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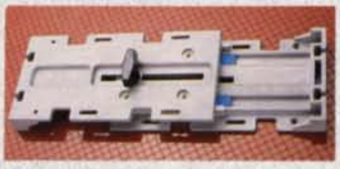

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Fine WoodWorking

March/April 1990

*Mark Duginske uses a dollar bill to gauge the tightness of a joint made with his simple mortise-and-tenon system on p. 46. Cover: Terry Moore finishes a chair he built using a series of jigs (article on p. 40).*

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## DEPARTMENTS



## ARTICLES



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**In Memory of**
**Roland Wolf 1946-1989**

Roland Wolf, art director of *Fine Woodworking* and creator of much of the finest artwork we've published in the last seven years, died last December, following an apparent heart attack. We will all miss his extraordinary talent, his good humor and his friendship. In gratitude for all he shared with us and the readers over the years, we dedicate this issue, the last one he worked on, to him.

*–The staff of Fine Woodworking*

**Ripping off designs**–They say imitation is a form of flattery. Since you published my article on my tambour boxes (*FWW* #75), I have been flattered by a number of amateur woodworkers who have contacted me to let me know how much pleasure they've had imitating my boxes for their loved ones.

I've also been offended by a few would-be-professionals who have tried to pick my brain to put my design into production. These boxes are a big part of my income and fetch an excellent price, based on originality of design and a fine finish. I published those plans to share an idea I was proud of and enjoyed and to be an inspiration to my peers. I didn't expect my idea to be ripped off by small-time operators without the gumption or intelligence to find their own marketable ideas.

*–Jamie Russell, Saskatoon, Canada*

**In defense of Norm Abrams**–Having read the article criticizing Norm Abrams and *The New Yankee Workshop* in the November/December issue (*FWW* #79), I feel a rebuttal is definitely in order. Here is a man that has given each of us a lift. I'm tired of turning on the tube and seeing the same old junk on every channel. I'm certain that an awful lot of guys out there like me can't wait until Norm comes on. From the guys I talk to, they all say the same thing–he is a heck of a nice guy. The author of the review, John McAlevey, is right in one way–he *is* a carpenter, but I didn't see anybody else come on television that does it any better. Until Norm came on, the average wood butcher had nothing.

It's easy to look over someone's shoulder to make corrections. And I feel he was really given a cheap shot. He only has 30 minutes to show you something. Yes, he may slop the glue on fast at times, but he has to work fast. It goes without saying that when *you* are doing it, the thing will be done slower and with a little more care.

I can't wait for him to come on television. Yes, you could say there are an awful lot of esoteric furniture builders out there who will look down on him. And most of them are thinking about the money he is making with the show and his tapes, and that is possibly what hurts most of these pros. I can't speak for everybody, but I get sick and tired of hearing "put on your safety glasses," "put on your ear muffs," "don't get near the blade" and all the rest of it. Your God-given sense should have told you that to start with. If people are that dumb that they have to be prodded into every little move, then they shouldn't be working wood to start with. And as far as criticizing him for using power tools for everything, I like it that way. At 57 years old and riddled with arthritis in the hands, I don't find woodworking easy. Power tools help me a lot. Besides, I don't expect to be building furniture at [Colonial] Williamsburg. I can do many things by hand, but come on, it's a real drag. Just look at what these dovetail jigs can do. When I build something, I want to finish it sometime this year. The only thing missing in the show is a big lazy pooch laying on the floor. I love the show, I can almost smell the sawdust from here.

*–John McDonnell, Hawthorne, N.J.*

**A Southerner joins with a Yankee**–Norm Abrams presents his version of furniture pieces that can be used in the modern home yet reflect something of the past. I have some old cabinets in an old shop that are better looking than the old Shaker pieces on the program, yet I would not put them in my house or present them to a friend. I am a real amateur at woodworking and I can understand the pride of completing a reproduction of fine furniture. This is not what the program is about. The program is about building presentable pieces of furniture in the home workshop. I think he does an outstanding job of presenting the projects. I have learned many things in the five or six programs I have watched. Norm is not trying to give a safety lesson on each program, even though there are imprints on the screen when guards are removed. As a woodworker that has numerous pieces of power equipment, I think it is *my* responsibility to learn to use the equipment safely. If I don't, then I'm the fool. I notice that Norm has all his fingers, seemingly good eyesight and hearing, plus I do not see any major scars. I think to be a master carpenter and to be Norm's age is a major accomplishment, so he must be a pretty safe guy.

I have not met Norm, but I would like to. I feel that he is a down-to-earth person who enjoys his work and enjoys contributing his knowledge to us–a bunch of amateurs. This is unusual and very nice in this day and time. Another thing–this is the age of power tools. Thanks Norm for helping me build things with them that I didn't have the knowledge to build before.

*–Robert D. Walton, Mansfield, La.*

**Norm a great teacher**–Norm is a great teacher. He allows a wonderful, rich pathway to inspire and motivate young people with the "you-can-do-it" attitude. You have to pay your dues at your craft and you have to start somewhere.

The book and video have excellent production values; the projects are interesting and the techniques are wonderful.

John McAlevey's reference to too much use of power tools is ridiculous. Chippendale and Sheraton would have used power equipment for their production work if available at the time. There is an old saying: "Principles are easier on a full belly." The idea we must be "intrinsically pure" and use a chisel/mallet and handsaw is a little naive!

*–Nicholas Tyler, Manotick, Ont., Canada*

**The high cost of custom work**–I very much appreciated Douglas Schroeder sharing his experiences in "Handling Large Commissions" (*FWW* #78), but I do find one thing very distress-

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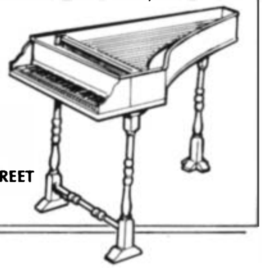

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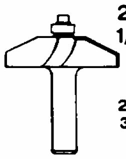

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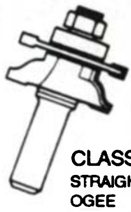

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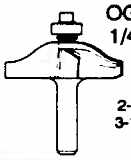

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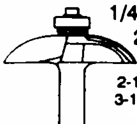

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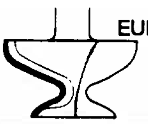

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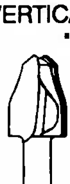

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ing. The client paid a total of $74,000 and Mr. Schroeder said there was no real profit! I am not trying to put down Mr. Schroeder's work; from what I could see in the photographs, the pieces are extremely well made. He goes on to explain costs and reasons, but as someone trying to get his furniture business off the ground, I see a very disturbing trend in the custom, handmade, one-off, etc. furniture market. More and more I see what I consider atrocious prices for furniture that appears to be made for everyday use. We all need to receive a fair price for our work, but $7,600 for a hall table or $2,600 for one dining room chair ("Gallery Fair," *FWW* #68) seems a bit out of line.

One of the largest stumbling blocks I have run into is when someone has seen some of my work and automatically thinks it is unaffordable because the piece is "handmade or custom."

Almost all of my work is in the Shaker style: simple, honest, solidly built and what I consider a very good value. I work entirely with hand tools in a very small shop, and my prices are competitive with the finer furniture stores and I offer a better made and finished product; but what is even harder to compete with is the preconceived notion by the public of how much a piece of handmade furniture should sell for.

There will always be people willing to pay astronomical prices for everyday things and there are people who want mass-produced junk for next to nothing, but somewhere there has to be a middle ground. Custom furnituremakers can supply a quality product for a fair price. *—Tony Konovaloff, Tahoe Paradise, Cal.*

**Another limed finish**—I enjoyed Michael Dresdner's article on "Creating a Limed Finish" (*FWW* #79), but I'd like to suggest another way to apply the white wash. I've been buying a water-base pigment called Hydrocote White Pickling Stain from the Hydrocote Supply Co. here in Pennsylvania (215-453-8663). It goes on easily, gives you a comfortable working time and wipes smoothly. Best of all, because it's water based, you can rework the material even after it has dried, without resorting to sandpaper or steel wool, simply by using a damp rag. On raw wood it dives into the pores beautifully, and on sealed wood it works indefinitely without "biting into" the finish. I've used it with no compatibility problems with lacquer, varnish and polyurethane, as well as Hydrocote's water-base lacquer. *— Steve Mutek, Kresgeville, Pa.*

**Hazard of drilling brass or copper**—After reading the article on "Metalworking in the Woodshop" by Roger Heitzman (*FWW* #79), I was surprised that no mention was made of the hazard of drilling brass or copper with a twist drill without first grinding a small vertical band on the cutting lips of the twist drill. Neglecting this can cause the drill bit to "grab" into the metal and this can snap a small drill; if a large drill is being used, it can wrench the work free to spin violently on the drill bit.

Drills for rolled brass or cast brass should be so treated. Most of the bronzes, when bored, produce a curled shaving like steel and they can be safely drilled with a bit sharpened in the usual manner.

In this article, mention also should have been made of securely bolting the metal to the drill press table with the work against the drill press column to prevent rotation, or if in a vise, that too should be securely fastened to the drill table.

A good safety precaution—I find that when using the slower speeds for metal, a slackened V-belt allows the belt to slip if the drill bit is overloaded. *—D.M. Thomson, Vancouver, B.C., Canada*

**Dangers of sawing aluminum**—I'd like to back up Roger Heitzman's admonitions about cutting aluminum in *FWW* #79. In 15 years of working with power saws on a daily basis, the closest call I've ever had came from cutting this metal.

I was cutting a fairly heavy 3x3 aluminum angle on my miter box, using one of those four-tooth-plus-raker carbide combination blades. This type of blade has a deep gullet in front of the raker for good sawdust removal. Well, the angled stock must have gotten caught in one of those gullets because all of a sudden the machine fairly exploded. Not only were several teeth ripped off the blade, but the fence was struck with such impact that the ⅜-in. cap screws bolting it down were ripped out of the bed of the machine, breaking out a good-size chunk of the aluminum bed casting in the process. I don't know where my hands were while all this was going on, but to my astonishment I counted 10 good digits in the aftermath. Any regret I might have had about the loss of $250 in equipment was overshadowed by my joy at still having a left hand.

The only blade I will now use to cut aluminum is one of those old-fashioned steel plywood-cutting blades with hundreds of little teeth. Most woodcutting blades, with their positive hook and deep gullets, are just too dangerous for the job.

*—Scott McBride, Irvington, N.Y.*

**Help for allergies**—This is in reference to the letter by Lane Jonah regarding "allergies and woodworking" (*FWW* #79). I am writing as a medical doctor, a patient with allergies and a woodturner.

The best doctor to see for such a problem is obviously an allergist, who will ask a rather long list of questions to zero in on the type of allergy tests a person will need. Skin testing can readily tell what a person is allergic to.

If one wants to work with something they are allergic to, then one of the best ways to deal with that is to undergo desensitization (allergy shots). With properly directed treatment and precautions, a high percentage of patients can resume woodworking.

A woodworker may not be allergic to pine or maple, but if a person is highly sensitized, a non-specific reaction to any dust particles can result. An ordinary dust mask is not good enough to remove allergens. *—Dr. Vijay K. Dixit, Mt. Clemens, Mich.*

**Preventing rust on cast iron**—In *FWW* #79, Rich Preiss suggests the regular use of carnuba wax to prevent rust on cast-iron tool surfaces. I find no fault with that. If people have trouble finding that wax, though, they might try plain clear paste shoe polish wax, which is available at any supermarket. I've used it for years and it's tough and long wearing.

Incidentally, if your planer ever hesitates while self-feeding, a quick coat of shoe polish applied to the bed—with the machine unplugged of course—will instantly remedy that problem in most cases. The only machine surface I *do not* wax is the drill press table; there I do not want the work to slip.

And you might try waxing the sole of your handplanes. They just glide over the work when waxed. If the supermarket does not have clear shoe polish, get light tan. It's a *hard* polish and *none* of it will show up on your work. *—Tim Hanson, Indianapolis, Ind.*

**Praise for pine**—I really enjoyed the article on pine (*FWW* #79). Of all the furniture I have made and admired in the past, my favorite pieces have been pine. Many furnituremakers avoid using pine because it gums up blades, cutters and sandpaper faster than the more popular furniture materials. Mahogany, oak, walnut and cherry have taken the spotlight in the furniture business mainly because these woods are "easy to please." Pine needs to be handled very carefully to obtain a furniture-quality appearance.

Since pine is a fast-growing wood, we should be using it for replacement cabinet material instead of tropical varieties that will soon become hard to obtain due to the deforestation problem we are faced with worldwide.

*—Peter B. Rock, Mt. Pleasant, S.C.*

**No substitute for good joinery**—Christian Becksvoort's article on gluing up panels in *FWW* #79, p. 68 is most appropriate reading for all woodworkers. In our efforts to complete work, we sometimes forget some of the fundamental rules that greatly in-

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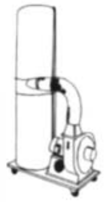
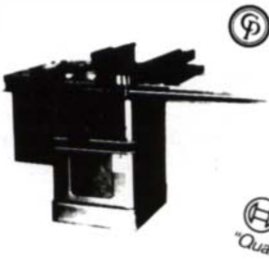

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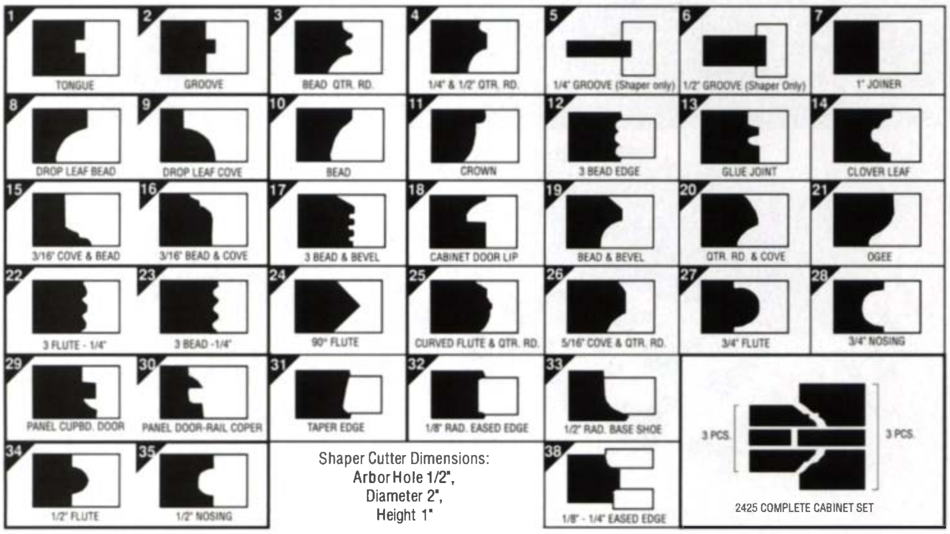


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crease the beauty and structural integrity of large panel glue-ups.

A well-executed edge joint is without question "more than adequate" for panels. However, I have found that in working alone, the "third hand" is very helpful at times. I routinely use plate joinery as an aid in handling large glue-ups. I do not view this as a compromise; only that "third hand."

One word of caution, though. If you choose to use plates, set the plate joiner depth as deep as possible. I experienced what could be termed as "biscuit draw." After jointing, inserting plates, gluing up and finishing a 32-in. by 96-in., four-board walnut tabletop, my customer noticed "dimples" throughout the surface. What I found were perfect impressions of the "biscuits" along each joint. I can only surmise that the depth of the cutter was too shallow and that the extra amount of glue at each plate pulled the surface toward the plate. *—Randall Grace, Franklin, Tenn.*

**A call for more basic information**—Every issue's crop of "Letters" must bring you new insights to the diversity and temperament of your readership.

In *FWW* #79, we find a gentleman who feels *FWW* should devote more space to working with plastics and mica. Fair enough. But he wants you to do so at the expense of another story on machine adjustment or, perhaps, some basic joinery.

Hear a voice from another precinct. You can never publish too many stories on basic woodworking operations and tools. Each one I have read contains some nugget of new information that broadens my knowledge of the subject. Sometimes the new information contradicts the old, other times it explains and amplifies it. Inquiring minds welcome that kind of stimulation.

By all means, give the gentleman a piece on plastics or mica. But don't think twice about another explanation of dovetailing, edge jointing or tuning up a bandsaw. Somebody out there has a new or different wrinkle on these matters and I want to read about it.
*—Robert W. Smith, Jr., Slidell, La.*

**Ban letters on ecological issues**—Although I am not a proponent of the deforestation of exotic lands or the harvesting of ivory, I must state that I feel space in your "Letters" column could be better used than as a forum for protest. Ecological issues, important as they are, are not the reason I take *FWW*.

I am sure the readership knows fully well about the travesty and rape of our planet. Those that use these materials will continue to do so regardless of "angry letters."

Let's remember that materials used by the trade are a small percentage of what is used by others. *—L.R. Pastukiw, Eldson, Tenn.*

**How far can ban mentality go?**—It is unfortunate that the "ban" mentality has now hit the "Letters" column. Following

**Erratum**

In *FWW* #80, we ran a letter from Lee Valley Tools Ltd., in which the company President Leonard Lee tried to correct an error that had appeared in an ad for the company's Stone Pond sharpening aid. Unfortunately, because of an editing error, the letter was printed incorrectly. We apologize for the error and would like to clear the record concerning the flatness of the tempered glass lapping plate. The ad indicated the flatness as plus or minus .001 in. It should have read .010 in. For further information, contact Mark Williams at Lee Valley Tools Ltd., 1080 Morrison Drive, Ottawa, Ont., Canada K2H 8K7; (613) 596-0350.


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the "logic" of the letter to ban ivory from the pages of *FWW*, it would follow suit to ban scrimshaw, mother-of-pearl inlay, leather work and actually most of the woods we now use. We then could use synthetic materials which are highly energy intensive, thus wasting our non-renewable resources and creating infinitely more pollution.

Hiding ivory objects from view will not stop the poaching that threatens the elephant herds. We need to encourage our legislators to pressure foreign governments to increase their anti-poaching efforts. Only after the elephant population can be returned fully to legitimate game management can we expect a steady supply of ivory and the healthiest possible elephant herds. This generally holds true for any type of natural resource, flora and fauna.

I applaud *FWW* for the wide-ranging coverage of the many facets of woodworking. *—Larry Hokenson, Isanti, Minn.*

**Hog-tusk inlay**—In recent issues, you have had several readers suggest that the use of ivory should be banned. I'd like to point out that ivory does not have to come from endangered species such as elephants and whales. Ivory is, by definition, dentine. An excellent source for this material is the tusk of the domestic hog. These tusks are often 2½ in. long and an inch broad at the base. They are readily available from rock shops that specialize in materials for lapidary work. The tusks also don't cost a month's salary. The last ones I bought were about 25 cents each.

You can also assemble larger inlays from the hog tusks by cementing smaller slices of the material together with the clear epoxy sold by the rock shops for setting gem stones. I use a material called epoxy 330, which makes an invisible joint. It seems to me that as long as we have sausage and bacon for breakfast and pork chops for dinner, we will have a continuous supply of material for fine inlays.

*—James L. Ennenga, Omaha, Neb.*

**A perfect piece of cabinetry**—We were *very* impressed by the back cover of your November/December issue. We always check the back cover first anyway—it's one of the most interesting pages in the magazine!

"Shall We Dance" is the most perfect piece of cabinetry we've seen. Closed, it sways alluringly to the right, ready to swoop around the floor; open, it has just as much sense of movement. We heard the lighthearted music of a '30s Astaire film as we looked at the pictures. Hank Hölzer has even captured the humor of Astaire in the bow tie pulls.

Thank you for a moment of aesthetic pleasure and nostalgia. We agree with the Art Deco furnituremakers that it is an art to make furniture and that the people who do it are sculpting space in creating finely detailed, beautiful forms.

*—Dan Everett and Jocelyn Paine, Anchorage, Alaska*

**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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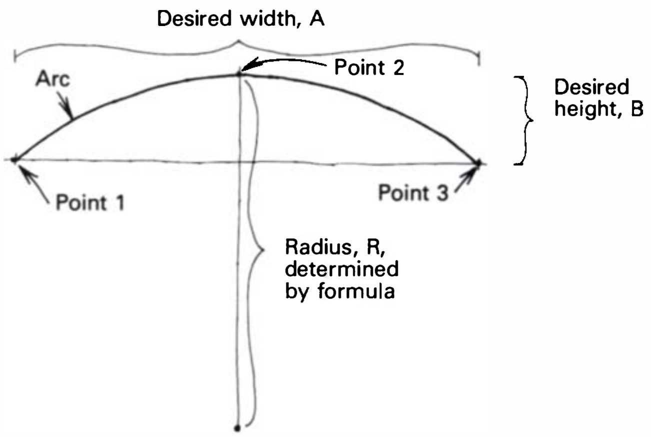
## Calculating the radius of an arc




Quite often, when designing a curved cabinet or tabletop, you need to determine the radius of an arc that will give you a specific amount of convexity (height of arc) and also fit within a specified width. Here's a formula for calculating the radius of an arc that must pass through three predetermined points. With it you can find the radius (R) from the desired width (A) and height (B) as defined by the three points, shown above. The formula is:

$$\frac{\left(\frac{A}{2}\right)^2 + B^2}{2B} = R$$

For example, to find the radius of an arc that is 12 in. wide and 2 in. high, let A = 12 and B = 2. Then:

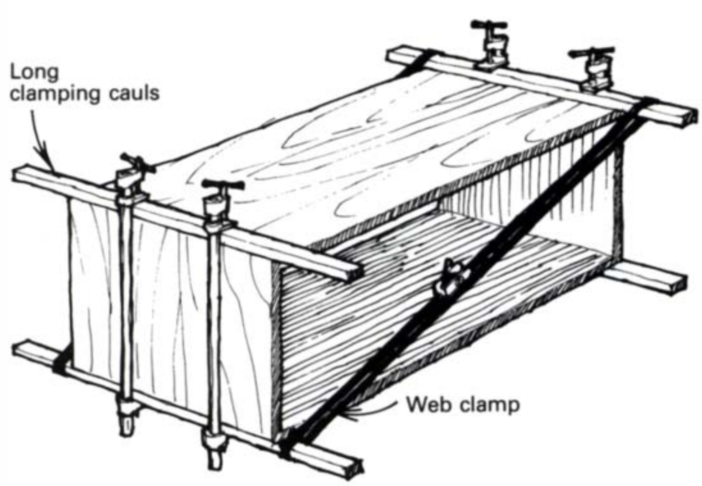
$$R = \frac{\left(\frac{12}{2}\right)^2 + 2^2}{2 \times 2}$$

$$R = \left(\frac{36 + 4}{4}\right)$$

Finally, R = 10. The arc's radius is 10 in.

*—Barrie Graham, Arundel, Que., Canada*

## Squaring cabinets during glue-up



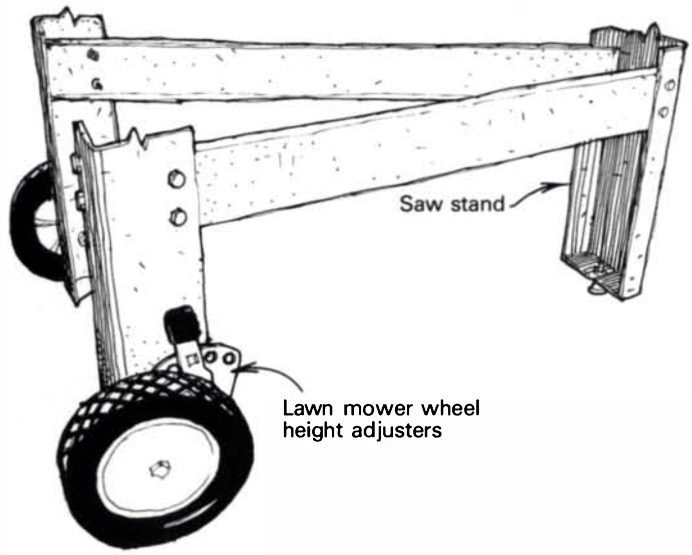

To square a cabinet, I use a pair of web clamps in conjunction with extra-long glue cauls. During glue-up, I determine in which direction the cabinet is out of square. Then, a web clamp is placed across the long diagonal, one on each side, and they are tightened. The cabinet is square when the diagonals are equal in length. This procedure is easy and exact, and best of all, these clamps can't slip and fall off when you finally get the cabinet square.

*—Mark G. Carls, Juneau, Alaska*

***Quick tip:*** To keep tiny drill bits from breaking, slip a sponge-rubber ball, like the ones children use to play jacks, over the bit before you use it. The point of the bit should just protrude from the ball. The ball gives the bit extra support and compresses as the bit goes into the stock.

*—Donald F. Kinnaman, Phoenix, Ariz.*

## Lawn mower height adjusters on tool stands



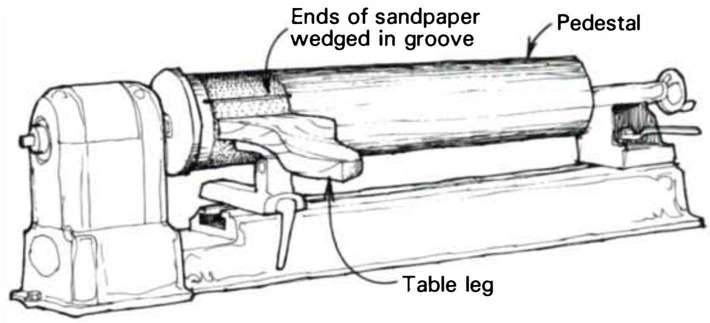

By attaching lawn mower wheel height adjusters to your tool stands, you can add portability without disfiguring the equipment. In my case, I fitted the height adjusters (Arnold model HA700) along with 6-in. lawn mower wheels to the two front legs of my 140-lb. scroll-saw stand. The adjusters and wheels are readily available at small-engine repair shops and simple to attach by following the manufacturer's instructions on the back of the package. Just be sure that the stand will sit on the floor when the wheels are all the way up.

*—Donald G. Hulsey, Tucson, Ariz.*

***Quick tip:*** Sand the small openings in a grill with a detoothed sabersaw blade that has sandpaper strips glued to its sides. Using fine sandpaper for the strips will reduce cross-grain sanding marks.

*—David E. Evenson, Cumberland, Wisc.*

## Fitting legs to a turned pedestal




Recently I built a pedestal table with four legs that were attached with hanger bolts secured by nuts inside the hollow pedestal. The

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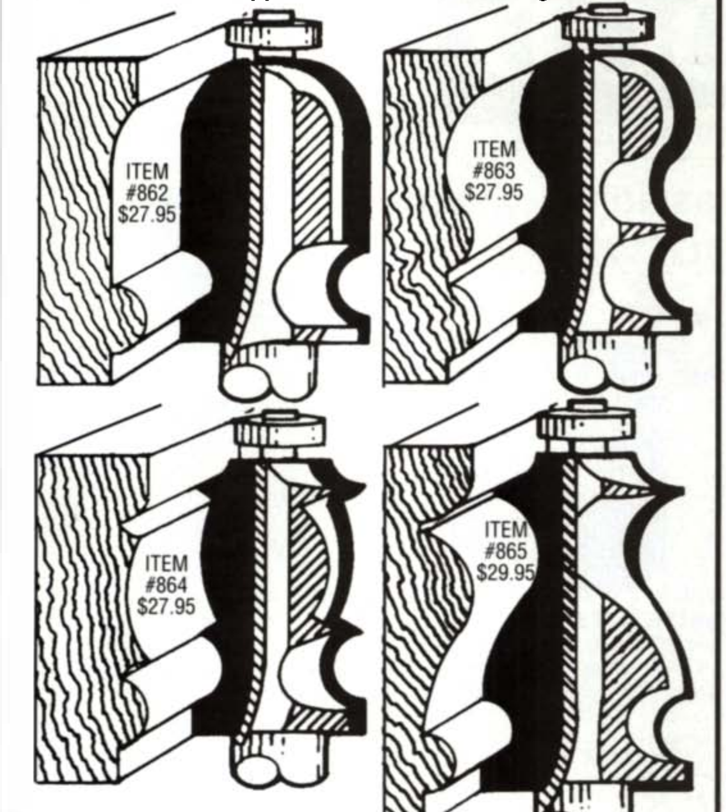


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problem I faced was machining a concave surface on the joint surfaces of the legs so they would mate with the cylindrical pedestal. A simple machine setup did not seem obvious and carving the leg profile with hand tools seemed like an all-day job. Thinking that a drum sander the same size as the pedestal would be just the thing, I happened to look over at the pedestal still on the lathe and things clicked. I decided to wrap sandpaper around the pedestal and use it as a sander.

I selected a 6-in.-wide E-weight paper belt to do the work. To hold the paper in place on the pedestal, I routed a groove ⅛ in. wide and ⅜ in. deep where one of the legs would be attached. I then tucked the ends of the sandpaper into the slot and secured them with a wooden wedge.

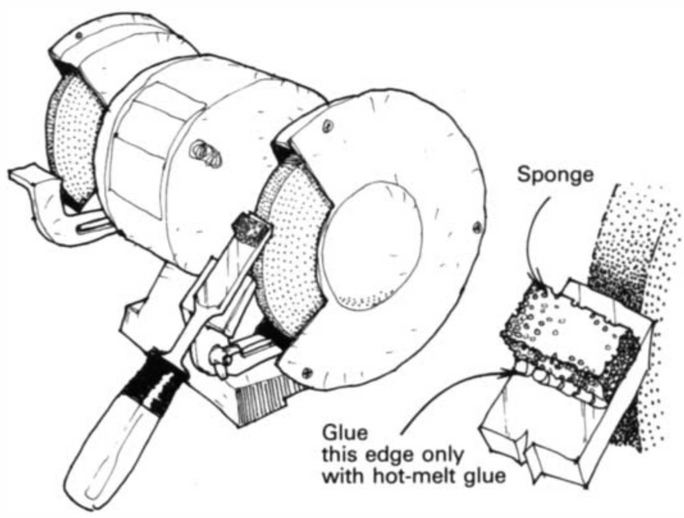
To sand the legs, I simply propped the leg on the tool rest, pushed the surface into the rotating pedestal and frequently checked the progress of the sanding. I was able to make small adjustments in the angle and pressure to keep the profile accurate. The profile cut by this method is off by the thickness of the sandpaper. However, the fit can be improved quickly by scraping the middle of the surface with a curved scraper.

The best thing about this method is the thought that someday someone will repair or refinish the table. They will take off the legs and ask "What in the world is that ⅛-in.-wide groove for?"

*—Frank D. Hart, Plainfield, Ind.*

***Quick tip:*** If airborne sawdust is a problem when working on-site or in a shop not equipped with a dust collection system, here's a solution. Drop a furnace filter on the back of a portable room fan, the kind that's about 22 in. square and sits on the floor. The suction holds the filter in place and clears the air in minutes. *—Ed Muldoon, Mt. Prospect, Ill.*

## Worry-free chisel grinding




When grinding plane irons or chisels, I first attach a small piece of dried sponge near the cutting edge with hot-melt glue. Then, before grinding, I dip the sponge in water until it is well soaked. Because the wet sponge keeps the edge cool, I can grind away in a continuous operation without worrying about me or the iron losing our tempers. *—Don Klimesh, Brownstown, Pa.*

## Reverse images for animal carvers

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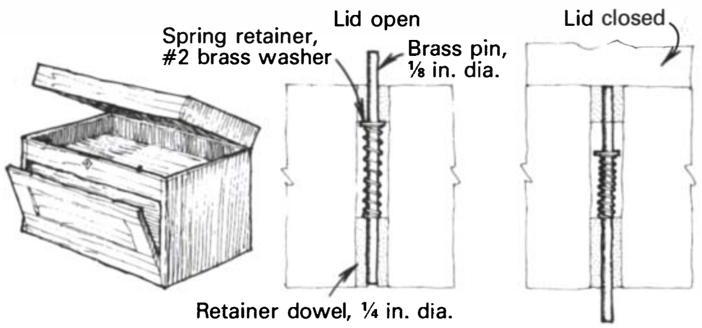
shows only one side of a figure. And to work on the left side of a horse, for example, using a picture of the right side is confusing and difficult.

The solution is to have the picture duplicated on transparent film at a graphics or blueprinting supplier. It costs about one dollar a copy. Then, you have views of both the left and right sides simply by flipping the film over. By the way, an excellent animal reference source for carvers is *An Atlas of Animal Anatomy for Artists* (Dover Publications, 180 Vanick St., New York, N.Y. 10014). *—George Meuse, Hockessin, Del.*

## Spring-loaded locking pins for toolboxes



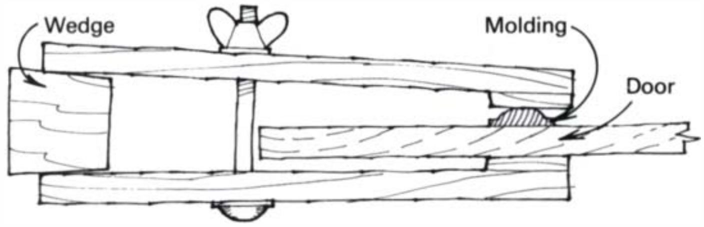

After building a toolbox that opened from both the front and top, I wanted commercial hardware that would automatically lock the front whenever the top was closed. I couldn't find anything that would do it, so I designed my own spring-loaded locking pins.

Make a full-scale sketch of the mechanism to find the length of the pin, where to solder the spring retainer, etc. Then, cut the pin from ⅛-in. brass rod and use a #2 brass washer for the spring retainer. You can hand-ream the hole in the washer to ⅛ in. with a drill bit, and then push the washer onto the pin and solder it in place. Cut the ¼-in. retainer dowels to length and bore a hole, slightly larger than the pin's diameter, down the center of each.

Now, drill ¼-in.-dia. holes in the front apron of your toolbox for the retainer dowels. Glue the bottom retainer dowel into place. Then, place a ball-point pen spring on each pin, insert the pins into the holes and hammer the top retainer dowel into place. I left the top dowel unglued so I can disassemble the pin mechanism if it needs repair. *—David Van Ess, Arlington, Wash.*

***Quick tip:*** An indispensable aid in my shop is a 25-lb. bag of lead shot. I use it to hold down sliding jigs on the tablesaw, dampen vibrations in delicate workpieces and weigh down hard-to-clamp joints for gluing. *—M. Felix Marti, Monroe, Ore.*

## Long-reach clamping




Most C-clamps do not have very long reaches and special long-reach clamps are too expensive to have around for just occasional use. So, when I needed to glue molding on the flat face of a door, about 5 in. from the edge, I adapted a system I used

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| L3507M | 3/4hp1ph 1725 TEFC | 120 |
| L3506 | 3/4hp1ph 3450 TEFC | 120 |
| L3510M | 1hp1ph 1725 TEFC | 140 |
| L3509M | 1hp1ph 3540 TEFC | 145 |
| L3514M | 1-1/2hp1ph 1725 TEFC | 185 |
| L3513M | 1-1/2hp1ph 3450 TEFC | 195 |
| L3516TM | 2hp1ph 1725 TEFC | 190 |
| L3515M | 2hp1ph 3450 TEFC | 230 |

## shop-vac
610-50 10 Gallon Stainless Steel Wet/Dry Vac $169

| | | |
|---|---|---|
| 464-38 | 12 gal Wet/Dry | 169 |

## HEGNER
Multi-Max II With Stand $659

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## POWERMATIC
1660760 66 Saw 3HP with 50" Biesemeyer $1649

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## realist
David White Instruments
LP6-20 20 X Sight Level Package $204

| | | |
|---|---|---|
| ALP6-18HD | 18 auto level pack | 399 |
| AL8-22 | automatic level | 429 |
| LT6-900 | level transit | 259 |

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## Qual-Craft
2200 Pump Jack $59

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

## BIESEMEYER
50-B 50" Commercial $299

| | | |
|---|---|---|
| 52B | 52" homeshop fence | 239 |
| 40B | 40" homeshop fence | 219 |
| 28B | 28" homeshop fence | 209 |

## Milwaukee
1676-1 2 Speed Hole Hawg Kit $224

| | | |
|---|---|---|
| 0359-1 | 3/8" VSR cdls drill kit | 159 |
| 0222-1 | 3/8" VSR 3.5A drill | 99 |
| 0234-1 | 1/2" VSR Magnum drill | 109 |
| 0244-1 | 1/2" VSR Magnum drill | 109 |
| 0385-1 | 3/8 VSR 7.2 V crdlss kit | 109 |

6507 VS Sawzall With Case $129

| | | |
|---|---|---|
| 6508VS | sawzall w/case | 129 |
| 5397-1 | 3/8" hammer drill kit | 139 |
| 5375-1 | 1/2" Mag. hammer kit | 169 |
| 6256 | VS jig saw | 129 |
| 6142 | 4-1/2" grinder kit | 114 |

6368 7-1/4" Saw w/CT Blade Case & Fence $135

| | | |
|---|---|---|
| 6750-1 | HD VSR screwdriver | 89 |
| 6540-1 | cordless screwdriver kit | 89 |
| 6753-1 | 0-4000 VSR screwdriver | 79 |
| 0375-1 | 3/8"close quarter drill | 129 |
| 0379-1 | 1/2" close quarter drill | 159 |

## DEWALT
1707 8-1/2" Compound Crosscutter Saw $449

| | | |
|---|---|---|
| 7770-10 | 10" 3-1/2hp radial saw | 799 |
| 7790 | 12" 3-1/2hp radial saw | 999 |

## JET
JWP-12 12" Portable Planer $379

| | | |
|---|---|---|
| JWP-12D | dust chute | 22 |
| DC-610 | 1 hp dust collector | 249 |
| HES-6108 | 6"x108" sander NEW | 1349 |
| JSS-6168 | stroke sander NEW | 1549 |
| OVS-10 | osc. spindle sander | 1549 |
| SWSS-3-1 | sliding table shaper | 1849 |

*Complete Line In Stock!*

## Emglo
AM78-HC4V 1-1/2 HP Vert. Twin Tank $299

| | | |
|---|---|---|
| AM99-HC4 | 2 hp twin tank NEW | 359 |
| AM78-HC4 | 1-1/2hp twin tank | 289 |
| AM39-HC4V | 3/4hp vert twin tank | 279 |
| K15A8P | 1-1/2hp whlbarrow | 599 |
| K2A8P | 2hp whlbarrow | 649 |
| K5HGA-8P | 5hp honda whlbarrow | 699 |
| 045 | 3/8" X 50' Goodyear hose | 20 |

## Panasonic
EY6200B 12 Volt 1/2" Cordless Driver $199

| | | |
|---|---|---|
| EY6205B | 12V, 3/8",VSR Drill | 229 |
| EY571B | 9.6V, 3/8", VSR Drill | 139 |
| EY503B | 2.4V, 2-Sp, Screwdriver | 69 |
| EY571H | Steel carrying case | 25 |

## BLACK & DECKER
3047-09 7-1/4" Super Saw Cat $169

| | | |
|---|---|---|
| 2663 | 3/8" VSR cdls drill kit | 119 |
| 2687 | 3/8" VSR cdls drill kit | 129 |
| 1703 | 10" mitersaw w/ct blade | 179 |
| 3048-09 | 8-1/4" super sawcat | 179 |

## RYOBI
RA200 8-1/4" Radial Arm Saw $238

| | | |
|---|---|---|
| R500 | 2-1/4hp plunge router | 148 |
| R501 | 2-1/4hp plunge router | 158 |
| RE600 | 3hp VS elec plunge rter. | 198 |

AP10 10" Portable Planer $348

| | | |
|---|---|---|
| TS251U | 10" miter saw | 178 |
| JP-155 | 6-1/8" joint planer | 318 |
| BE321 | 3X21 VS elec belt sander | 128 |

## LEIGH
D1258-24R 24" Dovetail Jig $299

| | | |
|---|---|---|
| D1258-12R | 12" dovetail jig | 259 |
| LJV | Instructional video | 29 |
| MMTA-12 | mortise/tenon attach | 229 |
| MMTA-24 | mortise tenon attach | 249 |

## Dugco
Zambesi 2' X 5.5' Solid Teak Bench $769

| | | |
|---|---|---|
| Deluxe | 1.9'X4.7' workbench | 429 |
| Major | 2.23'X5.5' workbench | 529 |
| Carver | 4.2'X1.35' workbench | 269 |

## BOSCH
1273DVS 4X24 VS Belt Sander $185

| | | |
|---|---|---|
| 1273D | 4X24 sander w/bag | 179 |
| 1272D | 3X24 sander w/bag | 169 |
| 3270D | 3x21 sander w/bag | 129 |
| 1290D | 1/2 sheet finish sander | 139 |
| 3050VSRK | 9.6V drill kit/2 batt. | 139 |

1581VS VS Top Handle Jig Saw $128

| | | |
|---|---|---|
| 1582VS | barrel grip jig saw | 124 |
| 1654 | 7-1/4" saw w/ct bl. | 99 |
| 11212VSR | 3/4" rot. hammer kit | 199 |
| 3258 | 3-1/4" power plane | 129 |
| 1632VSK | VS recip. saw kit | 135 |

1611EVS 3-1/4HP VS Router $238

| | | |
|---|---|---|
| 1611 | 3 hp plunge router | 195 |
| 1604 | 1-3/4 hp router | 118 |
| 1606 | 1-3/4 hp D-hndl. rtr. | 149 |
| 1609K | 3 in 1 trimmer kit | 169 |
| 1611-220V | 3-1/2hp router | 259 |

## HITACHI
C8FB 8-1/2" Compound Miter Saw $468

| | | |
|---|---|---|
| CB75F | resaw bandsaw | 1629 |
| F1000A | planer/jointer | 1529 |
| C15FB | 15" Miter saw | 389 |
| C10FA | 10" Miter saw | 279 |
| C12FA | 12" miter saw NEW | 349 |
| TR-12 | 3hp plunge router | 179 |
| M12V | 3-1/4 hp VS router NEW | 259 |

## Elu
3338 2-1/4 HP Electronic V.S. Plunge Router $259

| | | |
|---|---|---|
| 3337 | 2-1/4hp plunge router | 239 |
| 3304 | 1hp elec. plunge router | 179 |
| 40900 | 1hp router acces. kit | 135 |

4024 3" X 21" Elect. V.S. Belt Sander W/Sanding Frame $199

| | | |
|---|---|---|
| 4029 | 4X24 belt sndr. w/frame | 329 |
| 3375 | 3-1/8" universal planer | 189 |
| 3380 | jointer/spliner | 319 |

## Adjustable CLAMPS
8" Handscrew $12

| | | |
|---|---|---|
| 1 | 10" handscrew | 13 |
| 2 | 12" handscrew | 15 |
| 3 | 14" handscrew | 19 |
| 4 | 16" handscrew | 25 |
| 2/0 | 7" handscrew | 10 |
| 3/0 | 6" handscrew | 9 |
| 4/0 | 5" handscrew | 9 |
| 5/0 | 4" handscrew | 9 |
| 7224 | 24" I-bar clamp | 17 |
| 7236 | 36" I-bar clamp | 18 |
| 7248 | 48" I-bar clamp | 20 |
| 7260 | 60" I-bar clamp | 23 |

## makita
6093DWX 3/8" VSR W/ Keyless Chuck $138

| | | |
|---|---|---|
| 6093DW | 3/8 VSR cdls drill kit | 128 |
| 6012HDW | 3/8 2 sp. cdls drill kit | 118 |
| 3612BR | 3hp rd base router | 199 |
| LS1020 | 10" miter saw | 249 |
| 410 | dust collector | 269 |
| 2708W | 8-1/4 table saw w/ct bl. | 259 |

## freud
JS100 Jointing System With Case $154

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|---|---|---|
| EB-100 | edge bander NEW | 249 |
| EC-900 | 5pc shaper cabinet set | 279 |
| 94-100 | 5pc router cabinet set | 159 |
| 91-100 | 13pc 1/2" router bit set | 199 |
| 92-100 | 26pc router bit set | 299 |
| 90-100 | 15pc router bit set | 159 |
| 88-100 | 9pc router bit set | 99 |
| FB-100 | 16pc Forstner bit set | 149 |
| FRT-2000 | router table | 169 |

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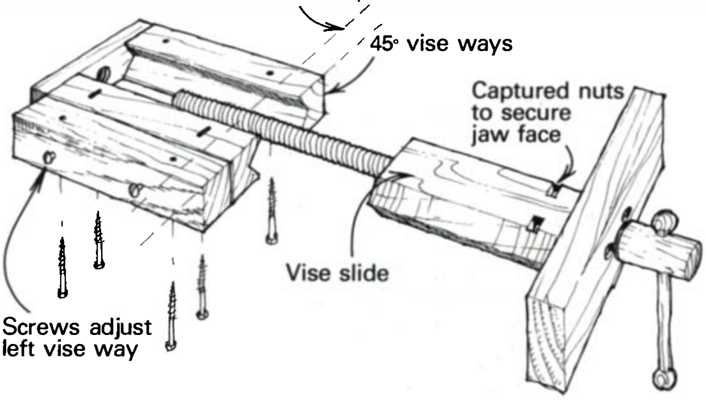
in my boat-building days.

In boat work, when parts had to be held together far from an edge, we fastened two boards loosely together with a nut and bolt. Then, we adjusted the bolt so that when a wedge was driven between the open ends, the other ends would clamp down on the parts.

For my door molding application, driving a wedge into the clamping strips would have moved the molding. So I carefully placed the wedge in position without hammering and then simply tightened the clamp arms with a wing nut.

*—Percy Blandford, Stratford-upon-Avon, England*

## Shopmade vise design




Since my traditional woodworker's workbench is not located against a wall, I decided to add a third vise on the back side across from the tail vise. The ways are designed like a cross slide on a metal lathe, and they consist of two 45° channeled blocks that are mounted under the bench with lag screws. One of the ways is adjustable, as shown in the drawing, to allow for humidity changes.

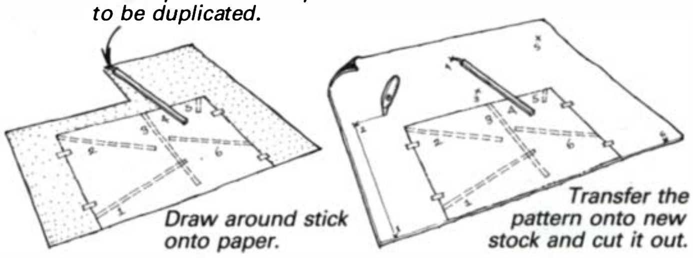
I attached the face of the vise to the slide with 5⁄16-in. bolts and captured nuts. Originally, I built this vise using 3⁄4-in. threaded steel rod. Later, I acquired a 1-in. wood threading outfit and have now converted the screw to 1-in. wood. Both the vise body and screw are hickory.

*—James L. Dunlap, Hartsville, S.C.*

***Quick tip:*** If troubled by machine lock-knobs vibrating off, spread a small dab of beeswax on their threads. This seems to work indefinitely.

*—Dixon Corum, Jackson, Tenn.*

## Spiling for making patterns




Spiling is a method for making very accurate patterns for flooring or countertops. A nail in one end of a stick is placed at critical points on the to-be-duplicated shape and the other end is traced onto a piece of paper. The paper and the stick can then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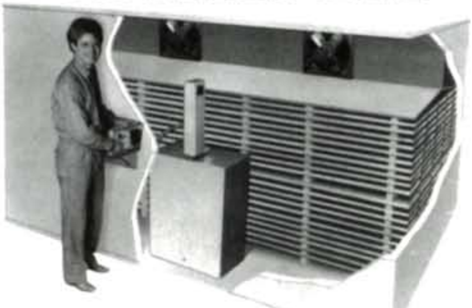

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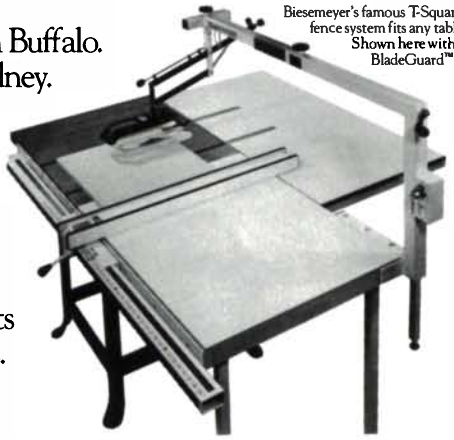

Biesemeyer's famous T-Square saw fence system fits any table saw. Shown here with our new BladeGuard™ system.

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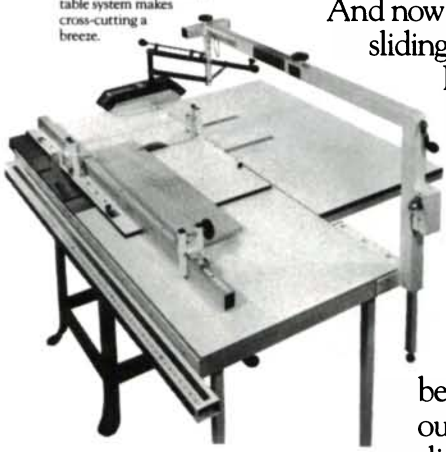

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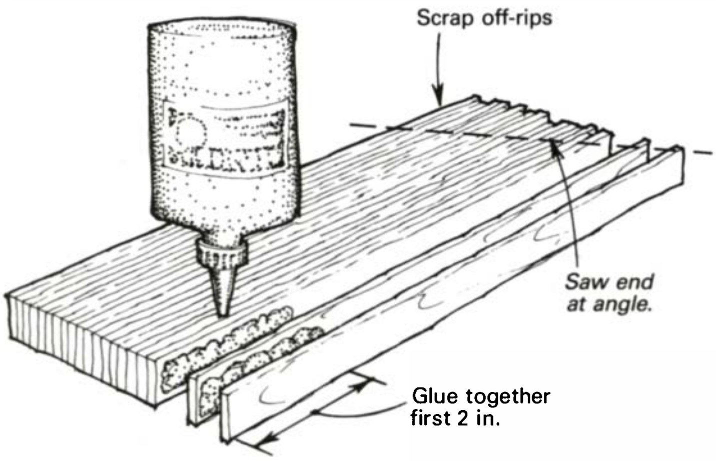
be used to transfer the critical points onto the stock to be cut out, allowing perfect reproduction of the original shape.

Here are tips that will help when spiling. Work clockwise and number each recording consecutively. It may help to make a quick sketch showing the locations for the numbered points. It simplifies the process if you can work from a straight edge. Tape the paper on this straight edge and measure from one side of the paper to one end of the straight edge. Using this measurement, locate the paper on a straight edge of your new stock and mark the pattern. *—Lynn Mickelson, Seattle, Wash.*

## Another featherboard




Periodically, as I'm processing lumber on the tablesaw, I'll generate a large number of small flexible off-rips that are identical in size. This is something I'm sure many woodworkers have encountered. So a few years ago, I started recycling some of these scraps into useful materials—featherboards.

I start with enough 1-ft.-long pieces to make a board 3 in. or 4 in. wide, dab glue on just the first 2 in. or so of each piece and clamp the lot together. If they misalign slightly during clamp-up, I just run the newly made "board" through the planer and trim the end to the angle I want. Now, the featherboard is ready for use. I like to screw two featherboards to a baseboard and then clamp the base to the tablesaw. I set the featherboards so one contacts the workpiece just before it enters the blade and the other just after it exits.

*—M. Felix Marti, Monroe, Ore.*

***Quick tip:*** When making intricate cuts on the scroll saw or bandsaw, first cut out the pattern from paper and then stick it to the wood with clear tape. I have found that this pattern is much easier to follow than a dim pencil line.

*—Charles H. Price, Winnsboro, Tex.*

***Quick tip:*** To avoid first-degree burns on my fingertips whenever I build up a head of steam with a cabinet scraper, I wear the rubber finger caps, commonly used for sorting paper. Besides deflecting the friction heat, the caps, available at office supply stores, provide a slip-free grip.

*—Steve Barrett, Kalispell, Mont.*

*Methods of Work buys readers' tips, jigs and tricks. Send details, sketches (we'll redraw them) and photos to Methods,* Fine Woodworking, *Box 5506, Newtown, Conn. 06470-5506. We'll return only those contributions that include an SASE.*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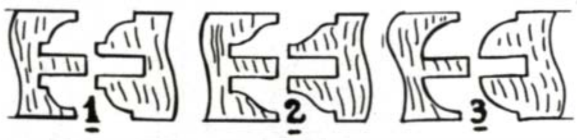


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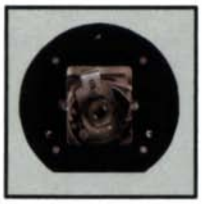
The **Sliding Shaft Lock** makes bit changing simple, safe and easy. Only the one wrench provided is needed. This is especially appreciated when changing a bit with your router mounted under a table.



**Safety** was an important factor when the on-off switch and the plunge lock were designed! Both were created with a downward stroke to disengage each feature. The on-off switch is controlled by the left hand and the plunge lock is controlled by the right hand.

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## Carving melaleuca

***I am a beginning wood sculptor and recently acquired several 8-in.-dia. freshly cut logs of a wood called melaleuca. This hardwood looks interesting in color, with light sap, somewhat reddish heart and fine, close grain. Can you tell me more about the wood, how to work it and keep cracks to a minimum as the wood dries?***

*—Tom Barnard, San Clemente, Cal.*

***Jon Arno replies:*** Melaleuca is a member of the same family as eucalyptus *(Myrtaceae)* and is native to Malay, Indonesia, New Guinea and parts of eastern Australia. Like eucalyptus, it has been planted in warmer regions all over the world and really adapted in various ways to local conditions. Since it was cut in southern California, the species you have is probably *M. quinquenervia.* This species is capable of attaining heights of 100 ft. and diameters of about 24 in. Although it's not an ideal timber producer, since the main stem seldom grows straight, melaleuca is commercially available and usually marketed under the common name "cajeput." Within its native range, the wood is used extensively for cabinetwork, carving, plywood veneers and construction timbers. Because cajeput has excellent weathering properties, it is also used for fence posts, railroad ties and boatbuilding.

Cajeput's very fine texture holds detail well and its natural luster allows it to take a nice polish. But from a sculptor's or carver's perspective, it has some rather negative features. With an average specific gravity of 0.65 (oven dry weight/green volume), it is about as hard to work as our domestic hickories; for example, shagbark hickory's specific gravity is 0.64. Forest Products Laboratory tests further indicate cajeput has high silica content, up to 0.95%, and this will quickly dull carving tools. Also, the wood is extremely unstable. Its very high, average volumetric shrinkage of 16.2% (green to oven dry) is compounded by the fact that it shrinks more than twice as much tangentially as it does radially and the resulting stresses make it prone to checking. For this reason, it should not be used unless it is thoroughly dry and, unfortunately, it is a very tricky wood to season. The endgrain must be well sealed with hot wax or glue and it should be allowed to air dry slowly. Treating it with polyethylene glycol (PEG) is an option, but this is expensive and will alter the appearance of the wood.

[Jon Arno is a woodworker and amateur wood technologist living in Schaumburg, Ill.]

## Quieting a noisy planer

***I own a Makita 2040 15-in. thickness planer that's a very satisfactory machine in all ways except noise. I'm a hobbyist woodworker and have had some complaints about noise on the weekends, even though I generally only use the machine briefly. I wonder if there's any way to make the planer more quiet by way of soundproofing or mechanical modification?***

*—D.F. Faulkner, Christchurch, New Zealand*

***Richard Preiss replies:*** Much to my chagrin, and surely to yours as well, there does not appear to be an aftermarket fix for the noise generated by your Makita 2040. In establishing the initial design parameters for this planer, I suspect that size, weight and performance (not to mention the final cost) were emphasized over the issue of sound generation. The Makita's universal motor and the high-operating RPMs necessary to achieve a reasonable number of cuts per inch with a two-knife cutterhead make this planer an inherently noisy machine.

As soundproofing is concerned, I believe that a plywood housing or hood lined with fiberglass insulation could be placed over the entire machine. I think this would provide enough sound dampening to appease all but the grouchiest of neighbors. The short duration of use, coupled with your apparent sensitivity to the problem, is also helpful. On the downside, the cover would mean some inconvenience, since it would limit access to the controls and impede setting thickness of cut.

Unfortunately, I do not know of any mechanical modifications that would help you. Traditional methods of achieving quieter machine operation involve powering the tool with enclosed induction motors, and building bases and tables with cast iron to dampen vibrations and noise. It would be next to impossible to install a quieter-running induction motor without the appropriate mountings, space and couplings, none of which are available for the 2040 model. The use of a cutterhead with spiral cutting knives is an expensive noise-cutting solution on larger machinery, again, not available for the Makita.

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

## Stripping a faux finish

***I have recently stripped an antique dresser. On the drawer fronts of this dresser was a beautiful pattern that disappeared as the finish was stripped off. I was quite disappointed because I thought that it was the grain pattern of the veneer. Can I reproduce the grain effect to restore the original finish? I've also noticed that the molded edges around the drawer fronts are stained quite dark, with very little of the grain pattern showing. Is this typical on fake-grain furniture?***

*—Chad Beecroft, Guelph, Ont., Canada*

***Michael Dresdner replies:*** The field of refinishing abounds with horror stories similar to yours, in which an unsuspecting refinisher stripped off a printed finish or an antique "faux boise" finish to find a bland whitewood substrate beneath what appeared to be walnut or rosewood. Although this practice is becoming less common, large panel manufacturers often upgraded cheaper woods by covering the surface with either paper or vinyl that's printed and textured to look like figured wood. An alternative method was to use a photo process that develops the pattern onto the wood in much the same way an image is printed onto photographic paper. In either case, it is impractical to try to reproduce this kind of finish.

You can indeed restore the faux finish on your dresser by applying "fake graining": a set of techniques whereby you hand-apply glazes and stains to imitate the grain patterns of natural wood. For guidelines on this venerable craft, try Nat Weinstein's book: *Woodgraining, Marbelizing and Glazing,* from Restoration Workshop, 489 27th St., San Francisco, Cal. 94131; (415) 641-5528. Or check out Joann Day's excellent video: *Woodgraining, Marquetry, & Fantasy Graining,* by Day Studio, 1504 Bryant St., San Francisco, Cal. 94103; (415) 626-9300.

The dark stain you noticed around the molded edges of drawer fronts is frequently applied to hide the edges of the plywood or lumber substrate. Though it can be effected with a darker stain, it is more common to "even up" these edges with a second or even third application of stain applied between the layers of finish to make them "take" with more uniformity. Although dyes can be used, finishers generally use pigmented stains or glazes for this operation because of their opacity and, hence, excellent hiding ability.

[Michael Dresdner is a Contributing Editor for *FWW* and an instrumentmaker and finishing consultant in Perkasie, Pa.]

## Bleeding knots in pine

***I recently built some cabinets out of #2 pine, finished by spraying two coats of white lacquer primer undercoat and two coats of off-white, semi-gloss lacquer. Now all the knots have bled through the finish. What should I have done to prevent this and what can I do now?***

*—Frank Simon, San Luis Obispo, Cal.*

***David Rudolph replies:*** When you say that the knots bled through, I assume you mean the pine sap came up through the

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final finish. To prevent this problem in my pine furniture and sculpture, I apply a coat of a good sealer, like Kilstain (available from most paint and hardware stores), over the knots before priming and lacquering. The sealer prevents the sap from coming up through the finish. To repair your cabinets, you can try repainting the problem areas with white lacquer paint, and then semi-gloss lacquer as you did before. You can retouch those spots only, or you may have to repaint the entire piece to match the new paint. If the sap still comes through, you'll have to strip the cabinets and start over with the sealer.

If you're having a problem with the knot outlines showing under the paint, like an imprint (called telegraphing), you could cover the knots with a bondo-type putty (I like Minwax putty) that mixes in two parts and does not shrink. Spread it over each knot with a putty knife, sand it when dry and use a good sealer to prevent bleed-through.

[David Rudolph is a wood sculptor and furnituremaker in Santa Barbara, Cal.]

## Calculating lathe pulley speed

***The motor on my wood lathe runs at 1,725 RPM and there is a 4-in.-dia. pulley on the motor shaft and one the same size on the speed-changer shaft. On the other end of the speed changer and on the headstock are matching four-step pulleys with 4-in., 3¼-in., 2½-in. and 1¾-in. diameters. How can I calculate the rotational speed of the lathe with the belt set on different pulley steps?*** *—Michael H. Kirch, Lucerne, Cal.*

***Roger Heitzman replies:*** The formula for calculating pulley speed is fairly simple: pulley speed = motor speed × drive pulley diameter, with that product divided by the diameter of the driven pulley (the one mounted on the lathe). The diameters of all pulleys are measured at the rims. For example, if we combine your lathe's motor speed with the 3¼-in. to 2½-in. steps on the multiple-step pulleys, we can calculate the speed with the formula: (1,725 (RPM) × 3.25) ÷ 2.5. This would yield a final headstock speed of 2,242 RPM, good for general spindle turning. It's worth noting that shaft diameter has no bearing on this equation and that pulleys of equal size produce equal speeds, such as between the motor pulley and speed changer pulley.

[Roger Heitzman is a furniture designer and a craftsman in Scotts Valley, Cal.]

## Discourse on Dutch elm disease

***I have acquired some wood from a dead elm tree cut in southeastern Pennsylvania and I'd like to turn some bowls and vases. I don't know what kind of elm it is or what killed the tree. The tree was dead for about two years before I cut it and the wood has some spalting in it. Somebody told me that this wood is capable of spreading Dutch elm disease. Is there any truth to this?*** *—Earl Edris, Mt. Gretna, Pa.*

***Walter R. Tschinkel replies:*** There is no truth to it. Dutch elm disease is caused by a fungus, *Ceratostomella ulmi,* carried by the elm bark beetles, *Scolytus multistriatus* and *Hylurgopinus rufipes.* These beetles carry the spores of the fungus in concavities on their bodies, and introduce them into the cambium of healthy elm trees when they feed on twigs and small branches. As the fungus weakens and kills the tree, the adult bark beetles bore into the cambium of the trunk and major branches, excavate an egg gallery parallel to the grain and reproduce there. The next generation of adults bore out through the bark, carrying the fungal spores with them. As you can see, it takes living beetles of the appropriate species as well as bark on dead elms to spread

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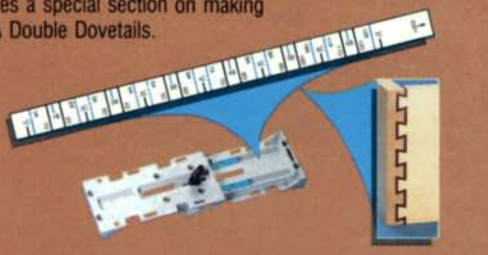

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| 9207SPC | 7" sander-polisher | 279 | 195 |
| 3601B | 1⅜ H.P. router | 255 | 139 |
| 3700B | ½ H.P. trimmer | 190 | 115 |
| 9501BZ | 4" grinder, 3.5 amp | 126 | 75 |
| BO4530 | 6" round sander | 101 | 59 |
| BO4550 | ¼" sheet pad sander w/bag | 96 | 55 |
| DA3000R | ⅜" angle drill | 270 | 148 |
| DP4700 | ½" v/sp w/rev. 4.8 amp | 209 | 125 |
| HP2010N | ¾" v/sp hammer drill w/cse | 300 | 169 |
| 2708W | 8¼" table saw | 504 | 259 |
| 2711 | 10" table saw w/brake | 841 | 489 |
| 2030N | 12" planer/jointer | 3120 | 1789 |
| 2040 | 15⅝" planer | 2595 | 1489 |
| 1805B | 6⅛" planer kit w/case | 679 | 358 |
| 5008BA | 5½" circular saw | 223 | 129 |
| 9503BH | 4½" sander-grinder | 148 | 89 |
| 6404 | ⅜" drill 0-2100 rpm, 2 amp. | 104 | 65 |
| 6510LVR | ⅜" drill rev. 0-1050 rpm | 145 | 79 |
| 6013BR | ½" drill rev. 6 amp | 241 | 139 |
| 5402A | 16" circular saw - 12 amp | 636 | 349 |
| 3612BR | 3 H.P. plunge router | 377 | 195 |
| 9401 | 4"x24" belt sander w/bag | 318 | 169 |
| 3620 | 1¼ H.P. plunge router w/cse | 192 | 109 |
| 4302C | V/spd. orb. jig saw | 302 | 165 |
| 5077B | 7¼" Hypoid saw | 252 | 138 |
| LS1440 | 14" Miter saw | 721 | 425 |
| 2414 | 14" cut-off saw AC/DC | 361 | 205 |
| 5007NB | 7¼" circ saw 13 amp | 209 | 114 |
| 3612B | 3 HP plunge router sq/b | 377 | 195 |

## SENCO AIR NAILERS

| Model | | List | Sale |
|---|---|---|---|
| SFN1 | Finishing nailer 1" - 2" | 377 | 269 |
| SFN2 | Finishing nailer 1½" - 2½" | 571 | 395 |
| SN325 | Nailer 1⅞" - 3¼" | 665 | 448 |
| M2 | General purpose 1⅜" - 2" | 475 | 345 |
| SN4 | General purpose 2" - 3½" | 685 | 489 |
| LS2 | Pinner ⅝" - 1" | 351 | 255 |
| SKS | Stapler ⅝" - 1½" | 351 | 249 |
| LS5 | Pinner, 1"-1½" | 399 | 295 |
| PW-RFR | Roofer, ½"-1¼" | 361 | 256 |

## SKIL SIZZLERS

| Model | | List | Sale |
|---|---|---|---|
| 5510 | (551) 5½" circ saw | 112 | 95 |
| 5625 | (552) 6½" circ saw | 175 | 124 |
| 5656 | (553) 7¼" circ saw | 132 | 119 |
| 5750 | (807) 7¼" circ - drop foot | 196 | 142 |
| 5765 | (808) 8¼" circ - drop foot | 216 | 149 |
| 5790 | (810) 10¼" circ - drop foot | 400 | 269 |
| 5825 | (367) 6½" worm saw | 229 | 155 |
| 5865 | (825) 8¼" worm saw | 250 | 164 |
| 4580 | Vari - orbit jig saw w/cse | 144 | 105 |
| 3810 | 10" Miter saw | 263 | 215 |
| 7575 | ¼" palm sander | 52 | 49 |
| 7313 | 3x18 belt sander 4.5A | 72 | 65 |
| 77 | 7¼" worm drive saw | 230 | 145 |
| 5350 | 2½ HP circ. saw | 80.99 | 77 |
| 5250 | 2¼ HP circ. saw | 58.99 | 66 |
| 2735-04 | 12v v/spd. cordless drill complete w/cse. & 2 batt. | 210 | 139 |

## LEIGH DOVETAIL JIGS

D1258-12—List 314.00—Sale 265.00
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|---|---|---|---|
| MMT 500 | NEW 24" multiple mortise & tenon jig | 509 | 399 |
| MMT | 12" multiple mort. & tenon attachment for D1258-12 | 269 | 219 |
| MMT | 24" multiple mort. & tenon attachment for D1258-24 | 299 | 239 |

## HITACHI TOOLS

| Model | | List | Sale |
|---|---|---|---|
| TR8 | Plunge router, 1½ H.P. | 219 | 119 |
| M12V | NEW 3 H.P. var/spd. router | 437 | 256 |
| TR12 | Plunge router, 3 H.P. | 354 | 175 |
| C10FA | 10" dlxe. miter saw | 495 | 279 |
| C8FB | 8½" slide compound saw | 859 | 489 |
| FREUD LU91M008 | 8½" c/bld 48 tooth | 58 | 45 |
| C15F8 | 15" miter saw | 745 | 399 |
| FREUD LU85M015 | 15" c/bld 108 tooth | 181 | 115 |

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## DELTA TOOLS

| | | |
|---|---|---|
| 34-444 | Table Saw Complete w/1½ H.P. motor & stand | 629.00 |
| 34-445—34-444 | Table Saw complete w/30" Unifence | 799.00 |
| 33-150 | 8¼" Saw Buck | 485.00 |
| 28-283F | 14" Band Saw w/enclosed stand & ¾ H.P. motor | 699.00 |
| 70-200 | NEW 20" Drill Press | 719.00 |
| 17-900 | 16½" Floor Drill Press | 385.00 |
| 40-601 | 18" Scroll Saw w/stand and blades | 699.00 |

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## PIRANHA By Black & Decker
CARBIDE TOOTH SAW BLADE

| Model# | Diameter | #Teeth | List | Sale |
|---|---|---|---|---|
| 73-716 | 6-1/2 | 18 | 13.10 | 7.10 |
| 73-756 | 6-1/2 | 36 | 28.96 | 16.30 |
| 73-717 | 7-1/4 | 18 | 13.14 | 7.10 |
| 73-737 | 7-1/4 | 24 | 18.36 | 9.00 |
| 73-757 | 7-1/4 | 40 | 29.72 | 16.35 |
| 73-758 | 8 | 40 | 42.04 | 24.15 |
| 73-759 | 8-1/4 | 40 | 42.88 | 24.60 |
| 73-719 | 8-1/4 | 22 | 16.96 | 10.60 |
| 73-739 | 9 | 30 | 31.48 | 16.25 |
| 73-769 | 9 | 60 | 66.58 | 35.90 |
| 73-715 | 5-1/2 | 16 | 13.00 | 7.30 |
| 73-704 | 7-1/4 | 18 | 19.50 | 12.49 |

THE SPECIAL BLACK AND DECKER PIRANHA BLADE PRICES ARE BACK!!!

| Model# | Diameter | #Teeth | List | Sale |
|---|---|---|---|---|
| 73-740 | 10 | 32 | 33.20 | 15.95 |
| 73-770 | 10 | 60 | 61.46 | 29.95 |
| 73-711 | 10 | 50 | 65.08 | 29.95 |

## JORGENSEN STEEL I-BAR CLAMPS

| Model | Size | List | Sale |
|---|---|---|---|
| 7224 | 24" | 27.11 | 17.55 |
| 7236 | 36" | 29.10 | 18.65 |
| 7248 | 48" | 31.96 | 19.75 |
| 7260 | 60" | 35.60 | 23.55 |

## ADJUSTABLE HANDSCREWS BY JORGENSEN

| Item No. | Jaw Length | Open Cap | List | Sale | Box of 6 |
|---|---|---|---|---|---|
| #3/0 | 6" | 3" | 15.57 | 8.89 | 49.98 |
| #2/0 | 7" | 3½" | 16.74 | 9.95 | 53.55 |
| #0 | 8" | 4½" | 18.63 | 10.75 | 61.29 |
| #1 | 10" | 6" | 21.30 | 12.99 | 71.49 |
| #2 | 12" | 6½" | 24.45 | 14.89 | 81.89 |
| #3 | 14" | 10" | 31.01 | 19.16 | 108.78 |
| #4 | 16" | 12" | 40.30 | 24.89 | 146.85 |

## STYLE 37 2½" Throat ¼"x¾" JORGENSEN

| Item No. | Jaw Length | List | Sale | Box of 6 |
|---|---|---|---|---|
| 3706 | 6" | 9.30 | 6.29 | 35.65 |
| 3712 | 12" | 10.30 | 6.79 | 38.59 |
| 3718 | 16" | 11.37 | 7.35 | 41.69 |
| 3724 | 24" | 12.42 | 7.99 | 45.25 |
| 3730 | 30" | 13.85 | 9.05 | 51.19 |
| 3736 | 36" | 15.15 | 9.95 | 56.65 |

## PONY CLAMP FIXTURES

| Model | | List | Sale | Lots of 12 |
|---|---|---|---|---|
| 50 | ¾" black pipe clamps | 13.10 | 7.89 | 83.99 |
| 52 | ½" black pipe clamps | 10.93 | 6.30 | 68.25 |

## PANASONIC CORDLESS DRILLS

| Model | | List | Sale |
|---|---|---|---|
| EY6205B | NEW v/spd. 12 volt drill w/15 minute charger | 390 | 219 |
| EY6200B | NEW 2 spd. 12 volt drill d-hdle w/15 minute charger | 350 | 198 |
| EY6281B | NEW v/spd. 9.6 volt drill w/15 minute charger | 350 | 195 |
| EY5718 | V/spd. 9.6 volt drill | 239 | 139 |

## BOSCH

| Model | | List | Sale |
|---|---|---|---|
| 1581VS | Top hdle. jig saw | 239 | 129 |
| 1582VS | Barrel grip jig saw | 225 | 123 |
| | Bosch metal case for above jig saws | 34 | 28 |
| | Bosch blade assortment for jig saws 30 of Bosch's best selling blades | 25.99 | |
| 1942 | Heat gun 650°-900° | 99 | 69 |
| 3268 | Heat gun 600° & 1000° | 89 | 65 |
| 1272 | 3"x24" belt sander | 279 | 165 |
| 1272D | 3"x24" B.S. w/bag | 299 | 168 |
| 1273 | 4"x24" belt sander | 295 | 169 |
| 1273D | 4"x24" B.S. w/bag | 315 | 175 |
| 11-212VSR | Bulldog ¾" SDS rotary | 339 | 189 |
| 1198VSRK | ⅜" v/spd hammer dr'll | 215 | 115 |
| 1198VSR | ½" v/spd hammer drill | 229 | 135 |
| 1608 | 5.6 amp lam trimmer | 140 | 89 |
| 1608L | Same as above w/trimguide | 145 | 92 |
| 1608T | 5.8 amp tilt base trimmer | 159 | 99 |
| 1609 | 5.6 amp offset base trimmer | 205 | 122 |
| 1609K | Lam installers kit w/1609 | 295 | 196 |
| | Offset base, trimmer tilt base, trimguide, ¼" collet, collet nut, wrenches, hex keys and case | | |
| 1601 | 1 H.P. Router 25,500 rpm | 165 | 105 |
| 1602 | 1½ H.P. Router 25,000 rpm | 199 | 125 |
| 1603 | 1½ H.P. D handle router | 223 | 137 |
| 1604 | 1¾ H.P. 2 hdle. router | 219 | 118 |
| 1604K | Same as above w/cse & access. | 269 | 165 |
| 1606 | 1¾ H.P. D hdle. Router | 243 | 142 |
| 3258 | 3¼" planer w/blade guard | 210 | 129 |
| 3270D | 3"x21" belt sander w/bag 5A | 225 | 135 |
| 1273DVS | V/spd. 4x24 belt sander | 339 | 169 |
| 1611 | 3 H.P. plunge router | 349 | 195 |
| 1611EVS | "NEW" 3 H.P. elec. v/spd. plunge router | 410 | 234 |
| 1651 | 7¼ circ. saw drop foot | 179 | 99 |
| 1654 | 7¼ circ. saw pivot base | 179 | 99 |
| 1632VSRK | Recip. saw 8.4A orb. v/spd. | 225 | 135 |
| 3050 VSRK | "NEW" 9.6V v/spd. cdls. drill w/cse. & 2 batteries | 235 | 129 |

## BOSTITCH AIR NAILERS

| Model | | List | Sale |
|---|---|---|---|
| N80C-1 | Utility coil nailer | 730 | 435 |
| N80S-1 | Stick nailer | 760 | 435 |
| T36-50 | Sheathing & decking stapler | 550 | 334 |
| N12B-1 | Coil roofing nailer | 725 | 436 |
| N60FN-2 | Finishing nailer | 595 | 355 |
| T31 | Brad nailer | 245 | 159 |

## ELU BY BLACK & DECKER

| Model | Description | List | Sale |
|---|---|---|---|
| 3338 | 2¼ H.P. var/spd plunge router | 387 | 265 |
| 3337 | 2¼ H.P. plunge router | 356 | 245 |
| 3304 | 1 H.P. var/spd plunge router | 261 | 185 |
| 3375 | 3⅛" universal planer 7.2 amp | 280 | 196 |
| 3380 | Biscuit jointer/spliner w/case | 485 | 325 |
| 4024 | 3x21" var/spd belt sander | 289 | 205 |
| 3303 | 1 H.P. plunge router | 210 | 159 |
| 4023 | 3x21" belt sander 5.2 amp | 261 | 195 |
| 4029 | 4x24" belt sander 9.2 amp | 469 | 319 |

## BLACK & DECKER

| Model | | List | Sale |
|---|---|---|---|
| 1166 | ⅜" drill 0-2500 rpm 4 amp | 96 | 55 |
| 2600 | ⅜" drill 0-1200rpm 4.5 amp | 125 | 65 |
| 2037 | Drywall gun 0-4000 5.0 amp | 160 | 95 |
| 1707 | 8½" crosscut miter saw | 813 | 469 |
| 1703 | 10" miter saw w/73-770 blade | 313 | 179 |
| 3157 | Orbital var/spd jig saw | 203 | 125 |
| 3153 | Variable speed jig saw | 196 | 120 |
| 3047-09 | 7¼" super saw cat w/brake | 282 | 168 |
| 3048-09 | 8¼" super saw cat w/brake | 297 | 179 |

## BIESEMEYER FENCES

| | | | |
|---|---|---|---|
| | 50" commercial saw fence | 329 | 285 |
| | 52" homeshop saw fence | 249 | 225 |

## JET TOOLS

| Model | Description | List | Sale |
|---|---|---|---|
| JBS-14MW | 14" band saw, 1 H.P. | 482 | 385 |
| JTS-10 | 10" table saw w/stand, 1½ H.P. | 554 | 459 |
| JTS-12 | 12" table saw w/stand, 1½ H.P. | 630 | 509 |
| JWS-18 | ½" spindle shaper w/stand, 1 H.P. | 479 | 375 |
| JJ-4 | 4" jointer, ½ H.P. | 310 | 285 |
| JJ-6 | 8" jointer, ¾ H.P. | 465 | 379 |
| JWP12 | 12½" bench planer, 2 H.P. | 569 | 359 |
| JWP12D | Dust chute for JWP12 | 45 | 22 |
| JSG-6 | 8" x 48" belt & 12" disc sander, 1½ H.P. | 634 | 475 |
| DR1012 | 10" bench drill press, ⅓ H.P. | 179 | 175 |
| DR1458 | 14" bench drill press, ½ H.P. | 279 | 259 |
| DR1758 | 17" bench drill press, ½ H.P. | 319 | 285 |
| DR1458F | 14" floor drill press, ¾ H.P. | 369 | 325 |
| DR1758F | 17" floor drill press, ¾ H.P. | 385 | 349 |
| DR2501F | 20½" floor drill press, 1 H.P. | 655 | 539 |

## RYOBI SPECIALS

| Model | Description | List | Sale |
|---|---|---|---|
| R500 | 2¼ H.P. plunge router | 326 | 155 |
| TS251U | 10" miter saw | 392 | 179 |
| TS251US | 10" miter w/acc. kit & B & D 73-770 carbide blade | 435 | 225 |
| AP10 | 10" surface planer 13 amp. | 820 | 358 |
| RA200 | 8¼" radial arm saw | 515 | 239 |
| RE600 | 3 H.P. plunge router | 399 | 215 |
| R150K | 1 H.P. plunge router w/cse | 208 | 105 |
| BE321 | 3"x21" v/spd. belt sander | 259 | 129 |

## PORTER CABLE

| | | | |
|---|---|---|---|
| 690 | 1½ H.P. router 8 amp | 225 | 125 |
| 691 | 1½ H.P. router D hdle | 245 | 135 |
| 536 | 1½ H.P. speedmatic router | 310 | 195 |
| 518 | 3 H.P. 5 speed router | 560 | 339 |
| 520 | 3 H.P. 15 amp router | 510 | 315 |
| 309 | 3.8 amp lam trimmer | 135 | 85 |
| 695 | 1½ H.P. router/shaper | 310 | 195 |
| 696 | H.D. shaper table | 170 | 119 |
| 351 | 3"x21" belt sander w/o bag | 225 | 125 |
| 352 | 3"x21" belt sander w/bag | 235 | 129 |
| 360 | 3"x24" belt sander w/bag | 310 | 175 |
| 361 | 3"x24" belt sander w/o bag | 290 | 196 |
| 362 | 4"x24" belt sander w/bag | 325 | 185 |
| 363 | 4"x24" belt sander w/o bag | 310 | 179 |
| 315-1 | 7¼" top hdle 13 amp circsaw | 195 | 115 |
| 9315-1 | 315-1 comp. w/cse. & carb. bld. | 225 | 127 |
| 617 | 7¼" pushhandle 13 amp | 195 | 115 |
| 9617 | 617 comp. w/cse. & carb. bld. | 225 | 127 |
| 314 | 4½" trim saw 4.5 amp | 215 | 124 |
| 9548 | X HD bayonet saw w/case | 290 | 179 |
| 9629 | Recip saw v/sp 8 amp | 235 | 135 |
| 9627 | Recip saw 2 speed 8 amp | 225 | 125 |
| 666 | ⅜" H.D. vsp drill 0-1200 rpm | 185 | 122 |
| 621 | ⅜" H.D. v spd. 0-1000 rpm | 155 | 95 |
| 320 | Abrasive plane 3 amp | 160 | 109 |
| 9118 | Porta plane 7 amp kit | 335 | 185 |
| 7545 | 0-2500 drywall gun 5.2 A | 169 | 99 |
| 7540 | 0-4000 5.2 amp gun | 185 | 98 |
| 505 | ½ sheet pad sander | 195 | 109 |
| 7511 | ⅜" v spd. drill 5.2 amp | 185 | 109 |
| 7514 | ½" v spd. drill 0-750 | 196 | 119 |
| 537 | 1½ H.P. D hdle router | 325 | 205 |
| 7548 | Top hdl jig saw 4.8 amp | 230 | 129 |
| 7648 | Barrel grip jig saw 4.8 amp | 225 | 139 |
| 330 | Speed block sander ¼ sht | 97 | 55 |
| 555 | Plate biscuit jointer w/cse. | 299 | 185 |
| 345 | 8" saw boss 9 amp | 170 | 99 |
| 5060 | "Stair Ease" stair templet | 194 | 125 |
| 5061 | "Stair Ease" hard wood | 204 | 135 |
| 100 | ⅞ H.P. router | 165 | 99 |
| 5008 | Dovetail template kit | 99.50 | 79 |
| 5009 | Mortise & Tenon jig | 54.95 | 49 |
| 7308 | laminate slitter | 190 | 129 |
| 5116 | omni-jig | 395 | 269 |
| 9647 | TIGER CUB recipro saw | 195 | 119 |
| 9850 | 12 volt cordless drill w/cse. | 230 | 129 |
| 8500 | Extra 12v battery | 48 | 33 |
| | **NEW Tools By Porter Cable!** | | |
| 7399 | 5.6 amp drywall cutout unit | 120 | 75 |
| 7310 | 5.6 amp lam trimmer | 145 | 89 |
| 7312 | 5.6 amp offset base lam trimmer | 209 | 119 |
| 7319 | 5.6 amp tilt base lam trimmer | 185 | 105 |
| 97310 | LAM TRIM KIT W/STD. BASE, TILT BASE, OFFSET BASE, SLITTER BASE, GUIDE & CSE | 330 | 185 |
| 7334 | 3.7 amp 5" random orbit sander 6000 rpm | 205 | 119 |
| 693 | 1½ H.P. plunge router | 260 | 196 |
| 97750 | ½" v/spd hammer drill w/cse | 260 | 169 |
| 6931 | Plunge router base | 120 | 75 |

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the disease. Even recently, dead elm wood without attached bark would not spread the disease. And your two-year-old, partly spalted elm wood is far beyond being able to spread Dutch elm disease.
[Walter Tschinkel is an entomologist living in Tallahassee, Fla.]

## Making a quilting hoop

*I would like to make some hoops for holding small quilts or needlework while the pieces are being worked on. Which woods are most suitable and what would be a good, low-tech way of bending and joining the wood for this purpose? Also, can you suggest any books on the subject?*

*—Claffertene M. Cheeks, Newark, N.J.*

***Drew Langsner replies:*** The best woods for bending are those with long, tough fibers. These include most oaks, ash, hickory, pecan and walnut. You can also use clear maple, cherry or beech, but expect more failures. For bending hoops, select wood free of all imperfections. The grain should have little runout from side to side and, as can be expected, thinner pieces will bend easier than thicker ones. A scarf joint is best for joining the ends of the hoop together, and these can be formed with a plane, spokeshave or abrasives. Make the scarf joints before bending, but join the ends after the bends are set.

To make the wood more pliable just prior to bending, heat the strips by ladling boiling water over them, or by steaming or "cooking" them in an open tray. For quilting hoops, the bending form can be a plywood disc (made as thick as necessary) mounted to a plywood back. Use pegs and wedges to hold the bent wood in place while the wood cools and the bends set. I would suggest forming the outer hoop over the inner hoop after the bend on the inner hoop is set.

The simplest way to lock the scarf joint on the hoop is to use glue. This joint would be very strong, but such a permanent fix would prevent you from adjusting the frame to allow for different thicknesses of fabric. Perhaps the inner hoop should be glued and the outer hoop left adjustable. For an adjustable joint, I suggest boring a row of overlapping holes in the hoop ends and then lacing the ends together with cord or thin leather strips. A more utilitarian approach could use a recessed stove bolt and a wing nut. For more information refer to: *Fine Woodworking on Bending Wood* (The Taunton Press, 1985) or my chapter on bending in *Green Woodworking* (Rodale Press, Emmaus, Pa., 1987).
[Drew Langsner is an author, farmer and woodworker living in Marshall, N.C.]

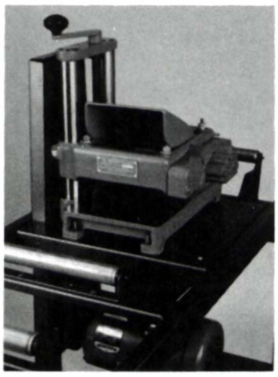
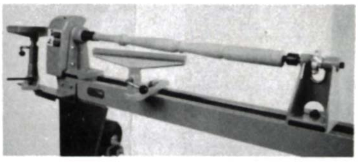
## Homemade wood fillers

*A few weeks ago, I read about making wood filler with Titebond glue, water and sawdust. But when I tried this method, my filler turned black. Can you explain what happened?*

*—Leroy D. Gifford, Zanesville, Ohio*

***George Mustoe replies:*** Polyvinyl acetate-based adhesives (white and yellow wood glues) may show two types of color change. When used at low temperatures, the glue turns chalky white during curing. Black discoloration might be due to iron contamination; even traces of iron will cause the adhesive to react with tannins (found in some woods, like oak) to produce a dark stain. In both instances, the glue's final bonding strength is not effected by the color change. Iron contamination is also the reason that you'll sometimes get dark stains at the glueline after gluing up a panel or tabletop with iron pipe or bar clamps; contact between clamp and fresh glue results in the stains.

Iron contamination can occur during the manufacturing process, but far more commonly this element is introduced when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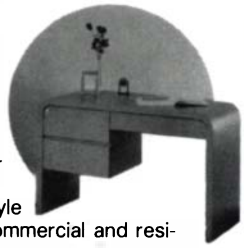
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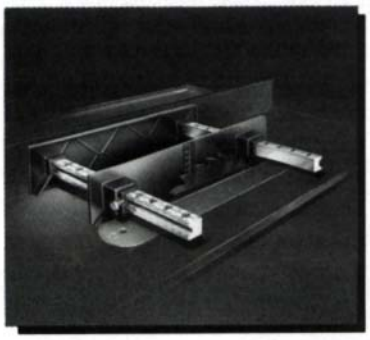

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the woodworker uses steel containers or tin cans to store or mix glue. To check for contamination, spread a thin puddle of glue on a scrap of oak or other tannin-rich wood. After drying, the glue should be colorless or light amber; black or bluish stains are proof of iron contamination. The discoloration may not be noticeable in the thin film of glue present in a well-mated joint. But when the same glue is used as a filler material, the resulting mixture may turn nearly black. In the latter case, the iron contamination usually results from sawdust that includes a minute amount of iron, such as iron filings or fibers of steel wool. If your sawdust was obtained by collecting floor sweepings, it's almost sure to contain these materials; since only a few parts per million of iron can cause discoloration, be extra careful to gather clean, fresh sawdust for your filler mixture. While you may wish to put this chemical reaction to good use to produce a dark-color wood filler, you may have trouble controlling the final color of the filler, since this depends on both the amount of iron in the glue and the amount of tannin in the particular piece of wood you use for sawdust.
[George Mustoe is a geochemistry research technician at Western Washington University in Bellingham, Wash.]

### Round bandsaw blades

*I've heard of a specialty bandsaw blade, circa 1940, that was spiral shaped and could cut in any direction. Are these still available, and what kind of bandsaw guides would be needed to run them? —Jeffrey Seaton, Santa Barbara, Cal.*

***Mark Duginske replies:*** Two types of round blades are available. One is a steel spiral band, the other one is a grit band. The grit that is used is either made of aluminum oxide, diamond or borazon. The round blade design allows cutting from all directions, not just from the front of the blade. This option is particularly useful when using CNC (computer controlled equipment) to guide the material through the cut. Unfortunately, round blades can only be used on specially designed bandsaws fitted with guides designed to accommodate that blade shape. Further, these guides are not available to retrofit other bandsaws. If you have the need for this kind of bandsaw, the machines are manufactured by the Doall Co., 254 N. Laurel Ave., Des Plaines, Ill. 60016-4398; (312) 824-1122.
[Mark Duginske is a woodworker, teacher and author who lives in Wausau, Wis.]

### Furniture mildew problems

*I have some furniture that has mold or mildew which has formed spots of light-color fuzz. The furniture appears to have a lacquer finish that has been periodically maintained with lemon oil. What is the best method for removing the mold or mildew and how can the resulting spots be removed from the finish? —Stephen L. Fitzhugh, Guilford, Conn.*

***Chris Minick replies:*** Mold and mildew problems in the home are usually caused by high humidity. The best solution to your problem is to prevent it by dehumidifying the house. The mold or mildew currently on the furniture can be removed by lightly scrubbing the effected area with household chlorine bleach. If the lacquered surface is in poor condition, then refinishing may be in order. Mildewcide additives for lacquer and varnish are available at most large paint stores. The additives are mixed into the lacquer before it is applied and are very effective in preventing future mildew problems. Two mildewcides that I have found particularly effective are Troysan Polyphase AF-1 Mildew Additive by Troy Chemical Co. and M-1 Additive for Mildew


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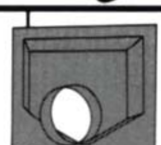

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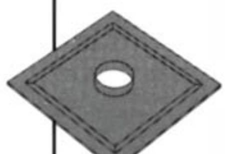

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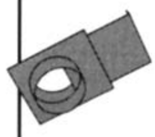

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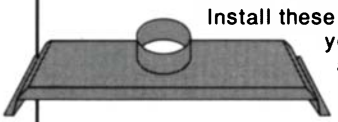

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[Chris Minick is a product development chemist and amateur woodworker in Stillwater, Minn.]

### When is lacquer too old?

***Is there any way to test the quality of a lacquer product? My old boss used to spray several small sample boards with different lacquers. When they were dry, he would put them in a freezer and pull them out repeatedly. The cheap ones, and presumably bad ones, always seemed to crack up. Also, what makes lacquers turn brown? Is it an indication of poor quality or does lacquer lose quality with age?***

*—Colin Conolly, Corvallis, Ore.*

***Michael Dresdner replies:*** Testing the quality of lacquer depends largely on how you define "quality." The test your boss used is one that specifically targets the lacquer's ability to withstand rapid temperature drops without cracking (called "cold checking" in the finishing industry), a characteristic that is of very little consequence for furniture finishes, unless the piece is a lacquered container designed for use in a microwave or freezer. Once furniture is placed inside a house, it will not go through radical temperature drops, since people generally like to keep their home temperature on an even keel. Hence, lacquer manufacturers often assign a low priority to a wood finishing lacquer's resistance to cold checking. One notable exception is the finish on a musical instrument. A guitar in a case is frequently carried from a warm winter home into a chilled car trunk during the ride to the concert hall.

The finishing industry uses a number of tests to gauge a material's characteristics, such as hardness, glossiness, cure time, chemical resistance, flexibility, etc. Formulating a lacquer product involves a trade-off whereby an increase in one characteristic means a decrease in another. Such is the case with resistance to cold checking. One way of making lacquer less susceptible to temperature change is to add plasticizer. This will increase the film's flexibility, but also result in a reduction in brittleness that may reduce a gloss lacquer's ability to be rubbed out to a high sheen. Lacking a complex lab, your best bet is to simply ask your suppliers about the particular qualities of the different lacquers they stock. In choosing a lacquer, it is important to decide what characteristics are important for the job at hand, and ask the supplier for a recommendation.

In regard to aging, lacquer, like many chemicals, has a limited shelf life before it goes bad. Different products have different shelf lives, which are also effected by the storage conditions both in your shop and in the warehouse where the lacquer was kept before you purchased it. Assuming the material is fresh when you buy it (an optimistic assumption at best), you should date the can at the time of purchase and toss it once it passes the manufacturer's recommended period of use. Under favorable conditions, most lacquers have a least a one-year shelf life. However, a material will not necessarily indicate its loss of viability by turning brown, but even if it were to do so, it would certainly not occur on the short trip from the manufacturer to your shop.
[Michael Dresdner is a Contributing Editor for *FWW* and an instrumentmaker and finishing consultant in Perkasie, Pa.]

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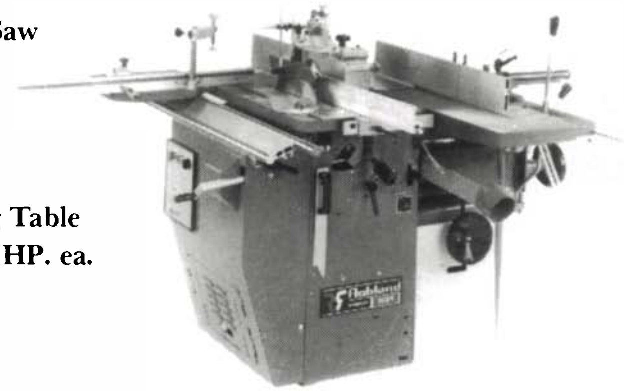

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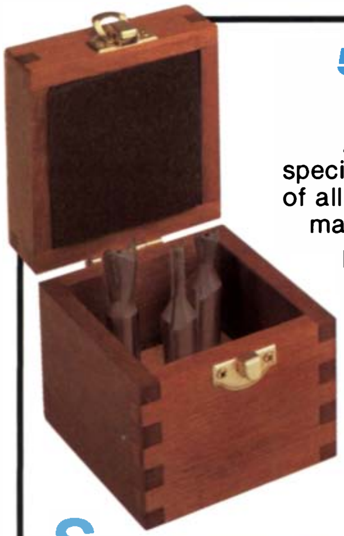

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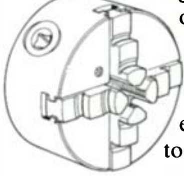

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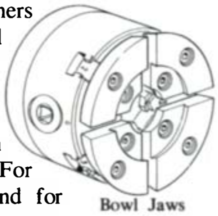
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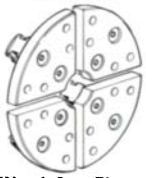
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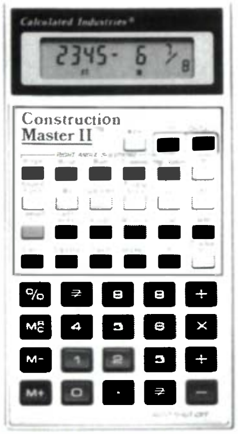


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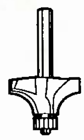

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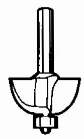

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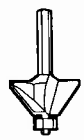

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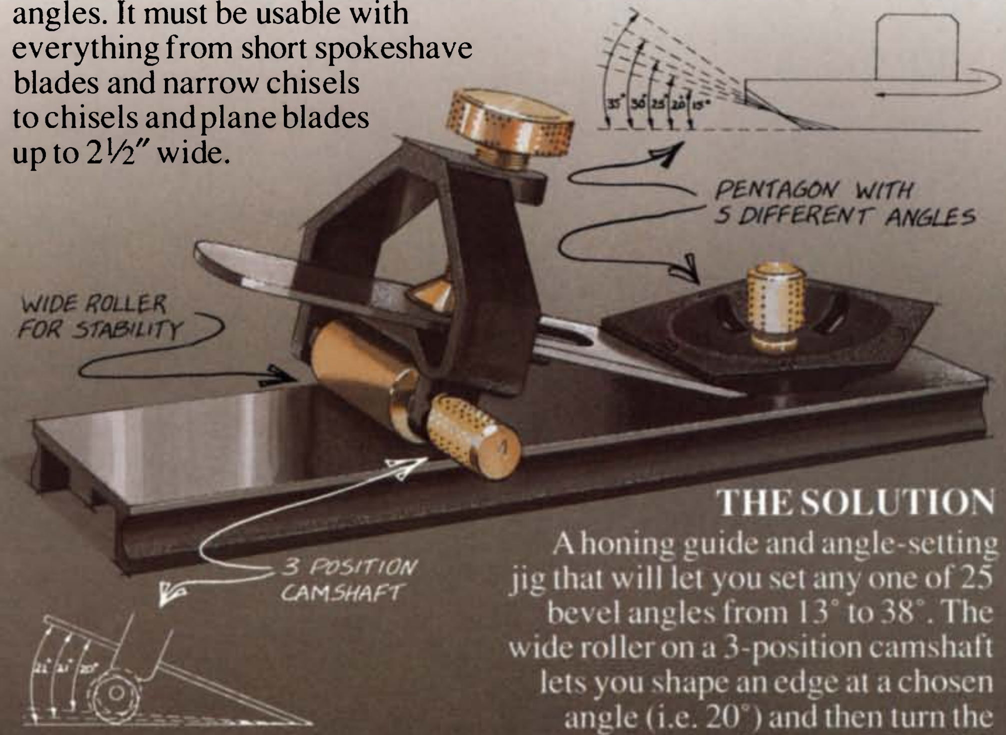


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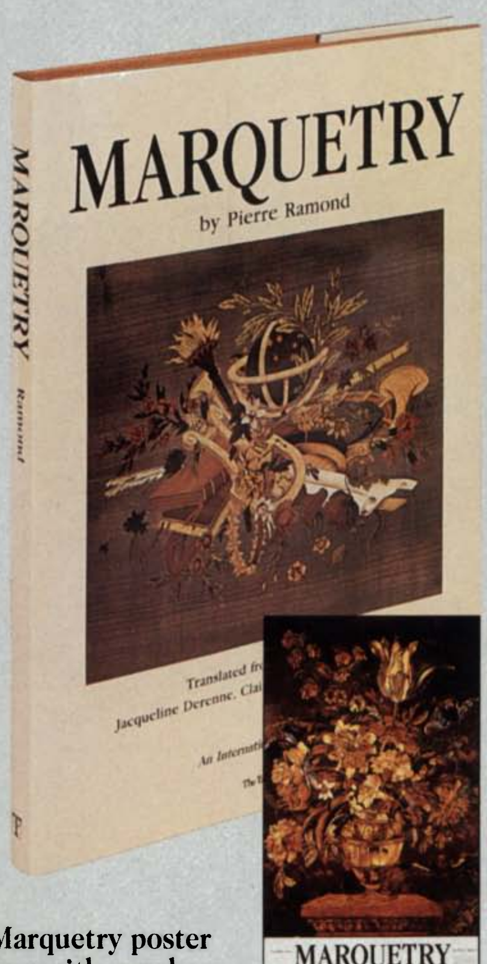


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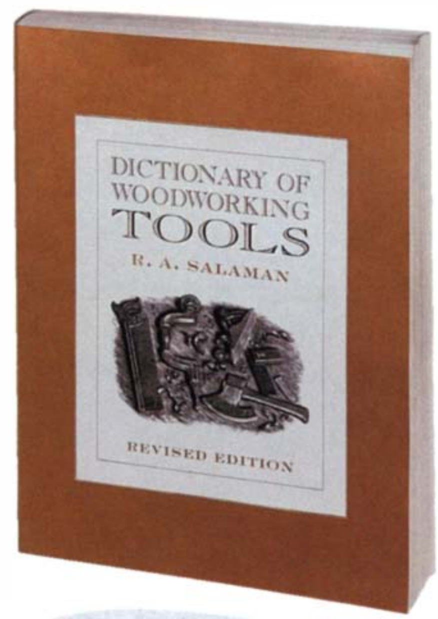


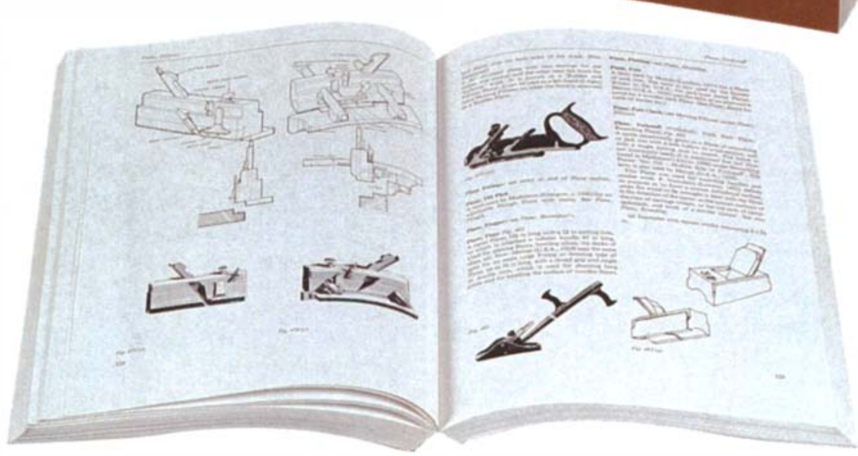

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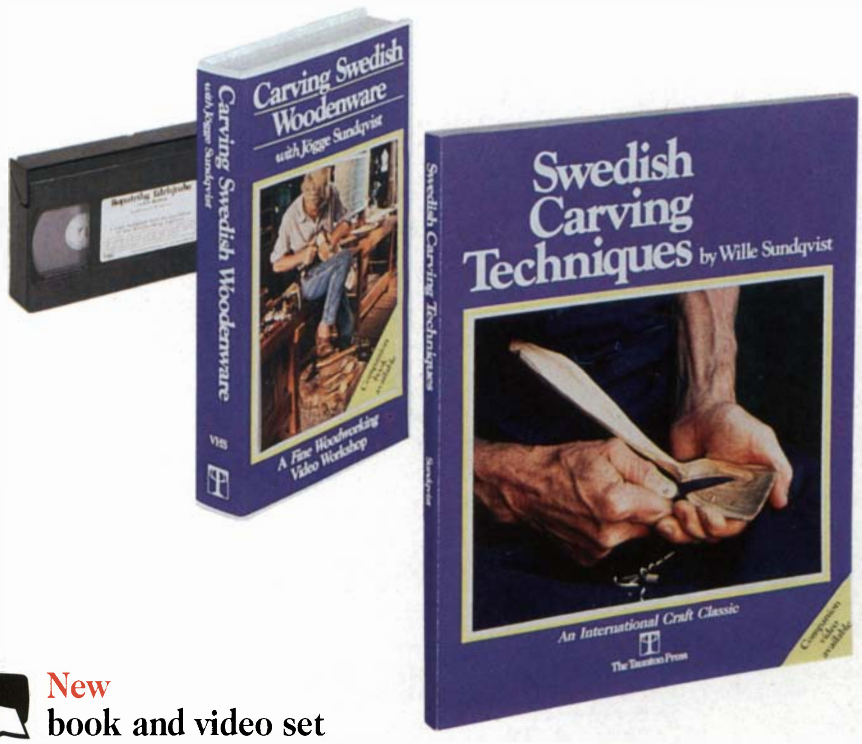


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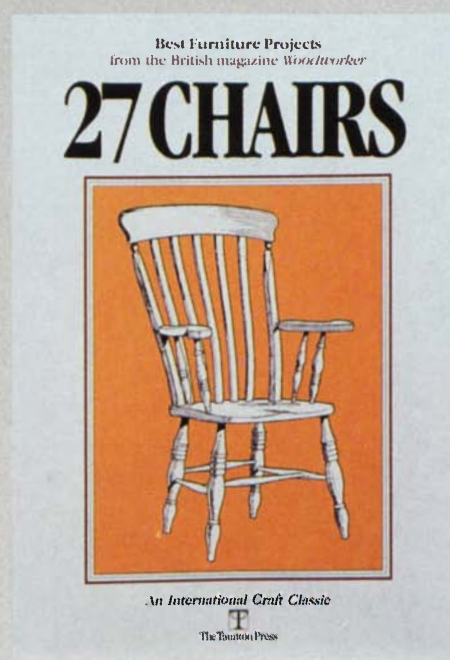


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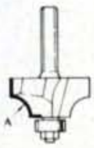

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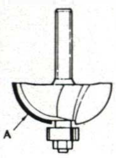

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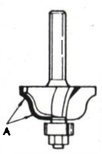

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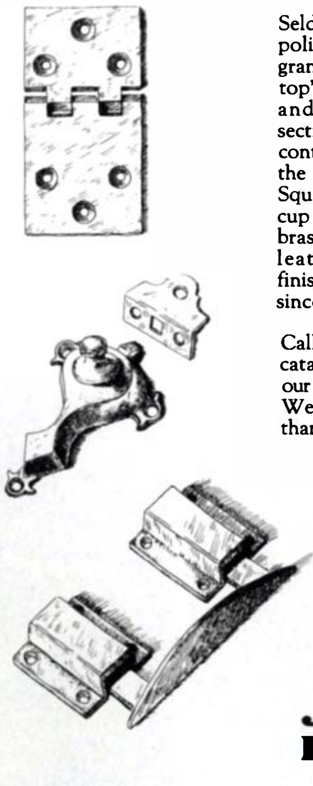

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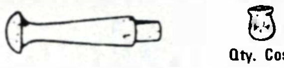

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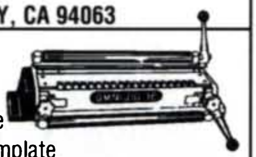

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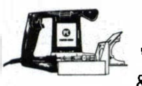

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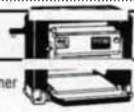

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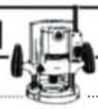

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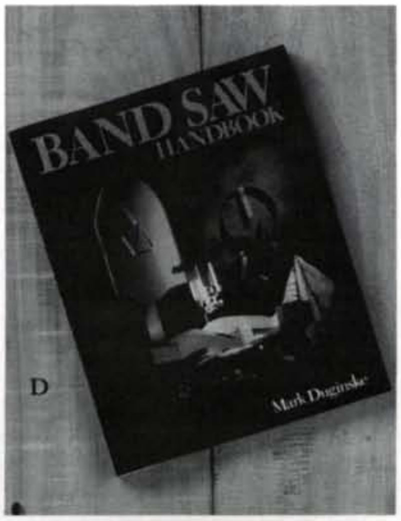


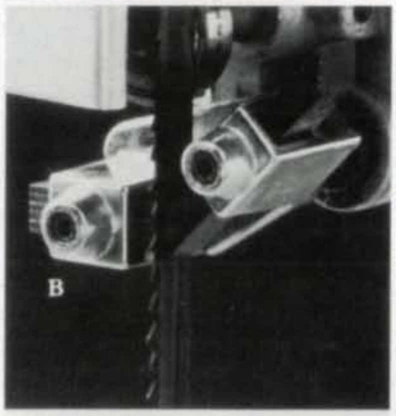


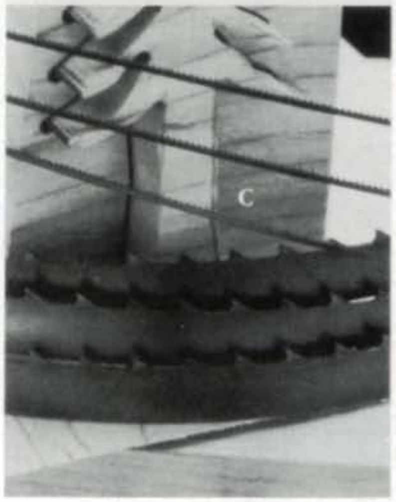


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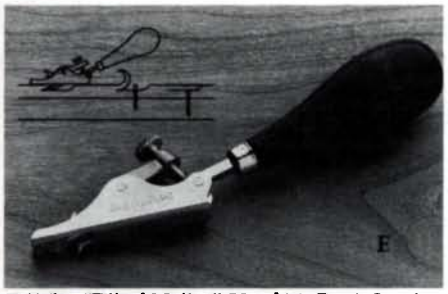


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# Production Chairmaking

## *Jigs and loose tenons simplify angled joinery*

by Terry Moore

Chairmaking seems to intimidate many an accomplished craftsman. I must admit, I shied away from all that angled joinery for years. However, my fears subsided when I eventually realized that people were buying someone else's chairs to go with my tables and desks and there was a risk that those chairs might detract from the beauty of my work. My other consideration was financial: I was losing money by letting all the chairmaking work go to other craftsmen.

Fussing with the angled joints in a typical chair can be a costly chore for many builders, but I simplified the process by basing the joinery on loose tenons, as shown in figure 1 on the facing page. After the parts are shaped, I cut mortises in both halves of each joint, and then join the two pieces with a loose tenon. Angled mortises are easily and accurately cut on the slot mortiser, once it's fitted with a wedge-like fixture, as shown in the top photo on p. 42; the loose tenon stock is ripped out on the tablesaw and the edges rounded over with a router bit. The joints are strong and don't require a lot of hand-fitting. However, the real beauty of this system is that it doesn't constrain my design creativity. Since even the most complicated angled joints can be easily made, my hand is free to design the form most appealing to my eye.

**Writing a plan**—Before beginning construction, I make full-size drawings of my chair and mentally formulate a preliminary step-by-step construction plan (see the sidebar on p. 45). I outline each step, including preparing the stock, cutting parts to length, mortising, milling tenon stock and assembling the piece, trying to anticipate any possible construction problems. I further refine my plan and modify procedures as needed when I build a prototype of the design. Once I'm actually ready to manufacture the set of chairs, most of the thinking work is finished and nearly all dimensions and angles can be picked up from the full-size drawing without using a ruler.

Photo: Thomas Ames, Jr.

*The curved lines of this trestle table are complemented by the walnut chairs that Moore built with a series of jigs.*

I begin production by planing, jointing and ripping stock for all the legs, seat rails and backs, as shown in figure 1. Extras of each part are prepared to avoid having to reset machines to remake damaged or defective pieces. Except for the profile shape of the back legs, I leave all parts square and parallel until the joints have been machined.

The 1⅝-in.-square blanks for the front legs are simply ripped and planed from 8/4 stock and crosscut to 17 in. using a miter gauge on my tablesaw. Stock for three of the seat rails on each chair is ripped and planed 1⅜ in. by 2½ in.; the back seat rail is cut 1⅜ in. by 3¼ in., wide enough to cover the back edge of the seat cushion. The stock for each crest rail and intermediate rail is planed on one side and jointed to 1¾ in. by 2½ in. Using a plywood pattern, lay out as many pairs of back legs as possible on a single piece of 1⅝-in.-thick stock. By choosing the widest stock available, you can orient the pattern so the grain follows the leg's shape and still make the most economical use of the board. The "waste" from cutting the back legs may be used later for back slats, thus ensuring that the grain and color will match throughout.

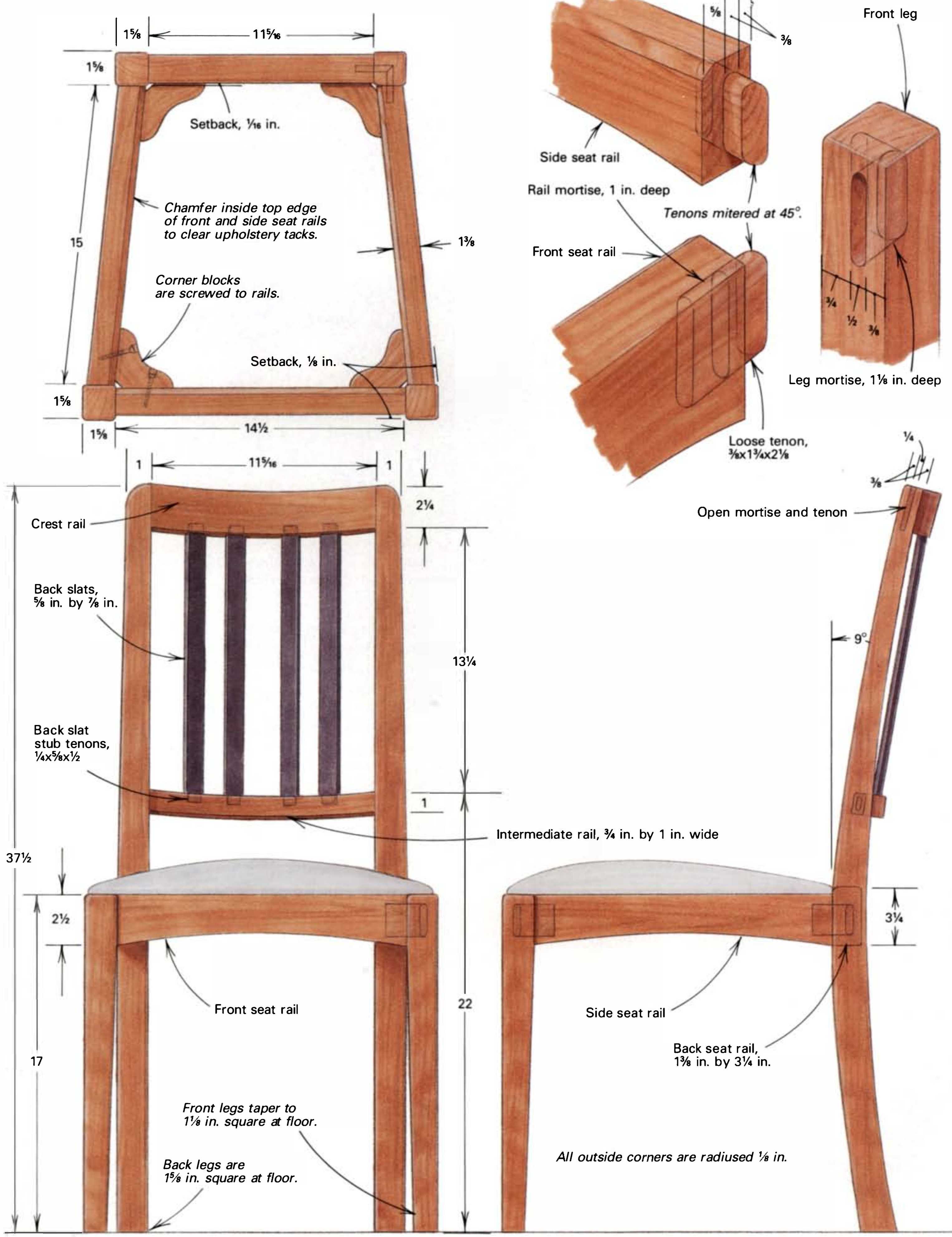
**Shaping from patterns and jigs**—Working with patterns and jigs eliminates the need to measure, so I can almost put my ruler away. The back legs, for example, are laid out with a ¼-in. plywood pattern, shown in figure 2 on p. 42, which was taken from the full-scale drawing. The pattern has a mark that, when transferred to the stock, aligns the roughsawn leg to my profile shaping jig (shown in the bottom photo on p. 42). After bandsawing the legs to within 1/16 in. of the pattern line, I clamp them in the profile jig and run the assembly over my shaper to finish the curve shown in the drawing.

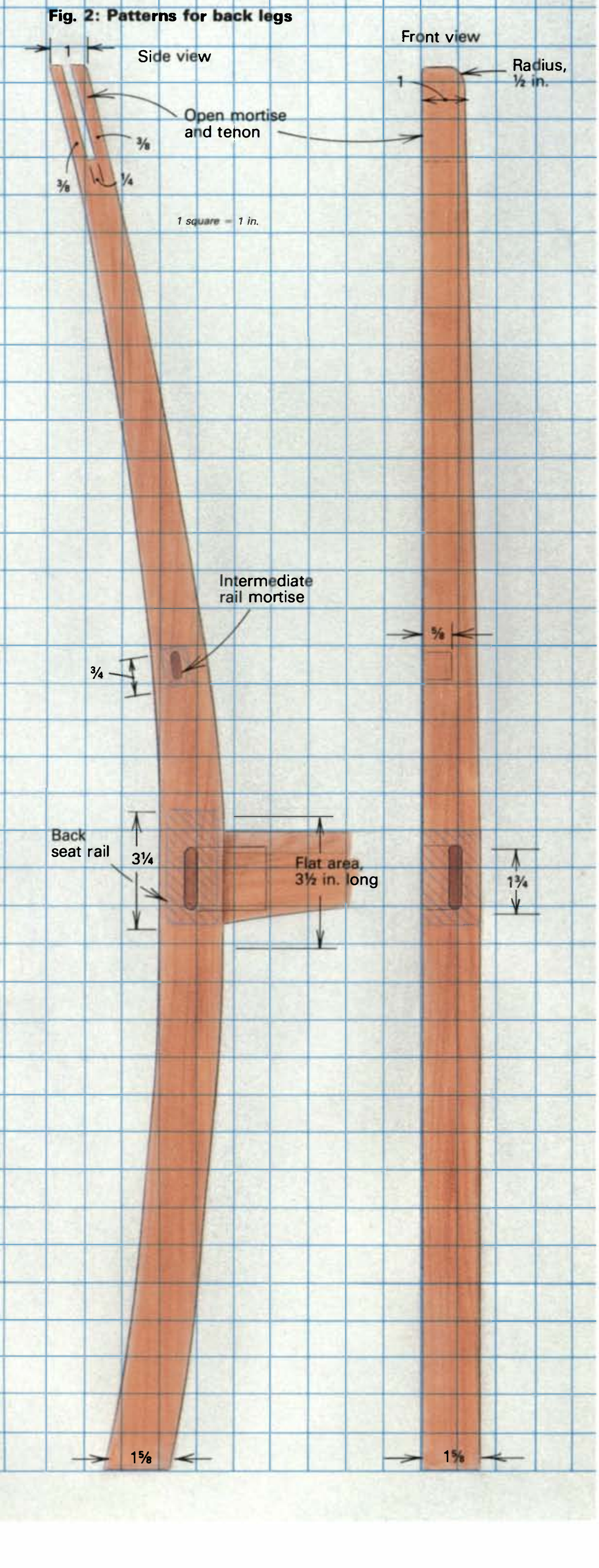
The shaper operation is straightforward. The jig holds the roughsawn back leg securely, while the jig's front edge, which is actually a profile template of the finished leg, follows a guide collar fit in the shaper's table. As the jig's template is run across

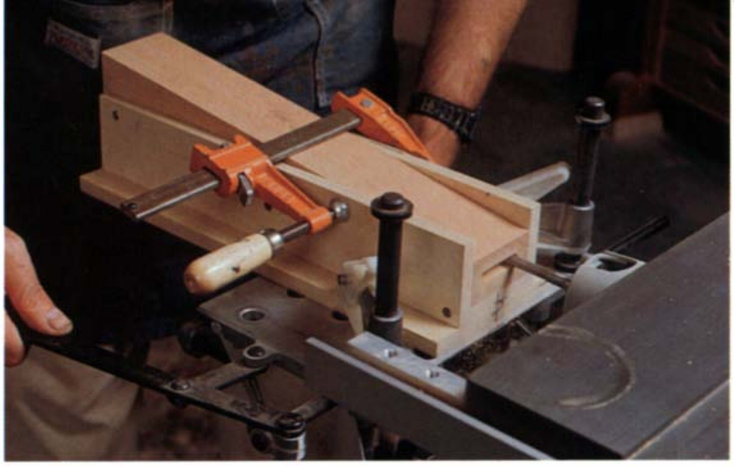


Drawings: Roland Wolf/Bob La Pointe

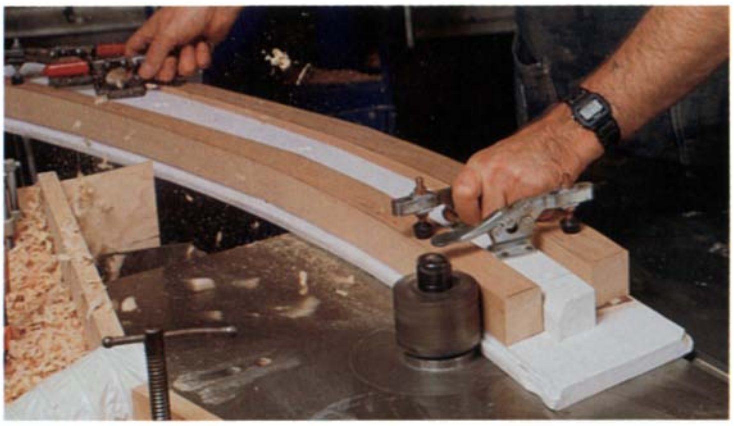
**Fig. 1: Chair plans**





*To cut angled mortises on the ends of the side rails, the author equips his slot mortiser with the auxiliary fixture shown. Note how the centerlines of the fixture and table align during the cut.*



*To shape the back legs, Moore clamps both roughsawn pieces to a jig that rides on the stationary collar in the shaper. The guard has been removed for the photograph.*

the collar, the shaper's straight cutter precisely finishes the leg's profile. Because my shaper's collar is smaller than the cutter, the jig template must be larger than the finished back leg. If you don't have a shaper, you can clamp the back leg in a vise and shape it with a 2½-HP to 3-HP router using a straight bit and bearing that follows a template.

A back leg sizing jig, which looks a lot like the back leg shaping jig, is clamped to the fence on my radial-arm saw to secure the rear leg at the proper angle while it's cut to length.

**Angled tenons and straight mortises**—My mortising system, which is based almost entirely on machines, relies on 90° mortises cut in legs and loose tenons fit into angled mortises in side rails. Gluing these tenons into the rail mortises in effect creates an angled tenon that is very strong because it doesn't have any weak, short grain areas possible on tenons cut at an angle. Both leg and rail mortises are cut to the same width on my Inca slot mortiser (available from Garrett Wade, 161 Ave. of the Americas, New York, N.Y. 10013; 800-221-2942, in N.Y. 212-807-1757), although other mortising machines or a router will work. Since the mortises are cut to uniform width and depth, tenon stock can be milled to uniform thickness and width and rounded over with a router bit. For strength, the tenons meet in a miter, shown in the loose tenon detail in figure 1 on the previous page, which strengthens the joint more than one long and one short tenon would.

Once I've laid out the first mortise of each batch of parts and set up the machine, my job is similar to that of a production worker. When you get the first rail of a batch to fit accurately, the rest are easy. The mortises are laid out on the rail ends with a ⅜-in. shoulder at the top, bottom and outside, and a ⅝-in. shoulder on the inside. The mortising of the front and back legs and front and back rails, which join the legs squarely, is done directly on the slot mortiser table, which is set at 90°. I use an auxiliary side rail fixture, which is shown in the top photo on the previous page, to align each end of the side rails to mill 7° angled mortises. The side rail mortising fixture is quicker to set up and more accurate than changing the angle of the mortiser table. The rail fits snugly on the fixture's 7° bed, which supports the rail so its end is perpendicular to the cutter. After aligning the centerline on the fixture with the centerline on the table and clamping the fixture in place, the mortise width is set with the table-movement-limit levers. The table height can then be adjusted and the first side rail mortise bored.

The 1⅛-in.-deep leg mortises are laid out by holding the appropriate seat rail in position on the leg, tracing the outline of the rail and then marking the mortise. The mortise should be located about ⅜ in. from the top of the front leg and ½ in. from its outside face; this will set back the side and front rails about ⅛ in. Finally, mark the centerline of the back leg mortise, as shown on the three legs in the left photo at right, so you will be able to align the pieces on the mortiser table. Clamp the first leg to the table and adjust the stop collars in the mortiser table's surface so the remaining legs in the series can be accurately placed on the table. Then with the handwheel, set the table height in relation to the cutter, but leave the mortise width set the same as for the rails. After making sure the seat rail tenon fits the first mortise, you can mortise the remaining legs with the same setup by simply marking and aligning the mortise centerline.

After mortising the front and back legs and all four seat rails, I taper the front legs and cut and shape the curve in the bottom of the seat rails, as shown on the patterns in figure 3 below. The straight tapers on the front legs are rough cut on the tablesaw, with a taper jig, and cleaned up on the jointer. Curves in seat rails are bandsawn from patterns and finished on the spindle shaper with jigs.

**Chair backs and crest rails**—The crest and intermediate rails are curved to conform to the roundness of the human back. Before sawing them to shape or cutting mortises in these rails for vertical back slats, I set up the tablesaw and cut the open mortise-and-tenon joint on the rail ends and on top of the back legs (see figure 1 on p. 41).

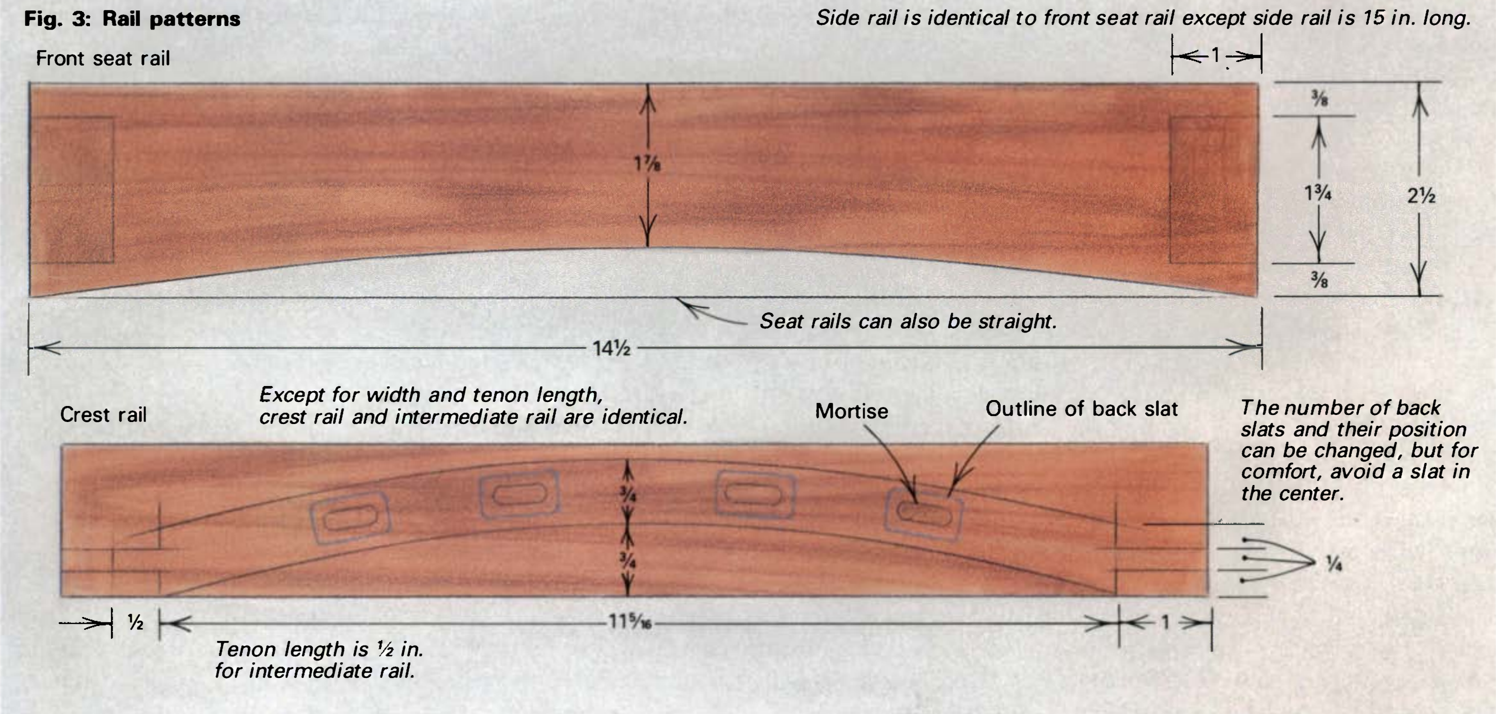
***Left:** Slot mortising is simple after careful preparation on the first leg (top). Moore has laid out the mortise on the joint's centerline. After cutting one (middle) and checking its fit, he can mortise the remaining legs by using only a centerline for reference (bottom).*

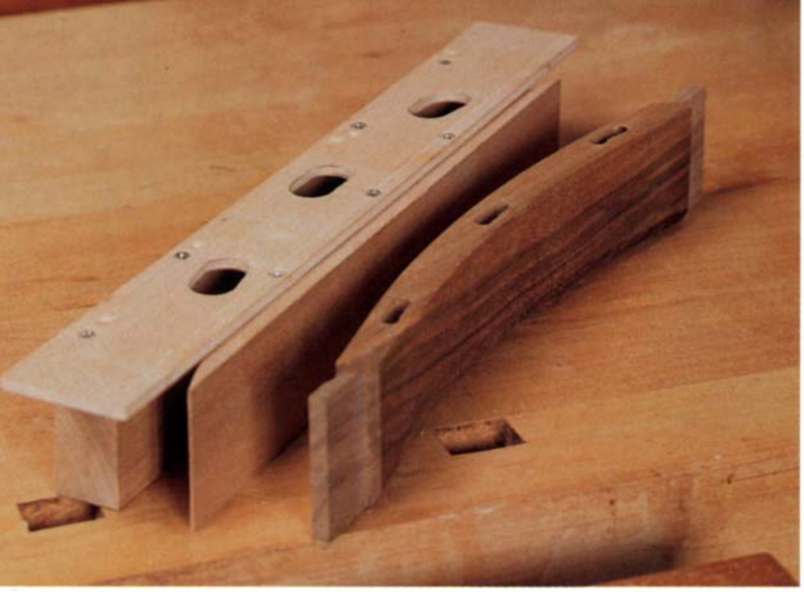
***Right:** The author cuts the ¼-in. open mortise in the top of the back leg with a tenon jig on the tablesaw. After squaring the leg's end to the table, a shim is temporarily taped to the jig to align the remaining legs.*

I use the tablesaw tenon jig and a dado blade to cut both back leg mortises as well as the shoulders on the crest- and intermediate-rail tenons. I set the blade 90° to the table and angle the back leg in the tenon jig to cut the open mortise parallel to the front of the back leg. Use a try square to check that the front line of the crest rail mortise is perpendicular to the saw's table, and tape a shim to the tenon jig, between it and the leg, as shown in the right photo above. If the setup is correct, cut the mortises in the top of all the back legs.

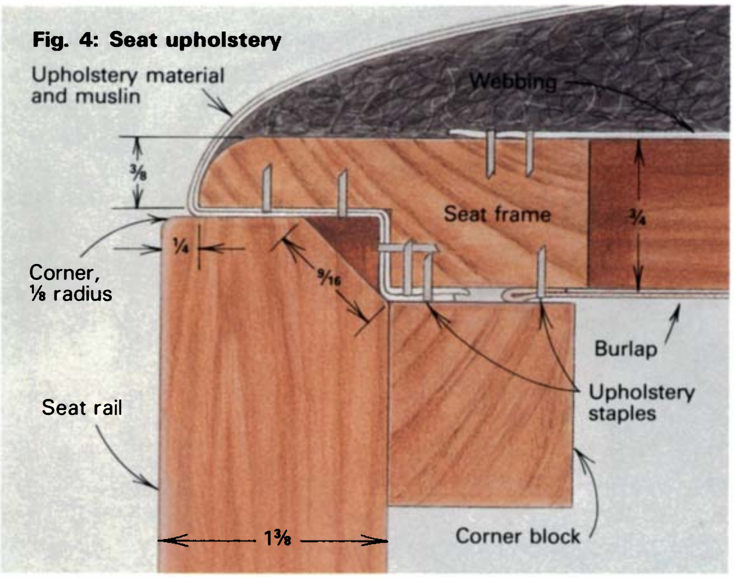
Then, in order to cut straight, parallel tenons on the crest and intermediate rails, remove the shim and reset the jig. Since the crest rail stock is still straight and unshaped, it's simply clamped in the jig perpendicular to the saw's table. You can eliminate considerable handwork and ensure that each intermediate rail will be of uniform curve if you use stock wide enough for two rails. I simply cut both crest rails and intermediate rails to the same dimensions, and then cut a single, continuous tenon on both ends of the stock; later I rip an extra crest rail in half to

**Fig. 3: Rail patterns**





*The author mortises the crest and intermediate rails to accept the back slats with this simple plunge-router jig. Each shaped rail is fit into the curved slot in the jig and the whole assembly is clamped in a vise; the slots shown guide the router's collar during the cut.*




produce the two intermediate rails.

Next, lay out the curve in the crest and intermediate rails from the pattern in figure 3 (see the previous page) and bandsaw them to shape. After sawing to the line, I use a compass plane to true up the front, concave curve and a smoothing plane to finish the back, convex curve before scraping and sanding. Then I rip intermediate rails from crest rail stock, and cut their tenons to ½ in. long by ¾ in. wide, with a ⅛-in. shoulder on the top and bottom. In each case, check the first tenon's fit in a leg mortise before cutting the rest of the tenons. Leave the crest rail tenons full width.

Mortises on the inside of the back legs, for intermediate rails, are cut with a plunge router and a ¼-in. straight bit guided by a slot cut in the leg profile pattern. To shape the outside of the rear leg, which tapers from the top of the seat to the top of the leg, I trace the pattern, shown in figure 2 on p. 42, rough-cut the shape on the bandsaw and finish with jigs on the spindle shaper.

**Back slat tenons and their mortises**—I use a plunge router and simple jig to plunge-cut the mortises in the crest rail and intermediate rail to accept the stub tenons on the back slats. The router jig, shown in the photo above, registers and holds the curved crest and intermediate rail stock, while the router's collar is guided by the holes in the jig's thin plywood template. Locate the collar in the hole, and plunge a ¼-in. straight bit into the rail as you move the bit in the slot and gradually plunge-cut to the ½-in. mortise depth.

The back slat tenons must be angled—about 1½° for the intermediate rail and 4½° for the crest rail. To measure these angles, dry-assemble the back legs, intermediate rail and crest rail; then, hold a straightedge against the rails at the chair's centerline and set a bevel gauge to the angle between the rail edges and straightedge. I cut the tenons in one pass on the spindle shaper, which is set up with two straight ½-in. cutters separated by a ¼-in. spacer. The stock is supported during the cut by a sliding-table jig that rides in the table's slot. Begin with stock that is wide enough for multiple slats and cut the pieces to length. Wedge up the tail end of the stock in the jig until the end to be cut is at the proper angle to the cutter, and then clamp the stock against the jig's fence. Once a continuous tenon is cut in both ends of the back slat stock, the stock is ripped into multiple slats, which are rounded over and finished.

After the mortising and shaping is done, I crosscut and miter the loose tenon stock to length and glue the pieces into the rail mortises.

**Assembling the chair**—Before assembly, I round over all corners with a ⅛-in. radius bit, sand and carefully apply a sealer coat of Watco oil (available from Minwax Co., 102 Chestnut Ridge Plaza, Montvale, N.J. 07645), making sure not to get it on joint surfaces. Sealing with oil helps keep parts free of glue during assembly.

A systematic approach to assembly is a must. After a dry run to check the joinery for fit, I glue up the 90° joints first, which are the front and back subassemblies. The front subassembly is the two front legs and the front seat rail and the back subassembly is the two back legs, back seat rail and intermediate rail. The crest rail and back slats, because of the open mortise-and-tenon joint at the top of the back legs, are added later. Try to match wood color and grain during assembly and clean up glue with a damp rag as you go.

When the glue has dried, dry-fit the front and back subassemblies together with their side rails. Pare shoulders and tenons as needed to ensure a good fit and then gather tools and parts for final assembly: two bar or pipe clamps, some clamp pads and a damp rag. Working on one chair at a time, I glue the side rails to the back subassembly and then the front subassembly to the side rails, working quickly so any needed adjustments can be made before the glue sets up.

The chair isn't complete until I have installed corner blocks on the inside of the seat rail frame and made a slip cushion seat frame, which will be padded and covered. Since my chairs are built of strong components joined with well-fit mortises and tenons, corner blocks serve only to secure the seat. Regardless, they are tightly fit and fastened to the inside of the seat rails with screws.

Traditionally, the seat is an upholstered hardwood frame with webbing and horse-hair padding, but I use a piece of well-padded ¾-in. plywood on some chairs. For more on upholstering a seat, see *FWW* #79, pp. 78-81. I allow room for the fabric and padding, which is stapled to the underside of the slip cushion, by routing the inside of the seat frame, as shown in figure 4 at left, with a chamfering bit. While I apply the oil to the chair frame, I send the slip seat frame out to be upholstered.

Finally, place the chair on a flat surface, check if it sits flat on all four legs; if one leg is long, mark it and cut or sand it to length. Now you're ready to rump test it and move on to the next chair or set of chairs. □

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*Terry Moore was brought to Newport, N.H., from Wales, Great Britain, as his wife's "souvenir" 15 years ago. He's been a cabinetmaker and furnituremaker there ever since.*

# Designing a chair

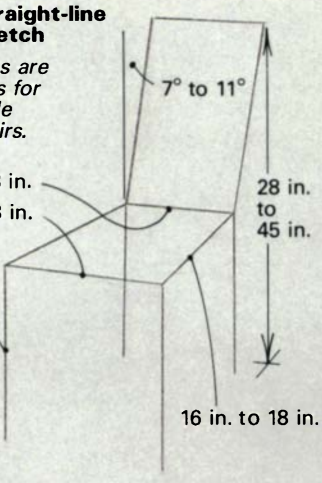



**Fig. 5: Straight-line sketch**

*Dimensions are parameters for comfortable dining chairs.*

When I set out to develop this chair series, it was not my intention to design something new or flashy. I simply wanted to develop a sound construction process that would leave the final design of the chair variable. When designing chairs, you must reconcile comfort, strength and aesthetics, but my foremost consideration is comfort. After all, if a chair isn't comfortable, its design fails. Secondly, it must be strong and durable, or it will fall apart. And if the chair isn't attractive, nobody will want it in their home. All three aspects are important and must be dealt with.

I studied dining chair comfort by analyzing and critiquing many different types of chairs and querying other adults of various sizes about their comfort requirements. The results of my research are the parameters listed for the chair in figure 5 above. The height of the back, often an aesthetic consideration, can be as little as 28 in., as in a Sam Maloof type low-back chair, or as great as 45 in., as in a Charles Rennie Mackintosh type high-back chair. My dining chairs have higher-than-average backs to provide comfort and upper-back support when reclining after a meal.

Once I established basic seat dimensions, I studied how other chairmakers blend comfort with aesthetics and sturdy construction. Excellent sources of information and inspiration were museums and galleries. I brought a measuring rule and notebook and remembered to ask permission before taking measurements. Taking special note of what I liked and disliked about a particular design, I tried not to be intimidated by what I saw while making rough sketches of designs and noting construction details.

**At the drawing board:** With sketches in my notebook and ideas fresh in my head, I drew simple, straight-line sketches, such as those in figure 5. Once I liked the basic dimensions, I refined the lines so the chair would blend with its accompanying table. Then I worked the simple sketches into detailed, measured drawings, like those in figure 1 on p. 41, with side and front elevations and a plan of the seat, along with any curvature designed into the back. At this point it's not necessary to draw many construction details, except you must remember to provide enough wood for joint construction and to show joints that will be visible, such as the open mortise and tenon at the top of the back legs in figure 1.

The crest rail, along with the space beneath it and the seat, is the designer's focal point of the chair. The chairs in the photo below are from the same design series, but each have different backs. In each successful variation, every aspect of the design must blend together to convey consistency.

**Full-size drawings and prototypes:** My last design steps are to draw the chair full size to show the front, side and plan views as well as joinery details. Full-size drawings have X-ray details of joints; unless I need to visualize construction details, I don't bother with perspective drawings.

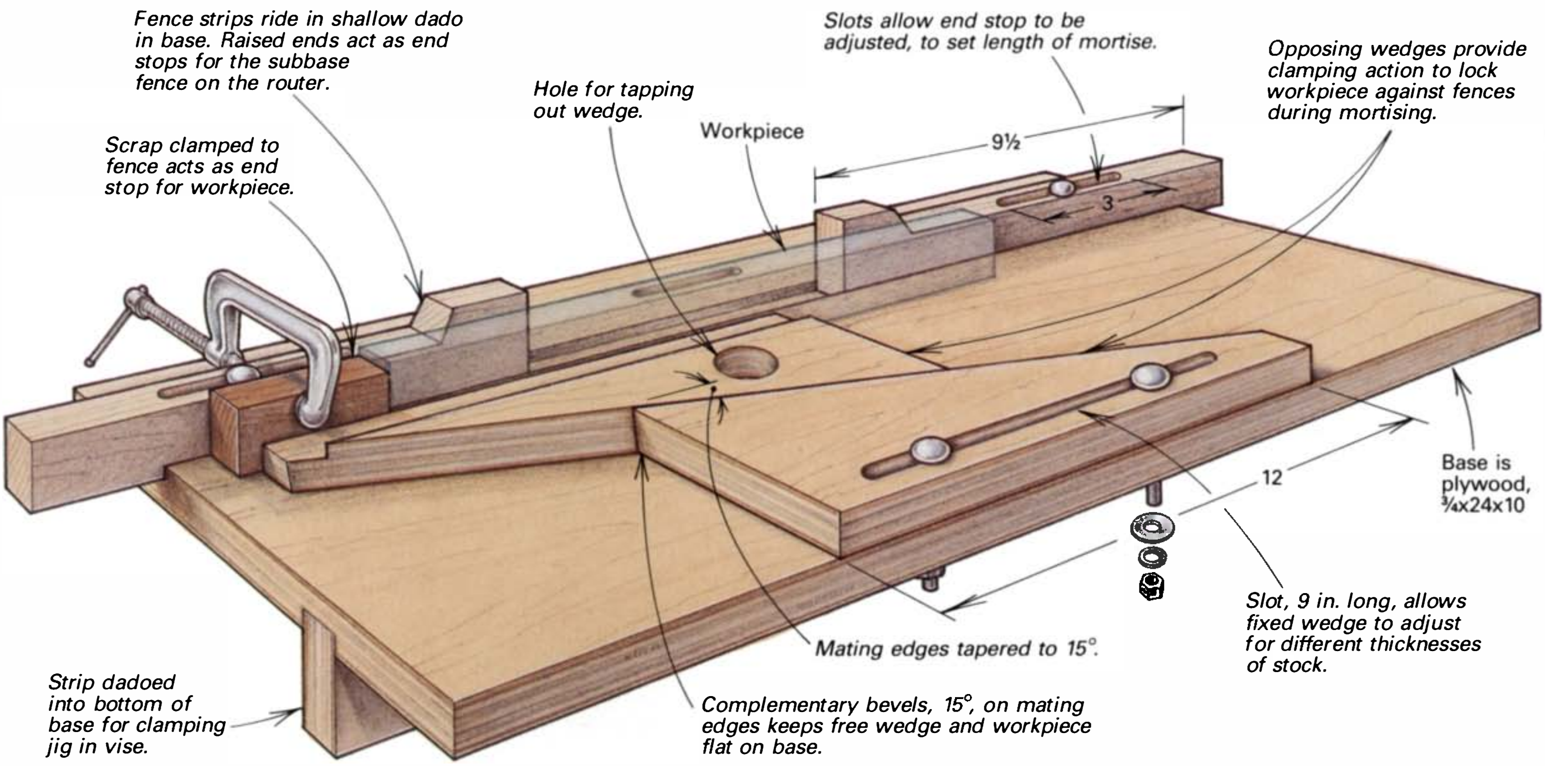
Before building a prototype, I pick up patterns, dimensions, angles and joinery details from the full-size drawings, as well as information to design jigs and fixtures that make construction faster and more accurate.

I build the prototype from oak with the exact dimensions and joinery details as shown on the full-scale design. The chair isn't a mock-up, built of glued-together cheap material; it's identical to finished chairs in every detail, so it becomes a tool for working out assembly details. I use the prototype's disassembled parts to set up machines for difficult cuts and to test my assembly procedures. Once the prototype is assembled without glue, I can see and sit on a real chair and affirm whether the design does or doesn't work. This is my last chance to make changes before beginning the production run. Once finished with a set of chairs, I save the knocked-down prototype as a model to show prospective customers and to refresh my memory when building the next set.

If the first chairs are comfortable, sturdy and attractive and if the design sells, the model can be changed and elaborated upon in future chair sets. Maintaining the same joinery details, I have changed leg and seat rail profiles, back heights, crest rails and other elements of a design series to produce different chairs that complement different table designs, such as the three chairs shown in the photo below. *—T.M.*

*These chairs are from the same design series developed by Moore. Although each is different, they all share the same construction methods based on a series of shop-built patterns and jigs. The chair on the left is of Honduras mahogany, the chair in the middle is curly maple with rosewood inlay and the chair on the right is cherry with ebonized back slats.*

**Fig. 1: Mortise jig**




# Machine-Made Mortises and Tenons

## *Production techniques for high-quality joinery*

by Mark Duginske

Craftsmen have been joining pieces of wood together for centuries, always looking for a better way to do it. Our ancestors had to depend on interlocking joints for strength because their glues were not reliable. Dovetails were preferred for carcases; mortise-and-tenon joints for frames. Today these joints are still favorites for high-quality work, but cost-conscious workers need economical ways to make them. Modern router jigs efficiently turn out miles of dovetails, but there's no comparable, low-cost machine for mortise-and-tenon production. So I decided to develop my own system for making mortises and tenons quickly and efficiently with shopmade jigs and standard machines found in most woodshops.

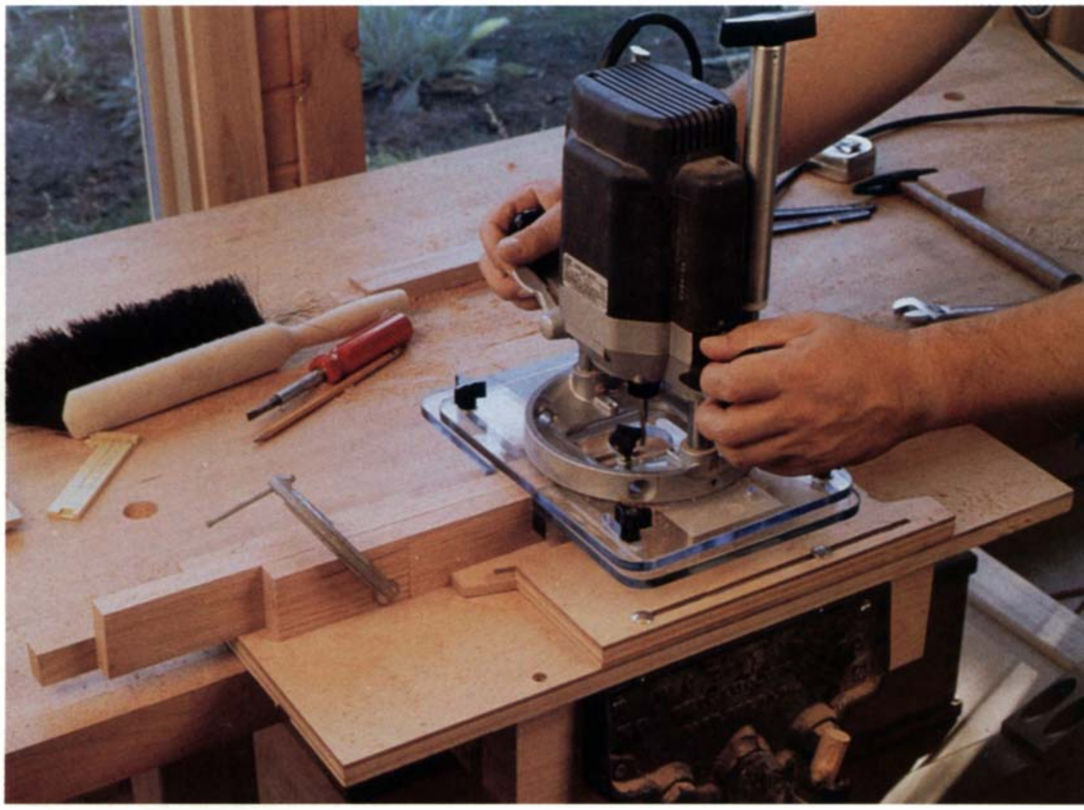
The mortise-and-tenon joint is ideal for frames of desks, chests of drawers, bookcases and cabinets of all kinds. Once a well-fit mortise-and-tenon joint is glued together, the mechanical contact and the large surface area of the mating faces make it very strong. Mortises and tenons are also great for joining stretchers to chair and stool legs, since the tenons' shoulders make the joint particularly resistant to racking. The joint's only real weakness is that the tenon can be pulled straight out of the mortise fairly easily, but this can be controlled by good gluing and, in demanding situations, a locking pin.

My joinery system is specifically designed for production with machines. A plunge router, fitted with an end-mill type bit and a special base, works in conjunction with a holding-and-referencing jig to cut slot-type mortises. The tenons are cut with both the tablesaw and bandsaw: shoulders are crosscut on a tablesaw, and then cheeks are ripped on a bandsaw equipped with an adjustable tenon fence. Finally, the tenons' square corners are chamfered to fit snugly in the rounded corners of the mortise (see the left photo on the facing page). One advantage of my three-machine system is that some setups can be fine-tuned independently of others. This allows you to go back and repeat a step, say if you accidentally mess up a cut.

**Preparing the stock**–The first step of my machine system is to rip all the frame stock to width and plane it to the same thickness. To ensure consistency and accuracy, every piece needs to be exactly the same thickness; otherwise it will be difficult to fit the tenons later. Also, make sure your planer's knives are parallel to the bed, or take the final pass over the same area of the bed. Next, cut all frame members to length, remembering to leave extra length on stiles or rails that will receive tenons. Be sure to cut a few extra



Photos by author except where noted; drawings: David Dann



*The author's system for cutting mortises and tenons, shown above, is based on three common shop machines: mortises are cut with a special plunge-routing fixture and tenons are cut accurately and efficiently with bandsaw and tablesaw setups. Shown at right, Duginske's shop-made mortise jig uses a pair of opposing wedges to firmly support the frame member on edge as the slot mortise is routed. The adjustable fence also features a set of stops, which limit router travel and hence the length of the mortise.*

pieces of stock, which are later used to set up the jigs.

Traditionally, mortise-and-tenon joints are proportioned so the thickness of the tenon equals one-third the thickness of the stock; for instance, a ¼-in.-thick tenon would be right for ¾-in. stock. Likewise, the deeper the mortise, the stronger the joint because of the increased contact area between the two pieces. Usually on 2-in.-wide stock, I make the mortises 1⅜ in. deep. Later, I cut the tenons 1¼ in. long, which leaves a ⅛-in. clearance at the bottom of the mortise. In this case, members with tenons on both ends need to have an extra 2½ in. in length. On a narrow, 1-in.-wide frame, I would use a ⅞-in.-deep mortise and a ¾-in.-long tenon.

**Cutting mortises**—My machine method follows the same order that is traditionally used for handmade joints: I make the mortise first, which is cut with the plunge router and end mill, and then cut the tenon to fit into the mortise. Since most routers are a little top-heavy, and this makes them hard to control, I replace the standard router base with a special auxiliary base fitted with two adjustable fences. These fences fit snugly on either side of the workpiece during mortising, to align the cut on the thickness of the stock and to stabilize the router atop the edge of the workpiece, allowing it to only move forward and backward. Although I have made bases out of wood, I now use a clear, plastic base and fence system made by Woodhaven, 5323 W. Kimberly Road, Davenport, Ia. 52806; (319) 391-2386. The clear base makes it easy to see alignment marks on the workpiece.

The mortise jig, shown in the right photo above and figure 1 on the facing page, holds the workpiece steady during routing and provides stops for limiting the cut of the router. It can be assembled in about an hour from pieces of scrapwood and a few nuts and bolts. The jig consists of a ¾-in.-thick plywood base with a strip dadoed into the underside for clamping in a bench vise. A shallow dado in the top of the base holds two fences, and their inside ends serve as stops for the router base fence. Once the stops are set, the fences lock to the base with bolts riding in slotted holes. Two plywood wedges, each tapered and beveled at a 15° angle, secure the workpiece during mortising. One wedge is fixed, bolted to the base via a slot, and the other wedge is free-moving. The tapered edges are driven against one another by tapping the free wedge with a hammer, forcing the workpiece against the fence. A hole in the free wedge provides a spot to tap, for separating the work after mortising. An end stop—a scrap the same width as the workpiece—is clamped or screwed to the router stop, to locate the end of the workpiece in relationship to the position of the router. Thus the distance between the mortise and end of the workpiece can be accurately set, for cutting corner joints. Only those frame members with mortises in the center need to be marked and positioned before mortising. In this case, I mark out the two ends of the mortise, put the router against one stop and then move the stock so one of the layout marks is aligned with the bit. After clamping the stock, I move the other stop to align the router bit with the second layout mark.

For efficiency, I follow a definite sequence in setting up the router and jig for mortising. First, I center the mortise, and then set the depth of cut of the router's bit; finally, the fence stops for the length of the mortise are set. The mortises must be exactly centered on the stock; it may take a little extra time setting up the fences on the router base, but you'll save time later when the tenons are made and fitted. The best way to check the position of the mortises is to make a plunge cut on one edge of a scrap piece, turn the piece over and make another plunge cut on the other side. When the cuts line up, the mortise is centered.

The router bit I use for mortising is a double-flute, "up-cut" end mill. This bit cuts on both the sides and the bottom, making a clean, slotted mortise. Flutes on an up-cut bit are similar to a drill bit: They pull the waste up and out of the cut. Although end mills are capable of taking up to a ⅜-in.-deep cut per pass, you'll get the best results with many small passes, perhaps taking ⅛ in. or less per pass. Move the router back and forth with a slow rhythmic motion and plunge slightly deeper on each pass until you reach the desired depth. Avoid heavy cuts: Overtaxing the bit can produce chatter or vibration that will leave the sides of the mortise irregular and rough and possibly cause bit slippage, which can rapidly wear the collet. The latter can not only cause too-deep mortises, but, if the bit slips completely out of the collet, it can be dangerous. Keep an eye on this by placing an ink mark on the bit and the collet; if the marks move during mortising, the bit is slipping and it may be time to order a new collet. Also, a sharp bit has much less of a tendency to vibrate than a dull one. If you do a lot of mortising, you might consider using solid carbide bits instead of high-speed steel bits.

If you're using a variable-speed plunge router, you should set it to run at about 12,000 RPM. The slower speed, combined with taking light passes, is best for smooth, clean mortises—especially with a small bit, such as ¼ in. dia., or with a particularly hard wood, such as maple. You should experiment on scrap stock before deciding on the best router speed.

The length of the mortise is now set by adjusting the mortise jig's stops. With my system, the mortise must be cut ¼ in. shorter than the width of the tenon stock because of the way the tenons are trimmed later. In this case, the stock is 2 in. wide, so the mortise is 1¾ in. long. Once the stops are adjusted, you're ready to run your batch of mortises. When machining wider stock, such as chair or table legs, the router can slide directly on the edge of a single member. But when mortising narrower stock, such as ¾-in. face frames, it's best to clamp two members side by side for a wider, more stable base for the router, to prevent it from tipping. After you've mortised all the necessary workpieces, mortise two extra scrap pieces for setting up subsequent operations.

**Sawing the tenons**—The tenons are made in three cutting stages. First, a shallow kerf is crosscut all the way around the end of the workpiece, to define the tenon shoulder. Second, the cheeks of the tenon, as well as the edges, are cut off. Finally, the edges of the tenon itself are chamfered to fit the round-cornered mortise. The shoulder cuts are made using the miter gauge on the tablesaw. I prefer to use a sharp crosscut or combination blade, which yields a crisp cut without tearout. The saw's rip fence is used as a stop for setting the length of the tenon, which is determined by the distance between the fence and the left edge of the blade. As a rule, you should not use the fence and the miter gauge together, but in this situation you don't have to worry about a cut-off piece binding between the blade and fence. To assure a perfect tenon shoulder all the way around, square the miter gauge to the blade and set the fence parallel to the blade. Further, it's important for the face of the fence to be square to the table; otherwise, when you rotate the stock for the various cuts, the wood will contact different parts of the fence and the shoulder cuts won't match all the way around.

All four shoulder cuts are made with the blade at the same height, which is set as follows. Crosscut one of the extra mortised pieces through its mortise, place it next to the blade and set the blade to be about ⅓₂-in. higher than the wall thickness (see the left photo below). Rotate the blade back and forth to make sure you are setting the saw height with the tooth at top dead center.

After all the shoulders are cut, I cut the tenon cheeks on the bandsaw, which yields some distinct advantages over a tablesaw. First, the bandsaw blade's narrower kerf makes taking this power-hungry end-grain cut easier. Second, the cheeks are cut with the stock horizontal on the table; with a tenon jig, the stock sticks straight up, and the length of stock you can tenon is limited. Also, frame pieces don't need to be clamped to a jig, which saves time when cutting dozens of tenons. For accurate, repetitive cuts on the bandsaw, use a rip fence. If your saw doesn't have one, you can make the special rip fence, shown in figure 2 on the facing page, from wood scraps and carriage bolts. The face of this fence bolts to a subfence with wing nuts, which allows me to insert paper shims for fine-tuning the fence-to-blade distance and, hence, the thickness of the tenon. The subfence is bolted to a crosspiece that references to the edge of the bandsaw table, and it's attached to the table with a clamp. The crosspiece allows the angle of the fence to be fine-tuned for accommodating blade lead, the tendency of the blade to pull slightly one way or another during the cut. An adjustable stop, bolted to the fence through a slotted hole, allows you to set the depth of the tenon cuts. Although it doesn't make a great deal of difference what bandsaw blade you use, a ¼-in. four or six teeth-per-inch (TPI) blade works well. The bandsaw must be properly adjusted for this technique to work. To prevent the blade from fluctuating sideways, the guides are actually placed in contact with

Staff

*Above: A scrap piece of frame stock that's been mortised and cut through serves as a gauge for setting up the tablesaw blade for the crosscut that defines the tenon shoulder. The frame members are guided through the cut by the saw's miter gauge, while the fence acts as an end stop. Right: The tenon cheeks are bandsawn because it's easier to hold the stock horizontally during the cut, rather than vertically as with a tablesaw tenon jig. The tenon fence position, and hence the thickness of the tenon, is fine-tuned with dollar-bill shims.*

the blade. I use cool blocks, which are non-metal replacement guide blocks containing a dry lubricant, to decrease the friction created by metal-to-metal contact. For more on bandsaw adjustment, see my article in *FWW* #75, pp. 75-77.

Set up the fence on the bandsaw, as shown in the right photo on the facing page, with the tenon between the blade and the fence, so as the cheeks are cut, the waste doesn't get trapped between blade and fence. Now use the scrap mortise as a gauge to set the fence-to-blade distance in the same way as you set the depth of the shoulder cuts earlier. With the mortise scrap against the fence, the blade should cut the first sample tenon about 1/64-in. oversize. Adjust the fence closer to the blade by inserting paper shims (I often use dollar bills for shims, because each one is 0.004 in. thick) between the fence halves and make another cut. Remember that the amount you move the fence will be doubled because you're taking that amount off each side of the tenon. Also, use a new piece of scrap for each new adjustment; if you use the previously cut piece, the bandsaw blade will deflect and you will not get a true reading. Ideally, the tenon should fit into the mortise with about 0.004 in. extra on each side, which is the thickness of a layer of glue.

After the face cheeks are done, trim the edge cheeks of the tenon back to the shoulder. This requires the fence to be reset so that the blade will take slightly more than 1/8 in. off each edge of the tenon. To do the trimming, follow the same procedure as with cutting the face cheeks, described previously. Remove material until the tenon is about 1/16 in. narrower than the mortise. In the case of a 1¾-in. mortise, the tenon will be 1 11/16 in. This space enables me to fit the tenons by chamfering the corners rather than fully rounding the tenon.

**Fitting the joint with bevel cuts**—Since the tenon corners are square and the mortise corners round, the tenon won't fit until either the mortise corners are chiseled square or the tenons are rounded. After years of experimentation, I've decided that it's easiest to chamfer the tenons. The chamfers allow a small space between the flat surface of the tenon and round surface of the mortise, and ensure a perfectly mating joint because the space allows glue squeeze-out. If there is too much glue in the mortise, the space releases the hydraulic pressure, allowing air or glue to escape. Chamfering can be accomplished by hand with a rasp, but it's better done on the bandsaw, especially if you need lots of tenons for a large job. Set the bandsaw table to 45° and adjust the fence so that it cuts off a small portion of the tenon's square edge. You may want to take the corners off a scrap tenon by hand and trial-fit it into a mortise, to get an idea of how much material has to be trimmed. Once set, chamfer all pairs of opposite edges on each tenon, and then tilt the table 45° the other way and repeat the cuts.

If you've been careful, you should have a close but not-too-tight fit between the mortise and the tenon. If the joint is too loose, the inside contact between the two pieces—so important for strength—is insufficient. If the joint is too tight, you may actually crack the frame members during glue-up or starve the joint of glue and leave it weak.

**Gluing up**—After all the mortises and tenons are cut, I usually test-fit the frames together. If I'm making face frames, as for kitchen cabinets, I like to reduce the thickness of the mortised members (usually the stiles) so that the tenoned members (the rails) on the front side of the frame are slightly proud (less than 1/64 in.). This makes it easier to plane the frames around the joints perfectly flush without cutting across the grain.

When I'm ready to glue up, I prepare all the clamps and clamp pads I'll need and clear a flat surface to work on. I apply glue to the tenons with a flux brush (available at a hardware store) with the bristles cut at a 45° angle. I then apply yellow glue into each mortise using a cotton-tip swab. When you clamp the frame, make sure the pressure is even at the joints. When all clamps are in place and tightened, check the flatness of the frame with a straightedge, measure the diagonals for frame squareness and clamp across to pull the frame true if necessary. Clean up squeeze-out with a sharp plane or chisel after the glue has dried for a couple of hours—not overnight. If the glue dries overnight, it becomes brittle and hard on sharp tools. □

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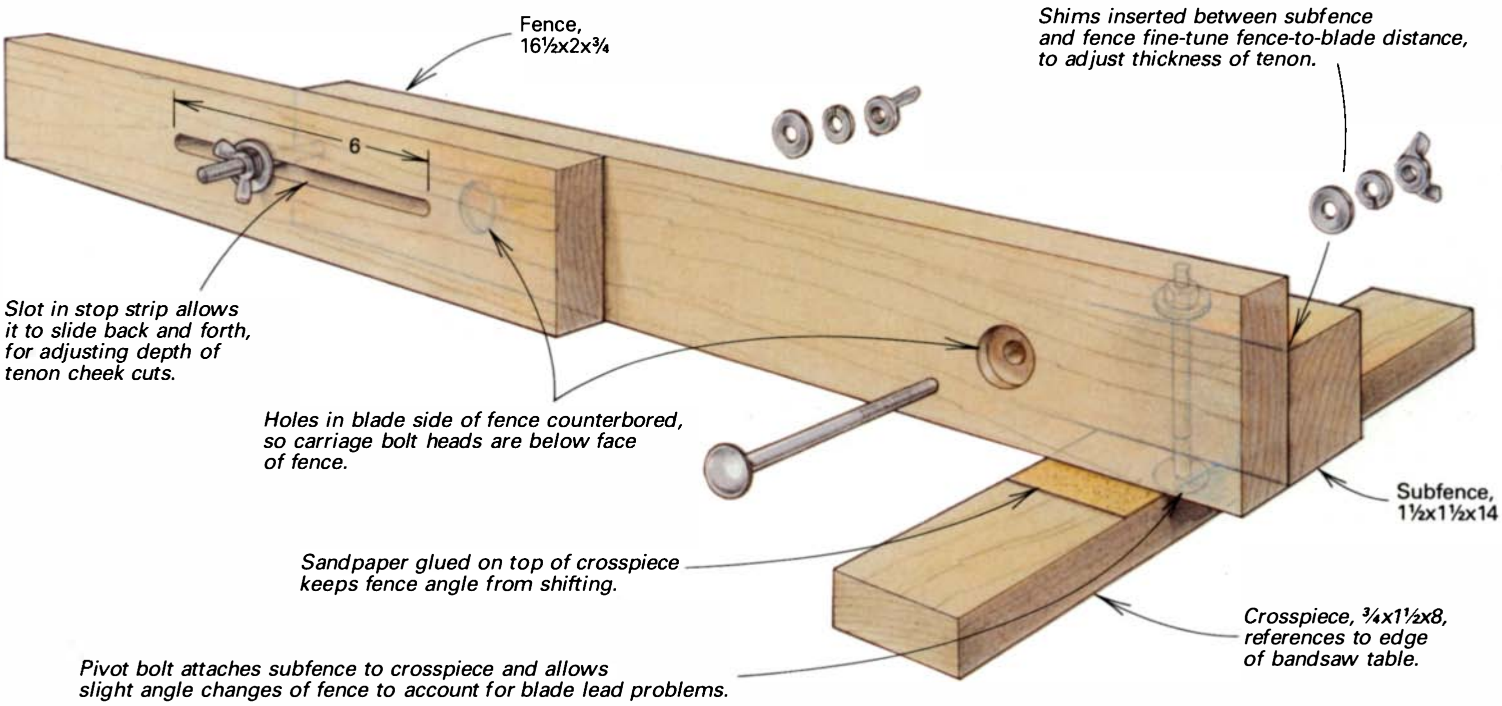
*Mark Duginske is a Wausau, Wis., author, instructor and woodworker. His latest book,* Bandsaw Handbook, *was published recently by Sterling Publishing Co., 387 Park Ave. S., New York, N.Y. 10016.*

**Fig. 2: Adjustable tenon fence**



# A Shop-Built Shaper

## *Tilting table adds a new angle to panel-raising*

by Frank Perron, Jr.

When I was faced with the task of making a bunch of raised panels for several large jobs, I wanted to avoid the drudgery of sanding out sawblade marks on panels raised on the tablesaw. This tempted me to buy a shaper big enough to handle panel-raising. I remembered a mammoth cast-iron shaper that an old furnituremaker in Vermont had shown me. The huge machine barely vibrated as it ran, even though the raised-panel cutter mounted on it was half a foot in diameter. Further, the machine was used primarily for panel-raising, so it sat in the corner always ready to go. Since I wanted the quality cut of that heavy, high-quality machine, but couldn't afford the luxury, I decided to design and build my own shaper.

Before starting on my shaper, I thought it would be prudent to check out the available selection of stock raised-panel cutters. I discovered that there were relatively few straight-style raised-panel cutters available right off the shelf. I would need a different cutter for each job and carbide-tipped cutters are more than $100 each. So I quickly decided to take a different slant on shaper design to get a variety of profiles with a single cutter. This meant I needed a way to change the attitude of the cutter in relation to the table. Some very expensive shapers have tilting spindles for just such a purpose, but this system would have involved devising a mechanism to tilt the entire motor and spindle assembly—a complicated task. My more practical solution was to tilt the shaper table.

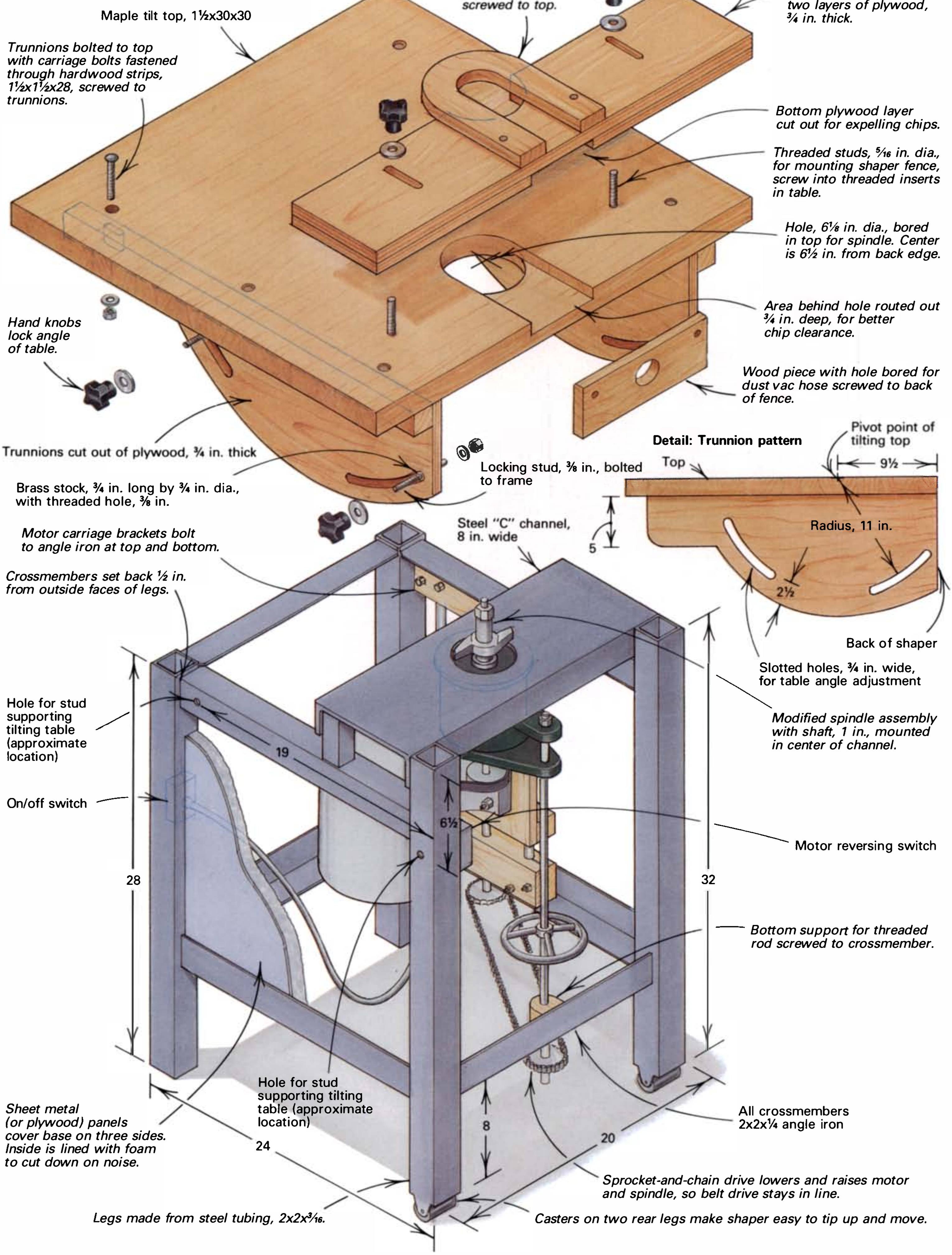
*Building your own shaper, using a commercially made spindle assembly, is an economical way to add heavy-duty, panel-raising capacity to your shop. With its tilting table, welded-steel frame and 1-in.-dia. spindle, Perron's shop-built shaper shown here is tough enough to handle large-diameter panel-raising cutters and produce clean, chatter-free cuts.*

My final design is shown in the photo below and figure 1 on the facing page. The shaper has a welded-steel base and employs a store-bought arbor assembly with a 1-in. spindle. The machine operates like a conventional shaper, except for the table: It tilts about 16° down and about 3° up. The machine weighs about 250 lbs., making it heavy enough not to dance all over the floor when I use it. Although the construction of the shaper involves quite a bit of metalworking (see "Metalworking in the Woodshop," *FWW* #79, p. 84), relatively few metalworking tools are needed to build the shaper, and you could substitute a wood base if you wish. Materials cost me about $350, including the spindle, but I used a lot of spare materials that were lying around my shop. While my machine was designed specifically for panel-raising, the basic shaper can handle any sort of cabinetmaking or millworking job, so you can customize it to suit your application. Whether or not you choose to duplicate the design in this article or alter it to your taste, I hope my experiences will inspire you to make your own shop-built shaper.

**Building the base**—Conventional shapers are built with the spindle/motor assembly hanging from the table, which in turn is mounted atop a base. Because I designed my table to tilt, the base became the heart of the machine, with motor and arbor bolted to it. The base, shown in figure 1, is made with welded steel tubing and angle iron, and has sheet metal panels on three of its sides. Foam insulation is glued to the inside surfaces of the panels to reduce noise. The top of the base is stepped, to provide clearance for the tilting table, and the 8-in. steel channel at the top of the welded base provides a mount for the shaper's spindle assembly. The two rear legs sport built-in casters that make the shaper easy for one person to move around.

All of the steel for my base came from a local scrap yard, so any suitable steel tubing or angle stock sizes you have lying around could be substituted for the ones I used. I cut all the pieces for the base frame to length with an abrasive blade in a motorized miter saw, and clamped the parts together. I used an arc welder and worked from the inside of the frame, so that the weld beads would not show, to give the machine a clean look. If you don't weld, you could have a friend or local welding shop make the base for you,

**Fig. 1: Tilting-table shaper**




Drawings: Kathleen Rushton

*Starting with the stock spindle he purchased, Perron modified the assembly to allow the cutter to be raised and lowered via a handwheel at the back of the shaper. A chain drive at the bottom links the handwheel shaft with a sliding motor carriage and adjusts the height of both the motor and spindle synchronously, to keep their V-belt drive pulleys aligned.*

or you could make it out of wood. If you choose the latter alternative, use fairly large-dimension stock and employ strong, tight-fitting joinery, like mortise and tenon, so the base will be heavy and withstand vibration. After the frame was finished, I attached the metal side panels with pop rivets and bolted the casters to the rear legs, notched earlier. For anti-vibration padding and skid resistance, I glued pieces of neoprene, a synthetic rubber material, to the bottoms of both front legs.

**Modifying the spindle**—After unsuccessfully trying to design a safe and easy-to-build spindle that could adjust up and down and turn safely at 7,000 RPM, I decided to buy a commercially made spindle assembly. The one I selected is heavy and well made, with a 1-in.-dia. shaft (available from Mooradian Manufacturing Co., 1752 E. 23rd St., Los Angeles, Cal. 90058). I chose a 1-in. shaft because it fits the large panel cutters I wanted to use and because I wanted the shaper to stand up to heavy cutting pressures without deflecting. Although the stock spindle comes with a simple height adjustment screw, I wanted to be able to raise and lower the cutter without throwing off the alignment of the spindle and motor drive pulleys. Hence, I designed the height adjustment system, shown in figure 2 on the facing page, that consists of a modified spindle with a threaded rod running down to a sprocket and chain that in turn connects with a threaded rod that runs through a sliding motor carriage. When the handwheel on the spindle rod is turned, not only does the spindle (and hence cutter) height change, but the chain drive raises or lowers the motor as well, keeping the V-belt pulleys in line (see the photo above).

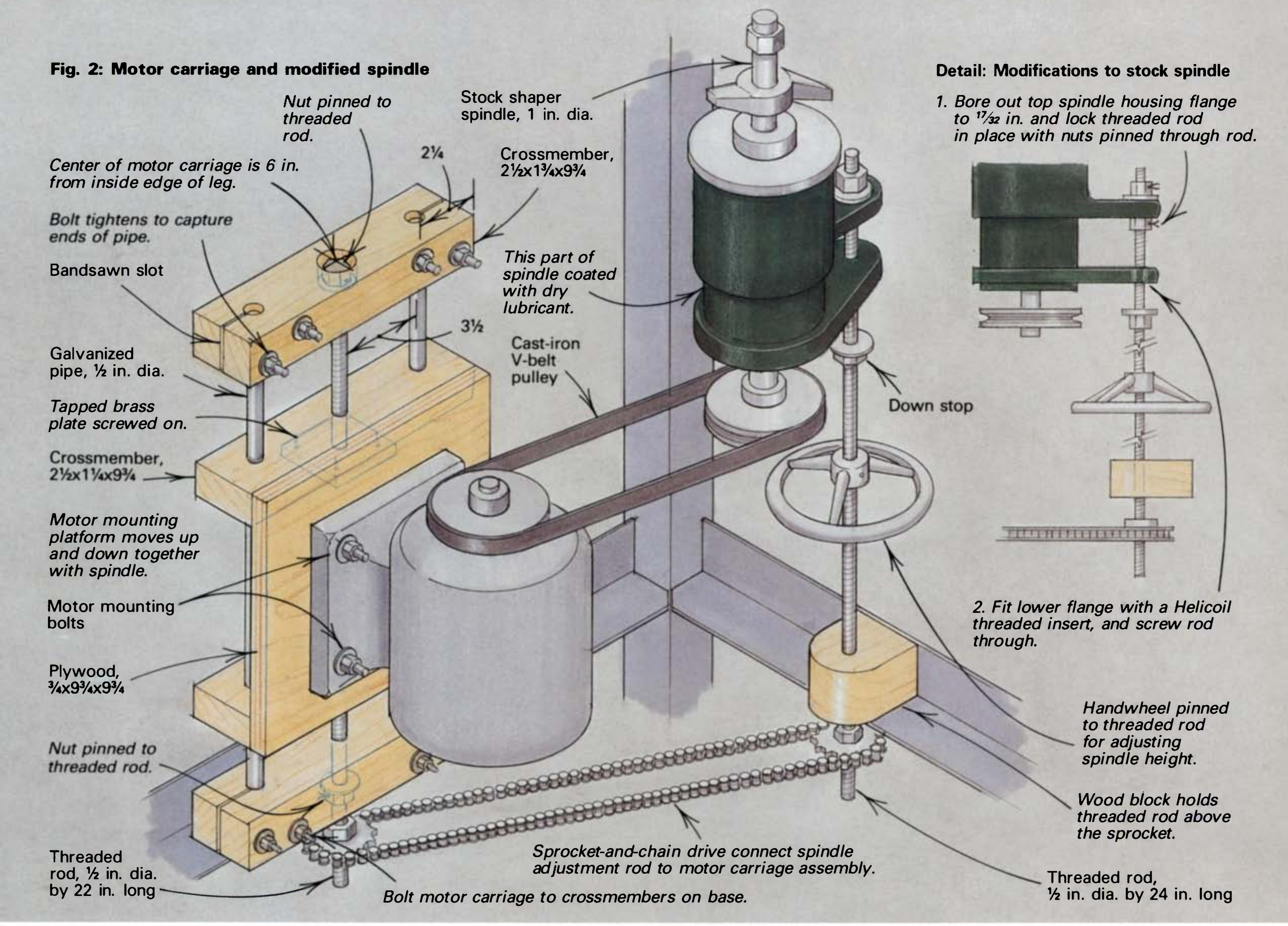
Modifying the stock spindle first requires drilling out the threads in the spindle housing flange. The lower flange on the moving part of the spindle is then fitted with a ½-13 Helicoil insert—a job I had done at a machine shop. Although you can thread the cast-iron flange, the Helicoil provides strong steel threads for the raising and lowering mechanism. One end of a ½-13, 24-in.-long threaded rod is locked to the upper flange with nuts that are drilled through so they can be secured to the rod with cotter pins. Next, the spindle assembly is bolted to the underside of the channel atop the base, with a 1/32-in. neoprene washer between them to act as a gasket. I scrounged a handwheel from an old lathe to use as the adjustment wheel, and I locked this on the threaded rod with a pin. A stop nut, to limit the travel of the spindle to about 3 in., is positioned and cotter-pinned to the rod, as shown in figure 2. The bottom end of the threaded rod is held by a homemade pillow block—a block of wood drilled to fit the rod and screwed to the angle iron crossmember at the back of the base.

At this stage, I tested the modified spindle and it worked well, except that the fit between the inner spindle sleeve and the outer housing was so tight that sliding them was difficult. To remedy this, I took the assembly apart, cleaned the surfaces and coated them with Molykote 321-R, a dry lubricant designed for use with tightly mating parts (made by Dow Corning and available from your local bearing supply store). After reassembly, the spindle adjusted much more easily. I fitted my shaper with a special spindle lock (you can see the knob beneath the table in the photo on p. 50), but the stock spindle lock is also easy to use.

**Making the sliding motor carriage**—The motor carriage acts as a mount for the shaper's motor and allows the motor to travel up and down in unison with the spindle. The carriage is made from four hardwood scraps, a square of ¾-in. plywood, two 20-in. lengths of ½-in. galvanized pipe (that act as guide rails) and a 22-in.-long, ½-in. threaded rod raising screw. For the carriage to slide smoothly, the holes for the pipe and rod need to be drilled accurately. Therefore, it's best to line up and clamp together the four hardwood pieces (dimensioned as shown in figure 2) and then drill them all at once. I ground down a ⅞-in. spade bit until it was a bit larger than the OD of ½-in. pipe. Also, drill a slightly oversize hole for the ½-in. threaded rod. Two of the hardwood pieces become the pipe holders and receive bandsawn kerfs and holes for ¼-in. carriage bolts in both ends. The other two pieces are glued and screwed to the plywood square, which has holes for mounting the motor. A piece of ¼-in.-thick brass plate, tapped to fit the threaded rod, is screwed to the motor platform as shown. After the pipes are slipped through the holes in the platform, which may require reaming so the platform slides smoothly over the pipe, they are fitted in their holders and the carriage bolts are tightened to lock the pipes in place. The threaded rod is then screwed into its plate and nuts and washers are fitted at each end. The nut at the top is recessed in a counterbored hole, and both nuts are pinned through the rod, to keep them from moving.

Once the carriage is completed, the motor is bolted on its platform and the entire assembly is bolted inside the base. My motor is a 1-HP, 3,450-RPM capacitor-start motor. While this has proved adequate in most conditions, you may opt for something a little more powerful, say a 2-HP motor. I mounted a metal on/off switch box to the front of the base, and also a reversing switch, fixed on the back of the machine to eliminate someone accidentally mixing it up with the on/off switch. A reversing switch is often necessary on a shaper, so that cutting direction can be changed. A V-belt connects the motor and spindle pulleys. The pulley ratio is a little more than 2-to-1, which yields a spindle speed of about 7,000 RPM. I

**Fig. 2: Motor carriage and modified spindle**




chose Browning cast-iron pulleys fitted with split-taper bushings that grab the shaft they're mounted on like a collet. At $30 apiece, these pulleys aren't cheap, but they're precise and won't come loose during high-speed operation. The bottom ends of the threaded rods on both the motor carriage and spindle are fitted with 2-in.-dia. sprockets, screwed on and pinned in place, and tied together with no. 35 roller chain. Sprockets, chain and pulleys are available from your local motor and bearing supply house.

**The tilting table**—Before I could build the tilting mechanism for my shaper, I had to determine the best pivot point: an axis for the top to turn around. Because I had decided to mainly use my shaper with 5¾-in.-dia. raised-panel cutters, I set the pivot point at the intersection of the tabletop and the outer shoulder of the cutter (see the detail in figure 1 on p. 51). Pivoting at this point allows me to set the height of the shoulder of the cut to stay the same depth, regardless of the angle of the table. Tilting allows me to get the desired thickness I want on the outer edge of a panel, regardless of the thickness of the stock I'm using.

The pivot mechanism I designed is a trunnion-type system, similar to the mechanism used on many bandsaws and sanders to tilt their tables. Two plywood trunnions attach to the underside of the table, each with a pair of curved slots that ride on studs, which are 4-in. lengths of ⅜-in. threaded rod, bolted to the base. A hand knob on each stud clamps the trunnion tightly against the base, locking the table in place. A bushing that rides in the trunnion slot is made from a ¾-in.-long, ¾-in.-dia. piece of brass stock, center-bored and tapped to screw on the stud.

Trunnions are bandsawn from a good grade of birch plywood, with no voids in the core layers, following the pattern shown in figure 1 on p. 51. The curved slots are cut with a ¾-in. straight bit in a router mounted on a swing-arm jig. The radius of these is 11 in. to the center of the slot, as measured from the desired pivot point of the table. To make the slots, the swing arm's pivot point is set in a small scrap of plywood, temporarily tacked to the top edge of the trunnion.

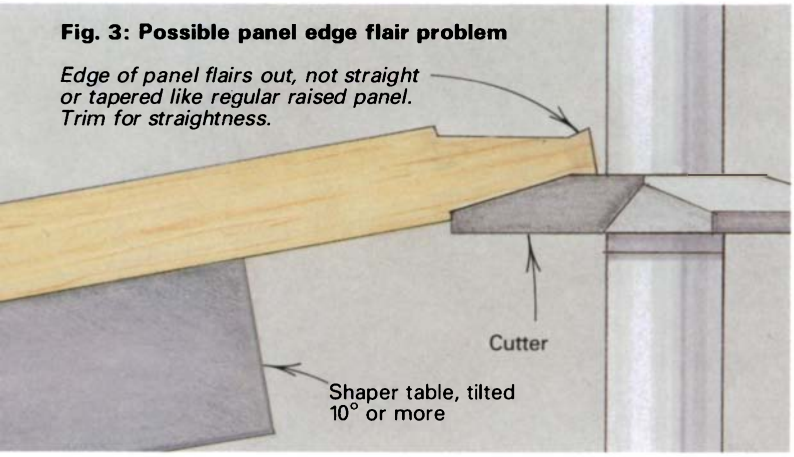
The shaper's 1½x30x30 tabletop is glued up from strips of 8/4 maple. Since my thickness planer only handles 12-in.-wide stock, I glued up the top in three 10-in.-wide sections. After planing each section flat, I glued the three panels together. To me, unfinished maple is smooth enough for the table, but you can make the top out of plywood or particleboard and cover it with plastic laminate, for a slicker, more wear-resistant surface. Then, a fly-cutter chucked in the drill press was used to cut out the 6⅛-in.-dia. hole for the cutter. Later, I decided to rout a ¾-in.-deep recess at the back of the cutter opening to increase the shaper's chip clearance.

The top is fastened to the plywood trunnions with carriage bolts through two 1½x1¾x28 hardwood strips screwed to the trunnions. These strips stiffen the top and provide a strong joint between it and the trunnions. Two slotted bolt holes at the ends of each strip allow for expansion and contraction of the solid-wood top.

Once the trunnion sections are attached to the top, the whole assembly is ready to be mounted on the base. First, the surface of the table is positioned square to the spindle in all directions. I use

*By tilting the shaper table relative to the cutter, Perron gets a variety of raised-panel profiles from a single cutter—a real bonus since carbide cutters are expensive. The U-shape guard on the adjustable fence protects Perron's hands as he feeds a cherry panel by the cutter.*

**Fig. 3: Possible panel edge flair problem**




wedges and shims made from scraps to align the table, and then use a pair of pipe clamps attached across the trunnions to temporarily lock the table in place. Next, the position of the locking studs is marked on the base, using the slots as a guide. With a metal punch, I mark the center position of each stud, one on the top crossmember and one on the rear leg, for each trunnion. After removing the table and drilling the ⅜-in. holes, the studs are installed with nuts and lock washers. The brass bushings must be shimmed out slightly on the crossmember studs to make them flush with the rear leg studs. Large washers fit under the clamping knobs, to distribute the clamping pressure on the plywood trunnions. I purchased easy-to-grip locking knobs from Reid Tool Supply Co., 2265 Black Creek Road, Muskegon, Mich. 49444.

**The fence**—Even on a commercially made shaper, I'll sometimes set the stock fence aside and make a custom one for a specific job or cutter setup. By doing this, I can make the operation safer and improve chip clearance. I made my shaper fence from laminated plywood topped with a guard that overhangs the cutter to keep hands out of harm's way. With the protection this fence affords, I feel safe raising panels as narrow as 10 in. wide, holding them free-hand. The fence is notched, to clear the top of the spindle, and the lower part is cut away completely behind the cutter, for chip exhaust. The outside profile of the U-shape guard is bandsawn slightly larger in diameter than the cutter and attached to the top of the fence with two drywall screws. Two 3-in.-long, ⅜-in. studs that fit through slotted holes cut in the fence attach the fence to the tabletop. The studs are screwed into threaded inserts installed in the tabletop. To take care of the prolific amount of dust and chips that panel-raising produces, I bored a hole in a wood scrap to fit the hose on my dust-vac and screwed this to the back of the fence (see the photo on p. 52).

My panel raiser is a joy to use, it's smooth running and I like listening to it hum. It is satisfying to run a piece of stock by the cutter and flip it over to find a panel bevel that needs no sanding. The only problem I have had is with panels cut using the full width of the panel cutter with the table tilted to 10° or more (see figure 3 at left). The panel edges flair slightly, preventing proper seating in a frame groove or rabbet. However, the problem can be eliminated by not using the full width of the cutter when raising, or by trimming the flared edge with a straight cutter in the shaper or with a handplane. □

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*Frank Perron is a Field Experiment Coordinator for the U.S. Army Corps of Engineers and part-time woodworker living in Pomfret, Vt.*

## Safety warning

**The shaper has the potential to be a dangerous machine. The rotational force of a large panel-raising cutter can grab even a large panel out of your hands and hurl it with surprising force. Worse, the force can unexpectedly pull your hand into the cutter, with disasterous results. Therefore, *always use the shaper with the guard in place and keep your hands well clear of the cutter*, wear safety glasses or a face shield and avoid wearing jewelry or loose clothing. As with any home-built machine, make sure all parts are properly installed, tightened and adjusted before use. Also when raising panels, always take several shallow passes rather than one deep cut.**

# Sharpening Chisels and Plane Blades

## *Producing razor-sharp edges with honing guides and waterstones*

by Bill Stankus

***Plane blades and chisels must be honed to a narrow range of cutting angles, and this precision can be difficult to attain when freehanding the blade on a sharpening stone. Honing guides, such as the Eclipse and Veritas, minimize the chance of error by holding the tool at a precise bevel angle. These guides roll on the stone itself, so you needn't reset the angle when going from one grit to another.***

Improper tool sharpening has probably done more to ruin tools, wood and enthusiasm than any other aspect of woodworking, yet there's no excuse for dull edges, with the sharpening equipment now available. I've developed a method that lets me flatten and polish the back of a chisel or plane blade, and then hone the blade's dull cutting edge to unbelievable sharpness in a matter of minutes. The secret? Using a honing guide, such as those in the photo above, a series of waterstones, and a strop or buffing wheel. Honing guides hold the chisel or plane iron at a specific, precise angle so the user can concentrate on removing metal; man-made Japanese waterstones have predictable grits, from very coarse to very fine; and final-polishing with green rouge on a leather strop or hard-felt wheel perfects the edge. Waterstones and buffing compounds are widely available through most woodworking and some industrial supply houses.

For the part-time woodworker, who wants an inexpensive system, I suggest an Eclipse honing guide (see source of supply note at end of article), 120-, 800- and 1,200-grit waterstones, and a leather strop. Over time I've added the finer 4,000- and 8,000-grit stones, nagura stones (which create a muddy slurry as they clean and remove the sharpening stone's bonding agent and expose fresh grit), a powered, hard-felt buffing wheel and green rouge, along with a second honing guide, the Veritas (see supply note), and various bevel gauges.

Here I'll concentrate on sharpening chisels and plane blades used by furnituremakers and cabinetmakers. For best performance, these tools must be shaped and honed to a consistent, narrow range of cutting angles, depending on the type of tool, the wood to be cut (hardwoods usually require steeper bevels than softwoods) and the type of cut. I grind a 15° to 25° bevel on light paring chisels driven by hand, without a mallet; for standard bench chisels and plane blades, bevels from 20° to 30° work best. My mortise chisels have bevels from 25° to 40°, depending on the type of wood I'm working. But for general-purpose chisels, a 25° bevel is a good compromise.

**Bevels and honing guides**—Many woodworkers have difficulty producing good cutting edges by hand-holding a tool on a stone. The human hand is just not steady and accurate enough to hold the tool at a specific angle while moving it back and forth on the stone. Honing guides eliminate the problem because they can be set to an exact angle to provide a steady platform to carry the blade across the sharpening stone.

Although many tool stores and mail order houses offer various honing guides, I prefer the Eclipse and Veritas models because they're adjusted easily to a specific angle and are designed to roll on the stone itself, rather than the bench. Guides with rollers that run on the workbench must be readjusted for each stone, whereas guides that roll on the stone guarantee the same angle from stone to stone, and thus produce more consistent results. The Eclipse honing guide grips the tool's side edges, which is fine for bevel-edged chisels and plane blades, but it won't grip all thick mortise chisels or narrow, 1/8-in.-wide chisels. The Veritas honing guide is good for most tools, including skewed blades or thick chisels, such as mortise or Japanese chisels. In addition, it has a spring-loaded, cam-type roller for fast, fine adjustment in small increments.

On the Eclipse, the bevel angle is determined by the distance the cutting edge projects beyond the guide. Instructions for honing 25° and 30° bevels are marked on its side. The Veritas guide is set with an optional angle jig, which measures bevels directly. On either guide, an engineer's metal protractor can also be used to set bevel angles: Hold one leg of the protractor against both the tool's bevel and the guide's roller and the other leg along the top of the tool and read the angle on the protractor.

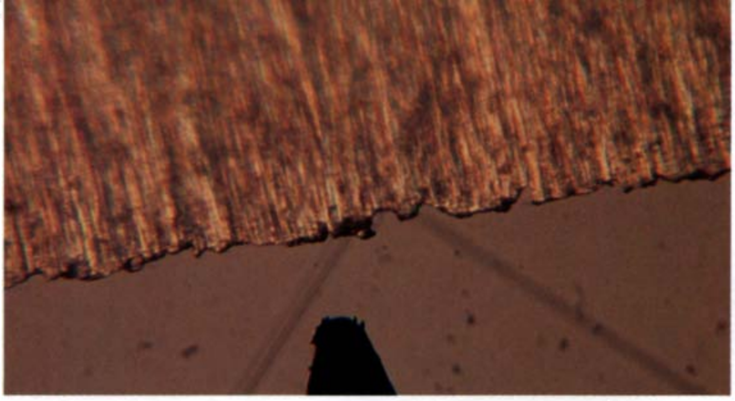
With proper technique, you won't groove the soft waterstones with the guide's roller, but since most sharpening operations normally wear away the stone's surface, you'll periodically have to dress the stone. Since it's easiest to gouge the stone during a push stroke, apply pressure and cut on the pull stroke. Place both thumbs under the blade, behind the guide and near the roller, and both index fingers on the tool's surface near the cutting edge. Apply even, downward pressure with your index fingers as your thumbs steady the guide as it's pulled on the stone (see the photo below). For the return stroke, lessen the downward pressure of the index fingers and gently push the tool back with the thumbs; then repeat the cutting, pull stroke with little or no pressure applied on the guide's roller. Check the straightness and squareness of the blade's cutting edge with a small square.

**Making secondary bevels**—I make a secondary or micro bevel on my tools because it provides a stronger edge and speeds the honing process, since only a narrow area of the edge must be polished. Secondary bevels are set by adjusting how far the cutting edge projects beyond the honing guide. Begin with a secondary bevel that's 5° greater than the primary bevel, but experiment with different angles for different woods and various cuts. As on the primary bevel, a steeper angle is better on hardwoods and end-grain cuts, and a shallow angle is better on softwoods and paring cuts. I reshape the main bevel when the secondary bevel is about one-third up its surface.

**Straightening the tool's back**—The back of a chisel or plane blade must be prepared as carefully as the bevel. The backs are generally buffed at the factory and this process may round the cutting edge or leave enough grinding scratches to make the cutting edge look like a serrated knife, as shown in the top photo at right. Such a rough edge won't stay sharp for as long a time as an edge that has been honed and polished on both sides, like the one shown in the bottom photo at right.

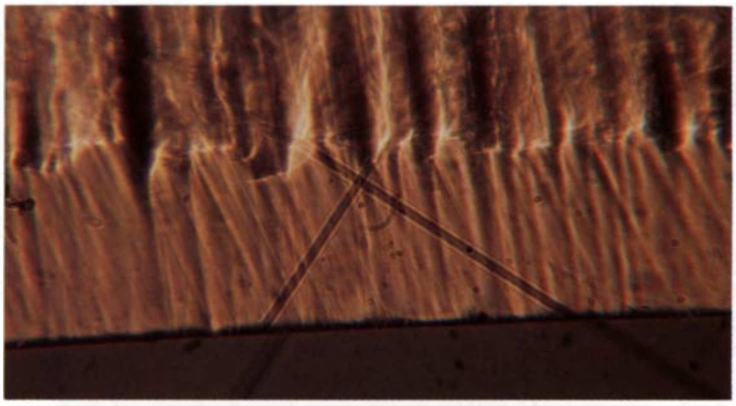
Test the back of a new chisel or plane blade for flatness by laying the back on an 800-grit stone and moving it back and forth a few times. If some areas remain untouched while scratches from the stone are on others, the back must be flattened, beginning with a 120-grit stone. When scratches evenly cover the entire back of

*The tool's edge is ground mainly on the pull stroke. The author's hands surround the chisel and honing guide as he pulls and presses with his index fingers while honing on a wet 1,200-grit stone. On the return stroke, he uses his thumbs to push against the guide and doesn't apply downward finger pressure. The small cube is a nagura stone used to prepare surfaces on fine waterstones.*



Author

*An 80-power microphotograph clearly shows how rough a chisel's cutting edge can be before it's properly sharpened. Stankus sharpened the bevel edge on an 800-grit stone to reveal the ragged edge created by the tool's rough, unpolished back. A pin points to rust visible from the tool's back. The pin looks as dull as a baseball bat.*



Author

*The edge of a properly flattened, sharpened and honed tool is smooth and true, under 80-power magnification. To create this cutting edge, the author honed the back to 8,000-grit, and sharpened the primary bevel to 800-grit and the 1/64-in.-wide secondary bevel to 8,000-grit before stropping it on a buffing wheel with green rouge.*

the tool, as on the chisel on the far right in the left photo on the facing page, the back is flat and straight. Now, move on to the 800-grit stone and work up to finer-grit, polishing stones.

**Why use waterstones?**—I find that flat man-made waterstones are more user friendly than oil stones because they offer such a wide variety of consistent grits, between 800 and 8,000. By comparison, the grit in a natural, hard, black Arkansas honing stone is twice the size of the grit in a 4,000-grit waterstone, which is made of compressed rare earths, ceramics or finely ground natural rock.

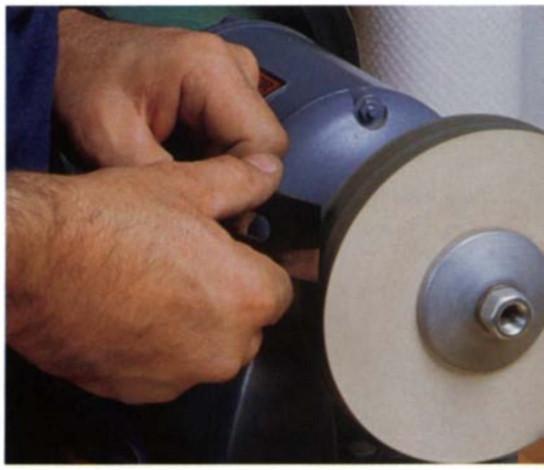
All waterstones are "soft," so they continually expose fresh grit as they're worn down. The stones are reasonably priced and most of them are 2¼ in. wide, so they can easily accommodate most plane blades. Usually, 800-grit through 1,200-grit stones cost about $15 each, and an 8,000-grit stone is about $50. Finally, using water as a stone lubricant is cleaner and safer than oils and solvents.

I used to keep waterstones soaking in a bucket, but now let the stones dry between jobs and only soak them for 5 to 10 minutes before use. This is a good policy since natural sharpening stones and nagura stones may decompose if they soak for protracted periods of time. I soak the fine-grit stones in a separate bucket, so coarse-grit particles can't contaminate them. Each of the various-grit stones react to water differently. For instance, the 120-grit is forever thirsty, while the 8,000-grit resists wetting. Keep the surfaces wet, not flooded, and don't wipe off the slurry while working. The slurry, which is worn grit and steel particles, acts as a lubricant and grinding compound on coarse-grit stones and a polishing compound on fine-grit stones. A good transitional step, when you're nearly finished with one grit, is to stop adding water until the slurry is dry, while easing up on the downward pressure.

Author

Dressing the tool's back is as important as honing its bevel side. Stroke the entire back on an 800-grit stone; if some areas are untouched while others are scratched from the stone, as shown on the corner of the chisel on the left and the middle of the chisel in the center, the back must be resurfaced. When the stone leaves scratches evenly over the entire back, as on the chisel on the right, the back is flat and straight.

The secondary bevels on these two chisels were polished with a few strokes on a fine-grit waterstone. The dull-looking bevel on the lower chisel should be reground until it looks like the chisel on the top.



Stankus removes the wire edge by lightly touching only the secondary bevel on a spinning hard-felt wheel charged with green rouge. He keeps the tool's edge parallel to the direction the wheel turns.

**Step by step, stone by stone**—For efficiency when honing a blade, don't skip a grit when working from a coarse-grit to fine-grit stone: 120-, 800-, 1,200-, 4,000- to 8,000-grit. After a few strokes on the first stone, be sure the edge is square, nicks are removed and a continuous wire edge is left. The wire edge occurs when the metal at the tip gets so thin it can no longer support itself and bends up and away from the stone. Each finer-grit stone produces a finer wire edge. Don't remove the wire edge until you've finished with the last stone or the strop, because the wire may tear back into the edge and destroy its sharpness. You're done with one grit when you've entirely removed the scratches left from the previous stone.

The 120-grit stone is for quick removal of steel, such as when resurfacing the back of a chisel or shaping and repairing a bevel. Next use the 800-grit stone, which may be a good first stone for removing minor nicks or to flatten backs that become uneven. Then follow this with the 1,200-grit stone. If the blade is just dull and undamaged, you can renew the edge by taking 5 to 10 passes on a 1,200-grit stone before going on to the finer-grit stones.

For general-purpose tool usage, it's possible to stop with the 1,200-grit stone. However, the delight in seeing highly polished secondary bevels, such as on the chisels in the top, right photo above, and their longer life and greater performance will make it impossible for you to be happy with what I consider to be partly finished tools.

Only the secondary bevel and back needs to be honed with the 4,000- and 8,000-grit stones. These fine-grit stones, which must be prepared with the small nagura stone, have similar characteristics, but the 8,000-grit stone refines the edge to a finer degree. Alternately hone the blade's secondary bevel and back with only a few strokes on the 4,000-grit stone and then on the 8,000-grit stone.

**Removing the wire edge**—Not polishing out the scratches and leaving a wire edge reduces the tool's ability to hold an edge. The fine wire edge left by the 8,000-grit stone, though it can sometimes be felt with a sensitive finger, is visible only with a hand lens. If not removed, the wire edge can "tear" back into the bevel and accelerate dullness.

Remove this micro wire edge by lightly touching the secondary bevel to a turning, hard-felt wheel that has green rouge on its surface. Pass the edge of the secondary bevel lightly once or twice on the wheel while keeping the tool's edge parallel to the direction the wheel is turning, as shown in the bottom, right photo above. A bench grinder that turns less than 1,800 RPM is best. For odd-shape blades or in the absence of a felt wheel on a grinder, pull the edge of the tool on leather impregnated with the rouge. A word of caution: These stones are somewhat softer than coarse-grit waterstones and they're gouged easily. Stroke them carefully!

If you should gouge a stone or if the stone becomes worn, you can easily resurface it. Although I've used a concrete floor, I now use a sanding screen to flatten uneven stones. Lay the screen on a flat surface and rub a dry stone against the screen until the stone's surface is flat. As when flattening the back of a chisel, observe the scratches the screen leaves on the stone; when they're spread evenly over the entire surface, the stone is flat.

Finally, forget about shaving your arm or nicking your fingernails to test an edge. Just go right to work. □

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*Bill Stankus is a furnituremaker living in DeWitt, N.Y. For the Veritas and Eclipse guides, write to the companies for the distributor nearest you: Veritas Tools, 12 E. River St., Ogdensburg, N.Y. 13669; James Niell Tools, Ltd., Napier Street, Sheffield, S11 8HB, England.*

# Making a Message Center

*Apprentice project develops woodworking skills*

by Luca Valentino

At first glance, the message center in the photo below looks like a very simple project. And in some ways it is. But there's more to it than meets the eye. Developed as a project for cabinetmaking apprentices at the Labor Technical College in Manhattan, N.Y., the message center involves a wide range of woodworking operations. As such, it's a neat project for those who want to hone their skills while producing a functional item. There are many ways to build the piece, but here I'll present only the apprentices' method, so you can work along with them and see how students learn to build accurately from detailed plans.

Projects like the message center are part of a four-year program for cabinetmakers. The apprentices attend four hours of classes one evening each week, while working full time in union shops that sponsor their school training. By the end of their fourth year, each apprentice should have mastered the major aspects of the trade, including drafting, reading blueprints and using both hand and power tools, and will have worked on some fairly complex projects, such as a flight of stairs and a French provincial commode.

*This mahogany message center is a second-year project at the Carpenters' Apprenticeship School in New York City. It's designed to teach techniques, tool use and how to work to a plan.*

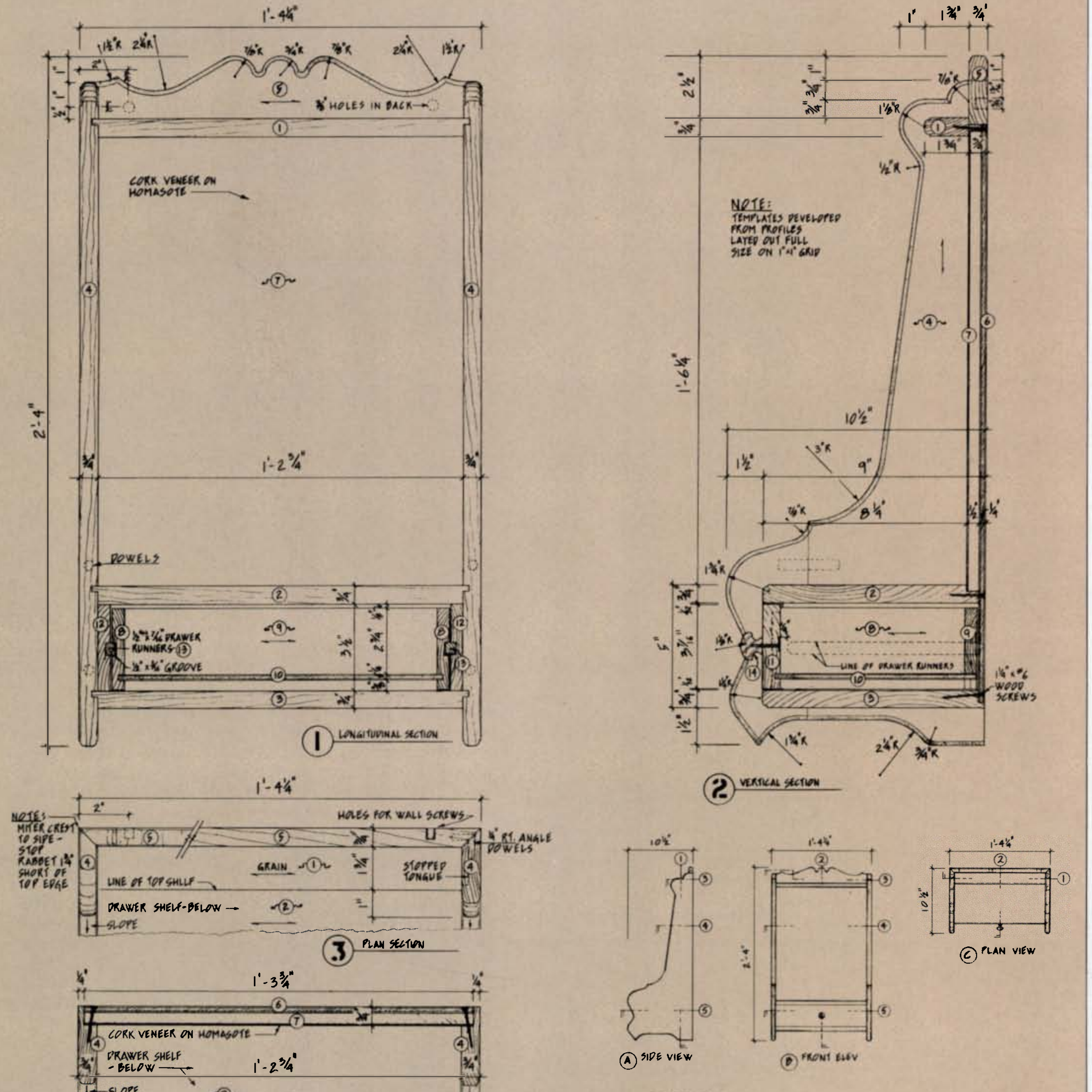
The construction plans for the message center, which I drew as an apprentice, are shown in figure 1 on the facing page. Basically it's a wall-hung shelf unit with a cork-veneered, backing board for tacking notes and a small drawer between the two lower shelves. All three shelves are tongued into stopped dadoes in the case sides. Sounds simple enough, doesn't it? But notice that even the radii of the curves on the case sides and crest rail are specified. The challenge for the students is to build the piece *exactly* as specified on the plan, and this requires the use of patterns and templates.

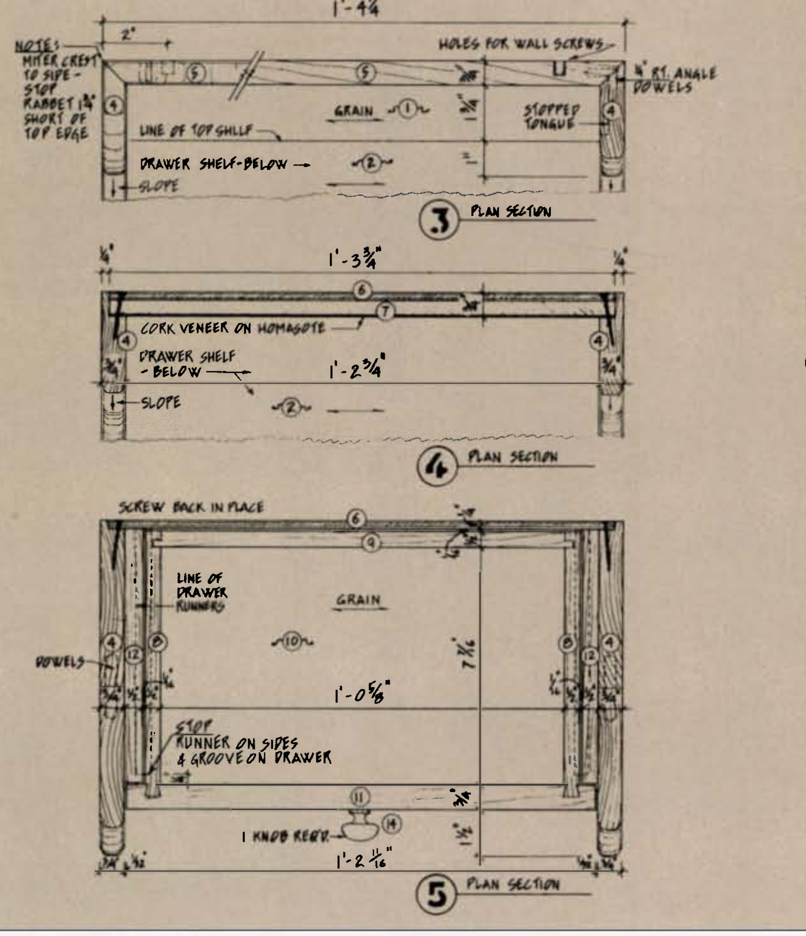
**Making the patterns/templates**—To ensure that the curved case sides and the crest rail will precisely match the specs on the plan, it's necessary to make full-scale patterns for these parts from ¼-in. tempered Masonite. The patterns serve a dual purpose. First, they're traced around for laying out the parts on the wood and then later they're used as template guides for final trimming the curves with a bearing-guided flush-trim router bit. With these templates, it's a snap to consistently reproduce the curves, whether you're making 2 parts or 200 parts. To aid in making the patterns so they match the specs exactly, draw a 1-in. grid on the Masonite. Swing the required arcs with a compass from the centers shown in figure 2 on p. 60 and connect these arcs with tangent lines. Mark the locations of the shelf dadoes and the template attaching screw holes. You should also mark on the case-side pattern for the locations of the shelf dadoes that will be routed on the inside of each side. Then, cut the patterns out with a bandsaw and smooth them carefully to the line with sanding blocks and files. Take care to keep the edges square and make the curves smooth and precise because any inconsistencies will be transferred to the wood parts. With patterns in hand you're ready to begin constructing the piece.

**Building the message center**—The stock bill, located in the lower right corner of figure 1, gives you all the information you need to cut out the shelves, backs and drawer parts. Rip the piece for the crest rail 2 in. wider than its finished width of 2¾ in. so you'll have some extra stock to attach the crest rail pattern when trimming it with the router (see figure 2).

The dimensions of the stock that's glued up for the case sides are given in figure 2. Center the glueline exactly 7³⁄₁₆ in. from each edge so it will intersect the point where the two arcs meet just above the drawer space on the case sides. Placing the glueline at this

**Fig. 1: Plan and stock bill**



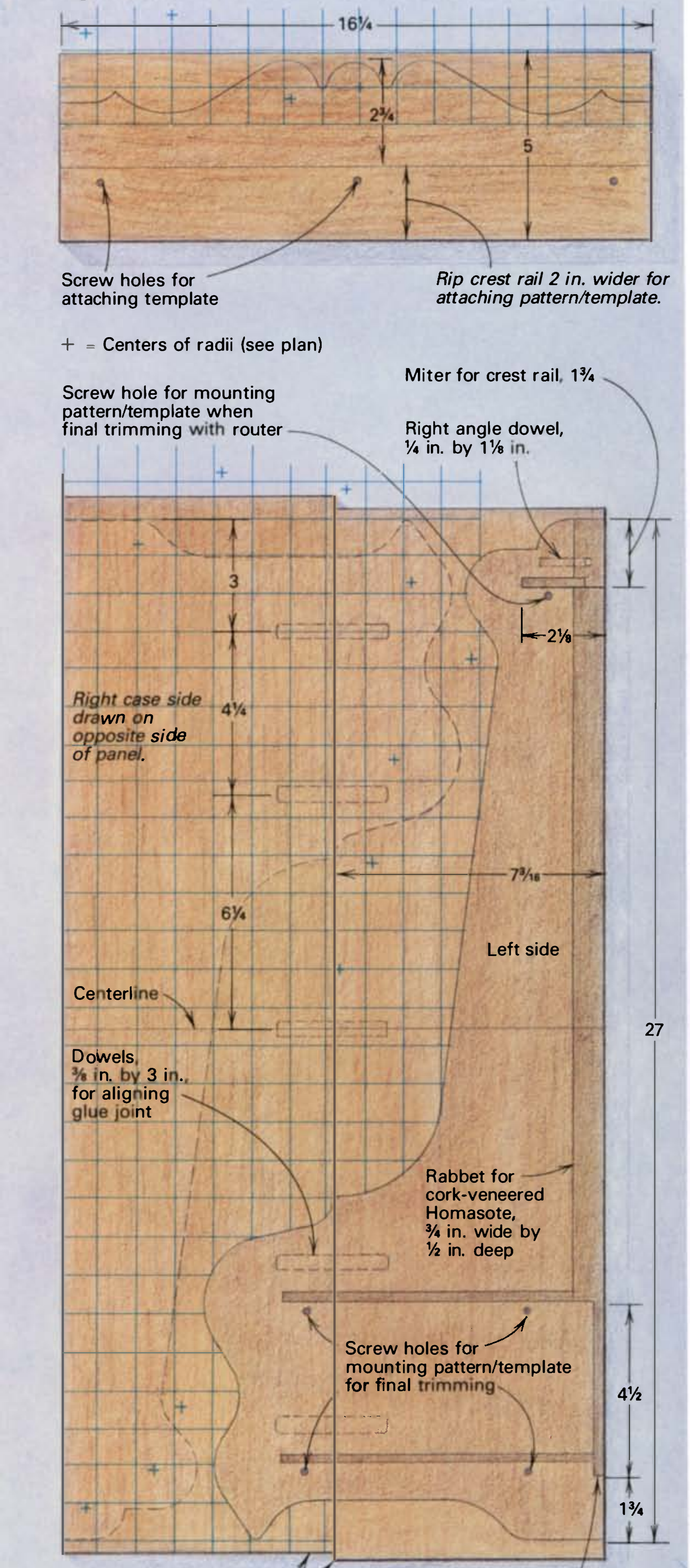




STOCK BILL

| # | ✓ | QTY | DESCRIPTION | TH | WIDTH | LENGTH | REMARKS |
|---|---|---|---|---|---|---|---|
| 1 | | 1 | TOP SHELF | ¾" | 2¼" | 1'-3¼" | SOL. MAHOG. |
| 2 | | 1 | DRAWER SHELF | ¾" | 8¾" | 1'-3¼" | -"- |
| 3 | | 1 | BOTTOM | ¾" | 9" | 1'-3¼" | -"- |
| 4 | | 2 | SIDES | ¾" | 10½" | 2'-3" | -"- |
| 5 | | 1 | CREST | ¾" | 2¾" | 1'-4¼" | -"- |
| 6 | | 1 | BACK | ¼" | 1'-3¾" | 1'-11½" | FIR PLY |
| 7 | | 1 | MESSAGE BOARD | ½" | 1'-3¾ | 1'-6¾" | CORK V. ON HOM. |
| 8 | | 2. | DRAWER SIDES | ½" | 3⅜"(+) | 8⅝" | SOL. BIRCH |
| 9 | | 1 | DRAWER BACK | ½" | 2¾" | 1'-1⅛" | -"- |
| 10 | | 1 | DR. BOTTOM | ¼" | 8 3/16" | 1'-1⅛" | BIRCH PLY |
| 11 | | 1 | DR. FRONT | ¾" | 3 7/16" | 1'-2 9/16" | SOL. MAHOG. |
| 12 | | 2 | DR. GUIDES | ½" | 3½" | 7 15/16" | SOL. BIRCH |
| 13 | | 2 | DR. RUNNERS | 7/16" | ½"(+) | 7¾" | -"- |
| 14 | | 1 | DR. KNOB | | | | SOL. BRASS |

| |
|---|
| LUCA VALENTINO |
| N. Y. C. D. C. L. T. C. |
| MESSAGE CENTER |

**Fig. 2: Layout for case sides and crest rail**




*Above: Valentino routs the rabbet for the back with a guide block clamped to the router base. The narrow portion of the back rabbet is for the ¼-in. plywood back that extends top to bottom; the wider portion accommodates the cork-veneered bulletin board. Below: The author cuts the stopped miter on the top of the left case side, stopping the cut when the pencil line on the workpiece aligns with the line on the saw's throat plate. The miter on the right case side was cut using the same setup, but with the side lying flat on the saw table instead of on edge. The holes in the miters, for the right-angle dowels, are drilled before mitering.*



Drawing: Vince Babak

point will make the joint virtually invisible on the front edge of the sides. To register the pattern, draw a horizontal centerline on both the pattern and the glued-up stock and align them while holding the pattern's back edge along one edge of the stock. Trace around the pattern once on each side of the stock as shown in figure 2. Don't forget to mark on the stock for the locations of the shelf dadoes.

Rout the shelf dadoes first with a ¼-in. straight bit and a guide fence clamped to the stock. Then, rout the ½-in.-deep back rabbet with a ¾-in.-wide straight bit and a ¾-in.-thick guide block clamped to the router base. The top photo on the facing page shows how the back rabbet steps in from ¼ in. wide, for the plywood back, to ¾ in. wide to accommodate the ½-in.-thick backing board that's framed between the bottom and top shelves and the sides. Rout the ¼-in.-wide rabbet from bottom shelf to top shelf. Leaving the bit set to ½ in. deep, reset the guide block to rout the wider portion of the rabbet. Flip the panel over and cut the dadoes and rabbets on the opposite case side. Square up the rounded ends of the rabbets with a chisel.

After the dadoes and the rabbets are cut, bandsaw out the case sides and the crest rail, leaving them about ¹⁄₁₆-in. oversize so you can final trim them with a ¼-in.-dia. flush-trim, ball-bearing-piloted router bit guided by the template. Carefully realign the patterns/templates on the stock and screw them in place. Screw the side template to the inside surface of the case sides, locating the screws ¼ in. below the dadoes so that when the case is assembled the shelves will cover the holes. Now, trim the curves with the flush-trim bit, using a climb or reverse cut to prevent end-grain chip-out. The tight corners that the bit can't reach are cleaned up with a sharp chisel and a mill file after the templates are removed. To rout the decorative profiles on the edges of the sides and crest rail, I use a high-speed steel, ¼-in. roundover bit, the kind with a guide pin as opposed to a bearing (available from Tools on Sale, 216 W. 7th St., St. Paul, Minn. 55102-2599). The guide pin's small diameter fits into the ¼-in.-radius curves in the crest rail, so the profile can be cut without having to work the tight corners with chisels.

In order for the molded profiles of the sides and crest to blend smoothly into one another they must be mitered. To align and strengthen these miter joints, I reinforce each of them with a ¼-in., plastic right-angle dowel, available from Dave Sanders and Co., Inc., 111 Bowery, New York, N.Y. 10002. It may seem troublesome to drill the mating holes in a miter, but it's quite easily done by drilling the holes with a doweling jig before cutting the miters (see the bottom photo on the facing page).

Cutting the stopped 45° miters on the top of the case sides with the tablesaw is a little tricky. One of the case sides is run laying flat on the saw table and the opposite case side is run on its edge. The bottom photo on the facing page shows my tablesaw setup. I screw an auxiliary fence to the saw's rip fence, tilt the blade 45° and raise it until it cuts into the auxiliary fence. I make a test cut on a ¾-in.-thick scrap to be sure the miter intersects the top corner of the test piece. Pencil marks on the fence and throat plate note the beginning point of the cut. I also square a line on the outside face of each case side 1¾ in. down from the top edge and I stop the cut when the line on the side reaches the line on the fence or throat plate. When cutting the miters, the small cutoff may be kicked back, so for safety, turn the saw off before backing either of the pieces off the blade.

The ends of the crest rail are mitered using the miter gauge and the same tablesaw setup. Hold the crest rail's straight edge against the miter gauge face and miter one end; then reverse the miter gauge in the same slot, so that it's in front of the workpiece, and miter the other end. To keep the triangular offcut from kicking back, I push the miter gauge with my left hand and push the offcut clear past the blade with a 2x2x12 backup block in my right hand.

When the curved parts are complete, you can cut the tongues on the ends of the shelves, rabbet their backs for the backing board where necessary (see figure 1) and rout the decorative bead on their front edges. After dry fitting the shelves to the sides, carefully spread glue in the dadoes and on the tongues and clamp the case together using edge-jointed 2x4s at each shelf to distribute the pressure. Check the case for squareness, and then test-fit and glue the mitered crest rail in place with the right-angle dowels.

**Making and fitting the drawer**—Drawer construction details are given in figure 1 on p. 59. The sliding dovetails that join the sides to the front are cut with a table-mounted router. First cut the dovetail-shape dadoes on the inside of the drawer front, and then cut the dovetail tenons on the ends of the drawer sides so they fit into the mortises. For more on routing sliding dovetails, see *FWW* #80, p. 91.

Before gluing up the drawer, rout the stopped grooves for the runners in both the drawer sides and the guide blocks. The guide blocks provide side guides for the drawer by spanning the ½ in. that the sides are setback from the ends of the drawer front. Use a ½-in.-dia. straight bit in a table-mounted router and clamp a stop block to the router table's fence to stop the grooves, ¼ in. from the dovetail shoulder on the sides and ³⁄₁₆ in. from the front of the guide blocks. Be sure to cut all the grooves from the bottom edges of the parts so they line up with each other. Make a single pass to cut the grooves in the drawer sides and then nudge the fence back about ¹⁄₃₂ in., indicated in the drawing, and run the guide blocks; this will raise the drawers just a hair to ensure that the sides don't drag on the bottom shelf. Round the front end of the drawer runners to fit the radius of the stopped grooves and glue the runners into the guide block grooves. Now you can glue up the drawer. However, if you're going to stain the drawer front but not the drawer sides, stain it first before gluing the sliding dovetails.

After the glue sets, slide the drawer and the guide block assemblies into place to check their fit. Remove the assemblies and make any necessary adjustments. I only glue the first 2 in. of the guide blocks to the case and then secure their back ends with screws in elongated holes to allow the case sides to expand or contract. Instead of clamps, I use the drawer itself to press the guide blocks against the case sides until the glue sets by wedging Formica shims between the drawer sides and the guide blocks above and below the runners. Then, I remove the drawer and screw in the backs of the guides.

To prepare the piece for finishing, sand it to 150-grit with garnet paper, raise the grain with a wet sponge and sand again to remove the fuzz. A light coat of shellac on the edges of the case sides prevents the endgrain from absorbing too much stain. I use Behlen's dry powdered aniline stain, available from Garrett Wade Co. Inc., 161 Ave. of the Americas, New York, N.Y. 10013. After staining, apply one sealer coat of shellac and two coats of varnish, sanding between coats with 220-grit finishing paper. I rub out the final coat of varnish with mineral oil and a 3M Scotch-Brite pad and top that off with several coats of Butcher's wax, available from most hardware stores, buffed to a soft luster. Although the drawing shows a simple knob for the drawer pull, I chose a polished brass pull (also available from Garrett Wade or from Paxton Hardware Ltd., 7818 Bradshaw Road, Upper Falls, Md. 21156) to add to the style and formality of the piece.

To complete the message center, put the backing board in place and screw the plywood back to the case. Finally, drill two ⅜-in.-deep holes in the back of the crest rail so the message center can be hung on flat-head screws anchored securely in the wall. □

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*Luca Valentino, a graduate of the Carpenters' Apprenticeship School, teaches woodworking classes at the school and is a project manager with Rimi Woodcraft. For more information on the school, write to 140 E. 26th St., New York, N.Y. 10010.*

*Kirk Beaver's walnut, frame-and-panel desk, left, won first place in his region's industrial education contest. Jake Davis won the overall grand prize with his towering desk, above.*

# Student Desks

## *High school shop class on a roll*

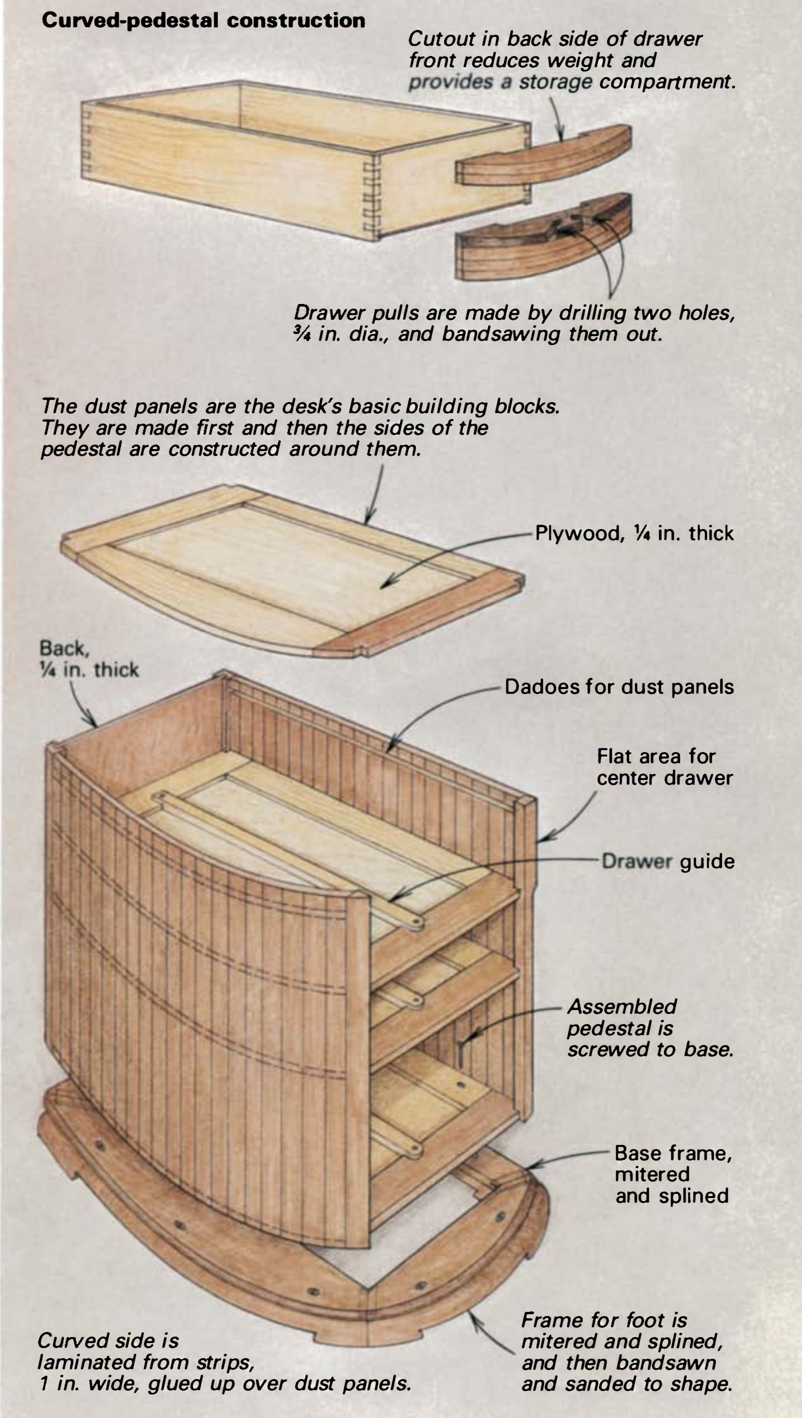
by John Moore

As a high school woodworking teacher with a background in design, I encourage my students to be ambitious and creative with their projects. No two pieces are ever exactly alike: We alter and vary the designs so each student gets design experience as well as building experience. In addition, no project is taboo. I've had students build everything from cedar chests and rocking chairs to tables, floor lamps and beds. Although many of the projects are both challenging and rewarding, nothing can quite compare to the majestic qualities of a roll-top desk. As you can see in the photos above showing three of my students' projects, roll-top desks lend themselves to a multitude of different forms and concepts, both in the exterior style and the design and execution of the interior compartments. In my 13 years at Kalkaska High School in Kalkaska, Mich., at least 30 different students have built large, pedestal roll-tops.

Most people have a hard time believing that these desks are high school shop projects. I often hear, "Even if students had the skill for these large projects, they'd never have the time to finish them." Well, that's half right. It's obvious that building desks such as these requires more than the one-hour class period each day. To accommodate the students who want to take on large projects, I often open the shop in evenings and on weekends so they can work an extra 10 to 20 hours a week. This enables them to complete their projects within one school year, which is a stipulation for entering the work in the annual regional contest sponsored by the Michigan Industrial Technology Education Society. As for whether or not high school students can develop the skill to build fine furniture, I'll let the awards won at the contests and the pictures here attest to that.

**Constructing a roll-top with curved sides**—Our desk designs are developed quite spontaneously, beginning with small sketches to explore ideas. After establishing the overall style and shape of the desk, we begin to consider how to construct it by concentrating primarily on the dust panels, which ultimately determine the shape and size of the entire desk. Using the original sketches as a reference, we make a full-scale paper pattern of one of the dust panels. From this pattern we work out the dimensions for the pedestals and then, step by step, for all the other parts of the desk. This way, the dust panels become the starting point and first building block of all the desks we build, enabling the students to get a grasp on such a large undertaking. But when the pedestals have curved sides, like James Green's desk in the photo on the facing page, the dust panels aren't just used to determine the desk's size and dimensions; they are also the form over which the curved sides are constructed. The drawing on the facing page and the following brief explanation illustrate how Green constructed the pedestals for his desk with a single curved panel on each pedestal. Other students have built desks with both

*It took James Green a lot of after-school and weekend hours to build his prize-winning, contoured roll-top desk, above. Moore says that people find it hard to believe that the students can complete their projects in one year.*




sides of the pedestals curved using the same methods.

After constructing the dust panels as shown in the drawing, random-width boards are glued up to make the flat, inside panels. The flat panels are first scraped and sanded to even out the joints between the laminations, and then squared up and crosscut to length, along with enough of the random-width stock, to make the curved panels. Next, the flat panels and the stock for the curved panels are dadoed to receive the dust panels. The dadoed, curved-panel stock is then ripped into 1-in.-wide strips and each strip is jointed along both edges to 3° or so, depending on the radius of the curve as defined by the dust panels. Our curves are usually not circle arcs, so the strips have to be individually fitted along the dust panel curve and numbered so they can be glued up in the proper order. Then, the corner posts that cap the ends of the panels are milled out and shaped to conform to the curved sides and to provide a transition into the eventual drawer front shape.

Since all the parts that make up the pedestals—the corner posts, the strips for the curved panel, the flat panel and the dust panels—are glued up in one operation, dry-clamping them together with belt clamps is essential to make sure everything fits. Then, the pedestals are glued and belt-clamped together with care taken to be sure that the drawer openings are square. The next day the clamps are removed and the curved sides are smoothed out and sanded with a body-grinder type disc sander. A note of caution is in order concerning gluing the pedestals together. If you don't have complete control of the humidity in your shop, I advise against gluing the curved-panel strips directly to the dust panel dadoes. Instead glue the plywood back panel into the corner posts and dowel the front of each dust panel into the corner posts. If you leave a little space at the back of the dust panels, the sides will then be able to expand or contract without splitting or buckling. We usually glue the dust panels into the dadoes in the strips and have never had a problem with sides splitting later. But then again, I've taken great pains to ensure that our wood is very dry and stays that way in storage here at the school.

The pedestal bases are made by screwing a 1-in.-thick frame to a 3-in.-thick molded and shaped foot. Each pedestal is screwed to its base from inside the bottom dust panel. The drawer boxes are dovetailed together and the drawer fronts are stack-laminated from 1½-in.-thick pieces that have been bandsawn to the desired curve. To form the drawer pulls, two holes are drilled about 3 in. apart in one of the laminates and bandsawn into the holes from its front.

The rest of the construction is similar to that of any roll-top desk. The two completed pedestals are connected with a center dust panel dadoed into the side panels, and a back panel that encloses the center drawer. Then, the desktop is glued up and bandsawn to conform to the shape of the joined pedestals. The upper sides are laminated from 4-in.-thick stock, shaped with a ½-in. round-nose bit in a high-speed grinder to match the contour of the pedestal side below and then finished up with the disc sander on the body grinder. We make our tambours by contact-cementing ¾-in.-square strips to lightweight canvas. For the sake of simplicity, the pigeon holes are glued up with a straight front edge and then the curve is bandsawn along their front. □

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*John Moore is a woodworking teacher at Kalkaska High School.*

Drawing: Vince Babak

# Making a Writing Desk

## *Customizing a leg-and-apron table with drawers*

by Christian Becksvoort

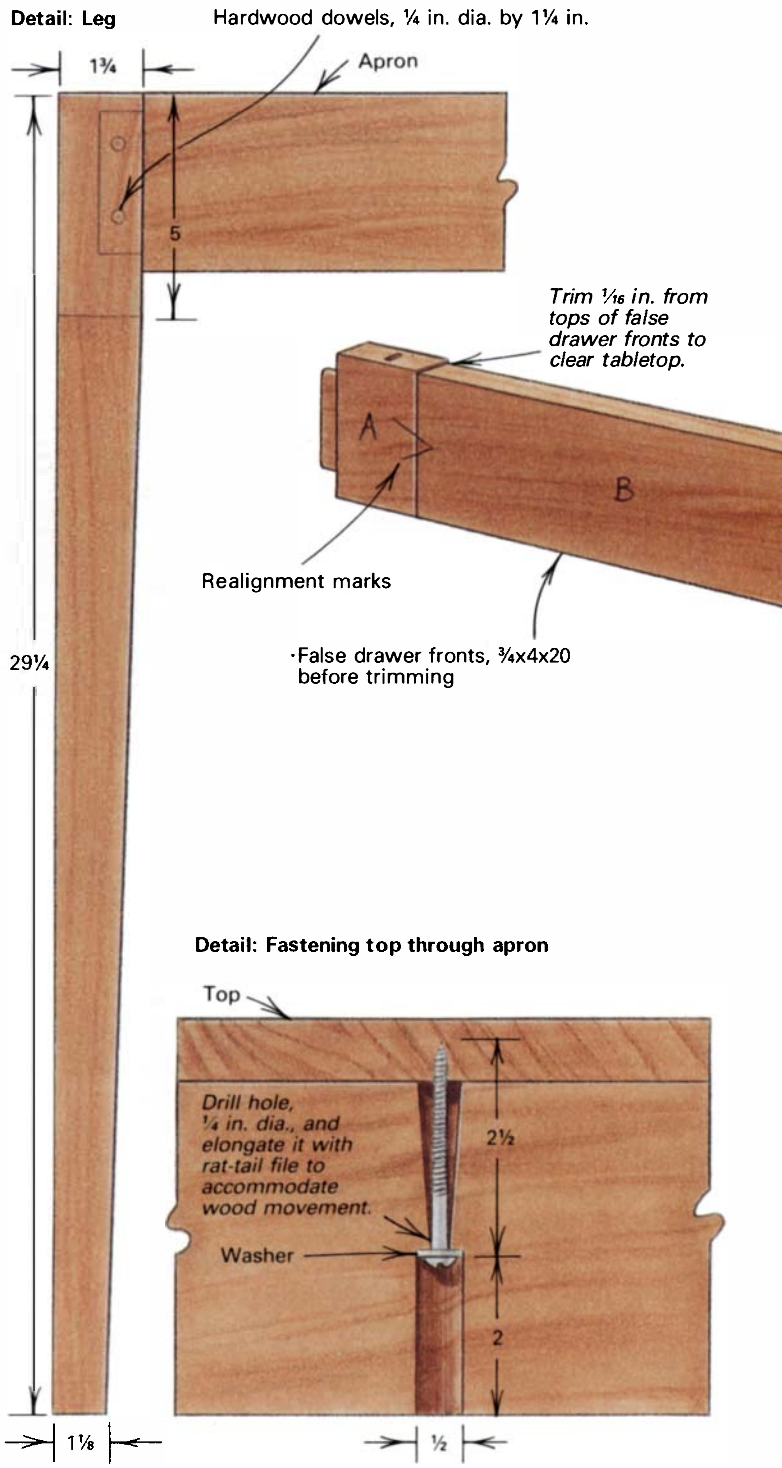
To me there are two types of desks: storage desks and writing desks. Storage desks, slant-tops, roll-tops and other "instant offices" consist of multitudes of drawers and pigeon holes designed to house not only pen and paper, but also ledgers, stamps, files, folders, books and various office supplies. On the other hand, writing desks like the one in the photo on p. 66 are multifunctional pieces of furniture consisting of a table with a few drawers built into the aprons. These desks are ideal for the kitchen, dining or work room, or even a regular office, where you are more concerned with having a large, usable work surface than with lots of storage space.

The writing desk described in this article is basic leg-and-apron table construction. An advantage of custom-made furniture is that it can be made to fit specific requirements. I usually make this writing desk with a 36-in. by 72-in. top, but to fit into a smaller room, this one was scaled down to 32 in. by 60 in. It overhangs the base by 6 in. on the sides, 2 in. at the back and only 1 in. at the front for easier drawer access. My desk has two drawers, but the number and layout of drawers can be altered to suit the function of the table. One drawer in the middle will suit for most purposes, although you may wish to have two identical drawers fit side by side, as shown in the drawing at right. For a three-drawer table, I usually put one big drawer in the middle and two smaller ones on either side. The side drawers can then be pulled out without moving the chair while working at the table. On a kitchen table or partners' desk, the drawers can be on opposite sides by using half-depth drawers back to back or full-depth drawers side by side in a variety of configurations. Another alternative is to place the drawers on the ends of the table.

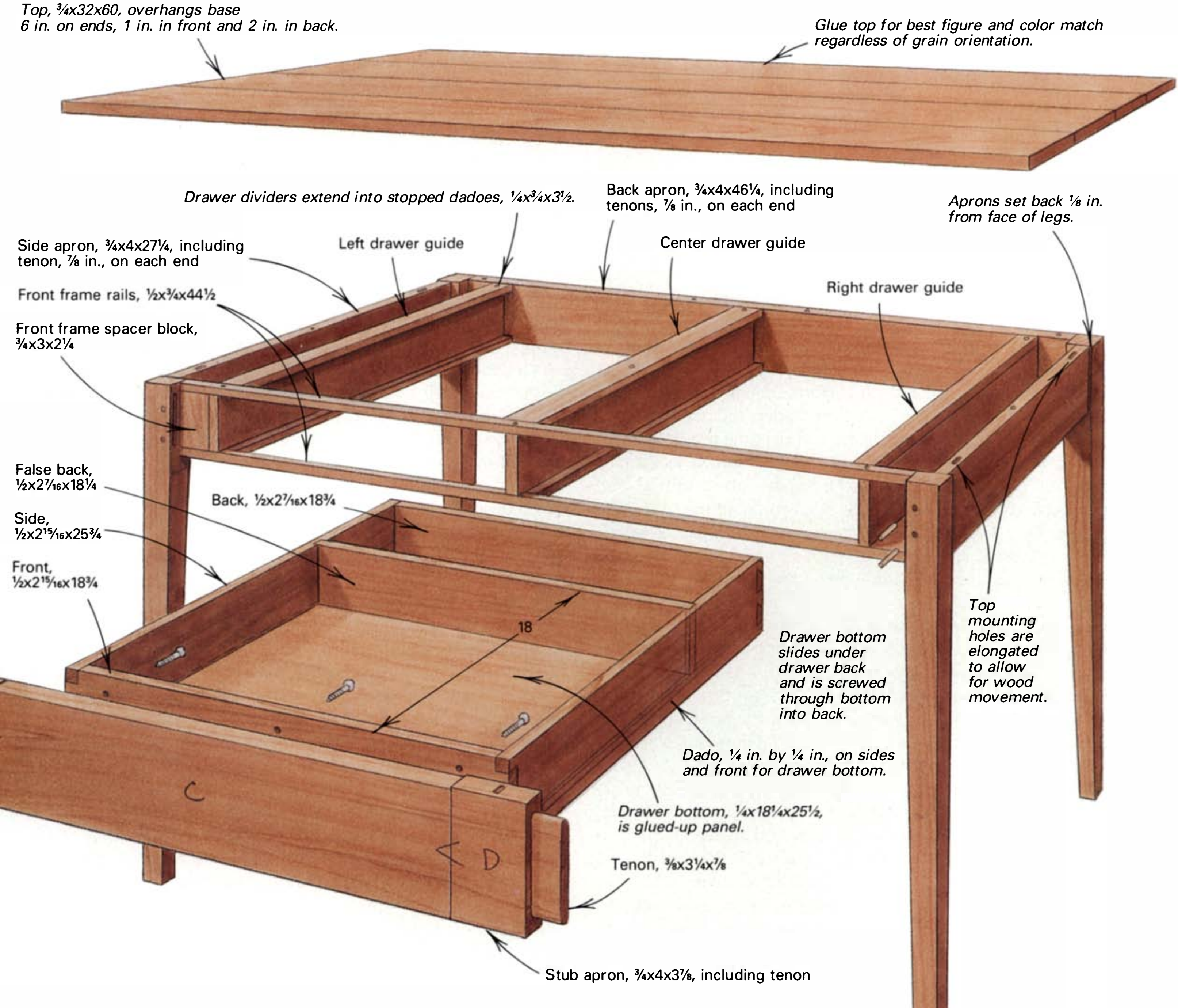
In any of these designs, I always try to make maximum use of the space available. If the distance between the aprons is 30 in., make the drawer 29½ in. deep, and then put a false back at 18 in. or 20 in. This allows ready access to a normal-size drawer, and provides an additional space at the back for seldom-used items or a secret compartment. Keep in mind that putting drawers through the aprons makes the table inherently weaker than one with four solid aprons. The writing desk is strong enough for normal use, but I advise people not to sit on it. While the addition of drawers somewhat complicates this piece, the construction remains straightforward.

I always start by gluing up my ¾-in. tabletops, as described in *FWW* #79, pp. 68-70, a week or so in advance. Then by the time I'm ready to work on the rest of the desk, I've had time to have them sanded perfectly flat on a 36-in. abrasive planer at a local millwork shop. My primary concern in gluing up tops or panels is appearance, so I arrange the boards for the best color and figure regardless of grain orientation; I've never had problems with cupping or warping.

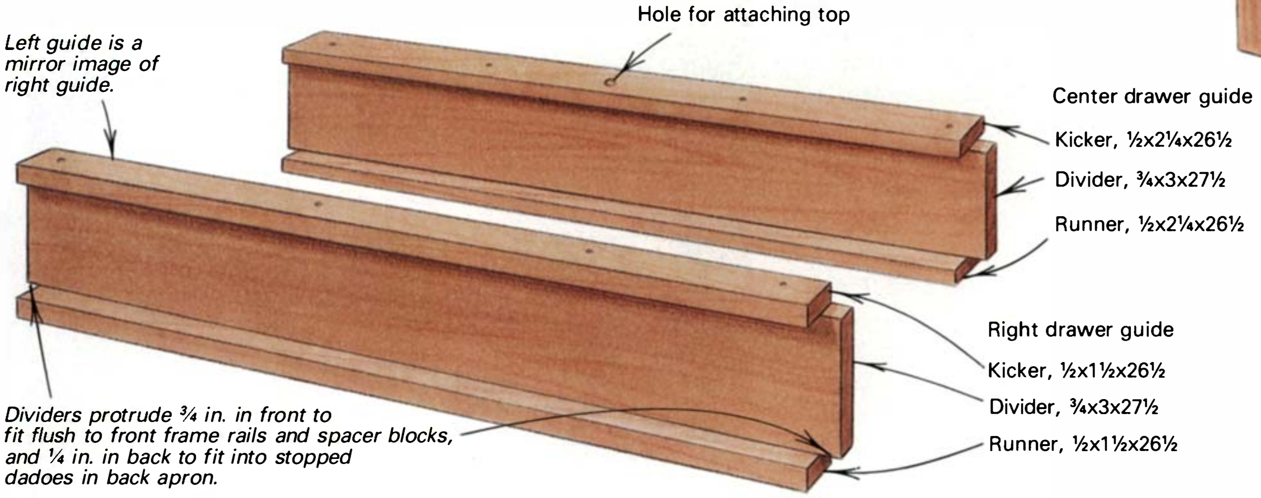
With the top needing only final sanding I begin constructing the base, as shown in the drawing, by cutting, shaping and mortising the legs. Solid aprons are tenoned into the legs on non-drawer sides.



**Writing desk**




**Detail: Drawer guides**




Drawing: Roland Wolf/Bob La Pointe

Aprons on sides that will receive a drawer are crosscut into the appropriate sections to form false drawer fronts and stub aprons, which are then tenoned into the legs. Next, I make a front frame of rails and spacer blocks, as shown in the top photo on the facing page, and screw it into the back of the stub aprons, for a solid connection across the front of the table, to prevent racking or splaying of the legs. Drawer guides are constructed as shown in the detail in the drawing by adding kickers to the top and runners to the bottom of a divider to support the drawers and further increase the rigidity of the table. With the base assembled, I attach the top, make the drawers and then attach the false drawer fronts to complete the table.

**Cutting and shaping the legs**—The legs on most tables are a great deal larger than necessary to support the loads placed on the tabletop. In my designs, I concentrate on developing more delicate legs that will still support any expected loads. The tapered legs of this table work well with the overall dimensions, creating a light, yet solid effect. To ensure that all legs will be the same length, I crosscut 8/4 stock to a length of 29¼ in. before ripping four pieces to 1¾ in. square (see drawing detail). Next, I orient the best figure and color to the outside surfaces of the leg and taper the two inside faces with a jig on the tablesaw. You can also taper the legs on a jointer, or rough them out on the bandsaw and refine the surface with a handplane. Depending on your methods, you may want to mortise the two inside faces prior to tapering. I use a slot mortiser that allows me to make one setup and then quickly cut all my mortises the same, although a router and jig or a drill press can be used.

**Apron design and installation**—The aprons also must harmonize with the other table components and I've found that a 3-in.- to 4-in.-wide apron provides adequate strength and avoids the bottom-heavy look of a 5-in. apron. I begin by first ripping my ¾-in.-thick apron stock to width, and then crosscutting the two side aprons and the back apron to length. The drawer apron is cut slightly long so I can reposition the drawer fronts and stub aprons to minimize the sawkerfs between the individual pieces. By working from the center to both ends, I maintain the selected grain pattern and have enough stock at each end to tenon the stub aprons. First, cut the drawer apron in half and reposition the two halves end to end. Mark the two drawer fronts to either side of the center cut, leaving 4-in.- to 5-in.-long pieces on each end, and crosscut the drawers fronts. Now, reposition all the pieces next to the back apron, and mark and cut the two stub aprons so the four separate pieces are exactly as long as the back apron, including tenons. I later disc-sand the ends and joint the tops of the false drawer fronts to allow about 1/16-in. clearance at the top and sides. Finally, I draw realignment marks and label the pieces A, B, C and D, as shown in the drawing. This ensures that they stay in the correct order and the grain forms a continuous pattern, making the drawers almost undetectable in the finished table (see the photo at right).

Tenons for the three full aprons, as well as the left end of piece A and the right end of piece D, are now crosscut on the tablesaw with the miter gauge and a stop block clamped to the fence. Position the stop block ⅞ in. away from the side of the blade farthest from the fence and set the blade height to 3/16 in. Test your setup on a piece of scrap apron cutoff, making sure the tenons fit snugly in the mortises. The shoulder is cut first by holding the apron against the miter gauge with the end butted against the stop block. After making a pass to form the shoulder, make multiple passes from the end toward the shoulder to clear away the rest of the waste. Flip the apron over and repeat to form the other cheek. Holes for attaching the top are drilled from bottom to top through the aprons, including the stub aprons A and D. All of the holes, except those in the middle of the side aprons and the center drawer guide, are elongated with a rat-tail file in the direction of potential wood movement of the top.

The table base is ready for assembly after sanding everything to 220-grit and checking the fit of the mortises and tenons. After making sure the aprons are all in their correct positions, glue and clamp the side aprons to their respective legs on a flat surface, checking for squareness by measuring the diagonals. Make necessary adjustments before drilling ¼-in.-dia. holes and pinning the joints with 1¼-in. hardwood dowels, as shown in the drawing. Connect the two glued-up sides by gluing, clamping and pinning the back apron in place, again checking for squareness across the diagonals. The two stub aprons are similarly installed, but a try square is used to check their alignment.

The base is rather flimsy until the cherry frame for the drawers (shown in the top photo on the facing page) is constructed to tie the sides of the table together. I cut two strips ½ in. thick by ¾ in. wide and the exact length of the back apron. These are then clamped, one flush with the top and the other flush with the bottom, to the backs of the stub aprons. Next, I fit a ¾-in.-thick spacer block between these strips so that it extends from the leg to within ¾ in. of the inside edge of the stub apron. Then the parts are unclamped and glued together on a flat surface; I usually do this on the long, plastic-laminated outfeed table of the tablesaw. When dry, the frame is sanded, reclamped in its position behind the stub aprons and screwed into the back of them, as shown in the bottom photo on the facing page.

**Installing drawer guides**—The rigidity of the apron is increased by adding drawer guides, which are constructed of three pieces: a divider, a kicker and a runner (see the drawing). The drawer guides are screwed into the frame in front and into dadoes in the back apron. For two drawers, three drawer guides are required. The vertical member against which the side of the drawer slides is the divider, the bottom horizontal piece that supports the drawer is the runner and the top horizontal piece that keeps the drawer from drooping when opened is the kicker. As shown in the drawer guide detail in the drawing, the dividers protrude ¾ in. in front to fit into the frame that was added to the back of the stub aprons and ¼ in. in back to fit into stopped dadoes in the back apron, shown in the top photo on the facing page. Lay out the left and right dadoes in the back apron by measuring from the front legs to the stub apron ends, transferring these measurements and squaring lines at each end of the back apron. Then, measure ¾ in. toward the legs and draw parallel lines. To locate the center dado, find the center of the back apron, measure ⅜ in. to either side of the centerline and mark out the ¾-in. dado. Although these dadoes can be cut on a tablesaw prior to assembly, I

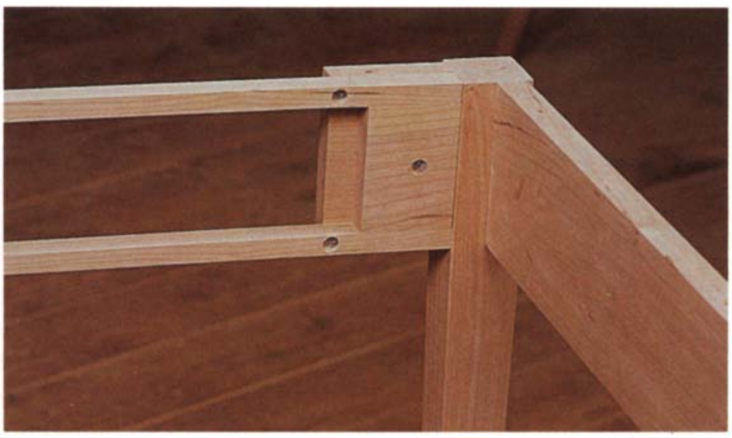
*Based on Shaker designs, this writing desk is basic leg-and-apron construction with drawers built into the apron.*

*This framework is screwed into the back of the stub aprons, connecting the ends of the table and providing an opening for the drawers. Note the pins securing the aprons to the legs and the dadoes visible on the back apron that will accept the dividers of the drawer guides.*

prefer to rout them ¼ in. deep, guided by a clamped-on fence, because it is easier to stop the cut ½ in. from the bottom of the apron.

Begin constructing the drawer guides, as shown in the drawing detail, by ripping the ¾-in.-thick dividers to the width of the opening of the front frame, which is 1 in. less than the width of the aprons. Measure the length of the dividers directly from the bottom of the stopped dado in the back apron to the back of the stub aprons. After crosscutting the dividers to length, test-fit and temporarily clamp them in place. Scribe the top and bottom of the dividers where they meet the front frame and the back apron. The kickers and runners are added to the top and bottom of the dividers between the front frame and the back apron to form the guides. Rip ½-in.-thick stock 1½ in. wide for the left and right drawer guides and 2¼ in. wide for the center drawer guide. Now I unclamp the dividers and glue and nail the kickers and runners to the top and bottom of the dividers, forming a left, center and right drawer guide. When the glue has dried, countersink and fill the nail holes and sand the finished drawer guides. Then drill and countersink a hole through the middle of the center guide for attaching the top.

The drawer guides are now installed by drilling and screwing through the top and bottom of the front frame, and drilling at an acute angle through the drawer guide into the back apron. The left and right drawer guides are located by their dadoes and the front frame. Although the back of the center drawer guide is also located in back by its dado, the front needs to be carefully laid out. For accuracy, I measure the location at the back, from the left and right drawer guide dividers to the center divider, and then transfer these measurements to the front frame. Consequently, if the center dado is not precisely in the middle, the drawer guides will be parallel, but not necessarily equal in width. Once the center drawer guide is located and screwed in place, all screw holes should be plugged and sanded. At this point, the top can be cut to size and its edges dressed, and then finish sanded and attached through the holes drilled in the aprons and center drawer guide. Suddenly the table becomes quite sturdy and substantial.



*The drawer framework is screwed directly into the back of the stub aprons to keep the legs from splaying or racking.*

**Making the drawers**—I prefer dovetailed drawers with a false front attached, but you can make your drawers using your favorite technique. Whatever method you choose, remember the false drawer fronts fit flush with the stub aprons in front of the frame. Cut all drawer sides, fronts and backs from ½-in.-thick stock, as shown in the drawing on pp. 64-65. Lay out and cut the dovetail joints before dadoing the sides and front to receive the ¼-in.-thick glued-up bottom panel. Now sand and assemble the drawers without their bottoms. Make sure the drawers fit the openings, planing any problem areas so they glide easily and smoothly.

I don't install the drawer bottoms until the false fronts are attached, so I can put the drawers in place and then work through the open drawer bottom to perfectly align the false fronts. First I rout a ½-in. cove into the bottom inside edge of the two fronts for finger pulls. Fit the first front, clamp it into place and then fit the second front. I like to leave a 1⁄16-in. gap between the drawer and the top and 1⁄16 in. between drawers and stub aprons. All four members must be flush on bottom. The actual trimming to obtain a clean 1⁄16-in. gap is done with a disc sander or a fine-tooth blade on the tablesaw. In either case, undercut the ends 4° to 5° because a good drawer fit requires some side clearance and the undercut will keep the drawer fronts from hanging up on adjacent members. Once both fronts are fit and clamped into place, I drill from the inside of the drawers for six screws each. These screws are not plugged in case any adjustment of the false fronts should ever be necessary. With the false fronts screwed in place, slide the bottoms into their dadoes and screw up through the bottoms into the backs.

Remove the top and drawers for a final light sanding and the finish of your choice. I generally prefer Watco oil (available from most hardware or paint supply stores), but if the table is more likely to see hard use, I will use a lacquer or varnish for a more durable finish. □

*Christian H. Becksvoort builds custom furniture in New Gloucester, Maine, and is a Contributing Editor to* FWW.

# Building a Wooden Hygrometer

*Measuring humidity's dramatic effect on wood*

by Warren W. Miller

Most woodworkers are well aware that wood moves with seasonal humidity changes, but few have a convenient way to measure moisture. You can get a rough idea by noting the relative humidity (RH) levels reported on your local weather station or you can buy an instrument called a hygrometer, which measures the amount of moisture in the air. But, since each species of wood expands and contracts at a definite measurable rate, I decided to use this natural relationship between wood movement and moisture as the basis of my own shop-built hygrometer.

My instrument consists of four pieces of wood: a laminated strip that bends with changes in RH, a clamp that anchors one end of the strip, a scale at the free, moving end of the strip, and a strut that connects the clamp and scale, as shown in the drawing on the facing page. The hygrometer looks simple, but it graphically demonstrates how RH causes wood movement by changing wood's moisture content (MC).

**Relative humidity's effect on wood**—Ignoring the effect of humidity on wood can create problems. Chairs, once tightly joined together in the workshop, become loose and wrack during winter's low RH. Door panels may buckle during damp weather or split during dry weather if they're fit too tightly or inadvertently glued into the door's rails or stiles.

The amount of movement can be significant. Increasing the MC of white oak from 5% to 13%, for example, causes a 2% increase in the width of a flatsawn board; that's 3⁄16 in. in a 10-in. board! Now, that 8% difference in MC happens when RH increases from 30% to 75%, a 45% change that's a common annual occurrence in many locations. A flatsawn piece of redwood, on the other hand, moves less than 1% across its face during the same change in RH. In general, softwoods are more stable than hardwoods. For more on moisture's effect on wood movement, see Bruce Hoadley's book *Understanding Wood* (The Taunton Press, 1980).

Within any one species, movement due to changes in RH is virtually zero along the grain compared to across the grain. Because of these predictable, moisture-related changes, I was able to base my wooden hygrometer on the same principle as some thermometers employing a thin bimetal strip laminated from two metals that move differently when the temperature changes. Instead of a bimetal strip, the wooden hygrometer has what I call a "biaxial" strip: two wafer-thin laminates, one ripped on the longitudinal-grain axis and the other crosscut on the end-grain axis.

**How biaxial laminates move**—My laminated strip moves as MC levels vary because of the different dimensional changes of the two laminates. The end-grain changes much more than the virtually stable longitudinal-grain that it actually bends the longitudinal-grain strip.

My hygrometer's biaxial strip is cherry, but most domestic hardwoods will do as well. With a 30% change in RH, the end-grain cherry strip will change dimension about 1½%, or about 5⁄32 in. in 10 in., making for dramatic strip movement. As previously discussed, softwoods are less affected by moisture changes than hardwoods, so they are a poor choice for a biaxial lamination since strip movement would be so subdued.

You should be sure to saw the end-grain laminate from a flatsawn board, where the annual rings are more or less parallel to its width. A quartersawn board, where the annual rings are more or less perpendicular to the board's width, shrink and expand only one-half as much as a flatsawn board of the same species. This makes quartersawn lumber ideal for woodwork, for which stability is important, but a poor choice for our hygrometer, for which movement is desirable.

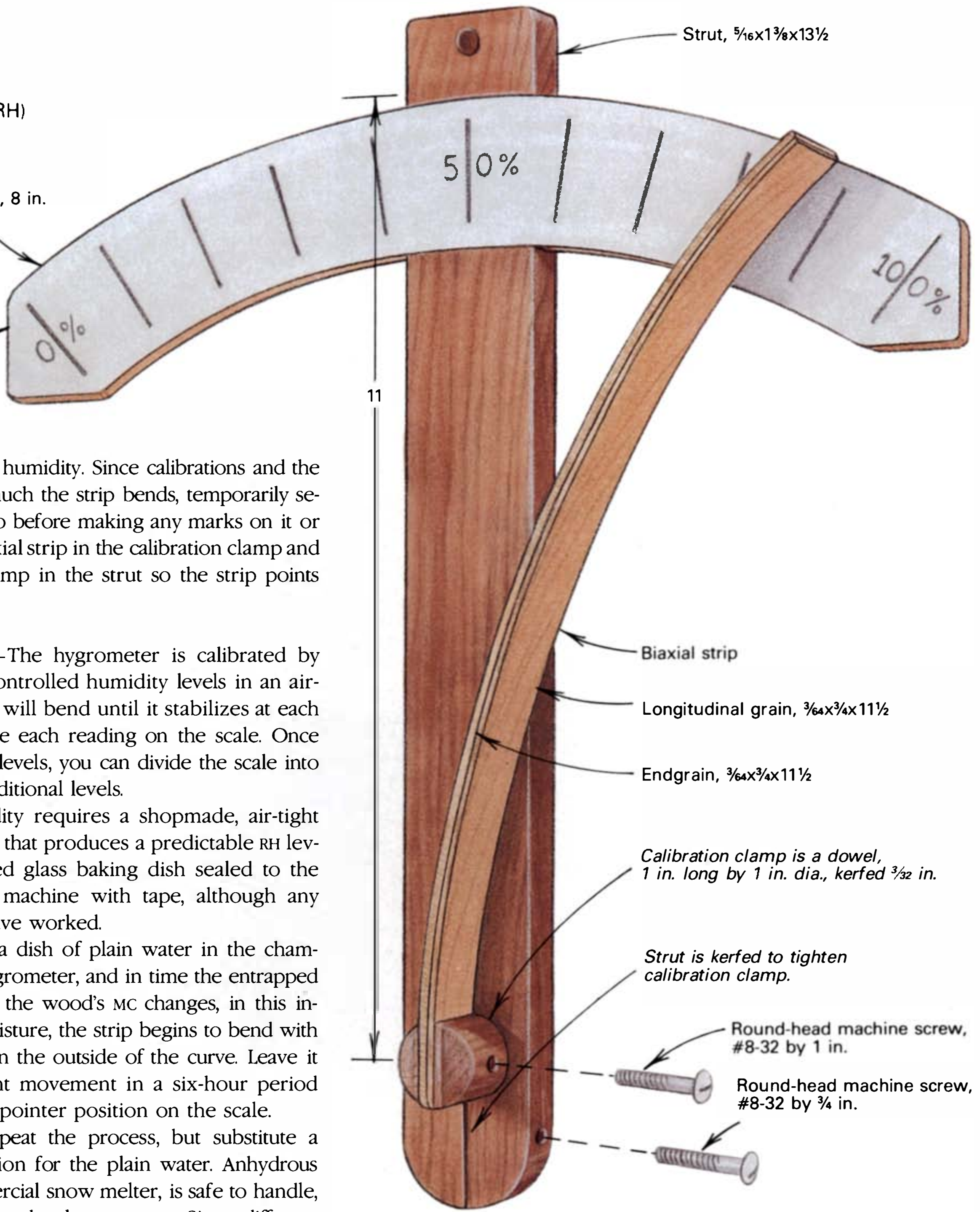
Using a thin-kerf ATB carbide blade in the tablesaw and a shop-made narrow-gap saw table insert, I ripped and crosscut the 3⁄64-in.-thick strips of cherry. This proved to be the thinnest section of a cross-grain strip capable of bending freely without breaking.

**Laminating the strip**—Since the hygrometer's strip should be straight when the RH is near 50%, be sure to laminate it when the RH in the shop is close to 50%, as reported on your local weather forecast. When laminating, avoid filling the open pores of the end-grain strip with glue. The end-grain surface will readily absorb glue, and this could hinder its ability to absorb moisture. To avoid this problem, I use a thick, viscous epoxy and take care to spread a thin coat only on the longitudinal-grain surface before pressing the laminates together. Applied this way the glue acts as a surface treatment and little of it is absorbed by the endgrain. Care should be taken to keep the strip clean and free of moisture-blocking substances, such as oily fingerprints. And, of course, no finish should be applied to the raw wood. After wrapping the laminates in wax paper, clamp the assembly between strips of wood and set it aside to cure overnight.

When the glue has cured, scrape and sand the excess from the edges of the biaxial strip and assemble the hygrometer as shown. The calibration clamp is a 1-in.-long piece of 1-in.-dia. dowel that is inserted into a 1-in.-dia. hole in the bottom of the strut. Kerf the dowel to accept the laminated strip, which is secured with a set screw. The strut also has a thin kerf and a screw tightens the clamp in position after the instrument has been calibrated. The strut, which is longer than the strip, is dadoed for the scale, as deep as the scale is thick, near its top (see the drawing).

The required length of the scale will not only depend on the wood species of the strip, but also its length and thickness and the amount of end-grain glue absorption. For the instrument in the drawing, the free end of the laminated strip moves about 6 in.

**A wooden hygrometer**




between very low and very high humidity. Since calibrations and the final size will depend on how much the strip bends, temporarily secure the scale in the strut's dado before making any marks on it or cutting it to size. Tighten the biaxial strip in the calibration clamp and then temporarily tighten the clamp in the strut so the strip points straight up the strut's midline.

**Calibrating the hygrometer**—The hygrometer is calibrated by subjecting it to a few known, controlled humidity levels in an airtight chamber. The biaxial strip will bend until it stabilizes at each humidity level so you can locate each reading on the scale. Once you've established two or three levels, you can divide the scale into equal increments to establish additional levels.

Accurately controlling humidity requires a shopmade, air-tight chamber and a chemical system that produces a predictable RH level. My chamber was an inverted glass baking dish sealed to the enameled top of my washing machine with tape, although any smooth, shiny surface would have worked.

Begin calibration by placing a dish of plain water in the chamber, along with your wooden hygrometer, and in time the entrapped air will stabilize at 100% RH. As the wood's MC changes, in this instance because it's absorbing moisture, the strip begins to bend with the end-grain side of the strip on the outside of the curve. Leave it until there is no more apparent movement in a six-hour period and then temporarily mark the pointer position on the scale.

To get a second reading, repeat the process, but substitute a calcium chloride chemical solution for the plain water. Anhydrous calcium chloride, such as commercial snow melter, is safe to handle, inexpensive and available in many hardware stores. Since different salts produce different results, be sure you get calcium chloride ($CaCl_2$) and not rock salt (NaCl). In a glass jar, dissolve a handful of the calcium chloride in about half its weight of water. Heat the solution by placing the jar in a pan of hot tap water, and then loosely cover the jar and leave it overnight to cool. A large crop of white crystals of the hydrate ($CaCl_2{\cdot}6H_2O$) should separate in the dish. If they do not, reheat the solution and add more calcium chloride. Transfer the crystals and some of the solution to the dish in the humidity chamber, add the hygrometer and seal the chamber. The RH of the atmosphere in the chamber will stabilize at 32%. As it does, the strip will bend toward its end-grain side, with the longitudinal grain on the outside of the curve, and establish a new position on your scale. Wait until there is no more movement, as before, and then remove the hygrometer and cover the chamber for final calibration.

Now replace the preliminary calibration marks with permanent ones. I've found that the scale is very nearly linear, meaning each 10% increment is equal. Determine these increments by bending a thin, supple measuring scale along and adjacent to the scale's arc; be sure to note the length of the arc between the 100% and 32% marks and divide it by 6.8. For instance, if there are 7 in. between the 100% and 32% marks, 10% increments equal 1.03 or one every 1 1/32 in., which is set on a pair of dividers and stepped off on the scale. Now, establish permanent marks at each 10% increment between 0% and 100%, but don't erase the temporary 32% RH mark until after you've fastened the scale and rechecked the calibration.

The next step is to permanently fasten the scale to the instrument's strut. Trim the scale's ends symmetrically, leaving some material beyond 0% and 100%, and permanently glue it in the dado with the 50% calibration mark on the strut's midline. Finally, return the hygrometer to the chamber, which is still set up for 32% RH, let the strip stabilize, turn the calibration clamp until the strip is pointing to 32% and tighten the clamp in the strut. Your instrument is calibrated and ready for use! □

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*Warren Miller is a retired chemistry professor whose woodworking shop is in State College, Pa.*

Drawing: Bob La Pointe

The design below is an example of the way some contemporary artisans employ ancient marquetry techniques to make attractive modern compositions. Despite the long tradition of marquetry around the world, today's practitioners contend that the decorative possibilities of the art form have not been exhausted, especially in light of plastics and other high-tech materials that are now available to marqueters. Made from multiple sheets of sycamore, amaranth, coral and satinwood, this elliptical casket represents an abstract design. It was designed and executed by students of the Ecole Boulle, and it is 9¼ in. high, 5½ in. wide and 3¾ in. deep. (Photo: J.P. Vial).

This inkstand box, which is approximately 6¾ in. high, 20 in. wide and 13¼ in. deep, is based on Islamic art (Alhambra Palace in Granada). Cut piece by piece, the marquetry is of kingwood and arranged as suns, and inlaid into a brass grill. The interior is from moiré satinwood and amaranth. The artisans who constructed the box carved their initials inside the cover.

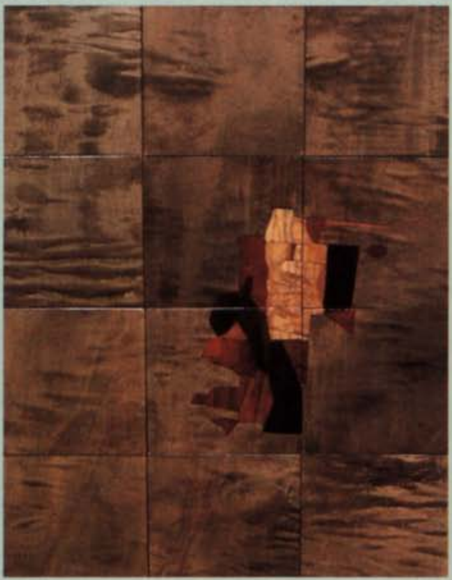
Left: This fantasy subject, by an Ecole Boulle student, is made from barwood, blackened pearwood and blue-dyed sycamore. The flowers are from amaranth, the butterfly from boxwood, the tree from stained bird's-eye maple and the background from flecked sycamore tinted silver-gray. Using dyed veneers enables the marqueter to enrich the overall piece without necessarily increasing the decoration. (Photo: B. Novi). Right: Constructed in 1976, this stereo cabinet has marquetry motifs. Notice the contrasting darker and lighter veneers typical of the period.

# Marquetry

*Decorating with a palette of colored woods*

by Pierre Ramond

**Above: This 25½-in. by 24½-in. piece was created in classes on perspective and executed by Ecole Boulle students. The sky is Brazilian rosewood; the dam is tulipwood and amaranth; the skeleton is West Indian boxwood, Ceylonese satinwood and pearwood; and the rocky cliffs are figured mahogany, walnut and macassar ebony. The veneer is in natural colors. (Photo: B. Novi). Below: More evidence of dyed wood that was used in marquetry are these ceiling tiles, created by Michel Lefèvre, that are made from sycamore that's been stained silver-gray.**




**Most furniture made by contemporary designers was rather conventional, although it was enriched with beautiful marquetry. The coffee tables, shown above and below, represent rather unique, and somewhat abstract, designs. The original ideas and designs are by Luis Ansa, who was inspired by the Cubist School, and the marquetry is by Pierre Ramond. (Photos: Peter Shummer).**

Marquetry is the art of painting with wood. Also called intarsia or inlay, it encompasses making pictures and geometric designs with thin slices of colored wood, shell and other precious materials. It is a popular technique for decorating the smooth surfaces of pieces of furniture, as well as a versatile means of creative expression.

The art of marquetry is ancient and dates back to marble incrustations in the palace of King Mausole in 350 B.C. For many centuries after that time, marquetry was centered in Paris, although English and German cabinetmakers were actively decorating furniture with marquetry as well.

In North America, marquetry was not as popular as in Europe. The decoration of 18th-century furniture was taken from the English and Colonial styles, but the shapes and designs were far less elaborate. Much of this early American marquetry was made by a constituent of cabinetmakers in Boston, Mass., who found wood plentiful in this country and worked with sculptors, gilders, turners, upholsterers and lumbermen to cut and prepare veneers.

Between 1788 and 1810, "Early Federal" furniture evolved, influenced by George Hepplewhite's and Thomas Sheraton's styles. The "Later Federal" period (1800-1840) boasted pieces veneered with light-color woods. Since many more European cabinetmakers settled in America during the mid-19th century and onward, some of the more popular European styles, such as Gothic, Rococo, Renaissance and Louis XIV, were very much in fashion in the United States.

In the years between the two World Wars, many cabinetmakers

**The marquetry in the chest, right, was cut in veneer from "luxury" woods of exceptional quality: kingwood and rosewood from Madagascar, and brass. Like many marquetry pieces, this is an interpretation of a drawing. In keeping with the originality of the drawing by Cornelius Escher, the tracing silhouettes the figures the same way on the top and bottom and the reverse way in the center. This type of composition can be executed in the 17th-century technique of Andre-Charles Boulle, who developed compositions made from wood, shell and metal, cut in superimposition, and assembled in positive and negative. Here the rosewood is superimposed on the brass, and obtains identical patterns at the same time, but with the contrasts reversed. After the pieces of marquetry were veneered on the box, the details of the figures were engraved with a burin. The engraved figures are more visible on the brass.**

continued working and adopted the Art Deco style. Although the merit of the artistic taste during this period is questionable, the marquetry created was of a very high technical standard. In fact, to cut the very fine grill work that was essential to cloisonné motifs, experience and great manual dexterity were required. Works by Jacques-Emile Ruhlmann with their delicate ivory interlacing are proof of such skill. (For more on Ruhlmann's work, see *FWW* #51, pp. 35-37.)

While the aesthetic quality of the style may be disputed, the artisans were still able to craft superb copies, faithful to the ideals of their predecessors. Since the last century, there has been considerable mechanical progress: The workbench is in its most advanced form and the pedal or electric scroll saw is able to cut a number of veneers simultaneously, producing several copies of a marquetry motif. Many tools, including the small circular saw and trimmer, accelerated the use of marquetry and improved the precision of the arrangements, thereby lowering the cost by increasing the output.

The industrialization of recent years and the progressive disappearance of artisans, however, have discouraged the survival of marquetry. After World War II, furniture was made in mass, and marquetry was not frequently included. It was at this time that marquetry decoration was adapted in "Moustache" style furniture. The furniture made during this period was rectilinear and rather conventional, although it was enriched with beautiful veneer work. Cabinetmakers produced large quantities of furniture that was almost identical, but was covered with a different veneer, that was either dark (Indian rosewood or ebony) or blond (Baltic birch, bird's-eye maple or sycamore), the paleness of which was accentuated by applying hydrogen peroxide before varnishing.

Fretwork medallions were incorporated into doors of wardrobes and cupboards and on tabletops and headboards. The main part of this decoration was in speckled, moiré, marbled or flamed veneer, arranged simply or with a background effect, such as mosaic squares or circles. The frame was either pierced or fretwork and made from striped veneer of the same tonality, contrasted by a fillet that was 1mm or 2mm wide. This fillet was commonly made from boxwood or sycamore on a darkened-wood ground, or amaranth, ebony, pearwood or hornbeam stained black and inlaid into light furniture.

**The elements of character**—Wood is the most frequently used material in marquetry. Although a wide assortment of natural-color wood is available, an infinite variety of hues are also possible with dyed wood. Veneer manufacturers classify wood into three categories: exceptional-figured qualities, which includes walnut, elm, oak, tropical wood, nearly all mahogany, avodiré, makoré and teak; luxury wood, which includes tropical wood that provides veneer that is moiré, waved, speckled or flamed, as well as maple, European cherry, tulipwood, kingwood, rosewood, amaranth, satinwood and ebony; and common wood, which is used for plywood and industrial veneer, and includes poplar, beech and most of the species in the other categories if they don't contain any unusual characteristics. All wood veneers composing a marquetry are selected from exceptional-quality wood, usually from the luxury category.

However, it is not uncommon to see imitations. Plastic laminates with a wood design or geometric composition on reconstituted veneer are easily identified as false marquetry. But new techniques, like transferring, make the expert's task of recognizing a false marquetry piece even more difficult. This method consists in making a genuine motif in wood, which is cut out, and then inlaid by a marqueter. It can be photographed and reproduced, sometimes by the thousands. The photograph, printed on paper or vinyl, is glued onto the piece of furniture, and a coat of polyester or polyurethane varnish eliminates any trace of lamination. Stenciling is another method and involves decorating pieces of furniture with paint that commonly imitates boxwood, ebony, mother of pearl and copper bandings. When the work has been done carefully, stenciling is a fairly good and undetectable method of reproduction.

In recent years, the increasing use of plastic laminate and the popularity of lacquered furniture have seriously impacted the use of marquetry. Louis XV, Louis XVI and Charles X furniture has been in demand, and the use of marquetry in these pieces has been maintained. A few contemporary artisans have created modern compositions decorated with new and different materials. However, the true marquetry craft is so relatively unknown and the standards of craftsmanship have declined that the decorative possibilities offered by this art form are not fully utilized. □

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*Pierre Ramond is a teacher at l'Ecole Boulle, the University of Paris I and Paris IV and at the Sorbonne, as well as at the French Institute for the Restoration of Works of Art. This article has been adapted with permission from the new English-version book,* Marquetry, *©1989, which was published jointly by Les Editions H. Vial and The Taunton Press.*



***The viscosity of gel finishes varies from the thick, paste-like consistency of Bartley's Paste Varnish and Stain, top left, to the pourable gel of Flecto's X-3D Wood Stain, top right. Nonetheless, all have been blended with thixotropic, or thickening, agents to keep the pigments, resins and solvents from separating. Since stirring is not required and convenience for the do-it-yourselfer is one of their selling points, the brands at left package their gels in plastic squeeze bottles.***

# Gel Stains

## *Producing even color with less mess*

by Jim Boesel

When I first noticed advertisements for new, improved gel stains and clear finishes, I was skeptical, but not surprised. In the last year or so, everything in my bathroom, from toothpaste to shaving cream, has "gelled," so why shouldn't this new advertising buzzword make its way into the shop? Next year, I had speculated, they'd be coming out with new, improved polyurethane *light*: covers great, less filling.

After awhile my skepticism gave way to curiosity and I tried these gelled finishes. They are available in the usual variety of wood stain colors, which can be intermixed to produce additional shades. There are also white and clear gels that can be tinted with most pigments, including Japan colors, artists' oils and universal colorants from your local paint store. White gels can also be thinned to create a limed or pickled effect. The latest entries in the gel marketplace are premixed pastel colors that subtly tint tight-grain woods and color the open grain in woods such as oak and ash.

To my surprise, these gels delivered what they promised. They were easy to apply, with little mess. They produced an even color coat without requiring you to continually stir the pigment into suspension. They were fast drying and didn't raise the grain enough to require sanding between coats. And they covered more area than a comparable portion of conventional oil-base stain. I was also surprised to learn that gel stains are not new. As Dick Fitch, finishing consultant to The Bartley Collection Ltd., pointed out, pigmented stains in paste form are at least as old as war paint, and wood finishers have been using them for centuries. Heavy-bodied wiping stains, which are thickened with additives that act something like cornstarch in gravy, have been a staple in professional finishing shops for decades. The thick consistency of these wiping stains keeps the pigment in suspension to provide predictable and repeatable results, but they have never been readily available to the weekend woodworker. Then about 20 years ago, gel stains made their appearance on the market. These new wiping stains owed their thick viscosity not to the addition of a thickening agent, as the earlier wiping stains had, but to rheology, the science of the deformation and flow of matter.

**Thickness through thixotropy**—Gel stains consist of basically the same ingredients as conventional oil-base stains: pigments suspended in a vehicle of alkyd resins (often alkyd-modified linseed or some other vegetable oil), driers and mineral spirits. Gels contain about twice as much pigment and resin as regular stains, but this higher solids content has little to do with their thicker consistency. So, what makes gel stains different from conventional wiping stains? The gels are thixotropic. Webster defines thixotropy as the property of various gels of becoming fluid when disturbed, as by shaking. In other words, gel stains are thick to begin with, but when disturbed, either by shaking, stirring or even just the action of applying them with a cloth, they become fluid and easy to work. When the materials are left alone again, they return to their gel state. In contrast, a conventional wiping stain will stay thick unless it's thinned with solvent.

Gels are made thixotropic by adding a polyamide-modified thixotropic alkyd resin and/or other thixotropic agents (such as bentonite clay) to the usual recipe of pigment, resin, driers and solvent. These ingredients are placed in large drums and then mixed together for about 20 minutes by a high-speed dispersion machine that looks just like a giant milk-shake mixer. The mixer blades spin at about 3,000 RPM and blend the ingredients evenly throughout the mixture. When the mixing stops, weak hydrogen bonds are formed between the thixotropic agents and the other ingredients, binding the mixture together to a uniformly thick consistency, which can be varied from a pourable gel to a thick paste. These weak hydrogen bonds break down when shear forces are applied, such as the mechanical action of applying the gel with a cloth, and then re-form shortly after the rubbing stops.

**Applying gel stains**—It's safe to assume that the proliferation of gel stains in the past few years is directed at the convenience or do-it-yourself market. Gels are well suited for small projects. And because they're wiped on and off almost immediately, they are especially handy where a dust-free environment for finishing is not available. Their thick viscosity makes them great for finishing in-place vertical surfaces, such as built-in cabinets or pre-hung doors. In fact, their thicker viscosity solves most of the common complaints associated with oil-base stains. They can be applied without splattering or running and, because the pigment stays evenly blended, they produce an even color coat. In addition, their higher solids content reduces their penetration into the wood, which increases the area that can be covered with a given amount of stain and makes it much easier to control the problem of splotchy color on irregular grain.

Unfortunately, even with gels, the final finish will only be as good as your surface preparation. Staining will accentuate any scratches or rough spots, so sand all wood surfaces thoroughly. Because of their high solids content, gels will help fill wood pores better than regular stains. But if you want a smooth, highly polished finish on open-grain woods, such as oak, ash or mahogany, you must still fill the pores with a paste wood filler before staining. After sanding or filling, blow the sanding dust from the wood's surface with an air compressor and then clean the entire surface with a tack cloth.

In preparation for finishing, gather a good supply of clean cloths; old T-shirts or terry cloth work well, but avoid any cloth that gives off lint. Brushes are handy for working the finish into intricate carvings or other tight spots. Have some mineral spirits on hand for lightening the color or blending lap marks when staining. As user-friendly as gel finishes are, don't forget that they contain mineral spirits or other solvents that are potentially hazardous. Rubber gloves are advisable and it's essential to provide proper ventilation, such as a window fan blowing out one end of the room and a door or window open at the other end.

Instructions for applying gel finishes are pretty much the same for all brands. Apply a small amount to a clean cloth and wipe it on the surface with the grain. If possible, cover a whole area, such as a cabinet side, at one time. On large tabletops and similar surfaces, work in logical areas—treat one leaf or one half of the table as a unit. You can blend lap marks with a little mineral spirits, although it isn't usually necessary if you work quickly. The recommended waiting time before wiping off the gel with another clean cloth varies from immediately to between two and five minutes. Again, when wiping off excess finish, work with the grain.

As with conventional stains, most common clear finishes can be used over gel stains that have dried thoroughly. The exceptions are brushing lacquer and other finishes containing high-boiling active solvents like ketones, which evaporate slowly and might redissolve the stain. The drying time before topcoating varies, depending on the final finish, but 24 hours seems to be the average. Up to 72 hours is recommended for spray lacquer.

What about the drawbacks of gels? For large areas such as a floor, it would be faster and easier to brush or spray on a liquid finish. And for most production situations, applying a gel is just too slow; they can't compete with a spray gun or dip tank for moving multiples out the door. Their lower solvent content, which prevents them from penetrating as deeply as conventional oil-base finishes, could be a disadvantage in some cases. However, this reduction in solvents is most likely one of the reasons for the finish industry's current interest in gels, because it will help them meet the tighter government restrictions on volatile organic compounds (VOCs) that have already been enacted in California and New Jersey and which promise to be the trend in the future.

So, in spite of my original skepticism, I have to conclude that for most small projects, the advantages of gels tend to outweigh the disadvantages. And if you dread the mess, and that feeling of uncertainty that often accompanies the finishing process, gel finishes might be just what you've been looking for. □

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*Jim Boesel is an Assistant Editor at* FWW.

## *Sources of supply*

***The following companies manufacture gel finishes:***

Bartley Collection Ltd., 3 Airpark Drive, Easton, MD 21601; ***stains in wood tones (stain and topcoat in one) and clear.***

H. Behlen and Brothers, Inc., Route 30 N., Amsterdam, NY 12010; ***stains in wood tones, white and clear.***

Fabulon Products, Box 1505, Buffalo, NY 14240; ***stains in wood tones, white and tung-oil varnish.***

Flecto Co., Inc., 1000 45th St., Oakland, CA 94608; ***stains in wood tones and clear.***

Minwax Co., 102 Chestnut Ridge Plaza, Montvale, NJ 07645; ***stains in wood tones, white and pastels (stain and topcoat in one).***

Thompson and Formby, Inc., 825 Crossover Lane, Memphis, TN 38117; ***stains in wood tones and tung-oil varnish.***

Wood-Kote Products, Inc., Box 17192, Portland, OR 97217; ***stains in wood tones and white.***

# *A professional's gel techniques*

by Gregory D. Johnson

As a professional wood finisher, I'm familiar with a large repertoire of wood finishes, from shellac and lacquer to high-tech catalyzed polyurethanes and polyesters. These finishes, which constitute the bulk of our work, are all film-type coatings that build up on the wood's surface. But now and then a piece comes through which, because of the customer's request or the style of the furniture, calls for the subtle beauty of a hand-rubbed oil finish. However, achieving a durable oil finish requires a good deal of labor, wiping each of several coats on and off. You also lose a lot of time waiting for one coat to harden before applying the next. This process can take anywhere from three or four days up to two weeks, which creates work-flow (not to mention cash-flow) and space problems for most finishing shops.

To give the customer a "close-to-the-wood" type finish without causing a backup in the shop, I've turned to paste stains and paste varnish. Compared to tung oil or Danish oil finishes or homemade oil/varnish mixtures that I've tried, paste varnish dries faster, builds faster and is more durable, while it still preserves that hand-rubbed look. Although any of the paste or gel finishes on the market will give good results, I prefer Bartley's paste stains and varnish because they contain a substantial amount of polyurethane (about 33% of vehicle solids), which increases the durability of the final finish and lets you stain and top-coat in a single step. Both the premixed stains and the clear varnish dry within four hours and can be buffed to a nice sheen after two coats.

For many pieces of furniture, such as chairs, beds and bookcases, a couple coats of paste varnish will suffice. But for a kitchen or dining room table or any piece of furniture with a flat surface that might attract an after-dinner drink or a cup of hot tea, I recommend a more durable film finish. Even with the addition of polyurethane, any finish that's wiped off almost immediately after it's applied will not build much of a film. When I want additional protection without the look of a film finish, I first brush on a sealer coat of Minwax fast-dry, semi-gloss liquid polyurethane and then top it off by rubbing on a couple of coats of paste varnish. The photos at right illustrate a test I did to see how much additional protection was gained with this sealer coat of polyurethane. The finishes looked and felt the same, but the sample that had the coat of polyurethane showed much greater resistance to water and alcohol damage.

**Working with a polyurethane/gel finish:** First, sand the surface well and fill or stain as needed. When the stain is dry, brush on the initial coat of polyurethane, being careful to avoid runs or drips along edges, or puddles in the corners. Often air bubbles will form right away, so without adding any more finish, brush the wet film again very lightly and with the grain to just knock the bubbles off. If there are still a few bubbles after the film begins to setup, leave them alone because further brushing will streak and damage the film. Bubbles seem to form more readily on open-grain woods, such as oak, walnut and mahogany. So when working with these woods, I first brush on a coat of polyurethane thinned 50/50 with naphtha or paint thinner to help fill the pores. Any bubbles that form with this mixture are easier to work out. I let this sealer coat dry overnight, sand it with 240-grit, 3M Trimite sandpaper (available from 3M Co., Consumer Specialties, 3M Center, Building 225-4S, St. Paul, Minn. 55144) and then apply a coat of unthinned polyurethane and let it dry overnight.

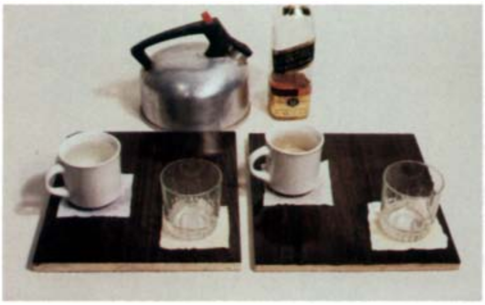
When the unthinned coat is completely dry, sand the entire surface well with 320-grit sandpaper. I prefer sandpaper because it will cut the surface flat, whereas steel wool or abrasive pads round over the dust nits or lumps in the surface. To keep paper from cutting through the film on sharp edges, I ball up used 320-grit to soften it and then flatten it out before using it. The older and more worn the paper gets, the better it is for sanding the finish on moldings and such.

If you stained the wood before applying the polyurethane and then created a large light spot by sanding too vigorously, you can repair the spot by reapplying the original paste stain. The edge of the repaired area must be carefully blended and then allowed to dry the recommended time before another coat of polyurethane is brushed over the entire surface. If there is only minor sand-through along sharp edges, which is almost inevitable on stained furniture, I touch up the area by padding with 2-lb. shellac colored with blending powder so I don't have to delay work while the repair dries. Blending touch-up powders come in a wide range of colors and are available from Mohawk Finishing Supply, Route 30 N., Amsterdam, N.Y. 12010 and Star Chemical, 360 Shore Drive, Hinsdale, Ill. 60521. Although shellac is not supposed to be compatible with polyurethane, I've used it for small touch-ups with no ill effect.

After sanding the polyurethane with 320-grit and touching up as needed, rub the surface with 0000 steel wool until it has an even matte finish. Remember, there's only one coat of polyurethane on the surface, so go easy; then blow and/or tack-rag off the dust. Now, to give the finish the sheen of hand-rubbed oil, apply two coats of paste varnish. Allow about four-hours drying time and lightly buff between coats with 0000 steel wool.

This finish is easily maintained; I give the customer a small bottle of Oz brand furniture cream polish, available from Mohawk and Star Chemical, to be used once or twice a year. The rest of the time a damp rag is all that's needed. The finish can be repaired much as you would repair an oil finish: rub with 0000 steel wool or sand first with fine-grit paper, and then apply another coat of paste varnish. □

*Greg Johnson operates the finishing shop at Wendell Castle Studio in Scottsville, N.Y.*



*To see how much protection one sealer coat of polyurethane provides, I made up two finish samples, left. The one on the left has one coat of Bartley's paste stain, a sealer coat of Minwax fast-dry liquid polyurethane and two coats of Bartley's paste varnish. The sample on the right has the paste stain and varnish, but not the sealer coat of polyurethane. The finishes looked and felt nearly identical. Then, I poured one teaspoon of whiskey on a rag, set a glass on it and left it for 15 hours. I also poured one teaspoon of boiling water on a rag and weighted it with a cup of boiling water for 35 minutes. Right: The sealer coat of polyurethane resisted both the whiskey and the hot water.*

Photos this page: Greg Johnson

# Building a Chest-on-Chest

## *A simple method for framing carcases with solid sides*

by Carlyle Lynch

*Pleasing proportions combine with a simple, unadorned design to give this chest-on-chest a friendly, informal feeling. In the 40 years since it was made, the Appalachian white pine has aged to a dark honey color.*

With its modest proportions and uncluttered design, the chest-on-chest in the top photo at right can easily find a place in most of today's homes. Standing only 1 in. over 5 ft. tall, the chest has a friendly, unthreatening scale unlike many of its 7-ft. tall period counterparts that nearly graze contemporary ceilings and dominate an entire room. Judging by the clean lines, the good proportions and the shape of the bracket feet, this double chest was probably based on designs made by Thomas Elfe, whose work delighted the people of Charleston, S.C., during the mid-18th century.

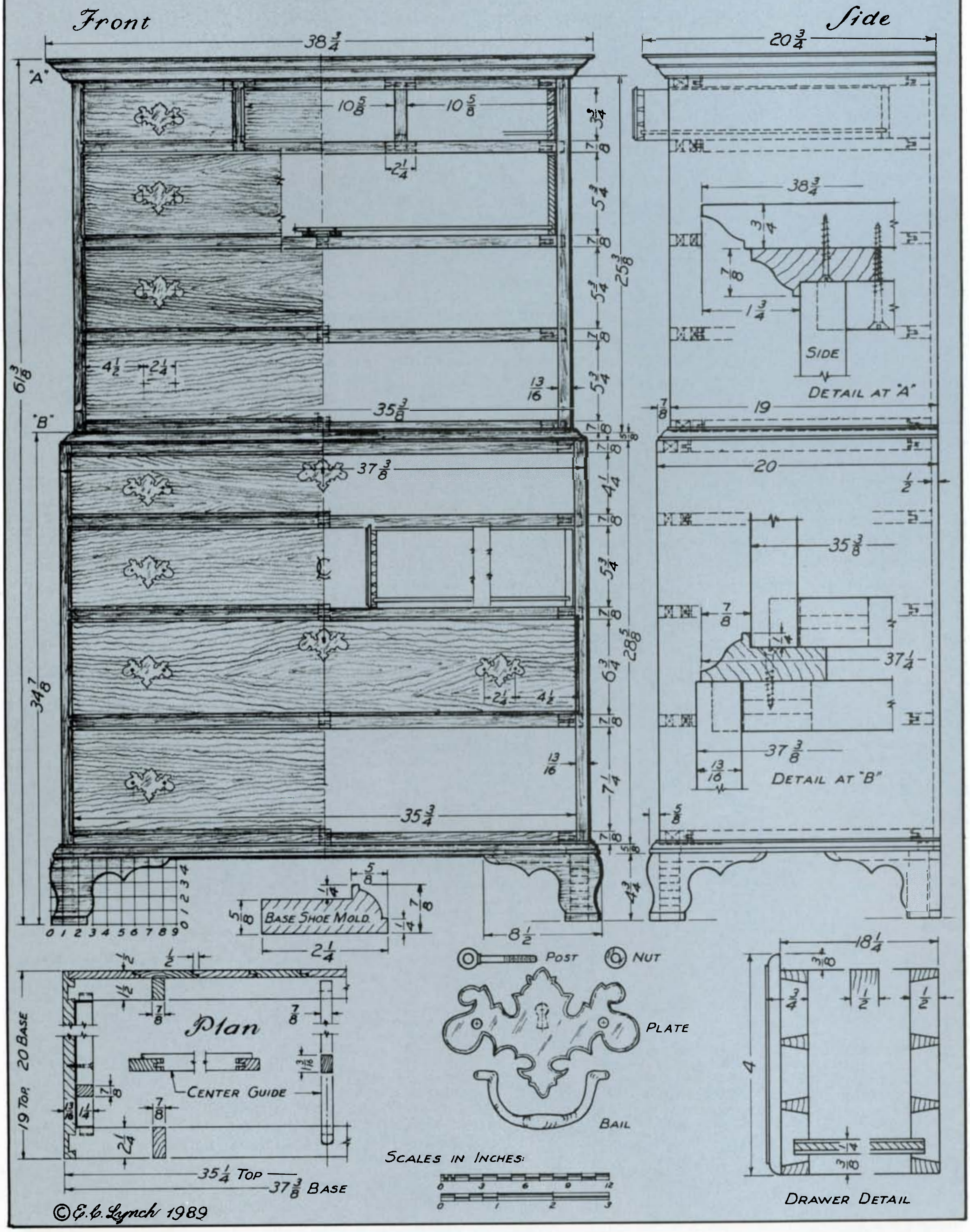
This chest was built to the plan on the opposite page 40 years ago by furnituremakers at Virginia Craftsmen, of Harrisonburg, Va., who have built reproduction furniture for many historical restorations. To avoid the problem of split sides, a common ailment of antique furniture, the designers at Virginia Craftsmen came up with a simple way to build carcase frames that allows the sides to expand and contract freely. To accomplish this, the rails that run side to side between the drawers are tenoned and glued into mortises in the sides, while the runners and center guides that run front to back within the case are tenoned, but not glued into the rails. These "dry" joints allow the sides to expand with increased humidity. In addition, the runners and guides are cut ¼ in. short to leave a ⅛-in. gap at each end, as shown in the bottom photo at right. These gaps provide space for the sides to shrink in drier conditions. Each runner is screwed to the center of the case side with a single 1¾-in.-long, #8 flat-head screw to keep the runners from ever sagging and to resist any tendency for the sides to cup or bow.

*A peek inside one of the chests shows why the solid-wood sides have aged without splitting. The horizontal rails are mortised and glued into the sides but the joints between the drawer runners and rails are not glued. The runners are cut short, to give the sides room to shrink, and fastened at the center with a single screw.*

**Building the base chest**—Begin construction by gluing up the base unit sides and cutting them to size as shown in the plan. Then, run a ½-in. by ½-in. rabbet on the inside rear edges for the backing. Next, make the front and back rails, drawer runners and center guides that make up the carcase framework. As you can see by the detail in the lower left on the plan, the top and bottom rails, both front and back, are dovetailed into the sides, while the other six rails that run between the drawers are mortised into the sides with double tenons. Bandsaw the dovetails on the ends of the top and bottom rails and mark the sockets from the rails onto the top and bottom edges of the sides. Saw and chisel out the sockets by hand. Cut the double tenons on the ends of the other rails with the

# CHEST ON CHEST

*Measured & Drawn by Carlyle Lynch*



dado blade on the tablesaw, and mark the case sides for the mortises to receive these tenons. You can chisel the double mortises entirely by hand or speed up this process by drilling out most of the waste with a Forstner or brad-point bit on the drill press. You might notice that the drawer rails on the chest in the top photo on p. 76 are all dovetailed into the sides. This is a possible variation, but when drawing the plan, I chose to go with the double tenons because they are easier to make and quite adequate for this application.

Next, cut the hardwood runners and guides to length. The runners and guides have ½-in.-long tenons on both ends that fit into mortises on the inside edges of the rails. The detail in the lower left corner of the plan shows how the center guides lap over the top of the rails. Determine the length of these parts by measuring the actual width of the rails and sides, but don't forget that you want a ⅛-in. gap at each end to allow the case sides to contract. I cut the cheeks on the tablesaw with a rip or combination blade first, and then change to the dado blade to remove the waste and establish the shoulders. It's a good idea to tenon the runners so their top surfaces will be about 1/32 in. higher than the rail to ensure that the drawer sides slide on the runners and not on the front rails.

The ¼-in.-wide by ½-in.-deep mortises on the inside ends of the rails that receive the runners can be made by cutting a stopped dado on the tablesaw. The mortises for the guides in the center of the rails can either be made with a router, drilled and chiseled square, or chiseled entirely by hand. After dry-assembling to inspect the joints for a good fit all around, take the framework apart and reassemble it with the rail tenons glued into the mortises in the chest sides. Clamp the carcase together across each rail and check the case for squareness before placing it to dry on a flat surface.

After removing the clamps, place the chest facedown on a padded bench and measure diagonally across the carcase to double-check that it's square before installing the backing boards. The chests get a good deal of their rigidity from the back that is nailed to the rabbets in the rear edges of the sides and to the top and bottom rails. If you choose to use solid, vertical ship-lap for the back, as specified in the plan, this is another place you must allow for wood movement. The first board should be nailed only to the rabbet in the edge of the side. The second board should overlap the first, but should not be pushed up tight to it. Use ⅛-in. spacers to hold the boards apart and nail the second board to the top and bottom rails near the overlap so it holds the first board tightly to the back rails. Then, the third board is lapped over the second board and nailed near this joint to hold it in place. By only nailing one edge of each board and leaving a ⅛-in. gap between boards, they are free to expand or contract. Continue in this way across the back and then end with a narrow board, no more than about 3-in.-wide, and nail it to the rails where it laps the previous board *and* to the rabbet in the side.

**Making and installing the moldings and feet**—Now you'll need to make the moldings that give a little style to the piece and provide transitions from one element to the next. There are three shoe moldings: A quarter-round at the bottom of the base chest, and two ogees, one at the top of the base chest and one at the top of the upper chest. All the moldings are made from 2¼-in. by ⅞-in. stock and you'll need about a 7-ft. length of each molding shape. First, shape the profile on the edges with a molding plane or shaper and then saw out the ¼-in.-deep recess behind the profile. Miter the two base chest moldings to fit, and then glue and screw them to the rails and runners. The ogee molding for the top of the base is set in about ⅛ in. from the chest's edges; since this molding retains the upper chest, it is the gauge for determining the top unit's dimensions. Cross-grain splines are in order to reinforce these wide miters. You'll need to screw a ⅝-in.-thick filler

### BILL OF MATERIALS

| Amt. | Description | Dimensions | Comments |
|---|---|---|---|
| | ***Base Chest*** | | |
| 2 | Sides | 13/16 x 20 x 28⅝ | |
| 5 | Front rails | ⅞ x 2¼ x 36¾ | 35¾ s/s |
| 5 | Back rails | ⅞ x 1½ x 36¾ | 35¾ s/s |
| 10 | Drawer runners* | ⅞ x 1¼ x 16½ | 15½ s/s dry mortise |
| 4 | Drawer center guides* | ⅞ x 1 3/16 x 18½ | 15½ s/s |
| 1 | Dust bottom** | ¼ x 16¾ x 34⅝ | Nail on |
| 1 | Back | ½ x 36¾ x 28⅝ | Ship-lapped boards, ½-in. lap |
| 1 | Top shoe mold | ⅞ x 2¼ x 38 | Miter, hold back ⅛ in. |
| 2 | Top shoe molds | ⅞ x 2¼ x 21 | Miter front corners |
| 1 | Bottom shoe mold | ⅞ x 2¼ x 39 | Miter |
| 2 | Bottom shoe molds | ⅞ x 2¼ x 21 | Miter |
| 3 | Back filler strips | ⅝ x 1¼ x 34¼ | Base and upper chests |
| 6 | Ogee foot pieces | ⅞ x 4¾ x 8½ | Or two pieces, ⅞ x 4¾ x 28 |
| 2 | Back foot pieces | ⅞ x 4¾ x 8½ | |
| 1 | Drawer front | 13/16 x 4½ x 36¼ | ⅜-in. lips on top, sides |
| 2 | Drawer sides | ½ x 4⅛ x 18¼ | |
| 1 | Drawer back | ½ x 4⅛ x 35½ | |
| 1 | Drawer front | 13/16 x 6 x 36¼ | |
| 2 | Drawer sides | ½ x 5⅝ x 18¼ | |
| 1 | Drawer back | ½ x 5⅝ x 35½ | |
| 1 | Drawer front | 13/16 x 7 x 36¼ | |
| 2 | Drawer sides | ½ x 6⅝ x 18¼ | |
| 1 | Drawer back | ½ x 6⅝ x 35½ | |
| 1 | Drawer front | 13/16 x 7½ x 36¼ | |
| 2 | Drawer sides | ½ x 7⅛ x 18¼ | |
| 1 | Drawer back | ½ x 7⅛ x 35½ | |
| 4 | Drawer bottoms** | ¼ x 17¾ x 35 | |
| 14 | Drawer center strips* | 5/16 x ⅞ x 17¼ | Base and upper chests |
| 8 | Foot-attachment blocks | ⅞ x ⅞ x 5½ | |
| | Corner glue blocks | As needed, see text | |

| Amt. | Description | Dimensions | Comments |
|---|---|---|---|
| | ***Upper Chest*** | | |
| 2 | Sides | 13/16 x 19 x 25⅜ | |
| 5 | Front rails | ⅞ x 2¼ x 34¾ | 33¾ s/s |
| 5 | Back rails | ⅞ x 1½ x 34¾ | 33¾ s/s |
| 10 | Drawer runners* | ⅞ x 1¼ x 15½ | 14½ s/s |
| 2 | Drawer stiles | ⅞ x 2¼ x 4¾ | 3¾ s/s |
| 4 | Drawer runners* | ⅞ x 2¼ x 15½ | 14½ s/s |
| 2 | Drawer side guides* | ½ x ⅞ x 16 | Glued to wide runners |
| 3 | Drawer center guides | ⅞ x 1 3/16 x 17½ | 14½ s/s |
| 1 | Top shoe mold | ⅞ x 2¼ x 38 | Miter |
| 2 | Top shoe molds | ⅞ x 2¼ x 20 | Miter |
| 1 | Dust bottom** | ¼ x 16¼ x 32½ | Centered to fit within molding on base chest |
| 1 | Top | ¾ x 20¾ x 38⅞ | Mold three edges |
| 1 | Back, ship-lapped | ½ x 34⅝ x 25⅜ | Random width, vertical |
| 3 | Drawer fronts | 13/16 x 4 x 11⅛ | ⅜-in. lips on top, sides |
| 6 | Drawer sides | ½ x 3⅝ x 18¼ | |
| 3 | Drawer backs | ½ x 3⅝ x 10⅜ | |
| 3 | Drawer bottoms** | ¼ x 9⅞ x 17¾ | |
| 3 | Drawer fronts | 13/16 x 6 x 34¼ | |
| 6 | Drawer sides | ½ x 5⅝ x 18¼ | |
| 3 | Drawer backs | ½ x 5⅝ x 33½ | |
| 3 | Drawer bottoms** | ¼ x 18 x 33 | |

Hardware: 17 polished-brass pulls, 2¼-in. bore; 7 matching escutcheons; 7 mortise or half-mortise drawer locks, 1¼-in. selvage to key pin; available from Ball and Ball, 463 W. Lincoln Hwy., Exton, Pa. 19341. 1½-in. and 2-in., #8 flat-head wood screws; 42, ½-in., #3 brass flat-head wood screws.

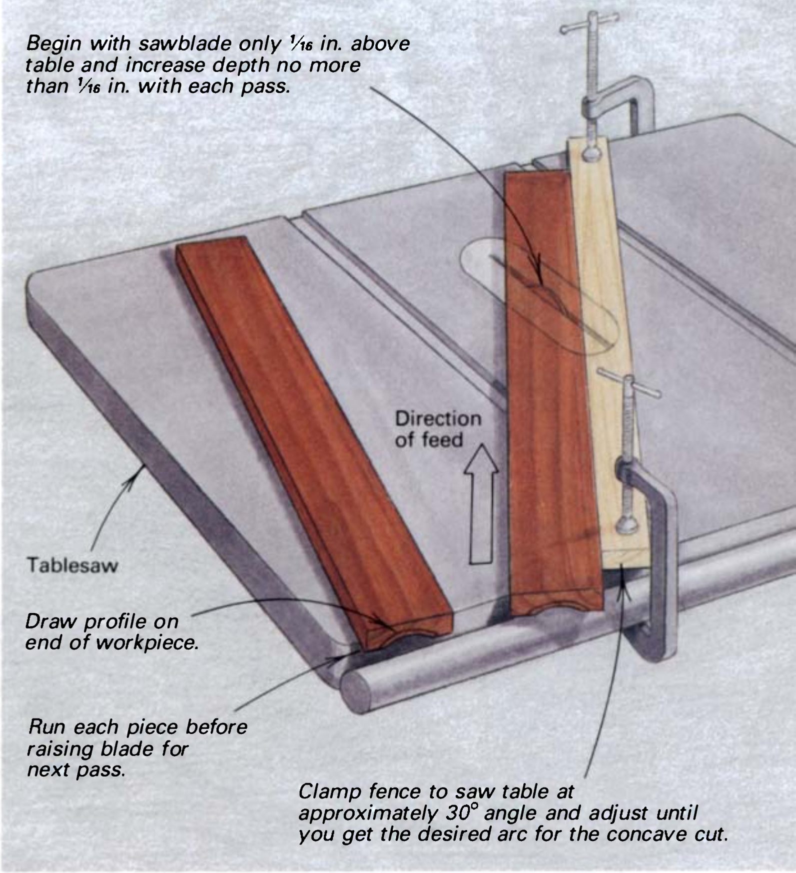
All wood is white pine except where noted.
s/s = shoulder-to-shoulder
* Hardwood
** Plywood

strip along the back rails, flush with the molding ends, to complete the perimeter for each set of moldings. These strips fill the gap at the back of the chests and cover the ends of the backing boards.

To make the shaped bracket feet, you'll need two 7/8x4¾x28 boards. The boards are shaped to the ogee profile and then crosscut into six 8½-in.-long sections. Two of these sections are mitered together to form each front foot. The remaining two shaped sections are each dovetailed at a right angle to a 7/8x4¾x8½ flat piece to form the rear feet. To make the concave shape, run the boards diagonally over the tablesaw blade, taking very light, repetitive cuts using the setup shown in figure 1 at right. Begin cutting with the blade exposed only about 1/16 in. above the table and raise it about 1/16 in. for each consecutive pass. Draw the desired profile on the end of one of the boards and as you approach the line, adjust the angle of the fence to get the cove cut that you're after. When the cove is complete on both pieces, use a jack plane to make the top curve. Sand the sawmarks from the cove and smooth the top curve before cutting the boards into the six 8½-in. lengths that make up the feet.

Now, take four of the pieces, and miter one end of each to make the front feet; cut the dovetails on the remaining two shaped pieces and the flat back pieces that go together to make the rear feet. After cutting the joints, bandsaw out the shapes and glue the pairs together, reinforcing the joints with stacks of corner blocks to avoid the cross-grain problems you'd have with one vertical grain glue block. The feet are screwed to the bottom runners and rails of the chest through two 7/8x7/8x5½ blocks glued to the top inside edge of each foot. After the feet are in place, nail a ¼-in. plywood dust bottom to the bottom rails and runners. The base chest is now complete except for the drawers, which should be built all at once after both the top and bottom carcases are complete.

**Fig. 1: Cove cut for bracket feet**




**Building the upper chest**—The dimensions for the upper chest are derived from the frame formed by the base's top molding. Since it nestles into the lip of this molding, the top unit doesn't require any bottom molding of its own. The construction of the upper chest is identical to the base, except for the absence of the bottom molding, the addition of the top board and some framing for the three small upper drawers. This framing consists of two vertical stiles between the small drawers that are mortised and glued into the two top front rails, and four wide hardwood runners mortised into the rails behind the vertical stiles. The lower runners carry the drawers and have ½-in. by 7/8-in. strips glued to their surface to act as side guides. The two upper runners are called kickers and keep the drawers from tipping when pulled out.

After the upper chest is assembled, the remaining ogee shoe mold is mitered and screwed to its top runners and rails, and the 5/8-in. spacer is screwed along the back rail as with the other moldings. Again, just as on the base, nail a ¼-in. plywood dust bottom to the upper chest. Cut this dust bottom undersize and center it on the chest's bottom so it will fit within the frame formed by the ogee molding around the top of the base.

**Drawers and hardware**—Build the drawers according to the detail on the plan. The sides are joined to the front with half-blind dovetails with a 3/8-in. setback on the top and sides. The back is joined to the sides with through dovetails. During assembly, the ¼-in. bottom is inserted into grooves that are 3/8 in. up from the bottom edge of the sides, front and back. If you use solid wood instead of plywood for the bottom, be sure to allow room in the grooves for cross-grain expansion.

After the drawers are glued up, saw and chisel a notch out of the bottom of each back to fit over the center guide. Then, as a track for the guides, each drawer gets two 5/16-in.-thick hardwood strips screwed to its bottom. To ensure accurate placement of these strips, insert one of the drawers into its opening until the front is against the face frame, and center the drawer side to side. Now, hold the guide strips alongside the center guide from below the drawer and drive three small brass screws down through the drawer bottom to hold each strip in place. Remove the drawer from the chest, unscrew the guide strips and put a spot of glue on the guide strip near each screw hole before replacing the screws.

When the guide strips are all in place on the upper chest drawers, you can screw the top board in place. Cut it to size to allow a 1¾-in. overhang on both sides and the front, and run the same ogee profile you used for the molding along the three overhanging edges. Fasten the top to the upper chest with eight 2-in.-long, #8 screws up through the top rails and runners—one near each corner and one 2½ in. each way from the center of the runners. Countersink and slot the screw holes in the runners to let the top expand front to back.

Brass pulls, escutcheons and drawer locks are available from Horton Brasses, Nooks Hill Road, Box 120F, Cromwell, Conn. 06416, or Ball and Ball, 463 W. Lincoln Highway, Exton, Pa. 19341. However, if you are so inclined, the backing plates can be easily bandsawn from sheet brass (available from a hobby supply store) using a fine-tooth metal-cutting blade running at your normal woodworking speed. Unless you also want to venture into casting brass, you can buy the posts and bails from Horton Brasses or Ball and Ball. □

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*Carlyle Lynch was a Broadway, Va., designer, cabinetmaker and retired teacher. He passed away shortly after writing this article (see his obituary on p. 114). His drawings have appeared regularly in* FWW *and are available from Garrett Wade, Lee Valley Tools and Woodcraft Supply.*

Drawing: Kathleen Rushton

# Round-Bottom Planes

## *Making tools to fit your hands and needs*

by Monroe Robinson

***Making wooden planes is a good introduction to tool construction: There are only a few parts, and high-quality custom plane irons and chip breakers are available if you don't want to make your own.***

Power tools are wonderfully efficient at roughing out furniture parts, but I think the ultimate in craftsmanship is integrating creativity with hand tools, away from the vibration, noise and dust of machines. When building furniture, I get a large part of the job done with labor-saving power equipment. But I turn to hand tools for final fitting and detailing because woodworking is an expression not only of skill, but also of the tools and methods used to create a piece.

One of my most satisfying hand tools is the plane, and although I value several commercially available metal models, my favorites are all-wooden ones that I've made. These planes work so well because they are customized specifically to fit a job's requirements, my hands and my way of working. And it just feels good using them. Making a wooden plane, like that shown in the photo above, is a good introduction to hand-tool construction, and the result is an efficient and enjoyable tool. And many of the same tuning techniques can be used to improve the performance of your metal planes as well.

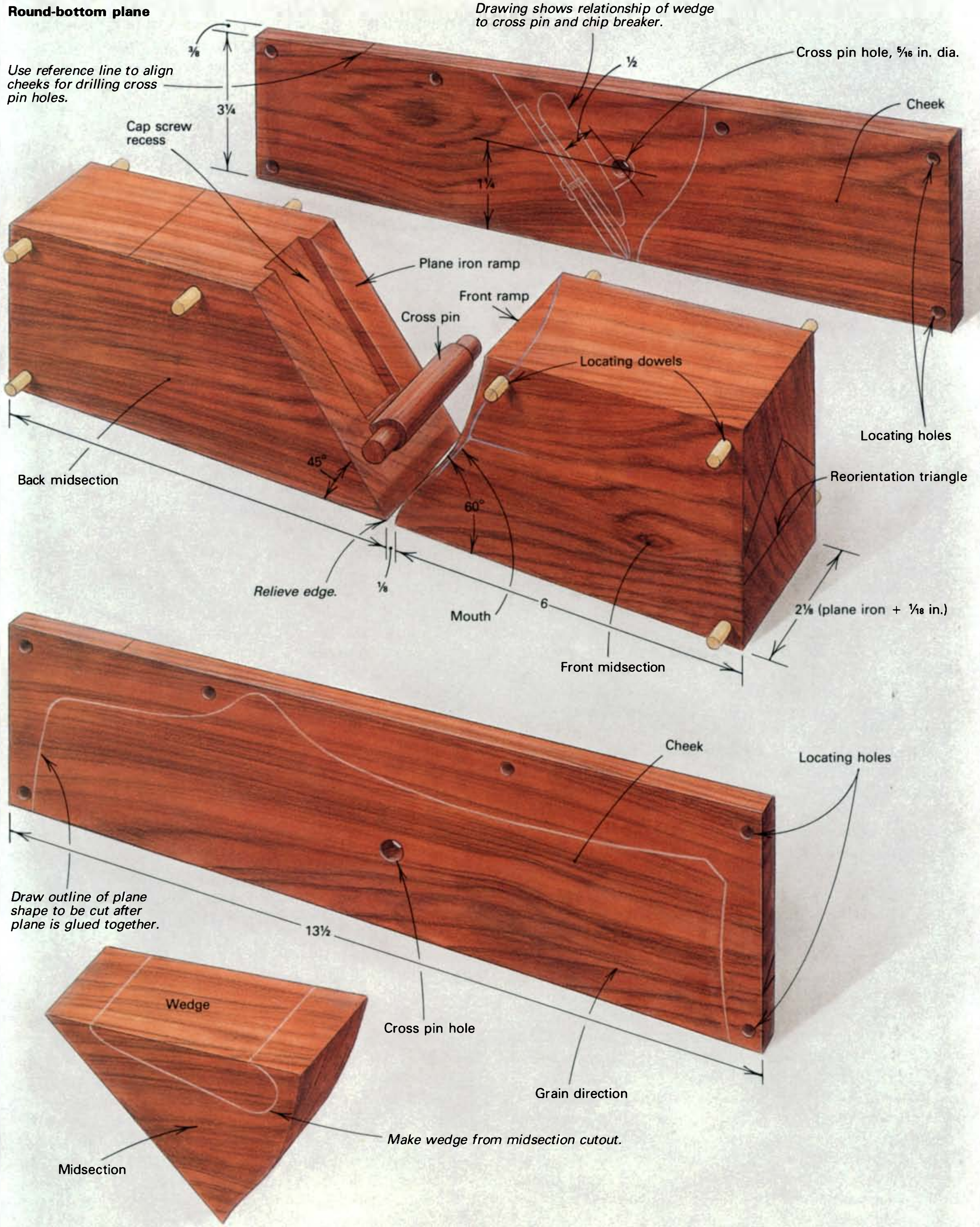
Once you know the basics of plane construction, which are much the same for any wood specialty plane, you'll be able to make one to suit your particular needs. The construction procedure incorporates two midsection pieces that hold the plane iron and chip breaker by means of a wedge, and are sandwiched between two cheeks, as shown in the drawing on the facing page. A single block of wood is cut into pieces that, when assembled, form the plane body. A cheek is bandsawn from each side of the block of wood, and then the midsection is bandsawn into three pieces, forming the plane iron ramp and creating a chip clearance opening. The wedge can be cut from the waste piece left from bandsawing the front and rear midsections to shape. The body and the sole of the plane are shaped after assembly and then the plane is fine-tuned. Although some of these planes are made for a specific job, I always seem to find other uses for them later.

A round-bottom plane is a great first plane project because it's a very useful tool and most woodworkers don't already have one. It excels at shaping coopered doors, creating scalloped reliefs on door panels or smoothing curved parts after they've been bandsawn to shape. By using round-bottom planes, along with spokeshaves or a compass plane, and a scraper, I can shape curved surfaces smoothly enough to eliminate the need for sanding before finishing.

**Plane irons and chip breakers**–Because the iron will determine the dimensions of the plane body, the first step is to choose a chip breaker and iron. You can salvage irons from flea markets and antique shops, buy commercial replacement or custom-made irons, or forge your own. My favorites for small specialty planes are from an old set of molding plane irons, but for the round-bottom plane, I prefer irons from Hock Handmade Knives (16650 Mitchell Creek Drive, Fort Bragg, Cal. 95437), as shown above. These irons are preground to specific radii and are available with a fitted breaker. For information on making your own plane irons, see *FWW* #55, pp. 63.

**Selecting and machining the blank**–Although I have used exotic hardwoods, such as cocobolo for the plane shown above, a growing concern for saving the rain forests of the world led me to question indiscriminate use of these woods. Domestic woods, such as beech, hard maple or ironwood, also make excellent planes. The blank should be 1 in. or 2 in. longer than the finished plane and 2½ in. to 3 in. high. The width is determined by the plane iron plus ⅛ in., and approximately ¾ in. for both cheeks and another ¼ in. for all machining. For a smaller plane, the cheeks may be as thin as ¼ in. On heavily used flat-bottom planes, I frequently add a sole of lignum vitae because of its natural oiliness and hardness. For the less frequently used round-bottom plane, a special, harder sole is not necessary if the plane is made of beech,

## Round-bottom plane




Drawing: Vince Babak

Author

*Align both cheeks using the reference line drawn across the top of the plane, clamp the cheeks together and drill a 5/16-in.-dia. hole on the drill press to ensure accurate alignment for the cross pin.*

hard maple or other hard, close-grained wood. Lay out the plane so the growth rings are perpendicular to the sole and the grain runs down from front to back. Mark a reorientation triangle on the front of the block with one point up indicating the top, as shown in the drawing on the previous page, so all the pieces can be returned to their original positions after being bandsawn apart.

I mark off the cheeks, leaving the midsection 1/8 in. wider than my plane iron and allowing an extra 1/8 in. for jointing the sides of the midsection square and smooth. Then I bandsaw the 3/8-in. to 7/16-in. cheeks from either side of the midsection. Jointing the inside faces of the cheeks and both sides of the midsection ensures the sides of the plane will be perpendicular to the sole. After laying out the plane iron ramp at 45° and the front ramp opening at about 60°, so the shavings escape smoothly, the midsection is bandsawn into its front and back sections, as shown in the drawing. The cutout will later be used to make the wedge. While the curved front ramp can be smoothed with a scraper, a block plane is better for flattening and smoothing the plane iron ramp on the back midsection because the ramp must be both flat and square to the sides. Using a simple plywood template and a template collar guide mounted on my router, I cut the recessed slot, which can be seen in the photo on p. 80, to accommodate the cap screw, stopping about 3/4 in. from the bottom. A router-mounted fence and stop blocks can also be used for making this recess or it can be chiseled or gouged out.

Before assembling the plane, I rough-shape the mouth of the front midsection by carving and filing it to match the radius of the plane iron. Rough-fitting the mouth to the iron at this time reduces the fine-tuning you need to do later through the opening of the completed plane. Check the fit by laying the back midsection on its side with the plane iron in place and slide the front midsection, also on its side, into position against the iron.

Now, using the reorientation triangle previously drawn, reassemble the parts leaving a 1/8-in. gap for the 3/16-in.-thick iron between the midsections to form the mouth of the plane. Leave a slightly smaller gap for a thinner iron. This spacing will further reduce the amount of work needed later in shaping the mouth to the iron. After aligning all the plane parts and clamping them securely together, drill several holes around the perimeter through the cheeks and into the midsections on both sides for locating dowels, as shown in the drawing. These dowels will be cut away when finish-shaping the plane, but until then, they allow you to precisely realign the parts after working on individual pieces as is necessary to fit the cross pin. Glue the dowels into the midsection and cut them flush with the cheeks so they won't interfere when gluing up the plane.

The cross pin has round tenons on its ends that fit into holes on each cheek, permitting it to pivot to the angle of the wedge. To drill the holes, as shown in the photo at left, that serve as the mortises for the cross pin, first square a reference line anywhere across the top of the plane. Now remove one of the cheeks from the plane assembly and, with the iron and chip breaker in position, trace their outlines onto the remaining cheek, as shown in the drawing. Remove the second cheek from the midsections and mark the center for the cross-pin hole 1 1/4 in. from the bottom of the plane and 1/2 in. from the top of the chip breaker, as shown in the drawing. Now align the cheeks using the reference line, temporarily clamp both cheeks together and make a 5/16-in.-dia. hole for the cross pin on a drill press to ensure straight, square alignment.

The cross pin, which can be made from either the same wood as the plane body or a contrasting wood, is a 1/2-in. square as long as the total width of the plane, including the cheeks; its tenons are as long as the thickness of the cheeks. To form the tenons, I use the miter gauge on the tablesaw with the blade raised 3/32 in. I cut four shoulders on each end of the cross pin, and then round the tenons with a knife. The top edges of the midsection of the cross pin are rounded with a plane to ensure easy exiting of shavings. Check the fit of the cross pin with the plane assembled to make sure it will turn: A snug but not too-tight fit is best.

**Assembling the plane**—I dry-fit the cross pin in place, making sure that the tenons and locating dowels are flush with the cheeks, and then I glue and clamp the plane together using backup blocks to protect the cheeks. Once dried, I clean up any glue squeeze-out and make one light pass over the jointer to flatten the sole of the plane.

Next I draw the desired profile and bandsaw the plane from the blank. If this is your first plane, I suggest you leave it very rectangular until you use it for awhile, and then reshape it to fit your hand and your style of work. I don't like top-mounted handles because they force you to hold the plane high, throwing off the balance of the tool. I enjoy the texture and look of my planes as they come from the bandsaw; the tools I make are working tools. Rather than fuss with smoothing and embellishing, I leave the bandsaw marks and add only finger recesses gouged into the sides, as shown in the bottom photo on the facing page.

The wedge is bandsawn to shape from the midsection cutout and smoothed with a scraper to fit between the chip breaker and cross pin. Note the fit of the wedge in relation to the chip breaker (see the drawing). Test-fit the tapered wedge: If it is too flat, it will be hard to tap out; if the taper is too great, the slightest tap will dislodge it.

With the plane together, I now shape the sole and rework the mouth of the plane for a more precise fit to the iron, customizing the plane's mouth to the intended use of the plane. Although a very thin opening in front of the iron is essential for fine, controlled planing, a wider mouth opening of 1/32 in. is better for hogging off waste or other rough planing. Fitting the mouth of the plane to the iron is the hardest and slowest part of the construction because you must carve away the front ramp to match the radius of the plane iron, while working through the small opening in the sole of the plane. I very lightly relieve the bottom edge of the 45° plane iron ramp to allow more working room through the mouth, as shown in the drawing. With the plane held upside down, I use a small knife and files to remove waste from the mouth at the front midsection until the cutting edge of the iron touches wood along its entire radius. Once the sole is shaped, this fit is further refined until the iron extends through the sole of the plane. If you are making or fine-tuning a plane to take thin shavings, it is crucial the mouth opening be very narrow, so be patient here.

I begin shaping the sole to match the radius of the iron by wedging the iron against the radius contour just carved in the front midsection. With the plane still upside down, I clamp it in a vise

Author

*Working through the small mouth opening, Robinson fine-tunes the plane to match the shape of the iron. Paper-thin shavings are possible only with a close fit between iron and mouth.*

*Shaping the mouth of the plane is the most tedious part of the construction, but the time and effort invested in attaining the fit shown here will be rewarded by top-notch performance.*

*Robinson prefers rectangular shapes for his planes and doesn't spend a lot of time refining the appearance of these working tools. Finger grips are gouged into the sides, corners are chamfered on the bandsaw and the bandsaw marks are left for a better grip.*

and take full-length strokes with a flat-bottom plane, starting on the two outside edges and gradually working toward the middle where very little planing is needed. Remember, every plane stroke needs to be straight and extend the full length of the plane to maintain a radiused but flat sole. When I am 1/32 in. or less from touching the radiused iron in the plane, I switch to a cabinet scraper to remove the planing ridges. I then place a strip of 220-grit sandpaper, grit up, on a flat surface. Rocking the plane from side to side while making long even strokes, I sand the bottom of the plane, being careful to keep it flat along its length. Now look carefully at the contour of the sole and the radius of the iron. If they don't match, you may need to lightly plane a little more and then resand. I then finish-sand with 320- and 400-grit paper on the flat surface.

**Fine-tuning the plane**—After sanding, the iron should come very close to, but not quite slide through, the mouth. Using a small file, I carefully file away the wood in front of the iron, as shown in the top, left photo, until the mouth and iron match perfectly, as shown in the top, right photo, and the iron just barely protrudes through the sole. Again, patience here will pay dividends in tool performance.

With the plane iron properly fitted to the mouth, the plane is ready for testing. If the plane doesn't cut a thin, even curl, first make sure that the plane iron is sharp. If it is, make sure that the chip breaker is adjusted to about 1/32 in. from the cutting edge of the iron and that they fit tightly together. If you find chips or wood dust between the chip breaker and the iron, file and hone the chip breaker edge until the fit is perfect. I find a magnifying glass helpful to check this fit. With the iron and chip breaker in cutting position, I recheck the opening between the iron and mouth of the plane to see if there's a continuous bead of light along the radius and file as necessary. If the breaker is hitting the front midsection of the plane, file away the high spots without widening the mouth.

Another potential problem area is that pressure from the iron can cause the sole to protrude directly behind the mouth. The pressure of the iron can cause this area to become a problem on older planes also. To check this, fit the iron and wedge in place, but not extended through the mouth, and then place a straightedge on the plane sole. If this area behind the mouth protrudes, the plane won't cut without a deep iron setting, which will produce a thick shaving and jam the mouth. I use a sharp scraper to remove a few shavings until this area is relieved. It is critical, however, that the sole directly in front of the iron contact the wood as you plane. If this area is relieved, the shaving will lift up and jam the throat or cause tearout ahead of the iron. Once I'm satisfied with the plane's performance, I seal the entire tool with a very thin varnish or oil, applying extra coats to all the endgrain.

Adjusting the iron in a wooden plane can be a little tricky, but it becomes quite easy with experience. I adjust my plane by holding it upright with two fingers under the sole, one touching each corner of the blade so I can feel the blade settings. You can also hold it upside down and sight along the bottom. Either way, the adjusting is done with light taps from a small hammer. A light tap on the back end of the plane body will back up the iron. Slightly harder taps will back up the iron and loosen the wedge. Light taps on the wedge will set the iron, while taps on the upper end or sides of the iron will adjust it deeper or to one side. With a little practice, you'll soon be setting up your plane for controlled cuts of only 0.001 in. or so. □

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*Monroe Robinson is a professional woodworker in Little River, Cal., and an instructor at the Anderson Ranch Art Center in Snowmass Village, Colo.*

# Tablesaw Safety Devices

## *A survey of blade guards, hold-downs and push sticks*

by Charley Robinson

Many woodworkers don't use guards on their tablesaws, and they're quick to offer various reasons why: the guards have a reputation for getting in the way during some rabbeting, ripping and molding-head operations; they decrease visibility during a cut or setup; they create a safety hazard because stock hangs up on the guard; and they can damage the stock, reduce control and be a real hassle when you try to switch from one operation to another. And in many shops there can be some peer pressure against guards—use one and brace yourself for an afternoon of assorted ridicule.

Even though none of the commonly cited reasons can make up for the loss of a finger or hand in an accident that might have been prevented by a guard or other safety device, few woodworkers invest much time or thought in improving the guards that came with their saws or in developing their own safety devices. Fortunately, some manufacturers now offer devices designed to overcome most of the standard complaints about stock guards. In this article, I'll examine a couple of these alternatives, as well as several available hold-down devices, that can make the tablesaw a safer tool and give you more control over your work. First, let's consider how accidents happen.

**Kickback's the key**—Our 1983 survey of hand injuries (*FWW* #42, pp. 76-78) indicated the tablesaw caused more injuries than any other tool in the shop, accounting for 42% of the accidents reported by the more than 1,000 woodworkers who responded to our survey. The jointer was second at 18%. Most of the accidents occurred when operators tried to rip short, narrow or thin pieces of wood, although ripping knotty or warped lumber, plunge-cutting and using accessories such as molding, dado or planer attachments were also cited.

Tablesaw accidents are generally caused by one of two factors: the first is kickback, which frequently leads to the second—the operator hitting the rotating blade. Kickback generally occurs when the work binds against the back of the blade. The force lifts the wood until it hits the top of the blade and is hurled with great velocity toward the operator. This can happen when the kerf in the workpiece closes enough to grab the back of the blade, when the work is pinched between the back of the blade and a misaligned fence, or when the workpiece is moved away from the fence or twisted so it binds the sides of the blade. Kickback can also happen when cutoffs left on the table vibrate into the blade or are caught between the throat plate and the blade. Kickback happens so quickly that the operator has no time to react, and often a finger or hand is pulled into the blade, or the projectile hits the operator.

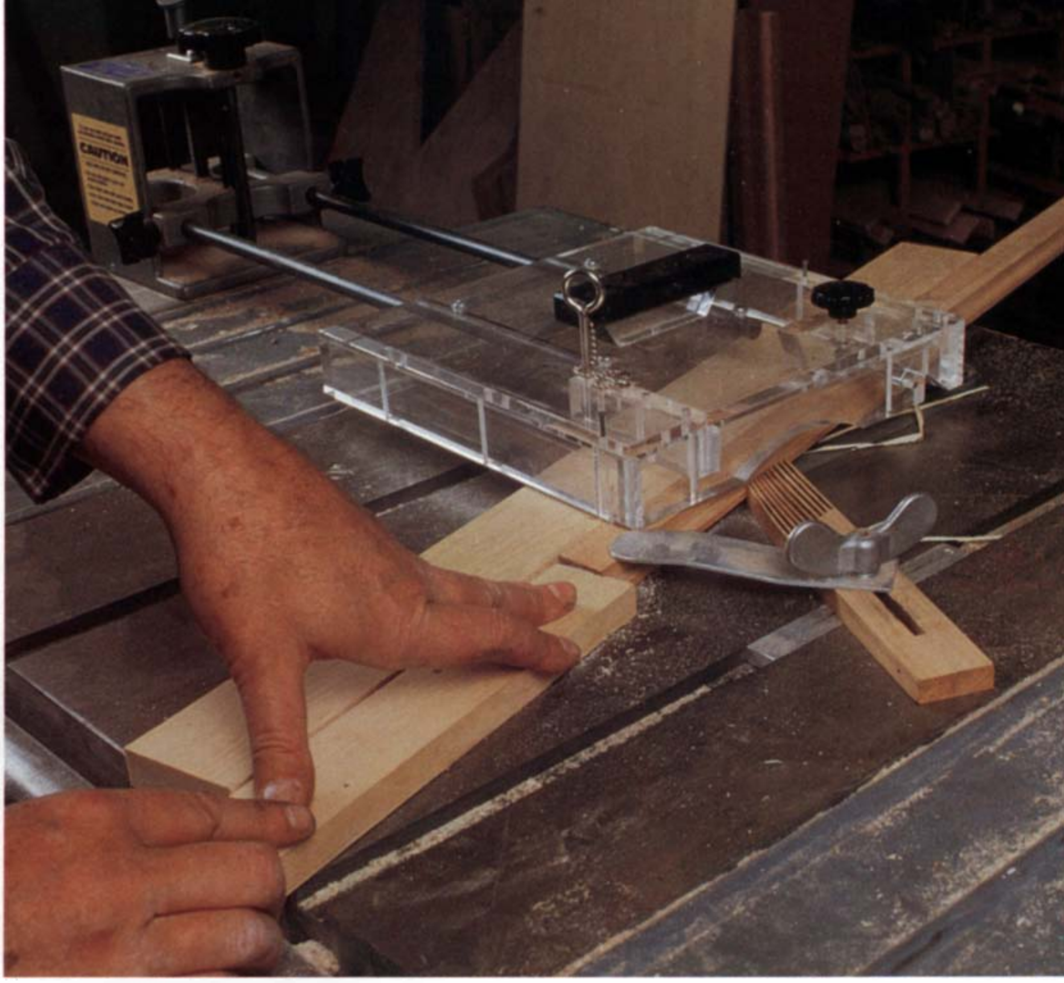
Safety devices can go a long way to protecting the operator. In the previously cited survey, reports of accidents to woodworkers using a blade guard, anti-kickback pawls and a splitter were practically non-existent. The American National Standards Institute (ANSI), composed of representatives of manufacturers and labor, established guidelines for safe operation of woodworking equipment in shops under the jurisdiction of the federal Occupational Safety and Health Administration (OSHA). These guidelines state that the blade on a tablesaw must be covered on the top and sides down to the table. Also, ripping operations must be done with a splitter and anti-kickback pawls in place, but there is no requirement that these devices be attached to the guard itself. And, there are no standards regulating guard manufacturers, so they have freedom in designing shields that provide the visibility, easy adjustability, versatility and anti-kickback features that would most benefit woodworkers. With this in mind, let's take a look at some of the safety devices currently available.

**Blade guards**—*Biesemeyer Manufacturing's BladeGuard,* shown in the left photo on the facing page, is a metal-and-Plexiglas assembly suspended over the saw table on the end of a 50-in. arm. I found this arrangement provides good visibility and the guard is wide enough to work with the blade set at any angle for miter or compound miter cuts without interference. The guard will protect hands from side or top access to the blade, but a hand slid along the table will raise the guard out of the way just as easily as a piece of wood will, and there are no anti-kickback pawls or splitters attached to the guard.

I experienced no problems with stock being fed through the saw hanging up on the guard, until stock was more than 2 in. thick. When the blade is centered in the guard, there is potential for kickback of scraps in production crosscutting-type situations where small scraps accumulate on the table. Cut-offs trapped between the guard and blade are thrown toward the operator with potential for injury. Adjusting the guard close to the cut-off side of the blade helped keep scraps away from the blade and all but eliminated this problem.

The 2-in.-square tubular steel arm that's mounted at the end of an extension table to support the guard gives 50 in. of clear cutting to the right of the blade and unlimited cutting to the left of the blade or behind the saw. This system was designed to work with an extended table and installs in about 15 minutes; there is also a floor mount model available. An adjustable counterweight lets you balance the guard so there is very little added resistance when feeding stock. The *BladeGuard* is easily raised and locked out of the way, about 8¼ in. above the table, for making fence setups or using a sliding table. Because the guard is suspended above the table, it can be left in place for dado or rabbet cuts or most operations that usually require removing a stock guard. The overhead arm that supports the guard slides inside the support arm that is bolted to the table. Turning a crank on the support arm positions the movable arm over the blade. While this procedure is fairly slow, it does provide safe and accurate adjusting and you normally would not have to move the setup more than a couple of inches.

In addition, the guard also has an alarm system that can be



*The large, clear Brett-Guard offers good visibility of the blade and the workpiece, and holes through the guard allow you to easily attach a fence for coving or other operations. The guard must be adjusted to stock thickness, however, and the inflexible mounting and large area covered can make it difficult to push the work past the blade.*

*The Biesemeyer BladeGuard, which is suspended over the table at the end of a 50-in. arm, allows operations, such as dadoing large panels with the guard in place, that are impossible with other guards. Although the unit is convenient and easy to use, a separate splitter and anti-kickback device are also needed.*

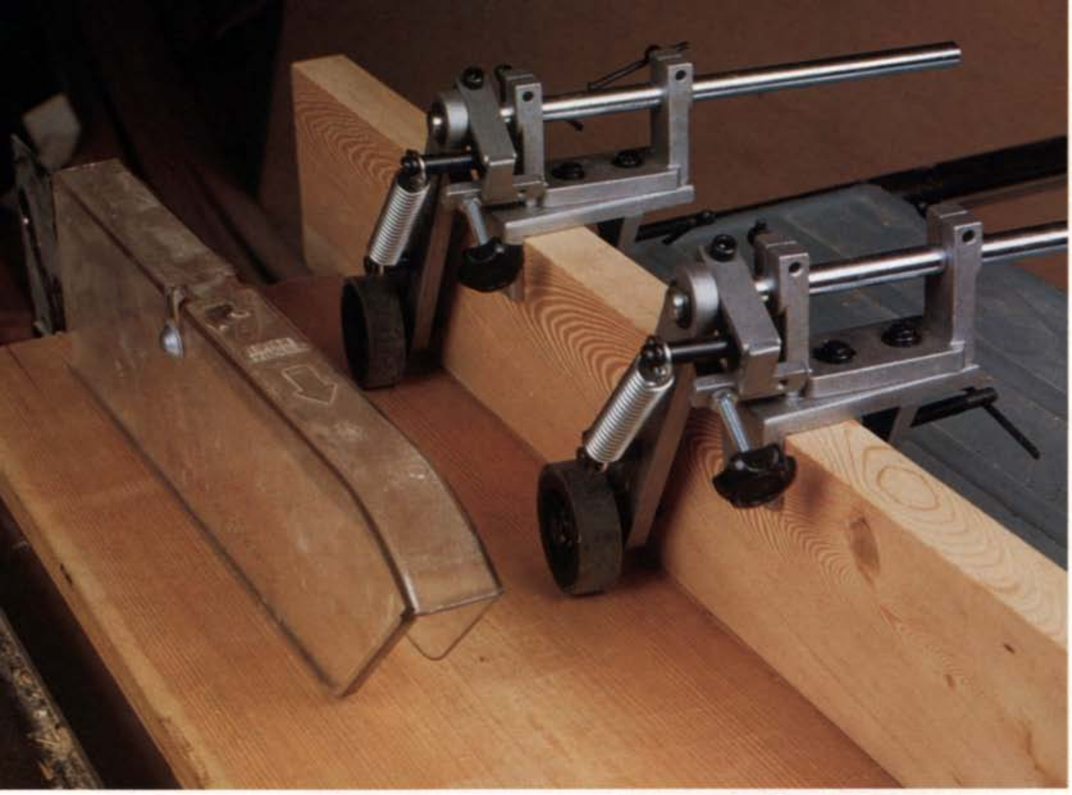
switched on or off with a key. A loud and obtrusive warning, equal in intensity to a smoke alarm, sounds the second the guard is locked into the raised position. This alarm system was primarily designed for high school shop situations so the shop monitor would be more aware of students' guard usage. Commercial shops may consider the alarm to be strong evidence of their commitment to safety when the OSHA inspector makes a visit, but I doubt it will be used at other times. One minor complaint is that with the guard down, the knob that releases it from the raised position is just about where I want my nose to be when I'm lining up my cutting mark with the blade.

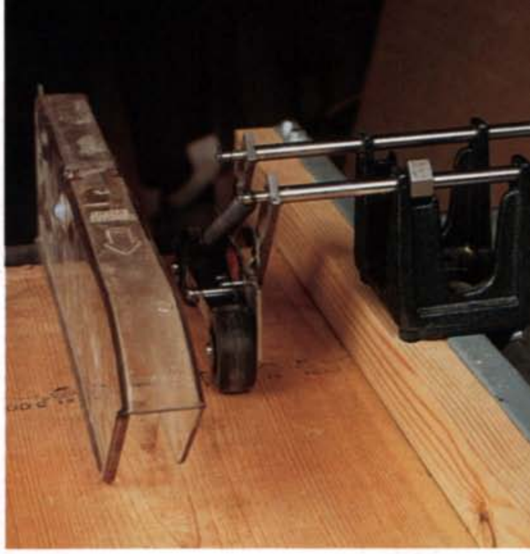
At $385, the *BladeGuard* may show up more in commercial production shops than the home market and that's where it will be most appreciated. This is the most convenient guard I've used: Once it's on the saw, it seems to do its job without needing readjustments and creates minimal interference with the work at hand. It is easily raised to a locked position, to adjust jigs or fences or to clear cut-off tables or other special operations, and then is just as easily returned to the working position. Although the lack of anti-kickback pawls and a splitter will require additional devices to meet OSHA requirements, the guard is so convenient that it will probably be used.

The *Brett-Guard,* manufactured by *HTC Products, Inc.*, is an 11-in. by 11-in. Plexiglas box that is suspended over the sawblade on steel rods attached to a control unit, as shown in the right photo above. The control unit is in turn secured by a locking rod and knob assembly to auxiliary plates bolted to the sides and back of the saw table. Although moving the guard to a new mounting plate is easily accomplished by unscrewing the locking knob, it did take an inordinate number of turns. Tim Hewitt, president of *HTC,* said that on newer models the thread length has been reduced by half and the knob will now lock down in about a turn and a half. The hardest part of installing the *Brett-Guard* is drilling holes in the saw table. One problem on saws like the Delta Contractor's model, to which I mounted it, is that the back mounting plate interferes with motor movement when the blade is tilted for bevel cuts. However, an optional mount is available that provides clearance for the motor.

The large, clear box that serves as the guard provides the best blade and work visibility of any of the guards I used. However, for precise alignment of the rip fence, I still found it easier to set up the fence before positioning the guard. As with all the guards I tried, static electricity attracted dust particles to the plastic box, but that was more of a nuisance than a real problem. The adjustable anti-kickback plate of the *Brett-Guard* works only when the guard is mounted on the left side of the saw and I found this device tended to scratch the work when adjusted to a position that would prevent kickback. A crank on the control unit raises and lowers the guard; and loosening a couple of thumbscrews allows it to be moved toward or away from the control unit. It is necessary to manually readjust the guard each time you work with material of a different thickness. The manufacturer recommends that the guard be adjusted to rest lightly on top of the work and in this position, it helps hold down the stock being cut. If the work is too high to fit under the guard, adjust the guard to form a channel between it and the fence through which the work can be passed. Although this leaves the blade uncovered, it does offer more protection than no guard. I also found a potentially dangerous situation might occur when ripping long boards or cutting large panels. Without some means of support on the outfeed side of the saw, a long board can lever up the guard, possibly exposing or jamming the blade and damaging the guard.

A stop pin included with the guard is handy for repetitive cuts, and a series of holes in the guard can be used for mounting accessories, such as an angled fence when making cove cuts. In theory this has some interesting possibilities, but in practice I found there was too much play in the suspended guard to yield consistent results when coving a piece of stock. Clamping the fence to the saw table would eliminate the play, but then why bother screwing it to the guard if you have to clamp it anyway. There were a few situations when the guard interfered with the saw operation, such as when ripping sheet goods, or limited the capacity, such as when





***Above: Ripstrate's hold-down is the most compact of the group and required the fewest adjustments, although it did not hold boards against the fence as well as the others.***

***Left: The flexibility of Leichtung's Anti-Kickback Hold-Down Guide System and the superior grip of its soft rubber wheels give it an advantage over similar systems.***

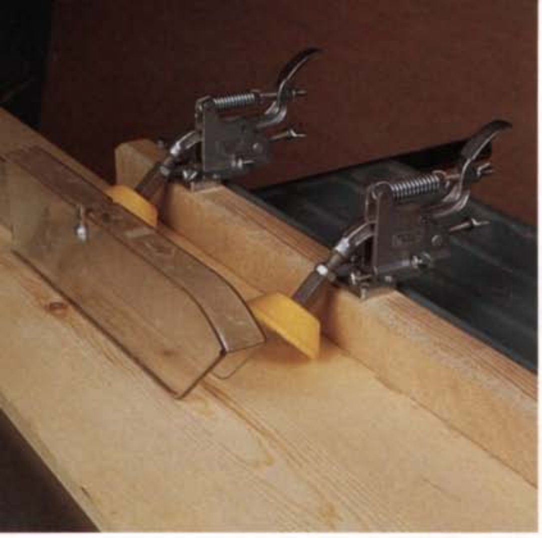
crosscutting. The *Brett-Guard* retails for $214, but the manufacturer advises that for $379 you can order a cantilevered system that mounts at the end of a 50-in. extended side table that solves these problems. Also, an overhead mounting system and a floor mounting system have been developed, but these are probably most suited for larger shops and industrial applications.

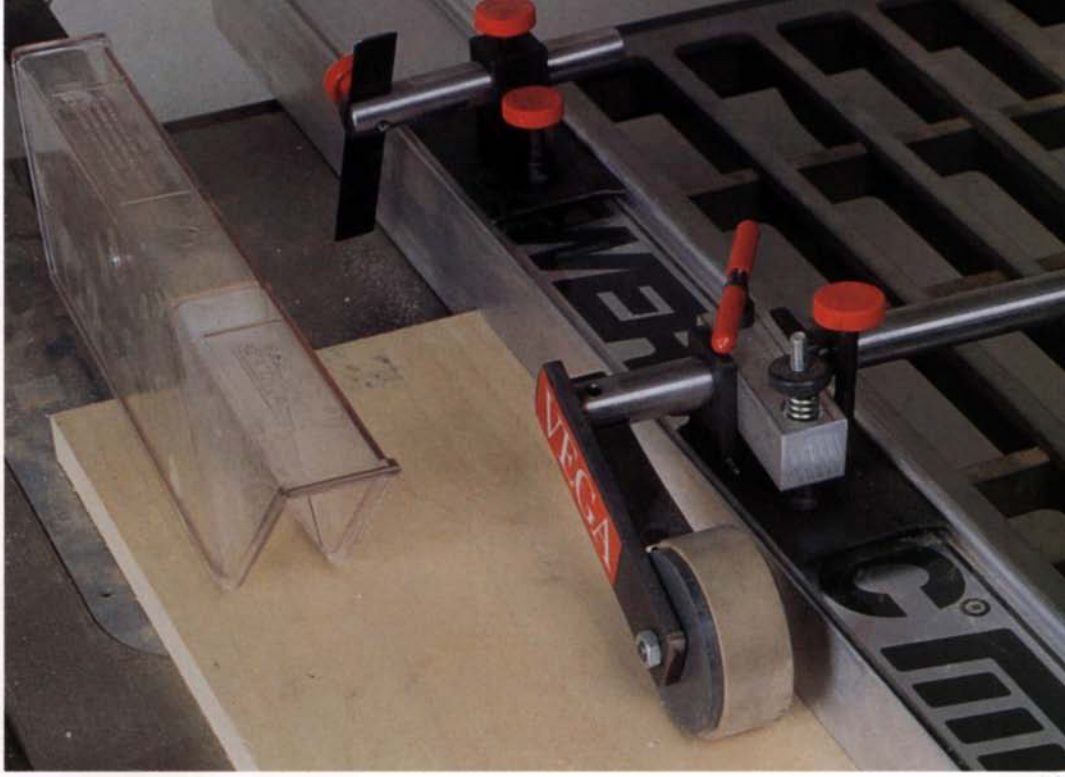
**Hold-down devices**—Most commercial hold-downs rely on a series of rollers to force stock snugly down on the saw table. This setup protects operators in two main ways: it allows them to feed stock through the saw without putting their hands near the blade and it reduces the likelihood of kickback because the stock cannot lift off the table enough to be thrown by the blade. Many hold-down devices also have additional anti-kickback features, which the manufacturers say allow operators to stop feeding stock in the middle of the cut, walk to the back of the saw and pull the work through. In all cases, make sure the motor pulley and belt guards are in place if you are going to be working behind the saw. Also, this technique can be dangerous and, at best, requires a little practice before you are able to produce perfect results. Many operators working on the back of the saw tend to pull the work away from the fence on the outfeed side, which in turn can wedge the stock between the blade and fence on the infeed side. Not only does this ruin the workpiece, it can cause kickback and possibly pull you into the blade. One problem I encountered with most of the hold-downs I tried is that they interfere with push sticks and with the normal function of the guards when trying to rip pieces narrower than 3 in. Sometimes the guards can be removed and the hold-down device positioned over the blade in its place. This does not protect the side of the blade, however, so be careful when using this setup. All of these devices should be used in conjunction with guards, safe practices and common sense, not in place of them.

The *Anti-Kickback Hold-Down Guide System,* shown in the left photo above, is available only from *Leichtung Work Shops* for $49.99. It was the best of the hold-downs I tried, although it took about 30 minutes to assemble the pieces. Two spring-loaded hold-down arms equipped with rubber wheels are independently mounted to an auxiliary fence and can be adjusted to hold the work firmly to the table and to the fence. I like the adjustability of these units the most. The wheels can either move freely or be set to lock in either direction. By adjusting the angle of the wheels to the fence up to 15°, the operator can fine-tune the amount of pull to the fence required by each job. Reversing the wheels on the arm allows you to rip very narrow stock with the wheels close to the fence, which contributes to one of the nicest features of this unit: When ripping very narrow stock, the wheels can be set parallel to the fence so they span the sawkerf. Pushing the stock through and past the blade from the left side causes the wheels to turn, acting like a power feed and driving the cut-off stock out the back side of the blade without a push stick. I was unable to duplicate this trick with any of the other hold-downs. Hold-down pressure is adjustable, as is the control arm for stock thickness. The anti-kickback feature also performed quite well. The soft rubber of the wheels was able to grip the workpiece firmly enough to prevent my pulling the board out from under the unit, although it did allow the board to back up about ¾ in.—enough to prevent a kickback from jamming the blade and possibly burning out your saw motor. As icing on the cake, all of this performance comes without having to buy any optional accessories.

The *Ripstrate* from *Fisher Hill Products,* shown in the right photo above, is $69 and consists of a pair of wheels mounted via spring-loaded arms to a cast-iron carriage. A built-in clamp on the carriage holds the auxiliary fence, as well as the unit itself, to your stock saw fence. Mounting the carriage at about a 5° angle helps direct any stock pushed under the wheels toward the fence. It took about 10 to 15 minutes to set up the first time, but then the auxiliary fence and hold-down could be removed or installed in just minutes. The *Ripstrate* is self-adjusting to the thickness of stock, and it requires fewer adjustments than any of the other devices. When ripping narrow stock, the small size of this unit left more room for push sticks than the other units.

I found the *Ripstrate* to work fairly well as a hold-down, but I was disappointed with its ability to pull and hold material to the fence, particularly when ripping large panels, a situation where hold-downs can be most helpful. Also, the hard rubber wheels didn't grip the workpiece as well as some of the other devices. Although I was unable to generate a kickback with any of these hold-downs, I could, without difficulty, pull the board back out of the *Ripstrate* in spite of the wheels locking up as they were designed to do. The manufacturer assured me that the *Ripstrate* will eliminate kickback under most circumstances, but in the rare in-






*Above: Shophelper's yellow wheels hold the work to the fence, but gaining the adjustability of other systems requires a considerable investment in accessory tracks and wheels.*

*Right: The simply designed Vega Stock Feeder can be stored in place on top of Vega fence, but it would interfere with the company's push stick, which rides in the same track.*

stance that it does occur, the wheels will stop the board.

At $69.95, the *Shophelper,* by *Western Commercial Products,* is a pair of wheels individually mounted on levered axles, as shown in the left photo above. The wheel-and-axle housing slips into a mounting bracket that is screwed to an auxiliary fence. Rather than relying on a canted position to hold stock to the fence, the spring action of the axle arms directly pulls the work to the fence. This results in the workpiece being held more firmly against the fence than all of the canted wheel designs except the *Leichtung* system, which has an adjustable cant. Anti-kickback is provided by single-direction bearings in the wheels that limit stock feed to a right-to-left direction. While the bearings stopped the hard composition wheels, the wheels themselves were less effective at gripping the workpiece. Again, although I wasn't able to induce kickback, the board could be pulled back out of the *Shophelper*. Optional wheels ($19.90) are available for reverse-direction feeding and an optional 24-in. mounting track ($29.95) will allow front-to-back adjustability. The long mounting brackets that are standard with the *Shophelper* allow the wheels to be adjusted between ⅝ in. and 5 in. of the fence.

*Vega Enterprises'* new entry in the wheeled hold-down market is the *Stock Feeder,* which mounts directly onto a *Vega* fence, as shown in the right photo above. The unit is $59 and optional mounting rails, 12 in. long for $7 and 24 in. long for $12, are available for mounting the Stock Feeder to other fences. Immediately evident is that this device has a single wheel that rides on the stock in front of the blade combined with a spring steel hold-down finger in the back. The wheel, canted at 4° to pull stock toward the fence, can be adjusted to ride directly in front of the blade for stock up to 10 in. wide and is adjustable fore and aft along the length of the *Vega* fence or of the optional mounting rails. Both the front and rear hold-downs must be adjusted each time stock thickness changes, and setting the hold-down wheel as directed by the manufacturer greatly increases resistance to feeding stock through the saw. Although the wheel is easily adjustable to stock thickness, by itself it doesn't offer much resistance to kickback. The spring steel rear finger, held at 40° to the stock, provides the real means for preventing kickback, and its end is ground and polished to prevent scratching stock. By adjusting the hold-down to the extreme right, the unit can be stored out of the way on top of the fence. In this position, however, it will interfere with *Vega's Finger Saver,* a push stick that also rides on top of its fence.

**Fingerboards**—In general, fingerboards operate in much the same manner as hold-down devices. As shown in the bottom photo on the following page, they can be homemade or commercial, clamped to the saw table or clamped in the miter slot to hold work tight to the fence, or clamped to the fence to act as a hold-down. Their slanted, flexible fingers also help control kickback.

The *Universal Clamp,* shown in the top photo on the following page, is one of those devices that makes you wonder "Why didn't I think of that?". It's a simple fingerboard that mounts in the miter gauge slot of your tablesaw. When the large, comfortable wing nut on top is tightened, it clamps the fingerboard in position and expands a split aluminum bar in the miter gauge slot to lock the unit to the table. An aluminum finger that serves as a hold-down for ¾-in. stock can be easily moved out of the way when it's not needed. Because the clamp mounts in the miter gauge slot, its capacity is limited, but it is so easy to use and effective that I want one; and at $24.95 it's not worth the trouble to try to make something like this in your shop. The *Universal Clamp* is available from a number of mail order sup-

## *Sources of supply*

Biesemeyer Manufacturing, 216 S. Alma School Road #3, Mesa, AZ 85210; (602) 835-9300.

Fisher Hill Products, Fisher Hill, Fitzwilliam, NH 03447; (603) 585-6883.

Garrett Wade Co. Inc., 161 Ave. of the Americas, New York, NY 10013; (800) 221-2942, (212) 807-1757.

HTC Products, Inc., 120 E. Hudson, Box 839, Royal Oak, MI 48067; (313) 399-6185.

Leichtung Work Shops, 4944 Commerce Parkway, Cleveland, OH 44128; (216) 831-6191.

The Original Wall-Marker Co., Box 436045, Louisville, KY 40243-6045; (502) 245-5930.

Shopsmith Inc., 3931 Image Drive, Dayton, OH 45414-2591; (800) 543-7586, (513) 898-6070.

Vega Enterprises, Inc., R.R. #3, Box 193, Decatur, IL 62526; (217) 963-2232.

Western Commercial Products, Box 1202, Tulare, CA 93275; (800) 344-7455, in CA (800) 828-8833.

Woodcraft, 210 Wood County Industrial Park, Parkersburg, WV 26102; (800) 225-1153.

Woodworker's Supply of New Mexico, 5604 Alameda Place N.E., Albuquerque, NM 87113; (800) 645-9292, (505)821-0500.

*A twist of the large wing nut quickly fastens the Universal Clamp into the miter slot of the tablesaw, firmly holding work against the fence and the table while providing kickback protection. The push stick, designed by Todd Randall, of Cupertino, Cal., to provide both downward and forward control, hooks over your hand so any kickback will push your hand back, even if you lose your grip, to prevent contact with the blade. The easily adjustable shopmade hold-down, visible on the fence just in front of the push stick, offers convenient extra protection.*

*A variety of push sticks and hold-downs that can help save your fingers are clockwise from the left front of the saw table: the Universal Clamp, the Shopsmith Safety Kit, a shopmade featherboard, a shopmade push stick, the Saw-Aid (manufactured by The Original Wall-Marker Co.), two shopmade push sticks and a Biesemeyer push stick.*

pliers, including Woodworker's Supply, Woodcraft and Garrett Wade (see sources of supply on previous page).

For $23 the *Shopsmith Safety Kit,* shown in the bottom photo above, offers a variety of push sticks, blocks and a featherboard, all made of a plastic that is designed to powder if hit by a blade. The conventionally designed push stick has a nice heft and a molded handle that feels good. The fence straddler is a push stick designed specifically for narrow rip cuts on the Shopsmith tablesaw fence. It could, however, be adapted for use on other machines and offers more stability than a regular narrow push stick would for these cuts. A pair of push blocks that could be used for rip cuts over 4 in. wide are also included with the kit. The tilted handles keep your hands away from the fence while the substantial feel and the excellent grip of the soft rubber base make them a pleasure to use. I found them far superior to any other push blocks I've used, particularly for face-jointing boards. The final item in the package is a featherboard designed to mount in the miter gauge slot. Tightening the lock knobs not only fastens the featherboard to the miter bar, but also expands the miter bar in the miter gauge slot to hold it in place. This unit worked well on the Shopsmith, but tended to slide in the miter slot on my Delta Contractor's saw. I found a piece of 100-grit sandpaper glued to one edge tightened the fit in the slot and provided the grip needed to keep it in place. Although these tools were designed with the Shopsmith in mind, they are readily adaptable to other machines and they keep your hands out of harm's way.

**Common sense**—All the best safety equipment in the world can't replace common sense when working with hazardous equipment. You should always be aware of where your fingers are and where they might go if the board you are working on should suddenly disappear. Use a push stick, like those shown in the bottom photo above, to keep your fingers away from sawblades. My favorite design, which is shown in use in the top photo above, came from Todd Randall, a Cupertino, Cal., woodworker. Randall, who lost four fingers to a molding head cutter in a tablesaw, designed this push stick to be gripped between his thumb and the first knuckle of his index finger. Maintain good balance and don't overextend yourself or push too hard toward the blade. A smooth and well-waxed work surface and fence will reduce the effort needed. Take a second look at your procedures, even if you've been doing the same thing for a long time; there may be a safer way of doing it. Many operations can be done more safely on the bandsaw, especially with small pieces and knotty or warped boards. Heed the premonitions you have as you're about to perform a dangerous operation and ignore the less informed who would have you believe you're less of a woodworker for using guards. As Randall says, "If you like woodworking enough, take the steps necessary to protect your ability to do it." □

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*Charley Robinson is an Assistant Editor at* FWW.

# Woodworking Schools

*Fine Woodworking* frequently receives requests from woodworkers and would-be woodworkers looking for schools and instructional programs to help them improve their skills. Our last list was published in issue #39, back in March of 1983, so we felt it was time to update it. We sent surveys to several hundred schools throughout the United States and Canada and asked them to describe their programs. We tried to locate all the schools, but if you are a teacher or a student at a school we missed, please let us know. We'll update the survey as more information becomes available.

Some of the schools listed offer full-time and/or part-time classes and others offer evening or summer seminars. The list is intended as a guide to help you locate schools in various parts of the country. For more details on course offerings, application procedures and catalogs, write to the admissions offices. This list of woodworking schools was prepared by Whitney Potsus.

### *ALABAMA*

Wallace State Community College
Technical Division
801 Main St. N.W.
Hanceville, AL 35077

### *ALASKA*

University of Alaska Southeast
7th & Madison
Ketchikan, AK 99901

### *ARIZONA*

Arizona State University
College of Fine Arts
Tempe, AZ 85287-2102

Roberto-Venn School of Luthiery
4011 S. 16th St.
Phoenix, AZ 85040

University of Arizona
College of Arts & Sciences
Dept. of Art
Tucson, AZ 85721

Yavapai College
1100 E. Sheldon
Prescott, AZ 86301

### *ARKANSAS*

Arkansas Art Center
Box 2137
Little Rock, AR 72203

Gallery B
11324 Arcade Dr.
Little Rock, AR 72212

University of Arkansas at Pine Bluff
Industrial Technology Dept.
UAPB Box 107
Pine Bluff, AR 71601

University of Central Arkansas
Industrial Education Dept.
Conway, AR 72032

### *CALIFORNIA*

Bakersfield Community College
1801 Panorama Drive
Bakersfield, CA 93305

Baulines Craftsman's Guild
Schoonmaker Point
Sausalito, CA 94965

California College of Arts & Crafts
5212 Broadway
Oakland, CA 94618

California State University at Chico
Dept. of Art
Chico, CA 95929

California State University at Fresno
Dept. of Industrial Technology
Fresno, CA 93740-0009

California State University at Fullerton
Dept. of Art
Fullerton, CA 92634

California State University at Long Beach
School of Applied Arts & Sciences
Technology Education Dept.
1250 Bellflower Blvd.
Long Beach, CA 90840

California State University at Los Angeles
5151 State University Drive
Los Angeles, CA 90032

California State University at Northridge
Dept. of Art
18111 Nordhoff St.
Northridge, CA 91324

California State University at San Bernardino
Dept. of Art
5500 State University Parkway
San Bernardino, CA 92407

The Center for Wooden Arts
Box 714
Sausalito, CA 94966

College of the Redwoods
1211 Del Mar Drive
Ft. Bragg, CA 95437

The Day Studio
1504 Bryant St.
San Francisco, CA 94103

Ganahl Lumber Co.
Box 31
Anaheim, CA 92805-5993

Grew-Sheridan Studio
500 Treat Ave.
San Francisco, CA 94110

Laney College
Wood Technology
900 Fallon St.
Oakland, CA 94606

Palomar College
Dept. of Cabinet/Furniture Technology
1140 Mission
San Marcos, CA 92069

San Francisco State University
School of Creative Arts
Dept. of Design & Industry
1600 Holloway Ave.
San Francisco, CA 94132

Sierra College
5000 Rocklin Road
Rocklin, CA 95677

### *COLORADO*

Anderson Ranch Arts Center
Box 5598
Snowmass Village, CO 81615-5598

Metropolitan State College
Dept. of Technology & Technical Communications
1006 11th St., Campus Box 90
Denver, CO 80204

R & D Framing School
227 Jefferson
Ft. Collins, CO 80524

School of Classical Woodcarving
1301 Wazee St.
Denver, CO 80204

University of Southern Colorado
College of Applied Science & Engineering Technology
2200 Bonforte Blvd.
Pueblo, CO 81001-4901

Western State College
Dept. of Art & Industrial Technology
Gunnison, CO 81231

### *CONNECTICUT*

Brookfield Craft Center
286 Whisconier Road
Brookfield, CT 06804

### *DISTRICT OF COLUMBIA*

Corcoran School of Art
17th & New York Avenue N.W.
Washington, DC 20006

### *FLORIDA*

Brevard Community College
1519 Clearlake Road
Cocoa, FL 32922

Daytona Beach Community College
Dept. of Technology
1200 Valusia Ave.
Daytona Beach, FL 32014

University of West Florida
Technical & Vocational Studies
Building 70
Pensacola, FL 32504

### *GEORGIA*

Atlanta College of Art
Woodruff Arts Center
1280 Peachtree St. N.E.
Atlanta, GA 30309

Berry College
Industrial Technology, Box 237
Rome, GA 30149

Highland Hardware
1045 N. Highland Ave. N.E.
Atlanta, GA 30306

Kirby Studios
Box 1769
Cummings, GA 30130

### *HAWAII*

University of Hawaii at Hilo
Hawaii Community College
Trade & Industry Division
Hilo, HI 96720-4091

### *IDAHO*

Ricks College
Division of Engineering & Technology
Technology Education & Construction Management
Rexburg, ID 83460-1030

### *ILLINOIS*

Chicago School of Violin Making
3446 N. Albany
Chicago, IL 60618

Chicago State University
95th at King Drive
Chicago, IL 60628

The Dovetail Joint
1332 Harlem Blvd.
Rockford, IL 61103

University of Illinois at Urbana
10 Henry Administration Building
506 S. Wright St.
Urbana, IL 61801

John Wood Community College
150 S. 48th St.
Quincy, IL 62301

### *INDIANA*

Indiana University
Herron School of Art
1701 N. Pennsylvania St.
Indianapolis, IN 46202

### *IOWA*

Des Moines Area Community College
2006 S. Ankeny Blvd.
Ankeny, IA 50021

Iowa State University
158 College of Design
Ames, IA 50011

### *KANSAS*

Bethel College
Dept. of Natural & Applied Sciences
300 E. 27th St.
North Newton, KS 67117

Fort Hays State University
Industrial Education Dept.
600 Park St.
Hays, KS 67601-4099

Independence Community College
Registrar's Office, Box 708
Independence, KS 67301

Neosho County Community College
1000 S. Allen
Chanute, KS 66720

Pittsburg State University
Industrial Arts & Technology Dept.
Pittsburg, KS 66762

Wichita Area Vocational/Technical School
301 S. Grove
Wichita, KS 67211

### *KENTUCKY*

Berea College
Industrial Arts Dept., Box 2313
Berea, KY 40404

Eastern Kentucky University
College of Applied Arts & Technology
Industrial Education & Technology
Richmond, KY 40475-3115

Murray State University
Dept. of Industrial Education & Technology
Murray, KY 42071

### *MAINE*

Haystack Mountain School of Crafts
Deer Isle, ME 04627-0087

The Landing Boatshop
Box 1490
Kennebunkport, ME 04046

Maine Maritime Museum
The Apprenticeshop
243 Washington St.
Bath, ME 04530

The Rockport Apprenticeshop
Box 539, Sea Street
Rockport, ME 04856

Southern Maine Vocational
Technical Institute
Fort Road
South Portland, ME 04106

University of Southern Maine
School of Applied Science
College Avenue
Gorham, ME 04038

The WoodenBoat School
Box 78
Brooklin, ME 04616

### *MARYLAND*

Chesapeake College
Outreach Services, Box 8
Wye Mills, MD 21679

Garrett Community College
Continuing Education Division
Box 151, Mosser Road
McHenry, MD 21541

University of Maryland
College of Education
Dept. of Industrial, Technological
& Occupation Education
J.M. Patterson Building
College Park, MD 20742

University of Maryland
Eastern Shore, Box 1124
Princess Anne, MD 28153

### *MASSACHUSETTS*

Boston Center for Adult Education
5 Commonwealth Ave.
Boston, MA 02116

Michael Coffey
1 Cottage St.
Easthampton, MA 01027

Heartwood
Johnson Hill Road
Washington, MA 01235

Horizons: N.E. Craft Program
374 Old Montague Road
Amherst, MA 01002

La Gitana Instruments
83 Riverside Ave.
Concord, MA 01742

North Bennett Street School
39 N. Bennett St.
Boston, MA 02113

Worcester Craft Center
25 Sagamore Road
Worcester, MA 01605

### *MICHIGAN*

Andrews University
College of Technology
Berrien Springs, MI 49104

Delta College
Academic Affairs/Occupational
Programs
University Center, MI 48710

Northern Michigan University
304 Cohodas
Marquette, MI 49855

Western Michigan University
Engineering Technology Dept.
Kalamazoo, MI 49008

### *MINNESOTA*

Dakota County Technical Institute
Intermediate District 917
1300 145th St. E.
Rosemount, MN 55068

Redwing Technical College
Pioneer Road at Highway 58
Redwing, MN 55066

St. Cloud State University
College of Science & Technology
115 Administrative Services
Building
St. Cloud, MN 56301

University of Minnesota
184 Darland Administration
Building
Duluth, MN 55812

Villa Maria Wood Workshops
Box 37051
Minneapolis, MN 55431

Wood Carving School
3056 Excelsior Blvd.
Minneapolis, MN 55416

### *MISSISSIPPI*

Mississippi Valley State University
Dept. of Industrial Technology
Box 930
Itta Bena, MS 38941

### *MISSOURI*

Missouri Southern State College
Newman & Duquesne Roads
Joplin, MO 64801

Northwest Missouri State
University
Dept. of Technology
Maryville, MO 64468

The School of the Ozarks
Dept. of Technology
Point Lookout, MO 65726

### *MONTANA*

Northern Montana College
Enrollment Management
Box 7751
Havre, MT 59501

Western Montana College of the
University of Montana
710 S. Atlantic
Dillon, MT 59725

### *NEBRASKA*

Peru State College
Division of Science & Technology
Peru, NE 68421

University of Nebraska
Vocational & Adult Education
44B Henzlik Hall
Lincoln, NE 68588-0359

### *NEVADA*

Northern Nevada Community
College
901 Elm St.
Elko, NV 89801

### *NEW HAMPSHIRE*

Keene State College
229 Main St.
Keene, NH 03431

University of New Hampshire
Paul Creative Arts Center
Durham, NH 03824

### *NEW JERSEY*

The American Wood Carving
School
21 Pompton Plains Crossroad
Wayne, NJ 07470

Geoffrey Noden Furniture Design
11 Park Lane Ave.
Titusville, NJ 08560

Kean College of New Jersey
Dept. of Technology
Morris Avenue
Union, NJ 07083

Montclair State College
Dept. of Technology
Valley Road & Normal Avenue
Upper Montclair, NJ 07043

P & F Binnington
7 Belmont Circle
Trenton, NJ 08618

The William Paterson College
Dept. of Art, 300 Pompton Road
Wayne, NJ 07470

Peters Valley
Route 615
Layton, NJ 07851

### *NEW MEXICO*

New Mexico Highlands University
School of Professional Studies
Las Vegas, NM 87701

### *NEW YORK*

City College of New York
Art Dept.
138th Street & Convent Avenue
New York, NY 10031

Craft Students' League
YWCA of the City of New York
610 Lexington Ave.
New York, NY 10022

Genoa
Box 250, Academy St.
Genoa, NY 13071

Hartwick College
Art Dept.
Oneonta, NY 13820

Jamestown Community College
Continuing Education
525 Falconer St.
Jamestown, NY 14701

The Luthierie
2449 W. Saugerties Road
Saugerties, NY 12477

Rochester Institute of Technology
College of Fine & Applied Arts
1 Lomb Drive, Box 9887
Rochester, NY 14623-0887

State University College at Buffalo
1300 Elmwood
Buffalo, NY 14222

State University of New York at
Morrisville
College of Agriculture &
Technology
Morrisville, NY 13408

State University of New York at
Purchase
Visual Arts Divison
Purchase, NY 10577

Stripping Unlimited & Refinishing
12 All Points Drive
Holbrook, NY 11741

Thousand Islands Craft School &
Textile Museum, 314 John St.
Clayton, NY 13624

Thousand Islands Shipyard Museum
750 Mary St.
Clayton, NY 13624

### *NORTH CAROLINA*

Appalachian State University
Industrial Education & Technology
Boone, NC 28608

Asheville-Buncombe Technical
Community College
340 Victoria Road
Asheville, NC 28801

The John C. Campbell Folk School
Brasstown, NC 28902

Cape Fear Community College
411 N. Front St.
Wilmington, NC 28401-3993

Catawba Valley Community
College
Route 3, Box 283
Hickory, NC 28602

Country Workshops
Route 3, Box 221
Marshall, NC 28753

East Carolina University
106 Whichard Building
Greenville, NC 27858-4353

Guilford Technical Community
College
Box 309
Jamestown, NC 27282

Haywood Community College
Freelander Drive
Clyde, NC 28721-9454

North Carolina State University
College of Forest Resources
Box 8005
Raleigh, NC 27695-8005

Penland School of Crafts
Penland Road
Penland, NC 28765

Pitt Community College
Drawer 7007
Greenville, NC 27835-7007

Rockingham Community College
Box 38
Wentworth, NC 27375

### *OHIO*

Conover Workshops
18125 Madison Road
Parkman, OH 44080

Ohio Northern University
Dept. of Industrial Technology
Ada, OH 45810

Ohio University
School of Art, 69 W. Union St.
Athens, OH 45701

Gary Perkins
422 6th St.
Fremont, OH 43420

University of Cincinnati
OMI College of Applied Science
2220 Victory Parkway
Cincinnati, OH 45206

University of Rio Grande
Rio Grande, OH 45674

Wayne Center for the Arts
Box 382, 237 S. Walnut St.
Wooster, OH 44691

### *OKLAHOMA*

Central State University
100 N. University Drive
Edmond, OK 73034

East Central Oklahoma State
University
Ada, OK 74820-6899

Northeastern State University
Tahlequah, OK 74464

Northwestern Oklahoma State
University
Oklahoma Boulevard
Alva, OK 73717

Panhandle State University
School of Education, Box 430
Goodwell, OK 73939

Southwestern Oklahoma State University
Dept. of Industrial Education & Technology
100 Campus Drive
Weatherford, OK 73096

## OREGON

Oregon School of Arts & Crafts
8245 S.W. Barnes Road
Portland, OR 97225

## PENNSYLVANIA

Bucks County Community College
Swamp Road
Newtown, PA 18940

James Cox
School of Woodworking
R.D. 2, Box 126
Honey Brook, PA 19344

Edinboro University of Pennsylvania
Dept. of Art
Edinboro, PA 16444

Jeffrey Greene Design Studio
Ney Alley
New Hope, PA 18938

Indiana University of Pennsylvania
Dept. of Art, 115 Sprowls Hall
Indiana, PA 15705-1087

Johnson Technical Institute
3427 N. Main Ave.
Scranton, PA 18508

Kutztown State College
Kutztown, PA 19530

Maxwell & Kelly Furniture Co.
109 S. 24th St.
Philadelphia, PA 19103

Millersville University
Dept. of Industry & Technology
Millersville, PA 17551

Philadelphia School of Chippendale Furnituremaking
7 N. Home Ave.
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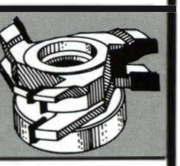

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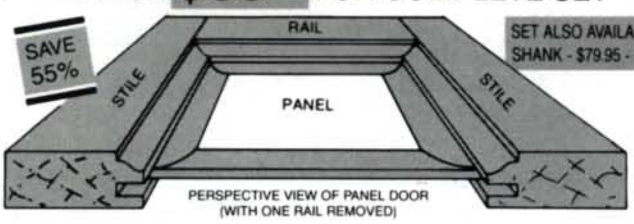


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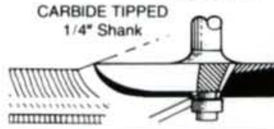

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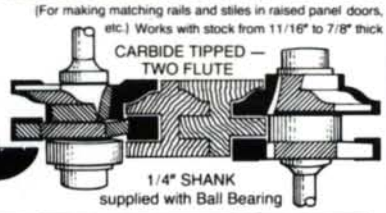

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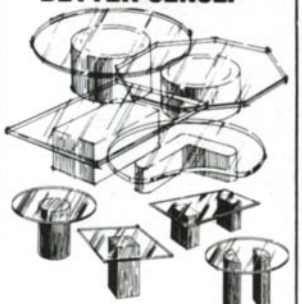

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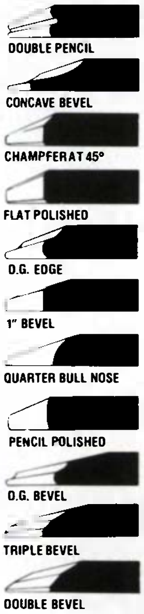


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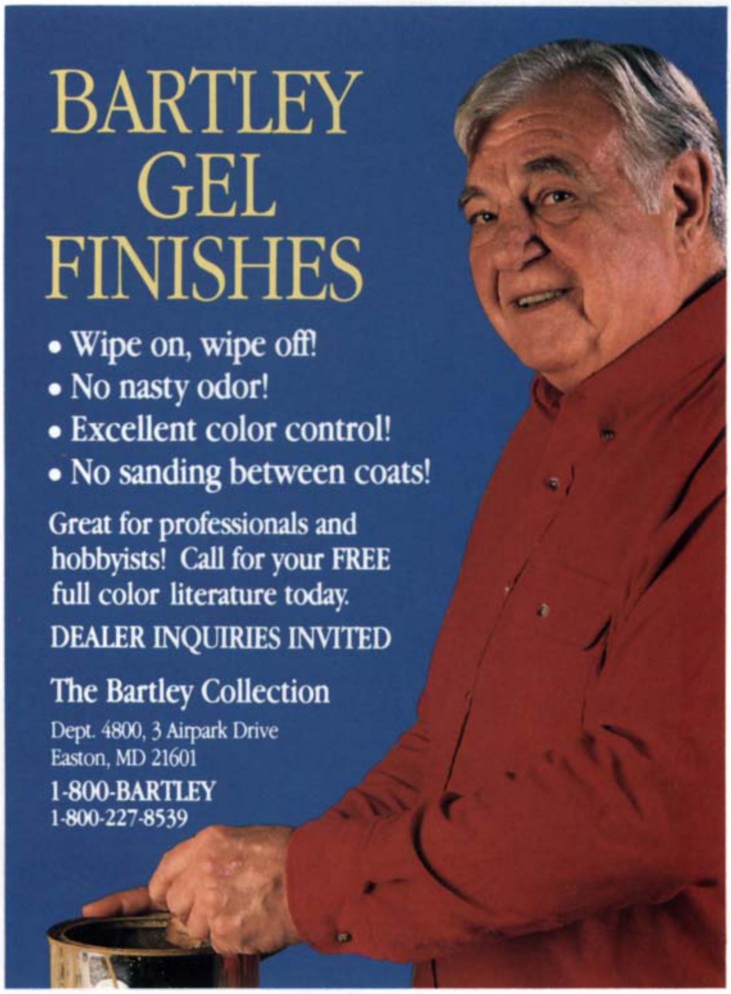


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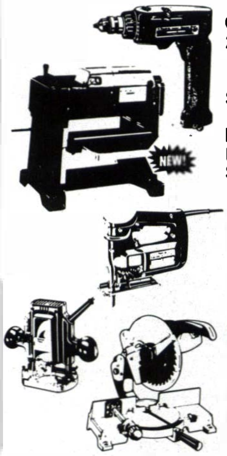

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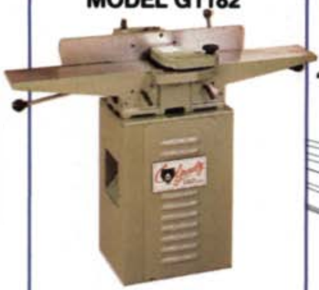

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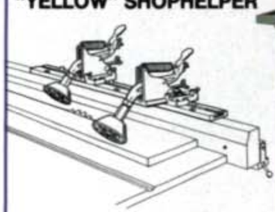

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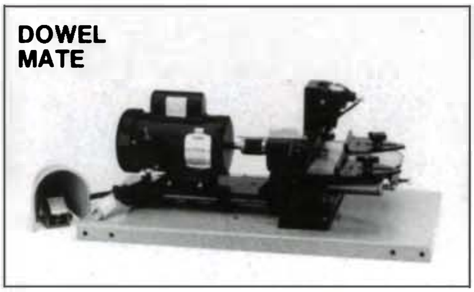


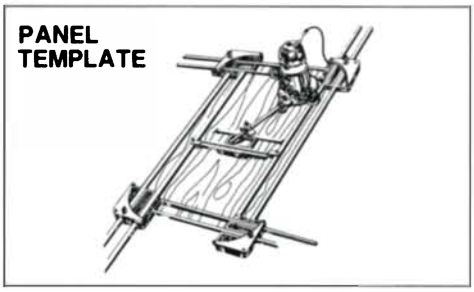




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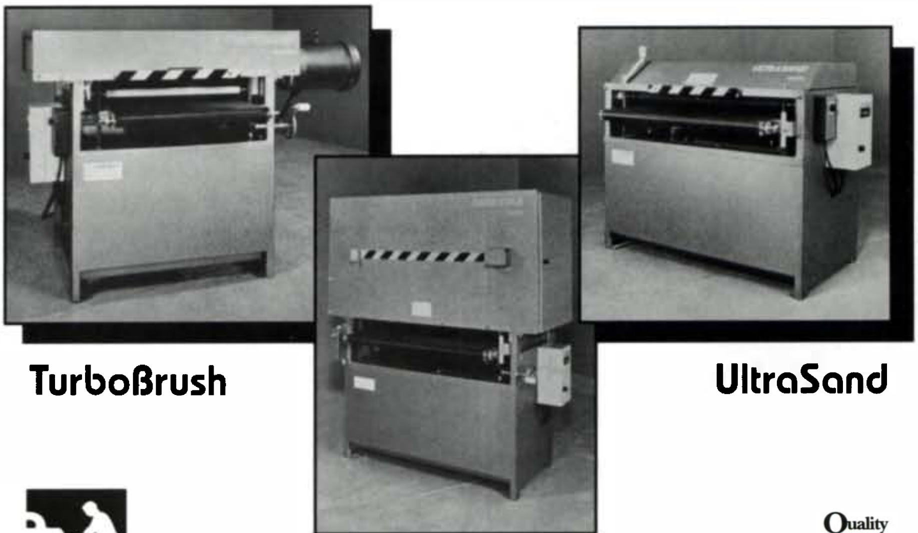

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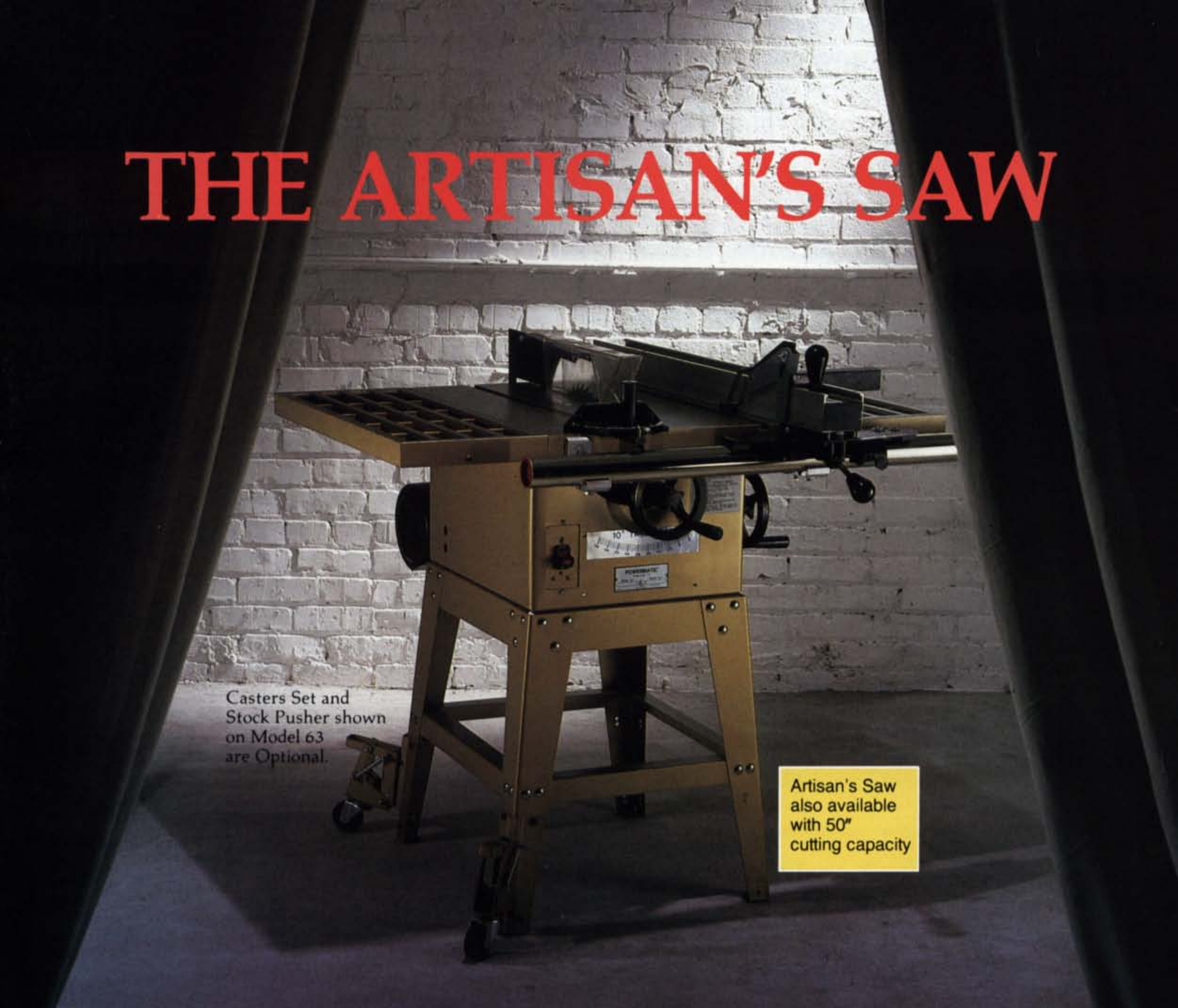


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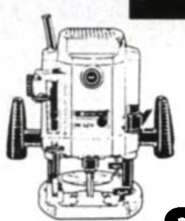

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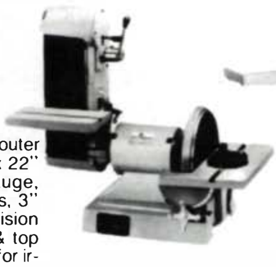

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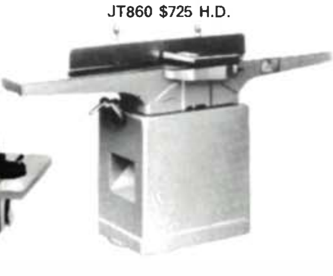

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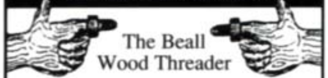


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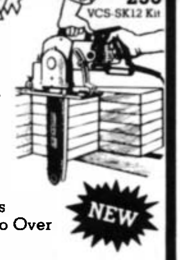

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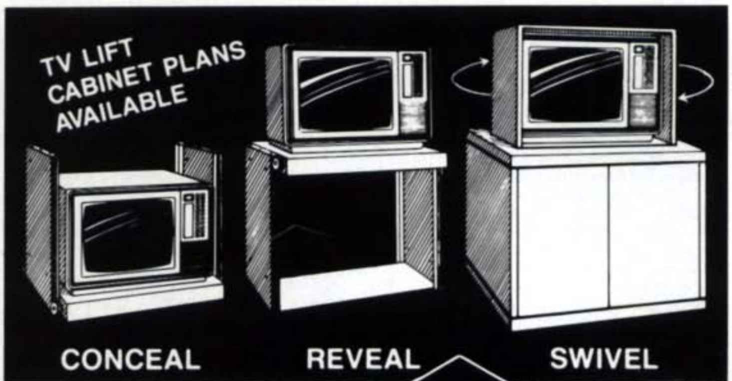


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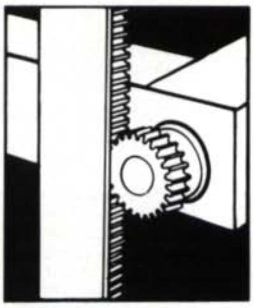

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*Listings of gallery shows, major craft fairs, lectures, workshops and exhibitions are free, but restricted to happenings of direct interest to woodworkers. We list events (including entry deadlines for future juried shows) that are current with the 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.*

***ALABAMA:*** **Exhibit**—Focus: Four Alabama Artists, thru Mar. 1. Birmingham Museum of Art, 2000 8th Ave. N., Birmingham 35203-2278. (205) 254-2566.

***ALASKA:*** **Juried exhibit**—International Turned Objects Show, Jan. 6–Feb. 25. Anchorage Museum, Anchorage. Contact Sarah Tanguy, International Sculpture Center, 1050 Potomac St. N.W., Washington, DC 20007. (202) 965-6066.

***ARIZONA:*** **Exhibit**—Woodturning Mastery, Mar. 1–31. The Hand and the Spirit Gallery, 4222 N. Marshall Way, Scottsdale, 85251. (602) 949-1262.
**Seminars**—Woodcarving seminars, Mar. 1–3, 5–7. Contact Dave Rushlo Woodcarvers Supply, 2530 N. 80th Pl., Scottsdale, 85257. (602) 994-1233.
**Show**—The Arizona Woodworking Show, Mar. 9–11. Veterans Memorial Coliseum, 1826 W. McDowell Rd., Phoenix, 85005. For more info., contact Michelle Troop, 1516 S. Pontius Ave., Los Angeles, CA 90025. (213) 477-8521.

***CALIFORNIA:*** **Workshops**—Various workshops including Japanese woodworking, joinery and sharpening. Contact Hida Tool Co., 1333 San Pablo, Berkeley, 94702. (415) 524-3700.
**Workshop**—Design, Operation and Maintenance of Saws, Feb. 26–27. Wood Machining Institute, Box 476, Berkeley, 94701. (415) 943-5240.
**Show**—The Northern California Woodworking Show, Mar. 16–18. San Jose Civic Auditorium, 145 W. San Carlos St., San Jose, 95110. For info., contact Diane Johnson, 1516 S. Pontius Ave., Los Angeles, 90025. (213) 477-8521.
**Festival**—Contemporary Arts Festival, Mar. 23–25. Convention and Performing Arts Center, San Diego. Contact General Expositions, 111 Liberty St., Petaluma, 94952. (707) 778-6300.
**Exhibit**—Robert Bassler: Large Scale Sculpture, thru Mar. 25. Gallery at the Plaza, Security Pacific Corp., 333 S. Hope St., Los Angeles, 90071.
**Festival**—Contemporary Arts Festival, Mar. 30–Apr. 1. Brooks Hall Civic Center, San Francisco. Contact General Exposition, 111 Liberty St., Petaluma, 94952. (707) 778-6300.
**Convention**—Wood Machinery Manufacturers of America and Woodworking Machinery Distributors' Association joint industry convention, Apr. 21–25. Hotel Del Coronado, Coronado. For info., contact WMMA, 1900 Arch St., Philadelphia, PA 19103. (215) 564-3484.
**Exhibit**—"Hands On! Objects Crafted in our Time," thru May. Craft and Folk Art Museum, 5800 Wilshire Blvd., Los Angeles. (213) 937-5544.
**Classes**—Boatbuilding classes, May 5–6, May 12–13. National Maritime Museum Assoc., Bldg. 275, Crissy Field, San Francisco, 94129. For info., call (415) 929-0202.
**Show**—The Southern California Woodworking Show, May 11–13. Pasadena Center, 300 E. Green St., Pasadena, 91101. For info., contact Michelle Troop, 1516 S. Pontius Ave., Los Angeles, 90025. (213) 477-8521.

***COLORADO:*** **Show**—The Colorado Woodworking Show, Mar. 2–4. National Western Complex, 1325 E. 46th Ave., Denver, 80216. Contact Diane Johnson, 1516 S. Pontius Ave., Los Angeles, 90025. (213) 477-8521.
**Classes**—Woodworking and related classes, year-round. Red Rocks Community College, 13300 W. 6th Ave., Lakewood, 80401. (303) 988-6160.
**Workshops**—One- and two-week workshops, June thru Aug. Registration until then. Anderson Ranch Arts Center, Box 5598, Snowmass Village, 81615. (303) 923-3181.

***CONNECTICUT:*** **Exhibit**—In Sono: design furniture and accessories by Eric Bergman and Gordon Naylor, thru Mar. 4. In Brookfield: various woodworking workshops beginning Jan. 20, including carving techniques with Eugene Landon, Mar. 24–25 and woodturning with Dennis Elliott, Mar. 31–Apr. 3. Contact Brookfield Craft Center, Box 122, Route 25, Brookfield, 06804. (203) 775-4526.
**Juried exhibit**—Society of Connecticut Craftsmen annual exhibition, Mar. 11–Apr. 8. Mattatuck Museum, Waterbury. For info., contact SCC, Box 615, Hartford, 06142. (203) 267-8475.
**Juried exhibit**—33rd annual handcrafts exposition, July 19–21. Guilford Green. Deadline: Mar. 3. For info., contact Guilford Handcrafts, Box 589, 411 Church St., Guilford, 06437. (203) 453-5947.

***DELAWARE:*** **Exhibit**—Furniture by Wendell Castle, Mar. 9–May 13. Delaware Art Museum. For info., contact Rochester Institute of Technology, 1 Lomb Memorial Dr., Box 9887, Rochester, NY 14623. (716) 475-5064.

**Program**—Grants-in-aid from the Early American Industries Assoc. to assist individuals with research and studies, including areas of woodworking. Application deadline for 1990 awards: Mar. 15. Contact Charles Hummel, Winterthur Museum, Winterthur, 19735.

***DISTRICT OF COLUMBIA:*** **Juried show**—8th annual Washington Craft Show, Apr. 19–22. The Departmental Auditorium, 1301 Constitution Ave. N.W. For info., contact Smithsonian Associates Women's Committee, Arts and Industries Bldg., Room 1465, Smithsonian Institution, 20560. (202) 357-4000.
**Exhibit**—Tradition and Innovation: New American Furniture, Apr. 20–Sept. 3. Renwick Gallery, 17th St. & Pennsylvania Ave. N.W. For info., call (202) 357-2247.
**Seminar**—20th-Century Furniture: The Spirit of Design, Apr. 30–May 4. For info., contact MaryBeth Mullen, Smithsonian National Associate Program, 1100 Jefferson Dr. S.W. (202) 357-4700.
**Exhibit**—Culture and Commentary: An '80s Perspective, thru May 6. Hirshhorn Museum and Sculpture Garden, Smithsonian Institution, Independence Ave. at 8th St. S.W. Featuring works of 15 artists, including wood sculptor Jeff Koons. For info., call (202) 357-2700.

***FLORIDA:*** **Show**—Woodworking World show, Feb. 23–25. Jacksonville Memorial Hall, Jacksonville. For info., contact WANA, Box 706, Plymouth, NH 03264. (800) 521-7623, in NH (603) 536-3768.
**Festival**—2nd annual Italian Street Festival, Apr. 5. Moroso Park. For info., contact the Italian Street Festival, Box 14157, N. Palm Beach, 33408-0157. (407) 844-8070.
**Juried festival**—21st annual spring arts festival, Apr. 7–8. Gainesville. Contact Spring Arts Festival, Box 1530, Gainesville, 32602. (904) 372-1976.

***GEORGIA:*** **Seminar**—Manufacturing Solutions for the 1990s and Beyond, Mar. 21–23. Westin Lenox Hotel, Atlanta. Featuring wood manufacturing experts Howard Feldman, Gunter Geiger and Richard Godfrey. For info., contact the Italian Trade Commission, 1801 Ave. of the Stars, Suite 700, Los Angeles, CA 90067. (213) 879-0950.
**Show**—The Atlanta Woodworking Show, Mar. 23–25. Lakewood Fairgrounds, 2000 Lake Ave., Atlanta, 30315. Contact Michelle Troop, 1516 S. Pontius Ave., Los Angeles, CA 90025. (213) 477-8521.
**Juried exhibition**—International Woodworking Fair Design Competition, Aug. 24–27. Challengers Award competition deadline: June 1. Contact Shirley Byron, International Woodworking Machinery and Furniture Supply Fair, 8931 Shady Grove Court, Gaithersburg, MD 20877.
**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.

***IDAHO:*** **Juried show**—Art on the Green festival, Aug. 3–5. North Idaho College campus. Deadline: Apr. 13. Contact Carol Clark, Citizens Council for the Arts, Box 901, Coeur d'Alene, 83814. (208) 667-9346.

***ILLINOIS:*** **Seminars**—Woodworking seminars, thru Mar. In the Chicago area. For info., contact Wood World, 1719 Chestnut Ave., Glenview, 60025. (708) 729-9663.
**Show**—The Chicagoland Woodworking Show, Apr. 20–22. Odeum, 1033 N. Villa Ave., Villa Park, 60181. Contact Diane Johnson, 1516 S. Pontius Ave., Los Angeles, CA 90025. (213) 477-8521.

***INDIANA:*** **Seminar**—Wood Dust and its Control, Mar. 20. Holiday Inn, Elkhart. For info., contact Daniel Cassens, Dept. of Forestry & Natural Resources, Purdue University, West Lafayette, 47907. (317) 494-3644.
**Workshops**—Second Saturday woodworking workshops, thru Apr. Edward B. Mueller Co., 3940 S. Keystone, Indianapolis, 46227. (317) 783-2040.

***IOWA:*** **Juried fair**—20th Art in the Park, May 19–20. Main Ave., Clinton. Entries deadline: Mar. 31. Contact Clinton Art Assoc., Box 132, Clinton, 52732. (319) 259-8308.

***KANSAS:*** **Juried show**—Dimensions, 3-dimensional art show, June 8–10. Sar-Ko-Par Trails Park, Lenexa. Deadline: Mar. 31. For info., contact William Nicks, Jr., Dimensions, 13420 Oak St., Lenexa, 66215. (913) 541-8592.
**Juried show**—Topeka Competition 14, Apr. 1–26. For info., contact Gallery of Fine Arts, Topeka Public Library, 1515 W. 10th, Topeka, 66604. (913) 233-2040.

***KENTUCKY:*** **Seminar**—Wood Veneering for Furniture, Panel and Cabinet Manufacturing, Mar. 5–7. Louisville. For info., contact Daniel Cassens, Dept. of Forestry & Natural Resources, Purdue University, West Lafayette, IN 47907. (317) 494-3644.
**Workshop**—Woodturing with Rude Osolnik and Todd Hoyer, Mar. 16–17. Civic Center, 410 W. Vine St., Lexington. Held in conjunction with the International Turned Objects Show, Mar. 10–May 6. Also at the Civic Center. For info., contact Kentucky Woodworkers Association, Box 22018, Lexington, 40522. (606) 252-3289.

***LOUISIANA:*** Woodworking World show, Mar. 16–18. Riverside Centroplex, Baton Rouge. Contact WANA, Box 706, Plymouth, NH 03264. (800) 521-7623, in NH (603) 536-3768.

**Juried show**—Craftsmen's show, Apr. 9–May 4. Louisiana Crafts Council Gallery, Baton Rouge. Deadline: Mar. 28. Contact LA Crafts Council, Box 1287, Baton Rouge, 70821. (504) 383-1782.

***MAINE:*** **Classes**—Design and build, Mar. 5–16, May 7–29; post and beam, Apr. 15–20. Contact Shelter Institute, 38 Centre St., Bath, 04530. (207) 442-7938.
**Show**—Woodworking World show, Apr. 27–29. Portland Expo Building, 239 Park Ave., Portland. For info., contact WANA, Box 706, Plymouth, NH 03264. (800) 521-7623, in NH (603) 536-3768.

***MARYLAND:*** **Fair**—ACC Craft Fair, Mar. 2–4. Baltimore Convention Center. For info., contact American Craft Enterprises, Box 10, New Paltz, NY 12561. (914) 255-0039.
**Juried fair**—Sugarloaf's 15th annual spring arts & crafts fair, Apr. 20–22. Montgomery County Fairgrounds. Contact Deann Verdier, Sugarloaf Mountain Works, 20251 Century Blvd., Germantown, 20874. (301) 540-0900.

***MASSACHUSETTS:*** **Workshops**—Various woodworking workshops in April. Contact Andover Historical Society, 97 Main St., Andover, 01810. (508) 475-2236.
**Show**—Lathe-turned furniture, thru Mar. 4. Ten Arrow Gallery. Contact Ten Arrow Gallery, 10 Arrow St., Cambridge, 02138. (617) 876-1117.
**Show**—New American Furniture, thru Mar. 11. Museum of Fine Arts, Boston.
**Juried exhibits**—Woodturners of the Northeast 1990, thru Mar. 17. Annual May craft fair, May 18–20. Contact Worcester Center for Crafts, 25 Sagamore Rd., Worcester, 01605. (508) 753-8183.
**Shows**—Boston Gift show, Mar. 24–28. Bayside Exposition Center; American & International Craft show, Mar. 24–27. World Trade Center. Contact George Little Management, 2 Park Ave., Suite 1100, New York, NY 10016. (212) 686-6070.
**Workshop**—Design and Construction with Bent Wood and Wood Forming, Apr. 7–8. Worcester. With Canadian furniture designer Michael Fortune. Contact the Worcester Center for Crafts, 25 Sagamore Rd., Worcester, 01605. (508) 753-8183.
**Workshop**—Cabinetmaking, Apr. 23–27. Washington. Contact Will Beemer, Heartwood, Johnson Hill Rd., Washington, 01235. (413) 623-6677.
**Workshops**—One- or two-day workshops including bandbox making and making hand tools, thru June. Old Sturbridge Village, 1 Old Sturbridge Village Rd., Sturbridge, 01566. (508) 347-3362.

***MICHIGAN:*** **Show**—American Craft Expo '90, Apr. 4–8. Minneapolis Convention Center. For info., contact American Craft Enterprises, Box 10, New Paltz, NY 12561.

***MONTANA:*** **Juried show**—The Good Wood show, Mar. 16–18. The Metra on the fairgrounds, Billings. Contact Bob Lund, Montana Woodcarvers Assoc., 2039 Walter Rd., Billings, 59105. (406) 248-5373.

***NEBRASKA:*** **Show**—Nebraska Woodworking Show, May 4–6. Aksarben Field, 63rd & Shirley Streets, Omaha, 68106. Contact: Diane Johnson, 1516 S. Pontius Ave., Los Angeles, CA 90025. (213) 477-8521.

***NEW HAMPSHIRE:*** **Classes**—Classes in fine arts and studio arts, beginning Jan. 15. Manchester Institute of Arts and Sciences, 114 Concord St., Manchester, 03104.
**Retreat**—Woodworking retreat, July 22–26. Waterville Valley Resort & Conference Center, White Mountain National Forest. Contact WANA, Box 706, Plymouth, 03264. (800) 521-7623.

***NEW JERSEY:*** **Shows**—Super Crafts Star Show, Mar. 9–11. Meadowlands Stadium, East Rutherford. Super Crafts, Mar. 30–Apr. 1. Garden State Convention & Exhibit Center, Somerset. Contact Creative Faires, Box 1688, Westhampton Beach, NY 11978. (516) 288-2004.

***NEW MEXICO:*** **Classes**—Building the Norwegian Pram, Apr. 14–15, Apr. 21–22. Sponsored by Albuquerque Woodworkers Association. Contact Jim Linke, 1414 Silver St., Albuquerque, 87106. (505) 243-7234.

***NEW YORK:*** **Classes**—Woodworking classes at all levels. Contact The Craft Students League, 610 Lexington Ave. at 53rd St., New York, 10022. (212) 735-9732.
**Juried exhibit**—Northeast fine crafts exhibit, Mar. 11–May 31. Schenectady Museum & Planetarium. Entries deadline: Feb. 26. Contact Marlene Scholl, Nott Terrace Heights, Schenectady, 12308. (518) 399-8381.
**Exhibit**—Crossing Boundaries, opening Mar. 14. New York City. Featuring five artists, including David Ellsworth. Bellas Artes Gallery, 584 Broadway, New York City. Call (505) 983-2745 for info.
**Lecture**—Furniture Finishing and Restoration by Homer Formby, Mar. 16. Strong Museum, Rochester. Sponsored by the Rochester Woodworkers Society. For info., contact Jim Hotaling, Rochester Woodworkers Society, Box 67054, Rochester, 14617. (716) 223-4877.
**Workshops**—Hand tool workshops with Robert Meadows, Mar. 17–18, Apr. 21–22. The Luthierie, 2449 W. Saugerties Rd., Saugerties, 12477. (914) 246-5207.
**Show**—Woodworking World show, Apr. 6–8. Erie County Fairgrounds, 5600 McKinely Parkway, Hamburg. Contact

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SAW BOSS 6" Circular Saw Model 345 99.

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|---|---|---|
| 621 | 3/8" VSR Drill | 94. |
| 7511 | 3/8" VSR Drill | 108. |
| 7514 | 1/2" VSR drill | 117. |
| 666 | 3/8" T-Handle drill | 120. |
| 7556 | 2-Spd. rt. angle drill | 175. |
| 303 | Pro 7" paint remover | 149. |
| 304 | Pro 7" disc sander | 125. |
| 305 | Pro 7" disc polisher | 125. |
| 320 | Abrasive plane | 95. |
| 367 | 3¼" plane | 145. |
| 9118 | Porta-plane kit | 209. |
| 9652 | Versa-plane kit | 270. |
| 7310 | Laminate trimmer | 95. |
| 7312 | Offset base lam. trimmer | 124. |
| 7319 | Tilt base lam. trimmer | 109. |
| 7399 | Drywall cutout unit | 78. |
| 100 | 7/8 HP router | 95. |
| 518 | 3 HP microprocssr, 5spd. | 330. |
| 536 | 1½ HP speedmatic | 195. |
| 537 | 1½ HP spdmatic, d-handle | 209. |
| 630 | 1 HP router | 109. |
| 690 | 1½ HP router | 119. |

Speed-Bloc Finishing Sander Model 330 57.

| | | |
|---|---|---|
| 691 | 1½ HP router, d-handle | 130. |
| 555 | NEW! plate joining machine | 165. |
| 505 | ½ Sheet pad sander | 112. |
| 352 | 3"x21" dustless belt sander | 125. |
| 360 | 3"x24" dustless belt sander | 175. |
| 362 | 4"x24" dustless belt sander | 185. |
| 503 | 3"x24" wormdrive belt sander with bag | 349. |
| 314 | 4½" Trim saw | 125. |
| 315-1 | 7¼" Top handle saw | 112. |
| 548 | Heavy duty bayonet saw | 165. |
| 7548 | VS, var. orbit, d-handle jigsaw | 125. |
| 7648 | VS, var. orbit jigsaw | 125. |
| 9627 | 2-Spd. Tiger saw w/case | 125. |
| 9629 | Var, spd Tiger saw w/case | 135. |
| 7523 | Pos. clutch screwdriver | 139. |
| 7542 | TEKS Driver | 119. |
| 7545 | VSR Drywall driver | 109. |

12 V. VSR Cordless Drill Kit SKIL Model 2735:04 135.

| | | |
|---|---|---|
| 77 | 7¼" worm drive saw | 139. |
| 5825 | 6½" Worm drive saw | 145. |
| 5510 | 5½" Trim saw | 95. |
| 5790 | 10¼" Circular saw | 259. |
| 5865 | 8¼" Worm drive circular saw | 159. |

## FREUD

| | | |
|---|---|---|
| LM72M008 | 8"x24T Rip | 32. |
| LM72M010 | 10"x24T Rip | 37. |
| LU73M010 | 10"x60T ATB | 43. |
| LU81M010 | 10"x40T thin kerf | 42. |
| LU82M010 | 10"x60T TCG | 47. |
| LU84M008 | 8"x40T combination | 39. |
| LU84M011 | 10"x40T combination | 39. |
| LU85M008 | 8"x64T ATB fine cut-off | 49. |
| LU85M010 | 10"x60T ATB fine cut-off | 59. |
| LU85M014 | 14"x108T ATB fine cut-off | 109. |
| LU85M015 | 15"x108T ATB fine cut-off | 109. |
| LU87M010 | 10"x24T thin kerf | 39. |
| LU88M010 | 10"x60T thin kerf | 49. |
| LU91M008 | 8½"x48T ATB miter saw blade | 39. |
| LU98M010 | 10"x60T TCG | 75. |
| PS203 | 7¼"x24T gen. purpose | 17. |
| PS303 | 7¼"x40T fine cut | 24. |
| SD308 | 8" Dado set | 115. |
| EB100 | Edge bander | 269. |
| EC900 | 5 pc. shaper cutter set | 279. |
| 88-100 | 9 pc. router bit set | 99. |
| 90-100 | 15 pc. router bit set | 169. |
| FB-107 | 7 pc. forstner bit set | 49. |

## Milwaukee

3/8" VSR Drill Model 0222-1 99.

| | | |
|---|---|---|
| 0239-1 | 1/2" drill, keyless chuck | 129. |
| 0224-1 | 3/8" Magnum holeshooter | 109. |
| 0234-1 | 1/2" Magnum holeshooter | 115. |
| 0375-1 | 3/8" close-quarter drill | 129. |
| 0379-1 | 1/2" close-quarter drill | 149. |
| 1676-1 | Hole-hawg kit | 230. |
| 3002-1 | Electricians rt. ang. drill kit | 179. |
| 3102-1 | Plumbers rt. ang. drill kit | 185. |
| 5397-1 | 3/8" VS hammer drill kit | 145. |
| 8975 | Heat gun | 57. |
| 5680 | 2 hp router | 219. |
| 5925 | 3"x24" dustless belt sander | 219. |
| 5936 | 4"x24" dustless belt sander | 225. |
| 6012 | 1/3 Sheet pad sander | 105. |
| 6014 | 1/2 Sheet pad sander | 113. |
| 6215 | 16" Electric chainsaw | 185. |
| 6226 | 2 speed bandsaw w/case | 249. |
| 6246 | Single speed jigsaw | 125. |
| 6256 | Variable speed jigsaw | 140. |

2 Speed Sawzall Model 6511 119.

| | | |
|---|---|---|
| 6507 | Var. sp. sawzall w/case | 129. |
| 6365 | 7¼" top handle circular saw | 115. |
| 6377 | 7¼" wormdrive saw | 160. |
| 6405 | 8¼" circular saw | 125. |
| 6539-1 | Cordless screwdriver | 65. |
| 6543-1 | VSR Screwshooter | 145. |
| 6750-1 | VSR Drywall driver | 95. |
| 6754-1 | VSR Magnum drywall driver | 115. |
| 6798-1 | Adj. clutch screwshooter | 105. |

## HITACHI

½" Plunge Router Model TR12 169.

| | | |
|---|---|---|
| F20A | 3¼" Plane | 99. |
| TR6 | Laminate trimmer | 95. |
| TR8 | ¼" Plunge router | 119. |
| CR10V | VS, Var. orbit recipro saw | 119. |
| DRC10 | 3/8" Cordless drywall screwgun | 85. |
| D10D | 3/8" 9.6 v. cordless driver/drill | 110. |
| W6V1 | 0-4000 drywall screwgun | 69. |

NEW! 8½" Compound Miter Saw Model C8FB 499. FREIGHT INCLUDED

| | | |
|---|---|---|
| C10FA | Deluxe 10" miter saw | 289. |
| C15FB | Deluxe 15" miter saw | 389.* |
| F1000A | 12" Planer/6" jointer combo | 1485.* |
| CB75F | Band saw | 1575.* |
| R100Y | Dust collector | 559.* |
| P100F | 12" Planer | 1059.* |

## RYOBI

10" Portable Planer 355. Model AP10 FREIGHT INCLUDED

| | | |
|---|---|---|
| RA200 | 8" portable radial arm saw | 249. |
| L120UK | 3-5/8" Planer kit | 99. |
| R500 | 2¼" HP plunge router | 159. |
| R150K | 1 HP plunge router kit | 99. |
| TR30U | Laminate trimmer | 79. |
| B7075K | 3"x21" Belt sander kit | 119. |
| S500A | Finishing sander, 1/6 sheet | 36. |
| TS251U | 10" Miter saw | 185. |
| TS380 | 14" Miter saw | 345. |
| RE600 | 3 HP Electronic VS Plunge Router | 195. |
| JP155 | 6 1/8" VS Joint Planer | 330. |

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Tiger Cub All Purpose Saw Kit No. 9647 119.

12 V. Magnequench VSR Cordless Driver Drill Kit No.9850 NEW! 135.

## DELTA

8¼" Bench Saw Model 34-330 199.

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Finish Nailer N60FN 339.

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3/4 HP Twin Tank Hand-Carry Air Compressor Model AM39-HC4 275.

David White Instruments Sight Level Package LP6-20 Includes instruments & tripod 229.

## Makita

VS Cordless Driver/Drill w/ Clutch Kit Model 6093DW 129.

| | | |
|---|---|---|
| 6302 | 1/2" Drill | 119. |
| 6012HDW | 2-Spd. cordless driver/drill kit | 119. |
| 6510LVR | 3/8" Drill, heavy duty | 79. |
| 9207SPC | 7" Electronic sander/polisher | 145. |
| 3612BR | 1/2", 3HP Plunge router | 187. |

7¼" Framers Saw w/hypoid gears Model 5077B 139.

| | | |
|---|---|---|
| 2708 | 8" Table saw/carbide blade | 259. |
| 9401 | 4"x24" Dustless belt sander | 165. |
| 9900B | 3"x21" Dustless belt sander | 145. |
| LS1020 | 10" Miter saw | 249. |

## Elu BLACK & DECKER

1 HP Plunge Router Model 3303 159.

| | | |
|---|---|---|
| 3304 | 1hp electronic plunge router | 189. |
| 4023 | 3x21 belt sander | 195. |

Call for Elu products not listed

7 ¼'' Super Saw Cat Model 3047-09 165.

| | | |
|---|---|---|
| 2690 | 7¼" Builder's saw cat | 112. |
| 3051 | 7¼" Worm drive saw | 139. |
| 7790 | 12" DeWalt cont. radial arm saw | 945.* |
| 7770-10 | 10" DeWalt cont radial arm saw | 759.* |

## AEG

Drywall Screwdriver 0-4000 rpm Model SCR2E-2 95.

| | | |
|---|---|---|
| HBSE75S | 3x21 VS Belt Sander | 155. |
| EZ502 | Cordless screwdriver | 59. |
| EZ506 | 3/8" Cordless drill screwdriver | 120. |
| OFS50 | 1 HP plunge router | 169. |

## NORTON

Multi-Oilstone Model 85960-9 99.

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| #2 | 12" JORGENSEN h/screw | 13.00 | 74.00 |
| 3712 | 12" Steel bar clamp | 5.95 | 32.50 |
| 3724 | 24" Steel Bar clamp | 7.35 | 40.00 |

## LEIGH

| | | |
|---|---|---|
| D1258-12 | 12" Dovetail jig, blind & through | 259. |
| D1258-24 | 24" Dovetail jig, blind & through | 309. |

## BOSCH

Var. Speed Var. Orbit Jigsaw 129. Model 1581VS

| | | |
|---|---|---|
| 1582VS | VS, Var orbit jigsaw | 123. |
| 3238VS | VS, Var. orbit std. duty jigsaw | 95. |
| 1654 | 7¼" Builders circular saw | 99. |
| 1500 | 16 guage shears | 205. |
| 1942 | Heavy duty heat gun | 69. |
| 3268 | Std. duty heat gun | 65. |
| 3258 | 3¼" Power plane | 129. |
| 1600 | 2½ HP, D-Handle router | 245. |
| 1604 | 1¾ HP Router | 119. |
| 1606 | 1¾ HP, D-Handle router | 140. |
| 90300 | 3¼ HP Production router | 329. |
| 1609K | Laminate trimmer installer's kit | 169. |
| 1609 | Off set base laminate trimmer | 119. |
| 9164VSR | 3/8" Mighty Midget VSR drill | 99. |
| 1631K | 2-spd Panther recipro saw | 119. |

3 HP Plunge Router Model 1611 198.

| | | |
|---|---|---|
| 1608T | NEW! tilt base laminate trimmer | 99. |
| 1632VSK | VS, Var. orbit Panther recipro saw | 134. |
| 1530 | 14 gauge nibbler | 269. |
| 9166VSR | 1/2" Mighty Midget VSR drill | 109. |
| 1158VSR | 3/8" VSR drill | 59. |
| 1196VSR | 3/8" Hornet II hammer drill | 109. |
| 1198VSR | 1/2" VSR hammer drill | 129. |
| 11203 | 1½" Rotary hammer | 409. |
| 11212VSR | 3/4" VSR bulldog SDS rotary hammer | 185. |
| 11304 | Brute breaker hammer | 1299.* |
| 11305 | Demolition hammer | 659. |
| 1272D | 3'x24" dustless belt sander | 175. |
| 1273D | 4"x24" dustless belt sander | 179. |
| 1273DVS | 4"x24" VS, dustless belt sander | 189. |
| 3270 | 3"x21" dustless belt sander | 129. |
| 1347A | 4½" mini grinder, 5/8" arbor | 85. |

## DELTA

10" Unisaw 1½ HP 34-761 1189.*

| | | |
|---|---|---|
| 32-100 | NEW! Stationary Plate Joiner | 445.* |
| 34-782 | 10" Unisaw, w/unifence 3 HP | 1569.* |
| 34-783 | 10" Unisaw, w/unifence 3PH | 1569.* |
| 43-375 | 2 Spd. wood shaper | 1489.* |
| 33-150 | Sawbuck | 509. |
| 33 050 | Sawbuck II | 549. |
| 33-990 | 10" Radial arm saw | 485.* |
| 11-950 | 8" bench drill press | 125.* |
| 17-900 | 16.5" Drill press | 329.* |
| 28-283 | 14" Wood band saw w/¾HP motor encl. steel std | 625.* |

10" Contractors Saw w/30" Unifence Model 34-445 (table optional) 769.

| | | |
|---|---|---|
| 28-245 | 14" Wood bandsaw w/std., ½hp motor | 465.* |
| 34-444 | 10" Contractors saw, 1½hp | 599.* |
| 22-661 | NEW! DC-33 13" Planer | 999.* |
| 37-154 | 6" long-bed jointer w/electricals | 929.* |
| 37-350 | 8" long-bed jointer w/electricals | 1290.* |
| 31-730 | 6" Belt, 12" disc w/electricals | 969.* |
| 34-985 | Production stock feeder | 575.* |

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WANA, Box 706, Plymouth, NH 03264. (800) 521-7623, in NH (603) 536-3768.
**Festival**–6th annual Spring Fling festival, Apr. 6–8. Nassau Colliseum, Uniondale. Contact Creative Faires, Box 1688, Westhampton, 11978. (516) 288-2004.
**Exhibit**–Discoveries in Folk Sculpture, thru Apr. 15. Museum of American Folk Art, Lincoln Square, Columbus Ave. and 66th St., New York, 10023. (212) 595-9533.

***NORTH CAROLINA:*** **Seminars**–Getting the most out of Computerized Carriage Setworks, Mar. 8–9; Improving Management Performance Through Better Communication, Mar. 27–29. Both in Raleigh. For info., contact NC State University, Box 8003, Raleigh, 27695. (919) 737-3386.
**Exhibit**–American Wildfowl Decoys, Mar. 18–May 12. Folk Art Center, Asheville. Contact Museum of American Folk Art, Lincoln Square, Columbus Ave. and 66th St., New York, NY 10023. (212) 595-9533.
**Juried exhibit**–Pride of North Carolina arts & crafts show, Mar. 30–Apr. 1. Raleigh Civic Center. Contact Gail Gomez, High Country Crafters, 46 Haywood St., Asheville, 28801. (704) 254-7547.

***OHIO:*** **Symposium**–North Coast Woodturners 2nd annual symposium, Mar. 29–31. Coventry High School, 3257 Cormany Rd., Akron, 44319. Featuring turners Al Stirt, Russ Hurt, Cleade Christiansen. For info., contact Dave Hout, 4124 Lake Vista Blvd., Akron, 44319. (216) 644-2232.
**Show**–Greater Cleveland Woodworking Show, Apr. 6–8. I-X Expo Center, 6200 Riverside Dr., Cleveland, 44135. For info., contact Michelle Troop, 1516 S. Pontius Ave., Los Angeles, CA 90025. (213) 477-8521.

***OKLAHOMA:*** **Show**–Woodworking World Show, Mar. 9–11. Myriad Exhibition Hall, Oklahoma City. Contact WANA, Box 706, Plymouth, NH 03264. (800) 521-7623, in NH (603) 536-3768.
**Seminars**–Between Center Turning, Mar. 10. Bowl Turning, Mar. 17. Francis Tuttle Vo-Tech Center, 12777 N. Rockwell, Oklahoma City, 73142. (405) 722-7799.
**Festival**–24th annual Festival of the Arts, Apr. 24–29. Festival Plaza and Myriad Gardens, Oklahoma City. For info., contact Arts Council of Oklahoma City, 400 W. California, Oklahoma City, 73102. (405) 236-1426.

***OREGON:*** **Classes**–Basic through advanced woodworking classes, beginning Jan. 8. Portland. Including bent lamination and woodcarving. Certificate program and part-time training in woodworking available. Contact the Oregon School of Arts and Crafts, 8245 S.W. Barnes Rd., Portland, 97225. (503) 297-5544.
**Juried show**–Artquake, Sept. 1–3. Streets of downtown Portland. Deadline: Apr. 1. For info., contact Catherine Wygant, 7017 S.E. 8th Ave., Portland, 97266. (503) 774-0919.
**Competition**–Table, Lamp & Chair Design regional competition, Apr. 29–May 12. Deadline for entries: Apr. 6. Design workshops in conjunction with show, May 5–6. Contact Lynda Anderson, 2701 N.W. Vaughn St., Suite 608D, Portland, 97201. (503) 224-9178.

***PENNSYLVANIA:*** **Workshops**–Various woodworking workshops, beginning Feb. 24. Including authentic Shaker oval box and carrier seminar, building a Windsor setee, Shaker furniture. Olde Mill Cabinet Shoppe, 1660 Camp Betty Washington Rd., York, 17402. (717) 755-8884.
**Workshop**–Hardwood lumber grading and inspection workshop, thru Mar. 2. Contact Agricultural Conference Coordinator, 306 Agricultural Administration Building, University Park, 16802. (814) 865-8301.
**Exhibition**–5th annual Northeast Wood Product Expo, Mar. 17–19. Hershey Lodge and Convention Center, Hershey. Contact NEWPEX '90, Dame Associates, 51 Church St., Boston, MA 02116. (617) 482-3596.
**Exhibition**–Lathe-Turned Objects: Trends, Transitions, Tradition, Apr. 13–July 15. Woodmere Art Museum, Chestnut Hill. Featuring objects made between 1700 and 1990. For info., call Woodmere Art Museum: (215) 247-0476.
**Fair**–Spring Pennsylvania Crafts Fair, Apr. 29. Featuring the Pennsylvania Craft Guild. Brandywine River Museum, Box 141, Chadds Ford, 19317. (215) 388-7601.
**Juried show**–Studio Days '90, Sept. 21–30. Open to DE, DC, MD, NJ, PA, VA, WV. Entries deadline: Apr. 30. Contact Chester Spring Studio, Chester Springs. (215) 827-7277.
**Competition**–Fish Images: A competition, May 5–June 10. Luckenbach Mill Gallery, 459 Old York Rd., Bethlehem, 18018. (215) 691-0603.

***SOUTH CAROLINA:*** **Juried show**–13th annual Piccolo Spoleto Crafts Fair, June 1–3. Gaillard Auditorium, Charleston. Deadline: Mar. 3. Contact South Carolina Crafts Association, 1314 Lincoln St., Suite 308, Columbia, 29202. (803) 779-8200.

***TENNESSEE:*** **Juried exhibit**–From Here to There: Vehicles for New Forms/New Functions, Feb. 24–May 19. Arrowmont School of Arts and Crafts, Box 567, Gatlinburg, 37738. (615) 436-5860.
**Workshops**–Various workshops including woodturning, coopering, bowl and plate turning. Beginning Mar. 5. Contact Arrowmont School of Arts and Crafts, Box 567, Gatlinburg, 37738. (615) 436-5860.

***TEXAS:*** **Show**–Woodworking World show, Mar. 2–4. Pasadena. Contact WANA, Box 706, Plymouth, NH 03264. (800) 521-7623, in NH (603) 536-3768.
**Juried exhibit**–15th annual Texas Crafts Exhibition, Apr. 7–8. Austin Winedale Historical Center. Contact the University of Texas at Austin, Box 11, Round Top, 78954. (409) 278-3530.

***UTAH:*** **Show**–Utah Woodworking show, Apr. 27–29. Salt Palace, 100 S.W. Temple St., Salt Lake City, 84101. Contact Michelle Troop, 1516 S. Pontius Ave., Los Angeles, CA 90025. (213) 477-8521.

***VIRGINIA:*** **Show**–Metro-Richmond Woodworking show, Mar. 30–Apr. 1. Richmond Centre, 400 E. Marshall St., Richmond, 23219. Contact Diane Johnson, 1516 S. Pontius Ave., Los Angeles, CA 90025. (213) 477-8521.

***WASHINGTON:*** **Classes**–Boatbuilding classes, beginning Mar. 7. Northwest School of Wooden Boatbuilding, 251 Otto St., Port Townsend, 98368. (206) 385-4948.
**Classes**–Various boatbuilding classes, beginning Mar. 17–25. Center for Wooden Boats, 1010 Valley St., Seattle, 98109. (206) 382-2628.

***WEST VIRGINIA:*** **Class**–Chip Carving, Apr. 23–29. Augusta Heritage Center, Davis & Elkins College, Elkins, 26241. (304) 636-1903.

***WISCONSIN:*** **Exhibition**–Reseated, Mar. 4–May 13. Featuring works that use the chair as medium, subject matter and/or object. Contact Reseated, Exhibitions Dept., JMKAC, Box 489, Sheboygan, 53082. (414) 458-6144.
**Juried show**–18th annual Festival of the Arts, Apr. 8. Stevens Point. Contact Brenda Gingles, Festival of the Arts, Box 872, Stevens Point, 54481. (715) 341-7543.

***CANADA:*** **Meetings**–Canadian Woodturners Assoc. meetings, throughout the year. Second Tuesday of each month. Contact Bob Stone, Box 8812, Ottawa, Ont., K1G 3J1. (613) 824-2378.

***ENGLAND:*** **Exhibit**–Touring craft exhibit, featuring woodworking, thru Mar. 25. Crafts Council Gallery, 12 Waterloo Pl., London, SW1Y 4AU. 01-930-4811.


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| 351 | 3x21 BELT SANDER | 128 |
| 361 | 3x34 BELT SANDER | 167 |
| 363 | 4x24 BELT SANDER W/O BAG | 179 |
| 504 | 3x24 BELT SANDER XHD | 329 |
| 505 | 1/2 SHEET FIN. SANDER | 105 |
| 520 | 3 HP ROUTER | 314 |
| 621 | 3/8" VSR DRILL | 99 |
| 5116 | OMNIJIG | 268 |
| 7310 | 5.6 AMP LAMINATE TRIMMER | 85 |
| 7334 | RANDOM ORBIT FIN. SANDER | 123 |
| 9118 | PORTA-PLANE KIT | 185 |
| 9629 | VAR. SPEED TIGER SAW KIT | 140 |
| 9647 | TIGER CUB RECIP. SAW | 116 |
| 9850 | 12V CORDLESS DRILL KIT | 136 |
| 97310 | LAMINATE TRIMMER KIT | 190 |

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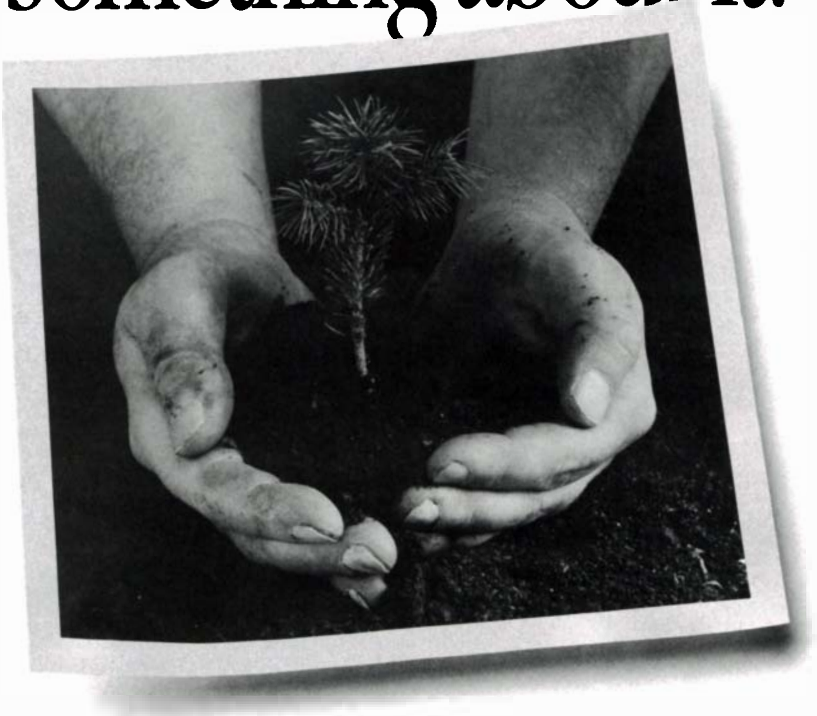

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**Router Projects for the Woodworker** by Brian J. Davies. *Stobart & Son Ltd., 6773 Worship St., London EC2A 2EL, England; 1988. paperback; 173 pp.*

In *Router Projects for the Woodworker*, a project is the subject of each chapter. Each project does employ the router to some extent. There are examples of template work, piloted trimming, circle cutting, lettering, overhead routing, table cutting, splining, boring, complementary routing and making a router table.

The examples in the book are unusual and sometimes involve very sophisticated woodworking, (i.e. triple miters, half-lap lattice, complementary template work, etc.). However, little attention is paid to router safety and some of the operations are dangerous (i.e. on-edge work and bit trapping). Additionally, there are instances where the setups for a "one-off" simply don't justify the complication or could be more easily done on another tool. In general, the photos and drawings are scanty and confusing.

The router today, with all its accessories, tool bits, jigs and fixtures, really makes woodworking a simple machine process. This book imposes a lot of handwork on the reader—exactly what the router is supposed to eliminate. Almost all of the routing is done with the Elu plunge router, although there is one example using an old fixed-base Stanley. The router table is designed to be used with a Black and Decker Workmate. The fixturing, materials and hardware for the table are, in my opinion, underdimensioned and underrated.

There are many interesting projects in this book and some good reading on the history of the pieces, selection of materials and woodworking in general. But the reader will learn little about the use, jigging, fixturing, selection or safe handling of routers. *—Pat Warner*

**Wood Repair, Finishing, Refinishing** by Allan E. Fitchett. *Albert Constantine & Son Inc., 2050 Eastchester Road, Bronx, N.Y. 10461; 1989. $9.95, paperback; 130 pp.*

Allan Fitchett is a fixture at Constantine's. An amateur woodworker, he began hanging around there at some point in the past, asking questions, helping out. He became a source of advice for customers, and he currently directs Constantine's education programs.

This book is too short to encompass everything in depth, but it's an excellent overview of techniques and materials, both old and new. Although some of Constantine's own products appear in these pages, you can get almost any material mentioned at the corner hardware store. Fitchett is full of basic, good advice and pays special attention to safety. He notes, for example, that we cannot trust our own senses to evaluate the toxicity of a chemical—mild-smelling epoxy fumes are very toxic, while sharp-smelling acetone is only mildly toxic. He's a great advocate of reading warning labels, and also points out that listed contents and directions may change as products are improved or modified.

Fitchett has kept in touch with real repair and finishing problems. By breaking down jobs into their separate parts, he makes the work clearly understandable. In fact, there are working "schedules" for a variety of projects. Followed step by step, the schedules will see the novice through almost any job.

The cover may be silly—Fitchett in vivid, spanking-new clothes, aimlessly wire-brushing one part of an old chair while simultaneously inserting three back spindles with his other hand. But you know what you can't tell a book by. *—Jim Cummins*

---

*Pat Warner is a designer and furnituremaker in Escondido, Cal. Jim Cummins owns a framing shop and lives in Woodstock, N.Y.*


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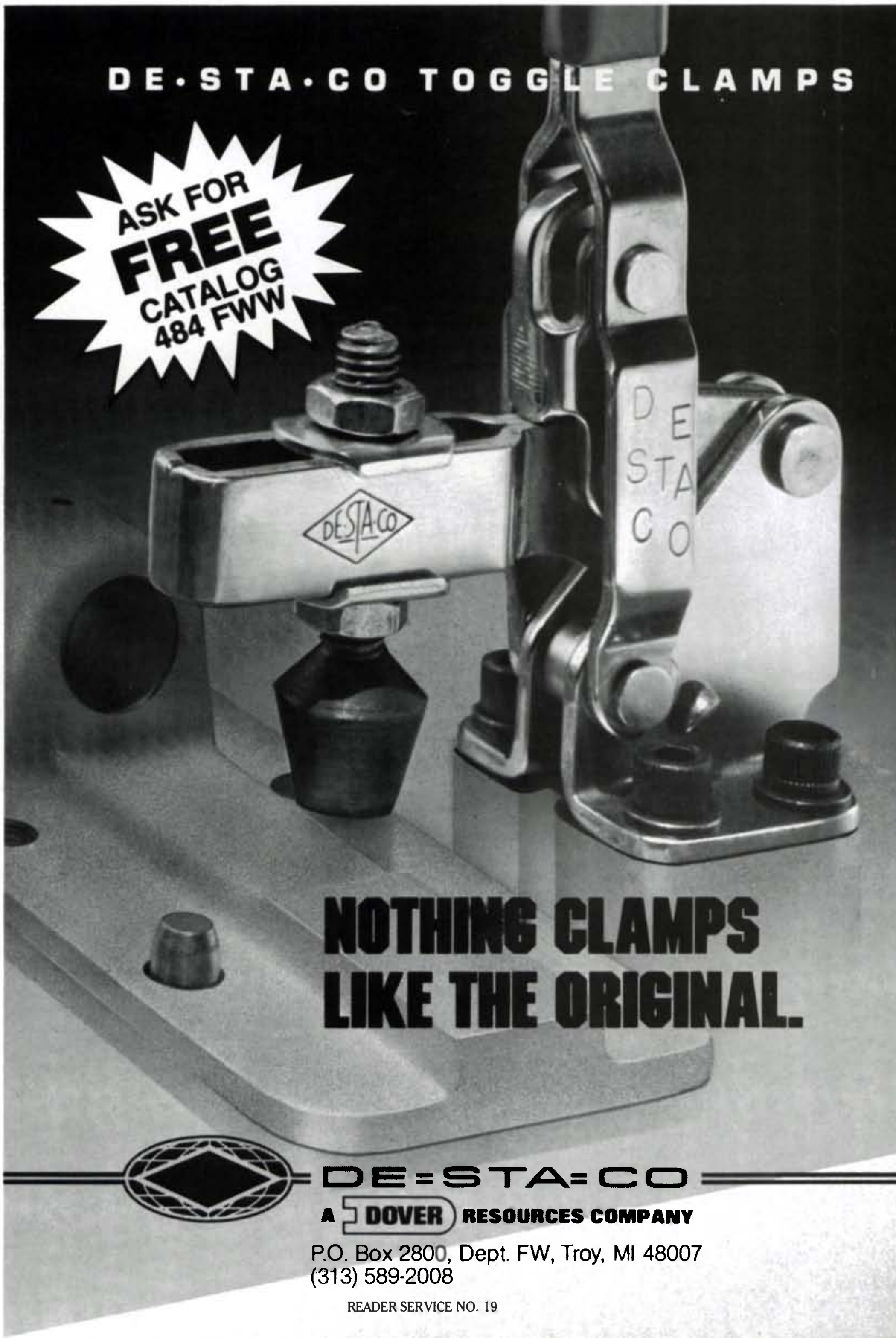


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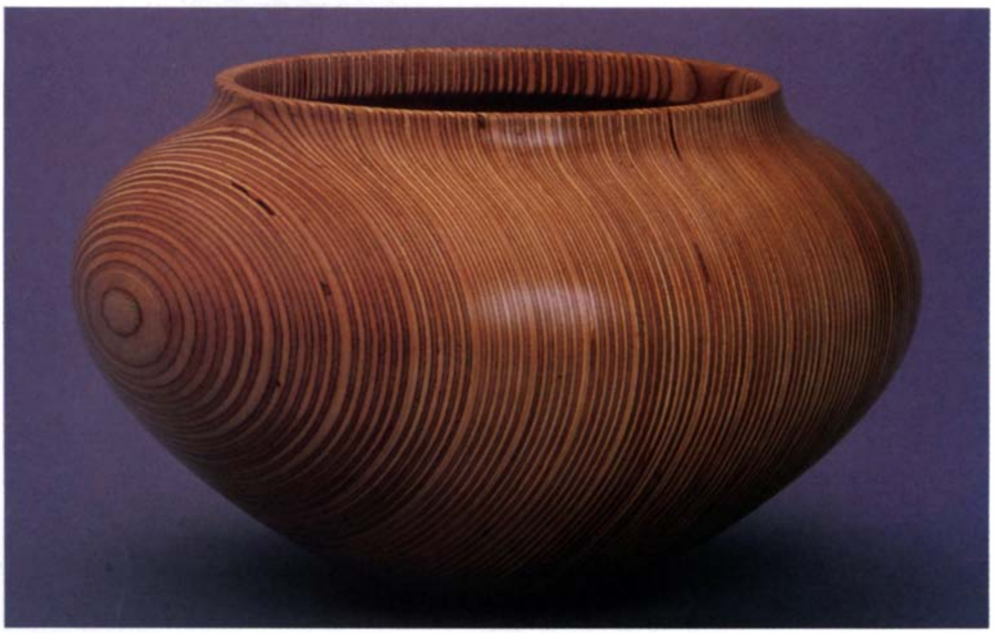
Photos this page: Steven Keull

*Rude Osolnik's trademark candlesticks in macassar ebony, which range in height from 14¼ in. to 6¼ in., shown above, evolved from an early 1950 design and in 1955 received the Award of Good Design from the Furniture Association of America. Although Osolnik first started turning laminated Baltic birch plywood in the mid-1960s, the 7-in.-high by 7½-in.-dia. bowl, shown below, was turned in 1988. A pioneer in turning natural-edge bowls, the 75-year-old Osolnik demonstrates that he has not lost any of his finesse at the lathe in the 5¾-in.-high by 6½-in.-dia. cork oak bowl turned in 1987, shown at left.*



# Osolnik retrospective—50 years of turnings

In 1937, Rude Osolnik took a job teaching industrial arts at Berea College, in Berea, Ky. He was to become an important figure in the transition of American crafts, from work based on traditional folk skills and forms to contemporary production, which welcomes experimentation in design and technique. Last October, the Southern Highland Handicraft Guild (SHHG) recognized his achievement with a 50-year retrospective exhibit at the Folk Life Center in Asheville, N.C.

Although Osolnik is a versatile woodworker, his greatest impact has been in the field of turning. Composing freely on the lathe, he has wedded a classical sense of form and proportion to the modern aesthetics of straightforward simplicity, thereby invigorating and updating a long-practiced craft.

Several of his designs have entered the craft culture as woodturners' standards. His dried-flower vases served as prototypes for self-taught turners trying to support themselves at craft fairs in the '70s. He was one of the first turners to loosen up form and use natural edges. And his use of birch plywood and inlaid veneer accents have been an inspiration for the dazzling array of techniques and materials showing up in contemporary work.

The oldest piece in the SHHG exhibit is an onion-shape alabaster vase made in 1939. A 1985 vase in salt cedar echoes that form. Pieces representing every phase of Osolnik's career are in the exhibit, including an oval tray from 1975, when he and a friend had a machine shop fabricate an oval-turning lathe they had invented. Another characteristic form, the tulip-shape bowl, looks elegant in all sizes and species, and free-form bowls from the '50s and '60s appear next to more recent natural-edge vessels, as shown in the middle and bottom photos at left. The exquisite hour-glass shape candlesticks, shown in the top photo at left, something of a signature piece for Osolnik, are represented here in macassar ebony.

Far from relaxing in recent years, the 75-year-old Osolnik has continued in new directions. A 2-ft. by 1-ft. salad bowl in mahogany is almost too big to be functional. And now that the market for natural-edge bowls is here, he's contributing his vocabulary of forms and techniques. A footed sphere in cork oak still has the bark on it. In another piece, two little pink ivory wood bowls from 1987 rise like soda glasses from small button feet.

The Osolnik retrospective shared gallery space with a touring selection from the International Turned Objects Show (ITOS), the current survey of the field put together by Albert LeCoff and the The Wood Turning Center in Philadelphia, Pa.

"Rude's the epitome of the all-around turner," LeCoff said at the opening. "One-of-a-kind, production, they're all great; he gives the same attention to all. He's a master of

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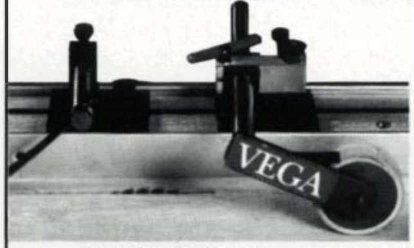


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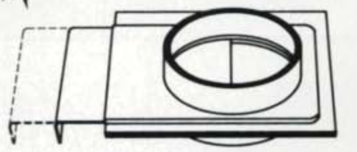

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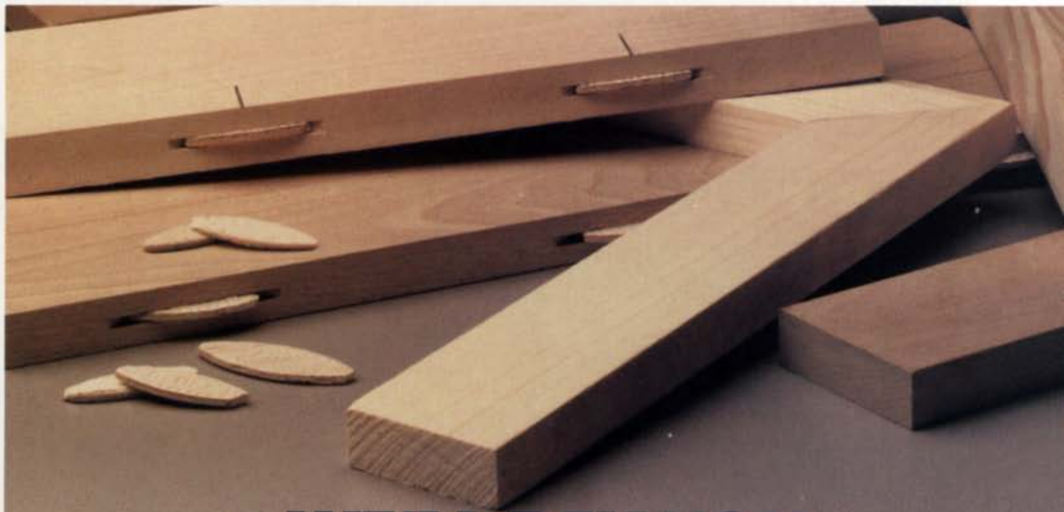

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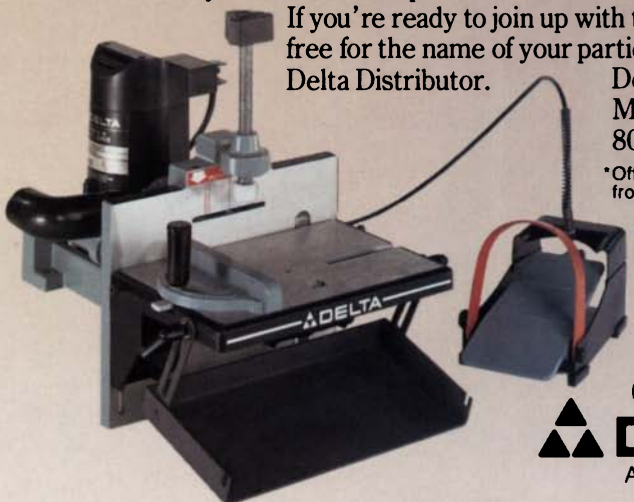


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form—no one can control form better. He pioneered woodturning in the South. And it was all done by legwork—demonstrating and word of mouth. He's never gotten media attention or sought it. He wasn't trying to make a name for himself. He really *loves wood*."

It is appropriate that the SHHG is sponsoring the exhibit, since Osolnik has been a strong force in the Guild for many years. "He was a mainstay for the Guild Fair all during the '60s and '70s," says Guild Director Jim Gentry. "During his tenure as treasurer, we developed our financial system. He was president of the board when they hired Bob Gray, previously the director of The Worcester Center for Crafts, Worcester, Mass., who served as director from 1961 to 1981 and brought in the current standard of professionalism."

Another admirer of Osolnik's is turner Stoney Lamar of Saluda, N.C. "The retrospective demonstrates Rude's idea of tradition as change, which is what the SHHG has done," he says. "Especially in the South, a lot of people think tradition is tradition, but for 60 years now, Rude's been showing that a vital tradition moves forward. He's made us possible."

Osolnik's capacity for hard work is legendary. "I used to teach from 7 a.m. to 5 p.m.," he says. "Then I'd get up at 2 a.m. and work on the lathe until 6 a.m. Even now I don't need more than four-hours sleep a night." This energy has led to long production runs of some items; he estimates that he's made more than 100,000 candlesticks. Yet careful attention is given to each one so that the gracefulness of the curve is maintained.

Unifying production work-rates with one-off care and design is a principle with Osolnik; he believes that everyday items should be well designed and beautiful and that such pieces will enhance the user's life. "I started turning in 1927," Osolnik says, "and I get just as much fun out of it now as I did when I started." In *Lathe-Turned Objects,* the ITOS catalog (available from The Wood Turning Center, Box 25706, Philadelphia, Pa. 19144), he writes: "My woodworking is a labor of love. It gives me a feeling of being in church, or in God's presence, when taking a piece of wood and making something out of it... I am at peace with the world when working with wood."

*—Fletcher and Carol Cox, Tougaloo, Miss.*

EDITOR'S NOTE: "Rude Osolnik: A Retrospective" is touring for two years and some dates are still open. A catalog of the retrospective featuring full-color photos of 50 objects, with essays by world-renowned woodturner Dale Nish and Donald C. Peirce, curator of decorative arts at the High Museum of Art in Atlanta, Ga., is available for $11 from the Southern Highland Handicraft Guild, Box 9545, Asheville, N.C. 23305.

Photo: Rickey Yanaura

*Above: Craig Nutt's 24Hx28Wx18D table, with a padauk top and a base finished with oil paints, heralds the dawning of the age of asparagus. Below: Chad Voorhees constructed this silver chest, 36½Hx25Wx20D, from quilted maple and macassar ebony.*

Photo: Clay Aigeo

## Woodworking grants

Two of the 10 artists selected to receive Southern Arts Federation/National Endowment for the Arts Grants in 1989 are furnituremakers. Craig Nutt and Chad Voorhees were each awarded $5,000 in recognition of their woodworking talents. Both Nutt and Voorhees were featured in one-man shows by the Great American Gallery in Atlanta, Ga.

Craig Nutt is an Alabama woodworker who has had a longtime fascination with vegetables, both as a consumer and grower and as a member of the now-defunct Raudelunas Marching Vegetable Band.

The "Vege Table," shown in the top photo at left, is a natural evolution of Nutt's vegetable fantasy to furnituremaking, which has been the major focus of his work since graduating from the University of Alabama in 1972. Cayenne peppers, asparagus and carrots make remarkable table legs. Historical references can also be found in Nutt's tables. A stalk of asparagus bent just right bears an uncanny resemblance to a Queen Anne cabriole leg. Trained in traditional cabinetmaking techniques, Nutt combines craftsmanship with the off-beat and the absurd to create pieces of furniture that are functional, sculptural and enjoyable.

Voorhees draws his inspiration from time he spent at the Shakers' settlement in Mt. Lebanon, N.Y. The utilitarianism of Voorhees' Shaker designs emphasizes the beauty of wood with high-quality craftsmanship, as shown in the bottom photo at left. Traditional joinery worked into pleasing forms that are sparingly decorated create an overall sense of refinement. Departing somewhat from the Shaker tradition, the fanciful legs and exotic wood inlays of the North Carolina woodworker's more recent works reflect the training he received at Virginia Commonwealth University, where he received a bachelor of fine arts while studying sculpture and furniture design.

*—Pamela Leonard, Atlanta, Ga.*

Photo: Kathryn Fox

*This collection of braces was just one of many such exhibits seen by the 200 members attending last year's annual meeting of the EAIA in Dearborn, Mich.*

## Tool collectors congregate

Tool collectors from all over the country congregated at the Henry Ford Museum in Dearborn, Mich., last year to show off, talk about, use, buy and sell old tools. The annual meeting of the Early American Industries Association (EAIA) attracted nearly 200 members with varying interests in antique tools, from private collectors to managers of museum collections and antique dealers. Many of the members are also actively engaged in the crafts, either making reproductions of traditional tools or actually putting them to use.

Malcolm MacGregor, a professional woodworker in Durham, N.H., who specializes in reproducing 17th- and 18th-century furniture, falls into this latter category. MacGregor's demonstration of making complex molding patterns with hand molding planes was one of the highlights of the May meeting. MacGregor explained that even in the old days most woodworkers didn't have a plane for every molding pattern, so he showed how simple molding planes could be used to reproduce complex patterns. After sketching the pattern on the end of the board, he planed

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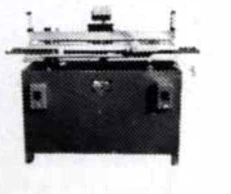

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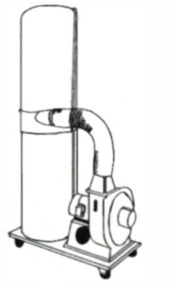

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## INDEX TO ADVERTISERS

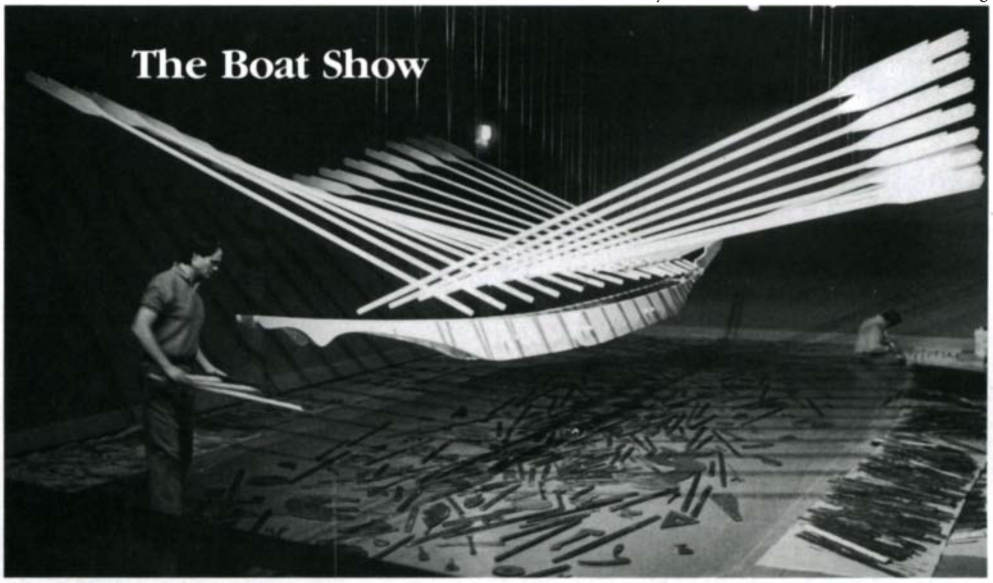
small V-grooves and then proceeded to connect the grooves with various curves and molding profiles. In a matter of minutes, he had planed a 2-ft. length of a complex molding. When called upon to produce more than one length of molding, he makes each cut on every board before going on to the next cut, to ensure that the profiles will all match.

Between demonstrations, members were treated to tours of some of the historic buildings that make up the Henry Ford Museum, such as the conservation department, where a Concord coach was in the process of being carefully restored, and Noah Webster's house that was moved to Dearborn from New Haven, Conn., in 1937, but was only recently restored.

The EAIA publishes *The Chronicle,* a quarterly journal that contains articles about all sorts of early technology. Members also receive a bimonthly newsletter and have access to the organization's library of books and films. Recently the EAIA began offering tours to Europe that take members and their guests to places that display traditional crafts and antique tools.

This year's annual EAIA meeting will be held from May 17 through 19 in Mystic, Conn. For more information, write EAIA, c/o John Watson, Box 2128, Empire State Plaza, Albany, N.Y. 12220.—*Kathy Fox, Summit, N.J.*

Photo: Courtesy of National Museum of American Art/Gene Young




*The boat has played a prominent role in mythology, religion, literature and art. From Egyptian burial barges to today's science-fiction spaceships, the image of the boat has been used as a poetic device to transport mankind imaginatively to distant realms. Artists' interpretations of ships and voyages were shown at "The Boat Show: Fantastic Vessels, Fictional Voyages," which concluded last winter at the Renwick Gallery, National Museum of American Art, Smithsonian Institution in Washington, D.C. Larry Kirkland's "Soulboat," shown above, is based on his experiences in the Far East. The hanging sculpture was inspired by Southeast Asian fishing vessels and canoes that incorporate human forms as well as Oriental ideas of the soul's journey to the afterlife as a voyage by boat. Kirkland says, "My man/person/boat is the recently departed spirit. To me, the moment the body dies and the new journey begins must be like the second a bird takes flight...a great upward rush of wing."*

## E. Carlyle Lynch Jr. 1909-1989

E. Carlyle Lynch, whose splendid drawings and instructional articles have been part of *Fine Woodworking* magazine for more than 10 years, died Dec. 12 at age 80.

Lynch's articles always had a loyal following among our readers, because he was not only a master draftsman who devoted much of his life to measuring classic antiques at places like Old Sturbridge Village in Massachusetts or the Museum of Early Southern Decorative Arts in Winston-Salem, N.C., but he was also a highly skilled builder who reproduced many of the pieces himself. And when he measured a piece, it was with the craftsman's eye, searching for those little details that would help him explain how the original maker had done his work.

I first met Carlyle shortly after I started working at the magazine six years ago. I had long admired his work, but didn't know enough about period furniture to fully understand how good it was. Carlyle must have sensed what a novice I was, but instead of criticizing or complaining, he just started teaching me. The teacher role was familiar to him, since he had founded the industrial arts program at Lexington, Va., High School and later taught at the high school in Broadway, Va., where he lived. Along the way, he was a furniture designer for the highly regarded Craft House in Harrisonburg, Va.

He continued to teach me a lot over the years, but the teacher soon became more of a friend as he shared his great love for the South, especially Virginia's Shenandoah Valley, and its craftsmen and antiques. And there was something else—perhaps his humor and wit or his concern for others or his elegant Southern manners—that made you sense he had mastered the craft of living well as thoroughly as he mastered the craft of working with wood.

He is survived by his wife, Jane McDowell Lynch; two sons Ernest C. Lynch III of Charlotte, N.C., and E. Houston Lynch of Harrisonburg, Va.; a daughter, Linda Lynch Cechura of Moedling, Austria; a step-daughter, Carolyn Craig Williams of Charlottesville, Va.; a sister, Elizabeth Lynch McShane of Rocky Mount, N.C.; and four grandchildren.

* * *

Lynch left a legacy of more than 100 measured drawings, many of which are available from Garrett Wade or Woodcraft Supply and in Canada from Lee Valley Tools.

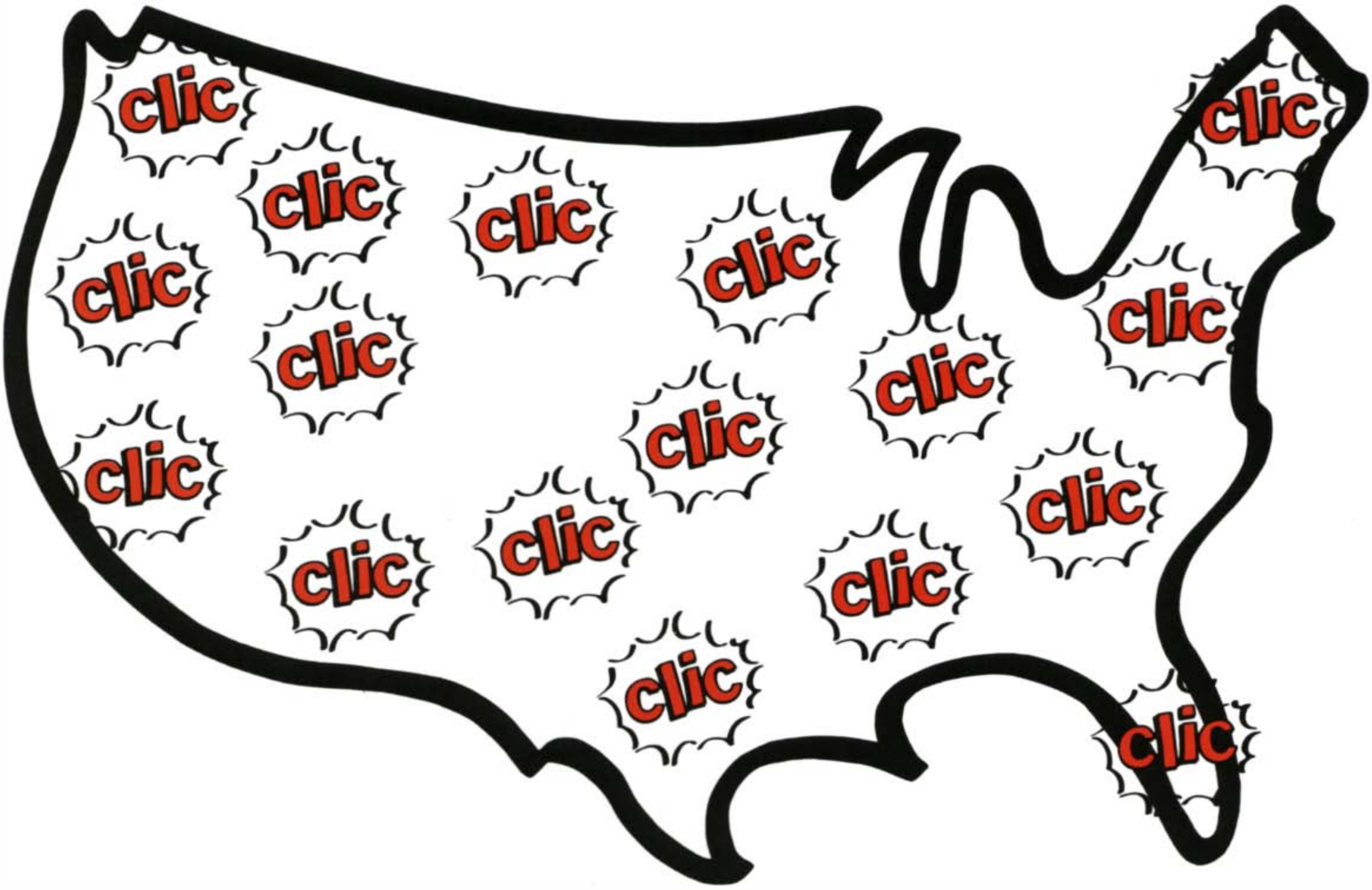
Shortly before his death, he completed work on his last article, this one describing how to build a chest-on-chest (see p. 76 of this issue) based on designs by the prominent 18th-century Charleston, S.C., cabinetmaker Thomas Elfe. Lynch's previous *FWW* articles include building a post-office desk (*FWW* #73, p. 72), making a wooden lathe (*FWW* #57, p. 44), building a southern huntboard (*FWW* #39, p. 74) and making a Hepplewhite bureau (*FWW* #48, p. 42).

—*Dick Burrows*

*The late Carlyle Lynch shown measuring a drawer on a tool chest made by Duncan Phyfe in New York City.*

### Notes and Comment

*Got an idea you'd like to get off your chest? Know about any woodworking shows, events or craftsmen of note? Just finished a great project? If so, we'd like to hear about them. How about writing to us? And, if possible, send photos (preferably with negatives) to Notes and Comment,* Fine Woodworking, *Box 5506, Newtown, Conn. 06470-5506.*

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# HIGH IMPACT, LOW RELIEF

Rick Harney's free-standing bas-relief carvings delight and trick the eye. His portraits appear three-dimensional and lifelike, but they are actually carved into boards that are ¾ in. to 1¾ in. thick. His works are based primarily on photos found in old family scrapbooks and include "Louie," above right, which is 24Hx14Wx1¾D basswood; "Sunning," top left, which is 29Hx25Wx1¾D jelutong; and "Einstein," bottom left, which is 36Hx14Wx¾D pine. Finished pieces are oiled, varnished and colored with layered washes of artists' oil paints. Harney, who lives and works in Normal, Ill., began sculpting fiberglass in 1975, but in 1985 health problems forced him to give up polyester materials and he began carving his portraits in wood.