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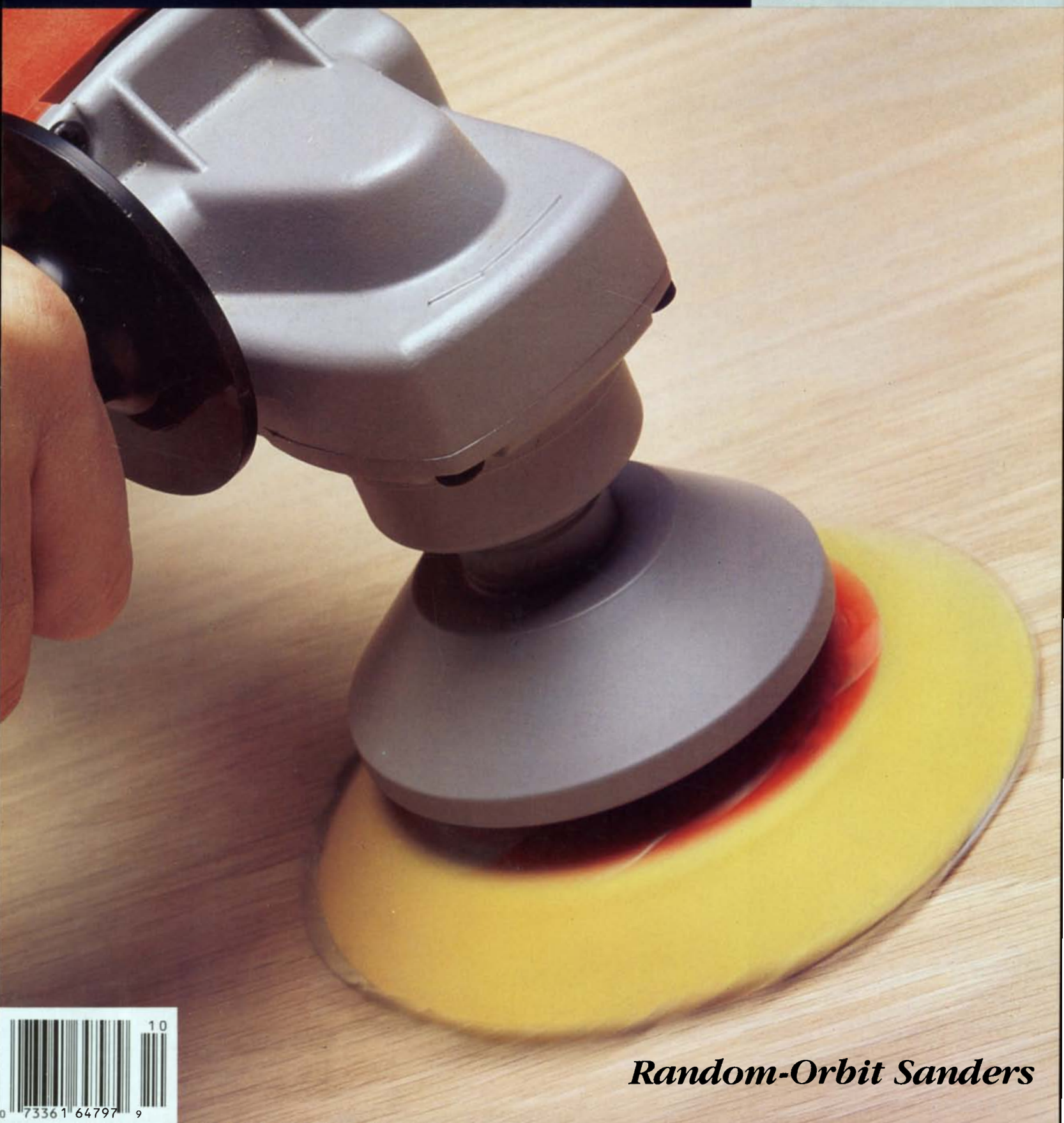

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Fine WoodWorking®
January/February 1992

Photo: Charley Robinson

Howard Wing hand carves flutes in a cockleshell after roughing out the shell and flutes with a jig-mounted router (article on p. 87). Cover: Random-orbit sanders promise swirl-free finish sanding (article on p. 46). Cover photo: Susan Kahn.

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*, PO Box 5506, Newtown, Conn. 06470-5506.

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The product review process—Over the past five years that I've been an editor for *Fine Woodworking* magazine, I've had the opportunity to try lots of different tools and machines, and to both write and edit a whole slew of tool review articles. I've also spoken with dozens of readers, and fielded hundreds of comments, most of which, I'm pleased to say, have been positive. But these contacts also have taught me that many readers have only a vague idea of how we conduct our product reviews. Therefore, I thought it a good idea to clarify our approach to tool reviews and to suspend some misconceptions about the review process.

Defining the field—Even though we try to select tools and machines of greatest interest to our readers, there are always more new products out there than we can try. For any one type of tool, there might be a dozen manufacturers that make three, four or more models. Therefore, we limit the number of tools featured in a review by developing a selection criteria to define the field. This allows us to dedicate more space to each model, and discuss its features and performance in greater depth. While criteria vary, we often use price or the tool's size or capacity as a limit, for example, cordless drills that cost less than $150 or tablesaws with 10 in. blades. A well-developed criteria also ensures that the review ends up comparing "apples to apples." But while hobbyists' models usually can't compare to professional tools, there are instances where inexpensive tools turn out to perform as well as their expensive counterparts. In such cases we include them and indicate their excellent value.

Readers sometimes ask, "Why didn't the article include Brand X's new model?" We make every effort to research the field and to include all appropriate makes and models. However, because of the time involved in developing an article, sometimes a new product becomes available only after the evaluations are complete.

The evaluation procedure—Unlike magazines that "review" products by printing the manufacturer's press release, our reviews are evaluations of actual tool performance. And since we don't have the personnel and resources of a true product-testing journal, like *Consumer Reports,* we limit our articles to the author's observations of features, performance and safety, experienced under workshop conditions. When a review is done out-of-house, we choose an author for his or her experience with the type of tool being reviewed as well as experience with the task the tool is used for. *Fine Woodworking*'s editors back up the author's evaluations by trying out the tools at the company woodworking shop. We also often conduct and write these reviews ourselves; each member of the staff has extensive woodworking experience (I had my own professional shop for 10 years). The actual tools used in the review are either borrowed or purchased from the manufacturer; if borrowed, they're returned after the article is completed. And we *never require* a manufacturer to give us a tool to keep; this would exclude smaller companies that couldn't afford to give away their products for review.

A product evaluation typically starts when the tool is removed from the box. There's often a lot to learn from what it takes to get a machine unpacked, assembled and adjusted before it's ready to run. The reviewer then puts the tool through its paces, using it on the job whenever possible. We encourage the reviewer to use the tool in a variety of situations and use it for several months whenever possible. If anything goes wrong with the tool during the review, we report the facts accurately. We do check with the manufacturer in these instances, to determine if the problem is only with our tool or common to that model. There is never pressure from our advertising department to "pull a punch" and leave out negative comments that reflect upon a tool's poor performance—even when that tool's manufacturer is an advertiser in the magazine. The only part of a review that a manufacturer is allowed to see prior to publication is the chart. We do that so data involving a tool's price, motor size, optional features, etc. can be verified and updated.

What's a reader to learn?—I often receive calls from readers who say, "I read your article, but I still don't know which one to buy." We're reluctant to elevate one tool over another, mainly because such declarations are terribly subjective given the diversity of our readership. The combination of features and price that makes one tool best for a professional probably won't make the tool a good choice for a hobbyist. And the same tool isn't always best in different applications. This is why our product reviews try to give you all the insights you'll need to make your own choice about which model will work best in your shop—used the way you want to use it. And, since specific models come and go, developing this sensibility will help you make the right choice when choosing tools in the future.

One of the most positive aspects of carefully and critically examining tools and machines in an article is that it can help readers to spend their money wisely. Few of us have unlimited budgets and can afford to replace a tool that turns out to not perform up to expectation. Just as important, our reviews can help steer you towards an inexpensive tool that's a good value, in lieu of a more expensive model. Working on review articles has taught me that a product isn't always better just because it's more expensive. Sometimes, a product review can help to dispel the advertiser's hype surrounding a new tool or device; pitches are often aimed to make consumers think they can't get along without that new wonder tool. Finally, another good reason to read our product reviews is to learn more about how to use the tools in question. Along with his evaluations of 10 random-orbit sanders on p. 46 of this issue, author Sven Hanson gives a variety of tips and tricks on how to use these new sanders to get the best results. —*Sandor Nagyszalanczy, managing editor*

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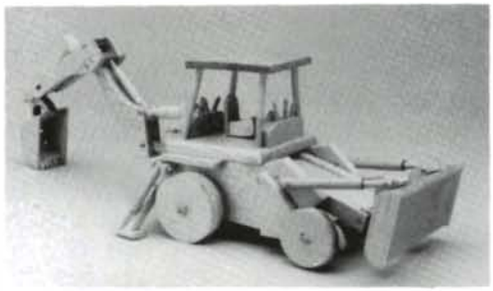

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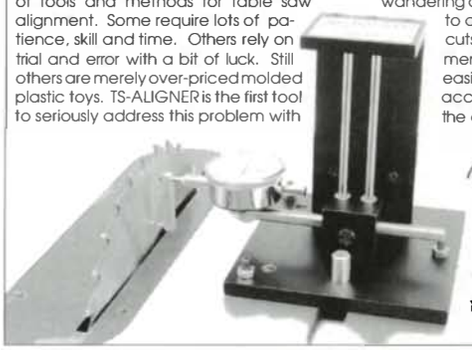

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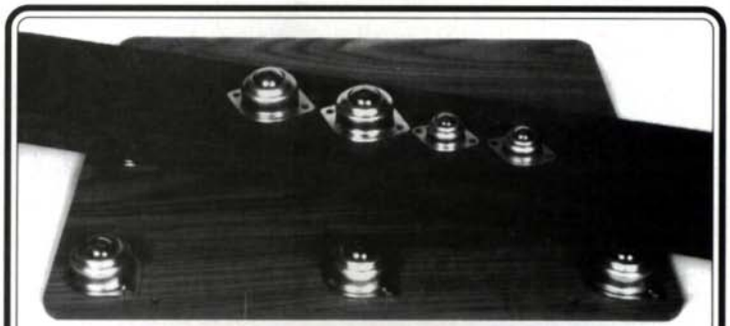

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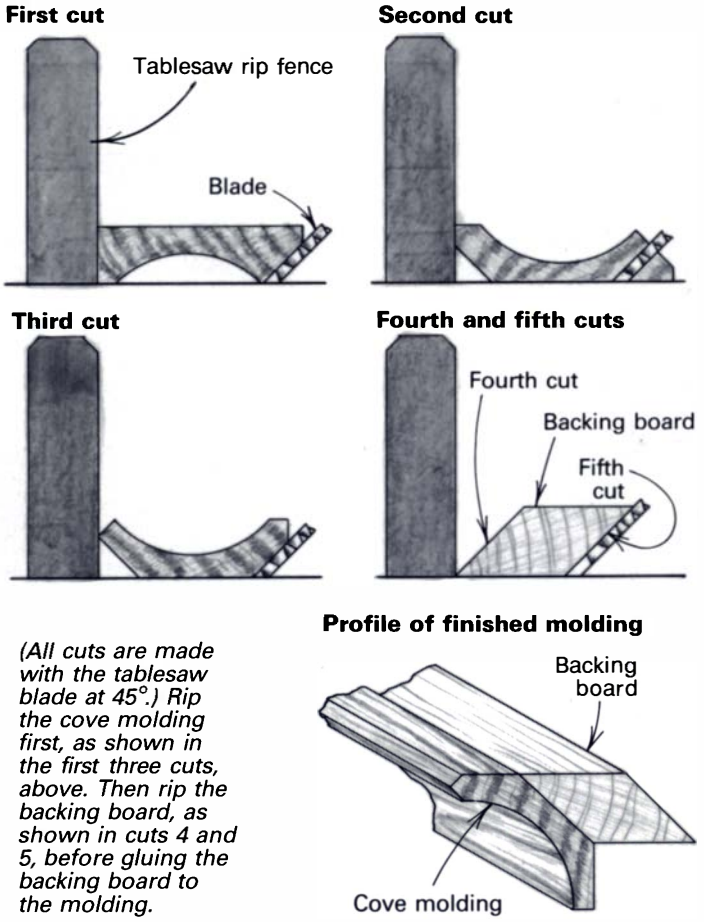
Tilting with a sawblade—It appears that you can't say enough about using woodworking equipment in a safe manner. After I tapered my thumb a few years ago while attempting to rip a bevel along the edge of a board on a 10-in. tablesaw, I researched the cause of the problem. I found the answer on p. 288 of *Cabinetmaking and Millwork* by John L. Freirer. When making bevel cuts on a tablesaw, the blade is supposed to tilt away from the rip fence. Otherwise, the work can bind and pull your hand into the blade.

Having learned this lesson the hard way, I was very concerned to see the drawing in *FWW* #89, p. 83 that shows four different cuts, all with the blade tilted *toward* the fence. I hope that I'm not too late. *—Jay E Rubel, Atlanta, Ga.*

Editors note: It is indeed potentially dangerous to rip a board with the tablesaw blade tilted toward the fence. The drawing in question shows how to make the angled cuts on a shopmade crown molding that is glued to a backing board. Although we illustrated the method that the author actually used, we should have rethought the problem in light of the hazards presented by his method. The drawings below show a safer alternate method for accomplishing this fairly common task. Keep in mind that some tablesaws tilt to the left and some to the right, so making bevel cuts safely on your saw may require a mirror image placement of the fence.



(All cuts are made with the tablesaw blade at 45°.) Rip the cove molding first, as shown in the first three cuts, above. Then rip the backing board, as shown in cuts 4 and 5, before gluing the backing board to the molding.

Support for women woodworkers—I am writing in response to several letters in recent *FWW* issues regarding women woodworkers. I have been a self-employed woodworker for 15 years; and even though I have not had the difficulty with tool size and design that other women woodworkers have experienced, I do realize there is a problem and that it should be addressed by tool manufacturers.

As a woman woodworker, I have been frustrated by the skepticism of potential customers (both male and female) concerning the ability of a woman to design and construct professional, high-quality woodworking pieces. For this reason, I keep a portfolio with newspaper articles about my business and top-quality color photos of my work, which includes everything from turned bowls to dining room tables and chairs. I use this as a marketing tool to provide credibility for my woodworking skills.

I believe articles on women woodworkers offer diversity to *FWW* and simultaneously support and encourage the women who have chosen to make a career of this historically male-dominated field. Perhaps it is a matter of knowing where these women are and exploring the quality of their work.

I would like to establish an informal support network for women woodworkers. If you are interested in participating, write to me at PO Box 182, Allenspark, Colo. 80510. Please provide some general information about yourself and the type of woodworking you do. *—Susan Maxson, Allenspark, Colo.*

Chuck-removal wedges—In the "Q&A" column of the July/Aug. 1991 issue of *FWW*, Robert Vaughan responded to a question about how to remove a chuck from a drill press. I was surprised that he didn't mention using chuck-removal wedges for the job because they are much easier to use than a hammer. Rather than banging away on the chuck with a hammer, you just insert the wedge between the chuck back and the spindle housing to force the chuck free. Be sure to put something under the chuck to catch it when it breaks loose and falls.

Chuck-removal wedges sell for less than $4, and they come in different sizes for different models of chucks. They are available from MSC Industrial Supply Co., 151 Sunnyside Blvd., Plainview, N.Y. 11803. *—J. Grunwaldt, Malvern, Pa.*

Undersize laminate—I recently had a rather unpleasant experience with the use of imported plastic laminate, which may be of interest to cabinetmakers.

While attending the Kitchen and Bath show in Dallas, Tex., this year, I came across several very attractive lines of imported laminate. Some of it came from Canada, and some of it came from Italy—all with striking colors not available from U.S. manufacturers. I found an importer of one of the Italian lines, Abet laminati, and ordered some for my latest kitchen renovation. At 99 cents/sq. ft., plus shipping, it was quite competitive with the American brands, which sell for that and more.

When this beautiful laminate arrived, I was happy to receive it, but when I started working with it, the dream turned into a nightmare. I soon discovered that the imported laminate that I ordered was not the same thickness as American laminate, because my design called for using it side by side on a tabletop. The imported laminate is .030 in., while the domestic is .050 in. The difference is astounding. I solved the thickness problem by putting some walnut iron-on veneer below the Italian laminate to bring it up to the domestic material.

But that was the least of my problems. Handling the thin Italian laminate was an invitation to disaster. If you brush up against it, it will crack; handle it with a crack and you've got two pieces of laminate in your hands.

I recommend that anyone interested in trying a new line of laminate inquire about its thickness. With anything thinner than .050 in., be prepared for a challenging laminating job. I had to throw out almost half of the laminate I ordered due to the tears and rips. *—Art Weiss, Natchitoches, La.*

Further precautions—It was with interest that I read "Losing your nerve" by Robert Feltman in the "Notes and Comment" section of *FWW* #90. All of Mr. Feltman's suggestions for avoiding accidents and for being prepared in case an accident should happen are commendable, and I agree with them.

I also have a couple of other suggestions which may be of value, particularly if you often work alone in your shop. First, install a push-button phone in the shop in a convenient spot—even with severed fingers, you could probably dial 911. Better yet, install an automatic dialer phone and program the first but-

ton for an emergency number. If the above measures are not practical, install a switch to sound an alarm outside the house so that if you get hurt when no one is home, the noise will alert the neighbors to call the emergency service.

I've implemented the first two of these precautions in my shop, and—thank God—I have not been obligated to use them. But there is comfort in knowing they are available.

—Robert J. McNeil, M.D., Cambria, Cal.

The trouble with magnetic tool racks—Carl Dorsch's article, "Making a Chisel Cabinet," in *FWW* #89, reminded me of a situation we encountered in our shop about four years ago. My wife, Michele, is a woodturner, and her first "nice" tool rack incorporated magnetic strips to hold her chisels. At first this seemed to be ideal, since she could remove and replace her tools without taking her concentration from the piece she was turning.

After a while, however, she noticed her tools were becoming slightly magnetized, and so they would no longer move easily on the tool rest. This became a nuisance for her, so she demagnetized her chisels and went back to a wooden rack.

To demagnetize, or degauss a tool, wrap a lamp cord tightly around the length of the tool's shaft, and then plug in the cord and turn the lamp on for a few hours, (or longer for large tools).

—Bruce A. Goddard, Pacific Grove, Cal.

Fingerboard safety—A word of caution regarding the so-called improved fingerboard in *FWW* #90, p. 12, and fingerboards in general when used for ripping on a tablesaw.

When setting up a fingerboard, make sure the workpiece will clear the last finger before the cut is complete. If the fingerboard overlaps the sawblade, finger pressure could force the cutoff piece against the side of the blade and result in a kickback.

I am sure that people who use fingerboards regularly know this, but a newcomer to the idea might overlook it.

—Alan Millard, Sechelt, B.C., Canada

Reglue it right—I usually turn to the "Q&A" column first when I receive a new issue of *FWW*. In issue #90, I found a question about regluing a family heirloom chair without taking it apart. Unfortunately, I found the answer—using cyanoacrylate glue and capillary action—totally misleading.

Repairing a piece of furniture with a product that is not easily removed is just going to cause severe headaches for a future restorer. Cyanoacrylate glue is one of those products. Because of its capillary action, cyanoacrylate is nearly impossible to remove from the wood without causing damage.

In addition, the technique for regluing the chair is wrong. First of all, the cyanoacrylate glue squirted into the assembled joint will, for the most part, be sitting on top of another layer of old glue. This may hold for the time being, but after a few seasons of humidity changes, joint failure is sure to occur. Also, for cleanup of the excess glue, you need to use a solvent such as acetone or an acetone-base cleaner, which can be dangerous to the health of the user and harm the chair's finish.

As for the chair in question, the owner should reglue it properly by disassembling the chair, cleaning the joints of old glue and regluing with animal hide glue or aliphatic resin glue (yellow carpenter's glue). Or she should seek the advice and expertise of a competent furniture restorer.

—Richard Cuddy, Middletown, N.Y.

Using the proper respirator—I would like to comment on the article, "Turbine Spray Systems," in the Sept./Oct. 1991 issue of *FWW*. There are two areas that are misleading and that could have negative health consequences for people using high-volume, low-pressure spray systems for finishing wood products. This method has the potential to produce fine mists of shellacs, lacquers and other finishing materials, as well as vapors from solvents if these products are not water base.

The first problem is with the lead photo which shows a person wearing a single-use dust/mist respirator while using a turbine sprayer. This respirator, while acceptable for low concentrations of some mists, will not protect from lacquer mists or organic vapors in the finishing products. In fact, the organic vapors may wet the respirator, and the person can possibly be exposed to a far greater concentration of vapor than in the air alone. For vapors, an organic-vapor chemical-cartridge respirator is necessary. For lacquer and paint mists, an organic-vapor chemical-cartridge respirator combined with a paint mist prefilter is required.

The second problem is in the caption accompanying the photo. It states that, when compared to conventional high pressure systems, HVLP sprayers offer, "...more efficient delivery of finish with less overspray and fewer toxic fumes released into the atmosphere." However, fumes are not produced by this method. Fumes are very small solid particles that originate from solids (usually metals) that volatilize and then condense and cool in air. Welding is a process that produces fumes, and this distinction is important for making the proper choice of respiratory protection.

—Lori Todd, Ph.D., Chapel Hill, N.C.

A Corian router-table top—I have what I feel is a unique addition to the wealth of information on router tables provided by Ed Walker in his article in *FWW* #90.

While most woodworkers are using either unfinished plywood or a plastic laminate for their router-table tops, I believe that the new solid-surface materials, such as DuPont's Corian, make a better tabletop. Through discussions with fellow woodworkers I've found that plastic laminate used for this purpose usually ends up de-laminating over time. This may be due to usage, damp conditions in the shop or improper application of the laminate to the substrate.

To avoid these problems when I built my router table, I bought a scrap piece of ½-in.-thick Corian for $10 from a local kitchen-remodeling center. I made the router-table top by laminating the Corian to a piece of ¾-in.-thick medium density particleboard. There is no chance that the Corian will curl or buckle, and the particleboard provides a stiff backing in case a heavy object is dropped on the table surface.

Because Corian can be machined with carbide tools, it was no problem to cut and rout a rabbeted opening to receive the router, which I mounted on an 8-in. by 12-in. piece of ⅛-in.-thick aluminum plate. I trimmed the perimeter of the tabletop with poplar to eliminate sharp edges and to minimize chipping. I also routed a slot so that I could use my Delta miter gauge with the router table. I used a pivoting fence that bolts to the table at the near end and is clamped at the far end.

You can write on the Corian with a pencil, and it cleans up easily with most surface cleaners (409 or Fantastik). As an added bonus, scratches can be sanded out as well. I suspect that this table will last indefinitely due to the rugged nature of this solid surface material.

—Raymond S. Tadry, Sterling Junction, Mass.

More tricks of the trade, please—It was a pleasure to see R.A. Sharp's "The last word on finding the radius of an arc" in the "Letters" column of issue #91. I too was amused to see the proliferation of mathematical solutions to this problem in previous issues because I'm one of those folks who tends to remember that there is a mathematical solution, but can never remember what the solution is when I need it. From a practical standpoint, once you've determined the radius of an arc, you still have to draw it, and if it happens to be over 10 ft., it could be difficult to draw. I just knew there must be a better way.

Mr. Sharp's hands-on method for drawing an arc with a given

chord and rise using three nails and a couple of sticks is not only more practical, but it is an example of one of those tricks of the trade that we are all in danger of losing if older craftsmen don't find a forum for passing them on to the new generation of woodworkers. I for one would like to appeal to other elder craftsmen among the readers of *Fine Woodworking* to share their time-proven methods. Otherwise, we may all find ourselves using mathematical formulas and biscuit joinery because we've forgotten how it used to be done.

—James Bartlett, Palouse, Wash.

Follow-up on electromagnetic fields—Stephen Peterson's letter in the Sept./Oct. issue of *FWW* focuses on the concern about possible health effects from exposure to fields generated by electric power tools operating at 60 cycles per second (C/S in the workshop. As an electrical engineer (and a happy woodworker) I have researched this topic over the last two to three years and I would like to offer readers of *FWW* a somewhat different view of the risk expressed in Peterson's letter.

First, it is incorrect to refer to this phenomenon as "radiation." The equivalent wavelength of a 60 C/S field is far too long to cause any radiation (ionization) effects. So the electric field (volts/meter) and the magnetic field (gauss or teslas) can be treated separately.

Second, the current status of research and measurements seem to indicate that there is little, if any, significant effect on the biological system from electric and magnetic fields, although work continues to find and isolate a cause-and-effect mechanism which might link field exposure to health risks.

Further, the statement that a magnetic field measuring 3 milligauss (mG) is acceptable and safe is, in my view, totally without scientific or medical foundation. Perhaps a few comparisons might be helpful here: The Earth's magnetic field (a steady state field) is approximately 500 mG; an electric shaver or hair dryer is over 1,200 mG; house background levels in a typical house are 0.1 to 10 mG; and water pipes can carry "return/leakage" currents which generate up to 30 mG. Squatting down to pick up a piece of wood generates internal body currents several times the induced currents caused by external magnetic fields. Finally, there is some research which suggests that cells are more sensitive to small external fields than they are to large fields. So reducing the external fields in motors may be a bad idea.

It may eventually be shown that external electric and magnetic fields do indeed have an effect on the biological system, but we are far from that state of understanding today. If such a cause-and-effect relationship is established, it would surprise me greatly if it will occupy a position in the top 20 things that place our health at risk today. It seems to me that the sensible approach is to avoid risks which are high on the risk/probability scale, such as driving on Saturday nights when the bars let out; walking in large cities after dark; sunbathing in order to get a tan; smoking; high fat diets and so on. Biological effects of low-frequency fields is so low on an ordered-risk list that I for one am willing to continue to work in my shop with that knowledge in mind.

—Harry L. Hill, Santa Cruz, Cal.

Reinforcing a fold-down futon frame—I liked the design of the futon couch that folds down into a bed described by Gary Rogowski in his article in *FWW* #77, and so I built one for my daughter. I used old-growth Douglas fir instead of cherry, and I replaced the standard bed-rail hardware with stub tenons secured with 5-in.-long bronze carriage bolts and captive nuts.

I was happy with the design, but after less than a year of regular use, the wood dowel pins that slide in grooves in the side rails when the backrest is folded down failed. I had to take the bed apart, replace the wood dowels with 5/16-in.-dia. steel dowel pins, and screw slotted brass plates over the wooden grooves. Since I don't have a machine shop, the job took about 10 hours. I had to make the slots in the 1/8-in.-thick brass plates by drilling a series of holes and then smoothing the sides of the slots with a file.

Because I didn't want to count on the wood to support the steel pins, I also drilled some small brass plates to fit around the pins, mortised the plates into the surface of the wood and screwed them in place. This step possibly could have been omitted, but I wasn't taking any chances. I also let two brass plates into the upper surface of the back rail so when the hinged back of the couch is lowered onto the rail to make a bed, steel pins engage to lock the bed platform against lateral movement.

I still like the design, but my experience has been that wood dowel pins sliding in wood tracks just don't work—or not for very long. *—Simon Watts, San Francisco, Cal.*

Oakland fire destroys luthier's workshop—It's every woodworker's nightmare: a spark from a woodstove that ignites a pile of shavings; oily rags ignited by spontaneous combustion; or the arcing current from an overloaded motor that smolders inside a dusty switchbox. But Ervin Somogyi's guitar shop wasn't undone by sawdust or oily rags. It was consumed from without—vaporized last October by the brush fire that ravaged the hills of Oakland, Cal.

Fire is terribly indifferent in choosing its victims, and in Oakland it paid no heed to the quaility of Somogyi's instruments—some of the finest in the business—or the work unfinished on his bench. Ironically, Somogyi thought more carefully than most about a healthy, safe working environment. Air quality, noise reduction and full-spectrum light were important considerations in his 14-ft. by 19-ft. workspace. In the end, he escaped with his life and five guitars. He had insurance, but nowhere near the $125,000 needed to cover the cost of rebuilding the shop he'd worked in for twenty-one years and to replace the wood, tools and musical instruments that went up in smoke.

Communities are defined by how they respond to hardship. The Amish will raise a new barn to help one of their own. Money won't replace all that Ervin Somogyi lost, but it will go a long way toward helping him build a new shop. If you would like to contribute, checks can be sent to: Friends of Ervin Somogyi (Acct. #0129058871), Elmwood Branch of the Wells Fargo Bank, Berkeley, Cal. 94705. Donations of tools and wood are also welcome. For a list of needed items, contact Ervin Somogyi: 127 Sheridan Road, Oakland, Cal. 94618.

—Scott Landis, Coatesville, Pa.

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, publisher

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9850K	Porter Cable cordless variable speed Drill Kit. Includes extra battery	288	169
9852K	Porter Cable New 9852 Drill Kit Includes: extra Porter Cable battery		188
7334K	Porter Cable 5" Random Orbit Sander with case & 1 roll 100X & 150X discs	253	152
7335K	Porter Cable 5" var. spd Random Orbit Sndr w/cse & 1 roll 100X & 150X discs..	273	162
7336K	Porter Cable 6" var. spd Random Orbit Sndr w/cse & 1 roll 100X & 150X discs..	278	169
555K	Porter Cable Plate Biscuit Jointer with case & 1000 assorted biscuits	339	192
JS100K	Freud Plate Biscuit Jointer with case & 1000 assorted biscuits	351	186
1581VSK	Bosch Top Handle Jig Saw with case & 30 Bosch blades	305	185
1582VSK	Bosch CLIC Barrell Grip Jig Saw with case & 30 Bosch blades	305	185

BIESMEYER FENCES

B-50	50" Commer. Saw Fence	329	295
T-SQUARE 52	52" Homeshop Fence	249	235
T-SQUARE 40	40" Homeshop Fence	242	209

WEDGE SMART LEVEL

SM-TR2	2 FT Level w/sensor	120	105
SM-TR4	4 FT Level w/sensor	150	125
SM-TR6	6 FT Level w/sensor	180	155
SM-PR2	2 FT Pro Level w/sensor		99.95
SERIES200	NEW 2FT Level with sensor		54.95

Msx636 FEIN	Electric Oscillating Triangle Sander Kit	Sale	279
LPN672 PONY	Air Palm Nailer w/glove	Sale	94.99

JORGENSEN ADJUSTABLE HANDSCREWS

Item#	Jaw Length	Open Cap	List	Sale	Box of 6
#0	8"	4-1/2"	19.00	11.95	62.95
#1	10"	6"	21.76	12.99	71.49
#2	12"	8-1/2"	24.95	15.95	81.89
#3	14"	10"	31.61	18.95	104.95

JORGENSEN STYLE 37 2-1/2" Throat 1/4"x3/4"

Item#	Jaw Length	List	Sale	Box of 6
3706	6"	9.86	6.49	36.55
3712	12"	10.92	6.99	39.75
3718	18"	12.05	7.75	42.99
3724	24"	13.16	8.39	47.75
3730	30"	14.70	9.55	53.45
3736	36"	16.05	10.39	58.75

PONY CLAMP FIXTURES

Model		List	Sale	Lots of 12
50	3/4" Black Pipe Clamps	13.61	7.99	84.99
52	1/2" Black Pipe Clamps	11.37	6.50	69.50

BOSCH

1581VS	Top Handle Jig Saw	265	132
1582VSC	NEW CLIC Barrell Jig Saw	265	132
	Bosch Metal Case for above Jig Saws	34	30
	Bosch 30 blade assortment for Jig Saws		25.99
1942	Heat Gun 600° - 900°	111	69
1272D	3" x 24" Belt Sander with bag	329	172
1273D	4" x 24" Belt Sander with bag	345	178
11-212VSR	Bulldog 3/4"SDS Rtry Drill	370	189
1194VSR	1/2" var. speed Hammer Drill	264	155
1194VSRK	above Hammer Drill w/case	292	179
1608	5.6 amp Laminate Trimmer	149	89
1609K	I.am Installers Kit with 1609	309	168
1601	1 HP Router	184	108
1602	1-1/2 HP Router	215	124
1603	1/2 HP D-handle Router	252	143
1604	1-3/4 HP 2 Handle Router	236	118
1604K	Same as above w/cse & acc.	287	165
1606	1-3/4 HP D-handle Router	273	155
3258	3-1/4" Planer w/blade guard	239	137
3258K	3258 Planer w/steel case	265	144
3270D	3" x 21" Belt Sander with bag	260	144
1273DVS	var. spd 4" x 24" Belt Sander	370	189
1611	3 HP Plunge Router	386	205
1611EVS	3 HP variable speed Router	448	232
1651	7-1/4" Circ. Saw drop foot	179	109
1632VSRK	Recip Saw 8.4A orb-v/sp	225	148
3050VSRK	9.6V cdls v/sp Drill Kit comp	256	132
1370DEVS	6" Random Orbit Sander w/case, sandpaper, sponge pad & buffing pads	481	259
3283DVS	5" Random Orbit Sander	159	104
3283DVSK	3283DVS Kit	220	129

ELU BY BLACK & DECKER

Model		List	Sale
3338	2-1/4 HP v/spd Plunge Router	427	259
3304	1 HP var. spd Plunge Router	292	185
3375	3-1/8" Univ. planer 7.2 amp	313	159
3380	Biscuit jointer with case	542	258
4024	3 x 21 var. speed Belt Sander	322	199

BLACK & DECKER

1166	3/8" Drill 0-2500 rpm 4 amp	100	65
2600	3/8" Drill 0-1200 rpm 4.5 amp	142	84
1703	10" Mitre Saw w/73-770 blde	313	179
2694	NEW 7-1/4 Super Sawcat.	248	154
2695	NEW 8-1/4 super Sawcat.	271	158
4011	1/4 sheet Palm Sander	82	59

JET TOOLS

JBS-14CS	NEW 14" Band Saw 1 HP	579	405
JTS-10	10"Table Saw w/std 1-1/2 HP	585	469
JJ-8	8" Jointer 2 HP	1325	975
DC610	1 HP Dust Collector	321	225
DC1182	2 HP Dust Collector	577	405
JJ-4	4" Jointer 1/2 HP	398	295
JJ-6CS	NEW 6" Jointer 3/4 HP	579	405
JWP12	12" Portable Planer	628	355
JSG-6	6" x 48" Belt & 12" Disc Sndr	749	499
JDP10	NEW 10" Bench Drill Press	209	179
JDP14M	NEW 14" Bench Drill Press	339	285
JDP17M	NEW16-1/2"Bench Drill Press	399	359

RYOBI SPECIALS

JP-155	6-1/8" Jointer/Planer	611	295
R500	2-1/4" HP Plunge Router	331	139
TS-254	NEW 10" Mitre Saw	397	198
TS-254K	above Saw with acc. kit & B&D 73-770 carbide blade	495	245
AP10	10" Surface Planer 13 amp	820	349
RA200	8-1/4" Radial Arm Saw	520	245
RE600	3 HP Plunge Router	431	205
BE321	3" x 21" var. spd Belt Sander	272	129
SC160	NEW 16" Bench Scroll Saw	261	139
TFD170VRK	9.6V cordless Drill Kit	292	145
TFD220VRK	12V cordless Drill Kit	325	165
JM100K	NEW Biscuit Jointer w/case	431	209
RS115	NEW4-1/2"v/sp Rdm Orb Sndr	134	75
BT3000	NEW 10" Table Saw	699	549
W660	BEST BUY 7-1/4"Circ Saw 13A	179	88
TSS220	NEW 8-1/2" Slide Comp. Saw	790	449

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690	1-1/2 HP Router 8 amp	240	134
691	1-1/2 HP Router D-handle	260	142
695	1-1/2 HP Router/Shaper	335	204
696	HD Shaper Table	185	119
351	3" x 21" Belt Sander w/o bag	245	134
352	3" x 21" Belt Sander with bag	255	139
360	3" x 24" Belt Sander with bag	330	177
361	3" x 24" Belt Sander w/o bag	310	169
362	4" x 24" Belt Sander with bag	345	184
363	4" x 24" Belt Sander w/o bag	330	179
315-1	7-1/4" Top Hdle Circular Saw	210	116
9315-1	315-1 comp. w/cs & carb bld	240	129
617	7-1/4" Pushhandle Saw	210	116
9617	617 comp. w/cse & carb blde	240	133
314	4-1/2" Trim Saw	240	138
97750	1/2" v/spd Hammer Drill w/cse	260	159
9548	X HD Bayonet Saw w/case	320	195
9629	Recip Saw var. speed 8 amp	250	142
9627	Recip Saw 2 speed 8 amp	235	132
666	3/8" HD v/spd Drill 0-1200 rpm	200	125
621	3/8" HD v/spd Drill 0-1000 rpm	170	98
320	Abrasive Plane 3 amp	190	113
9118	Porta Plane Kit 7 amp	360	195
7545	0-2500 Drywall Gun 5.2 amp	185	114
505	1/2 sheet Pad Sander	210	112
7511	3/8" var. speed Drill 5.2 amp	200	112
7514	1/2" var. speed Drill 0-750 rpm	210	117
7515	7514 with keyless chuck	215	122
7549	Top handle Jig Saw 4.8 amp	250	149
330	Speed Block Sander 1/4 sheet	102	55
555	Plate Biscuit Jointer w/case	315	165
345	6" Saw Boss 9 amp	180	99
9345	345 comp. w/cse & carb blde	220	124
100	7/8 HP Router	175	118
5116	Omni-Jig	400	249
9647	TIGER CUB Recip. Saw	195	115
9637	Full var. s pd Recip Saw 8 amp	250	135
7519	3-1/4 HP Router 2 Handle	410	224
7518	3-1/4 HP 5 speed Router	475	259
7536	2-1/2 HP 2 Handle Router	355	199
7537	2-1/2 HP D-Handle Router	375	209
7538	3-1/4 HP Plunge Router	410	224
7399	5.6 amp Drywall Cutout Unit	140	79
7310	5.6 amp Laminate Trimmer	150	85
7312	5.6 amp Offset Base Lam Trim	215	119
7319	5.6A Tilt Base Lam Trimmer	170	105
97310	Laminate Trimmer Kit comp	345	185
7334	5" Random Orbit Sander	210	119
7335	5" var. spd Rndm Orbit Sndr	230	129
7336	6" var. spd Rndm Orbit Sndr	235	134
73333	NEW Dust Collection system		24.50
693	1-1/2 HP Plunge Router Base	295	165
6931	Plunge Router Base	120	75
7539	NEW3-1/4HP v/sp Plge Router	475	265

NEW CORDLESS

9850	12V 3/8" Drill w/cse 0-400 rpm	240	135
9851	9850 with keyless chuck	240	135
9852	12V 3/8"Drill w/cse 0-1000rpm	210	159
9853	9852 with keyless chuck	210	159
9854	12V 1/2" Drill w/cse 0-360rpm	280	165
8500	12 volt battery for above drills	62	37

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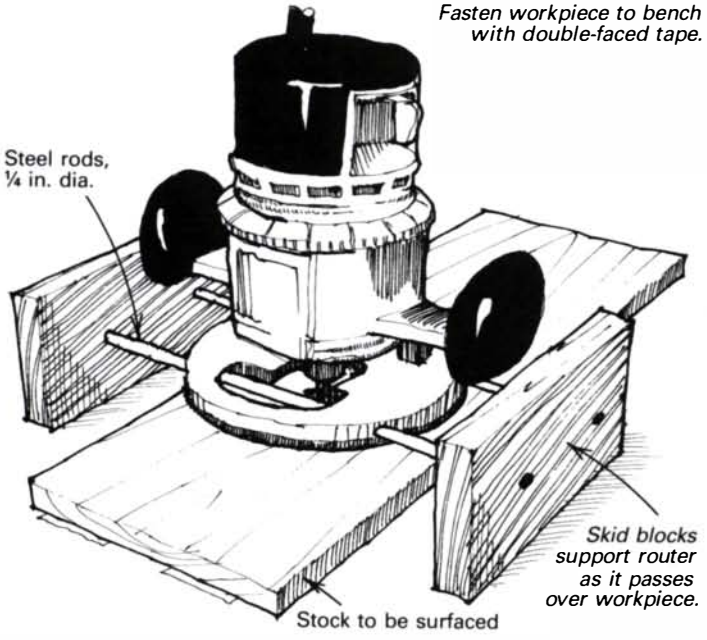
edited and drawn by Jim Richey

Surfacing small pieces with a router

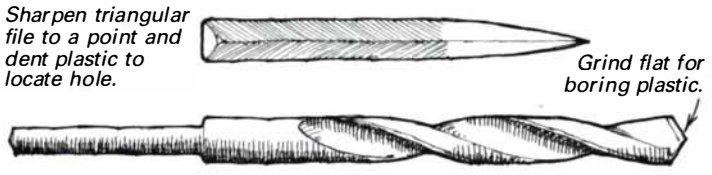


I recently needed to thickness-plane some small pieces of cherry to make a box. I don't have a planer, but I did the job quite satisfactorily using my router and the simple jig shown in the sketch.

To make the jig, run two ¼-in.-dia. steel rods through the guide holes in the router base. Tap the ends of the rod into ¼-in.-dia. holes bored into two wooden skid blocks that are large enough to hold the router above the workpiece to be surfaced. Then, chuck a ¾-in.-dia. carbide-tipped straight bit in the router.

Before using the jig, resaw the workpiece to the approximate thickness that you need, and fasten the wood to the benchtop, rough side up, with double-faced tape. Then move the router jig over the rough surface of the board, taking a light cut with each pass. It only takes a short time to surface and thickness the workpiece. *–Richard Adler, Gulf Breeze, Fla.*

Modifying drill bits for plastic



Many woodworkers use plastics for jigs and fixtures that require that holes be drilled in the material. The problem is that most plastics are liable to crack or split if they are drilled incorrectly. You could probably use a regular twist drill up to ⅛ in. dia. without trouble, but larger bits tend to grab as they break through the plastic. You can prevent this problem and obtain clean, smooth holes by honing a flat on the cutting edges of the bit, as shown in the sketch.

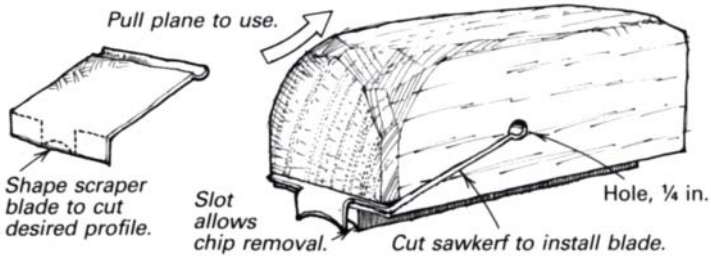
To accurately start a hole in plastic, you need to make a small dent in the material for positioning the drill point. Do not use a center punch, as you might do on metal, because the plastic is likely to crack from the force of the punch. Instead, make a dent in the surface with a piece of an old triangular file, which has been ground to a point as shown. Press and rotate the file backwards and forwards to make a dent.

–Percy W. Blandford, Stratford-upon-Avon, England

Quick tip: A great non-slip surface for holding wood for sanding and shaping is Slip-Stop (Camco Manufacturing Inc., 121 Landmark Drive, Greensboro, N.C. 27409). The rubbery, porous material, which comes in rolls, is often available from dealers carrying supplies for recreational vehicles.

–Kenneth C. Palmer, Lakeland, Fla.

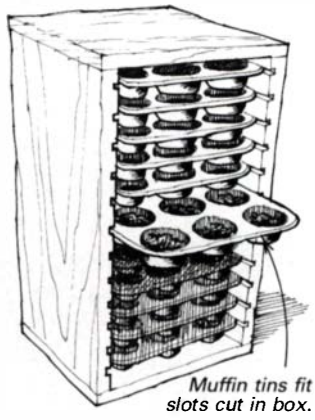
A devil of a scraper plane



When I need to cut a simple bead or groove in a workpiece and can't use a router, I make a scraper plane using Red Devil brand scraper blades. These steel blades, which are available at most hardware stores, are easily shaped and sharpened with a file. To make the body of the plane, drill a ¼-in.-dia. hole through a hardwood block and saw a kerf into the hole so that you can fit the blade into the block, as shown in the sketch. Shape the sole of the plane to match the contour of the blade and to adjust the depth of cut. Also, leave a 3⁄16-in. slot in front of the cutting edge to facilitate chip removal. *–Alden Trull, Union, Maine*

Quick tip: A good way to keep laminates separated from the underlying surface when gluing with contact cement is to place strips from old venetian blinds between them. When the laminate is properly positioned, the wide, thin strips can be easily removed. *–J.A. Wilson, Lexington, Mass.*

Hardware storage rack



In our antique-auto restoration shop we need a large inventory of standard screws, nuts, bolts and washers in a variety of sizes. When we finally got tired of messing with those flimsy metal cabinets with the little plastic drawers, we built this rack for storing hardware in muffin tins. The rack itself is a simple box with grooves cut into the sides; you could build it any way you want. The main advantages of our setup are compactness, sturdiness, visibility of hardware (when the drawer is pulled out) and number of bins. Our rack uses 12 muffin tins, each with 12 compartments, giving us an ample 144 bins per unit. The muffin tins retail for around $4, so it is worth watching for a sale or scouting up a wholesale price.

–Durward Brown and Wallace Wiebe, Alva, Okla.

Quick tip: Plane a flat on the handles of narrow chisels and gouges to keep them from rolling around or off the bench. If the flat is aligned with the underside of the blade, it will also position the tool so that you can pick up the tool the right way without looking.

–Percy W. Blandford, Stratford-upon-Avon, England

Quick tip: You can recycle dirty mineral spirits by letting the liquid set in a cool spot for a couple of weeks. Decant the clear stuff into an old mineral-spirit container, and then dispose of the residue. *–Gene Thoma, New Brighton, Minn.*

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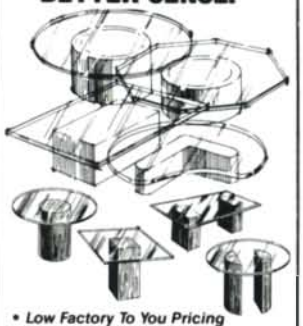

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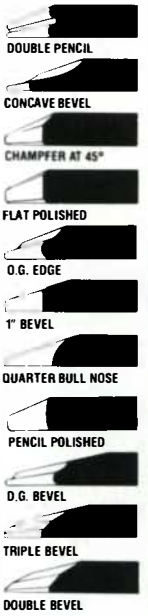

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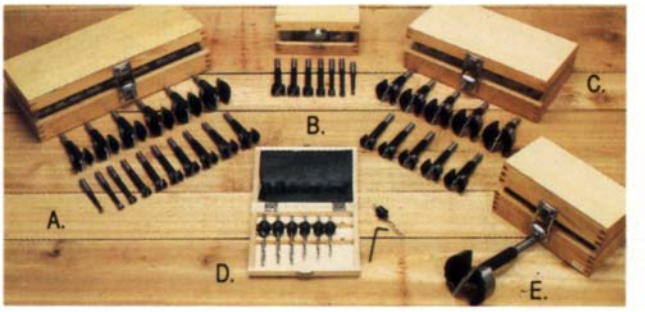

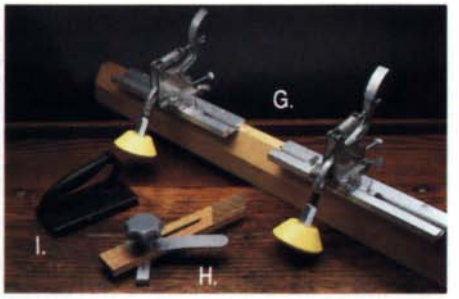

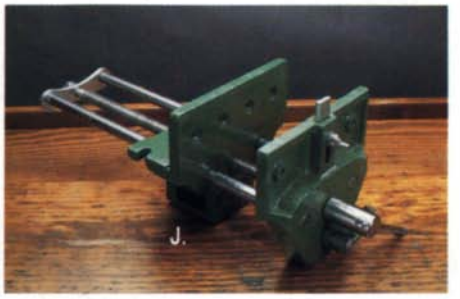

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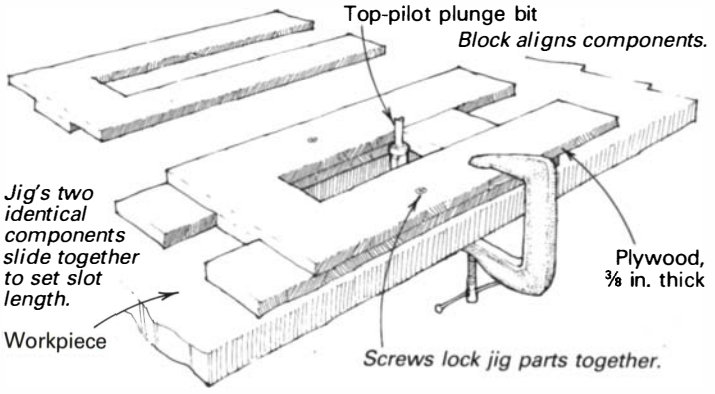
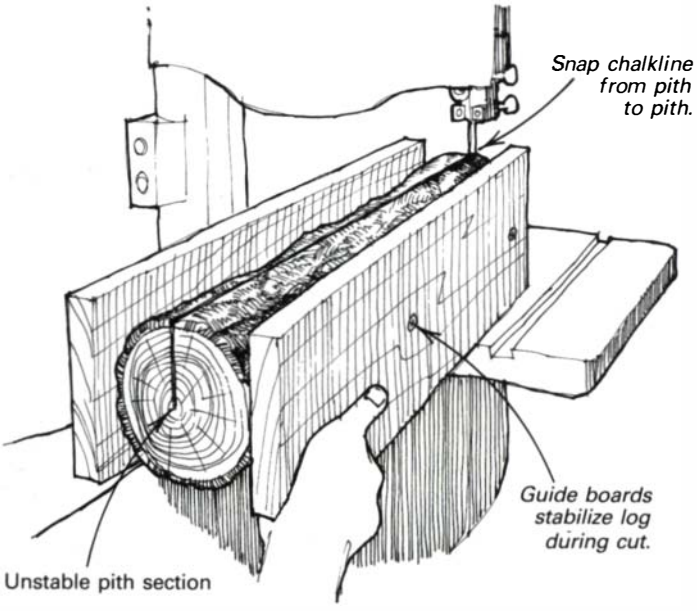


I build cabinets for audio, video and computer equipment. Each cabinet must be equipped with different-size access slots, depending on the equipment to be stored. To cut the various lengths of slots required, I came up with the router jig in the sketch. The jig, which I've found saves time and gives good results, is based on the two interlocking, identical parts cut from ⅜-in.-thick plywood. A block glued to each U-shaped component aligns the pieces as they slide together. For best results, the pieces must fit together snugly.

To use the jig, slide the halves to the desired slot length, secure the assembly with two screws and clamp it down in the desired location. I use a plunge router with an Amana top-pilot (on the shaft) flush-trimming plunge bit, which has several advantages over a standard router fitted with guide collars or bushings. First, with a plunge router, you can rout the slot incrementally without having to stop and reset the cutting depth, and second, with a flush-trimming bit, you don't have to widen the jig slot to compensate for the collars. I have made several jigs for various slot widths, but the 1¼-in. width gets the most use.

—Warren W. Bender Jr., Medford, N.Y.

Ripping logs on the bandsaw



Here's an easy, accurate way to rip short logs on the bandsaw to make bowl blanks. First, determine the best line through the length of the log, and then place the log on the saw table

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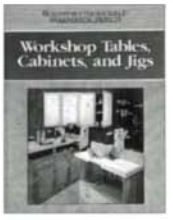

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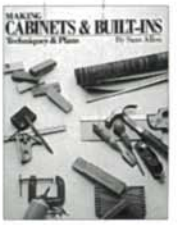

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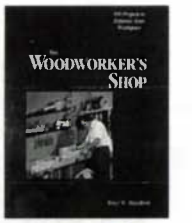

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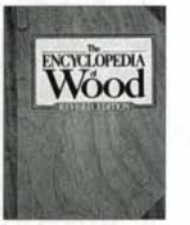

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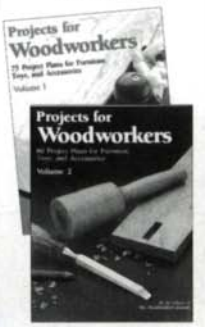

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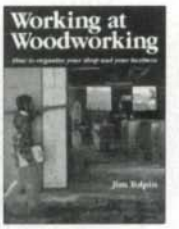

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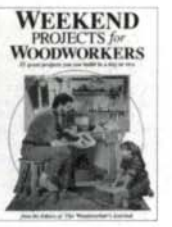

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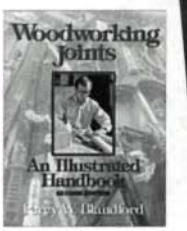

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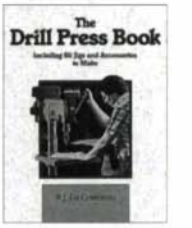

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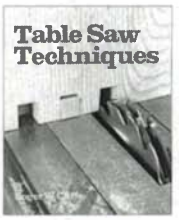

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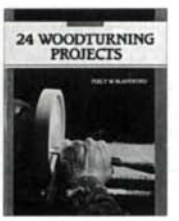

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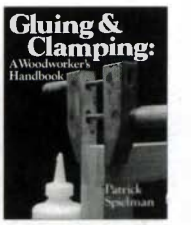

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or other flat surface, so it is lying just as you want it to go through the saw. Cut two 1x10s about as long as the log, and secure one of these pieces to each side of the log with drywall screws. The bottom edges of these guide boards should rest on the saw's flat surface, to stabilize the log.

Now drive a nail into the pith on one end of the log. Stretch a chalkline from this nail down the length of the log, center it on the pith at the opposite end of the log and strike the line. Carefully following this chalkline, rip the log. Sawing through the pith, which is prone to crack as the wood dries, ensures that this unstable section won't end up in the finished bowl. Remove the guide boards and rip the halves again with the first-cut surface held against a fence set so the saw will take ½ in. or so off what will be the bottom of the bowl. This gives you a flat surface to set on the saw table when you cut out the round bowl blank and provides enough space for attaching a lathe faceplate. *–Floyd Rogers, Lewisville, N.C*

Quick tip: To prevent tools from rusting in a canvas tool roll, soak the canvas in clear kerosene and let it dry.

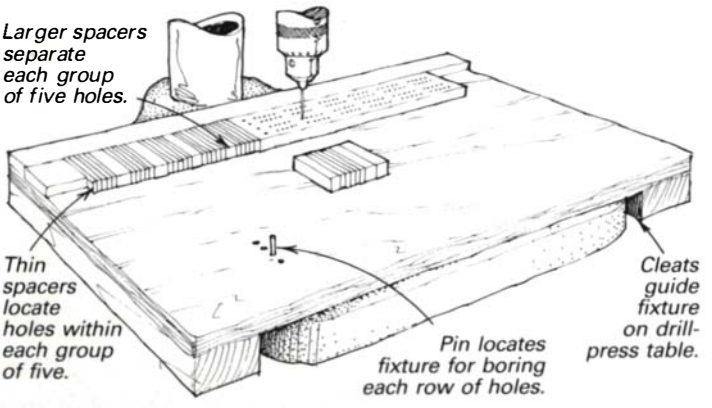
–Ken Klosterhaus, Romeo, Mich.

Quick tip: To stop tools from rusting, spray your tool roll with a silicone-base, water-repellent fabric spray. The spray reduces the amount of moisture that the roll picks up from the air.

–Robert Davidson, Traverse City, Mich.

Quick tip: A bench grinder will heat up tool steel very quickly. To avoid overheating a tool when sharpening, work on two tools at a time; when one starts to feel warm, set it down and pick up the other. *–Dario Biagiarelli, Kirkville, N.Y.*

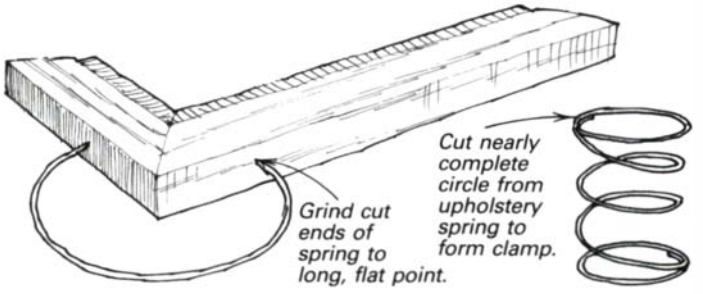
Drilling cribbage-board holes



Drilling holes in a cribbage board is time-consuming and very exacting. The fixture shown here produces fast, accurate holes by using small spacers to locate them. Four thin spacers are used for the holes within each group of five, and every fifth spacer is thicker, to set the wider areas between the groups of five. To use the fixture, put all the spacers in place and line up the bit with the first hole. Then drill the first hole, remove one spacer, move the board to the left, drill the next hole and move the board again. Repeat this process until you have completed the row. Realign the jig and replace the stack of spacers to begin the next row. One good method for locating subsequent rows is to slide the jig toward the drill-press post and pin it in place. The whole operation is almost as much fun as playing cribbage.

–Charles W. Whitney, Mount Vernon, Ohio

Clamping picture frames with coil springs

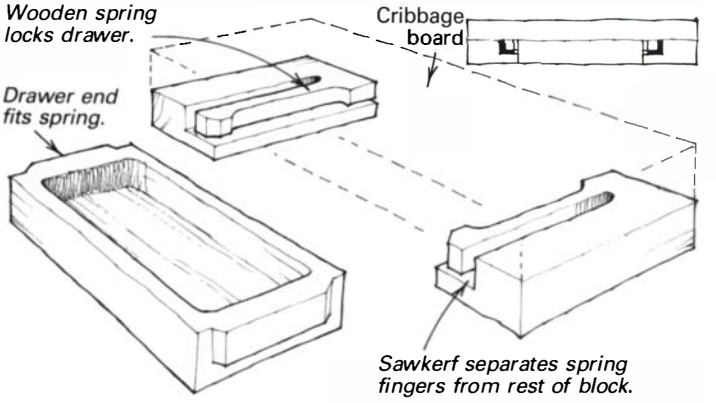


Here's a method for clamping picture frames that I learned years ago at the shop of a New York City framemaker. Use spring clamps made from upholsterer's coil springs to exert pressure. The sharpened ends of the circular springs bite into the sides of the mitered frame pieces putting pressure exactly where it's needed—on the glued miter.

To make the rings, saw nearly complete circles from the coil springs. Then carefully sharpen the cut ends on a belt sander or grinding wheel to form long, flat points. Two upholsterer's coil springs will yield two or three complete sets of four spring clamps of various sizes and tensions. *—Steve Manville, Amagansett, N.Y.*

Quick tip: Putting fresh sandpaper on an orbital sander can be frustrating if you start with the paper slightly misplaced. I keep handy a piece of plywood the same size and thickness as the sander pad. Fit the paper to this block, carefully creasing the four 90° bends. After that it easily falls in place on the sander pad and clamps down smooth and tight. *—Joseph T. Logan, Easton, Md.*

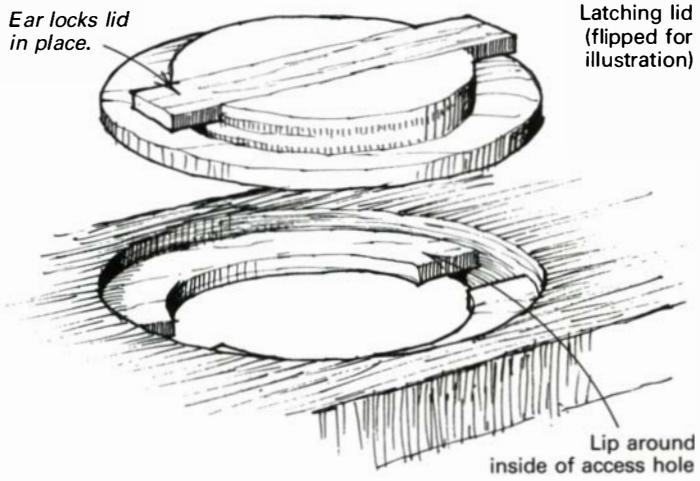
A wooden spring drawer latch



This cribbage-board drawer slides into the board and is held in place with wooden springs. The springs are wooden fingers routed into small blocks attached to the bottom of the board. To make the fingers, rout the indentations on the outside of the fingers that will hold the drawer in place. The cut should be about half the thickness of a 3⁄16-in.-dia. bit. Then, with the same bit, rout the slot that creates the finger in one pass, starting from the outside and moving to the root of the finger. Separate the finger from the rest of the workpiece, as shown above, by making a pass with a thin-kerf blade on a tablesaw. To tune the fingers to the proper tension, change the thickness of the shaft of the finger. Be careful, even a small change will affect tension. Straight-grain woods with good split resistance, such as maple or ash, are excellent choices for these springy fingers.

—Michael O'Banion, Westminster, Md.

Router-made latching lid



I designed this circular latching lid to conceal the access compartment in the back of a clock, but it could be used in other applications as well. The latch is milled almost entirely with a router pivoting on a trammel point. The dimensions here are based on using ¾-in.-thick material.

Start by drilling a small hole for the trammel point through the panel to be accessed. Pivoting your router around this hole, rout a circular groove ¼ in. deep with a ¾-in.-dia. straight bit. The outside diameter of this groove should be about 1½ in. larger than you want the access hole to be. Without changing the depth setting, turn the workpiece over and rout a groove on the other side using the same pilot hole and trammel setting. Now decrease the trammel radius by ¾ in. (the bit diameter) and rout a circular groove at progressively deeper settings until you're all the way through the workpiece. This will leave a ¼-in.-thick by ¾-in.-wide lip around the inside of the access hole.

To make the lid, use the trammel to rout a disc from separate stock that will fit snugly in the recess of the access hole. Next, decrease the trammel's radius by ¾ in. and rout a circular rabbet ½ in. deep on what will become the inside of the lid.

Once the pieces fit together satisfactorily, rout a straight groove ¾-in.-wide by ¼ in. deep across the inside of the lid. Glue a strip of solid wood in this groove to make the latching ears, as shown in the sketch. Mark where the ears contact the lip around the inside of the access hole and remove these two areas with a coping saw. You should now be able to push the lid flush with the back and lock it by turning. To complete the lid, add a handle, and wax the parts for easier twisting and removal. —

Russell Salter, Pittsburgh, Pa.

Quick tip: Here's a trick that makes it easy to square up a stack laminated block. When preparing the laminates, leave the bottom board slightly wider than the rest, with one long edge machined straight and square. During glue-up, have the squared edge proud of the rest of the stack, and then run this edge against the tablesaw rip fence to square the other side.

—Dario Biagiarelli, Kirkville, N.Y.

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Storing cyanoacrylate glue

I am having a storage problem with the various brands of cyanoacrylate adhesives. Once I open the bottle, I end up throwing away about half of the container because it dries up—no matter how tightly I fasten the plastic cap. Are there any tips on how to store this glue?

—David M. Levin, Longboat Key, Fla.

George Mustoe replies: Unlike most common adhesives, cyanoacrylate "super glues" set up due to chemical reaction rather than evaporation of a solvent. This solidification can be triggered by traces of various naturally-occurring catalysts, but the substance that's most likely to be responsible is plain old water. In your case, the glue probably petrifies from humid air that enters the bottle every time you remove the cap. Companies tend to market a small volume of cyanoacrylate in a container that includes a large volume of air, and as you've discovered, it's the half-empty bottles that go bad.

Shelf-life problems are particularly likely in a region such as Florida, where the warm coastal climate means high humidity. In dry parts of the country, cyanoacrylate glues usually have a longer shelf life. As you've observed, a tight-fitting cap doesn't eliminate the problem, though it can help in environments where airborne moisture is only an intermittent phenomenon.

There are several strategies you can try to extend the glue's storage life. One possibility is to search for the driest possible site to keep your adhesive supply—a high shelf in a heated room may be much less humid than a workshop located in a basement or attached garage. Another approach is to create a desert-like environment by keeping the glue container in a tightly-sealed jar along with a packet of granulated silica gel, a drying agent sold at some camera stores. These packets are also commonly included in cartons used to ship electronic products, so you might be able to get them free at the nearest computer or stereo dealer. Remember, though, the silica gel won't have any effect unless the glue container is left partly open to allow free air circulation within the sealed jar.

[George Mustoe is a geochemistry research technician at Western Washington University in Bellingham, Wash.]

Restoring an oak relic

I am restoring a Civil War cannon for a town in Iowa with a carriage made of native burr oak. When completed, the cannon will be constantly exposed to weather, and the wood will be painted. Could you recommend a wood-preservative product I could use under the paint to prevent deterioration?

—H. Richard Fishbaugh, Shenandoah, Ia.

Chris Minick replies: Achieving a durable, exterior paint job is a multi-step process. The U.S. Forest Products Laboratory in Madison, Wisc., recommends a three-step procedure: Treatment with a water-repellent preservative, followed by priming and two coats of a high-quality exterior paint. Water-repellent preservatives containing pentachlorophenol (such as Penta) are no longer available, but any preservative that contains copper naphtenate or copper-8-quinolinolate will function equally well. The Cuprinol line of water-repellent preservatives, manufactured by Darworth, Inc. (Box K, Tower Lane, Avon, Conn. 06001), contain the mentioned chemicals. These products are available at most hardware stores and home centers. Soaking the wood in preservative is by far the best method for treatment. Allow the preservative to dry for several days before proceeding with the finishing sequence.

Two coats of exterior-grade primer should be applied next. Tests conducted by the U.S. Forest Products Laboratory indicate that a pigmented-shellac primer provides excellent protection against moisture vapor transmission, the enemy of all exterior-paint jobs. BIN White Pigmented Shellac Primer Sealer (made by William Zinsser & Co., Inc., 39 Belmont Drive, Somerset, N.J. 08873) would be a good choice for your project.

Finally, apply two coats of exterior paint. It matters little if the paint is oil base or water base, equivalent results can be expected with either coating. My personal preference would be a 100% acrylic latex paint. The acrylic systems provide excellent protection from the elements and resist yellowing better than most oil-base systems. It's worth mentioning that a wealth of wood finishing information can be obtained by writing to the U.S. Department of Agriculture Forest Service, Forest Products Laboratory, Madison, Wisc. 53705. Ask for the wood-finishing list of publications. Most pamphlets are free or available for a minimal cost.

[Chris Minick is a product development chemist and amateur woodworker in Stillwater, Minn.]

Choosing a long-lasting boat finish

I just purchased a sailboat with a 28-ft.-long mast made of sitka spruce, and I'm in a quandary as to the best way to finish it. The previous owner refinished the mast every one to two years with a clear spar varnish, but is there a longer-lasting clear finish? It's troublesome to remove the mast and take it home each year or two to refinish it.

— David P. Biddle, Natural Bridge Station, Va.

Michael Dresdner replies: Spar varnish originally gained popularity among boatbuilders because its high degree of flexibility allowed it to last through the drastic changes in humidity a boat encounters. However, spar varnish is hardly the most durable of finishes. Recently, molecular architects have developed new and better polymers that combine durability with flexibility and throw in many favorable exterior properties as well.

Your best bet for longevity is a water-base aliphatic polyurethane, such as Hydrocote Polyshield (available from Highland Hardware, 1045 N. Highland Ave. N.E., Atlanta, Ga. 30306, 404-872-4466). Avoid aromatic urethanes since they are not ultraviolet (UV) light stable. Whichever product you choose should have UV absorbers as well as hindered amine light stabilizers (HALS) for the optimum life expectancy. In use, don't be surprised to see one of these finishes lasting at least three times as long as spar varnish. Don't be too hasty to get your mast back on the boat, though. While these water-base polyurethanes dry very quickly initially, they take at least 30 days to fully cure and should not be subjected to the elements sooner than that.

[Michael Dresdner is a finishing consultant, woodworker and author in Perkasie, Pa.]

Fixing a tippy table

I have recently completed a 48-in.-square oak dining table that has a split pedestal with two leaves. Unfortunately, the table is prone to tipping when even a small amount of pressure is applied to an edge or corner. Is there a mathematical formula to use in determining the minimum footprint the base must have to ensure stability of the table?

—Robert H. Wood, Oneonta, N.Y.

Richard Starr replies: I don't know a mathematical formula that will assure you of creating a stable table, but I can suggest some ways of thinking about the problem and designing your way around it. The most practical way to add stability to a pedestal table is to make the base very heavy; cafe tables have flat cast-iron bases to give them stability with plenty of legroom. Weighting the base is fine for small tables, but the weighty base required for a dining table would make the table very hard to move.

Regardless of whether you are designing a table with a pedestal base, a trestle or legs, think of each point of contact between the base and the floor as the end of a foot. The distance the tabletop extends beyond the perimeter of the feet (or footprint) is the overhang. The larger the overhang, or greater the weight that you set on the overhang, the greater the risk of overturning the table. The height of the table with respect to the footprint

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also affects stability. Even if you fastened legs at the corners of the top, a very tall table with no overhang could tip easily. That's why the footprint of a tall stool is usually larger than its seat. Increasing overhang and height may make a table easier to tip over, but if you make the table longer without increasing the height, you can get away with a lot more overhang on the long ends. That's because most of the table's weight (and its center of gravity) is further from the ends and, therefore, is more difficult to lift, which helps keep the table flat on the floor.

The number of points in contact with the floor in the footprint also affects stability. Euclid taught us that three points define a plane, so all three legs are always in contact with the floor, no matter how uneven it may be. That's why photographers use tripods, and why three-legged tables or stools don't wobble. Unfortunately, all other things being equal, a three-legged table or stool is more likely to tip over than one with four legs. Why? Because when an object tips over, it rotates on the ends of two of its legs. Think of the line between the leg ends as a hinge between the table and the floor. The hinge between the legs of a three-legged table is closer to the center of the footprint than that of a four-legged table with roughly the same size footprint. The further from the center, the more leverage it takes to tip the item over.

Add a fifth leg and the hinge gets even further from the center. Keep adding legs, and the legs will form a circle, which is the most stable shape for a footprint, since the hinge is a single point on the circumference as far from the center as it can be. But the disadvantage of multiple legs, or a full circular pedestal, is that the object will be more wobbly on an uneven surface. Further, you'll probably limit legroom.

To solve the problem with the table you've already built, you'll need to redesign the structure of your table and attach longer legs on your pedestal. To help locate where the points of contact of the table's new footprint should be, temporarily prop four scrap 2x4s (one for each foot) under the tabletop, and then try leaning on the top. Start by placing the 2x4s near the top's outer edge, keeping them perfectly vertical. Gradually move them inward until you find the point where the table is not too tippy. Then attach feet to the pedestal that protrudes to reach the points where the 2x4s contacted the floor.

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

The best tool steel for woodturning

While recently perusing a tool catalog, I read about a tool steel grading system for high-speed steels (HSS), listing the various types: T-1, M-2, M-4, A-11. While each steel seemed to be better than the one listed before it, which one do you think would be the best for woodturning tools?

—Wm. Stephen Fichter, New York, N.Y.

Jerry Glaser replies: All tool-steel manufacturers use standard tests to grade the steels for a number of important characteristics. Some of these tests compare the wear resistance and toughness of one steel against another—one important criteria for selecting a high-quality tool steel. It is the results of these tests that tool companies often use in making claims for the superior wear resistance of A-11 steel. In industry, A-11 is used in various cold-work applications where wear resistance, therefore tool life, is critical. These uses include powder compacting tooling, fire blanking and punches and dies.

The natural question is, why not use A-11 for everything and dispense with all the other tool steels entirely? The reason is that wear resistance is only one factor for selection, albeit an important one. A-11's usefulness as a steel for woodturning tools is supported by several tests conducted by production turners which demonstrated A-11's edge-holding properties. But since the casual turner might find it difficult to assess the value of a particular tool steel by reading technical test data, I decided to ask a production turner to make 88 balusters out of redwood. All were the same design and turned at the same speed, but using three gouges: one made out of M-2 steel, one out of CPM M-4 and the third out of A-11. The M-2 cut 12 balusters before it required sharpening, the M-4 went to 24 pieces and the A-11 finished the lot without resharpening. Comparing the A-11 performance to the M-2, it performed more than four times better. Though these were not scientific tests, they do confirm that steels such as A-11 are demonstrably better than the conventional T-1 and M-2 tool steels. The downside to using A-11 tool steel is its cost, which is two to three times more than M-2 steel. This limits its use to all but professional or production woodworking applications.

Incidentally, good wear resistance is not necessarily the product of high hardness. A-11 tools used for wood turning are normally hardened between 59-to 62-Rockwell hardness. This allows good wear resistance with enough toughness to prevent chipping from intermittent cuts and/or extremely hard woods. One has to reach a compromise between wear resistance and toughness to make a tool that can be used for turning all kinds of wood.

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

Electric drill gear problems

I have just replaced the main-drive gear in my portable electric drill for the second time in as many weeks, and it still sounds gritty. What can I do to remedy the problem?

—Barry Karloff, Wassila, Alaska

Robert Vaughan replies: My guess is that when the first gear in your electric drill stopped working, chips from the hardened gear teeth got into the grease packed into the surrounding casing. Then, each time you installed a new gear, those little chips worked their way between the moving gear teeth again and—"crunch!—" there went your new gears and more crunchy pieces of steel went floating around in the housing. To remedy this situation, I recommend that you disassemble the drive train and clean the parts and housing of all grease. Make it squeaky clean. Closely inspect all gears for broken or damaged teeth and replace as needed. Put in some new, clean grease, reassemble and you shouldn't have any problems. If the end of the armature has helical gears that are chewed up badly, then you may have to decide whether or not the drill is worth such an expensive repair.

[Bob Vaughan is a woodworking machinery rehabilitation specialist in Roanoke, Va.]

Curing a slow-starting electric motor

Lately, the single-phase motor on my jointer seems to be starting slowly. Could the motor be getting old, or is there some other problem? *—Archibald Leech, Manchester, England*

Ed Cowern replies: There are two common failure points in single-phase motors. One is the starting switch, and the second is the starting capacitor. Treating these one at a time, the starting switch is usually a centrifugal device built to snap open when the motor reaches approximately 3/4 of its full-rotational speed. The switch usually has weights and springs like an old-fashioned fly-ball governor used on a steam engine. Frequently in woodworking shops, the contacts or the moving components can get fouled with sawdust or pitch, and the action of the switch will become sluggish or get stuck. If it sticks in the open position, the motor will hum but will not start. If the switch gets stuck in the closed position, the motor will be quite noisy and, if left running, will get very hot and possibly fail. These problems can sometimes be prevented by either keeping the motor clean and blowing away accumulated sawdust before it gets into the motor and fouls the switch, or changing to a totally enclosed, fan-cooled (TEFC) motor.

The second failure point on single-phase motors is the starting capacitor. This is a black or silver cylinder, usually mounted under a sheet metal shroud on the outside of the motor (on some mo-

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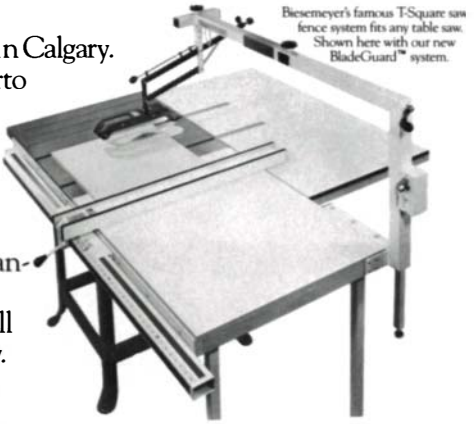

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tors, it's mounted inside). Occasionally the capacitor will weaken (change its capacitive value) or short out. When the capacitor weakens, the motor becomes slow starting; when it fails completely, the motor will hum but not start, as in the case when the starting-switch sticks open. If the capacitor shorts, then the motor will be very noisy, may start slowly or run slowly and exhibit the same symptoms as if the switch were stuck in the closed position.

If your motor is exhibiting these symptoms, the capacitor is relatively easy to replace, especially if it is externally mounted. The starting switch is more difficult to replace, but this job should be within the capabilities of most mechanically-inclined individuals. Capacitors and switch parts are usually available through your local electric-motor shop (see your yellow pages under electric-motor repair). You must purchase a capacitor of the correct value and voltage; value is usually stated in microfarads (mfd). As with any electrical job, always make sure the motor is fully disconnected from power before beginning the repair.
[Ed Cowern is an electrical engineer and president of EMS, a company that distributes Baldor electric motors.]

Itching to use silky oak

We've had a problem in our shop: Whenever we work with silky oak, we break out with an itchy rash. This is a beautiful oak, and we'd like to continue using it without these unpleasant side effects. Is there any way the green wood can be treated or soaked so that its toxicity is reduced once it has been dried? —*Greg Davidge, Kula, Hawaii*

Jon Arno replies: Silky oak *(Grevillea robusta)* is a very attractive timber, and I certainly understand your desire to keep using it, but it can cause health problems. Belonging to the botanical family, *Proteaceae,* it is not at all closely related to the true oaks, *Quercus spp.* Silky oak's light-tan color and large, conspicuous rays tend to give it an appearance, somewhat reminiscent of oak, but it is substantially softer and easier to work than any of the true oaks. Unfortunately, over the years this species has also earned a bad reputation for causing skin rashes and not just among woodworkers. The foliage is also known to affect some people in much the same way as poison ivy because the tree produces some irritating phenolic compounds. As with poison ivy, not all individuals are seriously affected by silky oak, but its toxicity bothers enough people to tarnish its reputation as a cabinetwood.

As for preventive measures, it is doubtful there is any way to make using silky oak totally safe. Chemical compounds tend to become more stable in their oxidized forms, so the chances are the compounds involved here would not be easy to remove by any practical, chemical treatment. The best preventive is to avoid extensive, physical contact with the wood or its sawdust. Good ventilation, a respirator mask, rubber gloves, clothing that minimizes exposed skin, and taking a shower as soon as possible after working with the wood might help prevent the woodworker from developing a sensitivity to the wood, or at least reduce the severity of the rash if it does occur. However, for those who show signs of serious allergic reaction, the safest answer is to stay away from this species altogether.
[Jon Arno is a wood technologist and consultant in Schaumburg, Ill.]

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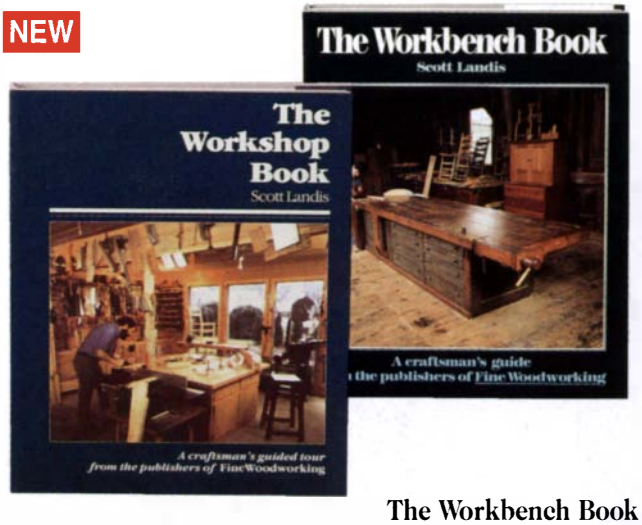

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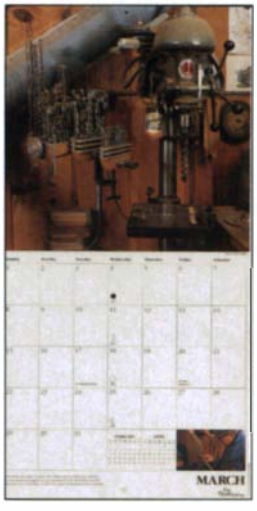

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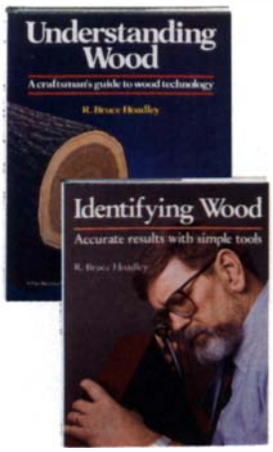

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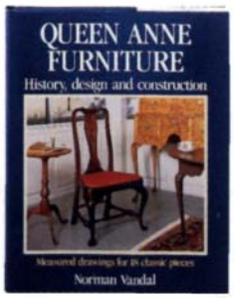

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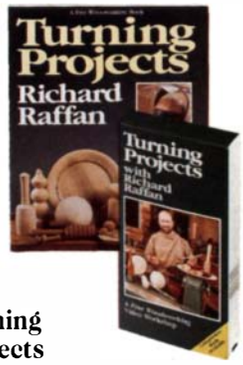

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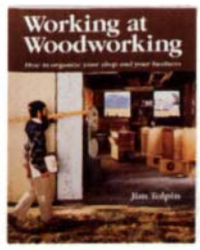

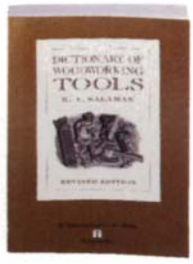

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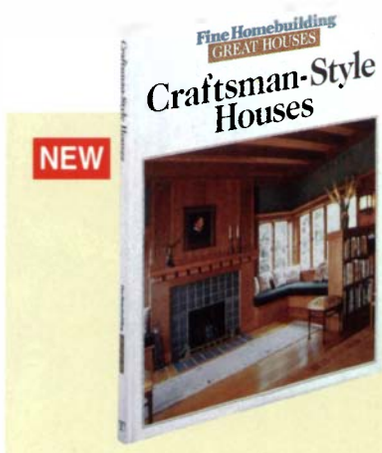

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77 7-1/4" worm drive saw 145
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Random-Orbit Sanders

Eccentric machines for fast, scratch-free sanding

by Sven Hanson

***Random-orbit machines sand agressively** with scratch-free results. From lower left clockwise: Wen 15, Porter-Cable 7336, Bosch 1370DEVS, Skil 7584, Fein MSf 636-1, Metabo SXE125, Bosch 3283DVS, Milwaukee 6125, AEG VSR600 and Ryobi RS-115.*

"Who in the world could possibly need another sander, no matter how new or different it is?" a friend of mine asked when I told him I was considering buying a random-orbit sander. But when I asked him if he knew a faster way to handle a tricky sanding situation (like leveling a cabinet's face frame or sanding across joint lines without leaving deep scratches), he didn't have a comeback. A random-orbit sander's combination of rotation and random orbits allows aggressive material removal while leaving the work surface relatively scratch free, ready for final sanding.

While random-orbit sanders are fairly new to woodworking, they have been a standard tool for many years in auto-body shops, where both electric and air-powered versions are used for rough-sanding metal and hard, sticky fillers, as well as for finish-sanding and for polishing finishes. But can they improve upon the performance of the conventional disc, orbital or belt sanders used in the woodworking shop? Random-orbit machines are capable of removing stock as quickly as portable or stationary disc sanders, but their clear advantage is that they don't leave deep scratches. Compared to standard orbital sanders, the random-orbit machines sand more aggressively, their paper stays cleaner longer and it is easier to change. For sanding large, flat surfaces, the belt sander remains the power tool of choice, but when you need to quickly sand narrow or curved surfaces, cabinet face frames or door frames, or if you need to sand off an old coat of paint or varnish, the random-orbit sander is the new champion.

Last summer, I tried and compared 10 different random-orbit sanders made by AEG, Bosch, Fein, Metabo, Milwaukee, Porter-Cable, Ryobi, Skil and Wen (shown in the photo on the facing page). I put each sander through its paces, both in my woodworking shop and on the construction site, and I discovered that although all are capable of producing good work, certain features may make some models a better choice for a particular job. Although I didn't try every random-orbit sander on the market, I included the other models (a total of 17) in the chart shown on p. 49. (You should peruse the information in the chart before purchasing a random-orbit sander.) Also included in the chart is a new cordless model by AEG, which wasn't available for me to try out at the time I was preparing this article.

Random-orbit drive

The magical mechanism behind these machines is the tool's drive system: A shaft rotates a counterweighted disc carrying an off-center thrust bearing (the amount of offset is anywhere from 3/16 in. to

Sanding discs: Adhesive back vs. hook and loop

Random-orbit sanders employ two different systems of attaching sanding discs, and your choice of sander should be based partially on which disc system better suits your needs. The pressure-sensitive-adhesive (PSA) system of AEG, Milwaukee, Porter-Cable, Skil and Wen uses a special glue to bond the disc to a smooth, vinyl-faced pad. The hook-and-loop system(a generic name of which Velcro is a popular brand) used by Bosch, Fein, Metabo and Ryobi uses a backing pad covered with rows of tiny hooks that lock into a woolly surface on the back of the sanding disc (see the photo at right). Either system can work with dust collection, although the only PSA-system machines that offer it are made by Porter-Cable.

Pressure-sensitive adhesive: The PSA system's biggest advantage is that the discs are about 40% less expensive than hook-and-loop discs. This is important because they can't be removed and reused, whereas hook-and-loop discs can. When purchased in a roll of 100 discs, they are cost-effective for a production user, like a larger shop that sands lots of cabinet face frames. Because PSA discs bond very firmly to a flat backing pad, they are capable of very precise work when surface flatness is crucial. However, PSA pads need to be stored dust free and at cool temperatures, or the adhesive gets fouled. Another problem of the PSA system is that the discs sometimes refuse to stick when working outdoors in frosty temperatures. In addition, when the discs heat up to very high temperatures due to excessive sanding friction, especially with fine grits, the adhesive softens. The eccentric motion then causes the sander to toss the disc, sometimes to Olympian distances, whereupon the pad smears a dollop of sticky adhesive on the work while picking up a fouling layer of sawdust. Fortunately, a few swipes of a cloth that is wet with denatured alcohol or naphtha will clean the pad. And a couple of passes with a sharp scraper will clean off the work surface. It is also worth noting that because the backing pads for PSA discs have a vinyl surface, plastic migration can cause the adhesive to bond tenaciously if the disc is heated during use and then left on the machine. Therefore, always remove a PSA disc before storing the sander.

Hook and loop: I've always found changing sandpaper to be one of the biggest bugaboos in woodworking. The great beauty of the hook-and-loop system for the small-shop woodworker is that the discs can be removed from the backing pad and remounted many times, until they are used up. To further extend disc life, you can clean a spinning coated-abrasive disc with a regular cleaning stick, like those used on belt sanders. Discs are available in grits from 25 all the way down to 600, and they can be purchased in small quantities.

Sanders of both disc systems come with a hard or a medium-hard backing pad, and softer pads are available for fine sanding and for sanding curvy surfaces. But I found that when used with the PSA system to sand a contoured form, the flexing, soft pad made the disc come off the pad easily. A wide range of other discs are available for hook-and-loop sanders, including plastic-abrasive discs, foam polishing and rubbing-compound applicators, and synthetic lamb's wool polishing or buffing bonnets, for waxing or finish-polishing furniture, a boat or a car (and you thought that you were just buying a sanding machine!). In lieu of a ready-made plastic-abrasive disc, a regular plastic scouring pad, such as Scotch-Brite, can be stuck directly to the hooked backing pad. I found this worked quite well and enabled me to do some fine finish-sanding. I'll bet that you could do the same with a nice, thick piece of wool felt, for rubbing out a finish with polishing compound. —S.H.

***The two methods for attaching sanding discs** to random-orbit sanders are the hook-and-loop system, left, and the pressure-sensitive-adhesive system, right.*

Photos: Sandor Nagyszalanczy

***The Ryobi RS-115 easily sands into corners** once its detachable front handle has been removed (above). The plastic-screen dust container nestled below the rear handle slides off for emptying.*

***The convertible drive system on the Bosch 1370DEVS machine,** left, allows the sanding aggressiveness to be adjusted. Beneath the backing pad is a reversible drive ring that can be installed one way for direct drive (heavy sanding) and then flipped over, in about one minute, for "slip drive" (sensitive sanding).*

⅜ in., depending on the model). This bearing holds the shaft of the sandpaper backing disc, which can be spun freely when the machine is off. The sanding disc is stuck to the backing pad with either pressure-sensitive adhesive (PSA) or with the hook-and-loop system (see the sidebar, "Sanding discs: Adhesive back vs. hook and loop," p. 47). In operation, the offset between the drive shaft and the disc causes a sanding motion akin to swirling ice cubes in a glass: The glass orbits, the cubes revolve and the two different motions create both rotary and orbital action. The rotation of the pad, when pressed down lightly on the work surface, causes a rather aggressive sanding action similar to that of a disc sander. The resistance between paper and workpiece slows the freewheeling disc to unpredictable and varying speeds, hence the scratch-hiding "random" orbits begin. The compound motion keeps sanding dust from building up and clogging the paper and tends to make the sandpaper scratch less than with either rotary or orbital sanding, which leave predictable scratch patterns. Heavier sanding pressure can cause the disc rotations to slow down or even stop altogether, but the orbits—one for each revolution of the drive shaft—continue just like an orbital sander.

The Bosch 1370DEVS has a novel convertible drive system, shown in the photo at left, that allows you to select between two different degrees of sanding aggressiveness. Removing the backing pad with a single, central Allen bolt (the Allen wrench stores conveniently in the motor housing) reveals the reversible drive ring. With the drive ring installed one way, you get direct drive, meaning the pad will rotate even under heavy sanding pressure. In this mode the Bosch model is a real workhorse. No matter how much weight I put into sanding, I could not significantly decrease the rotations. For finer work, the drive ring can be flipped over to what Bosch calls "slip drive," allowing disc rotation to decrease as sanding pressure increases. It took me about one minute to flip the ring over and get back to sanding.

Motor arrangements and handles

Random-orbit sanders can be divided into two types—right-angle or in-line—the distinction is based on motor style. Sanders like the Skil and the Milwaukee have motor housings like right-angle grinders used for auto-body work. Power is transmitted to the sanding disc via a set of rather noisy bevel gears. The in-line sanders, like the Metabo and the Wen, have their motors directly above the sanding disc, with a gearless direct drive to the random-orbit head. The right-angle machines generally have larger, more powerful motors than the in-line ones. Due to these design variations, each type of sander has a different balance and handle configuration, which greatly affects how the tool feels in use. All the right-angle sanders require you to wrap one hand around the motor housing while your thumb or fingers control the on/off switch. This "barrel" grip is popular on many European portable power tools. But with motor housings between 2½ in. and 2¾ in. in diameter, woodworkers with small hands (or with arthritis) might find gripping them difficult or tiring. All of the right-angle sanders also have removable front handles: Most have a bicycle-grip handle that can be screwed into either side of the sander, for righties or lefties. These handles lend a firm grip, but I also found that they promoted sanding more deeply on the handled side. I liked the center mounting of Skil's bail-style handle, which made it a breeze to apply even sanding pressure to the work. AEG now offers an optional bail-style handle for all of its models.

Except for the vertical-bodied Wen sander, all the in-line models have a rear handle with a trigger/speed control and some version of a front grip. Fore and aft positioning of the handles gives the user a choice of ways to grip the machine and distributes sanding pressure evenly around the circumference of the pad. For sanding into cramped corners, the Ryobi's front grip easily unclips and slides off, as shown in the photo at right. I found that the Ryobi was easy to grip and lightweight enough to work single-handedly even overhead, such as for touching up a kitchen cabinet soffit. I liked the Bosch 3283DVS's D-handle front grip, which adjusts up or down and can be removed for sanding in tight quarters. The Wen required a two-handed grip for controlled operation, which became very tiring when sanding a larger horizontal surface. The Metabo has a minimal knob grip atop the motor housing and an auxiliary side handle that I thought was mounted too far off center for good control. One disadvantage of all the in-line sanders is that their tall motor housings can make sanding inside cramped cabinets or under obstructions impossible. The lower-profile right-angle machines have the advantage here.

Power, RPMs and sanding efficiency

The motors on the random-orbit sanders in the sample have a tremendous range of motor sizes, from the 1.8-amp Metabo to the 6-amp Skil. But while amperage ratings are honest figures for comparing electrical motor input, amps are not a direct indicator of power output or of sanding efficiency. In my experience, the motor size or disc RPM didn't necessarily reflect sanding aggressiveness. For instance, I found that the Porter-Cable machines, with 3.7-amp motors that produce 6,000 maximum disc RPMs, sanded about as aggressively as the AEG models, even though the AEGs sport 5.7-amp motors and run up to 10,000 maximum RPMs. Among the in-line-motor sanders, the 1.8-amp Metabo sanded more aggressively than the 2 amp Ryobi (both are comparable in maximum RPMs), even though both draw about the same current.

With their heavy-duty bevel gearing and powerful motors, the right-angle sanders are designed to handle continuous, heavy use, including production situations. But while the in-line sanders generally have less-powerful motors than their right-angle cousins, these machines are no slouches. I found that the Bosch 3283DVS sanded about as aggressively as some of the more powerful right-angle machines. However, when using the less powerful units, the disc-rotation speed and even the orbits per minute tend to drop proportionately as pressure is applied to the disc, thereby reducing sanding efficiency. Remember, if you apply too much pressure, the machine will sand less effectively.

Unlike routers and most other power tools, these sanders are best started while in contact with the work. This reduces the tendency for the spinning-and-orbiting disc to gouge the work surface where it makes first contact. As with a belt sander, you must not sand too long in one spot or you'll dig in and create a divot. To prevent this, the Bosch 1370DEVS has a "soft-start" feature that gives you a second or two before the motor revs up to full speed. This is a real stress saver in delicate situations, such as when sanding face frame edges adjacent to plywood with thin face veneers.

With coarse discs, random-orbit sanders are capable of some fairly quick stock removal. But they can be tricky to use when you need to do precise, even work, such as when sanding down a sprayed finish with an ultra-fine-grit disc (shown in the photo at left on the following page). I discovered that, unlike a belt sander, which can be tilted to concentrate the sanding effort on one area of the belt, random-orbit sanders don't always sand in the direction you're applying pressure. I tested this on Plexiglas and then observed the scratch patterns. I found it best to keep the disc flat and in full, even contact with the work surface, but this was more difficult with the right-angle machines with the side-mounted handles.

Random-orbit sanders tend to be quite loud, producing up to 98 decibels (dB), as shown in the chart below. Ear protection is a must. If you work in an enclosed environment, the Ryobi, set to a slow speed, is capable of light sanding while producing only about 70 dB—hardly more noise than a loud conversation.

Switches and variable speed

It's funny how something as simple as an on/off switch can affect your entire opinion of a machine, but a switch that's hard to use

Random Orbit Sanders

Make	Model #	List Price+	Pad dia. (in.), pad type†	Motor Style, amps	No load Speed (RPM)	Net Weight	Noise (dB)	Dust Collect*
AEG (800) 243-0870, (203) 447-4600	VSR500 VSR600 VSRE500 VSRE600 AVSR5005 cordless	$220 $230 $240 $250 $379	5, PSA (H&L*) 6, PSA (H&L*) 5, PSA (H&L*) 6, PSA (H&L*) 5, PSA (H&L*)	Rt Ang, 5.7 Rt Ang, 5.7 Rt Ang, 4.6 Rt Ang, 4.6 Rt Ang, 12v battery	10,000 10,000 1,000-9,000 1,000-9,000 4,700	5 lb. 1 oz. 5 lb. 1 oz. 5 lb. 1 oz. 5 lb. 1 oz. 3 lb.	93 94 NA NA NA	None None None None None
Bosch (800) 334-5730, (919) 636-4200	3283DVS 1370DEVS	$169 $391	5, H&L 6, H&L	In-line, 2.3 Rt Ang, 5	6,000-11,000 4,800-12,000	4 lb. 9 oz. 6 lb. 3 oz.	77-89 82-93	Bag, Vac* Bag, Vac*
Fein (412) 331-2325	MSf 636-1	$610	6, H&L	Rt Ang, 3.3	7,500	6 lb. 6 oz.	95	Vac
Metabo (215) 436-5900	SXE125	$213	5, H&L	In-line, 1.8	5,000-12,000	5 lb. 7oz.	80-84	Bag
Milwaukee (414) 781-3600	6125 6126	$200 $205	5, PSA 6, PSA	Rt Ang, 5.5 Rt Ang, 5.5	10,000 10,000	5 lb. 1 oz. 5 lb. 2 oz.	95 NA	None None
Porter-Cable (901) 668-8600	7334 7335 7336	$210 $230 $235	5, PSA (H&L*) 5, PSA (H&L*) 6, PSA (H&L*)	Rt Ang, 3.7 Rt Ang, 3.7 Rt Ang, 3.7	6,000 2,500-6,000 2,500-6,000	5 lb. 2 oz. 5 lb. 4 oz. 6 lb.	90 78-89 78-89	Vac* Vac* Vac*
Ryobi (800) 323-4615, (803) 226-6511	RS-115	$134	4.5, H&L	In-line, 2	6,000-11,000	3 lb. 4 oz.	70-84	Bag
Skil (312) 794-7495	7584	$160	5, H&L	Rt Ang, 6	10,000	5 lb. 4 oz.	98	Bag
Wen (800) 462-3630, (312) 763-6060	15	$60	6, PSA	In-line, 2.5	3,000	4 lb.	91	None

\+ Dealer selling prices are typically 5% to 40% lower.
† PSA = pressure-sensitive adhesive; H&L = hook and loop
* Optional feature
NA Information not available

While sanding a lacquer finish with the Bosch 3283DVS, *the author strives to keep the machine absolutely flat on the cherry panel.*

The dust collection system for the Fein MSf 636 *includes the optional 920 13 shop vacuum. By plugging the sander into the vacuum, the vac is turned on and off automatically with the sander.*

The switch on the Milwaukee 6125 *is an easy-to-press flap on the underside of the motor housing. Hanson found this switch to be the safest and most comfortable to use.*

can indeed make smooth and safe operation more difficult. The right-angle sanders feature a variety of switch types, and I found some far better than others. Many of the right-angle models, such as the Bosch 1370DEVS, the Skil 7584 and all models by AEG, have sliding on/off switches that are spring loaded, as a sort of safety release in case you need to turn the machine off in a hurry (random-orbit sanders, much like angle grinders, can't be set down while they are running). But sometimes these switches were a little tough to turn on and too easy to turn off. All the Porter-Cable models come with a simple sliding switch, which is easier to operate, although it lacks the safety of the spring-loaded style. I found the Skil's switch to be very stiff-sliding and difficult to turn on. The Fein machine has a top-mounted, easy-sliding switch in a recess, making accidental switching on or off unlikely. Switches on the AEG models and the Bosch 1370DEVS are side mounted and thumb operated. Interestingly, the motor housing on the AEG sander can be removed and rotated relative to the gearhead, allowing you to change the switch position for left-handed operation. My favorite switch is the large flap on the underside of the motor housing on the Milwaukee 6125, shown in the photo at right. Turning the tool on or off is simply a matter of gripping or releasing the housing—a comfortable, positive and safe operation. In addition to the on/off switch, the variable-speed models by AEG, Porter-Cable and Bosch have a speed-change dial on the butt of the motor housing. While not as convenient as trigger speed control, it is still easy to reach and adjust.

Except for the Wen, which has a simple sliding on/off switch and no variable speed, the other in-line sanders have trigger speed-control switches, each with a small variable-speed dial in the center of the trigger itself. Ryobi puts a handy little "+ and −" above its dial, so you can tell which direction to turn it for higher or lower RPMs. Woodworkers with stubby fingers may find the Metabo's recessed dial difficult to grasp and turn. While the slowest speeds, given in the chart on p. 49, reflect the slowest dial settings with the trigger fully depressed, the triggers themselves are variable-speed controls. In other words, the dial just limits top RPM; you can still start sanding gradually, which is great for sensitive work.

Dust collection

Because random-orbit sanders are capable of kicking up quite a bit of dust, many of the sanders incorporate some form of dust collection. A standard pattern of holes in the sanding discs allows suction, generated either by the sander's fan or a separate shop vacuum, to pull sanding dust literally through the disc. In addition, a rubber or plastic shroud that is fitted around the disc keeps the dust from escaping and connects to either a dust bag or a vacuum hose. The underside of Metabo's snap-on dust shroud is covered with short, stiff brushes that create a seal to improve dust pickup; while this also increased the stability of the sander, I found it to be kind of cumbersome. All of the machines that incorporate dust collection use the hook-and-loop sanding discs, except for the Porter-Cable models, which use pressure-sensitive adhesive (PSA) discs. While dust collection is optional for the Porter-Cable models, it is not offered for the Milwaukee, Wen or AEG models. If these models were to be used indoors, it would probably be a good idea to set up a kind of dust shroud around the sanding area to prevent the dust that's thrown out during sanding from being strewn around the room.

The Bosch 3283DVS, Ryobi and Metabo all come with dust bags, but each is a little different. The Ryobi's bag has a polyethylene frame with a molded-in screen. While its capacity is small, the bag is easy to unclip and empty, and it seems to catch most of the dust produced by the sander. The Metabo and Bosch 3283DVS employ canvas bags; Metabo's bag sticks out beyond the back end of the handle and occasionally got in my way. A bayonet-style mount keeps it securely in place and releases it easily for emptying, but sanding dust can fall back out of the machine if it's tilted head down (also a problem with the Ryobi). The plastic fitting on the

Bosch 3283DVS that attaches the bag tends to slip out; Bosch's 1370DEVS has an O-ring on the same fitting that keeps the bag in place, which is a nice touch. It's worth noting that with a piece of plastic pipe and some duct tape, a vacuum hose could probably be adapted to any of the dust-bag models.

The most complete dust-collection system for random orbit sanders is offered by Fein (see the center photo on the facing page). Its model MSf 636-1 sander features a rubber dust boot between head and disc and a large-diameter dust hose port. The German company even offers an optional shop vacuum that connects to the hose port. Although this shop vacuum (model 920 13) isn't exactly cheap at $625, it is compact, quiet and features a special electrical outlet for the sander, which activates the vac automatically whenever the sander is switched on. Other features include an internal bag and a filter cartridge, for easier cleaning and collection of very fine dust particles.

Which sander to choose?

In case you've chosen not to read most of this article and have instead skipped to this conclusion, eager to follow my recommendations and buy the perfect sander, here goes. My favorite random-orbit sanders among the right-angle models included all three Porter-Cable models. The variable-speed 7335 and 7336 handled more smoothly than the single-speed 7334, and I feel they are definitely worth the extra $20 to $25. I would also definitely buy the optional dust-collection system—it worked great. I also liked the AEG models, which were very smooth-running machines with great balance (with the optional bail-style front handles) and high-power motors. If I did high-production work in my shop and had the cash, I'd seriously consider either the Fein (with its companion vacuum) or the Bosch 1370DEVS. Both sanders are continuous-duty machines, exemplary of high-quality European engineering and construction; they were a pleasure to use.

While most in-line sanders aren't as powerful as their right-angle brethren, they are generally lighter and have more versatile handles that allow them to be operated overhead or on vertical or curved surfaces. In this group of machines, my clear favorite was the Bosch 3283DVS. Despite its small motor, it sanded aggressively with very little vibration, and it is truly a bargain for its low price tag. On the job site, I found myself reaching for the little Ryobi, which I felt very comfortable using with one hand. I also found that the machine worked just fine with 5-in. discs, which are more widely available than the proprietary-size 4½-in. Ryobi discs. While the Ryobi felt a bit underpowered to handle heavy work, it would probably be a great choice for hobbyists. □

Sven Hanson is a woodworker and professional carpenter in Albequerque, N.M.

Putting your angle grinder into orbit

by Richard Danzey

Random-orbit sanders generally sell for nearly twice the price I paid for my right-angle mini-grinder. So my ears perked up when I saw an article for a random-orbit attachment (made by Marshco) designed to fit a right-angle grinder. I ordered the $60 attachment, shown in the photo at right, directly from the manufacturer. When it arrived in the mail, I mounted it to my Black and Decker 4½-in. right-angle grinder, put on a 40-grit sanding disc, and tried it out by removing old paint from some doors. The Marshco was aggressive, controllable and effective.

The body of the Marshco attachment is machined from a solid, cylindrical aluminum billet. A sealed ball bearing pressed into an offset counterbore on the bottom of the cylinder carries a press-fit threaded insert for the threaded spindle on the unit's high-quality backing pad. A counterweight is riveted opposite the threaded insert, to help ensure a vibration-free operation. The backing pad accepts PSA-type sanding discs.

The Marshco mounts on the grinder's spindle via a threaded mounting hole centered on the top. Mine was threaded ⅝ in. dia. by 11 threads per inch (tpi), to fit my grinder, but units are also available to fit many other brands with 1.25 by 10 tpi metric-threaded spindles.

The attachment is speed rated up to 10,000 RPM, which matches the speed of my angle grinder. However, the instruction sheet suggested slower speeds in certain circumstances, such as for varnish or paint removal and sanding resinous woods, like pine. Since my grinder is only a single-speed model, I used my Variac, a variable transformer, to slow down the RPMS (you could also use a universal-motor-speed control, such as the one offered by MLCS). Speed reduction by this method makes overheating more likely, since the grinder's motor cooling fan also slows down, so more conservative use of the grinder is advisable.

I've been using the Marshco attachment for about a year, and overall I have been pleased with it. The biggest problem I've encountered was that the original ball bearing, which allows the disc to rotate, soon wore out, causing the attachment to run very rough. I replaced it with a higher-quality bearing. (Marshco is now using a better, fully sealed bearing, so this shouldn't be a problem.)

Should woodworkers who already own angle grinders buy a Marshco attachment in lieu of a dedicated random-orbit sander? Yes and no. If you need both tools, it's obviously less convenient to convert from one to another. Also, if your angle grinder has a single speed, then you'll need a speed controller to have the full range of random-orbit-sanding applications. But because the only compromise the Marshco makes is in ease of setup, not in use, it is a cost-effective way to get started.

Marshco's random orbit sander is $59.95 plus shipping (RFD #2, Box 490, Brooks, Maine 04921; 207-722-3523.) The attachment is also available from Woodcraft, 210 Wood County Industrial Park, PO Box 1686, Parkersburg, W. Va. 26102-1686. And AEG sells a random-orbit head called the Rascal. Variable-motor-speed controls are available from MLCS (PO Box 4053 FM, Rydal, Pa. 19046, 800-533-9298.) □

Richard Danzey is a woodworker and a gentleman farmer in Sunman, Ind.

***The Marshco attachment on a body grinder** is a cost-effective way to access random-orbit sanding. The attachment's backing pad uses PSA-type discs.*

Computer-Desk Design

Keeping enclosed components cool

by Jim White

Ever since computers became small enough to put on a desk, there has been a need for well-designed computer furniture. But while computer technology has developed at a phenomenal pace, most computer furniture remains utilitarian at best. Although this mass-produced office-style furniture may be fine for a business work station, you certainly wouldn't want it in your living room. As more households acquire personal computers, there will be an increasing demand for furniture that matches a room's existing decor and also conceals all or most of the electronic components and wiring. The desk shown in the photo above meets those requirements.

If it weren't for the monitor, you wouldn't know this was a computer desk. Designed like a common writing desk, it has two side-pedestal cabinets that support the desktop and the bookcase above. But there are no drawers for paper, pens and file folders. Instead, the cabinets contain the computer's central processing unit (CPU), a fax machine, two printers and a keyboard.

I had been thinking about computer furniture design for several years, and so I was pleased when I received a commission that gave me the opportunity to use many of my ideas. After several meetings with my clients to determine the design, I enlisted the help of Lars Mikkelsen (a fellow professional woodworker) to build the desk. I usually work alone, but on large commissions such as this one (it also included a matching entertainment center), a second person in the shop helps to maintain momentum and morale. I had worked with Mikkelsen before, and I knew I could depend on him for the level of quality I wanted.

Design and construction

Making the desk match the room's traditional style was the first cabinetmaking problem posed by this project. I used hard maple for the cabinets, both for its durability and because its color matched that of an antique pine mantel in the room. Boards with knots, which would normally be discarded, were saved and used for door panels, adding a little character as well as matching the knots in the mantel. I also found a combination of molding cutters that matched the profile on the mantel's front edge and used them to shape the edge of the desktop.

On most desks, the two pedestal cabinets are tied together with a back panel and the desktop. However, as the design for this desk developed, several things came to light that made me question whether this type of construction would be adequate. First, the desk was to fit into a thickly carpeted alcove, but it was to be entirely freestanding—even held away from the back wall for ventilation purposes. In addition, the design called for flush-fit doors without applied face frames, which would normally add to the rigidity of the case work. Because of these requirements, I was concerned the combined weight of the computer components, along with the bookcase and its contents, would cause the cabinets to settle into the thick carpet and rack out of square, thereby causing the tight-fitting doors to bind in their openings.

To strengthen the pedestal cabinets, I set them each on a 4-in.-high base and joined the bases with a rigid 4-in.-high by 5¾-in.-wide plywood box beam, as shown in figure 1 on p. 54. Between the pedestals, the box beam is covered with a baseboard; the space above the beam and behind a removable panel became the central wiring compartment, which contains the wires that run between the pedestals as well as the exhaust fan for the ventilation system (see the photo on the facing page). So that I could level the desk on the carpet's soft, uneven surface, I screwed an adjustable leveler to each inside corner of both bases. Access to the levelers is through screwdriver-size holes drilled in the cabinet floors. The levelers can be adjusted to level the desktop and to center the flush doors in their openings.

With these problems solved, I was still left with the biggest challenge in this project: designing the desk so all the computer components and wires would be concealed, even when in use, and yet still be adequately ventilated and accessible for adjustments, maintenance or repairs. The solutions to these problems can be applied to any computer furniture, so I will detail how I made everything fit and function.

Concealing the components

To plan for the pedestal cabinets' interior shelving systems, I began by measuring the computer equipment. Although I designed the interiors for specific equipment, all the pull-out shelves, as well as the fixed-shelf cleats were screwed—not glued—to the cabi-

***A home work station doesn't have to be an eyesore** of tangled wires and electronic equipment. The desk on the facing page conceals a computer's central processing unit, two printers and a fax machine.*

***The wires that run between the pedestals are hidden** within the wiring compartment at the back of the knee space (left). A small, muffin-type exhaust fan near the center of the compartment ventilates the enclosed electronic components.*

net sides to allow for changes if necessary. I placed the CPU on a fixed shelf, since the user only needs to have access to the disk drives located on the unit's front. But the other components are on pull-out shelves, like drawers, which run on Accuride brand full-extension slides (available from many hardware stores and mail-order suppliers). In hindsight, it may be a good idea to put the CPU on a pull-out shelf, too. This would make it easier to add circuit boards or to plug in accessories such as a mouse.

The printers in the right pedestal are each on a separate pull-out shelf in the completed desk, although that was not the original plan. The need for a flexible design was proven even before the desk was installed. A dot-matrix printer was to sit on the top shelf in the right pedestal cabinet with its paper feeding from the shelf below. I had planned to use full-extension slides on both shelves and connect them so they operated as one. However, midway through the project, my clients bought a laser printer with a self-contained paper feeder. This meant that the old printer could be used exclusively for printing checks. To accommodate the change, I disconnected the two shelves and placed the laser printer on the top shelf. The bottom shelf holds the old printer with enough room behind it for the check feeder.

The CPU and a fax machine are stored in the left pedestal. Above the CPU, at the very top of the cabinet, is a pull-out shelf for a portable typewriter. The fixed shelf for the CPU is below the typewriter shelf, and below that is another pull-out shelf for a fax machine. The bottom of the left cabinet, below the fax, is for storage. On the door-hinge side of each cabinet, the extension slides are mounted on 1-in.-wide spacer blocks to clear the edge of the doors, which only open 90°. All the doors hang on Soss invisible hinges (see the sidebar on p. 55 for more about Soss hinges) and have non-magnetic touch latches. Magnet latches could interfere with magnetic data storage on the diskettes.

The keyboard tray looks like a typical pencil drawer, but its false front pivots up out of the way so the tray can slide out, as shown in figure 2 on p. 54. Each end of the false front is rabbeted to a triangular piece of plywood that pivots on screws in the cabinet's side panels. To reduce wear, a metal sleeve lines each triangle's pivot hole, and a fender washer fits between the triangle and the cabinet. When the front is up, it passes just beyond top dead center and rests against stops. In the down position, it rests against the keyboard tray. The tray itself rides on Accuride keyboard slides, which lock in the open position, and are suspended from spacer cleats screwed to the underside of the desktop.

The monitor is the only part of the computer out in the open. It is mounted on a pivoting steel platform like those used to hold a television in a hospital room (available from Pivotelli, division of Grant Product, Inc., 25 Commercial St., PO Box 560, Medford, Mass. 02155). The unit, which is bolted to the back of the desk (see the photo above), has a pivoting arm that allows the monitor to tilt, swing and move forward or back, so it can be positioned nearly anywhere on the desk or be pushed into the corner when not in use. The monitor's wires run along the arm, through a 1-in.-wide space between the bulletin board and the plywood back, and then down to the wiring compartment between the pedestals. The wires for lights under the bookcase that illuminate the desktop also run behind the bulletin board.

Concealing the tangle of wires

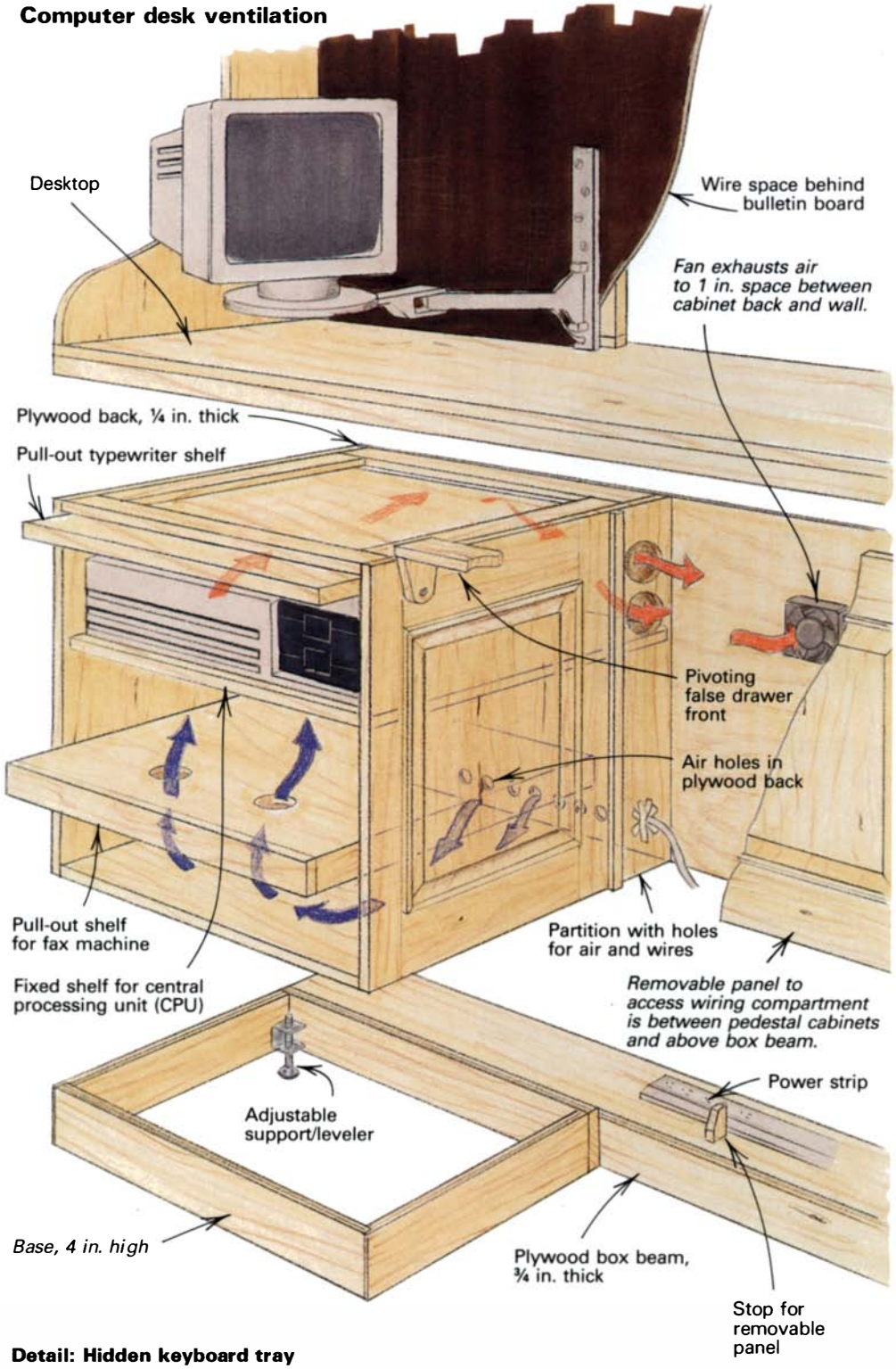
As I mentioned earlier, the wires that connect the various components run through the 5-in.-deep central wiring compartment (shown open in the photo above), which is behind the removable back panel and above the box beam that connects the pedestals. The bottom of the panel fits between the baseboard cap and two angled blocks screwed to the box beam and the top of the panel is held shut with a latch.

The wires from the components in the pedestal cabinets pass through 3-in.-dia. holes cut high in the plywood dividers on either side of the wiring compartment (see figure 1 on p. 54). All of the components are plugged into a power strip inside the wiring compartment. An illuminated on/off switch, which turns on the power strip (and therefore the entire system), is located just inside the left cabinet door.

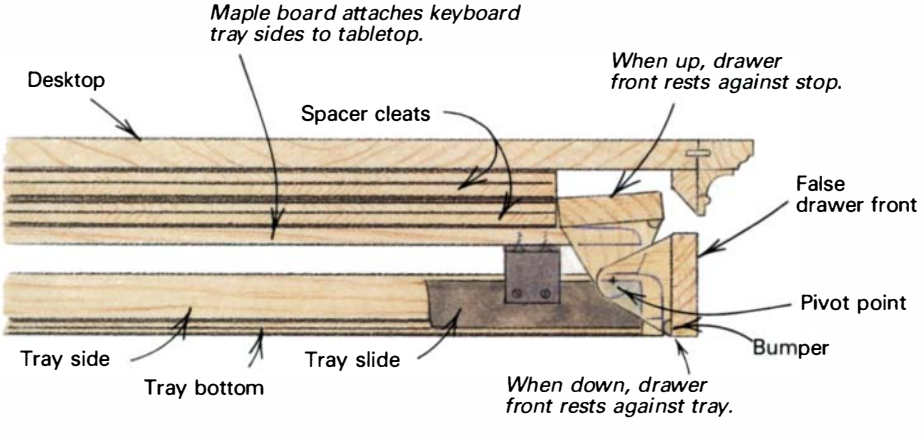
Although most of the excess wiring is hidden in the central compartment, it is also necessary to have a loop of wire in the ped-

Photos: Gary Weisenburger; drawings: Aaron Azevedo

Computer desk ventilation



Detail: Hidden keyboard tray



estal cabinets for each of the components, to allow for movement of the pull-out shelves. The CPU, which sits on a fixed shelf, needs even more excess wire so the unit can be removed from the cabinet and set on the desktop when wires need to be unplugged from its back. The extra wire for the CPU can just sit behind the unit, but each loop of wires to the equipment on the pull-out shelves is held together with plastic tie wraps and then hung on the inside of the cabinet with small plastic strap hangers (hangers and tie wraps are available at electrical-supply stores). The plastic hangers are screwed near the top of the space between the shelves and halfway between the cabinet's front and back. The wires also run through another hanger that's screwed to the back corner of the shelf; this prevents excess wire from dangling between the back edge of the shelf and the back of the cabinet. This is essential because the shelves extend all the way to the back of the cabinet when they are slid in.

Ventilating the components

The ventilation system I designed for this computer desk is simple but effective (see figure 1 on this page). The air is moved by one quiet, 3-in.-dia. muffin-type exhaust fan (which I bought at Radio Shack) mounted in the center of the wiring compartment. The fan is plugged into the same power strip as the components, so it automatically comes on whenever the computer is turned on.

The key to the system is that the shelves (which fit snugly up against the cabinet back) and the wiring compartment dividers act as baffles that restrict and direct the air flow produced by the exhaust fan when the computer is operated with all the cabinet doors closed. Here's how it works: The exhaust fan creates a vacuum that pulls cool air from the space between the wall and the cabinet back into the pedestal cabinets through holes near the bottom of their plywood back panels. Because the shelves fit snugly in the back, the air then moves forward and passes up through holes near the front of each shelf. Since each component has a different ventilation requirement, I used different size holes to adjust the amount of air flow. After passing over each component, the air passes into the wiring compartment through the 3-in.-dia. wire holes in the top of the partitions that separate the pedestals from the wiring compartment. I covered the wire holes in the bottom of the partitions with tape so as not to disturb the established air-flow pattern. Finally, the air is exhausted by the fan. □

Jim White builds cabinets and furniture in San Francisco and Los Osos, Cal.

A versatile mortising fixture

by Lars Mikkelsen

The design of the computer desk in the photo on p. 52 that Jim White and I built called for a minimum of hardware, which meant no visible hinges. Although typical European-style hinges, like those made by Grass and Blum, are not visible from a cabinet's exterior, they are generally fairly bulky and would have interfered with the electronic equipment on the pull-out shelves. So as an alternative, we used heavy-duty Soss concealed hinges on all the doors.

Soss hinges (available from The Woodworker's Store, 21801 Industrial Blvd., Rogers, Minn. 55374-9514, and other mail-order woodworking suppliers) fit the bill because they are not mounted on the surface of either the door or the cabinet side, where they would take up precious space inside the cabinets. Instead, the two halves of the hinges fit into ½-in.-wide by 2⅜-in.-long mortises in both the door stile and the cabinet side. Since the cabinets have no face frames, we had to mortise into the face of the edgebanded plywood sides as well as the edge of the door stiles. I devised the router mortising fixture, as shown in the photo and drawing on this page, to accommodate both.

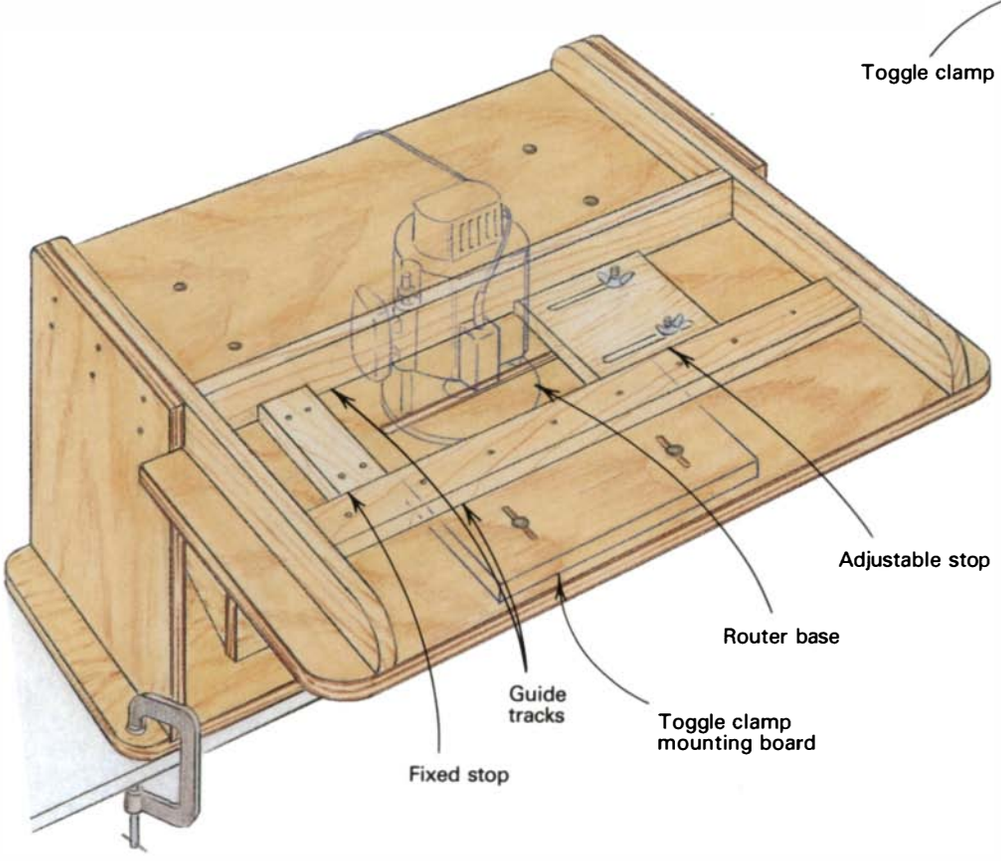
Although the fixture looks a little like a common router table, it works on a different principle. The workpiece is clamped below the fixture's tabletop and the mortise is cut by moving a plunge router's base between tracks on the tabletop. The mortise depth is set with the router's plunge mechanism; the width is limited by the diameter of the bit; and the length is limited by a fixed stop and an adjustable stop that fit between the tabletop tracks. If I want a mortise that's wider than one of my bits, I can move one of the tracks and make two passes. The fixture also has an adjustable fence on the underside of the tabletop for locating the workpiece in relation to the slot for the router bit, and an adjustable toggle clamp for holding the workpiece in place.

The fixture is quite versatile and accurate, which is essential for routing mating hinge mortises. To rout a mortise in the edge of a narrow stile, I secure the stile to the adjustable fence with the fixture's toggle clamp, after aligning the mortise centerline with a line marked on the fence. I then slide the router from stop to stop in the tracks and progressively plunge the bit until it reaches the mortise depth.

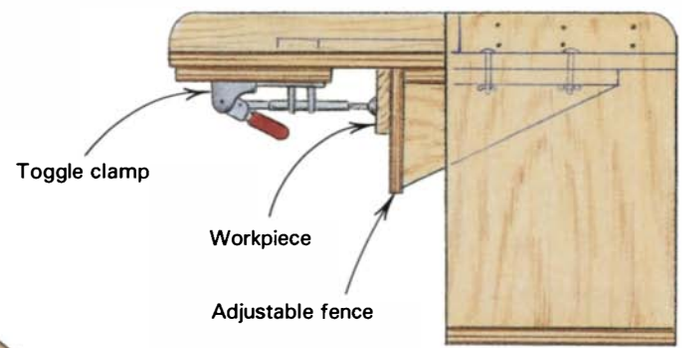
To mortise the edge of a completed door, I let the fixture's fence overhang the edge of the bench and then clamp the door to the fixture as I did the stile. To mortise the face of a wide panel, I remove the toggle clamp from below the fixture's table and C-clamp the panel to the tabletop. Because the front edge of the computer desk's side panels were radiused slightly, I moved the fixture's fence back somewhat when mortising them so that the face of the door would set back behind the curve of the radiused edge. □

Lars Mikkelsen builds cabinets and furniture in Santa Margarita, Cal.

A router mortising fixture



Detail: Side view

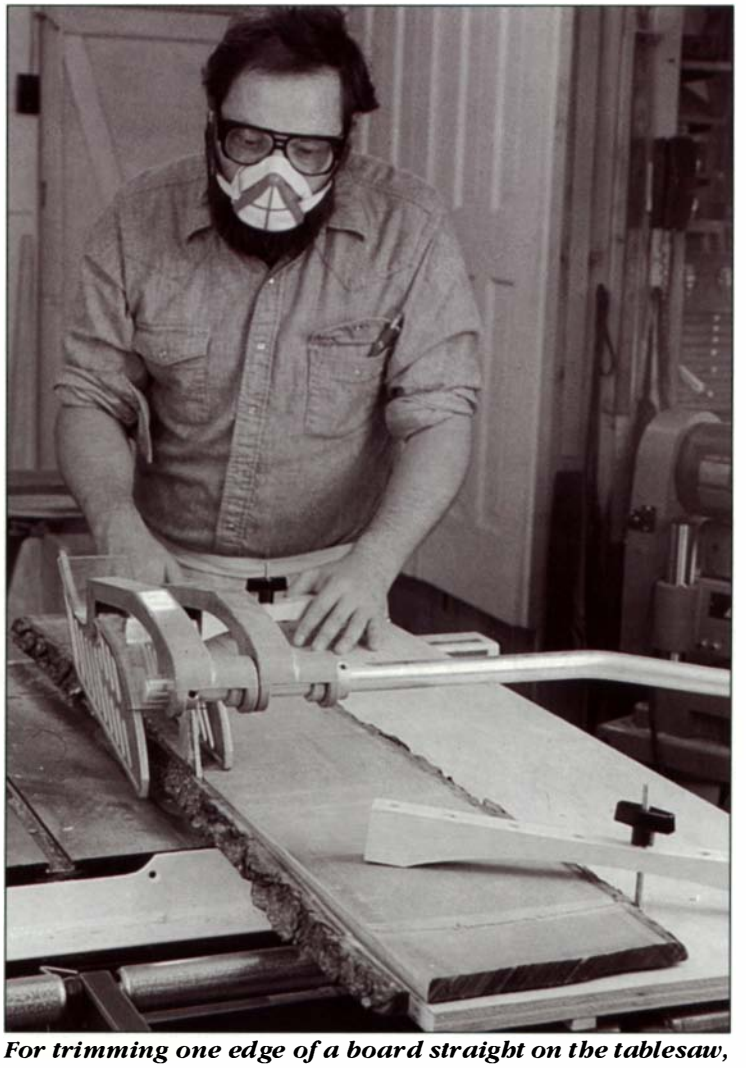


***Mikkelsen's plunge-router fixture is versatile** enough to cut mortises in edges of door stiles or assembled doors as well as in the face of wide cabinet sides.*

Stock Preparation

Dressing for success

by Mark Duginske



For trimming one edge of a board straight on the tablesaw, Duginske made a simple jig from plywood with a runner on the bottom for the miter-gauge slot. Holes in the plywood and the hold-downs make the jig adjustable for any width board.

High-quality woodwork is dependent on accurate stock preparation. Marking and sawing tools are designed to work with wood that has flat, straight and parallel surfaces and perfectly square edges. If the stock is not properly dressed, you won't get tight joints no matter how well tuned your tablesaw or radial-arm saw is. Negligence and sloppiness in the early stages of a project will haunt you because each step in woodworking is dependent on the accuracy of the previous step.

Before I actually get into preparing stock, there is a safety issue to contend with: Machining rough wood is one of the most dangerous things you can do in woodworking (see the safety box below). Two components that create potential hazards are the unflat surface of the board and the internal tension within the wood. The tension may come from the growth process or the drying process. Usually, the greater the bow, crook or twist (see figure 1 on the facing page), the greater the internal stress. You can take precautions when flattening a warped board (this will be discussed later), but the more subtle danger is the difficulty of predicting what affect internal tension will have on a machining operation. When a board is ripped on a tablesaw, tension in the wood may cause the

Safety tips for machining rough stock

JOINTER

- Always use the guard.
- Keep your fingers away from the cutterhead.
- Do not joint a board shorter than 12 in.
- If the board is shorter than 18 in. long, always use a push stick to keep your hand away from the cutterhead and to hold the wood down on the table while it is pushed past the cutterhead.
- Always run cupped or bowed boards concave-side down.

THICKNESS PLANER

- Don't plane a board shorter than 18 in.
- Rip cupped boards into individual lengths before planing.
- Don't stand behind a board in the planer, particularly when planing more than one board at a time.
- Keep the planer bed waxed or lubricated and free of chips.
- Don't try to remove too much in a single pass.

TABLESAW

- Don't rip warped boards on the tablesaw.
- If you must rip a board with internal tension on the tablesaw, use a short fence that extends just past the blade and a splitter. If possible, substitute a bandsaw for the tablesaw.
- Always use a push stick when ripping narrow pieces.
- Don't stand directly behind the blade when ripping.

two resulting pieces to spread apart or pinch together, both of which can cause a kickback. If you use the tablesaw to rip a board with internal stress, you should use a short, auxiliary fence that extends just beyond the blade and a splitter to keep the kerf from pinching shut. I recommend using the bandsaw for ripping warped boards because then if the wood pinches or spreads, it can't cause a kickback.

Planning your work and selecting your stock

Before you start cutting, it is important to have a clear idea of your project. Think of stock preparation as blending your design with the wood. Plans, working drawings and shopmade sketches will help you visualize the piece, and a cutting list will detail the number and size of the pieces you need. With the cost of good wood ever rising, it is best to make your mistakes on paper. Good plans and a cutting list are your ounces of prevention.

After you've finalized your plan, it is best to select the stock and prepare all of it at the same time. This will prevent confusion and make the whole process more economical in time, material and money. It also ensures uniformity in moisture content and finished dimensions. Selecting lumber is dependent on your immediate needs as well as your budget. The bigger the selection, the easier it is to pick pieces that match and work well together. If you are starting with roughsawn lumber, you should use a handplane or small power plane to remove enough of the sawmarks, so you can preview the grain pattern of each board. Then you can mark each piece from the cutting list onto the boards, so the grain will work with and not against the design of the finished piece. Always machine one or two extra boards in case you miscut a piece.

Preparing rough stock

Rough lumber is usually about ¼ in. thicker than its intended final dimension. This means a board that will be surfaced to a finished ¾ in. is usually cut to 1 in. or 1⅛ in. thick at the sawmill and sold as ¼ stock. The extra thickness allows for shrinkage and warpage as the wood dries. That extra ¼ in. of material may seem like a waste, but the board may lose ⅛ in. of thickness in the drying process. And if the tree had a lot of internal stress, even ¼ in. of excess material might not be enough to salvage a long, warped board.

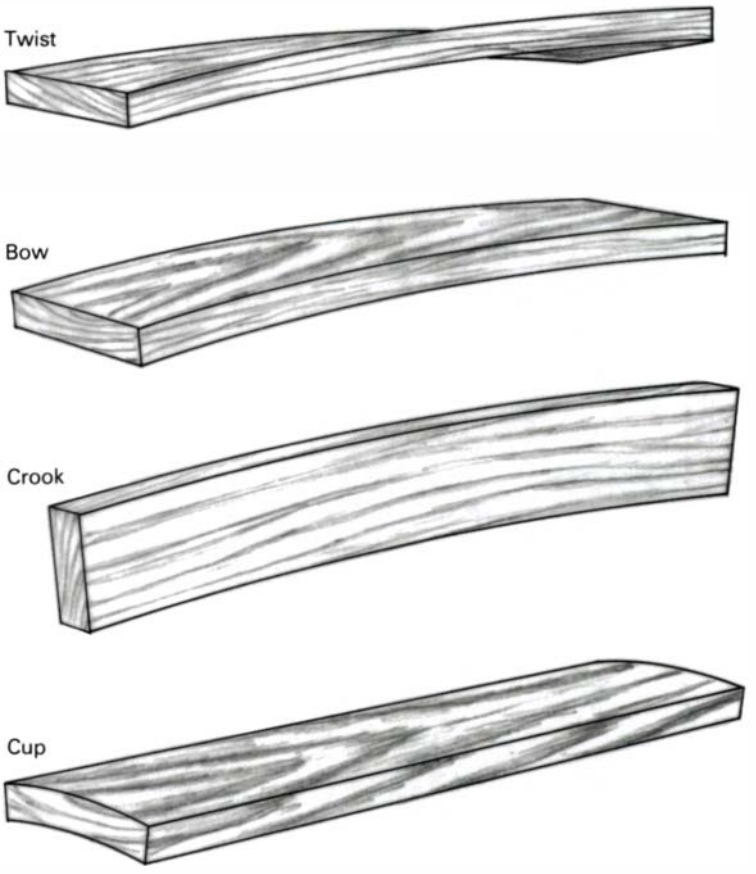
Usually boards are first cut close to length before surfacing (jointing and planing). When rough crosscutting, always allow an extra 3 in. or 4 in. of length for final trimming. However, if the parts list calls for short pieces, keep them in a longer form for planing and ripping, and then crosscut them to length last. A board that is about 48 in. long is the easiest to machine. Recently I had a maple tree bow and cup so much during the drying process that I was not able to salvage a long, wide board, and I was forced to crosscut it into shorter pieces and rip them into thirds before planing (see the center photo on the next page). This is a good strategy for utilizing your worst warped rough stock, and you should keep it in mind when you assess your woodpile.

You have two options when cutting the stock to width: you can surface it first or rip it first. It is quicker to do the jointing and planing first, but your stock may not allow that. For example, if you have a flat, 7-in.-wide board and you want three 2-in.-wide pieces, you can surface the board to create a straight, flat product and then rip the 2-in. boards out of the one. However, if the board is cupped, it is best to rip the board into individual lengths, and then surface and plane them individually to their final thickness.

Determining grain direction before surfacing

When using a surfacing tool, either a jointer, planer or a handplane, it is important to cut *with* the grain rather than against it.

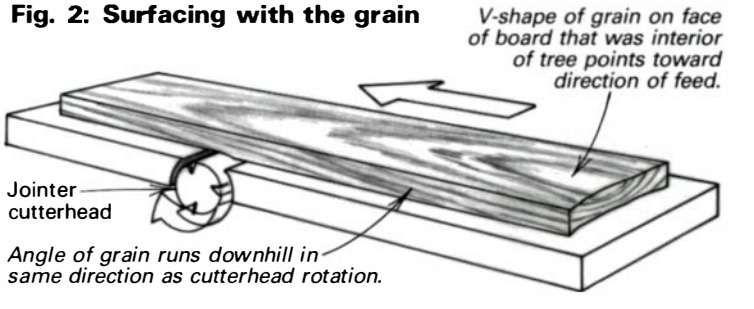
Fig. 1: Glossary of board distortion



Grain is the inclination of the growth rings. Cutting from the proper direction will leave a smooth surface, but cutting from the wrong direction will lift up or tear out the grain, leaving a rough surface with potentially deep pockmarks. A good analogy of grain direction is patting the hair on a dog. Stroked from head to rear, the hair lies flat, but stroked from rear to head, the hair raises.

The standard approach to determine grain direction is to observe the edge of the board to see which way the grain is running (see figure 2). However, this can be time-consuming when you have a lot to plane. Another option is to use the V-shaped figure on the surface of the board that faced the inside of the tree. (You can determine the inside face by looking at the growth rings on the board's endgrain.) When you look at the inner surface, the V-figure usually points in the direction that the board should be fed through the tool. The V-pattern will point opposite the grain direction when you look at the outside face of the board. The saying to describe this is "inside with, outside against." Of course, woods with distinct grain, like oak, are easier to read than plain-grain woods, like birch or maple. To complicate things further, it is not

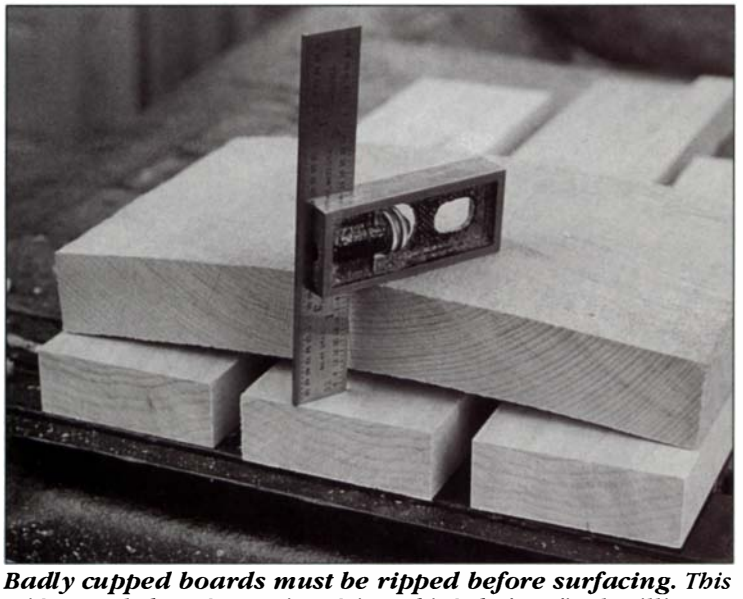
Fig. 2: Surfacing with the grain



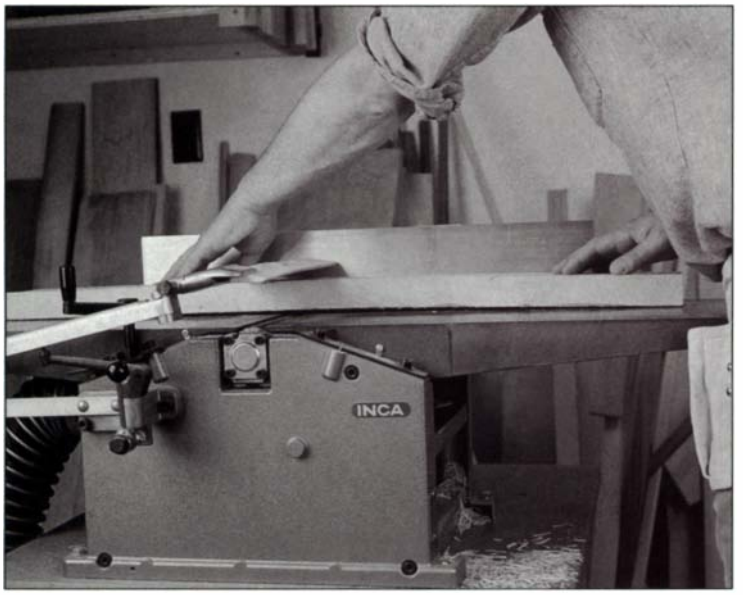
When running this board through planer, cutterhead is above board so opposite face should be down on table.

Drawings: Aaron Azevedo

Winding sticks are used to test for twist (or wind) in a board. *Any twist can be detected by sighting across the tops of two sticks with parallel edges placed near the ends of a board.*



Badly cupped boards must be ripped before surfacing. *This wide, maple board was ripped into thirds before final milling.*



Bowed or cupped boards should be run with their concave-side down *on the jointer to prevent the board from rocking.*

unusual for grain to change direction within a board. So, when it is difficult or impossible to determine grain direction, you can take your best guess, make a light first pass and then observe the results: If there is too much tearout, flip the board end for end before the next pass.

Surfacing rough stock

The goal when surfacing rough stock is to remove the waste from around the finished board. The first step is to face-joint one side to make it flat. This side will become the straight-and-flat reference for planing the opposite side parallel and for jointing or ripping the edges square.

Face-jointing—When you are face-jointing a cupped or bowed board, the concave side should rest on the table; this means that each end of the board will touch the jointer table, as shown in the bottom photo on this page. Having the concave side down will minimize any tendency of the board to rock from side to side as it is cut. The ends of the board are jointed first, and each successive pass over the cutterhead removes more material until the surface is flat. You can tell when the surface is flat by listening for the uniform sound of the cutter as it removes material along the length of the board.

A board that is twisted is harder to face-joint because it will have a tendency to rock diagonally back and forth on the table. The traditional way to check for twist is with a pair of winding sticks (as shown in the top photo at left). Winding sticks are two identically dimensioned pieces of wood that are set on opposite ends of the board and sighted across. You can see any deviation out of plane by comparing the top edge of one stick to the other. Identify the high, opposite corners on the board, and make successive light passes over the cutterhead until the board rests flat on the table. Don't be too aggressive and remove too much material from the offending corners. If the warp is severe, I remove excess material with a scrub plane before jointing (see *FWW* #90, p. 65 for more information on scrub planes).

Working with the jointer can be dangerous, but there are steps you can take to make the operation safer (detailed in the safety box on p. 56). Most importantly, when jointing short boards, always use the guard and a push stick/hold-down, as shown in the top photo on the facing page.

Thickness planing—After you have face-jointed one side of the board, you are ready to make the other side parallel using the thickness planer. The jointed side is laid flat on the planer table, and, as the board passes under the cutterhead, it is planed to a uniform thickness. After the rough upper surface is entirely planed, which may take several passes, you should flip the board over and plane the side that was face-jointed because the finish from the planer is usually better than the finish from the jointer. Plane all boards of the same desired thickness at the same time, and run every board through at each setting before raising the table for the next pass.

Check the planed boards to see that they have remained straight. Occasionally, a board may bow because planing releases tension in the lumber. If a board has bowed, rejoint the concave side, being careful not to remove so much material that the finished product will be thinner than desired, and run all boards of that thickness through at the final setting.

Not only can jointing and planing release tension in the board, but this process will expose the interior of the board, which may have a different moisture content than the outside. The fresh surfaces may either release or absorb moisture, thus the board may

resume the distortions that it originally went through during the initial drying. For this reason, many experienced woodworkers allow the wood to "settle" by beginning the stock-preparation process and then allowing the wood to stabilize in the shop environment for a few days to a month. The wood is cut to size, planed about ⅛ in. oversize, and then stacked with stickers between each board, which allow air to pass around the boards to ensure they reach equilibrium with the environment. After the boards have reached equilibrium, they are surfaced to final dimensions to remove any warp that occurred during the settling process.

Squaring the first edge

After both sides of the board have been surfaced to thickness, the next step is to square one edge on the jointer. If the board is crooked and the edge is out of line by more than ¼ in., it is faster to saw the edge off before jointing. And if the edge is rough, you must cut it off. One way to do this is to nail a straightedge to the board and cut the piece on a bandsaw with a rip fence. Alternatively, you can snap a chalkline on the board's surface and bandsaw close to the line without a fence. If you don't have a bandsaw and the piece must be ripped on a tablesaw, use a jig like the one shown in the photo on p. 56. A runner that rides in the miter-gauge slot is screwed onto the bottom of the plywood carrier board, and hold-downs secure the workpiece. After the edge is cut straight, it can be finished on the jointer.

Before edge-jointing the boards, check that the jointer fence is squared with the table by using an accurate square next to the cutterhead. When jointing, it is important to keep pressure down against the table and inward against the fence and to avoid passing your hands directly over the cutterhead. After you have edge-jointed the first two boards, check them for square by laying them on a flat surface and putting the jointed edges against each other.

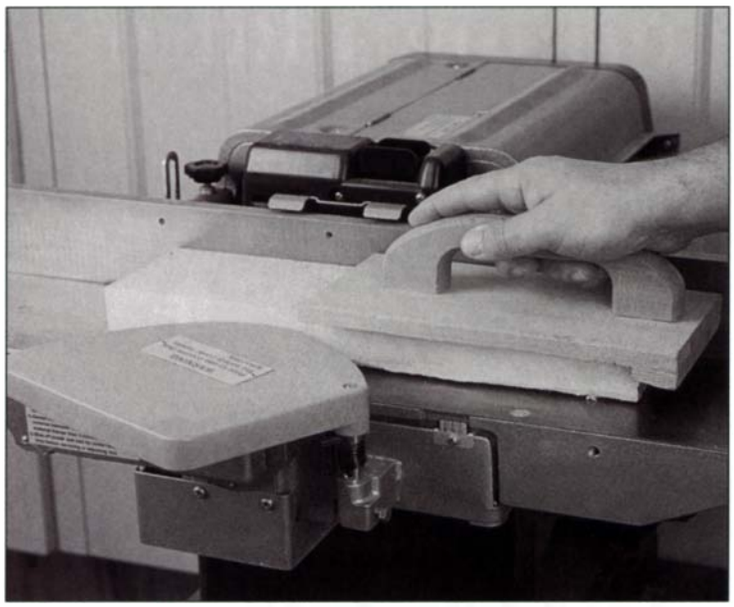
Cutting to width

After surfacing both sides of the board and jointing one edge, you're ready to rip the board to width. The first step is to cut the board on the tablesaw with the board's freshly jointed edge against the fence. However, the blade will leave sawmarks that must be removed before gluing or finishing, so when setting the distance between the rip fence and blade, add about 1/16 in. for cleaning up the edge on the jointer later. If it takes more than a couple of passes on the jointer, the board's edges may no longer be perfectly parallel to each other. On wide boards this discrepancy is so minor that it usually isn't a problem. However, on boards less than 4 in. wide, such as cabinet face-frame members, it is advisable to make a final cleanup pass on the sawn edges with a thickness planer, especially if you have a planer without bed rollers, which leaves a smoother surface on boards planed on edge.

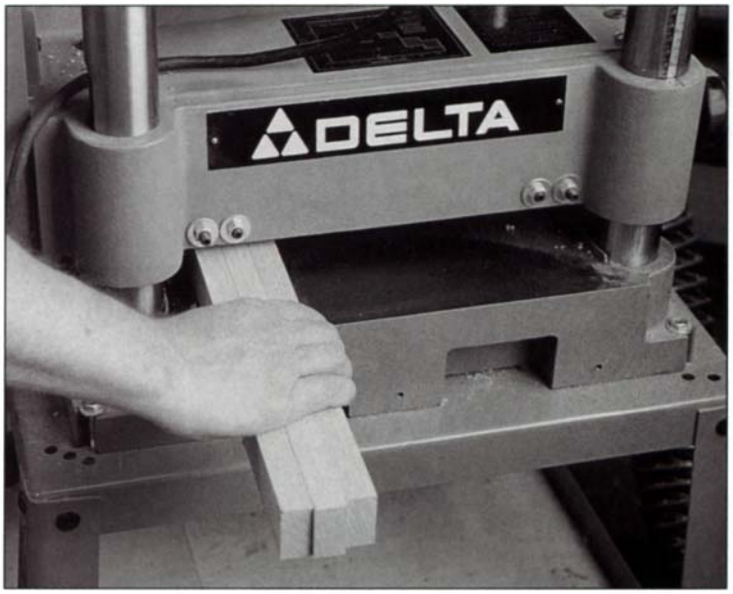
If you are finishing the edge of the board with the planer, run three or four pieces at a time. Hold the group together as they are fed through the planer, as shown in the bottom photo, to prevent individual pieces from tipping. After jointing or planing, double-check to make sure that both edges are square using the test described earlier. Another option for cutting a board to width is to rip the board on the bandsaw and then finish the edge with the planer. This approach is particularly desirable with short, narrow boards because it is much safer to rip this size board on the bandsaw than on the tablesaw.

Cutting to length

When the board is surfaced on all four sides, the last step is to crosscut the two ends. The first cut establishes one square end, and the second cut is to the desired length.



Jointer push sticks also hold the board down on the table and should always be used when jointing short boards.



Narrow boards can be run on edge through the planer to ensure that they are all the same width. Always run several boards at a time, and hold them tightly together.

The tablesaw can be used for crosscutting with either a miter gauge or a sliding crosscut box. (For more information on crosscut boxes, see Kelly Mehler's article in *FWW* #89, pp. 72-75). A radial-arm saw and miter saw are handy alternatives if you are crosscutting pieces longer than 48 in. If more than one board is cut to length, it is best to use a stop, which can be as simple as a piece of wood clamped to the miter gauge or the fence. If you use this kind of stop, it is a good idea to bevel the stop's bottom corner, or clamp the stop slightly above the saw table to keep sawdust from building up against the stop and affecting the length of cut. Some commercial stops are designed to flip out of the way when they are not in use. This design has the advantage of instant repeatability if more pieces of a desired length are needed. □

Mark Duginske is a woodworker in Wausau, Wisc., and contributing editor to FWW. *This article was adapted from his forthcoming book,* Mastering Woodworking Machines, *to be published in April by The Taunton Press, 63 S. Main St., PO Box 5506, Newtown, Conn. 06470-5506.*

Photos: Author

Turning a Rustic Birdhouse

A natural attraction for feathered friends

by Andrew Barnum

The rustic, natural-bark birdhouses shown here, are simply branches hollowed out on a lathe with turned bottoms. Beeswax seals the exterior surfaces and secures the roof to the body. Also shown are the decorative, complex structures, with coopered bodies and stack-laminated roofs, from which the organic birdhouses evolved.

The first birdhouses I made were highly decorative, nonfunctional structures. Because birds have often been portrayed as symbols for freedom and vulnerability, I felt that these birdhouses served as a metaphor for man's caring about nature. Symbolically, I was showing my concern for the birds and their importance in our environment.

But I realize birdhouses are normally made to be used. The rustic, functional birdhouses, shown in the photo above with some of my decorative birdhouses, are a nice balance of beauty and utility. Although they are minimally worked, the rustic birdhouses are examples of form following function. By resisting the urge to embellish them, I strove for a simplicity similar to that found in Shaker artifacts. The natural textures blend into wooded settings; eventually, the birdhouses weather and disappear into the landscape.

Selecting the wood

Turning rustic birdhouses on a lathe requires simply hollowing out the body and shaping the bottom and the roof. There is one problem area, however. Since the pith is left in the roof and bottom, checking and cracking can occur. A handful of woods, including cedar, pepperidge, ash and catalpa, will check very little, even with the pith. When turning green wood, I've been able to control checking fairly well by placing the finished piece inside double paper bags. The bags absorb moisture from the wood and provide a humid atmosphere, allowing the wood to dry gradually, thus reducing the risk of checking. To keep the bark intact, it is best if the tree or branch is cut in the fall or winter after the sap is down.

The dimensions of the tree or branch needed for the birdhouse will depend upon the type of bird that will be residing there. The size of the interior cavity, the diameter and location of the entry hole, and even the distance above ground that the house is hung will affect the suitability of a birdhouse for a particular species of bird. The U.S. Department of the Interior, Fish and Wildlife Service conservation bulletin #14, *Homes for Birds* (publication #024-010-00524-4), provides requirements for a variety of species. (The bulletin is available for $2.50 from the Superintendent of Docu-

Photo this page: Susan Kahn

ments, U.S. Government Printing Office, Washington, D.C. 20402.) It is a good idea to consult the bulletin before embarking on any serious birdhouse construction.

After selecting an appropriate-size branch for the body of the birdhouse, I pick another section that is 1 in. to 3 in. larger in diameter for the roof. I allow an extra 2 in. or 3 in. in length on both of these blanks for truing up the ends for faceplate mounting and for the mounting screws.

Hollowing the body on the lathe

These log section blanks tend to be out of balance and may throw off hunks of bark, so I run my lathe at its slowest setting. I consider 600 RPM to be the maximum speed for this type of work. I stand to the side when I first turn on the lathe, ready to turn it off again at the first sign of trouble. If the bark is stable and the lathe isn't bouncing across the floor, I proceed with the turning.

After truing up the ends between centers, I center and mount the bottom of the blank to a 6-in.-dia. faceplate with ¼-in.-dia. by 1¼-in.-long lag screws. I drill a ½-in.-dia. hole to the full depth of the interior cavity to serve as a depth guide for hollowing out the blank. Because I'm cutting into endgrain (the grain direction is parallel to the axis of the lathe), I've found that the normal technique of working from the edge toward the bottom is more difficult and produces a lot of tearout. The depth hole makes it easier to work from the inside out, as shown in the photo at left. To reduce tearout, I use a hook tool patterned after some vintage production tools. Pre-World War II piece-rate turners relied on the rapid cutting action of these tools to turn out large volumes of souvenirs for Adirondack and Catskill tourists. Sorby Tools, Ltd. makes a ring tool (available from Constantine, 2050 Eastchester Road, Bronx, N.Y. 10461) that also cuts well and might be easier to use than a hook tool. I leave the interior rough-turned to prevent some poor bird from getting trapped inside. Before repositioning the blank to shape the bottom, I turn a ¼-in.- to ½-in.-long lip around the top edge that will mate with a recess turned into the roof, as shown in the photo at right.

Turning the bottom of the body

After unscrewing the body from the faceplate, I screw on a waste block with a larger diameter than the birdhouse and turn a groove in the block to match the lip turned into the top of the body. The lip should fit tightly into the groove so that the body can be jammed onto the block for shaping the bottom. Supporting the body with the tailstock, as shown in the center photo, provides an extra measure of safety. I turn away the screw holes and shape the bottom, trying to keep a uniform thickness to reduce the chance of checking. I leave about a ⅛-in.-dia. spindle where the tailstock supports the bottom until I've finished shaping and sanding it. Then I saw through the last bit of waste with the lathe turned off so the turning doesn't fly off.

Turning the roof

I turn the roof of the birdhouse the same as I did the body by mounting it on a faceplate and turning the inside first. Before dismounting it to turn the outside of the top, however, I turn the recess that fits the lip on the top of the body (shown in the photo at right). The fit should be somewhat loose so that the roof doesn't crack if it shrinks on the body. I also turn the exterior of the roof in the same way as the bottom of the body by jamming the roof onto a faceplate-mounted block, with additional support from the tailstock. Too tight of a fit, however, might crack the roof. I have found that a spindle gouge works fine for finishing up the outside surface of the roof, but if you are adventurous, you could use a skew.

Beeswax secures the roof and finishes the birdhouse

Because birds can be highly sensitive to the volatile organic compounds found in many finishes, I use melted beeswax. Although I haven't tried any of the newer water-base finishes, they might also be a viable alternative. I finish only the exterior surfaces of the roof and bottom with the wax by melting the wax in a double boiler and then brushing it on. When the wax on both the roof and the bottom is hard, I secure the roof by inserting the lip of the body into its recess and then inverting the birdhouse. Next, I dribble melted wax into the crack between the body and the roof. This method forms a secure seal that prevents wind and rain from getting into the birdhouse, yet it still allows the roof to be easily removed for annual spring cleaning. To mount the birdhouse in a tree, I first drill a hole through the back of the birdhouse. Then, with a 3-in.-long screw on the end of a long magnetic screwdriver, I fasten the birdhouse to the tree, working through the entry hole. I use a mounting block between the trunk or branch and the body of the birdhouse to provide enough clearance for the roof overhang. □

Andrew Barnum is a woodturner in Carmel, N.Y. He is also co-founder and president of the Nutmeg Woodturners League, a local chapter of the American Association of Woodturners.

***To hollow out a birdhouse,** the author first drills a ½-in.-dia. hole for a hook tool, so he can work from the center toward the edge to avoid cutting into the endgrain.*

***Turning the bottom of the birdhouse** to a uniform thickness helps prevent checking. The blank is mounted on a jam chuck and supported between centers.*

***A lip turned on the top edge of the body** fits into a recess turned into the underside of the roof. Beeswax is used to seal and protect all exterior surfaces.*

Photos this page: Charley Robinson

***As real as it appears, this photo of Po Ku's "Hawksmoor" desk and computer cabinet** was created and printed on a powerful computer system called Alias. Ku initially made drawings of the desk using CAD software on a personal computer. Then the data was fed into the Alias system, which animated the three-dimensional image, rendering realistic wood grain, metallic and painted surfaces, and shadows.*

Computers in the Shop

From microchips to wood chips

by Sandor Nagyszalanczy

If you bought a personal computer years ago with dreams of using it to educate your children or balance the family budget, chances are that microchip-minded marvel has seen more action propelling heroes through game mazes. But if you're a woodworker, it's probably time to consider reclaiming your computer from the kids and putting it to work in the woodshop. Today woodworkers can use computer devices and programs to perform design and construction tasks undreamed of a very few years ago.

Many full-time woodworkers have been using computers in their businesses for years, doing bookkeeping, preparing job estimates and client correspondence, yet affordable computer technology has also become available to the amateur woodworker. While advanced computer-aided design (CAD) systems are replacing drafting tables in professional shops, personal computers and inexpensive drawing and drafting programs are helping hobbyists design more complicated projects. And affordable computer-aided manufacturing (CAM) devices, like computer-numerically controlled (CNC) routers, have started to appear in small, one-man businesses—for custom work as well as for production.

Even though this article isn't a comprehensive survey of computer software or hardware, it will give you some idea about how woodworkers are putting modern computer technology to work in their shops and businesses. Perhaps you'll want to take a trip to your local computer store—on your way back from the lumberyard. —*S.N.*

Photo: Courtesy of Design Vision Inc.

A computer's image of furniture

Even if you're really good at visualizing a piece of furniture in your mind's eye, you must have had occasions when you wished for a more concrete representation before actually making a model or building the piece. Drawings are helpful, but imagine having a realistic photograph of a piece of furniture that doesn't yet exist. That is exactly what you're being shown in the photo on the facing page. That photograph of Canadian furniture designer Po Ku's "Hawksmoor" desk and computer cabinet was generated by a sophisticated workstation computer system called Alias. Ku, owner of Quess Furniture in Toronto, Ont., and designer of high-end custom furniture, used Alias's computer imagery to refine the design for his elaborate wood-and-metal office furniture in lieu of developing expensive prototypes. He also used the image generated by Alias as a sales tool. With it he was able to sell his client on the furniture series before actually building the first pieces.

The process started not on a computer, but with pencil and paper: Ku drew many sketches before he arrived at his basic design. He then used a computer-aided drawing program (see "Computer-aided design" by Pete Conway on the following page) run on a personal computer to create a three-dimensional line drawing, also known as a "wireframe." Ku then used the CAD program's editing functions to modify the piece's curves and proportions and to refine any and all details.

For the next step, Ku contracted with Design Vision, a communications company in Toronto, to rent time on the Alias system. A complete set of CAD drawings was then used by a programmer to input all the initial coordinates that would define the furniture forms in Alias. It took the programmer approximately three days to input all the information before the machine could turn the wireframes into images with realistic surfaces and shadows. The actual running of the program took only about an hour. Then, refinements were made to the image as Ku and the programmer looked at the screen. Ku had brought along samples of the materials the furniture would be made from: pearwood, Australian lacewood, aluminum and colored metallic lacquer, and they tweaked the program to reproduce these colors and textures to match the originals. Once they were happy with the rendering, Alias output the data to a special printer that created a photographic-quality image directly on a 4x5 color transparency.

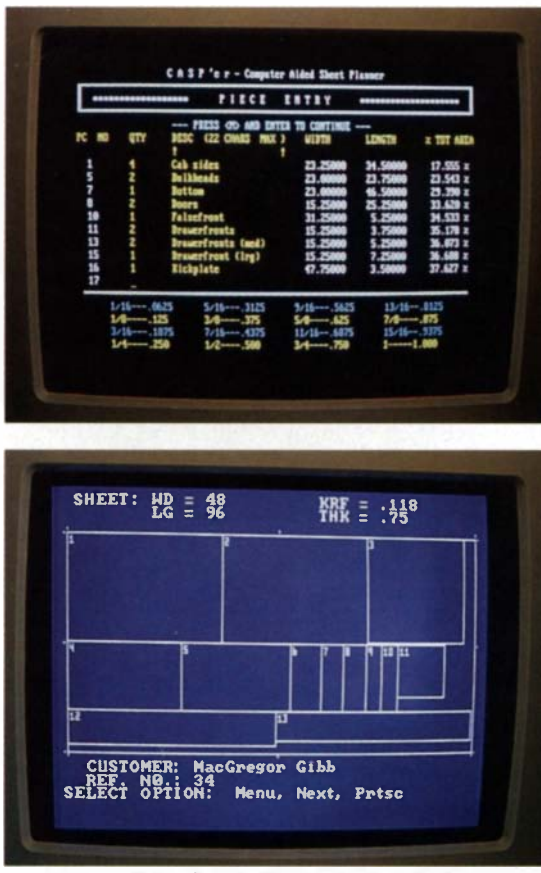
Amazingly, Ku used only a fraction of Alias's potential for simulating reality. All aspects of the "Hawksmoor" furniture—wood grain, lacquer sheen and fine details—could have been rendered even more realistically, but for a much higher price. Some of the most sophisticated work done on the Alias system includes modeling for the animation sequences in last summer's Arnold Schwartzenegger movie, *Terminator 2: Judgement Day.* —*S.N.*

Panel optimization programs

While expensive workstation computers may be reserved for professionals, there is lots of personal-computer software on the market that's useful and affordable to most woodworkers. If you've ever built a kitchen using expensive hardwood-faced plywood for the carcases, you've probably spent hours trying different schemes to lay out the parts with the least waste. But put that pencil to rest: there are two low-priced computer programs that will help you develop an efficient cutting scheme. The first, Plywood Planner, which retails for $29.95, can economically lay out up to 50 pieces on a single sheet; its more powerful brother Casp'er (Computer Aided Sheet Planner) retails for $149.95 and can handle up to 250 pieces and 50 sheets. The programs, designed to run on an IBM PC, XT or AT (or compatible) were developed by Roger Drummond and are sold through The Woodworkers' Store (21801 Industrial Blvd., Rogers, Minn. 55374-9514).

Both programs come on either a 5¼-in. or 3½-in. floppy diskette and run with either a color or monochrome monitor (a standard graphics card is required). They share many basic features: You can specify the size of your plywood sheet (up to 145 in. sq. in Casp'er; 165 in. by 61 in. in Plywood Planner) and the thickness of the sawblade's kerf in thousandths of an inch, which the program figures into the layout. The dimensions of each piece, which must be rectilinear, are entered into a piece list; Casp'er allows you to note part descriptions and allows identically dimensioned pieces to be entered as a group (see the top photo at right). Fractions must be entered as decimal numbers, which can be specified down to sixteenths of an inch or in metrics down to millimeters. After the piece list is done, either program computes and then displays a layout diagram showing each piece identified by number and economically arranged on the sheet, as shown in the bottom photo (subsequent sheets in Casp'er are displayed separately). Each layout diagram as well as a list of pieces for that sheet can then be printed out for use during cutout in the shop. Pieces the program can't fit on the plywood are transferred to another list. Casp'er's multisheet capacity is intended for the professional cabinet shop, cutting out parts for kitchens or large casework. Additionally, Casp'er allows storing the layout on diskette and includes more sophisticated optimization programs for adjusting the arrangement of pieces to best suit the job.

In an office full of computers, I did have a hard time finding a machine that had exactly the right internal configuration to run either program correctly. But once running, I found both programs easy to use. Since they are self-prompting (messages appear on the screen suggesting which keys to press to advance to the next step at



Casp'er, a panel-optimization program, *produced the colorful parts list and cutting layout above. The user enters a list of plywood pieces and their dimensions (top photo), and then Casp'er economically arranges the pieces on a plywood sheet(s) and produces a layout diagram (bottom photo).*

Photos this page: Sandor Nagyszalanczy

any given time), I could wade through the numerous program menus without having to delve into their skimpy manuals (Drummond has amended Casp'er's manual with a much-needed tutorial). When entering data in the piece list, I found it annoying to not be able to scroll backwards to fix a mistake; the piece must be re-entered correctly and the erroneous one deleted via commands from another menu. I also tried planning a whole kitchen's worth of parts with Casp'er and found it inconvenient that the program renumbers parts sequentially on each sheet—out of their original order on the original piece list. Therefore, you must print out each sheet's new piece list with its layout diagram—separate operations that I found time consuming. I also had to fiddle around quite a bit to get the best performance from Casp'er's optimizing functions. But the program does allow you to handle special situations such as finding out how big a sheet you'd need to fit all the pieces for a job. *—S.N.*

Computer-aided design

by Pete Conway

To work out the details of finished pieces before construction begins, I explore ideas through drawings. I use a personal computer set up with a computer-aided design (CAD) program. Besides being invaluable for developing a clearer idea of a piece's lines, proportions and construction details, a computer-generated drawing can help you sell a client on your ideas. And once your design is done, CAD programs that are part of many cabinet shop's software systems, such as Cabinetware or Cabinetvision, have peripheral programs enabling you to print out a precise bill of materials.

Software and hardware: A typical CAD system consists of both a CAD software program and the hardware needed to run it. Software ranges tremendously in price: Full-featured programs, like AutoCad and Cadkey, designed for advanced users like engineers and architects, can cost $3,000 or more. However, for less demanding users, such as hobbyists, simpler CAD programs and generic drawing and drafting software are available for less than $100. Each program has its own compatibility requirements, not only regarding the brand, model and memory capacity of the computer, but also the printer, monitor and other peripherals. (Ask your software dealer about compatibility, as well as future program upgrades.)

While most inexpensive CAD programs will run on a very basic computer, more complicated drawings, like the three generated on AutoCad shown on the facing page, will require more elaborate hardware. Such a system, which will set you back anywhere from $1,500 to $3,000, should have a powerful central processing unit (CPU). In the IBM and compatible world, that means an 80286 or 80386 chip, and at least 640K of random-access memory (RAM). For large or complicated drawings, you need a hard disk drive, which allows you to access and store your drawings faster. A numeric coprocessor chip (sometimes called a math coprocessor) installed in the CPU considerably speeds up its ability to do the calculations necessary to render complex drawings.

You'll need a mouse for making the multitude of cursor motions that create and alter your drawings, as well as for selecting program functions. CAD programs can run on a color or monochrome monitor, but in either case, the computer should contain an EGA, VGA or better graphics card, or else curved parts of your screen drawings will be too jagged and crude looking. Color also allows you to assign various hues to different parts of a complicated drawing, for better clarity. If you wish to import designs from paper drawings or plans, you'll want to add a digitizing tablet, which allows a drawing to be laid over a pad with an electronic grid in it and traced with a pen-like stylus (you can also use the pad to draw freehand). For highest-resolution printouts of plans or drawings, plotters are best. These are devices that use ink-filled pens to print on large sheets of paper. But some programs are also capable of producing reasonable looking drawings on less expensive ink jet or dot matrix printers.

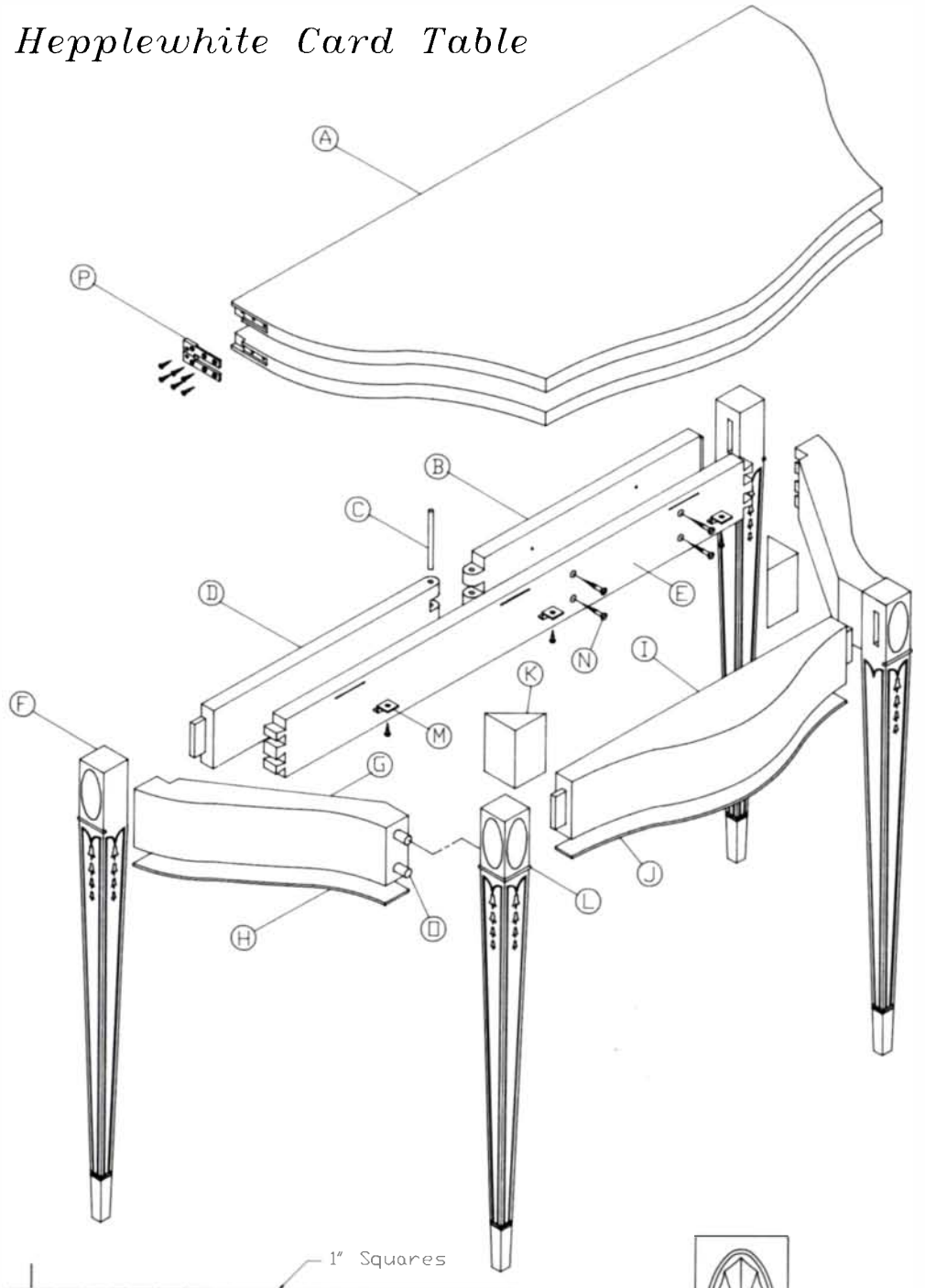
Drawing with CAD: I often use my CAD system to prepare accurate plans of cabinets and furniture and dimensioned drawings for parts to be constructed. I've found that the computer allows me to draw my ideas, using the mouse or digitizing tablet to create lines and curved forms on the screen and then to edit them as I see fit. Editing includes tasks such as moving sections of a drawing around the screen, changing the size or proportion of a form, adding or deleting parts, and typing in titles, instructions and dimensions. Certain CAD editing functions can save a tremendous amount of time, such as when drawing a symmetrical cabinet: I draw only half the cabinet and then instruct the program to create a mirror image for the other half. This not only saves time, but also helps avoid mistakes. When you do make a mistake, the program allows you to delete all or part of your design (thank heavens for that!). Some CAD programs allow you to work in layers, like transparent overlays. You can draw the carcase of a cabinet as one layer, the plinth as a second layer and raised panel doors as a third. I've found this can make decifering a complicated structure easier, and it allows me to produce a detailed drawing of just that one component if need be. But CAD programs aren't magic. You cannot expect the software to produce a detailed drawing unless you first tell it what you want. And telling it what you want involves familiarity and experience using the program—just like woodworking, you have to practice.

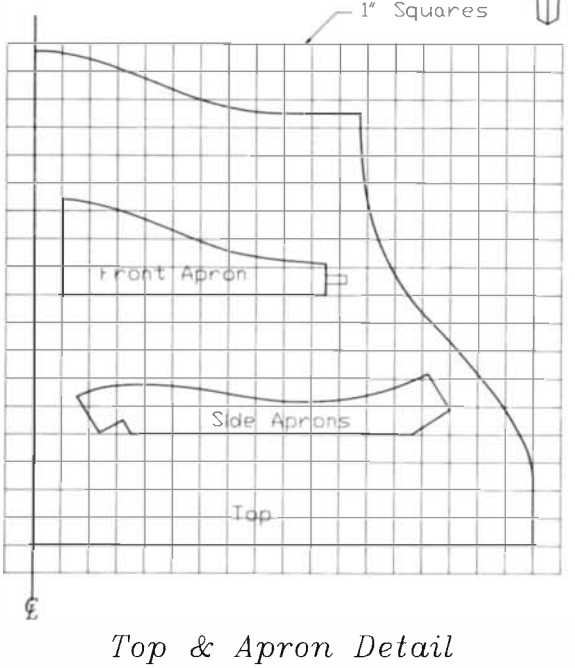
Once an overall drawing is fleshed out, CAD programs give you the ability to zoom in on one area in much the same way that a zoom lens on a camera enlarges part of a scene. This allows you to refine minor details of a larger drawing, say the joinery of a case piece, to work out the fine points of construction. Another powerful feature of CAD programs is their ability to work in exact scale and automatically dimension the lengths of parts. And once you've proportioned a cabinet in the drawing to your liking, you can print it out in feet and inches (decimal or fractional), metric or in other scales. The ability to create a life-size drawing also allows you to use the printout as a template or pattern.

Three-dimensional drawings: While all basic CAD programs produce designs in two dimensions, most advanced CAD programs also allow drawing in three dimensions (3D). I particularly like 3D illustrations because they allow me to examine a complex design from a variety of viewpoints. With the CAD program I use, called AutoCad, I can evaluate a design from as many as four different viewpoints that appear on the screen at one time. Further, if I make changes on an individual view, the changes automatically affect the other views, thus altering the overall design. Since objects in a CAD drawing are only outlined in wireframe, solid areas, such as a tabletop or seat of a chair, are implied; the program has the ability to hide lines wherever parts overlap, to create the effect of solid surfaces. □

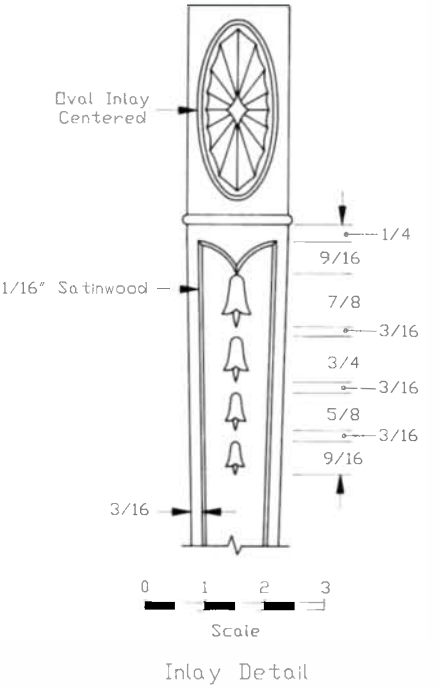
Pete Conway is an assistant professor at the United States Air Force Academy and an avid amateur woodworker.

Hepplewhite Card Table





Top & Apron Detail



Inlay Detail

Card table CAD

A mechanical draftsman for 30 years, Frank Pittman never thought a computer could replace his T-square and pencil. But he finally broke down several years ago and spent six weeks learning how to use a computer and AutoCad, a very powerful CAD program used by architects, engineers and other design professionals. Pittman, who teaches wood technology and furniture construction classes at Western Kentucky University, used AutoCad to create the drawings of the Hepplewhite card table reproduced at left. He and his students also use the program to create drawings of other furniture items and plans for possible production items. Before actually building the card table (see "Building a Gate-Leg Card Table," *FWW* #86), Pittman also created plan and elevation drawings and joinery details (not shown).

Pittman says that while developing a complicated presentation-quality drawing in CAD, like the exploded view above, can take quite a bit of time, it is no slower than drafting it in pencil and then inking it in. The speed of drawing with CAD is at least partially due to the ability to quickly duplicate like parts, such as the table's legs, and copy them to other locations. Pittman also finds the ability to manipulate the proportions of a part, without having to redraw it each time, to be a great design tool. One of the most difficult and time-consuming tasks in CAD is to create a free-form curve, because most CAD programs require you to define the curve via coordinates: You plot points on the screen that the line will pass through, and then command the program to connect the dots. A special function then smooths out the curve.

After the computer work was done, Pittman printed all the drawings shown here on paper using a relatively inexpensive plotter capable of printing on sheets up to 11 in. by 14 in. For the part drawing (below, left), he superimposed a scale grid over a plan view of one quadrant of the top and apron parts. Pittman then created a full-size pattern by redrawing the parts full scale on large grid paper. For the table's inlays, he printed four copies of the detail, shown below right, at full size, and then glued each pattern directly to a leg as a guide for cutting out the flowers. When designing complicated pieces requiring miter joints that meet at odd angles, Pittman will print out a paper drawing of an angled joint and, instead of trying to measure the angles, will use the drawing as a template for setting a saw's miter gauge or building a router jig. *–S.N.*

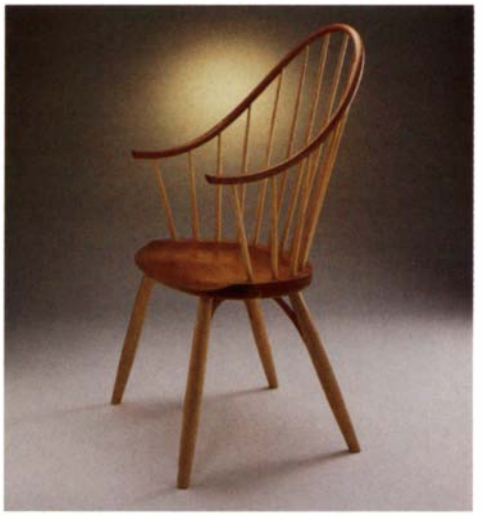
Drawings: Courtesy of Frank Pittman

The Maxym robot is a mechanized-milling machine run by a personal computer. *Shapes can be programmed easily and quickly by drawing them on a digitizing tablet (shown in front of the computer). Then the machine employs a regular router and spiral end mill to perform the desired task. Here, the Maxym robot has been programmed to cut out a curved chair part as an experiment for Thos. Moser Cabinetmakers.*

Woodshop Robots

While attending the Woodworking Machinery and Furniture Supply Fair in Anaheim, Cal., last fall, I was astounded at the number of small computer-numerically controlled (CNC) routing machines, that were both sized and priced to be practical for small- and medium-size shops. These machines are comparable to their behemoth brothers that are part of computer-aided manufacturing (CAM) systems used by factories and large production shops to churn out hundreds of identical parts economically. But small CNC machines employ a single—instead of multiple—router head, aren't as heavy in construction and typically can't produce very large parts. And they definitely don't compare in price: The heavyweights start at around $100,000, while some small CNC systems sell for as little as $10,000 including software (but not the computer needed to run them).

The milling head on a CNC router is designed to move in two axes for cutting out and shaping on flat surfaces, and three or more axes, for shaping complex three-dimensional forms. They're capable of astounding (and repeatable) accuracy—typically within 0.001 in. The heads' motions are directly controlled by the computer, which sends instructions to sets of servomotors. The operator programs the computer with numerical coordinates (this is where the CNC name comes from) that determine the path in which the head travels, such as to rout a rabbet or mill a groove in a cabinet side, to round over an edge on a tabletop or to shape a curved chair part. Many machines accept a standard router as the milling head.



Although this Thos. Moser continuous-arm chair is traditional in design, *part of its manufacturing may soon be done by the Maxym robot, which would carve and sand the chair's seat.*

Small CNC routers are even being used on custom jobs. This is partially due to improvements in software that circumvent the tedious coordinate plotting, making the new systems more "user friendly" and quicker to program when routing complex or curved shapes. Some systems even allow routing patterns to be imported directly from a CAD program. Some of the jobs that small CNC systems seem especially suited for include: signmaking; carving small objects, special hardware and trim; cutting out, routing, boring and shaping furniture parts; and producing multiple parts for limited-production items.

One of the most impressive CAM machines I've yet seen is the Maxym Robot (pictured in the photo at left), manufactured by USA Robot in Saco, Maine. The company's owner, David Jack Hanson, first became involved with CAM systems when he and a partner decided to produce children's music boxes and clocks. They soon faced a situation where their orders far exceeded what they could make using regular woodworking machinery: they needed 12,000 parts per month from 190 different patterns. After failing to find a CNC machine to fit their needs, Hanson asked a friend with extensive computer and electronics background to help build a robot. But their first model, up and running after only a month, was difficult and time consuming to program, so they wrote a special graphics program that allowed them to draw or trace the desired pattern on a digitizing tablet to control the robot's motions. This fit Hanson's idea of using a robot as a creative tool, not just for repetitive operations.

When interest in their robot system grew, Hanson formed a company to manufacture the robot he named Maxym. Among his clients is Thos. Moser Cabinetmakers, a company that is researching the use of a Maxym for both prototype development and production. Because Moser produces large quantities of custom furnishings for architectural applications, the company often needs to quickly produce prototypes to work out manufacturing details and to present to potential clients. Moser also plans to employ the Maxym for actual production work, carving and sanding the deep-saddle seats on one of its standard-series continuous-arm chairs, like the one shown in the bottom photo above, a process that's now done by hand. Maxym will do the routing and sanding after the chairs are assembled, which will require careful programming so the milling head can work around the chair's spindles. *—S.N.*

Sandor Nagyszalanczy is managing editor at FWW.

Top photo: J. York; bottom photo: Courtesy of Thos. Moser Cabinetmakers

Becksvoort made this glass-top coffee table from *¾-in.-thick stock rescued from the scrap bin. The legs are mitered together at the corners and also mitered to the aprons, so there is no endgrain showing on the finished table. The inset photo shows the gently curving shapes created by the bent-laminated glass supports.*

Glass-Top Coffee Table

Bent-laminated glass-supports within a mitered base

by Christian Becksvoort

When a client asked me to design a glass-top dining table, I decided to build a coffee table as a prototype to work out the joinery and design details. The resulting table (shown above) turned out well and required less than 7 bd. ft. of 1-in.-thick scrap lumber.

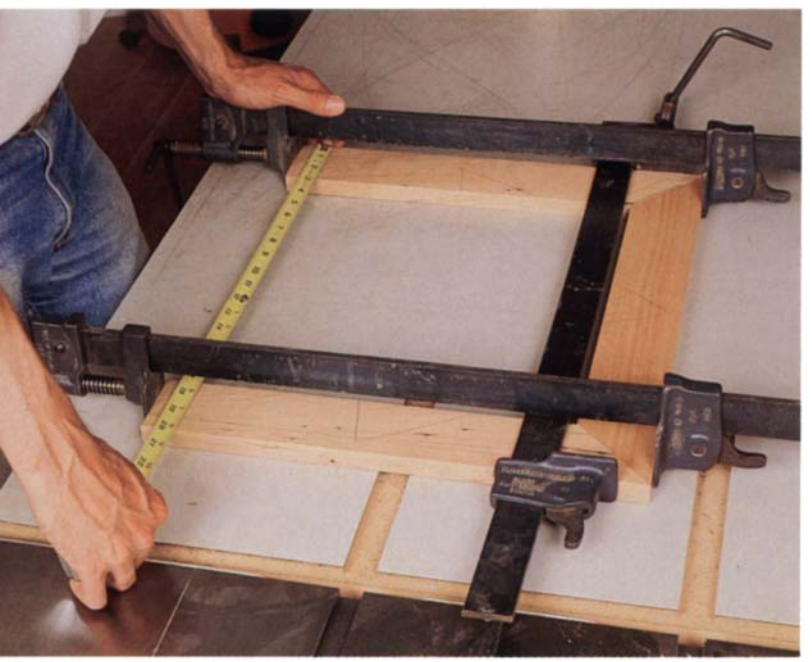
The table's construction is relatively simple. The four leg-and-apron units are assembled with miter joints strengthened with floating tenons. These units come together with glued miter joints that run the length of each leg. The glass top sits in rabbets in the top inside edges of the aprons and is further supported by glue-laminated diagonal rails joined with half-laps and screwed into the inside corners of the aprons (see the drawing on p. 69). Using miter joints throughout the table's design resulted in an unexpected benefit: I didn't have to contend with finishing any endgrain.

Mitering and joining the leg-and-apron units

I cut and assembled the four leg-and-apron units before tapering the legs and shaping the underside of the aprons to ensure a smooth transition. To make the leg-and-apron units, I first cut the eight legs and four aprons to the dimensions in the drawing. I then mitered each leg on one end and each apron on both ends. Whether you cut miters on the tablesaw by setting the miter gauge to 45°, as I do, or on a radial-arm saw or a chopsaw, always test the setup by mitering two scraps and checking the joint with a square.

Large photo: Kip Brundage

Because end miters, like those on the legs and aprons, are structurally weak joints, I strengthened them with ¼-in.-thick floating tenons, which also increases the gluing surface. I laid out the mortises for the tenons so that they would be ½ in. from both the top of the aprons and the outside edge of the legs, as shown in the drawing on the facing page, to keep the tenon from interfering with the rabbet for the glass. I used a slot mortiser to cut the mortises, but you could also bore them on a drill press or with a doweling fixture and portable electric drill. The mortises could also be cut with a table-mounted router and fence or a hand-held router and template. Whichever method you use, be sure the mortises are centered so that the surfaces of the legs and aprons will be flush when assembled. Making passes with each side of the leg or apron against the fence or table will automatically center the mortise but may also leave it a bit wider than ¼ in. However, this is not a problem because the tenons will be cut to fit into the mortises, and tenons should be 1/32 in. shorter than the combined depths of the mortises. A few test cuts will yield a perfect fit.



Three clamps pull the miters together and prevent the pieces from slipping when the leg-and-apron units are glued up.

Mitering the edges of the legs on the jointer is easier and provides better results than doing them on the tablesaw.

Dry-assembling each leg-and-apron unit ensures that the miters are tight, that the tenons don't bottom out in the mortises and that the legs are square to the aprons. I did most of my gluing on my saw's outfeed table since its plastic-laminate surface is easy to clean. After applying glue to the miter faces and inside the mortises, I reassembled the first leg-and-apron unit, holding it together with three bar clamps. I laid the first clamp flat and parallel to the apron, to squeeze the top of the legs to the apron miters, and tightened it slightly until the joints began to slip. Then I positioned the two remaining clamps upright from the bottoms of the legs to the top of the apron, as shown in the top photo on this page, and began tightening them. The trick was to tighten all three clamps alternately so the miters pulled together perfectly without slipping.

Tapering and shaping the legs and aprons

Next, I laid out the curves and profiles of the tapered legs and underside of the apron, as shown in the detail of the drawing. I drew the curve between the legs and apron using a coffee can. I bandsawed to the waste side of the line and then finished to the line with a belt sander, a pneumatic sander and by hand-sanding.

After all four leg-and-apron units were bandsawn and sanded, I mitered the outer edge of each of the eight legs. My first inclination for cutting these long miters was to use the tablesaw with the blade tilted to 45°. However, this didn't work well because the rip fence was too far away from the cut, resulting in chatter and vibration at the unsupported bottom end of the legs. I found that I could get nearly perfect miters by tilting my jointer's fence to 45° and making a series of passes until the last pass just met the face of the leg, as shown in the bottom photo at left. After both legs of all four units were mitered this way, I used the tablesaw to rip the rabbet for the glass top in each apron. Because this rabbet will be visible through the glass, it had to be sanded carefully. Before gluing up the leg-and-apron units, I also sanded all inside surfaces, starting with 120-grit paper and working up to 320-grit.

Joining the four leg-and-apron units

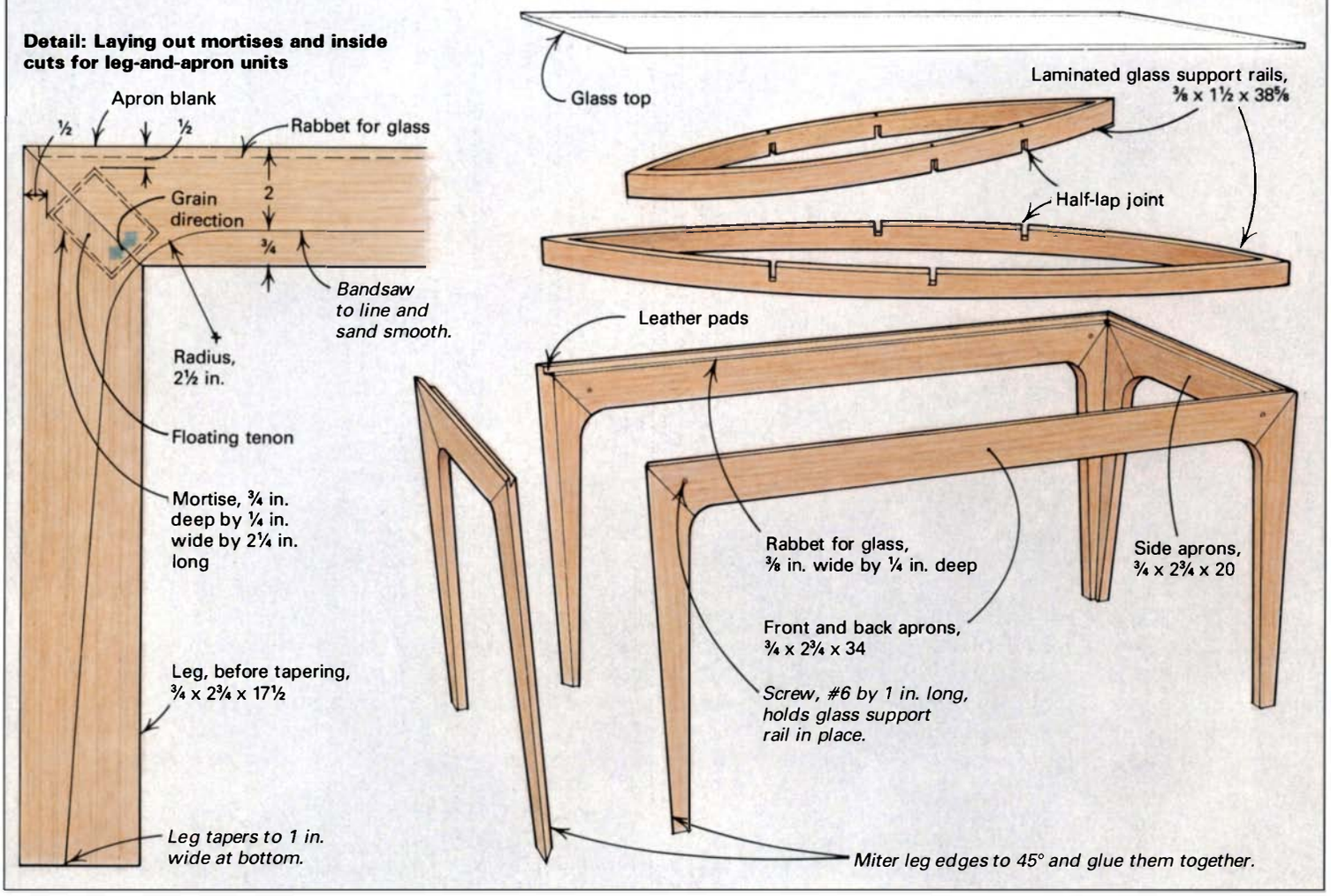
Gluing the leg-and-apron units together is an ideal job for an eight-armed Hindu goddess. It's not difficult, but it must be done quickly and efficiently, so laying out the clamps and planning ahead are essential. Almost any clamping arrangement will work. I used a band clamp around the apron and spring clamps and rubber bands along the legs. Before gluing, I dry-assembled the four units, using tape and rubber bands, checked the miters along the legs and touched them up as needed with a handplane. After gluing up the table, I allowed it to dry and then sanded the outside faces to 320-grit.

Making and installing the glass support rails

The curved support rails were made by laminating three strips of cherry over a curved plywood form. To simplify the procedure, I first laminated two wide strips and then ripped them to form the four required rails.

The form for the laminations is simply a stack of five pieces of ¾-in.-thick plywood glued and screwed together into a block. I laid out and bandsawed a 36-in.-radius convex curve along one edge of the block and then disc-sanded the curve fair and smooth.

I made the strips for the laminations by first resawing two ⅞-in.-thick pieces of cherry, 3¼ in. wide by 44 in. long, into six 3/16-in.-thick pieces on the tablesaw. Then I planed each strip to its ⅛-in. final thickness. Because my planer has a minimum capacity of only ¼ in. thick, I used a piece of ¾-in.-thick plywood as a tem-



porary planer bed and screwed a lip to the underside of the plywood to keep the bed from being drawn through the planer.

To laminate the curved rails, I applied glue to three of the strips with a narrow paint roller, wrapped them in plastic to minimize the mess and held them tightly to the form with a 3-in. heavy-duty band clamp. After the first lamination had dried for 24 hours, I repeated the process for the second set of rails. When the second lamination had dried, I scraped off all the excess glue and jointed one edge. Then I ran the jointed edge against my tablesaw fence and ripped the laminations into the four 1½-in.-wide rails.

The placement of the miter joints between the two pairs of rails is taken from the table, but the table must first be square. Measuring the diagonals will reveal problems, and a clamp can draw the table back to square if necessary. I placed one rail at a time diagonally across the top of the table, so the outside edge of the rail intersected the inside corners. With a square, I transferred these intersecting points along the side of the rail and marked the top edges at each end. Then I aligned a straightedge with both marks across the top of the rail to define the table's diagonal and to bisect the angle between the rails. I scribed lines across the top of the rails with a knife, bandsawed close to the lines and disc-sanded to them. With the first rail marked and cut, I clamped it in place inside the table to help align marks for the second rail. I repeated these steps to mark and cut the other rails. After sanding the rails to 320-grit, I glued pairs of them together, taping across the miters, to form football-shaped glass supports (see the inset photo on p. 67).

When the glue was dry, I dry-assembled the glass supports into the table to mark for the half-lap joints where the supports intersect. First I slid one support into place diagonally between the corners of the table frame until it was about ½ in. below the rabbet. Then I positioned the second support unit diagonally between the opposite corners, directly on top of the first. Spring clamps on the table legs prevented the supports from slipping farther down. With a knife, I scribed the bottom of the top support and the top of the bottom support where the curves intersected. Then I removed the supports and extended these lines halfway up the sides. After cutting along the lines with a dovetail saw, I chiseled the bottoms flat. Finally, I slid the two units together and trimmed them with a sharp chisel to get a perfect fit.

Once the glass supports fit properly, I glued them together and inserted them into the table. With spring clamps holding the supports in position, I drilled a hole for a wooden plug and then a pilot hole for a screw in each of the long aprons' corners and into the curved supports' mitered corners, as shown above. After inserting the screws and plugging the holes, I gave the entire table a final sanding with 320-grit paper. Four hand-rubbed coats of Watco oil provided a satisfying satin sheen.

Experience has taught me that it's better to take the finished table to a reputable glass shop and have a glass top cut to fit than it is to phone in the dimensions of the glass. For a finished look, I had the edges of the ¼-in.-thick plate glass ground, and to protect both the glass and the table, I glued round leather pads in each corner of the table and at the intersections of the supports. □

Christian H. Beckstoort builds custom furniture in New Gloucester, Maine, and is a contributing editor to FWW.

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

The Demise of American Chestnut

Tragic loss of a great American timber

by Jon Arno

At the conclusion of one of my recent wood-identification seminars, a shy and obviously puzzled young man came up to me with a 2-ft.-long 1x6 of grayish buff-brown wood. Before approaching me, he had fumbled through my set of samples on the table by the podium in search of a match that would save him from asking the inevitable question, "Do you know what kind of wood this is?"

Because the sample was so beautifully clean and clear, determining its identity stumped me for a minute. But one peek at the endgrain through the hand lens revealed the familiar flame-shaped pore pattern of American chestnut, *Castanea dentata* (see the two photos of the samples on p. 72). Chestnut was once a major American timber but millions of acres of the trees were destroyed by a blight early in the 20th century. Although my sample set contained American chestnut, there was little mystery as to why this fellow was unable to make the match. My only sample was a remnant of an old barn beam—wormy and streaked with black from the reaction between tannin and steel cut nails—but it was a treasure to me just the same.

As the young man's shyness subsided, I learned that this magnificent piece of chestnut came from his grandfather's shop. And since his grandfather had passed away recently, he wasn't willing to part with this board; its value to him went well beyond the rosewood, walnut and money I was prepared to offer in exchange. Later, it occurred to me just how brief each generation's collective experience is. Only a few decades ago, any schoolboy would have recognized chestnut at a glance. It seemed to be everywhere: the split rail fence he climbed on the way home, the spice rack on his mother's kitchen wall, even the chest of drawers from which he plucked his socks in the morning. And now it is gone; it's almost as if it had never been.

The tragedy of the blight

First reports of the chestnut blight came from the New York Botanical Gardens in 1904. The lethal Asian fungus *(Endothia parasitica)* that caused it probably was introduced on nursery stock brought to North America from the Orient sometime in the late 1800s. Radiating out from New York at a pace of about 20 miles per year, this unstoppable scourge had decimated the entire native range of American chestnut from New England to Georgia and west to eastern Missouri by the late 1940s.

Because the fungus does not destroy the root system, the term *extinction* cannot yet be applied. Chestnut still exists throughout its native range as sporadic thickets of sprouts coming off of ancient stumps. These sprouts may attain diameters of 2 in. to 4 in. and heights of 20 ft. Some may even bear fruit before they too succumb to the blight, but as a North American timber species, the status of chestnut has now been reduced to that of a shrub. To be sure, there are isolated specimens (see the photo at right on the facing page) that are of great interest to botanists seeking specimens that may have natural resistance. Reports of a healthy tree discovered in Oakland County, Michigan, made it into a suburban Detroit paper not long ago. Also, small woodlots planted by early settlers outside of chestnut's native range can be found that contain healthy specimens spared by their isolation. And there is a small grove in western Wisconsin as well as other occasional plantings all the way to the Pacific.

The demise of any species, fauna or flora, weakens the fabric of life on earth, but the loss of American chestnut represents a tragedy of epic proportions. Prior to the blight, chestnut may have been the single most important species in America's Eastern mixed-hardwood forest. Although not the largest of our native trees, in the forest it had attained heights of more than 100 ft. and diameters in excess of 6 ft. and often yielded clear logs up to 50 ft. or longer. The nuts (see the photo at left on the facing page), technically a seed, were as sweet as the European species *(C. sativa)* and plentiful, coming by the bushels from every tree in multiples of two or more to the burr. The annual food production per acre from mature stands of chestnut rivaled (in some cases surpassed) that of cereal crops such as wheat or even corn. "Chestnuts roasting on an open fire" were traditional holiday treats, and the nuts were also an important ingredient in stuffing. The remainder of the crop served as fodder for livestock or as a mainstay in the diet of native wildlife, thus ultimately coming to our table as meat from the butcher's shop or the hunter's bag.

But what about the timber?

As plentiful as chestnut was, it was never a prized cabinetwood of the caliber of walnut or mahogany. It was too common, too utilitarian and, frankly, it was lacking in some important functional properties. For instance, with an average specific gravity of only 0.40 (oven dry weight/green volume) which is identical to that of yellow poplar *(Liriodendron tulipifera)*, chestnut was much too soft to serve as the primary wood in truly rugged and durable furniture. Its ring-porous, open-grain surface (shown on this page in the background) presented some finishing problems, and its propensity to split, while a benefit to the shingle maker, made it risky to use for wide panels or structural members bearing weight across the grain.

Chestnut never was a pretentious choice for glamorous woodworking. It was a plebeian wood, a cheap and plentiful performer of common tasks. Its outstanding weathering properties made it an ideal telephone pole, a somewhat spongy but long lasting railroad tie and an exceptionally durable coffin. It was also used extensively

Photo this page: Susan Kahn

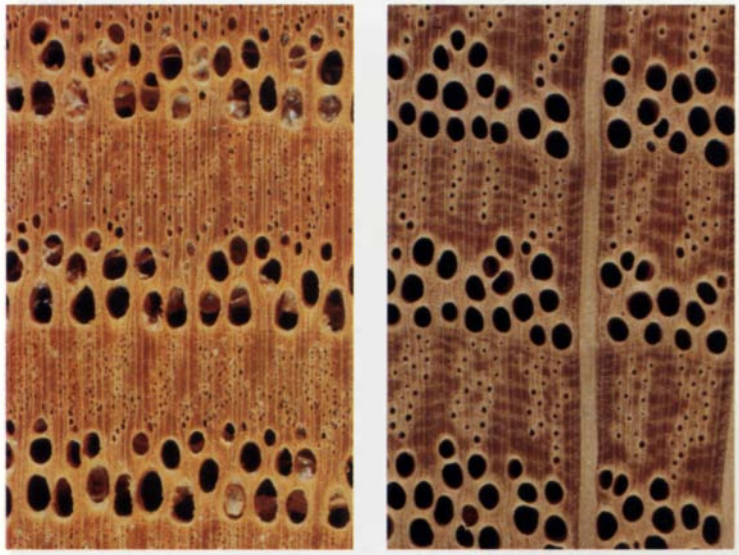
Chestnut trees once covered nine million acres of America. *The nuts (above) were a major cash crop in Appalachia, and the timber was used for everything from telephone poles to furniture. But around 1900, a fungus spread across the country and within 50 years had destroyed this resource. A few groves, like the one at right in Trumpelo County, Wisconsin, survived because of their isolation.*

for sash and trim, siding, beams and doors. Chestnut was also a popular choice for the substratum of veneers. With an average volumetric shrinkage of only 11.6% (green to oven dry), it was quite stable relative to other woods used for that purpose such as red gum *(Liquidambar styraciflua,* 15.8%) and even yellow poplar (12.7%). Given its stability, its soft, easy working characteristics and the fact that it was plentiful in the Connecticut river valley and southward through most of the original Colonies, it was commonly used as a secondary wood by some well-known Early American cabinetmakers. For example, chestnut can be found hidden away as the drawer sides and interior parts of some of the finest 18th-century work of the Newport, R.I., masters John Townsend and John Goddard.

As secondary woods go, chestnut has a lot of charm, and its absence leaves a gaping hole in our line-up of domestic species. A secondary wood can be bland, but chestnut isn't. Its ring-porous nature gives it a pleasant figure on the tangential surface, and its mellow light-brown color darkens just enough under a clear coat of varnish to produce a warm, attractive hue without the use of stain. In addition, a great deal of chestnut found its way into small, functional articles that seem to have a knack for surviving, such as sewing boxes, knife trays, spice chests and clock cases. It is not difficult to find items made in part or completely out of chestnut; however, because the wood has a faint resemblance to oak, examples of it are sometimes mislabled in antique stores. To identify chestnut in existing pieces, look for an unfinished surface to see if the wood has a natural grayish, buff-brown color. Then, if it also has an oak-like figure, but is surprisingly lightweight for oak and seems to lack oak's dominant ray flecks, there is a good chance it is chestnut.

For today's woodworkers, acquiring chestnut is, of course, a problem. If you watch the classified ads and browse sawmills, a trickle of chestnut can be found. Because of its great weathering properties, standing deadwood remained sound enough to harvest for many years after the blight. Also, lumber resawn from the beams of demolished barns and buildings finds its way into today's market as expensive, wormy-chestnut paneling, but this is an unreliable and finite source. Of the dozen or so species of chestnut worldwide, the European species, *C. sativa,* is most similar to the American variety, both in terms of the flavor of the nut and the

Photo above left: Larry Brewer; photo above right: Dale Hindale



How to tell chestnut from oak: *Chestnut, as shown in the background on p. 70, has a buff-brown color with an open-grain figure similar to oak, with which it is often confused. However, chestnut is substantially lighter and softer than oak, and oak's rays are clearly visible on all surfaces while chestnut's rays are difficult to see without magnification. For final verification, examine a smoothly cut section of endgrain with a 10-power hand lens. As shown in the photos of chestnut (left) and oak (right) above, the larger pores in both woods are concentrated along the outside of the annual rings. But chestnut's larger pores tend to form wavy bands with flame-like bursts radiating away from the annual ring (see the photo at left).*

stature of the tree. Because of these similarities, I think the insights provided by the European craftsman, Rudi Wolf (see the sidebar at right), are of special interest because they present a hands-on account of a woodworker who still has a plentiful supply of chestnut. Sadly, the blight was introduced into Italy sometime in the 1930s and apparently the European species is not significantly more resistant than ours was.

Some hope for the future

I would like to conclude this eulogy to the American chestnut by saying that it has been so much a part of the American scene that it will be forever fondly remembered. But I can't. As evidenced by the shy young man at my seminar, few generations will pass before it is as forgotten as the flavor of mammoth meat. But there may be hope. Like strains of flu in human populations, plant diseases are known to lose their virulence. Recently, scientists have isolated a less-lethal (hypovirulent) strain of the fungus that can be injected into a tree, like a vaccine, to protect an individual specimen, but it's not a workable solution for large numbers of trees. Also, there are Asiatic species with exceptional resistance such as Chinese chestnut, *C. molissima,* and plant breeders are hard at work searching for hybrids that capture this feature without carrying that species' genes for small stature and poor timber form. Perhaps a hybrid will be found, a chestnut that is almost as good as the one we will, by that time, have forgotten. For woodworkers today, however, it is only through the shared experiences of Old-World craftsmen like Rudi Wolf that we can "savor the flavor of mammoth meat." □

Jon Arno is a wood technologist and consultant in Schaumburg, Ill. For more information on breeding and other research projects aimed at re-establishing the American chestnut, contact The American Chestnut Foundation, 401 Brooks Hall, PO Box 6057, West Virginia University, Morgantown, W. Va. 26506-6057.

Chestnut: A European perspective

by Rudi Wolf

Fifteen years ago, I settled in the south of France, in a mountainous area called the Cevennes, which is part of the Massif Central. Coming from Holland, a flat land beneath sea level, it was quite a change for me. I had prepared for my new life by studying to be a woodworker for six months at a state school for jobless adults. When I arrived in this mountain village, I introduced myself as a carpenter, although I still had much to learn about the trade.

One of the first things I learned was that working for local people meant working with the local wood—chestnut. Chestnut *(Castanea sativa)*, shown in the top photo on the facing page, has been one of the most important cultivated trees in the south of France and in the whole Mediterranean area for thousands of years. It seems that a century ago there were more than 300 varieties adapted to all types of geographic and climatic situations. The trees produced nuts that could be used fresh, dried or for cooking; for making a kind of marmelade; to fatten up pigs or to feed to goats to increase their milk production. And then there was the wood.

Chestnut it should be: People in this region grew up with chestnut and would not accept a door or window made of oak. Even when I tell them that I have fine oak planks in stock, which were cut 12 years ago and are well seasoned, their inevitable reply is "Chestnut it should be." Chestnut is used for anything and everything: construction timbers, beams and roof planks, floors, doors, windows, shutters, tables, cupboards, matted chairs, bee-hives and barrels. The wood is also used to dam the river to provide a summertime water reserve in case of fire, and even the young shoots are split into thin strips and used for weaving baskets.

Unfortunately, in recent times many trees have died from the same blight that destroyed the chestnuts in America, and so the chestnut's economic importance has declined. But the blight has not been as bad here, and healthy trees are still plentiful. My 90-year-old neighbor, a farmer, can still distinguish about 20 to 30 varieties of chestnut on the basis of subtle differences in the nuts.

In spite of how commonly used chestnut wood is, I couldn't find it at the commercial lumber firms in town. I had to go inland to the smaller local sawmills where the newcomer, as I once was, tends to get the worst wood. It took me years to learn to recognize the wood's subtle characteristics. Healthy chestnut is whitish yellow and quite solid. Lower grades tend to be brownish in color and somewhat softer. Common defects are, of course, rot and wormholes and a kind of yellow discoloring caused by mildew. But worse yet is the "roulé" or "roulure," which is when the annual rings separate (not to be confused with heart split or dry split). In severe cases, a plank becomes like a bundle of matchsticks, and it is not uncommon to scrap 30% of each board by sawing out the roulé. When the wood is freshly sawn, it is sometimes difficult to see the defects, but I eventually learned to look carefully when buying my wood.

Photos this page: Bruce Hoadley

This roulé problem is undoubtedly the reason why modern industrial woodworkers won't touch the stuff—it's just too much trouble. But for the older people in this region, chestnut is an integral part of the traditional way of doing things. They are very proud of the knowledge that's been handed down from father to son about how to use chestnut because, after all, its their tree, their wood.

Working in the old ways: Some years ago I told my elderly neighbor that I wanted to buy a ladder. He sounded a bit angry when he said, "Don't throw your money away!" He told me that I should wait until winter, go to the north slope of the mountain and cut a pole of chestnut from a 12-to 15-year-old tree. Next, he said to saw the pole lengthwise, make mortises in both pieces and insert dry, split rungs of knot-free chestnut. He assured me that when the green wood dried and shrunk, the rungs would be secure. To prove this, he showed me some ladders that he had made more than 20 years ago. In spite of the fact that they were always left outside in the wind and rain, they were still perfect.

Last year a farmer commissioned me to make a "pastieire," which is a large slope-sided box or trough used to kill and butcher pigs. Upside down, the box makes a table on which the pig is secured and bled. Then the box is turned over and used as a kind of shallow bathtub as hot water is poured on the dead beast so that the hairs can be rubbed off the skin. I couldn't find the high-quality chestnut planks needed for the job, and so I proposed another type of wood. But no, he was willing to wait a year for chestnut.

Restoration work on local houses and furniture has also taught me much about how chestnut was used and how to work with it. When restoring the doors and paneling in the old houses around here, I usually discover beautiful, old chestnut after removing several coats of thick, brown paint. The doors and shutters in the center photo at right are copies of the doors that orignally graced this old shop front. When restoring old woodwork or furniture, it is sometimes necessary to darken new chestnut to match the old wood. An untreated plank of chestnut will turn a soft brown after a few years, but I've found that by putting the wood in my goat's stable, the coloring process is speeded up. This is probably caused by the dung's ammonia vapors reacting with the tannin in the chestnut.

One year I made several little stools with fancy carved tops like the one in the bottom photo at right, which I had planned to sell to the tourists. Chestnut is similar to oak, only a little more brittle, and although you can't cut fine details when turning or carving, shallow bas-relief is possible. Unfortunately, tourists didn't buy the stools because there were cheaper, mass-produced stools on the market. However, to my amazement, the usually frugal local farmers came looking. Turning the stools around in their hands, they commented on the quality: "Strong construction, and you used grafted chestnut on the top. Easier to carve, isn't it?" For them, the price was no problem. They know about good construction because they use their own hands to make most of life's necessities.

Slowly, the importance of the chestnut forest is diminishing. The blight plays a role, the people's changing lifestyle another. Now they are planting Japanese varieties that are not affected by the blight, but these new, heartier varieties just aren't the same. As an integral part of the culture, the chestnut is disappearing from the scene here as it did in America. □

Rudi Wolf is a woodworker in southern France.

Large, healthy chestnut trees, *like this one on the plateau of the Larzac in France, are still plentiful in Europe. However, the same blight that destroyed the American chestnut is slowly spreading through Europe.*

Chestnut has long been the wood of choice *for doors, windows and interior paneling in the mountain villages of Cevennes, France. The chestnut doors and shutters on this old shop front are copies of the originals. The old window frame above the doors is made of wild cherry.*

Wolf made chestnut stools with bas-relief designs, *like the one shown here, to sell to tourists. As it turned out, the tourists preferred the cheaper, mass-produced souveniers, but the locals appreciated the quality and bought Wolf's stools.*

Photos this page: Paul Starosta

A dedicated mortiser: *The author sinks a ½-in. bit nearly 2 in. deep into mahogany with only a moderate amount of effort. The rack-and-pinion gearing on Delta's hollow-chisel mortiser and the author's chisel sharpening and polishing method combine to make deep mortising manageable—even in tough woods.*

A New Hollow-Chisel Mortiser

Bench-top solution to boring square holes

by Robert M. Vaughan

For years I chopped out mortises using a heavy, old 15-in. Walker-Turner drill press with a hollow-chisel mortising attachment and a foot feed. After trying Delta's new 14-600 hollow-chisel mortiser (shown above), I sold the old Walker-Turner without a moment's hesitation.

If you cut a fair number of mortises, chances are you're either using a router with a template or you're using a drill-press setup, with or without a hollow-chisel mortising attachment. So why would you spend nearly $500 on a machine that only cuts mortises? Speed, accuracy and convenience are a few reasons. Whether or not those reasons are compelling to *you*, though, will depend on the size and volume of mortises you're cutting and on your budget.

The mortiser is small (31½ in. high) and portable enough (44 lb.) that you can store it out of the way when not in use. Then, when you need it, you simply screw it to a bench or to a subbase that can be clamped to a bench, and you are ready to go. A couple of dowels can be clamped to the bench on either side of the machine for supporting long stock. Setup time is minimal: You set the depth of stop, adjust the fence to locate the mortise on your stock, and lower and fasten the hold-down bracket; and that's it.

All the convenience in the world doesn't mean a thing, however, if precision suffers or the tool is tiring to use. My first test mortise was ½ in. wide by 1¾ in. deep in red oak. The bit crunched down with about the same effort my old drill-press mortiser required to drop a ⅜-in. bit ⅞ in. deep into poplar. I had expected the design mechanics would have resulted in easier mortising, but I hadn't expected this lightweight mortiser to perform quite so closely to the half-ton industrial machines I've used. And with only finger pressure holding the stock against the fence, the mortise was absolutely parallel to the sides of the stock. The hold-down bracket held the stock in place, and bit extraction was easy. The test mortises in cherry and mahogany further confirmed the machine's smooth, accurate operation.

With the supplied medium-density fiberboard (MDF) base in place, and using a long bit, clearance beneath the chisel is almost 4 in.—adequate for most face frame and leg stock mortising. The base can also be positioned behind the column, which allows clearance to the benchtop or the floor. Used in conjunction with a bench vise or clamps, the machine's flexibility is expanded greatly.

The bolt-together steel construction of the tool's frame lends itself to many interesting, though warranty-voiding, modifications. A little boring and welding on the steel column or plate steel base could result in a horizontal or other special-purpose mortiser.

Tool anatomy

The guts of this mortiser, and all structural components, are quite beefy for the machine's size, which becomes obvious when you lift

it. The ½-HP capacitor-start motor is ample for its task and runs quite smoothly at 3,600 RPM. The entire motor-and-head assembly moves up and down on large dovetail ways, one side of which is an adjustable brass guide that is used to maintain proper fit and smooth operation despite wear. An 18-in. handle engages a rack-and-pinion gear system; the handle can be inserted into the hub of the pinion gear at any of four positions. This allows a mortise to be cut with less than a half-turn of the handle. An hydraulic cylinder, similar to the kind you find on a car's hatchback door, counterbalances the weight of the motor-and-head assembly.

An angle-iron fence is welded to an L-shaped rod that slides in and out of a hole at the base of the column to adjust for stock width. A handle on the side of the column locks this rod in place. The short leg of the L, to which the fence is welded, also serves as the column for the hold-down bracket. The bracket slides up and down on this column and is secured in place using the T-handle hex wrench supplied with the mortiser. The minimum dimension of stock the hold-down bracket will secure is 1 9/16 in., although you could easily block up thinner stock if necessary. Mortise depth is set by adjusting a stop rod on the left side of the machine and fastening it in place with a hex-head setscrew.

Quality materials have been used throughout on this machine, from the German-made Rohm chuck to the neoprene power cord–a minor detail, but a nice touch nonetheless. The power switch, located on the left side of the motor housing, has a removable insert that prevents unauthorized starting. A self-ejecting chuck-key is supplied too, so you won't inadvertently start the machine with the chuck-key installed. An adapter is supplied with the machine to allow the use of both long and short shank mortising bits. The socket for the hollow chisel is 1 in. dia., but a bushing is included to permit use of the popular ⅝-in. shank chisels.

Taking its overall excellent performance as a given, I have a couple of minor gripes with the machine. The first is that holes weren't provided for the hex wrench and the chuck-key in the plastic cap that covers the top of the mortiser's column. The other is that cup-point socket-head setscrews were used on the adjustments. The cup point digs into the metal and creates a burr that can interfere with the smooth operation of the stops. I ground the setscrew tips flat, and the problem was solved. I called Delta to alert them to this, and I was assured that a different type of setscrew will be used in the future.

Conclusion

This new mortiser is superior to any drill-press rig I have ever used, including presses that sell for more than $2,000. The size makes it perfect for the space-conscious home-shop woodworker, and its performance makes it an attractive buy for the budget-minded commercial-shop owner. But, as Delta says in its ads, it is a luxury. I would recommend it unequivocally, though, for anyone considering dedicating a drill press to cutting mortises. □

Bob Vaughan is a woodworking-machinery rehabilitation specialist in Roanoke, Va. The Delta 14-600 hollow-chisel mortiser is manufactured in England by Multico Ltd. It is imported into Canada by General Manufacturing Co., Ltd, 835 Cherrier St., Drummondville, Quebec, J2B 5A8.

Honing a hollow chisel

A cutting tool is only as good as its edge, and a hollow mortising chisel is no exception. For years I used a small, tapered half-round file to sharpen the inside bevels of my hollow chisels. Then I read Ben Erickson's article (in *FWW* #83, pp. 52-56) on hollow-chisel mortising with a drill-press setup. Though there's no quick, easy method of obtaining a sharp chisel-and-bit setup, the high-speed steel Clico sharpeners (Sheffield Tooling Ltd., Unit 7, Fell Road Industrial Estate, Sheffield S9 2AL, England) and auger file that Erickson recommends make lighter work of a tedious task.

I've also found that I can improve a new chisel's performance by polishing it inside and out before using it. I hone the outsides of the chisel on my benchstones and follow that with polishing on a hard buffing wheel, using white rouge as a mild abrasive. I take the finish to as glossy a state as I can, without compromising the flatness of the sides.

To sharpen and polish the inside of the chisel, I put a short section of dowel (1/16 in. less in diameter than the width of the chisel I'm sharpening) into the chuck of a hand drill. For example, on a ⅜-in. chisel, which is what I normally mortise with, I use a section of 5/16 in. dowel. I hold the chisel fast in my vise, rub the dowel with white rouge and then bring the dowel into contact with the inside of the chisel. This polishes the high spots on the inside surfaces to a mirror shine, producing a much slicker passageway through which the wood chips may pass. I polish from both ends of the chisel to eliminate *any* potential hang-up spots. The difference in appearance and performance between an untouched chisel and one that has been sharpened and polished is astounding.

No matter how often I sharpen my hollow chisels, though, and no matter how sharp I've gotten them, they eventually turn blue from heat generated by friction. The only way I know to prevent bluing is to use the bit at an unacceptably slow feed rate or not at all. Keeping the bit sharp and reducing friction as much as possible will go a long way toward alleviating this problem but won't completely eliminate it. A constant stream of air from a compressor, a dust-collecting device or a vacuum cleaner with the air flow reversed, will also help keep the chisel cool and reduce chisel burning. Even burned, blue chisels cut. Although accepted wisdom says that the temper on these tools is ruined, mine have always seemed to sharpen and cut just as well as new chisels. *–R.V.*

Polishing a chisel's interior: *After rubbing the chucked dowel with white rouge, the author inserts it into the hollow chisel. The wooden dowel is soft enough that there is no danger of damaging the chisel while the rouge mildly abrades and polishes its interior passageways.*

Photos: Author

Profile: Chad Voorhees

Eavesdropping leads to more delicate furniture

by Dick Burrows

***Chad Voorhees developed his design sense from early exposure to Shaker furniture** and an appreciation of James Krenov's work. But the delicate proportions of his recent furniture are based partly on the reactions of patrons attending his shows.*

Chad Voorhees' best work is characterized by refined delicacy, jewel-like accents and impeccable craftsmanship, according to reviews of his one-man and gallery shows. When I visited Voorhees last summer at his small shop in Beaufort, on the North Carolina coast, he told me his visual sense largely developed from a marketing decision he made eight years ago. That decision was a turning point in his career.

Back then, he would sometimes hang out near his display in a particular show to eavesdrop on the audience's candid reaction to his furniture. His work at that time was more massive than his current furniture (see the photos on the facing page) because he was making a conscious attempt to break away from his earlier devotion to James Krenov, which he felt had become inhibiting. Voorhees said he noticed that men usually were drawn to his heavier constructions, but women were pretty lukewarm about the stuff. Ignoring any implications that might be considered a sexist cliché, Voorhees was most affected by the way these divergent reactions hampered sales. When the women resisted buying his work, the men backed off, confidently proclaiming that they could make furniture like that when they got home.

These overheard conversations inspired Voorhees to experiment with proportions. "As soon as I decided to take the opposite approach—to appeal to the feminine aesthetic, as it were—and design with tapered legs, delicate proportions and fine details, I really started to see the kind of furniture that I wanted to make. Seeing how people reacted to my work turned my whole sense of proportion around," he says. As an added bonus, he also no longer overhears men saying, "Honey, I can make one of those."

Voorhees theorizes that "you've got to make something that someone else can't make. You want your work to be like a piece of art. You want people to wonder how or why you did it. However, this stress on wonder doesn't in any way excuse you from doing high-quality work." Voorhees believes that an important part of woodworking is building things for other woodworkers. It's easy to spot other craftsmen at a furniture exhibit because they're on their hands and knees giving everything a white glove inspection. "If people want to get down on their hands and knees, they'll see that my stuff looks good and is well built."

Voorhees' style and his stress on top-notch craftsmanship appear to grow naturally out of his earlier experiences. Although he didn't start building furniture until he was well along in college, he went to high school in a Shaker village in New York state. There he recalls being deeply affected by an environment richly steeped in the Shakers' directness in dealing with things, their reliance on minimal detail and their uncompromising quality.

After high school, he headed to Virginia Commonwealth University in Richmond to study sculpture but soon lost interest. "I was

Photo this page: Dick Burrows

Photo at left, John Cram; photo at right, Clay Algeo

***These cherry-and-padauk pedestals** have been steady sellers, marketed nationwide by Voorhees since 1983.*

***Tambour-like ebony strips on the end panels add a textural design element to this curly maple desk.** The 70-in.-wide desk has Vorhees' typically slender legs and a central drawer flanked on each side by a drawer with a Gaboon ebony panel.*

taking furniture design at the same time and really got interested in the work being done by the instructors and students."

After college he built high-end display cases with his brother. His goal was to make simple furniture and master the woodworker's trade. That situation changed as he developed his distinctive design sense, especially after he came up with a series of pedestal stands (see the top left photo) that he could produce regularly and sell profitably through wholesale craft markets and galleries across the country. This national exposure led to more commissions, and he began doing more and more one-of-a-kind work.

Despite his art background and his success in the gallery world, Voorhees still exudes a tradesman's pride in his craft. "I'm no better than furnituremakers of 100 years ago. They had integrity, and that's what we've lost—quality and integrity." Voorhees believes that mastering basic skills—understanding wood movement, finishing, fine joinery for hardwood construction—is as crucial today as 100 years ago, especially if you want the freedom to concentrate on producing furniture that looks just the way you want it. "I don't even think about things like mortises and tenons anymore. Everything is second nature. I have the freedom to really concentrate on the visual. I can see beyond the technical parts. If I encounter a problem, I can look it up in books the same way writers use a dictionary while they work."

His emphasis on the visual means much of his design development comes from actual bench work, rather than from drawings or someone else's set of standards. "I design more from common sense than anything else. I'm concerned with what looks right rather than the golden mean or some set of standards. Often I try to pull the piece away from what might be considered standard."

Several years ago, for example, he built a 50-in.-high "Hunt Cabinet." A contemporary dining-room sideboard would normally be 32 to 34 in. high. But traditional huntboards were taller because they were carried outside during a hunt so that riders could serve themselves food and drink while on horseback. Although Voorhees didn't expect his cabinet to be used this way, his goal "was to raise the eye to a different level in the room."

Another tall piece is the 36½-in.-high curly maple and ebony silver chest (shown in the photo at right on p. 78). In addition to creating a light, visual effect with graceful lines that would blend into any setting, the long, tapered legs also improve the functional qualities of the cabinet. "It's just a logical aspect. It works better having the drawers at waist level, rather than forcing users to bend down everytime they want to get something." Like most of Voorhees' cabinets, the silver chest is a freestanding piece with interesting details all around. "I want my pieces to stand by themselves but not necessarily stand out." He added that traditional construction techniques—mortise and tenon, frame and panel—which he favors, also help his work fit into any setting, even a very formal one.

Photo: Clay Algeo

***Voorhees designed his demilune table in 1989** to incorporate the curved, Art-Deco doors with tapered legs and more classical lines. The curved plywood doors on the 44-in.-wide table are veneered with ribbon mahogany and have shell-like ebony handles.*

In working out design ideas, Voorhees considers sketches to be tools like saws or chisels, not restrictive blueprints. "The fun is in the building of furniture, not in the drawing. You can't design in three dimensions as well as you can build in three dimensions. As you're building, you need to ask yourself questions—re-evaluate how the piece looks and how all the parts work."

He feels that his sketches are somewhat liberating because they help answer joinery and other technical questions before he gets to the bench. Voorhees believes that the sketches make the bench work more spontaneous and exciting. "I know how the piece will go together, and I'm free to concentrate on the more visual things. I'm constantly thinking about how I can get the look I want. I take an idea and begin playing at the bench—working with combinations of wood types, finding out what will work. I'm convinced you have to stay flexible, take chances and rely a lot on your own instincts. You don't have to be locked in."

Voorhees says that he just assumes everything will work out. If not, he'll just build another piece. "It's wrong to get caught up in what has to be. I decided long ago that I was going to make tons of furniture. I'll be good when I'm 60. Meanwhile, I'm not going to get hung up worrying about everything."

Doing tons of work, as he puts it, is essential for personal and financial growth. He has found that someone will buy whatever he makes, although he sincerely wishes his trade was a little more financially rewarding. And each piece teaches him something new. "The only way you can develop your own sense of design is by building things." Voorhees credits the 2,000 pieces of furniture that he has made in the last 10 years with teaching him the most about proportions, form, balance and the crisp accents that distinguish a craftsman's best work.

***Voorhees veneered the top of this 72-in.-wide hall table with bird's-eye maple** instead of using solid wood because the frame and legs trap the top with no allowance for wood movement. On the top of each leg is a carved fan-like shell (see detail).*

Even though he doesn't follow his drawings exactly during construction, he keeps every one. Each idea in a drawing creates a focal point—often the spark he needs for another idea. "We're always influenced by things around us. When you go back to a drawing or idea years later, you look at it differently. You're not copying the drawing or idea, but reinterpreting it."

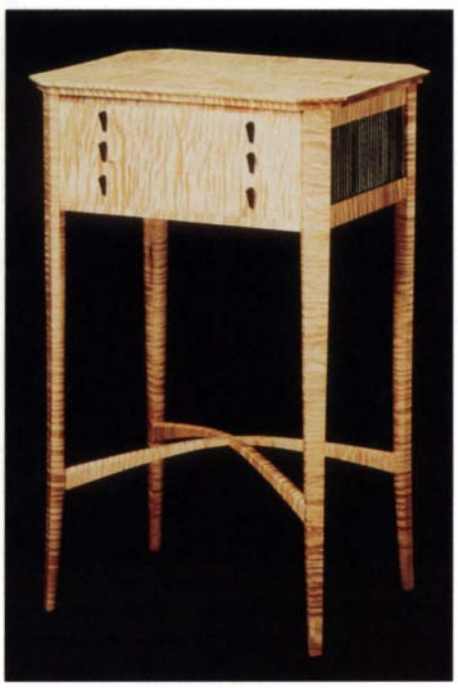
As he matures as a designer, Voorhees finds himself putting more detail into his work. Recently, he's been working with louvers to create texture and visual facets (see the top right photo on the previous page). He has also been working with veneer and various inlays as well as brass and sterling silver, a throwback to his college jewelry studies. These design elements also reflect his fascination with the work of Emile-Jacques Ruhlmann and other great French ebenistes from the early 20th century.

Handles are especially important accents for Voorhees. They are "the jewelry on the piece—the very last thing I do—the crown jewels—the superfine and delicate finishing touch. And it's an extra detail that makes sense; you've got to have handles, and they've got to be just right. On a small box, for example, I might make five different handles and try them before I decide which one to use. I really enjoy the effects I get with the different versions."

The shell-like ebony handles on the demilune table in the bottom photo on p. 77 are good examples of how the right detail can really individualize a piece. These details also give him a chance to express himself while creating something that has broad appeal. "My personality is expressed in every decision I make all through the designing and building process. I enjoy building the pieces, and the people who buy them really enjoy having them. They appreciate the little details and knowing who made them. Life is so full of throw-away stuff that more and more I enjoy knowing I helped people acquire something real and lasting."

What about the concern for integrity and quality he so admired in the master cabinetmakers of the past? "Integrity means you lose money while you spend hours and hours on things that you don't get paid for. But people are putting their trust in you. You sold them on the highest quality that you can make. That's what you have to deliver." □

Dick Burrows is a former editor of FWW *and a freelance writer and woodworker in Knoxville, Tenn.*



***The cross stretchers on this curly maple silver chest** add a sense of weight and visual stability to the 36½-in.-tall piece. Voorhees favors long, slender legs on many of his pieces, but in this case, the height also makes the chest more functional. The waist-high compartments provide easy access, a compatible feature with Voorhees' design emphasis on "what works and what's comfortable."*

Photos this page: Clay Algeo

Constructing carcase-housed drawers

by Chad Voorhees

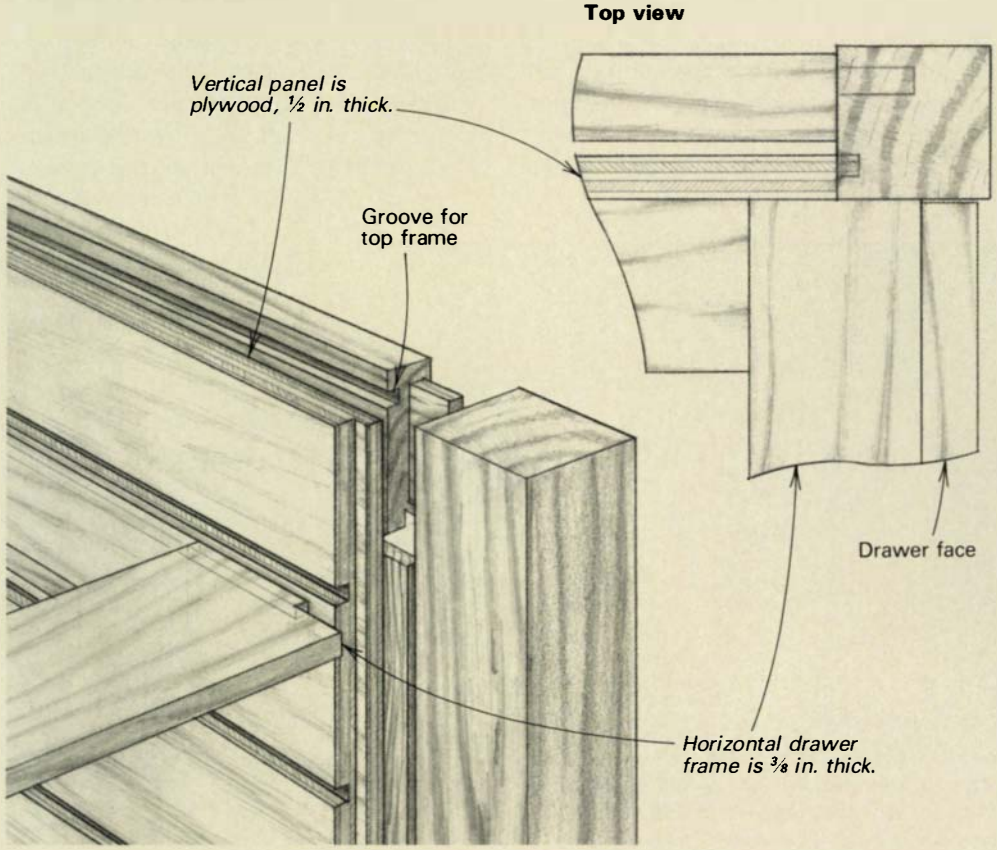
I've never been very happy with conventional drawer-hanging systems. There are just too many variables involved with supporting each drawer on runners screwed into a cabinet and let into grooves plowed into the drawer sides. So, to avoid the contortions needed to align grooves, runners and other parts inside the carcase, I incorporate prebuilt box-drawer assemblies in almost all my work.

A box (or carcase-housed) drawer is simply that—a drawer built to fit snugly inside a box or series of boxes inside a carcase. These boxes can be built very accurately; any necessary tweaking with the parts can be done before they are installed in the carcase. The drawer operates perfectly because its entire bottom runs on a flat surface and its sides can be precisely planed for a piston fit in the box opening. The flat surface under the drawer can be a solid frame construction or simply a plywood panel.

My method of carcase construction is detailed in the drawing below. The ⅜-in.-thick horizontal panels (or frames) under the drawers are rabbeted to fit into grooves in ½-in.-thick plywood vertical panels. These vertical panels are hidden by the legs (or stiles) in the finished carcase. The horizontal panels are concealed by the drawer fronts, which are higher than the drawers themselves.

***Voorhees crosscuts the vertical side panels** for his box-drawer construction from a single piece of plywood, after ripping the grooves that will receive the horizontal drawer dividers. Ripping the grooves first and then crosscutting the panel, ensures that the grooves on opposite sides of the case will matchup perfectly.*

Carcase construction



Making the vertical side panels

The key to accurately milling the grooves in the vertical panels is to rip all the grooves in a single piece of plywood that is long enough to complete both sides of the drawer compartment.

The grooves, which are simply sawkerfs ripped the length of the plywood, are located where I want the bottom of each drawer to be. You can space the grooves as you like. I generally prefer graduated drawers, like those used by the Shaker craftsmen. Having each drawer front ⅛ in. to ¼ in. shallower than the one below it is quite pleasing visually.

After the grooves are cut, I crosscut the panel in half, as shown in the photo at left, and fold it like a book to form each side of the drawer case. This ensures the grooves are square and match exactly. On the front and back end of each panel, I cut a ¼-in. by ¼-in. tongue from top to bottom, so the panel will fit into the carcase's leg or stile. I cut the stopped grooves in the leg or stile to receive the vertical panels with a slot mortiser, but you could do it with a router or by hand. Just make sure that the vertical panel will be flush with the leg's inner edge. As you can see from the drawing, fitting the vertical panels into the uprights not only creates side drawer guides but it also strengthens carcase construction.

Fitting horizontal panels and drawers

Next, I cut panels or frames for the horizontal supports and rabbet them on the tablesaw to create tongues that will fit into the grooves in the vertical panels. Accurately locating the rabbets' shoulders is a pretty exact operation, but since the tongues are on top, I always have a good clean joint where they are most visible. Any gap will be on the bottom where it's less obvious. I sand and wax both the horizontal and vertical panels before assembly.

The drawers themselves are pretty standard. I rip the sides a little oversize, and then plane them to fit the opening after assembling the carcase. Like much Shaker work, my drawers have blind dovetails at the front corners and through dovetails in the rear. As an additional design detail, I make my drawer fronts ⅝ in. thick and the sides 7/16 in. thick so that I can make the blind dovetails on the front longer and thinner than the through dovetails on the back. □

Chad Voorhees designs and builds furniture in Beaufort, N.C.

Photo this page: Dick Burrows; drawing: Aaron Azevedo

Workshop Solvents

Selecting the right chemicals and using them safely

by George Mustoe

The alchemists of the Middle Ages alternated their attempts to transmute lead into gold with the search for a universal solvent—a liquid capable of dissolving all materials (had they succeeded, I wonder how they'd have packaged their discovery). Six hundred years later, I'm still following in the alchemists' footsteps. As a chemist, I'm frequently asked to dilute a dish of gooey stuff or to dissolve some residue without damaging the underlying material. Woodworkers often face similar problems. Luckily, if you know a little chemistry, you can select a solvent that not only does the job, but also poses the least health and safety hazards.

Reactive and inert solvents

Despite the rising popularity of water-base finishes (see *FWW* #89, pp. 52-55; *FWW* #69, p. 80 and *FWW* #47, pp. 65-66), sooner or later you will need to use another solvent besides water. Solvents work in one of two ways. Inert solvents, like mineral spirits and lacquer thinner, reduce the viscosity of finishes and allow deeper penetration, more even application and faster drying. They don't alter the composition of the oils or resins used in the finish. In contrast, reactive solvents attack the chemical structure of the materials they dissolve; for example, when methylene chloride is applied to paint, it becomes a paint stripper.

Reactive solvents can dissolve stains or glues and strip finishes because they break apart the molecular bonds. These solvents change substances permanently, so they can't be used to thin paint. Reactive solvents must be chosen carefully, because you don't want them to dissolve more than you had intended. Some compounds in finish removers, for example, will also attack plastics.

Not all reactive solvents require you to don rubber gloves and eye protection, however. Water is a reactive solvent when it is used with soap (a surfactant), because it alters the structure of grease and dirt molecules, making them water soluble. In addition, solvents may act very selectively. Sugar dissolves readily in water but not in lacquer thinner, even though the latter instantly attacks the varnish on your table. The reactions are not the same because the molecular geometry of the two substances causes great differences in solubility.

Inert solvents make good thinners (diluents), degreasers and cleaners because they can freely intermix with a substance without disturbing its molecular structure. This ability is related to a phenomenon chemists call polarity. Depending on their structure, chemicals have a wide range of polarities. For example, two atoms of hydrogen bond to one oxygen atom to give a water molecule (H_2O) a wishbone shape (shown on the bottom of the facing page). This arrangement is polar because the hydrogen end has a slight positive charge compared to the end with the oxygen atom. In contrast, methane (CH_4), is non-polar. Its symmetrical structure causes the internal charges to be evenly distributed. The methyl alcohol molecule (CH_3OH) is weakly polar. Its central carbon atom is surrounded on three sides by hydrogen atoms. But on one side, the oxygen atom disturbs the symmetry of electric charge.

A useful rule based on this polarity lesson is "Like dissolves like." Oil, grease and wax have non-polar molecules, so they dissolve easily in non-polar solvents such as paint thinner, not as easily in weakly polar solvents like acetone, and not at all in water, which is strongly polar. When a substance (such as sugar) dissolves readily in water, it's proof that the material's atoms have a polar arrangement. When choosing a solvent for a particular task, you can eliminate a lot of guesswork by referring to the chart on the facing page. For instance, suppose sticky residue from a label has marred your new tool. If a dab of mineral spirits (non-polar) won't dissolve the gum, don't waste your time by trying turpentine or naphtha. Instead, try alcohol (slightly polar) or water (strongly polar).

***Flammable chemicals should be stored in a steel cabinet** that is vented to the outside. A lidded, metal bucket (at left above) provides temporary safe storage for solvent-laden rags.*

Solvent precautions and safer alternatives

You should use less dangerous chemicals in place of highly toxic solvents whenever possible. For example, save your lacquer thinner for its intended purpose, and use mineral spirits, instead, for cleaning brushes. And when diluting shellac, ethanol (denatured, ethyl or grain alcohol) can be substituted for the much more toxic methanol (wood or methyl alcohol).

Photo this page: Alec Waters

Common Shop Solvents

Solvent	Applications	Chemical Type	Toxicity[1] TLV (Threshold Limit Value) in PPM	Flammability[2] * FP (Flash Point) in Degrees F	Usual Route of Absorption L = Lung, S = Skin
Mineral spirits	General-purpose thinner, degreaser, brush cleaner, wood filler	Non-polar	200	86-105	L, S
Turpentine	General-purpose thinner, degreaser, brush cleaner, wood filler	Non-polar	100	95	L, S
VM&P naphtha (benzine)**	Quick-dry thinner, degreaser cleaner	Non-polar	300	20-55	L, S
Xylene, toluene	Some paints and glues	Non-polar	100	40-81	L, S
Hexane	Rubber and contact cements	Non-polar	50	−7	L, S
Lacquer thinner	Quick-dry thinner	Non-polar	100	−50	L, S
Halogenated solvents: methylene chloride†‡, perchloroethylene, trichloroethylene, methyl chloroform	Paint and varnish removers, refinishers, contact cement, aerosols, adhesives, some paints, degreasers	Non-polar	25-350	0-90	L, S
Ethanol (denatured or ethyl alcohol)	Shellac, spirit stain thinner	Weakly polar	1,000	55	L
Isopropanol (isopropyl or rubbing alcohol)	Surface cleaner	Weakly polar	400	53	L, S
Methanol (methyl alcohol)†	Shellac, spirit stain thinner, finish stripper, blush	Weakly polar	200	52	L, S
Acetone	Cleaner, thinner for epoxy and plastic cement	Weakly polar	750	1.4	L
Methyl ethyl ketone	Aerosols, plastic cement	Weakly polar	200	21	L
Methyl isobutyl ketone	Aerosols, plastic cement	Weakly polar	50	73	L
Ethyl acetate	Aerosols, plastic cement	Weakly polar	400	24	L, S
Water	Latex finishes, grime remover	Strongly polar	None	None	NA

Notes

1. Toxicity—highly toxic: less than 101 PPM; moderately toxic: 101-500 PPM; slightly toxic: more than 500 PPM
2. Flammability—extremely flammable: less than 21°F; flammable: 21°F-99°F; combustible: 100°F-150°F

* Even moderately flammable solvent vapors will ignite readily if exposed to heat sources, sparks or open flames, provided the solvent's temperature exceeds the FP. Vapors may be explosive if they are allowed to accumulate.

** Benzine is not to be confused with benzene (a known carcinogen).

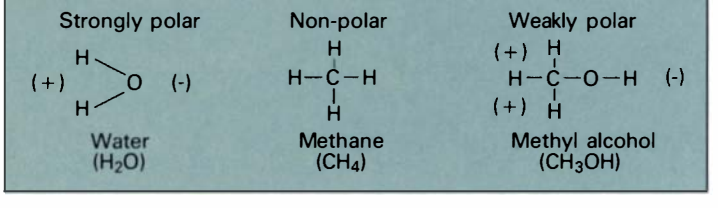
† This solvent's vapors pass freely through filters of most respirators.

‡ No FP, but flammable when vapors reach 14%-22% by volume at 77°F.

Halogenated hydrocarbons are the only petroleum-base solvents that are not combustible, but this safety feature is often counterbalanced by serious health risks. Carbon tetrachloride is a halogenated hydrocarbon that some older books recommend as a degreaser, but a single exposure to its strong vapors can be fatal. Instead, use mineral spirits or naphtha to remove oil or wax residues. Another familiar halogenated solvent is methylene chloride, a major ingredient in most paint removers and non-flammable brands of contact cement. This liquid is very effective as a stripper because it attacks the adhesion layer of a finish right at the wood, allowing the old coats of finish to be conveniently removed as a gelatinous layer. The acute toxicity of methylene chloride is relatively low, but the vapors have strong narcotic effects and may disrupt your heartbeat. Methylene chloride is also one of two solvents that pass freely through the filter cartridges of organic-vapor respirators (the other is methyl alcohol). Goggles are important since splashed droplets can cause serious eye damage.

The diluents used in both compressor-powered sprayers and spray-can finishes also are highly toxic. And since sprayers require liquids with exactly the right viscosity and drying rate, it's best to follow the manufacturer's recommendations for thinners. Most of these solvents are identified only by a trade name; they are typically a mixture of petroleum distillates and can produce health problems ranging from eye and throat irritation to neurological damage, liver and kidney injury, and blood diseases, so it's best to limit your use of them. One way of minimizing exposure to these solvents is to use brushes or rollers whenever possible, rather than spray guns or aerosol cans. With direct applicators, like brushes, you won't need to dilute the finishing mate-

Chemical polarity in solvents



rials as much, which greatly reduces the amount of toxic vapors that are emitted.

Many petroleum-base liquids can be used as thinners for brush-on varnishes and paints, and even though most of these organic solvents perform similarly, their toxicities vary widely. The least-hazardous choice for brush-on varnish and paint thinner is mineral spirits. Turpentine also has low toxicity, but it's more likely to cause allergic skin reactions. In fact, prolonged or repeated skin exposure to most solvents (except water) can cause skin irritation. This occurs because many solvents, like acetone, ethanol and ketones, extract natural oils from skin layers, which results in severe chapping. If you need a thinner that dries quickly, naphtha is safer than most other fast-evaporating solvents, but be aware that quick-dry solvents all pose substantial fire hazards. Woodworkers are usually surprised to learn that the most flammable shop solvent is acetone—a liquid that's often handled with very little caution.

Most finish removers contain solvents that are toxic to some degree when inhaled or absorbed through the skin. Some nonchemical refinishing alternatives are safe, but they require a bit more time and effort. Sanding and cabinet scraping are two methods that don't rely on chemicals. And the new, so-called safe strippers, such as Wood Finisher's Pride, Easy-Off, Bix Hydro Stripp and 3M's Safest Stripper, are other possible alternatives. These products utilize relatively safe compounds like methyl pyrrolidone (NMP), dibasic ester (DBE), d-limonene or citrus extracts. However it's still a good idea to conduct a test before using any of them to refinish one of your favorite antiques.

If you do have to use a highly toxic solvent, you can guard yourself against absorption and inhalation by avoiding spills, wearing goggles and butyl gloves, and using a chemical-cartridge respirator with an organic-vapor canister. And, of course, the warnings to "use with adequate ventilation" should be heeded. For more information on

Will new VOC regulations affect you?

by Michael Dresdner

Twenty-one years ago, Americans launched Earth Day to emphasize the environmental damage caused by humans. Since then, more attention has been paid to the hazardous wastes we've been putting into our air. Among these are hydrocarbon solvents called volatile organic compounds (VOCs) that evaporate into the air and are widely used by wood finishers.

The media has chronicled the problems associated with ozone depletion caused by the release of chloroflourocarbons (CFCs) into the upper atmosphere. Although CFC pollutants continue to thin our protective ozone layer, the VOC/ozone problem acts in reverse and occurs in our lower atmosphere. Since VOCs are photoreactive, sunlight causes them to create, rather than destroy, ozone. But excess ozone in our surface air makes breathing difficult and combines with particles to form smog. Unfortunately, the surplus ozone in our troposphere (surface atmosphere) doesn't travel high enough to benefit our stratosphere (upper atmosphere).

Since most of the solvents that make up finishing materials are ozone-producing VOCs, it's actually easier to name the three groups of VOC exceptions. First, there are additives, like ammonium hydroxide used in latex paint, which are not organic compounds. The second group contains VOCs that produce little or no ozone. Alcohol (a shellac solvent) and methylene chloride (a solvent in paint remover) fall into this category. The third group contains VOCs that evaporate so slowly they aren't counted in a paint's formula. Virtually everything else used to thin paint and varnish is an ozone-producing VOC.

As a way to reduce tropospheric ozone, the 1990 Clean Air Act restricted the amount of VOCs finishers (and everyone else) are allowed to release.

Presently, there are two actions being taken to reduce VOCs, and together they can create even more significant reductions. The first is for solvent users to increase their transfer efficiency (TE), which is a percentage of the amount of finish that actually contacts the wood. The TE rates the application method used on the wood and not the finish's solvent content. Brushes, paint pads and rollers boast TE's of almost 100%. By contrast, a typical compressed-air spray gun operates at only a 35% TE; two-thirds of the finish leaves via the spray-booth fan without ever touching the work. Between these application methods are high-volume, low-pressure (HVLP) turbine sprayers and airless systems with TEs from 60% to 85%.

The second VOC action deals with the finishes. Finish and paint formulators are redesigning coatings with lower solvent levels and, in some cases, replacing a portion of their product's VOCs with alternative diluents such as water. Most current water-base finishes still contain VOCs, but less of them.

Each state is responsible for meeting the national ambient air-quality standards. Regulations vary widely from state to state. The toughest come from the south coast air-quality management district (SCAQMD), the southern California area that includes Los Angeles. SCAQMD regulates both VOC content in finishes and the minimum TE of application methods.

Many states will eventually pass similar legislation, but in the interim, the Environmental Protection Agency (EPA) has suggested that all states use the Chicago, Ill., standards (see chart below) as a minimum guideline if stricter laws aren't already in place. Companies that want to find out a state's regulations can contact their local air-quality department. For information, call the EPA at (703) 308-8721.

Hobbyists and shop owners will, in most cases, be exempt from regulations because they represent a small part of the problem. In comparison, big furniture manufacturers put out more VOCs in one day than a dozen small shops produce in a year. But that doesn't mean small users shouldn't be concerned with the VOC issue. Voluntary compliance with these regulations sets a good example for other finish producers and sends a message to lawmakers. Considering the current state of our environment, we simply can't afford to look the other way. □

Finishing Material Limits

Item	(grams/liter)	(lb./gal.)
Clear topcoat	670	5.6
Opaque stain	560	4.7
Pigmented coat	600	5.0
Repair coat	670	5.6
Sealer	670	5.6
Transparent stain	790	6.6
Wash coat	730	6.1

Grams of VOC per liter of coating less water and any exempt compounds for the eight-county Chicago, Ill., area. Limits are given as guidelines by EPA for other states.

Michael Dresdner is a finish consultant, woodworker and author in Perkasie, Pa.

Chart courtesy of *Custom Woodworking Business*, summer, 1991, p. 68

safely using hazardous chemicals, see *FWW* #80, pp. 58-63.

Proper ventilation and fire safety

Adequate ventilation consists of a steady flow of fresh air across a work area in a direction that carries fumes away from the worker. Indoors, this means opening all the doors and windows for good cross-ventilation. If a strong odor is present or you develop dizziness, headache or nausea, leave the area immediately. But don't trust your sense of smell to protect you from all vapors. For example, the legal maximum limit considered safe for workplace exposure to methyl alcohol is only 200 parts per million (PPM), but most people can't smell it until the vapor level reaches 2,000 to 6,000 PPM. Also, most solvent vapors are two to four times heavier than air, so fumes accumulate near the floor. Because of this, ventilation is especially important for basement shops and storage areas. An air-to-air exchanger and a spark-free exhaust fan are ideal for basements.

The proper handling and storage of solvents are important for fire and ventilation safety. It's risky to stockpile large amounts of solvents; a few gallons will satisfy the needs of most shops. Woodworkers should not be using gasoline or kerosene except for its intended use as a fuel. Besides its high flammability, gasoline may also contain toxic tetraethyl lead or benzene. Kerosene is less hazardous and may work for degreasing machine parts, but like gasoline, it is a poorly refined petroleum product that has relatively inferior handling properties when used as a shop solvent. Frequently used solutions are best stored in a flame-proof safety can (shown at right). Keep solvent-contaminated rags in lidded, metal disposal cans (see the photo on p.80) that are located away from potential fuels. Flammable vapors must be protected from heat in case of a shop fire, to delay ignition so that occupants can escape. Rather than putting solvents in glass jars or using open containers to park used paint brushes, keep them in sealed cans. To store cans, buy a double-walled steel, flammable-liquid storage cabinet, like the one shown in the photo on p. 80, or build a fire-resistant locker. Most states require that the lockers be vented to the outside and limit the total amount of solvents that you can legally keep on hand. And some states have now imposed restrictions on the use of solvents that are volatile organic compounds (VOCs). See the sidebar on the facing page for more information on VOCs.

Records compiled by the National Fire Protection Association reveal that spontaneous combustion is a leading cause of woodshop fires. Turpentine and oil finishes are particularly hazardous because of their tendency to oxidize in air. A heap of oil- or turpentine-soaked rags can reach ignition temperature in a few hours. Soaking rags in water can delay combustion, but it's best to dispose of solvent-laden wastes each day. Fortunately, there are many environmentally sound options for removing waste solvents (see the sidebar below). Finally, make sure your shop's fire extinguisher is suited for flammable liquids, and keep it handy. □

Safety cans are ideal solvent containers. *The cans have flash arrestors and caps that release pressure, dissipate heat and retard vapor ignition. Here, Mustoe adds mineral spirits via a can's triggered spout.*

George Mustoe is a geochemist in Bellingham, Wash. His part-time woodworking projects include skis, snowshoes and Irish harps.

Disposing of solvents responsibly

by Jeff Jackson

As woodworkers, we use solvents and finishing products that end up as hazardous wastes, so it's important to keep abreast of environmentally responsible waste-disposal methods. The *Code of Federal Regulations* (Title 40—Protection of the Environment) defines hazardous waste and establishes reportable quantities for releases of certain chemicals. However, these laws don't apply to most woodworkers because they use such small amounts of organic compounds, such as solvents.

Nevertheless, even small quantities of hazardous wastes can contaminate the environment. A quart of stripper carelessly discarded in a stream can contaminate millions of gallons of water. But there are some safe ways to dispose of small amounts of hazardous waste, as follows:

- Air-dry brushes, rags and the hazardous liquids left in containers outdoors or in well-ventilated areas, away from pets, children and ignition sources. Even though this pollutes the air with hydrocarbons, sunlight and air will break down common volatile chemicals in hours or days. Dry wastes discarded in landfills are less likely to become part of the leachate (liquid) that may ooze into groundwater under a landfill or into nearby surface water. Also, solidified waste is more easily handled by municipal waste-disposal firms.
- Mix hazardous liquids with non-reactive absorbents, like cat litter, and dry the material or seal it in a container. Don't use sawdust because it could lead to spontaneous combustion.
- Never pour flammable solvents or hazardous-waste compounds down the drain. This could create a fire hazard, upset your septic system or allow the solvents to enter your groundwater. If you're on a municipal sewer system, the compounds may not be removed during waste-water treatment.
- Never pour hazardous liquids in surface water or ditches. When poured into the soil, chemicals may eventually enter the groundwater via rainwater or melted snow.
- Recycle waste finishes and solvents by brushing them on an old shed or other outbuilding. Also, take advantage of community recycling efforts and exchange programs for paints and varnishes. Check to see if your town's health department has a program to handle small volumes of hazardous wastes.
- Rethink your finishing processes to reduce or eliminate hazardous materials. If you need a quart of stripper, but the gallon container is on sale, buy the quart anyway. It's a small price to pay for reducing waste volume. □

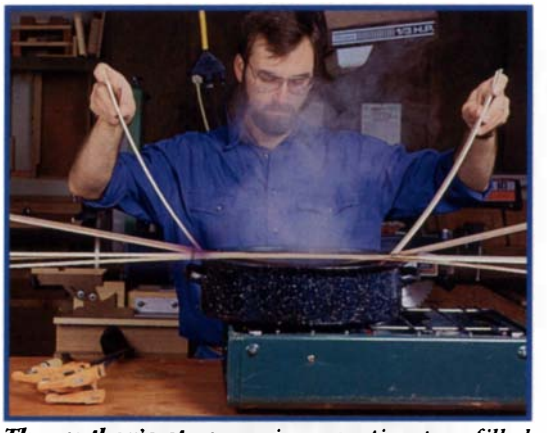
Jeff Jackson is an environmental engineer and part-time woodworker living in Taylors, S.C.

Photo this page: Patty Mustoe

Making a Landing Net

Steam-bending and laminating a curved frame

by Geoffrey G. Carson



***The author's steamer** is a roasting pan filled with a bit of water heated on a Coleman camping stove. Only the middle of the ⅛-in.-thick laminations are steamed before they're clamped around a plywood plug to form the frame.*

Photo: Geoffrey Carson

***A steam-bent landing net** is a welcome addition to any angler's gear. This bird's-eye maple and walnut frame holds a 28-loop bag.*

Besides woodworking, one of my favorite avocations is fly-fishing. Whenever I've had a good dose of shop sounds and sawdust, and it's time to clear my head and lungs, I take to the mountain streams of the Sierra Nevada. But I don't forget the pleasure of working with wood because I bring a piece of my craft with me in the form of a steam-bent landing net. To me, there are few things as rewarding as gently lifting a just-hooked rainbow trout from clear water using a piece of gear I crafted in my workshop.

The net is a straightforward project that offers practice in both steam-bending and bent-lamination techniques. The wooden frame is comprised of three ⅛-in.-thick strips that are steamed and bent around a form and then, after they're dry, laminated in a clamping fixture. A wooden-handle insert is then fitted and glued in place. After the frame is prepped for a net, it is sanded and finished and a net bag is attached.

The frame I use for an 18-in.-deep by 28-loop net bag is lightweight and comfortable to hold. It's long enough to accept a sizable fish, but narrow and compact enough to be maneuverable and to fit into my fishing vest. You may want a larger or smaller net depending on the type of fish you are after, but you should have a net in hand before building the frame (see the sidebar on p. 86 for a source for nets). Another consideration in the frame's shape is the radius of the bend. I've found a 3-in.-radius curve is as tight as I care to bend ⅛-in.-thick strips of wood.

Building a bending and gluing fixture

My bending fixture consists of a ¾-in.-thick plywood plug screwed to a plywood base. The plug, which is the exact shape and size of the desired frame hoop, has holes drilled equidistantly around the perimeter to accept clamps (see the drawing on the facing page). To keep the frame from being glued to the base, I place a sheet of 0.5- or 1-mil. polyethylene between the plug and base. When bandsawing the plywood plug, I remove a ⅜-in.-wide hoop of waste to allow space for the frame, so the outside scrap plywood can be used as clamping cauls. I bandsaw just outside the layout lines and then use a file and drum sander to smooth the edges of the plug and cauls to the lines.

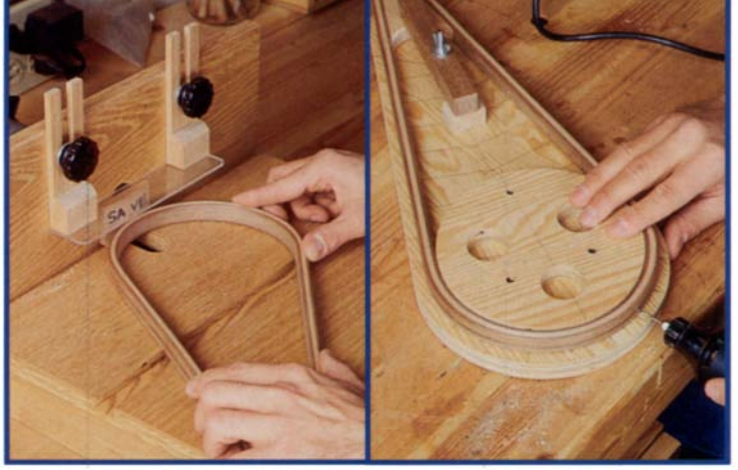
Selecting and preparing stock for the laminations

Various contrasting woods can be used for the landing net's frame, but each one will have its own bending characteristics. Woods like oak, maple, walnut and poplar bend with relative ease, while mahogany and many exotic woods require thinner laminations or longer steaming times during the bending process. I always select straight-grain lumber for the frame because it's frustrating to have steamed laminations snap in two due to slash grain.

After selecting the wood, I rip three ⅛-in.-thick laminations (usually two of one wood, one of another) from ¾-in. stock. The length of the laminations will vary with the size of the net frame; the strips for the frame shown here should be about 48 in. long. Once I've cut all the strips, I'm ready to bend them.

Using a simple steam-bending pot

Although my method of steam bending may seem somewhat crude, it works well enough for me. I use a turkey roasting pan, boiling approximately 3 in. of water in the bottom. I lay all of the wood strips across the pan, as shown in the top photo above, with the portion that will form the tight curve at the net's end over the steam, and then I cover the strips with the lid. It isn't necessary to steam the part of the strips that will form the handle portion because its curve is minimal and will be formed during laminating. I steam each strip until it is very pliable—both ends are bent upward until the strip's center is bowed down enough to touch the boiling water. As I mentioned earlier, different woods will require differ-



A ⅛-in.-wide groove for recessing the line that secures the net *is routed around the frame's perimeter (left). A curved, hardwood block, attached to the fence of the horizontal mortising table with double-faced tape, allows for full depth of cut all along the frame's outer edge.*

Equally spaced holes for mounting the net bag *are drilled along the groove that surrounds the frame. To minimize tearout, Carson drills with a high-speed Dremel Moto-Tool (right).*

ent steaming times. I've found that maple, poplar and walnut take about 10 to 15 minutes, while mahogany takes at least 30 minutes.

While the wood is still hot, I bend the laminations around either a 6-in.-dia. circular plywood form, like the one being used for drilling in the photo at right, or around the fixture's plug, as illustrated in the drawing at right. I clamp the net end of the frame's curve only, not the handle, and let the layers sit overnight. The next day I remove the laminations from the bending fixture, separate them and place a rubber band around their ends to hold the curve until they're fully dry, which usually takes two or three days.

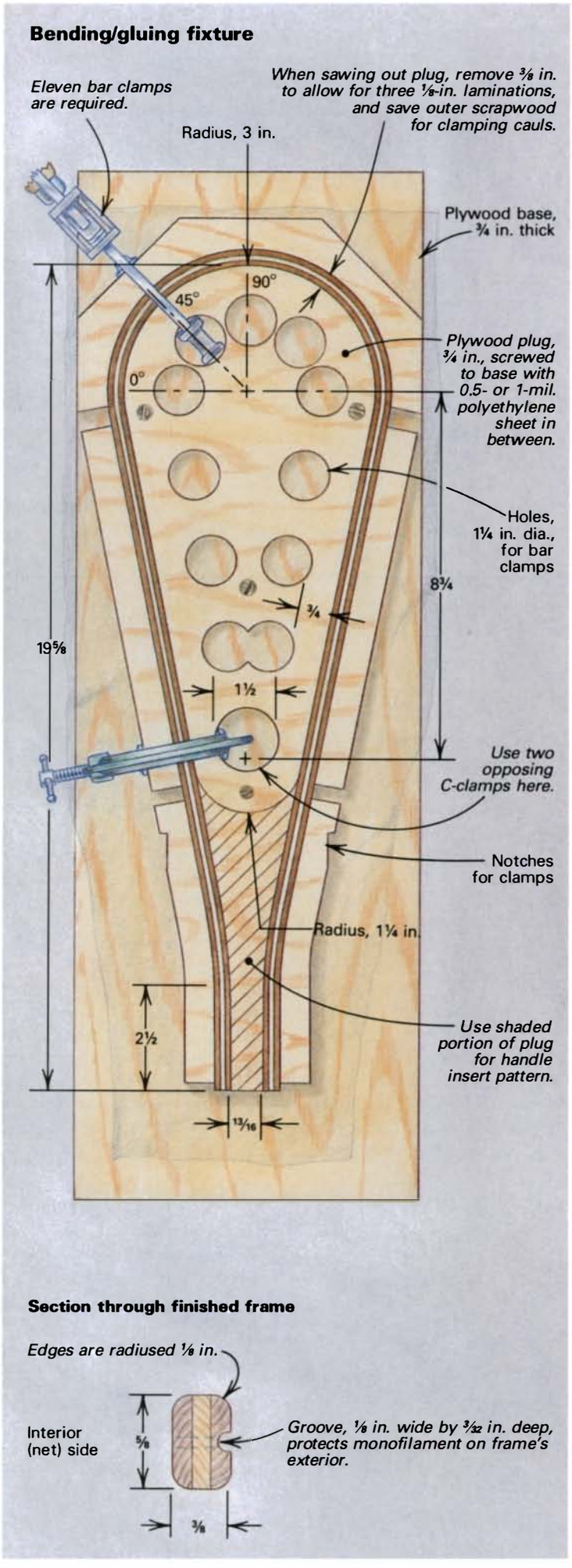
Gluing and clamping the frame

To glue the laminations, I use Weldwood's plastic resin glue with a water-activated catalyst. It's easy to mix, highly water resistant and strong (provided the manufacturer's recommended mixing ratios and clamping times are closely followed). Be aware that the pot life of this glue is relatively short and brushing glue on the strips can be time consuming.

Before gluing, I dry-clamp the strips in the fixture to ensure a proper fit. To prevent excess glue from sticking the frame to the fixture, I generously coat the plug's and cauls' edges with Minwax furniture paste wax. Next, I place the inner lamination on the fixture, and then liberally cover the inside surfaces of the middle and outer laminations with glue before adding them to the fixture. Starting at the top of the frame, I position the clamping cauls over the outer lamination and, working alternately in both directions, I tighten the clamps until there is even glue squeeze out around the frame. I also make sure that the edges of the laminations are lined up since this makes the frame easier to surface later. It's normal to encounter a small amount of springback when the frame is unclamped, but that won't be a problem once the handle insert has been glued in place.

Adding a handle insert and prepping the frame for a net

Before cutting the ¾-in. stock for the handle insert, I use the handle end of the glued-up frame to trace the insert's pattern. To overcome springback, I squeeze the ends of the frame to the desired width before marking out the handle. I shape the wide end of the insert to form a smooth transition between it and the frame. The insert is glued in place and clamped using two hand screws and the lower cauls. After the glue has cured, I run the frame through



Photos except where noted: Sandor Nagyszalanczy; drawings: Mario Ferro

my thickness planer to remove any offset in the laminations. I minimize cross-grain tearout at the end of the frame by keeping my planer's knives sharp and their depth of cut set for very light passes. When the top and bottom surfaces are even, I trim and round the end of the handle, sand and smooth the upper end of the handle with a drum sander. Radius all edges of the frame, inside and out, with a ⅛-in. roundover bit (see the detail in the drawing on the previous page). Occasionally, my mahogany and oak frames split out at the curved end while I'm routing. But almost all splitting can be eliminated by first easing the frame's sharp edges with a sanding block and then passing the router slowly over that area.

Although the net bag is hung on the inside of the frame (see the instructions in the sidebar), it is secured around the frame's perimeter with 50#-test monofilament fishing line. To reduce abrasion of the line and net loops, I rout a 3/32-in.-deep groove into the outside of the frame with a ⅛-in. veiner bit fitted into my shop-built mortising jig (see the left photo on the previous page). After counting the net's attachment loops, I lay out and mark the hole locations, starting at the center of the frame's curved end. The last hole at each side of the handle (below the hoop) should be drilled at an upward angle so that the hole spacing along the inside curve of the handle insert matches the spacing along the frame. I use a Dremel Moto-Tool to drill the evenly spaced 5/64-in.-dia. holes (see the photo at right on the previous page) along the frame's groove for attaching the net bag. The Moto-Tool's high speed minimizes tearout where the bit exits the inside of the frame.

Sanding and applying a protective finish

I hand-sand the frame to 220-grit in preparation for the finish. Then I brush on successive coats of clear Watco oil, allowing the frame to soak up as much oil as it can in 30 minutes. Next I apply two coats of Formby's High Gloss Poly Finish as a topcoat, which provides some protection against the net's occasional dunking. Because of the frame's curves, I make an applicator from an old T-shirt with rolled-up balls of cloth inside (similar to those used for French polishing). I dip the applicator several times to saturate the inner cloth with enough finish to do the entire frame. When the frame is dry, I tie on a net bag and install a brass screw eye in the butt of the handle to tether my landing net to my vest, ready for the next fishing adventure. □

Geoffrey Carson runs Carson Woodworks, a part-time woodworking company in Orange, Cal.

Hanging a net bag

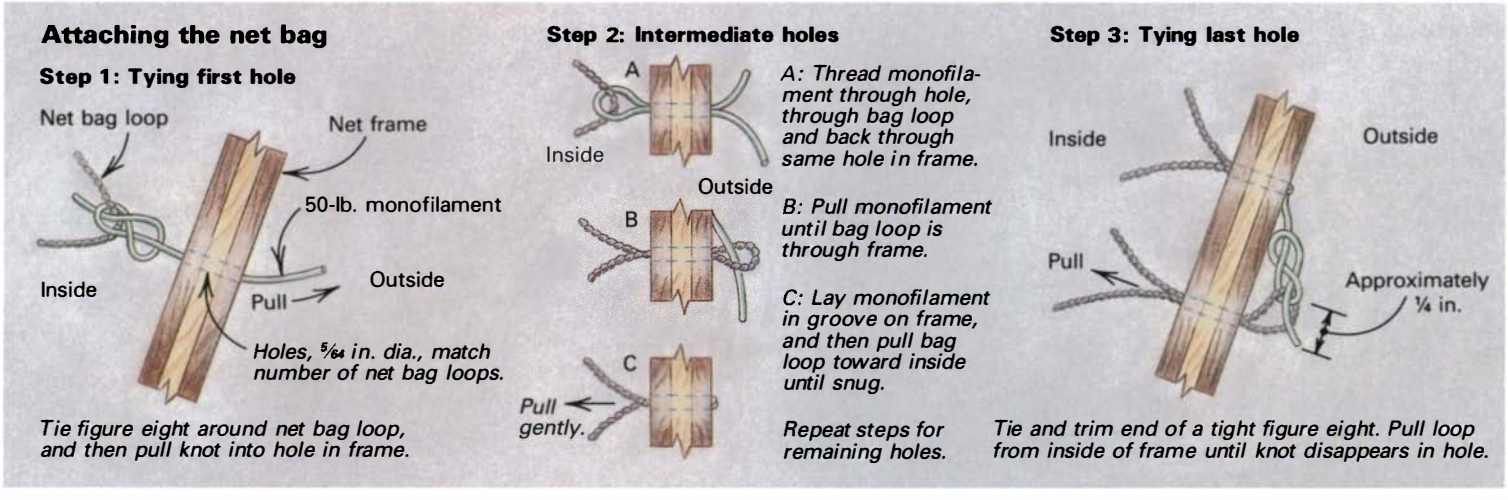
After making my first landing net frame, I decided to tie my own net using nylon line and a book on knots. Unfortunately, it took longer to tie the bag than it did to build the frame. I have since vowed never to tie nets again. Instead, I purchase net bags from Greg Lilly's, A Fly Fishing Adventure, 13011 Newport Ave., Suite 105, Tustin, Cal. 92680. The nets come in a variety of sizes, but the methods for hanging them on a frame remain about the same.

First, devise a stand, like the one in the photo at right, to secure the frame and free your hands for tying. Begin attaching the bag's loops on one side of the frame's handle and work up that side, around the net and then down the other side toward the handle again.

Here's my procedure: Cut a piece of 50#-test line about twice the length of the frame's perimeter, less the handle. With one end of the line, tie a figure-eight knot around the net bag loop, and then feed the other end through the frame's first hole from the inside. Pull the line until the knot just disappears into the hole, as detailed in step 1 below. This takes some force, so heavy gloves are a good idea to keep the line from cutting your hand.

Next, thread the monofilament through the second hole of the frame from the outside, as shown in step 2. Repeat this sequence for all the intermediate holes. For the last bag loop, pass the monofilament through the frame from the outside, through the loop and then back through the last hole in the frame. Pull the line until the bag loop is completely through the frame. While holding the line taut in the frame's groove with a small pair of needle-nose pliers, tie a figure-eight knot around the loop (see step 3). Trim off the excess monofilament, and then pull the loop from the inside of the frame until the knot and net-bag loop disappear into the hole. —*G.C.*

***The author built this stand** to clamp his work when he's hanging nets. It holds the net frame, so Carson's hands are free to attach the net. Using a length of 50#-test monofilament, which measures twice the length of the frame's perimeter (minus the handle), Carson secures the net loops within the perimeter groove.*



Router-Assisted Cockleshell Carving

A swinging jig shapes the interior and defines the flutes

by Howard Wing

The key to making a profit on a complicated piece like a shell-top cabinet is to control labor hours. When researching shell design before my first attempt at carving one, I read an article by Franklin Gottshall, an experienced carver and period furnituremaker. Gottshall acknowledged putting two weeks of labor into carving a shell, and I got the impression he worked long days. If I took that long just to carve the large cockleshell, the cabinet would be a sure budget-buster. So I began to think about a router set-up that could shape the basic spherical surface of the shell as well as rough out the flutes.

The two-axis router jig I developed worked well to shape the interior of the shell and to define the flutes for the cabinet shown at right. However, I did notice some undesirable flexing in the jig, so when the next shell-carving job came along, for a smaller shell to top off a clock, I reworked the jig to eliminate these problems. The new jig, shown in the top photo on p. 89, worked perfectly. I first cut the inside of the shell to a spherical shape with a straight bit mounted in the jig-held router. Next, I changed to a core-box bit to outline both edges of the flutes. Then, by shifting the vertical pivot point, as shown in the drawing on the next page, I was able to cut the bottom of the flute with decreasing depth from front to back. Although I could have continued to rout away the waste in each flute, I found it quicker to hand-carve the waste with a gouge, connecting the router cuts along the edges of each flute with the bottom cut that defined the flute's depth. The total time to make the shell, including building the jig, was just 36 hours.

Stack-laminating the shell

The blank for carving the shell is glued up from a series of decreasing diameter brick-layered arches. I made a full-size drawing so I could determine the inside and outside diameters of each layer, as shown on the next page. From the drawing I was also able to determine the approximate angle of the inside face of each layer. To minimize the amount of material I would need to remove with the router, I bandsawed the inner diameters to these angles. The angle for the top layer is too acute to bandsaw, so I left it as a solid slab for glue-up and later chiseled away enough waste to provide clearance for the router jig. After bandsawing the semi-circular bottom layer, but before cutting its inside face, I used an extended fence on my tablesaw's miter gauge to guide the piece while crosscutting flat reference surfaces on the outer ends. These surfaces are used later to mount the router jig on the shell. I also ripped a flat reference face along the center of the back edge of the bottom layer, so I could screw the shell blank to a mounting board. I then glued, stacked and screwed the individual layers as shown.

Building the router jig

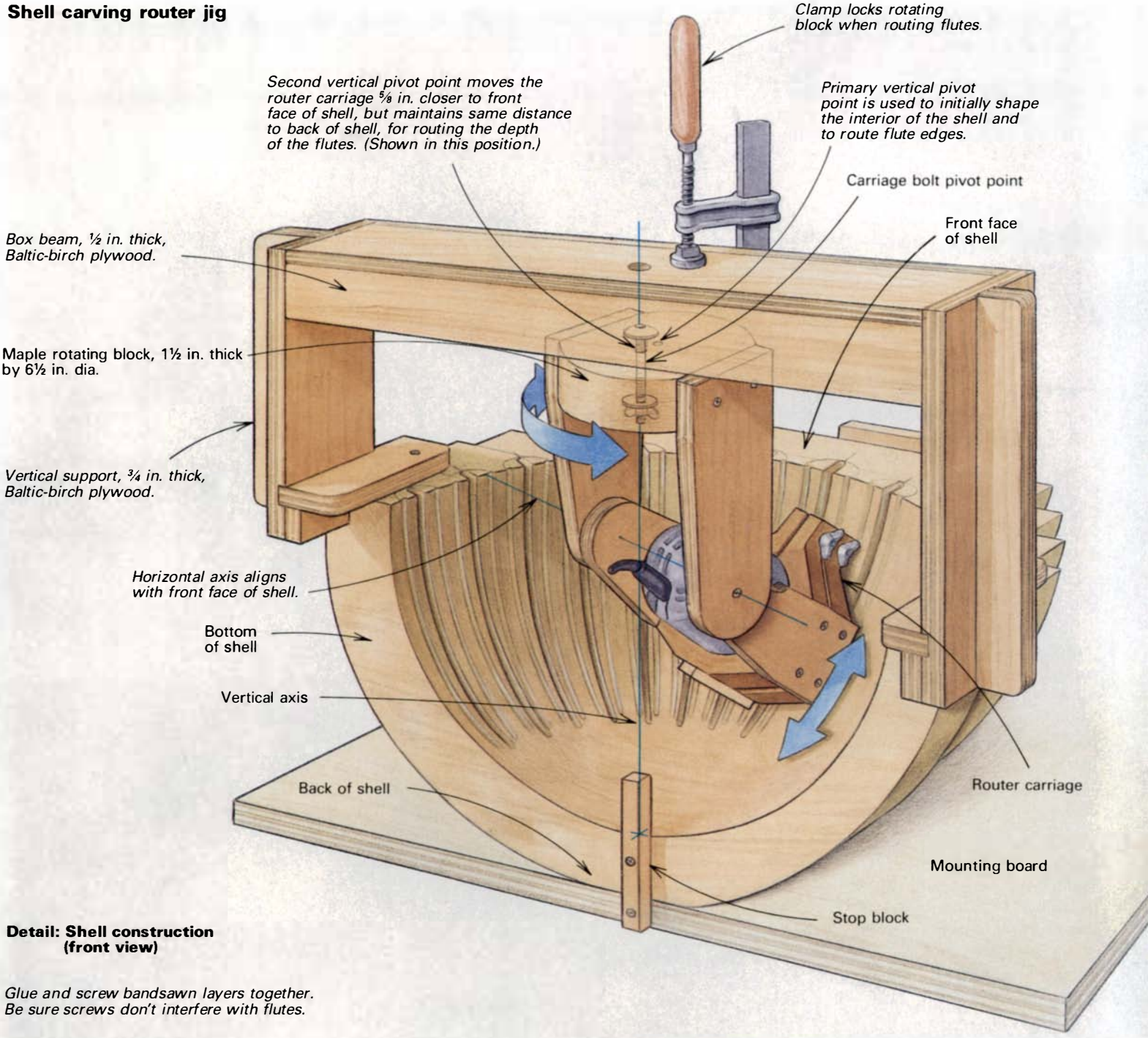
Although the jig in the top photo on p. 89 is for a much smaller shell than I used for the cabinet shown below, the principles are the same. The dimensions are immaterial as long as the jig is designed so that the pivot points are located directly on the shell blank's vertical and horizontal axes.

The jig has a fixed box beam that bridges the front of the shell and provides a mounting-and-pivoting point for a swinging arm that carries a router. The box beam is held by vertical supports screwed to the shell blank and supports the swinging router carriage so that the router bit is aligned with the vertical axis of the quartersphere. The

Cockleshells traditionally required many hours of skilled hand-carving. *But the author devised a router jig that helped him cut the time in half for making the shell in this cabinet.*

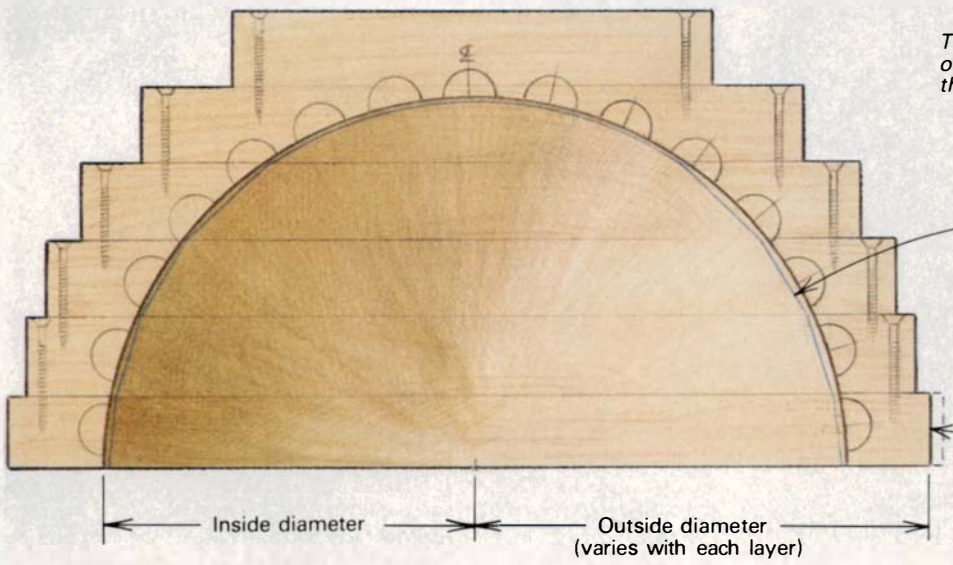
Photo this page: Wolfgang Motzafi-Haller

Shell carving router jig



Detail: Shell construction (front view)

Glue and screw bandsawn layers together. Be sure screws don't interfere with flutes.



To determine spacing of flutes, divide 180° by the number of flutes.

Bandsaw inside face of each layer slightly oversized and to approximate angle taken directly from full-scale drawing.

Cut flat reference surface 1¼ in. wide on ends of first layer for mounting router jig.

beam's key design consideration is to ensure it doesn't interfere with the swinging arm that carries the router through 90° of front-to-back movement and 180° of side-to-side movement.

The router carriage consists of split rings that hold the router and a pair of articulated plywood arms suspended from the rotating block bolted to the box beam. The arms are dimensioned so that their pivot point falls on the horizontal axis. It is important to eliminate vibration and play in the rotating axes and in the router hanging at the end of the swinging arm. For the pivot point at the vertical axis, I used a ⅜-in.-dia. bolt that fits tightly through holes in the beam and the rotating block to which the swinging-arm router carriage is attached. For the horizontal pivot points, I used two #10 flat-head wood screws. By slightly adjusting the screws, I can remove all play yet maintain smooth movement.

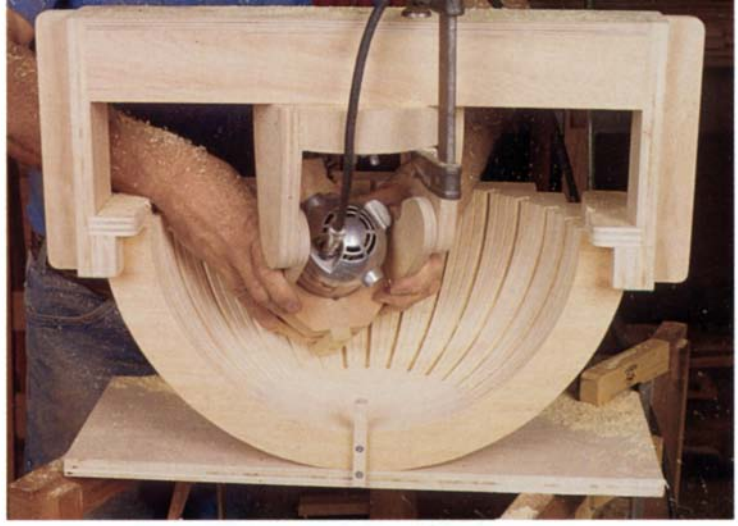
To rout the sides of each flute, the rotating block can be clamped to the beam to restrict movement about the vertical axis, and then the router carriage can be swung about the horizontal axis. While the bottom of the flutes have the same radius as the basic spherical section, they are deeper at the shell's front edge than at the back. So, I drilled a second vertical pivot point in the rotating block, ⅝ in. behind the first pivot point, to shift the jig's horizontal axis of rotation toward the front of the shell while maintaining the same relationship to the back. This allows the router to cut flutes that become shallower as they move from front to back.

Using the router jig

To hold the shell for routing (and later carving), I screwed it to a mounting board. I then aligned the jig on the shell, as shown in the drawing, so that the router bit lined up with the vertical axis and the router-carriage pivot points lined up with the horizontal axis. Because the jig is used to rout the internal surface of the sphere, this alignment was not critical; anything within 1/16 in. of the layout lines would be fine. Then I screwed the jig to the shell.

I started cutting the spherical interior surface with a ½-in.-dia. straight mortising bit adjusted to cut ⅛ in. deep. Depth of cut is adjusted by loosening the wing nuts that secure the router carriage's split wooden rings, sliding the router to desired depth and then tightening the nuts. I guided the router in both axes' directions using my hand to support the swing arm. I adjusted the depth and repeated this process until the inside surface was completely shaped. This went quickly, and in less than an hour, I had a nice spherical surface with only slight tool marks. I thought I might need to switch to a large core-box bit after rough-cutting with the mortising bit to get a better finish, but the straight bit worked very well. I then hand-sanded the shell down to 120-grit to get a paint-quality surface (only 15% is used because the rest is cut away in making the flutes).

Before cutting the 15 flutes, I laid them out along the front edge of the shell. I put a ¼-in.-dia. core-box bit in the router and, after aligning the bit to one of the layout lines, clamped the rotating block to the box beam to prevent any movement in the vertical axis. I adjusted the depth of cut until the bit was just shy of the inside surface of the sphere and swung the router toward the back of the shell to determine where to position a stop block to limit the length of the flutes. Because I wanted to leave room for a carved, semicircular design at the back of the shell, I needed a stop to prevent the flutes from converging. With the stop block in place, I swung the router back to the front edge, adjusted the router to cut ⅛ in. deep and made the pass from front to back to define one edge of a flute. Next, I unclamped the rotating block, realigned the bit with the other edge of the flute layout line and made a second pass to outline that edge. I repeated this procedure 28 more times to outline all the flutes. I found that having a helper work the clamps while I controlled the router cut the time required for this process in half.



***A two-axis router jig is used to define the edges** and bottom of each flute. By shifting the horizontal axis, the flutes are routed progressively deeper from front to back. The jig was also used to shape the interior of the shell before fluting.*

***Hand-carving the flutes on the shell with a gouge is fairly easy** after their sides and the depth have been defined by router cuts. A sharp gouge is essential to minimize tearout when carving endgrain, and a spoon gouge or bent gouge is helpful in tight areas.*

To rout the grooves that define the bottom of the flutes, I had to remove the router carriage from the bridge and remount it using the second vertical pivot point I had drilled in the carriage's rotating block. This moved the horizontal axis forward and allowed the router to cut the flutes deeper at the front of the shell than at the back. To cut the flutes to final depth, I used the previously described technique of aligning the bit, clamping the rotating block and swinging the router through the horizontal axis. Since I couldn't cut to the full ⅝ in. depth in a single pass, I had to make the circuit around the shell five times, increasing the depth of cut by ⅛ in. after each completed circuit.

Carving the flutes

After the machine work came a day of hand-chopping the flutes with gouges, as shown in the bottom photo above, and then scraping and sanding the flutes smooth. But it only took about 20 minutes to do each flute, because the router cuts had done the difficult work of making clean, straight edges and establishing the depth of each flute.

At this point I realized the biggest advantage of my router technique was the guarantee of a high-quality spherical surface as the starting point for the flutes. This was confirmed when I looked at museum pieces with hand-carved shells and saw that flutes with tiny imperfections tended to have slight wanderings in the lands between flutes. Aberrations like this are expected and charming in true period pieces, but I suspect that even oldtime carvers used every means available to make their flutes as straight and true as possible. □

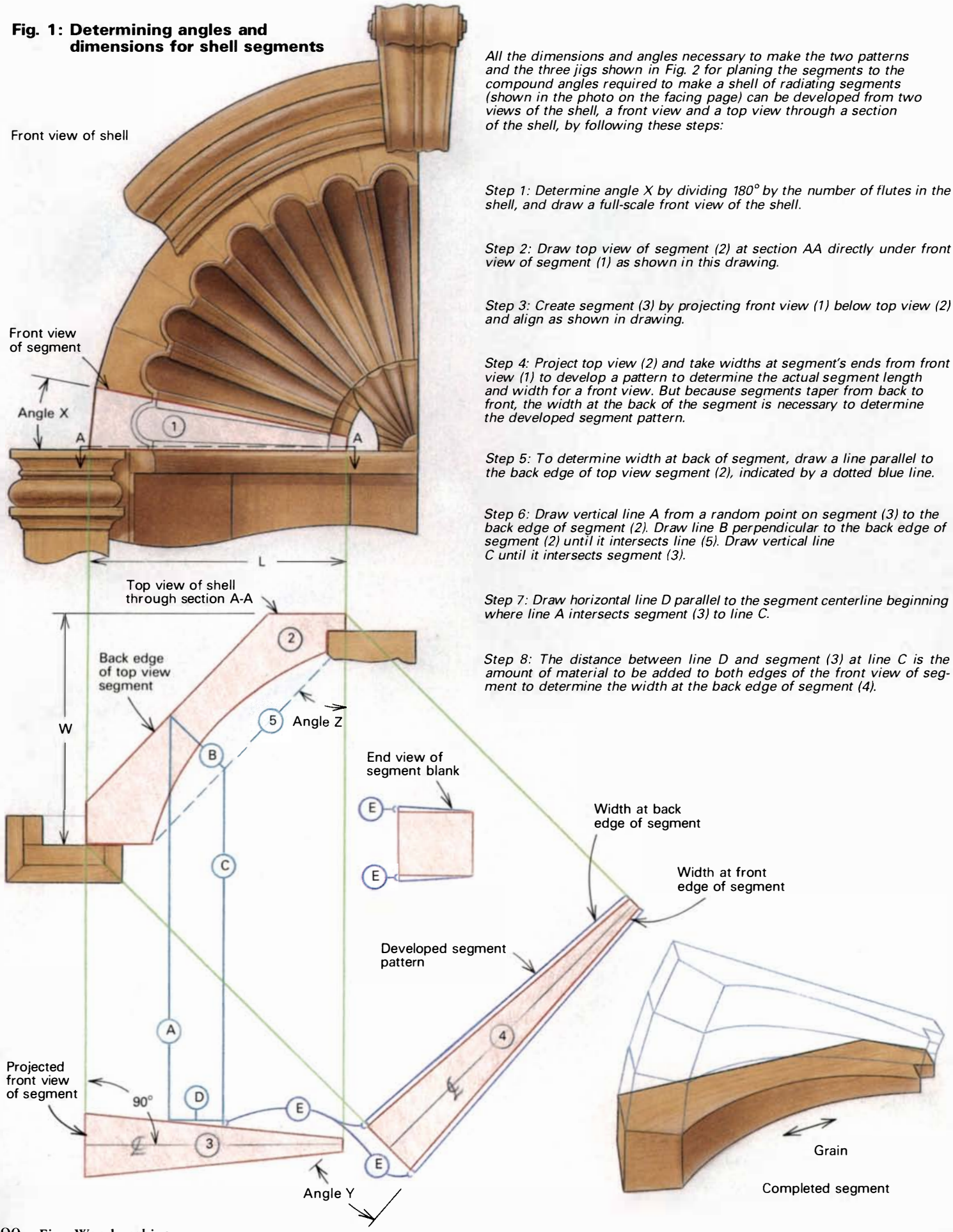
Howard Wing is a professional woodworker in Boxborough, Mass.

Photos this page: Charley Robinson; drawings: Bob La Pointe

Gluing up a shell with tapered segments

by Philip C. Lowe and Justin P. Smith

Fig. 1: Determining angles and dimensions for shell segments



All the dimensions and angles necessary to make the two patterns and the three jigs shown in Fig. 2 for planing the segments to the compound angles required to make a shell of radiating segments (shown in the photo on the facing page) can be developed from two views of the shell, a front view and a top view through a section of the shell, by following these steps:

Step 1: Determine angle X by dividing 180° by the number of flutes in the shell, and draw a full-scale front view of the shell.

Step 2: Draw top view of segment (2) at section AA directly under front view of segment (1) as shown in this drawing.

Step 3: Create segment (3) by projecting front view (1) below top view (2) and align as shown in drawing.

Step 4: Project top view (2) and take widths at segment's ends from front view (1) to develop a pattern to determine the actual segment length and width for a front view. But because segments taper from back to front, the width at the back of the segment is necessary to determine the developed segment pattern.

Step 5: To determine width at back of segment, draw a line parallel to the back edge of top view segment (2), indicated by a dotted blue line.

Step 6: Draw vertical line A from a random point on segment (3) to the back edge of segment (2). Draw line B perpendicular to the back edge of segment (2) until it intersects line (5). Draw vertical line C until it intersects segment (3).

Step 7: Draw horizontal line D parallel to the segment centerline beginning where line A intersects segment (3) to line C.

Step 8: The distance between line D and segment (3) at line C is the amount of material to be added to both edges of the front view of segment to determine the width at the back edge of segment (4).

A shell can be constructed with stacked, crescent-shaped pieces, as long as the resultant checkerboard grain pattern is covered with paint. When we make shells that will have a clear finish, like the one shown at right, we glue up radiating segments (one for each flute) to provide a more uniform appearance and to make carving with the grain easier.

The shell's blank is comprised of compound-angle segments that taper from outside end to inside end and from back to front. To cut the blanks for these segments, we developed patterns following the step-by-step procedures given in figure 1. It's easy to come up with a top-view segment pattern and a front-view pattern based on a full-scale drawing. But because the segment is wider at its back face, we used a boatbuilder's trick known as lofting to determine the front-to-back taper without resorting to complicated mathematical formulas (see steps 3 through 8 in figure 1). Using the patterns, we laid out and cut the segment blanks and then we planed the compound angles on the sides of the segments using the jigs shown in figure 2.

Before gluing the segments together, we bandsawed the front face of each to rough shape. A spare segment, ripped along its centerline and placed under each segment when bandsawing, ensured that the cut was perpendicular to the segment's centerline.

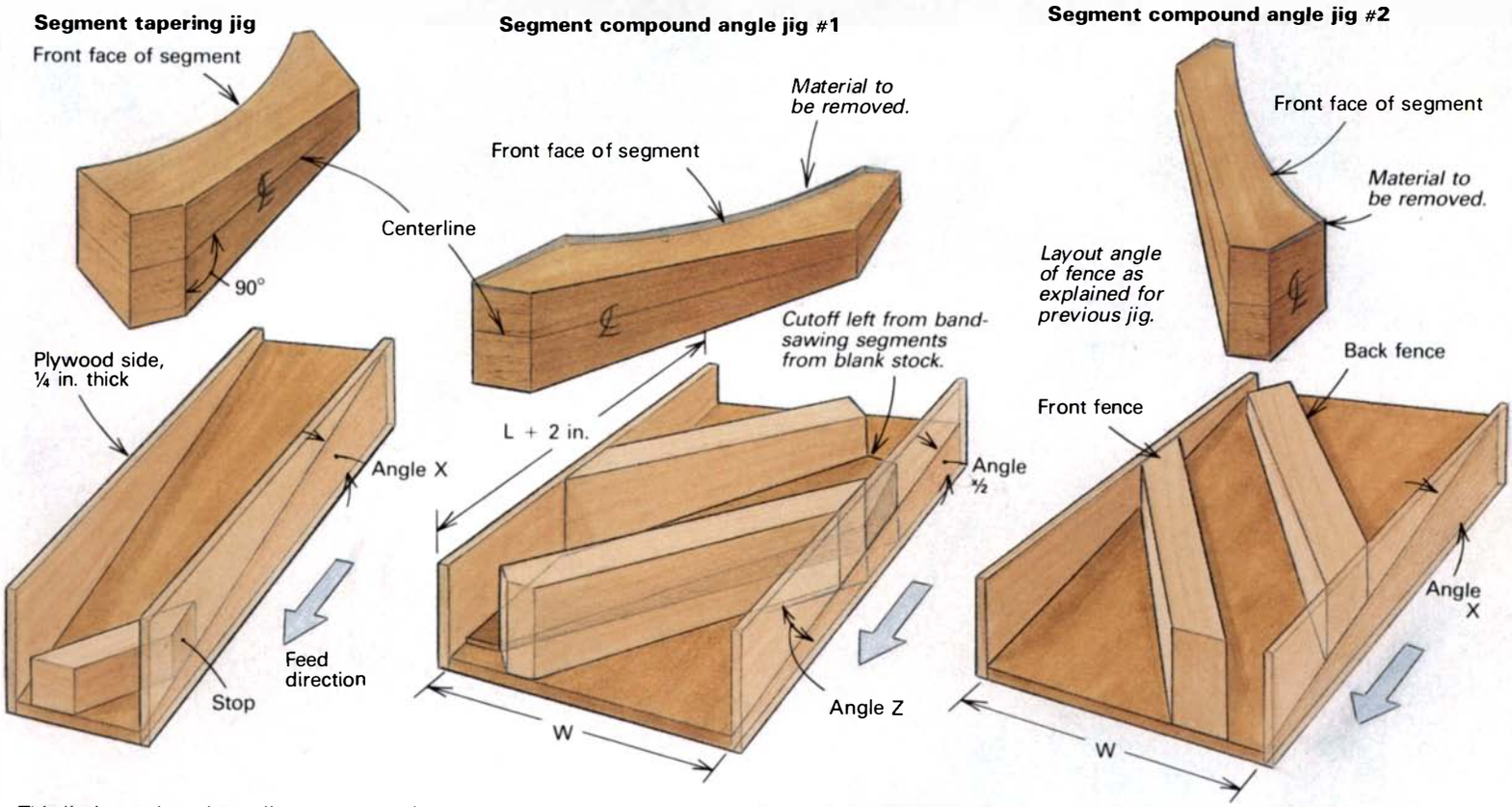
We glued up the segments in pairs with hot hide glue by rubbing the segments together until the glue just began to grab and then quickly aligning the pieces. If the joints are good, clamps are not necessary. We then glued pairs of pairs together until the shell was completed.

When we developed these methods we were making two cabinets, and so we glued the two shell blanks together with paper between them to form a bowl shape and then turned the interior on a lathe. Turning a blank this size requires a low speed on a large, well-anchored lathe. For a single shell, we normally hand-carve the interior shape before carving the flutes, but the jig shown in the previous article is an attractive alternative. □

Phil Lowe and Justin Smith specialize in designing, fabricating and restoring fine furniture in Beverly, Mass.

***A clear-finished shell glued up from compound, angled segments** has a more consistent color across the interior of the shell than the checkerboard pattern of endgrain and long grain found in the typical layered shell.*

Fig. 2: Angle jigs for preparing shell segments (angles and dimensions taken from Fig. 1)



This jig is used to plane all segments to the same dimension and create uniform end-to-end tapers as determined from full-scale drawings. Prepare the blanks by first planing stock to thickness and then layout each piece using the developed segment pattern. Bandsaw the segments from the blanks and save two cutoffs: one is used in the compound angle jig #1 and one is placed under the segments so that bandsaw cuts are perpendicular to the segment. Joint one face of the segment and then place it, jointed face down, in the jig.

When run through the planer, this jig adds a back-to-front taper creating a compound angle on one side of the segment.

Lay out angle of fence (angle Z from top view in Fig. 1) on flat bottom surface of base, transfer lines up sides with square and connect with straight edge.

This jig positions the segment for planing to final dimension and produces the required compound angle on the second side so that the segments, when assembled, will form the shell blank.

Note that the angle of the fences is reversed from previous jig for planing the opposite side of the segment.

Photo this page: Philip C. Lowe

It took William Schnute of Carmel Valley, Cal. seven months to sculpt both sides of these limed-finish, white oak doors *(above). To reduce weight and improve stability in the 9-in.-thick by 9-ft.-high doors, he engineered torsion-box cores for the pair. Schnute made the 16-in.-dia. brass pulls and his wife, Ronda Reinke, helped design the relief work, which is based upon an 18th-century Chinese silk screen.*

Photos: Tom O'Neal

Grand Entrances

by Alec Waters

Photo: Victor Brown

Main exterior doorways have traditionally been more than means of entry or exit. Visually, they can convey an invitation to people. Also, like a figurehead carved on a ship's bow that helps describe the vessel's charter name, purpose or crew, an entrance door can characterize a building's architectural design, function or occupants. And just as a figurehead may reveal something about a boat's builder, an entryway can represent a doormaker's style and acknowledge his or her skill. Because of this, entrances are prized commissions for woodworkers, and their construction usually shows a high level of craftsmanship. The results are often striking and may be an artist's or cabinetmaker's finest work. The doors shown here "speak" for themselves, so I'll let them offer their own opening and closing statements. □

Alec Waters is an editorial assistant at FWW.

Photo: Geri Anderson

Large and inset photos: Douglas Christiansen

Don Woodsmith designed the 3½-ft.-wide by 7-ft.-high teak entrance and storm doors *(above left) to adorn a log home near Steamboat Springs, Colo. The carved dragon has 1½-in.-deep relief and 1400 hand-chiseled scales. Fellow woodworker, Jeff Simon, assisted with the storm door and metalworker, Jim Selbe, helped Woodsmith fire a custom bronze-and-silver handle for the main door. It took Woodsmith over 1000 hours to complete the $28,500 pair.*

Douglas Christiansen laminated ⅜-in.-book-matched veneer for the face of this black walnut entryway *(above right) in Los Altos, Cal. To help the doorway resist earthquakes, he designed the framework with glued mortise-and-tenon and dovetail joinery, and he used tempered glass for the door's central- and side-lights. To reduce moisture exchange and decay, Christiansen treated all the components, including the hand-shaped raised panels, with preservative and marine varnish.*

Duane Brown of San Diego, Cal., carved the eagle on a 130-lb. Philippine mahogany door *(left). He laminated the 1⅝-in.-thick door and carved its 1-in.-deep relief, and then he coated its surfaces with sanding sealer in preparation for painting. The carved handle forms part of the cliff on the door's left side.*

Andre Poineau made the walnut entry *(right) in his company's Boyne Falls, Mich., shop, and Brendan Keenan hammered out the door's stainless steel hardware. The doweled-tenon door is 4½-in.-thick (including the carved trees on both sides) and has smoked thermal-pane glasswork.*

Photo: Randy Gross

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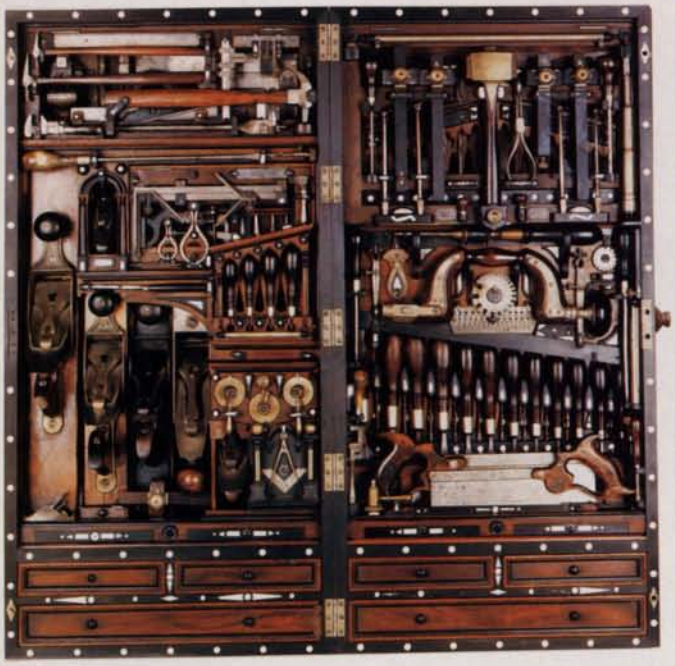

TOOL CHEST LEGACY

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

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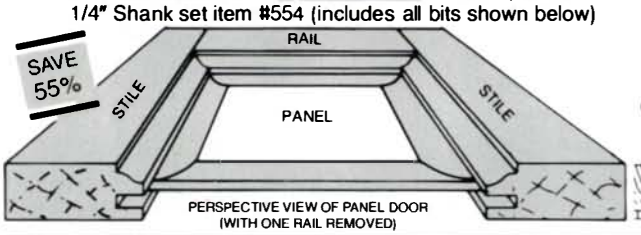

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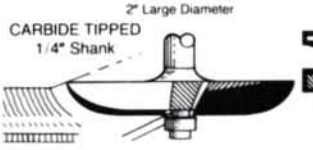

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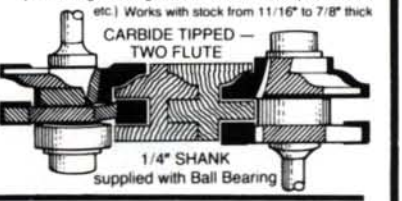

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#905		1/2" Spiral Cutter	*Proper Adaptor Will Be Supplied	1/2"	1 1/2"	1/2"	$29.00
#530		3/16" Edge Beading	3/16" Dia. of Circle		1/2"	1/4"	$15.00
#531		5/16" Edge Beading	5/16" Dia. of Circle		1/2"	1/4"	$15.50
#350		1/8" Round Over	1/8" R	3/4"	3/8"	1/4"	$11.00
#351		3/16" Round Over	3/16" R	7/8"	1/2"	1/4"	$11.00
#230		1/4" Round Over	1/4" R	1"	1/2"	1/4"	$12.00
#353		5/16" Round Over	5/16" R	1 1/8"	1/2"	1/4"	$14.00
#209		3/8" Round Over	3/8" R	1 1/4"	5/8"	1/4"	$15.00
#355		1/2" Round Over	1/2" R	1 1/2"	3/4"	1/4"	$17.00
#655		1/2" Round Over	1/2" R	1 1/2"	3/4"	1/2"	$17.00
#656		3/4" RoundOver	3/4" R	2"	7/8"	1/2"	$21.00
#199		Multiform Moulding	Unlimited Patterns	2 1/4"	2"	1/2"	$40.00
#205		1/4" Cove	1/4" R	1"	1/2"	1/4"	$12.00
#206		3/8" Cove	3/8" R	1 1/4"	9/16"	1/4"	$13.00
#207		1/2" Cove	1/2" R	1 1/2"	5/8"	1/4"	$14.00
#643		1/2" Cove	1/2" R	1 1/2"	5/8"	1/2"	$15.00
#208		3/4" Cove	3/4" R	1 7/8"	3/4"	1/2"	$26.00
#231		5/32" Roman Ogee	5/32" R	1 1/4"	15/32"	1/4"	$16.00
#232		1/4" Roman Ogee	1/4" R	1 1/2"	3/4"	1/4"	$17.00
#506		1/2" Pattern	Flush Trim	1/2"	1"	1/4"	$15.00
#508		3/4" Pattern	Flush Trim	3/4"	1"	1/4"	$17.00
#366		1/8" Slot Cutter	3/8" Deep	1 1/4"	1/8"	1/4"	$14.00
#368		1/4" Slot Cutter	3/8" Deep	1 1/4"	1/4"	1/4"	$14.00
#204		3/8" Rabbeting	3/8" Deep	1 1/4"	1/2"	1/4"	$13.00
#670		3/8" Rabbeting	3/8" Deep	1 1/4"	1/2"	1/2"	$14.00

ITEM NO.	BEST CUT BEST PRICE	DESCRIPTION	ANGLE/DEPTH/RADIUS CIRCLE DIAMETER	LARGE DIA.	CUTTING LENGTH	SHANK SIZE	PRICE
#211		3/8" Core Box	round nose	3/8"	3/8"	1/4"	$10.00
#212		1/2" Core Box	round nose	1/2"	11/32"	1/4"	$13.00
#418		3/4" Core Box	round nose	3/4"	5/8"	1/4"	$15.00
#213		1" Core Box	round nose	1"	3/4"	1/2"	$17.00
#548		Lockmitre		2"	7/8"	1/4"	$32.00
#214		1/4" Straight	plunge cutting	1/4"	3/4"	1/4"	$ 6.50
#216		3/8" Straight	plunge cutting	3/8"	1"	1/4"	$ 6.50
#474		1/2" Straight	plunge cutting	1/2"	1"	1/4"	$ 7.00
#219		3/4" Straight	plunge cutting	3/4"	1"	1/4"	$ 9.50
#779		3/4" Straight	plunge cutting	3/4"	1 1/2"	1/2"	$10.00
#462		1/2" Bull Nose	1/2" Dia. of Circle		3/4"	1/4"	$16.00
#464		3/4" Bull Nose	3/4" Dia. of Circle		1"	1/4"	$21.00
#764		3/4" Bull Nose	3/4" Dia. of Circle		1"	1/2"	$21.00
#545		Tongue & Groove	Straight	15/8"	1"	1/4"	$29.00
#845		Tongue & Groove	Straight	15/8"	1"	1/2"	$29.00
#546		Tongue & Groove	Wedge	1 3/16"	1"	1/4"	$29.00
#846		Tongue & Groove	Wedge	15/8"	1"	1/2"	$29.00
#450		1/8" Beading	1/8" R	3/4"	3/8"	1/4"	$11.00
#233		1/4" Beading	1/4" R	1"	1/2"	1/4"	$13.00
#454		3/8" Beading	3/8" R	1 1/4"	5/8"	1/4"	$15.50
#455		1/2" Beading	1/2" R	1 1/2"	3/4"	1/4"	$17.00
#500		3/8" Flush	Trimming	3/8"	1/2"	1/4"	$ 7.00
#501		3/8" Flush	Trimming	3/8"	1"	1/4"	$ 7.50
#503		1/2" Flush	Trimming	1/2"	1"	1/4"	$ 8.50
#221		1/2" Flush	Trimming	1/2"	1 3/16"	1/2"	$ 8.00
#558		Thumbnail		1 3/16"	3/8"	1/4" *	$18.50
#858		Thumbnail		2 1/2"	3/4"	1/2"	$35.00
#579		Molding Plane		1 1/8"	1 3/4"	1/4"	$31.95
#879		Molding Plane		1 1/8"	1 3/4"	1/2"	$31.95

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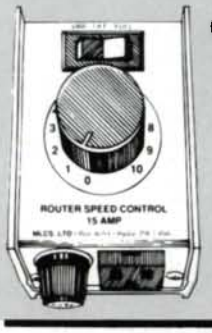

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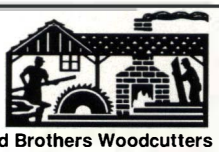

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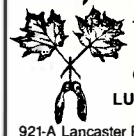

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1a. Title: Fine Woodworking. 1b. Publication no. 03613453 2. Date of filing: September 30, 1991. 3. Frequency of issue: Bimonthly. 3a. No. of issues published annually: 6. 3b. Annual subscription price: $25.00. 4. Location of office of publication: 63 So. Main Street, PO Box 355, Newtown, CT 06470. 5. Location of the headquarters of the publishers: 63 So. Main Street, PO Box 355, Newtown, CT 06470. 6. Publisher: John Lively, 63 So. Main Street, PO Box 355, Newtown, CT 06470; Executive editor: Jim Boesel, 63 So. Main Street, PO Box 355, Newtown, CT 06470. 7. Owner: The Taunton Press, Inc., 63 So. Main Street, PO Box 355, Newtown, CT 06470. Stockholders owning or holding 1 percent or more of the total amount of stock: Paul Roman, 63 So. Main Street, PO Box 355, Newtown, CT 06470; Janice A. Roman, 63 So. Main Street, PO Box 355, Newtown, CT 06470. 8. Known bondholders, mortgagees and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages or other securities: None. 9. Not applicable. 10. Extent and nature of circulation:

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A. Total no. copies (net press run)	335,394	331,046
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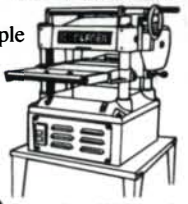

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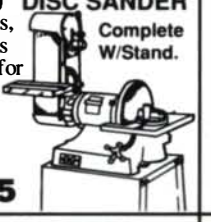

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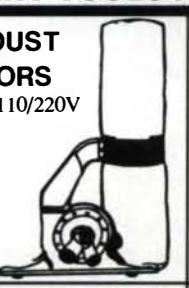

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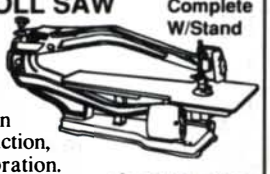

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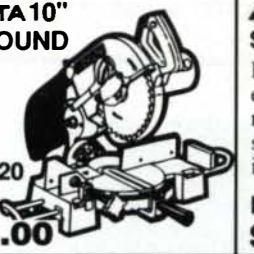

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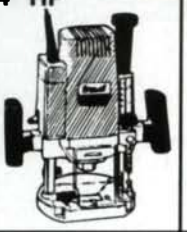

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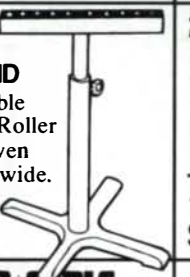

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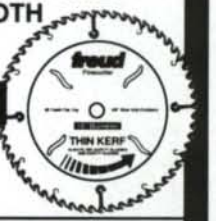

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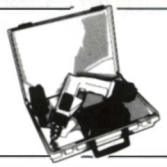

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11212VSR	3/4" VSR SDS Bulldog Rotary Hammer	195.
11215DVSR	3/4" Dustless Bulldog VSR SDS Hammer	289.
11304	Brute Breaker Hammer	1205.
11305	Demolition Hammer	689.
3258	3-1/4" Planer	129.
1942	Heavy Duty Heat Gun	72.
1604	1-3/4 HP Router	129.
1606	1-3/4 HP D-Handle Router	155.
1608LX	Laminate Trimmer w/ Deluxe Guide	105.
1608T	Tilt Base Laminate Trimmer	105.
1609	Offset Base Laminate Trimmer	125.
1609K	Installers Trimmer Kit	179.
1609KX	Deluxe Installers Trimmer Kit	229.
1611EVS	3-1/4 HP EFC VS Plunge Router	239.
1272D	3"x24" Dustless Belt Sander	175.
1273D	4"x24" Dustless Belt Sander	185.
1273DVS	4"x24" VS Dustless Belt Sander	199.
1370DEVS	6" VS Random Orbit Sander w/Access.	299.
3270D	3"x21" Dustless Belt Sander	139.
3283DVS	5" Dustless Random Orbit Sander	95.
1581DVS	VS, Var. Orbit Jigsaw, Dustless	159.
1582VS	VS, Var.Orbit Jigsaww/CLIC	135.
1581VS	VS, Var.Orbit Jigsaw. D-Handle	135.
1632VSK	VS Panther Recip. Saw Kit	145.
1654	7-1/4" Circular Saw	109.
1420VSR	VSR Drywall Driver, 0-4000 RPM	85.

MILWAUKEE

0399-1	3/8" VSR 12v Driver/Drill Kit	159.
0402-1	VSR 12v Driver/ Drill w/Keyless Chuck	163.
6546-1	Cordless Screwdriver, 2-spd	75.
0222-1	3/8" VSR Drill, 0-1000 RPM	104.
0224-1	3/8" Magnum Holeshooter, 0-1200 RPM	110.
0234-1	1/2" Magnum Holeshooter, 0-850 RPM	112.
0239-1	VSR Keyless Chuck Drill	119.
0244-1	1/2" Magnum Holeshooter, 0-600 RPM	112.
0375-1	3/8" Close Quarter Drill	125.
0379-1	1/2" Close Quarter Drill	149.
0567-1	Drain Cleaner Kit	229.
1676-1	Hole Hawg Kit	235.
3002-1	Electricians Rt. Angle Drill Kit	182.
3102-1	Plumbers Rt. Angle Drill Kit	185.
3107-1	VS Right Angle Drill Kit	190.
5192	Die Grinder, 4.5 Amp	169.
6140	4-1/2" Angle Grinder	95.
6141	5" Angle Grinder	109.
5362-1	1" TSCR Hawk Rotary Hammer	275.
8975	Heat Gun	59.
5680	2 HP Router	219.
5925	3"x24" Dustless Belt Sander	219.
5936	4"x24" Dustless Belt Sander	225.
6012	1/3 Sheet Finishing Sander	114.
6014	1/2 Sheet Finishing Sander	117.
6016	1/4 Sheet Finishing Sander	49.
6215	16" Electric Chainsaw	169.
6232	4-3/4" Bandsaw w/Case	275.
6365	7-1/4" Circular Saw	118.
6377	7-1/4" Wormdrive Saw	169.
6460	10-1/4" Circular Saw	249.
6528	VS Super Sawzall	169.
6750-1	VSR Drywall Driver	89.
6754-1	VSR Magnum Drywall	119.
6798-1	TEK Screwdriver	109.

FREUD

LM72M008	8" x 24T Rip	35.
LM72M010	10" x 24T Rip	36.
LU73M010	10" x 60T ATB	43.
LU81M010	10" x 40T TCG	39.
LU84M008	8" x 40T Combination	44.
LU84M011	10" x 50T Combination	38.
LU85M008	8" x 64T ATB Fine Cut Off	49.
LU85M010	10" x 80T ATB Fine Cut Off	55.
LU85M014	14" x 108T ATB Fine Cut Off	105.
LU85M015	15" x 108T ATB Fine Cut Off	105.
LU87M008	8" x 22T Thin Kerf	42.
LU87M010	10" x 24T Thin Kerf	37.
LU88M008	8" x 48T Thin Kerf	49.
LU88M010	10" x 60T Thin Kerf	43.
LU91M008	8-1/2" x 48T Miter Saw Blade	38.
LU91M010	10" x 60T Miter Saw Blade	49.
LU98M010	10" x 80T TCG	68.
TK203	7-1/4" x 24T Framing Blade	18.
TK204	8-1/4" x 24T Framing Blade	21.
TK303	7-1/4" x 40T Finish Blade	21.
TK304	8-1/4" x 40T Finish Blade	27.
SD308	8" Dado Set	117.
WC106	6 Pc. Chisel Set	49.
FT2000	3-1/4 HP Plunge Router	179.
90-100	15 Pc. Router Bit Set	159.

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3724	24" Steel Bar Clamp	7.99	45.25
3730	30" Steel Bar Clamp	9.05	51.19
3736	36" Steel Bar Clamp	9.95	56.65
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5090DW	3-3/8" Saw Kit, 9.6v	139.
6093DW	3/8" VSR Driver/Drill Kit, 9.6v	129.
6200DW	3/8" VSR Hi-Torq Driver/Drill Kit	155.
6404	3/8" VSR Drill, 0-2100 RPM	58.
9207SPC	7" Electronic Sander Polisher	148.
1805B	6-1/8" Planer w/Case	355.

MAKITA cont'd

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1911B	4-3/8" Planer Kit	145.
BD4510	1/4 Sheet Finishing Sander	52.
BD4550	1/4 Sheet Dustless Finishing Sander	57.
9401	4"x24" Dustless Belt Sander	164.
9900B	3"x21" Dustless Belt Sander	145.
LS1011	10" Compound Miter Saw	449.
LS1030	10" Miter Box	229.
LS1440	14" Miter Saw	435.
4200N	4-3/8" Trim Saw	129.
5077B	7-1/4" Hypoid Framers Saw	139.
5402A	16" Circular Saw	325.
2012	12" Portable Planer	455.
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2711	10" Table Saw w/Brake	475.

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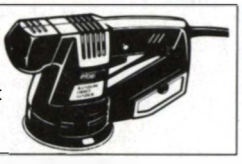

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Fine WoodWorking®

Index to issues 86 through 91

This alphabetized index to Fine Woodworking *covers departments and articles published between January 1991 and December 1991. We will publish an index once each year in our January issue. These indexes supplement, but do not replace, our cumulative indexes to issues 1 through 50 and to issues 51 through 65, which were published as separate booklets. The index to issues 1 through 50 is still available for purchase. Each reference consists of an issue number, a colon and page numbers for that issue. A hyphen between the page numbers means the discussion of the topic is unbroken on the named pages; commas between page numbers indicate an intermittent discussion. The index to issues 86 through 91 and the previous booklets were prepared by Harriet Hodges of New Castle, Va.*

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

ARIZONA: **Classes**–Carving Two Flat-plane Figures with Harley Refsal, Jan. 10–12; Carving a Standing Black Bear with Desiree Hajny, Feb. 13–15; Carving a Peccary (Arizona pig) with Desiree Hajny, Feb. 17–19; Carving a Cowboy-type Figure with Harold Enlow, Mar. 5–7; Carving a Hillbilly-type Figure with Harold Enlow, Mar. 9–11. Dave Rushlo Wood Carvers Supply, 2530 N. 80th Pl., Scottsdale. For more information, contact Dave Rushlo: (602) 994-1233.
Juried show–Desert Festival '92 Woodcarving Show, Feb. 7–9. Phoenix Civic Center, Phoenix Room. For more information, contact Claude Michaelson, Show Chairman, Grand Canyon State Woodcarvers, Inc., PO Box 6169, Carefree, 85377-6169. (602) 488-0318.
Show–Frozen Illusions by Tom Eckert, Jan. 1–31. Joanne Rapp Gallery/The Hand and the Spirit, 4222 N. Marshall Way, Scottsdale. For more information, contact Louise Roman: (602) 949-1262.

CALIFORNIA: **Exhibition**–Many Mansions, Jan. 4–Feb. 22. Structures as artistic statements. San Francisco Craft & Folk Museum, Landmark Bldg. A, Fort Mason, San Francisco. For more information, contact Mary Ann McNicholas: (415) 775-0990.
Juried shows–Contemporary Crafts Market, Mar. 20–22, Fort Mason Center, Herbst and Festival Pavilions, Marina Blvd. at Buchanan St., San Francisco. For information, contact Roy Helms & Associates, 777 Kapiolani Blvd., Suite 2820, Honolulu, HI 96813. (808) 422-7362.
Show–A Trio of Woodworkers, thru Dec. 31. Boxes by Lauren Yonan, Turnings by Vishnu and Marquetry by Dave Peck. Mendocino Gallery, 13500 S. Highway 101, Hopland, 95449. (707) 744-1300.
Juried exhibition–California Design '92, Jan. 16–Feb. 16. Furniture and the decorative arts. Contract Design Center Gallery, San Francisco. For info, contact California Design, Baulines Crafts Guild, Schoonmaker Point, Sausalito, 94965. (415) 331-8520.
Workshops–Woodworking for women. Furnituremaking with hand tools using traditional joinery, weekends. Call for schedule: Debey Zito, (415) 648-6861.
Solicitation–New artists wanted for the Los Angeles Craft & Folk Art Museum Research Library. Used by collectors, curators, architects, designers. For info, contact Craft & Folk Art Museum Library, c/o the May Co., 6067 Wilshire Blvd., Los Angeles, 90036. (213) 934-7239.
Juried Exhibition–Tables of Stone and Wood, new works by Paul Schurch, thru Jan. 4. Veneer marquetry combined with Pietra Dure (stone inlay). Morrey's Antique Gallery, 1225 Coast Village Rd., Montecito, 93108. (805) 969-4464.
Exhibition–Handmade for the Table at the Folk Tree Collection, thru Jan. 5. 1992. Fair Oaks Ave., Pasadena, 91105. (818) 793-4828.
Workshops–Various workshops including Japanese woodworking, joinery and sharpening. Contact Hida Tool Co., 1333 San Pablo, Berkeley, 94702. (415) 524-3700.
Exhibition–International Lathe-Turned Objects Challenge IV, Feb. 1 thru Apr. 12. Craft & Folk Art Museum, Los Angeles. Contact Wood Turning Center, PO Box 25706, Philadelphia, PA 19144. (215) 844-2188.

COLORADO: **Residency program**–Anderson Ranch Arts Center's Studio Residency Program, thru May 15. Offers interactive environment for furnituremakers and designers. For information, contact Anderson Ranch, PO Box 5598, Snowmass Village, 81615. (303) 923-3181.
Workshops–One- and two-week woodworking and furniture design workshops, summer. Scholarship application deadline March 13, 1992. For free catalog, contact Anderson Ranch Arts Center, Box 5598, Snowmass Village, 81615 (303) 923-3181.
Classes–Woodworking and related classes, year-round. Red Rocks Community College, 13300 W. 6th Ave., Lakewood, 80401. (303) 988-6160.
Show–7th Annual American Craftsmen's Custom Woodworking Show, Vale Public Library, Vale, Feb. 1–15. For more information call Tim O'Brien at (303) 328-7253 (after 6:00 PM).
Classes–Woodcraft classes, various topics. For info contact Woodcraft, Tamarac Terrace, 4403 South Tamarac Parkway, Denver, 80237 or call (303) 290-0007.

CONNECTICUT: **Juried show**–13th Annual Holiday Festival of Crafts, thru Dec. 24. Free admission. Guilford Handcrafts Center, Rte. 77, Guilford. For further information, call (203) 453-5947.
Juried exhibition–23rd annual Celebration of American Crafts, thru Dec. 23. The Celebration, Creative Arts Workshop, 80 Audubon St., New Haven, 06510. (203) 562-4927.
Exhibit–Fine Art Furniture by Thomas Stender, thru Jan. 6. South Norwalk Gallery, Brookfield Craft Center, South Norwalk. For info, call (203) 853-6155.
Juried Exhibition–Fifth Annual Fine Art Exhibition, Jan. 15 thru Feb. 4. For prospectus send SASE to Multimedia 1992, Guilford Handcrafts, Inc., P.O. Box 589, Guilford, 06437. (203) 453-5947.
Workshops–18th Century Carving Techniques, Jan. 11–12; Basic Furniture Construction, Antique Finishes, Jan. 18–19; Japanese Tool Sharpening Techniques, Desk Accessories, Jan. 25–26; Woodworking, Feb. 1–2. Brookfield Craft Center, Brookfield and Norwalk. For information, call (203) 775-4526 or (203) 853-6155.

DISTRICT OF COLUMBIA:
Fellowship program–Fifth annual fellowship program in crafts at the Renwick Gallery. Application deadline Jan. 15, with appointments to begin on or after June 1. For more info and application write Fellowship Program, Renwick Gallery, National Museum of American Art, Smithsonian Institution, Washington, D.C. 20560. (202) 357-2531.
Courses–Exhibition, Storage and handling of furniture, Feb. 10–13. For further info contact Training Secretary, CAL/MSC, Smithsonian Institution, Washington, DC 20560. (301) 238-3700.
Show–Woodworking World Shows, Feb. 14–16. DC Armory, 2001 East Capital St., Washington, DC 20003. For more info contact the Woodworking World Show information line at (800) 521-7623 or call (603) 536-3768.

FLORIDA: **Meeting**–Central Florida Woodworkers Guild, second Thursday of every month, Winter Park. For information, contact Ed Harte: (407) 862-3338.
Show–South Florida Woodworking Show, Mar. 13–15. War Memorial Auditorium, 800 N.E. 8th Street, Fort Lauderdale, 33304. For info call (800) 826-8257.
Show–Central Florida Woodworking Show, Mar. 6–8. Florida State Fairgrounds, Special Events Center, 4800 U.S. Hwy. 301 North, Tampa, 33610. For information call (800) 826-8257.
Juried exhibition–The Turners Dance, Jan. 10 thru Feb. 29. Florida Craftsmen Gallery, 235 Third Street South, St. Petersburg, 33701.
Show–Forida State Fair Fine Handcrafted Furniture Show and Exhibit, Feb. 5–16. Contact Lynn Keiter, 4538 W. Kennedy Blvd., Tampa, 33609. (813) 877-9585.
Juried festival–29th annual Coconut Grove Arts Festival, Feb. 15–17. Contact Coconut Grove Arts Festival, Box 330757, Coconut Grove 33233-0757. (305) 447-0401.
Demonstration–Polk County Woodcarvers. Florida Citrus Festival, Jan. 30 thru Feb.9, Winter Haven. For more information, call Florida Citrus Showcase (813) 293-3175.

GEORGIA: **Competition**–Call for entries. Design Emphasis '92 furniture design competition. Sponsored by and held in conjunction with the International Woodworking Machinery & Furniture Supply Fair '92, Aug. 21–24, Georgia World Congress Center, Atlanta. For info on the competition, contact Shirley Byron, IWF, 8931 Shady Grove Court, Gaithersburg, MD 20877. (301) 948-5730.
Workshops–Japanese woodworking by Toshihiro Sahara. One Saturday each month, year-round. Contact Sahara Japanese Architectural Woodworks, 1716 Defoor Place N.W., Atlanta, 30018. (404) 355-1976.

ILLINOIS: **Exhibition**–The Art of the Fish Decoy, Feb. 10 thru Apr. 6. John G. Shedd Aquarium, Chicago. For info, contact Susan Flamm: (212) 977-7170.
Show–Woodworking World Show, Feb. 29 thru Mar. 2. Illinois State Fairgrounds, Eighth St. and Sangamon Ave., Springfield, 62702. For more info contact the Woodworking World Show information line at (800) 521-7623 or call (603) 536-3768.
Show–The St. Louis Woodworking Show, Feb. 7–9. Gateway Center, Center Hall, One Gateway Drive, Collinsville, 62234. For info call (800) 826-8257.

INDIANA: **Exhibition**–The Art of the Fish Decoy, thru Jan. 20. National Art Museum of Sport, Indianapolis. For info, contact Susan Flamm: (212) 977-7170.
Show–The Indianapolis Woodworking Show, Feb. 21–23. Indiana Convention Center, Hall 4, 100 S. Capitol Ave., Indianapolis, 46225. For info call (800) 826-8257.
Classes–Various woodworking-related classes and workshops include general woodworking, lathe, and router seminars. Contact Woodworking Unlimited, 6038 E. 82nd St., Indianapolis, 46250. For current schedule call (317) 849-0193.
Show–Mid-American Lumbermen's Show, Feb. 14–15, Indianapolis Convention Center, Indianapolis. For info contact Trade Shows, Inc., P.O. Box 796, Conover, NC 28613. (704) 459-9894.

IOWA: **Juried fair**–22nd annual Art in the Park, May 16–17. Four Square Park, Main Ave, Clinton. Fine arts & fine crafts only. $5 jury fee. Closing date Mar. 15. SASE Clinton Art Association, Box 132, Clinton, 52733 or call Carol Glahn (319) 259-8308.

KANSAS: **Show**–The Kansas City Woodworking Show, Feb. 14–16. Merchandise Mart, Hall A, 6800 W. 115th Street, Overland Park, 66211. For more information, call (800) 826-8257.

KENTUCKY: **Workshops**–Woodturning and joinery instruction. Contact Jim Hall, Adventure in Woods, 415 Center St., Berea, 40403. (606) 986-8083.
Meeting–Kyana Woodcrafters Inc., first Thursday of each month. Bethel United Church of Christ, 4004 Shelbyville Rd., Louisville, 40207. (502) 426-2991.

LOUISIANA: **Juried competition**–Lafayette Art Association Annual National Juried Competition of Original Two and Three Dimensional Art, Mar. 3 thru Apr. 7. Fee: $25 for 3 entries, $8 for 2 additional, limit 5 entries. Slides due: Jan 10. For prospectus send #10 SASE to: J.K. Sommer, Lafayette Art Gallery, 700 Lee Ave., Lafayette, 70501.

MAINE: **Classes**–Woodworking for adults and children in daytime, evenings and on weekends. Portland School of Art, 97 Spring St., Portland, 04101. (207) 775-3052.

MARYLAND: **Exhibition**–The Art and Fantasy of the American Carousel, thru Jan. 12. Carved antique figures from 1880-1930. The Historical Society of Talbot County, 25 S. Washington St., Easton, 21601. (301) 822-0773.
Fair–The Winter Market of American Crafts, American Craft Council Craft Fair. Open to the trade Feb. 18–20, to the public Feb. 21–23. Baltimore Convention Center, Baltimore. For fair information, contact American Craft Enterprises (800) 836-3470.
Show–17th annual Spring Arts & Crafts Fair, Apr. 10–12. Montgomery County Fairgrounds, Gaithersburg, 20878. May 1–3, Maryland State Fairgrounds. Jurying begins Jan. 13. For detailed information and applications send 3 loose stamps for postage (NO SASE, please) to: Deann Verdier, Director, Sugarloaf Mouantain Works, Inc., 200 Orchard Ridge Dr., Suite 215, Gaithersburg, 20878. (301) 990-1400.
Show–15th annual Spring Arts & Crafts Fair, May 1–3, Maryland State Fairgrounds, Timonium. Jurying begins Jan. 13. For detailed information and applications send 3 loose stamps for postage (NO SASE, please) to: Deann Verdier, Director, Sugarloaf Mouantain Works, Inc., 200 Orchard Ridge Dr., Suite 215, Gaithersburg, 20878. (301) 990-1400.

MASSACHUSETTS: **Classes**–Woodworking classes, throughout most of the year. Boston Center for Adult Education, 5 Commonwealth Ave., Boston, 02116. (617) 267-4430.
Juried exhibition–Selected works by members of the Central New England Woodturners Assoc., thru Jan. 11. Worcester Center for Crafts, 25 Sagamore Rd., Worcester, 01605. (508) 753-8183.
Workshop–13th annual Wood Identification Workshop, R. Bruce Hoadley, Jan. 14–17. Univ. of Mass. at Amherst, Wood Technology Lab., Room 105, Holdsworth Natural Resources Center. For info, contact Alice E. Szlosek or Trudie Goodchild, Div. of Continuing Education, Goodell Bldg., Univ. of Mass., Amherst, 01003. (413) 545-2484.
Exhibition–Let Us Entertain You: Crafts for Special Occasions, thru Jan. 25, The Society of Arts and Crafts, 175 Newbury St., Boston, 02116 (617) 266-1810.
Classes–Turning Miniatures with Mark Salwasser. Jan. 18. Woodcraft, 313 Montvale Ave., Woburn, 01801. (617) 935-5860.

MICHIGAN: **Show**–3rd annual Grand Rapids Woodworking Show, Feb. 7–9. Grand Rapids Jr. College Fieldhouse, 111 Lyon NE, Grand Rapids, 49053. For info call (800) 826-8257.
Classes–Various woodworking classes available. Contact Woodcraft, Heritage Plaza, 14695 Telegraph Rd., Redford, 48239. (313) 537-9377.

MINNESOTA: **Show**–The Twin Cities Woodworking World show, Jan. 17–19. Minneapolis Convention Center, 1301 S. 2nd Ave., Minneapolis. For info, contact Woodworking Association of North America: (800) 521-7623, (603) 536-3768.
Classes–Various woodworking classes available. Contact Woodcraft, Plaza at Oxboro, 9741 Lyndale Ave. South, Bloomington, 55420. (612) 884-3634.

MISSOURI: **Classes**–Various woodworking classes available. Contact Woodcraft, Dierberg's Heritage Place, 12511 Olive Boulevard, Creve Coeur, 63141.

NEW HAMPSHIRE: **Classes**–Classes in fine arts and studio arts. Manchester Institute of Arts and Sciences, 114 Concord St., Manchester, 03104.
Classes–Various woodworking classes, year-round. Including antique repairs, carving canes & walking sticks, small boxes, kitchen utensils, lathe-turning, hand-carving, more. Contact The Hand & I, PO Box 264, Rte. 25, Moultonboro, 03254. (603) 476-5121.
Demonstration–Guild of N.H. Woodwokers and demonstration by Bill Thomas. Jan 18. Hillsboro. For info contact John Skewis; 132 Drinkwater Rd., Kensington 03833. (603) 778-7360.

NEW JERSEY: **Show**–The North Jersey Woodworking Show, Feb. 28 thru Mar. 1. Westfield Armory, 500 Rahway Ave., Westfield, 07090. For info call (800) 826-8257.

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

Show–Woodworking World Shows, The Albuquerque Show. New Mexico State Fairgrounds, School Art/Flower Building, Albuquerque, 87198. For info contact Woodworking World Show information line at 1 (800) 521-7623 or call (603) 536-3768.

NEW YORK: **Exhibits**–Ed Zucca, Michelle Holzapfel and gallery artists, thru Jan. 4; Thomas Hucker, Jan. 9–Feb. 1; Albert Paley, Feb. 6–Mar. 15; Timothy Philbrick, Jonathan Bonner, Mar. 15–Apr. 15. Peter Joseph Gallery, 745 5th Avenue, New York City, 10151. (212) 751-5500.
Classes–Contemporary Woodworking I, Doug Redmond, 15 sessions beginning Feb. 4. Contact Ken Coleman, Director, Craft Students League, YWCA of the City of New York, 610 Lexington Ave., New York, 10022. (212) 735-9731.
Exhibition–Swiss Folk Art: Celebrating America's Roots, thru Jan. 1. For more info, contact Museum of American Folk Art, Two Lincoln Sq., New York City, 10023-6214. (212) 595-9533.
Classes–Dovetailing a Shaker Blanket Chest; Building a Shaker Rocker, Eric Eklum. Begin Jan. 14. For more info contact Eric Eklum, 117 Beechview Ave., Jamestown, 14701. (716) 665-5344.
Festival–New York International Gift Fair®, Feb. 22–26. Juried. For info and applications, contact Lynn White Show Manager, George Little Management, Inc., 2 Park Ave., Suite 1100, New York, N.Y. 10016-5748. (212) 686-6070, ext. 249.
Exhibit–The Art of the Keyboard: Rediscovering Pianos and Organs, thru Jan. 15. New York State Museum, Albany. For more information, contact University of the State of New York, State Education Dept., Albany, 12234. (518) 474-1201.
Classes–Various beginning and advanced woodworking classes. Constantine, 2050 Eastchester Rd., Bronx, 10461. (212) 792-1600.
Festival–16th Annual American Crafts Festival, July 4, 5 and July 11, 12. Lincoln Center, New York. Juried. Application deadline Jan. 25. Send SASE to Brenda Brigham, American Concern for Artistry & Craftsmanship, P.O. Box 650, Montclair, NJ 07042. (201) 746-0091.
Meetings–New York Woodturners Association, first Tuesday of each month. Woodturning techniques exhibits, more. The Craft Student League, YWCA, 610 Lexington Ave., New York City.
Festival–8th Annual Autumn Crafts Festival at Lincoln Center, Fordham Univ. Plaza, New York. Juried. Aug. 29, 30 and Sept. 5–7. Application deadline Jan 25. Send SASE to Brenda Brigham, American Concern for Artistry and Craftsmanship, P.O. Box 650, Montclair, N.J. 07042. (201) 746-0091.
Show–Woodstock-New Paltz Arts & Crafts Fair, Spring Show, May 23–25, Ulster County Fairgrounds. Juried. Application deadline Feb. 1; Fall show, Sept. 5–7, application deadline Feb. 1; Capital Arts & Crafts Marketplace, Knickerbocker Arena, Albany, Dec. 4–6, Application deadline Feb. 1. For info contact Quail Hollow Events, P.O. Box 825. Woodstock, 12498. (914) 679-8087 or (914) 246-3414.

NORTH CAROLINA: **Workshops and programs**–Eddie Howard Wood, thru Dec. 31; Christmas with the Guild, thru Dec. 31. For info, contact Southern Highland Handicraft Guild, PO Box 9545, Asheville, 28815.
Video course–Wood Technology, six-lesson correspondence course on the wood industry. For info, contact Vann Moore, Dept. of Wood & Paper Science, North Carolina State University, PO Box 8005, Raleigh, 27695-8005. (919) 737-3181.
Workshops–Woodworking and woodcarving workshops, year-round. Including woodcarving, more. Contact John Campbell Folk School, Rte. 1, Box 14A, Brasstown, 28902. (800) 562-2440, (704) 837-2775.
Meetings–North Carolina Woodturners, second Saturday of every month. Also, woodturning workshops for all levels. For info, contact Eric Hughes, Rte. 3, PO Box 300, Conover, 28613. (704) 464-5611.
Show–The Charlotte Woodworking Show, Jan. 24–26. Charlotte Convention Center, Hall A, 101 S. College St., Charlotte, 28202. For info call (800) 826-8257.
Course–A Development Program for Managers in the Wood Industry, Jan. 20–24. North Carolina State University. For more information, contact Ms. Vann Moore, Department of Wood & Paper Science, North Carolina State University, Box 8005, Raleigh, 27695-8005. (919) 515-3181.
Conference–5th Annual Grove Park Inn Arts & Crafts, Feb. 21–23, Asheville. For info contact Bruce Johnson, P.O. Box 8773, Asheville, 28814. (704) 254–1912.
Show–High Point Woodworking & Furniture Supply Show, Mar. 6–7, Market Square Tradeshow Center, High Point. For info contact Trade Shows, Inc., P.O. Box 796, Conover, 28613. (704) 459-9894.
Exhibition–Showcase of Woodcarvings, Feb. 22–23, Charlotte. Juried. For info contact Bonita Heffner, Charlotte Parks and Recreation Department, 1418 Armory Drive, Charlotte, 28204. (704) 336-2584.
Show–Winterfest Art & Craft Show, Feb. 13–16, Asheville Mall. Contact Gail Gomez, High Country Crafters, 46 Haywood St., Asheville, 28801. (704) 254-7547.
Exhibition–Splendors of the New World: Spanish Colonial Masterworks, Feb. 1–Apr. 26. The Mint Museum of Art, 2730 Randolph Rd., Charlotte, 28207. For info call (704) 337-2000.
Workshops–Swiss cooperage, Jan. 6–10; ladderback chairmaking, Jan. 20–24, Mar. 2–6; Windsor chairmaking, Feb. 3–7, Mar. 16–20; advanced Windsor chairmaking, Feb. 17–24. Drew Langsner, instructor. For info, contact Country workshops, 90 Mill Creek Rd., Marshall, 28753. (704) 656-2280.

NORTH DAKOTA: **Show**–The Bismark Woodworking World Show, Jan. 24–26. Bismark Civic Center, Sixth & Sweet Ave., Bismark, 58502. For info call (800) 521-7623.

OHIO: **Workshops**–Doors, Drawers and Panels, Jan. 4; Chests and Cabinets, Feb. 1; Finishes, Mar. 7. Instructor: Earl Richards. Carriage Hill Farm, 7860 Shull Rd., Dayton, 45424. (513) 879-0461.
Exhibition–Awards in the Visual Arts 10, thru Jan. 26. Toledo Museum of Art. Call (202) 357-2700.
Show–The Columbus Woodworking World show, Jan. 10–12. Veteran's Memorial Hall, 300 W. Broad St., Columbus, 43215. For info, contact Woodworking Association of North America: (800) 521-7623, (603) 536-3768.
Classes–Traditional Furniture Building, Jan. 25; Cabinetry strutures and the use of plywood in cabinetmaking, Feb. 22. The Hardwood Store, 1813 Dalton Dr., New Carlisle, 45344. (513) 849-9174.
Show–The Columbus Woodworking World Show, Jan. 10–12. Veteran's Memorial Hall, 300 West Broad St., Columbus, 43215. For info call (800)521-7623.
Convention–111th annual convention and Our Town '92 Lumber and Building Products trade show, Feb. 25–27, Ohio Lumbermen's Association. Holiday Inn Crowne Plaza and Columbus Convention Center, Columbus. For info contact OLA (614) 267-7816.

OKLAHOMA: **Show**–Oklahoma City Woodworking World Show, Jan. 31–Feb. 2. Oklahoma State Fairgrounds, 500 Land Rush St., Oklahoma City, 73147. For info call (800) 521-7623.

OREGON: **Meetings**–Guild of Oregon Woodworkers, third Friday of every month. For location, contact the Guild at PO Box 1866, Portland, 97207. (503) 293-5711.
Show–Woodturning II lathed turned vessels, Mar. 14–Apr. 26. Made in Jefferson Gallery, 3259 Jefferson Scio Dr. S.E., Jefferson, 97352. (503) 327-2543.
Seminars–Furniture Design, Feb. 9 & 16; Introduction to Bowl Turning, Mar. 1; Sculptural Marquetry, Mar. 8. Contact Oregon School of Arts and Crafts, 8245 SW Barnes Rd., Portland, 97225. (503) 297-5544.
Show–Traditional African Crafts, Hoffman Gallery, Feb. 6–Mar. 1. Portland. Contact Oregon School of Arts and Crafts, 8245 SW Barnes Rd., Portland, 97225. (503) 297-5544.
PENNSYLVANIA: **Juried exhibitions**–Re-Awakening: A Celebration of Spring, May 2–June 7; deadline: Jan. 27. Also, Stories: The Narrative Art in Contemporary Crafts, Aug. 8–Sept. 20; deadline: Mar. 2. For more infomation, contact Luckenbach Mill Gallery, 459 Old York Rd, Bethlehem, 18018. (215) 691-0603.
Classes–Windsor chairmaking, all levels, weekly and weekends. For more information, contact Jim Rendi, Philadelphia Windsor Chair Shop, PO Box 67, Earlville, 19519. (215) 689-4717.
Exhibition–Philadelphia Buyers Market, Philadelphia Civic Center, Feb. 21–24. For more info call (800) 43-CRAFT, ext. 214 or 216.
Festival–Central Penn. Festival of the Arts, July 9–12. Juried. Application deadline early March. Call for application Katherine Talcott, Assistant Director, Central PA Festival of the Arts, P.O. Box 1023, State College, 16804. (814) 237-3682.
Seminar–Wood Technology with Dr. Bruce Hoadley. Feb. 20–Mar. 1. Olde Mill Cabinet shoppe, 1660 Camp Betty Washington Rd., York, 17402. (717) 755-8884.
Shows–Market Square Traditional Wholesale Shows. Feb. 8–10, Valley Forge Convention Center, King of Prussia.
Market–20th annual Lancaster designer spring art and craft market, June 6–7. Application deadline Feb. 29. Juried. For application send SASE to Lancaster Designer Craftsmen, P.O. Box 552, Lancaster, 17603. For more info call Pegge Shannon (717) 291-1173 or Lancaster Designer Craftsmen (717) 295-1500.
Competition and show–16th annual Mid-Atlantic Woodcarving Show and Competition, Apr. 4–5. Penn State Abington campus gymnasium, Woodland Rd., Abington. For info call Al Ritter, Show Chairman (215) 757-2152.
Show–Greater Philadelphia Woodworking Show, Jan. 17–19. Sun Center Complex, Auditorium, 63 Concord Rd., Feltonville, 19013. For info call (800) 826-8257.

SOUTH CAROLINA: **Show**–The Columbia Woodworking World Show, Feb. 21–23. Columbia State Fairgrounds, Hampton Building, Columbia, 29202. For info call (800) 521-7623.

TEXAS: **Competition and exhibition**–2nd annual Furniture of the '90s, Aug. 28–Oct. 31. National, juried, art furniture competition co-sponsored by American Society of Furniture Artists (ASOFA) and ASOFA Institute. Entry deadline: May 2. For prospectus, send a SASE to ASOFA, Furniture of the '90s, PO Box 270188, Houston,77277-0188. For more info, contact Adam St. John, executive director, at (713) 660-8855.
Show–The San Antonio Woodworking World Show, Mar. 20–22. Villita Assembly Building, Navarro at Villita, San Antonio, 78296. For info call (800) 521-7623.
Show–6th annual Rio Grande Valley Woodcarvers Inc. show and sale, Jan. 26-27. McAllen Civic Center. For info contact Dorothy Caldwell, PO Box 3824, McAllen, 78502. (512) 631-0422.

VIRGINIA: **Show**–5th annual Norfolk Woodworking World show, Jan. 3–5, Norfolk Scope, corner of St. Paul and Brambleton, Norfolk. For more information, call Woodworking Association of North America at (800) 521-7623, (603) 536-3768.
Exhibition–Spotlight '92, May 8–July 31. Sponsored by Southeast Region of the American Craft Council and Hand Workshop, Virginia Center for the Craft Arts. Entry deadline: Feb. 15. For application or info, contact Spotlight '92, Hand Workshop, 1812 W. Main St., Richmond, 23220. (804) 353-0094.
Show–12th annual Virginia Crafts Festival, Sept. 11–13, Prince William County Fairgrounds. Jurying begins Jan. 13. For info and applications send three loose stamps (NO SASE) to: Deann Verdier, Director, Sugarloaf Mountain Works, Inc., 200 Orchard Ridge Drive, Suite 215, Gaithersburg, MD 20878. (301) 990-1400.
Show–The Norfolk Woodworking World Show, Jan. 3–5, Norfolk Scope, on the corner of St. Paul and Brambleton, Norfolk. For info call (800) 521-7623.

WASHINGTON: **Meetings**–Northwest Woodworkers Guild, last Wednesday of each month. Contact Kirk Kelsey, 744 N. 78th, Seattle, 98103. (206) 789-2142.
Show–Rocking furniture, Gilman Village Gallery, Seattle. For more information, contact Cheryl Peterson (206) 625-0542.
Call for entries–3rd Annual Goblet Show, Feb. and Mar. Write for information to Cheryl Peterson, Northwest Gallery of Fine Woodworking, 216 1st Ave. S, #240, Seattle, 98104.
Show–6th annual juried show & Sale, Kitsap County Woodcarvers Club, June 13–14. Kitsap Mall, Silverdale. For info contact Chuck Malven, 6015 Osprey Circle, Bremerton, 98312.
Workshops–Steam Bending, Jan. 25; Sailmaking, Feb. 8; Pattern making & keels, Feb. 29. Port Townsend. For more information, contact Northwest School of Wooden Boatbuilding, 251 Otto St., Port Townsend, 98368. (206) 385-4948.
Classes–Various classes available. Contact Woodcraft, 5963 Corson Ave. South, Seattle, 98108. For more information, call (206) 767-6394.

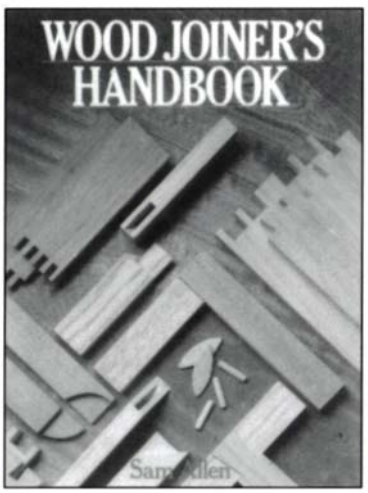
WISCONSIN: **Show**–The Greater Milwaukee Woodworking Show, Jan. 31–Feb 2. MECCA Convention Hall Arena, 500 W. Kilbourn Ave., Milwaukee, 53203. For info call (800) 826-8257.
Festival–20th annual Festival of the Arts, Apr. 12, Interior courtyard of the fine Arts Building at the University of Wisconsin-Stevens Point, Stevens Point. Juried. Application deadline, Jan. 31. For info contact Festival of the Arts, P.O. Box 872, Stevens Point, 54481.

CANADA: **Classes**–Furnituremaking, carving, lathe turning, router and more. Tools 'n Space Woodworking, 338 Catherine St., Victoria, B.C., V9A 3S8. (604) 383-9600.
Meetings–Canadian Woodturners Association meetings, throughout the year. Second Tuesday of each month. Contact Bob Stone, PO Box 8812, Ottawa, Ont., K1G 3J1. (613) 824-2378.
Meetings–Blue Mountain Woodworking Club meetings, throughout the year. Third Wednesday of each month. Contact Glenn Carruthers, PO Box 795, Stayner, Ont., L0M 1S0. (705) 444-1752.
Meetings–West Island Woodturners Club meetings, second Tuesday of each month. Also, woodturning courses. Contact Eric Webb, 61 Devon Rd., Beaconsfield, Que., H9W 4K7. (514) 630-3629.
Meetings–Northern Alberta Woodcrafters Guild meetings, third Thursday, Sept. thru June. Contact Douglas Lobb, 121 Healy Road, Edmonton, Alberta, T6R 1W3. (403) 430-7391.
Workshop–with Michael Fortune, Jan. 17–19. Northern Alberta Woodcrafters Guild. Contact Douglas Lobb, 121 Healy Road, Edmonton, Alberta T6R 1W3. (403) 430-7391.
Show–Beneath the Ice: The Art of the Fish Decoy, Sept. 9–Nov. 4., Kamloops Art Gallery, Kamloops, British Columbia, Canada.
Show–Ontario Wood Show, Mar. 6–8, Lansdowne Park, Ottawa. Contact Cryderman Productions Inc., 136 Thames St., Chatham, Ontario N7L 2Y8. (519) 351-8344.

ENGLAND: **Classes**–Woodworking classes. Smith's Gallery, 56 Earlham St., WC2. Contact Laetitia Powell, Parnham, Beaminster, Dorset, DT8 3NA. (0308) 862204.
Juried show–Nottingham Woodcarving Competition, May 1–2. Entry deadline: March 13. For more info, contact Mr. R. Flint, hon. secretary, Newark & District Woodcarvers Association, (0636) 707020.

TAIWAN: **Show**–Taipei International Furniture show, Feb. 17–21. Taipei World Trade Center Exhibition Hall, 5 Hsinyi Road, Sec. 5, Taipei, Taiwan. (886-2) 725-111.

Wood Joiner's Handbook by Sam Allen. *Sterling Publishing Co., 387 Park Ave. S., New York, N.Y. 10016; 1990. $14.95, paperback; 256 pp.*



The Wood Joiner's Handbook takes a thorough, well-organized look at woodworking joinery. The book is divided into three main sections: joinery fundamentals, advanced techniques, and joinery applications. And, the reader is taken from the most basic joints through final products. Allen assumes that the reader has a good grasp of hand and power tools and how to use them, and only devotes a cursory couple of pages to this area. This is a welcome relief from the numerous simplistic chapters on tools that most books on joinery contain.

Allen divides woodworking joints into six basic categories: butt, miter, rabbet, dado and groove, mortise and tenon, and dovetail. The fundamentals section of the book is concerned with techniques for hand-cutting these joints, as well as joint reinforcements like dowels, splines and biscuits.

The center section of the book, on advanced techniques, goes into greater detail on joint variations and covers machine setups for cutting them. There is a chapter devoted to cutting with dovetail jigs, as well as a section on cutting mortises with hollow-chisel mortisers and a plunge router. Setups for box joints and multiple spline joints are also included.

The last section covers practical applications for the information presented earlier in the book. A good chapter on frame-and-panel joinery emphasizes techniques for coping a frame, as well as various methods of cutting raised panels. Carcase and drawer joinery are covered, including a look at the special requirements of working with plywood and particleboard.

In addition, the book presents Chinese and Japanese joinery, and other specialty joints. Though enjoyable reading, these areas are not covered in enough detail to be very useful in a practical sense.

Throughout the book, special attention is paid to the seasonal movement of wood and dealing with this variable. One of the things I like most about Allen's book is the inclusion of numerous "rules of thumb" for everything from dovetail spacing to tenon thickness and dowel size. This, along with the progression of the book from simple to complex, makes it an excellent choice for novice or intermediate woodworkers. Advanced woodworkers probably have most of this information in their heads already, although it would be a welcome addition to the bookshelf for occasional reference. *—Ben Erickson*

The Marquetry Manual by William A. Lincoln. *Stobart & Son Ltd., 67-73 Worship St., London EC2A 2EL, England; 1989. paperback; 270 pp.*

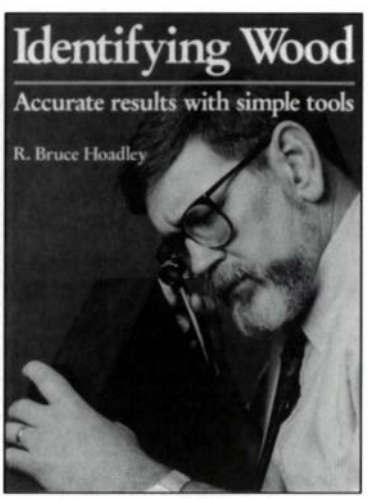
The Marquetry Manual is an extremely informative, well-organized and comprehensive text that presents a wealth of technical and design information on the subject of marquetry. It offers an approach to technique that can be easily understood by beginners, yet allows craftsmen to progress in a sensible way to more advanced areas. The book is organized by chapters that allow advanced or more skilled craftsmen to sort through basic information and focus on more complicated technical issues.

The book starts with several chapters about types of veneers, how they are made, useful characteristics, how they are best used in marquetry, and how they are prepared and flattened. Next, Lincoln discusses tools—what needs to be purchased or what can be made. Many options are given so that an eager reader can begin decorating with marquetry with only a minimal financial investment in hand tools. But Lincoln goes on to advise serious marqueterians which expensive tools are good to purchase, such as fretsaws. Interesting bits of history about how marquetry techniques developed in relation to veneer manufacturing methods and tool evolution are also explained.

One of the nice things about this book is that it encourages the reader. Methods of work are explained very well—all my questions were anticipated and answered—and step-by-step information is meticulously conveyed in clear, precise terms. Lincoln has written a nice introduction suggesting that beginners use kits or line drawing pictures with numbered parts, so that design is not a concern initially, and technique can be honed. But for those who are ready for design, Lincoln also devotes a section of his book to this aspect of the craft, including how to adapt an illustration or photograph and how to create an original design. There are several informative chapters on perspective drawing, composition, color, shadows and reflections, all of which help marquetarians expand their creativity after they have mastered various levels of technique.

The book progresses through marquetry, applied marquetry, parquetry and inlay, explaining the differences and specific methods of work involved. *The Marquetry Manual* also has a selection of some fine contemporary marquetry work, shown in both color and black-and-white photographs. The translation of a drawing or photograph into an assembly of veneers has to be approached knowledgeably and sensitively, and Lincoln offers helpful guidelines to ensure a successful design, both aesthetically and technically. *—Seth Stem*

Identifying Wood by Bruce Hoadley. *The Taunton Press, Inc., 63 S. Main St., PO Box 5506, Newtown, Conn. 06470-5506. 1990. $39.95; 223 pp.*



My strongest reaction to this book is an unshakeable sense of having been cheated. Mind you, it has nothing to do with the book itself or its price, but with the fact that it wasn't in print a quarter of a century ago when I began the laborious study of wood identification.

Like Hoadley's earlier work, *Understanding Wood*, this book is outstanding and destined to become a popular reference among woodworkers. Hoadley has an amazing talent for dissecting intricate topics and expressing them in a clear, novel-like style that is comprehensible even to readers who have little or no training in the field. To be sure, *Identifying Wood* is not what you might call light reading, but it presents a complex, technical subject about as simply as it can be handled.

Hoadley begins with a chapter on the botanical classification of species, then shifts into the meat of the topic with five chapters on the cellular anatomy, physical properties, chemistry and unique features of, first, softwoods and then hardwoods. After providing this general understanding of the structure and diversity of wood tissue, the emphasis turns toward practical application, with three chapters on selecting the necessary equipment and learning the techniques and processes involved in identifying wood. Use of the hand lens for macroanalysis is thoroughly discussed, as is the more certain, but more demanding use of the microscope in microanalysis.

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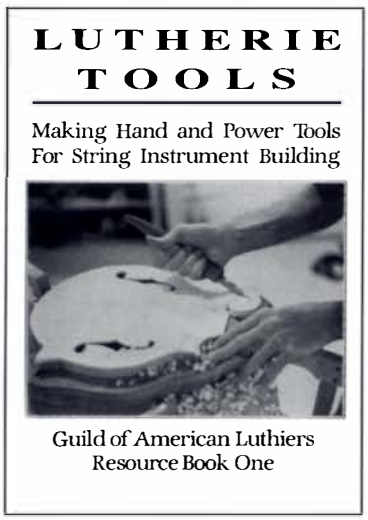
With the reader now versed in the finer points of what to look for and how to go about it, Hoadley offers three very well organized and beautifully illustrated chapters, one on hardwoods, one on softwoods and a third covering some of the more commonly encountered tropical woods. These chapters detail the unique features or individual "signatures" of more than 180 species and in so doing make this book one of the most valuable references I've yet seen on wood identification. In the last chapter, Hoadley loosens up and gets a little chatty with a discourse on the real world utility of wood-identification techniques as they apply to archaeology, antique restoration and civil engineering, providing a pleasant wind down from his more mentor-like approach elsewhere in the book.

The final 40 pages are dedicated to helpful appendices covering some interesting side eddies, such as identifying atypical woods and fibers, chemical analysis and dealing with partially decomposed or altered samples, as well as providing an excellent glossary, a lengthy bibliography and a thorough index. This first edition is marred by the inclusion of an errata sheet, but the errors relate primarily to misplaced or improperly described illustrations rather than significant points in the text. Personally, the book is too valuable a reference to ponder the option of waiting for a corrected second edition. If you really want to get into wood identification, I can't think of a better place to start. *—Jon Arno*

Lutherie Tools: Making Hand and Power Tools for String Instrument Building edited by Tim Olsen and Cyndy Burton. *Guild of American Luthiers, 8222 S. Park Ave., Tacoma, Wash. 98408; 1990. hardback; 122 pp.*



In any aspect of woodworking, whether it be cabinetry, furnituremaking or musical-instrument making, there are tricks of the trade and shop-made accessories devised to facilitate the project at hand. Through the centuries many of these shortcuts and jigs were private property, something that provided an edge over a competitor, or were strictly controlled by trade guild regulation. For example, templates for various musical instruments, a few tools and miscellaneous instrument parts survive from the shop of the great violin maker Antonio Stradivari. However, nothing indicating the day-to-day, smooth operation of his shop survives, and neither does anything definitive about his source of wood and varnishes. Those of us who emulate this master would greatly desire to know those very mundane secrets.

Lutherie Tools is a compendium of contemporary jigs, shortcuts, day-to-day operational techniques and sources of supplies from string musical-instrument makers and repairers, commonly known as luthiers. Through the Guild of American Luthiers, various luthiers over the past fifteen years have freely shared their secrets and ingenious inventions for the furtherance of their craft and the benefit of fellow luthiers.

Lutherie Tools is divided into 10 chapters including: Measuring and Inspection Tools; Bending Irons; Knives, Chisels, Scrapers, and Planes; Clamps, Gluing, and Holding Devises; Routers; Sanding Machines; Bandsaw and Drill Press; Circular Saw; and Two Approaches to Tools. Each section is replete with black-and-white photographs as well as line drawings, many with detailed measurements so that the reader may duplicate the item discussed. Interspersed are full-page photographs showing the workshops of various well-known luthiers. The appendices are comprehensive, including references, sources of supply, a survey of luthiers and a list of further reading on various subjects in *American Lutherie,* the quarterly publication of the Guild of American Luthiers. The surveys of 17 well-known and respected luthiers are particularly interesting since each one discusses his or her main focus as a luthier as well as the hand and power tools they prefer. These luthiers also share some trade secrets such as a list of supplies used as tools, including masking tape, a microscope, dental tinfoil, a computer and beer (for attitude adjustment!). The jigs discussed are clearly explained and range from incredibly simple to quite sophisticated; for example, the construction of a sanding machine for tops, sides and backs is described in detail. Other items discussed include making bridge slot-cutting jigs, an arch-top carving gauge, a miniature tablesaw, specialized instrument clamps and shaping the top of an arch-top guitar with a router.

A quality musical instrument requires that the luthier make not only a beautiful object but also an object that acoustically sounds good. *Lutherie Tools* will help provide the necessary jigs, short cuts, and insights for accomplishing that task. *—Joseph Johnson*

Antique and Collectible Stanley Tools—A Guide to Identity and Value by John Walter. *The Tool Merchant, Box 6471, Akron, Ohio 44312; 1990. $24.95, paperback, 460 pp.*

As both a user and collector of period and antique tools, I'm generally skeptical about tool price guides. I'm always pleased to know the "value" of the tools I happen to own, but I'm usually distressed at the prices I would have to pay for tools I could use in my shop. Price guides bring good and bad news, but in all fairness, I believe they generally have the best intentions.

One of the main reasons that Stanley tools are so "collectible" is that ample documentation is available concerning their production. Many original catalogs and excellent reprints exist illustrating the complete Stanley line, along with original price lists. Because collectors are able to classify and catalog their collections, and note the tools they have and the ones they want, Stanley tools are attractive. Walter's book does little to add to this body of information, except perhaps to consolidate it in one place.

Factors such as rarity, condition and vintage are rightfully discussed in the introduction and also in the tool listings. The average prices given are all retail; they represent what a dealer would be apt to charge, but are far from what he would pay you for that special plane you found at a yard sale. Admittedly, dealers need to make a profit. So, unless you happen to know an avid collector, and he happens to want exactly what you have, expect about 50% of Walter's average price. Indeed, many Stanley items are quite rare and relatively easy to sell, but the vast majority of extant tools are quite common, and sit on tool dealers' shelves for months, if not years, until they wind up being offered at the tail end of an auction. Bargains on these are a boon to the woodworker, but Walter makes no mention of this situation. I was always taught the old horse trader's philosophy: something is only worth what someone is willing to pay.

Nevertheless, it is quite interesting to peruse this guide, if just to see the fantastic stuff Stanley used to make (though you'll be saddened at the decline in production and quality that's come with so-called progress). Knowing approximately what a tool is worth is certainly helpful, and at least you'll lessen the chances of being tricked into selling too low. *—Norm Vandal*

Jon Arno is a wood technologist and consultant in Schaumburg, Ill. Ben Erickson is a furnituremaker in Eutaw, Ala. Joseph Johnson is the museum educator at the Shrine to Music Museum of the University of South Dakota. Seth Stem is a furnituremaker from Providence, R.I. Norm Vandal, a consulting editor to FWW, *is a cabinetmaker in Roxbury, Vt.*

Photo: Valerie Santagto

***This longleaf yellow pine desk** was made from a 400-year-old log felled in the 1880s, which sank and was preserved in the depths of the Suwannee river in Florida. DeWindt's design for the partner's desk was derived from a Nakashima dining table that her client owned.*

Treasures of the deep

The longleaf yellow pine desktop, shown in the photo above, was milled from a log that was preserved for more than 100 years in 50 feet of water. Years ago longleaf yellow pine was the mainstay of the American wood industry. Timbers, joists and flooring were made almost exclusively of longleaf yellow pine. So popular was the wood that it was milled to commercial extinction. Today there are two ways to obtain this rare and beautiful wood: by salvage or by diving deep into the rivers used to transport logs to sawmills. The Suwannee, one of two rivers that drain the vast Okefenokee Swamp, is a slow and wandering river; the kind of river where giant logs could get trapped in a bend. Some of these logs, including the one used in this desk, were so dense that they sank to the bottom, where they were preserved in an airless environment, which was immune from decay and rot.

The tree for this log was already over 300 years old when it was felled by ax in the 1880s. What made the log so unusual was its extremely large diameter and its consistently curly growth from end to end. Even in the rough it looked different from the many logs in the mill yard of the Goodwin Lumber Co., Micanopy, Fla., where it was slabbed into boards and dried.

Inspired by the magnificence of this log and the natural edges of my client's dining room table, built by George Nakashima, I designed the partner's desk shown in the photo. The design places the natural curly wane surfaces edge to edge in the center of the desktop. The top is supported by four drawer boxes, which are mounted on double trestles, and the trestle members incorporate the natural wane outline of the tree. The feet show the original ax marks from when the tree was felled.

Every piece of wood in the desk, which was built by Bob Richardson, Vince Gratta and Trent Edwards of Wood Design in Santa Fe, N.M., was milled from that one log.

—Lila DeWindt, DeWindt & Associates, Santa Fe, N.M.

Woodworking in the family

When the phone call came telling me that my father had died, I was just putting the finishing touches on a letter to him. One of the photographs I was enclosing was of his old tablesaw, a Craftsman of about 1950 vintage. It hadn't been used in 10 years or so when I got it from my brother. He thought I was crazy to lug it home because it didn't work, and he also thought that it couldn't be fixed. But after about 50 hours of patient examination, cleaning, adjusting and rewiring, I cranked it up, and it cut a pine board like a hot knife through butter.

In small-town Vermont, where I grew up in the 1950s and early '60s, woodworking was one of those *guy* things. (I apologize to all the female readers, but that's the way it was.) The men of the family were expected to be able to fix cars, catch fish, shoot animals and make things out of wood. It wasn't necessary to be a master cabinetmaker, but

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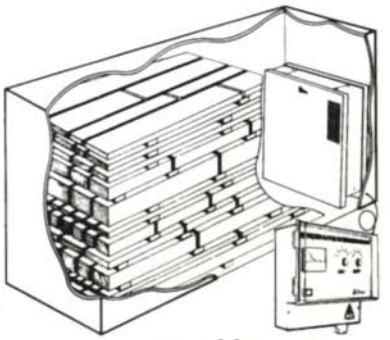

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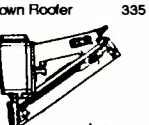

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when it came time to replace a porch step, you didn't pay someone else to do the job.

The societal imperative aside, woodworking was supposed to run in our family. My grandfather was widely acknowledged as one of the best around. He worked almost entirely by hand, with tools generally dating from the early 1900s. It wasn't that he didn't like power tools; I think he just wanted to enjoy each project as long as possible. And what incredible projects they were! He had a habit of just showing up at one of the relative's houses with his latest work (he gave away everything he made), and it was always something the recipient would scramble to make room for. His last and best efforts were the grandfather clocks he made for all his children and married grandchildren. He didn't build them from kits or drawings; he made his own patterns by scaling up photographs he had seen in a furniture catalogue.

My father was more utilitarian. He cranked out the usual plywood bookshelves, storage cabinets and toolboxes for the back of the station wagon, but he made these so well that they are still around our various houses and doing their jobs. Around town he was considered to be a pretty good carpenter.

He worked in a cavernous, two-level shed with a loft that was attached to the back of the house. That shed still comes to mind every time I smell sawdust. There resided the aforementioned tablesaw and all the other mysterious and dangerous tools. Like all kids, I wasn't allowed to touch any of the good stuff, but if I nagged enough I would get a hammer, some nails and some scrapwood to whack together into a vague approximation of a boat. That was the extent of my childhood woodworking education—probably because I never asked to learn more. I just wasn't very interested.

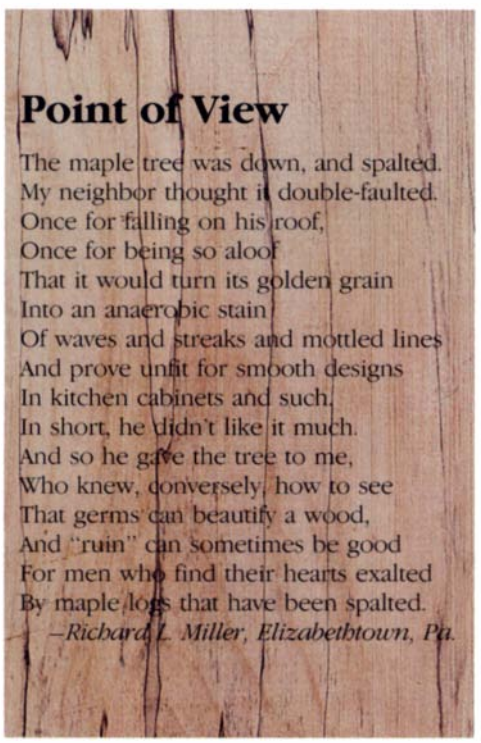
I became interested real fast, though, when I got divorced and moved into an empty house with an empty bank account. Although I was able to get along with just a rolltop desk and a set of bookshelves at first, I knew that eventually I would need more furniture. I had two choices: Head over to Goodwill to pursue bargains in the used furniture department, or buy some wood and basic tools for about the same amount of money and hope that my heritage and a few library books would provide the rest.

Well, I don't know if it was genetics or necessity that did it, but I now have a houseful of furniture that I made myself. As I look at each piece chronologically, I can see the improvement in skill, design and technique. Coming late to woodworking doesn't mean you can't learn quickly. And, of course, each new project provided a handy excuse to buy a new tool and learn how to use it. There are still a few spaces left in the house that I fill with shopmade projects. I'm even thinking about making a new sofa, if I can learn how to do the upholstery, and, of course, that will mean another trip to the tool store. But I won't need to buy a new tablesaw.

I kept asking my father to come to the house so he could see my furniture and how I had fixed up his saw as good as new, but he never made it. He probably figured he'd have time to do it later, as we all do.

I wish he had, though, because every time I complete a project, the child within wants to say what I said to him so long ago, holding up that ridiculous boat made of pine scraps and nails, "Hey, Dad, look what I made!"

—Colin Goff, North Branford, Conn.



Tools by telephone

The National Tool Trader is a subscription service offered by TRG Enterprises, Inc., Joliet, Ill., which allows members to buy and sell tools, materials and related items anywhere in the country via telephone. Membership is $15 a year, and the cost to place an ad is $3 plus $1 per minute access fee. (TRG accepts only Visa or MasterCard.) Typical access times are from two to three minutes, so placing an ad usually costs $5 to $6. The operator who answers the phone can help you place the ad, which can remain on the service for one year. When buying an item, you pay just the $1 per minute access fee while the operator searches the data base for the item you want.

The president of TRG, Anthony Taves, said that currently more than 23,000 tools are listed in the database, 70% of the listings are home-shop quality tools and the balance is industrial equipment. To keep the access fees to a minimum, it's best to be very specific about the piece of equipment you want; tell the operator the type, size, power (110v, 220v, 3 phase, etc.), dollar limits and any other requirements you may have. You can also specify an area of the country or state. For large ticket items, TRG will act as an escrow agent, holding payment until the purchaser has a chance to see the equipment.

For more information or a subscription to the National Tool Trader, call (815) 727-2400.

—Charley Robinson

Woodworkers' Forum on CompuServe

CompuServe is an electronic bulletin board that's available to computer users via a telephone modem. Subscribers to CompuServe can exchange information, keep abreast of the news, buy and sell stuff or research topics across a broad spectrum of interest, including woodworking.

CompuServe's woodworkers' forum provides access to a library of files on a variety of woodworking topics. The last time I logged on to the service, I downloaded a file that reports the best in woodworking books. Another file helped to clear up some common misconceptions about tablesaws. It's not just one-way communication, either. You can upload any information that you have just as easily as you download. (I know because I just uploaded the "Events" calendar from this issue of *Fine Woodworking*. And I'll upload subsequent issues as well.) Have a look, there's probably something in the library that will interest you, and I know that one of you is hoarding that widget I need for my Oliver bandsaw.

If you want to subscribe to CompuServe, you need a phone line, a computer and a modem. For more information, call CompuServe at (614) 457-8600, and drop me a note at 71141,552 when you get online. I'd love to swap lies with you.

—Andy Schultz, associate editor, FWW *Books*

Product reviews

PC Index to Fine Woodworking, *Meredith Associates, PO Box 792, Westford, Mass. 01886-0792*; (800) 831-3200

Anyone who's ever spent an evening sifting through a pile of old *FWW* magazines looking for a vaguely remembered article will welcome this new computer software. The "PC Index of *Fine Woodworking*" program ($29.95) provides a listing of all *Fine Woodworking* articles and departments (such as "Letters," "Q&A" and "Notes and Comment") as well as cross references to all *Fine Woodworking* books containing article re-

Photo: Charley Robinson

prints including: *Techniques, The Best of Fine Woodworking...*, and *Fine Woodworking on...*. The program, which comes on two diskettes, is designed to run on an IBM PC or compatible computer with at least 512K of memory. "PC Index" allows you to quickly access the table of contents of any issue of *Fine Woodworking* by typing in the issue number. Further, the index will indicate if an article has been reprinted in a *FWW* book and allow the table of contents of the book to be reviewed. "PC Index" also has a search function that will find, assemble and print a list of all magazine entries that contain a key word. One of the best features of the program lies in its ability to be updated by the user—a welcome alternative to many programs that require waiting and paying for the software developer's update.

Starting and running the program is made easy by on-screen prompts and an excellent manual. But I wish that I had a faster, more powerful computer; it took my antiquated PC several minutes to do a search that found a dozen articles. But that's a wink of the eye compared to the time it would have taken to find them the old-fashioned way!

—Sandor Nagyszalanczy

Shark Saws, *Takagi Tools, Inc., PO Box 14355, Torrance, Cal. 90503*

I recently received five Japanese handsaws made by Takagi Tools, Inc. for evaluation. Like all Japanese handsaws, these saws cut on the pull stroke. This means the blade is in tension when it's cutting, so it can be thinner and thus more flexible than its Western equivalent, which is pushed through the cut. The thinner blade produces a smaller kerf and requires less effort to make the same cut than a saw with a stouter blade. A professional-quality Japanese saw is flexible indeed, which can be difficult to control without practice. However, the saws from Takagi Tools had blades that are on average 50% thicker than their more traditional Japanese counterparts. The less experienced woodworker may welcome this increased rigidity.

On the cardboard protective jacket, which came with each saw, the manufacturer states that the saws can be used for both ripping and crosscutting. While I suppose one can make a saw do anything, I found this statement misleading since none of the saws I received came with teeth suitable for ripcuts.

Photo: Charley Robinson

***The Shark Saw** series from Takagi Tools, Inc. are reasonably priced Japanese-style, pull-stroke saws. The replaceable blades eliminate the need for sharpening.*

In the United States, one drawback to using traditional Japanese saws is the difficulty of finding someone to sharpen them. Because of this problem, the greatest advantage of the Takagi saws is the blades are replaceable. The blades, which range in price from $15 to $19, are removed by simply depressing a button on the handle. On several of the saws I found this mechanism had play in it; while this did not seem to affect the saws performance, the rattling was disconcerting.

The offset, black plastic handle on all but one of the saws (shown in the bottom left photo) proved to be the greatest departure from the traditional Japanese tool. The handle is a cross between the D-handle of a Western-style saw and the long, straight wooden handle of a Japanese saw. Because I am used to a traditional Japanese handle, I found this new configuration to be the saw's biggest drawback. The hand's position is more or less dictated; it's fixed in a certain position and distance from the blade. This would be okay if all cuts had the same requirements in speed, power, accuracy, angle, depth and position of stock and body, but I have always appreciated the variety of grips possible with a long, straight traditional handle. With a straight handle you can hold close to the blade, far away from it or anywhere in between; you can use two hands by placing one hand behind the other; or you can adjust the angle of the saw, rotating the handle in the palm instead of awkwardly cocking the wrist. In addition, on a hot and humid day, the plastic handle became slippery, and even though I could still adequately grip it, I had a certain loss of feeling for the tool. Under the same conditions, an unfinished, porous wooden handle fares much better than plastic.

In summary, I would characterize the saws as a Western version of a traditional Japanese tool, designed specifically for the American market. If, as a woodworker, you have learned to exploit the qualities of a professional-quality traditional Japanese saw, you will find these saws cumbersome and unsuited for critical work. For those of you who have found traditional Japanese saws difficult to control or too fragile, the compromise these saws offer may be welcome. Takagi saws range in price from $21 to $26 and are available from selected home improvement centers, or they can be mail ordered from C. R. S., Inc, PO Box 4567, Spokane, Wash. 99202-0567.

—Carl Swensson, Timonium, Md.

"April Fools' Library Ladder"

I titled the library ladder, shown in the photo at right, "April Fools' Library Ladder" because it was conceived on April 1. When an interior designer rejected my original idea for a rustic, heavy-timbered library ladder, she asked what else I had. Without hesitation I blurted out, "something with geometric shapes and bright colors!" I didn't have anything in particular in mind, but I had been playing around with these themes in some other work. Fortunately, the idea appealed to her client, and after receiving approval of a clay model, I began to build the 48-in.-wide by 36-in.-deep ladder that would stretch 104 in. to the tip of the pencil's eraser. The pencil wasn't a part of the original plans; it was an afterthought that just seemed natural in a library setting.

The green base and the blue pyramid are made of ash stained with aniline dye and then lacquered. I covered a turned foam core with fiberglass and then sprayed it with auto lacquer to form the red sphere. After shaping two pieces of maple, I glued them around a 2-in.-dia. steel tube to make the pencil. The entire unit is supported on 6-in.-dia. casters for mobility. Four fluorescent black lights under the base and a neon light under the pyramid add real pizzazz to the overall effect of the ladder.

—Michael Bright, St. Petersburg, Fla.

Photo: Frank Baptie

***This flamboyant library ladder is also functional.** A welded steel frame provides stability, and the 7-ft.-long pencil lends support when reaching for an upper shelf.*

Fine WoodWorking

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Woodworking: For love or money?

Recently I've seen several letters to the editor in *FWW* about the pros and cons of working with wood for a living. Doing for money what you already do for the love of it certainly sounds appealing. But it's the goal of many and the reward of few.

After more than 20 years of working at woodworking, I'm still discovering just what it takes to turn a wonderful avocation into a sustaining occupation. But in the beginning, I had to ask myself some major questions (and there were more I should have asked) before I felt I could make the plunge into self-employment.

If you're at this stage, you might find it helpful to take the following test, rating your answers on a scale of 1 to 10. Each question includes a brief explanation to help you give an informed and honest answer.

1. **Do I love woodworking well enough to do it all day, everyday (and in my sleep too)?** *For the self-employed, there are few, if any, holidays; no, and I mean no, paid vacations; and there is no such thing as an eight-hour workday.* _____

2. **Can I live with working man's wages?** *An established custom woodworker makes a little better wage than the janitor at the local high school, but not nearly as much as the backhoe operator gleefully excavating the neighbor's defunct septic system.* _____

3. **How much do I hate working for the "pharoah"?** *One of the greatest attractions (and addictions) of self-employment is the indescribable joy of working without the glowering presence of a boss (the pharoah reincarnate). But for an artist/craftsperson to really make the commitment to self-employment, the importance of this freedom must be no small thing.* _____

4. **How much will I likely hate working for myself?** *The successful entrepreneur must be his own "boss from hell." Instead of sleeping in, you'll need to boot yourself out of bed headlong into your tablesaw. When you want to catch the season finale of* L.A. Law, *you'll be dragging yourself to a client's house to collect a deposit so you can eat for the next month.* _____

5. **I'm pretty organized, but can I really handle doing three things at once?** *Do you think you can simultaneously run molding stock through the shaper, remember which client had to be called before noon and mull over a design decision? All that and ending the day with five fingers on each hand.* _____

6. **How much do I enjoy working alone?** *Do you really like to spend a lot of time without any social contact? You won't be able to hire anyone, at least not right away. And don't count on your spouse. (Remember the boss from hell back in question 4?)* _____

7. **Can I afford to live for at least six months with a neutral, or perhaps negative, cash flow?** *A very important question. Those first months will likely see more money going out than coming in, even if you've already paid for all your tools before you jump in full time. The best you can hope for at first is to break even.* _____

8. **Do I have access to a shop suited to commercial woodworking?** *Base this answer on the amount of overhead a shop at least the size of a two-car garage is going to set you back. Owning a garage where you can legally and practically do commercial work scores a 10; renting a space that will cost you a week's wages and requires a one-hour commute scores less than 5.* _____

9. **What are the chances that people in my community will appreciate custom woodworking enough to pay for it?** *The heck with appreciation. Are there people out there who will buy your work? Give this question some serious thought. If you live in a rural area, expensive fine furniture, or even custom kitchen cabinetry, may be as "local as a fish in a tree."* _____

10. **Do I believe that doing woodworking for money is a form of prostitution?** *Introducing the element of commerce into our happy little world of aromatic wood shavings and sweetly sharpened edge tools is like opening Pandora's box. It's a lousy box, too; it's badly fitted, poorly finished and of poor design, to say nothing of the demons inside. Knowing how money corrupts, can you keep it from tainting your joy of woodworking? No cheating on this one.* _____

Total: _____

Drawing: Bob Kato

Scoring

80 to 100: Go for it!

60 to 79: Go for it anyway. You're probably just more honest than those who scored over 80.

59 and below: Give this career move a little more serious thought. □

Jim Tolpin is the author of Working at Woodworking, *published by The Taunton Press, 63 S. Main Street, PO Box 5506, Newtown, Conn. 06470-5506.*

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, ***PO Box 5506, Newtown, Conn. 06470-5506.***

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BW-612PVG

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*U.S.A. motors.

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PBS-740 PBS-540 PBS-440

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READER SERVICE NO. 161

Photos: Sandor Nagyszalanczy

BLOCK PARTY IN BOMBÉ

Creating a wrap-around pattern of illusory blocks on the undulating surface of a bombé chest was a challenge for Elliot Price, a Tucson, Ariz., furnituremaker who spent 400 hours building the piece. The curvaceous front and sides are laminated $\frac{1}{8}$-in. poplar plywood and kerf-bent $\frac{1}{4}$-in. hardboard over a ribbed inner box. Price transferred the parquetry by taping drawings to the chest and punching through each line intersection with a pencil. The veneers—African mahogany, cherry and red elm—share a reddish hue, yet provide contrast to give the pattern depth. Before cutting out the 850 pieces, Price ironed a special heat-setting adhesive film to the veneer. He then ironed the pieces onto the chest individually, using pencil marks to align them before rubbing them down with a rounded wooden block. He averaged eight pieces an hour.