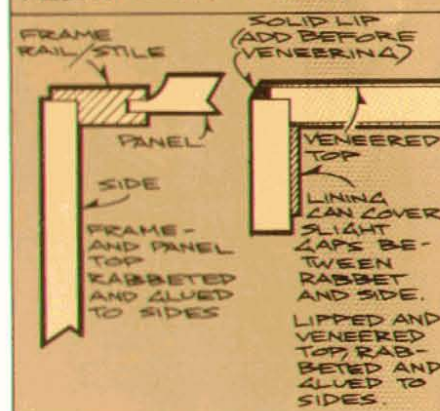


FIG. 13 (CONTINUED)

OPTIONS FOR JOINING TOP TO LID SIDES.



THESE TWO ARE GOOD FOR SOLID-WOOD TOPS. ASSEMBLED LOOSE (NO GLUE IN GROOVES) THEY ALLOW FOR MOVEMENT.

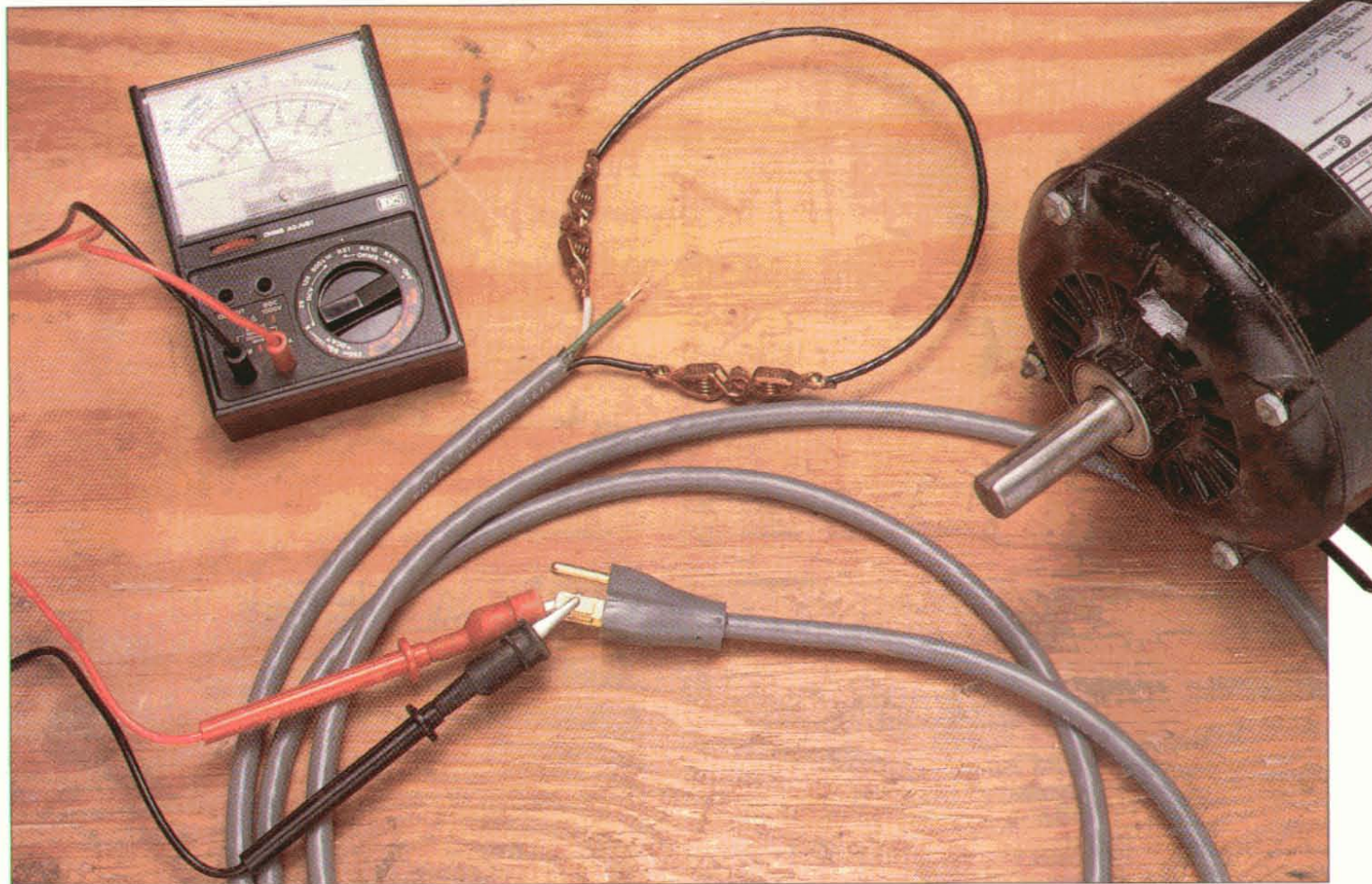


to house a solid top panel 9 in. across in sides as thin as $\frac{5}{32}$ in. This sort of box must also be glued up all at once—sides, bottom and top—which can produce a few anxious moments. Check and double-check the fit of the parts before you swab on any glue.

Boxes with veneered or frame-and-paneled tops can be a bit easier to tackle. I usually assemble these in two stages. First, glue up the sides and box bottom. Then rabbet the box top to slip snugly inside, its lip resting on the sides, and glue it in place. Finally, cut off the lid.

To sever the lid, I cut through two opposing box sides on the table saw, reset the blade to cut almost through the thickness of the final two sides, then complete the cut with a fine backsaw. (Cutting the lid free on the table saw risks damaging it with the saw blade.) After planing the mating edges of the lid and box body flush, I glue thin wooden lining strips to the inside faces of the box. Those in the body protrude about $\frac{1}{8}$ in. above the edges and align the lid as it closes. Those in the lid ($\frac{1}{8}$ in. below the edges) cover any small gaps showing between the rabbets and the sides.





Troubleshooting Electric Motors

What to do when the motor quits

by Jim Barrett

Because a woodshop environment is tough on electric motors, sooner or later you'll be faced with motor repairs or outright replacement. When motor troubles do arise, the usual course of action is to take the motor to a qualified repair shop or service center: there, the problem can be quickly diagnosed and fixed. However, you'll be a step ahead of the game if you can learn to identify some of the more common motor problems and determine whether or not the motor is actually damaged, or if the trouble stems from some external cause that you can remedy yourself.

I must tell you up front, though, that it's not a good idea to take any electric motor apart unless you have the experience and tools to do it. After interviewing the technical representatives at several major motor companies (Marathon, Baldor, and Emerson), all agreed that troubleshooting and repair of *internal* motor parts should be handled only by a qualified repair shop. While the motor manufacturers are looking at it largely from a product liability standpoint, there are several good reasons for this viewpoint.

The most important reason you shouldn't attempt to repair

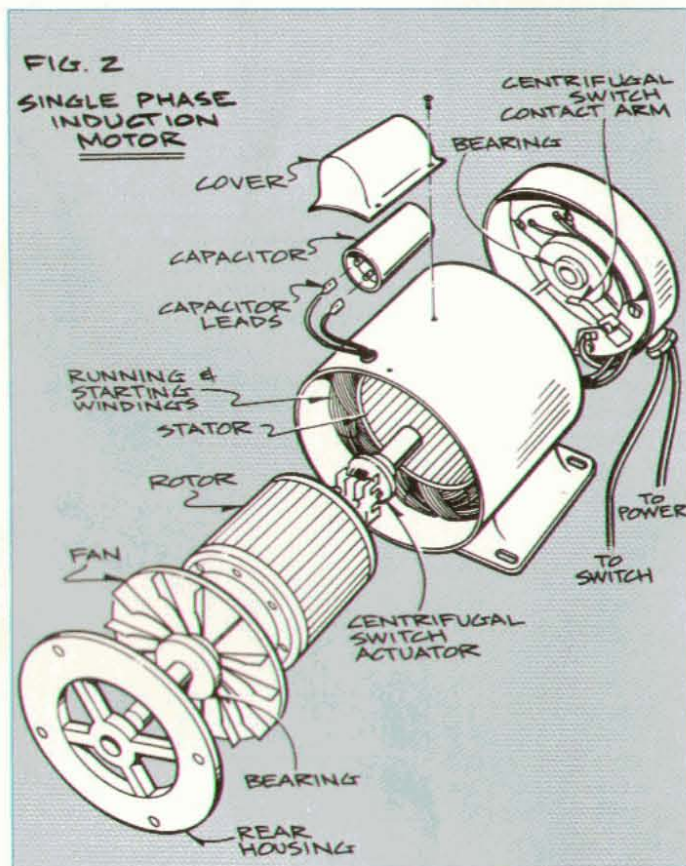
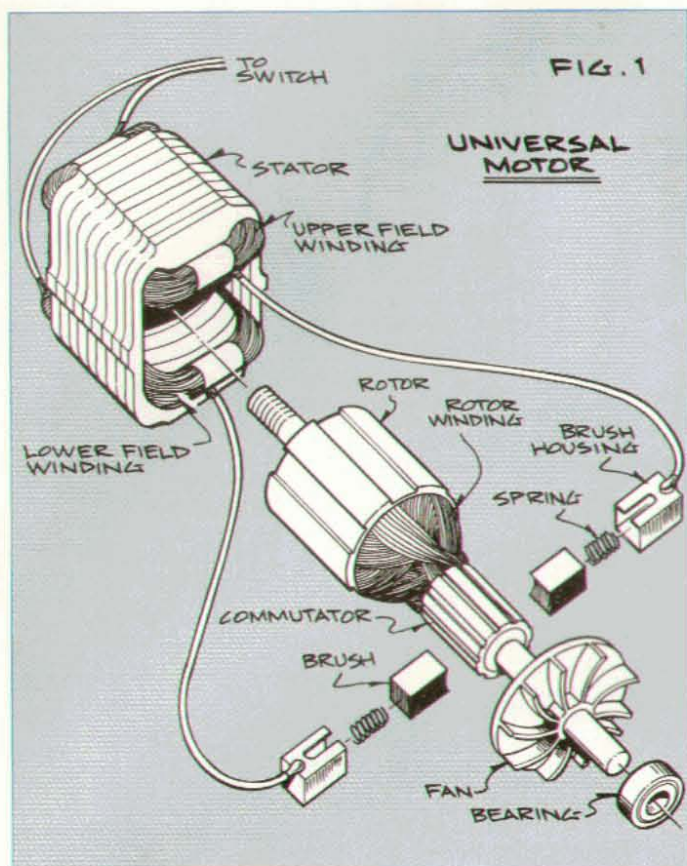
electric motors yourself is that most involve lethal amounts of electrical current; if you happen to reassemble a motor incorrectly, there's a possibility of electrifying the motor frame, which in turn could give you a potentially deadly electrical shock when you use the tool (not to mention frying the motor itself). Also, you usually need specialized tools and diagnostic equipment to troubleshoot and replace most internal motor parts—bearings, internal switches, motor windings, rotors, and so-on. Finally, if the motor is still under warranty, any attempted repairs made by the user will void the warranty.

In this article, I'll discuss what can go wrong with motors, which troubleshooting procedures and repairs you can do yourself, and which should be left to a pro.

Motor Basics

Two basic types of problems can occur with an electric motor: electrical and mechanical.

Electrical problems are those that relate to the motor circuitry—typically switches, wiring, and related electrical components. Examples are a faulty switch or capacitor, worn



brushes, damaged power cord or internal wire, poor electrical connections, or a short or open circuit in the rotor or field windings—in short, anything that interrupts or alters the proper flow of electrical current in the motor. Electrical problems can also be the result of insufficient line voltage or an incorrectly fused circuit at the power source (house wiring).

Mechanical problems relate to the moving parts of the motor: bearings, fan, rotor shaft, belts and pulleys. Sometimes, the two types of problems are interrelated. For example, a mechanical condition, such as sticky or frozen bearings, creates electrical resistance in the motor windings or other electrical components, causing them to overheat and eventually burn up. The same problem can happen if you physically overload the motor, such as cutting dense wood with a dull saw blade. The trick is to catch individual problems before they lead to further damage.

Types of Motors

To better understand what can go wrong with motors, it helps to have a basic knowledge of the various types of motors and their respective components.

The universal motor, used in portable power tools, is shown in Fig. 1, while the induction motor, used in most stationary woodworking machines, is shown in Fig. 2.

As you can see from the illustrations, universal motors differ from induction motors in two ways: first, they have windings in both the stator (field) and the rotor, whereas induction motors have windings in the stator only. Universal motors also have a set of carbon brushes that conduct current to the rotor by direct

contact through a commutator; in induction motors, a rotational electromagnetic field is “induced” into the rotor without actual physical contact with the field windings.

The term universal means that this type of motor can be wired to run on AC or DC current; induction motors run on AC current only. DC motors are similar to universal motors, in that they have a wound rotor, a pair of carbon brushes, and a commutator. However, DC motors use permanent magnets instead of field windings in the stator. As the name implies, they run on DC current only, and are widely used in cordless (battery-powered) tools. On both types, the brushes require periodic replacement; instructions are usually provided in the tool owner’s manual. A dirty, worn, or rough commutator is another potential source of electrical trouble.

Induction motors used for most woodworking equipment are referred to as *single phase* motors. These require separate field windings to provide the power necessary to start the motor. On most, additional starting power (torque) is developed through use of a starting capacitor, which is connected to an internal centrifugal switch on the motor shaft. When the motor reaches speed, the centrifugal switch cuts off power to the secondary starting windings and capacitor to prevent them from burning up. Single phase motors range from fractional horsepower sizes up to about 10 horsepower. Although these motors have no brushes to replace, electrical problems common to them include a faulty centrifugal switch or capacitor.

Other types of induction motors include light-duty *shaded pole* motors at one end of the spectrum and industrial-type *three phase* motors at the other. Shaded pole motors are

inexpensive and durable, but are relatively inefficient for their size, so they're used mainly for small electric appliances and devices such as can openers, record players, clocks, fans, and the like. Three phase motors are used to drive heavy industrial equipment, including some large woodworking machines, but they have special current and voltage requirements so they won't run on standard 115V or 230V residential service. Electric companies usually supply three phase power to industrial and commercial buildings only.

Troubleshooting

Troubleshooting electric motor problems is much like tracking down problems in a car engine. You start with a visual inspection and check the obvious things first. If your car won't start, you check to see if there's gas in the gas tank, or if the battery is dead. Likewise, if you flip the switch on a power tool



Volt/ohm meter is used to make several tests on electric motors.

or machine and nothing happens, you check to see if there's power at the electrical outlet. After ruling out the obvious, you use your eyes and ears to track down the problem. The following text covers some common problems.

Motor Won't Start

If you plug in a tool or machine and nothing happens, the first thing to do is check to see if power is being supplied to the motor. First, check the electrical outlet in the wall. Test the outlet with a test lamp or an electrical device you know is working. If there's no power, replace the fuse or reset the circuit breaker. If you continue to trip the breaker or blow fuses, the circuit is either overloaded or there's a short circuit somewhere in the motor.

Next, check the power cord for damage. On heavy cords especially, a broken or shorted wire inside the cord's insulated jacket is nearly impossible to detect by visual inspection alone, so you'll need to perform one of the following tests. First, unplug the cord and disconnect it from the motor leads. If you

have a volt/ohm meter, test the cord for continuity as shown in Fig. 3. Set the meter to the RX1 scale, zero adjust the ohms scale (see meter manual for instructions) and attach the metal leads to the cord prongs. Connect the black and white cord wires with a "jumper" as shown. A zero reading on the meter means the cord is okay; a high reading indicates the cord is defective. Volt-ohm meters are sold at many electronics store (such as Radio Shack) and auto supply shops.

If you determine that the cord is defective, replace it with an identical cord from the tool manufacturer (don't guess at wire gauges or cord lengths).

Next, check the ON/OFF switch. *After unplugging the tool*, set your volt-ohm meter to the RX1 scale, then attach the probes to the switch terminals, as shown in Fig. 4. Turn the switch on and off: if the switch is working, the meter will read zero ohms in the ON position, and high ohms in the OFF position. If the ohm meter reads zero in both the ON and OFF positions, then the switch is stuck in the ON mode. If the ohm meter reads high in both positions, then a contact is not being made. If you can access the switch contacts, clean them. Note that if you must disassemble the motor to access the switch terminals, you should leave this test to a repair shop.

If the above tests fail to identify the problem, you'll need to take the motor into a shop and have the internal circuitry checked for loose connections or open circuits inside the motor.

Motor Hums or Won't Reach Full Speed

If the motor makes a humming noise and won't turn, or if it starts slowly or won't come up to full speed, the problem may be either electrical or mechanical.

First, check to see if the rotor shaft is turning freely by unplugging the tool and turning the projecting end of the shaft by hand. If the shaft doesn't turn freely, the bearings may be at fault, or the motor may simply be clogged with sawdust. Sawdust is the major cause of motor problems; it can literally suck the grease out of bearings, foul up the centrifugal switch in single phase motors, and block air vents, causing the motor to overheat. So, before conducting any tests, vacuum or blow out any accumulated sawdust in the motor.

Other mechanical problems that keep a motor from reaching speed may be a bent rotor shaft, misaligned pulleys or arbor, an overtight belt, or mechanical problems with the machine to which the motor is attached. A scraping noise inside the motor usually indicates a loose fan or rotor.

Next, check the power supply for low line voltage or for a drop in line voltage during motor startup. The voltage supplied to the motor leads should be within about 8 percent of that stated on the motor nameplate, or about 106 volts minimum for a 115V motor. You can have a licensed electrician check this for you.

If the tool is connected to an extension cord, make sure the length and wire gauge of the cord match that specified in the tool owner's manual. If the cord is too long or the wire gauge too small, electrical resistance in the cord will result in a voltage drop, which will cause the motor to start slowly, fail to come up to full speed, and cause overheating in the cord and

motor. Typically, the longer the cord, the heavier the wire gauge must be. Also, larger motors require heavier-gauge cords than smaller ones, to handle the higher amperage draw. If recommended extension cord sizes aren't listed in the tool owner's manual, contact the manufacturer for these figures.

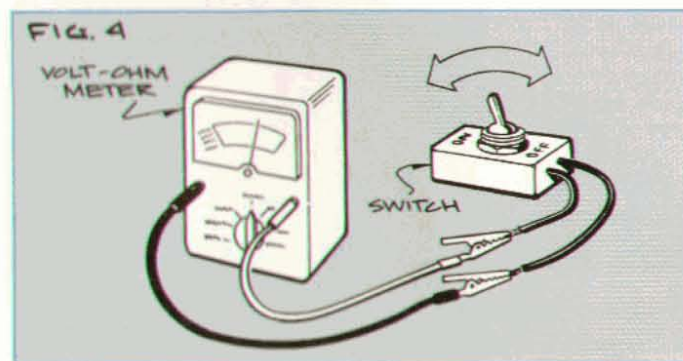
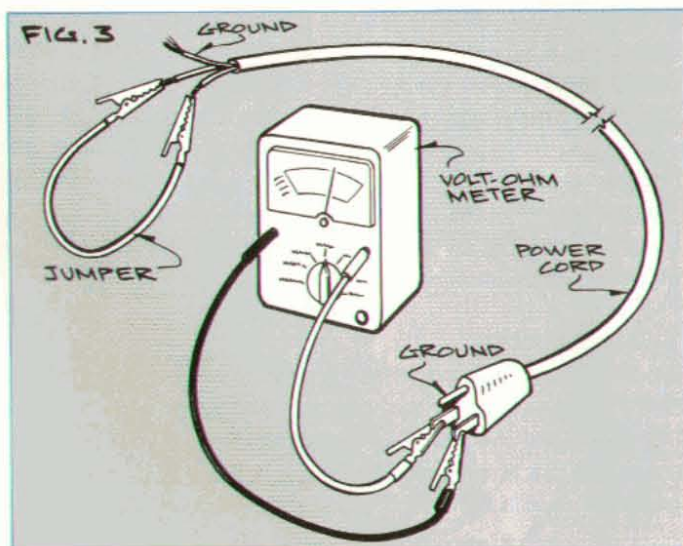
Similarly, if you suspect a voltage drop, check the voltage at the wall outlet. In most areas of the country, the power company provides 115/230 volt service to the house (plus or minus a few volts) at the service panel, but line voltage may drop as much as 10 volts during times of peak use. Also, the actual voltage at any given outlet in the house may be less than that provided at the service panel, depending on the distance between the outlet and the panel. Outlets at the end of a branch circuit will have lower voltages than those near the panel. Faulty or insufficient wiring (especially in older homes) is another cause of voltage drop. First, contact the utility company and have them conduct a line voltage test at the service panel, then at the wall outlet servicing the tool in question. If the voltage drop between the service panel and outlet is more than about 4 volts, the wiring is insufficient.

Once you've ruled out mechanical and power-supply problems, you can suspect internal electrical problems. On single phase motors, the most common electrical failures occur in the starting circuitry—the capacitor, centrifugal switch, or starting windings. If the motor hums but does not turn, the centrifugal switch may be stuck in the open position, or the capacitor has an open circuit. A motor that starts, but shuts down a few seconds later usually indicates a centrifugal switch stuck in the closed position. A shorted capacitor usually results in slow starting of the motor. In many cases, the switch is simply packed with sawdust, so you might be able to blow out the motor with compressed air. If the switch or capacitor are bad, they'll need to be replaced. If the motor has an externally mounted capacitor, you can test it by carefully disconnecting the leads and attaching them to an identical capacitor (one with the same microfarad and voltage reading) that you know works. Bear in mind that some capacitors may carry a residual electrical charge, even after the machine is unplugged; to avoid electrical shock, disconnect the leads carefully and avoid direct contact with the capacitor terminals.

Motor Cuts Out During Use

Single phase induction motors often have a thermal overload protector that shuts down the motor when it overheats. This is normally indicated by the words "Thermally Protected" on the motor nameplate. If the motor stops suddenly during use, turn off the machine and allow the motor to cool down for several minutes before restarting it. Most woodworking motors have a manual reset button on the motor housing, which you must depress before you can restart the motor. If the motor still won't start, check the fuse or breaker in the circuit supplying power to the tool.

While most universal motors don't have such overload protection, some have brushes that automatically disengage from the commutator when they wear down to a predetermined length. This feature is designed to prevent damage to the



commutator by worn-out brushes. When the brushes disengage, the tool stops cold—a cue to replace the brushes.

Motor Stalls Under Load

The same conditions that cause a motor to hum, start slowly or fail to reach full speed can also cause the motor to slow down or stall when a load is applied. An even more common cause is physically overloading the motor. A dull blade or cutter, or simply trying to force the tool beyond its capacity can be tough on motors. Keep blades sharp; if the motors starts to labor while using the tool, slow down the feed rate.

If a stalled motor results in blown fuses or tripped circuit breakers in the branch circuit, this means that the breakers or fuses don't have sufficient capacity to handle the electrical devices attached to the circuit. If this is the case, you'll either need to reduce the number of appliances, machines, and lights on the circuit, or provide a separate, dedicated circuit for the machine, with the correct size fuse or breaker to handle it. An overloaded circuit can also result in a voltage drop.

Motor Overheats

Motors will overheat when subjected to the overload conditions described above. In a woodshop environment, a more common cause of overheating is insufficient air supply to the motor's cooling fan; that is, the motor vents are blocked with sawdust. The obvious fix is to unblock the vents. Then, check for a

continuous stream of air from the motor while it's running. Sawdust inside the motor or piled up around the motor housing can also cause overheating.

Excessive Noise and Vibration

Motor noise and vibration can be caused by a variety of things, most of them mechanical. First, check to see that the motor is firmly mounted to its bracket or base, and that the mounting bracket is firmly attached to the machine. Tighten any loose screws or bolts on the motor housing (on portable power tools, tighten all screws on the tool housing). On belt-and-pulley setups, check for a loose or misaligned pulley, and make sure the belt is tensioned correctly (not too loose or too tight). Also check for a bent rotor shaft (indicated by a wobbly pulley), or blade "runout" on direct-drive saws.

Internal motor vibration (and noise) is usually caused by worn, misaligned or defective bearings. Check the rotor shaft for excessive end play and side play. A misaligned or unbalanced rotor shaft can also cause noise and vibration. All motors have a slight air gap between the rotor and the stator. If the air gap isn't uniform, the rotor is misaligned, usually due to incorrect bearing placement. Some motors have balancing weights on the rotor shaft; when these shift, the rotor is thrown out of balance, resulting in excessive noise and vibration. Again, don't try to fix these internal problems yourself—take

the motor to a repair shop.

General Maintenance

You may have gathered by now that sawdust is the biggest enemy of electric motors in the woodshop. To extend the life of the motor, vacuum or blow sawdust out of the motor each time you use the tool or machine.

The second major cause of motor failure is overloading the tool or machine. If the motor starts to bog down during use, slow down the feed rate; also, don't force the tool beyond its stated capacity. Keep blades, bits, and cutters sharp.

Also, check the motor periodically for loose or misaligned parts. Make sure the motor is firmly mounted to the machine and all connecting parts (belts, pulleys, arbors, etc.) are properly aligned.

If you have motor problems with a new or recently purchased used machine, make sure the new motor is correctly wired for the power source (115 or 230 volts). Most larger single phase induction motors can be wired for either voltage; check the voltage specifications on the motor nameplate. If you suspect the motor has been wired incorrectly by the tool manufacturer (this is rare, but it does happen), have the motor checked out by a qualified electrician or repair shop.

Finally, if you do need to replace a motor, make sure the new one is identical to the old.

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Finishing

If you're serious about finishing, you should probably own at least one high quality, natural bristle varnish brush, and take the extra time and effort required to keep it in top shape. While a good natural bristle varnish brush can be expensive—from \$8 to well over \$30, depending on size and quality—you'll be rewarded with a tool that provides professional, predictable results and one that will be a joy to use. And, if properly maintained, a top-quality varnish brush should last through many uses.

Of course, you can get away with not using a bristle brush at all. You could finish all your projects with wiping stains, tung oil, Danish oil, clear wipe-on gel finishes, or similar cloth-applied finishes, and get excellent results. Even if you decide to finish your project with an oil-based varnish, polyurethane or other clear topcoat, you need only buy a handful of inexpensive disposable foam brushes, then throw them out after use. After all, cleaning a brush requires extra work. And, in the case of solvent-based finishes, you'll probably go through several ounces of solvent each time you clean the brush.

In most cases, though, if you want a fine finish, you'll need a good bristle brush.

What Is A Varnish Brush?

"It's a brush for applying varnishes," you say. True, but when you visit your brush dealer or thumb through brush manufacturer's catalogs, you'll usually find that bristle brushes used for applying paints and varnishes, whether natural or synthetic bristle, fall into three basic categories: wall brushes, angular sash brushes, and varnish brushes. The difference between the three is in the width of the brush, the amount of bristles used, and the shape of the bristles at the working end of the brush.

The traditional brush for applying clear finishes to wood is called a flat varnish brush (see Brush Basics illustration). Flat varnish brushes range in size from 1 in. to 3 in. wide, with domed or chiseled tips, rather than flat, square tips, like wall brushes. Varnish brushes use a good mixture of different-length bristles, which form a gradual taper down to the tip; this enables you to hold the brush at an angle to flow on clear finishes smoothly and evenly. Wall brushes, on the other hand, have bristles that are mostly all the same length, forming a flat, square tip, for applying paint with the end of the brush, rather than the side. Wall brushes are also thicker and stiffer than varnish brushes so they hold more material and work better



Choosing A Good Brush

by James Barrett

applying paints; sizes range from 2 in. to 4 in. wide.

Angular sash brushes are easy to identify: the brush end is cut at an angle. They're used for painting window sashes and narrow trims. Sizes usually range from about 1 in. to 2½ in. wide. Flat sash brushes have square tips rather than angled ones, and usually contain less bristle fill (fewer bristles) than wall brushes of the same width. While angular sash brushes are also used primarily for painting, I find them useful for applying clear finishes to moldings, trims, and other narrow pieces. However, the main focus of this article is on varnish brushes, so I won't say any more about the other two types. In both natural and synthetic bristle varnish brushes, quality and performance varies widely, depending on a number of factors. I'll discuss each type in turn, then provide some general pointers for choosing a good brush.

Natural Bristle Brushes

All of the information on natural bristle brushes I've gained over the years from master finishers, "old-school" painters, and other sources, has confused rather than clarified the issue of choosing the best natural bristle brush for the job at hand. Some veteran finishers prefer black China bristles; others prefer white China bristles. Still others like brushes with mixtures of China bristles and badger, skunk, or ox hair. I've finally reached the conclusion that the type of natural bristle, along with bristle length, handle length, amount of flagging (splitting of the bristles at the tips), amount of taper, and other brush characteristics are purely a matter of personal preference. Even

so, here are a few basic guidelines:

First, you should know the differences between a natural bristle brush and a synthetic bristle brush. When viewed under a magnifier, natural bristles are rough and pitted, rather than smooth, like synthetic bristles. Thus, they hold more material and apply it more evenly. However, natural bristle brushes should be used only with solvent-based finishes (shellac, brushing lacquers, oil-based varnishes and polyurethanes). When used with water-based finishes, the bristles absorb water, which makes them swell and lose their shape. Water-based finishes also "load up" on natural bristle brushes, resulting in uneven coverage and less control when "cutting in" edges. Suffice to say, natural bristle brushes not only perform poorly with water-based finishes, but the water will eventually ruin the brush, making it useless. So, your brush collection should also include a few good synthetic bristle brushes.

Most natural bristle brushes on the market use hog or boar bristles. In the brush industry, imported China hog bristles are considered to be the best quality, so my first recommendation is to make sure that any hog bristle brush you do buy has 100 percent China hog bristles. These brushes usually bear the label "100% China bristle." The natural bristle colors are black, white or gray. Black China bristles are the most common, and usually the highest quality. White China bristles perform just as well as black bristles, but some finishers (especially boat builders) prefer white because any bristles that do shed into the finish will be less noticeable when the it dries. Gray bristle brushes are usually a mixture of black and white bristles. They're generally of lower quality and less expensive than brushes with pure black or white bristles.

Some lower-quality natural bristle brushes are dyed black; you can often tell because the bristles will feel crusty or unnaturally stiff; in some cases, the dye will transfer to your hand when you rub the bristles. Some higher quality China bristle brushes may also be dyed; these usually have white bristles that are dyed a brown or golden color. I might add here that hogs, like people, don't all grow exactly the same kind of hair. For example, hogs in the southern Chinese provinces tend to have thicker, stiffer, bristles than hogs in the northern Chinese provinces. Also, hogs don't grow hairs all the same length or color. As a result, brush manufacturers are able to mix

and match hog bristles of different lengths and thicknesses to make brushes with different performance characteristics.

Some very expensive natural bristle brushes include a mixture of China hog bristles and softer ox hair, skunk hair or badger hair bristles. Such brushes tend to be softer than 100 percent China bristle brushes. Generally, these brushes work best with stains and thinner finishes such as shellac and brushing lacquers because they hold material better and flow on the finish more smoothly. A top-quality varnish brush of this type usually contains a mixture of 20–30 percent ox, badger, or skunk hair bristles in proportion to China hog bristles. These blended bristle brushes aren't as common as they were several

decades ago, so you probably won't find them at your local hardware store or home improvement center. However, several of the companies listed in Sources make them.

Beyond the type of bristles used, performance is determined by the mixture of bristles (short and long) the amount of bristles (fill), the overall length of the bristles in relation to the width of the brush, the amount of flagged bristles at the tip of the brush, and the thickness of the individual bristles themselves.

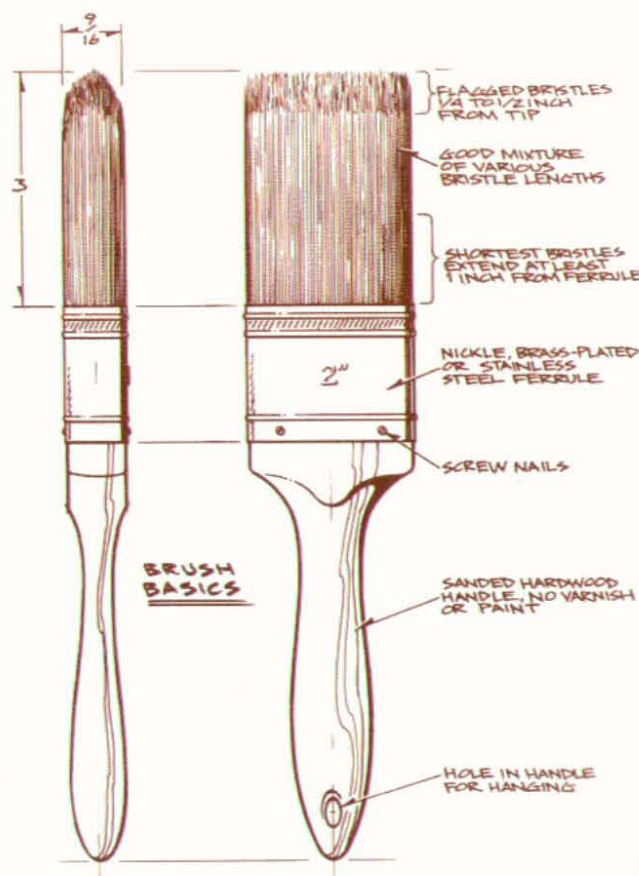
Veteran finishers learn through experience how particular types of natural bristle brushes perform with various types of finishes. Some finishers like softer brushes; others like stiffer brushes. For example a full, long-bristled brush with softer, pliable bristles and heavy flagging will probably work better with shellacs and fast-drying brushing lacquers, which require flowing on the finish in long, quick, even strokes. A short-

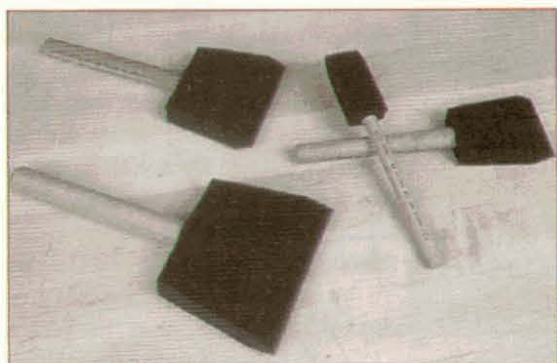
bristled brush with thicker individual bristles would be preferable for applying slow-drying oil varnishes or polyurethanes that require a certain amount of "hard" brushing to apply the finish and eliminate bubbles.

While the veteran finisher can often judge the performance and quality of a brush just by feeling the bristles, the price of the brush is also often a good indicator of quality. Realistically, the weekend finisher probably won't notice much difference in performance between a good consumer-quality China bristle brush and a top-end handmade \$30 China bristle brush.

Synthetic Bristle Brushes

Synthetic bristle brushes also vary in quality, although the quality difference is produced by artificial means, rather than





Foam brushes are excellent for applying stains and dyes.



Paint pads apply a smooth even coat with few bubbles.

by sorting and grading natural bristles. Expensive synthetic bristle brushes simulate natural bristle brushes. The bristle "fill" consists of bristles—technically, called filaments—of various lengths and, as with natural bristle, the bristle ends are split or "flagged."

Most good synthetic brushes are a blend of polyester and nylon bristles. Nylon comes in different grades: lower grades of nylon will eventually decompose when used with finishes that contain alcohol, lacquer, or acetone solvents. Higher grades of nylon may also be affected by these finishes, but not polyester.

While cheap, synthetic bristle brushes have their place in the finishing world, I generally avoid them—they spatter, shed bristle, apply finish unevenly, and are generally a frustration to use. When I'm finishing a project too small to warrant using and cleaning a good brush, or when I'm testing different types of stains and finishes, I'll usually opt for the convenience of throwaway foam brushes. I've noticed that the bristles on cheap, throwaway nylon brushes are mostly all the same length, with little or no flagging at the tips, and moreover feel like a wad of nylon fishing line when squeezed or fanned.

Price is often an indicator of quality—most manufacturers use a "good," "better," "best" designation in their synthetic brush lines. One of the best performing synthetic bristle brushes I've used is the "One Coater" made by EZ Paintr Corp. (The company dropped the "e" in Paintr, not me). The patented polyester bristles simulate natural bristles, and do a good job with all types of finishes. EZ Paintr and other companies also make brushes that contain a blend of natural and synthetic bristles. These brushes, at least in theory, combine the performance of a natural bristle brush with the durability and versatility of the synthetics. This said, I still prefer a 100 percent China bristle brush for applying

oil-based varnishes, brushing lacquers, and oil-based polyurethanes.

Foam Brushes: These come in a variety of sizes (see photo) from 1/2 in. to 3 in. wide, and run anywhere from 29 cents to \$1. They provide a smooth, even, drip-free coat of finish without brush marks and without shedding hairs. Foam brushes work very well for applying "watery" materials, like liquid stains and aniline dyes. In my opinion, foam brushes are better than cheap synthetic bristle brushes in most respects.

Foam brushes do have limitations, though. When used to finish large projects, the foam pads eventually wear out, leaving bits of foam on the surface. When used with heavy finishes, such as oil varnish or polyurethane, the brushes tend to drag on the surface, so you have to work slowly to get even coverage.

Don't use foam brushes with shellac and brushing lacquer. After a short period of time, the solvents in these finishes (denatured alcohol and lacquer thinner) tend to melt the glue holding the foam pad to the handle. After prolonged use in these finishes, the foam pad itself disintegrates. Also, foam brushes don't work well with water-based clear finishes because they tend to raise excessive bubbles in the finish.

Paint Pads

If you've ever used any of the new water-based clear finishes, you've probably discovered that they tend to leave bubbles in the surface when you apply them. While foam brushes don't work well with these finishes, another unconventional finishing tool provides excellent results: a fabric-covered paint pad, such as the one shown in the photo. Originally designed as a trim tool for latex wall paints, these pads come in several different sizes. They flow on the finish in a smooth, even coat, leaving few or no bubbles. Also, the beveled

Sources

Anderson Brushes

(Subsidiary of Wilton Corp.)
1040 Southbridge St.
Worcester, MA 01610
Tel. (508) 755-6100

EZ Paintr

Member of the Newell Group
4051 S. Iowa Ave
Milwaukee WI 53207
Tel. (414) 481-4500

(Baker natural bristle brushes,
synthetic bristle brushes)

Maryland Brush Co.

3221 Frederick Ave.
Baltimore MD 21229
Tel. (410) 945-3300

(Natural and synthetic bristle brushes)

Purdy Corporation

P.O. Box 83097
Portland, OR 97283-0097
Tel. 1-800-547-0780

(Natural and synthetic bristle brushes)

Wood Finishing Supply Co., Inc.

100 Throop St.
Palmyra, NY 14552
Tel. (315) 597-3743

(Natural bristle brushes,
including badger, ox, and skunk hair)

edges of the pads enable you to get into tight corners, such as when finishing the inside of a drawer or cabinet. The next best tool for applying water-based finishes is a good quality synthetic bristle brush (polyester, nylon, or a blend of the two) with soft, well-flagged bristles.

How To Spot Quality

Whether you go with a natural or synthetic bristle brush, it pays to buy the best you can afford—within reason. As I mentioned earlier, most woodworkers won't notice much difference between a \$10 brush and \$30 brush of the same size. Here are some general quality features to look for:

Fill: This term refers to the amount or number of bristles contained in the brush. Varnish brushes usually have less fill than wall brushes of the same width, although an expensive varnish brush will usually have more fill than a cheaper one. In a good varnish brush, you'll notice that the fill is nearly as thick near the brush tip as it is at the base.

Bristle Mixture: A quality varnish brush also contains a good mixture of bristle lengths to form a smooth, even taper toward the tip of the brush. (On cheaper brushes, the shorter bristles look chopped off in layers, like a cheap haircut). Ideally, the shortest bristles should extend at least 1 in. out from the base, or ferrule. Also, 70–80 percent of the bristles should be full length. They should feel nearly as full near the tip as they do at the base when you wrap your hand around the brush.

Bristle length and thickness: Cheaper brushes usually have shorter bristles than more expensive brushes. When viewed sideways, cheaper brushes are also thinner (because they contain fewer bristles). Use the following guidelines for choosing a flat varnish brush: Brush width and bristle thickness is measured at the ferrule; overall bristle length is measured from end of ferrule to tip of brush.

Size (width)	Min. Bristle Thickness	Min. Bristle Length
1	7/16	2
1 1/2	1/2	2 1/4
2	9/16	3
2 1/2	9/16	3 1/4
3	11/16	3 1/2

Splitting hairs: While we don't want to have split ends in our own hair, this condition is desirable in a brush because it helps eliminate brush marks: Natural bristle brushes have naturally split or flagged ends, which continue to split as the brush is used. On higher quality synthetic brushes, the bristle ends are flagged during the manufacturing process. On a good varnish brush, about 80 percent of the bristles are flagged, and the flagging extends from 1/4 in. to 1/2 in. back from the tip of the brush. You can tell good flagging by rubbing your hand across the working end of the brush—it should feel smooth and soft, not stiff and prickly. While you're at it, fan the brush briskly a few times; if more than one or two bristles fall out, don't buy the brush.

Handles: As far as I'm concerned, plastic handles are just as durable as wood ones, if not more so. But, for some reason (probably esthetics) the more expensive natural-bristle brushes usually have wood handles. If you're buying a consumer brush, go with a plastic handle, rather than a wood one. I've found that the wood handles on cheaper brushes are a varnished or painted softwood: on these, the handle tends to swell when exposed to water (such as when washing the brush), eventually loosening the ferrule. Professional brushes usually have sanded, unpainted hardwood handles. Some finishers prefer long, rounded handles; others prefer shorter beavertail handles. When I shop for a brush, I pick it up and pretend to paint with it to see how it feels in my hand.

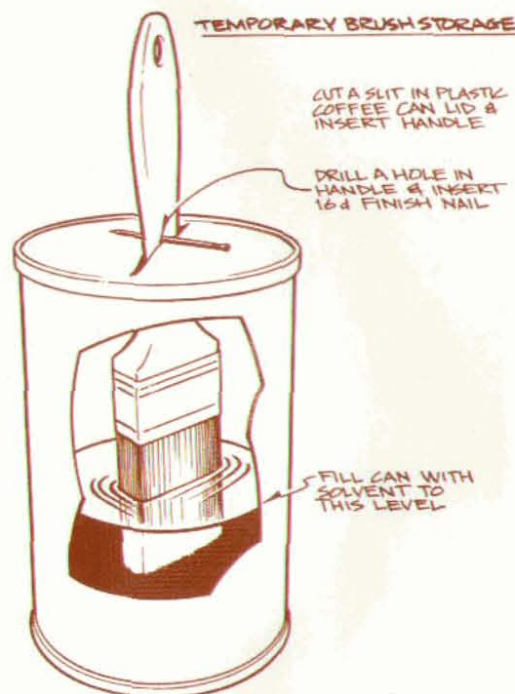
Ferrules: Better brushes have durable nickel, brass plated, or stainless steel ferrules; cheaper brushes have thin steel or tin ferrules, which are sometimes painted. On cheaper brushes, the ferrules start to rust after several cleanings.

A Few Tips On Brush Care

Never allow a brush to sit in a can of water or solvent for any length of time—this is the quickest way to turn even the most expensive brush into junk. If you need to walk away from the project for a few hours and don't want to clean the brush, wrap it neatly in aluminum foil to keep the finish from evaporating, or suspend it in a coffee can partially filled with solvent, as shown in the drawing.

After use, wash the brush thoroughly in solvent and/or warm, soapy water and rinse it out thoroughly. Next, remove excess water with a brush spinner or by shaking it gently. Never slap or bang the bristles, or wring them out with your hands—this will deform or break the bristles.

When the brush is nearly dry, gently comb out any tangles in the bristles with a brush comb, and wrap the brush in newspaper or the original plastic or cardboard cover that came with the brush, being careful not to deform the original shape of the bristles. Hang the brush vertically on a nail or hook, bristles down, to store.



Gardening is the number one hobby in the United States (yes, even more folks garden than do woodworking), and if you or someone in your house does gardening, chances are you've noticed the recent popularity of arbors. What's an arbor? Well, as we discovered, it can take many forms. We've seen arbors that serve as entryways to a garden path, seats within the garden, or just as a trellis for climbing vines like ivy or honeysuckle.

But you needn't be a gardener or even have a garden to enjoy an arbor. It makes a perfect seat in a quiet corner of the lawn, or it can be an elegant entrance for a walkway. Wherever you decide to place it, an arbor is a distinctive addition to your landscape, no doubt the reason we've seen so many of these in the various gardening catalogs that pass our way.

The Basic Concept

We've tried to design our arbor to be as versatile as possible. Although we show it with a seat, and a trellis formed by a series of shop-built latticework panels, you can build the arbor in any number of configurations. You can even substitute store-bought lattice (typically sold in 4 ft. by 8 ft. panels, which you then cut to size) if you'd rather not spend the time crafting the Chippendale-style lattice panels that we show.

If you decide to use the arbor as an entryway, and opt for the store-bought lattice, keep in mind that this lattice is mainly decorative, and has little strength. Since on our arbor, the lattice panels also serve as the supports joining the front and back pairs of legs, you'll need to add a few support stretchers between the legs. You'll also need to run a molding around the lattice, as a way to hold it in place.

The framework of the arbor is comprised of just three different parts, the posts (A), stretchers (B) and ends (C).

The four posts are pressure-treated 4 by 4's; the stretchers and ends, like all the remaining parts, are redwood. We might add here that cedar is an acceptable substitute for the redwood.

Before you start, consider how the arbor will be used. Although we just rested our arbor on the ground (leveling

Garden Arbor

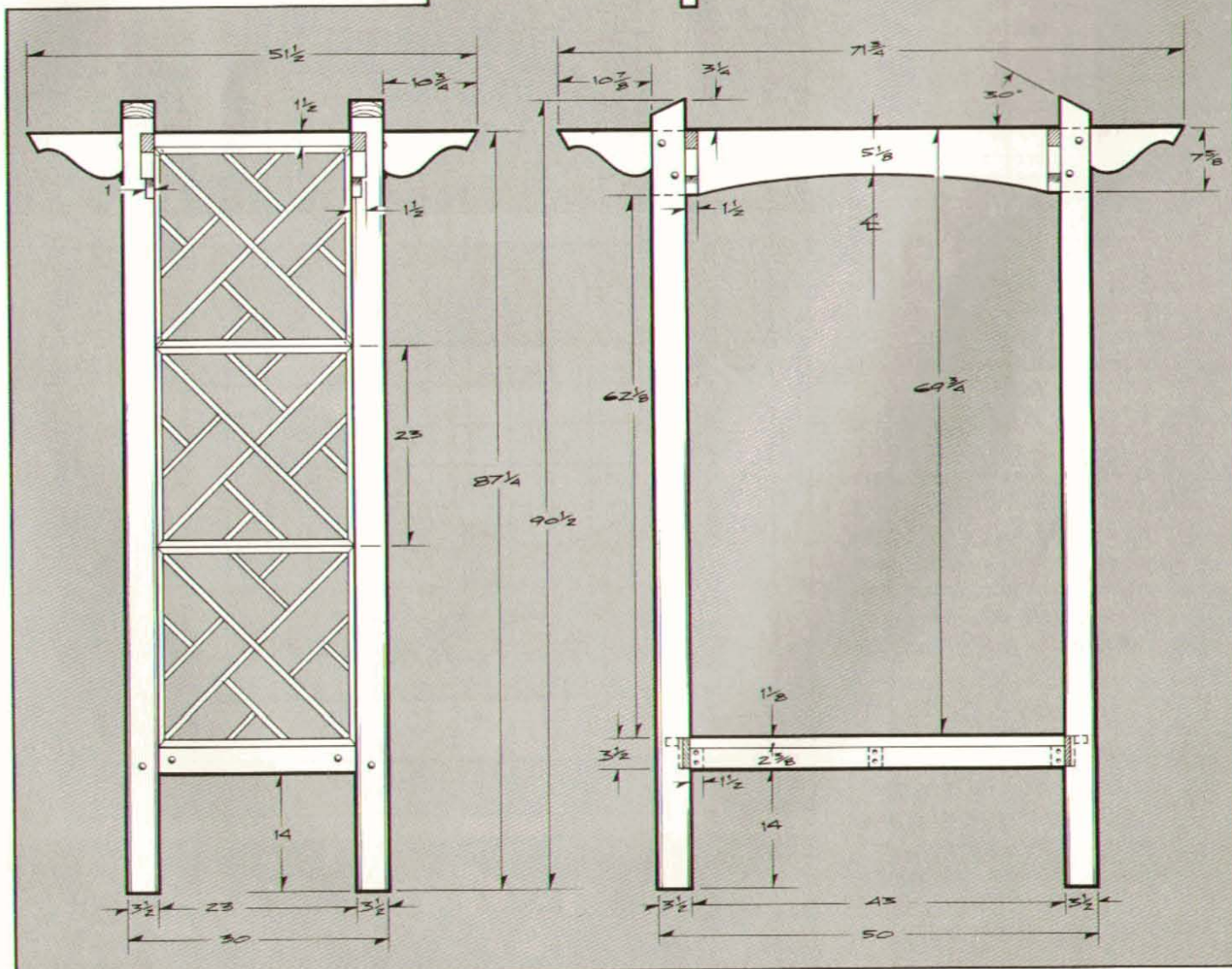
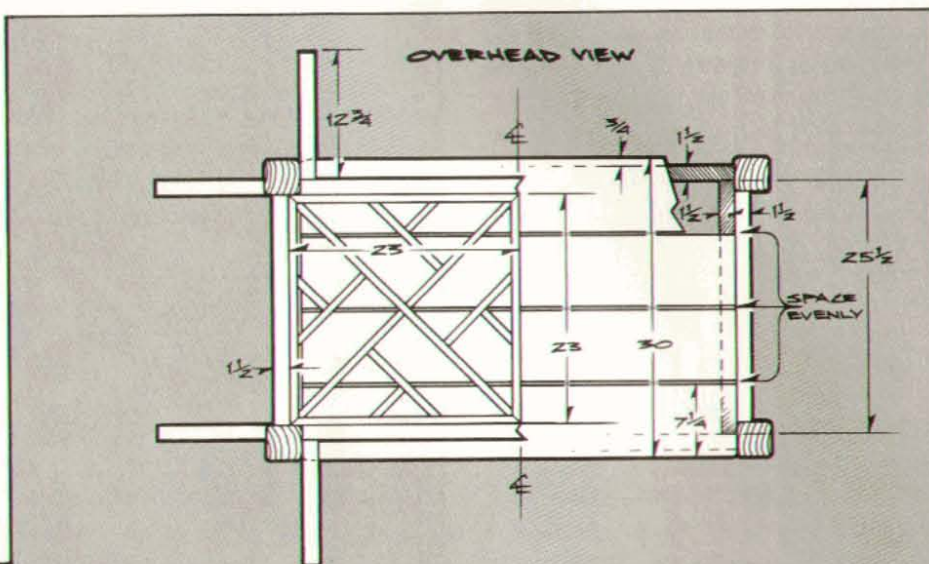


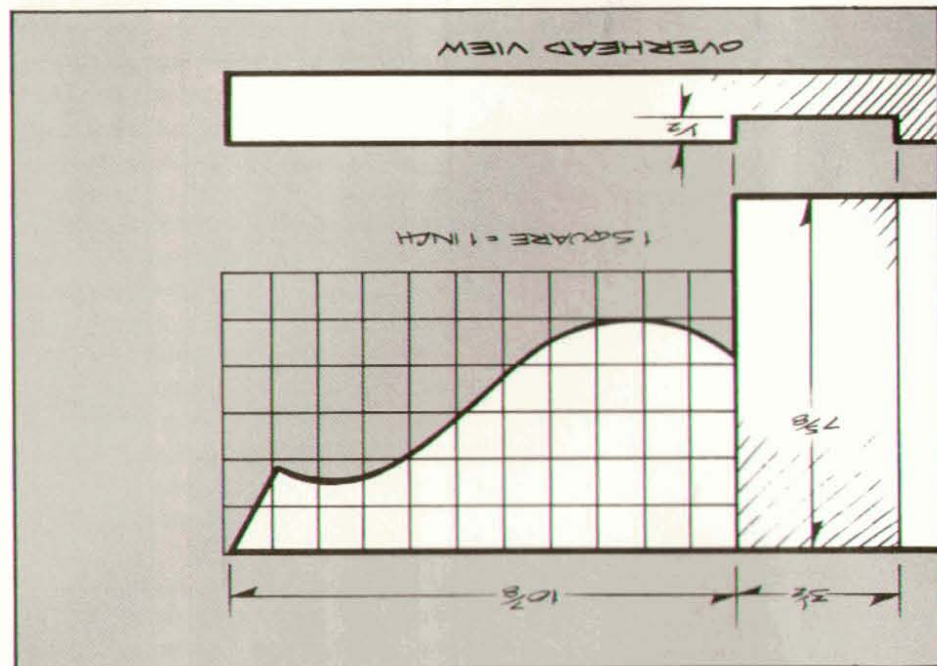
under the four posts), if you live in the frost belt, with the first frost heave your arbor will be out of kilter. To solve this problem, there are several options. First, the arbor can be permanently mounted *in the ground*. Add about 2 ft. in length to the length of the posts, dig out for this extra length, and pour concrete around the posts for added rigidity. Or, you can purchase post anchor kits at many hardware stores that fit over the ends of 4 by 4 posts. Another option is to pour little concrete footings under each post, with a post anchor set into each footing. The posts are then mounted into the post anchors.

However you decide to make, mount or use the arbor, the framework will be the same. Cut the four posts to length, chop off the top ends at 30 degrees, and cut a 1 in. deep by $7\frac{5}{8}$ in. long notch in each post for the stretcher. Note that the notches start $3\frac{1}{4}$ in. down from the top

ends of the posts. If you decide to make the arbor *with* the seat, you'll also need to cut a 1 in. deep by $3\frac{1}{2}$ in. long notch in each post for the seat support (I). Note that these notches are located exactly $62\frac{1}{8}$ in. down from the top notches.

The easiest way to cut these notches is with a hand-held circular saw, making a series of parallel cuts and then cleaning out the waste with a chisel. You'll note that we cut a notch in both the posts and the interlocking parts. The primary pur-





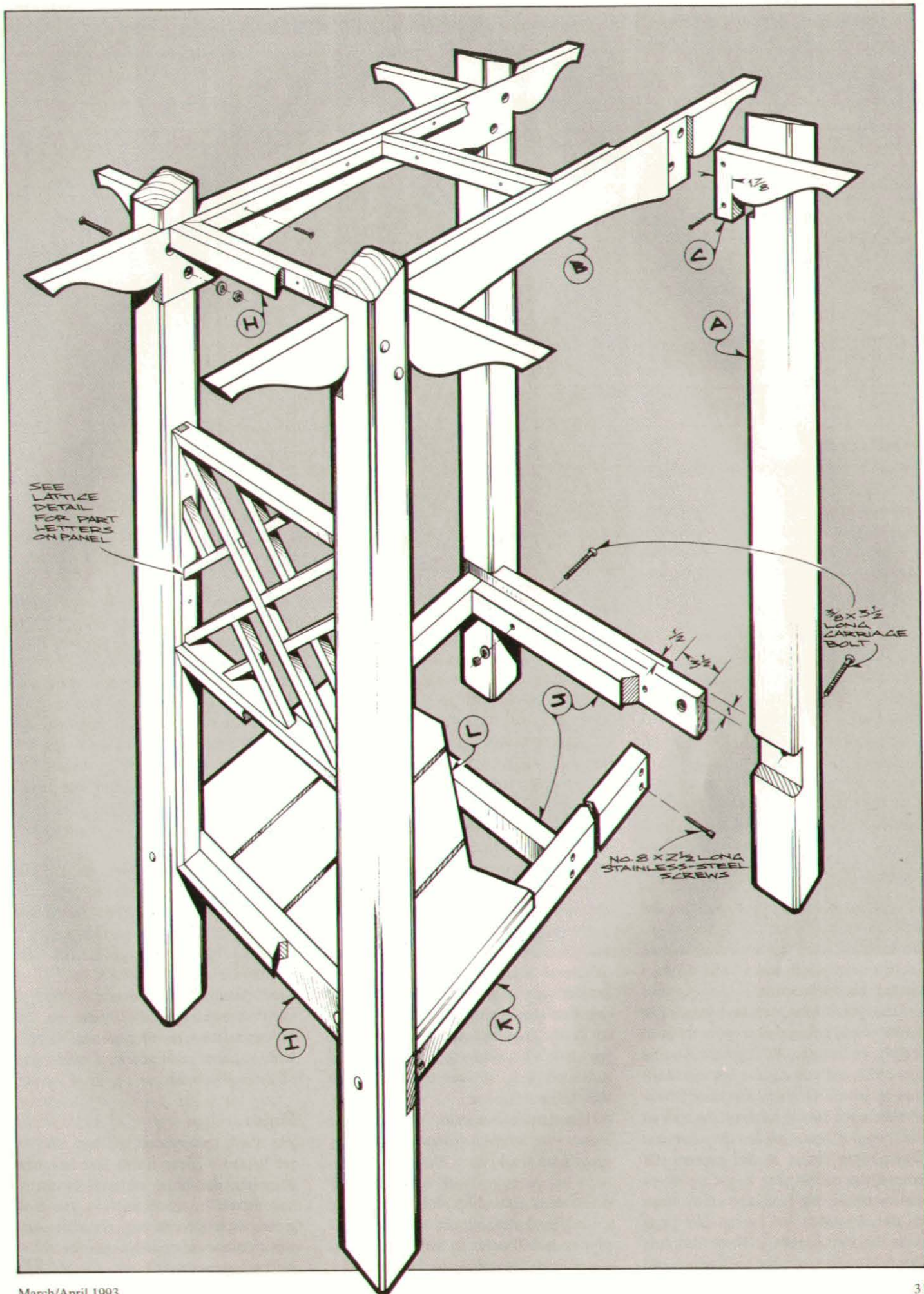
stretchers and ends. Cut out with a band saw and sand smooth. To lay out the broad curve in the bottom edge of the stretchers, first scribe a centerline bisecting the stretcher. Tack a nail on the centerline, 5 1/8 in. down from the top edge, then tick off two marks along the bottom edge of the stretcher. Now, bend a thin strip of wood around the nail so that it touches your two scribed marks, and use a pencil to mark the curve. Once you've cut and sanded the curve in one stretcher, use it as a template to mark the curve in the remaining stretcher.

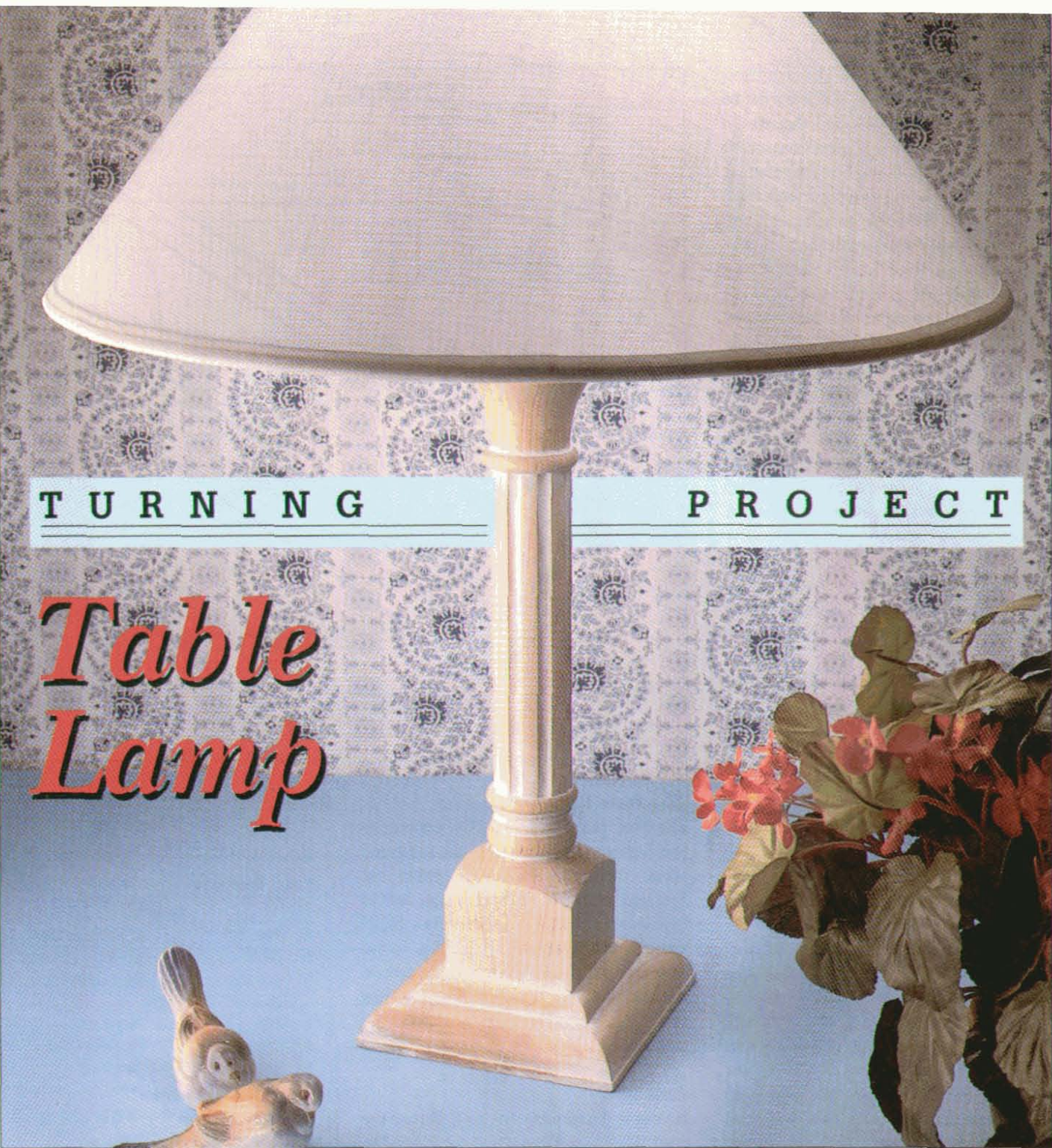
With the frame parts all cut, now assemble the frame. We used 3 1/2 in. long carriage bolts to mount the seat supports and stretchers to the posts, countersinking for the washers and nuts. The ends are screwed in place with no. 8 by 2 1/2 in. long stainless steel screws, which are also countersunk. Pre-drill for all assembly bolts and screws, lest you split the wood.

Bill of Materials (all dimensions actual)			
No.	Req'd.	Description	Size
Frame			
A	4	Post	3 1/2 x 3 1/2 x 90 1/2
B	2	Stretcher	1 1/2 x 7 5/8 x 7 3/4
C	4	End	1 1/2 x 7 5/8 x 12 3/4
Lattice			
D	32	Frame	3/4 x 1 1/2 x 23
E	16	Long Strip	3/4 x 3/4 x 32 1/2
F	32	Medium Strip	3/4 x 3/4 x 10 5/8
G	32	Short Strip	3/4 x 3/4 x 5 1/2
Seat			
H	2	Filler	1 1/2 x 1 1/2 x 23
I	2	Support	1 1/2 x 3 1/2 x 30
J	3	Frame End/Center	1 1/2 x 2 3/8 x 25 1/2
K	2	Frame Front/Back	1 1/2 x 2 3/8 x 43
L	4	Seat Board	1 1/8 x 7 1/4 x 43
* Length dimensions are to the nearest 1/8 in. The actual length of the medium strip is a little under 10 5/8 in., while the actual length of the short strip is a hair over 5 1/2 in.			

pose of this is because the notches in the interlocking parts help to index these parts perfectly at assembly. You could also just notch out the posts to the full 1 1/2 in. notch depth, which will cut down on some of the work required.

Once your notches are cut, lay out and cut the profile on the stretchers and ends. Using the grid pattern, make a template out of hardboard or plywood, then use the template to trace the profile on the





T U R N I N G

P R O J E C T

Table Lamp

Column style table lamps have been all the rage of late, and our handsome version captures all the best details. There's a fluted column, classic turnings, and a sturdy base. And to make this project easier for you to make, there's a one-stop mail-order source for the hardware, shade and finial.

You'll need a lathe—or access to one—in order to make this project. However, because the turnings are so basic, even if this is your first turning project, you should have little problem

with this piece. Our lamp is made of maple, and has a whitewashed finish, but you could use just about any wood and finish that suits your decor. With an eye toward the possibility that you may prefer a different shade and finial than we used, these two decorative items are parted out as a separate kit.

The Column Parts

As the Bill Of Materials details, the wooden parts of the lamp are broken down into two sections—the column and the base. The three column parts—

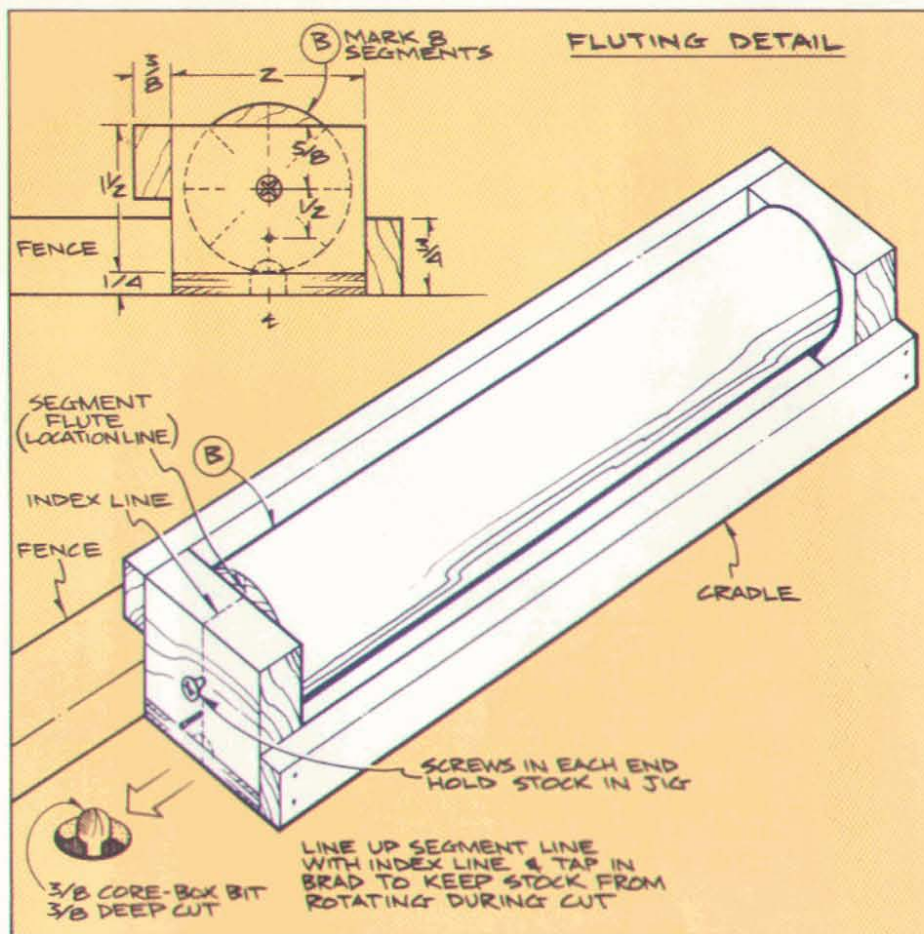
the top (A), center (B) and bottom (C)—are all lathe-turned. Although you could use separate turning blocks for all three parts, we laid up sufficient stock to yield both the top and bottom from a single turning blank. A blank measuring 3 in. by 3 in. by 8 in. long will be adequate. Turn the top and bottom to the dimensions shown (don't forget to include the 1/2 in. long by 7/8 in. diameter tenon on each part) then separate the individual parts. We accomplished all the turning work with just a skew and a few gouges.

The center section is a uniform turning, $1\frac{3}{4}$ in. in diameter. You may own a router/lathe fluting jig—and this would be fine for fluting the center—but we've worked out a simple method that enables you to do the fluting on your router table with a $\frac{3}{8}$ in. diameter core-box bit and an easy-to-make shop-built jig.

As shown in the Fluting Detail, the jig is essentially just a cradle to secure the center as it's passed across the core-box bit. You can construct the cradle exactly as we have, or use whatever scraps you have handy. The important things to remember are that the inside length of the jig must be $7\frac{1}{4}$ in., to fit the center length, and that your bit height must include not only the $\frac{1}{8}$ in. flute depth but also the thickness of the jig bottom. Since our jig bottom was $\frac{1}{4}$ in. plywood, our bit depth totaled out to $\frac{3}{8}$ in. Of course, you'll need to locate the fence (which the cradle guides against) so the core-box bit is on-center with the jig end.

As the Fluting Detail also shows, you'll need to drill for a screw and brad in each end of the jig. Drill these holes, then scribe flute location lines (45 degrees apart) on one end of the center, and mark an index line on-center on one end of the jig as a way to line up the flute lines. Once you've done all this, the fluting is fairly simple. Line up a flute location line with the index line, tighten the screws and tap the brad in to lock the position of the center in the cradle, then just pass the cradle across the core-box bit. For the initial pass, you'll want to make a first cut through the plywood, then reset the bit to final height and rout the flute. To rout subsequent flutes, just back off the brad, rotate the center 45 degrees so the next flute line is aligned with the index line, and repeat the procedure.

Once your flutes are done, you'll need to drill for the tenons and cord hole (we suggest that you use a drill press for this). Most long bits should handle the $\frac{3}{8}$ in. diameter holes through the top and bottom. But, the tenon and cord holes in the center are a several-step procedure. Start by using a Forstner bit to drill the $\frac{7}{8}$ in. diameter by $\frac{1}{2}$ in. deep tenon holes, then switch to the $\frac{3}{8}$ in. diameter bit, and drill the cord hole in from each end. Don't worry if the holes don't meet perfectly, you can always enlarge the hole enough for the cord to pass through.



The Base Parts

The base parts—the top (D), center (E) and bottom (F)—are cut to the indicated sizes, then the top and center are rounded with $\frac{3}{8}$ in. and $\frac{3}{4}$ in. radius roundover bits, respectively. Drill through all three parts with the $\frac{3}{8}$ in. diameter bit, then rout or chisel a groove in the bottom for the cord to exit out the side. Test assemble, then final sand the wood parts.

Assembly

If your test assembly fits well, thread the cord (K) through the wood parts one-by-one, then use epoxy to glue the parts together. Epoxy the threaded nipple (G) into the top of the lamp, leaving enough exposed to securely mount the neck (I), harp (H) and socket (J).

Finish

Now's a good time to apply your finish. We brushed on a white oil-based primer, wiped most of the paint off, let dry, added a paste wax and finally buffed with a soft cloth. Mount the remaining hardware, make your electrical connections, add the shade (L) and finial (M), and your lamp is complete.

Bill of Materials (all dimensions actual)

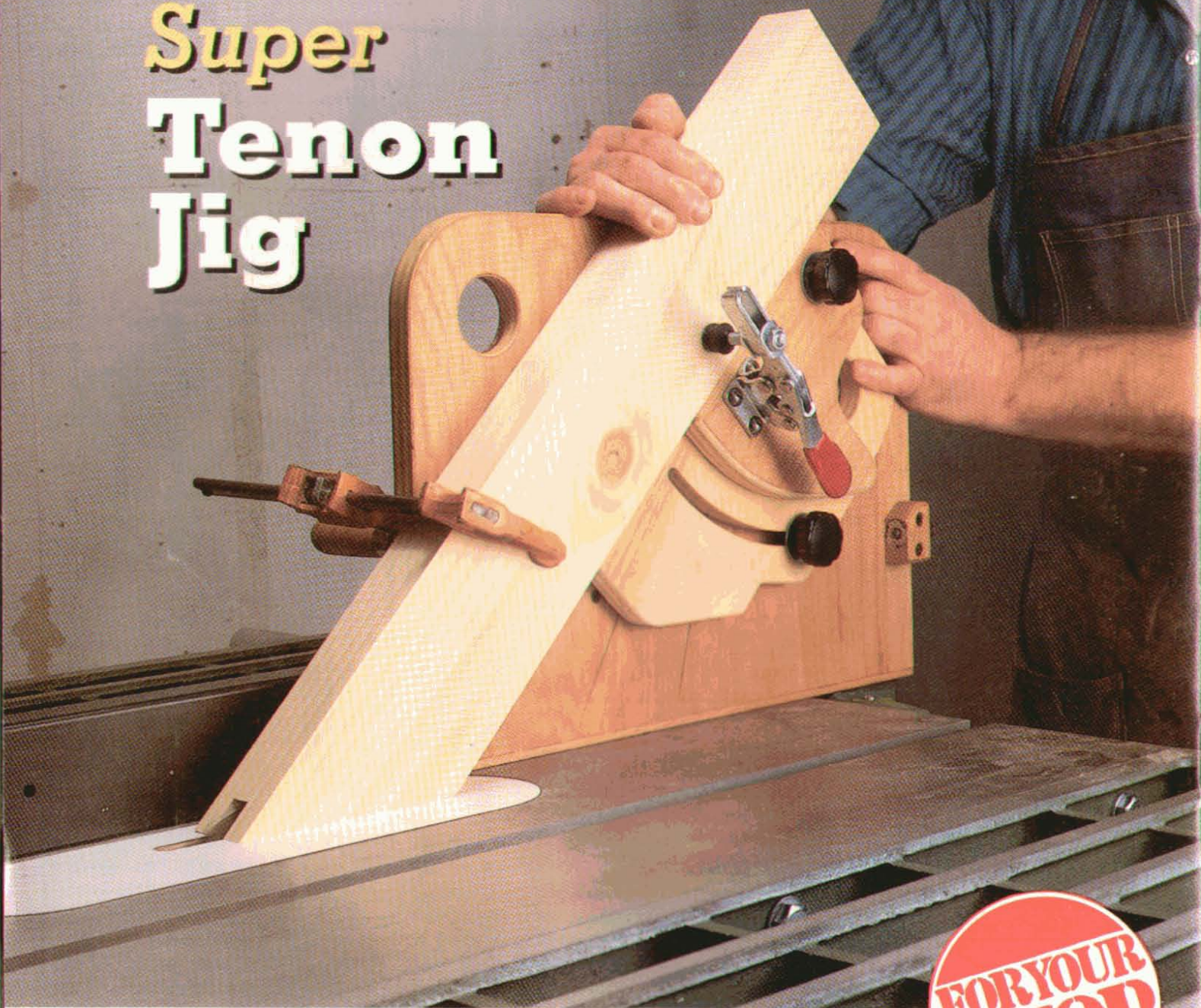
Part	Description	Size	No. Req'd.
Column			
A	Top	2 1/2 dia. x 3 long*	1
B	Center	1 3/4 dia. x 7 1/4 long	1
C	Bottom	3 x 3 x 4 5/8*	1
Base			
D	Top	3/8 x 4 x 4	1
E	Center	3/4 x 5 3/4 x 5 3/4	1
F	Bottom	1/4 x 6 x 6	1
Hardware**			
G	Threaded Nipple	3/8 O.D. x 2 long	1
H	Harp	9 in.	1
I	Neck	9/16 high	1
J	Socket	3-way	1
K	Cord w/plug	8 ft.	1
Decorative**			
L	Shade	20 dia.	1
M	Finial	1 1/4 dia.	1

* Length includes tenon

** Hardware and decorative parts are available in kit form from The Lamp Shop, 934 Federal Road, Brookfield, CT 06804; tel. (203) 775-1231. Hardware kit (\$10 postpaid) includes parts G through K. Decorative kit (\$44.50 postpaid) includes parts L and M.



Super Tenon Jig



FOR YOUR
SHOP

Precision work requires precision tools and accurate setups. While most of us have (or should have) an accurate rip fence and miter gauge on our table saws, when it comes to working stock on end, such as for tenon work, all too often we see woodworkers (with nothing more than the rip fence as a guide) using their hand to advance the stock through the blade.

Relying on nothing more than your hand to advance stock on end simply isn't safe. But fortunately, you needn't spend an arm and a leg for a good, accurate tenon jig. Assuming that you already have a little scrap plywood laying around, our Super Tenon Jig can

be made for just \$27, the cost of the hardware kit. As you'll note in the Kit Source information (see page 41), the hardware kit includes all the hardware that you'll need, plus the De-Sta-Co clamp and an extra long replacement De-Sta-Co spindle.

Special Features

If you've been thinking about buying one of those fancy commercial tenon jigs, and believe that a shop-built jig can't equal the accuracy of the store-bought versions, think again. This jig has all the desired features—perfect accuracy, robust size and a quick action toggle clamp. Like many other shop-

built jigs and fixtures, our super jig uses the rip fence as a guide. But it incorporates several very special features that you wouldn't expect to find in a home-built jig.

Swivel Work Support: Like the most expensive commercial tenon jigs, our Super Tenon Jig is much more than just a work support permanently screwed to a base board. Contributing Editor Dennis Preston designed this jig to not only handle stock on end, but also at any angle up to 45 degrees. This adjustability is especially handy for things like frame making, where you can use the jig to cut a spline groove in the mitered

frame corners (see photo). We've scribed lines on the jig base to index the swivel work support at the most common angles (15, 30 and 45 degrees), but you can scribe index lines at just about any angle that you regularly use.

Adjustability: With most home-made jigs and fixtures, the accuracy of the jig is only as perfect as the jig maker was with his construction and assembly. If the assembly isn't quite square to the saw table, or if it doesn't fit snugly over the rip fence, then whatever work is done with the jig will be imperfect by that amount of error. In fact, in order to do perfect work with a home-made tenon jig, your jig would need to be made just about flawlessly. Unless, of course, there was a way to fine-tune the

jig on the saw table.

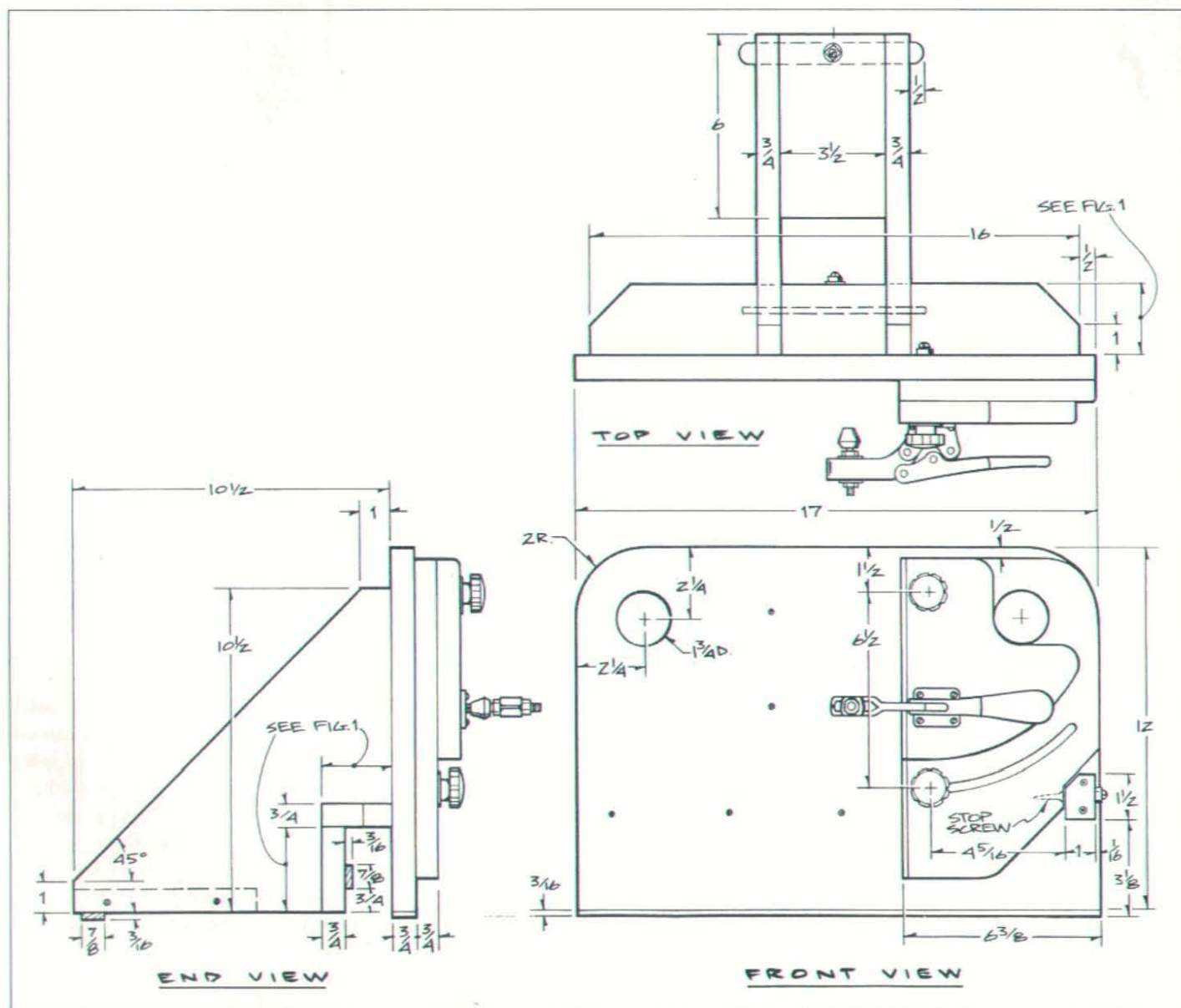
Our Super Jig incorporates exactly this adjustability. Using a simple machine screw/T-nut/rub strip alignment system, our jig can be precisely adjusted both for a snug fit over the rip fence, and to an exact right-angle setting with respect to the saw table. And, in addition to these adjustments, there's also a screw for "zeroing" the swivel work support at precisely 90-degrees.

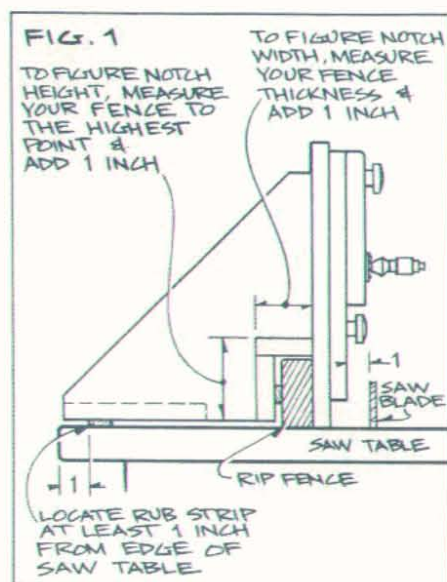
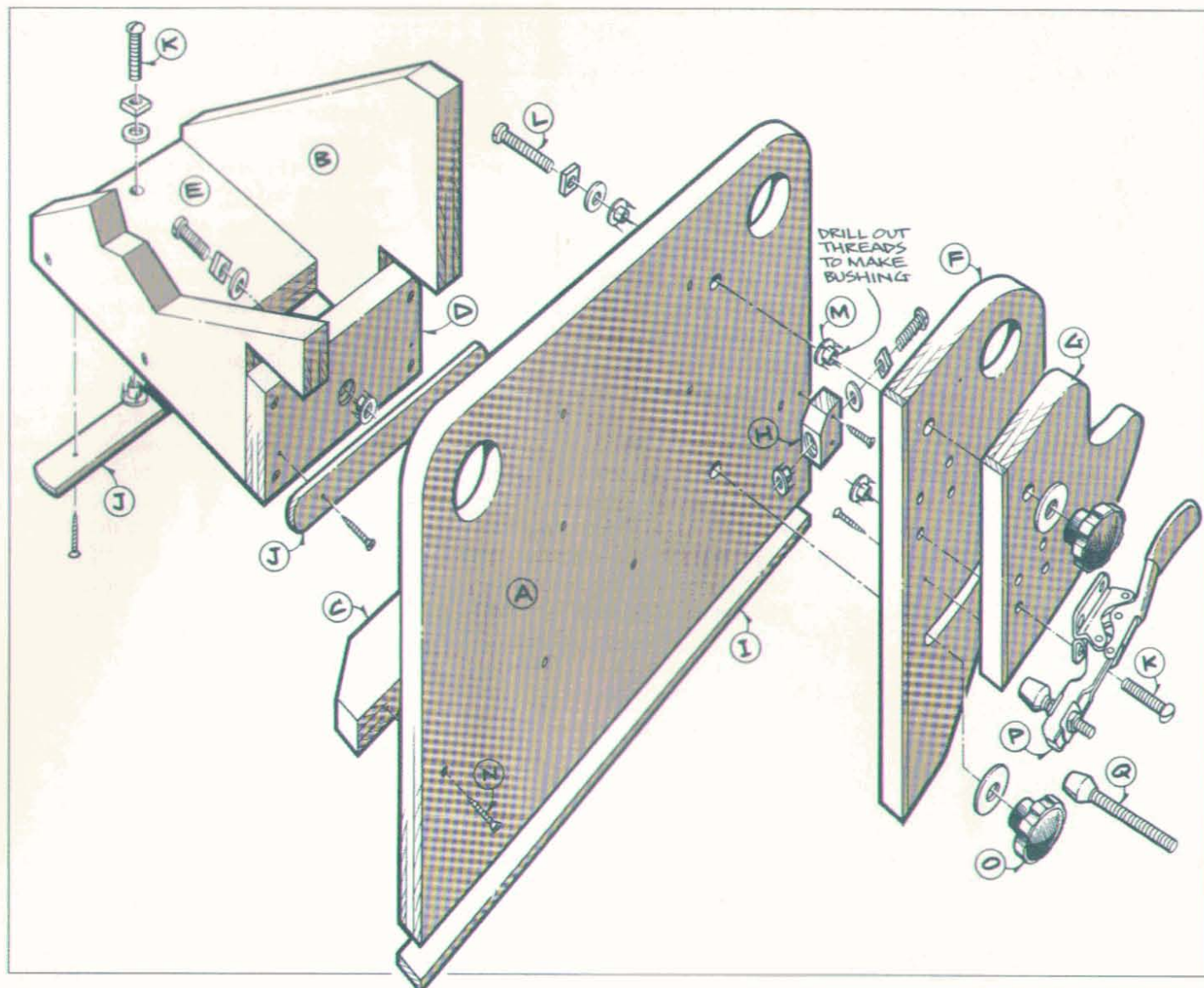
Before You Cut

As you can see from the photos and illustrations, the jig basically consists of the base (A), to which is screwed a pair of brackets (B), the base support (C) and the adjuster block (H). A fence guide (D) and connector (E) are screwed to the

brackets, and the rub strips (J) are in turn mounted to these parts. The swivel work support (F) and its stiffener (G) are mounted to the base with a pair of machine screws and knobs, and the hardwood edging (I)—applied to those edges of the jig where wear is most likely—completes the wooden parts for this project.

You could go to work and build the jig exactly as illustrated, but we don't recommend it. We built the jig to fit a particular saw, and obviously, all table saws aren't the same size, nor do they have the same size fence. In building your jig you'll need to size the notch in the brackets, and the widths of the base support and fence guide, based on the actual size of your rip fence. You'll also





need to locate the rub strip on the connector with respect to the size of your saw table. As illustrated in Fig. 1, move the connector-mounted rub strip inboard (toward the base) as needed so that it is

firmly on the saw table when the jig is mounted over the fence in the cutting position. If you locate this rub strip so that it is at least 1 in. away from the saw blade, your jig should be able to function in just about all situations. The 6 in. length of the connector provides sufficient area to mount the rub strip no matter what the size of your saw table.

Sizing the notch in the brackets to fit your fence is also easy. As shown in Fig. 1, to determine the notch height, measure the height of the fence to the highest point (such as the top of a screw), and add 1 in. This is the notch height. The notch height allows for the fence, a $\frac{1}{4}$ in. clearance space, and the $\frac{3}{4}$ in. thickness of the base support. To determine the notch width, measure the thickness of the fence and add 1 in. The notch width allows for the fence thickness, the $\frac{3}{4}$ in. thickness of the fence guide, the $\frac{3}{16}$ in. thickness of the rub

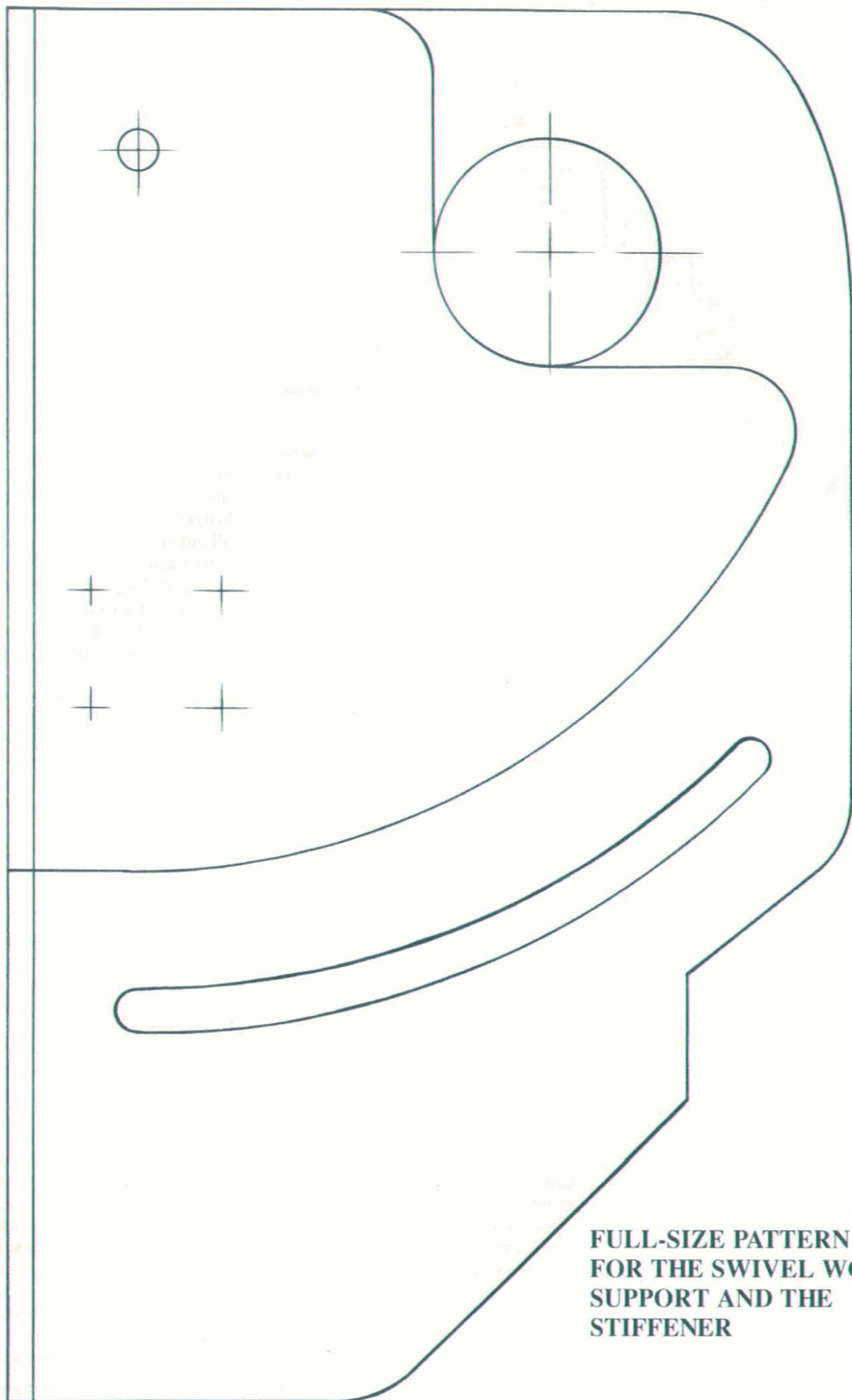
strip, plus a $\frac{1}{16}$ in. space in which to adjust the rub strip for a snug fit against the fence.

Get To Work

We used cabinet-grade birch plywood for our jig. If you have access to Baltic birch or Appleply, these would be even better choices. We don't recommend that you use fir construction plywood for jig making, since this plywood isn't made to exact enough specifications.

Once you've determined the notch dimensions in the brackets, you can cut the various parts to the sizes listed in the Bill of Materials. Note that the widths of the base support and fence guide will depend on the notch size. Once the parts have all been cut to size (refer to the full-size pattern on the opposite page for the profiles of the swivel work support and stiffener), you can begin the assembly work.

First, apply the solid wood edging to



**FULL-SIZE PATTERN
FOR THE SWIVEL WORK
SUPPORT AND THE
STIFFENER**

screws only (no glue) when mounting the base to the brackets and base support. This way, should the need ever arise to replace the rip fence rub strip, you'll be able to effect the replacement without destroying the jig.

Note that in locating the base with respect to the brackets, the bottom edge of the brackets should be just a little over $\frac{3}{16}$ in. higher than the bottom edge of the base. This $\frac{3}{16}$ in. allows for the thickness of the rub strip plus a little extra for adjustment so the base can be squared perfectly to the table.

One easy way to obtain this adjustability is to hold a framing square to the base, then mount the base to the brackets so there's just a little space between the top of the base and the square (Fig. 3). You can now adjust the machine screw in the connector to zero out the base at exactly 90 degrees. Also, adjust the machine screw in the fence guide so the jig fits snugly on the fence, slides easily, but exhibits no slop. Finally, once again using the framing square, adjust the machine screw in the adjuster block until the work support is square to the saw table (Fig. 4). All three of these adjusting screws should be mounted with a washer and nut; the screw position is locked in position with the nut.

Using a protractor and a sliding bevel, you can scribe index lines directly onto the base at commonly used angles. We show lines at 15, 30 and 45 degrees, which should handle just about all your needs. Although no finish is needed on the jig, we rubbed in a penetrating oil finish. Somehow, it always seems a bit more satisfying to use a jig that not only does great work, but that looks good doing it.

Using Your Jig

The majority of the times that you use the super jig, the work support will be in the vertical position. The De-Sta-Co clamp that's included with the kit will provide adequate holding power for just about all cuts with the work support in this position. When you are using the jig with the work support in the 45-degree position, an extra clamp is strongly recommended, as shown in the photo.

Depending on the thickness of the stock you are working on, you'll need to

either adjust the spindle on the De-Sta-Co clamp so the clamp provides the proper tension, or if you are working with thinner stock, replace the short spindle with the extra-long replacement spindle (Q) that's included with your hardware kit (see Kit Source). As shown, the jig has the capacity to handle any stock thickness up to 2 in. If you intend to use it for stock thicker than 2 in., you'll need to block up the De-Sta-Co clamp to accommodate the increased thickness (you'll also need longer machine screws to mount the clamp). In adjusting the De-Sta-Co clamp for the proper tension, keep in mind that the intent is for the clamp to exert enough force to hold the workpiece securely; if you have the clamp adjusted for excessive force, you risk racking the work support, especially when it's in an angled position.

To work very thin stock, employ a spacer scrap between the workpiece and the jig base. In the process of using the jig, you'll no doubt eventually cut away the bottom portion of the work support (this area of the work support is cut into when the blade is raised higher than about $1\frac{3}{16}$ in.) but this in no way effects the function of the jig.

Bells & Whistles

We designed this super jig to provide the most bang for the buck. Hence, we eschewed fancy things like Teflon rub strips (instead of the oak we used) and ultra high molecular weight (UHMW) polyethylene adhesive-backed tape on all the wear points. Practically speaking, we'd be hard-pressed to imagine any one wearing our jig out in normal use, but, if you're the type of person who just must have all the latest high tech stuff (or if you are really into jig making), here's a source for both these fancy plastics. It's the United States Plastic Corp., 1390 Neubrecht Rd., Lima, Ohio 45801; tel. 1-800-537-9724. Their $\frac{3}{16}$ in. Teflon sheet material is part no. 47485; the UHMW polyethylene tape ($\frac{3}{4}$ in. width) is their part no. 46-46242. The Teflon sheet runs about \$30 a square foot, and the tape about \$13 a roll, so be prepared to spend the big bucks if you want to customize your jig with these bells and whistles.



Bill of Materials

(all dimensions actual)

Part	Description	Size	No. Req'd.
A	Base	$\frac{3}{4}$ x 12 x 17	1
B	Bracket	$\frac{3}{4}$ x 10 $\frac{1}{2}$ x 10 $\frac{1}{2}$	2
C	Base Support	$\frac{3}{4}$ x 16 long*	1
D	Fence Guide	$\frac{3}{4}$ x 5 long*	1
E	Connector	$\frac{3}{4}$ x 3 $\frac{1}{2}$ x 6	1
F	Swivel Work Support	see full-size pattern	1
G	Stiffener	see full-size pattern	1
H	Adjuster Block	$\frac{3}{4}$ x 1 x 1 $\frac{1}{2}$	1
I	Edging	$\frac{3}{16}$ x $\frac{7}{8}$ ** as req'd	
J	Rub Strip	$\frac{3}{16}$ x $\frac{7}{8}$ x 6	2
Hardware***			
K	Machine Screw	$\frac{1}{4}$ -20 x 1 $\frac{1}{2}$	7
L	Machine Screw	$\frac{1}{4}$ -20 x 2 $\frac{3}{4}$	2
M	T-Nut	$\frac{1}{4}$ -20	10
N	Drywall Screw	1 $\frac{1}{4}$ bugle-head	29
O	Knob	1 $\frac{3}{8}$ dia.	2
P	De-Sta-Co Clamp	as shown	1
Q	Extra-Long Spindle	as shown	1

* Widths of base support and fence guide will be dependent on the size of the notch you cut in the brackets to accommodate your rip fence.

** Edging should be $\frac{7}{8}$ wide when applied to plywood. Then use flush-trimming bit to trim flush.

*** Hardware is included in kit (see Kit Source).

Kit Source

A complete hardware kit, including the De-Sta-Co clamp, an extra-long De-Sta-Co spindle and all the hardware that you need to build the Super Tenon Jig is available from Aspen Kits, 6 Hilltop Drive, Old Saybrook, CT 06475; tel. (203) 388-6179. Specify Super Tenon Jig Hardware Kit; price is \$27 postpaid (check or money order only, please; Canadian orders add \$2). Your hardware kit will include 30 bugle head drywall screws (1 $\frac{1}{4}$ in. long; kit includes an extra screw), 10 T-nuts (1 $\frac{1}{4}$ -20), 5 washers (1 of $\frac{9}{16}$ in. dia. plus 2 each of $\frac{3}{4}$ in. and 1 $\frac{1}{4}$ in. dia.), 5 nuts (1 $\frac{1}{4}$ -20), 9 roundhead machine screws (2 screws 1 $\frac{1}{4}$ -20 x 2 $\frac{3}{4}$ in. long plus 7 screws 1 $\frac{1}{4}$ -20 x 1 $\frac{1}{2}$ in. long), 2 plastic knobs (1 $\frac{3}{8}$ in. dia. with 1 $\frac{1}{4}$ -20 thread brass insert), 1 De-Sta-Co clamp (series 225), and 1 extra-long De-Sta-Co spindle with bonded Neoprene cap ($\frac{5}{16}$ -18 x 3 in. long).

This charming piece is a scaled-down version of the 7 ft. high Early American Tall Clock that we featured way back in our November/December 1985 issue. Mr. Harry M. Wilson of Tupulo, Mississippi liked that design, but wanted to make it in a size better suited for his two young grand-

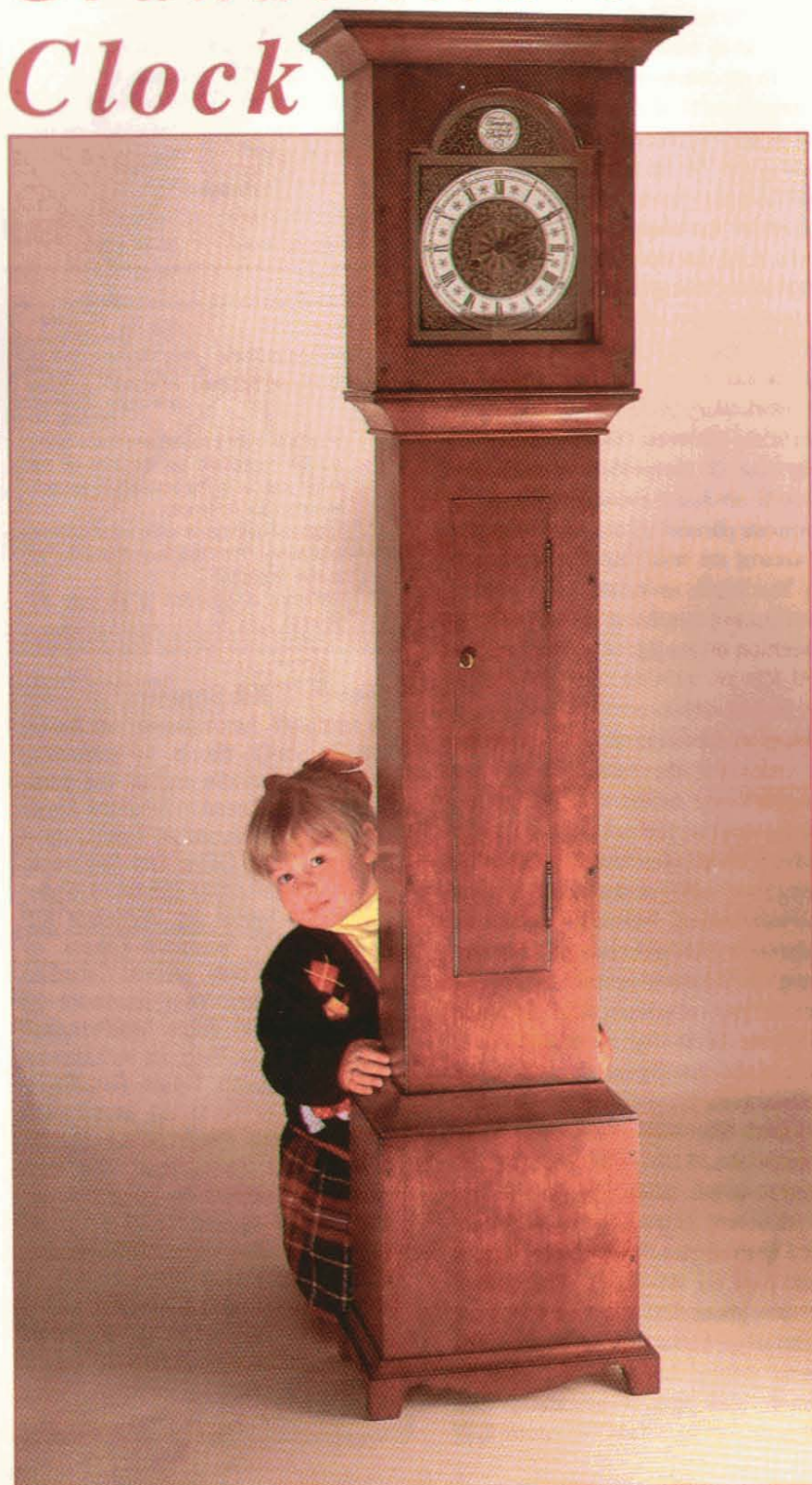
daughters. He built one for each of them and, as you might imagine, the clocks were a big hit. Harry was kind enough to send plans and a photo along to us, and we liked the idea so much, we built one (with minor modifications) in our shop.

Our clock was given an antique finish (see page 47), so we used poplar to cut

down on cost. However, if you prefer a stained or a clear finish, we'd suggest cherry, walnut, mahogany, or even pine. It doesn't matter much what wood or finish you use, though, as this project will soon become a family heirloom.

We used a battery-powered quartz movement that plays a full Westminster chime melody on the hour, a partial melody each quarter hour, and strikes out each hour. It features a volume control, chime silencer and automatic night silencer, so you have plenty of sound control. Like many antique clocks, the hood simply slides off the case to provide access to the movement. To simplify ordering, we asked the mail-order company Klockit to put together a parts kit for the movement, dial face and other hardware (see Sources).

Grandchild's Clock



Make the Base

Start with the front (A). It can be difficult to find 12 in. wide stock, so you'll probably need to edge-glue two or three narrower boards in order to get the necessary width. When cutting boards for edge-gluing, it's best to cut them so the glued-up stock will be a bit wider and longer than necessary. After gluing, the front will be trimmed to the length and width dimensions shown in the Bill of Materials.

Next, the two sides (B) and the bottom (C) are cut to final length and width. We used $\frac{1}{2}$ in. thick plywood for the bottom.

Use the table saw and dado head to cut the $\frac{3}{4}$ in. wide by $\frac{1}{4}$ in. deep rabbet along each side of the front, the $\frac{3}{8}$ in. wide by $\frac{1}{4}$ in. deep rabbet along the back edge of the side, and also the $\frac{1}{2}$ in. wide by $\frac{1}{4}$ in. deep dado for the bottom that's cut in the front and sides. Then, lay out the location of the cutouts on the bottom of the front and two sides. Use a band saw to cut them out.

The front, sides and bottom can now be assembled. Give the parts a thorough sanding, finishing with 220-grit. Add a thin coat of glue to the mating surfaces, then join the two sides to the front. Slide the bottom into place, but don't use glue here, as the sides must be free to expand and contract with changes in humidity. The dimensions of the bottom in the Bill of Materials allow for this movement. Clamp firmly with bar clamps and check the assembly for squareness. If all looks okay, set aside to dry.





Sources

Hardware

A hardware kit that contains the dial face, the battery-powered quartz movement with speaker (including the hour, minute, and second hands), two antique finish hinges, the polished brass knob, and the magnetic catch is available from Klockit, P.O. Box 636, Lake Geneva, WI 53147; tel. 1-800-556-2548. Specify promo number 71204; price is \$43.50 post-paid.

As an option, Klockit will also provide a kit that contains only the dial face and the battery-powered quartz movement with speaker (including the hands). Specify promo number 71203; price is \$39.75 post-paid.

Decorative Nails

Decorative 1 in. long (2d) clout nails can be ordered from the Tremont Nail Company, P.O. Box 111, Wareham, MA 02571; tel. (508) 295-0058. Order their part number "CT-2."

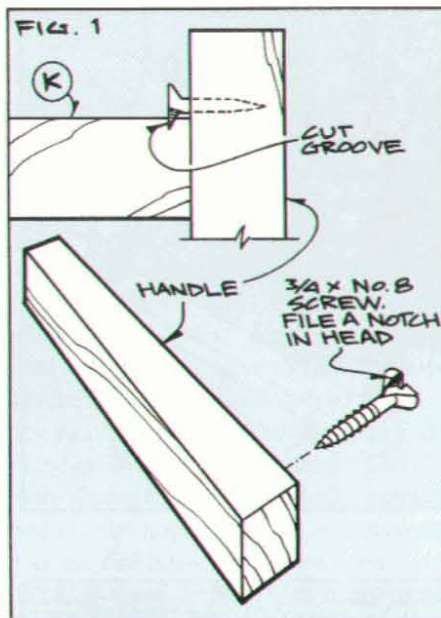
countersunk and filled. Due to the wood movement problems mentioned earlier, you won't want to use glue here. We used finishing nails because they hold the molding securely, yet tend to flex a little, allowing the necessary movement.

The spacers (D) and supports (E) can now be cut to size. Dry fit the parts on the base to establish the various lengths, then glue the supports to the spacers. Next, use 1 1/4 in. long by no. 8 wood screws to secure the spacer/support subassemblies to the inside of the base as shown. Make the screw shank holes a little oversized to accommodate movement of the sides and front.

Make the Waist

Begin work on the waist by cutting the bottom rail (G), top rail (H) and two stiles (I) to size. At this point in the construction, you'll want to take the measurements directly from the base. Ideally, when the waist is assembled to the base, it should fit snugly just inside the base spacers.

Once the stiles are joined to the rails, it will become very difficult to drill the screw holes for the hinges, so it's best to do that work now. The hinges that are supplied in the kit (see Sources) require



a mortise only on the stile, not on the door.

The stiles are simply edge-glued to the bottom and top rails. Since these are long-grain to long-grain joints, there is plenty of glue strength. Before clamping, though, check to make sure the distance between the rails is 21 3/8 in., the length of the door opening.

Once the rails and stiles are assembled, cut the 3/4 in. wide by 1/4 in. deep rabbet on the outside edge of the stiles. After that, cut the two waist sides (J) to size and cut the 3/8 in. wide by 1/4 in. deep rabbet along the back edges for the back. Sand all the waist parts, then assemble the sides to the stile rabbets. When the glue dries, add the cut nails.

Cut the door (K) to fit the opening. We applied a bead to the edge of the door using an old time hand tool called a scratch beader (Fig. 1). To use it, hold the "handle" of the beader against the edge of the door, then draw it along the stock. Make several light cuts, stopping them just short of the door corners.

Also, at this time, cut the door stop (L) to size and glue it to the top rail as shown.

Next, cut the two cleats (N) and the spacer (O) to size, then use finishing nails to join them to the top end of the waist as shown. When joining them, make sure the top edges of the cleats and spacer are flush with the top edges of the waist section.

Add the Waist

Assemble the waist to the base, locating it so that it sits firmly on the base

Bill of Materials

(all dimensions actual)

Part	Description	Size	No. Req'd.
Base			
A	Front	3/4 x 12 x 12 3/4	1
B	Side	3/4 x 6 3/4 x 12 3/4	2
C	Bottom	1/2 x 6 3/8 x 10 3/4	1
D	Spacer	3/4 x 1 3/4	as req'd
E	Support	3/4 x 3/4	as req'd
F	Bracket Molding	3/4 x 2 1/2	as req'd
Waist			
G	Bottom Rail	3/4 x 4 1/2 x 7 3/4	1
H	Top Rail	3/4 x 4 1/2 x 6 1/8	1
I	Stile	3/4 x 2 1/4 x 35 1/4	2
J	Side	3/4 x 5 1/4 x 35 1/4	2
K	Door	3/4 x 4 1/2 x 21 3/8	1
L	Door Stop	3/4 x 1 1/2 x 2	1
M	Cove Molding	1 3/8 x 1 1/2	as req'd
N	Cleat	7/16 x 3/4 x 6	2
O	Spacer	1/2 x 1 1/2 x 9	1
P	Bead Molding	1/4 x 3/8	as req'd
Q	Cove Molding	1 3/8 x 1 1/2	as req'd
R	Nose Molding	1/4 x 1 1/2	as req'd
Hood			
S	Bottom Rail	3/4 x 2 1/4 x 9	1
T	Top Rail	3/4 x 5 1/8 x 9	1
U	Stile	3/4 x 1 3/4 x 15	2
V	Side	3/4 x 6 1/2 x 15	2
W	Top	1/2 x 8 7/8 x 15 1/4	1
X	Cove Molding	1 3/8 x 1 1/2	as req'd
Y	Cleat	7/16 x 3/4 x 6	2
Z	Dial Board	1/4 x 9 7/8 x 13 3/8	1
AA	Dial Board Base	3/4 x 4 x 9 7/8	1
BB	Dial Board Bracket	3/4 x 3 x 5	2
CC	Back	1/4 x 11 1/4 x 60 1/2	1
DD	Glass	1/8 x 8 3/8 x 10 5/8	1
Hardware			
EE	Dial Face	see Sources	1
FF	Movement	see Sources	1
GG	Hinge	see Sources	2
HH	Knob	see Sources	1
II	Magnetic Catch	see Sources	1

support. If everything looks square, secure the waist to the base with several 1 1/2 in. long wood screws driven through the inside of the waist front and sides and into the base spacers.

Make the Cove Molding

All the cove molding on this project (parts M, Q and X) is the same. To make enough for all these parts you'll need a 4 ft. length of stock that measures 1 1/2 in. thick by 3 in. wide. After the cove is cut, the stock will be ripped lengthwise to create two, 4 ft. lengths.

The cove is cut on the table saw, using the technique of passing the stock, at an angle, over the blade. When making coves this way, the profile of the cove is determined by three factors: the blade

diameter, the blade height when making the final pass, and the angle that the stock is passed over the blade. The parallel-arm jig shown in Fig. 2 will make this procedure an easy one. And, once made, you'll be able to use it for any number of other cove shapes you may need in the future.

The jig is simply a pair of parallel arms joined by two connectors. For quick adjustment, we put ours together with T-nuts and wing nuts. No matter what hardware you use, though, keep in mind that it's most important to have the holes in the arms and connectors drilled on-center and the same distance apart. That insures that the arms and connectors are parallel.

To use the jig, set the arms to the desired cove width ($2\frac{1}{2}$ in.), raise the table saw blade to the desired cove depth ($1\frac{1}{4}$ in.), and position the jig at an angle so that the blade just touches both of the parallel arms (Fig. 3). Use a protractor or an angle finder to measure the angle between the jig arm and the blade.

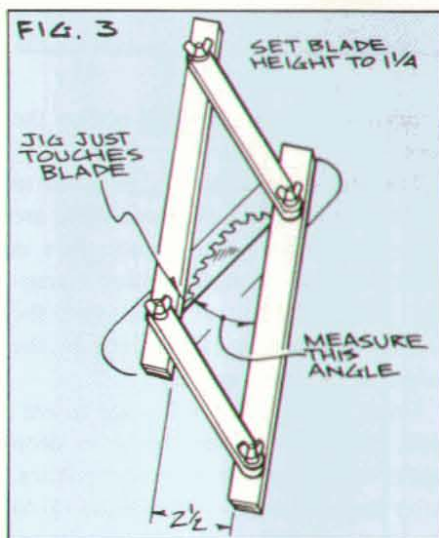
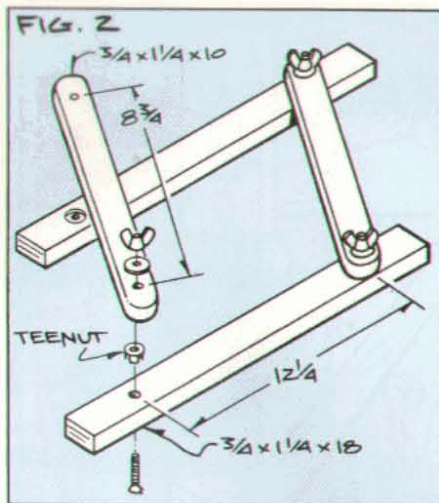
Remove the jig and set up a straight fence at the same angle that you measured, locating the fence $\frac{1}{4}$ in. from the $1\frac{1}{4}$ in. high blade (Fig. 4). Clamp the fence securely in place, then lower the blade to a height of $\frac{1}{16}$ in. Next, as shown in Fig. 4, slowly feed the stock into the blade. After the first pass, raise the blade to $\frac{1}{8}$ in. and repeat. Continue raising the blade in $\frac{1}{16}$ in. increments until you reach the final height of $1\frac{1}{4}$ in. This will create a lot of sawdust, so be sure to wear a dust mask.

Once the cove is complete, rip the molding into $1\frac{3}{8}$ in. widths (Fig. 5). The saw usually leaves a pretty rough surface, so you'll need to do some sanding. A gooseneck scraper, if you have one, will come in handy here.

Make the Bead and Nose Molding

The bead molding (P) and nose molding (R) are made next. All of this molding can be made from a piece of $\frac{1}{4}$ in. thick stock that's $2\frac{1}{8}$ in. wide and about 3 ft. long. Once the stock is cut to size, use the router table and a $\frac{1}{4}$ in. bullnose bit to apply a $\frac{1}{4}$ in. diameter roundover along each edge of the stock. If a bullnose bit is not available locally, you can mail-order one from MLCS, Ltd., P.O. Box 4053JP, Rydal, PA 19046; tel. 1-800-533-9298.

Use the table saw and rip fence to rip



the stock to a width of $\frac{3}{8}$ in. (for the bead molding). Then, relocate the fence to rip the remaining stock to a width of $1\frac{1}{2}$ in. (for the nose molding).

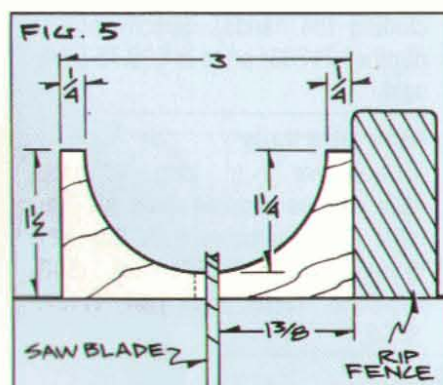
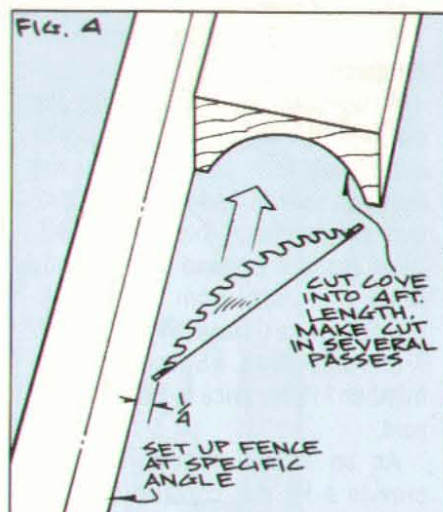
Add the Waist Moldings

The molding that fits between the base and the waist can be added first. Miter the parts as shown in the exploded view, then attach them with a few countersunk and filled finishing nails.

The molding that fits between the waist and the hood (and serves as the support shelf for the hood) is made up of the bead, cove, and nose moldings. We found it best to first glue the three moldings together, making a single, larger molding. This larger molding was then mitered and attached in place, using countersunk and filled finishing nails.

Make the Hood

Cut the bottom rail (S) and the top rail (T) to length and width, then cut the $\frac{1}{4}$ in. thick by $\frac{1}{2}$ in. long tenons on each



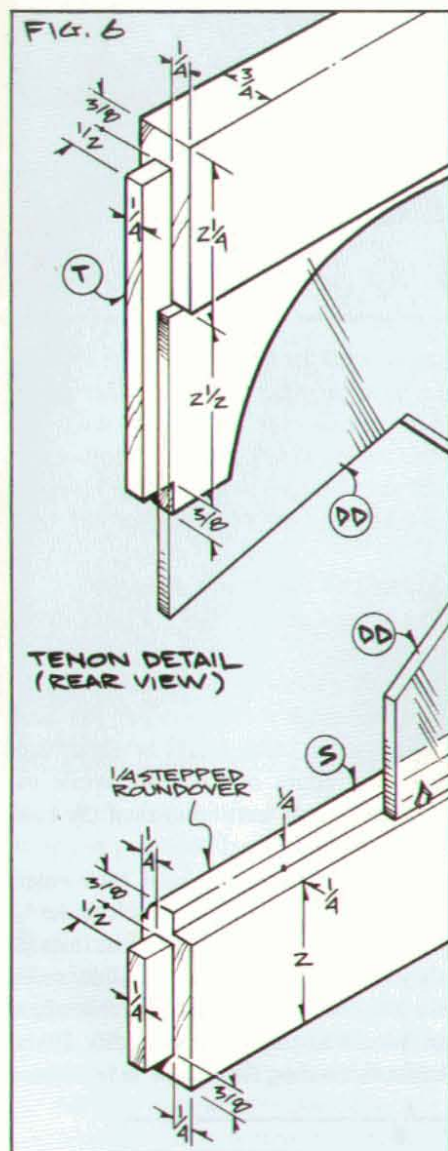
end (Fig 6).

The arch on the top rail is cut next. With a compass, scribe a $3\frac{3}{8}$ in. radius (see front view), then cut it out with the band saw. Sand the sawn edge smooth.

Cut the two stiles (U) to size and layout the location of the mortises for the bottom and top rails. We used the router table and a $\frac{1}{4}$ in. diameter straight bit to cut the $\frac{1}{4}$ in. wide by $\frac{1}{2}$ in. deep mortises in the stiles. To save strain on the motor, and to keep the bit from overheating, you'll want to make the $\frac{1}{2}$ in. deep cut in four passes, with each pass removing about $\frac{1}{8}$ in. of material. Once cut, use a chisel to square the rounded ends of the mortises.

The top rail, bottom rail and stiles can now be assembled. Apply a thin coat of glue to the mating surfaces and clamp firmly. When dry, remove the clamps and cut the $\frac{3}{4}$ in. wide by $\frac{1}{4}$ in. deep rabbet on the stiles to accept the sides. Then, use a router with a $\frac{1}{4}$ in. rabbeting bit to cut a $\frac{1}{4}$ in. by $\frac{1}{4}$ in. rabbet for the glass (DD) all around the inside (Fig. 6).

Now, change to a $\frac{1}{4}$ in. diameter straight bit and set it to equal the $\frac{1}{4}$ in. depth of the rabbet just cut. Scribe a line $2\frac{1}{4}$ in. from the top edge of the top rail.



Using the router freehand, clean all the remaining waste stock up to the $2\frac{1}{4}$ in. line. This will serve to "square up" the rabbet to accept the glass, eliminating the need to cut a curve on top edge on the glass.

Next, use a $\frac{1}{4}$ in. roundover bit to cut a $\frac{1}{4}$ in. radius stepped round all around the front of the opening. Make the step between $\frac{1}{16}$ and $\frac{1}{8}$ in. deep. The bit will leave rounded corners, so you'll need to do some hand work with a chisel, file and sandpaper in order to create a miter where the roundovers meet at the corners. Before working on the finished frame, it's a good idea to practice a few of these cuts on scrap stock.

Cut the hood sides (V) to size and cut the $\frac{3}{8}$ in. wide by $\frac{1}{4}$ in. deep rabbet in the back edge for the back. Sand all the hood parts, then glue and clamp the sides to the frame stiles and add the cut nails.

The top (W) can now be cut to length and width. Once cut, use a $\frac{3}{8}$ in. roundover bit to mold the front and side edges as shown. After sanding, the top can be assembled to the hood with flathead wood screws, counterbored and plugged. The cove molding (X) is added next, again using finishing nails.

Assemble the cleats (Y) to the inside of the hood sides. Together with the waist cleats, they serve to lock the hood on the case, yet they allow it to slide out the front. Like many antique clocks, the hood is not screwed or attached in any way. Once the cleats are added, check to see that the hood slides out and in easily. Cut the dial board (Z) to size from $\frac{1}{4}$ in. thick plywood or Masonite. Layout and bore the holes for the movement shaft and the speaker, then screw the board to the dial board base (AA) and brackets (BB). To look good, the front of the dial board must be somewhat dark in color, so apply a couple of coats of dark stain at this point (we used Minwax's Dark Walnut).

The dial face (EE) supplied with the kit has a pair of holes in it, called key wind holes. (The battery-operated quartz movement we used doesn't require winding, but the holes help add to the old-time look of the clock.) You'll need to use a pair of pliers to remove the eyelet that's in each hole. Now, use contact cement (the kind used to glue plastic laminate) to join the dial face to the dial board. Before adding the glue, though, apply a little black paint to the dial board in the area where the key wind holes are located. With the dial face in place, you can install the movement (FF), hands and speaker.

Cut the one piece plywood back (CC) to fit the base, waist and hood rabbets. In order for the back to fit in place, you'll need to chisel a couple of $\frac{1}{4}$ in. deep notches in the back edge of each waist side where the back laps over it.

The Antique Finish

The antique finish we used is not difficult to do, in fact, it's really a lot of fun. And it results in a lovely, warm patina that few finishes can match. But, before starting, we would suggest you do a test board first. Not only will a test board give you a chance to practice applying the finish, it will also show you exactly how the finished surfaces will look.

Once you are ready to go, give the entire project a thorough sanding, finishing with 220-grit. Vacuum all the surfaces and wipe with a tack rag to pick up as much dust as possible.

Next, apply a thin coat of a latex water-based red paint to all the exposed surfaces of the clock. You'll want to use a deep red, something similar to what is often called "barn red." To make it easier to apply, thin it with about 10 percent water. Use a rag to apply the paint, rubbing it "with the grain" to get good coverage. Put it on a little heavier at the moldings and inside corners. Open, flat areas, like the front and sides, should have a little less paint. Let it dry thoroughly.

Wipe-on a coat of Minwax's Colonial Maple Wood Finish to the painted surfaces and to all other surfaces of the clock, both inside and out. Allow to dry.

Now, on the surfaces that were painted, wipe-on a coat of Minwax's Dark Walnut Wood Finish. While the finish is still wet, make a pad from a soft cloth, dip it into the can of Minwax Dark Walnut to wet the pad, and pat it onto the wood surface. Work a small section at a time, dipping into the can and patting it on the wood. Overlap the pats as you go along. This technique creates the look of a "burled" wood, and we think it is especially attractive. Put it on a little heavier at the inside corners and the moldings.

Allow the stain to dry, then apply two coats of orange shellac. When the shellac dries, rub it out with 0000 steel wool. A coat of paste wax completes the finish.

Final Details

The entire dial board assembly can now be secured to the waist. Use a single screw through each end of the dial board base and into the top edge of the waist sides.

Add the door (K), hinges (GG) and knob (HH), as shown. Also, the magnetic catch (II) is screwed to the door stop with the striker added to the inside of the door. Attach the back (CC) with several small wood screws. Finally, secure the glass (DD) to the hood, using glazer's points (see Fig. 6) or small brads to hold it in place. Add the battery to the movement and slide the hood on the waist. We added a thin coat of wax to the cleats to help the hood slide on and off a little easier.

Years ago, salesmen for the big furniture companies didn't have the luxury of a big fancy color catalog to help sell their products. Instead, they brought along actual samples of the furniture to show prospective buyers. Those scaled down pieces were often quite detailed, and no doubt made the salesman's job a lot easier. We can only imagine that hauling a trunk full of samples from town to town, probably by railroad, must have tested the mettle of even the most enthusiastic peddler.

You can put this charming project to use in any number of ways. We like it as a storage chest for organizing odds and ends, but it will also make a nice jewelry chest, particularly if you line the drawers with felt. And, small pieces like these are perfect as doll furniture.

Prepare Your Stock

Except for the back, drawer bottoms and drawer knobs, the entire project is made from $\frac{1}{2}$ in. thick pine stock. Generally, a project like this will look best if clear stock is used. However, if knots are unavoidable, look for ones that are small and tight.

We used a thickness planer to plane

down $\frac{3}{4}$ in. stock to $\frac{1}{2}$ in. thick. If your shop doesn't include a thickness planer, check to see if $\frac{1}{2}$ in. stock is available locally. If not, a nearby lumberyard or millwork shop may be willing to plane down your stock for a small charge. Another option, of course, is to sharpen up your hand plane and go to work at the workbench. It won't take a lot of time to hand-plane stock for this small project.

Make the Sides

Begin by cutting the two sides (A) to the length and width dimensions shown in the Bill of Materials. Once cut, use the table saw and dado head cutter to plow the $\frac{1}{4}$ in. by $\frac{1}{4}$ in. rabbet along the inside back edge of each side.

The $\frac{1}{8}$ in. deep by $\frac{1}{2}$ in. wide dados are next. Note that there are three in each side. Lay out the dado locations, then cut them, again using the table saw and dado head cutter. Guide the stock through the

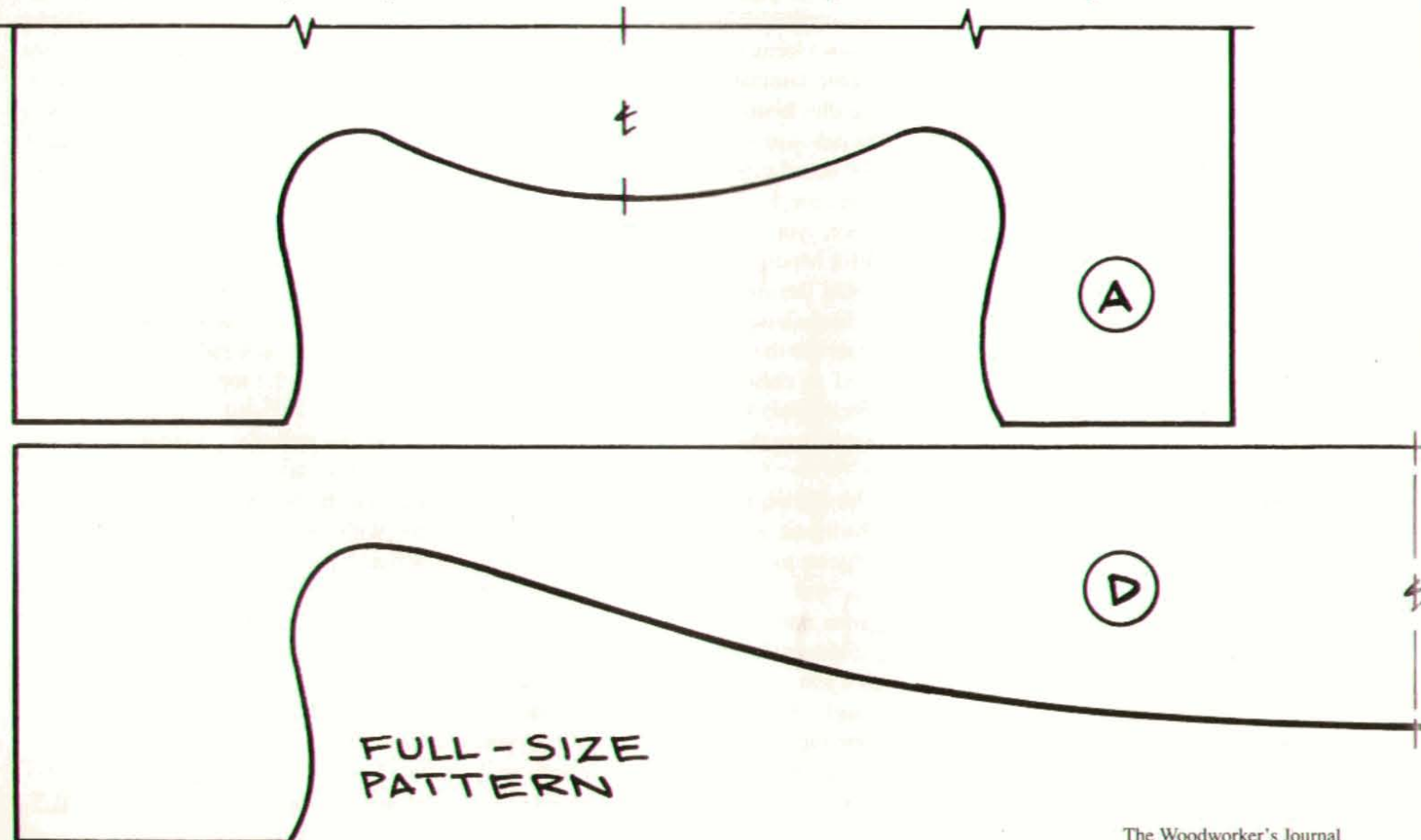
cutter with the miter gauge.

Next, transfer the full-size cutout pattern from the drawing to the sides. Use a band saw, jig saw or scroll saw to cut each shape, then file and sand the sawn edges until they are smooth.

Make the Rails and Runners

The three rails (B) and six runners (C) can be made next. Cut each one to length and width, then dry assemble them to the sides to check for a good fit. The front edges of the rails should be flush with the front edges of the sides, while the runners should butt up against the back edges of the rails.

As shown in the side view, the runners do not extend all the way back to the $\frac{1}{4}$ in. by $\frac{1}{4}$ in. rabbet in the sides. Instead, they are cut $\frac{1}{8}$ in. short, to allow room for any shrinkage of the sides that might occur due to changes in humidity. If you make this a snug fit, and the sides should





shrink, the resulting force could split the sides, or push out the rails or back.

Assemble the Sides, Rails and Runners

Once the dry assembly looks okay, the rails and runners can be assembled to the sides. Give the parts a good sanding, particularly the inside surfaces that will be difficult to sand after assembly.

Assemble the rails first. At a point $\frac{1}{2}$ in. from the front edge of the sides, drill a $\frac{1}{8}$ in. deep counterbored hole to accept a $\frac{3}{4}$ in. long by no. 6 flathead wood

screw. As shown, one screw is driven into each rail end. Add a thin coat of glue to the joint before adding the screws. When dry, glue a wood plug in each of the counterbored holes and sand them flush with the surface.

Next, assemble the runners. If glued in place along their entire length, the runners will prevent the sides from expanding and contracting with changes in humidity, and that could cause the sides to crack. To allow the necessary movement, secure each runner with three, 1 in. long brads (front, back and

center), adding glue only to the frontmost 1 in. length of each one (see Exploded View). To lessen the chance of splitting the runners, you'll first want to bore pilot holes for the brads. Note that the brads are driven through the runners and into the sides. Brads work nicely here, not only because they hold the parts securely, but also because they are able to flex a little, thereby enabling the sides to expand and contract without much danger of splitting.

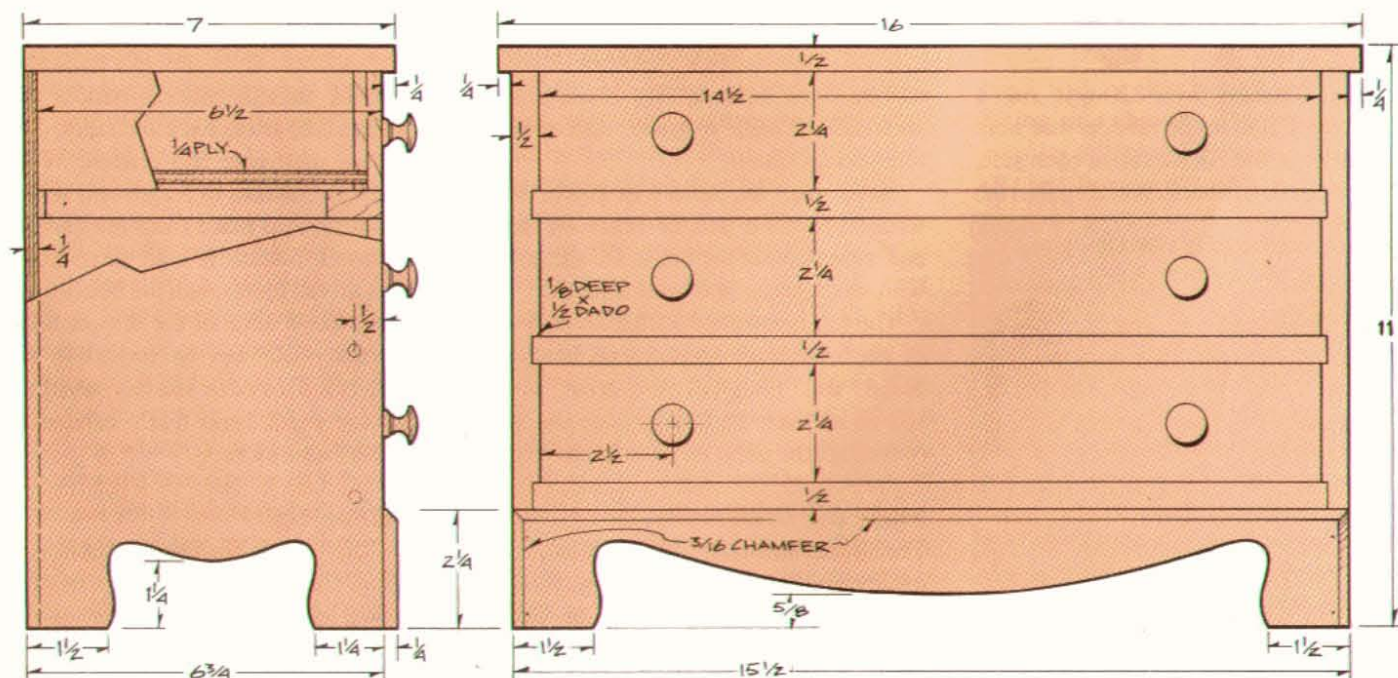
Make the Apron, Back and Top

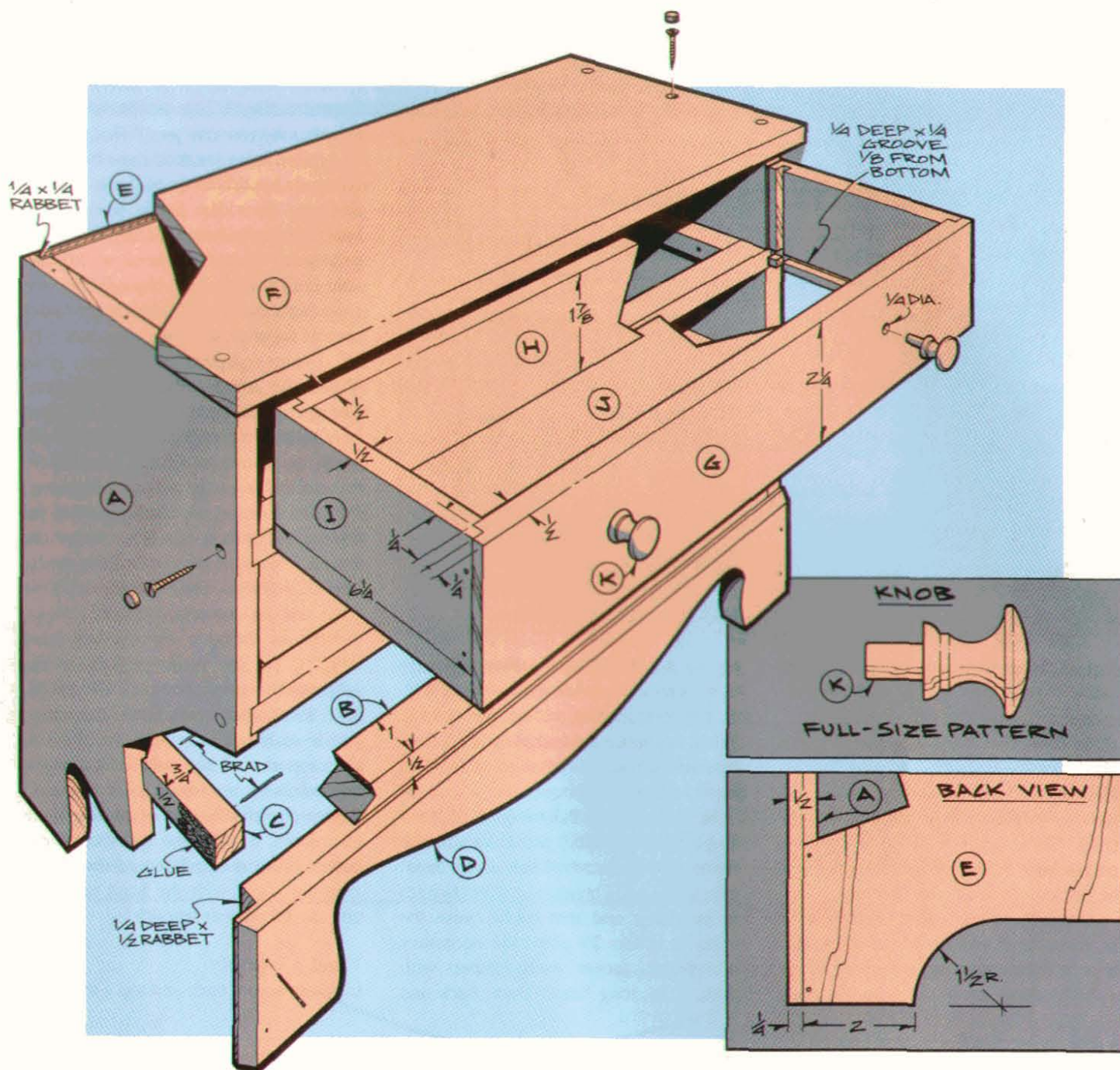
The apron (D), back (E) and top (F) can now be cut to size. At this point you'll want to take your length and width dimensions from the assembled project. We used $\frac{1}{4}$ in. thick birch plywood for the back. Use a compass to scribe the $1\frac{1}{2}$ in. radius on each end of the cutout (see Back View), and cut it out with the band saw, jig saw or scroll saw.

Now, use the table saw and dado head cutter to cut the $\frac{1}{4}$ in. deep by $\frac{1}{2}$ in. wide rabbet on each end of the apron. The miter gauge supports the stock while making the cut. The $\frac{3}{16}$ in. chamfer on the top and ends can be applied using the router table and a 45 degree chamfer bit. After the edges are chamfered, transfer the full-size cutout pattern from the drawing to the apron, then cut it out with the band saw. File and sand the edges smooth.

Final Assembly

Give the apron, back and top a thorough





sanding, finishing with 220-grit. Add a thin coat of glue to the rabbets that were cut earlier in the back edge of each side, then assemble the back, securing it in the

Bill of Materials

(all dimensions actual)

Part	Description	Size	No. Req'd.
A	Side	1/2 x 6 3/4 x 10 1/2	2
B	Rail	1/2 x 1 x 14 3/4	3
C	Runner	1/2 x 3/4 x 5 3/8	6
D	Apron	1/2 x 2 1/4 x 15 1/2	1
E	Back	1/4 x 15 x 10 1/2	1
F	Top	1/2 x 7 x 16	1
G	Drawer Front	1/2 x 2 1/4 x 14 1/2	3
H	Drawer Back	1/2 x 1 7/8 x 14	3
I	Drawer Side	1/2 x 2 1/4 x 6 1/4	6
J	Drawer Bottom	1/4 x 6 1/4 x 14	3
K	Drawer Knob	see detail	6

rabbets with four or five brads along each side. Check to make sure everything looks square.

Now, glue the apron in place, and secure it with a pair of brads on each end. Countersink the brads, fill the holes with wood putty, and sand smooth.

The top is attached with 1 1/4 in. long by no. 6 flathead wood screws, countersunk and plugged. We used three screws at each end. Note that the top overhangs the chest by 1/4 in. at the front.

Make the Drawers

The three drawers, all identical, are made next. The fronts (G), backs (H) and sides (I) are made from 1/2 in. thick stock. The bottoms (J) are 1/4 in. thick birch plywood.

Cut the various rabbets, dados and grooves in the front, back and sides, then assemble with glue and clamps. When dry, cut the bottom to length and width, and slide it into place from the back of the drawer. Secure it with three small screws driven up through the bottom and into the lower edge of the drawer back. The knobs (K) can be turned to the dimensions shown, or you can substitute most any small knob that's carried by your hardware store.

Finishing Up

Give the entire project a complete sanding, finishing with 220-grit sandpaper. We used a walnut stain on all surfaces, then two coats of a water-based satin polyurethane clear finish. 

There's a new collectibles fad that seems to be sweeping the country—miniatures. They're popping up in those eclectic catalogs that feature everything from housewares to furniture to bric-a-brac, and there are even entire catalogs specializing in this genre. We won't pretend to know just what's sparking all this interest in doll and miniature furniture, but with the growing interest in these items as collectibles, no doubt there's a fair number of folks who could make use of a handsome little display box to show off a favorite setting.

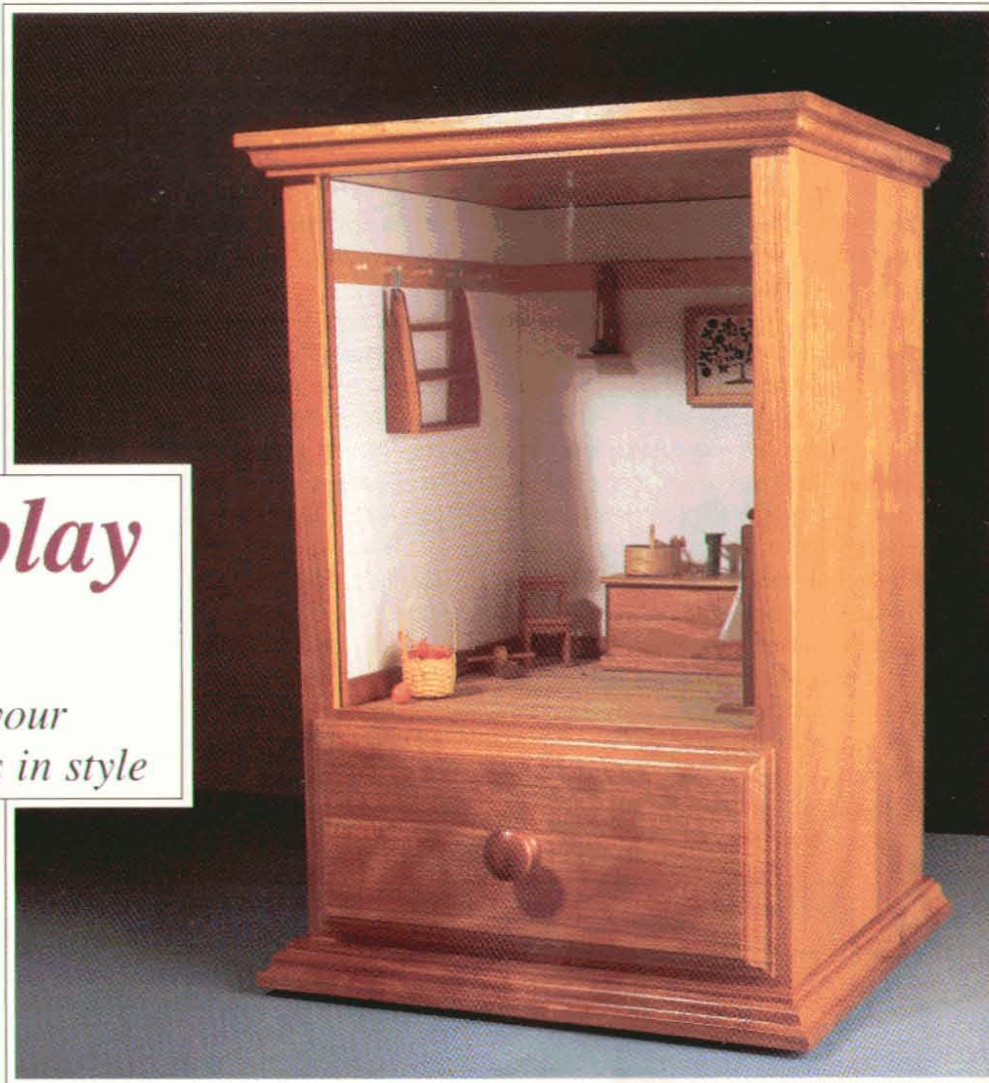
There are three accepted scales for making miniatures. The most common scale is 1:12 or 1 in. equals 1 foot. Less popular scales are 1/2 in. to 1 foot or 1/4 in. to 1 foot (this latter is really tiny). The display box

shown here, by Connecticut woodworker Dave Moretti, is sized to the 1:12 scale. The display area is 8 in. high, which corresponds to a standard 8 ft. high ceiling. Moretti made most of the items shown in the display box himself, but the candlestick, candle mold, basket and the Shaker pegs and pegboard were purchased at a local craft store. In keeping with the Shakers' affection for cherry, the box is made of cherry solids and plywood, but other woods, such as walnut, maple or mahogany would also be fine, depending on what you are planning to display.

Our display box features a top that unscrews, a Plexiglass viewing panel that is easily removed, and a small drawer for storage. Although it's shown with a Shaker-style room setting, the box needn't be used only for displaying miniatures. It can also serve as a display box for a favorite small vase, knick-knack or whatever. And of course, you can alter the box size to fit a particular item that you'd like to display. If you do opt to use the box for a miniature room display, and decide to purchase miniature furnishings, be sure to check size carefully before ordering. We looked through one catalog that claimed to

Display Box

Show off your miniatures in style



feature items made to the 1:12 scale, but found individual pieces may not always conform exactly to that scale.

There are many sources for miniatures, including catalogs, hobby stores and craft centers. These suppliers carry everything from the bare essentials—flooring, wallpaper, miniature rugs, etc.—to the finest minutia, such as sandwiches on plates, cans of beer, boxes of cereal, bags of cat food, all in miniature, of course. Although there are thousands of items available (quite literally, everything that you might find in a real house), we'd like to think that woodworkers would prefer making at least the furniture themselves. However, if you require a source for just about any miniature, one of the best we've seen is Rose's Doll House, 5826 West Bluemound Road, Milwaukee, WI 53213; tel. 1-800-926-9093 (catalog \$1).

A Simple Box

Broken down to its component parts, the display box is basically just a plywood box, with a hardwood top, bottom, facing and drawer. The plywood box consists of 1/2 in. thick sides (A), divider (B) and bottom (C) with a 1/4 in. thick plywood back (D). We've used a cherry plywood (good one side) for the sides, divider and bottom. In the sides, cut a 1/4 in. wide by 1/4 in. deep rabbet for the back, a 1/4 in. deep by 1/2 in. wide rabbet for the bottom, and a 1/4 in. deep by 1/2 in. wide dado for the divider. Measure the thickness of your plywoods carefully before cutting the rabbets and dados; most 1/2 in. thick plywoods actually measure a little less than 1/2 in. thick, and you'll want to adjust the rabbet and dado dimensions accordingly. Also, don't forget to make the divider 1/4 in. less in width than the bottom, to allow for the

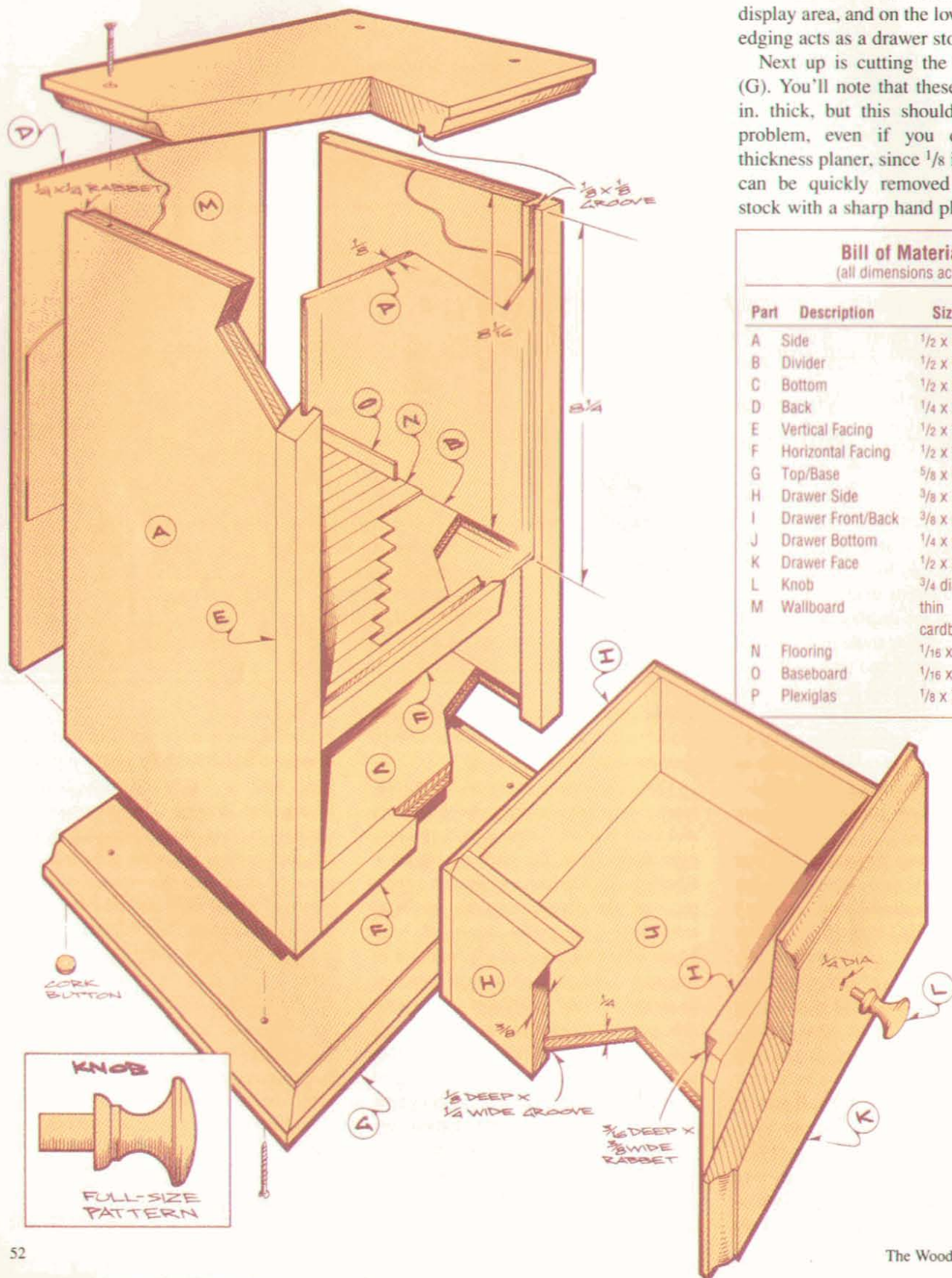
$\frac{1}{4}$ in. thick plywood back. Now glue, assemble and clamp the plywood box assembly. The back should serve to square up the assembly, but it's a good idea to check all the corners with a framing square, just in case.

Once the plywood box is out of clamps, you can cut, fit and glue in place

the facings (E, F). Note that the two vertical facings have a $\frac{1}{8}$ in. wide by $\frac{1}{8}$ in. deep by $8\frac{1}{4}$ in. long stopped groove in them (the groove is $\frac{1}{8}$ in. longer than necessary, but this avoids the problem of having to square the stopped end of the groove), and that the uppermost of the two horizontal facings has the same $\frac{1}{8}$

in. by $\frac{1}{8}$ in. groove in it. Glue and clamp the facings in place, taking care to keep the outside edges of the vertical facings, and the bottom edges of the horizontal facings, flush with the edges to which they are glued. Note that the inside edges of the facings overhang about $\frac{1}{16}$ in. This overhang serves to accommodate the wall and floor treatments of the display area, and on the lower horizontal edging acts as a drawer stop.

Next up is cutting the top and base (G). You'll note that these parts are $\frac{5}{8}$ in. thick, but this shouldn't present a problem, even if you don't own a thickness planer, since $\frac{1}{8}$ in. of material can be quickly removed from $\frac{3}{4}$ in. stock with a sharp hand plane. Cut both



Bill of Materials

(all dimensions actual)

Part	Description	Size	No. Req'd.
A	Side	$\frac{1}{2} \times 6\frac{7}{8} \times 11\frac{1}{2}$	2
B	Divider	$\frac{1}{2} \times 6\frac{5}{8} \times 7\frac{1}{2}$	1
C	Bottom	$\frac{1}{2} \times 6\frac{7}{8} \times 7\frac{1}{2}$	1
D	Back	$\frac{1}{4} \times 7\frac{1}{2} \times 11\frac{1}{4}$	1
E	Vertical Facing	$\frac{1}{2} \times 9\frac{1}{16} \times 11\frac{1}{2}$	2
F	Horizontal Facing	$\frac{1}{2} \times 9\frac{1}{16} \times 6\frac{7}{8}$	2
G	Top/Base	$\frac{5}{8} \times 8 \times 9$	2
H	Drawer Side	$\frac{3}{8} \times 2\frac{1}{4} \times 6\frac{5}{8}$	2
I	Drawer Front/Back	$\frac{3}{8} \times 2\frac{1}{4} \times 6\frac{7}{8}$	2
J	Drawer Bottom	$\frac{1}{4} \times 6\frac{3}{8} \times 6\frac{1}{2}$	1
K	Drawer Face	$\frac{1}{2} \times 2\frac{7}{8} \times 7\frac{3}{8}$	1
L	Knob	$\frac{3}{4}$ dia.	1
M	Wallboard	thin	
	cardboard	as req'd	
N	Flooring	$\frac{1}{16} \times \frac{1}{2}$	as req'd
O	Baseboard	$\frac{1}{16} \times \frac{1}{2}$	as req'd
P	Plexiglas	$\frac{1}{8} \times 7\frac{1}{8} \times 8\frac{1}{4}$	1

the top and base to the same overall size ($\frac{5}{8}$ in. by 8 in. by 9 in.), then set up the router table with a pair of stops, and using the same $\frac{1}{8}$ in. straight cutter that you used to establish the grooves in the facings, make the blind groove in the top for the Plexiglas. Note that the length of this blind groove must be at least $7\frac{1}{8}$ in.—the same as the width of the Plexiglas. However, to insure an easy fit, it's best to make the groove a bit longer. This way, you'll also avoid having to square up the groove ends with an $\frac{1}{8}$ in. chisel, a tool most folks aren't likely to have. Next, replace the straight cutter with a $\frac{5}{32}$ in. radius Roman ogee router bit, cut the drawer face (K) to size (the $\frac{1}{2}$ in. thickness can be easily resawn from $\frac{3}{4}$ in. stock), and mold the ogee profile on the top, base and on the drawer face. You can screw the base in place now. Also, drill, countersink and counterbore for the four screws that mount the top, but leave it off for now.

Now is a good time to cut and test-fit the Plexiglas (P). Plexiglas is available at most building supply centers, but you may already have a piece this small kicking around your shop. After the Plexiglas is cut to size, use a file to knock the sharp edges off.

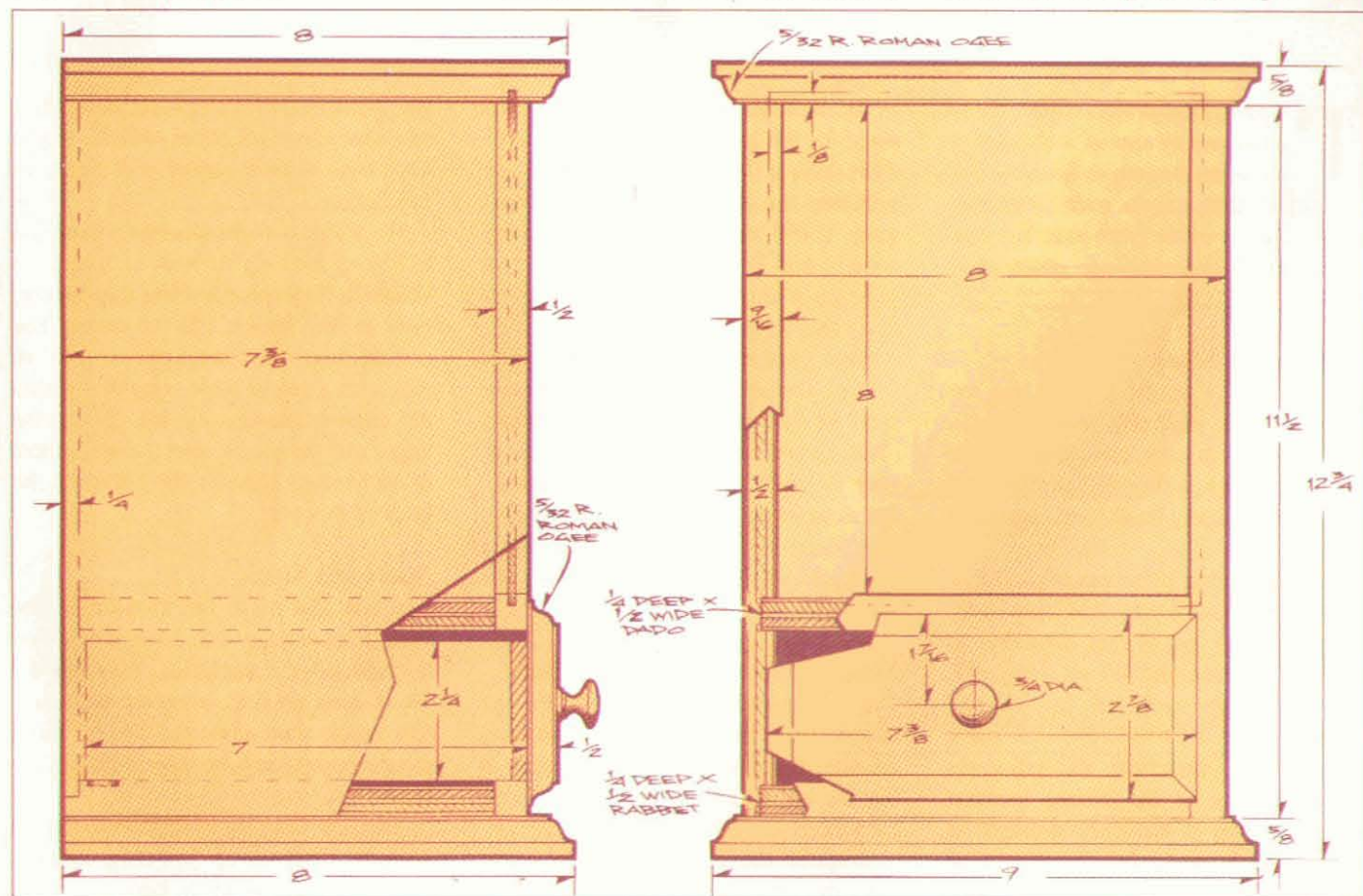
Next up is making the drawer box, which consists of the drawer sides (H), front and back (I) and bottom (J). Our drawer features a rabbeted drawer box construction, with an applied face. Cut the drawer sides, front and back to the dimensions shown, establish the $\frac{3}{16}$ in. deep by $\frac{3}{8}$ in. wide rabbets on the ends of the drawer front and back, cut the $\frac{1}{4}$ in. wide by $\frac{1}{8}$ in. deep grooves for the bottom, then glue and assemble the drawer box. Using a ball-bearing guided chamfering bit in your router, set for a $\frac{3}{16}$ in. deep cut, establish the chamfer on the sides and back of the drawer box. Using some doublestick tape to temporarily hold the face in place on the drawer box, slide the drawer box into the opening to check that the overhang of the drawer face is about even all around on the facings. When the alignment is good, glue and clamp the drawer face in place. Turn the knob (L) using our full-size pattern (or purchase a knob at your local hardware store) and mount it.

Now is a good time to apply a finish to the display box and drawer. We used a brush-on water-based lacquer, which is easy to apply and dries quickly, with little odor (a handy feature when you are working indoors). When the finish is

dry, add a stick-on cork dot (the same as the four stick-on dots that serve as feet) centered on the lower edge of the drawer back. This dot plays a dual role; it acts as a stop to prevent the drawer from being pulled all the way out and it serves to keep the drawer level, compensating for the $\frac{1}{16}$ in. lip on the lower facing.

Decorating

If you are planning to use your display box to show off a miniature room setting, you'll at least want to include a few basics—such as the wallboard (M), flooring (N) and baseboard (O). Our wallboard is just a thin stiff cardboard painted with a flat white wall paint. You could wallpaper over the wallboard, or add just about any other wall treatment (in miniature, of course) that you would find on a real home. We cut the flooring and baseboard from contrasting woods (the floor is walnut, the baseboard is pine), but you can buy similar items. If you make these yourself, be sure to use a zero-clearance insert in your saw, and push sticks, to keep your fingers well away from the blade. If you are really interested in miniatures, a miniature table saw, such as the unit made by Dremel, is the logical way to go. **W&J**





This practical project can be put to good use in almost any laundry room, mud room or kitchen. Use it to dry clothes, towels, even flowers or herbs. Ours is made from ash, but oak, maple, birch and pine are other good choices.

Prepare the Stock

You'll need $\frac{3}{4}$ in. thick stock for the upper rail (A), shelf (B), lower rail (C), two stiles (D), and the two sides (E). We used clear stock, although boards with a few small, tight knots are perfectly suitable.

The dozen long stretchers (F) and four short stretchers (G) are made from $\frac{1}{2}$ in. thick stock. A board that measures at least 5 in. wide and 40 in. long will provide enough material for all the stretcher parts. It's best to use clear stock here, as the stretchers are relatively small. A knot in the wrong location might weaken a stretcher enough to cause it to break under the weight of several wet bath towels.

We used $\frac{1}{2}$ in. diameter birch dowel stock for the long dowel (H) and the 11 short dowels (I). Be a little choosy when selecting the dowels at your hardware store. You'll want them to be reasonably straight and free from small knots that sometimes show up. Also, try to avoid those that are badly out of round.

Now, except for the long and short dowels, cut all the parts to the dimensions shown in the Bill of Materials. (The dowels will be cut to length later, after the rack has been test assembled.) Before starting, though, check your table saw, along with the rip fence and miter gauge, as you'll want all the cuts to be square.

Make the Upper Rail and Shelf

The upper rail and the shelf can be tackled first. You'll note that these parts are almost identical. They differ only in that the upper rail is curved at the lower corners.

Transfer the profiles of these parts from the grid pattern to the stock, then

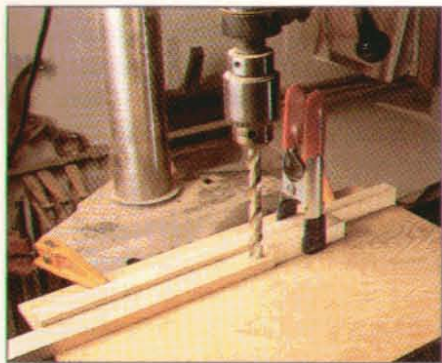
cut them out with the band saw. Once cut, sand the sawn edges smooth. If you have one, a disk sander will come in handy here.

We added a slight chamfer (about $\frac{3}{16}$ in.) along the long curve of each part. As shown in the exploded view, the chamfer ends at the "notch" in the curve. You can do this with a hand plane or, as we did, with a router table equipped with a 45 degree chamfering bit. Since the upper rail mounts against the wall, there is no need to chamfer the curve on the back of this part.

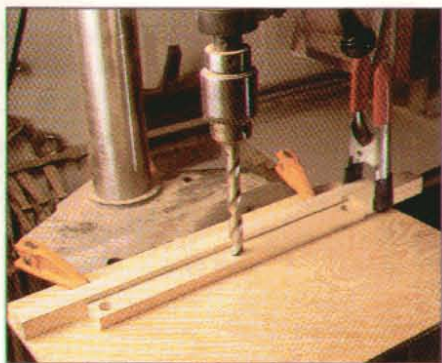
Make the Sides

Lay out and mark the location of the two, $\frac{3}{4}$ in. wide by 2 in. long, notches on the back edge of each side. We made the $\frac{3}{4}$ in. deep cut first, using the table saw. The stock was supported by the miter gauge as it passed, on edge, through the blade.

The 2 in. long leg of the notch was cut with the band saw. If you have one, use a wide band saw blade here ($\frac{3}{4}$ in. is



Above: Setup on drill press to bore end holes in the stretchers. Below: Relocate the stop block on the drill press to bore the middle holes



fine), as it will tend to cut straighter than a narrow blade.

The front edge of the sides has the same curve as the upper rail and the shelf. Use one of these parts as a template to trace the curve on each side, then cut them out on the band saw. Sand the edges smooth as you did earlier.

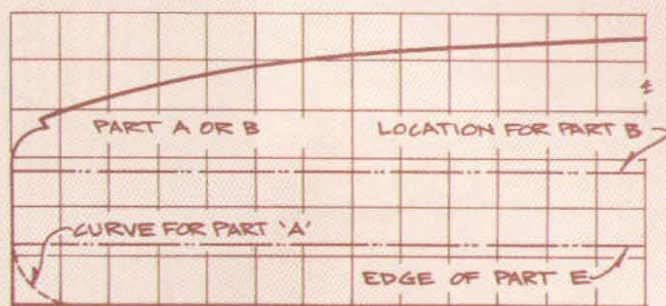
Now, referring to the end view, lay out and mark the centerline location of the $\frac{1}{2}$ in. diameter by $\frac{3}{8}$ in. deep hole that's bored in each side to accept the long dowel. You'll want the hole square to the side, so use the drill press here.

Bore the Stretcher Holes

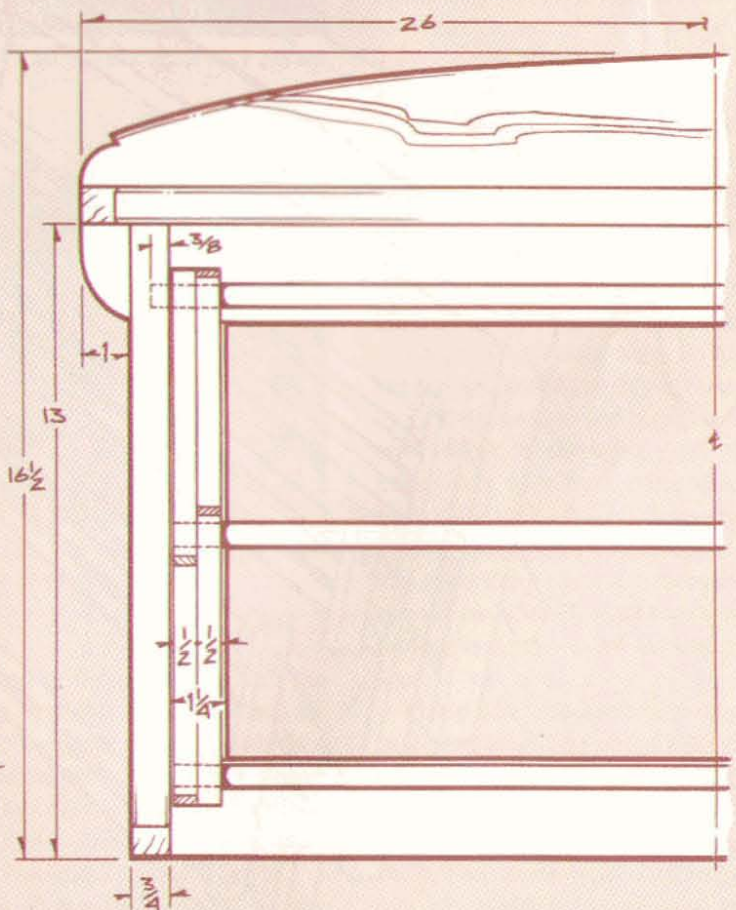
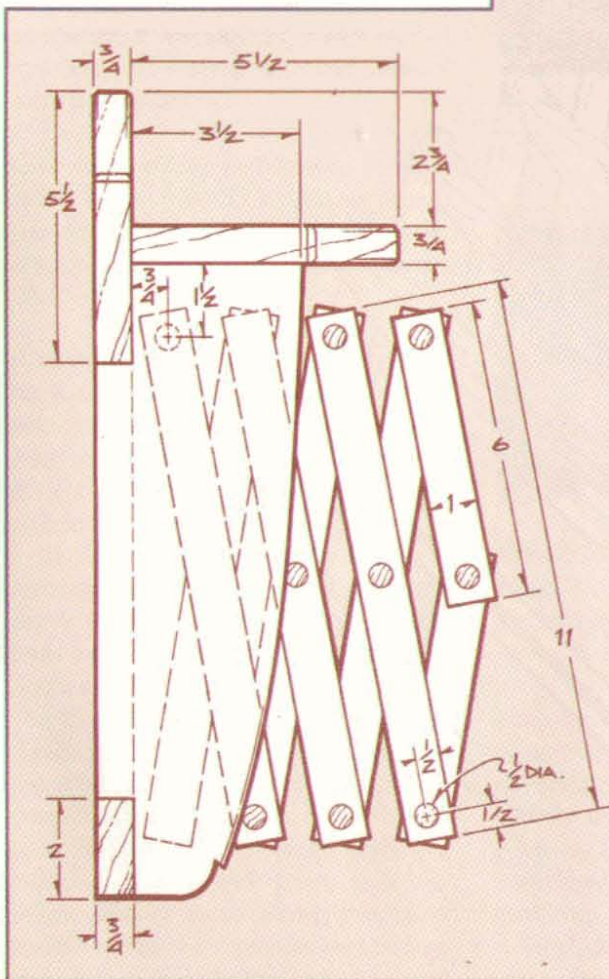
As shown in the end view, all the long and short stretchers have a $\frac{1}{2}$ in.

diameter hole bored $\frac{1}{2}$ in. from each end. In addition, the long stretchers have a $\frac{1}{2}$ in. diameter hole bored in the middle. All totaled, there are 44 holes to be bored, so some sort of locating setup on the drill press makes a lot of sense.

The setup need only be a $\frac{3}{4}$ in. square by 16 in. long fence clamped to the drill press table, with a spring clamp firmly securing a stopblock in place (see photos). Make the end holes first, locating the fence and stopblock to establish the proper hole centerline. (Before starting, to insure accuracy, make a couple of test holes in scrap stock.) After all the end holes are bored, relocate the stopblock to accommodate drilling the middle hole on the long stretchers.



GRID FOR PARTS A, B AND E 1 SQUARE = 1 INCH



When boring the holes, it's a good idea to always keep the same edge of the stretcher against the fence. Doing so will help insure that the holes line up pretty well, even if they are slightly off center in the drill press setup.

Assemble Stiles To Sides

Next, the stiles are glued to the sides. When joined, the back of the stiles should be flush with the back edge of the sides. Also, the ends of the stiles should

be flush with the ends of the notches cut in the sides.

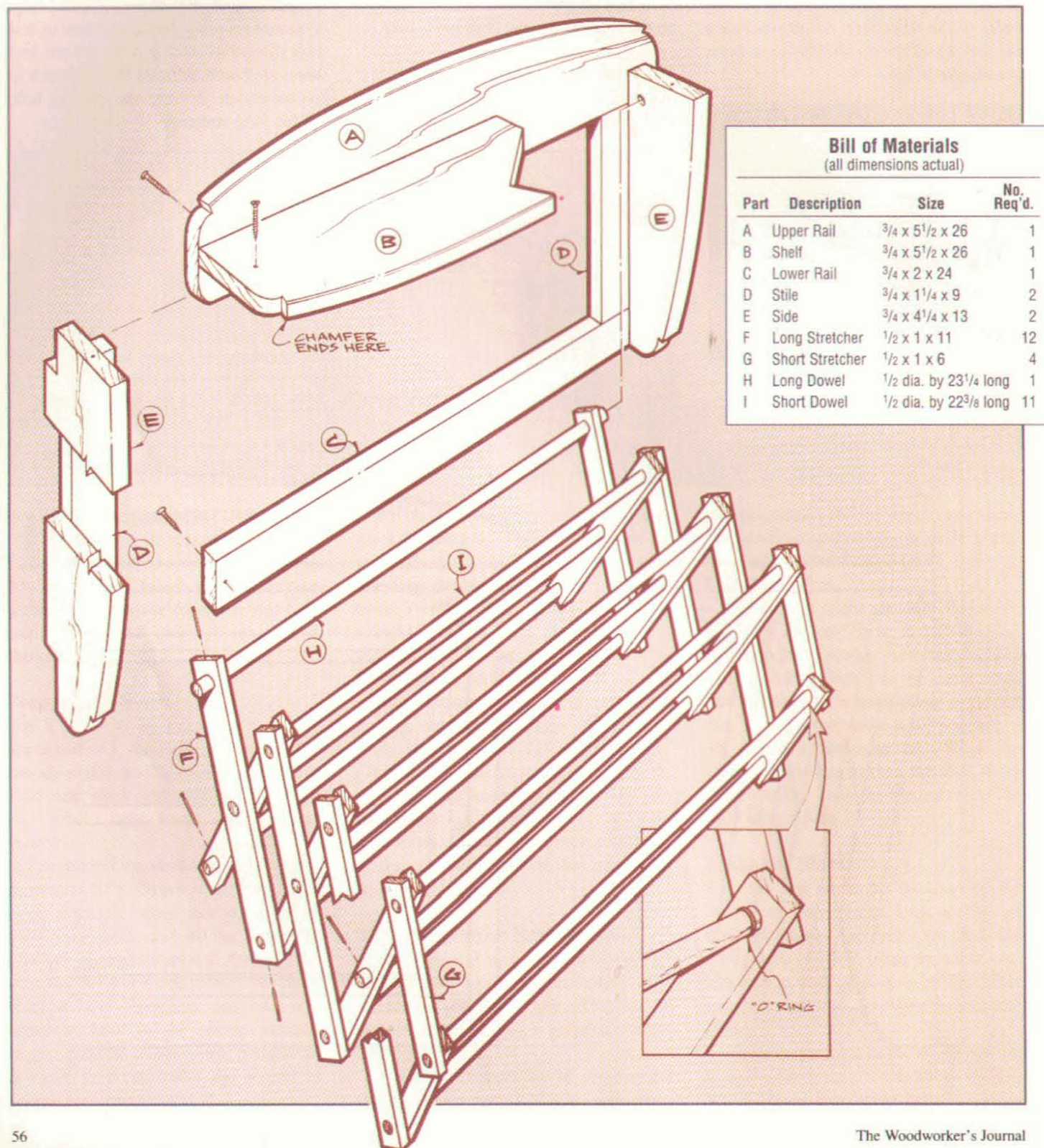
To join the stiles to the sides, add a thin coat of glue to the mating surfaces and apply clamp pressure. In order to prevent the parts from sliding out of position when the clamps are tightened, drive three or four small brads along the edge of each stile, then snip the heads off so that about $\frac{1}{16}$ in. is exposed. When the parts are clamped, the brads will keep them from moving around.

Allow the parts to dry thoroughly before removing the clamps. If necessary, scrape away any glue that may have squeezed out of the joint.

Test Assemble

At this point, it's a good idea to test assemble the parts to make sure everything is fitting up okay. It will also enable you to determine the exact length of the long and short dowels.

Use $1\frac{3}{4}$ in. long by no. 8 flathead



wood screws to attach the stile/side subassembly to the upper rail and the lower rail. As shown in the exploded view, a single screw is all that's used at each joint. Next, using the same size screw, attach the shelf to the top end of the sides and to the upper rail. Just one screw joins the shelf to the sides, while three screws secure it to the upper rail.

Measure the distance between the two sides and cut the dowels to length. The long dowel should extend at least $\frac{1}{4}$ in. into the $\frac{3}{8}$ in. deep hole in each side. The short dowels should be cut about $\frac{1}{16}$ in. less than the distance between the sides.

Sand and Finish the Parts

Remove the screws from the assembled rack so that all the parts, including the stretchers and dowels, can be final sanded. Sand each of the parts thoroughly, finishing with 220-grit. Take particular care when sanding the dowels, as rough edges will easily snag on delicate fabric.

Before final assembly, we applied two coats of varnish to all parts except the stretchers and dowels. Don't use shellac or any other of the clear finishes that won't stand up well to dampness or moisture. The stretchers and dowels were left unfinished.

Also, it's probably not a good idea to stain the stretchers and dowels, as some stains tend to "bleed." If that happened, your favorite sweater might come off the drying rack with an unwanted accent stripe.

Assemble the Rack

Looking at the exploded view, you'll note that each end of the rack has three long stretchers and a short stretcher on the *inside*, and three long stretchers and a short stretcher on the *outside*.

Begin by inserting three short dowels through the middle holes of the long *inside* stretchers. Note that the dowels must extend through the holes the $\frac{1}{2}$ in. thickness of the stretcher stock. Once you have the dowel extending the right distance, drive a $\frac{7}{8}$ in. long brad through the edge of each stretcher and into the dowel. Before driving the brad though, bore a pilot hole to help keep the stretcher and dowel from splitting. When joining these parts, you must make sure that the stretchers are lined-up (parallel) with each other when viewed



Photo A: Dry assemble the "H" subassemblies to all remaining parts



Photo B: Close up the rack and clamp together



Photo C: Lay the rack down and brad the outside stretchers

from the end of the dowel. Perhaps the easiest way to do this is to first attach the stretcher to one end of the dowel, then add the second stretcher while all three parts lay flat on your workbench. When completed, this subassembly has a shape that looks much like an "H".

Next, as shown in Photo A, all the remaining stretchers and dowels (except

the long dowel) can be dry assembled to the "H" subassemblies. We found that everything tends to stay together better if the assembly is done with the parts on end as shown.

When all is dry-assembled, close-up the rack, then use a clamp and a couple of pieces of scrap stock to help hold the upper parts together (Photo B). Now, carefully lay the assembly on the workbench as shown in Photo C. With the rack in the closed position, drill pilot holes for $\frac{7}{8}$ in. long brads in each end of the *outside* stretchers. Do one end at a time, first drilling the pilot hole, then driving the brad.

Do not add a brad to the middle hole of the long stretchers, or to the ends of the two *inside* short stretchers. A brad in any of these holes will prevent the rack from opening.

Because the two inside short stretchers don't have a brad at either end, they may slide out of position a bit if the rack is used a lot. We solved the problem by slipping a small rubber "O-ring" on each end of the dowel before assembly (see detail). You can find "O-rings" in the plumbing section of your hardware store. As another option, you can drive a short brad into the dowel just inside each stretcher.

Final Assembly

Using the screws from the test assembly done earlier, attach the upper and lower rails to one of the stile/side subassemblies. Now, slide the long dowel through the stretcher holes in the rack and into the pivot hole in the side, then add the other stile/side. Finally, attach the shelf to complete the assembly. By the way, the screws provide plenty of strength, so there is no need to add any glue to these joints. And, by not using glue, you'll be better able to make repairs should any part of the rack ever get damaged.

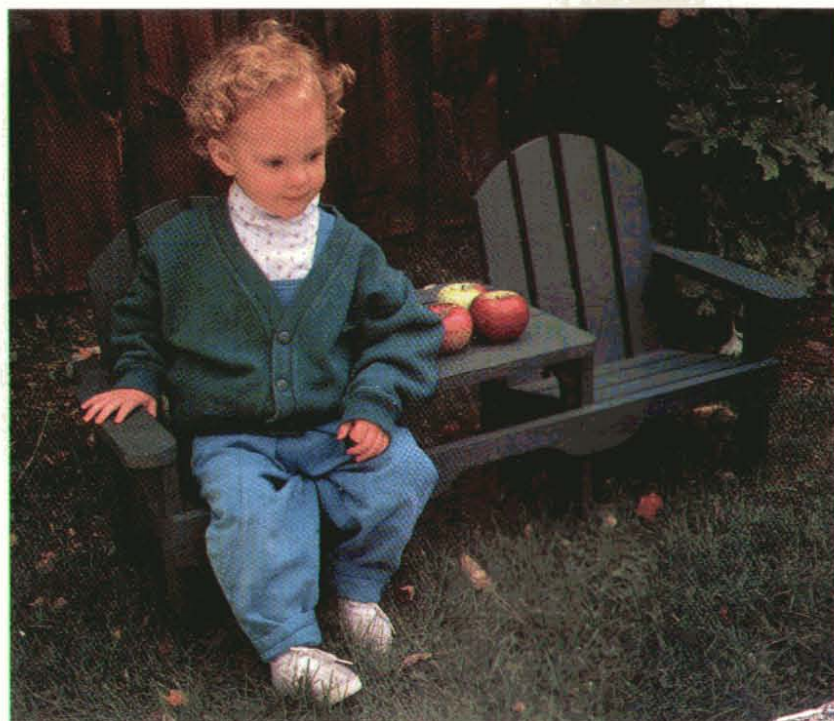
With the parts assembled, check to see that everything operates smoothly as it's opened and closed. If all looks okay, the project is ready to be mounted to the wall.

Make sure the rack is mounted securely, as it will be under a bit of strain when wet towels are hanging from it. Ours is mounted with two screws driven through the upper rail, just under the shelf. They were spaced 16 in. apart so that we could be assured of screwing into two wall studs.





Kids' Adirondack Chair & Settee



Country comfort for the little ones

In woodworking, a plan that marries a simple, easy-to-make design, with attractive looks and functionality is as scarce as the proverbial hen's tooth. All too often, we find a project that we really like, only to discover that a multitude of little details means that to make the piece, someone would just about have to be a rocket scientist. Even a project as elementary as an Adirondack chair may include miter, bevel or even compound angle cuts.

With this in mind, we set out to make this child's Adirondack chair and settee

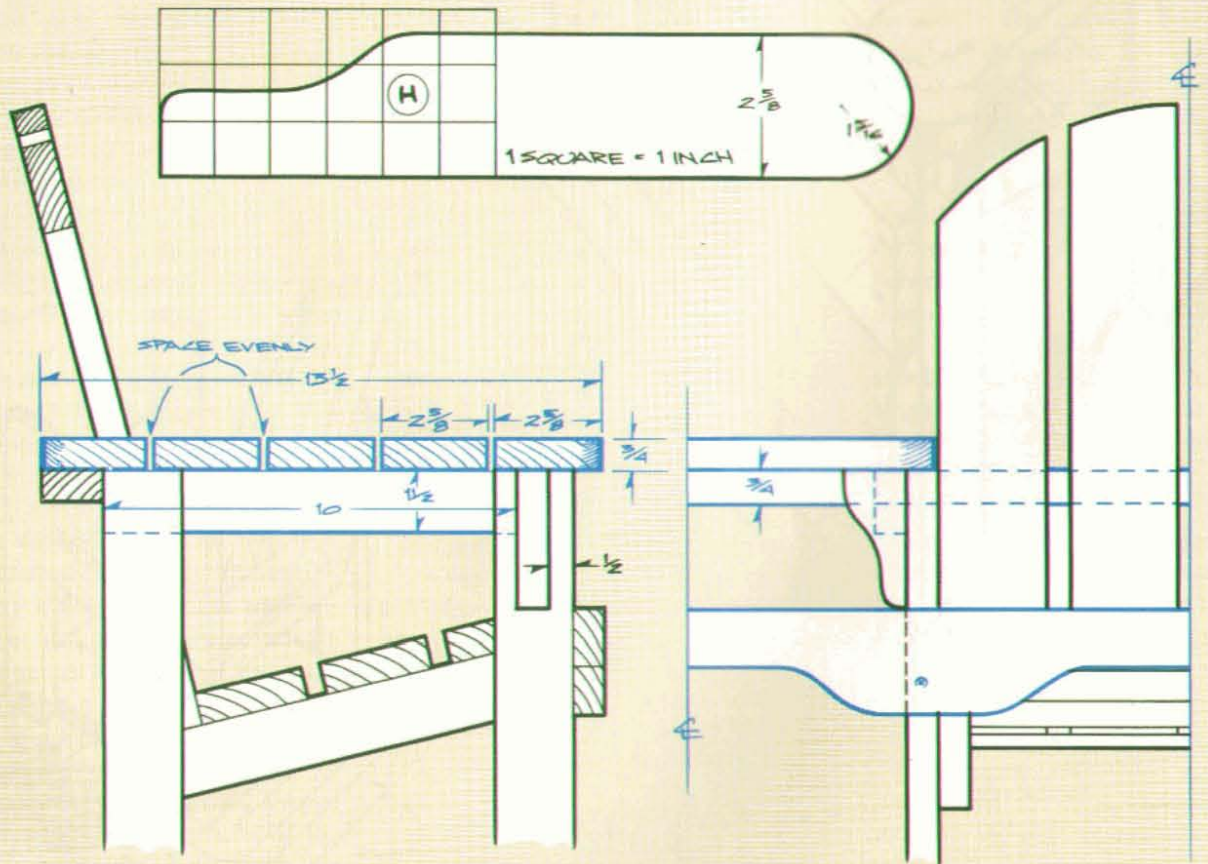
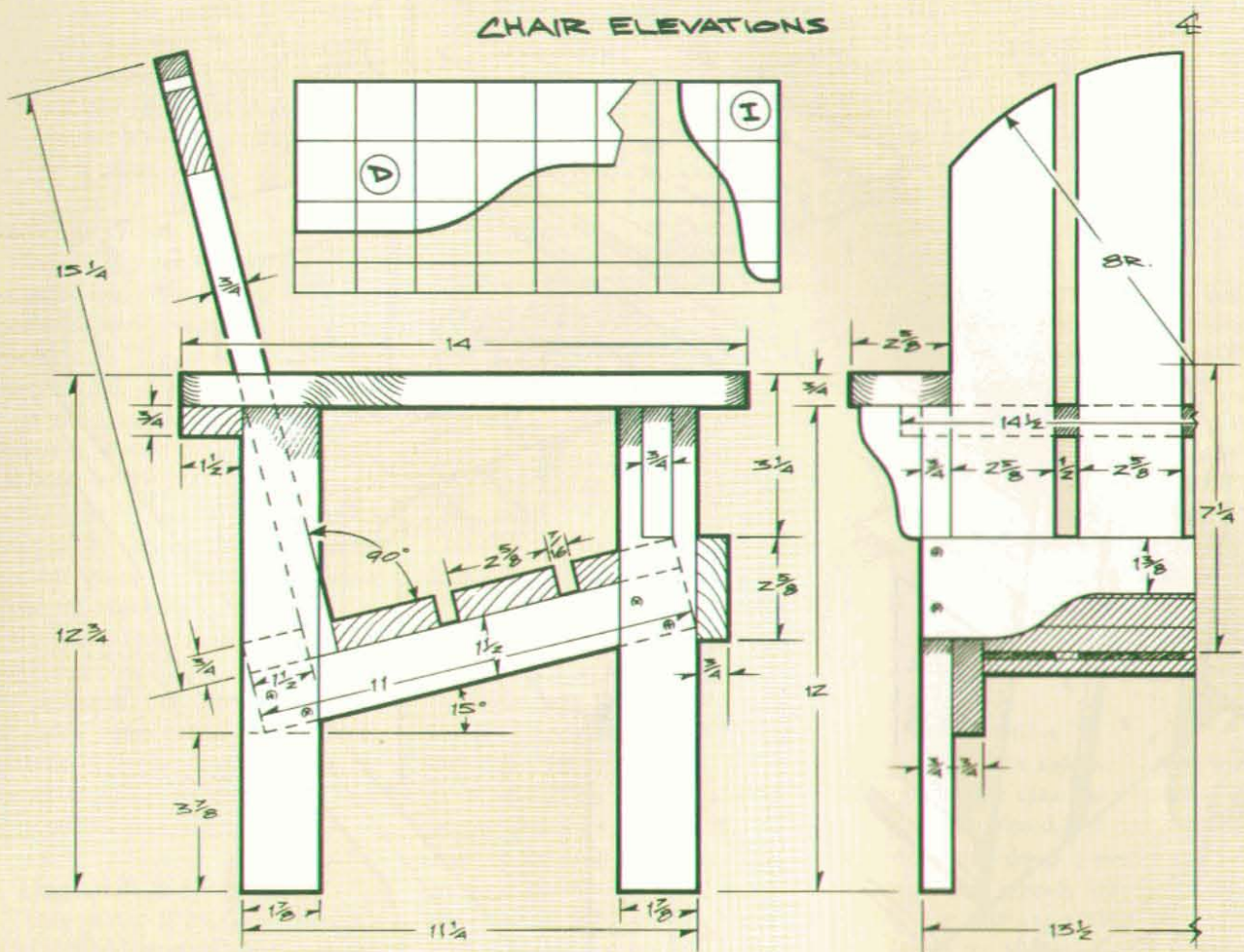
as easy to build as possible. Basing our design on traditional Adirondack chair structure, we've captured all the elegant simplicity of this venerable style, while eliminating all the fuss.

These projects are perfect starter pieces, especially if you're just getting acquainted with woodworking. All parts are obtained from $\frac{3}{4}$ in. thick boards, so no thickness planing is required. Although we used pine, cedar or redwood are better choices (both will likely cost more than pine but will last far longer when exposed to the elements).

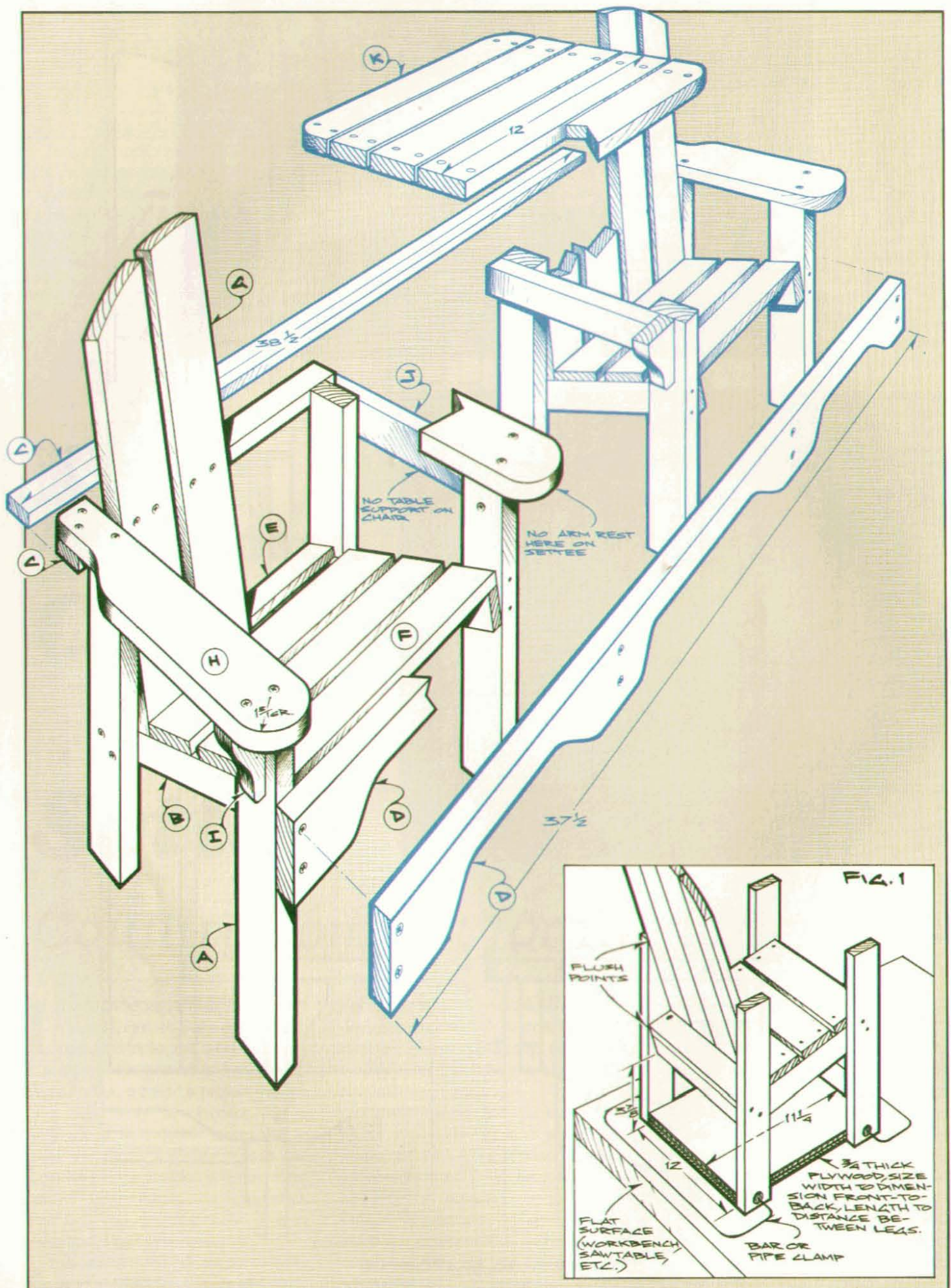
Since there are just three widths of stock required— $1\frac{1}{2}$ in., $1\frac{7}{8}$ in. and $2\frac{5}{8}$ in.—you can quickly and easily rip sufficient stock for the various parts. But perhaps best of all, there are no angle, miter or bevel cuts. With the exception of the shaped parts (for which we've provided full-size patterns), and the arc that's cut on the back slats, all cuts to length are simple 90-degree crosscuts.

The assembly of the chairs and settee is all accomplished with $1\frac{1}{4}$ in. long bugle-head screws—no glue is used. Galvanized or coated screws are fine,

CHAIR ELEVATIONS



SETTEE ELEVATIONS



but stainless-steel screws won't cost much more and will last forever. We painted our chairs and settee with an opaque exterior stain (Cabot's), but you could also just leave the wood plain and allow it to weather.

Buzz Some Wood

The chairs and settee share most of the same parts, including the legs (A), seat supports (B), seat stretcher (E), seat slats (F), back slats (G), arm rests (H), and brackets (I). The primary differences are that on the settee the back and front stretchers (C, D) are longer, and there are a few additional parts—specifically the table supports (J) and the table slats (K). In case you don't want to make both the chairs and settee, we've provided separate Bills of Materials.

Once you've ripped sufficient stock to the three required widths, cut the various parts to length. For the shaped parts, refer to the appropriate grid patterns, transfer the patterns to the wood, and cut out with a jigsaw or band saw. Then sand to remove any saw marks.

Get That Drill & Screwdriver

With your parts all cut, assembly is a simple matter. Chuck up your drill and screwdriver with a combination drill/countersink bit and driver bit, respectively, and get to work (don't drive the screws without first drilling pilot holes and countersinking, or you'll end up splitting the wood).

Whether you are working on the chair or the settee, the assembly sequence of both is identical for most of the way. Start by screwing the seat stretcher to the two seat supports. Screw the back slats to the seat stretcher, spacing the slats $\frac{1}{2}$ in. apart as shown, then mount the seat slats, spacing them $\frac{7}{16}$ in. apart.

Next, mount the legs to the seat supports. This may seem easy to do, but it can be difficult to get all four legs indexed correctly. Our Fig. 1 illustration shows a trick that you can use with this and similar assemblies where you are trying to get all the legs on the same plane. Just cut a piece of $\frac{3}{4}$ in. thick plywood to a length that's equal to the desired spacing between the legs (12 in. on the chair), and to a width that's equal to the front-to-back dimensions of the legs (11 $\frac{1}{4}$ in. on the chair). With the plywood on a flat surface, locate the legs at the four corners and use bar or pipe

Bill of Materials

(all dimensions actual)

Part	Description	Size	No. Req'd.
Chair			
(No. req'd is for one chair)			
A	Leg	$\frac{3}{4}$ x 17/8 x 12	4
B	Seat Support	$\frac{3}{4}$ x 11/2 x 11	2
C	Back Stretcher	$\frac{3}{4}$ x 11/2 x 14 1/2	1
D	Front Stretcher	$\frac{3}{4}$ x 25/8 x 13 1/2	1
E	Seat Stretcher	$\frac{3}{4}$ x 11/2 x 12	1
F	Seat Slat	$\frac{3}{4}$ x 25/8 x 12	3
G	Back Slat	$\frac{3}{4}$ x 25/8 x 15 1/4*	4
H	Arm Rest	$\frac{3}{4}$ x 25/8 x 14	2
I	Bracket	see full-size pattern	2

* Length of back slats is before arc is cut.

clamps across the front and back pairs of legs to hold them in position.

You can now locate the seat/back subassembly as shown in the side view, and screw it in place through the four legs. We show the seat/back subassembly at a 15 degree angle to the floor, but don't get out your angle finders and bevel squares for this job. The important points here are to first scribe an index line (on the inside of the back legs) $3\frac{7}{8}$ in. from the bottom, and then position the seat/back subassembly so the bottom corner of the seat support is flush with the index line, the back edge of the seat stretcher is flush with the back edge of the back legs, and the back plane of the back slats is aligned with the top back corner of the back legs. This is a lot to say in one sentence, but a glance at our Fig. 1 illustration should clarify just what points we are referring to.

If you are making the individual

chairs, all that remains is to mount the arms, the brackets and the front and back stretchers, and scribe and cut the 8 in. radius on the back slats. Mount the arms and brackets, then add the front and back stretchers, and last of all, screw through the back slats into the back stretcher. Finally, scribe the 8 in. radius, cut with a jigsaw and sand smooth.

For the settee, first make both chairs (each a separate assembly). Screw the arm rests, brackets and table supports in place on each of the chairs, then join the two chairs by mounting the front and back stretchers (obviously, the chairs should be on a flat surface when you join them). Screw through the back slats into the back stretcher, scribe the 8 in. radius on the back slats, cut and sand smooth. Lastly, add the table slats, spacing them evenly apart. Note that the four corners of the table surface are gently radiused.

Feel Creative?

Now that the kids are kicking back in the great little chairs and settee that you've just completed, you may be about ready to settle down yourself. If so, you're probably already asking yourself, "Can I use this same basic design and just scale the plans up to a full-size, adult version?" The answer is yes. You'll need to increase stock lengths and widths accordingly, and make a few other changes. Here are a few dimensions to get you started.

The leg length on the adult version should be 20 in., which will yield a 20 $\frac{3}{4}$ in. total arm rest height. The distance between the legs—and the length of the seat slats—should be about 20 in., the front-to-back dimension of the legs should be about 19 in., and the back slat length should be at least 24 in. And, you'll want to switch to wider stock—such as 4 in. to replace those parts that are 2 $\frac{5}{8}$ in.—for just about all the parts.

But there are other more subtle changes that you'll need to work out as you go. For example, you can't switch to 4 in. wide boards for the back, and space them $\frac{1}{2}$ in. apart, since the total adds up to less than the 20 in. total width required. Instead, use five boards about 3 $\frac{5}{8}$ in. wide each, and space them evenly to fill the 20 in. width. With some thought, and another trip to the lumberyard, you shouldn't have much trouble coming up with adult-sized versions of our kid-sized Adirondack set.

Bill of Materials

(all dimensions actual)

Part	Description	Size	No. Req'd.
Settee			
(No. req'd is for one settee)			
A	Leg	$\frac{3}{4}$ x 17/8 x 12	8
B	Seat Support	$\frac{3}{4}$ x 11/2 x 11	4
C	Back Stretcher	$\frac{3}{4}$ x 11/2 x 38 1/2	1
D	Front Stretcher	$\frac{3}{4}$ x 25/8 x 37 1/2	1
E	Seat Stretcher	$\frac{3}{4}$ x 11/2 x 12	2
F	Seat Slat	$\frac{3}{4}$ x 25/8 x 12	6
G	Back Slat	$\frac{3}{4}$ x 25/8 x 15 1/4*	8
H	Arm Rest	$\frac{3}{4}$ x 25/8 x 14	2
I	Bracket	see full-size pattern	4
J	Table Support	$\frac{3}{4}$ x 11/2 x 10	2
K	Table Slat	$\frac{3}{4}$ x 25/8 x 12	5

* Length of back slats is before arc is cut.

BACK ISSUES

Vol. 9 No. 3 May-June '85 Wall Cabinet with Recessed Finger Pulls, Shaker Desk, Kitchen Cart, Contemporary Wall Clock, Colonial Wall Sconce, Card Box, Towel Bar with Glass Shelf, Marble Race Toy, Cradle, Vanity Mirror, Miter Clamping Jig, Jacobean Joint Stool; *Articles:* Product Liability: Part I; Restoring an Antique Frame; Coping with Wood Movement; Making Recessed Finger Pulls.

Vol. 9 No. 6 Nov-Dec '85 Dulcimer, Dining Table, Shaker Washstand, Marking Gauge, Veneered Wall Clock, 4 x 4 Off-Roader, Teddy Bear Puzzle, Duck Pull-Toy, Landscape Cutting Boards, Early American Tall Clock, Desk



Slant-Front Desk N/D '92

Organizer, Moravian Chair; *Articles:* Weaving a Rush Seat, Part I; Table Saw Ripping Problems and Solutions; 4-Piece Book Match Veneering; Running a Profitable Business.

Vol. 10 No. 1 Jan-Feb '86 Chippendale Bachelor's Chest, Oriental Serving Tray, Country Bench, Antique Knife Tray, Tape Dispenser, Valentine Box, Toy Tow Truck & Car, Shaker Drop-Leaf Table, Shop-

Made Bow Saw, Child's Settle Bench, Plate Shelves, Freestanding Shelf System; *Articles:* On Getting Paid for Your Work; Weaving a Fiber Rush Seat, Part II; Table Saw Crosscutting; Router-Lathe Fluting: A Shop-Made Approach.

Vol. 10 No. 3 May-June '86 Contemporary Lamp, Early American Bench, Steam-Bent Clock, Pine Hutch, Goose Basket, Toy Crane, Condiment Holder, Shop Workstation, Parsons Table, Shaker Lap Desk, Victorian Whatnot Shelf; *Articles:* Toymaker Clare Maginley; Flattening Warped Boards; Choosing a Router; Supported Steam Bending.

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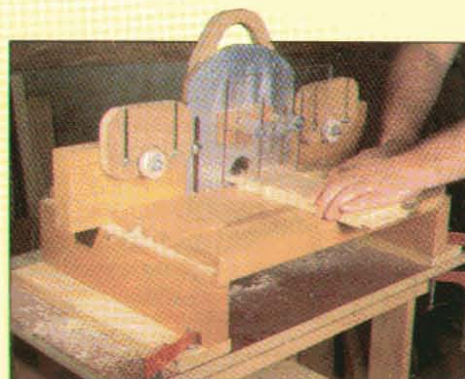
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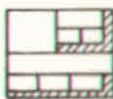
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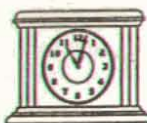
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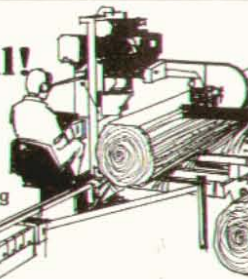
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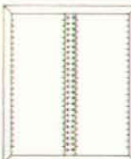


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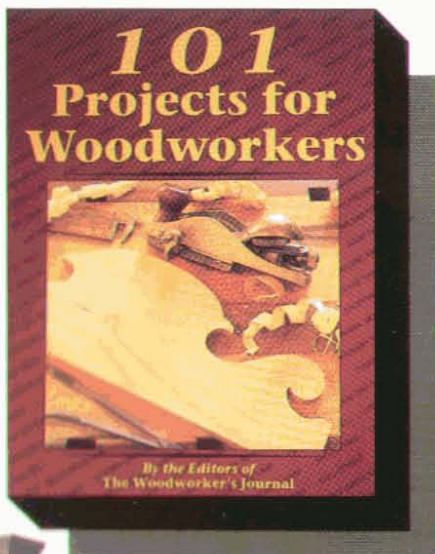
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