AMERICAN WOODWORKER™

OCTOBER 1995 #47

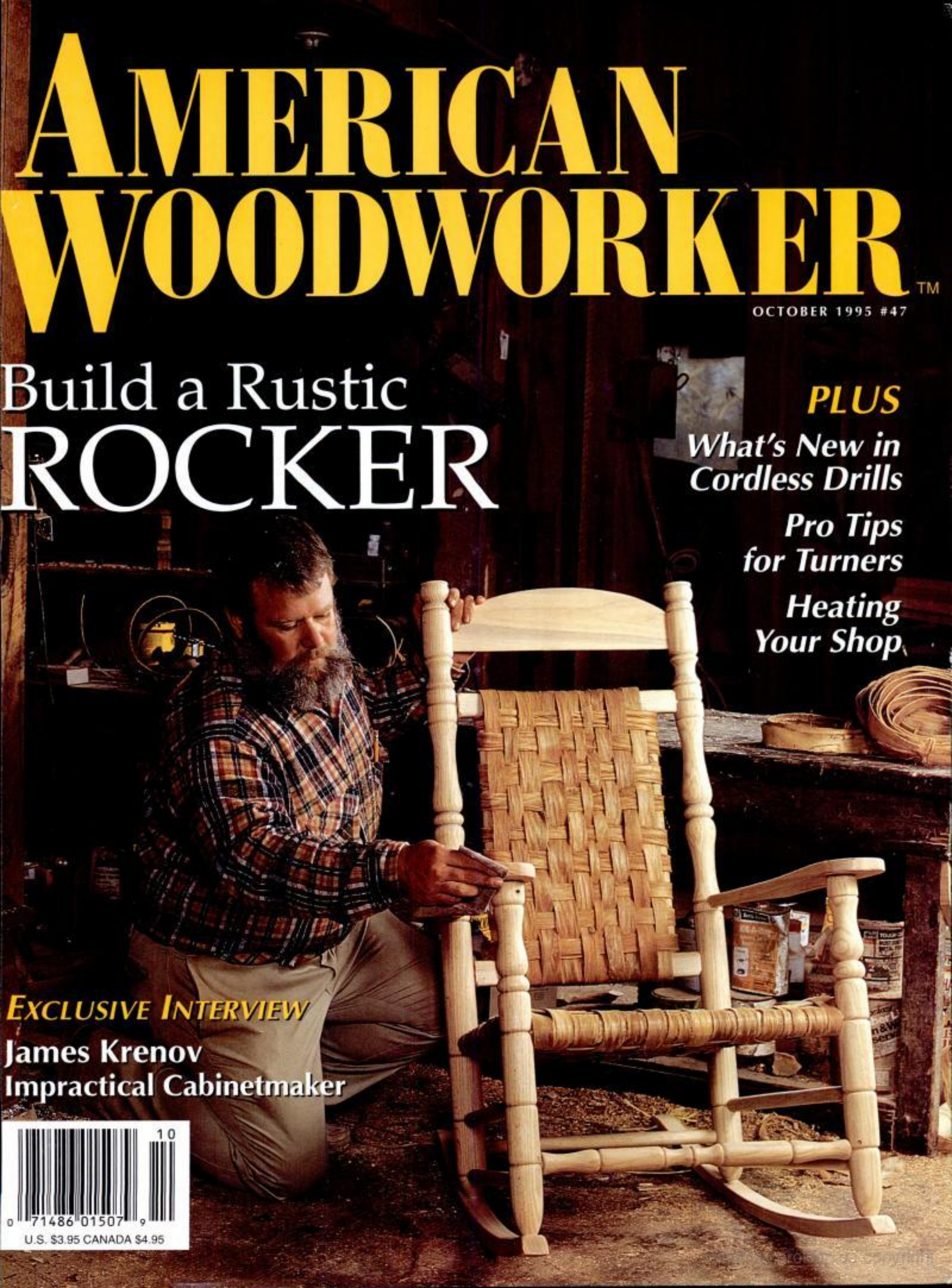
Build a Rustic ROCKER

PLUS

What's New in Cordless Drills

Pro Tips for Turners

Heating Your Shop



EXCLUSIVE INTERVIEW

James Krenov
Impractical Cabinetmaker

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AMERICAN WOODWORKER

Issue No. 47 October 1995

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DEPARTMENTS

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FEATURES

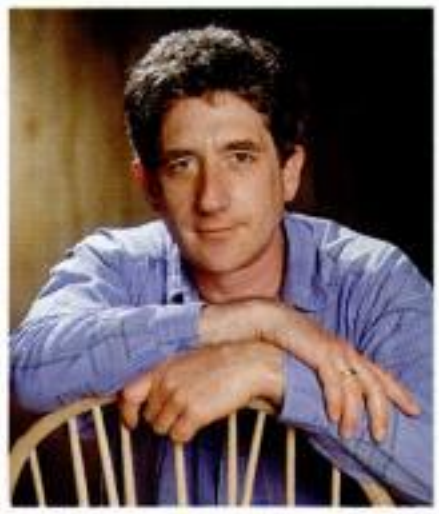
A RODALE PRESS PUBLICATION

On the cover: *Mississippi chairmaker Greg Harkins has made traditional, green-wood rocking chairs for U.S. Presidents and common folk alike. To build your own rocker, see page 78.*

COVER PHOTO BY BILL RAY

A WORD FROM THE PUBLISHER

The 1995 Woodworking in America Show™



Mark your calendars! This fall, AMERICAN WOODWORKER is hosting the biggest woodworking event of the year: the 1995 Woodworking in America Show™. This blow-out event takes place Friday, Saturday and Sunday, November 10-12, 1995 at the Fort Washington Expo Center in Fort Washington, PA (just outside of Philadelphia).

The 1995 Woodworking in America Show™ is like no other woodworking show you've seen. The emphasis is on learning, and we've put together a stellar list of expert demonstrators that reads like a *Who's Who* of the woodworking world—including Ian Kirby, Mike Dunbar, Frank Klausz, Toshio Odate, Mark Duginske, Ben Bacon and others.

Come meet these master craftsmen and see them demonstrate their skills in hands-on workshops and seminars. They'll cover a wide expanse of woodworking topics including furniture making, joinery, carving, hand-tool and power-tool techniques, Windsor chairmaking, woodturning and more. Check out our working exhibit of vintage 19th-century woodworking machines—all fired up and running on an original antique steam engine and lineshaft. Whatever your woodworking interest, you'll learn some new tricks at the Woodworking in America Show™.

And don't miss a chance to meet our special guest, Norm Abram, the well-known TV host of "This Old House" and "The New Yankee Workshop."

And if you need a few things for your shop, the Woodworking in America Show™ offers a unique opportunity to check out the latest in woodworking tools and equipment and take advantage of show-special prices. More than 100 exhibitors will be selling everything from the latest in power tools to hard-to-find hand tools, to specialty hardware and supplies. Bosch, CMT, Delta, DeWalt, Freud, Garrett Wade, Porter-Cable and Woodcraft are just a few of the many quality manufacturers and retailers you'll find at the show. You've never seen so many woodworking tools under one roof!

At AMERICAN WOODWORKER, we've built our reputation by publishing in-depth, accessible information that shows woodworkers how to do things right. At the 1995 Woodworking in America Show™ we'll bring the pages of AMERICAN WOODWORKER to life.

Don't miss it! Bring the coupon between pages 8 and 9 to the show for a dollar off the admission price.

David Sloan
Editor & publisher

SHOW INFORMATION

For more information about the Woodworking in America Show™, call Show Coordinator Lisa Unruh at (610) 967-8588. For travel and hotel reservations, call Rosenbluth Travel at (800) 841-8386.

PLAY IT SAFE

Woodworking can be dangerous. Safety equipment such as guards, hold-downs, goggles, dust masks and hearing protection can greatly reduce your risk of injury. But even the best guard won't make up for poor judgment. Use common sense and caution in the workshop. If a procedure feels dangerous, don't try it, no matter how many other folks work that way. Figure out an alternative that feels safe. Your safety is your responsibility.

AMERICAN WOODWORKER

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The Audit Bureau Member

LETTERS

Heavenly Hardwood Hints

A few notes to add to your story "Heavenly Hardwood" by Tim Snyder (AW #46). I keep seeing the word "exotic" being used in selling patterned or figured domestic woods. As a wood dealer/supplier for 18 years, I feel this is misleading. In our business, exotic has always meant "foreign, not native or imported." Many might think this is being a little too picky. But I can only see this as a way to charge new woodworkers a lot of money. Also, just a few tips when purchasing woods:

1: Buy when you have time and extra money to build your stock. You will most likely find better quality and price if you have patience.

2: Label name, date of purchase, cost, and where you bought the wood. This will help you identify the wood when it is unsurfaced and hard to tell as it ages. The date lets you know if it is climatized to your area and ready to use. Having the name of the dealer on the wood will be helpful if you need more of the same.

3: Look at buying figured or exotic hardwoods as an investment. High-quality woods are more in demand than ever before. People are now taking older furniture and musical instruments apart to use the wood on new items.

Mitch Talcove
Tropical Exotic Hardwoods
of Latin America
Carlsbad, CA

Extra Source for Concealed Hinges

In last issue's article on concealed hinges for cabinets, we omitted a major supplier of concealed hinges: Woodworker's Hardware. Call or write for a free catalog: Box 784, St. Cloud, MN 56302, (800) 383-0130. Woodworker's Hardware also sells other 32mm-system hardware.

Affordable Combination Plane

I enjoyed Ed Hobbs' article on tongue-and-groove planes (AW #45), and also Mike Dunbar's comments regarding the use of matched planes. One comment: If you want to purchase a combination plane today, there is a more affordable alternative to the $500 Paragon Multiplane. Stanley sells an English-made combination plane (No. 12-250) with a basic set of 18 cutters that include plow, rabbet, beading and tongue cutters. It retails for $150 or less.

Modern multiplane. *Inspired by classic antique multiplanes, Stanley's No. 12-250 combination plane comes with 18 standard cutters.*

With its rosewood handles and fences, the Paragon Multiplane is the lineal descendant of the Stanley 45 and 55 planes. Stanley's less expensive multiplane has a plastic handle and a more utilitarian appearance (see photo, above), but it gets the job done just the same. In the Stanley plane, the cutters are held in slots in both the main body and the sliding section. This allows accurate and firm adjustment of the cutter and the skates.

While few hardware stores stock the 12-250 plane, you can order the tool through the mail. Contact either Tool Traditions (800-453-6736) or the William Alden Company (800-249-8665). Wood is wonderful!

John Alexander
Baltimore, MD

Filters for Shop Vacuums

Your review of shop vacuums (AW #45) was very helpful and very well done. I have a large Sears vacuum (not like the really big one reviewed) and a small Shop-Vac. I find that my Sears filters do not last very long, usually as a result of one of the integral rubber gaskets breaking after removing the filter several times to clean it. The problem is that Sears now charges more than $16 for a replacement! From the quantity of replacement filters in stock at my local Sears store, it appears that the filters are purchased frequently. For future reviews, information about filter durability and replacement costs would be helpful to readers who are deciding which unit to buy.

Karl C. Thomas
Columbia, MD

Questioning Clamp Pressure

I have a question about the advice Lonnie Bird gives in his article "Gluing Up" (AW #44). Bird says "Remember that you only need enough clamping pressure to close the joint....too much force only serves to squeeze most of the glue out of the joint and weaken it."

In Bruce Hoadley's book, *Understanding Wood* (1980, Taunton Press, Newtown, CT 06470), Hoadley offers different advice on clamping force: "Clamping pressure should be adjusted according to the density of the wood.

(continued on page 10)

STAY IN TOUCH! ***If you have comments, corrections or news to share, we want to hear from you.***

- To write us, address letters to: **Editor, American Woodworker, 33 E. Minor St., Emmaus, PA 18098.**
- You can fax us at **(610) 967-7692.**
- Too busy to write? Call our Letterline: **(610) 967-7776.**
- For e-mail correspondence, American Woodworker's America Online address is: **AWLetters** Through the Internet, use **AWLetters@aol.com**

= Electronic Mail

For domestic species with a specific gravity of 0.3 to 0.7, pressures should range from 100 psi to 250 psi. Dense tropical species may require up to 300 psi."

Using Hoadley's data, a typical panel glue-up involving two 3/4-in.-thick maple boards with clamps every 9 in. (in the middle of the 6-in. to 12-in. range recommended by Bird) would require some 1,350 lbs. of clamping force from each clamp. But according to Hoadley, pipe clamps are capable of only 1,120 lbs. of clamping force.

My question is this: What is the proper amount of clamping force to apply? Should I follow Bird's advice and apply just enough pressure to close the joint, or should I follow Hoadley's advice and clamp for all I'm worth?

William T. Walker
Evergreen, CO

Bird replies: *The amount of clamp pressure required is in direct proportion to the trueness of the joint members and the number of joints in an assembly. A well-made edge-to-edge joint should require very little clamp pressure. Large assemblies with multiple joints that are less than perfectly true will require greater pressure to bring all the members into contact. (A laminated benchtop is a good example.)*

From a practical standpoint, I would disregard clamp pressure in psi and instead focus on achieving good close-fitting joinery. Also, experiment with clamp pressure and position by first dry clamping an assembly. I think you'll find that pipe clamps exert more than enough pressure to close a well-made joint. My own experience has been that "clamping for all you're worth" usually indicates a joint problem.

More on the AW Router Table

I built the router table almost exactly as it appears in the article (AW #44), and I'm more than satisfied with the results. Just a couple of changes: I made the stand out of oak instead of maple—it looks like a piece of furniture. Instead of using biscuit joints at the corners and bottom of the case, I made simple dado joints. I painted the inside of the router compartment and the dust collector with high-gloss enamel for a smooth surface that promotes dust movement.

Here are some difficulties I had. **1:** Getting the box and the top to sit perfectly flat. **2:** I bought 20-amp electrical supplies, did the wiring and discovered I couldn't plug it into anything in my house. Switching to 15-amp supplies solved the problem. **3:** I had a little trouble drilling the Lexan window. The bit grabbed and kicked up some burrs, hurting the cosmetics a smidge.

Overall I think the project is a greatly satisfying one. I plan to use it with my new INCRA Jig. I can recommend building this table; the design is excellent and it's fun to build.

TomPanone@aol.com
Thomas O. Panaccione
Enfield, CT

LETTERS

I've been wanting to build a router table for several years. I'm glad I didn't because your router table in the April issue looks great. Once I figure out how to adapt your bit height adjuster to my routers, I'll get started. The externally mounted crank mechanism for bit height adjustment is a fine idea.

Dick Dorn
Oelwein, IA

In Praise of Old Wood

"An old board...twice the value of the same piece new from the lumberyard. Each old board has its own individual history, always unknown, but always some degree of guessability from the kind of wood, its dimensions, its nails, screws or paint or lack of it, its wear or decay." A pile of old wood is a "collection of personalities...an anthology of human strivings..."—from *A Sand County Almanac,* by Aldo Leopold.

"We work with boards from these trees, to fulfill their yearning for a second life, to relearn their richness and beauty."—from *The Soul of a Tree,* by George Nakashima.

After 25 years of shaping "new" wood I have now turned to old discarded wood that was tossed aside when someone decided it had no further use. I value the many marks of age: weathered grays, cracked paint, blackened nail holes, the lighter outline of a hinge, the cracks and checks.

When I use this time-worn wood to make new objects (doors, for example) no amount of staining, chemical applications or "distressing" can match the beauty and charm of this wood in its "found" condition.

JBarn@aol.com

Book information: A Sand County Almanac, by Aldo Leopold (1989, Oxford University Press, 2001 Evans Rd., Cary, NC 27513). The Soul of a Tree: A Woodworker's Reflections, by George Nakashima (1988, Kodansha America, 114 Fifth Ave., 18th Floor, New York, NY 10011).—Eds.

More on Screws

I enjoyed Paul Anthony's excellent article on wood screws in the June issue (AW #45). I can't resist pointing out that the square recess drive for screws originated in Canada. Its inventor, Mr. Peter L. Robertson of Milton, Ontario, began production of the screws and drivers in 1908. The plant he built is still part of the modern facility in operation there today.

Tom Gaspick
Scarborough, Ontario

The "silicone bronze" coating you refer to in "Screws for Woodworking" should instead be silicon bronze.

Glenn Rees
Singapore

Mr. Rees is correct.—Eds.

Q&A

Wood for Food

Q What woods are best suited to making food utensils? Are there any toxic woods I should avoid? What's the best food-safe finish?

Peter Barnell
Los Angeles, CA

A Hard, close-grained woods are the best choice for food utensils. Hard woods are not only stronger than soft woods; they also finish nicely and stay smoother in service. Close grain keeps food from lodging in open pores.

Many domestic fruitwoods fit the bill nicely. I prefer cherry, apple, pear, apricot and plum wood. Unfortunately, these woods—with the exception of cherry—are not commonly available at lumberyards. For this reason, I primarily use cherry for producing quantities of utensils. Maple, birch and beech are also good and commercially available.

Although I don't use tropical woods, I recently called the USDA Forest Products Laboratory to inquire about their safety for use with food. I was told that any latent toxicity is negligible in the wood's finished form. Allergic reactions would more likely come from breathing the dust when working the wood. I was also advised that color which leaches from the wood into cooking water is basically a natural food coloring and only of concern to people with extreme sensitivities.

I use mineral oil as a finish. It's odorless and won't turn rancid like many food oils. I avoid polymerized, hardening oils because I worry about them melting into hot cooking oil during stir-frying or other high-temperature cooking.

Jonathan Simons
Jonathan's Spoons
Lenhartsville, PA

Saw-Blade Stabilizers

Q I bought a blade stabilizer recently to see if it would improve my saw cuts, which were already pretty good. I tried it on both my tablesaw and my radial-arm saw. The difference, if any, is negligible. So what's the purpose of these "support collars"? Do they flatten warped blades or reduce arbor runout?

Stan Bukowski
Fort Wayne, IN

Screwless Lathe Attachment

Q I'd like to know more about faceplate attachment. How can I avoid screw holes in my finished pieces?

L. Via
Saugerties, NY

A Screwless attachments commonly involve gluing or taping the workpiece to a waste block which is screwed to the faceplate.

Some turners glue the workpiece to the waste block with a piece of heavy construction paper. This *paper joint* allows you to break the finished piece free by wedging a chisel into the joint. The danger is, the work can be thrown free if your turning tool catches. I wouldn't use this method for work larger than 10 in. dia. or deeper than 4 in.

Alternatively, you could use professional, double-sided carpet tape (not the supermarket stuff). This tape is fine for work smaller than 6 in. dia. and 3 in. deep. Just be sure to press the pieces together well in a clamp or vise before mounting on the lathe. The joint can be difficult to disassemble, however, and—as with the paper joint—the attached surface must be cleaned after turning.

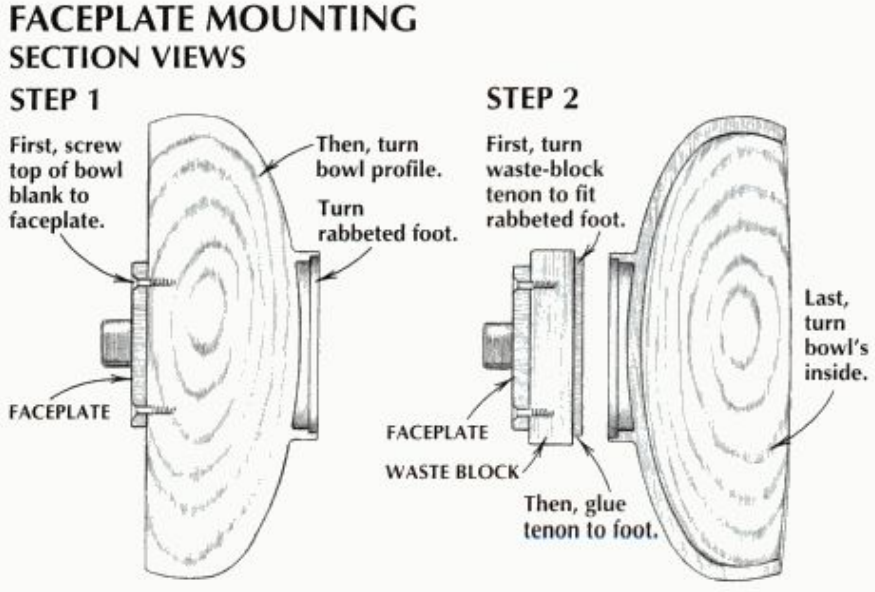
Here's a stronger method that leaves no screw holes or excess glue:

First, screw the faceplate to the bowl blank's upper face and turn the outside of the bowl. Create a hollow foot like the one shown in Step 1. When rabbeting in the foot, engage the tailstock to help insure accuracy. Use a waste block or pad under it to avoid marring the bottom of the bowl.

Next, make a faceplate waste block with a tenon that matches the rabbet in the bowl's foot. (See Step 2.) Glue the bowl to the waste block with medium-viscosity cyanoacrylate glue, and then turn the bowl's interior. (The screw holes from the first step will disappear with the shavings.) To remove the bowl, carefully part most of the way through the foot connection at low speed. Then rap it sharply with the handle of your parting tool. Clean up the thin jagged edge with a sharp skew and sandpaper.

If you find yourself doing a lot of faceplate mounting, consider investing in a good lathe-chucking system, which greatly simplifies the process. (See my article on lathe chucks in AW #43.)

Steve Blenk
Contributing editor to AW
Sequim, WA



Q&A

A Saw-blade stabilizers dampen vibrations in a running blade, reducing both noise and workpiece tearout. Although they won't give you a miracle cut on a badly warped blade or reduce arbor runout, they can improve cutting on a blade in good condition.

Normally, I only use stabilizers when cutting with thin-kerf blades. A stabilizer helps stiffen these blades, which tend to deflect during cutting. I use a stabilizer on a standard 1/8-in.-kerf blade when I'm cutting veneer plywood because it gives me the least tearout.

I usually mount a single stabilizer on the left side of the blade. However, when using an "ultra-thin" (0.064-in.-kerf) blade, I sandwich it between two stabilizers for maximum rigidity. If you sandwich the blade, remember to reset your saw fence cursor if you have one: A stabilizer to the right of the blade changes the blade's reference to the fence.

Depending on diameter, stabilizers will limit your depth of cut, so you may want to buy a couple of sizes. I use several stabilizers with diameters ranging from 3 to 6 in.

Matt Ver Steeg
Professional sharpener
and saw-blade designer
Carlisle, IA

Dressing Waterstones

Q I recently bought a couple of waterstones: an 800 grit and a 6,000 grit. After sharpening my plane irons and chisels, the faces of the stones are dished out. How do I dress them?

Larry Miller
Archdale, NC

A First, I suggest you get an intermediate stone. Moving from 800 to 6,000 is a big jump. It costs you a lot of time to work out the 800-grit scratches on your 6,000-grit stone. A 1,000- or 1,200-grit stone would help a lot.

I dress my waterstones every time I use them by rubbing them against each other—the coarse against the medium and the medium against the finish stone. If you rotate the faces as you rub, you won't transfer irregularities from one face to the other. You can recognize the flattened areas of the stones by the clean, even slurry that the rubbing produces.

As an alternative, you can dress stones on wet-or-dry sandpaper laid on a sheet of plate glass. Water sprinkled on the

WHERE TO FIND IT

Granite surface plates (for flat reference) are available from Enco, (800) 873-3626.

Cut nails are available from Tremont Nail Co., Box 111, Wareham, MA 02571, (508) 295-0038.

Spanish cedar is available by mail from Colonial Hardwoods, 7953 Cameron Brown Ct., Springfield, VA 22153, (800) 466-5451.

glass will hold the paper in place. Lubricate the paper with water as you rub the stone on it.

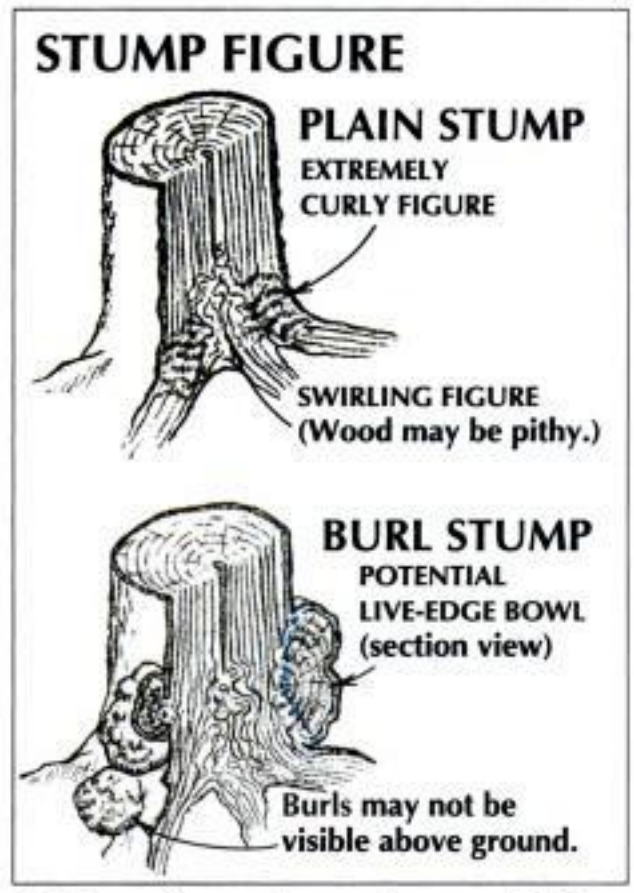
Paul Anthony
Assistant editor

Figuring Out a Stump

Q Can you give me advice on milling a walnut stump to yield any burl figure?

Walter Johnson
Columbus, MS

A First, stumps don't necessarily contain true *burl*—a conglomeration of dormant buds. Some people use the expression "root burl" as if it exists at the root of every tree. I wish it did, but in fact, all except one of the walnut stumps I've ever cut up contained mostly mild, swirling figure in the center (where the wood also tends to be pithy). In many stumps, the small area where the roots meet the trunk (see drawing, right) is extremely curly, but this area doesn't yield much wood—maybe enough for a gunstock. True burl is usually found in protuberances on the tree trunk, often just above or below ground level.



To mill a stump, first wash it off well with a hose to remove stones and dirt. Using an old chain on your saw, begin by ripping the stump in half along the axis of the trunk. If there is burl or appealing figure to be found, this cut should reveal it. If you're a turner, one of the halves might make a great bowl. Or you might consider halving one of the pieces again in search of good turning or carving material.

Your other option would be to slab the stump into whatever thicknesses suit your work by making a series of cuts parallel to the first.

Michael Mode
Woodturner
Champlain Valley, VT

WOODWORKING QUESTIONS?
Send them to: "Q&A," AMERICAN WOODWORKER, 33 E. Minor St., Emmaus, PA 18098. Or e-mail them to: AWQA@aol.com

offcuts

NET NEWS

WHAT'S UP AT AW ONLINE

Online classifieds— Looking for a good deal on a used tool? Have some surplus lumber to sell? Take out a free classified ad in "The Exchange" message center on AW Online.

The Exchange is like an online flea market just for woodworkers. You'll find everything from tablesaws to bubinga to "help wanted" ads. Interested parties can respond through private e-mail or by regular mail or telephone. A section called "How to Use The Exchange" walks you through the process.

Celebrity chats—You never know who'll show up in the "Shop Talk" chat room. Earlier this year, cabinetmaker James Krenov and AW executive editor Ellis Walentine set up a laptop computer right in Krenov's workshop and fielded questions from woodworkers nationwide. Like most online chats, this one took place in the evening, at 9:30 pm eastern time.

AW Online is part of the America Online computer service. Call (800) 764-4400 for free software and 10 free hours of online time.

HARDWOOD HABERDASHERY

Johannes Michelsen turns *wearable* hats from wood. Each hat begins with a 90-lb. blank, 9 in. thick and 16 in. across, and ends up as light as a Stetson and totally weatherproof.

Before he starts a hat, Michelsen considers the grain and color of the wood, trying to envision the finished product.

After turning, he embellishes the hats using "crayons" of exotic wood held against the spinning workpiece. Rosewood gives a red, ebony a black, and padauk a burnt-orange stripe.

Michelsen finishes with 15 to 20 coats of lacquer and many careful sandings, including a final 320-grit hand-sanding.

For more on Michelsen's hats, call (802) 362-3481.

—Pat Nichols

Hard hats. *Above, Michelsen turns a hardwood hat on the lathe. At right, he models a finished piece.*

BOATBUILDING, HAWAIIAN STYLE

Pete Balin has undertaken a project of Pacific proportions: He's building a traditional Polynesian boat, and he plans to sail it from San Francisco to Hawaii.

Balin, a native Hawaiian, explains that this type of canoe is 30,000 years old. Measuring 90 ft. long, it could hold an entire village—up to 300 people—and was used to escape war and famine.

The boat was traditionally made from a variety of ironwood and was lashed together with ropes made from coconut fibers. The prow bore the head of a *moa,* a flightless bird that is now extinct.

Balin hopes to complete his full-size boat before the year 2000. Donations are gratefully accepted. Write: Pete Balin, P.O. Box 105, San Francisco, CA 94133.

Reviving a tradition. *Pete Balin poses with a model of the 90-ft. traditional Polynesian canoe he's building to sail to Hawaii.*

VOLUNTEERS: MINWAX WANTS YOU!

Minwax Co. seeks entries for its 1995 Community Craftsman™ Award. Individuals, communities, groups, associations or companies are eligible. Nominees must be engaged in an activity that improves the community and instills pride through woodworking. The winner will receive a $2,500 grant and Minwax products.

Send a brief description of the nominee and their woodworking activities to: 1995 Minwax Community Craftsman Award, c/o Minwax PR Dept., Gilbert Whitney & Johns, 110 S. Jefferson Rd., Whippany, NJ 07981. To qualify, entries must be postmarked by October 31, 1995.

A MASTER CARVES CAROUSEL HORSES IN THE MINNESOTA NORTH WOODS

What woodworker hasn't dreamed of packing up tools and heading for the woods? Joseph Lutter did—and now he earns a living pursuing his craft. At his shop deep in the Minnesota woods, he hand-carves carousel horses with painstaking detail.

Most carousel horses have only one "show" side. But Lutter carves both sides, so his horses look spectacular from any angle.

Once a steed is carved and sanded, it's sealed with two coats of shellac and primed with three layers of enamel, with more sanding between coats. Lutter uses acrylics for coloring. "Acrylic paints move with the wood. It usually takes three coats of color to get the look I want."

Next he coats the horse with polyurethane and adds gilding and details. Then he finish-coats with polyurethane, adds jewels and eyes, and mounts the horse on its base.

Each horse takes 500 hours. Why such attention to detail? Lutter is a true craftsman: "I want each horse to last hundreds of years...I hope future generations will feel the joy and magic in what I do."

—Valerie Zehl

Master at work. *Above, carver Joseph Lutter hand-paints the details on a work in progress.*

NEW COMPANY SELLS HIGH-END FURNITURE PLANS

American Furniture Design Co. has brought together some of the country's best furniture makers to offer their designs in plan form. Participating artists include Del Cover, Garry Knox Bennett, William Ralston, Greg Harkins and AW's own contributing editor, Windsor chairmaker Mike Dunbar.

Projects are labeled according to the level of skill they require, from beginner to advanced. Each plan includes a 3-ft. by 4-ft. CAD drawing, comprehensive directions and detailed finishing suggestions, plus a picture of the finished product.

In a special arrangement with the San Diego Historical Society, the company also offers authentic plans of furniture from the California missions.

To order a catalog, send $3 to: American Furniture Design Co., Box 300100, Escondido, CA 92030.

Plans from the pros. *The American Furniture Design Co. offers furniture plans for the ambitious hobbyist. Projects include a loveseat by Paul Reiber (right) and a desk and chair by Roger Heitzman (below).*

Jim's Corner

Offbeat Answers to Common Woodworking Questions

Q: Where does the expression "elbow grease" come from?

A: Old-timers used to bend their arms frequently when doing repetitive tasks such as sanding highboys or planing down trees. "Elbow grease" was their jocular allusion to an imaginary lubricant that would make the work easier by reducing friction in the elbow joint. They also had expressions such as "sweat of one's brow." Exactly what this meant is unknown.

Q: What are the differences between basswood, linden and lime used for carving?

A: Basswood is a common American tree with light-colored, even-textured, fairly soft wood. It takes both paint and stain well, and usually needs it, because raw basswood makes even birch look like a noble timber. Carvers wanting to charge more for their work call basswood linden. Really expensive carvers call it lime.

Jim Cummins is a contributing editor to AW.

TECH TIPS

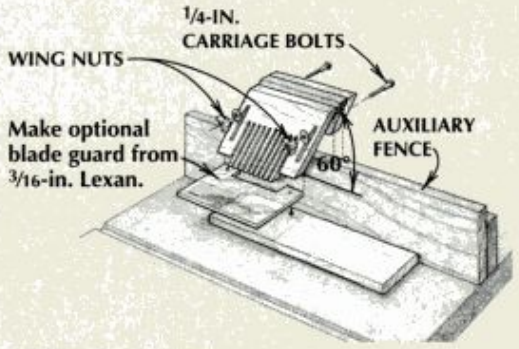
BEST TIP WINS $200

Know a better way of doing something? Designed a clever jig? Send your original woodworking tips, along with a sketch or a snapshot to: "Tech Tips," AMERICAN WOODWORKER, 33 E. Minor St., Emmaus, PA 18098. We'll pay $50 for each tip we publish and $200 for the best tip of the issue.

Boards of a Feather...

I mounted this homemade feather board on an auxiliary fence to provide both hold-down and anti-kickback protection. The wing nuts make it quick to install and adjust. The drawing shows an optional blade guard.

Frank Gregg
Dallas, TX



Bench Slave

When planing the edge of a long board, one often needs to support the end not held by the vise. My solution is to screw a steel shelving standard to the front leg

farthest from the front vise. I move a shelf-support bracket up or down on the standard according to the width of stock I am working.

Roger LaPlante, M.D.
Tecumseh, Ontario

Bullet Cleaner

You can clean files with a wire brush, but an equally effective method is to use a crimped brass bullet casing. Rub parallel to the ridges in the file—not across them. As the file wears grooves in the shell casing it will start to clean.

Paul Hamler
Snellville, GA

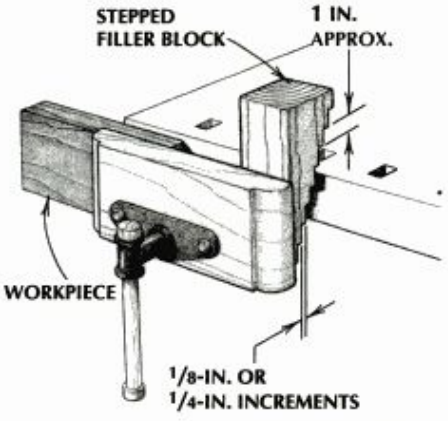
Glue Spreaders

Plastic strips, cut from detergent or bleach bottles, make great glue spreaders. I never have to clean them off because whenever I need one I just flex it a few times and the dried glue flakes off. I can also cut them to particular sizes to reach oddly shaped or hard-to-reach recesses.

Maynard Nordmoe
Knoxville, TN

Vise Helper

You can easily damage a vise by clamping wood on one side without blocking on the other. Instead of hunting around for scrap of the right thickness (and having it fall to the floor each time I release the pressure) I made up a stepped filler block as shown.



Yeung Chan
Millbrae, CA

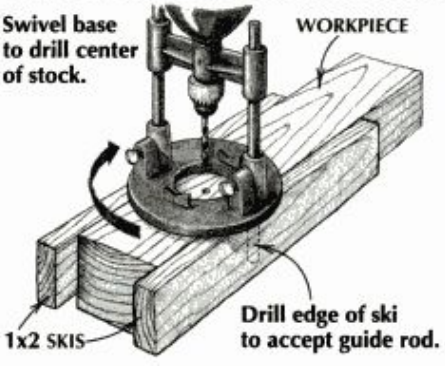
Waxing Clamps

When you've finished waxing your car, give your bar and pipe clamps a going-over, too. You'll find a coat of wax not only prevents rust but makes it much easier to clean dried glue off the metal.

Walt France
Lithia Springs, GA

Improving Portalign

I've found that adding a pair of wooden "skis" to a Portalign drill guide improves both stability and accuracy. The device is more versatile with the skis because



you can drill centered holes—even in the ends of rails. I made my skis from a pair of 12-in.-long maple 1x2s, center-drilled on their edges for a snug fit with the steel guide rods.

Edwin Borgeson
Portland, OR

Slack-Belt Sanders

Slack-belt sanders are some of the most-used tools in my carving studio. I control tension in the belt by pressing with my forefinger as shown in the sketch. The 2-in. convex tip is handy for getting into tight places. I cut the handles out of 1/2-in.-thick or 3/4-in.-thick scrap. Then I

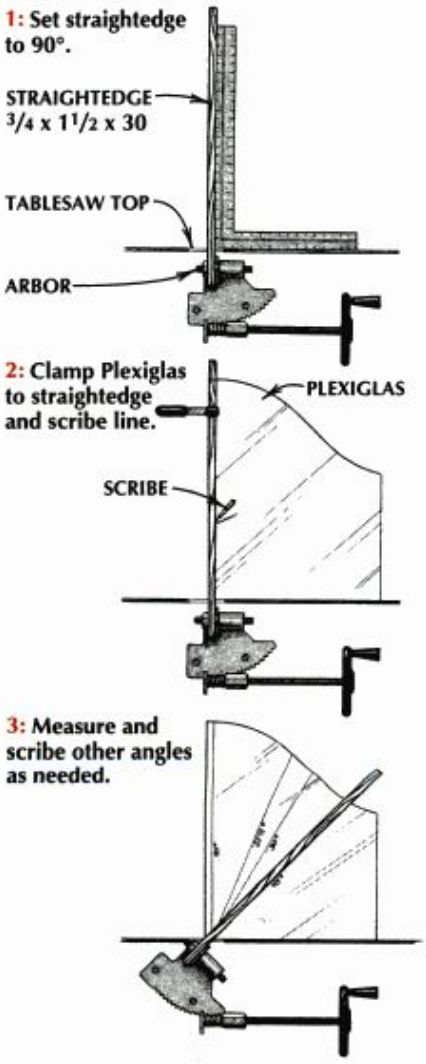
attach strips of Swiss sanding cloth with hot-melt glue. I find grits 150, 280 and 400 to be the most useful.

Chuck Malven
Bremerton, WA

TECH TIPS

Precise Tablesaw Bevel Gauge

Tilt scales on tablesaws are good only to the nearest degree. To get the accuracy needed to make the kaleidoscope featured in AW #40, I made the jig shown



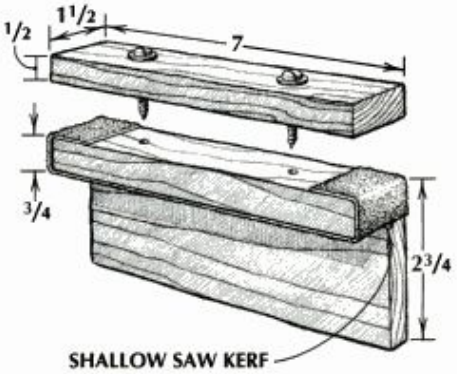
in the sketch. First, make a straightedge by drilling an arbor-sized hole 2 in. from the end of a straight piece of hardwood. Remove the blade, replace it with the straightedge and gently tighten the flange washer and nut.

1: Set the straightedge at exactly 90° to the saw table with a framing square. **2:** Clamp a piece of Plexiglas to the straightedge and scribe a line. **3:** Bisect this angle to get 45°; bisect it again for 22 1/2° and then add any other critical angles. Use this device to record an angle so the blade can be reset precisely.

Devore Burch
Fort Worth, TX

Edge-Sanding Jig

This simple jig is ideal for sanding edges dead square to a surface. I first ripped a length of 2x4 into an L-shaped section. I clamped the sanding strip with screws,

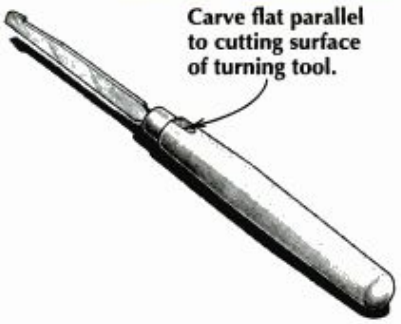


as shown, but you could equally well attach it with spray adhesive or double-sided tape. Vary the dimensions to suit your needs.

J.D. McGary
Spring Valley, MN

Indexing the Edge

When you're turning the inside of a hollow vessel, the cutting edge of the tool is often out of sight. To keep track of its position, I cut a small flat on the neck of the tool in the same plane as the cutting



surface. By placing my thumb on this flat I can feel the orientation of the cutting edge. I also carve flats in the handles of my larger lathe tools to keep them from rolling around on the bench.

Doug Ryan
Santa Clara, CA

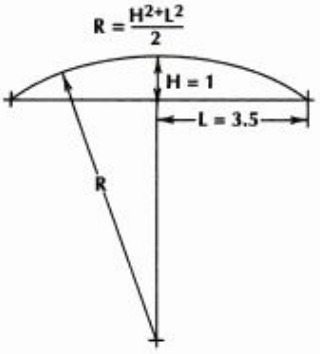
Miter-Gauge Upgrade

The tightening knobs on tablesaw miter gauges are too small to provide a good grip. Instead of resorting to locking pliers, I've replaced the metal knob with a larger wooden one off an old hand plane. To make the connection I epoxied a nut into the knob with threads matching those on the miter gauge. A lock washer completes the ensemble.

Ivor Pelikan
San Francisco, CA

Figuring Curves

Here is a quick way to figure the radius (R) of a curve when you only know the height (H) and half the length (L) of a chord. The formula derives from the work of ancient math whiz Pythagoras:



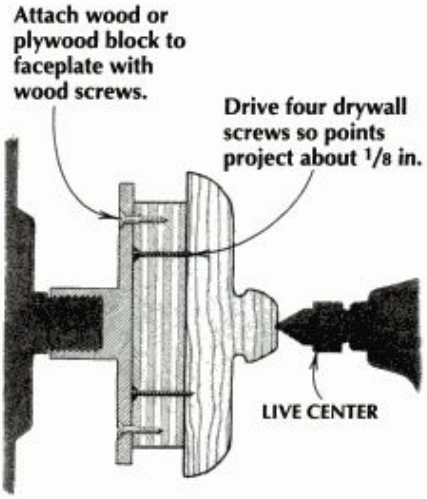
Here's an example to make it clear, based on the H and L values shown above.

$$R = \frac{1^2 + 3.5^2}{2} = 6.625 \text{ or } 6\tfrac{5}{8} \text{ in.}$$

Ray Straile
Blandon, PA

Lathe Drive-Head

When turning small objects such as bowl lids, I use a faceplate with the points of four drywall screws projecting.



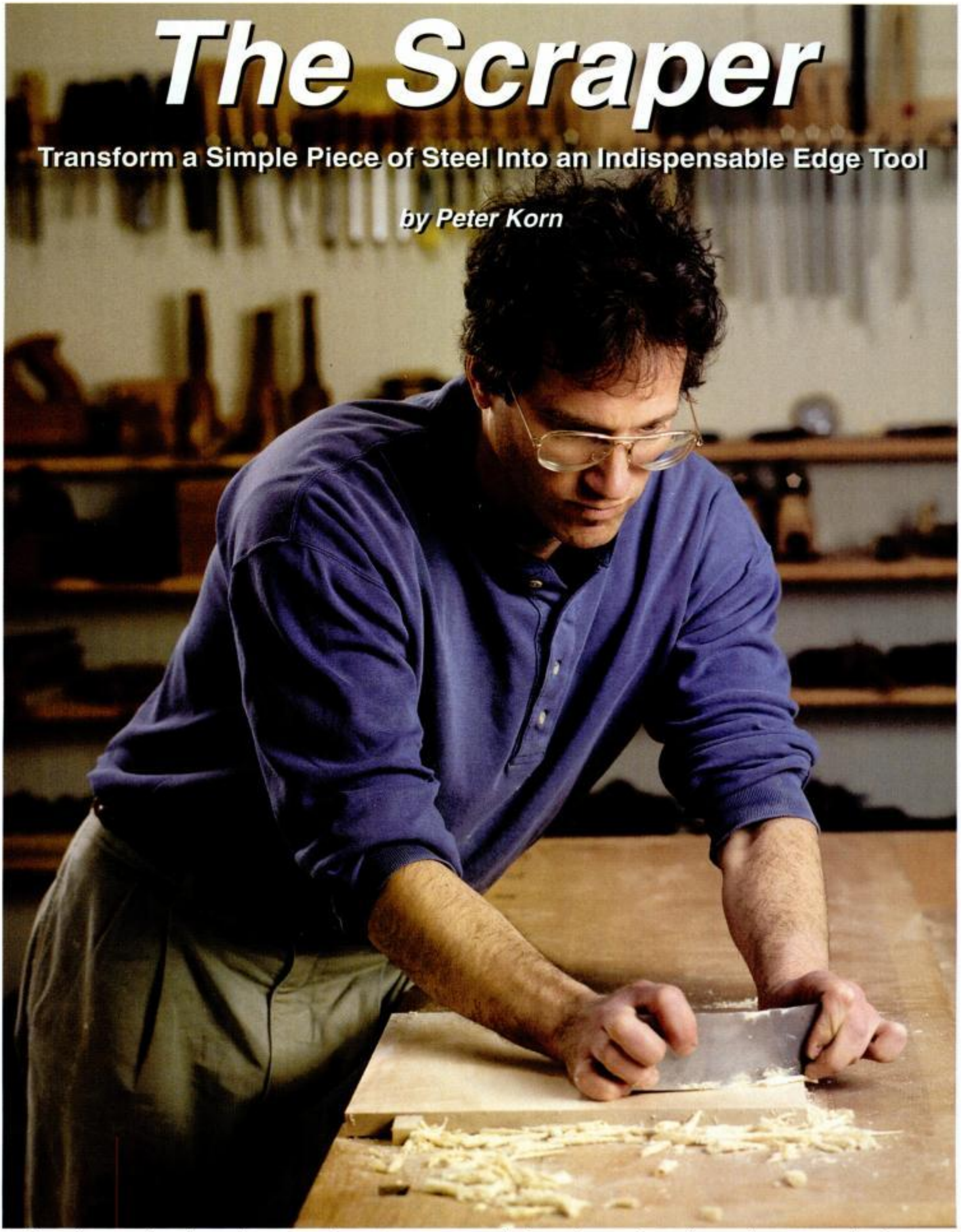
A live center in the tailstock helps to keep the work pressed firmly against the screw points.

W.J. Snowden
Tustin, CA

The Scraper

Transform a Simple Piece of Steel Into an Indispensable Edge Tool

by Peter Korn



A close shave. *Nothing beats the scraper when it's time to smooth the work. Here the author produces paper-thin shavings of maple with a freshly burnished hand scraper.*

STEP 1: SQUARING THE EDGE

Filing and honing. *With the blade clamped in a vise (left) Korn files the working edge flat and square. To hone the edge, Korn first works the blade vertically on the sharpening stone (center). He then hones with the blade held flat (right). Honing is done initially on a 1,000-grit stone, then on a 6,000-grit stone.*

The hand scraper is a paradox. It is the simplest tool in the workshop—just a thin piece of flat steel. Yet after 20 years I am still unfolding its intricacies. The hand scraper and its close cousin, the cabinet scraper, are indispensable for smoothing wood quickly and cleanly. With a little practice, you can make these tools work well for you, yet their subtleties will keep you interested for a lifetime.

Scraping vs. Sanding

The beauty of a scraper is that it takes thin shavings off of any sort of hardwood without the risk of tearout which hand-planing can entail. The surface left by a scraper can be so smooth that only minimal sanding, if any, is necessary in preparation for finishing. This is especially true when you are working with harder woods such as maple.

Scraping allows me to skip coarser sandpapers which can leave deep scratches in the wood. I like to use the scraper for removing machine marks, tearout, pencil marks, and other imperfections in the wood surface. Then I sand the wood with 150-grit paper, wet the wood to raise the grain and final-sand with 220 grit. The scraper cuts out a great deal of sanding and all the dust and machine noise that goes with it.

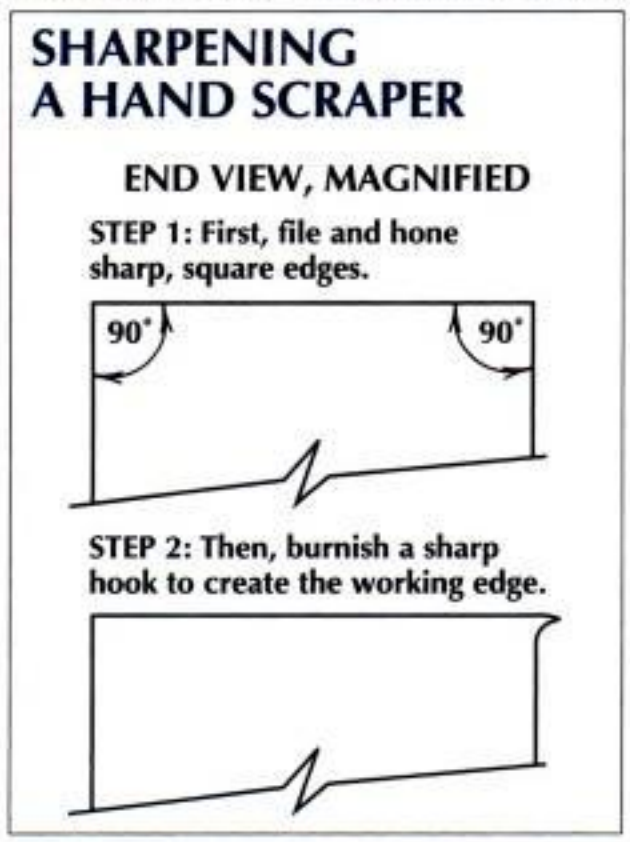
Scrapers are also good for flattening boards with wild grain. Where a hand plane might cause tearout in curly maple, for example, a scraper poses no such risk. I also use scrapers to remove hardened glue, take off veneer tape after pressing, and fair concave surfaces such as bandsawn edges and scooped-out seats. Cut and filed to different shapes, scrapers can be dedicated for smoothing specific profiles.

Choosing a Scraper

If I have to work a large, level surface, I'll usually do my scraping with a cabinet scraper. (See sidebar, page 37.) With its handles and flat sole, the cabinet scraper is less tiring to use than a hand scraper, and the blade doesn't burn my thumbs the way a hand scraper does as friction heats it up. However, the hand scraper remains my true love, probably because of the directness with which my hands comprehend the interaction of steel and wood.

Technically, a scraper is any flat piece of steel with an edge that has been burnished to form a minute hook. Hand scrapers vary in thickness, hardness, length and width. You can make a good scraper from the blade of a worn-out handsaw, but the one I use most frequently is made by Sandvik. It measures 0.030 in. thick, 2½ in. wide, and 6 in. long. The Sandvik is hard for a scraper (53 on the Rockwell scale) but soft compared to chisels and plane irons. A scraper made from softer steel is easier to burnish but dulls more quickly.

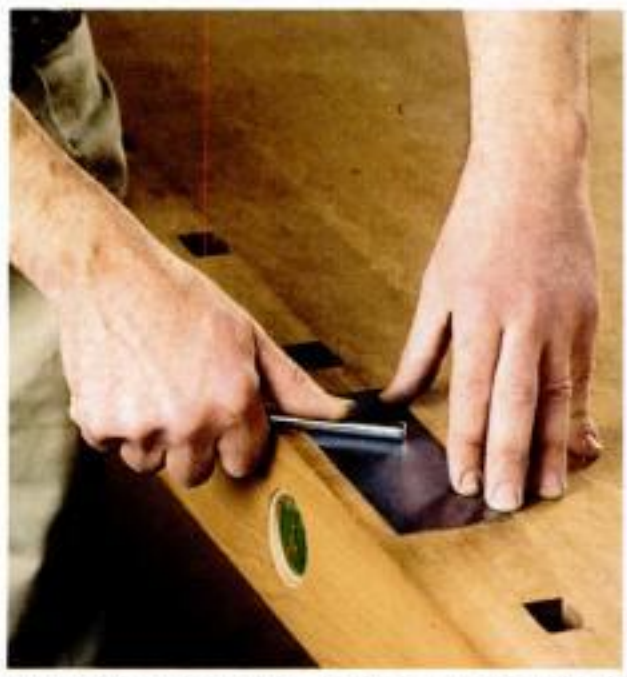
Thinner, more flexible scrapers can render wood even smoother than the Sandvik can, but they heat up quickly and seem to be less efficient. Thicker scrapers, on the other hand, aren't flexible enough to use comfortably in the typical curved position; they're better for tasks where no flex is required, such as removing veneer tape from a flat surface.



Getting the Edge

Putting a working edge on a scraper involves filing, honing and burnishing the blade. The file I use is an 8-in. mill bastard metal file, but any similar metal file will do. Honing is done with the same sharpening stones you use for chisels and plane blades. As for the burnisher, it can be round, oval, triangular or flat in section, as long as it's made of steel harder than the scraper itself. You can buy a burnisher, or make do with the back of a chisel or the shank of a Phillips screwdriver. My favorite is a highly polished round burnisher made from hardened drill rod (available from Hock Handmade Knives, 16650 Mitchell Creek Dr., Fort Bragg, CA 95437, 707-964-2782). The smoother the burnisher, the cleaner-cutting the hook will be.

STEP 2: BURNISHING THE EDGE



Drawing the burr. *Using a round burnisher, Korn pulls the edge flat in preparation for forming the burr (left). Then he begins to form a burr by holding the burnisher vertically and running it along the edge of the blade with an upward motion. To complete the burr, he burnishes with the rod held at 5° off of upright (right).*

There are many approaches to sharpening scrapers. Some pragmatists simply hit the edge with a file. For others, the rituals of tool preparation are as important as the work they produce. I fall somewhere in between. I use a filed edge for coarse work such as removing glue and a better-tended edge for smoothing surfaces.

However you get the final edge on your scraper, it's important to know how to square and then burnish the edge to create the burr, or *hook,* that is crucial to the proper performance of the tool. (See drawing, page 35.) This is my method for putting an edge on a hand scraper:

First, I file the long edges straight and square with a mill bastard or similar metal file. I clamp the blade upright in a vise, keeping the working edge of the file level as I flatten and square the scraper edge. (See left photo, page 35.)

Next I hone the long edges and the faces of the scraper on medium (1,000-grit) and then fine (6,000-grit) waterstones. (See center and right photos, page 35.) Honing creates sharp, polished right angles along the edges. When honing with the blade held vertically, keep the scraper at an angle to the line of travel to avoid grooving the stone.

After honing, I place the scraper flat on my workbench, near the edge of my benchtop. Holding the burnisher flat on the scraper with my thumb, I pull it along and off each long edge several times. (See left photo, above.) This pulls any remaining wire edge flat.

To form the hook along an edge, I extend the edge of the scraper about an inch beyond the benchtop. With the burnisher held upright at 90° to the scraper, I run it along the edge, pushing forward and up in one motion. I do this two or three times. This action deforms the edge to lift a preliminary burr.

Here we come to one of the fine points of scraping: how hard to press with the burnisher. I advise beginners to press fairly hard to be sure of creating a burr. As you become comfortable with the scraper, try burnishing more softly. A small hook cuts as well or better than a large one and can be reburnished many more times before refiling and honing.

Finally, I repeat the previous step with the burnisher held at about 5° off of upright. (See right photo, above.) This curls the burr into a hook. Two or three passes with the burnisher will suffice. A scraper burnished at 5° takes shavings in an almost upright position, which is the most comfortable working position. If you burnish at a more extreme angle, you end up having to use the scraper at a correspondingly greater angle and your knuckles begin to scrape the wood.

Using a Scraper

You can push or pull a hand scraper, but most of us to prefer to push. Hold the scraper at a slight angle forward, and with the burr away from you, push with the scraper flexed in a gentle arc. (See lead photo.) Through trial and error you'll quickly find the angle at which the edge takes shavings instead of making dust. To begin each stroke, bring the scraper gradually to the wood—like an airplane touching down. You can scrape with the grain or at a diagonal. Pushing across the grain tends to damage the surface. I find that keeping the scraper at an angle to its direction of travel makes for a flatter surface.

When a scraper makes dust instead of shavings regardless of your angle of attack, it's time to renew the hook. Several reburnishings are usually possible before you need to file and hone a fresh edge. To reburnish, simply loop back into the sharpening process at the point where you lay the scraper flat on the bench and pull the edge flat. As you learn to turn a hook with less pressure, you'll get more reburnishings between filings.

When you're learning to sharpen and use a scraper, results can be unpredictable. Don't let that deter you. There are still days when I don't get it right on the first try. A number of devices are available to make scraper preparation and use easier, including file holders, burnishing jigs, and hand scraper holders. Many of these are useful, but they diminish the aspect of scraping which I find most intriguing: the pleasure of relying on hand and eye to compel good work from this simplest of tools. ▲

PETER KORN
is a contributing editor to AW and the founder of the Center for Furniture Craftsmanship in West Rockport, ME.

THE CABINET SCRAPER

by John McAlevey

Two ways to shave. *The cabinet scraper (right) is better suited to heavier stock removal.*

At first glance, you might mistake my Stanley No. 80 cabinet scraper for a spokeshave. It's got the same kind of double-handled, cast-iron body. But the blade is thinner, and it's held almost upright rather than at an angle. Though it works on the same principle as the hand scraper, the cabinet scraper is better suited to heavier shaving work—the kind of stock removal you might do with a belt sander. I use my cabinet scraper to clean up mill marks left from machine joinery and thickness planing and also to level slight discrepancies that occur during glue-ups where one board may slip slightly lower or higher than an adjoining one.

To work correctly, a cabinet scraper needs to have a flat bottom. When I need to flatten the bottom of a cabinet scraper body, I use spray adhesive to temporarily adhere a piece of 220- or 320-grit, wet-or-dry sandpaper to a jointer bed, saw tabletop or other flat metal surface. Then I stroke the scraper bottom across the sandpaper. When the bottom is uniformly flat, it's time to sharpen the blade.

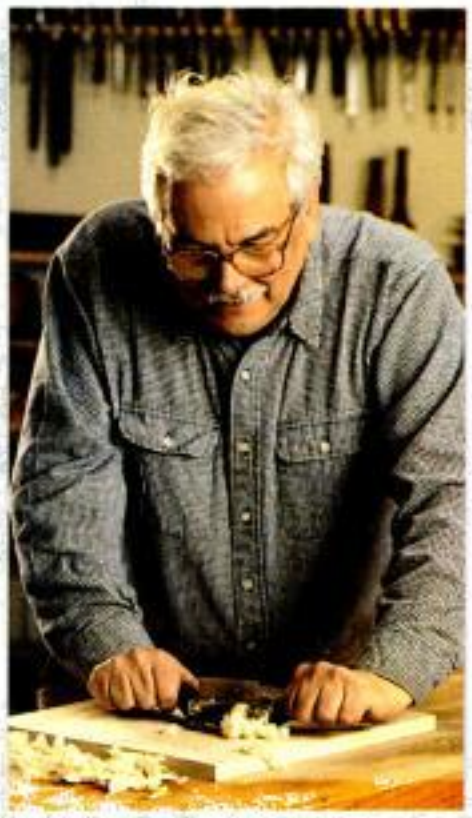
Place the blade in the vise, with the edge to be sharpened facing up. With a mill bastard file, file the edge straight across and at a 45° angle. (See left photo, below.) I use a protractor or a combination square to make sure my filing angle is about right. Then I use the file to remove the burr on the back of the blade.

When you've finished filing, it's time to hone the angle and remove the burr on your sharpening stones. The more time spent honing and polishing the bevel, the cleaner the burr will be when the blade is burnished. I like to finish up this work on a fine stone.

To burnish the blade, clamp it in the vise again and stroke flat across the back—one or two strokes should do it. Then burnish the 45° angle a few times, gradually changing the position of the burnisher from 45° off horizontal to about 15° off horizontal. (See right photo, below.) Feel for the burr with a fingertip; with experience you'll be able to tell when a good burr has formed. For a more aggressive burr I lubricate the burnisher with a drop of WD-40 or similar lubricant.

Placing the blade in the scraper body can be the most difficult part of setting up the cabinet scraper. First place the scraper on a flat surface. Then place the blade in the body. Apply downward pressure on blade and body and carefully tighten the two screws that force the pressure bar against the blade. Take care when tightening these screws that the scraper body and scraper blade do not shift or move on the work surface; if they do, the scraper may not work correctly.

When the blade is locked in place, you can tighten the thumbscrew on the opposite side of the body. The thumbscrew flexes the blade at its center, the same way that your thumbs flex a hand scraper. The more pressure applied by the thumbscrew, the heavier and more dished the cut will be. I take a heavier cut when I'm just starting to flatten a surface. I find that I get the best results by pushing the tool, keeping the blade at a slight angle to the grain. To finish up, I usually rehone and reburnish the blade, and then scrape with the blade almost flat. This gives you the finest shaving.



A handle on shavings. *Using a push stroke, McAlevey takes a shaving with his Stanley No. 80 cabinet scraper.*

JOHN MCALEVEY
teaches at the Center for Furniture Craftsmanship and makes furniture in Tenant's Harbor, ME.

SHARPENING A CABINET SCRAPER

File at 45°. *Use a mill file to create a straight edge at a 45° angle.*

Burnish the back edge. *Flatten the back of the blade with the burnisher.*

Form the hook. *Draw the burnisher across the angled edge at a 15° angle.*

What's New in Cordless Drills

This New Crop of Drills Offers More Value and a Broader Range of Features Than Ever Before

In the vast world of power tools—both portable and stationary—none have developed at a faster pace than cordless drills. Intense competition between manufacturers has yielded a new generation of cordless drills that were just on the drawing board when we did our Buyer's Guide to cordless drills two years ago. (See AW #35.) To make the process of picking a new drill a little easier, we've divided the new drills into different groups based on power, configuration (T-handle or pistol-grip), function and price. Read on to discover the right model for you in this revolutionary roundup.

Motors, Gears and Maintenance

Ever heard of *neodymium*? When used in the magnets of an electric motor, this "rare-earth" element can provide up to 25 percent more torque than a motor with regular magnets. Among the drills featured here, you'll find rare-earth motors in Bosch's D-handle models, Chicago Pneumatic's (formerly AEG) PES 12TPP, Milwaukee's 0431-1 and Sears' Craftsman 27139.

On many new drills, more compact planetary gears have replaced old-fashioned spur gears. Planetary gears run quieter and more efficiently.

Manufacturers are starting to pay more attention to maintenance issues, too. New DeWalt and Milwaukee drills are designed so you can easily replace the motor brushes. This costs just a few dollars, as opposed to the $40 (or greater) expense of replacing the entire motor—the only fix on some older models. Bosch takes a different approach. The brushes in their newest drills are guaranteed for the life of the tool.

Better Batteries, Faster Chargers

Until recently, most cordless-drill batteries used cells rated at 1.3 amp-hours. Now some companies are building batteries with 1.7-amp-hour cells. These "high-capacity" batteries are like a bigger gas tank on a car: You get more energy between charges.

You'll still find quite a few one-hour chargers among the newer cordless drills, but more drill kits now include advanced "fast chargers" that will recharge a battery in 10 to 30 minutes, while also providing better protection from overcharging.

As for battery voltage, 12-volt drills are becoming more popular and will probably dominate the market in a few years. But there's still a strong demand for 9.6-volt drills, especially for downsized models.

Less Is More

More efficient motors, more powerful batteries and compact planetary gears are the major factors behind the downsizing trend that's most apparent in the new selection of T-handle drills. (See page 40.) And balance and "feel" are better than ever. You'll even find padded grips and triggers, as on the Chicago Pneumatic, DeWalt, and Black & Decker drills.

Specialized Drills and Drivers

As drill technology grows, new models appear to address more specialized needs. The hottest new category is cordless *impact drivers.* With their *hex-type* chucks (that accept hex screwdriving bits) and rotary impact action these drills can develop greater turning torque—just the ticket for driving large screws and lag bolts.

Another new group of drills is designed for drilling in tight quarters. With the *right-angle* drills from Hitachi and Makita, you'll be able to drill and drive in all kinds of hard-to-reach spots. And Panasonic's innovative Corner Master model can drive screws with minimal side clearance. (See Easy to Reach, page 41.) In short, whether you're buying your first cordless drill or replacing an older-generation one, today's models offer features to suit just about any need and price. ▲

LOW-PRICED DRILLS

Not everyone needs brute power *or all the features of a high-end professional drill. These lightweight, no-frills models offer good power and professional features at very affordable prices.*

Black & Decker PS 330. Notable features on this 9.6-volt, 3/8-in.-chuck drill include an electric brake, a padded trigger and a built-in bubble level. The drill has a single variable speed range (0 to 700 rpm) and a five-position clutch. The kit includes one battery, a three-hour charger and a plastic case. Price: $79. *Circle #601*

Ryobi CD 75K. This 7.2-volt drill has a 3/8-in. chuck, single variable speed range (0 to 520 rpm) and a three-position clutch. The kit includes two batteries, a three-hour charger and a plastic case. Price: $60. *Circle #602*

Skil 2475. If 12-volt power is what you need, this 3/8-in. drill with single variable speed range (0 to 700 rpm) and five-position clutch is the least expensive model around. The kit includes one battery, a three-hour charger and a plastic case. Price: $85. *Circle #603*

IMPACT DRIVERS

Intended mainly for installing screws, *these drivers have rotary impact action, which means more torque for driving big screws in tough material. All these models have single variable speed ranges, electric brakes (except Hitachi) and 1/4-in., quick-disconnect hex chucks.*

DeWalt DW977K. At 4.1 lbs., this 12-volt driver is the heaviest in the group. It has electronic torque adjustment and a fan-cooled motor. The kit includes one high-capacity battery, a one-hour charger and a steel case. Price: $198. *Circle #604*

Bosch 3220. This 9.6-volt driver comes with one high-capacity battery, a one-hour charger and a plastic case. Price: $179. *Circle #605*

Hitachi WH8DC. A battery, a one-hour charger and a plastic case come with this 9.6-volt driver. Price: $210. *Circle #606*

Milwaukee 9057-1. This 12-volt model is fitted with a 3/8-in. square drive to let you slip on impact sockets for driving bolts and nuts. The kit includes a 1/4-in. hex adaptor, one battery, a one-hour charger and a steel case. Price: $269. *Circle #607*

Panasonic EY6588. This 9.6-volt driver is the lightest (2.9 lbs.) and most compact of the group. The kit includes one battery, a 15-minute charger and a plastic case. Price: $229. *Circle #608*

T-HANDLE DRILLS

Compact, powerful and well-balanced, *these new drills are great for general-purpose work. All the drills pictured have electric brakes; all except the Makita have two variable speed ranges.*

Makita 6221DW. The lightest (3.1-lb.) drill in this lineup, this 9.6-volt model has a 3/8-in. chuck and a five-position clutch. The kit includes one battery, a one-hour charger and a plastic case. Price: $145. *Circle #611*

Bosch 3110. This 9.6-volt drill has a "single-sleeve" 3/8-in. chuck that you can adjust with one hand—the spindle locks up when the trigger is off. The clutch has 15 settings. The kit includes two high-capacity batteries, a one-hour charger and a plastic case. A 15-minute charger is optional. Price: $179. *Circle #612*

Porter-Cable 9840. This basic 9.6-volt drill has a 3/8-in. chuck and a five-position clutch. The kit includes two batteries, a one-hour charger and a plastic case. A 15-minute charger is optional. Price: $170. *Circle #613*

Ryobi CTH1202K. Ryobi's first T-handle drill has a 3/8-in. chuck and six-position clutch. The kit includes two batteries, a one-hour charger and a plastic case. Price: $140. *Circle #625*

Chicago Pneumatic PES 12TPP. The most unique feature on this 12-volt drill is its "two-way" battery: You can reverse its position to change the drill's balance. It has a 3/8-in. chuck, a 19-position clutch, and a rare-earth-magnet motor. The kit includes one battery, a 15-minute charger and plastic case. Price not yet available. *Circle #614*

Panasonic EY6101SQK. The most compact 1/2-in.-chuck cordless drill on the market, this 12-volt model has 21 clutch settings. The kit includes one high-capacity battery, a 15-minute charger and a plastic case. Price: $259. *Circle #615*

Bosch B2310K. This 12-volt drill is a more powerful version of the Bosch 3110. The kit includes two high-capacity batteries, a one-hour charger and a plastic case. Price: $190. *Circle #616*

BIG BRUTES

If raw cordless power is what you need, *these tools can deliver. They're best suited to heavy-duty jobs like boring large-diameter holes or driving extra-long production screws and lag bolts. The duo's downside is weight—they're unwieldy for general-purpose use.*

DeWalt DW 994KQ. Still the highest-voltage cordless drill at 14.4 volts, this 5.4-lb. model is equipped with DeWalt's Versa-Clutch, a pressure-activated clutch with 23 settings. Other specs: 1/2-in. chuck, fan-cooled motor with replaceable brushes. The kit includes one high-capacity battery, a 15-minute charger and a steel case. Price: $235. *Circle #609*

Milwaukee 0431-1. This 5.6-lb. beast has a 1/2-in. chuck, a metal gearcase, and a rare-earth-magnet motor that runs within a single speed range (0 to 600 rpm) for maximum torque. Models with broader speed ranges are also available. The kit includes a side handle, replaceable brushes, two high-capacity 12-volt batteries, a fast charger and a steel case. Price: $270. *Circle #610*

PISTOL GRIPS

The traditional pistol-grip configuration *makes a drill front-heavy, but you can get your weight behind the bit to exert extra pressure. These new models have two variable speed ranges. All but the Craftsman have electric brakes.*

DeWalt DW 961K-2. This 9.6-volt, 3/8-in.-chuck drill has 15 clutch settings, a fan-cooled motor with replaceable brushes, and a rubber grip pad. The kit includes two high-capacity batteries, a one-hour charger and a steel case. Price: $175. *Circle #617*

Chicago Pneumatic PES12. An optional worklight is available for this 1/2-in.-chuck drill; it runs off the 12-volt battery. Other features include a rubber-padded handle and a 20-position clutch. The kit includes a 15-minute charger and a plastic case. Price not yet available. *Circle #618*

Bosch B2300K. Bosch introduces a line of D-handle drills, adding a brace to strengthen the body of the drill and protect your knuckles. This 12-volt, 3/8-in.-chuck model has a rare-earth-magnet motor and a silent electronic clutch with 21 settings. The kit includes two batteries and a one-hour charger. A worklight is optional. Price: $175. *Circle #619*

Metabo BEAT112/2 R+L. At 4.6 lbs., this 12-volt, 1/2-in.-chuck drill is the heaviest in the group—probably due to its adjustable auxiliary handle. The clutch has nine settings. The kit includes one battery, a 10-minute charger and a plastic case. Price: $350. *Circle #620*

Craftsman 27139. Sears beefs up their 12-volt drill with a rare-earth-magnet motor and overload protection. The 3/8-in.-chuck drill has a built-in bubble level and a five-position clutch. The kit includes two batteries, a one-hour charger and a plastic case. Price: $160. *Circle #621*

EASY TO REACH

Tight quarters don't present a problem for these drills. *Compact but still powerful, these new cordless models will be well-received by any woodworker who has struggled to drill holes or drive screws inside a cabinet.*

Hitachi DN 10DY. This right-angle-drive model has a 3/8-in. chuck, a 9.6-volt battery and a single variable speed range (0 to 800 rpm). It comes in a plastic case with one battery and a one-hour charger. Price: $225. *Circle #622*

Makita 6940 DW. This specialized 9.6-volt model has a hex chuck and a single variable speed range (0 to 2,000 rpm). It also has impact action, which multiplies its torque output. Optional accessory heads let you convert the tool into a straight driver or ratchet impact wrench. The kit includes one battery and a one-hour charger. Price: $250. *Circle #623*

Panasonic EY6780EQK. Panasonic's 9.6-volt Corner Master drill has a quick-disconnect hex chuck that can lock in eight different positions on the perimeter of the motor housing. You can drive screws in an inside corner with only 5/16 in. clearance. The single variable speed ranges from 120 to 800 rpm. The kit includes one high-capacity battery, a 15-minute charger and a plastic case. Price: $219. *Circle #624*

FOR MORE INFORMATION

Black & Decker (800) 762-6672
Bosch (312) 286-7330
Chicago Pneumatic (800) 243-0870
Craftsman See your local Sears store.
DeWalt (800) 433-9258
Hitachi (800) 706-7337
Makita (714) 522-8088
Metabo (800) 638-2264
Milwaukee (414) 781-3600
Panasonic (800) 338-0552
Porter-Cable (800) 487-8665
Ryobi (800) 525-2579
Skil (312) 286-7330

Build a Medicine Cabinet

Combine the Durability of Corian® with the Warmth of Wood

by Ellis Walentine

Reflect your good taste. *Crafted of wood and Corian® solid surface material, this medicine cabinet will retain its good looks through years of everyday use. Sliding mirror doors, plate-glass shelves and shop-made shelf rests add to the look of quality.*

When my ancient, painted-steel medicine cabinet finally rusted through, the writing was on the wall: It was time for a new one. After checking out the uninspiring collection of painted steel cabinets at my local home center, I decided I'd be happier if I built one of my own design.

A medicine cabinet poses an unusual design problem since it needs to stand up to daily use in a high-humidity environment. In the past, I've made medicine cabinets of varnished wood or plastic laminate on plywood for customers, but this time I decided to try DuPont Corian®, the "solid-surface" material known best for its use in high-class kitchen countertops and vanities.

Like other solid surface materials, Corian® is expensive. The Corian® to build this cabinet cost about $190. For a less expensive cabinet, you could build the case from solid or laminate-covered wood and use Corian® for the face-frame inlay only.

The cabinet I designed (see photo, above) is quick and painless to make—no fancy joinery here. Most of the work can be done on the tablesaw. The interesting part is learning how to work with Corian®. Once you get the hang of it, you'll be thinking up ways to use it in future projects.

About Corian®

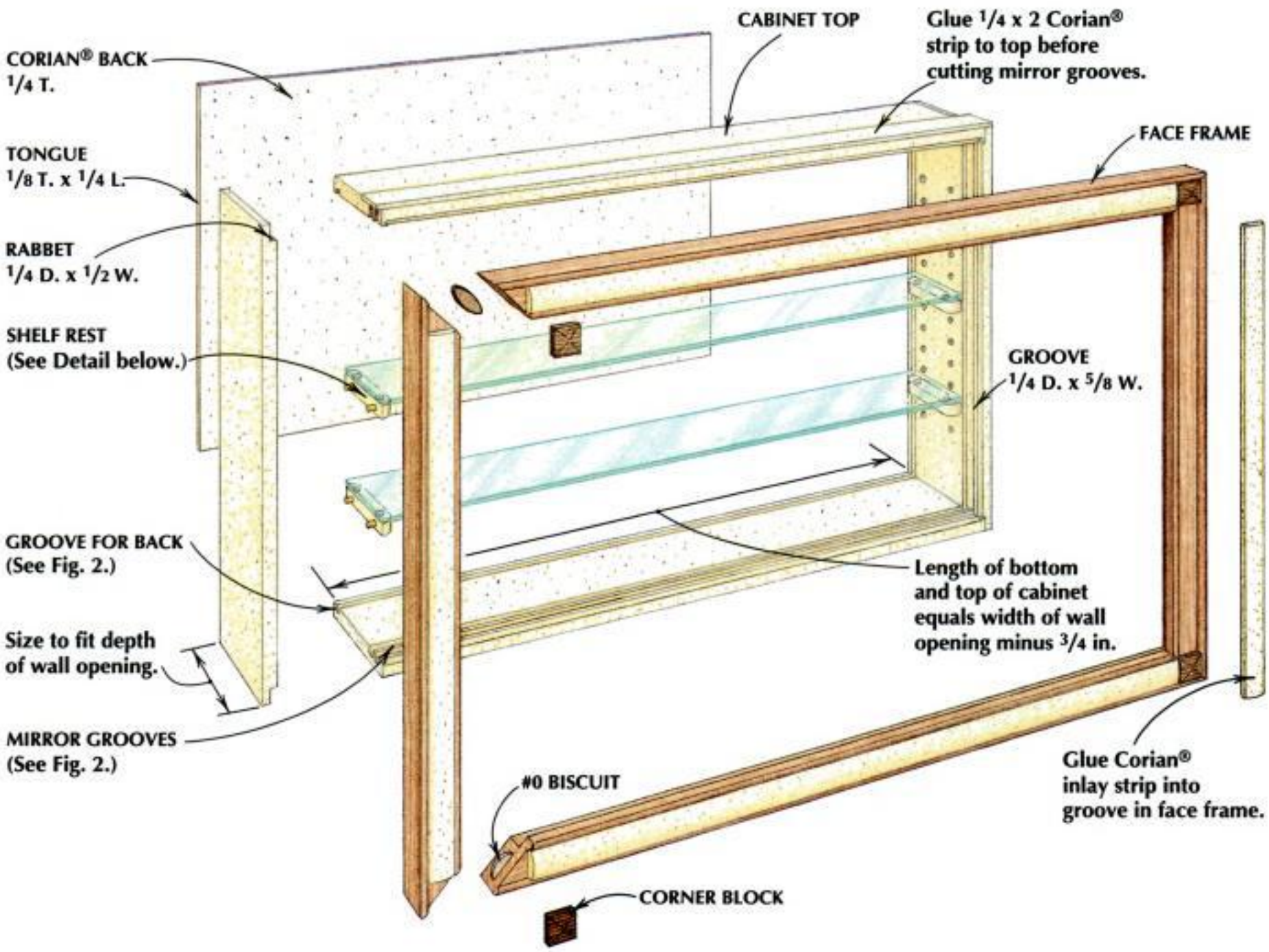
Corian® is one of an elite group of solid surface materials that look like stone yet work much like wood. Until recently it has been available only to professional fabricators, but now you can purchase it in retail quantities from Art Specialties International Inc. (Box 215, Depew, NY 14043, 800-724-1002). Sizes are limited to maximum widths of 15 in. for the 1/2-in. and 3/4-in.-thick material and 30 in. for the 1/4-in.-thick material. You may also be able to purchase small quantities of Corian® or other solid surface materials from a local cabinet shop that specializes in solid surface work. Check the phone book under "Kitchen Cabinets."

Corian® is a good choice for this project because it is impervious to moisture and it'll last indefinitely—perfect for a bathroom environment. But it has other attractive features as well: It doesn't require finishing, it works well with standard woodworking machines and it comes in a large selection of colors and patterns. The colors go all the way through the material, so you expose a finished surface wherever you cut.

Though it is fairly brittle (you don't want to drop it on the floor), Corian® is stiff and strong, even in sections as thin as the 1/8-in.-thick ribs between the mirror grooves in this medicine cabinet. (See Fig. 1.) It's also abrasive and it dulls tool-steel edges quickly, so carbide-tipped blades and router bits are a must.

Safety precautions are in order when you are working Corian®. Eye protection and a dust mask are essential because of the large amount of chips and dust that are produced during machining. Though the material gives off a distinct plastic odor when machined, these fumes aren't hazardous, according to the manufacturer. Still, very sensitive people may experience eye, nose or throat irritation. To play it safe, ventilate your work area. I'd also recommend hearing

FIG. 1: MEDICINE CABINET



protection. Corian® is extremely dense—about three times denser than oak—so your blades and cutters make quite a racket during machining.

Making the Cabinet

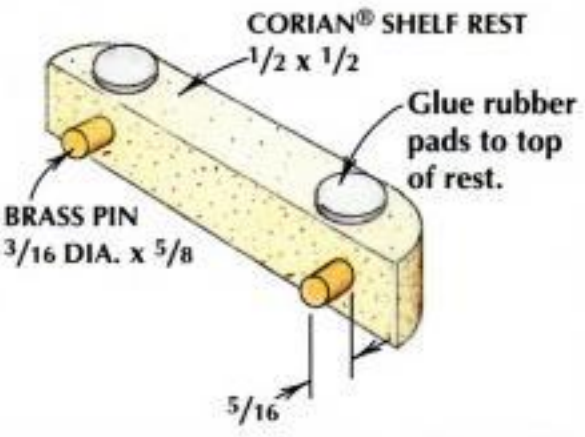
This medicine cabinet consists of two main parts: a Corian® cabinet and a wooden face frame with Corian® inlay. (See Fig. 1.) The rough opening in your wall determines the size of the cabinet, so the dimensions shown in the drawings are expressed in terms of this rough opening size. If you like, you can make your cabinet deeper by making a thicker face frame with a deeper rabbet.

I began by making the cabinet parts, ripping the sides, top, bottom and back to finish dimension on the tablesaw. The brochure that came with my Corian® shipment suggests a 60-tooth blade, but I found that an 80-tooth ATB blade also works well. Ripping and combination blades are not recommended. After cutting the parts to size, I used the same blade to cut a groove in each cabinet side (including the top and bottom) for the back panel's 1/8-in. tongue. (See Fig. 1.)

Next, I cut the mirror grooves in all four sides. I was concerned about ripping the deeper top grooves, so I beefed up the thickness of the top by gluing a strip of leftover 1/4-in. Corian® to the outside with cyanoacrylate adhesive. (See Fig. 2.) Then I cut all the mirror grooves with a 1/4-in. carbide dado set. (See Figs. 1 and 2.) While the dado set was still on the saw, I used it to rabbet the back panel to produce the tongue.

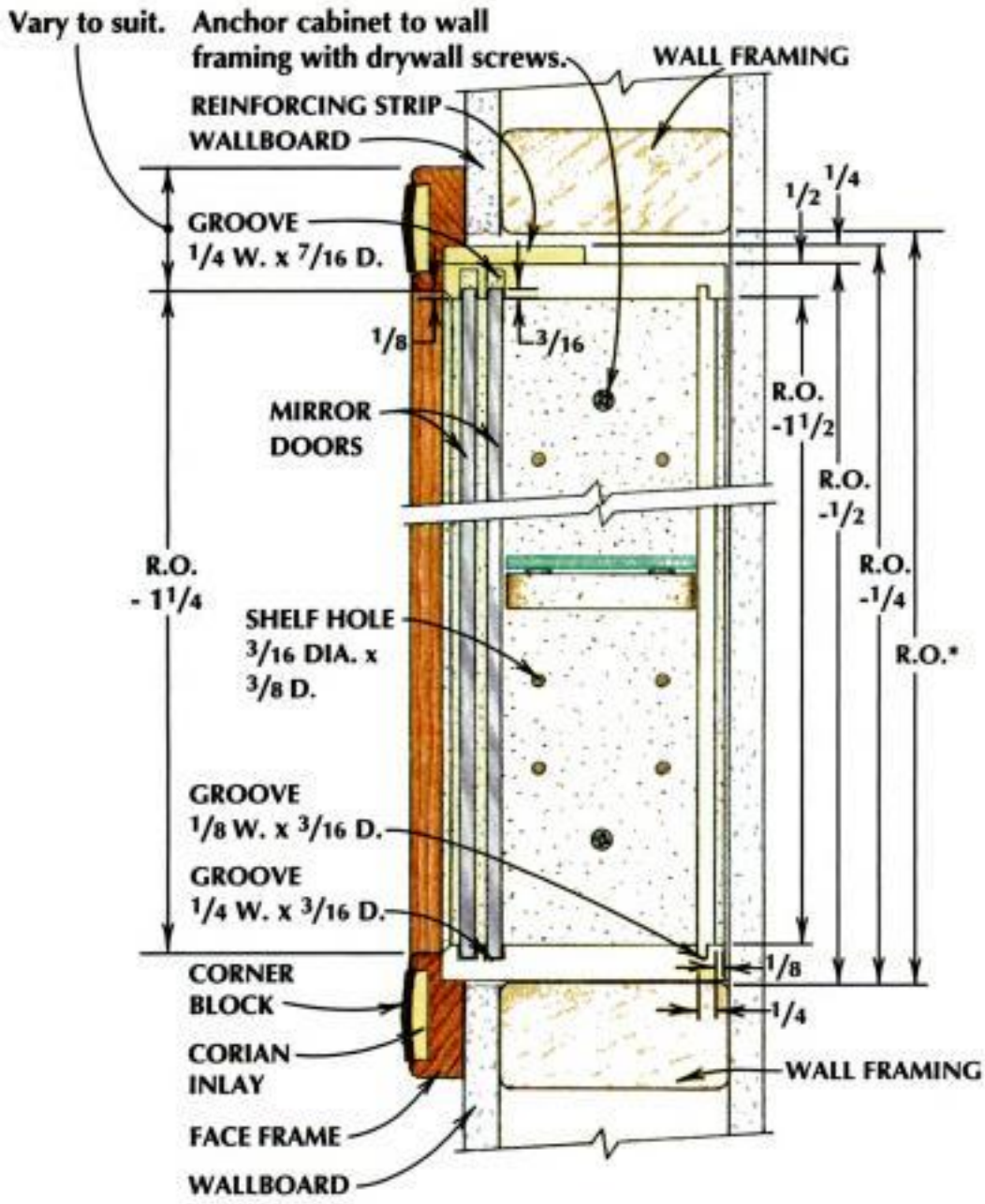
After cutting the grooves, I scraped them smooth with a chisel held upright

SHELF REST DETAIL



Ready for glue-up. *After machining and dry fitting, the cabinet parts stand ready for glue-up with cyanoacrylate adhesive. Rubber pads on the shelf rests keep the shelves from slipping.*

FIG. 2: SECTION THROUGH CABINET



*R.O. = Height of rough opening in wall.

FIG. 3: DOORKNOB DETAIL

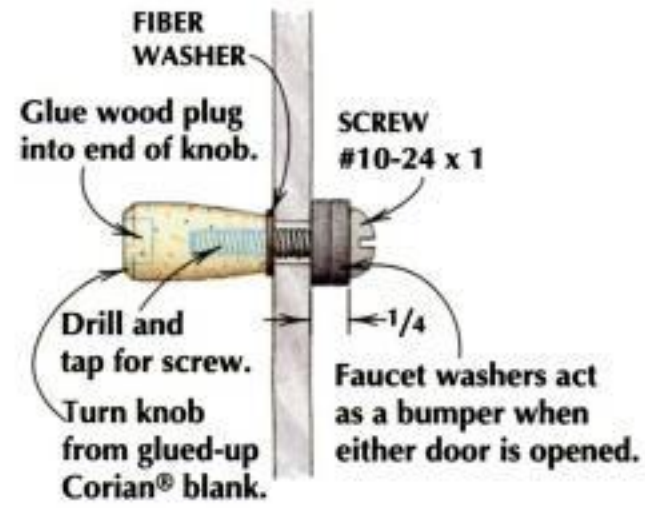
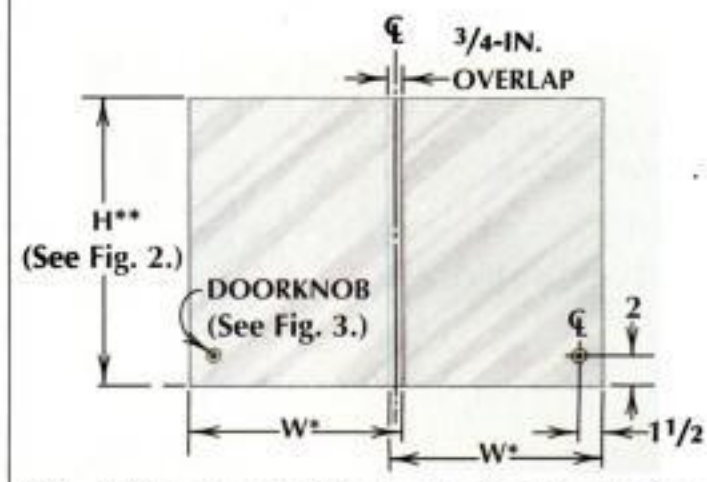


FIG. 4: MIRROR DOORS



*W = 3/8 in. plus half the length of cabinet bottom.
**H = R.O. - 1 1/8

and sanded the bottom grooves with 320-grit sandpaper. Extra care with the bottom grooves makes the mirror doors slide easily. Scraping tools work well on Corian® although they dull quickly.

Next, I rabbeted the corners of the sides. (See Fig. 1.) I had considered mechanical joints and fasteners for the corners of the box, but as I experimented with adhesives, I found that cyanoacrylate (CA) adhesive makes a very strong joint in Corian®. Simple rabbeted corners are more than adequate here.

I cut the rabbets with a dado blade on the tablesaw, using a miter gauge to feed the Corian® sides. Then, since CA adhesive works best on perfectly fitting parts, I filed the bottoms of the rabbets smooth with a mill file.

Before gluing up the cabinet, I drilled the holes in the sides for the shelf rests. I made my rests from leftover 1/2-in. Corian®. (See Fig. 1.) I glued two short sections of 3/16-in.-dia. brass rod into the back of each rest. Take care to drill the pin holes at the same spacing as the two rows of shelf holes.

You can also buy rests from hardware stores, glass suppliers and many mail-order suppliers. Make sure the rests have rubber pads or a rubber coating, so the glass shelves won't slip off.

Once I'd drilled the sides, I sanded all the cabinet parts. To remove major scratches, I started with 120-grit stearated sandpaper, then switched to 220 grit and finally 320 grit.

The final step before glue-up was to chamfer the inside front edges of the cabinet sides. I used a chamfer bit in a laminate trimmer, stopping the chamfers on the top and bottom pieces about 3/8 in. from each end, so I could blend them into the side chamfers with a file after glue-up. (See Fig. 1.)

Gluing up the cabinet is easy, but you need to move quickly. Use a gap-

Beading the face frame. *For the smoothest, chatter-free cutting, the author uses a feather board to hold the face-frame member tight to the router fence.*

A study in contrasts. *Corner accent blocks of wenge provide a visual counterpoint to the cherry face frame and the Corian® inlay strips.*

filling CA adhesive with no accelerator. (For more on CA adhesives, see AW #34.) Use adequate ventilation when gluing with CA adhesive; the fumes can irritate your eyes and nose.

Spread an even film of the adhesive in the corner rabbets, gather the sides around the back, and clamp the assembly with pipe clamps. DuPont suggests a clamping pressure from 25 to 50 psi, so don't overdo it with the clamps. The adhesive will tack up within about half an hour, but I suggest waiting a day before removing the clamps. Then, turn the cabinet over and squeeze a continuous bead of a thin, watery CA adhesive into the seam between the back and the sides to solidify the assembly.

Making the Face Frame

The face frame is the most visible part of your cabinet, so choose woods and Corian® colors that complement your bathroom decor. I made mine of cherry with a crowned inlay strip of Corian® and corner accent blocks of wenge.

Here's my face-frame procedure in a nutshell: First rip the four wooden frame members and groove them with a dado blade to a depth of 1/4 in. for the inlay as shown in Fig. 2. Rabbet the inside edges to receive the Corian® cabinet. Then, miter the pieces to exact length. Using a router table and fence, rout the face-frame profiles. (See photo, opposite page.) A feather board helps ensure the smoothest cutting.

To make the inlay strips, rip pieces of 1/4-in.-thick Corian® to fit your grooves. You'll need to hold your strips safely while you raise the crowned profile: Use hot-melt adhesive to temporarily attach them to scraps of wood of the same width. If you don't have a router bit that produces the profile you want in one pass, you can approximate the crowned shape with a tablesaw or router. Then, scrape the profile with a cabinet scraper ground and sharpened to the desired curve. Refine the final shape with progressively finer grits of sandpaper wrapped around a scrap of stiff leather.

When you've finished crowning the strips, cut them to length and glue them into the grooves with CA glue. I squared mine even with the short sides of the mitered grooves in the face-frame members to leave room for corner accent blocks. If you prefer the look of continuous Corian®, you can eliminate the corner blocks and simply trim your inlay strips flush with the miters.

Next, glue up the mitered face-frame members, using your favorite method of reinforcement: screws, dowels, splines, etc. I opted for #0 biscuits. (See left photo, above.) Because of my healthy respect for the biscuit joiner, I devised a quick jig that allows safe, hands-free cutting of this unwieldy joint. (See "Shop Solutions," page 120.) Then I glued up the face frame with Titebond II water-resistant yellow glue.

I made my corner blocks from 3/8-in.-thick wenge cut to fit the square recesses. I faceted their faces on the disc sander and glued them in with Titebond II.

I finished the completed face frame with wiping varnish and attached it to the face of the Corian® cabinet with a bead of Lexel (a clear, silicone-like adhesive available at most major hardware stores). When the adhesive had cured, I removed squeeze-out with a mat knife.

All that remains to be done at this point is to screw the cabinet into the wall opening and install the doors and shelves. I drilled and countersank two holes in each cabinet side and fastened the cabinet to the studs on both sides of the wall opening with drywall screws.

When ordering the mirror doors, be sure to figure the height accurately. They should be 3/8 in. taller than the inside height of the case. (See Fig. 4.) Your glass supplier can drill the 1/4-in. holes in the doors for the knobs, or you can do it yourself with a glass-drilling bit from the local hardware store. A little practice on scrap glass can save a lot of heartache when you drill the real thing.

I turned the knobs for the doors from a block of Corian® made of glued-up scraps of 1/2-in. material. (See Fig. 3.) After I cut the knobs free of the turning blank, I mounted them in a machinist's vise on the drill press and drilled the ends for wenge plugs. Then I drilled and tapped the other ends of the knobs for #10-24 machine screws and assembled them to the doors as shown in Fig. 3.

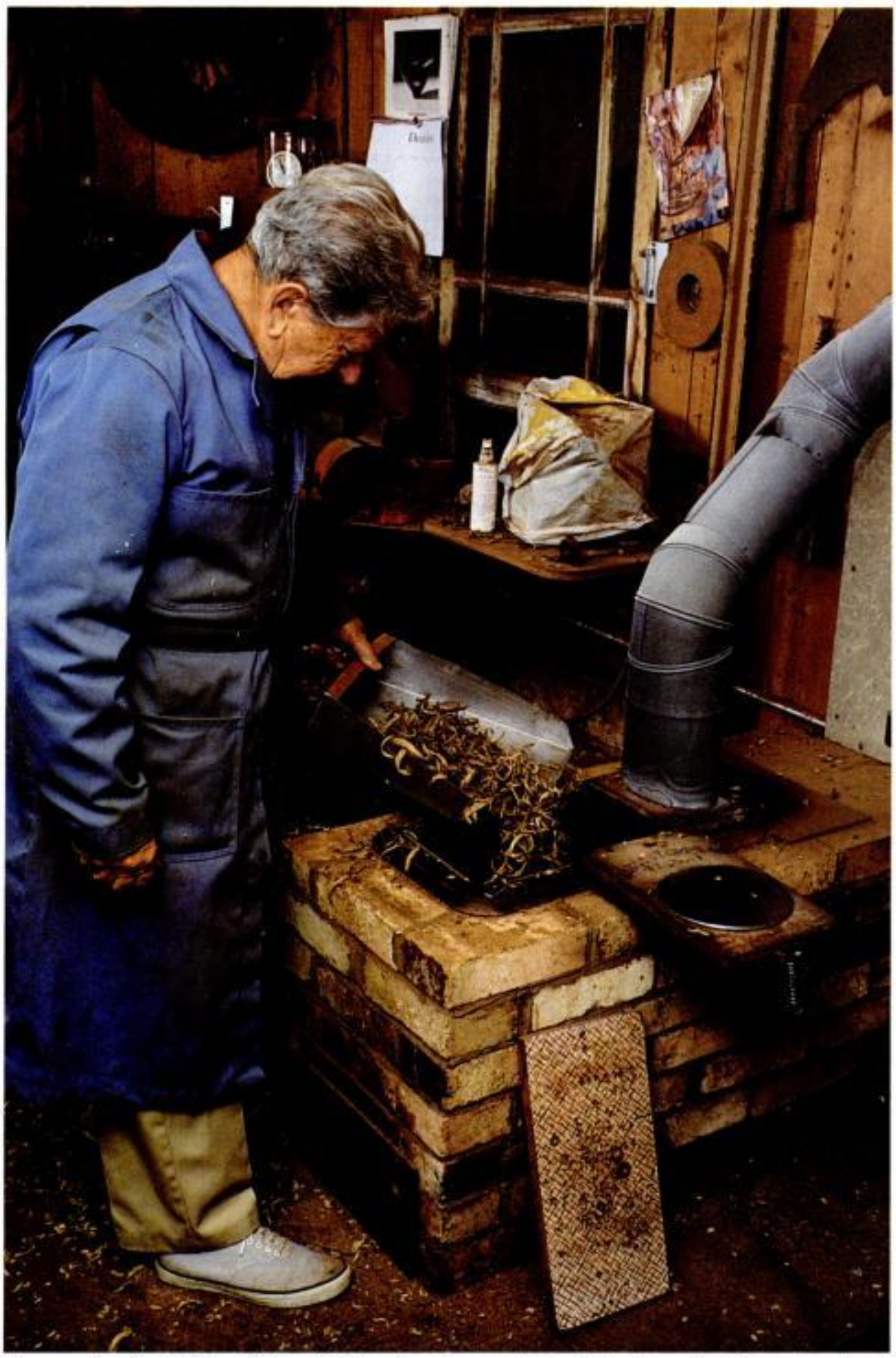
As a final touch, I wiped a thin film of petroleum jelly in the bottom mirror grooves to make the doors slide easily. ▲

ELLIS WALENTINE
is executive editor of AW.

Shop Heat

Find the Type and Size of Heater that's Best for Your Workshop

by Joe Wajszczuk



A woodworker's best friend. *Woodstoves work double-duty, heating your shop and helping to keep it clean.*

Whiling away the winter in a toasty shop may sound romantic, but for many woodworkers, the onset of cold weather means a long season of shivering in the shop. When Simon Watts (now AW's West Coast editor) worked out of a Vermont barn, he had to be careful that his hands wouldn't freeze to his iron planes and clamps. Jim Cummins, another winter woodworking veteran, remembers trying to keep the cold at bay by wearing electric socks and wrapping his boots with closed-cell foam.

The Cost of Keeping Cold

Even if you're not a candidate for frostbite, there are other costs in a cold shop. Waterstones and water-based glues and finishes can't survive freezing temperatures. Even at temperatures below 60°F, glues can chalk and finishes can fail; cold wood can also chill these materials below proper curing temperatures.

A heated shop makes woodworking safer and much more enjoyable. In this article, I'll discuss how to estimate your workshop's heating requirements and how to select a heating system that matches your needs.

Sizing Your Heater

It's not hard to get a rough estimate of your workshop's heating needs, which is expressed in BTUs. (See sidebar, opposite.) The major factors in the BTU equation are your shop's size, how well it's insulated, and your geographic location.

When sizing a heater, keep in mind that bigger isn't always better. For example, an oversized woodstove wastes space; and damping down a large fire produces more creosote, which can fuel a chimney fire.

Unless you plan to expand your workshop space someday, you'll probably be best served by a heating system that meets your BTU requirement or is

Safety shields. *A sheet-metal hood and floor plate reduce clearances and help radiate heat. Glued work is placed nearby to speed setup.*

PHOTO BY CRAIG WESTER

Small-shop solution. *In Tim Snyder's small but well-insulated shop, a 220-volt electric heater does all the warming work.*

PHOTO BY BARBARA SNYDER

Easy to vent. *Gas, pellet and kerosene stoves vent directly through the wall, saving the added expense of a stovepipe or chimney.*

PHOTO COURTESY OF VERMONT CASTINGS

slightly undersized. A smaller heater may not be able to handle the coldest days (keep a small space heater on hand for extra help), but it will run more efficiently for the bulk of the winter.

Never underestimate the value of insulation. Cutting down on air infiltration and providing just an average level of insulation can reduce your heating needs by 50 percent or more. A modest investment in weather stripping and insulation will save you money on the initial cost of your heating system and also on operating costs.

Let the sun shine in. If your workshop has suitable exposure, put solar energy to work. A simple passive solar design—perhaps a few insulated, south-facing windows—will give you heat for free. The key is to reduce nighttime heat loss. Insulated blinds or removable insulated panels will help to hold heat in after the sun goes down.

Choosing a Heating System

Visit a few workshops and you'll discover that woodworkers are as ingenious at cobbling together heating systems as they are at devising jigs and fixtures. But ingenuity shouldn't come at the expense of safety. Whatever heating option you choose, make it a safe one. If you have any doubts about sizing, installation or operation, be sure to consult a professional heating contractor. Below are some considerations that will help you choose a heating system to match your needs.

Adding on is the easiest option. With a garage workshop or any workshop that's adjacent to your house, you may not need a separate heating system. Instead, you can simply expand your existing home heating system. Most systems have the capacity to heat some additional space. If your workshop

HOW MUCH HEAT?

A heater's capacity is generally rated in terms of British Thermal Units (BTUs) per hour. One BTU is about equal to the amount of heat that is produced by burning a wooden match.

Your shop's BTU heat requirement depends on its size, its level of insulation and your geographic location. The chart below shows how many BTUs per hour would be required to heat both insulated and uninsulated shops in various regions of the U.S. Shop size for all cases is 1,200 sq. ft.

To get a *rough* estimate of your heating needs, you can extrapolate from the regional ratings below, or if your shop has an average level of insulation, multiply the square footage of your shop by 50 BTUs per hour. For a more specific evaluation, refer to the *American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Handbook* (available at your library). —*J.W.*

HEAT REQUIREMENTS BY REGION *(Figured for a 1,200-sq.-ft. workshop.)*

Shop Location	BTUs/Hour Required Insulated*	BTUs/Hour Required Uninsulated
Savannah, GA	8,400	18,000
Salinas, CA	16,800	36,000
Wichita, KS	33,600	72,000
Emmaus, PA	42,000	90,000
Grand Forks, ND	58,800	126,000

*Average insulation level based on region.

qualifies for this kind of heat, have a heating contractor check out your furnace. You might be able to heat your shop for the price of the ductwork or copper tubing and a couple of weekends of installation work.

Consider every cost. There's more than meets the eye in that woodstove you picked up for nearly nothing at a garage sale. Installing an insulated stovepipe can run you another $500. And apart from the cost of firewood there are other expenses, like maintenance (chimney cleanings), smoke alarms, and inflated insurance premiums. Electric heat, on the other hand, is inexpensive to install and won't cause a jump in your insurance rates. On the downside, operating costs will be high. The moral? Be sure to consider every cost when deciding on a heating system: the cost of the heater, installation costs, and costs for maintenance and operation. (See charts, below left.)

New shop or old? If you're building a new workshop, the price difference between heating systems will be a small percentage of total cost, so it makes sense to choose the better system. The financial picture changes when you're faced with heating an existing space.

Space—Floor space is valuable in a workshop. How much of it will your heater require? Building codes specify how much space you need to allow around different kinds of heaters. Figure in the clearance space for safety, ductwork and fuel storage.

Fuel cost and availability—Your heating system decision should factor in the availability and cost of fuel. Here in Pennsylvania, coal is cheap: You can buy a ton for about $100, roughly half the price you'd pay in Fairbanks, AK. Heating with wood is a more sensible option in Vermont than in New York City. Natural gas and electricity are also subject to regional price variations.

Comfort and convenience—Costs aside, choosing a workshop heating system also means considering the level of comfort and convenience you want.

You may want a programmable thermostat to ensure that the shop is warm when you get there. On the other hand, you may prefer the simplicity of loading up the woodstove and then waiting for the shop to heat up. Or how about something in between: a portable electric heater that takes the chill out of your shop until the woodstove gets going?

HEATING RANGE AND SYSTEM COST

	Heating System	BTUs/Hour (range)	Unit Cost ($)	Installation Cost ($)
CENTRAL HEATERS	Gas furnace	80,000 - 100,000	500 - 1,000	1,000
	Oil furnace	80,000 - 100,000	1,000 - 1,500	1,000
	Boiler	80,000 - 100,000	1,500 - 2,000	1,000
	Heat pump	80,000 - 100,000	1,500 - 2,000	1,000
	Radiant slab	—	(4 - 6 per sq. ft.)	
SPACE HEATERS	Multi-fuel stove	80,000 - 100,000	2,000 - 2,500	400 - 600
	Radiant gas	25,000 - 40,000	750 - 900	400 - 500
	Kerosene (vented)	22,000 - 40,000	1,200	150
	Kerosene (unvented)	17,000	300	—
	Woodstove	8,000 - 50,000	800 - 1,500	400 - 600
	Pellet stove	8,000 - 40,000	1,500 - 2,100	200
	Electric	5,000	100	—

COST OF FUEL

(Per million BTUs)

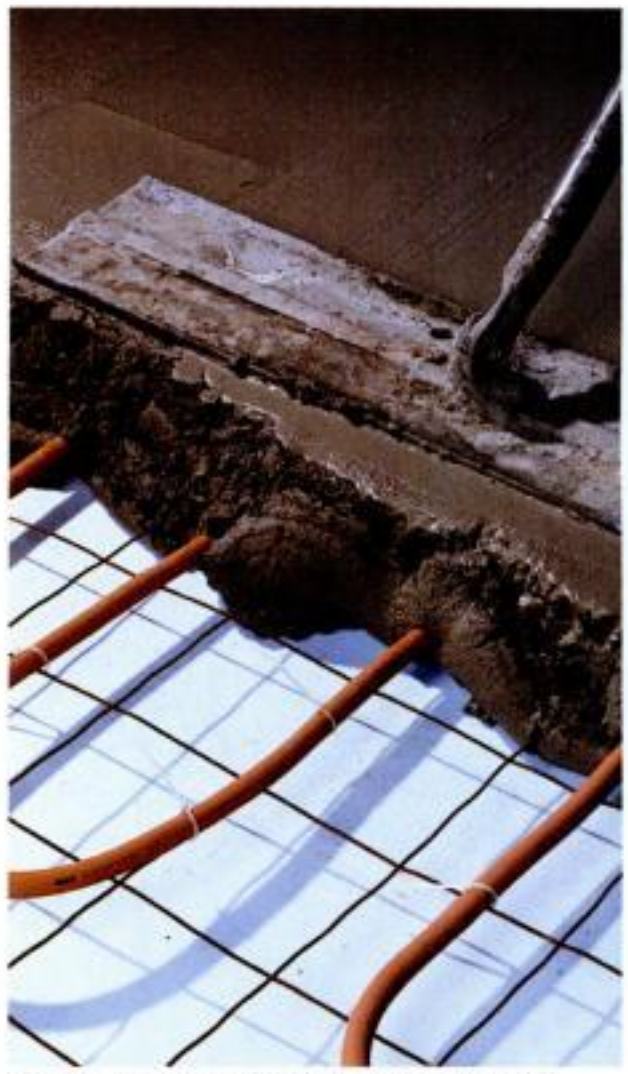
Type of Fuel	Cost
Coal	$2.90
Wood	5.37
Natural gas	5.72
Pellet	7.76
Kerosene	7.80
Petroleum	8.03
LPG	10.39
Electricity	24.07

Central Heating Solutions

Heating a large to mid-size shop is the same as heating a small house. In both cases, you're looking for a controllable, dependable system that takes up as little space as possible.

Furnaces and boilers provide heat through a system of ducts or piping; the main units are designed to be installed out of the way. In fact, many gas and oil-fired systems can be installed in utility closets or hung from the ceiling.

With a central heating system, you can have independently controllable heating *zones*. For instance, you can keep a finishing room or office warmer than the rest of the shop.



Room-sized radiator. *In a radiant slab, heated water is pumped through plastic tubing that is embedded in the slab when the concrete is poured.*

Of the two types of central heat, forced air is cheaper to install. But forced-air systems blow dust around the shop and pull dust-laden air into the blower. Hot water is preferable for shops because it doesn't pose the dust problems associated with forced-air systems. But with hot-water heat you'll need to allow space for baseboards or other types of radiators.

The ultimate in hot-water heat is the heated slab floor. In this type of system, hot water circulates in plastic tubing that has been embedded in a poured concrete floor. Used in Norm Abram's New Yankee Workshop, this heating system is unobtrusive, maintenance-free, and efficient—the floor acts like a giant radiator. On the downside, a concrete floor can be hard on your knees and back.

A heat-pump system will cost about 20 percent more than a comparable oil or gas-fired furnace. But because a heat pump transfers heat instead of producing it, it's more efficient than oil or gas, provided the outside temperature stays above 35°F or so. If you live in a climate where winters are mild, consider the heat pump route. As a bonus, heat pumps can be reversed during warm weather to provide air conditioning.

Stoves: Wood, Coal & Pellet

Woodworkers are naturally drawn to woodstoves for shop heat. Our affection stems in part from the abundance of fuel—what better way to dispose of scrapwood, planer shavings and mistakes you don't want anyone else to see?

Today's woodstoves may not look much different from those of yesteryear, but under the Environmental Protection Agency's "Phase II" emission standards, they must consume one-quarter to one-third less fuel and burn 80 to 90 percent cleaner than they did a decade ago. These efficient stoves also cost more: The stove, chimney and installation together can cost almost as much as a central heating system.

Despite our love for woodstoves, there are disadvantages. Stoves are dirtier than central heat, and they require more attention and maintenance. Since they heat primarily by radiation, stoves must be centrally located to provide uniform heat; even then, they may leave a few cold spots in remote areas of your shop. Stoves also create a fire risk, which may increase your insurance premiums.

If you live in a region where coal is available, consider a *multi-fuel stove* that can burn both wood and coal. BTU for BTU, coal takes up a lot less space than wood. Coal fires are also easier to tend. When equipped with a hopper, some coal stoves can run for as long as two days without refueling.

Pellet stoves are a fairly recent innovation. They have auger-driven feeding systems, and they can be vented directly through the wall without a chimney, which makes them a convenient option. But take note: While these stoves burn pellets made from wood, they aren't designed to burn wood itself.

Space Heaters

For many woodworkers, space heaters remain the best shop heat solution. They're a quick, convenient and affordable way to make a workshop workable. Besides serving as the sole heating source in many small shops, space heaters are valuable for small zones of larger shops. For example, Steve Blenk uses an electric heater to warm his spray booth. To eliminate the risk of fire, Blenk simply removes the heater from the room when he's actually spraying a finish.

Electricity is the cleanest, simplest and fastest way to warm up a shop. Though electricity has a high cost per BTU, electric heaters can be an economical option if you need to warm just one area of your shop. These resistance-type heaters all produce about 3,350 BTUs from one kilowatt-hour of electricity. Keep in mind that each heater should have its own circuit. Operating power tools and heaters on the same circuit is likely to cause overloading.

Radiant gas heating systems, also called *infra-red heaters,* generate radiant energy that's absorbed by the floor and machinery, then re-radiated to warm the air. Radiant heating is good in situations where there is a high volume of air movement—when a garage door has to be opened and closed frequently, for example. Units featuring *isolated combustion systems* are best for dusty woodshops because ductwork supplies outside air for combustion and vents flue gases. Radiant gas heaters can be fueled by bottled propane or natural gas.

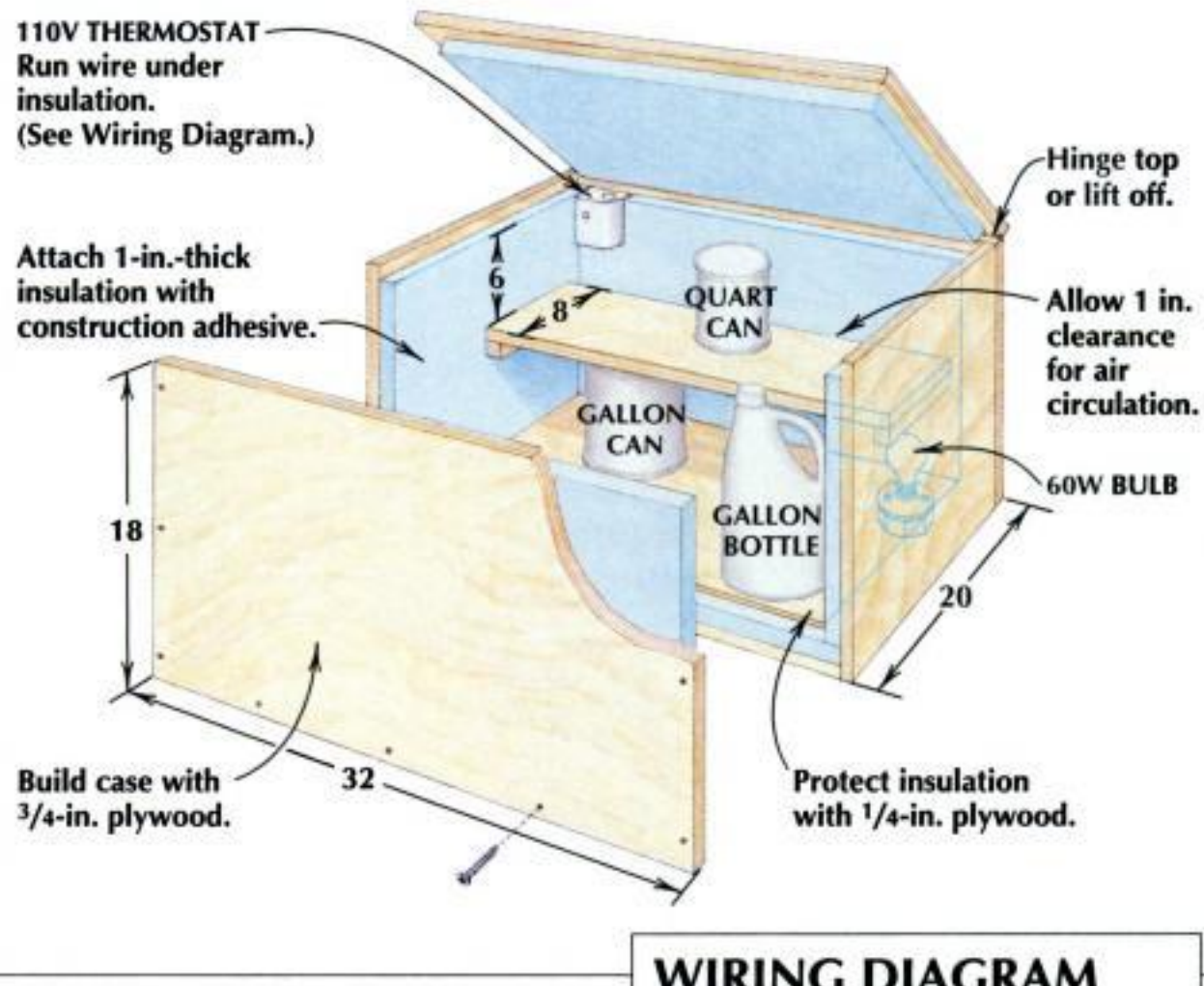
Kerosene heaters aren't as popular in the house as they were a decade ago, which means that even more units may find their way to workshop use. Be wary of portable, unvented units. Even when they're equipped with catalytic burners, unvented kerosene heaters produce carbon monoxide and are prohibited in many areas. Stationary, wall-mounted kerosene heaters are an affordable option. Many of these direct-vent kerosene heaters feature thermostatic control. ▲

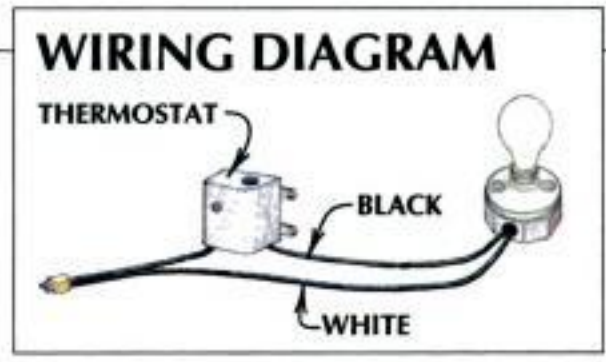
JOE WAJSZCZUK
is an assistant editor of AW.

BUILD A HOT BOX

Anti-Freeze Protection for Glues and Finishes

This inexpensive "hot box" will keep your water-based materials workable, even in an unheated shop. This box can hold six gallon-sized containers on the bottom shelf and eight quart-sized cans on the top shelf. Rigid foam insulation (available at building supply outlets and home centers) retains the heat produced from a 60-watt bulb. Be sure to include a thermostat (available from hardware or farm supply stores) to prevent overheating. —*J.W.*





Replacing
Babbitt Bearings

Pour New Life Into an Old Machine

by Bill McCarthy

Ready to run like new. *New babbitt bearings put the author's turn-of-the-century mortiser back in service. Here, McCarthy holds the top half of a babbitt bearing that is fitted with an oil reservoir.*

Most modern woodworking machines have ball bearings to keep their rotating shafts spinning accurately and friction-free. But prior to the 1920s, machines relied on soft cast-metal sleeves called "babbitt bearings" for the same purpose. These were cast in place around the shaft and lubricated by a constant flow of oil to prevent them from overheating and wearing out.

I love old machines because they're usually economical to buy and built to last. But old machines often develop excessive play in the shafts because of worn-out babbitt bearings. To restore one of these machines to "like-new" condition, you have to remove the old babbitts and repour them with fresh metal. As I'll explain, this is not a difficult process to attempt yourself, but it does require a few special supplies, some patience and a measure of caution.

Materials and Supplies

Babbitt metal (available from many bearing suppliers and from Grant Manufacturing, 60 Schoolhouse Rd., Souderton, PA 18964, 215-723-0330) is the key ingredient for pouring babbitts. It's an alloy of tin (88 to 90 percent), antimony (7 to 8 percent) and copper (3

Out with the old. *The author has chiseled an old bearing in half to remove it. Holes in the cast-iron housing act as keyways to keep the new bearing in place. A notched plywood saddle centers the shaft.*

Dual-purpose shims. *Cardboard shims are notched to allow molten metal to flow into the lower cavity, so the entire bearing may be poured at once. As the bearing wears, shims may be removed to extend its life.*

Ready to pour. *Molten babbitt metal is hot enough to pour when it will char a pine stick.*

to 4 percent), and sometimes a little nickel. Always use this "virgin" babbitt metal for high-speed shafts—those that spin at more than 2,000 rpm, such as cutterheads on jointers and planers. Old babbitt metal, which may have been adulterated with lead, can be melted and repoured for less critical, low-speed shafts like countershafts and bandsaw arbors. You'll need to add some fresh metal to make up for any that has been lost.

Babbitts for low-speed shafts may be used "as-is" after casting, but those for high-speed shafts must be hand-scraped to closer tolerances.

In addition to babbitt metal, you'll need the following equipment:

- A cast-iron pot
- A ladle
- Some thin cardboard
- A camp stove
- A steel funnel
- Metal tongs
- An oxyacetylene or propane torch
- Some potter's clay or cotton rope
- A small tube of Prussian blue (available at auto parts stores)
- A triangular scraper (see below).

Preliminary Steps

Before you can pour new babbitts, you must remove and polish the shaft, remove the old babbitt metal, and replace the shaft exactly where it is to be used. Unbolt the babbitt caps, remove the shaft and mount it in a lathe. Polish it with 220- and 320-grit wet-or-dry sandpaper and oil. If the shaft has any ridges or pits, you may need to remachine it on a metal lathe.

To make sure the shaft will be located accurately in the new babbitts, I drill holes in squares of plywood and mount the squares on the shaft. Then I replace the shaft in the old bearings and clamp notched pieces of plywood to the outsides of the babbitt housings to support the squares. (See photo, above left.) Depending on the layout of your machine, you may have to devise sheet-aluminum saddles instead and attach them tightly to the housings with machine screws.

Now, melt or chisel the old babbitt metal from its housings. Babbitt metal melts at around 600° F, so if you don't have an oxyacetylene torch, you can use a propane torch to melt it out. A "cape" chisel (a very narrow chisel you can make from an old file) will also work for removing old babbitt metal. Simply chisel a kerf in the center of each half of the bearings. (See photo, above left.) Then brush or blow out any debris that's in the housings.

Although some people pour babbitts one half at a time, I prefer to pour the entire bearing at once. To do this, I cut double shims from the cardboard, with notches to allow the molten metal to flow into the bottom cavity. (See center photo, above.) These shims will also create spaces between the upper and lower halves of the bearing so you can tune the fit later, as the bearing wears.

Pouring the Babbitts

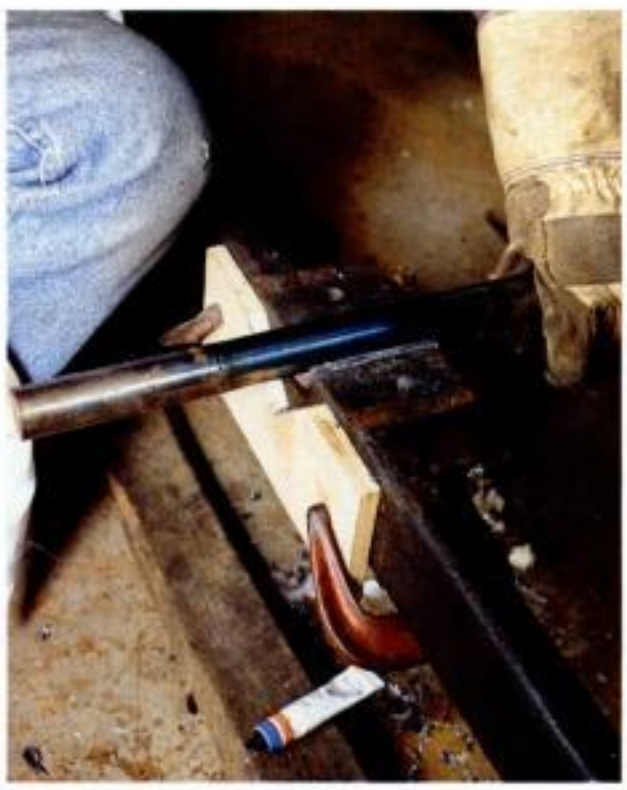
Melt enough babbitt metal for both bearings in the iron pot over a camp stove or charcoal fire. *Don't overheat the metal.* It is ready to pour when it will just char a pine stick. (See photo, top right.)

Caution: Molten metal is dangerous, so don't forget safety equipment. Be sure to

In with the new. *Molten babbitt metal, poured into a preheated cavity, will form a new bearing around this machine shaft.*

Moment of truth. *When the metal hardens, McCarthy removes the top cap and files off the triangular sprues left by the notches in the cardboard.*

Letting it flow. *Shallow channels carved into the top bearing will distribute oil evenly when the machine is running.*



Finding the high spots. *A thin coat of Prussian blue dye on the shaft will show where the bearing needs to be scraped to maximize surface contact with the shaft.*

wear goggles, leather gloves, leather boots, long pants and a long-sleeve shirt for the next operations.

While the metal is melting, clamp the plywood squares tightly against the sides of the housing, and preheat the shaft and surrounding castings with your torch. They should be hot enough that a drop of water instantly sizzles away. When everything is preheated and the babbitt metal is hot enough, place the shims next to the shaft and replace the bearing caps. Seal any tiny gaps between the plywood and the shaft with potter's clay or cotton rope.

The actual pour takes only a few seconds. Place your funnel in the oil hole of the bearing, pick up the pot with the metal tongs and pour the molten metal into the funnel. (See bottom right photo, page 51.) Then melt more metal if necessary and repeat the procedure on the other bearing.

When the metal has hardened—a minute or so after pouring—remove the cap bolts and pop the caps off with a screwdriver. (See photo, above left.) Clean up the sides of the babbitt with a chisel, and file off the sprues left by the notches in your cardboard shim stock. Finally, make a few oil grooves in the top babbitts with a veining chisel. (See center photo, left.)

If the babbitts are for a low-speed shaft, you're ready to replace the top caps, reinstall the oilers and use the machine. If they're for a high-speed shaft, you'll have to scrape the babbitts as explained below.

Scraping the Babbitts

Freshly poured babbitts may appear frosty or wrinkled. These surface imperfections will cause poor contact with the shaft and lead to wear and overheating, so you need to remove them by scraping. *Do not use any abrasives; these will leave particles in the soft metal and lead to scoring on the shaft.*

First lift out the shaft, coat it with a thin film of Prussian blue and replace it carefully in the lower babbitts. (See photo, below left.) Rotate the shaft a couple times and remove it again. You'll see blue marks on the highest spots of the babbitts.

Scrape the blue areas carefully with a small triangular scraper (see photo, above right) and repeat the procedure until at least 80 percent of the babbitt is blue. It's an easy but time-consuming process: You may have to do this 50 times before you get it right. Once the lower babbitts are scraped, replace the top caps and repeat the blueing and scraping process on them.

Tuning the fit. *McCarthy carefully scrapes the blue high spots with a triangular scraper.*

Before you use the machine, check to make sure that the shaft spins freely with no play. When you first use the machine, feel the babbitt caps occasionally to check for overheating. If they become too hot to touch, you may need to scrape some more or chisel some new oil grooves.

Babbitt bearings require constant lubrication in use. Whenever I use a machine with babbitt bearings, I always install snap-lever, sight-feed oilers (available from Wholesale Tool, 800-343-1008) on the main high-speed bearings. Flip the levers before you turn on the machine and they deliver one drop of oil to the babbitts every 10 seconds, providing the best protection for your new bearings. ▲

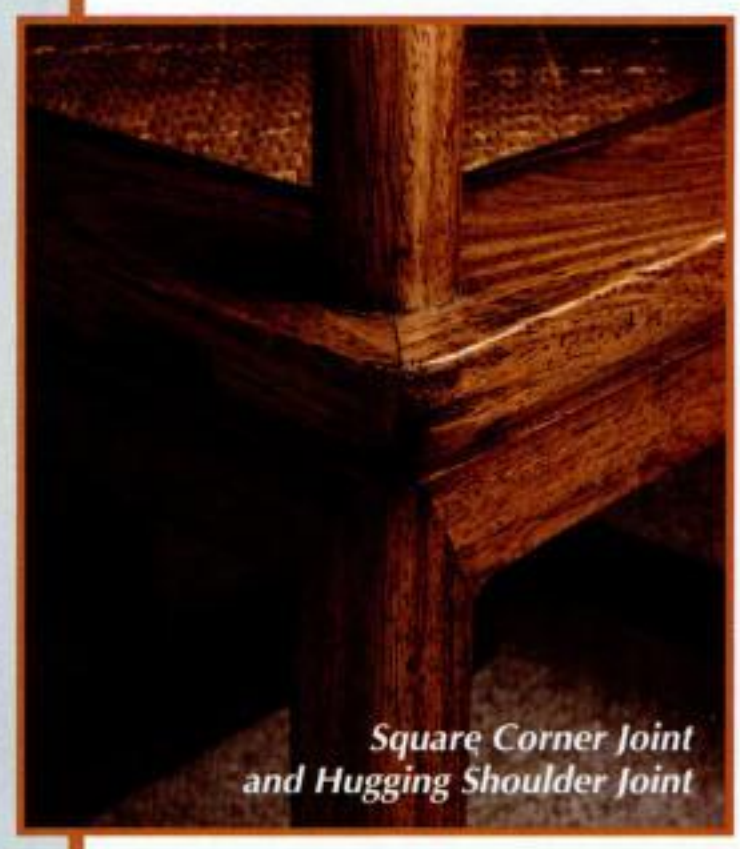
BILL MCCARTHY
restores and uses old machines in his architectural millwork business in Pennsylvania.

Chinese Chair Joints

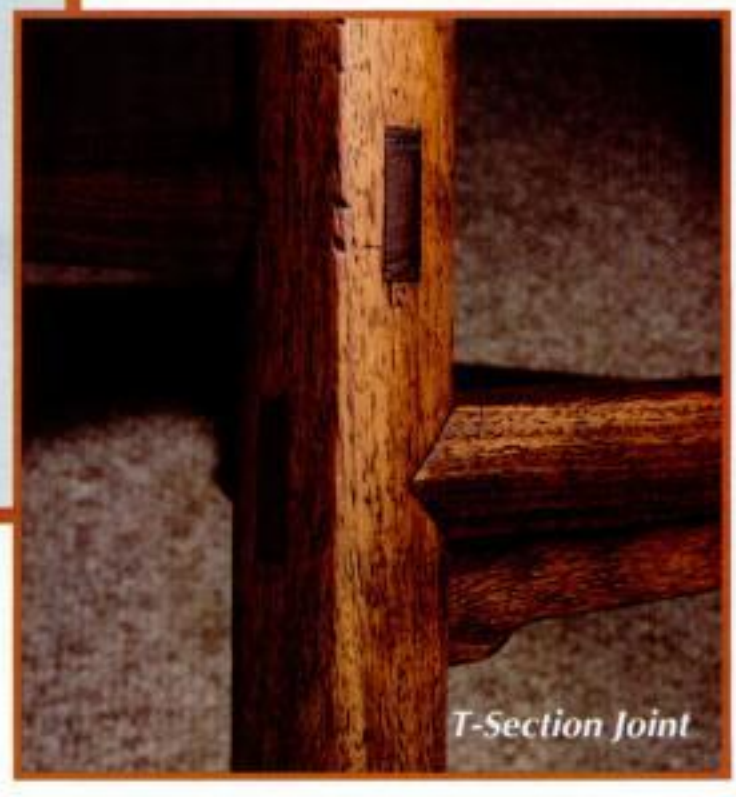
A Legacy of Oriental Woodworking Ingenuity

by Yeung Chan

Wedge Nail Joint



Square Corner Joint and Hugging Shoulder Joint



T-Section Joint

Mechanical marvel. *This 400-year-old Chinese "horseshoe" chair contains nearly a dozen different ingeniously designed joints. The inset photos show the joints discussed in this article.*

LEAD PHOTO BY JAMES KLINE,
COURTESY OF THE MUSEUM OF CLASSICAL CHINESE FURNITURE.
INSET PHOTOS BY FREDERIC CHOISEL,
COURTESY OF THE MUSEUM OF CLASSICAL CHINESE FURNITURE

T-Section Joint

方材丁字形接合

The chair stretchers connect to the bottoms of the legs with a type of mortise-and-tenon joint called, in Chinese, a "T-section" joint. (See photo, above.) The front stretcher (used as a foot rest) and the side stretchers are each made up of an upper and a lower piece. The tenons on the upper pieces run through mortises in the chair leg and are locked into place with wedges (not shown). The mortises are staggered so they don't weaken the leg. The tenons on the lower pieces fit into blind mortises.

Stretching into the leg. *Chan chisels out the V-shaped notch in the leg to accept the chair's side stretcher. This detail strengthens the joint and provides a visual transition from stretcher to leg.*

TOP PHOTO BY JOHN HAMEL. BOTTOM PHOTO BY YEUNG CHAN

The Chinese furniture of the Ming Dynasty has always had a special appeal for me. I enjoy the subtle elegance of the forms as well as the sturdy practicality of the pieces. Above all, I admire the skill and ingenuity of the woodworkers who created these classic furniture pieces. These anonymous craftsmen, working by hand and without the benefit of modern tools and adhesives, developed ingenious interlocking joints which have lasted for centuries.

I decided to try my hand at making some of these joints. I chose to duplicate several major joints from a 400-year-old Chinese "horseshoe" armchair. (See lead photo, page 53.) One of the finest examples of Ming Dynasty furniture, this beautiful chair belongs to The Museum of Classical Chinese Furniture in northern California. (See sidebar, page 57.)

Although the chair incorporates nearly a dozen distinctly different joints, I decided to copy those used for the back rail, seat frame, seat rails and stretchers. Without taking the chair apart, it was difficult to determine the exact joint design. But with the help of museum curator Curtis Evarts, Chinese-furniture expert Charles Wong, and some reference books, I learned the complex anatomy you'll see on the pages ahead. I'm confident that the joints shown in the photos closely match those of the original chair.

In this article, I'll show how these joints go together and I'll explain the procedures involved in making one of them—the "wedge nail joint" shown in the top photo on page 53. First, though, let's look at the way Chinese craftsmen approached traditional furniture joinery.

Joints of the Ancients

Centuries ago, complex joinery was found throughout the Chinese woodworking trades. The wedge nail chair joint, for instance, belongs to a

SHOP-MADE MINIATURE

Small and beautiful. *The author made these miniature chisels for cutting and cleaning up some of the very narrow mortises found in Chinese joints. The narrowest chisel blade above is just 1/8 in. wide.*

PHOTO BY YEUNG CHAN

family of keyed scarf joints that were used by wheelwrights and timber-frame builders as well as by furniture makers.

Unlike painting and calligraphy, furniture making was not considered an art form in China. Refined as they are, woodworking joints were designed from a very practical standpoint: They were to be mechanically sound while incorporating the grace of line and proportion so valued by the Chinese culture.

The horseshoe chair is an excellent example of this marriage of function and form. Each joint does the mechanical work it's supposed to do, but without intruding upon the smooth lines and graceful transitions that are crucial to the chair's overall design.

There's a general misconception that glue was not used in these interlocking joints. It's true that these joints don't need adhesive for solid assembly, but fish or animal glue was usually applied to eliminate slippage, which could eventually cause joints to fail. Lacquer was also used occasionally as a form of glue. Since organic glues deteriorate as they age, it's certain that most of the furniture which has survived over the centuries has been disassembled, rewedged and reglued a number of times. In fact, in the old days Chinese craftsmen traveled from town to town restoring furniture.

Another misconception is that nails were never used in Chinese furniture. In fact, they were occasionally found even in high-quality pieces. But they weren't used widely, in part because they were scarce. Since nails had to be handmade by a metalsmith, woodworkers tended to design joints that didn't require them.

A variety of hard- and softwoods were used in Chinese furniture. The horseshoe chair in the lead photo on page 53—like most furniture produced for royalty—was made of tropical hardwood. This particular chair was made from *Huang Hua Li*

CHISELS

My store-bought chisels were either too wide or too thick for some of the narrow mortises in the horseshoe chair, so I made several small chisels for the job. (See photo, left.)

I ground the blades for these chisels from commercial hacksaw blades, which are made of high-speed tool steel. I attached maple handles with rosewood ferrules. The first handles I made were round in cross section and tended to roll around on the bench. The newer versions, with oval or rectangular handles, stay put. I've found these miniature tools so handy that I now use them for marking and layout work. (For construction details, see "Shop Knives," AW #32.) —*Y.C.*

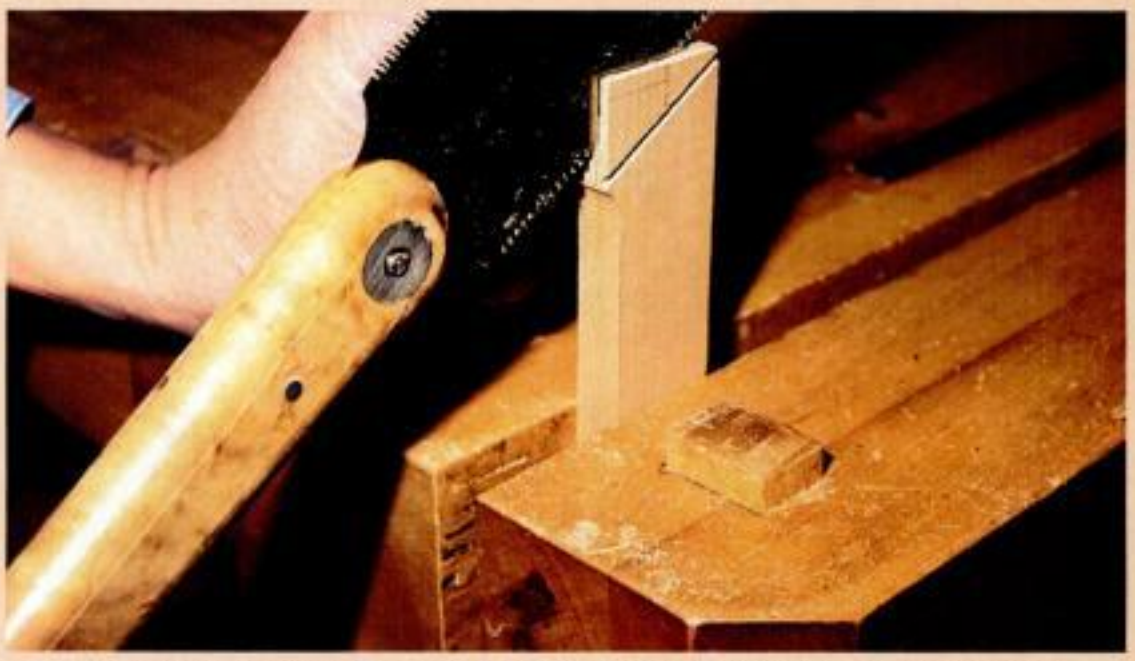
Square Corner and Hugging Shoulder Joints

格角榫　抱肩榫

The chair's seat frame is joined at each corner with a mortise-and-tenon miter joint called a "square corner" joint. The tenons are locked into their mortises with wedges (not shown).

Only after the joints are fitted and assembled are the holes for the rear chair post drilled in the mitered seat-frame pieces. The seat frame then slips into place over the posts.

Each seat rail is joined to the leg with a double-tenon joint called a "hugging shoulder." This joint was more commonly found in cabinets and tables than in chairs.



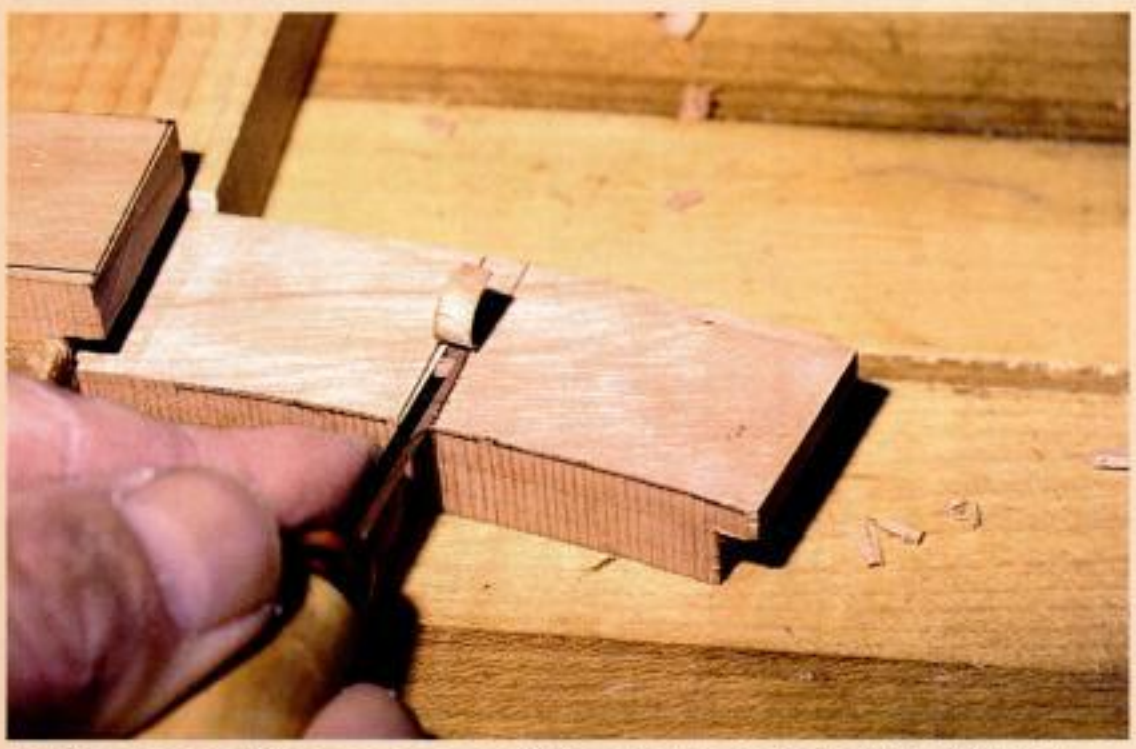
Thin-kerf work. *Chan uses a Japanese ryoba saw to cut the tenon cheeks on a chair rail.*

TOP PHOTO BY JOHN HAMEL. BOTTOM PHOTO BY YEUNG CHAN

Wedge Nail Joint

楔釘榫

The chair's back rail is made up of five pieces of wood sawn to a curve and joined end-to-end with "wedge nail" joints. A tapered wooden "key" locks each joint together. Chinese woodworkers probably developed this joint because much of the wood they used was not suitable for bending. The wedge nail joint is very strong but must be made precisely, because its strength and rigidity rely on a good fit.



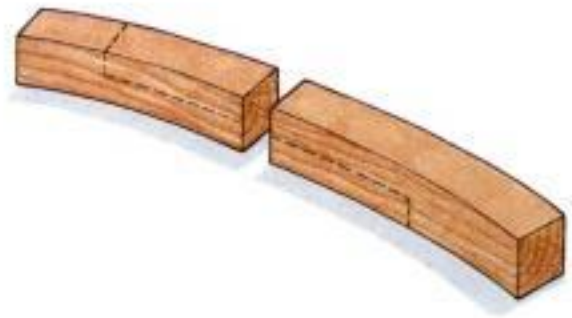
In the groove. *Chan uses one of his custom-made narrow-bladed chisels (see sidebar, page 54) to cut the bottom of the tapered keyway mortise in the wedge nail joint.*

TOP PHOTO BY JOHN HAMEL. BOTTOM PHOTO BY YEUNG CHAN

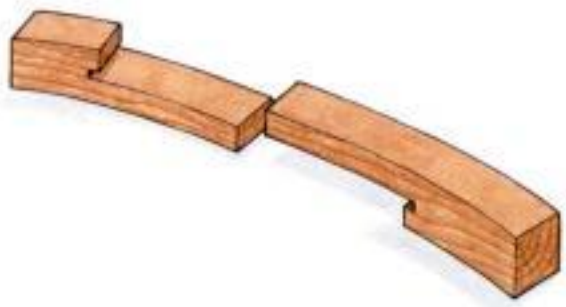
(Dalbergia odifera), a variety of rosewood. Furniture for the common people was often made of various indigenous softwoods, then finished with a semitransparent lacquer to provide a uniformity of color. Very few examples of early Chinese softwood furniture survive today.

Studying the furniture at the museum and recreating these authentic joints has given me an even deeper appreciation of Chinese joinery. There is no reason these joints should be relegated to antiquity. They are just as useful now as they were in the days of the Ming emperors more than 300 years ago. These joints could easily find applications in contemporary furniture design—

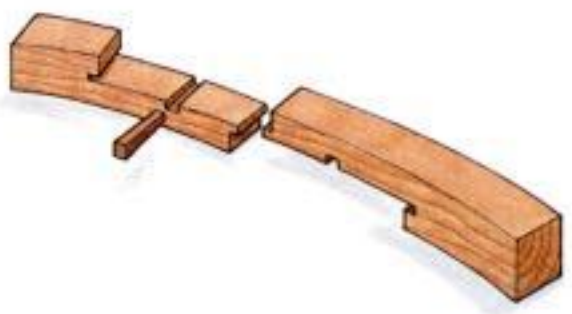
MAKING A WEDGE NAIL JOINT



Step 1: Lay out the lap joint. After dimensioning your stock and squaring its ends, lay out the lap joints. Mark each centerline using a marking gauge, then use a square to carefully measure and mark out the shoulders.



Step 3: Cut the mortises. Lay out the mortises and remove the waste to your lines with a dovetail saw and a narrow chisel. To ensure accuracy and prevent tearout, work from both ends of the mortise toward the middle.

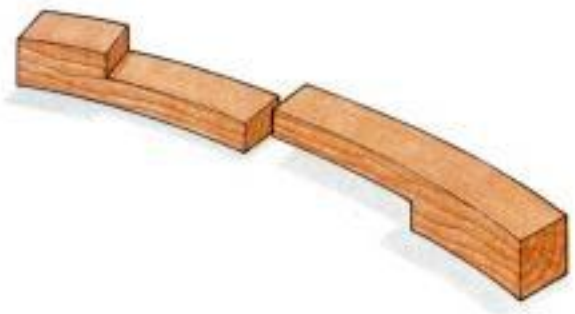


Step 5: Cut the tapered grooves. When the whole joint fits perfectly, cut mating tapered grooves in the lap faces to accept a locking pin. Make an overlong tapered pin and plane it to fit the mortises.

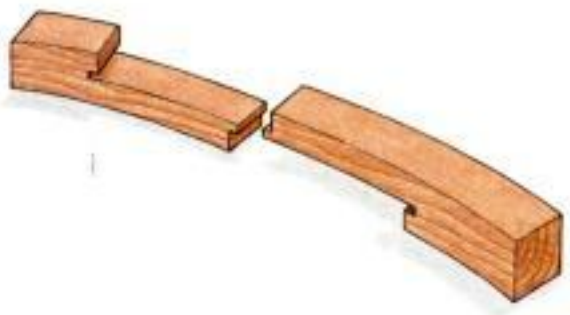
ILLUSTRATIONS BY HEATHER LAMBERT

oriental or otherwise. And, who knows, they might even spur you on to develop joint designs of your own. Well-designed, well-executed joinery in any form can be a challenge and a thing of beauty. ▲

YEUNG CHAN
designs and makes furniture in northern California.



Step 2: Cut the lap joint. Saw the lap joint a little bit oversize and trim it to final fit with chisels. Make sure that all the adjacent joint surfaces mate perfectly before you proceed to the next step.



Step 4: Cut the tenons. Lay out the tenons, measuring carefully. Saw them slightly oversize and pare them with chisels to fit the mortises. You may have to pare a bit off the mating surfaces to get everything to fit neatly together.

Step 6: Shape the round. Finally, tap the pin into place, cut it off flush, and round the rails. I used a spokeshave and block plane for this step, but you could use a router with a round-over bit if you prefer. —*Y.C.*

A MUSEUM FOR MING DYNASTY FURNITURE

by Simon Watts

An American home for Ming Dynasty survivors. *The Museum of Classical Chinese Furniture in northern California owns one of the most important collections of 16th- and 17th-century Chinese furniture in the world.*

PHOTO BY FREDERIC CHOISEL, COURTESY OF THE MUSEUM OF CLASSICAL CHINESE FURNITURE

Chinese furniture reached its peak of perfection during the latter part of the Ming Dynasty, which lasted nearly 400 years—ending with the suicide of Emperor Chong Zhen in 1722 AD. It was followed by the Qing dynasty, in power until 1910.

The harmonious form and consummate craftsmanship of the years 1550 to 1735 have never been equaled. Sadly, most of this legacy of wooden artifacts has been lost forever to fires, floods, earthquakes and civil strife.

Fortunately, The Museum of Classical Chinese Furniture was founded to promote the preservation and study of surviving Ming Dynasty furniture. Nestled in the Sierra foothills of northern California, the museum contains a collection of more than a hundred examples of Ming and early Qing Dynasty furniture. This collection of Chinese furniture has come to be considered one of the most important in the world.

Much of the furniture in the museum is arranged to simulate Chinese room settings.

In addition to furniture, the collection includes about 200 authentic miniature clay models of furniture, pieces which were buried in tombs to provide the comforts of home in the afterlife.

The museum will be closed while the majority of the furniture collection goes on tour, beginning with an exhibit at the Pacific Heritage Museum in San Francisco. The exhibit will run through March, 1996. (For exhibit information, call 415-399-1124.)

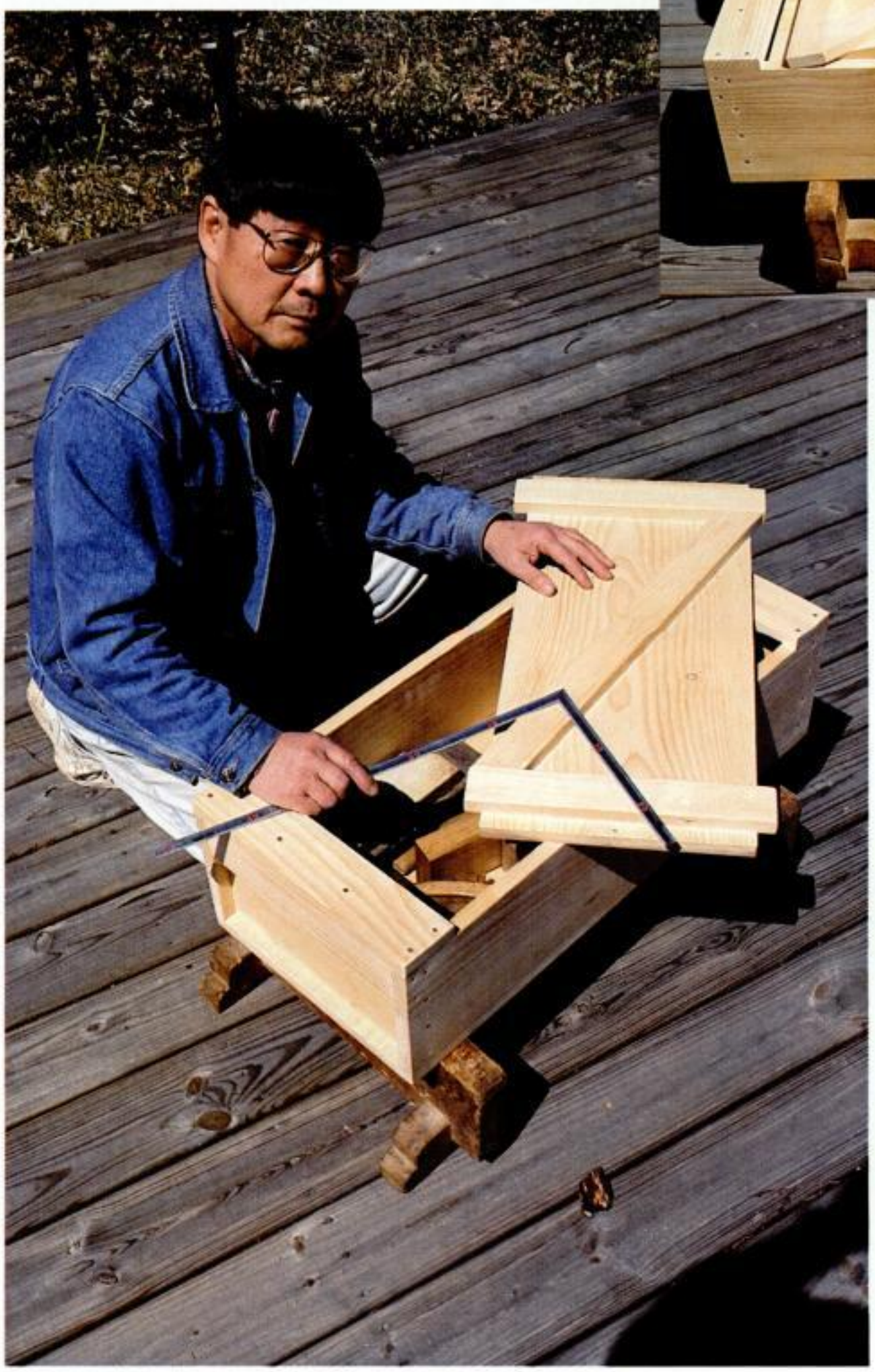
If you aren't able to visit the exhibit, but would like more information on Chinese furniture, you can contact the Classical Chinese Furniture Society. This group publishes a quarterly devoted to classical Chinese furniture. They also sponsor lectures and conduct research into the subject. You can reach them at The Museum of Classical Chinese Furniture, Box 100, Oregon House, CA 95962, (916) 692-3142.

SIMON WATTS *is West Coast editor of AW.*

Japanese Toolbox

Build a Sturdy Case with a Slide-Lock Top

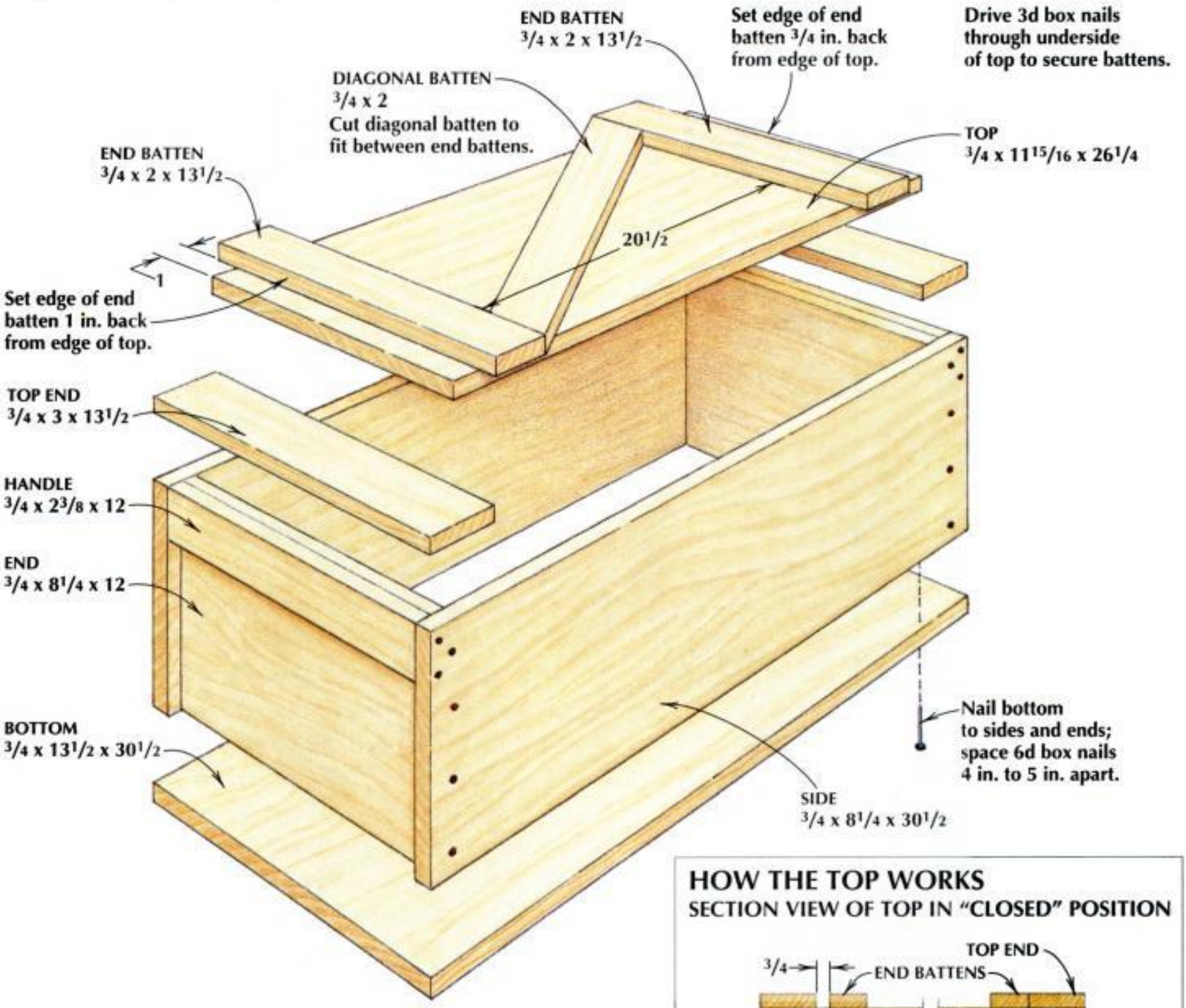
by Toshio Odate



Simple joinery, slide-open top. *Made from 3/4-in.-thick white pine, the author's toolbox has built-in handles and a cleverly designed top (above) that slides to open and close.*

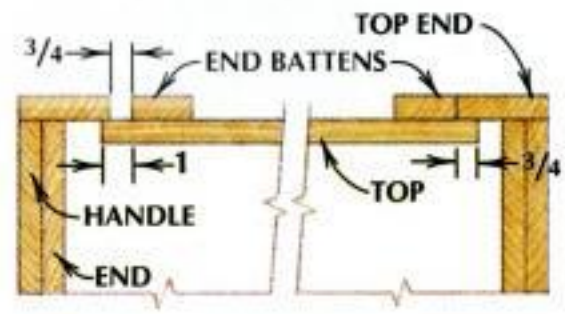
I first carried my master's toolbox in the spring of 1947. I remember the freshly plowed fields that stretched out on both sides of the road in the peaceful farm country where I had come to apprentice under a *tategushi,* or maker of sliding doors and screens. At that time the tategushi traveled from village to village, building or repairing doors and screen partitions.

JAPANESE TOOLBOX



HOW THE TOP WORKS

SECTION VIEW OF TOP IN "CLOSED" POSITION



As an apprentice, it was my job to carry the master's tools. Chisels, planes, saws, sharpening stones, marking gauges—these and other tools were carried in the *tategushi's* toolbox. Though the load was heavy, the proportions of the box and its built-in handles made it convenient to lift and carry on a shoulder, balanced with one hand.

When I traveled to Germany to give a presentation and workshop last fall, I met three young woodworkers who had toolboxes just like the one I used long ago. I decided it was time to recreate this traditional box. My new box, shown here, is a fairly close copy of the original. It is rectangular in shape and has a top that slides open and then lifts off. The large opening makes it easy to get tools in and out.

The simple butt joints and exposed nails in my toolbox make it different from many Western-style toolboxes made with intricate joinery or filled with drawers and compartments. But while fancier toolboxes are designed for storing tools, mine is made for transporting them. Durability and portability are important in a box that has to travel. I also like the simple, functional design of the top. It's easy to open and close, and no hardware is necessary.

If you build a box like mine, feel free to change the dimensions to suit your needs. If you make it bigger, however, it may be difficult to carry on one shoulder.

White pine boards, yellow wood glue and box nails (3d and 6d) are all it takes to make this box. I joined the sides to the ends first, then attached the bottom to square up the assembly. The handles and top end pieces went on next.

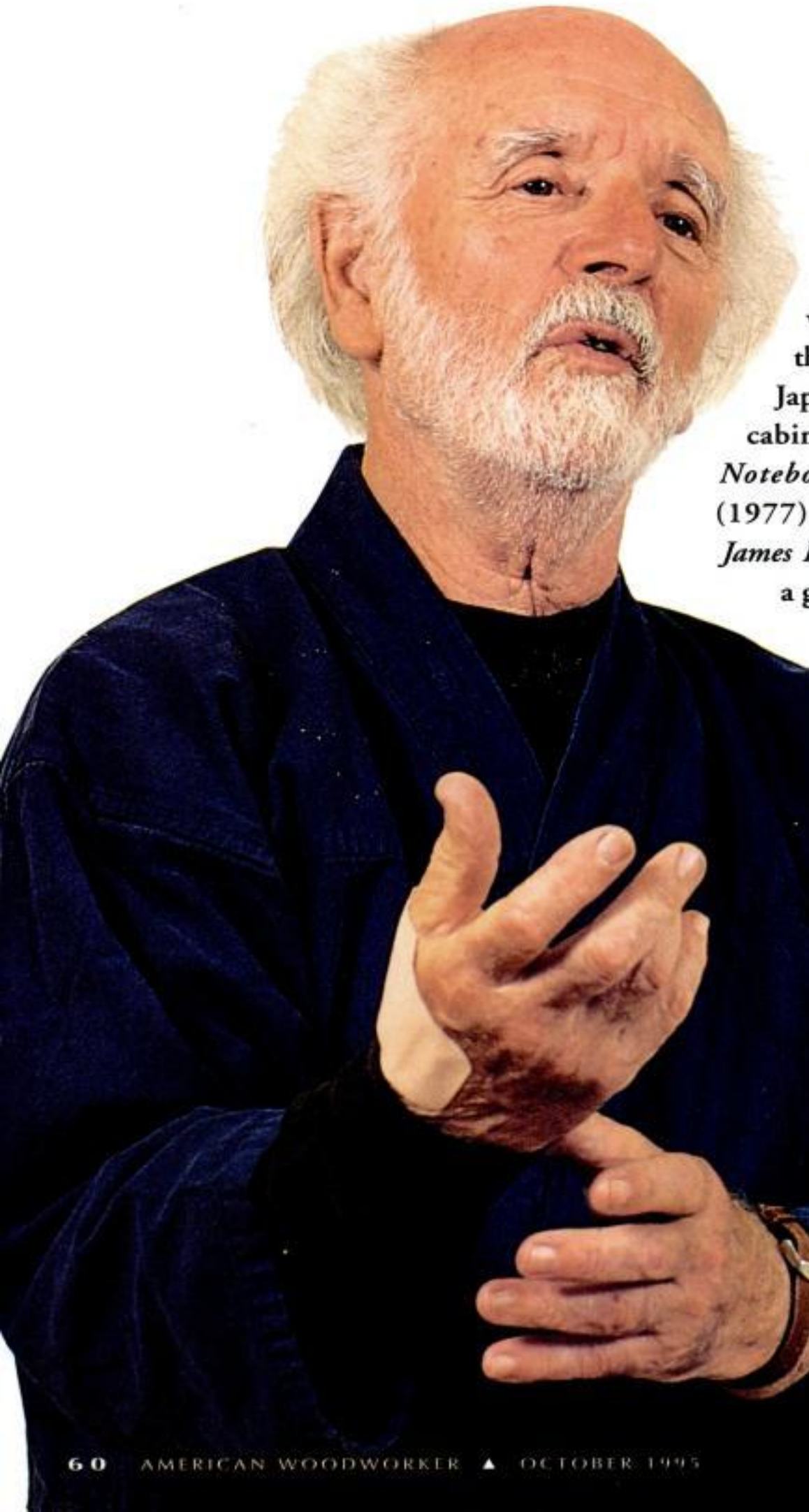
I cut the top just 1/16 in. narrower than the width of the opening. To get the length of the top, add 1 3/4 in. to the length of the opening. By locating the top's end battens as shown in the drawing, you'll create stops that allow the top to stay "locked" closed or slide open so that it can be lifted free. ▲

TOSHIO ODATE
is a noted sculptor and woodworker who lives in Connecticut and teaches at Pratt Institute.

The Personal Touch

An Interview with James Krenov

by Ellis Walentine



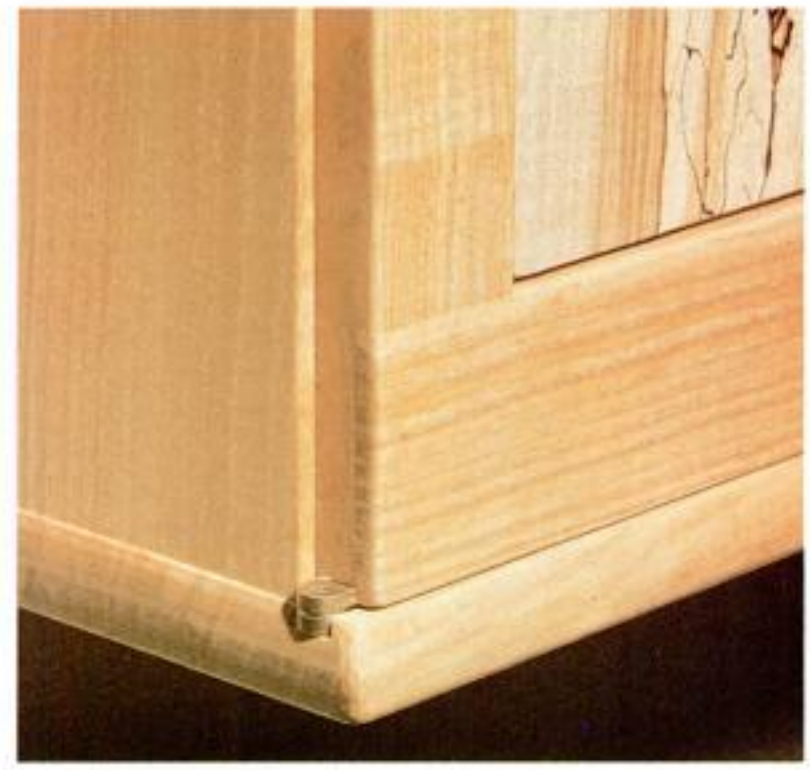
Tucked away in an unassuming building in Fort Bragg, California, 22 woodworking students are intensely working on their end-of-year projects, sweating details that most of us wouldn't even think about. They've come here to the College of the Redwoods from as far away as Japan to study with James Krenov, the legendary cabinetmaker whose four books, *A Cabinetmaker's Notebook* (1975), *The Fine Art of Cabinetmaking* (1977), *The Impractical Cabinetmaker* (1979) and *James Krenov: Worker in Wood* (1981), have influenced a generation of woodworkers worldwide.

Krenov is best known for his meticulously crafted cabinets, finished largely with hand tools, in which form, color, grain patterns and surface textures work together to create an overall feeling of balance and harmony.

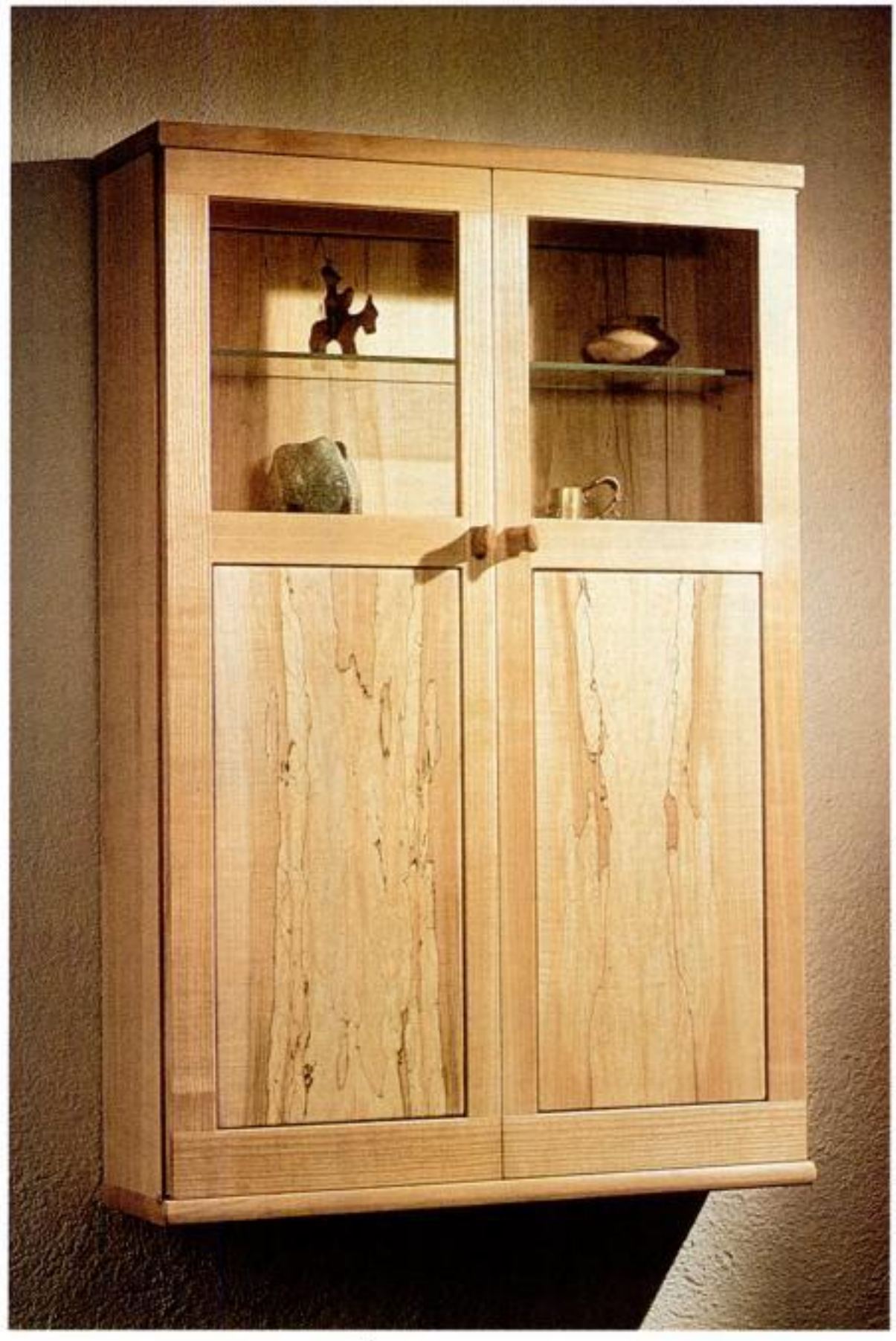
I visited Jim Krenov recently to try to discover the essence of his teachings—I call it the "personal touch"—that intimate sensitivity to material and detail so evident in Krenov's work and that of his students. On the pages that follow are excerpts from our conversations.

A legendary cabinetmaker. *James Krenov's views on craftsmanship have enlightened and inspired woodworkers around the world.*

PHOTO BY ELLIS WALENTINE



Balance and detail. *This wall cabinet (1978) subtly combines the straight grain of Swedish ash with panels of spalted maple. Krenov chose wax rather than an oil finish to prevent the panels from darkening. The olive pulls are mortised through the doors and wedged in place.*



PHOTOS BY KEVIN SHEA, COURTESY OF JAMES KRENOV

Composing with wood grain. *All the surfaces of this standing cabinet (1994) are covered with veneers sawn from a single small plank of English walnut brought to Krenov from England by a former pupil. It was Krenov's first attempt at parquetry.*

Your first book, A Cabinetmaker's Notebook, captured the imaginations of woodworkers around the world. Why do you think it had such a profound effect?

I think the positive reaction to *Notebook* was largely a social phenomenon, a sort of rebellion against the monotony of the time-is-money approach of purely professional craft. It happened at a time when there was a lot of social upheaval in America and other countries against authority and rigidity. Here was a guy who said you don't have to hate your work. *Notebook* was really the starting point for a lot of people who wrote to me, saying "I thought I was the only one in the world who felt this way, who was crazy enough to believe in this, and now I know there are two of us."

Today, it's more a matter of doing what you want with your craft and being happy in your work. There is an undying, recurring interest in this kind of work, even among the tremendous number of amateurs who want to do it for the pleasure, the satisfaction.

What is the first thing you teach your students?

Early on, we get into the fact that our tools and materials—and our work itself—will respond to our sensitivities. We remind students that all these little sensitivities *do* matter. If you don't believe in them you get sidetracked. But, if you believe in them, your chances of them becoming a part of you are so much greater.

This early reminder of the significance of seemingly insignificant things is the beginning of habit. It's the first link in a long chain that gradually becomes a natural way of working. You no longer worry about the physical aspects of a tool but about what you're going to do with it. You're thinking about how that's going to feel and how the result will look.

But, along with these sensitivities there is a responsibility. We don't build things and say, "Well, maybe it'll fall apart, maybe it won't; maybe these doors work here today but they won't work elsewhere tomorrow." The gallery visitor or the would-be owner of these pieces has to know that a piece is really well-made—that this veneered top is not only beautiful but it's stable and it's going to stay that way.

What is the secret of learning to do the best work?

First of all, you need curiosity and an open mind. Most of the ease and the enjoyment of woodworking comes through simple processes that require harmony, both mentally and physically. You have to focus on what you're doing and ask yourself questions. If you are not sharpening well, it is probably an unnatural movement of your hand or fingers or arm that's causing the problem. But you don't need to buy a gadget that ensures that you will maintain the correct angle as you sharpen. There's more satisfaction in learning to do it right and in believing that you can maintain that angle by yourself.

If you are curious about wood, that will lead you to discovering the individual properties of different types of

PHOTOS BY DAVID WELLER

"Owl Cabinet." *Krenov calls this small cabinet (1995), made of European cherry, spalted maple and kwila, "eccentric in its height and its fine dimensions." The interior of the cabinet was conceived as a "playroom for whatever one wants to see."*

woods, properties that are not really so much in books as they are in your fingertips and your eye. If you see that the wood has interlocked grain, you know it will demand to be worked differently than a very smooth wood. You need to be curious about that and learn those properties by yourself.

Your curiosity about the wood leads you to an interest in its relationship to certain tools. Some woods will demand that you learn how to use the scraper properly because they are too difficult to plane. Others will beg for fine planes or chisels or other cutting tools. When you balance the tools to the wood, it usually results both in enjoyment and in sensitivity of touch, for you and for the person who will live with that piece of furniture.

How do you go about designing a piece of furniture?

You start with a concept of the object you want to make and apply some common sense. In a functional object, you have the responsibility to consider its function and how comfortable it will be to use. Put yourself in the position of the user. You should believe and hope that people will live comfortably and enjoyably with it.

In a purely decorative object the responsibility changes. Sometimes the function is primarily to be beautiful—to appeal to people's senses and to convey the intimacy of the process involved in making it. Or, part of its function may be to amuse and delight—to give people something that has a content in it, an element of discovery that they can play with—something that makes it irresistible to someone. The physical function may be secondary or even irrelevant—it's simply a lovely little object. It doesn't necessarily solve a furniture problem, but somebody is going to enjoy living with it.

When you have sketched your concept and selected a piece of wood, you can draw the characteristics and rhythms of that particular plank on your sketch and see how they work visually. See what kinds of graphic lines the grain of the wood will give you—arches, swirls, straight lines and so forth—how certain wood grain works with the shapes of the piece and not against them. Being aware of these things will help you a great deal.

Then, there's the intermediate step from the sketch to a full-size mock-up, which we usually make of scrapwood and cardboard. The mock-up is not intended to reveal details; instead, it reveals the three-dimensional aspects of a piece—its balance or imbalance—that you can't see in the sketch. For instance, what people forget when sketching tables is that the spacing of the legs creates a volume of space under the table. Some tables have a very comfortable sense of space—a nice balanced feel. The mock-up lets you see that.

If you want to, you can add life to the mock-up by drawing lines or shading to represent certain elements. Otherwise you can just use it to solve the basic problems of dimensions and balance. If the mock-up only helps you see what you need to do to restore the balance you wanted, it was worth the effort.

Once you're satisfied with the mock-up, how do you begin making the piece?
First, it's terrifically important to determine the sequence of work. Set your mind on what is most important and try to think of what can go wrong. You are better off doing the most difficult part first, because if one element does not turn out well, everything has been spoiled. Learn to rely on your own logic rather than the traditional ways of doing things. Gradually your judgment improves.

And what if you make a mistake?
Somebody once wrote that death alone can prevent us from making mistakes. A part of any craftsman's honest work is to correct mistakes that can be corrected. If something goes wrong, you need to make a very important decision: Do you need to redo it, or is there a way out of the temporary difficulty that you are in? It's a matter of judgment and integrity. You can cover up mistakes like a cat covers a litter box but you can also do it in a way that will leave you honestly happy. That is craftsmanship. There never has been a craftsman who never made a mistake and there won't be. I'm a charter member of that club.

How do you decide what details a piece should have?
At an early stage, it's tremendously useful for the craftsman to have a sense of how an object will be used. Consider how people will relate physically to the object and it will help you in evolving forms and details that are comfortable for that physical use.

Another thing that helps you terrifically is the graphics of what you are doing. Not only the graphics of the wood—its grain and figure—but the graphics of your original sketch—the shadows, the little details. You look for those details in the wood; and if the wood is neutral, you add detail by means of a little profile, a groove, a chamfer, a rounded edge. You are, in effect, shading your little rough drawing, which was just an outline of your idea. You are putting substance into it with all these details.

If you have a dimension that's necessary structurally but that doesn't work well visually, you can change its appearance with the help of details. You can make a tabletop seem thicker by giving it a very soft little arched edge. Or, you can make it seem thinner by chamfering the underside of the edge or by creating a little profile which breaks up the thickness into two elements.

Part of the enjoyment for the craftsman is in playing with all these things—discovering what can be done with details. In other words, once you've got the rough substance of your piece, you work with the subtleties that add to the life of it. It's not pure chance that when I open the doors, the door pulls just beg to be caressed and ask a gentle handling rather than a rougher approach.

But, you have to remain sensitive to your work; don't be afraid to change. Just because your drawing or mock-up is this way it may not be right when you get your piece together. You may need to go with the way your piece is telling you to change. It is a visual experience.

Would you call it art?
We differentiate between "art" and "artistic." I think that is a very crucial distinction, because the notion of art intimidates people. It puts pressure on them. They're looking for a definition of art when really there is none. Art depends on the critic for its definition. It's something very, very far off.

But artistic means something different to me. Fortunately, my own background was such that I was made aware of ethnic art and people making things they needed. I was reminded constantly of this word "artistic." I think it is simply the quality in people that achieves balance and sensitivity and all these things that we are talking about.

What are some other ways to add your personal touches to your work?
For one thing, we find ourselves using fine carving knives to make little details like door pulls and shelf consoles [rests]. With a narrow, pointed blade you can turn on a dime.

There's also marquetry, which is a fine art but a very accessible one. A surprising amount of it can be done with a hand fretsaw; you don't have to invest in a machine.

Would you always prefer a hand tool over a router for shaping an edge?
Yes, definitely. Router bits and certain other tools usually produce mechanical shapes—half circle, quarter circle and so on—and they become a habit. You've got to be curious; you've got to believe that the shape that you can produce by experimenting with comfortable, friendly tools will be more interesting to both the eye and the hand than a purely mechanical shape.

What we are really about is classical tools. We've got the same basic woodworking tools and resources that cabinetmakers have had for generations, even centuries. But we do pay attention to what makes them tick. We know the difference between sharp and not sharp, and we tune our tools to work the way they were intended to work.

Is there a particular finish that you prefer?
We are rather conservative about finishing, but not categorical. We're open to suggestions. We use mostly traditional finishes—"polish" [shellac diluted with denatured alcohol] and various kinds of waxes—and we never try to make one wood look like another wood.

It's important to accept the responsibility that goes with functional furniture: It's going to be handled; it's going to be soiled; people are going to spill things on it. Certain kinds of furniture need a durable finish. But, that should not force you to use heavy varnishes or lacquers or something that will create a distance between the wood and the eye or hand. An oiled surface is remarkably durable. A waxed surface is too, if it is the right kind of wax.

Also, try to preserve the beauty of the wood. Don't use a finish that leaves it muddy or dirty looking. If you put oil on pear wood it looks like a garage floor—splotchy and uneven—no matter how evenly you have applied the finish. So you should always try different finishes on a trial piece of your wood, then make your decision.

What advice would you give to someone interested in starting out in woodworking?
First, ask yourself what you want to do, and don't be overly worried about what other people are doing. Cash is certainly a stimulant, but in the long run you end up living with yourself as a craftsman.

Learn your strengths and weaknesses, and devote yourself to the kind of work that you like the most. If you like it the most, it's partly because it comes to you naturally. If you are a carver you will be attracted by carving. You have a leaning toward that and you will enjoy it.

And try to be happy in your work. We've all had times when we were temporarily much less than that. ▲

"Fire and Smoke."
The dramatic figure of sawn pearwood veneers is framed by darker, milder-grained alerce in this parquetry cabinet (1994). The door pulls are made of pernambuco.

BENCH CHISEL *Challenge*

Edges to test. *From left to right: Stanley (England), Hirsch (Germany), Marples (England), Sorby (England), Footprint (England), Matsumura (Japan), Buck (U.S.), Japan Woodworker (Japan), and Nooitgedagt (Netherlands).*

EXPERTS TEST THE METTLE OF 9 POPULAR BRANDS

by Andy Rae

When renovating a kitchen years ago, I discovered an old chisel inside a wall—probably left there inadvertently by some unlucky carpenter. The chisel was a Stanley No. 750, which the company manufactured from 1930 to 1969. I've since discovered that the No. 750 is valued by collectors and woodworkers alike. It could be the metal—my chisel certainly takes a nice edge and holds it. But I also like the look and feel of the classic hickory handle.

Today, that combination of good steel and comfortable feel is still important when woodworkers compare one chisel to another. But how can you tell if the steel you're buying will hold an edge? And which of today's chisels has that comfortable feel? To find out, we decided to test 1-in.-wide chisels from nine manufacturers located in five different countries. This international selection encompasses quite a variety of blade lengths and handle sizes, shapes and materials. (See photo, above.) But despite their variety, all these tools qualify as cabinet or "bench" chisels. Their blades have beveled edges and are moderately thin, so they're suitable for paring and other fine work. On the other hand, all these chisels are also sturdy enough to be struck with a mallet.

We devised a two-part workout for these chisels. For an expert analysis of the steel, we sent a set of all nine brands to a metals-testing laboratory. (See Chisels in the Lab, opposite page.) We also sent identical sets of chisels to five noted woodworkers for some thorough bench tests. (See Bench Tests, opposite page.) And we made sure to keep a set in the AW workshop, so editors could have a hand in this chisel challenge.

CHISELS IN THE LAB

Laboratory Testing Inc., a metals-testing lab in Dublin, PA, performed three basic metallurgical tests on our chisels: chemical analysis, hardness testing and analysis of the steel's microstructure.

Chemical analysis provides a chemical "portrait" of the steel taken from each chisel. Chemical content affects working properties (strength and toughness) and the steel's ability to be hardened.

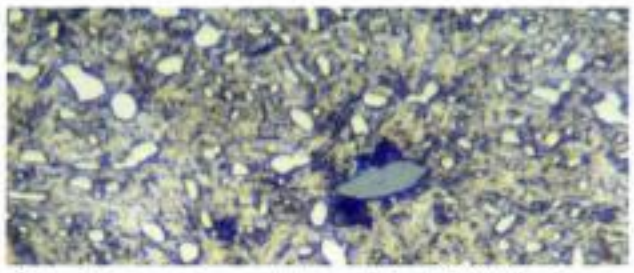
Hardness testing is just that: a measure of how hard the steel is. Embedded in plastic, a steel slice was tested with a diamond-tipped stylus to calculate a Rockwell number. (See main article.) For the results of this test, check out the chart on page 68.

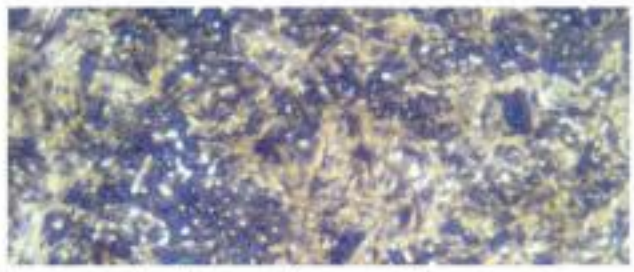
Microstructure is the steel's microscopic makeup—much like the pores of wood. (See photos, below.)

What constitutes good microstructure? First, the presence of carbides, which enhance edge-holding. Second, small grain, or particle size. Even dispersion of particles is also important. Scoring high in microstructure were the Marples and the Matsumura chisels.

—*A.R.*

Slices of steel. *In preparation for Rockwell hardness testing, slices from each chisel were embedded in plastic discs and polished.*





Steel structure. *Magnified 700X, these micrographs show the particle structure of two of the test chisels: the Marples (left) and the Stanley (right). More uniform particle distribution (left) promotes edge retention. The white spots are hard-wearing carbides.*

The Steel Story

The lab tests compared the chemical composition, hardness and microstructure of the steel used in each tool. Here's what the experts found:

Steel composition—The test chisels were surprisingly similar in this respect. All were made from high-carbon steel. Adding carbon—anywhere from 0.5 percent to 1.25 percent—makes the steel hard enough to maintain a sharp edge. Mild steel, which has a lower carbon content, won't hold an edge because there's no practical way to make it hard enough.

Eight of the nine brands we tested were made from *tool steel*, a type of high-carbon steel manufactured to stringent standards. According to the lab, only the Buck chisel fell into a category of non-tool steel as defined by the American Iron and Steel Institute. This less expensive type of steel is generally not as consistent in quality as tool steel.

Japanese chisels are traditionally made from two types of steel laminated together. The back, which forms the cutting edge, is made from a hard, thin layer of tool steel, which in turn is forge-welded to a piece of softer, mild steel that makes up the bulk of the chisel. In theory, this two-piece design allows the mild steel to absorb the shock of hammer blows, protecting the more brittle tool steel.

Seven of the nine chisels contained alloy metals—manganese, nickel, chromium or vanadium—added to the steel to increase wear resistance and toughness. The remaining two chisels—the Matsumura and Buck—contained only trace amounts of alloys, and as such were considered *plain* or nonalloyed steel. The Sorby chisel contained a significantly higher concentration of silicon to increase shock resistance. Our testers didn't report any noticeable differences in edge-holding abilities between the alloyed and nonalloyed chisels.

Hardness—Hardness at the cutting edge varied among the chisels we tested, but according to the lab, all of the tools

BENCH TESTS

Five Expert Woodworkers Pick Their Favorite Chisels

What better way to test a chisel than to put it in the hands of a master craftsman? Or several of them? That's exactly what we did. We asked five experts to test identical sets of nine chisels, with instructions to compare size, feel, edge retention, durability, ease of sharpening, and overall quality. Check out the expert opinions below and on the following pages.

PETER KORN

is a contributing editor to AW. He teaches at the Center for Furniture Craftsmanship in West Rockport, Maine.

The first criterion by which I judge any chisel is: Can the back be flattened with a reasonable amount of effort? Only four of the nine chisels—the Nooitgedagt, Marples, Footprint and Buck—passed muster.

Of the four, the blade of the Buck was too short for many paring tasks. The beveled sides of the Footprint tapered to such an extent that the narrow top was unstable on the tool rest when grinding. The Nooitgedagt was well-made, except that the metal ring at the top—right where you grasp the handle—was rough to the touch.

The Marples chisel was winner and grand champion in my opinion. In addition to being quick to flatten, this chisel took a sharp edge, was cleanly and durably constructed, and was well-designed for comfort and control.

Continued on next page.

TOSHIO ODATE

is a sculptor and shoji maker who teaches at Pratt Institute.

As a Japanese woodworker, I naturally found both Japanese chisels to be the most comfortable in my hands.

I was disappointed by the craftsmanship of the Japan Woodworker chisel. Its back, which should be truly flat, was very uneven.

The Matsumura was my favorite, although I was pleasantly surprised by the small size and hard edge of the Buck. Both these chisels initially chipped in use. This is a good sign: It means the temper is correct. For a Westerner not familiar with Japanese chisels—and for the price—I'd recommend the Marples or the Buck.

FRANK KLAUSZ

is a third-generation cabinetmaker in New Jersey.

My favorite chisel is the Marples, although I'd buy the company's wood-handled version. I liked the Japanese chisels, although the Matsumura was too small for my large hands. These chisels are good for working in tight spots, but their blades are too short for paring long tenons or for other work where a long blade is needed. I didn't like the Buck and the Hirsch because of the metal caps on their ends. They require striking with a metal hammer, and the tap of metal on metal is a harsh and annoying sound.

1-IN. BENCH CHISELS

Brand Name	Price	PERFORMANCE RATINGS* Edge Holding	Feel	Finish
Buck Buck Brothers (508) 865-4482 *Circle #626*	$9.50	●●●◖	●●●	●●●
Footprint Classic Woodcraft Supply (714) 532-4677 *Circle #627*	12.20	●●◖	●●●	●●◖
Hirsch Highland Hardware (800) 241-6748 *Circle #628*	26.95	●●●●	●●●◖	●●
Japan Woodworker Japan Woodworker (800) 537-7820 *Circle #629*	19.75	●●●●	●●●◖	●●●●
Marples Garrett Wade (800) 221-2942 *Circle #630*	10.95	●●●●	●●●●	●●●◖
Matsumura Japan Woodworker *Circle #631*	38.75	●●●●●	●●●◖	●●●●◖
Nooitgedagt Constantine's (800) 223-8087 *Circle #632*	15.95	●●●◖	●●●◖	●●●
Sorby Woodcraft (800) 225-1153 *Circle #633*	26.50	●●●	●●●●◖	●●●
Stanley Tool Traditions (800) 453-6736 *Circle #634*	16.99	●●◖	●●●	●●●

KEY

*Based on bench tests by five experts.

●●●●● = Excellent; ●●●● = Good; ●●● = Fair; ●● = Poor; ● = Unacceptable.

met an acceptable level of hardness for their intended uses. Creating the right hardness in a bench chisel is a compromise: After an individual chisel blank is heated red-hot, it is *quenched* in water or oil. Quenching changes the steel's crystalline structure into a harder, more brittle form. This harder steel will fracture at the cutting edge in use, so to make the tool tougher, the hardness is reduced by reheating the steel to a lower temperature, a process called *tempering.*

The hardness of steel is measured by the Rockwell "C" test (RC), which rates hardness in a range from RC 20 to RC 70, with RC 70 being the hardest. Of our test models, the Hirsch chisel and the Japanese chisels scored highest on the Rockwell scale. In our bench tests, there was a high correlation between the hardness of a chisel and its edge-holding ability. (See chart.)

Chemical uniformity—Edge-holding ability is also affected by how evenly the elements in the steel are mixed during heating. The more uniform the mix, the less likely the edge will fracture in use. The lab report showed that the elements in the Marples and the two Japanese chisels were the most evenly distributed, while those in the Stanley chisel were the least evenly distributed.

Carbide particles—Made from a compound of carbon and iron, carbides are very hard particles that help to increase the wear resistance of the steel. Ideally, carbides should be of uniform size and evenly distributed in the steel. According to the lab, the lack of carbides in the Japan Woodworker chisel may explain why it received a lower edge-retention rating than its cousin, the Matsumura.

Grain size—Grain size refers to the size of the particles that make up the steel. The smaller the particles, the more durable the steel will be in use. Grain size is expressed numerically, with #1 being extremely coarse and #10 or above extremely fine. All of the chisels we tested had grain sizes of #7 or #7.5 except the Footprint, which was significantly coarser at #5.

Finish and flatness—A chisel's finish reveals how carefully it was manufactured. Most of the Western chisels had rough factory grinds on their bevels and backs, although grind marks on the Buck were noticeably finer. The fronts of the Hirsch and the Stanley were buffed to a mirror polish—a nice touch. But on the Hirsch chisel, the back was also buffed, making it rounded in this critical area. Only the two Japanese chisels were honed on flat polishing stones on both their bevels and backs.

SPECIFICATIONS

Weight (oz.)	Blade Length, Overall Length (in.)	Handle Type	Steel Type	Cutting Edge Hardness (RC)
7.75	3, 8 7/16	Plastic, round	Plain steel; no carbides	55
6.75	4 1/8, 9 3/4	Plastic, oval	Alloyed tool steel	54
8	4 1/4, 11 9/16	Hornbeam, octagonal	Alloyed tool steel; no carbides	60
5.5	2 3/16, 8 3/4	Red oak, round	Alloyed tool steel laminated to mild steel; no carbides	62
7.5	4 5/16, 10 1/2	Plastic, oval	Alloyed tool steel	56
4.5	2 3/16, 8 1/2	Red oak, round	Plain tool steel laminated to mild steel	60
7	4 3/8, 10 7/8	Beech, round	Alloyed tool steel	55
7.75	4, 10 1/2	Boxwood, octagonal	Alloyed tool steel	56
9	4 1/16, 10 3/8	Plastic, oval	Alloyed tool steel	56

Before a chisel can be used for any serious cutting, its back must be flattened. If the area immediately behind the cutting edge isn't flat, it will be impossible to get a truly sharp edge. Also, a flat back ensures that the chisel will have an accurate bearing surface for paring. Our two Japanese test chisels had traditional hollow-ground backs, which makes flattening easier because there's less material to remove.

The Matsumura was the only chisel that didn't require a significant amount of time to create a truly flat, polished back; a few minutes on a 6,000-grit waterstone was all it took. All the other chisels needed successive honing on 800-grit and 1,000-grit waterstones to remove grind marks and—on the Japan Woodworker—to correct a slight upward bend behind the cutting edge. The Hirsch took the most work due to its badly rounded back.

The Right Size and Weight

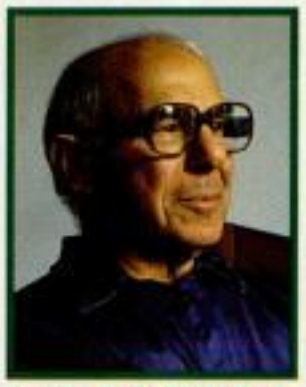
For many woodworkers, size and weight are major factors in choosing a cabinet chisel, as our testers confirmed. A long-bladed chisel lets you sight along its length to help keep the chisel square to the work, and gives a more accurate reference surface for paring long tenons or deep mortises. A short blade offers more control for corners, shallow mortise work, cleaning up shoulders and light hitting.

I personally liked the short blade and the overall small size of the two Japanese chisels. But they felt too light for heavy chopping, and their short blades limited the amount of paring I could do. The handles on the Sorby and the Nooitgedagt were a pleasure to hold. The 9-oz. Stanley was the heaviest of all the chisels, and the handle felt awkward. The Hirsch, with its long handle and blade, felt top-heavy and was the hardest chisel to control.

Recommendations

Our lab tests and bench evaluations revealed an important fact: There are far greater differences in the *feel* of these chisels than there are in the *steel* used to make them. The Sorby chisel earned the highest marks for good feel, while the Matsumura proved superior in edge retention. For a best buy, our testers picked the Marples. ▲

ANDY RAE
is a furniture maker and an assistant editor of AW.



SAM MALOOF
is a furniture maker and author. He lives and works in California.

For my furniture making, I'd choose the well-balanced Sorby for general use and rough-duty work. My assistant Larry White, who helped in evaluating all the chisels, liked the feel of the Sorby handle as I did, and noted that the plastic handles were generally too "slick" in his hand.

The Marples was certainly a best buy for the price. The Buck was too heavy and thick for furniture—it's more of a carpenter's chisel. For fine work, the two Japanese chisels were tops for me. I enjoyed their small size. Of the two, I preferred the Japan Woodworker for its slightly larger size and lower price.

MARK DUGINSKE
is a Wisconsin-based woodworker and writer.

All the chisels were easy to sharpen with the exception of the Hirsch, whose back was so rounded that it required extensive honing to get it flat.

Although I prefer a wood handle, I liked the plastic-handled chisels because I felt they would be good for situations that required really hard pounding. But the Stanley's oddly shaped handle felt clumsy to hold.

With proper sharpening, you could do really good work with any of these chisels. For a beginner, I'd recommend the Buck. My favorite was the Matsumura—the Ferrari of chisels—because of its feel.

Selecting Period Pulls

Give Your Furniture the Right Touch of Brass

by Mike Dunbar

Brass basics. *Polished brass hardware is an essential design element on many pieces of period furniture.*

Since their introduction, brass pulls have been almost obligatory on fine period furniture. Most of the highboys, secretaries and chests-on-chests of the 17th and 18th centuries had anywhere from four to ten drawers. Like jewels in a crown, polished brass pulls created spots of visual interest on plain drawer fronts and doors. Apart from their practical use, intricately detailed and highly polished brasses were a favorite way for colonists to show off their wealth.

Determining the correct hardware for period furniture can be tricky—even the experts make mistakes. In Wallace Nutting's *Furniture Treasury,* the Bible of American period furniture, plate 776 shows a Sheraton-style side table that someone "colonialized" by replacing the rosette pulls with Chippendale-period willow brasses. The replacement pulls were cast one war and five U.S. Presidents before the sideboard was built.

In this article, I'll discuss the types of pulls popular during each period. Fortunately, you can still purchase high-quality reproductions of many of these historical pulls. (See Sources, p. 73.) I'll also show how you can enhance and protect the hardware on your period piece.

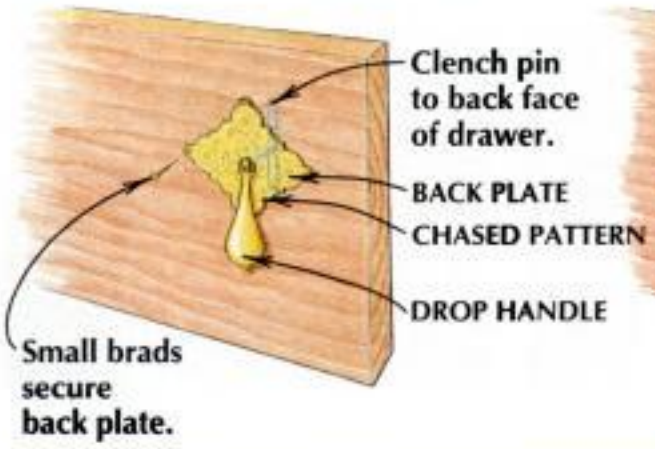
Pull Anatomy and Fabrication

Understanding how period pulls were made and attached to furniture is the first step in selecting authentic reproductions. Most brass pulls consist of three parts: the handle, the back plate and the fastener that connects them to the drawer or door. (See drawing, opposite page.)

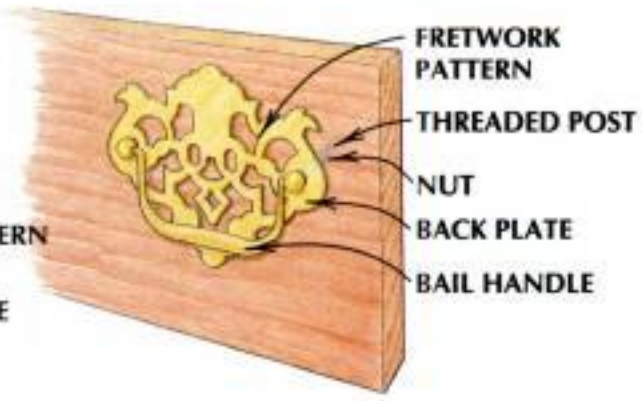
Casting vs. stamping—Until the mid-18th century, pendants and back plates were sand cast. In this process, a pattern was pressed into casting sand and the depression was filled with molten brass. The back plates were sometimes decorated with *chased* (stamped) or *fretted* (pierced) patterns. The rough casting was then filed smooth and polished.

PULL ANATOMY AND INSTALLATION

COTTER-PIN FASTENER



THREADED FASTENER



Manufacturing techniques evolved considerably during the 18th century and by the start of the Hepplewhite period (around 1780), back plates were made by stamping brass sheet stock between a set of steel dies. This process, which required much less handwork and less brass, enabled craftsmen to produce highly detailed hardware on an economical scale.

Today, most back plates are stamped out of sheet brass or brass-plated steel in cookie-cutter fashion. Sand-cast, reproduction-quality back plates are still available, but modern stamped hardware is far less expensive.

Cotter pins and threaded posts— Until the mid-18th century, pulls were installed with brass cotter pins. Looped through the handle, the pin extended through the back plate and the drawer front. Its two projecting ends were then *clenched,* or hammered, into the back face of the drawer front. This technique was not very durable. When a pin broke, its clenched ends had to be dug out of the drawer front and replaced.

By the end of the Queen Anne period (around 1750), brasses were secured to the drawer with hand-threaded posts and nuts. (See drawing.) Today, posts and nuts are threaded by machine. Because these parts aren't seen on a finished drawer, this modern technique is acceptable.

Marks of Quality

How to tell the good-quality reproduction pulls from the not-so-good? It's not always easy, but there are some key details you can look for.

When shopping for cast hardware, look for the flaws. Cast surfaces are not perfectly flat. Compared to stamped hardware, cast pulls should appear somewhat rippled. Looking at the backs of the hardware will also clue you in to its construction. Cast hardware will still be pitted on its back face where it has not been filed and polished smooth.

Hand-worked hardware should also display some subtle differences in its chasework or filed edges. These discrepancies show that these pieces were made by artisans, not machines. (See photo, below left.)

When selecting stamped hardware, pay attention to details. Despite modern production methods, antique hardware has sharper detail than most of its modern-day equivalents.

Protective and Decorative Finishes

Colonial cabinetmakers sought to keep brass hardware bright in order to show off its beauty. To do this, they would carefully polish the hardware and then protect it with a coat of shellac. After years of everyday use and countless polishings, these coatings would fade and wear away. The exposed brass would oxidize, or tarnish. (See photo, below right.) We refer to this appearance as an "antique" finish. Today, manufacturers offer "antiqued" brasses and "antiquing" solutions to make brass hardware appear older than it is.

I prefer that my brasses look as bright as they would have centuries ago. To protect my hardware pieces, I simply give them a coat of spray acrylic lacquer before attaching them to the case. (Spraying is much more important for stamped brasses because their stamped designs are difficult to polish.) Historically, tinted lacquers were also used to achieve a look similar to burnished gold. You can still use tinted lacquers to the same end, or for a more traditional approach, you can use button-lac shellac. (See Sources.)

The best and the rest. *Well-made brasses can make a striking difference on a period piece. Compare the reproduction-quality pulls on the left with the cheaper, stamped imitations on the right. Hand-filed edges, crisp details and turned posts indicate a high-quality product.*

Polish, patina and plating. *Protect bright brasses (top left) with shellac or lacquer. Alternatively, oxidizing solutions mimic the patina of antique hardware (top right). A silver-plating solution, rubbed onto the bottom pull, recreates the look of hardware used on High style Federal furniture.*

William & Mary 1690 to 1720

Pendant pulls consisted of a hanging drop handle with a cast back plate. The drops were typically hollowed out in back so that they could hang flat against the drawer front.

Most back plates were quite plain, often decorated with concentric circles, although some more elaborate plates were diamond- or clover-shaped. These plates could be solid or pierced, chased with engraved decorations, or covered with three-dimensional filigree.

Pendant pulls. *Teardrop-shaped handles were hollowed in back to hang flat and save on brass.*

Queen Anne 1720 to 1750

The pulls from this period are sometimes called "bat's-wing" brasses because they resemble a bat with outspread wings. The simplest back plates were smooth, polished castings; more elaborate examples were chased. The earliest type of Queen Anne pull had a plain bail handle which was fastened to the drawer with a pair of brass cotter pins. Later, the cotter pins were replaced with cast posts and nuts.

"Bat's-wing" brasses. *Brass cotter pins were initially used to anchor bail pulls against simple cast back plates. These were eventually replaced by threaded posts and nuts.*

Chippendale 1750 to 1785

This period had three distinct substyles of hardware. The first types of hardware to emerge were called *willow* brasses. These were similar to bat's-wing brasses but were generally larger and more elaborate, with pointed spurs and *trefoils* (stylized three-leafed patterns) on the rounded lobes. (See photo, near right.) Simple willow brasses had solid, unadorned back plates, while more elaborate ones were pierced.

The second substyle was derived from the popular interest in oriental design. "Chinese Chippendale" pulls were similar to willow brasses, but the lobes and spurs were more angular, suggesting the roof of a pagoda. (See photo, far right.)

The third Chippendale substyle—called "rococo"—included the most elaborate hardware in the 350-year history of American furniture, reserved for the most expensive Chippendale pieces. Rococo cast pulls were abundantly decorated with three-dimensional shapes such as scallop shells and C-shaped scrolls. Early versions of rococo pulls had one-piece back plates. Later versions had pairs of round or oval back plates. These were less ornate than earlier pulls, and foreshadowed the simpler tastes of the Federal period.

Chippendale substyles. *"Willow" brasses (left) were prevalent throughout the period; "Chinese Chippendale" and rococo brasses appeared later (right).*

The bails used with all of these brasses were *bellied,* or swollen in the center, enhancing the ornate appearance while providing a better grip for fingers. This swelling was sometimes accented by a detail such as a shell. The outside edge of its C-shape could also have small spurs.

Tinted wax is another, easy-to-control method of protecting your brasses while subtly coloring them.

Antiquing—One problem with commercially antiqued hardware is that it's all antiqued in exactly the same way. If you're looking for a halfway point between "bright" and "completely antiqued," you have two options. You can wait for bright hardware to tarnish naturally, or you can perform your own custom antiquing.

To antique your own hardware, first strip off any residual coating with a commercial paint stripper and rinse the brass with either acetone or ethanol. Next, lightly scuff the surface with a 000 abrasive pad. Some brass dealers offer antiquing agents, but another trick is to use the same chemicals used to blue gunmetal. (See Sources.) When you've arrived at the color you desire, rinse off the oxidizer, then protect and stabilize the finish with a coat of lacquer.

The pulls on High style Federal furniture were made of brass that was plated with Sheffield silver. I've duplicated this effect with a silver-plating solution that allows me to rub on a layer of silver. (See Sources.) Silver-plated pulls should also be given a coat of lacquer to protect them from tarnishing.

Think twice before refinishing an antique pull. Original finishes are quite rare and can serve as valuable sources of information to furniture conservators. Examine the piece closely. If it appears that the hardware has never been removed from the piece, and if the original finish is not overly abraded, check with a conservator before reaching for the stripper.

Finally, never use ammonia-based polishes to clean brass hardware. Ammonia reacts disastrously with the brass alloy, causing accelerated deterioration and even stress cracking. Your hardware supplier or local jeweler can recommend safer polishing solutions. ▲

MIKE DUNBAR
is a contributing editor to AW. He makes Windsor chairs and teaches chairmaking in New Hampshire.

SOURCES

For reproduction hardware:

Ball and Ball
(610) 363-7330 *Circle #635*

Crown City Hardware
(818) 794-1188 *Circle #636*

Horton Brasses
(203) 635-4400 *Circle #637*

Paxton Hardware Ltd.
(800) 241-9741 *Circle #638*

Period Furniture Hardware Co.
(617) 227-0758 *Circle #639*

Whitechapel Ltd.
(800) 468-5534 *Circle #640*

For button-lac shellac:

Garrett Wade Co.
(800) 221-2942 *Circle #648*

For antiquing chemicals:

Birchwood Casey
(612) 937-7931 *Circle #649*

For silver-plating solution:

JAX Chemical
(718) 347-0057 *Circle #650*

Federal 1785 to 1820

The Federal period can be divided into two distinct subperiods, each displaying its own sense of decor. George Hepplewhite's *The Cabinet-Maker and Upholsterer's Guide* was the design book that set the style for the first half of this period. Thomas Sheraton's *The Cabinet-Maker and Upholsterer's Drawing Book* was the style sourcebook by the start of the 19th century. (See Moldings by the Book, AW #46, page 47.)

Hepplewhite (1785-1810). *Highly detailed back plates of this style were economically stamped from sheet brass.*

Sheraton (1800-1820). *Rosette-type pulls, popular in this period, typically had a simple stamped back plate and an elaborate embossed face.*

Hepplewhite: 1785 to 1810. Some of the early Hepplewhite pulls had a pair of stamped back plates about the size of a half-dollar. (See photo, near right.) Hepplewhite back plates were round or oval; single-back-plate oval brasses were the most popular. Most plates were very plain, nothing more than raised concentric ovals. The most sophisticated oval brasses were stamped with finely detailed neoclassical motifs or patriotic symbols.

The bails used with oval brasses were lighter and less prominent than those of the Chippendale period. Post heads were decorated with concentric circles by turning the head in a metal lathe.

The most expensive and elaborate type of Hepplewhite piece consisted of a round pendant bail that encircled the stamped back plate and was attached by a single post. The bail's outer surface was often textured to look like rope or garland, while back plates usually bore patriotic or neoclassical motifs.

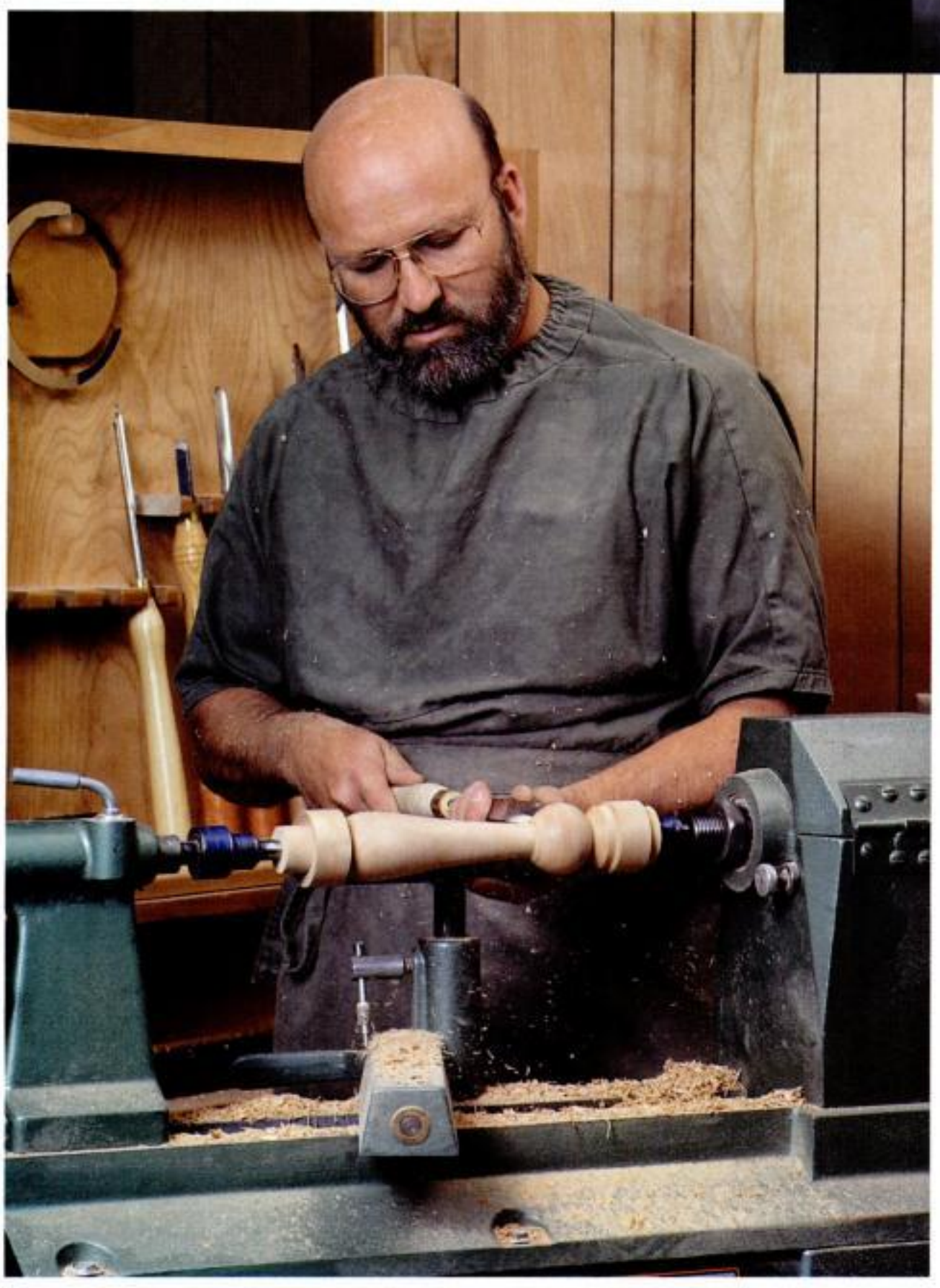
Sheraton: 1800 to 1820. Oval brasses were still used on some Sheraton-style furniture, but most pieces sported rosette pulls—knobs with stamped brass back plates and faces. Rosette back plates were usually decorated with concentric circles. The stamped brass faces were typically decorated with crisp floral motifs. More elaborate rosettes bore patriotic symbols or busts of American heroes.

Don't Get Caught!

A Pro Shows How to Avoid Common Turning Mistakes

by Richard Raffan

Digging in. *Using the skew, the author demonstrates a typical catch while spindle turning. At left, the edge of Raffan's skew catches the workpiece, producing the spiraling blemish shown above.*



Turning wood on a lathe is a wonderfully satisfying experience, but danger in the form of a catch is always just a twist of the tool away. The skew chisel is notorious for digging into spindles. (See photo, above.) And most bowl turners have had a nearly completed job flying in pieces across the shop—a good reason for wearing a safety helmet.

Most catches occur because the cutting edge of the tool is presented to the wood at the wrong angle. In this article, I'll analyze classic catches and tell you how to use scrapers, skew chisels and gouges so that the wood can't grab the tool. But before you can learn the finer points of each particular tool, there are some basic techniques to keep in mind that will minimize catches regardless of the tool you're using. Here's a checklist:

•**Keep your tools sharp.** A dull edge only increases the likelihood of a catch. (For more on sharpening turning tools, see AW #30.)

•**Use light pressure.** Don't push the tool hard into the wood, because the constant force of the rotating material increases the load on the tool edge and intensifies the severity of the catch, especially at the roughing-down stage. To produce a good size shaving, merely hold the tool at the right angle. If the tool doesn't cut, go back to the grinder. As with life in general, it never pays to confront force with force—someone or something always gets hurt.

•**Use leverage for control.** Any force on the tool edge has to be equalized at the handle end of the tool. To minimize the amount of effort needed to control a tool, position the rest close to the point of cut so it's easier to counteract any catch which does occur.

•**Hold lightly but firmly.** Avoid "heavy-handedness" when holding a tool, yet keep a firm grip so you can control the tool if it kicks back during a catch. If you grip the tool really hard, the cutting edge will want to pass through the wood when it catches, making the catch more harsh.

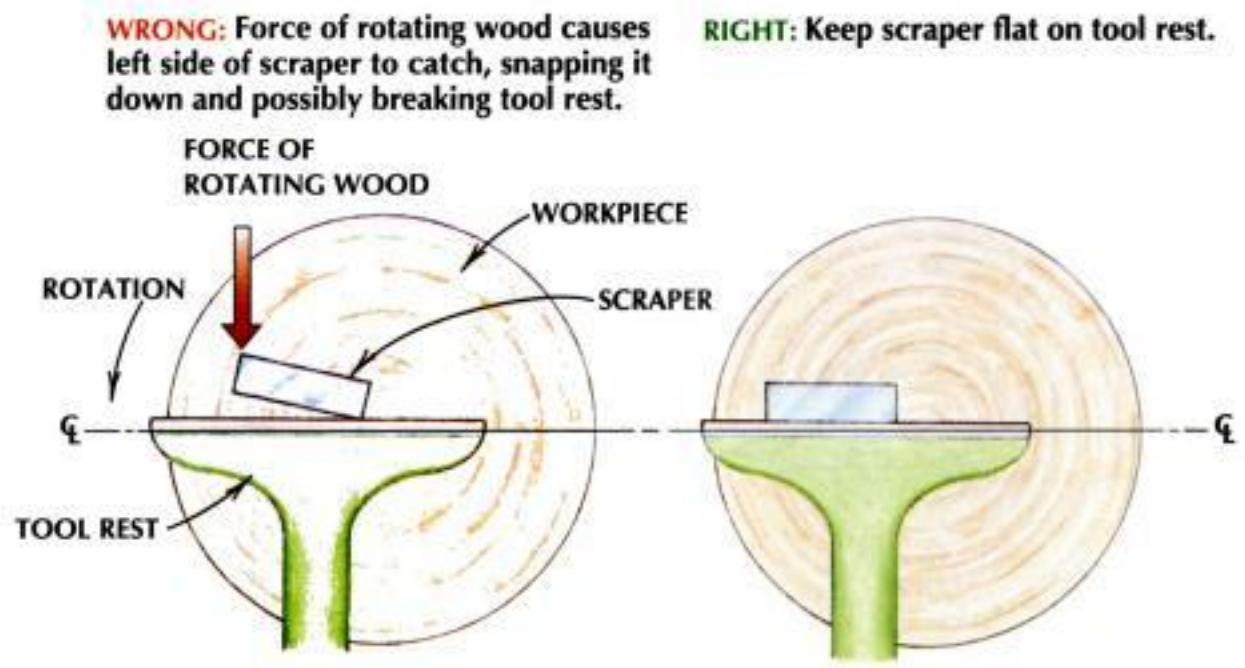
•**Position the tool rest at the proper height.** Set the rest at a height that allows you to hold the tool comfortably. Proper height depends on your height in relation to the lathe-center height (the center point on the headstock and tailstock), the thickness of the tool you're using and the diameter of the wood being turned. My lathes have a center height of 2 in. (50mm) above my elbow. Generally, I angle the handle end down a few degrees below horizontal and adjust the rest height frequently.

•**Keep the tool on the rest.** Many things can contribute to the ferocity of a catch, but one thing is certain: *Catches occur when the force of the wood rotating on the lathe is directed against an unsupported section of the tool edge.* This truism is well illustrated by the most basic catch, which occurs when you let the tool edge contact the wood before you have the tool blade on the rest. Because the tool is unsupported, it will smack down on the rest. During my early days at the lathe, I broke several rests doing just this. Call me a slow learner.

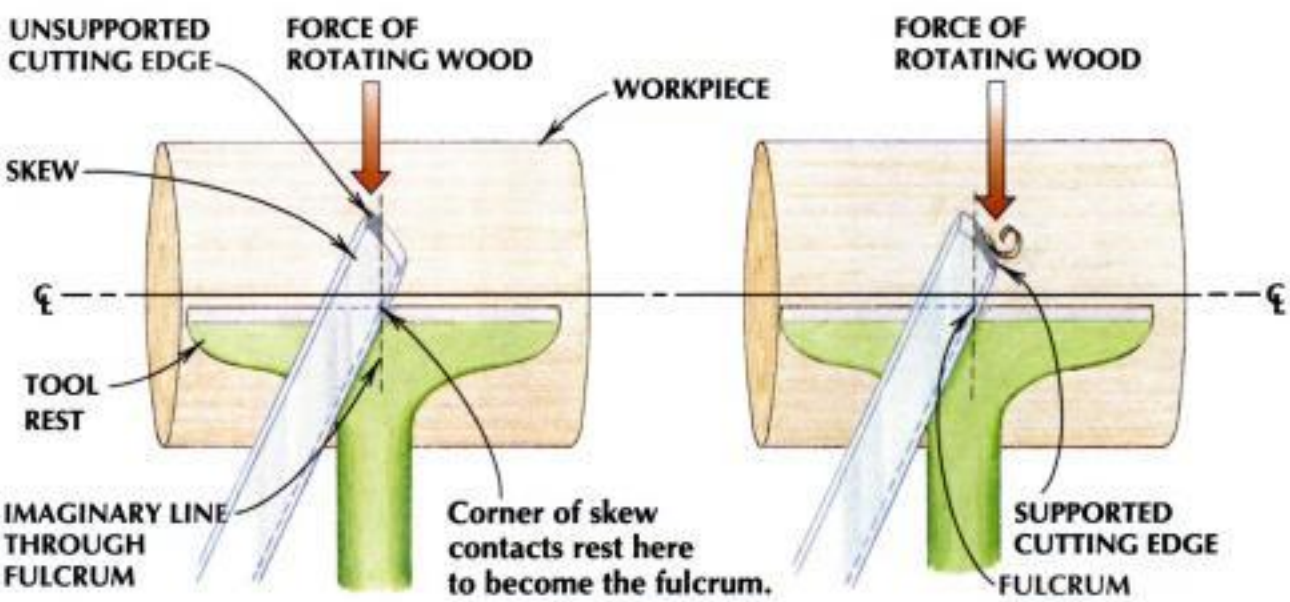
Keeping these basic points in mind, following are some specific approaches for the three common types of turning tools: scrapers, skews and gouges.

FIG. 1: AVOIDING A CATCH

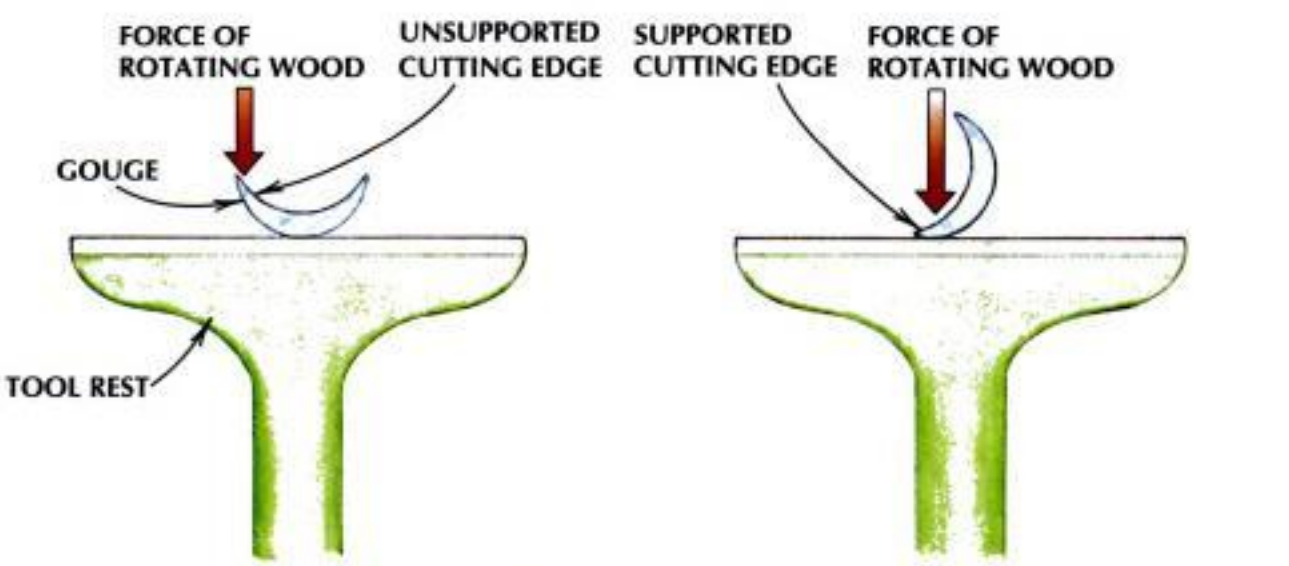
...WITH A SCRAPER

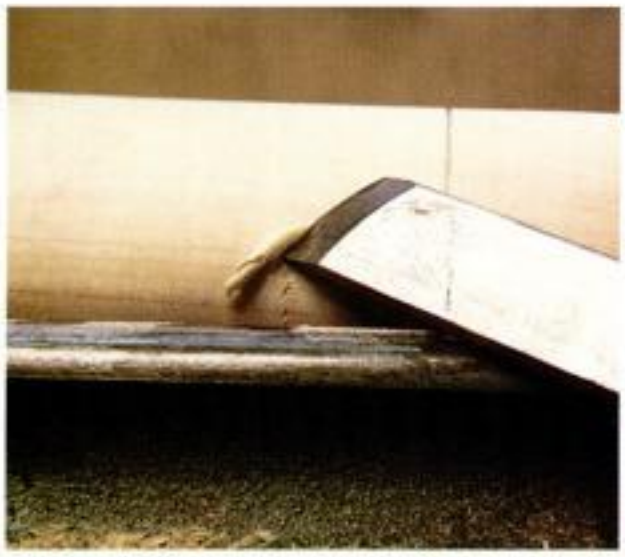


...WITH A SKEW



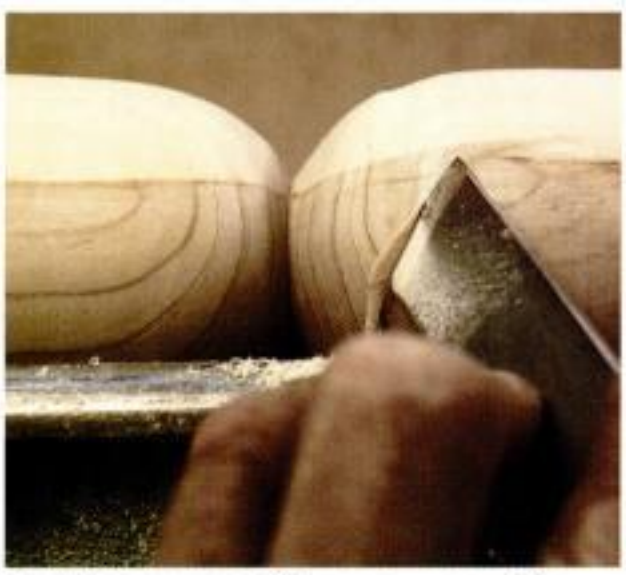
...WITH A GOUGE





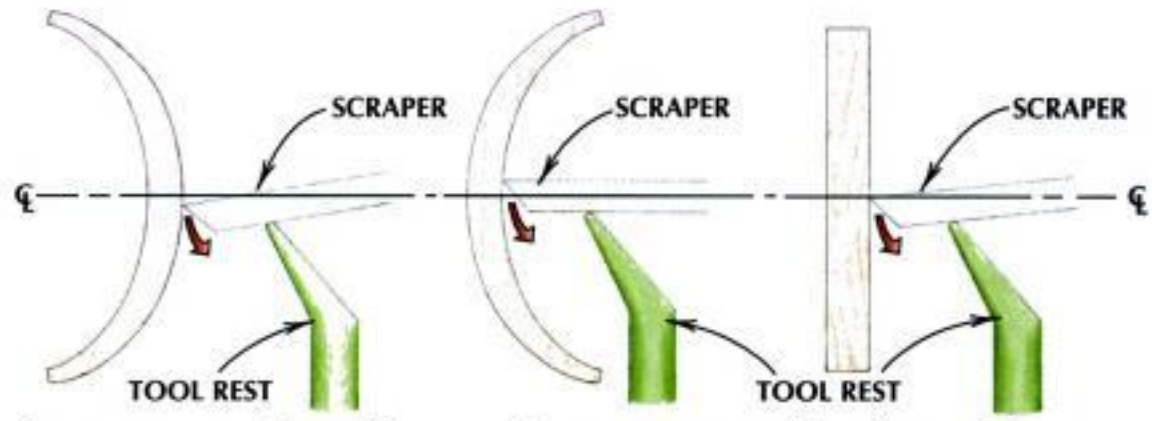
Planing cuts. *To prevent catches, keep the cutting edge of the skew on one side of the fulcrum (indicated by the black line), and the handle on the other. The bevel should rub the wood.*

End-grain cuts. *Cut with the long point of the skew down and leading. Keep only the point and the bevel in contact with the wood. If the full cutting edge contacts the work, the force of the wood will be against an unsupported section of the edge, and you'll get a catch.*



Cutting curves. *Shape curves with the long point of the skew facing up, cutting with the lower part of the edge. Catches occur when you cut with the upper edge of the chisel.*

FIG. 2: MINIMIZING SCRAPER CATCHES



Scrape convex surfaces with the cutting edge below center and pointed down. If the edge catches, it will carry into space, minimizing the catch.

Scrape concave or flat surfaces with the cutting edge at or above center. Never tilt the cutting edge up.

Scrapers

I use scrapers only for facework and for hollowing into end grain—never on spindles. While they can be used for hogging out waste, gouges are faster. However, scrapers excel as finishing tools. In fact, scraping is too harsh a word for the action required: Instead, think in terms of stroking the wood surface with the tool edge.

Catches occur whenever you allow one side of the tool to lift. Keep scrapers flat on the rest, and half your problems are solved. (See Fig. 1.) The other common problem is when you have too much of the edge in contact with the wood at once. The rule of thumb here is to reserve your straight-edged scrapers for convex curves. On flat and concave surfaces, use round-nosed scrapers. Never have all the edge contacting the wood at once, unless you're using small profiling tools.

The angle at which you use the scraper and the height of your rest are important, too. When working a flat face or a concave surface—the inside of a bowl, for example—keep the rest high so the cutting edge is above center, and never tilt the tool up. This way, if the tool catches it will pivot into space with limited damage. On convex surfaces, lower the rest, but keep the cutting edge tilted down. (See Fig. 2.)

Skew Chisels

Of all turning tools, the skew is probably the most frustrating for the novice. Master the skew, and the rest of turning is pretty easy. Skew catches are also caused by variations on the theme of force against an unsupported section of the tool. One basic rule for the skew is to keep the bevel rubbing on the wood at all times, except when the point first enters the wood to cut a groove.

Planing cuts—For a planing cut on spindle work, I use the skew with one corner only contacting the tool rest. I use the skew long point down for cylinders and long curves. The idea is to have the tool cutting on the opposite side of the fulcrum (where the tool contacts the rest) from the handle. In the photo at top left, I've marked the chisel and the workpiece to indicate the line that passes through the fulcrum. Provided you cut on the left side of the line with the handle to the right—and keep the bevel rubbing the wood—the tool shouldn't catch in this position.

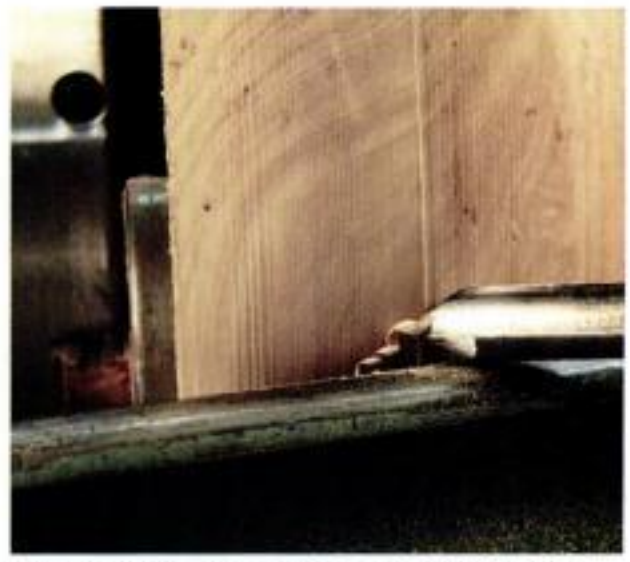
During planing cuts, skew catches occur when you let the point of cut drift toward the handle side of the fulcrum, where the tool does not contact the rest. (See Fig. 1.) At the handle end of the tool you have no control of the leverage because the wood is exerting force on the unsupported side of the fulcrum.

Cutting end grain—The safest way to cut "V" grooves or across end grain is to use the skew with the long point down and leading. Have only the point and the bevel side in contact with the wood, with the cutting edge angled clear. (See center photo, left.) If you allow the edge to contact the work, the force of the wood is against an unsupported section of the edge and you'll get a catch.

Cutting curves and beads—Curves are usually cut with the long point of the skew facing up and using the lower part of the edge as shown in the photo at bottom left. For small beads, I use the corner of a small, square-ground beading tool.

My final hint for the skew is to grind a

Shear scraping. *With the flute of the shallow gouge facing the wood, shear scrape by brushing the edge lightly across the surface.*



Shear cutting. *Whether you're turning a foot (center), a cove or a bowl profile (right), start the shear cut with the gouge rolled over so the flute is facing sideways. Once you're in the wood, roll the tool slightly in the direction of the cut to get a larger shaving (right).*

slight curve on the edge. It's less likely to catch, and when it does catch it's not as grabby as a straight edge.

Gouges

Turning gouges can be broadly classified as either deep fluted (designed to hollow bowls) or shallow (marketed for spindle turning). Of the two, the shallow gouge is the better all-purpose tool. Deep-fluted gouges are suited to hollowing deep bowls, having been designed for working well out over the rest.

Shallow gouges—Always use a shallow gouge rolled on its side. A shallow gouge will always catch if you use it with the flute up. (See Fig. 1.)

For trueing up a face and shear scraping, roll the gouge so the flute faces the wood. For the shear scrape, brush the edge lightly across the surface to remove fine dust or minuscule curly shavings. (See photo, above left.)

For shear cutting, start with the gouge rolled over so the flute faces away from the wood. (See center photo, above.) Once you're in the wood, roll the tool slightly in the direction of the cut to get a larger shaving. (See photo, above right.) I use the shear cut for turning a bowl profile, for turning the inside of a bowl, for turning a "foot" to fit a chuck, or for turning a cove on a spindle.

Deep-fluted gouges—When making hollowing cuts on a bowl with a deep-fluted gouge, the safest technique is to have the gouge rolled on its side. (See Fig. 1.) To prevent catches, keep the shoulder (the corner between the edge and the side of the blade) clear of the wood. (See center photo, right.) Always make hollowing cuts from the rim of the bowl inward and toward center.

As you gain confidence with the deep-fluted gouge, you can try a "back-cut" using the inside edge for a smoother finish. (See photo, bottom right.) At first glance, this might seem to be a catch in the making. But the steepness of the side bevel supports the tool, keeping the force of the wood close to the fulcrum.

During back-cutting, catches occur when you roll the inside shoulder of the edge into the wood. Having the wing of a deep-fluted gouge dig in is usually more dramatic than with a shallow gouge. Consequently, you need to be particularly careful when using the back-cut, especially on concave curves like the inside of a typical bowl. If you keep catching a square-ground gouge, try grinding the wings to a slight round so they don't grab so easily.

Catches are unnerving, and they never go away—they just become more controllable. Whenever you have a catch, analyze what went wrong. If the job is still on the lathe, switch the lathe off, fit the tool edge into the dig-in and work out how the catch started by rotating the lathe backward. Even better is to simulate catches with a buddy turner. One of you rotates the wood on the lathe against the tool while the other manipulates the tool. It's usually easy to see where you can go wrong. I'm sure you'll catch on soon enough. ▲

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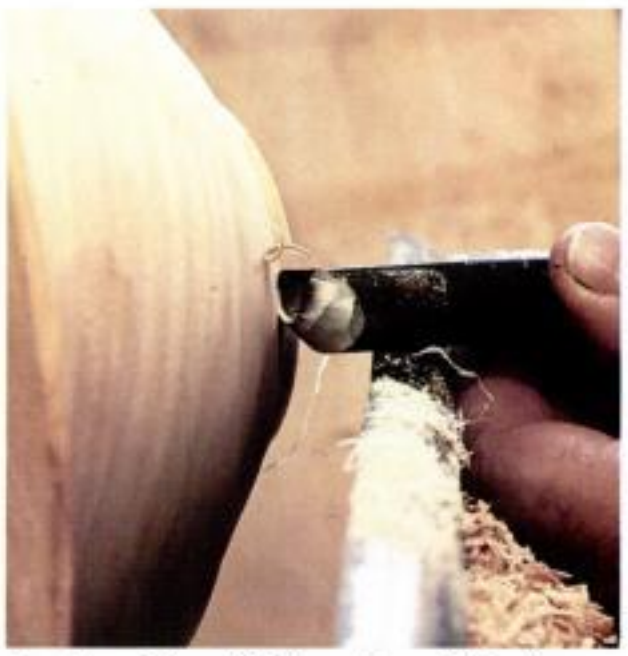
Standard hollowing cut. *When hollowing the inside of a bowl with the deep-fluted gouge, keep the corner of the tool clear of the wood. Always cut from the rim inward.*



Back-cutting. *With a deep-fluted gouge, make a back-cut using the inside cutting edge, supporting the tool with the steep side bevel. Don't let the inside shoulder of the edge roll into the wood or it will catch.*

Mississippi Porch Rocker

A Relaxing Project in Red Oak and Hickory

by Andy Rae

"Making a chair is as easy as fallin' off a log."
—Greg Harkins

In a converted milk barn in Possum Bend, a small community in central Mississippi, Greg Harkins makes chairs for all kinds of people. A sign in a corner of his shop proclaims his motto: "Chairs for Presidents, congressmen, celebrities...and other big dogs, but mostly just common folk." True to his word, Harkins has crafted chairs for the last four Presidents, yet his main business comes from the local customers who stream through his shop.

Inspired by an apprenticeship with a wizened Mississippi chairmaker, Harkins specializes in making rocking chairs like those that have graced Southern porches for more than a century.

Harkins' chairs are built to last, following traditional "green" woodworking principles: He cuts mortises in the green wood posts and tenons on the dry rounds. As the posts dry and shrink, they lock onto the tenons tightly, making his chairs unbeatably strong.

Harkins' familiarity with the process of chairmaking impressed me. I watched as he put together a rocker from start to finish, using an odd collection of homemade tools and old machines. "Making a chair is as easy as fallin' off a log," Harkins told me. Two days later, I believed him.

Making the Chair Parts

Harkins builds most of his rockers of red oak because it's cheap and plentiful in his neck of the woods, although he occasionally makes chairs from walnut for special customers.

He makes the posts and runners of his rockers from green wood; all the other parts are of air-dried or kiln-dried wood depending on what's available. He's careful to select straight-grained wood for the posts and plain-sawn stock for the rockers, or runners, because quarter-sawn stock tends to split.

He begins by rough-turning all the spindle parts—posts, "rounds" and "foot round"—on the lathe with a shallow 2-in. gouge. (See Fig. 1.)

After rough-turning, Harkins finish-turns the posts and foot round. He lays out the patterns on the rough blanks with a "scratcher" while they spin on

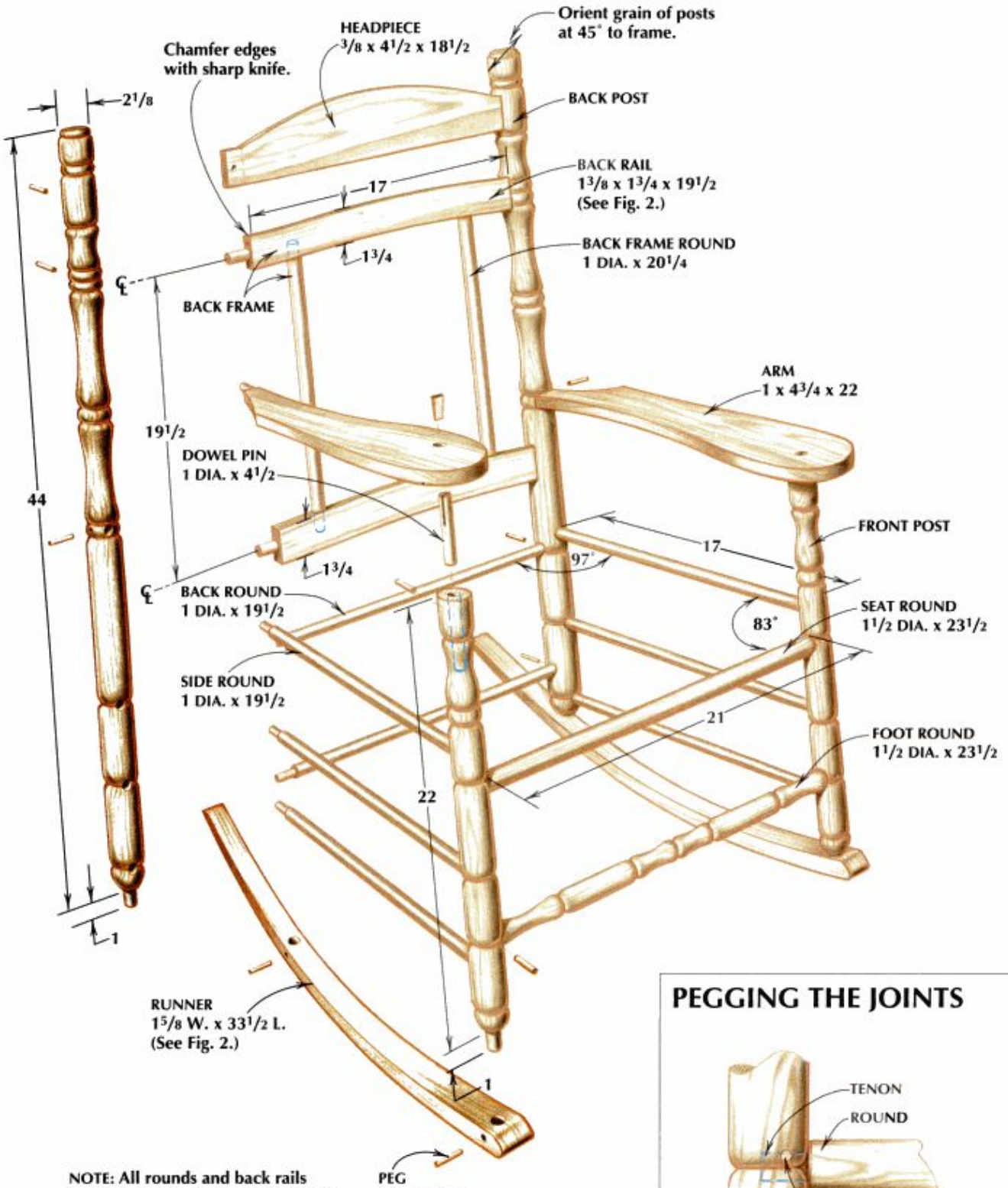
Turning post patterns. *Harkins uses a skew to shape the hollows and bellies.*

Sanding round. *Rough-turned chair rounds are fed through this dowel sander, using 80-grit followed by 220-grit belts. A rotating wheel turns the spindle steadily against the sanding belt for a perfectly round, smooth surface.*

Slot mortising. *Harkins cuts the mortise for the rocker's headpiece on a homemade slot mortiser. To provide maximum strength for opposing joints, Harkins orients the grain of the post at 45° to the axis of the mortise.*

Green woodworking. *At left, Harkins drives the green posts of the rocker's back assembly onto tenons cut in dry frame members. As the posts dry, they shrink around the tenons, holding them tight.*

FIG. 1: ROCKER



PEGGING THE JOINTS

Drilling the holes. *Harkins uses a shop-made drilling machine he calls a "belly punch" to drill the holes in the posts. To keep the holes aligned, he inserts a board into the headpiece mortise and reads a small level taped to the board.*

the lathe. (See Fig. 2.) The scratcher is simply a board with nails protruding from one edge.

He turns these parts to finished shape with a skew ground from an old planer blade. (See top photo, page 79.) He also turns rough tenons on the bottoms of the posts to go into the runners, leaving the tenons oversize for now. (See Fig. 2.) This initial shaping gives the tenons a chance to dry so they won't shrink later when installed in the runner.

Harkins finish-sands the posts and foot round on the lathe, using 120- and 220-grit paper. To speed up the process of smoothing the rounds, Harkins feeds them through a dowel sander, a stationary belt sander with a feed roller that keeps the rounds turning as they're sanded. (See center photo, page 79.)

Once he's turned the posts and rounds, Harkins uses templates to trace the "headpiece," back rails, arms and runners onto dimensioned stock. (See Fig. 2.) He cuts these parts on the bandsaw.

The runners are the most important pieces because they give the chair its "rockability," as Harkins calls it. He makes his runners relatively long with elliptical curves. The elliptical shape produces a smooth, controlled rocking action rather than the tippy motion of a circular arc. And the long runners create a longer, slower rock than shorter runners. When laying out the runners, Harkins is careful to orient the grain running lengthwise for strength. (See Fig. 2.)

Next, Harkins smooths the parts on a pneumatic drum sander with 80- and 220-grit paper, rounding over any sharp edges with the air-filled sanding drum. He's careful to sand smooth, continuous curves on the bottoms of the runners so the chair won't rock roughly.

Now, Harkins cuts the round tenons on the arms, back rails and rounds. (See Fig. 2.) He makes the tenons slightly oversize so they require a "drive fit" into the posts with a hammer.

He cuts the tenons with a tenon cutter attached to a motor shaft. This is a fast but somewhat risky operation, and Harkins doesn't recommend it, for safety reasons. He suggests two approaches that he used in his early days: Turn the tenons for the rounds on the lathe, and whittle the arm and back rail tenons with a sharp penknife.

All the post mortises are round, except those for the headpiece. Harkins first cuts the mortises for the headpiece on a horizontal slot mortiser with a straight, two-flute router bit. Since the joints meet at opposing angles, he orients the grain of the posts at 45° to the axes of the mortises for strength. (See Fig. 1.)

Harkins drills the holes in the posts and the back frame with a homemade horizontal boring machine that he calls a "belly punch"—so named because he uses his belly to push the sled that holds the stock into the bit. (See photo, above.) He uses a 3/4-in. auger bit that has the lead screw threads filed down slightly so the bit pulls the workpiece into itself slowly, without grabbing.

To keep all the holes in line with the headpiece mortise, Harkins inserts a flat

Pegging the joints. *Harkins taps a wooden peg into a predrilled hole to lock the foot round to the front post.*

Weaving a Hickory-Bark Seat

by Greg Harkins

Weaving one of my Mississippi rockers is fast—once you learn the steps you can finish a seat in an hour or so. I harvest my own strips from shag-bark hickory in the springtime, using the inner bark of the tree.

I cut the strips about 1 1/2 in. wide with a sharp knife. Traditionalists use a drawknife to shave off the outer layer of bark until the strip is anywhere from 1/16 in. to 3/16 in. thick. I machine my strips 1/8 in. thick with a dedicated thickness planer.

To prevent mold from growing and to keep the bark pliable, I store the strips in rolls that I hang on the wall. If you want, you can buy hickory bark by mail (available from The Caning Shop, 926 Gilman St.-AW, Berkeley, CA 94710, 800-544-3373).

When I'm ready to weave, I soak as many rolls as I can fit into a 5-gallon bucket full of clean, hot water. After three to five hours of soaking, the strips are pliable enough to bend without breaking.

I weave each seat (see photos, right) and back with strips that have been soaked at the same time. This keeps the color uniform, since the strips tend to darken more the longer they soak. When I've completed the weaving, I apply finish to the entire chair. (See main article.) Then I let the woven strips dry for a week before the chair is ready to use. For more information on weaving, see *The Caner's Handbook* by Bruce Miller and Jim Widess (1991, Lark Press, 50 College St., Asheville, NC 28801).

GREG HARKINS *makes chairs in Vaughan, MS.*

WRAPPING THE WARP

1 *Start weaving the seat by tacking a wet hickory strip to the side seat round. Wrap strips from front to back—called the warp—keeping them taut. Tack the last strip to the opposite side round.*

2 *Start a new strip by stapling it to the first strip, overlapping it about 6 in. (After weaving, remove all the tacks and staples.) The woven bark will dry and shrink to hold the strips together.*

WEAVING THE WEFT

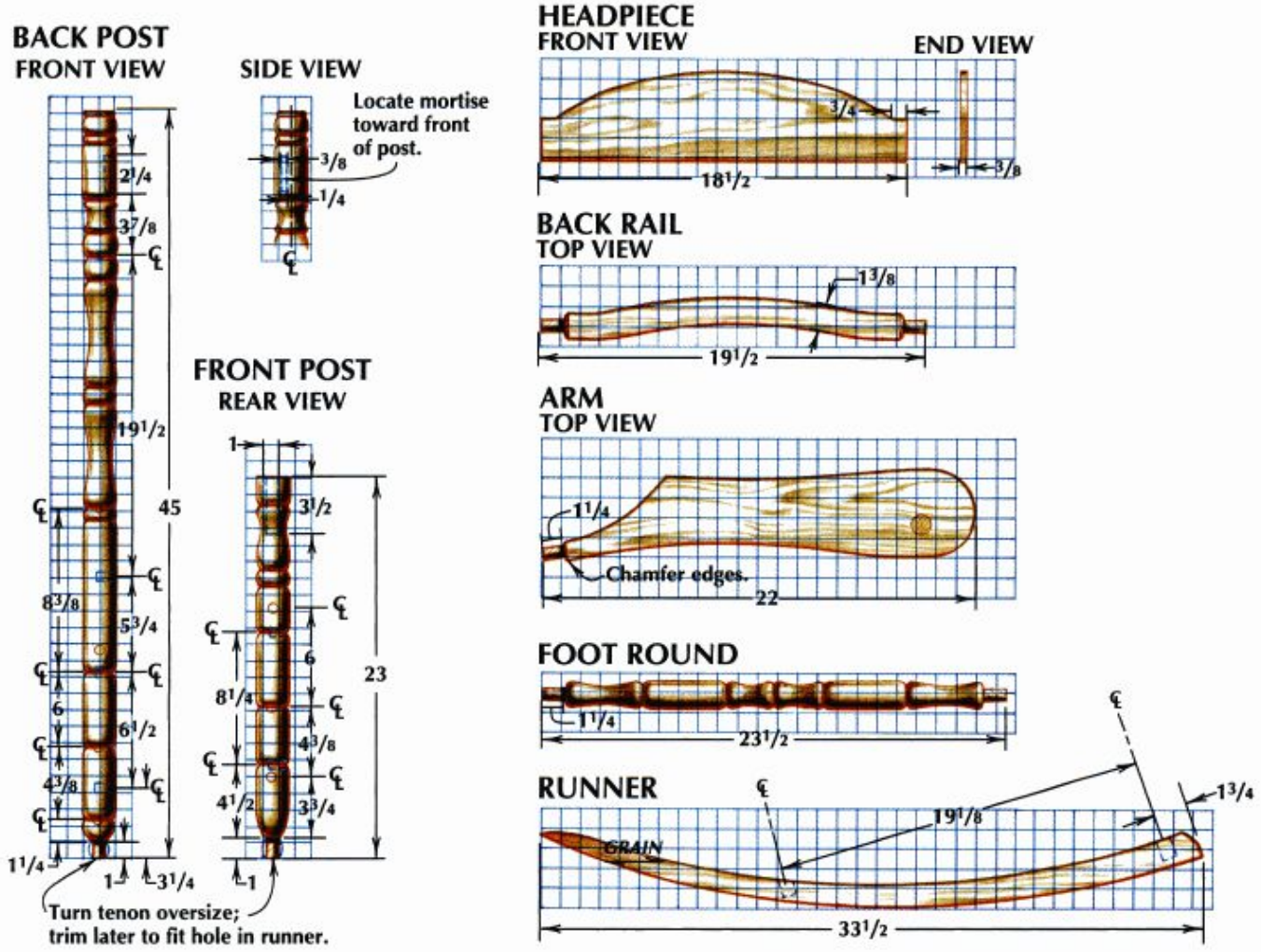
3 *For the weft, or cross strips, leave 1 ft. of strip to double back on the underside. To keep the cross-hatching loose enough to weave through, "cheat" the underside by weaving adjacent strips in the same pattern.*

4 *To add a new strip, slip it under four or more cross strips. Fold the end of the final weft strip back over itself, and weave it under several cross strips.*

FILLING THE GAPS

5 *Finish up by weaving a tapered strip into the gaps at the sides of the splayed seat.*

FIG. 2: CHAIR PARTS



1 SQUARE = 1 IN.

3/8-in.-thick stick into the mortise. The stick has a small bubble level taped to it that he uses to keep the stick in line with the drill bit, which is also level. (See top photo, page 81.) After drilling the first hole—for the upper back rail—he removes the stick.

Now, he assembles the back frame rounds to the back rails (see Fig. 1), positions the tenon of the upper back rail in line with the first hole drilled in the post, and marks the location of the hole for the tenon of the lower back rail. He realigns the post by running the first hole onto the stationary auger bit. Then, without changing his grip, he drills the remaining holes in the post. After 20 years of chairmaking, Harkins judges the hole locations by eye, so he doesn't bother to mark them out.

Once he has the back posts drilled, he attaches the headpiece, back frame and rounds to the posts by driving the joints together with a hammer. (See lead photo, page 78.) The green posts are resilient enough to resist marring from the heavy hammer blows.

Harkins then drills the front posts and assembles them with the seat and the foot rounds, creating the front assembly.

With both the front and the back assemblies completed, he drills holes in the front and back posts for the side rounds and the chair arms. (See Fig. 1.) To drill the holes in the back assembly, Harkins uses a sled that holds the assembly at 97° to the bit of the belly punch. (See left photo, page 84.) This angle produces the correct amount of splay in the seat. (See Fig. 1.)

On the front assembly, the holes for the side rounds are angled slightly inward at 83° to the plane of the assembly. (See Fig. 1.) To position the assembly at this angle to the bit, he installs a dowel into an angled hole in the sled and holds the front assembly against the dowel. (See right photo, page 84.)

Alternative Joinery Methods

Harkins didn't always have the efficient jigs and machines he uses today. Before he owned a slot mortiser, he used the drill press to make the headpiece mortises. He'd drill a series of 3/8-in. holes and square out the holes with chisels.

To drill the holes in the posts, he would use a 3/4-in. brad-point bit in a hand-held drill. He'd line up the first series of holes by placing a stick in the headpiece mortise as a visual guide for his drill. To drill the angled holes, he'd assemble the back and front frames, hold them at the correct distance from each other on his bench, and sight from one frame to the other, judging the angle by eye. He'd lay down one assembly, and hold the other upright while he drilled all the holes by hand. Then he would repeat the drilling process with the other assembly. You could also use the drill press if you devise a way to hold the workpiece at the correct angle to the bit.

Drilling at an angle. *To account for the splayed seat, Harkins uses the belly punch to drill the holes in the back assembly at 97° to the bit (above). Then he drills the holes in the front assembly at 83° (right).*

When the mortise-and-tenon work is done, Harkins joins the front and back assemblies with the side rounds, arms and runners. He begins with the side rounds, driving them home without glue as before.

At this point, Harkins weaves the bottom and the back of the chair with strips of hickory bark. (See sidebar, page 82.) Once the weaving is complete, Harkins proceeds with the final drilling and assembly, beginning with the arms.

Final Assembly

The arms are joined to the back posts with tenons and to the front posts by 1-in. dowels wedged and glued through the arms and into the tops of the front posts. (See Fig. 1.)

Harkins drills the holes in the tops of the front posts (see Fig. 2) with a 1-in. brad-point bit in a portable electric drill, and he saws kerfs partway into the dowels with a bandsaw. Then he glues the dowels into the posts with the saw kerfs parallel to the front of the chair. This crosswise orientation keeps the dowels from splitting the arms when the wedges are driven into place. He locks the dowels to the posts by pinning them with smaller, 1/4-in.-dia. dowels. (See Fig. 1.)

Next, Harkins marks and drills the dowel holes through the arms. To lay out each hole, he positions the tenon of the arm in line with the mortise in the back post and holds the arm over the dowel in the front post. He marks the dowel location on the arm and drills the hole on the drill press with a 1-in. spade bit.

To attach the arms, Harkins spreads glue on the dowels, and drives each arm into its back post and down onto the dowel. He puts a drop of glue into the kerf in the dowel, and drives in a wedge. After sawing any protruding parts of the dowel and wedge, he pares them flush with the arm.

Working with the chair upside down on his bench, Harkins cuts finished tenons on the bottoms of the posts with a 3/4-in. plug cutter in a hand drill, centering the cutter on the rough-turned tenons. (Plug cutters are available from Garrett Wade, 161 Ave. of the Americas, New York, NY 10013, 800-221-2942.)

Next, he drills holes 1 3/4 in. from the front of the runners for the post tenons (see Fig. 2), using a 3/4-in. brad-point bit in his portable drill. To find the correct angle for the hole, he holds a runner in place against the posts and visualizes the hole in line with the front post, then drills the hole by eye. He aligns this hole with the tenon on the front post, and marks the location of the hole for the back post. He drills the back holes by hand, eyeballing each hole so it's parallel to the hole at the front of the runner. After he drills these holes, he drives the runners onto the posts without glue. Once attached, the runners will help keep the posts from racking.

Pegging the Rocker

Now that the rocker is assembled, Harkins locks the main joints of the chair by nicking the side of each tenon with a peg. If he drilled *through* the tenon, its strength would decrease dramatically. He drills the peg holes with a 1/4-in. bit, judging each location by eye.

Once the holes are drilled, he installs 1-in.-long pegs. He bevels the show ends of the pegs on a belt sander, then taps them into the posts without glue, leaving them slightly proud of the surface as a visual detail.

Finishing Up

Harkins uses a wipe-on finish to complete the chair. First, he sands all the surfaces except the woven seat and back with 220-grit sandpaper. Then he applies two coats of a 50-50 mixture of polyurethane and linseed oil on the sanded areas, sanding between coats with 220-grit sandpaper. After the second coat has dried, Harkins covers the entire chair with two coats of a pasty concoction made from a ratio of 1 quart tung oil to 1 quart linseed oil, plus about two handfuls of melted beeswax shavings. He lets the mixture soak for 15 minutes, then he wipes off the excess with a clean rag. A couple more coats of the paste (on everything but the seat and back) gives the chair a glow that will last generations. ▲

ANDY RAE
makes frequent journeys into the Deep South and is an assistant editor of AW.

WOOD FACTS

Macassar Ebony

by Paul McClure

Macassar ebony is truly a gem among woods. The genus name, *Diospyros,* translates as "fruit of the gods." Beautiful, smooth and dense, it was a royal wood in India, where kings bore scepters of macassar ebony as emblems of their power.

The wood's common name comes from the town of Makassar in the Spice Islands. Several species of ebony are sold under the name macassar and grow in an area that includes Indonesia, India, Sri Lanka and the Philippines.

The trees can reach heights of 100 ft. and diameters of 2 ft. Because the lumber is very difficult to dry, trees are often girdled and left to stand for two years before felling, after which the wood is air-dried for six more months. Kiln drying is too labor-intensive for such a slow-curing lumber.

Appearance

Macassar ebony's black heartwood is variegated with cream, tan, gray and reddish-brown streaks and is sharply demarcated from the light red sapwood. The wood holds its color well over time. Flatsawn heartwood figure can be straight or can contain wild eddies and swirls of light and dark colors. Quartersawn figure is straight, often showing stripes of black and tan.

The black color results from dark, resinous tannins in the cells. The wood is hard, heavy, fine-textured and close-grained with small pores.

Workability

Macassar ebony is fairly difficult to work; it is dense and contains resins that dull cutting edges. It produces excellent turnings and carvings, though, and holds fine, sharp detail. (Be sure to ease sharp workpiece edges—they can cut flesh.) You'll have to predrill for screws and nails.

Gluing can be difficult; first wipe your surfaces with acetone or lacquer thinner. Macassar ebony sands to a very high polish but tends to clog sandpaper. For longer abrasive life, I recommend hand sanding rather than machine sanding. Use a respirator and dust collection; the dust can be a nose and lung irritant.

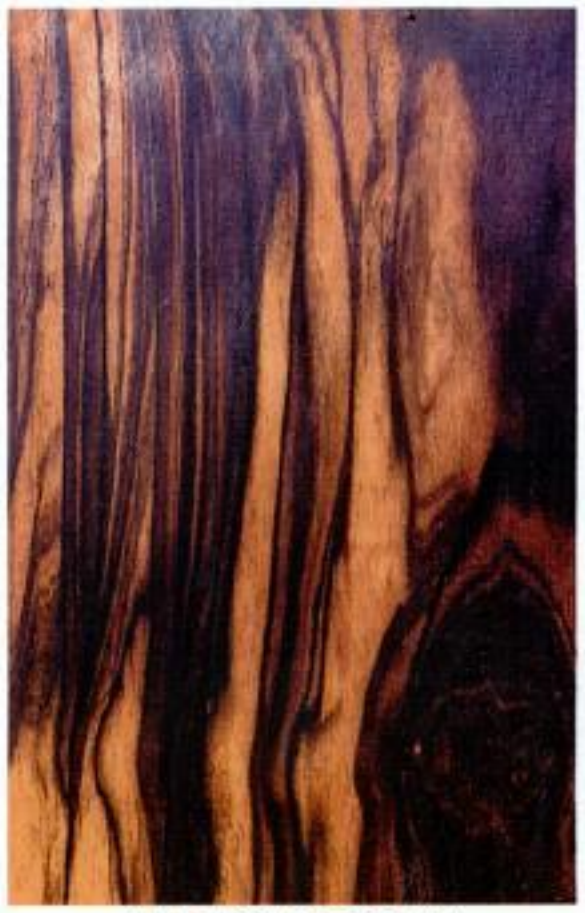
I find that lacquer and oil finishes work better than polyurethanes on this wood. Wood resins can react with chemicals in the the latter, creating a soft, gummy finish.

Uses

Due to its expense, weight and short lengths, macassar ebony lumber is seldom used to make an entire piece of furniture; veneers are available for that appearance. As lumber, it is often employed as an accent in furniture or as primary material for smaller projects such as jewelry boxes, walking sticks, carvings, piano keys and turned containers. ▲

MACASSAR EBONY

Species and Common Names		*Diospyros macassar, D. discolor, D. celebica—macassar ebony*
Growing Region		*Sulawesi, Indonesia, Sri Lanka, Vietnam, India and the Philippines*
Specific Gravity		*1.09*
Density		*70 lbs. per cubic ft.*
Wood Movement[1]		*Tangential (flatsawn): very small (3/32 in. per ft.)* *Radial (quartersawn): very small (1/32 in. per ft.)*
Durability		*Highly resistant to insect and fungal attack*
Sustainability		*Questionable at current harvest levels*
Availability		*Hardwood lumber dealers*
Size:	Thicknesses	*4/4 through 8/4*
	Widths	*3 to 5 in.*
	Lengths	*3 to 6 ft.*
Cost:	Lumber	*$27 to $49 per bd. ft. depending on thickness*
	Veneer	*$6.50 per sq. ft.*



MACASSAR EBONY

[1] *Indicates wood movement across the grain from 6 to 12 percent moisture content.*

JUST FINISHING

Choosing a Finish

Pick the Right Finish to Accentuate the Wood and Protect Your Work

by Michael Dresdner

Selecting a finish for a project is not always an easy matter. There is a vast array of finishing products on the market including shellac, lacquer, wipe-on oils and oil-varnish blends, oil-based varnish, polyurethane and wax. Each offers a different appearance and degree of protection. When choosing a finish, you will need to consider which of these qualities are most important to you and which method of application you'll use: wiping, brushing or spraying. Here, I'll discuss these factors and make some suggestions to help you select the right finish for your work.

First, let's quickly review the purpose of finishes in general: A finish protects wood by providing resistance to abrasion, water and chemicals. At the same time, it improves the wood's appearance by imparting luster and bringing out color and grain definition. All finishes protect and enhance the look of wood, but to varying degrees.

Your selection of a finish will depend on three key considerations: durability, appearance and ease of application.

Durability

All finishes provide some protection against moisture and abrasion, but some are more effective than others. (See chart, right.) The amount of protection depends not only on the type of finish, but also on how thick it is and how many coats you apply.

For high-wear surfaces like tabletops and cabinets, I prefer an oil-based or water-based polyurethane. Polyurethane gives good protection against abrasion, water and chemicals. Two or three brushed or sprayed coats should hold up to heavy wear. One drawback of polyurethane is that it's difficult to repair if damaged. Also, some people don't like the look of a thick film on wood.

An oil-based varnish or a solvent- or water-based lacquer would be my next choice. Though not as tough as polyurethane, these stand up to daily use and are more resistant to common stains like mustard. Lacquers are also easy to repair.

Oil-based varnishes include so-called wiping varnishes—thinner versions of brushing varnishes. Wiping varnishes require more coats than brushing varnishes to build up the same film thickness.

Oil-varnish blends, such as WATCO, provide very little protection because they don't build. These aren't recommended for heavy-use surfaces that are subject to liquids and abrasion.

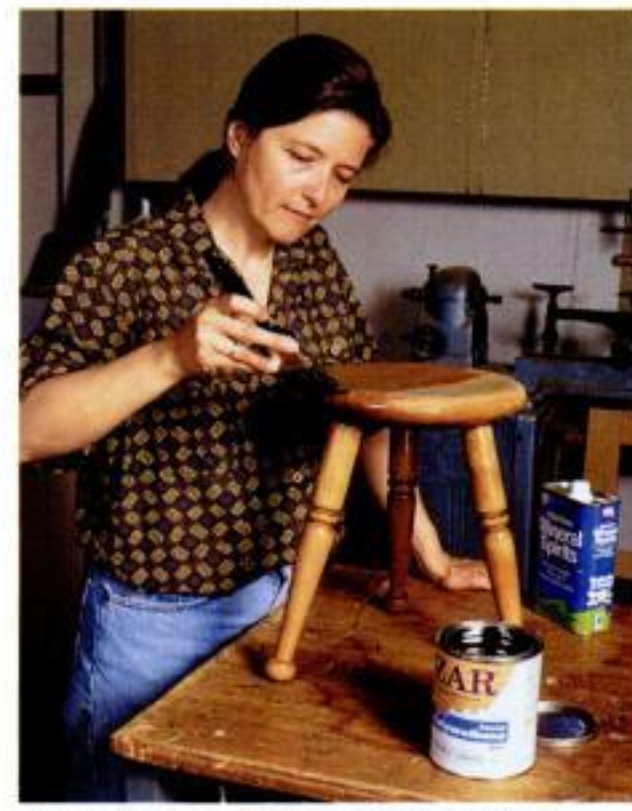
Appearance

Improving wood's appearance involves more than just making it shiny and more colorful. It also means increasing its depth and *chatoyance*—the "cat's-eye" quality that makes some woods appear to flip-flop their light and dark areas when viewed from different angles.

In my opinion, it's hard to beat shellac or oil-based finishes for sheer good looks. Both are ideal for turnings and any items that are treated with care. Shellac can be brushed, sprayed or French polished and then rubbed to produce either a satin or gloss sheen. As for the oil-based finishes, an oil-varnish blend will provide a low luster while a brushed-on oil varnish will provide more sheen. Shellac and wipe-on oil-based finishes, although not as durable as polyurethane, give a deep, rich look and bring out chatoyance.

After these, my next choice would be polyurethanes and solvent-based lacquers. Water-based finishes and waxes are the least attractive of all.

The color and clarity of a finish is another aesthetic consideration. Though



Tough enough? *When choosing a finish for high-wear surfaces, durability is a major consideration.*

FINISH CHARACTERISTICS

Finish	Durability	Appearance	Ease of Application	Color
Shellac	3	5	3	Amber
Oil-varnish blend	2	5	5	Amber
Wiping varnish	4	5	4	Amber
Oil varnish/poly	5	5	3	Amber
Spray lacquer	4	5	3	Amber*
Brushed lacquer	4	5	2	Amber*
Water-based poly	4	2	2	Bluish
Water-based acrylic	4	2	2	Clear
Wax	1	3	5	Clear, amber

*Water-based is clear.

Key: 5 = Excellent; 4 = Good; 3 = Fair; 2 = Poor; 1 = Unacceptable.

we think of finishes as "clear," some actually have either a slight amber or slight bluish hue to them, which affects their clarity and the look of the wood.

Shellac, oil-based finishes and most solvent-based lacquers are actually slightly amber in color. An amber cast tends to make dark wood grain look clearer and crisper.

Most water-based polyurethanes, on the other hand, have a slight bluish cast. This can impart a slight haze which isn't very noticeable on white woods but which can be disturbing on dark woods.

Water-based acrylic lacquers, though colorless, often make dark woods like walnut look pale or washed out: We're so used to seeing the added amber of traditional finishes that the wood appears to be missing something.

The final appearance consideration pertains to the "wetting" effect finishes have on wood. Oil-based coatings tend to soak into the wood, adding a look of depth. Conversely, waxes and most water-based coatings, which tend to sit atop the wood, won't bring the same deep look to your piece.

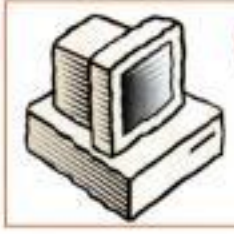
Ease of Application

The easiest finishes to apply are the wipe-on finishes, which include wiping varnishes, oil-varnish blends and waxes. But these finishes go on very thin, so they generally provide very little protection against abrasion and stains.

Brushing varnishes and lacquers are more labor-intensive to apply, but they are commonly available and don't require spray equipment. Brushing varnishes and water-based lacquers require sanding between coats for good adhesion.

Spray finishes require a spray gun, an air supply, and a ventilation system. But if you own this equipment, you can spray lacquers and oil- and water-based varnishes. Spraying lacquers are widely used in industry because they are easy to apply and dry quickly. They lay out smoothly and don't require extensive sanding between coats for adhesion—just a light sanding to get rid of roughness. It's a bit harder to get oil varnishes or water-based finishes to spray smoothly, and they require sanding between coats.

In my opinion, the finish that gets the highest overall marks is a brushed polyurethane oil varnish. But your best choice will depend on which characteristics are most important to you and which best suit your project. To make the choice a little easier, I've included a "scorecard" of coatings. (See page 90.) ▲

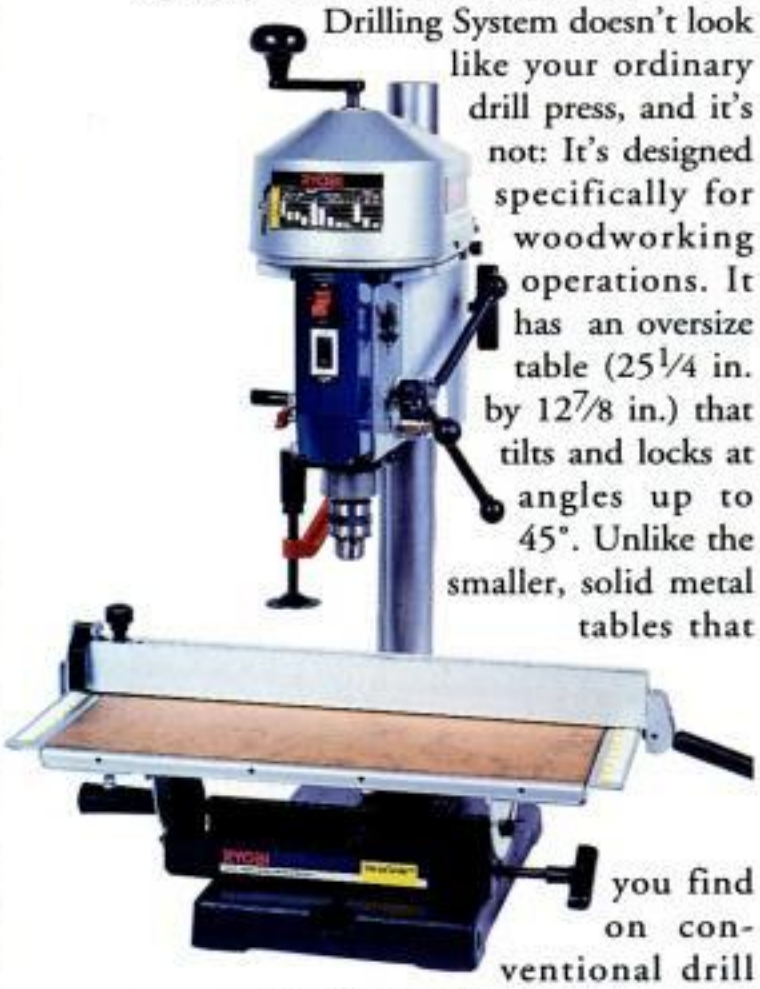


Join Michael Dresdner live on America Online Sunday nights from 9:30 pm to 10:30 pm eastern time for answers to your finishing questions. From AMERICAN WOODWORKER Magazine Online, click the "Shop Talk" icon to enter the finishing chat room.

TOOLBOX

A Drill Press for Woodworkers

Ryobi's new WDP1850 benchtop Wood Drilling System doesn't look like your ordinary drill press, and it's not: It's designed specifically for woodworking operations. It has an oversize table (25¼ in. by 12⅞ in.) that tilts and locks at angles up to 45°. Unlike the smaller, solid metal tables that



you find on conventional drill presses, the Ryobi table features a metal frame that holds a replaceable ¾-in.-thick MDF insert. Instead of changing belts to adjust speed, on this drill press you simply turn a crank to set rpm between 500 and 3,000. Throat size is 9¼ in. Also included as standard equipment: a worklight, clamp, and adjustable fence. The Wood Drilling System will be available in September. (Price: under $400) *Ryobi America Corp., Dept. AWT, 5201 Pearman Dairy Rd., Anderson, SC 29625, (800) 323-4615.* **Circle #641**

Plastic for Pipe Clamps

Powerpress pipe clamps offer several improvements over conventional all-steel pipe clamps. These new clamps are made from lightweight, high-strength plastic resin, and they will fit on standard ¾-in. pipe. The Powerpress clamp head can move along the pipe, just like the adjustable clamp head that faces it—no threads are required on the pipe.

Built-in clamp pads protect the work from marring. Another plus: The clamp is designed to rest horizontally, so there's no need for clamp stands. This is a convenient feature when you're gluing up panels. Just turn the jaws outward to convert the Powerpress into a spreader. (Price: $25 ea.) *American Tool Companies Inc., Dept. AWT, 8400 Lakeview Pkwy., Ste. 800, Kenosha, WI 53142, (800) 867-9002.* **Circle #642**

Router-Based Jig Makes Old-Fashioned Joint

Ever wonder how to make the "pin-and-crescent" joints seen on the drawers of antique furniture? A new jig from Woodworker's Supply makes these intricate joints easy. All you need are a plunge router, a template bushing and an electric drill.

The jig includes a base, a template, a spiral router bit and a round tenon cutter. The company recommends using a 1¾-HP or smaller plunge router. Jig templates are available in two sizes. The large template makes ½-in.-radius coves with ¼-in. pins, while the small template makes ⅜-in. coves with 3/16-in. pins. (Price: jig with both templates, $195; jig with small template, $135; jig

with large template, $140) *Woodworker's Supply, Dept. AWT, 1108 N. Glenn Rd., Casper, WY 82601, (800) 645-9292.* **Circle #643**

IN THE WORKS

A Bit Different

How'd you like a cordless drill that lets you switch bits at the touch of a button? You can try one early next year, when the Redi-Drill is scheduled to hit the market. Available in 9.6- and 13.2-volt versions, this ½-in.-chuck cordless drill/driver features a revolutionary new "keyless-touchless" chucking system with a rotating cartridge that holds up to 12 different drill or driving bits. You simply select the desired bit, then touch a button and squeeze the trigger to automatically load the bit in the chuck. Unloading is just as easy. Large bits that won't fit in the cartridge can be inserted in the chuck conventionally. The patented Redi-Drill will come with an assortment of bits, two batteries, a charger and case. Price is not yet available. *Orb Industries Inc., Dept. AWT, 14818 W. Sixth Ave., Ste. 10-A, Golden, CO 80401, (800) 593-7455.* **Circle #644**

Air-Powered Detail Sander

Detail sanders excel at sanding in small spaces. Now Fein's new Air Triangle Sander makes it possible to do detail sanding with air power. Like other air tools, it's smaller, more compact and lighter than its electrically powered counterparts. It requires only 3 cfm (cubic ft. per minute) of air at 90 psi, so even small compressors can operate the sander. Optional accessories include a saw blade, a scraper blade and a polishing pad. (Price: $275) *Fein Power Tools Inc., Dept. AWT, 3019 W. Carson St., Pittsburgh, PA 15204, (412) 331-2325.* **Circle #645**

Clog-Resistant Sandpaper

Tired of clogged, worn-out sandpaper when sanding between coats of finish? Try some of Norton's new clog-resistant sandpaper. Between Coats Sandpaper comes in 220, 320 and 400 grits. Norton guarantees that the new sandpaper will last twice as long as conventional sandpaper. And Norton's coarser Paint and Varnish Removal Sandpaper (available in 80, 100, 120, 150 and 180 grit) offers clog-resistant sanding for finish removal. Both types of sandpaper have an improved aluminum-oxide abrasive that stays sharp longer; and the "B" weight backing is heavier than regular paper. (Price: pack of 5 sheets, about $3.50; pack of 25 sheets, $12) *Norton Co., Dept. AWT, Box 15008, Worcester, MA 01615.* **Circle #646**

Between Coats Sandpaper *(front) from Norton resists clogging better than ordinary paper (rear).*

VERITAS ROUTER TABLE TOP by Andy Rae

SHOP TESTED

Looking for a basic, well-made router table? Check out the new Router Table Top from Veritas. It's designed around a simple plate of steel, with replaceable plastic inserts and a unique clamping mechanism that will secure any size of router to the underside of the top.

The top is a piece of well-machined, 3/16-in.-thick mild steel that measures 16 in. by 24 in. You supply the base, which can be of your own design or built using the plans that come with the top. I recommend using the Veritas plans. (See photo, right.) The Veritas base is designed so you can lift the top up and lock it in place at an angle for easy bit changing and adjustment.

I liked working on the smooth metal surface, which has no obstructions other than two tapped holes for a pair of pivot pins that are included. I was impressed with how flat the top was: just 0.003 in. of dip in the surface over 24 in. And there's no worry about flexing, which can be a factor on tables where the router hangs from a plastic plate. Plus, the weight of the top (24 lbs.) helps dampen router vibration and noise. All-steel construction also allows you to use magnetic hold-downs and feather boards. Veritas is planning to sell magnetic attachments and a router fence later this year.

A 35/8-in.-dia. opening in the top is machined to accept twist-locking plastic inserts. Veritas sells replacement inserts with different bit openings, including inserts with protruding collars for template work.

Simple, strong and flat. *Veritas takes a minimalist approach to router table design with a steel tabletop that is sold with plastic inserts and integral clamps for holding any router against the underside of the table.*

Another feature I like is the clamping mechanism. (See inset photo, below.) Because it's quick and easy to use the two clamps, this table is ideal for one-router shops, or for woodworkers who like to use more than one type of router in their table.

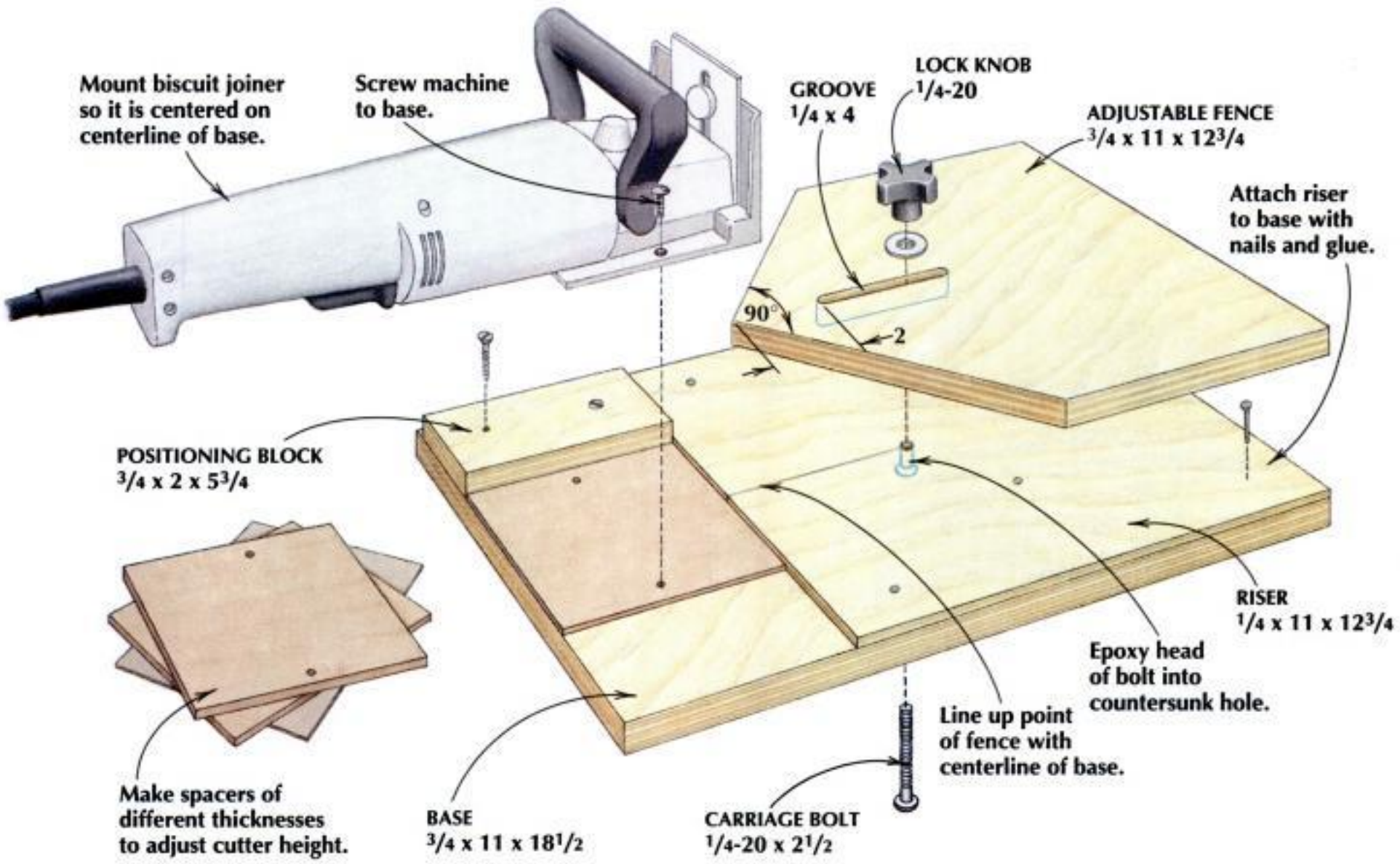
To initially attach your router to the top, you have to center the router's collet in the opening. This is easy, thanks to the alignment pin supplied. Once the router is centered and clamped, you can scribe index marks on the clamps and router base to make recentering the router quick and easy. (Price: table, $149; replaceable inserts, $3.95 ea.) *Veritas Tools, 12 E. River St., Ogdensburg, NY 13669, (800) 667-2986.* **Circle #647**

ANDY RAE *is an assistant editor of AW.*

SHOP SOLUTIONS

Miter Biscuit-Joint Jig

A Safe Way to Cut Perfect Biscuit Slots in Miter Joints



Biscuit joiners make quick work of cutting strong, accurate joints, but it's dangerous to hand-hold small or narrow workpieces while cutting. Furthermore, since their cutters are centered 3/8 in. above their bases, biscuit joiners can't cut centered slots in pieces thinner than 3/4 in. unless you place shims under the stock.

This jig solves both of these problems. The adjustable fence provides a firm backstop for both left- and right-handed miters while aligning them perfectly on the centerline of the cutter. And you can cut centered slots in workpieces as thin as 5/16 in.

Foolproof corner joints. *This jig makes it easy to biscuit-join mitered corners, even in thin stock.*

To use this jig, screw your biscuit joiner to the base, using an appropriate shim to raise the cutter to the center of your stock thickness, and clamp the base to a work surface. Adjust the fence so the mitered face of your workpiece is centered on the centerline of your biscuit joiner. Hold the workpiece tightly against the backstop and push the biscuit joiner forward to cut the slot. Then, repeat the process for the matching mitered face. ▲

SOURCES

Knobs are available from The Woodworkers' Store, (800) 279-4441.

Do you have a favorite shop fixture you'd like to share? Send a photo or sketch with a full explanation to: AMERICAN WOODWORKER, 33 E. Minor St., Emmaus, PA 18098. Next issue's "Shop Solutions" contributor will receive this Total Shop CleanAir System, list price $399.

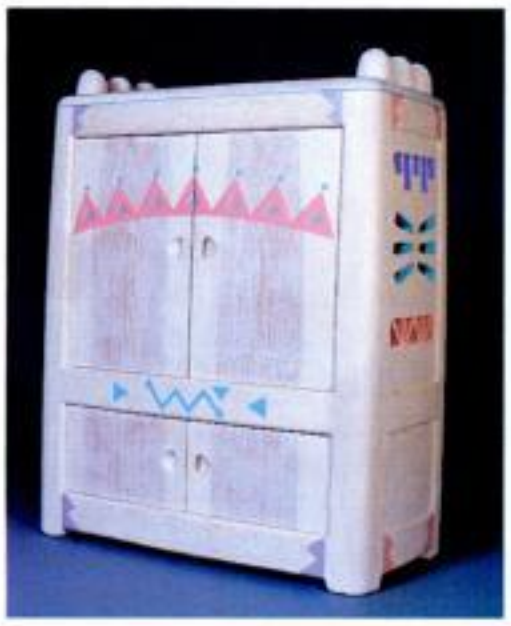
▲ Chairs by Richard Helgeson, Minneapolis.
Walnut, walnut crotch veneer, Ebon-X ebony substitute, leather. W: 18 in. D: 17 in. H: 36 in.

◀ Writing box
by John Nesset,
Minneapolis.
Winner: Best in Show;
Best Design.
Black walnut, maple.
W: 17 in. D: 13 in. H: 3 in.

▶ "Vase Table"
by Ted Wong, Jr.,
Roseville.
Winner: Best Finish;
Peer Award.
Ash, oak, cocobolo.
W: 12 in. D: 16 in.
H: 36 in.

▲ Blanket chest by Ted Wong, Jr., Roseville.
Winner: Most Technically Accomplished;
The People's Choice. Honduras mahogany, kwila, black oak, Spanish cedar, ebony. W: 36 in. D: 18 in. H: 20 in.

▼ "Coo-Coo's Nest from
El Pedregal—Cabinet for TV"
by Joe Gosnell, Minneapolis.
Ponderosa pine, paint.
W: 54 in. D: 28 in. H: 65 in.



Want to see your work in "Gallery"? Send color slides or color transparencies to: "Gallery," AMERICAN WOODWORKER, 33 E. Minor St., Emmaus, PA 18098. Please include materials, dimensions, name of photographer, your name, address, and phone number. We'll pay you $35 per entry published. If you want your photos returned, enclose a self-addressed stamped envelope.

GALLERY

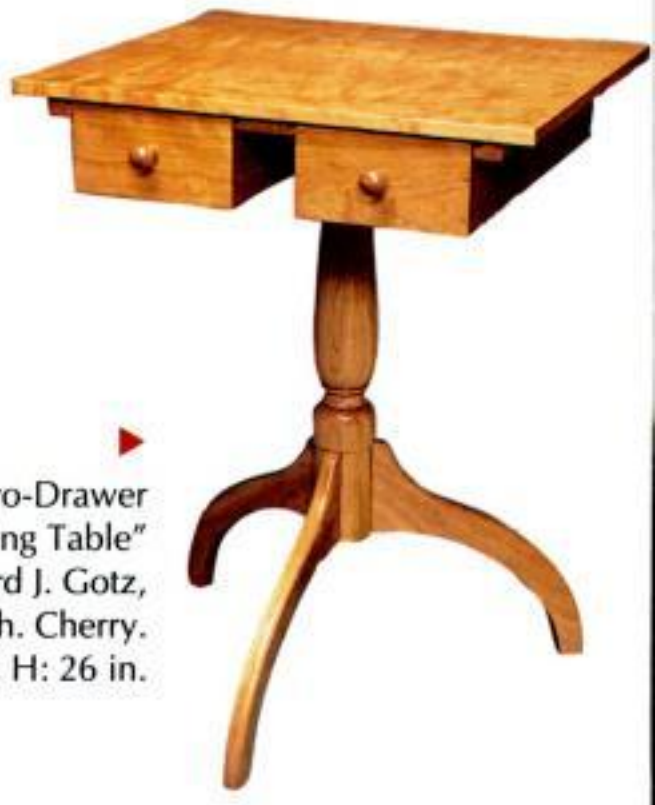
the Minnesota Guild Show

Here's a guild on the fast track. Organized, enthusiastic and full of serious woodworkers—pro and amateur alike—the Minnesota Woodworkers Guild continues to refine one of its favorite events: the annual Northern Woods Exhibition, a show of members' work.

The pieces shown here are from the October 1994 exhibition. To help with the judging, guild members recruited some local and not-so-local experts, including David Sloan, editor and publisher of AW. Awards were given in 11 categories.

▲ Kentucky cupboard by Chuck Pitschka, Minnetonka. Cherry. W: 37 in. D: 16 in. H: 77 in.

▲ "Norwegian Bentwood Carrier" by Jim Anderson, Minneapolis. *Winner:* Best Handwork. Elm, walnut, ash, cane. L: 15 in. W: 9 in. H: 11 in.



▶ "Shaker Two-Drawer Sewing Table" by Richard J. Gotz, Plymouth. Cherry. L: 20 in. W: 18 in. H: 26 in.

◀ Desk by Tom Caspar, Minneapolis. *Winner:* Judges' Award. Maple, oak, pine. L: 60 in. W: 30 in. H: 30 in.