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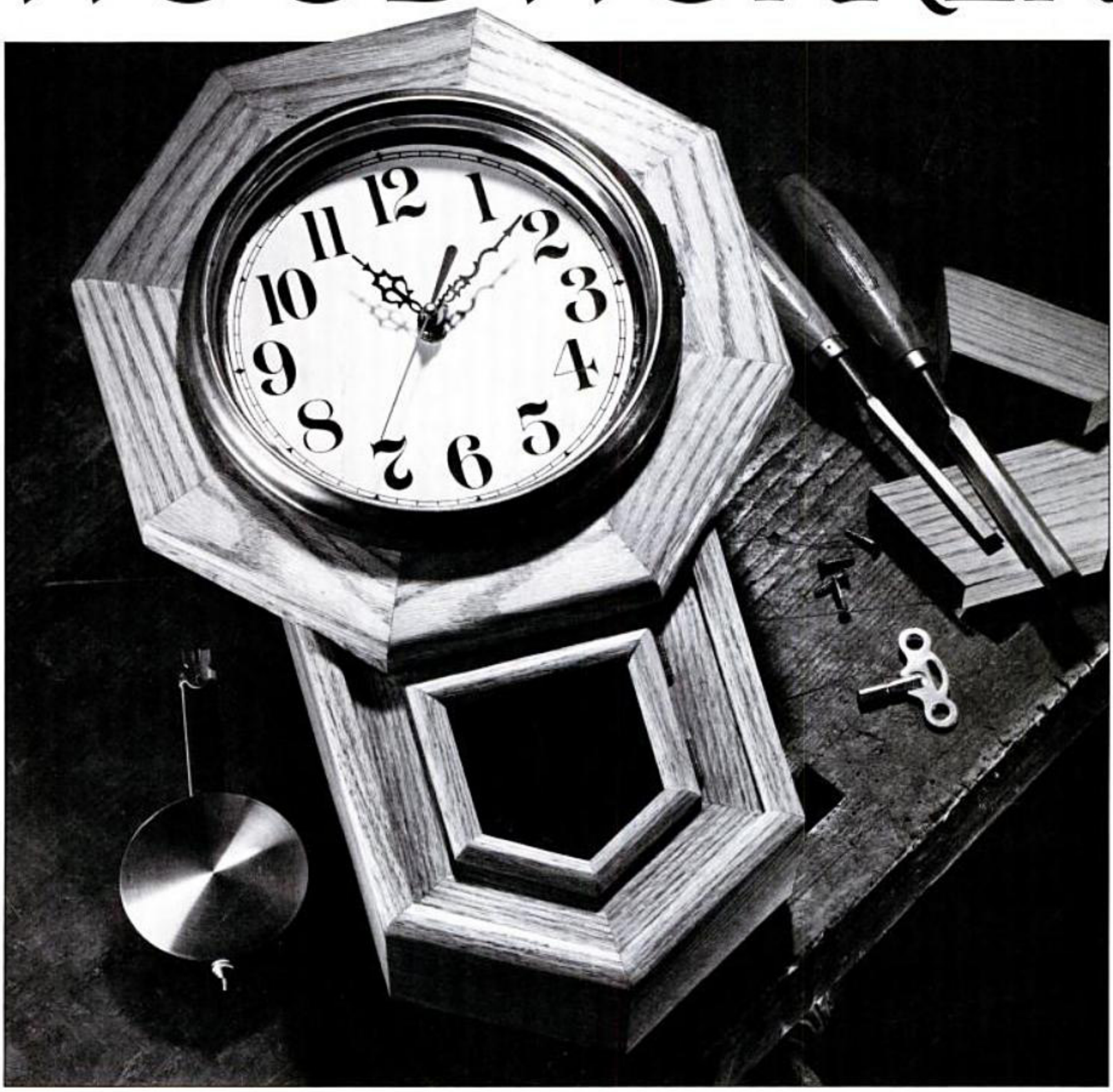
September/October 1989, Volume V, No. 5

AMERICAN WOODWORKER



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All About Woodworking Glues

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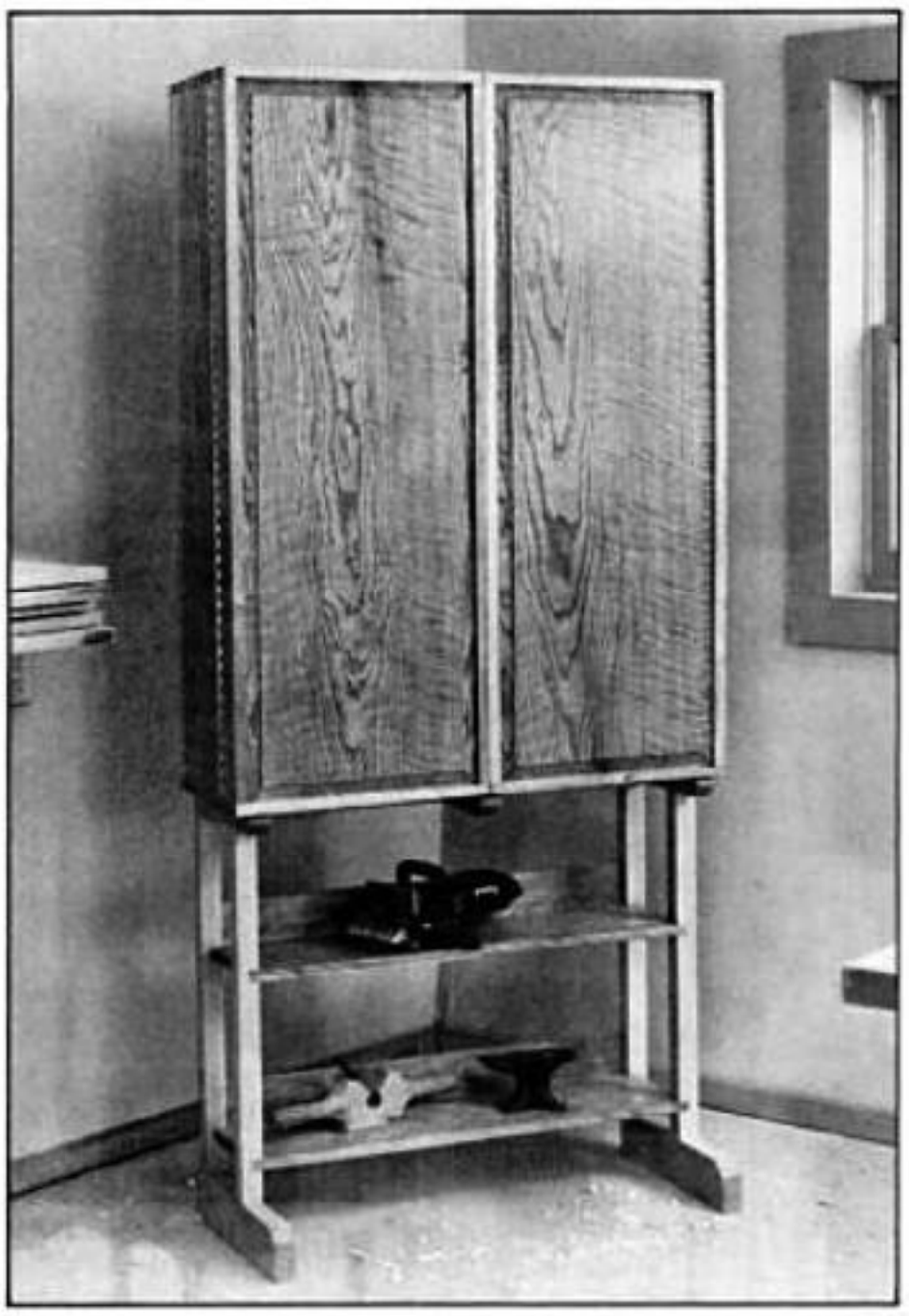

TOOL CABINET **40**

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A WORD FROM THE EDITOR

There are two types of woodworkers in the world: Those who design their own furniture and those who don't. Those who *don't* think those who *do* practice some sort of arcane magic, like mysterious, modern-day alchemists.

There's no great mystery to designing a piece of furniture. It's a trial and error process even for the best of designers, and everybody has a different approach.

What works for me is a combination of doodles and rough freehand sketches where I work out the general form and proportions I'm looking for in front, top and side views. I'll try all sorts of crazy variations at this rough-drawing stage. I'm no Rembrandt, so these sketches are pretty crude. I keep a tape measure handy to help me visualize how large, for example, 24 inches really is.

Once I have the basic form nailed down I cobble up a crude mockup from whatever scraps I happen to have at hand. If I'm designing a coffee table, for example, I'll prop a piece of plywood on books or blocks to see what different heights really *feel* like when I'm sitting on the sofa. It's hard for me to visualize sizes and shapes from a two-dimensional sketch and I get to a point with a design where I can't go any further on paper. I need to actually *see* how high, wide or fat a thing is before I can refine it further. Because of my visual limitations I've never been able to work out decorative details, like chamfers, on paper. I need to experiment on wood to see what they'll look like.

Next, I move on to the joinery. I figure out on paper what joints will be strongest and best suited for the job at hand. By this time, my drawing board is covered with coffee cups and reference books and the floor is ankle deep in crumpled-up balls of paper.

The last step, for me, is a three-view working drawing in which I work out all the fine points of construction. I draw full-size whenever possible and work to scale when a piece is just too large to fit on my drawing board.

When it comes down to it, the proof of a design is in the making. I've built more than a few pieces that looked good on paper but just weren't quite right when the idea finally took shape in wood. A thinner leg, perhaps, or a different angle on that chair arm. Back, as they say, to the drawing board.

What about you? What's your approach to designing furniture? We'd like to hear from you. Send us sketches or photos of some of your designs and tell us, in a letter, how the design evolved and what, if anything, you'd do to improve it next time around. We'll publish the best of your letters and designs in a future issue of *AW*.

DAVID SLOAN
Editor

LETTERS

Sir:

I take objection to Thomas E. Bewley's letter stating that "Most of us have no interest in taking on a project that could be defined as 'fine furniture'" (July/August, 1989 "Letters").

There are countless woodworking magazines on the market for the woodworking hobbyist. Your magazine is a cut above the run-of-the-mill because of the variety and high quality of articles which include plans for "fine furniture," weekend projects, toys, jigs, safety, etc.

Please keep those "fine-furniture" plans coming. If you don't believe me, take a survey.

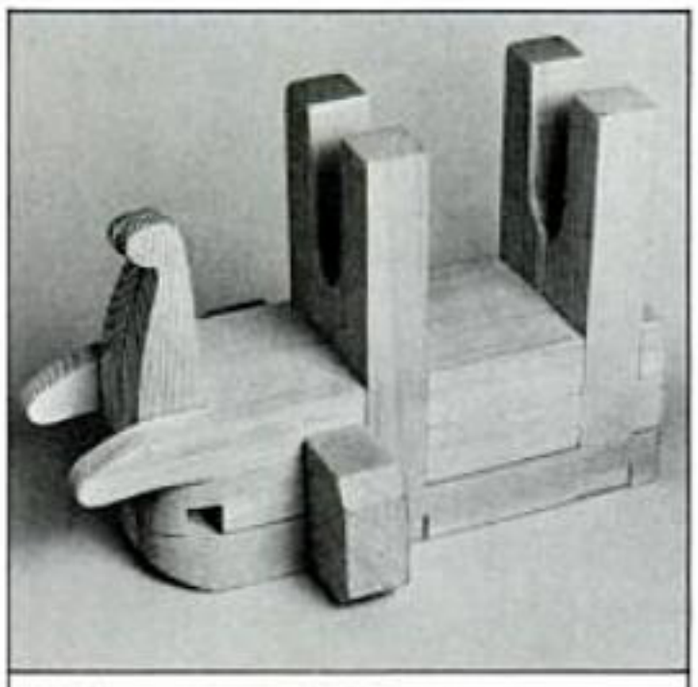
JOANN DITTAVIO
Vista, CA

Sir:

Let me compliment you and your staff on an excellent magazine. I subscribe to a number of woodworking magazines, but I always look forward to yours. I'm sure it appeals to all woodworkers, beginners and veterans alike.

How about an article on making a router table in a future issue?

BART F. GALLETTA
Sanford, IL



Mammoth Mixup

Four dimensions on the Elephant Puzzle drawing on pp. 48-49 of the July/August, 1989 AW *were incorrect. We'll send a drawing of the entire Elephant Puzzle, with corrections, to any reader that requests one. Write to: Elephant, c/o* AMERICAN WOODWORKER, *33 E. Minor St., Emmaus, PA 18098.*

Sir:

Your magazine is very good, but most of us woodeaters would like more weekend or long-evening projects. Games, puzzles, toys, folk art —short projects.

A. MARINO
North Babylon, NY

Sir:

While I realize that you cannot mention every individual or organization concerned in a short editorial such as "Pass It On" (July/August, 1989 *AW*), I was still surprised that no mention was made of Early American Industries Association. The EAIA has probably done as much, if not more, than any organization to try to accomplish what you advocate.

PETER M. COOPE
North Stonington, CT

EDITOR REPLIES: *Good point. The Early American Industries Association is devoted to promoting a better understanding and appreciation of Early-American trades. Their quarterly magazine,* The Chronicle, *is worth investigating. The EAIA's address is: P.O. Box 2128, Empire State Plaza Station, Albany, NY 12220.*

Sir:

First, a tip. To keep your saw blades clean, just dissolve 1/4-cup common baking soda in hot water in a glass pie plate big enough to hold your saw blade. Immerse and soak for a few minutes, then brush off with a stiff-plastic or brass-bristle brush. Voila! No pitch, gum, or debris. Better, or as good as any other commercial product, including oven cleaner and much safer for the environment—your own shop and the larger ecology. Plus, you help the drain when you pour it down after the cleaning is over. I can do two or three blades before the solution becomes less effective.

Next, kudos for the reader service card. It makes it so much easier to ask for new product info.

I'm glad Rodale took over *AW*. I returned as a subscriber because of that. I enjoy each issue and look forward to its arrival.

PAUL SMITH-VALLEY
Charleston, WV

Sir:

I am a recent subscriber to *AW* and I have been an amateur woodworker for several years. I find your articles very helpful.

L.A. LUTON
Memphis, TN

Sir:

In reading your editorial in the May/June, *AW*, I share your concern for the ecological impact of trees on the health of the earth and its populations. I was surprised, however, at the short-sightedness of your last paragraph. It *should* read, "Please plant at least one tree for every tree that you use, whether it be in the wood shop, construction or remodeling, or use of paper products. If personally planting a tree is not feasible, then give money generously to support your favorite reforestation effort, domestic as well as foreign."

JOAN BENGTSON
Rochester, MN

Send your comments, compliments, complaints and corrections to: Editor, AMERICAN WOODWORKER, *33 E. Minor St., Emmaus, PA 18098.*

Q&A

Workbench Woods

Q. *I'm making a workbench and would like to know which are the best woods to use.*

BERNARD HERSHKOWITZ
Commack, NY

A. I've seen fine benches made of everything from a salvaged bowling alley to black walnut and Hawaiian eucalyptus. I'm willing to bet that at one time or another every North American wood—hard and soft—has been used to build a workbench.

The top is the main ingredient of any workbench. The wood for it must be close-grained and hard, to resist dents and gouges. It must be heavy, to absorb shock and to keep the bench from moving. It should also be stable, so that it stays flat.

Hard maple has become the standard for North American benchtops because it is relatively inexpensive and meets all of the above requirements. Oak, ash or even moderately hard softwoods like Douglas fir or Southern yellow pine would make a reasonable second choice. Beech has been the preferred European benchtop wood for centuries.

Vises are generally made of the same wood as the top. They should be hardwood, or faced with a harder material like tempered Masonite so the jaws will stay smooth.

The material for the base is less critical. The base, like the top, should be heavy and hard, but warping is less of a problem because the pieces are narrower. For the base, open grain or non-structural defects won't matter. I've seen plenty of strong bases made from standard-dimension lumber, and even from heavy-duty aluminum angle bolted together.

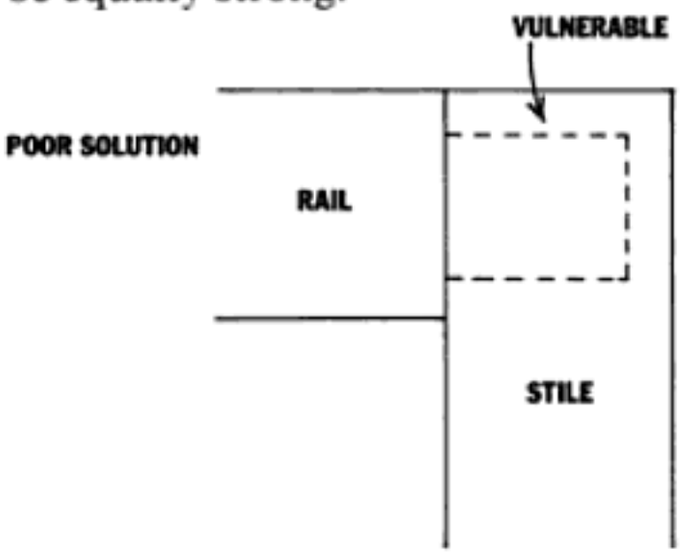
SCOTT LANDIS
Writer and former benchmaker
Newtown, CT

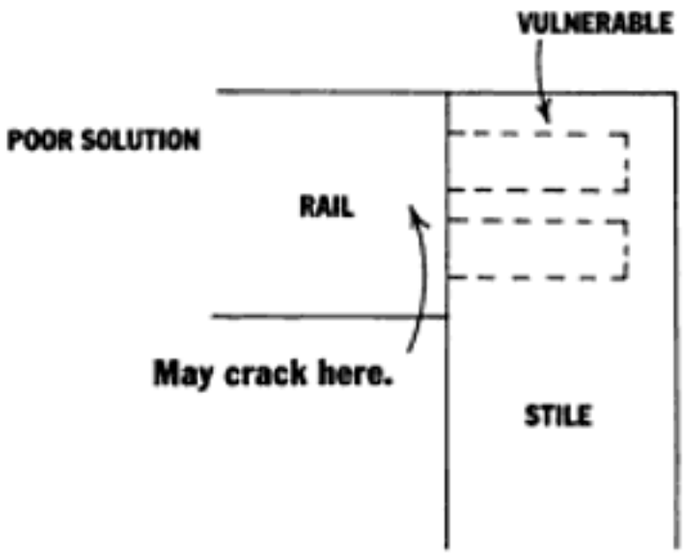
Double-Tenon Quandary

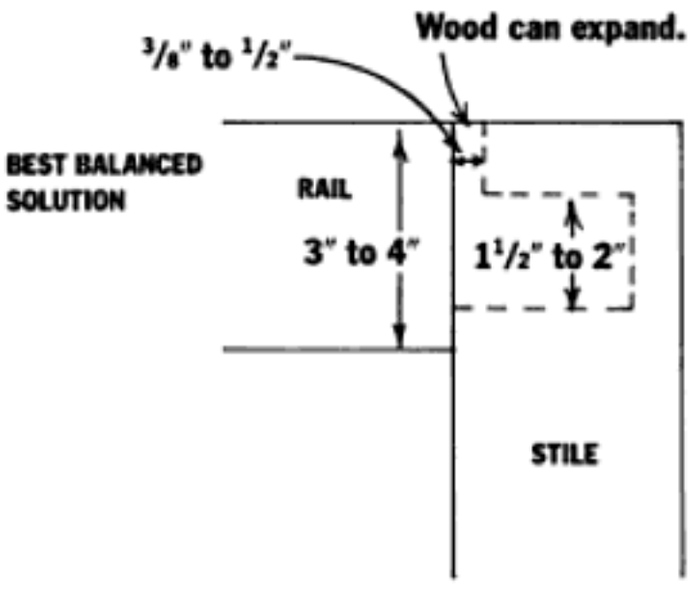
Q. *I've always been told that when making doors with wide rails, it's best to make two tenons, one above the other, instead of making just one wide tenon. This is supposed to keep the door from breaking apart by keeping the expansion and contraction of the tenons to a minimum. But since the expansion and contraction is across the entire rail instead of just across the tenons, I don't see what good a double tenon does. Is there another reason? Does the theory behind this practice make any sense?*

MITCH MANDEL
Allentown, PA

A. The old-timers used to teach that joinery is not just a matter of the wood you put in, it's also a matter of the wood you remove. When you cut a mortise-and-tenon joint, you must find the balancing point—you don't want to strengthen one member at the expense of another. You want both members to be equally strong.







DRAWING BY SALLY ONORA

You're right to question the logic behind using two smaller tenons in place of one wider tenon. Although one wide tenon is a poor solution, as it could expand and break out the top of the stile, two tenons don't really solve the problem. They still expand, and the top of the stile is still at risk. And the rail itself may split in the middle.

The best-balanced solution to this situation is a haunched tenon. The haunch allows the wood to expand without endangering the top of the stile, yet you still have a good-sized tenon to make a sound joint. If your rail is very wide, say 10 in. or so, you could break it into two tenons, but you would still want to haunch the one nearest the outside.

JAMES KRENOV
Cabinetmaker
Fort Bragg, CA

Making Your Own Tack Cloths

Q. *Tack cloths are great for wiping dust off a piece between coats of a finish, but their cost is going up, and they are getting hard to find. Does someone have a method for making tack cloths?*

JOHN KINDSETH
Lodi, CA

A. When I was an apprentice in Central Europe in the 1920s, the boss' wife made about five tack cloths at a time, a supply which lasted for three to four years.

She began with worn sheets or old shirts, which she washed and cut into handkerchief-sized rags. To keep loose threads from working out of the rags, she hemmed them on her treadle sewing machine and then rewashed them.

Instead of thoroughly drying the rags, she squeezed out all the water she could and spread them out on newspapers to absorb a little more moisture. Meanwhile, she mixed five parts turpentine with one part slow-drying varnish and 1/2- to 3/4-parts cooking oil. (Corn or safflower oil would work well.)

The boss lady stuck her fingers in the mixture and spritzed it on both sides of the cloth. The apprentices picked up the cloth and worked the

mixture into it with both hands. When finished, our squares were pleasantly moist and our hands were terribly sticky. The boss lady folded the squares, rolled them and stored them in an airtight glass jar, and released them—one at a time—as the shop needed them.

GEORGE FRANK
Woodfinisher
Venice, FL

Routing With a Drill Press

Q. *I'm equipping my shop on a limited budget. I'm thinking of buying a drill press and having it double as a router. What would you suggest?*

RON REID
Boynton Beach, FL

A. Attempting to run router bits in your drill press will damage your project and may also damage the drill press. Router bits are designed to operate at speeds ranging from 20,000 to 25,000 RPM. A drill press develops a maximum speed of less than 5,000 RPM. Running a router bit at such a slow speed results in an extremely rough cut, with lots of chipping and tear-out.

The bearings in a drill press are usually designed to take only vertical loads. Putting a lateral load on the bearings during routing may wear them out prematurely.

My advice is to buy a router. In our shop we use the router for shaping, cutting grooves, mortising, and cutting edge profiles. It is a much more versatile machine than a drill press. Then, when your budget allows, buy an electric hand drill if you don't already have one, and you will be well ahead of the game.

JAMES VAN ETTEN
Cabinetmaker
Perkasie, PA

The Right Stuff for Letter Openers

Q. *I want to make some wooden letter openers with handles made of a synthetic countertop material called Corian. The problem is*

Q&A

finding a suitable wood for the blade. My favorites—oak and ash—don't work because the cutting edge chips off. Any recommendations?

CLIFTON O. MYLL
La Quinta, CA

A. In designing a letter opener, you should consider not only the type of wood, but also the cross section of the blade.

The blade's cross section should be fairly beefy. The angle of the edge should be large to compensate for the fragile nature of wood. The point, however, can be longer and sharper.

Ideal woods are rosewood or ebony. They are strong, tight-grained and will "hold an edge well," as they say in toolmaking. If you don't have access to these exotics, I'd say hard maple would be the best domestic wood for letter-opener blades.

Corian handles could be interesting, but aesthetically, I'd prefer to see an all-wood design. Consider, too, that DuPont does not recommend laminating Corian to wood because of their different expansion/contraction rates. The width of a letter-opener blade is small enough that expansion and contraction probably won't matter. To be safe, you may want to use a mechanical fastener, such as screws or rivets.

BRAD SMITH
Bradford Woodworking
Worcester, PA

Where to Find It

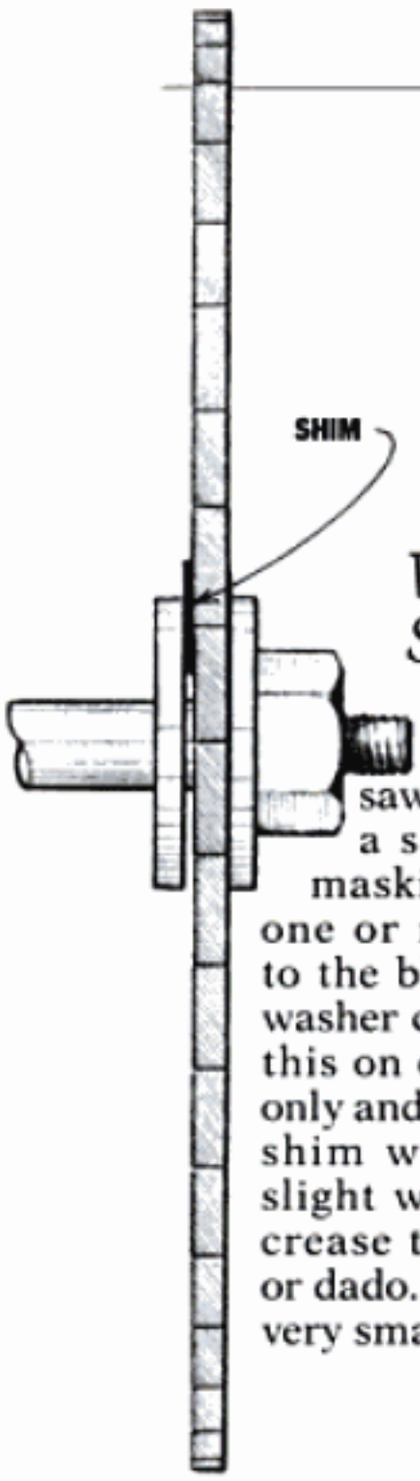
Solid oak tambours for making rolltop desks are available from Outwater Plastic Industries, 4 Passaic St., Woodridge, NJ 07075.

Plastic videotape and audio cassette holders for organizing tapes in drawers and cabinets are available from Woodworker's Supply of New Mexico, 5604 Alameda Place NE, Albuquerque, NM 87113.

Clamps and hold-downs for making jigs and fixtures are available from Reid Tool Supply Co., 2265 Black Creek Rd., Muskegon, MI 49444.

Got a woodworking question for the experts? Send it to Q&A, AMERICAN WOODWORKER, *33 E. Minor St., Emmaus, PA 18098.*

TECH TIPS



Widening Saw Kerfs

To increase the width of the kerf of a table-saw blade or a dado head a small amount, use a masking-tape shim. Apply one or more layers of tape to the blade where the arbor washer contacts the blade. Do this on one side of the blade only and in one place. The tape shim will give the blade a slight wobble which will increase the width of the kerf or dado. Remember, this is for very small increases only.

JOHN ROCCANOVA
Ancramdale, NY

You Won't Pay a Lot for This Adaptor

Here's a tip for readers who own the Ryobi AP-10 planer. Ryobi sells a dust-hood attachment designed to hook up to a shop vac. Unfortunately, the nozzle has a 2-in. O.D. which doesn't fit a standard 2¼-in. shop-vac hose.

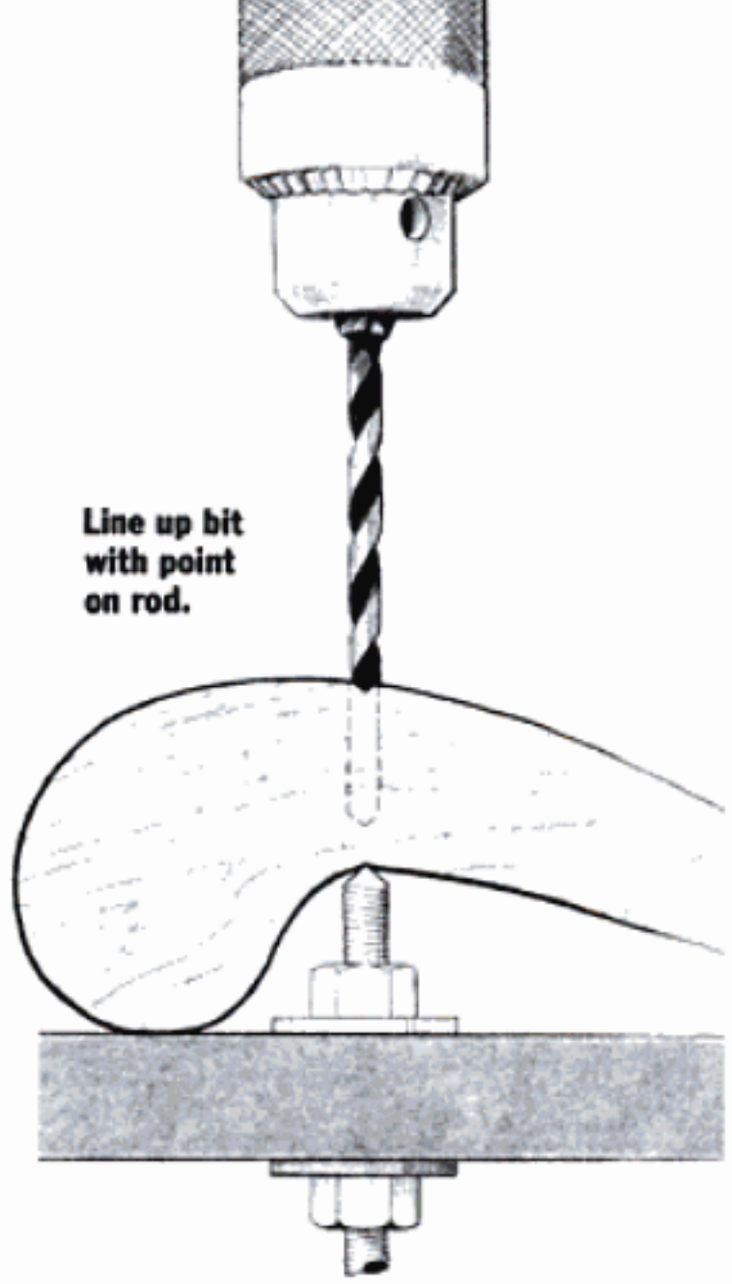
I took the dust hood and my shop-vac hose to a muffler shop. They took a 5-in. length of 2-in. pipe, expanded one end to fit over the dust-hood nozzle and the other end to fit my shop-vac hose. In just five minutes I had a convenient adaptor at nominal cost.

GORDON G. RUECKER
St. Paul, MN

DRAWINGS BY HEATHER BRINE LAMBERT

Drilling on the Mark

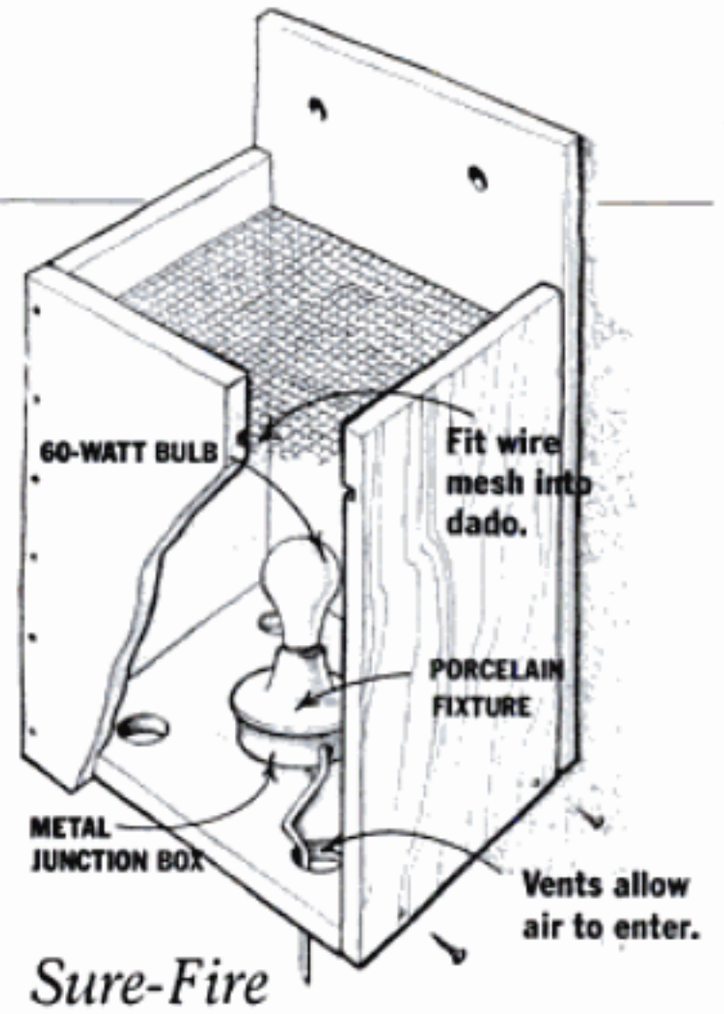
Sometimes I need to drill a hole through an irregularly shaped piece and have the hole enter and exit at exactly the right spots. I made a simple jig for my drill press that makes this difficult task easy.



I filed a point on a piece of threaded rod and cut two large washers out of thin plate steel. To drill the hole, I bolt the threaded rod through my drill press table and carefully align the drill point over the pointed end of the rod. I then center-punch the work at the desired hole entrance and exit points. I place the exit mark on the point of the rod and line up the entrance mark with the drill.

To prevent tear-out, I drill approximately three-fourths of the way through, then flip the piece upside down, placing the hole over the pointed rod and aligning the drill with the exit mark. I finish drilling the hole from this side.

RALPH AUMENT
Selinsgrove, PA



Sure-Fire Dowel Dryer

Have you ever driven a dowel into a hole and ended up splitting the board? Or maybe you've inserted a dowel for a test assembly only to find that you can't pull it out again. If you live in a humid area, as I do, you've probably experienced these problems.

I made a simple dowel dryer to shrink dowels slightly before using them. About an hour is sufficient drying time for a dowel to slide right into a hole.

One caution: Make sure everything fits before you glue up. Once glue hits these dry dowels they will expand and make a very tight joint.

BRENT EWEN
Hamilton, IN

Glue Bottle Top Swap

Replace the top of your glue bottle with a top from a liquid detergent bottle. The new top closes tight and there's no separate cap to come off and get lost.

BRIAN L. OTTO
Chesterton, IN

Know a better way of doing something? Designed a clever jig? Send your woodworking tips, along with a sketch or a snapshot to: Tech Tips, AMERICAN WOODWORKER, *33 E. Minor St., Emmaus, PA 18098. We'll pay you $25 if we publish your tip.*

One Handed Bar Clamps ▼

It seems like you always need an extra pair of hands at glue-up time. The QUICK-GRIP bar clamp is the next best thing. The pistol-grip handle enables you to quickly and smoothly adjust the clamp with one hand by simply squeezing the trigger. The cushioned jaws lock automatically when you let go, assuring that you'll get a tight grip. Made from strong, lightweight glass-filled nylon, these clamps come in five lengths with jaw openings ranging from 6 in. to 36 in. (Price: $20.99-$33.62)

■ *American Tool Companies, Inc., Customer Service Dept. AWT, P.O. Box 337, DeWitt, NE 68341.*

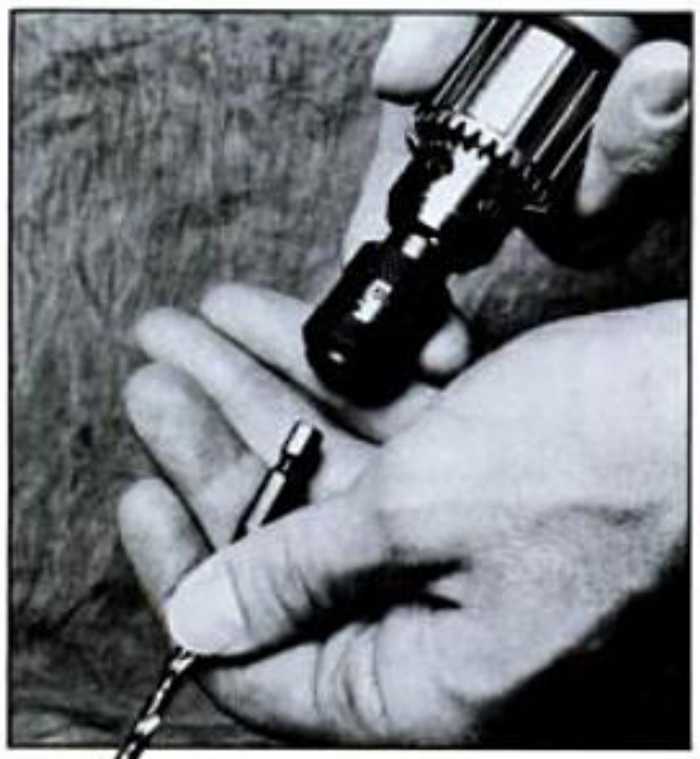
CIRCLE NO. 28 ON READER SERVICE CARD

Quick Change Drill Adapter ▼

When you have to change drill bits fast and often, fumbling with a chuck key is a real nuisance. Irwin's Insty Bit Chuck Adapter lets you change bits fast without a key. Once you chuck the Adaptor into your electric drill chuck, changing bits is as simple as a push on the adaptor; one push locks the bit in place, a second push unlocks it. The Insty Bit accepts only hex shank drills and screwdriver bits. (Price: $14.99)

■ *For information contact: Customer Service, The Irwin Company, Dept. AWT, 92 Grant St., Wilmington, OH 45177.*

CIRCLE NO. 30 ON READER SERVICE CARD

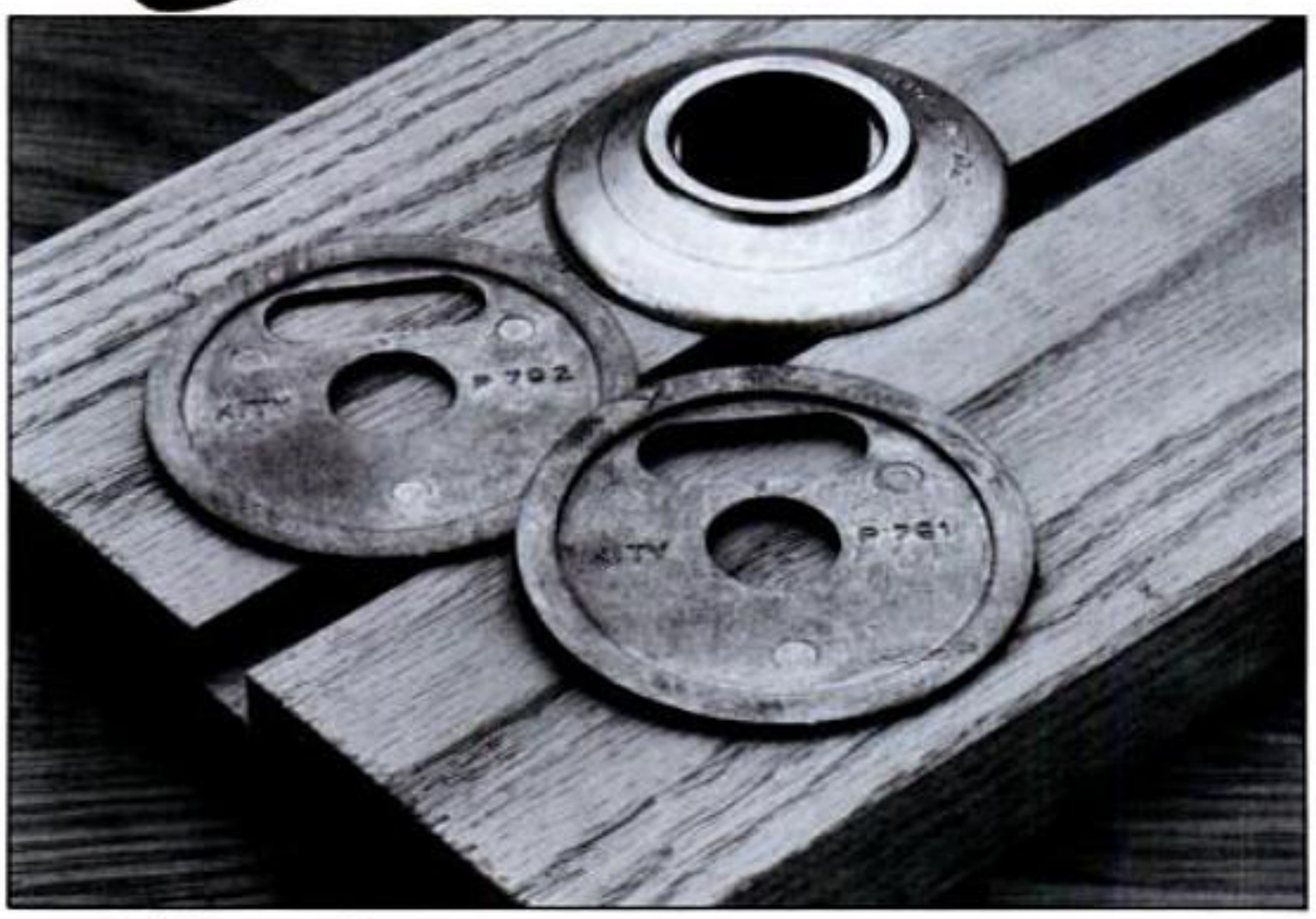


▲ *Depth and Angle Gauge*

This depth and angle gauge is just the thing for measuring the depth of mortises or grooves. The 6-in. rule slides up and down for measuring depth and also pivots so you can lay out and measure angles of 30°, 45° and 60°. The narrow, steel rule can fit into the smallest mortises and is marked in 1/64 in. for accuracy. (Price: $13.95)

■ *The Woodworkers' Store, Dept. AWT, 21801 Industrial Blvd., Rogers, MN 55374.*

CIRCLE NO. 26 ON READER SERVICE CARD



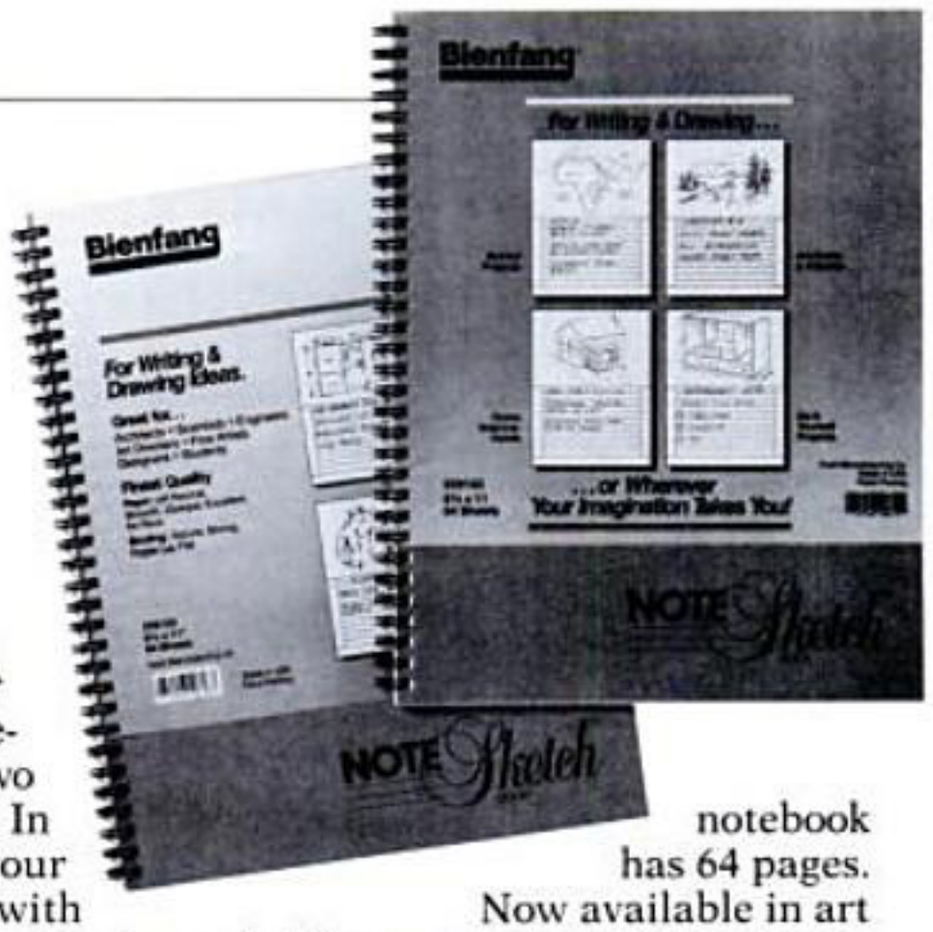
Wobble Dado ▲ Washer Set

Teach your old saw blade a new trick—dadoes. The Wobble Dado Washer Set fits on the arbor of your tablesaw or radial arm saw and makes the saw blade wobble, like a wobble dado head. A turn of the tapered washers enables you to make very fine adjustments to achieve any width dado or rabbet up to 1/2 in. An inexpensive solution for woodworkers who need to cut an occasional dado or rabbet, the set fits 5/8-in. arbors and saw blades up to 10 in. in diameter. (Price: $14.95)

■ *Woodcraft Supply Corp., Dept. AWT, P.O. Box 4000, Woburn, MA 01888.*

CIRCLE NO. 25 ON READER SERVICE CARD

Sketch 'N Write



Creativity needn't be chaotic. Each page in BIENFANG's NoteSketch notebook combines blank sketching space with a ruled description area, so you can write down your ideas as you sketch. The NoteSketch notebook comes in two sizes: 8½×11 and 5½×8½. In the larger size, you have your choice of a vertical format with an adjacent ruled area or a horizontal format with the ruled area on the bottom. The compact size comes only in the horizontal format. Each spiral-bound NoteSketch notebook has 64 pages. Now available in art and office supply stores. (Price: large, $6.95; small, $4.95)

■ *For your nearest dealer, call Hunt Manufacturing Customer Relations Dept., 1-800-USE-HUNT.*

▲ Just Say No to Wood Dust

Sometimes it seems like shop debris makes a beeline for shirt collars and pockets. It's not easy tending to an exacting task with little wood sticklers stabbing at you from all sides. You needn't encourage these pesky sticklers . . . the Dustblocker is the new protective apron with a turtleneck neckline that bars passage to shop debris. Hook and loop fasteners accommodate up to size 18 necks. Made of durable, water-resistant nylon, the Dustblocker apron has both pencil and waist pockets with dust flaps. It's the perfect apron for jobs both in and out of the shop. (Price: $19.95)

■ *For a list of dealers contact: National Decks, Inc., Dept. AWT, P.O. Box 1125, Alfred, NY 14802. (607) 587-9558*

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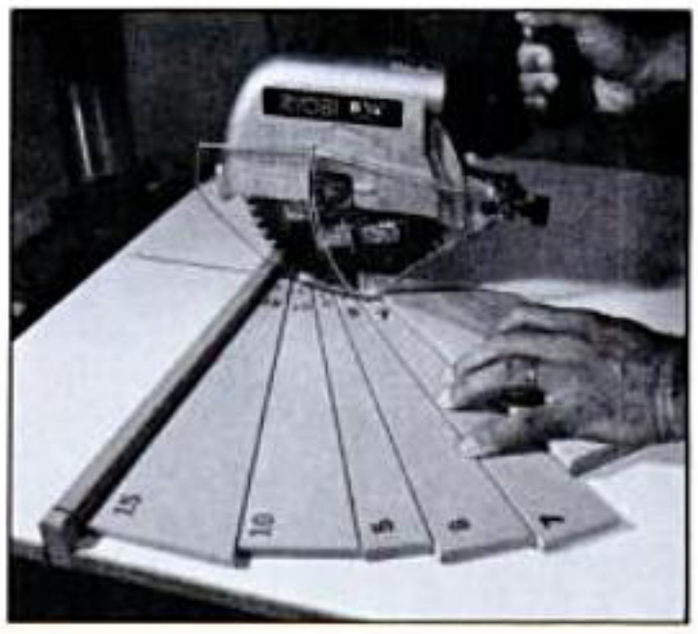


Safe-T-Planer ▲

It's hard to get by without a planer when you're working with wood—but many of us just don't have the space or the money. The Wagner Safe-T-Planer is an inexpensive alternative. Just chuck the Safe-T-Planer into your drill press or onto your radial arm saw arbor, and you're ready to plane. The planer has three cutters which, besides planing, can rabbet, shape moldings, raise panels, cut bevels, tapers and even make decorative cuts—leaving a smooth finished surface. Made of die-cast aluminum, the Safe-T-Planer was designed for safe operation—it will never grab or kick back. Each planer kit comes with a grinding wheel and arbor for resharpening the cutters. (Price: Drill Press Model, $35.00; Radial Arm Saw Model, $40.00)

■ *G & W Tool Co., Dept. AWT, P.O. Box 691464, Tulsa, OK 74169. (918) 486-2761.*

CIRCLE NO. 29 ON READER SERVICE CARD

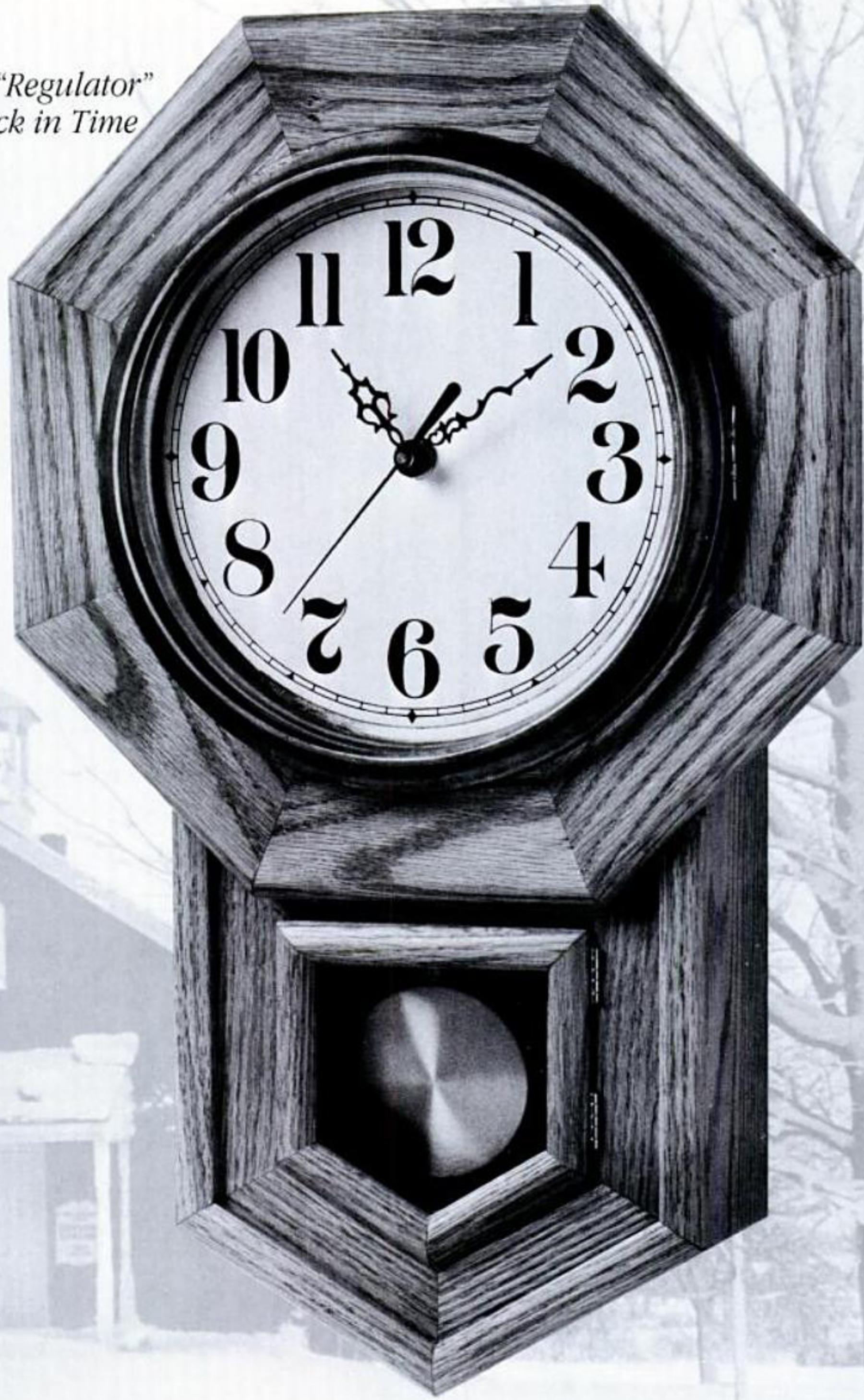
Eze-Angleguide ▲

Adjusting your radial arm saw to cut accurate angles can be a time-consuming project in itself. The Eze-Angleguide is a set of eight wedge-shaped templates that can free you from ever adjusting the angle on your saw, again. Just set the needed template(s) down against the saw fence, hold your work piece securely against them, then cut your angle. The end result is precise with no guesswork. You can cut any angle from ½° to 80° by combining the templates. Made out of medium-density fiberboard, the template set comes with optional sandpaper-backing tape. The Eze-Angleguide can also be used in a crosscut box on a tablesaw. (Price: $24.95)

■ *Steussy Creations, Dept. AWT, 334 Atherton Ave., Novato, CA 94945. (415) 897-1457.*

CIRCLE NO. 32 ON READER SERVICE CARD

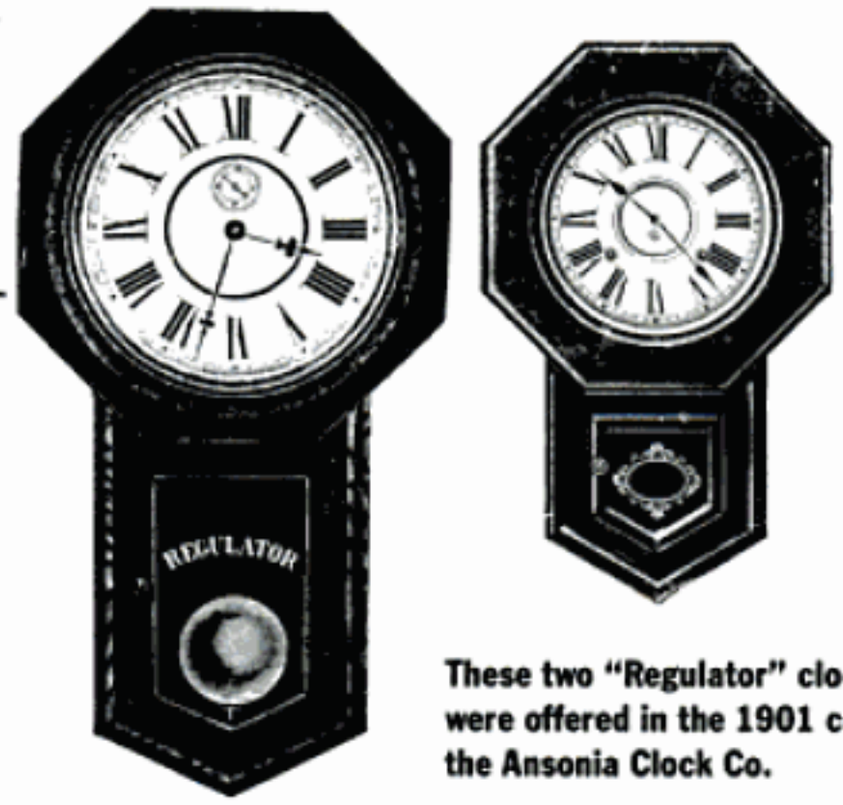
A Reproduction "Regulator"
to Take You Back in Time



Back at the turn of the century, a "Regulator" clock beat time in schoolhouses and offices all across the land.

BY JOHN A. NELSON

SCHOOLHOUSE CLOCK



These two "Regulator" clocks were offered in the 1901 catalog of the Ansonia Clock Co.

After all these years, I still remember looking at the schoolhouse clock. It was usually about halfway through spelling class. The clock hung up front, next to the portrait of George Washington, the one with what looks like clouds around his shoulders. I daydreamed about those clouds for hours, then lost in my dreams, I'd notice the clock. It was never late enough.

The original oak clock, on which I based my reproduction, was made around the turn of the century by the Ansonia Clock Co. in Ansonia, Connecticut, and cost about $6.

This type of clock was made in at least two case lengths. I couldn't find a windup mechanical movement that fit the short-case model, so I installed a battery-powered pendulum quartz movement instead (see Sources). Mechanical movements are available to fit the long-case clock, however (see Sources). The only difference between the two clocks is the length of the case and the pendulum door. The long clock is 3 in. longer. The drawing shows where to extend the case. Be sure to get your movement and hardware before building your clock.

The clock is made up of three separate assemblies: the carcase, the octagonal frame that surrounds the clock face, and the pendulum door.

Building the Carcase

The carcase top is rabbetted into the sides and the two angled bottom pieces are mitered to the sides. I cut the miters on the tablesaw with the miter gauge set to 90° and the blade tilted to 30°. I routed the rabbets for the top after cutting the miters, then assembled the carcase dry and measured to get the exact length of the top.

I spent some of the worst hours of my life assembling mitered carcases before discovering masking tape. Now, I simply stretch tape across my bench with the sticky side up and put the mitered pieces on the tape with their edges together as shown in the photo. The tape does an excellent job of keeping the miters from slipping during glue-up.

When everything fits, glue the carcase sides, top and bottom pieces together, and clamp with a band clamp. When the glue dries, rout a rabbet for the back.

The front of the carcase is a five-sided frame that fits inside the carcase sides as shown in the drawing. I set the miter gauge to 30°, cut each piece to fit inside the carcase and glue them in place as I go.

Note that the top member of the frame is $1\frac{3}{8}$ in. wide, while the other four pieces are $1\frac{1}{4}$ in. wide. Note also that the hinge notches for the pendulum door are best cut *before* you glue the frame together. It's a bit tricky to cut the notches by hand after the frame is glued in place. Trust me. I learned the hard way.

The Pendulum Door

While the miter gauge is still set to cut pentagons, cut and assemble the pendulum door. To make things a bit easier, mill the rabbet for the glass, and round over the edge of the door stock *before* cutting the joints. Here's how.

To avoid splitting the stock and to safeguard your fingers, start with a piece of wood $\frac{5}{8}$-in. thick and at least 2 in. wide. Round over the edge on the router table, then rout a groove as shown in Fig. 2. Rip the door stock to finished width as shown in the drawing. This creates a $\frac{5}{8}$-in. wide strip with a rounded edge and a rabbet along one edge.

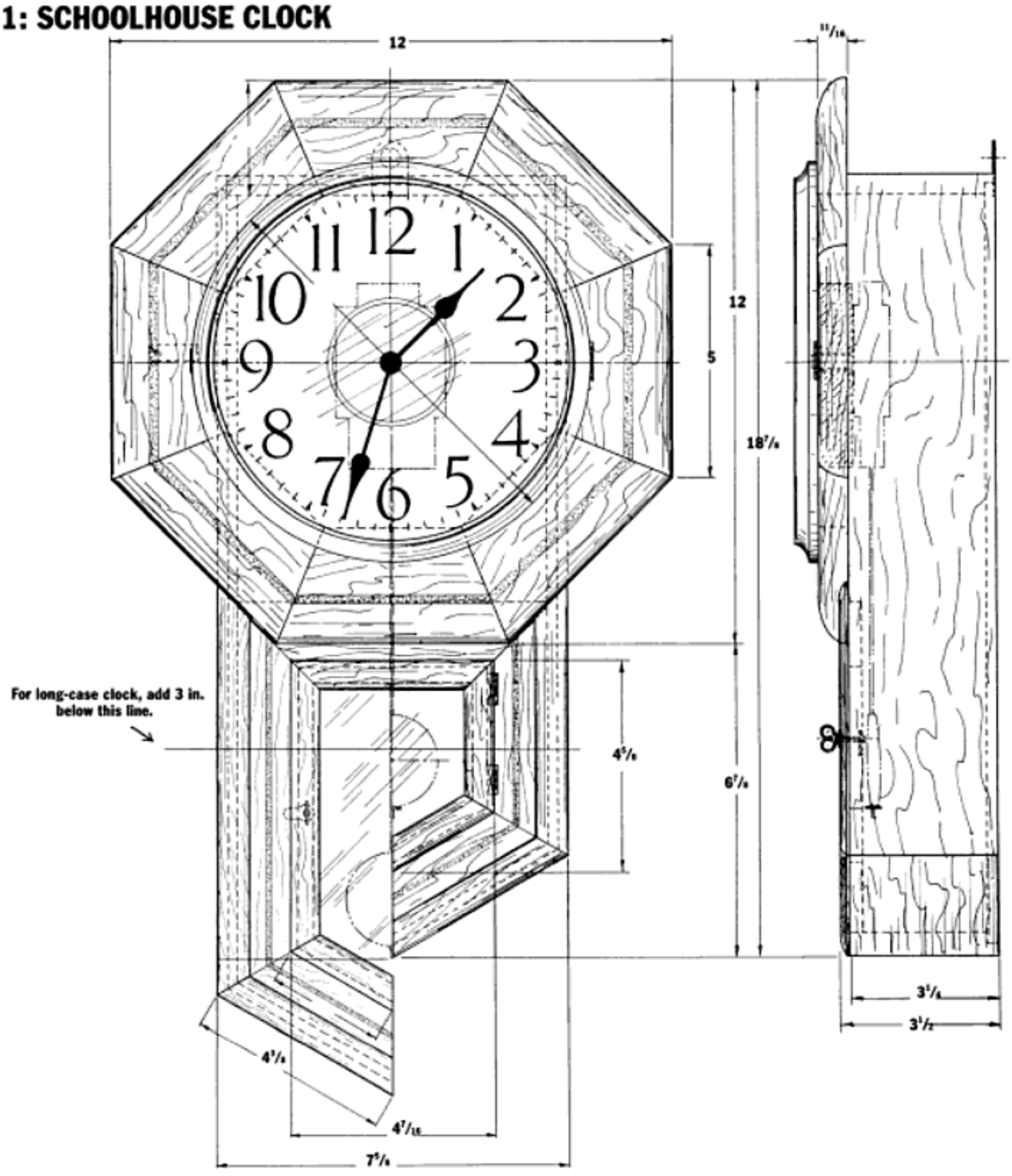
Cut the miters and assemble the door with the rabbet on the inside. When the glue dries, rout a rabbet around the outside of the door, too. Have your hardware store cut a piece of glass to fit the door.

Drill a hole for the pendulum-door latch, and install the latch. Hang the door on the cabinet. Note that the hinges are mounted to small blocks glued into the door rabbet as shown in the photo on page 22. This unusual arrangement allows you to use regular butt hinges for an overlay door.

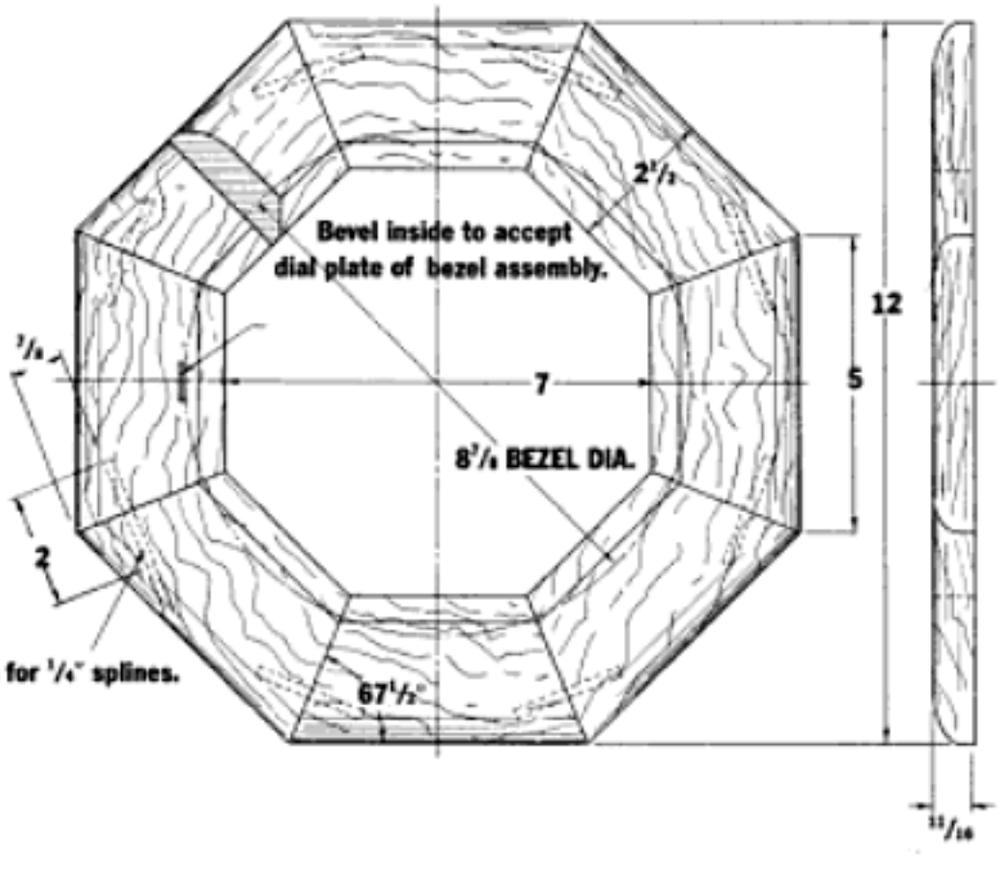
The Octagonal Frame

The octagonal frame has 16 miters. The cumulative effect of even a small error in angle can add up to a

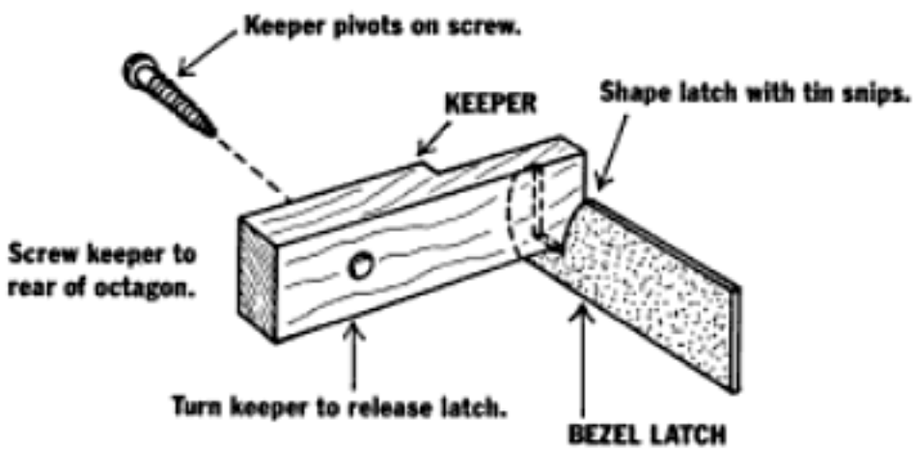
FIG. 1: SCHOOLHOUSE CLOCK



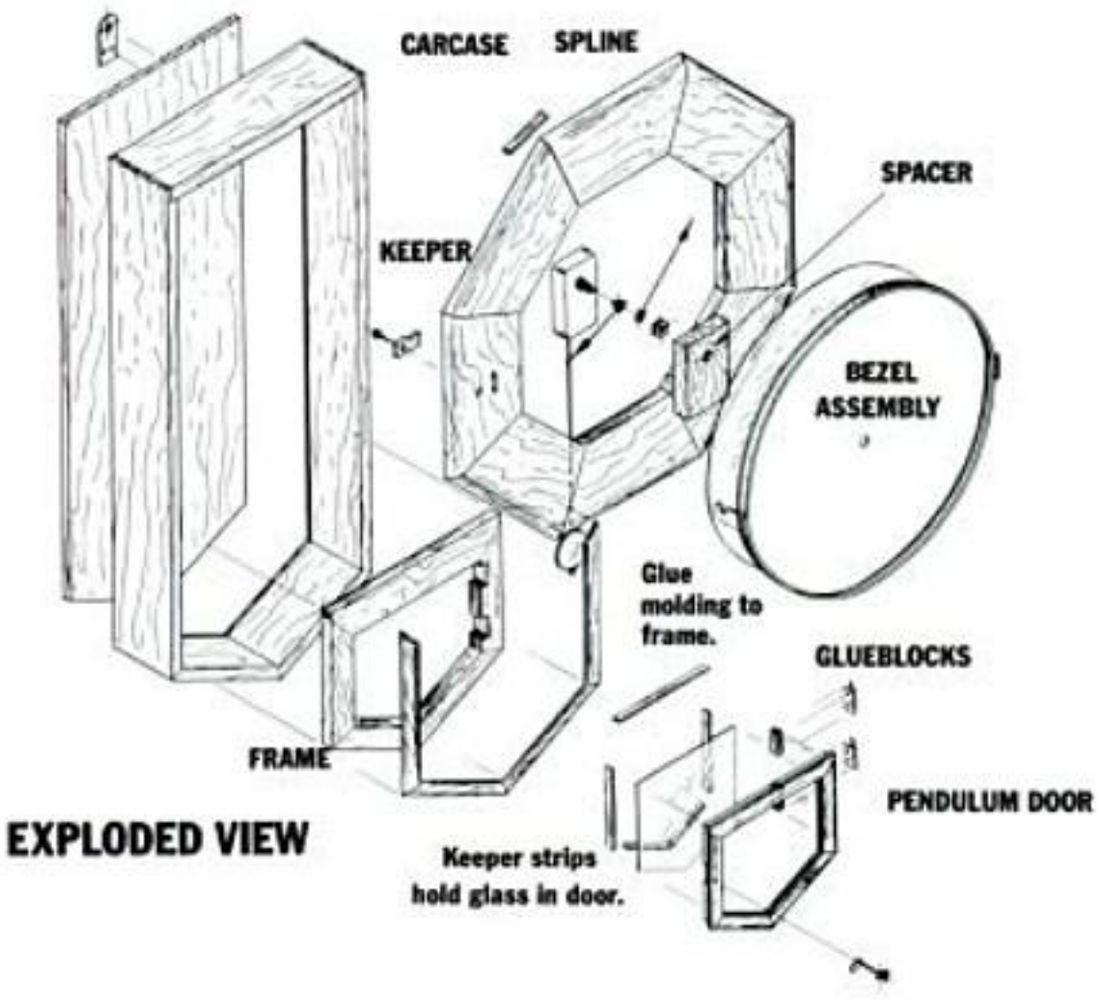
OCTAGON DETAIL



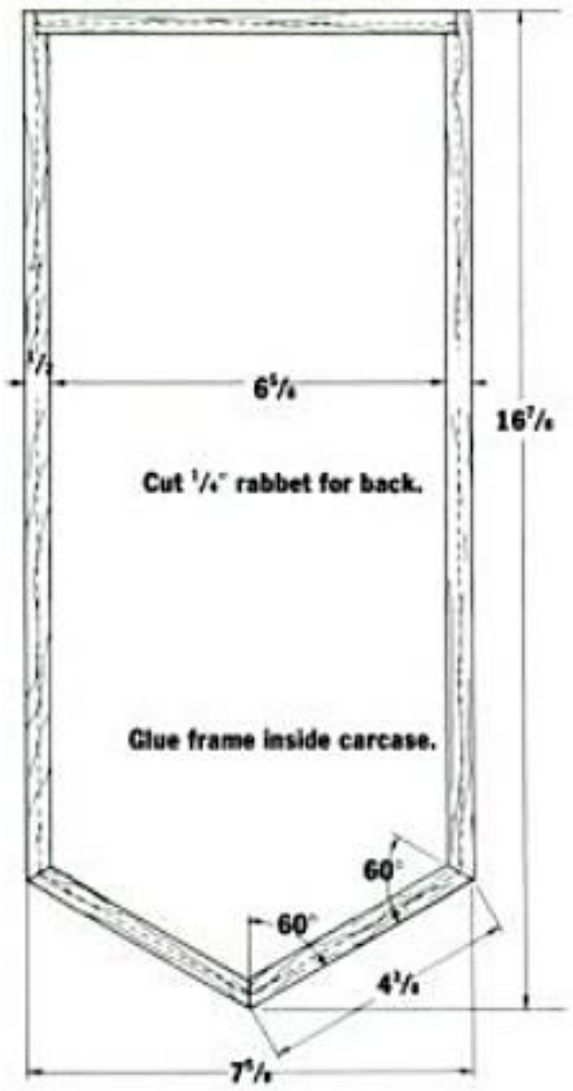
BEZEL-LATCH DETAIL

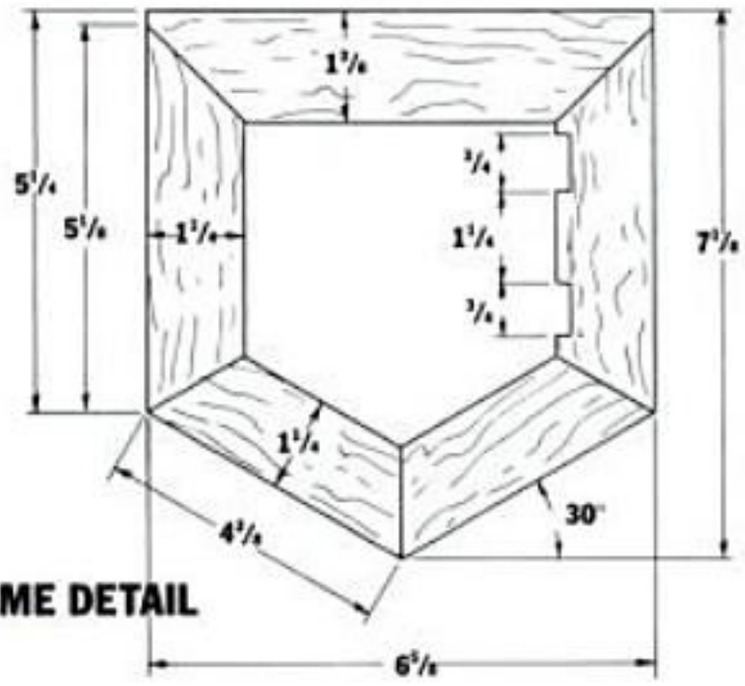


DRAWINGS BY JOHN NELSON

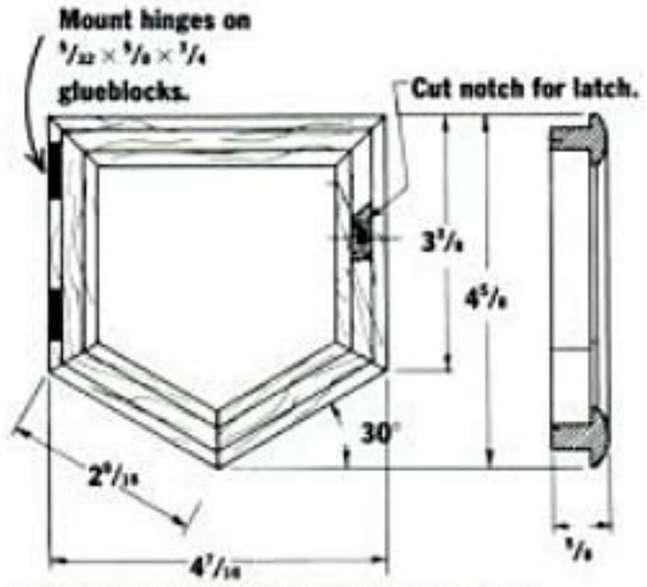


EXPLODED VIEW



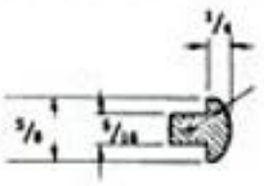


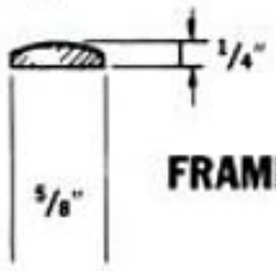
FRAME DETAIL



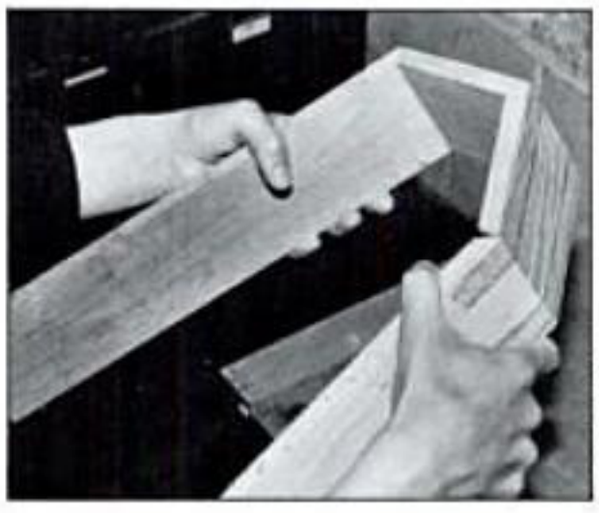
DOOR DETAIL (INSIDE VIEW)

DOOR MOLDING PROFILE





FRAME MOLDING PROFILE



PHOTOS BY JEFF DAY

Masking tape keeps mitered corners from slipping during glue-up.

large gap. A couple of tricks make life easier.

First, cut a sample octagon with your miter gauge set to 22½°. Piece it together with tape and see how it looks. Adjust your miter gauge as necessary. When you finally get a perfect sample, cut the actual pieces for the frame, and check the fit again.

If you see gaps in your dry-assembled frame, glue it up one half at a time, clamping the frame with tape and a band clamp. When the glue dries, dry fit the two halves together, and clamp them together. Put a backsaw along one of the unglued joints, as shown in the photo, and cut right along the joint down to the bench. Do the same to the joint on the opposite side of the octagon. Fit the pieces together again, and if the gaps haven't disappeared, repeat the process. When the gaps are gone, glue the two halves of the octagon together.

SOURCES

The hardware for this clock is available from S. LAROSE, INC., 234 Commerce Place, Greensboro, NC 27420.

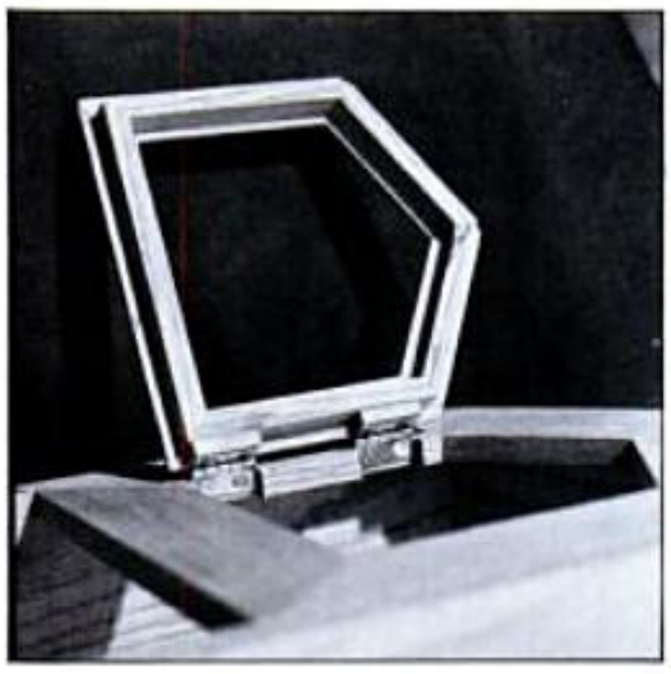
1 Bezel assembly #126-8007
1 7-in. dia. paper dial face #74-544
1 pair of hinges FL #22-86075
1 Hanger #125-8703
1 Door latch #FL 25 8717
1 "Regulator" door decal #82000
1 Quartz pendulum movement #812121(works in smaller case)

A new mechanical movement to fit the expanded case is available from Merritt's Antiques, R.D. 2, Douglassville, PA 19518. Order movement P-968-13 and P-89 hands. You will have to file the opening in the hands to make them fit. Order keyhole grommets P-90 to protect the clock face when using this movement.

The original clock has splines that reinforce each miter joint. The splines are set into slots in the back side of the octagonal frame as shown in the Octagon Detail of Fig. 1. Rout the spline slots after you've glued up the octagon.

I like to mount the bezel assembly before gluing the octagonal frame to the carcase. The bezel assembly consists of the dial plate—the metal pan that holds the paper clock face—and the bezel, which is the hinged door that covers the dial. Four #4 brass screws through the flange of the dial plate fasten the assembly to the octagon. Drill clearance holes in the dial-plate flange and pilot holes in the wood.

Once the bezel assembly is mounted, locate and cut the mortise for the bezel latch. The original latch was shaped as shown in the Latch Detail, and a little

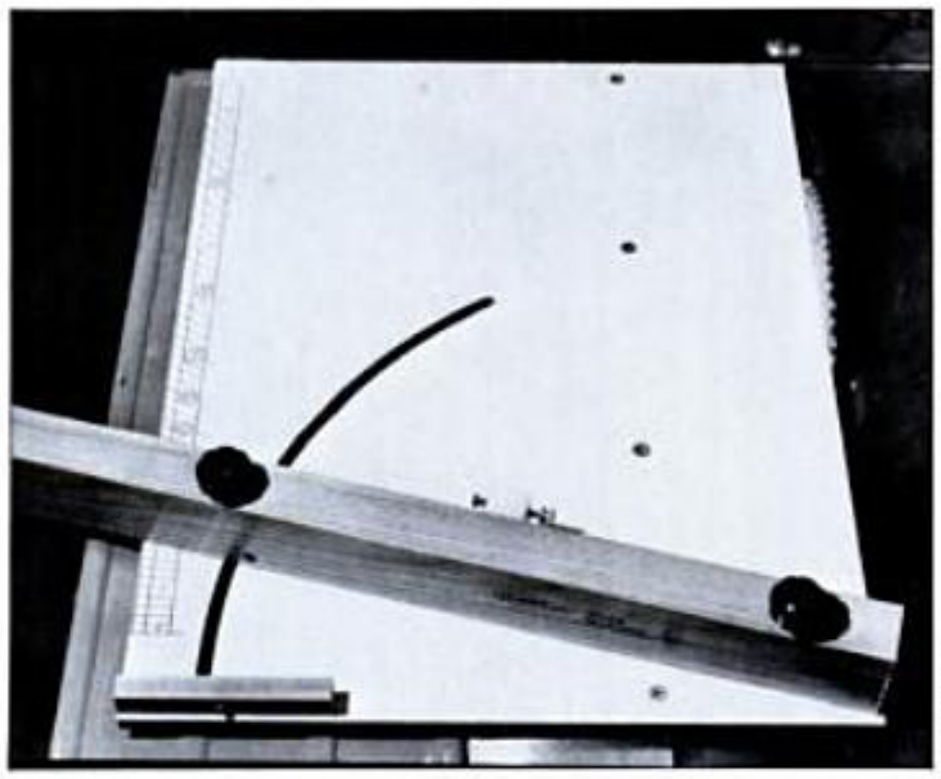


Small glueblocks in the door enable butt hinges to be used on an overlay door.

METHODS FOR MITERS

Cutting accurate miters may not be as easy as it first appears, but if you follow these few tips, it isn't very hard.

On the tablesaw, miters can be cut by changing the angle of either the saw blade or the miter gauge. Use whichever method will allow you to keep the widest part of the board in contact with the saw table. Follow the same principle when deciding how to set the angle on a radial arm saw—the widest part of the stock should rest on the saw's table.



DAVID SLOAN

"The Dubby" is a sliding cutoff box designed for cutting miters.

On a tablesaw, screw a long wooden fence to your miter-gauge head. Clamp a stop block against the fence, and snug the end of the stock against the stop to make the cut. On a radial arm saw, clamp a stop block to the saw fence. The stop block keeps the stock from slipping during the cut. Cut a miter on one end of each piece, and then reset the stop block to miter the other ends. Each piece cut against the stop block will be exactly the same length.

Set all angles with a sliding T-bevel and a protractor—the gauges on saws aren't accurate enough. Cut a sample joint, and check the angle with a square. Adjust the blade or the miter gauge accordingly.

Following the above guidelines got me about halfway through this clock. Then I discovered "The Dubby," a sliding cutoff box designed specifically for cutting miters. I tried The Dubby out on the last half of the clock, and I was impressed.

Briefly, The Dubby is a piece of plastic-coated plywood with a single, metal runner that travels in your tablesaw's miter-gauge slot. A fence pivots from 0 to 50° and locks in place for cutting angles. It also has a built-in sliding stop for setting the precise length of cut. An angle scale helps you set the fence at the correct angle. The degree marks on the angle scale are widely spaced, so it's easy to make minute adjustments.

Cutting the miters for the clock frame and the door was quick and easy on The Dubby. The angle scale gave me the exact angle I needed on the first try. The sliding stop allowed me to make an approximate setting quickly. Smaller changes were possible by turning an adjustment screw in the stop. Each turn of the screw is 1/32 in. so changes of 1/64 in. or even 1/128 in. are easy to gauge by eye.

The only weakness which I saw in the entire system was the stop against which the fence adjusts to make a perpendicular cut. The wooden fence comes to rest against a set screw, which allows you to fine-tune the cut to exactly 90°. Unfortunately the screw tends to dent the wood and throw off the setting.

I talked with Jerry Cole, president of Inline Industries, which makes The Dubby. He's aware of the problem and is working on a metal fence insert that will solve it. In the meantime, I simply drove a drywall screw into the fence. The set screw now comes to rest against the hardened head of the drywall screw, and the setting remains deadly accurate.

The Dubby comes disassembled, but setup is simple. The Dubby is available from Inline Industries, 661 S. Main St., Webster, MA 01570 for $130. Specify the make and maximum blade diameter of your saw when ordering. *—Jeff Day*

To eliminate gaps in the octagonal frame, glue up two halves of the octagon and place the halves together. Saw straight down the joint to correct gaps where the two halves join.

wooden keeper, screwed to the backside of the octagon,held the bezel closed. You turned the keeper to release the latch. The keeper and latch are a nice touch but not really necessary—the bezel door stays closed without it.

Shape the latch with tin snips, install the keeper, and then glue the octagonal frame to the carcase. Screw the carcase back in place and screw the hanger to a recess in the back of the clock as shown in the exploded view.

Now, for the last bit of woodworking. Make the frame molding, and glue it to the carcase. The molding is very thin, and it's best to shape it in much the same way you made the pendulum door stock; cut the molding on the edge of a wider board, and rip off the proper profile.

Next, install the glass in the pendulum door and bezel. Glue 1/4-in.×1/8-in. retainer strips to the pendulum door to hold the glass in place. The bezel glass is held in place by four small metal pads that come with the bezel assembly. Put the glass in the bezel, set the pads on top of the glass, and solder the pads to the bezel edge.

Installing the Movement

If you've ordered a mechanical brass movement it came from the supplier with the pendulum removed—leave it that way for now.

Lay the clock face up on the bench with the bezel assembly removed. You'll need to put a spacer between the back of the clock and the back of the movement to make the hand-shaft extend through the face of the clock. Measure carefully, and make sure the pendulum doesn't rub against the front of the case. On my clock, a 6-×6-×3/8-in. spacer was perfect. Screw the spacer to the back of the case. Put the bezel temporarily in place. Position the movement so that it is centered in the bezel. While the bezel is still on the clock, locate the holes for winding the clock. Remove the bezel to drill the holes; rubber cement the paper dial in place, and screw the movement to the spacer. Install keyhole grommets to protect the face, and screw the bezel to the case.

If you've opted to install a quartz movement, epoxy a 3/4-in. thick wooden spacer to the back of the dial face, and screw the movement to the spacer.

Adjusting Your Clock

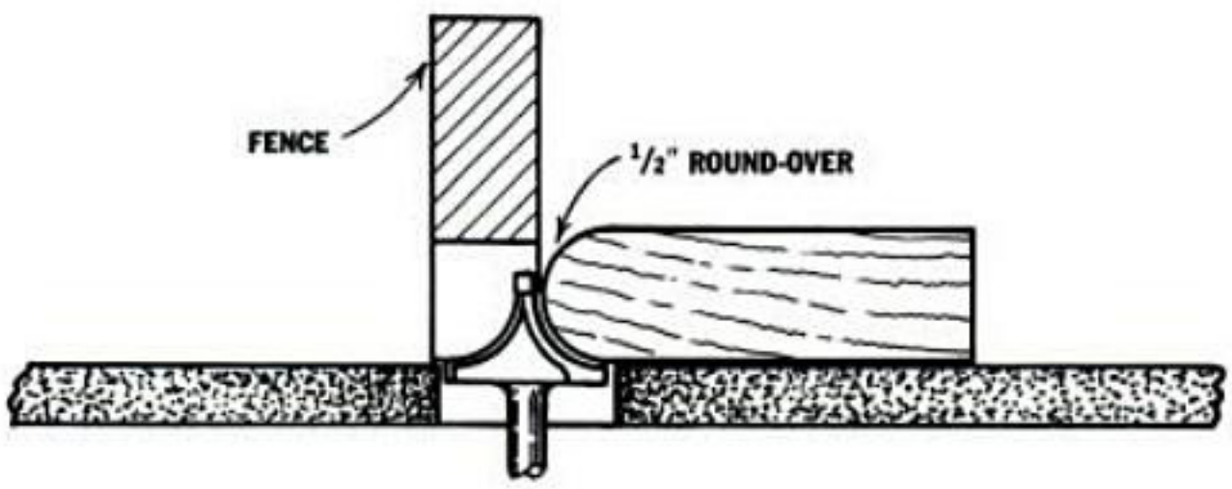
Mechanical pendulum clocks need a certain amount of coddling, which is one reason they have been largely replaced by quartz movements. A newly installed mechancial movement, in particular, needs a few minutes of attention.

Make sure the clock is plumb, and let it run for a few hours to see how well it keeps time. If it's fast or slow, make adjustments to the pendulum. A small knurled screw at the bottom of the pendulum will raise or lower the pendulum's weighted medallion. Raising or lowering the medallion, properly called the bob, adjusts the length of the pendulum and the speed at which it swings. To make the clock go faster, raise the bob; to slow it, lower the bob. In short: "Speed up, slow down."

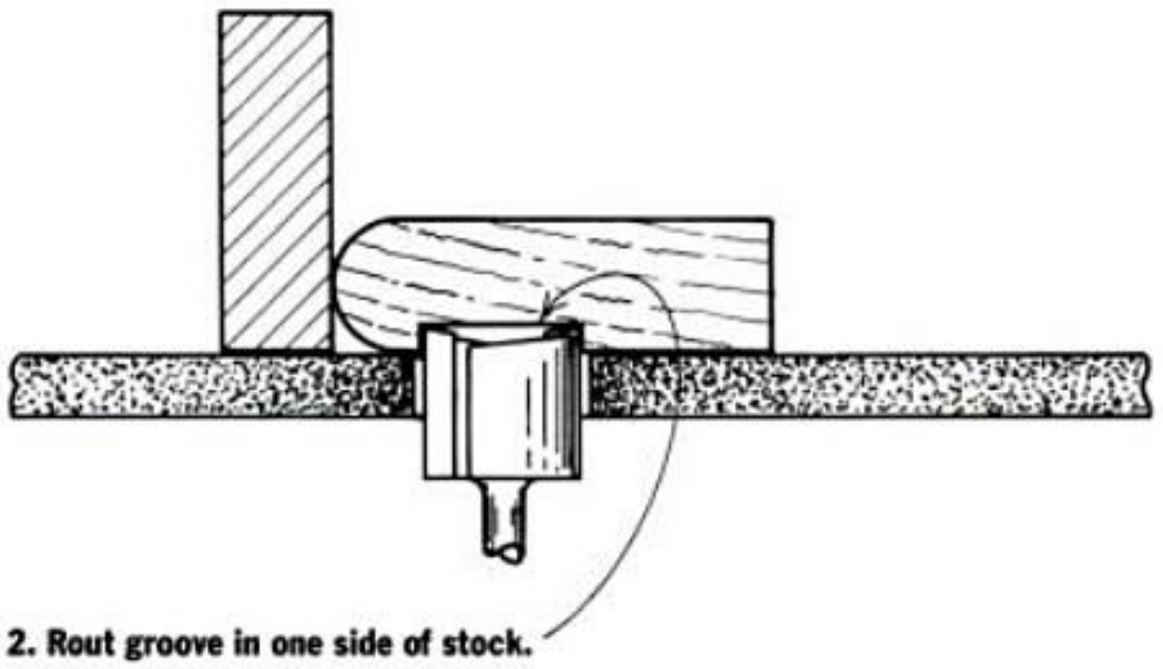
Always remove the pendulum when moving the clock. The pendulum can pop off its hanger and do untold damage to the movement and the clock case. ▲

John Nelson is a lover of clocks and a drafting instructor in Peterborough, New Hampshire.

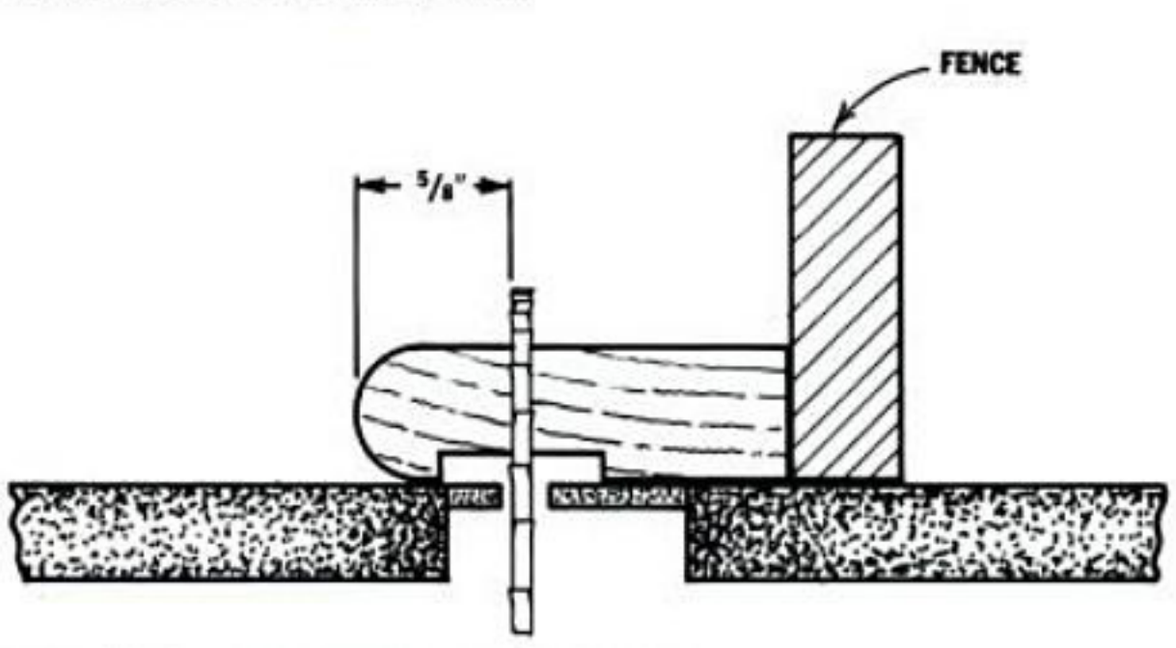
FIG. 2: MAKING THE DOOR STOCK



1. Round over stock on router table.

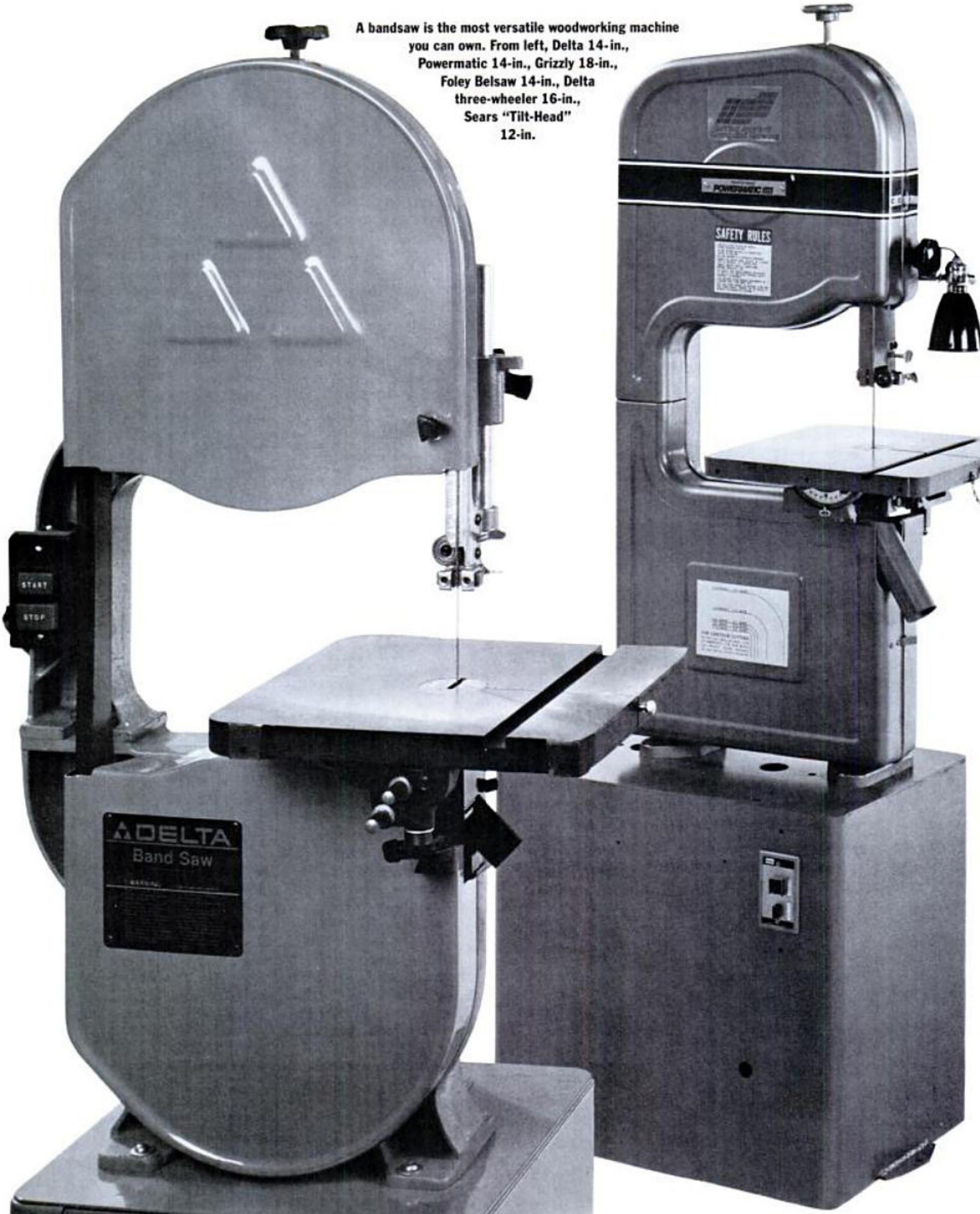


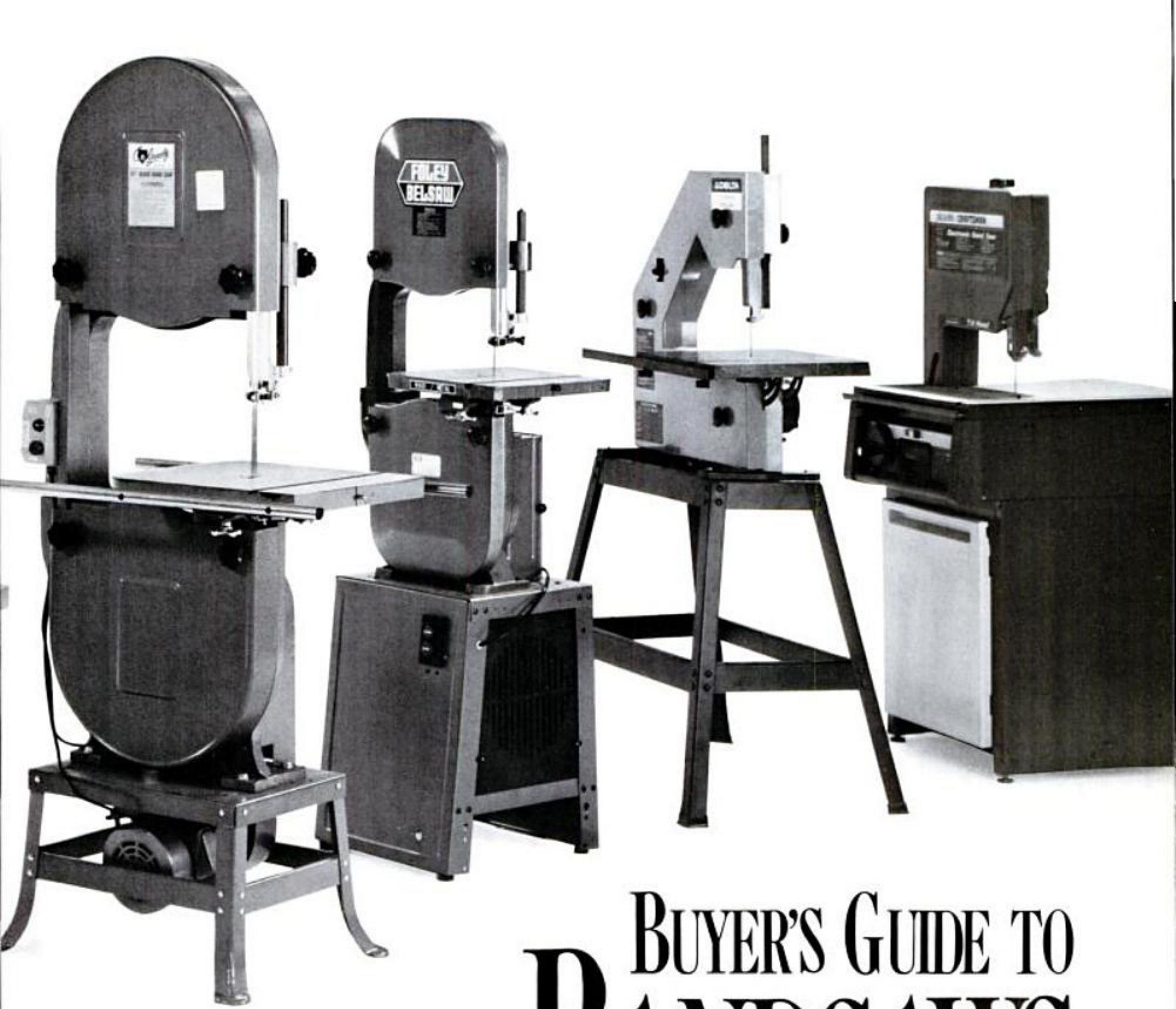
2. Rout groove in one side of stock.



3. Rip 5/8-in. wide door stock from board. Groove becomes rabbet.

A bandsaw is the most versatile woodworking machine you can own. From left, Delta 14-in., Powermatic 14-in., Grizzly 18-in., Foley Belsaw 14-in., Delta three-wheeler 16-in., Sears "Tilt-Head" 12-in.





BUYER'S GUIDE TO BANDSAWS

A Look at the Features of Mid-Size Machines

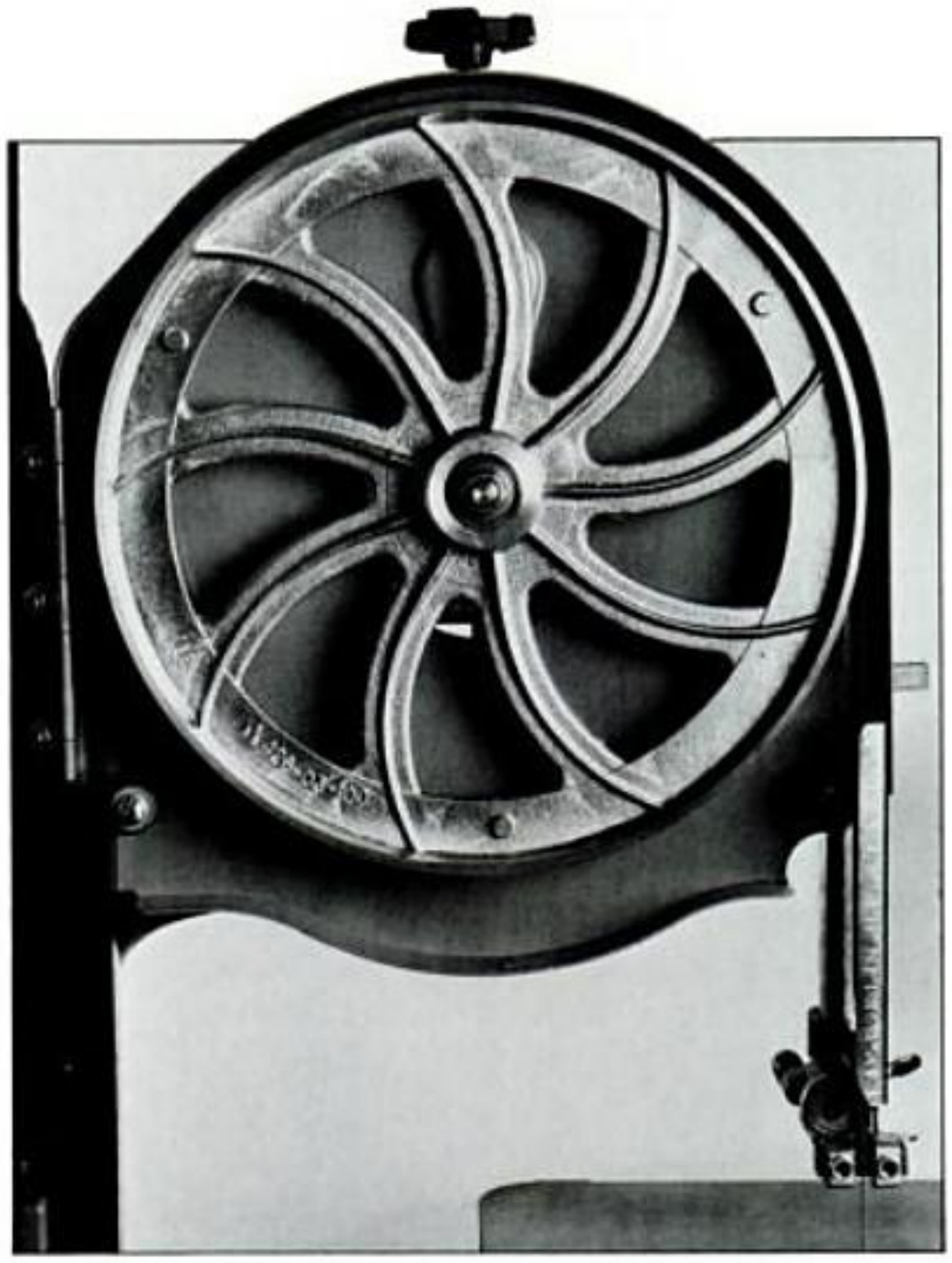
BY DAVID SELLERS

PHOTOS BY MITCH MANDEL

The bandsaw has been called the "queen of the workshop," and for good reason. It is arguably the most versatile woodworking machine you can own. The bandsaw can cut curves and irregular shapes in stock as well as make crosscuts, rip cuts, miters and bevels. And for resawing—slicing thick stock into thin boards—the bandsaw is a natural (see September/October, 1988 *AW*).

For woodworkers first setting up shop, the bandsaw often gets overlooked in the tablesaw vs. radial arm saw debate. Beginners don't always recognize the bandsaw's capabilities. Veteran woodworkers, on the other hand, have learned that bandsaws are very versatile machines. For straight cuts, a properly tuned-up bandsaw outfitted with a miter gauge or rip fence can rival a tablesaw or radial arm saw for speed and accuracy. A bandsaw is also somewhat safer to operate than either of these circular saws since the direction of blade travel makes kickback unlikely.

In this article, I'll talk about the features to consider when selecting a bandsaw in the 12-in. to 18-in. size range—the most popular size range for the serious small-shop woodworker. To get an overview of the sub-



The upper wheel tilts to adjust blade tracking and moves up and down to adjust blade tension. Wheels should be well-balanced and perfectly round.

ject, I interviewed seasoned woodworkers intimately familiar with woodworking machinery. Their collective bandsaw wisdom, included here, will help you choose the right machine for your shop.

The bandsaw is a simple, straightforward machine. Its endless loop, steel blade rides over two large wheels (three wheels on some models) that are rimmed with thin rubber tires. The fixed-axle bottom wheel is powered by a motor, while the adjustable upper wheel tilts to allow blade-tracking adjustment and moves up and down to adjust blade tension. On many saws, a tension gauge indicates the correct tension for different width blades. (Many woodworkers consider bandsaw tension gauges to be inaccurate. Savvy bandsaw users often tension their blade by sound—plucking it like a guitar string—or by a seat-of-the-pants sense of what works best, developed from years of trial and error.)

The blade passes through the worktable where the cutting takes place. Blade-guides above and below the table support and stabilize the blade to ensure straight and true cuts. A heavy-duty metal frame holds all the parts together in the proper relationship.

All bandsaws share these basic features, but it's the execution of the details, the quality of the fit and finish that makes some saws cost more than others. An expensive, top-of-the-line bandsaw is a pleasure to use—like driving a luxury car. But let's face it, most of us have a budget to consider. The trick is finding a bandsaw that adequately meets your needs at a price your budget can handle.

Choosing the right size bandsaw for your shop is the first and most important consideration.

The size designation 12-in., 14-in. or 18-in. refers to a bandsaw's *throat capacity*, the horizontal distance

BANDSAW

Manufacturer	Model #	List Price	Throat Capacity	Cutting Depth
AMT	4113	$299 (1,7)	14"	6"
DELTA INTERNATIONAL	28-283	$875 (1)	14"	6"
	28-245	$702 (1)	14"	6"
	28-560	$483 (1, 3)	16"	6"
ELECTRA BECKUM	BAS-450	$1535 (1)	18"	12"
EMCO	BS-3	$445 (2)	15"	6 3/4"
FOLEY BELSAW	482	$399 (1)	14"	6"
GENERAL	490-1	$899 (1)	14 3/4"	6 3/4"
GRIZZLY IMPORTS, INC.	G-1019	$295 (1)	14"	6"
	G-1538	$495 (1)	15 7/8"	10 1/2"
	G-1012	$625 (1)	18"	9 1/2"
HITACHI	CB 75F (4)	$3070	14 1/2"	11 5/16"
INCA	340	$795 (2)	10 1/2"	6 1/4"
JET	JBS-14MW	$482 (1)	14"	6"
	JBS-18	$991.25 (1)	17 1/2"	12"
KITY	613	$795 (2)	12"	8"
LOBO	BS0163	$505 (1)	16"	11 1/2"
	BS0183	$695 (1)	17 3/4"	11 1/2"
MAKITA	2114-C (4)	$1451 (2)	14"	7 1/8"
NORTH STATE	JBS-14	$350 (1)	14"	6 3/4"
	JBS-18	$795 (1)	18"	12"
POWERMATIC	141	$1412 (1)	14"	6 1/2"
RYOBI	BS 50N (4)	$1475	9 1/4"	7"
	BS 360 NR (4)	$2475	12 1/2"	12 5/16"
SEARS	24721 (8)	$289.87 (1)	12"	6"
	24741 (8,9)	$429.87 (1)	12"	6"
	24392	$999.99	14 3/4"	8 1/4"
SHOPSMITH	505641	$399 (7)	11"	6"
SUNHILL	VBS-14	$499 (1)	13 5/8"	6"
	VBS-18	$1035 (1)	17 1/2"	12"
TOTAL SHOP	PN 919	$359 (1)	14"	5 1/2"
	PN 958	$695 (1)	16"	10"
	PN 959	$975 (1)	18"	10"
TRANSPOWER	SB-500	$295 (1)	14"	6"
	SB-700	$795 (1)	18"	8"
VEGA	401	$995 (1)	13 5/8"	8"
WILKE MACHINERY CO. (BRIDGEWOOD)	BW-14BS	$299 (1)	13 5/8"	6"
	BWPBS-500	$1495 (1)	18 1/2"	12 1/2"

SPECIFICATIONS

Material: Frame	Material: Table	Material: Wheels	Table Size & Tilt°	Blade Widths	Blade Speed(s)	Rated H.P.	Motor Volts & Amps	Accessories
I	I	A	14"×14" R 45°, L 10°	1/4" to 1/2"	1	1	115 V, 15A	a, b, c, e
I	I	A	14"×14" R 45°, L 10°	1/8" to 3/4"	1	3/4	115V, 11.4A (5)	a, b, c, d, f, i
I	I	A	14"×14" R 45°, L 10°	1/8" to 3/4"	1	1/2	115V, 9.8A	a, b, c, d, f, i
I	I	A	16"×16" R 45°, L 3°	1/8" to 3/4"	2	1/2	115V, 7.5A	A, B
S	A	A	21 3/4"×19 1/4" R 45°	3/16" to 1"	4	1 1/2	220V, 5.1A	A, b, f, g
S	S	P	16"×18" R 45°	1/8" to 9/16"	3	2/3	115V, N/A	A, b, f, g
I	I	A	14 3/4"×14 1/4" R 45°, L 10°	1/8" to 3/4"	3	3/4	110V, 12A	A, c
I	I	I	15"×15" R 45°, L 10°	5/16" to 3/4"	1	1/2 (6)	115V, 7A (5)	a, b, d
I	I	A	14 1/2"×14 1/2" R 45°, L 10°	1/8" to 3/4"	1	3/4	110V, 12A	B, c, i
I	I	A	16"×16" R 45°, L 5°	1/8" to 1"	3	1 1/2	110V, 16A (5)	A, B, H, i
I	I	A	18"×18" R 45°, L 10°	1/8" to 1 1/2"	3	2	220V, 10A	A, B, H, i
S	I	I	20 33/32"×19 9/32" R 45°	1/4" to 3" (10)	1	N/A	115V, 15A	a, b, j
A	A	A	12 1/2"×12 1/2" R 45°	1/16" to 1/2"	1	3/4	110V, 8A	A, b, e, f, g
I	I	A	14"×14" R 45°, L 10°	1/8" to 3/4"	3	1	115V, 10A (5)	a, B, c
I	I	A	18"×18" R 45°, L 10°	1/8" to 1"	1	2	115V, 24A (5)	a, B
S	A	A	20"×20" R 45°	1/8" to 1"	1	1	110V, 11.6A	A, b, e
I	I	A	16"×16" R 45°	1/8" to 1"	3	1 1/2	110V, 16A	A, B, H
I	I	A	18"×18" R 45°, L 10°	1/8" to 1"	3	2	110V, 24A (5)	A, B, H
I	I	A	14"×14" R 45°, L 10°	1/4" to 1"	3	N/A	115V, 12A	A, B
I	I	A	14"×14" R 45°, L 10°	1/8" to 3/4"	3	1	110V, 5A (5)	B
I	I	A	18"×18" R 45°, L 10°	1/8" to 1 3/4"	1	2	110V, 24A (5)	A, B
I	I	I	15"×15" R 45°, L 15°	1/8" to 3/4"	1	3/4 (6)	15V, 14A (5)	a, b, D, f, h
S	S	I	15 1/4"×15 1/4" No tilt	3/4" to 2"	1	N/A	120V, 15A	A
S	I	I	18 1/2"×17 3/4" R 45°	3/4" to 3"	1	N/A	120V, 15A	A
A	A	A	18"×23" Frame tilts L 45°	1/16" to 1/2"	1	1/2	120V, N/A	a, b, D, f
A	A	A	23"×27" Frame tilts L 45°	1/16" to 1/2"	2	5/8	120V, 7.9A	a, b, D, f
S	I	A	15"×15" R 45°	5/16" to 1"	4	1	120V, N/A	A, B
A	I	A	11 3/4"×12"	1/4" to 5/8"	2	1/2	115V, N/A	b Note: Can be attached to Shopsmith Mark V
I	I	A	14 1/4"×14 1/4" R 45°, L 15°	3/16" to 3/4"	1	1	110V, 16A	B, c
I	I	A	20"×16" R 45°, L 15°	1/8" to 1 1/4"	1	2	110V, 24A (5)	A, B
I	I	A	14"×14" R 45°	3/16" to 3/4"	1	3/4	110V, N/A	B
I	I	A	16"×16" R 45°	1/8" to 1"	3	1	110V, N/A	A,B
I	I	A	18"×18" R 45°	1/8" to 1 1/2"	3	1 1/2	220V, N/A	A, B
I	I	A	14"×14" R 45°	1/8" to 1/2"	3	1	110V, 12A (5)	B
I	I	A	18"×18" R 45°	3/4" to 1 1/2"	3	2	110V, 20A (5)	A, B
S	S	A	14"×14" R 45°, L 10°	1/4" to 3/4"	1	1 (6)	110V, N/A (5)	A, B
I	I	A	14"×14" R 45°, L 10°	3/16" to 5/8"	1	3/4	110V, N/A (5)	a, B, c
S	I	A	20 1/2"×26 3/4" L 45°	3/4" to 1 1/2"	1	2 (6)	220V, 12A	A

SOURCES

AMT (American Machine & Tool)
Fourth Ave. &
Spring St.
Royersford, PA 19468

Delta International Machinery Corp.
246 Alpha Dr.
Pittsburgh, PA 15238

Electra Beckum USA
P.O. Box 10
Somerdale, NJ 08083

Emco-Maier
2757 Scioto Parkway
Columbus, OH 43026

Foley Belsaw
3300 NE 5th St.
Minneapolis, MN
55418

General Manufacturing Co.
835 Cherrier St.
Drummondville,
Quebec
Canada J2B-5A8

Grizzly Imports Inc.
P.O. Box 2069
Bellingham, WA 98227

Hitachi Power Tools USA Ltd.
4487 E. Park Ave.
Norcross, GA 30093

Inca
Garrett Wade
161 Avenue of the
Americas
New York, NY 10013

Jet Equipment & Tools
1901 Jefferson Ave.
Tacoma, WA 98402

Kity
Farris Machinery
320 N. 11th St.
Blue Springs, MO
64015

Lobo Power Tools
9034 Bermudez St.
Pico River, CA 90660

Makita
14930-C Northham St.
La Mirada, CA 90638

North State
Leneve Machinery
Supply Co.
305 W. Morehead St.
Charlotte, NC 28202

Powermatic
Morrison Rd.
McMinnville, TN 37110

Ryobi
1433 Hamilton
Parkway
Itasca, IL 60143

Sears Roebuck & Co.
Dept. 609, 16th Floor
Sears Tower
Chicago, IL 60684

Shopsmith
3931 Image
Dayton, OH 45414

Sunhill-Nic
1000 Andover Park
East
Seattle, WA 98188

Total Shop
P.O. Box 25429
Greenville, SC 29616

Transpower
322 Paseo Sonrisa
Walnut, CA 91789

Vega Enterprise Inc.
RR 3, Box 193
Decatur, IL 62526

Wilke Machinery
3230 Susquehanna
Trail
York, PA 17402

KEY TO FEATURE CODES

(1) Price includes stand
(2) Stand not included in price
(3) Three-wheeled bandsaw
(4) Designed for resawing
(5) Motor can be wired for 220V
(6) Other motors available
(7) Motor not included in price
(8) Frame tilts instead of table
(9) With electronic digital readout
(10) Optional blade-guides necessary for narrow blades

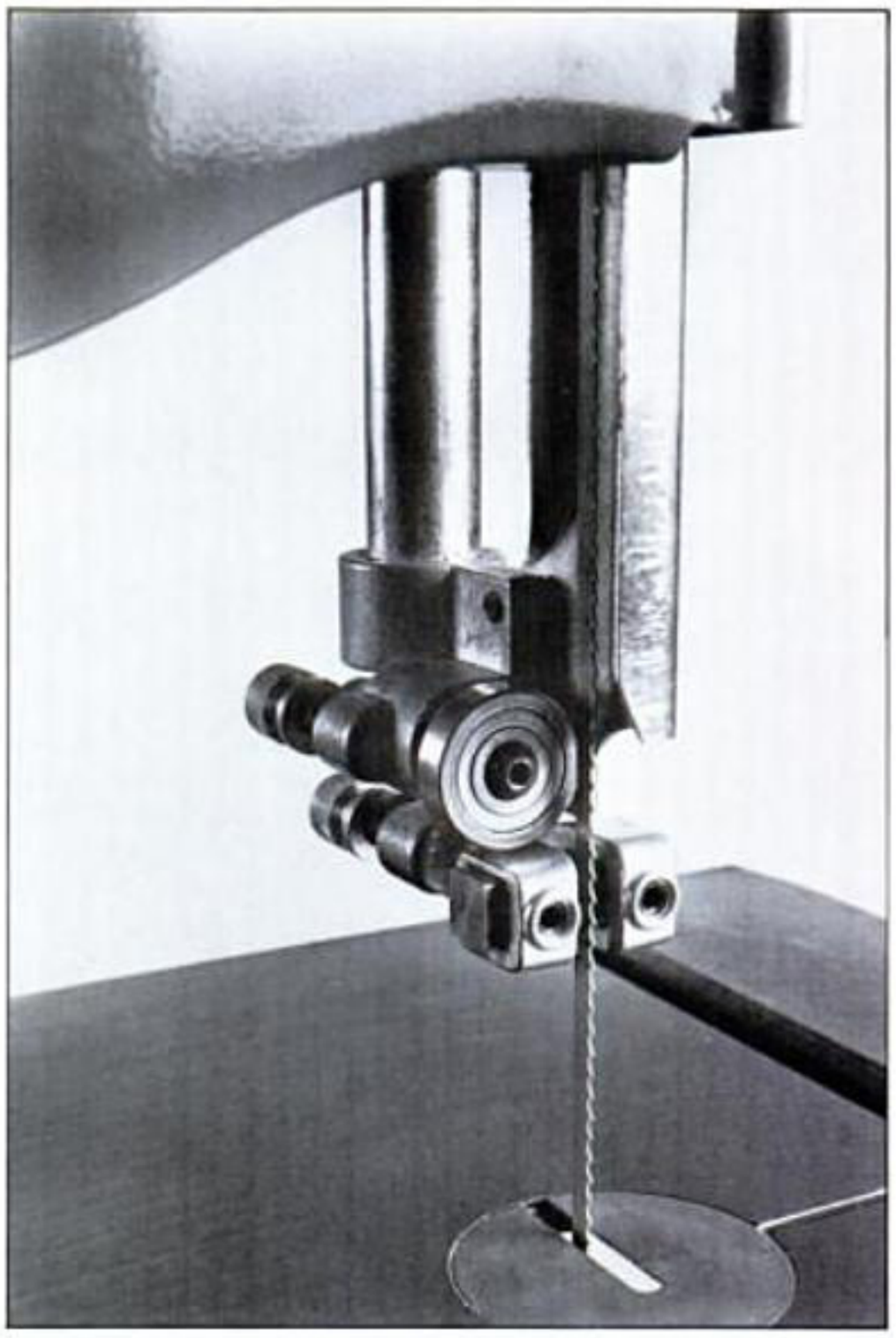
KEY TO MATERIAL CODES

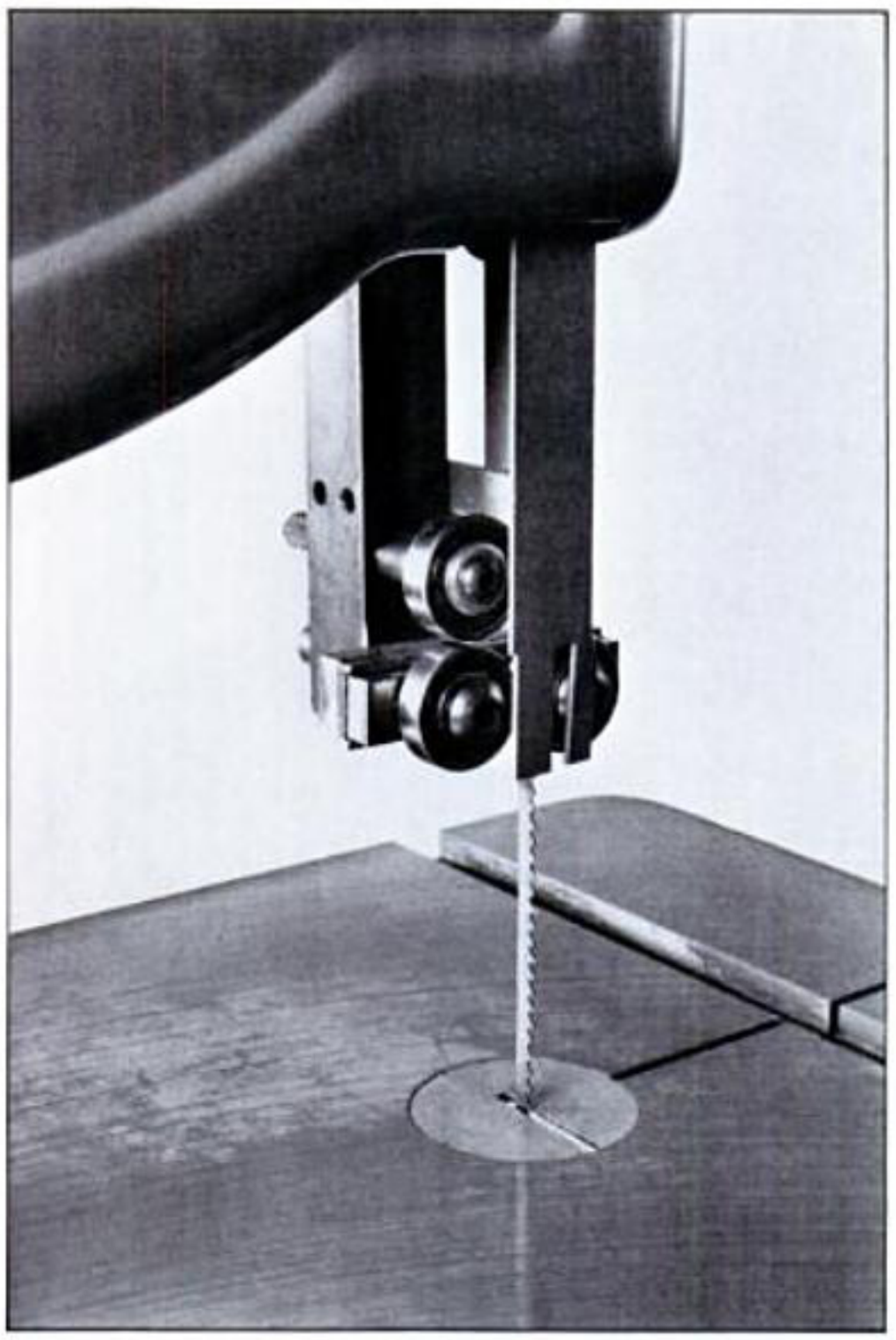
I = Cast iron
S = Fabricated steel
A = Cast aluminum
P = Plastic

KEY TO ACCESSORIES CODES

Upper case letter = Equipment included in price
Lower case letter = Available at extra cost

A Rip fence
B Miter gauge
C Height-extension kit
D Work lamp
E Table extension
F Circle-cutting attachment
G Belt-sanding attachment
H Magnetic switch
I Mobile base
J Optional blade-guides





Bandsaw guides support the blade during the cut. Three different approaches to upper guide design are shown here. The Delta 14-in. guide (left) and Sears 12-in. guide (right) use rub blocks to keep the blade from twisting, and a thrust bearing supports the blade from behind. The Powermatic 14-in. guide (center) features bearings instead of rub blocks.

from the blade to the frame (the part of the frame opposite the blade is sometimes called the column). This is the maximum width of stock that can be cut. The *cutting depth* is the vertical distance from the worktable to the upper guide when fully raised and represents the maximum stock thickness a saw can cut.

You can handle light-duty jobs such as scrollwork on a 10-in. or 11-in. bandsaw or even a smaller benchtop model. On the other hand, a small lightweight bandsaw won't have the power or depth-of-cut you'll need for resawing thick hardwood or sawing bowl blanks from a log.

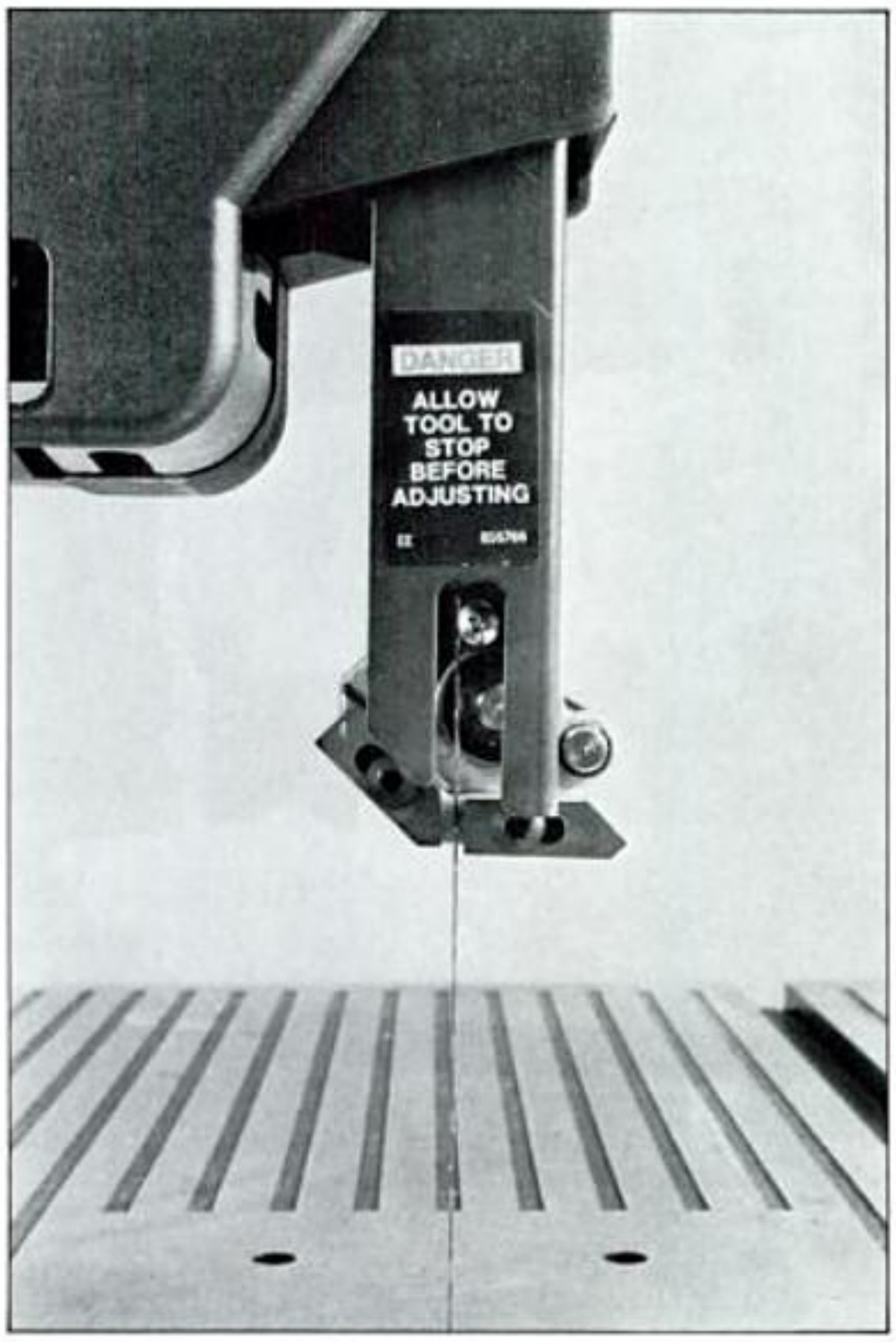
For light- to medium-duty work and the occasional resawing job, a 12-in. bandsaw may be all the saw you'll ever need. Although a 12-in. saw lacks the horsepower, throat capacity and depth-of-cut of the larger, beefier bandsaws, it's more than adequate for most jobs in the average small shop. Most 12-in. bandsaws have a 6-in. cutting depth and can handle blades from $\frac{1}{8}$ in. to $\frac{1}{2}$ in. wide. A 12-in. bandsaw will do everything a larger saw can do—even resawing—just on a smaller scale and a little bit slower.

For all-around general use, a 14-in. bandsaw is a popular and practical size in many home and professional shops. The 14-in. throat capacity and 6-in. cutting depth can handle nearly every job likely to come up in the average shop. Most 14-in. bandsaws can handle blades from $\frac{1}{8}$ in. wide up to $\frac{3}{4}$ in. wide. If extra cutting depth is what you need, some 14-in. bandsaws can be fitted with a height-extension kit that extends the frame and spaces the wheels further apart to obtain a cutting depth of about 12 in. (see chart).

If sawing thick hardwoods is the primary job you intend to do, consider a 16-in. or 18-in. bandsaw. These saws have sturdier frames and greater cutting depths than the smaller bandsaws and can handle wider blades—up to $1\frac{1}{2}$ in. wide on some 18-in. models. They also have more powerful motors than the smaller machines for continuous, heavy-duty use.

To get more throat capacity without going to a heavier, more expensive machine, consider a three-wheeled bandsaw. Three-wheelers, as their name suggests, have three wheels mounted on a triangular frame. This configuration affords more horizontal space for wider stock, without much increase in size or bulk. In general, though, three-wheelers are less rigid than two-wheel designs. Also, since the wheels are smaller in diameter, the blade must bend around a tighter arc. This increases metal fatigue and shortens blade-service life.

If your primary need is for a heavy-duty resaw, consider one of the specialty bandsaws designed specifically for resawing (see sidebar). These saws can handle blades up to 2 in. or 3 in. wide, for fast, straight cuts in thick hardwood.



Once you've decided the size you need, it's time to take a closer look at the details.

The frame is the backbone of a bandsaw. It must be rigid to resist the bending force of a highly tensioned blade. Even a tiny amount of frame deflection can throw off proper blade tracking on the wheels, which results in a poor cut.

Bandsaw frames are made of cast iron, cast aluminum or fabricated from welded steel. Given a choice, go with cast iron, however you won't find cast-iron frames on the smaller machines. The bottom line is, the rigidity and alignment of the frame are more important than the frame material.

The frame is usually bolted to a supporting stand which can be an open or closed design. Look for a heavy, rigid stand to minimize vibration. You might also want to consider designing and building your own wooden stand.

The best bandsaw wheels are also made of cast iron. The extra weight increases momentum and dampens vibration. Cast-aluminum wheels also work well if they're massive enough. Look for a slightly crowned profile on the rubber tires. It helps the blade track neatly in the center.

The wheels should be balanced and perfectly round, but aren't always delivered that way. Out-of-round wheels cause blade tension to vary slightly with each revolution—a cause of unwanted vibration and rough cuts. Wheel balance is tough to check for because a tight bearing could throw off a simple spin test (spinning the wheel by hand to see if a heavy spot consistently stops at the bottom). You can check for roundness by holding any convenient object (a screwdriver for example) against the frame as a reference point as you spin the wheel by hand (without a blade). You could also measure the runout with a dial indicator, if you have one.

Blade-guide designs vary a lot from one brand of bandsaw to the next. The most common design consists of a pair of guide blocks that prevent sideways movement and twisting of the blade, and a thrust bearing behind the blade to prevent backward movement from the pressure of feeding stock into the blade. Guides on the most expensive saws have bearings on either side of the blade instead of guide blocks.

The upper guide assembly is attached to a vertical post that adjusts up and down in the frame to accommodate stock of different thickness. The lower guide assembly is fixed in position under the worktable. The guide blocks and thrust bearing on each assembly must be carefully adjusted (after blade tracking and tensioning), so they don't quite touch the blade when it's free running, but allow no deflection or twist when it's cutting.

The upper guide post should slide up and down smoothly and lock positively. On some bargain-priced bandsaws, the post may fit sloppily in the frame so that the upper guide can twist or move in relation to the blade. This means you need to readjust the guide each time you reposition the guide post. On the most expensive saws the guide post is square or hexagonal in cross section, so it can't twist as it's moved and always locks in the same position relative to the blade. Look for lower guide blocks that fit as closely as possible to the underside of the table, because they will support the blade closer to the cut, where it counts. Better engineering is required to get the blocks close, so it's a sign of a superior saw.

Look for a smoothly machined table surface, and check the table with a straightedge laid corner to corner to ensure it's flat. For bevel cuts, the table tilts on curved brackets called trunnions (except for Sears 12-in. "Tilt Head" saw). Make sure the trunnion locking knobs hold the table securely at any angle and the small throat-plate insert fits flush in the table. You'll find cast-iron tables on the most expensive bandsaws.

For light-duty work, a ½-HP motor is adequate on smaller bandsaws. For heavy cutting on a 14-in. bandsaw, however, the motor should be at least ¾ HP, according to most of the experts I talked to. You might get by with ½ HP, but you'll have to go slow and easy when cutting thick hardwood. For frequent resawing on thick stock, you'll want a 1-HP motor or larger.

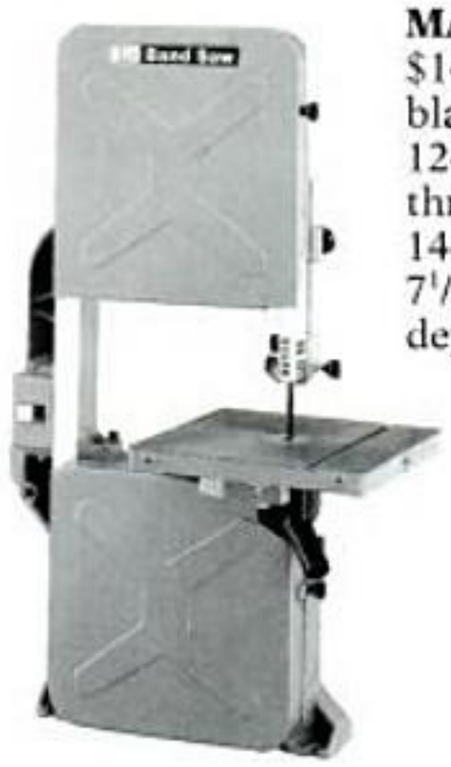
It's easy to get confused by horsepower ratings, because some makers quote a *peak* rating instead of a more conservative *continuous* rating. The peak rating is misleading, because it represents a momentary high output that a motor cannot sustain without burning up. The best way to judge motor power is to compare the amperage rating on the motor plate, or from a catalog specification. At 110-120 volts AC, a ¾-HP motor will draw about ten to 12 amps on continuous load.

Some bandsaws allow you to adjust blade speeds, an asset if you want the maximum in versatility. The blade speed for a typical wood-cutting bandsaw is about 3000 feet per minute. Slower speeds are handy for cutting metal and other non-wood materials. Adjustable-speed bandsaws are sometimes referred to as "wood and metal cutting" bandsaws. But you can al-

RESAW BANDSAWS

If resawing thick hardwoods is your primary need, consider one of these specialty bandsaws made for resawing. They feature low tables, powerful motors, and extra-wide blades.

RYOBI BS-360NR $2500.00: 3-in. blade; 120-volt/14-amp motor; 13-in. throat; 12¼-in. cutting depth.



MAKITA 2114-C $1451.00: 1-in. blade; 115 volt/12-amp motor; three speeds; 14-in. throat; 7⅛-in. cutting depth.

RYOBI BS 50N $1475.00: Blade widths, ¼ to 2 in.; 120-volt/12-amp motor; 9¼-in. throat; 7-in. cutting depth.

HITACHI CB75F $2896.00: Blade widths, ¼ to 3 in. (optional guides required for blades less than 3 in.); 115-volt/15 amp motor; 14½-in. throat; 11 13/16-in. cutting depth.

ways convert a single-speed saw to a multi-speed saw by swapping the existing drive pulley for a step pulley.

Power switches should be mounted within easy reach. Larger saws may have a magnetic switch which automatically resets itself to "off" if there is a power shutoff or a motor overload. This is a good safety feature, because it prevents the motor from starting up unexpectedly when the power comes back on.

Accessories increase the versatility of a bandsaw. Miter gauges, rip fences, and height-extension kits can be worthwhile additions but vary widely in quality. Two accessories appreciated by most pros are an adjustable work lamp and a dust-collection hookup.

Serviceability is very important. Look for a manufacturer with a reputation for *long-term* service. With reasonable care, a bandsaw can have a useful life of 20 to 40 or more years. If replacement parts aren't available, a broken bandsaw can't be fixed without an expensive trip to a machine shop for a custom-made part. This is a perpetual problem with older Sears equipment because Sears does not stock replacement parts for its older machines.

Cutting success on a bandsaw depends more on keeping it in tune than perhaps any other woodworking machine. Owning a quality machine makes life easier, because you don't have to spend as much time fussing with adjustments. To this end, look for obvious characteristics of quality: heavy frame, round, balanced wheels, flat table and smoothness and convenience of adjustments. Focus your attention on power and balance rather than on brute size (unless you really need the capacity of a larger saw). Buy the most powerful motor you can afford, consistant with the size of the saw and the expected workload.

"You get what you pay for" appears to apply to bandsaws as much as anything. The bottom line, however, is that any bandsaw can be made to work adequately with enough tuning. If you're on a tight budget, but have good machinery skills, buying a cheaper machine and "remanufacturing" it can be a valid approach. Most times even a crudely made bandsaw can be made to run well with extensive filing, reaming, shimming and other machinist's tricks. ▲

David Sellers is a woodworker and technical writer in Emmaus, Pennsylvania.

BY JOHN A. NELSON

New England Pipe Box

It's Not Just for Smokers Anymore

DEBORAH PORTER

The original pipe box dates back to 1750 and is on display at Strawberry Banke Museum in Portsmouth, New Hampshire.

MITCH MANDEL

Pipe boxes were popular in the late 1700s for storing tobacco and long-stem pipes.

Back in the early days of this country—before the surgeon general raised a cry over tobacco's ill effects on the lungs—pipe smoking was a popular custom. In fact, the habit gained in popularity until the late 1700s. With it, a need arose for a special place to store the long-stem clay pipes that were the fashion of the times—and so, the pipe box was born. Pipe boxes flourished from 1745 to around 1790, and although many were made during this time, the few that remain are mostly found in museums.

It's unlikely that any two pipe boxes were the same. They ranged from stocky, crude boxes to delicate, beautiful containers. The basic design had an open top compartment to hold the pipes and a small drawer below to store tobacco. Cherry, maple, mahogany and walnut were common choices for material, with an occasional box in pine—a likely choice for the more basic models. Today, though pipe smoking isn't the rage, the pipe box is an ideal candidate for a multitude of household uses. It could be a place to store envelopes and stamps or candles and matches (for that occasional blackout). Why, you could even track down some of the long-stem pipes of yore and have a little museum of your own.

The particular pipe box I chose to duplicate dates to around 1750 and comes from the Massachusetts South Shore. The original was made of pine and painted dark green. It belongs to the Phyllis Randall Collection and is on loan to Strawberry Banke Museum in Portsmouth, New Hampshire.

Building the Pipe Box

Start by milling all pieces to the sizes given in the Bill of Materials. Though most of the pieces in the original pipe box were $^{11}/_{32}$ in. thick (a rather unusual size), $^{3}/_{8}$ in. will do just fine.

Lay out the scroll work on the upper edge of the box on a $^{1}/_{2}$-in grid. Carefully transfer the shape of the backboard, the sides and the frontboard point by point to the grid. Transfer the shapes from your grid onto your dimensioned stock. On some of the tighter curves, it's easier to drill them out than to cut them on the saw. I have indicated these holes on the drawing.

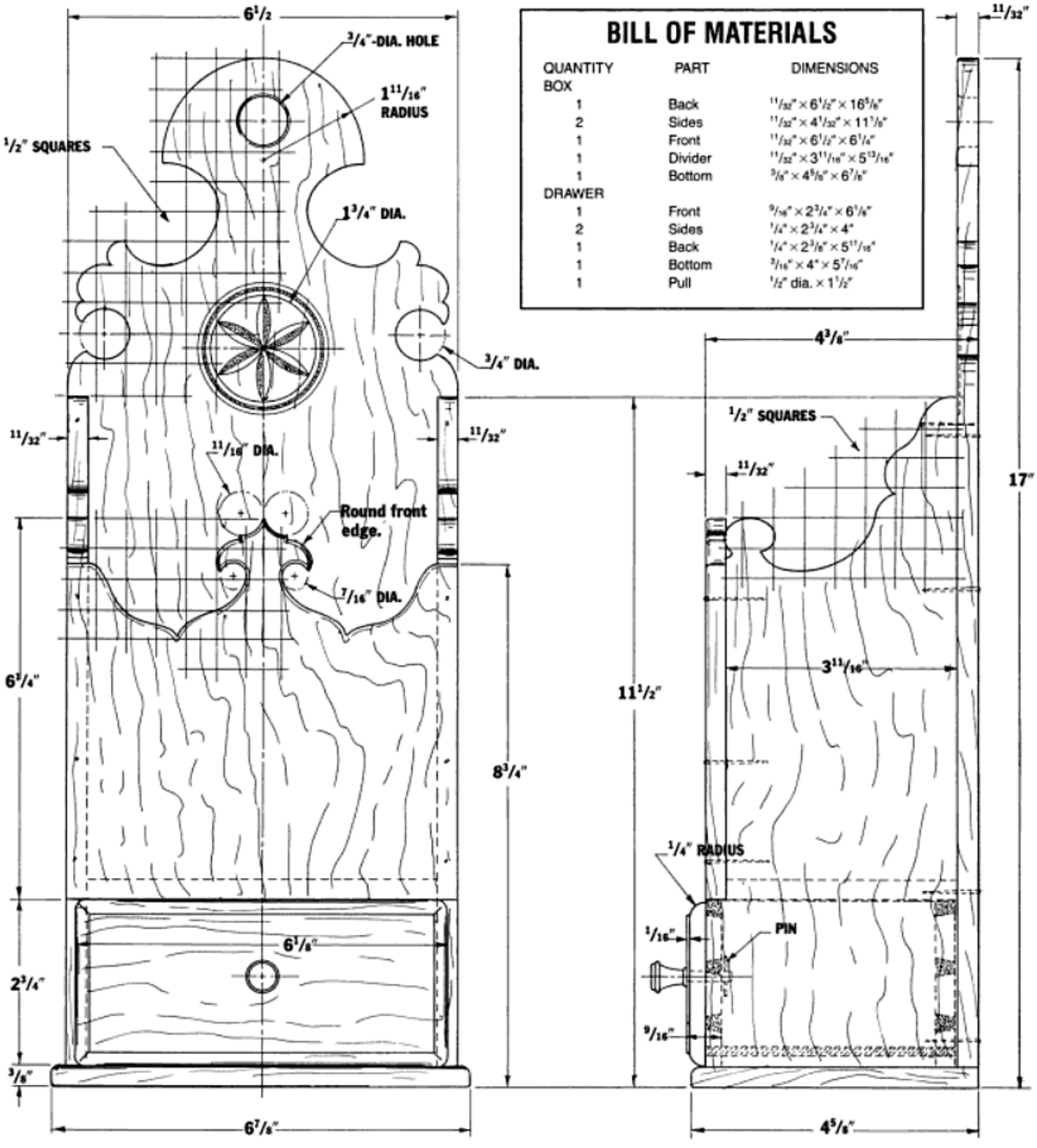
Cut out the parts, and sand all edges except those that will be glued together. It's a good idea to cut out and sand the two side boards simultaneously so that both sides will be identical.

The original pipe box has a flower chip carved into the backboard. It's a nice touch. If you haven't tried chip carving, the flower is a simple pattern on which to learn (see May/June, 1988 *AW* for more information on chip carving). But, if you don't intend to make chip carving part of your repertoire, you could paint on the flower, or omit it altogether.

Dry fit all the parts to check that everything will go together correctly. Make adjustments, if necessary. Glue and nail the side boards to the back first with 7/8 in. square-cut nails (available from Tremont Nail Co., 21 Elm Street, Wareham, MA 02571). Nail the front in place, and make sure the box is square. Insert and glue the divider to the front and back sides. Sand the bottom edges of the pipe box if they're uneven. Center the bottom board, and nail it to the box. Sand the assembly all over, but keep all the edges sharp and square. This completes the body assembly.

BILL OF MATERIALS

QUANTITY	PART	DIMENSIONS
BOX		
1	Back	11/32" × 6 1/2" × 16 5/8"
2	Sides	11/32" × 4 1/32" × 11 1/8"
1	Front	11/32" × 6 1/2" × 6 1/4"
1	Divider	11/32" × 3 11/16" × 5 13/16"
1	Bottom	3/8" × 4 5/8" × 6 7/8"
DRAWER		
1	Front	9/16" × 2 3/4" × 6 1/8"
2	Sides	1/4" × 2 3/4" × 4"
1	Back	1/4" × 2 3/8" × 5 11/16"
1	Bottom	3/16" × 4" × 5 7/16"
1	Pull	1/2" dia. × 1 1/2"



Making the Drawer

The original box has a drawer with dovetail joints at all four corners. If dovetail joints intimidate you, make simple rabbet joints in their place. Many early pipe boxes had rabbet joints, so using them won't compromise the authenticity of the box.

Cut out the drawer parts, and dry fit them. Start with the drawer front. Note that the drawer front overlaps the drawer opening only on the sides. You'll need to rabbet the backside of the drawer front (on the sides only) so that it fits in the opening with approximately a 1/32-in. gap on each side. The top and bottom of the drawer front are not rabbeted on the backside so they don't overlap, but aim for somewhere between a 1/32-in. to 1/16-in. gap (on top only) to allow for expansion in summer.

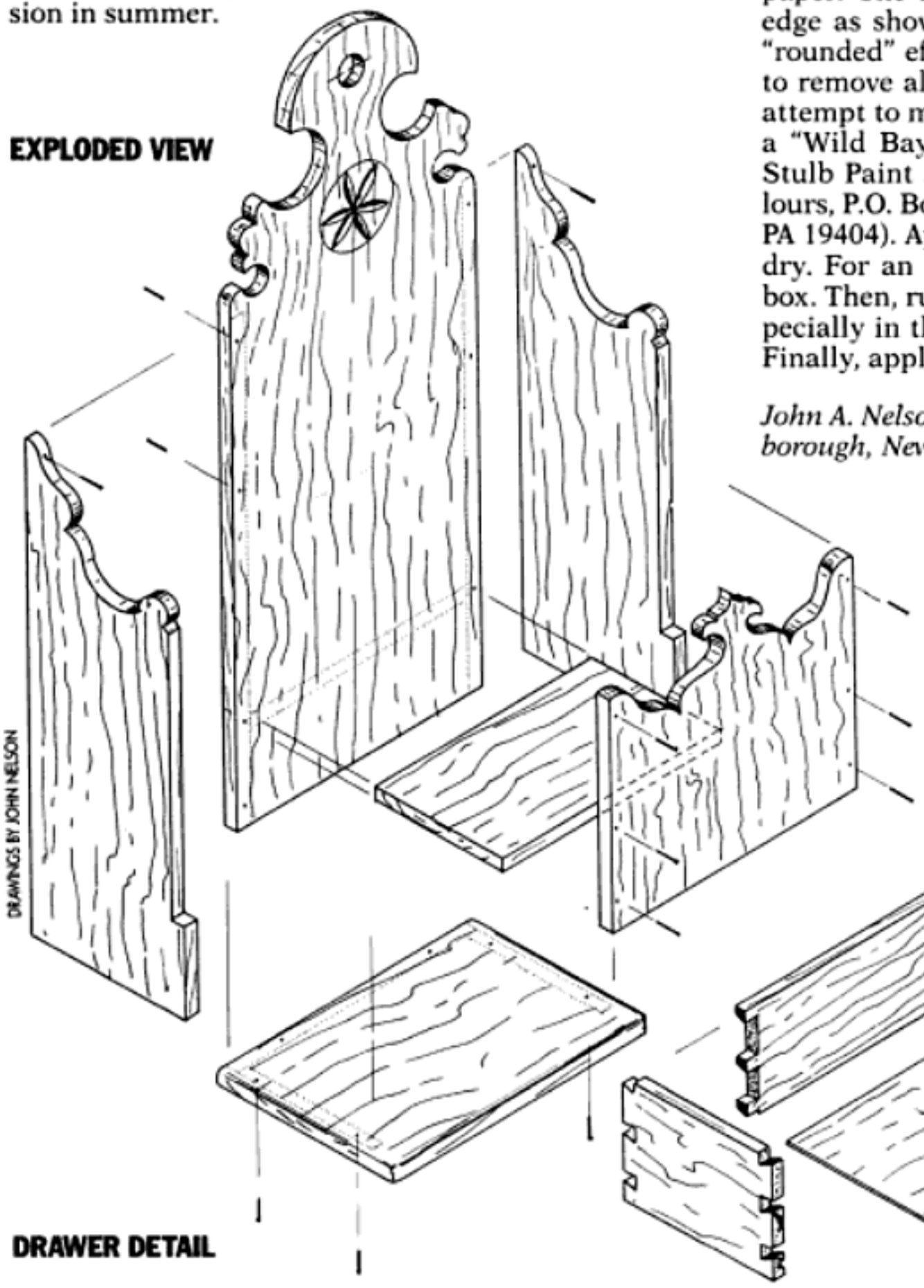
Next, cut the drawer sides to the same height as the drawer front and to the proper length for the drawer to close, again allowing extra room for expansion of the drawer bottom. The bottom slides in from the back, with grain running from side to side. Before assembling the drawer, rout a round-over profile on the edges of the drawer front with a 1/4-in. radius bit and bearing.

For the drawer pull, you may choose to buy a knob at the local hardware store, and simply screw it on. Or, if you have a lathe, you can turn your own drawer pull complete with tenon. Drill the hole for the tenon in the drawer front, and pin it with a square-cut nail as the drawing shows.

Go over the pipe box once with a very fine-grit paper. The frontboard has a slightly rounded front edge as shown. Use a rasp or sandpaper to get this "rounded" effect. Wipe off the box with a clean cloth to remove all dust. Now you're ready to paint. In an attempt to match the green of the original box, I used a "Wild Bayberry" green, No. 1214 (available from Stulb Paint and Chemical Co., Old Village Paint Colours, P.O. Box 297, West Washington St., Norristown, PA 19404). Apply a single coat of paint, and allow it to dry. For an antique look, distress the surface of the box. Then, rub it all over with No. 0000 steel wool, especially in the places where it would naturally wear. Finally, apply a coat of paste wax. ▲

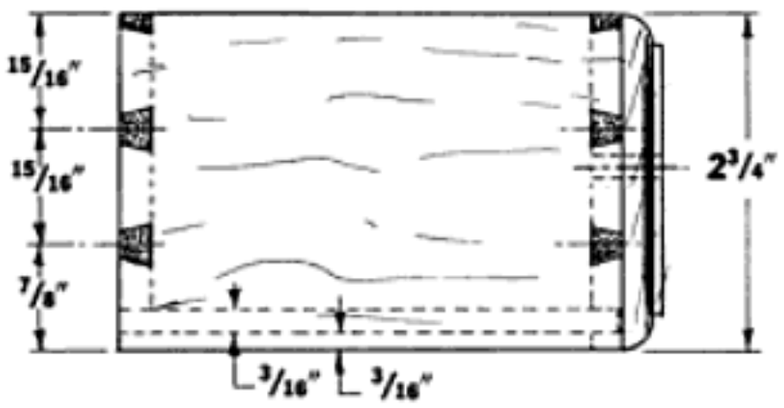
John A. Nelson is a high-school drafting teacher in Peterborough, New Hampshire.

EXPLODED VIEW



DRAWINGS BY JOHN NELSON

DRAWER DETAIL



As toys in themselves or the moving force for other toys, these mechanisms might just turn you into a crank addict.

WOODEN MECHANISMS

Apply the Principles to Animate Toys and Gadgets

BY RAYMOND LEVY

PHOTOS BY SALLY SHENK ULLMAN

You've probably seen a dozen wooden toys with parts that move up, down and around. If you would take a moment and peer into the inner workings, you'd notice that the mechanisms that make these toys move are usually quite simple. In fact, these mechanisms can be fascinating "toys" on their own.

I build a variety of wooden mechanisms, which I sell as assemblies and in kit form. These were originally intended for teaching and demonstration purposes. Since their introduction, however, people have been buying them for desk ornaments and just plain adult toys. Because I produce them in quantity, I've developed production jigs to make most of the parts, but these mechanisms can all be made in any modestly equipped workshop.

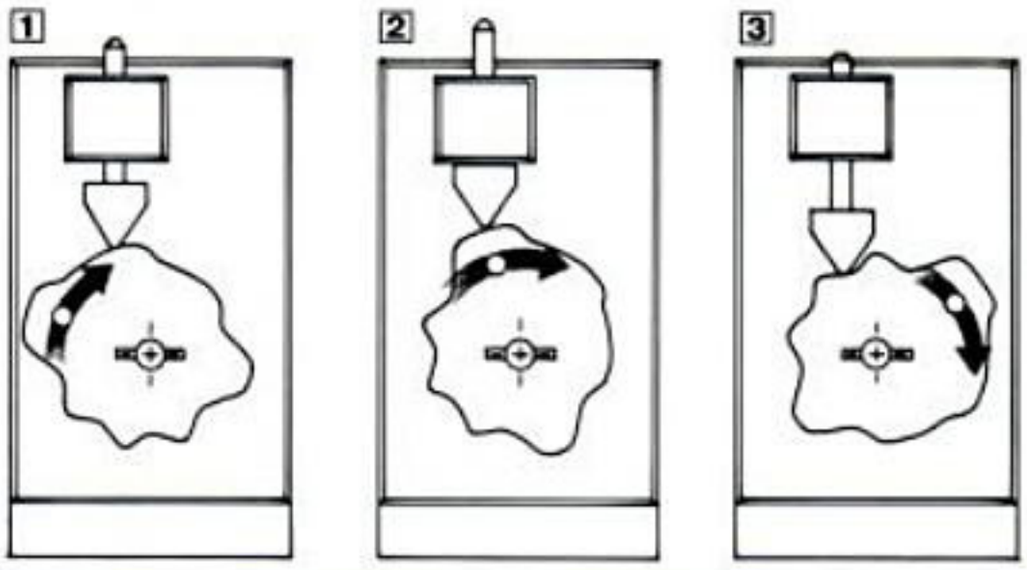
Rather than offer step-by-step instructions here on how to build each specific mechanism, I intend this article to be food for thought. However, many of the mechanisms are straightforward enough that a good look at the photos and drawings will tell you all you'll need to know to build them. Each of the mechanisms featured here moves in its own distinct manner. Most of them convert rotary motion into some form of linear or reciprocating motion—some move up and down, others back and forth. A few even allow you to vary the duration of travel for specifically timed motions. The main idea here is that once you understand how these mechanisms work, you'll find dozens of ways to put them to use. Their applications are as numerous as your imagination is crafty—from moveable wooden toys to wooden machines . . . the sky's the limit. For more information on adapting mechanisms to wooden toys, read *How to Make Animated Toys* by David Wakefield (1986, Sterling Publishing Co., New York, NY 10016).

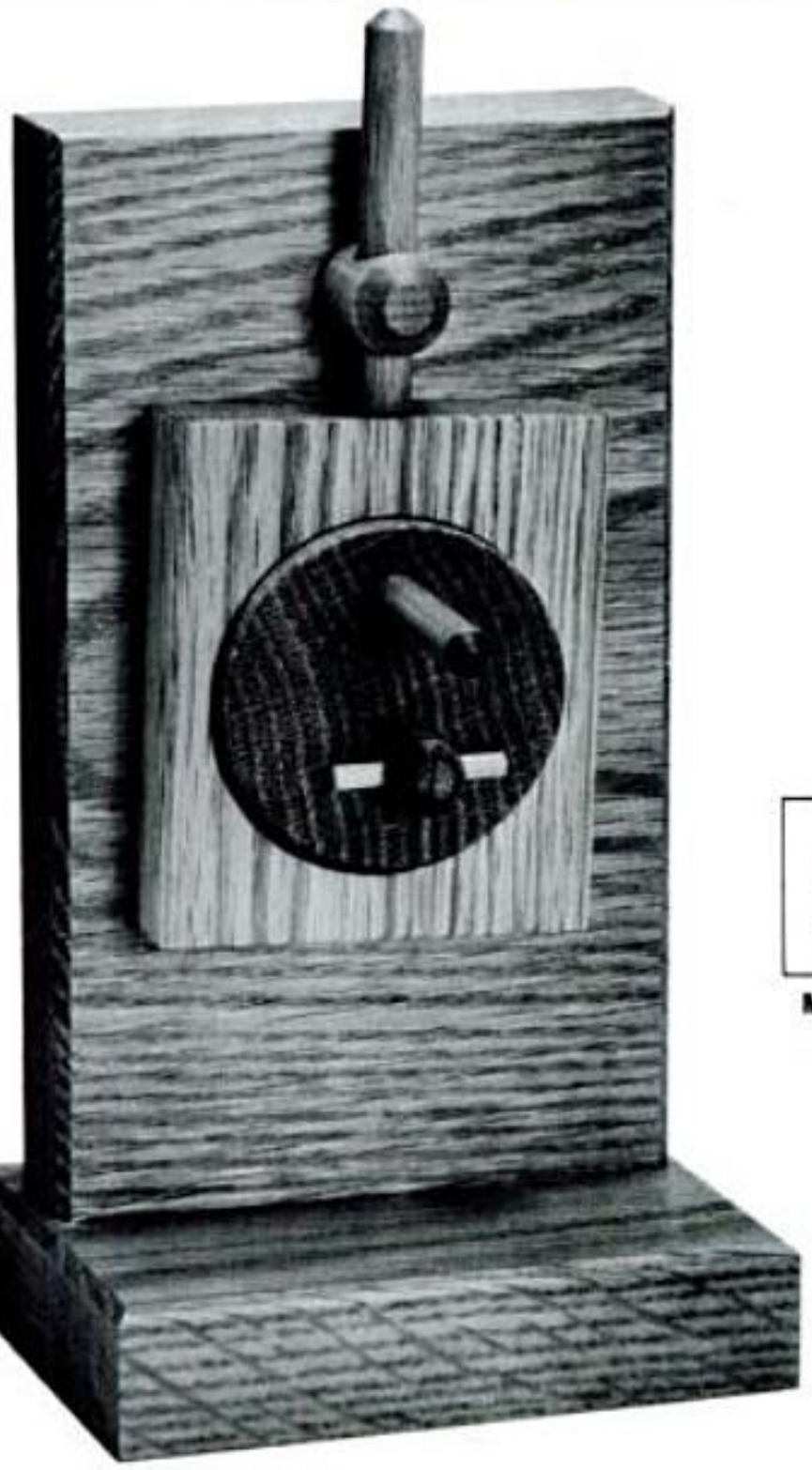
Cam and Follower

Cams are devices that convert rotary motion to timed, linear motion. The cam and follower is the most basic type of cam. A part called a follower rides against the perimeter of an irregularly shaped, rotating member called the cam. The follower tracks the hills and valleys of the cam to produce a programmed up-and-down motion. Cams of this type operate valves in car engines and timed electrical switches such as you'd find on a washing machine.

By varying the shape of the cam, you can affect the *distance* the follower moves, the *duration* of the movement, and the *number* of strokes per cam revolution, which can be timed according to your needs (see sidebar). The follower shown here relies on gravity to keep it in contact with the cam surface. A spring-loaded follower could be installed in any position.

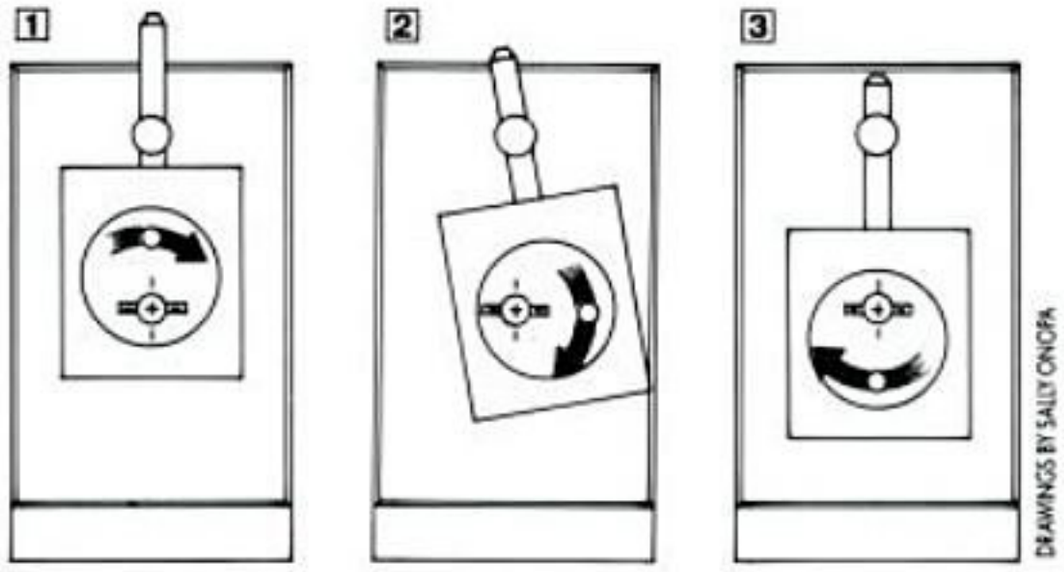
The cam and follower might be used to animate a wooden horse moving up and down, because the follower on this *particular* cam mechanism makes a hypnotic clackety-clacking sound, much like that of a horse in full gallop.





The Eccentric

The eccentric is a device for converting rotary motion into reciprocating motion. Though always referred to as an eccentric, it is actually a sort of cam, consisting of a rotating eccentric, a cylinder with an off-center axis, which travels within a block. Turning the crank on this mechanism gives you an egg-shaped up-and-down motion. The large bearing area between the eccentric and the block makes it desirable for short-stroke, heavy-load operations. Industrial applications of the eccentric are: vertical metal shapers, high-pressure piston pumps, punch presses, steam-engine valve gears, sheet-metal forming equipment and numerous small mechanisms in food processing, textile and printing machinery.

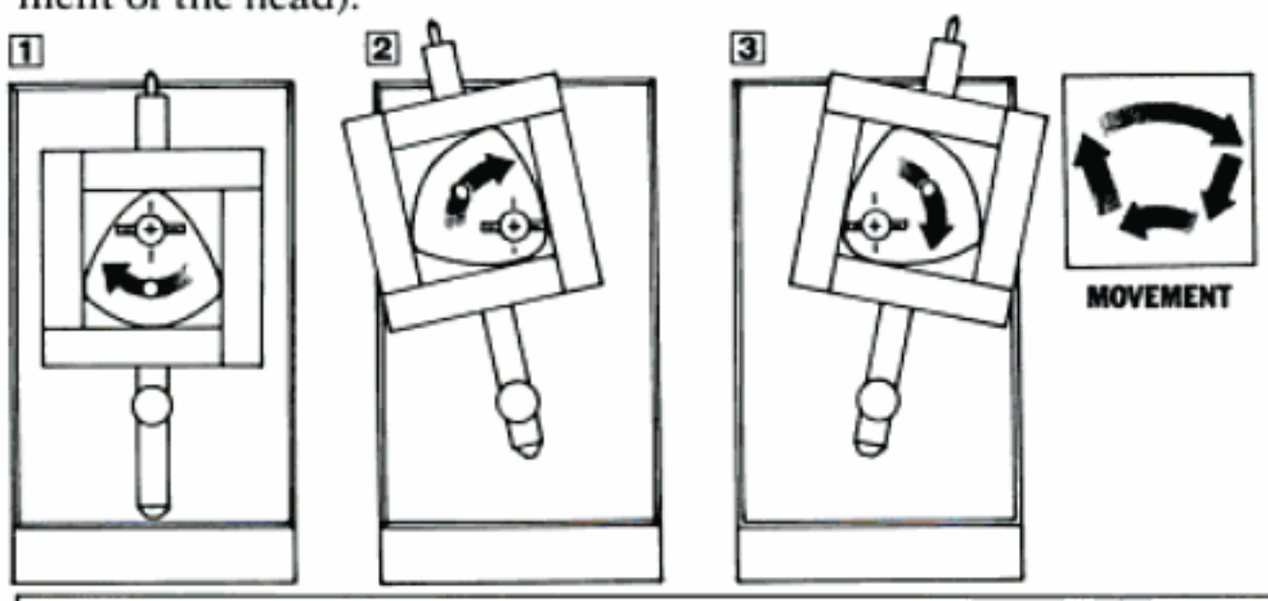


DRAWINGS BY SALLY ONOFA

Self-Conjugate Cam

The self-conjugate cam is a much more complicated cam. It's comprised of a specially shaped cam operating between close-fitting parallel surfaces—the followers—which the cam contacts throughout its rotation. The resulting motion is an arc-shaped trapezoid. Unlike the cam and follower, the self-conjugate cam requires neither springs nor gravity to maintain contact between the follower and cam. One drawback, however, is that the design of the self-conjugate cam is severely restricted by its need to contact both sides of the follower at all times. When the cam contour rises at one point, it must fall an equal amount at the opposite point. A vernier caliper must show an identical measurement anywhere around the cam's perimeter. The cam must fill the space between its follower surfaces at all points of rotation.

This particular example is named the Mitchell motion after its inventor. It has been used for many years to advance film in movie cameras and projectors. The specific motion this cam makes might work well inside a wooden toy chicken or pigeon (for the movement of the head).



DEVELOPING A CAM PROFILE

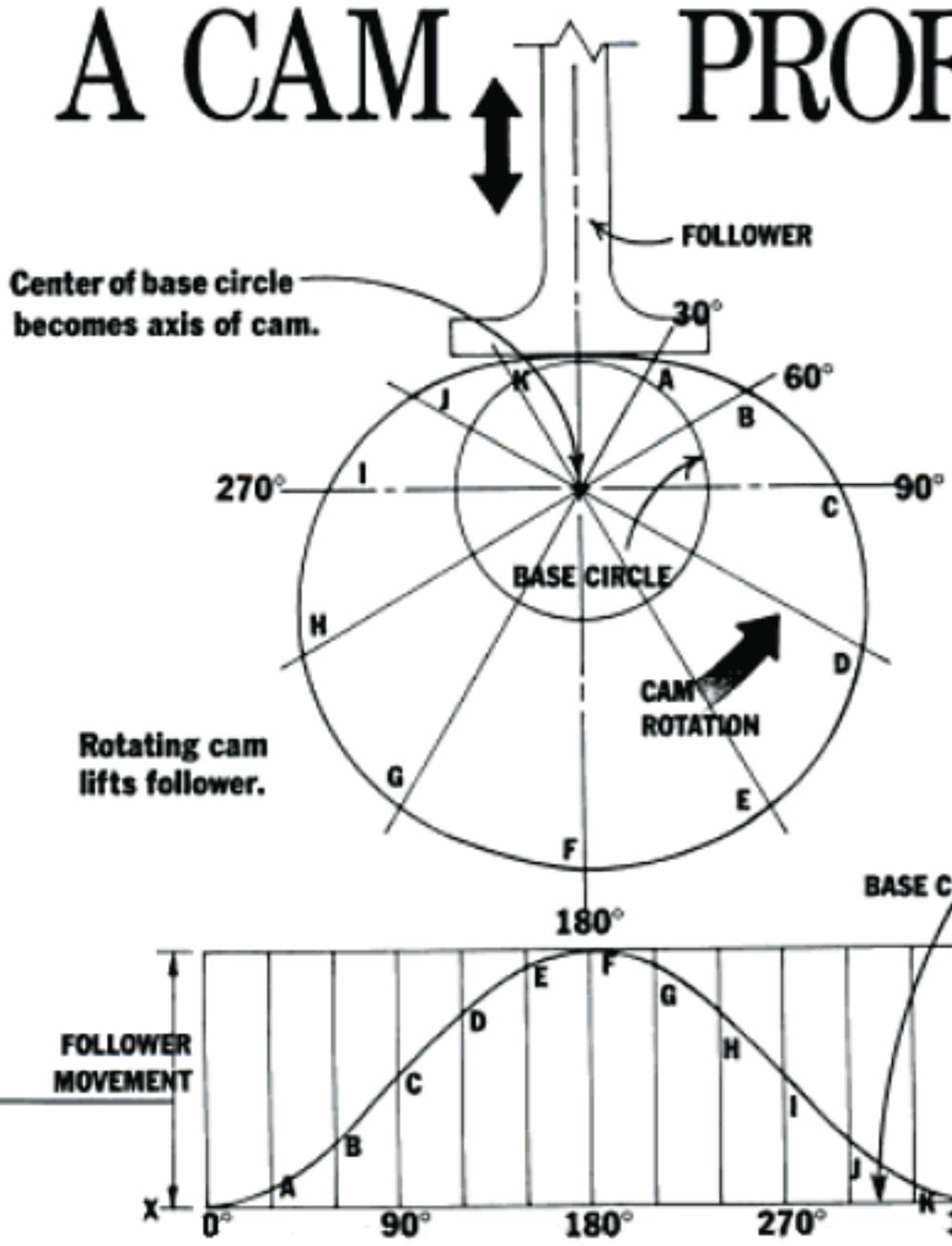
Before you can put cams to work moving toys or gadgets, you need to know how to design a cam that will give you the specific follower movement you want.

The shape, or profile, of a cam determines how far, how fast, and how frequently the follower moves up and down. The simple cam shown here, for example, raises and lowers the follower once every revolution. Raymond Levy's wooden cam and follower (see page 35) has a more complicated profile that raises and lowers the follower seven times for each revolution of the cam.

To keep things simple, I've explained how to develop a cam with a flat follower mounted directly over the cam's axis. Depending on its shape, a center-mounted follower can get hung up on the cam and prevent the cam from turning. To avoid this, followers are very often offset to one side of the cam axis. If the cam rotates clockwise, mount the follower to the left of the axis. If the cam rotates counterclockwise, mount the follower to the right of the axis.

To lay out a cam, you'll need basic drafting equipment—compass, T-square, triangles, and ruler.

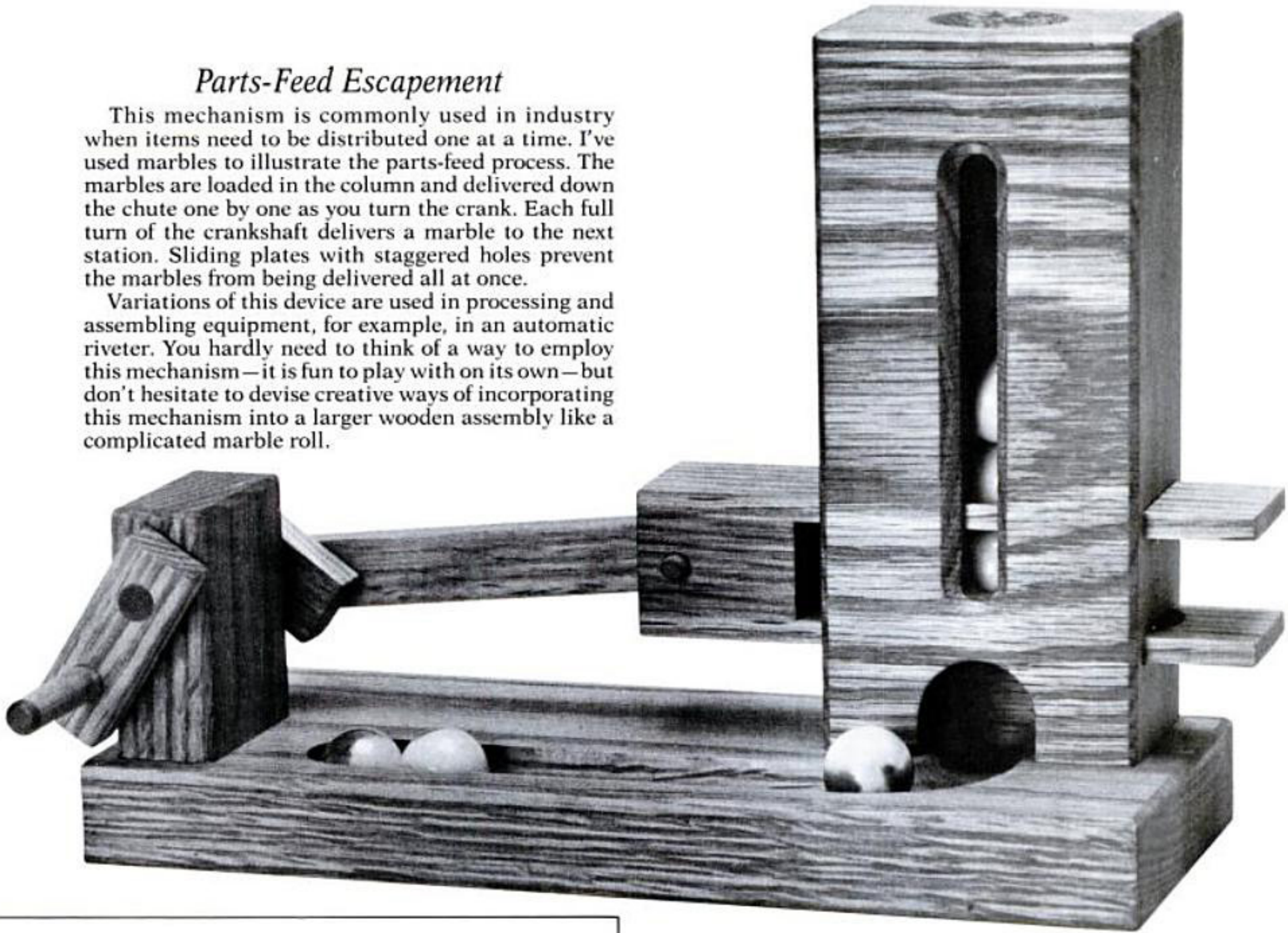
First draw a horizontal line—the base circle line XY in the drawing—to represent one revolution of the cam. The actual length of the line



Parts-Feed Escapement

This mechanism is commonly used in industry when items need to be distributed one at a time. I've used marbles to illustrate the parts-feed process. The marbles are loaded in the column and delivered down the chute one by one as you turn the crank. Each full turn of the crankshaft delivers a marble to the next station. Sliding plates with staggered holes prevent the marbles from being delivered all at once.

Variations of this device are used in processing and assembling equipment, for example, in an automatic riveter. You hardly need to think of a way to employ this mechanism—it is fun to play with on its own—but don't hesitate to devise creative ways of incorporating this mechanism into a larger wooden assembly like a complicated marble roll.



doesn't matter. Next, divide the base circle line into 12 equal sections as shown. Each section corresponds to 30° of cam rotation, from 0° to 360°.

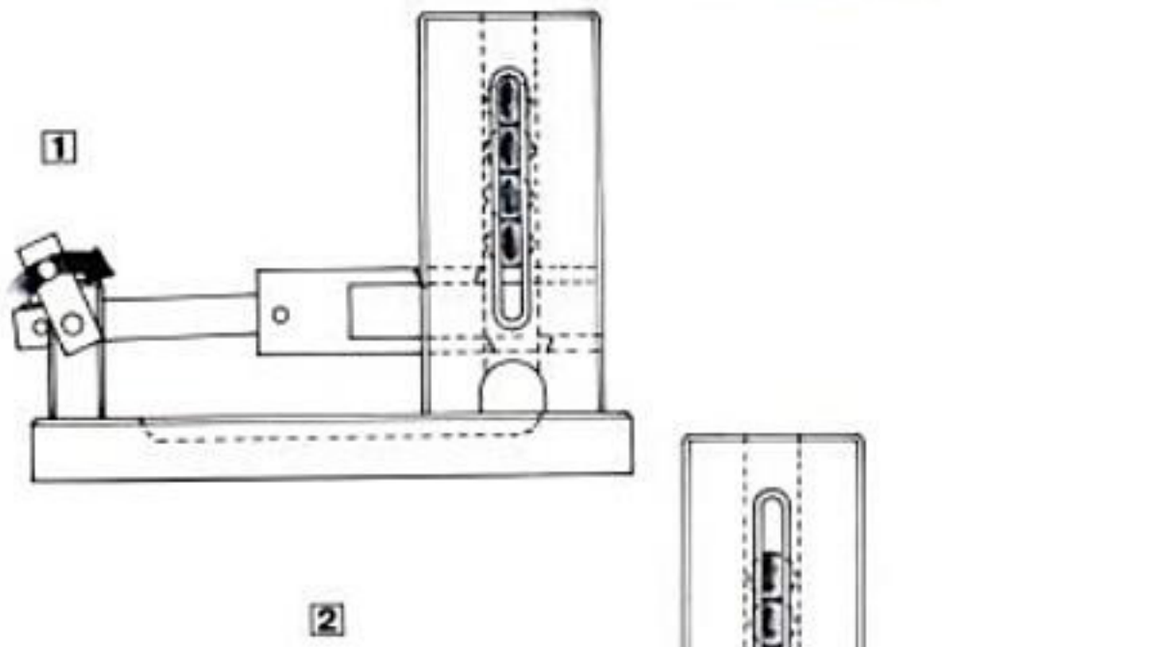
Next, determine the distance of follower movement you want, and mark off this actual distance from the base line. On the example shown, the high point of cam travel occurs at 180° of rotation (point F on the drawing).

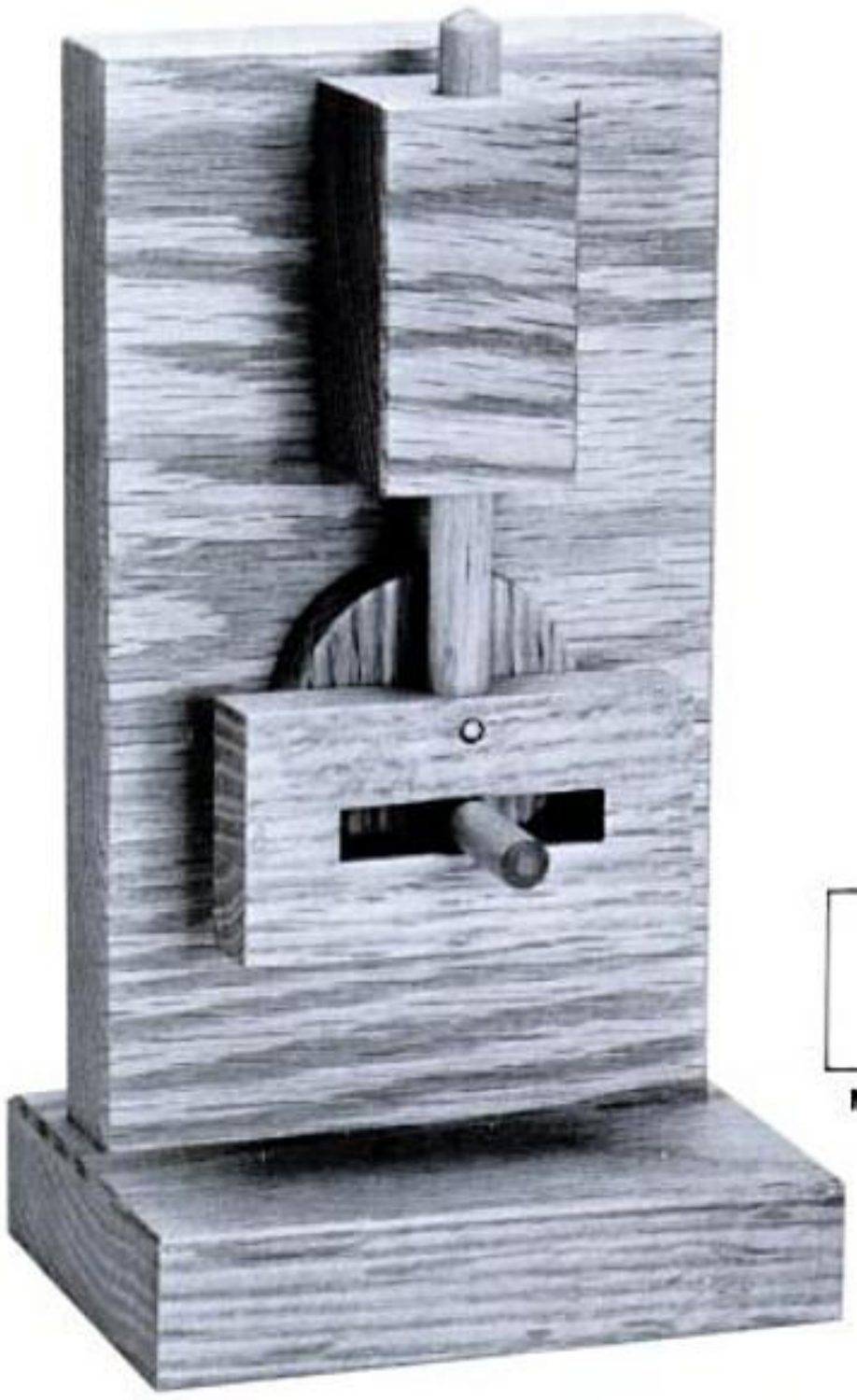
Now draw a smooth curve from the 0° point to the high point and back again to the 360° point. The shape of the curve determines the follower velocity, and you might want to experiment with different-shaped curves—both symmetrical and asymmetrical—to see what type of follower movement they produce.

Next, draw a small base circle as shown. This circle corresponds to the base circle line. Divide the base circle into 30° segments as shown. With the cam follower positioned at 0, plot points A, B, C, etc., plotting *against* the rotation of the cam.

Finally, connect the points with a French curve to form the cam profile.

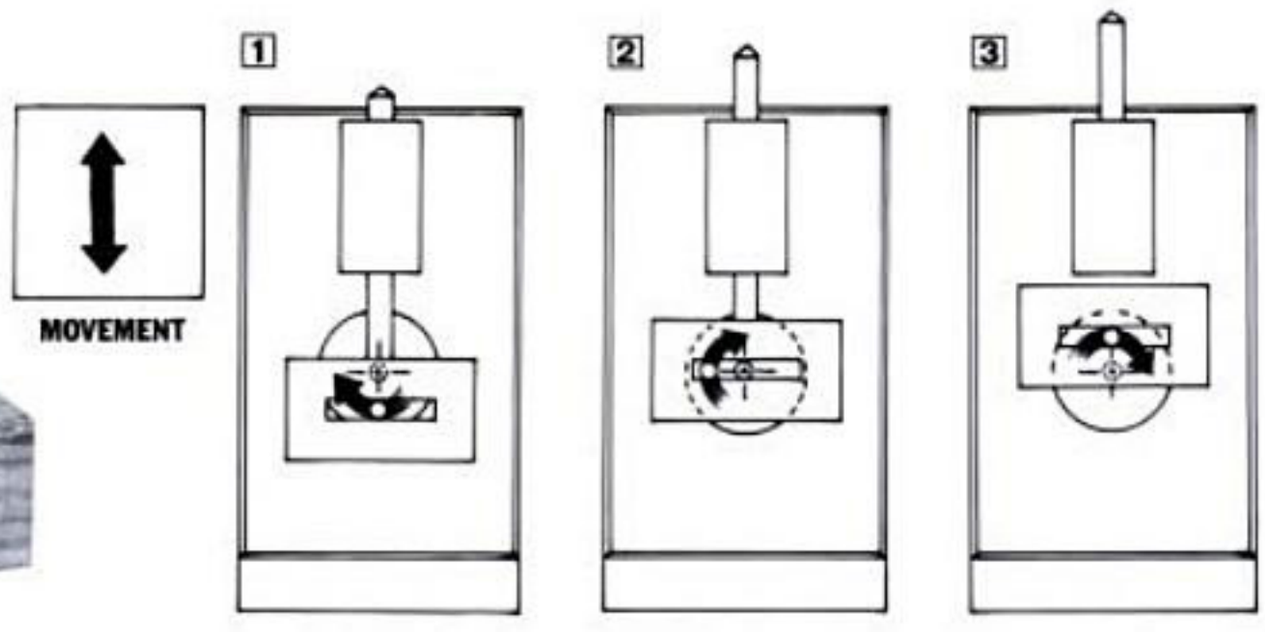
The same procedure can be used to lay out more complicated cams with multiple-follower cycles per rotation. You'll find more detailed information about cam development in any good mechanical-drawing textbook.—*David Sloan*





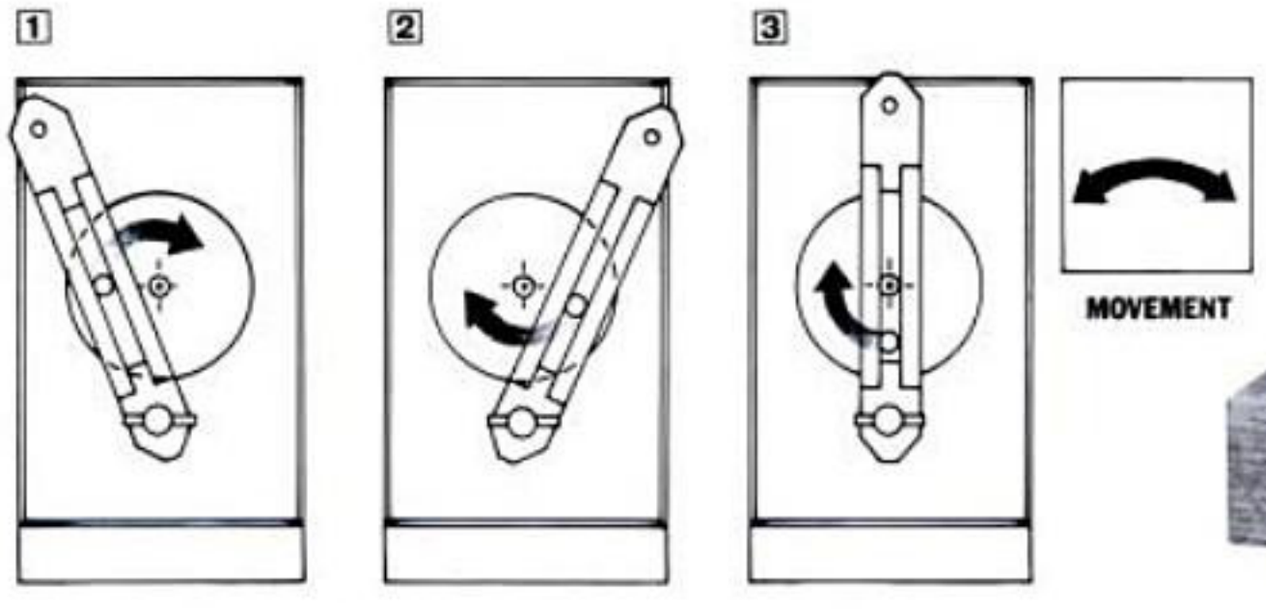
Scotch Yoke

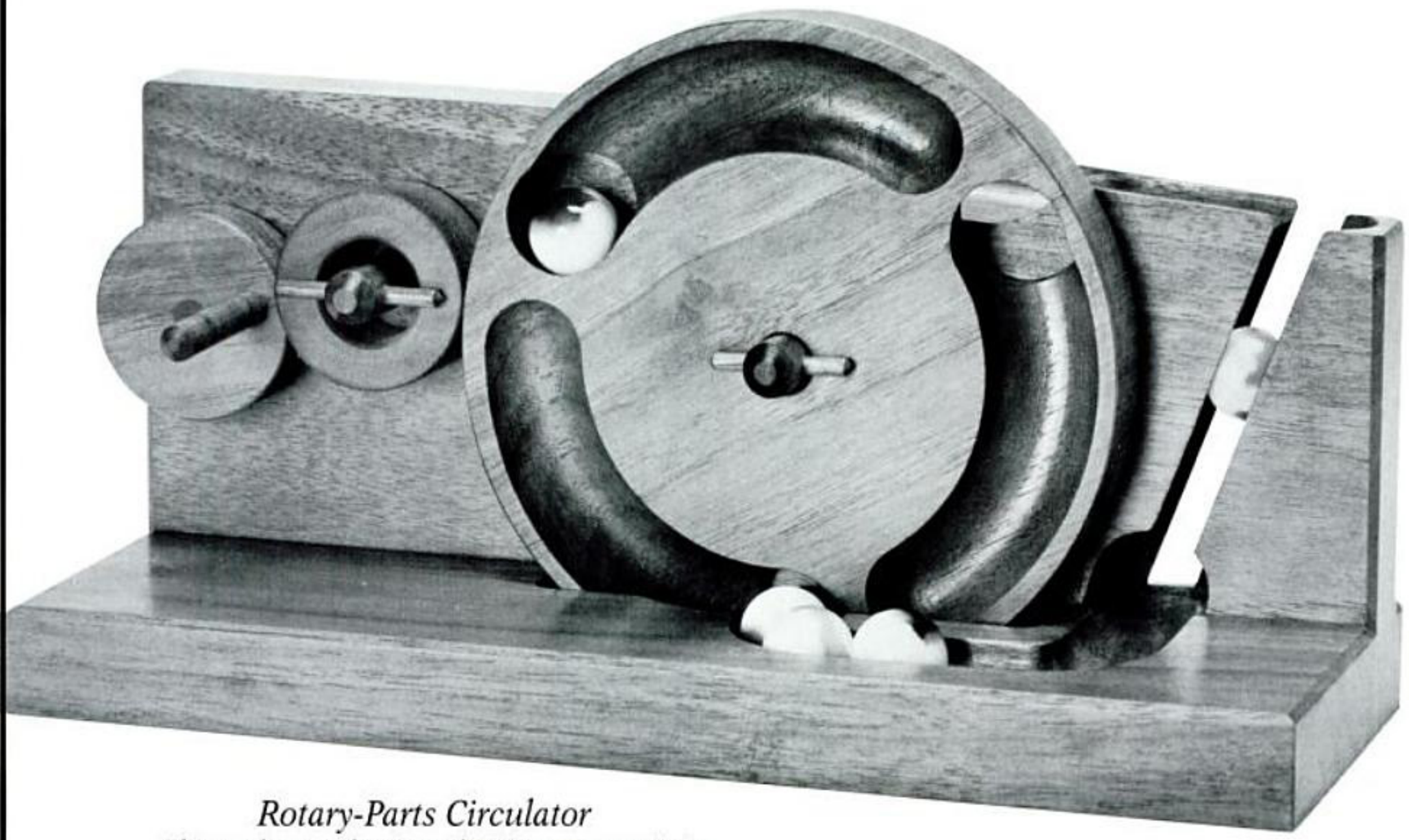
The Scotch Yoke is a mechanism in which a rotating crank pin slides back and forth within a rectangular slot, resulting in the uniform reciprocating up-and-down motion of a rod. It makes a very compact assembly. The Scotch Yoke was used in small steam engines in place of a more traditional connecting rod, saving about a third of the space. It is also used in piston pumps, where a compact design is required. It is frequently used in textile and food processing machinery today, but is almost always referred to as a pin and slot actuator. The Scotch Yoke might be used to animate a wary groundhog poking her head in and out of her burrow.



Fast-Return Actuator

The fast-return actuator is also known as the swinging block linkage. This device is used in machines that require a slow working stroke and a rapid return stroke. The motion traces an arc. In this *particular* example, the arm's return stroke is a little more than twice as fast as the initial stroke. The specific ratio of working and return stroke is dependent on the dimensions of the mechanism. The fast-return actuator is used in metal shapers and industrial sewing machines. You might use such a device to animate a toy Grandpa nodding off to sleep, then jerking back his head to stay awake.





Rotary-Parts Circulator

This mechanism does just what its name says: it circulates parts in a continuous rotary manner. Like the parts-feed escapement, the rotary-parts circulator is a self-contained device—and lots of fun to play with by itself. Once people get to cranking this one, it's hard to pull them away.

Turning the crank drives the elevator disk by means of a floating idler wheel which compensates for wear and seasonal dimensional changes. The idler is coated with a thin layer of General Electric Clear Silicone Sealant, which assures positive friction under all conditions. The rotating elevator disk picks up a marble from the feed chute at the bottom. The marble is carried up and released, at the top, into a chute behind the elevator disk. The marble rolls down a sloped horizontal chute to a vertical chute and back into the feed chute at the bottom of the device. The marbles continue to circulate without interruption.

Such devices are used in industry to circulate parts through different temperature or moisture zones for heating and cooling, wetting and drying, or chemical processing.

The rotary parts circulator is lots of fun to play with, but it's also the most difficult to make of all the mechanisms shown here. The holes in the disk are both angled and tapered, and the slots in the disk taper from shallow to deep. Making one from scratch will challenge you. I've developed several complicated production router jigs to produce the device more easily. ▲

Raymond Levy is a designer of physics apparatuses in Soquel, California. For more detailed information about his mechanisms, send a business-size, stamped envelope to him at: P.O. Box 804, Soquel, CA, 95073.

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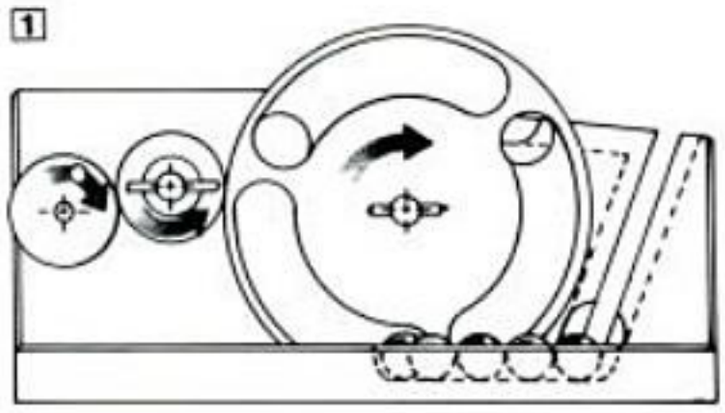

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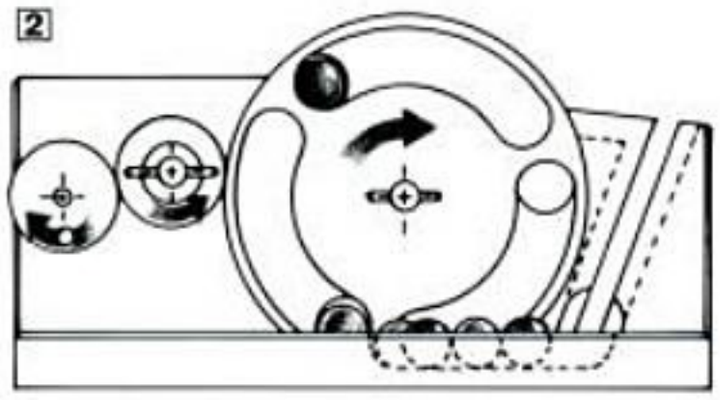

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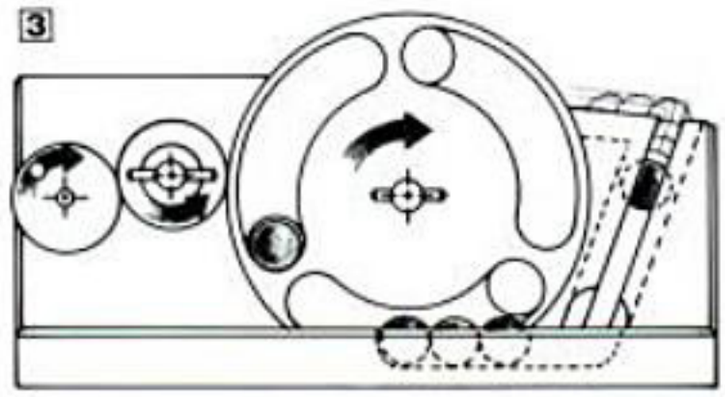


A WOODWORKER'S TOOL CABINET

Customize the Design to Meet Your Needs

BY NICK ENGLER

Good craftsmanship not only requires good tools, it also requires a good tool cabinet. A cabinet is an important tool in itself for both practical and aesthetic reasons.

On the practical side, a cabinet provides the organization you need to work efficiently. With all your important tools arranged in a single cabinet, it's easy to find a tool when you need it. Aesthetically, it's a pleasure to have a finished example of your craftsmanship in the shop, where you can enjoy it as you work. Sometimes, especially during a difficult operation, it settles your mind to be reminded of what can be accomplished with a little care and patience.

This tool cabinet provides three types of storage—shelves, drawers, and racks—to accommodate all kinds of hand-held woodworking tools. It opens to display your tools, holding each item at a comfortable height, so you can reach a tool without stretching. It closes into a simple, elegant chest on a stand, letting you appreciate the form as well as the function.

Notes on Construction

Although the cabinet looks complex, the joinery is very simple. Dovetails hold the case and the door sides together. All the other joints are either mortise and tenon or some sort of tongue-and-groove.

I joined the case and door parts with through dovetails for two reasons—one practical, and the other, as you might have guessed, aesthetic. Aesthetically, dovetails look nice, and nothing exemplifies good craftsmanship more than a well-made dovetail joint. For practicality, nothing does a better job of keeping a case square, and this particular cabinet case must withstand unusually high loads. Without strong joinery, the case may become distorted, or the doors may droop after the first few months of use.

As you build the cabinet, you'll run up against some specific construction problems. Here are some possible solutions:

Making dovetails—There are several different ways to make dovetails, both by machine and hand. I routed mine with the help of a dovetail template. There are two templates on the market that make through dovetails—the Leigh Dovetail Jig and Keller Dovetail Templates. The Keller is the simplest to set up, but the Leigh allows you to adjust the width and the position of the dovetails (see March/April, 1988 *AW*).

Making raised panels—There are also several ways to shape the edges of the door panels. Panel-raising cutters are available for both routers and shapers. You also can bevel the edges of the panels on a tablesaw (see May/June, 1989 *AW*).

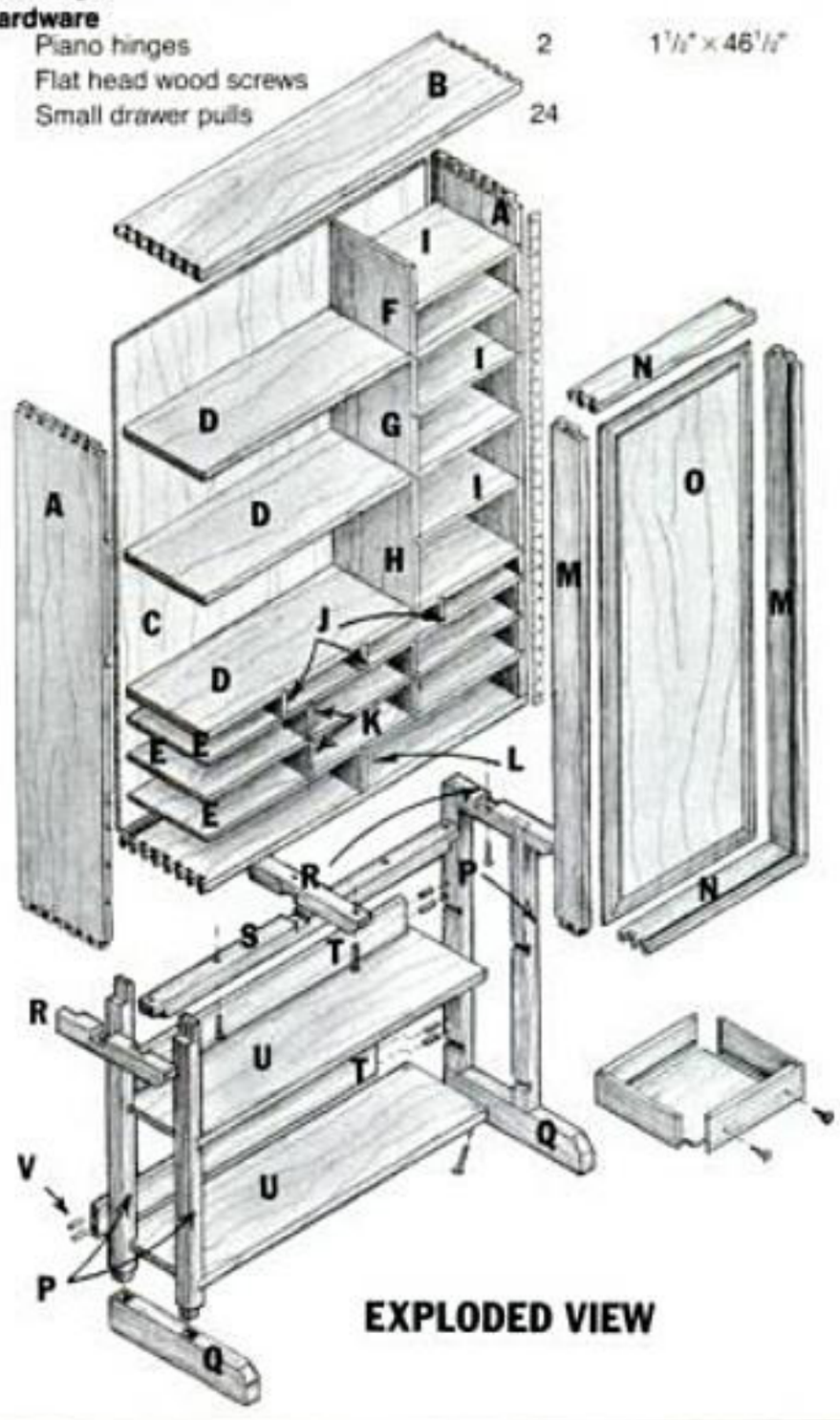
Routing stopped grooves and dadoes—The door panels and cabinet back all float in 1/4-in. grooves. These grooves are stopped grooves, and because of this, it's easiest to guide the router against a fence. I mark the beginning and end of each groove by drilling a 1/4-in. dia., 3/8-in. deep hole at the ends of the groove. Mount a 1/4-in. straight bit in the router, and place it in one of the holes. Set the router to take a very shallow cut—1/16 in.—and hold the router with both hands when you turn it on. Rout against the fence until you reach the second hole. Make the groove deeper in a series of cuts.

PHOTOS BY KAREN CALLAHAN

A well-designed tool cabinet organizes your tools so you can work efficiently.

BILL OF MATERIALS

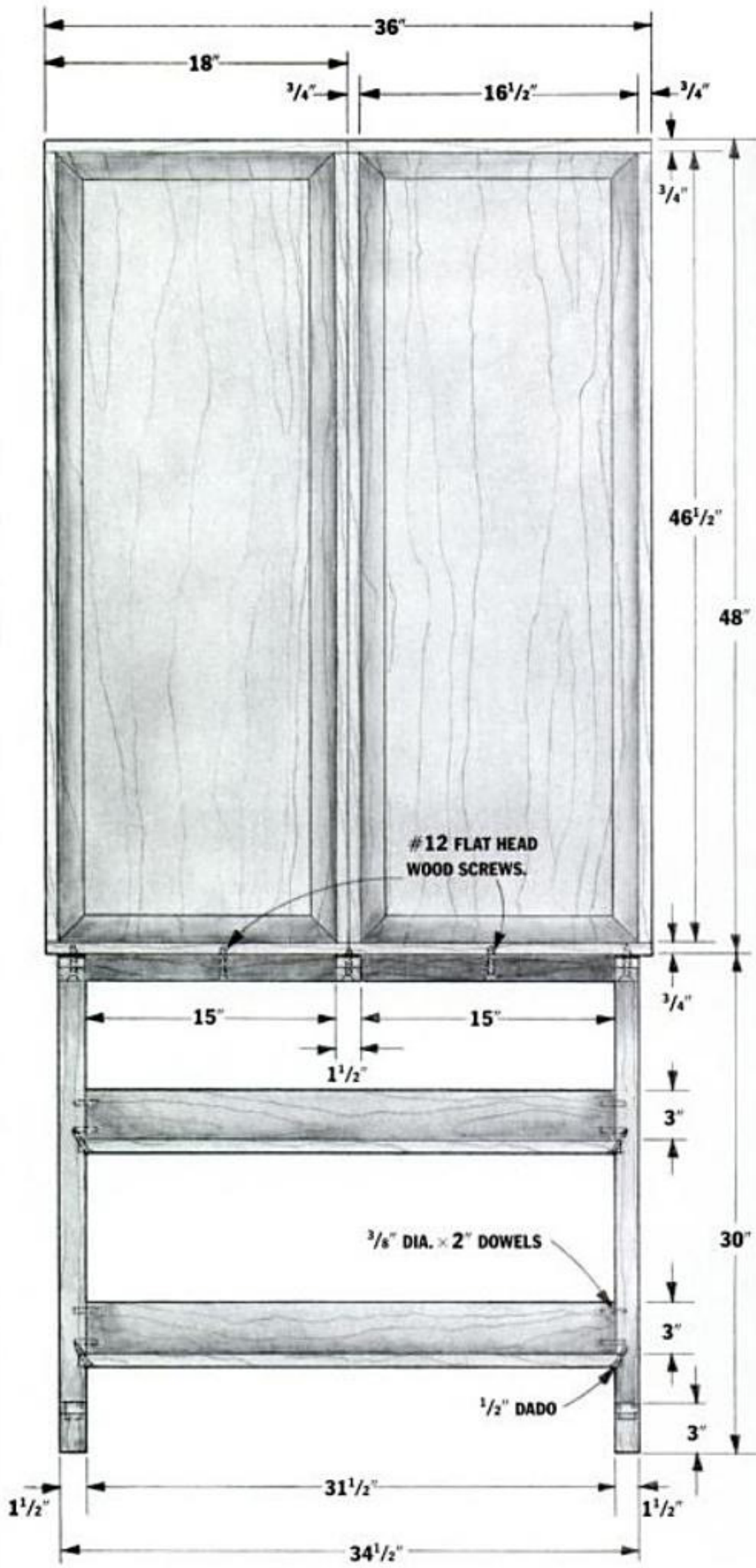
PART	QUANTITY	DIMENSIONS
Carcase		
A. Case sides	2	3/4" × 9" × 48"
B. Case top/bottom	2	3/4" × 9" × 36"
C. Case back (plywood)	1	1/4" × 35 1/4" × 47 1/4"
D. Long shelves	3	3/4" × 8 1/2" × 35"
E. Drawer partitions	3	1/2" × 8 1/2" × 35"
F. Upper shelving divider	1	1/2" × 8 1/2" × 8 1/2"
G. Middle shelving divider	1	1/2" × 8 1/2" × 11 1/2"
H. Lower shelving divider	1	1/2" × 8 1/2" × 12 1/2"
I. Short shelves	3	1/2" × 8 1/2" × 11 5/8"
J. Upper drawer dividers	3	1/2" × 8 1/2" × 2 3/8"
K. Middle drawer dividers	4	1/2" × 8 1/2" × 3 3/8"
L. Lower drawer divider	1	1/2" × 8 1/2" × 4 1/8"
M. Door sides	4	3/4" × 3" × 48"
N. Door tops/bottoms	4	3/4" × 3" × 18"
O. Door panels	2	3/4" × 17" × 47 1/4"
Stand		
P. Legs	4	1 1/2" × 1 1/2" × 28"
Q. Feet	2	1 1/2" × 3" × 15"
R. Supports	3	1 1/2" × 1 1/2" × 12"
S. Stretcher	1	1 1/2" × 1 1/2" × 34 1/2"
T. Back stops	2	3/4" × 3" × 31 1/2"
U. Bottom shelves	2	3/4" × 9" × 32 1/2"
V. Dowels	8	3/8" dia. × 2"
Drawers		
Small drawer fronts/backs	8	1/2" × 1 15/16" × 8 1/8"
Small drawer sides	8	1/2" × 1 15/16" × 8"
Small drawer bottoms	4	1/4" × 7 3/4" × 7 3/4"
Medium side drawer fronts/backs	8	1/2" × 2 15/16" × 11 1/8"
Medium side drawer sides	8	1/2" × 2 15/16" × 8"
Medium side drawer bottoms	4	1/4" × 7 3/4" × 10 5/8"
Medium middle drawer fronts/backs	4	1/2" × 2 15/16" × 10 7/8"
Medium middle drawer sides	4	1/2" × 2 15/16" × 8"
Medium middle drawer bottoms	2	1/4" × 7 3/4" × 10 3/4"
Large drawer fronts/backs	4	1/2" × 3 11/16" × 16 7/8"
Large drawer sides	4	1/2" × 3 11/16" × 8"
Large drawer bottoms	2	1/4" × 7 3/4" × 16 1/2"
Hardware		
Piano hinges	2	1 1/2" × 46 1/2"
Flat head wood screws		
Small drawer pulls	24	



EXPLODED VIEW

DRAWINGS BY MARY JANE FAVORITE

FIG. 1: WOODWORKER'S TOOL CABINET



FRONT VIEW

PHOTOS BY KAREN CALLAHAN

A multitude of storage options—from different-size drawers to door slots and hangers—make for easy access to your tools.

A router is also the best tool for cutting the stopped dadoes that hold the shelves as shown in Fig. 2. Clamp a fence to the stock to guide the router, and start cutting at the front edge of the stock. Stop when you reach the groove that holds the back panel, so you don't rout through the back edge.

Mounting the door hinges—The doors are mounted on piano hinges (see Fig. 1). Before you assemble the case, plane 3/32-in. off the edges of the case and doors to which you will attach the piano hinge. This creates a 3/16-in. gap between the two parts, making room for the hinge.

Fitting shelves and dividers—No matter how carefully you make the dovetail joints, the case will probably be slightly larger or smaller than planned. Completely assemble the case and the base, then hand-fit the shelves and dividers inside it.

As you put each shelf in place, chisel a step in either end as shown in Fig. 2. This keeps the shelves from interfering with the hinges.

Making and balancing the support stand—I joined most of the stand with lap joints and dadoes (see Fig. 1). Mortises and tenons, however, join the feet to the legs. To make these square blind mortises, start by drilling 1-in. dia. holes that are 1-in. deep. Square the corners with a sharp chisel.

Note the 5° incline on the top leg rails shown in the detail of Fig. 1. No matter how strong the joinery is, the weight of the tools causes the doors to sag slightly when you open them. The incline keeps the doors from catching on the stand when closed.

To keep the cabinet from tipping forward when you open and close the doors, the stand's feet are 3 in. longer than the depth of the cabinet. If you hang unusually heavy tools on the doors, it may tip anyway. If you're worried about this, temporarily assemble the stand, and fasten the cabinet to it (see Fig. 1). Fill the case with the tools you want to place on the shelves and in the drawers. Open the doors so they're 90° to the front edge of the case. Put the tools that will go on the doors in two cardboard boxes, and place each box on top of a door. If the cabinet starts to tip, you know that you need to cut a new set of feet for the stand sev-

eral inches longer than the previous set.

Making and fitting the drawers—The drawers are assembled with tongue-and-dado joints (sometimes referred to as lock joints). You can make these joints quickly on a tablesaw with any blade that cuts a 1/8-in. wide kerf. To save time, cut all the drawer parts to fit snugly in the openings, then make all the joints at once. Assemble the drawers, and sand them to travel smoothly. After putting the drawers together, sand them to fit the case, matching each drawer to a single opening. Carefully mark the drawers and the openings so you don't get them mixed up.

Making tool racks and holders for the doors—The hangers in the doors must fit your tools. The drawings show three types of tool racks and holders. Mount tools such as screwdrivers and chisels in holes drilled

DESIGNING A PERSONAL TOOL CABINET

A tool cabinet is a very personal item. Every woodworker collects a unique set of tools. The cabinet that holds and organizes them must also be unique. Because of this, you might not want to build a cabinet exactly like mine. You will probably change the size, the arrangement of the shelves and drawers, or borrow bits and pieces and incorporate them into an altogether different design. In the end, it will be your personal tool cabinet. To help you personalize this project, let me review some of my thinking as I designed my cabinet.

Size—The cabinet, I decided, shouldn't hold every tool in my shop, just those that I use most often. If there were too many tools, it would be difficult to find the ones I want. So, I made a pile of my favorite tools—chisels, saws, planes, screwdrivers, mallets, and so on. I included some of the portable power tools that I use frequently—a drill, a saber saw, a router, and two sanders—but I left out things like router fences and saw guides that I only need occasionally. When I finished, the pile was surprisingly compact. There were lots of items in it, but they didn't take up as much space as I thought. I figured everything would fit into a 1- × 3- × 4-ft. box, with room to spare.

Depth—The deeper the cabinet, the more tools it can hold. However, once you make a cabinet more than one or two tools deep, you create an organizational nightmare. Every time you need a tool from the back row, you must move several tools in front of it. As you work, the cabinet becomes more and more disorganized. Instead, I created some additional storage by hanging tools on the doors. The cabinet is actually two or three tools deep when it's closed, but everything is visible and accessible when it's open.

Height—I put the cabinet on a stand so the lowest shelf is the same height as my workbench, while its highest shelf remains well within my reach. The height of the cabinet is carefully planned so everything in it is visible. I don't have to bend or stretch to reach anything.

Woodworkers often put one cabinet on top of another and keep seldom-used items in the bottom cabinet. This is a good idea because it makes maximum use of the space. I wanted to place this cabinet within a few feet of my workbench, however, and was afraid that I'd constantly bang into open doors or drawers. I opted to mount a few shelves between the legs of the stand. This uses the space but saves my shins.

Shelve types—Your shelves can be either fixed or adjustable. Most woodworkers prefer adjustable shelves, so they can rearrange them as they get more tools.

I chose to make the shelves permanent for aesthetic reasons. I like the solid feeling of a fixed shelf. I also like pigeonholes because all the nooks and niches help me stay organized. I configured the shelves to create nine compartments of varying sizes. I don't miss the versatility of adjustable shelves. My collection of tools and my interests have been fairly stable for many years.

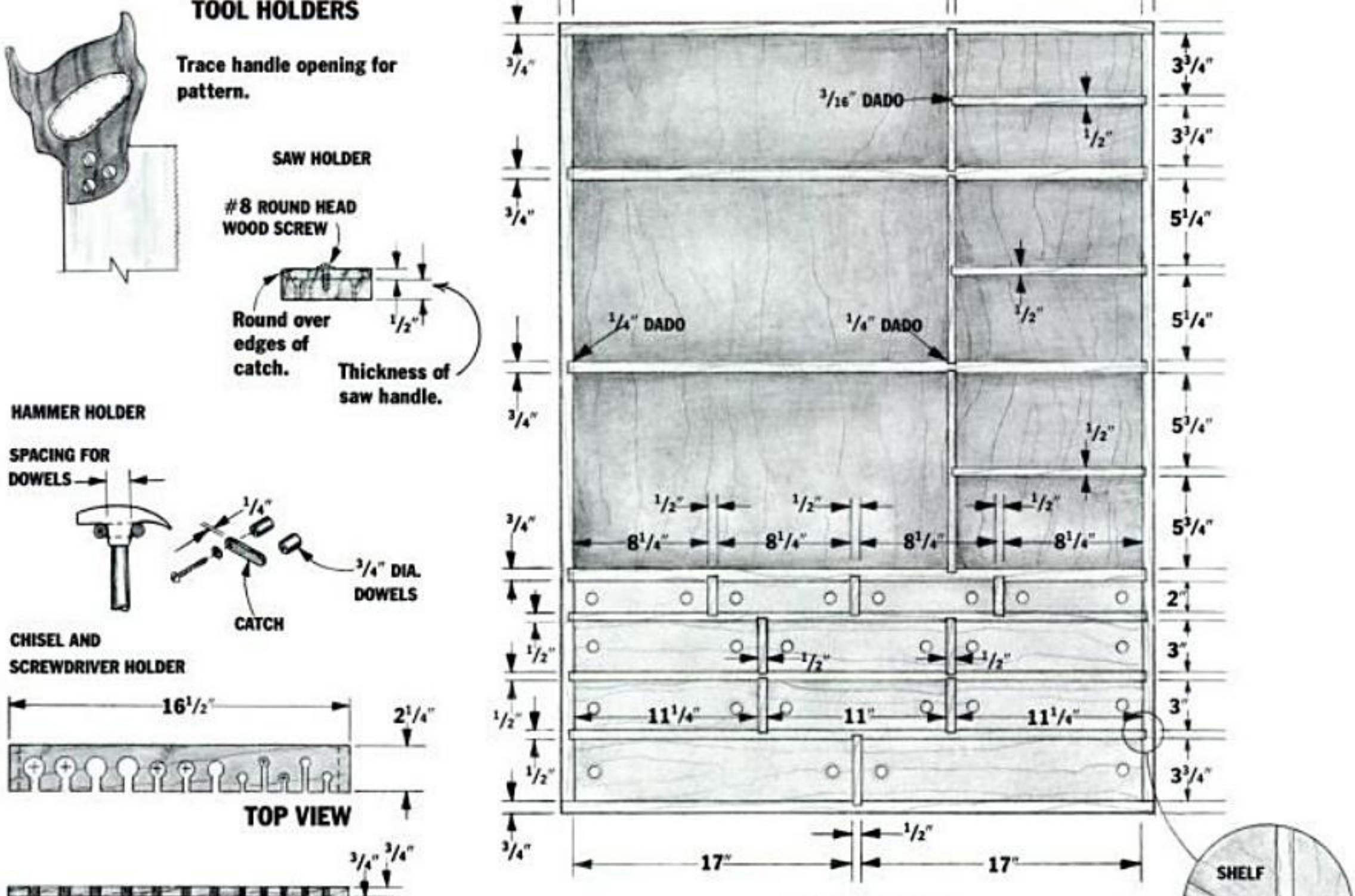
If you wish to rearrange the inside of the cabinet from time to time, mount the shelves on adjustable supports.

Drawer sizes—I chose to make drawers of three sizes for the same reason I decided to make various-sized pigeonholes. I also found that you can fit more drawers in a cabinet if you make several sizes. The construction is easier if you make the drawers all the same. If you do this, you have to build each drawer big enough to hold the largest item you want to store. That causes wasted space in the drawers that hold smaller tools.

I kept even the largest drawers as shallow as possible. The same logic applies here as it did to the cabinet: If a drawer is more than one or two tools deep, you'll find yourself moving tools to reach the one you need. The contents quickly become a jumble. If you must make deep drawers, consider building shallow, stacking trays to fit inside the drawers.

Please, remember that these are only one woodworker's answers to a few of the dilemmas you face as you design a tool cabinet. They aren't necessarily the right answers; there are no right answers in these kinds of situations. What works well for me may not work at all for you, so use your best judgment when laying out the cabinet. However (and this is a big, important however), consider each detail carefully. It's the "details" that determine the difference between a great tool cabinet and a mediocre one. —*N.E.*

FIG. 2: CABINET INTERIOR



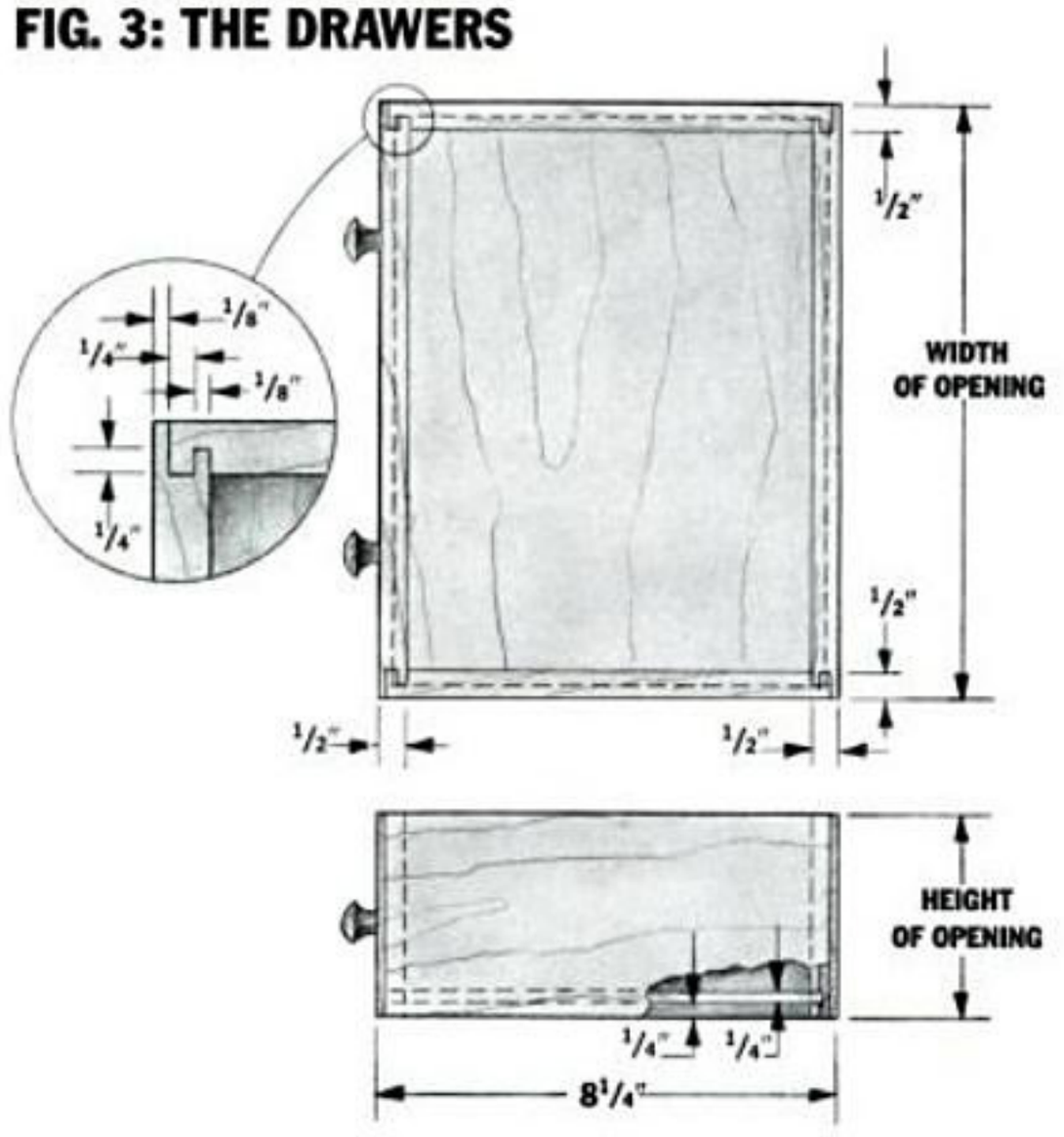
in a board that is mounted horizontally. To make it easier to remove and replace these tools, cut a narrow slot from the front edge of the board to the circumference of the holes as shown in Fig. 2. Hang hammers, saws, and similar tools on pegs or blocks, and keep them in place with catches or turn buttons. Space the pegs,and shape the blocks to fit the individual tools.

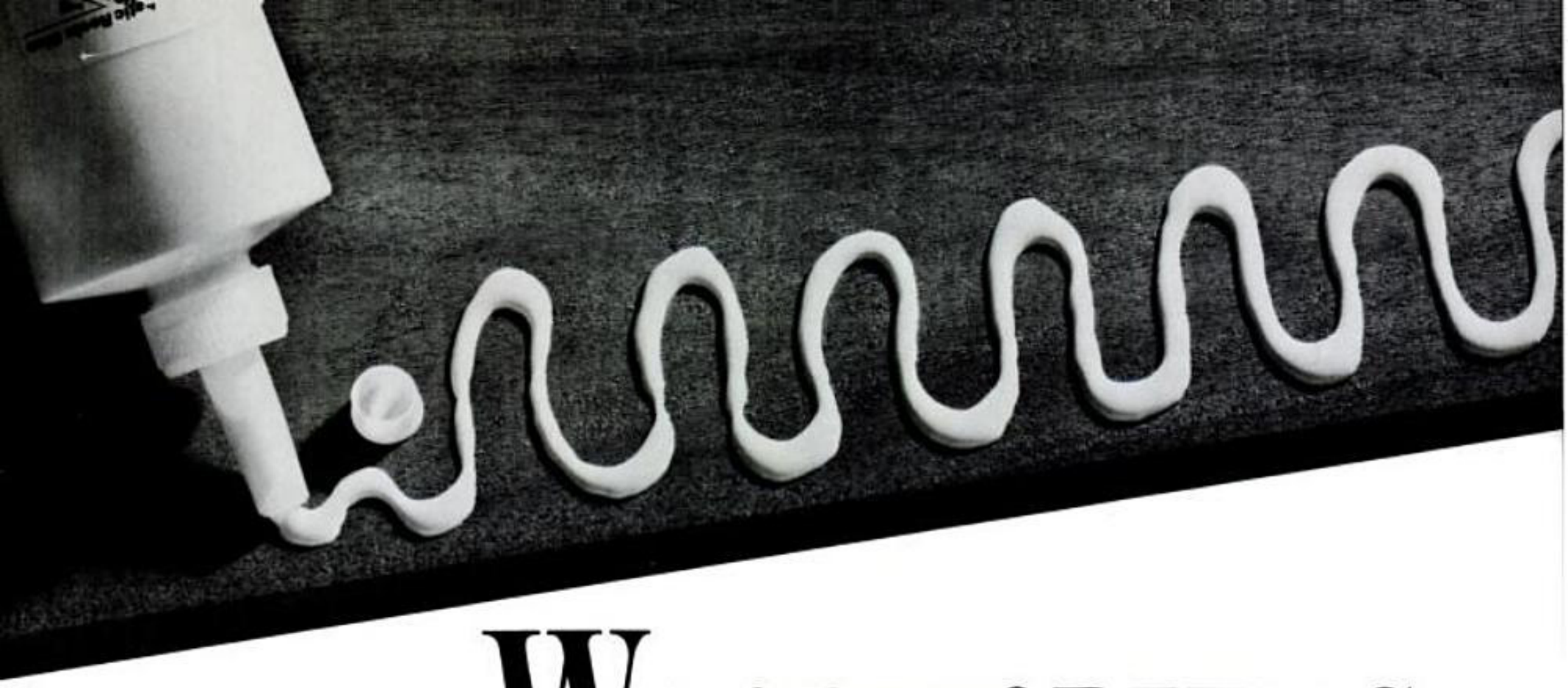
If you want to change the configuration of racks and holders from time to time, screw—don't glue—them to the inside of the doors. When you replace or add tools, unscrew the racks and holders, rearrange them, and tighten them, again.

Applying a finish—Finishes that build up on the surface scratch easily in the workshop. I like a penetrating varnish made of 75% tung oil and 25% spar varnish that I mix myself and apply with a cloth. The mixture makes a hard, waterproof finish that can be buffed to a deep, smooth gloss. Apply several coats taking care to coat the inside of the cabinet as many times as the outside. If the parts are coated unevenly, they may warp or cup. Rub out the finish with #0000 steel wool,and apply paste wax. ▲

Nick Engler is Contributing Editor of AMERICAN WOODWORKER *and owner of Bookworks in West Milton, Ohio.*

FIG. 3: THE DRAWERS





WOODWORKING GLUE

Choosing the Right One Needn't be a Sticky Proposition

BY W. CURTIS JOHNSON

You've probably done it more than once. Wandered up and down the glue aisle at the hardware store, trying to find the perfect glue for that masterpiece you're about to assemble. White glue, yellow glue, plastic-resin glue, epoxy . . . which glue do you buy?

The sad fact is there is no perfect all-purpose woodworking glue. But there are an awful lot of very good ones, each of which creates a bond stronger than the wood itself. The glue you choose depends on the requirements of the job, as well as a few other variables like the temperature of your workshop. Before I go into detail about specific glues, let's take a look at woodworking glues in general.

The first glues were made from natural materials. Vegetable starch will glue, and children often make paste from flour and water. Hide glue, the best known natural glue, is made by extracting a protein called collagen from hides and other animal parts. Casein glue, made from milk, is still used for laminating interior structural beams. Rabbit-skin glue is an adhesive used by gilders, and fish glue is often used to attach labels to bottles. While animal glues remain widely used in industry, modern synthetic adhesives based on today's plastics have largely replaced these natural glues in woodworking applications.

Let's take a brief look at how glues work. In general, adhesives are based on long molecule chains known as polymers. These polymers give the glue its internal *cohesion*—the ability to stick to itself. The bond between the glue and the wood is *adhesion*, a different type of bond based on a molecular attraction between the glue and the wood. In order for these molecular attractions to take place, a joint must be clean, snug, and gap-free, as discussed in the sidebar. Some mechanical bonding also takes place between the glue and the wood fibers, but the molecular attraction contributes far more to the strength of the bond.

Woodworking glues cure in three different ways. Some glues, like white and yellow polyvinyl acetate glues (PVA) cure when the solvent evaporates, leaving behind a solid glue line. Other glues—plastic resin or epoxy for example—cure when a chemical reaction takes place and the glue *polymerizes*. A few glues, such as hot-melt glues, flow when melted and bond as soon as they cool. In general, glues that cure by loss of solvent can be redissolved in that solvent which is why water-based white and yellow glues aren't waterproof. Polymerization, however, is a permanent chemical change, and the cured glue is usually resistant to solvents.

For general furniture making, assembly time is perhaps the most important characteristic to consider when choosing an adhesive. You need enough time to get each joint together and clamped before the glue starts to set. Once you apply the glue, the maximum time you have to assemble the joint is called *open assembly time*. Once you assemble the joint, the maximum time you have to clamp it is called *closed assembly time*. Assembly time varies from one type of glue to the next. Temperature also has an effect on open time,

with most glues setting faster in warmer temperatures.

All glues have a limited shelf life, usually about a year or so. Few containers are dated (Franklin dates Titebond bottles), so it's often impossible to know how old the glue is when you buy it. It's a good idea to buy your glue where the turnover is high, and mark the date of purchase on the container. With some glues, deterioration is obvious. Hot hide glue gets moldy and develops a nasty smell. Liquid hide glue gets runny with age. PVA glues boast a long shelf life but may thicken or dry up when they get too old.

Here's a rundown on the wide range of woodworking glues available today, with a closer look at the working properties of each type.

POLYVINYL ACETATE (PVA) GLUES—These popular white and yellow glues are the closest thing there is to an "all-purpose" woodworking glue. Both types are good for furniture making and general indoor woodworking applications. They are inexpensive, nontoxic and easy to use.

PVA glues are based on the plastic, polyvinyl acetate (PVA) mixed as an emulsion in water. The tiny particles of PVA coalesce into a rubber-like solid as the water is lost to the surrounding wood leaving a semi-transparent glue line that remains flexible. Clamping time for PVA glues is short, but it takes 24 hours for the water to evaporate from the surrounding wood and for the glue to reach full strength.

The difference between white and yellow glue is a source of confusion among woodworkers. Yellow glue—also known as aliphatic resin glue—is a PVA that has been modified to give it different working characteristics from white glue and colored yellow for easy identification.

White glue, the original PVA adhesive, is somewhat runny and tends to dribble out of a joint. Because heat softens white glue, it gums up sandpaper quickly. Yellow glue is thicker and less likely to dribble. Yellow glue also sands more easily than white glue because the dried glue is more heat-resistant. Yellow glue is reputed to be more water-resistant than white glue, but my informal experiments show them to be just about equal in water resistance (see sidebar page 51).

Yellow glues are available in a variety of formulations. Franklin International makes five different industrial PVAs, and two consumer PVAs—Titebond and Super Titebond. Garrett Wade sells four different PVAs: one for lamination, a slow-set glue, a gap-filling glue and a general formula glue. While they contain the additives that distinguish them as "yellow" glues these PVA adhesives come in a variety of colors. Borden recently introduced a brown "yellow" glue designed for use on dark-colored woods.

PVA glues have a lot going for them, but they do have their disadvantages—open time is short. Freezing ruins PVA glue, so be careful where you store your glue. Even those PVAs which claim to get tacky quickly are initially very slippery, causing pieces to slide as you try to clamp them. Low water-resistance makes PVA glue a poor choice for panels that may get wet. And the glue's flexibility means that joints that aren't mechanically solid *without* glue will shift under sustained load, or even from natural wood movement. I've had glued-up panels shift after a few years causing the glue line to protrude, ruining a smooth finish. This shifting, called "creep," can be a significant problem, especially in bent laminations.

PLASTIC RESIN GLUE (UREA-FORMALDEHYDE)

Plastic resin glue is my personal favorite for cabinetmaking. Its high water-resistance makes it good for jobs like tabletops, cutting boards or laminated countertops. It is slow setting, giving you a long open time to assemble your project. Its tan color blends well with even light colored woods. It sands well and it's good for laminations, because there is no creep. Low flexibility and reasonable assembly time make this the glue I prefer for veneering. The glue does shrink as it dries, so it isn't a good gap filler.

Plastic resin glue comes in powdered form. Adding water allows the catalyst and the urea-formaldehyde to form a rigid polymer right in the joint. When mixed, the glue is the consistency of a heavy cream and isn't as slippery as PVA glue. Mixed glue has a pot life of about two hours, after which it dries and cannot be reused. When dry, the glue is similar to hard plastic. It

PHOTOS BY SALLY SHENK ULLMAN

is rigid but brittle and impervious to *cold* water —hot water will eventually soften the cured glue. Uncured glue cleans up with warm water.

The open time and curing time for plastic resin glue varies significantly with temperature. The warmer it is,the faster it sets. Unfortunately, urea-formaldehyde won't cure in a cold shop, because the chemical reaction won't take place if the room is below 70° F. At 70°, the open time is about 15 minutes. The joint must be clamped for about 14 hours.

The curing time of plastic resin glue can be reduced from hours to seconds by bombarding the joint with radio frequencies. R.F. gluing machines are used in industry,and smaller models of these machines are made for small-production shops.

Plastic resin glue can cause skin irritation. Once mixed, as it dries, it gives off a small amount of formaldehyde gas, which is suspected of causing cancer in humans. Wear a mask to avoid breathing the powder as you mix, and work in a well ventilated area to avoid fumes. Protect your hands with rubber gloves.

EPOXY—Epoxies are two-part glues that are waterproof, solvent-resistant, have very low creep, dry without shrinking and do not require clamping. The non-shrinking characteristic makes epoxy an excellent gap filler. Epoxy can be mixed with sawdust and/or tinted and used as a wood filler. Uncured epoxy cleans up with denatured alcohol or lacquer thinner. Once dried, however, epoxy is insoluble, which makes it difficult to disassemble a joint for repairs.

General-purpose epoxies are available in either quick-set or slow-set formulations. The quick-set variety hardens in about five minutes and cures in a few hours. The slow-set can take up to 24 hours to cure.

Quick-set and slow-set epoxies aren't exact equals when it comes to water resistance or strength. According to Ernie Liporto of Devcon, a large epoxy manufacturer, Devcon's slow-set 2-Ton Epoxy is completely waterproof. Devcon's quick-set 5-Minute Epoxy is water-*resistant*, not waterproof, and shouldn't be used on objects that will be immersed in water for long periods. Quick-set epoxies have roughly half the shear strength of slow-set formulas, but the bond is still stronger than the bond between the wood fibers.

Shop temperature is critical with some epoxies, and you should always check the container label for the recommended temperature range. Some epoxies are specially formulated for cold temperature use. Industrial Formulators of Canada Ltd. makes G-2 Epoxy that works well down to 50° F. (available from Garrett Wade, 161 Ave. of the Americas, New York, NY 10013). Chem-Tech's T-88 Epoxy (available from Chem-Tech, Inc., 4669 Lander Rd., Chagrin Falls, OH 44022) works at temperatures as low as 35° F.

Other specialty epoxy formulations are also available. My local boating supply store stocks a line of specialty epoxies called "The West System" (available from Gougeon Brothers, P.O. Box X918, Bay City, MI 48707). West System epoxy consists of a base resin that can be mixed with either a fast or slow hardener, so you can control open time and working temperature. Additional additives are available to change the viscosity, color, or texture of the epoxy. In addition, Gougeon Brothers sells a line of pumps, mixing materials and solvents.

Epoxy is the most expensive of all woodworking glues—particularly when you buy it in the little tubes and dispenser syringes you find at the hardware store. If you use a lot of it, it's cheaper to buy larger containers.

Toxicity is another disadvantage. Some people develop an allergic reaction to epoxy. Long-term exposure seems to sensitize some people and increase the likelihood of developing an allergic reaction. Avoid contact with skin and wear chemical-resistant gloves to protect yourself.

Glue	Working Temp. (° F)	Water Resistance
WHITE PVA	60°–90°	Fair
YELLOW PVA (aliphatic resin)	45°–110°	Fair
PLASTIC RESIN (urea formaldehyde)	70°–100°	Excellent
RESORCINOL	70°–120°	Waterproof
EPOXY	35°–200° depending on formula	Waterproof
CYANOACRYLATE	65°–180°	Excellent
HOT HIDE GLUE	70°–100°	Poor
LIQUID HIDE GLUE	70°–90°	Poor
CONTACT CEMENT	65°–180°	Excellent
HOT-MELT GLUE	32°-160°	Good

RESORCINOL GLUE—Resorcinol glue is a two-part adhesive consisting of a resin and a hardener. It's completely waterproof and can stand long-term immersion in water. It's ideal for boatbuilding or outdoor construction projects, but it's dark red color limits its use on fine furniture.

Once mixed, resorcinol has a long pot life, but the adhesive needs at least 70° F. to cure properly. Resorcinol glue has a long open time and actually has a *minimum* open time of ten to 15 minutes to ensure that the glue is thick enough not to be squeezed out of the joint.

Like plastic resin glue, resorcinol can cause skin irritation, so wear gloves. The glue contains formaldehyde, so wear a mask when mixing and make sure there is good ventilation.

HIDE GLUE—This venerable animal glue dates back to the days of the Pharoahs. Until the advent of synthetics in the mid-20th century, hot hide glue was the only adhesive for woodworking, and every shop had a glue pot cooking away in a corner. These days, hide glue comes in two forms, a ready-to-use liquid and a solid that must be dissolved in water, heated in a glue pot and applied hot. (In England, it is also sold as a wiggly, gelatinous block called "Scotch Glue.")

To prepare hot hide glue, the solid glue is soaked in water overnight, then the mixture is heated no greater than 140° F., usually in a thermostatically controlled electric glue pot. Hide glue has a very fast tack, and the joint must be assembled while the glue is still hot, This makes it unsuitable for complicated glue-ups. The hard, brittle glue is easy to sand and the tan color

Working Characteristics	Cured Characteristics	Applications	Cautions
Short open time; 1 hr. clamp time; non-toxic; moderate gap-filling ability; cleans up with water	Transparent, flexible glue line; clogs sandpaper; creeps under stress	General interior woodworking	Freezing destroys glue
Moderately fast tack; short open time; 30 min. clamp time; non-toxic; moderate gap-filling ability; cleans up with water	Semi-transparent, flexible glue line, moderate creep under stress; sands better than white glue	General interior woodworking	Freezing destroys glue
Mix powdered glue with water; medium open time; 14 hr. clamp time; poor gap-filling ability; cleans up with water; can be fast-cured with R.F. gluing machine	Hard, opaque, tan-colored glue line; sands well; no creep under stress	General woodworking; bent laminations; structural uses	Contains formaldehyde; uncured glue toxic to skin; use adequate ventilation
Mix liquid resin and powder; long open time; 10 hr. clamp time; good gap filling ability; 2 to 3 hr. pot life	Hard, opaque, red-brown glue line; withstands most solvents; sands well; no creep under stress	Boatbuilding and outdoor applications requiring a waterproof glue	Contains formaldehyde; Uncured glue toxic to skin; use adequate ventilation
Mix liquid resin and liquid hardener; open time varies with formula—fast and slow-set epoxies available; no clamping required; uncured glue cleans up with lacquer thinner	Transparent; excellent gap filling ability; sands well; cured glue can be filed or machined	Boatbuilding and outdoor applications requiring a waterproof glue; bonding wood to glass, metal, etc.; mixing with sawdust for gap filler	Uncured glue and vapors toxic; use adequate ventilation; repeated exposure can cause allergic reaction
Bonds within 1 min.; no clamping required; thin formulas penetrate cracks; parts must fit perfectly; spray accelerator speeds set; difficult to remove excess glue; gluing oily woods difficult	Extremely thin, transparent glue line; resists most solvents; poor gap filling ability	Bonding wood to non-porous materials; small repairs; model making; consolidating punky areas of turned bowls	Bonds skin instantly—clean up with acetone or nail-polish remover; vapors irritating; use adequate ventilation
Mix dried glue in water and heat in glue pot to 145°; fast tack; short open time; 2 hr. clamp time; wood must be warm; non-toxic; mixed glue spoils within days; clean up with water	Hard, semi-transparent glue line; sands well; moderate gap-filling ability; cured glue remains water-soluble	General indoor woodworking; antique restoration; instrument making; hammer veneering; joints that may require later disassembly	Don't heat glue above 160°
Long open time; non-toxic; 12 hr. clamp time; longer in high humidity; cleans up with water	Hard, semi-transparent glue line; sands well; moderate gap-filling ability; cured glue remains water-soluble	General indoor woodworking; complicated joinery requiring long open time; antique restoration; instrument making; hammer veneering; joints that later may require disassembly	None
Apply to both parts, allow to dry 5 to 10 min., then assemble; parts bond on contact; no clamping required; solvent-based and water-based formulas available	Rubbery, yellowish-brown glue line; resists heat well; creeps under stress	Bonding plastic laminates to wood, plywood or particleboard; sometimes used for veneering	Solvent-based formulas are EXTREMELY flammable. Vapors of both water- and solvent-based formulas are highly toxic—use adequate ventilation
Heat glue sticks in glue gun to apply; extremely short open time; good gap-filling ability; non-toxic	Hard, opaque brown glue line; cured glue softens when heated; bond weaker than other woodworking adhesives	Temporary tacking; small repairs; model making	Some oil-based finishes may cause glue to break down

blends well with most woods. Temperature is critical, and both the room and the wood must be 70° F. or above. Once dissolved, hide glue stays fresh a few days and can be reheated only a few times before it loses its strength.

There's a lot of mystique surrounding hot hide glue. Musical-instrument makers like it because it dissolves easily in water, making it easy to disassemble a joint. Despite its nostalgic appeal and value in repairing antiques, I find hot hide glue impractical for the average woodworker. However, hot hide glue is the only glue that works for hammer veneering, a hand-veneering technique that uses a squeegee-like "veneer hammer" to press veneer in place without a veneer press.

Liquid hide glue, on the other hand, has its merits for general furniture making. It is not supposed to be as strong as hot glue, but it is still far stronger than the wood it glues together. It has a long open time—ten minutes or more—so it's nice for complicated joinery. It cures glass-hard and is very rigid, so joints won't creep. Like hot glue, liquid hide glue requires shop temperatures of 70° F. and above. It, too, is easily dissolved in water, making it possible to steam or soak apart a joint that needs repair.

CYANOACRYLATE GLUE—Also known as "super glue" cyanoacrylate is a clear, watery glue that dries to a thin, invisible joint within seconds, without clamping. Turners and carvers use cyanoacrylates a lot to repair tiny pieces that have broken off their work, and luthiers use it for fastening inlays.

The common one-part super glues cure when they react with moisture on the gluing surface. They work well on non-porous surfaces that mate perfectly, but few formulations work well on wood.

One manufacturer, Satellite City, Inc., (659 Laguna Dr., P.O. Box 836, Simi, CA 93065) makes cyanoacrylates in several different viscosities for use on wood as well as other non-porous surfaces. "Hot Stuff" is their brand of conventional, water-thin cyanoacrylate. "Super T," "Special T," and "UFO" are thicker formulations with limited gap-filling characteristics for wood and for gluing parts that don't fit perfectly. In addition to the glues, Satellite City also makes two accelerators, "Hot Shot" and "Kick-It," which reduce the glue's setting time to a fraction of a second. The accelerator can be sprayed on one part before assembly or on the glue line after the parts have been assembled.

Cyanoacrylates are famous for gluing fingers together, but the glue dissolves readily in acetone or nail polish remover. The fumes from cyanoacrylates can cause nose and eye irritation. Accelerators may cause headaches and nausea. Use with adequate ventilation.

CONTACT CEMENT—Contact cement is mainly used for attaching plastic laminates to countertops and cabinets. It's made of neoprene rubber dissolved either in solvents or emulsified in water.

The glue is rolled or brushed on both surfaces and allowed to dry. When the glue is no longer tacky or wet to the touch, you join the two pieces. The bond is instantaneous, and repositioning is impossible.

Some woodworkers use contact cement for veneering, but its low strength and high flexibility, make it a poor choice for veneering, in my opinion.

Contact cement (the British call it "impact adhesive") is sold in flammable and non-flammable formulations. All types are toxic to handle and breathe. The flammable formulas are *extremely* flammable—especially the vapors. The vapors accumulate near the floor, and the slightest spark can ignite them. Work outside, if possible or use adequate ventilation, and wear an organic vapor mask (available from Direct Safety Co., 7815 S. 46th St., Phoenix, AZ 85044) when working with contact cement.

HOT-MELT GLUE—Hot-melt glue is a thermoplastic adhesive applied with a glue gun. It's an instant adhesive that cools quickly, and you only have seconds to apply the glue and join the surfaces together. There is no need to clamp, so it's handy for tacking things together. Its unsuitable for joinery, however. The glue is weak, glue lines are thick, and there is no way to get complicated joints together before the glue sets up. ▲

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GLUE JOINT MECHANICS

What makes glue work? As you might expect, glue penetrates the porous cell structure of the wood and forms a mechanical bond. But, surprisingly, most of the strength of a glue joint is not mechanical.

Here's what happens. The glue flows into the pores of the wood. On a molecular level, this contact between the glue and the wood is so close that it gives rise to what chemists call *van der Waals forces*—weak attractive forces that act on neutral atoms and molecules caused by electric polarization of these particles. The attractive force of a single bond is weak, but the number of interactions between the glue and the wood is so large that the overall effect is a bond stronger than the bond between the wood fibers. Regardless of the glue you choose, the bond in a well-prepared joint is stronger than the wood itself.

The key to a strong bond is a well-prepared joint. The strongest joints have a glue line only a few thousandths of an inch thick. It's clear that gaps are unacceptable when gluing up a tabletop, but hidden gaps—in a mortise-and-tenon joint for example—will seriously weaken the joint. Most glues shrink as they dry, and internal stresses in thick seams of glue cause the glue to fail. Some glues, like epoxy, are gap filling, but don't consider that an invitation to leave gaps. If the joint doesn't fit well dry, don't count on glue to hold it together.

The strongest glue joint occurs between two long-grain surfaces. A joint between two pieces of end grain is only about 25% as strong as a long-grain-to-long-grain joint.

Some woods exude oils and resins that interfere with the glue. These substances tend to migrate outward to a freshly cut surface. Most woods still glue well up to 24 hours after the joint has been cut, but oily woods like teak and rosewood need to be glued as soon as possible after machining. Some people recommend cleaning the wood with acetone shortly before gluing to remove trace oils.

The surface of the wood is important to getting a good glue joint. It must be smooth, flat and free of debris for close contact over the entire area. Hand planing is an excellent way to achieve these objectives.

How much difference does the method of preparing a surface make in actual practice? Very little, according to Dr. Robert Snider, a chemist at Franklin International, a manufacturer of adhesives. As long as you don't crush the wood fibers by using dull planer, jointer or saw blades, glue works equally well on hand-planed, machined, even sanded surfaces. If you sand, don't finish with a paper coarser than 50-grit, and remove the dust according to Snider.

When gluing a joint, should you apply glue to one surface, or both surfaces? In order for glue to work, you must make sure that the glue wets *both* surfaces to produce the required intimate contact between adhesive and wood. The easiest way to do this, particularly when edge gluing, is to coat both surfaces. For closed joints such as the mortise and tenon or dovetail, glue can cause the parts to swell, making it impossible to assemble the joint. On these joints, glue only the leading edges and let assembly of the joint spread the glue.

How much glue to use? Aim for uniform coverage, and apply enough so the glue is still wet when the joint is assembled. You want a little excess glue to be squeezed out upon clamping but not enough to cause a mess. Flexible plastic spatulas meant for applying auto-body filler are excellent for spreading glue as are credit cards. The lower the angle that you hold the applicator, the thicker the spread.

The purpose of clamping is to spread the glue equally across the surface of the joint. If the joint fits well, you need only clamp snugly.

Finally, moisture content of the wood is also important. In general, you can't count on an adhesive to work properly if the wood moisture content is much over 12%. For interior work, 6% to 8% is the ideal moisture content.—*W.C.J.*

Gentle Curves
Update Classic Design

BLANKET CHEST

Old-fashioned joinery with a clean, modern look. This blanket chest features mortised frame-and-panel construction.

BY IVAN HASS

When I designed this chest, I had been thinking about practical, simple furniture: Shaker furniture, early New England styles, and the Spanish-influenced furniture of Texas and the Southwest. As I thought, I found myself sketching a lot of six-board chests—chests with the sides, top and bottom each made of a single board. When I started thinking of frame-and-panel chests, I experimented with the idea of adding some curves to the legs. This chest, with pine panels, oak legs and frame, and cedar bottom was the result.

When I build, I pay attention to the overall look of a piece. If an unplanned detour will improve the appearance, I take it. Originally, I had intended to center the middle stiles in the sides of the chest, but as the design progressed, I discovered that doing so made the chest look busy. Moving the stile off center gave the chest a more relaxed appearance, and the side panels then echoed the asymmetry of the front panels. I took the detour and positioned the stiles as shown.

I also pay attention to the grain as I build. On this chest, I decided the grain in the center panel should run horizontally, unlike the grain in the panels on either side of it. This change in grain direction isn't crucial to the design, but I liked the way it worked with the wood I had. If I'd been able to cut all three panels from a single board, I probably would have aligned them so that the grain flowed from one panel to the next.

Most of the chest's joinery is straightforward. The frame is mortised and tenoned together. The panels float in a groove in the frame. Fig. 1 shows the approach I took and displays the information needed to build the chest.

The curved legs, which are bandsawn out of thicker stock, present the only real challenge. Cut the mortises and the panel grooves before bandsawing and

PHOTOS BY RIC WOLFORD

shaping the legs. Note that the tenon on the upper rails is haunched as shown in Fig. 1. Note, too, that the mortises on each leg run into each other. Miter the ends of each tenon, as shown, to get the longest possible tenon in a tight space.

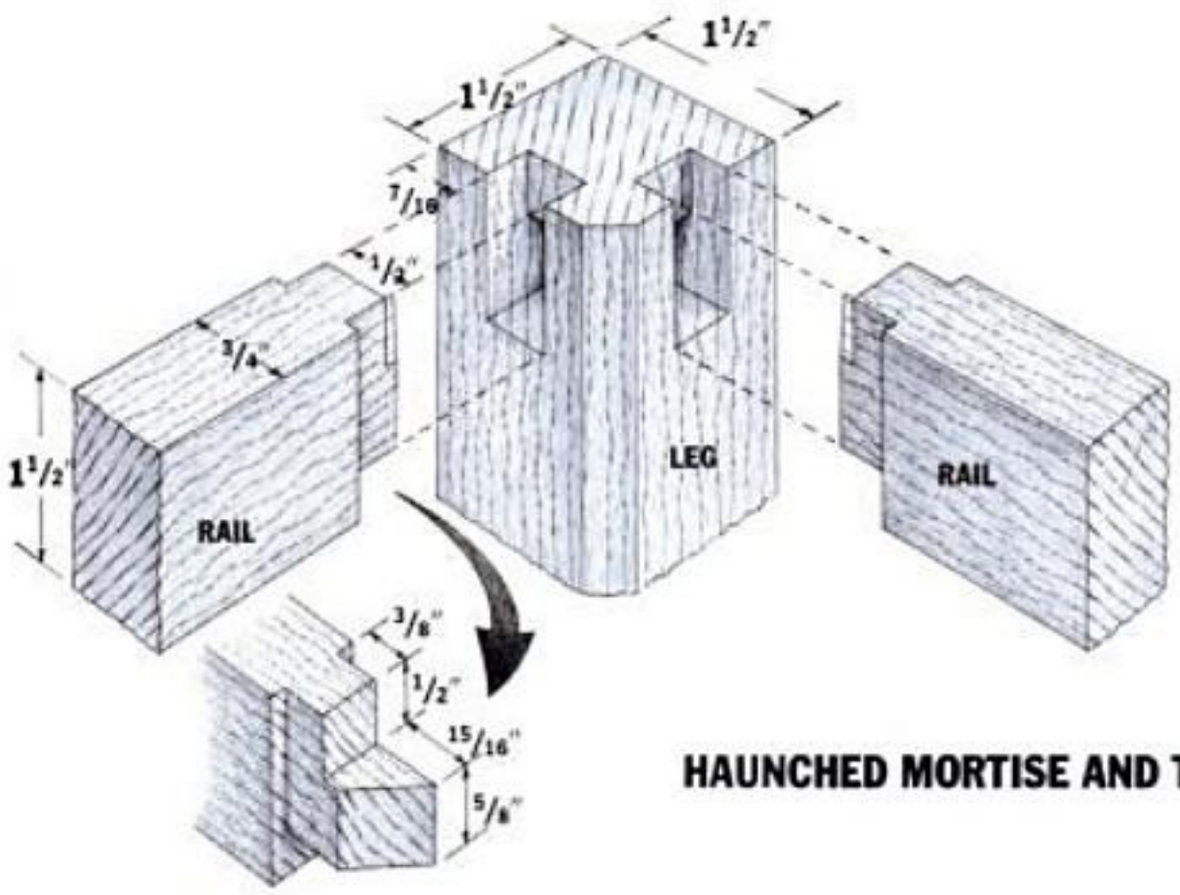
When cutting a haunched mortise, think of it as two adjoining mortises, one on top of the other. The upper mortise is shallower and runs right out through the top of the leg as shown. I cut this mortise with a series of cuts on the router table, each cut slightly deeper than the next. I then cut the deeper mortise by raising the bit and lowering the wood onto the spinning bit at the appropriate place as shown in the drawing. I cut the mortise in a series of progressively deeper cuts to reduce chatter.

I cut the haunched tenons on the tablesaw by making repetitive cuts with a dado head. Think of cutting a haunched tenon as subtraction: Just cut a full-width tenon, then trim it to create the haunch.

After you've cut the joints, rout a groove for the panels in the legs, stiles and rails. Chamfer the inside corner of each leg. The chamfer not only is pleasing to the

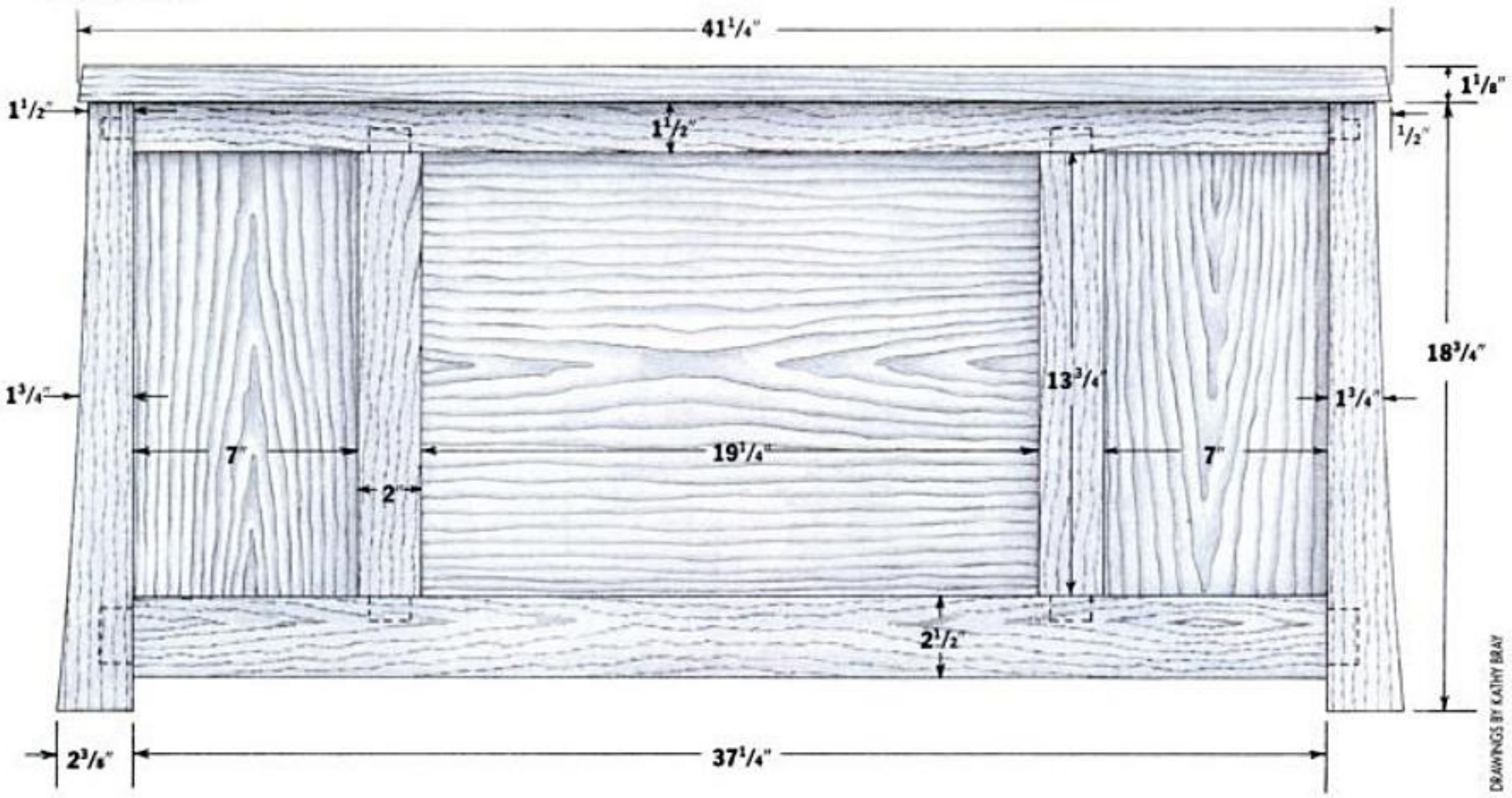
The bottom of the chest fits into grooved ledger strips glued to the insides of the bottom rails.

FIG. 1. FRAME-AND-PANEL CHEST



HAUNCHED MORTISE AND TENO

FRONT VIEW



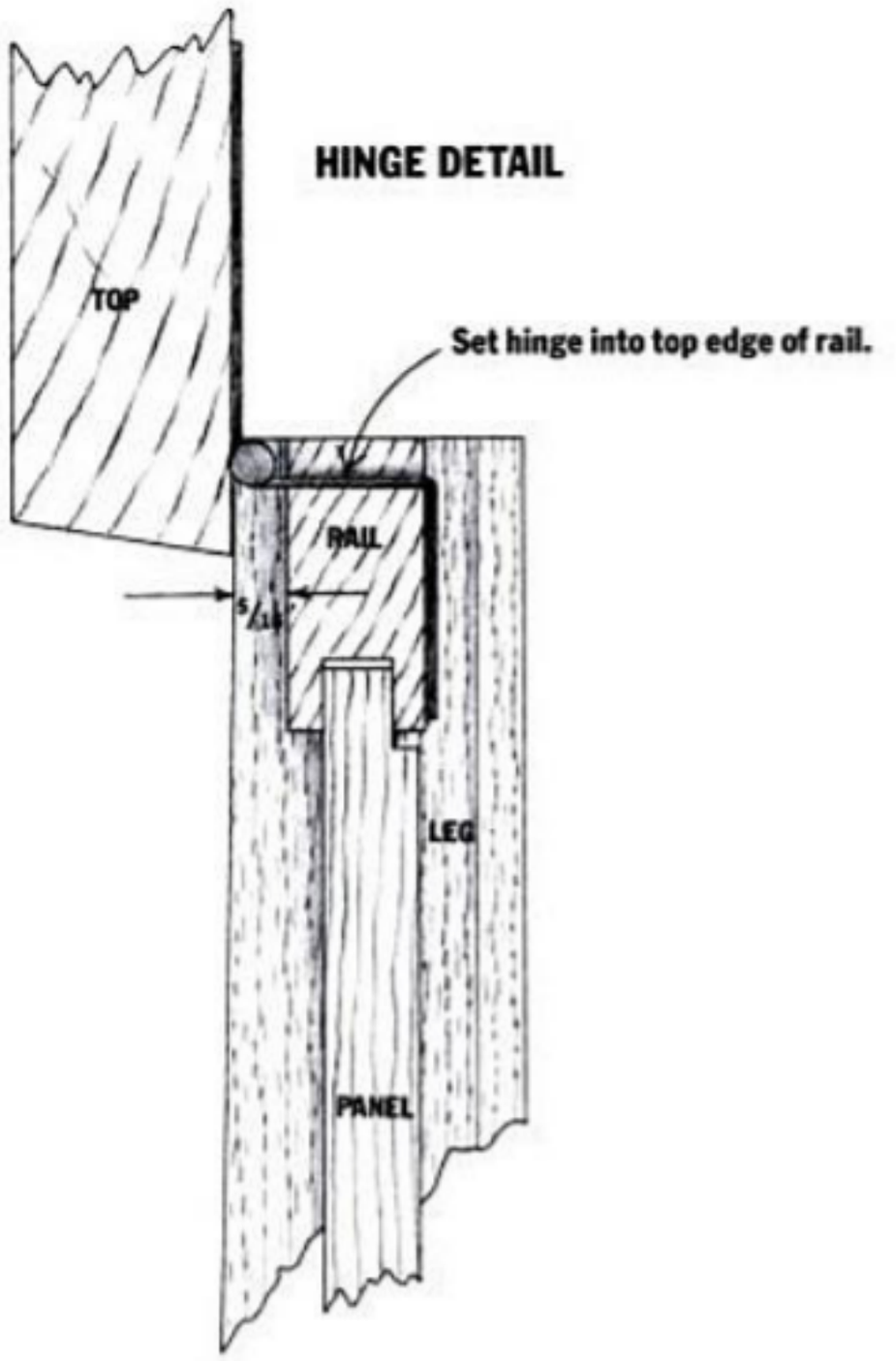
DRAWINGS BY KATHY BRAY

eye, but you'll appreciate the relieved edge the first time you bang your knuckles into the leg while rooting around for a sweater at the bottom of the chest.

Only after you've done all this is it time to bandsaw the legs to shape. Just two surfaces of the leg are curved as shown in the drawing. I've given the width of the leg at the top, bottom and center for the curve I used. To recreate the curve, lay the three points out on a cardboard template, and flex a piece of thin wood between the points to form a true curve. Trace the shape onto the template, cut out the template, and lay out the curves with it. After bandsawing the legs to shape, I cleaned up the kerf marks with an inshave (available from Constantine's, 2050 Eastchester Rd., Bronx, NY 10461) and a scraper.

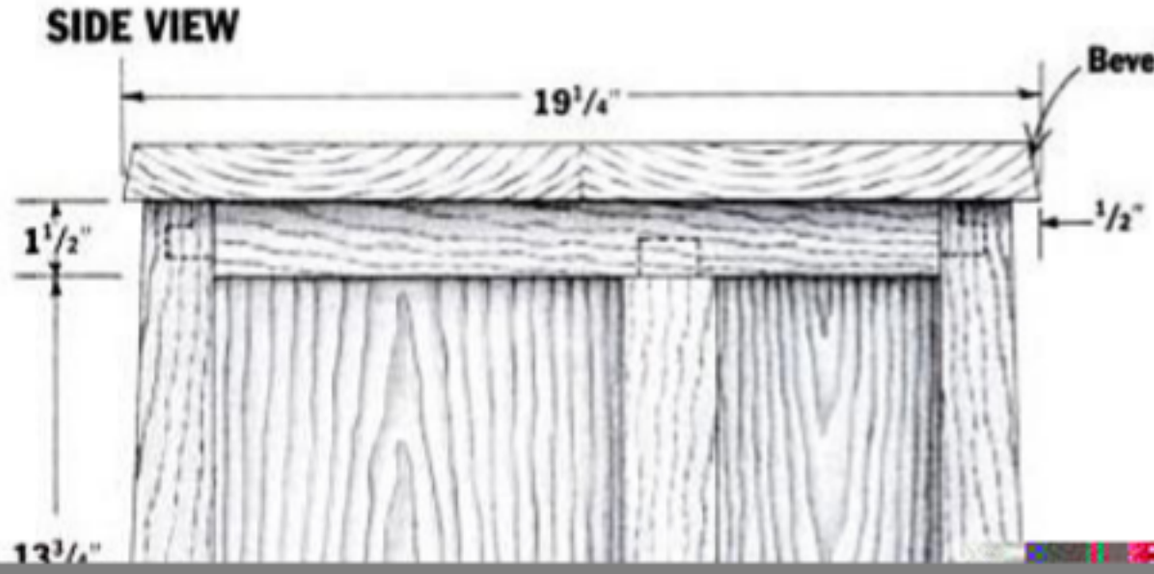
There are several ways to make the flat panels that

HINGE DETAIL

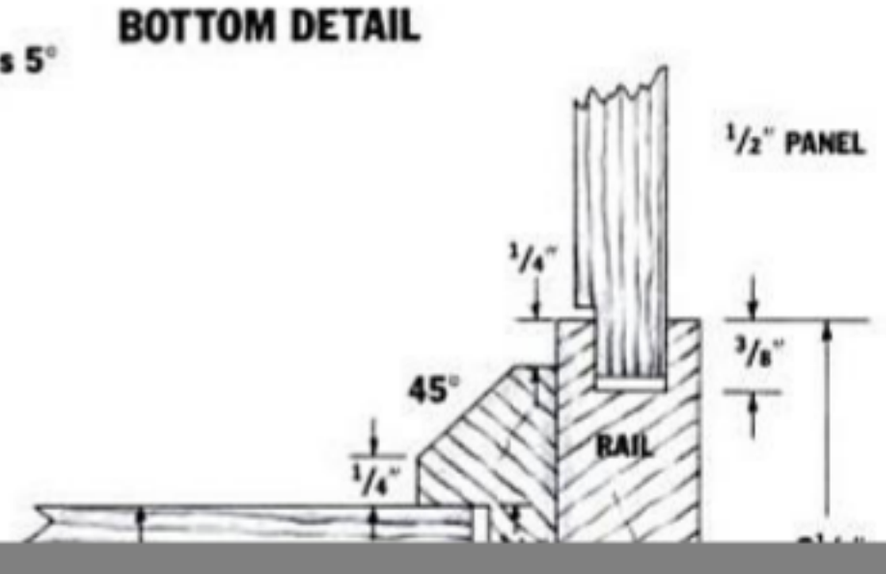


The hinge is flush-mounted on the lid and inside surface of the rail and set into the top edge of the rail.

SIDE VIEW



BOTTOM DETAIL



BOOKS & VIDEOS

BOOKS

Wood Repair, Finishing, Refinishing

by Allan E. Fitchett
(1989, Albert Constantine and Son, Inc., 2050 Eastchester Rd., Bronx, NY 10461) paperback; 135 pp; $9.95.

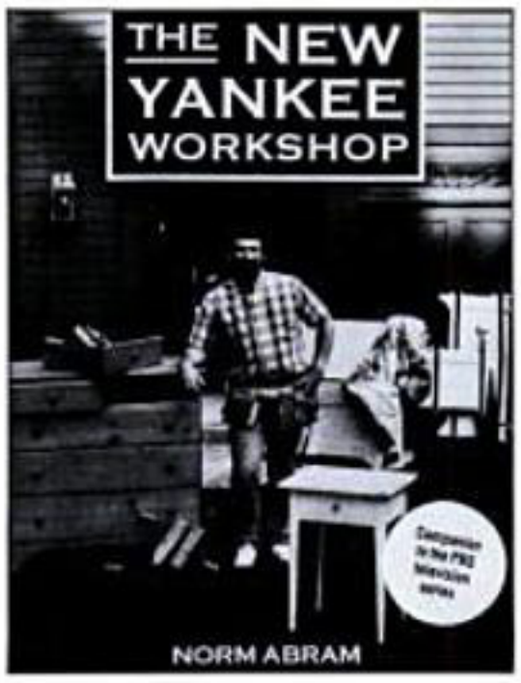
This book is like many others on the market: It's pretty good on techniques but weak on materials. Especially good are the sections on joinery, veneer repair, sharpening the hand scraper, and caring for aerosol spray cans. Most readers will pick up some new trick or procedure.

What's lacking is a useful discussion of materials, especially glues and finishes. We're given lists and technical descriptions but no guidance on choosing the proper finish or glue. We're instructed, often in bold type, not to do this or that, and then given no explanation. My favorite: "Do not attempt any finishing process if the humidity is above 50%." Where I live the humidity is *always* above 50%! What do I do now?

Much of the information about what the materials are made of is incorrect. We're told that pigmented oil stain is made from dyes, that padding lacquer is a lacquer, and that silicone is present in modern strippers. For the record: pigments and dyes are chemically different; padding lacquer is primarily shellac; there is no silicone in stripper. How can we ever expect to succeed in our craft without correct information about the products we use?

Perhaps worst of all, we're told that newer materials such as yellow glue and polyurethane are "superior" to hot hide glue, shellac and varnish. Superior in some ways, perhaps, but there's a tradeoff. We gain water- and solvent-resistance and perhaps greater toughness at the expense of reversibility. If we expect the next restorer who works on the piece to avoid seriously damaging what we repair, the finishes and glues we use must be easily removeable. It may be all right for manufacturers to neglect this point in favor of stressing durability, but it's unforgiveable in a book about saving old furniture.

BOB FLEXNER



The New Yankee Workshop

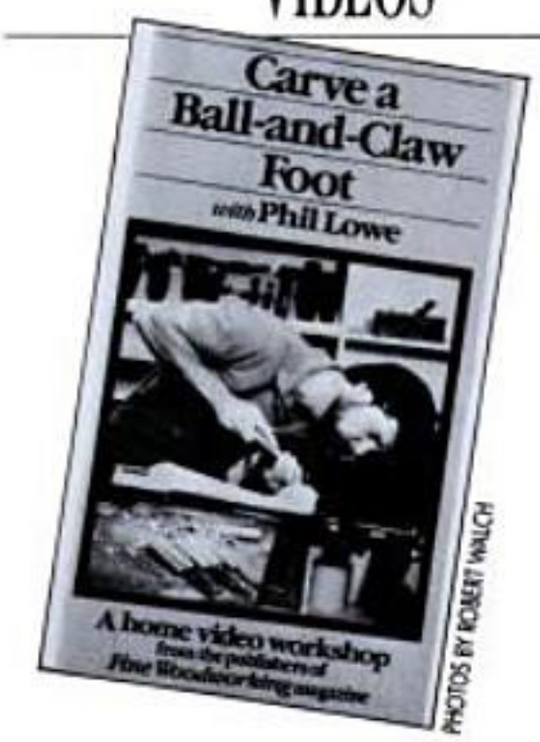
by Norm Abram with Tim Snyder
(1989, Little, Brown and Co. 205 Lexington Ave., New York, NY 10016) 181 pp; paperback; $16.95; hardcover; $24.95.

In this book, you learn by doing, and you learn a lot. Norm Abram, of public television's "New Yankee Workshop" and "This Old House," takes you step-by-step through 12 different, traditional furniture projects. New techniques are introduced in each project, encouraging you to add skills such as lathe turning and mortise-and-tenon construction to your repertoire.

Projects range from a simple candle stand to a large hutch and are largely inspired by Shaker furniture. Each project starts off with a "project planning" section which specifies tools, materials and estimated construction time. A full-color photo of each piece allows you to see what you'll end up with. Sharp black-and-white photos and large, three-dimensional diagrams illustrate the fine points of construction. The detailed text is intelligent and lively, with a first-person presence that brings clarity and a feeling of involvement to the reader.

DAVE SELLERS

VIDEOS



Carve a Ball-and-Claw Foot

with Phil Lowe
(1985, The Taunton Press, Box 355, Newtown, CT 06470) Length: 115 min.; VHS and BETA; $39.95.

The ball-and-claw foot is a classic and distinctive element of 18th-century furniture. It can also seem like an intimidating and difficult carving project, even for experienced woodworkers. In this easy-to-understand video, furniture maker and teacher Phil Lowe takes the mystique out of the ball and claw and leads the viewer through the production of a classic, Philadelphia-style leg.

Lowe begins with a brief history of the ball and claw and the development of its various styles in 18th-century America. He discusses planning and laying out the leg to meet particular needs. In a casual, conversational manner, Lowe then moves from the drafting table to the workshop. He shows how to bandsaw the leg blank in preparation for carving. The rest of the video is a very detailed and well-photographed discussion of exactly how to carve and shape the foot from first cut to final smoothing.

Lowe also discusses the selection and use of carving tools, how to keep them sharp, and how to let the tool do the work for you. While the discussion assumes the viewer has some woodworking experience, anyone with an interest in fine furniture will find this video fascinating and informative.

MITCH MANDEL

GALLERY

CURRENT WORK BY OUR READERS

The wall cabinet is a special item in the realm of furniture. While people tend to use bookshelves, desks and bureaus to store their everyday items, wall cabinets are homes for special objects. A wall cabinet's appearance often reflects this personal use. Some of the cabinets you see here are designed to display their contents while others seduce you into opening them to discover the keepsakes hidden within. Each one is as distinctive as the personal items it will hold.

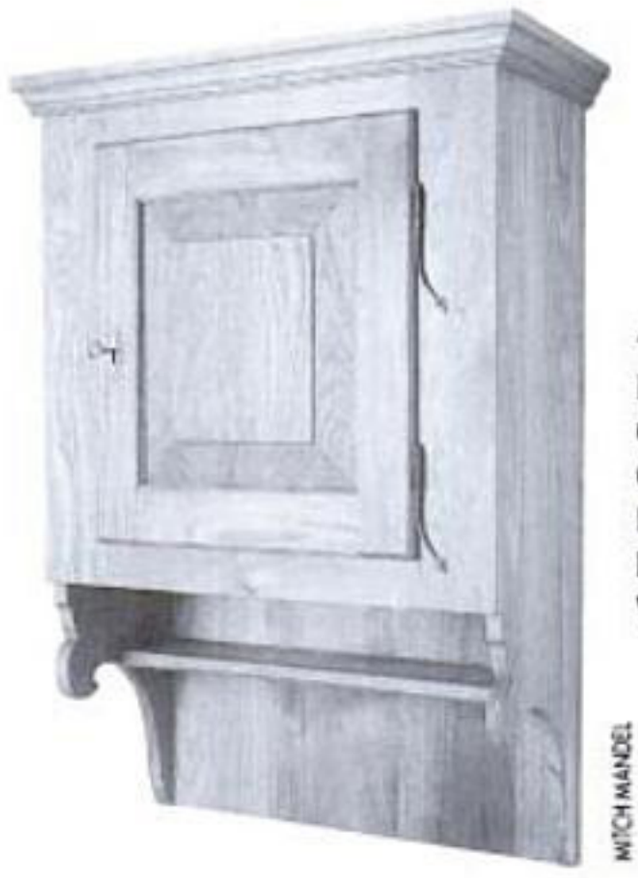
PHOTOS BY SARAH LAMBERT

"Jewelry Cabinet." By Kenneth S. Burton. Interior.

"Jewelry Cabinet." By Kenneth S. Burton, Jr., Penland, North Carolina. Cherry, ebony. Dimensions: H: 26 in., W: 14 in., D: 6 in.

SEAN SPRAGUE

"Display Cabinet." By Dan Stalzer, Fort Bragg, California. Elm, ash, Japanese white oak, glass. Dimensions: H: 25½ in., W: 21 in., D: 5½ in.



MITCH MANDEL

"Traditional Pennsylvania Hanging Cabinet." By Michael Eric, Coopersburg, Pennsylvania. Black walnut, iron rattail hinges. Dimensions: H: 36 in., W: 23 in., D: 10 in.

GALLERY

CURRENT WORK BY OUR READERS

SEAN SPRAGUE

"Wall Cabinet." By Jim Fuller, Sebastopol, California. Teak, bocote. Dimensions: H: 34 in., W: 16 in., D: 7 in.

"Wall Cabinet." By Jim Fuller. Interior.

"Hanging Cabinet." By Nathan Esau, Newton, Kansas. Doussie, Douglas fir, glass. Dimensions: H: 27 in., W: 19 in., D: 9 in.

SEAN SPRAGUE

"Separation." By Owen Edwards, Snowmass Village, Colorado. Eastern cherry, Eastern maple. Dimensions: H: 28 in., W: 18 in., D: 8 in.

NATHAN ESAU

Want to see your work in Gallery? Send photographs and a description of the piece to: AMERICAN WOODWORKER, *33 E. Minor St., Emmaus, PA 18098. Only black-and-white prints (4 × 5 in. or larger) or color slides will be accepted. Please do not send color prints or snapshots. Enclose a self-addressed envelope for return of photos.*

FINAL PASS

Nothingfree

I would like to save my fellow woodworkers a great deal of potential embarrassment and money by relaying an innocent but not-so-small blunder of mine. As manager of Martin Guitar's wood-products division, I get lots of calls from people who want to sell large quantities of wood. I like to find out exactly what they are selling and at what price even if I'm not interested in buying at the time. After all, it pays to know for the future. And I especially like to get free samples of the various species for reference or to add to my expanding wood collection that I prize in my very neurotic fashion.

I received such a call from Rio de Janeiro from a fellow named Dean who spoke flawless English. As we talked (at his expense) he mentioned that he'd been working for a wood distributor in Brazil and had seen our ad in *AMERICAN WOODWORKER.* I asked him about Brazilian rosewood (*dalbergia nigra*) and explained our desire to get high-quality billets at a reasonable price. Ha! I also asked about any other Brazilian species I was vaguely familiar with.

Well, Dean and I became great pals. And though I wasn't really interested in anything but *dalbergia nigra,* I led him on and finally asked if he'd send some *free* samples. He responded immediately and got a small box of about 20 samples off to me *at no charge.*

The box arrived by air in record time, again at his expense. I loved the samples, though I'm convinced one of them caused a skin rash that plagued me a month until I paid a dermatologist a fortune to cure me.

That wasn't the worst of it. A few days after the samples arrived, the head of Martin's shipping department called asking why I hadn't filled out a receiving report for the box. I indignantly told him the samples were free, and since there was no invoice involved, I thought it a waste of company time to fill out a receiver form.

It was then he let me have it. The importation fee on my tiny 2-lb. box was $127.36! There is no such thing as *free* if it's shipped from outside the U.S.

My jaw dropped. Some little guy in an air-conditioned office got $100 to sign a couple of customs permits. Is the whole world corrupt? Did my buddy Dean set me up? Will I be able to face the shipping manager again? Is this rash contagious?

The sad part is that the sample of *dalbergia nigra* was a complete bust. It was some off species, though I suspect Dean thought it was the real thing. He'll probably sell 1,000 feet to some guy for 9 million pesos, and the poor jerk will itch for months, not know why, and his wife will probably leave him in a state of bankruptcy.

I guess it's true. Never look a gift horse in the mouth, and never take a wooden nickel. Nothing is free in this world except this advice—until you get my bill!

DICK BOAK

Big Jointer Winner

In the May/June, 89 "Final Pass" we dared you to come up with a jointer bigger than Glenn Bostock's monster "Porter" jointer, whose tables measured 24 in. wide and 86½ in. long. We got lots of big ones, (Olivers mostly) but the hands down winner was another "Porter," sent in by Wayne Huebinger of San Antonio, Texas.

Wayne's jointer is a Porter Model 300 CM, Serial #5742, made by the C.O. Porter Machinery Co. of Grand Rapids, Michigan (now defunct). The tables measure 32 in. wide by 95 in. long. It has a 30-in., four-knife head powered by a 10-H.P., direct-drive motor with a power feeder perched on top.

Wayne wins 50 bucks, an *AW* T-shirt and a 1-year *AW* subscription.