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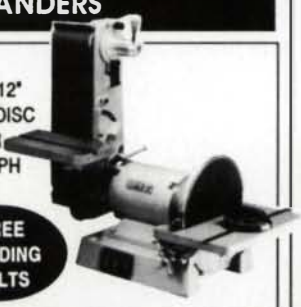

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Fine WoodWorking
January/February 1991

Cleaning your router's collet socket is a vital part of tuning this shop workhorse. Mark Duginske tells how on p. 56. Cover: Alec McCurdy's music cabinet blends tradition and uniqueness (article on p. 54). Photos above and cover by Sandor Nagyszalanczy.

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Update on respirators—I would like to voice my approval of the excellent article "Dust and the Woodworker" in *FWW* #83. All too many woodworkers feel they are practicing safe woodworking simply by putting on goggles and using push sticks, yet they ignore the noise and respiratory hazards that exist in the workshop. However, I felt the article omitted an important fact by not discussing the approval numbers issued by the National Institute for Occupational Safety and Health (NIOSH) and the Mine Safety and Health Administration (MSHA) that should be stamped on the cartridge or filter mask. These approval numbers generally are TC-21C-xxx, for particulate respirators (where "xxx" is a three-digit identifier for a particular model of respirator) and TC-23C-xxx, for vapor cartridge filters.

The distinction between TC-21C and TC-23C is important because it has been shown that small particulate matter, such as wood dust and varnish spray droplets, can be caught by a particulate respirator (filter masks), but pass through an organic vapor cartridge. The solvent vapors that evaporate from varnish spray droplets will pass right through a filter mask, but not the organic vapor cartridges. This leads me to make the following recommendations. When generating wood dust, it is best to use a lighter, cheaper particulate mask with a TC-21C stamped on it. When varnishing with a brush or cleaning up with organic solvents, it will be necessary to use an organic vapor cartridge type respirator with a TC-23C stamped on it. When spraying finishes, both types of protection are needed, and one should use an organic vapor cartridge (TC-23C) with a spray paint prefilter (TC-21C) snapped over it, or if money is no object, an organic vapor/HEPA (high efficiency particulate absolute) filter combination cartridge. HEPA is a particulate filter with a TC-21C approval number; unfortunately, the approval number for the combination cartridge is TC-23C. Lab Safety Supply Inc. (800-356-0722) is a distributor of safety equipment. The company's free catalog contains pictures and explanations of several brands and classes of respirator equipment. *—John M. Messinger II, Ph.D., Buffalo, N.Y.*

Storage box for 35mm slides—George Levin's "Storage Box for 35mm Slides" in *FWW* #84 demonstrates that he's a competent woodworker, but as a photographic archivalist he needs help. The life expectancy of color transparencies varies in relative stability from 6 years to more than 50 years, when the slides are kept in a reasonably safe environment. In a poor environment, such as one that could be produced by wood and many wood finishes, their stability could be measured in months.

Many museums and larger photographic agencies store slides in baked enamel boxes, which can be kept in a frost-free freezer. The rest of us ordinary mortals can do well by returning slides to the cardboard boxes they came in and storing the boxes in a relatively inert photographic paper box. The non-polyvinyl chloride binder pages sold in many photographic supply houses are also excellent for storing slides.

For more information, I recommend readers contact Light Impressions, 439 Monroe Ave., Rochester, N.Y. 14607; (800) 828-6216 and request its booklet on the care and storage of color slides and its archival supplies catalog.

—Robert Entwistle, Winter Park, Fla.

Amateurs turning pro—Responding to Perry Younker's letter concerning turning from an amateur to pro woodworker (*FWW* #84, p. 6), I would like to give a few words of encouragement. As an amateur woodworker for only 1½ years, I have produced several pieces for profit. Each project (three tables, a gun cabinet and a hutch) resulted from individuals seeing pieces I have built for my home. The main point is this: if a person asks you to build something, he/she is pleased with what they see. A simple skill title—amateur, pro, hobbyist—has nothing to do with it. What matters is that you, in that person's eyes, have produced fine furniture. Sure, a hundred questions go through your mind, but gracefully accept the compliment and commission!

As a hobbyist, you have much more freedom on price than a professional. Little overhead and not having to depend solely on profits from commissions for income enable you to practically "give it away." Remember, woodworking is a dynamic art and we learn by doing. Don't shy away from selling pieces because you don't think you're ready. If a person asks, you're ready!

—Steve Chartier, South Burlington, Vt.

Advice for "paying projects"—I read, with great interest, Perry Younker's letter about being asked to build his first "paying project." Having been an amateur woodworker for the past five years, I too began getting requests for work. (Isn't that something we *all* want to get?) Here are some ideas that have worked for me and some advice on things to avoid.

One thing I've discovered is that it's difficult to get people to pay you what you really should earn for your time. In order to justify the lower return, I charge an amount equal to or greater than whatever tool it is I wish to acquire next. So far, I've managed to equip my shop with a jointer, router table and various hand tools that I had coveted. I've also doubled the number of my clamps and hand screws. I currently have my eye on a thickness planer, if I can find the right project.

When discussing a project with potential clients, I find it helpful to offer a number of options. And there are a few important points that must be settled before you quote a price: what type of wood is preferred, do they want a style that matches or contrasts with their present furniture, and will the piece be delivered finished or unfinished. When you've gotten a good feel for the clients' wants and needs, take the time to create as professional a drawing or sketch as you can render. Clients are more likely to trust you if you act like a professional. One of my clients requested the plans, had them mounted and framed, and hung them over the built-in cabinets I produced for her. Whatever you do, don't start making sawdust until the clients are sure that your sketch really represents what they want. You

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could find yourself selling that purpleheart magazine rack at a yard sale for the cost of the biscuits that hold it together (don't ask me how I know this).

Figuring out what to charge can be difficult, and so here are some things to consider. After completing the plans, decide how many board feet of wood are required. Add a percentage for waste (I usually go for 20%; where you buy your stock and how good you are at laying out can make this higher or lower) and multiply by the cost per board foot. Add in any milling charges you'll be hit with, such as face-jointing, thicknessing and ripping to width. Add the cost for hardware, such as door and drawer pulls, drawer slides, shelf standards and brackets. Add the cost for finishing materials, stains, varnishes, oils and polyurethanes. Finally, add in the amount of the tool you want to buy (and don't forget shipping costs!).

Forms of payment can be important to your peace of mind since you *are* doing custom work. It is considered to be standard business practice to request a deposit when the plans are approved by the client. The amount of the deposit is up to you. I usually ask for a third of the agreed upon price on anything over $100. This amount will cover the cost of materials so there is no out-of-pocket expense for me (an important consideration on some large projects). Give your client a receipt showing amount paid and balance due, so there are no misunderstandings.

After completing the project, I do a couple of things to make my clients feel they have invested their money in something special. I sign every piece I make, and then provide a one-page write up on the piece, which describes the style, the types of woods used (with their scientific names), any special joinery involved and a brief history if it's a reproduction. There are also care and feeding instructions regarding the finish of the piece. All the stuff I make may not be heirloom quality, but it definitely won't be if I don't tell them how to care for it.

When it's time to deliver, I take along a camera. Get a picture of the piece in the client's home and maybe a picture of the piece and the owner together. (I'm building a scrapbook for future clients to see for ideas and to build their confidence.) Don't forget to collect the balance due when making your delivery.

–Brian Keller, Richmond, Va.

Moving to full-time woodworking–You need more articles and books on how to get up the nerve to transfer from one's present job into full-time furnituremaking. I am a very serious woodworker. I have built every stick of furniture in every room of my 3,000-sq.-ft. house. I would *love* to have my hobby be my vocation! You have had a few articles by "guys who had the guts," but you definitely need more on custom-furniture businesses, production techniques and how to set up a shop.

–John Wilde, Sacramento, Cal.

Call for metric plans–I would like to see more woodworking plans employing the metric system. Although the standard system has worked fine for a long time, as Mr. Thompson (*FWW* #84) puts it, so did the candle, outhouse, and horse and carriage. And I shouldn't need to add that it is not just "someone in another country" using the metric system; for all practicality, the entire world, along with the U.S. scientific community, uses this other method of measurement. Probably for good reason.

–Bryan Cowger, Sacramento, Cal.

Woodworkers should worry about exotics–I object to the theory advanced by R.J. Wilson in *FWW* #83. It seems that Mr.

Wilson feels that price determines demand, and for that reason, he rather naively maintains that we innocent woodworkers need not worry that we could somehow be contributing to the demise and extinction of some species of exotic woods. Tell that to the elephants and rhinos of the African plains who every day are but one poacher's shot from death, just to provide art or aphrodisiacs for those citizens of the world who possess wealth.

In this era of record-breaking consumption of our dear "Mother Earth," all of us must come to realize that prices of commodities have very little effect on the demand for those commodities (witness the trade in furs, ivory and exotic hardwoods). We can even justly assert that higher prices actually enhance demand, as these commodities become ever more desirable as they grow ever more scarce. Let us also not forget that there have always been, as there are now and as there will always be, those who have the means and for whom "price is no object." We must finally understand and admit that we are simply destroying our planet's ability to support life. The problem is not only that we are eliminating some (thousands) plant and animal species. Rather, the day is fast approaching that we will be the next species to disappear. Our "dear Mother" will no longer be able to provide for us—no more clean air, clean water or good food. The only question as yet unanswered is how many other species will we destroy before we ourselves are gone.

We woodworkers must face the truth and not seek solace in faulty rationalizations, no matter how comforting and reassuring they might feel. While we cannot, alone, save a species, we *can* help not destroy a species. We can do our part to help our planet. We can avoid the exotic and rare hardwoods (even if we can afford them!). We can help provide alternatives for poachers to put food on their tables legally so that the elephant, cheetah, rhino, jaguar, leopard (how we should wish the list ended here) might elude his bullet. We can avoid pesticides and herbicides in our homes and yards. We can recycle and do business with those who recycle. We can and we must begin to live a lifestyle that is environmentally responsible, that is, if we want our species to survive.

—Christopher H. Nelson, Virginia Beach, Va.

Environment and cultural progress—Recent correspondence and features regarding environmental issues, far from wasting space and engendering needless guilt, as a reader indicated in *FWW* #83, are essential for our cultural progress.

Such progress depends on each individual designer. The major problems facing our society are environmental and result from the culture we have developed. Much of this culture derives from the maxim that profit measures benefit. I suggest that fine artists and craftsmen not only disbelieve this, but recognize that unchanged it will lead to our destruction.

All craftsmen consciously searching for an environmentally sound alternative must produce fine work in their quest for durability. This is not simply an issue of which timber to use, but also involves energy costs, necessity and sustainability.

—P. Griffiths F.R.C.R., Cheshire, U.K.

Keep discussing tropical woods—I'd like to have my say in the discussion of using tropical woods. My first hope is that *FWW* keeps far from political essays and remains devoted to its title. Keep us informed but please stay away from articles on Western greed. The woodworker, as a group, adds such a small burden to the deforestation problem as to be non-existent. Many will

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agree that woodworking and furnituremaking are really the only noble ends to these wonderful woods.

–Dennis Mitton, Fircrest, Wash.

Making giant lathe safer–I read Dennis Elliott's article on giant turnings and massive lathes in *FWW* #84 with great interest, as I just finished building my own lathe.

I can see that turning the large blanks with jagged edges would be hard and dangerous. I suggest Mr. Elliott use an accessory slide on the tool post. Bolt a tool solidly to the carriage and use a feed screw to regulate the amount of cut. To be really tricky use a small variable-speed gear motor to drive the feed screw. I don't see how mechanizing the truing process would lessen the "art," and it would be a lot safer. *–Richard D. Frenthway, Kentwood, Mich.*

More on PVC and compressed air–When I read Paul Mierswa-Jacobson's letter in *FWW* #84, I had been using a PVC compressed-air system in my woodshop for 12 years without any problems.

Approximately four days after I read his letter, I was one floor above my workshop when I heard what I thought was one shot out of a large caliber gun. It turned out that a 2-in. tee in my compressed-air system had exploded and caused quite some collateral damage, but thank God no personal injuries. It took one second to realize that Paul was right and three days to replace that system with the recommended L-shaped copper pipe.

Thank you for explaining in advance what happened and why; I am sure I would not have replaced the whole system without your letter. *–A. Willem Kymmell, Boxford, Mass.*

Radio in kitchen–Frank Klausz's kitchen cabinets (*FWW* #84) omit a simple amenity that I haven't seen in any other kitchen cabinet, but which I built into the cabinets I made for my home in 1947: a radio loudspeaker in the panel at the front of the sink, so my wife and I could listen to the radio while preparing food or cleaning up. This space isn't useful for much else, and if you don't have a speaker here, some less-convenient place is usually found.

My speaker is a small 7-in. by 3½-in. elliptical unit, although any small unit could be used. The speaker fits easily between the panel and the sink. I used a wood grill of the same material as the rest of the cabinets. *–Howard C. Lawrence, Cherry Hill, N.J.*

Erratum–A sentence in Edward J. Mattson's letter in *FWW* #85, in which he discussed the importance of quality tools for producing top-notch work was garbled. He did not say that the skill of the worker couldn't compensate for the inferior tools. His letter stated: "If a worker uses poor-quality hand tools or machines that don't hold square, parallel, etc., or uses low-grade stock, then for anyone to expect class 'A' work is folly. A skilled worker can only compensate for the tool's faults more than a novice." We apologize for the error.

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Working wood is inherently dangerous. Using hand or power tools improperly or neglecting standard safety practices can lead to permanent injury or death. So don't try to perform operations you learn about here (or elsewhere) *until you're certain that they are safe for you and your shop situation.* We want you to enjoy your craft and to find satisfaction in the doing, as well as in the finished work. So please keep safety foremost in your mind whenever you're in the shop.

–John Lively, publisher

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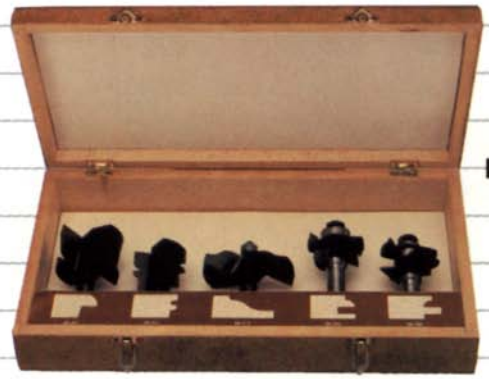

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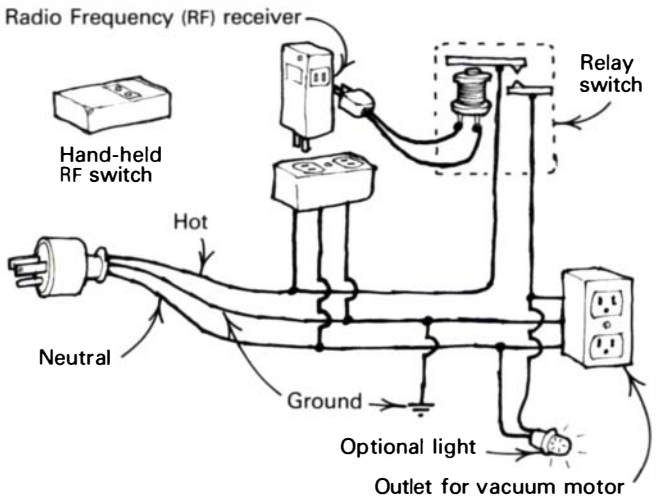
READER SERVICE NO. 166

edited and drawn by Jim Richey

Wireless vacuum switch

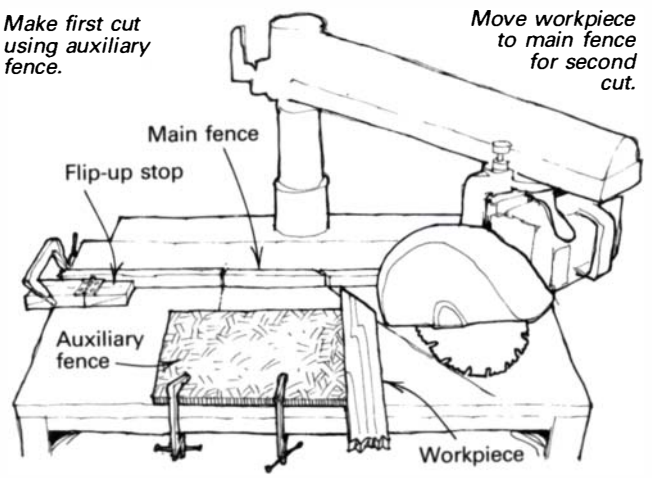


In articles about dust-collection systems, several workers have proposed some rather complicated methods using reconstructed transformers and bell-wire switches for turning the vacuum unit on and off. I've developed a simpler approach based on a device constructed from stock parts, and which has worked well in my shop. It combines a power relay with a wireless radio frequency (RF) switch to supply power to the vacuum motor. The power relay is a Potter & Brumfield 25-amp model with a 120v rated coil (#PR1AY–120 VAC. SPST N.O. from H&R Corp., 401 E. Erie Ave., Philadelphia, Pa. 19124-1187, catalog #TM25K042). The wireless RF switch (#61-2667) is from Radio Shack.

The simple schematic shows how I wired the relay. Please note that this wiring approach is fine for 120v motors, but won't work with 240v motors. The RF switch can be used by itself to control motors up to ⅓ HP, but I used the relay because the 1-HP motor on my vacuum draws up to 20 amps at start-up, which is too much current for the RF switch alone. I keep the RF controller in the pocket of my shop apron and turn the vacuum on and off while standing at the particular shop machine in use at the moment. I can keep one hand on the workpiece while operating the switch; moreover, I avoid a great deal of walking to and from the dust collector. *–Peter Loft, Rochester, N.Y.*

Quick tip: Fit an inexpensive rubber crutch bottom on your hammer to knock apart antiques or assemble new cabinets without damage. *–Adam Lempel, Chesterfield, N.H.*

Radial-arm saw picture-frame miters



Anyone who has attempted to make picture frames with a radial-arm saw knows how difficult and frustrating it is to set the arm to a perfect 45° angle. I developed a technique that allows you to produce perfect miters by canceling out error in the saw-arm setting.

Start by swinging the arm to 45°, as determined by the built-in stop, and locking the arm in place. Now clamp an auxiliary fence to the table at a right angle to the main fence, as shown in the sketch. I use a Masonite scrap with a straight factory edge for the auxiliary fence and align it with a large framing square.

Working with a long piece of molding stock, start the frame-cutting sequence by holding the outer edge of the molding against the auxiliary fence and trimming its end to a 45° angle. Next, hold the molding's inside edge against the saw's main fence and cut the first frame section to length. Now repeat this sequence; first trim the molding to 45° on the auxiliary fence and then move it to the main fence for the second 45° cut. The auxiliary fence is used only for trim cuts on the end of the workpiece, but the main fence is always used for cutting the frame sections to length. The saw arm never moves. By cutting in this sequence, each miter cut on the auxiliary fence will complement the adjacent miter cut on the main fence, producing four perfect 90° joints.

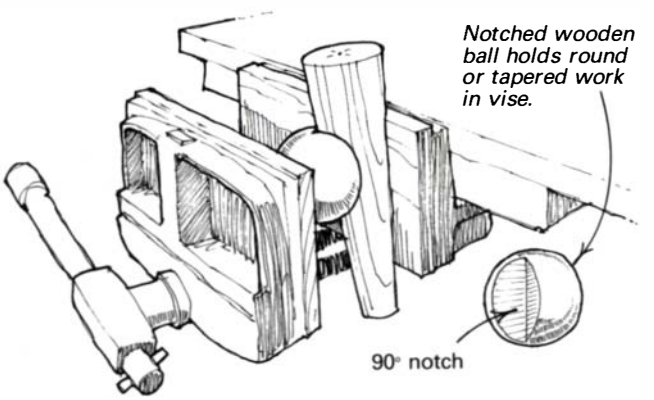
To ensure precise, reproducible lengths, I made an adjustable stop by screwing two boards to a hinge. The length of the flip-up board is the difference between the long and short sides of the frame. When clamped to the main fence, I can flip the stop up or down to gauge the length of a long or a short side.

–Stephen R. Springston, Upton, N.Y.

Quick tip: 3M's no. 2 Feathering Disk Adhesive, available from auto-supply stores, works great for fastening sandpaper to sanding blocks, orbital sanders or rubber sanding discs. One application will last through several pieces of sandpaper.

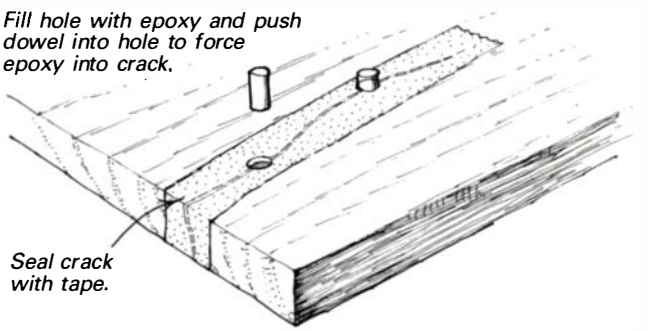
–Carl L. Roehl, Appleton, Wisc.

Holding round tapered work



To hold round tapered work, such as a table leg, in your bench vise, cut a 90° notch in a wooden ball, as shown in the sketch. The ball, which I bought from a hobby shop, applies even pressure to the leg and holds it securely. *–Albert T. Pippi, Baltimore, Md.*

Repairing cracks with hydraulic injection



I borrowed the idea of using hydraulic pressure to force glue into a crack being repaired from a concrete firm that was do-

ing some restoration work on a concrete pier. The basic method involves drilling holes along the crack partway through the workpiece from its back side, filling these holes with glue and then pressing dowels into the holes, thereby forcing the glue into the crack.

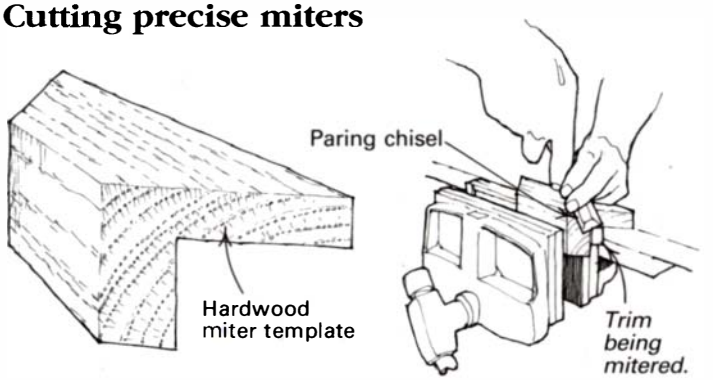
For most repairs, I drill ¼-in.-dia. holes about halfway through the board and space them between ½ in. and 1 in. apart, depending on the width of the crack. Then I seal off both sides of the crack with ordinary masking tape and cut the tape away to expose the holes. Although almost any type of glue will work, I like to make these repairs with five-minute epoxy because it sets quickly and cures to a clear color. After mixing up a small amount of epoxy, I drip it into one of the end holes until it's almost full. I then insert a ¼-in.-dia. dowel plug into the hole and push it down so that it acts as a piston forcing the glue to penetrate into the crack. When the epoxy starts squeezing into the next adjacent hole, I let the pressure off the first plug, add epoxy to the second hole and insert another plug. I repeat this process for all the holes. The pressure created by the plugs will move the epoxy into the smallest of voids, and the masking tape prevents the epoxy from running out of the crack. After the glue has cured, trim the plugs flush.

—Dario Brisighella, Sr., Oak Creek, Wisc.

Quick tip: To make a strainer for varnish or lacquer, you'll need a coffee can that has a plastic lid. Cut the middle out of the lid, leaving a ⅜-in. perimeter, and place cheesecloth over the top of the can. The cloth is easily secured by replacing the cut-out lid. Now, liquid you pour from the coffee can will be strained as you pour it into another container.

—H. J. Patterson, Reedsport, Oreg.

Cutting precise miters



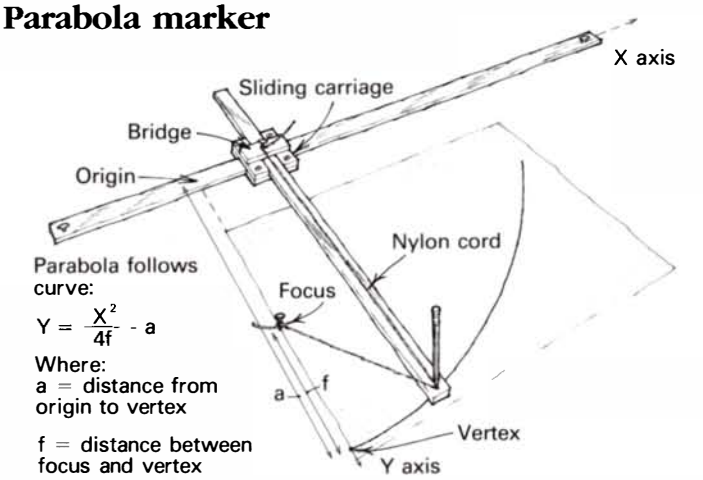
I found Mac Campbell's article, "Barred-Glass Doors," *FWW* #72, most informative, and I would like to offer a suggestion for cutting precise miters on small-scale stock to augment the methods presented in Campbell's article. I use a miter template as a guide for a paring chisel. I make the template by rabbeting a solid hardwood block into an L-shape and then by cutting the required miter angles on its ends. The miter angles on the template must be accurate, and so you should trim them with a sharp plane and check the angle with a bevel gauge. To use the template, clamp the workpiece and the template together at one end of your vise. Then, using the template as a guide, pare away thin slivers of waste with a sharp chisel.

—Leslie G. Greenhill, McDowall, Queenland, Australia

Quick tip: Various sizes of vent stack roof flashing can be mounted on tools and used as vacuum-hose hookups for dust collection. The rubber seal designed to fit tightly around the vent pipe will hold the vacuum hose in place, yet still allow it to be quickly disconnected. Best of all, the flashing is available at most lumberyards and hardware stores.

—Kevin Surovchak, Woodstock, Ga.

Parabola marker



This device, which traces a portion of a parabola, is a simplified version of one developed by Terry Soper of Lockheed Engineering and Management Services Co. and published in the NASA Tech Briefs. It's just as useful for laying out parabolic shapes for boat or furniture construction as it is for designing parabolic antennae.

The marker consists of just a few parts: two tracks, a sliding carriage and a piece of nylon cord. For small parabolas, I recommend maple splints about ⅜ in. thick and 1 in. wide for the wooden parts. Make the carriage by screwing together four pieces of wood into a simple lapped frame, as shown in the sketch. You want both tracks to slide smoothly through the carriage, but to remain at right angles to each other. Attach a small wooden bridge over the top of the carriage, as shown, to anchor one end of the cord.

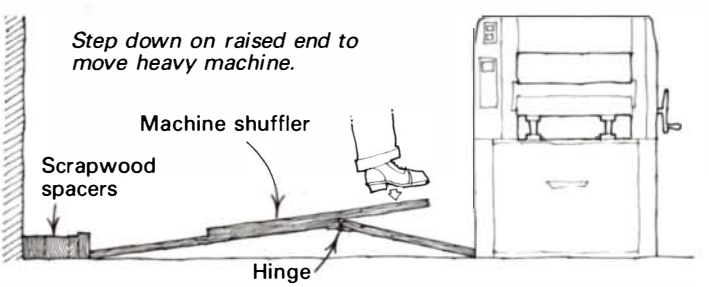
To use the device, first draw the Y axis, representing the parabola's centerline, and the X axis, which will be the stationary track's location. Next, locate two points along the Y axis: the focus, at the "center" of the parabola, and the vertex, at the bottom of the parabola. If you know the exact mathematical shape you want, use the formula shown to establish the focus and vertex. Or you can use trial and error to establish these points by keeping this relationship in mind: the nearer the stationary track is to the focus, the deeper the parabola; the farther away the track is from the focus, the shallower the parabola. Attach the cord to a nail driven at the focus, and then with the movable track slid up to the focus and the pencil point at the vertex, loop the cord around the pencil and back to the bridge on the carriage. The string should just be long enough to let the pencil touch the vertex. Now start sliding the carriage along the stationary track while pulling on the movable track to keep the string taut. The pencil will scribe a perfect parabola.

—Jim McGill, Seattle, Wash.

Quick tip: When tracing a pattern on dark wood, such as walnut, use a charcoal white pencil available at your local artist-supply store.

—Joseph M. Herrmann, Jefferson, Ohio

Heavy-machine shuffler



This "shuffler" is a simple device I use to move heavy woodworking machines around my workshop. With it I can shift the base of the machine 4 in. or 5 in. without rollers, wedges or back pains.

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The device is made from three pieces of 1x4 scraps, joined and hinged as shown in the sketch. To use it, I place scrapwood spacers between the end of the shuffler and a convenient wall or post so that the center of the shuffler is a few inches off the floor. Then I press down on the raised end with my foot, moving the machine about an inch or so. I repeat the process, adding more spacers until the machine is where I want it. The only drawback is that if you use too many spacers, they tend to spring out. So if you've got to shift the machine more than about 6 in., just rebuild the shuffler with a longer piece of scrap. *—Chris Yonge, Englewood, N.J.*

Quick tip: I can't wear out T-shirts fast enough to keep up with my need for good shop rags. So I was happy to discover a source for buying cotton-knit wiping cloths in bulk. OHCO Inc., Box 1305, Covington, Ga. 30209; (404) 786-4887, sells a 50-lb. box for $68. *—R. Charles Boelkins, Conyers, Ga.*

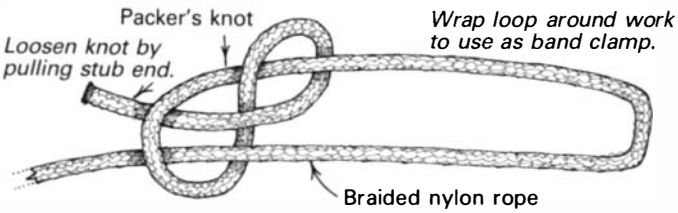
Storing electrical cords

Here's a method for storing and using long, heavy electrical cords. Drill a hole, large enough for the male end of the cord to pass through, near the base of an empty plastic bucket. I prefer 12.5-lb. Fresh Start laundry detergent buckets, but a 5-gal. paint bucket will be fine. Pass the male end through the hole from the inside and simply feed the remaining length of cord into the bucket. The cord will coil itself neatly as it falls into the bucket. Drape the female end over the side of the bucket and plug it into the male end so you don't have to fish around in the bucket for the end.

When you need to use a cord, place the bucket near the outlet, plug in the male end and simply take the female end where you need it. The cord will come out of the bucket without tangling as fast as you can pull it. *—James M. Dunnam, Ft. Worth, Tex.*

Quick tip: When clamping down veneer patches, I use 1-in.-thick rigid foam insulation (the kind builders use) between the veneer and the wooden cauls. It will conform to serpentine drawer fronts and can be easily cut into more elaborate shapes. *—T.A. Mickelson, Waupun, Wisc.*

Light-duty band clamp



A band clamp is indispensable for assembling mitered boxes, picture frames, chair frames and the like. All you need to make a light-duty band clamp is a length of 3/16-in.-dia. braided nylon rope tied in a packer's knot. The rope is available at most hardware stores, and is cheap, strong, easy to store and won't mar the wood. The knot, illustrated above in case you've misplaced your trusty Boy Scout Handbook, will hold all the pressure you can put on it, but will loosen easily when you jerk the stub end.

Since discovering this band clamp, I've stopped using looped rubber bands and strips of inner tube, because they are more difficult to apply and store. *—Robert Vaughan, Roanoke, Va.*

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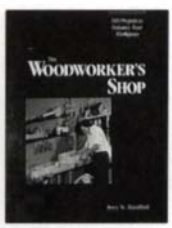

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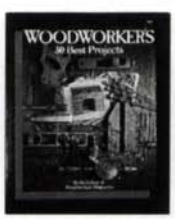

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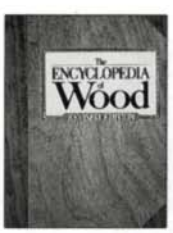

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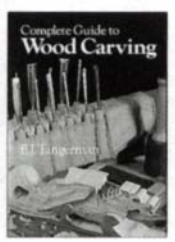

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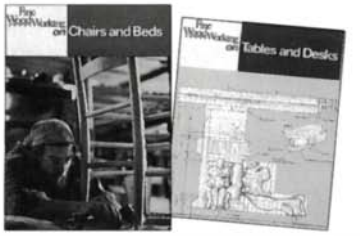

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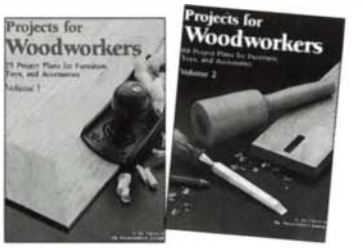

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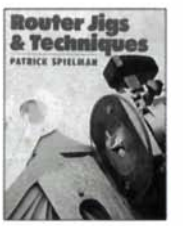

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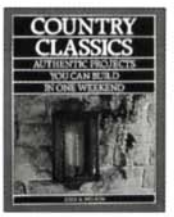

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Laminated sled runners

For some time now I've been building my own dog sleds for competitive races in Alaska and Europe. I need lightweight sleds, but can't compromise on strength. Hence, I'd like to laminate the sled runners from ash or hickory veneers combined with spruce and finish them with numerous coats of spar varnish. But I'm concerned about how these different woods will react to radical changes in temperatures and humidity often encountered along the trail and whether they will delaminate? ***—Macgill Adams, Big Lake, Alaska***

Scott Dickerson replies: Although I have never built a dog sled, I have built other sleds (see the article on p. 74), and I have laminated spruce and ash together to make light, strong canoe paddles. The individual pieces were planed flat, to assure tight seams, and then laminated together using epoxy glue. While there are many good epoxies available to woodworkers, I prefer the G-1 System epoxy, available from Garrett Wade (161 Ave. of the Americas, New York, N.Y. 10013; 212-807-1155). After lamination and final-sanding, I finish my paddles with multiple coats of spar varnish. This adequately protects the woods from moisture, although dings and abrasions from rocks soon break through the varnish film, necessitating recoating.

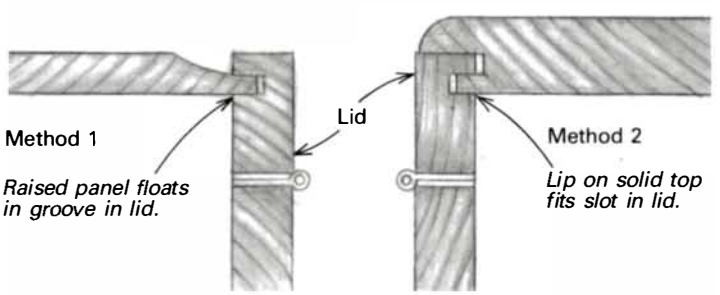
Although I haven't used my paddles in weather as cold as you're probably accustomed to in Alaska, I have paddled them in sub-freezing weather and then brought them into a heated room. Even this drastic temperature change hasn't adversely affected the paddles or separated the laminations.

[Scott Dickerson is a woodworker and a land-use planner in Harborside, Maine.]

Designs for a floating-panel box lid

I want to make a hardwood box about 10Hx16Wx5½D with dovetail joints at the corners. The lid would be about 1½ in. deep. The bottom of the box would be set in and floating on a lip in a groove cut in the sides. How can I join the top to the sides and provide for wood movement without using metal clips or cabinetmaker's buttons, which are used in fastening tabletops to their aprons?—J.C. Bates, Sewickley, Pa.

Sandor Nagyszalanczy replies: You are correct in assuming your box needs a "floating" top; I've seen too many badly designed boxes with lids glued cross-grain, which warped very badly after a season or two. There are several popular designs to eliminate the problem in the box you describe, and two of these are illustrated in the drawing.



In method 1, the lid is like a frame-and-panel door. The edges of the lid are equivalent to the frame, which is grooved around the inside near the top edge. This groove holds a solid-wood panel, the edge of which can be shaped with raised-panel cutters to add visual interest to the lid. You can adjust the distance between the groove and surface, and the amount of relief on your raised panel to set the center of the panel (the "field") flush with the top surface (as shown) or slightly proud of it. In any case, cut the groove deep enough to allow the panel a little room; it will expand slightly in width in humid weather.

The second method is a little trickier to make than the first, but produces a floating solid-wood lid that looks as if it has been glued together. The edge of the top panel is shaped with a lip, as shown, which rides in a groove cut around the inner top edge of the lid. This way, part of the panel overlaps the lid all the way around, and can be rounded over, as shown, or shaped any way you like. Be sure to leave a little reveal or space between the panel and edge, so if the top expands, it won't overhang the edge of the box. When assembling the top with either method, center the panels into their lids and only apply a spot of glue at the middle of the two long-grain edges, so that the panels float freely otherwise.

[Sandor Nagyszalanczy is associate editor of *FWW*.]

Restoring a glass ball-and-claw foot

In my work restoring furniture, I came across an old piano stool with cast-iron (or possibly steel) claw feet holding glass balls. I can break out the old, chipped glass, but how do I expand the claws to insert new balls? —S.D. Elrod, Seattle, Wash.

Bruce M. Schuettinger replies: First of all, the claws on your piano stool feet are most likely made of cast iron. Although it is possible to bend the claws and insert new glass balls, it is not practical. Cast iron is very brittle and will break when bent; it has to be heated slowly, along with the glass balls, in a specially designed kiln until the metal expands and is pliable enough to be bent. This is impractical, though, and so I suggest you either buy an old dilapidated stool at a flea market and salvage its feet, or buy a reproduction set from a supply house like Van Dyke's Restorers, Box 278, Woonsocket, S.D. 57385; (800) 843-3320.

[Bruce Schuettinger is owner of Antique Restorations Ltd. in New Market, Md.]

Lead inlay for a box

I've been commissioned to restore an antique English box that has inlaid metal strips, some of which are missing. When I removed one of the existing strips, I discovered that they are made from 1/16-in.-sq. lead stock. Where can I get lead stripping and how is it inlaid into wood? —Isaac Kershaw, Alexandria, Va.

Lance Patterson replies: While I didn't have any previous experience inlaying lead into wood, after making a small sample inlay, I don't see any specific problems other than those associated with other types of metal inlay work. Lead is so malleable that I expect it is easier to inlay than many other metals, and it is likely to withstand the wood's seasonal movement from humidity changes better too.

Traditionally, brass and pewter were by far the metals most commonly used in English decorative inlay. Pewter, as you probably know, is an alloy of mostly tin with copper and antimony added; the lesser grades of pewter can also contain as much as 20% lead. Pewter is sometimes referred to as "Britannia metal" because it was first made in Britain.

For my small sample inlay, I used some sheet lead (normally used for roof flashing, and may be ordered from a roofing-supply house). The flashing is ideal for your application, since it is 1/16 in. thick, but of course, lead is easily rolled to any thickness needed. (See a jewelery or sheet-metal shop that has a rolling mill.)

First I cut the lead into narrow strips with tin snips—an easy job. Next, I used a conventional scratch stock to groove the wood to accept the straight inlays. For curved sections, I used a set of trammel points with one point ground to a square shape to act as a cutter. Instead of using hide glue, which is the traditional adhesive for metal inlays, I used a five-minute epoxy to secure the lead strips. After filing the metal flush with the surface, I immediately coated my sample with shellac to keep the lead shiny; uncoated lead quickly oxidizes to a dull appearance.

If you are concerned about getting metal dust or filings in the pores of the wood, seal the wood with shellac before you do the inlay. I did not do this for my sample, but surely would before tackling an important job.

When inlaying square or quarter-round patterns along a cor-

ner edge, I often attach metal inlays with pins or nails fashioned from the same metal as the inlay. These fasteners are peened a bit and then filed flush, leaving them invisible. However, lead is too soft for this application; pewter might be a better choice.

[Lance Patterson is the director of the furnituremaking and cabinetmaking program at the North Bennet Street School in Boston, Mass.]

Wax vs. talc for cast iron

Recent** FWW **articles indicate that carnauba wax or shoe polish can be used to protect cast-iron surfaces of various woodworking machines. However, the owner's manual for my Taiwanese 8-in. jointer specifically states "do not use wax" and instead suggests talc. Which approach is best?

—Marshall G. Baldwin, Westport, Conn.

Richard Preiss replies: Having been a longtime advocate of using paraffin wax for protecting and making cast-iron machine surfaces slicker, I was interested in the Taiwanese company's recommendation on applying talc. I contacted the company's service manager, who told me that sprinkling on talc, or talcum powder, and then brushing it off will fill the pores in cast iron and keep surfaces dry, rust free and slick, albeit for a short time. He did not know where this procedure originated. He said that the company warned against wax because of fear that transferring oily or waxy substances to the workpiece may hamper subsequent finishing operations.

In my opinion, hard wax still provides excellent lubrication and protection for cast-iron surfaces, no matter who manufactures the machine. The most important aspect of applying the wax, however, is buffing off the excess 10 or 15 minutes after application (use plenty of elbow grease and a clean rag). And occasionally clean the entire surface with a mild solvent, such as mineral spirits or VM&P naphtha. Wax buildup is the problem; repeated applications where excess wax isn't rubbed off will build up on the metal, and the wax may eventually transfer to anything that touches the surface.

The issue of oily or waxy transfer is important, but consider this. Most wood will be planed, scraped or sanded extensively before finish is applied. Any wax buildup on the workpiece would be on the surface and would be removed before finishing. If you normally edge-join boards directly off the jointer, or if you wax the soles of your handplanes, make sure you use either surface to some degree prior to taking your final passes; this way, you wear off the bulk of the wax, minimizing the possibility that wax will transfer to the edge and later affect the integrity of your glue joint.

[Rich Preiss is head of the woodworking program at the University of North Carolina at Charlotte and a consulting editor to *FWW*.]

Steaming time for bending wood

I've read several articles in which wood has been steam-bent, but none gave a comprehensive explanation of the relationship between the duration, temperature, pressure and moisture content of the steam process and the size of the member being bent. With a lot of trial and error, I could establish the variables, but I would rather find a chart or graph that outlines how to deal with them. —David Foos, Studio City, Cal.

Drew Langsner replies: My students commonly ask for specific information on bending wood. Unfortunately, exact answers cannot often be given. This is because bending characteristics vary greatly depending on the wood's moisture content, size of the growth rings, how the wood was shaped, its thickness,

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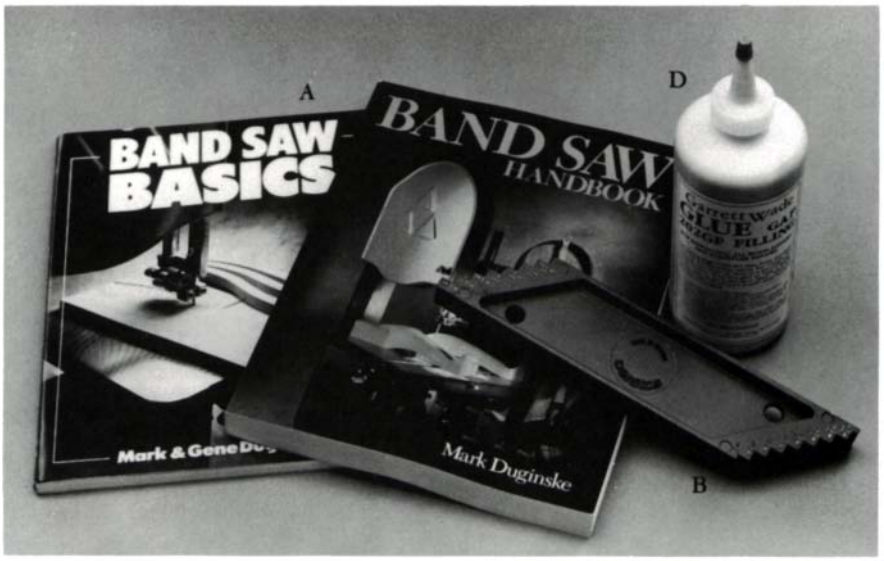

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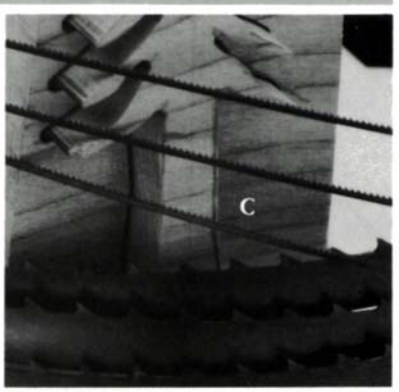

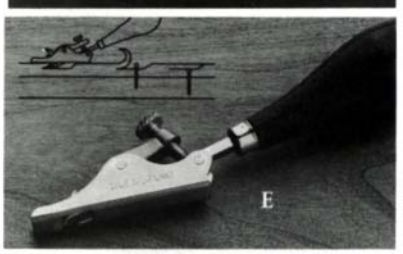

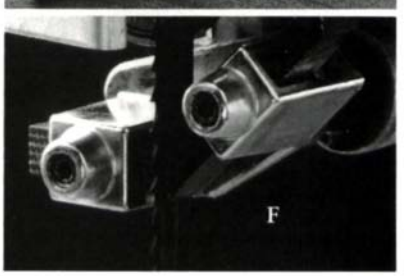

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its species, and variations from one board to another. Furthermore, any irregularities, such as uneven thicknessing or defects in the wood, make bending unpredictable and often lead to breakage.

For bending success, you should start with the right wood. The best choices include ash, beech, birch, western cedar, soft elm, filbert, sweet gum, white oak, osage orange, pecan, black walnut, willow and yew. Obviously, thick pieces will require more steaming than thin pieces. I believe that green wood bends easier than air-dried stock, since saturated fibers pick up and hold heat much better than dry wood, where the cells are filled with air. In the latter case, very little moisture is picked up during steaming. As a starting point, figure that bending 1-in.-thick green stock requires about a half hour in the steamer; 1-in.-thick air-dried stock takes about one hour.

Another variable that affects bending success is the *quality* of the wood. There should be very little grain runout in the stock, which is why rived and shaved wood can be bent more successfully than sawn stock. Also, the wood shouldn't have any obvious defects, such as knots, bug holes or rot, and no figured, wavy grain.

As you can see, there are no magic formulas for bending wood; you will have to experiment with your particular setup and go on from there. For more ideas on bending I suggest *Fine Woodworking on Bending Wood*, available from The Taunton Press, 63 S. Main St., Box 5506, Newtown, Conn. 06470-5506.
[Drew Langsner runs Country Workshops and is an author, farmer and woodworker living in Marshall, N.C.]

Keeping glues and finishes from freezing

I have a hobby woodworking shop in my barn, which I can't afford to heat all the time. As freezing isn't good for certain finishing materials, I've envisioned a heated cabinet to store these finishes. But I'm concerned that such a cabinet may pose a fire hazard. Can you advise me of a safe way to keep paint, varnish, glue, etc., warm in an unheated building?
—Chris Pasqualini, South Acworth, N.H.

Chris Minick replies: Protecting expensive finishing materials from the ravages of cold weather can sometimes be a problem. I wouldn't recommend a heated storage cabinet, because as you suspected, the fire hazard is too great. Cabinets intended for storage of flammable or combustible liquids must comply with the National Fire Protection Association Codes. You must check with your local fire department to determine the exact fire regulations in your area.

Fortunately, an easier and cheaper alternative for storing these materials exists. First of all, solvent-base finishes generally do not require protection from freezing temperatures and can be stored in your unheated shop. Freezing will cause them no harm, and you simply have to allow them to warm to room temperature before use. On the other hand, water-base finishes and adhesives are often sensitive to freezing and should be stored in an area that remains above 40°F; store these freeze-sensitive materials in your basement. Water-base materials are usually nonflammable (check the labels before storing indoors) and pose little fire hazard to your shop or home.
[Chris Minick is a product development chemist and amateur woodworker in Stillwater, Minn.]

Rip fence alignment problems

The rip fence on my contractor's-style tablesaw does not always align itself parallel to the blade when I'm setting it for a cut. The runout of the fence from front to rear can change by as much as 3/16 in., and sometimes the rear of the fence is clos-

er to the blade than the front, which causes the stock to bind during the cut. What should I do to correct the problem?

—Tom Harvey, Scottsdale, Ariz.

Mark Duginske replies: The problem of the fence not aligning correctly is common and the main reason why "aftermarket" rip fences are so popular. I have two suggestions. First, make sure that the fence's tightening lever is working properly. It is important that the fence's front casting contacts the guide bar at the casting's two outermost points. You can ensure this by gluing a couple of thin-plastic shims, made by cutting up an old credit card, to those spots on the casting that contact the guide bar. After this is done, adjust the rod that transfers the locking action to the fence's back locking clamp so that it tightens only after the front clamp has engaged.

My second suggestion is to always pull the fence from right to left when setting it to a new position. This will ensure that the back of the fence is always the farthest from the blade. Doing this will at least prevent the dangerous situation of the back of the fence being too close to the blade, encouraging kickback. Most fences can be adjusted correctly, but it takes a bit of time and patience to do so.

[Mark Duginske is a woodworker, teacher and author who lives in Wausau, Wisc.]

Blond mahogany

My dining room table was manufactured in the late 1940s, and I'm having a hard time locating a source of matching lumber so I can repair it. The wood appears to be a mahogany in terms of grain and figure, except its color is very light, both on and below the surface and reminds me more of alder. One source told me it was blond mahogany. Is there really such a wood, or is it regular mahogany that has been bleached or otherwise processed? —Matt Bailey, Petaluma, Cal.

Jon Arno replies: I strongly suspect that the original finish on your table was the one referred to in its heyday as "blond mahogany." This finish was extremely popular in the early post-World War II period and it was achieved using wood bleach. The fact that the interior of the wood is the same light color as the surface does not seriously challenge this conclusion. The bleaching process, as practiced by the commercial furniture manufacturers of that time, employed some very pervasive chemicals capable of penetrating completely through the wood. Using a two-part bleaching process, the first coat was a strong solution of caustic soda. Then, a coat of equally potent hydrogen peroxide was applied and the interaction of these two chemicals bleached out the wood's pigments by oxidation. Once bleached, the wood was rinsed off with water, or a solution containing a mild acid such as vinegar, to ensure that no caustic soda was left on the surface where it might interfere with the subsequently applied stain and/or sealer. Since chemicals this strong are potentially dangerous, this technique is not one I would recommend to amateur woodworkers.

As an alternative, there are many woods that are very similar to true mahogany in terms of figure and texture, but have a much lighter natural color. My first choice would probably be obeche, *Triplochiton scleroxylon.* This coarse-textured West African timber is somewhat softer and not quite as nicely figured as true mahogany, but it has a light, creamy yellow color. In fact, obeche is often stained dark and used as a mahogany substitute in the building trade. There are also a number of species in the *Dipterocarpaceae* family from Southeast Asia that might be appropriate to match with blond mahogany. The so-called Philippine mahoganies belong to this family and two of its genera,

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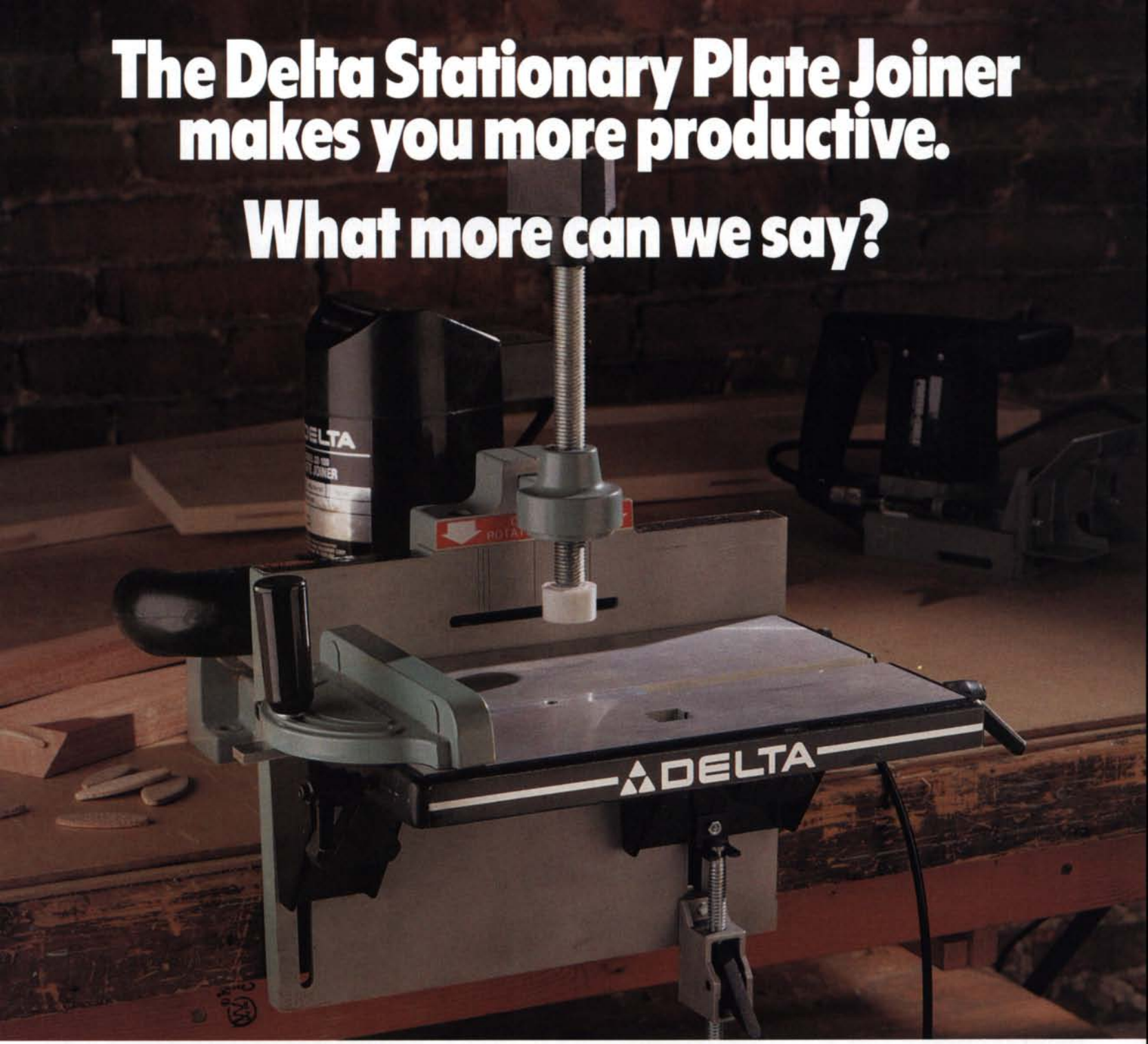

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Pentacme and *Shorea,* contain species with exceptionally light-colored woods. The trade separates these woods into groups based on their color, and the lighter ones are marketed as either white lauan or white meranti. The problem with these lighter-colored species, though, is that they are usually quite soft and, hence, not a good choice for making durable furniture. Another genus of the family, *Anisoptera,* does contain a few species with pale, creamy yellow wood about as dense and strong as true mahogany, but they are not as widely available in the United States as lauan is. These woods go by various trade names, depending upon the country of origin. When shipped from the Philippines, they are usually identified as palosapis, while those coming from Malaya are called mersawa. In the final analysis, none of these substitutes will be as pleasant to work with as true mahogany, but then working with wood bleach is no picnic either.

[Jon Arno is a wood technologist and consultant in Schaumburg, Ill.]

Wrinkles in shellac finish

Recently I purchased a pre-1850 Empire sideboard that needed some refinishing. After cleaning the piece with steel wool and washing it lightly with turpentine, I applied a coat of thinned-down shellac, which went on nicely and looked good. The next day I rubbed the surface slightly with steel wool, wiped it down and applied a second coat of shellac; the finish instantly wrinkled up. Despite further cleaning and reapplication, the problem has persisted. What can I do now?

—Steve Varga, New Waterford, Ohio

Michael Dresdner replies: You don't mention what was on the sideboard before you applied shellac; so I can't be sure that the shellac didn't react to some incompatible finish or other substance. However, the most common cause for a shellac finish wrinkling as you describe is the shellac being past its viable shelf life.

After shellac flakes are dissolved in alcohol, the mixture starts a gradual chemical change (esterification), in essence producing a plasticizer, which increases the flexibility of the finish but decreases its hardness. In time, the shellac will "over-plasticize" itself, making it rubbery and soft, and eventually it won't dry completely. This condition is usually not obvious on the first coat, as in your case, but a second coat of material will either crack or wrinkle from the movement of the first layer. This is why it is vitally important to keep track of the age of any ready-mixed shellac finish. Only buy cans that have been dated at the factory and use up the shellac within six months of that date, *not the purchase date.*

Better still, mix your own shellac fresh whenever you need it. Buy dewaxed shellac flakes (available from Garrett Wade Co., 161 Ave. of the Americas, New York, N.Y. 10013; Highland Hardware, 1045 N. Highland Ave., Atlanta, Ga. 30306; Wood Finishing Supply Co., 100 Throop St. Palmyra, N.Y. 14522; or Woodcraft Supply, 210 Wood County Industrial Park, Parkersburg, W.V. 26102-1686). These flakes have an indefinite shelf life as long as they are kept cool and dry. Add these flakes to ethanol or denatured alcohol. That way you can mix just what you need for the job, and mix a new batch whenever needed. For more information about shellac, see "Shellac Finishing," *FWW* #71.

[Michael Dresdner is a contributing editor to *FWW* and a finishing consultant in Perkasie, Pa.]

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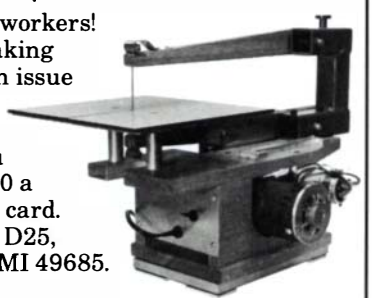

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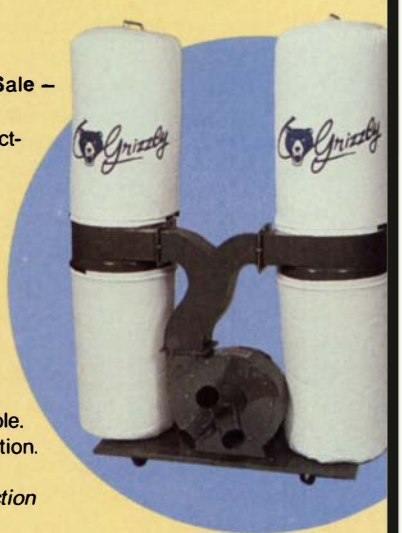

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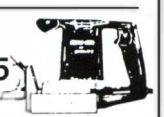

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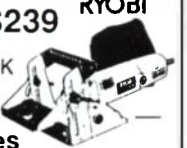

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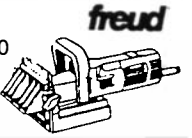

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by Dick Burrows

That's my dowel!—It's not unusual for makers to get excited when they recognize their work pictured in *FWW* or other publications. But it's pretty startling to receive a call from a guy proudly proclaiming he made the dowels pictured in an article, in this case Mac Cambell's piece on "Dowel Joinery" (*FWW* #84).

"How can you tell?" I asked. "All dowels are pretty much alike." That was the wrong answer, according to Trevor Halford, who runs a one-man dowel factory in South River, about five miles from the entrance to Algonquin Provincial Park in northern Ont., Canada. Halford recognized the unique tooling marks on the dowels pictured in the article, and besides he already called Mac and found that he had purchased the dowels from Lee Valley, the company that has been marketing Halford's products since 1983.

Also, he said he could see from the cross-section of the dowel joint how the dowels had expanded in the hole when they were exposed to the water-base glue. He says this feature is important, to ensure lots of contact surface between the wood and the dowel, and thereby make a strong joint. To make sure this expansion happens, Trevor said he carefully controls the moisture level of his stock, which he cuts and dries himself, and he uses only straight-grained Canadian hard maple from small logs.

He also has extensively modified his German dowel machine to produce dowels that are almost exactly 5/1000 in. oversize, and he maintains these tolerances from run to run. The machine compresses the dowels as the spiral pattern is formed on the surface of the dowel and, he said since wood has a memory, it tends to spring back as it absorbs moisture from the glue. The spiral itself is important because it tends to make the dowel twist slightly as it is inserted, thus spreading glue around the walls of the hole.

For more information about these dowels, write to Trevor at Laurier Wood Craft, Box 428, South River, Ont., Canada P0A 1X0. Dowels can also be ordered from Lee Valley Tools Ltd., 1080 Morrison Dr., Ottawa, Ont., Canada K2H 8K7; (613) 596-0350.

Basic woodworking gone wrong—Errors and oversights are the curse of every editor. No matter how hard we try, mistakes often creep into our work.

Paul Hansen of Farmington, Mich., for example, pointed out an apparent contradiction on p. 75 of *FWW* #84 in which George Levin, the author of our article on building cases for 35mm slides, advises against gluing the bottom of the box to the sides and ends because the bottom has to float to prevent wood movement problems. Then in the next paragraph he glues the top to the sides of the ends. "Why the difference? The top will expand and contract just like the bottom," Hansen reasoned.

Of course he's right. Both panels have to float to allow wood movement. Author Levin was also a little concerned about the inconsistency. He wrote, "To say that I am embarrassed by having publicly committed such an elementary error is a gross understatement. Of course the top should have been rabbeted into the skirt piece on all four sides and allowed to float free. I will write on the blackboard 100 times "I will never glue panels in place again. And I'll save a piece of chalk for the *FWW* editors who let this slip by."

Camphorwood is attractive—Jon Arno regularly provides us with informative articles on various woods and wood technology topics. He works hard to make sure all the information is accurate, and is careful in his choice of words. Unfortunately, a gremlin in the typing pool worked against him recently. His answer in the December "Q&A" column said that camphorwood was used for sea chests reproduced in the Orient in the 19th century. Arno wrote "produced." The item also described camphorwood as a material with an unattractive figure. Arno had written "attractive." We apologize to Jon for the errors.

Canceling the carpenter ants—A number of readers wrote that they couldn't find the sugar water-arsenic baits cited by Walter Tschinkel in the "Q&A" column in *FWW* #84 for controlling carpenter ants. As it turns out, the Environmental Protection Agency has "canceled" the use of these poisonous insecticides in all but a few products sold in the U.S. However, there are nearly 400 ant-control products available (at a garden-supply shop), many of which are suitable replacements for the sugar water-arsenic bait. Be sure the label states the product is a bait-type insecticide (not a spray) and is formulated to control carpenter ants.

Things don't add up—Also, in the drawing on p. 26, *FWW* #84, which shows a pattern for a wasteless plywood box, the width dimension for the top should be 25 7/16, not 25 7/8.

Credit where credit is due—Due to a printer error, a photo credit was dropped from the picture of two pieces built by Alaskan woodworker Lowell Zercher (*FWW* #85, p. 54). Those photos were taken by Dennis Hellawell of Anchorage, Alaska.

Flattening Japanese waterstones—Asa Reece of Plantation, Fla., asked for a clarification of Robert Meadow's method for flattening Japanese waterstones in *FWW* #84, p. 22. Meadow recommended that the best way to do the job was by rubbing "two stones of the same or similar grit together, bringing down the high spots of one with the high spots of the other." Reece said he felt the method wouldn't work, because you'd end up with two stones that would be in full contact over their surfaces, but not necessarily flat.

In response, Meadow stressed that the key to his method "is to rub the *high spot* of one of the stones on the *high spot* of the other. Rubbing the high spots together will flatten the stones. You can determine the high spots by swiveling a straightedge on the stone. The straightedge will pivot on the high spot."

Meadow said he recommended using stones, rather than sandpaper, for flattening operations because sandpaper abrasive tends to dull or glaze the surface of the stone. In contrast, when you rub two stones together, the slurry of mud that is created crumbles the surfaces, exposing fresh grit so the stones will cut better.

More on Plexiglas lathe guards—In *FWW* #84, we ran a "Methods of Work" item on a reader's shop-built lathe guard, which was fabricated from Plexiglas. William D. Cohen of Huntington, N.Y., wrote to advise that readers who want to build a shield would be better off using Lexan (polycarbonate), rather than Plexiglas (acrylic). He said acrylic can shatter, but the polycarbonate, which is just as transparent as Plexiglas, is virtually indestructible.

Several Lexan manufacturers supported Cohen's recommendation, saying Lexan is 30 times more impact resistant than Plexiglas. They also suggested that readers with projects involving Plexiglas and Lexan contact manufacturers for technical specifications on the materials to make sure they get the product best suited for the job.

Sources of supply

...After reading "Vacuum-Bag Veneering" (*FWW* #84, p. 68), Thomas B. Irvine of Williamston, Mich., wrote that interested people can also contact Gougeon Brothers Inc., 100 Patterson Ave., Bay City, Mich. 48706. He said the company offers vacuum-bagging supplies, as well as an inexpensive manual on the technique.

...In response to our evaluation of portable planers in *FWW* #84, George H. Gibson informed us that his company offers steel stands that will fit most of the thickness planers mentioned in the article. He said the stands are sold at Sears, Roebuck and Co. stores around the country and by mail under the Dayton brand from W.W. Grainger Inc., 5959 W. Howard St., Niles, Ill. 60648. You can contact Gibson's company directly by writing Soto P. Colovos, 444 W. Ohio St., Chicago, Ill. 60624. □

Dick Burrows is editor of FWW.

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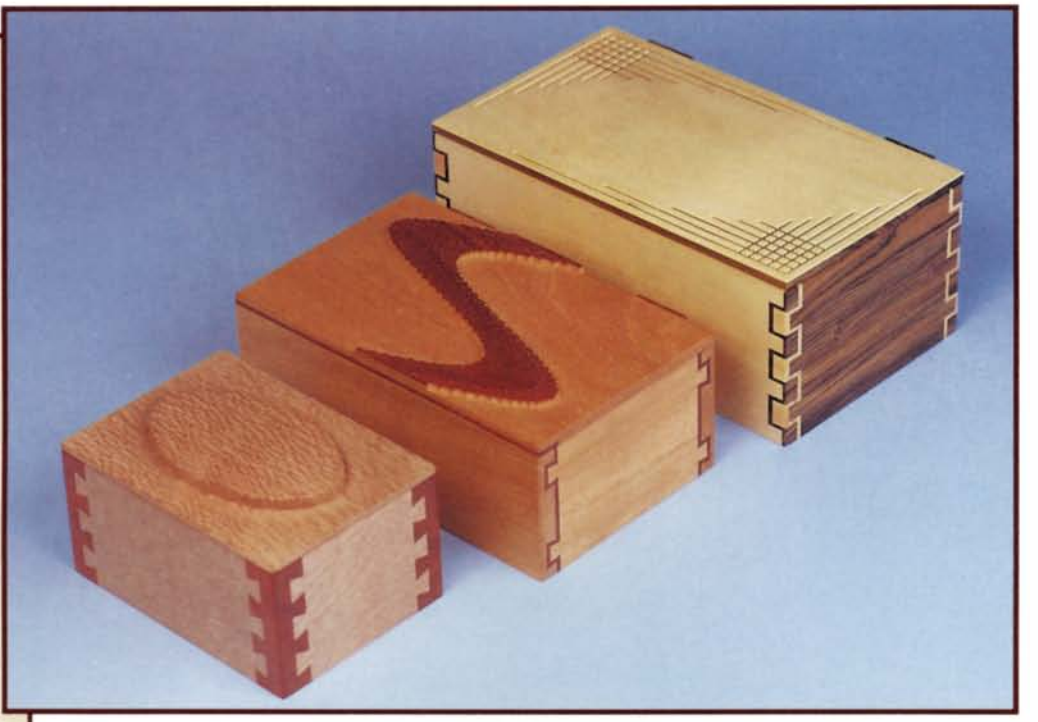

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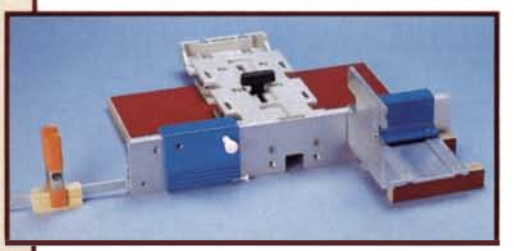

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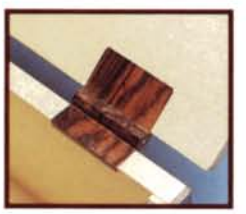

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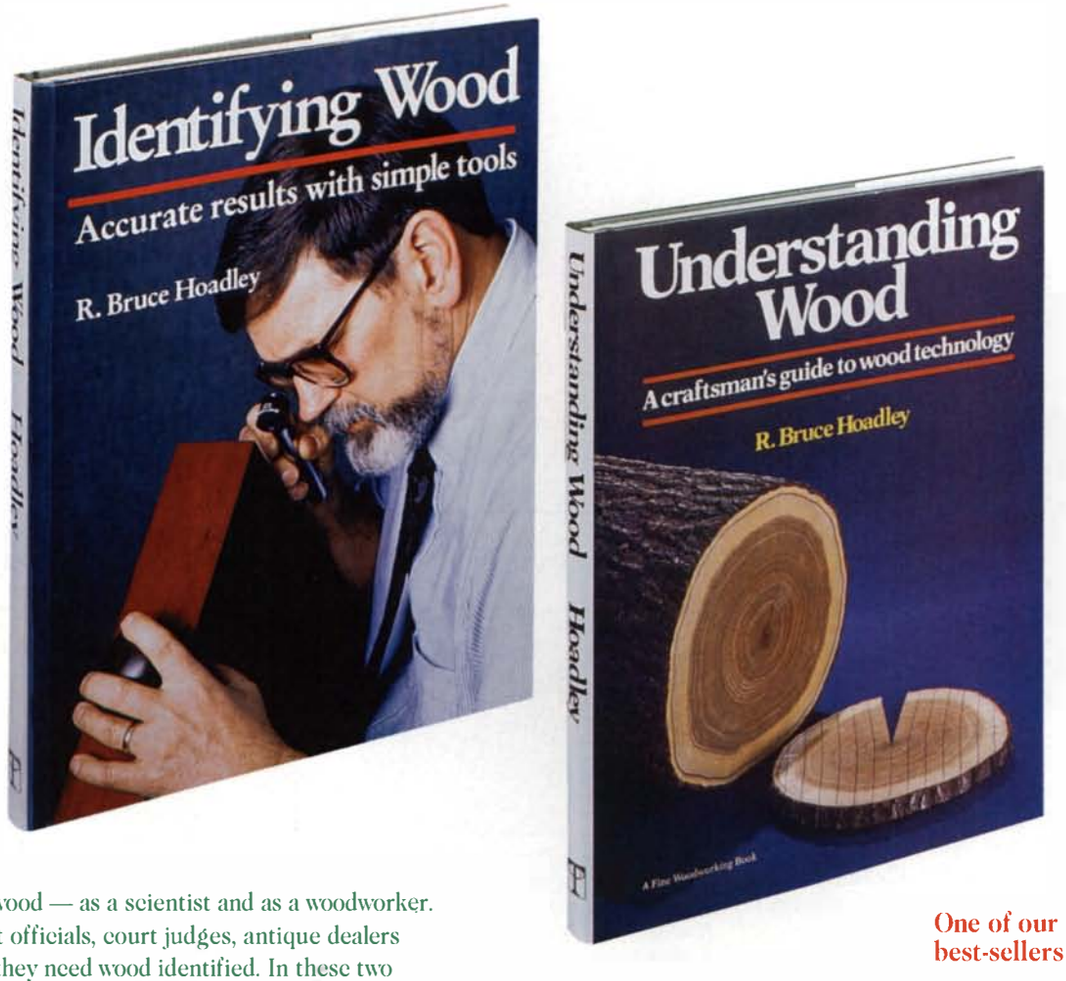

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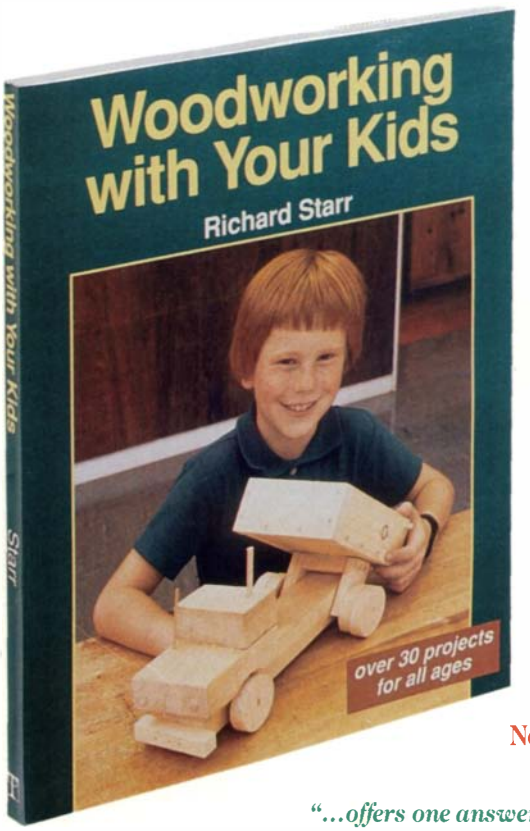

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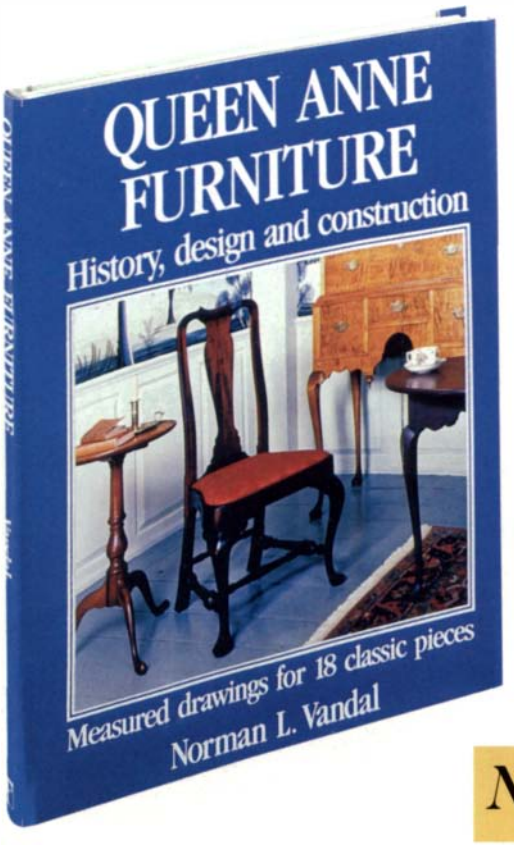

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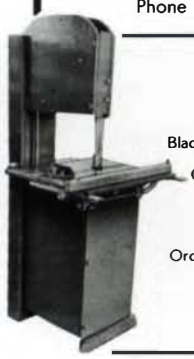

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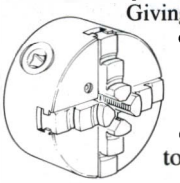

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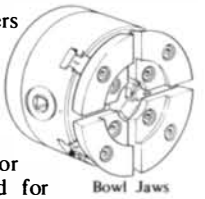

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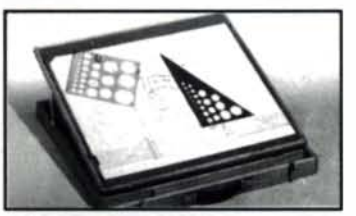

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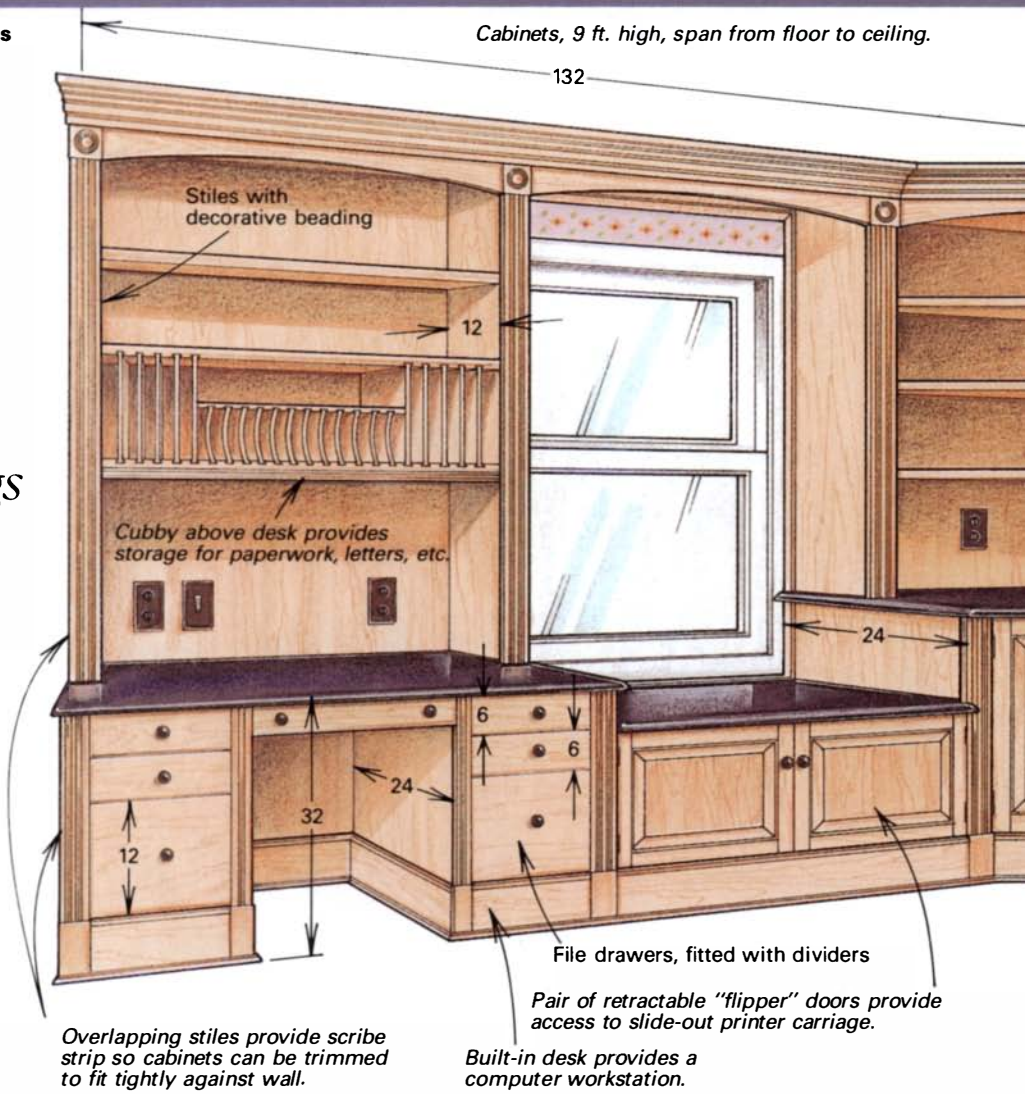
Fig. 1: Built-in cabinets



Wall-to-Wall Built-in Cabinets

Modular approach brings a big job down to size

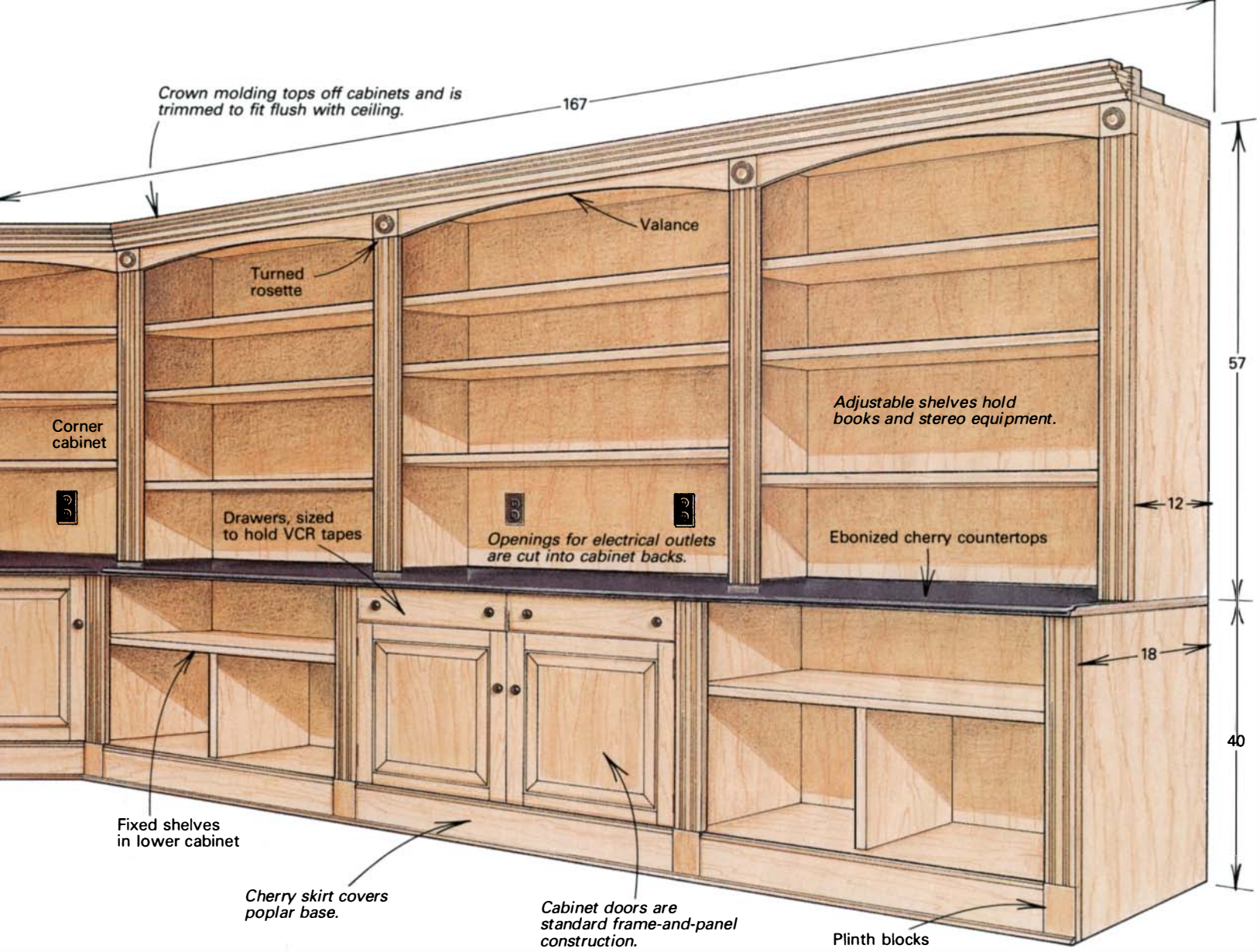
by John M. Foster

Big. The thought stayed in my mind as I drove away from my early morning meeting. My client wanted to convert a second-story bedroom into a study. The cabinets were to be built-in, floor to ceiling, covering two walls. There was to be a computer workstation on one wall; a stereo system in the corner; and a television and video player set up on the adjacent wall. All told, I'd have to build and install 25 linear ft. of 9-ft.-high cabinets: a big order for any small shop.

The client's house was old, circa 1868, and had extensive woodwork throughout. There were elaborate moldings around the doors and windows, with some nicely carved details surrounding the fireplace. I wanted my cabinets to match the traditional look of the existing woodwork, but I knew that if I tried to do it the way the original craftsmen did—entirely out of solid wood—the price of the job would fall outside my client's budget. Instead, the sensible solution for a room full of carcases seemed to be to use modern sheet goods: hardwood-veneered plywood and fiberboard. The sheet materials available these days are of excellent quality and are extremely stable. And a plate joiner and biscuits can make light work of assembling these cabinets. Further, these practical carcases could serve as a backdrop for the more detailed work I'd put into the job: decorative beaded moldings, rosettes and plinth blocks, valances and crown molding; details that would tie my cabinets in with the house's original woodwork. In this article I'll tell you how I designed and built the cabinets shown in the photo on the facing page. I won't go into all the construction details, but I will share some of the strategies I learned for handling the large carcase work and decorative details.

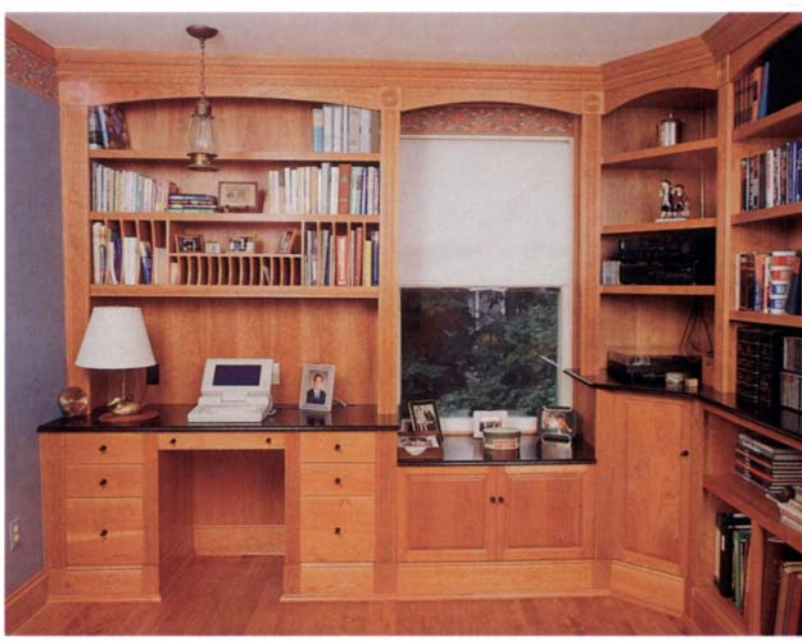
Planning cabinet construction—Because of the large overall size of the job and the limited amount of space in my shop, I had to figure out a way to make the wall-unit cabinets more manageable. I decided to divide the base cabinets into modular sections, including a computer station, corner cabinet and window unit along one wall. The separate units could then be bolted together during installation. The computer station took the form of a desk, with two file drawers on either side of a knee hole. It made sense to build the upper and lower cabinets in separate stages. This would not only save storage space in my small shop, because I could deliver the cabinet lowers before starting construction on the uppers, but it would allow me to install the two groups of cabinets into the irregular room separately, making for a better fit (more on this later).

Because the floor of the room was also uneven, I decided each cabinet should have a separate base that could be leveled on-site. The leveling system I chose employs elevator feet, mounted on the inner corner of each cabinet base, that can be screwed up or down separately, to adjust to the irregularities of the floor (see "Handling Large Commissions," *FWW* #78). To complete my design, I added visual details to the cabinets, such as the beaded moldings and rosettes.



Full-size drawings—Now that I had developed a construction strategy and felt confident about tackling the project, I prepared a 3/32-in. scale drawing of the wall unit, a version of which is shown in figure 1 above. I presented this to my client and explained my building and installation approach. I also recommended that the unit be made from cherry, as it would fit the character of the house. My proposal was accepted and I set about gathering materials and rendering a full-size drawing of the wall unit. A full-size drawing is a good tool for understanding the fine points of construction and how the entire job goes together. For example, the drawing of the computer desk and window unit allowed me to plan how the printer carriage would work, as well as to size the printer cabinet's retractable doors. You can also check hardware specifications ahead of construction and use the drawing to help determine which cutters will be needed for moldings and trim.

Milling the lumber—With all the hardware and supplies ordered, it was time to begin milling the lumber for the job. Solid cherry was used for all the cabinet face frames, doors and drawer fronts, moldings and trim, skirts and plinth blocks at the bottom of the lower cabinets, as well as the valances, rosettes and crown moldings that top off the upper cabinets. Cherry was also used for the countertops and desktop, which later received an ebonized finish. Since poplar is less expensive and easier to work, I used it as a secondary wood wherever it wouldn't show, such as for the



The author's cherry cabinets combine easy-to-build plywood carcases with solid-wood decorative moldings and details that complement the original woodwork in his client's 19th-century home. The cabinets, built and installed in modular units, provide a computer workstation and printer cabinet, a cubby for letters, space for a stereo system, and bookshelves.

Drawings: David Dann

lower cabinet bases. I chose solid maple for the drawer sides, and ⅜-in.-thick birch plywood for the drawer bottoms.

Building the lower cases—Basically, the carcases are simple plywood boxes held together with glue, plate joinery biscuits and screws. I chose ¾-in.-thick medium-density fiberboard (MDF) core cherry plywood for the sides, bottoms and shelves for the lower case work; ½-in. MDF ply for the cabinet backs; and ¾-in. lumbercore plywood for the sides and shelves for the upper case work. I chose lumbercore for the uppers because it's lighter and stronger than the MDF core material, even though it's more expensive, which is why I didn't use it throughout.

After I cut out all the plywood carcase parts and plowed the dadoes for the fixed shelves and the webbing that separates the drawers in the computer desk, I assembled the lower cabinets. The sides, bottoms and backs of the cabinets received biscuit slots, spaced about 1 in. apart (see the top photo on the facing page), cut with the plate joiner held vertically. To ensure that the slots would be properly aligned, a square plywood block was used to stabilize the machine. The work went briskly: within a week my helper and I had cut out and glued up all the carcases for the lower cabinets. Next, the poplar bases for the lowers were cut out and screwed together, and a cherry skirt was attached along the front face. I left some of the skirts off until installation.

To cover the raw edges of the fiberboard carcases, I applied solid-wood stiles decorated with a routed bead profile. Besides covering the edges, they provided a solid mounting for the door hinges. And since the stiles on the outermost cabinets are 3¾ in. wide, they provided an overhang that allowed trimming to fit the cabinets neatly against the room's out-of-plumb walls. The beaded stiles terminate at the bottom into the plinth blocks glued to the skirt, and they add a nice bit of decorative detail to otherwise simple cabinet faces.

To cut the beads, I used a triple-bead bit chucked in the router table and made two passes on each stile, to form two sets of side-by-side beads. I set a simple pivoting fence on my router table once, flipping each stile end for end between passes. Next, I used the tablesaw to cut a dado on the back of each stile, locating it off center to fit over the front edge of one carcase side (see figure 2). After crosscutting the stiles to their finished lengths, I dry-fit them to the carcases in order to take measurements for the doors and drawer fronts.

Doors and drawers—Using the door measurements from the stiles and carcases, I cut the rails and stiles for the door frames and shaped the edges using a cope-and-stick cutter set in the router table. For the door panels I resawed ¾ cherry stock in half, marking every board for book-matching. After gluing up the panels, I scraped and sanded them to 120-grit, and then I used a 3½-in.-dia. ogee-style panel-raising bit in my router table to shape their edges. When working with a bit this size, it's a good idea to use a variable-speed router set to its slowest RPM. Also, "sneak up" on the finish cut by taking several increasingly deeper passes. After shaping the door panels, I sanded them to 220-grit and assembled them in their frames. Then I glued up the panels and slightly beveled the front edge of each door frame on the jointer, to ensure a clean, close fit. Finally, I laid out and chopped the mortises on the stiles for the butt-style door hinges, and glued the carcase stiles to their respective cabinet sides, screwed on the hinges and hung the doors.

On the printer cabinet, I used retractable or "flipper" door hardware that allows the door to hinge open and then slide back into the cabinet (see the bottom photo on the facing page). This setup lends better access to the printer, which slides out on its own carriage. I used Accuride #1442 "anti-rack" slides (available from Builders Specialty Hardware, 26 Weston Ave., West Somerville, Mass. 02144) and followed the supplied instructions carefully when sizing the cabinet and door and mounting the hardware. It took a bit of fiddling with the hinge adjustments, but I got the doors working nicely. To conceal the retracted doors, I made and installed two ½-in.-thick plywood panels and screwed them to the bottom and back of the printer cabinet, creating a pocket for the doors. These removable panels also allow access to the door slide mechanism, in case it needs adjustment in the future.

To build the drawers for the unit (seven for the computer desk and two for videotapes), I started by thicknessing all the maple drawer sides and backs to ½ in. and the cherry drawer fronts to ¾ in. I then used a Leigh dovetail jig and a ⅜-in. dovetail bit in my router to cut half-blind dovetails in all of the drawer sides and fronts. The ⅜-in.-thick birch plywood drawer bottoms are captured in a groove dadoed around the bottom inside edge of each drawer. I dadoed a series of grooves on the inside of the lower file drawer sides for partitions and file rods.

After all the drawers were glued up and fit into their respective openings, I routed a small cove detail around the edge of each drawer front using a ⅜-in. core-box bit. The cove adds visual interest, and it made trimming the flush-fitting drawer fronts easier. When this was complete, two center-mount slides (Accuride #1029, available from Builders Specialty Hardware) were installed on each drawer. Using two slides instead of one not only provides better action, but it allows for easy up-and-down adjustment: simply shim each slide as needed.

The printer carriage was constructed from ¾-in. lumbercore plywood, edged with a thin strip of cherry and held together with biscuits. It is fitted with Hettich "Quadro 25" bottom-mount slides (available from Builders Specialty Hardware), which have a load capacity of 70 lbs.—more than adequate for a small printer.

Ebonized countertops—It was time to make the three tops for the lower case work and get ready for installing the lowers. Ebonizing the tops not only divided the lower and upper cases visually, but it also provided a way to hide the sapwood-laden cherry I used for the tops. After milling the boards to ¾ in., they were edge glued to make each top. With a roundover bit in the router, I ran a 3/32-in. fillet around the top edge, and then I scraped and sanded the top before ebonizing it with black aniline dye. I found out the hard way that the dye could be rubbed off the sharp edge of the fillet; were I to do it again, I wouldn't put such a sharp edge on a piece that was ebonized. As I completed each top, my helper applied several coats of Deft semi-gloss clear finish to the lower cabinets and doors. It was easy to apply and fast drying; when rubbed out with 600-grit, the result is very nice.

We delivered and installed the lower case work without much ado. After leveling the bases, we screwed the individual cabinets down and fastened them together into one continuous unit with carriage bolts. I knew that the room was out of square and the walls weren't plumb, and I had compensated for this with the adjustable feet on the bases and the stile scribes on the end cabinets. However, the room was worse than I had figured, and in retrospect, we were lucky that we had enough flexibility to make things fit in place neatly.

Building the upper cases—After the lower case work was installed, measurements were made between the countertops and the ceiling, for sizing the upper cabinets. The carcase construction for the uppers was identical to that of the lowers, except that the uppers have adjustable shelves, for books and such, and a multiple-compartment cubby above the desk. And as mentioned earlier,

Above: Plate joinery biscuits make quick work of joining plywood carcase parts. Here the author plunges a row of slots on the edge of a cabinet side. The plate joiner's fence acts as an edge stop, and the plywood block helps stabilize the machine.

Below: To gain better access to the computer printer, the author built a slide-out carriage from ¾-in.-thick plywood. It's housed in a frame-and-panel printer cabinet next to the desk that is fitted with "flipper" doors that slide out of the way after they are opened.

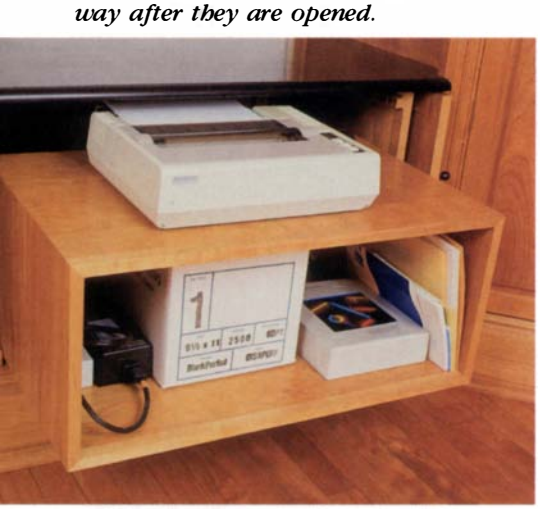
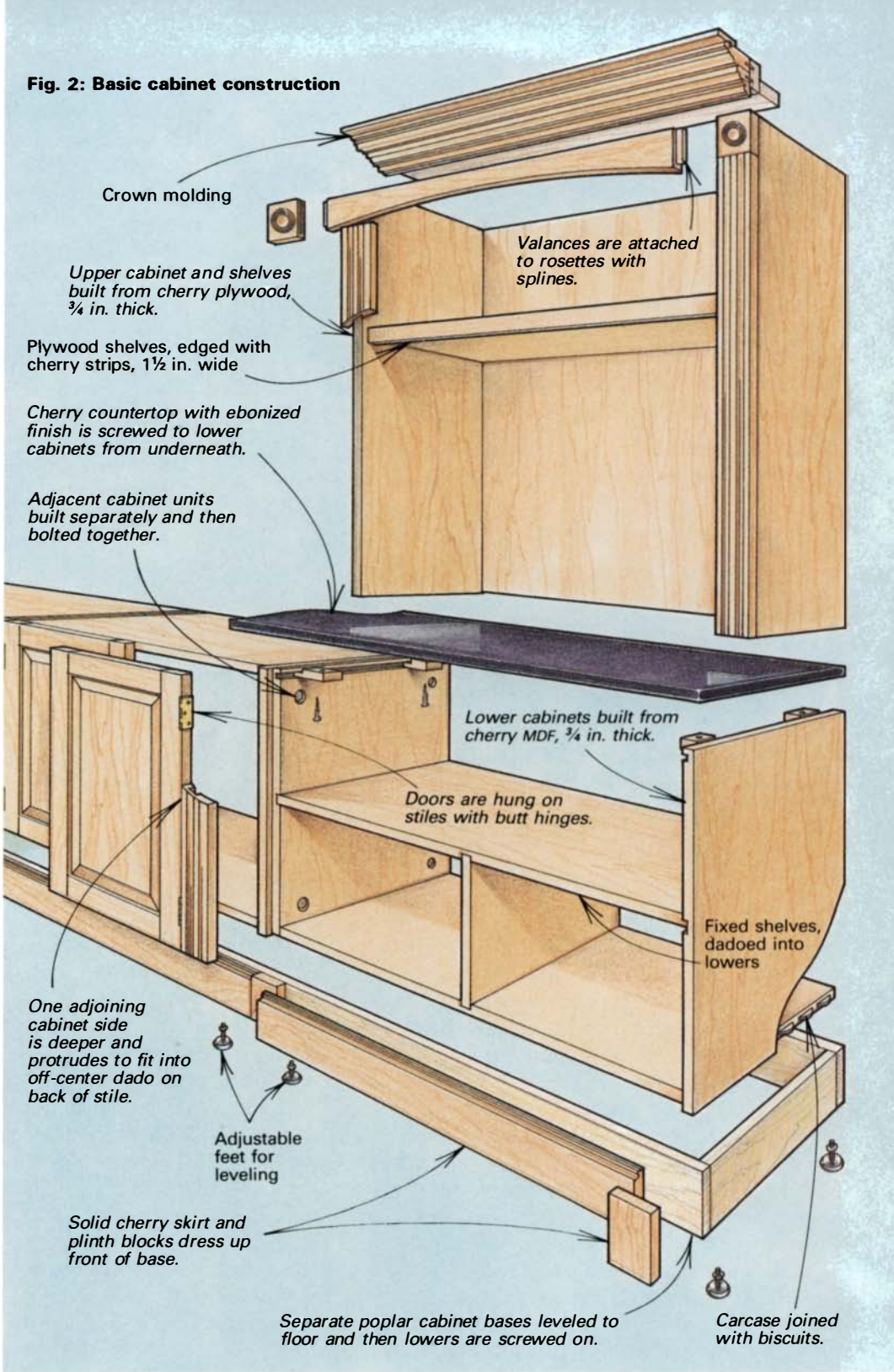


Fig. 2: Basic cabinet construction

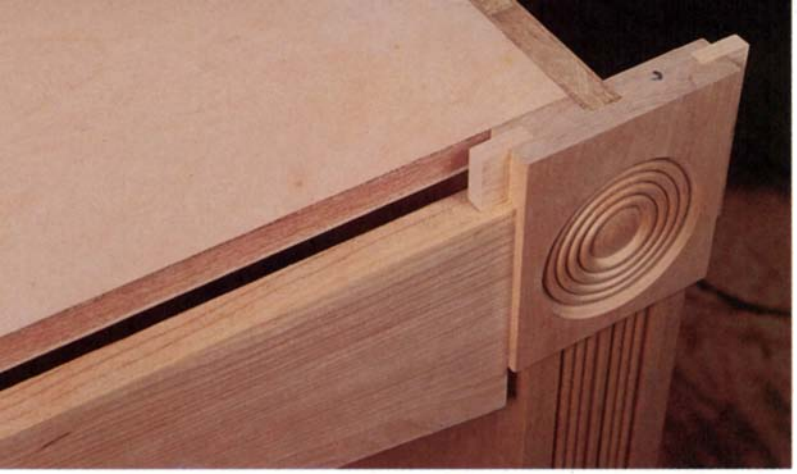


the uppers were made from ¾-in. lumbercore plywood, chosen for its light weight and strength.

As a rule, I normally cut parts to their final length after ripping them to width. However, with lumbercore plywood, crosscut tear-out can be severe. Therefore, I roughed out the cabinet sides a bit over the final dimensions, trimmed them to length and then ripped them to final width. The backs of the uppers were made from the same ½-in. cherry ply as the lowers, cut in the steps just outlined for the sides. To get a continuous 59-in.-wide panel with vertical grain, I had to edge-glue the back of the desk unit, relying on biscuits to reinforce the joints.

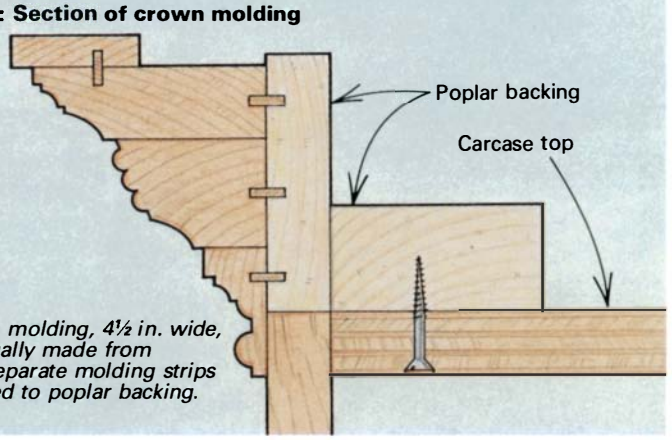
The next step required drilling holes for the adjustable shelves. There are many ways to lay these out, but I prefer using a template. Starting with a 2½-in.-wide strip of cherry plywood, I drilled a row of ⅛-in.-dia. holes 2 in. on center. Then I clamped the template to each cabinet side and used a 16d nail to transfer the hole positions. I worked from the bottom of each piece and kept track of the left and right sides. When all of the holes were marked, I set up the drill press with a long table, in this case an old hollow-core door, and drilled 9/32-in.-dia. holes in the sides using a brad-point bit.

To dress up the look of the holes, I installed short lengths of ¼-in.-ID thin-wall brass tubing (available at hobby shops) in each hole, as grommets. The tubing was cut off on the bandsaw, hammered into the holes and sanded flush. This sanding job was a bit tricky because the brass dust became ingrained in the wood if too



The cherry rosettes and valance strips that grace the top of the built-ins add a nice bit of visual detail to the otherwise simple upper cabinets. The parts are joined with loose maple splines fitted into grooves that Foster cut with a straight bit in the router table.

Fig. 3: Section of crown molding



Crown molding, 4½ in. wide, is actually made from four separate molding strips splinted to poplar backing.

much pressure was applied. I kept the air hose nearby and constantly blew the wood clean while sanding.

After the upper carcases were assembled, I built the cubby system for the computer desk (see figure 1). The top, bottom and sides of the cubby were made from ¾-in. lumbercore plywood and edged with cherry. The partitions were made from ½-in. MDF cherry plywood and were also edged with a wide piece of cherry, which I cut curved later. After sizing the cubby's bottom and top, I laid out the mortises for the sliding dovetails that hold the partitions. Using the tablesaw, I first cut a series of dadoes to remove most of the waste from each joint. Since the partitions were laid out in mirror symmetry, I dadoed both ends of the top and bottom using the same fence setting. I also clamped the top and bottom together, front edge to front edge, so that each pair of dadoes was aligned. Then I turned each dado into a dovetail slot using a dovetail bit on the router table, and made the pins on the partitions with the same bit.

I made templates for cutting the concave front edges of the partitions. After marking the curves with a pencil, I roughed them out on the bandsaw. Then I tacked the template to each partition and trimmed and decorated the curved edge using a half-round-profile bit, guided by a pilot bearing, in the router table. The tack holes were filled later. The sliding dovetails were final-fitted on each partition individually by shaving the pin with a block plane. When everything fit together nicely, I put a small amount of glue in each joint and slid the partitions home.

The rosettes and valances—Decorative turned rosettes top off the stiles on the upper cases and join the plywood carcases with a dado on their back. Also, slots were cut in two edges of each rosette, as well as on the ends of the valances, for loose maple splines to join the rosettes to the valances (see the photo at left). I cut these slots with a straight bit in my router table without changing fence settings, keeping the back side of each piece against the fence. The lower edge of each valance was then cut to form an arc that lends an open feeling to the upper cabinets. But the valances vary in length, thereby making the arc slightly different in each one; so I marked out each arc with a long ship's curve, adjusting the degree of curve to suit valance length. I made sure that the center of each arc was marked equidistant from the top of the case work. To cut the arcs, I first roughed out each one on the bandsaw and then cleaned it up with a rasp and spokeshave. After sanding, most of the rosettes and valances were splined and glued in place, but some had to be final dimensioned and glued in place during installation.

The crown molding—A wide crown molding tops off the upper cabinets, tying them together visually and filling them out to the ceiling. This complicated-looking, 4½-in.-wide molding is actually an assembly of four different strips: One rectangular strip at the top and three separate molding strips shaped with a variety of standard router bits. The bits I used include a classic combination bit, an ogee raised-panel cutter, and the three-bead bit that I shaped the stiles with earlier. I cut the profiles on the router table, employing long infeed and outfeed tables, which kept the stock flat and made getting a smooth, even cut a little easier. Instead of shaping individual narrow strips, I started with a 5-in.-wide, ¾ cherry board and shaped each profile on the edge and then ripped each molded profile strip out afterward. The advantages of working with a large piece of stock are that it is easier to handle and it is less susceptible to chatter during routing. After all the molding strips were done, I cut a ⅛-in. groove on the back of each and joined each to a poplar backing strip with a thin spline, as shown in figure 3 at left. Besides giving the completed molding strength, the splines helped keep the strips aligned during glue-up. With the crown molding completed, we delivered and installed the upper cabinets.

Final steps—Before the upper case work could be put in place, we had to cut rectangular holes in the backs of the cabinets to accommodate electrical outlets and switches. Then the cabinets were put in place and screwed to the wall studs, at the top, with heavy L-brackets (two per cabinet). Next, wires for connecting the various audio components were run above the cabinets and leads were fed in through small holes. The valances not already installed at the shop were measured, cut and glued in place. The crown molding was fitted next, with the necessary miters cut on a 15-in. portable miter saw, and then the crown molding was secured to the top of the case work with screws. After all the case work was fitted, any gaps due to the room being out of square were scribed and filled with cherry trim strips. Lastly, the skirts, plinth blocks and narrow shoe molding were installed around the base of the lower cabinets.

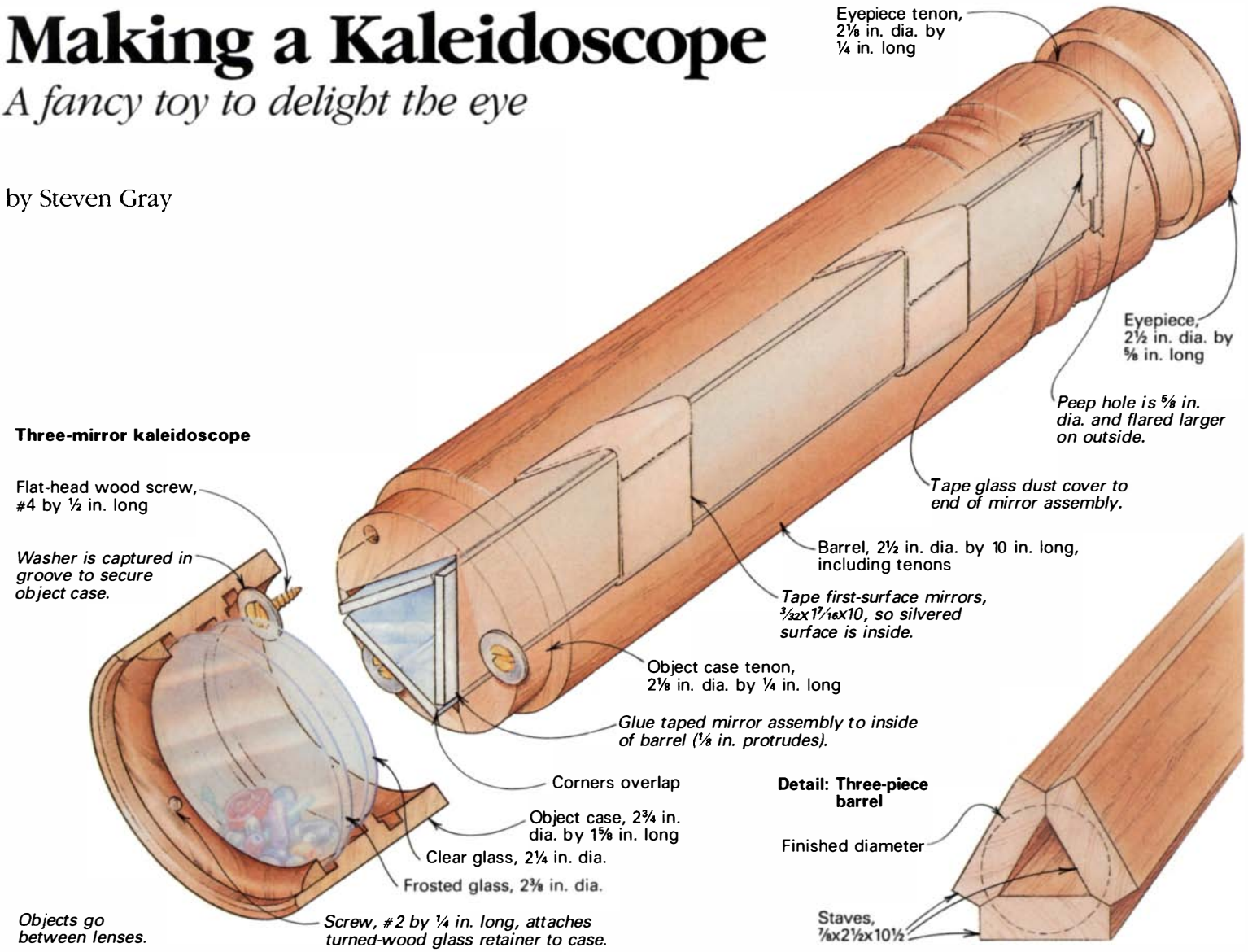
When I look back at this job, the thing that stands out the most is how easy the sheet material was to work with. The plywood and veneered MDF didn't have to be scraped, it only required light sanding, and we didn't worry about solid-wood cases expanding and contracting or warping. I was concerned that the plywood would age lighter than the solid cherry; but so far the color is mellowing nicely. I can't say how many hours we saved using sheet materials, but if we hadn't, I have to wonder if my helper and I wouldn't still be neck deep in a seemingly unending job. □

John M. Foster is a custom furnituremaker and cabinetmaker in Hopkinton, Mass. All photos by Charley Robinson.

Making a Kaleidoscope

A fancy toy to delight the eye

by Steven Gray



When you look through a kaleidoscope, you see a magical world of colorful, geometric images. Sir David Brewster made the first kaleidoscope 175 years ago and called it "an instrument of amusement to please the eye by the creation and exhibition of beautiful forms." Despite the complexity and infinite variety of these beautiful forms, the scope itself is a simple assemblage of tubes, mirrors, glass and brightly colored objects.

Kaleidoscopes have two essential parts: a system of two or more mirrors, which are usually encased in a tube, and an object case filled with bits of reflective material. Although I often put colored glass between the object case's two lenses, you can use just about anything, including plastic beads, paper clips and stones. When you rotate the case, the objects change position and the scope's image changes. The number of mirrors and the angle between them determines the geometric pattern of the image. Kaleidoscopes with three mirrors that form an equilateral triangle, like the scope described here, produce an endless number of three-point, hexagonal-ring patterns. Kaleidoscopes with two mirrors at a 36° angle and a piece of non-reflective flat-black glass opposite the angle produce a single five-point pattern, like the one in the top photo at right. The non-reflective third side of the triangle in a two-mirror scope absorbs light and limits the image to one ring.

I designed the wood scope shown in the drawing to be made with simple setups on the tablesaw, router and a lathe, and it is nearly identical to the production scope my wife and I make (see

Right: This single five-point kaleidoscopic image was created by a two-mirror scope with bits of colored glass in its object case.

Below: Steven and Debra Gray sell up to 400 production scopes a year, like the "Montana" on the left, which is made of zebrawood, and the "Old Faithful" on the right, made of boire. Both come with five interchangeable object cases.

Photos this page: Steven Gray; drawing: Clarke Barre

the bottom photo on the previous page). The mirror system, which has a clear glass dust cover under the eyepiece, is housed in a turned walnut barrel and the object case rotates, which makes the scope easy to use. For the scope presented here, the object case is permanently captured on washers that are screwed into the end of the barrel. On our production model, the object case has an interior groove that is captured on bullet catches in the barrel's tenon, which makes it possible for customers to change object cases, if they wish.

Making the barrel and eyepiece—Since the mirror glass you buy may be slightly oversize or undersize, start by acquiring three 3/32x1 7/16x10 mirrors and then make the barrel fit the triangular mirror assembly, as shown in the drawing. It's important to use "first-surface" mirrors (available from most stained-glass suppliers or from Gray & Gray Woodwrights, 2970 Sourdough Road, Bozeman, Mont. 59715; 406-587-0383). Unlike ordinary looking glass, first-surface mirrors are silvered or aluminized on the front surface instead of the back. With ordinary looking glass, light from the image is reflected through the glass; but with first-surface mirrors, light is cast directly off the reflective silver, resulting in less distortion and light loss. However, beware that first-surface mirrors are delicate and expensive and they should be handled with care. For

Earning a living from our craft

by Steven and Debra Gray

We consider ourselves fortunate to be making a living from crafts. We're doing what we want, having a good time at it and earning a comfortable living making wood kaleidoscopes. But as we look back, we realize that we didn't achieve success because of a few lucky breaks. The real secrets of our success are that we manage our time between creative and production work, we actively promote ourselves, as well as our wares, and we market our products at what we consider a fair price, considering the quality of our work.

Our business history: After struggling to earn a living at woodworking for seven years, we took some items, including kaleidoscopes, to a few local craft fairs in 1983. Our kaleidoscopes sold well, and soon they became our only product. We earned a good income selling scopes at craft fairs, but as our family grew, it became difficult to travel with our two small boys; so we began looking for other markets. At first, we refused to sell to galleries that wanted to buy our scopes wholesale, because we didn't want to market them at 50% of our craft fair price. Then, at the insistence of a few galleries, we wholesaled some orders at a 20% discount. We received reorders quickly and within a few months, most of our business was wholesale. This has been good, because we work almost exclusively from our home shop and we no longer need to travel to earn our living.

Photo: Steven Gray

The Grays' one-of-a-kind kaleidoscope, "Variation of a Parasol #1," produces a colorful image. It sells for about $7,000.

Mixing creativity and production work: Production work often has a mind-numbing affect on many craftspeople. To maintain our sanity, we strike a fine balance between production runs and more creative one-of-a-kind and limited-edition work. The obvious advantage to production work is that we only have to develop one design and make one set of jigs, spreading the cost of designing and setting up over a large number of items. And we have become very efficient at this repetitive work, which allows us to keep our prices down and make a fair wage. During two or three months of hard work, we can finish 350 to 400 production scopes, which is a year's supply. We feel a great sense of accomplishment when we produce a significant quantity of good work each day. On the other hand, production work can be boring.

In contrast, one-of-a-kind and limited-edition pieces test the limits of our creativity and woodworking skills. They are also expensive to make and must demand a high price. These special pieces give us a break from production work and offer design freedom, as well as an opportunity to use more exotic materials and optical systems.

Although limited-edition pieces take much longer to make than standard production work, we can control the costs by making 10 to 50 examples of more exotic scopes, like the one shown at left. Runs of this size help us make a decent profit and offer unique products at a more reasonable price. With any run, though, the anticipation of how enthusiastically people will accept or reject the pieces can be unnerving.

Promoting your work: One of the best lessons we've learned is that if our work stands out, it will promote itself. So it is critical to make the best quality product and at the same time keep up with demand.

We have also learned that individual buyers and galleries want to know who we are, and we keep our biography, artist statement, resume, portfolio and other personal information up to date. Professionally printed brochures were expensive initially, but they don't cost much per kaleidoscope. Brochures can be especially useful if your product doesn't change significantly. We send newsletters to individuals and galleries every three to four months, telling them that we're still in business, what we're making, when it will be available and what we can ship immediately. Our newsletters often have photographs of limited-edition and one-of-a-kind scopes we have on hand, and this regenerates interest in them. But you must budget your promotion expenditures. We follow a simple rule of thumb: If we have plenty of product on hand, we work on promotion and marketing; if we can't keep up with orders, we focus on production.

Keeping your name in front of the public is also important. We encourage the local media to run human interest stories on our business, and we submit articles to magazines and newspapers. We also make public appearances by attending and/or presenting workshops and seminars.

Pricing your work: Pricing your products can be difficult. We sold our original, simple scopes for $25, but as we refined them, we moved from the low end of the price range to the higher end, selling some for $200 or more. In part, our increase was a result of the demand from collectors for unusual pieces, more competition among low-end scope makers, and our need to be more creative. But it was also because we got better and our designs became more complex.

Limited editions of more technically involved kaleidoscopes demand a higher price to cover our research, development and design. Scopes in the collectibles market—new one of a kinds and limited editions, as well as antique scopes—sell for $500 to $35,000. Our limited-edition scopes sell for $1,000 to $7,000, which is the upper end for current work among contemporary scope artists.

this reason, tape together a mock-up of three pieces of ordinary glass or looking glass that are identical to the first-surface mirrors and then size the barrel to this mock-up assembly.

If the first-surface mirrors are even slightly larger than those called for in the drawing on p. 47, you will have to redimension the barrel's staves. If the mirrors are the correct size, you can now rip three ⅞x2½x10½ walnut staves and chamfer their inside corners 30°, as shown in the drawing. The dimension between the chamfers should be equal to one side of the triangle created by the mirror assembly. Dry-assemble the staves with tape and check that the chamfered surfaces fit together tightly and that the mock-up glass assembly fits inside. Then glue the staves together and wrap them tightly with tape. While the glue is drying, make the eyepiece.

By using a 2⅞-in.-sq. by 8-in.-long piece of walnut, you will have more than enough stock for the eyepiece, as well as the object case. I chamfer the long corners of the walnut 45°, making an eight-sided piece, which is easier to turn. (To mark the piece accurately, you can use the method in *FWW* #76, p. 34 or the spar maker's marking gauge described in *FWW* #53, p. 12.) Now, crosscut a ⅝-in.-long eyepiece blank and a 1⅝-in.-long object case blank. To finish roughing out the eyepiece, turn or drill a ⅝-in.-dia. peep hole through its center and turn or drill (with a Forstner bit) a 5/16-in.-deep by 2⅛-in.-dia. mortise in one end. Then, turn or rout a ⅛-in.-radius cove in the outside of the peep hole (see the top photo at right).

Next, crosscut the barrel assembly 10 in. long and turn it close to the final diameter. At the same time, turn a tenon to fit the eyepiece mortise, and then glue the eyepiece to it. Now, turn the assembly, as well as the object case tenon, to the finished diameter and shape. To turn the hollow barrel, I pinch it between a ball bearing, cone center and a turned wooden taper screwed to a faceplate, as shown in the center photo at right.

Turning the object case—There are steps in one end of the case, into which the glass lenses fit, and a groove in the other end, which captures an edge of three washers that are screwed into the barrel's tenon. I begin by gluing the case blank to the center of a 3½-in.-dia. glue block and screwing the block to the lathe's faceplate. Then I turn the outside of the case and its ½-in.-deep by 2⅛-in.-dia. mortise to fit the barrel's tenon. Size the mortise so the case will move freely on the tenon. I use a square side-cutting tool to scrape the ⅛-in. by ⅛-in. groove ¼ in. from the end of the case. Next, turn the inside of the case's outer end. To do this, cut the case from the glue block and convert the block to a jam chuck by turning a groove in the block to accept the lip of the case's mortise shoulders, as shown in the bottom photo at right. Now, assemble the object case and barrel with the screws and washers, and check the fit. To tighten the fit, shorten the barrel tenon; to loosen the fit, remove wood from the case's shoulders.

Before final assembly, finish all the wooden parts with oil. Then carefully tape the first-surface mirrors together without getting fingerprints on them, because even gentle cleaning can scratch the silver or aluminum. Blow dust off the mirrors and then tape the triangular glass dust cover to the end of the mirror assembly and slide it into the barrel. If it's too loose, wrap the assembly with more tape for a snug fit. Secure it in the barrel with hot-melt glue and then glue the clear inner glass to the object case. Finally, fill the object case and secure the frosted outer glass with a turned ring fastened to the case with wood screws. □

Steven and Debra Gray make kaleidoscopes in Bozeman, Mont.

Gray routs a ⅛-in.-radius cove in the outside of the peep hole so the viewer's eye can be closer to the clear dust cover underneath.

Gray pinches the glued-up barrel and eyepiece assembly between a ball bearing, cone center and a wood taper fastened to the lathe's faceplate. Then he turns the finished diameter, the object case tenon and decorations.

After turning the object case mortise, Gray cuts the case from the glue block. He then turns a groove in it, making the block a jam chuck to hold the case's lips so he can turn its other end.

Photos this page: Gary Weisenburger

Craftsmanship in Britain

Contemporary makers show their style

by Dick Burrows

Photo above: Lighthouse Studios; photo below: Bob Walker

In recent years, I've become increasingly fascinated by the objects created by British furnituremakers and designers. The best work is characterized by an attention to detail, a fine sense of proportion and balance, and extremely high standards of craftsmanship. Recently I was able to immerse myself in a large dose of some of this, thanks to a national exhibit called British Craftsmanship in Wood.

The exhibit, which opened as temperatures in Britain soared to within a whisker of 100°F, an all-time record, featured more than 300 works by nearly 100 individual woodworkers and companies. The work was generally good, a pleasant surprise in a show this large, and the variety of styles and periods represented were enthusiastically received by craftspersons and guests who attended the breathing-room-barely opening at the Thirlestone Long Gallery in Cheltenham.

In her preface to the book *British Craftsmanship in Wood*, published in conjunction with the show, curator Betty Norbury said the show refuted claims that craftsmanship is dead and workers don't build things as well as they used to.

"Craftsmanship is as good as it ever was and, in some cases, with the use of new technology, better. Many of our contemporary designers have as much to offer as Chippendale or Sheraton did in their time." All of the workers listed in the book and invited to the exhibit work in small shops, either alone or with a few assistants. "It is generally a world of quiet, methodical working, unhurried by the pressures of the current expected lifestyle. And whilst an element of machinery is used, timber still has to be selected and matched, glue has to dry, and the majority of the work has to be hand finished."

Mrs. Norbury said she tried not to impose her own likes and dislikes in selecting the work for the show or book. Rather, she said she tried to present pieces which represent the state of current work, both in contemporary design and in the reproduction or reinterpretation of classic pieces. The subjective decisions about what is pleasing or not are left up to the readers of the book or visitors to the exhibition. "Like it or hate it—it's part of today," she wrote.

In that spirit, we are presenting a sampling of work from the show. The book accompanying the exhibit can be ordered in the United States under the title *Fine Craftsmanship in Wood* from Linden Publishing, 352 W. Bedford #105, Fresno, Cal. 93711 ($39.95). The British edition is available from Stobart Davies Ltd., 67/73 Worship St., London EC2A 2EL, England (£25). □

Dick Burrows is editor of FWW.

Photo: Express Photographic Service

Above, left: This 72Hx38Wx16D display cabinet by Gary Olson features an unusual combination of yew and laburnum. Olson said, "The aim of the design was to produce an elegant display area uncluttered by traditional cabinet doors with their framing, hinges, catches and handles. Access to the top section is gained by lifting out the glass corner panels via a secret spring catch in the top of the cabinet." The piece was completed by Michael Shally. *Above:* This ash rocking footrest with removable padded cover by Leslie Plail shows how nice a small, functional object can be. It was priced at £155. *Above, right:* This sycamore and maple hall cabinet is by Mark Hutchins. Norbury quotes his design philosophy as "All my designs are intended to be visually uncluttered, though they may be structurally complex and interesting. I like to use decoration, such as inlays, joint details, etc., where this enhances and emphasizes the structure." *Below, right:* Jeremy M. Higson said his writing table/desk is a detailed copy of the original made for George III's son, Frederick Louis. The piece is satinwood and the writing area is leather with a book rest on a ratchet support. The tapered legs are inlaid with boxwood, ebony, tulipwood and purpleheart, with silvered brass casters. *Below:* Max Cooper specializes in spectacular marquetry pieces. This £6,500 collector's box is East Indian satinwood with rosewood bow-front drawers. *Below, left:* Philip Dobbins' 34Hx44Wx16D Chinese side table is from Santos rosewood and accented with ebony around the drawers, which open by concealed catches.

Photos above and below: Tony Boydon

Photo above: Graham Harding; photo below: Posers Photographic Studio

Photo left: Keith James-Robert Ellwood, photo right: John Baldwin

Photo: Ian Walters

Left: Robert Ellwood of West Yorkshire built this rocking chair in English ash. Exhibit curator Betty Norbury said the organic piece, priced at £650, resulted from Ellwood's early experimental work in steaming and laminating. *Center:* John Baldwin is a sculptor who says he hopes his work, like "Sardines" shown here, will involve and amuse the viewer. "I try to avoid explanations since they tend to confuse," he said. The lime carving is 21½ in. high by 24 in. wide. *Right:* This Cerdan chair in Rio rosewood and leather by Geoff Godschalk of the Silver Street Workshops was priced at £5,450. In describing its workers, this small company expresses an idea I heard from several British workers who consider themselves designers/craftsmen: "Someone who stands apart from the many fine craftsmen reproducing traditional styles by virtue of his ability to look again at old ideas and find new solutions to meet the rigors of modern living."

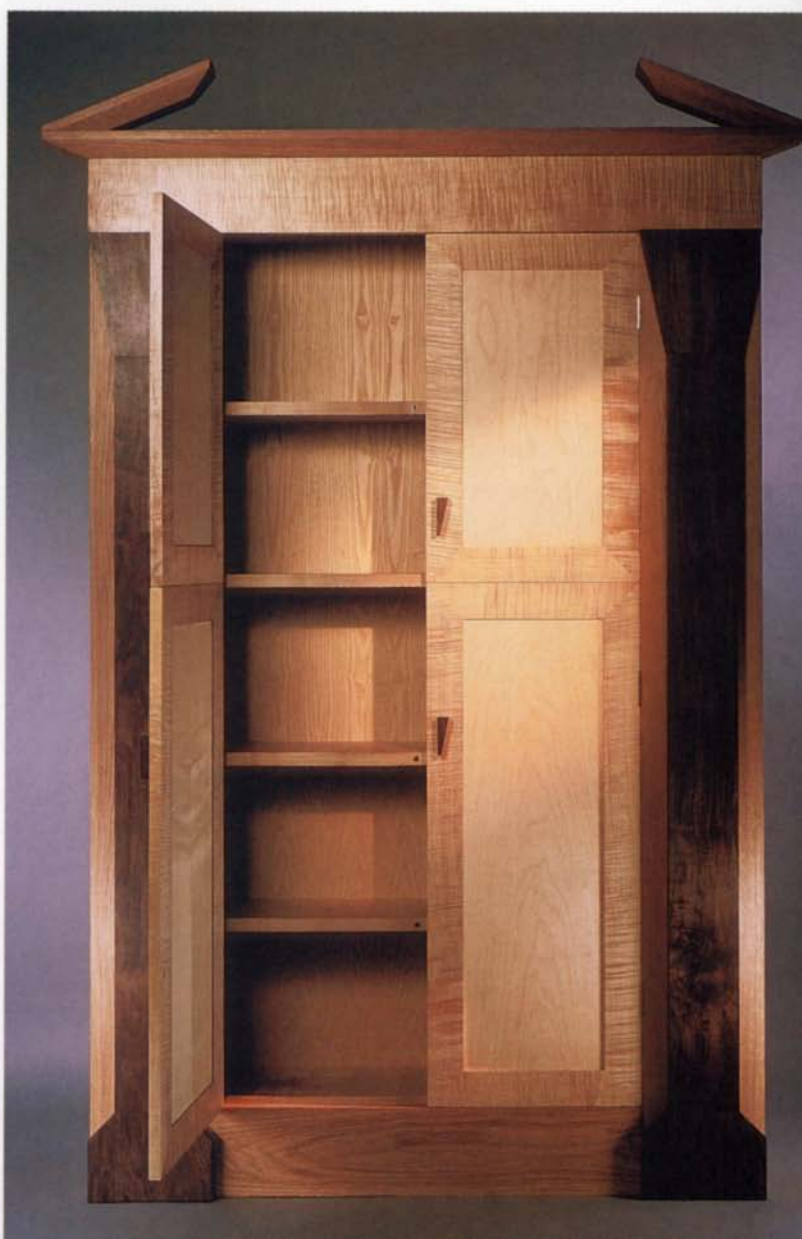
Below: Andrew Crawford's curved-form jewelry chest is 10Hx14Wx7D. The book-matched burl walnut chest has two fitted trays and one frieze drawer. Norbury said the shape of the sides "is derived from the very solid look of trees at their base."

Photo left: Andrew Crawford, photo right: Duncan MacQueen

Below: David Marshall's work, like this ash table and chairs, is generally on commission, because his Wales community is not a good market for unusual furniture pieces, which he prefers.

Photo: Anthony C. Thatcher

Below: Jess Christman lives near Edinburgh, Scotland, and prefers to use homegrown timber for most of his work, such as this cabinet in ripple sycamore, ash, oak, walnut and maple. The cabinet was priced at £2,500.



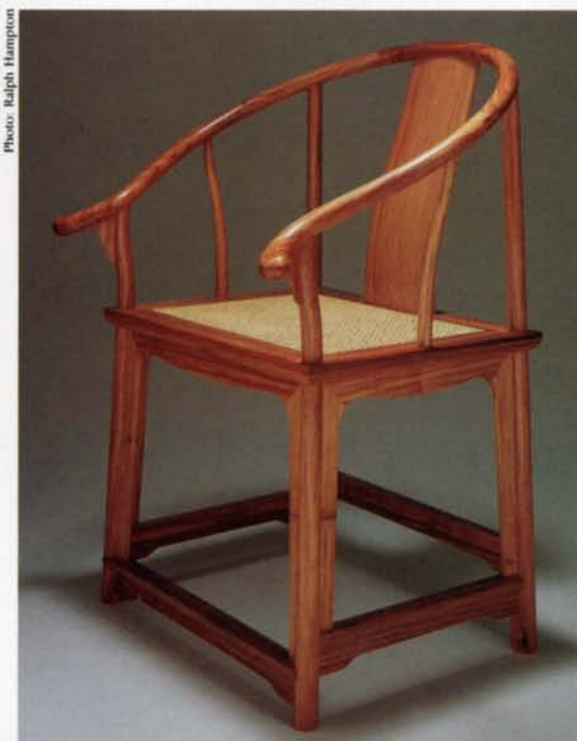
Above: John Sagar built this 29Hx96Wx48D English cherry dining table for a client who harvested the wood from his estate. *Right:* Antonios and Ruth Nielsen's settee was one of the more colorful and humorous pieces exhibited. The two-seater is made with pink-stained Canadian rock maple and has painted collar and feet details. The upholstered cushions are gray with pink tassels. *Below:* Martin Greshoff recently started working for himself making simple furniture with geometrically based influence, as shown in this beech cupboard.

Photo above: Dean Forest Studios; photo below: Antonios and Ruth Nielsen

Photo left: Robert Greshoff

Below: Ralph Hampton exhibited a round chair of Andaman padauk. Norbury quotes him: "My long-term goals are to get as close as possible to the attitude that created Chinese furniture, know it well, and then have fun with it; to really know that what I do, I do well, and is worthwhile. ..."

Photo: Ralph Hampton



Trained as a cabinetmaker in England's finest Arts-and-Crafts tradition, Alec McCurdy now mostly makes cellos in a small brick workshop in the country hamlet of Cold Ash, west of London.

Alec McCurdy's Music Cabinet

Traditional composition in English walnut

by Sandor Nagyszalanczy

If you asked most American woodworkers I know whether or not a particular construction method is "traditional," they would likely reply "Yes, I've been doing it that way for at least five years." This attitude may be fashionably individualistic, but it reflects a naivete about time-honored ways, and so it was refreshing to meet a man whose woodworking roots trace back to traditions that thrived before there was even a country called America.

Alec McCurdy, a furnituremaker and cello maker who lives in the small hamlet of Cold Ash, about 50 miles west of London, has been a woodworker for almost 40 years. Like many other English woodworkers of the time, he was trained in traditional techniques and design, but he is unique in that he studied under not one but two of England's finest cabinetmakers. After abandoning a career as a solicitor (an attorney in England) in 1954, he was taken on as a student, first by Stanley Davies and later by Edward Barnsley. In 1970 he commenced making cellos, and is now completing opus #14 and #15 for his sons. After he completes them, McCurdy plans to return to his first love, furnituremaking, in his charming, tile-roofed brick studio in Cold Ash (see the photo above).

I saw many of McCurdy's works during my visit to England last fall, but I was particularly impressed with a piece that combines both his furnituremaking and cello-making interests. His walnut music cabinet, shown in the left photo on the facing page, is one of two such pieces he built (the other is from cherry) in 1986 and displayed at the British Craftsmanship in Wood exhibition in Cheltenham (see the article on pp. 50-53 of this issue). Being a practical man, McCurdy designed the cabinets to be very functional. The compartments behind the doors provide storage for record albums and full orchestral scores; the middle drawer is for cello bows, mutes and other musical accessories; and the cubbies inside the fall front allow space for organizing and storing sheet music (see the top, right photo on the facing page). McCurdy's wife Jean makes good use of these latter cubbies; she is a member of a recorder ensemble and keeps her music there.

To build the walnut cabinet, McCurdy used wood from two different trees. A large tree that he cut down in his own backyard (a true English country garden) supplied the plainer wood for the carcase frame and base, but the sensationally figured panel stock was a little harder to come by. A big walnut tree had fallen in the yard of a retired naval commander in McCurdy's neighborhood. The commander informed McCurdy that he could take the tree only if he didn't damage the lawn that the huge trunk had to be moved across. Employing the assistance and expertise of the commander's gardener (a former seaman), two villagers, a 7-ft.-long crosscut saw and a low four-wheel carriage, McCurdy managed to move the trunk and leave the lawn unscathed. For the cabinet's less visible casework—dividers, cubbies and drawer sides—McCurdy used sycamore and locally abundant chestnut as secondary woods. He also used some flame-grained Bosnian sycamore veneer, which he had sawn from stock obtained in Germany for his cellos, on the inside panels of the cabinet's fall front.

Cabinet construction—In keeping with his traditional background, McCurdy went to great lengths to create a cabinet that adheres closely to the classic principles of solid-wood carcase construction. The carcase was designed to allow the solid-wood parts to expand and contract without problems; cross-grain joinery was avoided. The panels at the front, top and back were grooved into their frames, but not glued in place, to allow for seasonal wood movement. A central divider, just under the drawer, is through-mortised to the sides, with wedged tenons for strength and visual detail. Inside the music cabinet's top and bottom compartments, McCurdy divided the space into separate cubbies fabricated from sycamore and chestnut panels, which are dadoed into the carcase. The cabinet doors feature a symmetrical array of highly figured walnut panels, as does the fall front above them.

To lend the piece a bit of close-up detail, McCurdy used a scratch stock to cut a small single bead around the inside edge on many of the frame members, and he reduced the depth of cut as he worked into the corners of the frame to make the beads fade out visually. The chest's wooden pulls are bent-laminated strips of walnut and sycamore that fit into through mortises chopped in the doors and drawer front. On top of the 56-in.-high cabinet, McCurdy installed figured-walnut floating panels that overlay their frames and protrude above them about 3/16 in. This gives the top some relief and shows off the grain to better advantage.

As is traditional on larger case pieces, McCurdy built a separate base for his music cabinet and designed legs to elevate it about 10 in. off the ground. He made the base unusually heavy and rigid, laminating 4/4 chestnut to the back of each 4/4 walnut apron member to thicken it, and attaching hefty corner blocks to reinforce the inside corners. McCurdy said he felt the heavy construction was

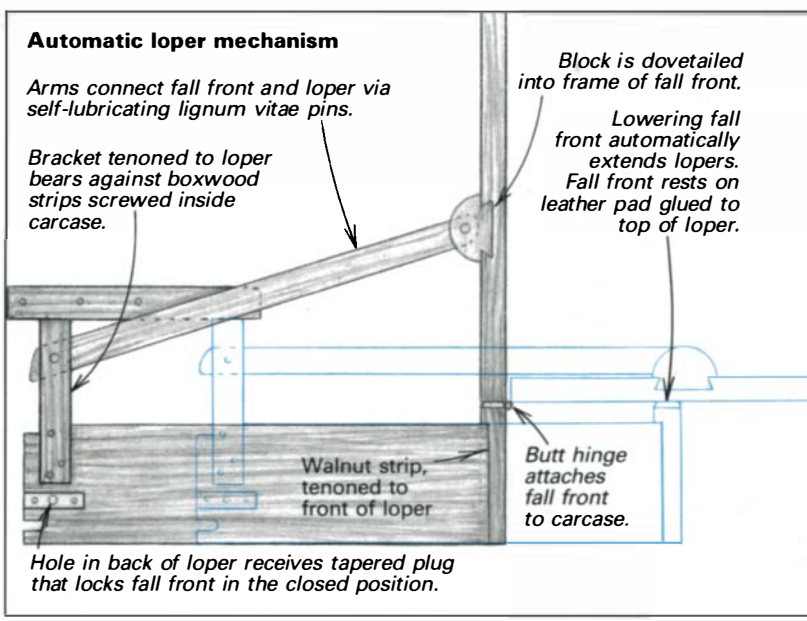
***Left:** Built from two walnut trees, one yielding the plain frame wood and the other the highly figured panel stock, McCurdy's fall-front music cabinet holds records, sheet music and musical accessories.* ***Above:** When the fall front is opened, a mechanism designed by McCurdy automatically extends a pair of lopers to support it. The sycamore and chestnut cubbies behind the fall are convenient for storing sheet music.* ***Right:** A hinged panel behind the cabinet drawer provides access to the loper mechanism. A tapered plug (shown in the storage position) may be set in a hole through a brass strip at the back of the loper, to lock the fall front closed.*

needed to keep the base from racking if it was placed on an uneven floor, which helps keep the carcase straight and square, so the doors and fall front wouldn't bind or stick.

The fall front—One of the most unique features of McCurdy's music cabinet is the fall-front mechanism, which automatically extends a pair of arms, called "lopers," that support the fall when it's down (see the top, right photo above). While most fall-front desks or secretaires have lopers, these must typically be pulled out manually before the fall is opened; however, if someone is in a hurry to open the fall and forgets the lopers, the fall may be torn from its hinges.

McCurdy's automatic loper mechanism, shown in the drawing at right, is operated by a pair of arms that are connected to the fall front and that pull the lopers forward as the fall is lowered. The arms are attached to a pair of blocks, which are dovetailed into the fall front, with pins made from lignum vitae (a naturally oily wood). The back ends of the arms are pinned into brackets that are slip-dovetailed onto the lopers. These ride in narrow compartments on either side of the cabinet drawer. The tops of the brackets bear against end-grain boxwood strips screwed to the inside of the cabinet. This design prevents the lopers from sagging should the lopers themselves shrink and change in width. The front ends of the lopers are faced with walnut strips, which are padded with leather to prevent scratches on the lowered fall. A narrow horizontal door at the back of the cabinet (behind the drawer) provides access to the loper mechanism, for installation and repair (see the bottom, right photo above). The door also allows access to a special tapered plug, which can be fitted through a hole at the back end of each loper, effectively locking the fall front closed, for security or transit.

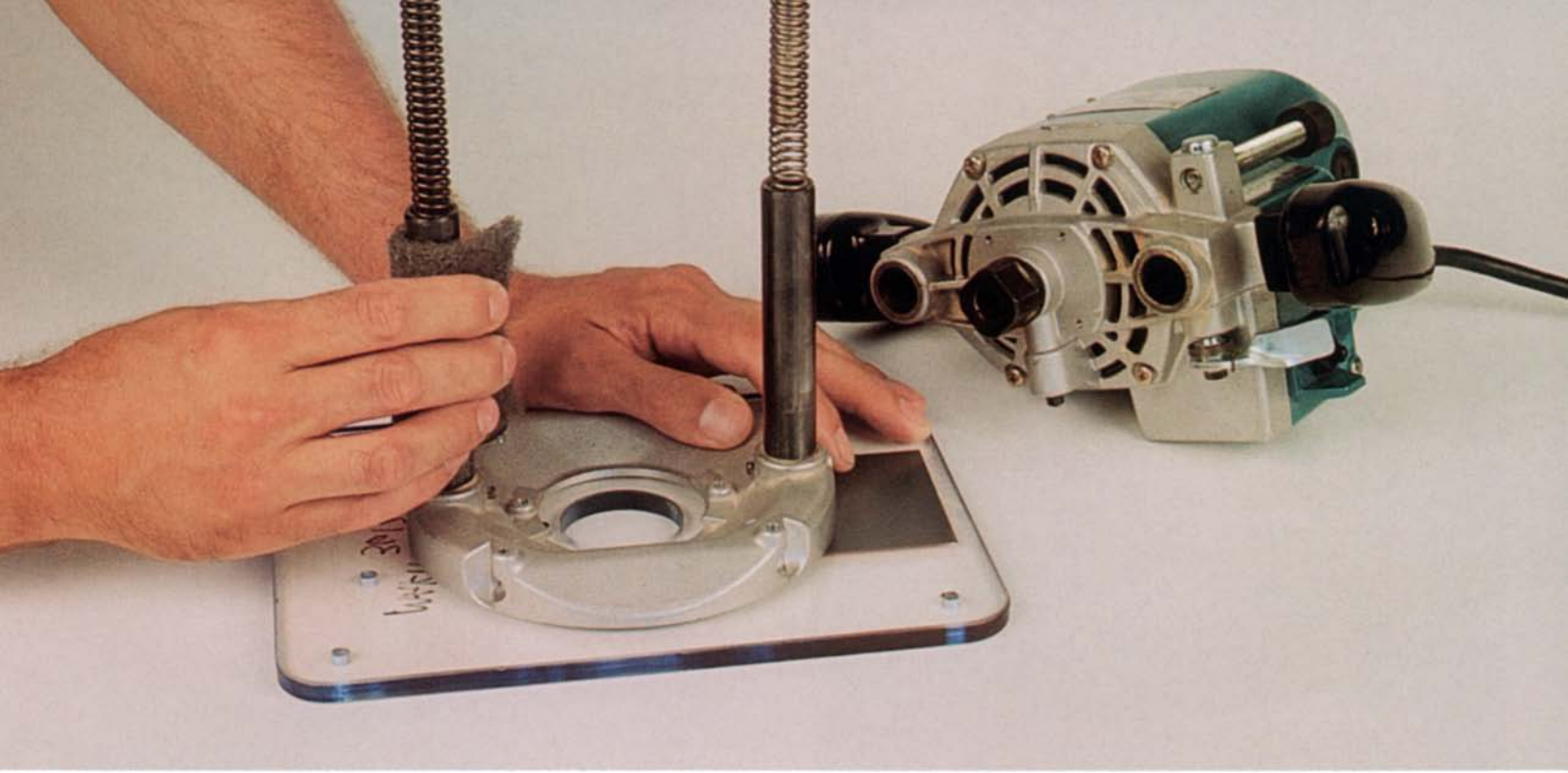
McCurdy designs all of his cabinetry with the future in mind,



as witnessed by one final detail in his music cabinet. The screws and fittings for the loper mechanism have very specific sizes and lengths, so McCurdy includes a full set of extras in a small tray attached inside the drawer at the rear. I think McCurdy, a man who hopes traditional practices will be carried into the future, finds it comforting to know that 200 years from now a furniture repairman working on the music cabinet will be thanking him for his foresight. □

Sandor Nagyszalanczy is associate editor of Fine Woodworking. *All photos by the author.*

Drawing: Aaron Azevedo



By cleaning your router regularly and maintaining its vital running parts, you can keep it operating at peak performance for many years. Here, a plunge router's motor housing has been removed from its base so that the columns can be cleaned with a plastic abrasive pad.

Tuning Your Router

Maintenance and tips for top performance

by Mark Duginske

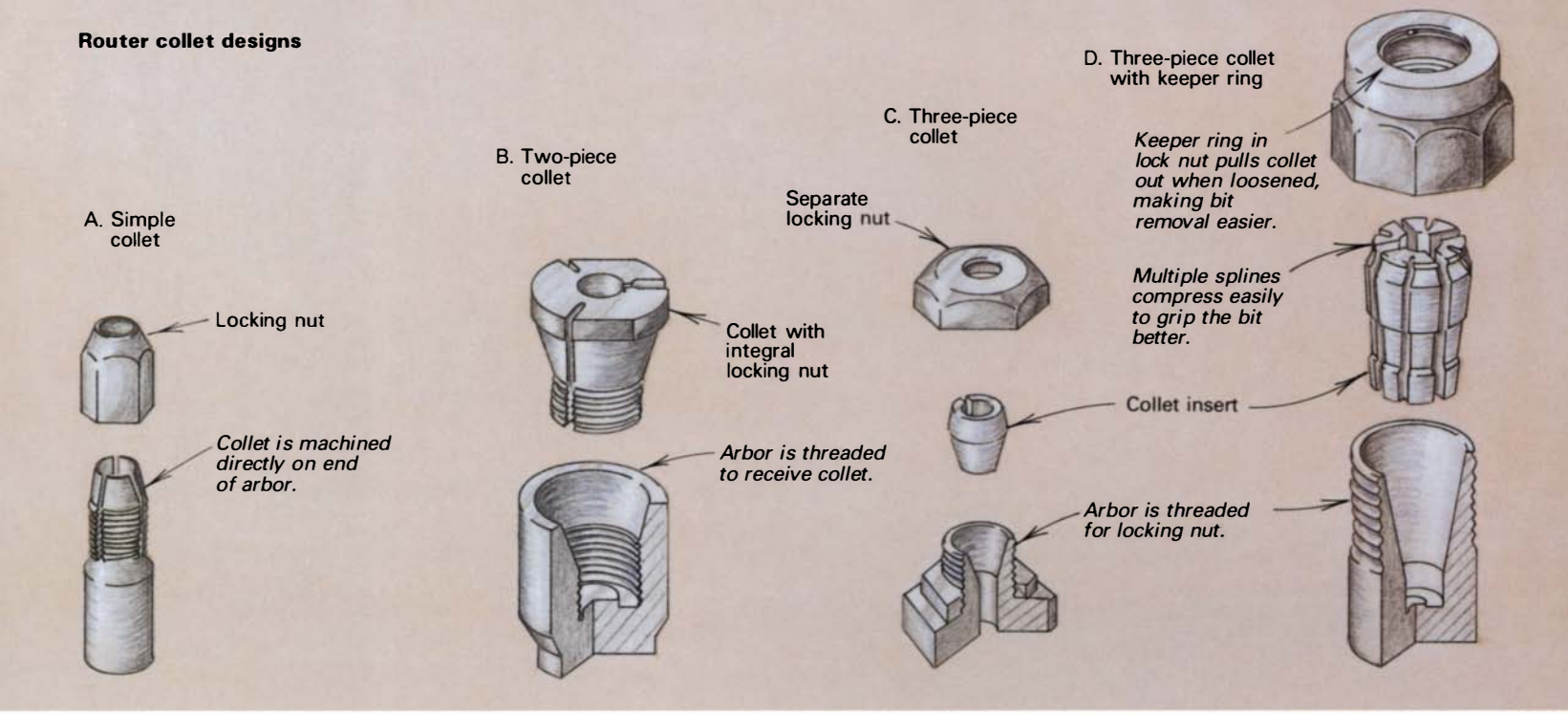
When woodworking historians look back at the 20th century, the tool they probably will spotlight is the router. This American invention has invaded all aspects of woodworking: It is the first-recommended power tool for a novice, and it is a workhorse for the professional. But while many woodworkers assume that a router will automatically produce good results—just install the bit and you're ready to go—it's not all that simple. In many respects, the router needs more maintenance and care than any other tool in the shop.

A router has wearing parts, such as the brushes, bearings and collet, that should occasionally be replaced over the life of the tool. Tuning your router means caring for its basic parts and knowing when those key parts need to be replaced. This and a few other tricks will help you get the best performance out of any router, whether it's a bargain-basement cheapie or a top-of-the-line bruiser, as well as help keep repair bills down. I'll tell you exactly what you have to do, but first let's examine the collet: the Achilles' heel of a router and the part that usually needs the most attention.

The collet—The collet is the device that holds the router bit. The inside is straight to fit the bit's shaft, while the outside is tapered and fits into the cone at the end of the arbor shaft. As the locking nut is tightened, the collet is pushed into the cone and the bit is squeezed tight. The compressive force on the outside of the collet is concentrated on the bit shaft. Unlike the drill chuck, which holds the drill with three points, the collet holds the bit with the entire inside surface.

Not all router collets are created equally and many routing problems can be traced to the design of the collet itself. A router can have a powerful motor and attractive features, but if it has an inferior collet it is still a poor machine. To hold a bit securely, a collet must be flexible; the best collets have many slits in them and are so flexible that you can easily compress them with your fingers (see the left photo on the facing page). Conversely, some simpler collets are very stiff and do not do a good job of gripping the bit. Here is a quick review of several collet designs found on most routers.

With the simplest collets, such as the ones used on many laminate-trimming routers and some Sears models, the actual collet that grips the bit is machined directly onto the end of the arbor (see A in the drawing) and a separate locking nut tightens the collet around the bit. The problem with this design is if the collet wears out or is damaged, the entire arbor must be replaced.



In order for a three-piece collet to get a good grip on the shank of a router bit, it must compress into its socket on the router arbor when the locking nut is tightened. ***Left:*** *Multiple-spline collets like the one here are very flexible and compress easily to grip a bit firmly.* ***Center:*** *To keep rust, pitch and grime from causing problems, a router collet should be kept clean inside and out. Using a fine-bristle brass brush to clean the collet's bore makes that job a snap. Pitch and dirt produced during routing can also foul the collet socket in the router's arbor* ***(right)****, as well as threads that hold the collet's locking nut.*

A two-piece system, such as that used on many Japanese-made routers and certain Porter-Cable and older Rockwell models, has a separate collet that screws into the end of the arbor (see B in the drawing). As the nut atop this collet is tightened, the arbor's tapered socket presses the collet's cone-shaped body, tightening the collet around the bit. But there are two problems with this design: Two-piece collets (even those models with multiple slits) tend to be stiff and don't grip the bit very well. Second, the collet cone and arbor socket surfaces can abrade and gall (explained below), making the collet difficult to tighten and loosen.

With a three-piece collet (see C in the drawing), the arbor, collet and locking nut are separate pieces; the collet fits into the cone on the arbor and is tightened by a separate locking nut. This design allows the collet insert to come out when the nut is loosened, making it easier to remove the bit. The most advanced collets (see D in the drawing) have a "keeper" ring on the nut that engages the collet, pulling it out when the nut is loosened. These last two types of collets are typically made of polished spring steel and have multiple slits, giving them great bit-holding power, even on bits with slightly undersize shafts. Routers made by Milwaukee and Elu, as well as the Makita 3612 and the Ryobi 600 series, feature these types of collets.

Collet use and maintenance—In order to get the best performance out of whatever style collet your router has, you must take care to use it correctly and to maintain it. To tighten a router collet properly, insert the bit until about ⅛ in. of space is left between the end of the shaft and the bottom of the collet/arbor. If the shaft is not long enough to go that deep, set the bit so that the cutting portion is about ⅛ in. above the top of the collet. Then tighten the locking nut, taking care not to fasten the collet onto the bit's fillet—the raised area just below the cutting portion of the bit—as this prevents the collet from tightening properly and allows the bit to slip. If you suspect any slipping, use a marking pen to indicate the same position on the bit shank and collet (like timing marks on an auto engine); if the marks shift when you use the router, the bit is moving in the collet.

Even a properly used collet may perform poorly if it is not well maintained. Dirt, rust, sawdust and pitch decrease a collet's ability both to grip and release the bit. A number of problems can be traced directly to a poorly maintained collet, including bit slippage, bit or collet freezing, excess vibration, bit bending or breakage, and even excessive bit runout (when the bit is not turning concentrically).

To ensure your collet is working properly, keep as smooth and clean a surface as possible on both the inside and the outside of

Drawing: Aaron Azevedo

When a collet fails to keep a bit from slipping during a cut, galling can occur, which is shown here as the shallow grooves in the shaft of the bit. Fortunately, these can be filed off to restore the shaft.

A simple method for determining the concentricity of the collet employs a bar clamped to the base and a special pointed bit called a "know bit" (demonstrated here by Brad Witt of Woodhaven). A feeler gauge indicates the amount of runout.

the collet, the collet socket in the arbor and bit shaft. The outside of the collet and the collet socket can be cleaned with steel wool, an abrasive pad or a fine-bristle brass brush. The best solution for cleaning the inside is to use a fine-bristle round brass brush like the one in the center photo on the previous page. (I bought mine from Woodhaven, 5323 W. Kimberly Road, Davenport, Ia. 52806; 800-344-6657.) Rust is much harder to remove than pitch or dirt and may take some extra effort. But no matter how badly the surface is rusted, resist the temptation to use sandpaper (even the finest grade), as the resulting scratches can decrease the collet's grip. Some people use rubbing compound to clean the collet and bits, but that leaves a fine film that must be removed with a dry cloth.

Don't make a habit of leaving the bit in the router after you have finished using it: release the bit and clean both the bit and the collet, as pitch and dirt can accelerate the rusting process. If you store the router in a humid area, remove the collet and place it in a plastic bag, to protect it from rusting. If your shop is very humid, you may want to put a fine layer of oil on the cone; but make sure you wipe it down thoroughly *before you use the router.*

Collet wear and replacement—Although proper maintenance will prolong the life of the collet, all collets eventually wear out and need to be replaced, perhaps even several times over the life of the router. One of the most common forms of collet wear is called "bell mouthing." This is when the collet wears more at the top and bottom than in the middle, leaving less contact area to hold the bit. The symptoms of bell mouthing include bit slippage and excessive bit runout. A slipping bit can cause galling on the bit shank, the inside surface of the collet or both. Galling is caused by the friction of two non-lubricated metal surfaces rubbing against one another and results in deformation of the parts, such as grooves or ridges (see the top photo at left). If the galling is deep or extensive, the bit, as well as the collet, may be ruined. Other clues that indicate your collet may need replacing include excess vibration during routing and problems removing router bits.

If you are unsure of whether or not you may need to replace your collet, there are two ways to check for collet wear: one is to feel whether the bit moves in the collet and the other is to check for runout. I suggest using both tests and if either is positive I would replace the collet. First, take a brand new, long straight bit and hand-tighten it in the router. Try to wiggle the end; if you detect movement, replace the collet. Next, check for runout by chucking up a precision rod, such as a drill rod or a "know bit," which is a very accurately machined rod with a point on the end for setting up equipment (available from Woodhaven). Then use a dial indicator to measure the concentricity of the rod an inch up from the collet. If the runout is more than 0.005 in., replace the collet. You can also use the dial indicator to check the tapered collet socket in the arbor: it should be concentric within 0.001 in. If it's much farther out, the arbor might be bent—a condition that probably means it's time to buy a new router.

If you don't have a dial indicator, here's a low-tech method for testing runout. Clamp one end of a narrow bar of wood or Plexiglas to the router's base with the edge pressing lightly against the bit about an inch up from the collet (see the bottom photo at left). Now rotate the arbor; if there is runout, the bit will push the bar away. The amount of runout can be measured with a feeler gauge between the bit and the bar. As with the previous method, 0.005-in. runout means replace the collet.

Bearings—Another area of the router that requires occasional maintenance and replacement is the bearings. Because they rotate at such high speeds, router bearings wear much faster than most

other motor bearings. Fortunately, there are a number of things that you can do to prolong bearing life. Surprisingly, router bearings last longest when they are under load. The worst thing you can do to your router is let the motor run when it is not cutting. This is called "run on," and during this process those smooth little bearings pound themselves into a mess. This can happen very quickly: in a matter of days in a production shop. The problem is especially prevalent with a router mounted in a table since there's a tendency to leave it on constantly when you're cutting a run of something like molding. One solution is to use a foot switch, which turns on the router only when you stand on it. Other ways to prolong bearing life include using slower RPM settings on a variable-speed router (when they're appropriate for the particular cutting operation). Also, the "soft start" feature found on some routers can reduce bearing wear by not exposing them to sudden start-up torque.

Eventually your router bearings will need to be replaced. Bad bearings will howl when they are ruined, but don't wait to hear a loud noise before replacing them; if you wait too long you could ruin other vital components that are more expensive to replace. Heat is a good early indicator of worn bearings: The router should never get too hot to touch. You can sometimes tell if the bearings are worn by rotating the arbor by hand. It should feel smooth; if it binds or if there is a rough spot, that's a telltale sign of bearing damage. Also, try to move the arbor back and forth and up and down. If you detect any movement here, it's probably time to replace your bearings.

When it's time for replacement, have the manufacturer's service center do the work (unless you are handy and can tackle the job yourself). Otherwise, a good bearing house can do the job (check the yellow pages under "bearing supply"). If possible, ask the service technician to install a higher grade of bearing than the ones that came in the router. I went through a number of bearing changes with one of my routers, and I always used the manufacturer's replacements. When I switched to a better grade of bearings, they outlasted the originals by a factor of three or four.

Other router parts that need occasional replacement are the motor brushes, found under the small removable caps on either side of the motor housing. These should be replaced every 50 hours of use, or sooner if they exhibit wear. You can change them yourself with the proper replacement brushes obtained from your dealer.

Router bits—Router bits also need care and maintenance for best performance and prolonged life. Not surprisingly, the quality of the bit you purchase is paramount to how well it will run and how long it will last. Good bits will last longer and work better, but most importantly, their shafts will be consistent in size, usually only varying by plus or minus 0.002 in. I once bought a bargain bit that was 0.005 in. undersize and it slipped in the collet like crazy. It is probably a good idea to measure the shafts of new bits when you get them and reject them if they are too far off.

After every routing job, you should clean the bit before putting it away. The surface of the shaft should be as clean and smooth as new. If the shaft is tarnished or rusted, clean it with steel wool or an abrasive pad, and then buff it with a metal polish such as Simichrome Polish (available from Woodhaven). Another option is to buff the shaft with rouge on a buffing wheel. The buffing wheel may be the last hope for a bit that is badly rusted or tarnished. Also, check the bit's shaft for galling; if it isn't too deep, you can usually clean it up with a small file. If a bit continues to gall and is your only bit that consistently slips in your router, throw it away. One of the easiest ways to ruin a collet is to use a damaged bit.

Another key to top router performance is to always keep the bit's cutting edges clean and sharp. Pitch or baked-on residue will prevent the chip from exiting the cut and this will increase the deterioration of the cutting edge. If you use wood such as pine or cherry, scrape the cutter frequently and/or clean it with a pitch- and gum-removing product (sold at hardware stores), oven cleaner or ammonia. Titanium nitride bits (those gold-colored ones) have a special coating that prolongs edge life by increasing the lubricity of the bit so that deposits do not stick as readily.

To keep your router bits running smoothly and to make them easier to get in and out of the collet, clean and polish the shank with steel wool or an abrasive pad. No need to tell you which bit in the picture has been polished.

A bit with a dull edge will rapidly deteriorate at a router's high speeds. Therefore, I like to touch up the edges of my bits by hand with a diamond hone (mine is from Garrett Wade Co., 161 Ave. of the Americas, New York, N.Y. 10013; 800-221-2942) before each use. If dullness does get a foothold, you can sharpen all but the most badly chipped bits by hand. High-speed steel (HSS) bits can be sharpened with regular oil or waterstones, while carbide-tip bits require using a diamond hone. Sharpen only the flat inside surface of each flute; never sharpen the bit's actual edge because you may destroy its profile or change its balance. And always clean the bit before sharpening. When the edge becomes dull or chipped, the cutter should be reground, preferably by a good sharpening shop. However, you may find that you can buy a new bit for what it costs to get one sharpened.

Keeping your router clean—Taking good care of the router will prolong the life of vital parts, and it will also make the router more dependable and pleasant to use. To prolong the life of the motor—the heart of the machine—you should clean your router after every use by blowing out the inside with compressed air. Sawdust and chips that aren't blown away can clog air passages and cause overheating or foul the motor's commutator (the part the brushes ride on). To keep your router gliding over the work smoothly, clean and lubricate the base occasionally with a dry lubricant, such as Teflon or graphite. (Avoid silicone sprays, as these can rub off on the work and cause finishing problems.) If you own a plunge router, remove the router itself from the base and clean the columns that allow plunging with an abrasive pad (see the photo on p. 56). Finally, rub the columns with a dry lubricant or wax them (avoid grease or any sticky lubricants that will attract dust), and then reassemble the router. Clean your router's working parts whenever needed and remember: an ounce of router maintenance is worth a pound of service center cure. □

Mark Duginske is a woodworker and author living in Wausau, Wisc. He is currently working on a book on advanced machine techniques that will be published by The Taunton Press. All photos by author.

Building a Gate-Leg Card Table

Tackling curved rails and inlaid legs

by Frank M. Pittman

Tapered legs with fine inlays, curved rails and light proportions give this gate-leg card table a delicate look. A knuckle joint built into the rear apron allows the left rear leg to swing back and support the flip top when fully opened. The deep reddish-brown color of the 50-year-old air-dried cherry used for the top and legs blends perfectly with the mahogany crotch veneer on the curved rails.

About 10 years ago I promised my wife I would build her a card table. Needless to say, after a decade of watching me "research" the problem, she had almost given up hope, and so she was especially delighted when I presented the gate-leg card table shown at left.

Tables such as these, with tapered legs and string inlay, are often attributed to the 18th-century furniture designer George Hepplewhite, but my research suggests that this association may not be entirely accurate. Hepplewhite's principle claim to fame is a book of furniture designs, *The Cabinet-Maker and Upholsterer's Guide,* published by his wife Alice in 1788, two years after his death. And although the tables illustrated in this book have the same light proportions and similarly tapered legs, none have the same balance of uncluttered lines and graceful curves that enhance the table shown here. Fortunately, I can avoid attributing the table's design to a particular style by crediting a former teacher of mine, Walter B. Nalbach, with its inspiration. Nalbach built a pair of tables similar to this in the 1930s, and with his permission I measured them and incorporated a few minor design changes of my own, such as running the string inlay on all four faces of each leg and inlaying the bell flowers on two faces of each leg instead of just one (see the photo at left).

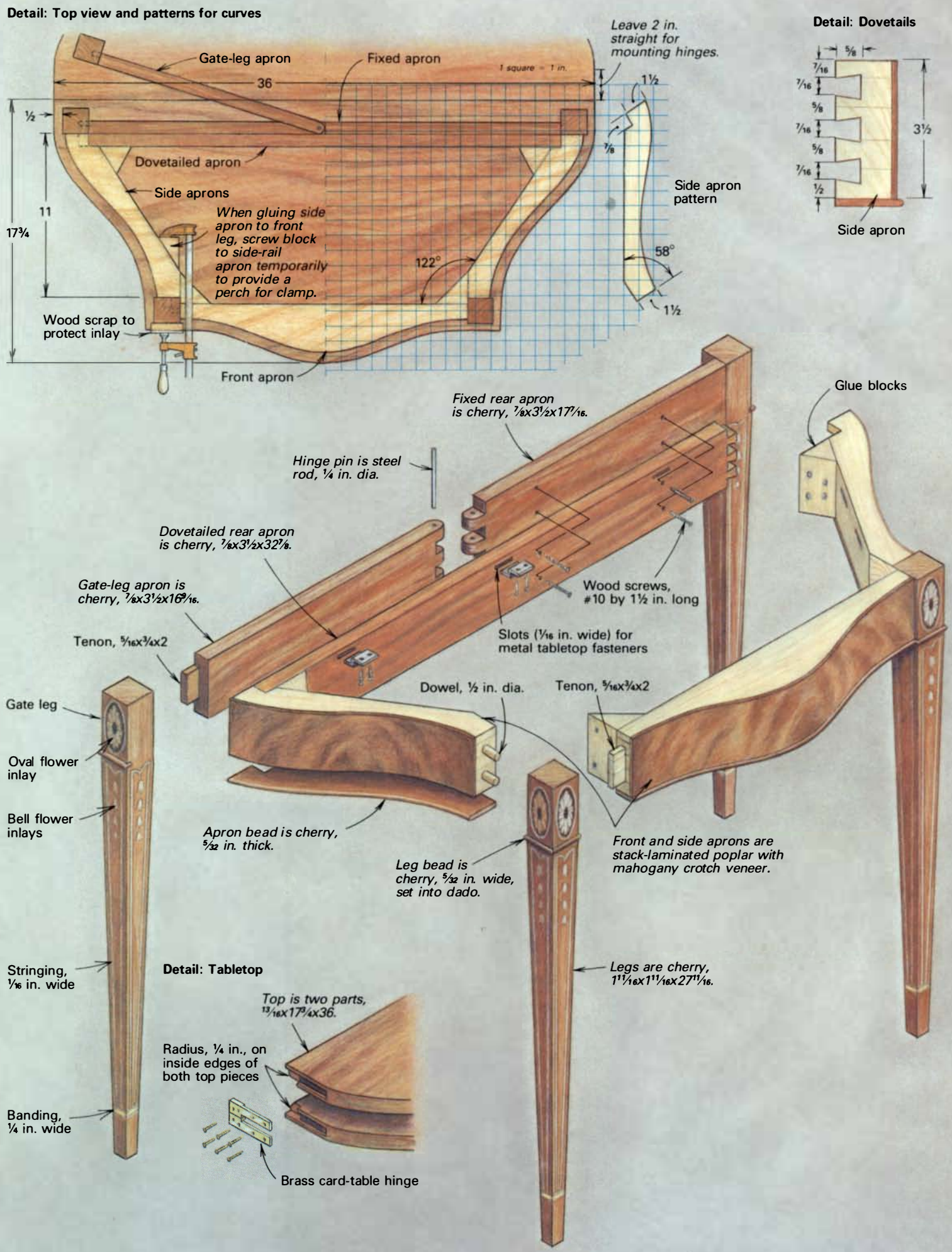
My table is from cherry, with crotch mahogany veneer on the aprons. The legs require 6 bd. ft. of 8/4 stock, which is enough for the table's four legs plus one extra for checking the tool setups for the many machining operations involved with the inlays. The top requires 11 bd. ft. of well-matched 4/4 stock. You'll also need an additional 2 bd. ft. of 4/4 cherry for the back apron, which is actually a three-part construction that includes an inner apron dovetailed into the side aprons and the two-part knuckle-joint gate-leg mechanism that supports the hinged top when open. The cherry apron beads can be made from leg or top scraps. The front and side aprons are stack-laminated poplar, bandsawn to shape and then veneered. I used about 10 bd. ft. of 3/4-in.-thick poplar for the laminated blanks.

Because of the curved aprons and the intricacies of the inlays, the first step in building this table is to make full-scale drawings to work out the details in actual size. You'll need patterns for the curved parts anyway, and so you might as well prepare them ahead of time. In addition, if you buy the oval flower inlays and the banding that trims the lower leg as I did, you should have them on hand before beginning the project. I got my inlays from Constantine, 2050 Eastchester Road, Bronx, N.Y. 10461; the banding is catalog #B3 and the ovals are #IW562. Stringing is traditionally made from holly, maple or satinwood. I was lucky enough to have a piece of 4/4 satinwood, which I sawed into 1/16-in.-wide inlay strips.

Legs, banding and stringing—Begin by ripping the five $1\frac{11}{16}$-in.-sq. leg blanks from the 8/4 stock. Crosscut the blanks to finished

Photo this page: Gary Weisenburger

Fig. 1: Gate-leg card table



Drawings: Lee Hov

length, and then taper each side using a jig that holds the leg at a slight angle as it's passed through the tablesaw. As you can see in figure 2 on the facing page, the taper begins 4 in. below the top of each leg and extends to its base, which is only ⅝ in. sq. After tapering, each leg requires five separate operations to cut the grooves for the inlays. The legs must also be mortised to receive the apron tenons and dadoed for the lower apron bead that runs across the legs, but it's best to do these operations after constructing and veneering the aprons to ensure these joints are located properly.

You should cut the banding grooves around the bottom of the legs first because they make handy stops for the long stringing grooves that you will cut next. This bit of wisdom comes from hindsight; I cut the stringing grooves first, as you can see in the photo below. But more importantly, the photo shows how I routed the banding grooves on the tapered legs with the aid of a miter gauge, even though the router table had no miter gauge slot; I simply ran the gauge's bar along the table's front edge with the router table fence clamped parallel to the front edge to locate the grooves. I set the miter gauge angle to compensate for the legs' taper by making test cuts on the fifth leg and measuring up squarely from the bottom of the leg until the groove ran parallel to the bottom.

I made the long, straight grooves for the stringing with a Dremel tool fitted with a router-base attachment and guide. My dentist helped me acquire a few carbide dental burrs (Pennwalt #559, from Health Co International, 1 Field Lane, Orchard Ridge Corporate Park, Brewster, N.Y. 10509; 914-277-4074), which I used to cut the 1/16-in.-wide grooves. (See *FWW* #83, pp. 62-64 for more on this method.) To cut the ¾-in.-radius grooves at the top of the stringing pattern, I made a ⅛-in.-thick Plexiglas fixture that has a ⅛-in.-dia. hole in the center of each of the arcs (see the top photo at right on the facing page). A pivot pin screwed through the router-attachment base is inserted into each center hole in turn and the Dremel tool is pivoted to cut the arcs. I used a pair of dividers with a dowel taped to one leg to locate the fixture on the surface to be inlaid, as shown in the top photo at left on the facing page. When the fixture was aligned so the arcs began at the ends of the straight stringing grooves and met at the centerline of the leg, I clamped the fixture to the leg and cut the grooves.

The author routs the banding groove in a leg by running the miter gauge bar along the router table's front edge. The router-table fence, which locates the cut, is clamped parallel to the table's front edge.

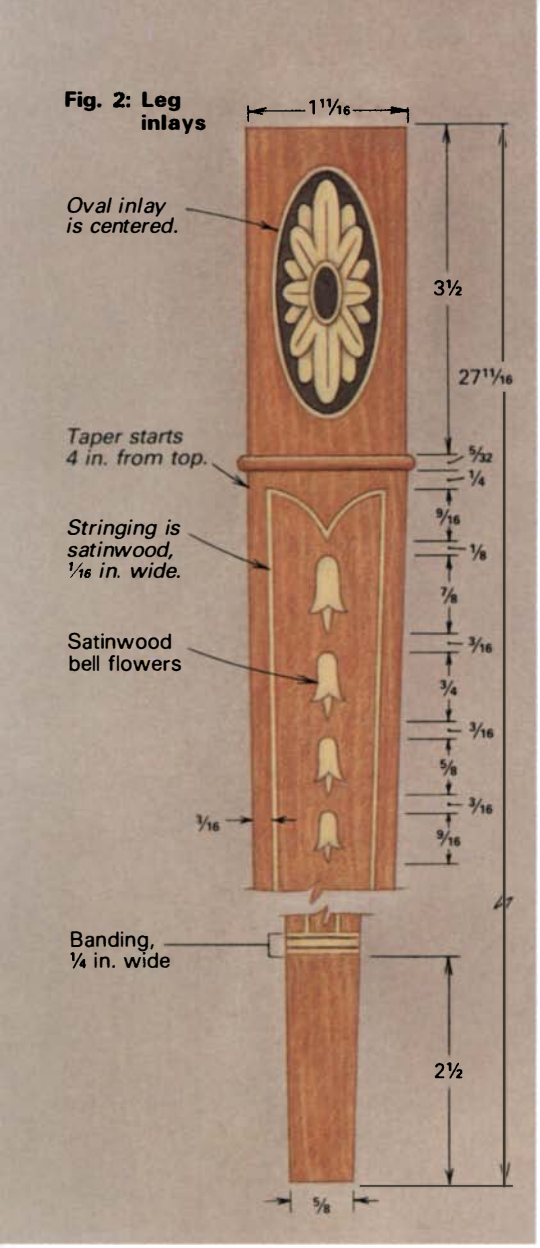
After cutting the banding and stringing grooves, I ripped out the thin satinwood strips. When I got around to fitting the curved stringing sections, I discovered that satinwood is too brittle to bend well, and so I had to soak the stringing in water for several minutes and then bend it over a hot pipe mounted on a soldering iron. The soaking and heating had to be repeated several times to achieve the desired bend, and even then I broke several pieces. I cut and fit all the stringing for one leg surface at a time, including miters at the corners, and then glued the pieces in right away so I wouldn't lose them. The stringing expands slightly when it absorbs glue; so you should press the pieces into the glue-filled grooves as quickly as possible. The expansion holds the pieces so tightly that there is no need to clamp the stringing. After all the stringing is applied, I glued the banding strips into their grooves at the base of the legs. Before inlaying the flowers, I sanded the stringing and banding flush using 100-grit paper on a sanding block.

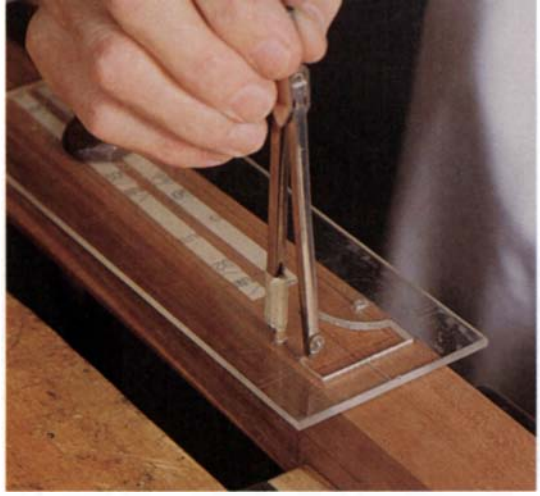
Flower inlays—My table required eight sets of satinwood bell flowers. Each set has four flowers that diminish in size from top to bottom, and so I needed 32 flowers in all. To streamline the process of cutting out the flowers, I glued up a stack of nine pieces of satinwood veneer with a piece of paper between each layer so the stack could be easily separated later. The ninth layer gave me an extra set of flowers just in case. Then I made a photocopy of the full-size inlay drawing and glued it to the top of the veneer stack. After cutting out the flowers with a scroll saw, I sanded and filed each stack to final shape and then inserted a sharp knife (you could also use a razor blade) on the paper glueline to pop the veneer layers apart (see the bottom photo on the facing page).

Inlaying the 32 separate flowers isn't difficult, but it is slow work. It's not something you can whip out in a couple of hours; so realize up front that you have to take your time. To begin, place one of the large flowers carefully on the centerline of the leg and trace around it with a sharp pencil; do one flower at a time. I use my Dremel tool with a router base to clear out most of the wood, and then I clean out the tight corners and final fit each flower with a knife and a small chisel. For both the routing and the final fitting, I use a lighted magnifying glass (the kind that clamps to a tabletop and that jewelers often use). I've found that if I'm satisfied with the way an inlay looks through the magnifying glass, it really looks great without magnification. Fit one flower at a time and then glue it in place with a clamp and waxed-paper-covered block. By the time you've inlaid one flower on each leg, the first leg will be dry enough to unclamp so you can inlay its next flower. The six oval inlays at the top of the legs are fitted the same way as the flowers.

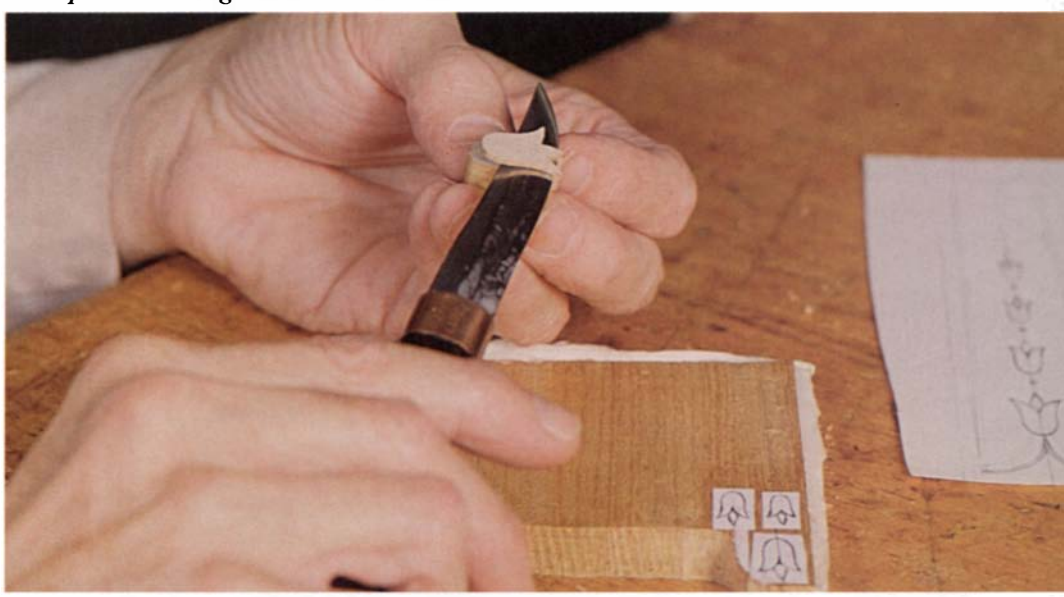
After all the inlaying is complete, finish-sand the legs through 220-grit. Make sure that all traces of dried glue have been sanded away. I thought I had done a thorough sanding job, but when I sprayed on the first coat of lacquer, several glue smears showed up and I had to resand all of these areas. You can locate dried glue before finishing by wetting the wood's surface with water: glue residue will show up as light-colored areas.

Veneered front and side aprons—The front and side apron blanks are made by stack laminating ¾-in.-thick yellow poplar to the following sizes: one 3½x4½x21½ front apron; and two 3½x3½x15 side aprons. Use the gridded drawings of the front and side aprons in the detail in figure 1 on the previous page to make full-size templates for laying out the curves on each blank. When you bandsaw the curves keep the cuts as clean as possible, because the waste part of each apron will be used to clamp the veneer to the apron. Sand or scrape out any slight irregularities in the apron





***Left:** Pittman uses a set of dividers with a dowel taped onto one leg to locate the plastic template for cutting the curved stringing grooves.* ***Right:** The arc is cut with a Dremel tool fitted with a screw that is inserted in one of the template's holes. The screw allows the bit to be pivoted through the ¾-in.-dia. arc.*



To make the flower inlays, the author glued up a stack of veneers with paper between each layer, cut the flowers from the stack and then separated the inlays with the tip of a knife.

curve, and then screw temporary blocks to each end of the waste portion of the apron blank to ensure perfect alignment when clamping the veneer. I recommend using backed veneer if you can find it because it is much easier to handle than single-ply crotch mahogany. I bought book-matched crotch mahogany veneer backed with poplar veneer from Cummings Veneer Co., Box 49, New Albany, Ind. 47150. Cut the veneer so it overhangs about ¼ in. on both edges of the blank. Then glue the veneer to the outer face of the apron, clamp the waste half of the blank over the veneer with C-clamps and let it dry overnight. The next day, unclamp the aprons and trim the overhanging veneer with a sharp knife.

As you can see in the detail in figure 1, the ends of each side apron must be trimmed to length at a 58° angle from the straight back side. Because of the difficulty of cutting tenons on these angled ends, the side aprons are doweled into the front legs. In addition, a notch must be cut at the back end of each side apron to square off an area to receive the dovetailed rear apron. Make the 58° parallel end cuts using the miter gauge on the tablesaw and with the blade tilted 32° from its usual 90° position. Then lower the blade and make the 58° cut on the inner face of the side apron to form the notch that will house the rear apron. Return the blade to its square position and complete the notch by standing the apron on its back end and supporting it with the miter gauge. After notching both side aprons, raise the blade and trim the front ends of both side aprons in a similar manner, with the aprons standing on their front ends, to form a flat area to join with the glue blocks, as shown.

The tenons that join the front apron to the legs must be cut in two steps because of the curve on the apron's face. Trim the apron to length first, allowing for the ¾-in.-long tenons. Then, on the tablesaw, cut the tenon shoulder and cheek on the apron's back side with its flat side down. The apron can't be flipped over and run facedown because of the curve and so the top shoulder and cheek must be cut from above with the radial-arm saw. I made the tenons 5/16 in. thick and centered them on the apron's squared-off ends.

When locating the mortises and the dowel holes in the front legs, keep in mind that the aprons are set back ⅛ in. from the corner of those legs. I bored the ½-in.-dia. dowel holes in the front ends of the side aprons on the drill press by clamping a wood hand screw to the back end of the apron to provide a "foot" to stand it up vertically on the drill-press table. Then I used another hand screw as a leg to support the upper portion of the angled apron. I inserted commercial dowel centers into the holes to locate the mating holes in the legs. To complete the front legs, locate and cut 5/32-in.-wide by 3/16-in.-deep dadoes on the outside surfaces of each leg to receive the bead that runs around the bottom of the aprons.

Rear aprons—The three-part rear apron consists of a long inner apron dovetailed to the side aprons, and two short aprons that are tenoned into the rear legs and joined at the middle with a knuckle

Photos except where noted: Jim Boesel

joint, or wooden hinge. The apron that's joined to the fixed rear leg is screwed and glued to the long dovetailed apron, while the other is tenoned to the gate leg and allowed to pivot to support the tabletop when the flap top is open.

To determine the length of the dovetailed apron, dry-assemble the front legs with the front and side aprons, and then while holding the joints together tightly, measure the exact distance between the notches in the back ends of the side aprons; don't forget to add the length of the dovetails. The detail in figure 1 on p. 61 shows the layout for the hand-cut dovetails I used on my table.

When making the two-part outer rear apron, don't cut the parts to exact length; leave each about 2 in. too long until after you've cut and fit the hinge. There's no reason to be intimidated by the idea of making a wooden hinge. Simply lay out the interlocking fingers directly on both hinge parts and mark the areas to be cut. Set the tablesaw blade at the same height as the thickness of the parts, and while holding the workpiece vertically and supported by the miter gauge (fitted with an auxiliary fence), make repeated cuts to remove the waste.

Before rounding over the corners to form the knuckles, put the two parts of the hinge together and use the drill press to bore the ¼-in.-dia. hole for the steel hinge pin, as shown in the photo below. Drill clear through the hinge assembly so you can easily remove the pin when trial-fitting. You'll trap the pin at final assembly by gluing a dowel plug in the bottom of the hole. After drilling the hole, take the hinge apart and use a disc or edge sander to round over the corners that form the hinge's barrel; replace the pin and make sure the gate-leg apron swings through 90°, even when the fixed apron is held tightly to the dovetailed rear apron.

When the hinge is complete, cut both parts of the hinged apron to length, allowing ¾ in. at each end for the leg tenons. Instead of centering the rear leg tenons as on the front apron, I made them flush with the back surface of the aprons to give the mortise a larger setback in the gate leg. Finally, locate and cut a mortise in each rear leg so that the hinged apron's inside face is flush with the face of the leg.

The hinge-pin hole is drilled through the two-part rear apron after an end-to-end finger joint is cut on the two parts, but before the vertical corners are rounded over to form the hinge barrel.

The front and side aprons can now be finish-sanded to 220-grit in preparation for assembly. However, before gluing up the table base, use the front and side aprons as patterns for bandsawing the 5/32-in.-thick cherry that is glued to the bottom of the aprons to form the bead. Make sure the front edges will protrude about ⅛ in. and round over these edges with a finger plane or small-radius router bit. Also, round over some of the scrap from the curved pieces to make the short sections of bead for the legs.

Gluing up the base and attaching the top—Because of the unusual construction of the base, I glued it up in several steps. First, I glued the two hinged aprons to the rear legs and the side aprons to the front legs. In order to clamp the side aprons, I had to screw blocks to the inside of the aprons temporarily, as shown in the detail in figure 1 on p. 61. After the side apron/front leg assemblies were dry, I glued the front apron and the dovetailed back apron in place. Then I cut, fit and screwed in the corner glue blocks. Next, I glued and screwed the fixed rear apron/leg assembly to the dovetailed apron and attached the gate-leg assembly by inserting the hinge pin into the knuckle joint (after plugging the bottom of the hole with a short dowel). Finally, I glued the apron beads in place, and fitted the small leg beads into the dadoes and glued them in place.

As you can see in figure 1, I used metal clips to secure my tabletop to the aprons. These tabletop fasteners, which hold the solid top to the aprons while still allowing it to expand or contract, are available from most woodworking mail-order companies and in some hardware stores. With the table standing on all four legs, it's easy to rout the slots with a 1/16-in.-wide, winged slot-cutting bit; of course, you need to buy the clips first so you know how far the slots should be from the upper edge of the aprons.

Construction of the two-part tabletop is very straightforward. The ¾ stock is planed to 13/16 in. thick and then glued up to make two pieces about 20 in. wide by 37 in. long. When these top blanks are dry, the glue squeeze-out is scraped from the joints and the mating (hinged) edge of each blank is cleaned up on the jointer. Then apply double-faced tape to the surface of one blank, and place the other blank on top, taking great care to perfectly align the mating edges. The top's shape is then drawn on the upper surface from a full-scale pattern and both pieces are bandsawn out at the same time. With the two tabletop halves still stuck together, sand the sawn edges to finished shape. Then you can separate the two halves and use a router with a ¼-in.-radius bit to round over the inside mating edge of both top pieces to provide clearance when the top is opened and closed.

I bought my card-table hinges from Wise Co., 6503 St. Claude Ave., Arabi, La. 70032 (catalog #H05A). I had to grind down a ½-in.-wide high-speed steel router bit to cut the 15/32-in.-wide mortises in the edges of the tabletops to receive the hinge leaves. I recommend that you use steel screws for fitting the hinges initially and then replace them with brass screws at final assembly. At this point, you can place the assembled top on the base, screw the tabletop fasteners to its underside and check that the top and gate leg both open and close as they should.

Finally, disassemble the tabletop from the base and the hinges from the tops and apply the finish. I used spray lacquer, rubbing between coats with 400-grit paper and smoothing the final coat with 0000 steel wool to produce a satin sheen. □

Frank Pittman teaches furniture design and construction, as well as wood technology and guitarmaking, at Western Kentucky University in Bowling Green. The Cabinet-Maker and Upholsterer's Guide, *by George Hepplewhite, is available from Dover Publications Inc., 31 E. 2nd St., Mineola, N.Y. 11501.*

Bleach's main role in the shop is for lightening the natural color of wood. Here the author sponges a two-part wood bleach, which has been mixed in a glass measuring cup, onto a walnut board.

Bleaching Wood

A versatile solution for lightening wood and more

by Michael Dresdner

Most of us are familiar with wood stains and dyes, the liquids we use when we want to darken wood or change its hue. But what happens when we need to remove color and make the wood lighter? Anyone who has set a piece of dark furniture near a window knows exposure to sun is one of the more effective ways of bleaching color out of wood. But while this method is cheap and easy, it tends to be hard to control. Instead, woodworkers often rely on a few liquid bleaching materials that take a bit more effort to use, but work nicely—even on cloudy days.

Why bleach a beautiful piece of wood when nature went to all the trouble of coloring it in the first place? In addition to lightening wood, there are numerous good reasons for bleaching. You may wish to prepare the wood for a special finishing treatment, such as bleaching mahogany to make it more cream colored (known as blond mahogany), or to lighten dark oak in preparation for a limed finish. Another reason for bleaching is to even out dark and light sections of wood, say a tabletop that has faded from sunlight on only one side or pieces that have drastic color variations. This technique can also impart a warm, sun-faded glow to darker new woods, like walnut and rosewood. Bleaching can do a nice job of removing a stain or dye color from a piece of woodwork before it is refinished, and it can also remove specific types of unwanted discolorations, such as water stains or iron stains on light woods (see the bottom photo on p. 67). Bleaching can even be used to bring back some of the original color of unfinished exterior woods, like faded, silver-gray teak boat decking or cedar and redwood patio furniture.

There are three bleaches readily available to woodworkers that can be used for a variety of wood-lightening tasks: Sodium hypochlorite, available as liquid laundry bleach or swimming pool chlorine; oxalic acid (sometimes called "deck brightener"); and A/B-type bleach, which is a two-part solution usually sold as wood bleach. Later in the article I'll tell you how to use a wood bleach, and the sidebar on the next page will help you choose the best bleach for your particular application. But first let's look at what happens when bleach is applied to a wood surface.

How bleach works—Understanding how and why bleaches work will help you decide when they should be used and predict what the likely results will be. Simply put, bleaches are highly reactive chemicals that break down the molecular structure of natural colorants in the wood or of artificial colorants, such as stains and dyes applied to the wood. This chemical reaction between the bleach and the colorant usually results in the wood's color becoming lighter. It's commonly thought that a liquid's pH is responsible for its effectiveness as a bleach. A pH is a measure of a liquid's acidity or alkalinity rated on a scale of 1 to 14, with a strong acid being 1 and a strong alkali (or base) being 14. Pure water is neutral, with a pH of 7. However, while most bleaches are either moderately strong acids or bases, their pH levels are *not* germane to their bleaching actions. Further, bleach does not actually "remove" a stain, but merely changes its color, frequently making it transparent. This means that the elements of the original stain are still present in the wood *even*

(continued on p. 67)

Photo this page: Sandor Nagyszalanczy

Choosing the right bleach

Each type of bleach reacts differently when applied to various natural or dyed woods. Although you can't always predict the exact effects (without a detailed chemical analysis), you can draw some general conclusions about which bleach to use for a particular application. This is because most colorants, both applied (stains, dyes) and naturally occurring pigments and extractives, fall into readily definable categories that, more often than not, will respond to a particular bleach.

The discussion of the three bleaches that follows, as well as the chart on the facing page, will help you choose the most effective bleach for your desired result. Nevertheless, a particular bleach may not always do what you expect; so try bleaching a scrap before working on a finished piece.

Oxalic acid: Although it is fairly ineffectual for color removal, oxalic acid performs two bleaching chores on wood that make it indispensable. Sold in liquid premixed form as "deck brightener," it will reverse the graying or silvering effect caused by oxidation of unsealed wood. Its other strength is as a reactant for a specific but rather common stain caused by iron and moisture coming into contact with woods containing tannin. This is most common in oak, because of its high tannin content and light color. The stain appears blue-black in color and is frequently seen on furniture with nails or iron hardware. Because the stain tends to spread, it can be an early warning that a hidden nail is lurking in a board. Scrubbing stained oak with steel wool will often leave tiny bits of the metal in the wood's pores, which will appear later as a pattern of fine black dots, especially if the humidity is fairly high.

Although premixed oxalic acid solution comes ready to use, it is more cost effective to buy as a dry powder in 1-lb. packages. Both liquid and dry solutions are generally available in hardware and paint stores. Although the mixing directions usually call for 1 lb. of powder to a gallon of water, oxalic acid is effective in any amount over 4% in a solution (5 oz. per gallon of water). Handle the powder carefully, as it is toxic and irritating to mucous membranes. Mixing into hot water will help the crystals dissolve faster, and the solution can be applied either hot or cold. Make certain that any embedded or attached ferrous metal has been removed from the wood before bleaching with oxalic acid.

Flood the surface of the wood with the solution and allow it to dry overnight. One application is usually enough to remove rust or iron stains. Brush or vacuum off any dry salt residue, and then wash the surface liberally with clean water and wipe it down to remove any additional residue.

Chlorine bleach: Like oxalic acid, chlorine bleach is available in both liquid and powder forms, though not from the same sources. Sold under trade names like Clorox and Purex, you'll find liquid laundry bleach in supermarkets and food stores. Chemically, these contain a 5% solution of sodium hypochlorite in water, which is on the weak side when it comes to stain removal; several applications may be needed for complete bleaching. You can mix your own stronger solution by buying dry swimming pool chlorine (usually calcium hypochlorite) and stirring it into hot water until you have a saturated solution (when you can no longer dissolve chlorine in the water).

Although chlorine bleach is very poor at lightening the color of wood, it's a fairly good bleach for removing stains or dyes that have been applied to wood, and it is especially effective on aniline dyes. One advantage of chlorine bleach is its selective stain removing capability. For example, it will take the applied dye out of an old mahogany piece without lightening the wood itself.

As with oxalic acid, coat the wood liberally with fresh chlorine bleach, applying as many coats as needed and allowing the wood to dry in between. This bleach is moderately alkaline, and it will cause natural fibers to disintegrate; so keep the liquid off your clothes, and apply it only with *synthetic* brushes, rags or sponges. Chlorine bleach generally does not require neutralizing, but a water wash down is still a good idea after application.

A/B wood bleach: Wood bleach, or A/B bleach, is a very strong oxidizing agent and will quickly and drastically lighten the color of many woods (see the top photo on the facing page), as well as a wide range of both pigment- and dye-type stains. The bleach, sold as a two-part system that must be mixed before use, is available in hardware and paint stores and through mail-order catalogs.

Typically, the "A" part of a wood bleach is sodium hydroxide, a moderately strong alkaline solution commonly known as lye. The "B" portion is an acid-hydrogen peroxide. (Be sure to check the label on the wood bleach you purchase; some manufacturers reverse the A and B designations.) Although each of these materials is an oxidizing agent by itself, a synergistic effect is created when they are mixed together, forming an oxidizing agent far stronger than either one alone. Both components will burn skin, and so you must use extreme caution when working with them. As one is an acid and the other a base, they also neutralize each other, making their action short-lived once they mix. This explains the need for packaging them separately. Generally speaking, optimum bleaching is achieved with a 25% solution of part A and a 35% solution of part B.

You apply a two-part bleach in two stages. Using separate synthetic sponges as applicators, first coat the wood liberally with part A. Wait a few minutes, and then follow with a wash of part B while the wood is still wet. It is important that part A is still wet and active when it contacts part B, or you will not get the full effect of the mix. Which part goes on first is not particularly critical; however, most containers suggest applying the lye first, as it is slower to evaporate and will give you more time to apply the peroxide. If the components are strong and viable, the mix will foam slightly on the wood's surface: a good indication that it is working. Allow it to dry completely before deciding whether a second application is necessary. Adding a wash of chlorine bleach while the first two applications are still wet will kick the solution slightly and make it work even faster.

Some manufacturers suggest mixing the two parts together before application. If this is done, the liquid must be applied to the wood quickly, before the chemical reaction wears out. As you continue to dip the applicator into the bowl, frothing may occur, but this is normal. To minimize this problem, two-part bleaches are frequently sold as weaker, slower-acting solutions.

The two-part bleach leaves a slightly alkaline surface, especially with multiple applications; so neutralize with a mild acid, such as vinegar and water. Otherwise, simply wash the surface liberally with clear water to remove any residue. *—M.D.*

after bleaching. Since the chemical process may be reversed inadvertently, you could encounter a situation where a stain that you've previously removed reappears or, worse, a new stain develops from a reaction between the bleach and chemicals in the wood.

Even though they're most commonly used for lightening wood, certain bleaches can have an entirely opposite effect when applied in different situations. For example, muriatic acid (which is diluted hydrochloric acid) will often decolorize aniline dyes. When used on ebony, though, it will darken white mineral spots. There are times when this chemical selectivity can work to your advantage. An A/B-type wood bleach will lighten the background color of Brazilian rosewood usually without affecting its dark figure lines; precisely the effect caused by long-term exposure to the sun (see sample #5 in the top photo at right). For years, furniture refinishers and repairers have taken advantage of this happy coincidence to make new rosewood look old.

Just as some people simply can't be bought (remember Elliot Ness in *The Untouchables*?), some things just can't be bleached. Any furniture refinisher who has struggled to get rid of a stubborn ink stain on a beautiful old roll-top desk will quickly confirm this. As another example, it is virtually impossible to bleach carbon black.

How to use bleach—Before you begin bleaching, keep in mind that all of the bleaches discussed in this article can be dangerous if handled improperly. Therefore, protect yourself with goggles, a respirator and neoprene gloves, and handle all materials cautiously. Do not mix bleaches with other chemicals or cleaning agents; for example, chlorine bleach forms a toxic gas when mixed with ammonia. Always work in a well-ventilated room, and keep all bleaches out of the reach of children.

Before application, make certain that the wood's surface is clean of any finish, wax residue or sealants of any kind. If possible, sand the surface to deglaze the wood and to rough up its pores. Bleaches can only be effective if they can get into the wood, and anything that prevents water from being absorbed will block the bleach. If there is any doubt, wet the wood with water and check if any areas shed the water. These areas will resist bleaching and may leave the surface splotchy and uneven.

Once you have selected the bleach (discussed in the sidebar), use only a glass, porcelain or plastic container to hold it and mix it (if necessary) according to the directions on the bottle. Metal containers may react with certain bleaches, and so you should avoid them. Also, use fresh bleach for each job; bleaches weaken with extended shelf time. Apply the bleach evenly and liberally to the wood, giving it plenty of time to work, sometimes overnight. Each subsequent application will bleach the wood more, and a second or even third application may be necessary to achieve the effect you desire. In any case, the bleaching action stops whenever the liquid has evaporated.

Although much is said about neutralizing bleach, *removing* the residues left after bleaching is more important than chemical neutralization. If left on the wood, residues, such as dry acid crystals or salts, can be removed by sanding and vacuuming the surface, but it is safer and easier to remove them by thoroughly rinsing the wood with clean water. This diluting process is effective because all common wood bleaches are water soluble. Wetting the piece with water to remove residue is also safer than trying to remove dry residue; dry oxalic acid crystals, for example, are a toxic irritant and can easily antagonize the mucous membranes of your nose and eyes.

After bleaching is complete, any of the three bleaches discussed here can be disposed of down the sink drain, followed by lots of clear water. Sponges, applicators and containers should likewise be well rinsed before disposal. If you decide to sand the dried bleached surface to flatten any raised grain, do so with care: The effects of the bleach aren't absorbed very deeply, and it is easy to sand through the bleached area into darker wood below. This can especially be a problem on carvings and sharp edges. One way to avoid this is to use abrasive pads instead of sandpaper.

Although wood bleaches must be handled carefully, they can open up many new options for the wood finisher, and especially for the refinisher, by doing what no other finishing materials can do: take away color. At times there is just no other alternative. □

Bleaches react differently to natural chemicals in wood, and even the same bleach has widely ranging effects on different wood species. An A/B wood bleach, applied to the top half of the above samples, had little effect on the oak and maple (#5 and #7), while it changed the cedar, walnut, cherry, rosewood and mahogany (#1, #2, #3, #4 and #6) more drastically. Although bleached rosewood is lighter, it retains its dark figure lines.

When bleaching iron stains from oak, oxalic acid virtually removes the blue-black stain from the sample (left), returning the wood to its natural color. A/B-type bleach (center sample) leaves the wood more silver, and chlorine bleach (right sample) leaves the wood gray.

Choosing a Bleach

Desired Result	Oxalic Acid	Chlorine Bleach	A/B Bleach
Lighten wood			*
Even out sun fade			*
Decolorize aniline dyes		*	*
Decolorize pigmented stains			*
Remove iron stains	*		
Remove water stains	*		
Rejuvenate aged exterior wood	*		

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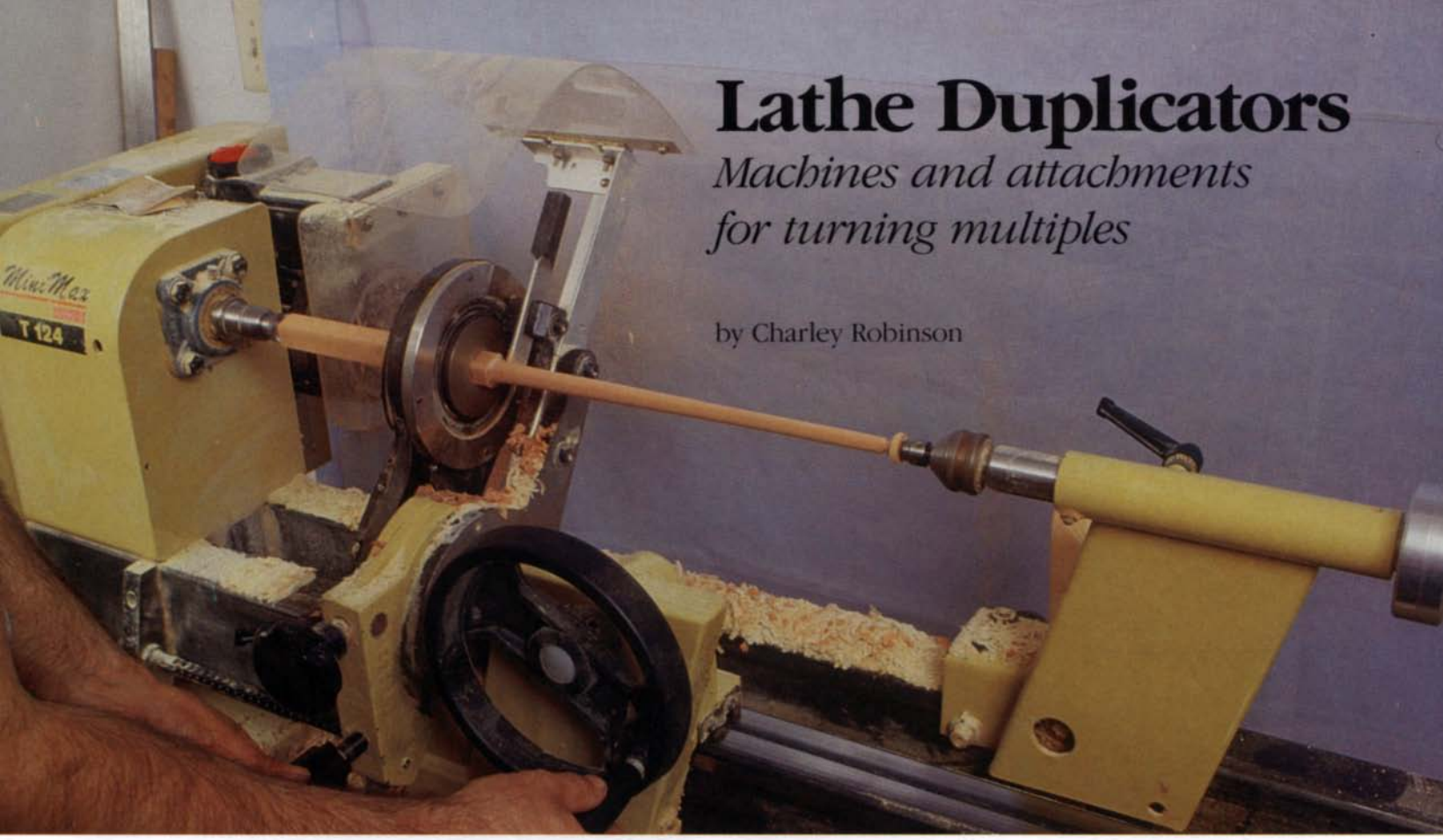
Photos this page: Susan Kahn



Lathe Duplicators

Machines and attachments for turning multiples

by Charley Robinson

Duplicating lathes can mass-produce spindles more quickly than hand-turning. A hand wheel and gear moves the carriage of this Minimax along the lathe bed via a stationary chain, while a stylus following a template (hidden behind the operator's hands) causes the V-shaped cutter, mounted on a cantilevered arm, to mirror the image in the spinning blank.

Working on the lathe is a lot of fun because it's quick and easy to turn out a bowl or spindle. But drudgery and complications set in when you have to produce duplicates, say four identical table legs or a series of turned balusters for a porch railing. Skilled production turners can hand-turn fairly uniform spindles with amazing rapidity by simply mounting a reference spindle behind the blank mounted on the lathe and then turning the required copies, judging the curves and dimensions by eye or gauging them with calipers. But I bet many less accomplished turners react as I did when faced with a big job: start thumbing through catalogs looking for a duplicator attachment to bolt to my lathe or for a copy lathe that includes the necessary hardware to simplify all that fussy repetitious work.

I was surprised to find more than 30 manufacturers selling duplicating lathes and/or attachments, with prices ranging from under $200 to more than $60,000. There were too many machines for me to try, and so I prepared the chart, shown on pp. 70-71, to compare the various models. I focused on those machines normally marketed to the home craftsman. These machines are generally less expensive than industrial-grade equipment, but shouldn't necessarily be considered cheap: some cost up to $3,600 and are adequate for even small production shops. In this article I'll discuss what I learned about how these machines operate and the things they can and can't do.

I was most concerned with duplicating spindles mounted between the lathe's headstock and tailstock, but some machines can also do faceplate work to copy bowls, as indicated in the chart. For ease of comparison, I divided them into two categories: manual models and semi-automatic devices, depending on whether the cutter is supported and controlled by a hand-guided unit, as shown in the bottom photo on the facing page, or in a carriage that runs along rails parallel to the lathe bed, as shown in the photo above. Basically each type produces copies the same way. A stylus, which is designed to bear against and follow the contours of a sample part or pattern, is connected to a cutter assembly in such a way that any movement by the stylus is mirrored exactly by the cutter, which runs against the spinning blank mounted on the lathe. Because the cutter ultimately determines the accuracy and the finish of the copy, I'll discuss it first.

The cutting edge – Duplicator lathes come with a variety of cutters (see the bottom photo on p. 73); some are designed to make a scraping cut, but I found I obtained smoother surfaces from those that made a shearing cut. Although some lathes had mild-steel cutters, which wouldn't hold an edge well and had to be sharpened frequently, most featured high-speed steel (HSS) cutters. HSS takes a keen edge that can yield clean, smooth cuts requiring a minimum of sanding. Carbide tools are rare because they are difficult to sharpen and because carbide doesn't take as sharp an edge. Different cutters will need to be sharpened differently; the reversible shear cutter shown in the bottom photo on p. 73 can be honed on a stone, but there is very little metal for grinding and so it will need replacing more frequently than other types. Most scraper-type cutters can be sharpened on a regular grinding wheel. In some instances, it will be necessary to reshape your wheel to match the shape of your cutter.

While there are a variety of cutters, almost all are V-shaped and sharpened to about a 30° included angle, as shown in the bottom photo on p. 73, which influences the cuts they can make. For the manual duplicators, the cutter shape is not a factor because you can control the angle at which the cutter is presented to the blank, enabling you to copy square shoulders and even some undercut details. The carriage of semi-automatic duplicators, however, travels parallel to the axis of the lathe and the cutter is restricted to moving

in and out perpendicular to the axis. Because of the linear track of the carriage and the shape of the cutter, any angle on the original that is greater than about 75° cannot be copied. This limitation leaves you with two options. You can design spindles without square shoulders and other fine detailing, or you can copy the spindle as best as the duplicator can and then touch up the details by hand.

Some of the duplicator attachments can be secured to and operated from the back of the lathe. In addition to throwing the chips down and out of the way, this leaves the front of the lathe free for using hand tools with the regular lathe tool rest for adding details before removing the turning from the lathe. A possible problem with this arrangement is that the lathe must be accessible from both sides, requiring a great deal more shop space. One turner's approach to detailing spindles was to design an auxiliary tool rest that clamps to his duplicator's carriage, as shown in the top photo on p. 73. After copying a spindle, he simply cranks the carriage into position and uses a skew or parting tool to square up shoulders and refine details. Another approach is to copy the full number of spindles that are required and then remove the duplicator mechanism, rechuck each spindle and add the details. This makes sense for a production shop where less-skilled workers could use a duplicator to turn out basic spindles, which could then be finished by a skilled turner.

There are other cutter factors that can affect the quality of cut. As the cutter extends farther from the carriage, vibration and, in turn, the amount of carriage movement increase, which can obliterate details and leave rough surfaces. Also, the stylus should be the same shape and/or size as the cutter. While you can use a larger cutter for roughing out stock, once you get into actual pattern work, differences between the cutter and stylus will be evident because the template shape will not be transferred to the stock accurately.

Making templates–All of the machines on the chart can make duplicates from either an original spindle, or a flat pattern or template. If you have just a few copies to make, you can clamp the original on the duplicator and crank out your copies. But every time you run the stylus over your original, you create a flat strip down the length of the spindle that gets wider with each pass, steadily deteriorating the details. Also, the original spindle may bend under the pressure of the stylus unless the spindle is supported in the middle, as well as at both ends.

If you are doing more than just a few reproductions, a template is recommended. Although some manufacturers recommend ¼-in.-thick plywood for templates, I found that after just a few copies, details were lost due to stylus pressure wearing down the high points. Tempered hardboard performed only slightly better. Aluminum and steel sheet stock, 3/16 in. or ¼ in. thick, will last almost indefinitely, but these materials are harder to obtain and work. Acrylic, like Plexiglas, or polycarbonate sheets, such as Lexan, make excellent, long-wearing templates, and these materials are readily obtainable and easily worked.

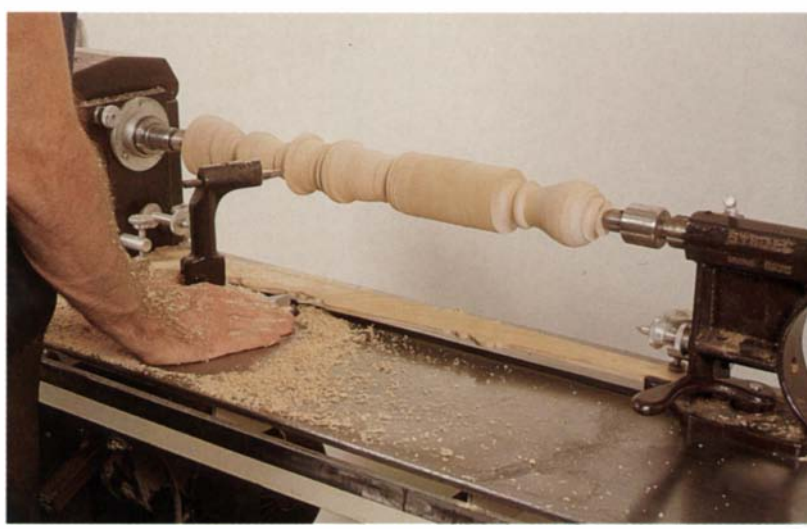
Take the time necessary to make your pattern accurate; any mistakes will be duplicated with each spindle. To make a template, you can bandsaw the original down the middle and simply trace the outline onto the template material. Or, if you can't afford to sacrifice the original, you can transfer the key transition points from the original to the template material and then, using calipers, lay out the diameters of the points (see the drawing on pp. 72-73). Complete the template, connecting the points with a variety of straightedges, French curves, a compass and freehand drawing. To get the most accurate templates, bandsaw to the waste side of the layout line, and then file and finish-sand precisely to this line. This also leaves a nice smooth edge that is easy for the stylus to follow.

You can include features in your patterns to overcome some of the duplicators' shortcomings. For example, if your duplicator doesn't have stops to keep the carriage from running off the end of the track, add ramps at each end of the template. Also, for duplicators that require you to bolt through the pattern to fasten it to the machine, make slots rather than holes, so you can fine-tune the pattern's position. When using long blanks, a slight notch in each end of the template will accurately mark the cut-off points for later bandsawing the spindle to length. And if you want to leave a square portion at the end of the spindle, as on many table legs, don't forget to measure the diagonal of the square that you want when laying out that part of the template, or else you'll wonder why that section you thought was going to be square is suddenly round.

How duplicators work–The manual models listed in the chart have the cutter and stylus mounted in a hand-held unit that is supported by the lathe's flat bed (see the bottom photo below) or by an auxiliary table bolted to the lathe. The operator guides the cutter into the blank by sliding the hand unit along the table and making progressively deeper cuts until the stylus fully contacts the

(continued on p. 72)

The spring-operated plunger mechanism of this semi-automatic duplicator pulls the stylus to the template and the cutter into the blank at the same time. Slots in the template for mounting screws allow adjustments; ramps at the end of the template act as carriage stops.



Manual duplicators have a hand-guided cutter-and-stylus holder that slides either on the lathe bed or a special table bolted to the lathe. The stylus is moved along the template, near the lathe bed, as the cutter shapes the blank to create duplicates. This freedom of cutter movement is a real advantage when copying undercuts and square shoulders on small-detailed work.

Woodturning Duplication Systems

Duplicator Attachments for Lathes

Company	Model	Duplicating Method	Carriage Drive	Carriage Stops	Universal Mount or Manufacturer Only	Number of Cutters	Cutter Action	Cutter Material	Cutter Feed
Delta (Taiwan)	46-408	Semi-automatic	Rack & gear	0	Manufacturer	1	Shear	High-speed steel	Spring plunger
Elektra-Beckum (Germany)	HDM-071	Manual	Patterned tool rest	NA	Manufacturer	1	Scrape	Carbide tip	Manual
Garrett Wade (Taiwan)	03BO1.02	Semi-automatic	Cable & pulley	2	Manufacturer	1	Scrape	High-speed steel	Manual
General (Canada)	2660	Semi-automatic	Rail guided, hand pushed	2	Manufacturer	1	Scrape	High-speed steel	Screw plunger
Hapfo (Germany)	KA-90	Semi-automatic	Chain & sprocket	0	Universal	1	Shear	High-speed steel	Spring plunger
Hegner (Germany)	LKH-1200	Semi-automatic	Chain & sprocket	2	Manufacturer	1	Shear	High-speed steel	Cantile-vered arm
	LQ-400	Semi-automatic	Threaded shaft	0	Manufacturer	1	Shear	High-speed steel	Spring plunger
Killinger (Germany)	KM-100	Semi-automatic	Threaded shaft	2	Manufacturer	1	Shear	High-speed steel	Hand-cranked threaded shaft
	KM-300	Semi-automatic	Rack & gear	2	Manufacturer	2	Shear	High-speed steel	Cantile-vered arm
Kity (France)	2660	Semi-automatic	Rack & gear	2	Universal	1	Shear	High-speed steel	Spring plunger
Konig (Germany)	K1368	Semi-automatic	Rubber friction wheels	2	Manufacturer	1	Shear	High-speed steel	Cantile-vered arm
Sears/Craftsman (United States)	9-24917	Manual	Tool post on platform	NA	Manufacturer	1	Scrape	High-speed steel	Manual
	9-24907	Manual	Tool post on platform	NA	Manufacturer	1	Scrape	High-speed steel	Manual
Shopsmith (United States)	555209	Manual	Tool post on platform	NA	Manufacturer	1	Scrape	Solid carbide	Manual
Toolmark (United States)	520B	Manual	Tool post on platform	NA	Universal	1	Scrape	High-speed steel	Manual
	3010	Semi-automatic	Rail guided, hand pushed	0	Universal	1	Scrape	High-speed steel	Screw plunger
Turn-O-Carve Tool (United States)	Offset System	Manual	Tool post on platform	NA	Universal	1	Scrape	High-speed steel	Manual
Vega Enterprises (United States)	D-36	Semi-automatic	Chain & sprocket	1	Universal	1	Shear	High-speed steel	Spring plunger
Wilke/Bridgewood (Taiwan)	BW-439	Semi-automatic	Cable & pulley	2	Manufacturer	1	Scrape	Carbide tip	Spring plunger

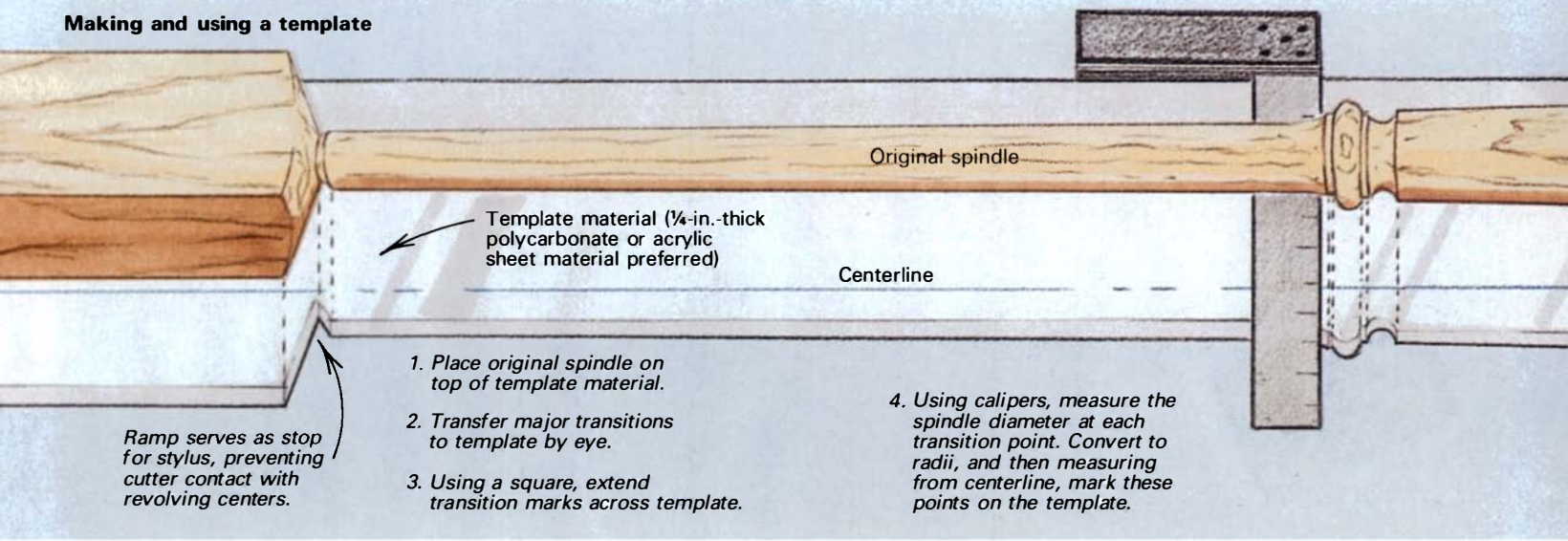
Copy Lathes

Enco (Taiwan)	199-9060	Semi-automatic	Rack & gear	0	NA	1	Scrape	Mild steel	Rack & gear
Grizzly † (Taiwan)	G1174	Semi-automatic	Rack & gear	0	NA	1	Scrape	Mild steel	Rack & gear
Minimax (Italy)	T-124	Semi-automatic	Stationary chain	1	NA	2	Shear	High-speed steel	Cantile-vered arm
Symtec (Australia)	1500	Manual	Tool post on flat lathe bed	NA	NA	1	Scrape	Special alloy	Manual

NA = Not Applicable
* = Dealer selling prices are typically 5% to 25% lower.

	Final Depth Stop	Duplicating Capacities			Net Weight (lbs.)	Comments	List Price*	Manufacturer (if U.S. office) or U.S. Distributor
		Spindle Dia. (max/in.)	Spindle Length (max/in.)	Faceplate Capability				
	Yes	6	36	No	57	Multiple depth stops and micro-adjustment knob on cutter feed; optional steady rest; fits lathes with channel beds	$595	Delta International Machinery Corp.—(800) 438-2486, (412) 963-2400
	NA	15	40	No	12	Optional templates	$160	Elektra-Beckum U.S.A. Corp.—(609) 784-8600
	Yes	10	40	Yes	83	Optional steady rest and longer tool rest	$395	Garrett Wade Co. Inc.—(800) 221-2942, (212) 807-1155
	Yes	12	36	No	48	Also available with 96-in.-long spindle capacity; optional hardware to fit other lathes	$660	Sisco Supply Inc.—(802) 863-9036 Wilke Machinery Co.—(717) 764-5000
	Yes	12	37½	Yes	75	Several high-volume production lathes also available	$2,043	E. & R. Supply Co. Inc.—(516) 435-0811
	Yes	7	54	No	120	Also available with 37⅜-in.-long spindle capacity; optional hardware to fit other lathes	$1,795	Advanced Machinery Imports Ltd.—(800) 648-4264, (302) 322-2226
	No	6¼	15¾	Yes	40	Adjustable for longer spindles; reversible cutters	$845	
	Yes	7⅞	39⅜	No	52	Optional hardware to fit other lathes; optional faceplate copying; high-volume production lathes also available	$2,250	Willow Pond Tools Inc.—(603) 485-2321
	Yes	7⅞	39⅜	Yes	176	Optional hardware to fit other lathes	$3,600	
	Yes	2¾	40	Yes	49	Reversible cutters; clear chip shield on carriage; optional steady rest	$892	Farris Machinery/Kity-U.S.A. Corp.— (800) 872-5489
	Yes	6	28	No	80	Optional steady rest, longer tool rest and spiraling attachment	$975	Garrett Wade Co. Inc.—(800) 221-2942, (212) 807-1155
	NA	6	33	Yes	25	Only fits Sears lathe model 9-22836	$90	Sears, Roebuck and Co.—(800) 366-3000, (312) 875-2500
	NA	6	36	Yes	40	Only fits Sears lathe model 9-22816	$150	
	NA	8	34	Yes	36½	Optional steady rest; diamond, round, square cutters available	$379	Shopsmith Inc.—(800) 762-7555, (513) 898-6070
	NA	4	Depends on lathe	Yes	19	Shield on hand grip; optional shear cutter	$210	Toolmark Co.—(612) 561-4210
	Yes	8½	27	No	50	Adjustable bushings; optional shear cutter; optional accessories for longer spindles	$498	
	NA	Depends on lathe	Depends on lathe	Yes	12	Optional steady rest; optional accessories required to copy from spindle	$178	Turn-O-Carve Tool Inc.—(813) 933-2730
	Yes	2½	36	No	103	Also available with 16-in.-, 48-in.-, 96-in.-long spindle capacity; optional steady rest and faceplate copying; adjustable bushings; can be rear mounted	$575	Vega Enterprises Inc.—(800) 222-8342, (217) 963-2232
	No	4¾	39⅜	Yes	96	Optional steady rest; clear chip shield on carriage	$499	Wilke Machinery Co.—(717) 764-5000
	No	7	31	Yes	183	Includes drive center and tool rest; does not include floor stand	$375	Enco Manufacturing Co.—(800) 621-4145, (312) 745-1500
	No	7	40	Yes	210	Includes outboard disc sander, pneumatic drum sander, flap sander, tool rest, five cutters	$375	Grizzly Imports Inc.—(800) 541-5537, (800) 523-4777
	Yes	7	43	No	375	Includes drive center, tool rest, micro-depth adjustment and traveling steady rest with steady rest precutter; optional fixed steady rest	$2,300	SCMI Corp.—(404) 448-1120
	NA	11	37	Yes	285	Built-in grind stone, tool rest and headstock indexer; optional fluting and beading accessories; custom-builds longer beds	$2,495	Symtec America—(902) 893-1915 (Canada)

† = Grizzly also sells three components to duplicate on its G1495 heavy-duty wood lathe.
# = All integrated copy lathes include bed, motor, duplicator and stand unless otherwise noted.



entire length of the pattern. I liked this type of duplicator for reproducing small, highly detailed spindles, but I found it somewhat tedious, and I had trouble getting a smooth surface when working on larger production runs of longer spindles, such as for a porch railing.

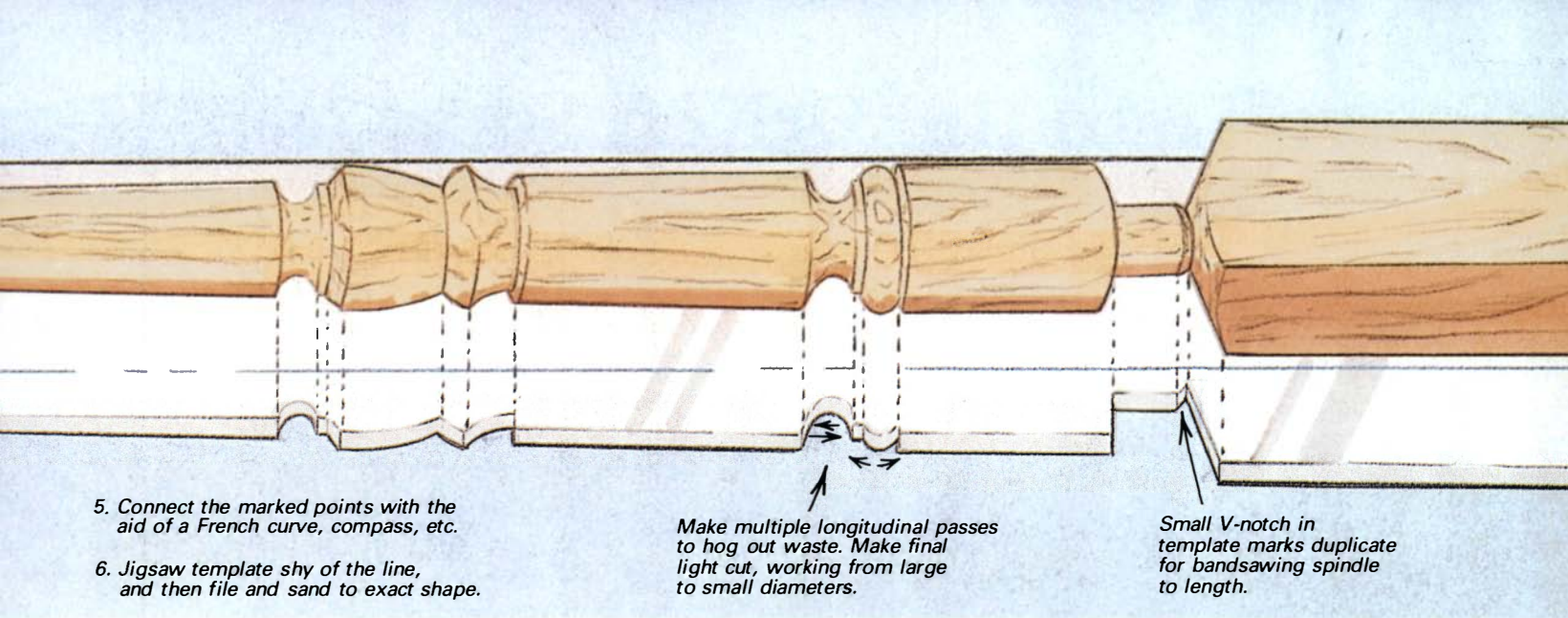
The semi-automatic duplicators have the cutter and stylus mounted in a carriage that is moved parallel to the duplicator bed, usually by some type of handwheel/drive mechanism, which I'll discuss later. The cutter and stylus are held against the work and the template by the mechanical force of a spring in a plunger or a cantilevered arm. The more common spring mechanism is a plunger that holds the cutter, as shown in the top photo on p. 69). Some plunger units have an internal spring, while others direct the spring tension through a lever. The plunger system is most often found on copier attachments, and in many cases the spring lacks sufficient force and so a little extra push on the mechanism is required. The cantilevered system consists of a pivoting arm with the cutter at one end and the stylus at the other (see the photo on p. 68). This arrangement provides greater cutting pressure without proportionally increasing stylus pressure, and makes it easier to move the carriage along its bed, which yields a smoother cut.

Some of the plunger and cantilevered systems are available with a special traveling steady rest that attaches to and moves along with the carriage, supporting the spindle right next to the cutter, as shown in the photo on p. 68, allowing heavier cuts and helping to control whip. Unlike a standard, non-moving, adjustable steady rest, these special steadies require separate ring inserts to accommodate various-diameter spindles, and the blank must be accurately dimensioned so that its diagonal is the same as the diameter of the ring insert opening. Some manufacturers suggest making your own wooden inserts, but the friction between the blank and the insert generates a great deal of heat and the inserts fall apart after 30 or 40 spindles. Most of the traveling steady rests can be fitted with a precutter, a lead cutting knife that makes a rough first cut in front of the steady rest as the regular knife makes the finishing cut just behind it. The combination of two knives and a steady rest makes it possible to easily turn out thin spindles, such as those for a Windsor chair, which are difficult to hand-turn because they whip and vibrate (see the photo on p. 68). And this system works best on simple designs because it must complete the entire turning in just a single pass.

Operating a semi-automatic model–Operating most of the semi-automatic duplicators is a two-hand operation. One hand controls the cutter, pulling it out as you approach high spots on the pattern or pushing it in to help the spring exert cutting force. The other hand moves the carriage up and down the length of the spindle. These lathes employ a variety of mechanisms to advance the carriage, including rack-and-pinion gears, stationary chains with movable sprockets, and stationary sprockets with moving chains or cables. Chain- and cable-drive systems will need periodic adjustments to maintain proper chain or cable tension, and you should avoid getting oil on cable-drive mechanisms, to prevent slippage. In operation, I didn't notice a particular difference between systems, although the cable drives tended to slip when the cutting depth approached ⅛ in. Some of the machines had an open chain mechanism and I was afraid these might clog or jam with chips during the cutting operation, but these fears turned out to be unfounded.

To get the smoothest cut, you must move the carriage down the length of the spindle at a slow, steady feed rate. It will take some practice to get the knack of it. Each machine has its own little idiosyncrasies; if possible, try out the duplicator you are considering or get references from the manufacturer so you can discuss performance with an experienced user. Smoothness of carriage operation is affected not only by the feed mechanism, but also by the fit of the carriage to the bed of the duplicator, which should move back and forth easily, with no play between carriage and bed. Any slop here is amplified at the point of the cutter and affects the quality of the reproduction. Carriages should have some means of adjustment, because even if the duplicator is set up perfectly at the factory, you will still need to adjust it to compensate for wear.

Manufacturers of duplicator lathes and attachments must feel that operating these tools is an intuitive process because the owner's manuals are generally very poor. In working with most of these duplicators, I found the first few attempts produced some pretty exotic firewood. Eventually I worked out a system of cutting my square blanks just slightly oversize and then roughing them out on the duplicators. You might prefer to rough the blanks out by hand first. For most of the duplicators, once the stock was roughed out, I found it easiest to watch the relationship of the stylus to the template instead of the more natural tendency to watch the cutter on the stock. Success of this approach depends on whether the template is visible while operating the machine. Working on one detail at a time, I hogged out the waste with multiple passes by running the carriage back and forth, stopping just shy of the template on each pass, as shown in the drawing. I then



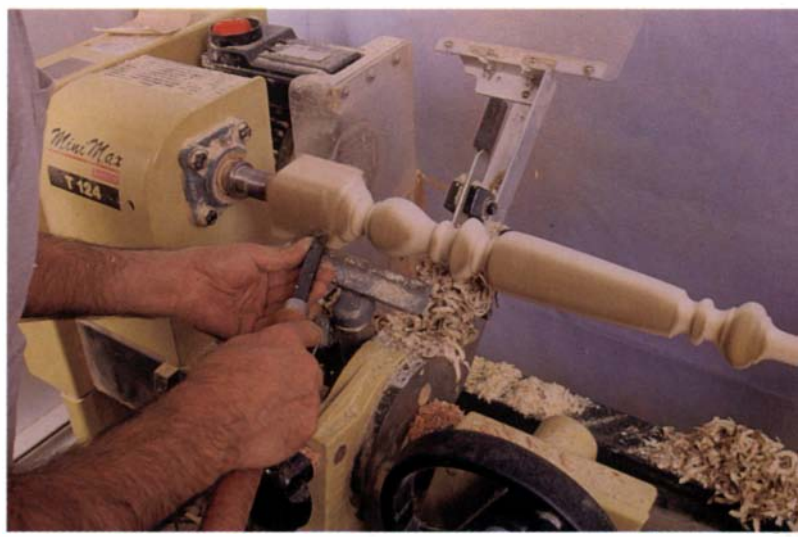
cleaned up each section with a slow, steady final pass, starting the cutter on the larger diameters of the pattern and working in both directions toward smaller diameters. A little additional hand pressure on the carriage ensures the stylus stays in contact with the template, producing a more accurate copy. I found that cutting from small to larger diameters produced more tearout and that if the stylus got hung up on the template, it could distort the carriage, which in turn gouged the stock.

Taking very deep cuts can cause vibration and result in a rough surface. If you are having a problem, try taking lighter cuts and increasing lathe speed, especially on finishing cuts. I also found that steadying the spindle with my free hand helped control whip. A light grip and a glove will keep your hand from getting too hot.

Duplicating devices don't automatically reproduce exact copies of the original. The relationship between the stylus and the cutter determines if the copy will be a one-to-one reproduction of the template. On some of these machines, adjusting the cutter for a deeper pass changes this relationship, and so you must use calipers to check your turning as it progresses, to know when to stop. The more convenient and easier-to-use duplicators offer a locking final-depth stop that ensures all copies will be the same size. Some also have a micro-adjustment knob that allows setting the stop lock slightly full and then making a very light cleanup pass. Another convenience feature is adjustable carriage stops at each end of the duplicator bed to prevent the cutter from contacting the revolving drive center or tail center, or to prevent the stylus from dropping off the end of the pattern. Hitting the centers will dull the sharpest cutter, but there is the potential for a great deal more damage: If the stylus drops off the end of the pattern, the cutter can dig into the stock, jamming the lathe and possibly damaging either the lathe or the duplicator.

Many of the turners I talked to while researching this article indicated there is a break-even point at which they would consider using a duplicator. This break-even point will vary depending on the operator's skill and the degree of accuracy required in the reproduction. One turner, Tom Fantaccione, of Tom's River, N.J., who does a lot of reproduction work for house restorations, felt it wasn't worth the effort to develop a pattern and set up the duplicator unless he was turning more than 10 spindles. When you've reached your break-even point, you'll find that one of the machines listed in the chart will get you rolling again. □

Charley Robinson is an assistant editor of FWW.



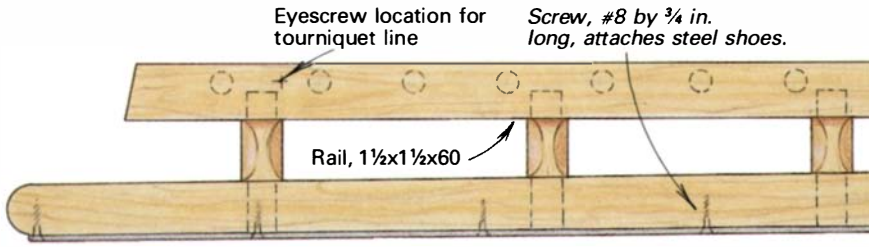
***Above:** This lathe was modified with a tool rest so the operator could easily crank the carriage into position to add hand-turned details, such as square shoulders and undercuts, which aren't possible with most semi-automatic duplicators.* ***Below:** Cutters come in a variety of shapes and materials; top row, left to right: mild-steel scraper, two HSS scrapers, carbide-tip scraper. Bottom row, left to right: tri-pointed HSS shear cutter, HSS reversible shear cutter, HSS shear cutter, and V-shaped HSS shear cutter.*

Photos: Charley Robinson; drawing: Aaron Azevedo

Faster Than the Driven Snow

Building a Cape racer sled

by Scott Dickerson



There is no thrill quite as intense as clattering down a snow-covered hill flat on my belly, inches above the crust, snow banks blurring past, riding a sled. The winters of my youth sped by under the runners of my Flexible Flyer, but now sledding has melted into my childhood memory. After a decade of finding my way toward maturity, at least vocationally, I found a new sled, a native to my chosen home on Cape Rosier on the Maine seacoast. The "Cape racer," shown below at right, is low, lean and swift. And it has an additional endearment—it is made primarily of wood.

During the peak of Cape racing, from the late 1800s to 1940, these sleds were built individually in the carpentry and boatbuilding workshops by craftsmen who had some free time during the long winters. While Cape racers are made in all different lengths, the sled shown in this article is 5 ft., a good size for young sledders, but large enough for most adults. (Regardless of age, every rider must be careful, and I wouldn't make a Cape racer for a child younger than eight years old, because it is very fast and requires some strength and finesse to steer.) Building a Cape racer isn't difficult, but the number of rungs and posts involved might make the project take longer than you'd expect. I'll tell you how to build one, complete with steel runner shoes, starting with the first decision you'll have to make: what wood to build your sled from.

Materials—Choice of wood is important because the sled design has been so refined that each component of the frame is essential and must be as strong as possible. I used hard maple for the side frame parts and white ash for the rungs. My neighbor and adviser on Cape racers, Lew Black, uses either all white ash or all red oak for the racers he makes. As important as choosing the species is selecting wood that has straight, even grain and has been air dried thoroughly. I wouldn't make a racer from kiln-dried stock because I have found it to be less resilient.

Building the side frames—To build the sled, I first made the two side frames, each of which consists of a top rail, six posts, a runner and its shoe. Start by milling the 60-in.-long top rails to 1½ in. square. Each rail receives six mortises for the posts that will join it to the runner. Mark out the ⅜-in. by ¾-in. mortises on the undersides of the rails (see the drawing), and chop them ¾ in. deep by hand or machine (you may wish to use a router and a jig similar to Tage Frid's in *FWW* #82). This is also the time to drill a row of 16, ½-in.-dia., ½-in.-deep holes, spaced as shown, in the inside surface of each rail for the rungs that will hold the sides of the sled together. Because the side frames are splayed in the finished sled, these holes must be drilled 12° off square. To do this, fit a wedge-shaped scrap on the drill-press table and angle the holes in each rail *toward* the top of the rail. Also drill a hole in each rail for the pull rope.

The rails now receive a taper on the surface opposite the rung holes. First, I snapped a chalkline atop each rail so it will taper from ¾ in. at the tip to full width at the aft end. Since the sled requires "left-hand" and "right-hand" rails, each rail should be a mirror image of the other. Then, bandsaw the waste and smooth the surface with a light pass on the jointer.

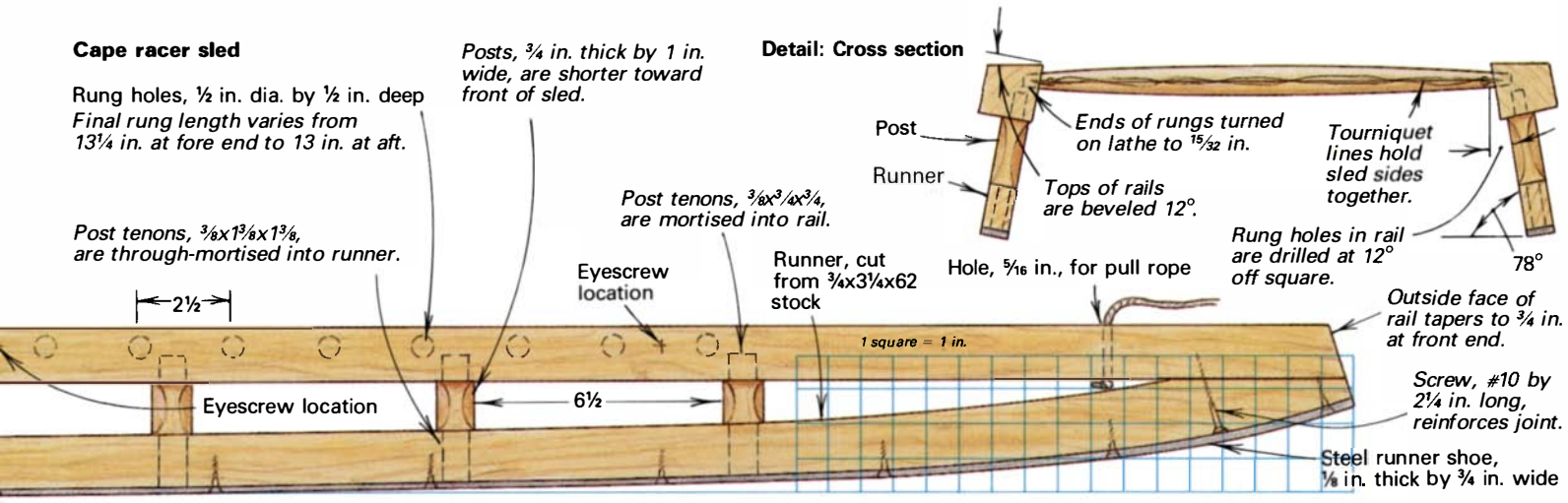
Next, the top of each rail (side opposite the mortises) is ripped to a 12° bevel on the tablesaw. This allows the top surface to lie in a flat plane when the assembled sled sides are splayed. As with the tapering, you must bevel the right-hand rail and left-hand rail in opposite directions, to produce a mirror-image pair. Now, with the

Photo: Scott Dickerson

Photo: Sandor Nagyszalanczy

Right: Based on a sled design native to the Maine seacoast, the mostly wood Cape racer is both sturdy and quick on the slopes. Here Dickerson attaches the pull rope on his maple and ash sled before taking it out for a trial run.

Left: After mortising the top rail for the posts and sawing out the runner, the author lays out one side of the sled to mark the position of the post mortises on the runner. Since the top rail and runner aren't exactly parallel, each post has a slightly different length and shoulder angle.



bandsaw table tilted to 12°, cut off and round the aft end of each rail. I completed the rails by rounding all edges (except where the rail will join the runner at the front) by sanding with 120-grit paper.

The runners—Because of the runners' gradual curve at the front, they are bandsawn instead of bent. First, scale the runner profile from the drawing and mark it out on a piece of ¾x3¼x62 stock. The next step depends on how you'll make the through mortises for the posts. If you chop them by hand, bandsaw the top and bottom lines of the runners (save the cutoffs) and clean up the surface with a spokeshave and plane. Be sure to keep the top edge of each runner square to the sides, so the shoulders of the post tenons will fit snugly. Now lay out the six posts in their correct position relative to the top rail and mark the top and bottom edges of the runners (see the left photo on the facing page). Center the ⅜-in. through mortises on the stock and chop them with a chisel and mallet, working from the top, and then flipping the piece and completing them from the bottom.

If you plan to make the mortises with a router and jig (as I did) or on a drill press equipped with a hollow-chisel mortiser, then bandsaw only the bottom of the runner and smooth it. After marking out the mortises, use the unsawn straight edge of the stock to square the runner in the jig or on the drill-press table, and chop the mortises from the bottom. After chopping all the mortises in both rails, bandsaw and smooth their top edges, and then round their aft ends.

Fitting the posts into the runners is a bit tedious because each post is a different length and meets the runner at a slightly different angle. Fortunately, they all meet the top rail at a right angle, and that's a good place to start. Cut the square-shouldered tenons with a handsaw or on the tablesaw, and then fit them into the top rail mortises. Align the top rail/runner joint at the front, leaving a 1¾-in. space between the rail and runner at the back post. Now, mark the shoulder angle and length of each tenon on each post by running a pencil or scribing knife along the top and bottom edges of the runner. Number each post and its respective mortise, so you can rejoin them later. Remove the posts from the top rail and cut the tenons. This job is done most easily by hand, since the shoulder angle and length of each tenon is a bit different. After repeating this procedure for the posts on the sled's other side, assemble each side frame and check the joints for a tight fit, including the joint between the runner and top rail. While the sled is assembled dry, drill the hole for the #10 by 2¼-in.-long wood screw that reinforces the top rail/runner joint. (Clamping will be easier if this screw is driven during glue-up.)

When gluing up the side frames, use waterproof glue, such as plastic resin glue (urea formaldehyde), which I prefer. You can also use an epoxy glue, like those for boatbuilding. Use the cutoffs you saved earlier from the runners and rails as clamping cauls, taping them back in their original positions. After the glue has cured, clean up the excess and shape a hollow in the edge of each post with a rasp. The hollows allow the posts to glide through the snow with less resistance. Next, miter the forward end of the frame at 20°, as shown, and round the leading edge. Finally, sand the frames and apply a finish.

To give each runner better glide and durability, steel shoes are screwed on. I made mine from strips of ⅛-in.-thick by ¾-in.-wide cold-rolled steel, which you can buy at hardware or steel-supply stores. To install the shoes, first cut the steel to length, and then drill and countersink a row of holes 6 in. apart for #8 by ¾-in.-long flat-head wood screws. Work each shoe around the curved front of the runner, bending it in place as it's screwed on. Then file the ends to match the ends of the wood runners.

The rungs and assembly—The rungs that tie the two side frames together are turned to shape on a lathe. If you don't have a lathe but do have lots of time, you can also whittle or spokeshave them; many old time Cape racers have shaved rungs. Starting with ¾x¾x14 blanks, turn rungs that are ¾ in. dia. in the middle, tapering to 15/32 in. dia. at the ends. The end diameter is crucial for the rungs to fit loosely in the rail holes; otherwise, the frame won't flex and you won't be able to steer the racer. After turning, sand each rung while it's still on the lathe.

In order for the Cape racer to run freely over the snow, the runners must be parallel. But because of the splay and lengthwise taper of the side frames, each rung is a different length. The forward rung is 13¼ in. long, while the aft rung is 13 in. To make all the in-between rungs the right length, cut the fore and aft rungs to length and place the other 14 rungs between them on the bench. To hold them steady, I sandwiched them between sheets of foam rubber and clamped a board over the bunch. Now align a ruler with the ends of the fore and aft rungs and mark across the other rungs with a pencil. Number each rung to keep their order, cut them to length, and then finish them the same way you did the frames.

After installing the three pairs of eyescrews on the frames, as shown in the drawing, you're ready to insert the rungs and wind on the tourniquet lines to hold the sled together. Using about 18 ft. of 100-lb.-test braided-nylon fishing line (obtained from a tackle shop) through each pair of eyescrews, I tightly wrapped eight passes, winding the last pass spirally to hold the strands together. Finally, tie on a 10-ft. length of ¼-in. nylon rope for the pull rope.

A Cape racer doesn't steer like a Flexible Flyer. To turn it, cross your arms and grasp the ends of the top rails with your hands. To turn left, shift your weight to the right runner and lift the left runner; the reverse to turn right. Remember, this is a fast sled; so be careful and practice on a less steep slope before taking on a big hill. □

Scott Dickerson designs seating. Full-size plans of the Cape racer are available for $8.50 from him at 117 Cape Rosier Road, Harborside, Maine 04642.

Drawing: Aaron Azevedo

Frame-and-panel construction is ideal for flush doors, which demand dimensional stability, and for lipped and overlay doors as well because of the frame-and-panel's strong aesthetic appeal. These doors are easily made on a spindle shaper or tablesaw.

Cabinet Door Frames

Machine methods for strong construction

by Joseph Beals

Frame-and-panel doors have always been popular because they are aesthetically pleasing and incorporate strong, reliable construction. Since the bulk of the door is a floating panel that can move freely with changing humidity levels, this type of door is dimensionally more stable than a solid door. Although the design is traditional, the frame-building techniques I'll describe are modern machine alternatives to handwork. If it seems a sacrilege to marry machine convenience with traditional design, consider that few of us fell our own trees, pit saw the logs, air dry the rough stock, and plane it all by hand. Even fewer of us have criticized our colonial predecessors for using tools and techniques unavailable to their grandfathers. Machine joinery is not a convenience of compromise, but a contemporary option made possible by the tools of our age, and it requires as much skill and attention to detail as any hand method. In the modern small shop, handworked joints are usually reserved for reproduction or restoration cabinetry. For short production runs, like a set of kitchen cabinet doors, or for jobs that don't allow time for traditional handwork, machine-made joints are an accurate, reliable alternative. With thought and care, there need be no structural or aesthetic sacrifice in the finished product.

The frame for the doors, like those shown above, can be made on the tablesaw or the spindle shaper. While many woodworkers find a table-mounted router satisfactory for occasional door making, I feel it is a poor second choice to a heavy-duty shaper with a large cast-iron table and a ¾-in. or larger spindle for production runs and heavier stock. The mass of the shaper dampens vibration and the large table provides the support necessary for

Photo this page: Susan Kahn

consistent high-quality work. Your tool choice will affect the look of the finished piece. The spindle shaper can mold the edge of the frame with a decorative quarter round or ogee to add visual detail around the perimeter of the panel. While this type of detailing is not possible on a tablesaw, you can install a separate molding after assembly, if you are not satisfied with the traditional square-edge frame.

Regardless of the machine you choose, the stock must be accurately dimensioned. I recommend making all doors in a project from the same planer run of finished material. I prefer 13/16-in.-thick door frames and cabinet fronts instead of the more common 3/4-in.-thick stock; the extra 1/16 in. adds a surprising visual and structural robustness. After selecting dry, straight-grained stock, the key to building a strong, flat door lies in the joints. A traditional door has long tenons on the rail ends, which seat in mortises chopped into the stiles. Mortises and tenons on small doors are commonly glued; heavy or large doors are usually wedged or pegged. In any case, the strength and flatness of the door derives from the substantial contact surface across the joints and from the accuracy of the joinery. Modern techniques, both on the tablesaw and shaper, often sacrifice this large contact surface for the expediency of shallow machine-cut mortises and matching stub tenons. I'll discuss techniques for reinforcing these quickly cut joints with dowels, as well as a technique for cutting more traditional longer tenons and deeper mortises on the tablesaw.

Machined mortises and stub tenons—Tablesawn door frames can be made quickly by ploughing a panel groove in the rails and stiles, and cutting a matching stub tenon on the rail ends. And using some special tablesaw techniques, which I'll discuss later, I made more than 300 flat- and raised-panel doors before I acquired a spindle shaper and several sets of door-frame cutters. At first glance, the shaper seems a liberating if expensive alternative to the rather mundane tablesaw method. The cutters are relatively simple to set up, and milling the stock is a pleasure. The apparent result is a finished door frame with very accurate joints that mimic the appearance of a traditional door. But the convenience is deceptive, and it has seduced many shaper converts into making structurally substandard doors. The joint that results from mating the coping cut on the rail ends with the pattern cut on the stiles is only a cosmetic reproduction of a mortise-and-tenon joint. The tongue on the rail ends is, in effect, a stub tenon barely 3/8 in. long. This tenon cannot be pegged or wedged, it offers very little gluing surface, and it is far too short to inhibit bending of the joint under clamping pressure. Except for the smallest, lightest doors, these stub-tenon joints alone, whether tablesawn or shaper cut, are inadequate. I dowel these joints, as shown in figures 1 and 2 below.

Although two dowels are normally used for simple butt joints, I have found that a single dowel in a mortise-and-stub-tenon joint is easier to assemble yet still lends tremendous strength. And the stub tenon prevents any racking or twisting. I like a 3/8-in.-dia. dowel, from 1 1/2 in. to 2 in. long, depending on the width of the frame stock.

You can buy dowels in a variety of lengths and diameters with flutes or spiral grooves for glue relief, or you can make your own by sawing standard dowel stock to length, leaving the pins a trifle short to prevent bottoming in the holes. Chamfer the ends with a file or on a sanding disc to ease the entry. Even though a twist drill leaves a conical-shaped cavity in the bottom of each dowel hole that can fill with excess glue, you should still groove pins to provide glue relief. A pocket of trapped glue will stop a dowel pin short, as surely as if it had bottomed, and increasing clamp pressure can rupture the hole. Bandsaw a 1/16-in.-deep kerf along the length of dowel while holding it in a pair of pliers, or manually run each pin along the edge of a sharp handsaw. A single kerf is sufficient, but make more if you want to be extra safe. Since stock dowel sizes are notoriously inaccurate, test the fit of each pin in a trial hole before drilling the frame parts. A smooth-sliding fit is ideal. If there is play in the fit, or more than a slight drag, change drills or get another dowel.

Drill the dowel holes after the rails and stiles are cut to size, but before any other machining so that you are working with flat, square surfaces. Remember, since the rail will enter the stile by the depth of the coping cut or tenon, you must drill the stile holes that much deeper. This is an easy point to overlook, because you're drilling the stock before shaping it. I once made frames for 22 doors without taking the coping cut into account. I had begun assembly on the first door and was drawing up the clamps when everything stopped dead far short of seating. It took me two hours to clean up the first door and redrill everything to correct one small oversight.

I drill holes in the rail ends on the lathe, using an accessory table mounted on the ways near the headstock, as shown in the

Fig. 1: Doweled stub-tenon joint

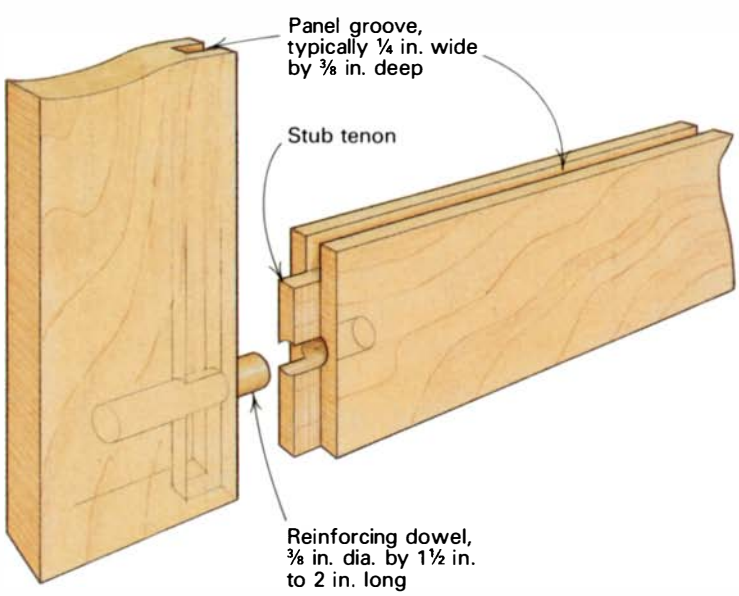
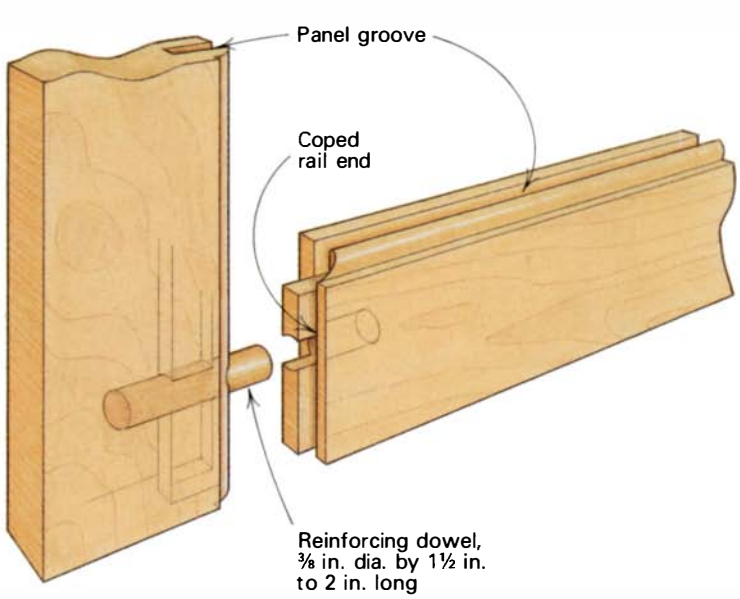
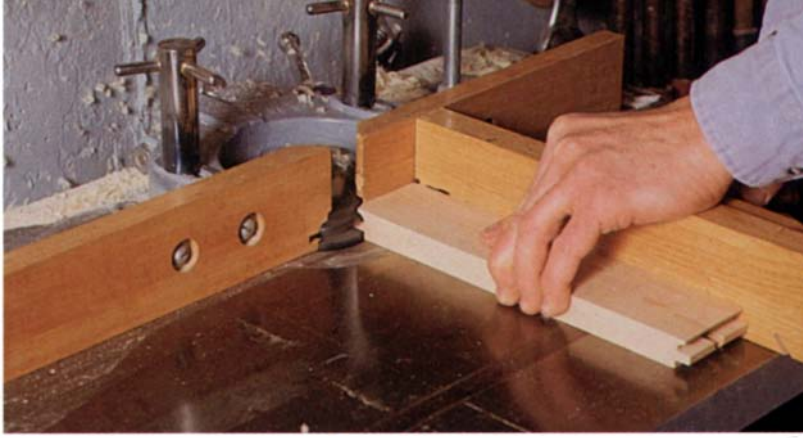


Fig. 2: Doweled shaper-cut joint



The author uses an auxiliary table on his lathe to end-drill the rails for reinforcing tenons. He drills these holes first, whether reinforcing tablesawn stub-tenon joints or shaper-cut joints.



A wooden auxiliary fence on the miter gauge increases control and makes coping the ends of rails and stiles safer. For reduced tearout, the auxiliary fence should be long enough to back up the cut.

left photo above. A piece of straight stock clamped to the table, parallel to the lathe bed, serves as a fence. Center the hole on both the width and thickness of the rail. For this and all other frame-cutting operations, I test my setups with scrap stock, and so I always prepare several extra pieces of stock for this purpose. In this case, I test the alignment by first drilling an extra rail, and then flipping it over to check that the drill re-enters the hole without the slightest resistance. A turn of masking tape around the drill bit or a pencil mark on the fence serves as my depth gauge, but a stop block could also be clamped to the fence.

Before boring the mating holes in the stiles on my drill press, I clamp a fence to the table to center the hole on the stile's thickness. A stop block clamped to the fence is set to place the hole exactly half the rail width from the stile end. Test the setup by drilling a scrap piece of stile stock and mating it with a dowel to a sample rail end. The faces should be flush and the outside edge of the rail should be flush with the end of the stile.

After all holes are drilled, plough the grooves on the tablesaw and cut the stub tenons, or finish up the frame on your shaper. Begin shaping by coping the rail ends first, as shown in the above photo at right, since some end-grain splintering is possible as the rail exits the cutter. A piece of scrap backing the rail or a wooden auxiliary fence on the shaper's miter gauge will minimize this tearout. The mirror-image pattern cut will remove any remaining damage on the inside of the joint, while damage on the outside edge is planed away when a flush door is sized to its opening or when a finished edge is worked on inset or overlay doors.

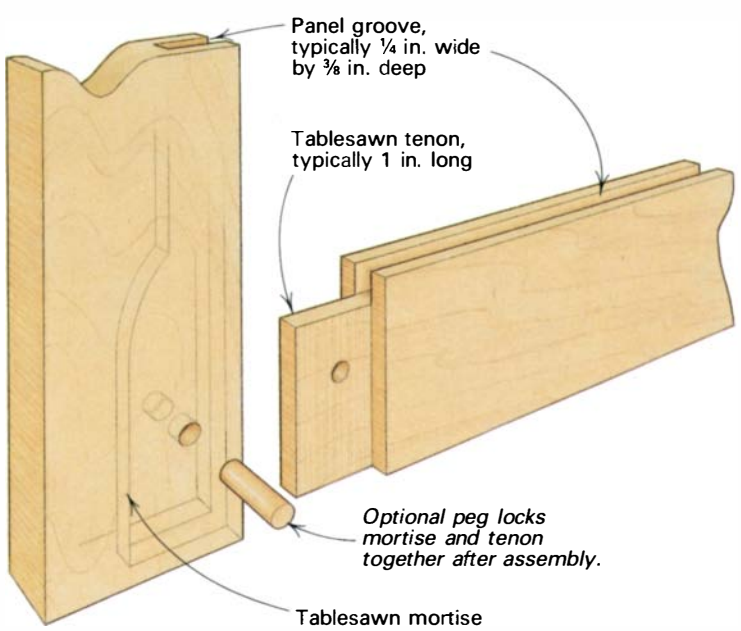
Tablesawn mortises and long tenons—As an alternative to doweling stub tenons, you can use the tablesaw to cut strong and accurate joints that have long tenons and deep mortises, as shown in figure 3 at right. The stiles are cut to the full height of the finished door and the rails are cut to the distance between inside edges of the stiles plus twice the tenon length. A 1-in. tenon is sufficient for most doors, but for heavy or large cabinet doors or for doors that may receive abuse, longer tenons are preferable.

Begin by ploughing the panel grooves, typically ¼ in. wide by ⅜ in. deep, in all the rails and stiles. Although you can cut the grooves with one pass over a dado blade, centering the cut in this manner is difficult and even a tiny displacement can result in alignment problems during glue-up. Ideally, you should plough the groove in two overlapping passes, flipping the stock end for end to run the opposite face against the fence for the second cut (this automatically centers the groove). Panel grooves can be sawn in two passes with a ⅛-in. kerf combination blade or in overlapping passes with a variable-pitch dado blade set for a 3/16-in.-wide cut. Making panel grooves a fraction less than ¼ in. wide when using a ⅛-in.-wide blade eliminates the wispy ribbon of uncut wood typically left between the ⅛-in. kerfs. Avoid the temptation to cut panel grooves by using the two outside blades of a stacking dado set without a chipper blade between them. It is not unusual for a splinter or a wedge of sawdust to jam between the blades, changing the width of the kerf. Because most blades do not produce a flat-bottom cut, measure cutting depths from the slightly raised part of the kerf.

The mortises can be sawn quickly and easily by making stopped cuts on the grooved edges of the stiles. To do this, leave the tablesaw fence in place after cutting the panel grooves and clamp a stop block to the fence, toward the back of the saw, behind the centerline of the arbor. The stops should be spaced the width of the tenon plus ⅛ in. for clearance. A vertical line on the fence, aligned with the arbor center, is a handy reference for setting the stop. Raise the blade until it is about 1/32 in. higher than the length of the tenon. If the mortise is too shallow, the tenons will bottom out before the shoulders seat, leaving a gap at the joint on the face of the frame. Too much clearance won't affect the strength of the joint, but it will leave a visible gap on the top and bottom edge of the frame.

With the fence, blade and stop set, hold a stile tight to the fence and advance it over the blade, as shown in the left photo on the facing page. When it hits the stop, withdraw it carefully. Flip the stile end for end and repeat the procedure. Make these cuts on all the stiles before adjusting the fence to cut the mortises to full

Fig. 3: Tablesawn long-tenon joint



Photos except where noted: Charley Robinson; drawings: Vince Babak

width. To set up for the second cut for each mortise, move the fence over until the blade teeth just score the other side of the panel groove. With the fence reset, cut the second half of all the mortises as you did the first.

I cut the mating tenons on the rail ends using the fence as a stop and a long wooden facing screwed to the miter gauge, as shown in the photo below, right. This is a safe procedure because the added support of the miter gauge facing keeps the stock square to the fence and there is no cutoff to jam between the fence and blade. For an added margin of safety, you could use a stop block clamped to the fence, just slightly ahead of the blade. A piece of sandpaper glued to the face of the miter gauge will help keep the rail from slipping when making the critical shoulder cuts.

Working from whatever side of the blade is most convenient, set the fence so the distance to the far side of the blade is exactly equal to the tenon length. Place a piece of scrap frame stock with the panel groove ploughed in it facedown on the saw table, and adjust the blade until it just hits the bottom of the groove; then lower the blade a hair. Make a sample cut, checking that the miter gauge is set at 90° and that the fence is set to the exact tenon length. If all is well, waste the remaining stock with multiple passes over the blade, as shown in the photo below, right, and then flip the piece over and do the same on the other side. Test the tenon in several mortises chosen at random. Aim for a snug, sliding fit, and shave the tenon with a sharp chisel if necessary. A too-tight fit will make assembly difficult and can crack the mortise; a loose fit can only be repaired by veneering the tenon cheeks, a tedious procedure at best.

If you are making a lot of doors, the tenon cheeks can be wasted much faster with a few passes over a dado blade after the shoulder cuts are made. To cut just a few doors, however, it's not worth the effort of resetting the machine. When wasting stock with a variable-pitch dado blade, consider the crowning cut it makes when setting the blade height. A dado blade can also be used to make the initial shoulder cut, but only if it is razor sharp.

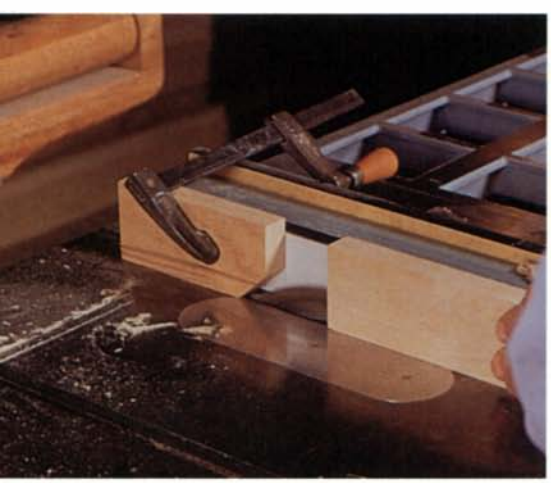
You can also saw tenon cheeks vertically by raising the blade to cut the full tenon length and standing the rail on end to make the cheek cuts using a commercial or shopmade tenoning jig. The jig and the blade must be accurately set to produce good joints. But because the shoulders must still be cut as described previously, I have found no advantage to vertical tenon cutting.

Assembling the doors—An orderly process is the key to a graceful assembly. If you are building a large number of doors of varying sizes, lay the mating rails and stiles together with their respective panels, and plan to work alone. In kitchen cabinetry, where there can be many door sizes differing by a matter of inches or less, it is absurdly easy to assemble the wrong pair of rails to a stile, and absurdly difficult to wrest them apart again. A casual visitor asking questions or giving advice almost always guarantees mistakes.

Lay out the frame for the first door, and sweep each dowel hole with a piece of stiff wire dunked once in the glue pot. A short section of coat hanger or the threaded end of a bicycle spoke works very well. Brush a little more glue on the rail ends and on the mating parts of the stile ends. Be conservative and work shy of the inside of the joint. Excessive squeeze-out can cause glue staining problems when finishing and can also glue up what is supposed to be a free-floating panel.

I like to start the dowels in one stile, tapping them home with a mallet. Set the rails on the pins and drive them home gently but quickly. The second set of dowels can be started either in the rails or in the second stile. Slide the panel in place, and then start the second stile onto the rails. Work it home equally from each end with a mallet or clamps, taking care that the panel enters the groove without hanging up. Make this final assembly in as fluid and as graceful a motion as possible. If the process is stalled for more than a few seconds, the dowels will grab with tremendous strength, making closure very difficult. Check for flat and square, and then draw the clamps up firmly, but not too tightly. If you are building mortise-and-tenon doors without dowels, check that the rails are flush with the stile ends. Clean up any squeeze-out with a sponge slightly dampened in very hot water, and as a precaution, move the panel within its frame to ensure that it hasn't been caught by glue inside the joint. Take a few swallows of the hot tea that goes so well with this job, and move on to the next door. □

Joe Beals is a designer, builder and custom woodworker who lives in Marshfield, Mass.



Above: After carefully aligning the fence and stop block, it is easy to accurately cut deep mortises on the tablesaw.

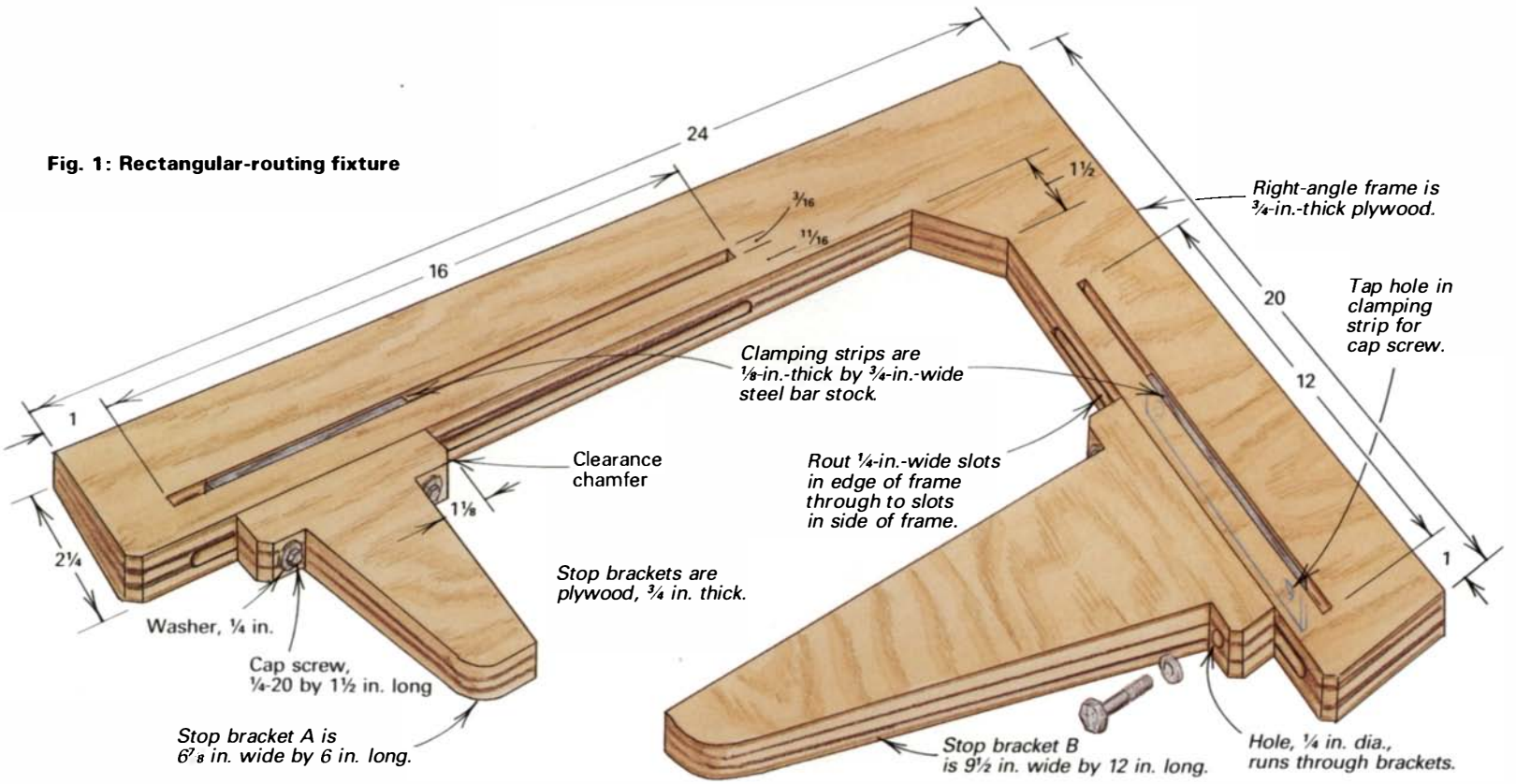
Right: Beals uses the miter gauge as a guide and the fence as a stop block to quickly cut the rail-end tenons. This same technique will work for either doweled stub tenons or longer tenons.

Routing Rectangular Recesses

Circular templates make setup easy

by Ralph J. Harker

Fig. 1: Rectangular-routing fixture



Routing a rectangular slot or a shallow recess is a common operation in furniture and cabinet work. Cutouts such as these are used for insetting mechanical components, like clockworks or locks, as well as for stopped dadoes or mortises to receive shelves or tenons. I've always found it difficult, time-consuming and inaccurate to rig up temporary router guides for this type of repetitive operation, and so I designed the plywood fixture shown above, which can be set up quickly to rout a series of identical mortises.

The fixture's right-angle frame carries two adjustable stop brackets that are perpendicular to each other and that can be locked to the frame to create a rectangular opening. Then the fixture is clamped to a workpiece and a router is moved around inside the rectangle. Since the router base is held captive within the frame and stop brackets, a rectangular cut is generated. A plunge router is ideal for use with this fixture, but a standard router can also be used.

To make it quick and easy to set the stop brackets for a particular mortise size, and to position the fixture on the work, I made two circular templates from ¼-in.-thick plywood, bandsawn round and then trued up and sized on the lathe (see figure 2 at left on the facing page). The large template is used for setting the stop brackets and the small template is for positioning the fixture on the work. Template sizes are determined by the diameter of the router base and the bit you use. To calculate template size, measure the diameter of the router base and divide it in half to get its radius, which is the distance from the center of the bit to the edge of the base. From this radius, subtract half the diameter of the bit you will be using, and this gives you the diameter of the small template. The large template will be twice the diameter of the small one. I designed my fixture and templates for use with a router that has a standard 6-in.-dia. base fitted with a ¼-in.-dia. bit, and so the dimensions in the drawings are based on these criteria. The fixture shown will allow you to rout recesses ranging from a ¼-in.-dia. hole up to a rectangle measuring 2¾ in. by 9½ in. Of course, the fixture's dimensions could be increased if larger mortises are required.

Construction—The frame and the two stop brackets are sawn from ¾-in.-thick plywood, following the dimensions in figure 1. The frame's two inside faces and the stop brackets' bases and working faces must be square. The brackets are held to the frame

Photo: Sandor Nagyszalanczy; drawings: Aaron Azevedo

Fig. 2: Sizing template

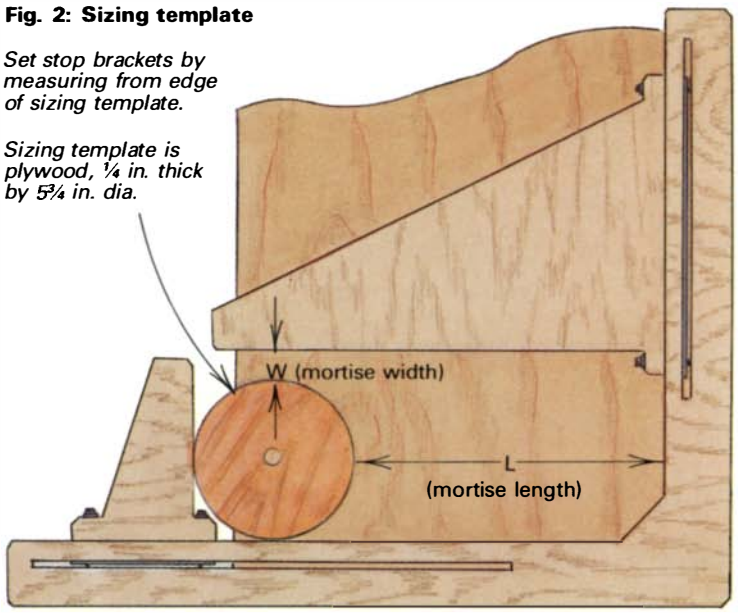
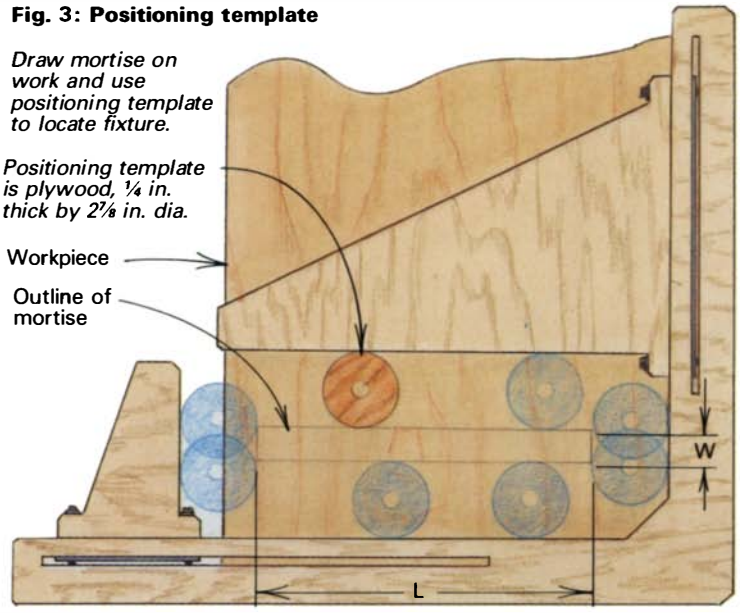


Fig. 3: Positioning template



with cap screws, which extend through slots in the edge of the frame and thread into holes tapped in the ⅛-in.-thick by ¾-in.-wide steel clamping strips. The 3/16-in.-wide slots that house the clamping strips are cut on a table-mounted router. Then the frame is clamped in a bench vise and ¼-in.-wide slots are routed in the inside edges of the frame. These edge slots extend all the way through to the clamping strip slots and provide the track for adjusting the stop brackets. You'll need to chamfer the inside corner of each bracket, as shown, to provide clearance for the router base. Then, drill two ¼-in.-dia. holes in each bracket for the 1½-in.-long, ¼-20 cap screws that lock the brackets to the frame.

Each clamping strip is the same length as the base of the bracket it goes with: 6⅞ in. for the small bracket and 9½ in. for the large one. Drill two 13/64-in.-dia. holes in each strip that align with the holes in the brackets, and then tap the holes in the metal to receive a cap screw. Finally, mount the brackets on the frame and make sure they slide freely along their entire stroke.

Setting and positioning the fixture—Remember, my fixture is designed for a 6-in.-dia. router base and a ¼-in.-dia. bit. For these two dimensions, the horizontal and vertical stop brackets must define a rectangle that is 5¾ in. larger in both directions than the actual size of the desired mortise (see figure 2 above, left). So place the 5¾-in.-dia. sizing template in the corner of the frame, and adjust each bracket to leave the actual size of the mortise between the bracket and the template's edge. Once the stop brackets are positioned and tightened, exact mortise size can be verified by clamping the fixture to a piece of scrap and routing a trial mortise.

To position the fixture, I draw the desired mortise on the workpiece and locate the fixture using the 2⅞-in.-dia. positioning template. When the template is rolled around inside the fixture's rectangular opening, its outer edge should follow the mortise outline exactly (see figure 3 above, right). When the fixture is precisely located, clamp it and the work securely to the benchtop. Spacer blocks are usually needed to support the fixture where it overhangs the workpiece (see the photo at right).

Routing the mortise—All you have to do now is plug in your router, place it within the fixture and move it clockwise inside the rectangle. For deep mortises, make shallow cuts and lower the bit in increments until you reach full depth. For wide mortises, rout the outside perimeter first and then remove the waste from the center of the mortise. The router is captive in all directions and so the exact mortise size is reproducible on any number of workpieces.

Comments—Although the corners of the mortises have ⅛-in. radii, they can be squared up with a chisel, or if the mortise will receive a tenon, you can just round over the tenon's edges. When cutting multiple parts, you can simplify positioning the fixture on the workpieces by tacking slats on the back of the fixture's frame that will act as stops to give you a repeatable edge distance. In addition to mortising, the fixture can also be used for decorative veining in rectangular patterns. Or if you want to cut angles or curves, you can attach wedges or curved templates to the fixture's internal surfaces. □

Ralph J. Harker retired in 1985 after nearly 40 years as professor of mechanical engineering at the University of Wisconsin, Madison. Because Mr. Harker passed away before completing this article, his friend, Frank Fronczak of Madison, helped with its final preparation.

The fixture shown above is for routing a series of rectangular mortises. Two adjustable stop brackets are set to allow the router base just enough movement within the rectangle to hog out the desired mortise. The larger of the two circular templates (bottom, left) makes it possible to quickly set the stop brackets; the smaller template is for positioning the fixture on the work.

These two oiled walnut chests are identical, except the one on the left has a straight front with convex drawer fronts and the one on the right has a concave front with concave drawer fronts. From a distance, these differences are subtle, but as you look closer, the details are distinct.

Variations on a Four-Drawer Chest

Divergent details make all the difference

by Tage Frid

Too often, furniture is overly decorated with contrasting colors or shapes that fight each other and shout at you from across the room. I prefer furniture that is more subtle and beckons to you with clean, quiet lines and well-thought-out details. Don't underestimate the power of details. To demonstrate how these little touches can change and enhance a piece, I made two identical chests of drawers, but gave each a distinct personality by experimenting with different drawer fronts. Both carcases have concave sides; a sweeping, curved bevel on the fronts of their flat tops and bottoms; dovetailed drawers; and curved pediments. But one chest has a concave front and concave drawer fronts, and the other is straight with convex drawer fronts. From across the room, their differences look slight; up close, the chests appear to be two different designs.

After building the two carcases, using simple tablesaw and router setups, I mocked up ¾x3x12 miniature fronts first to see what kind of effects I could get and then weeded out the designs I didn't like. For instance, to simulate a veneered convex front, I colored the surface with white chalk. From this I could see that any color would make the chest look like a parakeet, and I wouldn't want a creature like that squawking at me when I wake up in the morning. If a mock-up looked good, I made it full size so I could visualize it on a completed carcase. Eventually, I decided on the shaped fronts shown on the chests above. Here I'll concentrate on making the chest with convex drawer fronts, but I'll also give you enough information to make the chest with a concave front, if you prefer that design.

Making the carcase—Gather stock with similar figure and color, and cut all the parts following the dimensions in the bill of materials on p. 85. Joint the edges of the 1½-in.-thick pieces for the carcase sides, top and bottom, and after matching them for figure, glue and clamp them. Since my planer is too narrow for 17-in.-wide panels, I carefully aligned the long butt joints during glue-up so that I only had to lightly belt-sand the surfaces when the glue dried.

Next, rip the carcase sides, top and bottom to width and miter them to length according to the dimensions in the bill of materials. Because of the width of the workpieces, the best way to cut the miter is to set the blade at precisely 45° and guide the work on a sliding table or crosscutting jig. To test the angle, cut across a piece of scrap, put the cut ends together at a right angle and check the assembly with a square. Adjust the blade until the fit is accurate.

Routing the spline mortises—After the sides are mitered, the next step is to cut the spline mortises, as shown in the drawing on p. 84. Square thickness-planed splines, acting like loose tenons, are inserted in mortises that are hidden in the miter. The mortises are easily made with a router and template. I used multiple splined joints rather than similar full-blind dovetails because the splines have more glue surface and are stronger.

I set up my router with a ⅜-in.-dia. straight bit and a ¾-in.-dia. template collar and guided it in slots in one end of a ½x17x24 plywood template. The slots in the template are as wide as the collar and twice as long as the mortise (2 in.), so the collar will be

secure in each slot before the bit begins cutting. I cut the slots on the tablesaw with a dado blade, standing the template on end and guiding it across the blade with the miter gauge. Make a test cut in a piece of scrap and adjust the dado blade until the router's template collar fits snugly in the kerf. Although the slots don't have to be spaced precisely, they should be about 2¼ in. apart and the outer slots should be about ⅝ in. from the edges. You must be careful to cut each piece the same way so the adjoining carcase pieces fit together properly. Mark the front of the template to correspond to the front of each workpiece. Then, with the workpiece flat on the bench and its inner face up, align the template to cut the mortises 1/16 in. from the inside corner of the miter so the mortises are fully hidden inside the joint. On my router-jig setup, the bit is 3/16 in. from the edge of the slot when the collar is against it. Therefore, I marked a line on the inner face of each workpiece ⅛ in. from the miter corner and aligned the back of the slots on this line.

Clamp the template to the workpiece and cut the mortises on one end, as shown in the top photo below. When you've finished, flip the template end for end, realign and clamp it in place, and rout the other end. Do this for each carcase piece. I chisel the mortises square (and use square-edge splines) to increase the gluing area.

While the carcase sides are still flat, rout the ¼-in.-wide by 9/32-in.-deep dadoes in their inner face for the drawer runner tongues and the stretcher tenons. Guide the router base against a straightedge clamped to the workpiece. Each drawer front is 5¼ in. wide, so there is 5¾ in. between each dado, with the top and bottom dadoes 5½ in. from the miters' inside corners. In order to make the stretcher tenons invisible, stop the dadoes ¼ in. from each side's front edge and chisel their ends square. Be sure to cut the ¼-in.-wide shoulder on the outer edge of the stretcher's ¼x¼x2¼ tenons. Lastly, before shaping the carcase's outside surfaces, rip a ¼-in.-deep by ½-in.-wide rabbet in the back edge of the sides, top and bottom for the plywood back. Now you can begin working on the carcase top and sides.

Shaping the carcase top and sides—The front of the convex carcase is straight, even though its drawer front surfaces are shaped. The front edges of the carcase top and bottom have a curved bevel, as shown in the drawing. Mark the bevel's outline with thin plywood patterns. As you can see in the drawing, the curve is ⅝ in. deep over 40 in. on their front edges and 2 in. deep over 40 in. on the surfaces of the top and bottom. Spokeshave to the lines, and flatten the beveled surface with a cabinet scraper. Then finish with a sharp scraper blade before sanding. Use your fingers to feel when the surface is smooth, the curves are fair and the corners are crisp.

The drawer fronts of the concave carcase are curved ⅝ in. deep over 40 in., and so are the front edges of the carcase (see the drawing). Otherwise, the two carcases are identical. Bandsaw the curve in the front edge of the stretchers and the carcase top and bottom, and shape each piece identically with a router and template. Then lay out the bevels on the top and bottom with thin patterns (a curve ⅝ in. deep over 40 in. on the front edges and a curve 2⅝ in. deep over 40 in. on the surfaces of the top and bottom).

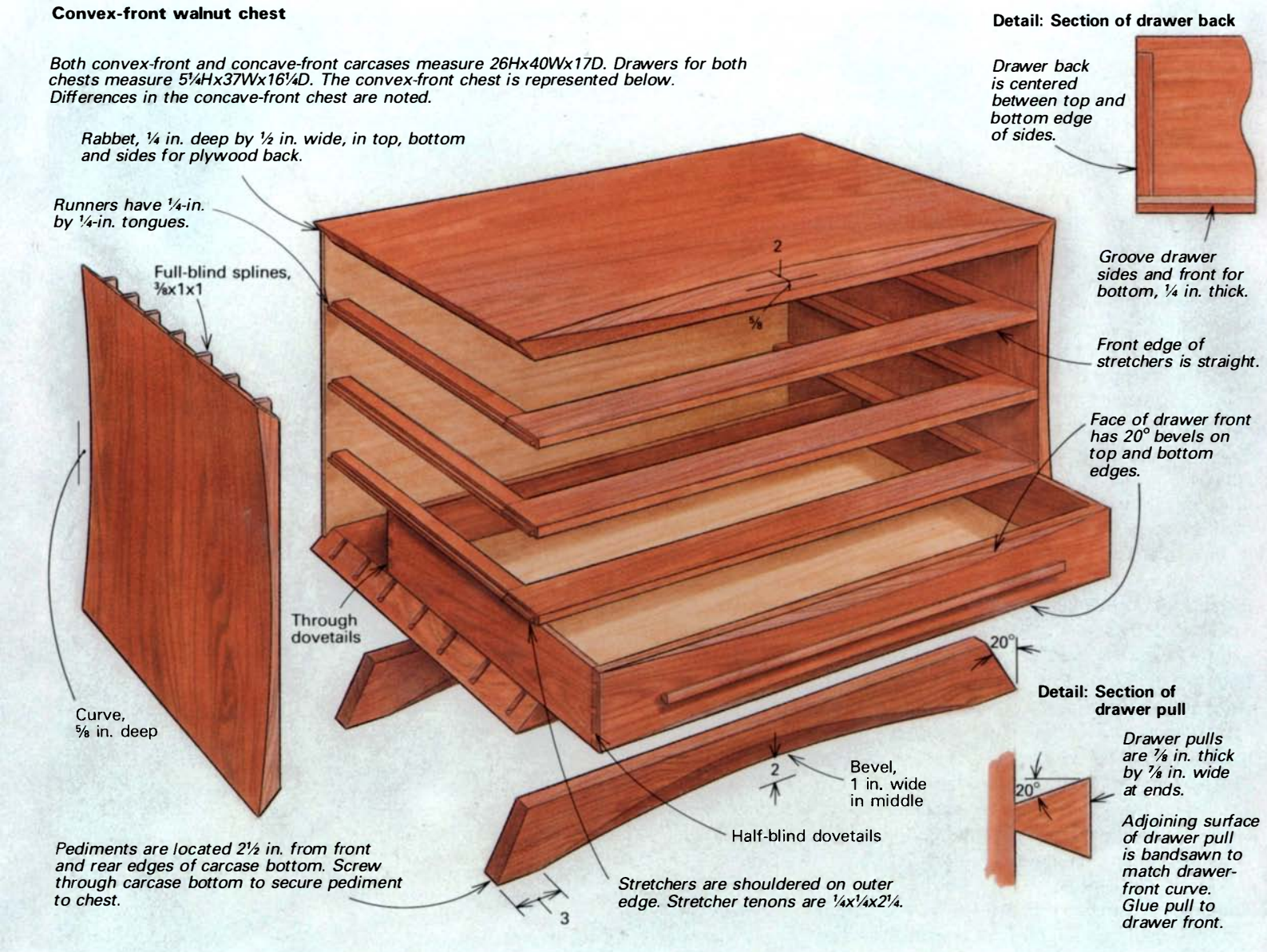
I scooped out the concave sides of the chests with my plunge router and the jig shown in the bottom photo at right, guiding the router in an arc over the workpiece surface. The workpiece is centered and wedged tightly between the jig's two tracks, which I screwed to a plywood base. A carriage containing my router's square base between two L-shaped rails slides over the tracks, the tops of which are curved the same as the carcase sides: ⅝ in. deep over 26 in. The router slides in the rails side to side across the workpiece, but I fastened stops on the rail ends to limit router travel and prevent the bit from cutting deeply into the tracks. I also fastened stops on the track ends, to limit the distance the carriage travels and prevent it from sliding off.

To use the jig, first align a centerline on the carcase side with a centerline on one track. Then secure the side in the jig by driving two opposing 24-in.-long wedges between one edge and a track and by clamping 45° beveled cleats to the base at each end of the workpiece (leave the cleats in place to align the other workpieces). Next, slide the carriage to position the router's ½-in.-dia. straight bit over the workpiece (about ½ in. from one end), extend it until it just touches the workpiece and set the router's maximum-cutting depth stop. Raise the bit and begin routing with the grain on one side, starting near the middle of the workpiece. Depending on your router's horsepower, cut only about ⅛ in. to ¼ in. deep per pass. (My 3-HP router can cut about ¼ in. per pass.) Move the carriage back and forth along the tracks and incrementally move the router sidewise for each pass—like mowing the lawn. Gradually plunge to the maximum depth stop, but remove only 1/16 in. on the final pass. This way, you'll leave a smoother surface that will only need to be lightly scraped and sanded after assembly.

Assembling the carcase—Since carcase assembly is complicated, you should do a dry run, inserting only two splines in each joint. Then, before glue-up, gather everything you will need: the four

Right: A template is aligned on a mark next to the inside corner of a mitered carcase side for routing hidden spline mortises. The line is evident on the piece at right.

Below: Frid routs the concave carcase sides on this shopmade jig. The router carriage slides along the curved tracks and the router slides side to side within the carriage rails. Stops on the track ends prevent the carriage from sliding off and stops on the rail ends limit router travel.



carcase pieces, three stretchers, 24 splines, glue, a damp rag, clamps and assembly jigs, and a helper or two (assembly isn't a one-man job). The plywood assembly jigs for the mitered carcase are the same width as and ½ in. shorter than the carcase pieces, with 45° beveled cleats glued and screwed to each end (see the top photo on the facing page). Since the surfaces of the jigs' cleats are parallel to the joints' mitered surfaces, clamping pressure is perpendicular, preventing the joints from sliding.

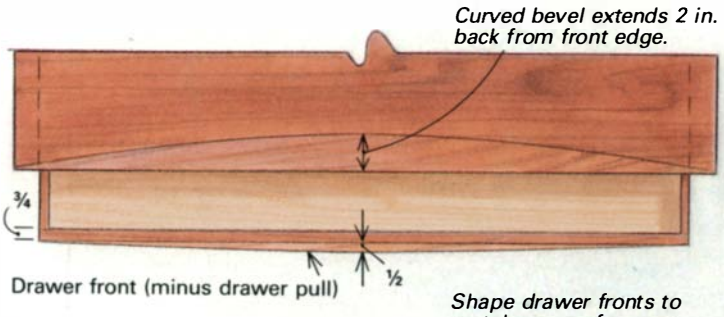
I used plastic resin glue for this project, because its dark color is close to walnut and it dries slower than yellow glue, allowing more assembly time. Using a cheap, small brush, spread glue on the joining surfaces of all parts and insert the splines in the sides' mortises. Then assemble the parts in four steps. First, stand the sides on their rear edges and join them to the three stretchers (without clamps). Second, join the top and bottom to the sides by pressing their joints together. Third, clamp the miters using the assembly jigs. To do this, secure the middles of the long jigs to the top and bottom with a short clamp and secure the short jigs to each of the sides with a pair of long bar clamps across the front of the carcase. But align the stretchers' front edge flush with the carcase front before tightening the bar clamps. Then draw the corners together, using three or four clamps across each jig's cleats and making sure the miters are tight inside and out. You can tap the jig's cleats to persuade the joints into alignment. Finally, ensure that the assembly is square by checking that its diagonals are equal. If it isn't square, change the angle of a long bar clamp or two. Then, with the glue still wet and everything square and aligned, lightly hammer the corner of any slightly open miters to bend the wood fibers and close the joint.

If I had built this chest from lighter wood, I would have used yellow glue, so its color would match the wood. But since it sets quickly, I would glue the opposite corners together first, making sure they were square, and allow them to dry. Then I would assemble the rest of the case as I did the walnut carcase. I never use liquid hide glue because I had a bad experience with it on a large commercial project: after several years, the glue became like chewing gum. Thank heaven I sold my business before anything came back for repairs.

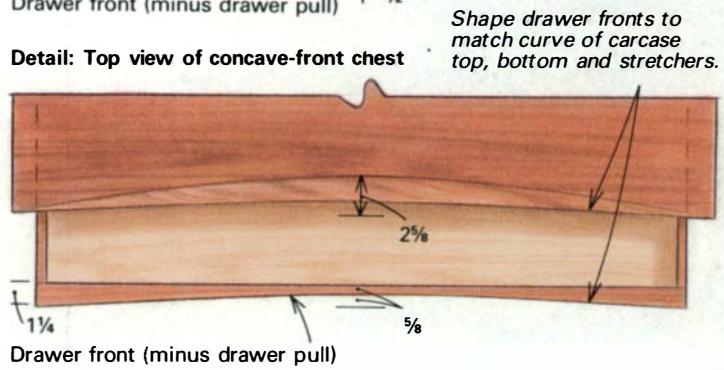
Although my shop was pretty dry when I started this project, the humidity was nearly 100% when I was ready to install the drawer runners. It was so hot and humid that Danish sweat (which is hard to come by and very expensive) was dripping from my brow onto the wood, and even though I knew that the chest would one day live in a drier atmosphere, the walnut carcase had expanded quite a bit. Therefore, to allow for wood movement, the runners are ½ in. shorter than the inside depth of the carcase and glued only at one end. Apply glue to the first inch of the runners' ¼-in. by ¼-in. tongue, butt that end of the runner against the stretcher and tap its tongue into the groove in the side. Before you screw on the back, screw the two shaped pediments to the bottom of the carcase.

Photos: Gary Weisenburger; drawing: Bob La Pointe

Detail: Top view of convex-drawer-front chest



Detail: Top view of concave-front chest



Bill of Materials

No.	Description	Dimensions (T × W × L)
1	Carcase top and bottom	1½ × 17 × 40
2	Carcase sides	1½ × 17 × 26
24	Splines	⅜ × 1 × 1
3	Stretchers	¾ × 2½ × 37½
6	Runners	¾ × 1¼ × 14¼
2	Pediments	1½ × 4½ × 38½
1	Carcase back	¼ × 24 × 38 plywood
4	Drawer fronts	1¼ × 5¼ × 37
8	Drawer sides	½ × 5¼ × 16
4	Drawer backs	½ × 4¼ × 37
4	Drawer bottoms	¼ × 15¹¹⁄₁₆ × 36³⁄₁₆ plywood
4	Drawer pulls	⅞ × ⅞ × 28

***Above:** To check the carcase for square, Frid measures across the diagonals. He placed the thin-plywood assembly jigs on the outside of the carcase. The jigs are the same size as each carcase piece, with beveled cleats on each end.* ***Below:** After routing the convex shape on a drawer front, Frid rips a 20° bevel in its top and bottom edges so the front's edges are straight and flush with the straight carcase front.*

Making the drawers—Before shaping the drawer fronts, fit all the drawer parts to the carcase, cut each drawer's dovetail joints (I cut them by hand: half blind in front, through in back), and then groove the sides and front for the bottom, as shown in the drawing. If you cut the drawer parts following the bill of materials, they will be slightly tight in the carcase openings. So trim the unshaped fronts to fit snugly in the carcase; trim the sides as wide as the fronts, for a snug fit between the runners; and cut the backs as long as the fronts. To allow for wood movement in the carcase, the drawer is ½ in. narrower than the carcase's inside depth, and the drawer backs are 1 in. narrower than the width of the drawer sides. This leaves ½ in. above the back, to keep the drawer from binding if a shirt sleeve falls overboard, and ½ in. below, so you can slide the bottom into the assembled drawer and screw it to the back from underneath.

To shape the convex drawer front, I used a jig that is similar to the one I used to scoop out the concave carcase sides, except that the drawer front jig's tracks have convex curves (½ in. deep over 37 in.). Set the router's maximum-cutting depth stop by positioning the cutter ½ in. from the centerline of the workpiece and extending the bit until it just touches. After routing the convex surface, rip 20° bevels in its upper and lower edges, setting the tablesaw fence a little more than ¾ in. from the blade (to leave the edges that thick after planing them smooth), as shown in the bottom photo above. Now, smooth the surfaces, but keep the corners sharp, because they emphasize the curves that give the chest's front its interesting shape. To shape a concave front, use a jig with concave curved tracks and set the cutter depth at the end, as you did on the carcase sides. Don't cut bevels in the edges of the concave drawer fronts.

I made wooden drawer pulls that fit the overall design. To make them for the convex fronts, mark a matching concave curve on the edge of a ⅞x4½x28 piece of walnut. Bandsaw to the line and scrape the surface smooth and fair. With the tablesaw blade perpendicular to the table, rip the concave piece into four 1-in.-wide pieces. Then, tilt the blade to 15° (angled toward the fence) and set the fence ⅞ in. from the blade. With the concave side up, rip both edges of each piece, and then crosscut their ends at the same angle. Scrape and sand the sawn edges, and glue and clamp the pulls on the fronts before you apply the finish.

Finishing—I finished both chests with Watco oil. Never finish the inside of the carcase or outside of the drawer sides, because they may stick together. Instead, rub them with paraffin. And never use an oil finish on the inside of the drawers, because it always bleeds and may spoil what is inside. Instead, you can seal the drawers' insides with shellac or lacquer. You needn't worry about moisture inside the chest, however, because the drawers are closed most of the time. □

Tage Frid is a contributing editor to FWW.

Which is the brass original and which is the fiberglass replica? The original die-stamped escutcheon is on the left; it was made in England and adorns a Hepplewhite chest. The brass-plated plastic replica is on the right; it was made by the author.

Replicating Stamped Brasses

Fiberglass copies for missing originals

by Jonathan Thornton

Replacing missing pieces of die-struck brass hardware on Federal period furniture can be a problem, because modern manufacturers produce a limited selection of high-quality brass replicas. But if you have a piece of original hardware in good condition, you can make replicas from brass-plated fiberglass—glass reinforced plastic. Not only are these replicas quite easy to make, but they capture all details of the original, and they are good enough to appear authentic to anyone but a serious furniture historian.

American furniture from the Federal period (1780 to 1835) is commonly adorned with stamped brass hardware that was imported in large quantities and hundreds of varieties. Until then, furniture brasses (as the hardware is called), such as Queen Anne and Chippendale flat-brass escutcheons and their bails, were made by sand-casting. In that process, molten brass is poured into cavities left in packed sand after a pattern is removed. Then, in the late 1770s, brass hardware changed both stylistically and technologically as Neoclassic furniture became popular. For example, lightweight and highly detailed escutcheons for a Hepplewhite design, like those shown above, were made by pressing a thin sheet of brass between metal dies. Compared to cast hardware, stamped or die-struck hardware consumes less brass and it can be produced with less labor. Finely detailed and polished dies produce a final finish, whereas the surface of sand-cast hardware must be scraped, chased and burnished (see "Period Furniture Hardware," *FWW* #34). However, it is too expensive to make dies for a small quantity of hardware, and sand-casting replicas using an original brass piece as a pattern doesn't yield the polished surface and fine details characteristic of die-struck brass. So when I can't find a match among the brass pulls available today, I make fiberglass replicas.

Making the mold—Using a well-preserved escutcheon as a pattern, I make a silicone rubber mold, coat the inside with brass powder and then fill it with resin and glass fibers. The brass-plated casting is durable and the mold is reusable.

To start, carefully remove an escutcheon from the furniture, keeping track of which fastener (screw, bail post and escutcheon pin) comes from which hole, since early fasteners aren't uniform. After cleaning and polishing the escutcheon's outer surface, stick it right side up on a piece of glass with modeling clay, using the clay to seal its holes and edge. (Don't use clay that contains sulfur, because it prevents the liquid-silicone molding rubber from hardening.) I use sulfur-free Klean Klay, which I bought from Art Chemical Products, 1019 Salamonie Ave., Huntington, Ind. 46750; (219) 356-2328. Fix the escutcheon to the glass by pressing a "worm" of clay inside its perimeter and a ball of clay into each hole in its hollow back, mounding the clay above the rim. When you press the escutcheon onto a piece of glass, the clay should extrude from around the edge of the brass and through its fastener holes, sealing it against the liquid silicone. Use a wooden modeling knife, like the one in the left photo on the facing page, to remove the clay extrusions from around the escutcheon edge and to smooth the clay until it's slightly below the surface of the holes in the escutcheon. Next, build a clay dam around the brass, about ½ in. from the escutcheon edge and 1 in. to 2 in. high. Seal the outside of the dam to the glass by using the modeling knife to press some of the clay from the dam into a fillet around its circumference, as shown in the left photo on the facing page.

Now make the reusable rubber mold into which you will pour the plastic casting resin. Use only silicone rubber because it doesn't corrode or damage original brasses as polysulphide and latex rubber do. (I use Silastic 3110 RTV and no. 1 catalyst by Dow Corning Corp., Midland, Mich. 48686; 517-496-6000.) Mix the silicone, following the manufacturer's instructions, and pour it over one side of the dam, as shown on the facing page in the center



***Left:** The author cleaned and polished an escutcheon to use as a pattern for a silicone rubber mold. He first sticks the original brass to a piece of glass with modeling clay, surrounds it with a clay dam and then uses a modeling knife to seal the dam to the glass. The dam contains the liquid silicone and clay plugs holes in the escutcheon to prevent silicone from leaking into its hollow back.* ***Center:** Slowly pour silicone molding rubber over one edge of the dam, allowing the rubber to crawl over the brass, filling its minute details and avoiding bubbles.* ***Right:** The author plates the plastic replica by using a soft brush to coat the mold surface with fine brass powder. The powder adheres to the cured casting resin.*

photo, so that it slowly covers the original and doesn't trap any air. Let the silicone cure (12 hours), remove the dam and gently peel the glass and brass from the mold.

Casting an escutcheon—Thoroughly coat the inside of your mold with fine brass powder (the consistency of talc), which is available at craft stores, of the appropriate color (it's available in a variety of colors, including pale green, rich gold and antique brass). The brass won't adhere to the silicone, but it will stick to the cured resin, forming a thin glaze inside the mold. Spread the powder with a soft brush, as shown in the above photo at right, until the mold's surface is shiny, and then gently blow off the excess.

Next, prepare the reinforcing glass and casting resin (available at boating-supply, auto-supply and craft stores). Cut a piece of fiberglass cloth or mat slightly smaller than the escutcheon's outline (in a pinch I've used synthetic window screen). Then, while working in a ventilated area or wearing a charcoal-filter respirator, mix the plastic resin and catalyst. You can use polyester resin or epoxy resin, but the properties are not the same: polyester cures faster, but epoxy shrinks less. In any case, be sure to use *waxless* resin or you will have to remove wax from the cured replica before you lacquer it. Be sure to follow the manufacturer's instructions and precautions, stirring gently so you don't create any bubbles.

Slowly pour the resin into the mold, being careful not to create and trap any bubbles. If bubbles adhere to the surface of the mold, gently tease them free with a single bristle from a stiff brush until they rise to the surface; but be careful not to remove the delicate layer of brass powder on the mold's surface. When there aren't any bubbles in the mold, it's time to add the fiberglass. Before putting it into the mold, saturate the fiberglass until it's transparent, so it will sink without bubbles. To do this, lay the fiberglass on a sheet of plastic, thoroughly brush it with the resin and roll out air bubbles with a piece of dowel. Then gently lay the glass into the mold and let it sink, as shown in the bottom photo at right.

Let the resin cure overnight or until the surface is hard, and then remove the replica. Its glaze should be bright and shiny and every detail on the original should be duplicated (including scratches). Flatten the replica's bottom by sanding it on a piece of coarse wet-or-dry silicon-carbide sandpaper laying grit-side up on the piece of glass. Lubricate the paper with water, and rub the replica back and forth until it's flat. Drill out the nail and screw holes and saw out larger holes, like key holes. A jeweler's saw with a no. 1 blade works best for this, but wear a dust mask so you don't inhale the glass-laden dust. You should size holes for missing bails and posts to the replacements, which are available from Ball and

After filling two brass-coated molds with resin, Thornton gently lays a piece of resin-saturated fiberglass mat in the molds, to strengthen the replica. The duct removes gases given off by the resin.

Ball (463 W. Lincoln Highway, Exton, Pa. 19341; 215-363-7330) and Horton Brasses (Box 95, Cromwell, Conn. 06416; 203-635-4400).

Polishing the plated surface with a steel or agate burnisher (available from jeweler's- or gilder's-supply stores) will add luster, but to keep the brass from tarnishing and to increase its gloss, brush or spray it with lacquer. You can color the lacquer, adding aniline stains or dry pigments to adjust the hue or to "antique" the replica if you prefer a tarnished look. Original escutcheons were coated with yellow-colored lacquer to produce "a fine burnished gold color," as specified by one 18th-century-hardware manufacturer's catalog. □

Jonathan Thornton is associate professor of art conservation at Buffalo State College in Buffalo, N.Y.

Photos: Gary Weisenburger

Making Elliptical Mirror Frames

Molding a profile on a curved surface

by Len Schmidt

Schmidt made his elliptical mirror frame with fixtures and techniques for making arched door trim and oval window casings.

Ellipses sneak into our lives all the time. From the orbits of the planets to the frame around a mirror, we are literally surrounded by them. But drawing one, cutting it out and shaping it each pose a different challenge. I was forced to confront these problems when I accepted a job from a local contractor to make some large elliptical moldings to be used as interior casings for oval windows and arched doorways.

To make the curved moldings, I first had to understand a little geometry so I could lay out ellipses of the exact dimensions I needed. The next problem was building an "ellipse-routing machine" for cutting the outer shape of the moldings (see the left photo on p. 90). Then I had to come up with a way to shape a complex profile on the face of elliptical trim—a challenge complicated by the fact that the radius of curvature around an ellipse varies. Plus, to ensure a perfect match, I needed to cut the profile on the curves with the same knife used on the molder/planer to shape the straight pieces. After a lot of head-scratching, the contractor and I came up with the guide mechanism shown in the center photo on p. 90. Two router-bit pilot bearings are mounted on an auxiliary table that fits on a molder/planer. Then a groove that follows the curve of the trim and that will act as a track for the bearings is routed into the back of each workpiece. As long as the line between the bearings is perpendicular to the cutterhead and centered under the knife, the groove will ride smoothly on the two bearings and hold the work in proper relation to the knife and cutterhead.

The mirror frame shown above is a convenient way to present the methods I came up with for making elliptical moldings. However, for the large-scale interior trim that inspired these methods, I glued up and molded half ellipses. If your molder/planer has one open side, as does my Williams and Hussey (Box 1149, Wilton, N.H. 03086) molder in the center photo on p. 90, you can assemble the entire mirror frame before molding its surface. If you are using a molder with its cutterhead assembly mounted on two posts, you will have no choice but to work with half ellipses and then join them with splines after running them through the molder.

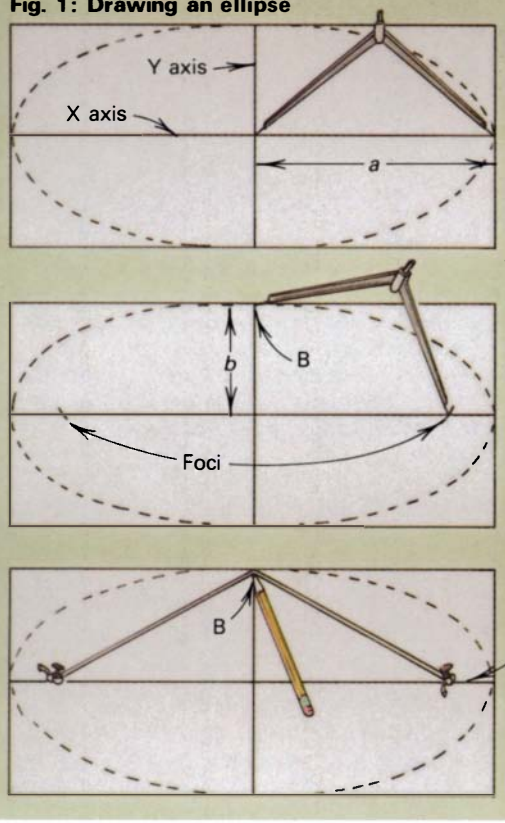
Understanding an ellipse—By definition, an ellipse is a closed curve traced by maintaining a constant sum of distances from two fixed points in a plane. In most practical applications you will be drawing an ellipse that has a specific length and width, which can be thought of as the dimensions of the rectangle within which the ellipse will fit (see figure 1). To lay out the ellipse, you will need to draw two axes, *X* and *Y*, through the center of the rectangle. The fixed points mentioned in the definition are the two foci of the ellipse and they will fall on the *X* axis, equidistant from the intersection of the *Y* axis. To locate the foci of your desired ellipse, set a drawing compass for distance *a* (half the ellipse's length). Then place the compass point where the *Y* axis intersects the rectangle and scribe arcs that intersect the *X* axis; these intersections are the foci.

Once you've located the foci, you can draw the ellipse with a pencil, a piece of string and a couple nails (see figure 1). Drive a nail at each focus and tie the string to one of the nails. Pass the string around the tip of a pencil held at the point where the *Y* axis intersects the rectangle and then tie the string to the other nail. Now, push the pencil against the string to keep it taut as you draw a line around the two foci. You will draw an ellipse because the string will keep the sum of distances from the foci to the pencil equal. This works well for quick approximations or for very large ellipses, but the accuracy is somewhat limited because it's difficult to hold the pencil completely erect as you move it. To draw an ellipse accurately, you should make an "ellipse machine" or set of tracks and trammel points that can be set to inscribe a variety of ellipses.

Ellipse machine—The machine I made for cutting out large ellipses is based on the ellipse-drawing apparatus used by the Dominys, a family of craftsmen who worked in Long Island, N.Y., in the late 1700s. Their device consisted of a pair of wood tracks that crossed at right angles and a trammel beam with three adjustable points; two of them were dowels and the third was a marking device. To inscribe a particular ellipse, one of the dowel points is set half the ellipse's width (*b* in figure 1) from the marker and the other is set half the

Photo this page: Susan Kahn

Fig. 1: Drawing an ellipse



1. *Draw a rectangle with the dimensions of the desired ellipse and draw the X and Y axes through its center.*
2. *To locate the foci, set a compass for distance "a" and swing two arcs from point B.*
3. *Drive a nail at each focus and tie a string to the nails so that a pencil placed at point B pulls the string taut.*
4. *Move the pencil around the foci while keeping the string taut to draw the ellipse.*

length (*a* in figure 1) from the marker. Then the device is tacked to the work and each dowel is placed in one of the tracks. When the marker is rotated around the assembly, the dowels move back and forth in the tracks and guide the marker around the ellipse.

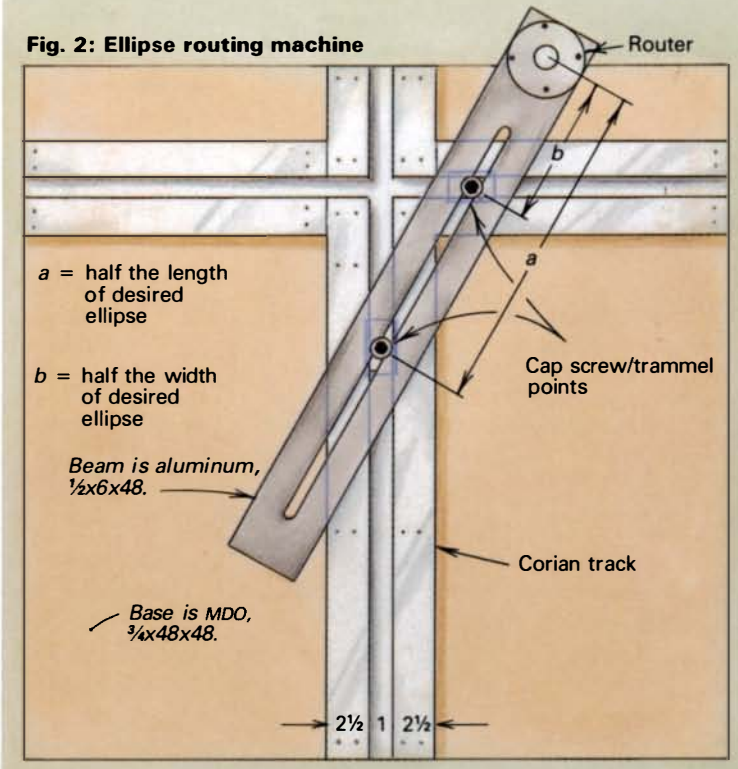
My machine operates on the same principle, but the beam carries a 3-HP router with a straight, ½-in.-dia. carbide bit instead of a marker. The crossed tracks are made from Corian, as shown in figure 2, and are mounted on a base of medium-density overlay (MDO), exterior-grade plywood with a slick, paintable surface of resin-saturated paper. A Corian "puck," with a brass bushing pressed into a hole in its center, rides in each track. I had a machinist make a ½-in.-thick aluminum beam with a ¾-in.-wide slot down its center for the adjustable trammel points. I used ¾-in. cap screws for the trammel points and I had the machinist turn the first ⅞ in. of each screw down to 0.498 in., which is 0.002 in. smaller than the pucks' brass bushings into which they fit. The sliding pucks with brass bushings and the machined trammel points ensure the accuracy of the machine, which I estimate to be within 1/64 in. on an ellipse with a 7-ft.-long axis.

Although the machine was designed to cut out half of a 4-ft.- to 8-ft.-long ellipse, I also use it for cutting smaller ellipses, such as the mirror frame. I just mount a ¾-in.-thick auxiliary table on the short end of the *Y* axis track to support the workpiece, and attach a 90° angle bridge to raise the end of the beam up to the same level (see the left photo on the next page). The auxiliary table is registered to the machine's base with two dowels so it can be easily removed to screw the frame blanks to it. I also had a set of 2¾-in.-long cap screw/trammel points made to span the extra distance. Because the *Y* axis track only extends a few inches past the intersection of the tracks, you can only shape half the mirror frame, and then you must reverse it on the machine to complete the other half.

Constructing the molding blank—Now that you are equipped to draw and cut an accurate ellipse, the next step is to glue up the molding blank. Draw your desired ellipse full scale and decide

Drawings: Aaron Azevedo

Fig. 2: Ellipse routing machine



Detail: Track and puck

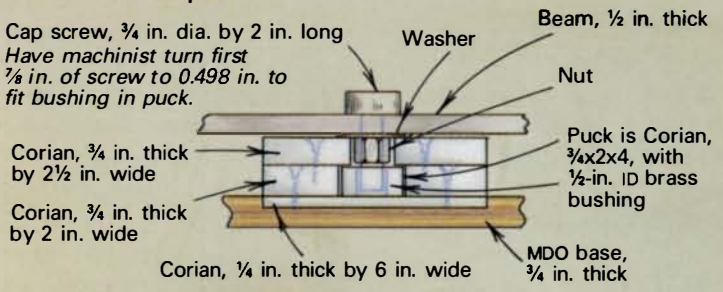
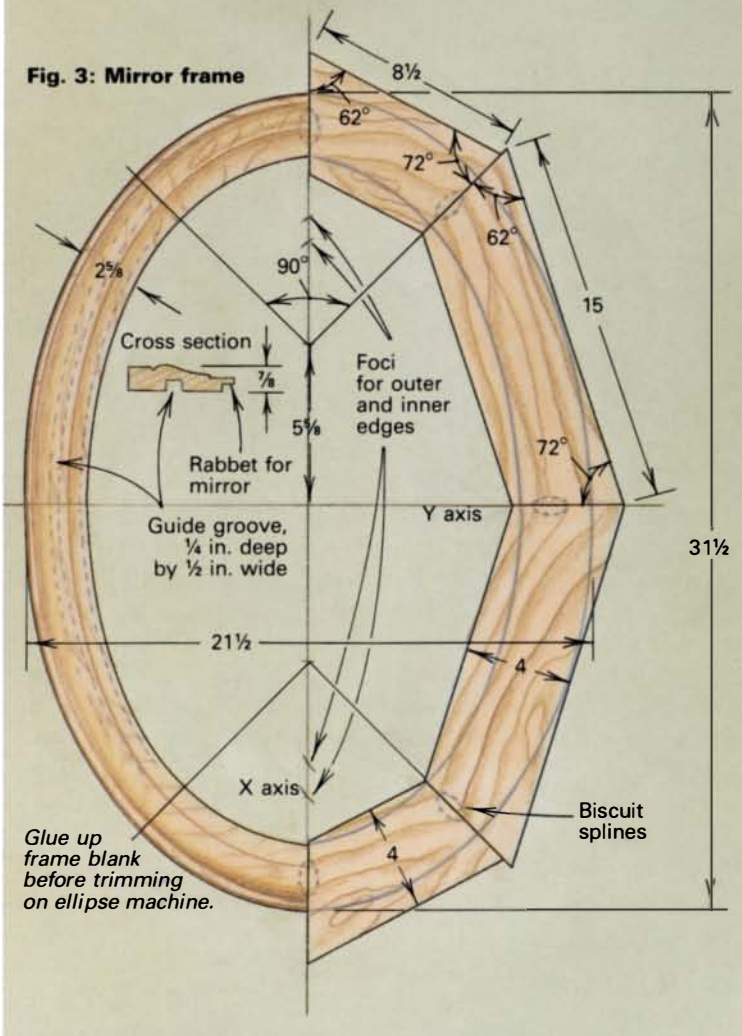


Fig. 3: Mirror frame



Schmidt designed his routing machine for cutting large ellipses. To cut out the small mirror frames, he added an auxiliary table to mount the frame atop the track and a right-angle bridge that supports the beam at the table's level.

For molding curved trim, the author uses an auxiliary table with two small bearings mounted about 2 in. apart. A guide groove routed into the back of the trim piece rides on the bearings and holds the trim in proper relation to the cutter.

A frame blank, screwed to a plywood template that is grooved to ride on the guide bearings, slowly rotates through the molder. The spring-loaded wood disc presses against the template edge to keep it from shifting on the bearings.

how many pieces you will need to make the curve. I was concerned about tearout on the figured maple that I used for the mirror frame and so I glued up eight short segments, as shown in figure 3 on the previous page, to keep the grain running close to the direction of the milling. I cut the angles on a radial-arm saw and used a plate joiner and biscuits to spline the ends of the pieces together. (With less-figured woods, such as ash or poplar, I've used as few as four pieces for the frame.) I clamped the octagonal frame together by laying it out on a sheet of MDO, screwing blocks around the frame, and then driving wedges between the blocks and the frame until all the joints were tight. To clamp half ellipses with wedges, you'll need blocks at each end to hold the curve in place, and you should make the blank 6 in. to 8 in. longer than final length to allow for irregularities when starting and ending molder cuts. Wax the MDO surface before gluing up the blank on it to keep squeeze-out from sticking to it.

When the glue dries you're ready to mount the frame on the ellipse machine and trim it (see the left photo). For a project that involves many ellipses of the same size, such as a run of mirror frames, I would make a plywood frame blank, trim it on the ellipse machine and then use it to trim the subsequent pieces with a router fitted with a guide collar. This way the guide groove can be routed into the template, which means you can leave the molding blank screwed to the template after trimming it to shape and then run it through the molder riding on the template's guide groove.

Whether you're making a template or cutting out a workpiece, screw the assembled frame to the MDO from the table's underside after carefully aligning the frame's long axis joints with the inner edge of the table; this makes it easy to realign the frame when you reverse it to trim its other half. Mount the auxiliary table on the machine, registering it on two dowels inserted into the machine's base. Then set the trammel points at 13⅛ in. and 8⅛ in. from the edge of the bit and trim the inside edge of the frame first. I used three passes to cut through the ⅞-in.-thick maple, lowering the bit for each pass. After trimming the inside of half the frame, reverse the frame on the auxiliary table and trim the inside of the other half. Then reset the points to 15¾ in. and 10¾ in. and trim half of the outside edge, reversing the frame to complete the job.

Next, set the trammel points to 14¾ in. and 9¾ in. for routing the guide groove in the back of the frame or template, and adjust the bit to cut just deep enough to clear the bearings. If you are making a template, rout the groove in the template blank's upper surface. But if you are trimming a workpiece, turn the frame face-down to rout the groove. Since you can't run screws into the face of the frame to fix it to the auxiliary table, C-clamp it to the table's front edge after carefully aligning it on the table. Of course, the clamps interfere with the swing of the beam, and so you'll have to relocate them to cut the complete groove.

Molding curved trim—Now you are ready to cut the molding profile on the elliptical flat stock. But first you need to make the guide mechanism and auxiliary table for the molder. As you can see in the center photo, the guide mechanism consists of an aluminum plate with two ½-in. router-bit bearings mounted 2 in. apart on center. To increase the accuracy of the mechanism, I added the spring-loaded wood disc, which pushes against the outer edge of the work as it goes through the molder and takes up any slack in the bearing-to-groove fit. The sides of the aluminum rectangle that carry the disc are cut at an angle to hold the spring-loaded mechanism in place. The aluminum guide mechanism is screwed to a piece of MDO that is clamped to a framework that extends up from the stand on which the molder sits. When you mount the guide mechanism to the molder, remember that the line between the bearings must be perpendicular to the cutterhead and the bearings must be placed so the workpiece will move under the correct part of the knife. I notched a piece of ½-in.-thick plywood to fit around the molder and the guide mechanism, and I screwed it to the MDO to provide a large extension table to support the work.

Before running your molding, reduce the feed roller pressure, to allow parts of the curve to slide sideways under the roller, and set the machine for its slowest feed rate. On some machines you can disconnect the feed roller chains, mount a hand crank directly to the roller sprocket and manually control the speed. Next, coat the guide groove with paraffin wax and place the workpiece on the bearings. Lower the cutterhead until the knife takes a shallow cut, about ⅛ in., and feed the piece through with the hand crank or let the machine pull it through slowly (see the photo at right). For continuous moldings like the mirror frame, lower the cutterhead about ⅛ in. after each rotation of the frame. If you're molding a half ellipse, follow the normal procedure for planing and lower the cutterhead a little before each pass until you reach the desired depth.

Finishing touches—The mirror frame is complete except for the rabbet in its back side for the glass, and sanding and finishing. The rabbet is easily cut with a router fitted with a standard pilot-bearing rabbeting bit. Since there was hardly any tearout on the face of the frame, I spent a few minutes sanding and then applied a tung oil finish. The mirror can be held in the rabbet with small nails or glazing points, and I recommend heavy-gauge picture wire looped around small screws in the frame's back for hanging it. □

Len Schmidt does horse logging and custom woodworking under the name Belgian Woodworks, in Starksboro, Vt.

Photos this page: Jim Boesel

Craig Nutt's 18-year woodworking career has encompassed restoring antique furniture to making finely crafted pieces, but currently he is best known for incorporating vegetables into furniture and sculpture. Before meeting him, I had seen photos of only his asparagus tables and a few flying vegetable bombs, and although they're finely made, I wondered why a skilled woodworker would devote so much time to sculpting vegetables. After spending some time with Nutt, I learned that his skills are firmly rooted in an understanding of traditional styles and techniques and that his superbly crafted furniture and sculpture develop from his artistic eye. His pieces are sincere and humorous at the same time, and some of them convey an underlying irony that encourages us to take a second look at our world and what we're doing to it.

Nutt began restoring furniture for a Tuscaloosa, Ala., decorator after earning a bachelor's degree in religious studies at the University of Alabama in 1972. During his six years as a restorer, Nutt saw enough broken furniture to learn the difference between good and bad construction while developing a keen sense of traditional design. From 1978 to 1980 he managed a shop for Studio Industries of Tuscaloosa, a program funded primarily by the First National Bank of Tuscaloosa to establish arts-and-crafts studios in the area. For those two years he trained apprentices in furniture restoration and made a few original adaptations of period styles. Then in 1979, Nutt assisted the Kentuck Art Association in establishing its Art Center in Northport, Ala., and it is here that Craig and four other artists work.

I met Craig unloading his van outside his studio. He had returned the previous night from an American Crafts Council Craftfair in Baltimore, Md., and he was hoarse after a week of talking about his art. He didn't say much as we carried numerous flying vegetable sculptures and a few pieces of contemporary furniture into his studio showroom. But when I first looked around his shop, I discovered that Nutt is more than a wood sculptor: he has the tools and machines of a well-equipped furnituremaker. And then his exquisite turtle-shell-and-claw foot dinosaur desk caught my attention.

Unique furniture—Nutt's furniture designs maintain structural integrity and reflect his own ideals: innovation, beauty, humor and irony. His lifelong obsession with dinosaurs, he admits, is responsible for the "Deinonychus Desk" (shown above). He started designing the takeoff on "terrible claw," a bipedal dinosaur, in 1980 for a customer who wanted an Egyptian-style piece. But the commission fell through and Nutt didn't finish the desk until 1986. Multiple tenons in the ends of its legs fit mortises in the flat apron-like frame, which hides a shallow drawer. Although the foot design is original, it is based on the feet of Egyptian chairs, which portray animal parts more naturally than Western furniture; the pairs of feet on "Deinonychus Desk" point in one direction, unlike Queen Anne ball-and-claw feet, which point outward unnaturally.

While the "Deinonychus Desk" was still in the design stage, Nutt built the first of three editions of the conservative rocking chair shown in the left photo on the next page. (Soon, he said, he'll make another run of this chair because it was so popular that he sold his own.) He used a discarded autoclave (in which hospitals sterilize equipment) to generate steam to bend the back legs and back slats for the first series. For the other two runs, he still steam-bent the back legs, but he laminated the slats in order for them to be a predictable, uniform shape. He used this method when he designed and built the "Braswell Bed," shown in the photo at right on the next page, for a customer who owns one of the rockers. The unique chair-back design of the headboard evolved because the customer (Braswell) wanted a bed that would be comfortable to sit up in.

But Nutt says that furniture can be taken too seriously, and I suspect that he may be thinking of Queen Anne furniture. His "Green Asparagus Table," pictured in *FWW* #81, p. 112, is pat-

Photo: Rickey Yamura

Left: **Nutt occasionally builds this walnut rocking chair, which he designed in 1982. The comfortable chair has a scooped out seat, laminated back slats and steam-bent back legs.** ***Right:*** **The cherry "Braswell Bed" (1989, 44Hx59Wx90D), with its chair back-like headboard, was conceived as a mate to Nutt's rocker and designed to be comfortable to sit up in.**

terned after the Queen Anne style, but its "cabriole legs" are realistically sculpted and painted asparagus spears. Similarly, the legs and pedestal of his tilt-top "Okra Tri-Pod Table," shown in the top, left photo on the facing page, are based on Queen Anne pieces and are carved from tupelo, which he commonly uses for painted sculptures. Nutt pointed out the similarity between the okra and a Coca-Cola bottle, and reminded me that they're both from Georgia.

His cayenne-pepper tables, like the one shown top, right on the facing page, have a more modern design. He turns the leafed shoulder and round tenon from a 2-ft.-long square billet, roughs out the pepper on the bandsaw, and then puts what's left of the billet back on the lathe and carves it with sharp-edge tools and rasps. Sometimes he sends out the pepper originals to be duplicated on a carving machine, but he says he can carve them almost as fast by hand. Nutt finishes shaping the peppers on a drum sander, and he says that sanding requires a lot of time for his sculptural work. Although he's trained a part-time helper to do a lot of the drudgery, sanding is a critical shaping operation. "You don't just sand something smooth," he says. "You refine its shape and form."

The colors of his finished peppers, like their shapes, are accurately rendered, and their surfaces feel waxy, just like real ones. While minoring in fine arts at the University of Alabama, Nutt studied painting as well as sculpture, and his eye for color and expertise with oil paints is evident in the finished vegetables. I commented on the different shades of orange used on carrots and he said that's the way they really are "unless they're cooked, and then they become somewhat whitish." The produce of his labor is surely recognizable.

Flying vegetables and social commentary—The "Amazing Three-Foot-Long Flying Wonder Bean" (1981) was Nutt's first vegetable sculpture, but it was too big to fit in most homes and so he scaled it down. The flying vegetables he currently makes are about the size of large porch-rail whirligigs, which they imitate. Some pieces are named for real vegetables, such as the "Georgia Jet," a species of yam. It, like most of his flying veggies, has a propeller on its "nose," and it's appropriately perched atop a turkey baster that looks like an intercontinental ballistic missile. At first glance, the pieces are funny, but the ideas are so bizarre that you will likely take another look—both at vegetables and at the weapons they represent.

Nutt's real intention is to blend humor with ironic social commentary, and some pieces are named after newsworthy and politically relevant statements that Nutt and his visitors have scrawled on the wall next to a bandsaw. "My helper and I were listening to the radio," said Nutt, "when we heard George Bush say 'I'll never use food as a weapon' during a campaign speech. This led me to make the flying vegetables into a series of vegetable bombs," like the one shown bottom, left on the facing page. This kinetic sculpture is as technically balanced as it is artistically crafted. In a slight breeze, the carrot turns into the wind and its propeller spins. Nutt put a ball bearing in a copper sleeve, which he inset into the carrot, so the vegetable easily pivots on a pin in the nose of the silo-like launch vehicle. This multimegaton carrot bomb illustrates one of Nutt's favorite themes: our ironic attitude that bigger, brighter chemical-fed vegetables and more devastating weapons are better. Combining vegetables and rocketry, admits Nutt, is likely the result of his being born in Iowa corn country and raised in Huntsville, Ala., America's rocketry capital during the space-race era.

Not all of Nutt's pacifistic sculptures are vegetal. In 1984 he made the bomb-shaped "Nuclear Medicine Chest," shown in the bottom, center photo on the facing page. A bandsawn drawer inside can hold antacid tablets, aspirin and iodine capsules—things, the artist says, you need to survive the atomic age. And its wind-up music box plays a humorous, intentionally sour version of *Raindrops Keep Falling on my Head* (Nutt altered the mechanism to produce flat notes). Nutt says the tune is to soothe a radioactive soul. "In the event of a nuclear exchange," he quips, "you'd still have an operating home-entertainment center." After a long silence he added, "I didn't create the world situation." In fact, Nutt's art only comments on it.

"Reliquary," shown in the bottom, right photo on the facing page, was made in 1986 and carries a much stronger message beyond humorous commentary. The domed lid atop the satin-lined dovetailed mahogany coffin was turned inside and out from a stack of thick laminations. The coffin contains a lost-wax bronze casting of deceased Earth. Cast-bronze lid stays look like missiles and the Earth's surface is littered with toy cars and parts of baby dolls. "I became really frustrated about the casual attitude toward nuclear arms and the way world leaders hurl threats back and forth," says the 40-year-old Nutt. "The piece is a statement of what it has been like for me to have lived my whole life with the specter of nuclear destruction hanging over me." □

Gary Weisenburger is an assistant editor of FWW.

Photos except where noted: Craig Nutt

Photo: Gary Weisenburger

Photo: Rickey Yanura

Left: **Craig Nutt stands next to his Queen Anne style "Okra Tri-Pod Table" (1990, 23Hx18Wx18D), which has a lacquered tupelo pedestal and legs. Its tilted top, which represents a cross section of okra, is clear lacquered curly maple that is painted on the edge (to imitate the vegetable). Nutt turned tenons on the legs before he carved them, a technique he also used on the cayenne-pepper tables.** ***Right:*** **The "Pepper Table with Fireworks" (1990, 24Hx17Wx35D) has giant cayenne-pepper legs that were carved from tupelo. Its lacquered top is pau amarello and the inlaid fireworks are pressure-dyed veneer.**

Photo: Rickey Yanura

Left: **"We Will Never Use Food as a Weapon" carrot bomb (1989, 20Hx15Wx24D), is oil paint on carved tupelo and poplar. The carrot pivots on a ball bearing in a copper sleeve.** ***Above, center:*** **The "Nuclear Medicine Chest" (1984, 12Hx5Wx4½D) is natural padauk, osage orange, maple, walnut and birch with a dyed blue sky. It has a music box that plays a flat version of *Rain Drops Keep Falling on my Head,* and a bandsawn drawer that contains over-the-counter drugs necessary to survive the nuclear age.** ***Above, right:*** **Nutt's dovetailed mahogany "Reliquary" (1986, 56Hx24Wx28D) is a white satin-lined casket containing a bronze casting of Earth after a final nuclear exchange. The casket's handles are anchored in bronze castings that are decorated with bombs, and its turned-dome lid is held open by bronze missile-like stays.**

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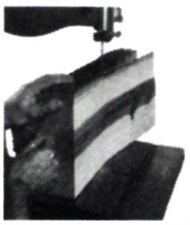

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Super Strong **"F"** weight **SANDPAPER**, pre-cut 3" x 10' rolls that outlast regular 9" x 11" sandpaper 3X or more! Available in assortment pack of 1 each . . . 80, 120, 220X . . . **$10.99.**

BONUS
- Buy 2 or more Drums, receive FREE Plans.
- Kit of all 4 Drums, receive FREE Plans & 1 FREE 3"x10' Sanding Roll . . . 80, 120, or 220X.

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Singley Sleeveless **DRUM SANDERS**

3/4"x3" Long	**$15.95**	Kit of all 4	**$59.95**
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2"x3" Long	**16.95**	3"x 10' Pre-Cut Sandpaper Roll Assortment	**10.99**
3"x3" Long	**18.95**		

Phone **1-800-776-5467** . . . they are out the next day!
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Address:_____

City:_____ State:_____ Zip:_____

(P.S.: I'm also interested in the NEW Mule router table that's designed to fit on the right side of my table saw. I'd like to hear why it saves space and how you sell if for just $149. ☐)

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A wide variety of plans from complete machines and attachments to handtools for home, school and commercial shops. Featured also are accessories for wood and metal cutting lathes, drills, saws, sanders, etc., plus things to make of wood and metal.

WOOD-MET SERVICES, INC
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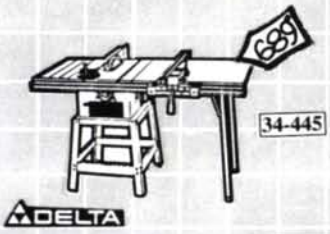
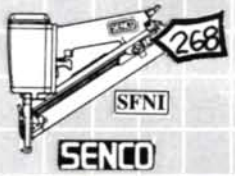
PEORIA, ILLINOIS 61604

READER SERVICE NO. 164

NEW TOOLS...





BIESEMEYER

50-B
50" Commercial w/12" Left
$299

52B	52" homeshop fence	239
40B	40" homeshop fence	219
288	28" homeshop fence	209

PORTER-CABLE

7334
Random Orbital Sander
$118

7335	***NEW*** VS random sander	129
7336	***NEW*** 6" VS random sander	134
505	1/2 sheet finish sander	114
330	speed bloc finish sander	59

9505
Commemorative Finish Sander W/Oak Case
$137

352	3x21 sander with bag	133
360	3x24 sander with bag	179
362	4x24 sander with bag	185
503	3x24 wormdriver w/bag	345
504	3x24 wormdrive sander	335

9850
3/8" Cordless 12 V Driver/Drill Kit
$134

9851	12v cdls w/keyless chuck	134
621	3/8" VSR 4 amp drill	99
7511	3/8" VSR 5 amp drill	114
7514	1/2" VSR 5 amp drill	119
7515	1/2" VSR 5 amp, keyless	124
7545	drywall 0-2500 VSR drvr	105

555
Plate Jointer With Case
$165

5556	adjustable tilt fence ***NEW***	49
5116	16" Omni jig ***NEW***	265
7536	2-1/2 hp router ***NEW***	205
7537	2-1/2 D hndl router ***NEW***	219
7399	drywall cutout ***NEW***	79
7310	laminate trimmer ***NEW***	89
9118	porta plane kit w/ct cutter	199

9345
Saw Boss Kit
$124

345	6" Saw Boss	98
314	4-1/2" trim saw	128
9314	4-1/2" trim saw kit	144
9315-1	7-1/4" saw w/case, ct bl	134
7548	top handle VS jig saw	128

690
1-1/2 HP Router
$128

691	1-1/2 hp D hdl router	138
696	router-shaper table	118
695	router table w/router	204
518	3 hp, 5 speed router	338
7519	3 hp production rtr ***NEW***	238
7538	3-1/4 hp pl. router ***NEW***	238
97310	laminate trimmer kit	185

9637
Electronic V.S. Tiger Saw Kit
$135

9647	tiger cub with case	118
9627	tiger saw 2 sp. w/case	128
693	1-1/2 hp pl. router	164
6931	plunge router base	78
97750	1/2" hammer drill kit	164

Porta-Nails

401P
Hardwood Floor Nailer
$199

DELTA

22-540
12", 15 Amp Portable Planer
$428

43-505	router/shaper ***NEW***	288
11-090	radial drill press ***NEW***	328
31-070	1x30 sander w/flex shaft	78
11-950	8" bench drill press	148

Milwaukee

0402-1
12 Volt VSR Cordless Kit W/Keyless Chuck
$169

5371-1	1/2" hammer drill kit	185
5365-1	Hawk 1" SDS rtry. h. kit	329
5353	Eagle 1-1/2" rtry hmr kit	549
5660	1-1/2 hp 10 amp router	189
5680	2 hp 12 amp router	219

6507
V.S. Sawzall With Case
$129

6508	VS sawzall w/case	129
6527	***NEW*** VS super sawzall	169
6528	***NEW*** VS super sawzall	169
5397-1	3/8" hammer drill kit	139
5375-1	1/2" hammer drill kit	169

0399-1
12 V VSR Cordless Drill Kit
$159

0395-1	3/8" VSR cordless dr kit	149
0222-1	3/8" VSR 3.5 amp drill	104
0234-1	1/2"VSR 0-850 magnum	114
0244-1	1/2"VSR 0-600 magnum	114
1676-1	2 sp. hole hawg kit	234

6368
7-1/4" Saw W/C.T Blade, Case and Fence
$135

6305	6-1/4" cdls circular saw	174
6546-1	2 sp cdls screwdriver	79
6753-1	0-4000 VSR screwdriver	84
6750-1	5 amp VSR screwdriver	94
0375-1	3/8" close quarter drill	124

3107-1
VS Right Angle Drill Kit
$195

6145	4-1/2" angle grinder	98
5455	7" 1750 rpm polisher	129
6256	VS top handle jig saw	129
6014	1/2 sheet finishing sander	119
8975	dual temp. heat gun	59

HITACHI

C8FB
8-1/2" Compound Miter Saw
$459

C15FB	15" miter saw	385
C12FA	12" miter saw	329
C10FA	10" miter saw	275
C7BD	7-1/4" saw w/elec. brake	134
M12V	3-1/4 hp VS pl. router	238
TR12	3 hp plunge router	174
CB75F	resaw bandsaw	1649
F1000A	12" planer/6" jointer	1529

POWERMATIC

1660760
66 Saw 3 HP W/50" Biesmeyer
$1679

1260100	#26 shaper 3hp 1 ph	1549
1000099	#100 planer/12"/2hp	1949
1800205	5hp,18" pl. w/knife gr	4399
1500040	6" jointer 3/4hp 1 ph	1149
1610050	8" jointer 1.5 hp 1ph	1399
1300134	6x48 belt/12" disc sdr	1129
1152825	15"VS dr. press 3/4hp	1299
1410040	14" bndsw 3/4hp 1ph	1199
1790808	25" wide belt sndr	8499

1791000
63 Artesian Saw W/Vega Fence
$699

1791001	63 Artesian w/50" Vega	799
1791020	3/4" wood shaper 1hp	479
1791010	15" scroll s. w/blower	159
1791030	14" bench drill press	329
1791040	14" floor drill press	369
1791050	6" jointer with stand	479
1791060	14" bandsaw w/stand	599

Panasonic

EY571B
9.6 Volt 3/8" VSR Drill
$129

EY970B	9.6v batt. w/purchase	39
EY6205B	12v 3/8" VSR drill	219
EY6200B	12v 1/2" cdls driver	189
EY503B	2.4v 2 sp. screwdriver	69
EY571H	steel carrying case	25

WEDGE

2" Level With Sensor Module
$118

TR-4	4' level w/sensor module	148
TR-6	6' level w/sensor module	178

SIOUX

690
Air Palm Finish Sander
$139

658	lever type finish sander	159
8000	3/8" VSR 0-1300 drill	129
8050	1/2" VSR 0-750 drill	159
8020	electric screwdriver	189

Emglo

AM78-HC4V
1-1/2 HP Vertical Twin Tank
$299

AM99-HC4	***NEW*** 2hp twin tank	359
AM78-HC4	1-1/2hp twin tank	289
AM39-HC4V	3/4hp v twin tank	279
K15A8P	1.5hp wheelbarrow	599
K2A8P	2hp wheelbarrow	649
K5HGA-8P	5hp Honda whlbrrw	699
045	3/8" x 50' Goodyear hose	20

DEWALT

1707
8-1/2" Compound Miter Saw
$449

1765	belt/disc sander	399
7770-10	3.5 hp 10" radial saw	869
7790	3.5 hp 12" radial saw	1069

DELTA

34-782
3 HP Unisaw w/Unifence
$1579**

34-782B	3hp unisaw w/Bies.	1599*
34-781F	1.5hp unisaw w/Unif	1379*
34-781B	1.5hp unisaw w/Bies.	1399*
34-763	3hp Jet-Lock unisaw	1399*
34-761	1.5hp Jet-Lock unisaw	1179*

34-445
10" Contractor's Saw w/30" Unifence
$689*

34-445B	10" cont. saw/28" Bies.	689*
34-444	10" contractors' saw	619
34-670	10" motorized table saw	389
34-330	8-1/4" bench table saw	199
33-890	12" radial arm saw	1269
33-990	10" radial arm saw	579

28-283
14" Bandsaw 3/4 HP Enclosed Stand
$589*

33-055	8-1/4" sawbuck w./legs	569
37-280	6" motorized jointer	379
37-154	6" jointer, DJ-15 w/stnd	1029
46-204	M12" 4 speed wood lathe	999
17-900	16-1/2" floor drill press	399

34-080
10" Miter Saw
$199

40-560	16" bench scroll saw	185
31-340	1x42 belt/8" disc sander	179
36-040	8-1/4" compound mitre	159
23-700	wet/dry grinder	159
31-460	4x36 belt/6" disc sander	139

43-375
3 HP HD Two Speed Shaper
$1479*

22-667	13" plnr w/stand &knvs	1149
31-730	6" belt/12" disc sander	1089
31-380	4" x 132" edge sander	1299
37-350	8" jointer,DJ-20 w/stnd	1399
46-541S	12" V.S. wood lathe	1399
43-502	overarm router shaper	1499

40-601
18" V.S. Scroll Saw w/Stand
$589*

50-181	2 hp dust collector	598
50-180	1 hp dust collector	418
50-179	3/4 hp dust collector	338
34-897	50" Delta unifence	338
34-915	30" Delta unifence	268

32-100
Plate Jointer
$288

34-995	3 phase stock feeder	749
34-994	1 phase stock feeder	799
34-985	1 phase stock feeder	469

43-355
NEW 1-1/2 HP, 3/4" Wood Shaper
$699

36-755	10" cabinet saw ***NEW***	889
36-751	10" cab.w/30" Uni ***NEW***	1089
36-752	10" cab.w/50" Uni ***NEW***	1169
70-200	20" floor dr. press ***NEW***	749
43-275	Onsrude#2003 Inv. rtr	2799

Price Includes Rebate

RYOBI

AP10
10" Portable Planer
$355

JP-155	6-1/8" jointer/planer	308
RA-200	8-1/4" radial arm saw	248
TS25IU	10" miter saw	178
TS380	14" miter saw	378
TS254	***NEW!*** 10" mitre saw	CALL
BT2500	10" bench table saw	298
W660	7-1/4" 13 amp circ saw	98

RE600
3 HP VS Plunge Router
$208

R500	2-1/4 hp plunge router	148
R501	2-1/4 hp plunge router	155
R150K	1 hp pl. router w/case	105
TR30U	laminate trimmer	88
BE321	3x21 VS belt sander	128
BE424	4x24 VS belt sander	179
JM100K	***NEW*** plate jointer	219
TFD170VRK	9.6v cdls kit	149
TFD220VRK	12v cdls kit	169
SC160	16" scroll saw	149

freud

FT94PK
Includes: 3-1/4 HP Plunge Router
$399

5 piece door system set (94-100) w/perfecta cutter (99-PK1) ***all***

95-100	5 pc rtr set w/99PK1	199
91-100	13pc 1/2" router bit set	189
90-100	15pc 1/4" router bit set	159
FB-100	16pc Forstner bit set	154

JS100
Jointing System W/Case
$159

FRT-2000	wooden router table	169
FT-2000	3.25 plunge router	184
EB-100	edge banding system	229
UC-900	5 pc shaper cabinet set	329
94-100	5 pc router cabinet set	154

Elu

3338
2-1/4 HP Electronic VS Plunge Router
$249

3337	2-1/4hp plunge router	239
3328	3-1/2hp fixed base router	339
3304	1hp VS plunge router	179
3303	1hp plunge router	149
2721	1.5hp fixed base router	139

3380
Jointer/Spliner W/Case
$249

3375	3-1/8" universal planer	159
4024	3x21 VS sander w/frame	189
4023	3x21 sander w/frame	179
4029	4x24 sander w/frame	309
4015	1/2 sheet finish sander	119

SCM

C4
NEW Panel Saw
$769

H5	64" capacity panel saw	1195

Adjustable CLAMPS

8" Handscrew
$12

1	10" handscrew	13
2	12" handscrew	15
3	14" handscrew	19
4	16" handscrew	25
7224	24" I-bar clamp	17
7236	36" I-bar clamp	18
7248	48" I-bar clamp	20
7260	60" I-bar clamp	23

JET

JDP-10
10" Bench 5 Speed Drill Press
$189

JDP-14M	14" bench 16 s. press	289
JDP-17MF	17" floor 16 s. press	389
JDP-20MF	20" floor 12 s. press	689

JBS-14CS
14" Wood Bandsaw
$399

JBS-18	18" bndsw 2hp w/stand	795
WBS-20	20" wdcttng bandsaw	1895
WBS-24	24" wdcttng bandsaw	2395
JSS-6188	6x168 stroke sander	1539
OVS-10	oscillating spindle sndr	1539
HES-6108	6x108 edge sander	1339

DC-610
1 HP Dust Collector
$249

DC-1182	d. col. 2 hp/1180 cfm	409
DC-1883	d. col. 3 hp/1880 cfm	649
EHVS-80	6x89 edge sander	549
JDS-20	20" disc sander 2hp	1139
JSG-6	6x48 belt/12" disc sndr	499

JJ-6CS
6" Long Bed Jointer
$399

JJ-4	4" deluxe jointer	279
JJ-8	8" long bed jointer	949
JJ-12	12" long bed jointer	2379

JCS-10A
10" Cabinet Saw With T-Square Fence
$879

CTAS-10B	3hp saw w/Beis.	1399
CTAS-12S	12" scoring saw	3989
JTS-12	12" table saw 1.5 hp	549
JTS-10	10" table saw 1.5 hp	459

JWB-37P
37" x 60" Wide Belt Sander
$9995

JWB-25P	25x60 w. belt sndr	6995
JWB-13P	13x60 w. belt sndr	4899
JWB-25PH	25x75 w. belt s.	11339
JWB-37PH	37x75 w. belt s.	12899

JWP-12
12" Portable Planer
$369

JWP-15H	15" planer 3 hp	999
JWP-208-1	20" plnr 2sp/3hp	1689
JWP-20H-1	20x7 planer 3hp	2679
JWP-24HWG	24" planer 10hp	7199

JWS-18H
1 HP Wood Shaper
$399

JWS34-1	2hp 1" spindle shaper	995
WSS-3	3 or 5hp wood shaper	1399
TWSS-3	tilting spindle shaper	2849
STSS2-3	wood shaper 7-1/2 hp	4199

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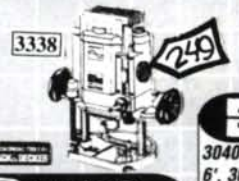

BOSCH

1370DEVS 6" H.D. Random Sander $249

3272	3-1/4" planer 4.2 amps	99
1608U	underscribe lam. trmr	139
1609KX	laminate trimmer kit	229

BOSCH

1581VS Top Handle Jig Saw $128

1582VS	barrel grip Clic jig saw	128
1632VSK	VS recip saw kit	135
3050VSRK	3/8 VSR kit w/2 batt	128
3258	3-1/4" power plane	128
1654	7-1/4" saw w/ct blade	98

3283DVS Dustless Random Orbital Sander $98

FB1600	16 pc forstner bit set	138
1348AE	5" elec. mini grinder	108
1608	laminate trimmer	88
1609	offset base laminate trmr	118
1942	heavy duty heat gun	68

1273DVS 4x24 V.S. Belt Sander $188

1273D	4x24 sander with bag	179
1272D	3x24 sander with bag	169
3270D	3x21 sander with bag	134
1290D	1/2 sheet finish sander	118

1604 1-3/4 HP Router $118

1611	3 hp plunge router	198
1611EVS	3-1/4 hp VS pl. rtr	233
1606	1.75 D-handle router	148
1609K	3 in one trimmer kit	168

1001VSR 3/8" VSR, 0-1100 4.8 Amp Drill $68

1021VSR	3/8" 0-1100VSR drill	89
1022VSR	3/8" 0-1100 XHD VSR	99
1023VSR	1/2" 0-550 hd VSR dr.	99
9164VSR	3/8" 0-1000 m. midget	104
9166VSR	1/2" 0-650m. m drill	114

1404VSR 0-4000 Drywall Driver $68

1405VSR	0-2500 drywall driver	79
1420VSR	0-4000 hd drywall dr	79
1421VSR	0-2500 hd drywall dr	89
1422VSRQ	0-2500 hd tek dr	109

1198VSR 1/2" Hammer Drill $138

1212VSR	Bulldog .75 SDS hmr	195
11202	1.5 rotary hammer	419
11214VS	1.75 VS rotary hmr	619
11304	Brute breaker hammer	1229
11305	demolition hmr 10 amp	689
11306	demolition hmr 7.3 amp	449

Dugco

Zambesi 2' x 5.5' Solid Teak Workbench $699

Deluxe	1.9' x 4.7' workbench	399
Major	2.2' x 5.5' workbench	499
Carver	4.2' x 1.4' workbench	249

BESSEY

WS-3 2" Angle Clamp $25

WS-6	4" angle clamp	59

David White

ALP6-18HD 18 Auto Level Pack $379

LP6-20	20x sight level pkg	204
AL8-22	auto level	429
LT6-900	level transit	259
LT8-300	26 x transit w/tripod	479
LT8300P	opt. transit w/tripod	549
ALT6-900	18xtransit w/tripod	399

Complete Line In Stock!

SKIL POWER TOOLS

2735-04 12 Volt 3/8" VSR Drill Kit W/2 Batteries $129

1605	NEW plate jointer	124
77	7-1/4" worm drive saw	145
5550	NEW 7-1/4" circular saw	99
5656	7-1/4" 13 amp circ. saw	119
5660	8-1/4" 60° pro bevel saw	139
5860	8-1/4" 60° rafter master	169

SENCO

SFN-1 1"- 2" Finish Nailer $278

SN-4	6d-16d frame nailer	478
SFN-II	1-1/2 to 2-1/2 fin. nlr.	398
SN325	6d to 12d nailer	458
SKS	1/4" crown finish stapler	258
M-II	1-3/8" to 2" HD stapler	348
LS-2	5/8" to 1" brad tacker	254
LS-5	1" to 1-1/2" brad tacker	288
PW	roofing stapler	348
SPS-RFR	roofing stapler	338

Not Available In All States

shop-vac

890-11 10 Gallon, 2 Stage, 2 HP By-Pass S.Steel Vac $249

610-50	10 gal. S.S. cont. vac	169
464-38	12 gal. poly. cont. vac	179

BAUER

30406 6', 300 lb Fiberglass Stepladder $84

30405	5' fiberglass ladder	75
30404	4' fiberglass ladder	65
10106	6' HD wood ladder	79
10105	5' HD wood ladder	74
10104	4' HD wood ladder	59

KRAUSE

121482 12' Multimatic 300 lb. Multi Purpose Alum. Ladder $129

121499	16 foot ladder	149

POWER TOOL SPECIALIST INC.

LPN672 Air Palm Nailer $99

Drives 5D - 70D nails!

TROJAN

TWC-24 Work Center $99

DREMEL

1671 16" 2 Speed Scroll Saw $179

1371	13" scroll saw	129
1631	1"x30" belt sander	89
1731	1"x30" belt/5" disc sander	119
7360	HD flexible shaft kit	199

Qual-Craft

2200 Pump Jack $59

2201	top brace	21
2203	guard rail holder	23
2204	work bench	41

Lignomat

Mini-Ligno Wood Moisture Meter 6-20% $99

Mini-ligno E	6-36%	109

LEIH

D1258R-24 24" Dovetail Jig $279

D1258R-12	12" dovetail jig	239
MMTA-24	24" mortise attach	159
MMTA-12	12" mortise attach	139
LJV	instructional video	29

DELTA

TARGET

VC-6 Versa Cut Tile Saw $699

PT1050	10" 1/2 hp tile saw	699
PS1421	14" 2 hp bricksaw	1149
PACIII85K	8 hp walk behind	1399

PARTNER

K500 50cc 12" Cut-Off Saw $549

K650	12" 65cc cut-off saw	699
K700	14" 70cc cut-off saw	749
K1200-14	100cc cut-off saw	829
K2000EL	12" 115v cut-off saw	549

Telpro Inc.

PANELLIFT™ Drywall Lift $449

FUJI

#HVLP High Volume Low Pressure Sprayer $649

No Compressor Needed!

BOSTITCH

N12B-1 Coil Roofing Nailer $399

N80S-1	16d stick nailer	409
N80C-1	coil nailer	399
N100S-1	6d-20d nailer	489
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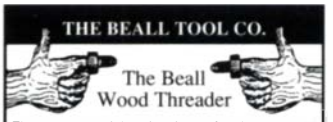

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1a. Title: Fine Woodworking. **1b.** Publication no. 03613453 **2.** Date of filing: September 28, 1990. **3.** Frequency of issue: Bimonthly. **3a.** No. of issues published annually: 6. **3b.** Annual subscription price: $25.00. **4.** Location of office of publication: 63 So. Main Street, PO Box 5506, Newtown, CT 06470-5506. **5.** Location of the headquarters of the publishers: 63 So. Main Street, PO Box 5506, Newtown, CT 06470-5506. **6.** Publisher: John Lively, 63 So. Main Street, PO Box 5506, Newtown, CT 06470-5506; Editor: Dick Burrows, 63 So. Main Street, PO Box 5506, Newtown, CT 06470-5506; Managing editor: James Boesel, 63 So. Main Street, PO Box 5506, Newtown, CT 06470-5506. **7.** Owner: The Taunton Press, Inc., 63 So. Main Street, PO Box 5506, Newtown, CT 06470-5506. Stockholders owning or holding 1 percent or more of the total amount of stock: Paul Roman, 63 So. Main Street, PO Box 5506, Newtown, CT 06470-5506; Janice A. Roman, 63 So. Main Street, PO Box 5506, Newtown, CT 06470-5506. **8.** Known bondholders, mortgagees and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages or other securities: None. **9.** Not applicable. **10.** Extent and nature of circulation:

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A. Total no. copies (net press run)	345,150	345,184
B. Paid and/or requested circulation		
1. Sales through dealers and carriers, street vendors and counter sales	58,879	59,834
2. Mail subscription	229,530	225,407
C. Total paid and/or requested circulation	288,409	285,241
D. Free distribution by mail, carrier or other means, samples, complimentary, and other free copies	4,195	2,021
E. Total distribution	292,604	287,262
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1. Office use, left over, unaccounted, spoiled after printing	11,741	17,666
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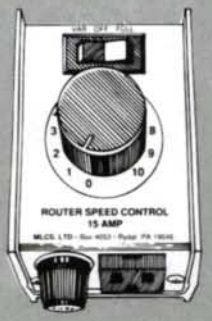

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#602		3/16" Spiral Cutter		3/16"	5/8"	1/4" *	$12.00
#603		1/4" Spiral Cutter		1/4"	3/4"	1/4"	$12.00
#903		1/4" Spiral Cutter		1/4"	3/4"	1/2" *	$12.00
#904		3/8" Spiral Cutter		3/8"	1"	1/2" *	$24.00
#905		1/2" Spiral Cutter		1/2"	1 1/2"	1/2"	$29.00
#350		1/8" Round Over	1/8" R	3/4"	3/8"	1/4"	$11.00
#351		3/16" Round Over	3/16" R	7/8"	1/2"	1/4"	$11.00
#230		1/4" Round Over	1/4" R	1"	1/2"	1/4"	$12.00
#353		5/16" Round Over	5/16" R	1 1/8"	1/2"	1/4"	$14.00
#209		3/8" Round Over	3/8" R	1 1/4"	5/8"	1/4"	$15.00
#355		1/2" Round Over	1/2" R	1 1/2"	3/4"	1/4"	$17.00
#656		3/4" Round Over	3/4" R	2"	7/8"	1/2"	$21.00
#199		Multiform Moulding	Unlimited Patterns	2 1/4"	2"	1/2"	$40.00
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#205		1/4" Cove	1/4" R	1"	1/2"	1/4"	$12.00
#206		3/8" Cove	3/8" R	1 1/4"	9/16"	1/4"	$13.00
#207		1/2" Cove	1/2" R	1 1/2"	5/8"	1/4"	$14.00
#208		3/4" Cove	3/4" R	1 7/8"	3/4"	1/2"	$26.00
#460		1/4" Bull Nose	1/4" Dia. of Circle		3/8"	1/4"	$14.00
#461		3/8" Bull Nose	3/8" Dia. of Circle		3/4"	1/4"	$15.00
#462		1/2" Bull Nose	1/2" Dia. of Circle		7/8"	1/4"	$16.00
#464		3/4" Bull Nose	3/4" Dia. of Circle		1 1/8"	1/4"	$19.00
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#508		3/4" Pattern	Flush Trim	3/4"	1"	1/4"	$17.00
#366		1/8" Slot Cutter	3/8" Deep	1 1/4"	1/8"	1/4"	$14.00
#368		1/4" Slot Cutter	3/8" Deep	1 1/4"	1/4"	1/4"	$14.00
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#211		3/8" Core Box	round nose	3/8"	3/8"	1/4"	$10.00
#212		1/2" Core Box	round nose	1/2"	11/32"	1/4"	$13.00
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#215		5/16" Straight	plunge cutting	5/16"	1"	1/4"	$ 6.50
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#846		Tongue & Groove	Wedge	1 5/8"	1"	1/2"	$29.00
#450		1/8" Beading	1/8" R	3/4"	3/8"	1/4"	$11.00
#451		3/16" Beading	3/16" R	7/8"	1/2"	1/4"	$11.00
#233		1/4" Beading	1/4" R	1"	1/2"	1/4"	$13.00
#453		5/16" Beading	5/16" R	1 1/8"	1/2"	1/4"	$14.00
#454		3/8" Beading	3/8" R	1 1/4"	5/8"	1/4"	$15.50
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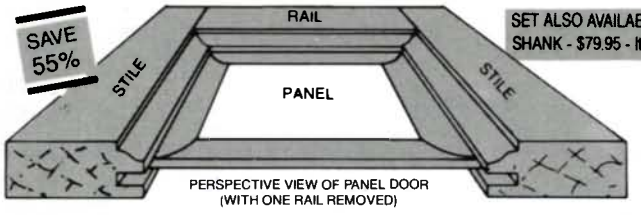

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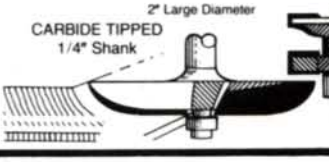

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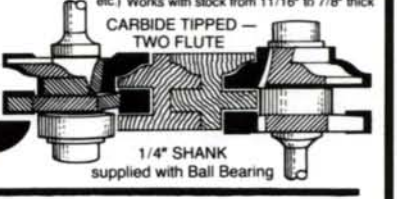

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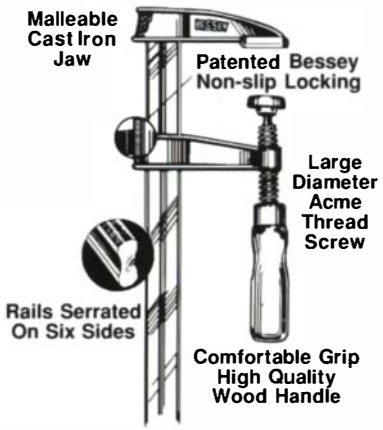

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40-601	18" VS SCROLL SAW	
33-990	10" RADIAL ARM SAW	
22-661	DC 33 13" PLANER	
50-179	3/4 HP DUST COLLECTOR	
50-180	1 HP DUST COLLECTOR	
50-181	2 HP DUST COLLECTOR	
34-985	1 PH STOCK FEEDER 110V	
34-994	1 PH STOCK FEEDER 230V	
34-995	3 PH STOCK FEEDER 230V	
33-150	8-1/4" SAW BUCK	
34-444	10" CONTR. SAW COMPLETE	
31-380	4" X 132" EDGE SANDER	
34-670	10" MOTORIZED SAW	
40-150	15" SCROLL SAW	
31-050	1" X 30" SANDER	
23-700	WET DRY GRINDER	
31-460	4" BELT 6" DISC	
17-900	16-1/2" DRILL PRESS	
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JS-100	PLATE JOINER W/CASE	$164
EC-900	DOOR SYSTEM SHAPER SET	278
94-100	DOOR SYSTEM ROUTER SET	159
FB-107	7 PC. FORSTNER BIT SET	49
FB-100	16 PC. FORSTNER BIT SET	154
FT2000	ROUTER	185

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5/8" BORE, INDUSTRIAL GRADE, CARBIDE TIPPED

LU72M010	Gen. Purp. A.T.B.	10"	40	58	39
LU81M010	Gen. Purp.	10"	40	45	43
LU82M010	Cut-off	10"	50	77	45
LU84M011	Combination	10"	50	55	42
LU85M010	Super Cut-off	10"	80	95	57
LM72M010	Ripping	10"	24	57	38
LU73M010	Cut off	10"	60	70	44
LU87M010	Thin kerf	10"	24	68	39
LU88M010	Thin kerf	10"	60	74	44
LU98M010	Ultimate	10"	80	107	79
LU89M010	Non-ferrous metal	10"	72	87	59
PS203	Plywood	7-1/4"	40	36	25
PS303	Gen'l Purp.	7-1/4"	24	25	19
DS306	6" Dado - Carbide			184	109
DS308	8" Dado - Carbide			196	119
F0	1-3/4"x1/8" Biscuits 1000 Qty			32	27
710	2-1/8"x3/8" Biscuits 1000 Qty			32	27
F20	2-3/8"x1" Biscuits 1000 Qty			34	27
FA	Assorts Biscuits 1000 Qty			34	27
WC104	4 pc. chisel set w/cse. 1/4"-1"			54	39
WC106	6 pc. chisel set w/cse. 1/4"-1"			73	52
WC110	10 pc. chisel set w/cse. 1/4"-1-1/2"			119	79
FB100	16 pc. forstner bit set 1/4"-2-1/4"			284	154
94-100	5 pc. router bit door system			230	159
JS100	Biscuit Jointer w/cse & 1000 ASST BISCUITS			300	186

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1604K	1-3/4 HP ROUTER KIT	166
1606	1-3/4 HP D-HANDLE ROUTER	144
1608	5.6 AMP. LAM. TRIMMER	88
1609K	3 IN 1 TRIMMER KIT	167
3270D	3 X 21 SANDER W/BAG	134
1272	3 X 24 SANDER	163
1272D	3 X 24 SANDER W/BAG	168
1273DVS	4 X 24 VARIABLE SPEED SANDER W/BAG	188
3050VSRK	9.6V CORDLESS W/CLUTCH	133
91066	1/2" MIGHTY MIDGET VSR	108
1347	4-1/2" MINI-GRINDER	89
1582VS	BARREL GRIP JIG SAW	132
1581VS	TOP HANDLE JIG SAW	132
1632VSK	VS RECIP. SAW W/CASE	135

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361	3 X 24 SANDER	169
362	4 X 24 SANDER W/BAG	185
363	4 X 24 SANDER	181
617	7-1/4" SAW 13 AMP	114
315	7-1/4" SAW 13 AMP	114
314	4-1/2" TRIM SAW	128
690	1-1/2 HP ROUTER	128
9118	PORTA PLANE KIT	185
555	PLATE JOINER W/CASE	164
505	1/2 SHEET PAD SANDER	109
7334	RANDOM ORBIT SANDER	118

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5007NB	7-1/4" CIRC. SAW	114
5007NBA	7-1/4" CIRC. SAW W/ELEC. BRAKE	124
1900BW	3-1/4" PLANER W/CASE	113
1100	3-1/4" PLANER HD W/CASE	210
2708W	8-1/4" TABLE SAW	257
3612BR	3 HP PLUNGE ROUTER	199
3601B	1-3/8" HP D-HANDLE ROUTER	137
9030	1-1/8" X 21" BELT SANDER	135
9900B	3" X 21" BELT SANDER W/BAG	145
9924B	3" X 24" BELT SANDER	139
9924DB	3" X 24" BELT SANDER W/BAG	148
9401	4" X 24" BELT SANDER W/BAG	167
JR3000V	RECIPRO SAW W/CASE	127
6510LVR	3/8" VSR DRILL	85
6093DW	3/8" CORDLESS KIT 2SP VSR	129
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Fine WoodWorking®

Index to issues 80 through 85

This alphabetized index to Fine Woodworking *covers departments and articles published between January 1990 and December 1990. We will publish an index once each year in our January issue. These indexes supplement, but do not replace, our cumulative indexes to issues 1 through 50 and to issues 51 through 65, which were published as separate booklets. The index to issues 1 through 50 is still available for purchase. Each reference consists of an issue number, a colon and page numbers for that issue. A hyphen between the page numbers means the discussion of the topic is unbroken on the named pages; commas between page numbers indicate an intermittent discussion. The index to issues 80 through 85 and the previous booklets were prepared by Harriet Hodges of New Castle, Va.*

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Listings of gallery shows, major craft fairs, lectures, workshops and exhibitions are free, but restricted to happenings of direct interest to woodworkers. We list events (including entry deadlines for future juried shows) that are current with the time period indicated on the cover of the magazine, with overlap when space permits. We go to press three months before the issue date of the magazine and must be notified well in advance. For example, the deadline for events to be held in March or April is January 1; for July and August, it's May 1, and so on.

CALIFORNIA: **Exhibit**–Contemporary American Wood, Jan. 11–Feb. 23. Featuring the work of turner Dennis Elliott. Banaker Gallery, 1373 Locust St., Walnut Creek, 94596. (415) 930-0700.
Juried exhibition–California Design '91, Jan. 17–Feb. 17. Contact Design Center, San Francisco. For info, contact Baulines Crafts Guild, Schoonmaker Point, Sausalito, 94965. (415) 331-8520.
Classes–Tool clinic, including how to sharpen, adjust and use tools, Feb. 16; building the Chamberlin Dory Skiff, Feb. 23-24, Mar. 2–3, Mar. 9–10. National Maritime Museum Association, Building 275, Crissy Field, San Francisco, 94129. (415) 929-0202.
Workshops–Various workshops including Japanese woodworking, joinery and sharpening. Contact Hida Tool Co., 1333 San Pablo, Berkeley, 94702. (415) 524-3700.
Rescheduled show–San Diego Gift & Stationery Show. San Diego Convention Center, San Diego. For info and new dates, contact George Little Management, 2 Park Ave., Suite 1100, New York, NY 10016. (212) 686-6070.
Solicitation–New artists wanted for the Los Angeles Craft & Folk Art Museum Research Library. Used by collectors, curators, architects, designers. No fee. Contact the Craft & Folk Art Museum Library, c/o the May Co., 6067 Wilshire Blvd., Los Angeles, 90036. (213) 934-7239.
Exhibit–Weaving...Wood, Mar. 16–Apr. 27. Featuring the work of turner Dennis Elliott. La Jolla Gallery Eight, 7464 Girard Ave., La Jolla, 92037. (619) 454-9781.
Workshops–Furnituremaking with hand tools using traditional joinery, weekends. Call for schedule: Debey Zito (415) 648-6861.

COLORADO: **Exhibit**–Vail Craftsmen Fine Custom Woodworking Show, Feb. 16–28. Vail Public Library. Contact Tim O'Brien, Box 1274, Avon, 81620. (303) 328-7253.
Classes–Woodworking and related classes, year-round. Red Rocks Community College, 13300 W. 6th Ave., Lakewood, 80401. (303) 988-6160.
Workshops–One- and two-week woodworking and furniture design workshops, summer of 1991. Scholarship deadline: March 15. Workshop registration begins Jan. 1. Teachers include Alan Peters, Thomas Moser, Peter Korn, Harv Mastilir, Kathleen Loe, Michael Emmons, Sam Maloof, Simon Watts. Anderson Ranch Arts Center, Box 5598, Snowmass Village, 81615. (303) 923-3181.

CONNECTICUT: **Workshops**–Marketing for Artists and Craftspeople with Bruce Baker, Jan. 19; Vintage Trim and Molding with Michael Saari, Feb. 2–3; Fine Art Restoration with Craig Kay, Feb. 9–10; Sign Carving with Frank Switaj, Feb. 16–17; Antique Identification and Restoration with Richard Morgan, Mar. 2–3; Carving the Ball-and-Claw Foot with Eugene Landon, Mar. 23–24. For info, contact Brookfield Craft Center, Box 122, Route 25, Brookfield, 06804. (203) 775-4526.
Juried exhibition–34th annual Guilford Handcrafts Expo, July 18–20. Guilford. Deadline for entries: Mar. 3. Contact Guilford Handcrafts, Box 589, 411 Church St., Guilford, 06437. (203) 453-5947.
Exhibit–Best of the Nutmeg Woodturners League, Mar. 9–Apr. 22. Opening reception on Mar. 9, 2-5 PM. Including the work of Dennis Elliott. Brookfield Craft Center, Box 122, Route 25, Brookfield, 06804. (203) 775-4526.

DISTRICT OF COLUMBIA: **Show**–Washington Gift Show, Jan. 6–9. Washington Convention Center. For info, contact George Little Management, 2 Park Ave., Suite 1100, New York, NY 10016. (212) 686-6070.
Show–District of Columbia Woodworking World Show, Feb. 15–17. DC Armory, 2001 E. Capital St., 20003. Contact Woodworking Association of North America, Box 706, Plymouth, NH 03264. (800) 521-7623, (603) 536-3876.

FLORIDA: **Festival**–3rd annual Italian Street Festival, Jan. 10–13. Along the Intracoastal Waterway on Flagler Dr., West Palm Beach. For info, contact Meg Feus at (407) 659-5660.
Juried show–6th annual Fine Handcrafted Furniture Show, Feb. 6–16. Florida State Fair, Tampa. Entry deadline: Jan. 11. For info, contact Lynn Keiter, 4536 W. Kennedy Blvd., Tampa, 33609. (813) 877-9585.
Juried festival–28th annual Coconut Grove Arts Festival, Feb. 16–18. Contact Coconut Grove Arts Festival, Box 330757, Coconut Grove, 33233-0757. (305) 447-0401.
Juried show–SunFest '91, May 2–5. West Palm Beach. Applications now accepted. Contact SunFest '91, 319 Clematis St., Suite 319, West Palm Beach, 33401.

GEORGIA: **Workshops**–Japanese woodworking by Toshihiro Sahara. One Saturday each month, year-round. Contact Sahara Japanese Architectural Woodworks, 1716 Defoor Place N.W., Atlanta, 30018. (404) 355-1976.

INDIANA: **Show**–Market Square Traditional Wholesale Show, Feb. 22–24. Coliseum & Exposition Center, Fort Wayne. For info, contact Kathy Goodrich, Box 220, Newville, PA 17241. (717) 776-6989.
Seminars–Woodworking and related seminars, one Saturday each month, thru April. Including tablesaw, router, bandsaw, lathe. Edward B. Mueller Co., 3940 S. Keystone, Indianapolis, 46227. (317) 783-2040.

IOWA: **Show**–International Turned Objects Show, thru Jan. 6. Iowa State University, Ames. For info, contact International Sculpture Center, 1050 Potomac St. N.W., Washington, DC 20007. (202) 965-6066.
Juried fair–21st annual Art in the Park, May 18–19. Four Square Park, Main Ave., Clinton. Deadline: Mar. 15. For info, contact Clinton Art Association, Box 132, Clinton, 52733. (319) 259-8308.

KANSAS: **Competition**–Topeka Competition 15, Mar. 30–Apr. 28. Topeka Public Library Gallery of Fine Arts, Topeka. Entry deadline: Jan. 19. For info, contact Larry Peters, Topeka Public Library, 1515 W. 10th, Topeka, 66604-1374. (913) 233-2040.
Juried show–Dimensions '91, June 7–9. Sar-Ko-Par Trails Park, Lenexa. Entries deadline: Mar. 31. Contact Dimensions '91, c/o Parks & Recreation, 13420 Oak, Lenexa, 66215. (913) 541-8592.

KENTUCKY: **Seminar**–Purchasing Wood and Wood-Based Materials, Jan. 28–29. Executive West Inn, Louisville. For info, contact Dr. Daniel Cassens: (317) 743-0607.

LOUISIANA: **Juried competition**–Lafayette Art Association national juried competition of two- and three-dimensional art, Apr. 1–30. Deadline: Jan. 15. Contact Marta Fielding, Lafayette Art Gallery, 700 Lee, Lafayette, 70501.

MAINE: **Classes**–House Design and Building, Mar. 4–15, May 6–24; Post and Beam Building, Apr. 21–26. Shelter Institute, 38 Centre St., Bath, 04530. (207) 442-7938.

MASSACHUSETTS: **Classes**–Wood II, Design & Artisanry and Wood III, Design & Artisanry, Jan. thru May. School of the Museum of Fine Arts, 230 The Fenway, Boston, 02115. (617) 267-1219.
Exhibition–V Viewpoints, Jan. 8–Feb. 2. Work by five artists, including furniture by Robert March. Main Gallery, School for Professional Crafts at the Worcester Center for Crafts, 25 Sagamore Rd., Worcester, 01605.
Workshop–12th annual Wood Identification Workshop, Jan. 15–18. University of Massachusetts, Amherst. For info, contact Alice Szlosek, Div. of Continuing Education, Room 608, Goodell Building, University of Mass., Amherst, 01003. (413) 545-2484.
Juried fair–21st annual Craft Fair, May 17–19. School for Professional Crafts at the Worcester Center for Crafts, 25 Sagamore Rd., Worcester, 01605. (617) 753-8183.
Classes–Woodworking classes, throughout most of the year. Boston Center for Adult Education, 5 Commonwealth Ave., Boston, 02116. (617) 267-4430.

MICHIGAN: **Exhibit**–Turned wood by Dennis Elliott, Jan. 12–Feb. 23. The Sybaris Gallery, 301 W. 4th St., Royal Oak, 48067. (313) 544-3388.
Show–The Grand Rapids Woodworking World Show, Jan. 25–27. Cascade Sports Arena, 2845 Thornhills S.E., Grand Rapids, 49506. For info, contact Woodworking Association of North America, Box 706, Plymouth, NH 03264. (800) 521-7623, (603) 536-3768.
Show–International Turned Objects Show, Jan. 26–Mar. 4. Northern Michigan University, Marquette. For info, contact International Sculpture Center, 1050 Potomac St. N.W., Washington, DC 20007. (202) 965-6066.

MINNESOTA: **Show**–The Twin Cities Woodworking World Show, Feb. 1–3. Minneapolis Convention Center, 1301 S. 2nd Ave., Minneapolis, 55403. For info, contact Woodworking Association of North America, Box 706, Plymouth, NH 03264. (800) 521-7623, (603) 536-3876.
Juried festival–19th annual Minnesota Crafts Festival, June 15–16. College of St. Catherine, St. Paul. Deadline: Mar. 1. For info, contact MCC-Festival, Suite 308, 528 Hennepin Ave., Minneapolis, 55403. (612) 333-7789.
Workshop–8th annual Villa Maria Woodcarving Workshop, Aug. 11–17. Frontenac. Classes include relief carving, birds, small animals, chip carving, marquetry, more. Villa Maria Workshop, Box 37051, Minneapolis, 55431.

MONTANA: **Juried show**–2nd annual Good Wood Show, Mar. 22–24. Sponsored by the Montana woodcarvers Association. At the Metra Center on the Billings fairgrounds. For info, contact Monty Sullins, 204 Nash Lane, Billings, 59105. (406) 245-8173.

NEW HAMPSHIRE: **Classes**–Classes in fine arts and studio arts. Manchester Institute of Arts and Sciences, 114 Concord St., Manchester, 03104.
Classes–Various woodworking classes, year-round. Including small boxes, kitchen utensils, lathe turning, hand carving, more. Contact The Hand & I, Box 264, Route 25, Moultonboro, 03254. (603) 476-5121.
Juried show–National Rocking Chair Show, thru Jan. 15. Hanover. Contact Rubens and Locke, 40 S. Main St., Hanover, 03755. (800) 333-3448, (603) 643-4327.

NEW JERSEY: **Show**–Atlantic City Giftware & Collectibles Show, Jan. 4–7. Convention Hall, Atlantic City. For info, contact George Little Management, 2 Park Ave., Suite 1100, New York, NY 10016. (212) 686-6070.
Seminars–Build a Shaker Table, Jan. 5; Hand Tool Joinery and Sharpening, Jan. 12; Build a VCR Tape Cabinet, Jan. 19; Japanese Tool Use, Feb. 16; Carving and Sharpening, Mar. 9; Wood Finishing and Refinishing, Mar. 16; Lathe Turning/Sharpening, Mar. 23. For info, contact Force Machinery Co., 2271 Route 22, Union, 07083. (201) 688-8270.

NEW MEXICO: **Classes**–Woodworking classes. Northern New Mexico Community College, El Rito, 87520. (505) 581-4501.

NEW YORK: **Classes**–Various beginning and advanced woodworking classes, including woodturning, wood finishing, router techniques, marquetry, tool sharpening, furniture repair and more. Constantine, 2050 Eastchester Rd., Bronx, 10461. (212) 792-1600.
Meetings–New York Woodturners Association, first Tuesday of each month. Woodturning techniques and exhibits also. The Crafts Student League, YWCA, 610 Lexington Ave., New York City.
Workshops–Japanese hand tools with Robert Meadow, Jan. 12–13, Feb. 2–3. The Lutherie, 2449 W. Saugerties Rd., Saugerties, 12477. (914) 246-5207.
Show–Long Island Woodworking World Show, Jan. 18–20. Hofstra University, 100 Fulton Ave., Hempstead, 11550. For info, contact the Woodworking Association of North America, Box 706, Plymouth, NH 03264. (800) 521-7623, (603) 536-3876.
Classes–Woodworking classes at all levels, beginning week of Feb. 4. Free demo (dovetails and bowl turning), Jan. 28. Contact The Crafts Student League, 610 Lexington Ave. at 53rd St., New York City. (212) 735-9732.
Juried show–Handmade in the USA, Feb. 23–27. Passenger Ship Terminal Pier 90, New York City. Sponsored by George Little Management and American Craft Enterprises. Contact Lynn White, George Little Management, 2 Park Ave., Suite 1100, New York City, 10016. (212) 686-6070.
Exhibition–Mondo Materials, thru Feb. 24. Collage panels created from commercially available materials and found objects, including wood. Cooper-Hewitt Museum, 2 E. 91st St., New York City, 10128. (212) 860-6868.
Fair–New York International Gift Fair, Feb. 24–28. Jacob Javits Convention Center, New York City. Including Accent on Design and American & International Crafts. Contact George Little Management, 2 Park Ave., Suite 1100, New York, 10016. (212) 686-6070.
Juried show–1991 Lilac Art Show, May 18–19. Highland Park, Rochester. Application deadline: Feb. 8. For info, contact Arts for Greater Rochester, 335 E. Main St., Suite 2, Rochester, 14604. (716) 546-5602.
Juried fair–Woodstock-New Paltz Arts and Crafts Fair, May 25–27. Ulster County Fairgrounds, New Paltz. Deadline: Feb. 1. Contact Quail Hollow Events, Box 825, Woodstock, 12498. (914) 679-8087.
Juried show–Clearwater's Great Hudson River Revival, June 15–16. Outdoors, Westchester Community College, Valhalla. Deadline: Feb. 22. For info, contact Joan Silberberg, RFD 2, Pudding St., Carmel, 10512.
Juried festival–15th annual American Crafts Festival, June 29–30, July 6–7. Lincoln Center, New York City. Deadline: Jan. 25. For info, contact American Concern for Artistry & Craftsmanship, Box 650, Montclair, NJ 07042. (201) 746-0091.

NORTH CAROLINA: **Workshops**–Ladderback Chairmaking, Jan. 7–11, Feb. 4–8; Windsor Chairmaking, Jan. 21–25, Feb. 18–22; Advanced Windsor Chairmaking, Mar. 4–8; Spoon Carving, May 4–5; Dough Trough, May 11–12. Country Workshops, 90 Mill Creek Rd., Marshall, 28753. (704) 656-2280.
Exhibit–Rude Osolnik: Retrospective of Turned Wood, Jan. 22–Feb. 15. The Crafts Center Gallery, Baise and Dunn Streets, North Carolina State University, Raleigh. For info, contact Christy Newell at (919) 737-2457.
Conference–4th annual national conference for Arts & Crafts Movement, Feb. 22–24. Grove Park Inn, Asheville. Contact Bruce Johnson, Box 8773, Asheville, 28814. (704) 254-1912.
Juried show–Showcase of Woodcarvings, Feb. 23–24. Grady Cole Center, 310 N. Kings Dr., Charlotte, 28204. For info, contact Showcase of Woodcarvings, 1418 Armory Dr., Charlotte, 28204. (704) 336-2584.

OHIO: **Show**–Columbus Woodworking World Show, Jan 11–13. Veterans Memorial Hall, 300 W. Broad St., Columbus, 43215. For info, contact Woodworking Association of North America, Box 706, Plymouth, NH 03264. (800) 521-7623, (603) 536-3768.

OKLAHOMA: **Seminar**–Build a Windsor Chair with Michael Dunbar, Mar. 2–3. Tulsa Area Vo-Tech School, Memorial Campus Cabinet Shop, 3420 S. Memorial Dr., Tulsa. Sponsored by Green Country Woodworkers, Box 470856, Tulsa, 74147-0856. (918) 743-2024.

OREGON: **Meetings**–Guild of Oregon Woodworkers, third Friday of every month. For location, contact the Guild at Box 1866, Portland, 97207. (503) 293-5711.

PENNSYLVANIA: **Seminars**–Hand Tool Joinery and Sharpening, Jan. 5; Build a VCR Tape Cabinet, Jan. 26; Japanese Tool Use, Feb. 23; Lathe Turning Between Centers, Mar. 2; Carving and Sharpening, Mar. 16. Force Machinery Co., 914 E. Main St., Norristown, 19401. (215) 279-0950.
Show–Market Square Wholesale Show, Feb. 9–11. Valley Forge Convention Center, King of Prussia. Contact Kathy Goodrich, Box 220, Newville, 17241. (717) 776-6989.
Juried show–Turner's Challenge IV. Entries deadline: Mar. 11. Port of History Museum, Philadelphia. For info, contact the Wood Turning Center, Box 25706, Philadelphia, 19144. (215) 844-2188.
Juried show–9th annual Pennsylvania National Arts & Crafts Show, Mar. 22–24. Pennsylvania State Farm Complex, 2301 N. Cameron St., Harrisburg, 17110. Deadline: Jan. 1. For info, contact Pennsylvania National Arts & Craft Show, Box 449, New Cumberland, 17070. (717) 763-1254.
Juried exhibitions–Water/Life, May 4–June 9; deadline: Jan. 15. The Dining Experience/A Craft Expression, Aug. 10–Sept. 22; deadline: Feb. 27. For info, contact Lynn Berkowitz, Luckenbach Mill Gallery, 459 Old York Rd., Bethlehem, 18018. (215) 691-0603.
Juried show–Long's Park Arts & Crafts Festival, Aug. 31–Sept. 2. Lancaster. Deadline: Feb. 28. Contact Long's Park Arts & Crafts Festival, Box 5153, Lancaster, 17601.
Show and competition–8th annual William Rush Woodcarving and Wildlife Art Show & Sale, Nov. 2–3. Penn State Delaware County campus, Lima. For deadline and info, contact Bob Young, 736 Oak Way, Havertown, 19083. (215) 446-8945.

TENNESSEE: **Exhibit**–Selections from the collection of Arrowmont School of Arts and Crafts, thru Jan. 26. Gatlinburg. Including turned wood. Call (615) 436-5860.

TEXAS: **Juried competition**–Furniture of the '90s, American Society of Furniture Artists and Council for the Visual and Performing Arts art-furniture competition and exhibition, Apr. 8–May 3. University of Texas Medical School Gallery, Houston. Entry deadline: Dec. 31. For prospectus, contact ASOFA, Competition, Box 270188, Houston, 77277-0188.
Symposium–American Association of Woodturners 5th national symposium, Apr. 4–7. Dallas. Activities include demonstrations, discussions, trade show, gallery of works. Contact AAW at (612) 484-9094.

VIRGINIA: **Show**–Virginia Woodworking World Show, Jan. 4–6. Norfolk Scope, St. Paul and Brambleton Streets, Norfolk, 23501. For info, contact Woodworking Association of North America, Box 706, Plymouth, NH 03264. (800) 521-7623, (603) 536-3768.
Exhibition opportunity–Place settings of three or four pieces that are functional or metaphorical. Deadline: June 30, 1991. Hand Workshop, 1812 W. Main St., Richmond, 23220. (804) 353-0094.

WASHINGTON: **Exhibitions**–Bedrooms: Where Your Dreams Come True, Jan. 3–Feb. 28. Contact Northwest Gallery, 202 First Ave. S., Seattle, 98104. (206) 625-0542.
Workshops–Steam Bending, Jan. 26; Sailmaking and Repair, Feb. 9; Oar Making, Feb. 23. For info, contact Northwest School of Wooden Boatbuilding, 251 Otto St., Port Townsend, 98368. (206) 385-4948.
Workshop–Timber Framing with Tedd Benson, Feb. 10–16. Port Townsend. Contact Timbercraft Homes, 85 Martin Rd., Port Townsend, 93868. (206) 385-3051.
Workshops–Silver Engraving, Jan. 13–Feb. 17; Canoe Paddle Carving, Jan. 31–Mar. 15. Port Gamble Klallam Tribe, Box 280, Kingston, 98346. (206) 638-2794.
Meetings–Northwest Woodworkers Guild, last Wednesday of each month. Contact Kirk Kelsey, 744 N. 78th, Seattle, 98103. (206) 789-2142.

WEST VIRGINIA: **Exposition**–Appalachian Hardwood Expo '91, June 13–15. Mercer County Technical Education Center, Princeton. For info, contact AHE, 105 Old Bluefield Rd., Princeton, 24740. (304) 425-9551.

WISCONSIN: **Juried festival**–19th Festival of the Arts, Apr. 14. Stevens Point. Deadline: Jan. 30. Contact Festival of the Arts, Box 872, Stevens Point, 54481. (715) 341-7543.
Exhibit–Beneath the Ice: The Art of the Fish Decoy, Jan. 21–Mar. 18. Milwaukee Public Museum, Milwaukee. Contact Susan Flamm, Museum of American Folk Art, 61 W. 62nd St., New York, NY 10023-7015. (212) 977-7170.

CANADA: **Exhibit**–Turned vessels by Ted Hodgetts, thru Jan. 6. The Craft Gallery, Ontario Crafts Council, Chalmers Building, 35 McCaul St., Toronto, Ont., M5T 1V7. (416) 977-3551.
Juried exhibition–Explorations in Wood, thru Jan. 13. Maltwood Gallery, Victoria, B.C. Contact Glenn Gerein at (604) 382-1939 or (604) 592-8264.
Exhibit–American Wildfowl Decoys, thru Jan. 19. Kamloops Art Gallery, B.C. For info, contact Susan Flamm, Museum of American Folk Art, 61 W. 62nd St., New York, NY 10023-7015. (212) 977-7170.
Show–The Maritime Woodworking World Show, Feb. 8–10. Atlantic Winter Fairgrounds, Prospect Rd., Armdale, N.S. For info, contact Woodworking Association of North America, Box 706, Plymouth, NH 03264. (800) 521-7623, (603) 536-3768.
Workshops–Vancouver's leading carvers demonstrate their techniques, Mar. 10. Lathe Turning with Dale Nish, May 25–26. For info, contact Tools 'n Space Woodworking, 338 Catherine St., Victoria, B.C., V9A 3S8. (604) 383-9600.
Classes–Various woodworking classes including bird carving, wood sculpture, willow chairmaking and more. Contact the Haliburton School of Fine Arts, Box 339, Haliburton, Ont., K0M 1S0. (705) 457-1680.
Meetings–Canadian Woodturners Association meetings, throughout the year. Second Tuesday of each month. Contact Bob Stone, Box 8812, Ottawa, Ont., K1G 3J1. (613) 824-2378.
Meetings–Blue Mountain Woodworking Club meetings, throughout the year. Third Wednesday of each month. Contact Glenn Carruthers, Box 795, Stayner, Ont., L0M 1S0. (705) 444-1752.

AUSTRALIA: **Shows**–Australian Timber & Working with Wood Shows, July 26–28, R.A.S. Showgrounds, Sydney; Oct. 3–6, Royal Exhibition Building, Melbourne. For info, contact Patrick O'Reilly, Riddell Exhibition Promotions Pty Ltd., 10 Mallett St., Camperdown, NSW 2050. (02) 565 1099.

ENGLAND: **Exhibit**–Can't Stop Me Now, Jan. 9–Feb. 24; focusing on the work and careers of 20 Setting-Up Grant recipients, covering a range of crafts. Crafts Council Gallery, 12 Waterloo Place, London, SW1Y 4AU. 071-930 4811.
Exhibition–International Practical Woodworking exhibition, beginning Feb. 21. Wembley Exhibition Hall. For info, contact Sovereign Exhibition Management, Park House, 55 Park Lane, Carshalton, Surrey SM5 3EE. (01) 773 3751.
Classes–Woodworking classes. Smith's Gallery, 56 Earlham St., WC2. Contact Laetitia Powell, Parnham, Beaminster, Dorset, DT8 3NA. (0308) 862204.

GERMANY: **Fair**–International Hardware Fair, Mar. 3–6. Cologne. For info, contact KölnMesse, Messeplatz 1, Postfach 21 07 60, D-5000 Köln 21 (Deutz).

ITALY: **Fair**–Milan Furniture Fair, Apr. 12–17. Running in conjunction with 5th Salone del Complemento dÁrredo (furnishing accessories exhibition). For info, contact Cosmit, 20123 Milano, corso Magenta 96. 02 48008716.

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14-040	14" drill press	313	309
40-150	15" hobby scroll saw	178	139
28-160	10" hobby band saw	189	144
31-050	1" belt sander 2.0 amp	93	78
31-460	4" belt/disc sander	178	139
31-340	NEW1" belt/8 disc sander	226	175

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40-560	16" 2 speed scroll saw	266	185
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11-990	12" Bench Drill Press	266	185
11-090	32"Radial bench drill press	399	279
43-505	1/2"Bench router/shaper	399	329

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33-990	10" radial arm saw	727	565
37-280	6" motorized jointer	440	375
50-179	3/4 HP 2 stg. dust coll.	435	339
50-180	1 HP dust collector	535	415
50-181	2 HP dust collector	760	599
22-667	13" planer w/2 HP motor w/stand & ext. wings	1750	1099
33-050	NEW 8-1/4 Sawbuck	742	545
33-050	Above saw comp w/legs	865	565
34-330	NEW 8-1/4" Tbl Saw 13A	321	195
34-985	1/6 HP stock feeder	698	459
32-100	NEW station plate jointer	645	289
36-040	NEW 8-1/4 cmpd mitre saw	216	159
34-897	50" Delta unifence	500	338
36-755	NEW 10" Tilt Arbor Saw	1203	875

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0395-1	9.6Vcdlss. drill w/cse	270	148
0219-1	9.6V cdlss. drill w/cse	295	165
0224-1	3/8" drill 4.5A magnum	189	112
0234-1	1/2" drill 4.5Amag0-850rpm	209	112
0244-1	1/2" drill 4.5Amag0-600rpm	209	112
0222-1	3/8" drill 3.5A0-1000 rpm	179	102
0228-1	3/8" drill 3.5A 0-1000 rpm	169	99
0375-1	3/8" close quarter drill	208	125
0379-1	1/2" close quarter drill	243	154
6539-1	Cdls. scrdrv. 190 rpm	119	69
6540-1	Cdls. scrdrv. w/bits & cse	159	108
6546-1	Cdls. scrdrv. 200 & 400 rpm	126	75
3102-1	Plmbrs rt angle drill kit	330	185
3002-1	Electricians rt angle drill	330	182
5399	1/2" D-hdle ham drill kit	312	179
1676-1	H.D. Hole Hawg w/case	429	229
6511	2 sp SawZall w/case	224	129
6750-1	Drywall gun 0-4000 4.5A	154	89
6507	TSC SawZall w/case	239	129
6170	14" chop saw	430	259
6014	Orbital sander 1/2 sheet	209	118
8977	Var. temp heat gun	114	75
5397-1	3.8" v/sp ham. drill kit	232	137
5371-1	1/2" v/sp ham. drill kit	335	185
3107-1	1/2" v/sp rt angle drill kit	340	189
6754-1	Drywall gun 0-4000 4.5A	179	119
3300-1	1/2" v/sp mag rt angle drill	309	179
5660	Router 1-1/2 HP - 10amp	325	195
5680	Router 2 HP - 12 Amp	355	219
5455	7/8" polisher 1750 rpm	219	127
6215	16" chain saw	280	169
6365	7-1/4" circular saw	204	119
6366	7-1/4" circ. saw w/fnc & bld	214	125
6368	7-1/4" circ. saw w/fence bld & cse	239	135
0235-1	1/2" drill kyls. chuck mag	215	125
6016	1/4 sheet pad sander	84	49
6145	4.5" grinder 10,000 rpm	159	95
6142	6145 w/case & access	197	125
6749-1	Drywall gun 0-2500 4.5A	189	125
6377	7-1/4" worm drive saw	295	169

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LU73M010	Cutoff 10"	60	70	44
LU87M010	Thin kerf 10"	24	60	38
LU88M010	Thin kerf 10	60	74	44
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SD308	8" Dado - Carbide		196	109
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F10	2-1/8" x 3/4" Bisc. 1000 Qty.		32	27
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WC106	6 pc. chisel set w/cse 1/4"-1"		73	52
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94-100	5 pc. router bit door system		288	155
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TK906	10" Combo	50	45	26.95

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6071DWK	3/8" v/speed rev. drill w/removable batt, 7.2v	199	115
5090DW	3-3/8" saw kit. 9.6v	256	139
6010DWK	3/8" cdls drill kit 7.2v	164	95
6010SDW	3/8" cdls. drill kit, 7.2v	99	59
DA3000DW	3/8" angle drill, 7.2v	251	139
8400DW	Hammer drill kit, 9.6v	272	149
4390DW	9.6 cdls recip saw kit	230	128
4300DW	Jig saw kit comp., 9.6v	232	129
6012HDW	2 spd. driver drill w/clutch & case 9.6	236	122
6092DW	V/sp drill, kit complete	250	125
6093DW	V/sp drill w/clutch-complete	261	127
632007-4	9.6 volt battery	48	30
632002-4	7.2 volt battery	40	28
5007NBA	7-1/4" saww/elec. brake	233	124
5008NBA	8-1/4" saww/elec. brake	284	158
B04510	1/4 sheet pad sander	85	54
9900B	3" x 21" belt sanderw/bag	268	144
9924DB	3"x 24" belt sander w/bag	282	145
9045N	1/2 sht fin. sand. w/bag	231	129
4200N	4-3/8" circ. saw 7.4A	225	127
4301BV	Orb. v/sp jig saw 3.5A	289	155
JR3000V	Vs. recip saw w/cse	227	124
LS1020	10" miter saw 3.5A	463	289
9820-2	Blade sharpener	373	195
1900BW	3-3/4" planer w/case	209	114
1911B	4-3/8" circ. saw 7.5A	240	139
1100	3-1/4" planer w/case	401	205
9207SPC	7" sander-polisher	276	149
3601B	1-3/8 HP router	255	139
9501BZ	4" grinder, 3.5 amp	126	69
B04530	6" round sander	101	64
B04550	1/4 sht pad sander w/bag	86	58
DA3000R	3/8"angle drill	270	148
HP2010N	3/4" v/sp hmr. drill w/case	300	165
2708W	8-1/4" table saw	504	249
2711	10" table saw w/brake	841	479
2030N	12" planer/jointer	3120	1665
2040	15-5/8" planer	2595	1459
1805B	6-1/8" planer kit w/case	679	359
5005BA	5-1/2" circular saw	223	135
6404	3/8" drill rev. 0-2100 rpm 2A	104	65
6510LVR	3/8" drill rev. 0-1050 rpm	145	79
6013BR	1/2" drill rev. 6 Amp	241	135
5402A	16" circular saw-12 amp	636	325
3612BR	3 HP plunge router	377	189
9401	4" x 24" belt sander w/bag	318	165
3620	1-1/4 HP plunge router	192	109
4302C	V spd. orb. jig saw	302	159
5077B	7-1/4" Hypoid saw	252	138
LS1440	14" Miter saw	721	435
2414	14" cut-off saw AC/DC	351	199
5007NB	7-1/4" circ saw 13A	209	112
3612B	3 HP plunge router sq/base	377	189

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SN4	Gen'l purpose 2" - 3-1/2"	685	479
LS2	Pinner 5/8" - 1	351	255
SKS	Stapler 5/8" - 1-1/2"	351	255
LS5	Pinner 1" - 1-1/2	399	295

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N80S-1	Stick nailer	795	399
T36-50	Sheaith & decking stapler	595	334
N12B-1	Coil roofing nailer	795	399
N60FN-2	Finishing nailer	625	335
T31	Brad nailer	245	149
CWC100	1 HP Pancake Comp.	445	295

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3810	10" Miter saw	263	209
3810S	3810 w/60 tooth carb blade	235	
77	7-1/4" worm drive saw	230	144
2735-04	12v v/spd cordless drill complete w/cse. & 2 batt.	210	125
1605	NEW Biscuit Jointer w/cse	200	118

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TR12	Plunge router. 3 HP	354	169
C10FA	10" deluxe mitre saw	490	269
C12FA	NEW 12" mitre saw	586	319
C8FB	8-1/2" slide cmpd saw	859	445
FREUD	LU91M008 8-1/2" c/bid 48 tooth	58	38
C15FB	15" mitersaw	745	379
FREUD	LU85M015 15"c/bid 108 tooth	181	115

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73-759	8-1/4	40	44.65	24.99
73-719	8-1/4	22	19.65	11.95
73-715	5-1/2	16	13.70	7.99
73-740	10	32	32.98	15.95
73-770	10	60	67.02	29.95
73-711	10	50	65.08	29.95

WINTER KIT SPECIALS

6012HDWH.... Makita cdls 2/sp drill kit w/clutch
Includes extra battery & holster 288 155

6092DWH Makita cdls v/sp drill kit w/brake.
Includes extra battery & holster 305 159

6093DWH Makita cdls v/sp drill kit w/clutch & brake.
Includes extra battery & holster 313 165

9850K Porter Cable cdls var/spd drill kit
Includes extra battery 288 165

7334K Porter Cable 5" random orbit sander w/case & 1 roll 100X & 150X discs 253 149

7335K Porter Cable 5" v/spd random orb sander w/case & 1 roll 100X & 150X discs 273 159

7336K Porter Cable 6" v/sp rand orb sander w/case & 1 roll 100X & 150X discs 278 165

555K Porter Cable plate biscuit jointer w/case & 1000 assort. biscuits 339 189

JS100K Freud plate biscuit jointer w/case & 1000 assort. biscuits 351 184

1581VSK Bosch top hdle jig saw with case & 30 Bosch blades 305 185

1582VSK Bosch CLIC barrell grip jig saw w/case & 30 Bosch blades 305 185

34-080K Delta 10" Mitre saw w/Freud LU85M010 80 tooth carb. blade 409 249

Freud Trio of 10" Carb. blades LM72M010 LU84M011 & LU85M010 ..... 232 125

PONY SPRING CLAMPS

Model	Size	List	Sale	Lots of 25
3201HT	1"	2.25	1.35	31.99
3202HT	2"	3.39	1.85	43.95
3203HT	3"	6.45	4.04	89.00

JORGENSEN I-BAR CLAMPS

Model	Size	List	Sale
7224	24"	27.11	17.55
7236	36"	29.10	18.65
7248	48"	31.96	19.75
7260	60"	35.60	23.55
7272	72"	37.30	25.29

ADJUSTABLE HANDSCREWS BY JORGENSEN

Item#	Jaw Length	Open Cap	List	Sale	Box of 6
#3/0	6"	3"	15.57	8.89	49.98
#2/0	7"	3-1/2"	16.74	9.95	53.55
#0	8"	4-1/2"	18.63	11.95	62.95
#1	10"	6"	21.30	12.99	71.49
#2	12"	8-1/2"	24.45	15.95	81.89
#3	14"	10"	31.01	18.95	104.95
#4	16"	12"	40.30	24.89	146.85

STYLE 37 2-1/2"Throat 1/4" x 3/4" JORGENSEN

Item#	Jaw Length	List	Sale	Box of 6
3706	6"	9.30	6.29	35.65
3712	12"	10.30	6.79	38.59
3718	18"	11.37	7.35	41.69
3724	24"	12.42	7.99	45.25
3730	30"	13.85	9.05	51.19
3736	36"	15.15	9.95	58.65

PONY CLAMP FIXTURES

Model		List	Sale	Lots of 12
50	3/4" black pipe clamps	13.10	7.89	83.99
52	1/2" black pipe clamps	10.93	6.30	68.25

BOSCH

Model		List	Sale
1581VS	Top handle jig saw	239	133
1582VSC	NEW CLIC Barrell jig saw	245	133
	Bosch metal case for above jig saws	34	30
	Bosch blade assortment for jig saws 30 of Bosch's best selling blades.	25.99	
1942	Heat gun 600° - 900°	99	65
1272D	3" x 24" belt sander w/bag	299	169
1273D	4" x 24" belt sander w/bag	315	178
1290D	1/2 sheet sander w/bag	209	115
11-212VSR	Bulldog 3/4"SDS rtry drill	339	194
1198VSR	1/2" v/sp hammer drill	229	133
1608	5.6A laminate trimmer	140	87
1608L	Same/above w/trim guide	145	92
1609	5.6A offset base trimmer	205	115
1609K	Lam installers kit w/1609	295	169
1601	1 HP Router	165	105
1602	1-1/2 HP Router	199	125
1603	1/2 HP O hdle. router	223	139
1604	1-3/4 HP 2 hdle. router	219	118
1604K	Same as above w/cs & acc	269	165
1606	1-3/4 HP O hdle. router	243	145
3258	3-1/4" planer w/bide guard	210	118
3270D	3" x 21" belt sand. w/bag	225	135
1273DVS	V/sp 4x24 belt sander	339	189
1611	3 HP plunge router	349	198
1611EVS	3 HP V/speed router	410	229
1651	7-1/4" circ. saw drop foot	179	109
1654	7-1/4" circ. saw pivot base	179	109
1632VSRK	Recip saw 8.4A orb-v/sp	225	135
3050VSRK	...NEW 9.6V v/sp cdls. drill w/cse & 2 batteries	235	135
3283DVS	...NEW 5" Random orbit disc sander 2.3 Amp	159	95

ELU BY BLACK & DECKER

Model		List	Sale
3338	2.25 HP v/spd plunge router	387	249
3304	1 HP v/spd plunge router	261	178
3375	3-1/8" univ. planer 7.2A	280	159
3380	Biscuit jointer w/case	485	245
4024	3 x 21 v/spd belt sander	289	188
3303	1 HP plunge router	210	159
4023	3 x 21" belt sander 5.2A	261	185
4029	4 x 24" belt sander 9.2A	469	307

BLACK & DECKER

Model		List	Sale
1166	3/8" Drill 0-2500 rpm4A	96	59
2600	3/8" drill 0-1200 rpm 4.5A	125	85
1707	8.5" crosscut miter saw	813	445
1703	10" miter saw w/73-770 bld	313	179
3047-09	7-1/4" super saw cat w/br.	282	169
3048-09	8-1/4" supersaw cat w/br.	297	185

BIESEMEYER FENCES

	50" commer. saw fence	329	285
	52" homeshop fence	249	229

JET TOOLS

Model	Description	List	Sale
JBS-14MW	14" band saw 1 HP	482	375
JTS-10	10" tbl saw w/std 1-1/2 HP	554	449
JTS-12	12" tbl saw w/std 1-1/2 HP	630	499
JWS-18	1/2 sharper w/std 1 HP	479	365
JJ-4	4" jointer, 1/2 HP	310	275
JJ-6	6" jointer, 3/4 HP	485	365
JWP12	12-1/2" bench plnr 2 HP	569	365
JWP12D	Dust chute for JWP12	45	22
JSG-6	6x 48 belt & 12" disc sander, 1-1/2 HP	634	465
OR1012	10" bench drill press 1/3 HP	179	139
OR1412	14" bench drill press 1/2 HP	299	245
OR2501F	20-1/2" flr drill press 1 HP	655	509
OR1758	17" bnch drill press 3/4 HP	369	289
OR1458F	14" flr drill press 3/4 HP	369	325
OR1758F	17" flr drill press 3/4 HP	395	349

RYOBI SPECIALS

Model		List	Sale
R500	2-1/4 HP plunge router	326	155
TS25IU	10" miter saw	392	179
TS25IUS	10" miter w/acc. kit & B&D 73-770 carb blade	435	225
AP10	10" surface planer 13A	820	358
RA200	8-1/4" radial arm saw	515	245
RE600	3 HP plunge router	398	205
R150K	1 HP plunge router w/cs	206	105
BE321	3 x 21" v/sp belt sander	259	129
JP-155	6-1/8" jointer-planer	602	309
JM100K	NEW Biscuit jointer w/cse	430	225

PORTER CABLE

Model		List	Sale
690	1-1/2 HP router 8A	225	124
691	1-1/2 HP router D hdle	245	135
518	3 HP 5 speed router	560	335
520	3 HP 15A router	510	315
695	1-1/2 HP router/shaper	310	198
696	H.D. shapertable	170	115
351	3" x 21" belt sand w/o bag	225	128
352	3" x 21" beltsand w/bag	235	129
360	3" x 24" belt sand w/bag	310	174
361	3" x 24" belt sand w/o bag	290	168
362	4" x 24" belt sand w/bag	325	184
363	4" x 24" belt sand w/o bag	310	179
315-1	7-1/4" top hdle circ saw	195	115
9315-1	315-1 comp. w/cs & carb bld.	225	129
617	7-1/4" pushhandlesaw	230	129
9617	617 comp. w/cs & carb bld.	225	129
314	4-1/2" Trim saw	215	125
9548	X HD bayonet saw w/case	290	195
9629	Recip saw v/speed 8A	235	139
9627	Recip saw 2 speed 8A	225	128
666	3/8" HD vsp drill 0-1200 rpm	185	122
621	3/8" HD vsp drill 0-1000 rpm	155	95
320	Abrasive plane 3 Amp	160	109
9118	Porta plane kit 7 Amp	335	189
7545	0-2500 drywall gun 5.2A	169	104
505	1/2 sheet pad sander	195	112
7511	3/8" v/sp drill 5.2 Amp	185	109
7514	1/2" v/sp drill 0-750 rpm	195	117
7548	Top hdl jig saw 4.8A	230	129
7648	Barrel grip jig saw 4.8A	225	145
330	Speed block sander 1/4 sht	97	55
555	Plate biscuit jointer w/case	299	165
345	6" saw boss 9 Amp	170	99
9345	345 comp. w/cs & carb bld	220	129
100	7/8 H.P. router	165	98
5116	Omni-Jig	395	265
9647	TIGER CUB recip saw	195	119
9850	12v cordless drill w/cse	230	135
8500	Extra 12v battery NEW Tools By Porter Cable!	48	35
9637	Full v/sp recip saw 8 A	240	135
7519	3-1/4 HP Router 2 Handle	399	235
7538	3-1/4 HP Plnge Router 2 Hdl	399	235
7536	2-1/2 HP 2 Hdle Router	355	205
7537	2-1/2 HP "D" Hdle Router	375	219
7538	3-1/4 HP plunge router	399	235
7399	5.6A drywall cutout unit	120	75
7310	5.6A laminate trimmer	145	89
7312	5.6A offset base lam trim	209	119
7319	5.6A tilt base lam trimmer	165	105
97310	Lam Trim Kit w/std. Base, Tilt Base, Offset Base, Slitter Base, Guide & Cs	330	185
7334	5" random orbit sander	205	119
7335	5" Var Speed 2500-6000 rpm Random Orbit Sander	225	129
7336	6" Var Speed 2500-6000 rpm Random Orbit Sander	225	134
693	1-1/2 H.P. plunge router base	280	165
6931	Plunge router base	120	75
9505	**505 Commemorative Edition** brushed steel 1/2 sheet pad sander w/oak cse. **SUPER SPECIAL**	139	

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READER SERVICE NO. 30

Shop Savvy by Roy Moungovan. *Sterling Publishing Co., 387 Park Ave. S., New York, N.Y. 10016-8810; 1989. $14.95, paperback; 352 pp.*

Shop Savvy is the type of unpretentious book that delivers exactly what it promises. Its subtitle "Tips, Techniques, and Jigs for Woodworkers and Metalworkers" sums up the book's contents quite nicely. As Moungovan states in his introduction, "*Shop Savvy* is the result of a lifetime of tinkering with tools and making things with them." I think anyone who spends any amount of time in a shop, whether it be as a seasoned professional in a fully equipped shop or as a weekend tinkerer in the basement or garage, *Shop Savvy* will be of interest. Moungovan has obviously spent a great deal of time in shop environments, and he has compiled an exhaustive collection of mostly very clever tricks and tips.

The book is organized into 14 chapters, each dealing with a general category. In fact, if I had to fault *Shop Savvy* it would be for trying to cover too broad a range of topics. However, I am sure that the editing process for a man of Moungovan's experience was difficult at best, and perhaps that is just as well, since this book does not pander to any one trade discipline.

Moungovan has written his book from the viewpoint of the amateur, and he presents the bulk of the book's information in a clear and concise format with ample photographs to illustrate its text. Many personal anecdotes are sprinkled throughout to add levity, and the absence of philosophical musing is appreciated. Moungovan states that he feels that almost anyone can do anything if he/she takes the time and effort to study the subject thoroughly. He has obviously studied the subjects thoroughly, and with his help and sage tips, we can all "do" a bit better. *—Roger Heitzman*

Whittling Simplified: Everything You Need to Know by Herb Reinecke. *Almar Press, 4105 Marietta Drive, Binghamton, N.Y. 13903; 1985. $13.95, paperback; 166 pp.*

When I first saw this book's title, I was immediately prejudiced against it: There are so many books about whittling that claim to teach "everything," but instead show a few simple projects that any grade-school child could breeze through. Fortunately, this book is different. It has a flavor and charm of its own. And don't let the title fool you: some of the projects will challenge most woodworkers.

By the author's definition, whittling is the art of creating in wood using primarily a pocketknife. The word conjures up a vision of an old-timer sitting on a crate outside the general store, a pocketknife in one hand, a stick in the other, and a huge pile of shavings at his feet. It was a popular pastime about 60 years ago, but has faded into relative obscurity since World War II. This book attempts to recapture the knowledge and nostalgia of those days with 21 different projects, including various types of chains, a folding pocketknife, ball in a cage, and other popular whittler puzzles, each made from a single piece of wood. There are also patterns for a variety of fish and a section on carving gnomes.

The text is complemented with profuse, well-drawn illustrations. The technical information is fairly complete, though brief, and gives readers whatever they need to know about choosing tools and where to make the cuts. The pages on knife sharpening are accurate and well illustrated.

In short, by following the author's instructions, a beginner will have no difficulty getting started, and there will be sufficient challenge to keep an experienced carver interested. *—Rick Bütz*

Historic Ship Models by Wolfram zu Monfeld. *Sterling Publishing Co., Inc., 387 Park Ave. S., New York, N.Y. 10016-8810; $19.95, paperback; 352 pp.*

This book was first published in West Germany in 1977. It is an unusual book on ship models, as it does not deal entirely with the construction of any one model. Its focus is on German, Spanish, English, Italian, Dutch and French ships of the 15th through the 19th centuries.

The first half of the book covers a brief history of ship modeling and every facet of the art, from reading ship plans, choosing materials, framing, planking and fittings to carving and coloring. Each item that makes up a complete hull is covered with historical notes, construction techniques, and clear, concise drawings.

The second half of the book is devoted to masts, yards, sails, rigging and flags. There are tables of spar proportions for ships of the various nationalities. Also included is a section on the names of masts and yards, again with finely detailed drawings to illustrate the text, and a glossary of shipbuilding terms in five languages.

I think that this book can be used by both novice and more experienced modelers as a reference work because all of the information is clear and easy to find. My personal interest is not in the type of ship primarily covered by this volume, but the information seems to have been well researched. I did note the following printing errors: p. 13, labels on deck plan and profile are reversed; p. 89, detail of slots in hull plate are reversed, i.e. #1 should be to the left of station line and #3 to the right of station line; p. 214, fore and main lower top gallant yards would normally be fixed at the topmast cap.

—William S. Quincy, Jr.

Clockmaking by John A. Nelson. *TAB Books Inc., Blue Ridge Summit, Pa. 17294-0850; 1989. $18.95, paperback; 222 pp.*

This is a project book offering historically accurate plans for 18 of the most famous antique American clocks. The collection starts with a monstrous grandfather clock more than 7 ft. tall and progresses down to more diminutive and practical varieties of wall and mantle clocks. Nelson did an outstanding job selecting his subjects: they are not one-of-a-kind oddities that would interest only clock collectors, but rather examples of the classic styles popular during the 19th and early 20th centuries. Counted among them are Eli Terry's pillar and scroll design, as well as typical examples of the ogee, steeple, cottage, banjo, schoolhouse, figure eight, tambour, gingerbread and regulator designs. Nelson has toured museums to painstakingly capture the fine, decorative details and joinery techniques employed in the originals, and he even includes an appendix listing the addresses and phone numbers of the museums where some originals may be seen.

The book features very clear and easy-to-follow line drawings, and each project is accompanied by a black-and-white photo of the original and by well-written, step-by-step instructions. If this was all the book provided, it would be well worth the price, which works out to be only a little over a dollar per plan. But unlike most project books on Early American furniture, this one provides some scholarly background in the form of a brief yet thorough, 2½-page history of American clock making, as well as additional historical notes with each of the plans. There is a general section on installing movements, another complete section on how to lay out and hand-paint dials, and also helpful appendices listing sources for both clock movements and the correct hardware.

Nelson delivers just about all the facts and gives the information a woodworker needs to get into clock making and develop an appreciation of this craft's place in American history. I seldom get particularly enthusiastic about a project book, but I found *Clockmaking* a joy to read. *—Jon Arno*

Roger Heitzman is a furniture designer/craftsman in Scotts Valley, Cal. Rick Bütz is a woodcarver in Blue Mountain Lake, N.Y. William S. Quincy, Jr. is a woodworker in Quaker Hill, Conn. Jon Arno is a wood technologist and consultant in Schaumburg, Ill.

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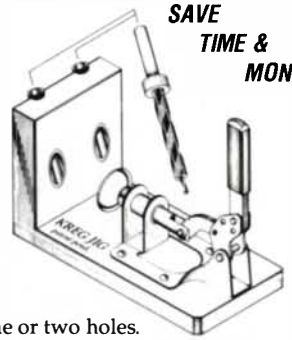

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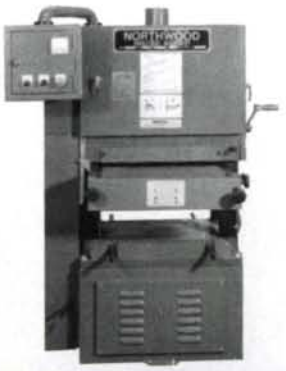

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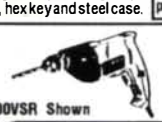

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Photo: Sean Sprague

Photo: Mark Safron

Crispin Hollinshead's "Sisyphus Series #1: Progress," is a motor-powered ball roll that won a judges award and Most Popular Piece in the Art in The Redwoods Show, Gualala, Cal.

A kinetic scu pture that keeps ro ling on

I began my career as a woodworker 17 years ago and eventually specialized in fine-scale miniature furniture for the doll house trade. But about three years ago, I walked past a store window displaying a kinetic ball sculpture that fascinated me and sent me off in a new direction. The photos above show my first attempt at a kinetic sculpture that I entitled "Sisyphus Series #1: Progress." (According to ancient Greek mythology, Sisyphus had offended the gods and was condemned for eternity to roll a boulder up to the top of a hill, only to have it roll to the bottom again.)

This sculpture, which is 30Hx24Wx16D in its glass case, is made of several woods (primarily madrone), copper plumbing, Tinkertoys, string, brass and styrene sheets and shapes, and 30 HO-scale (87:1) people, not to mention about three months of my life. When the start button is pushed, an electric motor drives a large wooden gear that moves an arm up and down. The arm is connected by pulleys to an elevator cage, which lifts ½-in.-dia. steel balls to the top of the tower, where they roll down one of four different paths. One path descends through a series of cups mounted on a manzanita branch. A second path is a sequence of ramps, while a third is a set of four pivoting scoops. The fourth path rings a bell. After lifting eight balls, the sculpture shuts itself off, awaiting the next push of the button.

The creative process was as stimulating as the work itself, for the design evolved as I went along. Sometimes I would get stuck during the day and dream the solution during the night. This combination of dream imagery, waking ingenuity and hands-on craftsmanship is, to me, the essence of creativity. I have deliberately mixed several scales, ranging from the HO people up to the full-size Tinkertoys. The result is a fantasy that defies classification, causing the observer to pause and investigate further. One of the highest compliments is the amount of nose grease on the glass case.

—Crispin Hollinshead, Mendocino, Cal.

Highlights from largest U.S. woodworking show

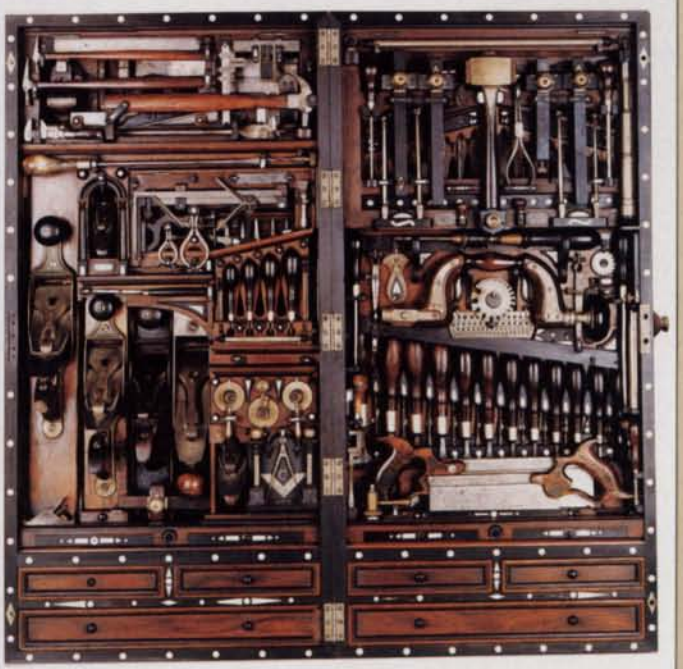
Did you say you just won the lottery and are looking to upgrade your single-car-garage-size woodworking shop with the latest computer-driven, 12-head, 200-HP, laser-actuated multitasking mega machine? Well, maybe not. But if you *were* looking for such a machine, or the latest in any kind of woodworking technology, you'd have found it at the latest International Woodworking Fair (IWF). I spent a few days at the IWF, which was held at the Georgia World Congress Center in Atlanta last Aug. 24-27, where the wares of more than 900 manufacturers, dealers and distributors of woodworking tools and supplies were available for demonstrations or hands-on use. Let me give you a quick overview of what went on at the largest United States woodworking exposition.

In addition to all the machinery and hardware on display, IWF is also a showcase for various manufacturers, trade and special-interest associations, and woodworking and design schools. Further, IWF featured technical conferences on various industry-related topics, an exhibition of work from a student design competition called "Design Emphasis '90," as well as the presentation of the annual IWF Challengers Award, which recognizes innovative technological achievements in woodworking machinery. And if all this wasn't enough, Miss Hitachi was on hand, too, signing copies of her poster.

Just in case you're like many of us who aren't interested in automated woodworking machines that cost more than the average New York City penthouse, IWF happens to be a treasure trove of the newest in basic (and considerably more *affordable*) woodworking tools and supplies. Every American and foreign manufacturer of commercial and consumer stationary and hand-held power tools that you can think of was there, and the exhibits featured a number of new and not-so-new woodworking tools. Some of the items that caught my eye: The Ryobi "Woodcarver," a 4-in. blade that looks like a sawblade with chainsaw teeth designed to run in a small angle grinder, which sculpts wood and plows grooves in hardwoods as if it was a hot knife cutting through butter. Ryobi also showed its new JM-100K plate joiner, which sports several innovative features such as positive stops in the angled fence for ease of adjustment, a dust-collection bag and a rubber-faced front fence.

Random-orbit sanders are becoming increasingly popular and both Porter-Cable and Bosch had their models on hand: Three from Porter-Cable, models 7334 and 7335 (5 in.) and the 7336 (6 in.), and the new Bosch model 3283DVS (5 in.). The two companies' sanders are designed very differently. The Porter-Cable models have their motors in the handle, like a right-angle grinder, while the Bosch's motor is vertically mounted directly above the pad assembly. Delta exhibit-

From Back Cover to Poster



TOOL CHEST LEGACY

If the workmanship in a tool chest is any indication of the maker's talent, then the craftsmanship of master carpenter and stonemason H.O. Studley must have been awe-inspiring. In an oak clamshell box adorned with rosewood, ebony, pearl and ivory, Studley kept both tools he made and a collection of the finest hand tools made prior to 1900, including a complete set of woodworking tools as well as machinist and stonemasonry tools. To pack the 300-plus tools into a case only 19½ in. wide, 39 in. long and 9½ in. deep, Studley devised a jigsaw-puzzle arrangement of flip-up trays, fold-out layers and hidden compartments. Maine native Pete Hardwick now owns the chest, which has been in his family since it was bequeathed to his grandfather by Studley. Hardwick acquired the chest from his brother by trading a 1934 Ford sedan for it. A good trade? It would seem so: Just one tool—the Stanley #1 plane housed in the ebony archway in the upper-left part of the chest—was appraised at $700. Hardwick, a nonwoodworker, plans to sell the chest.

Now available from *Fine Woodworking* magazine

The response to *Fine Woodworking's* July/August back cover was overwhelming. So many of you called or wrote asking for a poster reproduction of the exquisite tool chest by H.O. Studley, that we decided to go ahead and print one up.

We rephotographed the chest and enlarged the photo to fill the 18" x 26" poster shown above. Seen at this size, Studley's ingenuity and workmanship is even more apparent.

The poster is printed in full color on the same book-quality stock as the *Fine Woodworking* covers. And we'll mail it to you carefully rolled to keep it suitable for framing.

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TAUNTON MAGAZINES
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ed several new small machines aimed at home and small-shop users. These machines included Delta model 22540 12-in. portable planer, which will handle stock up to 6 in. thick, and the model 43505 bench-top router/shaper, which features a quiet 9-amp induction-type motor. The 43505 accepts regular ½-in. and ¼-in. shank router bits, and a ½-in.-dia. spindle accessory is available to accommodate regular shaper cutters.

The Onsrud Cutter Co. displayed its "Tersa" replacement cuttterhead for planers and shapers that features reversible and disposable knives. Turn the locking plate at the end of the cutterhead and knife changes are a breeze, because the gibs that lock the knives in place are tightened by centrifugal energy, not setscrews.

The 3M Co. demonstrated its recent line of DL6 sanding wheels made of abrasive particles and a resin binder. Designed to be mounted on a vertical shaft, but to turn slower than most shapers, DL6 wheels come in a variety of sizes and grits. They are easily shaped to any profile for finish-sanding panel edges or moldings.

Not all the developments in woodworking technology on exhibit at IWF were in the field of tools and machines. In addition to new, small-shop-scale computer hardware (such as affordable—under $10,000—computer numerically controlled milling machines), computer software for woodworking applications like cabinet design and cost estimation is becoming a larger and larger part of IWF. With environmental pollution standards becoming stricter every day, there were more than half a dozen companies either showing or introducing water-base finishes, including lacquers, varnishes and polyurethanes. Apropos of environmental issues, the demise of the rain forests has kindled a serious interest in replacement woods for tropical species. Supertech Woods (Box 242, Schoolcraft, Mich. 49087; 616-323-3570) introduced its line of Ebon-X ebony and rosewood substitutes that are manufactured by a special process from domestic hardwood. Its imitation ebony is jet black all the way through, much easier to work than ebony, and available in widths we haven't seen for real ebony in years.

In addition, there were hundreds of companies that either make or distribute cabinet and furniture hardware, materials, finishes, and accessories, as well as catalog-order companies, large hardware stores, importers of European and Asian machinery, and woodworking magazines.

If you're going to be on the West Coast this September, you might want to stop in and explore this year's latest woodworking wonders in Anaheim, Cal., where the IWF is held on alternate years. For more information, contact the IWF offices at 8931 Shady Grove Court, Gaithersburg, Md. 20877; (301) 948-5730.

—Sandor Nagyszalanczy

Photo: Jim Krebs Uptown Photography

This moradillo, ebony and glass coffee table by Dave Boykin, of Denver, Colo., won first place in last winter's Vail Craftsmen Fine Custom Woodworking Show.

Woodworking in the Rockies

Vail, Colo., only has about 2,500 year-round residents. But with 3,200 acres of skiable terrain, this small Rocky Mountain town claims bragging rights as the largest ski area in the country and as such attracts thousands of mid-winter visitors. For the past five years, a group of woodworkers in the area has capitalized on Vail's popularity as a vacation spot by putting on a show at the peak of the ski season.

For the first few years, entry in the Vail Craftsmen Fine Custom Woodworking Show was limited to craftspeople from the immediate surrounding area. But last year, for the first time, woodworkers from outside the area were invited to participate. The offer attracted work from the urban centers of Denver and Colorado Springs, both of which are some 100 miles away. And, as expected, the influx of new work broadened the scope of the show and brought with it a wide range of very interesting ideas. In fact, the panel of local judges, made up of an art dealer with many years of museum experience, an architect and an old-world trained German craftsman, awarded first place to newcomer Dave Boykin for his table shown above.

This year's Vail Craftsmen Fine Custom Woodworking Show will be held from Feb. 16-28, at the exhibition room of the Vail Public Library. Once again, the exhibit will feature a wide variety of woodwork by approximately 20 individuals from central Colorado.

—Tim O'Brien, Avon, Colo.

The dream shop

I started dreaming with the best of intentions: "If I floated a loan, I could spend to my heart's content and fill my shop with tools. Then I could get serious about woodworking. After all, I already had the perfect shop space. ..." So began my great expectations to equip the ideal workshop.

Since leaving my parents' home, it had taken me 10 years to put together a personal shop again. But I finally did it, designing this one the way I wanted. I built it too, including the slab, framing and wiring. A lot of thought went into the plan for my little sanctuary of sawdust and bliss, including insulated Sheetrock walls with electric receptacles every 4 ft. I even put in some skylights to let in natural light. (Jealously, my wife inquired why the house wasn't allowed such luxuries.)

Although feeling somewhat spoiled, I forged onward in my workshop quest. Next came the workbenches: 30 linear ft. of glossy Kortron. I felt the envy of anyone who had ever longed for a private space for quiet thought and unhurried projects. Finally the shop was complete. If I indulged myself, at least I had done it well. The result: Plenty of available shelves and open floor space just waiting for woodworking machines, hand tools, hardware and materials. Well, it all seemed too good to be true. In retrospect, I should have paid more attention to that feeling! Undaunted and glowing with pride, however, I celebrated the shop's completion with my wife, some bubbly water and a pizza.

In the months that followed, I got my contractor's license and then plunged into the waters of commitment, borrowing $10,000 for my tool binge. Plus we felt the thrill of expectation of a human kind—we were awaiting the arrival of our first child.

There was so much to do then, as each day my wife got bigger and bigger. In addition to planning for Baby, I squeezed in some time scanning magazines for tool sales, wanting to stretch every buck. I was like a kid who hoarded his allowance money. To rationalize, I frequently reminded myself that I would be paying on the loan for years to come. Each tool I bought was the realization

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of a fantasy. While trying out my new tools, I snuck time thinking of things to design and build with the relish of an anxious child on Christmas morning. Heady with these woodworking arrivals, however, I had neglected to keep track of the mounting expense of doctors and baby accessories for our more important arrival. (I never dreamed an unborn child could cost so much.)

As time for the big event grew closer, we began to experience that odd phenomenon of expectant parents—everybody seemed to be giving us things. I guess they assume you need charity after footing the expense of modern childbirth; and they're right! The clutter seemed innocent enough at first, lending no clue of the impending tide. Bags of baby clothes, diaper pails, high chairs and lawn toys all had to go somewhere. I shrugged it off good-naturedly: "Nice bunch of people to be so generous." But soon the house seemed too cramped for all the new gifts, and as the arrival of our first-born seemed imminent, so too did the overflow of debris.

The big day arrived. And despite the sleepless nights that followed our little nipper's homecoming, we were delighted with the birth of a healthy boy. We were flush with the excitement of our newest toy.

Meanwhile, the onslaught of baby paraphernalia began stacking up in the shop. Some never left. Shelves filled and floor area began to disappear. Reluctantly, I pushed back my planer and tablesaw to accommodate the stuff, as my shop time dwindled. The wife's car came next, needing engine work (unfortunately I had installed that darn overhead engine hoist). Then I inherited Grandma's dining set. My cherished haven began to resemble a multipurpose utility closet, suffering the fate of other guys' shops: "overburdened-garage syndrome." Despite the difficulties, I managed some projects while maneuvering around the crippled car and the boxes piled against the lathe.

Soon our child was collecting his own toys and kid's projects. All those precious childhood things, that we would never dare to part with, ended up you know where! With nostalgia, I remembered my early ambitions and then that premonition.

My son is going on three now, and so is my workshop. My bench is organized with crisp tools, standing shoulder to shoulder like stoic soldiers. The stationary machines stay harbored in their berths, patiently waiting for their call to arms. But while my boy is on an upward trajectory and filled with fuel, my woodworking business remains on the launching pad. Oh well, not to fret. I've renewed my vision of optimism for the 1990s. And we have our second child on the way too. Only this time around, I'm planning to spend our money on expanding the house instead of the tool collection.

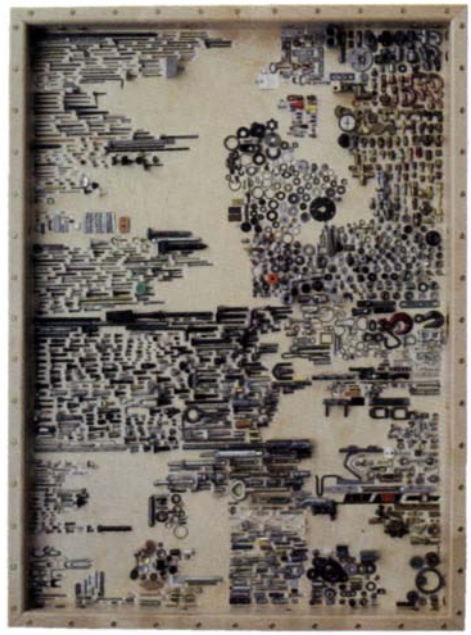
—Bob Brossard, Paso Robles, Cal.

A display of hardware

Jerry Blanchard, a high-school woodshop teacher from Carmel, Cal., thought a case displaying hardware could help teach his students about available items. The project quickly took on a life of its own: students took up the challenge of finding new items and even Blanchard stopped at every out-of-the-way hardware store he passed. The first display soon overflowed and Blanchard built a second, larger display case of brass-bound maple (shown at right). There are now over 1,635 items, each lacquered to prevent tarnishing; secured with a strand of very fine, almost invisible, stainless-steel wire; and numbered to correspond to a legend board with full details of each item. All in all, the project has been a rousing success: Blanchard met a lot of interesting people and the kids have become excited about the project.

—Charley Robinson

Photo: Jerry Blanchard



Toolworks in wood

As an instructor in the woodshop at Camp Treetops in Lake Placid, N.Y., I was amazed at the replica of a curved-claw hammer 12-year-old Danny Glickman made for his dad. Little did Danny or I know at the time that his hammer would provide the curriculum for a course that I now teach, entitled "The Woodworkers' Art," at Kean College of New Jersey.

The composition of this class is a mixture of students with various majors, including fine arts, occupational therapy and interior design, as well as postgraduates. Students of all ages are enrolled in my class and most have one thing in common: virtually no experience with woodworking tools or machines; and none is required for this course.

While downplaying the usual emphasis on design, I gave each student a choice of a hand or electric tool to reproduce in unfinished natural birch using any tools in the shop. Doubling the scale of the reproduction added interest and made the project more challenging. If a small tool was chosen, two different replicas were required. The primary goal was using hand and power tools rather than creating an exact reproduction.

The results of the class, some of which are shown in the photo at right, included more than 25 tools: oversize replicas of a sabersaw, a router, palm sanders, an orbital sander and a glue gun in the power-tool category; and a bit brace, an adjustable clamp, calipers, squares, saws, chisels, a mallet, a couple of planes, two vises and many more in the hand-tool category. A particularly interesting project was an antique rabbeting plane made by a high-school industrial-arts teacher.

The impressive collection of work was later displayed in an exhibit at the Student Gallery of Vaughn-Eames Hall on the college campus. *—Stuart Topper, Metuchen, N.J.*

Photo: Susan Walkley Topper

Stuart Topper was so impressed with the double life-size tool reproductions made by students in his class, "The Woodworkers' Art," at Kean College of New Jersey that he arranged an exhibition in its Student Gallery. The class is designed to give non-woodworkers valuable hands-on experience.

Notes and Comment

Do you know something we don't about the woodworking scene in your area? Please take a moment to fill us in. Notes and Comment pays for stories, tidbits, commentary and reports on exhibits and events. Send manuscripts and color slides (or, black-and-white photos—preferably with negatives) to Notes and Comment, Fine Woodworking, *Box 5506, Newtown, Conn. 06470-5506.*

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- AVAILABLE HEIGHT 0-140
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- THICKNESS OF FEEDING WHEEL ..... 50 M/M (2")

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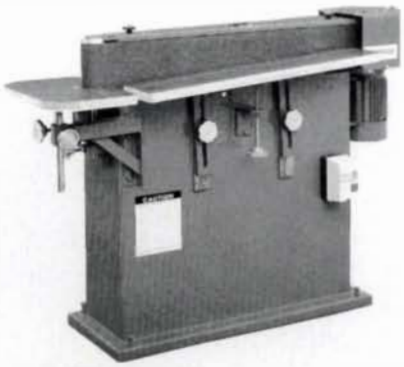

EDGE SANDER
MODEL: CT-108

- ABRASIVE BELT SIZE ..... 6x 108 inch
- TABLE SIZE ..... 37 x 7 3/4 inch
  ..... 19x 12 inch
- MOTOR ..... 2 HP 1 Phase
- MOTOR CONTACT WHEEL ..... 7 x 6 inch
- DUST OUTLET ..... 4 inch
- MACHINE SIZE Approx. ..... 64 x 22x 44 inch
- NET WEIGHT Approx. ..... 492 lbs

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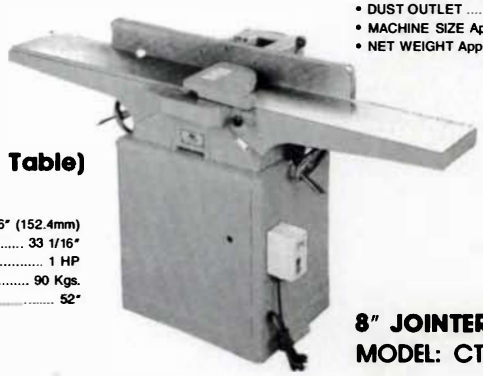
6" JOINTER (Long Table)
MODEL: CT-60L

- Cutting capacity width ..... 6" (152.4mm)
- Working height ..... 33 1/16"
- Spindle drive motor ..... 1 HP
- N.W. ..... 90 Kgs.
- Table surface long ..... 52"

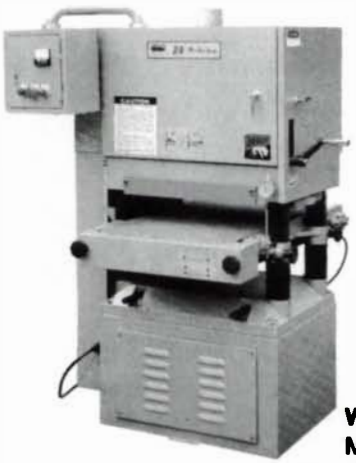
$429



8" JOINTER (Long Table)
MODEL: CT-200L

- Width ..... 8-1/8" (206.3mm)
- Number of Knives 3
- Size ..... 4" (101.6mm) High x 36" (914mm) Long
- Positive Stops ..... 90°, 45° Right and Left
- Length ..... 72" (1676.4mm)
- Basic Machine ..... 397 Lbs. (180 Kg.)
- Stand ..... 115 Lbs. (52 Kg.)
- Spindle drive motor ..... 2 HP

$859



$3865

WIDE-BELT SANDER
MODEL: CT-20S

- Working Width ..... 510 (20) mm (inch)
- Max. Working Thickness ..... 200 (8) mm (inch)
- Feed Speed ..... 4.4/7.2/9.6/15.7 (14.34/23.62/31.50/51.51) m/min (ft/min)
- Abrasive Belt Dimensions ..... 508 x 1220 (20 x 48) mm(inch)
- Motor ..... (7-1/2) kw (HP)
- Exhaust Requirement At 100 mm/4 inch
- Machine Size Approximately ..... 99 x 94 x 152 (39x 37 x 60) cm (inch)
- Net Weight Approximately ..... 545 (1202) kg (lbs)

CHISEL MORTICER
MODEL: CT-1913

$986

- Max. Chisel Size Softwood ..... 25mm 1in
  Hardwood ..... 19mm 3/4in
- Timber Capacity ..... 225 x 180mm ..... 10 x 7in
- Stroke of Chisel Head ..... 125mm 5in
- Motor T.E.F.V. ..... 0.75KW 1HP
- Table Movement Longitudinal ..... 400mm 16in
  Lateral ..... 90mm 3-1/2in
- Weight ..... 160kg 3cwt

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A Mantel Of Success

This unique mantel carved in American black cherry features woodcarver John Bryan's first love: fly fishing. The ornately carved-and-molded mantelpiece is reminiscent of those popular in the late 1700s and 1800s when they were considered symbols of success and affluence, as well as vehicles for fine craftsmanship. The hand-carved ornamentation includes a wicker creel, rods and reels, and a fly pouch resting in wildflowers and leaves, shown in the photo below, much as they might appear on a riverbank. Detailed carvings of hand-tied flies and other flora, and special moldings complete the mantel, which is built to allow for the extreme seasonal movement that wood built around a fireplace endures. Bryan, a resident of Pownal, Maine, has been a woodworker for more than 10 years and a fly fisherman since youth.

Photos: Warren Roos