

The Woodworker's Journal

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Projects:**

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- Router-built
Wall Cabinet
- Stick & Cope
Doorbuilding

Tool Review
High-End
Scroll Saws

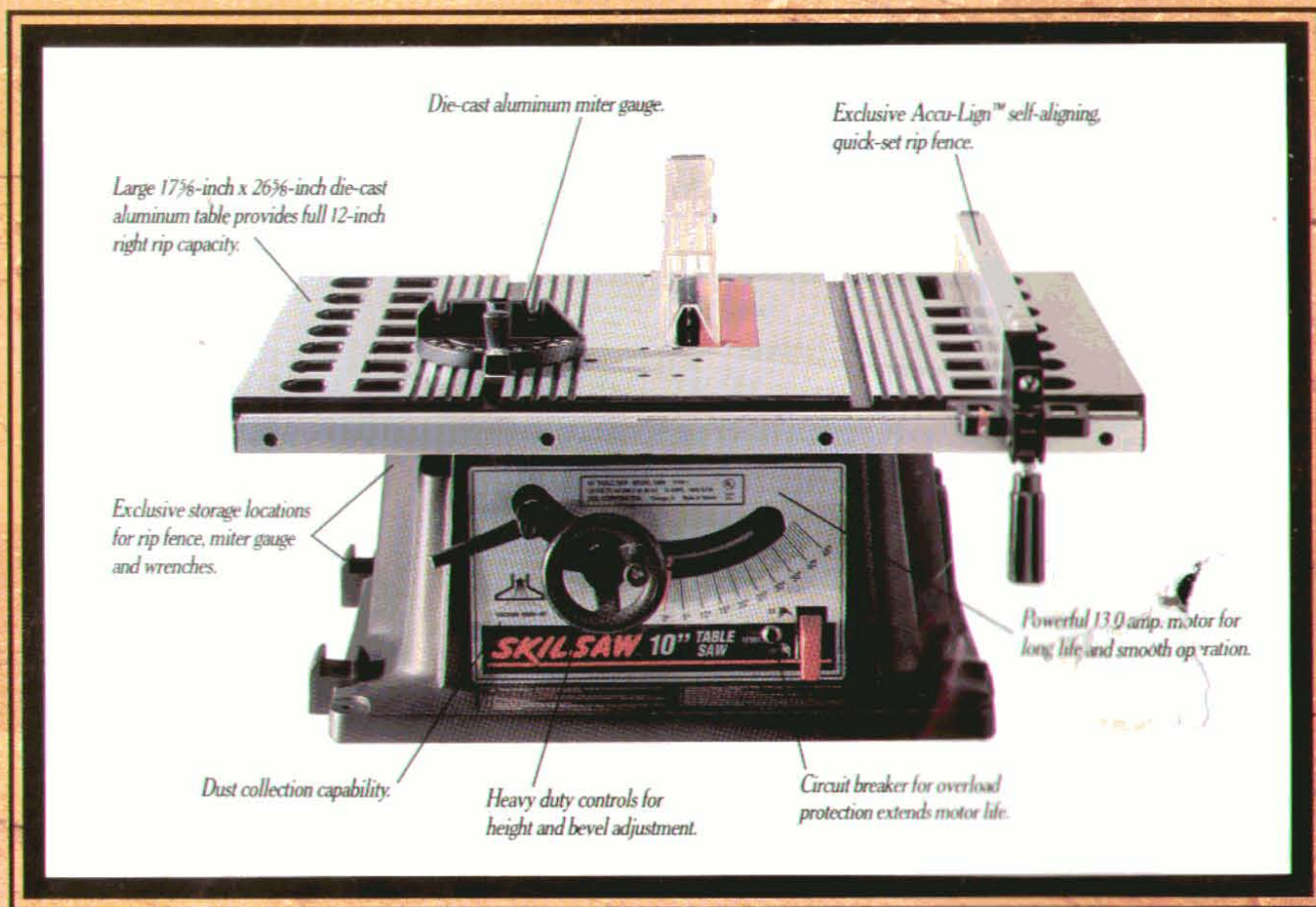
Step-by-step:
Linenfold Carving

Great Project Plans: Futon Bed
Tick • Early American Doll Bed
Box • Scroll-Sawn Nativity Scene

Vol. 16, No. 6

November/December 1992

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The Woodworker's Journal

NOVEMBER/DECEMBER 1992 VOLUME 16, NUMBER 6

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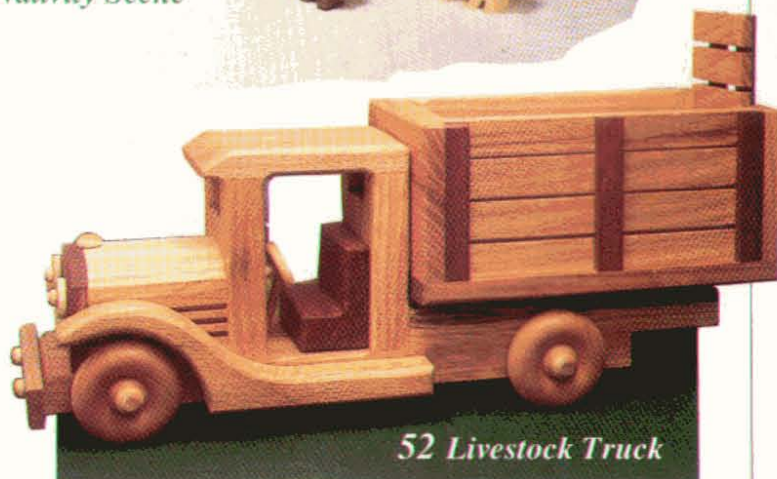
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Shoptalk

Getting to Know You

Every so often we get letters from woodworking traditionalists protesting the use of plastic laminates, particleboard and other such manmade products. Generally, they also disdain the extensive use of machinery and what they refer to as "high-tech woodworking." They not only collect antique hand tools but also use them regularly.

On the other side of the coin, there are readers working in the contemporary mode who accuse us of devoting too much space to traditional hand tool methods and period furniture projects. These woodworkers eagerly seek out new tools, materials and methods.

More than anything else, editors want and need to know just who their readers are and what they want, so we pay very close attention to these letters and try to categorize them as traditional or contemporary oriented . . . or somewhere in between.

Apart from unsolicited letters, the best way for us to find out more about our readers' needs is to survey a good percentage of them. Some of you may have, or soon will receive a questionnaire which will give you the opportunity to let us know what kind of woodworker you are. It's your chance to help change a small part of your world . . . and a big part of mine.

As the year draws to a close, the staff and I would like to wish you and yours tranquility, good health, and good woodworking in 1993.



Staff of The Woodworker's Journal—Row 1: Michael Gellatly; Row 2: Maureen Murphy-Gereg, Jim McQuillan; Row 3: Tom Begnal, Dan Thornton; Row 4: David Peters, Mark Ziobro; Row 5: Lynda Morris, Pat McLean, JoAnne Finkle; Row 6: Pat Malumphy, Kathy Shook; Row 7: Lynne Streeter, Kim Gellatly

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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 enjoyed reading the article in your March/April 1992 issue that described how to make the Salt and Pepper Shaker Combo. In fact, I ordered a tap and die set, and the Forstner bits needed to make the project. However, I'm having problems tapping threads in the holes, which were bored into the end grain. Am I doing something wrong, or is my tap defective?

Al Westbrook, Bellmore, N.Y.

Although it's difficult to tell from the project photo and art, the tap holes are bored into the edge-grain of the stock, not the end-grain. That means, when looking at the photo on page 42, the grain is running side-to-side on the page, as opposed to top-to-bottom.

Grain direction is important here because, as we learned when we contacted the folks at American Machine and Tool (AMT)—who manufactures wood cutting taps and dies—it's just about impossible to tap a thread in a hole that's bored into end grain.

Once you get the grain running in the right direction, your tap should cut the threads with a minimum of fuss. By the way, based on the above, you might think a die would be unable to cut a thread on a dowel, which has nothing but end-grain. But, because the basic cutting action of a die differs from that of a tap, a dowel will thread with little difficulty.

I am making The Big Rig Tractor/Trailer Toy from your July/August 1992 issue, but am unable to locate the Preserve Natural Non-Toxic Nut Oil you used for a finish. Can you give me the name of a supplier?

Allan J. Fairley, Urbandale, Iowa

Preserve, which is sold in an 8-ounce squeeze bottle, is available from Woodcraft, 210 Wood County Industrial Park, P.O. Box 1686, Parkersburg, WV 26102-1686; tel. 1-800-225-1153, or Woodworker's Supply, 5604 Alameda Place N.E., Albuquerque, NM 87113; tel. 1-800-645-9292.

It's been quite a while since Walker-Turner tools have been sold. Would you know where to get parts for any of those old machines?

Ed Collins, Coshocton, Ohio

There's a good chance you can get parts (or parts lists) for old Walker-Turner tools by writing or calling Robert Archer, Discontinued Product Specialist, Delta Machinery Co., 4290 East Raines Road, Memphis, TN 38118; tel. (901) 363-2843. Delta purchased Rockwell Tools a few years ago, several years after Rockwell purchased Walker-Turner.

HOW TO GET STUCK WITH WOOD ADHESIVE.

Buy the traditional yellow glue. It runs. It streaks.
It makes the job messy. And adds steps like cleaning and sanding
that you really don't have time for.



Mr. Archer told us that in most instances he is able to provide parts lists for old Walker-Turner tools at no charge. And, in about 60 percent of the cases, he is able to supply a replacement part (price on request). The parts and parts lists cover tools that were manufactured as early as the 1930's.

I enjoyed making the Intarsia project (The Knothole Gang) featured in your May/June 1992 issue. Where can I get more of these designs?

Leo S. Godelesky, Whitehall, Penn.

Robert Hlavacek, who provided us with that project, sells plans for a number of other intarsia designs. For more information, write to Robert J. Hlavacek, P.O. Box 1246, North Riverside, IL 60546. Also, Berg Sales and Service, 215 Main Street East, Powassan, Ontario, Canada P0H 1Z0 has over 60 intarsia patterns to choose from. Write them for a free brochure.

Odds and Ends

Our July/August 1992 issue featured an article on cordless tools (The Cordless Tool Revolution), however, we neglected to include the Skil Corporation in the list of sources. For more information on their cordless tools write to the Skil Corporation, 4300 West Peterson Ave., Chicago, IL 60646; tel. (312) 794-7495.

The Cincinnati Woodworking Club meets regularly at Reading High School. If you would like more information, contact the club at P.O. Box 428525, Cincinnati, OH 45242.

The Woodworker's Association of Arkansas meets the first Monday of each month at the Woodworker's Supply Center, 6110 Carnegie, Sherwood, Ark. Meeting time is 7 pm. For more info call (501) 835-7339.

The Warrensburg Woodworkers Guild

meets regularly at the Parks and Recreation Building, 510 East North Street, Warrensburg, Missouri.

Your safety is important to us . . . We strive to present our plans and techniques as accurately and safely as possible, and we try to point out specific areas and procedures where extra caution is required. But because of the variability of local conditions, construction materials and personal skills, we can't warn you against all potential hazards. Remember to exercise common sense and use safety measures when operating woodworking power equipment. Don't attempt any procedures you're not comfortable with or properly equipped for. Sometimes, for the sake of clarity, it's necessary for a photo or illustration to show power tools without the blade guard in place. In actual operation, though, you should always use blade guards and other safety devices on power tools that are equipped with them. Remember . . . an ounce of prevention really is worth a pound of cure.

—The Editors

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Events

We will gladly list as many events of interest to woodworkers as space permits. Listings are free and may include shows, fairs, competitions, workshops and demonstrations. The deadline is eight weeks before publication—January 2 for the March/April 1993 issue. Please address announcements to the Events Department. Readers planning on attending events should call ahead if possible. Scheduled dates and locations sometimes change between publication and the date of the event.

California: The San Diego Woodworking Show, Nov. 13–15, Del Mar Fairgrounds, Exhibit Hall, Del Mar. For more information call 1-800-826-8257.

The Southern California Woodworking Show, Nov. 20–22, Long Beach Convention Center, Hall 3, Long Beach. For information call 1-800-826-8257.

The Northern California Woodworking Show, Dec. 4–6, San Mateo Expo Center, Fiesta Hall, San Mateo. For information call 1-800-826-8257.

Canada: (Nova Scotia) The Atlantic Woodworkers' Association is planning a weekend workshop in Chairbuilding with Michael Dunbar Nov. 13–15. For more information call Valda Kemp at (902) 425-6422.

Colorado: The Colorado Woodworking Show, Nov. 6–8, National Western Complex, Expo Hall, Denver. For information call 1-800-826-8257.

Connecticut: The Brookfield Craft Center's 15th Annual Holiday Sale and Exhibition, Nov. 20 through Dec. 24, held at both the Brookfield and Norwalk locations. For more information, call the Craft Center at (203) 775-4526.

For information on classes at the Brookfield Craft Center, Brookfield and Norwalk, call (203) 775-4526.

The Creative Arts Workshop hosts the 24th Annual Celebration of American Crafts, a national juried and invitational exhibition, Nov. 9–Dec. 24, New Haven. For more information call (203) 562-4927.

The Guilford Handcrafts Center is sponsoring their 14th Annual Holiday Festival of Crafts, Nov. 7–Dec. 24, at the Mill Gallery, 411 Church Street, Guilford. For information call (203) 453-5947.

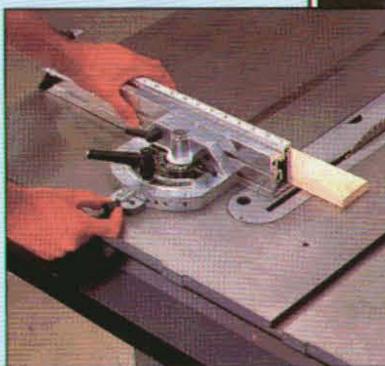
Illinois: The North Suburban Carvers are presenting an Artistry in Wood Show, Nov. 7–8, at the Chicago Botanic Gardens, Lake Cook Road, Glencoe. For more information call George Fisher, Show Chairman at (708) 394-1310.

Indiana: The Brown County Craft Guild will be sponsoring their 9th Annual Winter Art & Craft Fair, Nov. 27–28, at the Seasons Lodge Conference Center, State Road #46, Nashville. For information call Kathleen Sullivan at (812) 988-2596 or Joan Haab at (812) 988-7920.

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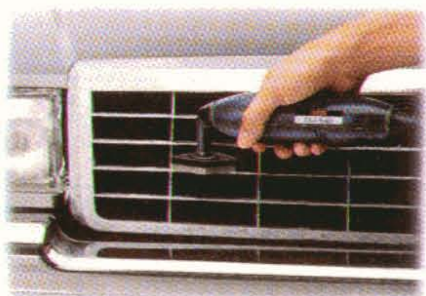
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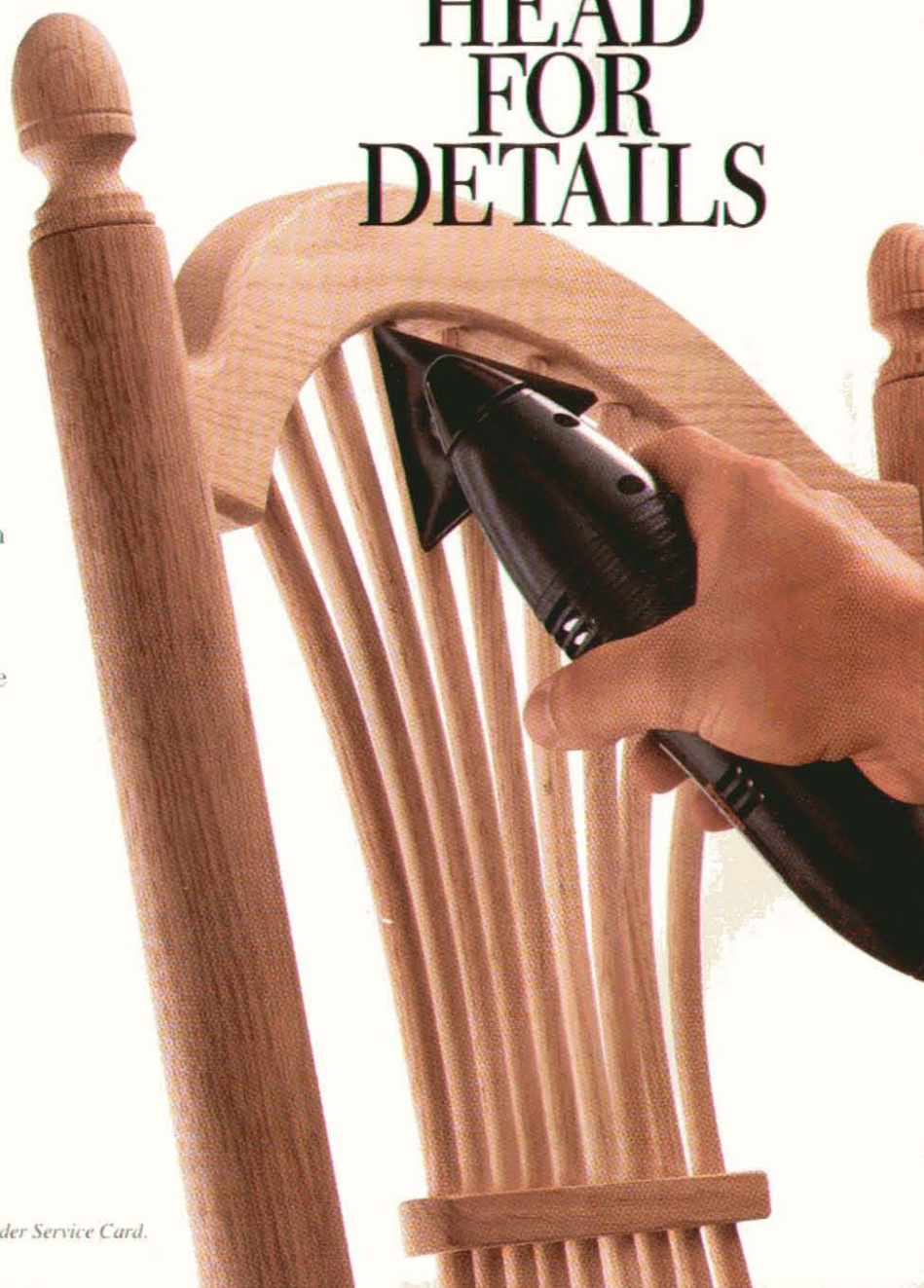
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A HEAD FOR DETAILS



Michigan: The Michigan Woodworkers' Guild will be sponsoring their first Wood Expo, Nov. 8, Royal Oak Senior/Community Center, Royal Oak. For information call (313) 345-6722.

New Jersey: South Jersey Woodcarvers' Annual Fall Show, to benefit Deborah Hospital of Browns Mills, Nov. 21-22, Mount Holly National Guard Armory, Mount Holly. For information call Paul Romaine (609) 468-7127 or Louise Wyckoff (609) 468-6846.

New York: Woodworking World—The Central New York State Show, Oct. 30-Nov. 1, Tri County Trade Center, Baldwinsville. For information, call 1-800-521-7623.

Oklahoma: Eastern Oklahoma Woodcarvers Association 8th Annual Wonderful World of Wood Show, Nov. 6-8, Eastland Mall, Tulsa. For more information call (918) 627-5169.

Oregon: Holiday Gift Show, Nov. 5-Dec. 24, Oregon School of Arts & Crafts, 8245 Southwest Barnes Road, Portland. For information call (503) 297-5544.

A seminar on Faux Finishes for Furniture, by Carol Connett, will be held Nov. 1 at the Oregon School of Arts & Crafts. For more information on this and other classes, seminars and workshops held throughout the year, write to the Oregon School of Arts & Crafts, 8245 Southwest Barnes Rd., Portland, OR 97225, or call (503) 297-5544.

The Oregon Woodworking Show, Oct. 30-Nov. 1, Portland Expo Center, Portland. For information call 1-800-826-8257.

Pennsylvania: Woodworking World—The Pittsburgh Show, Nov. 6-8, Expo Mart, Monroeville. For information call 1-800-521-7623.

Woodworking World—The Central Pennsylvania Show, Nov. 20-22, Pennsylvania Farm Show Complex, West Building, Harrisburg. For information call 1-800-521-7623.

The Philadelphia Craft Show, a juried exhibition and sale presented by the Philadelphia Museum of Art, Nov. 5-8, Civic Center, Philadelphia. For more information call (215) 787-5419.

Washington: The Northwest Carvers Association's 12th Annual Woodcarving Show, Nov. 7-8, Western Washington Fairgrounds Expo Hall, Puyallup. For more information write to the association at P.O. Box 6092, Federal Way, WA 98063-6092.

Wisconsin: Woodworking World—The Milwaukee Show, Nov. 13-15, Waukesha County Exposition Center, Waukesha. For information call 1-800-521-7623.



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Scroll Saw Article

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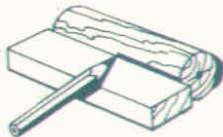
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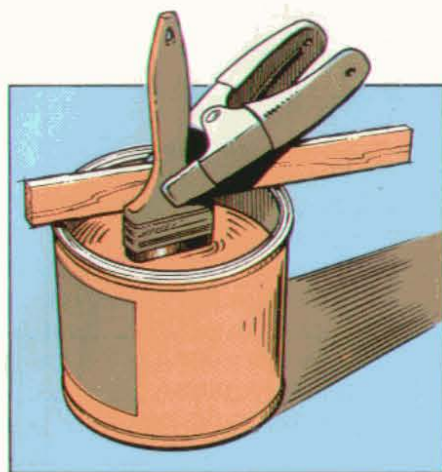
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Shop Tips



Try this trick next time you need to temporarily put down a brush when you're in the middle of a finishing job. Simply use a spring clamp to attach the brush handle to a stick of wood as shown.

Working with grid patterns can be annoying, given the time required to lay out your grid of 1 in. squares before you even start tracing the pattern profile. However, if you take a few minutes to make a permanent "pattern cutting board," you'll never have to lay out those 1 in. grids again.

It's easy to make the pattern cutting board. Just lay out a grid of 1 in. squares on a good-sized piece of stiff cardboard or hardboard (Masonite). Choose a size that is likely to take care of most of your future needs, and be sure that the lines are well darkened. A hole in an out-of-the-way corner will make it easy to hang on the shop wall.

To transfer a pattern, simply lay sewing pattern paper (also called tracing vellum) over the pattern cutting board and temporarily secure it in place with a few pieces of masking tape. The lines on the board will show through the pattern paper, allowing you to easily transfer the points and draw the pattern. No need to draw the grid squares.

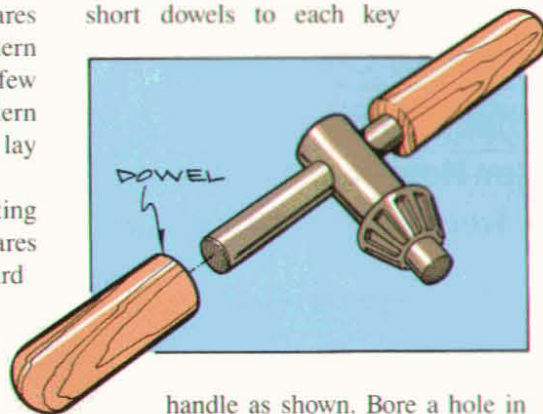
A 2 ft. wide by 30 ft. long roll of tracing vellum sells for about \$7. (In a pinch, though, most any light-transparent paper will do.) And, if you don't

want to make your own, you can buy a pattern cutting board. One measuring 40 in. by 70 in. will cost around \$7. Tracing vellum and pattern cutting boards can be found in most sewing centers or department stores.

A.B. Beavers, LaMarque, Tex.

Plate joiner biscuits, made from compressed wood, are design to expand when water-based glue is applied. If, however, the biscuits absorb a lot of moisture from the air before they are used, they may not work as well. To help keep the biscuits dry, it's a good idea to store them in those airtight plastic Zip-Lock bags.

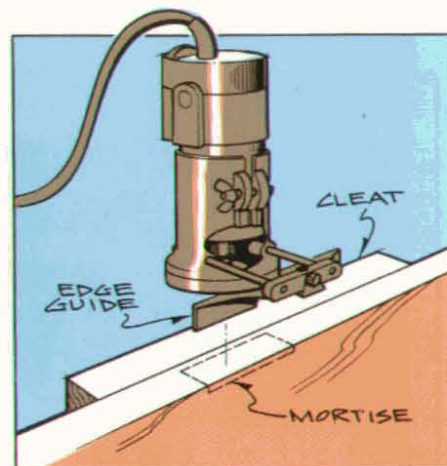
All woodworkers know that drill press chuck keys are not designed for comfort. However, you can make things considerably easier on your tightening hand if you secure a pair of short dowels to each key



handle as shown. Bore a hole in the end of each dowel to accept the key handles, then use epoxy glue to join the parts.

When a project has exposed screw-heads, many woodworkers prefer to use brass screws for the sake of appearance. However, brass screws are more expensive than those made from bright-steel, and they sometimes are harder to find. In a pinch, apply a couple of coats of orange shellac to the screw-heads. You'll be surprised how much like brass they will look.

A laminate trimmer, with an edge-guide and a straight bit, will come in handy for routing hinge mortises. A power rotary tool (such as the kind made by Dremel) that's equipped with a router



base can also be used.

First establish the mortise ends with knife or chisel, then set the edge-guide to the desired width, and the straight bit to the mortise depth. If you have one, a spiral down-cut mortising bit will work best here. When cutting the mortise on the edge of a board, it helps if you clamp a cleat, as shown, to help support the base of the tool.

Since a laminate trimmer or rotary tool is easily controlled by hand, you can cut right up to the knife or chisel line. Freehand back and forth action will quickly remove the waste. The rounded corners that remain can be cleaned up with the chisel.



The Woodworker's Journal pays \$25—\$100 for reader-submitted shop tips that are published. Send your ideas (including sketch if necessary) to: **The Woodworker's Journal**, P.O. Box 1629, New Milford, CT 06776, Attn: Shop Tip Editor. We redraw all sketches, so they need only be clear and complete. If you would like the material returned, please include a self-addressed stamped envelope.

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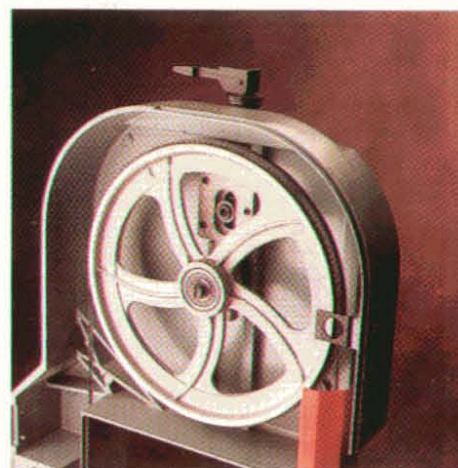
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Looking for an owner's manual for an old band saw? Need a bearing for a hand-me-down table saw? Can't find a source of supply for an odd piece of hardware? Maybe our readers can help. Send along your request and we'll try to list it here—and perhaps one of our readers will have an answer for you. We'll include as many requests as space permits.

I'm looking for an owner's manual and parts list for a Sears Craftsman scroll saw, model no. 103.23151.

Bill Marr
PO Box 623, 1600 Roundtop Rd.
Harrisville, RI 02830

I have a Grizzly drill press, model no. G1201, collar size is 3 1/2 in. I need to find a mortising attachment to fit the collar.

Dennis J. Lesko
PO Box 187
Eightyfour, PA 15330-0187

I need an owner's manual and parts list with instructions for installing a speedchanger on a Shopsmith model no. ER10.

Jim Martin
710 Park Ave.
Little Chute, WI 54140

Scrapping my venerable Craftsman jigsaw, model no. 103.23440. Mostly intact. Parts or entire unit free to anyone who pays shipping.

Carroll L. Spurling, M.D.
6944 Crest Road
Ranchos Palos Verdes, CA 90274

I need an owner's manual and parts list for a Craftsman 10 in. tablesaw, model no. 101-S10.

Dan Orgeron
556 Hydrangea Ave.
Orange, TX 77630

Looking for an owner's manual or a copy of one for a Craftsman benchtop drill press, model no. 335.25926.

Doug Bell
PO Box 918
Wikieup, AZ 85360

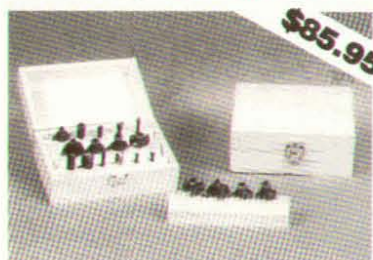
I need copies of owner's manuals and parts lists and parts for the following band saws: Sears 18 in., model no. 112.23580; Boice-Crane 14 in., model 2?? (the last two numbers are not legible). Boice-Crane was formerly of Toledo, Ohio.

Carlos D. Montgomery
605 N. Cambrian Ave.
Bremerton, WA 98312

I need the following parts for an old style 9 in. Delta-Rockwell table saw: tilt clamp, 1087381, no. 135 on the parts list; gear (24 teeth) with sleeve, 42216351001, no. 124 on parts list; positive drive belt, 49-082, no. 105 on parts list.

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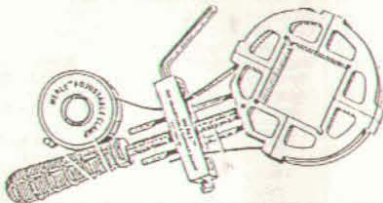
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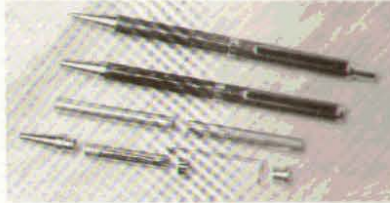


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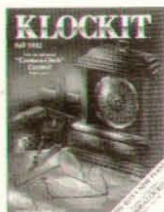
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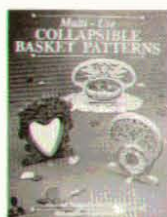
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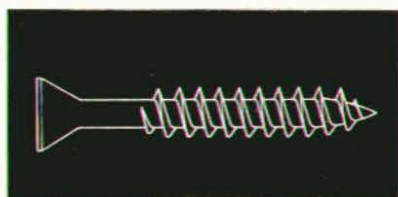
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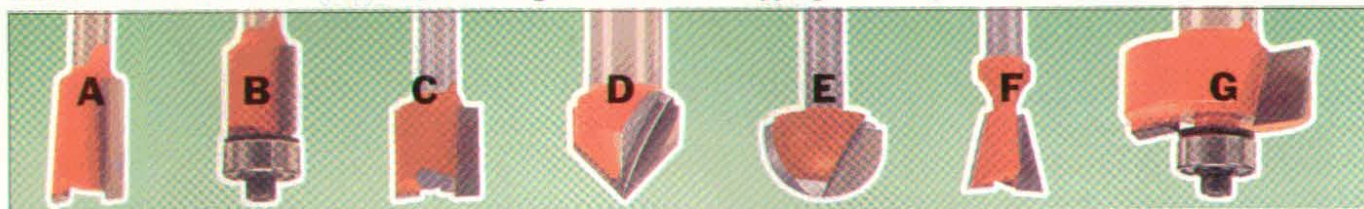


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801-627	1/2"	1/2"	3/4"	\$14.30
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806-096	1/4"	3/8"	1/2"	\$16.00
806-127	1/4"	1/2"	1"	\$16.40
806-128	1/4"	1/2"	1/2"	\$14.20
806-627	1/2"	1/2"	1"	\$16.10
806-628	1/2"	1/2"	1/2"	\$17.40
806-629	1/2"	1/2"	1-1/2"	\$18.40
806-630	1/2"	1/2"	2"	\$25.50

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811-081	1/4"	5/16"	1"	\$12.30
811-096	1/4"	3/8"	1"	\$12.30
811-127	1/4"	1/2"	3/4"	\$14.40
811-158	1/4"	5/8"	3/4"	\$15.40
811-191	1/4"	3/4"	3/4"	\$14.20
811-564	1/2"	1/4"	3/4"	\$15.30
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811-628	1/2"	1/2"	1"	\$15.20
811-660	1/2"	5/8"	1"	\$18.40
812-690	1/2"	3/4"	1-1/2"	\$21.40

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814-095	1/4"	3/8"	1/4"	\$20.40
814-127	1/4"	1/2"	3/8"	\$22.40

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F. Carbide Dovetail Bits

ITEM #	SHANK	DIA.	LGTH.	ANGLE	PRICE
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G. Carbide Rabbeting Bits

ITEM #	SHANK	DIA.	DEPTH	LGTH.	PRICE
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835-350	1/4"	1-3/8"	1/2"	1/2"	\$23.00
835-817	1/2"	1-1/4"	3/8"	1/2"	\$26.90
835-850	1/2"	1-3/8"	1/2"	1/2"	\$29.60

H. Carbide Cove Bits

ITEM #	SHANK	HEIGHT	RADIUS	PRICE
837-222	1/4"	1/2"	1/4"	\$26.00
837-286	1/4"	1/2"	3/8"	\$26.10
837-350	1/4"	5/8"	1/2"	\$26.20
837-722	1/2"	1/2"	1/4"	\$27.40
837-850	1/2"	5/8"	1/2"	\$29.60

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I. Carbide Roundover Bits

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838-317	1/4"	9/16"	3/8"	\$24.70
838-380	1/4"	3/4"	1/2"	\$27.90
838-754	1/2"	1/2"	1/4"	\$24.30
838-880	1/2"	3/4"	1/2"	\$34.90

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J. Carbide Chamfer Bits

ITEM #	SHANK	DIA.	HGHT.	ANG.	PRICE
836-130	1/4"	9/16"	1/2"	15°	\$21.50
836-190	1/4"	3/4"	1/2"	25°	\$21.50
836-420	1/4"	1-5/8"	3/4"	45°	\$27.70
836-920	1/2"	1-5/8"	3/4"	45°	\$26.90

K. Carbide Roman Ogee Bits

ITEM #	SHANK	LGTH.	RADIUS	PRICE
840-270	1/4"	1/2"	5/32"	\$28.40
840-350	1/4"	3/4"	1/4"	\$31.50
840-770	1/2"	1/2"	5/32"	\$30.30
840-850	1/2"	3/4"	1/4"	\$31.10

L. Carbide Slot Cutter Assemblies

Cutters have 1-7/8" diameter and a 7/8" ball bearing. Depth of cut 1/2". Choose 1/4" or 1/2" arbor.

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822-320A	\$23.10	822-320B	\$25.90	5/64"
822-324A	\$23.10	822-324B	\$25.90	3/32"
822-332A	\$23.10	822-332B	\$25.90	1/8"
822-340A	\$23.10	822-340B	\$25.90	5/32"
822-348A	\$23.10	822-348B	\$25.90	3/16"
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800-505	13-Pc. 1/2" Shank Set, w/ Cove, Rabbeting, Ogee, Chamfer, Roundover, Dovetail, Round Nose, V-Groove, Flush Trim, Mortising and 3 Straight	List: \$275.00	Sale: \$199.00

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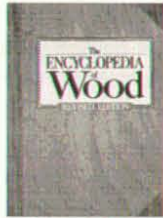
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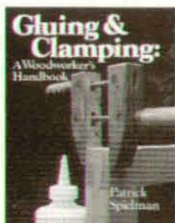
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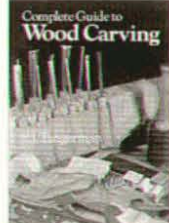
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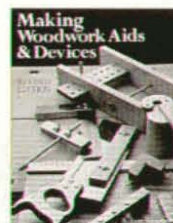
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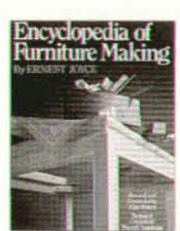
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Woodworking Basics

When you have to build a number of cabinet doors, fast, nothing beats a matched set of cutters, usually called a cope/stick or stile and rail cutter set. Traditionally, this job was done on a shaper but the trouble was that it required a lot of set up. A typical panel door set consisted of five or more special cutters that had to be assembled on the shaper spindle. Numerous trial cuts were necessary and often the spacing between the cutters had to be increased with paper shims so the tongue made with the cope set matched the groove made by the stick set. For one or two doors, I could hand-chop mortise and tenons and plane the groove faster than the time required to set up a shaper.

Enter stage right, cope/stick sets for router tables. What a joy, because much of the labor and guesswork is gone and setup is minutes instead of hours. I am

thankful, though, for all of those hours I spent struggling with the shaper. They taught me a number of tricks to produce professional results. Fortunately, these tactics carry over to the router table.

A Little History

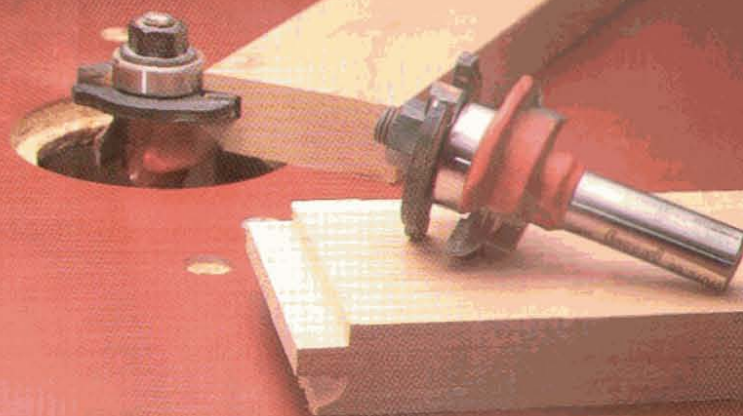
The terms stick and cope date from the days of hand-tool joinery. Understanding how they came about will help us to better understand the machine equivalent. In hand-tool joinery, to stick a molding is to clamp a suitable plank down on the bench and plane a molding shape on the edge. Such work is, of course, done with the grain and the finished molding is then rip-sawn from the wider board. The job was done in this way because it was easier to hold a wide board in the bench dogs than to hold a small molding.

Later, when machines replaced hand tools, the term sticking carried forward.

Using a shaper to mill a profile on square or rectangular boards was referred to as sticking or stickering. When sticking by machine, strips could be ripped to final width first on the table saw and no longer had to be separated from a wider board after the milling operation.

The term cope has a similar history. Most of us are familiar with the task of installing a crown or baseboard molding, and until the early part of this century such moldings were quite wide. When such a molding meets at an inside or outside corner, cutting the ends of each piece to a 45-degree angle is fine if the room is square. But even today it often is not. When faced with such a situation, a traditional workman would simply cut the first piece square to the corner. He would then cope the molding profile in the end of the mating piece. Armed with a coping saw, wood rasps, chisels and a knife he would adjust this profile until

Stick and Cope Doorbuilding



*Easy-to-make doors
on your router table*

by Ernie Conover

everything fit perfectly and so fudge for the room not being square. The term cope probably derives from the use of a coping saw as the main tool for this job.

Today any cut with a shaper across the end grain is known as a cope cut.

The Frame and Panel Door

The illustration at right shows a simple frame-and-panel door, consisting of a wood panel surrounded by relatively narrow strips of wood. Typically the strips at the sides of the door run from the extreme top to the extreme bottom and are called the stiles. The strips running horizontally at the top and bottom, between the stiles, are called the rails. Think of the rails of a split rail fence and you will never get the two mixed up.

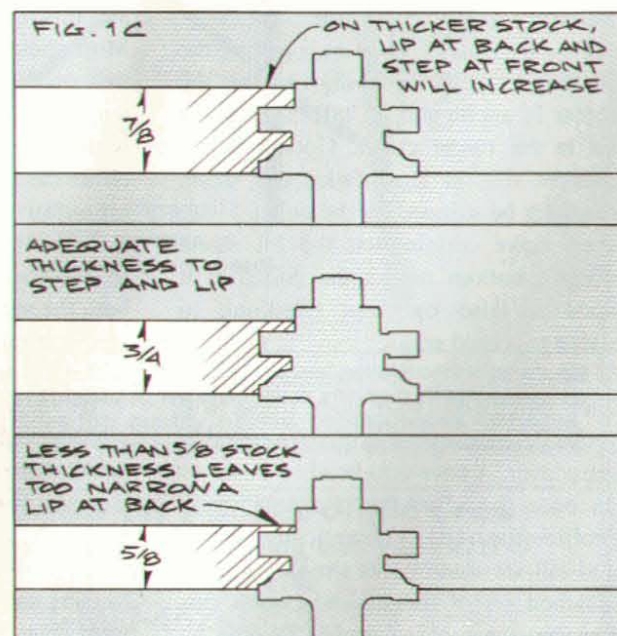
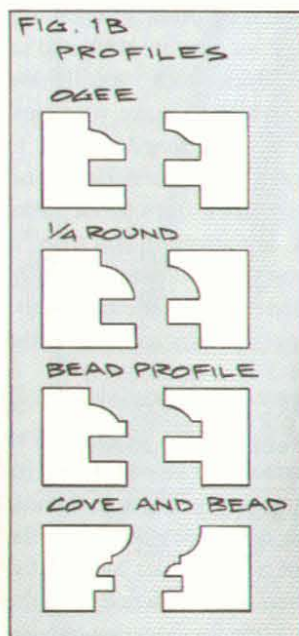
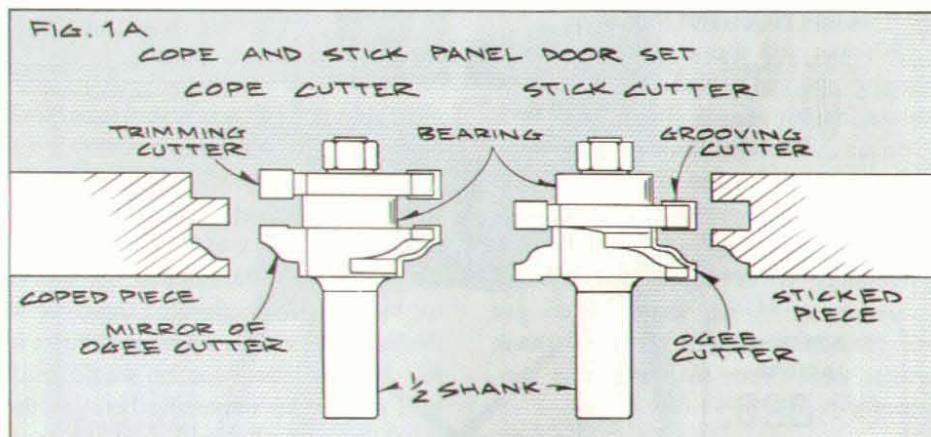
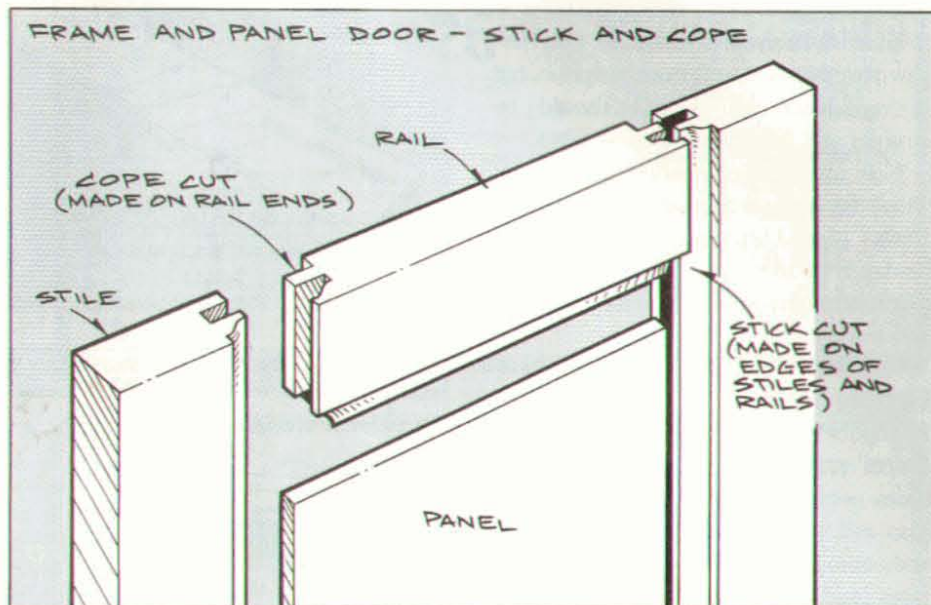
The stiles and rails have a groove running around the inside edge into which the panel is inset. The panel is sized smaller than the opening to allow for some wood movement side to side. In traditional joinery a tenon would be cut on the end of the rails and a corresponding mortise would be cut in the stiles. The result was a very strong door. The Shakers, with typical overkill, even cross-pinned the tenon with two wood pins at each corner to add mechanical strength, in case the glue failed.

The reason for using a mortise and tenon joint was to bring plank (or face) grain glue areas into contact, for as we all know, glue has little strength on end grain. Our stick/cope panel door set emulates this time honored method by coping a short tenon on the ends of the rails, which then fits within the panel groove. While this does not provide the glue area of a true mortise and tenon, it does give sufficient strength for most applications.

So, in a stick and cope door set there are two distinct cutter assemblies. One assembly mills a profile on the inside edges of the stiles and rails—this is the sticking set. The other assembly copes a profile matching that left by the sticking operation on the ends of the rails—this is the coping set (Fig. 1A).

Stock Preparation

By industry convention, panel door sets



are designed to work with $\frac{3}{4}$ in. material which is fine for most cabinet doors. Therefore, the first order of business is to plane $\frac{1}{4}$ material to $\frac{3}{4}$ in. Quarter-sawn lumber is best for our purposes but at minimum the boards should be straight and free from cup and wind.

Now joint one edge and rip sufficient strips for the stiles and rails from the freshly planed boards, as dictated by the demands of the job. I usually rip a few extra strips to allow for cutting mishaps and testing setups.

Getting Started

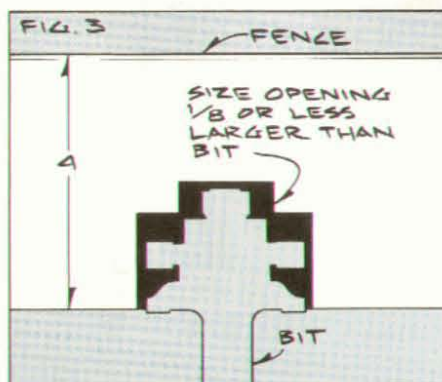
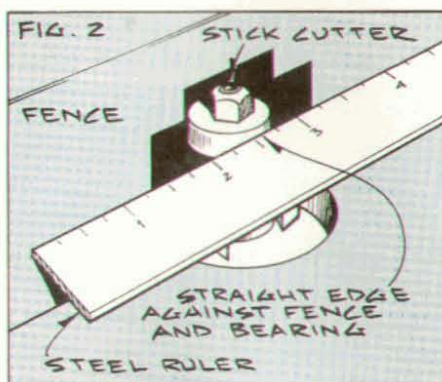
Remember, a few minutes spent on a proper setup will pay dividends many times over in safety and superior work. You will need a router table for sticking and coping. I use a router table that Dave Hout and I designed for use in our workshops and plans for this table can be found on page 47 of this issue.

Whether you use a plunge router or the conventional helical adjustment type router is immaterial, both have their partisans. The only limiting factors are horsepower and collet size. You'll need a $\frac{1}{2}$ in. collet router that delivers a minimum of $1\frac{1}{2}$ HP—with 3 HP being preferable. While panel door sets are available in $\frac{1}{4}$ in. shank, I do not recommend them, for the light shank makes them prone to chatter and slippage in the collet.

Setting Up For Sticking

Set the Bit Height: First up is setting the sticking bit height. Making sure that the router is unplugged, install the sticking bit in the router collet. Good practice dictates that at least twice the shank diameter be gripped by the collet. However, make certain that the bit shank doesn't bottom out in the collet. If it does, a false tightness (resulting in slippage) could result.

Depending on the style of bit you have purchased, your door frame will probably have either a quarter-round, a roundover, a cove-and-bead, a bead, or an ogee (or a reverse [Roman] ogee) profile (Fig. 1B). Theoretically, a stile and rail set could be as simple as just a matched set of tongue-and-groove cutters, but the molded profile favored by



most stile-and-rail sets makes for a much more attractive door frame.

The main objective in setting the sticking bit height is to allow enough material at the face of the door frame for the molded profile, without the groove for the panel being located too close to the back of the door frame. As shown in Fig. 1C, this latter situation would result in a narrow lip remaining between the panel groove and the back of the door, and this lip would be prone to breaking. Most stick/cope bit sets are designed so that on $\frac{3}{4}$ in. thick stock, you'll have ample area on which to make your cuts, without concern of getting too close to either the front or the back. A typical bit set will work on stock from about $\frac{5}{8}$ in. to $\frac{7}{8}$ in. thick, but anything less than $\frac{5}{8}$ in. and you won't have enough room for both the molded profile at the face of the stile and rail parts, and a solid lip at the back.

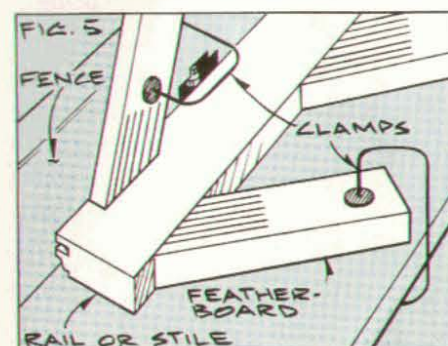
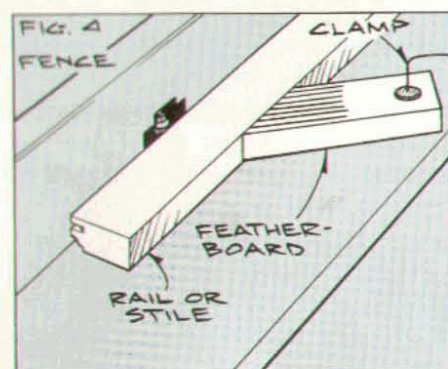
Set the Fence: Next, align the fence with the router bit set. The idea here is to position the fence so its face is flush with the ball bearing that will gauge against the stock. The easiest way to align the fence is to put a steel ruler against the bearing and then snug the fence up to the ruler (Fig. 2). I like the new one-handed

rubber-faced clamps for securing the fence, since I always seem to lack enough hands at times like this.

Most router table fences are not nearly high enough for comfortable stile-and-rail work. Ideally, the fence should be about 4 in. high, with an opening that closely matches the bits. I try to keep the opening profile within $\frac{1}{8}$ in. of the bit diameter. This will back up the work until just before it touches the bit, greatly reducing chipping ahead of the cutter (Fig. 3).

Locate the Featherboards: The next task is to place featherboards at key points on the table. Featherboards are indispensable in all shaper and router table work, as they hold the work down solid on the table, reduce the chatter, and act as a one-way ratchet preventing kick backs. If placed judiciously they even provide a degree of guarding around the cutter head. With a band saw or scroll saw they can be manufactured quickly, as the need arises. In a pinch, they can be made in minutes with a back saw. Without going into a long harangue, there is no excuse for not using plenty of featherboards!

For the average sticking situation, I like at least three featherboards. I use a C-clamp to secure at least one wide featherboard to the fence so as to hold





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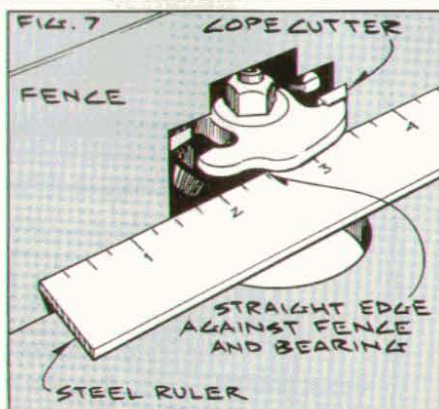
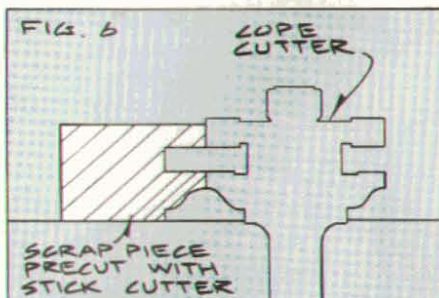
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Woodworking Basics

Continued



the work down solidly on the table directly over the cutter. In addition to preventing chatter at this critical area, it also provides some guarding of the cutter. I then clamp two or three featherboards flat on the table, so they hold the work securely against the fence.

There are several ways to set the featherboards. I first set a featherboard on the feed side of the router table, run a short length of material about halfway through (Fig. 4), turn off the router, and then set the featherboards above the cutter and on the outfeed side (Fig. 5). Then restart the router and complete the cut.

The nice thing about using featherboards is that you can push stock about half way, then with complete calmness walk around to the outfeed side and pull it the rest of the way through. If the bit is sharp there will not even be a sign that you paused. Armed with ear protection you can now stick all of the pieces safely.

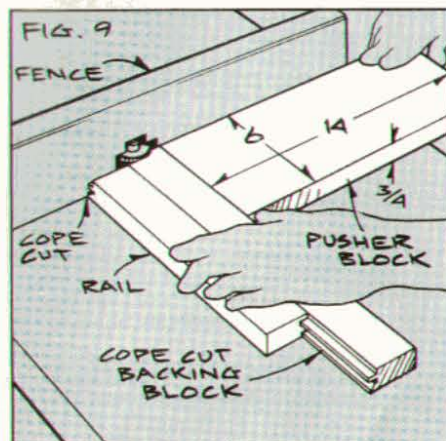
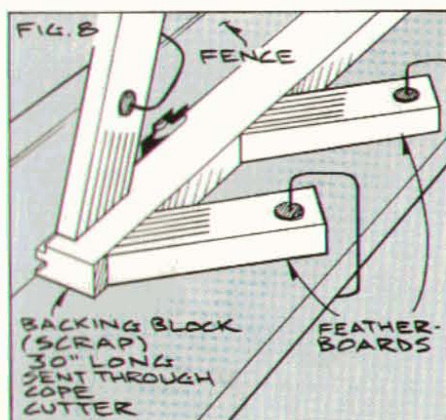
Coping the Ends of the Rails

Make a Coped Backup Block: Once all of the stiles and rails have been sticked, unplug the router and change to the coping bit set. Adjust the cutter height by comparing it to the work you have just completed as illustrated in Fig. 6.

Replace the fence and adjust it to the bearing guide with a steel ruler as we did in the sticking operation (Fig. 7).

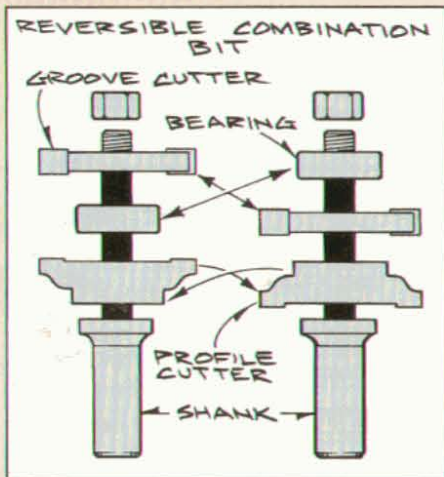
Now set up featherboards and stick about 30 in. of $\frac{3}{4}$ in. by $1\frac{1}{2}$ in. stock with the coping bit (Fig. 8). This material will provide backing blocks that can be placed in the sticked side of the rails during the coping cut. As the name implies, these blocks back up the cut and prevent splintering on that side. This small detail is not covered in any books or directions this author has come across, but is imperative if professional results are to be obtained.

Make the Cope Cuts: The traditional way of coping the rail ends is with a miter gauge, however, many router tables aren't slotted for a miter gauge. That is okay because my method does not require a miter gauge slot. Instead, use the fence, which is aligned with the cutter set, to guide a simple squared pusher block to advance the stock. Just square a piece of scrap (approximately 6 in. by 14 in.) on the table saw and use it to push the stock and backing block past



Single Cutter Sets: Worth the Savings?

Single cutter sets, in which the sticking parts are restacked on the router bit shank (the profile cutter is reversed, as is the stacking order of the bearing and grooving cutter) are sold for about 15–20 percent less than a two-bit set of matched cutters. In one popular catalog, for example the single cutter sells for \$65, while the two-bit set sells for \$75. The single cutter works fine, but is not nearly as convenient to use as the pair of matched, dedicated cutters. We don't feel that this small cost savings justifies the extra time and fuss in restacking the cutters.



the cutter (Fig. 9). The pusher block should be long enough to overhang the edge of the table so that your right hand can remain well back from the cutter. It should also be wide enough to support the work and keep your left hand away from the cutter. The advantage of this simple pusher block is that the work is well supported. The addition of the coped backup block between the pusher block and the workpiece eliminates the possibility of chip-out on the coped end of the rails.

Once you've coped the ends of the rails, it's a matter of making a suitable panel and gluing the stiles and rails together around it. Use glue sparingly, only on the rail ends and the corresponding area of the stiles. Work safely.

Tip

The first time using any stile-and-rail bit set, it's always a matter of trial and error to get the height settings right for the cutters. However, once you get the setting right, be sure to save a short length of scrap from your initial run. Store the piece of scrap with the cutter, then, when next you want to use the same cutter to mill stock of the same thickness, setting the cutter height only requires that you adjust the height to match the profile milled into your length of scrap. Obviously, the scrap piece is only good for setting up to mill stock of

the same thickness. If the stock is $\frac{7}{8}$ in. thick instead of $\frac{3}{4}$ in. thick, you'll need to have a separate piece for a setup on $\frac{7}{8}$ in. thick stock. Gradually, as you acquire a number of stile-and-rail cutter sets, and as you have occasion to mill stock of differing thickness, you'll save up a number of sample pieces. Mark each for its specific thickness, and store it with the cutter. Soon, you'll have a "book" of stile-and-rail molding profiles, sufficient for most every occasion.

Sources

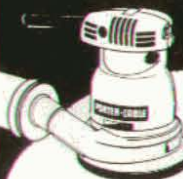
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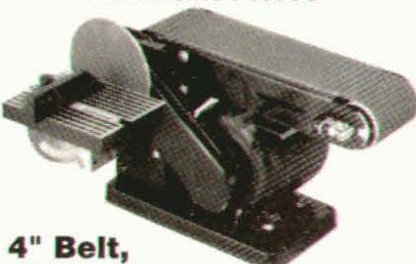
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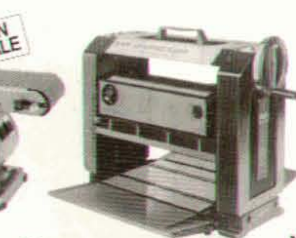
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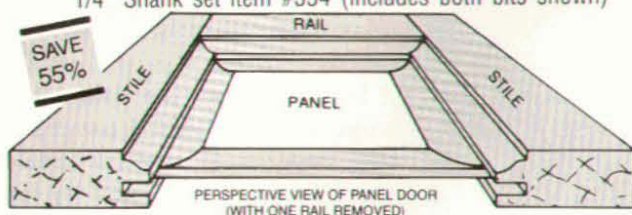
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Linenfold Carving

Traditional technique finds new favor

by Rick and Ellen Bütz

Authors Rick and Ellen Bütz prefer traditional tools for linenfold carving. Modern planes that serve the same function as the antique tools they show are available from a number of sources (including Garrett Wade, tel. 1-800-221-2942 or Woodcraft, tel. 1-800-225-1153), or you can use a router for much of the clearing out work that's done with the planes. Garrett Wade and Woodcraft also carry the carving tools that the Bützs use.

Linenfold carving was first used on 15th-century ecclesiastical woodcarvings to duplicate the pattern formed by draped altar cloths. It developed in the Low Countries of Europe and soon spread to France and England.

Linenfold reached the height of its popularity in Tudor England. That is the period from 1485 to 1603 when Henry VII, his notorious son Henry VIII, and Henry VIII's daughter, "Good Queen Bess," or Elizabeth I, ruled England.

Traditionally, linenfold carving was used to decorate chests, doors, beds, and paneling for walls. It was also used in churches for screens and pulpits.

Now, after several centuries of obscurity, linenfold carving is enjoying a revival. Woodworkers are adapting it to door panels on end tables, buffets, and other furniture. It is also being used for wall paneling in offices and homes. It adds interest to plain, flat surfaces in a subtle way that does not clash with modern lifestyles and furnishings.

Linenfold carving is unusual in that the folds of the cloth are shaped primarily with planes rather than carving tools. However, the end folds are shaped with carving gouges.

The planes we are using for this project are antique wooden ones that we have restored to working condition. These tools are very satisfying to use. The wooden handles fit comfortably and naturally in your hand.

A traditional project like linenfold works best using the same types of tools that the original carvers used. It creates a sense of historical continuity with the past. More importantly, the original designs were created for ease of shaping with the hand tools. While you can use modern electric shop tools (such as the router), it may take a little thought and creativity to adapt the techniques.

Traditionally, basswood, or limewood as it is called in England, was used for linenfold carving. Oak was also a very popular carving wood in medieval times. It has great strength and durability. If you choose oak for your linenfold carvings, don't make the details of the end folds too thin. Oak has a moderately course grain texture and may crumble in too thin a section.

Light colored wood is best for linenfold carving because it shows the shapes better. The effect of folded cloth is actually created by the shadows cast by the carved shapes. If the wood is too dark, there is not enough contrast between shadow and highlight and the drapery effect is lost.

The wood we are using for this carving is cherry. The board is 6 in. wide, 22 in. long, and $\frac{3}{4}$ in. thick. However, you can make the carving any length you need; the steps in shaping the folds are the same regardless of the length of your piece. This makes it very easy to adapt a linenfold design to fit different applications.

A good piece of cherry has a smooth, fine texture that makes planing a pleasure. The wood also has a warm color and a subtle grain pattern that adds interest to the carving without obscuring the details.

To begin, mark a line around the edge of the board, $\frac{3}{8}$ in. down from the top,

with a mortise gauge. This serves as a guide for taking down the background with a rabbet plane. Don't remove more than one half the total thickness of your board, because it would weaken the panel too much.

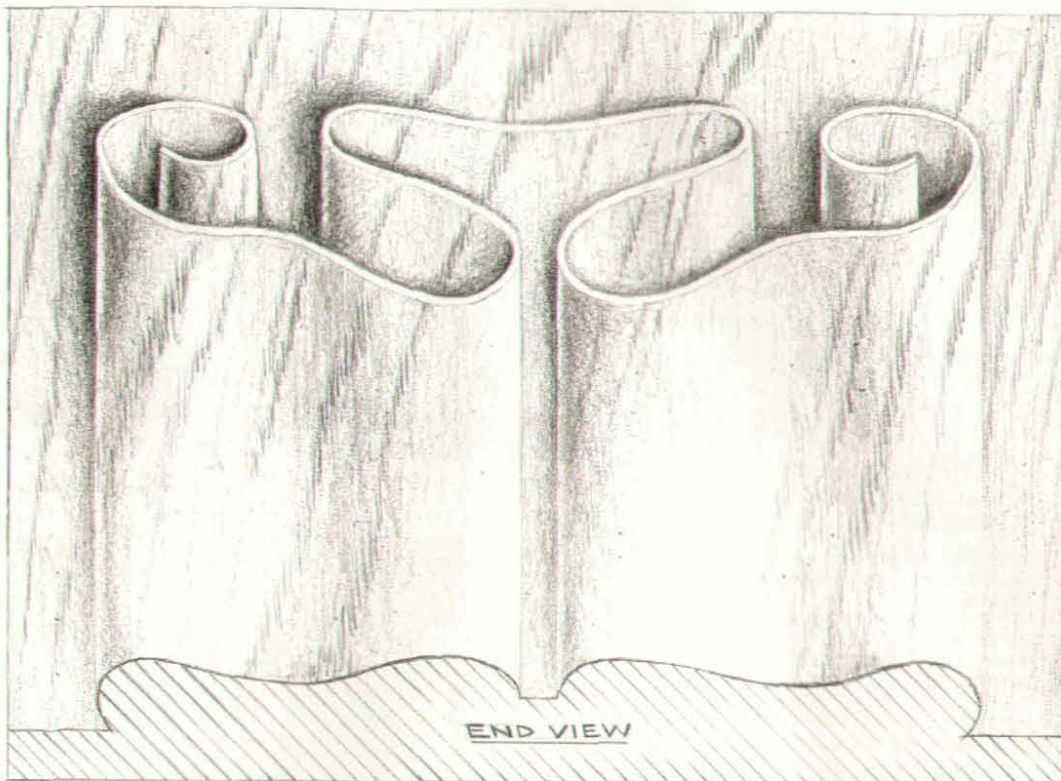
Fasten the board to the workbench, then remove a shoulder $\frac{3}{4}$ in. wide around the sides of the board with a rabbet plane. This forms a raised panel for the linenfold carving.

Take it slow and easy, and make sure your plane blade is razor sharp, so that the cuts are smooth and even. Waxing the sole of the plane with paraffin or cross country ski wax will help the plane glide smoothly over the wood. This makes it easier to control the cuts.

Cut the shoulder across the bottom and top of the board first. When you cut across the grain of the wood, as you have to on the top and bottom of the piece, the wood has a tendency to splinter slightly at the end of the cut. Then, when you plane down the long sides of the board you will remove these splinters, leaving a smooth, clean cut (Photo 1).

Use a plow plane, or fillister plane as it is called in England, to cut grooves that will serve as a guide for the depth of the hollows in the folds (Photo 2).

The width of the blade for this cut is $\frac{1}{8}$ in. The center cut is $\frac{3}{16}$ in. deep, the



FULL-SIZE PATTERN

two side cuts are $\frac{1}{8}$ in. deep. The side cuts are 1 in. in from the edge, while the center cut is $2\frac{1}{4}$ in. in, measuring to the center of the cut.

To get the proper depth for the cuts, set the depth stop guide to the desired setting. The blade will stop cutting when the guide touches the surface of the board. After making the cut you can double check the depth by measuring it.

I found this particular plane in an antique shop on Portobello Road in London twenty years ago. It looks

elaborate, but its purpose is simply to cut a precise groove. Similar planes are still being manufactured today, including the Stanley combination plane, however you can probably find a similar used plane for a good deal less money than a new one.

After cutting the grooves, refer to the full-size pattern and trace the end view pattern of the linenfold on the ends of the board.

Next, use a rounding plane to hollow out the concave surfaces of the folds.



Photo 1: Cut a shoulder with a rabbet plane around the board.



Photo 2: Use a plow plane to cut grooves.

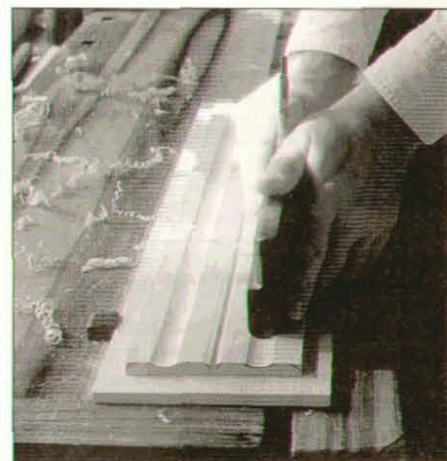


Photo 3: Use a rounding plane to hollow out grooves.

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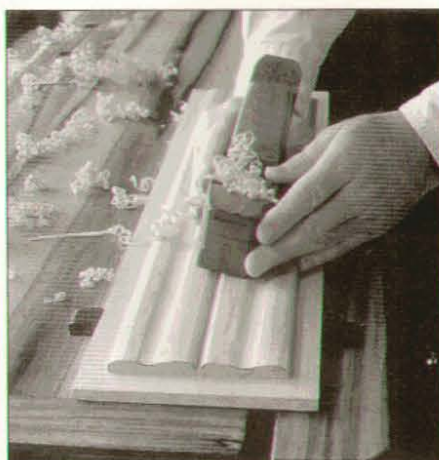


Photo 4: Use a block plane to round convex shapes.



Photo 5: Draw on end folds.

The rounding plane is unique in the shape of its blade, which is rounded to match the curve of the sole of the plane.

The grooves that you cut in the previous step serve to guide the rounding plane so that it cuts in a straight line. The grooves also serve as a depth guide (Photo 3).

Then use a block plane, a small plane with a straight cutting edge, to shape the convex curves (Photo 4).

Now you are ready to begin shaping the end folds. If you have trouble visualizing the shapes, make a model in clay to help guide you.

First, again referring to the full-size pattern, make a pattern of the end folds and transfer it to the wood (Photo 5).

Next, set in the end folds with carving gouges whose sweep matches the curve of the folds. Cut straight down with the gouge, using a mallet to drive the cutting edge into the wood. The gouge I am

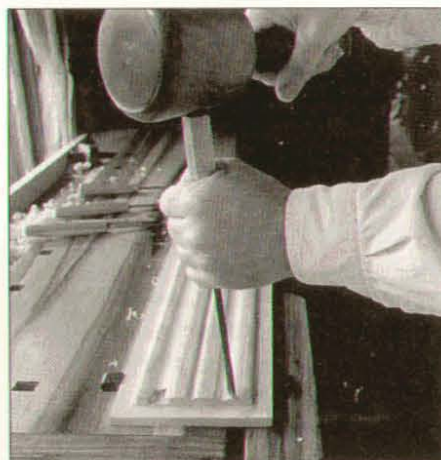


Photo 6: Set in the end folds.



Photo 7: Remove wood with horizontal cuts.

using here is a 10mm no. 5 gouge (Photo 6). I also used a 12mm no. 1 gouge. Make the sides of the cut as vertical as possible.

Then, make horizontal cuts in from the end with an 8mm no. 3 gouge to remove the waste wood (Photo 7). Don't try to remove all the wood in one step, take the cut down in several stages. Leave 1/16 in. of the background wood intact at this point. This is important because the final step in shaping these folds will be to undercut them slightly. If you have driven the gouge all the way down to the background surface, you will leave cut marks which will show when the carving is finished.

After the end folds are set in, sketch in the inner folds free hand (Photo 8). This will help you picture where the folds will fall in the wood.

Now, using a 20mm no. 5 gouge, bevel down from the inner edge of the

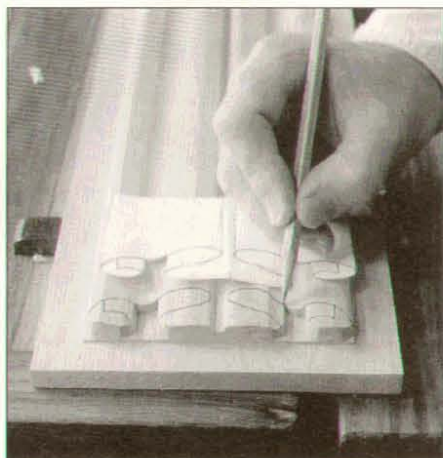


Photo 8: Sketch in the rest of the folds.

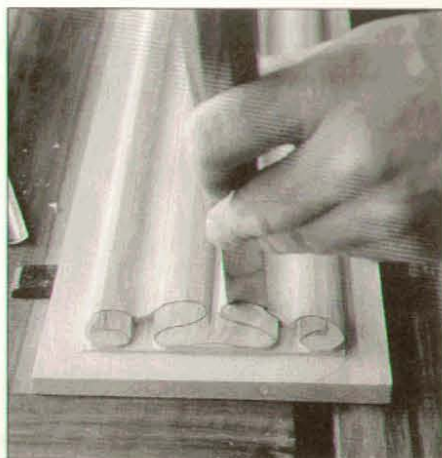


Photo 11: Set in the folds.

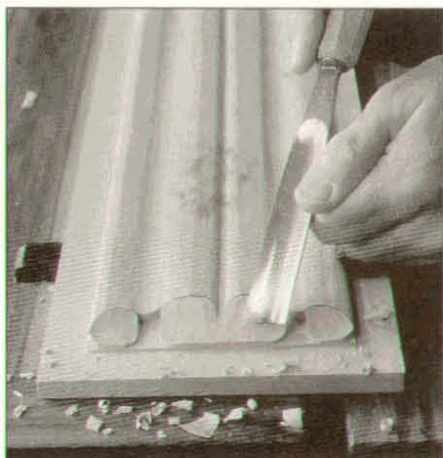


Photo 9: Bevel the folds.

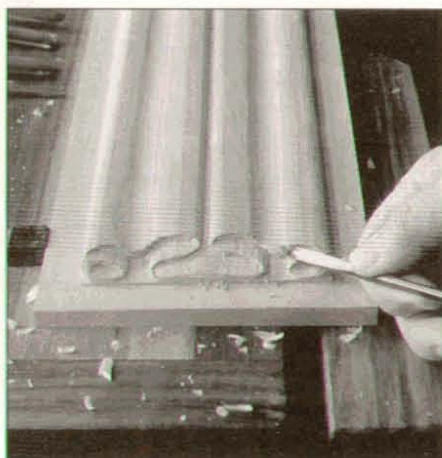


Photo 12: Cut in from the end.

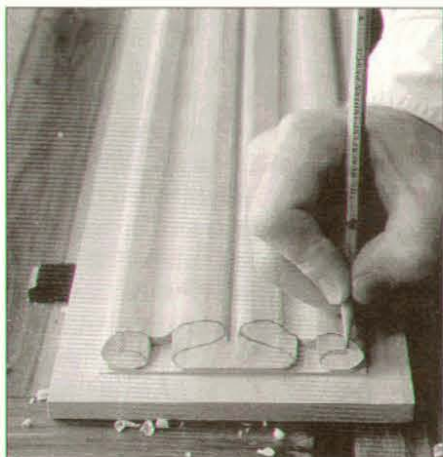


Photo 10: Redraw the folds.

folds to the outer edge, leaving the outer edge raised $\frac{1}{8}$ in. above the background (Photo 9). This step helps to create the illusion of folded cloth by making the outer folds appear to be behind the inner ones.

Redraw the fold lines which were

carved off when you shaped the bevel (Photo 10).

Using a gouge that matches the shape of the curved lines, make a series of vertical cuts along the edges of the folds (Photo 11). On this particular design I used a 14mm no. 7 gouge and an 18mm no. 7 gouge. Make the cuts about $\frac{1}{8}$ in. deep, angling them back slightly so that the edges will be undercut. This helps to create the effect of thin folds of cloth.

Next, cut in horizontally from the end to remove the waste wood using a 6mm no. 3 gouge (Photo 12). Work carefully to avoid splitting the wood; don't try to remove too much wood with one cut.

To detail the end scrolls, set in a vertical cut with a 6mm no. 1 firmer (flat) gouge (Photo 13). Clear away the background with a 4mm no. 7 gouge (Photo 14). A small spoon bent skew chisel, like a 4mm, is also helpful to clear away wood in narrow, tight cor-

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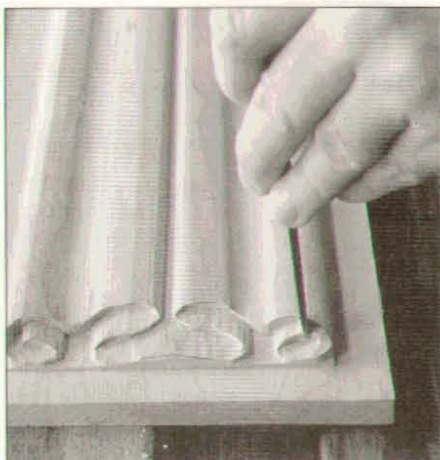


Photo 13: Set in end fold.



Photo 14: Clear away end fold back-
ground.

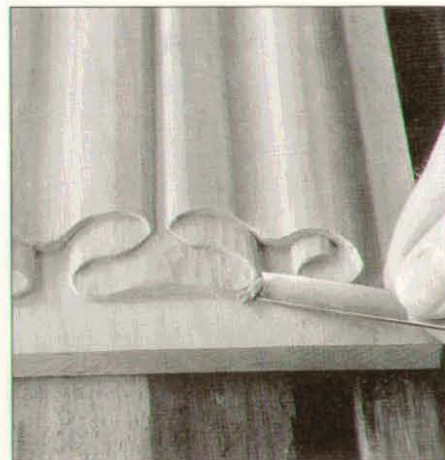


Photo 15: Smooth the background.

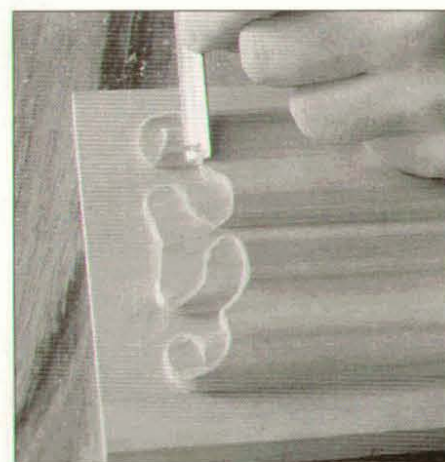


Photo 16: Bevel the edge.

ners.

To remove the final $\frac{1}{16}$ in. of back-
ground, use the same gouges you did
initially to set in around the outside
edges of the folds. These are the 10mm
no. 5 gouge and the 12mm no. 1 gouge.
Angle the gouge to undercut the folds
slightly. Undercutting the folds make
them stand out from the background
enhancing the three dimensional effect.
Then smooth the background using an
8mm no. 2 gouge (Photo 15).

For a final detail make a very small
bevel along the sharp edges of all the
folds with the 8mm no. 2 gouge. This
will reflect light making the folds more
visible. It will also strengthen the edges
of the folds and keep them from break-
ing off easily (Photo 16).

Finishing Up

Once your carving and planing work is
finished, the linenfold should be nearly

complete. If you've been really careful
with the gouge work, no sanding will be
necessary. However, especially for the
first few times you try this technique,
you'll likely need to use a little sandpa-
per to smooth out the lines left from your
block plane, and to clean up roughness
in the fold carvings. Just be careful not
to oversand, especially in the folds. Nice
crisp lines are what makes linenfold
carvings really stand out, and if these
lines are rounded over or dulled, the
carvings won't have the desired effect.
The judicious use of the gouges can even
be used to your advantage, and after
you've gained some experience, you
may find that leaving in some of the tool
marks actually enhances the realism of
the linenfold technique.

If your linenfold carving is designed
to fit into a piece of furniture, assemble
the whole piece before putting a finish
on the carving. This will ensure an even

carved details.

finish on the whole piece. Linenfold carvings look best in the natural wood color, or only lightly stained. Too dark a color can obscure the carved details.

If you enjoy linenfold carving you may want to try some of the other traditional historic carvings. Carvings of this type are an excellent way to improve your carving skills.



detailed here to carve the folds.

There are as many styles and types of linenfold carving as there are carvers who practice this traditional technique. The plainfold carving our step-by-step illustrations show is but one style. Two other types are the reverse fold (bottom photo), which is basically just a reverse of the plainfold carving, and the exaggerated V-fold (top photo). Once you are familiar with the technique of undercutting to create the illusion of depth, you'll find that it's even easy to come up with your own linenfold carvings, just by studying the way a draped cloth or linen hangs. Just make a pattern, then use the same basic steps as are

Other linenfold examples by John Whitney, Gothic Tradition Studio, Troy, New York.



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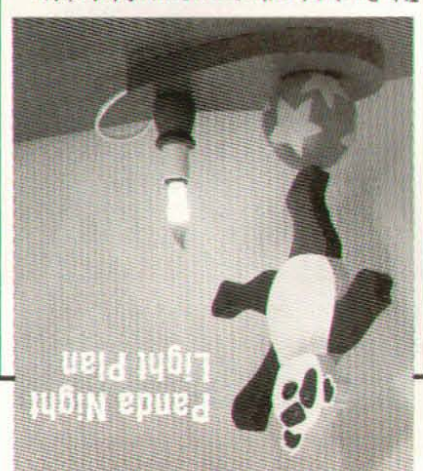


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Governor Winthrop Slant-Front Desk

Nearly every woodworker, no matter what his expertise, dreams of making some traditional "classic" woodworking project. A grandfather clock, a highboy, a tripod base tilt-top table, and a roll-top desk are a few of the most requested classics. Over the years, in addition to our many period or museum pieces, *The Woodworker's Journal* has featured all these projects, and we remain committed to offering more plans for such "top-shelf" work in the future.

A traditional slant-front desk is one of the classics that has been on our list for a long time. And we're especially proud

that the desk we're finally featuring is one of the finest, the handsome Governor Winthrop Desk, based on an original Wallace Nutting design from Berea College's Wallace Nutting collection. The collection has been housed at Berea College since 1945, when Nutting's widow bequeathed his furniture collection and blueprints to the school. The desk in the photo was built by the school's Woodcraft Furniture Division, and sells for \$5000 in their crafts catalogue (see "Berea College: A Place To Learn and Earn").

For those of you who are wondering just who Wallace Nutting and Governor

Winthrop were, here's a little background. The good Governor Winthrop, namesake of this desk, was one of the three famous 17th-century Governor Winthrops—father, son and grandson, all named John Winthrop. The first John Winthrop served as governor in the Massachusetts Bay Colony and the latter two served as governors of colonial Connecticut. We suspect, given the style of the desk, that the owner of the original was probably either the son (who served as Governor from 1657–1676) or the grandson (who served from 1698–1707).

Wallace Nutting was the famous eclectic pastor/collector/artist/entre-

better accommodate modern materials and techniques), the desk is faithful in size, proportion and detail to the original—right down to the inclusion of a very cleverly concealed secret drawer. As shown, the desk is crafted in walnut, though cherry or mahogany would also be good choices.

If you're like most woodworkers, there comes a time in your life when you step

up from small or easy pieces to “serious” work. Perhaps this seminal moment was when you made your first cabinet door, hand-cutting mortises and tenons and discovering that the process really wasn’t all that hard. Or perhaps the moment came when you first spent over \$200 just for the wood to build a specific piece. Or maybe that moment came when you bought that long-sought, fully-adjustable dovetail jig, and savored the compliments as friends admired your



dovetailed drawers that looked every bit like they'd been hand cut by the world's top craftsman.

We wouldn't suggest that you undertake this piece if you've never made a door or drawer, but if you've never made a piece this large, don't be scared off. Its important pedigree notwithstanding, the desk is basically just a box, with some drawers, a pigeonhole section, a slant front and bracket feet. If your shop is equipped with the basics—table saw, band saw, jointer, planer, router and a good selection of clamps—then you should have no problem making the desk.

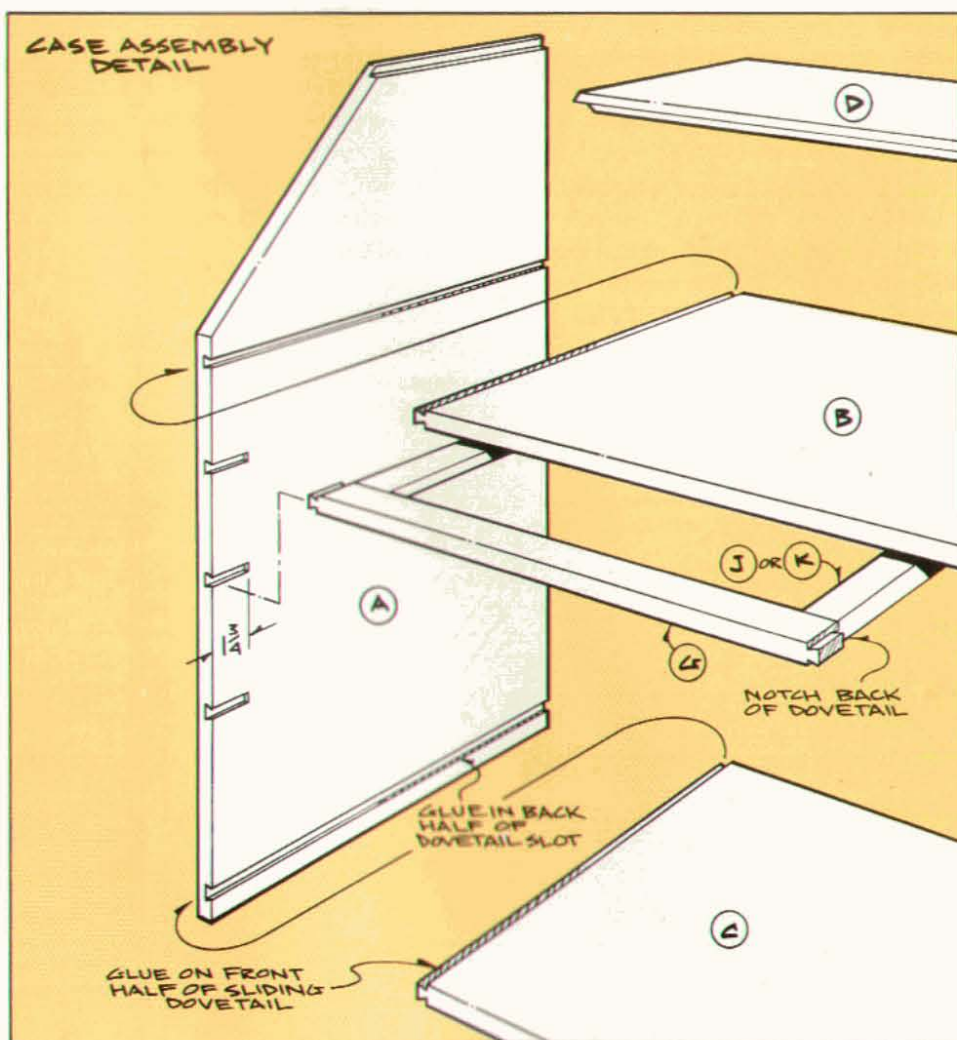
What You'll Need

Whatever your choice of stock for the desk, take care with your board selection. Try to avoid any boards that would seem out of place (such as walnut with sapwood), especially for the front-facing surfaces such as the drawer fronts and slant front. Also, make certain that the stock you are using has been kiln-dried to a moisture content of no more than 6 to 7 percent. Although most of the stock is standard $\frac{3}{4}$ in. thick material, there are a number of other stock size requirements. If you don't own a thickness planer, you can usually find a local millwork shop that will plane your stock to size for a reasonable fee.

In addition to your hardwood, you'll need $\frac{1}{4}$ in. plywood for the back and drawer bottoms, and of course, the hardware. To simplify finding all the hardware, we've asked Aspen Kits (see Hardware Package) to put a kit together that includes all the hardware that you'll need. Although there are many sources for similar Chippendale-style brass pulls, the pulls shown in the photo are just about the finest we've ever seen, with exquisite detail. You could probably find brass-plated hardware that will save a few dollars over our solid brass hardware, but with a piece of this stature, it's pennywise and pound foolish to demean the finished product with less than top-shelf brasses. All the hardware in the Hardware Package is the exact same hardware as that used on the desk in the photo.

Let's Get to Work

As with any large case piece, the first order of business should be getting out stock, arranging boards so their grain



matches as closely as possible, and jointing and edge gluing to make panels for the widest parts. For the desk, you'll likely need to edge-glue stock to yield the sides (A), desk surface (B), bottom (C), and slant front (E). Depending on what you have available, you may also need to edge-glue stock to yield the case top (D) and the pigeonhole tops (BB), bottom (CC), sides (DD), shelves (EE), (GG), and dividers (FF). All the $\frac{1}{4}$ in. pigeonhole stock can be resawn from thicker material. If you are resawing $\frac{3}{4}$ in. stock, that thickness should yield two $\frac{1}{4}$ in. thicknesses, taking into account a generous allowance for final thicknessing to the $\frac{1}{4}$ in. dimension.

Several of the parts are thicker than $\frac{3}{4}$ in. Although you could laminate several boards to yield the required thicknesses, it's better to just obtain the parts from thicker rough stock. Buy $\frac{5}{4}$ stock for the base moldings (R, S) and $\frac{8}{4}$ stock for the feet (T, U) and foot supports (V).

The easiest and the most logical way to build a piece like the desk is to divide the construction into a series of separate

assemblies. In both our written instructions and in the Bill of Materials, we've divided the desk into its component parts—the case, the case drawers, the pigeonhole section, and the pigeonhole doors and drawers. By tackling things one-at-a-time, you'll find that the desk isn't really all that complicated, after all.

The Case: Can You Make A Big Box?

As shown in the Case Assembly Detail, the case is basically just a big box. The main parts of the basic box are the two sides (A), the desk surface (B), the bottom (C), and the top (D). After cutting the above parts to length and width, set to work cutting the rabbets on the ends of the sides and top, and the various dovetail slots in the sides. These cuts are best made before you cut back the two topmost corners of the sides, establishing the slope of the slant front when the desk is in the closed position.

Cut the Dovetail Slots: There are a pair of through dovetail slots in each side, for the desk surface and bottom

respectively, and three stopped dovetail slots in each side, to fit the dovetails cut on the ends of the drawer rails (G). As also shown in the Case Assembly Detail, these stopped dovetails are $1\frac{3}{4}$ in. long, or $\frac{1}{2}$ in. shorter than the width of the drawer rails. Because the drawer rails and runners (J, K) are joined with a $\frac{1}{2}$ in. long tenon, the dovetails on the drawer rail ends are notched back that same $\frac{1}{2}$ in. A $\frac{1}{2}$ in. dovetail bit set for a $\frac{3}{8}$ in. deep cut is used for all these dovetails.

Make The Slant Front Slope: Once the rabbets and dovetails are cut, you can cut back the corners of the sides to the 55-degree angle shown in the side elevation (note that the cut starts $25\frac{3}{4}$ in. from the bottom end of the sides). Also, cut back the front edge of the top at a matching 55-degree angle, and rip the bottom edge of the top to establish the right angle surface into which the rabbet on the slant front will fit.

Cut Sliding Dovetails: With the sides and top all cut, next you'll need to establish the sliding dovetails on the ends of the desk surface and bottom. Since these two parts will be a sliding fit into the dovetails in the sides, it's important that you don't make the fit overly tight. The best approach is to first cut the dovetails a little tight, and then make a light trimming cut until the desk surface and bottom dovetails can slide effortlessly into their mating dovetail slots. Don't forget to make certain that the desk surface is $\frac{1}{4}$ in. less in width than the sides and bottom; this $\frac{1}{4}$ in. allows the case back (W) to fit in place. You can cut and fit the sliding dovetails on the ends of the drawer rails now, but don't worry about assembling the drawer frames just yet.

Case Assembly Secrets: You are now ready to assemble the case. There's a simple secret (see Case Assembly Detail) to getting the long sliding dovetails that join the sides, desk surface and bottom to go together without a panic. (When we say panic, just remember how you felt the last time a long sliding dovetail that you were assembling seized up before the dovetail had been fully seated!) The secret to an assembly like this is apply glue *only to the back* $\frac{1}{2}$ of the dovetail slot length and *only to the front* $\frac{1}{2}$ of the corresponding sliding dovetail. By using this system you are able to slide the parts half-way together

before you begin to encounter any resistance from glue. Work quickly, and don't let any time pass between the time that you apply the glue and start the assembly. The moisture in the glue will quickly swell the wood, and even a sliding dovetail that fit together effortlessly when dry may be impossible to assemble.

Assemble the sides and bottom first, then add the desk surface, and lastly glue, counterbore, screw and plug the top in place. Face grain plugs matched carefully to the grain of the top will help to make this joint all but invisible. If you are a stickler for authenticity, then use half-blind dovetails to join the top and sides.

Check Case for Squareness: Before the glue on the case assembly sets, you'll want to check the assembly for squareness, and make adjustments if needed. Measure across the diagonals on the case

work. However, where the desk surface interferes, you'll need to switch to a straight cutter and use the edge guide to guide the router. You can cut and fit the back, but don't mount it at this time. The back won't be mounted until after all the remaining work on the desk has been completed.

Make and Mount the Drawer Frames

Make three drawer frames, each consisting of one drawer rail and a pair of runners. The bottom two drawer frames are identical, but the topmost drawer frame has wider runners (K), to accommodate the connector (I) and guide (L), and to serve as runners for both the slides (N, O) and the narrow top drawer. Note that a stub tenon ($\frac{1}{4}$ in. by $\frac{1}{2}$ in. long) is used to join the runners to the rails on all three drawer frames, and that the back ends of the runners are drilled

Berea College: A Place to Learn and Earn

Long recognized as perhaps the premier school for a craft's education, Berea today offers its 1500 students a high-quality liberal arts education, with a unique twist. Students pay no tuition; instead student expenses, room, board and fees are met either in whole or in part by the student's earnings in one of a variety of work programs. According to Berea, the work programs help students "learn the independence of self help and the dignity of labor . . . Every student works at least 10-15 hours a week while carrying a full academic course load."

The Berea College Crafts program began in 1893 with the Fireside Weaving program, and now includes Weaving & Needlecraft, Ceramics, Broomcraft and Wrought Iron in addition to the renowned Woodcraft program. Students work side-by-side with master craftsmen at "the loom, lathe, forge and potter's wheel in the ageless apprentice system."

In addition to the Wallace Nutting Collection of Early American Furniture—reproductions of which are made and sold in the Woodcraft program—the college also is home to the Appalachian Museum. For more information on the Berea College Craft Program, or for a color catalog of their crafts (\$2), write: Berea College Crafts, CPO 2347, Berea KY 40404.

back (from corner to corner). If the measurements aren't exactly equal, use a bar clamp and some blocks (so you don't mar the wood) to apply some pressure across the longer diagonal. Check the diagonals again and fine-tune the clamp pressure until the measurements are equal.

Cut Back Rabbet: Once the case assembly is dry, you can cut the rabbet in the sides, top and bottom for the plywood back. You can use a ball-bearing guided $\frac{3}{8}$ in. rabbeting bit, set for a $\frac{1}{4}$ in. deep cut for most of the

with slotted holes. These holes are for screwing the back end of the runners to the case sides, and the fact that they are slotted permits some seasonal wood movement in the sides. If the runners were permanently fastened to the case sides across the full width of the sides, there's a danger of the sides splitting should some shrinkage occur across the grain of such a wide piece.

The full dovetail on the bottom end of the connectors, and its mating dovetail rail slot are both $1\frac{3}{4}$ in. long—the same as on the rail ends and case—so as to not

Bill of Materials

(all dimensions actual)

Part	Description	Size	No. Req'd.	Part	Description	Size	No. Req'd.
Case				Doors			
A	Side	3/4 x 18 x 37 3/4	1	JJ	Stile	3/4 x 1 3/8 x 10	4
B	Desk Surface	3/4 x 17 3/4 x 33*	1	KK	Top Rail	3/4 x 1 5/8 x 37 3/8*	2
C	Bottom	3/4 x 18 x 33*	1	LL	Bottom Rail	3/4 x 2 3/8 x 37 3/8*	2
D	Top	3/4 x 10 1/8 x 33	1	MM	Panel	1/4 x 3 3/4 x 6 1/2**	2
E	Slant Front	3/4 x 14 3/4 x 30 1/4*	1	NN	Trim Molding	1/4 x 1/4	about 8 ft.
F	Slant Front End	3/4 x 2 3/8 x 14 3/4	2	Pigeonhole Drawer			
G	Drawer Rail	3/4 x 2 1/4 x 33	3	OO	Front	3/4 x 2 x 9 1/2	2
H	Top Rail	3/4 x 2 1/4 x 30 3/4	1	PP	Side	3/8 x 2 x 10 1/2	4
I	Connector	3/4 x 2 1/4 x 4	2	QQ	Back	3/8 x 1 1/2 x 9 1/8	2
J	Runner	3/4 x 1 1/4 x 15 7/8*	4	RR	Bottom	1/4 x 9 1/8 x 9 13/16	2
K	Top Runner	3/4 x 3 1/2 x 15 7/8*	2	Secret Drawer			
L	Guide	3/4 x 3/4 x 15 3/8	2	SS	Front	3/4 x 1 15/16 x 12 1/4	1
M	Drawer Stop	3/4 x 1 x 1	8	TT	Side	3/8 x 1 3/4 x 7 3/4	2
N	Slide	3/4 x 4 x 16 1/4*	2	UU	Back	3/8 x 1 1/4 x 11 7/8	1
O	Slide End	3/4 x 2 1/4 x 4	2	VV	Bottom	1/4 x 7 1/16 x 11 7/8	1
P	Slide Stop	1/2 x 3/4 x 2 1/2	2	Hardware***			
Q	Filler	3/4 x 3/4 x 32 1/4	1	WW	Chippendale Pull	3 3/4 x 2 3/4	8
R	Base Front Molding	7/8 x 1 1/4 x 35 1/2	1	XX	Escutcheon	3 3/4 x 2 3/4	1
S	Base Side Molding	7/8 x 1 1/4 x 18 7/8	2	YY	Lock	1 3/4 x 2 1/2	1
T	Front Foot	1 1/2 x 4 1/2 x 7 5/8	4	ZZ	Knob	3/8 dia.	6
U	Back Foot	1 1/2 x 4 1/2 x 7 1/4	2	AAA	Slant Front Hinge	2 x 3	2
V	Back Foot Support	1 1/4 x 5 1/4 x 5	2	BBB	Butt Hinge	1 x 1	2
W	Back	1/4 x 33 x 36 1/4	1	CCC	Bullet Catch	5/16 dia. x 3/8 long	2
Case Drawers				* Length includes tongue(s) or tenon(s).			
(No's Req'd are per drawer)				** Panel width allows 1/8 in. for wood movement.			
X	Front	See Chart	1	***Hardware Package			
Y	Side	See Chart	2	This hardware is of the very highest quality, with the Chippendale pulls, matching escutcheon, knobs, hinges and lock all being solid brass. Cost of the hardware package is \$235 post-paid. Write or call: Aspen Kits, 6 Hilltop Drive, Old Saybrook, CT 06475; tel. (203) 388-6179. Check or money order only; please specify either antique or bright brass finish for pulls.			
Z	Back	See Chart	1				
AA	Bottom	See Chart	1				
Pigeonhole Section							
BB	Top	1/4 x 8 3/4 x 10	2				
CC	Bottom	1/4 x 8 1/4 x 32 1/4	1				
DD	Side	1/4 x 10 3/4 x 11 3/4	4				
EE	Shelf	1/4 x 10 3/4 x 9 3/4	4				
FF	Divider	1/4 x 10 3/4 x 7	4				
GG	Center Shelf	1/4 x 7 1/4 x 12 1/2	2				
HH	Front	5/8 x 2 1/4 x 10	2				
II	Drawer Runner	1/8 x 1/2 x 6 1/2	2				

interfere with the stub tenon joining the rails and runners. Also at this time, make the top rail (H), and cut the interlocking half-dovetail on its ends and on the top ends of the connectors. Take care to test fit all these parts within the case.

If everything fits as intended, assemble the drawer frames and mount them in the case. The two bottom drawer frame assemblies will consist of just the drawer rails and runners. But the top drawer frame will include not only the drawer rail and the two runners, but also the connectors, top rail and guides. Use a framing square to make certain that the runners and rails meet at a perfect right angle. A small machinist's square is a handy way to make certain that the connectors are at a true right angle to the

two rails that they connect. Once the drawer frame assemblies are out of clamps, apply glue and slide the rail dovetails into their mating stopped dovetails in the case sides. Measure carefully at the case back to insure that spacing between the drawer frames is the same at both the front and back, then screw through the slotted holes to secure the backs of the frames.

Make the Slant Front Writing Surface and Sliding Supports

The slant front writing surface consists of the slant front (E) and the slant front ends (F), with a 1/4 in. by 1 in. long tenon on the slant front and a matching groove in the slant front ends joining these parts. A 5/32 in. ogee router bit and a 1/2 in. by

3/8 in. rabbeting bit are used to mold the ogee profile and the rabbet around the top edge and ends of the writing surface, respectively. Mortise for and mount the slant front hinges (AAA) and lock (YY), and mortise for and mount the lock catch plate on the case top.

The sliding supports consist of the slides (N) and the slide ends (O). Note the grain direction of the slide ends is top-to-bottom, and that a 1/4 in. by 3/4 in. long tenon and matching groove joins the slides and slide ends. Also, make and mount the slide stops (P), which prevent the supports from being pulled all the way out.

The sliding supports don't butt against a stop when in the closed position. Instead, they butt right against the case back. In theory, one might think that given the width of the case sides, and the possibility for wood movement, the slides might be sticking out 1/4 in. proud of the case front in winter, and be inset 1/4 in. during a humid summer. Theory, however, takes a back seat here to experience. Once your case is finished, and given the fact that you've taken special care to select only the best kiln-dried material, expansion and contraction should really be negligible. The best way to size the sliding supports is to cut them a little long for starters, and then make a final trimming cut at the back end just before mounting the case back. If some further adjustment is needed after several years of use, the supports can be easily removed by unscrewing the slide stops. Incidentally, for this same reason, when you mount the case drawers, it's a good idea to screw—but not glue—the drawer stops in place. This way, there's the opportunity for fine adjustment of the stops at some later date, just by unscrewing and removing the case back.

Make the Base

The base consists of the filler (Q), front and side moldings (R, S), front and back feet (T, U) and the back foot supports (V). The filler is just a 3/4 in. by 3/4 in. strip, glued in place between the sides and filling the space at the desk bottom. The moldings are easily profiled with a cove-and-bead or classical router bit. The front and back feet will be the greatest challenge, but here too, we've worked out a simple system.

Start with a length of stock 1 1/2 in.

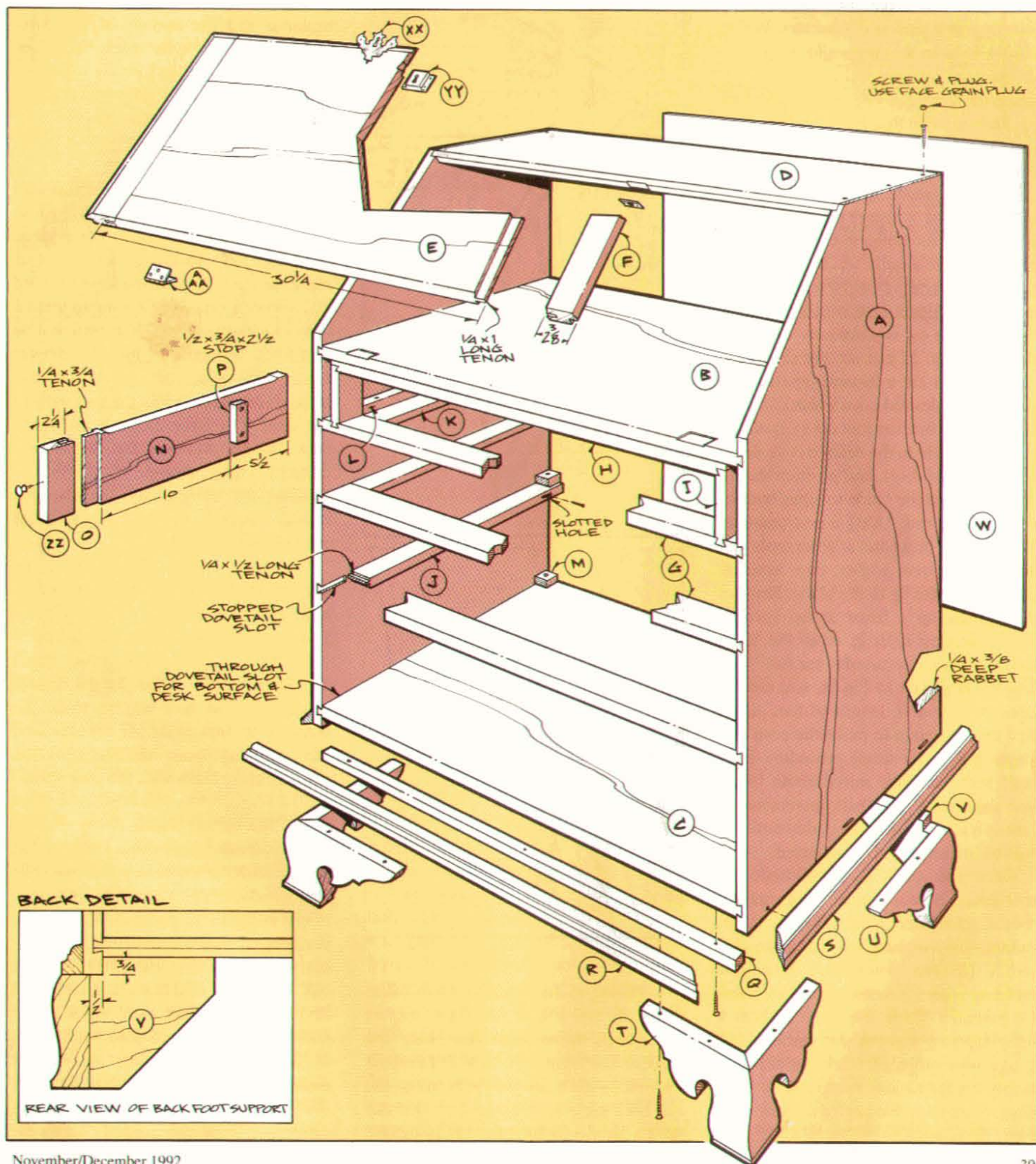
thick by 4½ in. wide by at least 4 ft. long. The traditional process to make a bracket foot, such as that on our desk, was to use a combination of hollow and round molding planes. The round sole planes established the concave portion of the molded foot, the hollow planes rounded the convex shape. The craftsman used a simple wooden template to check his profiles as the work progressed. Experienced craftsmen typi-

cally developed a "book" of such templates for their most commonly used shapes and molding profiles.

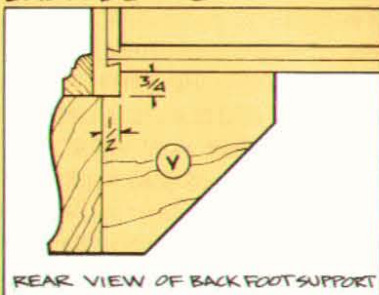
Traditional hollow and round molding planes are still quite common, and can be purchased for about \$15 to \$30. If you are lucky, you may even find a complete set of both hollows and rounds by the same manufacturer. However, a more modern approach to making bracket feet uses the table saw for most

of the work.

In a perfect world, every 10 in. table saw blade measures exactly 10 in. in diameter, and detailing a setup for making a cove cut on the table saw requires that we simply provide a blade height and a fence angle setting for you to duplicate on your saw. However, the problem with calling out a specific fence angle setting is that the angle will produce the desired cove only if your



BACK DETAIL



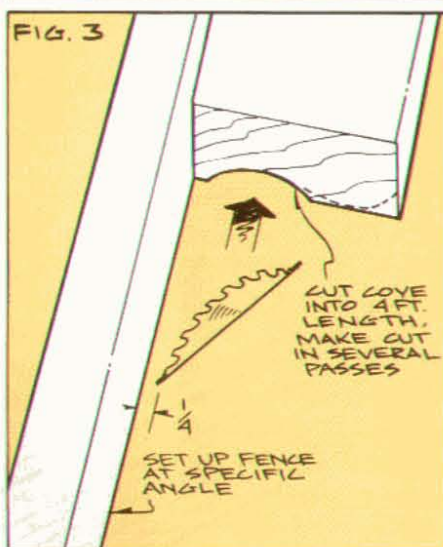
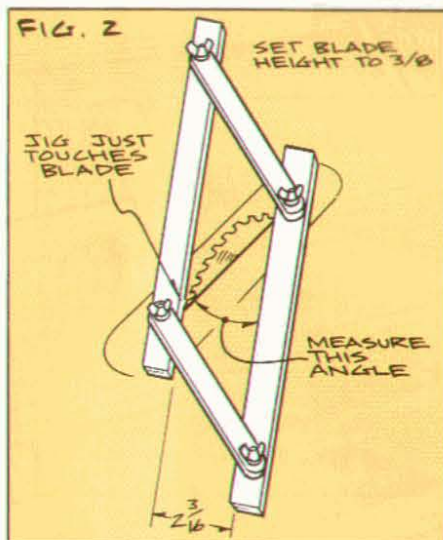
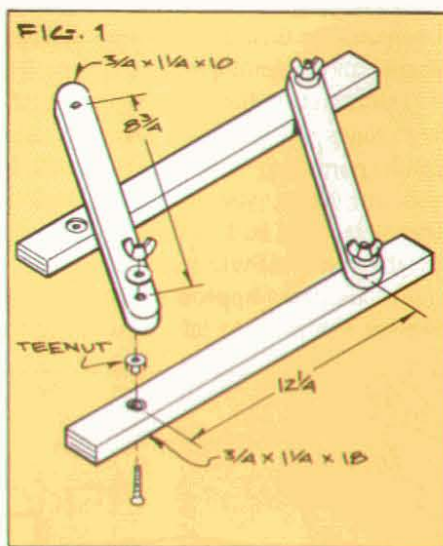
REAR VIEW OF BACK FOOT SUPPORT

blade is an exact 10 in. diameter. If you have a 9 in. table saw, or if your 10 in. carbide blade has been resharpened several times and now measures $9\frac{3}{4}$ in., then the cove that you get with your blade won't be the same as the cove we achieved in our shop using a specific fence angle and our 10 in. blade.

A better method is to use a shop-built parallel arm jig to set the fence angle. The jig, as shown in Fig. 1, is easy to make. It's just a pair of parallel arms joined with a pair of connectors. We've used T-nuts in the arms and wing nuts for quick adjustment and ease of use, but whatever hardware you use to make this jig, keep in mind that the most important point is to have the holes in the arms and connectors drilled both on-center and identical distances apart. The holes in our 18 in. long arms are exactly $12\frac{1}{4}$ in. apart, while the holes in the 10 in. long connectors are exactly $8\frac{3}{4}$ in. apart. This size parallel arm jig can be used to set up most coving operations with a table saw.

To use the jig is simplicity itself. As shown in Fig. 2, just set the jig so the parallel arms are a distance apart that's equal to the desired cove width ($2\frac{3}{16}$ in. apart for our bracket foot cove), raise the table saw blade to the desired cove depth ($\frac{3}{8}$ in. for our foot), and position the jig at an angle so the blade touches both of the parallel arms. Using a protractor, an angle finder, or whatever other tools you use to determine angles, now measure the angle of the jig to the blade. Remove the jig, set up a fence at the specific angle, locating it $\frac{1}{4}$ in. from the blade (when the blade is raised to the full $\frac{3}{8}$ in. height) as shown in Fig. 3, and cut the cove in your 4 ft. length of foot stock. Just don't attempt to make the cove in a single pass. The usual procedure is to start with the blade raised about $\frac{1}{8}$ in. and then raise the blade incrementally (about $\frac{1}{16}$ in. to $\frac{1}{8}$ in. at a time) until the full $\frac{3}{8}$ in. cove depth is achieved.

Once the cove is established, the roundover is made next. Our bracket foot's roundover is roughly a 2 in. radius. The simplest way to make this radius (if you don't have a hollow molding plane) is to use a jointing plane to gradually shape the radius. Make a template from wood or stiff cardboard to gauge your progress. Once the radius is nearly complete, use sandpaper to final shape it and remove any of the lines left from the plane.



With the molded profile established, crosscut the board into the lengths required for the individual feet. Miter the ends of the front feet, then transfer the foot shape (see full-size pattern) to the flat back surface of the feet, and cut out with a band saw or a hand-held jigsaw.

Final sand the shape, then glue the front feet together at the miters.

Mount the Molding and Feet: The front molding is a good long grain-to-long grain glue joint, but the side molding is glued only at the miters and near the front of the case sides. The remaining molding length is fastened with screws inserted through slotted holes in the case sides, as shown in the exploded view.

The feet are glued and screwed to the molding and the bottom of the case. Note that the $1\frac{1}{4}$ in. thick back foot support has a step cut into the top edge, to fit around the case sides and flush to the case bottom (see Back Detail).

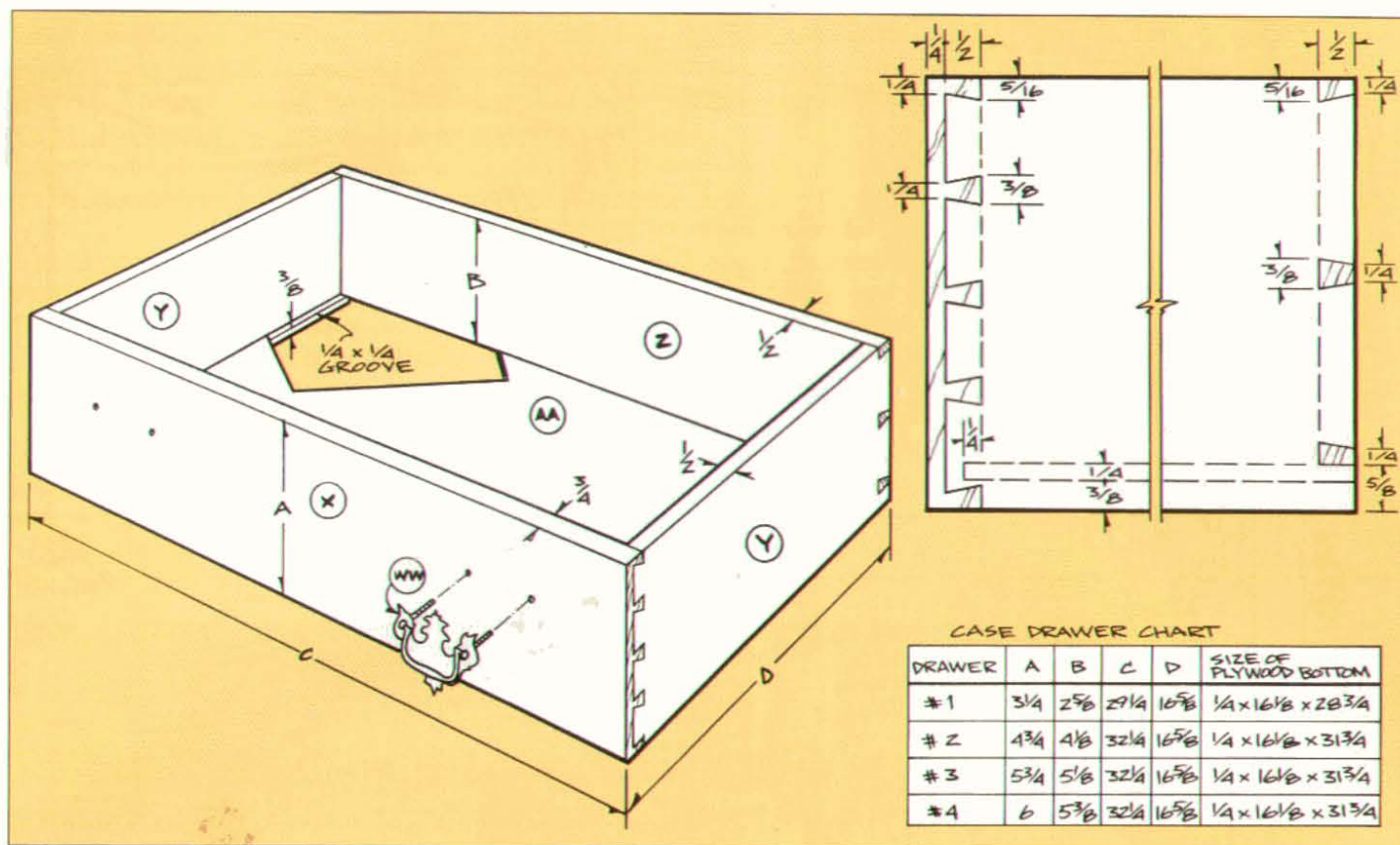
The Case Drawers

Because of the explanation required with the rest of this piece, we won't go into great detail on the drawers. For a piece such as this, hand-cut dovetails—or machine cut dovetails made with a jig that allows for random spacing to yield a hand-cut look—are the best choice. Use half-blind dovetails to join the drawer fronts (X) with the sides (Y), and through dovetails to join the backs (Z) to the sides. The piece shown in the photo uses $\frac{1}{4}$ in. plywood for the drawer bottoms (AA), though if you are a stickler for authenticity, bevel-edged drawer bottoms in solid stock could easily be substituted.

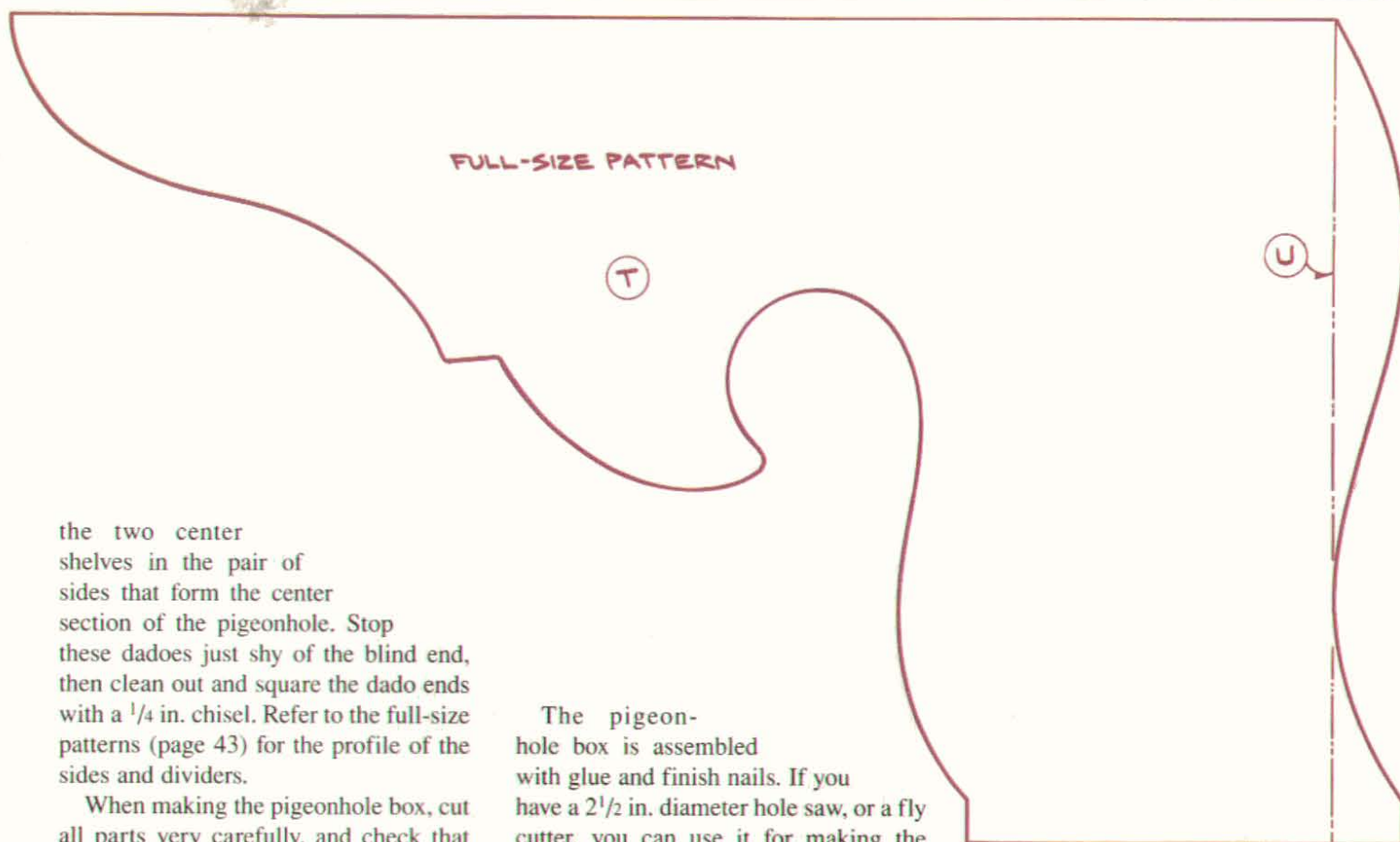
Our Case Drawer Chart shows the dimensions for the drawers, however, as with any case piece, you should make your drawers based on the actual dimensions from your case. The drawer depth should be sized to allow for the drawer stops (M). The best way to make the stops is to first make all the drawers, then cut and locate the stops so the drawers close flush with the case front.

The Pigeonhole Section

The pigeonhole section is cut, assembled and mounted in the case before the case back is added. The pigeonhole construction is basically just a box, with shelves, dividers, drawers and doors. The primary parts—the tops (BB), bottom (CC), sides (DD), shelves (EE, GG), and dividers (FF) are all $\frac{1}{4}$ in. thick stock. Use the table saw dado head, set for a $\frac{1}{4}$ in. wide cut, to establish the various dadoes and rabbets. Note that there are four nearly identical side parts, the only difference being the stopped dadoes for



FULL-SIZE PATTERN



the two center shelves in the pair of sides that form the center section of the pigeonhole. Stop these dados just shy of the blind end, then clean out and square the dado ends with a 1/4 in. chisel. Refer to the full-size patterns (page 43) for the profile of the sides and dividers.

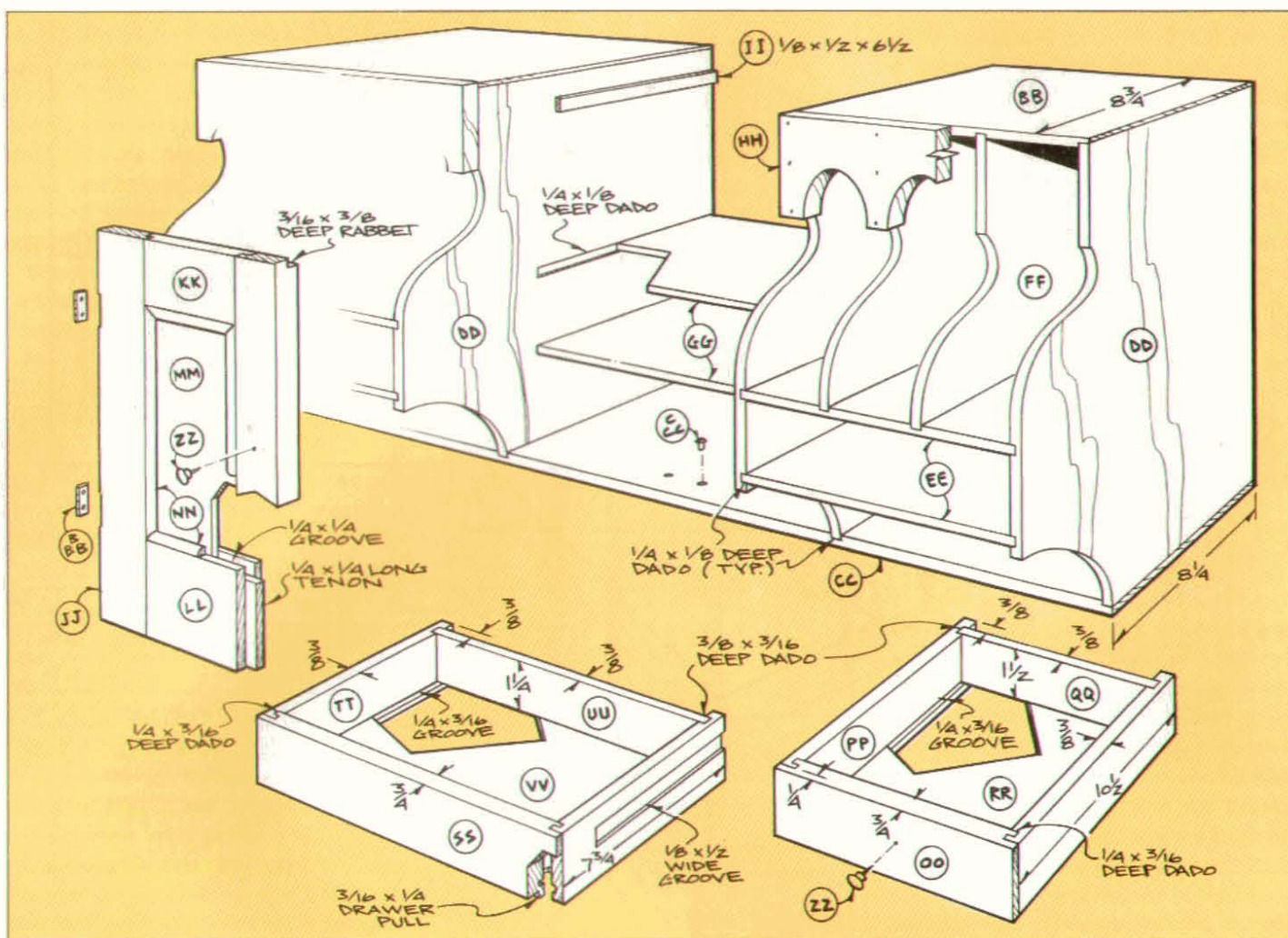
When making the pigeonhole box, cut all parts very carefully, and check that their lengths will allow the assembled pigeonhole box to fit within the desk cavity. The best way to avoid a problem is to dry assemble the box as you make it, checking regularly for the fit inside the desk.

The pigeonhole box is assembled with glue and finish nails. If you have a 2 1/2 in. diameter hole saw, or a fly cutter, you can use it for making the front parts (HH). Cut both parts to length and width, then edge-clamp the two parts together before cutting the three 2 1/2 in. diameter holes. Once the parts are unclamped you'll have a pair of front parts, each with their three 1 1/4 in. radius

cutouts. You can make the drawer runners (II) for the secret drawer, but don't mount them just yet.

The Pigeonhole Doors

The two pigeonhole doors are each just



a pair of stiles (JJ), with a $\frac{1}{4}$ in. by $\frac{1}{4}$ in. groove in one edge, and top and bottom rails (KK, LL), with the same size groove on one edge and tenons to fit the stile grooves. The panels (MM) on the desk shown are bookmatched sections of crotch walnut. A $\frac{1}{4}$ in. by $\frac{1}{4}$ in. quarter-round molding (NN) trims out the panels. Note that this molding is glued to the door frames only, and not to the panels.

As shown on the exploded view of the pigeonhole section, a $\frac{3}{16}$ in. by $\frac{3}{8}$ in. deep rabbet is cut into the top back edge of the two doors. Don't neglect to include this rabbet; it interlocks the bottom lip on the secret drawer, making it impossible to open the drawer with the doors in the closed position. You'll need to mount the doors, though, before you mount the pigeonhole unit in the case—the hinges (BBB) must be screwed in place from the back of the pigeonhole. Also note that the hinges are mortised into the doors only, and not into the pigeonhole sides. Make the hinge mortises in the doors deep enough to accommodate the hinges in the folded

(closed) position. Before final mounting the doors, you'll also need to drill for and mount the bullet catches (CCC). Since the holes for the bullet catches are $\frac{3}{8}$ in. deep, they extend through the pigeonhole bottom and into the desk surface. You'll need to first drill through the pigeonhole unit into place, and mark through the holes and onto the desk surface before completing the holes.

Pigeonhole Drawers

We show a rabbeted construction on both the pair of pigeonhole drawers and the secret drawer. Make your drawers to fit the pigeonhole unit, using $\frac{3}{4}$ in. thick stock for the fronts (OO, SS), $\frac{3}{8}$ in. stock for the sides (PP, TT) and backs (QQ, UU) and $\frac{1}{4}$ in. plywood for the bottoms (RR, VV). The only real difference between the drawers is their size and the fact that the secret drawer includes a $\frac{3}{16}$ in. by $\frac{1}{4}$ in. lip on the bottom edge of the front, and $\frac{1}{8}$ in. deep by $\frac{1}{2}$ in. wide stopped grooves in the sides to accept the drawer runners (II). Note that the lip on the bottom edge of

the front of the secret drawer doesn't run the full length of the drawer, but must be notched back on either end. The pigeonhole section is constructed so the secret drawer can only be removed when both doors are fully opened. The notched lip on the drawer front fits between the rabbets of the opened doors as the drawer is slid out. This is difficult to describe, but should be clear from the detail photo on page 43, which shows the secret drawer being opened.

The $\frac{1}{8}$ in. by $\frac{1}{2}$ in. wide stopped groove in the sides of the secret drawer is best cut with a $\frac{1}{2}$ in. diameter router bit, using the router table set up with a stop to limit the groove length to $6\frac{1}{2}$ in. Our illustration shows the groove and the runners as square-ended, so you'll need to use a chisel to square the groove ends. Back when the first Governor Winthrop Desk was made, routers weren't available (electricity had yet to be discovered). However, given our router-cut groove, an easier way is to just round the runner ends to match the radius at the groove ends. A pair of knobs (ZZ) completes the two pigeon-

hole drawers; the secret drawer, in keeping with its station, eschews the knob accoutrement. Instead, to open the secret drawer, one reaches under the drawer with both doors open, and the lip serves as a convenient finger pull.

Finishing Up

Needless to say, all the fine tuning and fitting of the drawers and doors for the pigeonhole section should be completed before the section is slid into the desk. When it finally comes time to mount the pigeonhole section, don't try to slide it into place from the desk front. That's a sure way to scratch the desk writing surface. The pigeonhole section is slid into place from the back, before the

Take care to set all finish nails, and fill the nail holes on visible surfaces, such as the nails holding the front pieces, before applying the finish.

As for the final finish, you could really take your pick of several finishes, including penetrating oil, shellac and polyurethane. However, by far and away the best choice—and the finish used on the desk shown—is lacquer. A century or two ago, craftsmen used shellac in much the same way that lacquer is used today, but lacquer has several distinct advantages over shellac. It's durable, attractive, easy to maintain, and unlike shellac, it won't show a white ring from a moist glass that's left on the desk surface without benefit of a coaster. A



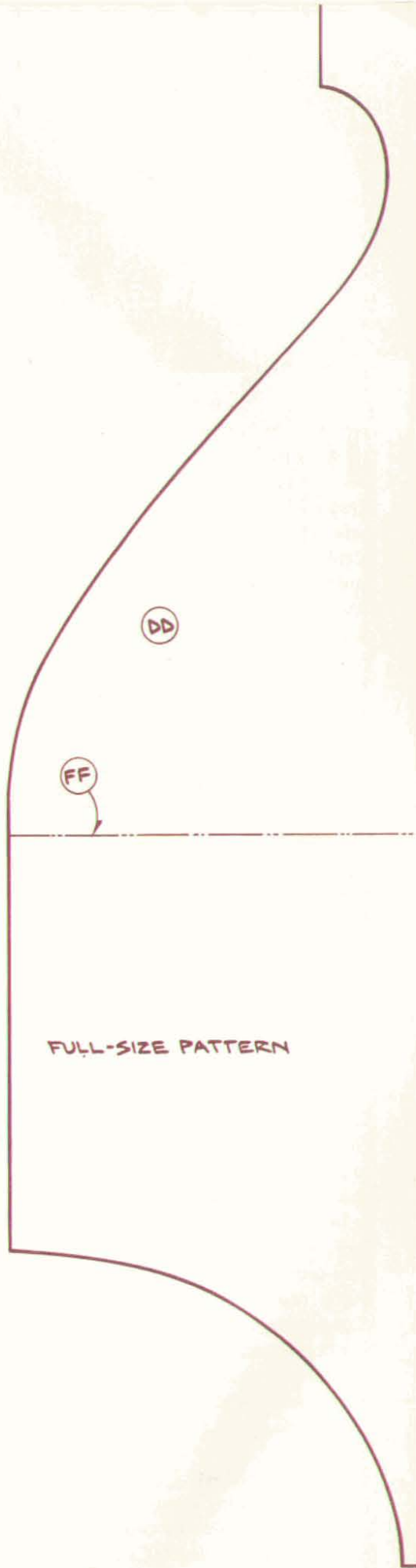
The secret drawer lip rides in rabbets on the top of the doors

plywood case back is screwed in place. Use a screw or two to fasten the pigeonhole section securely, so it won't move; no glue is needed here. And while we're on the matter of glue, don't use any on the case back either. There's always the possibility that at some future time you may need to remove the back to make some repair or adjustment.

For convenience sake, it's a good idea to finish the pigeonhole section, and its doors and drawers, before the unit is mounted in the desk. You could finish the desk with the pigeonhole section already in place, but it's a lot easier to get into corners, nooks and cubbies when there's easy access from all sides.

spray finishing outfit is the best way to apply a lacquer finish, but if you don't have one, you can use brushing lacquer instead. Aerosol spray cans are another option, though on a project of this size your finishing budget will quickly be in the red if you're buying your finish in little aerosol cans.

The Chippendale pulls (WW), matching escutcheon (XX), and knobs (ZZ) should only be mounted after the desk has been finished. If you've pre-drilled for and already mounted some of the hardware, be sure to remove it before applying the finish. The hardware has its own patina, and a layer of finish doesn't improve the look. 



FULL-SIZE PATTERN

The Fabulous Futon

BUILD THIS POPULAR CONVERTIBLE COUCH

Futons have become enormously popular of late—and for good reason. They easily convert from a sofa to a bed, making them ideal for spare rooms, small apartments and college dorms. And, since they are reasonably lightweight, you are less likely to suffer a week of sore muscles after moving one. We've worked out a design that simplifies the construction, so even woodworkers just starting out should be able to tackle this project with little difficulty. Our Futon, which is queen sized, is made from maple, but a softwood like pine is also a good choice—especially if you want to keep costs to a minimum.

In the sofa position (see Side View), the seat section tilts down at a 3 degree angle. The ends of the support cleats rest flat on the floor, and the two knobs are tightened to lock the back and support cleats in place.

To convert the Futon to a bed, simply loosen the knobs and straighten the seat, back and support cleats (see Fig. 1). Note that, as the back section is lowered to the floor, the seat section pivots up to create a flat sleeping surface.

In the event you can't find a satisfactory mattress locally, we've listed a mail-order supplier for a good quality Futon mattress (see Mattress Source). Since mattress sizes tend to vary a bit, it's best to have your mattress on hand before starting the project. It's never easy to make adjustments after a project is completed.

Prepare the Stock

Begin by selecting enough five-quarter ($5/4$) stock to make the two seat cleats (A), the two back cleats (C) and the two support cleats (D). Also, select enough

one inch ($4/4$) stock to make the seat front (B) and the 13 slats (E). When selecting the wood, look for straight-grained stock that's free from large knots or other defects. Boards that are cupped or twisted should be avoided.

If you purchased rough-sawn boards, you'll need to thickness plane the $5/4$ stock to 1 in. and the $4/4$ stock to $3/4$ in. thick. If you don't have a thickness planer, most lumber dealers will, for a small charge, plane the boards for you.

Cut the Parts to Size

Next, rip the 1 in. thick stock to $5\frac{1}{2}$ in. wide for the six cleats. Then, rip the $3/4$ in. thick stock to $4\frac{1}{2}$ in. wide for the seat front and $3\frac{1}{2}$ in. wide for the slats.

Once all the parts have been ripped to width, crosscut each one to the lengths shown in the Bill of Materials.

Shape the Cleat Parts

The two seat cleats can now be cut to final shape. First, lay out and mark the taper and the 4 in. radius curve (see Fig. 2). Then, using the band saw, cut the

taper and the curve. Make the saw cut slightly on the outside of the marked line, then sand exactly to the line.

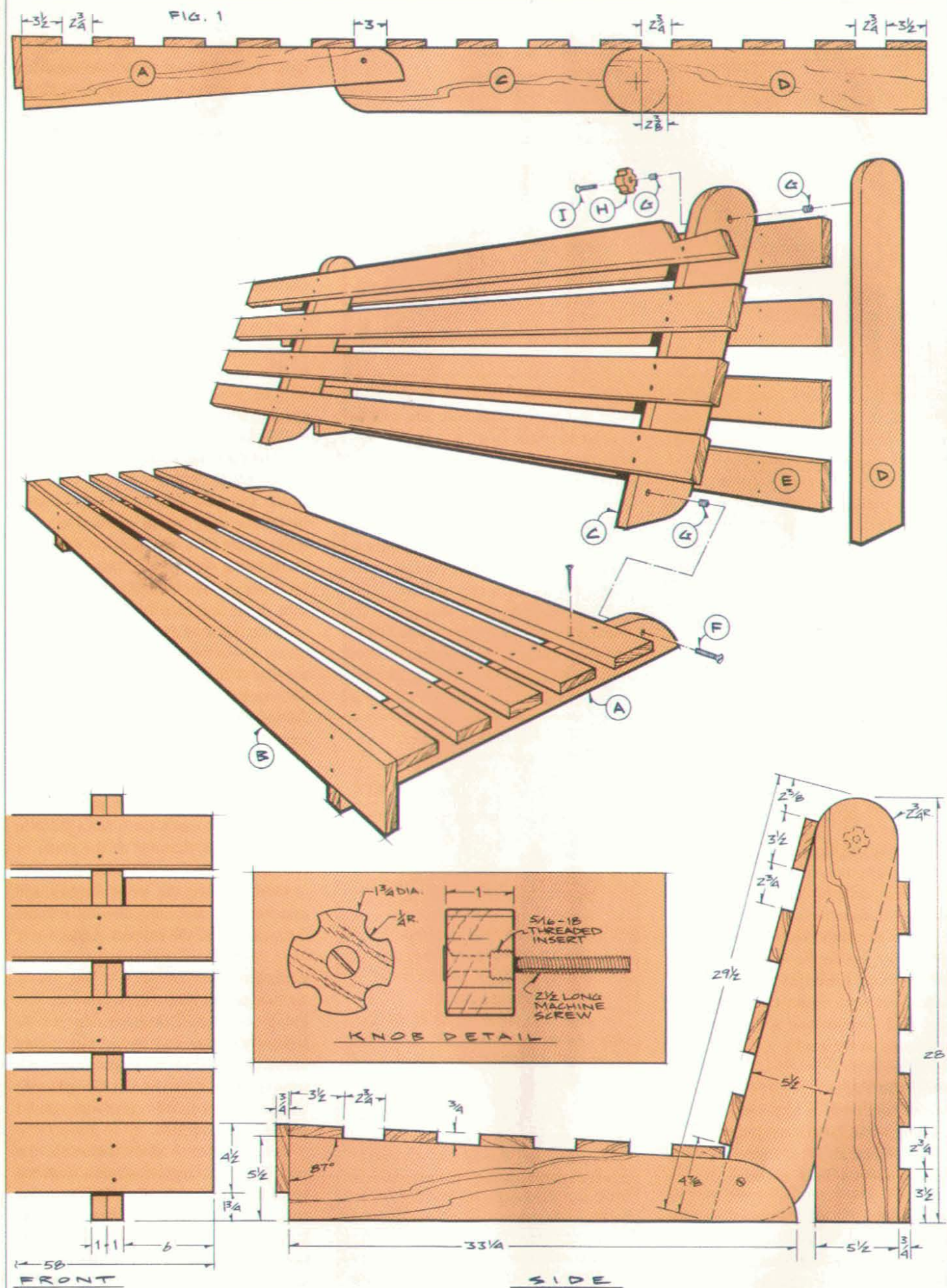
Still referring to Fig. 2, mark the location of the $3/8$ in. diameter through hole in each seat cleat. Once marked, bore each hole using the drill press. It's best to use the drill press here, and for all the holes that will follow (including those for the threaded inserts), as it's important for them to be square.

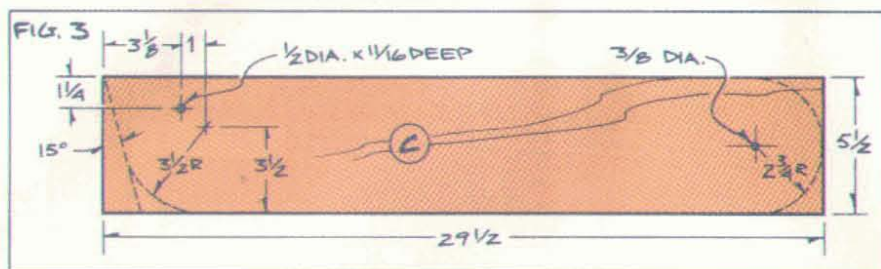
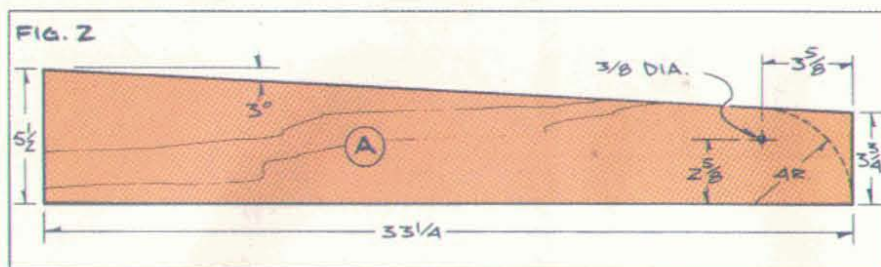
The back cleat has a 15-degree angle and a $3\frac{1}{2}$ in. radius cut on one end, and a $2\frac{3}{4}$ in. radius on the other (see Fig. 3 and Side View). The support cleat has a $2\frac{3}{4}$ in. radius on one end, while the other end is square.

Cut the 15 degree angle on the back cleat, then use a compass to scribe the various radii on each of the parts. Cut them out on the band saw. A disk sander, if you have one, will make it easy to sand the band sawn edges.

A $1\frac{1}{2}$ dia. by $11/16$ in. deep hole is bored in each back cleat to accept a $5/16$ - 18 by $5/8$ in. long brass threaded insert (G). Referring to Fig. 3, lay out and mark







the centerline of each hole, then bore them out. On the other end of the back cleat, at the center of the $2\frac{3}{4}$ in. radius, bore a $\frac{3}{8}$ in. dia. through hole.

Next, at the centerpoint of the $2\frac{3}{4}$ in. radius in the support cleat, use the drill press to bore a $\frac{1}{2}$ in. diameter by $\frac{11}{16}$ in. hole for the threaded insert. Once bored, thread the inserts in place. A thin coat of paste wax added to the outside threads of the inserts will help them go in easier.

Make the Knobs

To make each knob, use the compass to scribe a $1\frac{3}{4}$ in. dia. circle on a piece of 1 in. thick stock that's at least 2 in. square. At the center of the circle, bore a $\frac{1}{2}$ in. dia. by $\frac{11}{16}$ in. deep hole for the threaded insert and a $\frac{3}{8}$ in. dia. through hole for the knob machine screw (I). Thread the insert into the hole.

Next, mark the centerline location of the four $\frac{1}{4}$ in. radius cutouts, then use a $\frac{1}{2}$ in. dia. drill bit to bore each one. Now, to complete the handle (H), use the band saw to cut the scribed $1\frac{3}{4}$ in. dia. circle. Stay just on the waste side of the line, then sand the edges smooth. A disk sander will once again come in handy here. Add the machine screws to complete work on the knobs.

Sand the Parts

Give all the parts a thorough sanding, finishing with 220-grit sandpaper. When sanding, round all the corners and sharp edges to about a $\frac{1}{8}$ in. radius.

Assembly

We used $1\frac{1}{2}$ in. by no. 8 flathead wood screws to join the seat front and 13 slats to the cleats. A total of 56 screws are required. For each screw you need to

bore a pilot hole in the cleat. Also, you need to bore a shank hole and countersink in the seat front and slats. If you have one, a countersinking drill bit will make things much easier. These one-piece bits will drill the pilot hole, shank hole and countersink in one operation. If not available at your local hardware store, they can be ordered from most woodworking mail-order outfits.

Begin assembly by joining the seat front to the two seat cleats. Note that the seat front extends $\frac{3}{4}$ in. above the front edge of the seat cleats. Also, as shown in the front view, the cleats are inset 6 in.

from the ends of the seat front.

Now, add the first slat. To create a tight fit at the seat front, we used the table saw to cut a 3 degree bevel along the front edge of this slat only. (The remaining slats don't require any beveling.) After the first slat is beveled, butt it up against the seat front, then use the countersink drill bit to bore a pair of screw holes through the slat and into the cleat. With the holes bored on each end, secure the slat to the cleat with the flathead wood screws. We chose not to use any glue here, since the screws provide more than enough strength.

Now, rip a 58 in. length of scrap stock to $2\frac{3}{4}$ in. wide. This "spacer board" will be used to establish the $2\frac{3}{4}$ in. spacing between the remaining slats.

Butt the spacer board against the first slat, then butt the second slat against the spacer board. Make sure the ends are flush. You may want to use a bar clamp to hold everything in place. Once all looks okay, bore the holes on each end and add the screws. Use this same basic procedure to assemble all the remaining slats to the seat cleats.

Next, the slats are added to the back cleats. Begin by attaching the first slat at a point $\frac{4}{8}$ in. from the cleat bottom ends (see Side View). Before going any further, use the pivot screws to temporarily join the back cleats to the seat cleats, then pivot the parts from the bed position to the sofa position. The first back slat should just clear the last seat slat, but if it doesn't, use a hand plane to apply a slight chamfer to the slats, or readjust the slat spacing a bit.

Now, remove the pivot screws and assemble the remaining slats to both the back cleats and the support cleats.

Finishing

At this point, give the project one last going over with 220-grit sandpaper. To remove the dust you should thoroughly vacuum all the surfaces, then use a tack rag to pick up what remains. For a finish, we used two coats of a clear water-based polyurethane varnish.

Once the finish dries, assemble the seat, back and support sections with the pivot screws and knobs. The mattress simply lies flat when the Futon is used as a bed. When it's converted to a sofa, the mattress is folded under in the front as shown in the photo.

Bill of Materials

(all dimensions actual)

Part	Description	Size	No. Req'd.
A	Seat Cleat	1 x $5\frac{1}{2}$ x $33\frac{1}{4}$	2
B	Seat Front	$\frac{3}{4}$ x $4\frac{1}{2}$ x 58	1
C	Back Cleat	1 x $5\frac{1}{2}$ x $29\frac{1}{2}$	2
D	Support Cleat	1 x $5\frac{1}{2}$ x 28	2
E	Slat	$\frac{3}{4}$ x $3\frac{1}{2}$ x 58	13
F	Pivot Screw	$\frac{5}{16}$ -18 by $1\frac{1}{2}$ long	2
G	Threaded Insert	$\frac{3}{16}$ -18 by $\frac{5}{8}$ long	6
H	Knob Handle	See Detail	2
I	Knob Screw	$\frac{5}{16}$ -18 by $2\frac{1}{2}$ long	2

Mattress Source

The queen size (60 in. by 80 in.) sectional Futon mattress we used is available from The Company Store, 500 Company Store Road, La Crosse, WI 54601-4477; tel. 1-800-323-8000. The mattress fabric is 100 percent cotton twill (Scotch Guarded), the fill is 95 percent whole white European feathers and 5 percent European down. Order style no. F490-S32 (specify tan stripe or blue stripe). The current price is \$340 plus \$30 shipping and handling.

Should you prefer a pattern other than the tan or blue stripe, The Company Store also carries mattress covers in several prints and solid colors. Write or call them for more information.

The design of this router table was a result of my need for a good router table on which to demonstrate and teach basic stick and cope door construction (see *Stick and Cope Doorbuilding*, page 20). The router table actually serves several purposes. Yes, it's a good all-around basic router table, but in making this table, you coincidentally learn most of the basics employed in case/faceframe/panel door construction. Finally, even if you now have one of the inexpensive commercial bench-top router tables, making this table will give you a serious shop tool, capable of turning out work every bit as fine as in professional shops.

A Better Design

I believe this design has several advantages over most other router tables. First, the table surface is brought up to elbow level. The table illustrated fits my frame, but you should size your table so that the table surface is at your own elbow level. This is easy to do; just increase or decrease the length of the plywood cabinet box as needed.

Second, the placement of the router to the side of the cabinet allows easy access to the router for adjustment, and means that dust will fall onto the floor and not onto a storage cabinet below. And third, the design utilizes a simple fence and a clever bushing-guided miter gauge (more on these later). This miter gauge is super for cutting mock dovetails, finger joints, dados and more.

There's one more detail that makes this cabinet a pleasure to use, and that is the proportions of the working surface: narrow and long. In sticking operations, you might think that the best way to run stock past the cutter is along the table length, and in a perfect world, where all stile and rail stock is straight and true, that would be fine. But stile and rail stock is rarely perfect, and more often than not—especially on longer pieces—the stock usually has a bit of a bow. I run all my sticking operations across the short *width* of the table surface, with the stock oriented so the bow is up, concentrating the featherboards in the middle—fore and aft, and directly above the cutter. In practice, I've found that this orientation makes things much easier than trying to spring the material down flat along the table length. And by the way, the extra table surface to the right



Low-cost ROUTER TABLE

by Ernie Conover

of the work area comes in handy for stacking clamps, featherboards or workpieces.

Construction Details

The construction of this router table cameos the essentials of much cabinet work. There's a case, a face frame, a door and a drawer. I've tried to keep the construction as simple as possible—using butt or dado and groove joints wherever possible—so those who are just starting out will also be able to build this piece. But you can, of course, substitute whatever joinery you prefer. If you don't now own a router table, but would like to make this project, start out by making just the top. By clamping the

top to your workbench—so the router end overhangs the bench—you'll be able to use the top to do the door frame-and-panel work.

The Top

For the top, I've used medium density fiberboard (MDF) for the work surface (A), topped with plastic laminate (B). MDF yields a flatter surface than the typical plywood, and the plastic laminate is an ideal smooth, long wearing surface on which to work. You could substitute plywood for the work surface, if you can't find MDF locally, but use only a top-quality plywood such as Appleply or Baltic Birch. To prevent the work surface from warping, and to lend

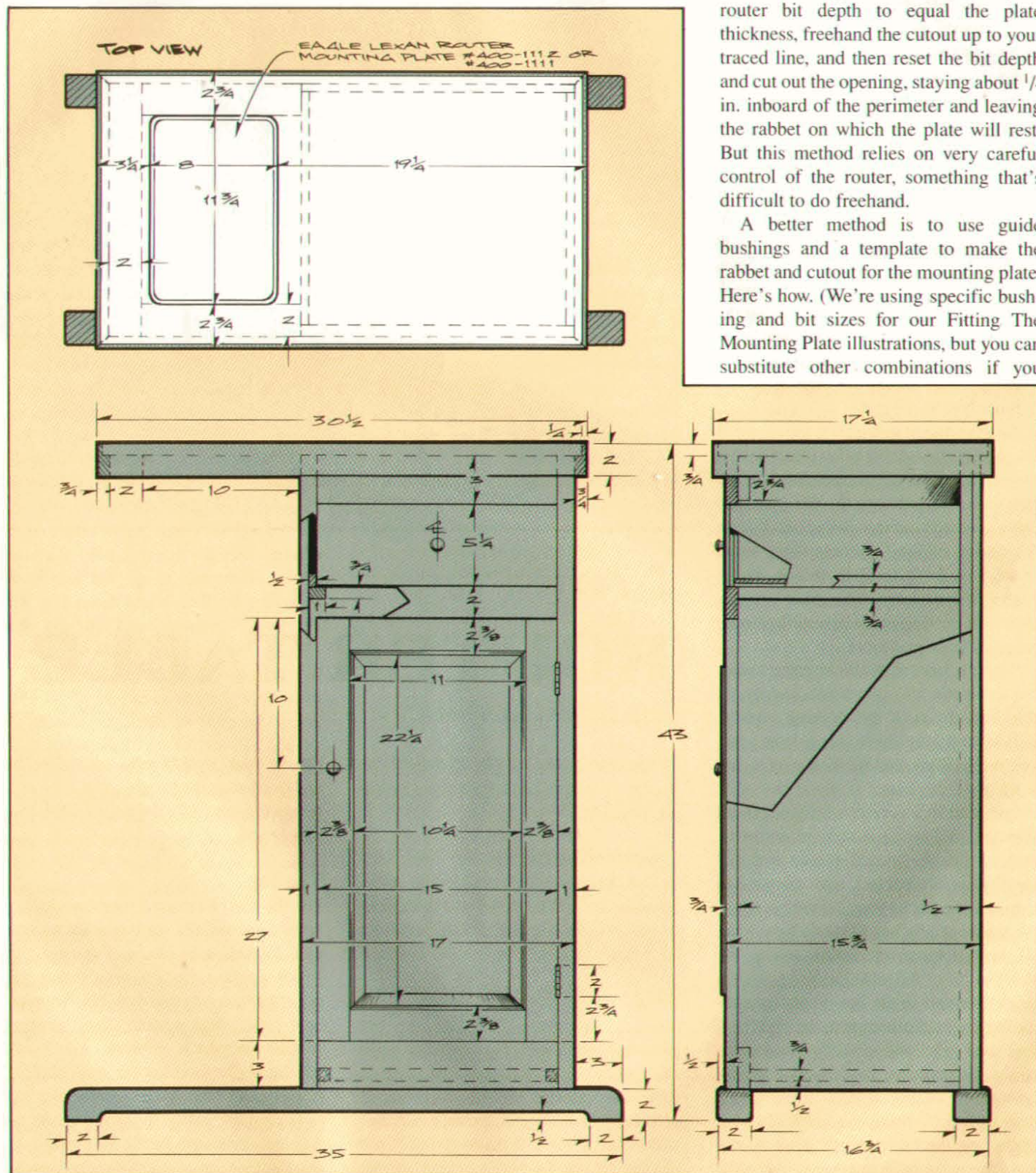
it added rigidity, the top is framed with a $\frac{3}{4}$ in. thick by 2 in. wide banding (C, D). Although in theory it's always best to apply a laminate to both sides of a substrate, with the router table work surface, the fact that extraordinarily stable substrates (such as MDF or high-quality plywood), plus a stabilizing banding are used makes it unnecessary to cover both surfaces.

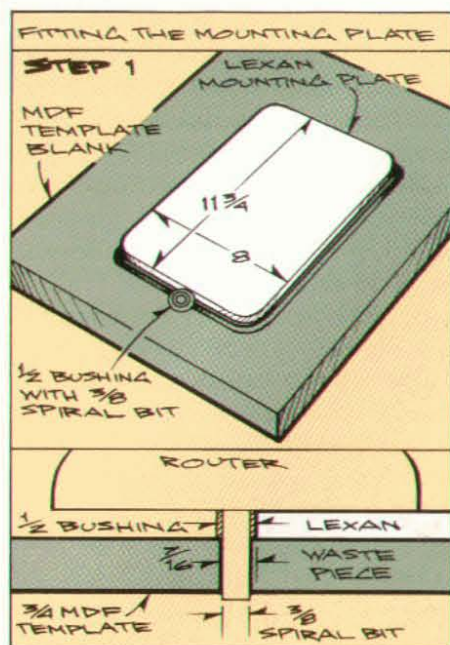
To make the top, cut the work surface to exact size, cut the plastic laminate oversize and apply it, then use the router equipped with a laminate trimming bit to trim the laminate flush with the work surface edge. Next, rip enough stock for the banding, and cut a $\frac{1}{2}$ in. wide by $\frac{3}{4}$ in. deep rabbet in the banding to accept the work surface with laminate. Note that the actual depth of the rabbet will be

slightly greater than $\frac{3}{4}$ in., since it must accept the combined thickness of both the $\frac{3}{4}$ in. MDF and the plastic laminate. Miter the ends of the banding to fit, then glue and clamp it in place, framing out the top.

The fussiest part of making the top is routing for the Lexan mounting plate (F). You could simply trace the plate profile directly onto the top, set your router bit depth to equal the plate thickness, freehand the cutout up to your traced line, and then reset the bit depth and cut out the opening, staying about $\frac{1}{4}$ in. inboard of the perimeter and leaving the rabbet on which the plate will rest. But this method relies on very careful control of the router, something that's difficult to do freehand.

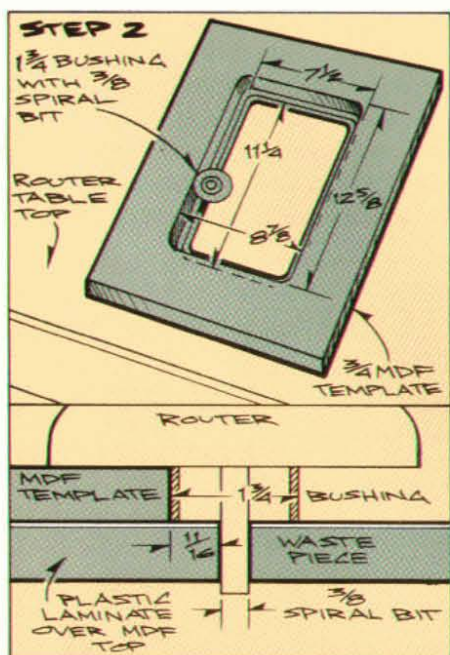
A better method is to use guide bushings and a template to make the rabbet and cutout for the mounting plate. Here's how. (We're using specific bushing and bit sizes for our Fitting The Mounting Plate illustrations, but you can substitute other combinations if you





don't have the sizes listed). For starters, use doublestick tape to temporarily mount the Lexan plate to a scrap piece of MDF, then using a $\frac{1}{2}$ in. diameter bushing and a $\frac{3}{8}$ in. diameter spiral cutter, make a cut around the plate (Step 1). You'll now have a template with a cutout that's exactly $\frac{7}{16}$ in. larger all around than the Lexan plate, which for our 8 in. by $11\frac{3}{4}$ in. plate translates into a template cutout measuring $8\frac{7}{8}$ in. by $12\frac{5}{8}$ in..

Next, again using doublestick tape, temporarily fasten the MDF template to the top (see Top View for proper location). Using a $1\frac{3}{4}$ in. diameter bushing with the same $\frac{3}{8}$ in. spiral bit,



plunge through the top and make the inside cutout (Step 2). The opening that you've cut will be $\frac{11}{16}$ in. smaller all around than the template opening, which translates into a cutout in the top measuring $7\frac{1}{2}$ in. wide by $11\frac{1}{4}$ in. long.

Bill of Materials (all dimensions actual)

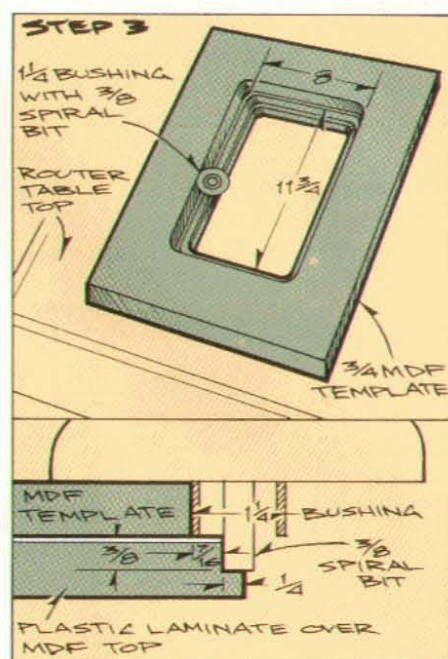
Part	Description	Size	No. Req'd.
Top			
A	Work Surface	$\frac{3}{4}$ x $16\frac{3}{4}$ x 30	1
B	Laminate	$16\frac{3}{4}$ x 30	1
C	End Banding	$\frac{3}{4}$ x 2 x $17\frac{1}{4}$	2
D	Front/Back Banding	$\frac{3}{4}$ x 2 x $30\frac{1}{2}$	2
E	Filler Blocks	$1\frac{1}{4}$ x 2	*
F	Mounting Plate	$\frac{3}{8}$ x 8 x $11\frac{3}{4}$ **	1
Cabinet			
G	Side	$\frac{1}{2}$ x $14\frac{1}{2}$ x $40\frac{1}{4}$	2
H	Back	$\frac{1}{2}$ x 17 x $40\frac{1}{4}$	1
I	Bottom	$\frac{1}{2}$ x $14\frac{1}{2}$ x 16	1
J	Stile	$\frac{3}{4}$ x 1 x $40\frac{1}{4}$	2
K	Top/Bottom Rail	$\frac{3}{4}$ x 3 x 15	2
L	Center Rail	$\frac{3}{4}$ x 2 x 15	1
M	Corner Block	$\frac{3}{4}$ x $\frac{3}{4}$	*
N	Drawer Runner	$\frac{3}{4}$ x 1 x $13\frac{3}{4}$	2
O	Drawer Guide	$\frac{1}{2}$ x $\frac{3}{4}$ x $13\frac{3}{4}$	2
Drawer			
P	Front	$\frac{3}{4}$ x $5\frac{1}{4}$ x 15	1
Q	Back	$\frac{1}{2}$ x $4\frac{3}{4}$ x $14\frac{1}{2}$	1
R	Side	$\frac{1}{2}$ x $5\frac{1}{4}$ x $14\frac{1}{4}$	2
S	Bottom	$\frac{1}{4}$ x 14 x $14\frac{1}{2}$	1
Door			
T	Stile	$\frac{3}{4}$ x $2\frac{3}{8}$ x 27	2
U	Rail	$\frac{3}{4}$ x $2\frac{3}{8}$ x 11	2
V	Panel	$\frac{3}{4}$ x $10\frac{7}{8}$ x 23^{***}	1
Base			
W	Foot	2 x 2 x 35	2
Hardware			
X	Porcelain Knob	1 dia.	2
Y	Butt Hinge	$1\frac{1}{2}$ x 2	2
Z	Magnetic Catch	as shown	1
Fence Accessory			
AA	Fence	$\frac{3}{4}$ x 4 x $17\frac{1}{4}$	1
BB	Bottom	$\frac{3}{4}$ x 2 x $17\frac{1}{4}$	1
Miter Gauge Accessory			
CC	Base	$\frac{1}{2}$ x 11 x 16^{****}	1
DD	Crosspiece	$1\frac{3}{8}$ x 2 x 11	3

* As required

** Lexan router mounting plate is available from: Eagle America, P.O. Box 1099, Chardon, Ohio 44024; tel. 1-800-872-2511. Order part no. 400-1111 for mounting plate pre-bored with $1\frac{3}{4}$ in. dia. hole (\$19.95), or part no. 400-1112 for blank plate (\$16.95). Both plates come with mounting instructions and will fit any router (you bore screw mounting holes to fit your router base).

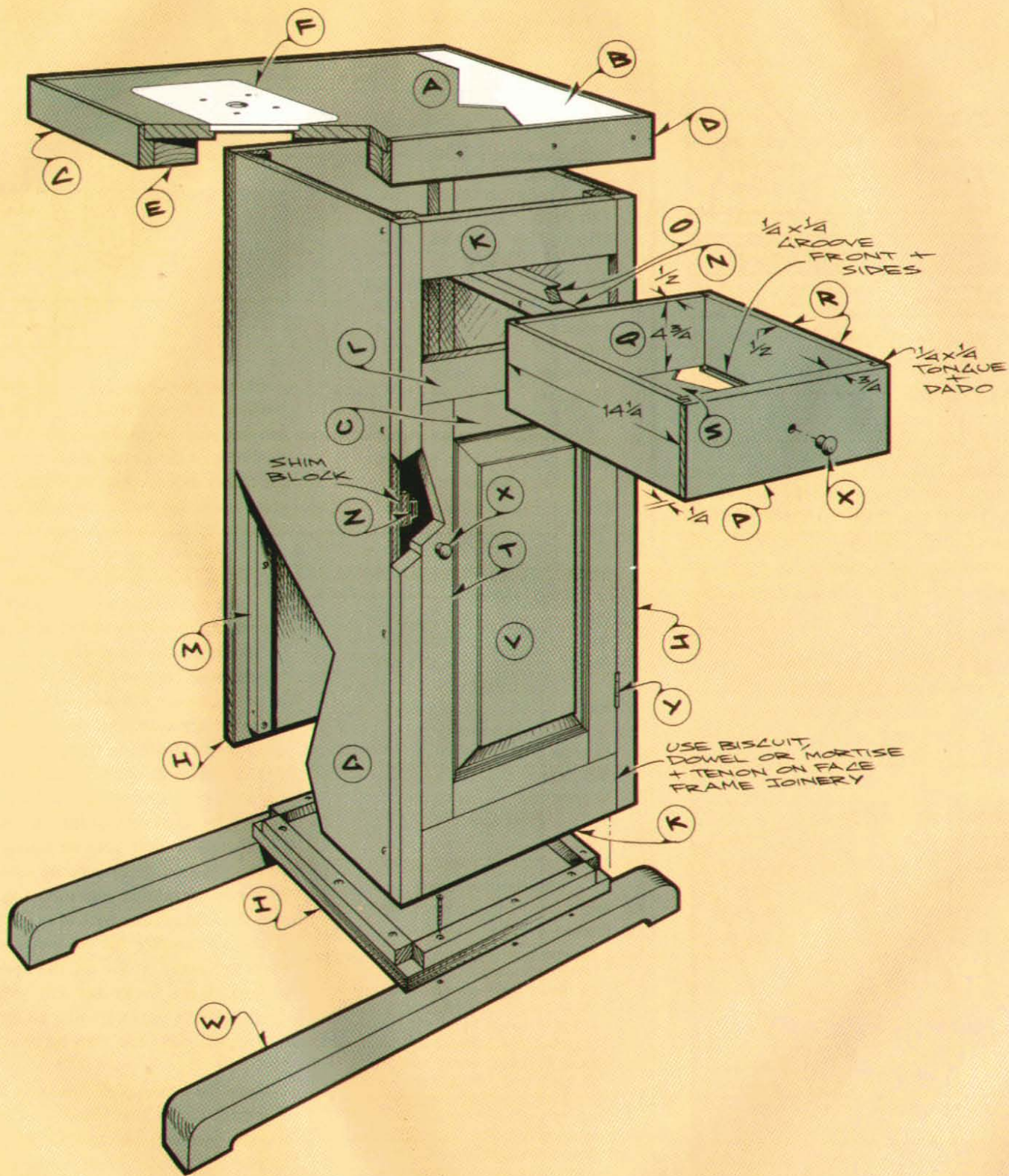
*** Panel width is sized $\frac{1}{8}$ in. less than groove-to-groove distance, to allow for wood movement.

**** Bushing groove separating base into two sections is made after miter gauge accessory has been assembled.



Finally, switch to a $1\frac{1}{4}$ in. diameter bushing, and using the same $\frac{3}{8}$ in. spiral bit—set for a $\frac{3}{8}$ in. deep cut (the thickness of the Lexan plate)—establish the rabbet in the top on which the Lexan plate will rest (Step 3). As illustrated, the bit will establish a $\frac{1}{4}$ in. wide by $\frac{3}{8}$ in. deep rabbet. Note that you haven't moved the MDF template, which is in the same position as it was in Step 2. As shown, the rabbet-to-rabbet dimensions should be exactly equal to the size of the Lexan plate. A snug fit of the Lexan plate is important if your router table is to be an accurate tool, so it's good to make a few checks as you proceed with this step-by-step. When in doubt, always opt for a slightly undersize rabbet—you can easily sand the Lexan to fit, but you'll have a hard time stretching that Lexan plate to fill an oversize opening! If you are afraid that your rabbet may be a little too large, one trick is to switch to a slightly smaller bit in Step 3. For example, using a $\frac{5}{16}$ in. diameter bit instead of the $\frac{3}{8}$ in. bit will yield an opening that's $\frac{1}{32}$ in. smaller all around. The Lexan plate can then be sanded to fit.

Once the Lexan plate has been fitted, and drilled to fit your router's mounting screws, you can cut and fit the filler blocks (E). These blocks add a little more rigidity to the top, but their main function is to fill the area behind the banding, thereby making it easy to quickly clamp the fence and featherboards.



The Cabinet

You can use whatever stock you have available for the cabinet. We show plywood for the case, with the remaining parts all an inexpensive hardwood (such as poplar or birch). Don't be picky about your stock here, since all the parts—including the drawer and door—are painted.

Case: The cabinet is made of $\frac{1}{2}$ in. thick plywood, just a pair of sides (G), a back (H) and a bottom (I). Our illustration shows the cabinet construction as just screwed together, with corner blocks (M) reinforcing the butt joinery, however you can use any joinery you prefer, such as biscuits, nails or whatever. We haven't specified a joinery for the face frame, consisting of stiles (J) and rails (K, L), but either biscuits or dowels would be fine. Use glue and screws (drywall screws are ideal for this type of construction) to fasten the face frame to the cabinet. Finishing up the cabinet are the drawer runners (N) and

guides (O), which are screwed and glued in place. Although we don't show any, if your needs so dictate, shelves can of course also be added to the cabinet.

Drawer: Our drawer is made of hardwood, with a $\frac{3}{4}$ in. thick front (P), $\frac{1}{2}$ in. back (Q) and sides (R), and a $\frac{1}{4}$ in. plywood bottom (S). We show a tongue and dado joint on the drawer box, but nail-reinforced rabbet joints would also be fine.

Door: We'll not detail the door construction here, since that's covered in the Stick and Cope Doorbuilding feature (page 20). Just note that the $2\frac{3}{8}$ in. widths of the stiles (T) and rails (U) are inclusive of the molded profile that's cut on one edge during the sticking operation. Part of the beauty of most stick and cope work is that both the stiles and the rails are cut to exact length—since the rail length automatically includes the coped ends that form the stub tenon fitting within the mating sticked stiles, there's no need for complicated calcula-

tions of rail length to include the typically unseen tenons.

Our door shows a raised panel (V), though if you don't have a panel raising bit a simple panel of $\frac{1}{4}$ in. plywood will suffice.

Base: The base is just a pair of feet (W). Levelers can be added if your floor is uneven. Mount the feet by screwing down into them through the reinforcing corner blocks and case bottom.

Details

Hardware: The top is slid into place over the cabinet, and several screws through the front and back bandings and into the cabinet secure the assembly. Once the parts are painted, add the porcelain knobs (X) to the door and drawer, then mount the door with the hinges (Y), and install a magnetic catch (Z) to keep the door closed. You will need a $\frac{1}{2}$ in. thick scrap to bring the magnetic catch out flush with the edge of the door.

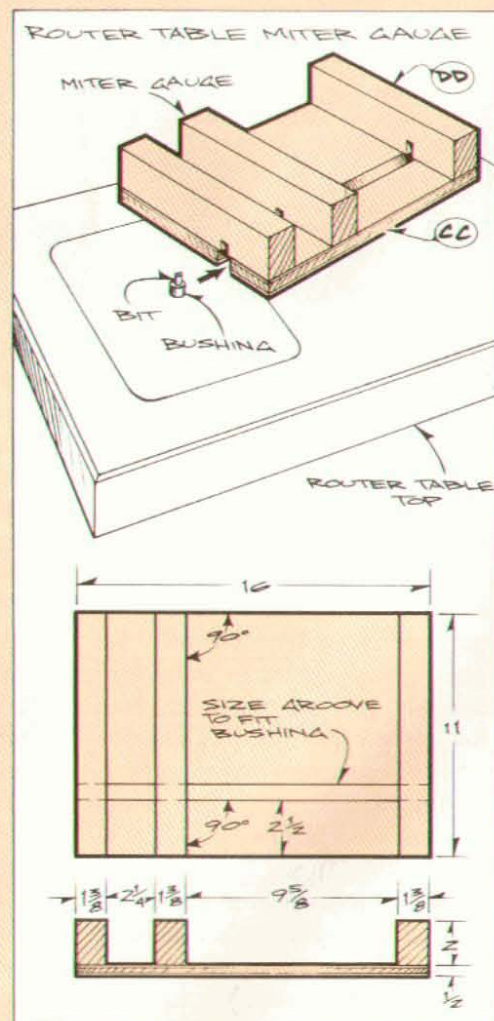
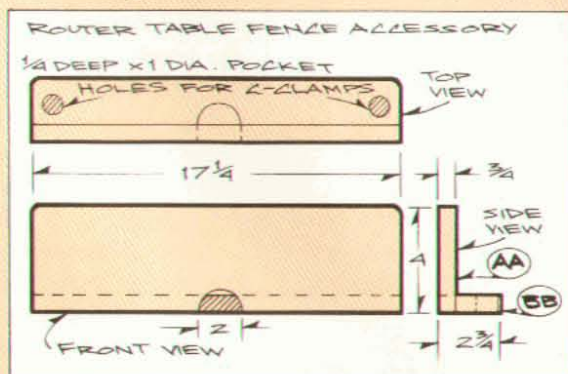


Accessories

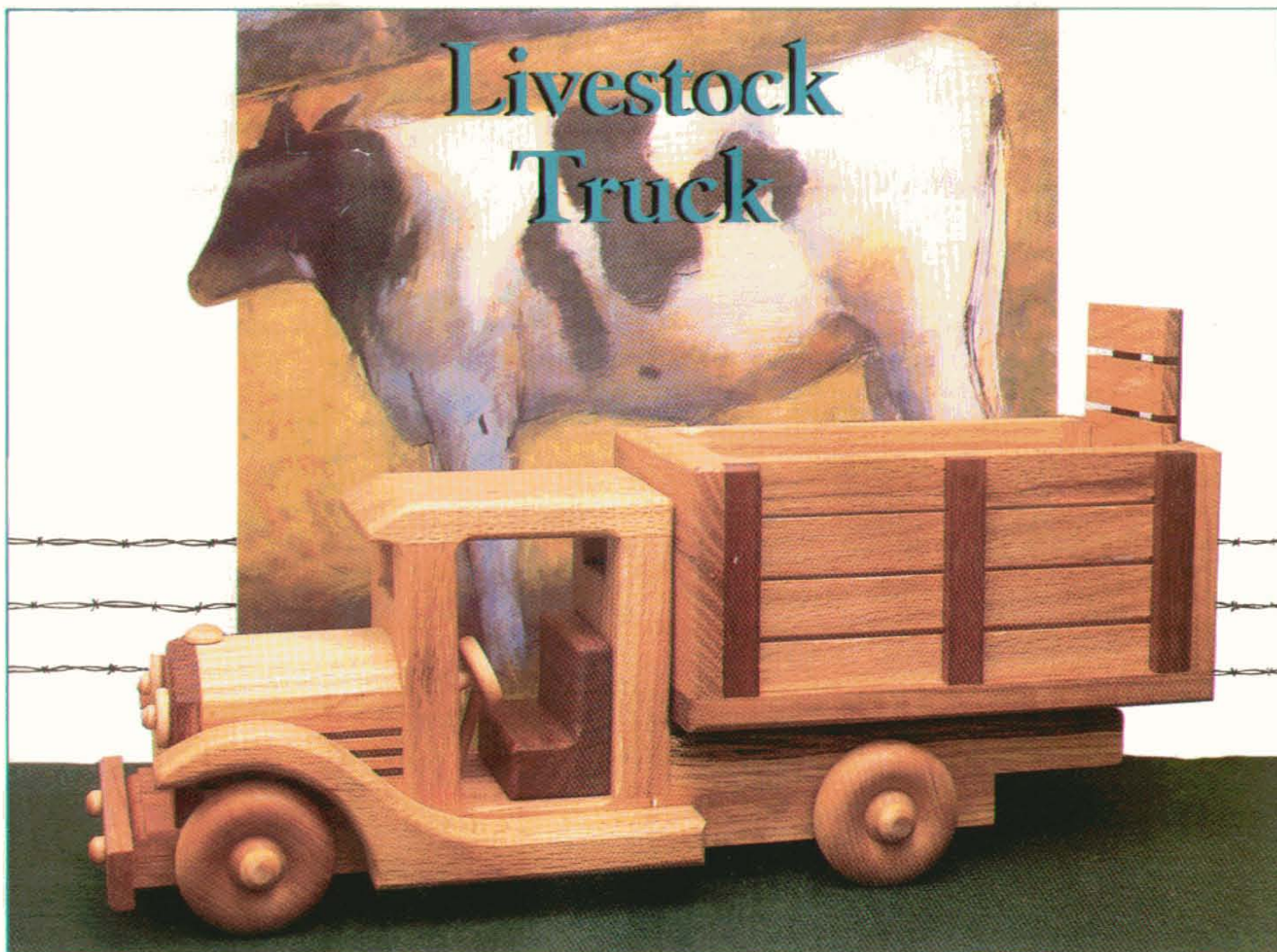
Accessory Fence: The fence is just a fence board (AA) glued and screwed at a right angle to a bottom board (BB). The important thing here is to use stock that is straight and true. If you don't have such stock, use $\frac{3}{4}$ in. thick Appleply or Baltic birch instead. We show a 2 in. cutout for bit clearance, but you'll probably want to make several fences, and customize the bit clearance hole for the bits you use most. The pocket holes near the fence ends are just a handy way to keep your C-clamps from sliding off when loosened.

Accessory Miter Gauge: The miter gauge accessory is a deceptively simple device—just a base (CC) with three crosspieces (DD). I used plywood for the base, but others who have made the base have used plastic instead, to eliminate the slight movement that can occur in any wood—even plywood. The slot in the base is exactly sized to fit a guide bushing of your choice. It's important for this slot to be milled at a precise right angle to the crosspieces, so you'll want to do this on your table saw, using the rip fence. If you use plastic for the base, this will also eliminate the possibility of wear on the groove sides, which could result in the bushing becoming sloppy over time.

There are multiple ways to use the miter gauge, and don't feel obligated to build yours exactly the same size as ours. Stock can be positioned flat between the crosspieces, on edge, on end, or you can even build a gauge that includes a 90-degree cradle for cutting mock dovetails on the corners of boxes.



Livestock Truck



If you are a parent or grandparent, then you know that one of the real pleasures in raising children is in sharing their delight at receiving a special gift. This Livestock Truck, from the Kansas workshop of Fred Cairns and Kathy Dawson, is one toy that's sure to have the little ones wide-eyed once they spy it beneath the Christmas tree.

Long-time subscribers will note that this latest design shares its basic construction with previous pieces from Fred and Kathy, specifically the Pickup Truck (November/December 1988), the Roadster (March/April 1991), the Dump Truck (September/October 1991), and the Big Rig (July/August 1992). As with their previous projects, Fred and Kathy have agreed to provide a kit (see Parts Kit Ordering Information) that includes all the wheels and pegs, just in case you can't find these parts locally.

As the photo shows, the Livestock

Truck is made primarily from oak, with a few parts made from a contrasting wood (padauk). If you don't have any padauk, walnut will yield much the same contrast. But don't feel restricted to these wood choices. Almost any combination of hardwoods or even pine (though it's softer and won't stand up as well to abuse) will be fine.

When building this project (especially if this is your first toy), keep in mind that the entire assembly is basically just a series of blocks, with wheels, pegs, and a few shaped parts for detail. There's no real joinery here, since all the parts are just glued to each other. To simplify the construction of the truck, we've divided the project into two sections, the cab/chassis assembly and the livestock box.

The Cab/Chassis

The easiest way to put the cab/chassis together is to consider the assembly as

actually a combination of several subassemblies. Begin by cutting the parts to length and width. Once the chassis (A), hood (B), lower hood (C), grill (D), cab front/back (E), roof (F), seat parts (G, H) and bed (I) have been cut to overall length and width, you can start making the first subassembly—the hood, lower hood and grill. Use the table saw to establish the $\frac{1}{8}$ in. deep by $\frac{1}{8}$ in. wide louver kerfs in the lower hood, then glue the hood and grill blocks to the lower hood. Scribe a $2\frac{1}{2}$ in. radius line to lay out the hood curve, then cut that curve with a band saw, sand smooth, and round the top and side edges of the grill front. Next, use a $\frac{3}{16}$ in. radius round-over bit in the router table to establish the stepped roundover detail on the front top end of the chassis.

Mount the hood/lower hood/grill subassembly to the chassis, locating it $\frac{1}{2}$ in. back from the front end of the chassis,

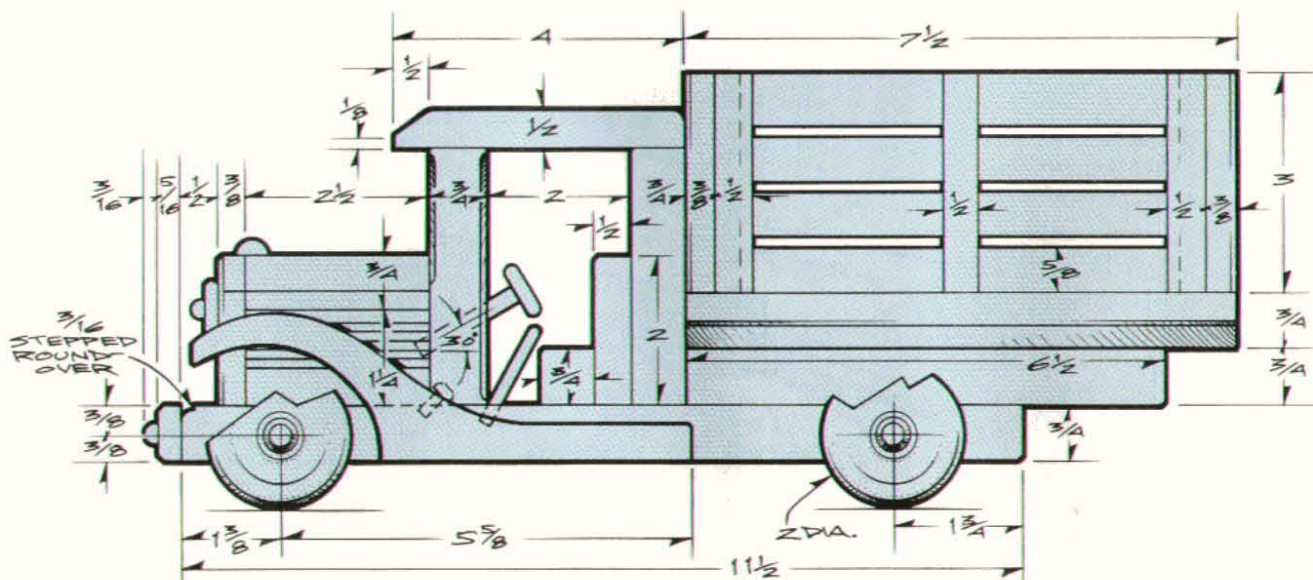
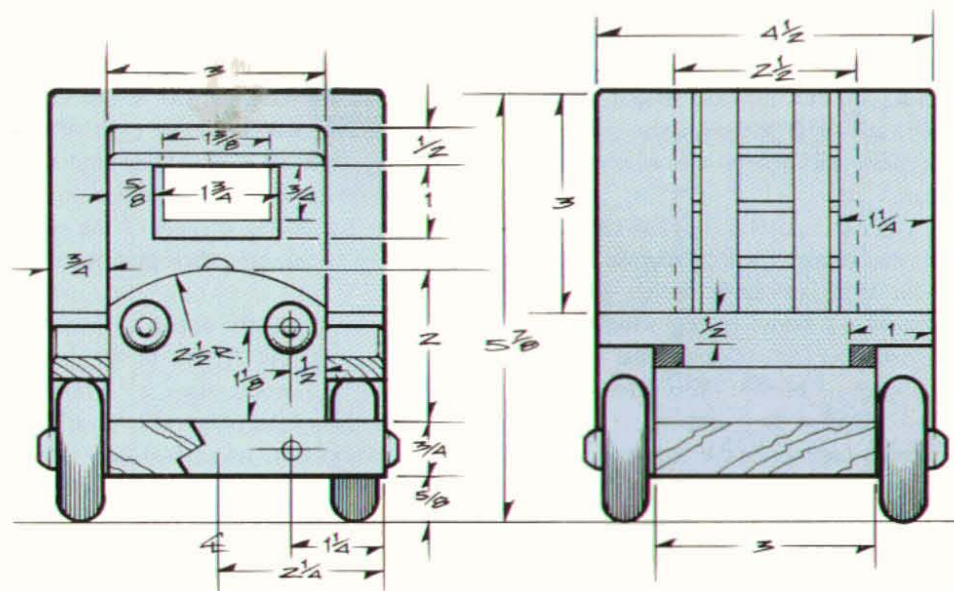
then drill the holes for the various controls inside the cab—the steering column (L), gear shift (M), and pedal pegs (Y). The Cab Detail shows the placement of these parts. Mount the medium wheel (U) that serves as the steering wheel to the steering column, then glue the column, the gear shift and the pedal pegs into their respective holes. We recommend mounting these parts now, before the cab front/back and roof are added, since access inside the cab is more difficult later.

Make the various cutouts in the cab front and back. As the exploded view shows, there's a windshield and control area cutout in the cab front, and a window cutout in the cab back. The front and rear elevations, and the Cab Detail, show the dimensions of the cutouts.

Test assemble the cab parts. If everything looks fine, glue the cab front/back

and roof to the chassis, then add the bed. Next, mount the seat to the seat back, and glue this subassembly to the chassis. Don't be overly concerned with getting all the cab parts to register perfectly flush with the chassis. As shown in the Sanding Detail, once the glue has dried you can use the disk sander to flush the sides. This step is an important one, since the sides must be flat for the fenders to have an even surface on which to mount.

Next, using a drill press (or a hand drill) establish the axle peg holes. Your parts kit will include five large pegs (W)—four are used to mount the four large wheels (T), the fifth is cut short and serves as the radiator cap. Mount the wheels, taking care not to press the axle pegs in too deep, since you want the wheels to turn smoothly. Also, drill for the small pegs (Y) that secure the pair of



Bill of Materials

(all dimensions actual)

Part	Description	Size	No. Req'd.
Cab/Chassis			
A	Chassis	3/4 x 3 x 11 1/2	1
B	Hood	3/4 x 3 x 2 1/2	1
C	Lower Hood	1 1/4 x 3 x 2 1/2	1
D	Grill	3/8 x 3 x 2	1
E	Cab Front/Back	3/4 x 3 x 3 1/2	2
F	Roof	1/2 x 3 x 4	1
G	Seat	3/4 x 3/4 x 2 1/2	1
H	Seat Back	1/2 x 2 x 2 1/2	1
I	Bed	3/4 x 3 x 6 1/2	1
J	Fender	See Full-size Pattern	2
K	Bumper	5/16 x 3/4 x 4 1/2	1
L	Steering Column	7/32 dia. x 1 3/4 long	1
M	Gear Shift	3/16 dia. x 1 1/4 long	1
Livestock Box			
N	Bottom	3/4 x 4 1/2 x 7 1/2	1
O	Front	3/4 x 3 x 4 1/2	1
P	Corner	3/4 x 1 1/4 x 3	2
Q	Side Rail	1/2 x 5/8 x 6 3/4	8
R	End Rail	1/4 x 5/8 x 2 1/2	4
S	Post	1/4 x 1/2 x 3	8
Wheels/Pegs*			
T	Large Wheel	2 dia. x 5/8 thick	4
U	Medium Wheel	1 dia. x 5/16 thick	1
V	Small Wheel	3/4 dia. x 3/16 thick	2
W	Large Peg	See Detail	5
X	Medium Peg	See Detail	2
Y	Small Peg	See Detail	4

Parts Kit Ordering Information

* All the wheels and pegs that you'll need for the Livestock Truck are available in a kit. Write or call Lynes Unlimited, Route 2, Greenleaf, KS 66943; tel. (913) 747-2612. Specify Parts Kit for Livestock Truck (cost is \$10 postpaid; checks or money orders only). Please note that kit does not include any parts other than the wheels and pegs.

small wheels (V) that serve as headlights, and glue these parts in place.

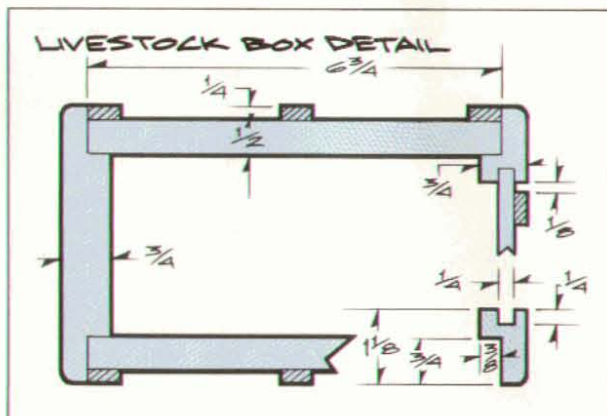
All that's left on the cab are the fenders (J) and the bumper (K). Cut the bumper to size, then chamfer the front edges and mount to the chassis by drilling through for the pair of medium-size pegs (X). To make the fenders, first use the full-size pattern to transfer the fender profile to your $\frac{3}{4}$ in. thick fender stock, then cut the fender shape with the band saw or scroll saw, and sand smooth. One trick to getting both the fenders to the exact same shape is to use doublestick tape to hold the fenders together, and then sand them at the same time on the drum sander. Apply a generous chamfer or roundover to the outside edges of the fenders (to avoid splinters), then glue the fenders in place, allowing adequate clearance for the front wheels.

The Livestock Box

The livestock box is made as a separate unit, which is then glued in place on the truck bed. You'll need three stock thicknesses: $\frac{3}{4}$ in. for the bottom (N), front (O) and corners (P), $\frac{1}{2}$ in. for the side rails (Q) and $\frac{1}{4}$ in. for the end rails (R) and posts (S). Use the table saw or the router table to establish the $\frac{1}{4}$ in. deep by 1 in. wide rabbet on the bottom, the $\frac{3}{8}$ in. deep by $\frac{3}{4}$ in. wide rabbets on the ends of the front, and to make the $\frac{3}{8}$ in. deep by $\frac{3}{4}$ in. wide rabbet and the $\frac{1}{4}$ in. deep by $\frac{1}{4}$ in. wide groove on the corners. The overhead view shown in the Livestock Box Detail should help you to

see the relationship of the various parts.

The simplest way to make the two corners is to start with a piece of stock about 8 in. long, establish the rabbet and groove, and then crosscut to yield the two corners. The extra length just makes the piece a little easier—and safer—to handle. The same holds true for the



remaining parts—the side rails, end rails and posts. Rip lengths of stock sufficient to yield the various parts, then crosscut to rough, but not final length. As we'll see, it's best to cut these parts—the corners, rails and posts—a little long for now.

Once the parts have been cut to size, all that remains is to assemble them. As with the cab parts, don't be overly concerned with getting everything to register perfectly flush at the sides and ends of the bottom. You'll be using the disk sander to sand these surfaces smooth later, once the glue has dried.

The easiest way to handle the livestock box assembly is to first make several subassemblies. Glue up four of

the side rails and three of the posts to form one slatted side, repeat the assembly to form the remaining slatted side, and glue up the four end rails with the two remaining posts to form the sliding gate. Here's where the extra length of the parts comes in handy. Once the slatted sides are out of clamps, you can use the

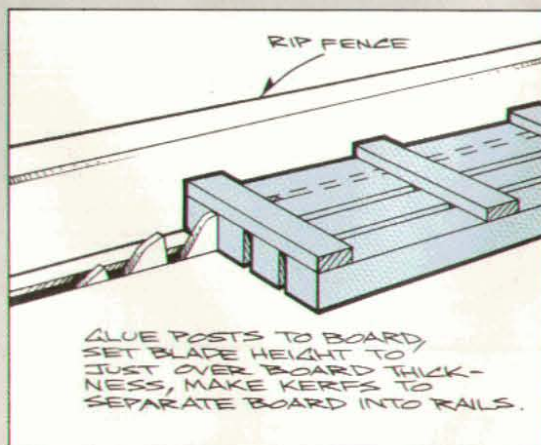
table saw to trim the ends flush. Another clever way to make the slatted sides and the sliding gate is shown in the Time-Saver Tip. The advantage of this method is that the boards that yield the side rails need only be cut to width and final length. The kerf from the table saw blade is then used to separate the board into four individual rails after the posts have been glued in place!

Whatever method you use to make the slatted sides and the sliding gate, now assemble these parts, the bottom, front and corners. When this assembly has dried, use the disk sander to fair in any irregularities at the sides, ends or top, then trim the ends of the sliding gate to allow it to slide smoothly up and down within the grooves in the corners. Round the corners of the completed livestock box, then glue it to the bed.

We don't usually apply a finish to wooden toys, but if you prefer something on the wood, then try Preserve Natural Non-toxic Nut Oil (available from Woodcraft, tel. 1-800-225-1153). Preserve is a penetrating oil that's made from nut meats, and it's truly safe, both as a liquid and when dry. 

Time Saver Tip

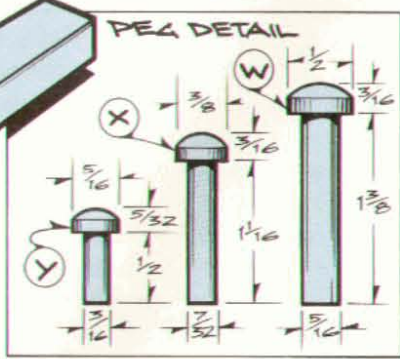
If you've ever spent time fussing with gluing up a series of slats or rails onto their carrying posts, you've probably been perplexed trying to keep all the rails or slats from sliding out of alignment, and with keeping them all spaced evenly apart. We've seen tips that help—such as inserting small brads, and snipping off the heads so that about $\frac{1}{8}$ in. stands proud—to keep the parts from sliding about. But none of the tips we've seen is as easy as this one.



First, glue the posts to a solid board, and then use the table saw, with the blade raised just a hair higher than the thickness of the rail board, to create the individual rails or slats. The advantages are obvious: perfectly spaced rails, perfectly even ends, an economy of time and effort, and no hassle. Don't even worry about setting the rip fence perfectly so each kerf is the same distance apart—no one will notice if the rails aren't all exactly the same width.

SANDING DETAIL

A perspective view of a sanding block. The block is light blue with a curved front face and a flat top. It is resting on a white surface. The background is a light yellow with a circular pattern.



One of the busiest booths at this year's Boston Buyer's Market of American Crafts belonged to Ford Thomas and his company, Benchworks. This gem of a little jewelry box is one of his best-selling designs—and a glance at the photo should leave little doubt as to just why. Sure, it's basically just a simple box, but details like choice of woods, a clever wooden hinge, and a lid lift and feet that share a common design theme all combine to give this box "heirloom" appeal.

If you like this box and plan to make one—think again—and make two, three or more. As with most woodworking, the time spent in box making is usually spent in getting setups right, not in actual cutting and assembly. Mill enough stock for several boxes, and your efforts will be well-rewarded.

Since he's a production woodworker, Ford Thomas makes these boxes in

multiples. But the fact that Ford's design helps him economize on set-up and cutting time should also result in savings for you if you make only one. One way Ford saves time is to employ grooves wherever possible that are the thickness of his table saw blade. For example, the grooves for the box bottom, lid panel, tray supports and splines, plus the tray bottom groove, are all $\frac{1}{8}$ in. wide, so they require only a single pass with the sawblade to cut. Ford actually uses a thin-kerf blade for his spline kerfs (the same blade that's used to separate the lid from the box, since these operations are done one after the other), but if you don't have a thin-kerf blade no one will ever notice the difference.

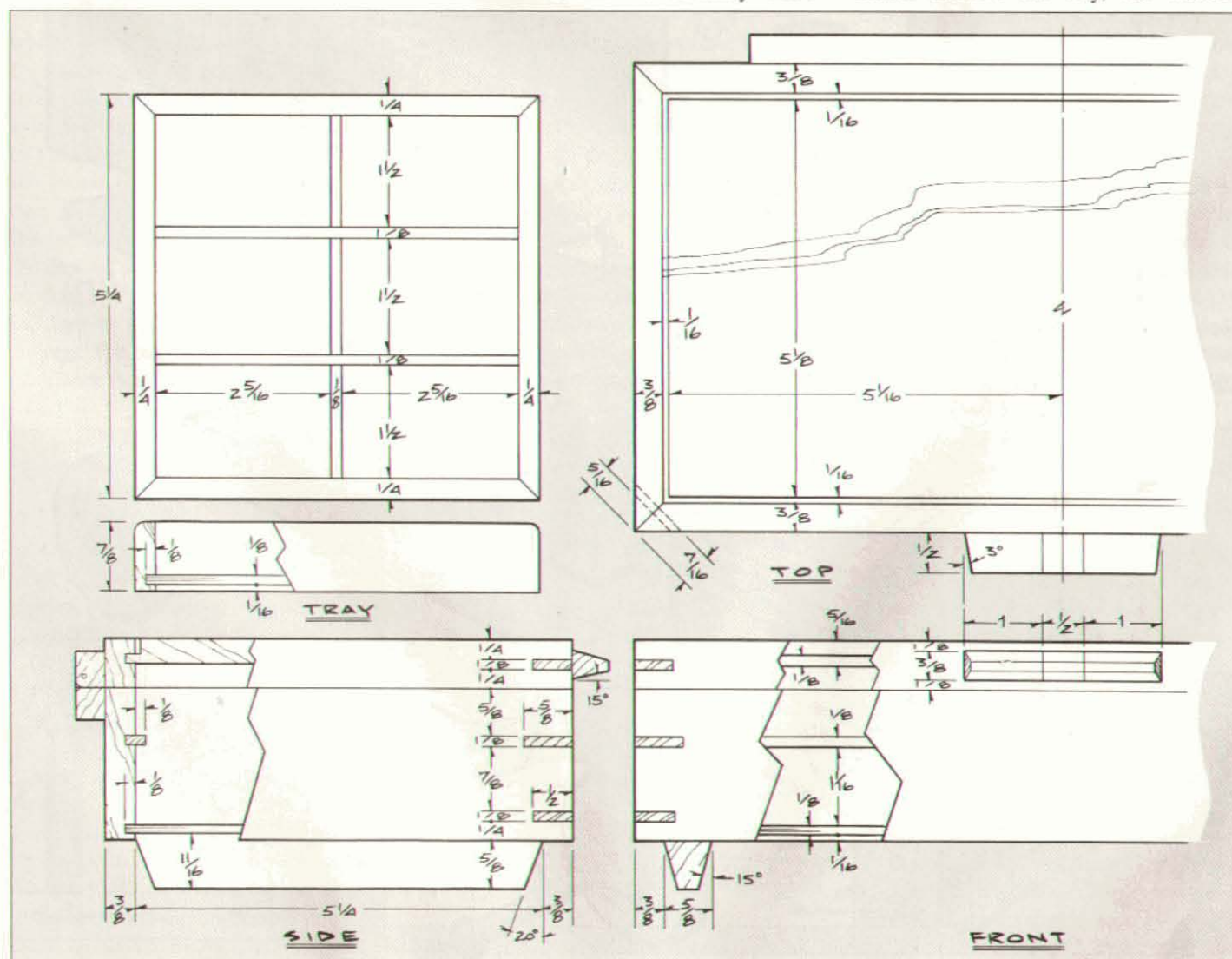
Boxes like this are showpieces for choice stock, and we certainly don't

Heirloom Jewelry Box

recommend using oak, pine or any other plain wood. The box shown is a combination of cocobolo and bird's-eye maple, with ebony accents, but other equivalent woods will also be fine.

The Box

When it comes to the actual work involved, a basic mitered-corner box is probably the simplest type of box to make. Remove the tray, the wooden





hinge, the lift (I) and the feet (J), and all that remains is a simple box. But there are some tricks to making a box with mitered corners, and without these tips, you could be frustrated. Here's how to get the job done right.

Size Stock: For the box shown, start with a length of stock $\frac{3}{8}$ in. thick by $2\frac{3}{4}$ in. wide by at least 3 ft. long. The box is glued up as a single assembly, with the lid cut away later, so the $2\frac{3}{4}$ in. width of your source board will yield the 2 in. wide ends (A) and front/back (B), the $\frac{5}{8}$ in. wide lid ends (C), and front/back (D), plus allowing $\frac{1}{8}$ in. for the cut to separate the lid from the box.

Establish Lid Panel and Bottom Grooves: Set up the table saw with the rip fence, and make the $\frac{1}{8}$ in. deep by $\frac{1}{8}$ in. wide grooves for the lid panel (E) and bottom (F).

Make Miter Cuts: The best way to make the miter cuts that establish the final lengths of the box parts is to first cut the parts to rough length. Then set up the saw, with the blade angled over to 45 degrees, and use some scrap to make a test box. Fine-tune your blade angle setting now. The test miters are important, since any inaccuracy in the miters

will show up as a gap at the corners.

When making miter cuts like this, you'll want a sharp blade, and you'll need to set up stops on your miter gauge so the parallel parts are of equal length. But even with all your settings just right, you may find that your cut may not be as smooth as you expected. We've found that the best way to cut long miters like this is to make a first miter cut about one-half the thickness of the saw blade from the final cut. This way, the final cut is actually just a trimming cut, shaving about $\frac{1}{16}$ in. of stock away.

By the way, the concept behind this is hardly new. A century ago, craftsmen using their cast-iron miter trimmers also made an initial rough cut, and then made one or two shaving cuts to establish final length. If you have the modern equivalent of the old miter trimmer—the power miter or “chop” saw—this is another option for making the miter cuts.

Cut Remaining Box Parts: With your miters complete, use the table saw to establish the grooves in the box front/back for the tray supports (G). Cut these parts, the lid panel and bottom, the splines (H), the lift (I), and the feet (J) to size. The rabbet in the lid panel is sized

so that when assembled, there will be about a $\frac{1}{16}$ in. reveal all around. Note that the lift is a sandwich of two pieces of cocobolo around a piece of ebony. The elevation views give the angles for the lift and feet. These pieces are small, so take care—and use pushsticks. If you don't feel comfortable working with small pieces on the table saw, as an alternate, just use the disk sander to establish the angles.

Glue Up Box: After a test assembly, glue up the box front/back and ends around the lid panel and bottom. The bottom can be glued in place, but don't apply glue to the lid panel. With small mitered boxes like this, we've found that large clamps are clumsy to use, and may actually cause the miters to open as clamp pressure is applied. If your miters are accurate, it's better to just use masking tape to hold the corners together. Assuming that the lid panel and bottom are square, the box should square itself up as it's assembled.

Make the Spline Kerfs: A simple right angle jig (see detail) is used to make the spline kerfs. The jig is basically just two cleats screwed to an auxiliary fence. The two outside spline kerfs are made with the blade set for a $\frac{5}{16}$ in. deep cut. Since both outside kerfs are the same distance from the top and bottom respectively, make the first cut in the four corners, then flip the box around to make the four identical kerfs. Raise the blade height to $\frac{7}{16}$ in., relocate the fence and make the center spline kerfs. Glue the ebony splines (they're just rectangular slips of wood, sized to fill the saw kerf) in place, and when dry, trim and sand flush.

Cut Off The Lid: Use the table saw with a thin-kerf blade to remove the lid. Although the usual method here is to make cuts on three sides, then shim the kerf and tape across the lid and box before making the final cut severing the lid, we have an easier method. As shown in Fig. 1, set your table saw blade height at just a hair less than the thickness of the box sides (a hair less than $\frac{3}{8}$ in. for our box), locate the rip fence just over $\frac{5}{8}$ in. from the blade, and make the cuts on all four sides. Now, using a sharp utility knife, cut through the little remaining stock to separate the lid. The use of a thin-kerf blade should allow sufficient extra stock so that after sanding, your box and lid dimensions are 2 in. and $\frac{5}{8}$ in. respectively.

The Hinge

You can make this box with a plain brass butt hinge, but the wooden hinge shown is a novel idea, and it's easy to make. Our illustration (pg. 59) shows how.

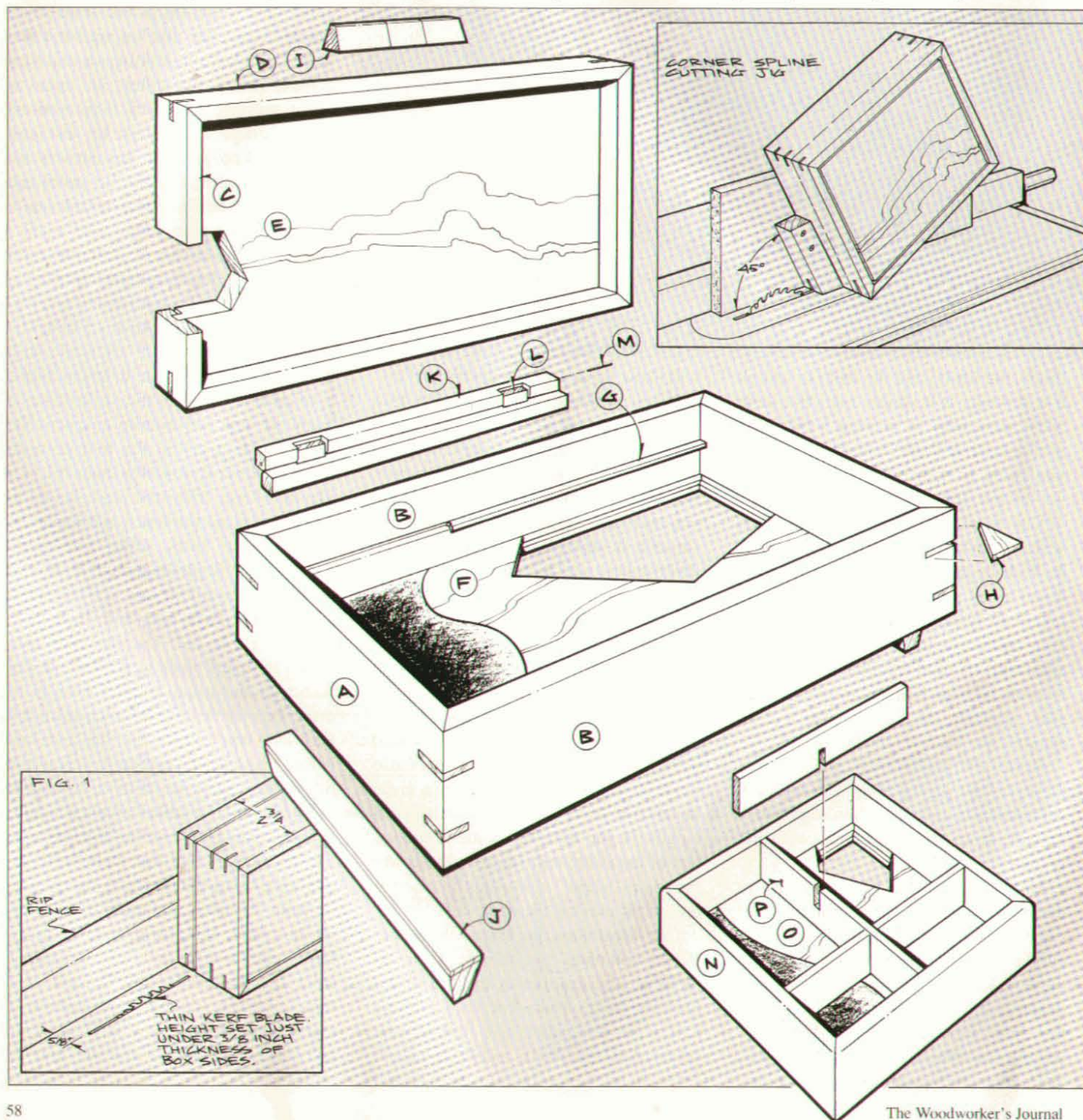
The hinge has only three different parts—a pair of leaves (K), a pair of posts (L) and a pair of brass pins (M). Starting with an 8 in. length of $7/16$ in. thick stock, crosscut a pair of dados, each $3/4$ in. wide by $5/16$ in. deep. Then rip off a pair of $7/16$ in. wide strips for the two leaves (Step 1). The width of your source board isn't important; we show a wider board for safety, but if you are

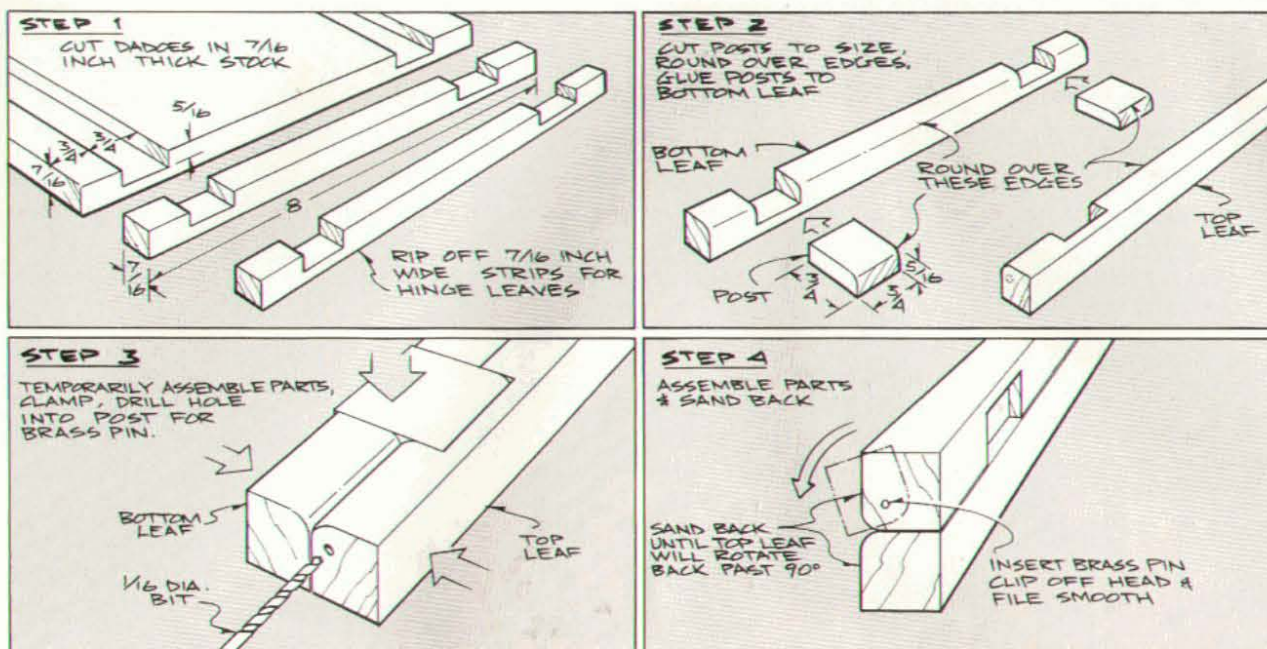
making several boxes as gifts, it's just as easy to rip a few extra strips as needed for the other hinges.

As shown in Step 2, cut a pair of $5/16$ in. thick by $3/4$ in. wide by $3/4$ in. long posts, then sand the same corner of both posts and the same corner of each leaf to a gentle radius. Glue the posts into the bottom leaf of the hinge, and stand the top leaf on edge, as shown.

When the bottom leaf/post assembly is dry, slide the top leaf into place as shown in Step 3, clamp securely, and drill into the ends of the bottom leaf and through the posts, using a $1/16$ in. dia. bit.

We used long brass escutcheon pins—clipping the heads off—as our pivot pins, but finish nails will work as well. The key here is to not use a pin that's larger than the $1/16$ in. hole. The leaf and post parts would split fairly easily if an oversize pin is forced into an undersized hole. As shown in Step 4, next up is sanding the *back* of the hinge, so that when opened, the lid will stop at just past 90 degrees. This sanding is pretty much an incremental sand-and-check procedure. Prior to sanding, pivot the top leaf back; it will probably open to just shy of 90 degrees. As you sand the





back of the hinge, gradually the degree of pivot will increase, until the hinge opens just past 90 degrees, as shown.

To mount the hinge, clamp the lid securely to the box, so that it's perfectly flush all around, then add glue and clamp the hinge in place. As shown in the side elevation, make certain the centerline between the hinge leaves is perfectly aligned with the line where the lid and box meet. Using a damp rag to wipe away excess glue immediately will save a lot of fuss with scraping away dried glue squeeze-out later.

The Tray

We show a square tray, just four sides (N) glued up around a bottom (O), with several dividers (P) to create the individual compartments. However, there's no reason why you can't customize the tray to suit your own needs, perhaps increasing the length and the number of dividers. If you plan your work carefully before starting this project, you'll be able to do all your mitering work at the

same time, saving time with resetting the saw to 45 degrees.

Details

Once your box and tray are made, all that remains are a few details. Glue the tray supports, feet and lift in place, then apply your finish. Our photo hardly does this sensuous little jewelry box justice, but the finish really is lustrous and swirl-free, with great depth. Yet according to Ford, there's no secret to the finishing process—it's nothing more than penetrating oil and multistep sanding, using a random-orbit sander with progressively finer grits, typically culminating in a 600-grit paper.

If you've been into woodworking for some time, but haven't yet figured out why everyone's so high on random-orbit sanders, take one look at the finish on a box like this, and you'll have your answer. The cross-grain sanding scratches that are the bane of belt and stroke sanders, and the curlicue or pig tail swirls that mark the passing of the pad sander are history. Hold the box so the light bounces off the top, and you'll detect neither scratch nor swirl!

Like most good jewelry boxes, ours sports felt liners on the box and tray bottoms. There are as many ways to tackle this as there are woodworkers making boxes. You can use spray adhesive to mount the felt directly to the bottom, wrap the felt around a stiff cardboard, or even mount the felt to the bottom *before* assembling the box. Everyone has their own reasons for feeling their method is superior, and we

Bill of Materials

(all dimensions actual)

Part	Description	Size	No. Req'd.
Box			
A	End*	3/8 x 2 x 6	2
B	Front/Back*	3/8 x 2 x 11	2
C	Lid End*	3/8 x 5/8 x 6	2
D	Lid Front/Back*	3/8 x 5/8 x 11	2
E	Panel	5/16 x 5 1/2 x 10 1/2**	1
F	Bottom	1/8 x 5 1/2 x 10 1/2**	1
G	Tray support	1/8 x 1/4 x 10 1/4	2
H	Spline	As Shown	12
I	Lift	3/8 x 1/2 x 2 1/2	1
J	Foot	5/8 x 1 1/16 x 5 1/4	2
Hinge			
K	Leaf	7/16 x 7/16 x 8***	2
L	Post	5/16 x 3/4 x 3/4***	2
M	Brass Pin	1/16 dia. x 2 long	2
Tray			
N	Side	1/4 x 7/8 x 5 1/4	4
O	Bottom	1/8 x 5 x 5**	1
P	Divider	1/8 x 5/8 x 4 3/4****	3

* Note that dimensions of these parts are after lid is separated from box. Actual starting width of box ends, front and back is 2 3/4 in.

** Panel dimensions as given are exact groove-to-groove distances. In practice, size the lid panel a bit less to allow for wood movement and the bottom panels a little smaller so they don't interfere with the box or tray glue-up. If you can't find 1/8 in. thick plywood for the box and tray bottoms locally, it can be ordered from Woodcraft (1-800-225-1153).

*** Leaf and post dimensions of hinge are before hinge is final sanded to establish lid stopping angle.

**** Width dimension of divider allows for felt liner.

won't attempt to resolve that issue here. Whatever method you choose, the box's recipient will thank you for the time spent in adding the felt liner.



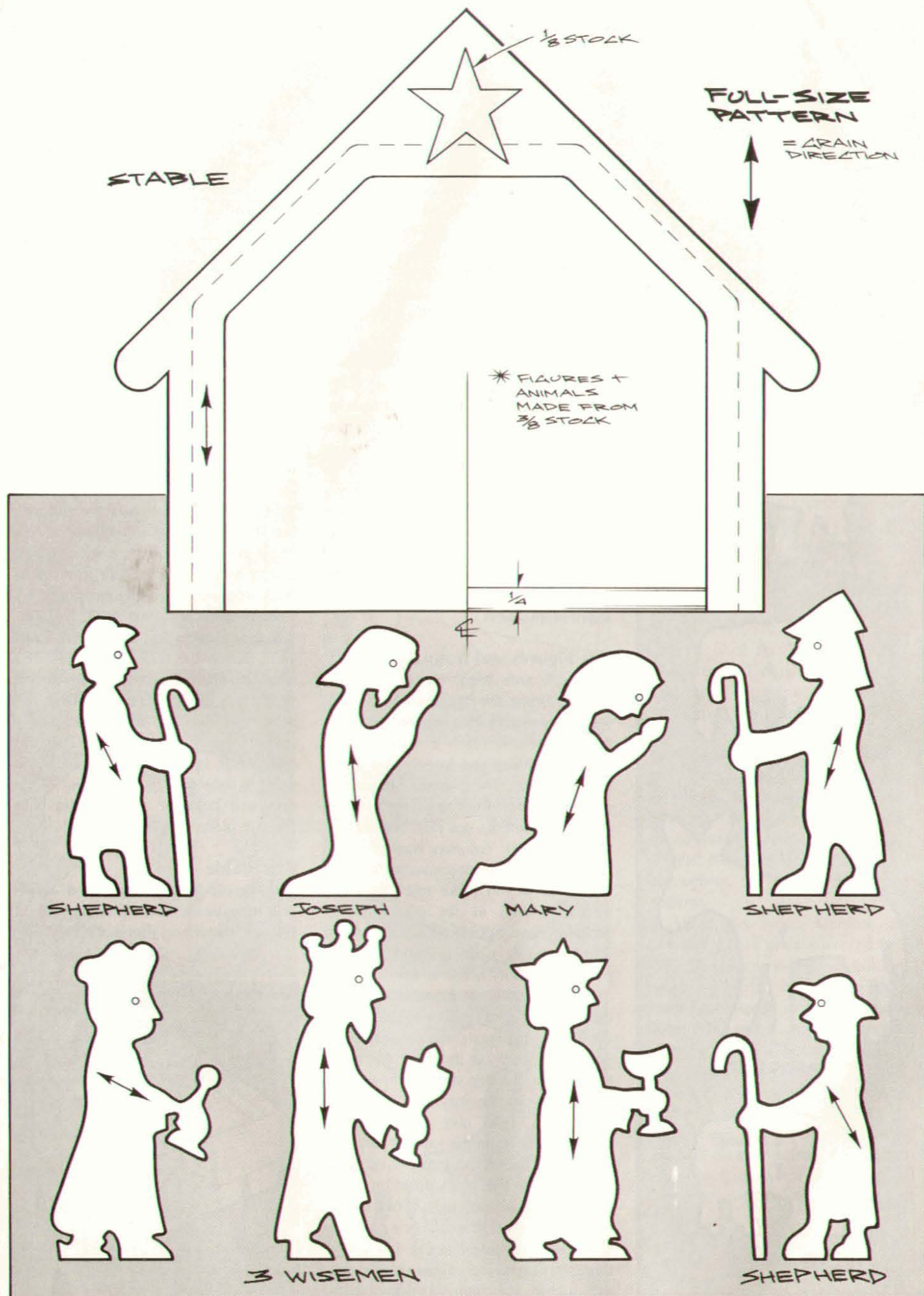


Scroll-sawn Nativity Scene

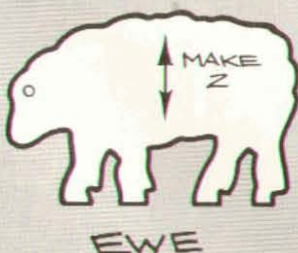
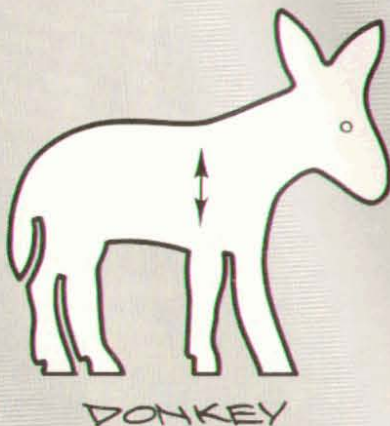
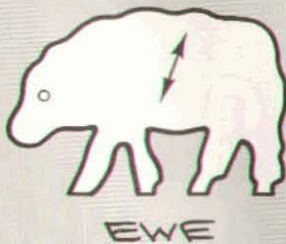
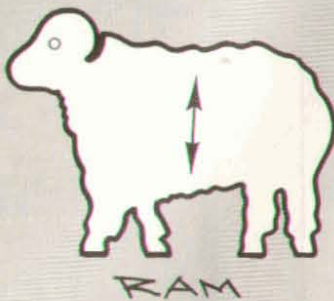
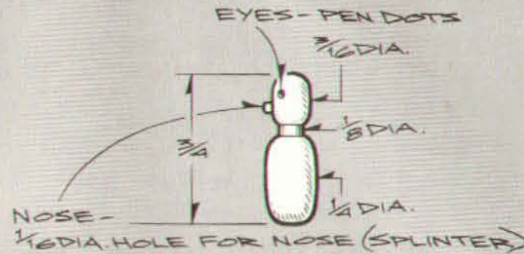
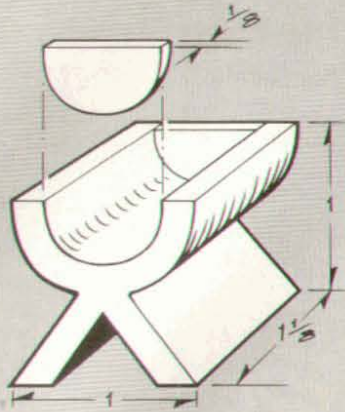
If you like scroll saw work and enjoy giving gifts, then this Nativity Scene—often called a crèche—is one project that's sure to satisfy. Designed by master woodworker Gunther Keil (see About the Builder sidebar), the Nativity Scene is one of his most successful concepts. All the pieces pack neatly into the stable, making the scene easy to store once the holiday season has passed.

As shown, we've provided full-size patterns for all the parts. The animals and figures are all cut from $\frac{3}{8}$ in. thick stock, the crib is cut from a 1 in. square by $1\frac{1}{8}$ in. long block, baby Jesus is carved from a $\frac{3}{4}$ in. length of $\frac{1}{4}$ in. diameter dowel stock, the stable is cut from a $1\frac{7}{8}$ in. thick by $5\frac{5}{8}$ in. wide by $4\frac{3}{4}$ in. long block, the stable bottom and back are cut from $\frac{1}{4}$ in. thick stock, while the sliding lid, the finger pull, the decorative star and the crib ends are all cut from $\frac{1}{8}$ in. thick material. Gunther uses a variety of woods—mainly cherry, maple, walnut, oak and pine for the figures and animals, walnut for the crib and cherry for the stable—but almost any combinations of woods will be fine. If you're making several Nativity Scenes, try varying the combinations. The exotics and decorative woods,





CRIB AND BABY JESUS



like curly or bird's-eye maple, are good choices. You may even want to make a few sets with painted animals, figures and stable.

This is one project that will make you feel justified for all those precious scraps squirreled away over the years; even the stable can likely be gleaned from a plank end or cutoff. If you don't have a piece that's at least 1 7/8 in. thick for the stable, then laminate a few scraps to obtain the required thickness.

The Figures and Animals

As you'll note from the photo of the Nativity Scene, the figures shown are the three wise men (each a separate pattern), three shepherds (each a separate pattern), plus Mary and Joseph (two separate patterns). The animals shown are three ewes (two from the same pattern, the third different), one ram, one donkey and one camel. You may want to make more shepherds or animals, but keep in mind that if you make more than the number shown in the photo, you'll probably have trouble fitting the extras into the stable when it comes time to pack the Nativity Scene away.

There's really not much involved in making the figures and animals. Photocopy the page, paste the patterns onto your stock, then cut them out. Or, trace the patterns onto the stock, using carbon paper between the magazine page and the board. Take note of the grain direction shown on the various patterns, and try to locate the patterns on your stock so that the grain direction is as indicated. This will help avoid cross-grain weakness that would be a problem if the patterns were laid out differently. Once the figures and animals are cut out, use a 1/16 in. diameter drill bit to

establish the eye holes, then lightly sand.

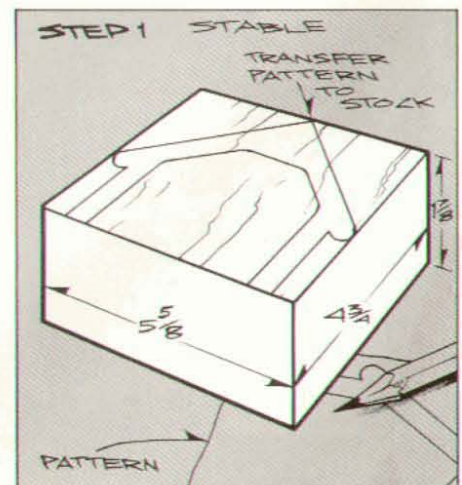
The Crib and Baby Jesus

Transfer the full-size pattern for the crib to your 1 in. thick by 1 in. wide by 1 1/8 in. long block. There's little danger in working small pieces on the scroll saw, but if you feel more comfortable, you could cut the crib from a wider block. The crib ends are cut to fit from 1/8 in. thick stock, and then glued in place.

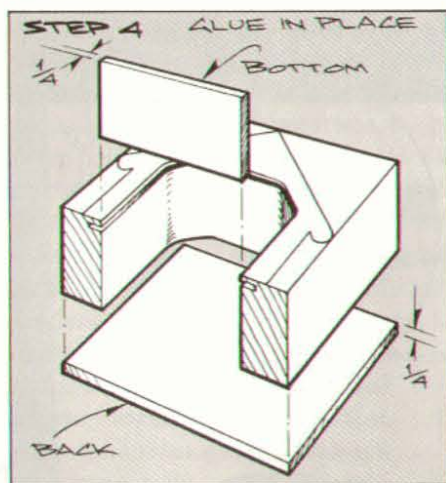
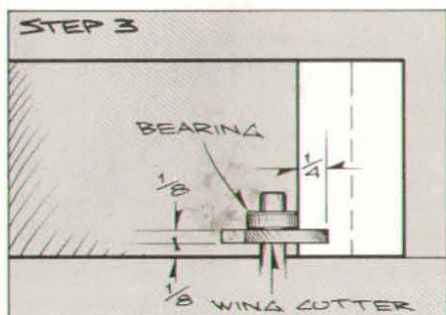
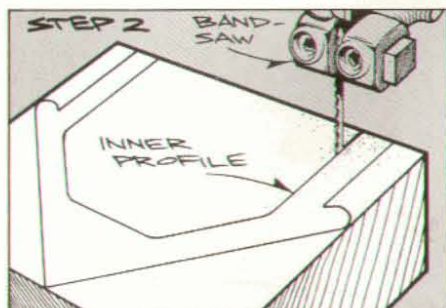
Baby Jesus is carved from the 1/4 in. diameter dowel. Just round the dowel ends, narrow the neck area to indicate a head and body, then add a pair of dots with a pen for the eyes, and finally drill a hole in the face center and glue a splinter into it for the nose. Then lay baby Jesus in a bed of sawdust in the crib. A little glue in the bottom of the crib will hold the sawdust and baby Jesus in place.

The Stable

Our simple 6-step illustration shows how to make the stable. First, lay out the full-size pattern on your stock, as shown

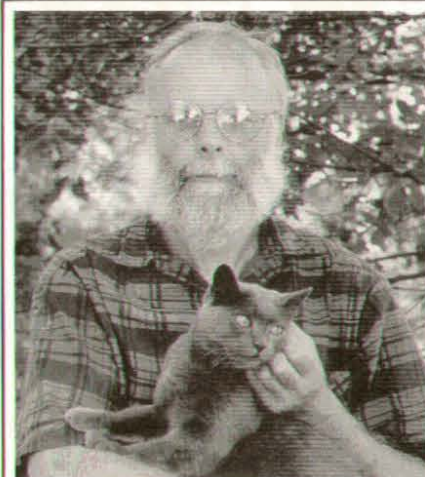
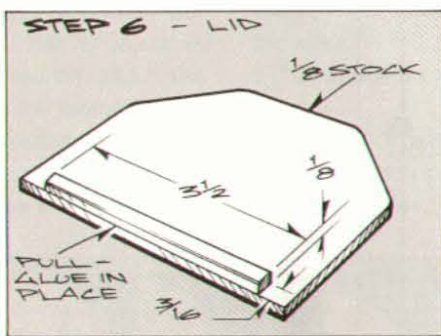
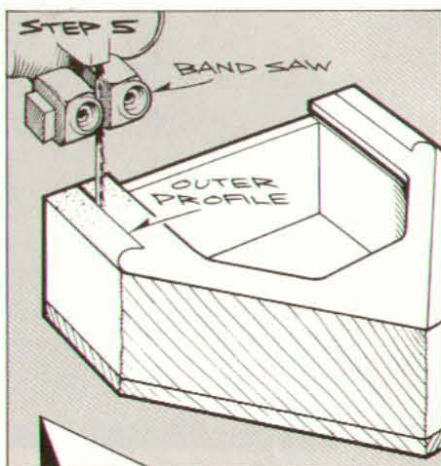


in Step 1. Next, cut the inside profile (Step 2). Now, using the router equipped with a wing cutter that makes a $\frac{1}{4}$ in. deep by $\frac{1}{8}$ in. wide groove, establish the groove for the sliding lid (Step 3). Glue the back and bottom in place (Step 4), cut the outside profile of the stable (Step 5), final sand, then make the lid (Step 6). Cut and glue the decorative star in place.



Finishing Up

Gunther uses only an oil finish on his crèche, which brings out the natural beauty and grain of the wood. When setting up the Nativity Scene, be creative. Some sprigs of dried grass, straw or moss and maybe a few small stones will help to create a pleasant scene. You could even take a piece of cardboard, paint a starry night sky on it, and place it behind the crèche for added ambiance. Although it should go without saying, the Nativity Scene is not a toy, and so should be kept well away from infants or little ones, whose well documented curiosity could be a hazard given the many small parts.



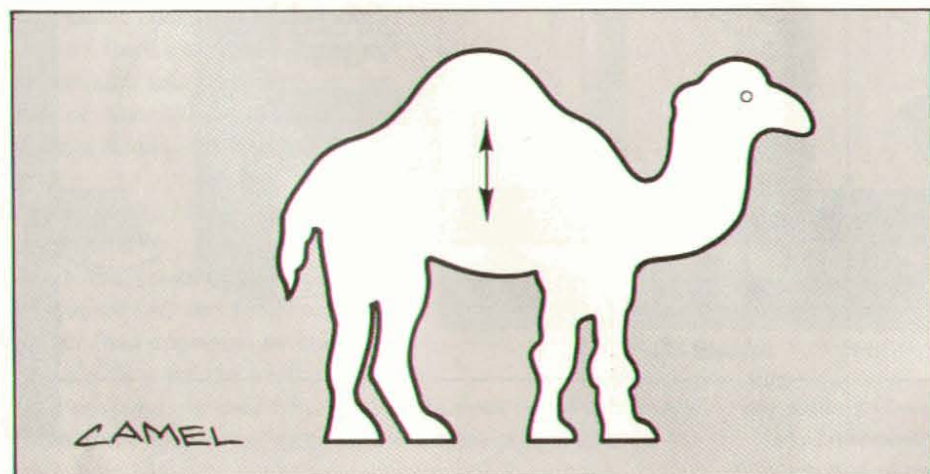
About the Builder

Gunther Keil immigrated to the U.S. from Berlin, Germany, as a professor of German Literature, and today lives with his family "on 55 acres in Trumansburg, on the west side of Cayuga Lake in central New York, where I raise sheep, bees, and utilize the trees that grow on my land."

Gunther tells us "my designs are known in both the Old and New World. They are in the permanent collection of the Toy Museum in Nuremberg, Germany, and in the Hartsville Museum in Hartsville, New York. They are also displayed at the "Toys For All Ages" show at the Smithsonian and in the American Crafts Museum. Gunther's work has been published in *Fine Woodworking Design Books* and in *The Woodworker's Journal*, and is sold in craft stores, galleries and catalogs throughout the United States and Canada.

About his work, Gunther explains, "I have always worked with animal shapes, homo sapiens included. I prefer to use the natural colors of wood to match natural forms, but occasionally add wood dyes for color or accent. Recently, I have developed a concept of habitats, which portray animals in their regional environments. All my work, especially the miniature habitats and my ark, express the fragility and exquisiteness of life, which is too easily forgotten in our technical world."

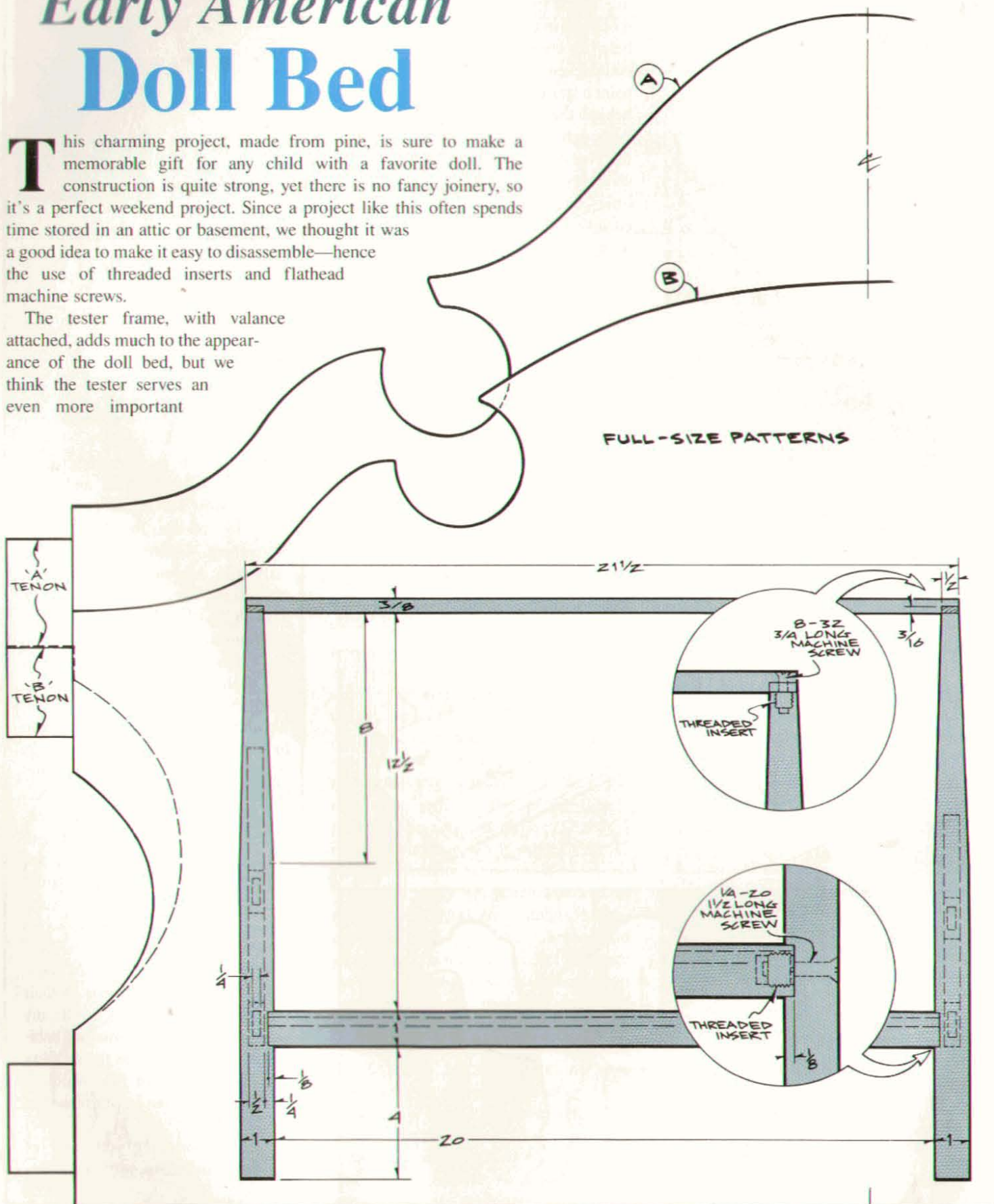
We'll be bringing you more of Gunther's excellent work in future issues.



Early American Doll Bed

This charming project, made from pine, is sure to make a memorable gift for any child with a favorite doll. The construction is quite strong, yet there is no fancy joinery, so it's a perfect weekend project. Since a project like this often spends time stored in an attic or basement, we thought it was a good idea to make it easy to disassemble—hence the use of threaded inserts and flathead machine screws.

The tester frame, with valance attached, adds much to the appearance of the doll bed, but we think the tester serves an even more important





If you don't have a thickness planer, and can't get $\frac{1}{2}$ in. thick stock locally, try checking with a nearby lumberyard or mill-work shop, as they often will plane stock for a nominal charge. Or, of course, you can do it just like the old-time cabinet-makers did—with a sharp hand plane.

Once stock for the headboard and footboard has been thickness planed, cut the parts to the length and width dimensions shown in the Bill of Materials. The tenons on each end can be cut following the three step procedure shown in Fig. 1. First, use the table saw and dado head, along with the miter gauge, to cut a $\frac{1}{4}$ in. wide by $\frac{1}{2}$ in. long tenon the full width of each part (Step 1). Next, using the full-sized patterns we've provided, transfer the curved profiles to the parts, then cut them out with a band saw (Step 2). Now, use a dovetail saw to establish the shoulders and cut the tenons to width (Step 3).

Cut Stock for the Posts and Rails

purpose. Without the tester frame, the posts present four rather sharp points that could injure a child who might accidentally fall on them. With the tester frame in place, the risk of injury is lessened. So, for safety's sake, be sure to securely attach the tester frame, even if you don't plan on adding the valance. Most well-stocked hardware stores will carry threaded inserts and machine screws. The material we use for the valance is called ruffled eyelet, and it's sold in various patterns in fabric stores.

In the event that the brass threaded inserts, brass flathead machine screws and valance material are not available locally, we've include a mail-order source to make shopping for them a bit easier. Ordering information can be found in the Bill of Materials (see Hardware/Valance Kits).

Make the Headboard and Footboard

Begin the project by making the headboard (A) and footboard (B). Rather than edge-glue several narrow boards to get the width needed for these parts, we used 1 by 10 nominal stock (which measures $\frac{3}{4}$ in. thick by $9\frac{1}{4}$ in. wide) and thickness planed it to $\frac{1}{2}$ in. thick.

The four posts (C) and the two rails (D) are made from five-quarter stock (which will measure about $1\frac{1}{8}$ in. thick). Rip the stock to 1 in. square before cutting the posts to a length of $17\frac{1}{2}$ in. and the rails to a length of $20\frac{1}{4}$ in.

Make the Posts

Note that each post has a $\frac{1}{8}$ in. deep by 1 in. wide notch to accept the rails. Mark the location of each notch, then use the table saw with a dado head to cut them out. Use the rails to check for a good fit.

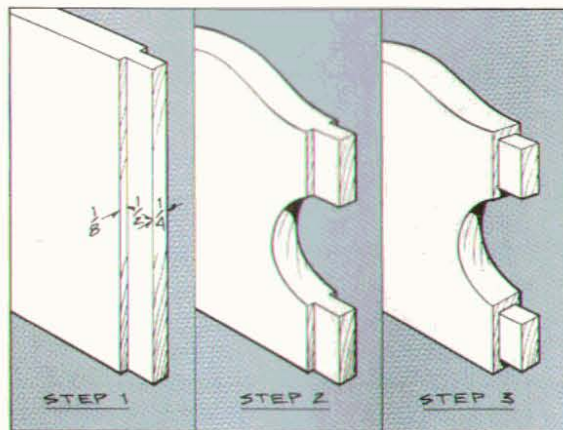


FIG. 1

Also, bore the $\frac{5}{16}$ in. diameter through holes for the rail flathead machine screws (I). You'll want these holes to be square, so use the drill press or a doweling jig when you bore them. Also, make sure the holes are centered in the notch. If they are not centered, the rails may not line up with the post notch at assembly time.

Layout and mark the mortises in the posts for the headboard and footboard tenons. Once marked,

use a sharp chisel to chop them out.

Mark the centerline location of the post threaded insert (J) on the top end of each post, then bore a $\frac{1}{4}$ in. diameter by $\frac{1}{2}$ in.

long hole to accept each one. Thread the inserts in place, then remove each one and set them aside for now. The inserts will be threaded back in after the posts have been tapered.

Now, cut the tapers on each post. If you have one, a table saw tapering jig will come in handy here. If not, lay out and mark the tapers on each leg, then hand plane the stock to the marked lines. With the tapering completed, the post threaded inserts can be once again threaded in place.

Make the Rails

Use the table saw and dado head, along with the rip fence, to cut the $\frac{1}{4}$ in. by $\frac{1}{4}$ in. groove along the inside edge of each rail. As shown in the exploded view, the groove is located $\frac{1}{8}$ in. from the top edge.

Mark the centerline location of the rail threaded insert (H) on the end of each rail. Bore a $\frac{3}{8}$ diameter by $\frac{5}{8}$ in. long hole to accept each one. It's important for the insert holes to be square, so we used a doweling jig as a guide for the drill bit. Once the holes are drilled, the inserts can be threaded in place.

Test assemble the rails to the posts using the rail flathead machine screws and check for a snug fit in the post notches.

Assemble the Headboard, Footboard and Posts

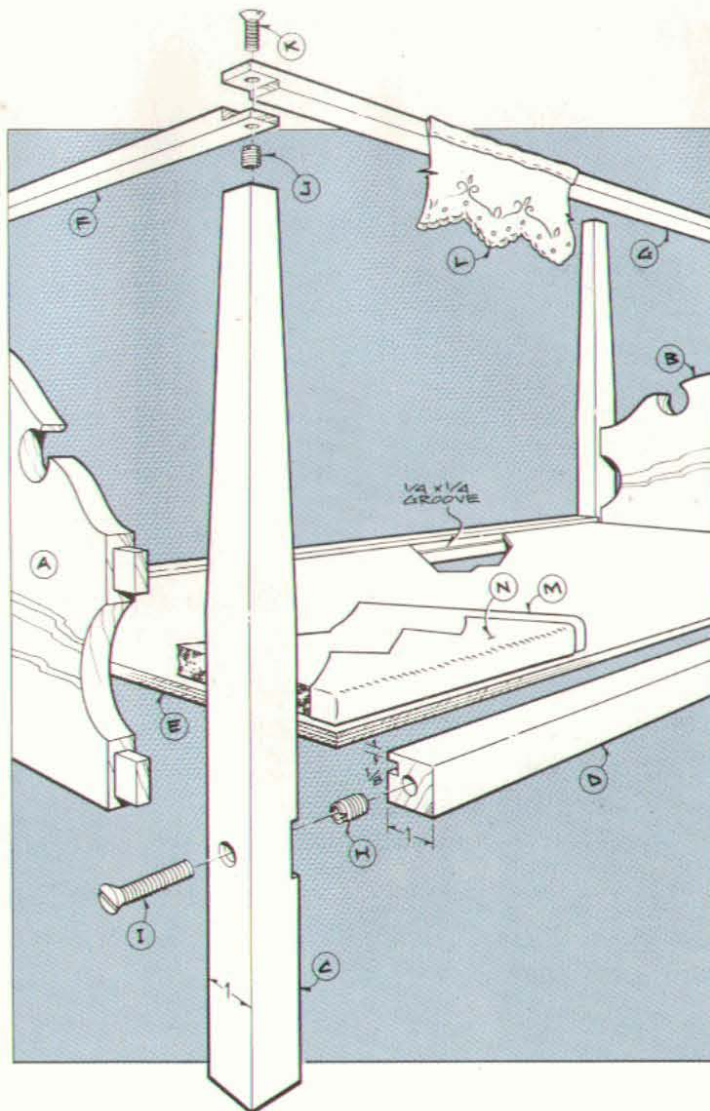
Remove the machine screws from the posts, then final sand the headboard, footboard and posts, finishing with 220-grit sandpaper. Take special care to smooth the band sawn edges of the headboard and footboard. Add a thin coat of glue to the mortises and tenons, then assemble and clamp. Set aside to dry.

Add the Rails and Bottom

Cut the bottom (E) to size and check for a good fit in the rail grooves. Final sand the bottom and rails, again finishing with 220-grit. Use glue to join the bottom to the rails, then before the glue sets, assemble the bottom/rail assembly to the posts using the rail machine screws.

Make the Tester Frame

You'll need about six feet of $\frac{3}{8}$ in. by $\frac{1}{2}$ in. stock to make the



two tester frame ends (F) and the two tester frame sides (G). It's best to take measurements from the assembled bed in order to get the actual length dimensions. Once cut to length, use the table saw and dado head to cut the $\frac{3}{16}$ in. by $\frac{1}{2}$ in. half-lap joints on each end of the tester parts.

Bore a $\frac{3}{16}$ in. diameter hole in each half-lap for the four post machine screws (K). Final sand the tester frame parts, then assemble to the posts using the screws.

Finishing Up

For a finish, we applied two coats of Minwax Special Walnut. When dry, we added two coats of water-based polyurethane. Although the water-based polyurethane costs somewhat more, we like it because it dries faster, doesn't require much sanding between coats, and easily cleans up with water. Next, use a sharp scissors to cut the foam mattress (M) to length and width. Wrap the mattress with the cover (N) and stitch the underside to secure it in place. We used bedsheets material for the cover, but most any thin fabric will do. Now, to complete the project, add the valance (L) to the tester frame, using a few brass tacks to secure it in place.

Bill of Materials

(all dimensions actual)

Part	Description	Size	No. Req'd.
Bed			
A	Headboard	$\frac{1}{2} \times 9 \times 13^*$	1
B	Footboard	$\frac{1}{2} \times 7 \times 13^*$	1
C	Post	$1 \times 1 \times 17\frac{1}{2}$	4
D	Rail	$1 \times 1 \times 20\frac{1}{4}$	2
E	Bottom	$\frac{1}{4} \times 12\frac{1}{2} \times 20\frac{1}{4}$	1
F	Tester Frame End	$\frac{3}{8} \times \frac{1}{2} \times 13\frac{1}{2}$	2
G	Tester Frame Side	$\frac{3}{8} \times \frac{1}{2} \times 21\frac{1}{2}$	2
Hardware**			
H	Rail Threaded Insert	$\frac{1}{4}$ -20	4
I	Rail Screw	$\frac{1}{4}$ -20 x $1\frac{1}{2}$ long	4
J	Post Threaded Insert	8 - 32	4
K	Post Screw	8 - 32 x $\frac{3}{4}$ long	4
Software			
L	Valance	3 in. wide***	6 ft.
M	Mattress	$\frac{3}{4} \times 12 \times 20\frac{1}{4}$	1
N	Mattress Cover	30 x 24	1

* Length includes tenons

Hardware/Valance Kits

**A hardware package containing four each (all are brass) of the rail threaded inserts, the rail flathead machine screws, the post threaded inserts and the post flathead machine screws is available from Aspen Kits, 6 Hilltop Drive, Old Saybrook, CT 06475; tel. (203) 388-6179. Specify Doll Bed Hardware Kit; price is \$8.50 postpaid.

***A 6 ft. length of 3 in. wide valance material is available from Aspen Kits (address above). Specify Doll Bed Valance Kit; price is \$13 postpaid.

Both kits can be ordered for \$19 postpaid.

Add \$2 per kit for orders shipped to Canada.

If you've just made the router table on page 47 of this issue and are looking for a good router-built project on which to sharpen your newfound skills, here it is. This elegant little wall cabinet, crafted in poplar by Ernie Conover, is perfect for any small space. It can be a spice cabinet in the kitchen, a storage cabinet for VCR tapes in the family room, or perhaps a spot for assorted toiletries in the bathroom.

The Case

Start with the case. We use a simple rabbet-and-dado construction to join the sides (A) to the top (B) and bottom (C). This joint (the dado in the sides and the rabbet on the ends of the top and bottom) is easily cut on the router table. Also, cut the $\frac{1}{4}$ in. deep by $\frac{3}{4}$ in. wide dado in the sides for the fixed shelf (D), and bore the holes for the shelf support dowels. Note that the width of the bottom includes an extra $\frac{3}{4}$ in. to fill out the space between the bottom ends of the face frame, and that the fixed shelf is $\frac{1}{4}$ in. inset from the back edge of the case, to allow for the plywood back (F).

With all these parts (except the back) cut, apply glue and clamp the case. Once dry, mount a $\frac{3}{8}$ in. bearing-guided rabbeting bit in your router, and establish the $\frac{1}{4}$ in. deep rabbet for the plywood back. Switch to the edge guide and a straight bit to continue the rabbet along the area where the fixed shelf prevents the bearing-guided bit from passing, then cut the back to size and glue and screw it in place. We show the back as square-cornered, but it's usually a bit easier to round the corners of the back to match the radius in the rabbet corners, rather than squaring up the rabbet corners with chisel work.

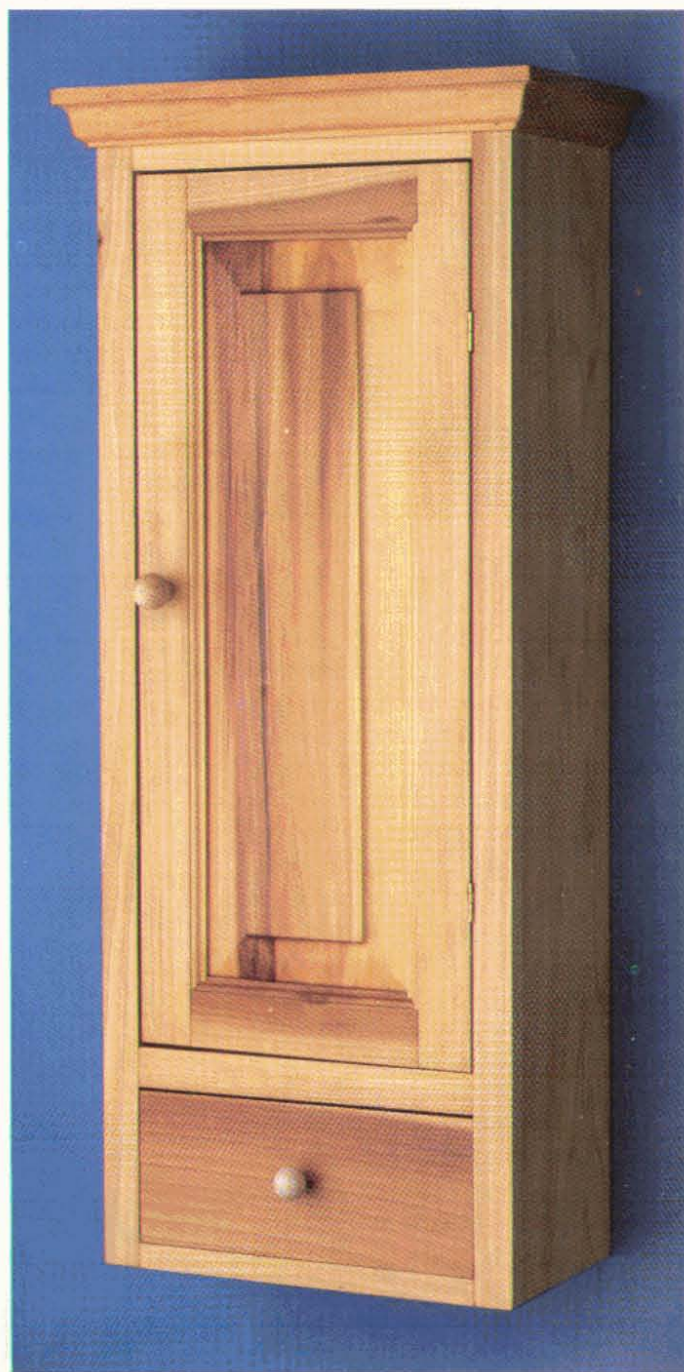
Next, make the face frame, consisting of the stiles (G) and upper and lower rails (H, I). Your new router table is ideal for mortise and tenon work such as this. Use a $\frac{1}{4}$ in. diameter straight bit, the fence, and set up stops to limit the length of the mortise cuts. We show the tenons as square-cornered, but you'll save some time if you just round the corners of the tenons to match the rounded ends of your router-cut mortises, rather than chopping out the mortise corners to square with a $\frac{1}{4}$ in. chisel. Glue and assemble the face frame, check with a framing square, and set aside to dry.

Once the face frame is out of clamps, position it on the case front, and use a sharp pencil or a marking knife to scribe marks from the bottom ends of the stiles to the case bottom. A dovetail saw is the ideal tool for notching back the front corners of the bottom to accept the stiles. Stay just inside (on the waste side) of your scribed line. You can always pare back the wood, but if you cut away too much you'll end up with unsightly gaps.

To complete the case, add the side and front moldings (J, K), cut and fit the drawer guides (L), and cut as many shelves (E) as your needs require. The molding we show is a solid crown profile, but other similar moldings will serve equally well.

The Door and Drawer

Both the door and drawer use the same basic construction as those on the router table cabinet. Stick the molded edge on the stiles (M) and rails (N), then cope the rail ends (see Stick and Cope Doorbuilding, page 20 for details). Cut your door panel (O) to size, mold the ends and edges to create the raised panel, then assemble the stiles and rails around the panel. Use glue on the frame but not on the panel. Small brads, centered on the panel and inserted into the rails, will equalize any movement in



Router-built Wall Cabinet

the panel from side to side.

The drawer shown uses a common groove and dado joint to join the front (P) and sides (Q), and a dado and rabbet to join the sides and back (R). The plywood bottom (S) is slid into place from the back, and anchored with a screw into the bottom edge of the drawer back.

Details

The cabinet in the photo uses a simple turnbutton (T) to hold the door closed. The knobs (U) are turned from Tagua nuts (see sidebar). A pair of small hinges (V) mounts the door.



Tagua Nuts

by Ernie Conover

With the ban on elephant ivory (excepting the fossilized variety), craftsmen in America—and in most other Western nations observing the ivory ban—have turned to other sources for a similar substance. With our penchant for the natural versus the synthetic, only one source has emerged as a suitable substitute for natural ivory. This source is the Tagua Nut tree, also called the ivory palm (which grows along rivers in South America), the nuts of which when dried yield a hard, almost plastic-like substance that closely resembles natural ivory.

Tagua nuts can be carved, turned, drilled, and in general worked with standard woodworking tooling. Depending on the exporter, the nuts may or may not be sold with their outer shell, which must first be removed (a sharp rap on the bench top should do the trick). The nut itself has a brownish outer surface. From the burr attachment point (where the nut was held to the outer shell) a fissure radiates to the center of the nut. This fissure is largely unpredictable, but if you are cutting into or turning the nut, it will almost certainly be a concern you'll need to address or work around.

There are several options for dealing with this fissure or cavity. If you absolutely must have a solid nut throughout, then you'll need to use several nuts, slicing and laminating them together to achieve the needed thickness. Cyanoacrylate (often called Super Glue) adhesive works fine for laminating. Another option is to drill into the cavity and inject it full of

cyanoacrylate. Once dry, when you hit the cavity and expose a part of it, the appearance is of a solid, clear section, not at all unattractive. The third option is to incorporate the cavity into your work, accepting the resulting irregularities as a natural part of using the nuts.

Turning the nuts is a simple matter. Sand a flat on the nut and glue it (on the flat) to a piece of wood attached to your lathe's faceplate. Use cyanoacrylate glue, and turn the wooden faceplate block to the form of a small pedestal. The nuts turn easily with standard lathe tools (I use mainly spindle gouges and scrapers). Follow your turning with sandpaper, finishing with 600-grit. To achieve a mirror finish on the nuts, buff with a small felt wheel mounted in your electric drill. I load the wheel with gray steel compound (don't use jeweler's rouge—it noticeably stains the Tagua nut), and buff with the electric drill-mounted felt wheel while the turning is

still revolving in the lathe.

To mount the knobs on the wall cabinet, just drill the back of the knobs for the mounting dowels, then glue the dowels in place. Make certain that the dowel for the door knob is long enough so you can add the turnbutton, which is secured with a small brad.

Tagua Nut Sources

Garrett Wade Inc.

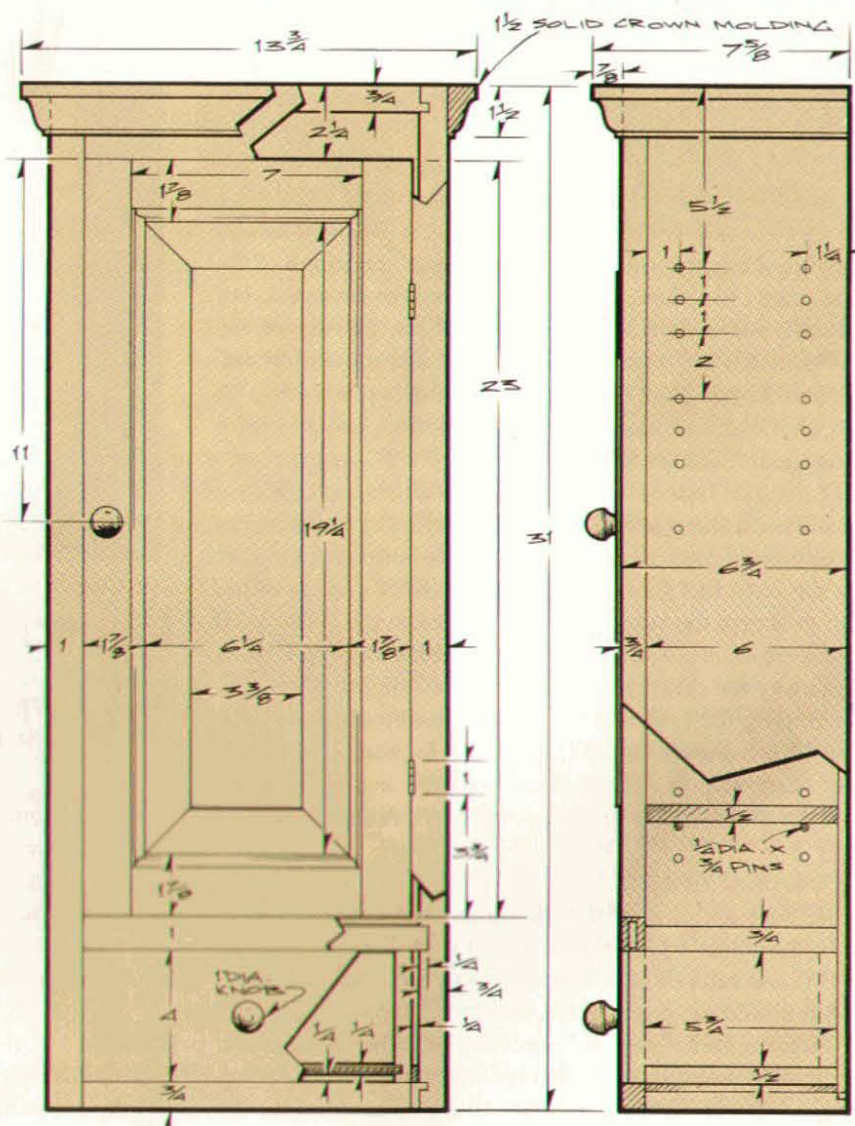
161 Avenue of the Americas
New York, NY 10013
Tel. 1-800-221-2942

Woodcraft

210 Wood County Industrial Park
P.O. Box 1686
Parkersburg, WV 26102-1686
Tel. 1-800-225-1153

Lee Valley Tools

1080 Morrison Dr.
Ottawa, Ontario K2H 8K7
Tel. (613) 596-0350.



Bill of Materials

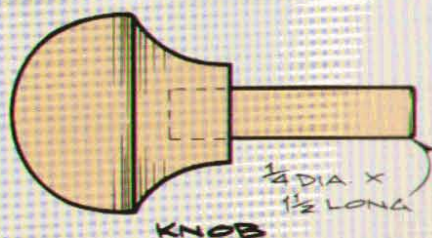
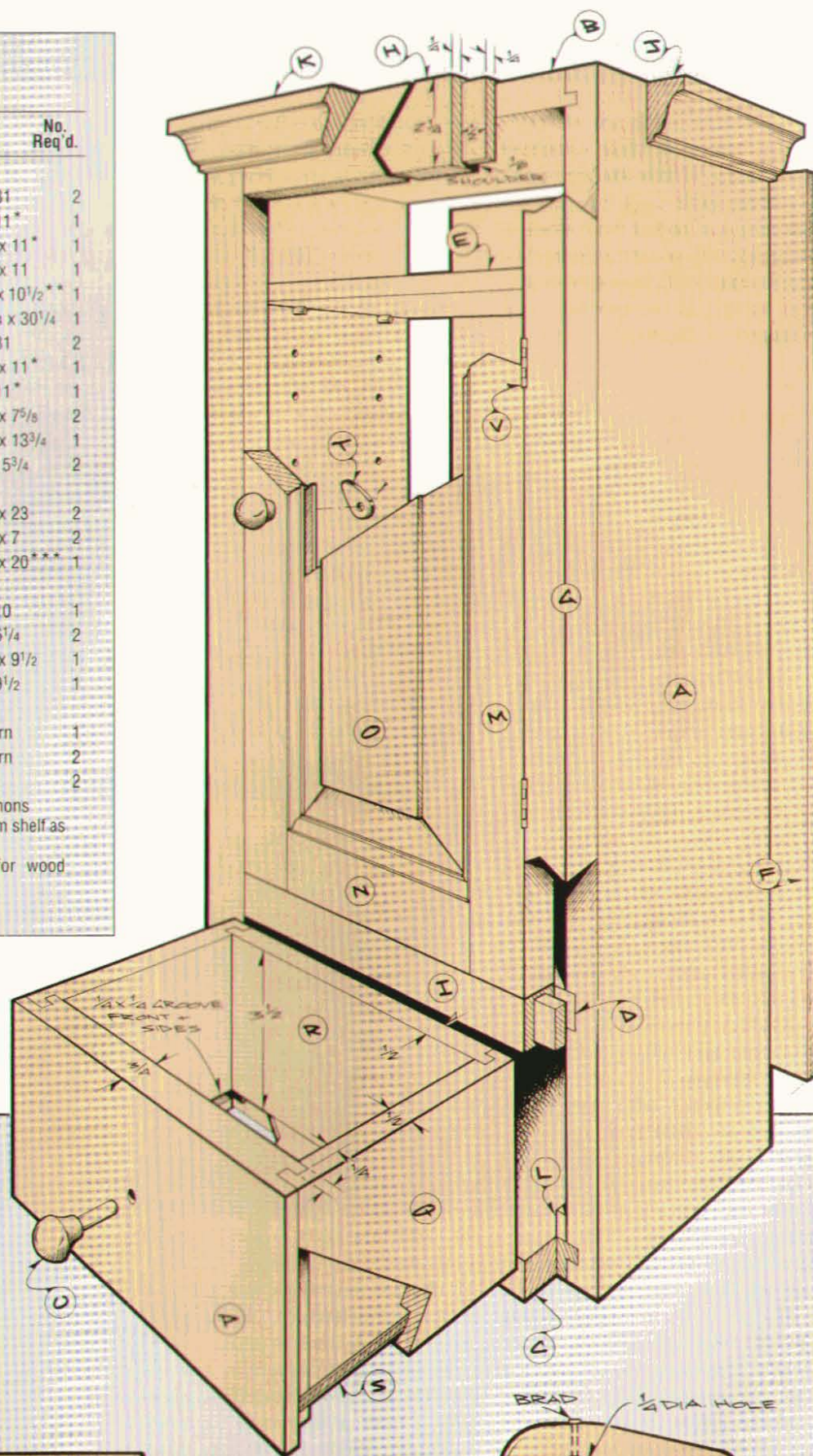
(all dimensions actual)

Part	Description	Size	No. Req'd.
Case			
A	Side	$\frac{3}{4}$ x 6 x 31	2
B	Top	$\frac{3}{4}$ x 6 x 11*	1
C	Bottom	$\frac{3}{4}$ x $6\frac{3}{4}$ x 11*	1
D	Fixed Shelf	$\frac{3}{4}$ x $5\frac{3}{4}$ x 11	1
E	Shelf	$\frac{1}{2}$ x $5\frac{3}{4}$ x $10\frac{1}{2}$ **	1
F	Back	$\frac{1}{4}$ x $11\frac{1}{4}$ x $30\frac{1}{4}$	1
G	Stile	$\frac{3}{4}$ x 1 x 31	2
H	Upper Rail	$\frac{3}{4}$ x $2\frac{1}{4}$ x 11*	1
I	Lower Rail	$\frac{3}{4}$ x 1 x 11*	1
J	Side Molding	$\frac{7}{8}$ x $1\frac{1}{2}$ x $7\frac{5}{8}$	2
K	Front Molding	$\frac{7}{8}$ x $1\frac{1}{2}$ x $13\frac{3}{4}$	1
L	Drawer Guide	$\frac{1}{4}$ x $1\frac{1}{2}$ x $5\frac{3}{4}$	2
Door			
M	Stile	$\frac{3}{4}$ x $1\frac{7}{8}$ x 23	2
N	Rail	$\frac{3}{4}$ x $1\frac{7}{8}$ x 7	2
O	Panel	$\frac{3}{4}$ x $6\frac{7}{8}$ x 20***	1
Drawer			
P	Front	$\frac{3}{4}$ x 4 x 10	1
Q	Side	$\frac{1}{2}$ x 4 x $6\frac{1}{4}$	2
R	Back	$\frac{1}{2}$ x $3\frac{1}{2}$ x $9\frac{1}{2}$	1
S	Bottom	$\frac{1}{4}$ x 6 x $9\frac{1}{2}$	1
Details			
T	Turn Button	See Pattern	1
U	Knob	See Pattern	2
V	Hinge	1 x 1	2

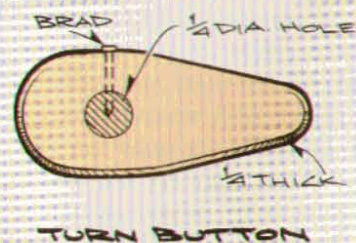
* Length includes tongues or tenons

** Shelf dimensions are exact; trim shelf as needed to fit.

*** Panel width allows $\frac{1}{8}$ in. for wood movement.



FULL-SIZE
PATTERNS



Tool Review

This review is the sequel to the one I did on scroll saws that sold for under \$200 in the September/October 1991 issue.

If you now own one of these saws, or your present scroll saw isn't giving you the cut you want, it might just be time to move up to one of the precision machines covered in this review.

What Makes A Quality Saw?

Nowadays, you can pay anywhere from \$650 to over \$1,900 for a precision scroll saw. How much you spend depends on the features you want and how much capacity and mechanical precision you need. Naturally, the more you pay for a scroll saw, the better you can expect it to perform; at the very least, the machine should make smooth, precise cuts that require little or no sanding. The blade should follow a line without excessive drifting to one side or another, and should not bow in the cut when scrolling thick stock. And a precision scroll saw should operate smoothly with minimal noise and vibration.

Cutting capacity is a second consideration: the throat depth of the saw (measured from the blade to the back arm of the saw) determines the largest workpiece you can cut on it. For example, an 18 in. saw will cut to the center of a panel 36 in. wide. Cutting depth refers to the thickest stock the saw will handle (typically 1 1/4 in. to 1 3/4 in.—see chart on page 73). One thing that separates the better saws from the cheaper ones, however, is how well the saw can cut thick stock without breaking blades, bowing in the cut, or burning the wood. A good scroll saw should be able to make reasonably clean, accurate, tight-radius cuts in 1 1/2 in. pine, or 1 in.

hardwoods, for instance.

Beyond these basic size and performance characteristics, the single most important feature to most production-oriented scroll-sawyers is how quickly the blades can be changed and tensioned. Each machine operates a bit differently in this respect. I'll discuss these and other features in more detail later.

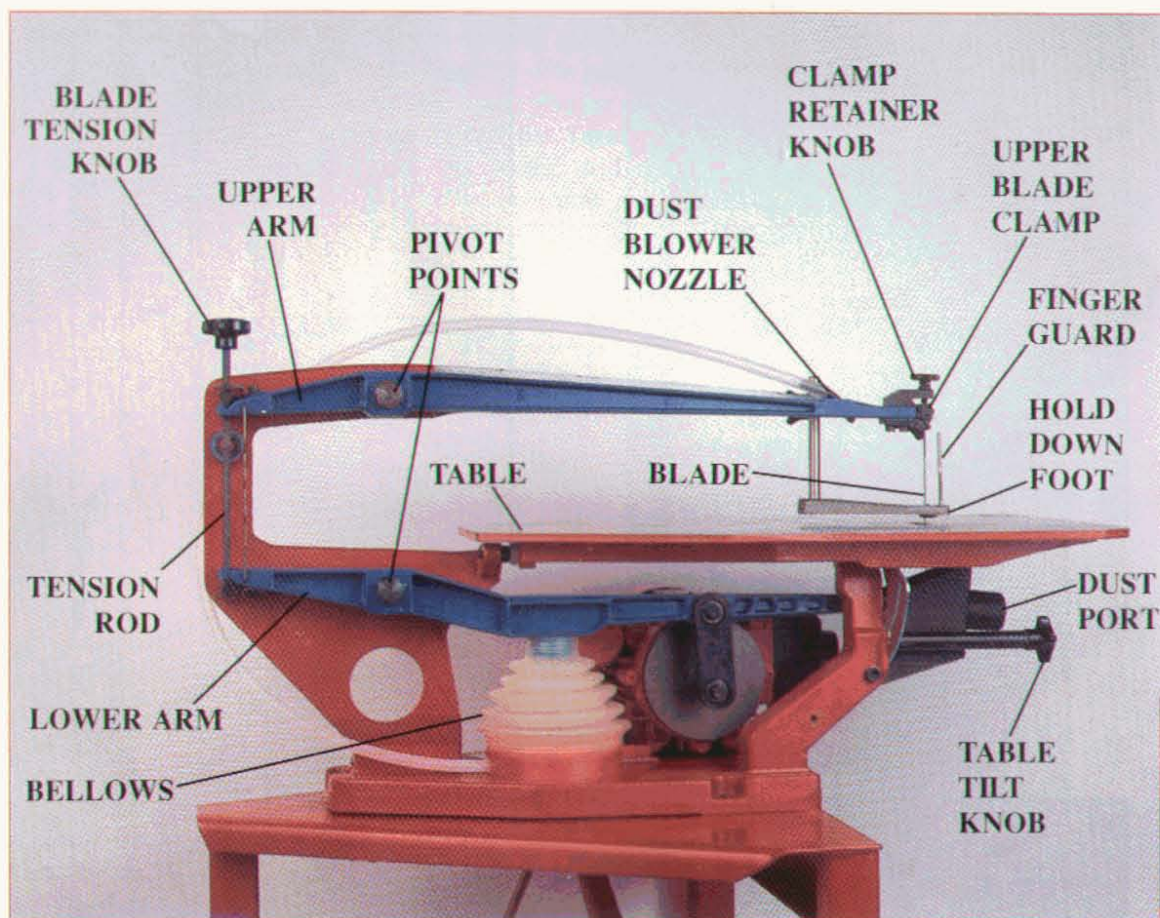
Which Saws Do the Experts Use?

In the world of precision scroll saws, four names immediately come to the

High-End Scroll Saws

Are You Ready To Move Up To A Better Machine?

by Jim Barrett



minds of veteran scroll-sawyers: Delta, Excaliber, Hegner, and RBI. These four manufacturers have the reputation of making quality "high-end" saws, with price tags to match. For this review, I asked each company to send me their best-selling model. These turned out to be 18 in. to 20 in. saws (RBI also sent me their 16 in. saw); the makers agree that this size range is the most practical for doing most scrolling projects. Each model I reviewed has variable speed control, along with a complement of

features I feel are desirable for production work, such as cranking out dozens of items at a shot for crafts fairs. These saws range in price from about \$700 to \$900, and are roughly comparable in performance and quality of manufacture. The four companies also sell larger and smaller models (with throat depths ranging from 16 in. up to 26 in.) with or without variable speed.

The models tested for my "apples-to-apples" comparison include the Delta 40-601 (18 in.), Excaliber EX II (19 in.), Hegner Multimax 18V (18 in.), RBI Hawk 220VS (20 in.) and RBI Hawk 216VS (16 in.). I also included the Shopsmith 20 in. scroll saw in this group. Even though it didn't perform quite as well as the others in several respects, it does fall into the same approximate price range. Also, it's one of several "accessory machines" that Shopsmith enthusiasts can attach to their Mark V. I tested the freestanding model (with motor and stand); the Mark V version comes with a conversion kit and costs about \$180 less.

For those who need a large-capacity saw but don't want to pay \$650-plus for one, I've also reviewed three machines in the \$300 to \$400 price range. One is the Sears Contractor's Series 20 in. scroll saw. While not as mechanically refined as the Delta, Excaliber, Hegner,

and RBI models, this new addition to the Sears line performed surprisingly well, making it a good value at \$390.

Likewise, I took a look at a couple of Taiwanese-made "monster" scroll saws: the 23-in. AMT (model 4671) and 26-in. Reliant (model DD26). Because these behemoths offer a lot of cutting capacity for the price (\$320 and \$330, respectively), I was curious to see how well they performed. My rationale was that they might be a reasonable alternative for those of you who need a saw 23 in. or larger, but can't justify spending a thousand dollars or more for one. Because I didn't think it would be fair to compare these and the Sears saw directly to their "high-end" counterparts, I've discussed them separately on pages 74 and 76.

Anatomy of a Scroll Saw

Before getting into the specific features of the saws tested, I feel it necessary to provide an overview of how modern scroll saws work, mainly because the basic arm designs of the various saws do influence their cutting action. You veteran scroll-sawyers can skip the anatomy lesson, if you want.

First, all modern scroll saws are of a constant-tension design; that is, the blade is held in constant tension between two arms that move in unison through-

out the cutting stroke. On the older "rigid arm" saws, the top of the blade is attached to a spring, which in turn is mounted to a rigid top arm. On rigid arm saws the thin blade tends to flex, resulting in frequent breakage and bowing in the cut. Constant tension saws minimize blade flexing, thus enabling the blade to make tight radius cuts without breaking or bowing. On most of the saws tested, the motor

powers the lower arm by means of a counterbalanced eccentric cam on the motor shaft, which is connected to the lower arm by a short tie rod; in other words, they are direct-drive saws (see Photo 1). The two exceptions are the Excaliber and Shopsmith, which are belt-driven saws.

Currently, there are three different constant tension arm designs.

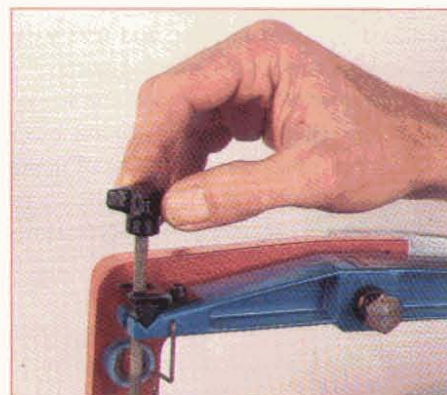


Photo 2: To adjust blade tension on most parallel arm saws, you loosen or tighten a knob-operated tensioning rod at the back of the saw.

Parallel Arm: Exemplified by the Hegner, RBI, Shopsmith, and most Taiwanese imports, parallel arm saws have two arms that pivot independently, connected by a threaded tensioning rod at the back of the saw, as shown in Photo 2. The arms drive the blade nearly vertically, with a slight forward cutting motion on the downstroke.

C-Arm: The Delta and Sears saws have a C-arm design, in which both the upper and lower arms are a single solid casting, operating off one pivot point at the rear of the saw. The result is an aggressive vertical arcing motion; you tension the blade by turning a knob that lifts a short extension on the front of the upper arm.

Double Parallel Link: The Excaliber saws have a unique double parallel link design. Both arms move horizontally instead of vertically; pivot points at the front of the arms transfer the horizontal motion into vertical motion.

One thing I noticed immediately was that the C-arm saws take a bigger bite on the downstroke than the parallel arm saws do. The blade on the double

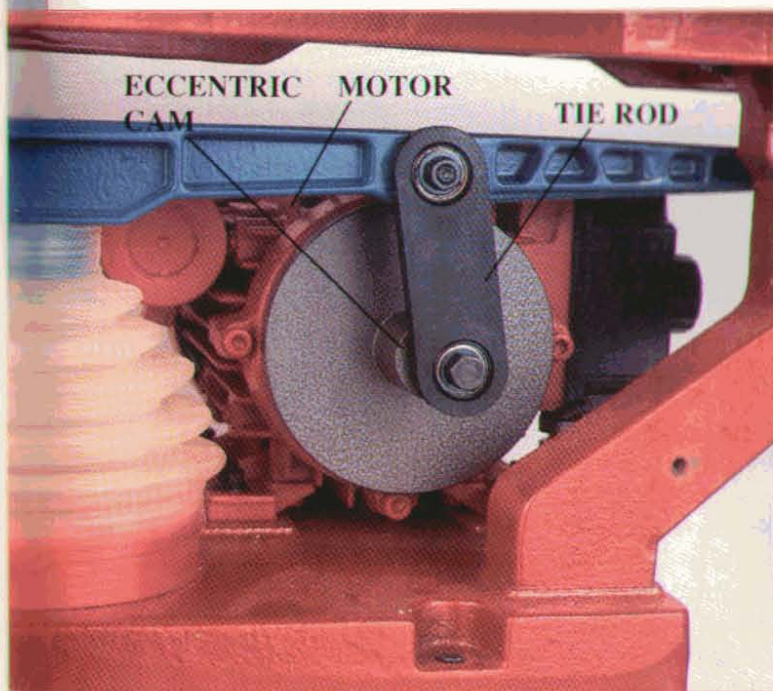


Photo 1

parallel link Excaliber had very little forward cutting action on the down-stroke, although the aggressiveness of cut was about the same as the Hegner.

What To Look For

Vibration—Because scroll saws cut with a reciprocating (up-and-down) motion, rather than a continuous cutting action like a hand saw, you can expect a certain amount of vibration—it's just the nature of the beast. However, better saws are engineered to keep vibration to a minimum, which results in greater cutting accuracy, prolonged blade life, reduced operator fatigue, and less wear on bearings and other moving parts.

A number of factors contribute to saw vibration; sloppy or out-of-round bearings or bushings, misalignment of upper and lower arms, or a poorly balanced drive system, to name a few. Some saws,

such as the Delta, overcome vibration problems largely by sheer mass alone; the sturdy cast-iron arms and base make this saw as sturdy as a rock. Lighter-weight saws, such as the Hegner Multimax 18V, Excaliber EX II, and both the RBI saws, rely on precision machining to keep vibration to a minimum. (This is not to say that the Delta is poorly machined, by any means). The Hegner and Excaliber, by the way, showed the least amount of vibration in my tests; they were a joy to use. In comparison, the Delta and RBI saws had some vibration, but not enough to affect cutting performance or to be particularly annoying. The Shopsmith vibrated the most—a bit too much, in my opinion. It did perform satisfactorily in my cutting tests, but the vibration was irritating.

The way the saw is mounted also has a lot to do with vibration. Most of the

saws tested have sturdy stands, either as standard or optional equipment. While testing one of the saws, it was making an irritating rattling noise. Upon closer inspection, I noticed that I hadn't fully tightened one of the bolts on the stand. As an aside, a dab of silicone seal placed in the hole around each bolt during stand assembly will further reduce the likelihood of stand vibration. Also, make sure you install the leveling feet that come with the stand and adjust them properly. You can mount any of these saws on a bench, but on most benches, you'll find that the saw will vibrate more than when mounted on a stand. We'll have more on stands later.

A final word on vibration: even with the best saws, you may receive a unit that has excessive vibration; the cause is usually due to nuts, bolts or screws that work their way loose during shipping.

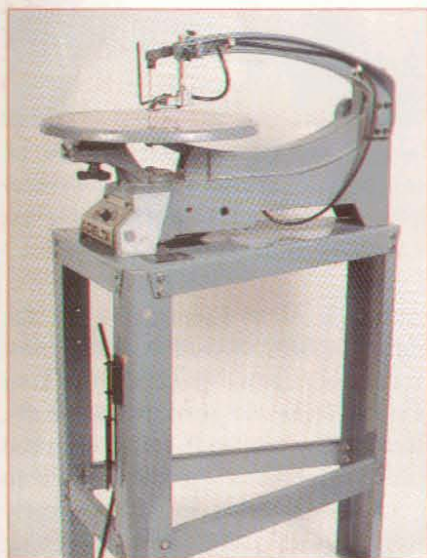


Photo 3: Delta 40-601



Photo 5: Hegner Multimax 18V



Photo 7: RBI Hawk 220VS



Photo 4: Excaliber EX II



Photo 6: RBI Hawk 216VS



Photo 8: Shopsmith 555272.

Check for this when you set up the saw. If you can't locate the problem, ship the saw back to the manufacturer for repair or replacement: all the saws featured in this article, including the two Taiwanese imports, come with excellent warranties and fast repair service.

Cutting Performance—When evaluating the cutting performance of a scroll saw, there are several factors to consider. **Smoothness:** The most important factor is smoothness of cut. The six "high-end" saws I tested all made clean, smooth-walled cuts that required little, if any, sanding. When cutting thick materials, you may notice some bowing in the cut. On the expensive saws, this is usually a result of improper blade tension, rather than poor saw design. Likewise, burning in the cut can be caused by several things. Improper tension, a dull blade, the wrong blade size, or too slow a feed rate in relation to blade speed are the usual culprits.

Precision: In this case, I'm referring to the blade's ability to follow a line. Most scroll saws, even the high-end ones, are prone to some blade drift to one side or another. This is more a result of the tooth configuration of the blade, rather than the saw—most blades tend to drift slightly to the right of the line; occasionally, you'll get one that drifts to the left. Once you get used to this, you learn to compensate for it, such as angling the stock into the blade slightly

problem. The improved versions should up the arm thickness to eliminate this more rigid thrust bearings, and beefing the upper arm pivot's ball bearings with the company is in the process of replacing spokesman Joe Chenoweth tells me the than the other saws. However, RBI It was also more prone to blade breakage stock in tight radius cuts during my tests. accounted for it's tendency to burn thick showed some stop, which probably tight. On the RBI saw, the upper arm except the RBI 220VS, seemed fairly The arms on all the high-end saws, the arm, the more flex will be apparent. flexing on all saws; usually, the longer arm. You can expect some sideways rarely as one with a tight, fairly rigid or sloppy, the saw won't cut as accurately it sideways; if the arm seems loose grip the upper arm at the front and try to Test No. 1: First, with the saw OFF, simple tests without cutting any wood.

However, if a particular saw is prone to excessive blade drift or wander, it's often because the upper and lower arms are either out of vertical alignment, flexing excessively, or are loose. These factors can also affect the smoothness of cut and increase the saw's propensity to break blades. When checking saws for cutting accuracy, you can perform two simple tests without cutting any wood.

when starting cuts. If the blade tends to wander off the line randomly in both directions, it's usually because you haven't tensioned it enough.

Aggressiveness—For production-oriented scrollers, the speed at which the saw cuts becomes important. Cutting speed is determined by three factors: blade speed, blade stroke length (vertical travel), and the amount of forward cutting action on each stroke, which I refer to as "cutting aggressiveness." The Delta is the most aggressive of the group due to its C-arm design—the blade moves in an arcing motion, taking a bigger bite on each stroke. The disadvantage of this radical cutting action is that the blade tends to make a slightly wider kerf on curved cuts, which is especially noticeable on tight radii. This only becomes a problem if your work requires hairline cuts, such as when making jigsaw puzzles. However, this can be overcome to some extent by using a smaller blade than would be required on the less aggressive saws, such as the Hegner and Excaliber. Slow

Test No. 2: After tensioning the blade, turn the saw ON and sight down the blade from front to back (with the teeth facing you). The less side-to-side blade "blur" you see, the more precisely the saw will cut. Of course, if you look at the blade from the side, you'll notice some blur because scroll saw blades move forward on the downstroke.

be available by the time you read this article. Interestingly, the RBI 216VS had less vibration than the RBI 220VS, and was less prone to breaking blades.

Scroll Saw Specifications

Company	Model	Throat Depth (inches)	Blade Speed (SPM) ¹	Amps @ 110V	Max. Cut Depth (inches) ²	Stroke Length (inches)	Table Size (WxL-inches)	Tilt (degrees) ³	Weight (lbs.)	List Price ⁴	Street Price ⁴
AMT	4671	23	1,725/825	2.2	2 1/2	3/4	10 x 20 1/2	45L	81	—	\$320 ⁵
Delta	40-601	18	40-2,000	1.2	2	1 1/8	16 dia.	30L-45R	132	\$1,025	\$699*
Excaliber	EX II	19	60-1,460	3	13/4	3/4	12 x 17	45L/45R	75	\$1,099	\$895*
Hegner Multimax	18V	18	400-1,700	2.83	2 5/8	1 1/8	7 x 9	38L/15R	48	\$1,098	\$895*
RBI	216VS	16	200-1,550	2.5	2	7/8	10 3/8 x 19	45L/45R	69	\$799	\$749*
RBI	220VS	20	200-1,550	2.5	2	1 1/8	14 x 22 3/4	45L/45R	97	\$999	\$909*
Reliant	DD26	26	1,720	2.2	2	3/4	10 1/4 x 24 3/4	45L	78	—	\$329.95*
Sears	23640N	20	300-2,000	1.3	2	7/8	16 x 16	30L/45R	143	—	\$389.99*
Shopsmith	555272	20	650-1,350	1.7	2	1 3/32	16 x 23 7/8	45L/45R	65	—	\$649*

¹(-) indicates 2-speed; (-) indicates variable speed

²Depth of cut with hold-down/blade guard removed

³L = left; R = right

⁴List = suggested list price. Street = actual price at time of writing, direct mail order from company or average price in woodworking supply catalogs. (*) Price includes stand.
⁵Price includes \$50 worth of free merchandise from AMT catalog.

Sears: A Decent Saw for a Decent Price

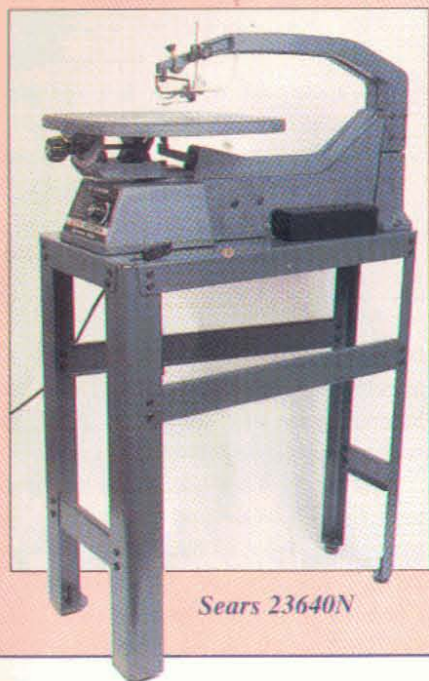
This C-arm-type 20 in. saw is similar in many ways to the Delta 40-601, although not quite as refined. While manufactured in Taiwan, the Sears Craftsman Contractor's Series saw was designed by Emerson Electric in the U.S.; it's by no means a Taiwanese "copy" of the Delta.

When I tested this saw at a recent Sears conference, I was impressed by how smoothly it ran; at least in comparison to the other two Taiwanese-made saws I tested. Just to make sure the demo machine I tried wasn't "tweaked" to improve performance, I called a saw in for the review—it operated just as well as the demo model. Saw vibration was minor. Surprisingly, the Sears has one of the smoother table-tilt mechanisms of the saws I tried. The table rides on two sturdy cast-iron trunnions, and locks securely in place with a large, easy-to-access knob. Like the

Delta, the variable-speed control is readily visible to the operator.

The cumbersome blade-guard/hold down/dust blower assembly is virtually the same as the one on the Delta, with minor design differences. On both machines, I'd be tempted to remove it and simply tape the blower tube to the upper arm. Two separate tools—a hex wrench and clevis pin—are required to change blades on the Sears' permanently-mounted blade clamps. (Delta uses a 2-in-1 tool for this purpose.) On the Sears, you can store the tools and extra blades in a plastic accessory box mounted on the saw stand.

If you can't afford one of the pricier saws reviewed in this article, the Sears is worth investigating.



down the speed and feed rate to put less stress on the smaller blade, however, since it will be more prone to breaking.

As mentioned, the double parallel link design of the Excaliber cuts about as aggressively as the parallel arm saws. But, unlike other saws, the forward motion of the blade can be altered to give a more or less aggressive cut. To do this, you adjust the length of the lower arm by means of two bolts that secure the arm to the back casting. Extending the arm results in a more aggressive cut, and vice-versa. If you're mechanically inclined, you may be able to make this adjustment yourself; otherwise, you can ship the saw back to the distributor, to have the change made for you.

Changing Blades: How Easy?

Here, two factors come into play: the amount of time it takes to secure the blade in the upper and lower blade clamps, and the amount of time it takes to release and re-tighten the blade ten-

sion. Because scroll-saw blades are tiny and delicate, the teeth wear out quickly (generally a blade is good for about 20-30 minutes of cutting before the teeth get too dull to cut efficiently). Also, you can expect some blade breakage, even on the best saws. And, because scroll saws are designed for making inside cutouts (something you can't do on the band saw), you'll want a saw that makes it easy to detach the blade from the upper blade clamp and thread it through holes drilled in the workpiece. A quick-tension release on the upper arm and a clamp knob on the upper blade holder will save time doing this procedure.

Blade Clamps—To change the blade on all scroll saws, you fit the blade ends into small, pivoting blade clamps mounted on the top and bottom arms, then tighten down the clamps. However, each saw has a slightly different clamp design, resulting in a different procedure for changing the blades. On the Delta and Excaliber, both the upper and lower

clamps are permanently mounted on the machine. The RBI saws have a fixed upper clamp and a barrel-type removable lower clamp. On the Hegner and Shopsmith, both upper and lower clamps must be detached from the arms to replace the blades. Even though I found the latter two saws to be the most difficult to change blades on, the Hegner does have an advantage: you can buy extra clamp sets and mount blades in them, then simply switch clamp assemblies when you break a blade. A slot in the table enables you to do this in a few seconds without having to stoop under the table to see what you're doing.

The RBI 220VS and Excaliber II are the only two machines that don't require tools to change blades. Instead, they have finger-tightened knobs on the upper and lower clamps. The RBI 216VS comes with a finger-tightened knob on the bottom clamp only—the upper clamp requires an Allen wrench and H-wrench. However, you can buy a knob-operated upper clamp as an accessory for the 216VS. On both RBI saws, you must still remove the bottom clamp to change blades. The rest of the saws require an Allen wrench to loosen and tighten the clamps, or in the case of the Hegner, a square-drive "clock key," which makes better sense than an easily strippable Allen screw.

I could spend several pages explaining the blade-changing procedures for each saw: Suffice to say, one saw stood heads and shoulders above the rest in ease of blade change: the Excaliber EX II. Both permanently mounted finger-release quick clamps have large knurled knobs connected by a threaded rod to a pivoting foot that holds the blade. The foot grips the blade much like a C-clamp. You simply loosen the knob, insert the blade end, tighten the knob, and the blade is perfectly centered in the clamp. I found that after practicing the procedure several times, I could replace a broken blade in about 20 seconds (Photo 9). The clamp knobs on the RBI saws don't operate nearly as well, but I still found them far more convenient than using wrenches.

Rarely do I rave about new innovations in tool design, but the Excaliber's finger-release quick clamps add a whole new dimension to production scroll-sawing. The good news is that the originator of the clamps—Seyco Sales



Photo 9: Finger-operated Quick Clamp on Excaliber saws: available for Delta, Hegner, and RBI as aftermarket accessory from Seyco Sales (see Sources).



Photo 10: Cam-type lever on RBI saws enables quick tension release for changing blades.



Photo 11: Front-mounted tension release lever on Delta is also available on RBI 220VS and Excaliber EX II saws.

(see Sources)—also offers variations of these clamp sets as aftermarket retrofits for the Delta (which also fits the Shopsmith), Hegner, and RBI saws (top clamp only). Hegner now offers a nearly identical version for their saws.

Saw Tensioning: For the most part, adjusting the blade to the proper tension has always been a hit-or-miss proposition: the ideal tension depends on the blade size and type of material you're cutting. However, once you have enough experience under your belt, the process becomes intuitive.

On most saws, you adjust the tension via a knob-operated tensioning rod at the back of the saw; on C-arm saws, the tensioning knob is located on the front of the top arm. The RBI saws have a cam-type lever, rather than a knob. This feature provides a nearly foolproof method of tension adjustment: you finger-tighten the tensioning rod until the cam contacts the tension-rod pivot block at the 11:00 position; you then flip the cam lever forward to tighten the blade to the correct tension. When changing blades, you simply flip the cam lever back to loosen the tension (Photo 10). The RBI 220VS also has a quick tension-release lever mounted on the front of the saw arm, as does the Delta (Photo 11) and Excaliber. Once you achieve the proper tension, all you need do is flip the lever forward to release tension for blade-changing, then flip the lever back to return to the same tension setting on the saw. Because the lever on the Excaliber wasn't yet available at the time of this review, the model pictured doesn't have one. As with the finger-release quick clamps, the front tension

release lever is a real time-saver, especially if you're sitting on a stool in front of the saw. Even with this device, however, you usually have to readjust the tension when you switch blade sizes.

In the final analysis, I found the Excaliber EX II had the best blade-changing system, followed by the RBI 220VS, Delta, RBI 216VS, Hegner, and Shopsmith, in that order.

Motors

The size and weight of some of these machines approach that of a small stationary band saw, but they don't require nearly as much power to run. (The motors range from 1.7 to 2.8 amps).

Why? All you need do is look at the size of the blade the motor needs to power. For example, even if you're aggressively cutting thick hardwoods with a no. 12 blade, you're more likely to bend or snap the blade before you bog down the motor to any great degree. All of the saws tested had more than enough power, in my opinion.

Electronic Variable Speed (EVS)

As a rule, most scrolling jobs are done at the saw's maximum speed—1,400 to 2,000 strokes per minute (SPM)—because the high speed generally provides the fastest, smoothest cuts in a variety of wood and wood composite materials. However, the ability to change to a lower blade speed becomes important when cutting plastics (which tend to melt at higher speeds) and metals (which tend to heat up the blade). It also helps to slow down the blade speed when you're first learning how to cut,

getting acquainted with a new saw or trying out new patterns—especially if you find the blade making burn marks in the tight curves. Even veteran users prefer lower speeds when making intricate cuts in thin stock, such as for marquetry or intarsia projects.

Before manufacturers added variable speed to their saws, speed changes were accomplished by means of a manually changed belt and a step pulley system, which provided two to five different fixed speeds. Now, all the major companies offer models with EVS, along with single-speed versions (several also offer step-pulley models). While EVS isn't exactly a must-have feature for most scrolling projects, it certainly adds to the saw's versatility and provides more precise control of the cut. Typically, this feature adds about \$100 to \$150 to the price of the saw.

All EVS controls have an electronic feedback feature that enables the motor to maintain a constant speed under varying loads. In my tests, the Hegner and Delta were slightly better at maintaining smooth, consistent speeds throughout their range, although the speed controls on the rest worked perfectly well. The controls on most saws have an arbitrary 1 to 10 speed-control dial; the dial on the Hegner reads in SPM increments. With its LED digital readout in actual strokes per minute, the Delta control (Photo 12) is the most sophisticated. My 9-year-old daughter said she likes the Delta best "because it has a little speedometer on it."

Accessibility of Controls—While some woodworkers might consider the Delta's LED readout a trifle gimmicky,

Big Cuts for Low Bucks: How About Those Taiwanese Imports?

Thumbing through my catalogs, I noticed that several importers of Taiwanese machinery were offering large-capacity scroll saws (23 to 26 in.) at attractive prices (\$250-\$350). While this article has largely focused on the 18-in. to 20-in. "high end" saws, I was curious to see if these Taiwanese giants might be a viable alternative to their \$1,200-plus counterparts (for budget-minded woodworkers who need a big-capacity saw; \$1,200 is about the minimum price you'd expect to pay for non-Taiwanese saws in this size.) I called in two: the 23-in. AMT 4671 and the 26-in. Reliant DD26.

Like most Taiwanese woodworking



AMT 4671



Reliant DD26

machines, these two saws boast heavy (though somewhat rough) cast-iron construction. While the cutting action on both saws isn't as smooth as that of the Sears (or the pricier saws in this article), they're a good step above the "under \$200" Taiwanese saws tested in my last review. They make a reasonably smooth cut, but with more vibration than you'd get with a high-end saw. On both, the tables tilt 45 degrees to the left only. The AMT doesn't come with a stand, nor is there one available for it. To minimize vibration, you'll want to make sure the saw is mounted on a sturdy benchtop. The 3-legged stand supplied with the Reliant is similar to the one on the Delta, and provides good support.

Both saws have hold-down foot pivots to match the table tilt. While the Reliant offers 3 inches more throat depth and a leg stand, the AMT has a 2-speed switch and runs slightly more smoothly. The motors themselves look identical.

Delta does get an A+ for switch location: the front-mounted PULL-ON/PUSH-OFF speed control knob is much more visible and accessible from the normal operating position than those on the Excaliber, Hegner, RBI, and Shopsmith saws. The Sears has a similar switch setup to the Delta, sans LED readout.

Table Talk

When it comes to tables, you'll want to look at several things. While the table shape is largely a matter of personal preference, shape and size in tandem determine how well the table supports the stock. Try to visualize if the shape and size of the table will provide adequate support for the type of work you do. The tables on the Delta, RBI 220VS and Shopsmith provide more support in front of the blade than those on the Hegner and Excaliber saws. The table on the Hegner is also much smaller than those on the other saws. The tables on all saws except the Hegner and Delta tilt 45 degrees left and right. Due to the position of the motor and front table-mounting bracket on the Hegner, its table tilts only 38 degrees left and 15 degrees right. The Delta tilts 30 degrees left and 45 degrees right. (The Delta table can also be rotated 90 degrees to tilt 15 degrees up and 30 degrees down). Not having a full 45-degree tilt in both

directions isn't a major problem unless you do work that requires it.

More important is how smoothly and easily the table tilts, and how accurate the settings are. The Delta and Hegner tables had the smoothest tilt action, followed by the RBI and Excaliber. All locked firmly in place and the scales were accurate. The Shopsmith table was difficult to tilt because, in addition to the front table lock, you need to loosen an Allen screw at the back of the table to tilt it. The operation of the tilt was somewhat sloppy and the table tended to hang up when tilting, due to a small hold-down pin that clamps the back of the table to the rear trunnion.



Photo 12: Delta speed control and LED readout are readily accessible (and visible) from normal operating position.

Stands

Unless you can mount the saw to a rock-solid workbench, all of the saws tested operate with less vibration when mounted on their respective factory stands. The Excaliber, RBI, and Shopsmith come with four-legged stands; the Delta and Hegner have three-legged (tripod) stands. While three-legged stands usually don't require leveling on uneven floors, the one on the Hegner seemed to make the saw a bit tipsy, even though it provided rigid support. Conversely, the Delta stand seemed to be the most substantial, followed by Shopsmith, Excaliber and RBI. I'll give Hegner credit for a couple of things about their stand—it comes completely assembled in the box, which meant I was able to set up the saw in about 15 minutes.

Hold-Downs

The material hold-downs on all the saws worked equally well at what they're supposed to do—hold thinner stock securely against the table to prevent material lifting or chattering. To some extent, the hold-downs also serve as a finger guard. When cutting stock $\frac{3}{8}$ in. or thicker, once you learn how to apply the correct downward pressure on the stock as you move it through the blade, you'll find the hold-downs are usually

unnecessary. Experienced scroll-sawyers generally consider the hold-downs a nuisance and remove them altogether. On the Excaliber, Hegner, and RBI 220VS, you can easily swing the hold-down out of the way without having to remove the blade. On most saws, you need to remove the hold-down to achieve the full depth of cut specified by the saw manufacturer (see chart on page 73.)

Dust Blowers

The dust blowers on all the saws I tested work as advertised; they blow the sawdust away from the cut line so you can see what you're doing. Hegner has the cleanest arrangement: the blower nozzle is built into the upper arm, allowing clear vision of the blade. On the Delta, the nozzle is attached to a cumbersome hold-down/finger guard assembly. The plastic blower tubes on the RBI saws require a slight adjustment each time you reposition the hold-down foot, in order to direct the air stream directly at the cut line. The metal blower tube attachment on the Shopsmith is a complicated-looking affair, most likely designed to double as a finger guard. Unfortunately, the nozzle makes it difficult to install the upper blade clamp when changing blades. The metal blower tube on the Excaliber comes mounted on the top of the upper arm. To increase the blower's efficiency, you can easily reposition it on the bottom side of the arm and adjust the blower tube slightly to direct the airflow. The blower produced enough wind, however, that I didn't find it necessary to

do this.

In addition to a dust blower, the Hegner has a dust port attachment beneath the table, which you can connect to a vacuum. It flips down to access the

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lower blade clamp. The Shopsmith has a dust evacuation port built into the stand beneath the saw.

The Final Analysis

In this review, I've pointed out what to look for in a quality scroll saw, and cited some examples of which tools were better than others in each respect. If you have a chance to try out any of the saws featured in this article, you may agree or disagree with my observations. After all,

we all have our own expectations of a tool, based on how we'll be using it. For example, if I needed a scroll saw to finesse precise, intricate cuts in thin materials, the Hegner 18V would win, hands-down. The Delta, on the other hand, is a durable, fast-cutting workhorse, perfect for mass-producing dozens of cutouts in thick or large work pieces. Compared to the Hegner, though, it's a bit too rough and aggressive for super-fine detail work.

My favorite of the lot has to be the Excaliber EX II because it's a smooth-running, precision machine with a good combination of features, not the least of which are its quick clamps. And, the Excaliber simply felt the most comfortable while cutting on it. The RBI saws didn't fare as well in my tests as the above three, but they're still good enough to be considered precision saws. And keep in mind that the main reason the RBI 220VS saw that I tested didn't measure up to the top performers was the tendency to burn on thick stock when making tight inside cuts, a situation that should be eliminated with the redesign of the upper arm and the switch to a more rigid thrust bearing. The Shopsmith was the most problematic of the lot, but it's also one of the least expensive. But don't take my word for it—test hop all the machines you're interested in, if you can. While doing so, take the weight of the saw into consideration—if you want to haul it around to craft shows, choose one that won't break your back.



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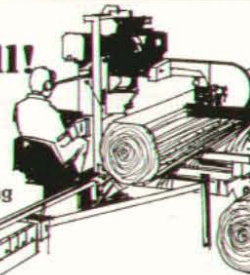
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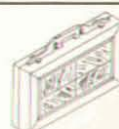
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Vol. 10 No. 3 May-June '86 Contemporary Lamp, Early American Bench, Steam-Bent Clock, Pine Hutch, Goose Basket, Toy Crane, Condiment Holder, Shop Workstation, Parsons Table, Shaker Lap Desk, Victorian Whatnot Shelf; *Articles:* Toymaker Clare Maginley;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

Vol. 10 No. 4 July-Aug '86 Wall-Hung Display Cabinet, Lattice-work Planter, Country Bucket Bench, Adirondack Chair, Coffee Mill, Clamdigger's Basket, Box of Shapes Toy, Disk Clock, Tenon Jig, Dictionary Stand, Shaker Slat-Back Side Chair; *Articles:* Selecting the Right Project for Production; More About Warped Boards; All About Router Bits; Sliding Dovetail Joints.

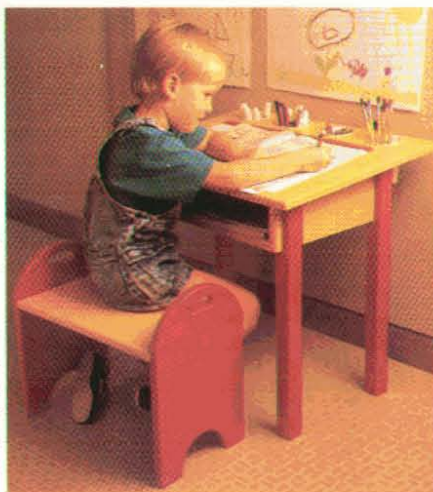
Vol. 10 No. 5 Sept-Oct '86 Vanity Case,

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.

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Vol. 11 No. 5 Sept-Oct '87

Contemporary Love Seat, Two-Drawer Platform Bed, Snail Pull Toy, Routed Trivets, Spice Rack with Chip Carving, Joiner's Tool Chest, Shaker-Style Step Stool, Turned Shop Mallets, Woodbox; *Articles:* French Polishing Made Easy; Plane Iron Sharpening; Making a Splayed Leg Drill Guideblock; Traditional Chip Carving; Shop-Tested: 12 Jigsaws; Making the Knuckle Joint.

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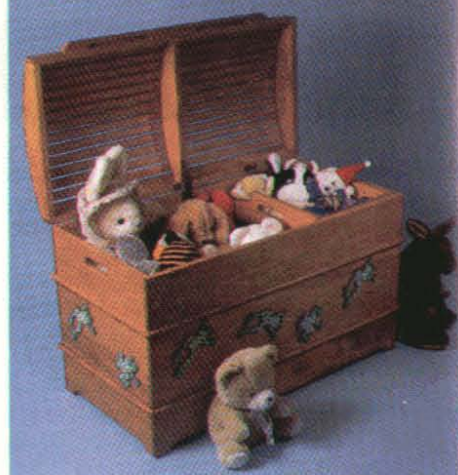
Contemporary Coffee Table, Puss 'n Books Bookends, Cookbook Holder, Wooden Jewelry, Child's Duck Puzzle, Shaker Wall Clock, Stereo Cabinet and Speakers, Country Occasional Table, Drill Press Jig, Early American Pierced Tin Cabinet; *Articles:* Edge-Gluing; The Drill Press; Pierced Tin; Four Shopmade Finishes.

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Toy Chest Nov/Dec '91

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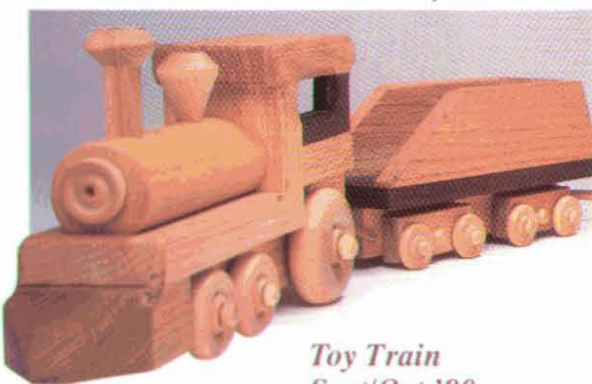
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**Toy Train
Sept/Oct '90**

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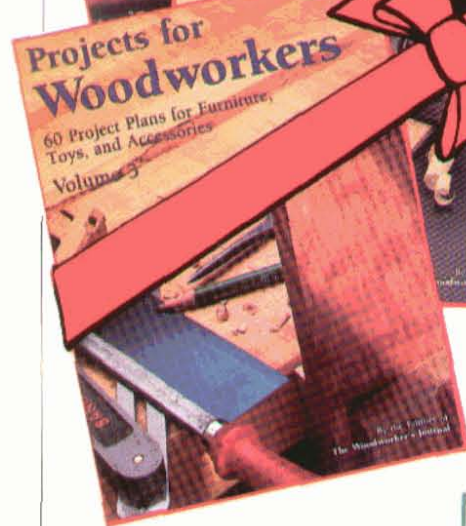
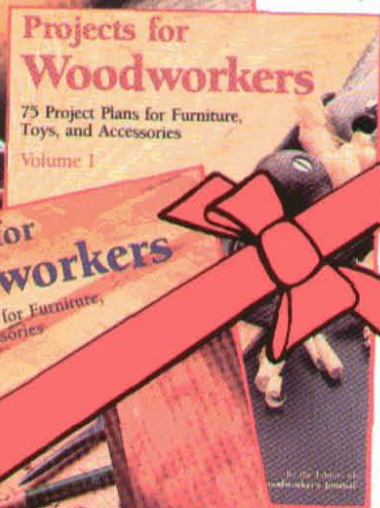
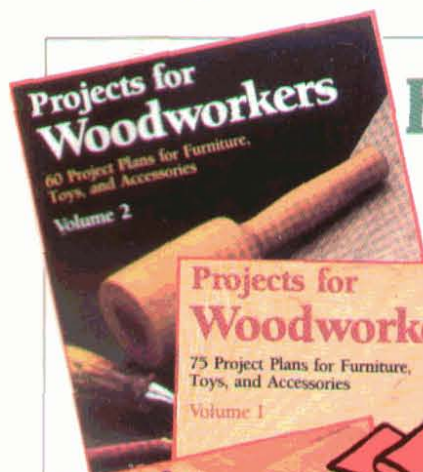
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Of course, this next big issue includes many more

Next Issue . . .



projects—a **Kitchen Message Center** and a new **CD Holder** are but two—plus the timely features you've come to expect, among them a how-to on **Sharpening Carving Tools**, a **Torsion Box Techniques** article, a **Tool Review** of the new **Sliding Compound Miter Saws**, and a fascinating article on **Working with Green Wood**. Don't miss this special issue!