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Photo: Ed Walker

Ed Walker tells how to build a drop-in router table with a dust-collection chute on p. 56. Cover: Tony Konovaloff displays his hand-tool storage chest (article on p. 62). Cover photo: Gary Weisenburger.

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Top-notch woodworkers reap profits

Electromagnetic radiation from shop tools—As some *Fine Woodworking* readers may be aware, there is increasing evidence that extremely low-frequency electromagnetic radiation (ELF-EM) causes biological effects at the cellular level. Some epidemiological studies also implicate ELF-EM in the genesis of certain types of cancers of the blood and nervous systems, although evidence for this is less clear. At this time, there are no official standards for safe exposure to these low-frequency EM fields.

As an amateur radio operator, I was curious about my exposure to these ELF-EM fields while transmitting, and so I obtained an ELF gauss meter (model SE16 from TRA Instruments; 800-582-3537) to make some measurements. The results indicated that there was no significant exposure from the radio equipment. However, other measurements made around the house and shop were startling.

The highest readings obtained came from motors in my woodworking shop. The TRA meter suggests that readings below 3 milligauss are acceptable. In order to be in this "safe" range, I would have to stand 1.23 meters from my 1/4-HP 1-in.-wide belt sander and 1.3 meters from my radial-arm saw. The motors of my drill press and shop vacuum had magnetic fields about half as strong. When I took readings at the tools' operating positions, the gauss meter went off scale—higher than 24 mG. By way of contrast, a reading of 16 mG was obtained standing directly under a 138,000v power line.

Woodworkers concerned about the possible health effects of ELF-EM fields should minimize their exposure to the fields generated by electric power tools. My measurements indicate that a wide variation in magnetic fields from different motors is not directly a function of motor power. Perhaps we as woodworkers should encourage manufacturers to minimize stray magnetic fields by better motor design.

—Stephen Peterson, Ph.D., Salt Lake City, Utah

Safer sphere-boring—The technique for drilling centered holes in spheres, illustrated in the "Methods of Work" section in *FWW* #88, p. 18, strikes me as inherently unsafe. I have seen what a drill bit can do to a hand, and the result is not pretty. To improve the method, bore a hole of the proper diameter through two jig boards. Position one of the boards on the drill-press table with its hole centered under the bit. Then set a couple of spacer cleats on this board, and place the wooden sphere on the hole. Next, place the second jig board on top of the sphere, and you can hold the sphere in place without endangering your hands.

—Mark G. Carls, Juneau, Alaska

Retrieving ball bearings—On p. 14 of the March/April issue, Jack Howard suggests cracking a ball bearing in a vise to retrieve balls for use in locating mating dowel holes. I would like to point out that it is very dangerous to crack a ball bearing in a vise because the outer case is very hard tool steel and very brittle.

When the outer case cracks it will shatter; shards from the outer case, as well as the balls, will fly all over, and there is a good possibility that one of these flying missiles will hit you in the eye or somewhere else on your body. To make this method safe, wrap the bearing in a cloth before cracking it in a vise; this way, all the pieces, including the balls, will remain in the cloth.

—C.D. Forman, Harare, Zimbabwe

Comments on book review—I have two criticisms of Steve Loar's review of Michael O'Donnell's book *Woodworker Guide to Woodturning* (*FWW* #87, p. 118). Loar is disparaging of the theory contained in the book; he describes it as "formidable and nearly impassable." Whether Loar is referring to its content or to its presentation is not clear, but if there are to be continuing developments in understanding woodturning and its techniques, we need more, not fewer, theoretical writings.

The main and unique feature of O'Donnell's book is its promotion of the deep-fluted bowl gouge as the preferred tool for spindle turning in addition to its usual role in bowl turning. On p. 82, O'Donnell states, "My choice of tool, where possible, is the deep-fluted gouge, which, as we have seen, will do almost anything." Loar fails to notice, let alone discuss, this central and contentious issue. —Mike Darlow, Chippendale, N.S.W., Australia

In search of the natural beauty of wood—There seems to be some confusion in the world of woodworking. Many times we have heard artisans explain that the "simple, unadorned" shapes of their work "allow the natural beauty of the wood to show." Readers of this magazine are very familiar with this ideal, which has been the conceptual backbone of most quality wood design for many years, probably since World War II. This is a sensible attitude, and it has most likely saved more than a few slabs of exotic wood from being transmogrified into hideous specimens of trendy junk. Especially in these days of high prices and deforestation, it seems almost moral to make something "pure and simple."

The conscious effort of doing one's best to both unveil the beauty of wood and to do it no harm is certainly commendable. But the people who pursue these goals have come to accept a very limited view of the beauty of wood. Wood has three dimensions, each one different and dynamic, and deep carving can free this tangible loveliness. Why is it then that the smooth, unadorned surface has come to represent the "natural beauty?" Is it because of some residual ancient snobbery that places the painter, a two-dimensional artist, higher in the pecking order than the sculptor, a three-dimensional artist? And what of the beauty of wood basking in the soft glow of bronze or standing proudly in violent contrast to chromium? If you wish to unleash the wild figure of some untamed log, there is no need to square it up, box it up and put it on a shelf. Scents are extinguished, muscular fibers are put out to pasture, curves are flattened, and fabulous allegorical creatures made of knots and twisting grain

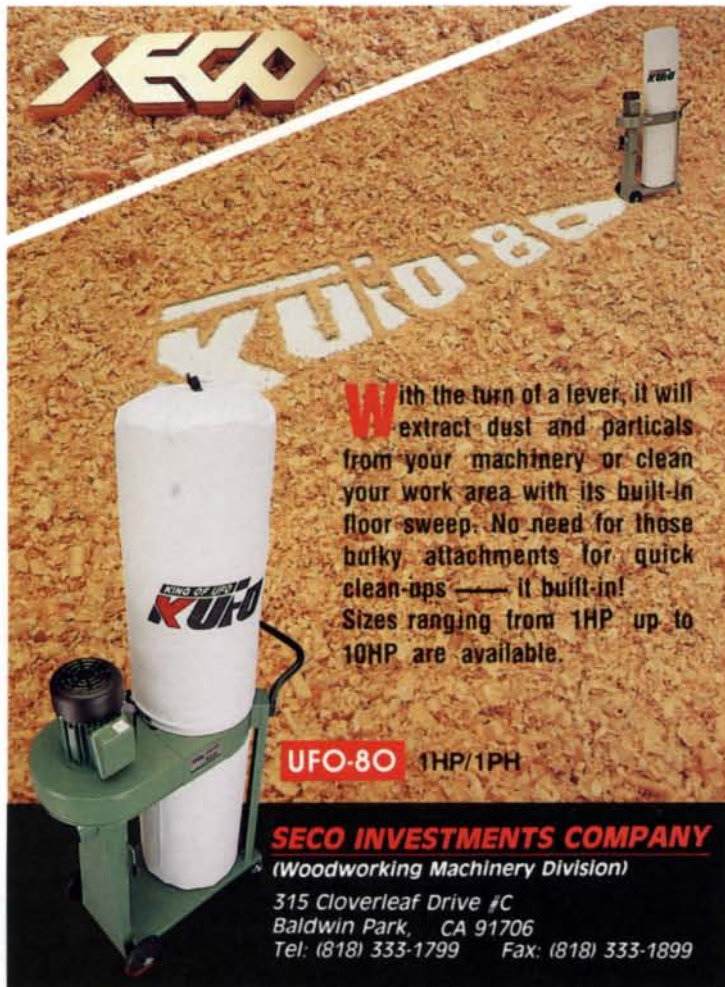
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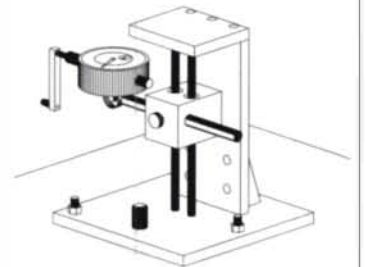
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are beaten into rectangular submission—all in the name of natural beauty. Of course, machined surfaces and right angles have their place and their own strangely natural beauty; just take a look at a salt crystal. We must continue to explore, but with caution and ability. Warning signs abound; the recent deluge of "art-iture," much of which is questionable art and worse furniture, can provide some entertaining examples of what happens when a fellow goes mountain climbing but leaves his pants at home.

—Cameron Bobro, Oakland, Cal.

Sexless woodworking—I'm a female woodworker. If you ever feature my work, I want to be sure that it is in your magazine because of its superb execution—not because of my sex.

You're doing just fine dealing with women by hardly dealing with us at all. But don't get into the quota system. Don't let a few shrill voices push you into self-consciousness on the issue. There is no issue. Woodworking has no sex. A friend of mine, a male woodworker, said, "You know, if it hadn't been for those letters about more female representation, I would hardly have noticed that a woman was on the cover of issue #88." Those complaining women have robbed Judith Ames of a little bit of her triumph. She'll always have to wonder if she was featured because she is a woman.

As for the problems women report with tool handling, I suggest that all women work—hard. Load bales in the hay field, handle heavy sacks, lift lumber, double-dig garden beds, nail siding. If all the exercise you get is guiding a router, no wonder you have trouble. Most women simply don't work enough to develop muscle. I am 51 years old, 5-ft. 3-in. tall, weigh 120 lbs., and have small bones and tiny hands. I have little trouble with tools, power or otherwise. My husband does have the advantage in speed

and stamina due to his years of harder work and his heavier weight, but I work fine at my own pace.

—Julia Williams, Somerset, Va.

Sawmill salvage—In response to Earle H. Haffa's letter on salvaging wood in *FWW* #88, I agree that salvaged wood is an excellent way to get inexpensive lumber, but salvaging wood—pulling nails and slivers—can also be a lot of work. I have found an easier way to salvage lumber. Sawmills will almost always have "planer outs." On the large scale of a mill, it is not economically worth recycling these boards of varying widths and thicknesses, but for an individual woodworker, these boards can be a gold mine. I have purchased enough pine planer outs to completely fill my half-ton pickup for a mere \$60.

In addition, sometimes a sawmill will have a batch of one species going through the mill and an odd log of another species will get in the flow. Rather than spend the time and money to sort and grade this lumber, it just gets tossed into a pile. I purchased enough red oak, maple and poplar, all of which the mill called firewood, to overload my pickup for \$75. Certainly some of this wood is checked and split; basically you've got to take what you can get. However, with a little creative milling, I've acquired quite a nice stock of lumber. On my limited budget, buying wood in this way enables me to build much more than I otherwise could.

—Mark A. Judd, Geraldton, Ont., Canada

Cove moldings and dial calipers—I'd like to offer a few comments about a couple of articles in *FWW* #87. First, and most importantly, the position of the angled fence used for cutting cove moldings on the tablesaw shown in the drawing on p. 51 is potentially quite dangerous. The fence should be on the near

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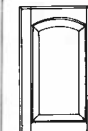
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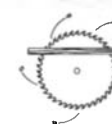


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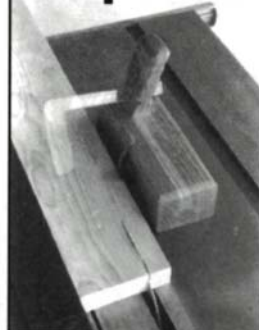


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side of the work, *not* the far side. As shown, the cutting force from the blade will tend to push the work away from the fence and *into* the blade, causing the molding-up-the-nose effect. If the fence is on the near side of the work, the saw's force will tend to hold the work against the fence—a much safer situation. However, even when the fence is positioned properly, it is still very important to hold the work firmly down on the saw table when sawing cove moldings.

As correctly pointed out in the article, you should take very light cuts with each pass. In addition, depending on the shape of the cove that you're making, you may want to consider hogging out some of the material with a few passes over a dado set, doing normal straight ripping, and then cleaning up the shape with angled cove-cutting.

Second, I thought that Robert Vaughan's article on dial indicators and calipers was very well done and useful. But I have a few things to add by way of clarification.

Under the subheading of "general machinery setup," Mr. Vaughan describes using an indicator to calibrate how much movement of a machine occurs with one turn of a handwheel. Readers should beware that in some machines, particularly table-saws, the up-and-down motion of the blade is *rotary* motion, and the component of pure vertical motion (determining depth of cut) per handwheel turn will not be the same at all blade heights. When the handwheel is coupled to the output motion with a rack and pinion, as in drill-press quills, there is no problem.

Later in the same section, Vaughan describes checking for an out-of-round pulley by placing the indicator against the *side* of the pulley. Runout detected this way would be caused by the pulley not being perpendicular to its shaft (or by a thickness variation, which might have no ill effect), but not by being out of

round. Runout measured at the outer edge of the pulley could be caused by the pulley truly not being round *or* by being perfectly round but not concentric with its bore.

When checking to see that a tablesaw's miter slot is parallel to the blade, you should mark a point on the blade, and then measure to the mark in both the forward and rear positions, to eliminate a false reading due to a warped blade. In other words, when you move the dial indicator from front to rear along the miter slot, rotate the blade also so that you measure to the same point on the blade.

Finally, I have to disagree with the idea of purposely setting the rip fence so it is not parallel to the blade, but instead is a little farther away from the blade at the fence's back end. When you set the fence out of parallel, you are asking for trouble if you ever need to use the fence on the other side of the blade. Sawblades have their teeth set in order to provide work clearance; misaligning the fence should be avoided.

—Abijah Reed, Newton Centre, Mass.

How strong is strong enough?—When I see such solutions to door-frame construction as Joseph Beal's article on dowel-strengthened joints (FWW #86, pp. 76-79) I have to ask, "How strong is strong enough?"

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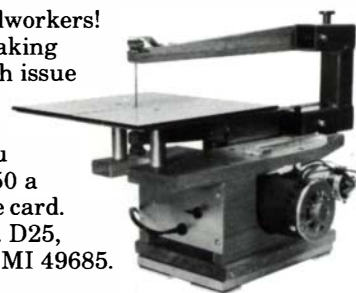
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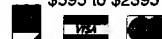
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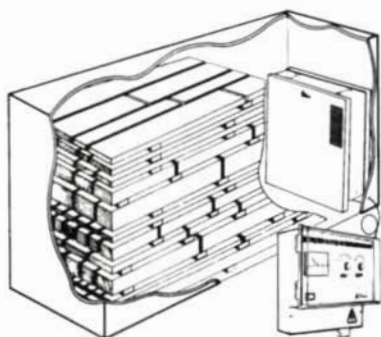
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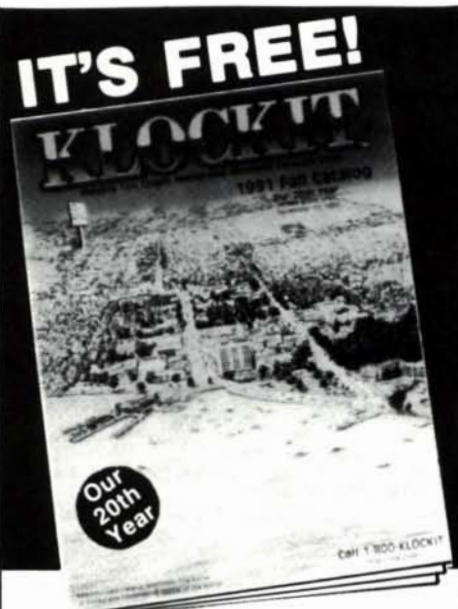
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indicates to me that the glue joint exceeds the strength of the surrounding wood. I assume that the increased resistance to racking and increased surface area of the coped joint (over square shoulders) contribute to the success of this type of construction. In addition, information in various *Fine Woodworking* articles has persuaded me that dowels installed cross-grain can create their own problems.

Having said all this, I want to thank Mr. Beals for his article, both for its content and for provoking thought about my own methods.

—Murray Yungblut, Ripley, Ont., Canada

Reproducing faulty design—Nicholas Tyler posed a fine question in *FWW* #87: "Why copy faulty design in reproducing antique furniture?" There are several reasons; I'll leave it to the reader to determine the validity of each.

The first reason is the one mentioned in Tyler's letter as a quote from an old French cabinetmaker: "ignorance." But that seemed a mighty broad condemnation. A second reason for using construction methods that will virtually guarantee some wood cracking is simply that the customer insists on it. There are a lot of antique-furniture-lovers out there who, when they realize they either can't find or can't afford the original they want, demand *absolute* authenticity in the reproduction they commission. This even includes museums and historical houses. When I receive this kind of commission, I thoroughly inform the customer what to expect. I also make a reasonable effort to suggest changes that will improve the construction, but not change the appearance. Often such suggestions are rejected.

When a reproduction will stand alone, the quandary expressed by Mr. Tyler is more compelling. But there is a situation where I think almost anyone would agree that absolute authen-

ticity is essential: Often a customer will find 2 or 4 exquisite antique dining chairs, and will want to fill the set out to 8 or 12; or they have one bureau and their design scheme calls for two; or a they have a highboy and they want the matching lowboy. In these cases, I think it would be folly to present new-looking reproductions. I know most of my customers would reject them. A set of chairs of the same design, but half old and half new, is truly silly looking. Therefore, in these cases, I even "age" the new pieces, taking great pride in being able to do so skillfully enough that they can't be discerned as new by casual inspection. However, I also insist on using one or two techniques that will clearly mark the reproductions as such to the educated eye, and I incise my name and date deeply into the wood in a prominent secondary space. I don't want to be known as a "faker."

At times it pains me not to use techniques that 200 years of experience have taught us are superior. But situations such as I've described have often compelled me to ignore these lessons. You may not agree, but at least I hope this is not "stupidity."

—Alfred Sharp, Woodbury, Tenn.

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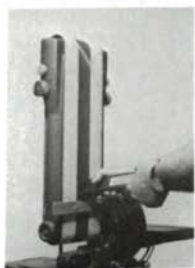
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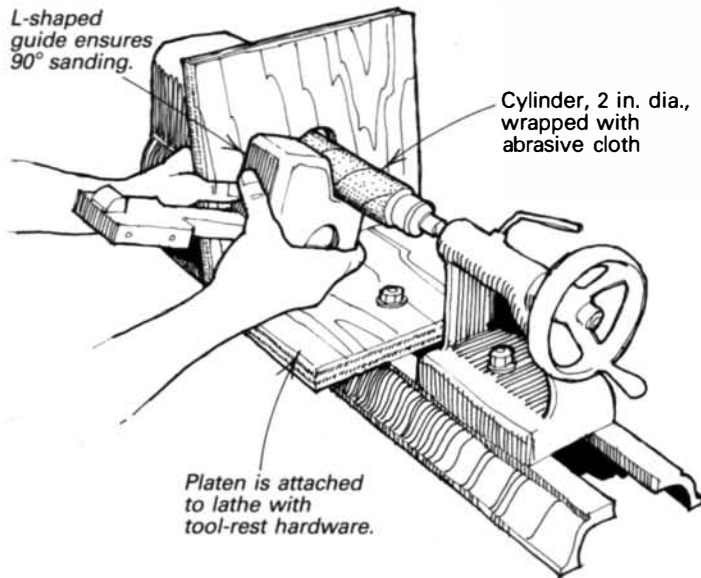
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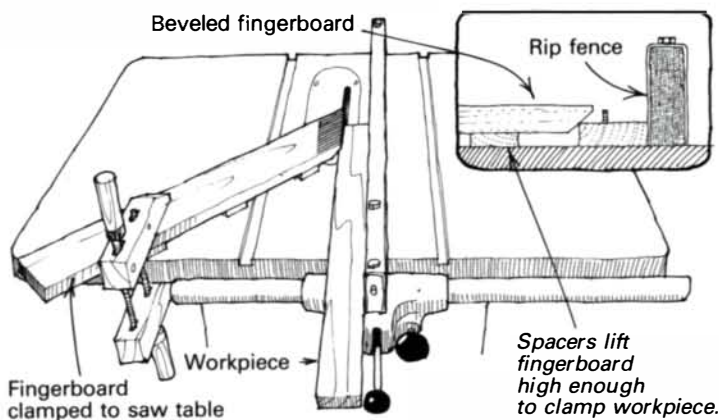
I use this drum sander on my lathe to smooth concave surfaces on the toy cars and trucks I build. The sanding drum is nothing more than a 2-in. wooden cylinder that's spiral-wrapped with coarse abrasive cloth. Since most of the sanding I do is at right angles, I built an L-shaped platen from 3/4-in. plywood; it attaches to the lathe's ways using the tool rest's hardware.

—George Clayton, Ft. Worth, Tex.

Quick tip: A penny has a diameter of 3/4 in. and is a handy reference gauge when other measuring devices are lacking.

—Robert Vaughan, Roanoke, Va.

Improved fingerboard



Fingerboards are great for holding boards against a fence or down on a table, but they usually can't do both jobs very well at the same time. However, if you cut a bevel on the leading edge, as shown above, the fingerboard can accomplish both tasks. Raise the fingerboard off the table with spacers to make it hit the stock at the right place.

—Richard Chiros, Marlboro, Mass.

Copying furniture carvings

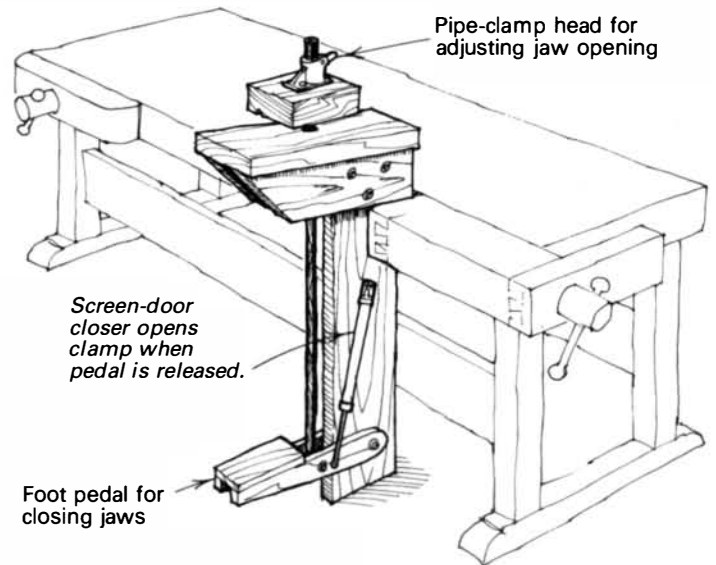
Before you can copy a carving from one piece of furniture onto another, you need to transfer a pattern of the original carving to the new piece. A quick method is to cover the original carved area with overlapping strips of masking tape. Next, rub the surface of the masking tape with the broad side of the point of a soft lead pencil. High areas come out dark, low areas come out light.

Now carefully lift off the masking tape as a single sheet, and transfer it to the piece to be carved. The masking tape becomes a throwaway template to guide the carving process, thereby

eliminating a lot of tedious measuring and marking. Any tape residue remaining on the surface can be peeled off easily.

—Frank D. Hart, Plainfield, Ind.

Standing shaving horse



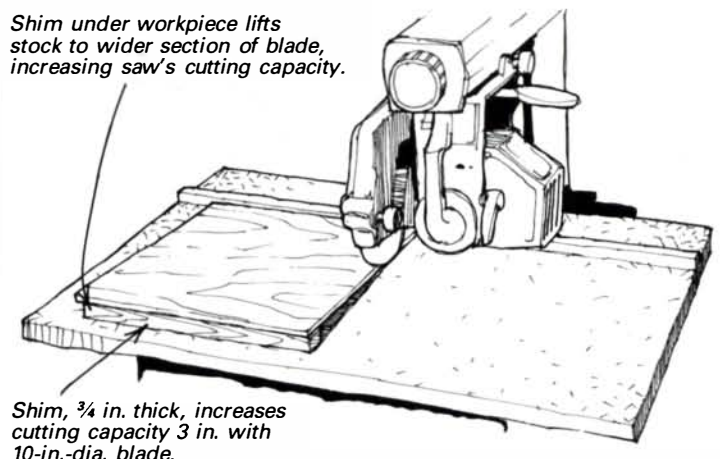
The design of the conventional shaving horse, despite its evolution over hundreds of years, has some disadvantages: the seat gets pretty uncomfortable after a time, and the horse just takes up too much space. This compact alternative, made mainly from 2x6 and 2x8 lumber, solves both problems. To make the horse, use hardwood for the clamp block and foot pedal, and yellow pine construction lumber for the frame and clamp table. Install a 4-ft. length of iron pipe between the clamp block and the foot pedal, using a pipe-clamp fixture on the top, as shown, to adjust the clamping width. A screen-door closer attached between the foot pedal and the frame will provide a strong return spring with a gentle action.

—Paul Weissman, West Redding, Conn.

Quick tip: When cleaning up a curved cut on the edge of plywood with a rasp, you can avoid tearing out the veneer by holding the rasp at both ends, 90° across the edge, and drawing it along the edge. Begin with a coarse rasp to remove a lot of stock, and then continue with finer and finer rasps or files until you can hand-sand.

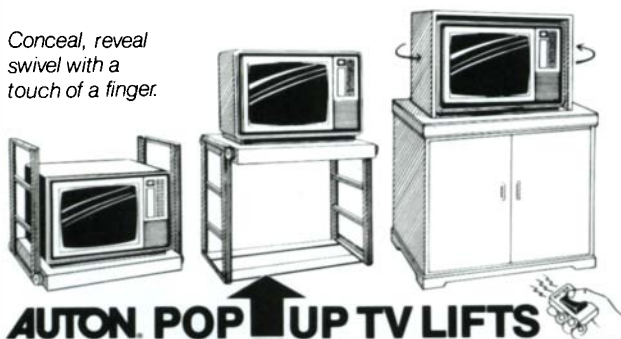
—Dario Biagiarelli, Kirkville, N.Y.

Wider cuts with radial-arm saws



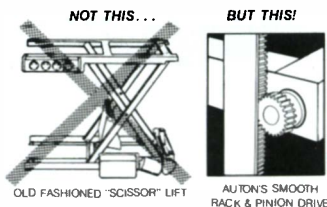
It's very frustrating to crosscut a piece of work on a radial-arm saw and find that the saw's capacity is short by an inch or two. However, there is an easy way to get an extra few inches of cut. As shown above, place a piece of scrapwood under the edge of

Conceal, reveal
swivel with a
touch of a finger.



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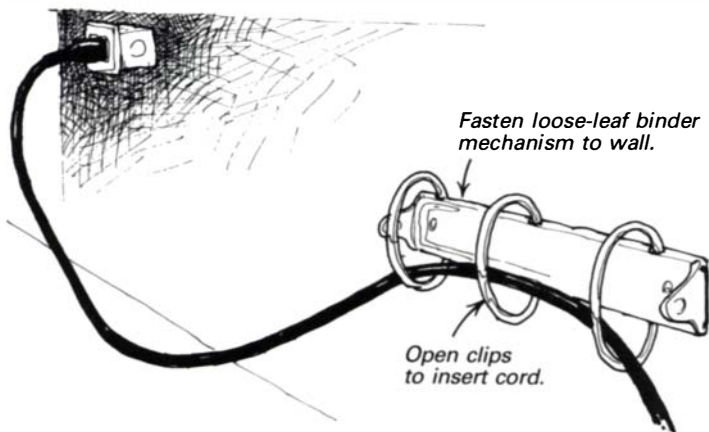
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the work farthest from the back fence. This moves the work up into the wider part of the blade and gains you extra capacity. For example, a 3/4-in. shim will add about 3 in. to the length of cut of a 10-in. sawblade.

—Jack Jerome, Nokomis, Fla.

Binder clip cord holder



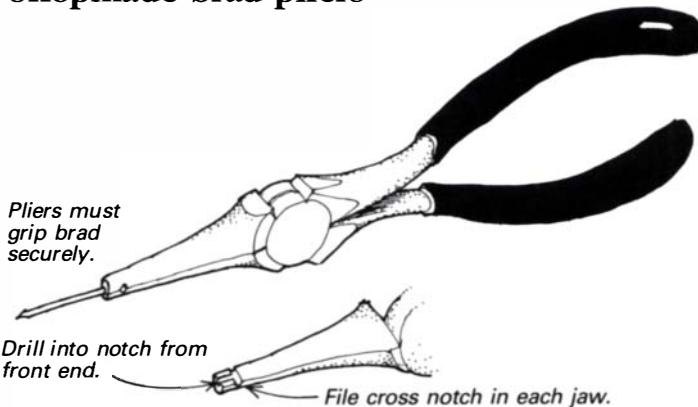
Recently I came across a simple trick to untangle the extension cords or air hoses that collect haphazardly underfoot in the shop. Salvage the mechanisms from old three-ring loose-leaf binders, and fasten them to walls, machines or benches at an appropriate height. Then, click them open and insert your extension cord as you would a sheet of paper. This setup gets the cord off the floor, but leaves it free to move back and forth with the tool. And the push of a button frees it entirely, should it be needed elsewhere.

—Greg Moore, Oakville, Ont., Canada

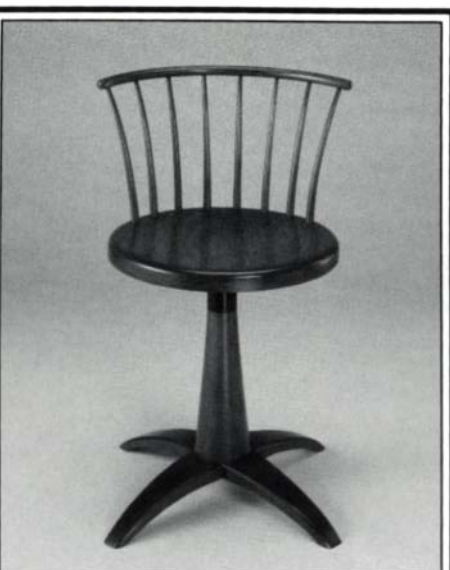
Quick tip: The sapwood edge of walnut boards or veneer makes excellent edging for lauan (Philippine mahogany) plywood. The color and texture are almost identical, and both accept stain the same.

—Dario Biagiarelli, Kirkville, N.Y.

Shopmade brad pliers



Here's how to alter a pair of needle-nose pliers to drive brads quickly and easily. Start by filing a slot across the inside faces of the jaw; locate the slot about 1/8 in. to 1/4 in. from the end of the pliers, depending on the brads you will be using. The slot should be deep enough and wide enough to grab the brad head snugly. Now, close the pliers in a vise, and drill straight down into the closed jaws until the bit reaches the slot. Use a drill bit that is slightly smaller in diameter than the brad shaft. It's a good idea to buff the end of the pliers so the rough edges won't mar the wood.



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11-090 32" Radial Bench Drill Press.....	399	279	
43-355 3/4" Shaper 1 1/2 HP.....	964	685	
43-505 12" Bench Router/Shaper.....	399	279	
22-540 12" Bench Top Planer.....	595	389	
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50-179 3/4 HP 2 stage Dust Collector.....	483	335	
50-181 2 HP Dust Collector.....	885	605	
22-662 13" Planer with 2 HP motor.....	1635	1175	
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33-050 NEW 8-1/4" Sawbuck.....	781	549	
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34-330 NEW 8-1/4" Table Saw 13A.....	343	229	
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34-670 10" Motorized Table Saw.....	511	385	
32-100 NEW Station Plate Jointer.....	645	285	
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0224-1 3/8" Drill 4.5 amp magnum.....	199	113	
0234-1 1/2" Drill 4.5 amp 0-850 rpm.....	219	118	
0244-1 1/2" Drill 4.5 amp 0-600 rpm.....	219	118	
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0228-1 3/8" Drill 3.5 amp 0-1000 rpm.....	179	102	
0375-1 3/8" close quarter Drill.....	129	129	
0379-1 1/2" close quarter Drill.....	249	147	
6539-1 cdfs Screwdriver 190 rpm.....	125	73	
6540-1 6539-1 Driver w/bits & case.....	159	108	
6546-1 cdfs Screwdriver 200 & 400 rpm.....	135	79	
3102-1 Plumbers right angle Drill Kit.....	350	195	
5399 12" D-handle Hammer Drill Kit.....	319	184	
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6511 2 speed SawZall with case.....	234	134	
6750-1 Drywall gun 0-4000 5 amp.....	159	93	
6507 TSC SawZall with case.....	249	135	
6170 1/4" Chop Saw 15 amp.....	479	275	
6014 Orbital Sander 1/2 sheet.....	209	116	
8977 Variable temp. heat gun.....	114	75	
5397-1 3/8" var. spd Hammer Drill Kit.....	239	135	
5371-1 1/2" var. spd Hammer Drill Kit.....	335	185	
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5680 1-1/2 HP Router - 10 amp.....	325	185	
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5232 4-3/4" Band Saw with case.....	461	275	
6256 var. speed Jig Saw 3.8 amp.....	249	145	
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0235-1 1/2" Drill w/kyls chuck mag.....	219	125	
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6142 6145 with case & acces.....	197	125	
6749-1 Drywall Gun 0-2500 5.4 amp.....	199	122	
6353 Eagle 1-1/2" Rot. Hammer/case.....	499	289	
5365 7-1/4" Circular Saw 13 amp.....	209	118	
6367 above Saw - double insulated.....	205	120	
6366 6365 w/ncse & carbide blade.....	129	125	
6368 6365 w/ncse, carb. blade, & cse.....	239	134	
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60105DW	3/8" cdfs Drill Kit 7.2 volt.....	99	59
DA3000DW	3/8" Angle Drill 7.2 volt.....	251	134
43900W	9.6 cordless Recip Saw Kit.....	230	127
6012HDW	2 speed Drill w/clutch-comp.....	236	125
6092DW	var. spd Drill, Kit complete.....	252	127
6093DW	v/spd Drill w/clutch-complete.....	261	129
6095DW	above Drill w/keyless chuck.....	268	135
6093DL	6093DW Drill Kit w/Flash Lt.....	299	169
632007-4	9.6 volt Battery.....	48	30
632002-4	7.2 volt Battery.....	40	28
5007NBA	7-1/4" Saw w/electric brake.....	238	124
5008NBA	8-1/4" Saw w/electric brake.....	253	154
B04510	1/4 sheet Pad Sander.....	93	58
9900B	3" x 21" Belt Sander w/bag.....	278	144
99240B	3" x 24" Belt Sander w/bag.....	293	153
9045N	1/2 sheet Fin. Sander w/bag.....	241	128
4301BV	Orb. var. spd Jig Saw 3.5A.....	289	149
JR3000V	var. speed Recip Saw w/cse.....	235	129
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1100	3-1/4" Planer with case.....	426	219
9207SPC	7" Sander/Polisher.....	288	154
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9501BZ	4" Grinder 3.5 amp.....	130	69
B04530	6" Round Sander.....	106	64
B04550	1/4 sheet Pad Sander w/bag.....	89	57
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6404	3/8" Drill Rev. 0-2100 rpm 2A.....	104	58
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3612BR	3 HP Plunge Router.....	377	165
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4302C	var. speed Orbital Jig Saw.....	302	159
5077B	7-1/4" Hypoid Saw.....	255	138
LS1440	14" Mitre Saw.....	744	449
LS1030	NEW 10" Mitre Saw.....	420	225
5007NB	7-1/4" Circular Saw 13 amp.....	210	112
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EY571B	var. speed 9.6 volt Drill Kit.....	239	128
EY6207BC	NEW 12 volt 1/2" Drill w/keyless chuck var. spd w/15 min. charger & case.....	421	219

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P12R	NEW 12" Portable Planer.....	1185	619
C7BD	7-1/4" Circular Saw.....	230	129
M12V	NEW 3 HP var. speed Router.....	447	225
TR12	Plunge Router 3 HP.....	354	167
F1000A10	12" Planer/6" Jointer.....	2835	1489
C10FA	10" Deluxe Mitre Saw.....	538	275
C12FA	NEW 12" Mitre Saw.....	632	285
C8FB	8-1/2" Slide Compound Saw.....	899	445
FREUD LUS1M008	8-1/2" c/bld 48 tooth 68		
C15FB	15" Mitre Saw.....	745	375
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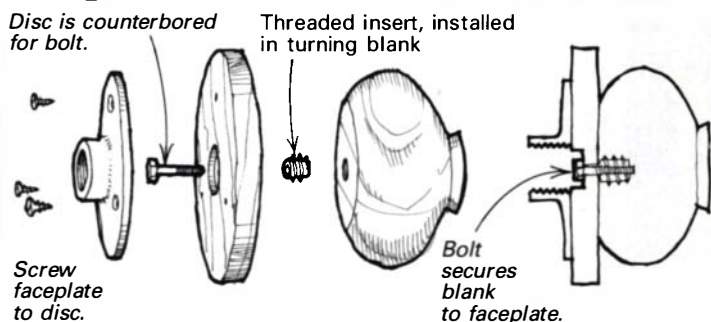
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For maximum control when using the tool, it is important to keep a firm grip and rotate the nail slightly as you push it in. With a little practice, you'll be able to drive brads in at any angle, even sideways.
—Stephen D. Knight, Santa Rosa, Cal.

Quick tip: Although lead can be hazardous to work with, it is occasionally needed for inlaying or for weighting small turnings. Those who use lead should be aware that there is a ready supply of it literally lying on the ground. You can find lead wheel weights (donated by cars with unbalanced wheels) all along the roads in urban areas.
—David Nebenzahl, East Palo Alto, Cal.

Inexpensive screw chuck for turners



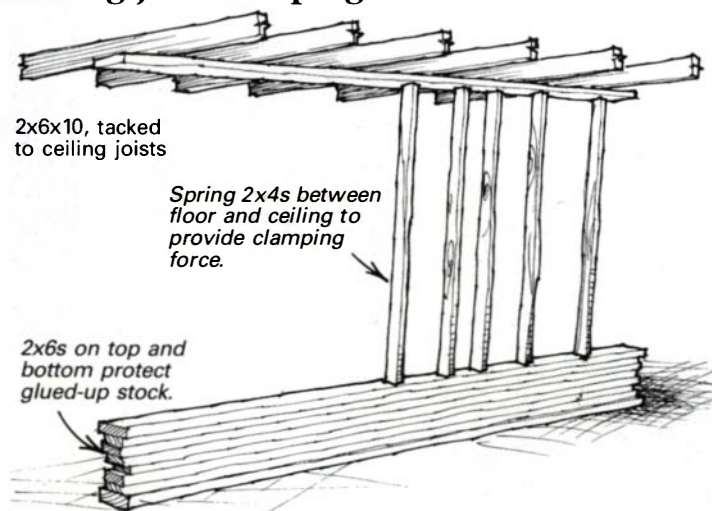
Metal threaded inserts can be adapted to make an inexpensive screw chuck for turners. First, screw a wood block to your faceplate, and turn a disc large enough to support the turning blank. Drill a centered hole through the disc, and then counterbore the hole on the back side to make a recess for a bolt head. Next, drill a pilot hole in the blank, and push in a metal insert, accord-

ing to the manufacturer's instructions. Now, you can quickly attach the blank to the chuck with a bolt sized to fit the insert.

This chuck is particularly useful for securing a bowl blank while you turn a foot on it for remounting the blank in a collet or three-jaw chuck. The screw chuck leaves the top surface of the work unmarred, except for the small pilot hole, making it possible to finish the bowl with only a small opening on the top.

—Dewey N. Garrett, Livermore, Cal.

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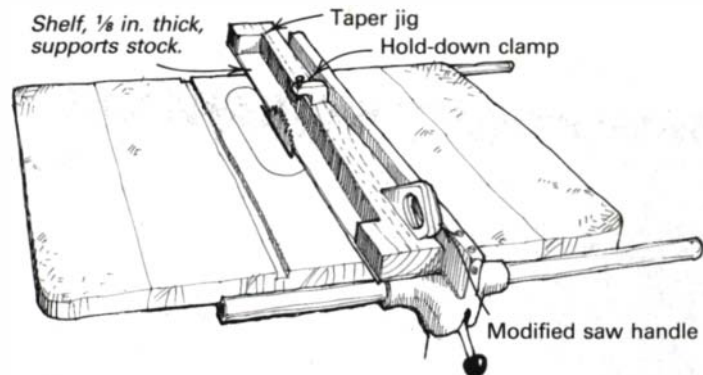
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ceiling runs at a right angle to the ceiling joists. Now, one by one, quickly roll glue on the face of each 2x4 and stack the laminates. Cover the stack with another 2x6, and then spring precut 2x4s between the stack and the ceiling to provide clamping pressure. The large amount of force is surprising; be careful you don't lift the joists too far.

—David Foos, Los Angeles, Cal.

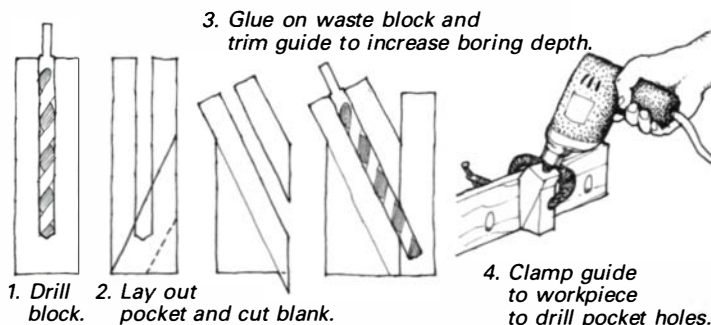
Making a safer taper jig



You can make a shop-built tablesaw taper jig safer and easier to use by adding a 1/2-in.-thick plywood or Masonite shelf to the bottom, and a hold-down clamp and a handle to the top. The shelf-and-hold-down combination holds the workpiece snugly enough to eliminate the balancing act that usually accompanies cutting tapers. The combination also lets you push the jig through as a unit with your hand far away from the blade. I find that the system is especially good for tapering narrow table legs.

—Joe Voltas, Fall River, Mass.

Screw-pocket drilling jig



This jig makes it simple to drill screw pockets for securing a tabletop to its apron. Start with a 1-in.-sq. by 4-in.-long hardwood block, and drill a 3/8-in. hole in the end of the block as deep as your drill will reach. Draw the profile of the hole on the side of the block, and decide how deep and at what angle (usually 25° or so) you want your pocket. Then draw a line across the block to define the pocket, and saw the pieces in two along this angled line. Glue the sawn-off waste onto the other side of the block, as shown, to re-create a square corner. Now clamp the block to a scrap piece, and test-drill a pocket. Trim the end of the block to make the pocket deeper, if necessary. After you've drilled the pockets in the apron, finish by drilling screw-shank holes through the pockets with a hand-held drill.

—E.G. Lincoln, Parsippany, N.J.

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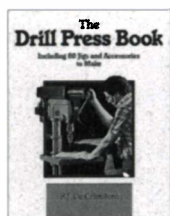
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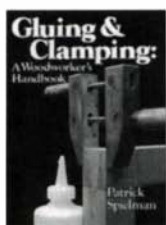
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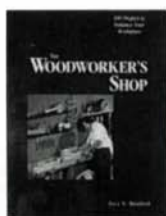
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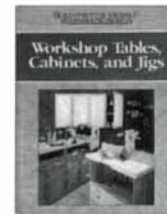
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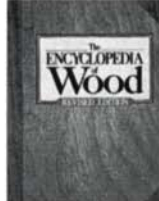
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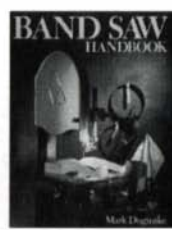
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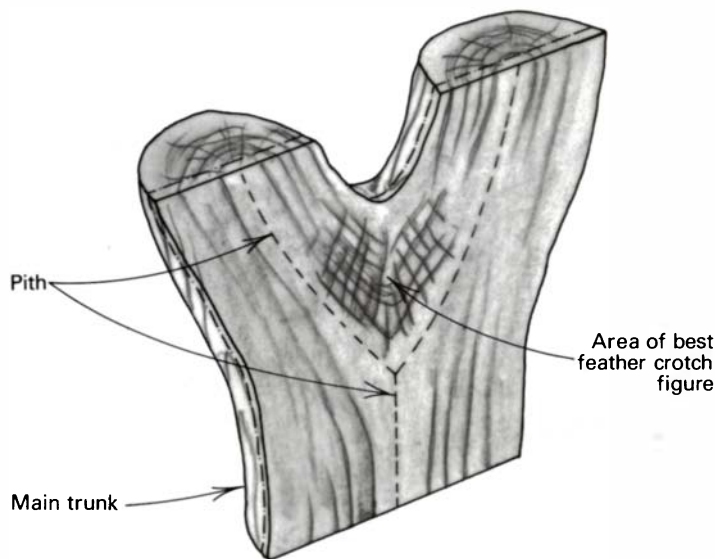
Cutting a walnut crotch for best figure

I recently acquired a large walnut log that has a section where the trunk splits into four or five large branches. I would like your advice on how to saw this crotch for boards with optimum figure. I have not been able to find any information, and I'm not even certain where the figure occurs within the log. Any assistance you could offer would be greatly appreciated.

—Jeffrey Bruni, Southampton, Pa.

Bruce Hoadley replies: In walnut crotches, probably the most desirable figure—the classic feather crotch—occurs on the inside of the converging stems in the area between the highest point of the crotch and the convergence of the piths of the other branches involved. The figure will be best if the two side stems of the crotch are about equal in size. Lesser areas of figured wood occur where a subordinate branch forks from a dominant stem.

The figure is best displayed when the crotch is sawn in a plane common to the piths of the main stem and both branches (see the drawing below). A board or thin slab cut through the crotch and containing the piths of stem and branches should show strong figure on both faces. Successive side cuts will have weaker figuring. Just outside of the crotch area, swirl figure, often quite attractive, may also be found.



In your walnut log, with its multiple-branching stem, try to visualize where the converging piths lie, and make your initial cuts align with the plane of the piths. I am sure you will reveal some surfaces with spectacular figure.

[Bruce Hoadley is professor of wood technology at the University of Massachusetts at Amherst and a contributing editor to *FWW*.]

Problems with a bleeding oil finish

I recently applied a Danish type of oil finish to a 6-ft. red-oak kitchen bar top. After sanding it down to 220-grit, I applied the oil in accordance with the directions on the can. However, I had a hard time getting the surface dry without more oil bleeding out of the pores, and I had to continue wiping down the top for two days. Once the finish finally dried, I waited a few days and then waxed it. However, the top doesn't seem to be very durable or resistant to stains. Can you make some suggestions on what to do now? —Dennis E. Hurley, Carlisle, Pa.

Michael Dresdner replies: Your problems stem from some basic misunderstandings concerning Danish oil finishes, most of which are quite similar. These finishes are actually extremely thin, long oil varnishes, consisting of linseed oil cut with a large amount of mineral spirits and buffered with a small amount of alkyd resin. After the mineral spirits evaporate, the oil makes a poor moisture barrier; so the bulk of the protection comes from the resin, but there is little of that in many mixtures I've used.

The problem you had with oil bleed during application was a result of overloading the oak's especially large pores with this mixture of mineral spirits and oil, and this made it virtually impossible for the finish to dry. And you ended up probably wiping off the lion's share of finish you had applied, leaving little, if any, protective coating. Even under the best circumstances, one coat of Danish oil is a poor barrier for moisture resistance or heavy wear. And waxing the surface will do little to help; although wax, when applied over a finish, will repel water, it is a poor moisture barrier.

Next time, put on at least three or four lighter coats of Danish oil, allowing the film to completely dry between coats. Or better still, switch to a more protective varnish or polyurethane finish. Asking a single coat of Danish oil to stand up to the daily rigors of a bar top just isn't realistic.

[Michael Dresdner is a finishing consultant in Perkasi, Pa.]

Regluing a chair with cyanoacrylate

We have a family heirloom chair that has loosened in all the joints. Because of its delicacy and sentimental value, I am very reluctant to attempt to disassemble the chair to reglue it. Is there any way that the chair can be reglued without taking it apart?

—Roberta Munsey, North Hollywood, Cal.

Randy Jenkins replies: Recently I was faced with a similar situation: repairing a friend's set of six dining chairs that had come unglued. After disassembling the first chair and regluing it, I realized that the time and trouble involved far exceeded the money available for the job. The remaining chairs waited for some other solution.

Some time later, I was turning a cherry bowl and repaired a small crack with cyanoacrylate glue. (I use Jet brand, available nationwide in model, hobby and craft stores.) I was struck by the capillary action that literally pulled the glue into the crack. This seemed to offer hope for regluing the dining chairs without time-consuming disassembly. I started on chair number two immediately. First, I used a scraper and an awl to remove any old glue from joints that were already separated. The chair was then dry-assembled with nylon web clamps and bar clamps, and the screws in the glue blocks on the underside of the seat frame were tightened. Then, using the very fine tip of the glue bottle, I ran a line of glue along one tightly clamped joint line. The glue disappeared into the joint immediately—capillary action at work! I continued to apply glue to all sides of the joint that I could reach until excess glue began to run out. The joint line was then sprayed with a cyanoacrylate “accelerator” (available from hobby stores) to set the glue more quickly, and one more light application of glue was made to thoroughly seal the joint. All the other joints in the chair were treated the same way.

When the clamps were removed, the chair was as solid as the first one repaired by traditional methods. As an added test, I brought the second chair in and let my teenager test it for a week; there was no indication of glue failure. Since cyanoacrylate glues make long-lasting and strong bonds with wood, the test here was primarily of the method of application, which proved successful. The chairs have been in daily use for some months now with no joint failures. Approximately 1 oz. of glue, about \$2.50 worth, was used per chair. Work time averaged less than 30 minutes per chair, so even with the much higher glue cost, the work was done within budget. Eliminating the risk of damage due to disassembly was also a solid plus.

[Randy Jenkins is a woodworker and retired compressor-systems specialist in Lafayette, La.]

Trouble with a tablesaw's cut

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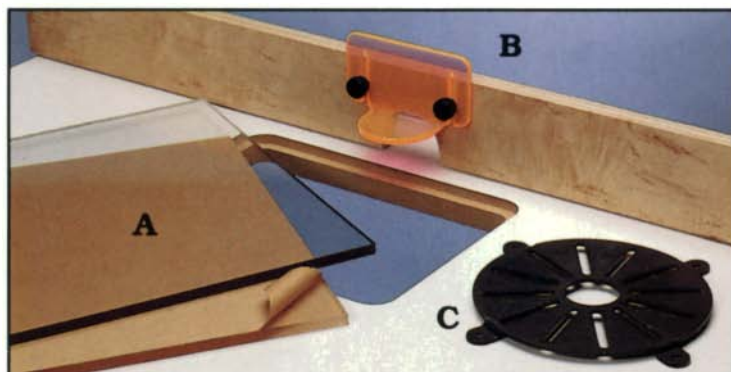
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invariably moved away from the fence just beyond the blade. I have tried to correct this deficiency by switching sawblades and checking their runout; rebuilding and checking the alignment of the rip fence; and making sure the saw's throat plate was absolutely flush with the tablesaw surface. Nothing has worked, and I've exhausted all the remedies I know. Do you have any suggestions?

—Ronald D. Frey, Clay, N.Y.

Mark Duginske replies: The problem of the material invariably moving away from the fence on the outgoing side is not only disturbing, but can also result in dangerous kickback. There are a number of things that can cause this problem; it is best to deal with the simple ideas first and then explore the more complex possibilities. First of all, the rip fence should be perfectly straight. As simple as this sounds, I have seen many saw fences come right out of the manufacturer's box and not be straight. The best way to straighten a crooked fence is to bolt an auxiliary wood (preferably plywood) fence to it. Shims are used to keep the new straight fence from assuming the shape of the crooked one when it's bolted on. You can punch out your own shims from cardboard or from aluminum-can stock and insert them between the auxiliary and stock fences. Also, you can use the shims to square the fence to the saw table.

Next, check for blade misalignment, also called "heeling." (See my article on tablesaw tune-up in *FWW* #78.) Follow the directions in the article to align the blade and saw table properly. Don't mistakenly assume that you can just set the rip fence parallel to the saw table's miter slot. The slot and sawblade may not be parallel. Without actually seeing your tablesaw, I think this is most likely the cause of the problem you're having. Some people prefer to have the fence angled very slightly so that the distance between the fence and blade is minutely greater (be-

tween 1/64 in. and 1/32 in.) at the back of the blade.

Another condition that can cause the problem you describe is not related to the tablesaw at all. The wood may be releasing tension and distorting as a result of being cut. This can cause the wood between the rip fence and the blade to bow away from the fence. If this is what's occurring, it's best to fit the saw with a kerf splitter—a special thin, curved bar that's mounted behind the blade to keep the sawkerf from closing up and pinching the blade. However, if internal tension in the wood is the problem, the opposite situation may also arise: the two pieces may spread apart after being cut. The spreading can cause the portion of the workpiece between the fence and blade to bind against the blade, generating a kickback. For this reason, Europeans prefer to use a short fence for ripping, which only reaches as far as the back of the blade, providing clearance when cutting solid wood. [Mark Duginske is a woodworker, teacher and author who lives in Wausau, Wisc.]

Making traditional pigeonhole partitions

I am making an 18th-century-style slant-top desk for my daughter, and I've gotten as far as making the pigeonholes. The examples I've seen in museums have V-shaped ends on the partitions that fit into V-shaped grooves in the supporting pieces. How were these V-grooves cut? Also, why was this particular joint used?

—John Caywood, Sunnyvale, Cal.

Lance Patterson replies: I consulted with the other cabinet-making and furnituremaking instructors at the North Bennett Street School about your questions, and we think that the V-shaped housings were cut by handplanes in the 18th century. It's likely that a specific molding plane was used traditionally, but you can use a regular rebate plane tipped over to a 45° angle

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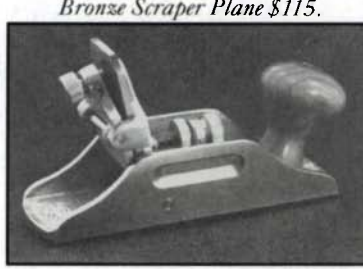
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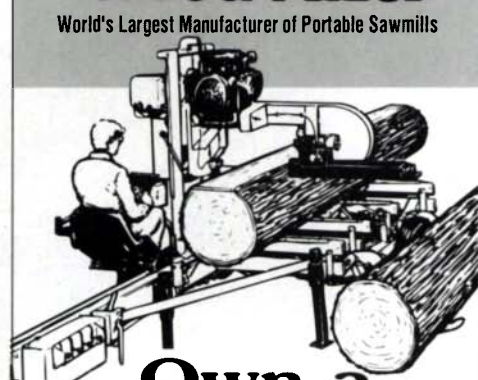
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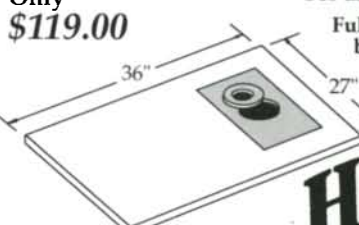
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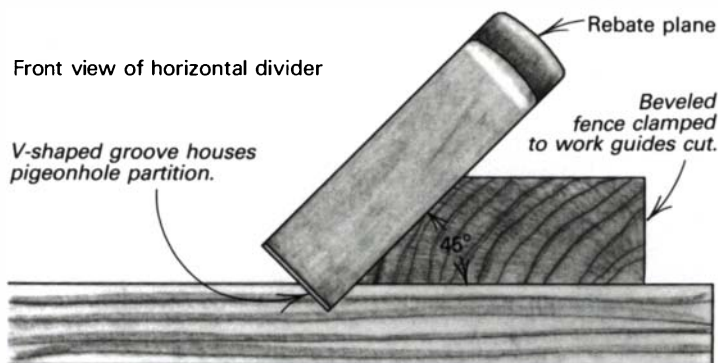
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and guided by an auxiliary fence (a board with an edge cut at a 45° bevel and clamped to the work), as shown in the drawing below. You could also make a special stop, to limit the depth of cut (perhaps another 45° fence), or you could just plane to a scribed line on the work and then trial-fit each partition.



I think it is safe to conclude that there are two main reasons why the V-shaped housings were used. First, the miter allows a clean juncture between the rounded edge on the front of a partition and the rounded edge (or bead) on the horizontal divider. Secondly, making the V-shaped housing using either method described above is a practical and efficient way to create that mitered connection. Stopped V-shaped grooves or dados were avoided in early furniture, because a plane couldn't easily make a stopped cut; the ends needed to be chiseled out. But these days, it is a common practice to cut a stopped dado, say with a router, and just cut the V-shape for the last 3/8 in. or so at the front. The V-shaped groove is cut with the aid of a scrap block

with a face cut at 45°, to act as a guide for the chisel.

If you want or need a full V-housing for a removable partition or secret compartment (see Alex Krutsky's spice box article in *FWW* #72), the housing can be cut with a V-groove router bit. Cutting the V-shape on the ends of the partitions is easily done with a careful setup on the tablesaw or router table. Bury the cutter or blade into an auxiliary wood fence clamped to your standard fence, and leave just the right amount of blade or cutter exposed to saw or shape the desired bevel.

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

Replacing flat leather drive belts

I recently purchased an 8-in. jointer and a 24-in. planer at an auction. After getting them home, I discovered that the planer will need new leather roller-feed belts. Can you offer any sources of supply for replacement parts, leather belts and fittings?

—Alani Willett, Kailua-Kona, Hawaii

Bob Vaughan replies: Whenever I am confronted with flat-belt-driven machines, I usually convert them to use standard V-belts because it is a much more efficient power transmission setup and is no more expensive than replacing the original flat leather belts. In cases where I'm asked to retain the original belt-driving system (as in cases where I'm restoring a machine to original specifications), I obtain new leather belts from McLeod Leather & Belting Co., PO Box 2310, Greensboro, N.C. 27402; (800) 632-1316. If the machines's flat-belt pulleys also need replacing, I go to my local power transmission distributors armed with the dimensions of pulleys and the arbor or shaft diameters as my needs dictate. An alternate choice for leather belts are the seam-

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- Cast iron table
- Spring hold down & miter gauge
- Extra heavy duty
- 1 year warranty
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- **FREE FREIGHT**
- Tiltspindle model avail.
- *** **FREEBORN*****

Shaper cutters available

NORTHSTATE 10", 12", 14" CABINET SHOP SAWS

- **BIESEMEYER, VEGA, EXCALIBUR** fences available



- 3, 5, 7-1/2 hp motors
- Magnetic controls
- Cast iron top
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- **HTC MOBILE BASES**

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- 5 hp & 7-1/2 hp

NORTHSTATE BANDSAWS

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- 18", 2 hp: **\$795**
- 20": **\$1,495**
- 24": **\$2,465**

PORTER CABLE

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- 330: Sander: **\$53**
- 360: Sander: **\$174**
- 505: Sander: **\$108**
- 9505: Commemorative 505: **\$129**
- 351: Sander: **\$124**
- 352: Sander: **\$128**
- 363: Sander: **\$174**
- 362: Sander: **\$179**
- 361: Sander: **\$166**
- 7549: VS jigsaw: **\$134**
- 9627: Rec. Saw: **\$127**
- 7519: Router: **\$224**
- 7538: Router: **\$224**
- 690: Router: **\$124**
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- 314: Saw: **\$124**
- 315: Saw: **\$114**
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- 97310: Lam. Trim Kit: **\$184**
- 7334: Orbital Sander: **\$117**
- 5116: Omnijig: **\$262**

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- Heavy cast iron const.
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- Dual tilt fence
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- 7770-10: Radial Arm Saw: **\$865**
- 7790: Radial Arm Saw: **\$1147**
- 1765: Belt/Disc Sander: **\$427**
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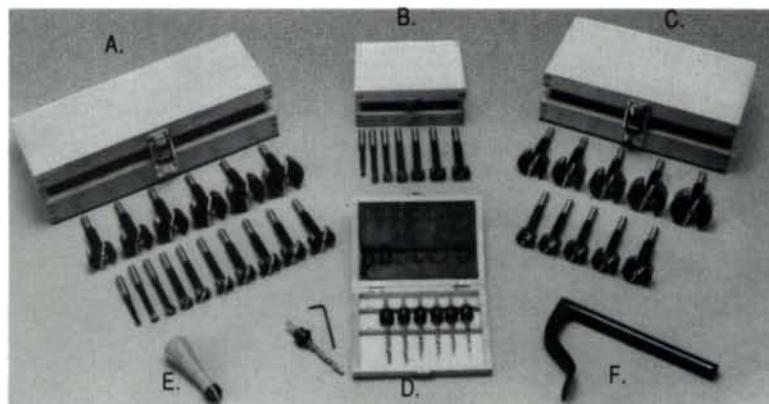
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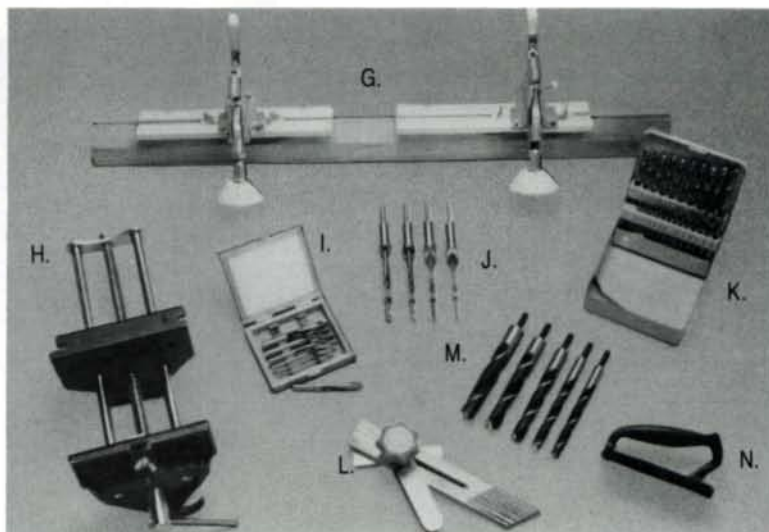
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 Heavy, cast iron construction with built-in steel bench
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NEW

This Stationary Plate Joiner goes way beyond a portable joiner. A foot pedal controls blade movement so both hands are free to control your work. Handles all types of joints in all three biscuit sizes.



A handful of prevention is worth a shopful of cure. If you agree it's time to stop eating, breathing and sweeping all that dust, we've got the right dust collector to meet your needs. A whole range of two-stage, industrial quality, portable dust collectors, ranging from 3/4 to 3 HP, will let you breathe easier.

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Buy now and we'll throw in our heavy-gauge steel stand for free.* And just for good measure, we'll add on a free Electronic Measuring System to eliminate the guesswork.*



*Standards of the Industry. We set them and we won't compromise them for any reason. But how about a rebate or two. Or four. Choose one or all four of these "Standards." Our Combination 6" Belt/12" Disc Sander, 8" Precision Jointer, Heavy Duty Wood Shaper and any model Unisaw® 10" Tilting Arbor Saw. Each comes with a hundred dollar rebate check from Delta.**

*Offer good only from participating distributors in the continental U.S., Alaska, Hawaii and Canada, from September 1, 1991 thru March 31, 1992. To qualify, machines must be purchased with motors.

READER SERVICE NO. 124

less rayon belts, typically found on over-arm routers. These smoother-running, stronger-than-leather belts are usually available from belting and rubber distributors that you can locate in a metropolitan area by checking the yellow pages.

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

Formaldehyde fumes from building products

I've read that many products made with formaldehyde and other chemicals continue to give off hazardous fumes in our homes long after the obvious odor of these chemicals becomes unnoticeable. There are many articles and instructions on the hazards of working with these products and the precautions on how to handle and work with them in the shop. But is there a way to control formaldehyde vapor and test for its presence?

—Daniel P. Parker, Saddle River, N.J.

Chris Minick replies: The most significant source of formaldehyde contamination in the home is likely to be pressed-wood products such as particleboard, hardwood-plywood paneling, and medium-density fiberboard (MDF). Interior-grade pressed-wood products are bonded with a urea-formaldehyde (UF) resin system. During the manufacturing process, residual free formaldehyde becomes trapped in the wood product, and it is slowly released over a period of several months or years.

For some individuals, low levels of formaldehyde can cause watery eyes, burning sensations in the eyes and throat, nausea and difficult breathing. Some studies indicate that formaldehyde may also be a central-nervous-system depressant. And formaldehyde has been shown to cause cancer in laboratory animals and is classified as a suspected human carcinogen by the federal government.

As bad as all that sounds, it's fairly easy to minimize exposure

to formaldehyde vapors in the home. Formaldehyde contamination can be kept to a minimum by properly ventilating your home and by using exterior-grade products in the construction of your home, furniture and cabinetry projects. Exterior-grade pressed-wood products are manufactured with an alternate adhesive bonding system that emits far less formaldehyde vapors.

Testing for formaldehyde contamination in the home is inexpensive and very easy. Two companies, 3M Co. (PO Box 33211, St. Paul, Minn. 55133-3211) and Air Quality Research, Inc. (901 Grayson St., Berkeley, Cal. 94710) sell portable monitoring devices specifically designed to detect low levels of formaldehyde vapors in the home environment. The device is placed in the suspected area, exposed for a specified time, and sent back to the manufacturer for analysis. A detailed analysis report and information on formaldehyde abatement steps are returned to you. Your local health department may have a listing of the monitor distributors in your area. Expect to pay between \$60 and \$75 for each monitor, which includes the laboratory analysis. Additional information on formaldehyde contamination can be obtained from the EPA Toxic Substance Control Act (TSCA) assistance line (202-554-1404). A very informative booklet, *The Inside Story, A Guide to Indoor Air Quality*, is also available from the EPA. To get a copy, write to the Indoor Air Division, Office of Air and Radiation, U.S. Environmental Protection Agency, Washington, D.C. 20460.

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

Is walnut poisonous?

A very knowledgeable woodworker friend of mine told me that it is unwise to make objects that will contact food, such

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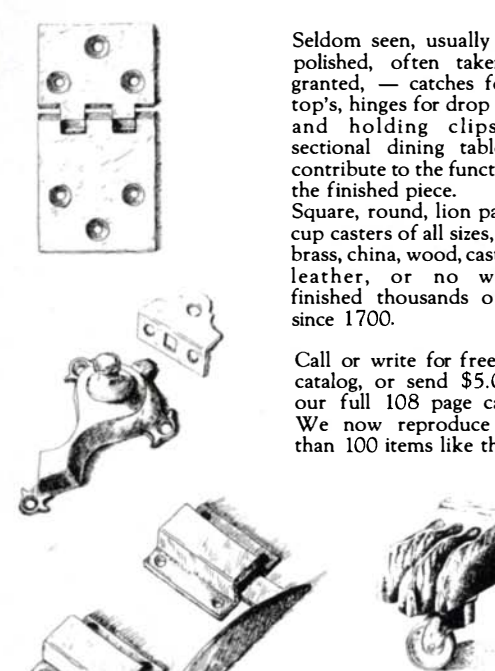
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Hickory	4/4	Select	1.50
Mahogany (Genuine)	4/4	Select	2.70
Maple (Hard)	4/4	Select	1.55
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Pecan	4/4	Select	1.50
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READER SERVICE NO. 162

New from the makers of INCRA JIG!

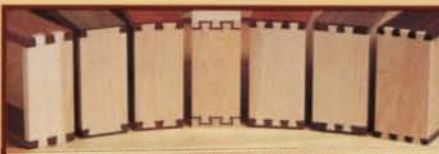
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1/2" CHUCK!

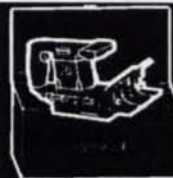
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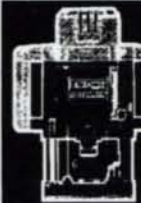
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READER SERVICE NO. 15

as salad bowls and cutting boards, out of walnut because it is poisonous. Is this really true? —*Jim Tupper, Seattle, Wash.*

Jon Arno replies: Although walnut is probably not the best wood to use in making such items as salad bowls and cutting boards, there is little likelihood that any poisoning will result from the wood itself. Walnut does, however, contain a couple of substances with pharmacological potency. One of them is a chemical called juglone, which the tree produces to ward off attack by decay-causing organisms such as fungi. Juglone is believed to cause dermatitis in some woodworkers who have become sensitized to it. It is also known to be both an antiseptic and a laxative. Walnut also contains ellagic acid, which is a fairly strong tranquilizer and sedative. Because of the presence of these active compounds, I definitely do not recommend using walnut containers for storing moist or acidic foods over long periods of time. As a practical matter, though, food prepared on a walnut cutting board or served in a walnut salad bowl is not exposed to the wood long enough to present much of a risk of absorbing dangerous quantities of toxic substances. A greater concern with making wooden kitchen utensils rests in selecting a finish that does not contain toxic ingredients. For example, some penetrating oils, such as boiled linseed oil, may be formulated with driers containing heavy metals, which are harmful. In contrast, most film-type finishes, such as lacquer or polyurethane, are food safe once they have cured. There are many special food-safe oil finishes available, such as Behlen's Salad-Bowl Finish (available from Garrett Wade, 161 Ave. of the Americas, New York, N.Y. 10013).

Assuming that whatever wood you use is going to be thoroughly sealed with a food-safe finish, perhaps the next most important issue is selecting a species with the appropriate physical

characteristics for the item's intended use. In the case of cutting boards and salad bowls, walnut is certainly not the ideal choice. Because walnut is a semi-ring-porous wood with an open grain, food can get trapped in the pores and provide a culture medium for all sorts of unsavory microorganisms. A finer-textured, diffuse-porous wood, like sugar maple, would be a more practical choice. Maple also turns well and yields a smooth surface that is easier to wipe clean. Also, being about 10% harder than walnut, maple will withstand more abuse when used for cutting boards. [Jon Arno is a wood technologist and consultant in Schaumburg, Ill.]

Difficulty dyeing maple

I've been trying to dye a maple table I built, but I can't get the color as dark as I'd like. What can I do?

—*George Matelinas, Hunlock Creek, Pa.*

Michael Dresdner replies: Wood accepts dye to varying degrees, depending on the wood species, type of dye and its carrier (water, oil, alcohol). Maple is one wood that is reticent to accept dye—especially oil-soluble dye. You will get the deepest and darkest color on maple with a water-soluble aniline dye. Make sure that the wood is clean of any oil or wax and that the stained areas are resanded. Control the intensity of the color with the mixture of dye powder to hot water because subsequent applications of dye won't make the wood darker.

[Michael Dresdner is a contributing editor to FWW.]

Send queries, comments and sources of supply to Q&A, Fine Woodworking, PO Box 5506, Newtown, Conn. 06470-5506. We attempt to answer all questions, but due to the great number of requests received, the process can take several months.

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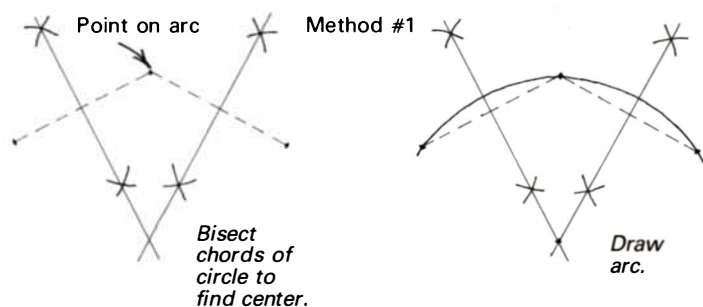
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The radius of an arc revisited—An item in the “Q&A” column of *FWW* #88 brought in an avalanche of reader mail. Ernest Dean, of Felton, Cal., wanted to know of a way to find the radius of an arc based on the arc’s rise and the length of its chord. Robert Vaughan answered the question with an equation: Where A equals the arc’s rise (height); B equals half the arc’s chord (length); and Y equals the unknown radius, then: $2 \times A \times Y = B^2 + A^2$. This is basically the same equation that Barrie Graham, of Arundel, Que., Canada, used to solve the same problem in a “Methods of Work” tip in the March/April 1990 issue. Both Graham’s method and Vaughan’s answer elicited the same response: Dozens of letters with methods for solving the problem without memorizing a mathematical formula. Each of the letters contained an alternate solution based on one of the three methods illustrated below.

Finding the radius of an arc #1

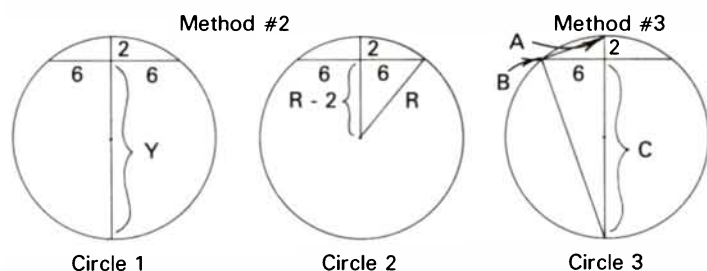


The equation for finding the radius of an arc is fine for folks who like complicated calculations. But formulas and numbers just tend to stir up my dyslexia, and the thought of multiplying or dividing fractions is simply horrifying.

My simple alternative is based on the fact that the perpendicular bisector of any chord of a circle passes through the center of the circle. Three points on a circle define three chords. Bisect any two chords, as shown in the sketch, and you determine the center of the circle. All you need is a pair of dividers and a straightedge.

—Rodney Bean, Yellow Springs, Ohio,
and Albert Fiebig, Enosburg Falls, Vt.

Finding the radius of an arc #2



Our geometry class inspected Mr. Graham’s formula and decided that it would soon become a cloudy memory and eventually be forgotten. A better way, we believe, is to learn two simple underlying principles that would provide a lifetime of solutions. First, when two chords intersect, the products of the created pieces are equal. For example in circle 1 on the left of the sketch above, $2 \times Y = 6 \times 6$; $2 \times Y = 36$; $Y = 18$.

Since $Y + 2$ is the diameter of the circle, it follows that the radius of the arc is half the diameter, or 10.

The second principle is the Pythagorean theorem: In any right triangle, the square of the hypotenuse is equal to the sum of the squares of the legs. For example, by drawing in radius R in circle 2 above and using the theorem, we get the following: $R^2 = (R - 2)^2 + 6^2$; $R^2 = R^2 - 4R + 4 + 36$; $0 = -4R + 40$; $R = 10$.

Mr. Graham’s formula was apparently derived from the Pythagorean theorem.

—Nicole Doan, Debbi Hartman, Jill Schreiber,
Karissa Kruse and Michael Sansing (teacher),
Rampart High School, Colorado Springs, Colo.

Finding the radius of an arc #3

I’ve used an alternative to finding the radius of an arc for many years to determine the radius of curvature of cathode-ray-tube faces. By the laws of geometry, A, B and B, C are the sides of similar triangles. Therefore, the ratio of A to B equals the ratio of B to C. In the example in circle 3 below, $A \times B = B \times C$; $2 \times 6 = 6 \times C$; $2 \times C = 36$; $C = 18$. After you know that $C = 18$, it is easy to calculate the diameter ($C + 2$, or 20) and the radius.

—Ray Levy, Soquel, Cal.

Determining shelf spans—Another “Q&A” in *FWW* #88 also prompted several readers to write in. Bob Maxwell, of Washington, D.C., asked advice on how to determine the acceptable span for a bookshelf to avoid sagging. David Stenstrom answered with some practical ideas for stiffening shelves when necessary, such as gluing on hardwood edging and using 1-in.-thick plywood.

Virtually all of the reader mail we received on this subject gave us the same technical information but in various forms. In his letter, David O. Mann, of Rancho Palos Verdes, Cal., did a good job of translating engineering jargon into layman’s terms.

“There are three factors needed to calculate the mid-span deflection of a simply supported beam, which is all a shelf really is.

The first factor is the property of the wood to resist bending. This is known as the modulus of elasticity and is usually denoted by the letter ‘E.’ The value for E for various species of wood is available in any worthwhile book on wood technology. The stiffer the wood, the higher the value of E. These values vary from 1.2 million to 1.9 million pounds per square inch (p.s.i.); for example, the value for white oak is 1.5 million p.s.i.

The second property is the cross section of the shelf. Engineers commonly refer to this property as the moment of inertia and they use the letter ‘I’ to denote it. As most shelves are of a constant rectangular shape, the section property, or value of I, is the shelf’s width multiplied by the cube of its thickness, divided by 12. The equation is $I = (W \times T^3) \div 12$.

The third property is the length of the shelf, which is called the span and is usually denoted by ‘L.’

Now, assuming that the wood you have selected is free of major defects, the cross section is constant, and the ends of the shelf are resting on supports and are not clamped down, the formula for the deflection at midspan for a uniformly loaded bookshelf is $(5 \times W \times L^3) \div (384 \times E \times I)$, where W equals the weight of the load.

If the shelf has a concentrated load in the center, deflection will be $(W \times L^3) \div (48 \times E \times I)$.

If the ends are fixed, the deflection will be about 20% to 25% of the value derived from these equations.”

Richard Stiennon, an engineering manager in Plymouth, Mich., also wrote to us and summed things up with a few rules of thumb.

“First, the stiffness of a shelf varies inversely with the cube of the length. So, if a shelf is twice as long, it is one-eighth as stiff. Second, the stiffness of a shelf varies with the cube of the thickness. In other words, a 1-in.-thick shelf is eight times stiffer than a ½-in.-thick shelf. Third, the end conditions are extremely important. A dadoed, mortised or sliding-dovetail joint makes a shelf five times stiffer than one that is resting on adjustable tabs.”

Missing photo credit—Our apologies to photographer Jon DeGroot whose photo of Colin Reid’s “Batrille Tables” in *FWW* #89, p. 85, was not credited. □

Jim Boesel is executive editor of *FWW*.

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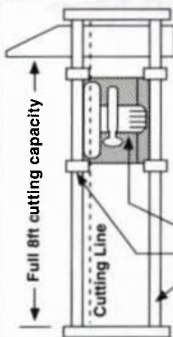
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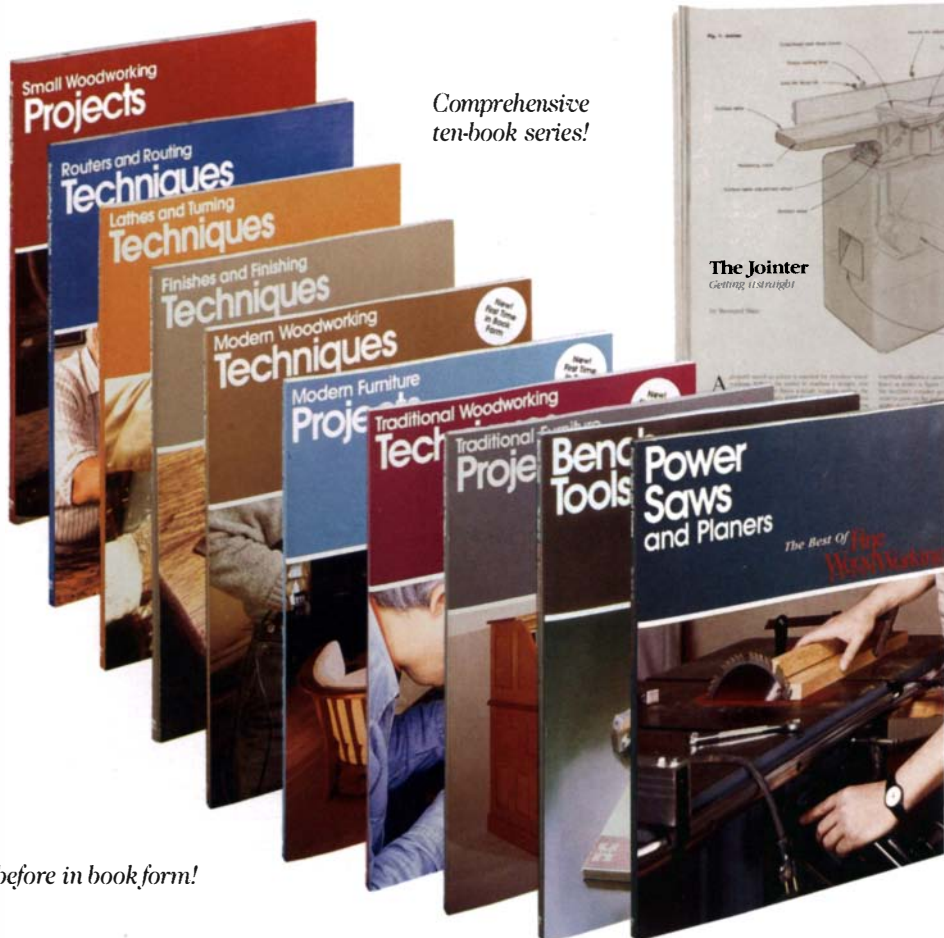
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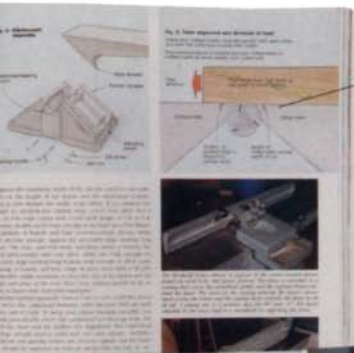
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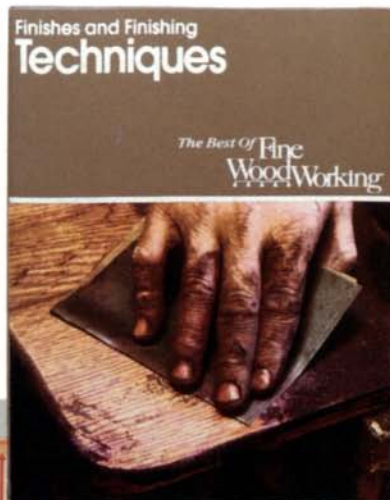
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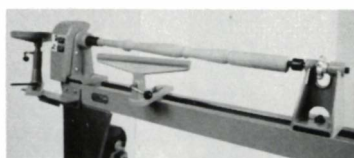
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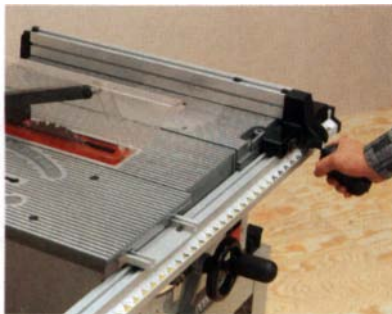


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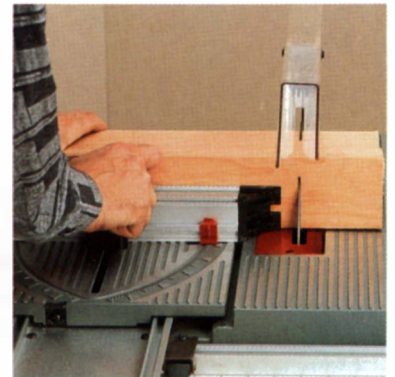
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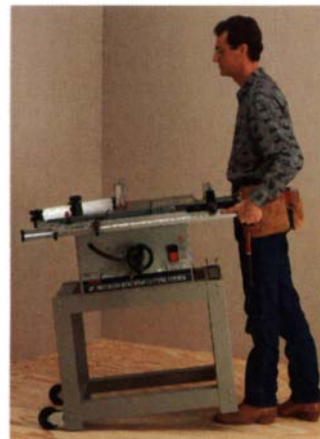
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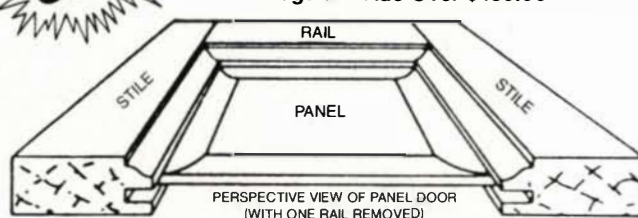
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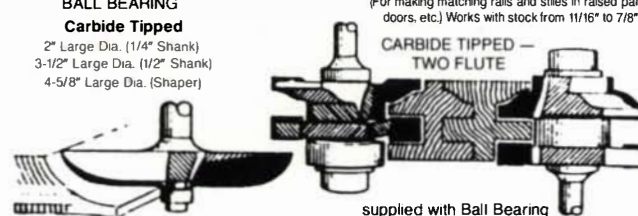


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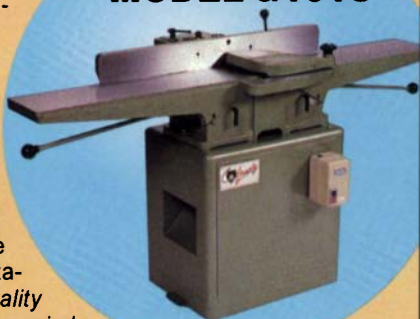


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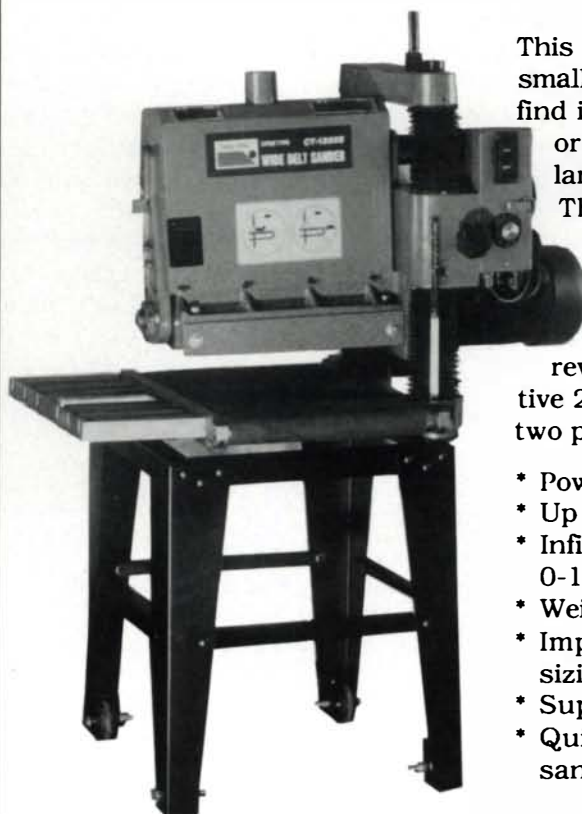
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Building a Loveseat

Interlocking tenons for a strong frame

by Gary Rogowski

It's hard to say where some of my designs come from. This loveseat, for example, grew out of scribbles in my notebooks. I liked the movement and energy expressed in those few lines, and I transformed them into the rails and legs of the piece shown in the photo on the facing page. From this innocent starting point, I embarked on a more technical journey to discover all the subtleties and challenges of making an attractive, comfortable seat.

Scale drawings of the loveseat initially helped me design and locate the various components of the frame. I developed the basic dimensions from measurements of chairs and couches that I admired or found comfortable. If you study figure 1 at right, you can see that constructing the loveseat is pretty straightforward. The trickiest part is mortising the legs so that the tenons on the front, back and side rails can intersect within the narrow legs; but it's easy to cut these joints with the template guides described on the following pages.

I also extensively shaped and machined many of the parts, including the side and backrest slats and the armrests. These details are a matter of personal taste; you may prefer a simpler design. The important thing is not to let yourself be overwhelmed by the size or apparent complexity of projects like this. I've found that the key to success is to first break the piece down into units, assemble those units separately and then later fit everything together.

Developing a construction plan

While designing the loveseat, I tried to simplify construction as much as possible. Rather than gluing up the back components between the assembled sides, I built the backrest as a separate frame that would slide into grooves in the rear legs. This construction method became invisible once a cap piece

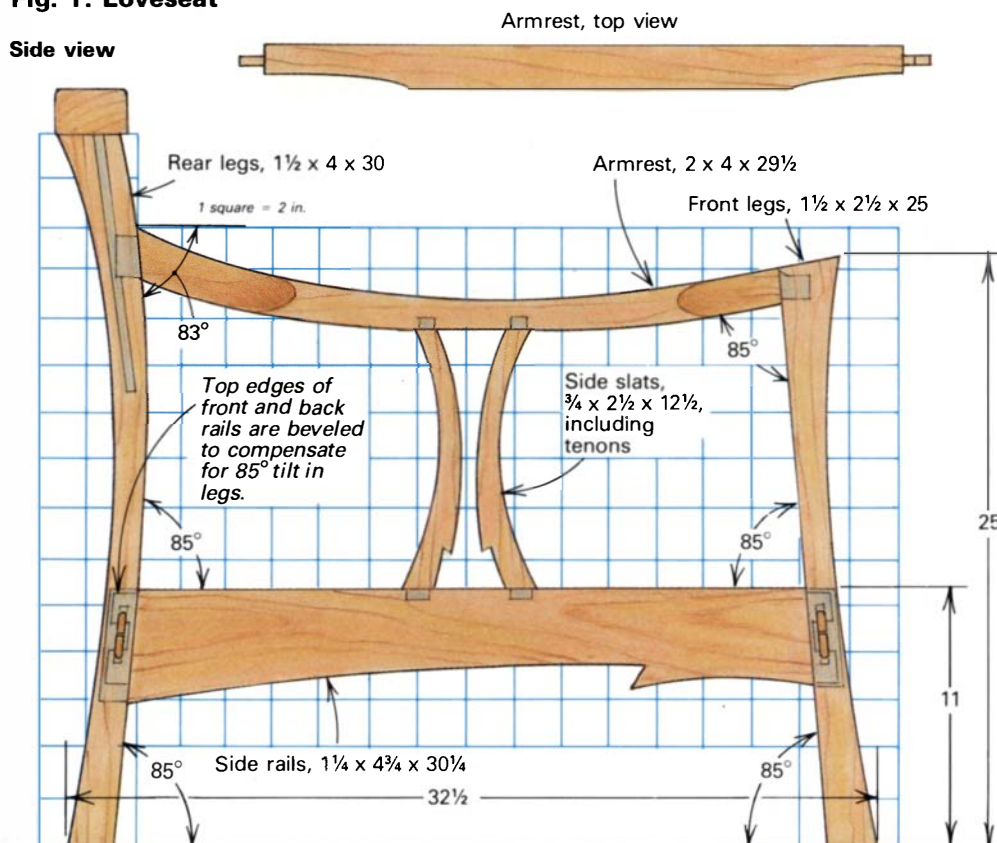
was glued to the frame and the rear legs. I also built the webbing frame separately and then screwed it to the loveseat rails and to glue blocks attached to the frame.

The legs are also simpler than they appear; their gentle curves largely conceal the flats left where the side rails and armrests join them. The inside face of each front leg is a straight line tipped back at an 85° angle to meet the side rail and armrest; only the leg's front edge is curved. The rear legs are a little trickier because of the way they bend away from the flats where the side rails and armrests intersect, as shown in figure 1. The top section of each rear leg leans back at 83°; the

lower part leans back 85°, just like the front legs. I refined these details, along with the armrest shape, slat profiles and the overall look of the piece, by making a full-size drawing and templates for the curved pieces before I began building.

Mortises with haunched-and-wedged tenons are used throughout. I cut the tenons on the tablesaw with a crosscut box and inserted wedges between the box's fence and the workpiece to angle the shoulders where necessary. A 5° wedge was used for the side-rail and armrest joints for each front leg; a 7° insert was needed for each armrest-and-rear-leg joint. In each case, I roughed out the

Fig. 1: Loveseat



tenon cheeks on the bandsaw, and then I trimmed them and cut the haunches with a tablesaw tenoning jig. The edges of the tenon were rounded over with a router. The tenons on the long front and back rails were cut the same way, but the job was tougher because of the length of the rails. Again, I cut the shoulders with my tablesaw's sliding carriage, but I had to set an auxiliary table beside the saw to support the end of the rail. I cut each tenon long enough to protrude through the leg slightly to facilitate cleanup after assembly. I also cut $\frac{3}{32}$ -in.-wide slots in the tenons for wedges, which I made from rosewood to contrast with the lighter cherry. To avoid splitting the tenons, I bored a $\frac{3}{16}$ -in.-dia. hole at the base of the slots to disperse the pressure when the wedge is inserted. The wedges were milled about twice the thickness of the slot and exactly to width.

Routing mortises for interlocking tenons

My system for cutting mortises is very simple. All that is required is an ordinary plunge router fitted with a guide bushing and several shop-built, L-shaped template guides. I keep several of these guides, like the one shown in the top photo on p. 47, in my shop; each is sized to accommodate a specific bit diameter and joint size. After the proper guide is clamped to the part being mortised, I can cut haunches, housed mortises or through mortises with this single template



Gently curving lines and pleasing proportions highlight this cherry loveseat. The slender legs conceal interlocking haunched mortises and tenons joining the sides and rails.

just by changing depth of cut with the router's adjustable stops. If I need to increase the setback of a mortise, as I did on one side of the legs of the loveseat, I insert shims between the guide and the workpiece. The key to making these versatile templates is to keep the guide slot perfectly parallel to the fence; I'll show you how to do that in the sidebar on p. 47.

In building the loveseat, I began by rough-milling enough cherry for the loveseat components and enough maple for the webbing frame. Then I cut the mortises in the legs before shaping them because cutting joints is easier when working from straight reference

surfaces. Because of the way the rear legs are laid out on the 4-in.-wide stock, I mortised at 90° to their inner faces for the armrest and side-rail joints. Then I shaped their inner faces as described below in the section on special procedures. The front-leg mortises, however, need to be at an 85° angle to the inside face of the leg so that the mortise will be parallel to the floor when the leg is tilted back. To angle the mortise, I routed an undersized 90° mortise and then chiseled the mortise ends at 85° to match the crosscut on the bottom of the legs. As an alternative, you could bore out the angled mortise with a drill press fitted with an angled table (see

Front view

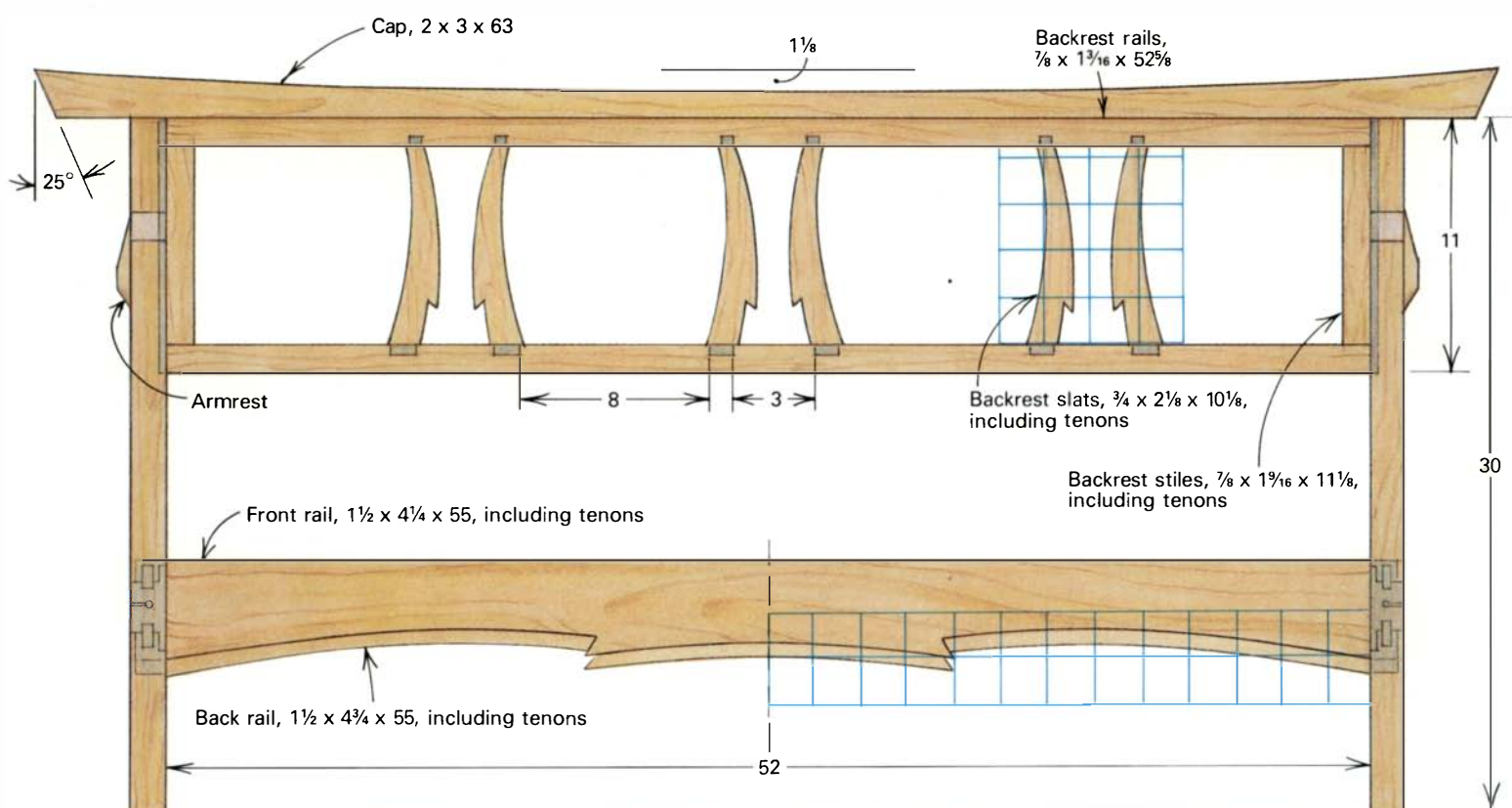
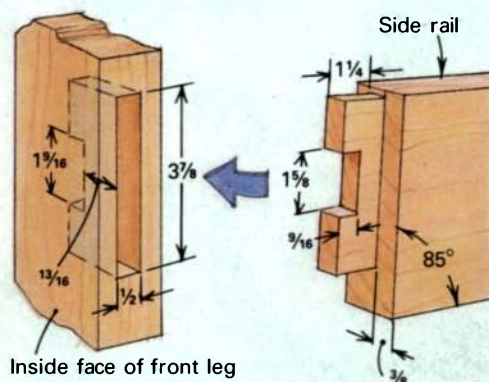


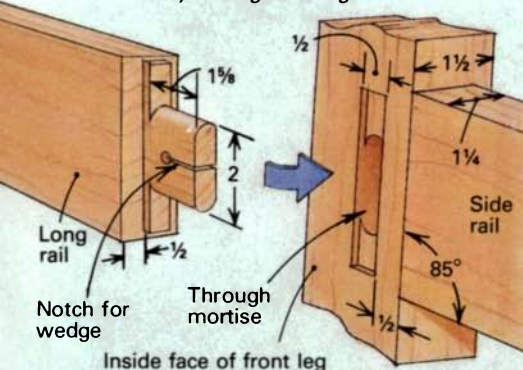
Fig. 2: Interlocking tenon joint

Step 1:
Mortise leg for side rail. First cut mortise $\frac{13}{16}$ in. deep; then cut to $\frac{1}{16}$ in. deep at both ends to leave $\frac{1}{2}$ -in. by $\frac{13}{16}$ -in. step in middle of mortise.



Step 2:
Cut side-rail tenon and notch it with bandsaw to fit over step in mortise.

Step 3:
Insert side rail in leg and rout shallow haunch mortise first; then rout 2-in.-long mortise all the way through the leg.



Step 4:
Cut haunch tenon on long front rail to fit through mortise.

Side-rail tenon will look like this after mortising through the leg for the long rail.

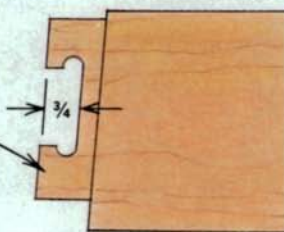
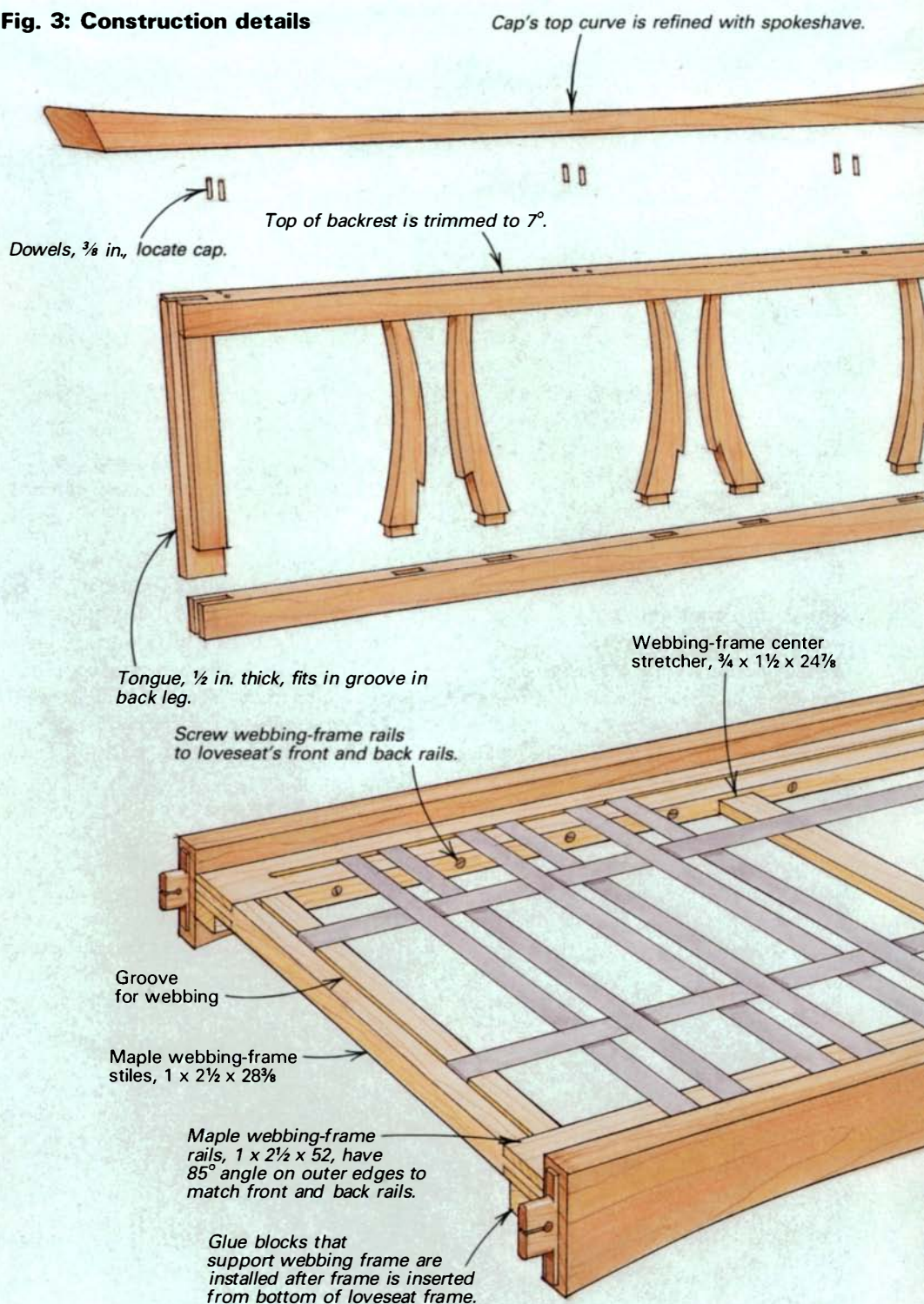


Fig. 3: Construction details



FWW #69, pp. 42-44), or you could simply insert a shim under the L-shaped guide.

The real beauty of these guides shows whenever I cut ramps and steps for haunches or interlocking joints, such as those between the legs and rails of the loveseat shown in figure 2 above. For the loveseat, I had to fit the long rails into skinny legs that had already been mortised for the side rails. And all the rails had to be at the same height and had to line up flush with the inside corners of the legs to support the webbing frame.

My solution was to cut double tenons for the side rails and a single, through-wedged

tenon for the long rails. The single tenon intersects the double tenon and locks it inside the slender leg. Since I wanted to cut both mortises with the same guide, I inserted a $\frac{13}{16}$ -in. shim between the guide and the wide face of the leg before routing the mortises for the side rails.

After clamping the guide and spacer to the wide side of the leg, I plunged down $\frac{13}{16}$ in. to cut the main mortise. Then I set the router's next depth stop $\frac{1}{2}$ in. deeper than the original mortise, and I made plunging cuts on each side of the mortise to accept the double tenon. I notched the center of the

original wide tenon on the bandsaw, so that the tenon would slide into the mortise. After the pieces were fit together, I clamped a guide to the adjacent face of the leg, this time without the spacer, and plunged down through the tenon and leg in two depth settings. On the first setting, I cut the shallow recess for the haunch; then I cut all the way through the tenon and leg to refine the mortise to accept the tenon from the long rail, as shown in the top photo on the facing page. You could also wait and mortise for the long-rail tenons after each side is glued up. In any case, repeat the process for each leg.

Next, the side rails were mortised for the two curved side slats, as shown in figure 1 on pp. 44-45. After dry-assembling the side to check the fit of the roughed-out armrest and side-rail joints, I measured the height between each armrest and its side rail to determine the shoulder-to-shoulder length of the slat. I also used a straightedge and square to extend lines up from the $\frac{3}{8}$ -in.-wide side-rail mortises to locate the slat mortises in the armrest. These mortises can't be centered in the armrest because it is slightly offset (see figure 1).

I trimmed the curves on the slats and rails with a flush-trimming router bit running against the full-size templates I previously made. To give the pieces a nice feel, I also crowned the concave edge of the slats and beveled their inner edges with a spokeshave. The armrests presented me with slightly different problems because they curve in two directions. I first bandsawed the top and bottom curves on each armrest and then refined them with a template-guided router. To curve the outside edge of each armrest so that it flows into the rear leg, I used a thin, flexible ruler to draw in the curve; then I bandsawed to the line, pivoting each armrest on its convex

face during the cuts. Finally, I crowned the top edges of each armrest with a spokeshave.

Special procedures for the loveseat

My design required a couple of special procedures before the sides and rails could be assembled.

To make sure that I angled the faces of the rear legs accurately, I cut the angles with an adjustable taper jig on my tablesaw. Two passes were necessary: one for the 83° angle on top and one for the 85° angle on the bottom. Later, I blended the areas between the flats and the angles with a spokeshave to create the impression of one continuous curve.

The bandsawn curve of the back edge on the rear legs also adds to the continuous-curve illusion, but the back-edge curve and the curve on the front legs aren't sawn out until each side frame is assembled (it's easier to clamp square components). Before glue-up, I chopped shallow flats into the front legs to prevent the clamps from slipping; the rear legs were clamped right on. When the frames were dry, I bandsawed the legs roughly to shape and cleaned up the curves with a router template guide and flush-trimming bit.



A plunge router and a simple L-shaped guide clamped to the leg are used to cut mortises in the legs. Here, the side rail is inserted into its mortise in the leg, and the author is routing through the leg and the side-rail tenon to form the interlocking rail-to-leg joint. The notched wood blocks flanking the template are stops for setting mortise length.

A simple router template for complex joints

Accuracy is an essential part of joinery, but you don't have to spend a lot of money to obtain it. One of my favorite and most-reliable mortising methods is based on an ordinary plunge router fitted with a guide bushing and an L-shaped template guide. The guide is made by tacking a piece of $\frac{1}{4}$ -in. plywood to a $1\frac{1}{4}$ -in.-thick strip of pine or other softwood nearly as long as the plywood. A 6-in. by 10-in. piece of plywood worked fine for the leg mortises in the loveseat discussed in the main article, beginning on p. 44.

The major difficulty in making a template guide is cutting the router slot parallel to the fence. The trick is to tack the plywood onto the softwood strip, with the plywood edge set back about $\frac{1}{8}$ in. from the outside face of the softwood. Then when the guide slot is routed, the softwood strip can be referenced right off the router-table fence and the slot will be cut square to the fence, as shown at right.

If you want to make a guide, first find the difference between the diameter of your guide bushing and the diameter of the router bit. This difference lets you know how much larger you must make the slot in the guide to cut the desired mortise. For example, if you have a $\frac{3}{8}$ -in.-dia. bit and a $\frac{1}{2}$ -in.-dia. bushing and want to cut a $\frac{3}{8}$ -in.-wide mortise, the slot must be $\frac{3}{8}$ in. plus $\frac{1}{16}$ in. on each side, or $\frac{5}{8}$ in.

To cut the guide slot, carefully draw layout lines on the plywood to indicate the mortise width plus the offsets. This way, the mortise wall will be the proper distance from the inside reference edge of the softwood fence. Also draw in the ends of the mortise, again with the proper offset.

Now, locate the router-table fence so you can hold the guide against it and over the bit. Plunge the guide onto the

bit to rout inside the mortise layout line farthest from the fence. Next, calculate the thickness of a shim needed to move the guide away from the fence enough to rout inside the other layout line. Remember to account for the bit's diameter when shimming the guide to cut the far wall. Hold the guide against the fence and the shim and over the spinning bit, and plunge the piece down. To finish, clear out the waste.

By using angled fences and shims, you can also make mortising guides for beveled surfaces. Just make sure to label these guides clearly so you can match them up with the proper bushing, bit and mortise setback. —G.R.



To widen the mortise guide's slot, Rogowski shims between the guide and the router-table fence, moving the guide enough for the spinning bit to cut the inner side of the guide slot.

Before assembly, I grooved the rear legs to accept the backrest. This 1/2-in.-wide groove was cut with a table-mounted router with its fence set to locate the groove parallel to the 83° flat area where the armrest joins the leg. The groove is centered in the leg; this ensures that the frame is well supported.

Because of the angle of the legs, the long rails automatically tip in toward the center of the loveseat. To establish a flat to match the webbing frame, I trimmed the upper edges of the long rails at a 5° angle. The bottom edges of the rails were bandsawn and routed to match my original pattern. The front rail fits into a narrow section of the front legs. To prevent the face of the rail from extending beyond the leg, I tapered the rail's ends with a spokeshave. I prefer this to thinning the entire length of the rail.

Assembling the loveseat

Gluing up a large frame like this takes some planning and careful attention. Clamping blocks must be routed out enough so that they can be taped to the legs and still allow the tenons to protrude. Also, blocks had to be cut to fit under the rails and support them when I glued up the long rails to the side frames. I began the actual assembly by putting glue in all the mortises, leaving a little extra glue at the mouth of each joint. After spreading glue on the tenons, I ran the long rails into one side frame, which I had set flat on a newspaper-covered bench. Then I tipped this frame up and set the rails on the support blocks, which held the rails at the

proper height to enter the other side frame. After pushing the side mortises onto the tenons, I clamped everything tightly. However, the job wasn't done because I had to insert the wedges before the glue set. So, once the shoulders were seated, I removed the clamps, braced the loveseat with my leg and pounded the wedges home. I usually don't put the clamps back on because they're not needed if the joints fit well. But if you have any doubts, it would be a good idea to reapply the clamps to ensure that there's adequate pressure on the joints.

Building the backrest and webbing frame

I milled the backrest, cap and webbing frame slightly oversized to allow for final fitting and trimming. The top rail of the backrest frame was trimmed at a 7° angle to match the tops of the rear legs. The cap was milled a little thick because I thought the piece might warp along its length after I cut its top curve. I planed off the extra material and flattened the piece before glue-up.

The backrest was assembled by fitting tenons on the six slats into mortises routed into the frame rails. Since the piece was designed to be seen from all sides, the backrest slats had to be shaped and finished like the side-frame slats. I also found it was a good idea to cut the tongues along the outer edges of the backrest stiles and test-fit them into the grooves in the rear legs before gluing up the frame. After the frame was dry, I routed the ends of the frame rails to form a matching

tongue and ripped the edge of the backrest's top rail flush with the tops of the rear legs.

After the backrest was glued in place, I used dowel centers to locate mating holes in the cap, the tops of the legs and the backrest's top rail, centering the cap over the legs. After drilling all the dowel holes, I put a thin bead of glue on the top rail of the backrest and clamped the assembly together using a long strip of 1/4-in.-thick plywood as a clamping pad. After the glue dried, I crowned the top edge of the cap with a spokeshave and sanded the cap smooth.

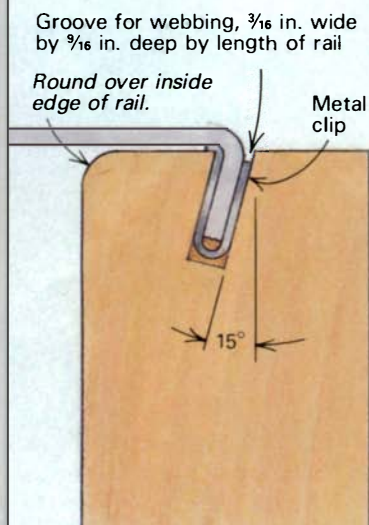
Now that the loveseat was essentially finished, I measured along the inside of the rails, about an inch below their top edges, to determine how big to make the maple webbing frame. I cut the long rails a little thick so I could rip opposing 85° bevels along their edges; this way, they would be parallel with the tilted front and back rails. Also, to prevent the seat webbing, described in the sidebar below, from distorting the frame, I added a center stretcher to the frame. Once all the parts were cut to the required dimensions, I mortised and tenoned the frame together.

I inserted the webbing frame from the bottom and screwed it to the rails. I also added glue blocks underneath the frame. Since foam-rubber cushions are available in different resiliencies, I made the seat cushion slightly firmer than the back cushion. The upholstery work was done by a friend. □

Gary Rogowski designs and builds furniture in Portland, Oreg.

Webbing for a comfortable seat

Fig. 4: Webbing detail



In recent years, I've had the opportunity to build furniture that has cushions. And I have been working with a tough, stretchy webbing that both increases comfort and regulates the softness or stiffness of seats and backs. As an added bonus, it's easy to install.

I generally buy this 2-in.-wide rubber webbing in 100-ft. rolls, and I also buy a couple dozen of the special metal clips needed to install the webbing. Each clip has a lip that fits into a slot machined into the seat frame. Four tiny teeth inside the clip grab the webbing firmly when the metal piece is crimped down with pliers or bench-vise jaws. The webbing and clips are available from The Woodworkers' Store (21801 Industrial Blvd., Rogers, Minn. 55374-9514) for \$1 per foot or 80 cents per foot if you

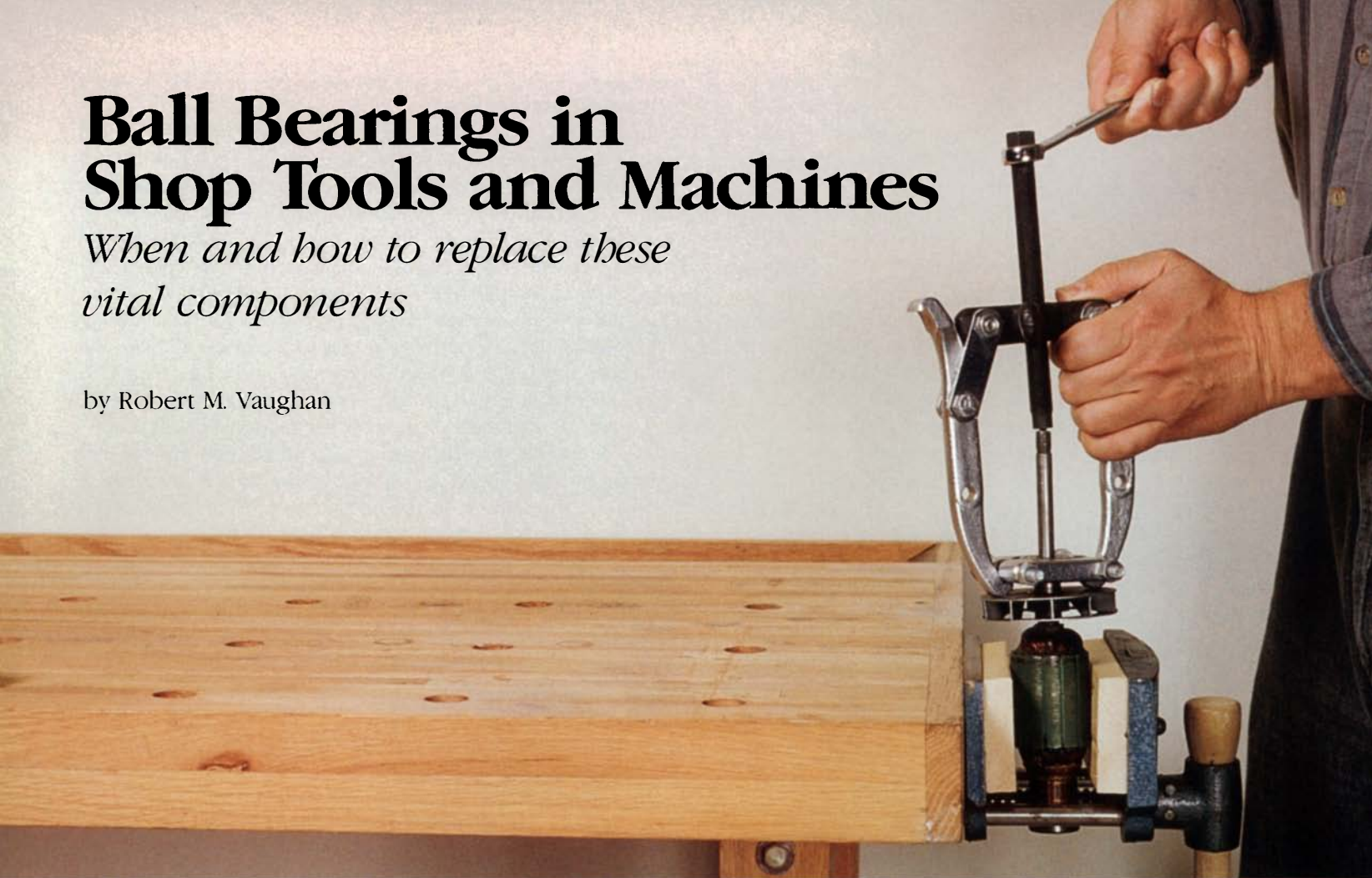
buy more than 100 ft. The metal clips are \$1.45 for a package of 10. Chances are, you can also buy small quantities from a local upholstery shop, but you'll probably pay a bit more.

To install the webbing for the loveseat in the main article, I cut the material to length with a knife. To get medium tension for the 26-in. front-to-back span, I cut the webbing 24 in. long and set 12 strips about 2 in. apart across the frame; two long strips of webbing run the length of the frame and are woven through the crosspieces to hold everything in place. I fit the clips in 3/16-in.-wide by 3/16-in.-deep angled grooves ripped the full length of the rails and stiles of the webbing frame, as shown at left. I also rounded over the inside edges of the frame to prevent damage to the webbing. —G.R.

Ball Bearings in Shop Tools and Machines

When and how to replace these vital components

by Robert M. Vaughan



Removing a ball bearing with a gear puller is the first step in replacing worn-out bearings. Shown above, a bearing separator inserted between the bearing and the fan on a hand-drill motor's armature provides a means for the puller to grasp the bearing.

Ball bearings are among the hardest-working components in any woodworking machine or portable power tool. At rest, they are constantly under stress from tight V-belts, and under a load, bearings take an incredible high-speed pounding. In addition, sawdust packs around ball bearings, threatening to contaminate their inner workings or soak out the lubrication within. The fact that these precise, compact, antifriction components last more than a few working hours is amazing.

Eventually, all ball bearings succumb to the affects of heat, dust and friction that are part of normal tool use and need to be replaced. Fortunately, a bearing is designed to be the weak and replaceable link in the power transmission train in any piece of quality woodworking equipment. Unfortunately, you might not know when a bearing is good or bad, whether you can remove and replace it yourself, or what size and type of bearing you need to replace the old one with. Since ball bearings are used in a million different applications in woodworking alone, I can't cover all the situations. But I can give you some good tips on how to spot a bad bearing and on how to remove and replace a bearing, if you're inclined to do so.

Ball-bearing anatomy

While all machines, motors and running mechanisms have bearings of some kind, not all are ball bearings. Some machines have bronze-sleeve bearings or poured-lead babbitt bearings, but ball bearings are more complex than either of these. A basic ball bearing is comprised of an inner race, which is a sleeve that fits around a precisely ground area on the machine's shaft (called the bearing seat) and has a groove in which the balls roll; an outer race, which captures the balls in another groove and fits into the socket or housing on the machine; a cage, located between the two races that

keeps the balls evenly spaced; any number of hardened-steel balls; and a shield that keeps the bearing's lubricating grease or oil from leaking out and prevents dust and debris from contaminating the bearing. Variations in size, material, design and grade differentiate one bearing from another. Some bearings use double rows of balls, and some use rollers—straight, tapered or thin needles—in lieu of balls. Any ball bearing is capable of operating under a higher work load, running at a higher RPM and lasting longer without relubrication than less-expensive bronze-sleeve bearings. But state of the art or not, ball bearings still do wear out and need to be replaced, so you must be able to tell a good bearing from a bad one.

Diagnosing bearing problems

Figuring out whether or not your machine has a bad ball bearing isn't as simple as you might think because different problems will often produce the same symptoms. A difference in the feel or sound of a running power tool might indicate that a bearing has started to go bad, but not always. For example, loose pulleys on stationary power tools are infamous for mimicking the sound of bad bearings, and on portable power tools, bad brushes will do the same. Since fixing a pulley or brushes is easier than replacing bearings, check your machine carefully for loose or vibrating parts before disassembling it. Audible rumbles and clicks when a machine starts or coasts to a stop can indicate a lack of lubricant in a bearing and warn of an oncoming failure. When a machine's sound changes octaves—from a whispering baritone to a sore-throat soprano—you should suspect that the bearings are the problem. Any looseness in a power tool's shaft or arbor indicates a bearing-related problem, but not necessarily a bad bearing. A worn bearing socket, a common problem with portable power tools, usu-

ally results in a worn shaft. Excessive shaft wear can also occur when the ball bearing itself freezes up, but the shaft continues to rotate inside the inner race—usually requiring extensive repairs.

Some shop situations that seem unrelated to a machine's bearings can cause problems. For example, repairing a stationary machine with an arc welder can ruin the bearings; the massive current flow can cause the electric arc to jump the small gaps between the bearing's balls and the races, causing fine pitting and, eventually, premature bearing failure. A machine that's been submersed in water, such as in a flood, is another candidate for early bearing failure. Grit and debris can flow and settle into bearings and cause failure, sometimes after only a few hours of operation. Hence, any machine that has been in a flood should have all bearings replaced. If a machine's bearings continually go bad, examine other causes, such as a bent shaft, an out-of-round bearing seat or a worn bearing housing.

When you locate a bad bearing, your first tendency will probably be to relubricate it. However, the majority of ball bearings found in woodworking machines either are permanently sealed and lubricated or they are shielded bearings, which can be difficult to relubricate; in either case, replacement is recommended. Non-sealed bearings that lack shields are most often seated in housings with grease nipples, and these bearings should be lubed as part of the machine's standard maintenance. Whatever you do, resist the temptation to spray a noisy bearing with a penetrating lubricant, like WD-40; it will eventually dry and leave an undesirable sludge film inside the bearing.



Pressing a new ball bearing on a machine's shaft is best done with a hydraulic or arbor press, but it can also be done with a pipe and a mallet. Above, the shaft (a table-saw arbor) is placed on a wood block on the floor. Then, a pipe fit over the bearing's inner race is pounded until the bearing seats.

A drill press can press on small ball bearings, like the end bearings on a router's armature (right). Pipe that fits over the bearings' inner race is mounted in the chuck, and pressure is applied by lowering the drill-press quill.



Extracting bearings

Removing and replacing ball bearings yourself can save time and money, but you must proceed carefully to avoid problems. Before old bearings can be extracted, a power tool or motor must be disassembled, and usually the arbor assembly must be removed from the machine. First and foremost, *unplug the tool or motor before beginning*. Keep in mind that disassembling a tool usually voids a still-valid warranty, and that unless you're careful and work in a clean environment, taking any machine apart can lead to other problems, such as losing or contaminating crucial parts or reassembling the tool incorrectly. If you don't have the proper tools, take the job to a reputable machinery-repair shop. Portable power tools can usually be sent back to the manufacturer for bearing replacement.

Once a bearing shaft or housing is exposed, you may have to remove snap rings, which are sometimes used to hold the bearing in place on the shaft or in the housing. Snap rings are best removed with special pliers designed to engage the holes on their ends. There are two separate kinds of snap-ring pliers: one for snap rings that have to be compressed for removal (used in bearing housings) and the other for rings that must be expanded for removal (used on a shaft). Trying to remove snap rings without these special pliers is extremely difficult, and you also risk damaging the seals or shields of a bearing.

After the snap ring is removed, the bearing will usually slip fairly easily from its housing, which is typically part of the cast body of the machine or motor. But if the bearing's inner race fits tightly

against the shaft, a lot of force is required to remove the bearing from the tool's shaft or armature. I've used a couple of big screwdrivers and a vise to remove a few bearings, but I damaged the parts in almost every instance. The lesson here is use the right tools. Hydraulic H-frame or rack-and-pinion arbor presses are the best devices for either removing or pressing on bearings. However, a bearing (or gear) puller also works well, is affordable, is available at better auto-supply stores and bearing suppliers, and can also be rented. A good, all-around puller has two or three claws, which grip the bearing's outer race, and a center screw that bears against the end of the shaft and pulls the bearing out as the screw is tightened with a wrench. Sometimes the claws can't reach around the bearing, such as when a motor's cooling fan is in the way. In that case, you can use a bearing separator. This device consists of a split plate that is dished out to fit into tight places and is drawn together behind the bearing with two bolts. The bearing puller's jaws are then fit around the edges of the separator, and the puller is used as just described (shown in the photo on p. 49).

For light bearing-pressing work, like removing armature bearings on portable power tools, you can use a drill press as an arbor press. First, insert a hardened-steel dowel or pin all the way to the back of the chuck, and tighten the dowel in place. Then, support the ball bearing on either side with a couple of scraps of wood, and lower the drill-press quill to force the tool's shaft from

the bearing. However, reserve this method for *small bearings that press out easily*, and use it only with a high-quality drill press; the abuse could strip drill-press gears.

Buying replacement bearings

Ball bearings come in hundreds of types and sizes. Standard sizes for bearings are in metrics, except for a couple of inch-size series and a few metric/inch combination sizes. These specifications are also true of router-bit pilot bearings and other portable-power-tool bearings. Bearings also come in different grades, from one to seven, the latter being the most precise, durable and expensive.

When I'm ready to buy new ball bearings, I contact the machine's manufacturer or dealer so that I'm certain of getting the right replacement bearings. If the manufacturer or dealer doesn't stock the part (or if I need bearings quickly), I visit my local bearing supplier. (Check the yellow pages of your local phone book under "bearing suppliers" or "power transmissions.") I've purchased ball bearings from mail-order companies, such as W.W. Grainger Inc., 5959 W. Howard St., Niles, Ill. 60648; call (312) 647-8900 for your regional distributor. I've also gone to local skateboard shops, lawn-mower shops and other equipment-repair shops to get a replacement when in a pinch. Visiting a skateboard shop may seem farfetched, but skateboard-wheel bearings that sell for about \$1.50 are the same size and type as the sealed bearings commonly used in portable power tools. And these bearings can cost \$5 or more from a bearing-supply shop.

Each manufacturer has its own numbering and lettering system (marked on the bearing) to denote the bearing's dimensions, type of seals and grade. Bearings of the same external dimensions may seem interchangeable, but may not be. For example, ball bearings found in many tablesaw arbors and lathe headstocks contain a double row of balls; single-row bearings of the same size do exist, but aren't as durable. So before ordering a replacement, get a strong magnifying glass and read the numbers, letters and manufacturer's name on the side of the bearing. If bearing suppliers don't carry the same make of bearing, they can cross-reference your bearing's designation to their brand. I always bring the old bearing along; if I can't get an exact replacement, I can usually find a substitute that will work. Exact bearing replacement is usually recommended, but changing an older machine's open or shielded bearings to fully sealed bearings may be a good idea, such as on a tablesaw where sawdust has caused premature bearing failure. Without getting into a lengthy discussion of choosing higher-grade bearings (for information on this, consult SKF's booklet cited at the end of the article), let me just say this: Don't try to save money by buying bearings that are a *lower* grade than those the machine's manufacturer specifies. You'll face more frequent replacement with inferior bearings, and they can cause more serious problems, such as scored shafts.

Installing new bearings

Pressing a ball bearing on a shaft usually isn't as delicate as extracting a bearing, but it's still best done with a hydraulic or arbor press. In lieu of a press, a hammer and pipe will suffice if used judiciously. Select a pipe that just fits over the machine's shaft and that will contact only the inner race of the bearing. Make sure the pipe's ends are cut square and that any rough edges are filed smooth, lest they damage the bearing or shaft. Now, place one end



You can build up a worn-out bearing socket, such as the one shown here on the bottom plate of an orbital sander, with fortified epoxy. To do this, give the new bearing a light coat of wax, apply epoxy to the worn socket and set the bearing in place.

of the shaft on a hardwood block on a solid floor, slip the new bearing on the shaft, and fit the pipe down over the bearing's inner race. Tap carefully on top of the pipe with a hardwood mallet, a dead-blow hammer, or a regular hammer and a block of wood until you feel the bearing make solid contact with its seat (see the left photo on the facing page). When you first start tapping, be sure the bearing is straight on the shaft, or you could ruin the shaft, the bearing or both. For pressing lighter bearings onto portable-power-tool shafts, you can use a good drill press as discussed earlier (see the photo at right on the facing page); just substitute a piece of pipe for the pin in the drill chuck.

Occasionally, you'll find that a new bearing fits loosely on its shaft or in its bearing housing, indicating excessive wear in those areas. You can usually repair the worn areas with fortified epoxy (such as Loctite Weld brand, available at bearing- and machinist-supply stores), but I mix my own by adding finely shredded fiberglass from insulation to regular two-part epoxy. To build up a worn bearing housing in a router, for example, I first apply a thin coat of wax over the new bearing to keep it from gluing permanently in place. Next, I spread a layer of the epoxy on the inside of the worn housing (shown above). Then I reassemble the machine and let the epoxy cure. I've also used this technique to build up the bearing seat on lightly worn tool shafts; if you do the same, clean the shaft thoroughly with a solvent, such as lacquer thinner, before applying the epoxy. Loctite makes a more expensive compound called Quick Metal #660 (also sold at bearing- and machinist-supply stores) that works well for filling gaps up to 0.020 in.

More information

I've just skimmed the surface of ball-bearing problems and remedies encountered with woodworking machinery. If you face a problem not discussed here, you might try contacting a bearing manufacturer's technical-service department, although I prefer talking to a knowledgeable person at my local bearing-supply store. A booklet by ball-bearing manufacturer SKF called the *Bearing Installation and Maintenance Guide* is free at bearing stores and through SKF Bearing Industries Inc., 1100 First Ave., King of Prussia, Pa. 19406-1352; (215) 391-8000. Although primarily for maintenance engineers who service big machines, like newspaper printing presses, the booklet offers useful technical information that relates to the bearings used in woodworking machines. □

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

A Beginner's Jewelry Box

Tablesaw tricks with casing, curves and coves

by Jim Cummins



A tablesaw is the only tool required to build this jewelry box. The curved sides are glued-up strips that were ripped from standard, lumberyard-variety door and window casing. The sides were then covered with shopmade veneer that was steam-bent over a tea kettle.

Although gray around the muzzle now, I can remember being a novice woodworker with a lot more enthusiasm than equipment. My workhorse at first was just a cranky old Sears tablesaw, and I often felt intimidated by my lack of a full workshop. Eventually I replaced my old saw, and through the years, I acquired a 6-in. jointer, a radial-arm saw, a bandsaw, a drill press, a planer, a light-duty shaper and a lathe. With tools properly sharpened and set up, this old dog can finally make just about anything that takes his fancy; except that darn box on p. 76 of *FWW* #87.

The box is barely noticeable in the background of a photo—just an incidental knickknack on a bedside stand. But this box bothered me because I knew that with all my tooling, I still couldn't machine its gently curved sides. I'd need either a crown-molding plane, and an apprentice to help pull it, or a \$7,000, 3-phase shaper and a custom cutter to mold that profile.

Then I reconsidered. After all, in the early days, I had made a living with my trusty tablesaw without resorting to fancy machines and high-priced technology. How would I have handled this job way back then? How could any beginning woodworker handle it today?

A few minutes spent studying the moldings available at the local building-supply yard provided the answer. The shallow curve of a standard 3-in.-wide ranch-style pine casing was just what I was looking for. All I had to do was buy two 6-ft. lengths of casing, rip a 1½-in.-wide strip from each length and edge-glue the strips together to form the curved surface I was after for the box sides (see the drawing on p. 54). The rest was easy. Since I didn't want to build a pine box, I covered the sides with walnut veneer that I resawed on the tablesaw. The bottom of the box is ¼-in.-thick plywood set into a rabbet in the sides. Because plywood is stable, I also used it for the hinged lid, but surrounded it with solid-walnut mitered edging. The edging is rabbeted to hold both the ¼-in.-thick plywood that forms the top surface and a ½-in.-thick mirror on the inside of the lid. I veneered the plywood top with an unknown species that

was left over from a variety pack assortment of veneers that I got years ago from Constantine (2050 Eastchester Road, Bronx, N.Y. 10461). As a finishing touch, the interior is velvet lined. And the best part of building this box is that the only power tool I needed was my tablesaw.

Making and veneering the sides

The secret weapon that forestalls many problems in the construction of this box is a roll of 1-in.-wide masking tape. Consider the first step: After you've ripped the curved edges from the ranch-style casing, you have to edge-glue two strips together to form the curve of the sides, as shown in the drawing. Because of the curve, ordinary clamps won't bear properly, and the pieces will snap apart under pressure. But masking tape wrapped tightly around the work every few inches will hold the pieces in perfect alignment, and the tape generates enough pressure for an airtight glue joint. Keep your masking tape handy; it will prove essential again as this job proceeds.

After the sides are dry, you need to veneer the curved surface. You could use store-bought veneer, but I cut my own on the tablesaw by ripping thin slices from a 2¼-in.-wide board that I ran with its edge down and its face guided by the rip fence. When sawing the veneer, you will get the cleanest surface if the veneer is not trapped between the blade and the fence. If you cut the veneer in several pieces (like from a short scrap), you'll have to reposition the fence between cuts. The slices should be approximately ⅛ in. thick, but they don't all have to be exactly the same. Next, for convenience in handling, cut the core and veneer into pieces a little longer than the box sides will be. Take note that the veneer must be slightly narrower than the core or it will buckle during glue-up.

Shopmade veneer in hand, you will doubt that it will bend to the core's curve. Don't despair. I used a standard kitchen tea kettle to steam one side of the veneer only, as shown in the photo at the



Masking tape is an essential "tool" for building the jewelry box. Above, the author "clamps" the steam-bent veneer to one of the pine box sides. Masking tape was also used to clamp the two pieces of curved molding together to form each side.

bottom of this page. As the steamed side expands from heat and moisture, the whole piece will curve smoothly. To hold the curve as the piece cooled and dried, I placed it inside a paper restraining sleeve, which can be seen in the foreground of the top photo. To make the sleeves, just wrap paper around each flat veneer strip and tape it up. Remove the veneer for steaming, and gently coax the wood to its curve. The thinner the veneer, the easier it will bend. The process can happen rapidly, or it might take as long as 15 minutes for a stubborn piece. Don't rush; brute strength will crack the veneer. When you have the curve, slide the hot wood into the sleeve, and stuff the concave side with crumpled newspaper to hold the shape (see the top photo).

When the veneer is dry, apply glue to the core only. Ordinary white glue works better than yellow carpenter's glue for this job, because white glue doesn't grab as quickly. Lay the veneer over the core and quickly secure this assembly with masking tape at the center and ends, as shown in the top photo. Then encircle the entire piece with strips of tape. Work quickly because as the veneer becomes wet from the glue, it will begin to flatten out again. If the veneer resists, apply a tight first layer of tape one piece at a time, and then wrap the whole length in an overlapping spiral of tape, pulling each turn tightly. The masking tape prevents the glue from drying as fast as usual, so don't remove the tape for at least 24 hours.

To clean up the top and bottom edges of the veneered sides, rip about $\frac{1}{8}$ in. from each edge of all the side pieces. Then, attach a wooden auxiliary fence to the rip fence so that you'll be able to cut with the blade against the auxiliary fence. Now, cut a $\frac{1}{4}$ -in.-wide rabbet in each side piece, for the box's bottom, by making two passes with a standard $\frac{1}{8}$ -in.-wide blade. Make the first pass on all the sides laid inside-face down on the saw table with the auxiliary fence against the blade. Move the fence $\frac{1}{8}$ in. away from the blade, and make the second pass. The blade should be raised just high enough to meet the veneer when the box side is laid inside-face down on the saw table.

At this point, you can veneer the inside face of the core for a better appearance and a more balanced construction, or you can leave it bare and then later line the box with fabric as I did.

To cut miters for joining the corners of the box, I tilted the tablesaw blade to 45° , laid two opposite-side pieces flat-face down and edge to edge on the saw table, and pushed them past the blade with the miter gauge. By cutting two side pieces at one time, I was assured that their length would be equal.

With the miters cut, I used masking tape to dry-assemble the box sides so I could measure for the top and bottom. Next, I cut the $\frac{1}{4}$ -in.-thick plywood bottom and then fit it into the taped-up



Steaming one side only of shop-cut veneer causes the steamed side to expand, gently curving the veneer along its length. Cummins then slipped the veneer into a paper sleeve to hold the curve.

box. With a tight-fitting bottom in place, you can double-check the accuracy of the miters; the bottom will also hold the box square during glue-up. But don't glue the box yet because you will need to take it apart to install the hinges.

Making the lid and coving the edge profile

Rip enough wood for the rabbeted lid frame, according to the dimensions in the drawing. I mitered the lid's frame as I did the sides, rabbeted it for the mirror and the veneer-covered plywood, and then glued the frame pieces together using masking tape for alignment and a light-duty band clamp for pressure. If you don't have a band clamp, you can use a string tourniquet or rubber bands cut from an old inner tube.

I originally planned to simply round over the edges of the lid using a router, but my wife, Karen, insisted that an ogee shape would look better. Since I didn't own a suitable router bit, I shaped most of the edges by making cove cuts on the tablesaw and then finished up with sandpaper. (For more on coving on the tablesaw, see *FWW* #87, p. 51.) Cove cuts are made by passing the work over the blade at an angle, as shown in the top photo on the

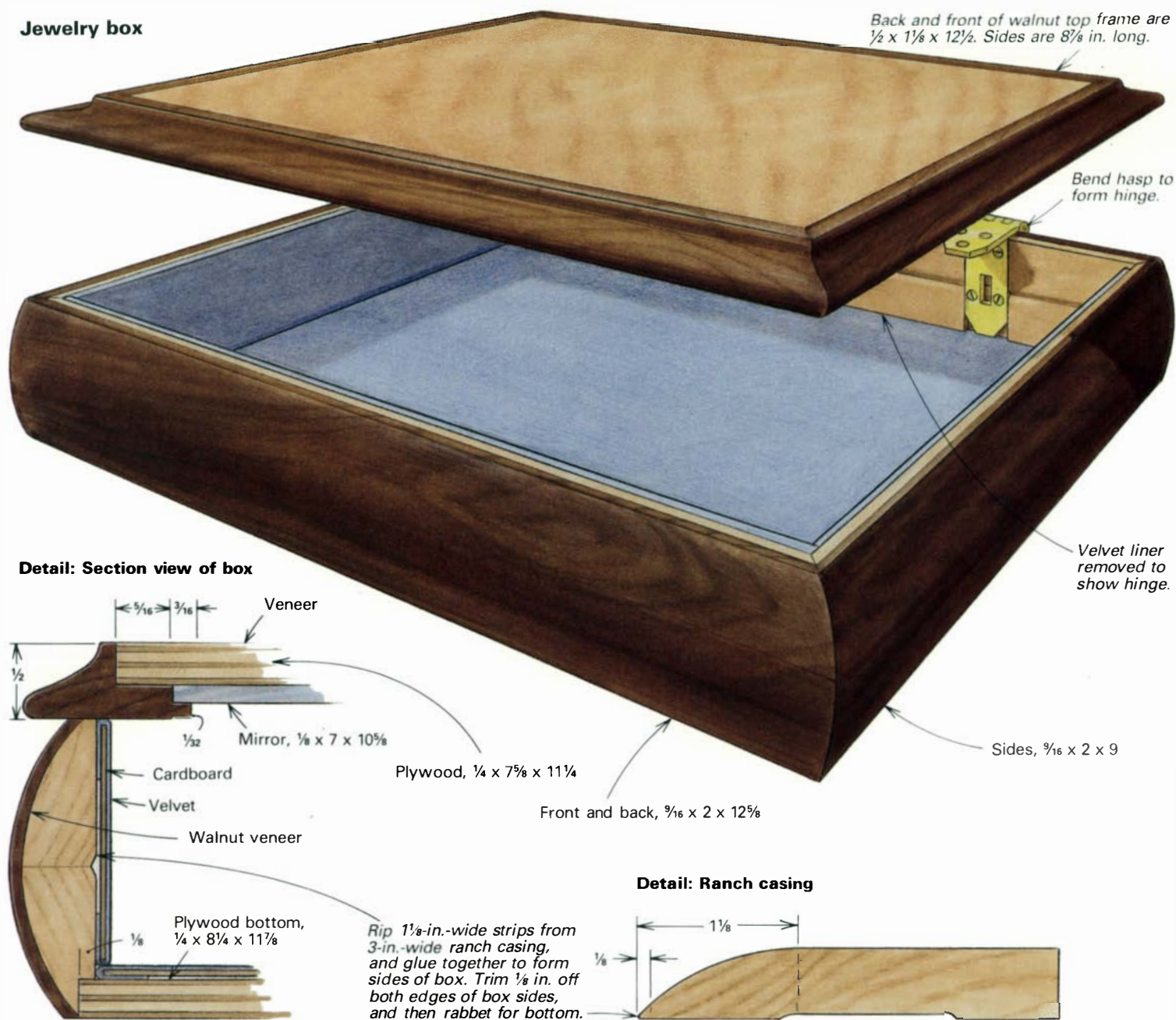
facing page. The resulting shape is a segment of an ellipse. Cove cuts have to be cut with a series of very shallow passes, removing a maximum of about $\frac{1}{8}$ in. at a time. Be sure to run all four edges past the blade before you raise it for the next series of passes. Your final cove doesn't have to match mine, but be sure you have left enough wood for the hinge screws.

For final-shaping the lid frame and to remove sawmarks from the cove, I used 80-grit sandpaper on a Rockwell pad sander. I also used the sander to round over the outer lip on the top and bottom of the lid. To avoid swirl marks, which are the bane of a pad sander's existence, dust the work frequently and slap the paper to remove clogging dust and any loose abrasive particles.

Mounting the hinges

Because I couldn't find suitable hinges in my woodworking catalogs, I purchased two solid-brass hasps (Brainerd Manufacturing Co., 115 N. Washington St., East Rochester, N.Y. 14445; #804XC) at a local hardware store and bent them to shape in a vise. I then drilled and countersunk screw holes. Your hinges don't have to match mine exactly; anything similar should work fine.

Jewelry box



To mortise the bent hinge leaves, I first disassembled the box and raised the tablesaw blade the thickness of the leaf. Then I laid the back side of the box flat on the saw table, and with the edge riding against the miter gauge and with a mitered end riding along the saw's fence, I crosscut a slot 1½ in. from each end of the piece. By moving the fence a blade width farther from the blade after each pair of cuts until the slot width matched the hasp width, I was left with matched hasp mortises, as shown in the bottom photo. Because the hasps I used have a large hinge barrel, I notched the back of the box to lower the barrels so there would be just a slight gap along the back of the box when the lid is closed. I cut these barrel notches in the same way as the leaf mortises, but with the flat side of the back, instead of its edge, against the miter gauge.

This is a good time to screw the hinges to the back of the box. If you wait until the box is assembled, you'll be working in tight quarters. I drilled pilot holes and then clipped off the ends of the screws so they wouldn't break through to the outside or show up under the finish a few weeks later as a telltale split or bump.

After you have attached the hinges to the body of the box, glue up the sides and bottom using masking tape to hold the pieces in alignment until you can get a band clamp in place. Now you can attach the lid using the old epoxy trick: First, shim the hinge leaves slightly open with a loosely knotted rubber band. Then, apply a scant drop of five-minute epoxy to the top hinge leaves, and lay the lid in position. Wait a few minutes before opening the lid and drilling pilot holes for the screws. You can then pry the lid from the hardware with a chisel and go on to finishing the box.

Finishing touches

I sanded the sides with 80-grit paper to remove the sawblade marks and the fuzzy grain that had been raised by the steam. Then I went over the entire box with 220-grit sandpaper, first with the pad sander and then by hand in the direction of the grain. Next, I applied walnut stain to the edges of the sides so the pine core wouldn't be obvious.

Because of the small size of this project, I decided to finish it with Crystal Clear Krylon, an aerosol lacquer available at hardware and art-supply stores. For small jobs, an aerosol saves me the trouble of setting up and cleaning my regular spray equipment. If you want to try Krylon, spray on coats that are wet but very thin. The first coat will show any areas that may need further sanding, which can be done almost immediately because the raw wood will absorb most of the solvent in the lacquer. Another couple of coats will be needed before the entire surface begins to acquire a gloss. These first few coats offer a chance to practice your spraying skills because runs, drips, spitting (from residue allowed to accumulate around the nozzle) and puddles can be wiped off with a clean rag. Allow this base of lacquer to dry overnight, and then apply subsequent coats at the rate of about two per day until you are satisfied. For an ultimate finish, apply a dozen coats, and let the box sit a week. Then cut the gloss with 600-grit, wet-or-dry paper (used with water), and polish with a paste of rottenstone and water (or auto-polishing compound). When polishing, check your work frequently to avoid cutting through the finish.

The box is lined with velvet-covered strips of cardboard, as shown in the bottom photo. Mat board is ideal, but even cardboard from a cereal box will do. Cut the cardboard and the velvet strips to size, and glue the velvet to the cardboard. Be sure to keep your work area and your hands clean during this operation; if any glue gets onto the show surface of the velvet, you'll have to start over. When these pieces are dry, tack them into the box with small drops of glue.

Further refinements such as locks, lid stays and compartments



The edge of the box lid is coved on the tablesaw. Numerous shallow passes are made over the blade guided by a rip fence, the angle of which determines the shape of the cove cut. Cummins uses a simple jig to support the workpiece and to shield his hands from the blade.



Velvet-covered cardboard strips line the interior of the box and conceal the hinge mortises. The hinges are actually brass hasps from a hardware store. The mortises were made with a series of shallow cuts on the tablesaw before the box was assembled.

are beyond the scope of this article. At this point, I'm satisfied to have proven to myself that I can get by without that expensive shaper, at least for one more year. Karen fully agrees with this sentiment, and she also appreciates her new jewelry box, with lid of her own design. □

Jim Cummins, a past associate editor at FWW, owns a picture-frame shop in Woodstock, N.Y. His two woodworking videos, on small-shop techniques and making boxes, are available from The Taunton Press, 63 S. Main St., PO Box 5506, Newtown, Conn. 06470-5506.



This shop-built router table is sturdy yet lightweight and knocks down for portability. It also has a quick-clamping fence with an adjustable bit opening, a dual-router setup and a built-in dust-collection system.

Building a Router Table

A drop-in baseplate for easy access

by Ed Walker

There is no quicker or cheaper way to increase your shop's versatility than by table-mounting your router. A table-mounted router is an excellent substitute for a light-duty shaper. With an almost endless variety of reasonably priced bits to choose from, a router table lets you shape, mold, bevel, groove, dado, mortise or trim just about any wood part you can balance on a tabletop.

A router table can be as simple as a piece of plywood sitting on sawhorses, or it can include an elaborate base cabinet full of drawers. Many woodworkers have installed a router in their workbench or tablesaw extension. Others have made router tabletops that can be clamped in a vise and supported on hinged legs and then stored out of the way when not in use. Some of these options are discussed in the sidebar on pp. 60-61. The popularity of shop-built router tables has led to the recent proliferation of commercially available models offered by both small and large manufacturers. When I was in the market for a router table, I examined most of the commercial tables. I concluded that because of their simplicity and because most of them incorporated different ideas developed

by ingenious woodworkers in the first place, I could build a router table that would suit me better than any I could buy.

I thought my first router table was the ultimate design. It included a large, heavy base cabinet with lots of storage, and it had built-in retractable casters so I could move the table around the shop. However, my second router table, shown in the photo above and in figure 1 on the facing page, has become my favorite. The base of this router table is designed to be easily disassembled so I can transport it to job sites or to demonstrations that I conduct. My portable router table incorporates one of the most significant advancements in table-mounting routers: The concept of mounting the router to an oversized baseplate that can be inserted flush into a rabbeted hole in the tabletop. There's no need to screw the plate to the table because the weight of the router holds it down. This method of mounting allows fast removal of the router from the table for changing bits or for using the router by hand. I decided to make two cutouts in my tabletop so I could insert two routers with different bits. Occasionally, this is a handy feature, but since I

(continued on p. 58)

Fig. 1: Router table

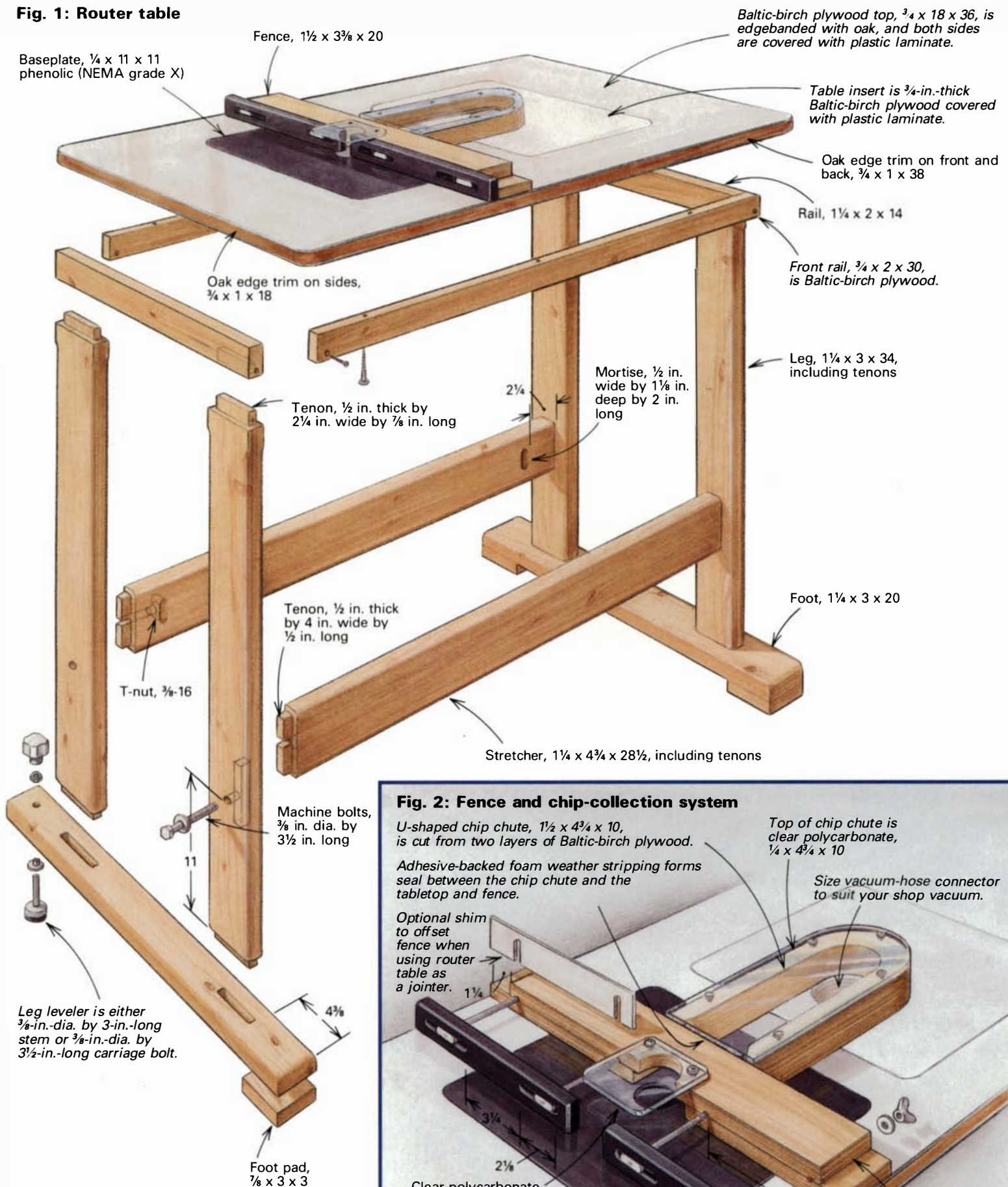
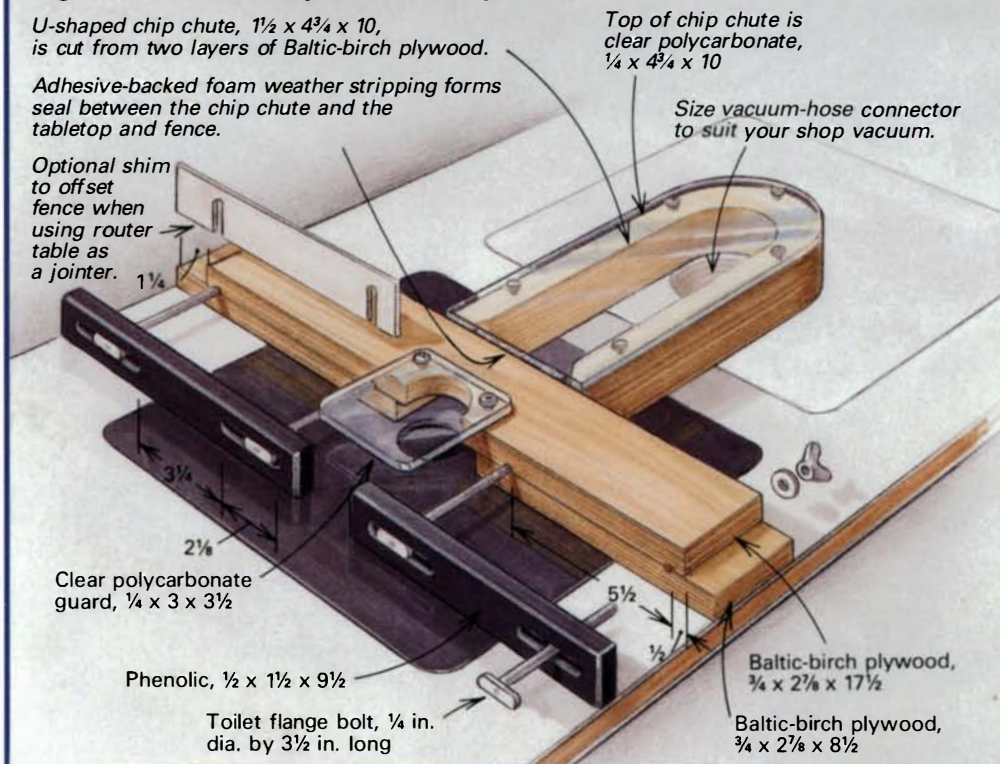


Fig. 2: Fence and chip-collection system



usually only have one router mounted in the table, I made a special table insert for the other cutout that allows me to hook up a shop vacuum for chip removal (see the photo on p. 56).

You may choose to build a more elaborate router table than the one I'm describing in this article, or you may go for the piece of plywood on sawhorses. But no matter what type of table you decide to build, I think you'll find the tips and guidelines I present on the main components of my router table helpful.

The router-table base

The primary function of the base is to place the work surface at a comfortable height. The tabletop should be at least as high as the distance from the floor to your wrist, but lower than the distance from the floor to your elbow; 34 in. to 38 in. is about right for most people. The type of work you do will help determine the best height. Generally, small, detailed work will be most comfortable at elbow height.

As I mentioned earlier, I needed a portable but steady router table to take to demonstrations. To reduce both costs and weight, I built the base from construction-grade spruce 2x4s and 2x6s. The legs are mortised, tenoned and glued to the top rails and feet, but the stretchers are attached to the legs with $\frac{3}{8}$ -in. machine bolts that thread into T-nuts captured in mortises in the stretchers, as shown in figure 1 on the previous page. The front and back rails are screwed into the ends of the side rails and to the underside of the top. After mortising and tenoning the legs and stretchers, I routed blind mortises in the stretchers for the T-nuts. Then I drilled $\frac{7}{16}$ -in.-dia. holes through the legs and through the ends of the stretchers to meet the mortises. I dry-assembled the base to make sure everything fit properly. Then I rounded over all the edges except the top rail and the top inch of the legs, and sanded the individual components. I glued up the two leg assemblies (each consisting of two legs, a side rail and a foot), making sure they were flat and square. To complete the leg assemblies, I glued three pads onto the feet and installed a leg leveler in place of the fourth foot pad. One leveler is all that's needed to stabilize the base on uneven floors. If you cannot find a suitable leg leveler at your local hardware store, you can substitute a carriage bolt screwed through a T-nut on the bottom of the foot with a threaded knob locked in place on the threaded end of the carriage bolt.

After bolting the leg assemblies to the stretchers, I fastened the front and back rails to the ends of the side rails with #10 by 2½-in.-long washer-head screws countersunk $\frac{3}{8}$ in. deep. These screws reach into the leg tenons, providing much better holding power than the endgrain of the side rails alone. The top is later secured by screwing through the front and back rails into the underside of the top.

The router-table top

A router-table top needs to be strong, stable and smooth. I made my top from $\frac{1}{4}$ -in.-thick Baltic-birch plywood. I glued on oak edgebanding and then covered both sides of the top with plastic laminate, as shown in figure 1 on the previous page. The front and back rails attached to the underside of the top help keep it flat. Medium-density fiberboard (MDF), at least 1 in. thick, also makes an excellent top. Particleboard could be used, but I don't recommend anything less than 1¼ in. thick because I've heard of router baseplates tearing through the $\frac{1}{2}$ -in. thickness left after rabbeting $\frac{3}{4}$ -in.-thick particleboard. No matter what material you use, both sides of the top should be covered with high-pressure plastic laminate, and all edges should be laminated, banded with hardwood strips or otherwise sealed for stability. A light-colored, matte laminate allows temporary layout lines to be marked on the top and

then cleaned off easily. An occasional coat of paste wax will prolong the top's life and make sliding material over the top easier.

A top that is 16 in. to 24 in. wide by 30 in. to 48 in. long will suit most needs, although you may want to modify these dimensions to suit your situation. Keep in mind, however, that with router tables, bigger isn't necessarily better. If the work is too large for the table, the router can be removed from the table and hand-guided over the stationary work. Mounting the router on one end of the top instead of in the middle provides space for work in progress or for mounting a second router, which greatly facilitates multiple-setup operations. In addition, the top should overhang the base by at least 2 in. to provide space for clamping the fence and other fixtures.

Router baseplates

An integral part of the router-table top is the drop-in baseplate to which the router is mounted. A variety of baseplate materials can be used. Clear acrylic is often used for baseplates to increase visibility, which is beneficial if the router is operated freehand. However, concentration of stresses around mounting screws in acrylic can cause chipping and even breakage, allowing the router to fall out of the table. If acrylic is the only material available, it should be at least $\frac{3}{8}$ in. thick, and the baseplate should be as small as possible. The baseplate must be checked regularly and discarded if cracks radiate from the screw holes. Polycarbonate, another clear plastic, is safe to use, but it will sag over time. In addition, heat from the router can cause the polycarbonate to expand enough to jam in the recess. I think $\frac{1}{4}$ -in.-thick phenolic resin board is the best choice for a router baseplate. The phenolic securely holds the router without danger of breaking or flexing, which can affect the accuracy of setups. And phenolic's strength allows the use of a thinner and larger baseplate, which makes inserting and removing the router easier and maximizes the cutting depth of router bits. Phenolic comes in a bewildering assortment of grades for various purposes, but paper-base phenolic resin board (NEMA Grade X) makes an excellent baseplate; it is available in natural (brown) or black from most plastic-supply stores.

I made an 11-in.-sq. baseplate to accommodate even the largest router without requiring a lot of twisting and turning to get the router through the table opening. A square baseplate can also be rotated 90° to reposition the router controls in relation to the table—a handy feature at times.

Routing the baseplate recess

The baseplate should fit snugly into its recess in the top so that the baseplate is flush or about $\frac{1}{64}$ in. proud of the top. If the baseplate is low, stock will catch on the edge of the recess and depth of cut will change as the work passes from the baseplate to the table surface. A $\frac{3}{8}$ -in.-wide rabbet around the perimeter of the recess will adequately support any of the various baseplate materials. I've developed a method for routing the recess that takes into account the fact that most router bases are not concentric with the router bit. I made separate templates of $\frac{1}{4}$ -in.-thick hardboard for each side of the router and used them in conjunction with the phenolic baseplate to set up router guides on the tabletop. This procedure has yielded extremely accurate baseplate rabbets with non-concentric circular bases or any other shape router base. I recommend practicing routing with the templates on some scrap before cutting into a nice, new router-table top.

To make the templates, I first cut four pieces of hardboard slightly shorter than the sides of the phenolic baseplate and slightly wider than the distance from the edge of the router base to the cutting edge of a 1-in.-dia. straight bit chucked in the router. Next, I marked one of the template blanks "left" and butted it against a



The router jig above is used to trim templates that are the same width as the distance between the router's edge and the cutting edge of the bit.

This chip-collection system is a chute that connects an opening on the back of the fence with a vacuum port in the tabletop or in a second insert plate (left).

straightedge tacked to a piece of scrap plywood, as shown in the photo above at right. A piece of double-sided tape secured the template to the plywood. With the left edge of the router base held firmly against the same straightedge, I routed off the edge of the template, making it exactly the same width as the distance from the router base's edge to the straight bit's edge. I repeated this operation to make templates for the front, right and back sides.

Next, I positioned the baseplate on the router table where I wanted the cutout and placed the templates on their respective sides of the baseplate. This way, I could clamp straightedge guides firmly against the templates and then remove the templates and the baseplate. With the router oriented correctly in relation to the templates that I used to set up the guides, I am ensured of a perfectly sized recess. After setting the router depth of cut about $\frac{1}{64}$ in. shy of the baseplate's thickness, I routed a recess with the 1-in.-dia. bit used to make the templates. This recess is the rabbet that will support the baseplate. I cleared out chips that built up along the guides and made passes until the bit no longer cut. Then I checked to be sure no chips were holding the router away from the guides.

To remove the waste in the center of the cutout, I switched to a $\frac{1}{4}$ -in.-dia. straight bit, and, without moving the straightedge guides, I routed all the way through the top. Because of the difference between the 1-in.-dia. bit that cuts the recess and the $\frac{1}{4}$ -in.-dia. bit that cuts through the top, I was left with a $\frac{3}{8}$ -in.-wide rabbet. Before removing the straightedge guides, I eased the sharp edges of the recess with a file, rounded the corners of the baseplate to match the recess and test-fit the plate. If necessary, additional passes can be made with the 1-in.-dia. bit until the baseplate is just barely higher than the top. If the recess is too small, the baseplate can be filed until it fits, or the appropriate guide can be lightly tapped and then the recess can be trimmed with one more router pass. Conversely, if the recess is too deep or too large, the rabbet can be shimmed. I make shims by sanding the back sides of thin strips of plastic laminate until they are the proper thickness, and then I glue them into the recess. A snug fit is essential. When the baseplate was properly fitted to the table, I drilled two 1-in.-dia. finger holes in opposite corners of the baseplate and removed the sharp edges with a $\frac{1}{8}$ -in.-radius roundover bit. This makes the baseplate easy to grasp when placing it in or lifting it out of the table.

Fitting the router to the baseplate

I positioned my Elu router diagonally on the baseplate; this diagonal orientation makes it easier to get the router in and out of the

table and moves the height-adjustment mechanism toward the front of the table. To mount the router, I first located the center of the baseplate. Then, using the router's subbase as a pattern, I marked, drilled and countersunk the mounting-screw holes. If your router does not have a removable subbase, or if you wish to locate the router precisely in the center of the baseplate, you can easily make a subbase from a piece of clear plastic large enough to cover all the router-base screw holes. Place the plastic over the base, mark and drill the screw holes, and then mount the subbase on the router. Chuck a $\frac{1}{4}$ -in.-dia. bit in the router, and plunge through the subbase to mark its center. After removing the subbase, drill a $\frac{1}{4}$ -in.-dia. hole in the center of the baseplate blank, place it on the subbase, and insert a $\frac{1}{4}$ -in.-dia. rod through the center holes to align the subbase and baseplate. A dab of hot-melt glue or double-sided tape will hold the subbase in position while you drill the mounting-screw holes through the baseplate.

To cut the clearance hole in the baseplate, I chucked my largest bit (it must be sharp) into the router and mounted the router to the baseplate. In most cases, the screws that secure the subbase to the router will not be long enough to fasten the router to the thicker baseplate. For longer screws, I recommend socket flat-head cap screws because heads of both Phillips head or slotted screws are easily stripped, making them difficult to remove. Next, I placed the baseplate in the table recess with the router above the table and cranked down the height adjustment to advance the cutter steadily through the baseplate. Variable-speed routers should be set to their slowest speed for this operation. If the bit is not designed for plunge cuts, the center of the baseplate must first be pierced with a smaller plunging bit.

To support workpieces when using smaller bits, I made a variety of inserts with center-hole diameters about $\frac{1}{8}$ in. larger than each bit's diameter. First, I routed a $\frac{1}{4}$ -in.-wide by $\frac{1}{8}$ -in.-deep rabbet around the clearance hole in the baseplate with a bearing-guided rabbeting bit. Then, using a circle-cutting jig I designed for my router, I cut several inserts and routed mating rabbets on the inserts, again with a bearing-guided rabbeting bit. (A similar circle-cutting jig is available from Woodhaven, 5323 W. Kimberly Road, Davenport, Ia. 52806.) I also made an insert with no hole to prevent chips and dust from falling into the router when it is not in use. To keep the inserts from rotating, I drilled a $\frac{1}{4}$ -in.-dia. hole at the edge of the bit clearance hole in the baseplate, epoxied a short piece of $\frac{1}{4}$ -in.-dia. brass rod into the hole, and cut a matching notch into the edge of each insert.

The fence

In its simplest form, a router-table fence is a straightedge for guiding the workpiece past the router bit. The utility of the fence can be increased greatly with a few minor modifications, such as a recess for bit clearance, a cutout on the bottom of the fence for chip ejection and a 1/8-in.-wide chamfer on the bottom corner of the face to prevent chips from building up between the fence and workpiece. A guard mounted over the cutter will help protect the operator's hands and eyes. The fence shown in figure 2 on p. 57, will meet most users' requirements. It has a thinner profile on each end for clamping to the table, a cutter guard for safety, movable faces to adjust the opening for different-size bits and an unobstructed chip-ejection chute. The outfeed fence can also be shimmed for jointing operations.

To ensure stability, I glued together the main body of the fence from plywood, as shown in figure 2. I used phenolic for the adjustable faces because of its durability and low-friction surface; howev-

er, plywood would also work well for these parts. The large, flat heads of toilet flange bolts fit nicely into the rabbeted slots that I routed in the adjustable faces. I also routed a 1/8-in.-wide chamfer around the front edges of the phenolic faces to make it easier to slide workpieces across the faces and to prevent dust buildup at the base of the fence. A clear polycarbonate guard screwed to the top of the fence over the cutter provides good visibility and greater impact resistance than acrylic. When using the router table for edge-jointing, I insert a shim of stiff paper or plastic laminate to offset the outfeed fence by the amount I want to remove in one pass. Slots cut in the shims allow them to slide into place without the face of the outfeed fence having to be removed completely. Also, for supporting stock on edge, high vertical faces can be mounted on the fence in place of the adjustable faces.

As you can see in the photo at left on p. 59, I like the fence oriented front to back across the short dimension of the top. This orientation allows for shorter fences and fixtures and for easier

Space-saving router tables

by Charley Robinson

Not every shop has room for a large, permanent router table. And while the portability of the knockdown table described in the main article makes it great for on-site work, the router table also may take up more floor space than some of us are willing to allocate. When I was ready to add a router table to my shop, I decided to use a surface that was already taking up space—my tablesaw's extension table (see the photo below). I mounted my router on a clear polycarbonate baseplate for visibility during freehand operations. Then, I cut a recess in my tablesaw's extension table and used the same drop-in technique discussed in the main article. Not only did

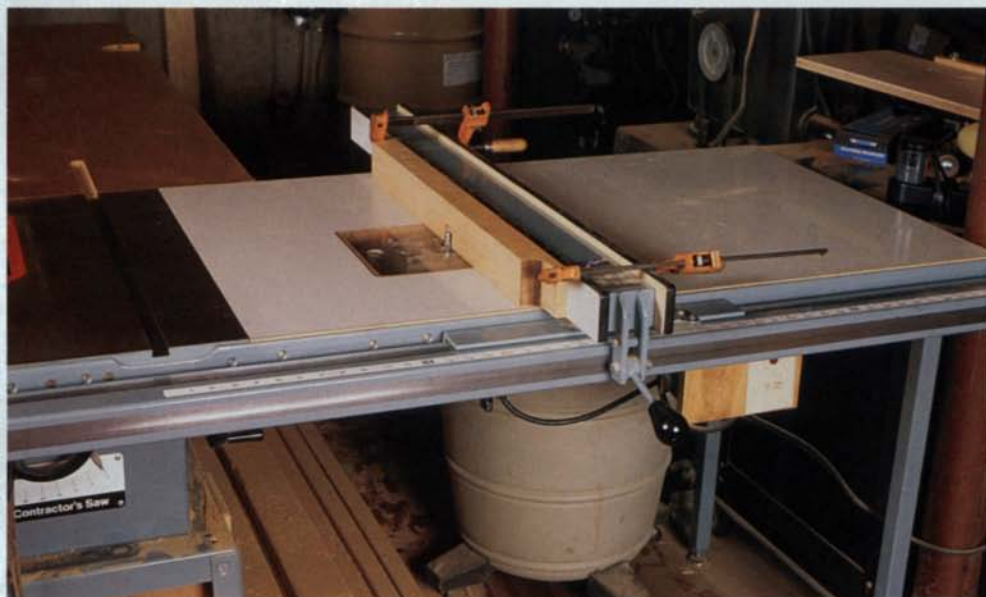
this save shop space, but I ended up with a large surface to support longer workpieces. Also, without extra effort, I had an extremely accurate and easily adjustable fence. To protect the laminated face of my rip fence when using it with the router, I clamp on an auxiliary fence with a hole bored in the middle for bit clearance.

Because it was difficult to reach the router's on/off switch, I mounted an electrical box with two outlets, both controlled by the same switch, beneath my extension table. After dropping the router into the table, I lock the router's switch in the "on" position, plug the router into the switched outlet and then plug my shop vacuum into

the other outlet. This way, I control the router and the vacuum with one switch. The disadvantage of this outlet setup is the danger of forgetting to unlock the router from the "on" position when removing it from the table for freehand use. To make sure the router doesn't start up unexpectedly when it's plugged into a live outlet, I always unlock the switch immediately upon removing the router from the table.

A folding router table: Another idea for woodworkers with limited shop space is to mount the router to a folding table that can be quickly set up when needed and then folded compactly for storage. The sturdy, stowable router table shown in figure 3 on the facing page was sent in by David Finck, a professional woodworker in Reader, W.V. His torsion-box top is extremely strong and stable, and because the router is mounted to the underside of the top plywood skin, Finck sacrifices only 1/4 in. of a router bit's maximum depth of cut. A pair of legs are hinged to one side of the table and can be locked in the open position with notched, diagonal braces, which pivot to allow the table to be folded for storage. On the side opposite the legs is a mounting block that clamps into a workbench's face vise, as shown in figure 3, to hold the table securely. The wide open base provides easy access to the on/off switch and the router chuck for bit changes.

Although construction is straightforward, as shown in figure 3, Finck offers several construction hints. The plywood block that reinforces the center of the table should be about 2 in. larger than the router base, and the cutout should allow 1/32-in. clearance between the block and the router base. If your router base is rec-



Mounting a router in a tablesaw extension table offers a large work surface, with no additional loss of floor space, and an extremely accurate fence. Attaching an electrical box with two switched outlets to the front of the extension table provides safe and convenient control of the router and the shop vacuum.

fence adjustments. The shorter fence also makes it easier to work with slightly bowed stock, and since I have a two-router table, I can set up separate fences for two operations. Although any C-clamp can be used to secure the fence to the table, I prefer Vise-Grip locking C-clamps with swivel pads. The lock/release action of these clamps makes it quick and easy to reposition the fence or to remove the fence to gain access to the router. Because the fence will always be parallel to the bit in any horizontal orientation, I can make accurate and fine adjustments by simply tapping one end of the fence.

Chip collection

I designed my fence for efficient chip clearance even without a dust-collection system in operation. But the router makes a lot of chips, and most of the time I run it with a shop vacuum to collect the mess before it gets blown all over my shop.

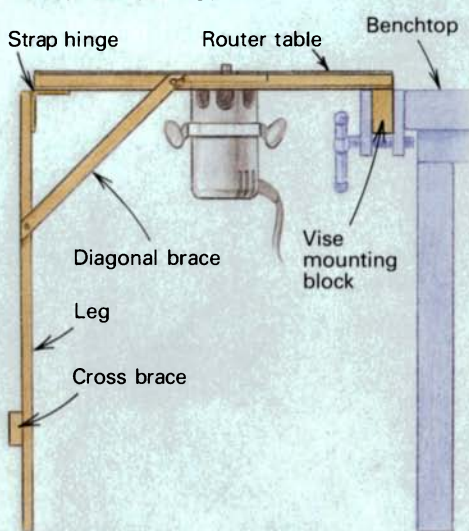
My chip-collection system, shown in figure 2 on p. 57 and the photo at left on p. 59, consists of two main parts: a U-shaped chip

chute that extends from the fence over to the other baseplate cutout in my router table; and a plywood table insert with a hole cut through it into which a vacuum-hose connector is glued. The chip chute was first bandsawn from two pieces of $\frac{3}{4}$ -in.-thick birch plywood that had been laminated together, and then the chute was topped with a sheet of clear polycarbonate. Adhesive-backed foam weather stripping forms an air seal between the chip chute and the fence and tabletop. When chip collection is needed, I just place the chute in position, connect the vacuum hose and turn on the vacuum; the pressure created by the vacuum holds the chip chute in place. I routed a rabbet around the vacuum connector hole in the plywood table insert, and made a plug to fill the hole when the vacuum is not in use. □

Ed Walker is executive director of the Triangle Area Woodworkers Club (Raleigh, N.C.), conducts router seminars, and manufactures and markets router tables in Apex, N.C.

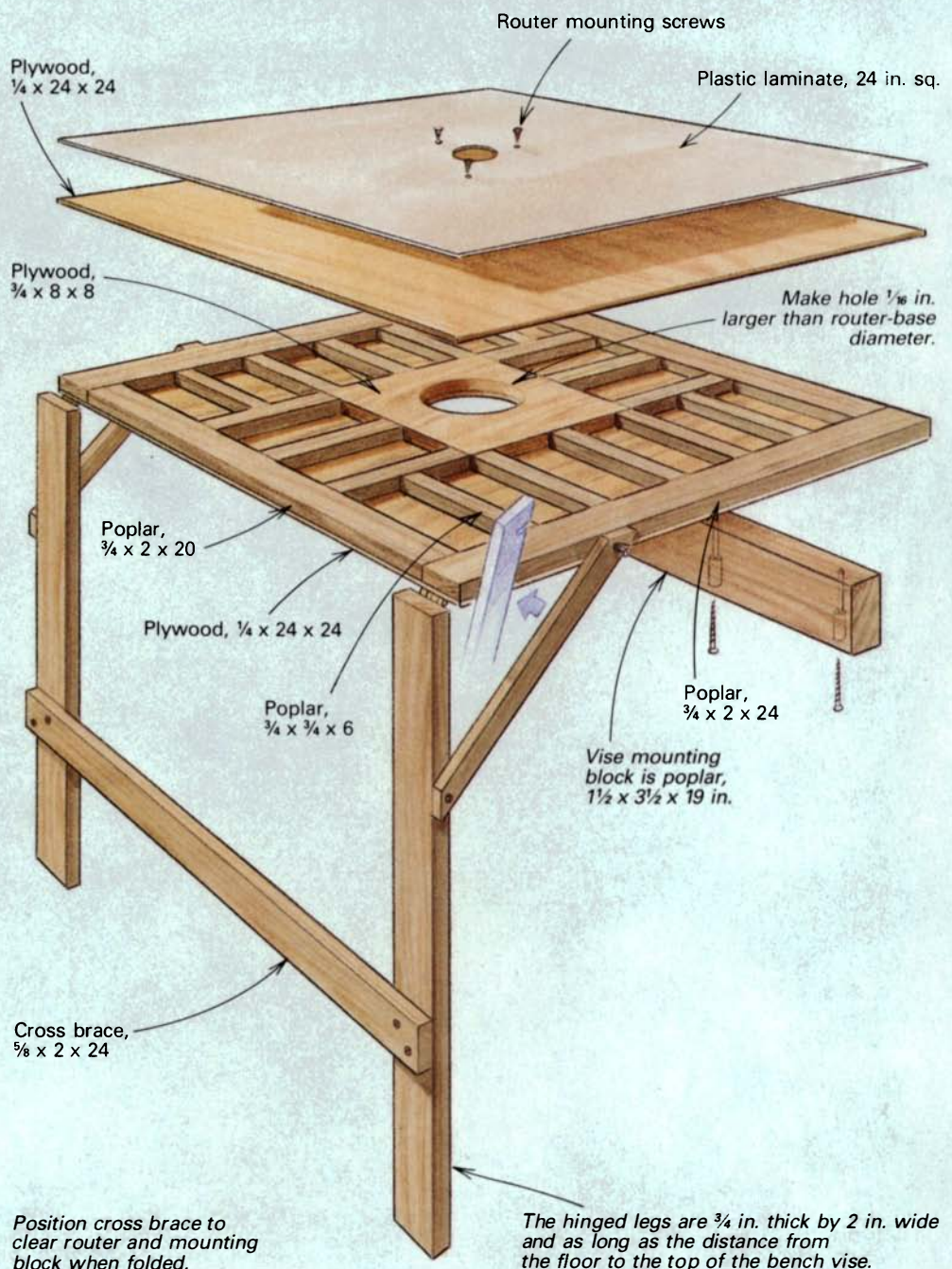
Fig. 3: A stowable router table

Router table in use



tangular, orient the router cutout so that the controls will be facing forward. Finck also cautions you to position the router cutout to avoid interference between the router and your bench-vise handle. The wider stock around the edges of the torsion-box core provide a solid area for attaching the hinges and vise mounting block and for clamping fences to the table. Finck also suggests that the legs be made slightly long and then trimmed to length after the table is completed; this way, the table can be made level when it's clamped in position in a bench vise. When assembling the table, position the cross brace, legs and vise mounting block so that they won't interfere with each other when the table is folded. For a fence, Finck uses a $1\frac{3}{4}$ -in.-thick by $2\frac{1}{2}$ -in.-wide piece of jointed-and-squared hardwood with an opening for chip and bit clearance. □

Charley Robinson is an assistant editor at FWW.



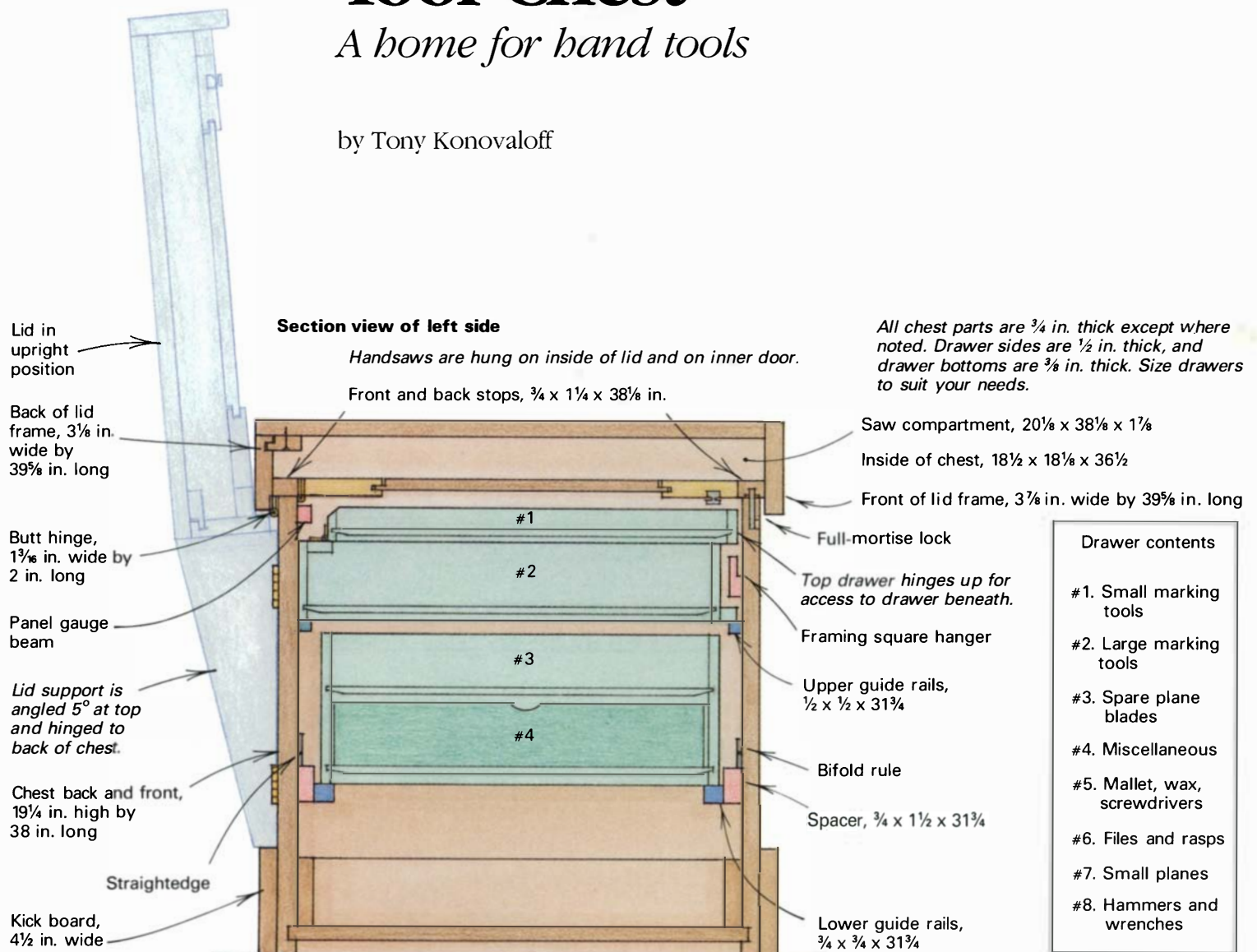


All these tools fit inside the pine chest on the left. Saws hang inside the lid; planes sit on the bottom; a drawknife, spokeshaves and chisels hang on the chest's ends; long marking and measuring tools hang on the front and back; everything else fits inside eight drawers or in two removable boxes. Konovaloff built the walnut chest on the right to refine some of the storage systems.

A Cabinetmaker's Tool Chest

A home for hand tools

by Tony Konovaloff



If you work wood, you need a place to store your tools. So for many of us, a tote box, a tool cabinet or a chest is one of the first woodworking projects we undertake. My pine tool chest, shown on the left in the photo on the facing page, was one of my earliest projects, and it served me well for years. Each tool has a home—on the bottom of the chest, in one of eight drawers, in removable boxes or on a rack inside the chest or its lid. As I collected new tools and learned new storage tricks, I altered the chest's storage layout by moving drawer guides and tool racks. The inside of the chest is now pockmarked with screw holes, as evidence of these alterations. So after too many alterations on my pine chest, I decided to build a new chest of walnut.

Since the size of my first tool chest is as practical as it is big, I made the new one, which is shown in the drawing on the bottom of these two pages, the same size. I wanted the chest to be portable, although it takes two people and a forklift to carry it. I was so familiar with my first chest that I could find anything with my eyes closed. So, I reasoned, why not just refine that same storage system in the new chest?

I went through the same steps to plan my new chest as I did when I built the first one—listing, grouping and measuring all my tools (as well as some I hoped to buy)—but in the end, I only altered my original design slightly. I decreased the tolerances between drawers and boxes, I made some drawers shallower, and I added a couple of drawers. And, for appearance sake, I made the kick board wider so it would be in balance visually with the sides of the lid. I'll tell you how the new chest was built and more about its design, but remember that the compartments inside (see the drawings) are for my tools. So use the drawings as a guide to customize a chest for your own tool collection.

Planning a place for each tool

A snug home for the tools not only saves space, but also prevents them from banging around when I move the chest or shuffle through its contents. I arranged my planes and other large tools on a "floor plan" of the bottom to arrive at the chest's overall length and width. The chest's depth was determined by the 16-in.-long

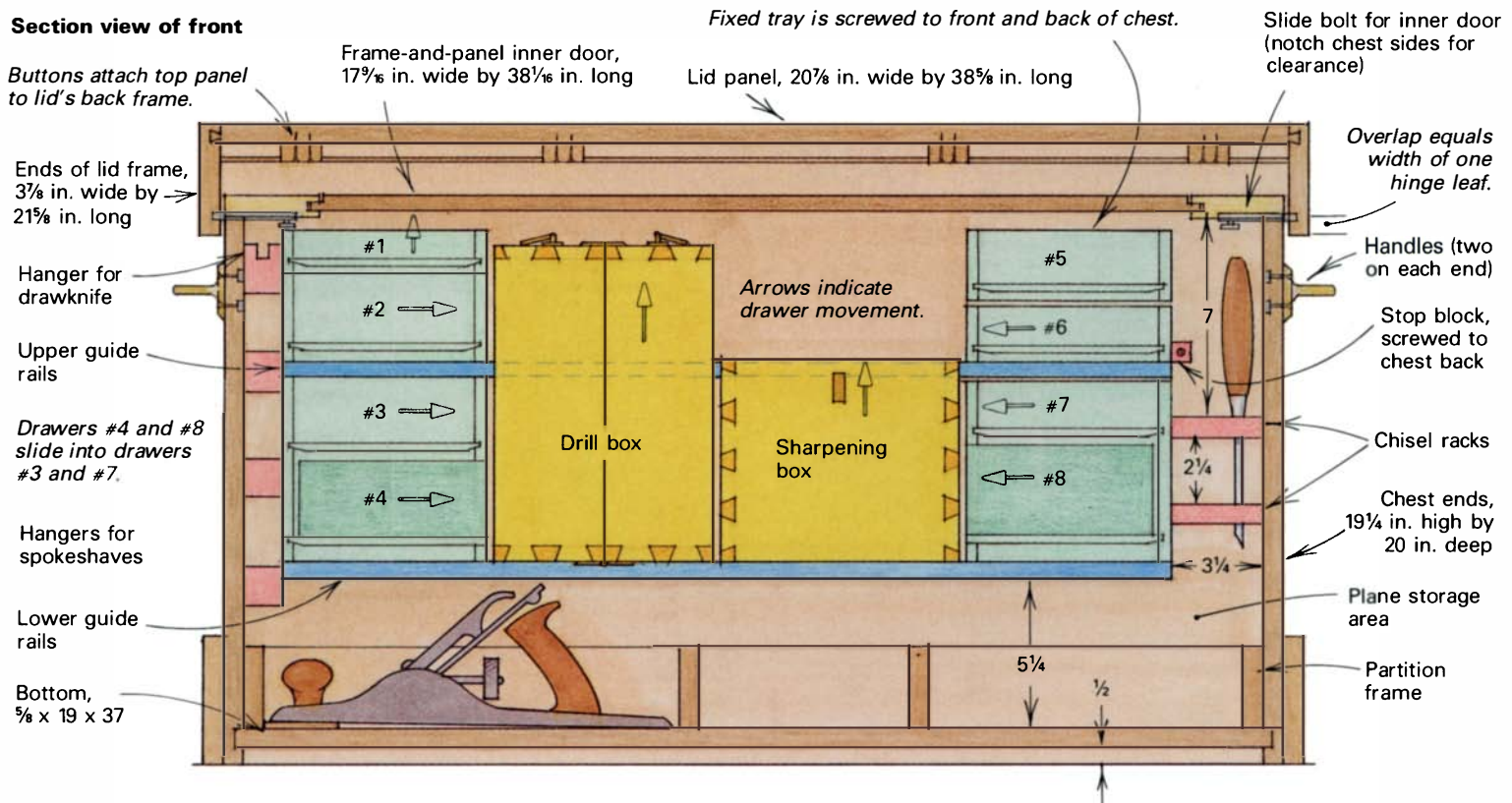
tongue of my framing square, which I decided to hang between the drawers and the front. And I designed a compartment within the lid for storing my handsaws.

Once I knew the chest's overall size, I turned my attention to the storage racks, drawers and removable boxes inside. Since I had already decided to store my planes on the bottom, I needed to devise a way to get them out without having to remove everything else first. The solution was to have a bank of drawers at each end of the chest with an open well between them. I can lift the planes out through the central well, or I can slide all the drawers to one end of the chest and lift the planes out through the open space at the other end. I filled the space in the well with two removable boxes. One box holds my screwdrivers and my drilling tools (bits, a brace and a geared drill). All my sharpening equipment fits in the other box. The minimum size of the well was determined by how much space I needed to remove my largest plane, a Stanley #7 jointer. Once I knew the minimum size of the well, I divided the remaining space between the two banks of drawers and racks for hanging tools on the back and on the sides, as shown.

Like the framing square, long or awkward tools hang on racks between the drawers and the chest's sides and ends. I also hang the tools I use often, like a folding rule and chisels, because this way they're always visible and accessible. My drawknife and spokeshaves hang on one end; chisels hang on the other end; a square, straightedge, folding rule and panel gauge beam hang on the front and back sides. I then sized the depth of the drawers according to their contents. I put a mallet and commonly used screwdrivers in one top drawer, and measuring and marking tools in the other. Each of the other six drawers contains a different tool group, with the least-used tools in the lower drawers.

The chest holds too many tools to list. I'm amazed that everything fits inside when I see all the tools spread out on the floor in front of the chest, as shown on the facing page. In that photo, the empty walnut chest is almost complete, except for the drawer guides and tool racks. Although I could have glued the guides and racks into carefully spaced grooves, I chose instead to screw them to the chest sides so I can alter their arrangement easily.

Section view of front





Sliding dovetails on the ends of the lid are hand-cut with a dovetail plane (left). The scoring blade on the plane's side prevents tearout when cutting across the grain.

Konovaloff hangs the lid by screwing hinges to the chest's back. Then he turns the lid upside down, props up the chest to align hinges and mortises, and screws the hinges to the lid (below).



Making the chest

I made the chest and most of its drawers, boxes and racks from walnut. My first chest is a testament to the durability of pine, but hardwood can take more abuse and still look good. However, I used alder for the bottom panel because its lighter color improves visibility inside the chest. Before starting the project, I bought 80 bd. ft. of 4/4 lumber: 50 bd. ft. for the chest, kick board and lid, and 30 bd. ft. for the storage compartments inside. I also used a lot of scrap.

I began by gluing up all the large panels for the sides, ends, top and bottom, and then I thickness-planed them after the glue dried. I work exclusively with hand tools, and so I scrub-planed the panels nearly to thickness (see the sidebar on the facing page for more on this) and then surfaced them flat with a jointer plane. Next, I cut each panel to size (given in the drawings) and plowed a groove in the sides and ends 1/2 in. from their lower edge, for the bottom panel. The sides and ends are joined with dovetails, and I cut the tails first because I find that it's easier to make the pins fit the tails. As unorthodox as it may sound, I used a file and fine-tooth rasp, rather than a chisel, to trim the pins.

I made the kick board next. Although it strengthens the bottom of the chest, the kick board is really just a protective base molding. On my first chest, I made the kick board the same width as the sides of the lid, but the kick board looked too narrow. So on the walnut chest, I made the kick board 1/2 in. wider, and it looks more balanced. To ensure that the dovetailed kick board fit the chest tightly, I cut the pins on the end pieces first, glued them to the chest, screwed them in place from inside, and then held the front and back pieces up to mark for the tails. After cutting and fitting the tails, I glued and screwed the front and back pieces in place.

Making the lid

The lid is basically a shallow box that overhangs the outside of the chest. Long wood cleats, glued inside the front and back of the lid frame, act as stops and rest on the top edges of the chest when the lid is closed. An inner frame-and-panel door is hinged to the back stop and held closed with slide bolts that engage the sides of the lid frame. The space between the underside of the lid and the inner door is 1 7/8 in.—enough for saws to be hung on both surfaces.

The construction of the lid is somewhat unconventional unless you think of it as a traditional dovetailed drawer turned upside down. In traditional drawermaking, the back is made narrower than the sides so that the bottom can slide over the back and into grooves in the sides. In the case of my chest's lid, the top-to-side-frame joints aren't just tongues in grooves, they're sliding dovetails. The top panel is butted and glued to the frame in front and secured to the back with cabinetmaker's buttons, like those used to hold solid tabletops to aprons. This construction anchors the panel at the front while allowing it to expand or contract at the back.

I cut the sliding dovetails on the ends of the top panel and the mating grooves in the sides of the lid frame before joining the frame parts. The sliding dovetails, which are half as thick as the top panel, are not centered on the panel's ends. I located the tails close to the panel's inner surface so there would be as much wood as possible above the mating grooves in the side frames. I cut the tails with my Ulmia dovetail plane, as shown in the top photo. (I bought my Ulmia plane from Woodcraft Supply, 210 Wood County Industrial Park, Parkersburg, W.V. 02102-1686.) After planing the side frame's grooves, I cut the angled sides by tilting a side rabbet plane to match the dovetails' angle. It may seem imprecise to do this by eye, but it's easy with practice.

When the panel slid freely in the grooves, I cut the dovetails that join the lid-frame corners. I laid out the corner dovetails so that the sliding-dovetail groove would fall between two pins at the frame's front and in the middle of a wide pin at the frame's back. I cut the pins on the side pieces first, and then slid them onto the top panel's dovetails to mark the tails on the front and back frame pieces. When assembling the lid, I was careful not to get glue in the dovetail grooves, lest the panel not be able to expand and contract.

Hanging the lid

After planing and scraping the lid smooth and gluing the stops inside, I hung the lid on the chest. The brass butt hinges that mount the lid to the chest are screwed to the back of the chest and to the inside edge of the lid's back frame (see the bottom photo). I used five 1 3/16-in.-wide by 2-in.-long hinges, which fit perfectly on the 1/2-in.-wide overlap below the stop on the back of the lid frame. The hinges 1/16-in. overhang on the back of the lid frame allows the lid to open slightly past 90° and rest on two fold-out supports hinged to the chest's back (see the drawings on pp. 62-63). The lid tilts just enough so I can unlatch the inner door without it falling open.

I first chiseled hinge mortises in the lid's back frame and temporarily mounted the hinges so I could set the lid in place and mark the hinge locations on the chest. Then, after chiseling the hinge mortises in the back of the chest, I removed the hinges from the lid and screwed them on the chest, since the hinge screws in the chest aren't accessible with the lid in place. To screw the hinges to the lid, I put it upside down on my bench, laid the chest on its back, and propped up the chest with a piece of wood to align the hinges in their mortises on the lid (shown in the bottom photo).

The chest was complete except for installing the lock. I chiseled the front of the chest for a full-mortise lock and screwed its strike plate on the lid's front stop. I didn't use a spring-loaded lock, as is suggested in early-cabinetmaking texts, because I was afraid I might

leave my keys inside the chest. If I were to close it with a spring-loaded lock, the chest would lock automatically. Need I say more?

Installing the storage compartments

I built the storage compartments from the bottom up. First, I divided the bottom of the chest for individual planes by dadoing partitions to a 3-in.-high frame that fits around the inside perimeter of the chest. Next, I screwed the tool racks to the sides and ends of the chest and then installed the drawer guides around them. The L-shaped guides keep the drawers and removable boxes at various distances from the hanging tools. As shown in the drawings, the

framing square and 24-in.-long straightedge sit in their own racks or directly on the drawer guides. After installing the drawers, I added the two top trays; one is hinged to the drawer beneath it, and the other is screwed to the front and back of the chest.

I finished the chest's outside with three coats of a mixture of 4 oz. of beeswax melted in 1 gal. of boiled linseed oil. I applied a coat on the inside too, leaving the chest open to dry. Then I fastened bronze handles on the ends with $\frac{1}{4}$ -20 stove bolts. □

Tony Konovaloff formerly made furniture in Tahoe Paradise, Cal. He is presently a woodworking student at the College of the Redwoods.

Thicknessing boards with a scrub plane

If you've ever considered working wood only by hand, you probably shuddered at the idea of thickness-planing rough boards. But I flatten and thickness a board quickly with a scrub plane and smooth the board with a jointer plane.

A scrub plane, which has a flat sole and a convex cutting edge, leaves a rough, fluted surface, and removes stock quickly. I not only use mine in the shop, but also to preview lumber I want to buy. You can even scrub-plane tabletops or panels that are too wide for your thickness planer. A wood scrub plane sells for about \$50; but you can use a plane you already own and just regrind an extra blade. (A new blade is about \$12 at hardware stores.)

Turning a jack plane into a scrub plane: The difference between my jack plane and its scrub plane alter ego is how the blades are ground: A jack plane's blade is straight and a scrub plane's blade has a $\frac{3}{32}$ -in.-high convex curve (see the top photo). You don't need more curve than that because it's hard enough to plane a $\frac{1}{16}$ -in.-thick shaving. To make the curved edge, I first beveled each corner $\frac{3}{32}$ in., and then I ground the curve from the outside corners of the bevels to the middle of the cutting edge. I worked slowly with a hand-crank grinding wheel and quenched the edge often so I didn't anneal the tempered blade. While grinding, I maintained a 27° bevel, and I sharpened the cutting edge by honing a secondary bevel on it.

Since a scrub plane removes thick shavings, I opened the throat by setting the plane's frog as far back as possible. However, when scrub-planing figured wood, I move the frog forward a bit. To set the depth of cut, I align the edge of the cap iron with the corners of a convex blade, as shown in the top photo, and put the blade in the plane. I start by exposing about $\frac{1}{32}$ in. of the blade and adjust depth to suit the wood's hardness and figure.

Using a scrub plane: I use my scrub plane to cut with the grain, shown in the bottom photo, diagonally to the grain or, with care and a sharp blade, directly across the grain.

To flatten and thickness-plane a warped or twisted board, I first scrub equal amounts of wood off the high spots on one side, and ensure that it is flat by sighting across winding sticks and planing the board until the sticks are parallel. I then finish that surface with a jointer plane. Lastly, I scribe a line on all four edges to mark the desired thickness of the board, and then I scrub the other side to the line and joint it flat. When removing lots of wood like this, I plane with the grain and diagonally to it.

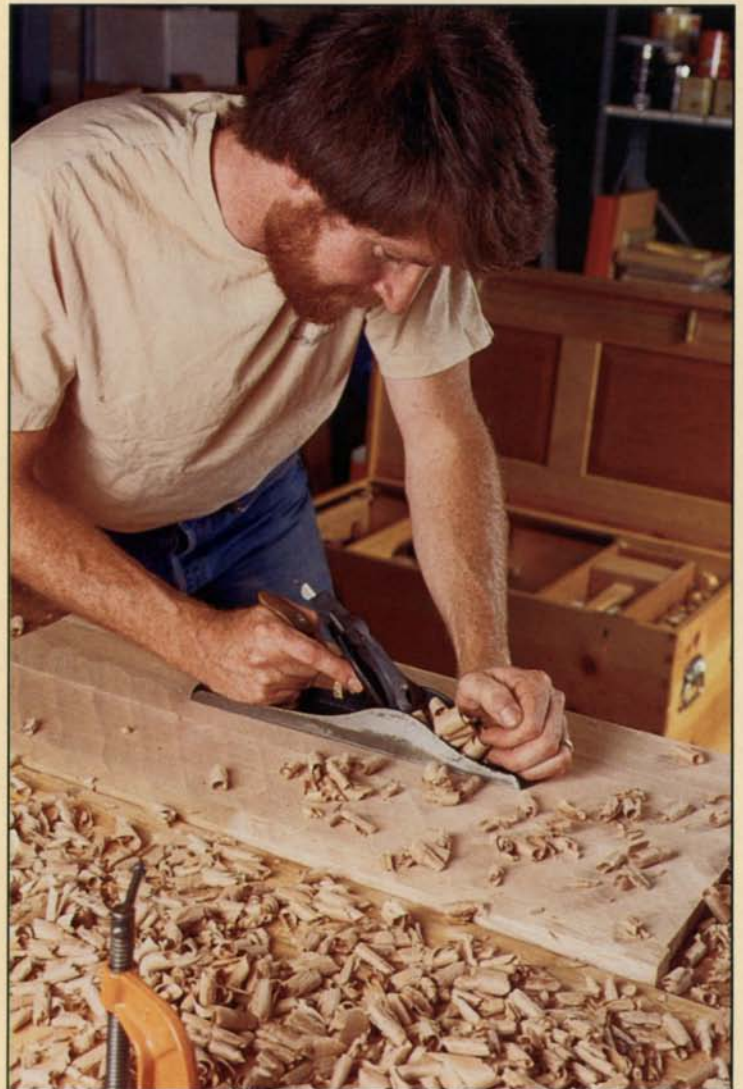
When planing a large panel, the blade can get hot, so I'm careful not to lay the plane where the blade could burn me or the workpiece. To keep the blade cooler and to avoid dulling it, I don't drag the plane blade back over the wood before taking another cut. I also scrub-plane dried squeeze-out from glued-up panels before I thickness-plane and smooth them. I use the leading edge of the plane body, not the blade.

—T.K.



A scrub-plane blade can be made by grinding a convex edge on a 2-in.-wide jack-plane blade (left). In use, the cap iron's edge should align with the blade's corners.

To thickness-plane a panel, the author scrub-planes diagonally to the grain. Then he scrubs with the grain (below) and smooths the panel with a jointer plane.



Turbine Spray Systems

A high-volume, low-pressure finishing alternative

by Philip Hostetter

Until recently, one of the most common ways to apply a finish was to use a spray gun and a conventional air compressor. But another kind of spray system best known by its acronym, HVLP, has been receiving a lot of attention lately. HVLP stands for high volume, low pressure, and refers to spray systems that apply finishing materials in an entirely different way than conventional high-pressure spray systems. But there's a lot of mystery surrounding HVLP systems and their purported advantages, such as the systems' efficiency and ease of operation. Some manufacturers have gone so far as to promise that their HVLP system will cut the amount of finishing materials you use in half.

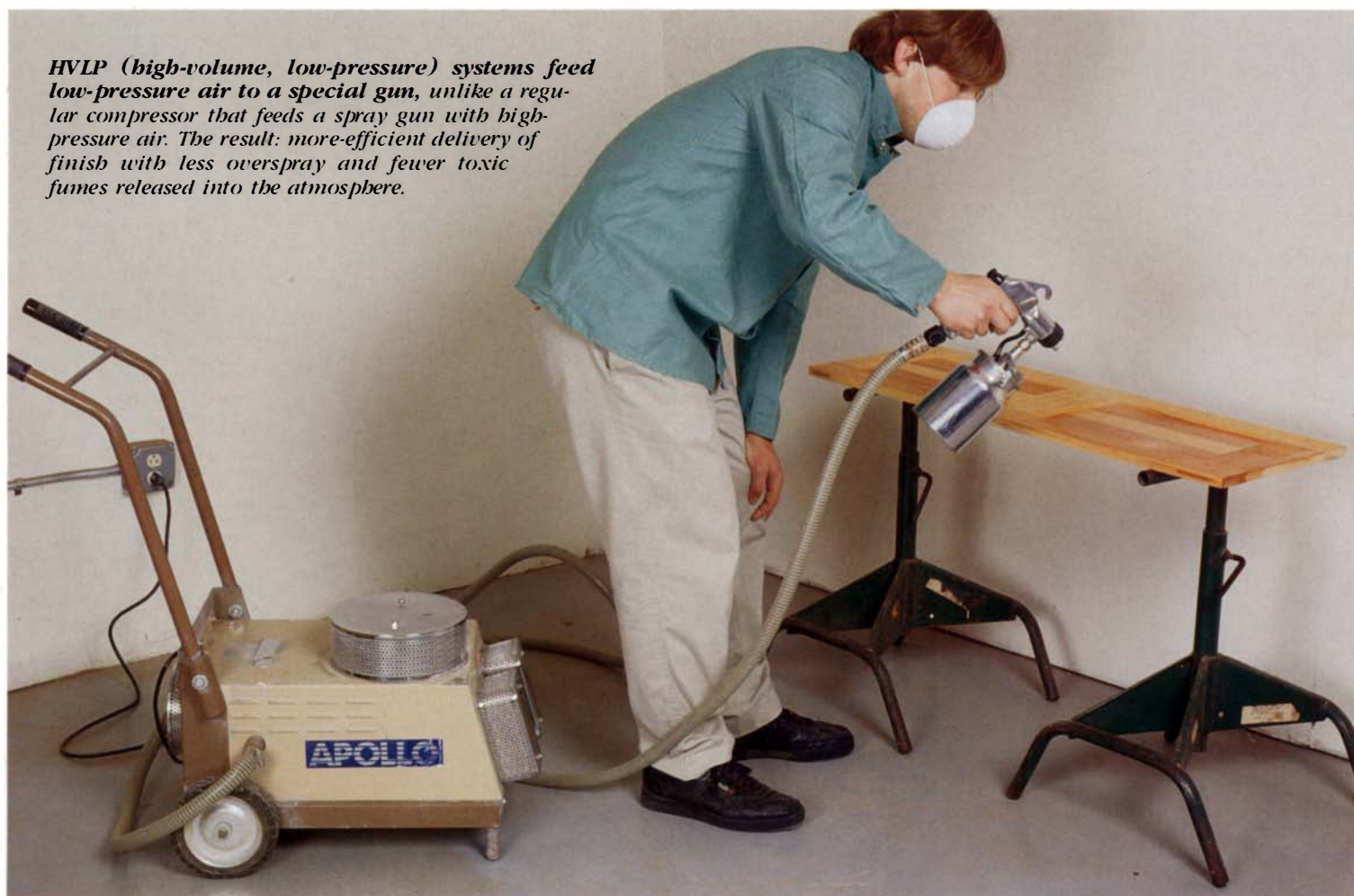
For many years, I have used compressed air and HVLP systems for applying a variety of finishes, including shellacs, lacquers (both nitrocellulose and water base) and catalyzed finishes, to the cabinets and furniture made in my commercial shop. As you might

guess, I've found that both systems have advantages and shortcomings. Anyone considering buying an HVLP system should understand its pros and cons, as well as how this system works and how it differs from compressed-air setups. The information in this article is intended to help you decide if an HVLP system is right for your finishing needs.

How an HVLP system works

Unlike a compressor and standard spray gun that apply a finish with a relatively low volume of air at high pressure, an HVLP system uses a blower and a special gun to (as the name says) apply a finish via a high volume of air at a lower pressure. A typical HVLP system consists of a turbine, a gun and a large-diameter air hose, all of which look and function somewhat differently than a compressed-air system.

HVLP (high-volume, low-pressure) systems feed low-pressure air to a special gun, unlike a regular compressor that feeds a spray gun with high-pressure air. The result: more-efficient delivery of finish with less overspray and fewer toxic fumes released into the atmosphere.



At the heart of a typical HVLP system is the turbine, which pushes out a large volume of air with relatively good efficiency. For example, a small (7 amps to 8 amps), one-stage turbine unit typically produces 3 p.s.i. at 40 CFM to 50 CFM (cubic feet per minute), while a larger (10 amps to 12.5 amps), three-stage unit may deliver 6 p.s.i. at 85 CFM to 100 CFM. Each stage means the unit employs another fan, and fans working in a series are capable of generating higher pressures. An increase in motor size (amperage) produces a higher volume of air. Because they don't require heavy, bulky, steel air-storage tanks, turbine units are compact and lightweight. Small, single-stage and two-stage units are typically housed in a sheet-metal box about 2 ft. sq. Larger, multiple-stage turbines intended for the professional finisher are considerably heavier, weighing 50 lbs. or more, and have wheels for portability.

The turbine discharges air through a quick-change outlet, which accepts an air hose that connects to the spray gun. Many larger HVLP turbines have two air outlets, which allow two guns to be run at the same time. To carry the large volume of air efficiently, an HVLP hose is fairly large—about 1 in. in diameter. Since the turbine has no air-storage tank, the turbine-produced air must escape when the gun is not spraying. Therefore, an HVLP gun is called the “bleeder” type: The gun contains a valve that emits a constant stream of air whether or not its trigger is pulled.

Like a regular spray gun, the air passes through an HVLP spray gun and atomizes the liquid finish, propelling it onto the wood. Most conventional spray guns are “siphon” type: Air passes through the gun and creates a partial vacuum that draws fluid up from the cup. In contrast, an HVLP gun uses pressurized air to force fluid into the gun via a small tube from the sealed cup to the gun. An HVLP gun can be fitted with a variety of different fluid tips and air caps, depending on several variables: the desired spray pattern (a wide fan is used for spraying large surfaces, a narrow jet for detail work); the output of the turbine; and the viscosity of the finish.

Setting up and using an HVLP system is a breeze. You just plug the turbine in, connect the hose, load the gun's cup with finish and shoot. Some professional HVLP systems, like the Lex-Aire LX-75A and the Croix CX-20 (see sources of supply on p. 69 for addresses), feature a large, pressurized paint pot or tank that holds 2½ gal. or more with a feed line that runs to the gun to supply finish. Turbine units have air filters that require occasional cleaning or replacement, but no other special maintenance is usually required.

HVLP's high transfer efficiency

One of the most touted advantages of HVLP systems is their ability to deliver finish with a much higher transfer efficiency than compressed-air systems. Transfer efficiency is specified as the percentage of sprayed material that actually ends up on the workpiece as opposed to the amount that's lost as overspray. For example, if you are spraying door panels with three quarts of lacquer through a standard compressed-air spray gun with a 35% transfer efficiency, little more than *one quart* ends up on the wood. My experience has been that if you spray those same three quarts through a properly tuned HVLP gun with a transfer efficiency of 50% to 70%, about *two quarts* end up on the panels.

An increase in transfer efficiency translates into a savings in finishing materials, as well as a reduction in harmful solvent emissions to the atmosphere. Clean-air legislation in some areas of the country, such as Southern California, mandates that commercial finishers maintain a minimum transfer efficiency of 65% while spraying solvent-base materials. This percentage, which is difficult to achieve with an ordinary compressed-air system, is another reason why finishers are turning to HVLP spraying. In addition, a reduction in overspray means spray-booth filters don't need to be changed as often.



Portability is one of HVLP systems' greatest advantages. Most small, single-stage turbines, like the EagleSpray Turbo shown here, are light and have a handle so that the unit, its hose and the spray gun are easy to carry.

Another advantage of spraying with a high-transfer-efficiency system is that it reduces spray “bounce back.” This is a common finishing problem when spraying the inside corner of a closed-back cabinet, for example, where the overspray bounces back into your face in a choking cloud and settles on adjacent cabinet surfaces, leaving them rough and pebbly. HVLP guns have less bounce back because their low-pressure spray is more like a gentle mist than a forceful shower.

HVLP vs. compressed air

For the past five years, I have used an HVLP system side by side with a conventional compressed-air system as part of my wood-working business. This has given me the opportunity to see how the two systems compare. First of all, HVLP systems are very easy to set up and use, which makes them a good choice for the inexperienced or occasional finisher. Setting up a standard compressed-air system requires more experience, time and physical effort. Plus, the spray gun mix must be set very carefully to yield optimum finish delivery. In contrast, an HVLP turbine produces a preset volume of air at a fixed pressure, and people who have never sprayed a finish before usually find they get acceptable results the first time around.

One of HVLP's greatest advantages is the system's portability: Single- and two-stage units are typically between 18 lbs. and 30 lbs. (see the photo above), and most turbines either have a handle on top or wheels on the bottom. They're also wired for 110v; so you can plug them into a standard household electrical outlet. This makes HVLP a good choice for those who must spray-finish at an installation site. Further, the air that a turbine produces is warm and dry, in contrast to the chilled, damp air released by a compressor. This warm air can actually help water-base finishes dry faster

Conversion air systems: HVLP performance with a standard compressor

by Michael Dresdner



A conversion-air-system (CAS) spray gun allows a finisher who already owns a standard air compressor to spray with an HVLP gun. The Accuspray model 10, shown here, features a regulator and gauge mounted below the gun for convenient air-flow adjustment.

There is little doubt that converting to a high-volume, low-pressure (HVLP) spray system can save you money by reducing the amount of overspray; this is probably the single biggest reason for HVLP's quick acceptance by the manufacturing community. For example, when General Motors replaced its standard spray guns, it paid for the entire cost of the new equipment with the amount of money saved in paint in just *one day*. But like many other shops, GM saw no reason to tear out its extensive compressed-air system when making the change. Instead, it turned to HVLP's sister technology: conversion air systems (CAS). CAS provides a way for even small shops to adopt a highly efficient, cost-effective spray system while continuing to use existing compressors and air lines.

How CAS works: Instead of using high-volume/low-pressure air from a turbine, a conversion air system reduces

high-pressure compressed air to low pressure and high volume mainly in one of two ways. The first is by using a dedicated CAS gun (like the Binks Mach 1, the DeVilbiss V2 or the Croix 711V) that has a mechanism inside that performs the conversion with a venturi tube or other device. These guns spray like HVLP guns, but connect directly to standard, high-pressure compressed-air lines. The second system, manufactured by Accuspray, features a small pressure-conversion unit that mounts directly to an HVLP gun (shown at left). This system is versatile because it can be fed from either a compressor or a turbine. A third type of conversion air system uses a wall-mounted unit, which takes in compressed air and provides an outlet for an HVLP hose that feeds a standard HVLP gun. (DeVilbiss and Accuspray manufacture these systems.) Because these wall-mounted systems are mostly intended for large production users, I won't discuss them here.

and flow out better, and it also can reduce blushing problems that sometimes occur when spraying solvent-base lacquers. I've found that I can spray lacquer with an HVLP system even on rainy days—an activity that would more than likely result in a blushed finish using compressed air and a regular spray gun.

If material costs and application time are your major criteria for selecting a spray system—as they should be if you run a production shop—HVLP systems again have the edge. I use my HVLP unit to great advantage when I'm spraying lots of large cabinets or furniture, since the high transfer efficiency allows me to spray on more finish in less time. And frankly, I like the feeling that I am doing something to reduce the amount of toxic material that's polluting the environment.

If HVLP has an Achilles' heel, it is its lack of versatility. Merely by cranking up the pressure of a compressed-air line, you can spray thick finishes (even contact cement), drive a sandblaster, blow sawdust from surfaces or run a variety of air-powered tools. An HVLP turbine, on the other hand, is designed only to spray finishes. If your shop already has a compressor, yet you'd like to use a system that has the efficiency of HVLP, you'll want to consider a conversion-air-system setup (see the sidebar above).

Finishers accustomed to a conventional system will need time to adjust to HVLP's idiosyncrasies. Since HVLP guns generally deliver a higher volume of finish, the tendency at first is to inadvertently flood panels with finish. Also, conventional-spraying veterans will feel much less recoil when pulling the trigger on an HVLP gun (due to the lower operating pressure); this can upset spraying rhythm and result in an uneven spray pattern on a large surface. One annoyance of HVLP systems is the constant drone of the tur-

bine, which sounds quite a bit like a shop vacuum. Another irritation is the stiff, thick hose that tends to be unwieldy. Fortunately, maneuverability can be restored by attaching a special 2-ft.-long, extra-flexible "whip end" at the gun. And although most HVLP guns sport adjustment controls that are almost identical to those on conventional guns, others employ mechanisms that may be unfamiliar. For example, the width of the spray pattern (fan) on several HVLP guns is controlled by turning the air cap instead of by adjusting the more-common thumbscrew at the back of the gun.

After weighing all of HVLP's pluses and minuses, I'm still not ready to retire my compressed-air system. When it comes to very fine spray finishing, such as on tabletops and other horizontal surfaces, I still prefer my "old-fashioned" compressor and spray gun. Perhaps it's just that I'm accustomed to my old gun, but I think it produces a superior surface film, especially for gloss finishes. However, other wood finishers I've talked to say that they've achieved spraying results comparable to compressed-air guns with HVLP guns that are of a higher quality than mine.

Choosing an HVLP system

If you've decided that an HVLP system fits your finishing needs, you'll still be faced with deciding which one to buy. There are nearly a dozen manufacturers producing HVLP systems (see the list in the sources of supply box on the facing page), and most offer several models. To ease the confusion, rest assured that turbines of a given motor size (amperage) and number of stages (one, two or three) will output about the same amount of air, regardless of the brand. The same cannot be said of the guns, however, which vary as much in quality as they do in price. It seems that the difference

Advantages: The greatest advantage of conversion air systems is that they are driven by a regular air compressor; no special turbine is needed. Also, CAS guns use a standard, flexible, 1/4-in. or 3/8-in. compressed-air hose. This is in contrast to the thick, stiff, 1-in.-dia. hose used with HVLP systems. Also, the compressor and air line can be used to drive blow-off guns, vacuum pumps and air-powered tools—things that a turbine can't do.

Dedicated CAS guns are the non-bleeder type, which means air flow can be stopped totally when the gun's trigger is released. This makes a CAS gun handle just like a compressed-air spray gun—a real plus for the veteran finisher who is familiar with conventional equipment.

Another advantage of a dedicated CAS gun is that it can generate high pressure at the tip, up to 10 p.s.i., allowing the gun to spray much more viscous finishes than a regular HVLP gun—even adhesives such as contact cement. By the time air and finish mix at the tip, CAS guns spray like HVLP guns, and so it is reasonable to expect the same high transfer efficiency from a CAS gun as from an HVLP system.

Some CAS guns have a control valve and dial gauge at the base of the gun handle, offering adjustability for different spraying conditions, convenience and an instant readout of gun pressure. At least

two companies, Binks and Accuspray, have gone a step further by adding a cup-control valve, which allows the sprayer to create separate fluid-feed and air-feed pressures. For instance, this degree of gun adjustability is great when spraying latex paints, which require high atomization pressure and low feed pressure.

Disadvantages: The largest drawback of using CAS is the compressor itself; larger compressors tend to be heavy and bulky, and hence lack portability. Also, many compressors aren't wired to run on standard 110v household electricity. Another disadvantage of CAS involves air-quality requirements. Standard air compressors produce cool, damp air, which is undesirable for trouble-free finishing. Fitting compressed-air lines with filters and moisture traps will take care of the contaminants, but warming the air involves a more costly air-line heater. Most CAS finishers I know have chosen to live with the cooler air since it's not a significant liability, especially when spraying solvent-base finishes. If you shoot water-base finishes, you may experience orange-peel problems in cold weather.

There's another fly in the ointment to using a CAS gun: Converting air from high to low pressure is inefficient. As a consequence, CAS guns generally need to be fed from a rather large compressor. CAS guns typically draw at least 10 CFM

(cubic feet per minute), but they can draw as much as 17 CFM to 20 CFM—a sizable volume of air—when higher tip pressures are used to spray thick materials. Wall-mounted CAS devices that drive standard HVLP guns are even worse, since the gun bleeds air even when not in use. Therefore, it is important to consider your compressor's CFM output before buying a conversion air system. I wouldn't attempt to run a CAS gun with a compressor smaller than 5 HP.

Buying a CAS gun: Most of the better-known spray gun manufacturers (see the sources of supply box below) currently offer CAS guns in a wide range of prices. But expect to pay at least \$450 for a good-quality CAS gun; more-elaborate models can top \$1,000. Outfitting an entire conversion air system—gun, lines and filters—will generally cost \$200 to \$300 less than a comparable turbine-driven HVLP system, provided that you already own an adequate compressor.

When selecting a gun, make certain that the company you buy it from offers a complete range of tip and needle sizes so you can set up the gun to handle the range of finishes and the type of spraying you plan to do. □

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in cost between comparable HVLP systems is largely due to disparities in guns rather than turbine units.

As far as my recommendations are concerned, most small-shop woodworkers spraying furniture or cabinetry will need a turbine with no less than two stages, powered by a motor that's rated at no less than 9 amps. One-stage turbines, which are usually too small for most full-size finishing jobs, are a great choice for hobbyists spraying small projects or for furnituremakers and finish carpenters who want a light, portable unit for touch-up work. Some small units, like the Accuspray Series 23, come complete with an adjustable carrying strap, allowing you to tote them around a job site. Professional wood finishers or production-shop workers who plan to use an HVLP system for most of their finishing shouldn't settle for less than the power and versatility of a three-stage turbine. The three-stage unit I own, an Apollo model 1100, has two switches on top, which allow me to select between three air-flow levels, depending on the job at hand. At the highest setting, I can connect two guns to my unit, and a helper and I can finish even a big spray job expediently. Regardless of what size turbine you choose, I suggest you buy the best gun you can afford, since the gun is the most crucial component of an HVLP system. If you plan to spray water-base finishes, catalyzed lacquers or epoxy paints, choose a gun with stainless-steel fluid passages to avoid corrosion problems.

Manufacturers of HVLP equipment usually sell their systems as a complete package, including the turbine, hose and spray gun; there's nothing else to buy to get started spraying. An HVLP system should cost less than a conventional compressed-air system. Typically, single-stage HVLP systems run about \$500; two-stage systems are about \$700; and three-stage systems start at about \$1,000. Inci-

dentally, some manufacturers don't mention in their literature how many stages a particular turbine has; you'll need to ask. □

Philip Hostetter is the owner of The Woodshaper Ltd., a cabinet shop in New York City that specializes in architectural cabinetry and finishing.

Sources of supply

The following U.S.-based companies offer HVLP systems.

Accuspray, Inc., 26881 Cannon Road, PO Box 391525, Cleveland, OH 44139; (800) 321-5992, (216) 439-1200.

American Spray Industries (Amspray), 221 S. State St., PO Box 86, Harrison, OH 45030; (800) 443-4500, (812) 637-3215.

Apollo Sprayers International Inc., 1030 Joshua Way, Vista, CA 92083; (619) 727-8300.

Binks Manufacturing Corp., 9201 W. Belmont Ave., Franklin Park, IL 60131; (708) 671-3000.

Croix Air Products Inc., 520 Airport Road, Fleming Field, South St. Paul, MN 55075; (612) 455-1213.

DeVilbiss Ransburg Industrial Liquid Systems, PO Box 913, Toledo, OH 43692-0913; (800) 338-4448, (419) 470-2169.

Graco Inc., 4050 Olson Memorial Highway, Minneapolis, MN 55422; (612) 623-6000, (800) 367-4023.

Hood Products (EagleSpray—Kace Technologies Inc.), PO Box 513, Milltown, NJ 08850; (800) 966-5223, (908) 651-1555.

Lex-Aire Spray Systems, 34 Hutchinson Road, Arlington, MA 02174; (800) 537-2473, (617) 646-1102.

Wagner Spray Tech Corp. (Capspray), 1770 Fernbrook Lane, Minneapolis, MN 55447; (800) 328-8251, (612) 553-7000.



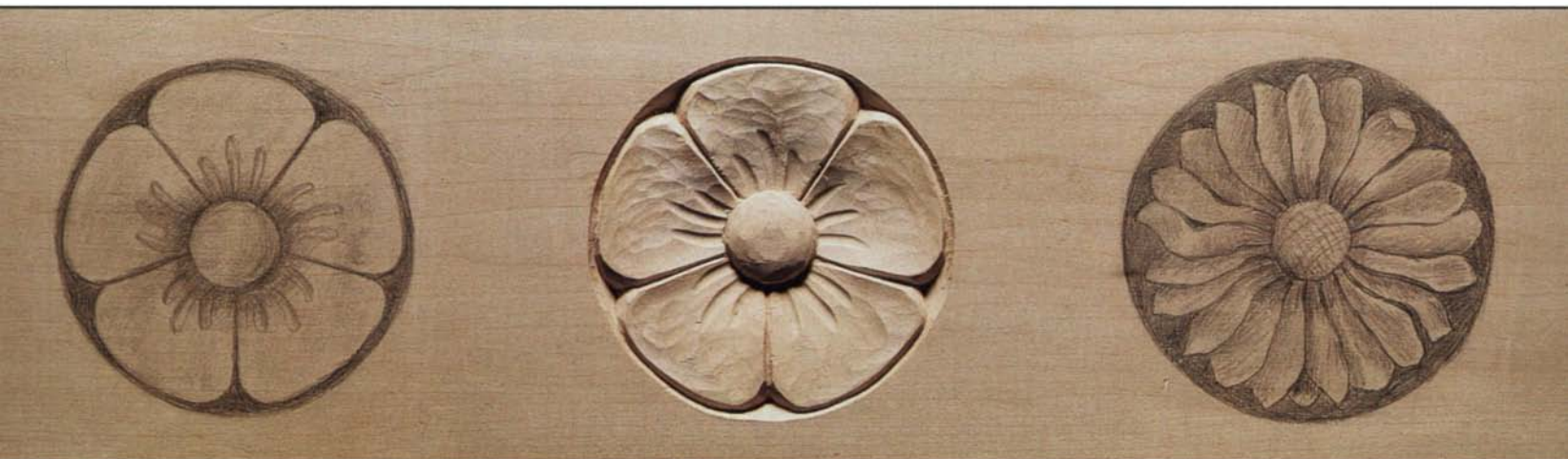
Master carver and teacher Nora Hall (above) starts her students off with a kit of only about eight tools, which is all they need to outline and shape most relief carvings. The flowers in the photos below, which were drawn and carved by Hall, are ideal

first projects for teaching the principles of tool use and the manipulation of light and shadow to imitate life. Hall's 5-ft.-high carving in the inset photo shows how simple motifs, such as these flowers, can be worked together into intricate classical arrangements.

The Basics of Classical Relief Carving

A first lesson from a second-generation woodcarver

by Nora Hall



Anyone can learn how to carve wood. All it takes is patience, seven or eight tools and a lot of practice. I work with hundreds of students from across the country each year, and I am continually fascinated by how quickly they master the skill. Furnituremakers are especially eager to learn because they know that carving gives them an important design tool: a way to manipulate light and shadow. That's really what decorative carving is all about—controlling light and shadow to create realistic forms.

The method I teach to beginners is the old-European way of relief carving that I learned from my father in Holland. I began carving during World War II, when I was 18. The boys were hiding from the Germans, and since my father needed help in his carving studio, I went to work for him. I'm thankful about the way things worked out; otherwise, I might not have had the patience to master the traditional methods of carving motifs like flowers, leaves and scrolls.

Woodcarving can be as simple or as complex as you want, but in either case, the underlying principles are the same. First and foremost, your carving should appear lifelike and possess a sense of movement, whether you're carving a single flower, as described below, or a full-size human torso. You must observe your subject carefully, and use your imagination to come up with ways to make things appear real.

Take an oak leaf, for example. Right off the tree it's a pretty shape, but it becomes more attractive and complex as it dries, twists and wrinkles. The same idea applies to carving. You don't want any perfectly flat or boring surfaces. Something carved exactly round will look unnatural. You never want any part of your work to appear heavy and wooden, so you may want to undercut the edges of some parts slightly, to create a dramatic shadow or a feeling of lightness. Avoiding that heavy feeling might even require you to distort the scale of an object; carving something larger or smaller than life may suggest life and movement more than an exact copy. Keep these basics in mind as you begin to sketch and shape your own carvings.

A basic tool kit for carvers

Your enthusiasm for woodcarving shouldn't be dulled by fears that you can't start without the hundreds of gouges and chisels pictured in catalogs. With my system, you'll need only eight tools to outline and shape the convex and concave surfaces on any relief carving. I always stress that these are not beginners' tools; they are starter tools, and you'll use them as long as you carve.

Carving tools are generally classified by their sweep, or the shape of the cutting edge—flat, gently curved, deeply fluted or V-shaped—and by the width of the edge. As you might expect, narrow, flat tools are designed to remove less wood with each stroke than wider, deeply fluted tools. The sweep is specified by a num-

ber, and the width is listed in either inches or millimeters.

The starter set I specify for my students includes two #3 gouges, 8mm and 12mm; two #5 gouges, 6mm and 10mm; two #7 gouges, 8mm and 12mm; one #11, 10mm veiner (deep-fluted) gouge; and a #12, 60° V-parting tool. You'll also need sharpening stones and slips and some type of leather or abrasive strop for honing the tools. Sharp cutting edges are essential (see the sidebar on p. 73 for my double-bevel sharpening method). For more on sharpening carving tools, see *FWW* #66, pp. 48-51. Finally, you'll need some type of bench that you can clamp the work to as you carve.

Learning to carve with the grain

A simple flower, like one of those drawn and carved on the boards in the photos on the bottom of these two pages, makes a great practice piece. It requires a variety of cuts and uses all of the tools in the starter set described above. Also, it's a good project for learning how to hold tools properly. For maximum control and a smooth cut when using a chisel, you must have your wrist and forearm on the board, as shown in the top photo below. You may have to raise the level of your benchtop before you can do this comfortably.

It's also important to learn to work ambidextrously. Carvers must constantly change the direction of cut to avoid tearing the grain. It's not practical to keep moving to the other side of the bench or to reclamp your work just so you can hold the chisel with the same hand. Initially, some students sit on the bench and attempt various acrobatic maneuvers to cut with either their right or left hand. But after I insist they use both hands, it takes them only about two hours to learn. It really isn't that hard.

Basswood is good for beginners because it's soft and has a fine grain. But even with such an easy-to-work wood, you should carve



The first step in carving a flower is to outline the shape with a V-shaped parting tool. Carving the outline, as opposed to scoring it with vertical cuts, removes wood and gives you space to work.

Photo: Susan Kahn





Hall uses a V-tool to outline the center of the flower. It's important to just tap the chisel lightly with a hand or mallet at this stage, to avoid tearout and to maintain control of the cut.



A shallow gouge is used to shape the petals and round over the center of the flower. For maximum control, the carving tool should be held low on the handle and blade, as shown.

with the grain as much as possible. Don't get uptight about this; cutting in the right direction on the first try isn't a matter of life or death. Learning to distinguish between smooth cuts and rough cuts, and then adjusting to the changing grain, is the key to success. The whole process will be a lot clearer once you put tool to wood.

To start, clamp the basswood to your bench so the long grain runs from right to left. Begin carving by making some practice cuts with the V-tool. This tool is essential for outlining any carving before you begin shaping details. You may have seen other carvers outline a carving with stop cuts, which involves driving a tool straight down into the wood. This operation wedges the wood fibers apart, rather than slicing them, and leaves weak areas that are likely to chip out later. Outlining with the V-tool actually removes wood and gives you space to work. Once the shape is outlined, you can form deep perpendicular walls by making converging cuts, one straight down and then one at an angle to the first cut.

To practice with the V-tool, make a series of small, shallow cuts. For the first 15 minutes, cut diagonally, working from right to left. Then switch and cut from left to right, nearly perpendicularly across the first series of lines, creating a pattern that resembles the checkering on a gunstock. Hold the V-tool close to the cutting edge (see the top photo on the previous page). Most people are reluctant to hold onto the metal below the handle and therefore hold the tool too high. Keep your arm and wrist on the work, and tap the chisel with a mallet. To save wear and tear on your hands and muscles when roughing out, use a mallet, but don't swing so hard that you lose control. When working with a mallet, the more you push your wrist down on the board, the better the cut and the greater your control. Another way to increase control is to take light cuts. Most beginners mistakenly cut straight down into the wood; they look as if they are going right through the workbench.

Once you've covered a small area with a cross-hatch pattern, look carefully at the lines you've cut. You'll notice that the wall on one side of the V appears smooth, and the wall on the other side will be rougher. This shows the relationship between direction of cut and wood grain. Think of wood grain as the straw bristles on a worn broom. If you rub the bristles on the bottom of the broom in the direction the broom is used for sweeping, the straw lays flat and feels smooth; if you rub in the other direction, the straw resists and the feeling is rougher. Cutting with the grain is smoother because you're pushing in the direction that causes the fibers to

lay down as they do naturally; on the other side of the cut, you're forcing the fibers apart, opening the grain. These sections of open grain are difficult to finish and prone to break off as you carve.

Carving flowers as a first lesson

Now that you understand the basics about grain direction, you're ready to really start carving. But first you need a sketch. It doesn't have to be very elaborate, especially for practice pieces. In my classes, everyone usually has a coffee cup with them in the morning, and that becomes the pattern for the first flower. Trace the bottom of the cup to form a circle, and then sketch a smaller circle free-hand in the center of the first one. Next, draw in petals and round their ends (see the flower at the far left on the bottom of p. 70).

Begin work by outlining the flower with the V-tool, as shown in the top photo on the previous page. Again, keep your forearm and wrist on the wood, and make light strokes to determine grain direction. At first, don't worry about making a perfect line. That way you can change your mind about the shape as you study the grain. You want to cut in the direction that will leave the inside of the outline smooth and the outside rough. If the internal area is rough, it will be prone to break as you shape the various components of the flower.

Continue making light cuts as you outline the center circle and petals. When you outline the petals, always cut toward the center. To begin shaping the areas within the V-tool outline cuts, use your #7 gouges. If you need to deepen or clean up any of the outlines, switch back to the V-tool, as shown in the left photo above, rather than making stop cuts with the gouge.

As you carve with your gouges, once again hold the handle down low, so that your hand is partially on the blade, for maximum control, as shown in the above photo at right. Experiment with the #7, #5 and #3 gouges, but practice your cuts on scrap before touching the real carving. This practice time will let you discover what cuts work best with each gouge. If you have honed an inside bevel on your tools, as described in the sidebar, also experiment with carving with the main bevel up, as well as down.

At this stage, your flower carving still looks rough, but you can refine it by rounding over and smoothing the flower's center before working any more on the petals. The petals can be shaped in a variety of ways. Try hollowing them slightly with a #5 or #7 gouge, as shown in the above photo at right. As you smooth out the shape, use



To form the notch between the ends of the petals, Hall makes two converging cuts with a gouge and then pops out the chip between the petals with a third angled cut.

hand pressure rather than a mallet to move the tool, and be careful not to chip out the edges of the petals. All the petals are shaped in the same way. Again, rely on your V-tool for refining outlines.

Shape the notches between the ends of the petals with a #3 gouge. You need to make three cuts in from different angles, so you should make a couple of practice cuts first. Continue practicing the moves until you master the angle needed to pop out the chip. The two cuts going into the corner, shown in the photo above, must be deeper at the V of the notch between the petals. The third cut frees the waste because this cut is angled in toward the other two. This method for coming in from three different angles is a very important maneuver; you'll use it for years to come.

Finally, smooth the surfaces with your gouges and the outlines with your V-tool to eliminate any rough or torn areas. If you work carefully, you shouldn't need to sand much at all, except perhaps to freshen areas that appear soiled from being handled. Don't rely too much on sandpaper; it will destroy the hand-carved look and

feel of your work. Sharp edges and crisp corners are the hallmark of high-quality carving.

Teaching yourself

Continue to practice by carving the other flower designs in the photos on the bottom of pp. 70-71. When you think you've learned all you can from carving flowers, you might try letters, grapes, leaves or other simple shapes. Then you can put those shapes together into unique arrangements. Once you begin to master the basics, you'll discover thousands of subjects and millions of design variations to explore. Check your library for books with carving illustrations, such as *The Manual of Traditional Wood Carving* by Paul N. Hasluck (Dover Publications, 31 E. 2nd St., Mineola, N.Y. 11501; 1977). Most of my students find that once they get started, they can improve their skills on their own; if they are very observant and practice a lot, they don't need me or any other teacher for long.

Here are some additional hints to help you along the way. I carve all my letters freehand, but you can find books on the subject at local libraries and art-supply stores. Just remember to relate tool size to the size of the shapes in your design. Be conscious of grain direction, and don't hesitate to make practice cuts until you get a sense of the movements needed to cut a graceful letter.

Leaves are carved just like a flower: outline the shape, rough-carve the features, refine the details. Again, you want your work to reflect life, so most of your cuts should either originate from the center or go toward it. Grapes are another good practice project. When drawing out the pattern, you can obtain a more realistic look by determining how the grapes will be hanging; the bottom of each grape should be somewhat fuller than the top.

There's no end to what you can do. As you proceed to more elaborate reliefs, you might want to experiment by modeling the piece in clay before working in wood. I definitely recommend clay modeling when you are ready to try carving a human face. A face is one of the hardest things to carve. But, like any other carving, all it takes is practice, practice, practice and a little imagination. □

Nora Hall has been carving wood professionally since 1941. She carves and teaches carving at her studio in Cloverdale, Oreg., Anderson Ranch in Colorado and Peters Valley in New Jersey.

Beveling both sides of a carving tool's edge

Photo: Susan Kahn



For crisp, smooth cuts, carvers prefer tools that have long, shallow bevels between 22° and 30°. Unfortunately, the cutting edge on long-beveled gouges is quite weak and prone to chipping. To avoid this problem, European carvers often form a second bevel on a gouge's inside curve (see the photo at left). Beveling the inside edge of the tool makes a slightly thicker cutting edge and extends the time between regrinding. I've found that even when a double-beveled tool begins to

dull, it will cut better than one with a single bevel because the wood being removed seems to slide more smoothly over the edge.

The inside bevel that I use is about 7°, measured off the gouge's inside surface. After sharpening the primary bevel and honing it razor sharp, I then make a series of strokes on the inside, concave face of the gouge. To do this, I use either a round, hard Arkansas stone or the round edge of a slip stone.

I also slightly round the corners of most of my gouges

before sharpening them. The rounded corners make it easier to excavate deep areas when carving in the conventional manner with the primary bevel down. In addition, the combination of rounded corners and the inside bevel lets me carve with the inside bevel down, for more versatility in rounding over raised portions of a carving. Taking the corners back also means that I can cut with the tool handle held higher than I could with a tool straight from the factory. —N.H.



This bubinga writing desk with maple highlights has an intimate center alcove and elegant details, including tapered-and-fluted legs that are attached to the case's diagonal corner blocks.

An Elegant Writing Desk

A three-drawer case on fluted legs

by Terry Moore

Of all the different pieces of furniture I build, desks are my favorite. I think they are special objects, set apart from the common table by their utilitarian designation. Whether an austere business desk for an executive, an office computer workstation, or an elaborate cabinet secretaire for the home, each desk is designed to fit a specific purpose. When I designed this writing desk, I wanted to create an elegant piece of furniture that would be used for occasional handwritten correspondence. To this end, the desk's form could be of more delicate and airy proportions. One of its two main focal points is the curved central drawer, which creates an inviting intimate alcove; the other focus is the tactile form of the fluted legs attached to the drawer case's diagonal corner blocks.

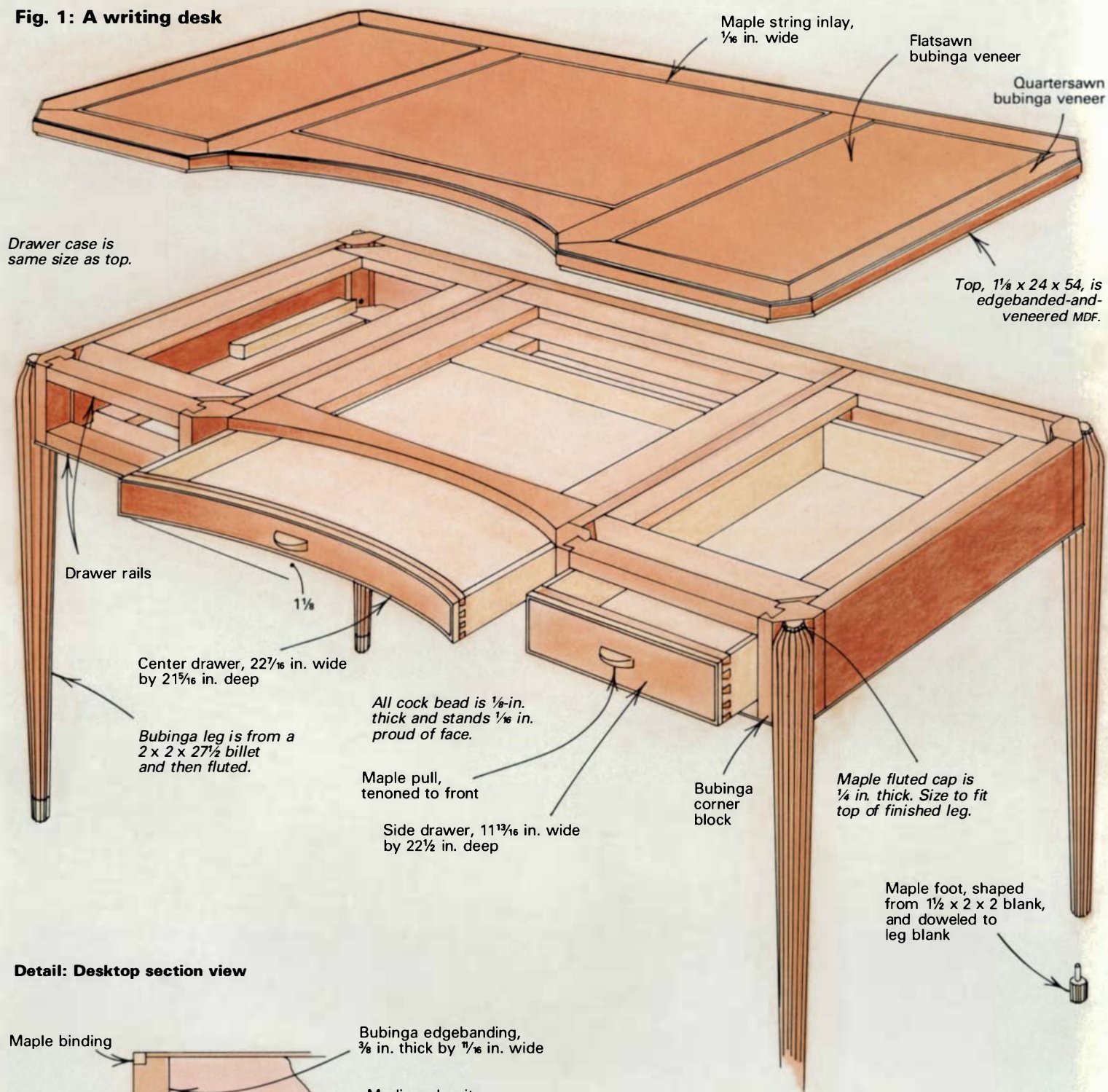
Making the drawer case with its corner blocks and aprons, and later attaching the legs, not only simplified the construction process, but also allowed me to experiment with different leg profiles. Though I initially tried square-tapered and lathe-turned designs, I eventually chose 12-sided, tapered, fluted legs. I'll explain more about how I made these legs later. The desktop is the same size and shape as the drawer case, and the top has veneered book-

matched bubinga "panels" that are outlined with curly maple string inlay. A veneered "frame" borders the panels, and the edge is trimmed with a curly maple binding.

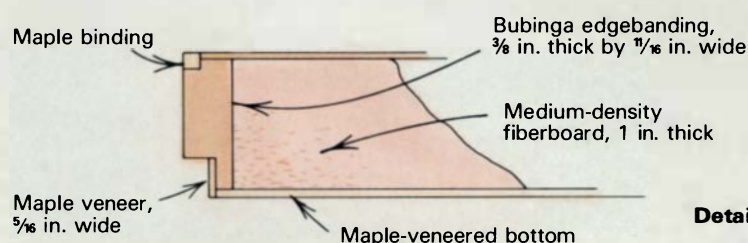
Making the drawer case

Once I decided on the overall size and shape of the top, I began building the drawer case. I made its visible parts from bubinga and used cherry for parts that aren't visible. The drawer case has two short side aprons and one long back apron; a drawer rail above and below each drawer opening; and a center divider between each drawer compartment. As I mentioned, the case is assembled around angled blocks: one at each of the corners and one on each side of the center drawer. These blocks are mortised to receive the ends of the aprons and the two center dividers. The ends of the four side-drawer rails are dovetailed to both the front corner blocks and the front face of the center-drawer blocks. Within each drawer compartment are two drawer frames. The top frame keeps the drawer from tipping when opened, and the drawer slides on the bottom frame. The drawer frames are made from cherry, ex-

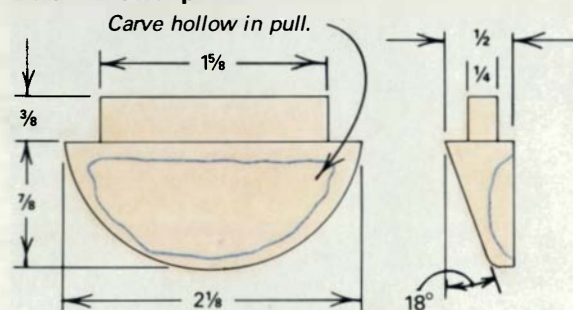
Fig. 1: A writing desk



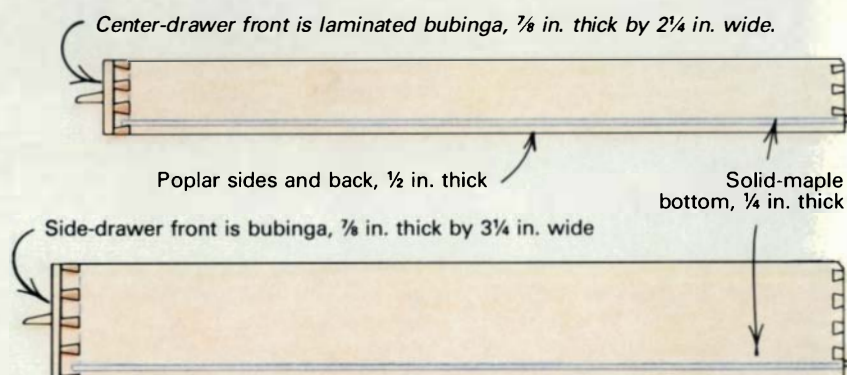
Detail: Desktop section view



Detail: Drawer pull



Detail: Drawer construction



cept for the front pieces of the two center frames, which are bubinga because they are actually the curved center-drawer rails. The drawer frames' side and back edges have tongues that fit into grooves on the inside of the aprons and dividers.

The first step was to cut the corner blocks to the size and shape shown in figure 2 on the facing page. I began with a 36-in.-long piece of bubinga, which I milled to $1\frac{1}{16}$ in. thick by 3 in. wide. I then tilted the tablesaw blade to 45° and ripped the corners off the stock to form the four facets shown in figure 2. After planing the facets smooth, I crosscut the stock into six 5-in.-long blocks.

Next, I laid out and cut the mortises in the blocks to receive the aprons and dividers. The mortises were located so that the outer surfaces of the side and back aprons would be flush with the outer face of each corner block. The mortises in the two center-drawer blocks were aligned so that the dividers were flush on the side that faces the center-drawer opening. Since the tenons were centered on the $\frac{7}{8}$ -in.-thick aprons, I centered the mortises $\frac{7}{16}$ in. from the face of the block that the apron was flush with. I cut all the mortises on a slot mortiser (shown in my article in *FWW* #81), but the job could be done with a router or a drill press.

With the mortise sizes established, I cut the aprons and dividers to length (see the dimensions in figure 2) and formed the tenons on their ends. The back and side aprons have tenons on both ends, but the center dividers only have tenons on the front ends; they are doweled to the back rails. For cutting tenons, I mounted a dado blade on the tablesaw and clamped the workpiece vertically to a tenoning jig. With the tenons cut, I filed their corners round to fit the mortises. Next, I measured over $13\frac{1}{2}$ in. from the tenon shoulders at each end of the back apron and marked the centerlines of the center dividers' dowel holes. I drilled three, $\frac{3}{8}$ -in.-dia. by $\frac{3}{8}$ -in.-deep holes on each centerline, and I used dowel centers to locate the holes in the ends of the dividers. To guide each divider into position, I clamped a block on the back apron, $\frac{7}{16}$ in. from the centerline (half the divider's thickness). I then held the divider against the block and kept the top and bottom edges aligned as I pressed each divider's end against the dowel centers. I drilled 1-in.-deep holes in the ends of the dividers and inserted loose-fitting dowels without glue to test for fit and to aid in the dry assembly.

Also in preparation for dry-assembling the parts, I hot-glued a triangular softwood clamping caul on the outside diagonal face of each corner block, as shown in the photo at right below, so I could apply clamping pressure directly in line with the tenons. I left these blocks in place until after the final glue-up, and then I popped them off with a chisel and peeled the hot glue from the blocks.

Now I was ready to dry-assemble the aprons, dividers and corner blocks to measure the length of the side-drawer rails and the length and width of the drawer frames. To ensure accuracy when measuring, I clamped the dry-assembled parts to a piece of MDF, making sure the side aprons and dividers were square with the back apron, and the drawer openings were parallel. After determining the dimensions of the drawer rails, I cut them to length, allowing for the single dovetails on their ends. I then cut the dovetails with a thin-kerf blade and the tablesaw crosscut box, shown in the left photo below. The dovetails were cut with the blade tilted 8° and the workpieces held vertically and against a stop clamped to the box's fence. I set the blade back to 0° to cut the shoulders, again using a stop block. I chiseled away the small ridge in the corners left by the thin blade. To mark the corner blocks for the dovetails' mating sockets, I held each tail against the end of its block and scribed around the tail. Then I handsawed to the line and chiseled out the waste.

Making the drawer frames

Since the drawer frames fit inside the case, the frames must be square and to the exact dimensions of the drawer openings. I added $\frac{1}{4}$ in. to the sides and the back of each frame for the tongues that fit into grooves in the aprons and dividers. After cutting the side-frame parts to length, I joined them with open mortises and tenons. The center frames also have open mortises and tenons on the back corners, but the bubinga front rails are joined to the frames' sides with blind mortises and tenons.

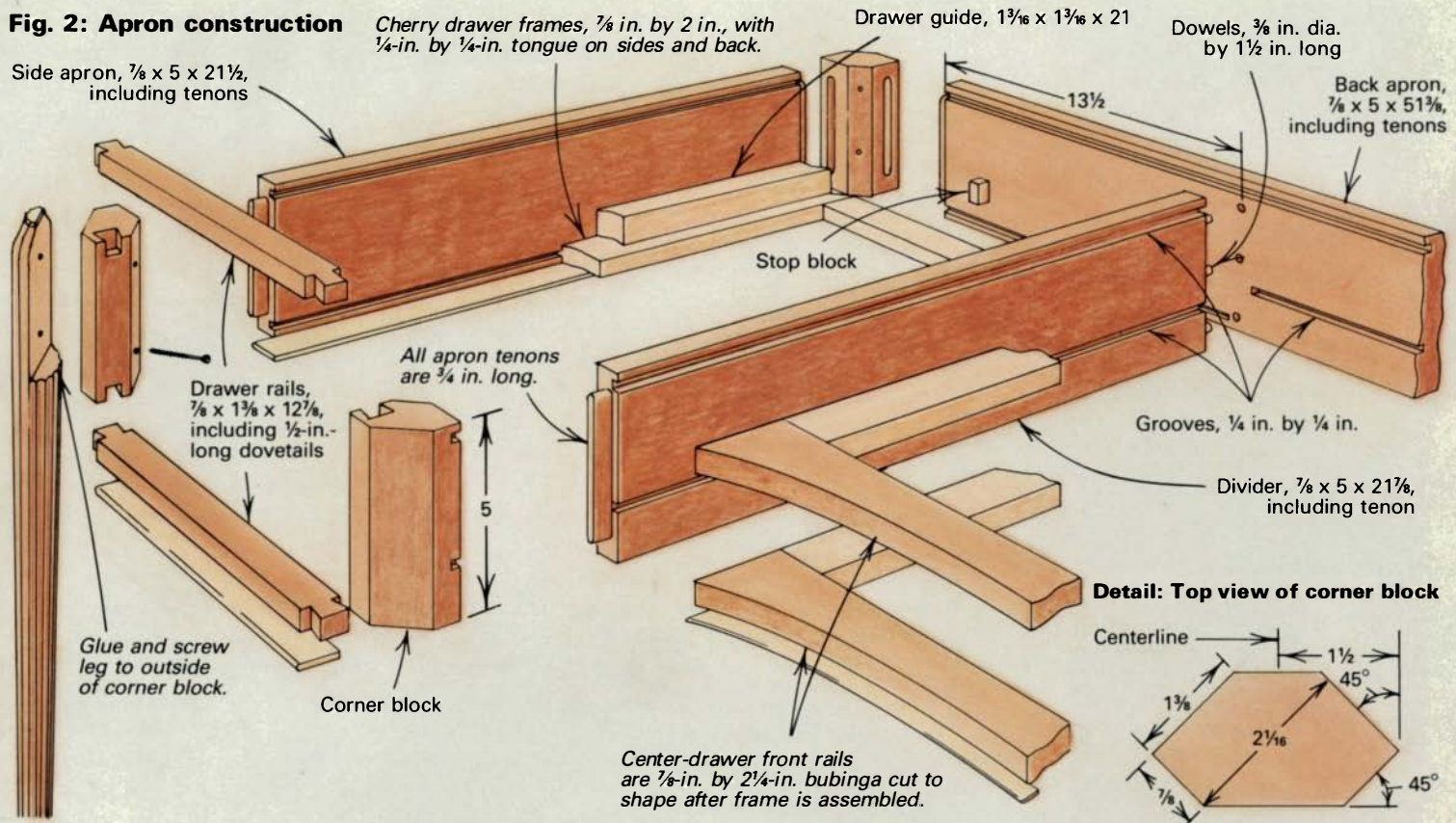
After removing all the glued-up frames from the clamps, I scraped off dried squeeze-out and handplaned the joints flat. Then I stacked one center frame on top of the other, taped them securely together and bandsawed the curve in both front rails at the same time. I left the frames taped together while I smoothed the curved edges with a compass plane (a spokeshave would also work).



To cut dovetails on the ends of the drawer rails, Moore uses a tablesaw crosscut box and clamps a vertical guide on its fence. Cutting different angles widens the box's kerf, so he renews the box by screwing plywood to the base and fence and cutting a fresh kerf.



The drawer case is dry-assembled to check that joints fit and to measure for the drawer frames' size. Softwood cauls, hot-glued on the beveled corner blocks, keep clamping pressure in line with the apron tenons. The cauls are chiseled off after final assembly.

Fig. 2: Apron construction

Next, I cut the tongues that are centered along the side and back edges of each frame. I did this on my shaper, but tongues could be cut easily with a router or tablesaw. To groove the dividers and aprons to receive the drawer frames' tongues, I guided my hand-held router with its fence against the workpiece edge. I located the grooves so that the inside surface of the side frames would be flush with the inside face of the drawer rails, allowing the drawers to slide smoothly. To allow for assembly, I cut off the corners of the side-drawer frames so they fit around the inside facet of the corner blocks (see figure 1 on p. 75). The top center frame is flush with the case top, but because the center drawer is narrower than the others, I adjusted the router fence to raise the center-drawer-frame groove 1 in. farther up from the case's lower edge (see figure 2). After grooving all the aprons and dividers, I glued the appropriate angled corner block on the front end of each divider, and I extended the 1/4-in. center-frame grooves 3/8 in. into the block. When gluing the blocks on the dividers, I also glued the corner blocks on both ends of the back apron and on the front end of the side aprons.

Gluing up the drawer case

I organized the drawer-case parts into four manageable subassemblies, each of which I glued up and let dry before going onto the next assembly stage. First, I glued the center-drawer frames to the dividers; second, I glued the dovetailed rails to the dividers' and side aprons' corner blocks; third, I glued on the four side-drawer frames one side at a time; and finally, I added the back apron with its corner blocks. When gluing up a case in subassemblies like this, parts must be aligned so they will fit properly at the next assembly stage. For example, when I glued the drawer frames to the dividers, I made sure all the back edges were aligned before setting aside the subassembly to dry.

When I glued the dowels in the dividers before the back apron was glued on, I didn't hammer the dowels to the bottom of the

holes because pressure from excess glue might have split the dividers. Instead, I held a 1 1/16-in.-thick block against the ends of the divider and hammered the dowels in until their ends were flush with the block.

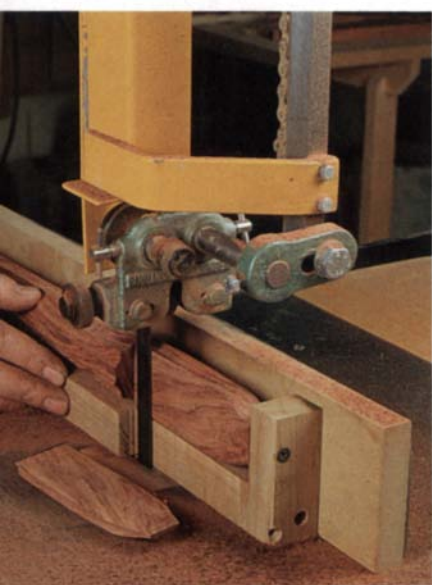
To complete the case, I glued the back-apron-and-corner-block assembly to the side-apron tenons and the dividers, clamping from corner block to corner block to press the side aprons' shoulders up tight. Also, during this last stage, I glued a drawer glide on each side of the bottom side-drawer frames, as shown in figure 2. With the drawer case completed, I moved on to building the desktop.

Making and veneering the desktop

Although the desktop appears to be a mitered frame with three book-matched panels, it is actually bubinga veneer with curly maple stringing glued on a substrate of 1-in.-thick medium-density fiberboard (MDF). I thought the frame-and-panel design would emphasize the writing alcove, but I wanted to avoid the wood movement associated with solid stock.

To lay out the substrate, I turned the case upside down on the MDF and traced around the case's perimeter. Then I sawed to a line 3/8 in. inside the tracing to allow for solid-bubinga edgebanding around the substrate's perimeter. I made the banding a bit thicker than the MDF, and after gluing on the banding, I planed and scraped its edges flush. Next, I used my shopmade vacuum-bag veneer press to glue maple veneer to the bottom of the MDF. Then, I routed a small rabbet along the substrate's bottom edge and glued curly maple veneer to the rabbet's shoulder. This visual transition elevates the top from the drawer case. After trimming the curly maple flush with the bottom surface, I turned to the top surface.

First, I selected a bubinga plank with spectacular grain and resawed it on my bandsaw to yield the 1/16-in.-thick veneer for the book-matched panels. I resawed veneer from a piece of vertical-grain bubinga for the frame veneers. I glued the frame veneers



Moore flutes legs on his shaper by using a lathe-like jig with a 12-point index wheel and a $\frac{3}{8}$ -in.-radius cutter (above). A profile template screwed to the jig's base follows the collar in the shaper table, and stops on the ends prevent the cutter from touching the jig's steel headstock or tailstock centers. The block in the jig's middle keeps the leg from deflecting.

A leg is notched to fit on the corner blocks using a jig that guides the leg against the bandsaw fence (left). The leg is rotated in the jig so that the notch will intersect at the ridges between flutes.

down first, using clamps and softwood cauls, and then I glued down the maple string, which I ripped from $\frac{1}{10}$ -in.-thick bandsawn veneer. I held the strings in place with pins until the glue dried. Since the veneer was so thick, I was able to joint and edge-glue the book-matched panels before gluing them on the MDF. I cut each panel slightly larger than its opening and handplaned it to a perfect fit. Then, I spread glue in the panel areas on the substrate, positioned the panels and secured them with tape before putting the top in my vacuum press.

After removing the top when the glue had dried, I scraped the veneers level and then rabbeted around the top edge for the curly maple binding. I glued the binding in the rabbet and held it with a piece of tape every inch or two while the glue dried, just as I do when trimming around the edge of a guitar (building guitars is my hobby). When the glue was dry, I removed the tape, scraped the binding flush and slightly rounded its corner with a sanding block. Then I sanded the desktop and fastened it to the drawer case with screws through the top drawer frames. Next, I made the legs and attached them to the corner blocks.

Fluting legs on a shaper

Although the tapered, fluted legs on this desk look somewhat intimidating to shape, it's a fairly easy operation with the aid of the

jig shown in the top photo. My jig supports the leg billet between centers, and a profile template screwed to the jig's base runs against the shaper's guide collar as the billet is shaped and fluted with a three-wing, $\frac{3}{8}$ -in.-radius cutter. The jig's fixed headstock has a 12-point index wheel that allows me to rotate the billet in equal increments and lock it in place as I cut each of the 12 flutes. The tailstock block has a tenon that slides in a groove in the base so that the tailstock can be adjusted for different-length legs. Once the tailstock is adjusted, a bolt and wing nut hold it in place securely.

To make the tailstock center, I drilled the end of a $\frac{1}{2}$ -in.-dia. steel rod and inserted a finishing nail filed to a point. And for the headstock center, I drilled and tapped the steel rod to accept a hanger bolt, which has machine threads on one end and lag threads on the other. The rods fit tightly in holes in the center of the headstock and tailstock blocks.

I prepared the leg billets by doweling and gluing a maple foot block on the bottom end of a bubinga blank. Then, I center-drilled the top of the square blank to accommodate the headstock screw and tapered the billet on all four sides using the bandsaw. Next, I beveled the billet's corners with a router and chamfer bit to make it into a rough, tapered octagon. I screwed the billet to the indexed headstock screw and tightened the tailstock's center against the billet's maple foot. Then I cut each flute in two passes.

I used another jig, shown in the bottom photo, to hold and align a fluted leg while I bandsawed the notch for attaching the leg to the drawer-case corner blocks. The leg was screwed to the jig at both ends, and the assembly was rotated so that the bandsaw blade intersected at the high points of flutes on opposite sides of the leg. I crosscut the shoulder by placing the leg, still in the jig, against my radial-arm-saw fence. And, with the blade adjusted to the correct height, I crosscut for the shoulder.

To complete the legs, I glued maple caps on their tops with epoxy and extended the flutes onto the caps with sandpaper wrapped around a $\frac{3}{4}$ -in.-dia. dowel. To attach the completed legs to the corner blocks, I turned the table upside down, and glued and clamped each leg in place. When the glue had dried, I screwed into each leg from inside the drawer case. While the case was upside down, I glued cock bead (shown in figure 2) to its bottom edges.

Making the drawers and pulls

I put the drawers together with traditional hand-cut joints: Through dovetails join the back to the sides, and half-blind dovetails join the sides to the front. The solid-wood bottom panel slides under the back into grooves in the sides and front. For more on traditional drawer work, see *FWW* #73, p. 48. I made the curved front by laminating seven pieces of $\frac{1}{8}$ -in. resawn bubinga over a form. I resawn the veneers from one piece and laminated them in the same order, so the glueline would be almost invisible. After assembling the drawers, I glued blocks on the back apron that stop each drawer when its front is flush with the drawer rails. To complete the drawers, I routed a cock-bead rabbet around the perimeter of each drawer front. The $\frac{5}{16}$ -in. rabbet allows the $\frac{3}{8}$ -in.-wide maple cock bead to stand proud of the drawer face.

I like the feel of carved wooden drawer pulls, and this desk's curly maple pulls contrast nicely with the bubinga. The pulls are hollowed underneath to provide a grip, and each pull has a tenon, which is glued into a mortise in the drawer fronts. After shaping the pulls, I carved the hollow with a gouge and left the tool marks for a pleasant tactile surprise. Finally, I sprayed the completed desk with four coats of clear high-gloss lacquer and rubbed the final coat to a satin finish with 0000 steel wool. □

Terry Moore is a furnituremaker in Newport, N.H.

A Router Fixture for Making Dowels

Spinning square blanks into round stock

by Ken Wells



When you need dowel stock in unusual or exotic species of wood, where do you turn? The ebony, cocobolo, elm, mabogany, walnut, oak and sycamore dowels above were all made by running square stock through a simple fixture that mounts on a router.

Have you ever wanted to use exposed dowels for a piece of furniture, but rejected the idea because you couldn't find any dowels of the right wood species? Store-bought dowels are available here in the United Kingdom in only *ramin* (a yellowish, featureless tropical hardwood) and sometimes *beech*. If dowels are hidden, it doesn't matter what they look like—they need only be durable and fit the hole. But for the games and puzzles I manufacture, I need small-diameter dowels of various species, such as *wenge*, *ebony* and *yew*, and so I make them. I routed the dowels shown above by chucking a square blank in an electric hand drill and feeding the blank through a fixture screwed atop my router's baseplate, as shown at right. The dowel is formed as the fixture guides the spinning blank past the side of a $\frac{5}{8}$ -in.-dia. straight bit.

My fixture (see the drawing on the next page) is a 1-in.-thick block through which I bored several holes: two screw holes, for mounting the fixture to the base; one center hole, for the router bit; and two different-size guide holes on either side of the bit. Since the dowel blank goes in square and comes out round, each guide hole must start large and decrease to the diameter of the finished dowel. The diameter of the infeed portion of the guide hole is equal to the diagonal of the square blank. And the surface of the outfeed hole must be tangent to the arc of the bit's cutting edge; this principle is similar to the relationship of a jointer's outfeed bed to the cutter head. The difference between the radii of the infeed and outfeed holes is equal to the depth of cut. The chart on the next page lists the size of the blank and diameter of the infeed portion of the guide hole for dowels from $\frac{1}{8}$ in. dia. to $\frac{1}{2}$ in. dia. in $\frac{1}{16}$ -in. increments.

Making the fixture

I've made three fixtures; each makes two different-size dowels. My fixtures are hard phenolic plastic (from afar it looks like wood), which can be worked with woodworking tools, but you could also use aluminum or wood. If you use wood, choose a strong and hard species like *lignum vitae*, which is oily and self-lubricating. You can

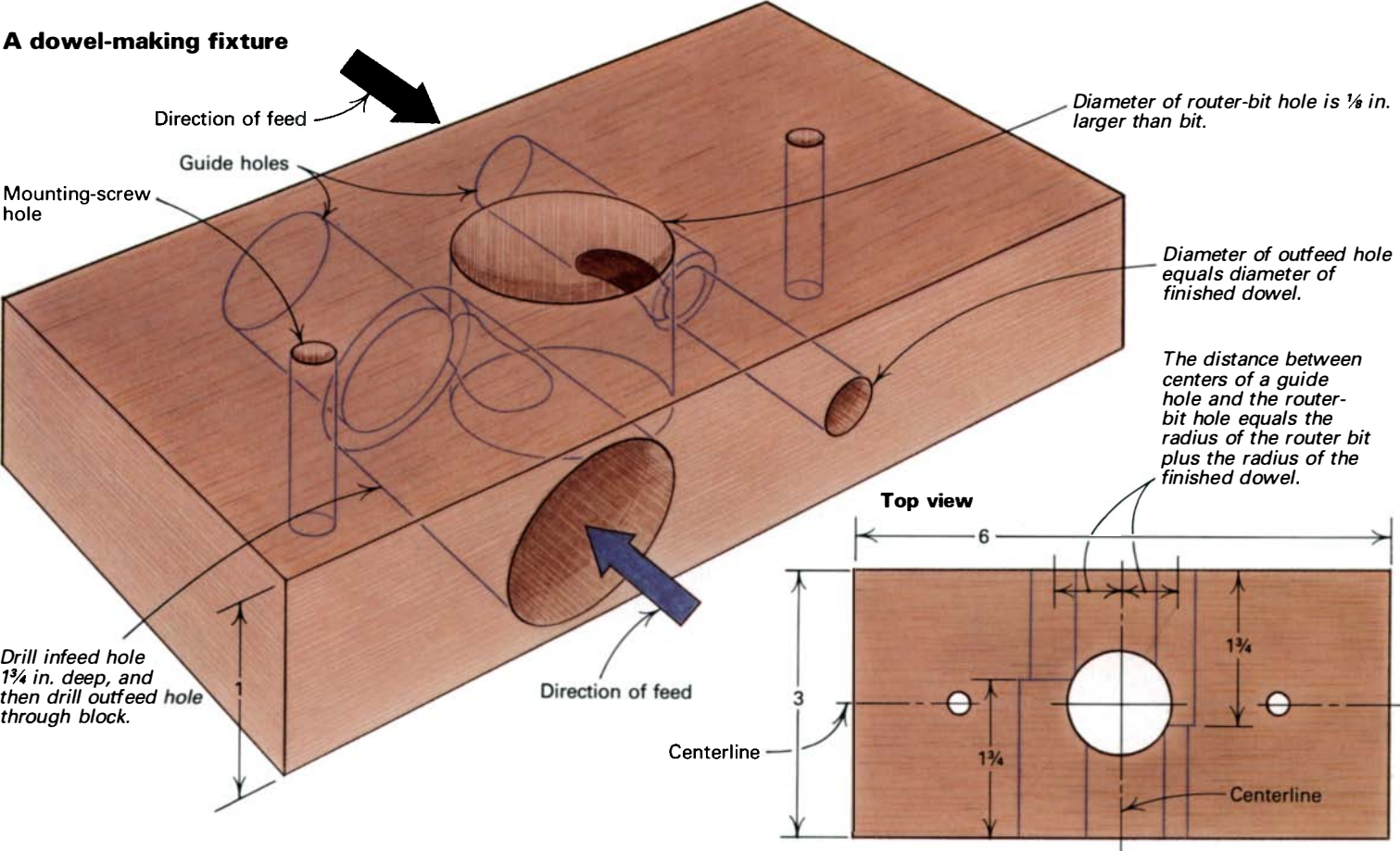
buy phenolic in thicknesses up to 2 in. from Ridout Plastics (5535 Ruffin Road, San Diego, Cal. 92123; 800-542-6325), but I used epoxy to laminate four $\frac{1}{4}$ -in.-thick pieces into a 1-in.-thick block. If you want a fixture for dowels larger than $\frac{1}{2}$ in. dia., make the block about $\frac{1}{4}$ in. to $\frac{3}{8}$ in. thicker than the diameter of the infeed hole. As shown below, my fixture is bolted through threaded holes in my router's metal base and baseplate. If your router is fastened to a table or to an oversized plastic baseplate, it may be more convenient to make the fixture longer and screw it to holes in the table or baseplate on either side of the router.

After cutting the glued-up block to width and length, I scribed it with the centerlines of the five holes (see the drawing). The screw holes are 1 in. from the ends, the bit hole is in the center, and the



To make a dowel, a square blank is chucked in a drill and fed, spinning, through the fixture's infeed hole. The blank's corners are trimmed off as it rotates past the straight router bit's cutting edge.

A dowel-making fixture



guide holes are offset from the center of the bit a distance equal to the radius of the bit plus the radius of the dowel. For example, if the bit is 1/8 in. dia. and you want a 3/8-in.-dia. dowel, then the center of the guide hole must be 1/2 in. from the center of the bit. I bored the holes on a drill press using a brad-point bit. If you don't have one or if you're drilling aluminum, use a twist bit, but first drill a pilot hole the same diameter as the web on the dowel-size bit (one-sixth of the bit's diameter).

The guide holes were drilled first so the drill bit wouldn't be deflected by the router-bit hole. I clamped a fence to the drill-press table to center the bit on the block's centerline and then clamped the block to the fence before drilling. The depth of the infeed portion of the guide hole is half the width of the block plus 1/4 in. I drilled the larger-diameter infeed portion of the hole first, changed bits and drilled the outfeed portion through the block. If you want your fixture to accommodate two different dowel sizes as I did, drill the infeed holes in opposite edges of the fixture so the dowel blanks will be fed past the bit in the same direction relative to bit rotation. Next, I reset the drill-press fence to align the bit with the centerline running the length of the block's surface, and then I drilled the router-bit hole. For chip clearance, I bored a 3/4-in.-dia. hole for my 5/8-in.-dia. bit. (As a rule, the bit hole should be 1/8 in. larger than the bit's diameter.) Then the screw holes were drilled in the block equidistant from its center. For more than one block, drill the screw holes in each in the same location so that all the blocks share the same mounting holes in your router's baseplate. To align the outfeed hole with the bit, I made the mounting-screw holes 1/32 in. larger than the diameter of the screw shank. Oversized holes allow for fine-tuning the position of the infeed/outfeed holes relative to the router bit. I bolted the fixture on my router by setting the fixture's bit hole on an equal-size bit in the router collet. I then traced the fixture's screw holes on the router base (or table) and drilled holes equal to the screw-shank diameter through the base.

Determining Dowel Size

Dowel Dia. (in.)	Square Blank (in.)	Infeed-Hole Dia. (in.)
1/8	5/32	7/32
3/16	7/32	5/16
1/4	9/32	13/32
5/16	11/32	1/2
3/8	13/32	5/8
7/16	1/2	11/16
1/2	9/16	3/4

Making dowels

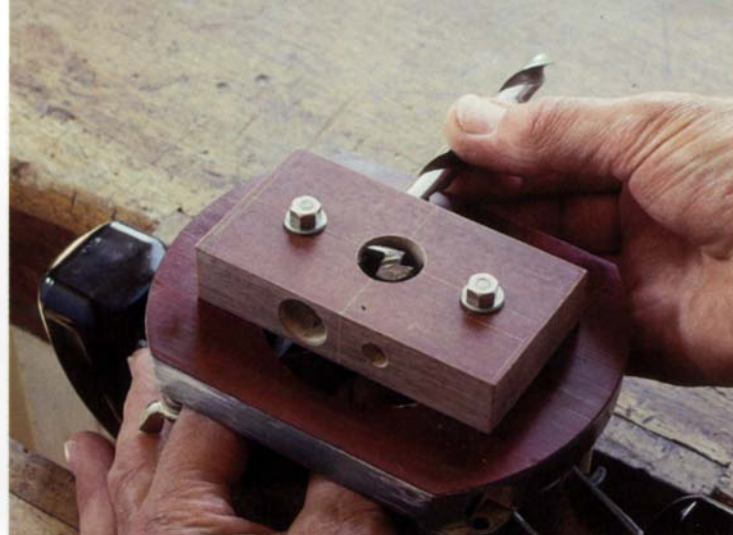
Safe router use dictates that stock be fed against bit rotation, but climb-cutting, feeding the dowel blanks in the same direction as the bit's rotation, produces a better finish on the dowels. Climb-cutting is safe with this fixture because the dowel fits snugly in the holes, preventing stock from self-feeding. To reverse the feed direction, the fixture can be flipped over and the opposite face screwed against the router base. To adjust the fixture so its outfeed hole is aligned with the bit's edge, I loosely fasten the fixture to the baseplate, insert the shank of a dowel-size drill bit in the out-feed hole (shown on the top of the facing page), and adjust the fixture until the drill shank just touches the bit's cutting edge. Once the screws are tightened, the fixture can be tested.

I prepare a blank by ripping it to correspond to the desired dowel diameter, as indicated in the chart. I check the blank's fit in the infeed hole, making sure it is snug, yet can still be turned by hand. If the blank is larger than my portable drill's 1/2-in. capacity chuck, I whittle 1 in. of one end until I can fit the blank into the chuck and tighten its jaws on the blank. Now I'm ready to cut the dowel. I turn on the router, but not the drill until the end of the blank is in the infeed hole; then I slowly feed the blank, turning at about 1,000 RPM, through the fixture. If the dowel is too big to exit the outfeed hole, the fixture can be moved so the guide hole is closer

to the bit; if the dowel is smaller than the outfeed hole, the hole can be moved away from the bit. By taking time to fine-tune the fixture, I can make perfectly sized dowels at production speed.

To keep a long dowel from whipping, I feed its finished end through a dowel-size hole in a steady rest, which I clamp to the bench about half the dowel's length from the outfeed hole. You can also prevent whipping by pushing half of the blank into the fixture in the normal fashion, and then chucking the drill on the finished end of the dowel and pulling it the rest of the way through. Whipping also results from the bit being set inside the diameter of the outfeed hole, which makes the fit loose. If this condition is carefully controlled, you can produce dowels of lesser diameters than the fixture was made for. To control whipping in this instance, I clamp a pressure pad over the exit hole so the pad bears against the dowel. □

Ken Wells, author of Wooden Puzzles and Games (Sterling Publishing Co.), makes puzzles and games in Portsmouth, England.



Perfect alignment of the outfeed hole with the router bit's cutting edge is essential to ensure an accurately sized dowel. Slightly oversized mounting holes in the fixture let you move it side to side while testing alignment with a drill-bit shank.

A dowel maker you can buy

by Gary Weisenburger

If you like the idea of making dowels from the wood of your choice, but you would rather buy a tool to do the job than make one, there are two on the market to choose from. One is a fairly expensive, hand-held, stationary cutter through which you feed square stock, using a lathe, a drill press or an electric drill. This hand-held dowel maker, which has only one size cutter and costs about \$160, is available from Woodcraft Supply, 210 Wood County Industrial Park, Parkersburg, W.V. 26102-1686. The other tool, the Woodhaven Dowel Maker (shown below), is router mounted like Ken Wells' fixture (see the main article) and is very reasonably priced. It is a rectangular aluminum tube with a maple infeed block screwed to one side. The blank is guided past the end of a $\frac{3}{4}$ -in.-dia. core-box bit instead of past the side of a straight bit like Wells' tool.

I tried the jig and found the instructions very easy to follow. Since the dowel blank

is cut on top of the bit, I only roughly centered the fixture on my router table. I mounted the fixture using machine screws and lock nuts (provided) and adjusted the bit height to get a perfectly sized dowel. As with Wells' fixture, the finished dowel must fit snugly in the outfeed hole, which should burnish the dowel's surface. Anything less than a snug fit and the dowel will feed too quickly, which yields a rough finish or short spots that are skipped over.

Although the square blank should fit snugly in the infeed guide hole, my blanks must have been slightly oversized because friction caused burning in the infeed hole. To decrease the friction, I handplaned a chamfer on the corners of the blank. If you burn and enlarge the infeed hole in the maple block, you can buy or make a new one and screw it to the aluminum tube.

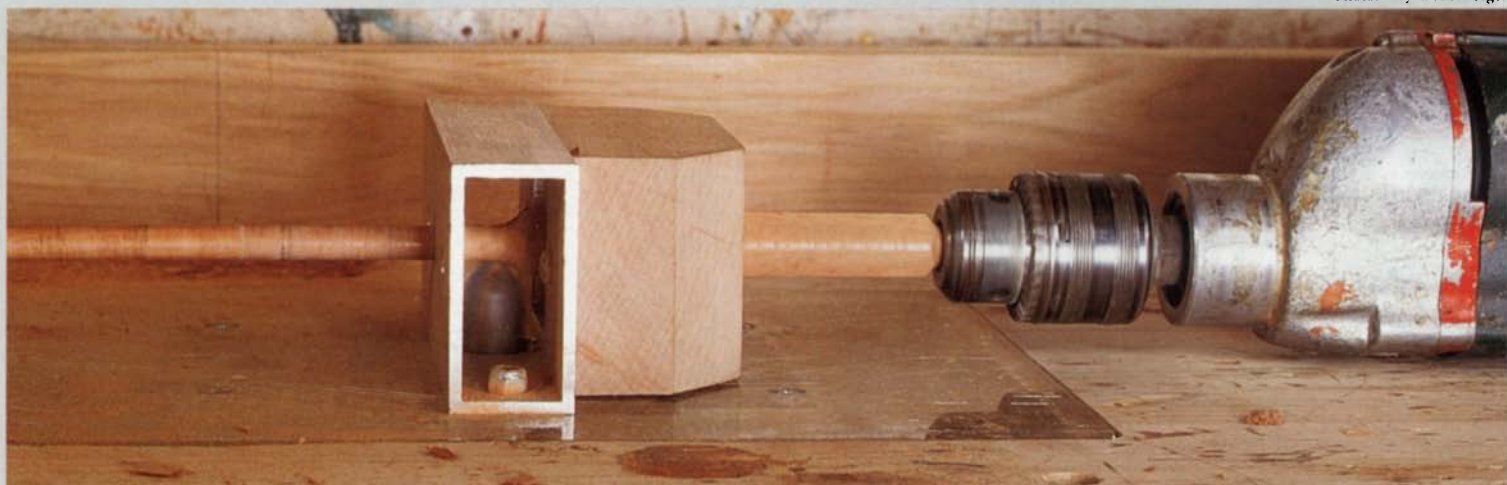
Photos in the product literature suggest feeding the blank through the fixture by inserting the blank's end in a square sock-

et, which is shown chucked in an electric drill. I didn't have a $\frac{1}{2}$ -in.-sq. socket to try this, but it's a great idea.

Woodhaven (5323 W. Kimberly Road, Davenport, Ia. 52806; 800-344-6657), makes fixtures for five dowel diameters: $\frac{1}{4}$ in., $\frac{3}{8}$ in., $\frac{1}{2}$ in., $\frac{3}{4}$ in. and 1 in.; each fixture is for only one size dowel and costs about \$16. Replacement maple blocks are about \$3. Also, for about \$17, Woodhaven sells a hardware kit, which contains a clear-plastic baseplate that attaches to a router's subbase so that the fixture can be mounted on the baseplate. The hardware kit also includes clips that allow a router-mounted fixture to be inverted and attached to plywood or a benchtop. Dowel-making fixtures are also available from Garrett Wade, 161 Ave. of the Americas, New York, N.Y. 10013; (800) 221-2942. □

Gary Weisenburger is an assistant editor at FWW.

Photo: Gary Weisenburger



Woodhaven's dowel-making jigs work on the same principle as Wells' fixture except that the blank is guided over the end of a $\frac{3}{4}$ -in.-dia. core-box bit instead of past the side of a straight bit. Here, a $\frac{7}{16}$ -in.-sq. mahogany blank is being turned into a $\frac{3}{8}$ -in.-dia. dowel.

Quilt Patterns in Parquetry

Scroll-sawing interchangeable pieces

by Charles Detweiler

My wife, Linda, and I launched a new career rather unexpectedly in 1982 when a recession in northern Texas caused a slump in our home-building business. With time on our hands and a need for income, Linda innocently suggested that we combine my interest in woodworking with her admiration of fabric quilts and make something to sell at a local arts-and-crafts show. After some prodding from our friends who sold at craft fairs regularly, we agreed to make some parquetry wall hangings based on traditional quilt patterns.

From that humble and hesitant beginning, our business has grown and prospered. Today, we make “wood quilts,” the trademark we coined for the type of woodworking we do, in nearly 200 different designs and sell them to individuals, gift stores and galleries nationwide. Although the wall hangings are our largest sellers, we’ve also used quilts as tabletops, and we’ve grouped quilt blocks with different geometric and pictorial patterns into larger afghan-like works and montages. Recently, we’ve begun to sell wood-quilt kits, which have unpainted, pre-



cut pieces that hobbyists can assemble, paint and frame themselves. But if someone wants a challenge and prefers to “quilt” from scratch, this article will show the fundamentals that we use to cut out and assemble a custom quilt.

Methods and materials

When most woodworkers hear the word parquetry, they think of floors decorated with geometric patterns. Our quilts are similar, in that small pieces of wood are cut out and glued to a substrate to form patterns. If only straight-sided geometric shapes, such as triangles, squares and parallelograms, are used, it’s fairly easy to cut uniform, interchangeable pieces. You just rip strips of wood and then crosscut them into pieces at the proper lengths and angles. This method works fine and produces some beautiful patterns, but it limits you to straight-sided pieces. So in order to introduce curved pieces into our quilt designs, we developed a method for scroll-sawing the pieces.

Just as in conventional fabric quilting, most of our scroll-sawn wood quilts are based upon repeated block patterns, like the full-scale pattern in figure 1 on p. 84. Once we’ve sketched a block design, we decide how many times to repeat it to make up the quilt (we used 16 blocks for the quilts shown



Dramatic design variations are possible simply by swapping colors within a pattern. The quilt shown above and the one at left have the exact same pattern, and even the same colors. A subtler variation is introduced when different kinds of plywood are used; the quilt at left is oak and the one above is lauan.

The 31-in.-sq. painted parquetry quilt, left, was inspired by a traditional quilt design. The quilt’s field and borders are 1/4-in.-thick plywood glued to a wafer-board substrate. Grain directions of the pieces were alternated to add texture and variety.

here). Then we cut squares—one for each block in the quilt—from 1/4-in.-thick plywood. These squares are stacked in groups of four, the block pattern is drawn on the top squares and the stacks are sawn into pieces.

The beauty of this scroll-saw method is that we can use straight-sided, curved and irregular-shaped pieces, and they all have a well-matched fit in the finished quilt. Since multiple layers of plywood blocks are cut at one time, pieces shaped with arcs or free-hand curves are always uniform. Thus, various species of plywood can be used and the pieces interchanged, or the grain direction of adjacent pieces can be varied to introduce the look and texture of cloth. This scroll-saw method allows more design freedom, so I'll detail the process.

For a scroll-sawn quilt and borders, any species of 1/4-in. plywood can be used. For example, in the bottom photo on the facing page, 1/4-in. oak ply was used, while in the top photo on the facing page, 1/4-in. lauan plywood was used. Thinner plywoods will be easier to cut, but they might be more trouble to glue and fit because they tend to warp. Solid wood can also be a problem, as the water from the glue can cause the pieces to swell and buckle or leave gaps when dry. We use 1/4-in.-thick wafer board (available at most building-supply stores) for the back boards, though a thicker backing might be better if you're making a tabletop. All our scroll-sawn quilts are framed with solid oak and have 3/4-in.-thick by 1 1/8-in.-wide sub-frames, ripped from 1x12 white-pine boards, to stiffen the back boards (see figure 2 on the following page).

Although experience in making cloth quilts is helpful in laying out an original block design, you can find inspiration and traditional patterns in quilting magazines and books. By reversing color combinations of the pieces within each block or by rotating the blocks, you can achieve kaleidoscope-like variations. The quilts on the facing page illustrate the dramatic diversity possible by alternating colors and materials in identical blocks. Note that simple geometric shapes, like squares and diamonds, usually have common opposite- or adjacent-side lengths. By lining up equal sides, the shapes can be combined to make extraordinary schemes. Once you've arrived at a design, you can start to "quilt" your blocks.

Preparing plywood stacks

After you've selected the type of plywood, you're ready to cut out the squares that will later be scroll sawn into the pattern pieces. I rip 5-in.-wide strips on the tablesaw and then crosscut these into squares using a radial-arm saw and stop blocks.

Because the 16 squares will be arranged in four stacks of four squares each before they are cut into pieces, you need to draw your pattern on the four top squares only. There are several options for this: You can copy the pattern onto the plywood with carbon paper; you can cut a poster-board stencil with an X-Acto knife and trace it (see the top photo below); or if you are planning to make several quilts with the same pattern, you can make plywood marking jigs to trace the lines quickly and accurately; two or three jigs may be necessary to draw the whole quilt pattern. To make the jigs, cut single-pattern shapes out of plywood, and then tack and glue stops on two adjacent sides. These corner stops will align the jig on the plywood squares.

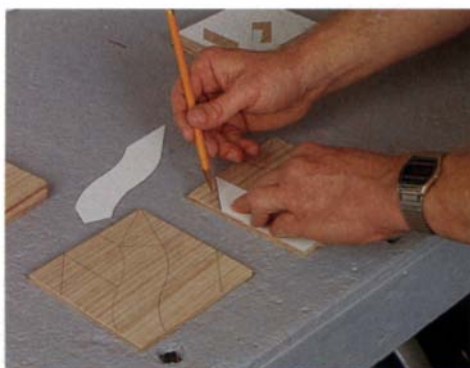
After you've transferred the pattern to the four top squares, you're ready to assemble the stacks with double-faced carpet tape, which is carried by most hardware stores. Place small pieces of tape on your design where you won't cut through them, because the glue on the tape will gum up the teeth of your scroll-saw blade. Since removing the tape is rather tedious, don't use any more than necessary. The placement of the tape will depend on the design, but don't put tape

on parts that will be snipped away early in the cutting process. However, at least two pieces of tape will be needed to hold the stack together until the last cut is made. To ensure that the tape is precisely placed each time, you can make a poster-board or paper stencil with windows cut out where you want the tape (see the top photo below).

When taping the squares together, alternate grain direction (two vertical and two horizontal), as this makes the quilt more visually interesting (unless you want a more homogeneous look). Also, align all the edges of the squares perfectly in each stack. It's a good idea to check this alignment with a combination square after the stack is taped together but before you cut. If the stacked squares are only out of alignment slightly (plus or minus 1/32 in.), you can belt-sand the edges flush since the glue-up procedure is somewhat forgiving of minor errors and since the frame can accommodate small discrepancies. When the taped-together stacks are aligned and square, you're ready to scroll-saw them into pieces.

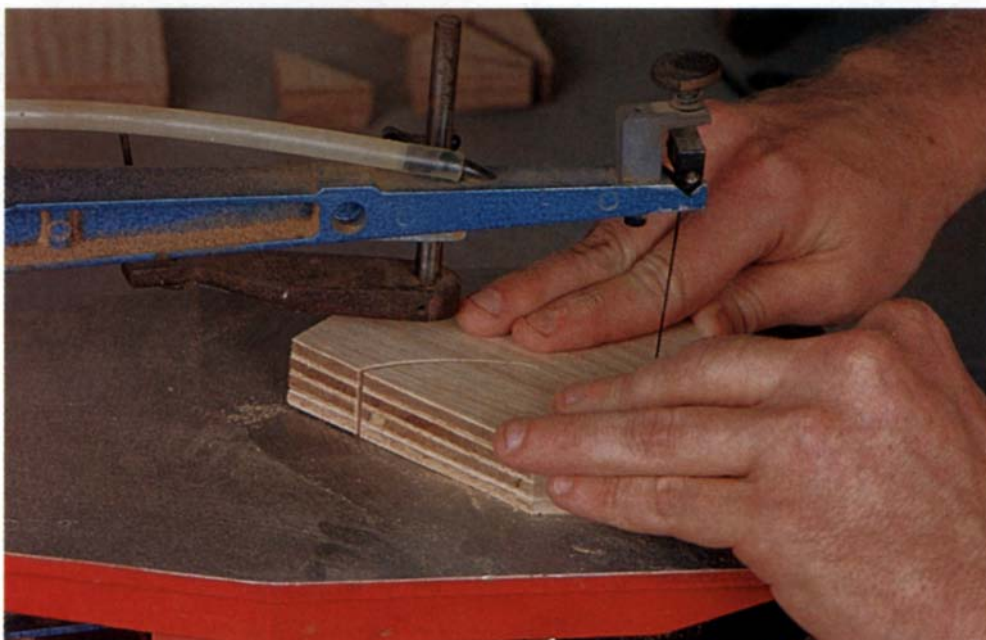
Cutting and arranging the pattern

For sawing the plywood stacks into pattern pieces, I use a Hegner Multimax scroll saw



Poster-board patterns are used to trace the block design on the squares that will be on top of four stacks. Detweiler also cuts out stencils, like the one shown in the background at left, so he can precisely place double-faced tape between block layers, but away from lines to be cut.

By scroll-sawing four squares at once, Detweiler makes uniform pieces throughout a stack, allowing a piece to be exchanged with others directly above or below it. He uses a #5, 16 1/2-t.p.i. Pebecco blade in his Hegner Multimax scroll saw (below).



(available from Advanced Machinery Imports Ltd., PO Box 312, New Castle, Del. 19720) fitted with a #5 Pebeco blade (also carried by Advanced Machinery). I prefer a #5 (0.0150-in.-thick by 0.039-in.-wide) blade with 16½ teeth per inch (t.p.i.) because it cuts smoothly and quickly and because it's stiff enough to cut sharp corners without much deflection. As you cut the stacks into pieces, set the pieces aside in the same positions as they were marked to keep things organized until the cutting is finished.

After cutting all the pieces, pry apart the taped parts carefully with a pocket knife or similar thin-edge tool, and peel off the tape.

If any of the tape's glue is left on the wood, clean it off with some paint thinner or alcohol. After removing the tape, the individual pieces within each stack are rearranged and laid out into new pattern blocks with the parts and grain alternated or rotated to complement the design (see the top photo on the facing page). Remember that all of the parts from one square will only interchange with others in that stack and only in the same place in the pattern. In other words, even if each square contains four similar triangles, each triangle should only be interchanged with others that are above or below it in the stack. This ensures that the pieces will fit

perfectly, even if you veered from the line slightly when cutting.

Borders

For first-time wood quilters, I recommend a single border, consisting of four equal-width strips around the quilt's sides. The strips can be whatever width you choose, but leave them ½ in. too long and trim the ends later. For the quilt described here, we used three borders. A ¾-in.-wide strip acts as a thin accent border to set off the block pattern. A 3-in.-wide border was cut into segments to form a pattern that complements the overall design. Segmented borders can consist of triangles or other geometric shapes determined by continuing joint lines and colors from the quilt's field. A little arithmetic will help you figure sizes. Finally, a 1¼-in.-wide outer border surrounds the exterior, like a mat. I recommend butting the joints of this outer border and the accent border, as opposed to mitering them, so that size adjustments can be made more easily.

Determine the length of the accent-border strips by compressing them around the field of pattern blocks lightly (four hands are required for this) and marking where each strip runs past its adjacent strip. Then I take the average length of the four strips and cut them all the same length by using a stop block on the radial-arm saw. I cut the segmented-border pieces by fitting them alongside the accent borders just established. I repeat this for the outer border, but I leave those ends long and trim them at the same time as the back board after the glue dries.

Now, cut out your ¼-in.-thick wafer-board substrate about ½ in. larger than the overall quilt size. This will allow for any block inconsistencies, accumulation of spaces between the pieces or out of squareness.

Painting the pieces

After all the components are cut, arrange the blocks and borders to make up the quilt on a smooth tabletop, and check that all the pieces fit well. Then spread out the arrangement, leaving space between the pieces so you can pick them up to color the wood. We brush on water-base liquid-acrylic paints, such as Accent brand (HPPG Borden, Accent Products Division, 300 E. Main St., Zurich, Ill. 60047) and Ceramcoat brand (Delta Technical Coatings, 2550 Pellissier Place, Whittier, Cal. 90601), which have a cream-like consistency and are available in 2-oz. jars at most craft-supply stores. We prefer these water-base paints for their ease in cleanup and overnight drying time, but you could also use household oil-base stains, enamel paints or thinned artist's oils; you should experiment on scraps first. Working with one color at a

Fig. 1: Full-scale block pattern

Sixteen plywood blocks are required for whole quilt.

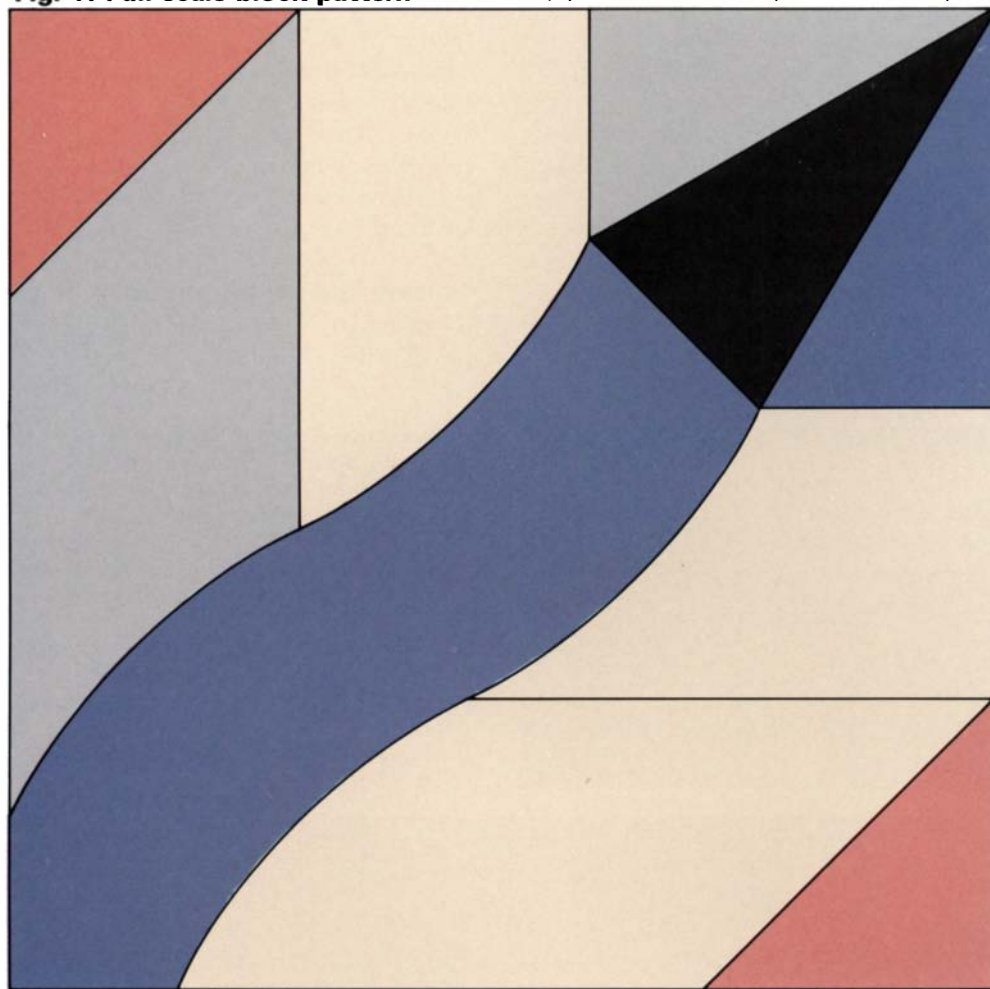
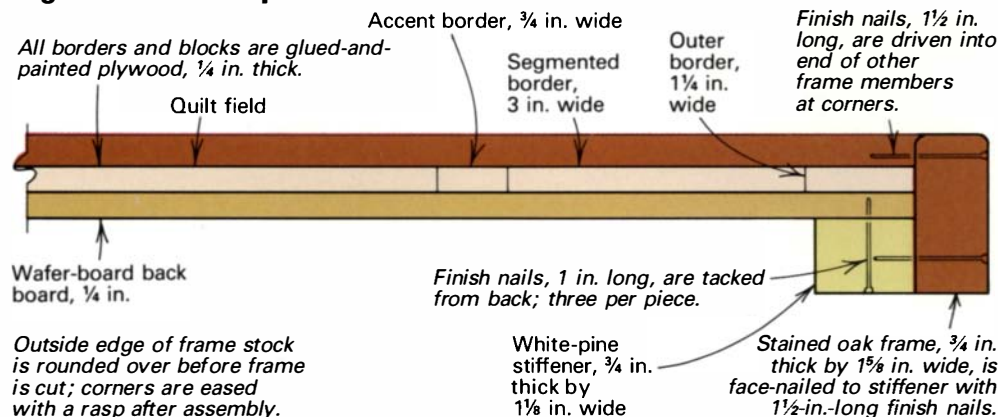


Fig. 2: Section of quilt's frame and borders



time, paint each piece and border, picking up and returning each to its designated spot in the layout. Spread the color evenly, brushing it in the direction of the grain. If you want the grain to be more apparent, apply a thinned wash coat of paint and immediately wipe it off to the degree of transparency you want. Let the painted components dry for 12 to 24 hours before gluing them to the back board.

Gluing and clamping

After the parts are dry, push the whole assembly snugly together again, but off to one side to make room for the back board. Next, mark the center of your back board, and from that point, calculate and measure where the outside edge of the accent border will be located. Clamp the accent strips in place, but don't glue them yet. With a carpenter's square, check that these strips form 90° corners. Span across the corners with strips of 1/2-in.-thick scrapwood, secured with spring clamps (see the bottom photo at right). Now you're ready to transfer the pieces that make up the quilt's field to the back board and glue them in place.

Starting in the clamped accent border's corner, spread a coat of glue (we use regular white glue) over just a portion of the back board, and then, working quickly, place the quilt's pieces; two people are needed to glue a quilt this size. When the field of pieces is laid out, clamp the other two accent strips to the back board to complete the far corner. Be sure you don't push the pieces and borders together too tightly or the assembly may buckle. Although the joints may spread a bit while the glue is drying, you can further exaggerate the space between the pieces to emphasize patterns and individual blocks. But work fairly rapidly so that you can make adjustments before the glue sets. (I use a water-filled spray bottle to wet the tops of the pieces to keep them flat and to lengthen the glue's setting time.)

After this inner assembly is dry, carefully fit and glue the accent-border strips and 3-in.-wide segmented-border pieces around the completed field. Finally, glue the 1 1/4-in. outer-border pieces at the perimeter. To prevent the border pieces from bowing, hold them down with scrapwood and spring clamps the same way you anchored the accent border when you began gluing the field. Leave the clamps on for approximately 60 to 90 minutes or until the glue has set, but hasn't completely dried. Then remove the clamps and scrapwood, and wipe down the surface with a clean, damp rag to remove any glue squeeze-out. To maintain flatness in plywood pieces, cover the assembly with a clean piece or two of Masonite or plywood, weighted evenly with 10 lbs. to 15 lbs. per



Pieces with different grain directions are interchanged to create texture in the overall quilt. First, the taped blocks are pried apart carefully with a knife. After the tape is removed, individual pieces are laid out into new pattern blocks. Note that all of the pieces of a stack are kept in their original positions in the pattern.



To keep the borders from bowing, they are secured with spring clamps and four, 1/2-in.-thick strips of scrapwood across the corners. The assembly is then covered with Masonite and weighted evenly with 10 lbs. to 15 lbs. per square foot while the glue dries.

square foot (we've used piles of books, stacks of plywood and paint buckets), and allow the assembly to dry overnight.

Framing and finishing

When the quilt is completely dry, trim the 1/4 in. or so off the oversized back board even with the outer border's edges. We use a sliding crosscut box on the tablesaw to do this, but with a steady hand or a fence, you could use a bandsaw. For wall hangings, we glue and nail four, 3/4-in.-thick by 1 1/8-in.-wide white-pine stiffener boards around the perimeter on the underside of the back board (see figure 2) to help counteract the wafer board's tendency to bow as a result of the parquetry being glued on only one side.

If the quilt is going to be framed, round one edge of some long pieces of 3/4-in.-thick by 1 1/8-in.-wide frame stock using a 3/8-in. roundover bit in your router (this will be

your frame's outside top edge). We use oak frames, but you could use any hardwood. Prestain the frame stock, and crosscut the four pieces 1 in. longer than required. Butt the frame pieces around the quilt, and then glue and fasten them to the stiffener boards with finish nails (see figure 2). Trim the excess at each corner, and ease the sharp, outside corners with a rasp to match the rounded-over frame edges. Fill the frame's nail holes, touch up these spots and the corners with stain, and paint any blemishes in your quilt before applying the finish. With a clean rag, rub on a coat of thinned linseed oil (we use a 50/50 mix of oil and mineral spirits) to complete the quilt and frame. □

Charles Detweiler and his wife, Linda, make wood quilts in northern Texas. Their precut quilt kits are available through Detweiler Folk Arts, PO Box 2883, Sherman, Tex. 75091.



Routing spiral grooves in a turned column lends a decorative touch that's hard to create any other way. The author's setup employs a plunge router held in a carriage that is pulled along the lathe bed as a cable and system of pulleys synchronously rotates the turning blank.

The walnut lamp base, above, was stave-constructed and then turned to a smooth taper. The four decorative spiral grooves that wrap around the base were routed using Zentil's lathe system.

The mahogany plant stand, left, made by the author, has a column made from a stave-constructed, hollow turning blank that was spirally routed using a combination of regular and custom-made bits.

Spiral-Routing on the Lathe

A shopmade setup for putting a twist on turnings

by Norman Zentil

Photo: Norman Zentil

Spiral shapes have always appealed to me. So when I turned a wooden plant stand a couple of years ago, I decided to decorate it by routing an accelerating spiral pattern into its tapered column. I built my own spiral-routing system, shown in the large photo on the facing page and figure 2 on p. 89. The system employs a router mounted in a sliding carriage, which the operator pulls along the lathe bed. A system of pulleys and weights, connected to the carriage by a cable, rotates the turning blank synchronously with the travel of the router, hence creating grooves, flutes or reeds on the turning.

Although my setup may look complicated, it's actually not all that difficult to build, once you understand how it operates. And although nine years of experience making tools and jigs gave me the skill to fabricate many of the parts from metal, you can just as easily substitute plywood and plastic for some of the parts.

Because spiral-routing is done with the lathe *off*, most of the system's components don't have to withstand the force of a spinning lathe. My system is adaptable to just about any lathe with dual ways—wood- or metal-turning—and is flexible enough to allow dozens of different spiral patterns to be routed. The setup isn't limited to just routing cylindrical turnings. By offsetting the axis of the turning, I can rout spirals on the surface of a tapered turning, such as the column on my lamp base shown in the small, top photo on the facing page. And my system is capable of creating even more complex forms, like the column on my plant stand shown in the bottom photo on the facing page.

It would take pages of drawings to show you every dimension of every part of my lathe system, and then it probably wouldn't fit your lathe. Therefore, I'll concentrate on explaining the construction, features and critical elements of each part so that you can build your own spiral-routing system. But first, here's a rundown of all the components and how they function together.

How the system works

The spiral-routing system consists of a number of different parts, most of which are mounted on the lathe itself. The components include: the universal drive center and tailstock offsetting device; the indexer; the router carriage; and the weighted drive cable and guide assemblies. My shopmade drive center and offsetting device make it possible to align a tapered turning off of the lathe's normal central axis.

The indexer is the real heart of my setup: It provides the means of rotating the turning in a way that's synchronized to the linear movement of the router. The body of the indexer is made up of two parts: an inner disc, which gets screwed to a 1¼-in.-dia. shoulder turned on the end of the turning blank, and an outer ring, around which the drive cable is wrapped. A repositionable cursor is screwed to the disc. Stops are screwed to the ring and allow the position of the inner disc and outer ring to be partially shifted for routing multiple, evenly spaced grooves around a turning.

I adapted my router-carriage design from one I saw in a magazine, adding cleats and bearings so the carriage can slide along the ways of the lathe bed. The carriage holds a plunge router above and parallel to the top edge of the turning during spiral-routing. The carriage also provides a means for raising and lowering the router. An "outrigger arm," which is screwed to the base of the carriage, is grooved for a sliding anchor block that the drive cable attaches to. This arrangement allows the location of the anchor point relative to the carriage to be changed for creating spirals of varying character, from a "uniform" spiral—one that twists evenly all the way around, like the stripes on a barber pole—to an "accelerated" spiral—one with a twist that changes from tightly wound at the bottom, to no twist at all at the top.

From the outrigger, the drive cable passes through a pair of guide pulleys, mounted to the lathe bed, that keep the cable running smoothly as it changes direction from horizontal to vertical. The cable then wraps completely around the indexer ring's pulley once and continues up to a guide assembly screwed to the wall behind the lathe. Finally, the cable end is tied to a lead weight that keeps the cable taut during spiral-routing.

Here's how all the components work together. After the surface of the blank has been turned to a smooth cylinder or taper, the router carriage is fitted to the bed ways with the cleats and bearings, and then the universal drive center and the indexer are screwed to the ends of the blank. If the work is tapered, the offsetting device is adjusted to make the top edge parallel with the lathe bed. The anchor block is positioned and clamped to the outrigger, and the drive cable is threaded in place, as described above. Next, I set the indexer cursor to the 0° hole, lock the cursor between the stops on the pulley, and tighten friction clips on the back of the indexer. To prepare the carriage, I chuck a bit into the plunge router and then set the plunge depth to take a shallow cut on the first pass. I slowly plunge the bit into the blank and slide the carriage toward the tailstock, creating the spiral flute. Each flute is routed in three passes, with plunge depth increased between passes. The position of the blank and indexer are shifted for subsequent spirals: The cursor is removed and repositioned in the proper hole to yield evenly spaced spirals, as desired (for example, choose holes 90° apart for four spirals). Subsequent flutes are routed just like the first.

Jig construction

Most of the components in my setup were made from either Baltic-birch plywood or aluminum. I chose aluminum for some parts because it machines easily, but I'm sure that high-quality plywood or plastic parts would be adequate for most applications. For the sake of brevity, I've simplified some of the parts described below from the way I originally made them.

The tailstock offsetting device and universal drive center—

The tailstock offsetting device (see figure 2 on p. 89) has two basic parts: the main block and the sliding block. The main block is bored out to fit the lathe's tailstock spindle. A female dovetail is machined in the block, and two holes for locking bolts are drilled and tapped in one edge. Part of that edge is then slit on the bandsaw, and another slit is cut at the bottom of the block into the spindle-mounting hole. The sliding block is machined with a matching male dovetail. A hole bored into the sliding block receives a pressed-in ball bearing, which in turn gets a lathe-turned and case-hardened ¼-in.-dia. ball-end center pressed into it. When the sliding block is slipped into the main block and set to the desired offset, the Allen head locking bolts close the slits to lock the sliding block in place and simultaneously lock the assembly on the tailstock spindle.

I made my custom drive center by welding a small universal joint, purchased from a bearing-supply store, to a small faceplate on one end and to a #2 Morse tapered shank (to fit my lathe's headstock) on the other end. Incidentally, I use the center to actually turn tapers on my metal lathe using the lathe's screw-cutting feed to make the cut. If you plan to only use the setup for spiral-routing, you can simply substitute a regular multispur drive center.

The indexer—The indexer is made up of an inner disc and an outer ring, each made from two layers of ½-in. Baltic-birch plywood glued together and then lathe-turned. My inner disc has a diameter of 5½ in. with a ¼-in. by ¾-in. rabbeted shoulder on the outer edge. I divided the face of the inner disc to create 2, 3, 4, 5,

6, 8 and 12 evenly spaced divisions (shown in figure 1 at right). Next, I drew a circle on the disc, drilled $\frac{3}{16}$ -in.-dia. holes at each index line, and routed a $\frac{3}{8}$ -in.-wide, shallow circular groove around the disc. The holes and groove are for mounting the cursor, which I made from $\frac{1}{4}$ -in.-thick aluminum. Two stops, also made from $\frac{1}{4}$ -in.-thick aluminum, provide a means of locking the cursor, and hence the position of the disc to the ring. The stops are slotted so they can be repositioned for changing groove width during spiral-routing (described later). I bored a $1\frac{1}{4}$ -in.-dia. hole in the center of the indexer, and then I drilled two $\frac{1}{8}$ -in.-dia. holes at an angle for screws that attach the disc to the end of the turning.

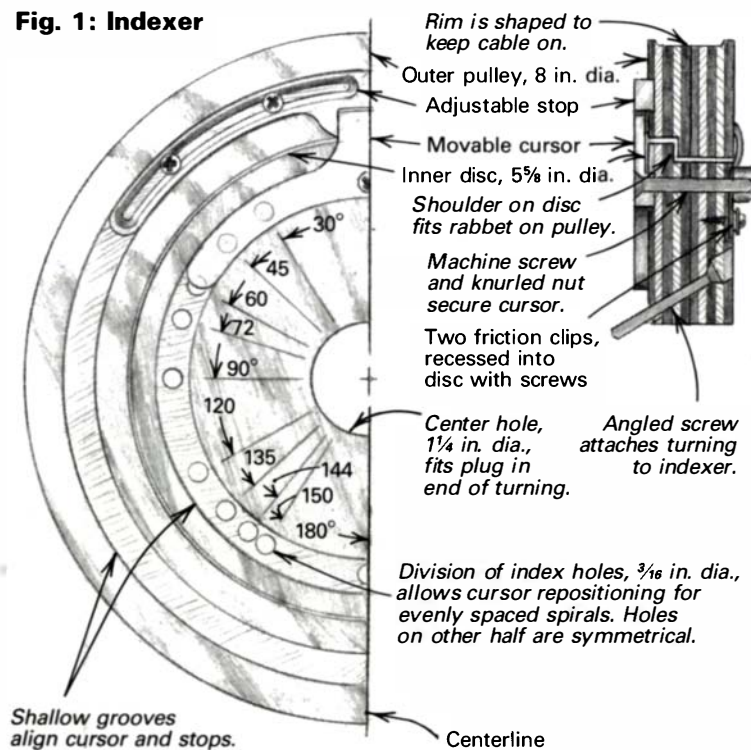
The outside edge of the outer ring was turned with a small rim, which forms a sort of pulley to contain the drive cable. The center of the outer ring was turned to match the diameter of and fit the rabbet on the inner disc. The fit should be snug, but not tight. The outside diameter of my pulley is 8 in.; however, this diameter determines the number of times the turning rotates as the carriage travels along its length. Hence, a smaller-diameter pulley will produce more turns over a given length, yielding a more loosely coiled spiral; a larger diameter yields fewer turns, producing a more tightly coiled spiral. You may need to experiment to determine the best pulley diameter for the spirals you desire (I wouldn't go under 8 in.). After the pulley was turned, another shallow groove was routed near the rim, and the two cursor stops were screwed on. Finally, the friction clips that keep the disc and pulley together were bent from some cold-rolled steel. Holes in the clips allow them to be screwed to the tailstock-facing side of the inner disc. O-rings under the screws and washers (see figure 1 at right) permit the degree of friction that locks the inner disc and the outer ring together to be adjusted.

The guide assemblies and drive cable—Both upper and lower guide assemblies (shown in figure 2) use aircraft-cable pulleys I bought at a surplus store. The lower assembly has two pulleys: One ($1\frac{1}{8}$ in. dia.) is aligned vertically to accept the cable as it comes off the indexer, and the other ($\frac{3}{4}$ in. dia.) is set at an angle to guide the cable as it travels to and from the carriage outrigger. Both pulleys are attached to an aluminum block clamped between the lathe's ways with a plate screwed on from underneath. The larger pulley bolts to the guide block through a slotted hole, with a washer under the nut, to allow up-and-down adjustment. The smaller pulley is screwed to the notched end of a short rod, which mounts through a hole in the guide block and locks with a set-screw. The rod and setscrew allow this pulley's angle and position to be adjusted. The upper guide, made from wood scraps, uses a 2-in.-dia. pulley mounted vertically between wood blocks with a machine screw for an axle. A $\frac{3}{4}$ -in.-thick plywood backing strip allows the assembly to be screwed to the wall behind the lathe.

For the drive cable, I used 90-lb.-test, stainless-steel, seven-strand fishing line (available at a sporting-goods store that carries salt-water-fishing tackle). For the weight, I used two 5-lb. lead weights (available from a tackle shop); that much weight was required to keep the indexer rotating properly against the pressure of the cutting router bit as the carriage moved. In lieu of lead, you could use sand in a cloth sack tied to the end of the cable.

The router carriage—I made the carriage as two separate units: an outer housing, which rides on the lathe bed, and an inner cradle, which holds the plunge router. Rows of $\frac{3}{8}$ -in.-dia. holes (spaced $\frac{3}{4}$ in. apart on the outer housing and $\frac{5}{8}$ in. apart on the inner carriage) on both sides of each unit allow router height to be adjusted in $\frac{1}{8}$ -in. increments to accommodate larger- or smaller-diameter turnings. To strengthen the housing, which is glued

Fig. 1: Indexer



and screwed together from $\frac{1}{2}$ -in. Baltic-birch plywood, I allowed the base and top to overhang the sides and then glued on reinforcing strips at these junctures. Two wood strips, one on each side of the lathe bed, act as lateral guides. Two ball bearings (I used regular skateboard-wheel bearings) bolted to cleats through the guides on each side ensure that the carriage is held down flat and slides smoothly (but with some resistance) on the lathe bed. The outrigger arm, which is screwed to one edge of the carriage, has a $\frac{3}{8}$ -in.-wide slot dadoed into it. The cable anchor block, an aluminum bar fitted with an eyebolt for tying on the drive cable, fits into the outrigger's slot and is secured in place with a small C-clamp.

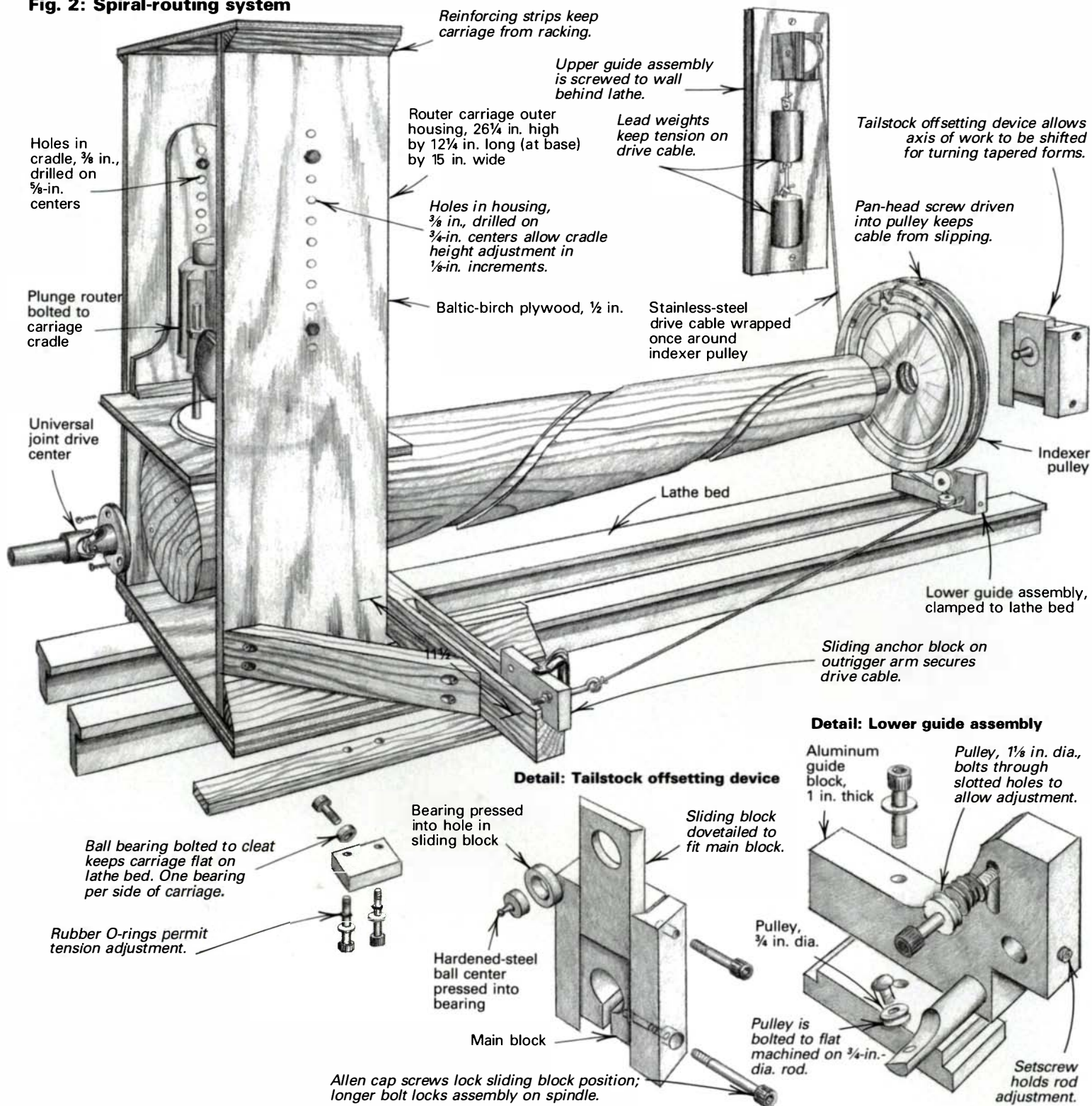
For a router, I use a Hitachi TR12 plunge model that accepts $\frac{1}{2}$ -in. shank bits. I've had some success routing spirals with regular, straight carbide bits. However, a bit with two spiral flutes (cutting edges) eliminates the tendency for wood chips to back up behind the cut. Even better is a two-flute milling cutter, which I've found completely removes the chips during routing.

Spiral-routing variations

With a few alterations to the setup, you can produce a wide variety of spiral shapes and patterns on your turned work. The indexer allows you to rout just about as many spirals as you want around the turning. Also, by changing the location of the cable anchor block on the outrigger arm, you can adjust the curve of the spirals. For example, by setting the block very close to the carriage, you'll produce very uniform spirals down the length of the turning; for accelerated spirals, move the block farther out on the outrigger. Once you've found an arrangement you like, try core-box, veining or V-bits for different decorative effects. To change the width of cut using any given bit, set the cursor stops on the indexer pulley farther apart, and then take two passes—one with the cursor against one of the stops and another with the cursor against the other stop. The friction clips provide enough friction to keep the inner disc and outer ring from slipping out of position.

Changing the direction in which the cable wraps around the indexer pulley will allow you to rout spirals that twist in the opposite direction—a handy option for a pair of columns or matching

Fig. 2: Spiral-routing system

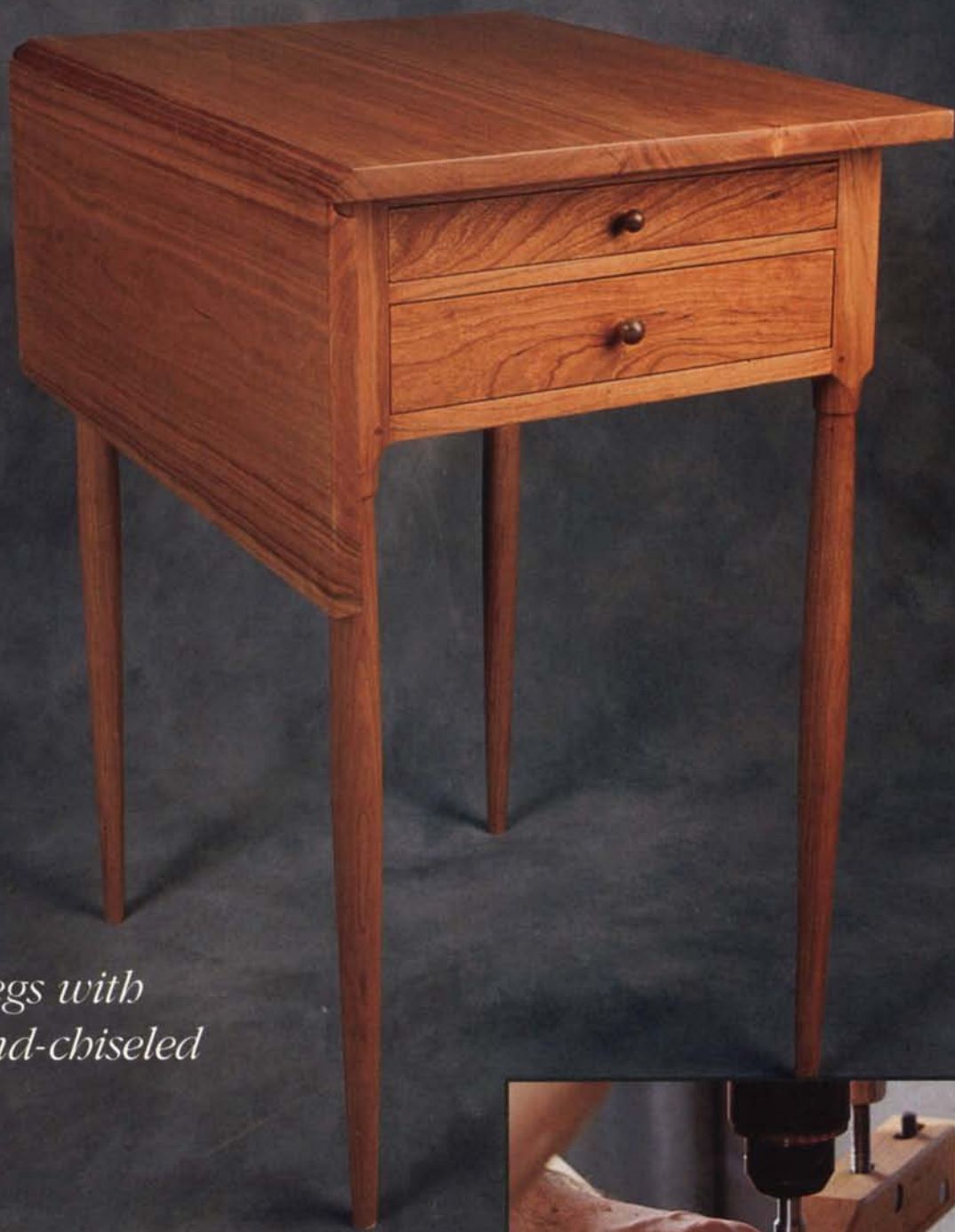


candlesticks. You could even rout two sets of spirals on the same turning—one set twisting clockwise and the other counterclockwise—to create a really intricate pattern. Another simple, yet attractive effect is to get spiral flutes or reeds to “light out” at one end. This is done entirely with the tailstock offsetting device. Instead of leveling the top edge of the cone or cylinder-shaped blank, raise or drop the tailstock end so that the router bit takes a full-depth cut at one end and a progressively lighter cut along the blank until the bit stops cutting at the other end. If you wish to rout stopped spirals or a short section of the turning, fit a pair of stop blocks to the lathe bed to limit carriage travel; I made my stop blocks from 3/4-in.-thick aluminum and clamped them to the ways.

If you feel really ambitious, you can try making a hollow spiral column, like the one on my plant stand shown in the bottom photo on p. 86. To make the column, I glued up a hollow turning blank from tapered staves. I routed accelerated spiral grooves through the wall of the turning, and then I employed a custom-made router bit (with a cutting edge on the top) that was “plunged up” and run the length of each groove to clean and shape the inside of the column. This process creates the effect of four ribbons of wood swirling up from the base. □

Norman Zentil is a retired general contractor and woodworker living in Redondo Beach, Cal.

A Shaker Style Drop-Leaf Table



*Turned legs with
drilled-and-chiseled
mortises*

by Greg Isaak

This single-drop-leaf table was inspired by several original Shaker pieces in New York and Massachusetts. The author modified the legs to reflect his fondness for the designs of Thomas Sheraton.

To cut a mortise with the drill-and-chisel method, the author first bores out most of the waste using a brad-point bit that just barely fits within the layout lines.



I first became interested in Shaker furniture because of some pieces my mother owned. I was drawn to the Shakers' simple, unadorned designs, their restrained, but strong joinery, and their uncompromising insistence on quality. As I examined my family's furniture and studied pieces presented in books and museums, I also became fascinated with the way Shaker designs had been influenced by Federal furniture built in the United States between 1782 and 1815. The ideas of designers like Duncan Phyfe, Robert Adam, Thomas Sheraton and George Hepplewhite can be easily identified in many Shaker originals.

Since I like this diversity of design ideas, it's not surprising that my table, shown finished on the facing page, is not an exact replica of any one piece. Rather, it incorporates the features of several New York and Massachusetts pieces. I based the overall size of the table and the shape of its legs on a New York original, but I modified the turned legs to capture the graceful look of Sheraton furniture. The single drop leaf is from a table at the Hancock Shaker Museum in Massachusetts.

Like its Shaker ancestors, my table is very functional. Its small size and two shallow drawers make it ideal as an occasional table, end table or nightstand. And there is nothing tricky about building the piece; all the work can be done with a few simple tools. Stock preparation is relatively easy because the components are so small. The legs were milled into square blanks, mortised and then turned to shape. After cutting the aprons to size, I tenoned their ends to fit the leg mortises. The top is two edge-glued boards, with a routed rule joint for the drop leaf.

Mortising and turning the legs

I cut the leg mortises with the old drill-and-chisel method. This is one of the simplest methods for cutting mortises if you don't have a horizontal mortising machine, hollow-chisel mortiser or router. A drill press and a chisel or two are the only equipment needed. I started by cutting the stock for the legs to the dimensions given in the drawing on p. 93. To avoid splitting the wood when mortising near the top of the legs or when turning the narrow feet, I cut the square blanks about 1½ in. oversize on each end.

Next, I laid out the mortises and bored out the space between the layout lines using a brad-point bit with a diameter just slightly smaller than the width of the mortise, as shown in the bottom

photo on the facing page. If you don't have a correct-size brad-point bit, you could also use a Forstner or spur bit. A fence clamped to the drill-press table helped me align the holes. After boring out as much waste as possible, I squared the mortise walls with a chisel (see the left photo below). Although the side walls can usually be pared with hand pressure alone, you may need a mallet to drive the chisel into the tougher endgrain.

After the mortises were chopped out, the legs were ready to be turned. If you don't have a lathe, you may prefer to use a square-sectioned tapered leg, a characteristic of Hepplewhite design. For stability while turning, I mounted the end that will have the least amount of stock removed, in this case the square top section, on the lathe's headstock, as shown in the photo at right below. Then I measured down each leg to locate several checkpoints: the transition point between the square and turned section; the largest diameter, which is at the midpoint of the turned section; and the diameter of the bottom, as shown in the drawing on p. 93. Basically, my method was to turn the blank to the required diameters at the major checkpoints with either a parting tool or a ½-in. round-nose scraper. Calipers worked well to gauge the diameters. After establishing the checkpoints, I used a roundnose scraper (see the photo at right below) to blend the rest of the leg with the three diameters I had established. (If you don't have a roundnose scraper, you can use a sharp gouge.)

After turning the first leg, I realized that taking additional measurements would help in locating other checkpoints. When I measured my first leg, I found that its diameter was 1⅞ in. at a point 1½ in. from the bottom of the transitional collar, and 1 in. in diameter 14¾ in. below the collar. Establishing these checkpoints, in addition to the original three, not only ensured that all four legs were consistent, but it also sped up the turning process by minimizing guesswork. Next, I smoothed the roughed-out leg with a sharp gouge and a roundnose scraper, and then I lightly sanded the leg. If you work carefully and check the leg with calipers as you turn, all four legs should come out pretty close to the dimensions I've given in the drawing on p. 93. I didn't sand the transitional collar while the piece was on the lathe because I didn't want to soften this crisp detail. Instead, I sanded it by hand after the leg was removed from the lathe, and then I crosscut it to final length.

The ridges left by the drill bit are pared away with a sharp chisel. Hand pressure is usually sufficient to pare the side walls of the mortise, but a mallet is better for squaring up tougher endgrain.



The legs are turned after the mortises are complete. Isaak mounts the top of the leg in the headstock and then uses a scraper to shape the transition between the square top and the rest of the leg.

Case construction

I cut the apron tenons and drawer-rail tenons shown in the drawing by making multiple passes on my tablesaw with the workpiece laid flat on the table and guided by the miter gauge. I made the cuts with a regular sawblade, although you might prefer to mount a dado head on your saw to speed the process. Each of the 6-in.-wide apron tenons is $\frac{1}{2}$ in. thick by $\frac{5}{8}$ in. long. The drawer-rail tenons vary in size, as shown in the drawing. The tenons on the top rail are flush with its upper surface, while the tenons on the bottom rail are centered in the $\frac{3}{4}$ -in.-thick stock. The $\frac{3}{8}$ -in.-thick tenons on the center rail are $\frac{1}{2}$ in. wide by $\frac{5}{8}$ in. long.

I was then ready to assemble the table frame. First, I dry-fit the two front legs and drawer rails, and pared the tenons slightly to achieve a good fit. I glued up the front assembly first, making sure that the assembly was square and that the two legs were on the same plane while drying. The clamps may need to be readjusted. Care at this stage is well invested; if the case is twisted or out of square, the drawers will fit poorly. Next, I assembled the two back legs and the back apron. Because of the wide tenons, this assembly should square itself if the mortises have been cut straight.

Now, I notched the left side apron for the pivoting leaf support. I angled the ends of the notch and the support so they would swing past each other easily and blend together without an apparent break when closed. I cut the 45° angles with a dovetail saw, and then I formed the opening by bandsawing away most of the waste. After trimming to the line with a chisel, I cut and fit the matching leaf support. With the support screwed in place, as shown in the drawing, I then planed it until the top surface was flush with the top of the apron. This ensured that the raised leaf would be level with the rest of the tabletop. Be aware that the screw head must be well countersunk to avoid damaging the plane iron. To complete the table frame, I glued the front assembly to the back-legs-and-apron assembly, again making sure that the table was square and true. I assembled the frame upside down on my bench and then measured from corner to corner after applying the clamps. The clamps may need to be adjusted to make the diagonals equal. After the frame was dry, I pinned the tenons with $\frac{3}{16}$ -in.-dia. dowels and sanded them flush. Besides strengthening the frame, the dowels add a nice design detail. To complete the case, I glued on the cleats, which secure the top.

Drawer construction

After assembling the frame, I measured each opening and assembled the drawers to fit with about $\frac{1}{16}$ -in. clearance on the top and sides. I used half-blind dovetails on the front corners, but made through dovetails on the back because I think these are essential components of high-quality work. In keeping with my affection for the Shakers, I cut the joints by hand. Over the years, I've found handwork satisfying, and it doesn't take much more time than setting up a router and jig, once I get into the swing.

Each drawer bottom is a $\frac{3}{16}$ -in.-thick piece of ash, with its grain running side to side. I glued the bottoms into rabbets in the drawer fronts and fastened the bottoms to the sides with brass brads. Bottoms that float in grooved drawer sides were more common in the Federal period, but my research showed that the Shakers often used nailed-on drawer bottoms for very shallow drawers. Apparently, they felt that the floating panels wasted too much space. The brads flexed enough to allow seasonal wood movement and to prevent the bottom panels from cracking. I turned the pulls shown in the drawing by mounting each one like a small spindle between centers on my lathe. After turning, I trimmed off the waste with a saw, and then I hand-sanded each pull as it was spinning in the Jacobs chuck of my drill press.

The next step was to position the supporting runners to ensure smooth-sliding, level drawers. I screwed the filler blocks in place, as shown in the drawing, clamped the runners for each drawer into position and slid in a drawer. If a drawer slid without binding and its four corners contacted the drawer runner, I screwed in the runners and glued in the drawer stops. Otherwise, I adjusted as needed.

Making the top

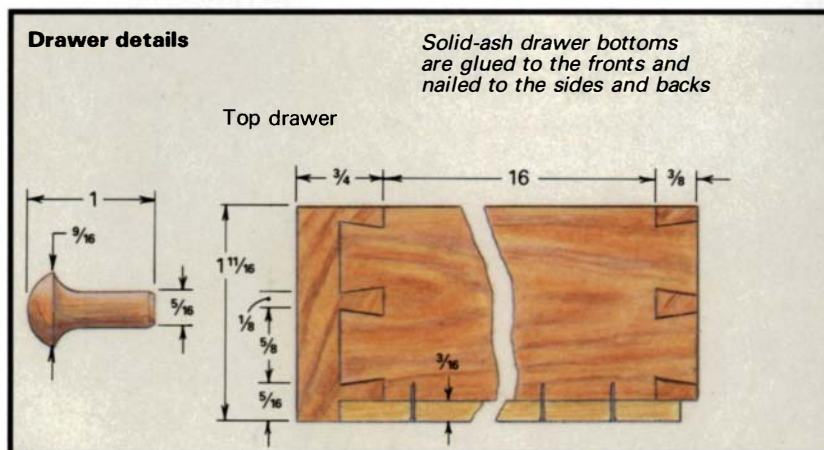
I edge-glued two pieces of wood to obtain an 18-in.-wide top. After the top and leaf were squared up and cut to the proper dimensions, I made the rule joint. I milled the top pieces enough oversize so that an offcut was left that I could use for testing router setups for the rule joint.

The rule joint, when done correctly, adds a very attractive visual detail. My method is pretty simple; I used only a $\frac{1}{2}$ -in. round-over bit and a $\frac{1}{2}$ -in. cove bit. First, I rounded over the edge of the tabletop that will butt the leaf. I made this cut deep enough to leave a $\frac{1}{8}$ -in. shoulder. Similarly, I made a cove cut on the leaf that was deep enough to leave a $\frac{1}{8}$ -in. lip that will mate with the tabletop's shoulder cut.

Hinge locations are crucial for a good joint, and so these specially made hinges should be bought before the mating edges are shaped. The hinges are available from Paxton Hardware Ltd., 7818 Bradshaw Road, Upper Falls, Md. 21156; (301) 592-8505, or Lee Valley Tools, 1080 Morrison Drive, Ottawa, Ont., Canada K2H 8K7; (613) 596-0350, and several other supply houses. To ensure that the leaf will move smoothly, the center of the hinge pin must be mortised in line with the shoulder created by the roundover on the tabletop. To locate the center of the hinge pin, I marked down from the shoulder on each edge of the top with a try square and connected the two points with a straightedge on the underside of the top. The hinge pin goes directly on this line or slightly toward the table's edge. If you move the hinge pin's center $\frac{1}{32}$ in. toward the leaf, the leaf will fit tightly to the shoulder when the leaf is up, but will gradually draw away from the roundover as it is lowered; this way, parts do not rub, regardless of the season. The hinges can be mortised in with a chisel or router. I used two hinges, each placed about $2\frac{1}{2}$ in. from the end of the joint. (For more information on making a rule joint, see *FWW* #80, pp. 48-52.)

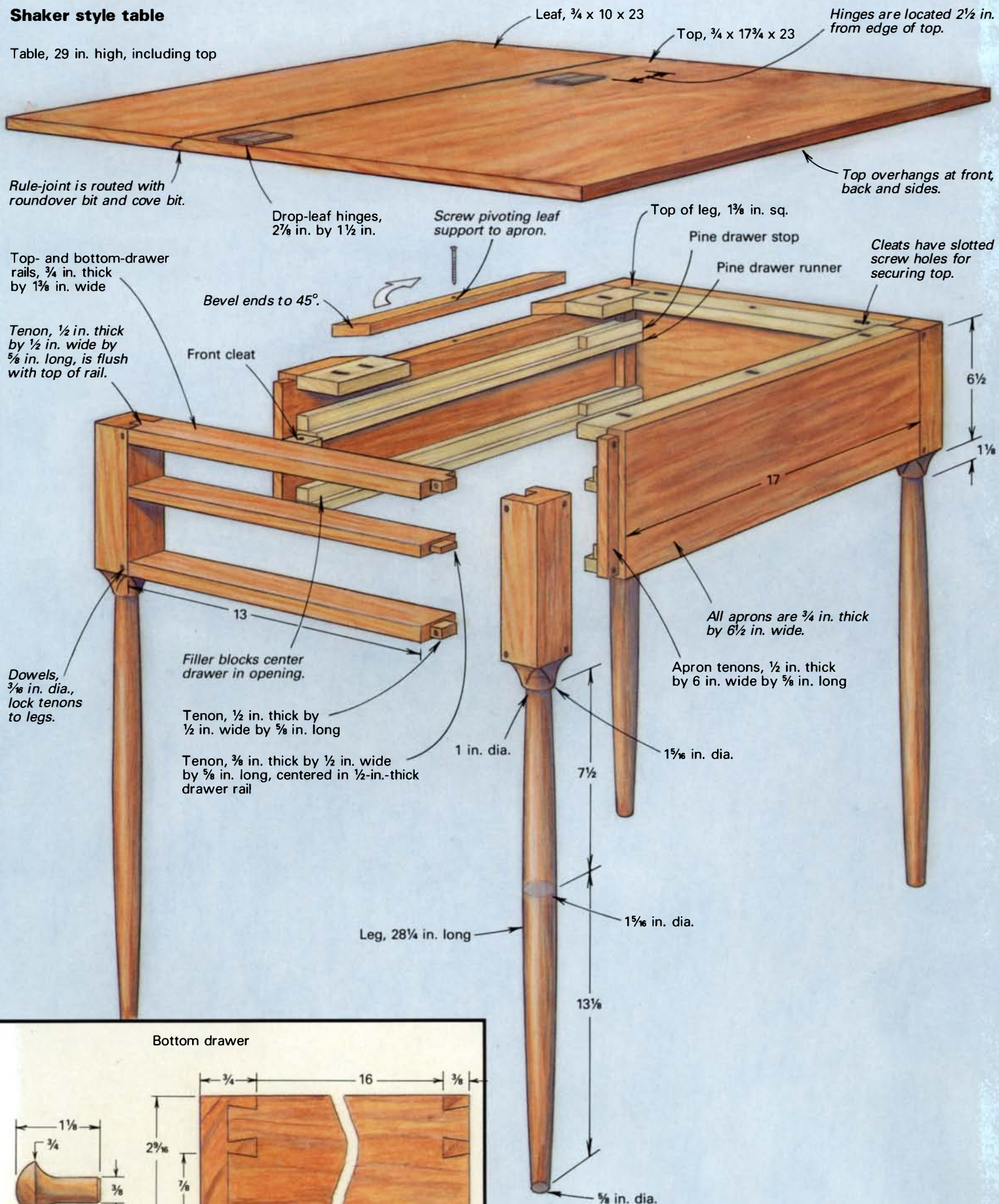
Before assembly, I sanded all parts of the table with 150-grit and 220-grit paper. To make sure everything was smooth and clean before finishing, I resanded again after assembly. I applied six coats of tung oil because I thought this finish would be most in keeping with the oil finishes and thin varnishes that the Shakers used. □

Greg Isaak makes period furniture and teaches in LaFox, Ill.

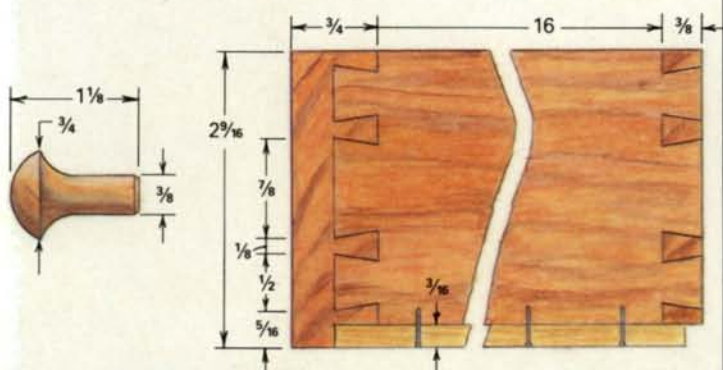


Shaker style table

Table, 29 in. high, including top



Bottom drawer



Craft Show at the Smithsonian

Top-notch woodworkers reap profits

by Dick Burrows



The scoop-like form below by Norm Sartorius of Parkersburg, W.V., was one of the smallest wood objects highlighted in the 1991 Washington, D.C., Craft Show, which featured work by more than 100 woodworkers and other artists from across the country.

The 9-in.-long scoop is maple burl that was bandsawn and then hollowed out with carving burrs in a die grinder. The piece was refined with files, scrapers and sandpaper until the surfaces were finely shaped and felt "extremely good," said Sartorius.

Sartorius, who's been making spoons for 15 years, said his early work concentrated on functional spoons, but many people said the pieces were too nice to use. Over the years, he has moved toward more sculptural forms, which just happen to resemble spoons.

Stoney Lamar of Saluda, N.C., uses a lathe as a carving tool to create sculptures like the 15-in.-high redwood-lace-burl piece, part of his "Temple Series 11," shown in the top, right photo below. To produce the carved effect, Lamar mounted the wood between cen-

ters in different positions so he could turn each section of the piece from a different axis. He describes the piece as a vessel in an architectural context. This de-emphasizes the vessel, he said, which is just a small part of the top of the sculpture, but at the same time elevates the vessel's importance in a larger architectural structure.

Alan Lorn's "Diamond Cabinet" (shown on the opposite page) and Lee Weitzman's "Ciello Buffet" (shown in the bottom photo) were also highlighted at the show. Proceeds from the craft show held last spring went to support programs and projects at the Smithsonian. A spokesperson for the Women's Committee of the Smithsonian Associates, which sponsored the show, said about \$275,000 in sales were made by woodworkers. For information about next year's show, write to the Washington Craft Show, Arts & Industries Building, Room 1465, Smithsonian Institution, Washington, D.C. 20560. □

Dick Burrows is senior editor at FWW.



Finely finished surfaces are characteristic of spoon maker Norm Sartorius' work. The 2-in.-wide form above is based on ancient Roman and Greek vessels.

This redwood-lace-burl sculpture was lathe-turned despite its carved appearance (right). Turner Stoney Lamar produced the effect by mounting the wood between centers in different positions so he could turn each section of the piece from a different axis.

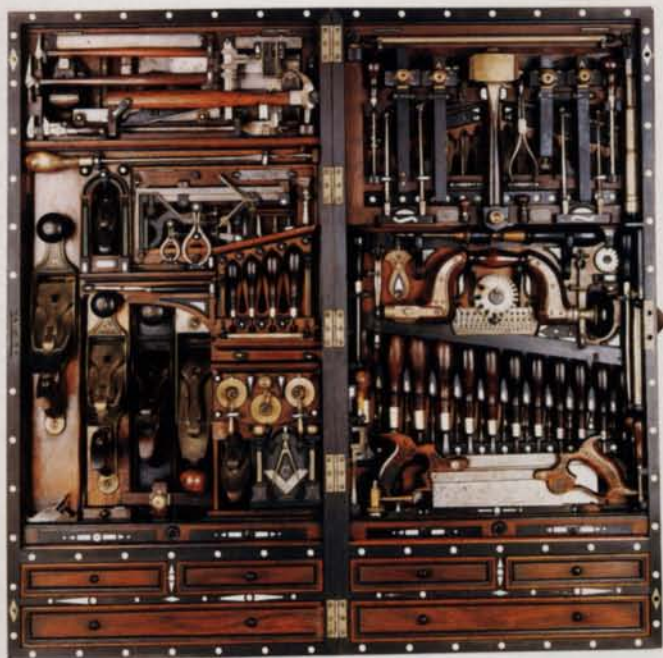


Alan Lorn's "Diamond Cabinet," left, has quilted maple panels, tiger maple legs, and African ebony trim, inlays and pulls. "The design is somewhat Art Deco—Ruhlmann-like. I've always admired Ruhlmann's furniture, and I enjoy working with figured woods and inlays," says Lorn, who operates a furniture-and-architectural-cabinet shop in Northampton, Mass. The 36-in.-wide piece was commissioned by a client who wanted a liquor cabinet, and it has large, adjustable shelves fitted inside the 18-in.-deep carcass.

The broad reflective surfaces on Lee Weitzman's "Ciello Buffet," right, were made by applying gold leaf to bendable plywood that was specially treated to accept the gold. "Gold works very well around curves. The reflection gives the piece a very opulent look," says Weitzman, who runs a Chicago, Ill., furniture-design-and-manufacturing studio. The 42-in.-high piece, which derives its name from the Spanish word for beautiful, is mahogany with ebony accents and has a granite top. The center doors and two curved end panels open to reveal adjustable shelves.



From Back Cover to Poster



TOOL CHEST LEGACY

If the workmanship in a tool chest is any indication of the maker's talent, then the craftsmanship of master carpenter and stonemason H.O. Studley must have been awe-inspiring. In an oak clamshell box adorned with rosewood, ebony, pearl and ivory, Studley kept both tools he made and a collection of the finest hand tools made prior to 1900, including a complete set of woodworking tools as well as machinist and stonemasonry tools. To pack the 500-plus tools into a case only 19 1/2 in. wide, 39 in. long and 9 1/2 in. deep, Studley devised a jigsaw-puzzle arrangement of flip-up trays, fold-out layers and hidden compartments. Maine native Pete Hardwick saw it as the chest, which has been in his family since it was bequeathed to his grandfather by Studley. Hardwick acquired the chest from his brother by trading a 1934 Ford sedan for it. A good trade? It would seem so! Just one tool—the Stanley #1 plane housed in the ebony archway in the upper-left part of the chest—was appraised at \$700. Hardwick, a non-woodworker, plans to sell the chest.

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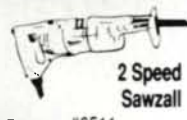
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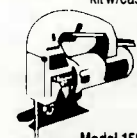
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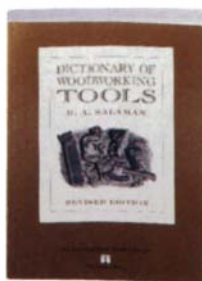
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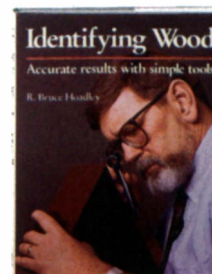
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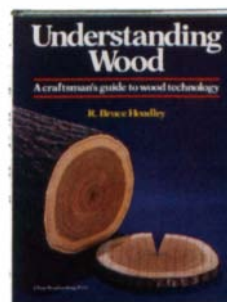
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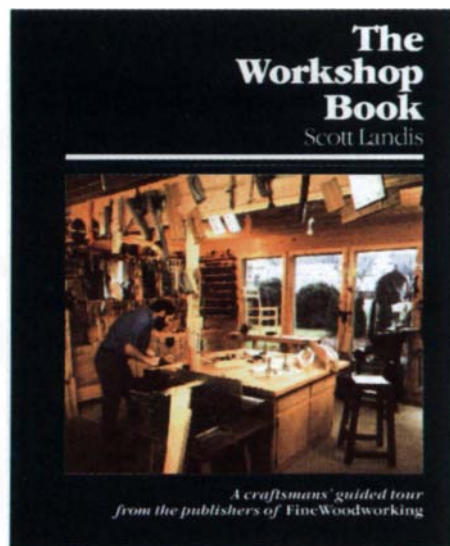
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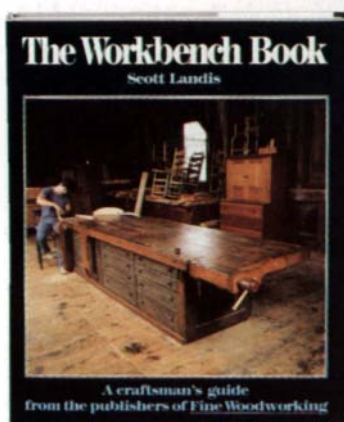


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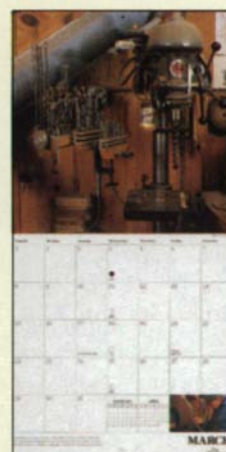
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Listings of gallery shows, major craft fairs, lectures, workshops and exhibitions are free, but restricted to happenings of direct interest to woodworkers. We list events (including entry deadlines for future juried shows) that are current with the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

ARIZONA: Exhibition—The Turned Wood Vessel: A Group Exhibition, Sept. 1–Oct. 31. Reception: Oct. 17, 7–9 P.M. Joanne Rapp Gallery/The Hand and the Spirit, 422 N. Marshall Way, Scottsdale, 85251. (602) 949-1262.

Exhibition—International Lathe-Turned Objects Challenge IV, Sept. 8–Nov. 3. Arizona State University Art Museum. Contact Wood Turning Center, PO Box 25706, Philadelphia, PA 19144. (215) 844-2188.

Show—Phoenix Harvest Festival, Nov. 1–3. Phoenix Civic Plaza. For info, contact Harvest Festival, 111 Liberty St., Petaluma, CA 94952. (800) 321-1213, (707) 778-6300.

Show—9th annual Woodworking Show, Nov. 3. Los Olivos Adult Center, 38th and Devonshire, Phoenix. Sponsored by Arizona Association of Woodworkers. Contact Herb Miller, 1115 W. Stottler Dr., Chandler, 85224.

CALIFORNIA: Shows—9th annual Long Beach Harvest Festival, Aug. 31–Sept. 2, Long Beach Convention Center; Fresno Harvest Festival, Sept. 13–15, Fresno Convention Center; 8th annual Riverside Harvest Festival, Sept. 20–22, Riverside Convention Center; 2nd annual Ventura Harvest Festival, Sept. 27–29, Ventura County Fairgrounds; Sacramento Harvest Festival, Oct. 4–6, Sacramento Community Center; San Diego Harvest Festival, Oct. 18–20 & 25–27, Convention and Performing Arts Center; San Francisco Harvest Festival, Nov. 1–3 & 8–10, San Francisco Civic Center in Brooks Hall; Los Angeles Harvest Festival, Nov. 15–17, Los Angeles Convention Center. For information on all, contact Harvest Festival, 111 Liberty St., Petaluma, 94952. (800) 321-1213, (707) 778-6300.

Exhibition—The California Duck, Aug. 31–Oct. 27. San Francisco Craft & Folk Art Museum, Landmark Building A, Fort Mason, San Francisco, 94123-1382. (415) 775-0990.

Juried exhibit—Artistry in Wood '91, thru Sept. 15. Sponsored by the Sonoma County Woodworkers Association. Also, demonstrations on various woodworking topics, every Saturday and Sunday afternoon. Sonoma County Museum, 425 7th St., Santa Rosa, 95401. (707) 579-1500.

Show—Woodworking Machinery & Furniture Supply Fair, Sept. 28–Oct. 1. Anaheim Convention Center, Anaheim. For information, contact Arthur Schwartz, 1516 S. Pontius Ave., Los Angeles, 90025. (800) 826-8257, (213) 477-8521.

Workshops—Tool clinic, Oct. 5; Building the Norwegian Pram, Oct. 12–13, 19–20, 26–27. National Maritime Museum Association, Building 275, Crissy Field, San Francisco, 94129. (415) 929-0202.

Juried shows—Contemporary Crafts Market, Oct. 12–13, San Diego Convention Center, 111 W. Harbor Dr., San Diego; Nov. 1–3, Santa Monica Civic Auditorium, Main St. at Pico Blvd., Santa Monica; Mar. 20–22, 1992, Fort Mason Center, Herbst & Festival Pavilions, Marina Blvd. at Buchanan St., San Francisco. For info, contact Roy Helms & Associates, 777 Kapiolani Blvd., Suite 2820, Honolulu, HI 96813. (808) 422-7362.

Seminar—10th International Wood Machining Seminar, Oct. 21–23. Berkeley. Contact Continuing Education in Engineering, UC Berkeley, 2223 Fulton St., Berkeley, 94720. (415) 642-4151.

Juried show and competition—Palm Springs Wildlife Art Show and Competition, Dec. 7–8. Doubletree Resort Hotel, Palm Springs. Carving competitions, demonstrations, juried wildlife show. For info, contact John Fairfield, show chairman, 9340 Gregory St., La Mesa, 91942. (619) 462-0232.

Workshops—Furnituremaking with hand tools using traditional joinery, weekends. Call for schedule: Debey Zito, (415) 648-6861.

Exhibit—Mixed media including woodturning by Ruth Hardin and furniture by Yuko Shimizu. Banaker Gallery, 1373 Locust St., Walnut Creek, 94596. (415) 930-0700.

Workshops—Various workshops including Japanese woodworking, joinery and sharpening. Contact Hida Tool Co., 1333 San Pablo, Berkeley, 94702. (415) 524-3700.

Solicitation—New artists wanted for the Los Angeles Craft & Folk Art Museum Research Library. Used by collectors, curators, architects, designers. No fee. For info, contact the Craft & Folk Art Museum Library, c/o the May Co., 6067 Wilshire Blvd., Los Angeles, 90036. (213) 934-7239.

COLORADO: Classes—Woodworking and related classes, year-round. Red Rocks Community College, 13300 W. 6th Ave., Lakewood, 80401. (303) 988-6160.

Show—Denver Harvest Festival, Oct. 4–6. Denver Convention Center. Contact Harvest Festival, 111 Liberty St., Petaluma, CA 94952. (800) 321-1213, (707) 778-6300.

Residency program—Anderson Ranch Arts Center's Studio Residency Program, Oct. 1–May 15. Offers interac-

tive environment for furnituremakers and designers. For info, contact Anderson Ranch, PO Box 5598, Snowmass Village, 81615. (303) 923-3181.

Juried exhibit—7th annual woodworking exhibition, Oct. 19–Dec. 11. Entries accepted: Oct. 11–12. Colorado Springs Pioneers Museum, Colorado Springs. Contact John Lewis, Woodworkers Guild of Colorado Springs, 918 N. Royer St., Colorado Springs, 80903. (719) 632-8548.

Show—Colorado Woodworking Show, Nov. 8–10. National Western Complex-Expo Hall, Humboldt St. & E. 47th Ave., Denver. For info, contact 1516 S. Pontius Ave., Los Angeles, CA 90025. (800) 826-8257, (213) 477-8521.

CONNECTICUT: Classes—Bandsaw Boxes with Bill Gundling, Sept. 14–15; Spindle Turning with Palmer Sharpless, Sept. 21–22; Fine Finishes for Furniture with Frank Klaus, Sept. 28–29; Furnituremaking with John Dunnigan, Oct. 5–6; Router Techniques with Bill Gundling, Oct. 19; Joinery Techniques with Robert March, Nov. 9–10; Woodturning with Al Stirt, Nov. 16–17. Brookfield Craft Center, PO Box 122, Brookfield, 06804. (203) 775-4526.

Exhibit—56th annual Society of Connecticut Craftsmen exhibit, thru Sept. 29. Presentation of certificate to Dennis Elliott, SCC's master crafter/educator for 1991, July 21. Stamford Museum and Nature Center, 39 Scofield Rd., Stamford. Contact SCC, PO Box 615, Hartford, 06142. (203) 423-4350.

Juried exhibit—New Views, Sept. 29–Oct. 12. Deadline: Aug. 31. Connecticut artists. Guilford Handcrafts, PO Box 589, 411 Church St., Guilford, 06437. (203) 453-5947.

Juried exhibition—23rd annual Celebration of American Crafts, Nov. 11–Dec. 23. Contact The Celebration, Creative Arts Workshop, 80 Audubon St., New Haven, 06510. (203) 562-4927.

DELAWARE: Fellowships—Winterthur Library fellowships available. Application deadline: Dec. 1. For info, contact Dr. Katharine Martinez, Winterthur Research Fellowship Program, The Winterthur Library, Winterthur, 19735. (302) 888-4649.

DISTRICT OF COLUMBIA: Exhibition—Awards in the Visual Arts 10, thru Sept. 2. Hirshhorn Museum and Sculpture Garden, Smithsonian Institution. Call (202) 357-2700.

Panel discussion—Fine Handcrafted Wood Objects—Marketing Strategies, Sept. 28. Topics: magazine ads, galleries, craft shows, direct mail, more. Panel members: Thomas Moser, Judith Lippman, Craig Nutt, Hugh Belton. Sponsored by Smithsonian Institution. Call (202) 357-3030.

Course—Furniture Conservation Training Program, beginning Aug. 1992. Application deadline: Nov. 30. For info, contact Training Secretary, CAL/MSC, Smithsonian Institution, 20560. (301) 238-3700.

Exhibition—Marketplace for 19th-Century Crafts, Nov. 1–3. Decatur Carriage House, 1610 H St. N.W., 20006. (202) 842-0920.

Courses—Conservation of Gilt Wood, Nov. 4–7; Structural Conservation of Furniture, Dec. 3–6. For info, contact Training Secretary, CAL/MSC, Smithsonian Institution, 20560. (301) 238-3700.

Exhibition—Work by J.L. Heatwole, Nov. 10–16. Senate rotunda of U.S. Capitol. Sponsored by Virginia Senator John Warner.

FLORIDA: Juried festival—20th annual Riverside Art Festival, Sept. 28–29. In Riverside Park. For info, contact Riverside Art Festival Committee, Riverside Avondale Preservation, 904 King St., Jacksonville, 32205. (904) 389-2449.

Festival—17th annual Florida Heritage Festival, Nov. 6–10. South Florida Fairgrounds. Contact Fantasma Productions, 2000 S. Dixie Highway, West Palm Beach, 33401-7714. (407) 832-6397.

Juried exhibition—The Turner's Dance, Jan. 10–Feb. 29, 1992. St. Petersburg. Entry deadline: Oct. 6. National juried exhibition of lathe-turned work. For info, contact Donna Sinicrope, Florida Craftsmen Gallery, 235 3rd St. S., St. Petersburg, 33701. (813) 821-7391.

Juried festival—29th annual Coconut Grove Arts Festival, Feb. 15–17. Application deadline: Sept. 16. Contact Coconut Grove Arts Festival, PO Box 330757, Coconut Grove, 33233-0757. (305) 447-0401.

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

Show—International Turned Objects Show, thru Nov. 10. Morgan Cultural Center, Madison. For info, contact International Sculpture Center, 1050 Potomac St. N.W., Washington, DC 20007. (202) 965-6066.

Conference—Custom Woodworking Business Conference and Exposition, Nov. 22–24. Georgia World Congress Center, Atlanta. For info, contact John Berry, Trade Show Div., Vance Publishing Corp., 400 Knightsbridge Pkwy., Lincolnshire, IL 60069. (708) 634-2600.

Competition—Design Emphasis '92 furniture design competition, call for entries. Sponsored by and held in conjunction with the International Woodworking Machinery & Furniture Supply Fair '92, Aug. 21–24, 1992, Georgia World Congress Center, Atlanta. For info on the competition, contact Shirley Byron, IWF, 8931 Shady Grove Court, Gaithersburg, MD 20877. (301) 948-5730.

ILLINOIS: Juried show—Evanston/Glenbrook Hospitals' 7th annual American Craft Exposition & Sale, Sept. 6–8. Reception, Sept. 5. Henry Crown Sports Pavilion, Lincoln St., Evanston. For info, contact Shelly Robinson, Winger & Associates, 320 N. Michigan Ave., Suite 1901, Chicago, 60601. (312) 263-4313.

Seminar—Computers for Woodworking, Sept. 13–15. Chicago. Contact Architectural Woodwork Institute, 2310 S. Walter Reed Dr., Arlington, VA 22206. (703) 671-9100.

Exhibition—New Art Forms, Sept. 19–22. The Navy Pier, Chicago. Sponsored by Joanne Rapp Gallery/The Hand and the Spirit. For info, contact the gallery, 422 N. Marshall Way, Scottsdale, AZ 85251. (602) 949-1262.

Exposition—Chicago International New Art Forms Exposition, Sept. 20–22. Including Social Signals, Sept. 21, a symposium focusing on issues pertinent to artists and collectors. Navy Pier, Chicago. For info, contact Coalition of Creative Organizations, 600 N. McClurg Court, Chicago, 60611. (312) 787-6858.

Workshop—End use applications of adhesives and sealants, Sept. 23–25. The Forum Hotel, Chicago. Contact The Adhesive and Sealant Council, 1627 K St. N.W., Suite 1000, Washington, DC 20006. (202) 452-1500.

Show—Chicagoland Woodworking Show, Oct. 18–20. Inland Expo Center/Ilinois Exhibition Hall, 400 E. Ogden Ave., Westmont, 60559. Contact 1516 S. Pontius Ave., Los Angeles, CA 90025. (800) 826-8257, (213) 477-8521.

Show—20th annual Midwestern Wood Carvers Show, Nov. 2–3. Belle-Claire Exposition Hall, 200 S. Belt East, Belleville. For info, contact Don Lougeay, 1830 E. D St., Belleville, 62221. (618) 233-5970.

INDIANA: Festival—50th Chautauqua of the Arts festival, Sept. 28–29. On the streets of Madison. For info, contact Dixie McDonough: (812) 265-5080.

Show—Tri State Woodcarvers Show, Oct. 26–27. Washington Square Mall, 1100 S. Green River Road, Evansville. For info, contact Bob Koressel, 3901 Rose Ave., Evansville. (812) 424-2622.

IOWA: Show—Woodcarvings by Leif Melgaard, thru Sept. 2. Vesterheim, Norwegian-American Museum, 502 W. Water St., Decorah, 52101. (319) 382-9681.

Class—Beginning and Intermediate Figure Carving with Harley Refsal, Sept. 20–22. Vesterheim, Norwegian-American Museum, 502 W. Water St., Decorah, 52101. (319) 382-9681.

KENTUCKY: Workshops—Woodturning and joinery instruction. Contact Jim Hall, Adventure in Woods, 415 Center St., Berea, 40403. (606) 986-8083.

MAINE: Workshop—Design as Exploration with Milton Glase, Aug. 25–31. Haystack Mountain School of Crafts, PO Box 87, Deer Isle, 04627. (207) 348-2306.

Class—Post and Beam Building, Sept. 15–20. Shelter Institute, 38 Centre St., Bath, 04530. (207) 442-7938.

Workshops—Various week-long boatbuilding and wood-working workshops, thru Oct. 12. Including Marine Carving, Fundamentals of Boatbuilding, Basic Woodworking, Oar & Paddle Making, Boatbuilding Tools & Techniques, Joinerwork. Contact WoodenBoat School, PO Box 78, Brooklyn, 04616. (207) 359-4651.

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

MARYLAND: Exhibition—Emerging Masters, thru Sept. 14. Furniture by students from the Rhode Island School of Design and Southeastern Massachusetts University. Meredith Gallery, 805 N. Charles St., Baltimore, 21201. (301) 837-3575.

Juried festival—Sugarloaf's 15th annual Maryland Crafts Festival, Oct. 11–13. Timonium. For info, contact Deann Verdier, Sugarloaf Mountain Works, 20251 Century Blvd., Germantown, 20874. (301) 540-0900.

Show—Baltimore/Washington Woodworking Show, Oct. 25–27. Pikeville Armory, 610 Reisterstown Rd., Baltimore, 21208. For info, contact 1516 S. Pontius Ave., Los Angeles, CA 90025. (800) 826-8257, (213) 477-8521.

Conference—Chesapeake Area Woodturner's Conference, Oct. 25–27. Maryland Hall for the Creative Arts, Constitution and Greenfield, Annapolis. For info, call (301) 263-5544.

MASSACHUSETTS: Juried exhibition—Functional and practical studio furniture with which to live and work, Sept. 28–Nov. 16. Contact Julie Mansfield, Society of Arts and Crafts, 175 Newbury St., Boston, 02116. (617) 266-1810.

Workshops—Finish Carpentry, Sept. 30–Oct. 4; Cabinet-making, Oct. 7–11. The Heartwood School, Johnson Rd., Washington, 01235. (413) 623-6677.

Classes—Woodworking classes, throughout most of the year. Boston Center for Adult Education, 5 Commonwealth Ave., Boston, 02116. (617) 267-4430.

Workshop—Rustic Furniture with Daniel Mack, Oct. 12. Horizons, 374 Old Montague Rd., Amherst, 01002. (413) 549-4841.

Class—Timber Framing: A Traditional Approach with Jack Sobon. For info, contact Jack Sobon, Shaw Rd., Windsor, 01270. (413) 684-3223.

Show—Woodworking World New England show, Oct. 18–20. Eastern States Exposition Center, 1305 Memorial Ave., West Springfield, 01089. Contact Woodworking As-

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sociation of North America, PO Box 706, Plymouth, NH 03264. (800) 521-7623, (603) 536-3768.
Class—Basic Oval Box Construction with Clifford Myers, Nov. 2-3. Hancock Shaker Village, PO Box 898, Pittsfield, 01202. (413) 443-0188.

MICHIGAN: Show—Metro-Detroit Woodworking Show, Oct. 4-6. Michigan Fairgrounds-Community Arts Exhibit Hall, 1120 W. State Fair Ave., Detroit, 48203. For info, contact 1516 S. Pontius Ave., Los Angeles, CA 90025. (800) 826-8257, (213) 477-8521.

MINNESOTA: Class—14th annual Kiln Drying short course, Sept. 9-13. University of Minnesota, St. Paul. Contact Harlan Petersen, Department of Forest Products, University of Minnesota, 2004 Folwell Ave., St. Paul, 55108. (612) 624-3407.

Show—Twin Cities Woodworking Show, Sept. 27-29. Minnesota State Fairgrounds, Empire Commons Building, Snelling & Como Aves., St. Paul, 55108. For info, contact 1516 S. Pontius Ave., Los Angeles, CA 90025. (800) 826-8257, (213) 477-8521.

Show—Minneapolis Harvest Festival, Oct. 11-13. Minneapolis Convention Center. For info, contact Harvest Festival, 111 Libert St., Petaluma, CA 94952. (800) 321-1213, (707) 778-6300.

MISSOURI: Fair—Woodcraft fair, Oct. 5. Demonstrations, exhibits Oct. 6. Paxton Beautiful Woods, 6311 St. John, Kansas City, 64123. (816) 483-0659.

Competition—Turned Visions, May 8-June 27. Deadline: Sept. 20. Contact Craft Alliance, 6640 Delmar, St. Louis, 63130. (314) 725-1177.

MONTANA: Workshop—Woodturning with Richard Raffan, Oct. 7-13. For info, contact Bud Pearson, Northern Rockies Woodworking Guild, 316 W. Beall, Bozeman, 59715. (406) 587-3989.

NEBRASKA: Class—Woodcarving class with Desiree Hajny, Oct. 11-13. Midwest Woodworkers Supply, 13209 I St., Omaha, 68137. (402) 330-5444.

NEVADA: Show—Las Vegas Harvest Festival, Oct. 11-13. Cashman Field Exhibition Center. For info, contact Harvest Festival, 111 Liberty St., Petaluma, CA 94952. (800) 321-1213, (707) 778-6300.

Show—Reno Harvest Festival, Oct. 25-27. Reno Live-stock Events Center. For info, contact Harvest Festival,

111 Liberty St., Petaluma, CA 94952. (800) 321-1213, (707) 778-6300.

NEW HAMPSHIRE: Demonstration—Laminating techniques by Jerre Osgood, Sept. 21. Following meeting of Guild of New Hampshire Woodworkers. For info, contact John Skewes, 132 Drinkwater Rd., Kensington. (603) 778-7360.

Classes—Classes in fine arts and studio arts. Manchester Institute of Arts and Sciences, 114 Concord St., Manchester, 03104.

Classes—Various woodworking classes, year-round. Including antique repairs, carving canes & walking sticks, small boxes, kitchen utensils, lathe-turning, hand-carving, more. Contact The Hand & I, PO Box 264, Route 25, Moultonboro, 03254. (603) 476-5121.

NEW JERSEY: Show—Woodworking World Morris-town show, Sept. 27-29. Mennen Sports Arena, 53 E. Hanover Ave., Morristown, 07962. Contact Woodworking Association of North America, PO Box 706, Plymouth, NH 03264. (800) 521-7623, (603) 536-3876.

Juried exhibit—Waterloo Arts and Crafts Festival, Sept. 28-29. Waterloo Concert Field, Waterloo Rd., Stanhope. Contact Stella Show Management Co., 105 Shady Lane, Randolph, 07869. (201) 895-3356.

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

Juried show—Southwest Arts and Crafts Festival, Nov. 7-10. Manual Lujan Building, New Mexico State Fairgrounds. For info, contact Southwest Arts and Crafts Festival, 525 San Pedro N.E., Suite 107, Dept. P, Albuquerque, 87108. (505) 262-2448.

NEW YORK: Workshops—Making St. Lawrence Skiff Oars with Bill Smithers, Sept. 14-15; Boat Restoration and Refinishing Techniques with Philip Gillespie, Sept. 21-22. Antique Boat Museum, 750 Mary St., Clayton, 13624. (315) 686-4104.

Classes—Fall woodworking with Maurice Fraser and Bill Gundling, beginning Sept. 16. Free demonstrations, Sept. 11. For info, contact Craft Student League, 610 Lexington Ave. at 53rd, New York City. (212) 735-9732.

Show—14th annual New York Renaissance Festival, thru Sept. 15. Sterling Forest, Tuxedo. Weekends only. For info, contact Creative Faires Ltd., PO Box 1688, West-hampton Beach, 11978. (516) 288-2004.

Exhibition—Swiss Folk Art: Celebrating America's Roots, Sept. 26-Jan. 1. Contact Museum of American Folk Art, Two Lincoln Sq., New York City, 10023-6214. (212) 595-9533.

Exhibit—Group exhibition of art furniture, Sept. 26-Oct. 26. Peter Joseph Gallery, 745 5th Ave., New York City, 10151. (212) 751-5500.

Workshops—Japanese Hand Tool Workshops with Robert Meadow, Sept. 28-29, Oct. 12-13, Nov. 16-17. The Lutherie, 2449 W. Saugerties Rd., Saugerties, 12477. (914) 246-5207.

Juried show—17th annual Fall Festival Arts & Crafts Show, Oct. 12-13. For information, contact Fall Festival Art Committee, PO Box 808, Ellicottville, 14731. (716) 938-6794.

Show—Woodworking World Albany show, Oct. 25-27. New Scotland Ave. Armory, 130 Scotland Ave., Albany, 12208. Contact Woodworking Association of North America, PO Box 706, Plymouth, NH 03264. (800) 521-7623, (603) 536-3876.

Classes—Various beginning and advanced woodworking classes, including woodturning, wood finishing, router techniques, marquetry, tool sharpening, furniture repair and more. Constantine, 2050 Eastchester Rd., Bronx, 10461. (212) 792-1600.

Juried show—Woodworking expo, Nov. 8-9. Ballston Spa. Entry deadline: Oct. 25. Sponsored by Northeastern Woodworkers Association and Curtis Lumber Co. Contact Dave Bielawski, Curtis Lumber, 885 Rte. 67, Ballston Spa, 12020. (518) 885-5311.

Meetings—New York Woodturners Association, first Tuesday of each month. Woodturning techniques and exhibits also. The Craft Student League, YWCA, 610 Lexington Ave., New York City.

Show—Woodworking World Central New York State show, Nov. 1-3. New York State Fairgrounds, Horticulture Building, Syracuse, 13209. Contact Woodworking Association of North America, PO Box 706, Plymouth, NH 03264. (800) 521-7623, (603) 536-3876.

Exhibit—The Art of the Keyboard: Rediscovering Pianos and Organs, thru Jan. 15. New York State Museum, Albany. For information, contact University of the State of New York, State Education Dept., Albany, 12234. (518) 474-1201.

NORTH CAROLINA: Workshop—Country Living, Sept. 2-6. Country Workshops, 90 Mill Creek Rd., Marshall, 28753. (704) 656-2280.

Class—Furniture: Quick & Fun with Douglas Prickett,

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With this ONE ALL PURPOSE blade 40 Teeth you can SMOOTH RIP & CROSSCUT 1" - 2" ROCKHARDS and SOFTWOODS with smooth-as-sanded surface. PLY-VENEERS oak/birch crosscut with NO BOTTOM SPLINTER.

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Note: Fine Woodworking Editorial Nov./Dec. 1988 No. 73 pg. 65 S. N. recommends high alternating top bevel (ATB) thin kerfs and large blade stiffeners for smoothest cuts on RADIAL SAW etc.



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Ryobi-Makita 10" x 80T x 5/8" \$207	119
Hitachi 12" x 80T x 1" \$229	129
Ryobi-Makita 14" x 100T x 1" \$266	169
Hitachi 15" x 100T x 1" \$277	179

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READER SERVICE NO. 95

Sept. 2-6. Penland School, Penland, 28765-0037. (704) 765-2359.

Exhibits—Celebrate Folk Art, Sept. 7; annual members' exhibit, thru Dec. 1. Both at Folk Art Center, Blue Ridge Pkwy., Asheville. Sponsored by Southern Highland Handicraft Guild. For info, contact the guild at PO Box 9545, Asheville, 28815. (704) 298-7928.

Workshops—Wood Carving with Tom Wolfe, Sept. 7-8; Marquetry with Claude Edwards, Sept. 21-22. Blue Ridge Hearshide Craft Center, Highway 105, near entrance to Seven Devils. For info, contact the craft center, Route 1, Box 738, Banner Elk, 28604. (704) 963-5252.

Workshop—Woodturning with Rodger Jacobs, Sept. 28. Hamilton-Jacobs Studios, Route 1, Box 575-A, Newland, 28657. (704) 733-9819.

Workshops—Woodworking and woodcarving workshops, year-round. Including woodcarving, woodturning, Windsor chairmaking, bowl turning, more. Contact John Campbell Folk School, Route 1, Box 14A, Brasstown, 28902. (800) 562-2440, (704) 837-2775.

Show—Woodworking World Carolina show, Oct. 4-6. M.C. Benton Convention and Civic Center, 501 W. 5th St., Winston-Salem, 27101. Contact Woodworking Association of North America, PO Box 706, Plymouth, NH 03264. (800) 521-7623, (603) 536-3876.

Juried show—Blue Ridge Hearshide Crafts Show, Oct. 11-13. Blue Ridge Hearshide Craft Center, Highway 105, near entrance to Seven Devils. For info, contact the craft center at Route 1, Box 738, Banner Elk, 28604. (704) 963-5252.

Meetings—North Carolina Woodturners, second Saturday of every month. Also, woodturning workshops for all levels. For info, contact Eric Hughes, Route 3, PO Box 300, Conover, 28613. (704) 464-5611.

Fair—Guild Fair '91, Oct. 17-20. Asheville Civic Center. Call the Southern Highland Handicraft Guild at (704) 298-7928.

Seminar—Project Management, Nov. 15-16. Charlotte. Contact Architectural Woodwork Institute, 2310 S. Walter Reed Dr., Arlington, VA 22206-1199. (703) 671-9100.

OHIO: Show—Greater Columbus Woodworking Show, Sept. 13-15. Ohio Expo Center/Fairgrounds, Lausche Building, 600 E. 17th Ave., Columbus, 43211. For info, contact 1516 S. Pontius Ave., Los Angeles, CA 90025. (800) 826-8257, (213) 477-8521.

OREGON: Show—Cat theme multimedia show, thru Sept. 15. Including woodturning. Made in Jefferson Gal-

lery, 3259 Jefferson Scio Dr., Jefferson, 97352. (503) 327-2543.

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

Show—Oregon Woodworking Show, Nov. 1-3. Memorial Coliseum Complex-Convention Hall, Williams and Weidler Sts., Portland, 97227. For info, contact 1516 S. Pontius Ave., Los Angeles, CA 90025. (800) 826-8257, (213) 477-8521.

PENNSYLVANIA: Juried show—Long's Park Arts & Crafts Festival, Aug. 31-Sept. 2. Lancaster. Contact Long's Park Arts & Crafts Festival, PO Box 5153, Lancaster, 17601.

Workshops—Authentic Shaker Furniture with John Kasay, Sept. 14-15; Build a Sack Back Windsor with Michael Dunbar, Sept. 21-25; Build a Lowboy with Gene Landon, Sept. 28-Oct. 2; Wood finishing and Antiques with George Frank, Oct. 5-6; Woodcarving with Elmer Jumper, Oct. 12-13; Spindle Turning with Palmer Sharpless, Oct. 19-20; Joinery Techniques, Finishing Techniques and Dovetail Joinery with Frank Klausz, Oct. 26-27; Chip Carving with Wayne Barton, Nov. 2-3; Traditional Shaker Oval Boxes with John Wilson, Nov. 8-9; The Tuning, Care and Use of Old Tools with Mike Dunbar, Nov. 16-17; Painted Furniture with Eli Rios, Nov. 23-24. For more info, contact Olde Mill Cabinet Shoppe, 1660 Camp Betty Washington Rd., York, 17402. (717) 755-8884.

Classes—Windsor chairmaking, all levels, weekly and weekends. Contact Jim Rendi, Philadelphia Windsor Chair Shop, PO Box 67, Earlville, 19519. (215) 689-4717.

Exhibition—8th annual Studio Days '91, Sept. 20-28. Chester Springs Studio, 1668 Art School Rd., PO Box 329, Chester Springs, 19425. (215) 827-7277.

Show—Philadelphia Woodworking Show, Sept. 20-22. Philadelphia Armory, 3205 Lancaster Ave., Philadelphia. For info, contact 1516 S. Pontius Ave., Los Angeles, CA 90025. (800) 826-8257, (213) 477-8521.

Juried exhibitions—The Dining Experience/A Craft Expression, thru Sept. 22. Also, Re-Awakening: A Celebration of Spring, May 2-June 7; deadline: Jan. 27. Also, Stories: The Narrative Art in Contemporary Crafts, Aug. 8-Sept. 20, 1992; deadline: Mar. 2. Luckenbach Mill Gallery, 459 Old York Rd., Bethlehem, 18018. (215) 691-0603.

Show—Woodworking World Philadelphia Area show, Oct. 11-13. Valley Forge Convention Center, N. Gulph and First Aves., King of Prussia, 19406. For info, contact Woodworking Association of North America, PO Box 706, Plymouth, NH 03264. (800) 521-7623, (603) 536-3876.

Show and competition—8th annual William Rush Woodcarving and Wildlife Art Show & Sale, Nov. 2-3. Penn State, Delaware County campus, Lima. For deadline and info, contact Bob Young, 736 Oak Way, Havertown, 19083. (215) 446-8945.

Workshops—Woodturning workshops for all ages and skill levels. Including applications of tool design, principles of sharpening, finishing, more. Call for dates. David Ellsworth School of Woodturning, Fox Creek, 1378 Cobler Rd., Quakertown, 18951. (215) 536-5298.

Fair—State Craft Market, Nov. 9-10. Memorial Hall at York Fairgrounds, York. Work by members of the Pennsylvania Guild of Craftsmen. For info, contact Pennsylvania Designer-Craftsmen, PO Box 718, Richboro, 18954. (215) 860-0731.

Show—Woodworking World Central Pennsylvania show, Nov. 15-17. Pennsylvania Farm Show Complex, West Bldg., 2301 N. Cameron St., Harrisburg, 17110. Contact Woodworking Association of North America, PO Box 796, Plymouth, NH 03264. (800) 521-7623, (603) 536-3768.

TENNESSEE: Show—Smoky Mountain Sculptures in Wood show, Oct. 5-6. Chilhowee Park, Kerr Building, Golden Gloves Arena. Woodcarving competition with 17 categories. Contact Jack or Carole Williams, 2608 Reagan Rd., Knoxville, 37931.

Juried exhibitions—From All Directions, Oct. 17-Dec. 14. Everything but the Kitchen Sink: Artists and the Kitchen, New Forms, New Functions, Feb. 27-May 16, 1992. Entry deadline: Dec. 12. Arrowmont School of Arts and Crafts, PO Box 567, Gatlinburg, 37738. (615) 436-5860.

Juried show—5th annual Master Woodworkers show, Oct. 25-27; Candy Factory, Knoxville. Furniture and accessories. For deadline and info, contact Michael Perrin, Route 2, Box 195-A, Blaine, 37709. (615) 933-8436.

TEXAS: Show—7th annual East Texas Woodcarving show, Sept. 13-14. Longview Mall, Longview. Contact W.A. Chronister, PO Box 244, Gladewater, 75647. (903) 845-4334.

Competition and show—Los Amigos del Mesquite annual convention, competition and trade show, Sept. 13-15. Hyatt Hotel, Austin. For info, contact Herb Nordmeyer, Los Amigos del Mesquite, PO Box 68, Knippa, 78870. (512) 934-2616.

Show—Woodcarving show and sale, Oct. 18-19. Ridgmar Mall, Ft. Worth. Sponsored by Ft. Worth Woodcarvers. For info and an application, contact Dan Mingea, 1805 Thomas Place, Ft. Worth, 76107. (817) 731-9565.



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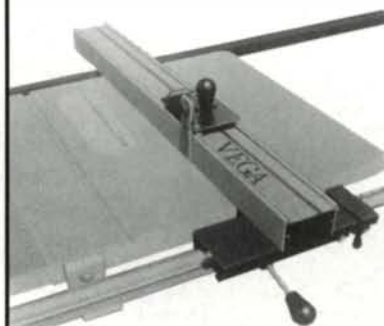
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VERMONT: Courses—Ultralight Lapstrake Boat Construction with Tom Hill, Sept. 2–7; Shaker Boxes with John Wilson, Sept. 16–17. Vermont State Craft Center, Frog Hollow, Middlebury, 05753. (802) 388-3177.

Show—Woodworking World Burlington show, Sept. 20–22. Burlington Memorial Auditorium, 250 Main St., Burlington. For info, contact Woodworking Association of North America, PO Box 706, Plymouth, NH 03264. (800) 521-7623, (603) 536-3768.

VIRGINIA: Juried show—Wood Show, thru Sept. 2. Furniture, sculpture and art made mostly of wood. Middle Street Gallery, Middle St., PO Box 341, Washington, 22747. (703) 675-3440.

Juried festival—Sugarloaf's 11th annual Virginia Crafts Festival, Sept. 13–15. Prince William County Fairgrounds. Contact Deann Verdier, Sugarloaf Mountain Works, 20251 Century Blvd., Germantown, MD 20874. (301) 540-0900.

Exhibit—Shrines and Icons, thru Oct. 4. Objects of wood and other media. Hand Workshop, 1812 W. Main St., Richmond, 23220. (804) 353-0094.

Show—Metro-Richmond Woodworking Show, Oct. 11–13. State Fair of Virginia, Better Living Center, 600 E. Laburnum Ave., Richmond, 23222. Contact 1516 S. Pontius Ave., Los Angeles, CA 90025. (800) 826-8257, (213) 477-8521.

Juried show—16th annual Richmond Craft and Design show, Nov. 15–17. Richmond Craft Centre for Conventions and Exhibitions. For info, contact Hand Workshop, 1812 W. Main St., Richmond, 23220. (804) 353-0094.

WASHINGTON: Conference—18th annual Museum Small Craft Association Conference, Oct. 4–6. Contact MSCA Conference, Center for Wooden Boats, 1010 Valley St., Seattle, 98109. (206) 382-2628.

Meetings—Northwest Woodworkers Guild, last Wednesday of each month. Contact Kirk Kelsey, 744 N. 78th, Seattle, 98103. (206) 789-2142.

Workshop—Carvel Dinghy workshop with Eric Dow, Oct. 19–26. Center for Wooden Boats, 1010 Valley St., Seattle, 98109. (206) 382-2628.

Juried show—11th annual Woodcarving Show, Nov. 9–10. Western Washington Fairgrounds Expo Hall, 9th and Meridian, Puyallup. For deadline and info, contact Northwest Carvers Association, 115 Del Monte Ave., Fircrest, 98466. (206) 564-3278.

Show—Western Washington Woodworking show, Nov. 15–17. Seattle Center Exhibition Hall, Mercer St. at 3rd Ave. N., Seattle, 98109. Contact 1516 S. Pontius Ave., Los Angeles, CA 90025. (800) 826-8257, (213) 477-8521.

WEST VIRGINIA: Workshops—Pewter Spinning with Ralph Gooch, Oct. 4–6; Dovetail Box with David Finck, Oct. 18–20; Shaker Oval Boxes with John Wilson, Nov. 15–16. Crafts Center, Cedar Lakes, Ripley, 25271. (304) 372-7005.

WISCONSIN: Exhibition—Wood sculptures by three artists, thru Sept. 1. West Bend Gallery of Fine Arts, 300 S. 6th Ave., West Bend, 53095. (414) 334-9638.

Workshop—Furniture restoration, Sept. 5–6 or 19–20, Oct. 21–22 or 31–Nov. 1. Minuteman, 115 N. Monroe St., Waterloo, 53594. (800) 733-1776.

Exposition—Woodworkers World Expo, Sept. 28–29. Brown County Expo Centre Complex, Green Bay. Contact John VanStechleman, Woodworkers World, PO Box 10596, Green Bay, 54307-0596. (800) 236-EXPO, (414) 494-9507.

Show—Woodworking World Milwaukee show, Nov. 8–10. Waukesha County Exposition Center, Northview Rd., Waukesha, 53188. Contact Woodworking Association of North America, PO Box 706, Plymouth, NH 03264. (800) 521-7623, (603) 536-3768.

Seminars—Training seminars on moulder setup and operations and profile knife grinding, November. For dates and info, contact Kelly Markofski, Fox Valley Technical College, 150 N. Campbell Rd., Oshkosh, 54903-2217. (414) 233-9191.

CANADA: Classes—Various woodworking classes including bird carving, wood sculpture, willow chairmaking and more. For information and schedule, contact the Haliburton School of Fine Arts, PO Box 339, Haliburton, Ont., K0M 1S0. (705) 457-1680.

Exhibit—Beneath the Ice: The Art of the Fish Decoy, Sept. 9–Nov. 4. Kamloops Arts Gallery, B.C. For info, call Susan Flamm at (212) 977-7170.

Show—1st Ottawa/Hull Woodworking Show, Sept. 13–15. Palais des Congres, 200 Dubortage, Hull, Que. For information, contact Woodworking Association of North America, PO Box 706, Plymouth, NH 03264. (800) 521-7623, (603) 536-3876.

Show—Pickering Wood Show, Oct. 18–20. Metro East Trade Centre, off Highway 401. For info, contact Ontario Wood Shows/Cryderman Productions at (519) 351-8344.

Classes—Furnituremaking, carving, lathe turning, router and more. Tools 'n Space Woodworking, 338 Catherine St., Victoria, B.C., V9A 3S8. (604) 383-9600.

Meetings—Canadian Woodturners Association meetings, throughout the year. Second Tuesday of each month. Contact Bob Stone, PO Box 8812, Ottawa, Ont., K1G 3J1. (613) 824-2378.

Meetings—Blue Mountain Woodworking Club meetings, throughout the year. Third Wednesday of each month. Contact Glenn Carruthers, PO Box 795, Stayner, Ont., L0M 1S0. (705) 444-1752.

Meetings—West Island Woodturners Club meetings, second Tuesday of each month. Also, woodturning courses. Contact Eric Webb, 61 Devon Rd., Beaconsfield, Que., H9W 4K7. (514) 630-3629.

AUSTRALIA: Show—Australian Timber & Working with Wood show, Oct. 3–6. Royal Exhibition Building, Melbourne. For info, contact Patrick O'Reilly, Riddell Exhibition Promotions Pty. Ltd., 10 Mallett St., Camperdown, N.S.W., 2050. (02) 565 1099.

ENGLAND: Classes—Woodworking classes. Smith's Gallery, 56 Earlham St., WC2. Contact Lactitia Powell, Parnham, Beamster, Dorset, DT8 3NA. (0308) 862204.

Exhibition—10th Exhibition of Early Musical Instruments, Nov. 8–10. Royal Horticultural New Hall, Westminster, London. For info, contact Exhibition Organizer, The Early Music Shop, 38 Manningham Lane, Bradford BD1 3EA. 0274 393753.

FRANCE: Démonstrations—Les 28 et 29 sept., démonstrations par les artisans-professeurs de "La Main et l'Esprit" de sculpture sur bois, tournage, ébénisterie, polissage, placage, vernissage au tampon, finitions, patines, peinture faux marbre et bois, dorure, cannage et rempaillage, garnissage, reliure. 1060 Burzelles, 123, rue de Fierlant. 02/538 09 70.

GERMANY: Fairs—Furniture and Interiors fair, Sept. 25–Oct. 1. Trade Fair for Building Systems, Building Materials and Building Renovation, Oct. 31–Nov. 6. Contact Koch Trade Fairs, 157-161 E. 86th St., New York, NY 10028. (212) 369-3800.

ITALY: Competition—The Year 2000: 3rd Office Design Competition. Exhibit of designs, Sept. 19–23. Milan. For info, contact Cosmit, Corso Magenta, 96, 1-20123 Milan. (02) 48008716.

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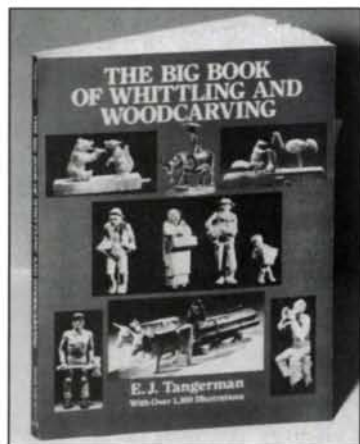
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The Big Book of Whittling and Woodcarving by E.J. Tangerman. Dover Publications Inc., 31 E. 2nd St., Mineola, N.Y. 11501; 1989. \$12.95, paperback; 192 pp.



This is more good stuff from E.J. Tangerman. His latest collection of designs, techniques and examples of whittling and woodcarving from a global perspective is both instructive and knowledgeable.

Tangerman has kept a "carver's eye" peeled throughout his international travels, and he shares with us the fruits of such famous woodcarving centers as Oberammergau in Germany and remote areas in Bali, Indonesia.

There is much here for those wishing to take up carving or for the carver ready to take on that next challenge. The designs and interpretive text are clear and concise and leave room for individual creativity. Sections on tools, tool sharpening and choosing the right wood for various projects will also prove helpful.

The comprehensive collection of photographs shows how timeless themes, such as the family and religion, are rendered in various countries with unique results.

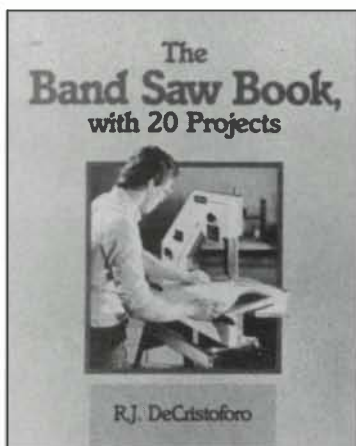
The section on the work of Emil Janel (originally of Orsa, Sweden) featured on pp. 106-107 is certainly character carving at its finest. The warmth and humor featured here is wonderful.

I did feel, however, that the slightly "fuzzy" photo of the "ecology door" (p. 145) was out of place, and I only mention it because it did not do justice to what was certainly a major undertaking.

All in all, *Whittling and Woodcarving* is highly recommended and will prove helpful to beginning and intermediate carvers. Its international aspect will also reward those interested in advancing their knowledge of the art itself.

—John E. Meyers

The Band Saw Book, with 20 Projects by R.J. DeCristoforo. TAB Books Inc., Blue Ridge Summit, Pa. 17294-0850; 1989. \$16.95, paperback; 291 pp.



At first glance, *The Band Saw Book* offers everything you would expect in a manual about the bandsaw. The introduction stresses the word "small" a number of times, and upon closer examination, that is essentially what this book is all about. Though it briefly touches on the existence of larger models, and even includes information on the specialized Japanese resaw models, it deals mainly with the "small" bandsaw.

The format is slightly reminiscent of the old Deltagrams. The book features good-quality black-and-white photos with many illustrations to clarify the generally informative text.

The book kicks off with a chapter explaining the anatomy of the tool and its various features. This leads into a section on blade selection, which I found very helpful. It explains the various cutting arcs of the different-width blades and compares the different tooth designs available and their respective applica-

tions. Included in this section is a good explanation of the problem of "blade drift" or "lead," which causes the wood to bind against the fence or drift away from the fence when you try to make a straight cut. The author's diagram as to the cause and the correction of "lead" is very clearly defined and helpful.

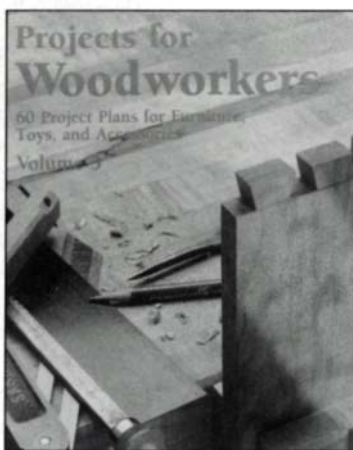
Another enlightening chapter is the one on adjusting and aligning the saw. It is all elementary stuff, but crucial to the smooth and efficient operation of any tool. In fact, this seems to be the drift of the whole book: fundamental, basic information presented in an orderly fashion.

If you are an experienced woodworker, you may find information about circle cutting, compound-sawing a cabriole leg and kerf-bending old hat. In fact, it could be said that this book was written specifically with the novice in mind, as the simplistic projects tend to indicate. But I think there is some very useful information even for the intermediate and advanced woodworker. For instance, the chapter on sawing patterns was very informative and the principles found there can be adapted to repetitive production work like chair parts. I found the chapter on resawing a little light: It is limited to resawing multiple thin units from one preshaped thick block. Absent are good examples of resawing book-matched panels and resawing your own thick veneer. There does not seem to be any real "meat and potatoes" on the menu!

Being somewhat familiar with the author from his previous books, I would have been disappointed if this book didn't include his talent for making useful jigs and fixtures. Indeed there are some to be found here also. Although the book adequately covers the material, it stops short of being a comprehensive, definitive work on the bandsaw.

—Terry Moore

Projects for Woodworkers, Volume 3 by the editors of *The Woodworker's Journal*. Madrigal Publishing Co., 517 Litchfield Road, PO Box 1629, New Milford, Conn. 06776; 1987. \$12.95, paperback; 121 pp.



Books of woodworking plans, especially those containing contributions from a variety of individuals, are often collections of boring, uninspired designs that look as if they were churned out in a desperate attempt to meet a publishing deadline. *Projects for Woodworkers, Volume 3* is a welcome exception.

Of the 60 plans contained in the book, about 51 (an unusually high percentage) are guides to attractive pieces of one style or another. The Ori-

ental section has only two plans of tables, but the tables are especially attractive for the level of woodworking skill their construction requires. In addition, the 10 toy designs range from attractive to very attractive, and these toys are the kinds that kids love to play with: a dump truck, a car with a boat trailer, a steamroller, a locomotive with train, and many other wonderful examples. Most of the contemporary designs, mainly tables and cabinets of various sorts, are sleek and elegant; pieces with American influence, like an Early American corner cupboard and a Shaker chest of drawers, comprise the largest portion of the book, and about one-half of the pieces display a good sense of proportion and flow. The level of quality only begins to fail when the book deals with such things as wall shelves and hanging mirrors—items in which elegance is hard to achieve.

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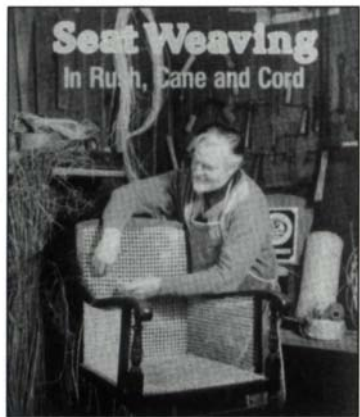
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is overengineered; in fact, *FWW* readers may find themselves substituting a dado or rabbet for nails here and there. Nonetheless, the instructions are both adequate and clear, and the authors provide alternate methods of construction for those who do not own stationary power tools.

As project books go, this is a good one. If you're an amateur woodworker wanting to branch out into new areas of design or craft, I recommend that you take a look at it. —*Richard Griffin*

Seat Weaving In Rush, Cane and Cord by Ricky Holdstock. *Guild of Master Craftsman Publications Ltd., 166 High St., Lewes, East Sussex BN7 1XU, England; 1989. \$25, paperback; 142 pp.*



This is no overnight rush job, but rather a well-thought-out, descriptive work written by a master craftsman who obviously enjoys his work.

The profusion of clear black-and-white photos, line drawings and descriptive text take you all the way from start to finish on the seating materials and designs described. Final finishes and future care are also covered.

Weaving techniques and methods of joining the various

materials employed are discussed in full, and usually several different ways of doing each are examined, indicating the

merits as well as the disadvantages. Holdstock acknowledges the individuality of a craftsman's work without touting one way as being better than the other, and he thoroughly examines different techniques so that you can try several avenues to find a way that suits you best. This leaves you with a better understanding of the work in progress and eliminates some of the frustrations of a beginner. Configuration of seat shape is also taken into consideration in each of the various weaves, and the proper filling for these seats is explained.

Rush, cane and cord are listed on the cover as being the materials used. Holdstock not only delves into those, but also into using fiber rush, sea grass, Danish cord, poly cord and several varieties of cane. He acknowledges man-made fibers and their uses as alternatives for materials not readily available or hard to work with. The use of complementary materials for the same work is also covered, and Holdstock gives advantages and reasons for using each. The only materials familiar to me and not covered were ash, fiber and reed splints, which are more common in the United States than in England. There is no description of the uses or patterns for these materials, even though they could apply to much of the work described.

Tools basic to the craft are discussed. Suitable alternative handmade and commonly owned tools and their uses are explained, sometimes eliminating the need for you to buy a special tool.

Three woodworking projects—a stool, a ladderback chair and a caned armchair—are included, all of which require woven areas of one form or another. The woodworking measurements are given in metrics, with inches in parentheses. Indigenous woods are used and the reasons for using each are discussed. How to bend the ladderback pieces is covered. The author gives an illustration of a readily made steam box, a bending jig and a

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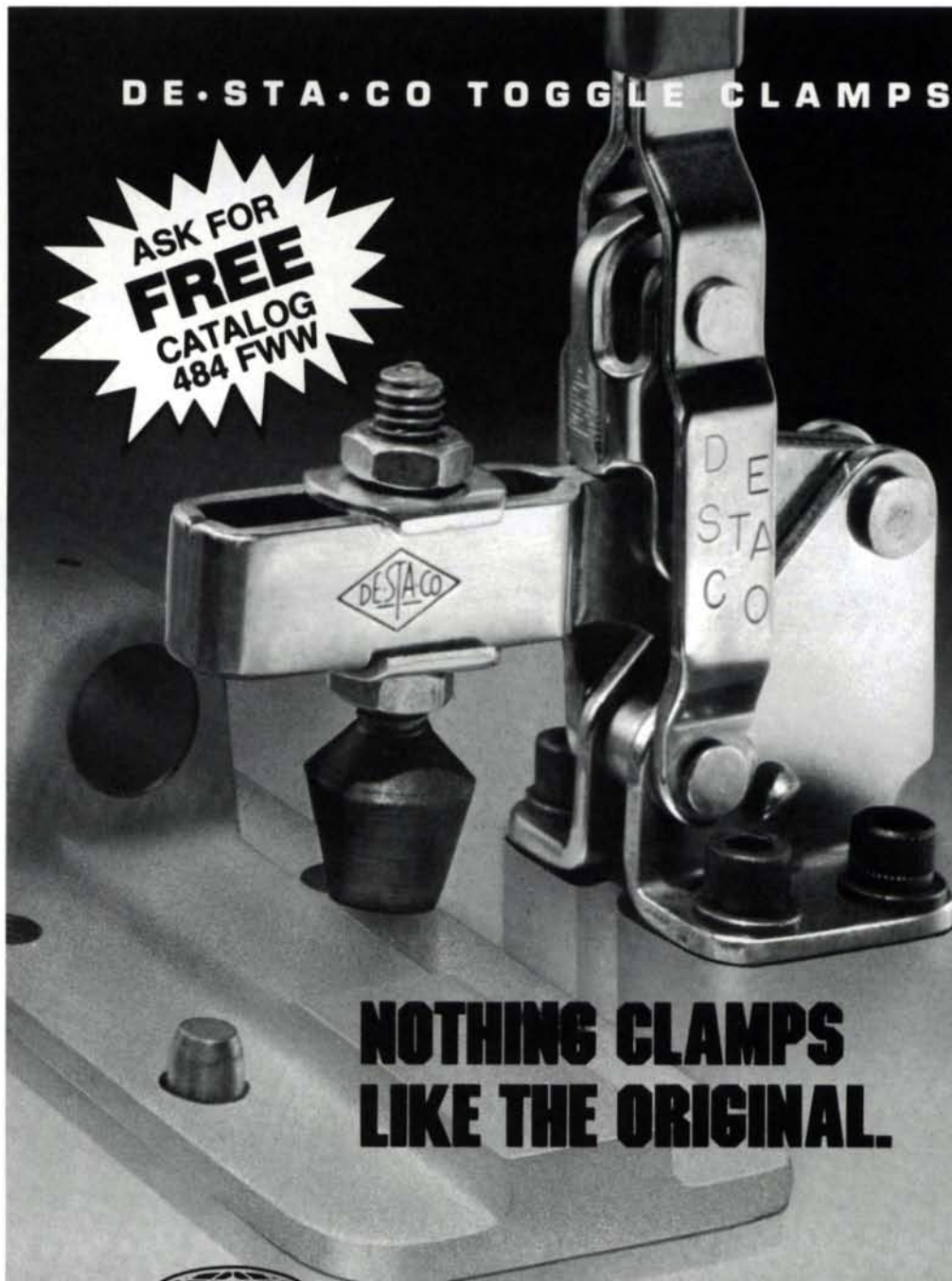
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drilling jig with configurations and measurements. And in the back of the book you'll find a metric conversion table, a list of material suppliers and a selection of seat patterns.

I found much of interest in this book and had no trouble understanding the few areas I was unfamiliar with. Occasional difficulties with phrasing or colloquialisms were quickly remedied by rereading the text and/or referring to the appropriate photo or line drawing. If you are currently weaving seats or are considering doing so, this is a "must-have" book for your library. Well written and informative, *Seat Weaving in Rush, Cane and Cord* will surely become one of the most reached for books on your shelf, supplying information on materials and patterns for those special projects.

—Tom Phillips

Making Country Rustic Wood Projects by Patrick Spielman. Sterling Publishing Co., 387 Park Ave. S., New York, N.Y. 10016-8810; 1985. \$12.95, paperback; 160 pp.

In the title of this work, *making* and *rustic* are definitely the operative words. A good writer, Spielman does an excellent job of conveying some very helpful hints on shopping at local sawmills for inexpensive softwoods, air-drying them, selecting boards for the charm and character of their "defects," and assembling them, unplanned, into useful objects. The projects used to illustrate these techniques include both indoor/outdoor furniture, such as benches, tables and chairs; a handsome gun cabinet; and numerous decorative items, such as plaque-type clocks, picture frames, knickknack shelves, weather vanes, turnings, carvings and mailboxes.

Black-and-white photos are found on virtually every page and measured drawings are employed here and there, but step-by-

step, descriptive text on shaping and assembly methods is not provided with each project. The joinery employed is so simple, however, that this doesn't detract from the projects, and the author conveys his design concepts concisely, allowing him to share more topics than might otherwise have been possible. Under the heading "Architectural Projects" are some rustic-style options for doors, shutters, a flower planter, a plank walkway and various wall-paneling treatments using cedar shakes and endgrain blocks. Spielman demonstrates a good eye for the value of texture in achieving a rich, solid look with minimum effort and at the lowest possible cost. Also, he shares his considerable experience in getting the most out of common woodworking tools and selecting appropriate glues and finishes for both indoor and outdoor applications. No doubt about it, this book offers a lot of helpful tips and practical guidance from an accomplished professional, but the book is also somewhat tainted with commercialism.

Spielman, who runs a furniture operation in northern Wisconsin, uses this book to sell mail-order plans, while making it abundantly clear that the commercial use of his designs by others is prohibited. I suspect that after a fair number of his more entrepreneurial readers cough up \$12.95 for this rather lean paperback, they may be soured by his protective attitude. Spielman's designs are attractive, but they are based on Early American style elements that have been in use for literally centuries and are therefore not all *that* unique.

—Jon Arno

John E. Meyers is a woodcarver in Stirling, Ont., Canada. Terry Moore is a professional furniture maker in Newport, N.H. Richard Griffin is an amateur woodworker in Oak Park, Ill. Tom Phillips is a rustic-furniture maker in Tupper Lake, N.Y. Jon Arno is a wood technologist and consultant in Schaumburg, Ill.

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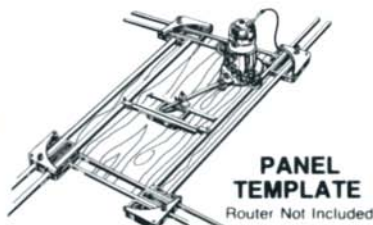
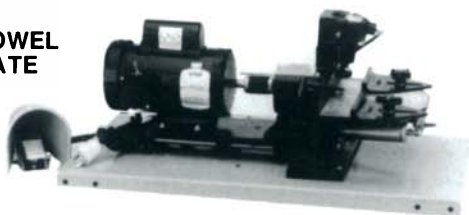
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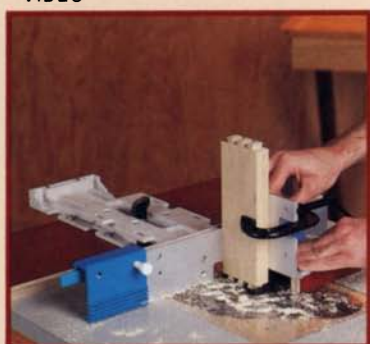
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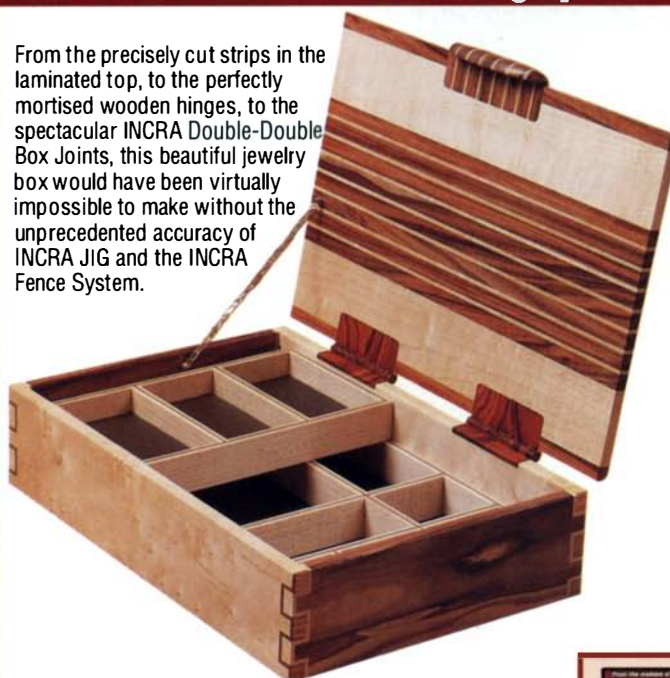
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NEW



Mark Buchalter, a student at Genoa, a design and furnituremaking school in upstate New York, built his piece, "Nysam (New York studio apartment multipurpose) Table," above, from African mahogany, with inset marble squares and silver candle holders.

"Vessel Series—Tempest Sea" (right) by Robert Winland of Cincinnati, Ohio, is a 22-in.-high vessel that is dovetailed together from African mahogany and topped by a red oak and curly bird's-eye maple structure. The medallion on the front is turned from spalted wood and wenge.

Cincinnati furnituremaker Michael Toombs' mauve-tinted vanity table and stool, "From the Vineyard," has a 55-in.-wide bird's-eye maple carcass, steel legs and sheet-metal trays in the top. Bins in the front pivot out from behind doors (below).



Canton's "Across the Board" woodworking show

If you want to see an extensive collection of top-quality woodworking, you have to go to a gallery or museum in a large metropolitan area, right? Well, not if you live in Canton, Ohio. The Canton Art Institute recently sponsored Across the Board: Creative Expressions in Wood, an ambitious and extensive display of a surprising variety of wooden objects, including furniture, cabinetry, sculptures and turnings from local to international makers.

The exhibit, which ran from April 6 to July 7, was really four shows in one: Ohio Artists: New Directions in Wood, a display of work by 14 regional artisans; Three Generations of Studio Art Furniture, a representative collection of work by five internationally recognized designers and makers, including John Makepeace (England), Helmut Lueckenhausen (Australia) and David Delthony (Germany); the International Turned Objects Show, a touring exhibit of 93 pieces created by the world's finest woodturners; and a display of work by the faculty, students, graduates and artists in residence at Genoa, a design and furnituremaking school in Genoa, N.Y. Visitors to Canton were able to wander through the institute's roomy gallery spaces, each accommodating a different show, and see a remarkably diverse range of woodworking, including the three pieces shown here.

In addition to the impressive amount of woodwork, M.J. Albacete, Canton's executive director, and Clifford Buisch, president of

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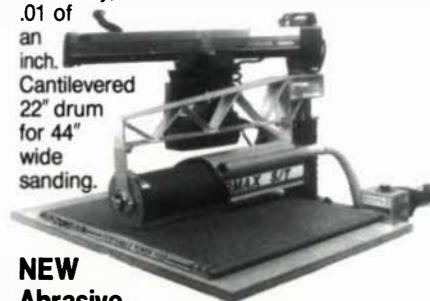
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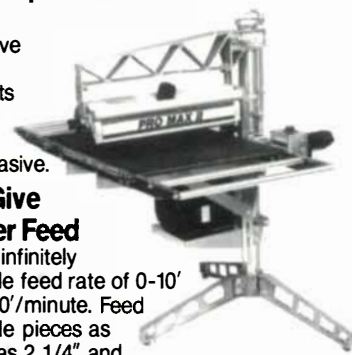
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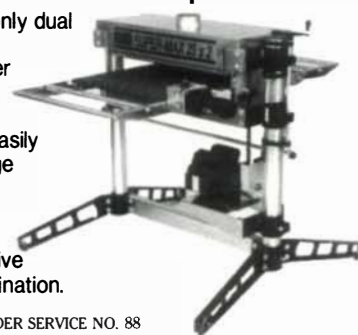
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Genoa and guest curator of the exhibit, assembled an extensive assortment of other displays and activities. These included several exhibits featuring historic model ships, antique tools and scale models of wooden buildings; a Judge's Choice Exhibition where local woodworkers brought in pieces for display, with prizes awarded to the best; and a variety of woodworking displays and events, including a furnituremaking demonstration by Mike Bellinski and a lecture/workshop on basic wood technology by yours truly.

If you live in the Ohio region and missed the Canton show, take note: The success of this show has encouraged the institute to undertake other such projects in the future. For information, call the Canton Art Institute at (216) 453-7666. —*Sandor Nagyszalanczy*

Losing your nerve

It's not supposed to happen. Serious woodworkers don't take chances and they don't get hurt. Right? Wrong!

It was a lazy Saturday afternoon in the park, and I was enjoying that annual ritual known across the nation as the "company picnic." Lunch was over. The kids were terrorizing the park, and a number of grown-ups were sitting around relaxing.

I am an amateur woodcarver, and I'm pretty serious about what I do. I had been working on a myrtle belt buckle as a gift for the husband of one of my employees. The piece was about finished, but I was cleaning up a few rough places with a small skew chisel. I was anxious to show off the completed work, and so I rushed it a little.

Snap! The edge of the buckle gave way and the chisel went straight to the bone at the base of my right-hand index finger. Call it instinct or reflex, but the chisel was on the ground and the thumb of my left hand was on the wound before I realized what had happened. Within a minute, I was lying on a bench feeling a little dizzy; I lay there until someone realized I needed help.

We headed straight for the nearest hospital. The 45-minute ride and the lack of feeling in my finger brought me no comfort. The bowl of ice I had my hand in looked like strawberry jello. I knew that I had done something terrible to my hand.

Once the bleeding was controlled, the doctor began probing my finger with a pin. "Well, you did it," he said. I was informed that I had clipped the radial nerve leading to my right index finger. Stitches were next and then came the most troubling news: There was no way to repair the damage. The finger would remain numb.

Fortunately, when I returned to the hospital a few days later to have the wound inspected and the stitches removed, the young doctor who removed the stitches had a different diagnosis. She referred me to the

hospital's hand clinic, and the doctors there said they could repair the damage.

The required surgery was quite an experience. A tight-fitting rubber cuff was applied to my wrist to stop the flow of blood long enough to repair the nerve and stitch things back together. The incision site was numbed by several injections at the base of my index finger, and then a drape was placed between my line of vision and my extended right hand.

The repair was done under a special microscope, which allowed the two surgeons to see the incision at the same time. One held the severed nerve ends together, while the other stitched. Three tiny stitches and less than an hour later the job was done. I kept my hand in a sling to position it above my heart for a few days, and then it was back to normal.

It has been almost five years since the surgery, and although I still do not have full feeling in my finger, most of it is back. It has taken time. For the first two years, I could not pick up small parts between my thumb and index finger. The flat pick that I used to play the guitar kept falling on the floor, and I didn't even feel it slip out of my grasp. The worst is over, and I see (feel) some improvement even now.

I hope this story will help a number of fellow woodworkers. The obvious lesson here is the issue of safety. Familiarity seems to breed contempt even when working with dangerous power tools, let alone a chisel. It takes a great deal of discipline to continue working in a safe manner for long periods of time. Increased skill seems to bring along the notion that increased risk is a tolerable option. Most accidents can be prevented, but only if we are convinced of the danger and take action.

And what about the "true" accident? Odds are, many of us are going to have one. My reaction was certainly not predictable. Even though I didn't have a life-threatening injury, I experienced mild shock and most certainly needed assistance. How many times have you headed for the shop with no one else around, absolutely certain that there would be no accident and that if by chance there was, you could handle it? Are you ready for that accident? Do you have any first-aid resources available? These should include equipment (adequate first-aid kit), people (it's hard to dial a phone with no fingers) and a plan (what to do and where to go for emergency treatment).

Lastly, follow-up health care requires no less attention than accident prevention and first-aid resources. Suppose you do your best to prevent injury, but still have an accident. Even if you do have first-aid help available, will you know what the next best step is? Certainly you can't go wrong hotfooting it to the nearest emergency-treatment facility. But what happens after that? I got two different diagnoses, and it was just a fluke that

I ran into the second doctor who knew my nerve damage could be fixed. Nearly all woodworkers face the risk of serious injury, yet we are generally ignorant concerning possible treatments. We of all people should be up to date on what the medical community can offer. Start doing your homework now by interviewing your own doctor, and then branch out to the nearest medical facility. You never know when you may lose your nerve.

—*Robert Feltman, San Jose, Cal.*

The rocket-powered tricycle

"Netley's Rocket-Powered Tricycle," as I have entitled the sculpture shown in the photo below, was inspired by a tricycle given to me by a neighbor and by a passage from a book.

The tricycle was probably 50 or 60 years old, and I held onto it for several years before I decided to attempt a reproduction of it in wood. Over a period of about six months, I gradually assembled the frame, handlebars, seat and wheels.

At about the same time that I decided to make the tricycle, I came across a story in a book by the old-time radio comedians "Bob and Ray." The story is about a guy named Netley and his polished hardwood tricycle, which differs from a normal trike in its method of propulsion, as discussed in the following excerpt from the story. So I decided to combine the antique tricycle with the "Bob and Ray" story. The results are shown in the photo below.

Ray: "... And I see you've brought several products with you today to analyze for our listeners. I'm particularly interested in that thing there with the three wheels on it."

Netley: "That's a child's tricycle I'm recommending for its safety features. It's made in Denmark of polished hardwood. And you can see how the corners of each piece have

Photo: John Taye



This life-size sculpture of a rocket-powered tricycle was based on an antique version and an old comedy routine.

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been rounded off. That protects small children against a lot of the minor scratches they get from sharp points on metal tricycles—or even plastic ones.”

Ray: “Well, that’s truly an important safety feature. And I hope I didn’t sound foolish by failing to recognize the thing as a tricycle. But it doesn’t have any pedals on it.”

Netley: “No. That’s another feature. It doesn’t have pedals.”

Ray: “Well, I guess that’s for safety, too. But how does the child move it along without pedals?”

Netley: “It’s really a whole new concept in tricycles. This little box under the seat is a simplified rocket engine that propels the trike.”

Ray: “You mean you put rocket fuel in this thing?!”

Netley: “No, no. Nothing that sophisticated. It works more like a simple Fourth of July skyrocket. A small charge of gunpowder goes in here. And the child just lights the fuse when he’s ready to ride.”

Ray: “Well, don’t you think it’s kind of dangerous for a child three or four years old to be playing around with matches and gunpowder?”

Netley: “Oh, I don’t know. I hadn’t thought much about that aspect. I suppose a parent could supervise at first—and make the child aware of any possible danger.”

Ray: “Well, I suppose. But even so ...”

Netley: “The instruction booklet says that the tricycle never attains a speed of more than 15 MPH if the correct gunpowder charge is put in there. And, as I said before, the corners are rounded off in case the child should take a spill.”

Ray: “Well, I guess it’s okay then. ...”

—John Taye, *Boise, Ida.*

EDITOR’S NOTE: The previous excerpt was reprinted with permission of The Putnam Publishing Group from *The New! Improved! Bob and Ray Book* by Bob Elliot and Ray Goulding. Reprinted by McGraw-Hill Publishers, 1985, by arrangement with G.P. Putnam’s Sons.

Piano bar

As a longtime cabinetmaker, I have been asked to make some outrageous pieces. The photo below of a piano altered to accommodate liquor bottles and glasses is the latest of these projects.

The client who ordered this piece had the piano in storage for 15 years since her mother’s death. She had promised never to dis-

pose of the baby grand. But since the storage costs had become so high, and having an additional piano was not in her interest, she was faced with either violating a promise to her mother or adapting the piano’s use. By altering the normal perspective and recycling some of the piano’s parts, I built this liquor cabinet. Promise intact, the client now enjoys using the piano.

—John C. Packard, *Sea Cliff, N.Y.*

Photo: Gene Hennessey



A wood finisher’s winged helpers

In the early ’40s, I knew an antiques dealer I’ll call Monsieur Leroy who had a store on the south side in midtown New York City. In the windows of his store, he displayed mostly restored, but flashy French antiques. His interpretation of restoration was to dress up poor imitations with atrocious glossy finishes and freshly gold-replated hardware (what the French call *ormolu*). And although each piece had a sky-high price tag, Monsieur Leroy’s sales talk, delivered in a heavy French accent, rarely failed to convince prospective buyers—mostly the *nouveau riche*—that they were making an excellent investment by purchasing the item.

One day, at an auction sale, Leroy purchased a “sunburst” round clock, about 6 in. in diameter, surrounded by a gold-leafed wood frame carved to look like stylized sun rays. Leroy’s purchase was a genuine antique, about 200 years old, and he soon realized that it had great sales appeal. So, shrewdly, he located and purchased a dozen antique clock and barometer mechanisms that would suit a similar frame. Then, he contacted his cabinetmaker and had him make a dozen wood frames, all copies of his genuine antique sunburst.

I got involved in Leroy’s little scheme when the ersatz frames were complete. He invited me to his store, and pointing to the brand-new sunbursts, he asked if I could finish them to match the original. Even though I had no real experience with gilding and didn’t have the faintest idea how it was done, I assured Leroy that I was the best man for the job. But before Leroy agreed, he warned me that one of the most common ways antique experts detect frauds is by the lack of “fly specks” in a supposedly aged finish. These spots are usually crudely imitated by unqualified fakers. Jokingly, I assured Leroy that I would hire well-fed flies and provide them with fur-lined toilet seats to help me create an authentic finish.

Luckily, I was able to locate a very good gilder, an elderly fellow by the name of Szabo. His name and accent over the telephone assured me that, like myself, he was a Hungarian. Szabo’s shop was only two blocks away from mine, and he hardly had time to hang up his receiver before I walked through his door. I found there a man nearing his ’80s—a man of power and competence, balanced by friendly generosity. After we shook hands, he gold-leafed the first new sunburst frame while I watched. Then we gold-leafed the second together, and finally, I gold-leafed the third while he watched and asserted his uncompromising demands for perfection. In the next few days, I gold-leafed the remaining nine sunbursts, but I never had a chance to pay back Szabo for his teachings (except maybe through my tears at

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his burial a few months later).

To complete the finish on the sunbursts, I followed my standard procedure for reproducing an antique finish. First, I made the finish look the way it did when it was new, and then I recreated the conditions that aged it. This involved some inventiveness when it came to reproducing the fine fly specks on those gilded frames. I started by laying the frames in my backyard and surrounding them with uncovered dishes of leftover food, to attract flies. I then coated the frames with honey water and waited for my little winged helpers to descend and "perform their duties." While the flies' finishing methods may have been uncouth, the specks they left behind were authentic enough to put most antique fakers to shame!

When at last I delivered the replica sunbursts, Leroy could not tell the original from the duplicates. After examining each closely with his magnifier, he finally yelled, "These fly specks look real!" "But they *are* real," I replied. "Didn't I tell you I would hire flies for the job?" I don't think he ever suspected that I was telling him the truth.

—George Frank, Warm Mineral Springs, Fla.

Product reviews

Elmer's Fill 'N Finish Wood Filler, Borden, Inc., 180 E. Broad St., Columbus, Ohio 43215.

It must be fairly daunting to compete in an arena full of products that, for the most part, all do pretty much what they are intended to do. About the best one can hope for is that one product will do the job a little better than its competitors. To that end, Elmer's Fill 'N Finish by Borden, shown below, would have to be declared a success.

Wood filler, or wood dough (so as not to be confused with pore filler), is a thick, pasty material designed to fill nicks, holes and defects in raw wood. It is generally applied with a putty knife and allowed to dry, whereupon it is sanded flush with the surrounding

Photo: Charley Robinson



Elmer's Fill 'N Finish applies easily and shrinks very little. Large holes can be filled with successive layers, and then the last layer can be sanded flush with the surface.

wood surface. The goal is to find a wood filler that dries quickly (we are all a bit impatient, are we not?), sands easily, takes a stain well and generally acts as much like wood as is possible. Frankly, most brands of wood dough on the market have these characteristics to some degree, although some are a bit too grainy, some don't take stain well and some don't sand easily. Elmer's Fill 'N Finish has all of its ducks in a row. It sands easily, dries quickly, doesn't smell too bad, is non-flammable, and has a good consistency both in its initial handling and in the dried texture. It shrinks very little as it dries, and it takes a stain better than most others that I have come across.

Mind you, these are only minor differences, but Fill 'N Finish does marginally outperform most of its fellows on the hardware store shelf. In such a tightly competitive field, that may well be enough.

—Michael Dresdner, Perkasie, Pa.

Plano Glue Press, SL—Innovation, Umeå, Sweden.

The Plano Glue Press, shown in the photo above, is a vertical, wall-hung clamping system that applies pressure across both faces, as well as the edges, of a panel. To use the system, the bottoms of the clamps are set to the appropriate width for the material. I found that numbering the square holes on each bar, starting from the top, makes setting up the clamps easier. The glued pieces are dropped into the clamps from the top, the clamp heads are secured and then the hand wheels are tightened. Because as much as 1,750 p.s.i. of pressure is applied to all four panel surfaces at once, the panels I glued up came out flatter than any I had done before, even though I had previously used dowels, splines or biscuits to align the boards before clamping with bar or pipe clamps.

There are two basic components to the system: a wall-mounted back rail and a clamp that is held vertically by the back rail. The back rail (model PCR1000) is only 39 in. long, so longer panels may require two or more back rails, as shown in the photo above. The back rails are screwed to a 3/4-in.-thick by 4-in.-wide board that is mounted on the shop wall. This mounting board, located 39 1/2 in. above the floor, provides knuckle clearance between the clamps and the wall, and makes a convenient storage space. The clamps, with 1 3/8-in.-wide extruded aluminum bars, are available in two different capacities: Model PC1000 handles panels up to 43 in. wide (\$159/clamp), and model PC1250 (\$179/clamp) accepts panels as wide as 48 in. The length of panel that can be edge glued is limited only by the number of clamps and the wall space.

The maximum thickness that can be clamped for both models is 4 3/8 in., and the minimum thickness is about 1/16 in. Key-



Photo: John Roebor

Gluing up flat panels is greatly simplified with the Plano Glue Press because the easily loaded, wall-mounted clamps apply pressure to the face of the panels as well as to the edges.

board-instrument makers won't be the only woodworkers who will appreciate this capability. While the Plano Glue Press is an excellent edge clamp, it's also a pretty good veneering clamp when used with flat, stiff sheet stock for platens.

In addition to providing a better glue up, the Plano Glue Press is easy to load, and the vertical orientation frees up bench space. I save time because I can glue up more quickly, and I don't have to move large glue-ups from my bench while the glue dries. If you don't have wall space for the clamps, you can attach the back rail to the back of your workbench.

Although more than \$150 per clamp may seem high, the Plano Glue Press is actually only slightly more expensive than a comparable number of good-quality bar clamps. Factoring in the time saved in clamping up and then flattening panels, the higher costs are easily justified. Also, the distributor, Advanced Machinery Imports Ltd. (PO Box 312, New Castle, Del. 19720; 800-648-4264) offers four different package deals, at substantial savings, that should satisfy everyone from the occasional woodworker to the professional.

—Hugh Foster, Manitowoc, Wisc.

Notes and Comment

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

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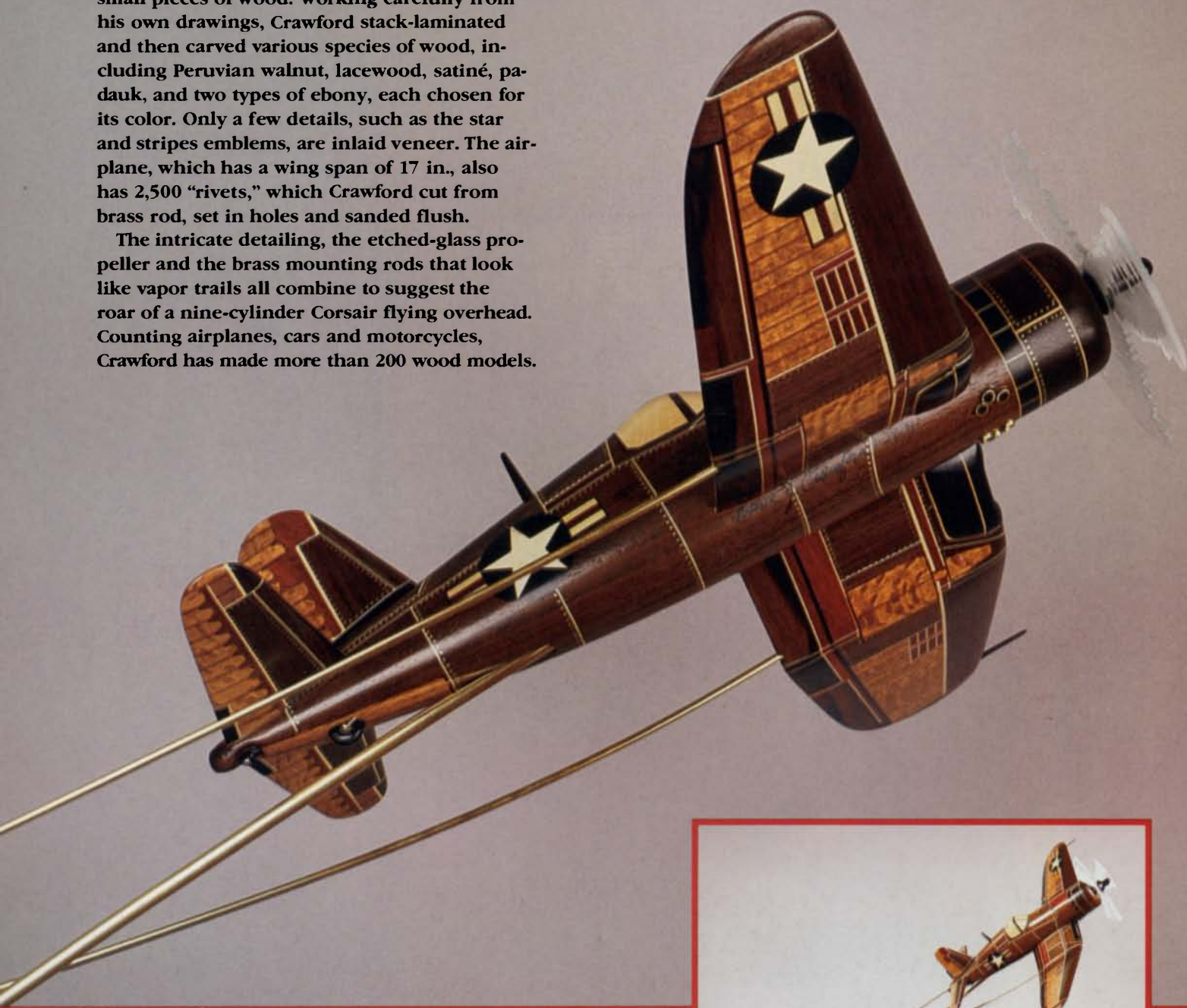
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Model maker Bruce Crawford, of Los Osos, Cal., built this F4U Corsair fighter plane by gluing up more than 1,000 small pieces of wood. Working carefully from his own drawings, Crawford stack-laminated and then carved various species of wood, including Peruvian walnut, lacewood, satiné, padouk, and two types of ebony, each chosen for its color. Only a few details, such as the star and stripes emblems, are inlaid veneer. The airplane, which has a wing span of 17 in., also has 2,500 "rivets," which Crawford cut from brass rod, set in holes and sanded flush.

The intricate detailing, the etched-glass propeller and the brass mounting rods that look like vapor trails all combine to suggest the roar of a nine-cylinder Corsair flying overhead. Counting airplanes, cars and motorcycles, Crawford has made more than 200 wood models.



HIGH-FLYING MODEL

Photos: Gary Weisenburger