

Woodworker's Journal

Vol. 19, No. 5 September/October 1995

ART DECO EARRING CHEST

page 46

Part 2 FINISHING BASICS

Staining
Alternatives

GREAT PROJECTS

- Arts and Crafts Era Hall Tree Seat
- Knee-High Woodworking Bench
- Layered Canyonscape Puzzle
- Bevel-Edged Long Mirror



FALL COMBO SALE

FREE \$45 IN SHARPENING COUPONS

GOOD ON ALL FORREST OR OTHER MAKES OF CARBIDE BLADES OR DADO SETS. EXPIRES 9-30-95.

Must mention **Woodworker's Journal** to receive coupons & extra bonus.

CHOPMASTER FOR SLIDING COMPOUNDS & MITER SAWS

New specs, 5° Neg. Pts. & flat, runs out less than .002 for perfect, tight, smooth, splinter-free miter joints.

EXTRA 10% - 20% OFF FALL SALE!

NEW SIZES AVAILABLE

	LIST	SALE
Delta Sidekick 6-1/2"x40T5/8"	\$149	\$ 89
Sears 8-1/4" & Delta 8-1/4"x60T5/8"	\$170	\$ 99
Hitachi 8-1/2"x60T5/8"	\$179	\$109
DeWalt 8-1/2" & Ryobi 8-1/2"x60T5/8"	\$179	\$109
Delta 9"x80T5/8"	\$204	\$119
Ryobi-Makita & all 10"x80T5/8"	\$207	\$129
DeWalt, Makita, B&D, Hitachi 12"x80T1"	\$229	\$139
Ryobi-Makita 14"x100T1"	\$266	\$179
Hitachi 15"x100T1"	\$277	\$189

For good general purpose cuts use Woodworker II 30T & 40T or Woodworker I. Use small stiffener where possible.

WOODWORKER I - For TABLE and RADIAL SAW

This trim and crosscut ALL PURPOSE blade gives scratch-free polished cuts on all materials RIP or CROSSCUT UP TO 2".

- ALL 60T AND 3/32" THIN KERF 30° ATB and 5° face hook on 10" diameter and under. 12" and 14" are 20° ATB 1/8"K.
- DOUBLE HARDER and 40% STRONGER CARBIDE.
- THIN KERF: Saves 1/3 wood loss on each cut, radial or table. Feeds easy when used for moderate rip and crosscut on table saw. Reduces "JUMP IN" for better "PULL CONTROL." Practically eliminates bottom splinter on RADIAL CROSSCUT.
- Totally stops ALL bottom and top splinter on ply veneers in push-cut mode on RADIAL.
- Our STIFFENER STRONGLY RECOMMENDED AGAINST outside blade for best cuts. Made and serviced in U.S.A. for your benefit.

	LIST	SALE
14"x60T1" 1/8"K	\$224	\$159
12"x60T1" or 5/8" 1/8"K	\$198	\$139
10"x60T5/8" 3/32"K	\$162	\$129
9"x60T5/8" 3/32"K	\$156	\$119
8"x60T5/8" 3/32"K	\$150	\$109

	LIST	SALE
8-1/4"x60T5/8" 3/32"K	\$150	\$109
7-1/4"x60T5/8" 3/32"K	\$150	\$109
RYOBI RA200		
SEARS TS200		
MAKITA 500B NBA		
HITACHI PSM8		
PORTER CABLE 368-1		

SPECIAL FALL SALE
EXTRA 10%-20% OFF

BUY 1 BLADE OR DADO AT **10% OFF** SALE PRICE
2ND BLADE **20% OFF** (EQUAL OR LESSER VALUE)
15% OFF DADO AS SECOND CHOICE.

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With this one ALL PURPOSE blade you can RIP & CROSSCUT 1"-2" ROCKHARDS and SOFTWOODS resulting in a SMOOTH AS SANDED surface. PLY-VENEERS OF OAK and BIRCH will crosscut with NO BOTTOM SPLINTER at moderate feed rates.

- DOUBLE HARD and 40% STRONGER C-4 CARBIDE
- Ends blade changing
- Ends scratchy saw cuts
- Ends second-step finishing
- Ends cutting 1/16" oversize to allow for RESURFACING
- BUY AND SHARPEN 1 BLADE INSTEAD OF 3

5/8" holes, boring thru 1-1/4" add \$7.50. Larger at Time Basis — Shipping \$4.50

WOODWORKER II	LIST	SALE
14"x40T1"	\$215	\$149
14"x30T1"	\$195	\$139
12"x40T1"	\$183	\$129
12"x30T1"	\$162	\$119
10"x40T1/8" or 3/32"	\$156	\$119
30T 1/8" or 3/32"	\$135	\$ 99
9"x40T	\$146	\$ 99
30T	\$125	\$ 99
*8-1/4"x40TX 3/32"	\$136	\$ 99
8"x40T 3/32"	\$136	\$ 99
30T	\$115	\$ 89
7-1/4"x30T 3/32"	\$112	\$ 69
**6"x40T 3/32"	\$136	\$ 89

*NEW for Sears & Makita Table Saws **New For Saw Boss



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BUY OUR BEST SELLER 10" X 40T FOR ONLY \$119 PLUS EXTRA 10%-20% OFF FOR FALL SALE!

RECEIVE WITH EVERY FORREST BLADE OR DADO LISTED, 9 SHARPENING COUPONS WORTH \$5.00 EACH!

Outperformed 36 other premium blades, both foreign and domestic! WOODS Magazine test, Sept. '93, pg. 45

NET COST TO YOU AFTER USING SHARPENING COUPONS

TRY A FORREST CARBIDE BLADE TODAY!

NEW DELUXE DADO-KING!

FROM THE LEADER IN DADO TECHNOLOGY!

"No tearout on all five woods tested"

(INCLUDES MELAMINE)
Fine Woodworking J/A '91, page 51
"Best Value" WOOD Magazine, Oct. '91, pg. 62-63

NEW 3/32" CHIPPER

- allows twice as many groove widths to match thin plywood

FREE SHIMS INCLUDED

- when cross-cutting oak, ply-veneers, and melamine

PERFECT FLAT BOTTOM GROOVES

- not staggered steps or round-bottoms like a wobble-dado leaves

CUTS IN ALL DIRECTIONS

- rip, cross-cut, miter any depth

CUTS ALL SIZED GROOVES

- 1/8" through 29/32" in 1/32" increments

SUPER-HARD CARBIDE

- gives up to 300% longer life, especially good on plywoods and abrasive particle boards



Dado FOR AS LOW AS \$229
(PLUS \$45 IN SHARPENING COUPONS)

American Woodworker Editors Choice Award

Here is why this great Dado Head has no equal!

C-4 Carbide Tips — 24 on each saw blade — twice as many as most competitors!



C-4 Carbide Tips — 4 on each chipper with special negative face hooks.

	LIST	SALE	10%	15%
6" D. 5/8" Bore NEW	\$299	\$269	\$242	\$229
8" D. 5/8" Bore	\$321	\$289	\$260	\$245
10" D. 5/8" & 1" Bore	\$389	\$349	\$314	\$297
12" D. 1" Bore	\$499	\$449	\$404	\$382

(Bore up to 1-1/4" Add \$25 — Plus \$5.50 S&H)

DURALINE HI-A/T FOR TABLE & RADIAL SAWS ALL FLAT FACE

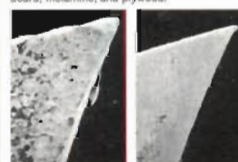
5/8" HOLES. Boring up to 1-1/4" \$7.50 extra. Larger holes—time basis. Shipping \$4.50.

SIZES AVAILABLE	LIST	SALE	SIZES AVAILABLE	LIST	SALE
7-1/4"x60T3/32" K	\$149	\$129	12"x100T1-1/8"K	\$253	\$215
8"x80T1/8" & 3/32" K	\$202	\$169	14"x80T1"	\$232	\$197
9"x80T1/8" & 3/32" K	\$207	\$179	14"x100T1"	\$266	\$226
10"x80T1/8" & 3/32" K	\$207	\$159	16"x80T1"	\$262	\$223
12"x80T1-1/8"K	\$212	\$181	16"x100T1"	\$294	\$243

SPECIAL FALL SALE
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CARBIDE IS THE HARDEST OF THE C-4 GRADES AND 40% STRONGER, NOT WEAKER!
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Standard C-2 Carbide (below, left) and FORREST still sharp (Oxidation and Corrosion Resistant Sub-Micron C-4 Carbide (below, right). Each shown after cutting 3,500 feet of MDF. Similar results obtained cutting particle board, melamine, and plywood.



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6"	\$25

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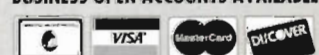
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Woodworker's Journal

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PROJECTS

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Bring this popular turn-of-the-century revival to your front entryway

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SAFETY FIRST, SAFETY ALWAYS



A recent tablesaw kickback event in our shop reminded us all of the importance of constant vigilance while working with tools. Fortunately, only a small project awaiting some final touches received the brunt of that swift-flying projectile.

That reminder was reinforced when, a day or two later, I received phone calls from two craftsmen. Both, it so happened, had just returned to work after recuperating from tool-inflicted injuries.

Obviously, the causes of shop accidents are many and varied: impatience, inattention, inexperience, overfamiliarity, bad habits, worn or improperly tuned

equipment, neglect of proper guards, push sticks, and personal protective devices—I could go on.

Tool manufacturers put considerable research and development into making their tools as safe as possible. The inherent danger, of course, is still there; spinning cutters and blades do cut. But removing blade guards, overriding safety switches, and using tools carelessly defeats the efforts they've put into safe design.

Think about it. How recently have you reviewed the operator's manual for your tablesaw or jointer? When did you last go into your shop fatigued or mentally unprepared? How often do you force a tool beyond its capacity or knowingly use a dull or out-of-tune tool? When was the last time you performed a machining operation that you hadn't carefully thought through beforehand? Few of us, I'm sure, can truthfully give the right answer to all of the above.

As a pilot, I have to complete a checklist before every takeoff and landing. I think we would all do well to work through a mental checklist before we open the shop door, especially before operating power tools or performing maintenance on them.

Want some help and suggestions? For starters, write to the Power Tool Institute for several of their free and thoughtfully written safety booklets. Ask for Safety Is Your Decision (no. 113), Power Tool Safety (no. 116), and the Power Tool Safety Maintenance Check List (no. 102). You can contact PTI at 1300 Sumner Avenue, Cleveland, OH 44115-2851.

Charles Sommers

Woodworker's Journal

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READERS' INFORMATION EXCHANGE

I want to build a wooden console to fit between the front bucket seats of my Dodge Caravan to hold my cellular telephone and ham radio and also provide storage space for small items. Has anyone built something like this or know where I might get plans?

Any help would be greatly appreciated.

David K. Gordon
P.O. Box 217
Holbrook, NY 11741-0217

I have a Stanley cordless 1/4" screwdriver, type 1, 75-002 (140 rpm/3.6V DC). The nicad battery pack for it (75-012, 3.6V DC) no longer accepts a charge. I am looking for a replacement. In fact, I really would like to buy two of these rechargeable batteries. Anyone know where they might be available?

Philip J. Hamman
1515 Wolf Run
College Station, TX 77840-3134.
Telephone: 409/696-1252 (evenings)

I was told that if anyone could help, it would be *Woodworker's Journal* readers!

Recently a family hand-me-down DeWalt radial-arm saw landed in my workshop—a DeWalt by AMF, model MBF, rel. no. 232, serial no. 235680. Now, I need an owner's/operator's manual for it and will gladly pay copying and postage costs.

Thanks for your help.

Mark R. Smith
10 Holmes Court
Sayville, NY 11782-2408
Telephone: 516/589-9027

I would like a copy of the owner's manual for a Sears 10" radial-arm saw, model no. 113.29501.

James Glander
14726 Myer Terrace
Rockville, MD 20853
Telephone: 301/460-5225

I notice that a lot of readers request information and manuals for Craftsman tools. Here's a telephone number I uncovered that may be helpful to many readers needing such material:

Sears Teleparts
800/366-7278

Telephone hours are 6:30 am to 9:00 pm weekdays, 6:30 am to 6:00 pm on Sunday.

Jack Poston
Marion, Va.

I'm looking for any information on the Duracraft Company. I have one of their 12" bandsaws that needs some parts. I also need a copy of the owner's manual or a current address where I might contact the firm.

Thanks.

Robert Leggett
166 W. Wood St.
New Lenox, IL 60451

I would like to purchase a Saw-Mite kit manufactured by the Peppin Corporation of California and sold by Harbor Freight for use as a radial-arm saw. If anyone has one they'd like to sell or knows where I might get one, I'd appreciate the information.

Lawrence Mathon
225 Coachman Way
O'Fallon, MO 63366
Telephone: 314/821-7220, ext. 279 (days)
314/281-8831 (evenings)

I recently acquired an older Sears Craftsman radial-arm saw model no. 103.29300 and would like to get an owner's manual and parts list for the saw.

Thanks.

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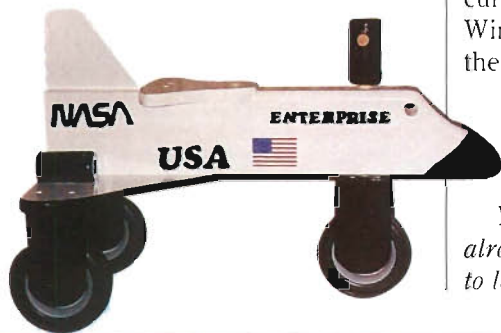
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READER LETTERS

Here's the Space Shuttle toy I made for my grandson. The project first appeared in *Woodworker's Journal* (Sept./Oct. '89).

I made the vehicle's body of solid pine, the wheel housings out of maple, and the fuselage of 3" stock instead of the 1½" suggested on original plan. I used a 3" swivel-type bearing to make steering easier. I couldn't get the parts



kit anymore, so I purchased the wheels and other hardware locally and painted all logos myself.

Over the years, I've made many projects from your magazine. I'm currently building the Governor Winthrop slant-front desk from the Nov./Dec. '92 issue.

Herbert Emery,
Adrian, Mich.

Herbert:

You (and many others who have already built the desk) may be happy to learn that we will present the

matching cabinet top for that desk as a project in our next issue (Nov./Dec. '95). So, when you finish the desk, you can start on the top. The cabinet was designed specifically to match the desk and features leaded glass in the doors. Watch for it.

—the Editor

Here's my first turning project—the Jenny Lind cradle (Sept./Oct. '94) that I just completed in time for my first grandchild. The project was challenging for me and a pleasure to do.

Note that I changed the end and side rail spindles to match the spool on the leg, added two spindles on each side and one on each end, and

AMAZING SCROLLSAW PATTERNS



The 50" dome clock at left recently sold for
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1X44	.81 ea.	4X21 3/4	1.06 ea.
2 1/2X16	.85 ea.	4X24	1.10 ea.
3X18	.86 ea.	4X36	1.35 ea.
3X21	.90 ea.	6X48	3.50 ea.
3X23 3/4	.93 ea.	6x89X80	6.24 ea.

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used five mattress support slats rather than three.

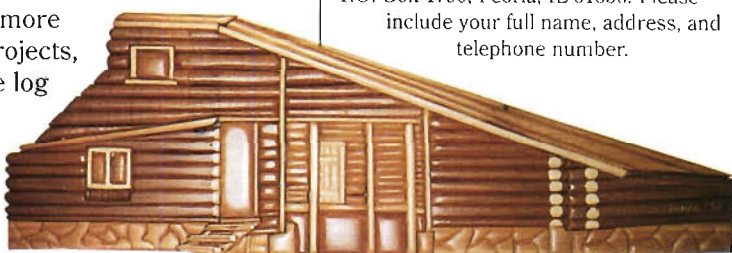
I know a number of your projects have been inspired by the Wallace M. Nutting Collection at Berea College. I hope you'll be providing more projects from that collection.

Gary L. Fox,
Shell Lake, Wis.

Gary:
See my earlier response to reader Emery's letter. We also have another Berea design, a cane-seated rocker, scheduled for later in 1996.

—the Editor

Since my first encounter with Sintarsia projects (Toucan-On-a-Branch, Jan./Feb. '92), I have evolved to more complex projects, such as the log cabin I designed. It took me over a week

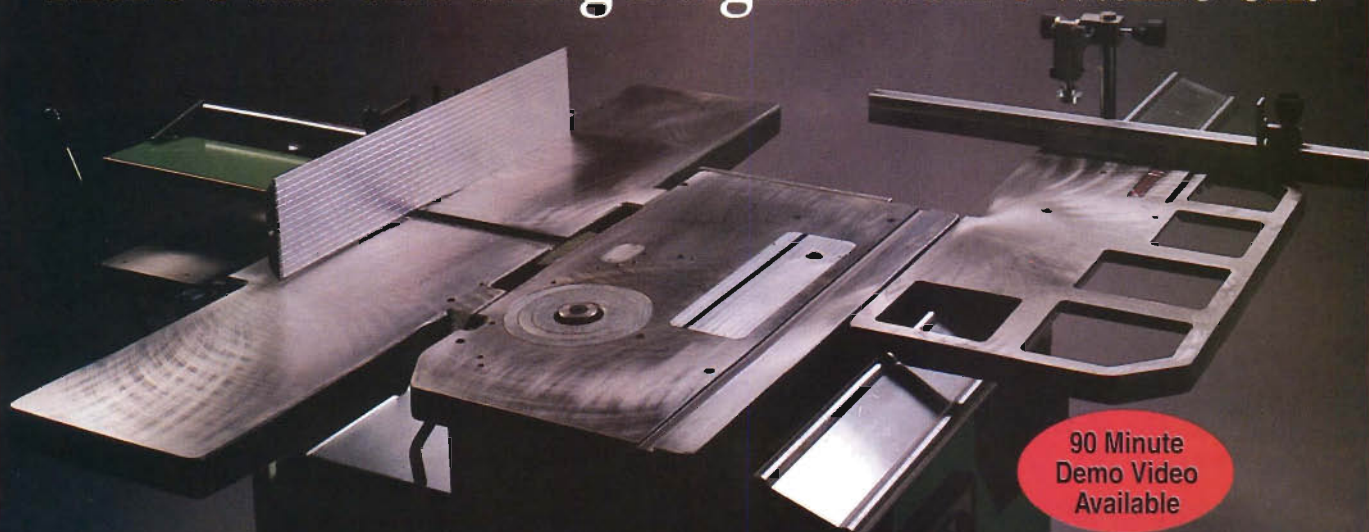


to complete to my satisfaction, but I consider it time well spent. If readers want more information about it, they can write to me.

Irina Romosan
10883 Highway 48N
Markham, Ontario L3P 3J3

We welcome opinions and comments (both pro and con) from our readers. Address correspondence to: Letters Dept., *Woodworker's Journal*, News Plaza, P.O. Box 1790, Peoria, IL 61656. Please include your full name, address, and telephone number.

Here's the one thing Belgians don't waffle on.



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That's why Belgians call the Robland X31 The Intelligent One Man Shop. About the only thing you can't make on it is breakfast.

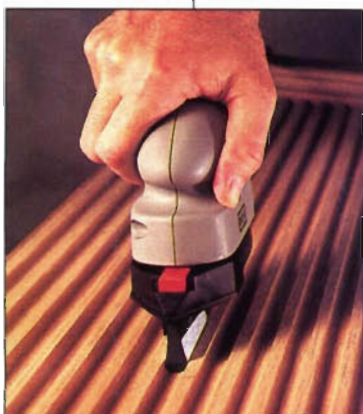
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PRODUCT NEWS

Sand Corners, Angles, Beads, and More

Porter-Cable's detail sander represents the newest effort to mechanize the sanding of unusual shapes and angles. The firm's new model 444 profile sander (kit no. 9444) offers 17 unique "profile" pads for sanding concave and convex radii found on moldings and other decorative stock. And, if a pad doesn't fit quite right, you can customize it. There's



Porter-Cable profile sander

also an offset pad that makes sanding shutter slats a breeze.

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continued on page 10

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PRODUCT NEWS

Continued from page 9

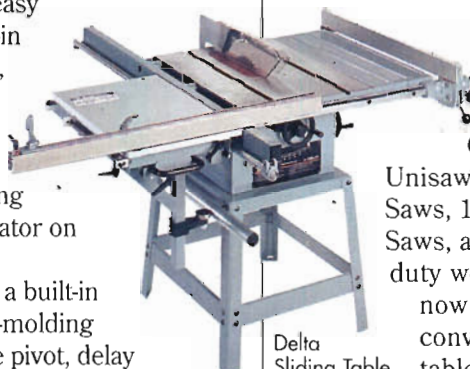
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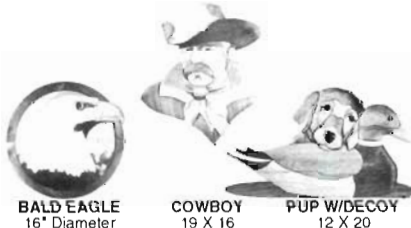
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continued on page 64

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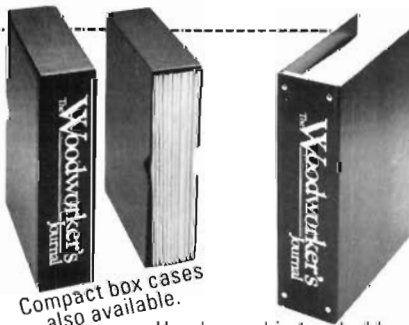
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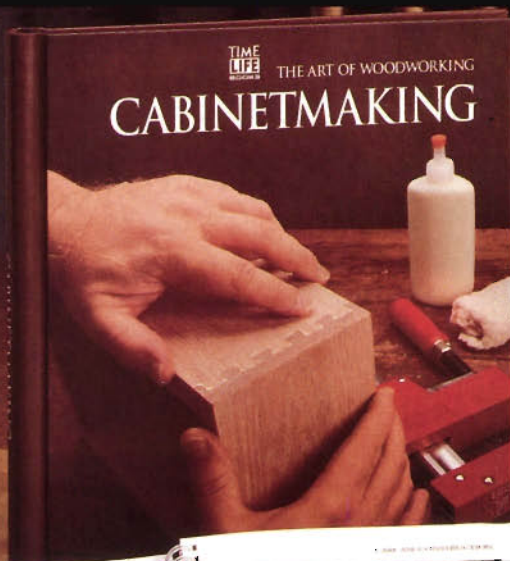
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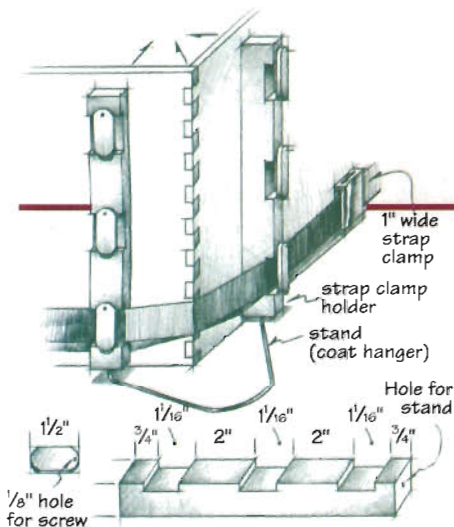
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SHOP TIPS



A Strap-Clamp System

I use strap clamps to assemble many of my projects. To make them more effective and less frustrating to use, I developed these holders. Depending on the project's size, I'll use two or more holders per side. I've sized mine for 1"-wide strap clamps and for projects up to about 10" wide, but you can make the holders as narrow or as wide as you want.

The flaps help hold the straps in position. The stands, which I've made by cutting and bending coat-hanger wire, help keep the holders in place while I draw up the strap clamps. As the diagram shows, this clamping system applies pressure at each holder location as well as at the corners. The holders can be adjusted easily if necessary to square the project.

When I'm not using the clamps, I either hang them on the wall or roll them up and store them.

Caiaphas Nunnally, Phoenix, Ariz.

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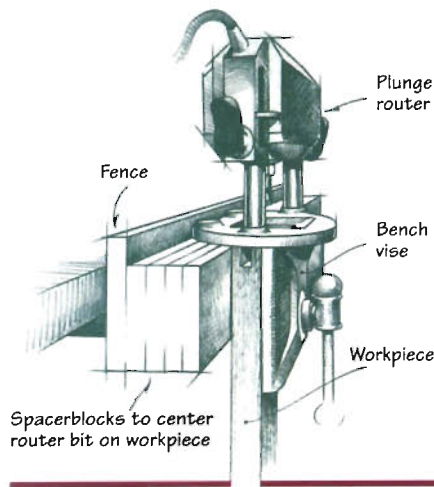


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Quick and Easy Mortising Jig

My jig consists of a fence attached to a block on which the router rides. I make the block's thickness equal to the distance from the edge of the router base to the center of the bit,



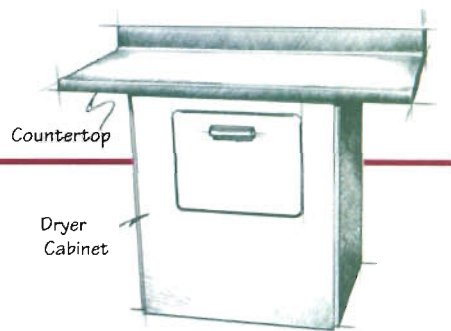
minus half the workpiece's thickness. This centers the cut on the stock.

Butt the stock against the block's face, and drop the whole thing in your woodworking vise. Then, line up the top of the stock flush with the block's top. I lay a flat board on top to line up the two. Tighten the vise, and you're ready to rout. For stop cuts, simply clamp or tack stops to the block.

*Kristian Eshelman,
Highland Park, New Jersey*

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How to Make The Pin and Crescent Joint

You'll often find this decorative, machine-cut joint on turn-of-the-century furniture pieces.

The interconnecting crescents and pins give this joint its aesthetic appeal, especially if done in contrasting woods. Properly cut, the joint offers structural strength that rivals even that of the more commonplace dovetail.

We chose this joint for the drawers on the child-sized workbench project that starts on *page 20*. We found, in making the three drawers, that joining each corner with a pin and crescent requires five separate steps, or 20 individual operations for each drawer. However, these are not difficult steps, and with help from our instructions and those provided with the jig, you'll be cutting joints in a very short time.

Always refer to the manual supplied with the jig for specific settings. As with all new techniques, we recommend that you practice on scrap stock before attempting to make the joints on your actual workpieces.

What You'll Need

You'll need a router as well as a pin-and-crescent set like the one we obtained from Woodworker's Supply. (See the Source listed at the end of the article.) The jig and templates work with $\frac{1}{2}$ "- to $1\frac{1}{4}$ "-thick stock of up to 12" in width. For effective clamping, the sides must be at least 8" long, the fronts and backs at least 2" in length.

For the workbench drawers, we used the small template with a $\frac{3}{16}$ " spiral

up-cut router bit, tenon cutter, and a brad-point drill bit. This template repeats the crescent every $\frac{3}{4}$ " (center to center), so size your drawers accordingly when possible.

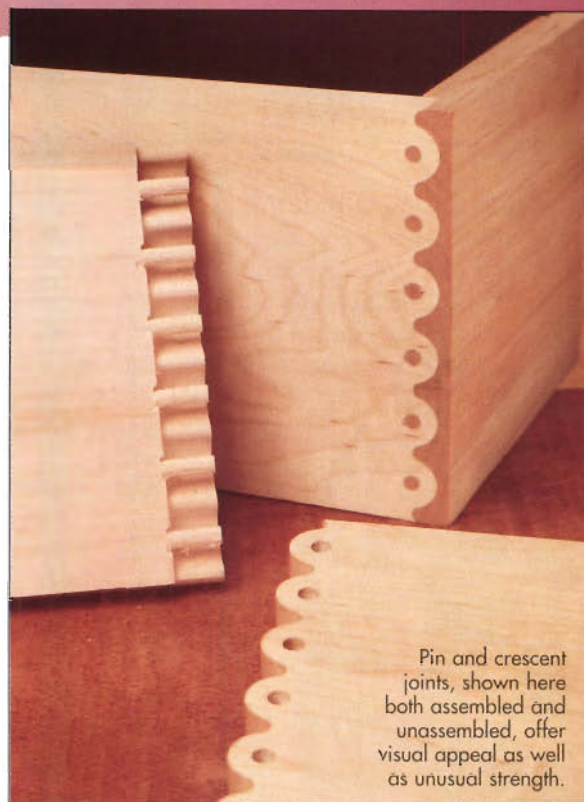
Cut the drawer fronts and backs to final size before starting the joint cuts. The drawer sides, however, need to be cut longer initially to compensate for the length lost in shaping the crescents. Use the formula in the manual to calculate their initial length.

Step 1. Set Up the Jig

Prepare the jig as described in the manual. We prefer to offset the template $\frac{1}{16}$ " rather than using the zero setting suggested. This moves the template slightly forward, providing more tolerance for cutting the tenons and minimizing chip-out on the inside shoulder.

We had trouble keeping the brass thumb screws tight in the vertical support brackets. Once you've established the template offset, gently tighten these two screws with a pliers, but be careful not to twist them off. Don't confuse them with the pair of thumb screws on the guide rods that engage the template—those need be only finger-tight.

Carefully center your workpiece on the jig using the built-in scale, then secure the fence blocks on the front and top. These blocks align the pins and crescents on your workpieces automatically.



Pin and crescent joints, shown here both assembled and unassembled, offer visual appeal as well as unusual strength.

You'll machine the front and back pieces first, so position the first piece in the front jig clamp, square it to the template, and tighten the clamp. Attach the correct template guide bushing (you provide) to your router base and secure the $\frac{3}{16}$ " spiral upcut bit in the collet. Set the router cutting depth. We set ours to cut $\frac{1}{32}$ " deeper than recommended so the fronts/backs would stand slightly proud when assembled.

Position the template as instructed, then rout. This wavy cut (shown partially routed in *photo A*) forms the profile that will mate with the crescents.

Step 2. Form the Rear Shoulder and Back Half of Pins

Move the template forward to the rear slot. Using the rearmost template and same router setup, rout the piece

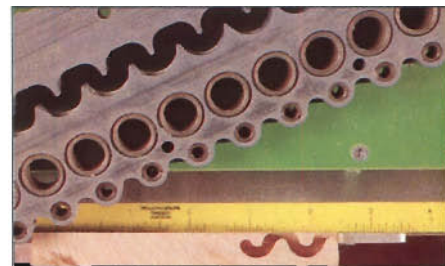


Photo A: First routed groove (partially completed here) establishes sockets for the crescents in end of drawer front/back.

again to form the back half of the pins and inside shoulder (*photo B*).

Step 3. Make a Modified Depth Stop (Optional)

You may have difficulty keeping the depth-stop collar tight on the cutter in Step 4. To remedy this, cut a 1x1x1¼" block, drill a ½" hole through it, and place it over the bit as a depth stop (*photo C*). To set the depth, adjust the cutter's length in the chuck and let the block bottom against the drill.

Step 4. Complete the Pins

Move the template to the front slot. Chuck the tenon-cutting bit into a hand drill, and set the depth-stop collar. Center the bit in the template's guide bushing hole (*photo D*) and make the cut. Hold the drill perpendicular while making these cuts. To shape the pins accurately, hold the bit in the guide but just above the workpiece surface. Start and run the drill at high speed, slowly feeding it into the wood.

Step 5. Cut Crescents On Ends Of Sides

Raise the template and move it to the front slot. Slide a drawer side piece into the jig, extend it ¼" past the template's front edge, and align its edges with those on the front/back piece still clamped in the jig. Clamp. Note: Leaving the last front/back piece in the jig makes it easier to align the side pieces. Make sure the template lies flat on the workpiece, then tighten the vertical support locking lever on each side.

Using the ¾" spiral upcut bit, rout left to right, following the contour of the front-most edge of the template to form the crescents (*photo E*) on the workpiece edge. Hold the guide bushing firmly against the template while making the cut.

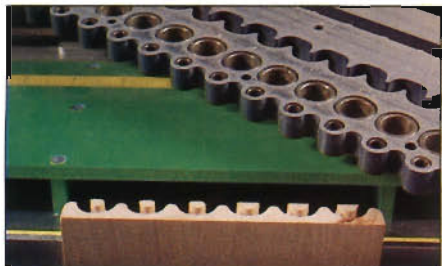


Photo B: Second rout forms shoulders and back halves of pins in end of front/back.

Step 6. Drill the Pin Holes

Fit a piece of scrapwood between the bottom face of the workpiece and the clamp bar underneath. The manual doesn't show this but we found it limits chip-out and keeps the bit from hitting the bar.

Chuck a ⅜" brad point bit into your hand drill, then drill the holes, using the small guide bushings in the template to position them on the workpiece (*photo F*). Make sure the bit is idle before inserting it into the bushing, and hold the drill straight.

Repeat the steps shown in *photos E* and *F* to shape the ends on the rest of the drawer sides.

Cutting Grooves For the Drawer Bottom

Set the groove location using one of the front or back pieces. Keep the groove sides off the pins and crescents, and limit the groove depth so it doesn't score the crescent profile. This way, the grooves will not be visible after you assemble the drawers.

Assemble the Drawers

Using a small brush, spread a light film of glue on the front and back joints and on the lower half of the crescent surfaces. Working one joint at a time, drive each joint home using a wooden block and hammer. Work in the following order: join one front to a side, add the back to that same side, slide the bottom into the groove, then add the second side.

Stretch bar clamps from side to side, using blocks to protect the pins. Clamp with enough pressure to force any air and glue from the bottom of the joint. Note: The glue squeeze-out will appear on the inside of the drawer.



Photo C: Portable drill and tenon-cutter complete the fully rounded pins.

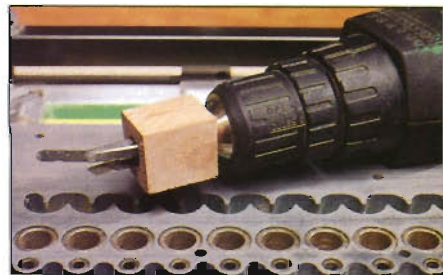


Photo D: Shop-made wooden depth stop proved more effective on tenon-cutter than collar provided with jig kit.

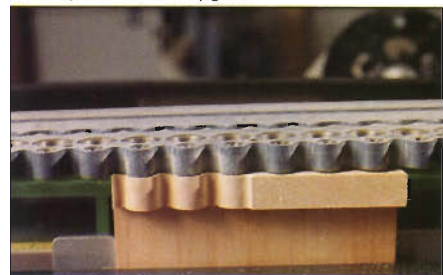


Photo E: Edge profile on template is used to rout the rounded crescents on ends of drawer sides.



Photo F: Drilling pin holes (centered in crescents) in ends of drawer sides using brad-point bit and portable drill.

If any of the pins split or break, replace them with ⅜" dowel of the same stock. Carefully pare off a similarly shaped replacement piece, and glue it into the pin hole. 

Photographs: Kevin May

Technical assistance: Dick Coers

SOURCES

Pin and Crescent Joint Jig Set. Kit includes jig base, large and small templates, two tenon cutters, and two spiral upcut bits. Catalog no. 886-459. Price: \$195.00 plus s/h. Smaller sets and components may be purchased separately. Order from:

Woodworker's Supply, Inc.
800/645-9292



Near-Perfect Wood Finishing

Part 2: Staining

by Sven Hanson

In “Part 1: Surface Preparation” (July/August 1995), author Sven Hanson emphasized sanding and even prefinishing parts before assembly. He demonstrated his technique for ironing out dents, and showed how to blow-dry a wet-sponged surface before final sanding—a technique that ensures a transparent finish with improved water resistance.

—the Editors

Some woodworkers put stain on everything they build, as if “Thou Shalt Stain” were the eleventh commandment. I color the wood only if the project calls for it. For example, new work must occasionally match old work, and some projects have larger surfaces or multiple pieces that need a bit of enhancement to improve color uniformity. (For more on this topic, see “Using Artist’s Oils to Match Colors” *opposite*.)

You’ll want to figure out beforehand whether to leave the natural beauty of the wood to speak for itself or to play with the colors in hopes of making the

project look exactly as you had pictured it in your mind. With careful craftsmanship, you win either way.

Stain comes in three formulas: oil-based, solvent-based (alcohol, lacquer thinner, or paint thinner), and water-

based. Each has its virtues, its drawbacks, and its particular rules of application. In the universe of woodworking, the true expert knows at least three ways to solve every problem, and this also holds true for coloring wood.



For color uniformity, author prestains walnut sapwood first, then overcoats entire panel with oil stain, wiping off excess with a lint-free, absorbent cloth.

And Still Champion: The Oil Stain

Oil stains have four main components: some variety of oil, a thinning solvent, a pigment, and a curing agent. The curing agent causes the oil to solidify in the presence of air. Ready-mixed oil stains contain more than 75 percent thinner, which permits easier application, better penetration, and also slower drying.

Most oil-stain manufacturers tell us to flood on the product, wait 10 or 15 or 30 minutes, and then wipe off whatever the wood hasn't absorbed. This approach puts fairly equal quantities on all parts, which doesn't even up the colors of the light and dark boards. To get more uniformity (and also waste less of the product), begin by applying stain carefully to the lighter areas that need it most. Then, treat the areas that need very little.

I apply stain with the grain, using a small brush or small rag and working from the lightest areas to the darkest. If I have a striking color discrepancy, as between heart- and sapwood, I'll outline the sapwood areas by brushing on a line of stain (*photo A*). Next, I'll fill in the light area, let it set up, and then overcoat the whole piece (*photo B*).

By following the grain patterns when you stain, you'll fool the eye more effectively. The unavoidable dark overlaps and strips where the passes didn't quite meet will resemble natural streaks in the wood—rather than the heavy-handed strokes of your favorite kindergartner. (See the lead photo *opposite*.)



Photo A: To pre-stain sapwood areas, first outline them with a small brush, then apply stain to the outlined area with broad brush or a rag.

Using Artist's Oils To Match Wood Colors

I recently built an eight-paneled door from red oak, using both pinkish heartwood and some noticeably yellower sapwood. My test samples showed that a single stain would not even up the color. So, I got out my tubes of oil colors to see if I couldn't split the difference. (See the photo at *right*).

For the pinkish areas, I wiped on a blend of ochre and raw sienna using a small, alcohol-dampened rag. This brought the color closer to that of the sapwood. I then applied some Indian red mixed with a bit of



burnt umber to the sapwood, which in turn brought it closer to the color of the (stained) heartwood. When I'd reached a more or less happy medium, I let the stains set up. Then, I washed all eight panels with the original walnut oil stain to tie them together.

When I've darkened all areas sufficiently and no unfilled pores wink back at me, the stain has done its job. I then wipe gently with the grain to remove the excess and allow it to dry.

Before you apply a particular stain to your project, you'll want to test it on some cutoffs from the same stock that have been sanded to the same grit. Oil stains, more than the other types, tend to fill the grain of the wood, which then refuses to take much (if any) more color if you don't get it dark enough on the first application.

Conversely, if your surface gets too dark on this first pass, you'll have a tough time sanding the color out, because oil stains clog abrasive papers almost instantly. If

you don't have any cutoffs to use for testing, experiment on a hidden surface of the project.

I Stained It My Way

For some projects, you won't find a ready-mixed stain that gives the perfect color. I often adjust a store-bought oil-based product by adding artist's oil colors from the squeeze tubes, which you can find at art-supply and crafts stores. I consider four colors indispensable: cadmium red, to warm up colors; black, which darkens and adds contrast; green, to subdue the reds and yellows; and burnt umber, which makes an excellent basic brown.

You don't really even need to buy stain. In fact, you'll get more for your money if you make it yourself by adding oil pigments to a clear finishing oil product (*photo C*). You can create the perfect color from scratch by adding pigments to transparent Waterlox. It absorbs well, dries fast, and cures hard with good clarity.



Photo B: After stain on walnut sapwood sets up, overcoat the entire surface to get a more uniformly dark color.

How To Stir Things Up

I start with a clear peanut butter jar, which lets me observe the color and check for any undissolved pigment. I squeeze out a half-inch of oil paint (or less, for minor color adjustments) onto the tip of a putty



Photo C: To make your own stain, start with a half-cup of clear oil finish (Waterlox in this example), then add small quantities of artist's oils to fine-tune the color.



Photo D: Using artist's oils to mix your own stains frees you from the limited selection of commercially prepared colors. You can even use intense primary colors like the cadmium red shown here.

knife and begin to stir it into a measured amount of clear Waterlox (usually a half-cup). When the paint has dispersed completely, a test patch goes onto my sample board and indicates whether more or different color is called for.

If you've gone overboard, add a measure of oil to thin the stain back to its proper color. As you work, keep track of the recipe, including the brands, colors, and lengths of pigments you've stirred in. (I record the formula on a strip of masking tape that goes onto the jar.) This way, you'll be able to duplicate the color any time you need it.

Mixing your own stains also frees you from the limited selection of storebought color choices. For modern designs or children's furniture, I've mixed intense primary colors like yellow, blue, and red into oil and created strikingly bright and unnatural-looking surfaces (*photo D*).

Solvent-Based Stains: They're Worth Trying

Solvent-based products consist of a finely ground aniline dye suspended in a fast-drying solvent such as lacquer thinner, paint thinner, alcohol, or a combination of these. They should by all rights be more popular than they are, because we woodworkers like to experiment, and solvent stains lend themselves to this practice. Also, these stains don't raise the grain nearly as much as water-based products usually do.



Photo E: Use a solvent-based jet-black stain for ebonizing. Here, author applies several coats of Behlen's to maple drawer pulls, scrubbing between coats with a purple Scotch-Brite pad.

Because the solvent evaporates and disappears rather than filling the grain like oil, you can get away with adding more or different color in the second coat. If the color gets too dark, I scrub some off using a purple Scotch-Brite pad and a bit of solvent. If that doesn't remove enough stain, you'll find that solvent stains sand more easily than oil stains after they've dried.

Solvent stains dry very quickly, which can make them a challenge to work with. To avoid streaks, you need to apply them swiftly but evenly. If your shop temperature creeps much above 75°F, you'll probably have trouble coating large surfaces uniformly.

I generally use Behlen's solvent-based stains for ebonizing maple and for other work that demands intense but transparent colors (*photo E*). To ebonize, apply several coats of a jet black, scrubbing between coats with a

purple Scotch-Brite pad. This will smooth the wood and even the color. To obtain the striking hue you see on the wagon wheels (*photo F*), I mixed some dark green into this same jet-black stain.

I usually fine-tune a ready-mixed solvent stain by adding universal colorants. One of my local paint stores sells these in tubes in a wide range of colors. If I can't make do with these colors, I'll talk the paint dealer into selling me some pigment out of that custom paint-tinting machine. Those formulated dollops of color



Photo F: For these wagon wheels, author mixed solvent-based stains (Behlen's dark green and jet black), which produced an intense but still transparent color.

they add to latex and oil paints will mix universally with oil, solvents, water, or alcohol.

Safety: An Ounce Of Prevention....

I apply both the oil stains (thinned with some form of paint thinner) and the solvent stains (lacquer thinner, methanol, etc.) in a well-ventilated area. When that's not possible, I wear a vapor mask. If you can't manage these precautions, it's time to consider stains suspended in water.

But, keep in mind as you use finishing products that it's not just the solvents that pose a hazard. A number of pigments and dyes can be allergenic and even toxic. Sanding these substances calls for a dust mask at the very minimum, and the new power respirators offer more serious protection.



Photo G: To apply water-based stains, use a foam brush, dampening just the tip and following the grain. Avoid overlapping, but use an alcohol-dampened rag to blend streaks where you do overlap.

Breathe Easier With Water-Based Stains

One way to reduce your exposure to toxic solvents is to switch over to the relatively new water-based products. They come in a wide range of colors, dry quickly, and usually sand with relative ease.

Before you apply water-based products, raising the grain with water and

resanding are critical. (For more about this technique, see my article on surface preparation in the July/August '95 *Woodworker's Journal*.) If you skip this step, you may end up with a rough surface that still requires some sanding—which will remove much of the stain.

Dry wood readily soaks up these stains, so I take extra care in applying them strictly with the grain, very evenly, and with as little overlap as possible. If you strive for perfection with water stains, however, you'll find yourself adding a dab here, a dab there, until the finish gets too dark.

My favorite technique for applying water-based stain is to swipe it on with 2" and 3" foam brushes. I barely dampen the first ¼" of the foam, then gently begin at one edge and follow the grain pattern to the other edge (*photo G*). Sometimes a dark stain will run out too quickly into thirsty wood, causing streaks. If this happens, I use a small rag dampened with alcohol to blend in the streaks and even up the color.

If the color comes out too light, repeat the application. Multiple thin coats make for a very rich and even stain. As with the solvent and oil stains, you can add universal colorant to these products to enrich and darken the hue. In addition, acrylic artist's paints and water colors will also blend into the water base. **VWV**

Photographs: By the author

SOURCES

The following suppliers carry at least one complete line of reputable staining products:

Constantine's
Telephone: 800/223-8087

Garrett Wade, Inc.
Telephone: 800/221-2942

Woodworker's Supply, Inc.
Telephone: 800/645-9292

The Troubleshooting Corner

Avoiding Compatibility Problems

Incompatibility of finishes ranks among the true poltergeists of woodworking: Will the clear coats on that beautiful desk peel from the stained surface like skin off an onion? Here, time favors the tortoise. Within a couple of days at room temperature (maybe a bit longer in the Humidity Belt), even the weirdest stain concoction will have dried to an inert state. If you make sure your stain is thoroughly dry before you apply the top coats, this will eliminate the great majority of incompatibility problems.

If you're still in doubt about next-coat adhesion, lightly scuff the surface with 320-grit paper or a purple Scotch-Brite pad to create invisible ridges for the next coat to grab onto. (If the sandpaper clogs immediately, it's telling you that the surface should dry for another 24 hours.)

Solvent Stains as Lifesaver

Every now and then, a project stained with an oil-based product comes out too light and refuses to absorb more color on subsequent coats. I give the oil stain at least 48 hours to dry, then scuff-sand it with a purple Scotch-Brite pad or 220-grit sandpaper. I follow this with a heavy wash of solvent-based stain one or more shades darker than the desired color. The change might not be huge, but it's usually enough to add the intensity

I want. I let that stain firm up for another 48 hours and then put on the top coats.

Beating the Blotches

We've already suggested several strategies for dealing with uneven stain absorption: raising the grain before final sanding, more thorough sanding in general, and applying stain more sparingly. If these precautions still don't cut it, try using a stain conditioner.

Finishing manufacturers such as J.E. Moser, Behlen's, and Minwax all sell these products. However, you can prepare a "home brew" in the shop that will serve the purpose adequately. For oil stains, which blotch most readily, use a 1-to-1 mixture of clear shellac (3-lb. cut) and denatured alcohol. Simply apply a thin, even coat before you stain. The conditioner prevents blotching by filling up the coarse-grained parts of the wood, which absorb more of it than the smoother, finer-grained parts. This preliminary coating prevents the coarser grain from absorbing too much stain.

Conditioners have their drawbacks, however. They even things up but limit the total amount of stain the wood can absorb, leaving you with a lighter color than you'd originally planned. To compensate, I go to the next darkest shade in the series of stains or add some additional pigment to the stain.

To make this bench both durable and good-looking, we chose birch plywood for the bench top, shelf, and drawer box; solid maple for the rails, edgings, drawer fronts, sides, and backs; and poplar for the legs. However, feel free to substitute other woods if you prefer.

For the drawer joints, we revived the pin-and-crescent joint. If you'd like to recreate this interesting joint for this or any other project, have a look at our Special Techniques article starting on *page 14*.

First, Cut the Legs and Rails

Step 1. From 1½"-thick hardwood, cut and plane four leg blanks to 1½x1½x26".

Step 2. Lay out and cut a ¾"-deep, 2¼"-wide notch across each leg to accept the lower rail. See the Exploded View and Front View drawings for notch locations.

Step 3. Cut a ⅛" chamfer along the four bottom edges of each leg.

Step 4. From ¾" hardwood, rip and crosscut two lower rails (B), two upper rails (C), two upper end rails (D), and two lower end rails (E) to size. (See the Bill of Materials.)

Assemble the Legs and Rails

Step 1. Using #8x1" flathead wood screws, attach an upper and lower end rail (D, E) to each pair of legs. Note: Counterbore the shank holes ¼" deep to accept ⅜" wooden plugs.

Step 2. Attach the upper and lower front and back rails (B, C) to the leg/end rail subassemblies.

Step 3. Using a ⅜" tapered plug cutter, cut enough plugs from matching scrapwood to fill all screw holes. Then, glue a plug in each exposed hole. After the glue has dried, sand the plugs flush.

Add the Shelf and Top

Step 1. From ¾" plywood, cut the shelf (F), top (G), and the top's stiffener (H) to size. Note: To determine shelf length, measure the distance between the legs, subtract ½", and cut it to that length. Also, since the stiffener fits between the end rail and

Give them their own **knee-high** **woodworking** bench



There's no better way to get your kids or grandkids interested in woodworking than to provide them with their own bench. Though our scaled-down design may be diminutive in size, the features we've built into it will stand shoulder to shoulder with those on most full-sized benches.

the vise block, you need to procure a vise and determine the size of the block (W). Measure the distance between the rail and block to determine the stiffener length.

Step 2. From hardwood stock, rip enough ½x¾" edging to cover the front edges (I, J) of the shelf and top.

Step 3. From the same stock, rip enough ¼x¾" edging to cover the ends (K, L) of the shelf and top. Glue and clamp all edgings in place, then sand and trim.

Step 4. Using a ¼"-radius round-over bit, rout the top front edge of

the top and shelf. Then, glue and screw the stiffener to the underside of the top.

Step 5. Lay out centerpoints for the bench-dog holes on the top where shown. Bore the ½" holes through the top and stiffener.

Step 6. From scrap, cut nineteen ¾x1x2½" glue blocks (M). Drill and countersink one ⅛" shank hole through each block. Then, glue the blocks to the rails where shown. Position the top, then attach it by driving screws through the blocks. Attach the shelf the same way.

Make the Back

Step 1. From $\frac{3}{4}$ " hardwood, rip and crosscut three back supports (N).

Step 2. Cut the back (O) to size. Using $\frac{5}{8}$ " panhead screws, attach the back to the supports.

Construct the Drawers

Our drawer dimensions assume a $14\frac{5}{8}$ " by $14\frac{1}{16}$ " case opening. However, since plywood thicknesses vary, measure the opening, then adjust the drawer height. (We made our three drawers identical, allowing $\frac{1}{8}$ " clearance at the top and bottom and along each side.)

If you decide to make the pin-and-crescent joints, turn to the Special Techniques article on *page 14*, and follow the instructions to size the drawer sides and locate the bottom grooves. If not, adjust the drawer dimensions to accommodate whatever joinery technique you use.

Step 1. Prepare $\frac{1}{2}$ "-thick hardwood stock, and cut six drawer fronts/back (P) and six drawer sides (Q) to size.

Step 2. Lay out and cut a $\frac{3}{4}$ "-radius finger hole in each drawer front, using either a bandsaw or a $\frac{1}{2}$ " Forstner bit.

Step 3. Cut the corner joints in each set of drawer parts. Then, rout or cut the $\frac{1}{4}$ "-deep grooves for the bottoms. Test-assemble one drawer and measure the inside, adding $\frac{1}{16}$ " to each dimension. Now, cut three drawer bottoms (R) to that size.

Step 4. Glue and assemble each set of drawer parts around a bottom. Clamp the drawers, and check them for squareness.

Step 5. Rout the $\frac{1}{4}$ "-deep slots into the drawer sides where shown on the Drawer drawing.

Step 6. Rout a $\frac{1}{8}$ "-radius round-over along all drawer edges except where indicated on the Drawer drawing. Then, finish-sand the drawers.

Construct the Drawer Case

Step 1. Rip enough $\frac{3}{4}$ " plywood for the case top, bottom, and sides to specified width.

Step 2. Rip 66 linear inches of $\frac{1}{8}$ "x $\frac{1}{16}$ " hardwood edging. Glue it to

BILL OF MATERIALS

BENCH

PART	T	W	L	MAT.	QTY.
A Legs	$1\frac{1}{2}$ "	$1\frac{1}{2}$ "	26"	H	4
B Lower rails	$\frac{3}{4}$ "	$2\frac{1}{4}$ "	$34\frac{1}{2}$ "	H	2
C Upper rails	$\frac{3}{4}$ "	3"	36"	H	2
D Upper end rails	$\frac{3}{4}$ "	3"	$14\frac{1}{2}$ "	H	2
E Lower end rails	$\frac{3}{4}$ "	$2\frac{1}{4}$ "	13"	H	2
F Shelf	$\frac{3}{4}$ "	14"	31"	BP	1
G Top	$\frac{3}{4}$ "	$17\frac{1}{2}$ "	$35\frac{1}{2}$ "	BP	1
H Stiffener*	$\frac{3}{4}$ "	$4\frac{1}{2}$ "	$33\frac{3}{4}$ "	PW	1
I Edging (shelf)	$\frac{1}{2}$ "	$\frac{3}{4}$ "	$31\frac{1}{2}$ "	H	1
J Edging (top)	$\frac{1}{2}$ "	$\frac{3}{4}$ "	36"	H	1
K End edging (shelf)	$\frac{1}{8}$ "	4"	14"	H	2
L End edging (top)	$\frac{1}{8}$ "	$\frac{3}{4}$ "	$17\frac{1}{2}$ "	H	2
M Glue blocks	$\frac{3}{8}$ "	1"	$2\frac{1}{2}$ "	H	19
N Back supports	$\frac{3}{4}$ "	$1\frac{1}{2}$ "	$19\frac{3}{4}$ "	H	3
O Back	$\frac{1}{8}$ "	16"	36"	PB	1

CASE AND DRAWERS

P Drawer fronts/back	$\frac{1}{2}$ "	$4\frac{3}{4}$ "	$14\frac{1}{2}$ "	H	6
Q Drawer sides**	$\frac{1}{2}$ "	$4\frac{3}{4}$ "	$13\frac{1}{2}$ "	H	6
R Drawer bottoms***	$\frac{1}{4}$ "	$13\frac{7}{8}$ "	$13\frac{1}{8}$ "	PW	3
S Case sides	$\frac{3}{4}$ "	$14\frac{3}{8}$ "	$16\frac{5}{16}$ "	BP	2
T Case top/bottom	$\frac{3}{4}$ "	$14\frac{3}{8}$ "	$14\frac{3}{4}$ "	BP	2
U Case back***	$\frac{1}{4}$ "	$15\frac{3}{8}$ "	$15\frac{9}{16}$ "	BP	1
V Slides	$\frac{1}{4}$ "	$\frac{3}{4}$ "	$13\frac{3}{8}$ "	H	6

VISE PARTS

W Vise block	To Fit Vise	H	1
X Vise face (fixed)	To Fit Vise	H	1
Y Vise face(movable)	To Fit Vise	H	1

* Length of stiffener will depend on vise used. Please read all instructions before cutting stock.

** See Special Techniques article on *page 14* for help with figuring drawer side lengths for pin-and-crescent joints.

*** Cut to size during construction.

MATERIALS LIST

H-hardwood
BP-birch plywood
PB-perforated hardboard
PW-plywood

SUPPLIES

#8x1", 1 $\frac{1}{4}$ ", 1 $\frac{1}{2}$ ", 2 $\frac{1}{4}$ " flathead wood screws; #6x $\frac{5}{8}$ " panhead screws; #6x $\frac{3}{4}$ " flathead wood screws; 1" brads; #20 biscuits; $\frac{1}{2}$ ", $\frac{7}{8}$ " dowel stock.

the edges of the plywood. Now, flush-trim the edging.

Step 3. Cut two case sides (S), a top (T), and a bottom (T) to finished length. Next, mark centerlines for #20 biscuit slots along the top and bottom edges of the sides and the mating ends of the case top and bottom. Cut the slots where marked.

Step 4. Test-assemble the case with the biscuits in place. If the fit is satisfactory, glue, assemble, and clamp the case. Check for squareness and adjust if needed.

Step 5. Round over all inside edges of the case front and also the right outside edge. Cut a $\frac{3}{8}$ "-wide rabbet $\frac{1}{4}$ " deep around the inside

back edge of the case to accept the back panel.

Step 6. From 1/4"-thick plywood, cut the case back (U) to fit the opening.

Fit and Install the Drawers

Step 1. Stack the drawers inside the case, then shim them in place with 1/8"-thick strips of hardboard.

Step 2. Determine the thickness of the drawer slides.

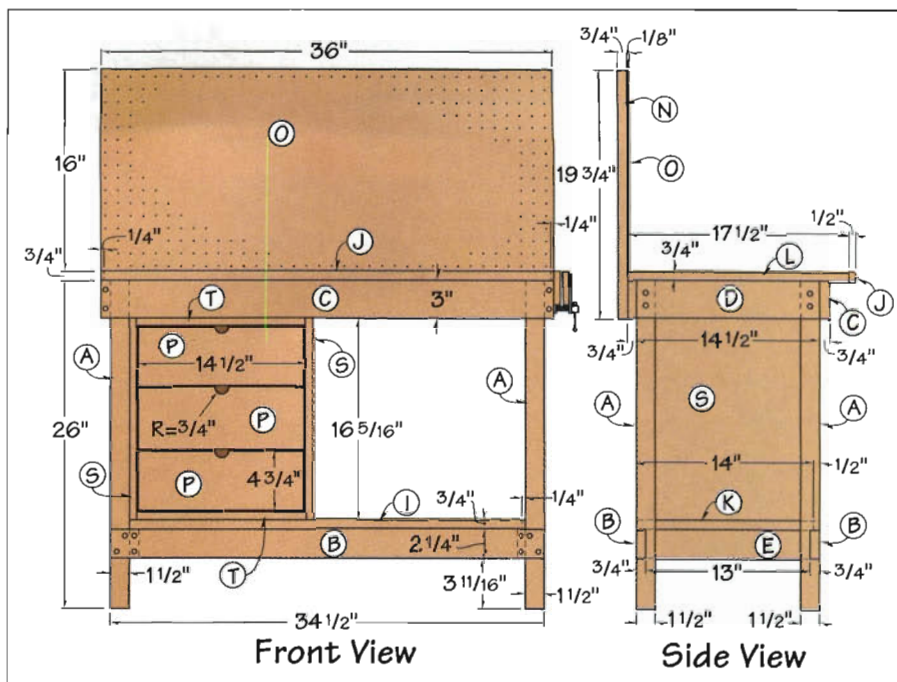
Step 3. Make six drawer slides (V). (We radiused the front end of the slide blank as shown in figure 1, then ripped the slides to 3/32" thick.) Note: You may want to cut a few extras in case the stock warps.

Step 4. Position the drawer slides. (We pushed the drawers against one side, then transferred the location of each drawer groove to the side panel.) If you've followed our plans exactly, the bottoms of the grooves should measure 2 3/16", 7 1/8", and 12" from the inside surface of the box bottom. Cut a pairs of spacers to match each dimension or to match the groove locations you just marked.

Step 5. Drill and countersink shank holes in the slides where shown on the detail that accompanies the Exploded View drawing.

Step 6. Using the paired spacers as guides, attach the three pairs of slides to the case walls.

Step 7. Insert the drawers into the box to test their action. If a drawer binds, use a scraper or sharp chisel and remove a little material from the slide. Also, apply paste wax to the



slides and grooves to reduce friction and improve the action.

Step 8. Install the case back using 1" brads.

Mount the Case and Vise

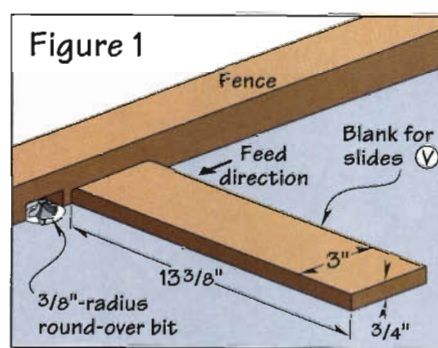
Step 1. Position the drawer case in the bench opening and drive four screws through the case bottom and into the shelf.

Step 2. Measure your vise and determine the vise block size. Cut the block (W) to this size, then mount it and the vise, following the manufacturer's instructions.

Step 3. Rip and crosscut the two vise faces (X, Y) to fit your vise.

Step 4. Bore a 1/2" hole into the top edge of the movable vise face to accept a bench dog. Notch the fixed-face blank to fit over the fixed jaw.

Step 5. From 7/8" and 1/2" dowel stock, make several bench dogs. (See the detail shown with the Exploded



View for dimensions. To create a good fit, buy an undersized 1/2" dowel, or chuck the dowel into your drill press and sand it to reduce its diameter.

It's Time To Apply Finish

Step 1. Finish-sand all parts, then vacuum or blow away the sanding dust. Next, apply your choice of finish. (We applied a clear, water-based polyurethane.) Let the finish dry, then buff with a synthetic wool pad.

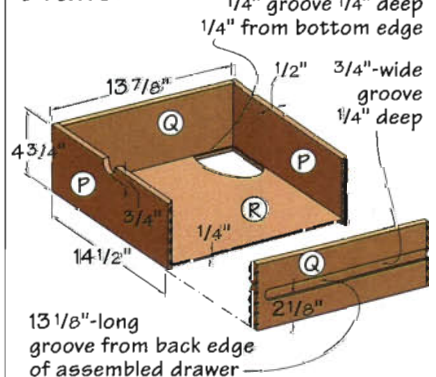
Step 2. Paint the perforated hardboard back and back supports with a gloss oil enamel. Screw this assembly to the bench using #8x1 1/2" flathead wood screws.

Step 3. Disassemble the vise, and attach the wooden faces to the jaws. Screw the fixed jaw to the bench, reassemble the vise, and finish mounting it. 

Design: Mark Ziobro, Dick Coers

Photos: Studio Alex

Drawer



Note: 1/8" round-overs on all edges after assembly except bottom inside and back edges of back (P)

PRO TIP

To center a 1/2" hole in the end of a 3/4" dowel, first clamp a piece of 2x4 to the drill-press table and bore a 3/4" hole 1/2" deep. Without moving the table or 2x4, remove the 3/4" bit and install a 1/2" bit. Place a 3/4" dowel in the hole, and bore a 1/2" hole in it.

ARTS AND CRAFTS TREE SEAT

Good designs don't go out of style, and this handsome hall tree proves the point. It will look as much at home in your entryway today as its predecessors did in turn-of-the-century households. Designer Cary Stage and craftsman Dick Coers have combined efforts to produce a piece in the austere, appealing style that challenged the Victorians' taste for ornate decoration. As a project, the seat's limited number of parts and straightforward construction make it almost foolproof to build.

Before You Start

We built our hall tree out of quartersawn oak, in keeping with the Arts and Crafts tradition established in this country by Gustav Stickley and others during the early years of the century. Oak, when sawn parallel to its medullary rays, reveals a striking pattern called *ray fleck*. The dense cells of these rays resist stain, while the larger, open pores of the surrounding wood readily soak it up. This creates the same dramatic flair that was so distinctive in the furniture crafted during that early era.



Distinctive quartersawn oak lends authenticity to this Arts and Crafts era reproduction, and biscuit joinery makes its construction thoroughly modern.

To simplify construction, we reinforced the joints with biscuits, which require a plate joiner. If you don't own a plate joiner, you can still construct the piece (without changing rail length) using dowels or loose tenons.

While not essential, the beveled-edge mirror and brass swivel hangers enhance the appearance of this piece considerably. So, we've asked the designer to supply both. (For mail-order information, see Sources on page 57.) We recommend that you have the mirror and hardware on hand before building the hall tree seat.

Because of the lid's weight, we installed a toy-box lid support. It keeps the lid from slamming shut, an important safety consideration, especially if there are small children around. (Again, see Sources for a mail-order supplier.)

First, Machine the Back Parts

Step 1. To make the middle and bottom rails (A), rip and crosscut two 5/4 (1 1/16"-thick S2S) blanks to 2 5/8 x 17". (We initially oversized these and certain other parts, then planed and cut them to final size during construction. See the Bill of Materials on page 28 for finished dimensions.)

Step 2. Plane and finish-sand both faces of the middle and bottom rails, along with your 5/4 stock for the back slats (D), to a 1" final thickness. Using double-faced tape, stack the two rail blanks face to face, aligning the edges and ends.

Builder's Notes

I have lately become a serious fan of Arts and Crafts furniture, as represented by this distinctive hall tree seat. With their strong lines and Far Eastern accents, these furniture pieces blend nicely with either traditional or contemporary decors.

I chose to construct the hall tree out of quartersawn red oak because of the subtle flash of its ray flecks. We chose a golden oak stain, which, on the quartersawn oak, produces what I call a "directional show." Light tends to glint off the ray flecks, so that a walk around the piece produces an interesting and ever-changing show.

—Dick Coers

Step 3. Mount a 3/4" dado head on your tablesaw and elevate it to cut 1 1/16" deep. Cut 14 dados spaced 1 1/32" apart across the edge of the stacked rail blanks where shown on the detail that accompanies the Exploded View. This will produce the slat spacing detailed on the Front View drawing. (See page 29.) Note: Handle these fragile parts carefully. (For help on dadoing the rails, see the Pro Tip below.)

Step 3. Using the same dado setup, make a slat thickness gauge. (We cut

a dado across one edge of a 3/4"-thick piece of scrapwood.) Set the gauge aside temporarily.

Step 4. From 1/4"-thick stock, cut four rail faces (B) to 2 5/8 x 17". (We resawed thicker stock on our band-saw, then planed it to this thickness.) Glue and clamp a rail face to each side of both rails, aligning the parts at the ends and along the dadoed edge of the rails (photo B). Note: To make invisible glue joints, apply glue sparingly to each finger of the dadoed rails, then clamp firmly

PRO TIP

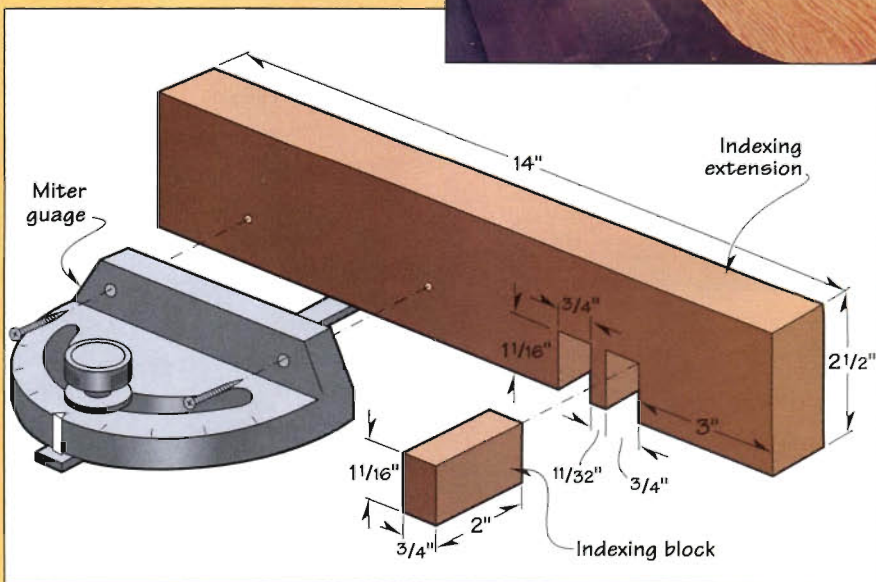
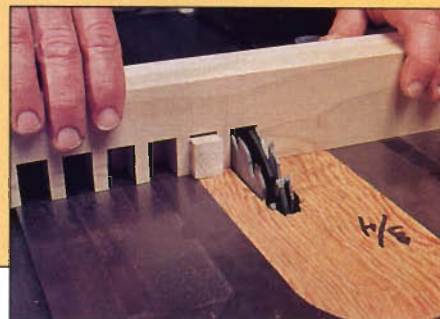
To cut uniformly spaced dados, we suggest making the miter-gauge indexing extension shown on the drawing below. These dimensions fit our tablesaw and miter gauge. If the dimensions of your saw differ, make sure you space the two dados 1 1/32" apart with the first one starting 3" from the end. Be precise on the 1 1/32" spacing—any deviation will affect the spacing of the back slats later. From scrapwood, cut a 3/4 x 1 1/16 x 2" indexing block.

Attach the indexing extension to the miter gauge. To do this accurately, place the extension's second dado over the dado head. Insert the miter gauge into the slot left of the blade, move it against the extension, and drive the screws. When attached, the extension

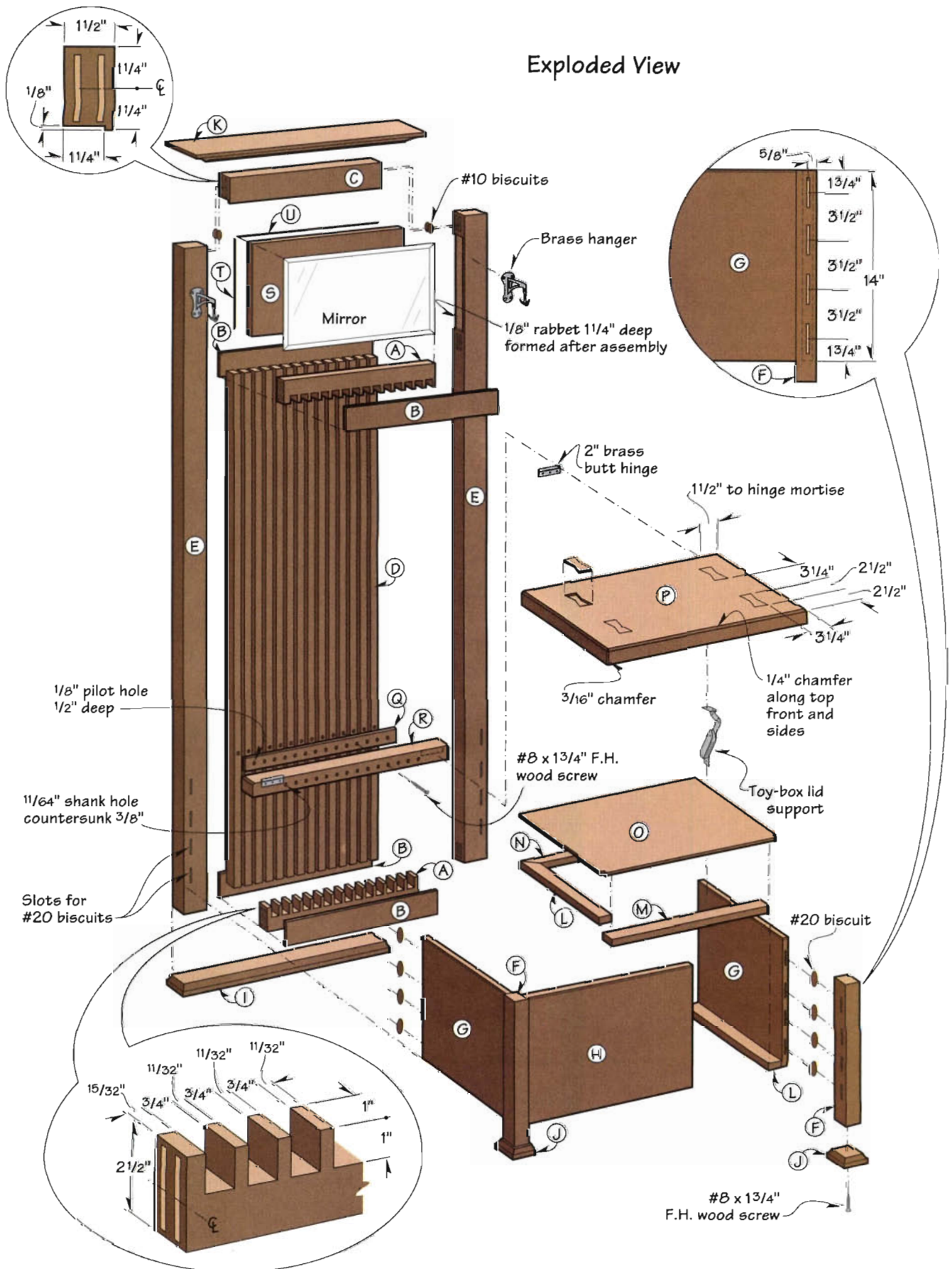
should move smoothly across the dado head.

To dado the two rail blanks, first cut a dado through the blanks 3/4" from the right end. Next, glue or tack the indexing block into the right-hand dado of the extension. Place the dado you just cut over the indexing block (photo A), then cut the next dado. Repeat this operation until you've cut 14 dados in both rails.

Photo A: An extension attached to the saw's miter gauge and fitted with an indexing block makes cutting equally spaced dados a cinch.

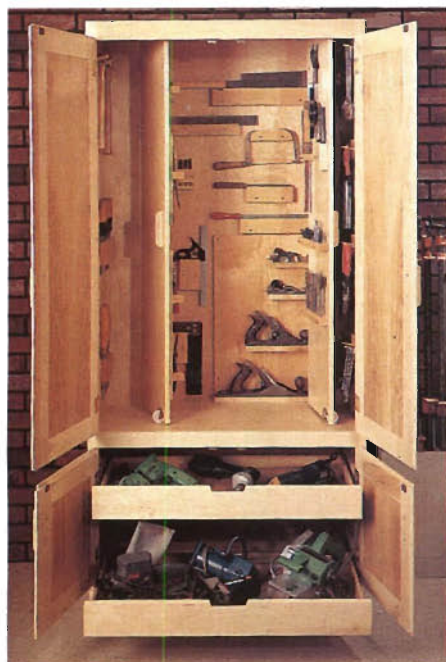


Exploded View



continued on page 28

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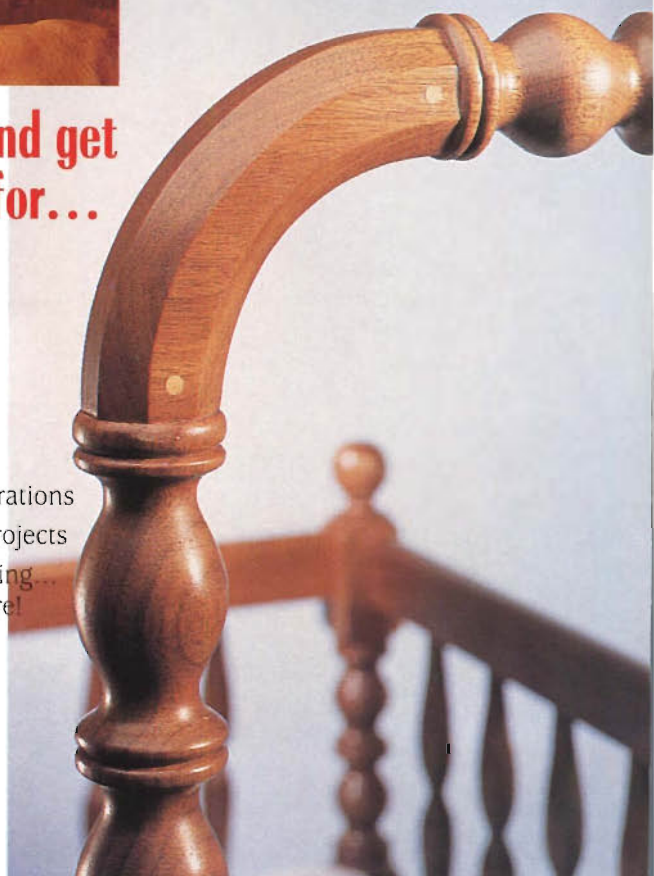
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Hall Tree Seat

Continued from page 26

using plenty of clamps and heavy clamp blocks.

Step 5. After the glue has dried, unclamp the rails and joint the dadoed edges square. Then, cutting the opposite edge, rip both assemblies to 2½" final width.

Step 6. To make the top rail (C), cut a piece of 1½"-thick stock to 27½"x17". Plane it to 2½" final width.

Step 7. Crosscut the three rails (A, C) to 15⅞" final length. Note: The middle and bottom rails must be trimmed from both ends for equal spacing between the ends and the first dadoes. To do this, mark the centerpoint between the seventh and eighth dadoes, measure 7⅝" in both directions, and crosscut at those points. (We set a stopblock before making the final cuts to ensure they would be cut to the same length.)

Step 8. Cut a 1¼"-wide rabbet ⅛" deep along the bottom edge of the top rail (C) and the top edge of the middle rail (A). (See the detail on the Exploded View drawing. We cut the rabbets in two passes on our tablesaw, making the shoulder cut with the stock lying facedown and the cheek cut with the stock standing on edge.)

Next, Prepare the Slats and Stiles

Step 1. To cut the 14 back slats (D), take the stock you planed and sanded to 1" thick earlier, and crosscut it to 54⅜" final length. Then, rip ⅜"-wide slats from it. Next, using the slat thickness gauge you made in Step 3, surface-plane the slats until they fit snugly in the dado on the gauge.

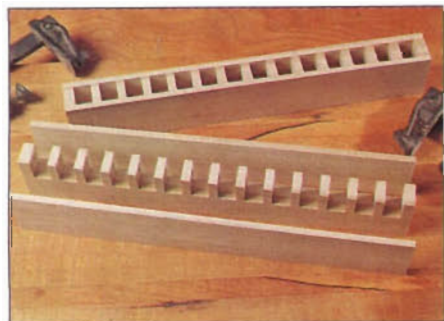


Photo B: Adding faces to the dadoed rails forms precise, uniformly spaced pockets for the slats to fit into. Gluing and clamping parts carefully will ensure invisible joints.

Step 2. From 1½"-thick stock, rip and crosscut two stiles (E) to finished dimensions. Now, carefully block-sand the rails, stiles, and back slats. After sanding all the flat surfaces, sand the edges just enough to break the hard edges.

Step 3. Because of the close spacing after assembly, you'll find it easier to prefinish the slats and the dadoed edges of the bottom and middle rails before assembling the back. (We applied an oil-based stain, let it set for 5 minutes, then wiped off the excess. After the stain had dried, we applied a coat of Pratt and Lambert Magnalac clear lacquer to the slats. If you use this precat-alyzed product, follow the application

directions and use an approved organic vapor respirator or supplied-air mask when spraying.)

Step 4. While the slats dry, lay out the slot centerlines on the ends of the three rails where shown on the Exploded View detail. (We located the center on the front face of each rail, then used a combination square to transfer the centerlines to the back face.)

Step 5. Set your plate joiner to the #10 biscuit setting, then slot-cut the rail ends, aligning the tool's centerline with the marked centerlines. (We placed each piece on a flat surface, cut one slot, then flipped it over to cut the second slot in the same end.) Note: The slots will break out around the rail rabbets, but these areas will be covered by the mirror.

BILL OF MATERIALS

HALL TREE SEAT

PART	T	W	L	MTL.	QTY.
A Rails*	1"	2½"	15⅞"	O	2
B Rail faces*	¼"	2½"	15⅞"	O	4
C Top rail*	1½"	2½"	15⅞"	O	1
D Slats*	1"	⅜"	54⅜"	O	14
E Stiles	1½"	2⅜"	69⅞"	O	2
F Posts	1½"	1½"	15½"	O	2
G Sides*	¾"	11½"	14"	OP	2
H Front*	¾"	17⅞"	14"	OP	1
I Rear foot	1"	21⅞"	21⅞"	O	1
J Front feet	1"	2¾"	2¾"	O	2
K Crown*	¾"	3"	23⅞"	O	1
L Cleats	⅝"	1"	11½"	O	2
M Front cleat	⅝"	1"	17⅞"	O	1
N Back cleat	⅝"	1"	18⅞"	O	1
O Bottom	¼"	12⅞"	19⅞"	OP	1
P Lid*	1½"	12⅞"	20⅞"	O	1
Q Spacer*	¼"	1½"	15⅞"	O	1
R Lid mount*	1½"	1¼"	20⅞"	O	1
S Back	¾"	16⅜"	10⅞"	OP	1
T Retainers*	¼"	¼"	10⅞"	O	2
U Retainers*	¼"	¼"	16⅜"	O	2

* Parts cut oversized initially, then trimmed to final size during construction. Please read all instructions before cutting.

MATERIALS LIST

O—oak
OP—oak plywood

SUPPLIES

#10 and #20 biscuits; 2—2x1½" brass butt hinges; 10x16" mirror; toy-box lid support; #8x1¼" flathead wood screws; #4x¾" brass flathead wood screws; 2—brass swivel hangers

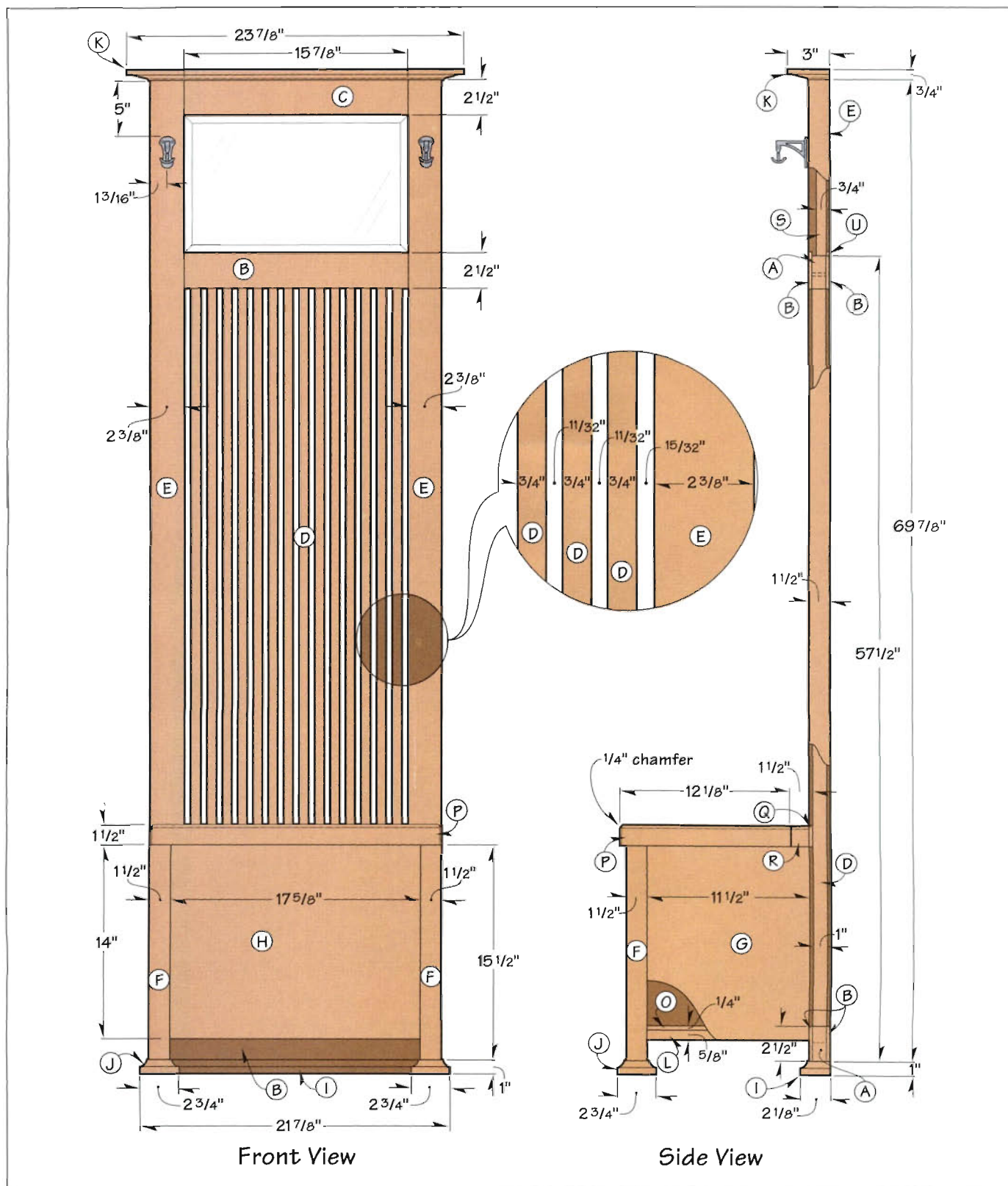
Next, Assemble the Back

Step 1. Insert—but do not glue—the slats into the dados in the bottom rail. Tap them until all have bottomed. Next, insert the slats into the middle rail. (This may be tough with snug-fitting slats. We started at one

end, angled the rail, and then inserted them one by one a short distance into the rail as we worked across. You may want to try pulling the slats up and into the middle rail.) When you've started all slats into the middle rail, squeeze the assembly together

with pipe clamps until it measures $57\frac{1}{2}"$ long overall on the back (rabbeted) side.

Step 2. Dry-assemble the stiles, slat assembly, and top rail front-face down. Align the parts, temporarily clamp them, and then transfer the



rabbet marks and slot centerlines from the rails to the stiles. Check that the back opening will accept the mirror. Separate the parts, then transfer the slot centerlines around to the inside edge of the stiles.

Step 3. Cut the biscuit slots in the inside edge of both stiles where marked. Cover the slots with masking tape, then stain these edges. (We used a fairly dry cloth to apply the stain.)

Step 4. Rout the rabbets in the stile edges where marked. (We formed the rabbets using a table-mounted router, a $\frac{1}{2}$ " straight bit, and a $\frac{3}{4}$ "-high fence. We made two passes, carefully cutting to the pencil lines. You could use a stop, but it would require a 70"-long fence.)

Step 5. Glue, assemble, and clamp the stiles, slat assembly, and top rail. (We brushed white glue into the slots, on the joint faces, and on the biscuits. Then, we inserted the biscuits, joined the pieces, and clamped.) Check the outside frame corners and mirror opening for squareness. If necessary, you can tap the top rail to square the opening, then belt-sand the top rail flush with the stile later.

Step 6. After the glue has dried, remove the clamps and sand all joints flush. Using a chisel, square the round rabbet ends.

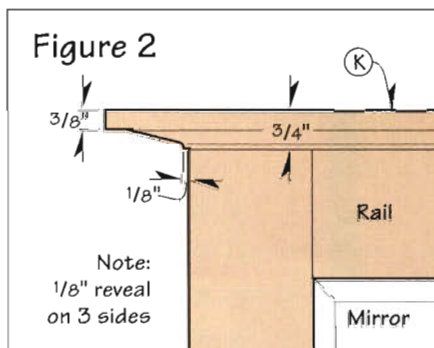
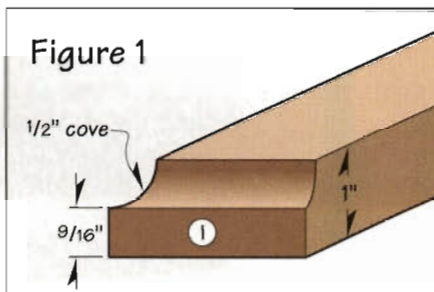
Now, Make the Seat Parts

Step 1. From $1\frac{1}{2}$ "-thick stock, rip and crosscut the two post blanks (F) to dimension.

Step 2. From $\frac{3}{4}$ " oak plywood, rip and crosscut two side panels (G) and one front panel (H) to dimension plus $\frac{1}{8}$ ". Note: We ran the grain vertically.

Step 3. Rip 42" of $\frac{1}{8} \times \frac{7}{8}$ " solid oak edge banding. Crosscut the banding to fit the top edges of the three plywood panels. Then, glue and clamp the edging to the panels. After the glue has dried, trim the edging flush with the panel faces. (We used a flush-trim bit in our small laminate-trimming router.) If you sand, make sure you don't cut through the veneer.

Step 4. Rip and crosscut the three panels to final size. Note: Saw the panels with their outside face up, and either bring the edge band into the blade first or use a backing block to avoid splintering it.



Step 5. Using dimensions shown on the Exploded View drawing, lay out centerlines for the biscuit slots on two adjacent surfaces of each front post. Note: The front and side panels are inset $\frac{1}{4}$ " from the face of the posts and stiles, so the slots must be cut an additional $\frac{1}{4}$ " in from the edge. Transfer the slot centerlines from the posts to the edges of the adjacent panels and to the front face of each stile.

Step 6. Set the plate joiner for #20 biscuits. Then, cut slots in the posts, in both edges of the panels, and in both stiles where marked.

Step 7. To make the seat lid, first cut enough $1\frac{1}{2}$ "-thick stock to edge-join a $14 \times 21\frac{1}{2}$ " blank. Edge-glue and clamp the pieces, aligning the ends. Set the lamination aside to dry.

Step 8. From 1"-thick stock, cut one rear foot (I) and two front feet (J) to the dimensions listed in the Bill of Materials. Using a $\frac{1}{2}$ "-radius cove bit in your table-mounted router, rout the cove as dimensioned in figure 1. On the rear foot, rout the ends, then the front edge only. Using the same setup, rout both ends and then both edges of the two front feet.

Step 9. To make the crown (K), first figure out final dimensions for the part. (See the Pro Tip at right.) To do this, fit your table-mounted router with a panel-raising bit that will create a profile on $\frac{3}{4}$ "-thick stock similar to the one shown in figure 2. (A Freud no. 99-215

or MLCS no. 8680 will work.) Next, cut the crown to final dimensions, then rout the ends and front edge.

Assemble the Seat Parts

Step 1. Glue, assemble, and clamp the front panel to the two posts. When dry, glue and clamp the side panels between the front assembly and stiles, and check for squareness.

Step 2. Glue and clamp the crown and rear foot to the back, centering both parts from side to side and aligning the back edges flush. Glue and screw the front feet to the posts, orienting the feet so the grain direction matches the grain of the rear foot.

Step 3. From $\frac{5}{8}$ "-thick stock, rip and crosscut the bottom support cleats (L, M, N) to fit where shown on the Exploded View drawing. Note: Miter-cut both ends of part N, and one end of both parts L. Glue and clamp the cleats in place.

Step 4. Measure the seat interior, then cut a plywood bottom (O) to fit. Notch the two front corners to fit around the front legs. Glue the bottom in place.

Step 5. Measure the width of the back, then trim the lid blank to this width. Finish-sand both faces and all edges. Rout a $\frac{3}{16}$ " chamfer along the

PRO TIP

The width of profile cut by your panel-raising bit determines the final size of the crown. To calculate the crown's width and length, set up the bit to rout the profile, and make a test cut on scrapwood. Measure the width of the cut.

To calculate the crown's length, measure the length of the top end (rail plus stiles), then add twice the width of the bit's cut plus $\frac{1}{4}$ " (to allow for a $\frac{1}{8}$ " reveal at both ends). To calculate the crown's width, add the width of the top rail to the width of the bit's cut, then add $\frac{1}{8}$ " for the reveal.

When working with large bits and narrow pieces, we suggest you start with a piece 2 or 3" wider for safer handling during the routing operation, then rip it to final width later.



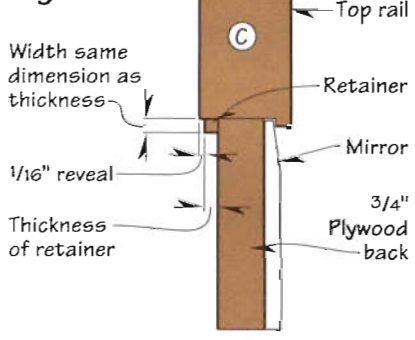
Photo C: Four inlaid maple butterfly keys enhance the appearance of the seat's lid.

two front corners and a $\frac{1}{4}$ " chamfer along the three top edges.

Step 6. Rip a $\frac{1}{4}$ "-thick strip from the back edge of the lid blank to use as the spacer (Q). Trim this strip to fit snugly between the stiles where shown on the Exploded View drawing, then place it in position.

Step 7. Joint the back edge of the lid, then rip the lid mount strip (R) to $1\frac{1}{16}$ " wide from that edge. Plane the sawn edge to make the piece $1\frac{1}{4}$ " wide. Place it against the spacer, aligning the top edge and ends, and scribe a faint aligning mark across the face of both pieces near the center. Remove both parts, then glue and clamp them, aligning the marks. Note: Use plenty of clamps to ensure an invisible joint.

Figure 3



Step 8. To attach the mount strip to the slats, first lay out, counterbore, and drill 14 shank holes on the front edge of the mount strip. (For help with this operation, see the Pro Tip below.) Next, space the slats evenly, and drill a pilot hole in each. Dry-assemble the mount strip to the slats (screws but no glue) to check the spacing, then disassemble for now.

Step 9. Rip the lid panel to $12\frac{1}{4}$ " wide, then joint and sand the sawn edge to a $12\frac{1}{8}$ " final width. Next, lay out and form the hinge mortises on the mount strip and lid. (We cut the hinge mortises to depth using our handheld router and mortising bit, then cleaned up the corners and edges with a sharp chisel.) Now, temporarily attach the hinges to both parts to check the action.

Step 10. Glue and screw the mount strip to the stiles and box sides. Use #8x $1\frac{1}{4}$ " flathead wood screws and a sparing amount of glue.

Add the Finishing Touches

Step 1. If you wish to add the inlaid butterfly keys to the seat lid (photo C), see the Special Techniques article on page 32 for detailed instructions. Use the full-sized pattern below as a template. To position the keys on the lid, see the Exploded View. (We made our keys from $\frac{3}{16}$ "-thick bird's-eye maple. This left them slightly proud so we could sand them flush with the lid's surface after installation.)

Step 2. To make the mirror back (S), first measure the rabbeted opening, then cut a piece of $\frac{3}{4}$ " oak plywood to fit. Note: The grain should run vertically. Place the mirror and back in the opening as shown in figure 3, then measure the depth of the inset. To determine the thickness of the retainer strips (T, U), subtract $\frac{1}{16}$ " from this depth (for reveal). Rip enough retainer stock to this thickness to fit the opening's four sides. Miter-cut the ends, then drill and countersink two holes in each strip. Set them aside.

Step 3. Temporarily install the hangers where dimensioned on the Front View. Then, remove them for now. Finish-sand all unfinished surfaces, then blow or vacuum off the sanding dust.

Step 4. If you've inlaid keys of maple or other light-colored woods, mix up an ounce of lacquer with and equal amount of lacquer thinner. Using a small artist's brush, apply

Continued on page 57

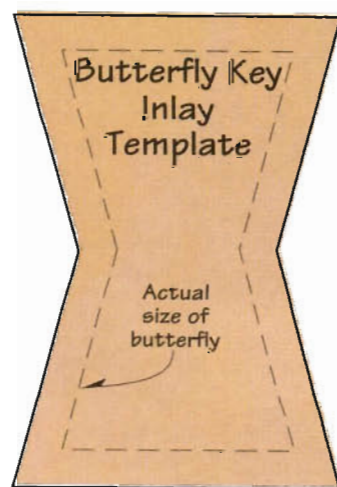
PRO TIP

Because the assembled slats are apt to be slightly bowed in the middle, don't try to establish hole centerpoints based on the slats' actual spacing at the point where they will attach to the mount strip. Instead, position and dry-clamp the mount strip against the slats at one end (where they join one of the rails), and mark an approximate centerpoint for each slat on the mount strip. (No need to find exact center here.) Using your drill press, counterbore and drill $\frac{1}{16}$ " shank holes in the mount strip at these points.

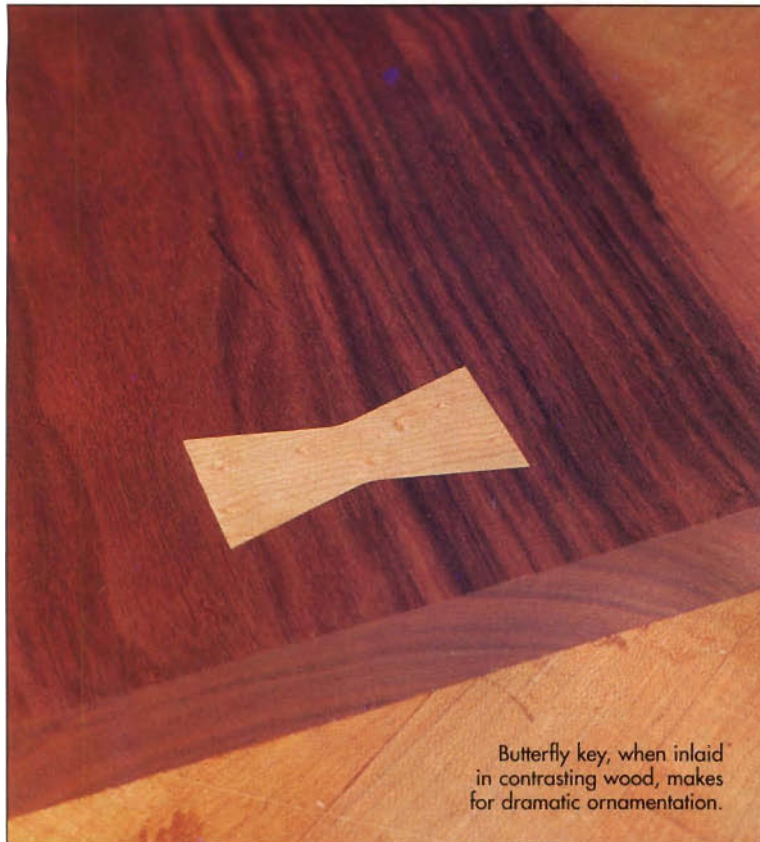
To drill pilot holes in the slats, first measure the slat spacing at the rail (again at one end or the other), then

cut two spacers—one to match the spacing between the stile and the outside slat, one equal to the spacing between the inside slats. (Our spacers measured $\frac{15}{32}$ " and $\frac{1}{32}$ " respectively.)

Dry-clamp the mount strip to the slats in its designated location. Using each shank hole as a guide, drill a $\frac{1}{8}$ " pilot hole $\frac{1}{2}$ " deep into each slat, holding the slat in position with the appropriate spacer. Start with one outside slot and then the other, working back and forth until you reach the two middle slats. Eyeball the remaining space, and split the difference among the last three slats.



Full-sized pattern



How to Make a Butterfly Inlay

Butterfly inlays or keys, as shown at left and as used on the Arts and Crafts hall tree seat featured on page 24, serve both a decorative and a structural purpose. Sometimes referred to as "double dovetails" or "bowties," they were used by early artisans to edge-join stock or were inlaid on a concealed face to hold a split together. Today, craftsmen use them primarily for ornamentation. The techniques described here, along with a bit of practice, should have you making precision butterfly inlays in a couple of hours.

What You'll Need

If you own a plunge router, you're already halfway there. You'll also need an inlay kit, for which we've listed a mail-order source at the end of the article.

If you own a number of guide bushings, don't bother with the inlay kit. Instead, use the following formula to select the right combination of bit and bushings: Start with a small-diameter straight bit, preferably $\frac{1}{8}$ " or $\frac{3}{16}$ "; choose a bushing that is not too much larger than the bit's diameter; calculate the second bushing's diameter by doubling the bit's diameter and adding the first bushing's diameter.

For example, if you started with a $\frac{1}{8}$ " straight bit and selected a $\frac{3}{8}$ "-O.D. small bushing, use a $\frac{5}{8}$ "-O.D. for the larger bushing. Use the $\frac{5}{8}$ " bushing to rout the socket, the $\frac{3}{8}$ " bushing to rout the inlay. Even if you've done this kind of inlaying before, by all means test your router setup and your technique on same-sized scrap stock

before you start routing your actual project stock.

Step 1. Prepare the Template

Lay out a template pattern centered on a $\frac{1}{4}$ x 10 x 16" blank of plywood, hardboard, or acrylic sheet (*photo A*). If this is your first attempt, we suggest you use the full-sized template pattern shown on *page 31*.

Step 2. Cut the Template Shape

Remove the interior waste. We cut ours by making plunge cuts with a sliding compound miter saw (*photo B*). Make the cuts as straight as you can, but don't worry about slight imperfections. They will be mirrored in both the key and socket, so they'll match. To properly orient the template and parts, mark an X at one end of the template. Then, always mark the same end of each socket and key so you can keep them oriented the same way.

Step 3. Rout Out the Socket

Lay out your butterfly locations. (If you're building the hall tree seat, see

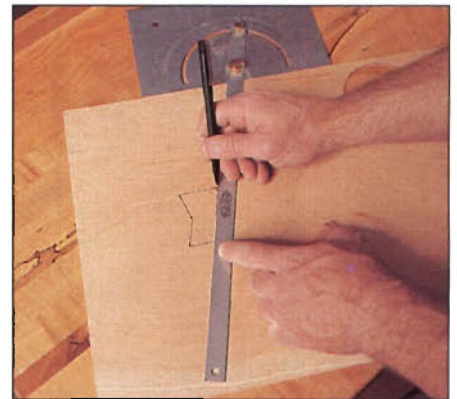


Photo A: Use the pattern or lay out your own template in the center of a large blank.



Photo B: Cut out the interior waste from the template. We cut ours by making plunge cuts with a sliding compound miter saw.

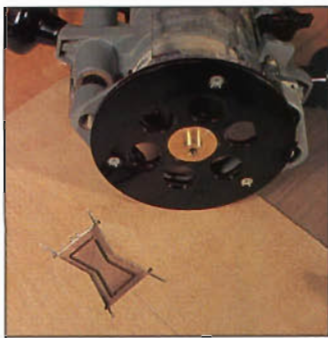


Photo C: To form the socket, first rout around the periphery of the template, then remove the waste.

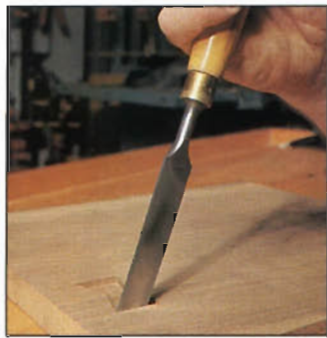


Photo D: Using a sharp chisel, square the radiused socket corners left by the router bit.



Photo E: To cut out keys, remove spacer ring from guide bushing, reset cutting depth, then rout.



Photo F: After gluing keys in sockets, carefully sand them flush with the surrounding surface.

the Exploded View drawing on *page 26* for butterfly locations on the seat lid.) Position and clamp the template at one of these locations.

Secure the bit in the collet. Next, screw the guide bushing to the router's base plate, and slip the brass spacer ring over the bushing's tip. Plunge the router down against the depth stop, and adjust to the desired socket depth. Note: On the kit we used, clearance between the bit and guide bushing limits the cutting depth to $\frac{5}{16}$ ". Since you want the keys to stand at least $\frac{1}{32}$ " proud of the face before sanding, stay at least $\frac{1}{16}$ " off maximum depth when routing the sockets.

Position the guide bushing in one corner of the template and against the wall. Turn on the router, and plunge it straight down into the workpiece. Then, rout clockwise around the template (*photo C*). After completing the circuit, stop, and lift out the router. Clean the chips out of the template, and check to make sure there were no chips packed in between the template and bushing that may have prevented the router from following the template. If this occurred, rerout the affected area.

Next, rout out the socket waste. If you miss any small islands of wood, remove them with a chisel. Before you unclamp the template, mark the end of the socket bottom to correspond with the template mark. Rout the remaining sockets using the same procedure.

Step 4. Square the Corners

Using a sharp chisel, square the corners of each socket. If you used a small-diameter bit, you'll have very little material to remove, so be careful not to overcut the corner.

Cut the crossgrain side first. Rest the flat of the chisel against the router-cut shoulder to guide it (*photo D*). Angle the chisel slightly, then cut as you rock it to vertical. You may want to pencil-mark the corners to define exactly where they intersect before attempting to clean out the waste.

Step 5. Cut the Keys to Shape

Plane your key stock to final thickness, adding $\frac{1}{32}$ " to the socket depth so the keys will protrude slightly from the surrounding face. Lay down a piece of scrap to protect your bench top, then clamp the scrap, key stock, and template to the bench. Remove the spacer ring from the guide bushing, and set the cutting depth on the router to cut through the key stock.

A word of caution: Cutting keys is the most critical step—any variance will spoil the part. Keep track of the bit's position on the template so you'll know when to make directional changes. Be careful to maintain uniform pressure against the template as you rout. When you reach a point where the angle changes, remember to shift directional pressure. Also, keep the router oriented in the same direction; don't rotate it in relation to the template.

To cut out a key, position the router in the far left corner with the guide bushing hard against the template and the handles parallel to you. Start the router, plunge to full depth, and then slowly rout clockwise around the template and back to the starting point. Now, stop the router and lift it from the cut.

Mark the key (*photo E*), then remove and inspect it. If you find a burr at the final breakout point, remove it carefully with a sharp chisel.

Cut the rest of the keys the same way, making a few extras just in case.

Step 6. Install Keys In the Sockets

Resist any urge to test the keys in a socket. They'll fit snugly, and once inserted, they're almost impossible to remove. If the keys appear to be slightly too large for the sockets, or if you're working with a soft wood, file a slight chamfer along the bottom edges of each key to make insertion easier.

Apply a thin, uniform coat of glue to the socket bottom. Orient the key properly with respect to the socket, then insert and gently push the key home. Tap it with a hardwood block and hammer to seat it properly.

Let the glue dry, then sand the keys flush with the surrounding face (*photo F*). Use a medium-grade sandpaper and large sanding block to avoid gouging, then finish-sand the area with a random-orbit sander. 

Photographs: Kevin May

Technical assistance: Dick Coers

SOURCES

Inlay Kit. Includes brass template guide bushing, retainer ring, snap-on spacer ring, and $\frac{1}{8}$ " down-cut spiral bit. Catalog no. 880-2K. Price: \$29.90 plus s/h. Order from:

CMT Tools
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Note: Similar kits can be purchased from other mail-order suppliers.

At a major-league crafts show in Columbus, Steve Malavolta stands out because he's having too much fun. Other exhibitors look uneasy because merchandise is moving sluggishly today, but not "the puzzle guy," as his colleagues know him. After 17 years of these shows, Malavolta no longer gets bent out of shape over a slow day.

The puzzle guy has continually refined his puzzles, which continue to attract those show-goers who seek out the slightly bizarre. Malavolta's booth delights them twice. The imaginative impact of his work first catches their eye from a distance. Then, on closer inspection, they discover that these are also finely wrought toys. Even Steve's most elaborate pieces function as fully operable jigsaw puzzles. (See photos at right and the article on *page 36*.)

I envy Malavolta's way of life. But how, I have to wonder, do self-employed artisans like the puzzle guy get by in the office-park culture of the '90s? How do they handle health care without a corporate umbrella? How do they keep up with profit-gobbling overhead? And how do they survive those IRS regs that plague the one-person business?

Over the phone, Steve gives me another earful about his health insurance costs, about the heavy hit he's taking on travel expenses, about his labyrinthine taxes. He can't talk long because he's weeks behind on production for the San Francisco show. I offer once again to trade livelihoods with him. Once again, he declines.

Malavolta looks like nobody's idea of a shrewd businessman. He drives a vintage Harley Davidson and lives among free-roaming iguanas and exotic birds in what you might call an adobe terrarium in Albuquerque. He looks a bit sun-blasted from years of snowboarding and ski-patrolling on Sandia Peak. He looks...like he's having fun.

And yet, in an unforgiving arena, the puzzle business has supported a family, paid for a home (much cozier, actually, than a terrarium), and enabled Malavolta to build and appoint his own studio. One reason is that Steve has freshened his line of designs each season, which keeps wholesale customers coming back. He's also made an art of streamlining puzzle production.

Traditional businessman or not, Steve Malavolta has gotten by for 17 years making beautiful things with his hands. We should all be so shrewd. We should all have so much fun. 

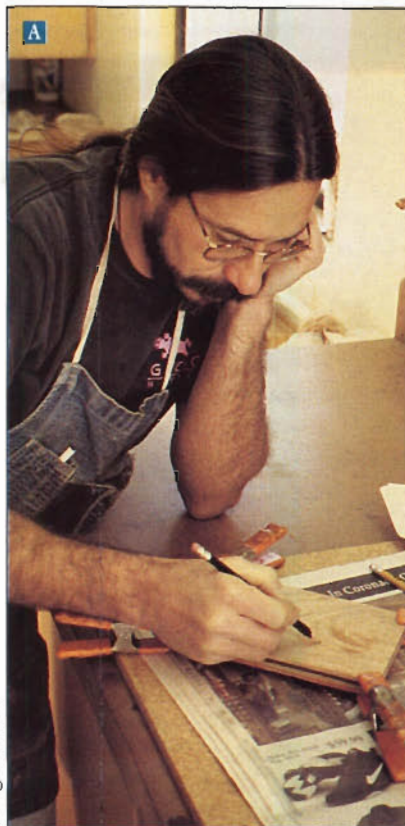
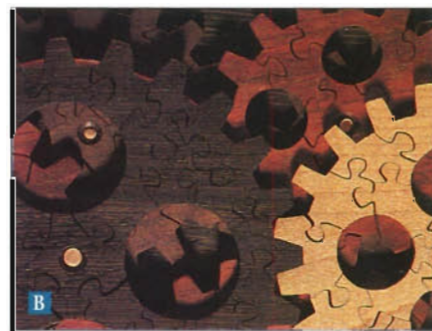


Photo A: Malavolta lays out a multilayered "canyonscape" in his Albuquerque studio.

Photo B: Detail of *Time Piece*. Three-layer puzzle, 400 pieces, wenge, cherry, padauk, maple.

Photo C: *Pyramid*. Seventeen-layer puzzle, 900 pieces, wenge, bird's-eye maple.

Photo D: *Four-Corner Circle*. Four-layer puzzle, 350 pieces, wenge, imbuia, maple, sterling silver, turquoise.



Steve Malavolta

The
Puzzle
Guy Has
Fun
Getting
By

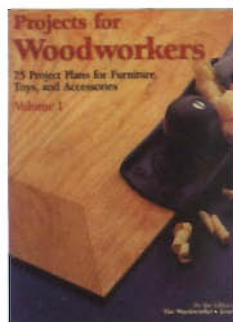
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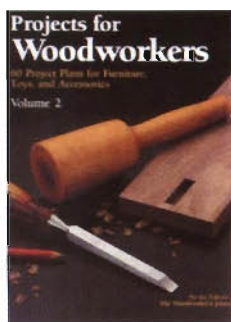
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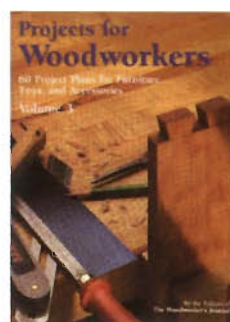
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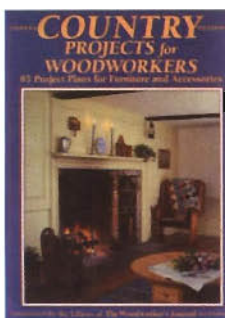
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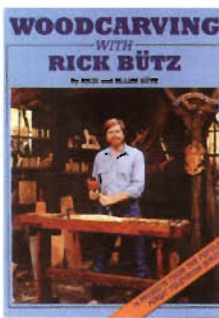
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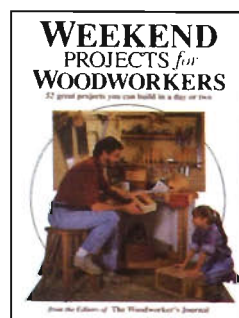
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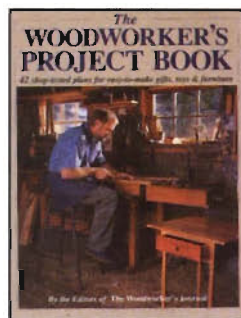
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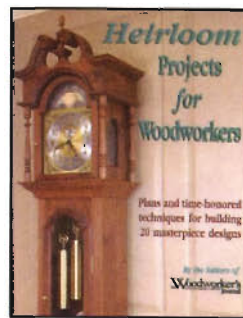
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Puzzling Art

by Steve Malavolta



One canyonscape, two versions: Rising moon (left) combines (top to bottom) birch, walnut, bloodwood, holly, and cocobolo with malachite planet and sterling silver stars; for setting sun (right), author used wenge, cherry, cocobolo, bloodwood, and arariba.

On the arts-and-crafts show circuit, those who don't know Steve Malavolta by name refer to him simply as "the puzzle guy." There are others out there who make and sell puzzles, but none whose colorful wares (and personality) have become quite the institution that Steve's have. Here, the puzzle guy describes the ins and outs of making his multilayered "canyonscape."

—the Editors

It all started 17 Christmases ago during the traditional gift-making, when I made my nephew a stand-up serpent puzzle. Today, at 19, he's still asking for a percentage of my income, and he still gets confused when I send him my electric bills.

Anyway, this puzzle thing stuck in my head. At the time, I was making dulcimers and doing guitar repair, and life offered an ample amount of spare time. I'd also gotten pretty adept at inlay work and had heaps of 1/8" stock lying around the shop. So, I cut out a dozen puzzles that consisted

of nothing more than nicely figured woods sawn into poorly defined pieces, framed and backed with contrasting woods. I sent them off to a crafts show with a friend, and the response was terrific. The puzzle guy was born, and life has never offered ample spare time since.

Today's puzzles have become much more refined. I feel they have heirloom potential, although they're definitely intended to be played with. We'll start off here with a fairly simple canyonscape that consists of three layers and about 60 pieces.

Choosing and Surfacing Your Stock

I hand-pick all of my woods for consistency of grain as well as color and figuration. Most of it I buy as 4/4 or thicker stock, in the rough-sawn state whenever possible. This sometimes makes it tough to see just what you're getting, but a pocket knife used as a scraper can help uncover the true color and figure.

I look for dry and check-free lumber. Since I resaw down to much thinner slabs, the dryer and more stable the better. For fragile puzzle pieces, dense and consistent grain is a must. Woods like oak and alder are too porous or soft and can become flimsy in these thicknesses. Arariba, cocobolo, bird's-eye maple, and walnut, to name a few, offer consistency of grain, vibrant colors, and good figuration.

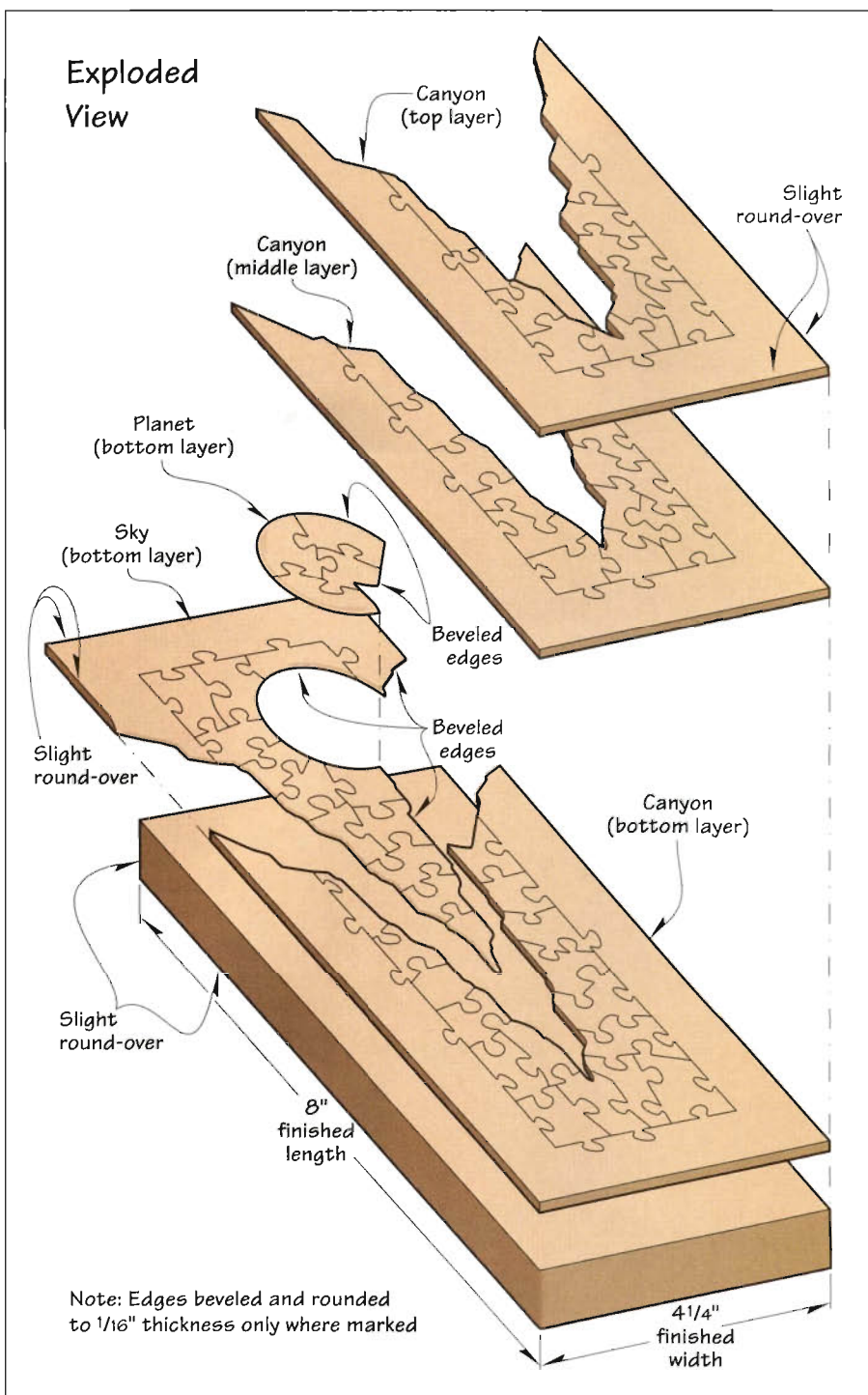
Resaw and then surface your stock to $\frac{5}{32}$ ". You can use either a thickness sander or planer, although if you try to plane material this thin, you're liable to have chipping problems. To avoid this, adhere it to a flat piece of thicker stock before running it through the planer. As another alternative, you can also purchase many woods in prefinished thicknesses from hardwood suppliers.

Tuning Your Scrollsaw

You'll need to use very fine blades, which can't handle a lot of stress. To minimize blade stress, first check for parallel stroke. As you view the blade from the front, the top and bottom points of clamping should align vertically. As the blade moves up and down, it should remain perpendicular to the table and not move from side to side.

On most older scrollsaws, you can adjust the stroke using the large nut on the back of the frame. Newer scrollsaws usually don't allow such adjustment, and you may find it necessary to add shims or clamps at the blade hold-downs.

When sawing puzzle pieces, keep a close eye on your blade tension. A blade that is too tight will break prematurely, and a slack blade will bevel the cut, which will prevent the sawn pieces from detaching freely from



one another. Once you've found the correct tension for the machine and blade you're using, pluck the blade like a guitar string. If you make a regular practice of this, you'll learn to recognize the pitch that tells you you've reached proper tension.

I also remove all blade guides and hold-down mechanisms from the machine. Guides cause friction, which can heat up the blade and shorten its life. Hold-down mechanisms not only block your view of the

cut but also get in the way when you want to maneuver the wood quickly.

Laying Out the Design

With a tuned scrollsaw and surfaced stock at hand, you're ready to begin layout. (See the Exploded View drawing above.) For the canyon, start by cutting four $5 \times 8\frac{1}{2}$ " pieces of contrasting stock. (The limitations of your equipment will determine whether you can effectively cut

four stacked pieces at a time. You may have to go with just three.)

You'll want to choose woods that have a lot of figuration to help create a dramatic canyonscene. Save your most highly figured stock for the sky,

unless you're interested in a night scene. Use a wood for the planet that contrasts abruptly with the sky. To enhance the illusion of depth, alternate light and dark woods on the canyon layers. Note: The canyon

design requires that the grain run vertically in all layers.

Stack and align the four layers (*photo A*). Tack them in each corner with a small amount of quick-set epoxy, then spring-clamp them until the epoxy cures. This will keep the woods fixed in position while you make the inlay cuts.

Lay out the landscape on the face of the stacked pieces as shown on the Bottom Layer pattern at *left*. Install a no. 2 blade in the scrollsaw, and cut along the lines (*photo B*). I find that a 20-tpi skip-tooth blade works best. You'll now have four identical pieces of wood for each section drawn (four skies, four planets, four canyons). Next, interchange the sections until you have four landscapes, each consisting of three different woods (*photo C*).

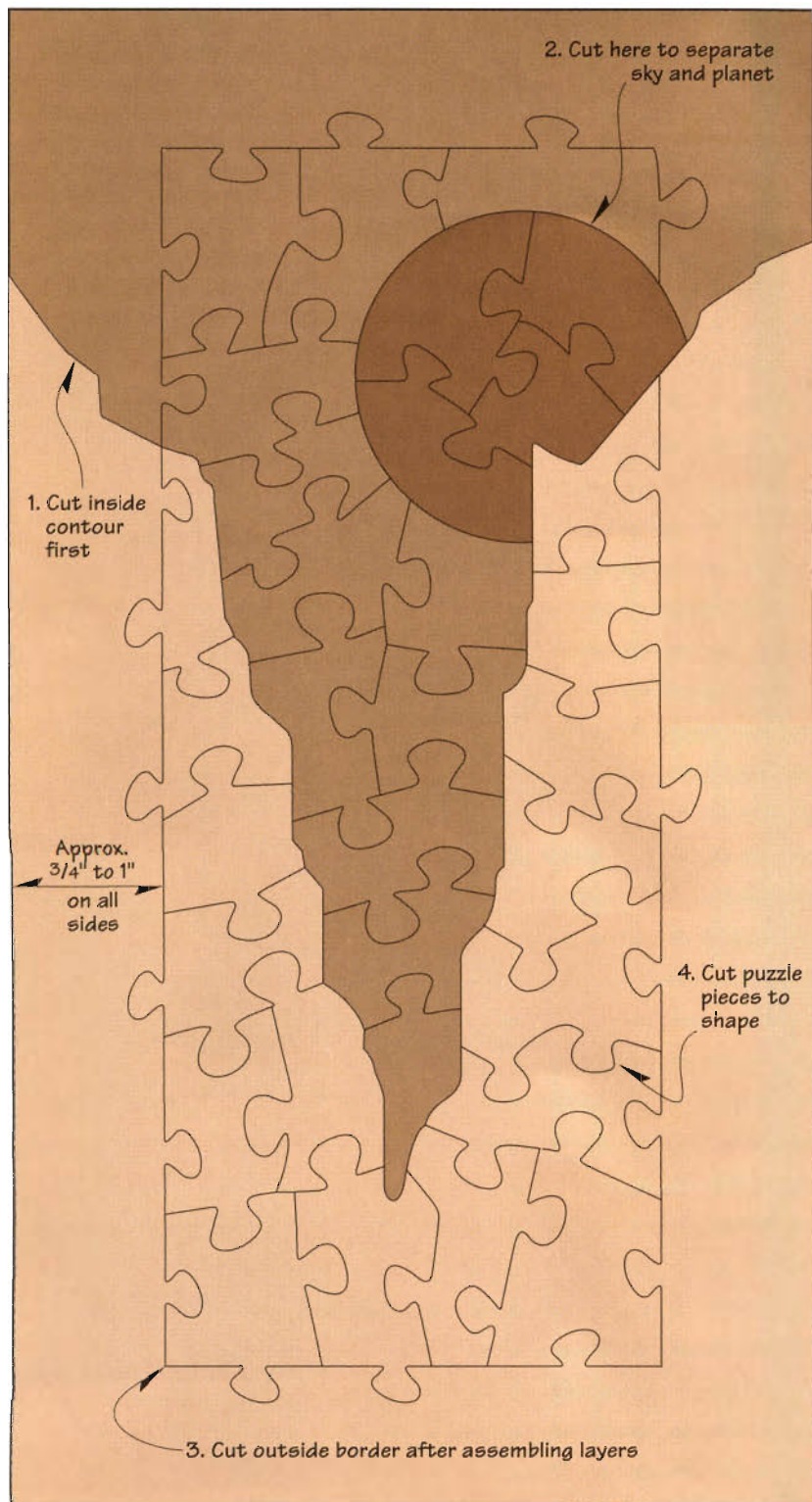
Next, bevel the edges of the sky and planet sections to add depth to the puzzle. To do this, I work on the idler pulley of a stationary belt sander (*photo D*). Using a 120-grit belt, I hold the section at a slight (15°) angle and sand a bevel just shy of half the stock's thickness (approximately $\frac{1}{16}$ ").

To soften and smooth out this bevel, I use a pneumatic bag sander with a 220-grit sleeve that is burnished along one half its width (*photo E*). This lets me sand to an even finer grit without changing sleeves. The pneumatic bag sander gives a hand finish in a fraction of the time, although hand-sanding will also do the job.

To layer the puzzle, first cut two more blanks equal in width and length to the canyon section of the original layout. Next, lightly trace the outline of one of these canyon sections onto one of the new blanks (*photo F*). Now, draw a new canyon contour that is slightly lower in height but generally wider across. (Do this freehand, or follow the Middle and Top Layer patterns shown on *pages 40 and 41*.) Add a few irregularities, even overlapping the bottom layer at a couple of points. Then, scrollsaw to shape. This will become the middle layer of the puzzle.

Repeat this step on the last blank, using your new middle layer as the template for the top layer. (Or, follow

Bottom Layer



Full-sized pattern



Photo A: To create the bottom puzzle layer, select four contrasting woods, then align and stack them using a drop of epoxy at each corner.



Photo B: Transfer the landscape pattern to the face of the stacked pieces, then scroll saw the sky, planet, and canyon sections to shape.



Photo C: Separate the stacked pieces, then sort and interchange them to form four landscapes, each consisting of three contrasting pieces.



Photo D: Using the roller on a stationary belt sander, bevel the interior edges of the sky and planet sections.

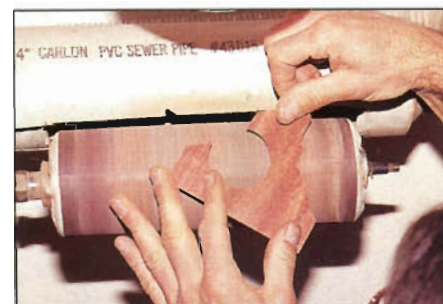


Photo E: Soften the beveled edges using a pneumatic bag sander with a 220-grit sleeve. Hand-sanding also works fine but takes longer.

the Top Layer pattern.) Next, soften the inside edges of the canyon contours on the three layers using 220-grit sandpaper (*photo G*). Apply a small bead of wood glue along the outside edges of the three canyon layers, then clamp them. Glued together, they should resemble the receding contours of a canyon (*photo H*).

Next, draw a border approximately 1" from the outside edge of the top layer. (See the Bottom Layer pattern.) This will serve as a guide for cutting the inner (puzzle) sections free and creating the outer frame. Now, using the same blade you used for the inlay cutting, scrollsaw along the line, adding alternate lobes and sockets every $\frac{3}{4}$ " or so (or follow the Bottom Layer pattern).

Sawing the Puzzle Pieces

For me, piece-cutting is a spontaneous, freehand action. After 17 years, I no longer need to predraw the pieces. But I do recommend predrawing if you've never cut puzzle pieces before. As you draw, let the odd shape of each puzzle section influence the shapes of your pieces. Also, try to plan several pieces ahead of the one that you're drawing. Or, if you'd like, just follow the patterns to "piece out" the top, middle, and bottom layers.

You need to make at least one lobe or socket on each side of a piece. About every five pieces or so, I try to lock two adjacent pieces into one side of a third single piece. This helps bond the pieces in groups, which takes up some of the slack that is compounded by the kerf of the blade from cut to cut.

You'll want to switch to an ultra-fine blade for piece-cutting. (I use a no. 00 skip-tooth blade with 28 tpi.) A blade of this size leaves you with a much tighter-fitting puzzle, but because of its fragility, it will effectively cut only a single layer at a time.

First, draw that same border 1" in from the outside edge of the sky area (where shown on the Bottom Layer pattern), then draw your pieces. As you cut them out, lay the pieces on a piece of newsprint. You can usually cut four to eight pieces before you



Photo F: To lay out middle and top canyon layers, either follow the patterns, or trace the outline of the preceding layer onto contrasting stock, then draw a slightly lower and wider contour (outside the traced line).

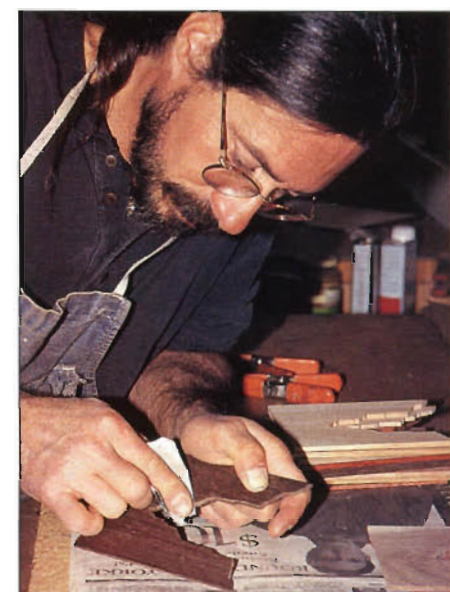


Photo G: Soften canyon contour edges on all three layers by hand using 220-grit paper.

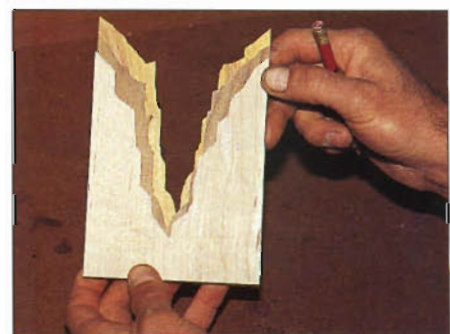


Photo H: Assembled canyon layers should resemble the irregular, receding contours of a real canyon.

run into what I call a "dead end"—a place from which you can no longer move forward, and where backing up would only risk damaging the puzzle. When you reach a dead end, remove all loose pieces, and start again with a new outside cut. (If you try to back-track along a loose piece with the

Adding Ornamentation: *Sterling Stars and Malachite Moons*

If it suits the wood, I add highlight work to the sky section using silver and semiprecious stones. I use sterling wire for stars in a night sky and a domed stone to represent a distant moon or planet. (See photo at *right* and also lead photo.)

Add stars and moons after cutting the stacked bottom-layer sections to shape and separating the layers. For variety, I use two different gauges of silver wire. Simply drill through your material, dip a short length of the wire in quick-set epoxy, and insert it into the hole, leaving excess on both faces of the stock. Later, when the glue has dried, sand the ends of the wire flush.

For the moons, use $\frac{3}{16}$ "-diameter domes (half-spheres) of malachite, turquoise, or other stones. To mount them,

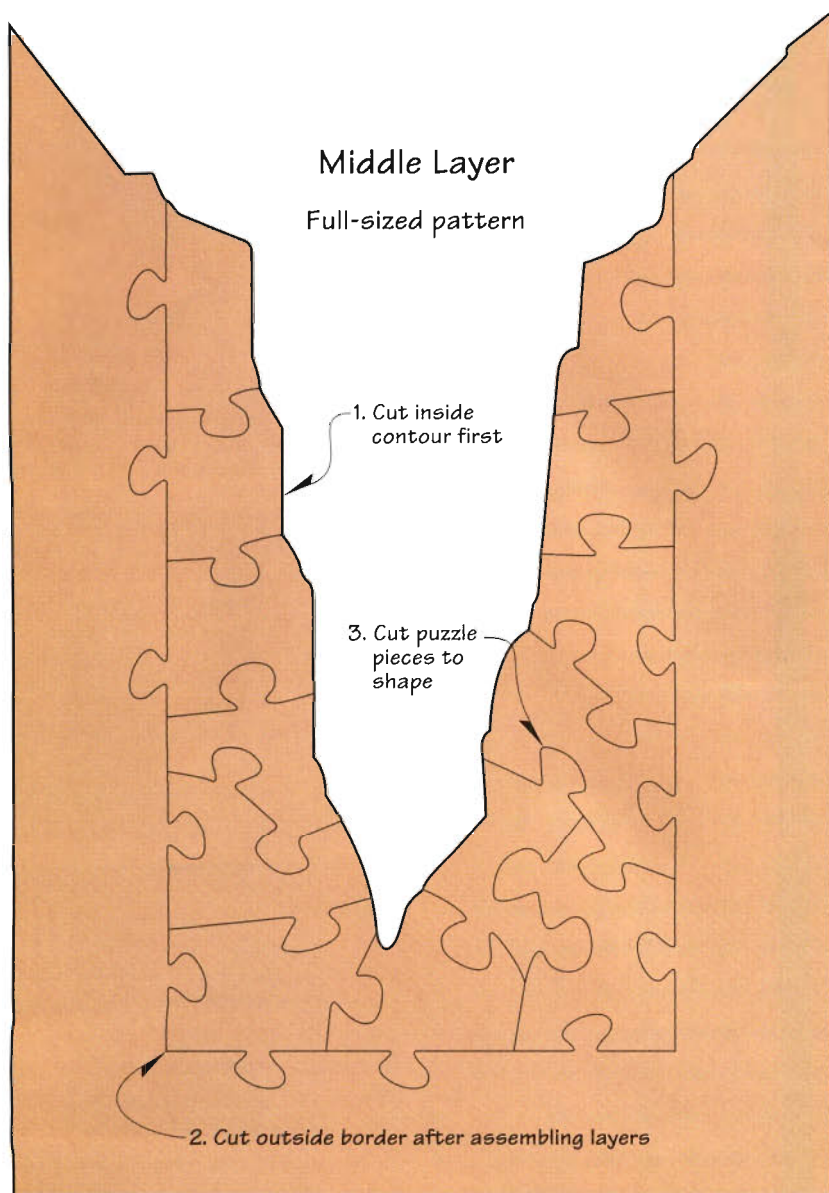


To add stars to a night sky, as shown on this eight-layer, 1,500-piece landscape, use a couple of different gauges of sterling silver wire.

first drill a countersink in one of the sky pieces, stopping the depth $\frac{1}{16}$ " shy of the bottom. Next, use a Dremel or similar tool with a round burr to "dish out" the countersink, flattening the bottom in the process. Mount the stone using a drop of quick-set epoxy.

Middle Layer

Full-sized pattern



machine running, it's easy to bind up and break pieces.)

Placing the pieces on paper not only keeps the puzzle together, it also makes for an easy transport to the next step. You'll notice that, by cutting all the sky pieces, you've also created the upper frame section. Now, cut up the three layers of inner canyon sections into pieces, sawing each layer individually so as to produce a different puzzle. Lay all of the layers on the same sheet of newsprint.

Finishing Your Puzzle(s)

Hand-sand both faces of each layer of pieces with 220-grit or finer paper to remove pencil marks and scroll-saw burr. Then transfer each layer to a manila folder by overlapping the newsprint and carefully sliding the layer over.

After sanding, buff a shine using 0000 steel wool. To do the backside of the pieces, simply butt the puzzle up to the seam of the folder, close the folder, apply some pressure, and flip it over (*photo I*). After this, I slide the puzzle pieces and frame sections into a sandwich screen I've devised (*photo J*) and blow out any dust with compressed air. Slide the pieces back onto the newsprint, remove the frame from the sky section, and place it with the lower frame.

The pieces are now ready for oiling, but for now, let's work on the frame. Cut a $\frac{4}{4}$ piece of backing wood slightly larger than the puzzle.

(I prefer using alder.) Lay a bead of wood glue along the outside back edges of both the upper and lower frames. Fit them together as you spring-clamp them to your backing wood (*photo K*).

Once the glue has dried, trim the backed frame on your table- or radial-arm saw. Then, sand the backing to 220-grit, softening all corners and edges. Finally, do a bit of steelwooling to even the finish on the frame pieces.

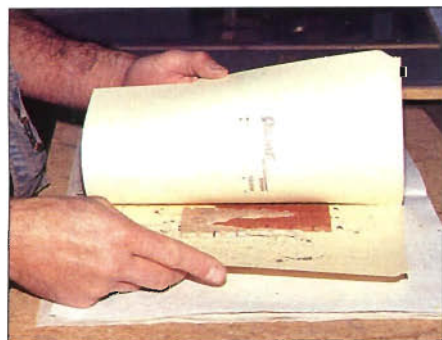


Photo I: For convenient handling of puzzle layers during finishing, use a manila folder to move and flip assembled pieces.



Photo J: After finish-sanding, blow dust off pieces using compressed air and a hinged sandwich screen.



Photo K: Glue and clamp frame sections to backing, then square and trim using table- or radial-arm saw.

To preserve your puzzles I suggest a clear oil finish. Make sure it's thin enough that it won't gum up between the pieces, causing them to stick together after it's dried. Start with a coat of Watco Natural or other Danish oil finish, brushing it on lightly. Just before it starts to get tacky, wipe off the excess with a soft, absorbent rag.

After the oiled pieces have dried for 24 hours, hand-rub them with tung oil. Using another manila folder, you can flip the pieces and repeat this process on the opposite face. I oil the frame at the same time to keep the penetration times fairly equal; this helps ensure consistent finishes. After another 24 hours of drying, slide the pieces, a section at a time,

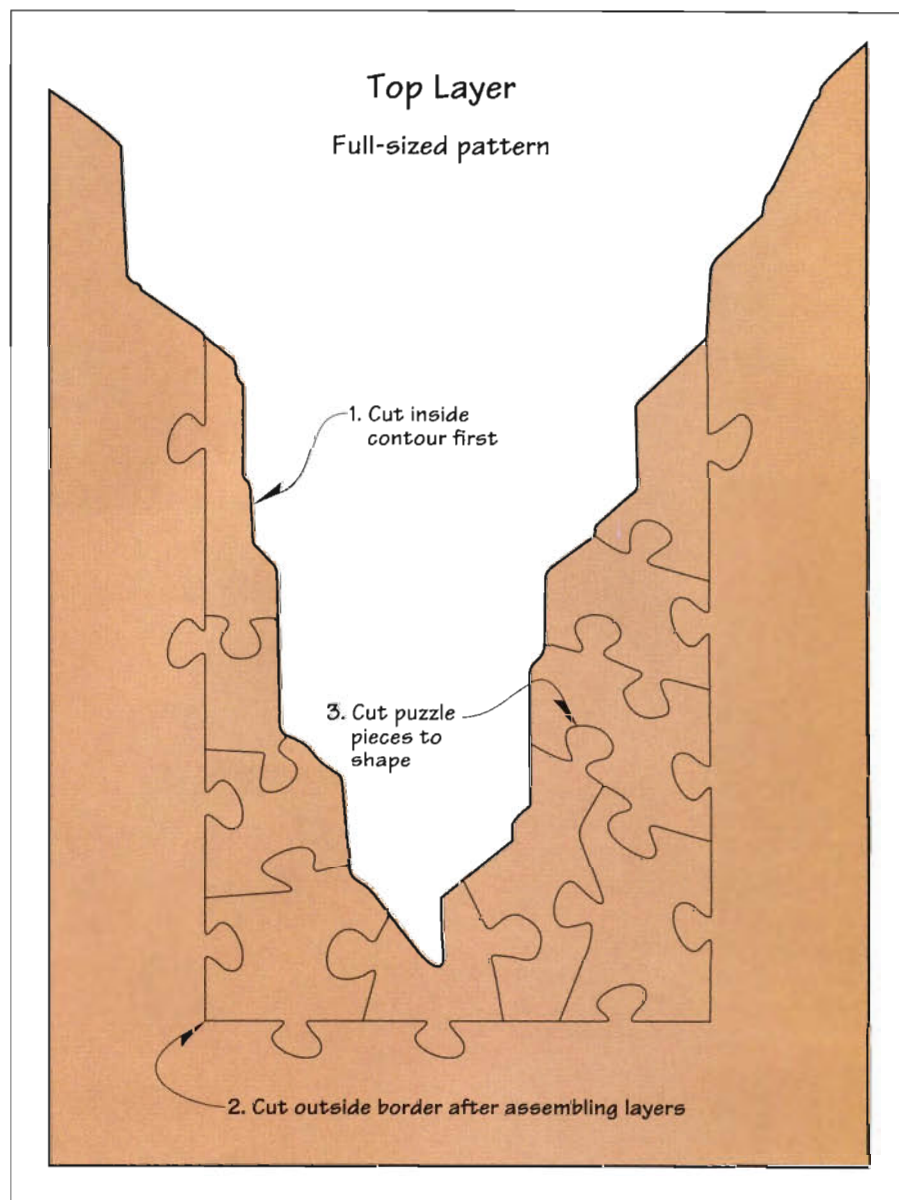
into the frame, starting with the bottom layer and working upward.

Now, after you've gone to so much trouble to keep all the pieces in order, dump them out on the table. Because the tops and bottoms of the pieces are indistinguishable, you'll find these puzzles more challenging than you expected. You don't have any straight-edged pieces to help you get started, either. What you do get (that you don't get with a cardboard puzzle) is the tactile pleasure—handling beautiful, smoothly finished hardwoods is always a nice experience. 

Steve Malavolta skis, makes puzzles, and accepts commissions in Albuquerque, N.M.

Lead photo: Lynxwiler Photography

Other photos: Cheryle Finlayson



Crafted in cherry

Bevel-Edged

LONG MIRROR

by David F. Peters

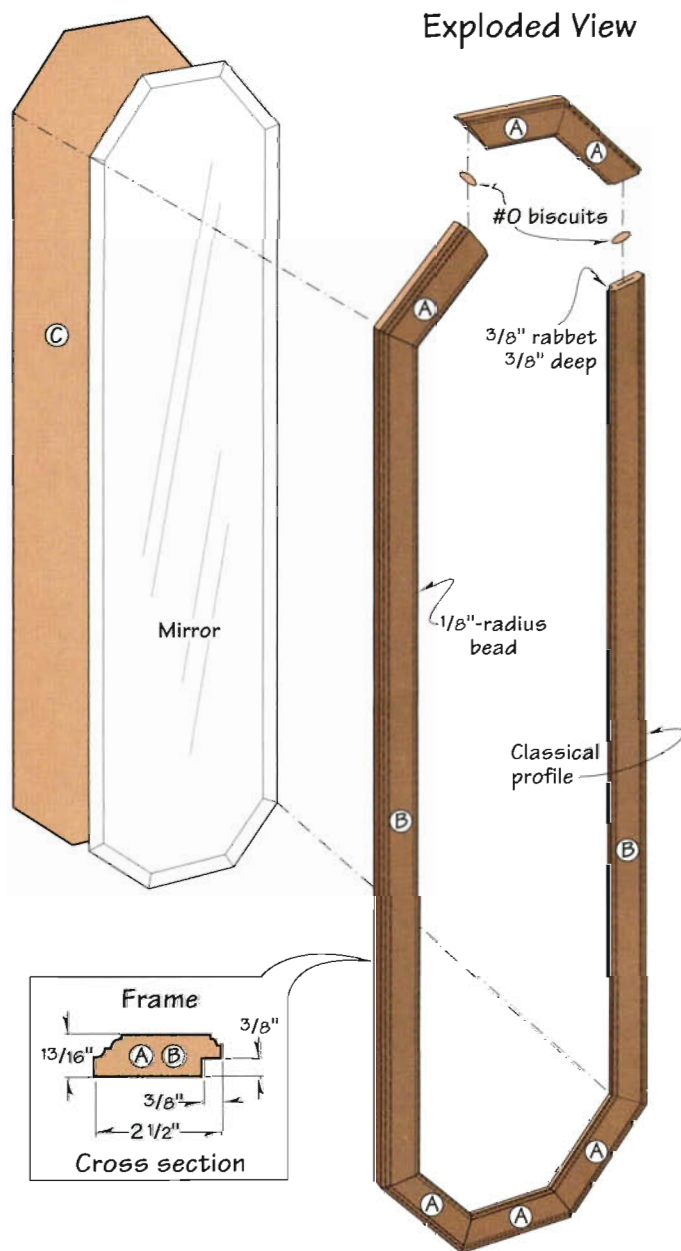
Nothing changes the character of a room like adding a mirror. A small space suddenly seems larger; a dull wall takes on new depth and added light. If you've been looking for a handsome wall mirror, consider this classic designed by Reedsburg, Wisconsin woodworker Cary Stage.

Before You Start

This mirror will go together in a weekend, although we suggest, as with most hardware, that you procure the glass and check its dimensions before cutting any stock. Since you're liable to run into some serious time and expense having the mirror prepared at a local glass shop, Cary has agreed to supply it at a reasonable price. (See the Source at the end of the article.)

We chose cherry for our frame, but you might find that a different wood will better complement your other furnishings. Walnut and figured maple come to mind as appealing alternatives. We assembled the frame sections using #0 biscuits. If you don't own a plate joiner, consider joining the sections with splines instead.





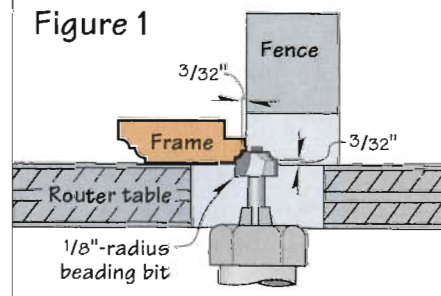
Builder's Notes

For the sake of appearance, I laid out the stock so the grain would continue around the frame. The simplest way to do this would be to start with a long board and cut the long and short frame pieces from it in sequence. However, my available stock was short. I studied it carefully, and found that by cutting the long sides from two pieces and the six short sections from two additional pieces, I could get the grain continuity I wanted.

When you miter-cut the parts, accuracy is critical. The length of the sides will help a little to compensate for slight inaccuracies, but a design this simple requires precision to look good. Also, take care in centering the biscuit slots on the mitered ends; you don't have much room for error. If need be, you can allow the slots to break out into the rabbet. They won't cause any problem there, and you can chisel away the exposed portion of the biscuits.

—Dick Coers

Figure 1



Prepare the Stock, Then Mold the Edges

Step 1. Start with 1"-thick stock and plane it to $\frac{1}{8}$ " thick. (You need approximately 12 linear feet of stock, of which two pieces must be at least 46" long and six must be 8" long.) Rip the stock into $2\frac{3}{4}$ "-wide strips, then rip and joint both edges to $2\frac{1}{2}$ " final width.

Step 2. Lay out your $2\frac{1}{2}$ "-wide strips to produce the most attractive grain pattern. (See the Exploded View for parts orientation.) Mark the pieces, then cut a $\frac{3}{8}$ " rabbet $\frac{3}{8}$ " deep along the

inside back edge of each strip. (We cut the rabbet in two steps using our table-saw, although a router and rabbeting bit would also work for this.)

Note: To mold decorative edges like ours, you'll need a $\frac{1}{8}$ " round-over bit for the inside edge and a classical bit for the outside profile. (See the detail accompanying the Exploded View.) Don't worry if your classical bit doesn't exactly match the profile we show; most classical bits will produce an attractively molded edge. However, do check the bit's cutting height against

your $\frac{1}{8}$ " stock, and check its overall cutting radius to make sure that the frame will still be wide enough after routing to accept #0 biscuits.

Step 3. Rout a bead along the inside edge (front face) of your frame stock. To do this, remove the guide bearing from a $\frac{1}{8}$ " round-over bit, and mount the bit in your table-mounted router. Then, set the fence and bit to form the bead as dimensioned in figure 1.

Step 4. Rout the front outside edge of your frame blanks. To make this cut, secure a classical bit in your router, then position the bit as shown

BILL OF MATERIALS

LONG MIRROR

PART	T	W	L	MAT.	QTY.
A Ends*	13/16"	2 1/2"	6 27/32"	C	6
B Sides*	13/16"	2 1/2"	44 7/8"	C	2
C Back*	1/8"	12 1/4"	50 3/16"	HB	1

*Parts cut to final length during construction.
Please read all instructions before cutting.

MATERIALS KEY

C=cherry

HB=hardboard

SUPPLIES

1/4"-thick beveled mirror,
#0 biscuits, glazier's points



Photo A: Use the slotting jig to ensure accurate slots on mitered ends of frame parts

in figure 2. Hold the stock against the bearing to rout it, using the fence for safe starting. (We made two shallow passes to rough out the cut, then finished with a very light cut to clean up any roughness or burn marks.)

Step 5. Miter-cut the frame parts at 22 1/2° to the lengths dimensioned on the Front View drawing *opposite*. (We used a power-miter saw equipped with stopblocks to produce uniform lengths.) Ease the blade through the stock to produce accurate cuts with minimal chipping of the profiled edges. Note: If you have leftover stock, cut one or two additional pieces to use for testing the slots and profile later.

Note: You need two stop settings—one for the 6 27/32" length of the six short sections (A) and a second for the two 44 7/8"-long sections (B). If

you can't set up your miter saw or tablesaw miter fence with stops, cut one short and one long section, then use these pieces as a pattern and cut the remaining sections to match them. When cutting, remove the pencil mark but don't try to hit it perfectly with the first cut. Instead, take short, partial chops until you reach the line, then make the through cut.

Next, Prepare the Frames For Assembly

Step 1. Dry-assemble the frame sections using masking tape to hold them together. Test-fit the mirror in the rabbet. (It should have about 1/8" clearance all around.) Remove the mirror, then flip the frame over and inspect the miter joints for gaps. Make any slight adjustment needed for a better-fitting joint. When you're satisfied with the assembly, number the parts lightly at each joint so you can reassemble the frame in the same order later.

Step 2. To cut the slots for the #0 biscuits, make the jig shown on the Slotting Jig drawing *opposite*. The jig will hold each piece firmly in place, and the stops will ensure that you cut each slot in exactly the same position on the frame ends.

Step 3. Set your plate joiner to the #0 biscuit cutting depth, then test-cut slots in the mitered ends of one of your cutoffs (or a same-sized scrap piece) to check the accuracy of the jig and establish stop positions. As shown on the detail accompanying the Slotting Jig drawing, the centerline of our slot measured 1 7/16" from the outside edge of the frame (measured

along the mitered edge) and 5/16" from the top surface.

Note: Make sure the slots don't break through either frame edge. Don't worry if the slot breaks out slightly into the rabbet. When you're satisfied with the slot position in the test piece, attach the jig stops to guide the plate joiner.

Step 4. Slot the mitered ends of each frame piece. We cut all of the slots on one end (*photo A*), then switched to the opposite side of the jig and cut the slots on the opposite ends. Note: Before cutting each slot, check to see that you have the part faceup and clamped firmly in the jig.

Step 5. Dry-assemble the frame with the biscuits in place to verify that everything fits together correctly. The biscuits should fit somewhat loosely; you won't get good joints if the biscuits hold the miters open. To thin swollen biscuits, either sand them or strike them with a hammer.

Now, Glue and Assemble the Frame

Step 1. Assemble and glue up the three short frame sections (A) for each end separately. Note: With accurately cut miters, an old-fashioned "rub" joint works well and eliminates the need for complicated clamping cauls. To do this, brush glue on the mitered faces and into the slots of two adjoining pieces and on both faces of one biscuit. Working quickly, insert the biscuit into one of the slots, press the two pieces together on a flat, smooth surface, and rub them from side-to-side to force out air and excess

Figure 2

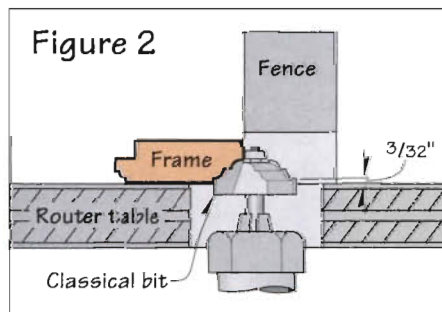
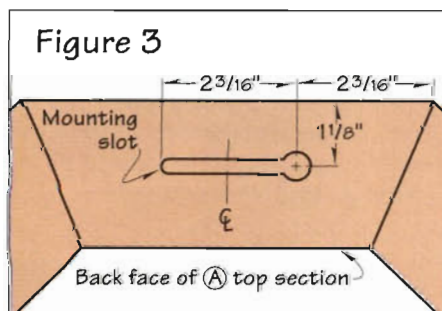
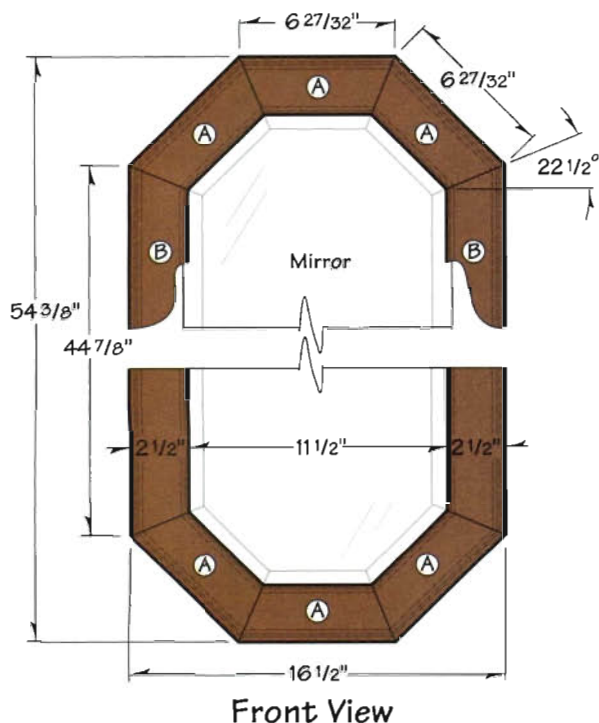
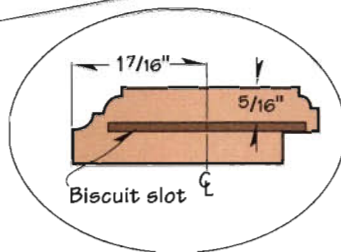
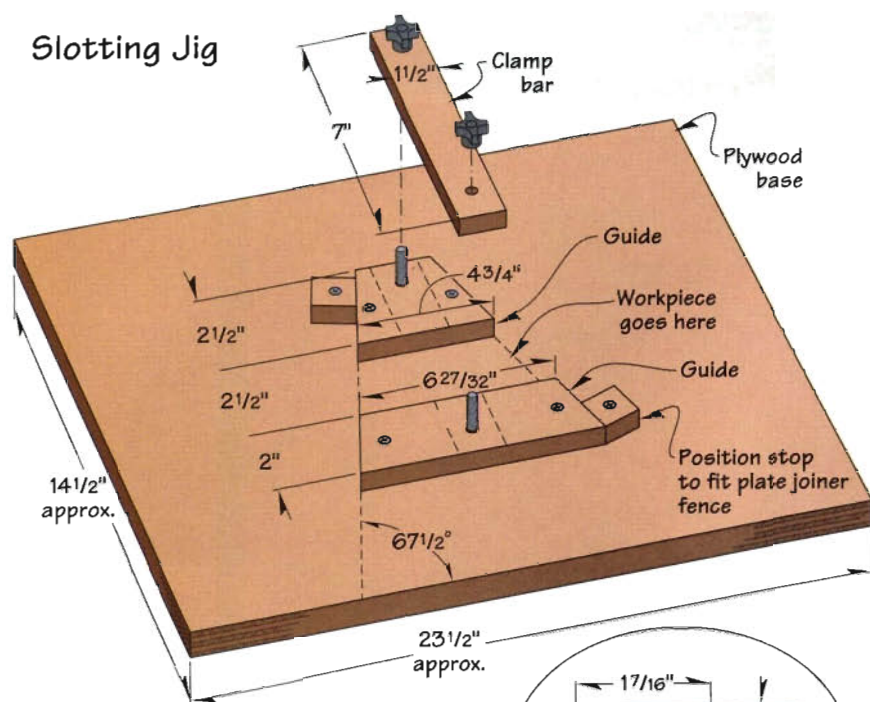


Figure 3



Slotting Jig



Front View

glue. (We worked on a melamine-covered, glue-resistant surface).

Step 2. Repeat this operation to add the third section to the assembly. When done, lay the assembly on the melamine to dry. Glue up the second end the same way. Do not disturb either assembly for at least an hour.

across the frame to ensure that the opening is uniform, then set the assembly aside to dry.

Step 5. After the glue has dried, remove the band clamp and check the frame. If any biscuits protrude into the rabbet, chisel them flush with the rabbet's edge.

Step 3. Dry-assemble the two ends to the long side pieces to make sure they fit correctly; you won't have much latitude to adjust their fit during the glue-up. Also, prefit a band clamp to the assembly at this time so you'll have it ready when you need it.

Step 4. Working on a flat surface, apply glue to the joints as before. Insert the biscuits, join the ends to the sides, and then snug up the entire frame using the band clamp. Measure

Add the Final Touches

Step 1. To prepare the frame for wall-mounting, fit your table-mounted router with a keyhole bit, and rout a centered, horizontal, 2 1/2"-long slot along the back of the frame's top center piece where dimensioned in figure 3. This slot will allow you to mount the mirror flat against the wall with one screw. As an alternative, use standard mirror hangers and picture wire.

Step 2. Finish-sand the frame, then remove all sanding dust. If necessary, touch up any joints with wood filler or color sticks. (We used oak-colored Famowood to fill in hairline joint cracks, after masking the wood along the joints with tape to prevent the filler from getting into the wood pores.)

Step 3. Apply your choice of finish. (We applied several coats of Deft aerosol lacquer, sanding lightly between coats with 320-grit sandpaper).

Step 4. To make the back (C), place the frame faceup on a piece of 1/8" hardboard. Then, holding a pencil at an angle, trace around the rabbet to outline the opening. Rip the back to width on your tablesaw, then use a portable jigsaw to cut the ends to shape.

Step 5. Place the frame facedown on a bench, and center the mirror in the rabbet. Apply a bead of silicone caulk between the frame and the mirror's top and bottom edges to hold it in place. When the caulk has set, place the back in the rabbet and secure it with glazier's points. 

Project design: Cary Stage

Lead photograph: Studio Alex

Other photograph: Kevin May

SOURCE

Bevel-Edged Mirror. Eight-sided, 1/4"x12 1/4"x50", with 1" bevel along all edges. Price: \$80.00 ppd. Order from:

Stage Productions

1232 E. Main Street

Reedsburg, WI 53959

Telephone: 608/524-2428

A MONUMENT TO MODERNISM—
THAT ALSO HOLDS JEWELRY

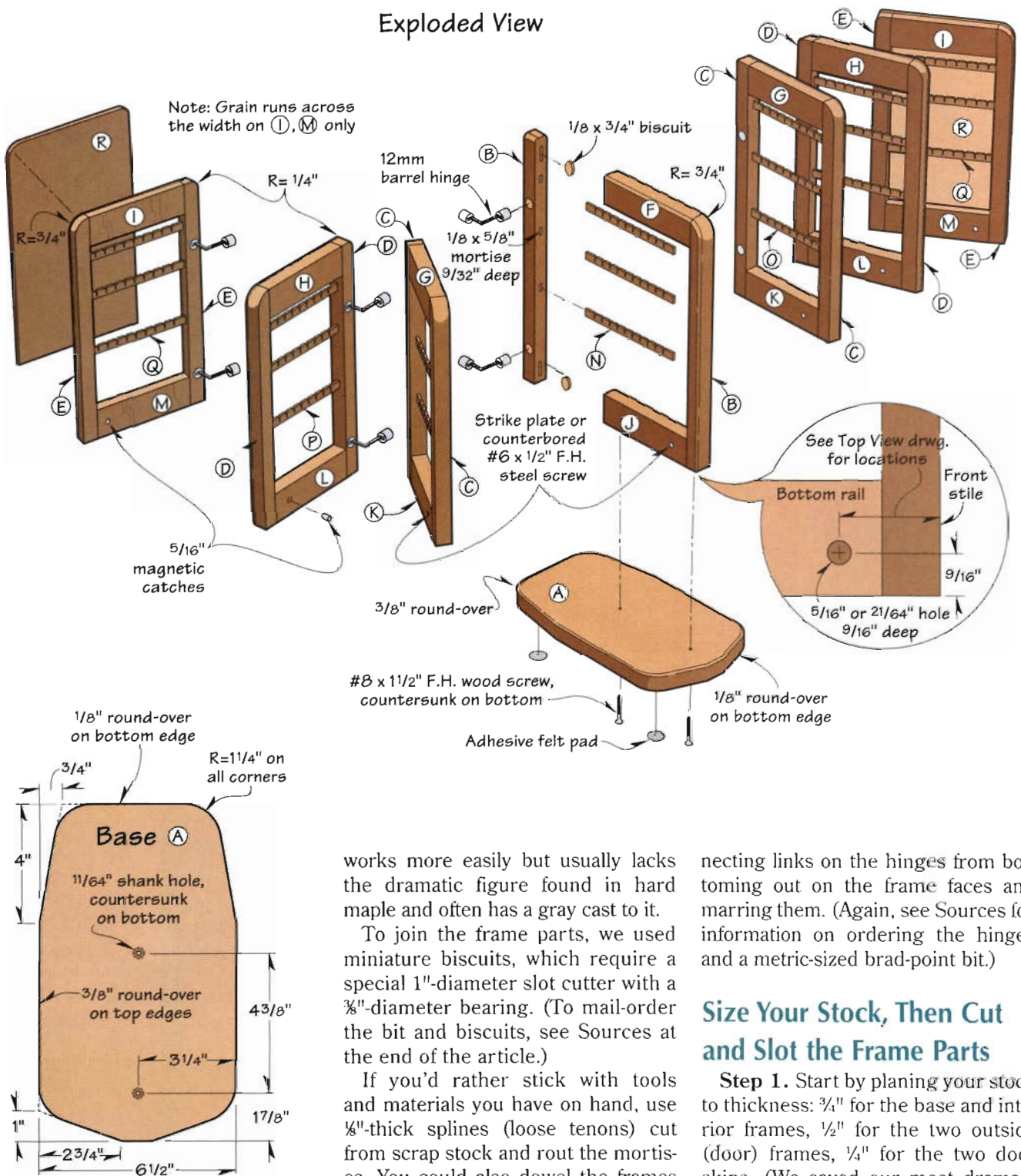
ART DECO EARRING CHEST



When Doug Stowe of Eureka Springs, Arkansas, first showed us this arresting design, we assumed that its purpose was purely sculptural—you know, art for art's sake. When we opened

the pages of his “book,” however, we found that it told a different tale. (See the inset photo.) Fanned outward, the seven offset frames reveal hangers that hold nearly 80 pairs of earrings.

Exploded View



Before You Start

We followed Doug's lead in selecting curly maple for our chest. Be advised, however, that curly hard maple, which we used here, requires light cuts with well-sharpened tools. Curly soft maple

works more easily but usually lacks the dramatic figure found in hard maple and often has a gray cast to it.

To join the frame parts, we used miniature biscuits, which require a special 1"-diameter slot cutter with a $\frac{3}{8}$ "-diameter bearing. (To mail-order the bit and biscuits, see Sources at the end of the article.)

If you'd rather stick with tools and materials you have on hand, use 1/8"-thick splines (loose tenons) cut from scrap stock and rout the mortises. You could also dowel the frames together using a drill press or doweling jig to drill the holes and dowel centers to transfer centerpoints.

We suggest you acquire the barrel hinges and check their actual dimensions before you begin construction. Ours required a 12mm hole $\frac{9}{16}$ " deep, although we went a bit shallow on the depth (about $\frac{1}{64}$ ") to prevent the con-

necting links on the hinges from bottoming out on the frame faces and marring them. (Again, see Sources for information on ordering the hinges and a metric-sized brad-point bit.)

Size Your Stock, Then Cut and Slot the Frame Parts

Step 1. Start by planing your stock to thickness: $\frac{3}{4}$ " for the base and interior frames, $\frac{1}{2}$ " for the two outside (door) frames, $\frac{1}{4}$ " for the two door skins. (We saved our most dramatically figured pieces for the skins.) Note: To improve appearance and prevent delamination (from cross-grain construction), you'll want to cut the four door-frame rails (I, M) with the grain running widthwise instead of lengthwise. To plane the stock for these parts safely, start with boards at least 12" long.

BILL OF MATERIALS

CHEST

PART	T	W	L	MAT.	QTY.
A Base	3/4"	6 1/2"	11 3/8"	CM	1
B Stiles 1	3/4"	3/4"	13"	CM	2
C Stiles 2	3/4"	3/4"	12 1/2"	CM	4
D Stiles 3	3/4"	3/4"	12"	CM	4
E Stiles 4	1/2"	3/4"	11 1/2"	CM	4
F Top rail 1	3/4"	1 1/2"	5 1/2"	CM	1
G Top rails 2	3/4"	1 1/2"	5"	CM	2
H Top rails 3	3/4"	1 1/2"	4 1/2"	CM	2
I Top rails 4*	1/2"	4"	1 1/2"	CM	2
J Bottom rail 1	3/4"	1 1/8"	5 1/2"	CM	1
K Bottom rails 2	3/4"	1 1/8"	5"	CM	2
L Bottom rails 3	3/4"	1 1/8"	4 1/2"	CM	2
M Bottom rails 4*	1/2"	4"	1 1/8"	CM	2
N Hangers 1	1/8"	5/8"	6"	M	3
O Hangers 2	1/8"	5/8"	5 1/2"	M	6
P Hangers 3	1/8"	5/8"	5"	M	6
Q Hangers 4	1/8"	5/8"	4 1/2"	M	6
R Door skins**	1/4"	5 1/2"	11 1/2"	CM	2

* Grain direction on door rails runs opposite that of other rails to match door grain.

** Parts cut to final dimensions during construction. Please read all instructions before cutting.

MATERIALS LIST

CM – Curly maple
M – Maple

SUPPLIES

12–12mm barrel hinges; 6–5/16"-diameter magnetic catches; #6x1/2", #8x1 1/2" flathead wood screws; 5/8x3/4" biscuits; self-adhesive felt pads.

Step 2. From 3/4"-thick stock, cut the base (A) to shape as dimensioned on the Base drawing on page 47. Sand the edges smooth. Then, rout a 3/8" round-over along the top edge and a 1/8" round-over along the bottom edge.

Drill and countersink 1/64" shank holes where shown on the drawing, then finish-sand the base and set it aside.

Step 3. Cut all stiles (B, C, D, E), top rails (F, G, H, I), and bottom rails (J, K, L, M) to the dimensions listed in

the Bill of Materials, using the correct stock thickness for each. Note: To ensure uniformity, rip all of the stock for the stiles using a single fence setting, then do the same in turn for the top rails and bottom rails. Now, cross-cut all parts of each length using a single stopblock setting.

Step 4. Rout mating biscuit slots in each end of all rails and along one edge of all stiles, using the techniques described in "Slotting the Frame Parts" *opposite*. Then, dry-assemble the seven frames using biscuits, and check for fit. Adjust any parts that need it, but keep the frames dry-assembled to avoid confusion during glue-up.

Make the Earring Hangers, Then Mortise the Stiles

Note: Before you make the hangers, figure out which approach you'll use to rout the hanger mortises. (See "Mortising the Stiles" on page 51.) If you opt to rout a single long groove in each stile and then glue spacers into the gaps between hangers, you'll want to omit the 1/6" round-over on the hanger edges. If you choose to cut individual mortises for each hanger, we suggest routing a test mortise first. As you machine the hanger blanks, use this mortise as a width/thickness gauge to ensure a snug fit.

Step 1. To make the hangers, prepare 9' of 1/8x1/8" stock. (We used a 36"-long scrap of hard maple, ripping 3/16"-thick strips and then planing them to 1/8".) Note: If your planer has table rollers, run these thin strips on a piece of scrap stock to support the

Hanger

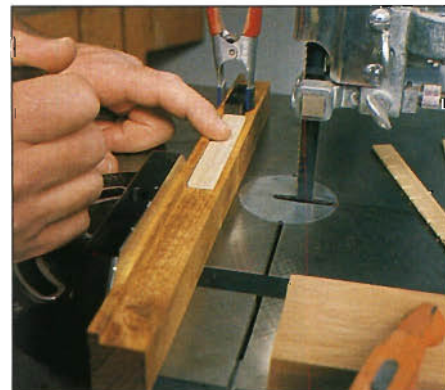
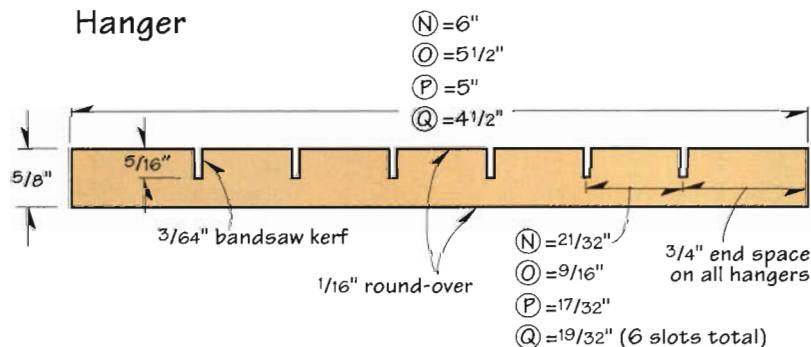


Photo E: Use a rabbeted miter-gauge extension and stopblocks to bandsaw the hanger slots accurately.

Slotting the Frame Parts

Because it's difficult to center a routed slot vertically on the end or edge of a workpiece, we opted instead to mark a common face on each pair of mating parts and made sure we routed both slots with

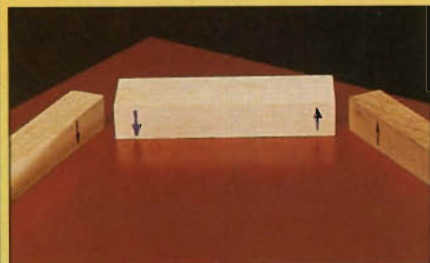


Photo A: Dry-assemble frames, then mark a common face at each joint. To slot parts, lay them common face down.

the common face down. This ensured that the slots would mate perfectly.

Dry-assemble the seven frames, then mark a common face on the mating parts at each joint (*photo A*). We're using a single setup to rout both ends of the parts, so you'll need to flip-flop the two pairs of parts with respect to each other for both the top-rail and the bottom-rail joints. As shown in *photo A*, we thus marked a common "down" face at each joint (i.e., the face that had to be down for routing).

We used a 6x10" piece of $\frac{3}{4}$ " plywood as a stopblock and used just one setup. Before positioning the stop, we cut a $\frac{3}{16}$ x $\frac{3}{4}$ x6" shim from solid stock and attached it to the stop's leading edge with countersunk flathead screws (*photo B*). This allowed us to set the stop for a centered slot on the end of the 1 $\frac{1}{2}$ "-wide bottom rails and then to rout a centered slot on the 1 $\frac{1}{2}$ "-wide top rail ends by simply removing the shim.

(Because the bit on a table-mounted router turns counterclockwise, we set the stopblock to the right of the bit to resist its rotation.)

To slot the $\frac{3}{4}$ "-thick frame parts, elevate the bit so it clears the table

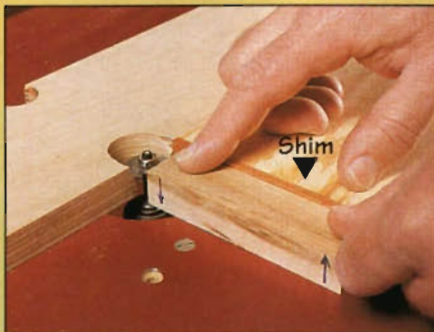


Photo B: To slot 1 $\frac{1}{2}$ "-wide rail ends, attach a $\frac{3}{16}$ "-thick shim to end of router-table stopblock.



Photo C: Use same setup (with shim still in place) to slot stile edges for bottom-rail joints.

by $\frac{3}{16}$ ". Next, set a fence flush with the bearing on the slot cutter. Position and clamp a stopblock to the fence to center the slot horizontally on the end of the 1 $\frac{1}{2}$ "-wide top rails. Note: Before you rout any of your actual parts, test the setup using same-sized scrap stock.

Rout one end of the bottom rail on one of the $\frac{3}{4}$ "-thick frames by sliding

it along the stopblock until it makes contact with the bearing. Check the corresponding stile to make sure its common face is oriented the same way, then rout a slot along the edge at its mating end (*photo C*). To do this, place the left end against the fence and the right end against the stopblock. Keeping this end against the block, pivot it into the cutter.

Now, flip the rail over and orient the other stile the same way before routing slots for the other bottom-rail joint. Repeat this operation until you've routed slots for all bottom-rail joints in the $\frac{3}{4}$ "-thick parts.

To slot the top-rail joints, first remove the $\frac{3}{16}$ "-thick shim from the stopblock (*photo D*). Then, repeat the procedure you used to rout the bottom-rail slots, making sure you

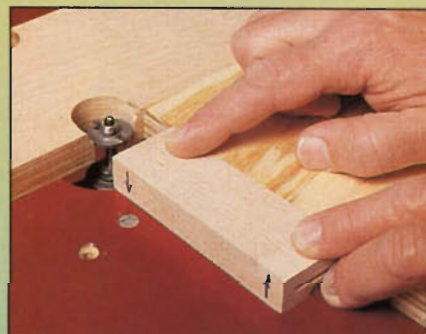


Photo D: To slot 1 $\frac{1}{2}$ "-wide top-rail ends and mating stile edges, use the same setup, but remove shim from stopblock.

orient the common faces properly. Rout slots for all four joints in turn on each $\frac{3}{4}$ "-thick frame.

To cut slots in the $\frac{1}{2}$ "-thick door-frame parts, first lower the bit so it clears the table by $\frac{3}{16}$ ". Then, reattach the shim to the stopblock, and repeat the operations described for the $\frac{3}{4}$ "-thick frame parts.

thin material during planing. Next, rout all edges of the hanger blanks using a $\frac{1}{16}$ " round-over bit and fence. (See the Hanger drawing *opposite*.) Now, crosscut the hangers (N, O, P, Q) to the lengths and quantities specified in the Bill of Materials.

Step 2. Cut earring slots in the hangers. To do this, first set up your bandsaw with a miter gauge and rabbeted extension (*photo E*). To make the

extension, start with a 2x12" piece of 5/4 stock, and cut a $\frac{3}{4}$ "-wide rabbet $\frac{1}{8}$ " deep along the top edge. Screw the extension to your miter gauge as shown, and lay the hangers in the rabbet to bandsaw the slots. Now, clamp a stopblock to the bandsaw table where shown in the photo to limit the slot length to $\frac{5}{16}$ " (half the width of the hangers).

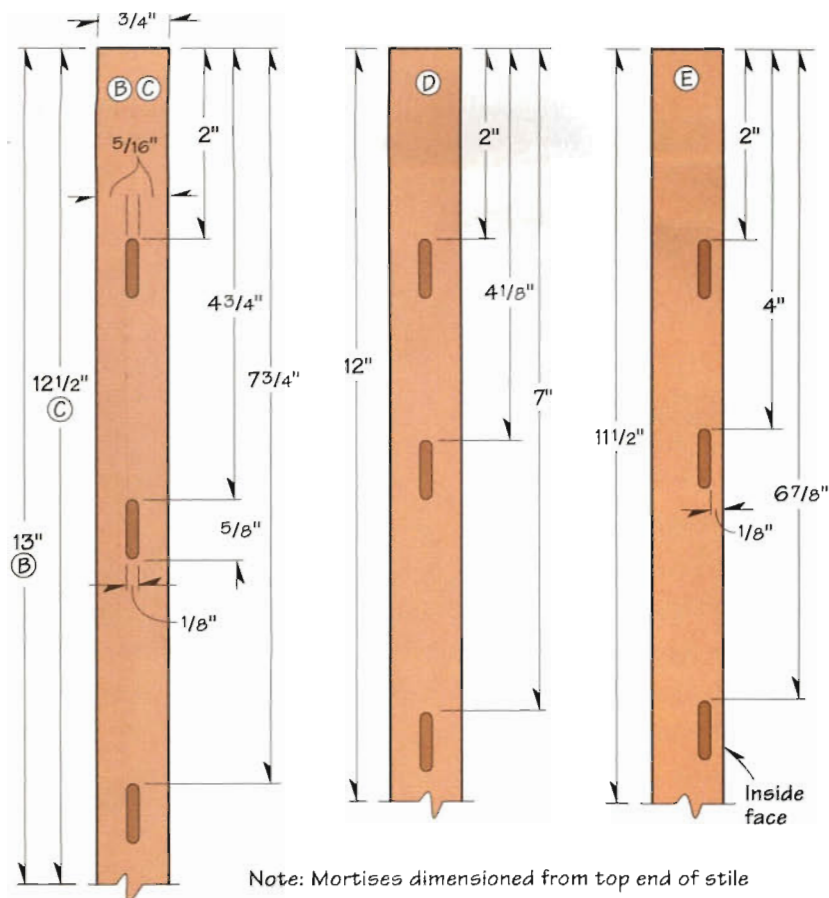
Step 3. Using a spring clamp, attach a stop to the miter-gauge extension to

position the first slot $\frac{3}{4}$ " from each end of all hangers. Bandsaw the slot at one end, flip the hanger end for end, and slot the other end. Note: Feed the stock into the bandsaw slowly to minimize chip-out on the bottom face.

Step 4. Using the stop on your miter-gauge extension, cut six additional evenly spaced slots (between the two end slots) on the 15 hangers (N, O, P) that will go in the interior

Figure 1

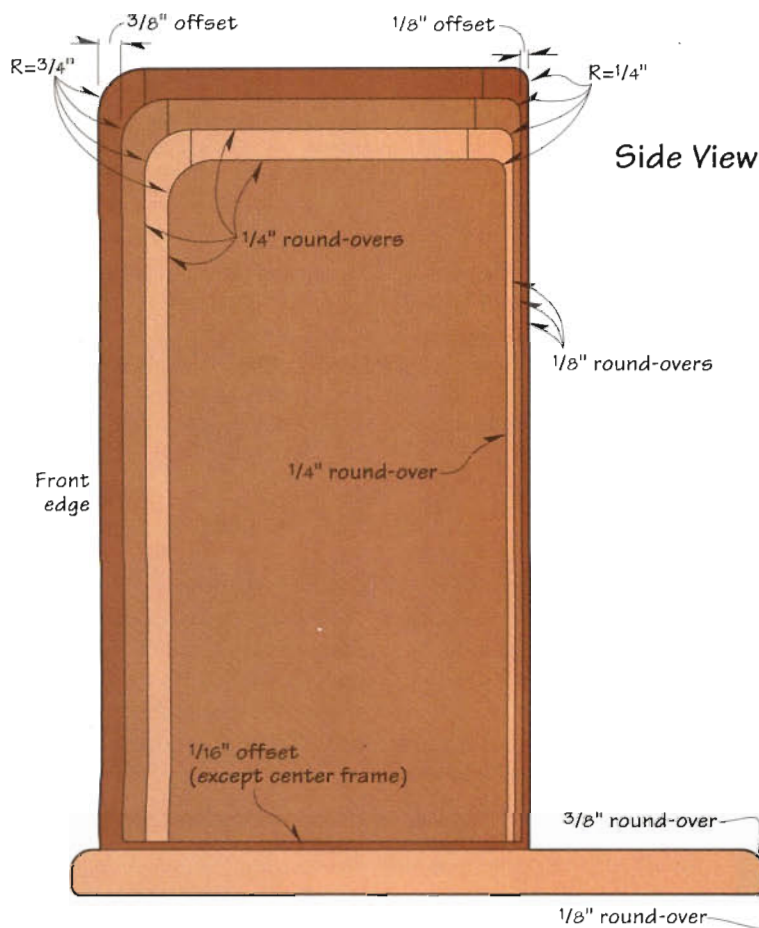
Hanger mortise locations



frames. As you did in Step 3, set the stop, slot one end, flip the hanger end for end, and repeat. (See the Hanger drawing for center-to-center spacing intervals on the various hanger lengths.) The $4\frac{1}{2}$ " length of the door-frame hangers (Q) will allow only four additional slots. (Ours ran $\frac{1}{32}$ " on center.) Now, sand the hangers lightly, but avoid reducing their thickness any more than is necessary.

Step 5. To lay out hanger mortises on the four pairs of stiles (B, C, D, E), use the dimensions shown in figure 1 at left. Note: The mortises are centered on the edge of all interior stiles (B, C, D), whereas those on the door stiles (E) are $\frac{1}{8}$ " from the inside face. If you use a router table and fence, you'll either need to use two different fence settings for the two door stiles ($\frac{1}{8}$ " and $\frac{1}{2}$ " from the edge of the bit) or, if you prefer to use a single fence setting, reverse the three stop setups to rout the second of the two stiles.

Step 6. Cut the three hanger mortises on each stile using one of the approaches described in "Mortising the Stiles" *opposite*. Whichever technique you use, test each setup using scrap stock. Also, mark the ends of the stiles "top" and "bottom" and double-check before you rout to make sure you have them oriented correctly.



Assemble the Frames, Then Treat the Edges

Step 1. Dry-assemble and clamp each door frame (with biscuits but without the hangers) in a large hand-screw clamp, keeping the clamp offset from one face so a handheld router will sit flat on the frame (*photo F*). Install a $\frac{1}{8}$ " round-over bit in the router, and rout the inside edges of the two frames along just the interior face. With the frame still clamped, hand-sand the inside edges at this time as well. Unclamp, then repeat the process for the five interior frames, this time routing the inside edges along both faces.

Step 2. Dry-assemble the biscuited frames with the hangers to make sure everything fits. Note: In each frame, check to see that the slotted edge of every hanger is oriented toward the $1\frac{1}{2}$ "-wide top rail and

that the hangers fit snugly in their mortises. Assemble the hangers into the mortises without glue, then glue and clamp the frames. Check for squareness and flatness, and allow the glue to dry.

Step 3. Sand the outside face of each door frame flat. (We attached two sheets of 100-grit sandpaper to our saw table and applied equal pressure to the entire frame as we sanded.) From your surfaced $\frac{1}{4}$ "-thick stock, rip and crosscut the two door skins (R) to $\frac{1}{8}$ " larger than the finished dimensions. Finish-sand the inside faces of the skins, but avoid rounding the edges—this would leave an unsightly gap after assembly. Mark the outside face of each door frame, then glue and clamp the skins to these faces.

Step 4. After the glue has dried, sand the inside faces of the door frames the same way you sanded the outside faces. Install a flush-trim bit in your table-mounted router, and rout the skins flush with the door-frame edges.

Step 5. Now, sand or bandsaw a $\frac{3}{4}$ " radius on the top front corner of each frame, including the doors. (See the Side View drawing *opposite*. We laid out the radii using a plastic template, then sanded them to shape on our stationary disc sander.) Next, lay out and sand a $\frac{1}{4}$ " radius on the top back corner of each frame. Now, block-sand the frame edges, taking care not to round them.

Step 6. Fit your table-mounted router with a $\frac{1}{4}$ " round-over bit, and rout the top end and front edge of the

center frame along both faces. Rout the same surfaces on the remaining frames and doors along the outside face only, and include the back (out-

side) edge on the doors. Switch to a $\frac{1}{8}$ " round-over bit, and rout the outside back edge of the interior frames and both back edges of the center frame.

MORTISING THE STILES

To mortise the stiles, we used a horizontal mortising machine. However, you can use any of the following approaches, depending on the equipment you have available.

If you have a router table, you can use a $\frac{1}{8}$ " straight or spiral upcut bit. Set a fence to center the mortise on the stile edge, and use start- and stopblocks to limit the mortise length, moving the stops

use a sanding block to break the edges after assembly.

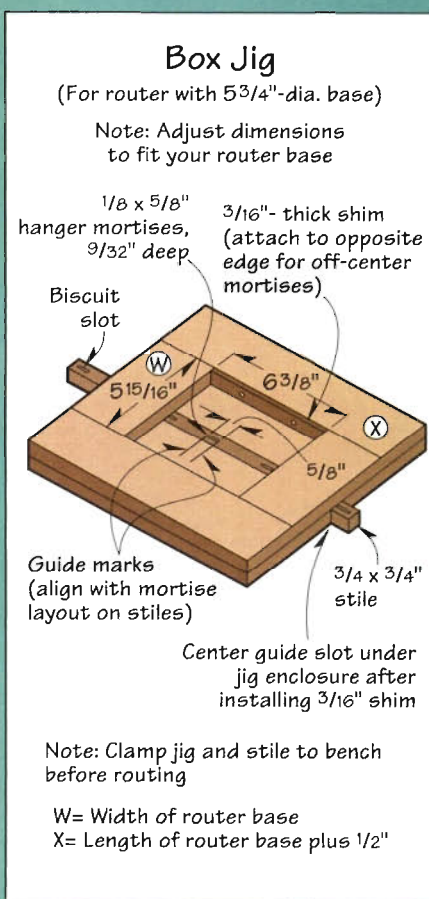
If you don't have a router table, or simply want to avoid all of the stopblock setups, we suggest making a box jig like the one shown on the drawing *below*. Instead of limiting the travel of the stile across the bit, the jig limits the travel of a handheld router across the stile, which is held in place beneath the

jig by a pair of guides that also function as the jig's base. Attach a removable $\frac{3}{16}$ " shim to one edge of the jig enclosure.

Center the guides beneath this shimmed enclosure, then rout all the centered mortises. Next, attach the shim to the opposite edge of the enclosure, and mortise the off-center door-frame stiles. Also, use a $\frac{1}{4}$ "-thick shim underneath to hold these $\frac{1}{2}$ "-thick stiles snugly between the guides.

You'll need to adapt the

dimensions of your jig enclosure to fit your router-base diameter. Note: To cut the $\frac{3}{8}$ "-long mortise with a $\frac{1}{8}$ " bit, size the jig to allow only $\frac{1}{2}$ " of router travel. Use a plunge router if you have one. If you have a fixed-base router, make the jig enclosure from thick stock ($1\frac{1}{4}$ to $1\frac{1}{2}$ "). The taller walls will help guide the router as you rock the bit into and out of the cut.



for each mortise location. To cut each mortise, rest the right end of the stile against the right-hand stop, then lower the left end onto the bit, and feed the stile from right to left. When you reach the left-hand stop, lift the right end of the stile off the bit. Remember to reset the fence for the door-frame stiles, which are mortised $\frac{1}{8}$ " from the inside face.

As an easier alternative, use the same tools (router table, fence, and stops), but rout a single long groove in each stile. At each end of the stile, stop the groove $\frac{1}{8}$ " beyond the point at which it joins the rail, so the ends of the groove will be hidden. Cut spacers to match the dimensions of the groove, and glue them into the gaps between hangers. As mentioned earlier, refrain from routing a round-over on the hanger edges. Instead,



Photo F: Dry-clamp frames using large handscrew, then rout $\frac{1}{8}$ " round-over on inside frame edges.

PRO TIP

Before you lay out your frames, we suggest making full-scale mockups of two adjacent frames from scrap $\frac{3}{8}$ "-thick plywood. Using an extra-sharp pencil, practice your layout techniques on them. Then, drill holes and install hinges. Check the accuracy of offset and mechanical action before you proceed to the real thing.

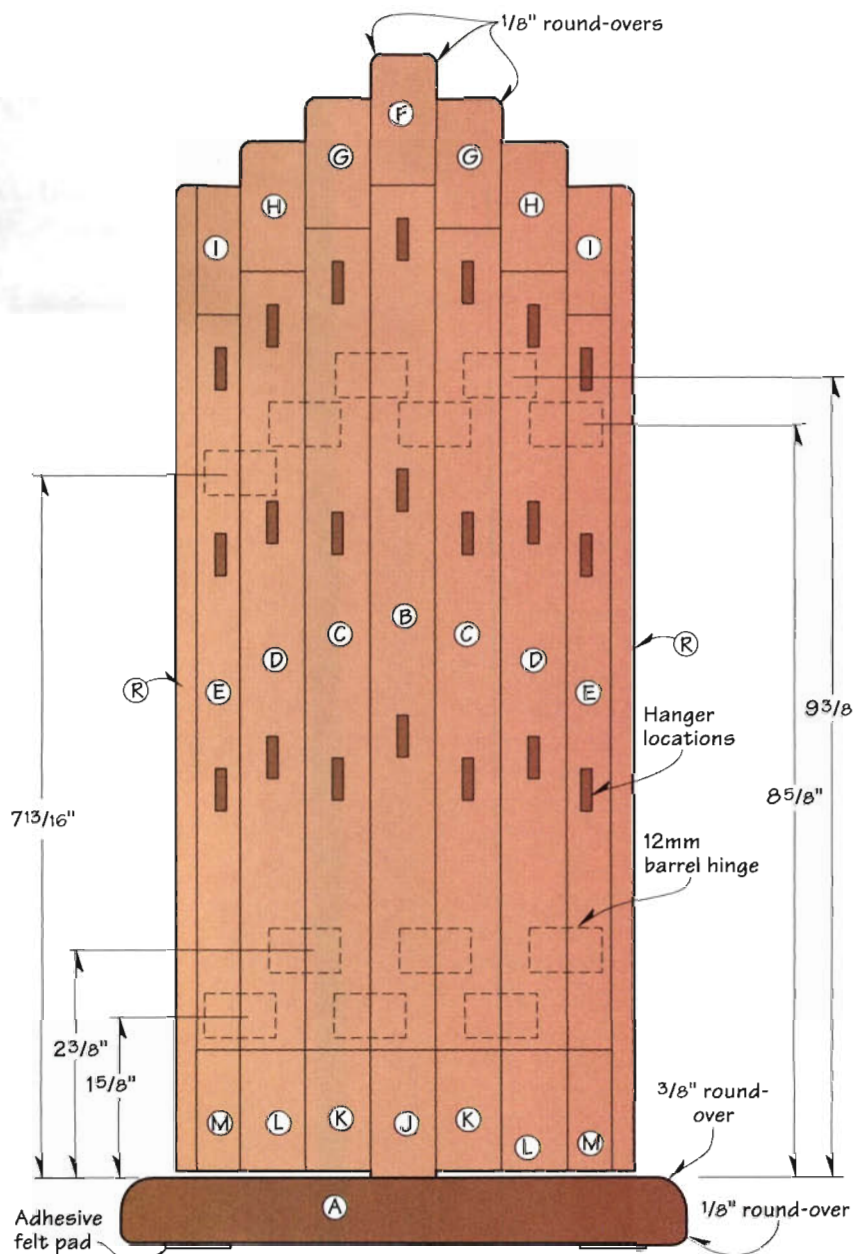
Mark each frame on both faces to indicate whether the hole centers are located $\frac{1}{16}$ " or $\frac{7}{16}$ " from the edge. (See the Frame Assembly Top View drawing.) On both pairs of interior frames (those located between the center frame and the door), center the holes $\frac{1}{16}$ " from the edge on the inner face, $\frac{7}{16}$ " from the edge on the outer face. On both faces of the center frame, center the holes $\frac{7}{16}$ " from the edge, and on the inside door faces, center them $\frac{1}{16}$ " from the edge.



Photo G: To lay out mating hinge holes accurately on adjacent frames, use combination square to establish hole location vertically.

Install the Hinges, Then Add Magnetic Catches

Note: Accuracy in laying out and drilling holes for the barrel hinges is critical both to the finished appearance and to the mechanical action of the chest. To create the correct offset between each pair of adjacent frames, you need to center the two hinge barrels $\frac{1}{16}$ " and $\frac{7}{16}$ " respectively from their back edges (*photo G*). Also, the six outer frames (all but the center frame) must be offset $\frac{1}{16}$ " from the base in order to open freely. (We used a $\frac{1}{16}$ "-



Note: Hinge locations are dimensioned from base. Use $\frac{1}{16}$ " shim to lay out locations on offset frames.

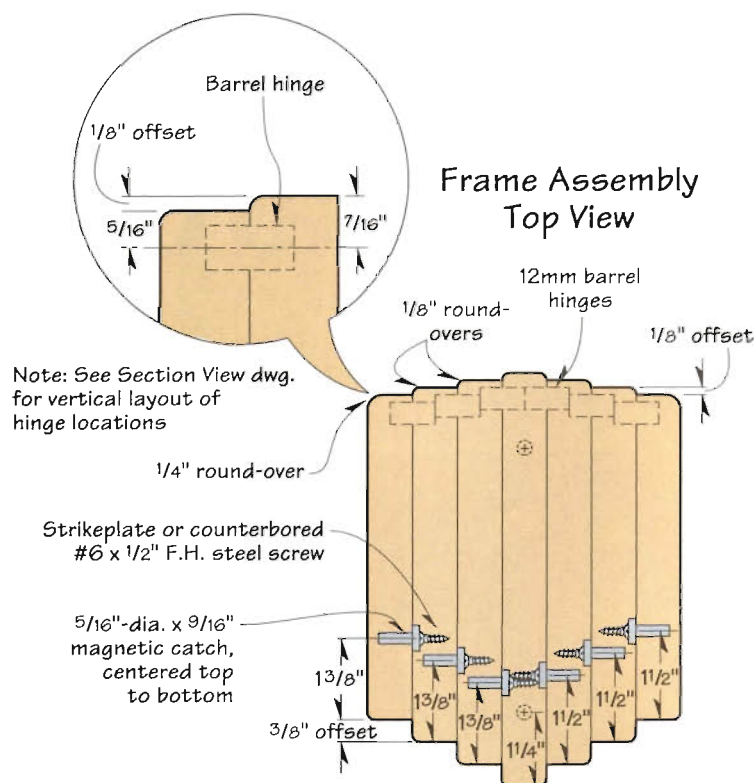
Section View

thick shim to create this vertical offset during layout and a $\frac{1}{8}$ "-thick hard-board shim during drilling to create the horizontal offset.)

Step 1. Lay out locations for the 12mm barrel hinges on each pair of adjacent frames where dimensioned on the Section View and Frame Assembly Top View drawings *above* and *opposite*. To do this, first align the bottoms of each pair of frames by butting them against a straightedge such as your rip fence. Use a try or combination square to align the centerpoints horizontally. **Note:** To properly align the center

frame with its two adjacent frames before laying out, remember to insert a $\frac{1}{16}$ "-thick shim under the adjacent frame to offset it. (Before drilling, see the Pro Tip *above left*.)

Step 2. To drill the hinge holes, set a fence $\frac{7}{16}$ " from the point of the bit, then drill a test hole in scrap stock to double-check the setup. (We sawed the hole in half to get a precise measurement.) **Note:** To be on the safe side, you may want to blunt the brad point on your 12mm bit slightly to ensure that it won't break through the opposite frame face during drilling. Set

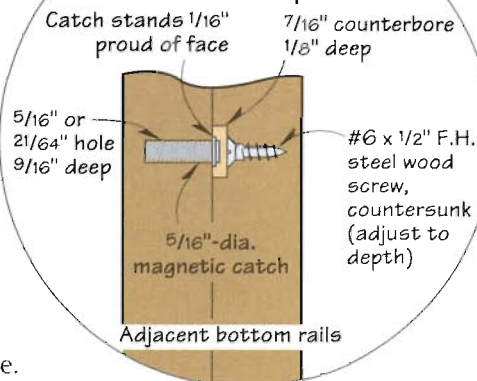


Note: Lay out strike plate locations to align with magnetic catches

the depth on the drill press to a scant $\frac{9}{16}$ \"; this will prevent the connecting links from bottoming out on the frame faces when you open the frames completely. Once you've thoroughly tested the drill-press setup, drill those frame faces designated for holes $\frac{7}{16}$ \" from the edge. Then, cut a shim from $\frac{1}{8}$ \"-thick hardboard, and use it to offset the remaining faces for holes $\frac{3}{16}$ \" from the edge. Now, dry-assemble all frames using the barrel hinges, and check the fit and action.

Step 3. With the parts still assembled, lay out hole centerpoints for the magnetic catches and strikeplates where dimensioned on the Frame Assembly Top View drawing. Double-check the layouts, then disassemble the frames and drill the holes. Note: We found that the $\frac{7}{16}$ \" hole recommended for the catches listed in the Sources was too small. We used a $\frac{21}{64}$ \" bit, which made installation easier and prevented pos-

Magnetic catch and strike plate



sible splitting. Also, instead of using the strike plates that came with our catches, we drilled $\frac{1}{8}$ \"-deep counterbores and installed $\#6 \times \frac{1}{2}$ \" flathead steel screws opposite the magnets. The counterbored screws can be adjusted to just below surface level, which allows the doors to close snugly without an audible click.

Apply Finish, Then Assemble the Chest

Step 1. Finish-sand the frames and base to 320-grit, then break all remaining sharp edges. Next, apply your

choice of finish. (We brushed on two coats of Minwax Antique Oil, allowing each to penetrate for 10 minutes, then wiped off the excess. We allowed the finish to dry overnight, then applied a coat of amber Butcher's Wax, buffing it to a low sheen.)

Step 2. Position and clamp the center frame to the base. Using the shank holes in the base as guides, drill $\frac{3}{4}$ \" pilot holes $\frac{3}{4}$ \" deep into the bottom rail of the center frame. Then, assemble the two parts using $\#8 \times \frac{1}{2}$ \" flat-head wood screws.

Step 3. Install the magnetic catches and strikeplates in their respective holes. Hinge the two sets of frames together, then assemble these to the center frame. Adjust the strikeplates, and attach adhesive felt pads to the underside of the base. 

Lead and inset photographs: Studio Alex

Other photographs: Kevin May

Illustrations: Cad Art

SOURCES

Slot Cutter, "Itty-Bitty" Biscuits. Carbide-tipped, $\frac{1}{4}$ \" shank, 1\"-dia. bit, $\frac{3}{8}$ \"-dia. bearing. Cuts a slot $\frac{1}{8}$ \" wide, $\frac{5}{16}$ \" deep, $\frac{29}{32}$ \" long. Catalog no. 930, \$24.99 plus \$5.00 s/h. Slot cutter plus 100 biscuits (no. 955), \$27.99 plus \$5.00 s/h. Biscuits only (no. 940), \$4.99 plus \$3.50 s/h. (IA residents add 5% sales tax.) Order from:

Woodhaven
800/344-6657

Barrel Hinges, Magnetic Catches. Kit includes twelve 12mm-dia. hinges, solid brass with brass-plated steel connecting links (no. 13516); six magnetic catches with strike plates, $\frac{5}{16}$ \" diameter (no. 29272); 12mm brad-point drill bit (no. 46797). Ask for kit no. 16081, \$47.95 ppd. Order from:

The Woodworkers' Store
800/279-4441



Cyanoacrylates

Not Your Mainstream Woodworking Adhesives,
But They Do Have Their Uses



by Doug Cantwell

The "wickability" of low-viscosity cyanoacrylate (CA) allows you to insert snug-fitting key splines into slots, then apply CA and let it wick into the joint.

Most of us have had some experience, successful or otherwise, with cyanoacrylates—when we found ourselves recruited for a last-minute science project, or when the rear-view mirror post on the '76 Buick finally separated from the windshield. You may even have turned to these adhesives for wood repair, to fill a starved edge joint or persuade an unruly veneer to lie flat.

We don't tend to think of cyanoacrylates (CAs) as initial glue-up adhesives. But, if you've ever made a bandsaw box, you'll know that bonding an entry/exit kerf doesn't go that smoothly with yellow (aliphatic resin) glue. If you've tried gluing key

splines into corner slots on a jewelry box with a conventional adhesive, you've probably found yourself with a mess on your hands (as well as on the box).

Unusual glue-ups sometimes call for unusual adhesives, as well as a bit of care in matching the product to the job. Because cyanoacrylates, ounce for ounce, cost more than any other adhesive on the market, and because even the "slow-cure" formulas offer only a brief open time, they're not liable to supplant your everyday yellow or white woodworking glue. However, if used with care, CAs offer certain advantages that you won't get with conventional shop adhesives. (Don't forget to read "CAs: Use Them Safely, Store Them Smartly" opposite.)

CA Products: What's Out There

Don't look for shop-quality cyanoacrylates in the checkout line at your local discount mart. If you want CAs that offer any kind of quality assurance, consult the woodworking mail-order catalogs or visit a hobby store that caters to radio-control (RC) model builders. (See Sources at the end of the article.)

The four or five product lines sold through the catalogs and "serious" hobby stores offer three formulations of CA (*photo A*). The low-viscosity formulas, which have a watery consistency, wick readily into seams and bond in seconds. These work effectively on tightly fitting surfaces. The semi-viscous products, which have a thicker, syrupy consistency, will fill small gaps and usually cure in 10 to 25 seconds, depending on the materials being joined. The slow-cure formulas have the consistency of honey, offer a respectable gap-filling capability, and take 60 to 90 seconds to cure.

To speed the cure time of the slower CAs, you can use an "activator" or "accelerator" (also shown in *photo A*). These low-viscosity, aromatic products come in atomizer bottles, so you can spritz the mating (non-CA) surface before joining parts. Or, join the parts with CA and then spray accelerator along the seam. This "tack-welds" the parts almost instantly while the interior CA (not reached by the accelerator) cures at its usual rate. Used properly, the accelerator can also help strengthen the bond by dissolving oils and other contaminants on the mating surfaces.

CA manufacturers observe that many users go overboard with the accelerators. If you spritz a joint too generously, you'll get a combusive reaction, complete with a puff of smoke. As the overdose of accelerator reacts with the CA, it forces a too-rapid cure, leaving an unsightly white residue or "crackle" that really stands out on darker woods (*photo B*). The CA forms a stronger, less brittle joint if you use an accelerator sparingly.

CAs: Use Them Safely, Store Them Smartly

- Never open or use CAs without first putting on eye protection, preferably goggles or a face shield.
- Use these products with ample ventilation—especially if you're using accelerators—and avoid inhaling the vapors.
- Store CAs and accelerators well out of the reach of children or in a locked cabinet. If the kids need something glued with CA, do it for them.
- CAs will bond skin almost instantly, so pick up a bottle of debonding agent when you purchase the glues.
- If you do bond skin to skin or to another material, apply the debonding agent and use a gentle peeling action—never direct pulling—to separate.
- To increase the shelf life of unopened CAs, store them in a freezer. Warm cold CAs to room temperature before using. Store opened containers in a dark, dry place at room temperature.
- To open a CA container initially, first unscrew the top to relieve any pressure, then retighten. Without squeezing the bottle, hold it upright against a vertical surface, and cut off the top 1/16" of the nozzle with a sharp knife.
- Once you've opened a bottle of CA, keep the original cap tightly in place, and store the bottle in an upright position at least 10 feet away from accelerators.
- Do not use a pin or brad to plug the hole; anything you insert into the nozzle will have trace moisture on it, which will activate the curing process. Avoid touching the nozzle to a surface that has been sprayed with accelerator.
- Before replacing the cap after use, set the bottle down firmly a couple of times to shake the remaining CA back into the bottle. Gently squeeze it in an up-right position to blow air through the nozzle, then wipe the tip and cap it securely.



Photo A: Distributors typically offer three CA formulas as well as one or two grades of spray accelerator and a debonding agent.

How CAs Bond

Cyanoacrylates, or CAs, consist of cyanogen and acrylic resins. These reactive monomers polymerize (link chemically by way of a thermal reaction to form a plastic) when activated by the microscopic layer of trace



Photo B: Spray-on accelerator causes slow-cure CAs to bond instantly, but too much of it can leave an unsightly white residue that's difficult to get rid of. Accelerator "overdose" also can weaken bond, make it more brittle.

moisture present on almost all surfaces (or contained in a material such as wood).

If you live in the Southwest and are using CAs on a particularly arid day, it's a good idea to add a little moisture to the air. Even a pan of

warm water placed near the glue-up will accomplish this. At the other extreme, if enough moisture is present in the air that it dampens tables and countertops, as during very muggy weather, it can diminish the strength of the bond. In short, CAs work best in moderate humidity.

In addition to excessive dampness, other surface contaminants—oxidation, oils, dirt, acidic materials—can adversely affect the bonding strength and curing speed of CAs. Mold-release compounds used to coat plywoods during manufacture can also hamper bonding. Before you try to bond naturally oily or pitchy woods, wipe the mating surfaces with lacquer thinner to reduce the oils, and use an accelerator. (Lacquer thinner doesn't react with CA adhesives, whereas acetone and related solvents do.)

The folklore that has grown up around cyanoacrylates is at least partly true: the low-viscosity formula really will bond skin to skin almost instantly. Fortunately, most distributors include a debonding agent in their product line. (See photo A.) These acetone-based solutions make separation of bonded body parts, as well as other unintentional glue-ups, fairly painless. However, don't let this encourage you to use the debonders liberally or carelessly. The aromatic compounds used in these products can be absorbed readily through the skin and should be used as sparingly as possible.

Where To Use CAs— And Where Not To

When used properly on most woods, cyanoacrylates will create bonds with tremendous shear strength. This means that if you suspend a Volkswagen using a pair of edge- or face-glued blocks, such that the stress is applied in a direction parallel to the joined surfaces, the lamination probably will hold fast. (This dramatic demonstration, if you recall, was used as a promotional come-on back in the 70s by one of the less sophisticated CA distributors.)

On the other hand, because of their relative brittleness, CAs are not



Photo C: Thicker, slow-cure formula works best for attaching small, fragile hardwood parts. To speed curing, spritz joint with accelerator after gluing and positioning.

known for great peel strength, which may have some bearing on their use in veneering. Nor do they fare particularly well in impact testing. If you clamped the bottom block of that laminated pair in a vise, for example, then applied lateral impact (again parallel to the glued surface), it wouldn't require more than a middling shock load to break the joint.

The mechanical properties of cyanoacrylates don't stand up well to higher temperatures either, which may be worth keeping in mind as you start belt-sanding joints adhered with CA. You might also think twice about using CAs to repair the fireplace mantel. At about 160°F, these adhesives begin to turn yellow and decompose.

The above comments are intended not to bash CAs, but rather to give you a realistic picture of where they may not perform well. There remain, however, a number of woodworking situations where cyanoacrylates have the edge over other woodworking adhesives.

Where Clamping's Out Of the Question

CAs prove invaluable for glue-ups that cannot, for whatever reason, be clamped. The fast-cure capability enables you to hold small or fragile trim pieces in place during bonding, which also means that they don't have a chance to skate out from under a clamp (*photo C*).

In no-clamp situations, the slow-cure formula works best. You can apply a narrow bead along the mating edge of your fragile part, and its vis-

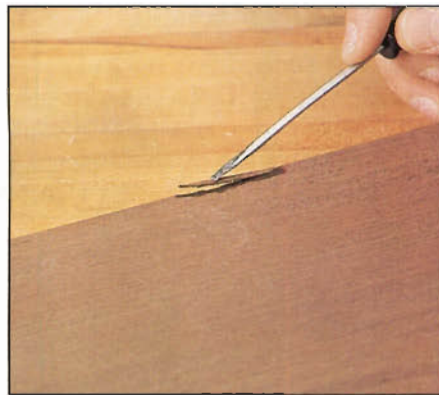


Photo D: For quick, tidy repair of edge splinter, hold splinter in place and apply low-viscosity CA along seam.



Photo E: To fill surface check neatly and invisibly, pack check with sanding dust, then apply just enough low-viscosity CA to saturate dust.



Photo F: Use medium-grade, gap-filling CA to close entry/exit kerf in bandsaw box. Apply CA along kerf, close joint with hand pressure, then spritz with accelerator.

cosity will keep it from sagging as you join the two parts. The slow-cure also allows you time to maneuver the part into position. Once you've got it where you want it, spritz the glue line lightly with accelerator to tack the part in place.

Where Wicking Does the Trick

When *WWJ* craftsman Dick Coers found yellow glue (aliphatic resin) less than satisfactory for gluing key splines into box corners, he remembered the remarkable wicking capability of low-viscosity CA and tried a different approach. He resawed his spline stock to fit snugly, then fitted the splines in place without glue. He applied low-viscosity CA along the edges, allowing its capillary action to wick the glue in between the mating surfaces. (See the lead photo on page 54).

On another occasion, Dick found after ripping some old, air-dried walnut that he was left with several long edge splinters. He didn't have time to glue up with aliphatic resin and clamp, so he simply pushed each splinter back in place with a blunt instrument and held it there while applying low-viscosity CA along the length of the seam (*photo D*). In both situations, the CA's "wickability" provoked less aggravation, required negligible cleanup, and saved precious minutes.

This capillary action also lends itself to quick and nearly invisible repair of



Photo G: To create reinforcing fillets along butt joint, apply bead of slow-cure CA, then spritz with accelerator to "tack-weld" parts.

surface checks. First, sand the area thoroughly to fill the crevice with sanding dust. Use a small screwdriver or other thin blade to pack in as much additional dust as possible. Then, apply several drops of low-viscosity CA—enough to saturate the dust without overflowing it onto the face of the stock (*photo E*). Sand again, and repeat the application if necessary to build up the fill flush with the face.

Where Gap-Filling's Essential

When we made some bandsaw boxes recently from 8/4 stock, we encountered the problem of how to close the entry/exit kerf. Because aliphatic resin offers little gap-filling capability and is difficult to apply in tight spaces, we turned to the medium-grade, gap-filling CA. We applied it along the kerf, closed the joint, and held it while spraying accelerator along the glue line (*photo F*).

If you have to join the edge of a thin panel to the face of another, but can't glue and clamp it in the conventional way, try filleting the joint with slow-cure, gap-filling CA. First, position the panel, then apply a bead of CA along the inside corner formed by the joint (on both sides if possible). Spray the fillet with accelerator to tack the joint instantly (*photo G*). This technique will reinforce conventionally glued joints as well, especially where there's no groove or dado to back up the adhesive. 

Photographs: Kevin May

Hall Tree Seat

Continued from page 31

this mixture to the keys to mask them from the stain. If any of the mixture gets on the surrounding oak, let it dry, then scrape it off with a single-edged razor blade.

Step 5. Stain and finish the hall tree, seat lid, mirror back, and retainer strips.

Step 6. Attach the seat hinges, toy-box lid support, and hangers. Install the mirror and mirror back, then attach the retainer strips. (We used #4x5/8" brass flathead screws.) 

Design: Cary Stage, Dick Coers

Lead photos: Studio Alex

Other photos: Kevin May

SOURCES

Bevel-Edged Mirror. One 10x16" bevel-edged mirror, ready for installation. Price: \$60 ppd. (Check or credit card accepted.) Order from:

Stage Productions
1231 E. Main Street
Reedsburg, WI 53959
Telephone: 608/524-2428

Brass Swivel Hangers. One pair of bright brass, three-point swivel wardrobe hangers with screws. Price: \$15/pair ppd. Order from supplier listed above.

Toy-Box Lid Support. Specify the 35-40 inch pound version and either left-side (no. 26187) or right-side (no. 26211) mounting. Price: \$3.95 plus s/h. Order from:

The Woodworker's Store
800/279-4441

SOURCES

For additional information about cyanoacrylate products, contact the following:

Satellite City, Inc.
Telephone: 805/522-0062

Pacer Technologies
Telephone: 909/987-0550

Bob Smith Industries
Telephone: 805/466-1717

The following mail-order sources carry at least one line of cyanoacrylates:

Constantine's
Telephone: 800/223-8087

Woodworker's Supply, Inc.
Telephone: 800/645-9292

Garrett Wade, Inc.
Telephone: 800/221-2942

Woodcraft
Telephone: 800/225-1153

The Woodworkers' Store
Telephone: 800/279-4441

SCROLL SAW PACS:
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SHOP TEST

Ryobi's Hot New Mini-Lathe: Big Performance From A Small Package

by David F. Peters

For years I've looked for a compact, inexpensive, multi-function lathe. I want one that's big enough to handle an occasional spindle, but small enough that I can move it around easily in—or even outside—the workshop. I say outside because, given decent weather, I enjoy woodworking out-of-doors on my deck. There, wood chips blow harmlessly away, and I can enjoy the fresh air and my favorite hobby at the same time.

When news of Ryobi's ML618 Mini-Lathe crossed my desk, I had high hopes that this was the machine I'd waited for. Two days before Christmas, when the UPS driver knocked on my door with a trim, oblong package, it felt like Santa had arrived early. Fortunately, I had no shortage of urgent test projects—

Christmas tree ornaments, a chess set, and several columns for a desk clock I was working on.

At about \$230, the Ryobi lathe hits a price point that will entice many entry-level woodworkers into turning. This price tag compares favorably with those on several other benchtop models, yet the machine offers much of the versatility you expect from higher-priced lathes.

What You Get In the Box

Unlike several of its competitors, the Ryobi has a fully detachable head stock (as shown *below*), so you can mount it perpendicular to the bed for bowl turning, plate turning, and similar "outboard" work. In conventional posture, the machine will handle spindles up to 18" long and plates up to 6" in diameter (10" if you release the head from the tool rest).

But give some credit for the lathe's versatility to its silky smooth variable-speed motor, which allows you to select speeds of 500 to 2,500 rpm (and anywhere in between). I found its capacity to turn stock at slow speeds especially handy for sanding, finishing, and polishing work with the lathe in the conventional posture.

As I unpacked the machine, I noticed—and admired—its heft. Ryobi has not overlooked the fact that quality and performance in a lathe start with mass. If the manufacturer skimps on mass, this fact will get passed along to the turner in the form of vibration. Vibration tends to foil the smooth and effortless peeling off of shavings that makes for successful turning.

Virtually no piece of wood you turn—regardless of how even-grained it may appear—will have perfect balance. On a lathe that lacks the mass to offset it, any off-centered weight will produce vibration. Weighing in at about 30 pounds, the Ryobi has enough ballast to provide the necessary stability, while still offering the portability I've been looking for.

Assembly out of the box went without a hitch. If you're a first-timer, I suspect you'll find that a few more photos, illustrations, and attention to detail in the instruction manual would help.

For example, the section on outboard turning explains how to mount the provided faceplate on the workpiece, but neglects to explain how to then attach the faceplate to the lathe.

The instructions for mounting the workpiece specify four screws. This may also bewilder you, since the faceplate has but three holes.



The Ryobi ML618 mini-lathe with head detached and set perpendicular to the bed for bowl or plate turning.

Minor bum steers like these, however, aren't completely foreign to tool instruction manuals.

For my testing, I first mounted the lathe on a length of 2x10 stock. With such a base as this, the lathe can be clamped to a table or workbench and then removed for storage. Bore a hole in one end of the base, and you can even hang a machine of this size on the wall, provided you have a securely mounted wall peg or hook.

So I Gave It a Whirl

I started with a particularly grueling test. I keep a stack of rough-sawn cherry turning blanks on hand, pieces cut from a prize cherry tree and air-dried for about 15 years. Chucking up a rough-sawn blank will produce vibration in all but the stoutest lathes, and the Ryobi was no exception. But thanks to the variable-speed feature, I quickly found a speed that minimized vibration and enabled me to turn the blank to a cylinder in fairly short order (*photo B*). When I mounted properly prepared blanks, there was no vibration, and I ran the lathe at optimum speed right from the start.

Most mini-lathes owners don't expect to do production or large-scale turning. They've likely bought the lathe to have fun making things like tops, toys, chess pieces, ornaments, bowls, and the like. For projects like these, the Ryobi excels.

I found the motor to be exceptionally quiet, and the variable speed offered a "comfort level" for every task. Fortunately, quiet doesn't necessarily mean underpowered. The machine had torque enough to spin a large lamp base blank that required all of the lathe's 18" distance between centers as well as a 6 1/4" swing over the bed. In the outboard setup, such as you'd use for

bowl work, the lathe handles 10"-diameter projects with ease.

For me, the bottom line with any tool is ease of use. My test unit performed flawlessly, although I have one complaint about the design of the locking handles for the tail stock and tool rest. I found the handles much more difficult to use than they should be. When I queried Ryobi about this problem, marketing director Brian Sponsler reported that the handles are being redesigned, and new ones should be available by the time you read this. I hope Ryobi will address the operating manual shortcomings as well.

Ryobi thoughtfully employed common standards in the machine's design. It's outfitted with a 3/4"x16 tpi hollow headstock spindle and a no. 1 Morse taper, and will accommodate a broad range of standard lathe accessories. You aren't limited to a few special items. In fact, many of the popular aftermarket accessories, from simple spur centers to special four-jaw chucks, will work on it.

If you're planning to purchase the Ryobi or any mini-lathe, I suggest you set aside a few dollars for a good set of mini-sized tools. I've tried several brands, but for a good balance of quality and price, I'd recommend Sorby. Their basic set retails at about \$50, which I feel is an excellent value.

The Bottom Line

Ryobi's mini-lathe roundly impressed me. With its versatility, heft, smooth operation, variable

speed, and a price that's not far north of \$200, I expect the tool will find a home in more than a few shops this year.



The Ryobi lathe handles spindles up to 18" long, plates up to 10" in diameter, and accepts standard spur centers, face plates, and chucks. The author especially liked the unit's variable-speed control feature.

In the several weeks I've had to work with this machine, I had more than my share of fun. My five-year-old daughter even got into the act with a little hand-over-hand turning. I turned projects as large as a lamp base and as small as tiny cocobolo heater-control knobs to replace the cheap plastic ones in the car. And best of all, I got started on a chess set that has long been on my must-make list.

The final measure of a tool's success should not be gauged by any esoteric compilation of statistics or "bench" tests, but by how frequently the tool gets used—and how it performs—in real-world situations. The fact that I haven't let a day go by without firing up the Ryobi lathe bears testimony to just how pleased I am with this machine. You won't be disappointed with its performance.

A word of caution: Mini-lathes are hot items right now, and it seems that some manufacturers are rushing models to market to take advantage of this. So, check and compare features carefully before you buy. 

SHOP TEST

Arbortech of Perth, Australia, manufactures four unique accessories for the wood carver. (I think, after having used the tools, that the title "wood sculptor" might have been more appropriate.)

Arbortech's product line includes the Woodcarver Pro-2 cutter, the Industrial carbide-tipped cutter, the Pro-Guard, and a Grinder Sanding Kit. Each item works on 25 different 4" and 4½" angle grinders manufactured by 15 companies. (See the tables on *page 63*.) The Pro-2 and Industrial each come packaged in a Pro-Kit as well, which includes the Pro-Guard. The Pro-2 Pro-Kit also includes a power sharpening stone and an aluminum oxide sharpening stick. The Industrial Pro-Kit includes a wrench to change the cutter tips.

The Woodcarver Pro-2 and the Industrial tungsten-tipped cutter are used for freehand power carving. The adjustable Pro-Guard completely encases the blade and the grinder's metal guard in a tough, clear polycarbonate case. The Grinder Sanding Kit features a flexible disc with industrial-strength hook-and-loop for cloth-backed abrasives. The arbor nut is recessed so the entire disc surface

Power Carving— Australian Style

With the advent of this new offering from Down Under, the dangerous days of chainsaw woodcarving are history. Now there's an accessory for your angle grinder that does the job safely and efficiently.

by Rob Cook

can be used for sanding and shaping flat or curved surfaces.

Although the Woodcarver has been around for some time, the Pro-2 has been redesigned with safety in mind. Depth-of-cut stops between each cutting tooth restrict the bite to ⅛" at a

time. The Industrial model has three circular carbide cutters mounted with torx-head screws. You can rotate these cutters as they lose their edge, then replace them when they wear out. It also has depth stops to lesson the tool's inclination to run away from the user during cutting.

The Test

I tested each blade on two different grinders: the Skil HD9611 (6-amp, 12,000 rpm) and the DeWalt DW402 (6-amp, 10,000 rpm). I also tested the Ryobi WC400 (6.7-amp, 11,000 rpm) which is a complete woodcarver with a Pro-2-styled blade and Pro-Guard made by Arbortech.

The Skil, DeWalt, and some of the other grinders require a washer kit (see table on *page 63*) to properly position the blade and the Pro-Guard. The Pro-Guard fits nicely over the metal guard that comes with the grinders, and I recommend that you use it as described in the instructions. (I'm one of those woodworkers who sometimes remove obtrusive safety devices, but not in this case. Considering the aggressive way the cutter throws chips, it's a good safety addition.) I also recommend wearing a face shield to protect against flying chips and dust.

The blade on the Ryobi unit is keyed so you can't use it on other grinders, but you can use the Pro-2 or Industrial blade. The Pro-Guard on the Ryobi is spring-loaded in the down position to keep the blade covered when in use. When you apply downward pressure, the guard lifts as the blade cuts into the wood.

I found the spring on the Ryobi guard limiting. You can't set the depth of cut to rout a groove—you have to freehand the cut. The Ryobi guard tended to hang up on raised edges when cutting to the side. I found myself using the tool left-handedly



(I'm right-handed) so I could hold the switch in the *on* position (the standard trigger lock has been removed) and use a finger to lever the guard up and out of the way. With the guard all the way up, 1" of blade is exposed and you can see more clearly what you're doing.

The Arbortech guard can be preset to a desired depth, then locked into position. With a fence clamped to the work and the depth set by the position of the fence, you can rout a straight groove of even depth.

I realize that most of you will use a grinder you already own. If you're planning to purchase a grinder with the intent of also using it as a wood-carver, I would strongly recommend buying one that lets you attach the handle perpendicular to the blade. Most grinders allow you to mount the handle parallel to the blade on either the right- or left-hand (blade down) side of the grinder body.

I found the perpendicular position more comfortable when removing stock on horizontal or diagonal surfaces, the parallel position better suited for working on vertical surfaces. Of the three grinders I used for this test, only the DeWalt has this feature.

Carving Power

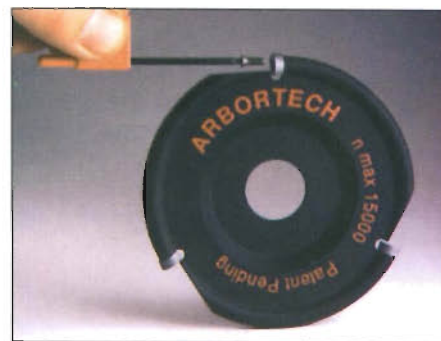
The Ryobi unit is one of the most powerful grinders on the list (804 watts for 1.08 hp). There was no audible loss of power with the Pro-2 on a full-depth cut into the green camphor log shown in the photos. The Skil and DeWalt units dropped a few rpm, but nothing significant considering the amount of material being removed. With the Industrial (carbide-tipped) blade, there was no power loss.

After the full-depth cutting test, I tested the cutters in a side-to-side sweeping motion. First, I lowered and secured the guard so only 1/4" of blade was exposed. I then proceeded to

The Ryobi WC400 (right) can be purchased as a complete unit.

The Industrial blade (below right) has replaceable cutters. You can rotate the cutters to position a sharp edge.

The Arbortech Industrial blade (below) and Pro-Guard mounted on a DeWalt DW402 grinder.



remove the bark in sweeping strokes. The Pro-2 had a smoother feel when cutting to the left, but it tended to catch on sweeping cuts to the right. Although this may have been a result of my technique, the action on the Industrial blade was equally smooth by comparison in both directions. The cutters and the depth-of-cut ridge on the Industrial blade have a round cross section, which I presume contributes to the smoother action.

I also tested both cutters on red oak. Although they both removed significant amounts of wood with each pass, the Industrial carbide cutter worked more smoothly and also left a nicer finish on the wood. The finish with the Pro-2 was a little rougher, and a small number of torn fibers were clearly visible.

Sanding

The Sanding Kit fitted to a high-speed grinder is the most versatile angle sander I've used (excluding random-orbit finishing sanders, which are intended for a different use). The pad

comes packaged with one disc of each available sanding grit and an adapter nut to fit the Makita grinders.

The abrasive action of a small disc mounted on a high-speed grinder depends on a simple matter of mathematics. A typical angle sander with a 7" disc turning at 1200 rpm has a tip speed of roughly 25 mph (2,200 feet/min.). The grinder and sanding-disc combination, running at 10,000 rpm, has a tip speed close to 120 mph (10,500 feet/min.)—giving almost five times the cutting action.

Considering the high speed of a grinder, I was concerned about burning the adhesive that binds the abrasive to the cloth-backed pad. I also wondered whether the hook-and-loop could hold its grip under a heavy load.

Using high pressure on the red oak, I found that the loss of abrasive was hardly noticeable. The pad remained relatively cool, and the hook-and-loop held fast. The sanding pads, 1934 Sialac made in Switzerland, come in 40-, 60-, 80-, and 120-grit.

The fairly stiff rubber backup pad has a small amount of flex on the outer

SHOP TEST

edge to give it good control on concave surfaces. The recessed fitting under the hook-and-loop makes it ideal for sanding flat and rounded surfaces.

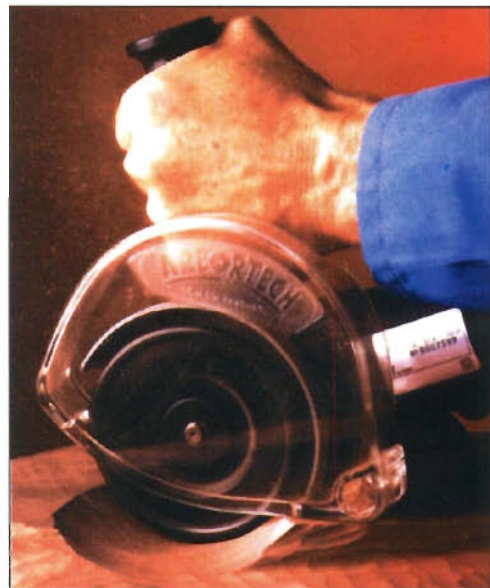
After using the woodcarver on the oak, I easily smoothed the ridges left by the cutter with 40-grit, then finished up with 80- and 120-grit for a really smooth finish. The 4"-diameter disc allows better access to tight corners than the larger-diameter buffer/sander combination tools. I also found the 4" disc useful for sanding turnings on the lathe.

Conclusion

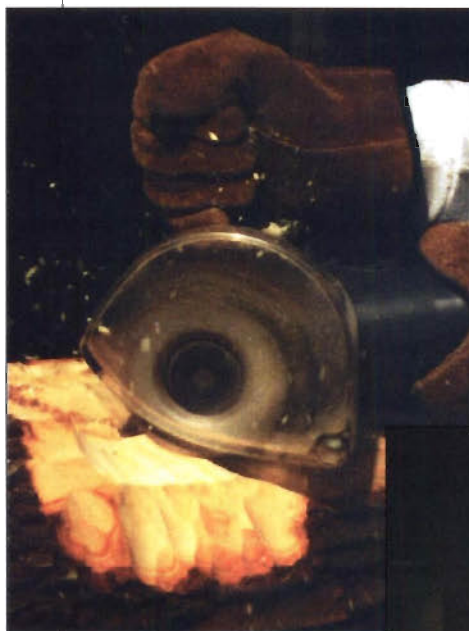
I'm planning to build a spindle-backed rocking chair with a contoured seat. Before testing the Arbortech, I had figured on hogging out the seat with a gouge, then sanding and sanding and sanding. With the Industrial cutter and sanding disc, this part of the project shouldn't take me more than a couple of hours.

The Arbortech system is soundly manufactured from quality materials. The carbide teeth on the Industrial cutter are built to last. When they do start to blunt, they can be rotated to find a new edge or even lapped on a diamond stone to touch them up. The Pro-Guard is tough and should hold up indefinitely. The sharpening stick does a quick and efficient job of touching up the teeth on the Pro-2. I found overall performance to be excellent. 

▶ The Arbortech Industrial makes quick work of forming a contoured chair seat.



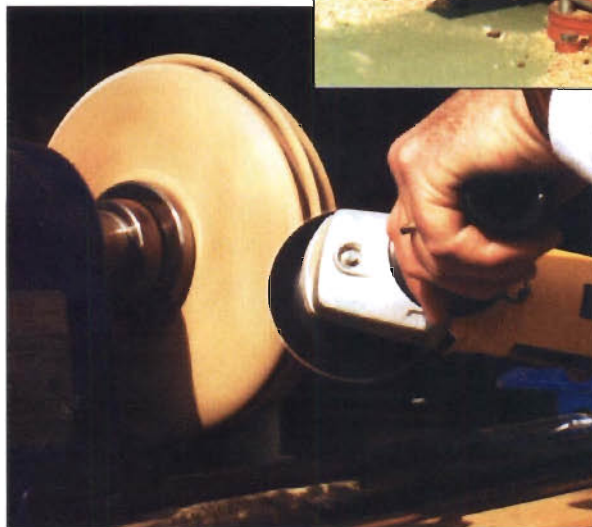
▼ The Pro-2 blade removes material quickly with little effort.



▶ The sanding attachment smooths the rough cuts made by the woodcarver.



◀ The sanding attachment is ideal for sanding turnings on the lathe.



SOURCE

For more information, contact:

Arbortech USA
5029 La Mart Drive
Riverside, CA 92507
(800) 700-8411
fax (909) 788-05026

ARBORTECH PRICE LIST

	Part Number	Price
Pro-2 Pro-Kit	WCB200	\$ 79.00
Woodcarver	WBC100 [◇]	\$ 45.00
Pro-Guard	PGU100 [◇]	\$ 29.00
Hand Sharpener	WBC010 [◇]	\$ 7.98
Power Shaper	WBC040 [◇]	\$ 13.85

Washer/Spacer Kit	ACC001	\$ 5.00
Double Handle Kit	ACC002	\$ 9.90
Sanding Kit	SAN100	\$ 19.90
40-grit (5-pack)	SAN010	\$ 6.90
60-grit (5-pack)	SAN010	\$ 6.90
80-grit (5-pack)	SAN010	\$ 6.90
120-grit (5-pack)	SAN010	\$ 6.90

[◇] Included in WCB200

	Part Number	Price
Industrial Pro-Kit	IND200	\$ 99.00
Industrial Cutter	IND100 [△]	\$ 79.00
Pro-Guard	PGU100 [△]	\$ 29.00
Teeth (3 pack)	IND010	\$ 12.90
Teeth (10 pack)	IND011	\$ 39.00
Screws (3)	IND030	\$ 9.90
Spare Key	IND040	\$ 5.00

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120-grit (50-pack)	SAN010	\$ 49.00

[△] Included in IND200

GRINDER SPECIFICATIONS

Manufacturer	Model #	Diameter	Power [†]	Spindle	Notes
AEG	WS601	.4½"	.5 amps	⅝"-11	.1
Black & Decker	2750	.4½"	.6 amps	⅝"-11	.2
Bosch	1347A	.4½"	.5.3 amps	⅝"-11	
	1347	.4½"	.5.3 amps	14-20	.metric
Chicago Elec.	1090	.4½"	.5 amps	⅝"-11	
	530W	.4"	.3.3 amps	⅝"-11	
DeWalt	DW402	.4½"	.6 amps	⅝"-11	.2, 6
Jepson	4204S	.4"	.5 amps	10-1.5	.metric
	4245S	.4½"	.5 amps	⅝"-11	
	402	.4½"	.6 amps	⅝"-11	
Hitachi	G12SA	.4½"	.6.9 amps	⅝"-11	
Makita	N9514B	.4"	.5 amps	10-1.25	.metric, 3
	N9501BZ/BKW	.4"	.4 amps	10-1.25	.metric, 3
	9503BHZ	.4½"	.5.1 amps	⅝"-11	
Master Mechanic	MM9620	.4½"	.5.5 amps	10-1.25	.metric, 2
Metabo	AG650SL	.4½"	.6.4 amps	⅝"-11	
Milwaukee	6140	.4½"	.5.5 amps	⅝"-11	.4, 6
	6145	.4½"	.5.5 amps	⅝"-13	.4, 6
Ryobi	WC400*	.woodcarver	.6.7 amps	.dedicated unit	
	G1155C	.4½"	.5.3 amps	⅝"-11	.1
Sears	27723	.4½"	.6 amps	⅝"-11	.2, 6
Skil	9611HD	.4½"	.6 amps	⅝"-11	.1, 5
	9410	.4½"	.5.5 amps	⅝"-11	.1, 5
Talon	TAG100	.4"	.5.4 amps	10-1.5	.metric
	TAG115	.4½"	.5.4 amps	14-2.0	.metric

[†] Amps x 120v = watts, 746 watts = 1 hp.

* The Ryobi WC400 is a dedicated tool; the blade and guard cannot be used on other grinders.

Notes: 1— Additional washer(s) needed under the blade to correctly position the blade.

2— ACC001 washer/spacer kit required.

3— ACC002 double handle kit required to mount Pro-Guard.

4— A 4½"x⅝" (longer then supplied) bolt is required to mount the Pro-Guard.

5— Request template to drill mounting hole in the metal blade guard.

6— Two handle positions available.

PRODUCT NEWS

Continued from page 10

large mitering and cut-off jobs. With the fence in the rear position, the sliding table enables cutting of plywood and other oversized stock up to 36" wide. Set the fence at the 45° miter setting, and you can miter stock up to 28" wide. With the fence at 90°, the attachment handles cut-off work up to 25½" wide.

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For more information, see a dealer or contact Delta International at 800/438-2486.



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Disk Clock, Tenon Jig, Dictionary Stand, Shaker
Slat-Back Side Chair; *Articles*: Selecting a
Production Project; More About Warped Boards;
About Router Bits; Sliding Dovetail Joints.

Vol. 11 No. 3 May-June '87 (Item #8705)

Kitchen Canister Set, Riding Biplane,
Contemporary Serving Cart, Napkin Holder,
Decorative Planter, Country Vegetable Bin,
Medicine Cabinet, Drum Sander, Vienna
Regulator Clock, Display Pedestal; *Articles*:
Penetrating Oils; The Jointer; Veneer, Part 1;
Dovetail Key Butt-Miter.

Vol. 13 No. 2 Mar-Apr '89 (Item #8903)

Adirondack Settee, Country Village, 18th-Century
Tilt-Top Table, Toy Fishing Trawler, Two Trivets,
Folk-Art Cow, Greek Revival Birdhouse, Pine
Armoire, Oriental Mirror; *Articles*: Transferring
and Enlarging Patterns; Making Tripod Legs;
Three Easy Finishes for Pine; The Portable Circular
Saw.

Vol. 13 No. 6 Nov-Dec '89 (Item #8911)

Mission Style Trestle Table, Jewelry Box, Kids'
Bobsled, St. Nick Carving, Carousel Toy, Box
Drum, Dancing Man Folk Toy, Towel Rack,
Secretary Desk, Bed Tray; *Articles*: Mortising
Butt Hinges; Dado Heads; Marquetry; The Empty
Window Method; Aniline Dyes; Lynes Unlimited;
Making Toys in a Kansas Chicken Coop.

Vol. 14 No. 5 Sep-Oct '90 (Item #9009)

TV/VCR Cabinet w/Pocket Doors, Shaker
Woodbox, Cabinet with Punched Tin Doors, Sushi
Set, Carved Pineapple, English Cutlery Tray, Toy
Train Set, Workbench, Portable Tool Chest;
Articles: Files and How to Use Them; Compound
Angle Dovetails; Water-Based Finishes; Making
the Slip Joint; Shop Test: 6 Dovetail Jigs.

TV and VCR Cabinet Sep/Oct '90



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Kids' Bobsled Nov/Dec '89



Vol. 16 No. 5 Sept-Oct '92 (Item #9209)

Early American Pine Hutch, Child's
Windsor Chair, Universal Table Saw
Jig, Convertible Step Stool/Chair,
Finger-saving Plastic Bag Handle,
Acrobatic Bear Folk Toy, Kids' Kitchen
Playcenter, Easy-build Bookshelves;
Articles: Amps vs. Horse-power; An
Introduction to Chairbuilding; Vacuum
Turning; Tool Review: Benchtop Table Saws.

Vol. 16 No. 6 Nov-Dec '92 (Item #9211)

Gov. Winthrop Slant-front Desk, Futon
Bed/Couch, Low-cost Router Table, Toy
Livestock Truck, Heirloom Jewelry Box, Scroll-
sawn Nativity Scene, Early American Doll Bed,
Router-built Wall Cabinet; *Articles*: Stick and
Cope Doorbuilding; Linenfold Carving; Tool
Review: High-end Scroll Saws.

Vol. 17 No. 3 May-June '93 (Item #9305)

Country Pie Safe, Collapsible Basket, Intarsia:
Humpback Whale, Classic Jewelry Chest, Skittles
Game, Porch/Yard Swing, Handsaw Caddy,
Shaker Wall Cabinet; *Articles*: Doweling Jigs,
Taming the Hand Scraper; Shoptest: Porter-
Cable's Pocket Hole Cutter.

Vol. 17 No. 4 Jul-Aug '93 (Item #9307)

Early American Corner Cupboard, Gossip Bench,
Band Saw Cutoff Table, Roaring 20's Sports Car,
Pussycat Napkin Holder, Aerobic Step, Desktop
Bookshelf, Cherry Letterbox w/Mountain Scene
Relief Carving; *Articles*: How to Buy Wood;
Incised Lettering; Choosing and Using Sharpening
Stones; Shoptest: The Inera Jig System.

Vol. 17 No. 5 Sep-Oct '93 (Item #9309)

Intarsia: American Eagle, Blockfront Chest, Super
Box Joint, Old Fashioned Farm Table, Sunset
Rider Desk Set, Scroll-sawn Bunny Puzzle, Quilt
Crane, Magazine Slipcases; *Articles*:
Pennypincher's Clamp Organizer; How to Flatten
Rough Stock; Faux Antique Cracked Finish; Tool
Review: Benchtop and Mini Lathes; Shoptest:
Safe-T Planer by Wagner.

Vol. 17 No. 6 Nov-Dec '93 (Item #9311)

Old-Time Icebox, Contemporary Jewelry Box,
Windowpane Mirrors, Miter Gauge Fence, Toys
(Boat, Helicopter & Truck), Noah's Ark & Scroll-
sawn Animals, Victorian Wall Shelf, Kids'
Modular Furniture Set, Santa Carving; *Articles*:
How to Rip and Crosscut on the Table Saw;
Getting Started in Carving; Turning Bricklaid
Bowls; Shoptest: Laguna Tools Mortising Table;
Tool Review: Random-Orbit Palm Sanders.

Vol. 18 No. 3 May-June '94 (Item #9405)

Through-Dovetail Jig, Woody Wagon Toy,
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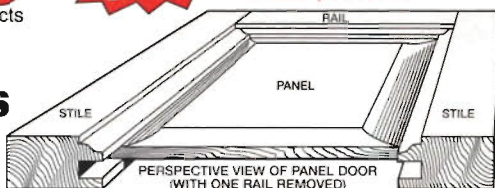
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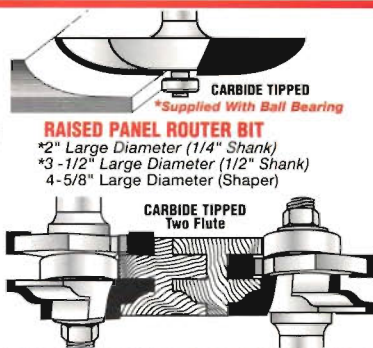
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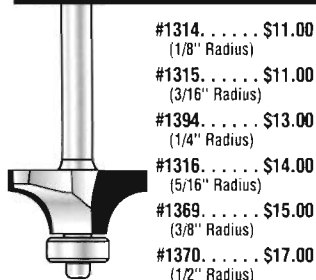
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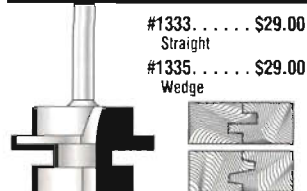
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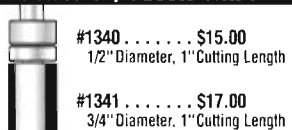
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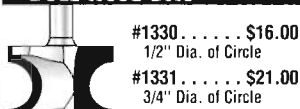
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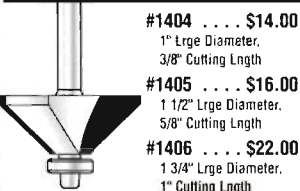


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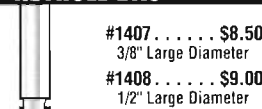
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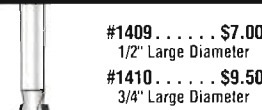
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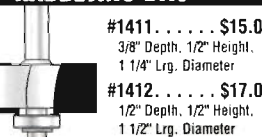
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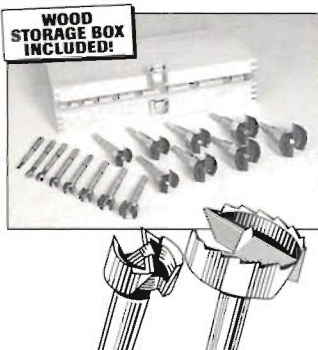
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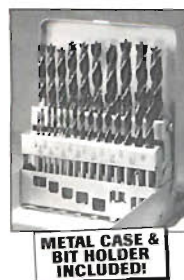


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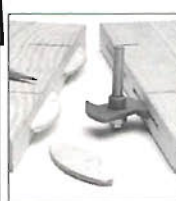
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