Fine WoodWorking

July/August 1989, No. 77, $4.95

Computer Furniture

All About Rosewood

Working With Varnish

Making a Futon Couch

Relief-Carving

Building a Pedestal Table

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Fine WoodWorking
July/August 1989

Gary Rogowski tells how to build this cherry couch, which converts into a bed, on p. 38 (photo by Jim Piper). Cover: Mac Campbell assembles the top and base of his pedestal table, a variation on a Shaker classic (see article on p. 45).

Fine Woodworking is a reader-written magazine. We welcome proposals, manuscripts, photographs and ideas from our readers, amateur or professional. We'll acknowledge all submissions and return those we can't publish. Send your contributions to *Fine Woodworking*, Box 355, Newtown, Conn. 06470.

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DEPARTMENTS

ARTICLES

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Architects, practicality and aesthetics—The architecture students whose works are featured in *FWW* #76 should be applauded for their interest in the practical aspects of cabinetmaking and furniture construction. A sensitivity for the material and a feel for the handwork involved will, no doubt, help these students produce better work. I, however, remain unconvinced about architects' abilities to design appropriate and functional pieces.

My experience has been that architects are much too willing to sacrifice usability, comfort or practicality of construction just to enhance or complement a building's aesthetic theme. I'm certain it's a real ego trip for the designers, but if their clients pay the heavy price for such one-off pieces and they are subsequently found to be uncomfortable, impractical or even unusable, it ends up being a king-size ripoff. I'm thinking of such things as sharp edges and corners "that carry the main theme forward," disregarding the hazard for children or older people; or, smooth, even slippery (but elegant) and unyielding, surfaces that reflect that "clean, modern look of the building." But architects seem unmindful that people may be expected to sit or stand on such uncomfortable places for hours.

I'm sure many of us have seen similar examples of the thoughtless use of glass, metal tubes, wires, concrete blocks and wood being palmed off as "exciting, innovative new designs."

Please don't misunderstand; I find many fine buildings of exquisite beauty designed by architects both past and present and my admiration for these people is genuine. But, even the best can sometimes fall prey to the desire to carry their design themes to ridiculous and unnecessary lengths. I point to a man I hold in great reverence, as does the rest of the world—Frank Lloyd Wright. Just don't sit on any of his chairs; they're torture racks. *—Don Dill, St. Louis, Mo.*

How long do *FWW* projects take?—Most of the articles in *FWW* appear to be by people who sometimes try to make some money from their skills. It would be very useful to have a statement of the time used to create each product (or better still, each phase of the project) and the retail/wholesale price received. This would be of great help for those of us trying to orient ourselves in the professional market.

Of lesser import perhaps, but useful to many, would be some effort toward standardized terminology. I have a fairly good background of experience and have read widely, but hardly an issue goes by when some new term doesn't come up that makes nebulous the meaning of some process. Usually, after a little puzzling, I realize that I know what is being talked about, and simply have a different name for it. I am always glad to learn the new terms, but I don't like the guessing and struggling.

I suggest you establish a standard vocabulary for common woodworking activities. When an author uses a different term for something, just put the *FWW* standard term in parentheses. This way, we could learn the new terms and avoid the temporary confusion. This would make some articles more accessible to beginners, to those of us who are not familiar with every branch of woodworking or to those have learned only one set of regional terminology. *—Derek Roff, Rigby, Ida.*

Woodworking journalist

To join *Fine Woodworking* staff as assistant or associate editor. We're looking for an energetic, idea person with experience in a cabinet or general woodworking shop, plus experience as a writer or editor or proven deftness with the English language. Drawing and photographic abilities and formal woodworking training are an asset. Must be willing to relocate to southwestern Connecticut and to travel on the job. Send resume and photos of recent work in wood to: Personnel Manager, The Taunton Press, 63 S. Main St., Box 355, Newtown, Conn. 06470.

Craft isn't art—The trend over the last few years appears to be for craftspeople to "blur the distinctions between art and craft." The resulting blur has become evident in the field of woodworking with the appearance of furniture that has consciously been designed to be either useless or near useless, however flawlessly crafted it may be. This form of woodwork has at some point been referred to as "artiture." Contemporary with the development of this work has been a similar movement in woodturning. With many turned works, the emphasis is on sculptural qualities and exploring the physical limits of the materials. There has even been a revival of faux finishes such as marbleizing and opaque colors. While these forms emphasize originality, they certainly don't emphasize utility. The exhibition of these forms at high-end galleries and shows indicates that these contemporary forms are considered to be worthy of top consideration and top dollar, usually at the expense of more traditional work.

As a *craft*sperson I protest. Craft differs from fine art in that the craft's inherent utility determines the majority of an object's form. After that utility is served there is room for freedom of design. I see craft as both utilitarian and aesthetic, while fine art is purely aesthetic. What bothers me is that I see a trend of flashy, "original" and fairly useless fine-art objects taking over the place of fine craft at galleries and shows that claim to be craft oriented. It seems that these craft galleries prefer to sell these new "decorative crafts" because the managers and, of course, the artists can gain more publicity (and money) by being more arty, flashy and hip. Money tends to follow the hype for this supposed innovation. It seems that "newer is better" in these circles while traditionally inspired crafts tend to fall by the wayside.

Perhaps functionality is now out of fashion or perhaps even simply unnecessary, as are structural integrity, integrity of materials and other antiquated concerns of traditional craftwork. Appearance, superficiality and clever statements are now in fashion. If this "new craft" were simply labeled "fine art" and was kept in what are termed "art" galleries, then actual functional craft could take over the "craft" galleries again. The time is ripe for an arts and crafts revival to redefine the nature of craft. The previous Arts and Crafts movement (an unfortunate title) of earlier this century was a reaction to the excesses of Victorian design. It is now time to react to the excesses of 1980s design. Instead of

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...by fellow enthusiasts

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blurring distinctions it is now time to establish some and put the proper forms back under their proper categories and contexts.
—Woody Pistrich, Hadley, Mass.

Let's have some political comment—The quality of *Fine Woodworking* suggests a learned and discriminating readership. If true, such a readership would respond to issues pertinent to woodworking and exert political influence. I don't want the magazine to become a political platform, but occasionally the readership might benefit from brief comments on such things as why copper prices are so inflated when we have copper mines shut down. Higher copper prices push up the costs of electric motors and that pushes up the prices of woodworking machinery. *—Charles H. Price, Winnsboro, Tex.*

Praise for Japanese tools—It was great to read the article, "Tuning a Japanese Plane," by Robert Meadow in *FWW* #75. Information like this is hard to come by. The article was clear, concise and packed full of information.

I use Japanese planes in my woodworking and I've studied with Robert; yet as I read his article, I still learned more. It reinforced what I knew, reminded me of what I had forgotten and encouraged me to keep working toward the ultimate fine-tuning of my planes as I use them on various woods.
—Christopher Smith, Quincy, Fla.

Coloring wood with liquid iron—I have been using an extension of John McAlevey's vinegar-and-steel-wool method for ebonizing (*FWW* #76) on pear and other low- or non-tannin woods for years. After allowing a coat or two of the "liquid iron" to dry, however, I paint on a coat of tannic or pyrogallic acid. This gull-nut extract will also even out the color in areas that don't "take" on high-tannin woods. Acetic acid from the local photography shop will dissolve the steel wool quicker and yield improved results. Most vinegar does not contain enough acetic acid. Do not use plastic or metal lids or containers!
—Jim McFarland, Lancaster, Pa.

Combination squares and plate joiners—A safety tip for the use of the plate joinery machines, such as those reviewed in *FWW* #76: Using a combination square is a great way to lay out plate positions, but there is a potential safety hazard within this procedure. You can avoid the hazard if you realize, from the onset of the operation, that it exists. I had been using a plate joiner for the past four years, and no dangerous situation had arisen (other than my fingers being close to the rotating and plunging cutter) until the following disaster occurred.

I had my square set to a designated layout point which would be used throughout the operation at hand. The procedure for this operation went as follows. Using the square, I marked my cutting points; then I laid the square aside and picked up the machine to plunge-cut my spline slots at these points. After each of the previous layout points was cut, I turned the machine off and set it aside, then picked up the square to mark the next board for plunge cutting. This procedure worked well until I was about one-third through the job. I turned the machine off after cutting a slot and set it aside (as usual) before picking up the square. When I put the square down on the bench, though, the blade slipped into the waste port of the joiner and hit the cutter head as it was idling to a stop. The square's body was just the right height and positioned such that the blade was parallel to the benchtop allowing for the insertion into the waste port. The cutter's port is also the exact height and has all the potential hazards as that of the waste port. This left a nasty 3⁄16-in. cove cut in the end of my prized combination square, and sent it sailing over my benchtop. This can be avoided in several ways, but basically I suggest laying the square to the non-ported side of the machine or raising the height of the square's resting place.
—Rick C. Baynard, Greensboro, N.C.

Rounding bandsaw blades—This is in regard to your piece in the March/April 1989 issue (*FWW* #75) on adjusting bandsaw wheels. Sometime back—before the age of throw-away tools—some fine old-time craftsmen, who believed they could get five-years' to ten-years' use from their bandsaw blades (with sharpening and setting), maintained that the rubbing and wearing on the thrust block or roller tended to work-harden the blade's back edge and to create a wire edge on the corners that was highly prone to cracking. Rounding the corners with a stone, as suggested in the article, eliminated the wire edge and extended blade life.
—W.H. Moore, Covington, La.

Consistency in design and craftsmanship—In looking over a back issue of *FWW*, I ran across an article on drawer construction, which proposed through dovetails with an applied front. I have used this method and I must say it works well. You end up with a very strong drawer box and the outside does not have exposed joinery to contrast with other features.

There are things that bother me about this method, however. When I open a drawer and see that the front is twice as heavy as it needs to be, I think that this is a waste of material and looks bad from a design point of view. Also when you compare the facts that the drawer box is put together with hand-cut dovetails, and the applied front is just held on by a few screws, it seems that these features are not consistent. The applied front, when viewed in this light, appears to be a patch or quick fix that hides the dovetails. I find it hard to improve upon drawer construction as used by the "old guys" in the better pieces of furniture from the past. I refer to half-blind dovetails in front-to-side joints, through dovetails in back-to-side joints and a groove for thin bottoms. I prefer plywood for bottoms, secondary wood for sides and back and primary wood for fronts. Fronts should be slightly thicker than sides.

Another thing that comes to mind about solid-wood applied fronts is that they might warp in a humid climate due to an unfinished back side. Screws used for mounting probably will not prevent this. After weighing the pros and cons, I have decided to sharpen up on my half-blind dovetails and stop applying patches to my drawer fronts. *—Joseph R. Robison, Bicknell, Ind.*

Skateboards and strip sanders—I enjoyed the strip sander article in *FWW* #75. Robert Vaughan arrived at an interesting, functional design. I offer a couple of alternative construction methods. To drive the belt, I mounted a rubber industrial caster drive wheel on an arbor on the motor drive shaft. The wheel was dynamically balanced by using a rasp to true up the wheel with the motor running. The result was no vibration.

I found Vaughan's laminated idler wheels to be unnecessarily complicated, and I substituted the wheels and truck assembly from a skateboard. These wheels have superior ball bearings and are readily available. Tracking did not prove to be a problem. Adjustment can be made by way of the truck bolt. The resulting machine ran surprisingly quiet and was easy to build.
—Arthur J. Hammond, Yucaipa, Cal.

British English versus American English—There are many occasions when it is obvious that the only thing to separate us—the United Kingdom and the United States—is the common language. Is it possible to do an article sometime which is a glossary of different terms? You'd be surprised at how often I find difficulty in translating things like glues and adhesives, products that are known by trade names (e.g. Masonite, Plexiglass and so on) and things like grading terms (e.g. sizes of timber—sorry—

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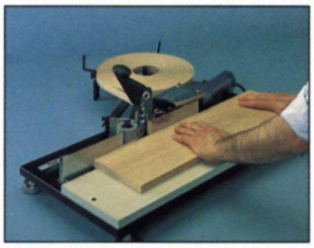

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lumber!) and abrasive papers. Whilst translating, we look very jealously at the advertisements—can anyone find an easy way to trade on an individual level across the Atlantic?

—J. Richard Inston, Oldham, England

Use guard on tablesaw—I realize now that the method I used while cutting the side for an octagonal-shape walnut box was not the safest, but I want to tell the story so that somebody may benefit from my mistake.

The tablesaw blade was tilted at 22½° and I was crosscutting with the board and miter to the left of the blade. The cut-off piece fell in the space between the blade and the insert. I tried to turn the power off, but it was too late. The blade jammed, and with a nasty bang it hurled the steel insert at me, hitting me on the side of the neck. The saw started shaking like it was going to self-destruct. In a daze, I managed to turn it off. At any moment, I expected to see blood. Luckily, it was just a nasty bruise. The sawblade, a carbide with very low mileage, had half of one tooth missing. The insert had a gash on the inside edge, and it was warped. This was not only a scary experience, but I wasted more than one hundred dollars, just because I didn't use a guard and did not install the small hold-down screw in the insert.

—Jose Perez-Chiesa, San Antonio, Tex.

Don't cut exotic species—I would like to comment on the letter in *FWW* #75 from a reader in Rabual, Papua New Guinea (PNG), concerning tropical rain forest destruction.

From 1972 to 1976, I worked and lived in PNG and was involved in programs for the economic development of that country's indigenous people. Ironically, I lived for part of that time in Rabaul and am now a professional cabinetmaker. When I was in PNG, I, along with most others, cheered on any form of economic development as being ultimately worth any "passing" social disruption or environmental cost. Time and subsequent travel elsewhere in the Third World have shown me that what I thought was a passing or transitory phase is actually a permanent and deepening malaise engulfing both developed and developing worlds.

I agree that the tropical forests of PNG and elsewhere should be left uncut until their true value can be realized and be reforested properly. The irony is that here in Canada, in terms of jobs and economic development, we are also cutting down our virgin forests for low-value products and we are inadequately and incompetently attempting to replant only part of the logged-out areas. The wonder is that developing countries with tropical rain forests, like PNG, aren't doing a worse job of forest management with us in the developed world as role models.

—David Edwards, Toronto, Ont., Canada

Small bits & power drills—In *FWW* #75 Tom Seward questions the wisdom of driving very small drill bits with any type of electric drill, on the assumption that the forces involved are excessive. He recommends using a hand-power egg-beater type drill instead, but I think his faith is misplaced. Very small twist drills are extremely susceptible to radial loads, which is just the sort of angular stress a hand-power drill necessarily imparts as a function of its design and use.

An electric drill allows the operator to concentrate on aim and radial stability, and so limits most of the load to axial stress where even small drill bits are surprisingly resilient. The variable speed control found on most drills makes control of applied power easy. I suspect that Mr. Seward shares with myself

and many others an instinctive pleasure in hand-power tools, but this is a case in which the modern tool is a better choice.

—Joseph Beals, Marshfield, Mass.

Substitute bone for ivory—I also object to showing objects embellished with ivory, such as Frank Cummings' ebony vessel in *FWW* #74. Please remind your readers that bone can be used instead of ivory. Bone can be obtained inexpensively from any supermarket and from cattle that can be successfully farmed. More people should consider using bone rather than ivory from endangered elephants.

—David B. Hulslander, Bedford, Mass.

Helpful hint on cam clamps—I enjoyed Dave Flager's article on cam clamps in the July/August 1988 issue (*FWW* #71, p. 71). In the process of building the clamp, I discovered an additional step that may be helpful to your readers. By adding a 3/16-in., drilled relief hole at the end of the kerf cut, you will reduce the chance of the arm splitting past the end of the kerf cut when the cam is thrown.

—Varant C. Blasingame, Pontiac, Mich.

Modifying Elu router—In his evaluation of the Elu router (*FWW* #66), Bernard Maas points out a serious problem with this otherwise fine router. This is the "tough-to-twist" plunge-lock lever, which must be depressed to allow plunging. A simple extension of the lever will reduce the force needed to operate it by half and eliminate the problem for someone of average strength. I extended the lever by bolting to it a 1/8x3/4x2 1/4-in. piece of tempered aluminum. The bolt nearest the hub should be offset from the centerline of the lever to avoid the web, which is part of the lever casting.

—William W. Daniels, Kingston, N.C.

Keeping safety glasses handy—Face it, we woodworkers never wear our safety glasses in the shop all the time. I have two pair in my very small shop (11 ft. by 22 ft.) and I am always looking for them. So, I pick the two places I would most likely need my glasses: the tablesaw and radial-arm saw. I found sunglass holders at a local auto-parts store, painted them bright yellow and fastened them to each machine.

—L. D. Fredrick, Aspen, Colo.

Boos for Toronto woodwork—"Furniture-Making in Toronto" (*FWW* #73) reminded me how glad I am that I don't live in Toronto, Canada.

Odd, "enchantingly droll," "eccentric mix of traditional and avant-garde," "furniture for a world that's a purely imaginative construct"; let's be generous and say it's sophomoric.

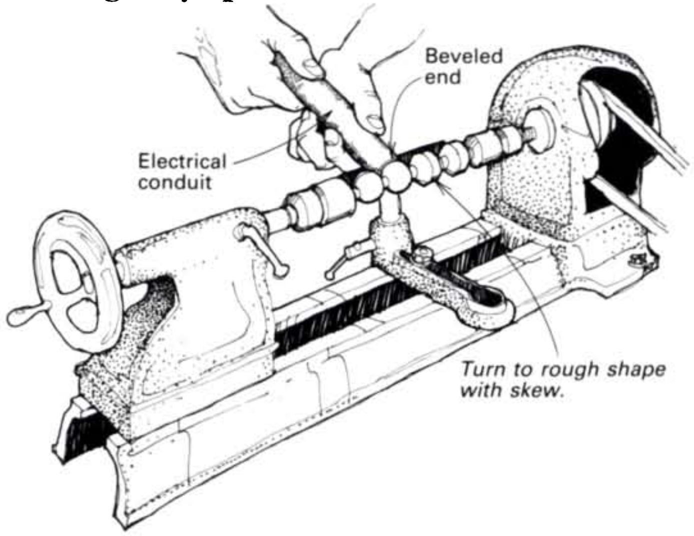
"Furniture-Making in Toronto" will, of course, appeal to the kind of people who wear sandals and smoke LSD.

—Deaf Wiley Stillwater, Alta., Canada

About your safety:
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, associate publisher

Turning tiny spheres



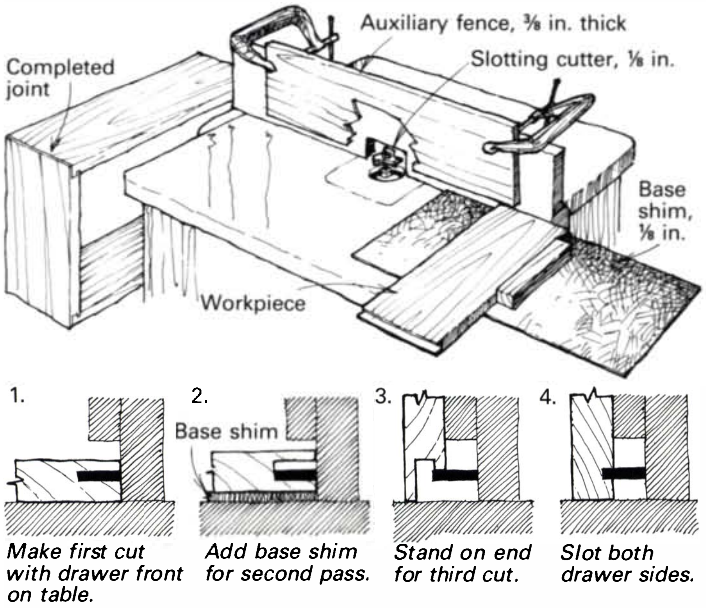
The next time you need several small spheres for a project, try this technique. On a cylinder turned slightly oversize, lay out the number of balls you want, and with a parting chisel, make a cut to separate each ball segment. Be sure to leave at least a ⅜-in.-dia. section between the segments so the workpiece won't break.

With a skew, turn the balls to a rough spherical shape. Now take a section of thin-wall electrical conduit with a sharpened end and slip it over each rough sphere as it turns in the lathe. The conduit will cut the sphere to final size and give you a perfectly round ball. Be careful not to push the conduit too hard, or you will cut through the wood separating each ball.

—Donald F. Kinnaman, Phoenix, Ariz.

Quick tip: A 12-in.-dia. pizza pan can be quite handy around the shop. Use it as a tub to clean your circular saw blades, to keep small parts from rolling off the bench and, with a sheet of non-slip rubber in the bottom, as a basin for sharpening with Japanese waterstones. *—Mike Hipps, Minneapolis, Minn.*

Single-setup routed drawer joint

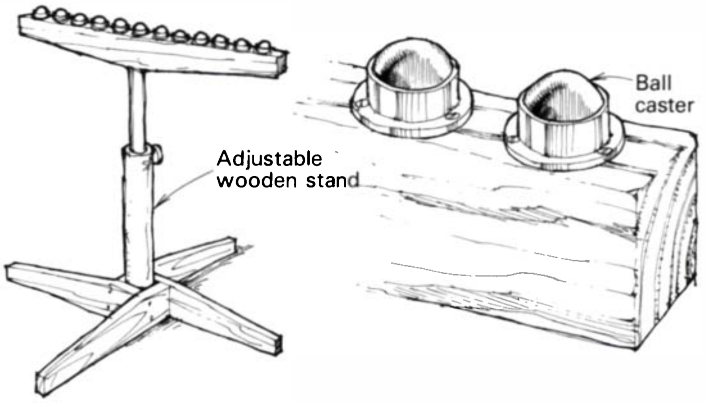


Claude Graham's article on production drawermaking (*FWW* #72, pp. 82-85) prompted me to send this single-setup solution for routing tongue-and-rabbet drawer joints. The setup uses a standard ⅛-in. slotting cutter chucked in a router that's mounted under a router table. You'll also need a piece of ⅛-in.-thick Masonite for a base shim and a length of ⅜-in.-thick material for an auxiliary fence. Adjust the height of the cutter so the slot starts ½ in. above the router table, and adjust the fence so the slot's depth is a shade over ½ in., (this is usually the full depth of the cutter). Clamp the auxiliary fence to the main fence, ¾ in. above the table so a ½-in. drawer side and the base shim can slide underneath.

The sequence of cuts is shown in the sketch. Three passes will produce the tongue and rabbet on the drawer fronts and backs. One pass will produce the groove on the drawer sides. Although it's not shown, you can also use the same setup to groove the drawer sides to receive the bottom. Screw the auxiliary fence to the tool's fence so you can remove the clamps for clearance and make two passes, one against the table and another using the base shim. The result will be a ¼-in. groove ⅛ in. from the bottom of the drawer side. *—Brad Schwartz, Deer Isle, Maine*

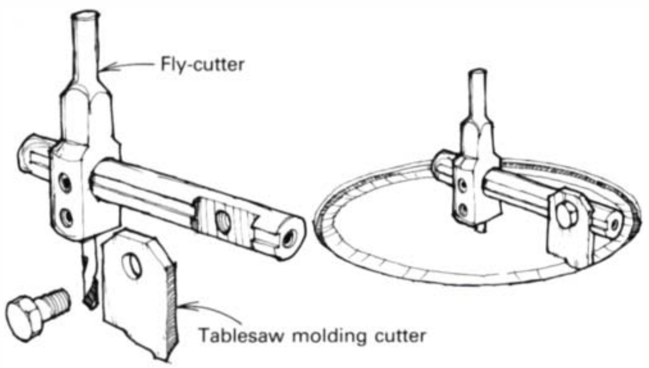
Quick tip: Graphite-impregnated canvas cemented to the platen of a stationary belt sander greatly reduces friction and improves the speed and quality of sanding. It costs about $8 per yard from Derda Inc., 3105 S. U.S. 31-33, Niles, Mich. 49120; (616) 683-6680. *—Tom Irvine, Williamston, Mich.*

Roller support for crosscutting



Although there are many freestanding roller stands available for supporting work being ripped on the tablesaw, I've never seen a similar support for crosscutting. The support I developed has served me well in both ripping and crosscutting. Its principal component is a unique ball-shape caster (available from The Woodworkers' Store, 21801 Industrial Blvd., Rogers, Minn. 55374-9514). The caster rides on ball bearings, allowing smooth movement. Keep them clean and free from sawdust or they'll clog and won't run freely. The wooden stand is adjustable and has a weighted base. *—William A. Lemke, Hendersonville, N.C.*

Cutting rosettes with a fly-cutter



Here's how to convert a common drill-press fly-cutter to cut interesting circular patterns, or "rosettes," using an interchangeable blade borrowed from a tablesaw molding head. First, remove the

swing arm from the cutter and file or grind a slot in the arm to fit the molding cutter. Size the width of the slot carefully so the cutter is snug and can't shift during use. Drill and tap a hole in the arm, and secure the molding cutter to the arm with a short bolt.

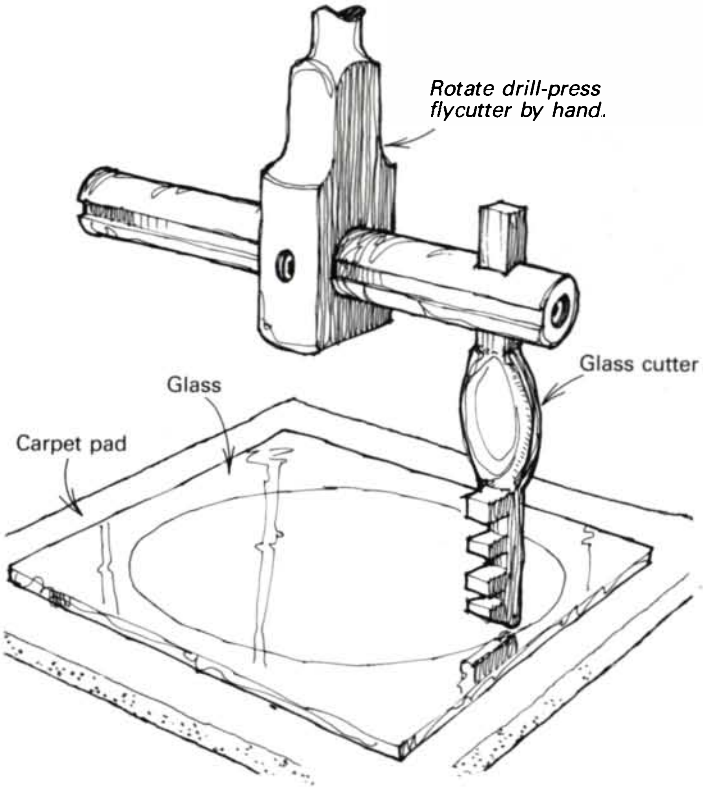
The unit works best with the fly-cutter's center drill bit acting as a pivot. You may want to replace the center bit with a tapered rod to leave a smaller center hole. If you must work without a center pivot, clamp the workpiece firmly to the drill-press table, run the drill press at its slowest speed and be careful.

—Donald F. Kinnaman, Phoenix, Ariz.

Quick tip: To keep opened tubes of caulking or silicone adhesive from drying out, screw a large wire nut on the snout of the tube. It will keep the contents in perfect condition.

—J. Don Hazlewood, Ft. Worth, Tex.

Cutting glass circles on the drill press



You can cut circles from glass or mirror using a drill-press fly-cutter and a modified glass-cutting tool. First, remove the cutting bit from your fly-cutter and replace it with a glass cutter that has its handle cut down and ground or filed to fit the hole in the fly-cutter. Adjust the device for the desired diameter circle and chuck it into the drill press. Place the glass on the drill-press table, with a thin carpet pad beneath the glass to absorb the shock. Lubricate the cutting wheel with kerosene, lower it onto the glass and lock the spindle so the cutter exerts light pressure against the glass. Then turn the drill press one revolution by hand. Caution: Don't do this under power; it would be dangerous. Besides, once around will do a better job.

Remove the glass from the drill press and make radial cuts with a glass cutter from the circle to the edge of the glass to help break the circle free.

—Bill Kilmain, Orlando, Fla.

Using kitchen knives for lathe chatterwork

Years ago, I read an article in *Fine Woodworking* (#49) about chatterwork for decorating turnings. I was fascinated, and tried the technique of applying pressure against a thin spindle with a standard lathe tool until the workpiece would bend and chatter against the tool.

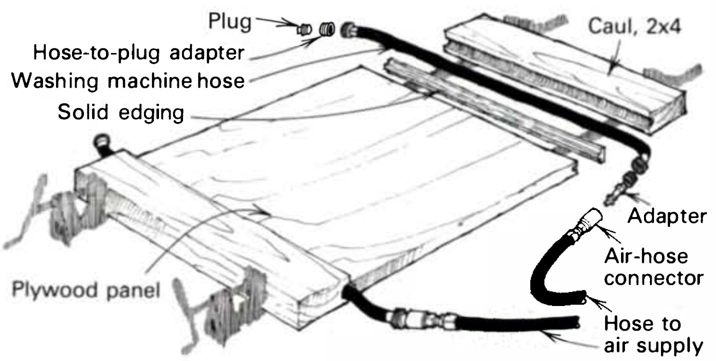
As you can imagine, this technique is risky, and I ruined a lot of expensive ebony before I discovered that it makes no difference whether the work chatters against the tool or the tool chatters against the work. So, I began making special chattering tools from thin stainless-steel kitchen knives. Although these scrapers don't hold an edge long, they're flexible enough to produce beautiful chatterwork patterns. The patterns can be altered by approaching the work at different angles or by using different shape scrapers.

—Ken Hopps, Tacoma, Wash.

Quick tip: To keep lathe faceplates from binding tightly against the headstock spindle, making them difficult to remove, put a garden-hose washer between the faceplate and the spindle collar.

—Willem P. Haan, Newport News, Va.

Edging plywood with pneumatic clamps



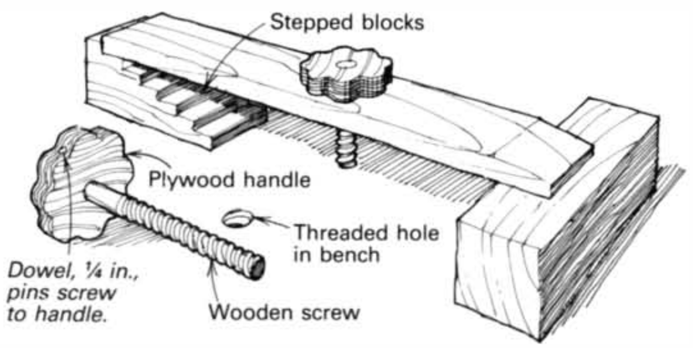
Clamping solid wood edging to plywood panels with standard bar clamps is not only a tedious and time-consuming job, but it also depletes my entire supply of clamps. So I designed the pneumatic clamping system described below which is faster, gives strong, even pressure to the wood and results in virtually invisible gluelines.

The key component of the system is a 2x4 caul, coved along one edge to fit around a stiff, high-pressure hose. Ordinary washing-machine connector hose is rated at 125 psi and works well for this. Plug one end of the hose and fit the other with a standard air hose connection.

To use the device, clamp it to the plywood being edged with a couple of bar clamps. Make sure the hose is centered over the edging being glued. Then connect the air supply (60 to 100 psi) to activate the pneumatic clamp and watch the gaps disappear as the hose expands. I made my cauls 10 ft. long so I can clamp three cabinet sides at a time. To conserve space, I plan to mount the units on the wall and stack the panels vertically.

—Jeffrey P. Gyving, Point Arena, Cal.

Threaded-dowel workbench helpers

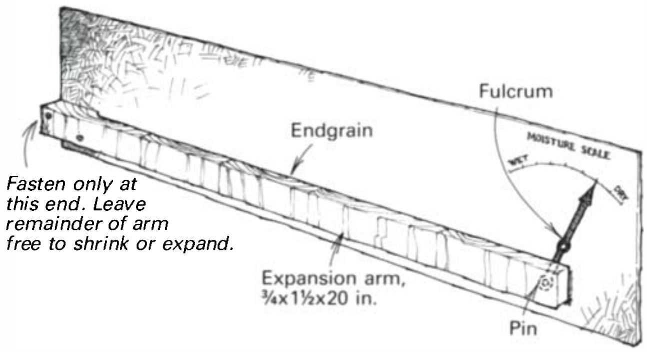


Here's a way to make that fancy wooden thread-cutting tool earn its keep. First make up a plywood handle in the shape of an oversize faucet handle. Drill and tap the handle, then insert a

length of threaded dowel and secure it in the handle with glue and pins. You now have a strong wooden screw that can be adapted to a multitude of clamping, hold-down and fastening jobs. In fact, I've found the wooden screws to be so useful that I have worked out a standardized system using holes tapped into the top of my workbench for fastening jigs and fixtures. The screws are not only strong and adaptable, but they are also ridiculously cheap.

—Thomas C. Turner, St. John's, Newfoundland, Canada

Making a shop moisture gauge



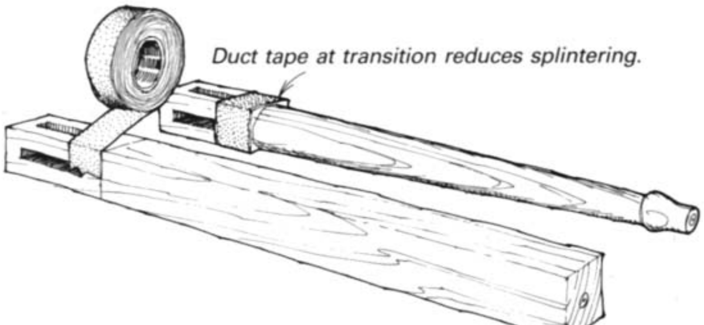
The sketch above shows a simple gauge you can make that will give you a general idea of the relative humidity in your shop. The gauge will graphically show your customers how wood moves and why you build the way you do. For the gauge to work properly, the 20-in. wooden expansion arm must be sliced off the end of a wide panel or glued up from flatsawn segments, as shown. Movement of the gauge will be more dramatic if you pick a wood species that has a large tangential shrinkage percentage, such as beech, sugar maple or white oak. If you have access to a moisture meter, you can scale the gauge numerically.

—John Sillick, Gasport, N.Y.

EDITOR'S NOTE: For formulas on predicting wood movement, check Bruce Hoadley's book *Understanding Wood* (The Taunton Press, 63 S. Main St., Newtown, Conn. 06470; 1980).

Quick tip: To make first-class clamping pads, cover 38-in. Baltic-birch plywood with ⅛-in. cork auto gasket material. These pads won't slip around, and they are gentle on finished surfaces. *—Andrew Jacobson, Petaluma, Cal.*

Taping square shoulders on turnings



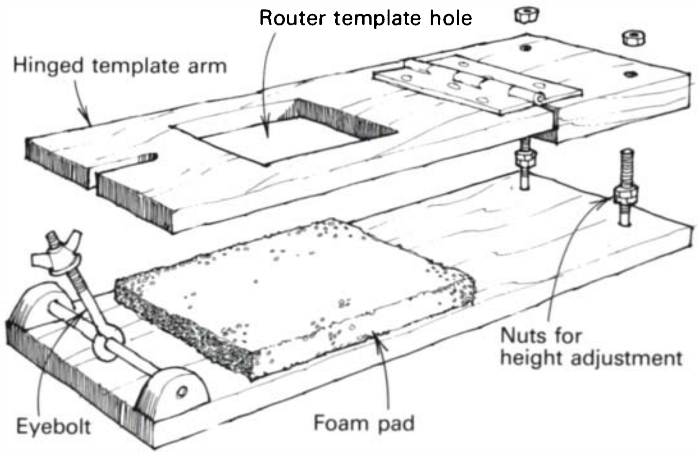
When your spindle pattern calls for a sharp transition from a square to round section, wrap the square section with duct tape so the tape edge defines the line of transition. The tape will re-

duce chip-out and provide an exact reference for making the shoulder cut. If chipping should occur, the tape holds the splinter for later regluing—no more searching through the pile for a lost splinter with less than a needle-in-a-haystack chance.

—*Robert M. Vaughan, Roanoke, Va.*

Quick tip: To flute a gluing dowel, hammer or press it through a box-end wrench that's 1/32 in. smaller than the dowel's diameter. This compresses the flutes into the dowel, so when they're exposed to the moisture in glue, they expand and create a tighter fit than cut flutes. —*Kenneth E. Kobezak, Ringoes, N.J.*

Clock cavity routing jig



Although I devised this jig for routing a cavity for a quartz clock works, the idea could be adapted to many routing operations. The beauty of the jig is that it combines a workpiece hold-down and a routing template into one device. It's well suited for small production runs because you can quickly pop workpieces in and out of the jig.

The jig consists of a base, a foam pad, the hinged template arm and an eye-bolt. The eye-bolt pivots on a bolt axle to fasten the template arm down over the workpiece. I attached the template arm to the base with bolts as shown in the sketch. The template arm can be set for the thickness of the workpiece by adjusting the nuts below the arm.

To use the jig, simply lay the workpiece on the foam pad, lower the template arm, lock it down with the wing nut and rout away. —*Les Stern, Denver, Colo.*

Quick tip: Next time you're passing by a sporting goods store, drop in and ask to see a selection of rifle and shotgun bore-cleaning brushes. These copper-bristle, cylindrical brushes come in various diameters and can be used freehand or chucked in an electric drill. I find these brushes invaluable around the shop. —*Douglas Ruuska, Quincy, Mass.*

Quick tip: To adapt an electric orbital sander for sanding gentle concave surfaces, such as those on the inside of a cedar-strip canoe, attach strips of foam weatherstripping to the pad of your sander. This extra cushion allows the sander to conform to the curves. —*Mark Blieske, Selkirk, Man., Canada*

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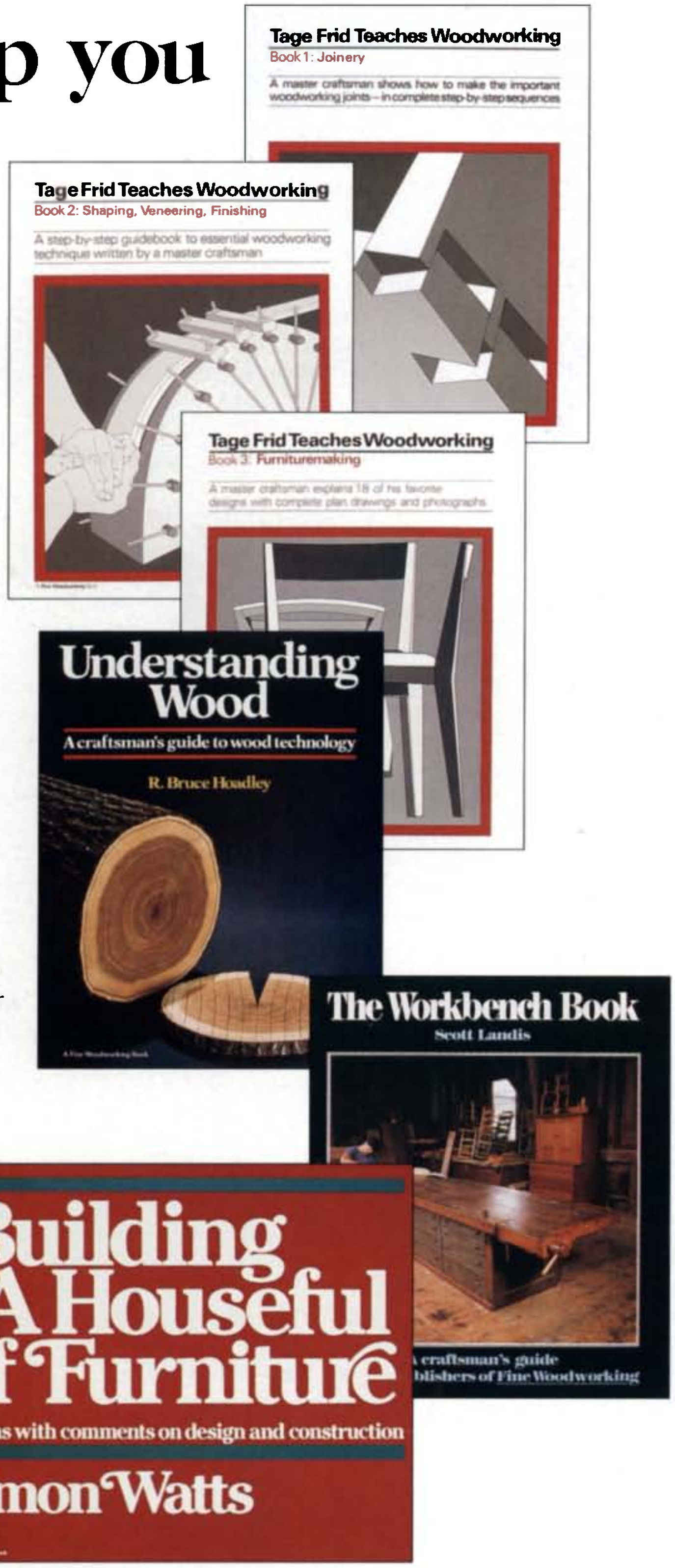

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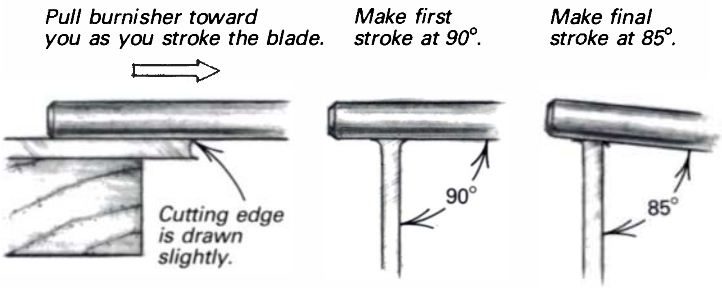
Sharpening a scraper

I've always had trouble getting a really good edge on a cabinet scraper. I am sure the edge is dead square after honing, but how should I hold the burnisher as I rub it along the edge of the scraper to produce the best cutting edge?

—Glenn Marchione, Penndel, Pa.



Kelly Mehler replies: Turning a good edge on a hand or cabinet scraper is a recurring problem among many woodworkers. Even though the burnishing action you ask about is important, I often find that the sharpening problem lies elsewhere. After the scraper edge is polished and square to the smooth sides (no file marks), many workers frequently neglect to burnish the broad, flat surface of the scraper. This step must be done carefully if you want to obtain a good hook on the cutting edge.

With the scraper lying flat, close to the workbench edge, burnish each flat side, keeping the burnisher flat on the side of the scraper. I draw the cutting edge slightly by pulling the burnisher toward me with long, firm strokes. Under magnification you would actually see two ears protruding above the scraper sides, as shown in the above drawing.

In preparation for burnishing the top edge of the blade, first put a drop or two of oil on the burnisher. Place the burnisher flat on the far end of the scraper, held vertically in a vise, and firmly pull it toward you. Two or three firm strokes should do; the first at 90° and then with the handle lowered slightly at 85° to the side of the scraper, as shown in the drawing. It is important to hold the burnisher firmly by the handle and make long, slicing strokes, which extend over a large section of the blade. This will keep the blade smooth and prevent nicks or grooves in the edge.

As you may know, scraper blades come in different thicknesses. In your initial efforts, you may find thin blades easier to sharpen. As you become more adept, you may prefer thicker blades, which hold an edge longer.

[Kelly Mehler builds custom furniture and operates the TreeFinery Gallery in Berea, Ky.]

Treadle-power machinery

I recently read an article by Richard Starr on a treadle-operated freewheel lathe. Could this device be made into a circular saw or a drill press? *—Allen Stewart, Phillipsburg, N.J.*

Richard Starr replies: The challenge in building foot-power machinery is to apply an efficient mechanism to a task that doesn't require more effort than our muscles can supply. I teach woodworking to kids and their physical resources are even more limited than adults, so efficiency is paramount. The treadle drive I use on our school lathes wastes very little energy and could certainly be adapted to run woodworking tools like grinders, drill presses, belt sanders, fretsaws and even bandsaws. I'm afraid a circular saw would probably be too power hungry for muscle drive.

The treadle-power system converts the up-and-down motion of your foot to continuous rotation by running a bicycle chain over a rear gear cluster from a 10-speed bike. When you push the treadle down, it pulls the chain, turning the cluster mounted on the machine's input shaft. As you release the treadle, a spring mounted at the far end of the chain pulls the chain back to the starting position. The ratchet mechanism (freewheel) in the cluster allows the shaft to coast forward while the treadle returns to the up position, its momentum maintained by a flywheel. Because the ratchet in the cluster allows the shaft to turn only in one direction, when you first power up, it will always start rotating in the correct direction. Also, you don't have to maintain a particular rhythm and, again due to the freewheel, the treadle doesn't keep going up and down when you stop pumping.

The entire treadle-drive system is made from inexpensive stock parts you can get anywhere. However, building a piece of home-conceived machinery requires seat-of-the-pants engineering and a period of development during which nothing seems to work right. But if you enjoy that sort of thing (as I do), the process, as well as the product, will be worth your while. (For more on Starr's treadle-power system, see *FWW* #15 or *FWW on Making and Modifying Machines,* published by The Taunton Press, 63 S. Main St., Newtown, Conn. 06470.)

[Richard Starr is a teacher and the author of *Woodworking with Kids,* published by The Taunton Press, 1982.]

Motor mounting positions

Some electric motors are intended to run with the shaft horizontal, some with the shaft vertical. Can you tell by the model number or specifications which is which?

—William Stilwell, Alta., Canada

Ed Cowern replies: Motors with ball bearings can be operated in any position because the ball bearings can handle both thrust and radial loads (thrust being force applied to the shaft in or out and radial loads being what's exerted sideways on the shaft you would expect from a pulley and belt-drive arrangement). Thus, the additional weight of the motor rotor against ball bearings is not going to be a problem in a vertical position.

Motors with sleeve bearings, on the other hand, are typically meant to run with the shaft running horizontally, because sleeve bearings won't stand up to thrust as ball bearings do. Fortunately, these motors are more common on large industrial blowers, rather than on woodworking machinery. Sleeve bearings can have lubrication and wear problems if the motor is mounted in the wrong position. If you do run across an old industrial motor, you can usually tell that it is a sleeve bearing motor by the presence of grease fittings, or oilers (oil caps or oiling tubes). If the motor has oilers, the motor must be mounted so that these fittings will gravity feed oil to the sleeve bearings.

[Ed Cowern is an electrical engineer and president of EMS, a company that distributes Baldor electric motors.]

Oil finish on carvings

I love to carve reliefs in walnut and I love the look that rubbed-on tung oil gives walnut. But removing the excess oil from all the nooks and crannies in a deeply carved relief is next to impossible. Am I using the wrong product or do I need a special technique to achieve the look of hand-rubbed oil finish on a relief carving?

—Leslie McGregor, Elkhart, Ind.

John Heatwole replies: Personally, I've never much liked tung oil; to me the finish has always seemed weak. I recommend two alternative finishes for carvings. For low relief carvings, I prefer a very traditional finish. In a double-boiler (a small sauce pan sitting in a larger pan that contains about an inch of water) pour a pint of boiled linseed oil, add a ¼ pint of turpentine and season to taste with a few healthy shavings from a bar of beeswax. Heat this on a stove over medium low heat and stir until the wax is totally melted into the mixture. Remove from the burner and let cool until warm and then pour it into a jar with a tight lid. *(Note: Because of the possible fire danger, perform*

this technique very carefully, preferably on an electric hot plate, never over an open flame, that's set up in a fire-safe area outdoors.)

When you're ready to use your oil mixture, shake the jar vigorously and then brush a medium coat of the oil on the wood (you don't have to re-heat the mixture). Let this set up for 10 to 15 minutes and then buff with a soft, lint-free cloth. You should get a nice satin sheen.

The second finish is virtually fail-proof for both high and low relief work. Brush boiled linseed oil on the carving and wipe off the excess immediately with a lint-free cloth or soft paper towels. Make sure the damp linseed oil is completely wiped off. Let the carving sit for about an hour and then lay it flat and spray on a medium coat of Grumbacher's "Tuffilm" matte spray (available from art supply stores). Let it dry for five minutes and then spray another coat. Repeat spraying again and then let it set up for a few hours.

The surface will feel slightly rough when the Tuffilm has dried completely. Take a small piece of 0000 steel wool and gently rub the carving, making small twists in the steel wool to get down into the carving's crevices. Fortunately, the places you can't reach with the steel wool come out looking as smooth as the prominent surfaces on the carving. With a soft brush whisk away all of the steel-wool particles and then spray one more coat of the Tuffilm. Let it set up again for a few hours and then lightly steel wool it again. You will have a nice satin finish. I've found Tuffilm is the most dependable spray finish for carvings on the market; the finishes are consistent and always even.

[John Heatwole is a professional woodcarver with a studio in Bridgewater, Va.]

Rubbing out a finish with cigar ashes

An old-time refinisher told me that cigar ashes were better than rottenstone or pumice for rubbing down a finish. Have you ever heard about cigar ashes being used this way? I have about two lbs. of them saved up and I don't know what to mix them with.

—Louis Thomas, Silver Spring, Md.

Michael Dresdner replies: Rubbing out a finish using cigar ashes is one of those delightfully apocryphal tales that make up the bulwark of finishing mythology—everyone has heard of the method, or even knows someone who does it that way, but no one has actually ever done it that way. A similar story involves the mixing of a supposedly superior glaze using a base of stale beer. While both "trade secrets" can be supported with arguments steeped in logic, neither is a common or even practical technique. While I can think of no reason why cigar ash would not work (it is, after all, a very mild abrasive), I would hardly suggest it as the optimum rubbing material.

The process of rubbing a gloss finish is one of using increasingly finer abrasive grit, with each graduation removing the scratches from the previous coarser one. Whether you mix your own abrasive slurry, using various grades of pumice and rottenstone, or use pre-mixed rubbing and polishing compounds, it is hard to believe that you will need to go beyond readily available commercial products. In addition to being easy to obtain and use, the commercial grits are very consistent—a characteristic that's important for a uniform sheen. If you do feel the need to mix your own rubbing compound, abrasives manufacturers make lapping minerals with grit sizes as small as 1⁄10 of a micron, which is about four millionths of an inch (.000004 in.). Bear in mind that beyond a certain point you will run into the law of diminishing returns: The added work of finer and finer grits may soon get you to a point where, while there may be a theoretical improvement, there is no visible change. A surface appears completely glossy as the size of the scratch approaches one half of the shortest visible light wave that humans perceive, which is about 400 nanometers, or just under half a micron.

[Michael Dresdner is a contributing editor to *Fine Woodworking* and an instrumentmaker and finishing specialist in Zionhill, Pa.]

Shop-built grinding arbor

I plan to build my own bench grinder using an existing arbor with a V-belt drive and a multiple-step pulley. What's the maximum circumferential speed I can run an 8-in. grinding wheel, in feet per minute (FPM)? If I decide to use a 10-in.-dia. by 1-in.-thick wheel, what size motor do I need?

—Avrum Silverman, Wellesley, Mass.

Jerry Glaser replies: An 8-in.-dia. grinding wheel has a maximum recommended RPM of 3,600. In order to calculate the maximum speed in FPM, you need to multiply wheel diameter, in inches, by RPM; multiply this figure by pi (rounded off to 3.14) and divide the total by 12 (to convert inches per minute to feet per minute). For an 8-in. wheel, the equation would be: (8 x 3.14 x 3,600) ÷ 12 = 7,536 FPM. But this is the maximum speed, and I like to run my 8-in.-dia. wheel at 3,000 RPM or 6,280 FPM. This is also a reasonable FPM speed for a 10-in.-dia. wheel, in which case the rotational speed would be 2,400 RPM. Since a typical 2-pole motor runs at 3,450 RPM and a 4-pole motor runs at 1,725 RPM, you'll need to use a pulley-drive setup (rather than mount the wheels on a directly driven shaft arbor) to get the wheel speed where you want it.

If your grinding arbor will be used only for tool grinding and sharpening, a ½-HP motor should provide ample power for a 10-in.-dia. wheel. Additional horsepower will permit you to remove material faster, but remember that grinding generates heat and the more heat, the greater the chance that you will ruin the temper of the steel in the tool you're grinding.

[Jerry Glaser is a retired aerospace engineer living in Torrance, Calif. He also manufactures a line of woodturning tools and accessories.]

Uses of maple

I was considering using maple for some exterior trim on my house. The wood is kiln dried and I plan to prime and paint it. Is maple a good choice?

—Paul Baglione, Brighton, Mass.

Jon Arno replies: Because of its density, maple will take a great deal of abuse and is, therefore, a fine choice for interior applications such as flooring, cabinet work and trim. However, maple doesn't have outstanding weathering characteristics and I would avoid using it for exterior projects. Aside from its poor weathering properties, maple has an additional disadvantage in that it experiences considerable expansion and contraction when exposed to extreme changes in humidity. Sugar maple has an average volumetric shrinkage of 14.7% (green to oven dry), while yellow poplar is a little better at 12.7%; nevertheless, both are inferior relative to virtually all of the common softwoods in this respect. For example, Eastern white pine, Pinus strobus, has a volumetric shrinkage of only 8.2%. A number of domestic hardwoods, such as sassafras, catalpa and white oak, have excellent weathering properties; however, they are all ring-porous woods and would require some sort of filler coat to produce a good surface for painting.

Among the hardwoods, black cherry would be ideal for exterior work since it has excellent weathering properties. It is a diffuse-porous wood and remarkably stable, but it is also prohibitively expensive. My choice for painted exterior trim would be one of several softwoods, probably in the following order depending upon availability and price: redwood, Western red cedar, white cedar (Northern or Atlantic) or bald cypress. These woods all have excellent weathering characteristics and are quite stable. If

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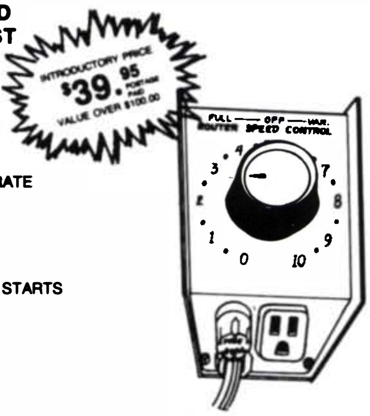

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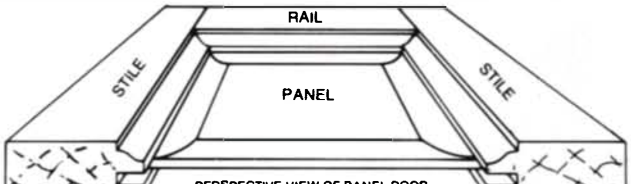

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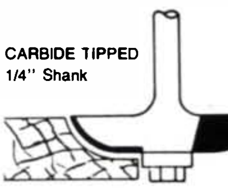

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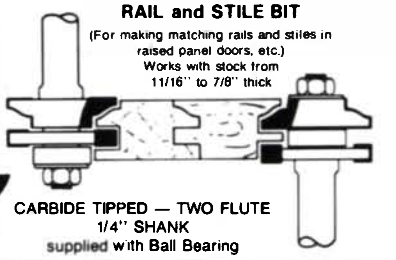

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34-994	Prod. Stock Feeder	829
28-283	14" Band Saw 3/4 hp	588
28-243	14" Band Saw 1/2 hp	480
33-890	12" Radial Saw	1148
33-990	10" Radial Saw	568
37-350	8" Precision Jointer	1388
37-154	6" Jointer DJ-15	908
37-280	6" Motorized Jointer	295
43-122	Wood Shaper	599
34-080	10" Motor. Miter Box	195
17-900	16-1/2" Drill Press	298
34-330	8-1/4" Bench Saw	225
40-601	18" Elec. Scroll Saw	699
31-340	1x42" Belt/Disc Sander	159

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$266
#3338
2-1/4 hp Elec. Plunge Router

3337	2-1/4 hp Plunge	247
3304	1 hp Electronic Plunge	180
3303	1 hp Plunge	145
4024	3x21 Electrnc Belt Sndr.	206
4023	3x21 Belt Sander	192
3375	Universal Planer	195
3380	Jointer/Splinter	325
4029	4"x24" Belt Sander	325
40900	Router Acess. Kit	135

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1-3/4 hp Router
$118 — #1604

1581VS	VS Orb. Jig Saw	$128
1611	3 hp Plunge Router	198
1196VSR	1/2" VSR Ham. Drill	124
1196VSR	3/8" VSR Ham. Drill	107
1609K	Laminate Kit	155
1582VS	VS Orb. Jig Saw	118

HITACHI

1/2" Super Duty Router
$159
TR12

CB75F	Band Saw	$1575
C15FB	15" Hvy Duty Miter Saw	359
C8FB	8" Compnd Miter Saw	479
TR8	1/4" Hvy Duty Router	118
#F1000A	12" Planer Jointer	1389

RYOBI

10" Surface Planer
$347
#AP10

RE600	3 HP Router	$195
BE321	3x21" VS Belt Sander	119
R500	2-1/4 HP Plunge Router	154

PORTER CABLE

$54
#330
Speed Bloc® Sander

690	Router, 1-1/2 hp	$114
100	Router, 7/8 hp	90
691	D Hndl Router 1-1/2 hp	129
7548	VS Top Hndl Jig Saw	124
555	Plate Joiner	157
	Biscuits pkg	25

a stronger wood is required, Douglas fir might be acceptable, but neither it nor pine will weather as well as any of the woods I mentioned. Because of its dark color, redwood may require an extra coat of paint; however, some redwood is exceptionally fine-textured and will produce a very smooth surface. Even though it might cost a little more, redwood has few rivals if your objective is to achieve the kind of durability that is measured in terms of centuries.
[Jon Arno is a woodworker and amateur wood technologist in Schaumburg, Ill.]

Search for the ideal wood finish

Donald Steinert says (FWW *#68, p. 70) "Don't use acrylic auto finishing lacquers, [for wood] which are primarily designed for metal." If finishes can be designed specifically for metal, is there such a thing as a lacquer or other finish that's ideal for wood? Wouldn't such a finish have to expand and contract at the same rate that the wood does?*

—Norman Stomacher, Perrez, Mont.

Donald Steinert replies: Wood has always been a problematic substrate for finishing. Everybody from the weekend do-it-yourselfer to the major furniture manufacturer seems to be looking for a finishing product that is fast, cheap, easy, looks great 15 minutes after application and is permanent—having a life expectancy of 150 years—in all environments from the Gobi Desert to the Arctic Ocean. Unfortunately, such a product does not exist and will probably be as long in coming as the perpetual motion machine. While we're waiting, finishing wood remains a game of trade-offs. No particular type of finishing product will do all things equally well. Your best approach is to clearly define what your finishing needs are for your particular design and material and discuss the problem with your local finish supplier.

You are on the right track when you surmise that solid wood, even after it has been dried, sealed and finished, continues to expand and contract with changes in ambient temperature and relative humidity. Even if a wood finish could be developed with the exact same coefficient of expansion and contraction as a particular species of wood, it would not be as effective on other species, each having its own coefficient.

While the moisture content of wood can be fairly well controlled through proper drying, oily—or oleoresinous—woods will retain their oil content no matter what is done to them short of incineration. Exotic hardwoods such as teak, rosewood and ebony generally have an extremely high oil content. Oil-type finishes are most compatible with these oily woods. But oil finishes are not satisfactory for exterior applications and shouldn't be exposed to moisture, alcohol, or most any type of solvent or chemical. Plastic-base finishes do not adhere well to oily woods: The oil acts as a release agent that prevent the plastic finish from adhering. Nitrocellulose, acrylic, alkyd, urethane, polyester and epoxy are all plastic-base finishes.

A high-build finish is desirable for a final product that is to be rubbed out or buffed leaving no visual or tactile evidence of the natural texture of the wood on the finished surface. Enough finishing material is built up on the substrate to allow for the requisite block sanding and buffing without going through to the primer or substrate.
[Don Steinert restores Rolls Royce woodwork and lives in Grants Pass, Ore.]

Send queries, comments and sources of supply to Q & A, Fine Woodworking, *Box 355, Newtown, Conn. 06470.*

by Dick Burrows

Slates for pool tables—Quite a few readers are apparently well along in planning their own pool tables, based on the article by Paul Bowman in the March/April issue (*FWW* #75). We've already received a few letters from people like Bob Lewis of San Jose, Cal., requesting additional sources for buying slate sets, pockets and other accessories for pool tables.

Lewis was especially interested in finding a West-Coast source for slate. He writes, "I am not crazy about the idea of buying the slate on the East Coast and hoping that a freight company delivers it without cracks. If I can find a West-Coast source for this item, I am willing to travel to pick it up myself." We figured that other readers might also be having problems, so we called some other suppliers in various regions of the country.

Fortunately, we had little trouble finding dealers who said they would be glad to sell everything necessary to individuals building their own pool table. We've listed the dealers below. Some of the dealers also said they could obtain carved legs for people who wanted to buy the legs rather than make their own. However, most also stated that they didn't have the resources to help anyone build the table itself.

Bowman's original article recommended that you consult the yellow pages for the city nearest you to find a billiard manufacturer or supply house. This is still the best advice because, according to the suppliers we contacted, Bob Lewis' concerns about slate breakage during shipping are well founded. So, find a dealer nearby or plan on driving to one of the listed sources.

The suppliers include American Billiard Supply of Rockland Inc., 14 Lafayette Ave., Suffern, N.Y. 10901; (914) 357-2727; Tucker's Billiards, 3381 Ashley Phosphate Road, N. Charleston, S.C. 29406; (803) 767-0700; Saffron Billiard Supply, 23622 Woodward, Pleasant Ridge, Mich. 48069; (313) 542-8429; Art's Billiard Supply, 6223 Truman Road, Kansas City, Mo. 64126; (816) 241-6750.

Also, Billiard Table Sales and Service, 3817 Ross Ave., Dallas, Tex. 75204; (214) 824-1334; Triangle Billiard Supply, 74 Federal Blvd., Denver, Colo. 80219; (303) 935-3734; Corner Pocket Billiard Supply, 134 Regal, Billings, Mont. 59101; (406) 259-4898; Washington Billiard Co., 17808 Palatine Ave. N., Seattle, Wash. 98133; (206) 546-1377; and Whitehead and Zimmerman Inc., 2949 Mission, San Francisco, Cal. 94110; (415) 282-6324.

Well, now you can get back to your shop and resume work on your table. As further inspiration, we've included pictures on this page of two more nice tables. Good luck, and please send us a picture of your completed table.

Photo below: Keith Harding

Furnituremakers in the billiard room: The Queen-Anne-style table in the top photo was built by South Carolina furnituremaker Curtis Whittington. The table in the bottom photo, built by Charles Wheeler-Carmichael and Rupert Senior of Surrey, England, has a patented mechanism for swiveling the top 30° in either direction to provide cue clearance around obstructions in the room.

Guns and vanities—The pool table article was developed in response to many requests from readers. We try to fulfill the requests for special projects whenever possible, so now we're looking for a well-designed vanity with matching chair or bench and free-standing gun cabinets. If you have designed and built one of these pieces and might be interested in writing an article on the process, send use some photos and information about your work.

More on out-of-whack bandsaws—Like many other readers, Alan Thomson of Northwood, N.H., tried Mark Duginski's method for aligning bandsaws for top performance *(FWW #74)*. Thomson had too much of a bad thing, though. When he checked the alignment of his bandsaw wheels with a 4-ft. aluminum level, he found the upper wheel was almost 3⁄16 in. out of plane. He tried to shim the wheel with washers, as recommended by Duginski, but only managed to push the outer wheel bearings partially off the machine. The washers didn't do much to correct the alignment problem and Thompson feared adding more washers would just push the bearings right out of the machine. He examined the saw more closely and began to suspect that the upper casting had been bolted out of line onto the lower, main casting. He loosened the bolts and realigned the two pieces. This structural realignment just about eliminated the problem, but he wondered what a tool expert like Duginski would think of the solution.

We presented the problem to Duginski and he replied that Thompson had used good judgment in readjusting the castings. "A magazine article can give you ideas, but you must somehow incorporate the ideas into your particular situation," he said.

Duginski said the washer method works the best and easiest on the Delta and Taiwanese bandsaws with wheels that are slightly out of alignment, 1⁄8 in. or less. The casting method is best for wheels that are grossly out of alignment. You often have to shift the table, as Thompson did, so the tensioned blade will track in the middle of the table slot. Even after the castings are aligned, though, you may still have to add a washer or two to align the wheels when the blade is tensioned, Duginski said.

Also, Duginski added, "There is one point that was covered in the article that is worth reiterating. Once the wheels are aligned to be co-planar, the goal is to allow the blade to find its own equilibrium on the wheels. That position will often not be in the middle of the wheels, but toward the front of the saw. This is because the blade is usually shorter in the front (due to the manufacturing process) than in the back. When properly aligned, the blade exerts the same amount of pressure on both

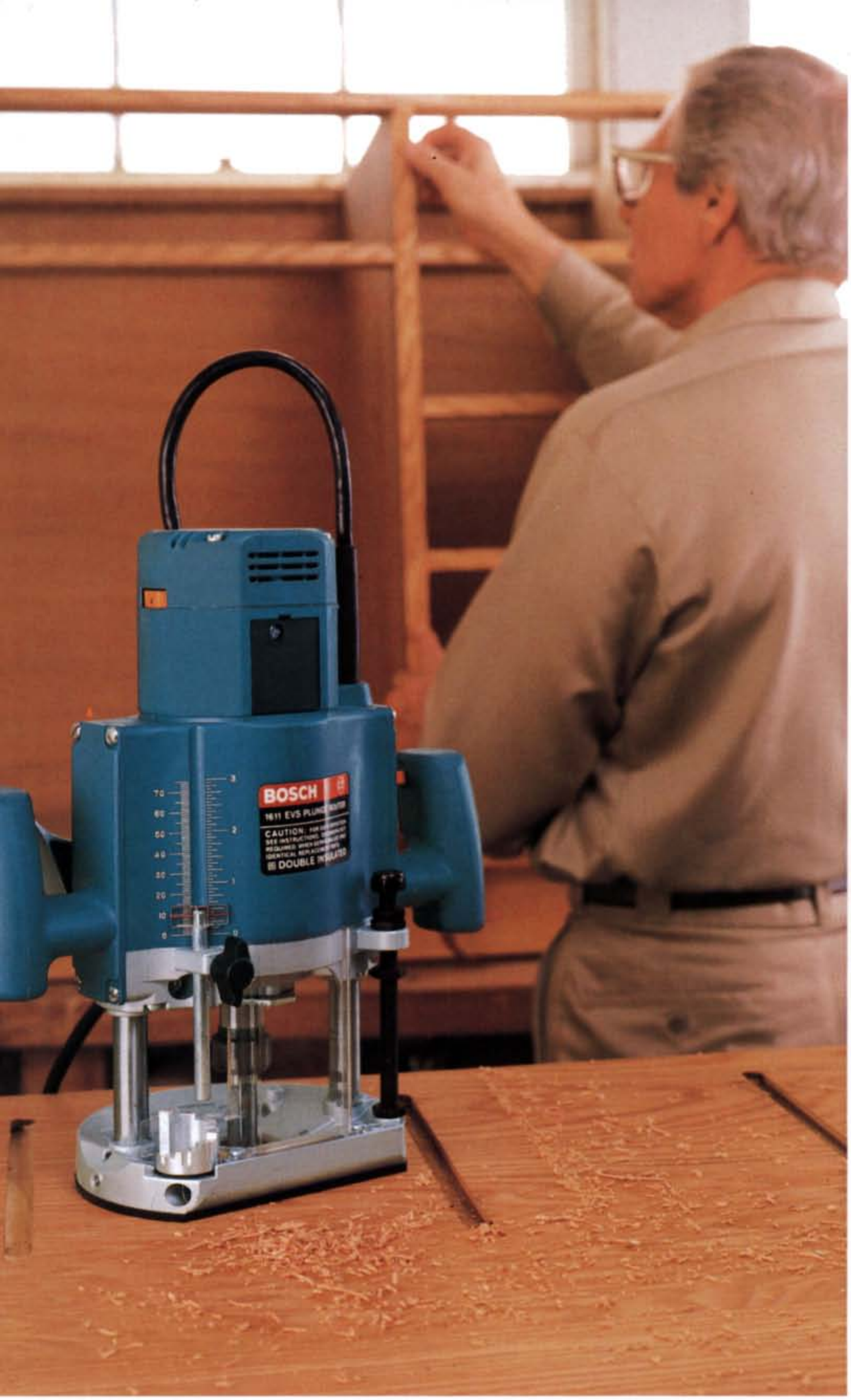
wheels. The top-wheel angle mechanism should be used sparingly. Avoid the standard procedure of angling the top wheel until the blade tracks in the middle of the wheel."

Sources for Clifton planes–For readers interested in one of the Clifton shoulder planes discussed in Maurice Fraser's article in *FWW* #76, the two United States sources for these planes are Garrett Wade, 161 Ave. of the Americas, New York, N.Y. 10013 and Woodcraft Supply, 41 Atlantic Ave., Woburn, Mass. 01888.

Alabaster, alabaster–After reading Max Krimmel's article on turning alabaster (*FWW* #74), Ken Cunningham of Blissfield, Mich., wrote to tell us about Flatlanders Sculpture Supply in Blissfield. He said the company offers a wide selection of alabaster, priced from $.35 to $1 per pound. He says you can get a catalog by sending $1 to the company at 11993 East U.S. 223, Blissfield, Mich. 49228. The company's toll-free order line is (800) 243-4591.

Straightening out compound joints–A couple of readers have pointed out that we made an error in the drawing accompanying Graham Blackburn's article on Laying Out Compound Joints (*FWW* #76, p.65). The diagram on the top, right-hand corner of the page is mislabeled. The X-Y and T-labels on the triangle should be reversed. The formula for calculating the blade tilt is correct, as published. We apologize for the error. □

Dick Burrows is editor of FWW.



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The Bosch models 1611EVS and 1611 are available in cooler running, higher horsepower 220V models, too. Ask about them and the complete line of fine Bosch power tools for woodworkers, at your nearest Bosch power tool distributor. He's listed in the Yellow Pages under "Tools—Electric."

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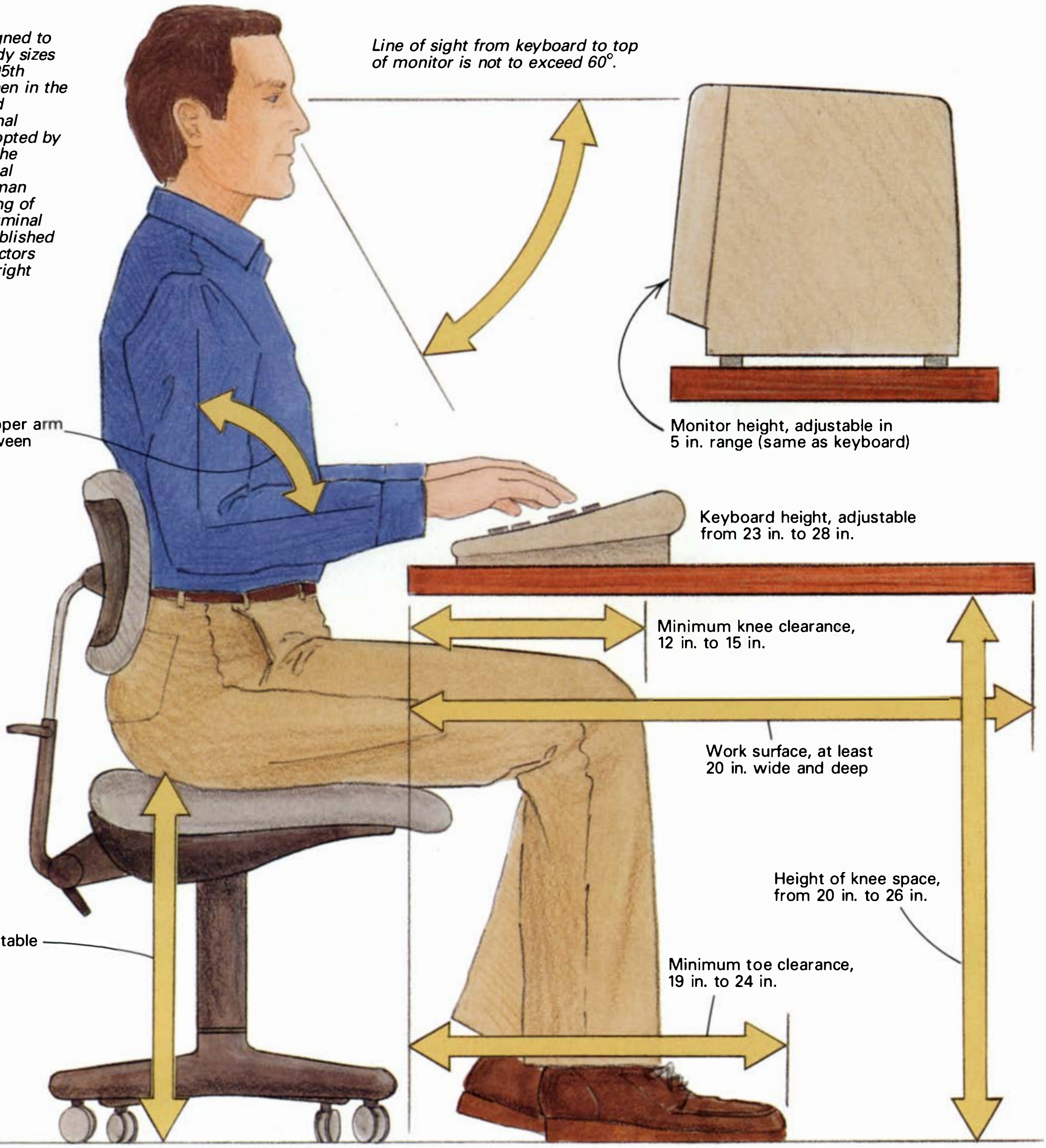
Designing Computer Furniture

Considering components and user comfort

by Sandor Nagyszalanczy

Fig. 1: Computer workstation ergonomics

Dimensions, designed to accommodate body sizes from men in the 95th percentile to women in the 5th percentile, and general dimensional guidelines are adopted by permission from the "American National Standards for Human Factors Engineering of Visual Display Terminal Workstations," published by The Human Factors Society Inc., copyright 1988.



Drawings: Roland Wolf

Whether we like them or not, computers have become integral parts of our lives, and they're here to stay. Computers handle our finances, connect our phone calls and teach our children. And while we can't ignore computers, few people seem concerned about furniture for them. Some folks think any object can be transformed into a piece of computer furniture just by setting a computer on it. I've seen one digitally possessed person pecking away on a keyboard set on an old orange crate, watching a monitor propped up on the floor by a carton of cigarettes—Neanderthal furnishings for high-tech tools.

Fortunately, more suitable furnishings for computers do exist. There are many commercially available workstations made from metals and plastics. However, the warmth of wood provides a pleasant contrast to the high-tech austerity of computer components, and many people are willing to pay for well-designed, custom-built units to harmonize with other furniture pieces in their homes and offices. In researching this article, I visited with more than a dozen cabinetmakers and furnituremakers who built pieces to house personal computer systems. While the work pictured here and other pieces I saw generally were attractive and well built, I was surprised at the small amount of wooden computer furniture being built, considering the proliferation of computers.

Part of the reason may be complexity: Though not nearly as complex as microchips and computer software, designing a good piece of computer furniture can be as demanding as developing the most sophisticated desk or cabinet. A well-designed computer workstation—the modern equivalent of a desk—needs to fulfill an impressive set of requirements. The equipment itself has specific needs: Components must be accessible to a seated worker, and they must be well ventilated and easily wired together. In addition, the workstation must accommodate a comfortable seat. Most workstations also serve as regular desks for paperwork. In an office in which several persons share the same computer equipment, a workstation must be flexible enough to be adapted to different people, as well as provide room for future additions to the computer system.

These diverse requirements don't mean you have to be an engineer or a magician to build a first-class workstation that's functionally and ergonomically suited to your needs. There are few restrictions on the construction methods or joinery; workstations don't require special abilities outside the realm of basic woodworking skills. This article will outline how to design and build a piece of computer furniture, as well as provide general dimensions for a typical workstation. A description of the most common computer components and hints on accommodating them in your furniture piece are provided in the sidebar on pp. 35-37. First, let's examine a few different kinds of furnishings that can function as computer workstations.

Types of computer furniture—While many people think computer furniture should look as if it came off the bridge of the *Starship Enterprise,* a functional workstation actually may resemble a conventional piece of furniture. Practically any desk, hutch or cabinet can be adapted to fit the needs of a computer user and to harmonize with the rest of the furniture in the room. For instance, the "Motus" workstation, shown in the top photo at right, designed and built by Emeryville, Cal., furnituremaker Dean Santner, is based on the modular furniture seen in modern offices: The workstation has ample surface area for computer components or paperwork (and file space), it's adjustable to fit different-size people and it can be expanded with optional work surfaces, shelves or accessories.

But computer furniture doesn't necessarily have to be part of a true workstation made for full-time computing; the furniture may be used to hide the computer most of the time. Cabinetmaker Frank Klausz of Pluckemin, N.J., built a computer cabinet for executives who don't require full-time computer access. It's designed to match the existing furniture in an executive's office and to hide the keyboard and printer behind bi-fold doors, allowing them to be pulled out when needed (shown in the bottom photo, above). In many situations, a computer is only an incidental part of the furnishing. Furniture designer/craftsman Glenn Gauvry, who owns a company called Heartwood in Philadelphia, Pa., says he isn't commissioned to build computer workstations as often as he's asked to accommodate computers in the desks and cabinets he has always built. When I visited Heartwood, its employees were working on a reception desk for a hotel built in what Gauvry described as "cleaned-up Victorian" style. The desk's counter had a recessed cubby in the top to house a computer monitor and keyboard, so a clerk could easily check room reservations.

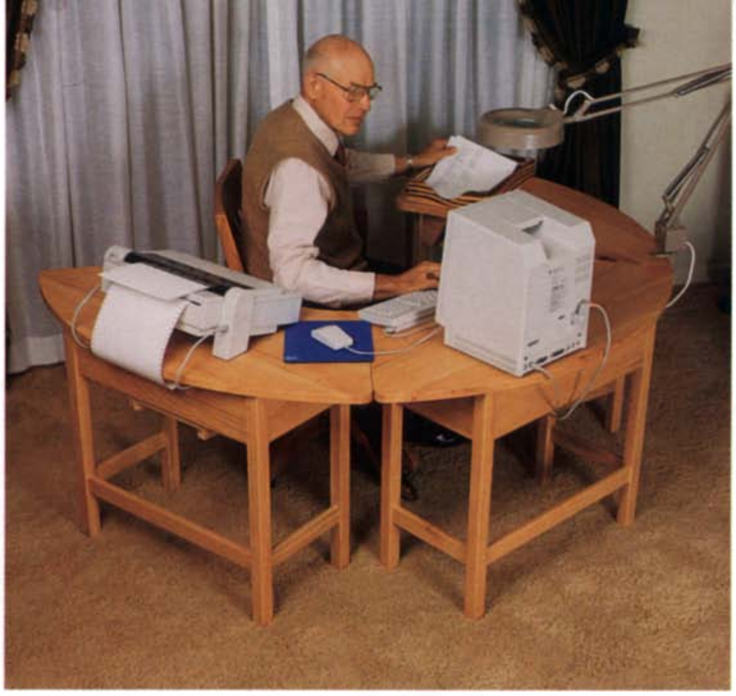
Work surfaces, storage and lighting—While a workstation may be just a single, flat table, Dean Santner says that a more functional computer workstation should have three separate levels: one to hold the monitor at eye level, one for the keyboard at a comfortable typing height and one for a regular writing surface. Despite a computer's electronic medium, computer work always involves paperwork as well. Therefore, a good workstation needs to function as a regular desk, if only to provide places to put copy while typing. If you are

Photo: Terry Heffernan/Light Language

Dean Santner uses mahogany lumbercore plywood covered with plastic laminate for the surfaces and shelves in his "Motus" modular furniture system. The leg columns, which are painted with a tough acrylic finish, allow the height of each work surface to be adjusted independently for user comfort.

Frank Klausz does the final drawer adjustment on a computer cabinet he designed for an executive office. The mahogany cabinet has bi-fold doors that conceal a pull-out keyboard and a two-tier printer drawer that has one slot at the front for loading paper, and another slot at the rear for paper to feed up to the printer.

This computer workstation, built from cherry wood by Hugh Foster, features a retractable keyboard drawer, a raised shelf for two monitors, a drawer for floppy discs and two mechanical-arm lamps on wooden bases that can be moved to give light where needed.



E.D. Groves sits at his workstation built from solid oak. A swivel chair and the round design of the top allow the user to reach all work surface easily. Each of the three segments has a hinged top that lifts up for loading paper or supplies.

going to use a rolling "mouse"-type computer control, there should also be some flat space at desk height near the keyboard.

In addition to filing drawers for documents and other papers, the workstation must include a safe, clean place to store floppy discs and prevent their magnetic messages from being scrambled. Many computer-desk makers prefer drawers with built-in dividers to organize floppy discs. Just be sure to find out what size discs fit the computer before making the drawer; discs are typically either 3⁹⁄₁₆ in. by 3¾ in. or 5¼ in. square. For paper storage, a regular file drawer is useful, as well as a pencil drawer for assorted office supplies.

Lighting is a particularly tough issue with computer workstations: The trick is to keep glare off the monitor screen, yet have plenty of light available for illuminating the keyboard or writing surface. In offices with ambient light or with desks located near windows, glare can become a real problem. Monitors can be fitted with anti-glare filters over the screen (see monitor section of sidebar) or perhaps a recessed compartment can be designed into the workstation to shield the screen.

Another solution to lighting problems is to outfit the workstation with one or more adjustable lamps that can provide lighting only where it's needed. Any adjustable desk lamp is capable of giving this kind of task lighting, but architect's mechanical-arm lamps are popular because of their long reach and wide range of adjustability. Hugh Foster of Manitowoc, Wis., employs a pair of these lamps on his cherry computer desk, shown in the left photo, above. The lamp stems fit into holes in round wooden bases, which allow the lamps to be set up wherever needed. Santner's modular workstations have special fittings that will hold an architect's lamp. These fittings are designed to mount anywhere on the leg columns.

Dimensions and adjustability—Like chairs and other furniture that must provide user comforts, workstations must be designed ergonomically, which means taking into account factors such as how far the user can reach comfortably to open drawers and operate components, and what are comfortable heights for keyboards and writing surfaces. E.D. Groves, a retired professor of vocational education and technology at Mississippi State University in Starkville, Miss., tackled the problem of putting all computer components within reach (as well as within view) by making a circular workstation, shown in the above photo at right. Groves' workstation is made up of three segments, which allow portability and flexibility in arranging the workstation to suit the user's individual needs.

Work surfaces must be at comfortable heights, so tailor them to fit your needs or the comfort of your client. For instance, to find the best keyboard height for his workstation, Foster sat down at his partially completed desk and measured where the keyboard felt comfortable, something he's concerned with since he's a professional writer. His rule of thumb is "the closer the keyboard is to your lap, the faster you'll type." If you're designing a workstation that must accommodate a range of different-size people, you may want to take a more scientific approach. The ergonomics of computer workstations have been studied by The Human Factors Society, which sells a book called "American National Standards for Human Factors Engineering of Visual Display Terminal Workstations" (available from The Human Factors Society Inc., Box 1369, Santa Monica, Cal. 90406; 213-394-1811). While the book goes into great depth on specific issues, like what kinds of casters are most efficient for workstation chairs, the book shows a few critical dimensions to use as a starting place in workstation design: keyboard height, knee space, monitor height, size of work surface area, and seat height and angle. A drawing that includes both general guidelines for determining dimensions and a range of dimensions designed to fit most people can be found in figure 1 on p. 32.

Santner, who has built workstations for hundreds of different clients over the past 10 years, takes exception to the idea of plotting workstation dimensions from an ergonomic chart. He says, "When you try to create a single, rigid design that'll fit anybody, you're bound to miss-fit almost everybody." Santner's solution to the dimensions dilemma is adjustability: The leg columns on his modular workstations are drilled with adjustment holes that allow the user to change the height of all work surfaces independently, at increments of ⅝ in. up or down. This allows the keyboard, monitor and writing surface to be optimally located. Interestingly enough, laws in Europe already mandate adjustability in workstations, and many people expect similar laws to be passed in the U.S.

Adjustability is also an important consideration when enclosing computer components in cabinets or cubbies or on multiple shelves. This is because component sizes aren't standardized—even for the same kinds of components (you encounter a similar dilemma building a stereo cabinet). Adjustable shelves allow you to tailor spaces to existing component sizes, as well as add many new components and accessories in the future.

Construction and materials—The kinds of construction techniques for building a computer workstation are as limitless as they are for building most furniture. Popular systems include plywood carcases, solid-wood frame-and-panel constructions, or veneer- or plastic-laminate-covered particleboard. The main concern is strength; computer components can be extremely heavy: CPUs, monitors (especially some of the newer, large-screen models) and laser printers can weigh 35 lbs. to 75 lbs. or more. Workstation tops, drawers and shelves must support this weight, as well as the weight of someone who may sit or lean on the piece. For instance, if the component is placed on a shelf, the span should be short—about 24 in. maximum for ¾ stock—or the shelf should be reinforced with battens glued to the underside. Otherwise, the shelf may sag or even break. If you want to gain greater strength in shelves or carcases without having to build a workstation that weighs as much as a Sherman tank, you can use torsion-box or honeycomb-core panel construction. By gluing two skins over a thin inner lattice, the resulting panels will be strong, yet very lightweight (for more on honeycomb construction, see Scott Peck's article in *FWW* #76, pp. 76-78). Because cabinet backs are often left off workstations, for ventilation or access to wiring, it's a good idea to add glue blocks or bracing on the inside carcase corners to prevent the case from racking. As an alternative, cabinetmaker Klausz used a pegboard back on his computer cabinets, like the one shown in the bottom photo on p. 33. The pegboard prevents racking while the holes allow ventilation.

Joinery for workstations depends mostly on the materials and the design; Foster used mortise and tenons and dovetails to join the frame members on his solid-wood computer desk. However, exposed dovetails would be inappropriate in a modern-style, laminate-covered desk, in which biscuit joints or dowels are most commonly employed. Drawer construction depends on the materials and the load the drawer will carry. Like regular file drawers, pull outs or drawers meant for heavy components should be mounted on full-extension metal drawer slides rated to carry at least as much weight as the components. For keyboard trays, choose drawer slides that will lock in the extended position. Accuride series 3037 full-extension slides and series 322 slides, for heavy drawers and pull-out shelves, as well as series 2008 keyboard-tray slides are available from The Woodworkers' Store, 21801 Industrial Blvd., Rogers, Minn. 55374; (612) 428-2199.

Finishes—Work surfaces should be finished to withstand abrasion, so treat these as you would any other desktop, applying several coats of a durable finish. While traditional lacquers and varnishes are acceptable, finishes like catalyzed lacquers and polyurethane are even more wear-resistant. Some makers have even resorted to "industrial-strength" finishes: Gauvry's Philadelphia, Pa., shop was commissioned to build a set of computer cabinets for an insurance company and chose a paint called "Plextone" as a finish. Though the product was originally designed for auto luggage compartments, Plextone can be sprayed with regular spray equipment modified to handle the viscous mixture. Gauvry sprays the Plextone on the carcase surfaces, as well as the rounded-over edges of his cabinets. It is highly resistant to abrasion, and is also anti-static—an added benefit when working with floppy discs that can be ruined by a single jolt of static electricity. (Plextone is available in 5-gal. cans from the Plextone Co., 2141 McCarter Highway, Newark, N.J. 07104; 201-484-4443.) Plastic-laminate surfaces are easy to keep clean, and are popular for office furniture that doesn't get much maintenance. Santner's workstation has plastic laminate applied over lumber-core hardwood plywood, which he uses because it's stronger than regular veneer plywood. Both sides of each panel are covered to prevent warping, the same reason you should veneer both sides of any panel.

Seating—Since practically all computer work is done while seated, the choice of the chair used with a workstation is as important as the rest of the setup. While workstation seating is the subject of an entire article in itself, it's important to choose a computer chair that's truly comfortable: Compared to a regular dining chair used during a two-hour meal, a computer chair used in an office situation must keep the user comfortable all day long. Design-wise, this is no small feat.

I talked to Richard Schultz, a freelance contract furniture designer in Barto, Pa., about workstation seating he's designed for the contract furniture industry. Schultz says that an individual's own definition of comfort changes during the course of a workday, and the chair should, ideally, adjust to accommodate a range of different seating positions. On many modern office chairs, a host of levers and knobs allows adjustment of height, angle, rotation and even firmness. Contrary to a high-tech approach, Schultz says a rocking chair might be a good solution to allay fatigue at the workstation. That strikes me as a nice balance; front-porch comfort on the edge of the technological frontier. □

Sandor Nagyszalanczy is associate editor for Fine Woodworking.

Accommodating computer components

The components of a typical personal computer system are a CPU (central processing unit), one or more computer disc drives, a monitor or CRT (cathode-ray tube), a keyboard and a printer. The CPU, a metal box that contains the computer's central "brain," is connected to all the other components. The system's one or more disc drives load and store information on magnetic floppy discs. The monitor is similar to a television set and displays the words, numbers or graphics being processed by the computer. The keyboard resembles a typewriter keyboard: In addition to the usual letters and numbers found on a typewriter keyboard, a computer keyboard has a cursor (a flashing spot on the screen that shows you where the characters you type will be entered) and function keys that let you control various computer operations. A printer produces paper copies of your on-screen work.

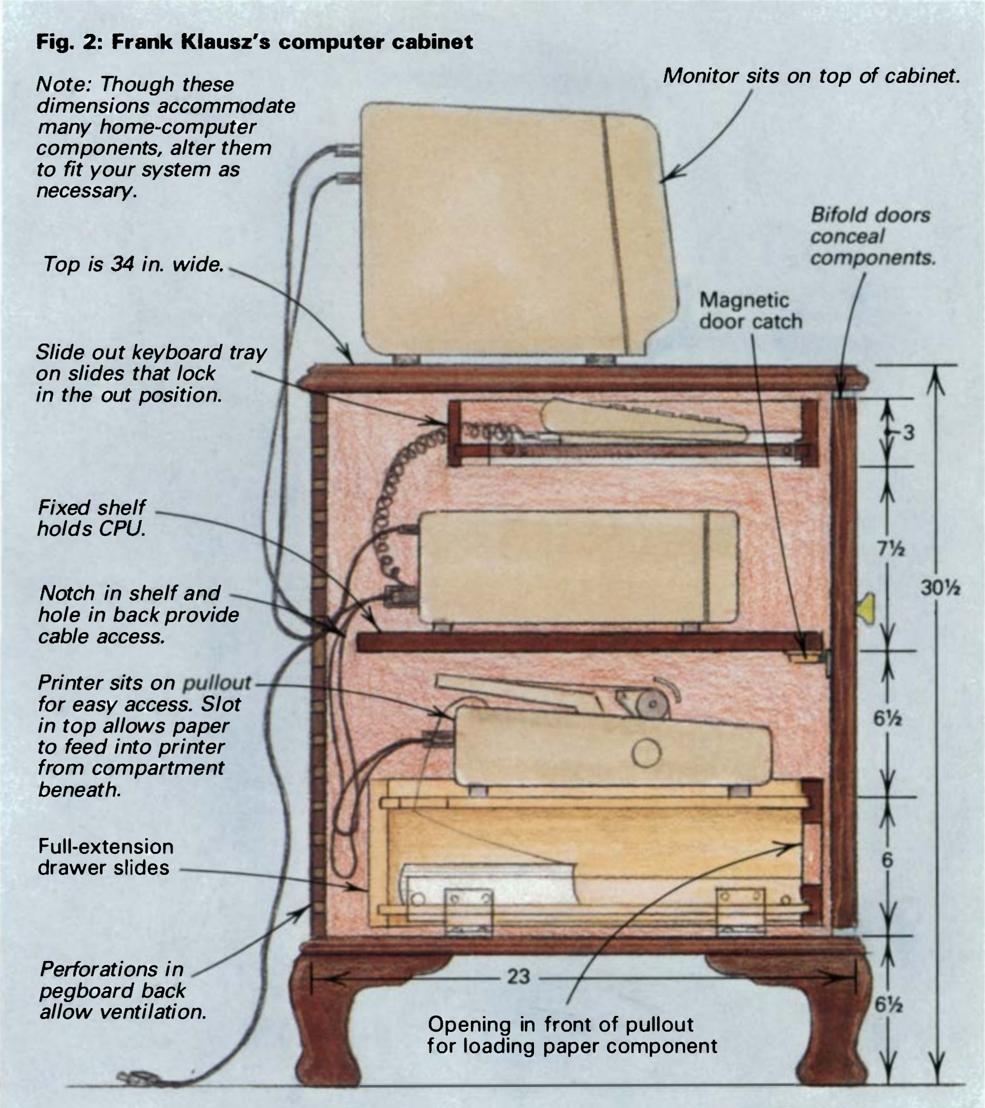
Computer accessories commonly found in a simple home/office computer system include a mouse, a palm-size control unit that rolls on a flat surface, controls the cursor and performs some other keyboard functions; a power strip, an extension cord with multiple outlets designed to protect equipment from electrical surges and to provide a convenient central location for switching everything on and off; a modem, a device that allows computers to transmit information over phone lines; and a "hard" disc drive, which, like a floppy disc drive, stores information.

On the next pages are descriptions of the characteristics of individual computer components you should consider before designing any piece of computer furniture. In addition, a discussion on wiring and ventilation is provided.

Photo: Sean Sprauge

Covered in bandsawn and slip-matched Honduras mahogany veneer, the executive desk by David Welter features a pivoting drawer, that swings around to hide the keyboard and make the desktop an uninterrupted surface. The far end of the cabinet has a compartment that houses the computer's central processing unit (CPU).

Fig. 2: Frank Klausz's computer cabinet



Keyboard: Unlike a regular typewriter, a computer's keyboard is most often a detached, separate unit that connects to the CPU via a coiled cord. The keyboard can be used on your lap or on a table or desktop. However, typing with the keyboard too high can be uncomfortable and can even lead to wrist problems, like carpal tunnel syndrome. Many computer desks employ a pull-out drawer or tray that's mounted under the desktop. This lowers the keyboard and allows it to be rolled out of the way when not in use. David Welter, a cabinetmaker and instructor at the College of the Redwoods in Ft. Bragg, Cal., designed a more novel way to hide a keyboard in his computer desk, which is shown in the photo at left. Mounted to a pivoting tray, the keyboard flips over when not in use to return the desktop to an uninterrupted surface. Aside from the addition of a keyboard tray and a compartment for computer components, Welter's executive desk is a typical desk. Welter's reasoning behind designing a hide-away keyboard is that an executive uses a computer occasionally.

CPU: The CPU location depends partially on whether it also houses the system's disc drive. Most home-system CPUs have at least one drive that's accessed through a slot on the front. This should be accessible to the user since discs need to be inserted and taken out often. The CPU can rest flat on a desktop or shelf, or can be enclosed in a cabinet or drawer; in any instance, it can be mounted either horizontally or vertically (check the computer's manual before doing the latter). If the CPU sits in a tight space, make sure there's clearance at the unit's intake and exhaust ports for ventilation, as well as clearance to get at the unit's on-off switch (you can also plug the CPU into a power strip, described later). Also, your design should permit the CPU to be removable, both for service and for access to the plugs and wiring on its back or side panels.

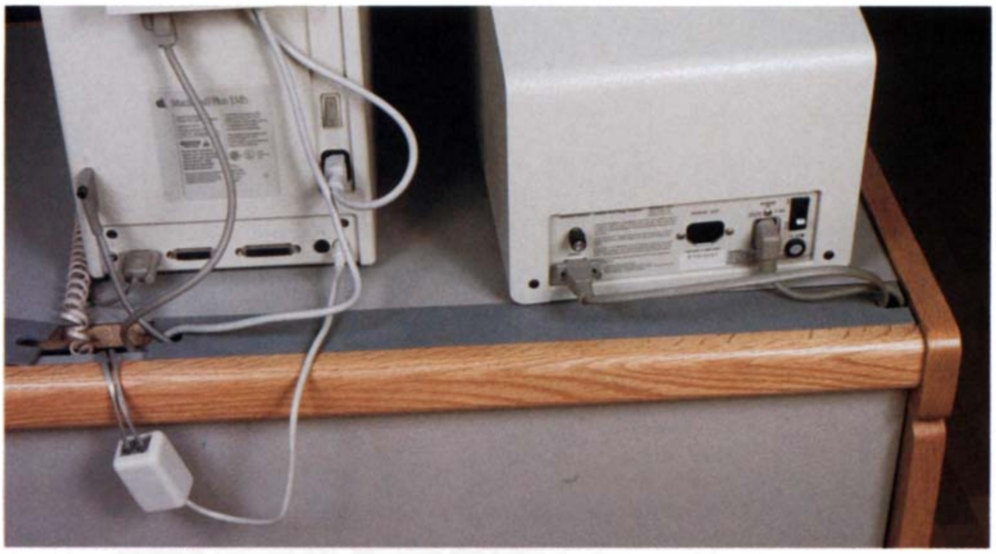
Monitor: A computer monitor should sit on the workstation so that the top of the screen is at or below eye level, with the viewing angle between monitor and keyboard not exceeding 60° (see figure 1 on p. 32. Many people put the monitor on top of the CPU, but this isn't always an attractive or a functionally desirable arrangement. If you provide a special shelf for the monitor, you also free up space below the screen for paperwork. Computer monitors are often deeper than regular TV sets of the same screen size; so make the shelf deep enough to hold the monitor without too much overhang. If the monitor is enclosed in a hutch or wall unit, leave at least a couple of inches of space around the monitor for ventilation. Extra clearance at the top also allows the monitor to be used on top of a tilting-and-pivoting monitor stand, a device that allows the user to position the screen for the best glare-free viewing. Monitor stands, as well as copy stands, anti-glare screens and other accessories, are available from Misco, One Misco Plaza, Holmdel, N.J. 07733; (201) 946-3500.

Printer: In offices, several individual computers may be connected to a single printer, housed in its own stand. A home computer setup, on the other hand, usually has a printer directly connected to the CPU. Printers will work on any flat surface, but can be fitted into all manners of compartments, drawers and pullouts. Because printers are noisy, some people prefer to enclose them entirely inside a cabinet or drawer. Cabinetmaker Frank Klausz's computer cabinet, shown in the bottom photo on pg. 33 and in figure 2 on the facing page, features a pull-out printer drawer with a built-in paper compartment. Phil Smith, a Long Beach, Cal., woodworker and contractor, built a hinged cover on a printer stand he was commissioned to build to reduce the printer's noise. The cover had a slot at the back for the paper to exit, and was lined inside with thin, dense-cell foam (available as sleeping pads from outdoor supply stores) to muffle the printer's noise.

But before deciding to enclose the printer, you should consider how the printer will be used. Printers that are manually fed or are only used to print a few sheets at a time may be located on a desktop or shelf, within easy view and reach. If the printer uses a continuous paper-feed mechanism, the cabinet should provide a way for the paper to enter and exit the machine without jamming. If the printer is in the middle of a table or large desk, you can cut a slot in the surface and feed the paper up from a storage area underneath the work surface.

Disc drives and accessories: Even a simple computer system may incorporate extra drives or accessories, and you may wish to plan extra shelves, compartments or drawers to accommodate them now or as they are added in the future. Unlike regular disc drives, the memory-powerful hard drives don't use removable discs, and don't need to be located within close reach. Hard drives can be housed practically anywhere in the workstation, and can be remotely switched on and off from a separate power strip. Most other accessories can be housed on shelves, in little cubbies or in a single hutch or pullout. Some of these accessories (or peripherals as they're known) need easy access; so again, locate them within reach.

Wiring: Besides the usual AC-power cords, computer systems involve a series of cables connecting all the components. While wiring a computer system usually isn't more complex than wiring a stereo system, there are several points to consider. Computer cables tend to be thicker than stereo wires, and their clutter can be just as unsightly. Therefore, a well-designed workstation should provide some way of containing these cables, yet allow the cables to be easily removed and rerouted if components are added, serviced or relocated. Two different approaches to wire management can be seen in the workstations designed by cabinetmakers Bill and Jim Kochman, of Kochman Woodworking in Stoughton, Mass., and Emeryville, Cal., furniture designer/builder Dean Santner. The Kochmans provide access to the cables by creating a wire trough or raceway fit along the back edge of the desktop. The raceway is concealed by a removable cover, as shown in the photo at the top of this page. Santner's modular workstation holds the wires in hook-and-loop fasteners suspended underneath its shelves and work surface. Both of the systems allow wiring to be changed instantly.



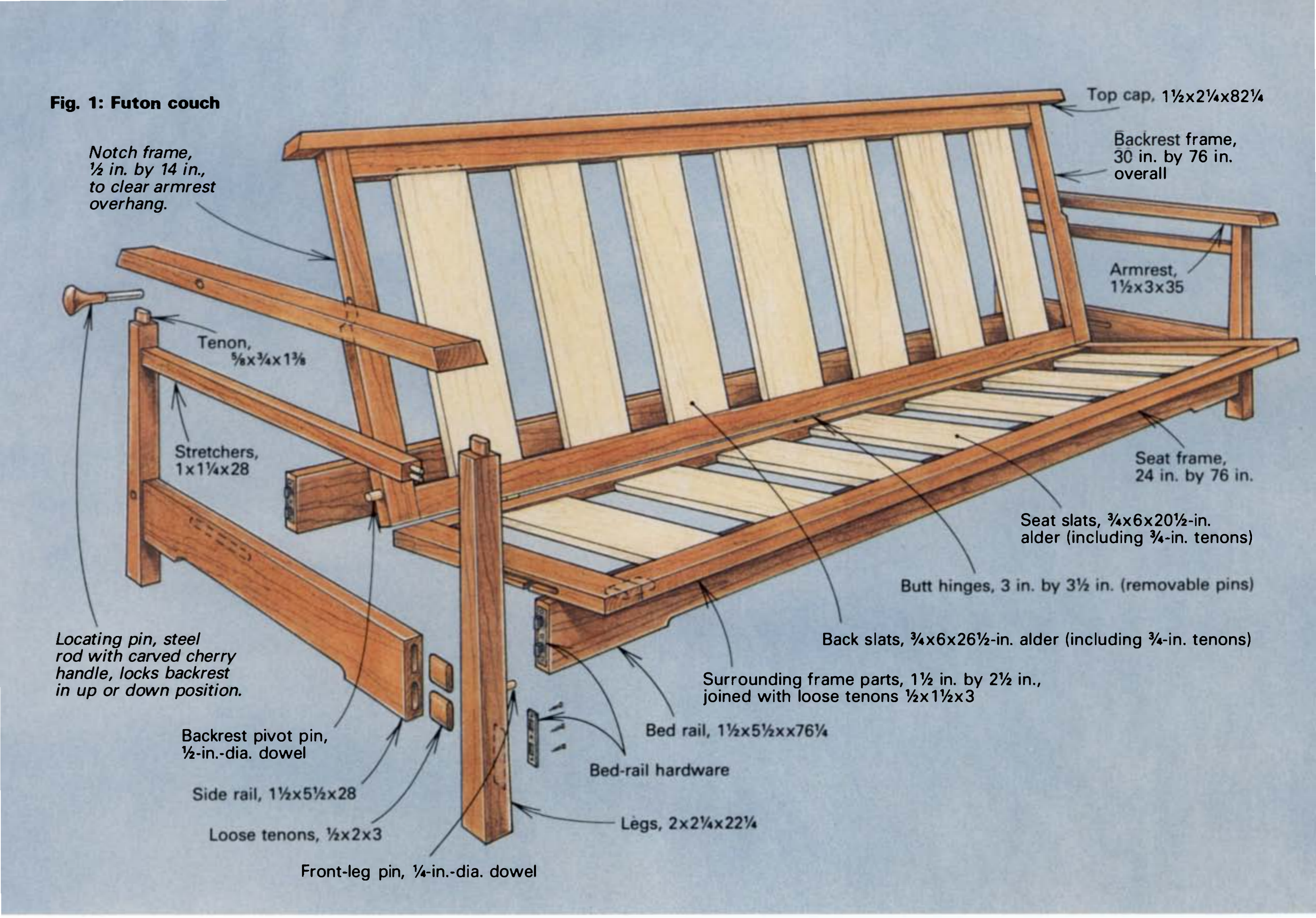
Bill and Jim Kochman's computer workstation is a prototype for a line of computer furniture the brothers were considering manufacturing in their partially automated cabinet shop. A removable plastic strip at the back of the top reveals a raceway for computer cables, which allows a user full access to the cables while keeping them neatly hidden.

Where wires pass through tops or carcases, holes or slots must be made large enough to pass not only the cables, but end connectors as well. Proportional to cable thickness, these holes can be surprisingly large. One computer-desk maker told me he had to painstakingly remove a 50-pin connector from the end of a cable, then solder all 50 wire connections back on because he failed to make a large enough opening to pass the connector. But instead of leaving gaping holes in your workstation, you can buy wire grommets, which reduce holes and slots down to wire-size openings. Wire grommets, as well as plugs for as-yet-unused holes, are available from Doug Mockett & Co., Box 3333, Manhattan Beach, Cal. 90266; (213) 318-2491. Also, when sizing compartments for components, leave enough room for protruding connectors, plus extra clearance for cables that must turn a corner before being routed through a raceway or passage hole.

Ventilation: All computer components (except keyboards) need ventilation. If they're enclosed inside a cabinet, consider leaving the cabinet's back or bottom open to avoid obstructing the component's cooling vents. Though a CPU can create a fair amount of heat, the unit's built-in fan will usually cool it, provided you leave an opening in the case or drawer at least equal in size to the component's ventilation port. If you are in doubt or if the unit seems to get too hot inside the cabinet, you can always install a "muffin" fan (a 3-in. muffin fan is available from Radio Shack, part #273242). This is a small, flat AC-power exhaust fan that mounts over a hole in the cabinet and circulates cooling air.

Unlike other sensitive electronic gear, most computer components aren't particularly susceptible to dust problems in the average home or office environment. Unless you want to close a workstation with doors or with a tambour roll top to keep out kids, to ensure security or to cut down on visual clutter, there's no reason the components can't sit out in the open.
—*S.N.*

EDITOR'S NOTE:
Relatively few woodworkers today are building computer furniture, but as computers proliferate, hopefully we'll see a boom in computer furnishings as well. If you've designed a piece you're pleased with, send a slide or transparency along with a description to: *Fine Woodworking* magazine, The Taunton Press, 63 S. Main St., Newtown, Conn. 06470. We'll consider the best submissions for future publication.



Making a Futon Couch

Pivoting backrest converts from seating to sleeping

by Gary Rogowski

A futon is simply a mattress-size cotton shell filled with cotton batting to a thickness of 4 in. to 6 in., then tied through, like an overstuffed comforter. Ideally suited for the small quarters and austere interiors of Japanese homes, futons have been traditional bedding in Japan for more than 2,000 years. They are laid down over tatami mats on the floor for sleeping, then rolled up in the morning for daytime storage or removal to the outdoors for airing. However, because sitting and sleeping on the floor is not customary in the West, we've adapted the use of the futon to suit both our habits and our interiors. That adaptation is in the form of a contemporary-style, wood-frame couch that lifts the futon off the floor and converts it from a couch to a bed and back again (see the top photos on the facing page).

At first, the idea of sleeping on a 4-in.-thick cotton mattress may strike you as lumbar torture, but the futons now available in the United States are made 6 in. thick and are filled with 100% cotton batting or a cotton and polyester blend. When used on a frame, they often have a 2-in.-thick, high-density foam core sandwiched between 2-in.-thick layers of cotton batting. Futons are available in standard mattress sizes from twin to king and can be purchased with a fitted, zippered case in a wide variety of colors and patterns.

The futon couch described here consists of two side frames for the armrests and legs, connected by two long bed rails that lock into the side frames with standard, knockdown bed hardware. Two larger frames are hinged together and convert from seat and back-

Drawings: David Dann

The hinged seat and backrest frames, along with a simple system of pivot pins and slots, allow the author's cherry couch frame (above) to be converted to a bed (below). A futon is the perfect mattress for this application, because of its flexibility.

Photos above: Jim Piper

rest for the couch to a sleeping platform for the bed. The backrest frame pivots on two ½-in.-dia. dowels that fit into slots routed in the side rails. After the backrest has been laid down flat, the platform is slid forward about 3 in. to center it over the bed rails. As the platform is slid forward, the seat frame is guided by ¼-in.-dia. dowels that are glued into the front legs and run in slots routed in the edge of the seat frame. Two steel locating pins with carved cherry handles are inserted through holes in the armrests to lock the backrest in the upright position, or through holes in the back legs to lock the platform in the sleeping position.

Design–Although smaller than an overstuffed hide-a-bed, a futon couch is still a fairly large piece of furniture and must be tailored to fit comfortably in the room for which it's planned. Make sure of the futon size before you begin your frame, and check if there's room to convert the couch to a sleeping platform. My couch was built so that a double-bed, 54-in. by 76-in. futon would fit on it lengthwise between the armrests. You'll note in figure 1 on the facing page that the seat and backrest frames are different widths. I determined the front-to-back depth of the seat frame by measuring the seat of a couch that I found comfortable. When sizing the seat frame, take into account the thickness of the backrest portion of the futon, and make sure that the seat isn't so deep that it interferes with your knees, forcing you to dangle your feet up in the air. When the futon is folded in the couch position, it will extend beyond the wood frame, providing a softer front edge. In the bed position, the total width of the two frames should equal the full width of your futon; both of these frames should be the same length as your futon.

Two other important details are the size of the armrests and the method for securing the futon on the frames. I made my armrests wide enough and thick enough to sit on, because contrary to the wishes of your Aunt Shirley (the same Aunt Shirley that would cover your futon couch in clear plastic if she had the chance), people will invariably sit on the arm of your couch. To ensure that the futon stays on the couch, sew straps onto the back of the futon cover where it folds for the backrest. When these straps are tied to the backrest slats, they prevent the futon from shifting forward.

I recommend you make full-scale joinery drawings to work out the construction details. This will help you see how each joint looks and how it will be cut. A full-scale drawing of the side of the couch will help you visualize the motion of the couch as it is transformed into a bed so you can plan for the placement of the pivot pins and slots.

Joinery–I used about 30 bd. ft. of 6/4 cherry for the side, seat and backrest frames. The legs require about 5 bd. ft. of 8/4 stock. Because I knew the back of my couch would be up against the wall and would not show, I used alder instead of cherry for the slats, about 20 bd. ft. of ¾-in.-thick stock. I've learned through experience to rough-mill all my parts and then remill them to final dimensions. I crosscut 1 in. over in length and rip ⅛ in. over in thickness and width. This way, if the wood wants to move, warp or cup, as it invariably does, my final milling will straighten, flatten and smooth it exactly to the dimensions I need.

The side frames are constructed with loose tenons fitted into mortises plunge-routed in the ends of the side rails and the sides of the legs. Loose tenons simplify my cutting list and eliminate the hassles of sawing tenons on the ends of long pieces. In addition, cutting twice as many mortises, once you're set up for them, is often faster than setting up, cutting and fitting integral tenons. The photo below, left, shows one of the jigs I use to mortise with the plunge router. The slots in the jig are cut out on a router table to the same width as the template guide that's screwed to the router base. The jig is positioned on the joint area and clamped in place. The router is placed over the jig, with the collar in one of the slots; a ½-in.-dia., carbide-tipped, spiral mortising bit is used to rout the mortises, as shown in the photo below, right. The same jig is used to rout the mating mortise. Because the inside face of the rail and the inside of the leg are flush, I simply clamp the jig's fence to the inside of each of the pieces. If they weren't flush, I would clamp a spacer, the width of the desired "set back," between the jig's fence

A single jig is used to rout the mating ½-in.-dia. mortises for the loose tenons that join the side rails to the legs. In the photo below, left, the jig is clamped to the end of the side rail. In the photo below, right, the author routs the mating mortise in the leg. The jig's slots are cut on the router table to fit the template guide screwed to the base of the Hitachi plunge router.

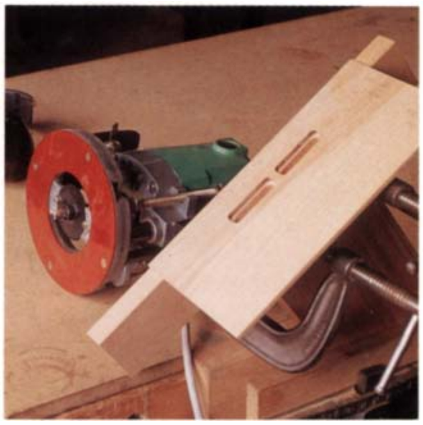
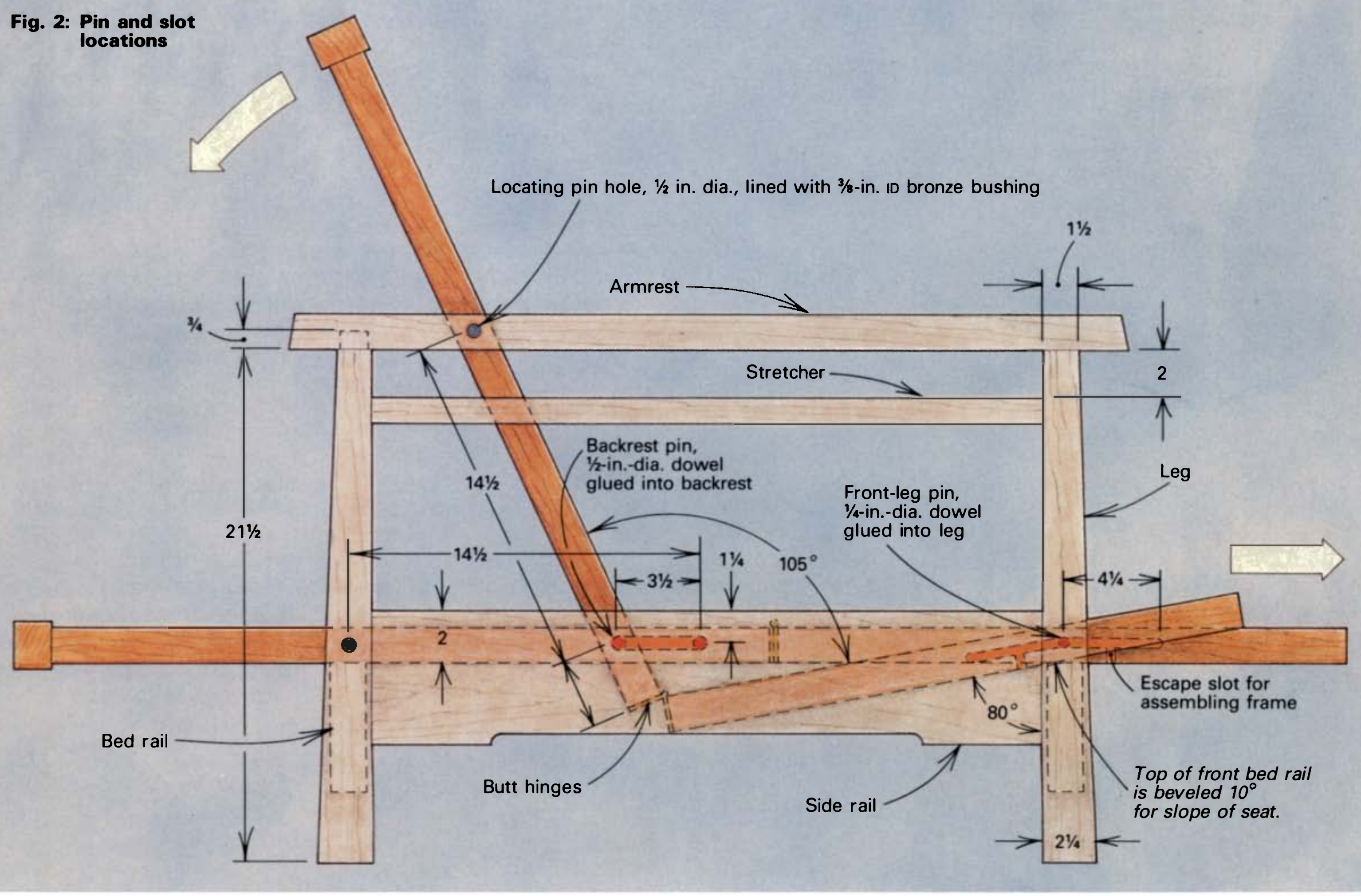


Fig. 2: Pin and slot locations



and the piece that is to be inset. For extra insurance, I always pin these loose tenons with dowels. Sometimes I hide the pins on the inside of the joint, but they can be made decorative by using a contrasting wood for the pin.

I make the loose tenons by ripping lengths of solid stock on the tablesaw thick enough and wide enough to fit the mortises. I round over the long edges with a ¼-in. roundover bit on the router table to match the curved ends of the mortises left by the ½-in.-dia. router bit. Then, I crosscut the tenon stock to length, cutting it slightly short to allow space for excess glue and to ensure the joints come tightly together.

I mill all the side-frame parts to final dimensions and rout the mortises in the side-rail ends and in the legs using the mortising jig I made for the 1½-in.-thick stock. I chose not to use loose tenons on the armrests and leg tops; instead, I cut integral tenons on the 1½-in.-sq. tops of the legs so I could have as large a tenon as possible. I saw the tenons on the tablesaw before tapering the outside edge of the legs so I have all straight sides to work from. I fit the tenons to the ¾-in.-deep, ⅝-in. by 1⅜-in. mortises that I rout and chisel in the underside of the armrests. Then, I draw the taper on the legs, bandsaw them and clean the tapered side up on the jointer. I don't bother with a taper-cutting jig for tapering only four legs. I have all my legs cut and cleaned in the time it would take to set up a jig for the proper taper.

The only other joints I use on the side frames is another form of loose tenon–dowels. The stretcher below the armrest is doweled with two ¼-in.-dia. dowels per end. The dowels are more than strong enough to hold the stretcher in place, as no stress will be put on the joint.

The two long rails that connect the side frames and support the sleeping platform are essentially the same as the bed rails that join the headboard and footboard of a conventional bed. On the couch in the top photo on the previous page, I glued the bed rails into the side frames with loose tenons, but this makes it difficult to move the couch and impossible to remove the platform frames. Instead, I recommend using bed hardware so the couch can be completely disassembled. Crosscut the bed rails ¼ in. longer than your platform frames (which are the same length as your futon), and saw a ¾-in. bevel on the back edge of the front rail (see figure 2 above) so that whether seat or bed, the seat frame is always bearing on a flat surface. Rout the mortises into the legs for the hardware before gluing up the sides frames, so you can run your router fence along the untapered inside edge of the leg. Mortise the mating hardware into the end of the bed rails. Because this hardware relies on screws to hold it in place, I use 3-in.-long screws in the endgrain of the rails.

Sand all the side-frame parts to 180 grit before gluing them up. I glue the loose tenons into the side rails first, spreading glue on all the surfaces with a brush or stick. Then, I glue the dowels into the stretcher and spread glue into the mortises on the legs. Use clamps to pull the joints home, making sure the frame remains square by comparing the diagonal measurements. If there's room for more clamps, glue on the armrests now; if not, wait until the glue dries and then glue them on.

While the side frames are drying, I assemble the seat and backrest frames. The finished frames will be ¼ in. shorter than the length of your bed rails so they can pivot and slide freely between the side frames. The widths of the frames will be based on your futon's width and the depth of your couch seat, as described in the section on design. There are seven alder slats in each of these frames to support the futon. I use slats instead of plywood panels, to provide air circulation around the cotton futon. This helps the cotton batting hold its fluff and reduces the chance that any dampness will lead to mildew. If you use plywood for the platform, be sure to drill a series of holes to ventilate the futon.

Although the frames themselves are joined with loose tenons and pinned, I tablesaw ¾-in.-long integral tenons on the ends of the slats. The cherry for the frames is milled to size and crosscut to length, then the mortises for the loose tenons in the corner joints and the mortises for the slats are made with a plunge router and jig. The slat mortises are ¾ in. deep, ½ in. by 5½ in., evenly spaced along the inside edges of the long frame pieces. On the 6-in.-wide alder slats, I tablesaw 5-in.-wide tenons to fit the mortises. The 5-in. tenons fit within the 5½-in. routed mortises without having to round over the cheeks of the tenons to match the rounded ends of the mortises.

Before sanding and gluing up the backrest frame, you'll need to bandsaw a ½-in. notch 14 in. down from the top of the end pieces, to clear the overhang of the armrest when the backrest is up (see figure 1 on p. 38).

Sand your frames and slats to 180 grit. Glue the slats into the long frame pieces first. Then, glue the loose tenons into the ends of the frames, brush glue on both the tenons and the mortises, and clamp on the frame's end pieces. After the clamps are removed from the frames, I pin all the loose tenons with ¼-in. dowels and sand them flush. I round over the outside edges that will be exposed with a ⅜-in. roundover bit. Don't round over the top rail of the backrest if it's to receive a cap piece, or the long edges of the frames that get hinged together.

Pins and slots—Converting the couch to a bed depends on two pivot points, as shown in figure 2: one where the backrest pivots in the side rails; the other where the seat frame slides past the front legs. The first of these is the most crucial: The ½-in.-dia. dowels glued into the sides of the backrest frame pivot and slide in slots routed in the inside of the side rail; these dowels help support the load on the seat and act as the pivot for the backrest. The other pins are ¼-in.-dia. dowels glued into the front legs; they slide in slots in the side of the seat frame and anchor this frame in both the couch and bed positions. The slots are long enough so the sleeping platform can be slid forward until it's centered over the bed rails.

You should note that the slots for these two sets of pins are, somewhat mysteriously, not the same length. This is because as the backrest frame is laid down, pivoting on its pin, the arc of the pivoting frame pushes the seat frame forward approximately 1 in. Therefore, the slot in the seat frame must include this 1 in. of travel, plus the 3 in. of travel as both frames are slid forward to center the sleeping platform. Adding the ¼-in. diameter of the front-leg pin, the slot in the seat frame must be 4¼ in. long; the slot in the side rail for the backrest pin, adding the ½-in. diameter of the pin, must be 3½ in. long. In addition, notice that the distance between the backrest pivot pin and the locating holes for both the couch and bed positions must be the same.

My seat slopes back at an angle of 10° with the backrest angled 105° from the plane of the seat. You might want to measure the angles on a chair or couch that you find particularly comfortable and then adjust the placement of your pins and slots accordingly. To calculate for any such changes, cut two sticks: one as long as the width of the backrest, the other as long as the width of the seat frame. Hinge these two sticks together and use them in conjunction with a full-scale drawing of your side frame to see how the frames will pivot and slide, and to determine the placement of the locating pins. Refer to figure 2 on the facing page or your full-scale drawing when laying out the pivot-pin holes and slots; carefully measure and mark their locations on the appropriate pieces.

I recommend using a doweling jig or some other guide to ensure that the holes for the pins will be straight and true. Drill a ½-in.-dia. hole 1 in. deep into each side of the backrest frame, and glue a 2-in. length of ½-in. dowel into each of these holes. Next, drill ¼-in.-dia. holes ½ in. deep in the front legs, and glue in 1-in.-long, ¼-in. dowels. Then, clamp the seat frame in a vise and use the plunge router with a fence attached to cut the ½-in.-deep slots, one in each end, for the ¼-in.-dia. front-leg pin. Make an entrance and escape slot to allow for assembly of the seat frame near the center of each of these slots. The side panels are then clamped to the top of the workbench, and again using the plunge router with a fence, I rout the 1-in.-deep slot for the ½-in.-dia. backrest pin. After the slots are completed, I find and mark the centers for the ½-in.-dia. holes in the armrest and rear leg for the locating pins and drill them through, again using a doweling jig. To make sure these holes won't become sloppy with use, I line them with bronze bushings and use 4-in. lengths of ⅜-in.-dia. steel rod epoxyed into carved cherry handles for the locating pins. Bronze bushings are readily available at well-equipped hardware stores. I use 1-in.-long bushings with an outside diameter of ½ in. and an inside diameter of ⅜ in., driving them into the holes from both sides and sawing off the excess. The handles, although almost an afterthought, will probably be the first thing noticed, so take your time and have some fun with them.

Now you can mortise for the three butt hinges that join the large frames and glue the cap piece onto the back frame. Sand the rounded-over edges of the frames and clean up any glue squeeze-out with an orbital sander and 180-grit or finer sandpaper. Finally, oil or lacquer the four separate frames and two bed rails. When the finish is dry, wax the pivot pins and slots well with paraffin so they'll slide easily.

Assembling the couch will be easier with two people. Begin by locking the back rail to one side frame. With the hinge pins removed so the large frames are separate, lay the backrest frame on the back bed rail and insert the ½-in.-dia. backrest pivot pin into the slot on the side frame. While your helper holds the first side frame and the backrest together, align the opposite backrest pivot pin with the slot in the other side frame and simultaneously connect the mating hardware of the back bed rail with the second side frame. Now you can connect the front bed rail to both side frames. Put the seat frame in place by lining up the escape slots routed in the sides of the seat frame with the front-leg pins and by inserting the three hinge pins to join the two platform frames. Mark the edge of the backrest frame for the locating pins, double-checking their placement in both the upright and sleep positions. Drill the ½-in.-dia. holes 1 in. deep with the doweling jig, line them with bronze bushings and insert the carved locating pins. To dismantle the couch frame, reverse the procedure described above. □

Gary Rogowski designs and builds furniture in his Portland, Ore., shop.

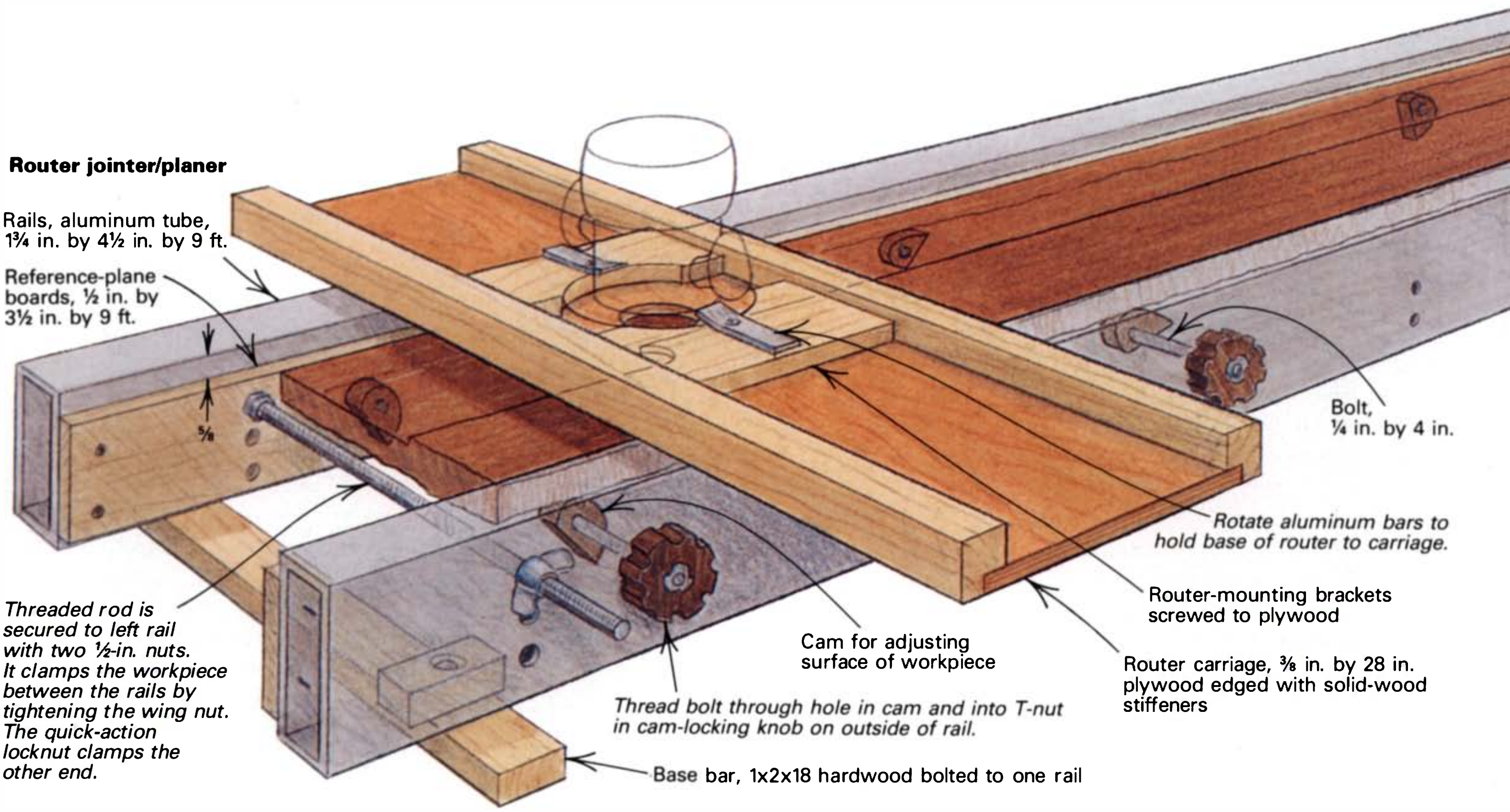
Sources of Supply

Steel rod and bronze bushings for the locating pins can be found at well-equipped hardware stores. Knockdown bed hardware is available from W.C. Winks Hardware, 903 N.W. Davis, Portland, Ore. 97209; or by mail from The Woodworkers' Store, 21801 Industrial Blvd., Rogers, Minn. 55374-9514. Futons can be purchased from Northwest Futon Co., 400 S.W. Second, Portland, Ore. 97204; or check your local Yellow Pages under futons or bedding.

Surfacing Stock with a Router

How a simple fixture can true up wide boards

by Tim Hanson



Did you ever get a good deal on a load of lumber, only to notice while unloading it at home that the rough boards were all twisted, bowed or cupped? Then, as the stack of 8- and 12-in.-wide boards began to dwarf your narrow jointer, and it became clear that it would take forever to process the lumber, did the flush of a great deal give way to disappointment? I know the feeling. I put off using 500 bd. ft. of roughsawn walnut for more than two years because of the limitations of my 5-in.-wide combination jointer/planer.

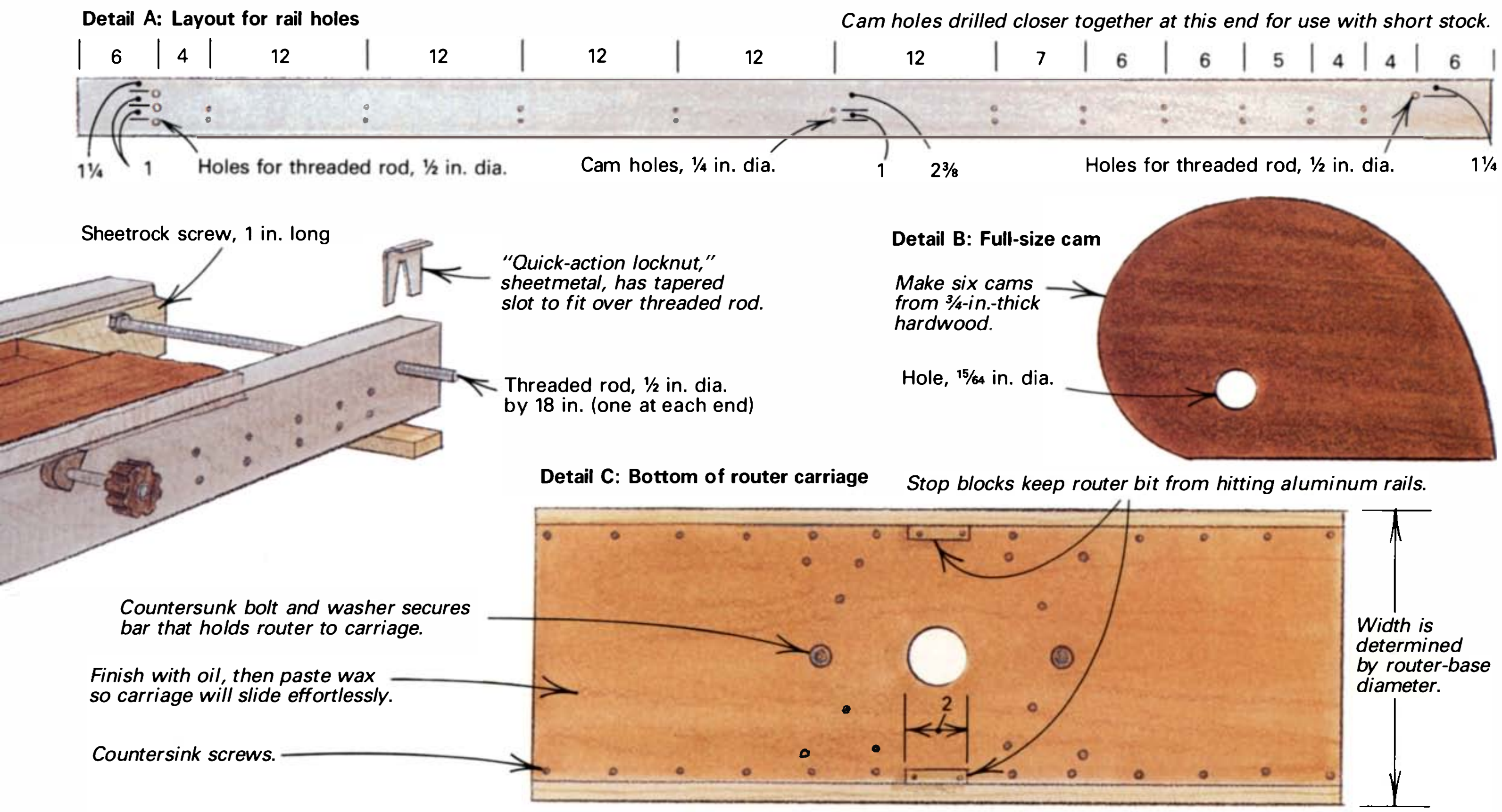
Finally, I decided to set up a router to flatten the boards. I mounted my router on a bridge that would slide on my workbench while straddling one of the rough boards clamped to the bench. Oh, I got a smooth face, but when I removed the clamps, the bow and twist were still there. I needed to hold the board without clamping out its twists or bends, then pass the router over the board in a straight, flat plane—and I needed to know where that plane was in relation to the board. The router jointer/planer in the drawing above solved these problems better than I hoped. It consists of two aluminum rails with "reference-plane" boards screwed to their inside faces, six cams with locking knobs for aligning the workpiece's top surface with the reference plane boards, some all-thread rod to clamp the rails to the workpiece and a carriage for my 1½-HP Black & Decker router. For "planing" with the router, I use a 1¼-in.-dia. carbide mortising bit with a ¼-in.-dia. shank made by W.K.W. Wisconsin. The bit is available from Edwin B. Mueller Co. Inc., 3940 S. Keystone Ave., Indianapolis, Ind. 46277; (317) 783-2040.

How to surface stock—The two 9-ft. rails are the backbone of the rig. They provide a flat and true plane for the router carriage to slide on. The rough or twisted workpiece is supported between the rails on the adjustable wood cams. By adjusting the cams, you can raise or lower one end, or even one corner of the workpiece until its entire top surface is level with or higher than the reference-plane boards. The reference-plane boards are also used to set the depth of the router bit, therefore defining the plane in which the cutter will pass over the surface of the workpiece. After the top surface of the workpiece is set, the rails are "clamped" to the edges of the workpiece with an all-thread rod at each end of the rails. Then the carriage-mounted router is switched on and slid along the rails, "planing" the board flat.

The cutting passes are made in a continuous motion and at a moderate speed along the grain of the wood from one end of the board to the other. The cutter should be in motion at all times to avoid scorching a circle into the work. To thickness-plane the flattened board, set a combination square for the desired thickness and use it to set all six cams the proper dimension from the tops of the reference-plane boards. Lay the workpiece on the cams, flattened side down. When the router carriage is passed over the board, the result will be a flat, planed board.

I can surface both sides of a 1-ft. by 8-ft. board in a matter of minutes. Short boards, only 6 in. or 8 in. long, can be surfaced just as easily. I wouldn't cut a ¼-in.-deep pass with a planer, yet I think nothing of making such heavy cuts with one pass of the rout-

Drawings: Roland Wolf



er. If I want a super-fine finish, I raise the cutter 1/64 in. above the reference plane for the first cut, then lower the cutter to just clear the plane and make the final cut. I end up with a smoother finish than the planer gives me, with no little waves in the surface. In addition, the shearing action of the router bit leaves a nice finish on curly maple with no chip-out. Even if you have a thickness planer, this rig will come in handy as a 12-in.-wide jointer for flattening one side of a wide board in preparation for planing.

Jointing edges—I've had the router jointer/planer for about three months, and I'm still finding new tricks it can do. By removing the cams and clamping the rails to both faces of a board, you can "joint" edges for a straight glue joint. Using the same method, you can plane the faces of a 12-in. by 12-in. timber, or any other piece too thick to fit through a normal planer. Going to the other extreme, I've planed stock to 3/32 in. thick for my son's dulcimer. First, I surfaced two sides of a ¾-in.-thick board and resawed it in half on the bandsaw. Then, with double-faced tape, I stuck the finished side of the resawn board to the finished side of a thicker board and used the rig to plane the resawn board to 3/32 in. thick. No other tool in my shop would have handled such thin stock.

Building the fixture—The aluminum rails are light, rigid and perfectly straight. I got them free of charge from the owner of a glass company who salvaged them from a remodeled storefront. New, they would cost about $80. Drill the holes for the cams and the threaded rods, as shown in detail A of the drawing above, in one rail with a drill press. Then clamp the two rails together and use the holes in the first rail as guides for boring into the second rail.

After all the holes are drilled, attach the reference-plane boards to the rails. Make sure both boards are straight and true, then clamp them to the insides of the rails using a ⅝-in. spacer to check their distance from the tops of the rails. Don't forget, you want to end up with a left and right rail. Attach the boards to the aluminum rails with 1-in. drywall screws by drilling slightly undersize pilot holes through the wood and the aluminum. This way the screws will act like sheet-metal screws and will cut their own threads in the ⅛-in.-thick side wall of the rails. After the reference-plane boards are secured, drill the holes in the rails on through the boards with a portable electric drill.

The cams, shown in detail B of the drawing above, and the cam locking-knobs are bandsawn from ¾-in.-thick hardwood. A ¼-in.-dia. bolt is threaded through a 15/64-in.-dia. hole in each of the cams. The bolts pass through the rails and thread into T-nuts in the center of each knob. To make a knob, draw a 2-in.-dia. circle on the wood and then draw diameters to divide the circle into eight equal parts. Drill a 5/16-in.-dia. hole at each point where the diameters cross the circle, then bandsaw out the original circle. Sand the rough edges and you have a nice knob with good finger grips.

The two walnut "base bars," shown above, provide a flat surface for the rails to sit on and ensure that both rails are aligned in the same plane. The bars are attached to a single rail with one bolt so they can pivot "closed" when not in use.

The all-thread rods are secured to one of the rails with a nut on each side of the rail. A wing nut on one of the rods and a shop-made, sheet-metal, "quick-action locknut" on the other clamp the rails to the workpiece.

Build the router carriage as shown in the drawing and in detail C above. Glue and screw the solid-wood stiffeners and the mounting brackets to the plywood. The router is held in place by two aluminum bars bolted to the carriage. Two small blocks screwed to the underside of the carriage restrict its sideways movement so the router bit can't contact the aluminum rails (see detail C). I finished all the wood with two coats of Watco Danish Oil and waxed the bottom of the carriage so it slides easily along the rails. □

Tim Hanson is a retired general contractor who still enjoys woodworking as a hobby in his shop in Indianapolis, Ind.

Shaker-Style End Table

Shaping a pedestal without a lathe

by Mac Campbell

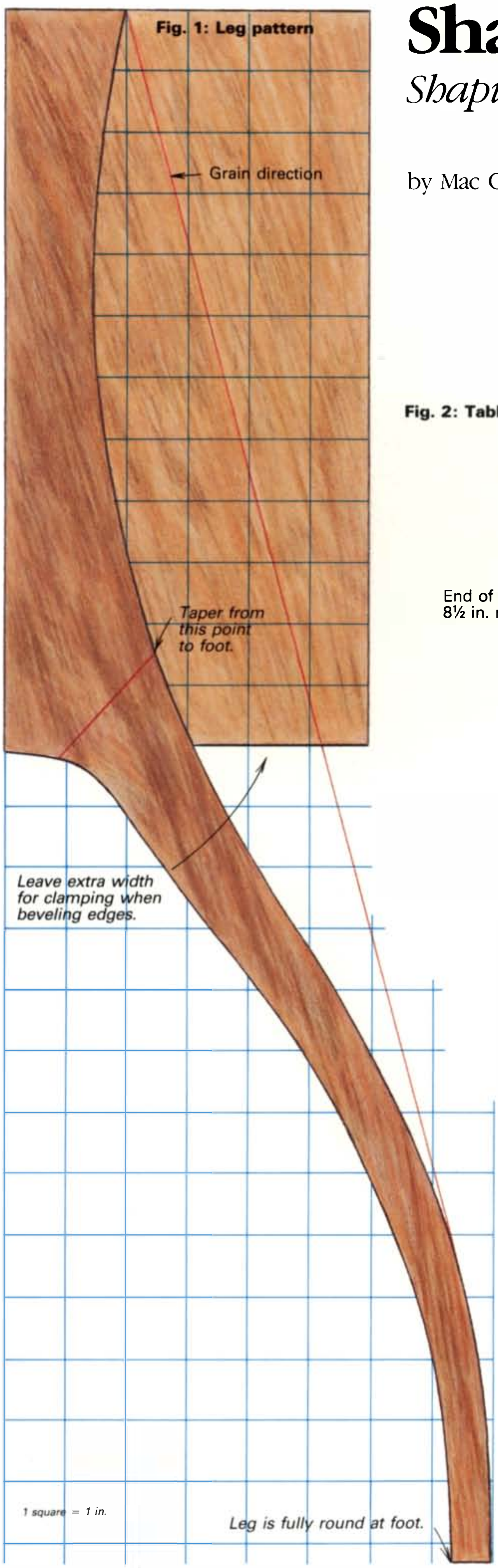
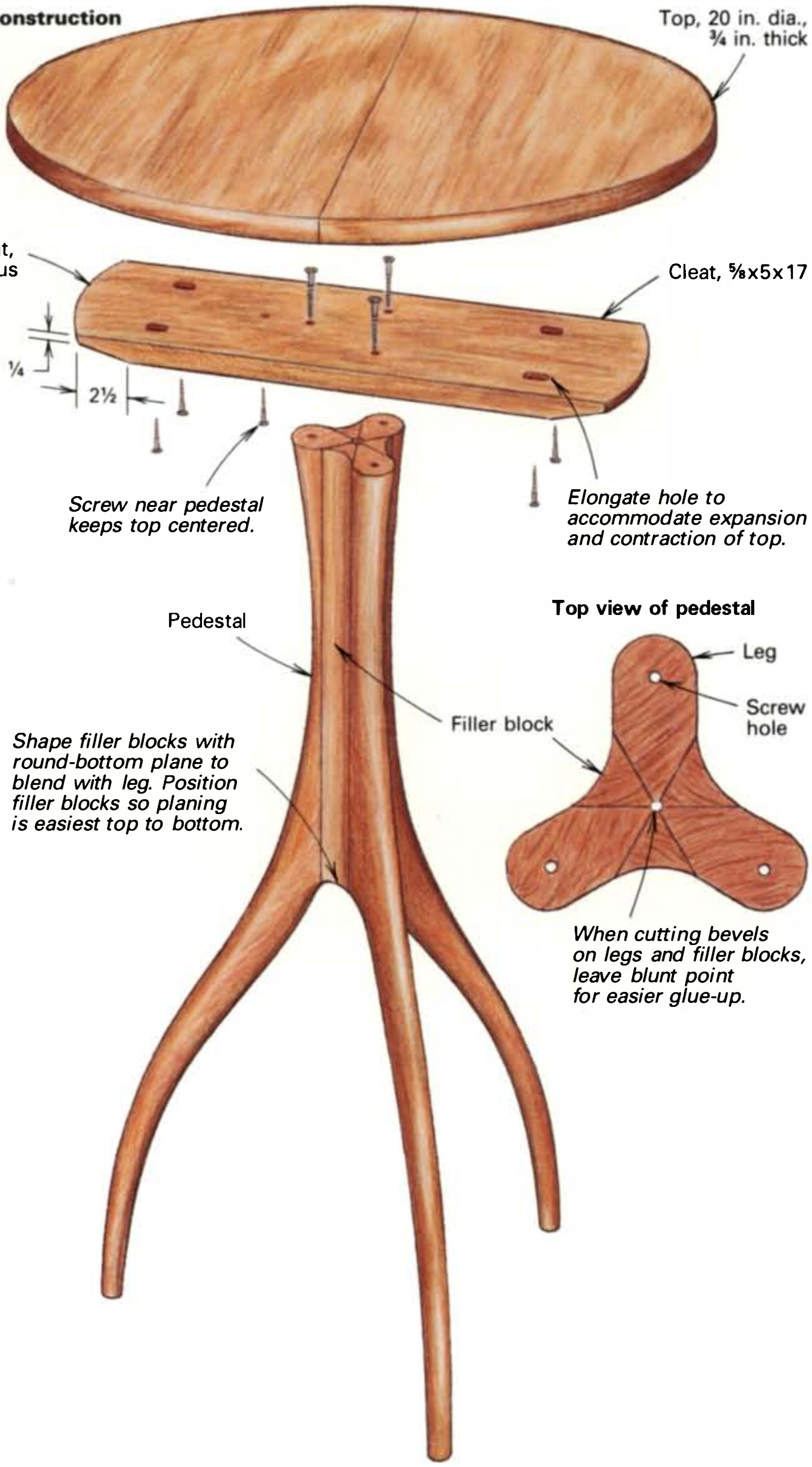


Fig. 2: Table construction



Drawings: Lee Hov

To my taste, the Shakers developed the finest pedestal tables. I'm particularly fond of the cherry table made at Hancock, Mass., Shaker Village around 1830. The transition along the leg, up through the pedestal, is remarkably smooth. Still, there is a transition, and I've never been comfortable with the visual disruption it creates. Ideally, I think, the lines of the table should flow from the floor to the tabletop in a single, smooth, unbroken sweep. When a client asked me to design a contemporary pedestal table based on the Shaker theme, I jumped at the opportunity to "get it right."

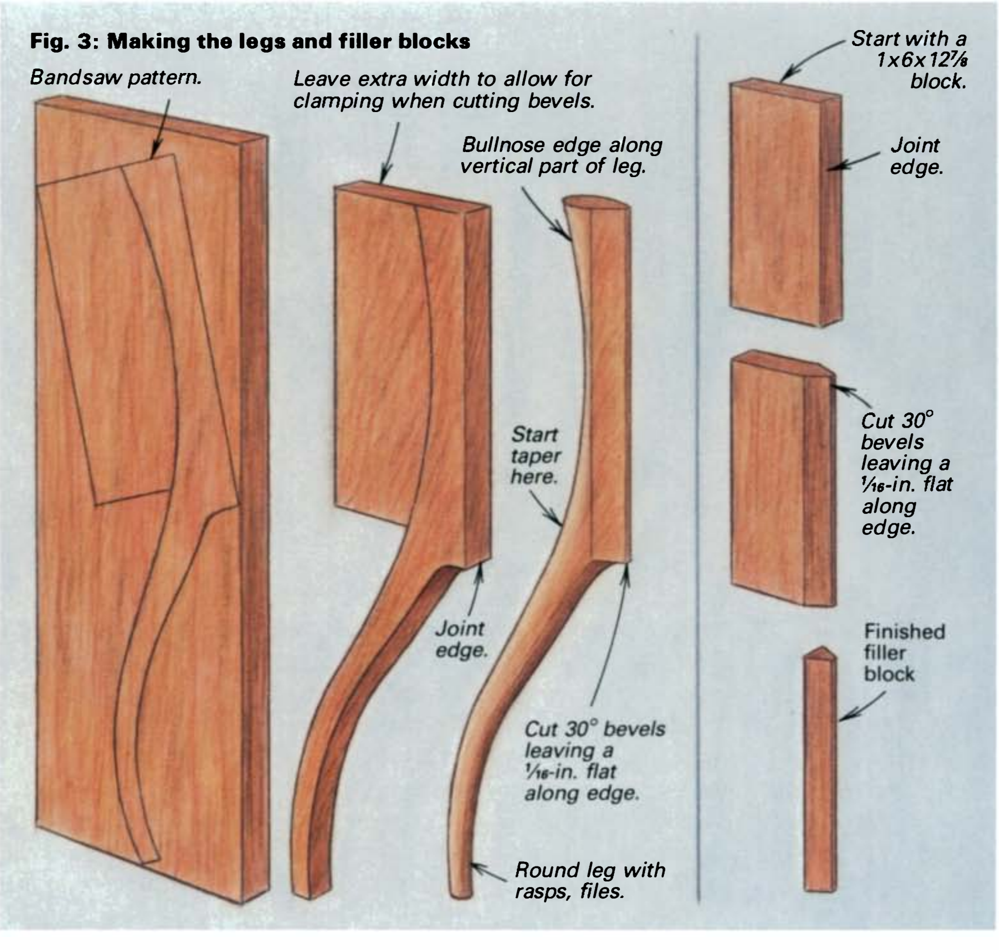
My solution was to form each leg as an extension of the pedestal itself. Where the Shaker stand has a turned pedestal with legs joined at the bottom, my pedestal takes its shape from the way the three legs join together continuously along the vertical centerline of the table. And unlike the Shakers, I don't have to turn any parts to build it. Instead, I add filler blocks in the angled space between adjacent legs and then shape them to smooth the transition from leg to leg. The table shown in the photo below is the result. It is mahogany, but walnut or cherry are equally suited to the style.

In building the table, I first make a template for the legs. I mark out 1-in.-thick stock for the three legs and rough them out on the bandsaw. I also prepare stock for the filler blocks. Then, I carefully rip-cut a 30° angle along both edges of each leg and of each filler block where they will be joined together along the table's vertical centerline. After tapering the legs on a jointer and further refining their shape with rasps and files, I glue up the legs and the filler blocks, using specially made fixtures, to form the pedestal. A cleat is screwed to the top of the pedestal and screws, in turn, are run up through the cleat to secure the top. After sanding the table, I apply French polish or oil.

Making the leg/pedestal template—The basic information you'll need to make the full-size leg template and to construct the rest of the table is shown in the drawings on the facing page and below. Plywood and Masonite are good materials for patterns, but I prefer to use ⅛-in.-thick Lucite. Because Lucite is transparent, I can lay out the work with an eye toward the best grain orientation and avoid defects in the wood. Cut out the pattern on a bandsaw, then smooth the pattern edges to eliminate flat spots and to ensure fair curves. Rasps, files and sandpaper work best for this. Smoothing the pattern at this point is far easier than correcting mistakes on each of the three legs later on.

The grain patterns of the filler blocks and legs should match closely; you want the visual "fit" of the shaped pieces to be as good as the physical fit. When roughing out the 1-in.-thick stock for the legs and filler blocks, leave the pieces wide enough to extend a few inches above the fence on your tablesaw, so you'll have room to clamp the pieces when you make the 30° ripcuts along the mating edges. Mark out the leg with the template, orienting the grain parallel to the leg's long dimension for maximum strength. As you bandsaw each leg, cut away from the pattern (as shown in figure 3 below) to leave extra width opposite the leg's inside edge; this edge must be straight and square to run against the saw table. Save the waste from these bandsaw cuts because it'll be used later when making the clamping jigs and cauls needed to assemble the pedestal. Finally, joint the inside edge of each leg and one edge of each filler block. Final shaping of the legs and filler blocks isn't done until after you bevel the edges, as shown in figure 4 on the following page.

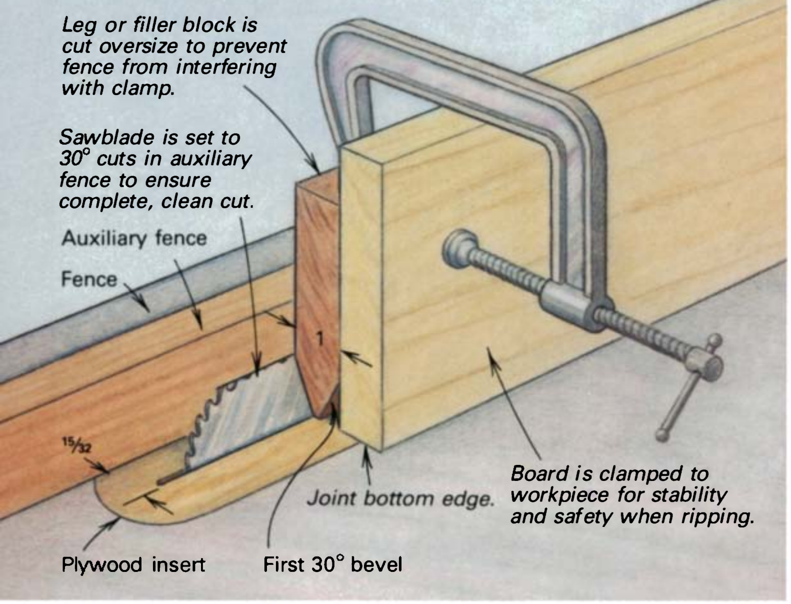
Fitting the legs and filler blocks—The legs project radially from the vertical centerline of the pedestal, separated from each other by 120°. For a good fit, the mating edges of the legs and filler blocks must be cut accurately, so it pays to be meticulous in setting up your saw to make these 30° cuts. You will be making a total of



The pedestal of this sleek update of the Shaker classic is constructed by laminating filler blocks in the gaps between the legs and shaping the juncture with a round-bottom plane. This table is made of mahogany and finished with French polish.

Photo this page: Keith Minchin; all other photos: Mac Campbell

Fig. 4: Tablesaw setup for bevel cuts



The author freehands penciled guidelines along the leg's edge before shaping with planes, rasps and files.

12, 30° ripcuts: two cuts along the mating edges of each leg and each filler block. The error from each cut accumulates, so after the parts are assembled, the total error can be appreciable.

These cuts, like any made on a tablesaw, can be dangerous, so be extra careful. It's a good idea to make a plywood insert for the blade slot so the work will be fully supported at all times. Lower the blade below the level of the table (use a smaller-diameter blade if necessary, to get sufficient clearance) and fit the insert snugly into the blade slot. Set the blade to 30° (from the vertical), turn on the saw and raise the blade slowly so it can cut its own clearance slot. I continue to raise the blade until it just cuts into the auxiliary fence. This ensures that the ripcut will extend cleanly through the legs and filler blocks. Be careful to stand away from the back of the saw while making these cuts, as the waste piece, pinched between the blade and fence, may be kicked back by the blade at the end of the cut.

Here's how I set the blade to eliminate any perceptible error: Square up a length of 1-in.-wide scrapwood to about ½ in. thickness. With the ½-in. edge down, I make a crosscut with the blade set at 30°. Then I flip the piece 180° (the other ½-in. edge will now be down) and make another crosscut to produce an equilateral triangle. When I have six triangles, I fit them together on a flat surface with sawn surfaces butted to form a hexagon. Any error in the tilt of the blade is evident when I try to fit the last triangle. If necessary, I adjust the blade a bit and cut six more triangles, repeating the process until all the joints in the hexagon are snug.

After setting the blade angle, I adjust the fence so the blade will begin its cut a hair less than halfway into the thickness of the legs and filler blocks, as shown in figure 4 at left. The small flat that will be left after both angled cuts have been made will allow for a little play in aligning the pieces when they are glued up. Figure 4 also shows how I clamp the workpiece to a scrapboard (its bottom edge jointed) for making these angled ripcuts. In addition to keeping your hands well clear of the blade, the scrapboard increases accuracy, because the jointed edge of the scrap piece bears on the saw table and minimizes the tendency for the workpiece to wobble during the cut. Remember to stand off to the side, away from the back of the saw.

Finish the job by bandsawing off the extra width you had left for clamping the legs. Also, reset the tablesaw blade to its vertical position and rip-cut the filler blocks along the edge formed by the intersection of the bevel and the flat side of each piece. Now the cross section of each filler block is an equilateral triangle measuring 1 in. on each side, but with one of the corners slightly flattened. For easy shaping later, determine the grain orientation of the surface opposite the flattened corner by making a light pass with a handplane. The direction of easiest planing–no tendency for the wood to tear–for each filler block should be oriented from top to bottom when you assemble them to the legs; mark each block accordingly.

Shaping the legs–Before gluing up the legs and filler blocks, I use rasps, files, flat Surforms and a spokeshave to refine the leg profiles and to eliminate any remaining bandsaw marks and irregularities. At this stage, the goal is to produce a nice flowing line rather than velvety smoothness, so don't worry about sanding yet. Take time to fair the profiles nicely: Shaping will be more difficult after you've assembled the legs and added the filler blocks. Now is also the best time to finish shaping the legs' cross sections. The legs should be bullnose shaped along the vertical part of the pedestal, then taper gradually to the foot, where they are fully rounded. I shape the legs in two steps: First, I taper the sides of the lower portion of the legs; second, I form the cross-sectional contour of the legs.

The taper begins at the bottom of the pedestal, where the legs flare away from the center of the table, and continues to the foot, where ⅛ in. is removed from each side of each leg. You can make this taper with a handplane, but I find it is easier and faster to do it on the jointer. Adjust the infeed table so it is ⅛ in. lower than the outfeed and clamp a stop block securely to the infeed table 14½ in. from the leading edge of the outfeed table. For safety, I use push boards to move the legs over the cutterhead. Both sides of each leg get tapered.

Contouring the cross section of the legs is strictly handwork, but it's not particularly difficult. I first shape the lower, tapered portion of each leg. The goal here is to gradually soften the shape, ending with the foot fully rounded. As a guide, pencil in three lines lengthwise along each edge and side of the leg, dividing each surface into quarters. Make these lines freehand, running your fingers along the leg's edge to guide and steady your hand as you draw each line. All of the shaping is done with files and rasps: First, chamfer the corners between the outermost lines on each side and edge; then round these newly formed corners, working between the middle of the chamfer and the centerlines on each side and edge. The upper half of the leg is simpler: Here you just need to soften the edges a bit. You can do this with files and rasps or by routing with a ½-in. quarter-round bit, but I prefer to do all the shaping by hand to avoid the harsh uniformity of a machined surface. Finish the shaping by hand-sanding the legs with 150-grit.

These three photos show the fixture and clamping arrangements used for assembling two legs with a filler block (left); two filler blocks with a leg (center); and the final pedestal glue-up (right). A scrap piece, left over from the bandsawing of the legs, is used as a caul.

Gluing up the pedestal—Assembling the legs and filler blocks to form the pedestal is a little tricky because there are so many pieces. To make glue-up easier, I do the job in three stages: First, gluing two legs to a filler block; then gluing two filler blocks to the third leg; and finally, gluing these two assemblies together (see the photos above). Two simple clamping fixtures make the job go smoothly. First I place two legs on a 12-in.-sq. piece of 3/4-in.-thick plywood, inside edge to inside edge (separated by about 1/16 in.) and resting on the 30° angled surface. Double-face tape acts like a third hand to hold the legs temporarily in place. Then I fit a filler block between the legs and adjust the position of the legs until the four angled surfaces mate cleanly along their length. Butting three blocks of scrap along the outside edge of each leg and screwing the blocks to the plywood prevents the legs from slipping laterally when gluing pressure is applied to the filler block. The pressure on the filler block will also tend to squeeze the legs up and out of the jig, so it's a good idea to hold the legs down with a piece of scrapwood spanning the legs and screwed to the middle, butting edge blocks. Waxed paper under the legs prevents glue squeeze-out from sticking to the plywood and a clamp at each end of the fixture insures uniform pressure is applied to the filler block.

Follow a similar procedure to fashion a fixture for gluing up the two filler blocks to the third leg. Position the blocks edge to edge (the edges with the flat tips) on the plywood, separated by about 1/16 in. Fit the third leg between the filler blocks and make any necessary adjustments as before. Screwing scrap pieces to the plywood along the outside edges of each filler block prevents sideways slippage. I use waxed paper again to eliminate problems with glue squeeze-out, and clamp the leg in position. Scrap pieces, left over from bandsawing the legs, are placed under the clamp and distribute the gluing pressure evenly.

When these subassemblies have dried, I then joint their mating faces—just enough to produce a good, flat gluing surface. To prevent the pieces from sliding out of alignment during glue-up, I use two 1/2-in.-long dowels (3/16 in. in diameter) inserted into the face of the surfaces being glued; small brads (with the heads nipped off) will work as well. Again, cauls, fashioned from scrap pieces I saved when the legs were bandsawn, help position the gluing clamps and distribute the pressure.

All that remains to complete the pedestal is to shape the filler blocks, adjust the pedestal so it will be plumb to the floor and true up its top. I do most of the shaping on the filler blocks with a shopmade round-bottom plane, but you can also do the job with a carving chisel, scraper and sandpaper. I aim for a shape that is pleasing to the eye and smooth to the touch. After the shaping is completed, place the table base on a large, flat surface and use a framing square, held against the outside surface of each filler block, to see if the pedestal is plumb. If the pedestal touches the square at its top end but there is a gap at the bottom between it and the filler block, you'll need to trim a bit off the bottom of the leg directly opposite that filler block. Work from filler block to filler block, trimming the appropriate leg a little bit at a time, until the square contacts each filler block along its entire length.

When the pedestal is plumb, place a large, flat piece of plywood on the pedestal's top and measure the distance from the plywood to the floor. Trim the top of the pedestal gradually until the distance to the floor is the same all around. A small auto-body grinder with a medium-grit disc does the trimming quickly.

Finishing up—The rest of the table is straightforward. Make the cleat from 5/8-in.-thick stock, form the beveled ends with a handplane and round all of its exposed edges. The cleat supports the table's top and holds it in position with four screws. Cut elongated holes, 3/16 in. wide by 5/8 in. long, in the cleat for these screws, to allow for seasonal expansion and contraction of the top; a fifth screw, near the pedestal, keeps it centered. The grain of the cleat will be oriented perpendicular to the grain of the top, so the elongated holes should be cut parallel to the cleat's long dimension. Position the cleat on the top of the pedestal and drill a 3/16-in.-dia. pilot hole through the cleat into the top of each leg for three 2-in. #8 screws.

In keeping with the simple lines of the piece, the table's top is circular and bandsawn to 20 in. in diameter from 3/4-in.-thick stock. Use a file and sandpaper to gently round the edges. Position the cleat on the underside of the top and use the elongated holes to mark the location for the screws. Drill pilot holes for the four screws that will fasten the top to the cleat.

Before assembling the table, sand and apply the finish. I French-polished the table shown on page 45; a traditional oil finish would also work well. This table has a distinctly modern look, but its relation to the Shaker classic is evident. The blend of modern and traditional styles is one of my primary goals as a furniture designer. □

Mac Campbell operates Custom Woodworking in Harvey Station, N.B., Canada, specializing in furniture design and construction.

The Rosewood Jungle

Finding your way in and out

by Dick Boak

As if the density of rosewoods wasn't hard enough on sawblades, sawyers are sometimes surprised by large mineral deposits, such as the one above. Minerals drawn from the soil can also fill the pore structure as in the East Indian rosewood sample in the background.

Rosewoods are prized for their richly exotic and vividly contrasting figure. In terms of sheer beauty, few woods can compete with rosewood. To be considered a "genuine" rosewood, the tree must be a member of the specific genus ***Dalbergia*** (***Leguminosae*** family). However, there's always been a great deal of confusion and misinformation about the many varieties of genuine rosewoods, as well as the so-called "substitute" species.

In Europe, during the Renaissance, rosewood was imported from Brazil and the Lesser Antilles. The preferred timbers, the ones with the darkest purplish colorings, were commmonly called "palissander." The term palissander continues to this day to be overused in the European wood market to refer to any species of wood that "is or resembles" rosewood. Jacarandá and granadillo are also such catch-all terms, used in South and Central America respectively for any wood, genuine or not, that resembles rosewood. This confusion has not been confined to the New World varieties. East Indian rosewood was distributed throughout the Orient before being introduced to Europe and eventually became so common in South China that it acquired the name "Chinese blackwood." During the past 100 years, much of the teak furniture (and smaller objects) produced in the Orient are actually made of the finer, heavier and darker East Indian rosewood.

In the musical-instrument building trade, in which I'm involved, it's common for rosewood purchases to be made sight unseen. Then when the wood is delivered, it's often not the desired item. A prime example is Brazilian rosewood (***Dalbergia nigra***), the ideal tone wood for the back and sides of acoustic guitars. It is extremely rare and expensive. Because there are many species of genuine rosewood from Brazil (kingwood, tulipwood, jacarandá do para, etc.), it's easy for a seller to stretch the truth: They're all "Brazilian rosewood." Often the buyer has paid in advance and therefore is tempted to play dumb and continue the misrepresentation.

Hopefully the photos of rosewood samples and some of their common substitutes on pp. 50-51 will help you find your way through the rosewood jungle. Even the most educated buyers sometimes get led astray, so all should remain somewhat cautious. The price ranges given for each sample are approximate. Prices fluxuate with political conditions (embargoes and export restrictions) and with weather conditions that affect the ability to harvest. Some species are available in small dimensioned cuttings only and are sold by the piece. Some species are sold by the pound.

Weight and density—The various rosewoods range in weight from 53 lbs./ft.^{3} to 75 lbs./ft.^{3}, averaging 60 lbs./ft.^{3} This translates to about 5 lbs./bd. ft., or an average specific gravity of .96 (only slightly less dense than water, with a specific gravity of 1.0). This high density makes rosewoods exceedingly durable and resistant to biodegradation. However, it also makes the wood slow to expel moisture, so internal tensions begin to develop immediately after the log has been felled, resulting in fairly severe heart crack and checking, even when the log's ends have been carefully waxed or painted. After the log is sawn into lumber, the wood dries reasonably well, especially if dried slowly in a carefully monitored kiln, but considerable degradation from checking is unavoidable.

Sapwood, wormholes and mineral deposits—All of the genuine rosewoods and many of the common rosewood substitutes have a creamy white sapwood (similar in texture to poplar), which is slightly softer than the dark heartwood, and as a result, more prone to attack by insects. When the insects gnaw through the sapwood, they're usually discouraged by the denser heartwood, so they give up, turn around and exit. For this reason, rosewoods are considered fairly resistant to insect attack. If there are wormholes at all, they are usually extremely small and fairly close to the bark.

Certain growing regions have a high concentration of calcium, sulfur or other trace minerals in the soil or water table. These minerals are drawn up through the roots and deposited into the tree's pore structure and heart. Some of these deposits are substantial in size, resembling crusty rocks in appearance and hardness, as shown above. In smaller concentrations they will show up as chalky white dots in the board's pores. Mineral deposits can cause problems for the sawyer, because they don't register on a metal detector, and large pieces or extensive amounts will dull saw and planer blades. Small deposits can be removed after fine-sanding by tedious digging with a needle or small X-Acto knife, or they can be chemically darkened with muriatic acid. This will seriously alter

Working with rosewood

by Eric Brostoff

In my shop, we work with various rosewood species to produce our line of desk accessories and gift items. Because of their high density, working with these beautiful woods can present special problems.

First of all, many species are available only in very narrow boards, with the useable wood further reduced by checking. The more specific your requirements are, such as sorting for width or special grain, the more you'll pay. It's a good idea to test your wood with a moisture meter as soon as you receive it. Because most rosewoods are shipped either green or air-dried, you should expect a moisture content of 15% or more. The high density and high resin content of rosewoods slow the drying process; trying to rush the drying only leads to increased loss from checking. The new vacuum kilns seem to work better than traditional kiln-drying methods, but kiln-drying dense resinous woods that are over 2 in. thick (or wide) is always a risky proposition. The best way to limit drying problems is to buy stock as close as possible to the size you need, then take the time to let it air-dry in a heated interior environment. I wax the ends of each board, sticker the stack and cover it with plastic to prevent it from drying too rapidly. It can take a year or more for 4/4 stock to reach the 6% MC to 8% MC required to safely work it, and considerably longer for thicker stock.

Oily or resinous woods are notorious for being difficult to glue. Although I sometimes use regular wood glues (Titebond, for example), when the glue bond is critical to the strength of a joint I hedge my bet by using G-2 epoxy. This epoxy, specially formulated for oily or acidic woods, is available from The Wooden Boat Shop, 1007 N.E. Boat St., Seattle, Wash. 98105; (206) 634-3600; or from Garrett Wade, 161 Ave. of the Americas, New York, N.Y. 10013; (212) 807-1757.

To make more efficient use of an expensive commodity, rosewood is frequently resawn. This can be quite a job with a wide board. Always use the widest blade you can put on your bandsaw and make sure it's sharp. The new Japanese resaw machines come with 3-in.-wide blades and work very well (particularly if you put a larger motor on the machine). Don't plane the board's surfaces before resawing, or you'll only aggravate the drying differential between the outside and the freshly cut inside of the board. After resawing, the thin boards should be stickered, allowing one to two weeks before planing. A heavy weight placed on top of the pile will help to keep the boards from cupping. Unfortunately, the most highly figured plainsawn boards are the most likely to cup, twist and cause problems. I never try to get three pieces out of a 4/4 piece. You're better off resawing a little thicker and planing the board down after it stabilizes.

Because of their density, working with rosewoods is a little like working with metal. Like metal, their high density allows machining to very close tolerances, and joint components aren't compressible—joints will either fit or they won't. Carbide sawblades are a must. A thin-kerf blade with a stabilizer will give a smooth cut and save you money by reducing waste. I also use carbide-inlaid blades on my planer and solid carbide on my jointer. I've kept my Shopsmith planer because of its adjustable feed rate: Slowing down to 7 ft. per minute is ideal for planing highly figured material with a minimum of chipping. Most species rout well, even across the endgrain. Again, carbide tips are advised for boring bits, although good brad points will also work.

Sanding rosewoods can be tricky. The more resinous types will literally melt and coat your abrasives with a nonremovable glaze. Because the paper or belts don't last long and cleaning them is expensive and time-consuming, I buy the cheapest available. I avoid orbital sanders because they invariably leave telltale swirl marks. Belt sanders are good for your initial sanding, because any scratches will run with the grain. Pneumatic drums work well for blending in curves and for eliminating machining marks. Flap-sanding or hand-sanding to 400 grit is necessary to bring out the true beauty of the wood. I rub on a mixture of three equal parts of boiled linseed oil, turpentine and spar varnish; and then wipe it off almost immediately, because highly resinous woods won't absorb much oil anyway. For small items, I simply buff with wax to give them a nice polish.

Although rosewoods often have a pleasant smell, a good dust-collection system is a must. When machining rosewood, the fine dust will cover everything, making quite a mess and giving rise to thoughts of what your lungs must look like. Even with a good vacuum system, you should wear a dust mask to protect yourself. □

Eric Brostoff owns and operates Rosewood Specialties in Portland, Ore., producing rosewood desk accessories and gift items.

the color and grain contrast of rosewood if applied to the whole surface, so it's important that the acid be carefully applied to each spot with a metal quill pen or a similar precise applicator.

Toxicity—Although rosewood is not actually toxic, most of the varieties are considered potential irritants. Most people can work with rosewood safely, but it is possible to have or acquire an acute allergic reaction to the sawdust of certain species. Sneezing or headaches can result from breathing the sawdust, and some people react to skin contact with itching, rashes or hives. To be safe, you should wear a dust mask when working with rosewoods; if you have a reaction upon skin contact, try wearing a heavy sweatshirt and a pair of rubber gloves, or simply avoid working with that particular variety.

Resin content—Most members of the *Dalbergia* genus have high levels of resins, which can gum up sawblades, planer knives and sanding belts fairly quickly. The resin build-up can be removed from blades and knives by occasional soaking and/or scrubbing in an appropriate commercial cleaner. Hell-Cat, made by the Calgon Corp. and available from local industrial suppliers, is a strong caustic with the active ingredient sodium metasilicate. Sanding belts are harder to clean. There are some belt-cleaning systems available, but their expense often restricts their use to high-production situations. The resins in rosewood can also cause adhesion problems when gluing. A strong polyvinyl glue is usually effective—Titebond works well. The secret is to scuff the gluing surfaces with sandpaper just before gluing up: I find the common practice of washing gluing surfaces with acetone of dubious value. Although this might remove surface resin, it's likely the acetone will in fact draw deeper resins up to the surface, thereby rendering this a useless process.

The open pores of rosewoods will soak up finish like a sponge unless filled with a grain filler. Dark fillers work best because uncolored fillers tend to dry white, resembling undesirable calcium or mineral deposits. Filling the pores will allow you to achieve a smooth, glass-like finish, but it will not solve all your resin problems. The resins in true rosewoods can prohibit polyurethane and other oil-base finishes from curing (see *FWW* #73, p. 18). I recommend avoiding oil-base finishes and using lacquer instead. A compatible vinyl sealer is very effective as a first coat, to hold the resins down. I've used one coat of vinyl sealer before applying mineral spirit-base fillers to seal in the wood's resins, and then

Genuine species

African blackwood *(Dalbergia melanoxylon)*—Africa. $25 to $50 per board foot. Also known as grenadillo (not to be confused with granadillo) or Mozambique 'ebony.' Dark purple to black. Density and working properties similar to true ebony. Traditionally used for the finest wind instruments, bagpipes, violin bows, ornamental turnings and precious treen. Very rare, very expensive and generally available in small pieces only.

Amazon rosewood *(Dalbergia spruceana)*—Brazil. $7 to $16 per board foot. Also referred to as 'jacarandá do para' or 'spruceana.' Resembles Brazilian rosewood somewhat and is used for similar purposes, though odor and subtle grain characteristics are noticeably different. The pores are often filled with a characteristic yellow sulfur deposit. Generally logged during mahogany harvests in the Amazon River region.

Brazilian rosewood *(Dalbergia nigra)*—Brazil. $20 to $50 per board foot. Sometimes referred to as 'jacarandá.' Dark brown to violet with spidery black pigment lines that often overlap, giving the illusion of a landscape. When freshly cut, has a rose-like smell. Optimum species for the back and sides of acoustic guitars. Its popularity as veneer in the first half of the century has driven it to near extinction, though some sparse new-growth timber has appeared on the market. Very resinous, turns beautifully, polishes well and is very durable. Very expensive, if available at all.

Cocobolo *(Dalbergia retusa)*—Mexico & Central America. $7 to $16 per board foot. This highly exotic, wild-grained species is brilliant orange, rust, purple and yellow, with distinctive superimposed lines of purple and black. The color darkens gradually after cutting. The sawdust can cause itching or sneezing. Typically available in small cuttings, due to the small size of the tree. Used extensively for knife handles, partly because of the presence of an oily substance that waterproofs the wood and makes it very easy to polish.

East Indian rosewood *(Dalbergia latifolia)*—India. $12 to $22 per board foot. Light to dark purple, with occasional red and brown streaks. Prized for its size and consistent color. Filling the vacancy when Brazilian rosewood became scarce, it is more stable and comes in larger planks. Recent embargoes and regulations have limited the sizes allowed out of India. Some plantation growth of the same species is available as 'sonokeling' from Indonesia. Another close relative includes 'sissoo' *(Dalbergia sissoo)* from the region in and around India.

Honduras rosewood *(Dalbergia stevensonii)*—Central America. $9 to $18 per board foot. Pinkish brown to salmon red with dark irregular grain lines. Very hard, heavy and durable. Difficult to dry and prone to heart cracking, which causes poor yield, but quite stable after drying. Highly regarded by instrumentmakers for marimba bars. Similar species include Guatemala rosewood *(Dalbergia tucurensis* or *Dalbergia cubilquitzensis)*—two botanical names for the same species).

Kingwood *(Dalbergia cearensis)*—Brazil. $11 to $22 per board foot. Often referred to as violetwood. Brownish purple with fine stripes of black and luminous violet, approaching royal blue. Appreciably denser than most other rosewoods, but works well and takes a high natural polish. Clear cuttings are very small. Especially popular for fancy trinkets and decorative marquetry.

Tulipwood *(Dalbergia frutescens)*—Brazil. $12 to $24 per board foot. Sometimes distributed as 'Brazilian pinkwood.' A rich, pinkish, golden hue with luminous salmon stripes. The color is much lighter than any other rosewood. Quite valuable and generally available in small cuttings only.

Common substitutes for rosewood

***Bocote** (Cordia elaegnoides)*—Mexico. $7.50 to $15 per board foot. Commercially known as 'Mexican rosewood' and often referred to by its genus, *Cordia*. Vibrant green and golden-yellow color, with contrasting black in tight, wild figure patterns. Has a waxy texture similar to teak. Available in relatively small cuttings.

***Bubinga** (Guibourtia demeusei)*— Africa. $4 to $8 per board foot. Often referred to as 'African rosewood.' Purplish pink to salmon red with dark red veining. A mottled or 'flamed' figure is often seen in quartersawn lumber. Very dense with a fine texture. Often available in wide planks. Thick stock is difficult to dry and prone to kiln degradation from checking.

***Granadillo** (Platymiscium yucatanum)*—Mexico. $5 to $10 per board foot. Reddish brown to purplish orange, dependent upon the source of origin. Granadillo (not to be confused with grenadillo or African blackwood) is a catch-all term for a number of look-alike species with properties relatively similar to rosewood (specifically cocobolo), though the grain and figure are often more bland in comparison.

***Jacarandá pardo** (Machaerium villosum)*—Brazil. $5 to $10 per board foot. Of the same genus and very close in appearance to morado; probably marketed interchangeably with morado.

***Morado** (Machaerium scleroxylon)*—Bolivia. $5 to $10 per board foot. Also referred to as Santos rosewood, Bolivian rosewood or 'striped caviuna.' A close rosewood substitute. More brown than East Indian and more purple than Brazilian rosewood, with occasional variances of yellow, red or black. A pleasant fragrance, similar to rosewood. Its very small pore structure gives it a fine texture so it can be finished without the filling and resin problems characteristic of true rosewoods. The sawdust is a skin irritant, similar to cocobolo.

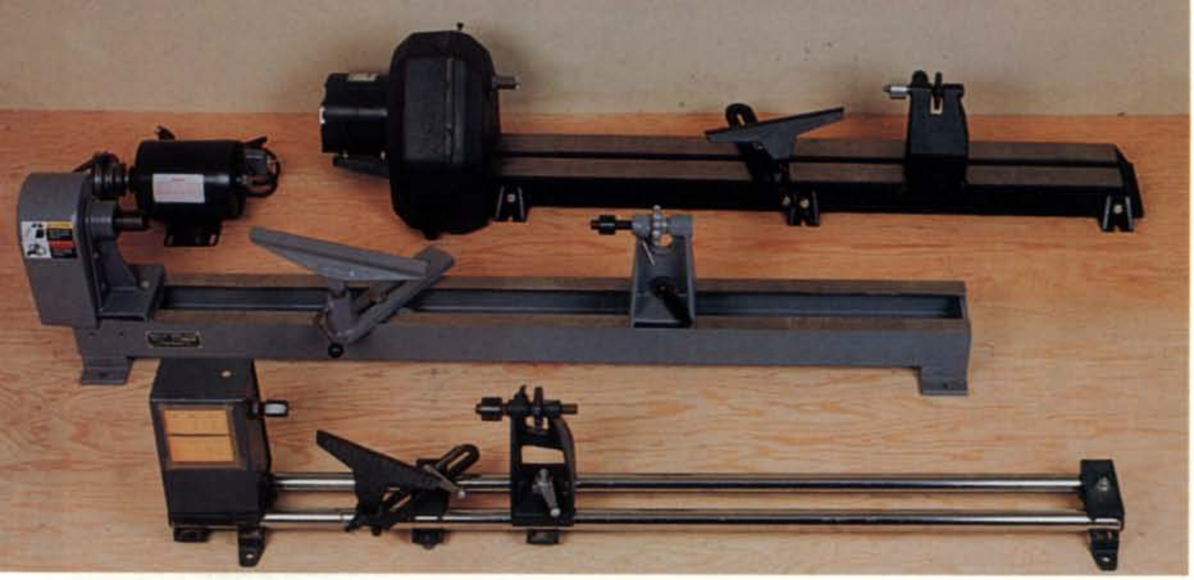
***Padauk** (Pterocarpus* spp*)*—Africa, Burma, Andeman Islands. $3.50 to $7 per board foot. Often referred to as vermillion. Varies in color, but most varieties have a brilliant red-orange color when freshly cut, with darker crimson grainlines. With extended exposure to light, the color gradually fades to a dark crimson or walnut shade. Easy to work and often available in reasonable widths.

another coat after filling to seal in the filler's solvents.

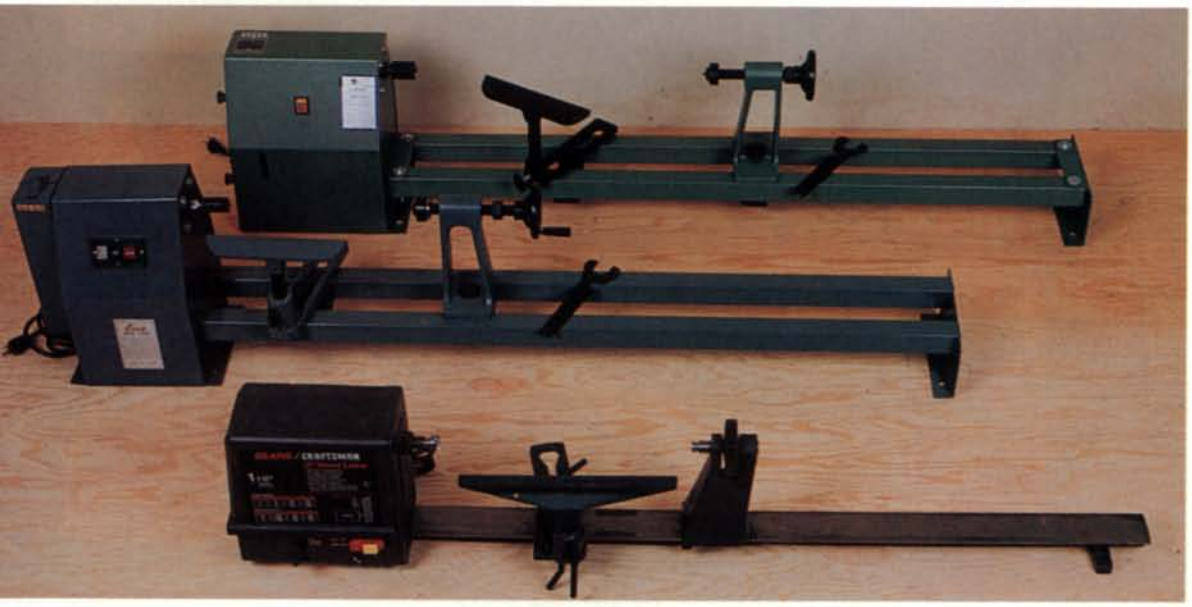
Solvents in the initial finish coat can often dissolve the resins in rosewood, causing the pigment to bleed or migrate onto adjacent laminates or trim (see *FWW* #69, p. 12). To avoid this, mist several extremely light coats of sealer before spraying the successive heavier coats. It may be necessary to mask highly contrasting white woods or seal them by brushing on shellac, vinyl sealer or lacquer sealer. Areas discolored by bleeding can be scraped clean with a single-edged razor or sharp scraper, then resprayed.

Plantation growth—As a footnote: It has become viable to grow rosewood trees commercially, though few countries have actually taken this idea seriously. The exception is Indonesia, where a wood called sonokeling is grown on plantations. Sonokeling is the exact genus and species as East Indian rosewood (*Dalbergia latifolia*), except it's grown in Indonesia instead of India. These transplanted trees are grown in regular rows without underbrush or competition for light. The fast growth that these conditions promote results in wide and even growth rings and grain pigment that is often less rich and diverse, usually much lighter than the more unpredictable wild growth. Nonetheless, plantation growth is easier to harvest and can be replanted on a regular schedule. This lowers the cost and eliminates the need to ravage the natural tropical forests for the exotic woods favored by crafstmen. □

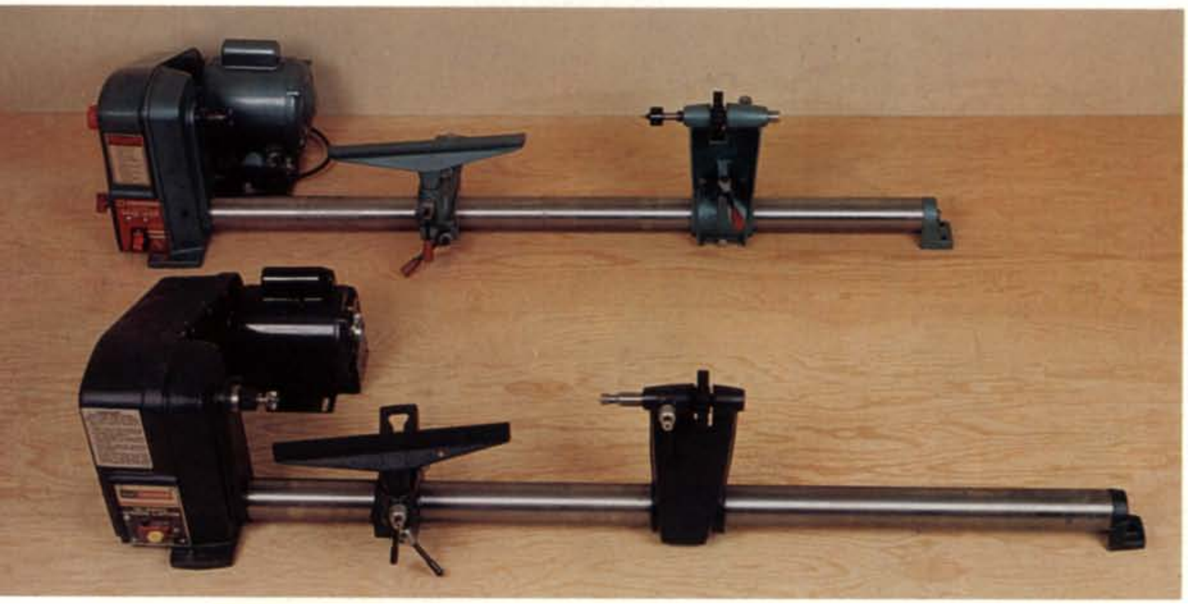
Dick Boak is manager of the wood division for the Martin Guitar Co. He also operates The Church of Art, a multimedia art gallery, music studio and residence in Nazareth, Pa.



The AMT 4370 (top) and the Williams & Hussey L-82 (middle) lathes are the only economy lathes constructed with heavy castings throughout. The lighter construction in the AMT 373 (bottom), shown without motor, is more typical.



The Grizzly G1025 (top) and Enco 199-9055 (bottom) look-alike lathes are Taiwan imports. The motors for these, and the smallest Sears lathe (bottom), are mounted compactly in the headstock housing.



The differences between the Bridgewood BW-1240 (top) and Sears' largest lathe, catalog #9BT22816N, (bottom) are mostly cosmetic.

Economy Lathes

Turning on the light side

by Alan Platt

If you have a yen to try turning, or if you're a furnituremaker with only a limited need for a lathe, you can get started in the craft for less than $500. For years I've had a small, $85 AMT lathe and have been surprised at how many drawer pulls, cabinet knobs, chair spindles, small bowls and candlesticks I've been able to turn. These light tasks don't require the rugged lathes, speed controls or quick-change adjustments demanded by full-time turners, who specialize in production runs of ballusters and other spindles or who turn giant bowls from wood burls or other recalcitrant materials. Stability and vibration-free operation are critical for the professional, and this requires a heavy-duty lathe, precision-machined parts, high-quality bearings and an arsenal of chucks and other accessories. These features, while great for someone needing to turn out a paycheck, push the cost of a lathe to more than $1,500, a price that's difficult for an amateur furnituremaker to justify.

In researching this article, I evaluated several benchtop lathes by turning a series of small spindles and bowls. The benchtop lathes have few frills, but that doesn't mean they are shoddily constructed. And even though they cost less than $500, these lathes are not toys: Many professional woodturners developed and honed their skills on similar lathes before moving up to a heftier machine. If you really like turning, you may want to invest in a larger lathe right away, but I found the benchtop lathes adequate for light work and for developing basic turning skills.

Benchtop lathe characteristics–All lathes, economy models or not, are basically the same: A rigid bed, supports a fixed-positioned headstock and a tailstock that can be moved to accommodate blanks of various lengths. Spindles in the headstock and tailstock allow the wood to rotate. The headstock spindle center is connected to the motor and actually rotates the stock, via a spur center that penetrates the wood or a faceplate that is screwed to the stock. If you're turning a spindle such as a candlestick or a table leg, the tailstock is brought up to support the non-driven end of the stock, which allows it to rotate freely. A faceplate attached to the headstock is all that is needed for bowl turning, although some turners snug up the tailstock to provide extra support when roughing out. The headstock spindle is threaded and is either solid or hollow. The solid spindles can accept only threaded drive centers and faceplates; the hollow spindles accept screw-on faceplates and tapered drive centers that friction-fit into the hollow spindle. On small lathes, turning speeds are controlled by a belt-driven step-pulley system. The motor itself is either directly attached to the bed assembly, or bolted to the bench, or a shop-built stand supporting the bed. A T-shape tool rest, which supports turning tools as they cut the wood, slides along the bed and can be adjusted to different heights and angles. The distance between headstock and tailstock centers indicates the lathe's maximum spindle length; the diameter of the piece being turned is limited by the swing, the distance between the headstock spindle and the lathe bed.

To reduce costs, manufacturers have made lathes lightweight, about 100 lbs.; some are manufactured in Taiwan. The biggest savings are in the bed, which is usually cast iron in more expensive lathes for maximum stability and low vibration. Most economy-lathe manufacturers rely on less-expensive, well-engineered, hollow-steel tubing for beds. (Williams & Hussey and AMT's top-of-the-line models are exceptions.) Cast iron is used for the headstock, tailstock and tool rest, but expensive machining of the surfaces, mostly, is missing.

The Enco and Grizzly lathes come preassembled; the others require an hour or so to assemble and align, which is an easy job: It requires no special tools and the directions are clearly written. If you don't already have a solid bench to support the lathe, you'll have to construct one. Don't skimp here: A rigid bench is essential because it absorbs and dampens vibration and contributes to work stability. Mine, assembled with 2x4s and ¾-in. plywood, is stable enough for light turning, but I installed a bottom shelf so I could add concrete blocks for additional stability.

The lathes I evaluated are shown in the top and middle photos on the facing page; the chart on page 56 provides their vital statistics for comparison. Accessories available for each lathe are also listed.

Evaluating the lathes–To see how well each lathe performed, I turned some 20-in.-sq. maple spindles, up to 30-in. long, and some 8-in.-dia. maple bowl blanks (1¾ in. thick). Each of the lathes I checked can handle up to 12-in.-dia. blanks. All of the lathes worked well for the turnings I tried, and I didn't see dramatic differences in their performance. The headstock and tailstock were adequately rigid on all the models, and didn't flex or move on the bed when the blank revolved or when a cutting tool contacted the wood. The beds also were stiff and rigid, once firmly attached to a sturdy bench. When turning long spindles, all of the lathes were prone to some vibration and whip, making it necessary to take lighter cuts. One or two steady rests, properly positioned to support the workpiece, would help here. Apart from these considerations, your choice boils down to cost and personal preference of each lathe's available accessories and features, such as tool rest setups and speed-changing systems. Power wasn't generally a problem with any of the lathes, but I do note where I felt some of the lathes could benefit from additional punch. Finally, if you're really on a tight budget or don't have much room in your shop, you may want to build the "beer-box" lathe discussed in the sidebar on page 54.

American Machine Tool–AMT's basic lathe (model #2731) uses twin 1¼-in.-dia. steel tubes for the bed. The tubes are aligned in V-slotted castings, which, in turn, bolt to the benchtop. The headstock, tool rest and tailstock are light castings and bolt directly to the bed cylinders. Because the castings are not machined smooth, the sliding surfaces of the tool rest and tailstock tend to jam, making adjustments annoyingly awkward. If you are handy with a file, the castings' rough surfaces can be smoothed to minimize the problem. Also, the lock bolt, used to anchor the tool rest's horizontal position, easily tilts out of position, making tool rest adjustment cumbersome.

Two other AMT models (#2731B and #373) are built the same as the basic model but have some added features. The basic model (#2731) comes with a ¾-in.-dia. headstock spindle and a ball-bearing (live) cup center in the tailstock. Ball-bearing centers rotate with the spindle and are less likely to burn the wood than dead centers, which are stationary tapered posts. The headstock in #2731B is equipped with a ¾-in. double-sealed, ball-bearing spindle–a step up. Model #373 also has the double-sealed ball bearings for the headstock spindle, in addition to a live tailstock center and longer bed cylinders, which increase the spindle capacity from 36 in. to 41 in. The recommended ½-HP motor, three-step motor pulley, mounting brackets and faceplate are sold separately for all three models.

The headstock spindle is belt-driven, providing four speed options (860 RPM to 3,850 RPM); the weight of the motor on its pivoting mount tensions the belt. I found it quick and easy to change speeds by simply lifting the motor to release belt tension, then repositioning the belt onto the appropriate pulley. When making medium to heavy cuts, I found that even light tool pressure would slow, and sometimes stop, rotation because the weight of the motor alone provides insufficient belt tension. Hanging a 25-lb. sandbag from the motor solved the problem. Even with short spindles (20 in.), vibra-

Beer-box lathe

by Tim Hanson

I don't do enough turning to justify having a lathe take up valuable space in my small shop, so I designed a portable model that fits in a beer case. When I want to turn, I clamp the components to a sturdy bench, as shown in the photo below, and go to work. The lathe has a 12-in.-dia. swing. Turning distance between centers is limited by the bench size, but 36 in. is a more practical limit for this lightweight tool. When I'm through working, I disassemble the lathe and put it back into the beer box. The box is small enough to fit under my bench or in an out-of-the-way corner.

For the past eight years I've used this "beer-box" lathe to turn table legs, chair rungs, tool handles, Shaker pegs and other small items. You can build it for under $60 (not including the motor). The headstock and tailstock components are readily available; the other necessities are some miscellaneous hardware and a few board feet of a hardwood, such as maple. With everything you need, building the lathe won't take you more than a day or so.

The headstock, tailstock and tool rest are made from 1-in.-thick stock. Maple is tough enough to stand up well to the rigors of turning and its tight grain means the lathe's few critical dimensions can be machined accurately without chipping. The tailstock and headstock are U-shape; each has two vertical endpieces that support the spindles and a bottom spacer block that connects the endpieces. I used a glued tongue-and-rabbet joint, but you can use any strong corner joint. The vertical endpieces are 7½ in. high by 4⅛ in. deep. The overall width of the headstock is 6½ in.; the tailstock, 5½ in. The centerlines of the tailstock and headstock spindles are located 6 in. from the bottom edge of the endpieces, making a 12-in.-swing diameter. Before assembling the headstock and tailstock, and while the pieces were still square, I clamped the endpieces together and drilled holes in them for the spindles.

I first drilled ¾-in.-dia. holes in the tailstock endpieces to accept the commercial spindle parts. The spindle, handwheel and tapered cup center (live) are from a Duracraft lathe (model #50537) and are identical to those used on the Bridgewood and Sears lathes. The parts are available from Gateway Resources, 419 N. Main St., St. Charles, Mo. 63031; (800) 431-5937.

Alternatively, you can use a ⅝-in.-dia. bolt to make your own spindle-and-handwheel assembly. If you decide to do this, drill ⅝-in.-dia. holes, instead of ¾-in.-dia. holes, in the tailstock endpieces. To make the spindle, hacksaw off the head of an 8-in.-long by ⅝-in.-dia. bolt. File a 2½-in.-long flat (⅛ in. deep) starting 1¼ in. from the bolt's unthreaded end to provide a bearing surface for the spindle-locking screws discussed below. A tailstock cup center (#4216) for the ⅝-in.-dia. spindle is available from Gilliom Manufacturing Inc., 1700 Scherer Parkway, St. Charles, Mo. 63301; (314) 724-1812.

The handwheel used to adjust the tailstock center is a 3-in.-dia., 3-in.-thick maple disc cut with a fly-cutter on a drill press. Drill a hole in the center of the disc and use a vise to press-fit a ⅝-in. nut into the hole.

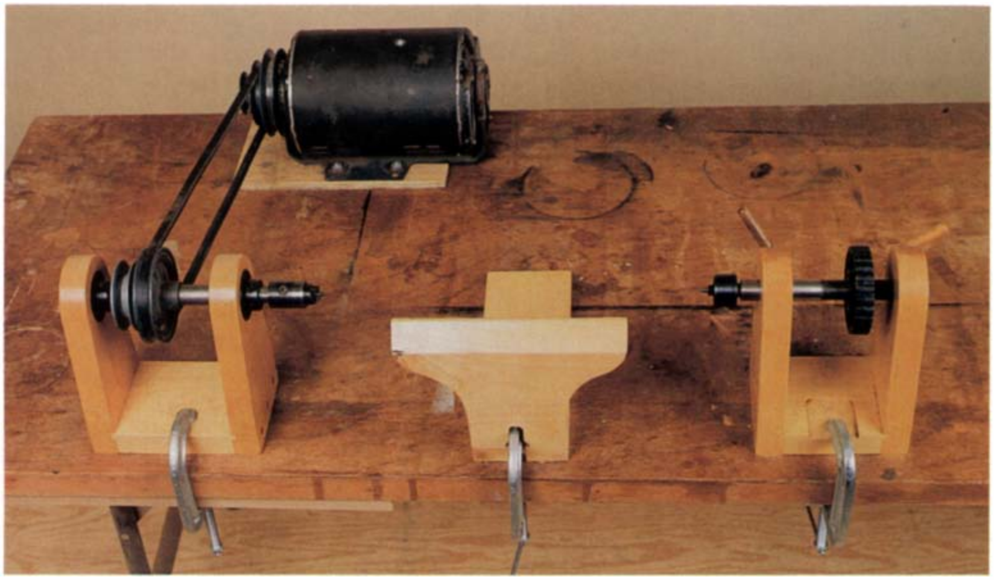
To lock the spindle I used ¼-in.-dia. by 2-in.-long thumb screws through the back edge of each tailstock endpiece. I cut the threads by drilling $\frac{3}{16}$-in.-dia. holes and screwing in a ¼-in.-dia. bolt. I filed and tapered the end of the bolt so I could get the thread started easily. If you work the bolt in and out a few times, you'll have threads adequate for holding the thumbscrew. To prevent the wood from splitting, I clamped the endpiece tightly in a vise.

The headstock endpieces require ⅝-in.-dia. holes for the spindle. In addition, recessed holes for spindle bearings are needed on the inside face of the left endpiece and on the outside face of the right endpiece. The bearings are press-fit into the wood, so size the hole for your bearings. I used McGill #ER10, ⅝-in.-ID x 1.8504-in.-OD bearings, available from Bearings Inc., 930 N. Illinois St., Indianapolis, Ind. 46204; (317) 634-4393. The spindle is a ⅝-in.-dia. by 8-in.-long steel shaft from the hardware store. Tighten the set screws in the bearing case onto the flats filed on the spindle to hold it. A headstock spur center (#4218) and faceplate (#4219) for the ⅝-in.-dia. spindle are also available from Gilliom Manufacturing Inc.

After cutting the spindle and bearing holes, I rounded the top edges and tapered the sides of the tailstock and headstock endpieces on a bandsaw and smoothed the edges with a file. Three, 3-in.-long sheet-rock screws through each endpiece into the spacer blocks reinforce tongue-and-rabbet joints on the spacer blocks and endpieces. To be sure the clamped endpieces are snug on the benchtop and don't rock, the spacer block is offset $\frac{3}{32}$ in. from the bottom edge of the endpieces.

The tool rest is also made from maple. To set its angle or distance from the blank, place the tool rest in the desired position and tighten a C-clamp to secure it to the benchtop. The fixed height of the tool rest is 6⅛ in., just above the centerline of the blank. The 8-in.-long, tool-bearing edge is angled at 45°. I shaped the sides and cut a slot for the C-clamp on a bandsaw. The base of the rest is made from 10-in.-long x ¾-in.-thick x 3½-in.-wide stock. A wide, $\frac{3}{32}$-in.-deep groove along the bottom of the base ensures that the outer edges of the base bear on the benchtop when the tool rest is clamped in position. The bottom butts to the vertical piece and is secured with four, 2½-in.-long sheet-rock screws.

I use a 1,725-RPM, ½-HP motor, bolted to a piece of ¾-in.-thick plywood, to power the lathe. To tension the belt or change speeds I adjust the position of the motor and clamp the plywood base to the bench top. Belt length, therefore, depends on the width of the bench being used (45 in. on my 28-in.-wide top). The three-step motor pulley (2, 3 and 4 in. dia.) in combination with the two spindle pulleys (2½ in. and 3½ in. in diameter) provide six speed options, from 985 RPM to 2,760 RPM. □



Hanson's shop-built lathe is made from maple and uses readily available hardware. In use, its components are aligned to the edge of a sturdy bench and held in position with C-clamps as shown above. It is stored conveniently out of the way in a beer case when not in use.

Tim Hanson is an amateur woodworker and lives in Indianapolis, Ind.

tion was often a problem, which meant I had to take lighter cuts and invest some time to achieve a smooth finish, particularly on endgrain.

AMT's top-of-the-line lathe, #4370, and the Williams & Hussey model I'll discuss later, are the heftiest and most-expensive lathes I evaluated. All of the 4370's components, including the bed, are quality, machined castings. The headstock bolts to the cast-iron bed, and additional bolts facilitate aligning the headstock spindle parallel to the bed. A bracket and locking nut under the tailstock can also be adjusted to align the live center with the spur center in the headstock—a feature missing on most of the lathes. For most turning jobs, perfect alignment isn't important; but when turning very short spindles or bowls, in which the tailstock is snugged up to the blank for additional support, misaligned centers can cause the bearings to wear faster. I like the solid feel of this lathe and found that its machined surfaces made movement and adjustment of the tool rest and tailstock, which function similarly to those on AMT's less-expensive lathes, smooth and trouble free.

The #4370 model is equipped with a three-step pulley-drive system that provides six easy-to-select speed options (275 RPM to 3,065 RPM). It is powered by a ½-HP, 1,725-RPM General Electric motor, but I think this ruggedly constructed lathe could benefit from the additional power of a larger motor for heavier cuts and larger workpieces. The additional power would also come in handy if you installed the optional gap bed that extends the swing from 12 in. to 16 in.

The 4370 has an indexing feature that divides the circumference of the workpiece into 24 equal parts. This allows you to precisely orient and lock the workpiece in position for cutting decorative flutes or notches on turned stock. A screw through the headstock engages slots in the rim of the indexing spindle pulley and is secured with a locking nut. When I wasn't using the indexing feature, I had to lock the screw to prevent vibration from "walking" it into the spinning pulley. For ordering information, contact American Machine & Tool Co. of Pa., Fourth and Spring streets, Box 70, Royersford, Pa. 19468; (215) 948-0400.

Bridgewood BW-1240—The Bridgewood BW-1240 from Wilke Machinery Co. (120 Derry Court, York, Pa. 17402; 717-846-2800) is an economy lathe that looks very much like one of the Sears models I tried. Its 2-in.-dia., machined-steel bed is two hollow cylinders held together end to end with a ⅜-in.-dia., 20-in.-long bolt. The same bolt secures a cast-iron foot at the tailstock end and, in turn, is bolted to the benchtop. The bed fits to a bored hole in the headstock and is secured with a setscrew. The tailstock and tool rest ride smoothly on the bed. The tailstock is aligned with the headstock by means of a keyway along the bottom of the bed. To make the alignment, the setscrew and bolt that hold the bed sections together are loosened and the bed is rotated in place along with the headstock and tailstock until their centers align. I found this clever arrangement easy to assemble and align, and it worked well.

The adjusting levers on the tool rest and tailstock also work effectively, but I found them a bit small for comfortable handling. The belt guard is hinged to swing open for changing speeds; unfortunately, it's made from flimsy sheet metal and didn't fit well on the lathe I had. A useful chart on the belt guard shows the belt settings required for the five available spindle speeds (575 RPM to 3,580 RPM) as well as recommended speeds for roughing out and finish-turning soft and hard woods. There's no way to reduce the belt tension; changing speeds requires both hands to wrestle the belt onto the desired pulley. This lathe performed well for both spindle and faceplate turning. I liked the reserve power its ¾-HP motor provided, permitting heavy cuts without stalling.

Wilke's Bridgewood lathe offers two standard features that are sometimes unavailable with other economy lathes. The first feature is that its hollow drive spindle and tailstock spindle accept #1 Morse tapers, making for quick and easy spindle-mounting. I prefer tapered drive centers because I can quickly tap them into the end of a blank then slide the center into its spindle without having to screw the whole assembly onto the headstock, as is common with threaded drive centers. The second feature is the lathe's outboard turning capability, although the lowest-speed, 575 RPM, seems too high for safely turning large-diameter work in which the surface speed at the rim of the workpiece can be dangerously high. The headstock also has a 36-position indexing mechanism, handy for simple fluting operations and for locking the headstock when removing the faceplate.

Enco 199-9055—This lathe and the Grizzly discussed later are both made in Taiwan and look very much alike. The Enco (Enco Manufacturing Co., 5000 W. Bloomingdale Ave., Chicago, Ill. 60639; 312-745-1500) comes preassembled, ready to be secured to your benchtop. At first I was concerned about its lightweight, steel construction: Two square cross-sectional steel tubes form the bed and are welded to the steel-plate headstock at one end and a steel-plate foot at the other. The lathe did, however, run smoothly when I turned spindles and bowls; I was surprised that vibration and whip were no more bothersome with this lathe than the others I reviewed.

The long tool rest and tailstock are well-made solid castings and slide smoothly on the bed. Both are inconvenient to adjust because tightening or loosening them requires you to blindly feel for the locknut located underneath the lathe's bed rails. All the adjustments are made with a wrench, rather than an attached adjuster; I find the wrenches are liable to be misplaced or lost under piles of shavings. To snug up the tailstock, most economy lathes have a handwheel, which is generally located in the center of the tailstock casting, making it awkward to turn. The large handwheel on this lathe, however, is conveniently located on the far end of the spindle and is easy to operate.

The ½-HP motor provides sufficient power, but changing speeds is time consuming (the owner's manual recommends loosening the two motor-mount bolts each time). I found I could get around this by rotating the pulley shaft while coaxing the round drive belt onto the desired pulley with my fingers.

The Enco comes with a sanding table that attaches to the lathe bed and has a 9-in.-dia. sanding disc to fit the headstock spindle.

Grizzly G1025—Only small differences distinguish this lathe from the Enco: The bed is bolted, rather than welded, to the headstock and foot plate, and the round drive belt and step pulleys are visible through a window in the headstock, so it's easy to see the lathe's speed setting at a glance. The lathe performed about the same as the Enco model. For more information, contact Grizzly Imports PA Inc., 2406 Reach Road, Williamsport, Pa. 17701; (717) 326-3806.

Sears models—Sears offers two lightweight lathes. The bed on the least-expensive lathe (catalog #9BT24907C) is a sturdy, machined ¼-in.-thick steel T bar. It comes in two sections and is bolted together with two 5/16-in.-dia. bolts. Castings at each end of the bed have holes for bolting the lathe to your benchtop. The cast-iron headstock is grooved on the underside to slide onto the bed and is held in place with a single setscrew. In addition, the tool rest and tailstock are also castings and are grooved to slide freely on the bed; the bolt that locks them in position on the bed has an attached, pivoting handle to make adjustments convenient and quick. The tool rest surface has been machined smooth and is 12 in. long; adjustments to its height, angle and proximity to the blank

ECONOMY LATHES								
Company and model	List price	Motor	Motor speeds (RPM)	Distance between cutters	Swing	Bed	Standard equipment (see footnote #1 below)	Available accessories
AMT 4370	$340	½ HP**	275, 515, 920, 970, 1725, 3065	36 in.	12 in., 16 in. with gap bed	Cast iron	Indexing attachment	Gap bed, 3- and 4-jaw chucks, 8-in. faceplate, live center.
AMT 2731 and 2731B	$73 $85	½ HP**	860, 1150, 1725, 2600, 3450	36 in.	12 in.	Two steel cylinders, 1¾ in. dia.		Heavy-duty tool rest, 4- and 8-in. faceplates, live center, long bed conversion to 55 in.
AMT 373	$104	½ HP**	860, 1150 1725, 2600 3450	41 in.	12 in.	Two steel cylinders, 1¾ in. dia.		12-in. tool rest, 4-in. faceplate.
Bridgewood BW-1240	$99	¾ HP	575, 980 1560, 2520 3580	37 in.	12 in.	1 steel cylinder, 2 in. dia.	6- and 12-in. tool rests, indexing attachment, outboard turning	3- and 4-jaw chucks, 9-in. sanding disk, sanding tube, 6-in. faceplate, bowl-turning tool rest.
Enco 199-9055	$178	½ HP	875, 1350 2250, 3450	40 in.	12 in.	Two steel cylinders, 1⅜ in. dia.	Sanding table	
Grizzly G1025	$155	½ HP	850, 1250, 1750, 2570	40 in.	12 in.	Two steel cylinders, 1¾ in. dia.		3- and 4-jaw chucks, 8-in. faceplate.
Sears 9BT24907C	$150	1 HP*	875, 1350, 2250, 3450	36 in.	12 in.	T-bar steel plate		3- to 12-in. faceplates, duplicator attachment, bowl-turning tool rest.
Sears 9BT22816N	$210	½ HP	875, 1350 2250, 3450	37 in.	12 in.	1 steel cylinder, 2 in. dia.	Indexing attachment, 6- and 12-in. tool rests	Speed reducer, 3- to 12-in. faceplates, sanding table, disc duplicator attachment, bowl-turning tool rest, 3- and 4-jaw chucks.
Williams and Hussey L-82	$498	½ HP**	800, 1200, 2500, 3750	46 in.	12 in.	Two ground steel ways, 3 in. wide	Outboard turning	8-in. faceplate, sanding discs, drill chuck and adapter, live center, indexing attachment.

1. All lathes are supplied with tool rest, headstock (spur center), tailstock center (live or dead) and a faceplate.
* Maximum-developed HP. ** Motor not included.

are easy to make. Here again, a pivoted handle locks the tool rest.

I like the convenience the #1 Morse-taper centers, used on both the drive and tailstock spindles, afforded in changing blanks. Because of the lathe's light weight, I didn't expect it to perform as well as it did. I did, however, have to take light cuts to prevent the motor from stalling. Sears rates this motor at 1 HP (maximum developed horsepower), but it still seems underpowered.

Sears' top-rated lathe (catalog #9BT22816N) has four available speeds (875 RPM to 3,450 RPM), a 36-position indexing capability and a hollow-steel bed much like the Bridgewood BW-1240 discussed earlier. Unlike the Bridgewood, the Sears' lathe doesn't have outboard turning capability. Other than that, the lathes seem to differ only cosmetically. For example, the belt guard on one is made of plastic and on the other it's made of sheet metal; of course, the labeling is also different. In operation I wasn't able to detect any differences at all. (For your nearest Sears distributor, contact Sears, Roebuck & Co., Chicago, Ill. 60684; 312-875-2500.)

Williams & Hussey No. L-82—The L-82 lathe from Williams & Hussey Machine Co. (Riverview Mill, Souhegan Street, Box 1149, Wilton, N.H. 03086; 800-258-1380, 603-654-6828) has few frills, but it is a ruggedly constructed lathe that's hefty in the right places, runs smoothly and is relatively vibration free. The headstock, tool rest and tailstock are heavy castings and fit to a pair of machine-surfaced, $\frac{3}{16}$-in.-thick steel, U-shape channels that form the lathe bed. Foot castings at each end of the lathe are bolted to the bottom of the bed and have predrilled holes for securing the lathe to your benchtop. Even the belt guard, bolted to the headstock, is a heavy casting that is open at the back, making it easy to move the belt to change turning speeds.

A motor mount that permits quick belt changes can be purchased separately, but I found that bolting the ½-HP motor to a piece of plywood and, in turn, clamping the plywood to the benchtop worked well for aligning the motor and spindle pulleys and for tensioning the belt. The four available speed options range from 800 RPM to 3,750 RPM. (The power switch is mounted directly on the motor, which I don't like because it requires reaching over the spinning blank to operate the switch.)

The tool rest and tailstock slide smoothly on the bed, and the adjusting mechanisms for changing the tool rest height and securing the tailstock spindle are attached and easy to use. I wish the locking mechanisms for securing the tool rest and tailstock in place on the lathe bed were also built-in, rather than having to use the separate, small wrench provided. The spur center and cup center used on this lathe are the screw-on variety. □

Alan Platt is an assistant editor at Fine Woodworking.

Turning Segmented Pots

Elegant woods, artful joinery and graceful shapes

by Dan L. Mongold

The author's larger decorative pots are assembled from segments of woods with contrasting color and grain. Specially made jigs ensure crisp joints and speedy construction. After the pots are turned, they're sanded and finished with several coats of a urethane-varnish finish.

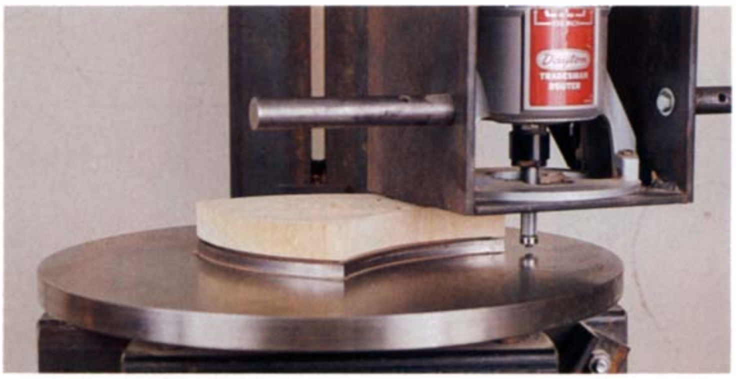
Weed pots commonly display dried flowers or perhaps a bloom or two, but my segmented and turned hollow pots are intended to stand alone, as beautiful displays of graceful shapes, spectacular woods and subtle grain patterns. I started making these laminated pots several years ago after seeing some bowls made by Dennis Bodily, a local high-school teacher and woodworker here in Bozeman, Mont. I was taken by the shape and form of his work and the way fine joinery made the turnings strikingly different from those shaped from a piece of wood. My early efforts were dissatisfying: Making the pots was time-consuming, and it was difficult to produce crisp, tight joints and finishes that enhanced the wood's grain and color. The solutions to these problems didn't come rapidly; over time, I've come up with tools and jigs that simplify the process and enable me to make pots in limited quantity.

The construction of my pots, like the ones shown above, is not complicated, but it does involve many steps. Unlike David Ellsworth's hollow vessels (see *FWW on Faceplate Turning*, pp. 52-56), which are skillfully turned by working from the outside in through the vessel's small opening, mine are formed from two turned bowls glued together rim to rim. Before assembly, I turn two shallow bowls to the same inside and outside diameter at the rim. Double-face cloth tape holds each bowl to its faceplate while it's being turned. One of the bowls will become the bottom half of the pot; the other becomes the top. The lower half is turned from a single piece; the top often is turned from a glued-up segmented disc made from different woods. The segments are precision-shaped with templates on a specially designed radial-arm router I'll describe later. After shaping the inner surface of the bowls, I apply a gunstock finish (John Bivens Express Oil Filler, available from Ted Nicklas, 5504 Hegel Road, Goodrich, Mich. 48438; 313-797-4493) to the hollowed-out portion and then glue the bowls together, rim to rim. I clamp up the two halves in my special shopmade press, and after the basic bowl is dry, glue on a decorative 2- to 3-in.-dia. plug in the center of the upper half. The three-piece assembly later is mounted on the lathe, where the center hole is formed and the outer shape of the pot is turned. I complete the pot on the lathe, sanding and applying several coats of the gunstock finish.

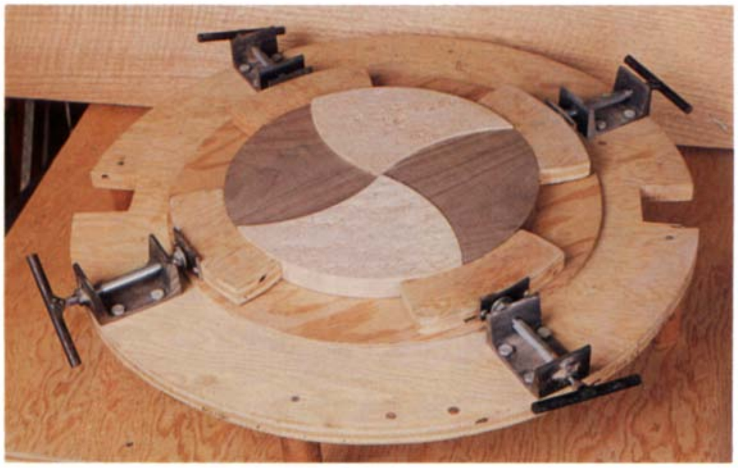
Designing the pots—I've tried working with the open form of bowls, but it's the closed-form hollow pot that holds greater appeal for me. Most of my pots are squat, not more than 2 in. to 3 in. high and from 8 in. to 12 in. in diameter. I think their broad surfaces are ideal for displaying the patterns and exotic woods I like to use, such as padauk, bubinga and bocote. I don't have a rigid approach for designing my pots: Freehand sketches, approximately full-size, help me develop pleasing profiles and segment shapes. (Later, the segment shapes will have to be drawn precisely so accurate metal patterns can be machined.) This loose approach usually works well, but occasionally something gets lost in the translation from a two-dimensional drawing to the three-dimensional object. I've made some pretty clunky pots that only the local landfill will ever see.

The simplest pots I make aren't segmented at all: They're made in the same way as the more complex segmented pots, but because they're smaller and have a one-piece top, I can make them more quickly. These simpler weed pots have created a demand for the larger, segmented pieces I'll discuss in this article.

Making the templates and shaping the segments–Once I've settled on a pot design, I begin working on the templates needed to shape the segments that make up the upper half of the pot. I first tried working without templates, bandsawing the segments directly from a stack of different woods, "mixing and matching" pieces to create a pot's pattern. But the joints between the segments were not tight because the bandsawn edges were not perfectly smooth. Now I use metal templates and shape each ¾-in.-thick wood segment (first roughed out on my bandsaw) on a shop-built radial-arm router using a flush trim bit with a ball-bearing pilot that rides along the edge of the template, as shown in the top photo this page.



Mongold uses a shop-built radial-arm router to shape segments. The segments, rough-cut with a bandsaw, are firmly positioned on steel templates and held in place by a vacuum chuck. A flush trim router bit guided by a pilot bearing does the final shaping.


This gluing fixture applies uniform pressure in a radial direction. The wood cauls can be modified to accommodate various size discs.


This shop-built thickness sander flattens the segmented disc so it can be mounted and shaped on a lathe. The sander is similar to the one in 'FWW on Making and Modifying Machines,' p. 38.

To make the radial-arm router, I mounted a Dayton Tradesman router in a steel frame that rides along a steel arm made from 3-in.-sq. box channel. I adapted bearings and other parts from an old Ward's radial-arm saw for this. Two 3-in. angle irons welded together provide vertical support for this arm and a 1-in.-dia. steel bar attached to the end of the arm fits to pillow blocks (bolted to the vertical support) to allow the arm to swivel in a horizontal plane. A machine-surfaced steel table that supports the work is also attached to the vertical support. To create a vacuum chuck for holding the patterns and workpieces, I drilled a hole through the table, installed piping and connected it to a milking pump I bought from a dairy farmer for $50. I'm partial to this tool, but the segments could be shaped using the templates and a hand-held or table-mounted router.

In my setup, which works just the opposite of a pin router (which could be used as well), the workpiece is held stationary in the vacuum chuck while the cutting tool moves, its guide bearing riding along the template's edge, defining each segment's shape. Each template has weather stripping around the periphery of its top and bottom surfaces, forming vacuum seals to the workpiece and the vacuum table. Also, each template has two or three small pins that penetrate the wood segments when the vacuum is applied, to prevent any shifting between the template and the wood while it is being shaped. The patterns are not expensive: Mine, made at a local machine shop, cost less than $100. I like this method of making the segments because it ensures precise and reproducible joinery and is very fast. I can knock out all the segments for a pot in a few minutes.

Gluing up the segments–The next step is to glue up the segments to form a disc. I use a specially made fixture that applies uniform pressure in a radial direction and prevents the segments from sliding out of alignment, as shown in middle photo this page. The push clamps around the circumference of the jig are made from 3-in. channel iron and ⅜-in. by 4½-in. carriage bolts. A small T-handle is welded to the threaded end of the bolt after it is passed through a nut welded to the channel iron. By varying the curvature and width of the wood cauls between the push clamps and segments, I can glue up circles up to 14 in. in diameter. The jig makes glue-up simple and quick, and it's easier to use than the band clamps often used for gluing up discs. With simple modifications, the jig can be readily adapted for a variety of production glue-up situations.

I use Titebond yellow glue exclusively. I've never had a joint failure with it, even with weak endgrain-to-endgrain joints or with the hard-to-glue, dense and oily woods, such as teak or bocote. I don't do any special surface preparation, but I'm careful to glue up the pieces within an hour or so of the time they're machined or sanded. The only other precaution I take is to place waxed paper on the gluing jig's surface, to prevent the glue squeeze-out from adhering.

Turning the discs–The last step before turning the assembled disc is to sand both sides flat with 80-grit paper, as shown in the bottom photo this page. I rely on double-face, cloth carpet tape to hold the disc to the 6-in.-dia. lathe faceplate: A flat surface is essential to ensure good adhesion and to prevent vibration or "chatter," which might cause the disc to pop loose. My shop-built thickness sander is similar to the one described in *FWW on Making and Modifying Machines*, p. 38. Mine uses a 1¾-in.-dia. steel drum instead of wood; the diameters of the ends are turned down to ¾ in. to fit pillow bearing blocks bolted to the sander's steel frame. The drum is belt-driven by a 1,750-RPM, 1½-HP motor. The table is made from two sheets of ¾-in.-thick plywood hinged together on the outfeed side, and I installed a screw adjustment on the infeed side to raise and lower the table. For dust collection, I built a plywood collector and use plastic hose connected to my shop-vac.

After taping the disc to the faceplate, I turn the disc to within ⅛ in. of the pot's finished diameter with a roundnose scraper. Later, after the insides of both top and bottom halves have been hollowed out and glued together, I'll turn the outside of the pot to its final shape. The goal at this point is to remove as much wood as possible from the inside of the top—I want my pot to be lightweight—while leaving sufficient wall thickness for strength. I also need to form a flat-surface rim for gluing the top to the bottom half of the pot. Again, using a scraper, I take the center of the disc down to about 3⁄16 in. thickness. Then I work from the center out toward the perimeter to form a slightly concave surface, leaving about 3⁄16 in. at the outside edge for the rim.

While the disc is still on the lathe, I sand the inside surface with 120 and 220 grit, using a flexible disc sander. Next, I cover the rim with masking tape to protect the gluing surface, and apply two coats of John Bivens Express Oil Filler with a brush or rag. Although the inner surface won't be seen in the completed pot, the finish seals the surface and protects the pot from humidity changes that could otherwise cause it to distort. Also, the smooth, finished inside surface is its own answer to the curious individual who can't resist feeling inside the pot. I remove the piece from the lathe, but leave it attached to the faceplate, and turn my attention to the bottom half.

The pot's bottom half is not segmented, so it's just a matter of turning it bowl shaped with a diameter and rim width to match the upper half I've just completed. The match isn't critical: Any mismatch on the inside won't show; any outside discrepancy can be corrected when I shape the pot's exterior. I use thicker stock for the bottom half: for the smaller pots, 1 in.; larger pots, 2 in. Although I usually rely on solid stock, occasionally I laminate thinner pieces to make the required thickness. As with the upper half, double-face cloth tape holds the piece to the faceplate; after marking the outside diameter (to match the top half) with a compass, I shape the piece with a scraper. At this point, the piece's inner surface is turned to its final shape, but the outside is only roughed out. As with the top half, oil sealer is applied to finish the bottom's inner surface, after the rim is protected with masking tape.

Assembling the turned discs and turning the pot—With both inner surfaces completed, the top and bottom halves are ready to be glued together. Even though I use only kiln-dried wood, some slight movement and rim warpage occurs in both halves by the time they're ready to be glued, so I return each piece to the lathe and true the rims with a scraper. Finally, I sand the rim of each half for a second or two on a vertical disc sander (80 grit) to make certain each is perfectly flat. I remove the top half from its faceplate but leave the bottom half mounted, to ensure the assembled pot will be centered on the faceplate for finish-turning. The two halves are glued together rim to rim with yellow glue and clamped in a press I built especially for this purpose. The two flat rims form a simple butt joint. Close mating of the surfaces is more important than clamping pressure, and only enough pressure should be applied to squeeze out the excess glue. When the glue has dried, I center and glue a ¾-in.-thick, 2- to 3-in.-dia. piece to the top. This will be shaped to form the pot's rim and center hole. Use the press for clamping here also, as shown in the photo this page.

The glued-up pot, its bottom still attached to the faceplate and its hollow interior now completed, is remounted on the lathe so the pot's exterior can be shaped with a scraper. I complete the shape of the bottom piece, then shape the top to form a subtle dome. The center hole, which is usually between 1½ in. to 2 in. in diameter, can be bored, but I find that roundnose and squarenose scrapers do the job well and quickly. The center hole's lip is made to protrude slightly upward from the domed top, then its edge is rounded over.

A versatile shop-built press clamps the top of the pot to its bottom during glue-up. Its external profile is later refined on the lathe.

Finishing—Most of the finish-sanding is done before removing the pot from the lathe. I use a power disc sander, and while the pot is rotating, sand with 120, 220 and 400 grit. Finally, I stop the lathe and hand-sand with the grain using 600 grit to remove circular scratches. While the pot is still on the lathe, I apply finish to all the surfaces, except the bottom.

With the pot spinning, I brush on the same gunstock finish I used to finish the pot's inside. This urethane varnish penetrates and seals well, with only slight darkening of the wood (about the same as with lacquer). The finish works well to develop clear, visual access to the wood, highlighting the wood's iridescence, depth and subtle color nuances. I apply as few as three coats, but more often as many as 20 to fill the pores of the wood, buffing the pot's surface between each coat with 0000 steel wool.

The gunstock finish dries in four to six hours; on oily woods, such as cocobolo, bocote and bloodwood, it may take two to three days or not dry at all. Washing these woods with solvents, such as acetone or lacquer thinner, before applying the gunstock finish doesn't seem to help. So, for these oily woods, I spray clear lacquer instead, as it dries on any wood.

The last step in constructing the pot is to remove the faceplate, sand the bottom through 320 grit with an orbital sander and apply the gunstock finish. The trick is to find a way to hold the pot while doing this without damaging the completed finish on the rest of the pot. My solution is to build a vacuum chuck. It's simply a wood box with a 6-in.-dia. hole cut in its top surface and connected to my shop-vac. The pot is turned upside down to cover the hole like a lid, and the hole is lined with foam weather stripping to cushion the pot, form a vacuum seal and prevent damage to the finish. □

Dan Mongold is a full-time woodworker in Bozeman, Mont.

The author sights along the side-panel rungs of a stool to make sure they're aligned. By beginning with green wood and monitoring the moisture content of the parts, you can capitalize on wood movement as the pieces dry to make stronger post-and-rung joints.

Green-Wood Joinery

Dry tenons, wet mortises for long-lasting joints

by Drew Langsner

Most contemporary woodworkers depend on commercially sawn, kiln-dried lumber. Green wood, high in moisture content (MC), is generally avoided: We hear that it warps, twists and shrinks unpredictably. However, in past centuries, wood was commonly worked green, often with outstanding results. All successful joinery is dependent on attention to and control of the moisture content of the wood being used. Even with kiln-dried wood, it's necessary to take into account the potential for expansion or contraction of parts being joined. The techniques used in working green wood not only allow for wood movement, but actually use it to advantage to make post-and-rung mortises and tenons that are often superior to comparable joints in kiln-dried wood.

"Green woodworking" is a term coined by ladderback chairmaker John Alexander. The techniques begin with riving (splitting) your material directly from a log and rough-shaping the green (wet) wood with hand tools, such as drawknives and spokeshaves. Riven wood has very high tensile, shear and bending strength, because each rived "billet" follows the natural, long fiber direction of the wood. "Green-wood joinery" does not mean joints are assembled wet: Final joint dimensioning and assembly are not undertaken until each of the parts has dried to a specific moisture content. A more accurate term is dry/wet joinery—dry tenons into moist mortises. Most dry/wet joints utilize cylindrical tenons and bored mortises. I'll briefly discuss the principles involved in dry/wet joinery, then I'll describe my techniques for applying these principles in the construction of the post-and-rung stool in the bottom photo on p. 63.

Moisture content and differential shrinkage—In green woodworking, the most important principle to remember is that wood is hygroscopic, which simply means the wood will absorb and release moisture with variations in environmental humidity. Freshly cut wood contains moisture within the cell cavities, called "free water"; and moisture in the cell walls, called "bound water." As wood dries, it first loses free water, down to about 30% MC. This is the "fiber saturation point." The cell cavities are empty, but the cell walls are still saturated. As wood dries, its dimensions remain stable until it reaches the fiber saturation point. Then it begins to shrink, check and warp as it loses bound water. Tangent to the growth rings, most woods can shrink from 10% to 15%, while on the ray plane (perpendicular to the growth rings), maximum shrinkage is only half as much, 5% to 7%. This is "differential shrinkage." Because of differential shrinkage, a cylinder shaped from green wood will eventually dry into an oval cross section, with the oval's long axis on the ray plane (see figure 1 on the facing page). Oak and other ring-porous hardwoods, commonly used by "green woodworkers," are among the species that shrink the most. For a successful dry/wet joint, you must take into account both of these principles: the fluctuations in the moisture content of the joint components, and the differential shrinkage that occurs during these fluctuations.

In a heated house during the winter, the moisture content of the wood in your furniture can drop to between 5% and 10%. You don't want the tenons that join this furniture to shrink under these dry conditions and come loose. When the tenons are fitted to the mortises, they should be at 5% MC to 8% MC, to ensure that they're as dry and as small in diameter as they will ever get. In contrast, the ideal moisture content of mortise components at time of assembly is about 15% to 20%. This allows for slight swelling of the dry tenon as it absorbs moisture from the shrinking mortise.

In the Eastern United States, air-drying wood in a drafty shed will lower moisture content to between 15% and 20%, ideal for "wet" mortise components. A homemade kiln, like the one described in the sidebar on p. 63, can be used to dry the tenon stock to the desired 5% MC to 8% MC. In the arid West, wood air-dries to below 10% MC, which should be within allowable tolerances for mortise wood, as long as the tenon stock is thoroughly kiln-dried. As a rule of thumb: Air-dry mortise wood; kiln-dry tenon wood.

You can account for the second principle—differential shrinkage—by paying attention to growth-ring orientation of the mortise-and-tenon components (see figure 1). Chairs tend to fall apart during winter when the dry interior environment causes the tenons to shrink. However, much of the structural damage occurs as the tenon swells during the humid summer, causing the fibers of both mortise and tenon to crumple from overcompression. With a subsequent change to low humidity, moisture content drops and the tenon shrinks; but because of the crumpled fibers, it dries to a size smaller than its original diameter, thus creating a loose joint.

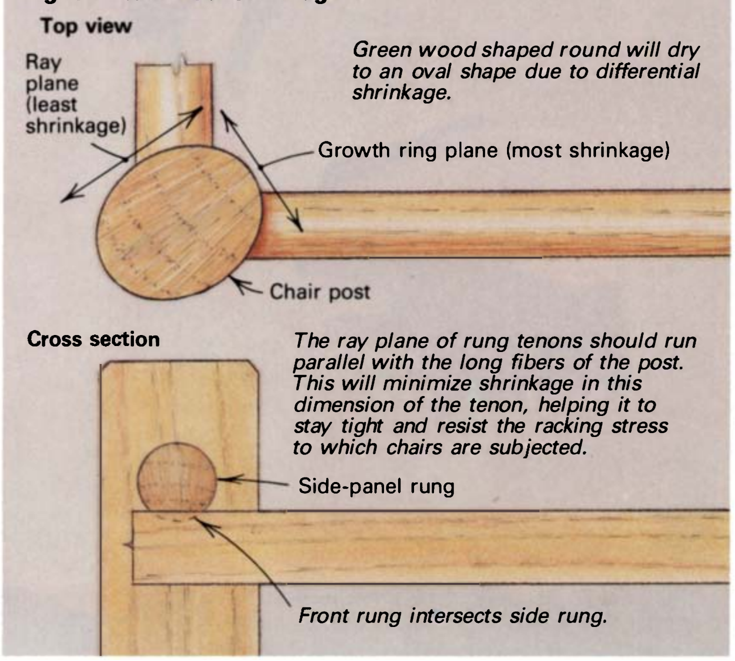
When a dry/wet joint is assembled, you can compensate for this potential compression. Orient the tenon's ray plane, which is subject to the lesser amount of shrinkage and swelling, parallel to the long fibers of the mortise wood, which also will shrink less (see figure 1). This orientation is partly dependent on the purpose and the anticipated stresses that the joint will be subjected to. For instance, a chair or stool rung is stressed mostly by racking, which puts the load on the top and bottom of the tenons. There is very little force on the sides of the joint; therefore, rung tenons are positioned with the ray plane parallel with the long fibers of the chair posts. This ensures that the joint will stay tight in the racking plane. If there is any compression of the tenon from expansion during a humid cycle, it will occur in the less critical sides of the tenon. In fact, I usually slightly undersize my tenons on the sides to allow for the additional shrinkage of the mortise and the expansion of the tenon.

Differential shrinkage is also considered when locating mortises. If mortises are on one plane only, they should be bored tangent to the growth rings (into the surface perpendicular to the ray plane). Because this is the plane of minimum shrinkage, the mortised wood is less likely to split as it dries around the tenon. However, in many cases, such as on the legs of the stool in the bottom photo on p. 63, multiple mortises in one member are located perpendicular to one another. Then, a compromise position is selected so shrinkage is about equal for mortises bored in either location (see figure 1).

A moisture-resistant finish on completed furniture helps minimize swelling and shrinkage from moisture cycling. I've used tung oil thinned with turpentine on my ladderback chairs, but recent studies show that tung oil is not an effective moisture barrier. I'm now experimenting with a mixture of tung oil and polyurethane varnish.

Building a post-and-rung stool—To show how the above principles are applied, I'll describe the joinery involved in building the stool. If you begin with green wood in log form and intend to rive

Fig. 1: Differential shrinkage



billets for your stool parts, you should use strong, straight-grained, ring-porous hardwoods, such as white and red oak, hickory or ash. Avoid defects; rot, bug holes and knots, or a combination of heartwood and sapwood in one piece, can all cause the wood to dry and shrink unpredictably. You can also use diffuse-porous hardwoods, such as birch, cherry and maple, but they don't split as well and must be machined or turned on a lathe.

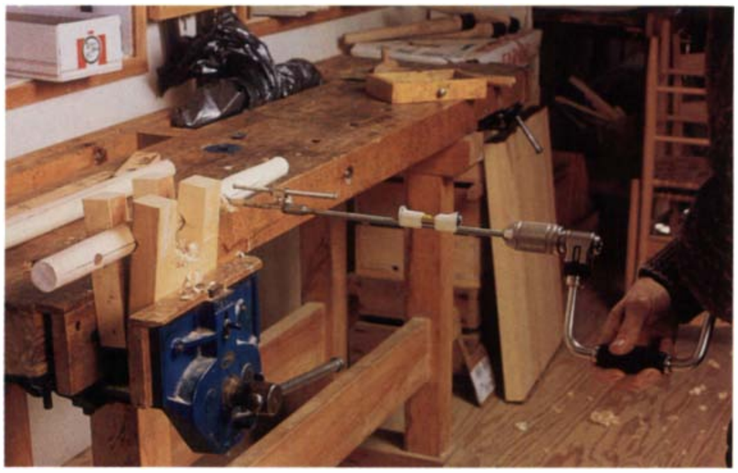
Wet wood splits, shaves, whittles, bends and turns much easier than dry stock. So after riving, I immediately rough the parts out with a drawknife or spokeshave. I shave the parts square; then octagonal; then round, leaving them about 10% oversize in diameter to allow for shrinkage and final sizing. This translates to about 3/32 in. per 1 in. of thickness, or 1/16 in. for a 5/8-in.-dia. rung tenon. You'll note in figure 2 on the next page that the top rungs in the front and rear have an "airfoil" shape to make the seat more comfortable on the backs of legs. Then, I crosscut the parts to length, making sure that the tenons have a diameter/length ratio of about 1:1½. Shorter tenons have too little surface area to resist racking and may pull loose. The 5/8-in.-dia. tenons for the stool should be 1 in. long. The posts are roughed down to a green diameter of about 1⅜ in. To prevent the top mortise from splitting during assembly, I let the post length run long about 1 in.

If I'm not in a hurry to use the parts, I begin by air-drying them slowly, leaving them in a shed or a corner of my shop. If you air-dry the wood in a heated room, away from the heat source, it will take about two weeks for very wet green wood to dry to 15% MC to 20% MC. A couple of days before I plan to assemble the stool, I dry the rungs on a rack located above a wood stove or in a drying kiln.

Sizing the tenons—Final shaping and sizing of the tenons is done when the rungs are thoroughly dried (5% MC to 8% MC). I size tenons with a spokeshave, then use a wood file to remove the small facets left by the spokeshave. If it's humid, I keep all rungs on the drying rack or in a plastic bag, except the one I'm working on; in humid conditions I've seen swelling occur within 30 minutes.

To test-fit the tenons as you work them to size with the spokeshave, make a gauge from a piece of dry hardwood about ½ in. thick (see the top photo on the next page). Bore three holes, using the same bit that will be used to drill the mortises, and number the holes. With a rat-tail file, enlarge the entry to hole #1, and use

Langsner uses a shaving horse to hold a rung as he shapes and sizes it with a spokeshave. The small block with the three holes is his fitting gauge. The sides of the first hole are colored, so when a tenon is rotated in the hole, the color shows where the tenon needs to be shaved more.



The notched blocks hold the post so all the mortises in one side can be bored without having to loosen the vise to move the post. A builder's line-level taped to the bit extension aligns the bit and a depth-stop clamped to the bit controls depth.

a water-soluble drawing pencil (available from art-supply stores) to coat the inside of the hole. Slightly chamfer the tenon ends with a file, to ease their fit into the gauge holes. As you insert the tenon into hole #1 to gauge your progress, the pencil marks will rub off on the tenon, showing where to shave more. When the tenon is close to size, use hole #2 for the final test fits. You'll be fitting 24 tenons for the stool, so when hole #2 gets enlarged from repeated reaming, use hole #3 to check the final fit.

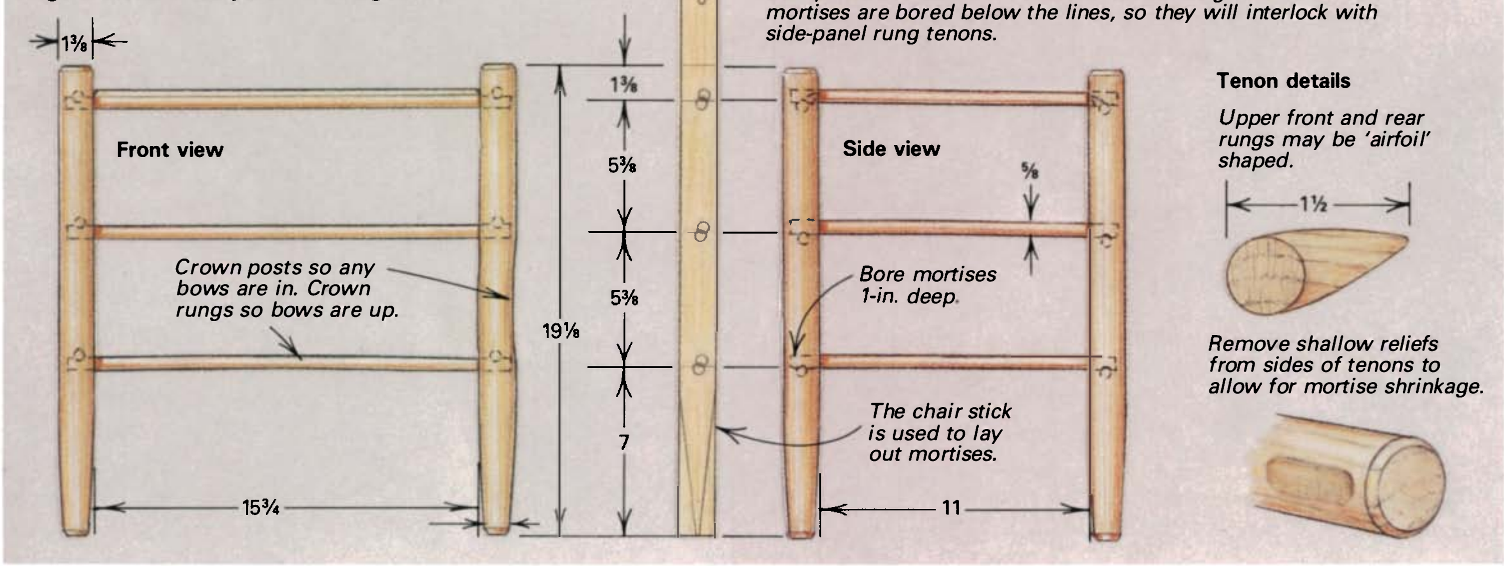
You want a squeaky-tight fit on the top and bottom of the tenon. The side-to-side dimension, tangent to the growth rings, can be slightly undersize. Remove wood in small increments and test often. Final sizing is done with the file. After fitting the tenon to the mortise, I often relieve the tenon sides with a half-round file, reducing the chance of mortise split-out during assembly or later drying cycles. The shallow relief begins about ⅛ in. from the end of the tenon and ends ⅛ in. from the tenon's "shoulder" (see detail in figure 2).

On stools and ladderback chairs, the side-panel rung tenons, which bear the brunt of the fore-and-aft racking stress, can be further strengthened by interlocking with the tenons of the front and rear rungs. To accomplish this, bore and assemble the side panels first. Then bore the mortises for the front and back rungs so they slightly overlap and cut through the tenons of the side-panel rungs inside the chair post, like a log-cabin notch. To lay out the mortises on the posts, make a chair stick as shown in figure 2. The lines are not the centers of mortises. The side-panel mortises are drilled above the line, with their bottoms tangent to the line; the mortises for the front and rear rungs are drilled below the line so they overlap the line by $\frac{1}{16}$ in.

Boring the mortises–Mortises should be bored after the wood has been air-dried to about 15% MC to 20% MC. Determine this by testing with a moisture meter or by kiln-drying a spare post along with the rungs and using it to compare relative weights to air-dried posts, as described in the sidebar. If mortises are bored in saturated green wood, they are often rough or fuzzy and as the wood dries, they take on an oval shape. In addition, mortise wood that's too wet can cause bone-dry tenons to absorb excessive moisture, leading to overcompression of the joint fibers as the tenons expand.

When mortise wood is thick enough that there's no danger of running a leadscrew out the back end, I use ordinary auger bits; in close situations, I switch to Forstner or Stanley Powerbore bits. I prefer the Powerbore bit because it's easy to sharpen, but I file the

Fig. 2: Plans for a post-and-rung stool



lead point to about half the factory length. A Stanley #47 auger-bit depth-stop ensures that the mortises are consistently 1 in. deep. To bore at the proper angles, I use a variety of sighting aids, including try squares and sliding bevel gauges. A drill extension makes it easier to align the bit, and a builder's line level, taped to the extension, provides a constant horizontal reference. The post, or assembled side panel, is clamped in a bench vise, as shown in the lower photo on the facing page. The simple clamping device holds the post so all the mortises on a side can be bored without having to unclamp the vise.

I bore the side-panel mortises above the layout lines with a brace or hand-held, variable-speed electric drill, and then assemble both side panels. Check each panel by eye for flatness, as shown in the photo on p. 60. You may have to twist it to eliminate any wind in the panel. Then, bore the front and rear rung mortises below the line so they will intersect the side rungs.

Although green woodworkers often assemble chairs without glue, I use it. Even though stressed surfaces in the joint mate endgrain to long grain, modern glues do provide some bonding strength. Perhaps more importantly, glue seals the endgrain of the tenon, slowing down moisture exchange within the joint. I use common white glue instead of yellow wood glue, because it sets up slower and is slipperier, thus serving as a lubricant during assembly. After the front and back rungs are glued into the side panels, you may have to "wrassel" the frame to eliminate any unevenness. With one of the legs braced on the floor, use your strength and body weight to force the frame into alignment. Check this by lining up the top rungs by eye until you have a flat seat plane. Then if necessary, scribe and saw off appropriate post bottoms so the stool stands flat.

For seating, you can use the inner bark of hickory, as shown in the photo below, or ash or white-oak splits. Woven cotton "Shaker tape" is also an option and is available, along with weaving instructions, from Shaker Workshops, Box 1028-FW17, Concord, Mass. 01742. Wrap the warp from front to rear in a continuous strip—not tight and not loose, rather slightly snug. Then, weave the weft in a checkerboard or herringbone twill pattern. □

Drew Langsner and his wife, Louise, run Country Workshops (90 Mill Creek Road, Marshall, N.C. 28753), offering summer and winter programs in green woodworking. Langsner is author of the book "Green Woodworking" (Rodale Press, Emmaus, Pa.; 1987).

This oak post-and-rung stool is an example of finely crafted furniture built with green-wood joinery techniques.

A piece of sheet metal on the bottom rack of this kiln deflects the direct heat from the electric baseboard heater below.

Drying green wood

Small drying kilns: During summer, when we're teaching week-long classes at Country Workshops, we often need to speed up the drying process for our chair parts. Over the past 10 years, I've built several small wood kilns. The first was built with cinder blocks and used a wood fire. Later, we used a 500-watt radiant heat lamp set in the bottom of a horizontal 55-gal. drum. Last summer, I built a more sophisticated kiln, shown in the photo above, with a 3-ft.-long heater in the bottom. The walls are two pieces of ¼-in. plywood that sandwich ¾-in. styrofoam insulation, assembled into a box 4 ft. by 4 ft. and 18 in. wide. Because the maximum setting on a standard thermostat is too low, the temperature is controlled by a heat-limit device mounted near the top of the box (stock #2E372 from W.W. Grainger Inc., 5959 W. Howard St., Chicago, Ill. 60648; 312-647-8900). A relay, appropriate for the amperage of the heater and the temperature control, is wired between the two. A small exhaust fan in the top of the kiln is used at the beginning of drying, when a great deal of moisture is being released. Doors at both ends of the cabinet double as adjustable dampers. Don't let the temperature rise above 160°. Charring or internal honeycombing can occur if the interior fibers dry too quickly.

With Windsor chairs, legs and stretchers present a unique drying requirement; their ends are tenons, which should be bone-dry, but they also have mortises, which should be left slightly damp. The solution is to dry the end tenons in a pot of heated sand. For heat, I use an electric hot plate, again limiting the temperature to 160°. Tenons are dry when they develop an oval cross section.

Checking moisture content: A piece of wood with 75% MC weighs 75% more than the same sample if it were completely dry (5% MC is the attainable minimum). To determine moisture content by percent, weigh a wet sample piece of wood and then dry it in an oven (under 200°) and weigh it again. Wood is "kiln-dry" when it stops losing weight. Percent moisture content equals green weight minus dry weight, times 100, divided by the dry weight.

Moisture meters measure electrical resistance between two probes inserted in the wood, but they're expensive, and most green woodworkers find them unnecessary. With experience, you can judge approximate moisture content by knowing the history of the wood after it was cut, and by sensory tests. When two pieces of dry wood are knocked together, they "plink"; wet wood "thunks." And, a piece of dry wood held to your cheek feels warm; wet wood feels cool. Try these tests with samples you know to be wet, air-dried and kiln-dried. *—D.L.*

Versatile Varnish

A reliable finish for a small shop

by Craig Deller

Brushing varnish can yield good results. To avoid air bubbles in the finish, don't scrape the brush on the side of the can, but allow excess to run off, as shown by the author.

One difficulty of running a small shop, either as a hobby or a business, is producing a flawless finish without a huge investment of time or money. Lacquer is first choice in many operations, but the potential health and fire hazards of lacquer mist require special booths, exhaust fans and spark-proof electrical components for spraying this highly volatile material. Varnish is not as explosive, although it doesn't set or cure as quickly as lacquer. Also, varnish can be applied easily with a pad, brush or by spraying, making it an excellent, reliable finish well suited for use in the small shop. You can also mix varnishes of various sheens to create the exact gloss and toughness needed for a particular job. Even though it's less explosive than lacquer, varnish should be sprayed only with adequate ventilation, and users should always be aware of any local fire codes.

Modern varnishes offer advantages over other traditional finishes as well. I prefer it over shellac and lacquer because it's more durable and more resistant to heat and alcohol damage. A kitchen table in a house full of "wee ones" demands the tough, elastic finish of varnish that shellac cannot achieve. Oil finishes, due to their deep penetration, are irreversible and therefore unsuitable for restoration work I do on historic objects. Linseed oil is the worst because it darkens the wood initially and continually darkens it until the piece is almost black. My ethics will not allow me to use a urethane—no plastics in this shop—so a high-quality varnish fits the bill perfectly. A purist may argue that synthetic resins are, in fact, ingredients of plastic, but I don't consider them in the same category of liquid plastics as urethane.

The long and short of varnishes—Although varnishes have been used for more than 2,000 years, early varnishes were mainly spirit varnishes, such as shellac, dammar or mastic dissolved in alcohol. These spirit varnishes were brittle, susceptible to alcohol and water damage, and difficult to polish to a high gloss. It wasn't until the middle ages that a German monk, Theophilus Presbyter, developed a way to heat and mix amber, a fossil resin, and linseed oil to create what I refer to as drying-oil varnishes. Based on oils such as linseed, safflower or other vegetable-based oils, these varnishes dry by chemical change through oxidation, polymerization and evaporation. The fossil-resin varnishes have two major disadvantages: the resins are rare and expensive, and the linseed oil yellows and darkens the wood. Fortunately, the mid-20th-century development of much cheaper and cleaner synthetic alkyd resins in a soya, safflower or china-wood oil vehicle has given the use of drying-oil varnishes a new lease on life. (For further discussion see *FWW* #35, pp. 54-57.)

All modern drying-oil varnishes can be divided into two groups: long oil and short oil. Long-oil varnishes, commonly known as spar varnishes, have a high proportion of drying oil in relation to resin. High oil content retards the curing of the varnish, but makes the cured film tougher and more elastic, rendering spar varnishes ideal for exterior work and boats. Short-oil varnishes, with lower proportions of oil to resin, are more appropriate for furniture. They are the only type I use because they produce harder, faster and more completely cured finishes and thus polish better. Cured varnishes are impervious to their original solvent and removable only with methylene chloride or a similar caustic solution. Such a harsh removal procedure would be unacceptable for an object of historical value, making varnish an inappropriate finish for these pieces. The insolubility of varnish, however, offers some distinct benefits, especially when spraying.

I have been spraying a variety of off-the-shelf and commercial varnishes in my restoration work for years. I've found that Pratt & Lambert's #38 Clear Finish works best. It can produce nearly any effect from a subtle, waxed glow to a hard, mirror-like shine by mixing various sheens. All varnishes come in a naturally glossy state. Manufacturers make varnishes satin or dull by adding flatting agents, such as aluminum stearate and silica, to break up the light reflection and produce the softer look. Even though all commercial varnishes are prepackaged as gloss, satin or dull, the amounts of the flatting agents can be adjusted simply by mixing gloss with satin or satin with dull in various combinations. I buy varnish in gallon cans, but break it down into quart containers because they are easier to work with and increase the varnish's shelf life by decreasing its exposure to air. I also mix various sheens to achieve the desired degree of gloss. I have found a 50:50 mix of gloss and satin is best for most situations. A straight satin is good for projects with lots of turnings and carvings. You can steel wool and wax the finish to produce a good luster without beating your brains out trying to tone down the shine from the gloss or even the 50:50 mix. If you are looking for the simple elegance of a soft, waxed glow, apply a thin coat of dull varnish to seal the wood before waxing. By using the same mixture of varnishes for each coat of a project, you can eliminate variations in sheen and the possibility of rubbing through one layer to a different sheen.

Spraying varnish requires a minimum investment in equipment, is easy to do and yields extremely good results.

Ease of application–Varnish is a good brush-on finish because its 15-minute working time is sufficient to do a fairly large table top. Although I prefer spraying whenever possible, brushing is the only choice for some jobs, such as on-site finishing of cabinets or paneling. The first consideration here is the brush. I prefer a well-broken-in china-bristle brush; I've been using one for years and I'm comfortable with it. You might prefer a foam brush because it doesn't generate as many air bubbles and it eliminates problems with brush marks and loose bristles. Although I use the varnish straight from the can, thinning with a good-quality turpentine will slightly retard setting time.

Air bubbles are a major concern when brushing varnish because they leave little pockets in the finish. Bubbles can be introduced when mixing sheens, stirring the varnish or loading your brush. While the big bubbles go away fairly quickly, it may take the little ones overnight. I stir the varnish gently with a regular paint stick. Proper loading of the brush, as shown in the photo on the facing page, however, is dependent upon the quality of the brush you are using. Better brushes will hold more varnish without dripping, allowing you to apply a more even, consistent coat with fewer trips to the varnish can. Start off by dipping your brush into the varnish about 1 to 1½ in. If the varnish runs from your brush, you have too much and will end up with runs and sags. Don't put so much on that you must scrape the brush along the edge of the can as this will fill the brush with air bubbles. Too little varnish will result in more frequent trips to the varnish can. I've always found it best to brush against the grain, then lightly "tip-off" with the grain using long, light, even strokes. This helps to work the varnish into the open grain, provides a more even distribution and avoids trapping any air bubbles. Remember, applying a number of thin coats, rather than a couple of thick ones, avoids the sags, runs and wrinkles that are sure signs of an amateur.

Since drying-oil varnishes polymerize, the subsequent coats do not "melt" the previous layers as the spirit varnishes do. I hand sand between coats, starting with 220-grit silicon carbide paper for the first coat and then use 320-grit and 400-grit for subsequent coats, which levels the finish and provides a physical "key" for the next coat. An electric palm sander works well if you stay with light grits to avoid orbital marks. I wipe off the sanding dust between coats with a homemade tack cloth, which is made by spraying a small amount of varnish on a lint-free cloth, and lightly dust the piece. Don't blow the sanding dust off because it will just land on something else. Avoid commercially prepared tack cloths as some contain non-drying oils, like mineral or raw linseed oil, and any residue may impede the drying of the next coat. I generally allow 16 hours to 48 hours between coats depending on drying conditions. If the surface is still a bit soft (the sandpaper clogs), I lightly sand the surface using the current grit paper to break open the skin and allow further solvent evaporation and oxidation before proceeding with the next coat. You will find curing from the outside in, known as "skinning over," to be a problem if you try to speed up drying with a fan. Without driers, standard short-oil varnishes require about 30 days for a full cure.

Spraying varnish is faster, speeds up drying time and eliminates brush marks, air bubbles and foreign matter that comes off a brush. And no, it does not destroy the spray gun. Basic equipment is all that's required (see photo at left). The air compressor doesn't have to be big and expensive, but should be rated at about 100 psi and have an in-line filter to prevent water and oil from mixing with the varnish. My compressor is about 30 years old and the motor needs an occasional smack with a hammer, but it works just fine. The spray gun is important enough to warrant a good one, so stay away from the toys. I have a stainless-steel, siphon-feed type gun available from any of a number of manufacturers such as Binks, DeVilbiss or Grainger (see sources of supply box on p. 67). In addition to the spraying equipment, I have constructed a room with an old furnace blower inside a sealed box to pull the air through a series of filters to trap the solids and prevent the overspray from settling on other projects. Again, you should check to be sure you are in compliance with any local fire codes. And even though the vapors aren't anywhere near as obnoxious as lacquer, you should have a high-quality face mask to protect yourself. I use a Pulmosan #10768 with a 17160 CAM charcoal cartridge, available from Reliable Finishing Products Inc.

Before pouring the varnish into the gun cup, it should always be strained, for even the smallest particles will cause the gun to clog and spit. The simplest strainer is made from panty hose. I use a relatively low spraying pressure (40 psi), which minimizes overspray, reduces the amount of material wasted and eliminates "pooling," which is caused by excessive air pressure pushing the varnish around. I spray in a normal crisscross pattern, about 12 in. from the piece, keeping the pattern tight to ensure even coverage. Although varnish, unlike lacquer, will build easily, it is still best to spray more light coats than few heavy ones. I find commercial varnishes spray quite easily without thinning even at 40 psi. If you prefer a thinner mix, I recommend adding a high-quality naptha until the varnish is thinned to the consistency of loose honey. It will take very little naptha, perhaps ½ oz. per quart, to achieve this consistency. The naptha will also speed up the drying process slightly. Because turpentine extends the drying time, it would be a mistake to use it as a thinner when spraying.

To further enhance drying, one of varnish's touted "problems," I add a metallic drier; I prefer Grumbacher's Artist's Oil Medium Cobalt Drier over the more common and inferior japan driers because it doesn't crack, crawl, alligator or darken. I add the drier to each quart container of varnish; one drop, maybe two, per quart is plenty, as too much drier can actually retard the drying process. Then I mix thoroughly with an ordinary kitchen blender on low. Don't worry about the air bubbles because they'll be eliminated when sprayed. By shortening set-up time, the driers help eliminate sags and dust collection. Even with the drier I still allow 16 hours to 48 hours between coats, sanding as previously specified. I allow about a week before doing the final rub out.

Varnish finishes can also be colored to match old work or to achieve an antiqued appearance by adding oil-based stains before spraying.

The fact that varnish does not melt the previous coats allows greater freedom during spraying. By inspecting a piece after spraying, I can catch those drips, sags and fly tracks that may appear, level them with my finger without removing previous coats and lightly touch up with additional sprayed varnish. Although working time to catch these drips will vary depending upon the amount of driers or thinners used, I find about 10 minutes to be optimal. This allows time for the sags and runs to develop, but allows you to catch them before they start to set.

The non-melting advantage can also help in the constant battle against silicone contamination, the most common source being spray-on waxes like Pledge. Cleaning the piece with TSP (trisodi-

Silicone damage, shown at right, can be covered by "dusting," spraying several light coats, and allowing five minutes drying time between coats until the silicone is sealed in, as shown on the left. Additional coats can then be sprayed on without fear of fisheye and other defects.

Glazing is done by thoroughly sanding the first coat of varnish and then wiping with an oil-based stain (above, left). Remove any heavy build-up before spraying additional coats of varnish. The subtle tone change obtainable is evident in the photo above, right.

um phosphate), available from most hardware stores, will not solve the problem, but will lessen the severity of the reaction between the new finish and silicone. I never use commercial silicone eliminators, such as fish-eye eliminators, because these products are pure silicone themselves, merely making the finish compatible with silicone and contaminating your equipment. If silicone damage does show up, wipe off the offending coat and begin "dusting." Spraying very light coats from 18 in. to 24 in. will merely dust the surface, not allowing the varnish to flow and separate. After five minutes, dust again, then repeat until you have an adequate coat to seal the surface and any residual silicone. Once thoroughly dry, the dusting coats are sanded and leveled for the next coat. Since the fresh coat of varnish will not melt the previous one, the first coat will not flow and separate. But should the second coat still show some reaction to the silicone damage, simply wipe it off and dust again. Although the stability of any finish over silicone is unknown, I've never had any trouble with a finish I've dusted. The bottom photo on the facing page demonstrates the results obtainable by the dusting technique.

After each spraying session, your spray gun should be cleaned thoroughly no matter what you are shooting. For cleanup after varnishing, I use the highest-grade gum-spirit turpentine because it effectively dissolves varnish in ways mineral spirits, or even naptha, cannot. Occasionally it will be necessary to thoroughly clean the gun with a mild, liquid, non-flammable methylene-chloride mixture by soaking, not spraying, then rinsing with lacquer thinner to remove all the dissolved residue. Don't allow the gun to sit too long in the methylene chloride as it may damage the seals.

Additional techniques—Varnish can also be colored with a certain degree of success by using chemically compatible oil-based stains, such as Fuller O'Brien's. Adding a small amount of additional oil to the varnish mixture may prolong the drying slightly. Dry pigments work well also, but require more mixing to achieve natural tones. Because it can be difficult to achieve the proper mix, I use dry pigments only when trying to match a finish or for custom work. Although not recommended for heavy coloring, this technique is helpful for subtle tone changes, as shown in the top photo on the facing page. If you do not wish to color the varnish directly, you can do a simple glazing. After a thorough sanding of the first coat of varnish, dip a paper towel into the desired color of oil-based stain and wipe down the piece; don't allow any heavy buildup to remain. Allow the piece to dry and proceed with the next coat of varnish. (See the two photos above.)

Another good feature is that varnish can be used as a light filler on open grain wood. I spray on a fairly heavy coat of varnish, allow it to set slightly, then, using a lint-free rag, work the varnish into the grain and wipe off any heavy excess. While this does not fill the grain completely, it doesn't change the color tone as most fillers do. Also, varnish can be used as a sanding sealer by thinning slightly before spraying. While some people will use alcohol-based shellac for this purpose, I feel it is chemically prudent to stick with a single class of finishing products throughout the project, such as the oil-based varnish for filler and/or sealer and the top coats.

I always rub out the finishes starting with fine-grit sandpaper, 320 for brushed finishes and 600 to 1200 for sprayed surfaces, using parafin oil as a lubricant. This is followed by buffing with any one of a variety of rubbing compounds, from pumice and rottenstone to automotive compounds. See Michael Dresdner's article "Rubbing out a Finish" in *FWW* #72, pp. 62-64 for appropriate techniques in applying these compounds. Even though varnish tends to be much tougher than shellac or even nitro-cellulose lacquer, it still needs proper care after rubbing out. The best protection for any finish is a superior-quality paste wax. After much experimentation in my shop I have settled on "Beauté Satin Creme Wax," available from Roger A. Reed Inc. It can be very easily colored by mixing in a bit of artist's oil colors, a particularly helpful trick for coloring marks and sealing leather. The wax can even be made into a rubbing compound by mixing in pumice or rottenstone for that final, satin-smooth shine. □

Craig Deller owns and operates Deller Restorations Ltd. Inc. in Geneva, Ill. He specializes in fine antique furniture restorations.

Sources of supply

Fuller O'Brien and P&L products are available from most hardware stores or write for the location of the nearest distributor:
Fuller-O'Brien, 450 E. Grand Ave. S., San Francisco, CA 94087.
Pratt & Lambert Inc., Box 22, Buffalo, NY 14240.

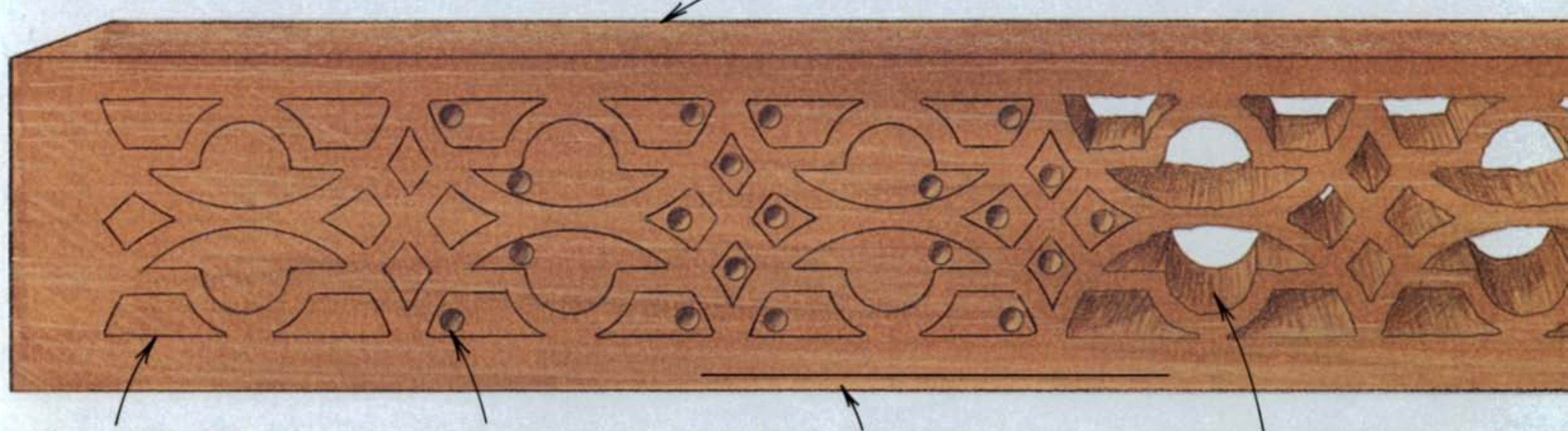
For spray guns and pneumatic equipment, write to the following suppliers for the location of the nearest distributor:
Binks Manufacturing Co., 9201 W. Belmont Ave., Franklin Park, IL 60131.
The DeVilbiss Co., Box 913, Toledo, OH 43692.
W.W. Grainger Inc., 5959 W. Howard St., Chicago, IL 60648.

Cobalt driers are available from most artist supply houses or from the following supplier:
Grumbacher, M. Inc., 30 Engelhard Drive, Cranbury, NJ 08512.

Face masks and filters are available from:
Reliable Finishing Products Inc., 2625 Greenleaf Ave., Elk Grove, IL 60007.

Beaute Satin Cream Wax is available from:
Roger A. Reed Inc., Box 508, Reading, MA 01867.

Fig. 1: Making a fretwork gallery



Fretwork

Laying out and sawing intricate filigree

by David R. Pine

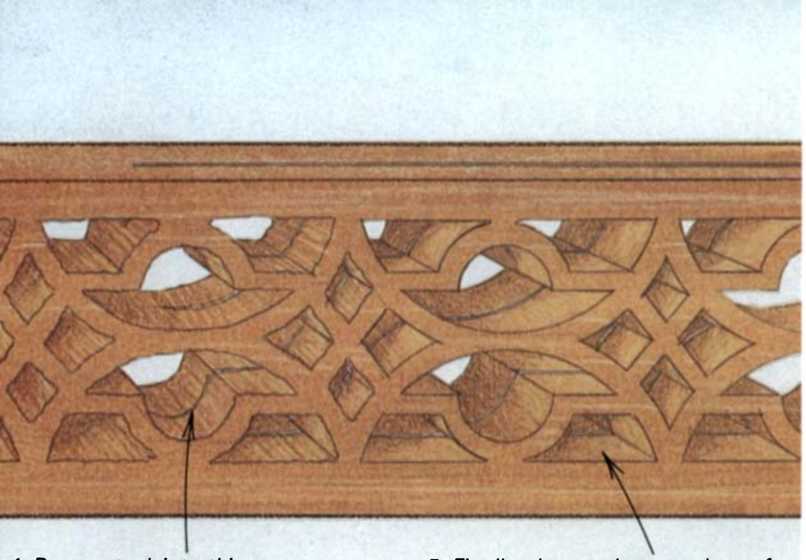
A fret is a thin piece of wood with a decorative pattern that is created by cutting away the entire background of a design with a fine-tooth saw. Well-designed and carefully sawn fretwork can add an extra dimension to an otherwise plain piece of furniture. In addition, the attraction to fretwork seems to be contagious; many potential customers who see examples of my fretwork are immediately convinced that it's just the finishing touch they are looking for.

Because of its delicacy and the expense associated with its production, pierced fretwork is generally found on furniture with some pretension of style. From the Chippendale period (mid-18th century) onward, fretwork was used for corner brackets, as a rim or gallery around tabletops or cabinet tops, and to decorate the frieze under a cornice or tabletop. It was also used to lighten the appearance of an otherwise bulky area on a piece of furniture, such as the pediment of a cabinet or the back splat of a chair. In some cases, intricate fretwork on an antique can double or triple the value of the piece.

The above drawing shows the steps in making pierced fretwork. The decorative pattern is traced onto a thin piece of wood from a template, based on a traditional pattern or original design. Because the background is sawn away, leaving the thin, continous lines of the pattern intact, a small hole for sawblade access must be drilled within each area of the design that is to be cut out. The design is then sawn out with a hand fretsaw or an electric jigsaw and cleaned up with files and chisels. The bracket, gallery or frieze is attached to the piece of furniture with tenons and/or nails and glue. A fretsaw is similar to a coping saw except the fretsaw's frame can adapt to various blade lengths (making it possible to use broken blades). In addition, the blade is held in place with thumbscrews instead of the pin-in-slot method used on coping saws. The thumbscrews make it easier to disconnect and reconnect the blade for insertion through the holes in each successive cut-out area. Since the 18th century, much fretwork has been sawn out by hand, but I use my old Craftsman jigsaw that I modified to speed the work.

It's common to find antique furniture that has the geometric or foliate patterns characteristic of fretwork relief-carved directly into the surface of the furniture parts. Because this "blind fretwork" can't be split or knocked loose, as applied fretwork can, it is most often used on areas that will receive hard use or wear, such as chair or table legs. However, carving these ⅛-in.- to ¼-in.-deep patterns can be quite a tedious job on any wood and a nightmare on figured or cross-grained wood. Other than the similarity of the patterns, this is an entirely separate technique from the delicately pierced, applied fretwork I'll discuss in this article.

Laying out the design—All fretwork begins with a full-size drawing. Even if you use a traditional design from a source listed in the further reading section at the end of this article, you will probably need to adapt the proportions to suit the piece of furniture you're decorating. If the design is for a corner bracket, the basic shape is usually an isosceles triangle, for which the length of the two equal sides is some fraction (usually ⅕ or ⅙) of the height or length of the piece it embellishes. Brackets usually include tenons, as shown in the bottom drawing on the facing page. However, if the bracket is very delicate, inserting and adjusting snug-fitting tenons is liable to break the thin filigree, so it's safer to glue and nail the base of the bracket to the furniture.



4. Resaw stock into thinner strips and sand the bandsawn faces.

5. Finally, the roughsawn edges of the pierced design are cleaned up with small files and chisels.

If the design is for a tabletop gallery or cabinet frieze, the basic pattern will be repeated end to end. The length of the basic pattern of a repeating fret is usually about 1/5 to 1/8 of the fretwork's total run before it stops or turns a corner. The design is laid out from the center of the run so the repeating pattern either ends at the corner or so the center of the pattern falls exactly at the corner. In the latter case, the fretwork continues uninterrupted around the corner. The height of a repeating fret is usually related to the vertical dimensions of adjacent moldings or some fraction of the total width of a frieze or pediment. In designs with circles or semicircles, such as the example in the above drawing, the radius of the circular or semicircular elements will affect the height and length of the pattern.

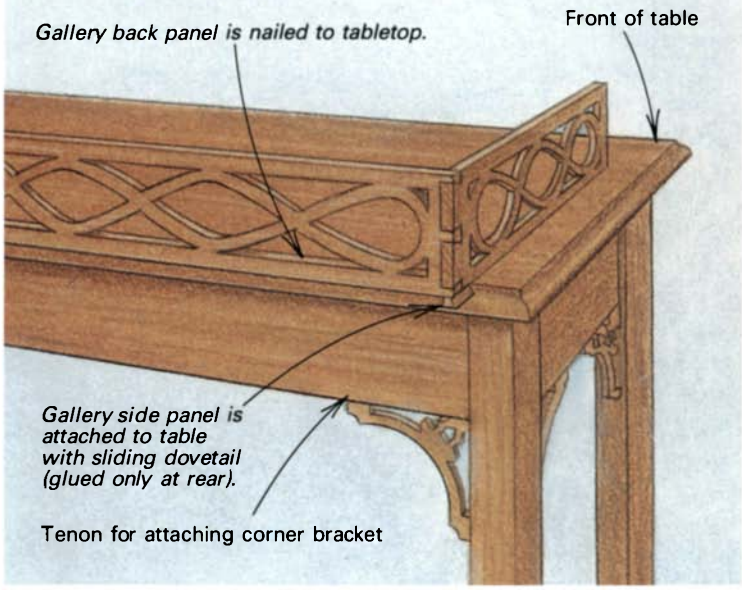
Frieze fretwork is usually glued to a pediment with the grain of both running in the same direction. Galleries on tabletops can be let into shallow dadoes as wide as the gallery's thickness. You'll need to allow for the depth of the dado when laying out the pattern. If the gallery is 3/8 in. or more thick, I dovetail the sections together where they turn corners and increase the height of the end pieces so they can be attached to the table with sliding dovetails, as shown in the drawing below. I glue the sliding dovetail into its slot only at the back corner, leaving the remainder free so the cross-grain top can expand or contract. The fretwork that runs with the grain along the back can be nailed to the top.

Whether you're designing your own pattern or adapting a traditional one, play around with the arcs and angles within the defined area until you get a pleasing silhouette. Take into account the smallest arc your blade will cut without binding. Beware of long kerfs with no way out except by backing up the blade. Don't forget to include any tenons for attaching the fret to the furniture. The next step will be to transfer your design onto your template material.

Sawing out the design—It is important to note that the beauty of many fret patterns is in direct proportion to their delicacy, and it is imperative that this delicacy not be lost through repeated copying of one pattern onto another. Every time the pattern is traced around, the resulting fret is coarsened by the width of the lines. When jigsawing (or bandsawing), most woodworkers are accustomed to cutting close to the pattern lines and then working to the lines when cleaning up the roughsawn edges. However, fretwork is the exception to this rule. If the delicacy of the pattern is to be preserved, it is essential to remove the entire line and then some, as shown in the photo below. If part of the line is left when the original drawing is cut out, and again when the drawing is traced around for the template and then one more time when the template is traced around and the fret is sawn out, the resulting pattern will bear little resemblance to the first drawing.

The effect of this accumulated error was obvious on an Aaron Willard, tall-case clock that was brought to my shop. The piece had recently been restored by someone else and many missing parts had been replaced, including a band of fretwork above the hood. However, the owner was dissatisfied with the restored fretwork and directed me to "knock that clumsy stuff off there." He had taken a photo of a clock nearly identical to his, and had it enlarged until its fretwork exactly fit his clock's hood. I carefully cut the fret out of the photo and used it as a pattern for the replacement. The curving bands of the fret were barely 1/8 in. wide on the pattern, but after tracing around them with a pencil, they were nearly 3/16 in. (or 50% wider). It was obvious that the restorer who first tried to fix the piece had worked in his accustomed way, leaving some portion of the pencil lines showing so that he was sure of the shapes. Unfortunately, the width of those

Fig. 2: Attaching fretwork



It's important to cut away the line completely to preserve the delicacy of the fret design. By replacing the saw's upper blade guide with a roller blade support from an old sabersaw, the blade need not be attached at the top. This makes it easy to raise the guide and insert the blade into the next opening to be sawn.

Drawings: Roland Wolf

two pencil lines meant the difference between a lacy filigree and a coarse failure.

Keeping that lesson in mind, lately I've been using a fine-tip, ball-point pen instead of a pencil to trace around the template onto the stock. This results in a finer line that is more consistent and easier to see; it also eliminates the frustration of repeatedly breaking the pencil lead when it gets wedged in the small openings and sharp corners of the patterns.

When you're satisfied with your full-scale design, cut it out and trace around it, or transfer it with carbon paper onto some material suitable for repeated use as a template. If you use cardboard or heavy plastic, like that used for quilting-pattern templates, you can cut the template out with an X-Acto knife. For durability, I usually use ⅛-in.-thick hardwood or plywood, in which case the template is sawn out and cleaned up using the following process, which is exactly the same process you'll use for the finished fret.

First you'll need to drill through each opening in the design for blade access. Use a drill press and the smallest drill bit you can, without making it too difficult to thread the blade through the holes. The blades I use (the smallest I could find at my local hardware store) are slightly less than ⅛ in. wide. I drill 5⁄32-in.-dia. holes to accommodate these blades. Locate the holes near a corner of each opening, rather than in the center, to save time while sawing and to make it easier to saw into the corner from both directions.

When sawing out the fret design, it's important to keep the saw blade as vertical as possible. Any variation from the perpendicular will double when one cut meets another, and will add to the time it takes for cleanup. Be careful to make smooth cuts and saw the line away to save cleanup time. After the wood template is cut out, it's time to clean up ragged edges, smooth out curves and make intersections meet precisely.

For cleanup, I use various small files and chisels while supporting the work on a bird's-mouth fixture as shown in the photo at right. In particular, I have a small tri-corner file, one flat of which I ground smooth to make a "safe" side for filing into corners. A tiny (3⁄16 in. or so) corner chisel that I ground from the broken end of a mortising chisel and fitted with a handle is useful for paring corners true. Carving gouges can be used for smoothing bumps on larger curves, but don't wedge the chisel in a corner and split the fret.

If you're cutting out a lot of thin fretwork, it's usually more efficient to trace the design onto thicker stock, drill and saw out the pattern and then resaw on the bandsaw to yield the thin bands of fretwork. If you use this method, resaw the bands of fretwork and sand the bandsaw marks out of the surface with 80-grit paper wrapped on a block before cleaning up the filigree. After the cleanup on the pierced pattern is complete, the face of the finished fret is finish-sanded. Keep in mind that the thicker the stock the more important it is to maintain a perpendicular cut.

I mount the frets before staining the entire piece of furniture with water-base aniline dyes. After wet sanding with 240 grit, I dab the stain into the piercings with a brush and then lightly rub the fret's surface with 0000 steel wool to knock down any raised grain. Avoid brushing varnish onto fretwork; the drips will drive you crazy. Spraying light coats of lacquer doesn't present too many problems other than having to lightly sand between coats to eliminate the overspray that tends to collect in the small, cut-out corners. When applying an oil finish, excess oil should be blown out of the fretwork with compressed air and then blotted up before it dries.

Modifying a jigsaw for fretsawing—As I began work on my first commission for a band of fretwork, one thing soon became apparent about my old Craftsman jigsaw: If I had to disconnect the blade from the upper tensioning device and then reconnect it for every piercing, the job was going to take an extremely long time. It occurred to me that I might not need tension on the blade because the stock was so thin and the blades I was using were nearly ⅛ in. wide. But I knew I would still need a support that would backup the blade above the cut. To test my theory, I salvaged the roller blade support from a discarded sabersaw and had a local metal-shop worker weld it to a piece of mild steel rod. This item replaced the metal V-block and adjusting rod that came with my saw, providing more support with less drag (see photo on the previous page). I still had to raise this blade support for each insertion and then be careful to align the support to keep the cut vertical, but not having to refasten the top of the blade each time was really a time-saver. I was pleasantly surprised to find that this setup showed no increased tendency to break blades.

The author supports the fret on a bird's-mouth fixture clamped to the workbench while smoothing out the roughsawn edges of the design with small files and chisels.

My new blade support saved time and let me efficiently saw fretwork for chair splats, corner brackets and even galleries that were shorter than the 22-in. throat distance between the blade and the blade-support arm on my jigsaw. When a job came along that required a gallery back more than 60 in. long, it was time to once again modify my saw. I remembered a saw used for cutting marquetry, described in *FWW* #27, pp. 46-49, in which the blade support was suspended from the shop ceiling, thereby creating a limitless throat. Using a few 2x4s and lag bolts, I made a sturdy triangular frame and screwed it to the ceiling joists. I placed the jigsaw beneath the frame and screwed on a blade-support bracket at an appropriate height above the saw table. With the saw base

The 22-in. throat of Pine's scroll saw limited the length of stock he could easily cut. To overcome this limitation, he attached a 2x4 frame to the ceiling to hold the roller blade support, removed the saw's arm and positioned the saw table directly below the upper guide.

Each section of the fretwork gallery on this mahogany table, built by the author, was steamed in a pressure cooker and bent over a form after it was sawn out and cleaned up.

After steaming, a section of gallery is bent around this 4-in.-dia. form. The fret is forced tightly to the form with a clamp between the wooden block screwed to the metal band and the notch on the form.

positioned so the lower blade support was directly underneath the upper blade support (shown in the left photo above), I could saw fretwork of practically any length.

If you've recently replaced your old jigsaw with a new scroll saw, you might want to pull the old saw out of the corner and dust it off for fretwork. The scroll saw may allow you to cut tighter radii with smaller blades, but its design probably makes it impossible to run it without the blade attached at both ends. This eliminates the possibility of removing the upper arm, and it means you'll have to disconnect and reconnect the blade for each piercing.

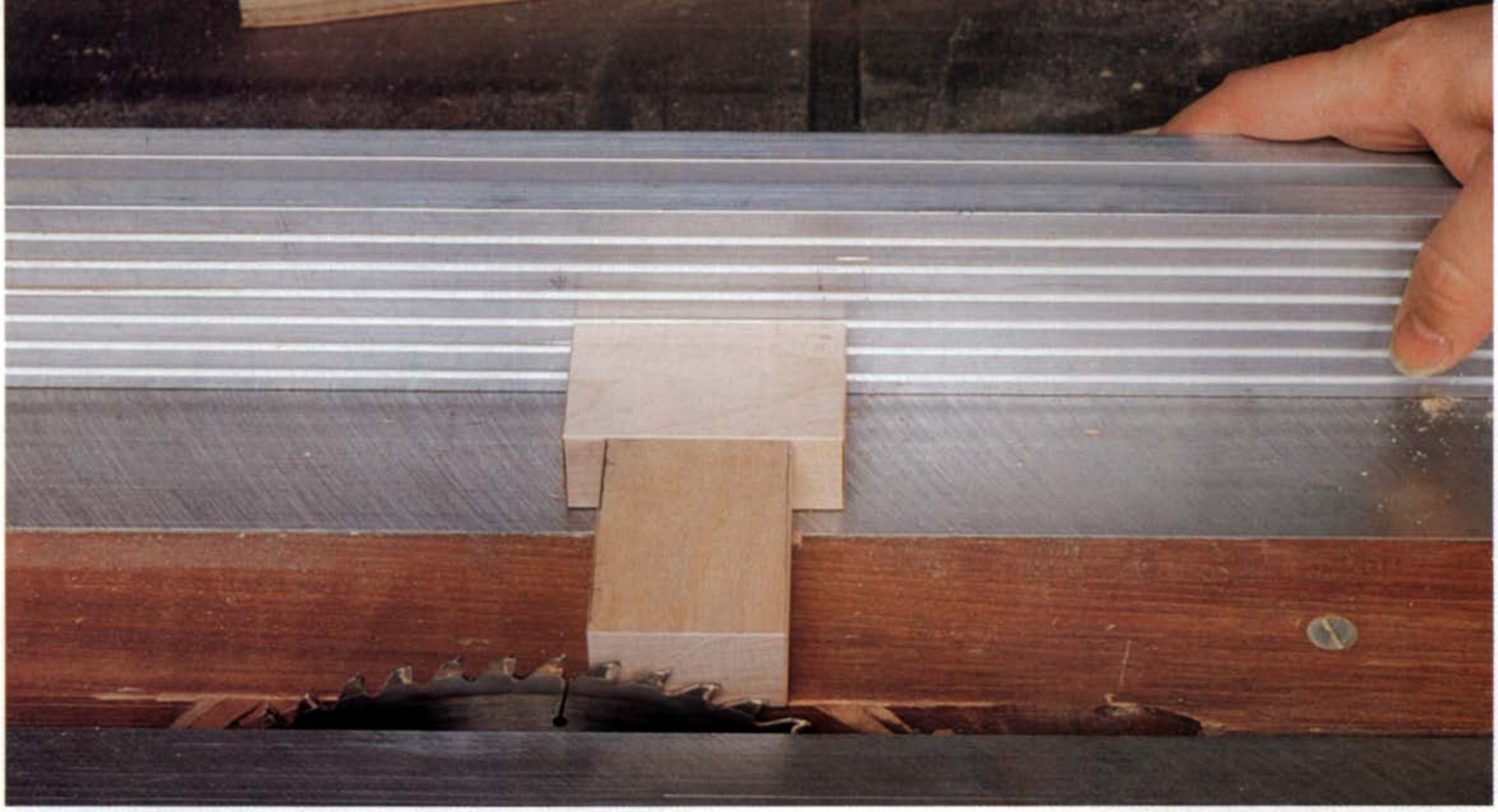
Other applications for fretwork—Occasionally, thicker stock is fretsawn for use as a pediment top on a chest-on-chest or bookcase, or as a table apron or chair splat. It's possible to achieve a lighter effect on heavy stock by easing or chamfering the back side of these pieces around the openings. This is seen quite often on pierced chair splats.

Fretsawn wood, while naturally fragile due to the removal of most of its long grain continuity, does gain an advantage in another area: It is much more easily bent. Even so-called "unbendable" wood can be steamed or boiled and made to take curves not possible with solid stock. I discovered this when building the scalloped-top tea table shown in the top, right photo. My client wanted a fretted gallery to follow the shape of the mahogany top. Although I had read and been told that you can't bend mahogany, I still thought using it was worth a try, instead of using a bendable wood, like hickory or birch, and then trying to color it to match the mahogany. The gallery was pretty uniformly pierced, and I used the blandest and straightest grain material I could find. The ⅛-in.-thick fretsawn pieces were cleaned up, then one at a time, each section was boiled for 20 minutes in a pressure cooker that had its saftey valve open. Each piece was then removed from the cooker and clamped around a curved wooden form with a metal band, as shown in the bottom, right photo. I was able to bend the fret into 2¼-in.-radius semicircles with about an 80% success rate. The more shallow curves of larger radius were no trouble. My guess is that the sawn interruptions of the long grain allowed the stress of the bend to dissipate somewhat, and all the exposed endgrain in the pierced pattern allowed free absorption of moisture and softening of the wood fibers. □

David Ray Pine makes period reproductions in Mt. Crawford, Va.

Further Reading

If you want to make some fretwork, but would like to see more designs, help is available from Dover Publications Inc., 31 E. Second St., Mineola, N.Y. 11501; (212) 255-3755. You can go right to the source with Thomas Chippendale's *The Gentleman & Cabinetmaker's Director*. Also, Franz Sales Meyer's *Handbook of Ornament* has a wealth of inspiration. Finally, Blackie and Son's *The Victorian Cabinetmaker's Assistant* has many examples of fretted panels and other marvels of the Victorian furnituremaker's imagination.



A set of 1-2-3 blocks can serve as a means of setting up machine tools. For instance, it can be used to set a radial-arm saw's depth of cut, check a jointer's fence for squareness or set a tablesaw's rip fence, as shown here.

1-2-3 Blocks

Measuring less and enjoying it more

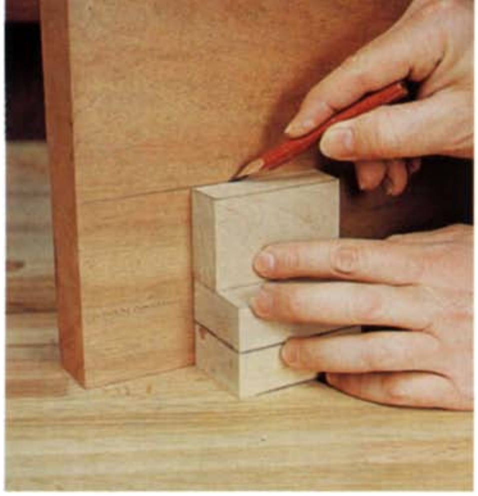
by David L. Wiseley

"I cut it twice and it's still too short. Where's the board stretcher?" Humor does little to blunt the sick feeling that strikes when you realize you've just measured wrong and cut a piece too short. I was all too familiar with this feeling until I learned how to reduce woodworking mistakes by reducing the amount of measuring I did in my shop. Reaching back to my early days as a die maker, I remembered a great way to cut back my dependence on a measuring tape: 1-2-3 blocks.

A standard tool used by tool-and-die makers, 1-2-3 blocks are a set of three hardened-steel, rectangular gauge blocks machined exactly 1 in. thick by 2 in. wide by 3 in. long. Individually or stacked together, the blocks serve as distance standards for marking out or checking dimensions with great accuracy. Also, by using 1-2-3 blocks instead of a tape or ruler, you eliminate the possibility of making errors by misreading the scale, and you can focus more mental energy on the project instead of worrying about measurements. You can buy a set of gauge blocks from a machinist supply house, but they are expensive, so I'd recommend making your own from wood. A set of wooden 1-2-3 blocks probably won't be as precise or durable as a steel set, but they should satisfy the demands of most woodworking projects.

Making a set—To make your own blocks, start with a 2-ft. length of any dense, stable hardwood, like kiln-dried maple or oak, and thickness plane a narrow 5/4 board down until it's exactly 1 in. thick. Make sure the thickness is consistent on both edges of the board; if it isn't, your planer knives probably aren't parallel to the bed and need adjustment. Next, joint one edge of the board straight and square, and rip the board into a strip that's about 2$\frac{1}{16}$ in. wide. Then on the jointer or with a handplane, plane the rough edge until it's square and the strip is exactly 2 in. wide. Finally, using either a radial-arm saw or a miter gauge on the tablesaw, slice the strip into 3-in. lengths. Make a test cut on a scrap to ensure the blade is cutting the ends perfectly square.

Before using your new set of 1-2-3 blocks, you need to check them for accuracy. Check all the corners of each block for squareness with an accurate try square, then check all the block dimensions. A dial or vernier caliper is ideal for this, but you can get by with just a fine-line ruler or tape measure if that's all you have. If necessary, trim the blocks to final size using a fine-grit disc on a disc sander. Avoid using a disc with a foam-rubber backing pad, as this can distort the squareness of the blocks. You can also use a block plane for trimming if you prefer. Set the



1-2-3 blocks are a handy alternative to measuring with a ruler or tape measure. Here, a stack of blocks that's 4 in. high is held against a board, on edge on the workbench. The line is marked as the stack is slid along the board.

Used in conjunction with 1-2-3 blocks, plywood spacers allow fractional distances to be marked. Shown here, distances between spacer sizes can be marked by shimming the workpiece and subtracting that distance from the marking-block stack.

Another method for marking fractional distances uses square-steel tool bits—cutters commonly used on the metal lathe. By grinding the tip to a bevel and using it on top of 1-2-3 blocks, the tool bit serves as both a spacer and a marking knife.

plane for a fine cut: If you take too much off, you'll need to start over. Try to get the blocks within a few thousandths of an inch of the proper dimensions. When the individual blocks are done, stack the blocks, re-check their measurements for cumulative error and do any final trimming as necessary. Finally, chamfer all edges and corners of the blocks slightly, smoothing them with fine sandpaper. Finishing them isn't necessary, but you can apply a light oil finish or wax them if you wish.

Marking out—While it may take time and patience to make a set of 1-2-3 blocks accurately, they're not difficult to use. To mark a line on the face of a board 1 in. from the edge, say for laying out a line inlay, stand the board on edge on top of the workbench and butt a 1-in.-high block against it. Now lay the point of a marking knife or razor-sharp pencil on top of the block, as shown in the above, left photo, and slide the block along the board to mark the line. For marking distances greater than the length of a single block, blocks can be stacked in any combination to produce the required distance. For instance, you can locate a series of holes 6 in. from the edge of a carcase side, say for adjustable shelves, by laying two 1-2-3 blocks end to end. With a set of four or more 1-2-3 blocks, you can quickly locate mounting holes for hardware, lay out tenons or mortises, or mark guidelines for truing an edge with a handplane—all without a measuring tape.

If you want to check or lay out distances that are not whole numbers, fractional dimensions can be laid out using 1-2-3 blocks in combination with either plywood scraps or machinist's tool bits. For the plywood method, cut some 2-in. by 3-in. spacers from different thicknesses of plywood. Since standard plywoods don't come in all the thicknesses you may need and usually aren't precisely thicknessed, you'll have to do a little surface planing or sanding to make each spacer the exact thickness you desire.

I keep a set of plywood spacers handy in a drawer next to the bench where I do my lay-out work. To locate a line 2⅜ in. from an edge or other reference point, use the 2-in. side of a 1-2-3 block along with a ⅜-in. plywood spacer. Place the block on the spacer and scribe along the top. You can also use scraps of plywood to lay out distances less than 1 in. To mark lines at distances that don't correspond with your spacer set, shim up the workpiece, as shown in the above, middle photo. The thickness of the spacer under the workpiece is subtracted from the height of the 1-2-3 block and its spacer for the final marking distance. Admittedly, this is a little clumsy and you may prefer to use a marking gauge for such marking operations, but once you get the hang of using blocks and spacers, my method is quick and accurate.

The second method, which I learned in a tool-and-die shop where I once apprenticed, uses tool bits: square-steel blanks normally used as cutters on a metal lathe. Tool bits are available from most machinist supply houses for about $1 to $3 per bit; you'll want at least one each in ¼-in., ⁵⁄₁₆-in., ⅜-in. and ½-in. sizes. Before using, grind a 45° bevel diagonally across one end of each tool bit, so a point is formed on the end. This point is used like the point on a marking gauge to scribe a very fine line that's in line with one surface of the tool bit (see the above, right photo). With a set of tool bits and four 1-2-3 blocks you can lay out any fractional size, from 0 in. to 12 in., in ¹⁄₁₆-in. increments. For instance, to lay out a line 2⁵⁄₁₆ in. from the edge of a board, stack a ⁵⁄₁₆-in. tool bit on top of a 2-in. block, then use the bit's sharp end to scribe the workpiece.

The tool bits also have several uses of their own. One that saves me lots of time and frustration is locating the center of the width of a board without measuring. On ¾ stock, simply lay the board flat on the bench and scribe a line along the edge with the ⅜-in. tool bit slid along the benchtop. Flip the board over and scribe a second line on the same edge. If the board is a little thicker or thinner than ¾ in., then there'll be two lines very close together. The center of the board is exactly half way between those two lines. If the lines are too far apart, a piece of thin cardboard under the tool bit makes a useful shim.

Other uses—Besides helping with marking jobs, 1-2-3 blocks can be used for positioning or spacing parts for assembly. The overhang of a tabletop and cabinet top can be a pain to measure accurately if the edges of the underside have been rounded over. With the table upside down, place four blocks, one on each side, against the apron and slide the top around until you can feel that the overhang is equal on all sides.

Machines can be set using the 1-2-3 blocks instead of a ruler. The homemade cut-off stop on the right side of my radial-arm saw fence is easier to set with 1-2-3 blocks than trying to see under the saw motor to read a scale. I use blocks for quickly setting the rip fence on my tablesaw, as shown in the photo on the facing page. Because the blocks' edges are square, I also use them to check the squareness of the sawblade relative to the table, as well as fence-to-table squareness on my jointer. □

David Wiseley runs House of Woodworking, which makes hardwood home and office accessories in Waters, Mich.

Building a Stand-up Desk

It all hinges on your router

by Charles Prowell

My grandfather was a cabinetmaker, and my father a carpenter, so most of my designs spring from the handcrafted techniques of the cabinetmaker pitted against the practicality of the carpenter. When a San Francisco, Calif., securities analyst ordered a stand-up secretaire desk, my forebearers began arguing over veneers versus glue-ups and inlays versus profit margins, even before the customer could explain how difficult it is to sit at a desk for 10 hours a day. His only stated requirements were that the desk be 30 in. deep, have a lift-up top and accommodate his 5-ft., 7-in. frame. The rest was up to me.

Because I had been mulling over designs for a stand-up desk for years, I quickly worked up a prototype and preliminary drawings, all the while trying to balance my forefathers' concerns for craftsmanship and profit with some of my own prejudices, such as a fondness for wooden hinges. Deciding on a desk frame of California walnut inlaid with quilted maple accent strips was easy for me because I liked the impact of the quilted maple grain and the contrast between the light wood and the dark walnut. The top would be Peruvian walnut because of its rich color and warp-resistant straight grain.

Photo: Madeline Schnapp

This stand-up secretaire desk features inlaid accents and wooden hinges, as well as ample storage, pigeonholes and a drawer. The joinery and detail work are easily accomplished with a router.

The final design is basically an oversize lap desk fitted into rabbets routed in the legs of the base, which is mortised and tenoned together; the sculpted caps on top of the legs hide the rabbets and endgrain. Tapering the legs creates a more delicate appearance. The desk is doweled together after being fit with pigeonholes and a drawer. The last and most challenging task was to fit the wooden hinges to the top, which would form the slanted writing surface.

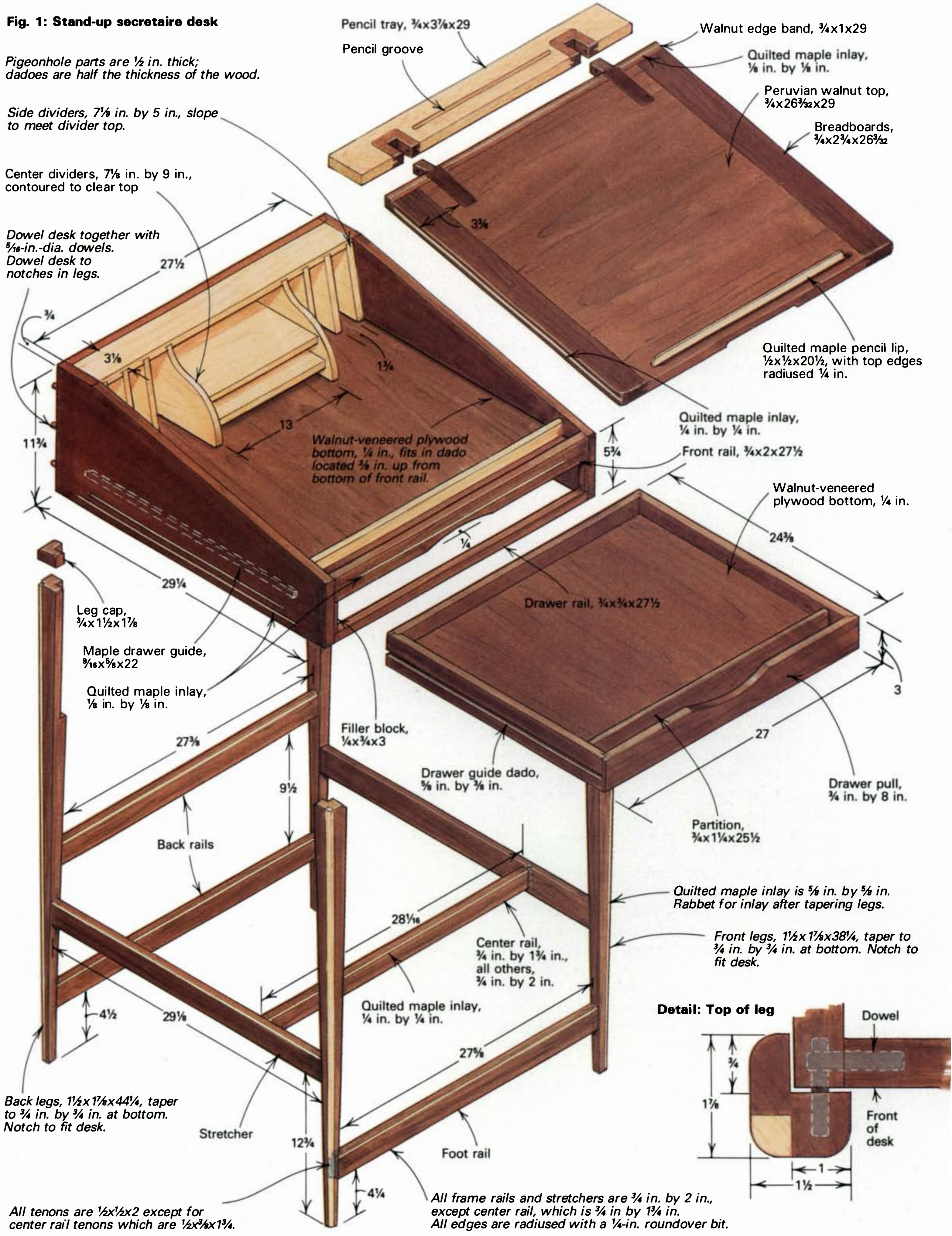
Routing the joints—My construction techniques are straightforward and rely heavily on a hand-held router guided by a stock router-mounted fence, a straightedge with stop blocks or bearing-guided bits, such as rabbet and roundover bits. These guides provide maximum control, versatility and quick yet effective cuts. I used three routers for the various jobs this desk entailed: a Makita #3612BR 3-HP plunge router for mortising the legs, plunge cuts and the heavy work; a Milwaukee #5660 1½-HP router for straight rabbets and grooves for inlay and shaped edges; and a small Porter-Cable #309 laminate trimmer for detail work. If you don't own a variety of routers, you can cut the joints with a single table-mounted router or modify my methods to suit your equipment.

I generally rout in a left-to-right direction when facing the work, against the clockwise rotation of the bit so the router is pulled into the work. When cutting across the grain to form tenons, however, I start routing in the same direction as the bit rotation. With this operation, known as climb-cutting, I make light cuts, a maximum of ⅛ in., and remove a small section along each edge to prevent tearout, before finishing the cut in the normal left-to-right direction. Climb-cutting can be dangerous, because the router tends to self-feed and may get out of control, so you may want to start out with a 1/16-in.-deep cut.

Building the base frame—To ensure a matching grain pattern on the front legs, I rough out both pieces by ripping a walnut 2x4 down the middle. Because the legs extend to the top of the tapered desk, the front legs are naturally shorter than the back legs. After dimensioning the leg stock, lay out the mortises, measuring up from the bottom to accurately locate the joints at the correct height. The legs are not trimmed to final length until the carcase is test-fitted to the base.

I rout all mortises with a plunge router, using a ½-in.-dia. bit set

Fig. 1: Stand-up secretaire desk



Drawings: Kathleen Creston

to a final cutting depth of ½ in. and a router-mounted fence fitted with stop blocks to control the length of the mortise. Because the router fence needs a straight surface to run against, I don't taper the legs until after cutting the joints. The fence and stop blocks are also used to rout the ¾-in. by 1-in. stopped rabbet needed to fit the legs to the carcase. Next, the legs are tapered on three sides, as shown in figure 1 on the previous page. You could taper the legs with a jig on a tablesaw, but I prefer to rough-cut them on the bandsaw and then true them up with a handplane.

Once the tapers are satisfactory, I rout a ⅝-in. rabbet along the outside corner of each leg for the maple inlay with a ball-bearing guided rabbet bit. The inlay is glued proud of the leg and belt-sanded flush after the adhesive cures. The belt sander is a concession to the miserable working qualities of quilted maple, which is very difficult to plane without tearout. I radius the inlaid corner with a ⅝-in. roundover bit and the other three corners of the leg with a ⅜-in. roundover bit.

Before continuing with the legs, rout the tenons on the frame rails and stretchers, as shown in figure 1. To cut ½-in. tenons for the mortises, I set a ball-bearing guided, ½-in. rabbet bit to cut ⅛ in. deep. Run the bearing against the end of a rail to cut one tenon cheek. The rail is then flipped over and the operation repeated for the other cheek. To compensate for the leg taper, I angle the shoulders of the tenons 1⁄16 in. with a chisel. The ⅜-in. tenons for the center rail are routed in the same manner. Then, rout the rails with a bearing-guided ¼-in. rabbet bit and install the inlays as shown in the drawing.

After routing the mortises for the center rail, assemble the piece and glue the stretchers and legs together to form the left and right sides. Then, I glue in the rails and clamp up the assembled base on a flat surface, and leave it to dry while I work on the carcase.

Carcase construction—The sides, back and top are glued up from several strips of walnut. The sides will be identical if you clamp them together and bandsaw them simultaneously, then clean up the edges with a handplane. The side pieces can be fit into the leg rabbets and used as templates to mark the height and angle for trimming the legs with a fine handsaw. If you want to further emphasize the caps on the legs, you can sand or carve a slight chamfer around the top of the legs to create a reveal.

The back, front rail and drawer rail are now cut out as shown in figure 1. Note: The upper edge of the front rail is ripped at a slight angle to align with the tapered sides. After routing a dado in the front rail for the walnut-veneered plywood bottom of the pigeonhole compartment, I dry-fit the front rail to the sides. Then scribe the dado location from the front rail onto the side pieces, carrying the layout lines onto the back piece, and rout the dado. After sawing the lower edge of the front rail to the curve shown to counterbalance the drawer's finger pull, I dowel the carcase together. Don't forget to position the bottom into its dadoes before gluing up. After the carcase dries, glue filler blocks to the sides to eliminate the gap formed between the carcase and the drawer when the rabbeted legs are glued to the carcase. Next, rout out the quilted-maple pencil tray as shown, using a ½-in.-dia. cove bit and a router-mounted fence, then glue and clamp it to the carcase.

Figure 1, on the previous page, shows how I dowel the carcase into the rabbets cut in the legs. Even though the base has been glued together, the legs can still flex enough to allow the carcase and protruding dowels to drop into place. Apply glue to the dowels and rabbets, and clamp the assembly together.

Carcase detailing—You can make any style drawer you want. Because I prefer router joinery, I cut lapped rabbets for the corners. The joints also cover the dadoes holding the drawer bottom. A small curve, ¾ in. high by 8 in. wide, bandsawn on the top edge of the drawer front serves as a finger pull. After gluing a partition for a pencil tray inside the drawer, rout the drawer sides to fit the maple guides screwed inside the carcase.

The ½-in.-thick maple pigeonhole dividers are installed in dadoes routed in the divider top. The side dividers taper from 3⅛ in. to 5 in., top to bottom, while the center dividers have an S-curve profile to accommodate the paper shelves and to fit under the closed top. The stopped dadoes for the paper shelves are routed with a straightedge guide and a stop block, while the through dadoes in the divider top are guided simply by a straightedge. After gluing the divider top to the underside of the pencil tray, glue the paper shelves to the center dividers. I then apply a thin film of glue to the top and bottom of the center dividers and slide this assembly into position between the divider top and the plywood bottom. The side dividers between the divider top and the plywood bottom are installed in a similar fashion, using temporary spacer blocks between the bottom of the dividers to maintain alignment.

My top is based on a breadboard construction, which works fine in California, where humidity levels are fairly constant; you might want to avoid this construction if the humidity fluctuates significantly in your area, because the resultant wood movement will ultimately break the glue joints. Inlays, like those on the top of my desk, are optional. If you want to use inlays, you can cut grooves as shown in figure 1, with a straight bit and router-mounted fence or with a slotting bit and an oversize guide bearing. You should, however, rip the upper edge of the top to the same angle as the side taper, to prevent the hinge from binding when the top is closed.

Routing wooden hinges—You'll learn a lot when you make your first wooden hinge. I know I did, so I'll suggest some improvements I've come up with. Three major steps are involved in routing wooden hinges: making and fitting the pencil-tray hinge leaves; making and fitting the top hinge leaves; and mating the leaves together. Starting with the pencil tray, rout out a 1⅞-in.-sq. mortise ¾-in. deep with a straight bit. Using a ball-bearing guided, ½-in. rabbet bit, rout a recess around the top of the previous cut, then rout a keyway using a 3⁄16-in. slotting bit (see the hinge detail in figure 2 on the facing page). When fitted with a purpleheart spline, the keyway secures the hinge leaf into the pencil tray. If I could do it over again, I'd do all this work before gluing the tray on, bandsawing away most of the waste before performing any routing operations.

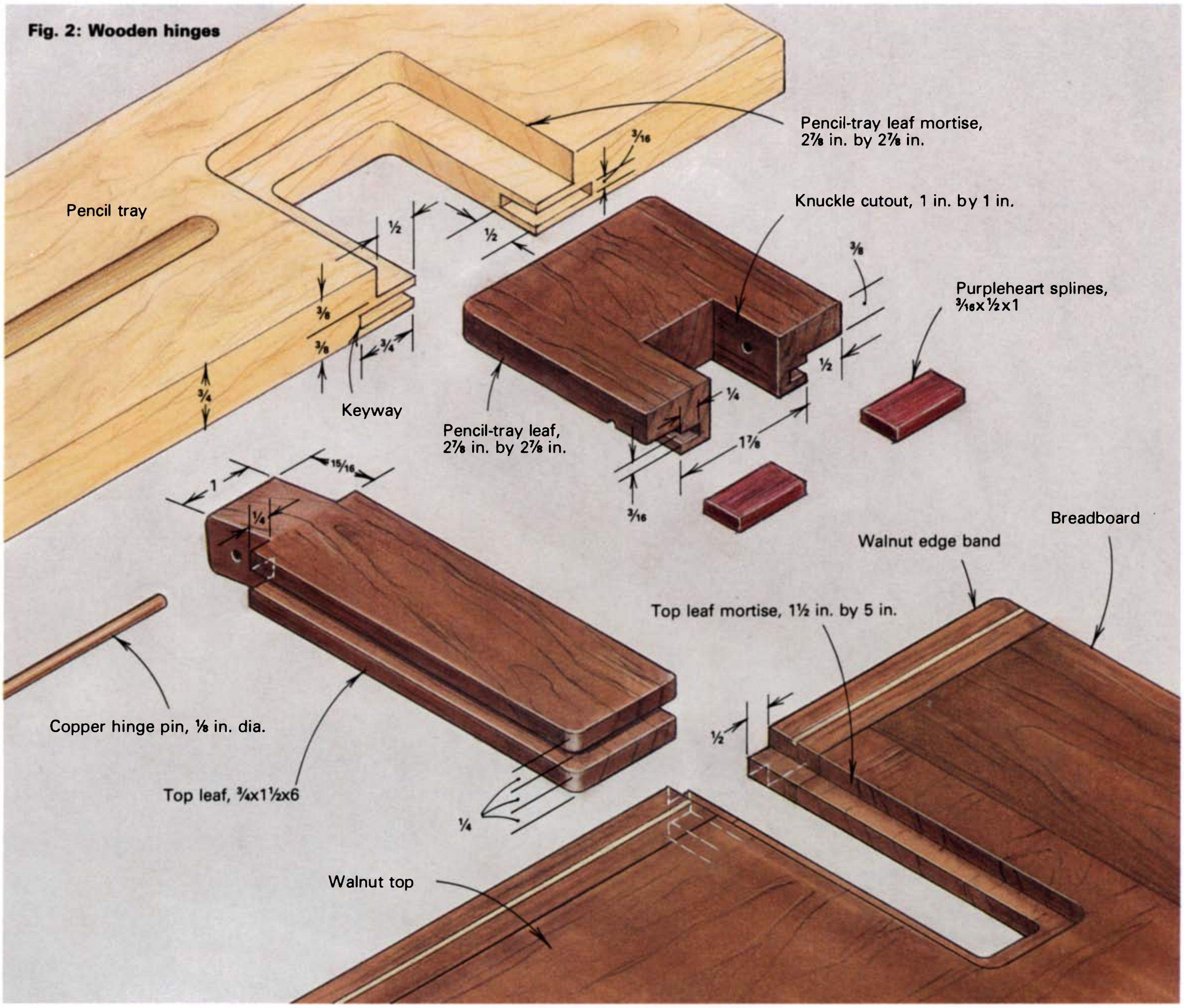
To make the pencil-tray leaf, I transfer the measurements from the pencil-tray mortise to a 2⅞-in.-sq. block of Peruvian walnut. Clamping this block in my bench vise, I rout the ⅜-in.-deep rabbet around the bottom with the ball-bearing guided ½-in. rabbet bit, then rout the keyway slot with a 3⁄16-in. slotting bit. After fine-tuning the fit on a bench-type Dremel sander, I scroll-saw a 1-in.-sq. cutout for the hinge knuckle and sand over the edges.

To form the top-leaf mortise, I set up a straightedge guide so I can rout a ½-in. slot 4½ in. long through the top. Routing rabbets on both the top and bottom face of these slots produces the tongue shown on the facing page.

The top leaf is also easy to make, because I can lay the walnut block on top of the cutout and trace it, allowing an extra inch for the knuckle. I cut the groove with the ¼-in. slotting bit in my Porter-Cable router after clamping the leaf in the bench vise. After the knuckle is cut to a 1-in. width, the edges are softened on the sander.

Drilling the hinge-pin holes presents the greatest danger of ruining the work. While aligning the two leaves, I cut and adjust

Fig. 2: Wooden hinges



the knuckles for a snug fit all around and clamp the fitted hinge between two boards to maintain alignment. After locating the hinge on the drill press, bore a ⅛-in.-dia. hole through the pivot point of the two leaves. A drill press is essential for a straight bore; otherwise, the procedure becomes hopelessly random.

Proper hinge action entails assemblying and disassemblying, each time sanding the knuckles until the movement is satisfactory. My hinge uses a copper hinge pin to reduce any chances for chemical reaction between the pin and the resins in the wood. Next, the purpleheart splines are glued into position and then the leaf is glued to the fixed pencil rail. With a thin glueline applied to the tongues and grooves (a miniaturist's syringe helps here), the top is slipped and fitted in place on its leaf.

Pieces of walnut, shaped by a ¾-in. roundover bit and sanding, cap the legs. Pencil trays are formed with strips of quilted maple, as shown in figure 1 on p. 75. I thought I was finished with the decorative inlays, but after evaluating the piece, I decided to rout ⅛-in. grooves in the sides and front and install quilted maple strips. I rounded the ends of the strips with a file to match the router bit's profile. The strips were installed proud of the surface and later block-planed and belt-sanded flush.

The finish—I do all of my sanding before putting on any finish; once I start finishing, I don't sand. I sand all surfaces working progressively from 80-grit paper to 220-grit, then I give the surfaces a lighter sanding with 400-grit and a final, quick rubdown with 600 grit. At this stage, the wood is as smooth as glass and ready for my favorite finish: a mixture of ⅓ thinner, ⅓ linseed oil and ⅓ polyurethane. This mixture is heated by placing the can containing the finish in a pot of boiling water after it has been removed from the stove. This mixture is brushed on liberally, allowed to dry for 30 minutes or so, then wiped dry. I build up to six coats, allowing 24 hours between coats, then top the piece off with a coat of paste wax. The wax is a lot like putting on a coat in 50° weather: You don't really need it, but it makes you feel better.

Once the desk was completed, all that remained was a final critique, a process endured in the wake of my forefathers' passing with the completion of every job. I imagined an analysis by my grandfather, searching for flaws, and my father, questioning the profitability with his usual "Time is money, boy." □

Charles Prowell owns and operates Charles Prowell Woodworks, building custom furniture in Sebastopol, Calif.

Author John Meyers carves on an upright easel-like support, with drawing and panel mounted side by side. Parallel lines on the panel and drawing make it easy to check details. The rack of overhead lights accentuates the depth of field developed in the carving.

Relief-Carving

Tricking the eye to create a different perspective

by John E. Meyers

I've always been fascinated with relief carvings. I am amazed how much emotion and detail carvers can create by shaping two-dimensional images in a relatively thin slab of stone or wood. It's really something of a magician's trick: By "tucking" one piece of a person or object behind another, you can tell a visual story in what appears to be a miniature version of the real world. That's satisfying on a very basic level. Relief carving may not be the world's oldest profession, but it has probably been with us since someone invented the knife. Be it in the form of expertly detailed Eskimo scrimshaw, the ornate boats and paddles of the South Sea islands or the classical elegance of Renaissance murals, humans have a need to embellish the objects in their world.

When I explain relief carving to students, I ask them to visualize a magician taking a deck of playing cards from his bag of tricks. The deck of cards gives us a medium with 52 levels. In comparing this to the carving of work horses and a hay wagon, shown in the top photo on the facing page, the last 10 cards in the deck would equal the background. If you slide those 10 cards over so they stick out from the rest of the deck, the next level (working from the background forward) includes the trees and foliage at the horizon line. Pull out five more cards so that they are not quite as high as the ten background cards. The next level would be the sheaves of hay in the wagon and the wagon racks, and so on to the top of the deck.

One common error in carving a relief–forgetting how these cards stick out, yet remain part of the deck–is not tucking the subject matter into the carving in its proper sequence. The best way to avoid this error is learning to see how the foreground, usually the ground, water or a floor, "tapers" or "wedges" through several levels in the carving to the horizon line. In the hay wagon relief (top photo on the facing page), for example, note how the cedar rail fence diminishes in height and recedes into the background, creating a sense of perspective. If the foreground did not wedge into the horses' hooves (or if the bottom of the hooves were undercut) then you would have a "cliff" problem and the horses would look as if they were glued on the panel. The fence and plowed furrows in the bottom photo at right are other examples of how receding lines create perspective.

Once you learn to see the wedge and bury the foreground figures into it, you're well on your way to mastering relief carving. In this article, I'll discuss some ways to work with these wedges to the horizon line, sketch out the scene accurately, then transfer it to a prepared panel in such a way that you can continually resketch the drawing as you carve away more layers. The carving requires no special tools or techniques. Just make sure your tools are sharp and you block off and rough shape the general forms before adding any details.

Preparing the drawing—The first step in carving any relief is to prepare a detailed drawing the same size as your wood panel. You'll need a full-size plan because it's a lot easier to work out the details on paper than it is to experiment on the wood. Don't risk ruining the panel: It's not easy to patch a miscut section. To prepare the drawing, use Bristol board, blueprint paper or other durable stock. I like to work from photos I take of my neighbors and the farms near my home. Sometimes I'll combine elements from several photographs in a single drawing. If I get stuck on a certain pose, a family member poses for a photo. I also keep a mirror next to my carving bench, so I can refer to my anatomy.

Gluing-up panel stock—I carve 1½-in.-thick edge-glued butternut and black walnut panels, but some carvers prefer basswood and red oak. To minimize warping and other wood movement problems, I glue up boards with less than 10% moisture content (MC). I find these assembled panels are much more stable than single, wide planks, as long as the width of the boards is less than four times the thickness of the stock. The boards should also be straight-grained and, if possible, the same color and patina. Avoid sapwood, dark streaks and knots.

Size the pieces so the completed panel will be slightly larger than your drawing, to allow for squaring and trimming. I also rabbet the perimeter of the panel, so the relief will fit in a frame. The rabbet is generally ½ in. wide and creates a lip about 3⁄16 in. thick, which will equal the thinnest area of my carved panels. The boards (and grain) should run vertically, to emphasize how the wedge goes to the horizon. To assemble the panel, I butt-joint the boards, applying Elmer's Carpenter's Wood Glue to both long edges of each board, then apply pipe clamps approximately every 6 in. Don't use splines or dowels because you risk cutting into them as your carve.

Transferring the drawing—Once I'm satisfied with my drawing, I trace it onto the wood, transferring the image with either dark chalk spread on the back of the drawing or with regular carbon paper. Affix the drawing to the top edge of the panel with masking tape. This will avoid slippage while tracing and will allow you to peek at the panel image before the drawing is removed to make sure all the lines are clearly transferred.

Before you remove your drawing from the panel, take a 24-in.-long carpenter's level and grid the drawing approximately every two inches both vertically and horizontally. If you take the time to level the edge of your easel and carefully align your panel and drawing with the edge, the level will prove especially handy for drawing the grids. You can easily make sure all your lines are plumb and parallel, which will make it easy to redraw them if they're carved away. I label the vertical grid lines A, B, C, etc., and the horizontal lines 1, 2, 3, etc. Therefore, by crossing any two grid

Photos below: John Meyers

Hay wagon relief involves carving on six different levels, extending from the high spots—the horses' heads and the front of the fence rails—to the background, which is at the same level as the rabbet cut to fit the completed panel in a frame. The various levels should be broken down graphically.

Relief carvers use converging lines, as in the receding fences and furrows above, to create a sense of depth in thin, carved panels.

lines on the panel with a pencil, you can determine exactly where you are carving in relation to the drawing. Should some of your sketch be carved away, you can use a level, as shown in the top photo on the next page, to re-establish the grid of the carved area and resketch the missing details. Sometimes I'll cut out a square of the drawing, say a face or other important area, align the grids and tape the drawing next to the area being carved. Because the grid of the drawing and panel are identical, it's easy to match areas.

Roughing out the relief—I find the quickest way to get rid of waste wood is with a radial-arm or hand-held circular saw. Set the blade to cut within 1⁄16 in. of the finished level in the area being worked. This method is ideal for background areas, such as the open area at the rear of the work horse/hay wagon carving. Make your saw cuts about every ¼ in. and knock off the remaining waste with a mallet. You could also remove the waste by boring a series of overlapping holes with a Forstner bit or by routing out major background areas.

With most of the waste removed, I outline the major forms by making perpendicular cuts around the edge of the figures and oth-

A 2-ft. level is used to transfer grid lines from original drawing to carved area of panel depicting an elderly couple on a porch swing. Here, a section of the drawing including the figures has been cut out of the main drawing and mounted next to the area to be carved.

Carving always proceeds from broad, general forms to details. Outline the major elements with a chisel or gouge (above, left), model the major shapes, undercutting the forms as needed to create a three-dimensional look, and refine the details as shown (above, right).

er forms (as shown above in the bottom, left photo) with a mallet and ¼- and ½-in chisels, before moving onto details (as shown above in the bottom, right photo). After smoothing the background with gouges, I regrid it. Use a set of calipers or a compass if you have trouble gridding accurately over the various thicknesses.

I usually remove the excess wood and smooth the background while the panel is clamped flat to a work table, but then set the panel in a vertical position, as shown in the photo on p. 78, just as an artist mounts his canvas on an easel. It's also important to step back and view your work from a distance (6 ft. to 8 ft. away) as you complete each section of the carving. Gainsborough, the English portrait artist, had 6-ft.-long handles on his brushes so he could work and view his progress from the right perspective. As you start carving, I'm sure you'll appreciate the value of this.

Shaping the major forms—As you develop your drawing, you will get a sense of how the elements of the carving relate to one another. Remember, it's important to rough out the shape of the whole carving, striving for a three-dimensional look on each element, before doing any fine detail. After outlining all the major figures, begin to taper from the forground to the outline cuts. On the horse wagon shown in the top photo on the previous page, for example, this would involve tapering the cedar rails toward the horizon line. In the end view of the couple-on-the-swing relief shown in the top photo on the facing page, you can see how the porch slats taper back below the couple's feet. Also note how the whole panel tapers back to the rabbet that will eventually fit into a frame.

As you work into the panel, redraw your grid lines over each completed section so you can refer back to your drawing. Just think of each square as a small drawing in itself. Where there is a lot of detail, such as in a face, you can also use a finer grid, with lines ¼ in. to ½ in. apart, then caliper it out on the panel. This type of accuracy is important to achieve a realistic look because every section can involve several levels. If you lose your reference points, details such as the horse harness or the chain on the swing will be more intimidating than they really are. Again, the key is to work in braod strokes, to rough-out the carving, then do the details.

If you hit a bad internal knot or seriously miscut an area, all is not lost. Simply cut out that board from the panel and glue in a new one. Redraw your grid and carve the piece to match its neighbors. This is a lot of extra work and will definitely convince you of the value of working out all your questions in the drawing, before you actually start carving.

Defining details—Once you have the overall carving roughed into the approximate shape you require, redraw your image on the panel in detail. Here again, work from the front of the panel to the back of the panel. For example, complete the detail on the horses before starting in on the driver. Don't forget to connect minor pieces of detail such as the reins, which go from the horses' heads all the way back to the driver's hands. If possible, work with a movable overhead light source, such as a drafting lamp. The tighter you bring the light in over the top of the carving, the better depth of field perception you have.

Always get back and view each piece of completed detail from a distance—judge its merit in comparison to its immediate neighbors and the overall carving. When in doubt, do not carve anything until you step back and look again. Before carving, ask yourself, "Can I carve this section down without error?" If so, do it; if not, go back to your drawing. Get another picture or an actual piece of the material to study if you find your drawing does not clearly define a detail, such as the chain in the bottom photo at right.

In doing fine detail work, such as the sheaves on the wagon, the "shape" before detail principle still applies and an overall sheave "plug" has to be roughed out and tucked before applying the surface detail. The detail was put in a strand at a time with a #11 X-Acto blade (tucking some over, some underneath). The heads were shaped by rolling the edges over and then veined with a small parting tool and awl.

Finishing treatment—I always sand my carvings until they feel good to the touch. Usually I start with a 50-grit or 80-grit paper and work up to a 120 grit then 220 or 320. By cutting your paper up into 3-in. by 3-in. squares, and using a small piece of foam as backing, you can easily get into the nooks and crannies. Use 220 grit on fine details and sand with the grain where possible. On flat surfaces I use a foam-backed sanding disc chucked in an electric drill and go from 80-grit paper to 120 grit to 220 grit.

I usually finish the carving and frame with three coats of satin urethane. Thin the first coat 50:50 with mineral spirits for maximum penetration and sand the first two coats with 220-grit sandpaper. Use a Scotch Brite pad or 000 steel wool on the final coat. It's most important to coat the back of the carving and frame with the same number of coats as the front, thus allowing it to breath evenly and not warp. Finally, apply a coat of Minwax or carnuba floor wax and buff with a lambswool buffer chucked in an electric drill or with a soft cloth.

Framing a relief carving—Relief carvings tend to warp unless they are reinforced with a frame and back-support plate. The frame stock should have a lip on it for the carving to press against and should be wide enough so that no part of the carving's foreground hangs over the front surface of the frame. Before framing the carving, pad your table or work area with a flattened cardboard box or blanket to prevent damage to the relief. Push the carving into the frame and pin it in by squeezing in finishing nails behind the carving into the frame (similar to mounting a photo in a frame). I find pliers with one head angled and one jaw padded with masking tape ideal for this, as shown in the middle photo above at left.

Once your carving is fixed into the frame cut a 3/16-in. thick Masonite or plywood back plate and nail it into place with small finishing nails, as shown in the middle photo above at right. This back plate adds strength the way siding reinforces the stud wall of a house and helps avoid warpage. Screw on a saw-tooth hanger (making sure you catch the frame edge under the back plate) or use wire and screw eyes. □

End view of the couple-on-the-swing relief shows how the porch slats taper back below the couple's feet. Also note how the whole panel tapers back to the rabbet so that it will fit into a frame.

Carving is secured in the frame with finishing nails squeezed into place with a pair of pliers (above, left). The jaw on the outside of the frame is padded with tape to prevent marring. To reinforce and protect the carving, a plywood backing is nailed to the frame, as shown above, right.

Photo: John Meyers

The couple-on-the-swing scene, carved in a glued-up butternut panel, is based on magazine pictures and the author's own photographs.

John Meyers is a woodcarver in Stirling, Ont., Canada.

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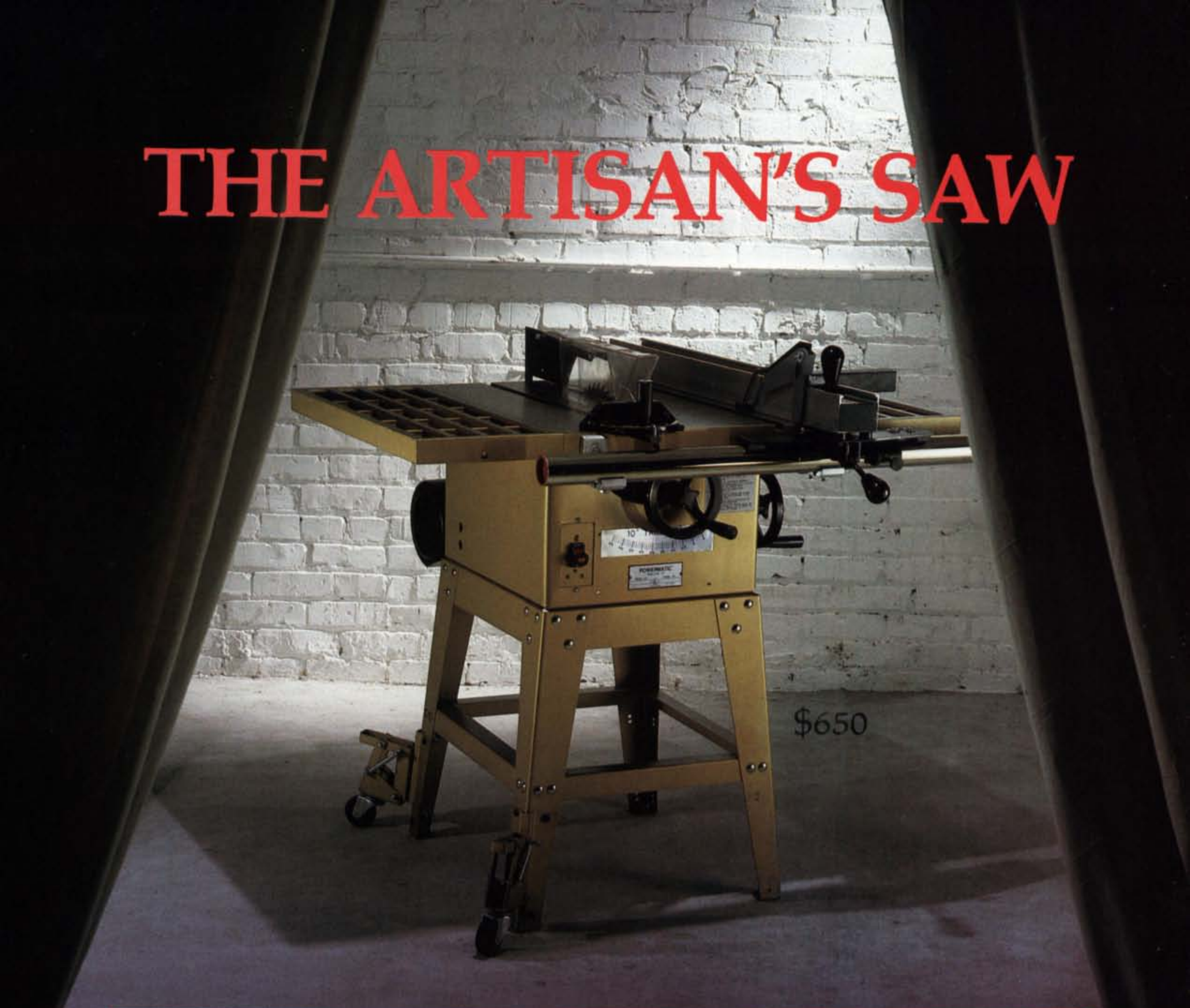

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Listings of gallery shows, major craft fairs, lectures, workshops and exhibitions are free, but restricted to happenings of direct interest to woodworkers. We'll list events (including entry deadlines for future juried shows) that are current with the months printed on the cover of the magazine, with a little overlap when space permits. We go to press two 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: **Class**–Morning tool clinic w/ Simon Watts, July 15. Students bring their own woodworking tools and learn how to sharpen, adjust and use them. For more info., contact Crissy Field, National Maritime Museum Assoc., Building 275, San Francisco, 94109. (415) 929-0202.
Classes–Tools & techniques, June 26–July 14; projects, July 17–Aug. 11. College of the Redwoods Woodworking Program, 440 Alger St., Ft. Bragg, 95437. (707) 964-7056.
Classes–Numerous home-improvement, woodcarving, business, and furniture-making & cabinetmaking classes. For schedule, contact Ganahl Lumber Co., 1220 E. Ball Road, Box 31, Anaheim, 92805-5993. (714) 772-5444.
Juried show–"California Woodworking Art & Craft," Jan. 12–Feb. 9. Open to California woodworkers. Deadline Oct. 31. For information and prospectus, contact Bill Docking, 3501 Teton Dr., Fullerton, 92635. (714) 526-7100.
Show–ACC Craft Fair's Pacific States Craft Fair, Aug. 9–10 (trade), 11–13 (public). Fort Mason Center, Bay and Laguna streets, San Francisco. For more info., contact ACC Craft Fair, Box 10, 256 Main St., New Paltz, NY 12561. (914) 255-0039.
Exhibit–7th national lathe-turned objects exhibition, Aug. 5–31. Highlight Gallery, 45052 Main St., Box 1515, Mendocino, 95460. (707) 937-3132.
Show–Woodworking, machinery & furniture supply fair, Aug. 5–8. Anaheim Convention Center, Anaheim. For more info., contact Association of Western Furniture Suppliers, 1516 S. Pontius Ave., Los Angeles 90025. (213) 477-8521.
Workshop–Lumber drying workshop, Aug. 7–11. UC Forest Products Laboratory, 1301 S. 46th St., Richmond, 94804. (415) 231-9487.
Class–Boatbuilding class, July 22–29. Build the sailing pram, Sea Lion. National Maritime Museum Assoc., Crissy Field, Building 275, San Francisco, 94129. (415) 929-0202.
Juried exhibit–"The Fine Art of Woodworking," Sept. 2–Oct. 29; deadline Aug. 10. For info., contact Highlight Gallery, 45052 Main St., Box 1515, Mendocino, 95460. (707) 937-3132.
Workshop–Wood science and technology for conservation workshop, July 31–Aug. 4, Richmond. For info., contact Campbell Center, Box 66, Mt. Carroll, IL 61053. (815) 244-1173.
Conference–4th annual Southern California Woodworking Conference, Aug. 9–13. Harvey Mudd College, Claremont. For more info., contact Southern California Woodworking Conference, 3825 W. 139th St., Hawthorne, 90250. (213) 679-2485.
Class–Building the Petaluma, a recreational rowing shell, Sept. 30–Oct. 7. For more info., contact National Maritime Museum Assoc., Building 275, Crissy Field, San Francisco, 94109. (415) 929-0202.

COLORADO: **Workshops**–15 summer workshops in craft & art furniture and product design, June thru Aug. For a free catalog, contact Anderson Ranch Arts Center, Box 5598, Snowmass Village, 81615. (303) 923-3181.
Juried exhibit–The 5th annual juried exhibition, Sept. 17–Oct. 29. Colorado Springs Pioneer Museum, Colorado Springs. Entries deadline Sept. 8–9. For more info., contact The Woodworkers Guild of Colorado Springs, 918 N. Royer St., Colorado Springs, 80903. (719) 632-8548.

CONNECTICUT: **Workshops**–Evening and weekend woodworking workshops in Brookfield, June thru Aug.; evening and weekend woodworking workshops in Sono, June thru Aug. Workshops focus on things like router techniques, woodworking techniques, elements of design, cabinetmaking and more. Contact Brookfield Craft Center, Box 122, Route 25, Brookfield, 06804. (203) 775-4526.
Exhibit–"A New Elegance: Furniture for the '90s," thru July 16. The Elements, Gallery of Fine Contemporary Design, 14 Liberty Way, Greenwich, 06830. (203) 661-0014.
Juried exhibit–54th annual exhibition of Society of Connecticut Craftsmen, thru Aug. 13. Mon.–Sat. 9 A.M. to 5 P.M., Sun. 1–5 P.M. Stamford Museum, 39 Scofieldtown Rd., Stamford. Contact Emily Zeitlin, (203) 267-8475.
Show–Sono Arts Celebration, Aug. 5–6. Over 100 exhibiting and demonstrating artists in the streets of S. Norwalk. Contact Kristi Skiba, 134 Main St., Norwalk, 06851. (203) 846-1508.
Juried exhibit–32nd annual crafts exposition, July 13–15. On the Guilford Green. 12–9 P.M. Contact Guilford Handcrafts, Box 589, 411 Church St., Guilford, 06437. (203) 453-5947.

FLORIDA: **Juried show**–"Spotlight '89," a juried exhibit featuring artists from the 11 states of the Southeast Region of the American Craft Council, June 18–July 23. Univ. of Fla. Gallery, 102 F.A.B., Univ. of Fla., Gainesville, 32611.

GEORGIA: **Show**–Art Buyers Caravan show, Sept. 9–11. Atlanta Merchandise Mart, Atlanta. Contact Paul Karel, ABC, 408 Olive St., St. Louis, MO 63102. (314) 421-5445.
Juried exhibit–36th Arts Festival of Atlanta, Sept. 16–24. Piedmont Park, Atlanta. For info and prospectus, contact Arts Festival of Atlanta, 501 Peachtree St. N.E., Atlanta, 30308. (404) 885-1125.
Exhibit–"New Work: Handmade Furniture," June 28 thru Aug. 19. Great American Gallery, 1925 Peachtree Road N.E., Atlanta, 30309. (404) 351-8210.
Show–Prater's Mill Country Fair, Oct. 14–15. Prater's Mill, Dalton. An Appalachian folk festival featuring works of fine art and traditional crafts. 10 A.M. to 6 P.M. both days. Admission is $3 for adults, children under 12 free. For more info., contact Prater's Mill Foundation, 101 Timberland Dr., Dalton, 30720. (404) 259-5765.

IDAHO: **Juried show**–21st Art on the Green festival, Aug. 4–Aug. 6. Fort Sherman grounds, North Idaho College, Coeur d'Alene. For more info., contact Citizens Council for the Arts, Box 901, Coeur d'Alene, 83814. (208) 667-9346.
Workshop–"Manufacturing & Marketing Log Furniture," Aug. 21–22, McCall. For information, contact Dept. of Forest Products, Univ. of Idaho, Moscow, 83843. (208) 885-7402.

ILLINOIS: **Classes**–Numerous conservation and preservation training classes, April thru Aug. Campbell Center For Historic Preservation Studies, Box 66, Mount Carroll, 61053. (815) 244-1173.
Juried exhibit–The 5th Annual American Craft Exposition, Sept. 7–10. The Henry Crown Sports Pavilion, Lincoln Street, Evanston. For more info., contact Christine Robb, American Craft Exposition, 530 Willow Rd., Winnetka, 60093. (312) 441-7964.
Workshop–Veneer & marquetry workshop, July 9–13. Contact Campbell Center, Box 66, Mt. Carroll, 61053. (815) 244-1173.
Show–Woodworking World Chicago Area Show, Oct. 6–8. The Metro Center, Rockford. For more information, contact CDI Productions, Box 796, Plymouth, NH 03264. (603) 536-3768.

INDIANA: **Exhibit**–"Artful Objects: Recent American Crafts, thru July 16. Fort Wayne Museum of Art, Fort Wayne. Contact September McConnell, (219) 422-6467.
Show–Chautauqua of the Arts art festival, Sept. 23–24. Outdoor show on Vine and Main streets, Madison. More than 200 artists and craftsmen, including woodworkers. For more info., contact Chautauqua of the Arts, 1119 W. Main St., Madison, 47250. (812) 265-5080.

IOWA: **Classes**–Numerous one-day woodworking classes, June thru Sept. Contact Vesterheim Norwegian-American Museum, 502 W. Water St., Decorah, 52101. (319) 382-9681.
Exhibit–1989 Old-Time Country Music Festival & Pioneer Exposition of Arts & Crafts, Aug. 30–Sept. 4. Pottawattamie Fairgrounds, Avoca. For more info., contact National Traditional Country Music Assoc., 106 Navajo, Council Bluffs, 51501.
Juried exhibit–8th annual exhibition of woodcarving in the Norwegian tradition, July 28–30. Vesterheim Norwegian-American Museum, Decorah. Entry dates July 1–16. For more info., contact Vesterheim Norwegian-American Museum, 502 W. Water St., Decorah, 52101. (319) 382-9681.

KENTUCKY: **Show**–Art Buyers Caravan show, Aug. 21. Bluegrass Convention Center, Louisville. Contact Paul Karel, ABC, 408 Olive St., St. Louis, MO 63102. (314) 421-5445.

LOUISIANA: **Juried show**–Lafayette Art Assoc. Annual Juried Competition of Fine Art & Original Crafts, Oct. 9–Nov. 10. Slides due July 1. For prospectus and info., write Sara Parker, Lafayette Art Gallery, 700 Lee Ave., Lafayette, 70501.

MAINE: **Classes**–2- and 3-week homebuilding classes, July 10–28, Aug. 7–25. Post & beam class, Sept. 10–15. The Shelter Institute, 38 Centre St., Bath, 04530. (207) 442-7938.
Workshops–Various workshops focusing on boats, including boat building, July thru August. Contact The Rockport Apprenticeshop, Sea Street, Box 539, Rockport, 04856. (207) 236-6071.

MARYLAND: **Exhibit**–"Small Contemporary Wood Objects," July 2–Aug. 27. Washington County Museum of Fine Arts, Box 423, Hagerstown, 21741. (301) 739-5727.
Juried exhibit–Rocky Gap Music & Crafts Festival, Aug. 4–6. Rocky Gap State Park, Cumberland. For more info., contact Governor's Office of Art & Culture, 80 West St., Annapolis, 21401. (301) 974-5110.
Show–26th annual Havre de Grace art show, Aug. 19–20, 10 A.M. to 5 P.M. Featuring over 200 craftsmen including woodworkers. Contact Cindy Height, Box 174, Havre de Grace, 21078. (301) 879-4404.
Juried exhibit–Gaithersburg Craft Market, Sept. 30–Oct. 1. Summit Hall Farm Park, Gaithersburg. For more info., contact Lipman Designer Productions, Box 164, Dallastown, PA 17313. (717) 244-8438.
Show–Southern Maryland Wildlife and Seafood Fest, Sept. 23–24, in Charles County. For info., contact Pamela Hungerford Frank, Box 400, Indian Head, 20640. (301) 753-6111.
Juried exhibit–Sugarloaf's 13th Annual Maryland Crafts Festival, Oct. 13–15. Maryland State Fairgrounds, Timonium. Featuring 365 artists and craftsmen. For more information, contact Deann Verdier, Sugarloaf Mountain Works Inc., 20251 Century Blvd., Germantown, 20874. (301) 540-0900.

MASSACHUSETTS: **Classes**–Various creative arts classes including woodworking, throughout the year. For more info., contact The Boston Center for Adult Education, 5 Commonwealth Ave., Boston, 02116. (617) 267-4430.
Exhibits–Floor coverings & lamps, thru July 15; "Boxed In II" featuring boxes in a variety of sizes, shapes and media, July 22–Aug. 26; group furniture show, Sept. 2–Oct. 21. The Society of Arts & Crafts, 175 Newbury St., Boston, 02116. (617) 266-1810.
Juried exhibit–"Surface and Substance: Exploration of Texture in Craft," thru Aug. 6. The Berkshire Museum, 39 South St., Pittsfield, 01201. (413) 443-7171.
Workshops–Housebuilding, June 26–July 14; timber framing, July 17–21. For a brochure, contact The Heartwood School, Johnson Rd., Washington, 01235. (413) 623-6677.
Show–Day-long workshops, Aug. 19, 10th annual Doll House & Miniature Show & Sale, Aug. 20. Sheraton Hyannis, Route 132, Hyannis. 10 A.M. to 5 P.M. For more info., contact Gordon Harris, Cape Cod Miniature Society, Box 1596, Orleans. (508) 155-3216.
Juried exhibit–"Woodturners of the Northeast 1990," Feb. 10 thru March 17, 1990. The Worcester Center For Crafts, Worcester. Entries deadline Sept 22. For more info. and entry form, contact The Worcester Center For Crafts, 25 Sagamore Road, Worcester, 01605. (508) 753-8183.

MICHIGAN: **Exhibit**–15th annual carving exhibition and competition, Aug. 5–6. Eddie Edgar Ice Arena, Livonia. Contact Jim Rowe, 10953 Sherman, Southfield, 48034-4321. (313) 357-5741.
Juried exhibit–30th annual Ann Arbor Street Art Fair, July 19–22. Set up in Ann Arbor's downtown area and next to the Univ. of Mich. campus. For more info., contact AASAF, Box 1352, Ann Arbor, 48106. (313) 994-5260.

MINNESOTA: **Juried show**–7th annual Upper Midwest Woodcarving Exhibit, July 23–28, Blue Earth. For more info., contact Harley Schmitgen, 311 E. 14th St., Blue Earth, 56013. (507) 526-2777.
Workshop–Villa Maria Woodcarving Workshop, Aug. 13–19, Frontenac. Contact Villa Maria Workshops, Box 37051, Minneapolis, 55431.
Exhibit–7th annual Northern Woods Exhibit, Oct. 5–8. Bandana Square in Energy Park, St. Paul. Submission deadline Sept. 1. For more info., contact Elaine Carney, Orchard Woodworking, 948 Orchard Lane, Roseville, 55113. (612) 483-5647.

MISSOURI: **Conference**–"The Purpose of the Object: Why We Create & Why We Collect," July 7–9. Craft Alliance Gallery, 6640 Delmar Blvd., St. Louis, 63130. Contact Wood Turning Center, Box 25706, Philadelphia, PA 19144. (215) 844-2188.
Classes–Classes cover a broad range of folk and fine arts, June, July & Sept. For catalog or more info., write or call Bethel Colony School of the Arts, Box 127, Bethel, 63434. (816) 284-6493.
Exhibit–"Works Off The Lathe: Turners Face A Challenge," July 7–Aug. 12. Craft Alliance Gallery, 6640 Delmar Blvd., St. Louis. 63130. For more info., contact The Wood Turning Center, Box 25706, Philadelphia, PA 19144. (215) 844-2188.

NEBRASKA: **Show**–Cottonwood Quilter's Guild show, Oct. 27–29. Elkhorn Middle School, Elkhorn. For more information, send SASE to Joanne Traise, 1803 S. 169th Circle, Omaha, 68130.

NEW HAMPSHIRE: **Workshops**–16th Annual Violin Institute workshops intended for violin builders, bowmakers, musicians, stringed-instrument craftspeople and music educators, thru Aug. For a brochure, contact Univ. of NH, Div. of Continuing Ed., Violin Institute, 6 Garrison Ave., Durham, 03824. (603) 862-1088.
Show–Pratt Institute's "Summer Creative Arts Therapy Institute," June 19–July 15. Lincoln. For more details, contact Leslie Abrams, Creative Arts Therapy Dept., at (718) 636-3428.
Show–56th annual Craftsmen's Fair, Aug. 5–13. More than 100 League of New Hampshire Craftsmen featuring exhibits, demonstrations, workshops, performing arts. For more info., contact Judith Northup-Bennett, 205 N. Main St., Concord, 03301. (603) 224-1471.
Show–31st annual Canterbury Fair, July 29, 9 A.M. to 5 P.M. Contact Doneta Fischer, Canterbury Fair, 99 Old Tilton Rd., Canterbury, 03224. (603) 783-9024.
Sales–Antique & Craftsmans Tool Auctions: listed sales,

July 22 & Aug. 19; unlisted sale, Sept. 9. Dansforths 4 Corners, Hillsboro. For more info., contact Your Country Auctioneer Inc., R.F.D. #2, Box 339, HIllsboro, 03244. (603) 478-5723.

NEW JERSEY: **Workshops**–Numerous woodworking workshops (including Decorative Carving for 18th Century, Table Workshop, Using the Hand Plane, Cabinetmaking, Vessels from the Lathe), June thru Aug. For more info., contact Peters Valley Craftsmen, Route 615, Layton, 07851. (201) 948-5200.
Juried exhibit–The Super Crafts Star Show, Oct. 20–22. Giants Stadium Club, East Rutherford. For more information, contact Creative Faires Ltd., 134 Fifth Ave., New York, NY 10011. (212) 645-1630.

NEW MEXICO: **Exhibition**–"Bellas Artes 1989," July 1–Oct. 31. Featuring over 17 artists including woodturners. For more info., contact Bellas Artes, 301 Garcia at Canyon Road, Santa Fe, 87501. (505) 983-2745.

NEW YORK: **Juried show**–"Artitudes, New York–1989," a multi-media international art & craft competition, including wood. Winners will exhibit at Art 54 Gallery, Soho, NYC. Slide submission deadline June 23. For application, Artitudes, Dept. RW, Box 380, Hartsdale, 10530. (914) 633-5333.
Class–Building Sea Urchin, a traditional Nova Scotian dinghy, Aug. 12–19. Shipyard Museum, 750 Mary St., Clayton, 13624. (315) 686-4104.
Show–12th Annual New York Renaissance Festival, July 29–Sept. 17. Sterling Forest, Tuxedo. Weekends only plus Labor Day Monday. Contact Creative Faires LTd., Box 1688, Westhampton Beach, 11978. (516) 288-2004.
Workshop–Hand tool workshops by Robert Meadow, June 24–25, July 15–16, Aug. 12–13. Learn to use Japanese tools, sharpening techniques, joinery, furnituremaking, instrumentmaking. Hands on; individualized instruction; all levels. The Luthierie, 2449 W. Saugerties Rd., Saugerties, 12477. (914) 246-5207.
Show–Woodworking World Long Island show, Sept. 15–17. Nassau Colliseum, Hempsted. For more info., contact CDI Productions, Box 796, Plymouth, NH 03264. (603) 536-3768.
Juried show–Chautauqua Crafts Festival '89, June 30–July 2 & Aug. 11–13. Application and slide deadline April 20. Bestor Plaza, Chautauqua Institution. For application, send SASE to Gale Svenson, Chautauqua Crafts Festival '89, Box 89, Mayville, 14757.

Exhibit–"George Nakashima: America's Living Treasure Series," May 7–July 9. American Craft Museum, 40 W. 53rd St., New York, 10019. (212) 956-3535.
Juried show–13th annual American Crafts Festival, July 1–2, 8–9, 15–16. Lincoln Center, Fordham Univ. Plaza, NYC. Contact Brenda Brigham, American Concern for Artistry & Craftsmanship, Box 650, Montclair, NJ 07042. (201) 746-0091.
Show–Woodstock-New Paltz art & crafts fair, Sept. 2–4. Ulster County Fairgrounds, New Paltz. For more info., contact Quail Hollow Events, Box 825, Woodstock, 12498. (914) 679-8087.

NORTH CAROLINA: **Workshops**–Week-long summer workshops, July thru Oct. Contact Country Workshops, 90 Mill Creek Rd., Marshall, 28753. (704) 656-2280.
Show–Woodworking World Carolina show, Sept. 22–24. McBenton Convention Center, Winston-Salem. For more info., contact CDI Productions, Box 796, Plymouth, NH 03264. (603) 536-3768.
Juried exhibit–10th annual Summerfest Art & Craft Show, Aug. 18–20, Asheville Civic Center, Asheville. For more info., contact Fail Gomez, High Country Crafters, 46 Haywood St., Asheville, 28801. (704) 254-7547.
Workshop–Numerous workshops, including broom making and introduction to woodcarving; summer edition guild fair, July 20–23. Folk Art Center, Milepost 382, Blue Ridge Parkway, Asheville. For info., contact Cornelia W. Graves, Southern Highland Hadicraft Guild, Box 9545, Asheville, 28815. (704) 298-7928.
Workshop–Timber Framing workshop, July 2–15. Campbell Folk School, Brasstown, 28902. For more info., call (800) 562-2440.
Juried exhibit–International Turned Objets Show, Oct. 7–Dec. 3. South Highland Handicraft Guild, Asheville. Will include various approaches to using the lathe, the materials turned and the intentions in creating the final forms. For more information, contact Sarah Tanguy, International Sculpture Center, 1050 Potomac St. N.W., Washington, DC 20007. (202) 965-6066.

OHIO: **Workshops**–One-week intensive, hands-on instruction on a number of subjects, June thru July. For information, contact Conover Woodcraft Specialists, Inc., Conover Workshops, 18125 Madison Road, Parkman, 44080. (216) 548-3481.
Juried exhibit–American Contemporary Works in Wood '89, Sept. 16–Oct. 15. Selected works from the exhibit will be a featured display for the 1989 Furniture Exposition at the International Home Furnishings Center, High Point, NC. For more info., contact The Dairy Barn Southeastern Ohio Cultural Arts Center, Box 747, Athens, 45701. (614) 592-4981.

OKLAHOMA: **Show**–13th annual National Woodcarving Show, sponsored by Eastern OK Woodcarvers Assoc., July 7–9. Kensington Galleria Shopping Mall, 71st & S. Lewis, Tulsa. For more info., contact Dale Hill, Rt. 1, Box 75, Broken Arrow, 74011. (918) 455-8683.

OREGON: **Workshops**–Various workshops in woodworking for summer quarter, June 13–Aug. 22. Oregon School of Arts & Crafts, 8245 S.W. Barnes Rd., Portland, 97225. Call (503) 297-5544 for a summer schedule.
Exhibit–"From Inside Out," garden pieces of multi-discipline appropriate for the Northwest environment, June 25–July 29. Contemporary Crafts Gallery, 3934 S.W. Corbett Ave., Portland, 97201. (503) 228-2308.
Juried exhibit–Artquake Artist's Marketplace, Sept. 2–4. 100 exhibitors of crafts, including wood. On the streets surrounding pioneer square, Portland. For info., contact AAM, Box 9100, Portland, 97207. (503) 227-2787.
Show–"American Folk Art: Expressions of a New Spirit," July 9–Sept. 2. Portland Art Museum, Portland. For info., contact Museum of American Folk Art, 444 Park Ave. S., New York, NY 10016. (212) 481-3080.
Show–Summer show of woodworking, July 20–29. Pioneer Hall, Ashland. For information, contact Dave Maize, Siskiyou Woodcraft Guild, 60 Fifth St., Ashland 97520. (503) 482-1436.

PENNSYLVANIA: **Juried exhibit**–42nd annual state craft fair, July 27–30. Features 250 juried members of the PA Guild of Craftsmen. Franklin & Marshall College, Lancaster. For more information, contact Pennsylvania Designer-Craftsmen, Box 718, Richboro, 18954. (215) 860-0731.
Exhibit–"Wood, Water & Light," thru Oct. 9. Philadelphia Maritime Museum, 321 Chestnut St., Philadelphia, 19106. (215) 925-5439.
Workshops–Various woodworking workshops including furnituremaking and making the mountain dulcimer, July thru Aug. Contact Pioneer Crafts Council, Box 2141, Uniontown, 15401.
Exposition–Symposium '89: A National Exposition of Stringed Musical Instrument Making and Repair, June 22–25. Lafayette College, Easton. For info. and applications,

contact (SASE) Symposium '89, 14 S. Broad St., Nazareth, 18064. (215) 759-7100 (evenings).
Workshops–Japanese joinery & techniques w/ Toshio Odate, June 23–25. Olde Mill Cabinet Shoppe, 1660 Camp Betty Road, York, 17402. (717) 755-8884.
Juried show–The Pocono State Craft Festival, June 24–25. On the grounds of the Shawnee Inn Resort; 10 A.M. to 6 P.M.; $3 adults, children 12 and under are free. For more info., contact Pennsylvania Designer-Craftsmen, Box 718, Richboro, 18954. (215) 860-0731.
Juried exhibit–Juried exhibition of contemporary crafts, Oct. 7 thru Nov. 5. Luckenbach Mill Gallery, Historic Bethlehem Inc., 459 Old York Road, Bethlehem, 18018. Application, slides and SASE due July 12. For more info., contact Janet Goloub, (215) 691-0603.
Juried show–The State Craft Festival, Sept. 22–24. Tyler State Park, Route 332, Richboro. Open daily 10 A.M. to 6 P.M. Admission $4 for adults, children 12 and under free. For more information, contact Pennsylvania Designer-Craftsmen, Box 718, Richboro, 18954. (215) 860-0731.
Juried exhibit–17th Annual Lancaster Designer Craft Market, Oct. 28–29. Pucillo Cymnasium, Millersville Univ., Millersville. More than 80 exhibitors representing various crafts including woodturning and woodcarving. Admission is $3 per day. For more information, contact Terri Lipman, 437 Lombard St., Dallastown, 17313. (717) 244-8438.
Juried exhibit–Studio Days/Design '89, Oct. 13–15. 6th annual invitational exhibition of contemporary crafts in all media. Demonstrations throughout two-day show. Chester Springs Studio, Art School Road, Chester Springs, 19425. (215) 827-9111.

TENNESSEE: **Classes**–Numerous one-week summer classes available, June thru August. Also workshops, conferences and exhibits. For information, contact Arrowmont School of Arts and Crafts, Box 567, Gatlinburg, 37738. (615) 436-5860.
Classes–Numerous guitar construction and repair programs. For more information or a free brochure, contact The Apprentice Shop, Box 267, Spring Hill, 37174. (615) 486-2615.
Workshop–Technical program on small dry kilns, Sept. 9, Gatlinburg. Contact TN Valley Authority, Forestry Industry section, Norris, 37828.

UTAH: **Workshops**–Dale Nish, June 19–23, 26–30, July 17–21, 24–28; Rude Osolnik, Sept. 18–22. Contact Craft Supplies USA, 1287 E. 1120 S., Provo, 84601. (801) 373-0917.

VERMONT: **Workshop**–One-week cabinetry courses, July 9–15 for beginners; July 16–22 for advanced. Contact Diane Lisevick at Yestermorrow Design/Build School, Box 344, Warren, 05674. (802) 496-5545.
Exhibit–The 16th annual Wood Carvers Exhibit, Aug. 19, 9 A.M. to 4:30 P.M. Peoples Academy Gymnaseum, Morrisville. For more info., contact C.A. Brown, Box 268, Waterville, 05492. (802) 644-5039.
Shows–Numerous shows and craft celebrations throughout the year. For information, contact Vermont State Craft Center at Frog Hollow, Mill Street, Middlebury, 05753.

VIRGINIA: **Juried exhibit**–"Sound Arts," a juried and invitational exhibit at Vista Fine Crafts, Aug. 19–Sept. 9. Slides/photos & resume deadline June 1. Eligible: all craft artists with work in musical instruments (traditional & experimental), bells & chimes, anything that makes music or sound. For application/info., send SASE to Sherrie Posternak, Vista Fine Crafts, Box 2034, Middleburg, 22117. (703) 687-3317.
Exhibit–"New Art Forms: Virginia II," thru Sept. 29. Hand Workshop, 1812 W. Main St., Richmond, 23220. (804) 353-0094.
Juried exhibit–America's Masters Series III Arts & Crafts show, July 21–23. Prince William County Fairgrounds, Manassas. Contact America's Masters, Box 3279, Shiremanstown, PA 17011. (717) 697-8288.
Juried exhibit–Sugarloaf's 9th Annual Virginia Crafts Festival, Sept. 22–24. Prince William County Fairgrounds, Manassas. Featuring 260 artists and craftsmen. For more info., contact Deann Verdier, Sugarloaf Mountain Works Inc., 20251 Century Blvd., Germantown, MD 20874. (301) 540-0900.

WASHINGTON: **Workshops**–Various boatbuilding workshops, June thru Aug. Northwest School of Wooden Boatbuilding, 251 Otto St., Port Townsend, 98368. (206) 385-4948.
Show–13th annual Lake Union Wooden Boat Festival, July 7–9. 10 A.M. to 6 P.M. The Center for Wooden Boats, 1010 Valley St., Seattle, 98109. (206) 382-BOAT.
Show–New member's work, July 6–30. Contact Northwest Gallery, 202 First Ave. S., Seattle, 98104. (206) 625-0542.
Show–Woodworking and demonstrations by Scott Jensen, July 29–30. Artwood Gallery, 1000 Harris Ave., Bellingham, 98225. (206) 647-1628.

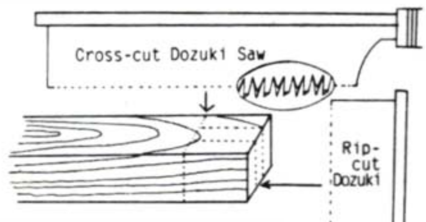
WEST VIRGINIA: **Show**–Oglebay Woodcarvers show, Sept. 2–3. Oglebay Park Pine Room at Crispin Center, Wheeling. Contact Leonard Subasic, 423 Winter Ave., Wheeling, 26003. (304) 242-1929.

WISCONSIN: **Show/workshops**–7th Annual Festival of Crafts, June 16–25. Univ. of Wisc.-Stout, Menomonie. Workshops include boatbuilding, woodturning, basketry, woodcarving. For more info., contact Nancy Blake or Jim Bjornerud, Center for Craftsmanship, 111A Tech Wing, Jarvis Hall, Univ. of Wisc.-Stout, Menomonie, 54751. (715) 232-2213; 232-1102; or 962-3062.
Exhibit–American Wildfowl Decoys, July 9–Sept. 2. Leigh Yawkey Woodson Art Museum, Wausau. Shorebird and duck decoys carved between 1870–1960. Contact Susan Flamm, 444 Park Ave. S., New York, NY 10016. (212) 481-3080.

CANADA: **Conference**–Contemporary Furniture Design & Techniques 2, a conference examining current trends in furniture design, Aug. 5–7. Kelsey Campus, Saskatoon, Sask. Participating instructors include Gary Bennett, Wendel Castle, Judy Kensly McKie, Wendy Maruyama and Alan Peters. For more info., contact Michael Hosaluk, R.R. #2, Saskatoon, Sask. S7K 3J5. (306) 382-2380.**Show**–6th annual Wood Show, Aug. 11–13. Durham, Ont. Featuring woodworking tools & machinery, sculpture, turnings, carvings, etc. Free seminars and demonstrations. For more info and brochure, contact The Wood Show, Box 920, Durham, Ont. N0G 1R0. (519) 369-6902.

ENGLAND: **Exhibition**–9th Exhibition of Early Musical Instruments 1989, Sept. 29–Oct. 1. Royal Horticultural New Hall, London. For more info., contact The Early Music Shop, 38 Manningham Lane, Bradford, BD1 3EA. (0274) 393753.
Juried Exhibit–6th annual ICMS, July 15 thru Sept. 10. Christchurch Mansion Museum and Gallery, Ipswich. Entries deadline July 1. For info., contact Suzanne Cartwright, 63 Church Lane, Sproughton, Ipswich, Suffolk IP8 3AY.

U.S. VIRGIN ISLANDS: **Show**–Arts Alive Festival, Aug. 11–13. In the Tillett Gardens, featuring island artists and craftsmen. For more info., contact Arts Alive, Box 7549, St. Thomas, 00801. (809) 774-3716.



Precision Machinery Techniques: A Woodworker's Handbook by Mark Duginske & Karl Eichhorn. *Sterling Publishing Co. Inc., 2 Park Ave., New York, N.Y. 10016; 1986. $9.95 ($12.95 in Canada), paperback; 158 pp.*

Upon first glance, *Precision Machinery Techniques (PMT)* appears to be a thorough, yet compact treatise delivering exactly what the title promises. Indeed it does contain a fairly comprehensive discussion of four basic shop machines (tablesaw, bandsaw, shaper and planer/joiner), and there are numerous tips, techniques and special jigs that any novice or advanced woodworker will find extremely useful. However, upon a more close inspection, *PMT* takes on the appearance of an expanded Inca tool-and-machinery manual. The book is, in fact, written in collaboration with the Inca Machine Manufacturing Co. of Switzerland, and this may be its greatest failing. Since only Inca machinery is used in the illustrations, many of the special jigs and accessories (especially the hold-downs) are available only for Inca machines. This may make the book less useful to those who do not have Inca machinery.

The illustrations, however, are quite clear and concise, and occupy a majority of the pages, offering easy-to-understand, step-by-step instructions for many operations. The outline of cutting through dovetails on the tablesaw is especially good. Using planed spacer blocks and paper shims for measurements and fine adjustments is an excellent technique that I know from experience works better than most. I plan to make the adjusting ruler illustrated in the shaper chapter.

Although over half the book is devoted to the tablesaw, I was surprised at how little discussion was given to sawblades and saw setup. Also, illustrations with the Inca tablesaw show all beveled operations with the table tilted rather than the more common blade tilt. This may be slightly disorienting for some readers who are unfamiliar with this variety of saw.

All in all, I came away from *PMT* feeling that this book is an outstanding manual for Inca machinery, but not a "A Woodworker's Handbook" as it claims. *—Roger Heitzman*

World Woods in Color by William A. Lincoln. *Macmillian Publishing Co., 866 Third Ave., New York, N.Y. 10022; 1986. $39.95, hardback; 320 pp.*

There is no shortage of wood identification books on the market, but a number of good features makes this one the best and easiest to use.

Organized in dictionary fashion, more than 275 commercially available woods are listed alphabetically by their official names, their botanical names (binomial nomenclature), and the various trade and vernacular names dealers often use. Each wood is accorded a full page. The top half of the page features a colorful photo of the wood. Unlike other books that offer reduced-size photos to give an overall view of the figure or grain pattern, Lincoln offers exact-size reproductions to allow a more accurate comparison of the grain and texture, hence making it easier to actually identify a wood sample. Below the photo on each page, the author gives a general description of the wood, its area of origin, its mechanical and working properties, and information on its durability and common uses. For those who prefer working backward, there is a "Table of Uses" that features many different category headings, allowing you to quickly identify all of the woods appropriate for a particular application.

Perhaps the biggest problem with wood identification books is that many woods are known by a variety of names. With foreign or "exotic" woods, the wood's name may change every time a different country's border is crossed. To make matters worse, certain names work overtime and are used to define a variety of woods. The author points out, for example, that there are more than 80 different species called "ironwood." To deal with this confusion, the author provides cross-referenced indices: an index of standard names; an index of trade, vernacular and common names; an index of Latin botanical names; and an index of botanical family names. Between the outstanding photos and the comprehensive lists, this book makes it possible to accurately identify a wood no matter how shaky your information. I've been using it in my shop for the past year and it has yet to let me down, in spite of the fact that as a guitarmaker, I run across some pretty obscure woods. *—Michael Dresdner*

Woodworker's 30 Best Projects by the editors of *Woodworker* magazine. *TAB Books Inc., Blue Ridge Summit, Pa. 17294-0850; 1988. $14.95, paperback; 212 pp.*

The title of this book is not at all misleading. The text bursts open with a skimpy two-paragraph introduction and bangs shut with a one-and-one-half-page index. Like the meat in a well-made sandwich, the intervening 210 pages are chock full of 30 tastefully prepared projects, each with drawings, black-and-white photographs, a materials list and step-by-step instruction.

This is an especially good project book if you are into Early-American styles and like to be talked through the project with helpful hints and expert guidance. Some of the items are pretty hefty, including several china cabinets, a pool table and four nicely assembled desks. The publisher indicates that the book's intended audience is the "intermediate to advance-level craftsman." Unfortunately, I suspect this may scare off more readers than it should. While some of the projects will require patience, none of them, especially the smaller end tables, chests and bookcases, strikes me as that awesome or technical. The plans generally don't call for a lot of close tolerances, hand fitting or carving. Most of the suggested ornamentation relies on readily available moldings, turnings and stock hardware.

In fact, what I find most appealing about this collection of plans is the style and novelty of many of the pieces, considering their off-the-shelf heritage. One item, a "mini-office" typewriter stand, has caught my eye as just the ticket for organizing what is surely the sloppiest corner in my household. Chances are there's something in this somewhat pricey $15 paperback that is equally appealing to you. *—Jon Arno*

Making Antique Furniture: A Selection of Detailed Designs for Creating Your Own Classic Furniture Pieces. *TAB Books Inc., Blue Ridge Summit, Pa. 17294-0850; 1988. $15.95, paperback; 151 pp.*

This is the book for you if you are a furnituremaker and live in a half-timbered, English-style house. All but one of the book's 36 measured drawings are definitely of English origin; the other is a very familiar Southern huntboard. This book offers a fresh, new approach to furnituremaking, with detailed suggestions and construction plans that are unavailable elsewhere. Most dimensions, which are in inches as well as millimeters, may confuse American readers because length precedes thickness and width.

Among the designs are 16 tables (two of them beautiful Regency-style dressing tables), a Sheraton-style sideboard, two tall clocks, five assorted chairs, two corner cupboards, a Georgian-style bookcase, an excellent dressing-table mirror and a fire screen. A few pieces are from very early English periods, such as a medieval aumbry (small cupboard) and a linen press with linenfold carving. *—Carlyle Lynch*

Roger Heitzman is a woodworker in Scotts Valley, Cal. Michael Dresdner is an instrumentmaker and contributing editor for FWW. *Jon Arno is an amateur wood technologist in Schaumburg, Ill. Carlyle Lynch is a designer and retired teacher in Broadway, Va.*

Photos: Courtesy of Interwood Holdings Pty. Ltd.

Kelvin Freer's aptly titled "Stingray Guitar," shown above, left, has highly polished undulating curves in Drooping Sheoak and Myall, and is finished in two-part polyurethane. The guitar and Kelvin won an award recently at an Australian woodworking show. "Bucket," by Mike Darlow, shown in the top, right photo, is turned from backberry and finished in polyurethane. Vic Wood's lidded bowl in rare Tasmanian Huon Pine (bottom, right photo) is another undulating turning, and embellished with a carving by Susan Wraight.

Woodworking "Down Under"

Woodworking is experiencing tremendous growth and recognition "down under" in Australia. One good indication is the growth of woodworking guilds and organizations, from about 18 in 1986 to more than 70 today.

Because of their long-term association with the woodworking industry through their small, family-owned furniture business, Rod and Linda Nathan, of Interwood Holdings P/L, sensed this growth signaled that Australian woodworkers were ready for a show dedicated to their craft. Previously, "there had been a number of peripheral shows, directed toward the handyman and home owner. This show, a combination of The Working With Wood Show and The National Woodwork Exhibition was the first one, however, directly for the woodworker," said Art Burrows, editor of *The Australian Woodworker*. By providing a focus and a means of communications for woodworkers, Burrows said he felt *The Australian Woodworker* has been instrumental in the development of woodworking in Australia.

In spite of the fact that some of the country's major show organizers rejected the idea of a woodworking show, Interwood Holdings put together what they hope will become an annual event. At the three-day show, held last fall in Melbourne, Australia, more than 19,000 people, hungry for new product information, lined up to compare the different manufacturers' wares. (Australia is a country with a relatively small population. To put the attendance in proper perspective, it would be equivalent to a show in the United States drawing over 337,000 people.) Visitors saw displays by more than 70 exhibitors who demonstrated the latest in woodworking machinery, woods and finishing products.

A juried display of 216 pieces representing the work of 116 Australian woodworkers also drew considerable attention. Display categories for awards were furniture (com-

mercial, traditional and contemporary), woodturning, sculpture, bowls, joinery, musical instruments and carving.

While financial awards drew some of the entrants, many were there for the opportunity to have their work seen in such a large exhibition. Although the organizers reported they had received some minor criticisms for display and lighting deficiencies, they said the general feeling was that for a first attempt, the exhibition went quite well and served to significantly increase the public's awareness of the high quality of Australian woodcraft.

The Working With Wood Show 1989 is scheduled for October 20-22, 1989 at the Royal Exhibition Buildings, Melbourne, Australia. For more information contact Interwood Holdings P/L, Livio Drive, Gembrook, 3783, Australia; (059) 68 1753.

—Charley Robinson

Bird's-eye cabinetry

During my career as an amateur woodworker, I have been faced with a continuing problem: the need to improvise. Usually a screwdriver becomes a chisel, a cinder block becomes a clamp, and it goes downhill from there. In the past, I have fallen prey to those fancy tool catalogs and own a lot of odd-looking dust collectors to prove it. It was for this reason, that when faced with a kitchen remodeling project, I turned my garage into a spray booth.

It all started innocently enough—the wood was bought, sawn, shaped, sanded and readied for finishing. Converting the garage into a makeshift spray booth was an excellent idea. It afforded plenty of space to lay out all the doors on the floor and spray them all in one motion. Besides, the bike and the garden tools needed a fresh coat of overspray. The doors looked great and the garage door was shut on a very satisfying day's work. Later in the evening, unable to fend off the urge to admire my work, I strolled out to the garage. It was not a pretty sight. Spread over the faces of the door panels were large white blotches. Humidity? Chemical reaction? I knew I had seen this effect before—on the hood of a freshly waxed car, on statues in the park. The culprit was a fat robin, perched solemnly on a rafter. His bloodshot eyes showed the effects of the lacquer fumes as he stared down at me, while I worked feverishly to repair his damage. A wet rag repaired the damage, but no amount of cursing or throwing things would remove him from his perch. I left him there thinking that maybe he too wanted to admire my expertise. Or perhaps he saw a familiar tree limb in the face of one of the doors. Or (sigh), maybe he was just letting me know what he thought of my work.

—Don Feldman, Tonawanda, N.Y.

Product Reviews

Two cordless drills: Porter-Cable 9850 and Panasonic EY571, *Porter-Cable Corp., Box 2468, Jackson, Tenn. 38302-2468; Panasonic Industrial Co., 2 Panasonic Way, Secaucus, N.J. 07094.*

Few technological innovations have changed the way craftsmen work as much as cordless tools: They are extremely handy and safe outdoors or in damp conditions, and they're surprisingly powerful and affordable. Dozens of models currently on the market are designed specifically for the hard-core professional. I recently tried two new additions to this elite rank: The Panasonic EY571 and the Porter-Cable 9850, "Magnequench."

On the first take, the two drills are quite similar. Both models have durable, black plastic bodies, and they depend on high-voltage, removable nickel-cadmium battery packs for their power—the Panasonic's is 9.6 volts and the Porter-Cable's is 12 volts. In addition, both drills have variable-speed control, feature a six-position clutch and are reversible. The first five-clutch settings allow the drive to slip at a predetermined torque setting (great for driving screws); the sixth setting is a non-clutched, direct drive for boring holes. While both drills have high-quality chucks that will hold any bit from a hair-thickness #80 up to ⅜ in. maximum capacity, the Panasonic has a special keyless chuck: A great feature if you're always searching for your chuck key.

In use, I could not detect any appreciable distinction between the driving and drilling power of the drills—both deliver torrents of wrist-twisting torque. The Porter-Cable has a very slight edge on the Panasonic in the overall amount of work it performs on a single charge. However, this edge is offset by the Panasonic's two speed ranges that allow drilling and driving up to 1,000 RPM—more than double that of the Porter-Cable's 400 RPM top speed. The Panasonic also has an electronic brake on the motor, which is very helpful if you must stop and start the drill often.

Charging is a breeze with either model: You merely remove the battery pack from the drill, plug it into the charger, and in about an hour (when the charging light goes out) you're ready for more cordless action. The Porter-Cable charger has an extra "trickle"-charge feature designed to allow a battery that's left in the pack to stay charged, even for months.

The biggest distinction I made between the two drills was how they felt. I liked the Porter-Cable's comfortable handle that's designed for an in-line grip, which allows your hand to push directly in line with the chuck and drill or screw bit, giving maximum power and control. While the grip on the Panasonic also felt comfortable to my medium-size hand, its cylindrical motor

The new Porter-Cable and Panasonic cordless drills both deliver the power needed for amateur or professional use.

housing extends behind the handle and prevents an in-line grip. Balance-wise, I clearly prefer the Panasonic—the Porter-Cable's battery pack, which protrudes from the bottom of the handle, is huge (necessary for the extra batteries that make up a 12-volt pack) and throws off the balance of the tool.

On the subject of reversing switches, both drills are fairly easy to use, but I prefer the Panasonic's thumb-and-index-finger-operated sliding switch, which is the easiest to use of any cordless drill I've ever tried. The Panasonic's keyless chuck can be a real time-saver, if you change bits often: you just pull back on the chuck's locking collar while pressing the trigger, and the drill motor tightens or loosens the chuck. In cases when the chuck has been over-tightened, Panasonic provides a lock-release rod, which fits in a hole in the chuck for leverage when loosening the bit. This also saves wear and tear on your hand as holding the locking collar requires considerable force.

I found the performance of both the Panasonic and the Porter-Cable excellent. Either drill fulfills the needs of a professional woodworker and both score high marks compared to any other cordless drills I've tried (see *FWW* #72, p. 52 for a comprehensive test of cordless drills).

—Sandor Nagyszalanczy

For accurate angled cuts: Eze-Angleguide, *Steussy Creations, 334 Atherton Ave., Novato, Cal. 94945.*

Picture this: You're making angled cuts with your radial-arm saw set just so. For some reason you need a fresh square cut to work from. Of course, you don't want to reset the arm to 90° and then have to reset it again for the desired angle. You turn to the tablesaw, but inevitably your helper is in the middle of a run that involves a precise setup that won't allow a simple square crosscut.

I've lived this scenario and so must have Richard Steussy, developer of the Eze-Angleguide, shown in the photo on the next page: His set of angle templates for a radial-arm saw or tablesaw can make this

INDEX TO ADVERTISERS

Eze-Angleguide lets you cut any angle without resetting your radial-arm saw.

episode a thing of the past.

By combining the precisely cut Medite templates in various combinations, you can cut any angle from ½° to 80° in ½° increments without changing the radial-arm setting from its square position. This method eliminates the need for trial-and-error test cuts in which you have to raise and lower the saw for each little adjustment, and it lets you set up your radial saw to cut square and leave it that way. The Eze-Angleguide also simplifies angle cutting on paired furniture parts, like right or left chair legs. In these cases, all you have to do is move the templates instead of swinging the arm and hoping to get the identical setting.

I tried the templates and found them to be accurate, even when I combined four separate templates to cut a desired angle. My only complaint was that the templates have a slight tendency to slide toward the cut when used in combinations over 45°. But this is easily remedied by gluing a strip of sandpaper to the surface of each template. Eze-Angleguide can also be used with a crosscut jig (cradle) on a tablesaw. In fact, Steussy Creations is coming out with a small table slide specifically for tablesaws.

The set of eight templates (2½°, 5°, 6°, 7°, 8°, 9°, 10° and 15°) is $24.95, and it comes with detailed instructions and a money-back guarantee. A smaller set of five templates, which allow angle cuts in 2½° increments, is $15.95. Both sets are available from Woodworker's Supply of New Mexico, 5604 Alameda Place, N.E., Albuquerque, N.M. 87113; Trendlines, 375 Beacham St., Chelsea, Mass. 02150; and Woodcraft Supply, 41 Atlantic Ave., Woburn, Mass. 01888. *—Jim Boesel*

Chuck-Mate, *Chuck-Mate Co., 830 First St., Suite B-1, Encinitas, Cal. 92024.*

I avoid using a chuck key on my ⅜-in. drill whenever possible. To change bits I just grab the chuck and squeeze. My intention is to save time, but too often I find I have to use the chuck key because the bit slips under load. The Chuck-Mate is a simple device that increases leverage on the chuck so you can tighten or loosen a chuck by hand without damaging your skin.

The Chuck-Mate is a thick-rubber donut that fits tightly around the chuck of most ¼-in. and ⅜-in. portable electric drills.

If you change bits often, for instance when drilling pilot holes and countersinking for screws, this $5.95 investment might speed the process and save your hand. *—Jim Boesel*

The Gripper tape-measure holder, *Guildwood, Box 372, St. Marys, Ohio 45885.*

My 12-ft. tape measure has a metal clip designed to slip easily over my belt or pocket. The trouble is, it doesn't. I can remove the tape with one hand, but replacing it involves both. As a consequence, I rarely bother to use the clip and misplace my tape frequently.

The Gripper is billed as "the quick draw of tape holders," and I found it lives up to this billing. The rugged, leather tape holder is designed to be worn on your belt and a mating pair of hook-and-loop fasteners—one attached to the leather holder, the other to your tape measure—holds the tape securely. A piece of U-shape plastic riveted to the leather also protects the tape from being knocked loose.

The holder makes removing and attaching the tape measure easy and rapid, and its simple and convenient design encourages use. Besides promising to cure the lost-tape syndrome, this product could extend the life of your jeans by eliminating fraying pockets. At $9.95, the price is right. *—Alan Platt*

No ode to oak

I'm often amused when I see or hear a sales pitch that loudly and proudly proclaims that the item in question is made of "genuine oak," "solid oak" or "real oak." And if the announcement lauds the article as having "genuine oak veneer," it's just begging me to take a few cheap shots at it. Oak is an American tradition, it seems, and every American should own some and display it with pride, as if it were the national emblem. There is even talk being tossed about to declare oak the official national tree. Oak is bestowed, say the claims, with all manner of marvelous properties, including beauty, durability, solidity, hardness, high value, permanence and who knows what else. Give me a break! Oak is cheap, plentiful and prone to more problems than most woods. I would like to apologize to all those readers who are oak lovers and are distressed by my seemingly blasphemous words about their favorite wood. I'm not saying oak is no good. Why, I even have some in my own home; but let's set the record straight.

One of the main drawbacks of oak is its differential rate of expansion and contraction, which is due to its ring-porous structure. The pores in wood are empty holes created by the vessels that transported fluids when the wood was a living tree. If these pores are dispersed uniformly throughout the wood, as in Honduras mahogany, the wood is classified as diffuse porus. If the pores are clustered in bands along the growth rings, as in oak, it's called ring porus. The trouble is that these bands of clustered pores, which are mostly air, are zones of weakness in the wood. When oak expands and contracts due to temperature or humidity fluctuations, most of the movement is concentrated in the weak zones containing the pores. The result is checking: lots of little (or not so little) cracks that occur in the wood. This is most apparent in oak that is exposed to the weather, even if it's covered with a protective finish. The finish simply splits open where the check occurs. Moisture then gets in and the check becomes progressively larger. More than many other woods, oak is prone to warping, twisting, cupping and a few other undesirable things like discoloring and supporting fungus growth. If these things weren't enough, oak stains and finishes unevenly, again due to the clusters of large pores. If you want a smooth surface, you must plug the holes with paste filler before applying the finish.

Despite oak's shortcomings, we still revere it as the solid, durable all-American wood—a symbol of colonial heritage, apple pie and the American way. So much for advertising, hype and narrow-mindedness. Oh, don't get me wrong. I think oak can be a very reasonable choice of wood, particularly if one is looking for economy or anonymity. It's also excellent to walk on and makes superb firewood. Personally, however, I think oak is best when left as a living tree. In that form, it looks reasonably good, it provides acorns for the squirrels, and its leaves smell nice after they fall. For furniture, architectural woodwork and cabinetry, however, I wouldn't give it more than a 3 on a scale of 10. *—Peter Good, Oakland, Cal.*

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 355, Newtown, Conn. 06470.*

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23-880	8" bench grinder 1/2 H.P.	136	99
23-980	10" bench grinder 1 H.P.	246	220
11-950	8" drill press	164	125
14-040	14" drill press	313	259
40-150	15" hobby scroll saw	178	129
28-160	10" hobby band saw	189	139
31-050	1" bell sander 2.0 amp	93	69
31-460	4" belt/6" disc sander	178	129
31-340	"NEW" 1" belt/8" disc sander	226	159

DELTA STATIONARY

34-761	10" unisaw 1½ H.P.	1715	1339
34-740	Super 10" motorized table saw	690	399
34-429	10" tilting arbor bench saw 1½ H.P.	1479	1049
33-990	10" radial arm saw	727	555
11-072	32" radial drill press	487	385
37-280	6" motorized jointer	440	335
50-179	¾ H.P. 2 stage dust collector	435	339
50-180	1 H.P. dust collector	535	425
50-181	2 H.P. dust collector	760	615
37-154	Deluxe DJ-15 6" jointer w/¾ H.P. motor	1288	999
33-050	"NEW" 8¼" Sawbuck	742	559
34-330	"NEW" 8¼" Table Saw 13A	321	245
34-670	10" motorized table saw	437	325
34-985	⅙ H.P. stock feeder	698	545
28-560	16" 3 wheel band saw	546	359

MILWAUKEE TOOLS

0395-1	"NEW" 9.6V cdlss. drill comp. w/case	264	159
0224-1	⅜" drill 4.5A magnum	179	110
0234-1	½" drill 4.5A mag 0-850 rpm	189	107
0244-1	½" drill 4.5A mag 0-600 rpm	189	107
0222-1	⅜" drill 3.5A 0-1000 rpm	169	97
0228-1	⅜" drill 3.5A 0-1000 rpm	154	90
0375-1	⅜" close quarter drill	208	119
0379-1	½" close quarter drill	243	139
0212-1	⅜" cordless drill w/spd.	263	149
6539-1	Cordless screwdriver 190 rpm	108	64
6540-1	Cdlss.screwdriverw/bits & cse	137	89
6546-1	Cdlss. screwdriver 200 & 400 rpm	120	75
3102-1	Plmbrs rt angle drill kit	295	175
3002-1	Electricians rt angle drill	290	175
5399	½" D-hdle ham drill kit	299	179
1676-1	H.D. Hole Hawg w/cs	395	225
6511	2 sp SawZall w/cs	209	119
6405	8¼" circle saw	209	120
6750-1	Drywall gun 0-4000 4.5A	149	89
6798-1	Tek screwdriver	173	105
6507	TSC SawZall w/case	219	129
6170	14" chop saw	430	275
6012	Orbital sander 3⅝"x7⅜"	179	105
6014	Orbital sander 4½"x9¼"	189	110
6305	6¼" cordless circle saw	284	165
6753-1	Drywall gun 0-4000 3.5A	129	83
8977	Var. temp heat gun	109	70
0214-1	⅜" v. spd. cordless drill	220	125
5397-1	⅜" v. spd. hammer drill kit	227	135
5371-1	½" v. spd. hammer drill kit	313	179
3107-1	½" v. spd. rt angle drill kit	305	179
6754-1	Drywall gun 0-4000 4.5A	179	110
6747-1	Drywall driver-0-2500	149	87
0230-1	⅜" drill 0-1700 rpm	169	99
3300-1	½" v. spd. magnum rt angle kit	289	179
5620	Router 1 H.P.—8 amp	289	169
5660	Router 1½ H.P.—10 amp	299	179
5680	Router 2 H.P.—12 amp	350	205
5455	⅞" polisher 1750 rpm	199	125
6215	16" chain saw	280	189
8975	Heat gun	85	55
6366	7¼" circular saw	198	112
6368	7¼" circular saw w/cse	226	129
0216-1	2 spd cordless drill Hi-torque	222	145
0235-1	½" drill keyless chuck mag	199	115
6016	¼ sheet pad sander	75	45
6145	4½" grinder 10,000 rpm	149	95
6142	4½" grinder 10,000 rpm w/cse & access.	182	114
6141	5" grinder 10,000 rpm	159	99
8950	8 gal wet/dry vac	205	145
0239-1	½" drill keyless chuck	189	114
6749-1	Drywall gun 0-2500 4.5A	189	115
6377	7¼" worm drive saw	275	159

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LU81M010	Gen Purp TrCh	10"	40	79.32	39
LU82M010	Cut-off	10"	60	98.89	42
LU84M011	Combination	10"	50	85.25	35
LU85M010	Super Cut-off	10"	80	126.90	50
LM72M010	Ripping	10"	24	74.22	30
LU73M010	Cut off	10"	60	91.16	37
LU87M010	Thin kerf	10"	24	56.90	36
LU88M010	Thin kerf	10"	60	69.90	43
PS203	Gen'l Purp	7¼"	24	31.42	16
PS303	Plywood	7¼"	40	37.74	22
DS306	6" Dado - Carbide			168.13	105
DS308	8" Dado - Carbide			205.83	115
F0	1¾"x⅝" Biscuits 1000-Qty				25
F10	2⅛"x¾" Biscuits 1000-Qty				25
F20	2⅜"x1" Biscuits 1000-Qty				25
FA	Assorts Biscuits 1000-Qty				28
WC104	4 pce chisel set w/cse ¼"-1"			39	33
WC106	6 pce chisel set w/cse ¼"-1"			52	43
WC110	10pce chisel set w/cse ¼"-1½"			88	63
FB100	16 pce forstner bit set ¼"-2⅛"			262	149
94-100	5 pce router bit door system			260	159
JS100	Biscuit Jointer w/case			285	154
EB100	"NEW" edge banding machine			350	275

MAKITA CORDLESS

Model		List	Sale
6070DW	⅜" var. spd. rev. drill, 7.2v	123	75
6071DWK	⅜" var. spd. rev. drill w/removable batt, 7.2v	190	105
5090DW	3⅜" saw kit, 9.6v	243	129
5600DW	6¼" circular saw, 10.8v	317	169
6010DWK	⅜" cordless drill kit, 7.2v	155	89
6010SDW	⅜" cordless drill, 7.2v	103	59
DA3000DW	⅜" angle drill, 7.2v	238	130
4390DW	9.6 volt cdls. recip saw kit	218	124
4300DW	Jig saw kit comp., 9.6v	220	125
6010DL	⅜" drill w/flashlight, 7.2v	198	113
6012HDW	2 spd. driver drill w/clutch & case*, 9.6v	224	115
6710DW	Cordless screwdrvr kit, 7.2v	186	103
6092DW	V/spd. drill, kit complete	237	120
6093DW	V/spd. drill w/clutch—complete	248	129
6891DW	Drywall gun 0-1400, 9.6v	225	119
632007-4	9.6 volt battery	49	30
632002-4	7.2 volt battery	42	28
5007NBA	7¼" saw w/elec. brake	228	125
5008NBA	8¼" saw w/elec. brake	276	145
B04510	¼ sheet pad sander	80	48
9900B	3"x21" belt sander w/bag	254	139
9924DB	3"x24" belt sander w/bag	268	149
9035	⅓ sheet finish sander	106	60
9045B	½ sheet finish sander	216	125
9045N	½ sht fin. sand. w/bag	219	127
4200N	4⅜" circ. saw 7.5 amp	213	119
5201NA	10¼" circ. saw 12 amp	560	290
4301BV	Orb. v/sp jig saw 3.5 amp	274	145
JR3000WL	2 sp recip saw w/cse	220	122
JR3000V	Vs. recip saw w/case	224	125
LS1020	New 10" mitre saw	440	235
9820-2	Blade sharpener	354	199
410	Dust collection unit	480	269
3705	Offset trimmer	255	139
19008W	3¼" planer w/case	198	115
1100	3¼" planer w/case	381	219
9207SPC	7" sander-polisher	262	145
3601B	1⅜ H.P. router	242	125
3700B	½ H.P. trimmer	180	92
2040	4" grinder, 3.5 amp	137	69
B04530	6" round sander	95	60
B04550	¼" sheet pad sander w/bag	85	55
DA3000R	⅜" angle drill	256	138
DP4700	½" v/sp w/rev. 4.8 amp	198	119
HP2010N	¾" v/sp hammer drill w/cse	285	155
2708W	8¼" table saw	474	259
2711	10" table saw w/brake	800	460
GV5000	Disc sander 5"	109	65
6800DB	2500 rpm 3.5 amp	140	89
6800DBV	0-2500 rpm 3.5 amp	154	95
6801DB	4000 rpm 3.5 amp	140	89
6801DBV	0-4000 rpm 3.5 amp	154	95
2030N	12" planer/jointer	2970	1599
2040	15⅝" planer	2470	1375
1805B	6⅛" planer kit w/case	646	345
JV1600	var. speed jig saw	220	125
JV2000	var. speed orb. jig saw	242	130
5005BA	5½" circular saw	211	119
9503BH	4½" sander-grinder	153	85
6404	⅜" drill 0-2100 rpm, 2 amp	102	59
6510LVR	⅜" drill rev. 0-1050 rpm	137	79
6013BR	½" drill rev. 6 amp	240	125
5402A	16" circular saw - 12 amp	605	325
3612BR	3 H.P. plunge router	376	199
9401	4"x24" belt sander w/bag	302	169
3620	1¼ H.P. plunge router w/cse	182	97
4302C	V/spd. orb. jig saw	287	145
5077B	7¼" Hypoid saw	248	139
LS1440	14" Mitre saw	624	409
2414	14" cut-off saw AC/DC	350	195
5007N8	7¼" circ saw 13 amp	209	119
3612B	3 HP plunge router sq/b	376	205

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Model		List	Sale
5510	(551) 5½" circ saw	112	92
5625	(552) 6½" circ saw	175	115
5656	(553) 7¼" circ saw	132	105
5665	(554) 8¼" circ saw	204	129
5750	(807) 7¼" circ - drop foot	198	125
5765	(808) 8¼" circ - drop foot	216	135
5790	(810) 10¼" circ - drop foot	400	245
5825	(367) 6½" worm saw	229	139
5865	(825) 8¼" worm saw	250	149
4580	Vari - orbit jig saw w/cse.	144	95
3810	10" Mitre saw	263	195
595	3"x21" sander w/bag 5.5A	197	125
7565	¼" palm sander	52	34
7313	3x18 belt sander 4.5A	72	58
77	7¼" worm drive	230	137
5350	2⅓ HP circ. saw	80.99	69
5250	2¼ HP circ. saw	68.99	59

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TR8	Plunge router, 1½ H.P.	219	119
TR12	Plunge router, 3 H.P.	354	175
C10FA	10" dlxe. mitre saw	490	265
C8FB	8½" slide compound saw	859	479
C15FB	15" mitre saw	745	395
FREUD LU85M015	15" Carbide Blade 108 Tooth	181	115

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73-756	6-1/2	36	28.96	16.30
73-717	7-1/4	18	13.14	7.10
73-737	7-1/4	24	16.36	9.00
73-757	7-1/4	40	29.72	16.35
73-758	8	40	42.04	24.15
73-759	8-1/4	40	42.86	24.60
73-719	8-1/4	22	18.96	10.60
73-739	9	30	31.48	16.25
73-769	9	60	66.58	35.90
73-740	10	32	32.98	18.95
73-770	10	60	67.02	36.90
73-715	5-1/2	16	13.00	7.30

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3203-HT	3"	5.22	3.40	67.50
3204-HT	4"	9.48	5.40	115.85

ADJUSTABLE HANDSCREWS BY JORGENSEN

Item No.	Jaw Length	Open Cap	List	Sale	Box of 6
#3/0	6"	3"	14.83	8.35	47.60
#2/0	7"	3½"	15.94	8.95	51.00
#0	8"	4½"	17.74	10.25	58.40
#1	10"	6"	20.29	11.95	68.10
#2	12"	8½"	23.29	13.75	78.00
#3	14"	10"	29.53	17.85	101.75
#4	16"	12"	38.38	23.00	139.95

STYLE 37 2½" Throat ¼"x¾" JORGENSEN

Item No.	Jaw Length	List	Sale	Box of 6
3706	6"	8.86	5.75	32.50
3712	12"	9.81	6.25	35.00
3718	18"	10.83	6.85	37.50
3724	24"	11.83	7.35	40.00
3730	30"	13.19	8.25	45.00
3736	36"	14.43	8.95	49.00

PONY CLAMP FIXTURES

Model		List	Sale	Lots of 12
50	¾" black pipe clamps	12.48	7.50	80
52	½" black pipe clamps	10.41	6.00	65

STYLE J. ADJUSTABLE HANDSCREW KITS

Model	Length Jaws	List	Sale
J04	4	7.10	4.99
J06	6	8.13	5.29
J08	8	9.12	5.89
J10	10	10.66	6.39
J12	12	13.21	7.69

BOSCH

Model		List	Sale
1581VS	Top hdle. jig saw	235	129
1582VS	Barrell grip jig saw	220	119
	Bosch metal case for above jig saws	34	26
	Bosch blade assortment for jig saws 30 of Bosch's best selling blades		23.99
1942	Heat gun 650°-900°	99	69
1272D	3"x24" B.S. w/bag	299	168
1273D	4"x24" B.S. w/bag	315	178
11-212	Bulldog ¾" SDS rotary	339	189
1196VSRK	⅜" vs hammer drill	215	110
1198VSR	½" vs hammer drill	229	129
1608	5.6 amp lam trimmer	140	85
1608L	Same as above w/trimguide	145	88
1608T	5.6 amp tilt base trim	155	95
1609	5.6 amp offset base trim	205	122
1609K	Lam installers kit w/1609	295	165
	Offset base, trimmer tilt base, trimguide, ¼" collet, collet nut, wrenches, hex keys and case		
1601	1 H.P. Router 25,500 rpm	165	105
1602	1½ H.P. Router 25,000 rpm	199	119
1603	1½ H.P. D handle Router	223	129

The famous Bosch 1604 1¾ h.p. Router List $219 Super Spec. $119

1606	1¾ H.P. D hdle. Router	243	139
3258	3¼" planer w/blade guard	210	135
3270D	3"x21" belt sander w/bag5A	225	139
1273DVS	Var spd. 4"x24" 6 speed range sander 10.5 amp	339	185
1611	3 H.P. plunge router	349	198
1611EVS	"NEW" 3 H.P. elec. v/spd. plunge router	410	255
1651	7¼ circ. saw drop foot	179	99
1654	7¼ circ. saw pivot base	179	99
1922K	Cdlss. jig saw w/cse.	239	165
921VSRK	⅜" cdlss. drill v/spd. w/clutch and case	235	135
1632VSRK	Recip. saw 8.4A orb. v/spd.	225	129
11-304	"The Brute" breaker hammer	1950	1185

BOSTITCH AIR NAILERS

Model		List	Sale
N80C-1	Utility coil nailer	730	399
N80S-1	Stick nailer	760	409
T36-50	Sheathing & decking stapler	550	309
N12B-1	Coil roofing nailer	725	405
N60FN-2	Finishing nailer	595	349
T31	Brad nailer	245	149

SENCO AIR NAILERS

Model		List	Sale
SFN1	Finishing nailer 1" - 2"	377	288
SFN2	Finishing nailer 1½" - 2½"	571	435
SN2	General purpose 1⅞" - 3"	621	465
M2	General purpose 1⅜" - 2"	475	359
SN4	General purpose 2" - 3½"	685	515
LS2	Pinner ⅝" - 1"	351	269
SKS	Stapler ⅝" - 1½"	351	269
LS5	Pinner, 1"-1½"	399	305
PW-RFR	Roofer, ½"-1¼"	351	269

WORKMATES By Black & Decker

Model		List	Sale
79-029	#85, 18#	63.00	42.00
79-032	#200 23#	103.00	69.00
79-033	#300, 28#	117.00	75.00
79-034	#400, 35#	152.00	99.00

BLACK & DECKER DEALS

1707	8½" crosscut mitre saw	813	469
1166	⅜" drill, 4A, 0-2500 rpm	96	55
2037	0-4000 5 amp drywall gun	160	92
1703	10" mitre saw w/73-770 blade	313	169
2660	0-4000 4.5 amp drywall gun	138	87
4015	½ sheet sander 3 amp	190	109
2600	⅜" 0-1200 4.5 amp drill	125	79
3047-09	7¼" super saw cat w/brake	282	168
3048-09	8¼" super saw cat w/brake	297	174
3157	Orb v/spd. jig saw	202	125
3153	V/spd. jig saw	195	120

BLACK AND DECKER
"NEW" 29 pce. Bullet Drill Bit Set
Model 14769 Black Oxide Bits
LIST 168.00 SPECIAL SALE 84.95

RYOBI SPECIALS

Model		List	Sale
JP155	"NEW" portable 6" jointer/planer	545	329
R500	2¼ H.P. plunge router	326	159
TS251U	10" mitre saw	392	169
TS251US	10" mitre w/acc. kit & 60 tooth carbide blade	435	199
AP10	10" surface planer 13 amp.	820	358
RA200	8¼" radial arm saw	515	235
RE600	3 H.P. plunge router	398	199
R150K	1 H.P. plunge router w/cse	206	99
BE321	3"x21" v/spd. belt sander	259	125
801020ARK	7.2v cdls. drill w/cse	193	79
801025RK	9.6v cdls. drill w/cse	234	99

PORTER CABLE

Model		List	Sale
630	1 H.P. router 6.8 amp	170	110
690	1½ H.P. router 8 amp	215	122
691	1½ H.P. router D hdle	235	133
536	1½ H.P. speedmatic router	310	195
518	3 H.P. 5 speed router	560	339
520	3 H.P. 15 amp router	510	319
309	38 amp lam trimmer	135	85
310	38 amp H.D. lam trimmer	190	114
312	Offset base lam trimmer	215	125
319	Tilt base lam trimmer	221	129
695	1½ H.P. router/shaper	299	190
696	H.D. shaper table	165	115
351	3"x21" belt sander w/o bag	215	125
352	3"x21" belt sander w/bag	225	129
360	3"x24" belt sander w/bag	310	175
361	3"x24" belt sander w/o bag	290	170
362	4"x24" belt sander w/bag	325	185
363	4"x24" belt sander w/o bag	310	179
7556	½" right angle drill	295	175
315-1	7¼" top hdle 13 amp circ saw	195	115
9315-1	315-1 comp. w/cse. & carb. bld.	225	129
617	7¼" pushhandle 13 amp	195	115
9617	617 comp. w/cse. & carb. bld.	225	129
368-1	8¼" top handle 13 amp	205	135
314	4½" trim saw 4.5 amp	205	119
548	X HD bayonet saw	255	165
9548	X HD bayonet saw w/case	275	175
9629	Recip saw v/sp 8 amp	230	135
9627	Recip saw 2 speed 8 amp	220	125
666	⅜" H.D. vsp drill - Hdl	185	122
621	⅜" H.D. v spd. 0-1000 rpm	155	95
320	Abrasive plane 3 amp	150	99
126	Porta plane 7 amp	290	185
9118	Porta plane 7 amp kit	325	185
9652	Versa plane 10 amp kit	430	275
7545	0-2500 drywall gun 5.2 A	169	105
7540	0-4000 5.2 amp gun	165	99
505	½ sheet pad sander	195	109
7511	⅜" v spd. drill 5.2 amp	185	105
7514	½" v spd. drill 0-750	195	114
303	Paint remover	230	149
304	7" disc sander 4000 rpm	195	125
305	7" disc polisher 2000 rpm	195	125
367	3¼" planer 6.5 amp	225	148
537	1½ H.P. D hdle router	325	199
7548	Top hdl jig saw 4.8 amp	215	119
7648	Barrel grip jig saw 4.8 amp	210	119
330	Speed block sander ¼ sht	97	58
555	Plate biscuit jointer 5A w/cse	280	165
345	6" saw boss 9 amp	160	99
5060	"Stair Ease" stair templet	194	125
5061	"Stair Ease" hard wood stair templet	204	135
659	0-4000 drywall gun 4 amp	130	79
100	⅞ H.P. router	160	94
5008	Dovetail template kit	99.50	75
5009	Mortise & Tenon jig	54.95	40
5002	"NEW" stub-mte plastic pipe cutter	99.95	75
308	"NEW"laminate slitter	189	135
5116	"NEW" omni-jig	395	269
9647	TIGER CUB recipro saw	185	119
9850	12 volt cordless driver/drill comp w/charger-batt-case	210	129
8500	Extra 12v battery	48	33

FREE FREIGHT TO THE 48 CONTINENTAL STATES ON EVERY ITEM.

Photos: Mark Becker

EGYPTO-DECO PHARAOH CABINET

The custom-built cabinet shown above is made from materials as exotic as its design, including satinwood, Macassar ebony, ivory and gold leaf. Designed and built by San Francisco, Cal., furniture designers/cabinetmakers Peter Malakoff and Norman Jones, the cabinet was originally commissioned as a breakfront to house a collection of art-deco crystal and china. Standing 8 ft. high and 15 ft. long with its doors open, the cabinet is decorated with Egyptian images and motifs based on objects found in the tomb of Tutankhamen, including the winged goddesses Isis and Nephthys that are relief-carved and gold-leafed on the inside surfaces of the outer doors (top photo). The applied central figure, shown above right, was carved from carefully obtained "legal" ivory—a 30-year-old elephant tusk dredged up from a basement. The design of the carving represents a lotus flower, with the two flower petals on either side acting as handles for the doors. The edges of the central doors are banded with inlaid ivory and satinwood. Most of the cabinet's exterior surfaces, shown above left, are covered with quartersawn sycamore veneer and the columns are turned from poplar. The entire inside of the cabinet was painted by Michael Mills, a San Francisco, Cal., artist who specializes in Egyptian illustration.