

SEPTEMBER/OCTOBER 1980, No. 24, \$3.00

Fine Woodworking

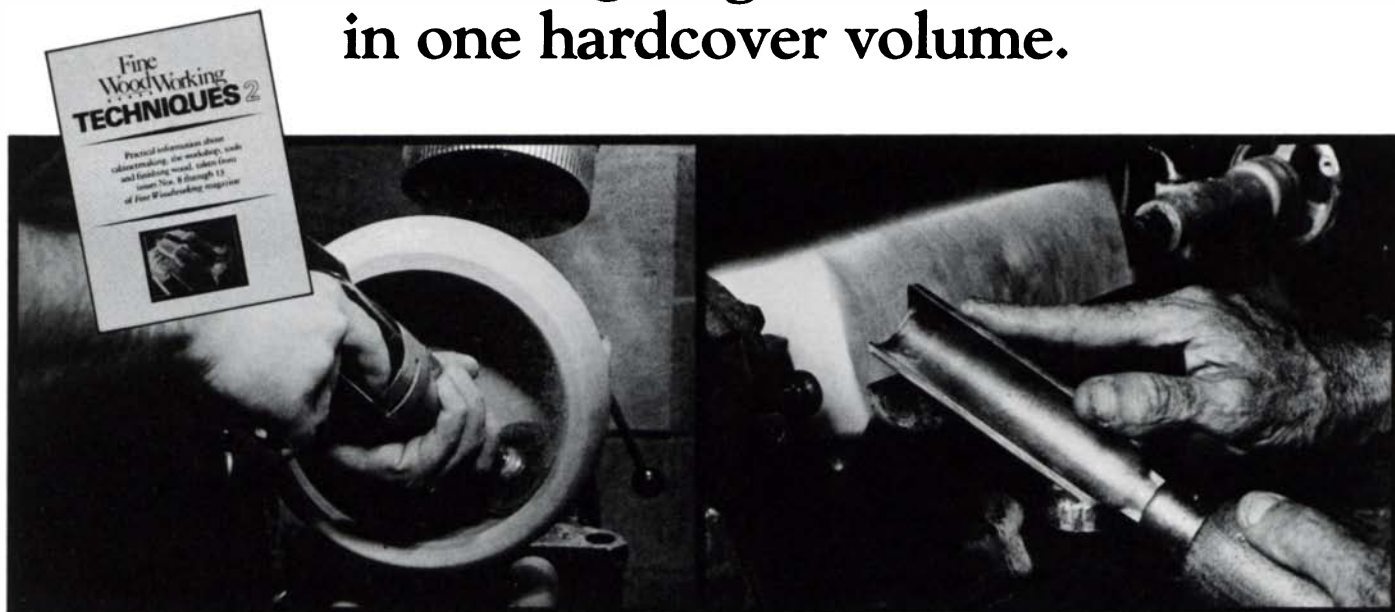


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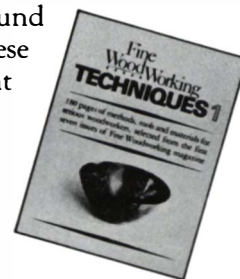
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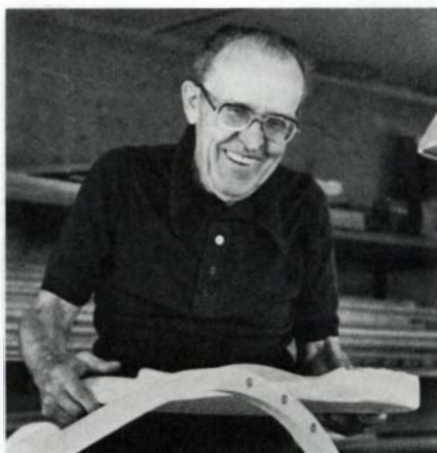


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On the cover: A view inside Andy Marlow's shop in York, Pa., shows how one craftsman has solved the problem of working in limited space. For over 40 years, Marlow has worked here building period reproductions a piece at a time and in multiple runs. Equipped with a 10-in. table saw, a 6-in. jointer, an 18-in. band saw, a jigsaw, a homemade stroke sander and a drill press, his shop has proven adequate for production at a commercial pace. Beginning on p. 46, Marlow and four other veteran woodworkers offer advice on setting up small shops. Most of the articles in this issue also deal with the practical side of setting up a woodworking shop, from choosing machinery and tools to selling what you make with them.

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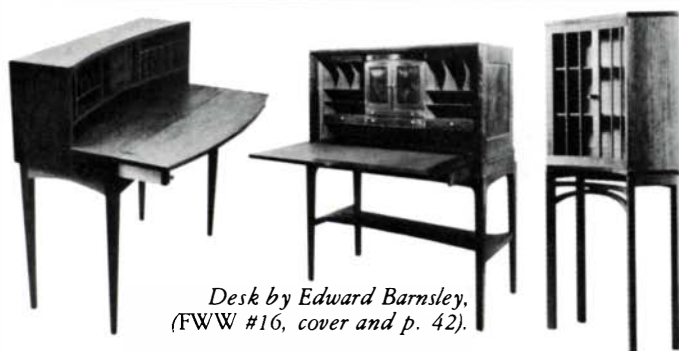
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Desk by Edward Barnsley,
(FWW #16, cover and p. 42).

Desk by Simon Watts,
(FWW #20, p. 75).

Showcase by James Krenov,
(FWW #18, p. 44).

It's a treacherous subject, criticism. But I must comment on the pigeonhole desk by Simon Watts and compare it with two other cases on stands you've published recently. The Barnsley desk and Krenov showcase are largely successful, masterly in certain ways. The Watts desk succeeds only in part.

How do the case and stand relate to one another in these designs? In the Barnsley desk, they meet in an obvious transition in two steps. The motif of a broad element flanked by two narrower ones recurs regularly in the stretcher, the drawer fronts, the fall front, and on the top of the case. Inside, there's the same arrangement, though probably not the same dimensions. Conceivably the motif is overworked, but here is thought, great care, and life.

The Krenov showcase sits firmly across its stand, the apparent weight carried down the sides. Where the parts meet there is a slight swelling in the breadth of the stand. At the sides a polished band of end grain defines the bottom of the case, then a cove carries the eye outward onto the rail of the stand. At the front the concave facade of the case determines the curve of the stretcher (which plays a change with an additional curve in the vertical plane), as well as the most interesting inward rotation of the legs. A calculated space separates the stretcher from the bottom of the case, there being no pretense of support. Again we find a theme of threes: the glazing, the shelving, the door stiles, the stretcher divisions.

The Watts desk, while attractive in some generally modern way, puzzles the eye. The case appears to have been partly cut away and sits improbably on a stand about an inch smaller all around than itself. The forward part of the case, under the writing surface, has no visible support and looks as if it might snap off. This is a serious fault. There is not much relationship between the case and its stand, which might formerly have seen service under an oval or rectangular tabletop. The front rail looks unreasonably slender to support a thick mass of wood comprising the folded surface, the drawer fronts, and the bottom of the case. On the other hand, the curves on the front of the case, together with the cleverly stopped curve of the folding writing surface, look pleasant indeed, and the sweep of the rail does something to relate stand and case.

What, I wonder, is the logic of the folding surface? It makes the desk compact, but to operate the system one needs to clear everything off the surface back to the shallow space under the pigeonholes, and all the clutter remains visible. Without making the desk any bigger, one could have had a slant-top or fall-front, with their desirable abilities to cover the mess and lock away the private or the valuable. Or if the curves are the essence of the piece, then I wonder at the missing tambour door that would normally complete the idea.

The interior of the Barnsley desk is rich in conscious arrangement. Thin oak lightens the whole, and there is play with color, shadow and bright points. The space under the pigeonholes is generous, and the three drawers at the top integrate them with the case. Notice the alternative in the

Watts desk: redundant and rather thick framing around the pigeonholes. Some of this material, along with four dovetail joints, would not be necessary if the top and bottom shelves of the pigeonholes were housed directly in the sides of the case, a simpler and more satisfying construction if the use of contrasting wood is not contemplated. The top of the pigeonholes would thus be a drawer's depth below the top of the case, with the visible purpose of supporting something. Watts' inversion of the divider units left and right seems forced, a distraction from the faulty proportioning of the central file of drawers, which is much too narrow. The flow of opposed curves when the writing surface is unfolded does, however, seem to bound a comfortable space, and the concavity of the whole piece when closed is inviting.

The concave facade of the Krenov showcase likewise invites you in, but intriguingly the case holds things slightly away from you, suggesting care when entering the space. Austere it may be, yet it is purposeful, orderly, full of dignified intention, with a clear rhythm to the march of stiles and bars across the front. There is a different rhythm to the facade of the Barnsley desk, weightier, ordering an abundance of surface. The piece is solidly there, apparently forever. Rhythmically, the front of the Watts desk is at odds with itself: in-out, thick-thin, straight-curved. Above are the pigeonholes, always on view, in one realm of division and dimension, while below, in another, are six identical pulls stiffly spaced four-plus-two, further contraried by the three differently spaced bright hinges. Here is noise but no music.

Clean lines and neat work are ordinarily necessary but they are not sufficient. To choose our mentors we require evidence of careful thought and conscious artistry, and a considerable amount of perception made substantial in the work.

—Kenneth Rower, Newbury, Vt.

SIMON WATTS REPLIES: I am flattered that Ken Rower should compare my work with Edward Barnsley's. Barnsley had established his reputation long before I was born, and I consider him to be the foremost furniture maker in England. I am less than flattered to have my desk compared to James Krenov's showcase, for I have done enough repair work to know how fragile that base really is.

My objectives are different from either Barnsley's or Krenov's. I want to make handsome, durable pieces that ordinary people can afford. I don't want to work for museums or for the very rich. I also like to use the shop to train young people, which necessitates straightforward designs that can be made by apprentices. This is why most of my work has a simplicity of design and construction that Rower faults, but which my clients enjoy.

"Drawing the Ellipse" (FWW #22, May '80, p. 73) came at a perfect time. At the custom shop I work at, we were doing some furniture for a Saudi Arabian client, and one of the pieces I had to construct was an elliptical dining table (48 in. by 78 in.) with an elliptical base. Such a table wouldn't be difficult if the top were a solid lamination. However, since the bosses were worried about the wood (white oak) moving and possibly checking en route to Saudi Arabia, it was decided to make the top out of ¾-in. white oak plywood with solid banding 1½ in. thick by 1½ in. wide. The top was to be rabbeted to receive the banding. . . .

I decided to try to hook up a router to the jig described in the article. By using combinations of template guides, with straight and rabbeting bits, I hoped to swing the ellipse with the attached router (and a ¼-in. straight bit) and use the inner ellipse as my tabletop guide and the waste Masonite as templates for freehand shaping of the solid banding.

The router ran smoothly except where one of the guide dowels in the jig moved through the intersection of the tracks. I had a fellow worker position a piece of wood as a stop

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at each intersection while I ran the router around the full ellipse. A little filing was needed to smooth up the edges left by the router... and I felt the setup was a success. The next time I am going to make the jig with some type of T-slot or sliding-dovetail arrangement to guide the router more smoothly.

—William Tappe, Denver, Colo.

With regard to John Lively's article on French fitting (*FWW* #23, July '80), I would add a word of warning about using leather for the lining. The old gunsmiths knew what they were doing when they used cloth to line fine gun cases. Leather is tanned using various acid washes, and even though it is rinsed repeatedly, a small amount of this acid remains. Leather is also hygroscopic and when you have these two enemies of steel—acid and water—in combination, corrosion is bound to occur. Storing guns in contact with leather for long periods inevitably leads to corrosion at the point of contact...

—Joseph T. Whilaw, Jr., Forest Hill, Md.

JOHN LIVELY REPLIES: The unfinished leather of pistol holsters will leach oil from the metal and make it vulnerable to oxidation. The finished side of upholstery leather, however, is impermeable and will neither absorb oil nor react with the metal. In fact, in the 15th and 16th centuries, armorers commonly stored pistols in hard leather cases that were treated with tallow. Any gun will rust if not provided periodically with a film of oil, regardless of the case it's kept in.

Re William Woodcock's suggestion for using propane to displace air and lengthen the shelf life of partly filled cans of finish (*FWW* #22, May '80, p. 4). I want to warn readers of the extreme danger in using propane to displace air or for any reason other than for heat. Perhaps Woodcock is not aware

that he is creating small bombs in his workshop... Propane gas is heavier than air and will settle in confined spaces, propane will saturate clothing, and propane is highly flammable. The slightest spark will ignite it. Imagine the explosion that could result from a quart can of varnish filled with propane gas if a spark were made while opening the lid.

—Farren Lander, North Vancouver, B.C.

... Try filling the half-empty can with marbles to bring the liquid up to the top. This forces out the air...

—A. E. Dameron, Galesburg, Ill.

... My solution for years has been to displace unwanted air in cans of paints and varnishes with old light bulbs. Also, the last half of an expelled breath is nearly oxygen free, and not explosive like propane...

—Gilbert A. Pitman, San Leandro, Calif.

I'm writing in regard to Donald E. Wetzler's comments on foreign tools (*FWW* #22, May '80, p. 13) and why he buys only American tools. My father and I have many fine American-made woodworking tools that we use daily, some of which were my grandfather's. They were made by Stanley, Millers Falls, Winchester and a host of other names one doesn't hear anymore. These tools are all one could ask for; the quality is super and the designs are excellent. Many of these tools were made before World War I. One can easily see why American technology led the world at the time...

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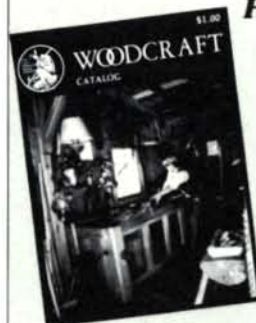


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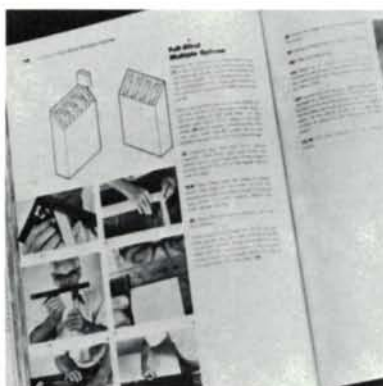
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series, which was Stanley's best, featuring the easily adjusted frog. . . . Sadly, the present Stanley plane is the old Bailey model, which didn't have this clever improvement. . . . Thank heavens for Ken Wisner, who makes the old Stanley edge-trimming block plane, a real beauty. We could use about 500 more Wisners.

When I compare my grandfather's tools to the ones now made here, I get depressed. Our country is in trouble these days because so much junk is made and most people don't know the difference.

—Mark Duginske, Wausau, Wis.

I roared with laughter when I read the name R. Bruce Hoadley—one of your own contributing editors—at the end of the long letter in the May issue detailing the woeful wobble in his newly minted "regular retail \$695" drill press. I am laughing sympathetically, for I am an amateur woodworker and a professional machine buyer. I should like to make an observation about mechanical equipment in general and this bargain type in particular.

Each machine has its own special purpose, and certain of its components are critical to good operation while others are almost incidental. In the case of the drill press, the purpose is to turn and translate a drill on its own centerline with an accuracy on the order of 0.001-in. runout. This requires that the quill spindle be supported in rotating bearings with good concentricity. (Hoadley had 0.005-in. runout at a point which reflects mainly the quality of the bearings.) Next, the chuck taper must be bored coaxial with the centerline of the bearings, and finally the chuck jaws must be coaxial with the taper. Provided that the quill spline then permits coaxial translation, you will have a reasonably accurate drilling ma-

chine. Hoadley's problem may be overcome by reboring the taper hole in a good lathe and then fitting a good-quality chuck. Sears Craftsman chucks, for instance, would be a suitable match. . . . In virtually every other part of the machine, the criteria are stiffness (to prevent vibration and/or elastic distortion under load) and strength (to prevent self-destruction). Hoadley was impressed by the ruggedness of his machine, and I am quite sure it will be adequate once he gets the problems caused by poor machining sorted out.

As a general observation, where precision is required, there are no bargains. Where close tolerances must be held during machining and assembly, expensive equipment is required in the factory, and the amortization of that equipment is a cost that must be included in the price. One notable exception is in the ball bearings which, while having good precision, are phenomenally low in price because of the enormous volume of the major manufacturers. You can bet the company that made Hoadley's drill press did not make its own bearings.

There are a lot of bargains to be had from developing countries like Taiwan but high mechanical precision items are not usually on the list. What Hoadley has purchased is really \$150 worth of materials and rough castings, and \$50 worth of labor to make it look like a drill press. The \$50 was wasted because to make it work right it will need some remachining and reassembly, but the \$150 worth of parts is a pretty good bargain.

—William G. Ovens, Potsdam, N. Y.

Re articles where home-constructed woodworking machines are described, you should be more reasonable regarding the costs. "A Low-Tech Thickness Sander" (*FWW* #21, March '80, p. 50) states that the entire device cost less than



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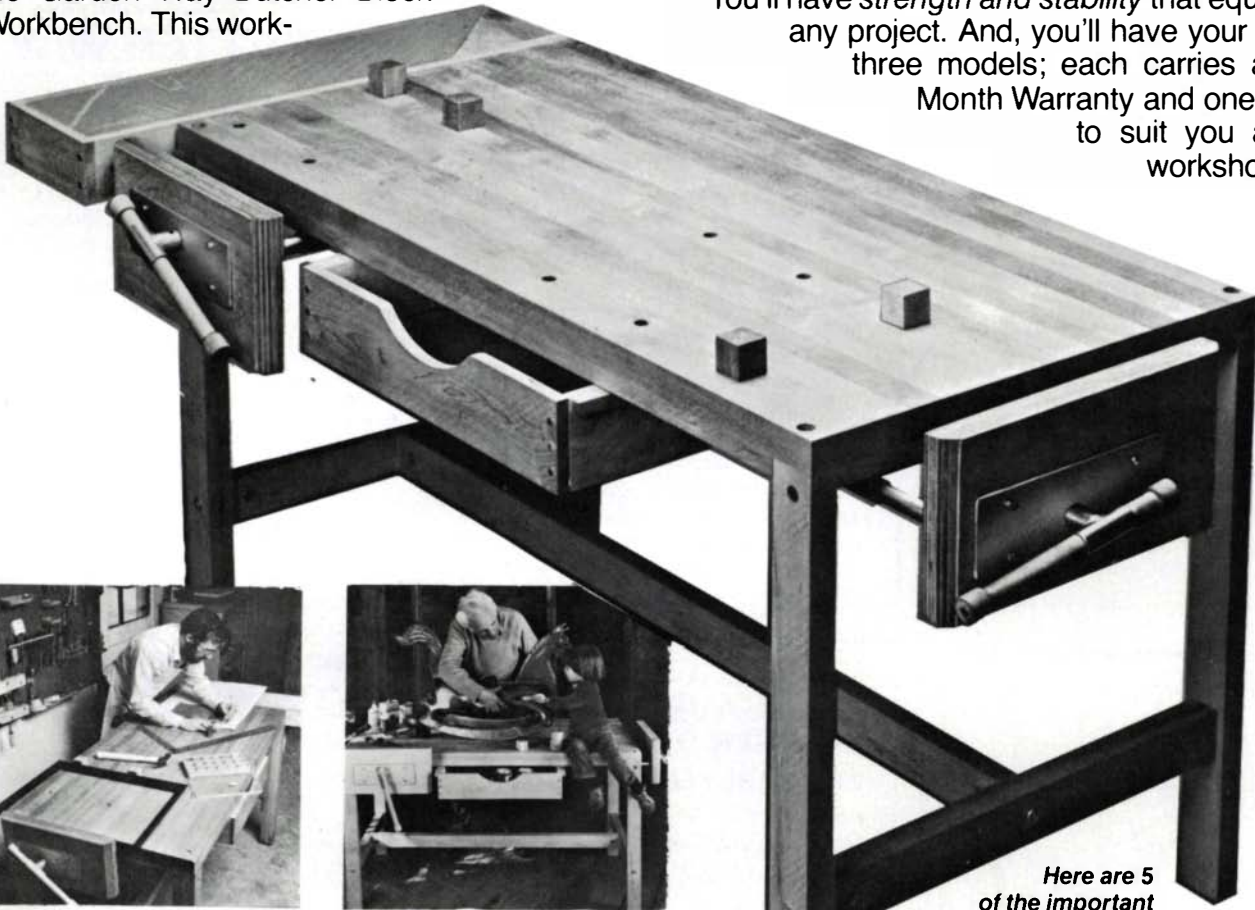
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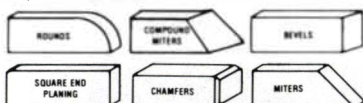
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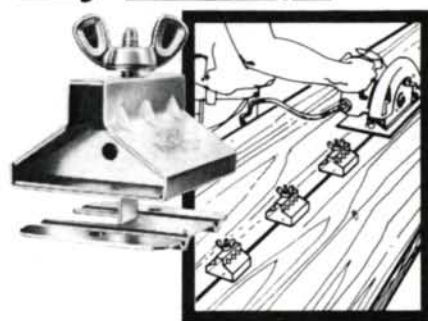


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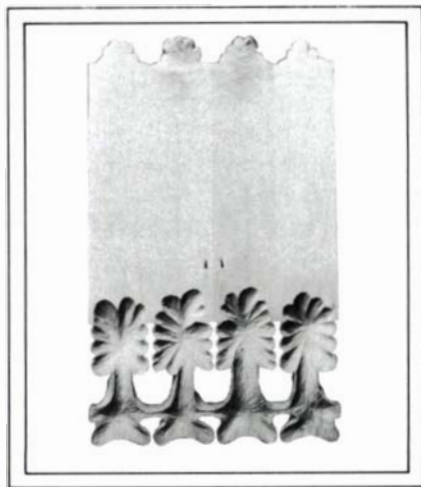


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—Jack Gardner, Anaheim, Calif.

I particularly enjoyed the article about the low-tech thickness sander, so much so that I built one for myself. I turned my drum to 6½ in. in diameter and made it 13½ in. long. I cut two grooves in it, each ¼ in. wide and ½ in. deep—180° apart. This allows me to use three standard 9x11 sheets of sandpaper, one of them cut in half lengthwise. I make a ⅝-in. fold at each end of the sheets, tuck it into the grooves, and wedge with an old hacksaw blade. I can change grits in a few minutes...

—R. A. Wright, Phillipsburg, N.J.

I must comment on Earl Beck's "Shaper Cutters and Fences" (FWW #20, Jan. 80). No one should attempt to operate (much less build) a shaper on the basis of a magazine article. There is no machine in the shop that is more dangerous than this one. I find it appalling that you should encourage people to attempt difficult setups without experienced supervision.

In our shop, we would never ask an employee who is not reliable and safety conscious to operate the shaper. Then we supervise very closely for at least several weeks. Even with an experienced operator, it still pays to check difficult setups before the machine is turned on. If your readers wish to learn to

operate the spindle shaper, I suggest they look for a trade school that has one. If not, a local professional may be willing to tutor. No one should set out to learn this skill without supervision...

—Steve Taylor, Gardena, Calif.

In reading a newspaper article on the economic plight of the Philippines, reference was made to Japanese and American multinationals who are denuding the forests and destroying the watersheds. Most of us are also aware that lumber interests play a major part in the decimation of South American and African jungles that is beginning to alarm the environmentalists. Now on a recent walk through Seattle's Pike Place Market and a glance through *Fine Woodworking's Design Book 2*, I notice a large percentage of woodworkers are using these fancy, exotic hardwoods. Then a stroll through a large department store's kitchen woodenware display makes me wonder about the part we woodworkers play in this situation.

Surely there is a varied enough selection of domestic hardwoods to satisfy our needs, both as producers and consumers. I realize the problems our forest industry faces, and these would be compounded if we all turned to native woods, but imagine the fiasco in those countries that have nowhere near the protective forestry legislation we do.

Perhaps *Fine Woodworking* and its readers are interested in considering these issues when planning for and purchasing imported hardwoods. I am suggesting that as a collective body of woodworkers we can affect this growing problem of timber exploitation, whether for environmental, political, financial and yes, even spiritual, reasons... I am not saying we should stop using imported hardwoods or stop supporting the underdeveloped nations. But the emphasis needs to be

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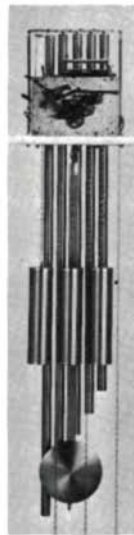
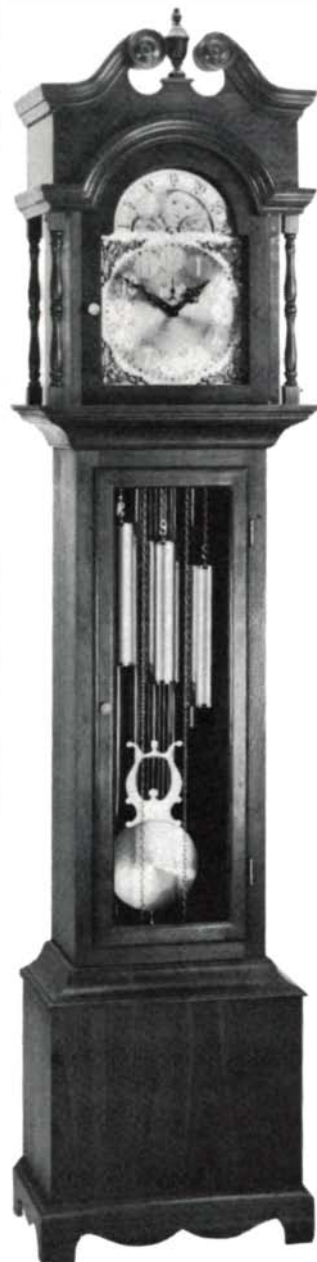


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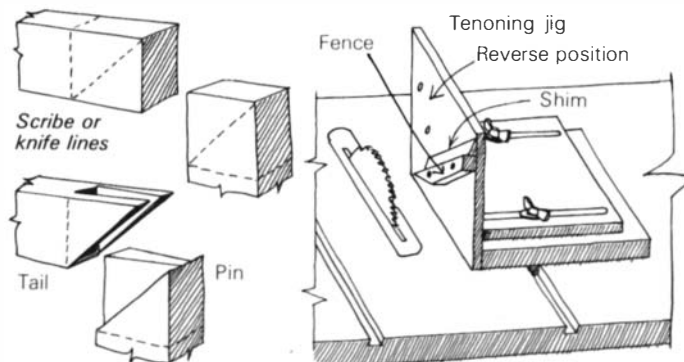
As a collective, I think there are effective measures we can take to rectify this situation. We need to plant more hardwoods, and I wonder if the landowners among us could set aside 10% to 20% of their acreage for hardwood production... Perhaps the urban dwellers among us could support city green-belt plans and land management. There are many innovative ways we can approach this, and I'd be interested in hearing from other concerned woodworkers. . . .

—Sian Newman-Smith, Rte. 3, Box 221,
Marshall, N.C. 28753

An open mortise-and-tenon, slip or bridle joint is no more of a machine joint than a mitred dovetail as Simon Watts suggests (*FWW* #22, May '80, p. 51). I'd rather do the slip joint by hand than the mitred dovetail any day. If I had as many joints to do as in Watts' chair, I'd certainly rather do the mitred dovetail by machine. Anyway, here is how I do it: First, lay out the joint as shown (drawing, above right):

I cut the pin first, using a table-saw tenoning jig with an added shim. To cut the shim, run a piece of scrap stock through the table saw with the blade at the angle you want your tails to slant (i.e., 7°). Screw a 45° fence to the tenoning jig and stand the shim on it (point toward the top). Lay the stock on the fence and run through the saw. Now reverse the 45° fence and run the stock through again.

Now, using a table-saw mitering jig to miter the shoulders, set the blade just shy of full depth and clean up after with a chisel. Use the completed pin to scribe the tail. Saw out the tail using the tenoning jig (this time, standing the fence and



the stock vertically) with the blade tilted to the angle scribed on the tail (the same as the original shim, 7°). Clean out the waste with a chisel. Now miter the tail on the table saw, using the miter jig. I aim for a perfect fit the first time, rather than cutting a little to the waste side, trial fitting and running a hand-saw into the joint on both sides until the miter closes. . . .

—Sy Balsen, Chatham Center, N.Y.

I read with considerable interest Eugene Stephens' excellent article on copyright (May '80). Much of what he says is generally applicable to Canada, but the laws differ in numerous details, and Canadian readers may not rely entirely on the specific provisions discussed. For information in Canada, write the Department of Consumer and Corporate Affairs (Place du Portage, Ottawa-Hull, K1A 0E1 Ontario) regarding copyright, patents, trademarks and industrial designs. . . . The department will also provide a list of qualified patent and trademark agents.

—John F. Griffiths, Orleans, Ont.

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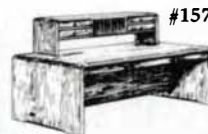
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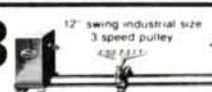
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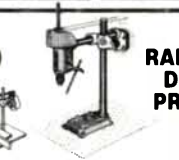
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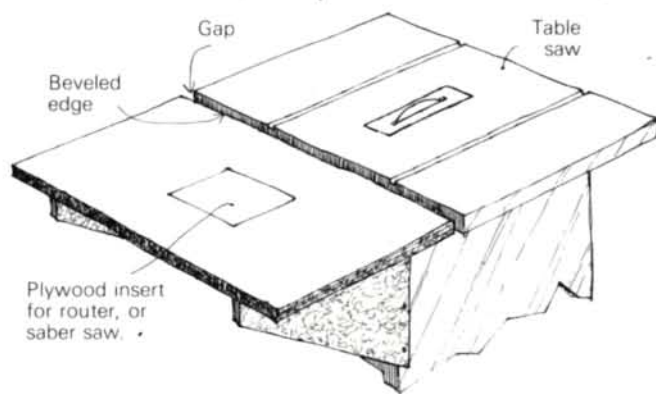
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Methods of Work

Two router-table/table-saw extensions

My shop is too small to endure much more big equipment. So when I needed both a router table and additional outfeed support on my table saw, I combined both functions in the extension table shown in the sketch. Since the table is bolted to the saw, alignment between extension and saw table is better and the table is easy to clean under.

I made the ¾-in. flakeboard table 32 in. wide. Added to the saw table, this gives 44 in. of support. Leave a gap be-

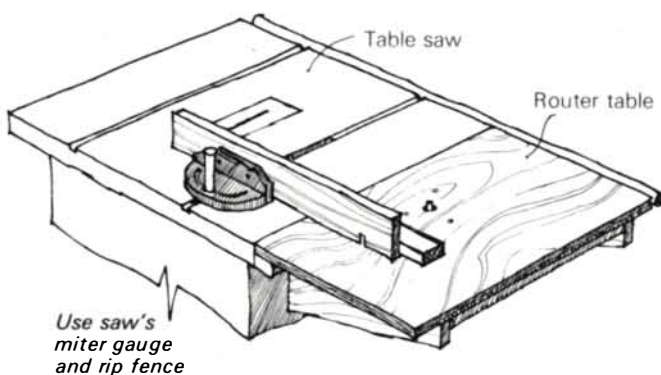


tween the saw table and extension so that a plywood panel can be ripped, then crosscut with a saber saw or circular saw without moving the panel off the table. The blade will travel between saw table and extension. Bevel the front edge of the table so it won't catch work as it leaves the saw table. Cut a 10-in. square hole in the middle of the outfeed table to hold a router or saber saw mounted on 10-in. plywood inserts. Cut another insert blank to fill the hole when not in use.

—W. Davis Smoot, Duncanville, Tex.

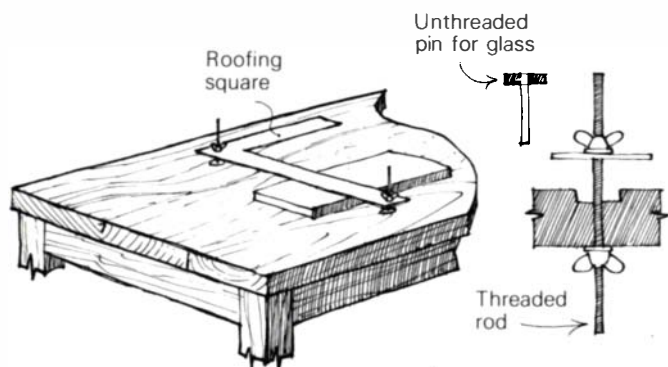
By mounting a router table to the side of the table saw as shown, you can combine the control of the saw's miter gauge and rip fence with the safe, crisp cuts of the router. You'll find the saw's miter gauge useful in cutting cross-grain dados, dovetails and finger joints. Cut mortises, tenons and with-grain grooves using the saw's rip fence. The combination saves shop space and increases the surface area of your table saw. There's no need ever to remove the router table—just lower the bit when not in use.

—Mark Duginske, Wausau, Wis.



Bench-top hold-down

An old steel roofing square makes an excellent workbench hold-down and glass-cutting aid. Drill mating ⅝-in. holes in the ends of the long side of the square and in the bench top. Insert 1-ft. lengths of ⅝-in. threaded rod through the holes with washers and wing nuts above and below. For cutting glass, make two short sections of non-threaded ⅝-in. rod



capped with dowel heads to use in place of the threaded rod. The non-threaded pins are easier to install and remove. Use the shorter side of the square as a backstop or measuring aid. If it's in the way, just flip the square over.

—Malcolm McKeag, Peace Dale, R.I.

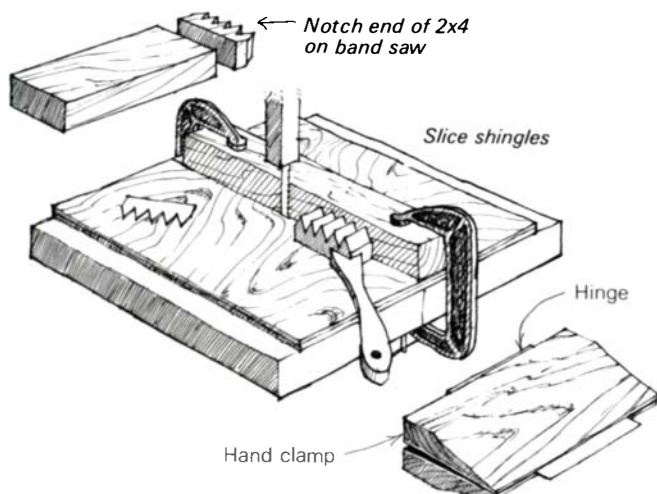
Making miniature shingles

To make small wood shingles for miniature buildings, start with a length of straight-grained 2x4. Any softwood will do, but white cedar is best as it is quite flexible. To make pointed shingles, cut $\frac{3}{8}$ -in. notches across the end of the 2x4 with a band saw, using a regular (not skip-tooth) blade. To make square-end shingles, substitute a series of $\frac{1}{2}$ -in. saw kerfs for the notches. Now cut off a $\frac{1}{8}$ -in. length from the notched (or kerfed) end of the 2x4. Continue notching and cutting off $\frac{1}{8}$ -in. blocks until you have plenty to complete the job.

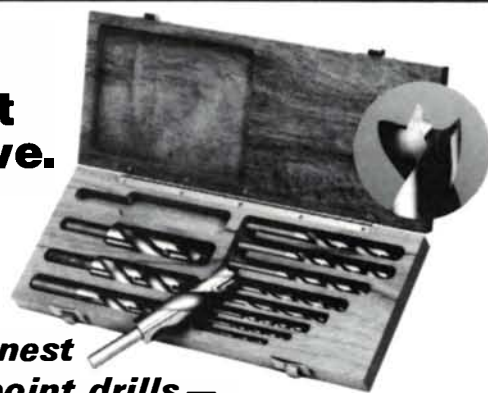
To prepare your band saw for slicing gang shingles from the blocks, saw straight into the center of a piece of $\frac{1}{4}$ -in. plywood and stop. Clamp a wood fence on top of the plywood and as close to the blade as the thickness of shingle you want ($\frac{1}{16}$ in. or so). Use a push-stick to hold the block snugly up against the fence. Slice gangs of shingles from the block until the block is cut down to $\frac{1}{4}$ in. Glue this remnant to the next block to be sliced.

Alternately, the slicing operation can be done on the table saw using a fine-tooth plywood blade. To keep the thin slices of shingle from falling through the space beside the blade, tape a thin, flat board to the saw table against the rip fence and over the blade. Elevate the blade through the board to provide a gap-free surface.

You should taper by hand the first course of shingles around the eaves of your miniature building. If you don't, the second course won't lie right. To accomplish this, build a hand clamp (useful for other work as well) from two pieces of hardwood and a hinge as shown. Pinch a gang of shingles in



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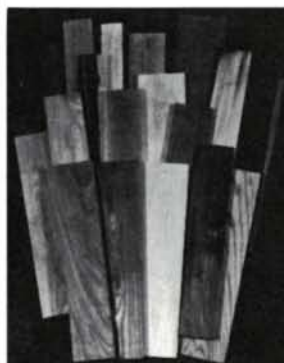
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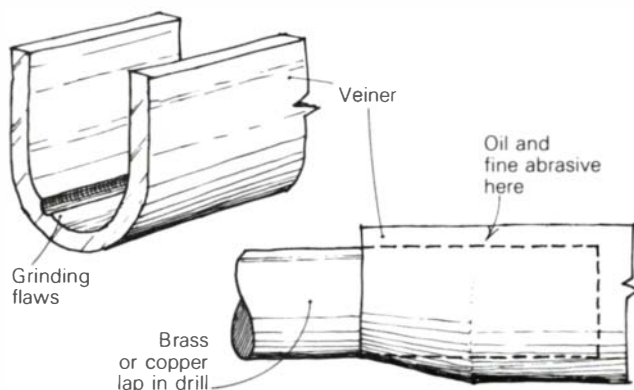
the clamp (points in) and feather the back end of the shingles by pressing lightly on a belt sander.

To install the shingles, match up the ends and glue in place on a line. Hold each row in place with masking tape until the glue sets.

—Floyd L. Lien, Aptos, Calif.

EDITOR'S NOTE: Some miniaturists use a hot-glue gun to fasten down gang shingles. Since the glue sets in seconds, it is possible to shingle an entire roof in a single session.

Correcting veiner flaws



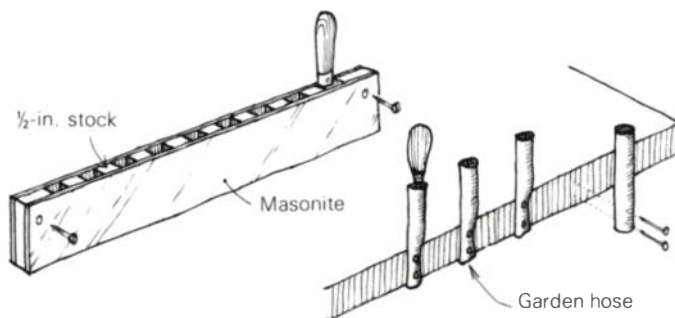
I bought a veiner carving tool with grinding imperfections that made it impossible to sharpen. The inside radius wasn't true and the inside face was grooved. I chucked a brass rod (copper works as well) in my drill and lapped the inside face using fine silicon-carbide abrasive and oil. It trued the radius and eliminated the groove.

—Ellis Thaxton, Arlington, Tex.

Tool holders

This tool holder is simple to build from scrap lumber and Masonite. The hole spacing can be varied for different tools. A mounting hole on each end allows the rack to be hung from the wall, the workbench or even a door.

—Jay Wallace, Gilbert, Ariz.

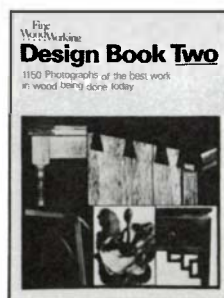


Six-inch lengths of garden hose fastened to the wall or bench with two nails at the bottom make excellent tool holders for screwdrivers, awls, etc. Tools are easy to remove, and the soft, flexible hose won't damage sharp edges.

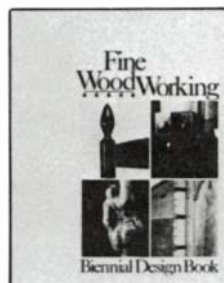
—Carl R. Vitale, Cranston, R.I.

Heating the shop

Heating a woodworking shop can be a problem—sawdust and paint vapors present a fire hazard. Local heating firms suggested several approaches including a separate "heating room," a gas wall heater, infrared heating and electric base-board heating. All these approaches were either too expensive.



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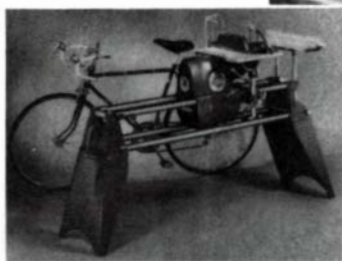
You should have a table saw, vertical drill press, horizontal boring machine, lathe and disc sander. But now you don't have to spend several thousand dollars to get the capabilities of all these machines. And you don't need a lot of space, either. All you need is a Shopsmith MARK V.

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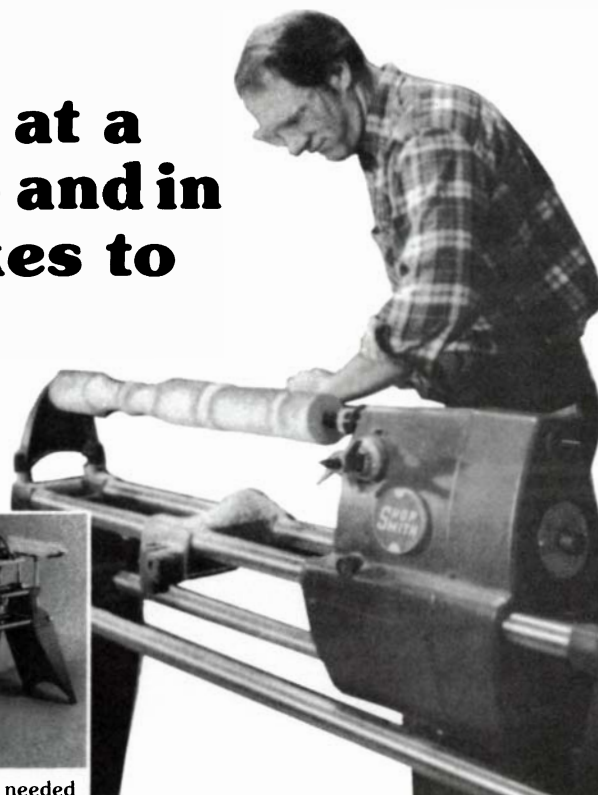
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sive, a fire hazard or both. Finally, I chose electric hot-water baseboard heat for my just completed 14-ft. by 22-ft. wood-working shed. I was a little worried about the operating cost, but surprisingly, costs have been only slightly higher than gas heat. The unit keeps the water at an even temperature and doesn't cycle on and off like other heating systems. Hot water baseboard units weigh less than 30 lb. and can be purchased as portable or permanently mounted models. They don't stir up the air—an ideal situation for a dusty shop or paint room. Because the units operate at a continuous low heat, they're not a fire hazard.

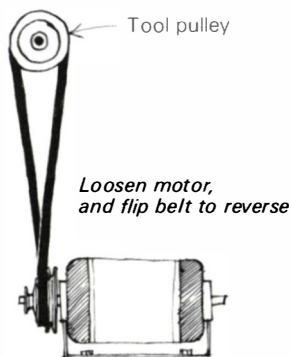
I chose the largest model the supplier had—a 220-volt portable unit that sells for about \$150. It measures 4 in. by 9 in. by 107 in. long and produces 6,800 BTU. The supplier: Intertherm Inc., 3800 Park Ave., St. Louis, Mo. 63110.

—R. Voorhees, Ft. Wayne, Ind.

Reversing belt-driven tools

It's easy to reverse disc sanders and other belt-driven tools if the motor is mounted perpendicular to the shaft it drives, so there's a quarter-turn in the belt, as shown. To reverse, simply loosen the belt, flip 180° (on either pulley) and tighten. The twist in the belt seems to dampen vibrations—an added advantage.

—Roger Lynne,
Bloomington, Minn.

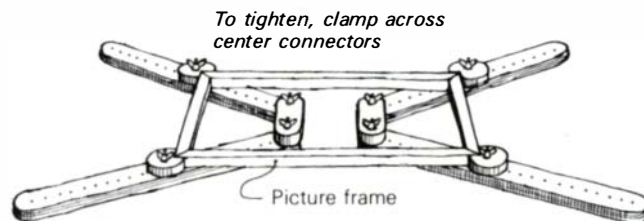


Picture-frame clamp

This picture-frame clamp beats anything else I've tried. Make the device from 3/4-in. thick, 2-in. wide hardwood strips. I covered the hardwood with smooth Formica for extra strength and for freer action of the parts. You'll need four 16-in. legs, two 4-in. connectors and four 2-in. discs notched to hold the corners of the frame.

To use, determine the positions of the notched discs on the legs through a dry run. When everything is ready, apply pressure to the frame using a parallel-jaw wooden clamp across the center connectors.

—John L. Van Scoyoc, Bartlesville, Okla.



Ferrules from end caps

Over the years I have seen all kinds of homemade tool handles ranging from an old corncob jammed on the tang of a rasp (a surprisingly comfortable improvisation) to ornate, French-polished creations. For most of us whose efforts fall between these extremes, locating a suitable ferrule is a larger problem than turning the handle. Plumbing stores stock an attractive, inexpensive solution—copper-tubing end caps. The end caps, available in several sizes, are tough enough to

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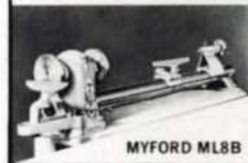
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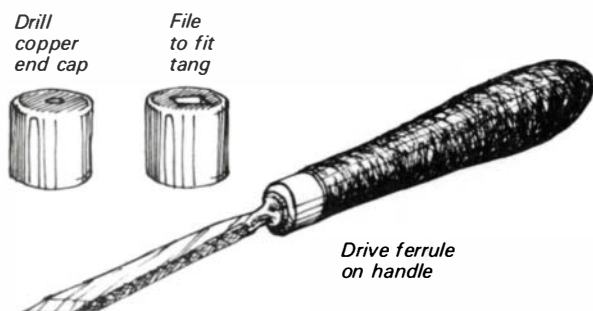
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hold up to mallet blows. To make a ferrule, drill a hole for the tool's tang through the soft metal. Shape the hole, if necessary, with a needle file. Drive the ferrule onto the wood handle, which has been sized to give a tight friction-fit. Rubbing the copper with fine steel wool produces a beautiful satin finish and reddish-gold color that complements all woods. An occasional coat of paste wax will protect the copper from tarnish.

—George Mustoe, Bellingham, Wash.

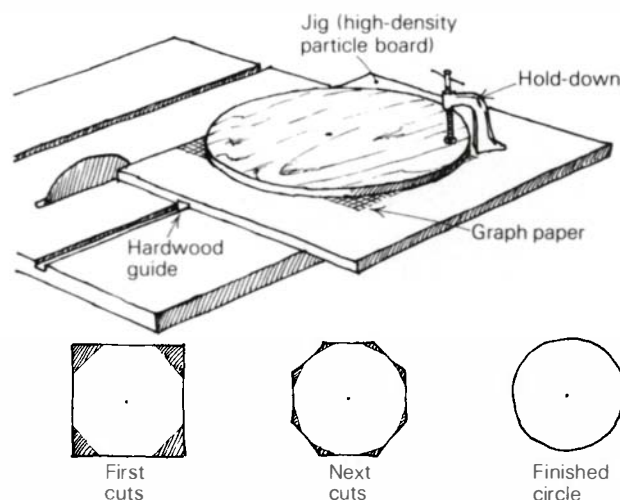
Cutting circles on the table saw

Round tabletops, lazy-susan shelves and other large circles can be cut on the table saw with a simple jig. Cut a dado in the underside of a 3/4-in. high-density particle-board base and glue in a hardwood key, sized for a sliding fit in the saw's left-hand miter slot. Wax the jig bottom and key to reduce friction. Measuring from the blade, accurately locate and paste sheets of 1/4-in. graph paper to the jig top to aid in layout.

To use, first cut the circle blank somewhat oversize and locate its center. Next mark the radius of the finished circle on the graph paper and pin the center of the circle blank at

this mark. Make sure the blank will rotate freely but is firmly pinned to the jig. Start by lopping off the corners of the blank. Hold the blank and jig firmly while sliding them past the blade. If hand-holding the work appears unsafe, mount a hold-down clamp on the base to lock the blank while cutting. Continue cutting off the corners of the blank until it is almost round. Then, with the work just touching the blade, rotate the blank to trim off all the high spots. The smoothest circles are produced using high-quality, sharp carbide blades.

—Philip Margraff, Coeur d'Alene, Idaho



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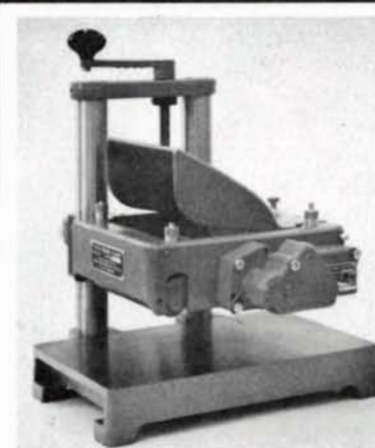
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Please give me whatever information you might have on Chinese lacquer. I'm interested in knowing where I could buy real Chinese lacquer and what its chief ingredients are.

—William E. Journey, Kosciusko, Miss.

Chinese lacquer is not produced by insects, as is shellac. It originates from the juices of the lac-tree, called *Rhus vernicifera* (the Chinese name is *Ch'i shu*). Its use dates back 3,000 years. The sap of this tree (related to the American sumac tree) is collected during the summer months from trees that are at least 10 years old. This thick, milk-like product, when dehydrated and purified, becomes the base of the real Chinese (or Japanese) lacquer.

Shortly after the Chinese discovered the great potential of this sap the Japanese followed them, soon surpassing their teachers. First, they cultivated better trees. Next they discovered that the sap varies depending on where and when it is collected. Small branches of the tree produce a lacquer different from, but not inferior to, the one from the tree trunk.

It could be that the process of refining the sap and making it into lacquer was a closely guarded secret, but for whatever reason, no Westerner learned the process properly or at least nobody recorded it properly. I have spent days in libraries digging for information with very little reward for my toil.

What I do know is that the smoothness of the most beautifully French-polished object is easily matched by the porcelain-like finish of lacquer. And the Chinese lacquer offers unquestionably greater protection to the wood. In Japan, the archeologists who excavated the Lo-lang tombs, many of which were flooded for several centuries, found lacquered objects floating in the water unharmed. In 1878 a ship carrying a Japanese exhibit back from Vienna was sunk. Two years

later divers recovered lacquered objects intact from the wreck. Oriental lacquer actually hardens when exposed to water. It is not only waterproof but also resistant to acids, heat and shock. Its greatest enemy is bright light. Exposed to it, in time it will fade, dry out and probably decompose.

Oriental lacquer is applied like modern lacquer. But Oriental fillers are mostly starches (powdered rice) combined with the sap produced by the smaller branches of the lac-tree. The wood is filled and refilled many times, and this is followed by uncounted layers of under-coating using a sap called *sesbime*. Between coatings the smoothing process never ends. The undercoating is followed by the actual lacquering, consisting of 30 to 40 coats of lacquer with proper sanding between coats. For this they use whetstones and volcanic ashes, followed by a clay, kin to our rottenstone. The final rubbing is done with charred deer-antler, followed by pine soot. The smoothness achieved will rival that of a mirror.

To the best of my knowledge neither the Oriental lacquer nor the proper know-how of its application is available in the U.S. This is disappointing, since I am convinced that with proper research it could replace shellac, varnish and maybe the modern lacquers, or it may become a worthy additive to them. Young Marco Polos, what are you waiting for?

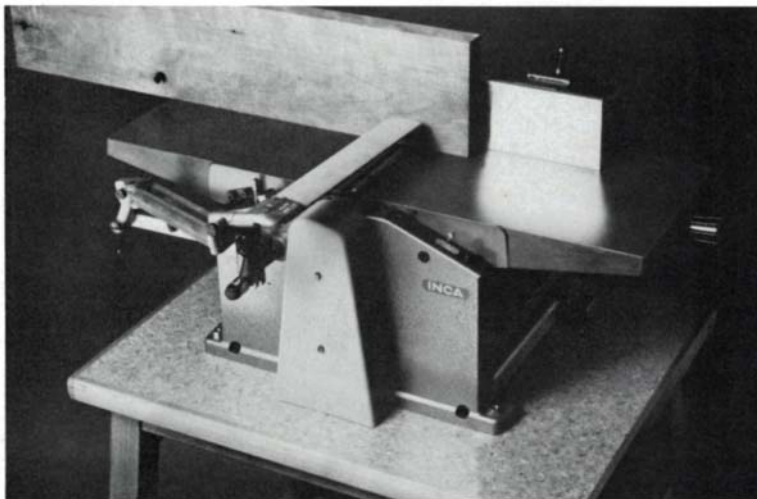
—George Frank

I would like to know why there are two tapers available for drill-press spindles. What are the advantages and disadvantages of each (#33 Jacobs taper and #2 or #3 Morse taper)?

—Warren M. Swager, Jr., Sheridan, Mont.

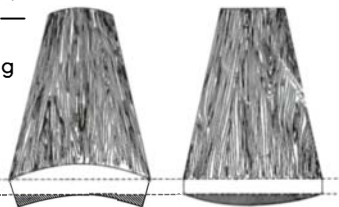
If routing is attempted in a drill press equipped with a Morse taper, the shank will vibrate loose from the excessive radial

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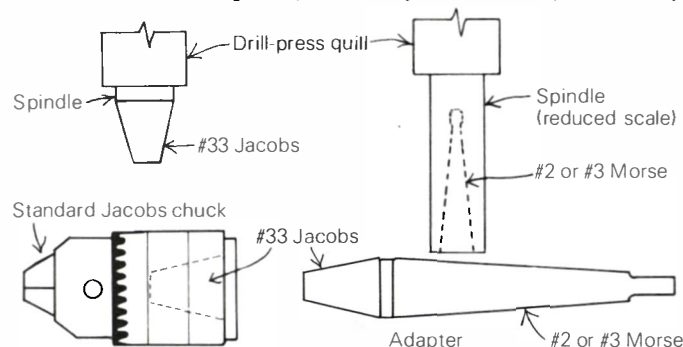
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thrust, causing the chuck to drop down with resulting consequences and excitement. But you'll encounter no problems with the Morse taper as long as normal axial thrust is maintained in ordinary drilling operations.

Unlike Morse tapers, which can be separated with a tapered drift, the #33 Jacobs taper is used for semi-permanent attachment. The female part (here the Jacobs chuck) is usually



heated and shrunk onto the stub taper. One manufacturer recommends immersing the chuck in boiling water for about 30 min. to expand it, then quickly tapping it onto the male taper. Don't, under any circumstances, apply a torch to your chuck. You'll warp it if you do.

For general woodworking, including routing, the Jacobs #33 taper or a threaded chuck is sufficient. But for heavy drilling in metal, a Morse taper is an absolute must. You can have both if you have a Rockwell 17-in. drill press. It can be fitted with an adapter that has a Morse taper at one end and a #33 Jacobs taper at the other. A threaded retainer ring receives either the chuck or the Morse taper. Some machines

have a chuck that screws onto a stub spindle extension, and some use threaded locking rings.

—Lelon Traylor

I would like to make a banjo using materials and techniques from the 1880s. Can you recommend a book or other source of information? Under normal circumstances it would be easy for me to run down this information, but I am home-ported in Japan and am presently in the Arabian Sea.

—Lt. Robert E. Riess, USS White Plains

Actually, banjo-making has not changed very much since the 1880s; in fact, I suspect some of my machinery dates from that period. Then, as now, there were classy makers in large cities catering to a sophisticated market (the instrument was the rage for classical and popular music at the time), while at the same time craftsmen in the Appalachian mountains were making simple, folksy instruments.

Materials have changed little: Hide glue has given way to more modern adhesives, lacquer has replaced French polish and varnish, but it seems that the quality of ebony and mahogany has deteriorated. The techniques of that time no doubt varied with the skill and ingenuity of the maker, just as they do today. Suffice it to say that most of the work was done by hand, probably with fewer and simpler tools than most of us possess.

As to design, again little has changed. The rim would be thin, perhaps 1/4 in. or 3/8 in., with a thin (0.025 in. to 0.050 in.) covering of nickel-silver spun on after lamination. The entire instrument would be more delicate, as the gut strings of the day caused less stress than the steel of the present. Of course there would be no resonator.

Very little information is available in print on banjo-

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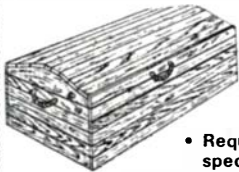
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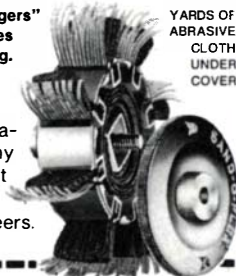


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making. Building an Appalachian banjo is covered in *Foxfire 3* (Doubleday, 245 Park Ave., New York, N.Y. 10017). There is also a chapter on building in the book *Earl Scruggs and the Five String Banjo* (Peer International Corp., 1619 Broadway, New York, N.Y. 10019). I also recommend the *Banjo Newsletter* (Box 364, Greensboro, Md. 21639), a monthly devoted to the five-string banjo. It has a column on construction, although it is modern rather than historical.

The best way to learn is to get a fine old banjo and try to copy it. A little advice from an experienced woodworker and hands-on experience are the best teachers. —Richard Newman

Do you know of a mixture of coal tar and kerosene that will produce a good stain for oak? I have a table that is supposedly stained with such a mixture, and its top is beautiful. My problem is that I have to stain some chairs to match the table, but I can't find anyone who knows the proper mixture of the two ingredients. Can you help?

—Peggy Gefellers, Greenville, Tenn.

I suspect that the mixture you're referring to is a mixture of asphaltum and kerosene. The asphaltum (or asphalt) supplies the color, and the kerosene is merely a solvent.

Though I have used dissolved asphalt as a wood stain, it has one major drawback—it never hardens permanently or polymerizes as it ages and can always be dissolved by an organic solvent. The result is that the subsequent application of a lacquer or varnish will lift the stain and thereby lighten the wood. It will work as a stain, but it's a trifle difficult to get the exact color desired.

I would never use kerosene as a solvent. Use mineral spirits, which dries much more quickly and more dependably than

kerosene. Obtain asphalt from a hardware store: a small can of asphalt roofing or gutter paint, without any fillers or additives. Then a teaspoon of asphalt paint in two or three ounces of paint thinner. Try it on a scrap of wood, thinning or thickening the mixture to get lighter or deeper shades.

When you have the color you want, brush it on in fairly wet coats, let it soak in and lightly dry the surface with a paper towel. After an hour or two, you can apply the finish—a good satin varnish is a safe choice. —Don Newell

Recently I had some green ash logs cut into 1-in. and 2-in. stock. The sawyer told me that this wood is very prone to damage by worms after the lumber is cut and even when dried and built into furniture. The lumber is currently stacked and stickered outside. If there is a problem with worm damage, what is the solution?

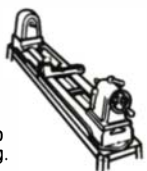
—Steven Senseney, Valentine, Neb.

Ash is one of the ring-porous hardwoods whose sapwood seems prone to attack by powder post beetles. The larvae tunnel through the wood, leaving pencil-lead-size passageways partly filled with powdery frass. These are probably the "worms" your sawyer refers to.

Attack by these larvae is worse in some areas than in others. There are various dips and sprays that can be used to keep them under control in lumber. Local sawmills are a good source for advice and supplies. It's best to inspect the lumber frequently and to watch for the tiny, tell-tale piles of dust that usually show up on the board below the one the insect has just emerged from. Infected lumber should be separated.

When the lumber is used, the presence of the larvae will be obvious as the tunnels are exposed when the wood is ma-

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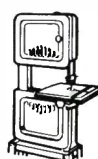
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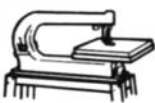
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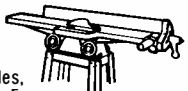
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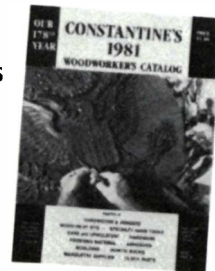
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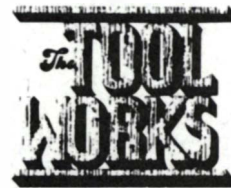


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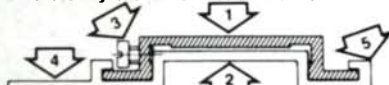
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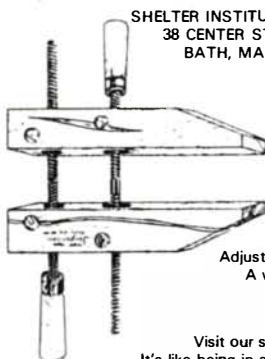
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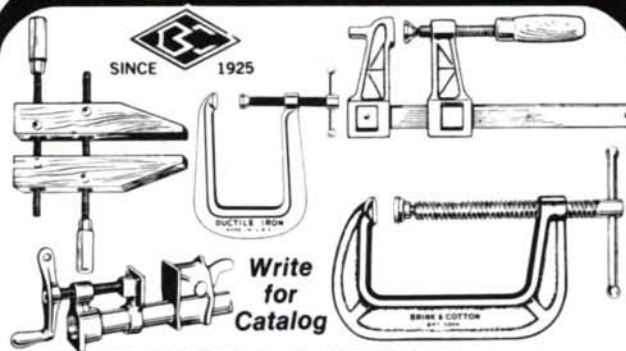
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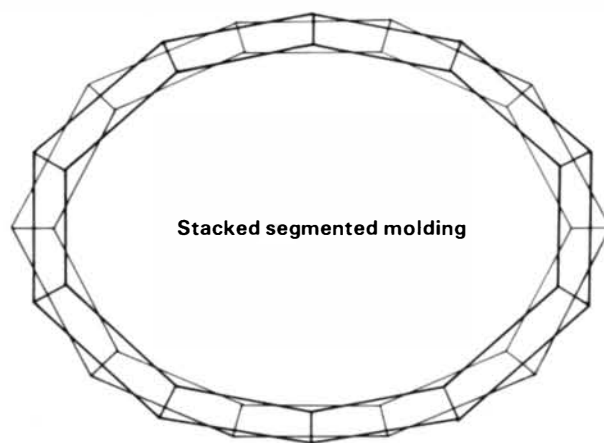
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Q & A (continued)

chined. It's difficult to kill the larvae once they are in the wood, short of heating the lumber in a dry kiln.

But if furniture is made from larvae-free lumber, infestation is rarely a problem if the furniture is given a coat of finish, since the adults lay their eggs in the open pores of the wood.
—R. Bruce Hoadley

I would appreciate your advice on the best method for joining segments of an oval molding that is to surround an oval marble slab for a coffee table. The marble is heavy, and the table will undoubtedly be moved by lifting the edge molding, so strength is important. —W.J. Ripley, Clayton, Calif.
The strongest way to make the oval molding is to use a method of bricklaying, which can be very attractive. First, draw the oval full scale, and decide upon the number of



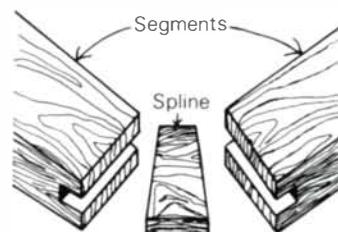
layers you'll need and upon the number of segments required for each layer. The thickness of the "bricks" is determined by the final thickness of the molding and by the number of layers you want to stack. Use at least three.

In the drawing the dark lines represent one layer, and the light lines represent another. When you've mitered all the blocks to proper length, rub the joints together using hot hide glue, which will set up as soon as it cools, allowing you to assemble these joints by hand, without having to use clamps. When the rings are complete, glue them together, one on top of another so that they are staggered like bricks. Once the outside is smoothed into an oval, you can veneer the edge if you've made the molding from a utility wood like poplar. If you've made it from the same wood as the rest of the table, then you might like the stacked look it has already.

—Tage Frid

I recommend that you spline the segments of the molding together. The thickness and the length of the splines will be governed by the size of the frame molding. The grain of the segments will, of course, run parallel with their lengths, and the grain of the splines must be perpendicular to the line of the joint. Not knowing the size of the finished molding, I would say that the splines should be five or six times the width of their thickness.

—Andy Marlow



I have some 5/4 cherry, walnut and white oak. The lumber is 18 months old and air-dried. I planed a cherry board to thickness and ran the edge through a jointer, then cut the board on a table saw. During cutting, the board bowed severely. Approximately 10 weeks later I purchased a moisture meter

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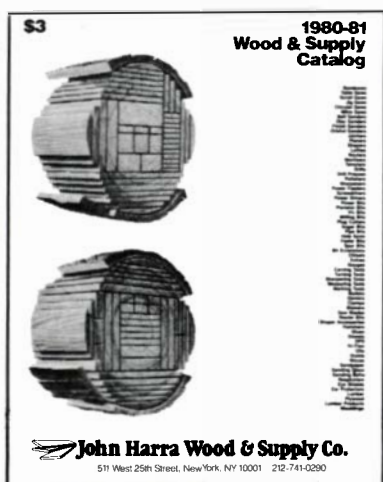
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Q & A (continued)

and checked just a few of the boards. I obtained a reading of 6.5%. Can you tell me why the boards bowed?

—Nelson L. White, Hammond, Ind.

The culprit might be casehardening, which results when the outer tissues of a board dry rapidly and trap moisture on the inside of the board where it can't escape through the hardened outer layers, thereby causing warping as the surfaces are dressed. You mention bowing (deviation from flatness end to end), but suggest that it developed during ripping on your table saw. Could you really mean crooking (deviation from straightness along the edge of a board)? In either case the warp results from uneven relief of stresses.

Another possibility is reaction wood, which has abnormally high longitudinal shrinkage, and as the wood dries, uneven stress occurs in the boards. When dressed, the boards warp.

A third possibility might be that the lumber was brought into a dry shop and allowed to remain only long enough to dry partially at the surface, thereby creating stress. After the lumber reaches equilibrium with your indoor conditions (you can check by monitoring the weight), see if your lumber dresses normally. If not, your problem is probably casehardening or reaction wood.

—R. Bruce Hoadley

Follow-up

I carried out an experiment last week that confirmed Bruce Hoadley's advice about contact adhesives (*FWW* #23, July '80, pp. 18-19). Two nearly identical veneer samples were prepared, each consisting of two halves joined along a 6-in. line and tightly taped. One sample was glued with acrylic latex cement, and the other, on the opposite side of a ¾-in. Novaply panel, was bonded with Constantine's Veneer Glue, a trichloroethylene-based adhesive. The procedures for applying the glue and rolling the veneer were the same for both samples. The sample glued with Elmer's acrylic latex cement began to separate at the seam after about 30 minutes and by the next morning had separated to a bit more than ½ in. A small crack also developed in the center of one of the pieces of veneer. The sample glued with Constantine's adhesive remained perfectly joined.

Despite the lack of a warning on the can, Elmer's Professional Acrylic Latex Contact Cement should not be used for gluing down veneers. For plastic laminates, it's probably all right, since there's no hygroscopic movement to cope with.

—Richard E. DeSimone, Lisle, Ill.

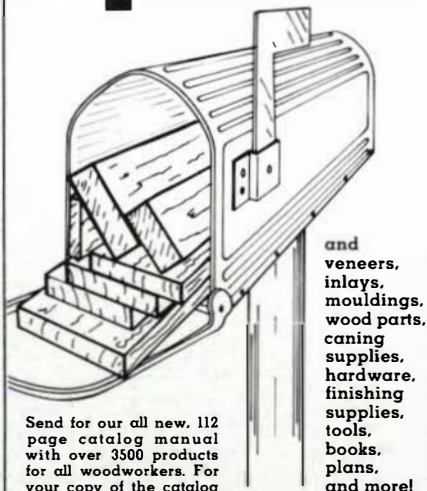
Your answer to Jon Gullett's problem (*FWW* #21, May '80, p. 21) was indeed accurate, but I think his problem might be more basic. I, too, have a Sears router, and quite by accident I discovered why I was having trouble cutting accurate dovetails with it. The three screws holding the plastic router sub-base to the rest of the unit are not countersunk, and the base therefore will not be accurately centered with the spindle each time it's removed and replaced.

To correct this, the bit and guide bushing should be installed according to the owner's manual. Then with the router resting on its top, loosen the three base screws. With the lock knob fairly tight (not so tight as to stop vertical movement), lower the cone-shaped dovetail bit until its edges make uniform circumferential contact with the inner edge of the guide bushing, which can be moved about to accomplish this. Rotating the shaft will automatically center the base.

—James L. Campbell, Orlando, Fla.

In *FWW* #21, May '80 p. 24, Lelon Traylor seems to be saying that on small planers a snipe is inevitable. As importers of Inca equipment, we must point out that generalizations valid

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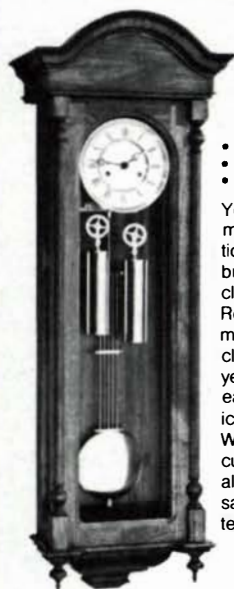
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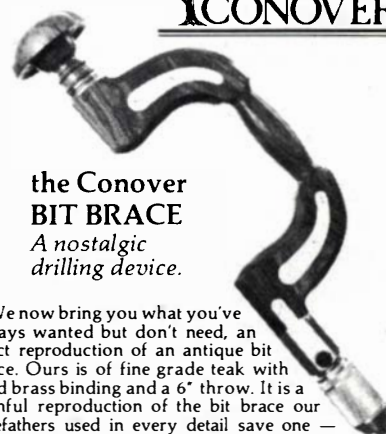
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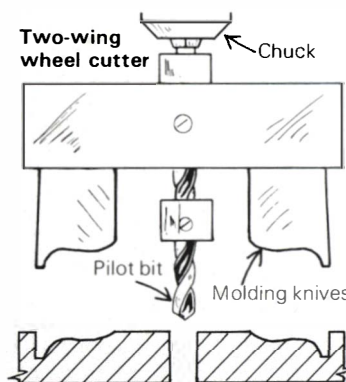
—Polymerized tung oil in quantity: Wood Finishing Enterprises, Box 10117, Milwaukee, Wis. 53210.

—Wheels and hardware for coaster wagons: Wisconsin Wagon Co., Janesville, Wis. 53545.

Readers want to know:

I make wooden toys and would like to know if anyone has ever seen or used a two-wing contour wheel cutter. This tool resembles a circle cutter that is used in a drill press, only the wheel cutter, instead of having a single peripheral knife, has two pattern-ground molding knives. These cut the edge or rim of the wheel, while a drill bit pilot-bores for the axle. I'd like very much to acquire one of these.

—Arthur J. Witheril, Sturtevant, Wis.



EDITOR'S NOTE: For the joint Tage Frid describes in *FWW* #23, July '80, p. 22, he recommends using hide glue rather than epoxy glue.

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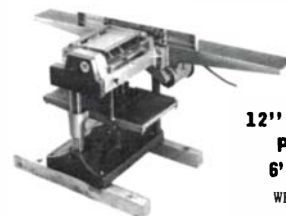
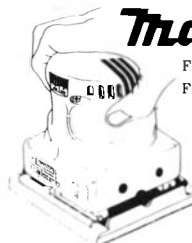
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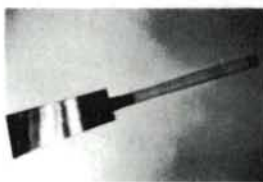
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Adventures in Woodworking

MY FIRST SHOP

BY JOHN BURROWES

“Well, it looks as though the only place I can have my shop is on the stairwell in the hall,” I said with a laugh. I sat myself down on a trunk to share a cup of coffee while we looked over our third-floor apartment. It was a nice old Pennsylvania farmhouse, but this seemed a lot like an attic.

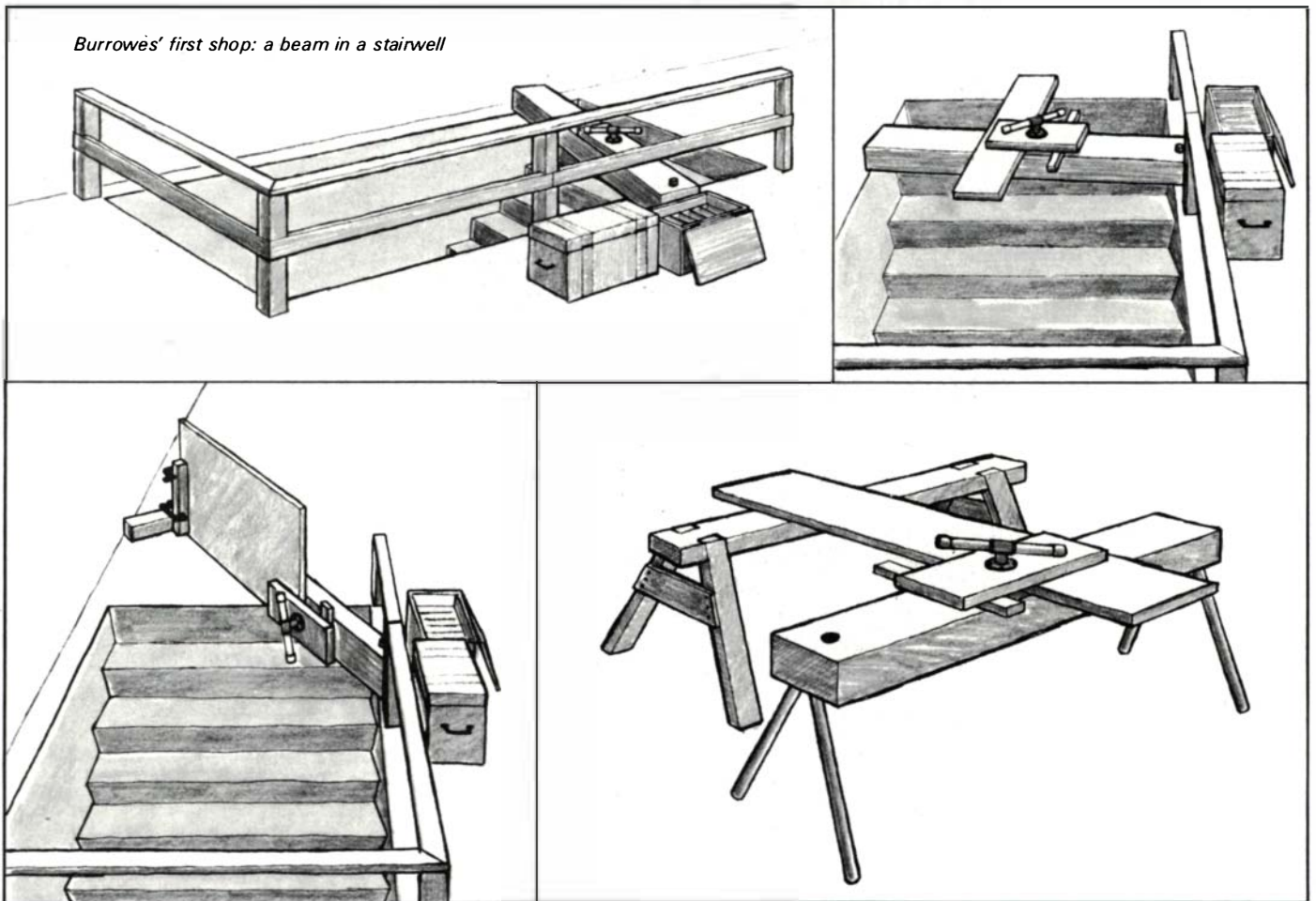
It was true that I had never had a shop of my own, and it was also true that I had three orders to fill as soon as I could. Two of the orders were from customers and the other was from my wife, who sat across from me on the other trunk looking wearily at the rows and rows of clothes and dishes, and furniture and shoes and records and books, and three boxes of tools. The children were running from room to room, happy to be in a new setting.

The next morning I went to two lumberyards where I got the boards and the beams for the furniture I was going to make, and I begged a 4x6, 4 ft. long. Without the faintest idea how I was going to find a place to do the job, I brought all these materials home. As I climbed the stairs with the 4x6 under my arm, it occurred to me that the stairs would actually make a fine shop. I bored a 1-in. hole toward the end of the 4x6 and another hole through the middle. I took an old bench screw, saved for just such a moment, and installed it with a board and a spacer stick for a jaw, in the center hole. The hole on the far end was placed over a dowel fitted in an old hole where some fancy spindles had formerly been part of the stairwell. Here was my bench with hold-down, firmly

stretched across the stairwell, and I, standing on the fourth step, was at a perfect working height. I got out a board and a plane and started to make some shavings. They rolled down the steps and out of my way. Not that I wouldn't have to clean them up eventually, but they were not under foot. On the flat of the board I could plane only half of its length at one time, but I couldn't have reached the full board anyway. I drilled another hole through the 4x6 so it could be rotated 90°, and in that position, with a wooden brace clamped to stabilize the other end of a long board, I could easily plane the long edges. I had one power tool, an old-fashioned ¼-in. drill to which I could attach a grindstone when I needed to sharpen my tools. I set my tool box along the crude railing of the stairwell where I could reach it and where it would keep the children from tumbling into the stairwell. Next to it was a box full of all the hardware I had saved through my years of apprenticeship and teaching.

As I sat down to the task of sharpening my tools, I discovered another advantage of working in a stairwell, for there on the top step like two python rock snakes sat my oldest children, watching me and fiddling with the vise. This turned out to be the most sociable of all the shops I have ever worked in, sometimes disadvantageously so because neighbors would want to come up the stairs, or my wife with wet laundry in her hands would want to go down. But one swing of the 4x6 on its dowel pivot, and traffic could move as usual.

Burrowes' first shop: a beam in a stairwell



Since my 4x6 with bench screw could be slipped off its dowel at any time, I soon found that on nice days I wanted to work outside, under the trees. So I bored a slanted 1-in. hole in a 2x4 and, holding the 2x4 over the bottom of the 4x6, bored four symmetrically angled holes for 1-in. dowels. This made my 4x6 into a "vise-horse" with a bench screw in the middle of its crosspiece. Then I made the 2x4 into another horse, 6 ft. long and nice and squat. With the saw horse at one end and the 4x6 on its dowel legs at the other end, I could work big pieces of wood outdoors. When things began to rock too much, I just drove stakes into the ground. It was clumsy when thunderstorms arose, but in fair weather the summer's work proceeded with pleasant dispatch.

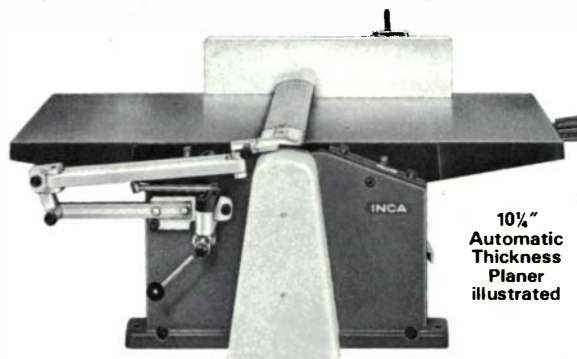
Toward the end of the summer I came to my biggest assignment, a black walnut table 4 ft. wide and 10 ft. long. I could barely manage the boards to glue them together on their splines, and I had to do that outdoors on a clear day. I could have handled the gluing on the stairs, but then I wouldn't have been able to fit the tabletop down the stairwell. I was glad to have figured that out before trying it. The hardest part of the job was cutting housings all the way across the width of the table for the crossbraces for each pair of legs. I attached my little electric drill to a dovetail router bit. I carved out a piece of 4x4 that would hold the drill at just the right height, then clamped a fence onto the table so I could run the cutter the whole width. I knew that routers are supposed to run at thousands of RPM, and I knew the dovetail bit was not designed to be used this way, but necessity is the mother of adaptation and compromise. With frequent pauses to let the drill cool and gentle pressure to gain an inch now and then, I made a beautiful housing joint—after about two hours. The dovetail tenons I had cut slipped in with a snugness that quite surprised me.

Even with hand tools there is constant alternation between courage and caution. Like a sculptor or a surgeon, a woodworker must be able to strike the material at the right point so that it splits in the right way. With good materials, he must have that sense of care that makes it often happen just the way he wants it. Experiences like these taught me that there are no tools that will take a man out of these problems. No fancy benches or fancy shops can ease the burden of sensing the way a given piece of wood can be used.

Since then I don't know how many times I have been approached by people who want to know what power tools are absolutely necessary, or how to get started making things of wood. The answer is so simple that people have a hard time believing it. There are no essential power tools and there are no necessary pieces of equipment. If you need a clamp, go buy one. If the work needs a sharp saw, get a saw file. You can always find a need for more tools, but the essential beginning is so simple that you can always afford to start. I did not learn from my first shop that power tools are not needed, but I certainly learned that you would do well to get a good drawing board long before you buy a table saw. The drawing board will give you a clearer notion of what you want to accomplish and how. I have always found that the best means to speed is not having to do the job over again. After 30 years I still find that extra deliberation and a slower pace are the best way to save time. Sometimes the pace is set by the rhythm of hand tools, which allow me time to think and to feel both the texture and the proportions of the work. Now I sit in a large shop with all kinds of equipment and a huge bench, and in the middle of that bench is the same old bench screw installed much as it was in the 4x6 vise-horse. It reminds me that although we have moved many times, my shop has never been closed since that time in the stairwell. □

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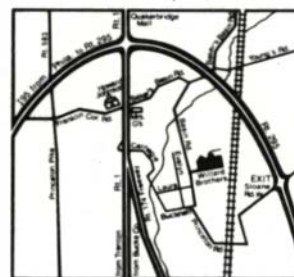
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Business Notes

THE GRANTS GAME

BY STANLEY N. WELLBORN

The appeal of getting a government grant is obvious: The money is usually generous, it typically comes with no strings attached (except for the taxes that must be paid on it) and the award can enhance a craftsworker's reputation. Grants can be used to set up apprenticeships, to experiment with new materials and techniques or to branch out into different types of work. Grants-in-aid can even be used to buy equipment or to pay food and utility bills.

The number of grant offerings has proliferated in recent years, with the advent of the federally funded National Endowment for the Arts and various state arts agencies, as well as increased patronage of craftsworkers by corporations and privately endowed foundations. However, such growing attention to artistic support may encourage applicants for grants to feel overly optimistic about their chances of success. That optimism frequently fades once a craftsworker begins the long process of assembling the application materials.

Many more people apply than there are grants to receive. In 1978, for example, 1,421 craftspeople applied for the Arts Endowment's 41 Craftsmen's Fellowships, which then were funded at \$7,500 per grant. Thus, each applicant had only a 3% chance of getting a grant. Of the 1,421 applicants, only 167 were wood-oriented, and of those 167, only two were awarded grants. In 1979, the picture was just as bleak. Only two woodcrafters were given grants, increased in size to \$10,000 per award. This year, seven woodworkers won \$10,000 awards, out of 1,348 applicants. One reason for the improved showing by woodworkers was that one of the six judges was Arthur (Espenet) Carpenter, the California wood designer. It was the first time in several years that a woodworker had been part of the selection panel. Here's a run-down of grants offered by the Endowment:

Craftsmen's Fellowships—These \$12,500 grants are limited to "professional craftsmen of exceptional talent and demonstrated ability." A total of \$535,000 was awarded in 1980. This year, 25 grants of \$3,000 each also went to emerging artists "whose work is exceptionally promising and worthy of encouragement." Deadline: Dec. 19, 1980.

Craftsmen's Projects—Begun in 1979, this category is for craftsworkers who desire support for travel, research or experimentation in their field. Amount: Up to \$5,000 per grant. Deadline: Feb. 2, 1981.

Crafts Apprenticeships—Grants of \$5,000 "to enable

Further reading

Bibliography: *Grant References for the Craftsman*. The American Crafts Council, Publications Dept., 44 West 53rd St., New York, N.Y. 10019., \$1.00. An indispensable directory of sources of funds from federal, state and private organizations.

A Guide to Corporate Giving in the Arts, The American Council for the Arts, 570 7th Ave., New York, N.Y. 10018, \$12.50. A listing of more than 350 corporations that contribute to art and craft groups and commission work by individual craftsmen.

National Endowment for the Arts Annual Report, National Endowment for the Arts, 2401 E St. N.W., Washington, D.C. 20506. Describes the federal arts endowment grant programs, with a list of recipients and amounts granted.

Ocular, 1549 Platte Street, Denver, Colo. 80101, \$14 per year. Quarterly publication with updated news and information on available grants and fellowships in the crafts, federal legislation and legal issues of interest to craftspeople.



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craftsmen to work as apprentices in the studios of master craftsmen, and to cover the cost to the master of taking on the apprenticeship." Deadline: Feb. 2, 1981.

Building Arts—A new category in 1980, to award \$5,000 grants to "promote the integration of the arts in the construction of permanent buildings and their components," and to "encourage craftsmen and artists to pursue new designs and experiment with materials and techniques for building construction." Projects could include such things as one-of-a-kind handmade houses, the use of innovative or historical tools and techniques, timber joinery and building of log cabins. Deadline: Jan. 2, 1981.

Crafts Exhibitions—Grants of up to \$50,000 to enable organizations to develop craft exhibitions of contemporary or historical significance. Deadline: Sept. 30, 1980.

Crafts Workshops—Grants of up to \$20,000 each to assist organizations undertaking year-round workshop programs for craftsmen. Deadline: Sept. 30, 1980.

Woodworkers interested in applying for any of these grants should request a copy of the *Visual Arts Application Guidelines* from the National Endowment for the Arts, 2401 E St. N.W., Washington, D.C. 20506. The booklet contains application forms and procedures and complete descriptions of funding programs in all categories. Other Endowment awards promote crafts instruction in community centers, prisons and hospitals, encourage traditional and ethnic art forms, and aid museums in the preservation and restoration of their collections. Persons interested in examining all of the grant programs offered should request a copy of the *Guide to Programs* from the Endowment.

How grants are granted—According to John McLean, an official of the Endowment's Visual Arts crafts program, panels comprise five independent experts who are chosen by the Endowment but not formally affiliated with it. The makeup of each panel changes each year, and the identity of panel members is not revealed until after selections are announced. If there is a tossup between two applicants, the grant will usually go to the craftsman who is in mid-career—the one who is clearly established but who needs a good boost to get to the next level of the art or craft.

For individual fellowships, craftsmen are judged on past work as portrayed in 10 color slides. In McLean's opinion, photography is the single most important factor in any application. "Good photos submitted with the entry make an enormous initial impression, and bad photos can mask excellent work simply because the panel can't tell much about its quality or design. Most experienced craftsmen get a professional studio photographer to photograph their work."

Critics of grants contend that money too often goes to persons who submit experimental, highly aesthetic and impractical work, rather than to craftsmen who produce skilled, traditional and above all functional designs. Some add that woodworkers are often discriminated against by judging panels that have little expertise or interest in woodworking.

On the other side, supporters of grants say that because most programs award public money, they cannot favor craftsmen who have not proven that they merit a grant. Rather, they say, the awards should favor those who are extending the limits of their craft by exploring new techniques and forms. The Endowment's John McLean acknowledges the dilemma; "The competition is rigorous and the funds are limited. Undoubtedly many deserving people do not get funded, and we only hope they will keep trying." □

Stan Wellborn is a correspondent for this magazine.



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Handbook of Doormaking, Windowmaking and Staircasing edited by Anthony Talbot. *Sterling Publishing Co., 2 Park Ave., New York N.Y. 10016, 1980. \$7.95 paper (\$9.95 in Canada); 256 pp.*

Long awaited and much appreciated, this is the republication in one volume of three English joiner's handbooks dating from the era just before widespread use of power tools. It describes in somewhat archaic language the measuring, setting out, making and assembly of parts for a variety of traditional doors, windows and stairs. Bench methods and the efficient order of operations are emphasized—the anonymous author assumes that readers already know how to chop mortises and plow grooves. The information in this volume is simply not available elsewhere, and although much of it is relevant to the machine woodworker, it's really for the hand craftsman who wants to take the time to do it right. Line drawings show the work at each stage of construction.

Mechanick Exercises, or the Doctrine of Handy-Works by Joseph Moxon. *Early American Industries Association, 2 Wind-ing La., Scarsdale, N.Y. 10583, 1980. \$12.50, cloth; 354 pp.*

Moxon describes in turn the tools and basic working methods of the blacksmith, joiner, carpenter, turner and bricklayer, then he shows how to lay out sundials. Published serially between 1678 and 1700, *Mechanick Exercises* is the first how-to book in the English language—the grandfather of this magazine and all the other practical literature we enjoy today. Moxon was writing when the guilds still held closely the secrets of the crafts, but also when London had just been decimated by plague and destroyed by fire. There was more work than the guildsmen could handle, and willing hands to try it if only they knew how. The language and typeface are archaic, but intelligible to the modern reader.

The current EAIA edition is a good facsimile of Moxon's 1703 reprint, the first time all the parts of his work were gathered together. EAIA has also printed Moxon's drawings alongside the relevant text. Until now we have had only the 1970 Praeger edition (now out of print), a composite of several earlier Moxon texts, with all the drawings gathered together at the back. Praeger more than made up for this fault by adding a superb introduction by Dr. Benno Forman of the Winterthur Museum. This EAIA edition, however, suffers for want of a thorough introduction.

Tools and Technologies: America's Wooden Age edited by Paul B. Kebabian and William C. Lipke. *Robert Hull Flem-ing Museum, University of Vermont, Burlington, Vt. 05405, 1979. \$10.00, paper; 112 pp.*

This large-format book collects the lectures given in late 1978 in conjunction with the University of Vermont's Tools and Technologies exhibition. The exhibition put old tools against the products they made, and traced the evolution from hand production to mechanized production. The lecturers tried to put that work into social and historical context.

The most interesting essay is Charles F. Hummel's summary of his research into the business of woodworking, 1700 to 1840. Hummel is a curator at the Winterthur Museum in Delaware, and author of the classic *With Hammer in Hand: The Dominy Craftsmen of East Hampton, New York* (1968). He shows that woodworking shops were small and the trades were highly specialized; that a cabinetmaker procured his own timber only when he could not buy it; that obtaining tools was a horrendous problem since most had to be im-

ported from London, and that although many journeymen tried to become master of their own shops, few could amass the financial wherewithal.

A journeyman worked eleven hours a day, six days a week, and was paid about a dollar a day—he'd have had to save several months' wages to buy his basic kit of hand tools. Barter was common. Labor costs approximated the number of days required to make a piece of furniture, and retail prices averaged 3½ times the labor cost. Everybody used patterns, furniture parts were stockpiled, and individual production was high: A 4-ft. by 5-ft. mahogany dining table took 88 hours to build, a Pembroke table less than 40 hours. A cane-seated Hitchcock chair in 1829 cost \$1.50, indicating it could be made in less than four hours. Writes Hummel, "Part of much romanticizing... is the myth of perfect craftsmanship. Many fine products were created and, frequently, the finest examples of a woodworker's production have survived. It is also true that a master craftsman was personally accountable for what was produced in his shop. But the number of lawsuits between (house) builders and clients is indicative that much was still to be desired when a structure was considered finished by the craftsmen who built it."

Tree Decay: An Expanded Concept by Alex L. Shigo, with watercolor paintings by David M. Carroll. *U.S. Department of Agriculture Bulletin No. 419, Government Printing Office, Washington, D.C. 20402, stock number 001-000-03937-7, 1979. \$2.75, paper; 72 pp.*

Alex Shigo is a plant pathologist who studies how and why trees decay. His work is summarized here, and brought to life by exquisite watercolor paintings. The scientific gist of it is that trees cannot heal a wound; they can only isolate and confine the damage. When a tree is wounded, a succession of bacteria, fungi and insects invade. The tree reacts chemically and biologically, but within the isolated zone the damage proceeds. Carroll's watercolors show how this happens, via artful diagrams, imaginative cutaway views and microscopic analysis. Their beauty is breathtaking.

The Lazy Man's Guide to Barnwood by William D. Manning. *P.O. Box 455, Marietta, Ga. 30061. \$4.95, paper; 67 pp.*

How to find and dismantle an old farm building, how to store the wood, and advice on how to use it. A pleasant, practical little book, printed directly from typewritten text.

Wood Turning: The Purpose of the Object by Stephen Hogbin. *Van Nostrand Reinhold, 135 W. 50th St., New York, N.Y. 10020, 1980. \$14.95, cloth; 83 pp.*

Fine Woodworking readers know of Stephen Hogbin and his controversial woodturning explorations (see *FWW* #13, Nov. '78, pp. 74-76 and #21, March '80, pp. 56-60). Here he documents his year as craftsman-in-residence at Melbourne State College in Australia. The book is mostly photographs, superb in quality, showing the things Hogbin made during that year along with brief remarks about why. Part of his purpose was to explore the possibilities in native Australian woods, from the point of view that every wood is useful somehow, for Hogbin is a dedicated scavenger. The technical notes are brief, but include a diagram with construction notes of his enormous lathe, made for \$150 from a truck axle. If his articles made you think, you'll love the book.

This sampling of recent titles was prepared by John Kelsey.

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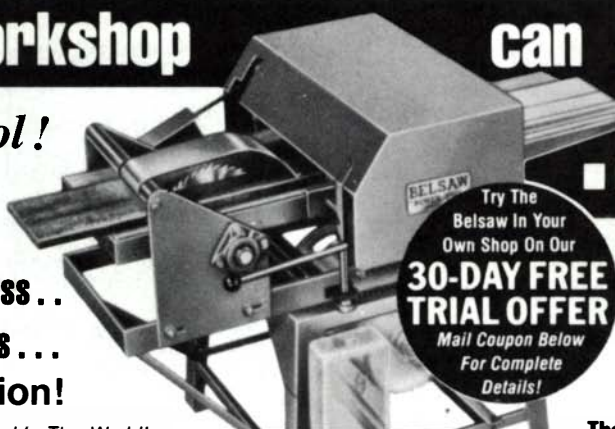
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Events

Events listings are free but restricted to workshops, fairs, lectures and exhibitions of direct interest to woodworkers. The next deadline is September 1, for events beginning Nov. 1 to Jan. 15.

CALIFORNIA: The Work of Donald Carl Bjorkman—show, mostly wood furniture and turnings, also ceramics, metal, fabrics, photography. Through Sept. 17, 12 to 5 p.m., Tuesday through Sunday, San Luis Obispo Art Center, Mission Plaza, San Luis Obispo.

GEORGIA: Weekend Seminars by Ian Kirby—The Georgia Woodworker, Atlanta. Woodworking Skills, Sept. 12-14; Woodworking Techniques, Oct. 10-12; Frames and Panels, Nov. 7-9; Carcase and Drawermaking, Dec. 5-7. \$150 a seminar, \$550 for all four. Registration limited to 40 per seminar. Contact Herb Teeple, 5015 Spalding Drive N.E., Atlanta, Ga. 30360.

ILLINOIS: Excellence in Woodworking—trade show, woodworking exhibit. Oct. 2-5, Hyatt Regency Hotel, Chicago. Write Marvin Park and Associates, 600 Talcott Rd., Park Ridge, Ill. 60068.

ILLINOIS: James Krenov—talk, slide show, demonstration. Sept. 27, 9 a.m. to 5 p.m., Frog Tool Co., 700 W. Jackson Blvd., Chicago.

INDIANA: Crafts Exhibit and Sale—Indiana Memorial Union, Indiana University, Bloomington, Nov. 2-4. Entry deadline, Sept. 30. Contact Katherine Hoheb, IMU Craft Shop, Indiana University, Bloomington, Ind. 47405.

INDIANA: Chautauqua of the Arts—art show and craft fair, Sept. 27-28, Vine St., Madison. Contact Dixie McDonough, 1119 W. Main St., Madison, Ind. 47250.

INDIANA: Containers—juried show, all media. Oct. 3-30. Fort Wayne Museum of Art, 1202 W. Wayne, Fort Wayne.

KENTUCKY: International Woodworking Machinery and Furniture Supply Fair—Sept. 13-17, Convention Center, Louisville. Write Marvin Park and Associates, 600 Talcott Rd., Park Ridge, Ill. 60068.

MARYLAND: Maryland Crafts Festival—Oct. 10-12, Maryland State Fairgrounds, Timonium; Autumn Crafts Festival, Nov. 21-23, and Winter Crafts Festival, Dec. 5-7, both Montgomery County Fairgrounds, Gaithersburg. For application details, send large SASE to Deann Verdier, Director, Sugarloaf Mountain Works, Rt. 2, Box 89-68, Ijamsville, Md. 21754.

MARYLAND: Winter Market of American Crafts—Feb. 18-22, 1981, Convention Center, Baltimore. Deadline, Oct. 1, 1980. Write American Craft Enterprises, Box 10, New Paltz, N.Y. 12561.

MASSACHUSETTS: Clavichord Workshop—a ten-week course (meets in weekly two-hour sessions in Belmont), covers clavichord making (including in-class building and demonstration of a monochord) as well as historical study of the origins and evolution of the clavichord. Taught by Clifford Boehmer and Bernard Brauchli. \$150. Details from the Musical Instruments Collection of the Museum of Fine Arts, 465 Huntington Ave., Boston, Mass. 02115.

MISSISSIPPI: Flea Market—arts and crafts show and sale, Oct. 9, Madison County Courthouse Grounds, Canton. Contact Ginny Ray, Canton Flea Market Arts and Crafts Show, Box 202, Canton, Miss. 39046.

NEBRASKA: Furniture by Robert Erickson—Sept. 9 to Oct. 5. Sheldon Memorial Art Gallery, University of Nebraska, Lincoln.

NEW HAMPSHIRE: The Woodworkers—exhibit, work by north-country craftsmen. Sept. 27 to Oct. 19, Alpha Gallery, Main St., North Conway. Contact Gary Wright, Woodworks, Box 1661, Conway, N.H. 03818.

NEW HAMPSHIRE: Weekend Workshops in the Artists' Studio—Turning Spalted Wood, Melvin and Mark Lindquist, Sept. 5-7 and Oct. 3-5; Harvesting Spalted Wood, Melvin and Mark Lindquist, Sept. 12-14 and Oct. 10-12; Photographing and Presenting Your Work, Mark and Kathy Lindquist, Sept. 19-21 and Oct. 17-19. \$250 a workshop; enrollment limited to 10. Patch Rd., RFD 1, Henniker, N.H. 03242.

NEW YORK: Exposition/Competition—work by members of the Marquetry Society of America, Sept. 1-29, U.S. Custom House, #6 World Trade Center, Manhattan; Oct. 3-16, Constantine's, 2065 Eastchester Rd., Bronx.

NEW YORK: Crafts Students League—Sept. 15 and 18. Open shop: lathe demonstrations 12 to 5:30 p.m.; exhibit of work by students and by instructor Maurice Fraser. Open woodworking class and lecture/demonstration, 6 to 8 p.m. Fall woodworking classes start the week of Sept. 15. Contact the Young Women's Christian Association of the City of New York, YWCA Bldg., 610 Lexington Ave., New York, N.Y. 10022.

NEW YORK: Green Mountain Craft Fair—Sept. 12-14, Washington County Fairgrounds, Rt. 29, Easton. Contact Green Mountain Craft Fair. William and Holly Patrick, Directors, R.D. 1, Arlington, Vt. 05250.

EDITOR'S NOTE: American Craft Enterprises has cancelled the St. Louis (Mo.) Craft Market, scheduled Sept. 25-28 in the Checkerdome.

NEW YORK: Wood—national juried exhibition of furniture and smaller works. Oct. 1-30, Westlake Gallery, 210 E. Post Rd., White Plains.

OHIO: Traditional Cabinetmaking Tools—exhibit, through December, Ohio Historical Center, I-71 and 17th Ave., Columbus.

OHIO: Smoking Wood Carvers Show—work by craftsmen from Ohio, Pennsylvania and West Virginia. Oct. 11-12, Fort Steuben Mall, Steubenville.

PENNSYLVANIA: Woodturning Symposium—lectures, demonstrations, panels, exhibit. Sept. 12-14, Memorial Hall, Fairmont Park, Philadelphia. Details, brochure from A. LeCoff, Amaranth Gallery and Workshop, 2500 N. Lawrence St., Philadelphia, Pa. 19133.

PENNSYLVANIA: 5th Annual Yorkcarvers—woodcarving and decoy show, Oct. 4-5, York College. Contact Ken Murray, 871 Satellite Dr., York, Pa. 17402.

TENNESSEE: The Box: New Form, New Function—juried exhibition for Southeast artists, Oct. 10 to Nov. 21, Arrowmont School of Arts and Crafts, Gatlinburg.

TENNESSEE: New Handmade Furniture—Sept. 16 to Oct. 31, Brooks Memorial Art Gallery, Overton Park, Memphis.

VERMONT: Tool Auction—Sept. 22-24, Holiday Inn, Brattleboro. For further information and consignment forms, write J. P. Bittner, RFD 3, Putney, Vt. 05346.

ONTARIO: Conference of the Ontario Woodworkers Association—lectures, seminars, demonstrations, Sept. 26-28, Owen Sound. Contact Dafydd Bohn, 187-A Bristol St., Guelph, Ont. N1H 3M2.

ONTARIO: Patterns of Growth—show of wood objects and photos of work by past and present students of Sheridan College, Ontario Crafts Council Gallery, Toronto, Feb. 1981. Deadline: November 1980. Contact Stephen Hogbin, Patterns of Growth, c/o Sheridan College School of Crafts and Design, 1460 S. Sheridan Way, Mississauga, Ont. L5H 1Z7.

Connections

In CONNECTIONS, we'll publish membership calls for guild-style organizations, letters from authors compiling directories in which craftsmen might like to be listed, and appeals from readers with special interests looking for others who share them.

The Northwest School of Instrument Design announces a new two-year apprenticeship program in guitarmaking in the Cascade Mountains of Washington. Apprentices will build all tools, benches, forms and molds necessary to the craft, and also become skilled in the design and construction of contemporary musical instruments. Write Anthony Huvard, Director of Studies, N.S.I.D., Box 220, Skykomish, Wash. 98288.

I am writing an article on how to make cross-country skis and snowshoes, and would like to hear from anyone with experience in their production. Write Simon Watts, c/o *Fine Woodworking*, Box 355, Newtown, Conn. 06470.

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Woodcarvers and whittlers: A one-year membership in the National Carvers Museum costs \$10 and includes a subscription to *The Mallet*, a monthly publication. Write National Carvers Museum Foundation, 14960 Woodcarver Rd., Monument, Colo. 80132. Another group of interest to woodcarvers, with local chapters in most states, is the National Wood Carvers Association, 7424 Miami Ave., Cincinnati, Ohio 45243. Annual dues of \$5 include a subscription to their bimonthly magazine, *Chip Chats*.

The Hardwood Institute, a division of the National Hardwood Lumber Association, is sponsoring a national awards program for the furniture industry. Awards will be given in nine categories: modular upholstery, upholstery, modular casegoods, occasional seating, other occasional pieces, dining room, bedroom, wall units and quick-assembly furniture. The judges include editors, merchandising executives and faculty heads of leading design institutions. Entrants must be furniture or space designers, manufacturers of residential furniture or manufacturers and designers of contract furniture for residential usage, and entries must be from production. Deadline: Dec. 31. Further information and entry blanks are available from the Hardwood Institute, 230 Park Ave., New York, N.Y. 10017.

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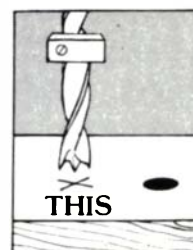
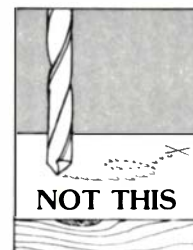
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Limited space need not mean an inefficient workshop. Open central area of Henry Jones' former shop gives ready access to bench and machinery, leaving ample room for assembly. Platform in alcove at right is piled with 8/4 mahogany, out of the way but easily reached.

Setting Up a Small Shop

Five woodworkers tell how they'd do it

How can you set up a serious woodworking shop on a slender shoestring? Many readers have asked us variations of this question, so we made up our own composite question and put it to five expert craftsmen:

"I am an amateur woodworker, and I wish to start building a proper shop. As my skills improve, I'd like to make at least part of my living from the craft. I can move into a single-car garage (about 10 ft. by 20 ft.) with an overhead door. I have some basic hand tools, but no machines yet. What machines should I buy first, and what should I add as my finances permit? How should I arrange them in the available space? What about lighting, ventilation, storage, finishing?" The answer men are as follows:

—Henry Jones of Vineyard Haven, Mass., an industrial designer turned professional woodworker. His article on how to produce square frames in batches of 100 appeared in the

Sept. '79 issue of *Fine Woodworking*.

—Tage Frid, professor emeritus at the Rhode Island School of Design and senior editor of *Fine Woodworking*.

—Franklin Gottshall, of Boyertown, Pa., cabinetmaker and author. Eleven of his fifteen books, including *How to Design and Construct Period Furniture*, are still in print.

—Andy Marlow, consulting editor of *Fine Woodworking*, a professional wood craftsman and author of several books on reproducing antiques. His most recent book, *Classic Furniture Projects*, contains plans and instructions for 13 different pieces of furniture, most of them with inlay.

—Frank Klausz, a cabinetmaker in Bedminster, N.J. His article on cutting mortise-and-tenon joints appeared in the Sept. '79 issue of *Fine Woodworking*.

We invite readers to send us their own floor plans and ideas so we can treat this subject again in a future issue.

Leave room in the middle

by Henry Jones

When I opened a commercial cabinet shop about six years ago, I had to decide whether to rent suitable space or attempt to work in my detached single-car garage. The convenience of having a shop only a few steps from my front door was incentive enough to favor the garage, but economic considerations decided the issue, and I set about transforming the tiny 10-ft. by 26-ft. building into a production shop.

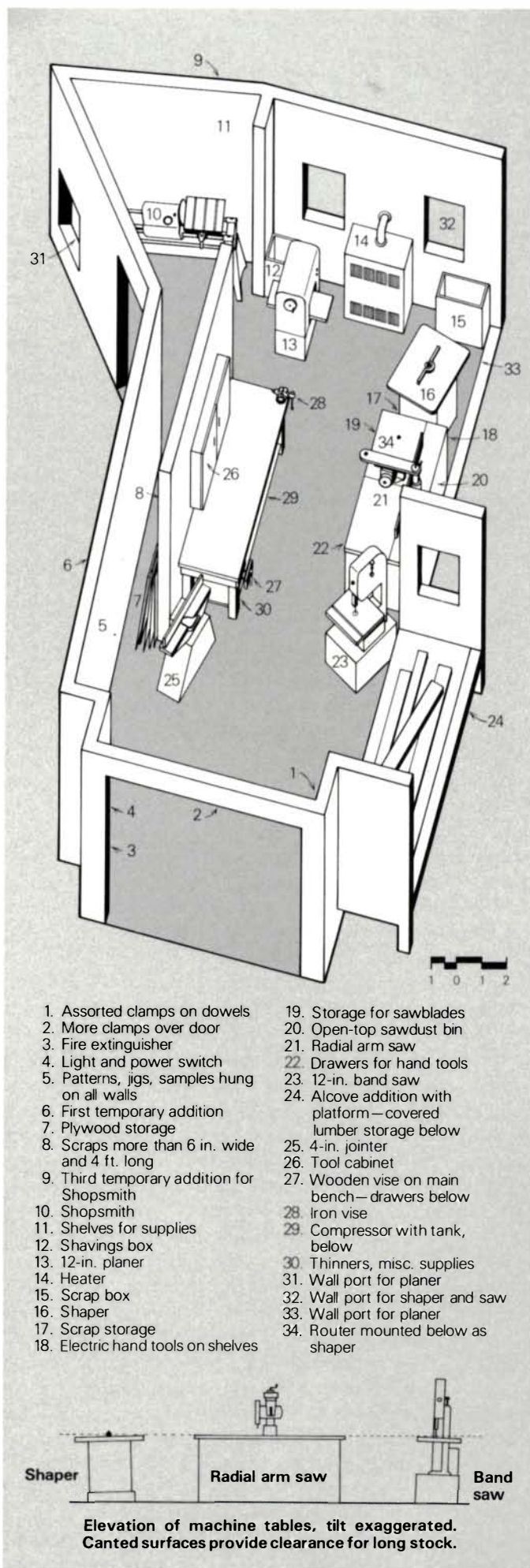
To cram my entire operation into 260 sq. ft. meant that I would have to use every available square inch. My first step was to prepare a diagram that included every machine, fixture and cabinet and the clearance paths required for the use of each machine and for my bench as well. I had to make many changes once I actually started setting up, but the original plan helped me decide that the limited space could be made to work. From the plan I knew that if I managed the space properly, I wouldn't have to move my machines around much to make room for other operations and that I would still have storage for lumber, fixtures, supplies, patterns and miscellaneous tools. In the midst of all this I had to have room to set up and assemble work in progress, without having to shift furniture parts and tools all over the shop every time I needed to use a given machine.

Deciding from the outset to limit stock length to 12 ft. or less on all but rare occasions, I was able to compute the amount of space needed to operate each machine. A 12-in. planer requires an unobstructed path 26 ft. by 24 in. by 6 in. A radial arm saw or a shaper needs about the same. A 4-in. to 6-in. jointer needs a space about 16 ft. long and 8 in. wide. And my 8-ft. workbench has to have at least 10 ft. on either side of the vise. Having satisfied myself that I could fit all these into the existing space, I was confident that somehow I could squeeze in my band saw and my Shopsmith.

With only minor modifications and several simple, inexpensive additions to the basic structure, I managed to produce a meager but acceptable income in this shop for five years. But last year I tore away about half of the garage and built it anew, doubling the floor space and tripling the volume. However, the methods I worked out to cope with limited space and which I'll describe here were successful in enabling me to run a cabinet shop on a small budget until it was financially feasible for me to enlarge the space.

To make the old shop workable, but without disturbing the existing roof or major structural members, I added a narrow shed and a bay clear of the ground—a kind of elevated alcove—to provide areas for storing and working large plywood sheets. I also cut ports through the two walls at opposite ends of the planer so the machine could be operated across the short end of the shop. The ports were then fitted with lift-out covers that latch in place. Because the arrangement precluded the use of a table saw, obliging me to use my radial arm saw for ripping (which I find entirely satisfactory), I cut another port in the wall that stands about 10 ft. from the saw. This lets me rip boards as long as 14 ft. and provides almost unlimited crosscut capacity.

I located my shaper to the left of the radial arm saw's 6-ft. table, and the band saw to the right of it. To keep the work



on one machine from running into the table of another required precise angular as well as linear positioning. First I spaced the tables at least 1 ft. apart. Next I placed the shaper spindle and the band-saw blade about $\frac{1}{2}$ in. behind the rear-most fence position of the radial arm saw, so boards being ripped pass in front of them. Then I turned the shaper and the band saw so that a long workpiece going through either machine clears the radial-arm-saw fence by running in front of it. Long pieces from the shaper run out the radial-saw port, while those from the band saw run into the alcove.

The trickiest problem to overcome with in-line machines is height. A board with a downward bow will run into the edge of the adjacent table on the outfeed side. Since I couldn't solve this problem by raising or lowering one table or the other, I simply tilted the shaper and the band saw slightly. This allowed me to lower these tables about $\frac{3}{8}$ in. and still maintain good clearance as their workpieces passed over the radial-saw table, and vice-versa.

With its two extension wings, the underside of the radial-arm-saw table serves as a storage cabinet for two dozen sawblades, dado heads and buffing wheels. The base also contains shelves for twelve portable electric tools and finishing supplies as well as six heavy drawers for hand tools, hardware and fasteners. I've still got room under the saw for a trash box, a small scrap box and a sawdust bin. I keep the four most frequently used portable power tools plugged in on their shelves so they can be grabbed, used and as quickly put away again. The area beneath my bench is also used for storage. Here I keep my air compressor with tank, thinners, glues and seldom used tools. Two drawers hold sandpaper and sanding belts.

Handling and storing plywood had to be given special consideration because laying out a 4x8 sheet took up so much work space that I couldn't step around it. So I built an alcove, 3 ft. by 11 ft. with a floor 18 in. above the main floor; the alcove's platform is ideal for cutting sheets of plywood, better than sawhorses. The alcove is also useful for stacking wood I'm about to use and for assembling kitchen cabinets.

I like to stock 20 to 30 sheets of various plywoods, and such a stack just leaning against a wall is very difficult to manage. You can't extract one sheet while holding those in front of it against your stomach. So I built a narrow extension to the building, a kind of storage corridor only 16 in. out from the existing wall and still under the existing eaves. This has been so convenient that I've kept it in the new shop. Because they're supported on either side, I can shuffle through a large number of sheets like pages in a book, then slide out any one of them with ease.

The main hand-tool box hangs over the bench. Measuring 48 in. by 36 in. by 6 in. closed, with its two doors open it's 8 ft. long. I built this cabinet many years ago so that I could move into a new shop, hang it on the wall and be at work in a few minutes with over 100 tools in front of me.

I would not have had room for all the machines I needed if it weren't for the Shopsmith, which has its own space in the shop's third modest addition. It has served me faithfully since 1954 and I have gotten out a great deal of work with it, although I rarely use it as a saw. However, as a 12-in. disc sander it is unbeatable. As a drill press, horizontal boring machine, grinder and light-duty lathe, it is perfectly adequate. The shiftovers have been so well designed that I don't object to the setup time as a trade-off for space saved.

Scrap storage needs attention too, and I've found that any such pile has a critical size. You don't use what you can't see,

and obscured scraps might as well not be there. But I'm basically a squirrel, and I can't bear to toss out a nice, clean block of cherry or even pine. So there are about six scrap stacks scattered around wherever one fits in conveniently. Blocks smaller than about 8 in. long and 4 in. wide go in a box under the radial arm saw. Most of these are cut-offs and go there directly from the saw. Long, skinny rippings go directly overhead. Sticks and boards less than 40 in. by 4 in. lean between the radial arm saw and the shaper, where I can see the end of each one. Those shorter than 20 in. go vertically in a box under the other side of the shaper. Squarish small panels are stacked like books under one end of the bench. Larger panels lean against another wall, with patterns hanging above them. Most lumber is up on the roof collar ties, and since there are three tiers of collar ties, few boards have so many others on top that one can't be hauled out. Every inch of every wall is covered with tools, supplies, patterns, jigs or clamps. I have nearly seventy clamps of at least eight different types which hang on $\frac{3}{4}$ -in. dowels, as many as six per dowel. I hate to hang a tool on a nail, and I despise pegboard holders. A dowel with a nice, crowned end is much more respectful to the tool.

With all this, I still had space to assemble cabinets or produce small pieces in batches of 100. But a lot of time was wasted keeping things out of the way, stowing each item just so. It was like working aboard a boat. To turn a 14-ft. board end-for-end meant walking outside. The final straw came with a load of new lumber I couldn't store. My new shop, constructed phoenix-like from the old, eases everything. But there still is not enough space. There never is.

Start with a table saw

by Tage Frid

The most versatile machine is the circular saw. The choice comes down to the radial arm saw vs. the table saw, and my advice is to buy the table saw. The radial arm was designed for crosscutting lumber to length, but even there it is limited by the length of its arm. Though it can be made to do all the things a table saw can, it is more difficult to use and less accurate for fine joinery. Some joints would be impractical and even dangerous to make on a radial arm saw, sawing tenon cheeks or ripping small pieces of wood, for example.

When buying a table saw, get at least a 10-in. one; it doesn't cost much more than an 8-in. saw. The motor should be at least 1 HP; 2 HP is even better. Make sure the arbor tilts for angle cuts, not the table. I find a long extension rail on the side of the table helpful for ripping large pieces of wood. You will find the table saw the most used piece of equipment in the shop, so don't stint on quality. I don't have experience with all the brands on the market and can't give advice about which might be the best, but I can say that I have had a Rockwell saw for many years and we are old friends. If I had limited space, I would definitely look hard at the Inca 10-in. cabinetmaker's saw, although I have never worked with it, only seen it demonstrated. The disadvantage is its tilting table, very awkward for beveling long boards. But it has a mortising spindle that you can use like a horizontal boring

machine, and this might offset the inconvenience of the tilting table. It is a lightweight machine, easy to move around, and that is an important consideration where space is limited.

After the table saw, I feel the jointer and thickness planer are the most important big machines. These two machines can be a big investment, but if you want to make a living out of woodworking, they will pay for themselves. A used jointer or thickness planer can sometimes be bought inexpensively and will usually do as well as a new machine. But don't buy a jointer with a square cutterhead; it is just too dangerous. The smallest jointer I would buy is a 6-in. model (an 8-in. is better) with at least a 1-HP motor. The smallest thickness planer I would buy is a 12-in. model with a 2-HP motor. If I had limited space I would look at combination planer/jointers (see *FWW* #17, July '79). Inca and Makita have one, and so does Parks, and there are a number of other imported machines available on the American market. The disadvantage of combination machines is that the infeed and outfeed tables might be too short for handling long boards. So it pays to find people who already have the machine you are interested in, to see how they like it.

After these big machines, it all depends on what kind of work you are going to be doing. The possibilities include a mortiser, band saw, shaper, drill press and lathe.

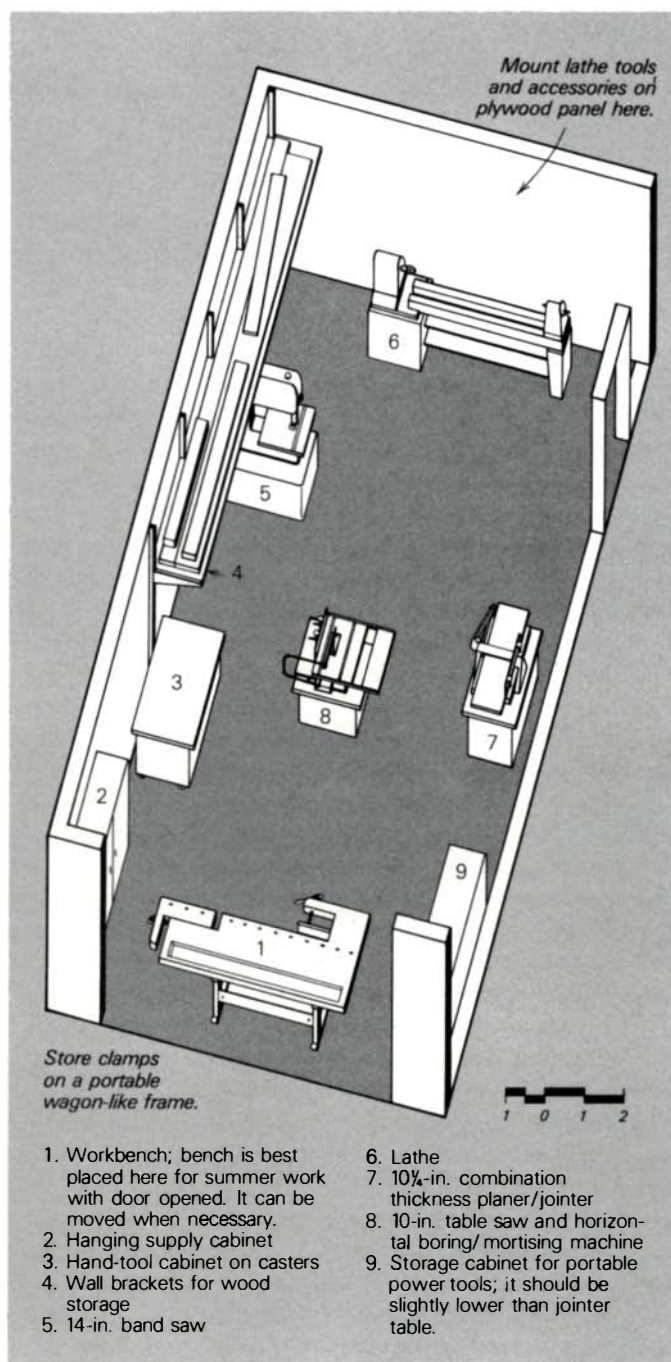
For the mortiser, the cheapest would be to buy the hollow chisel attachment for a drill press. I find these attachments fine for soft wood, but the chisel tends to stick in hard wood, and I would rather have a long-hole boring machine, or slot mortiser; with the right bit, it is one of the fastest ways to cut a mortise. Like a high-speed drill lying on its side, it has a table for the workpiece in front of the bit. The table can be moved up, down, in, out and sideways.

If you plan to cut many curves, or resaw boards for laminating or bookmatching, you will need a band saw (*FWW* #19, Nov. '79). The 14-in. saw might be large enough if you are making musical instruments, but for cabinetmaking I would buy a 20-in. saw with a 2-HP motor. A lathe, I have found, is a very useful machine and does not take up much space. The shaper is important if you plan to do production work.

Sometimes I see advertisements for combination machines that do everything. A machine like this might be fine if your space is tight, if you do woodworking as a hobby, or if you have a small production shop making little things like boxes or toys. If you plan the work so the change from one operation to another is minimal, that type of machine might do. But if you have the space and want to have a more flexible shop, I suggest you buy separate machines.

Actually, after I had some good hand tools—saws, planes and chisels—one of the first things I would buy, before any stationary machinery, would be an electric router. It can make joints, including half-blind and sliding dovetails, and it can cut small moldings. It has many other uses as well. Get a good router that can take 1/4-in. and 1/2-in. bits, with at least a 1-HP motor. Make sure the mechanism that moves the router up and down in its base is easy to work and accurate, and make sure the switch is easy to turn on and off while routing.

If I were setting up to work in a single-car garage with an overhead door, I would put my bench right in front of the door. It is not too hard to move out of the way when big things have to go in and out, and this would be the best place to work in the summer with the door open. The table saw is the most used machine, so I would put it right in the middle



of the room, where I could get at it from all sides with all sized pieces of wood. The jointer and thicknesser should be nearby because while preparing stock you have to move the wood back and forth between these machines and the table saw. There shouldn't be anything else along the wall with the jointer/planer that will be in the way of long boards. The exception would be a low cabinet near the bench for portable electric tools, low enough for boards to pass over the top. I would keep my hand tools in a cabinet on casters, and I would make a portable frame for storing clamps. Lumber could be stored along the walls overhead, on wall brackets or on racks hanging from the ceiling.

In designing a small shop, don't underestimate the space you need to leave open for assembling work, and for storing parts of jobs in progress. In a one-man shop, I would not have any specific finishing area—it takes up too much space. Instead I would plan my work so the finishing could be done late in the day and cleared away in the morning. →

High ceiling, wood floor, good light

by Franklin H. Gottshall

A good shop should have a high ceiling. A minimum height of 7 ft. will do, but 8 ft. or 9 ft. is much better. My shop, a part of which is shown in the photograph, has a 9-ft. ceiling. I do not like a cement floor in a shop, and unfortunately most garage and basement shops have one. A wooden floor is much easier on the feet and the work, and if either a garage or a basement is to be made into a workshop I strongly advise superimposing a wooden floor over the cement, though this will mean lowering the ceiling. Walls and ceiling should be adequately insulated to keep the shop warm and dry.

Proper lighting is extremely important, and is often inadequate both in home workshops and in buildings used for commercial purposes. You need natural daylight as well as enough artificial lighting. Walls and ceiling should be white to make full use of all the light you can bring into the shop. Good eyesight is precious.

The drawing shows what I think is an ideal natural lighting situation, with the workbench situated to get lighting from the north. This eliminates a lot of glare and shadows you might get having to work facing in another direction. You need enough overhead lighting at your machines and workbench to eliminate shadows and eyestrain, and in my shop it is possible to move some lights as necessary.

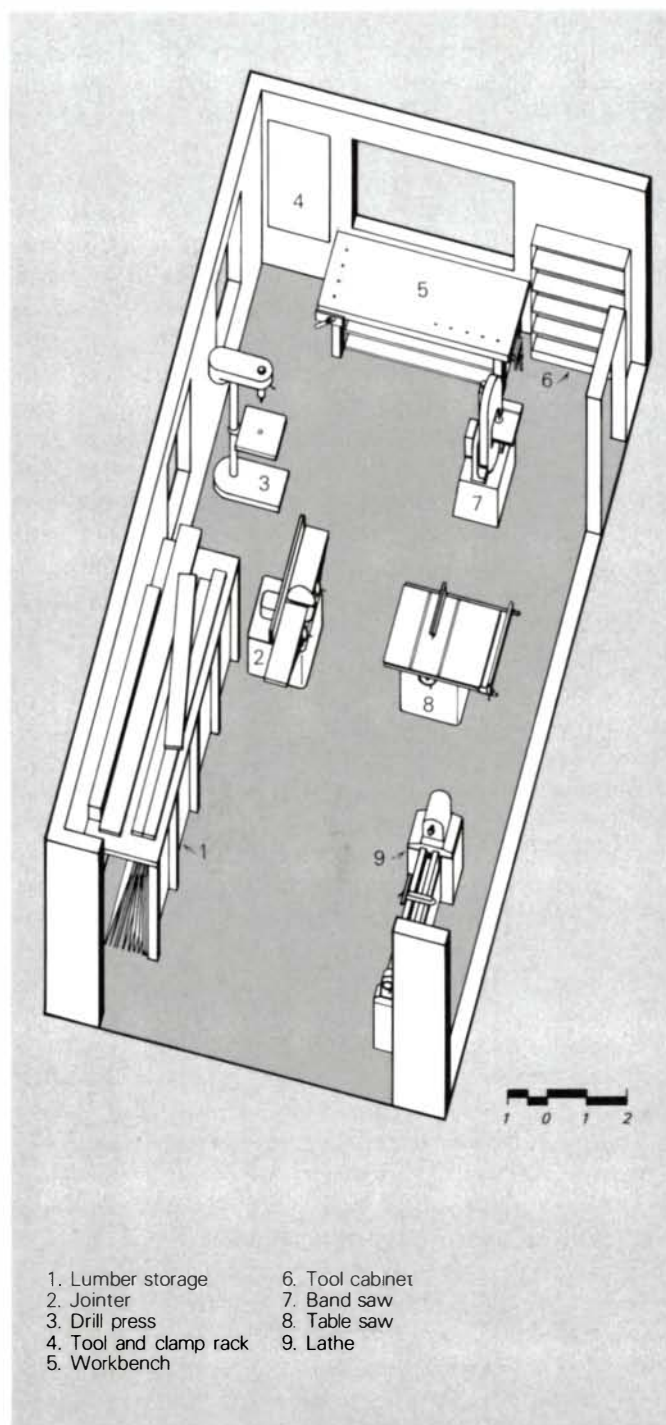
As to equipment and machinery, first priority should be given to a good workbench, equipped with a good vise or two. I recommend a bench with a flat, hardwood top, 2 in. or more thick, and a substantial base. It should not be fastened to the floor, because you may need to move it.

Machinery should be the best quality obtainable. I recommend buying single-purpose machines and avoiding multi-purpose machines that combine saw, jointer, lathe, and what-have-you. They are inefficient because too much time must be spent on the adjustments and changes needed to carry out sequential operations. All of my machines have sturdy cast-iron bases, and each has its own electric motor.

If I were to purchase machinery for a shop, one item at a time, I'd buy a good table saw first. You should be able to tilt either the saw or the saw table, and it should be equipped with a 10-in. combination crosscut and ripping blade and with a dado head. A radial arm saw could be substituted here but would require more room. My table saw has a $\frac{3}{4}$ -HP motor, which meets all my cutting requirements.

Next, I would buy a 6-in. jointer, equipped with a $\frac{1}{2}$ -HP or $\frac{3}{4}$ -HP motor. A 14-in. or 16-in. band saw should be your third machine, and for this a $\frac{1}{2}$ -HP motor is adequate. A floor-type drill press ($\frac{1}{2}$ HP will do) should be next, and it would pay you to equip it for hollow-chisel mortising.

Fifth, get a woodturning lathe with one or more faceplates, as well as a good set of woodturning chisels. If possible buy a lathe equipped with an index head and a bed long enough so you can turn spindles 38 in. or more. A $\frac{1}{2}$ -HP motor will be adequate for this machine. A 12-in. surface planer is a good machine if you can afford one, but it might crowd you for space in a small shop. You need floor space for assembling large projects and for safety—don't sacrifice it for equipment you can get along without.



Gottshall in his own shop, somewhat larger than 200 sq. ft.

Photo: John Massey

Get a big band saw and a jigsaw too

by Andy Marlow

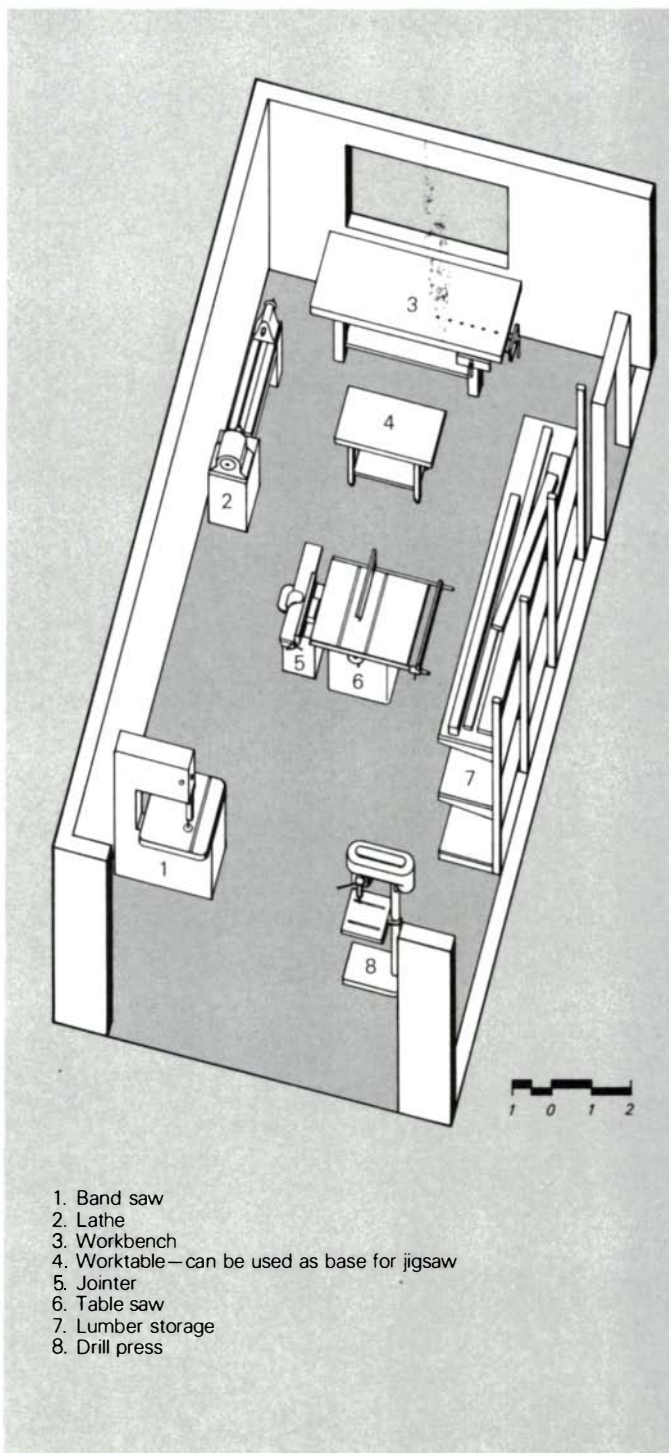
For a home shop I would start with a 10-in. table saw. This is one machine that requires space in all four directions for work maneuverability, so it must be placed with the fence running parallel to the length of the building and equidistant from all four walls. Though the power cable should come up through the floor (this is not too difficult to arrange if the floor is wood), it may not be worth the trouble of chipping away cement to bury the conduit. So to keep from tripping over the conduit, simply border it with chamfered strips of wood on each side. Your jointer, for convenience of operation, should be placed next to your table saw and can be powered by the same cable.

The placement of other machines and equipment is optional and deserves careful consideration. I would place the lathe along a wall somewhere near the workbench because extra space at the ends of this machine is unnecessary, and operational space out into the general shop area can be held to a minimum. A band saw is an indispensable tool, so don't buy a small toy. I believe that a 16-in. throat is the minimum, not only because of its width capacity but also because on smaller size saws the blade will wander, distorting the shape on the bottom of the cut, especially if the stock is thick. The column of the band saw may be placed quite close to a wall, though there should be plenty of room on the other three sides to move your body and negotiate the workpiece.

Two more machines I consider necessary are a drill press and jigsaw. As you continue to use your shop equipment, you will begin to realize how many different operations can be done on a drill press. In addition to light shaper work, you can do dowel boring and mortising. True perpendicular boring is, in many cases, quite important. A jigsaw is indispensable for fine scroll work on thin stock, and no other machine can saw a complete inside cutout. If you look at the shop sketch, it will become apparent that space is running out. Fortunately a jigsaw can be mounted on a table with casters so that you can move it about the shop. Two more machines for later consideration are a bench shaper and a homemade 6-in. belt sander needed for larger work.

The idea is to get as much daylight as possible on the bench, so you might want to place it close to the entry door. You could get by with a bench top as small as 48 in. by 20 in. At least 95% of your work will be performed at the right end of the bench (if you're right-handed), where two 7-in. wood-working vises should be mounted. The vise on the end should have a dog, and on the bench, in line with this dog, should be a series of $\frac{7}{8}$ -in. diameter holes to receive a bench stop. You can make a suitable bench stop by starting with a block $1\frac{1}{4}$ in. square by $2\frac{1}{2}$ in. long. Put it in your lathe and turn a $\frac{7}{8}$ -in. by 2-in. dowel on the end of it. This stop can be inserted in any one of the holes in the bench to hold workpieces of various lengths.

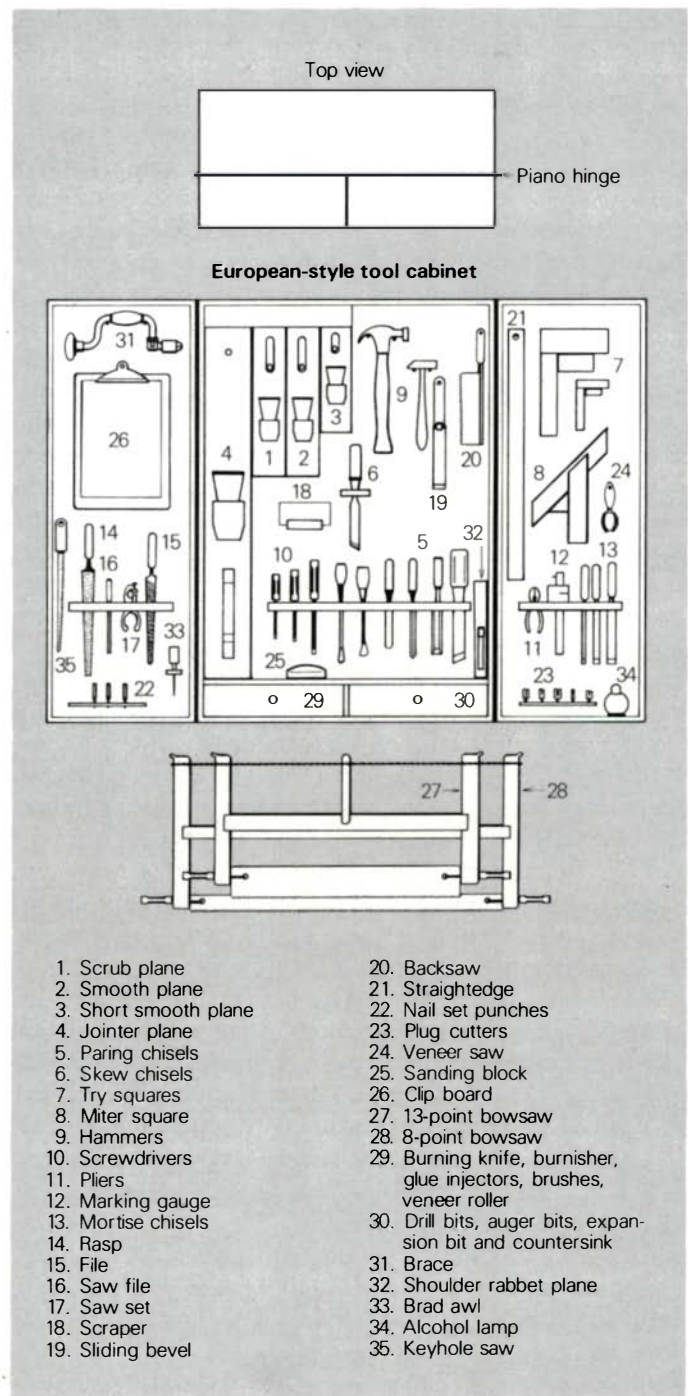
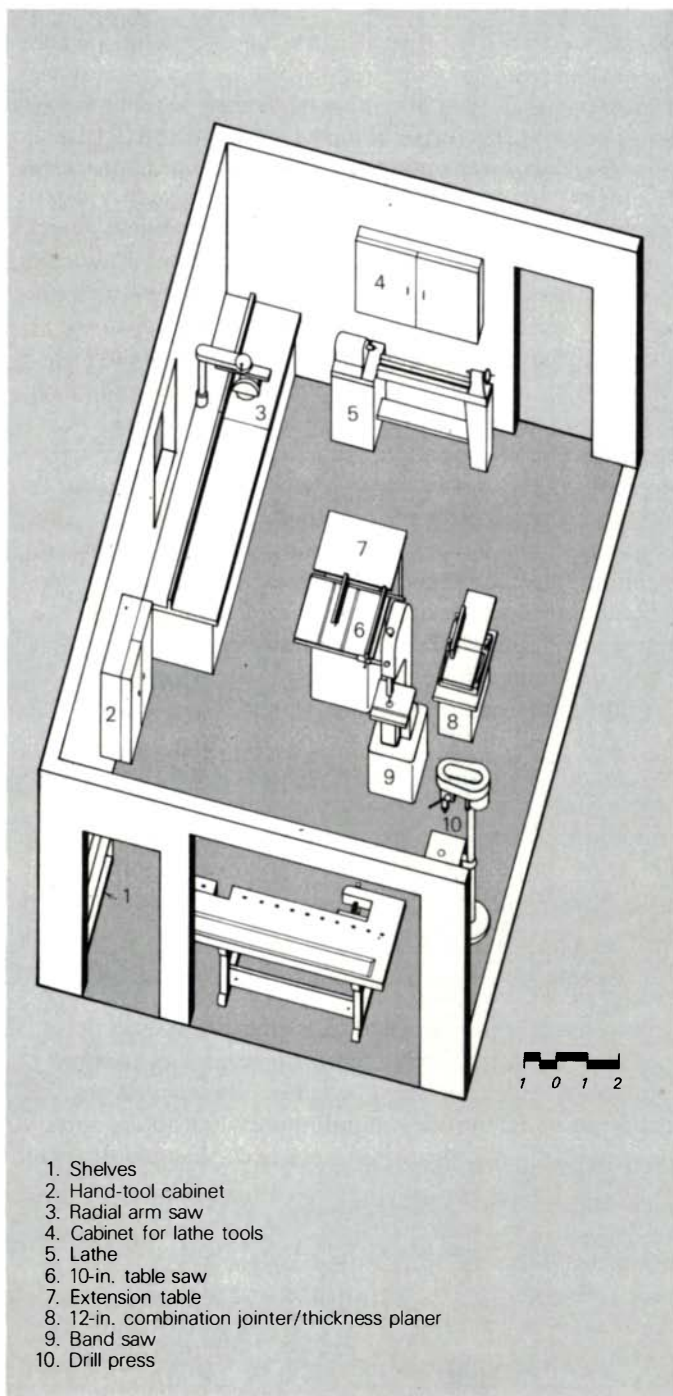
The kind of lighting you use is optional, but your fixtures must be placed so that no shadows will be cast on your work. Only one other suggestion—don't use a fluorescent light over your lathe. Rapidly revolving objects appear to writhe and squirm under this kind of light.



1. Band saw
2. Lathe
3. Workbench
4. Worktable—can be used as base for jigsaw
5. Jointer
6. Table saw
7. Lumber storage
8. Drill press



Though his shop is not much larger than a typical single-car garage, Marlow works quite comfortably and efficiently here reproducing period furniture. His work includes multiple productions and one-of-a-kind pieces.



Build around bench and hand tools

by Frank Klausz

It is very difficult to plan a shop for a woodworker and to recommend specific tools without knowing the kind of work done in the shop. But for general furniture making, repairing and refinishing, I can make several suggestions for the woodworker with limited space. One of the most important items in the shop is the workbench. It should be at least 7 ft. long and equipped with a side vise, a tail vise and a good set of steel bench dogs. Of equal importance to the bench is a set of fine hand tools. Don't waste your money on cheap ones; buy the best and keep them well honed. Sharp tools are easier and

safer to use, and they do nicer work. If you have your bench and a good set of hand tools, you are ready to tackle almost any kind of furniture work. This is especially true if woodworking is your hobby and you don't care how long it takes you to make a piece.

If you want to make a living working wood or if time is at all important, you'll definitely want to buy some machinery. It would of course be preferable if you could buy your machines all at once, but few people can afford to part with that much money at one time. So if you're going to spread your investment out over a long period, I suggest that you buy your machines in the following order. The first one I would pick is a 14-in. or 16-in. band saw. The reason is that with this machine you can rip and crosscut as well as make contoured cuts, producing everything from a haunched tenon to a Queen Anne leg. If your budget is limited and you want a

table saw too, you can make a temporary one by simply mounting a portable circular saw on a piece of $\frac{3}{4}$ -in. plywood, inverting it and fixing the table to a base. Clamp on a straight-edge for a rip fence.

The second machine I would get is a radial arm saw, a very versatile machine that can be used for ripping, crosscutting, grooving and shaping. Actually, the machine is best suited for crosscutting, dadoing and mitering. A good 10-in. table saw would be my third choice, and you'll want to attach a sturdy extension table on the outfeed side of the saw. Next would come a jointer, the longer and wider its bed, the better. For a small shop, a combination jointer/planer would do very well. Finally I would get a drill press and a lathe, and be content with these machines until I could afford to move into a bigger shop.

With care, these six machines and a workbench can be arranged to fit into a small shop 12 ft. wide and 20 ft. long. I would group the table saw, the jointer and the band saw in the center of the shop. There are several reasons for this. One is that you can easily run the electricity to this central area, and you can run all three machines from a single breaker box or fuse box, minimizing the amount of cable necessary to power them. Second, you don't have to carry your workpieces all over the shop to perform various operations on them. Third, lighting can be concentrated on this central area; and finally, you have more space in your shop for storage, assembly and walking around.

If your shop is in a free-standing building, you have the option of feeding some machines across the width of the shop by cutting ports in the walls where needed. In Hungary my father has a cabinet shop, and all the machines are in a room that is only 12 ft. by 16 ft. His only machines are a 30-in. band saw and a combination table saw/jointer/planer/mortiser/shaper. There we used to cut our own lumber from 20-ft. logs that came in one window on a steel roller, were fed through the band saw and exited through the opposite window on a roller at the sill. Once the log was put in position, it wasn't that hard a job to cut it up, needing only two men working in close harmony.

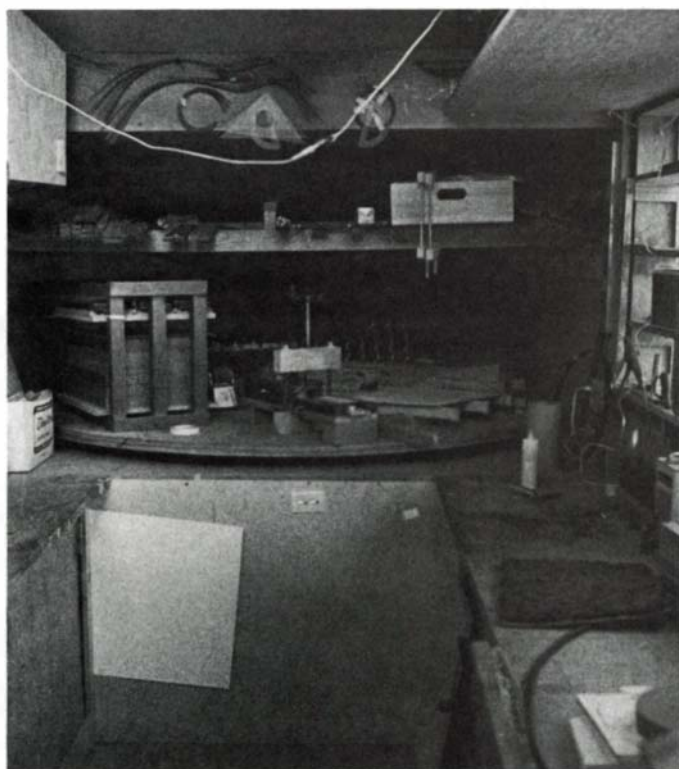
In a small shop it's especially important to keep your machinery clean and your work areas orderly; you need to organize storage space so that tools and supplies can be put away as soon as they are used. A carefully planned, wall-mounted tool cabinet is essential. Lighting is another aspect of shop planning. The aim is to achieve shadow-free lighting wherever possible, certainly over your bench and machines. In addition to getting as much sunlight as you can in your shop, you need to install as many long fluorescent tubes as it will take to give you shadow-free illumination. Stand a dowel on your bench and on each machine; if it casts no shadow your lighting is good.

Finishing in a one-room shop is always a problem because there is going to be a lot of dust in the air, even long after you've stopped working and swept up. So it's best to use finishing products that don't require a dust-free environment. Shellac, linseed oil, Watco oil, and polymerized tung oil are best for finishing furniture in a small shop because they harden in the wood rather than on its surface like varnishes and lacquers, which become rough to the touch and unsightly when they dry in a dusty shop. Sprayed finishes don't belong in the small shop. They are health and safety hazards and will never look right. □

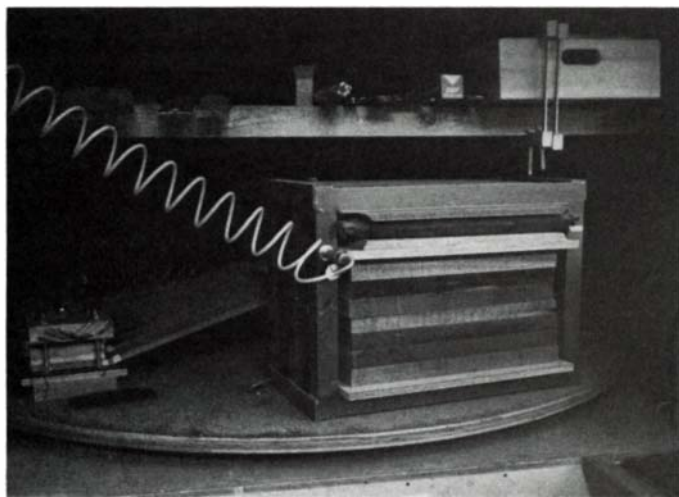
Tool Carousel in Alcove

by Richard Starr

To save shop space and to organize a variety of jigs and tools, Charles Fox of the Guitar Research and Design Center, South Strafford, Vt., made a revolving tool tray. About 8 ft. in diameter, the turntable pivots on a large lazy-susan bearing and is supported two-thirds of the way out by a series of cabinet casters. The entire unit is situated in an alcove, which protrudes over a lower room, adding storage without taking up floor space. □



Though used here to hold specialized luthier's tools, the basic design of this revolving tool tray can be adapted to suit the needs of almost any workshop in which floor space is at a premium.



Capacity of carousel tool tray is large enough to accommodate this veneer press, which operates on compressed air and is used for gluing tops to guitar bodies.

Photos: Richard Starr

Woodworking in Seventy-Five Square Feet

It takes more time, and careful planning

by J. A. Hildebeitel

Neither limited shop space nor a small tool budget need discourage an amateur woodworker from attempting serious projects. Respectable work can be done in less than 75 sq. ft. with a modest selection of hand and power tools. The tradeoff is time—time planning the work before the wood is cut, time to move and set up the tools, time to do what could be done faster with a more appropriate tool, and (in my particular case where the shop is a through-traffic room) time to clean up.

Identifying the particular limitations imposed by available space is a good place to start setting realistic limits on the size and type of work that you will undertake and will help avoid frustration. You shouldn't try to make a solid-top dining table or other large piece of similar proportions. To save on tools and the space they require, I decided to purchase them only when they were absolutely essential to the work planned. This has proven a valuable rule, and the only two hand tools purchased in violation of it I've since found unnecessary.

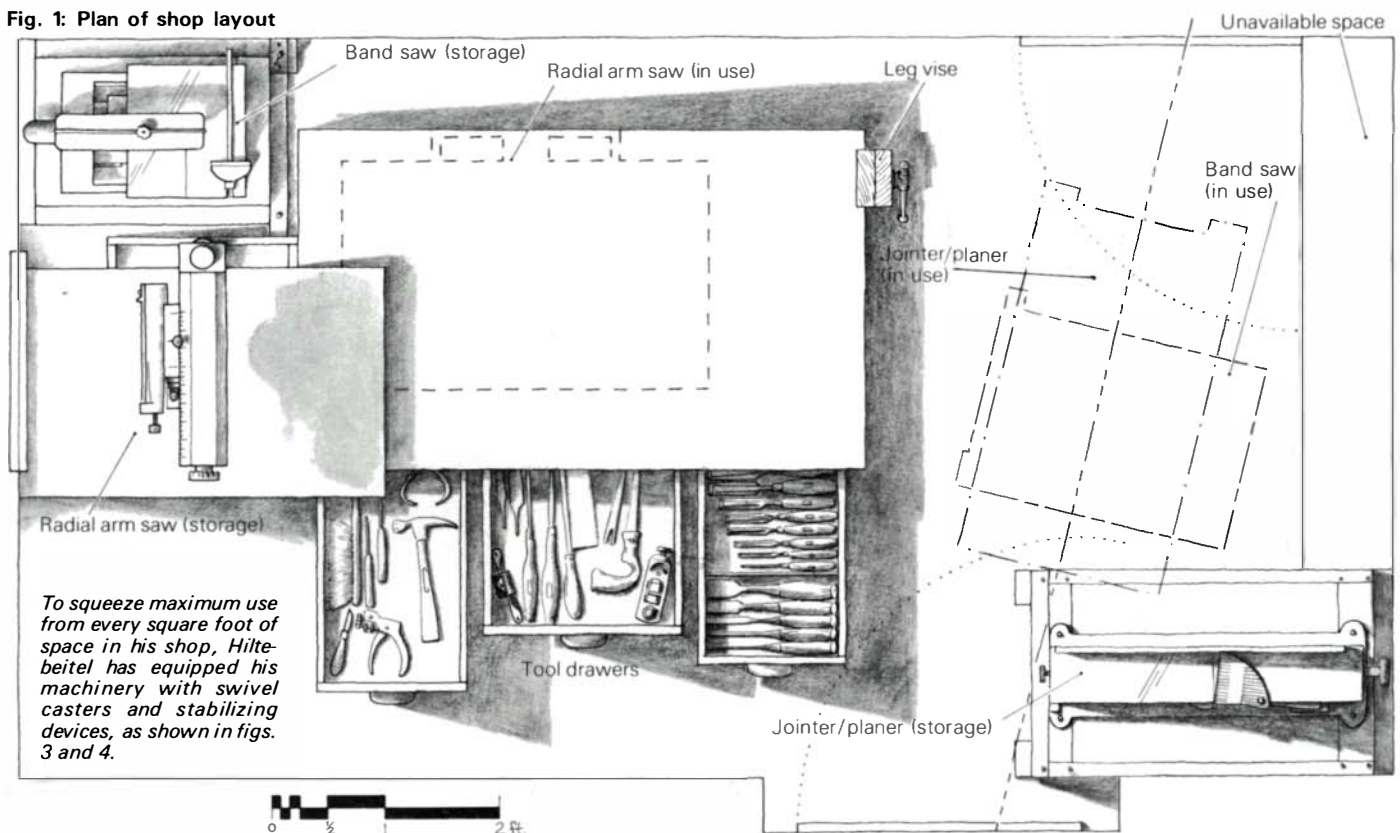
I began by using a sturdy 3-ft. by 6-ft. desk as my bench and a radial arm saw as my only power tool. The efficient use of space is the only basis on which this tool can be recommended, as it is very difficult to make it cut with the consistent precision necessary to good cabinetwork. However, acceptable accuracy can be achieved by truing up the whole tool

periodically and keeping it in tune. Make your most precise cuts (like slip joints) with the blade stationary, moving the work into or through the blade with appropriate guides, jigs and guards. In addition to the saw, I bought a few hand tools—a smoothing plane, a marking gauge, an offset dovetail saw, a $\frac{1}{4}$ -in. chisel and a router. I discovered early that routing hardwood with a bit chucked in the radial saw gives unsatisfactory results and can be unsafe.

For my first project—a padauk jewelry box with a frame-and-panel lid—I devised a leg vise for cutting dovetails and for edge-planing small pieces. I found that a small-diameter dado blade is good for slotting the frame with only a small amount of squaring up and cleaning out necessary at the ends of the members. When attempting to rout inner edges of the frame, I learned my first lesson on the importance of planning operations in the proper order. A router bit's pilot bearing does not guide very well against an already-cut slot.

Planning for my next project—a wall cabinet with inset doors and a through-mortised shelf—suggested a few more tools—a rabbet and bullnose plane, a $\frac{1}{2}$ -in. mortise chisel, a jointer plane, and as an alternative to the offset dovetail saw, a *dozuki* saw. I found the latter easily controlled as you can stand well back from the work and improve the accuracy of that important initial cut. Because I had to rip a few long

Fig. 1: Plan of shop layout



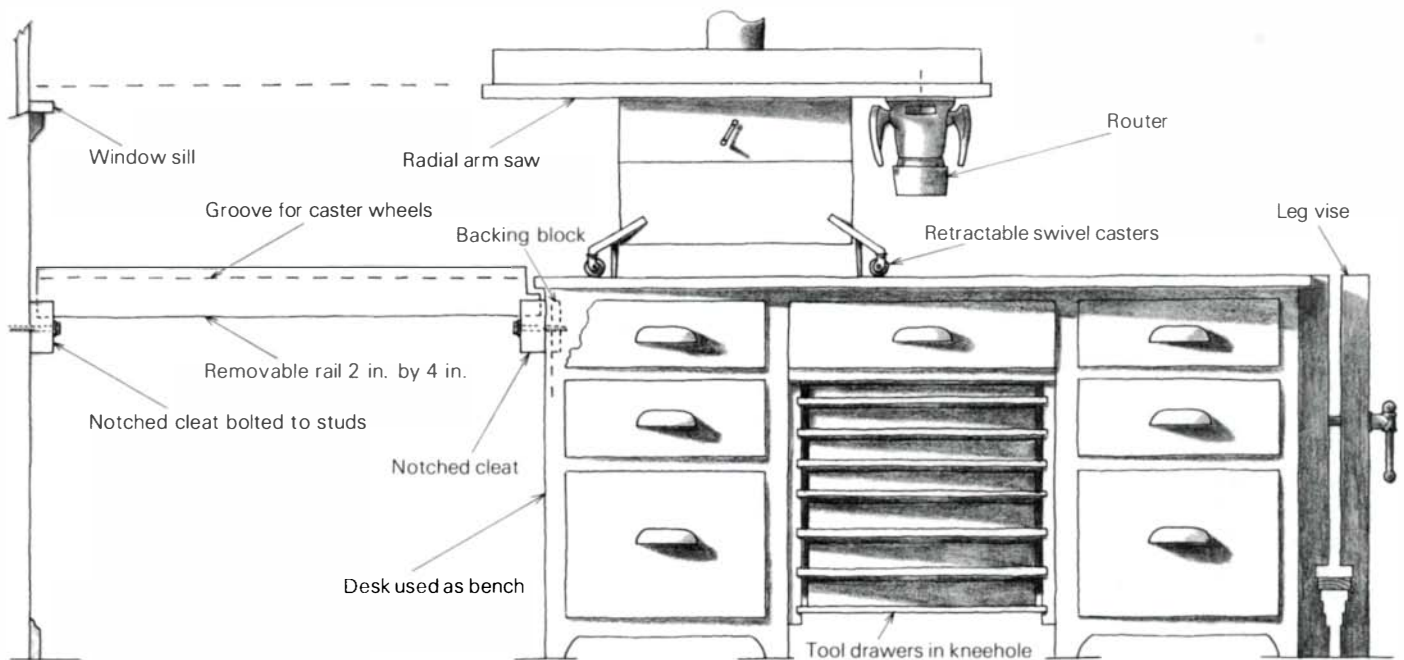


Fig. 2: Radial-arm-saw platform and storage rails

Fig. 3: Band-saw platform

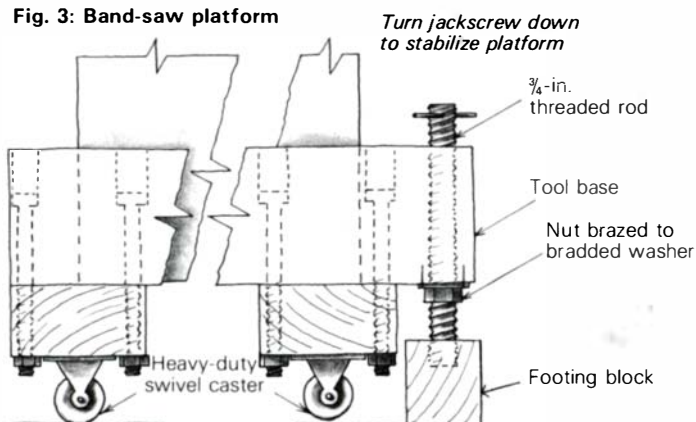
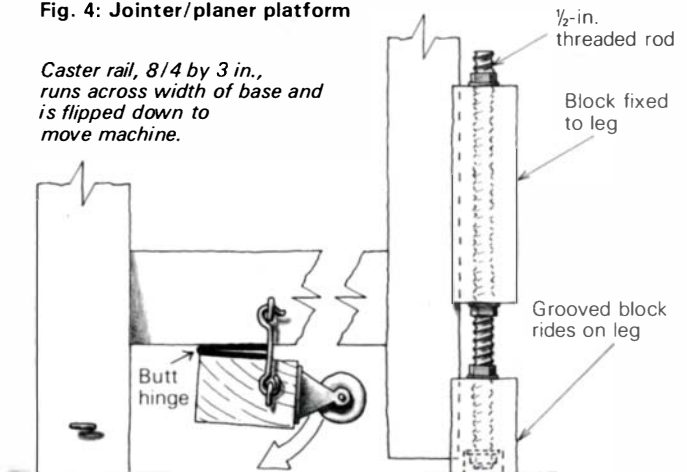


Fig. 4: Jointer/planer platform



boards, I mounted the radial saw on a platform which allowed the boards to extend through an open window (figure 2). This put the saw table at elbow height and provided me a better view of the work. I added retractable casters to the platform along with removable, grooved rails between the bench and the wall, which allow the saw to be rolled off the bench when I need more work surface. The saw can be used in this stored position as well, though only for cutting relatively short pieces. I found an out-of-the-way place for tool drawers in the kneehole of the desk.

Later I got a band saw and made it mobile too using heavy-duty casters. I added threaded rods that passed through fixed nuts near two of the casters to jack one end of the platform off the floor and keep the machine from rolling. Wood blocks on the ends of the rods eliminate skidding. The result is a portable platform that is very stable on an uneven floor (figure 3).

Mounting the router under one wing of the radial-arm-saw table provided modest shaper capability without taking up any extra space. I use it in this position with either a pilot bit or a fence clamped to the table, and it is easily removed when necessary. Though not without its hazards, it does an acceptable job of slotting, rabbeting, molding and other guided shaping operations.

After hand-planing many resawn boards, I decided to buy a jointer/planer. I made it portable with a wheel and leg-stabilizer scheme. One end of the stand is lifted and a hinged rail with casters is flipped down (by foot) and then hooked in place; the stand may then be maneuvered wheelbarrow fashion. Once the jointer/planer is in operating position, I flip up the caster rail and then adjust the legs at the opposite end (figure 4).

In a situation where I'm forced to move, use and replace one machine prior to doing anything with another, an organized work schedule is essential. I have found the following quite dependable for preparing rough stock. Cut to approximate length; plane one face and joint one edge; resaw; rip; joint all edges; plane the opposite face; cut to precise length; scribe and proceed with joint details. A floor-plan layout with the various work and storage positions for each tool is shown in figure 1. Things are indeed cramped, but with realistic goals (I can't, for example, make several large pieces of case furniture at the same time) and thoughtful planning, you can do rewarding work. □

J. A. Hildebeitel, 42, an electrical engineer and amateur woodworker, lives in South Burlington, Vt.

Mobile-Home Wood Shop

by Anthony Wheeler

Few can afford to build a shop, but a house trailer affords a good solution to the one or two-man business or to the serious hobbyist. Since the house trailer is somewhat mobile, it allows for changes in residence or even for the building of a new shop while already having a completely functional one. The cost can be as low as \$5/sq. ft., with internal alterations kept to a minimum; a fixed-foundation building of equal size would run \$10 to \$12/sq. ft. Most trailers are designed with windows on one side, good for solar heating. The basic shape of a trailer accommodates long stock, and even plywood can be maneuvered in trailers 12 ft. or 14 ft. wide. The longest trailers are 950 sq. ft. (14 ft. by 70 ft.), with low ceilings; thus the size and variety of the equipment that can be used is limited.

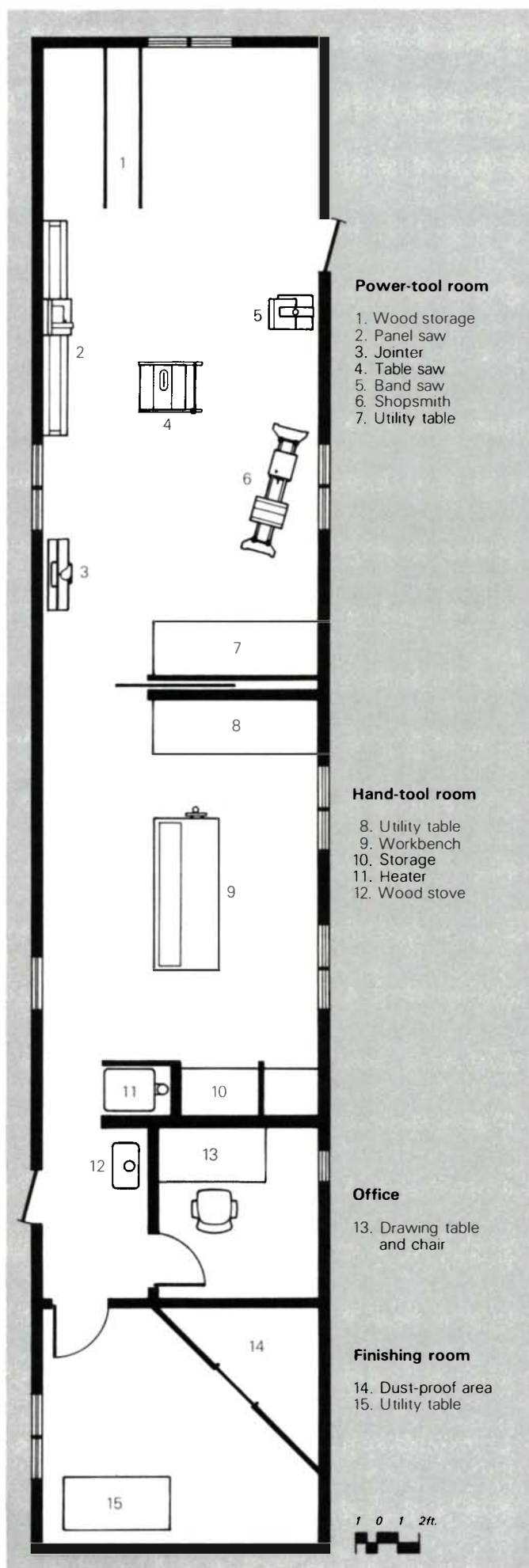
I live on rented property out in the country, where a 1974 Shultz 14-ft. by 70-ft. house trailer has become an extremely functional shop for about \$7/sq. ft. It had been damaged in a fire. In hunting it out, I saw other trailers ranging from a 1965 10-ft. by 50-ft. for \$600 to a 1976 14-ft. by 70-ft. with expanded living room for \$7,600. My fire-damaged trailer cost \$5,000 (this may have been high), plus \$2,000 to lay a new plywood floor, replace interior walls with drywall, replace over half the windows, rewire for power-tool equipment and fluorescent lighting, repair the ceiling and put in bench areas.

An extra-heavy block base was constructed to spread the trailer's weight over soft earth. The location required blocking one end up about 5 ft., and once skirted, this space has provided a good storage space for lumber. All of these details can increase the cost of setting up this type of shop.

The long narrow shape of the trailer is well suited to a cabinet shop. My shop is laid out so that work moves in one direction, from the front door as rough stock to the finishing room in the rear. The first and largest room (13 ft. by 30 ft.) is devoted to wood storage and power-tool work. A narrow storage area here will hold approximately 15 to 20 sheets of plywood and 100 bd. ft. of lumber. The power tools include a 10-in. table saw, a 12-in. band saw, a jointer, a panel saw and a Shopsmith. The table saw and Shopsmith are on casters so they can be moved when working on odd-size stock. The panel saw's proximity to the lumber storage area saves work. The Shopsmith has been an adequate tool thus far. For this room I made a large router table that can be stored vertically when not in use.

The second room (13 ft. by 20 ft.) is the bench room and is separated from the first room by a large sliding door, which reduces dust flow. This room contains a woodworking bench and an auxiliary bench and is where final assembly and gluing are done, and all carving. The adjacent area includes an office, converted from the bathroom, a gas furnace and a woodburning stove. The last room is used for wood finishing, stained-glass work and storage. I plan to install a large bank of sunlamps to improve finish results. Once a piece is finished it makes a single trip back through the shop and out to the customer. There is really no place to store completed work. □

Tony Wheeler, 30, of Nevada, Iowa, is a self-taught professional woodworker.



Converting to 3-Phase Power

More surges per cycle can save you money

by Mac Campbell

Recently I had the basement of my house wired to supply the power that's required to drive both the single-phase and 3-phase machines I need to run a one-man, custom woodworking shop. From a two-pole, 60-amp fuse box, I get enough power to drive portable hand tools as well as my standing shop machinery. I have a 10-in. table saw (2 HP, single phase), a central dust-collection system (3 HP, single phase), a 14-in. jointer (2 HP, 3 phase), a 24-in. thickness planer (7½ HP and ¾ HP, 3 phase), a stationary belt sander (1½ HP, 3 phase) and a 30-in. band saw (5 HP, 3 phase). I use a phase converter to provide the power I need to drive the 3-phase machines. This converter takes the 220-volt, single-phase, alternating current that's supplied to my house and changes it to 3-phase electricity, as is normally found in commercial and industrial zones.

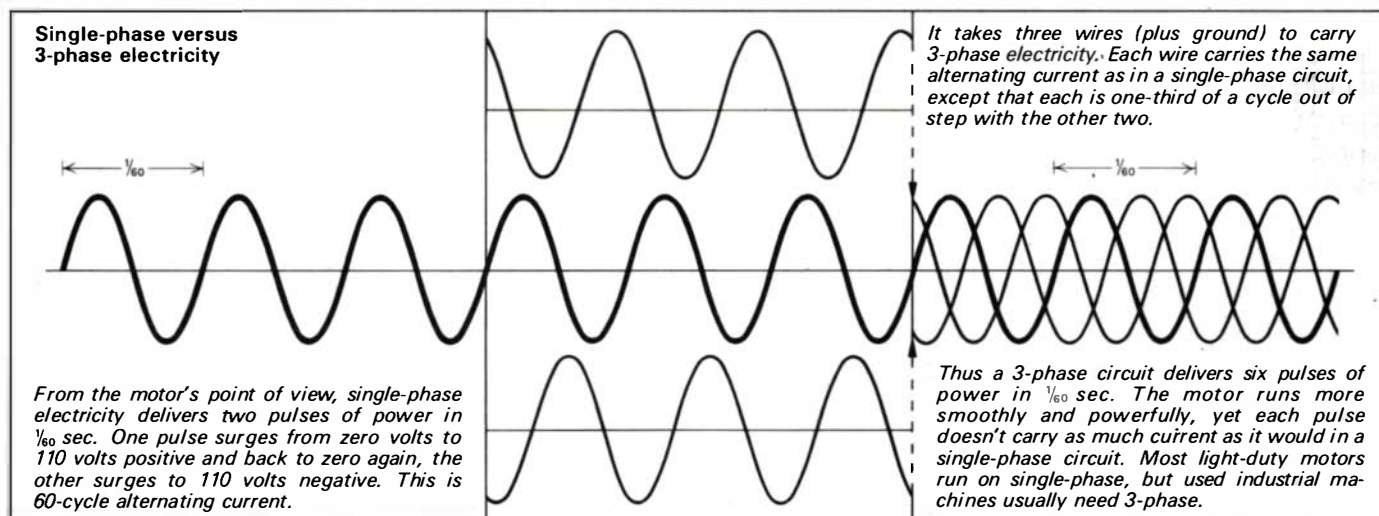
Before saying more about the advantages of 3-phase power and about making a phase converter, a warning is necessary. Electricity must be treated with respect, deliberation and caution. Improper planning, poor layout or failure to observe those safety standards set forth in the National Electrical Code (NEC) or the Canadian Electric Code (CEC) can result in blown fuses, burned-out motors, shop fires, personal injury or death. So if in the process of setting up your shop and installing your electrical system you have doubts or run into problems you can't readily solve, call in a licensed electrician. You may have no choice in the matter because in many cities and towns only licensed electricians are authorized to do the kind of electrical work I describe here.

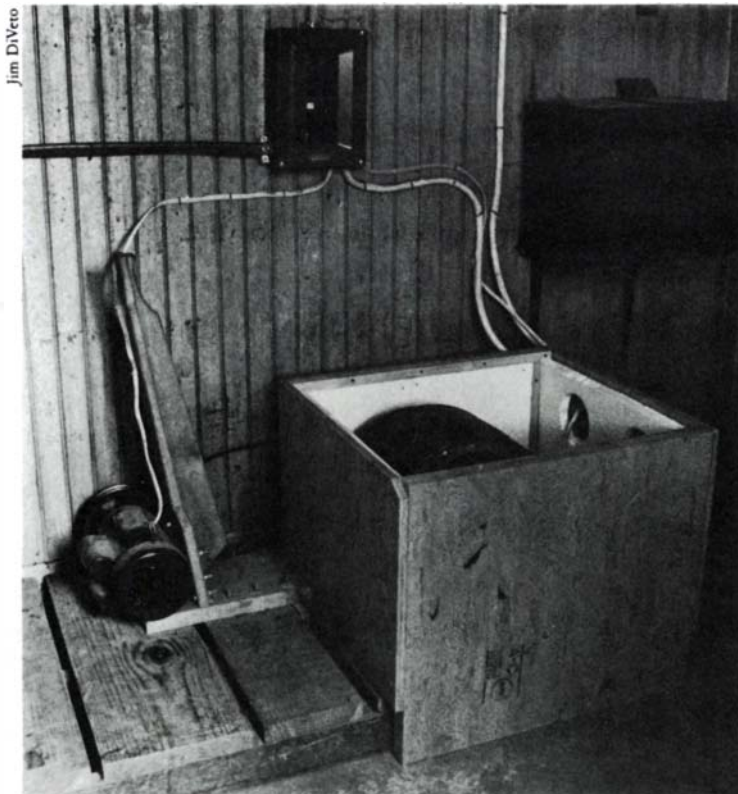
In addition to observing standard safety practices when wiring your shop, you'll need to put each machine on its own separate circuit, which will protect the individual motor from overload with either a fuse or circuit breaker. Each machine will also require its own power switch that's rated to match the voltage and current draw of the motor. And for maxi-

mum safety, especially on concrete floors, each motor circuit should be equipped with a ground-fault interrupter. This device senses current leaks and breaks the circuit before the leakage gets powerful enough to cause a harmful electrical shock.

Next to safety, the efficient use of energy should be your chief concern, and here's where 3-phase electricity is important. Consisting of three separate sources of single-phase alternating current, 3-phase electricity is generated so that the voltage peaks of each phase follow one another at regular intervals, dividing the duration of one cycle of single-phase current ($\frac{1}{60}$ second) into even sixths. So instead of two voltage peaks every $\frac{1}{60}$ second, you get six, each $\frac{1}{360}$ second apart. Electric motors get their driving force from surges of electromagnetic energy, a power surge occurring with each voltage peak (one positive, one negative). At 60 cycles per second, an 1,800-RPM motor running on single-phase current will receive about four power surges per revolution. But an 1,800-RPM, 3-phase motor will get three times as many power surges per revolution, and will produce smoother, more efficient rotary power and higher starting torque. Single-phase electric motors are to 3-phase motors as two-cylinder gasoline engines are to six-cylinder engines. Aside from getting more energy efficiency, the woodworker who's supplied with 3-phase power has ready access to the used machinery market and can equip his entire shop, if he wishes, with superior industrial-duty machines, most of which have 3-phase motors. Such machines sometimes can be purchased for what it would cost to buy new consumer-grade tools with single-phase motors.

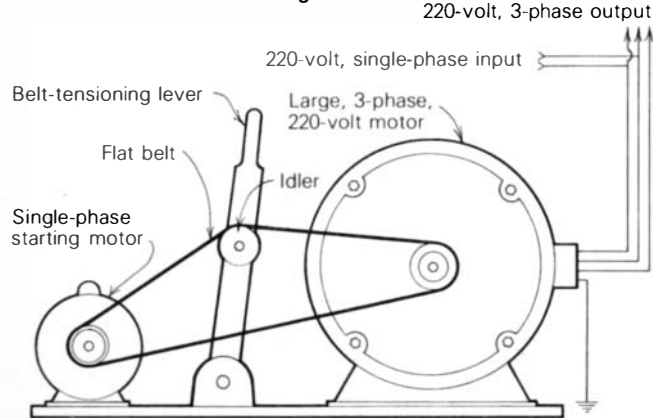
Three-phase wiring requires three insulated conductors plus a ground wire, rather than the two conductors plus a ground needed for single-phase wiring; the practical advantages of 3-phase are numerous. Three-phase motors contain fewer internal parts. They do not, for example, require a separate starter winding and centrifugal switch or a starting



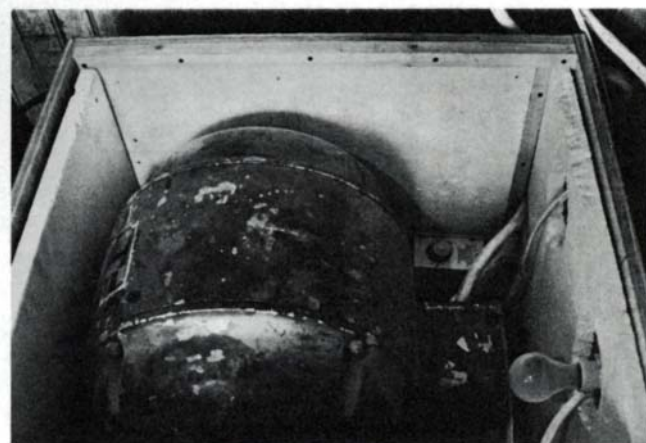


A phase converter is simply a large, 3-phase motor coupled to a smaller, single-phase starter motor. In the setup shown (photographed at an upstate New York shop), the starter motor is mounted on a hinged plate attached to a lever. This does the same job as an idler, allowing the V-belt to be disconnected when the converter reaches operating speed. Wall-mounted breaker-box controls power to both motors, while the large cable at right takes 3-phase current to shop machinery. Since this converter is in an unheated room, it's housed inside an insulated box (photo, right) along with a light bulb connected to a timer. This setup holds enough heat to prevent the grease from freezing, else the motor wouldn't start on winter mornings.

Phase converter and starting motor



Once started and with no mechanical load, a 220-volt 3-phase motor will run on 220-volt single-phase current. You tap two power legs from the same wires that feed the motor, while its rotation generates the third phase via its third wire. With a small converter in a heated shop, the starter motor can be eliminated: Just wrap a rope around the motor shaft, give a smart tug to start the rotor turning and then switch on the electricity.



capacitor; consequently they are less likely to break down, and they're cheaper to repair if they do. Because they're simpler they are usually more compact, a useful feature if you want to increase the horsepower of a given tool and not the space taken up by its motor. They are much more efficient in terms of power consumption (see Table 1, facing page) and cheaper to install, though this is partially offset by the requirement of the fourth wire. Because of its increased efficiency, switch components for 3-phase are usually comparably priced to those for single-phase motors of the same horsepower. An added bonus is that any 3-phase motor is reversible simply by transposing any two lead wires.

There are two ways to obtain 3-phase power. The best way is to buy it directly from the power company, but this may not be possible in many locations because of zoning restrictions. Or you can produce your own 3-phase electricity, as I have done, with a phase converter. Of the several kinds available, I prefer the rotary type because it's the most durable and efficient. Mine is still going strong after 15 years' use in a dry-cleaning plant and another year's duty in my shop. Basically a large, 3-phase motor, used like a generator, this unit puts out the same voltage that's fed into it; so when you drive the converter with a 220-volt, single-phase current, you'll get 220-volt, 3-phase current out of it. (Since it's not running under a mechanical load, single-phase power is sufficient to keep it turning.)

If you want to make your own phase converter, you'll need

to buy a 3-phase motor whose rated horsepower is twice that of the largest motor you'll run in your shop. If, for example, your most powerful machine motor is 5 HP, you'll need to obtain a 10 HP, 3-phase motor as your converter.

Because the converter won't start itself on single-phase power, you need a way of mechanically bringing this 10-HP motor up to operating speed. The simplest is the slack-belt and idler-pulley system diagrammed above. Old-fashioned flat belting is ideal, and the pulleys can be made of plywood discs, bolted and glued together and turned on the lathe. Crown the pulley faces slightly, and space the bolts evenly around the center to maintain balance and reduce vibration. You can, however, use a V-belt and pulleys. A fairly small single-phase starting motor (1 HP or less) should work, since the load is applied gradually with the lever and only after the starting motor has come up to operating speed.

To start and run the converter, first start the single-phase motor. After it reaches full speed, gradually tighten the belt and bring the 3-phase motor up to speed. When it reaches full speed, release the belt tension, shut off power to the starting motor, and apply single-phase power to any two legs of the 3-phase motor. It will continue to turn by itself, and will generate 3-phase power, which is available from the three motor leads as shown. □

Mac Campbell, 36, designs and builds cabinets and furniture in Harvey Station, New Brunswick.

Shop wiring: switches and breakers

Whether you are wiring your own workshop or contracting to have it done, you'll need to understand the principles and practices involved. Here is some information that I consider especially important to the woodworker who operates electrically powered machinery.

Because of the increased current needed to start (as opposed to run) a motor, simple toggle switches or light switches won't do. While Table 1 shows the current required to produce the motor's rated horsepower, the current required to start the motor under load, as in most woodworking machinery, is about three times this figure. A switch should carry a current rating of at least three times the full load amperage (FLA) of the motor it controls. An ordinary light switch rated at 15 amps is too small to start even a 1/4-HP motor safely. The danger is that the contacts will arc each time the switch is thrown and will become less efficient, building up heat and creating a fire hazard. Another danger is that the heavy starting current can generate enough heat to weld the switch contacts together, making it impossible to shut the machine off. Lastly, this type of switch provides no overload protection for the motor.

There are two basic kinds of motor switches—manual and magnetic. The manual switch has an amperage and/or horsepower rating equal to or greater than that of the motor it controls, and the current used by the motor runs through the switch contacts. A magnetic control uses a momentary contact switch (usually push buttons) at a reduced current and voltage to control heavy-duty, magnetically operated contacts, which in turn conduct power to the motor. The magnetic control is safer because the push buttons, even if they operate at full-line voltage, do not carry the heavy current of the main contacts. Magnetic switches also make remote control, as in a dust-collection system, safe and easy.

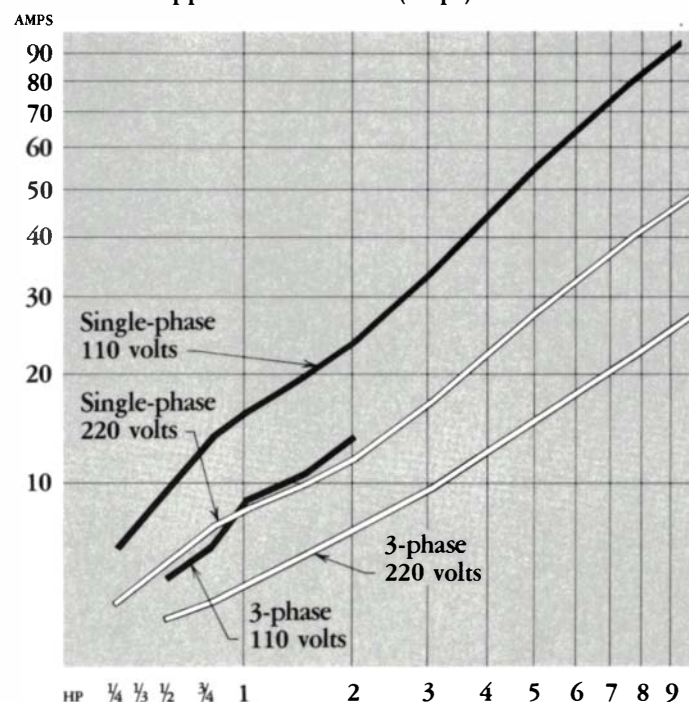
Either type of switch requires two or three heaters to provide burn-out protection for the motor. These heaters are small lengths of wire or flat strips of metal that screw into receptacles in the starter. They

are made so they will conduct their rated current and remain fairly cool, but any increase in current beyond the rated amount, as when a motor is overloaded, causes them to heat up very quickly. This heat trips a built-in circuit breaker. The size of these heaters is determined by the FLA rating of the motor. If the nameplate is missing, use the values in Table 1. If your motors don't have built-in overload protection, the money that protective switches cost is well spent. The control switch should be mounted so it is easy to reach, yet out of the way of cut-off pieces, heavy streams of chips and dust.

For the actual wiring, stick to copper; sizes can be obtained from Table 2. Aluminum wire requires considerable care and expertise for safe installation. While local code requirements vary, the general rule of thumb is that BX (metal-covered) cable or conduit is necessary only where the wire is liable to receive mechanical injury. For most shop wiring NMD-7 Romex cable is perfectly satisfactory (NMD-7 means non-metallic covering for dry location with temperature below 90°C.). Fasten Romex to the wall with staples designed for this purpose, but don't drive them so hard they pinch or cut into the insulation. BX cable and conduit must be attached to walls and floors with metal straps. Most wire connections are made with twist-on connectors. But when there are too many wires for these, use a junction box with a fully insulated bus bar mounted on the inside, or use a split bolt and wrap it securely with several layers of electrical tape. All of these supplies can be purchased from building and electrical supply stores, discount stores and wholesalers.

All your shop wiring should comply with NEC regulations and with local electrical codes. To get a copy of the NEC, write the National Fire Protection Assn., 470 Atlantic Ave., Boston, Mass. 02210, and ask for NFPA No. 70-78. It costs \$6.75. Obtain the CEC from Canadian Standards Assn., 178 Rexdale Blvd., Rexdale, Ont. M9W 1R3. I also recommend H.P. Richter's *Practical Electrical Wiring*, (McGraw-Hill, 1978). —M.C.

Table 1: Approx. current draw (amps) for different motors



Once you know a motor's horsepower, these tables allow you to plan wire and fuse sizes. Suppose your biggest motor puts out 1 1/2 HP at 220 volts, single phase, and your shop is 200 ft. from the main electrical panel. Table 1 tells you the motor will draw 10 amps under load. Table 2 tells you to protect the motor with a 30-amp fuse, and

Table 2: Wire size required to maintain 3% voltage drop for given length of copper wire

Motor current (full- load amperes)	Fuse (amps)										
3	15										
4	15										
5	15	14									
6	20										
7	25										
8	25										
9	30	12									
10	30										
12	40										
14	45	10									
16	50										
18	60										
20	60	8									
25	80										
30		6									
110 volts		30	45	60	75	90	105	120			
220 volts		60	90	120	150	180	210	240			
		Length of run (ft.)									

to run at least No. 10 wire to carry the current from the main panel out to the shop. If the motor were 3-phase, you'd need only No. 12 wire, saving expensive copper. In reality, main-panel-to-shop runs must be figured by adding the current draw of all motors and lights that might be on at one time, and to be safe, be generous.

Building a Walking-Beam Saw

Poor man's band saw has almost unlimited capacity

by Mark White

A walking-beam saw uses two parallel arms or beams, and a thin sawblade tensioned between them. The arms can be made of either wood or metal, and they pivot on pins or bearings. A twisted piece of line or a turnbuckle is used to tension the blade, which moves up and down, powered by either a treadle or a motor via a flywheel and crank.

The saw works like a band saw with two notable exceptions. First, since the cutting action is reciprocal, it is neither as smooth nor as continuous as that of a band saw. Second, since the walking-beam saw has only a single section of blade to worry about, it can be used to crosscut stock of almost infinite length. A band saw's width of cut is limited by the diameter of its wheels, but its length of cut is virtually unlimited. The length of cut a walking-beam saw can make is limited primarily by the length of its arms and by the configuration of its supporting members. While a circular saw is generally better for ripping long boards, the walking-beam saw can be used for ripping long stock by mounting the blade at a 90° angle to the arms and adopting a fairly short stroke.

The major advantage of the walking-beam saw is the fact

that it can be easily and inexpensively constructed by the average home craftsman. However, it will do some things that the band saw cannot. It can cut an inside hole in a large piece of material, such as through mortises in the legs of a heavy trestle table. It can cut substances such as meat, bone, asbestos board, and metal—things that usually require extensive cleanup or which gum up the works or strip teeth from a band saw. Blades for the walking-beam saw are cheap and easily replaced with little or no adjustment necessary for different widths. The saw can be constructed in various sizes. While a band saw with wheels much bigger than 14 in. is usually quite expensive, a walking-beam saw with 8-ft. or 10-ft. arms will cost only slightly more than one with 3-ft. arms.

The prospective use of the saw will dictate its relative size and the rigidity of its frame. The saw (figures 1 and 2) was designed for trim work and for the precision cutting of boat frames and small parts. It has arms that measure about 3 ft. from the central pivot bearing to the sawblade bearing. When the width of the supporting frame is taken into account, useful throat depth is about 33 in.—enough for most

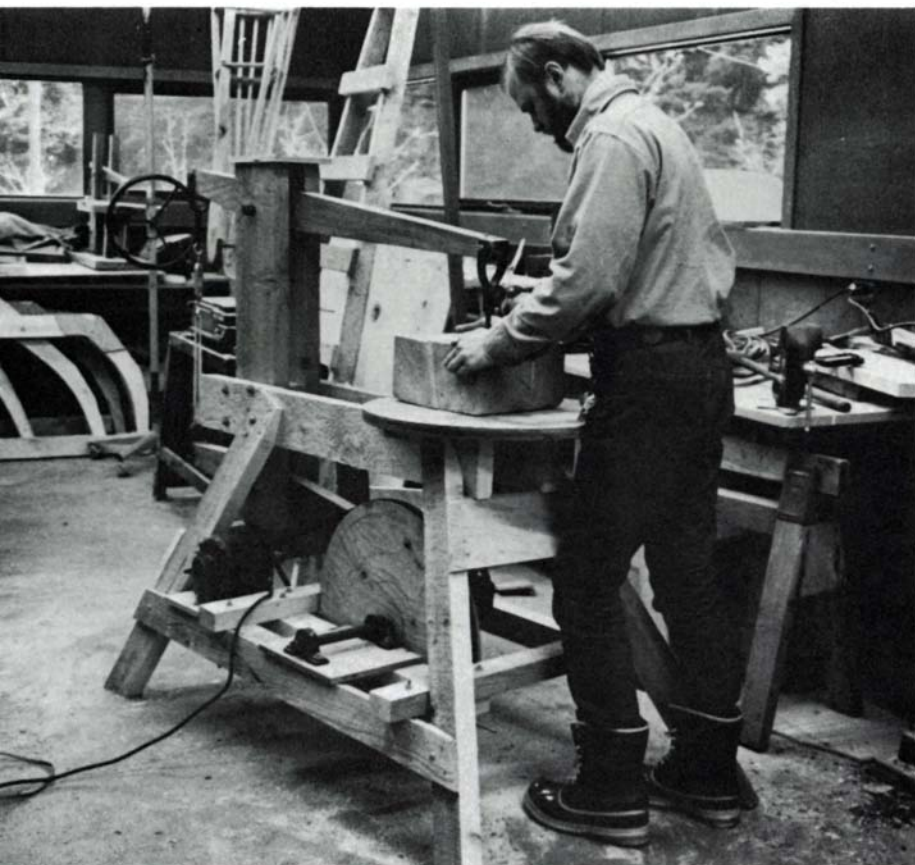


Fig. 1: Using his walking-beam saw, White cuts through an 8-in. hardwood block. The saw is well suited for contour cutting, crosscutting and ripping both thick and thin stock, but long rippings require special attachments for the arms. Drive mechanism with $\frac{1}{4}$ -HP motor produces 144 cutting strokes per minute.

Bill of materials (all dimensions in inches)

Arms—2 pcs., 2x4x54
 Upright supports—2 pcs., 2x8x38
 Block between uprights—2x8x6
 Table supports—2 pcs., 2x6x48
 Legs—4 pcs., 2x3x40
 Side rails—2 pcs., 2x3x56
 Cross rails—2 pcs., 2x3x32
 Main bearing support (near crank)—1 pc., 3x4x41
 Table—1 pc. of plywood, approx. $\frac{1}{4}$ thick by 23 sq.
 Main drive pulley—2 pcs., $\frac{1}{2}$ x24x24 ACX or CDX plywood; 1 pc., $\frac{3}{8}$ x24x24 ACX or CDX plywood
 Pivot pins—2 pcs. 1-in. rod, approx. $7\frac{1}{2}$ long, cold-rolled steel
 Crank—1 pc., 1-in. cold-rolled steel rod from 18 to 20 in. long
 Counterbalance—1 pc., $\frac{1}{4}$ x2x6 steel flatbar
 Blades—any dimension and style desired, suggest pruning-saw blades, 20 in. between pins to start
 Turnbuckle— $\frac{3}{8}$ in., min. opening 6 in., max. opening 10 in.
 Blade brackets and tensioner supports—approx. 50 in. of $\frac{1}{4}$ or $\frac{1}{2}$ x1 steel
 1— $\frac{3}{8}$ -in. steel clevis or shackle
 Bracket and tensioner bearings—approx. 10 in. of $\frac{1}{2}$ or $\frac{3}{4}$ brass pipe
 Leg bolts—16 ea. $\frac{1}{2}$ x3 $\frac{1}{2}$ carriage bolts with washers and nuts
 Crank and drive bearings—3 or 4 1-in. pillow-block bearings with zirc fittings
 Drive motor— $\frac{1}{3}$ to 2-HP motor with 2-in. or 3-in. pulley
 Misc. nuts, bolts, washers, screws and nails to hold motor, brackets and pieces in place—best determined at construction, rather than from a prescribed list.

work. As a general rule, the arms should be about 6 in. longer than the anticipated maximum length of cut.

The arms—Once the arm length has been determined, lay out and construct a set of arms. Straight-grained ash, cherry, and basswood are good choices; they're tough, hard, stable and fairly light for their strength. The top arm is essentially an idler, which tensions and aligns the top of the blade. The bottom, driving arm has a heavier forward section to take the strain of the up-and-down motion imparted by the eccentric drive. A hole, bored a few inches back from the blade, receives the bearing for the drive crank (figure 3).

As with most reciprocating saws, the part of the stroke that does the most work is that part that draws the workpiece toward the table as it cuts. But there is a considerable difference between a cheap saw with a blade that moves merely up and down, and one on which the blade moves into the cut and backs off on the return stroke. The difference can amount to as much as a threefold increase in cutting efficiency and tooth life. One of the features that gives the walking-beam saw its efficiency is the fact that this automatic blade advancement can be easily built into the machine during construction simply by making the forward part of the top arm a little longer than the bottom arm. The parallel arms will then move the blade away from the cut on the up stroke and into the cut on the down stroke (figure 4).

On a saw with a blade length of 20 in., I would make the top arm about $\frac{3}{4}$ in. longer than the bottom arm. Thus, the distance between the arm pivot and blade bearing hole is 34 in. on the bottom arm and 34 $\frac{3}{4}$ in. on the top arm. A

small saw with a 6-in. blade should probably have the top arm a scant $\frac{3}{16}$ in. to $\frac{1}{4}$ in. longer than the bottom arm. As a result of the relatively short stroke of the blade and the elasticity of the parts, the actual forward/backward motion of the blade is probably less than half of the difference built into the arms. Nevertheless, this difference will add considerably to the saw's cutting efficiency.

Wood/metal bearings—While all of the bearings in the walking-beam saw could have been commercial roller bearings, I went with wood/metal on seven out of ten of them to save time and money. The main pivot bearings for the arms were fashioned from pieces of 1-in. steel rod about 7 $\frac{1}{2}$ in. long. I bored test holes in a scrap of koa, the wood I used for the arms, with a number of different bits to make sure the hole would be snug. The blade bearing, tensioner bearings and one arm-drive bearing were fashioned from 2-in. lengths of $\frac{1}{8}$ -in. brass pipe. The blade holders and tensioner brackets I made from $\frac{1}{4}$ -in. by 1-in. mild steel flatbar, as shown in figure 5 on the next page.

Assembly of the arms and frames—The metal bearings that were to run in wood were cleaned up with a file and polished with fine sandpaper. The tensioner supports and blade holders were assembled permanently on the arms. A bit of grease in each hole ensured initial lubrication. Oil holes ($\frac{1}{4}$ in.) drilled before assembly make lubrication easy.

I fitted the arms with a blade and set them in a trial position on a piece of 2x8 stock in order to get an idea of placement for the pivot pins. I tried to get the arms parallel to each

Fig. 2: Walking-beam saw

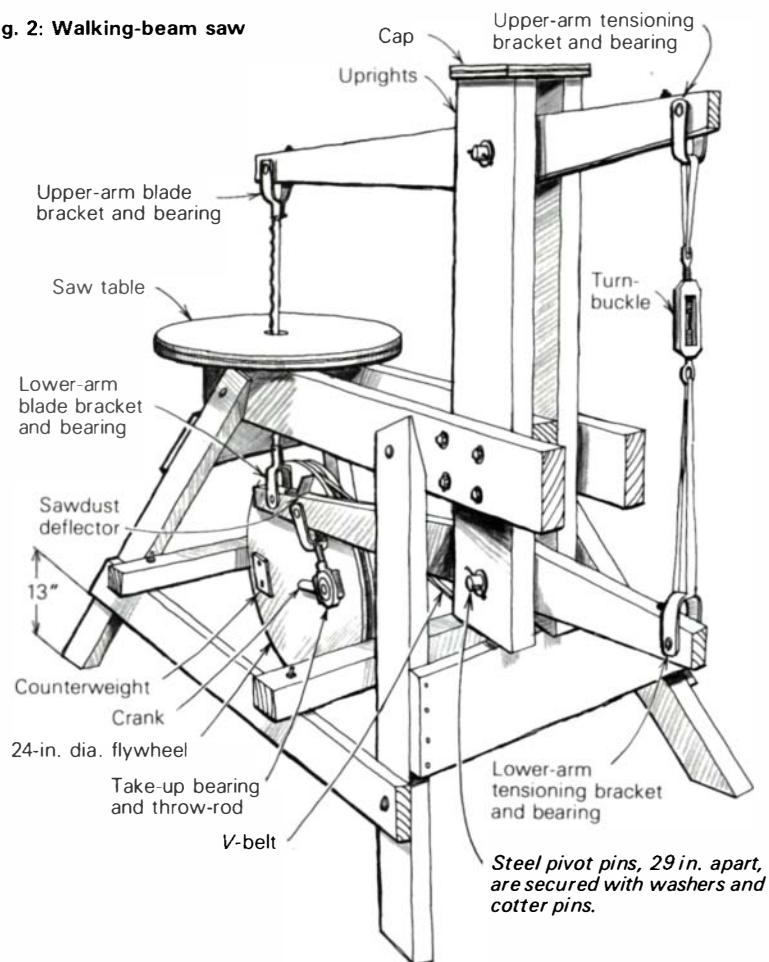


Fig. 3:

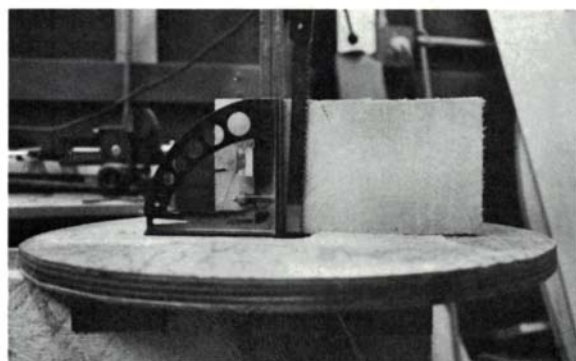
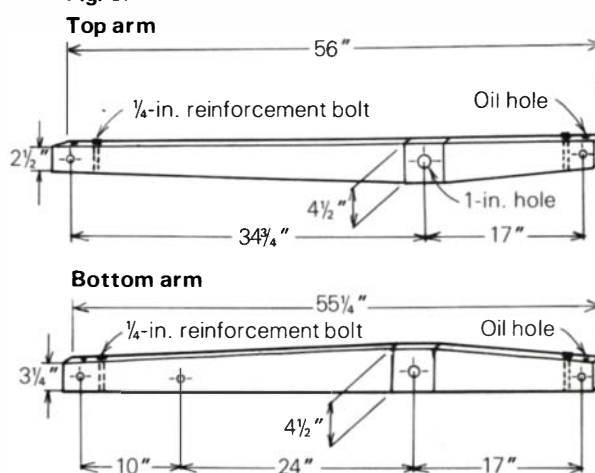


Fig. 4: Since top arm is longer than bottom arm by $\frac{3}{4}$ in., blade angles into cut on downstroke and away from cut on upstroke, increasing cutting efficiency and blade life.

Fig. 5:

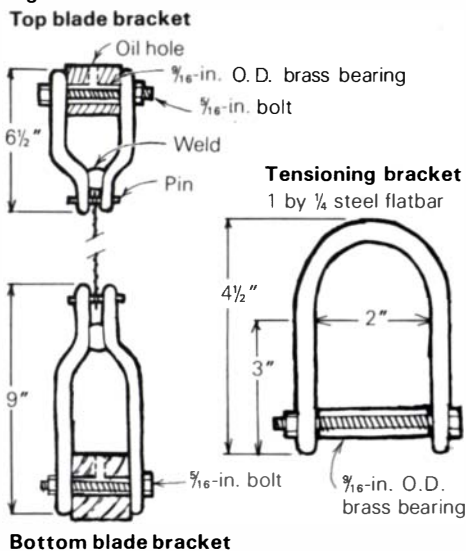


Fig. 6 (above): Crank rod is checked for squareness after being heated cherry red and bent into shape. Fig. 7 (right): Crank, take-up bearing, throw-rod and U-shaped coupling connect flywheel to lower arm of saw. Metal plate bolted to flywheel opposite crank acts as counterbalance.



other—and then spread the turnbuckle ends an extra $\frac{1}{2}$ in. to allow for bearing wear and blade stretch. I noted the vertical distance between pivot pins and cut two pieces of 2x8 plank to serve as upright supports for the arms. These I cut about 12 in. longer than the pin-to-pin distance. They were clamped together and bored for the pivot pins on a drill press to ensure proper alignment. I cut a small block $\frac{1}{8}$ in. thicker than the arm, and glued and nailed it in place between the uprights where they would be bolted to the two table-support members, which I cut from 2x6 stock. They were glued and lightly nailed in place on the upright. Then the whole assembly was bolted together with four $\frac{3}{8}$ -in. threaded rods. The pivot pins were lightly greased and inserted into the assembly, securing the arms (rocking beams) in position.

The assembly was held upright while four 2-in. by 3-in. legs were attached to the table support members. The joining cheeks of the legs were beveled at 15°, splayed to the front and rear and attached with nails, bolts and glue. After leveling the unit, I attached braces and stretchers to stabilize the legs and to support the motor and drive system.

The drive crank—I took my 20-in. piece of 1-in. steel rod over to the local auto shop to use their cutting torch. The section of rod was heated cherry red about 7 in. from one end and inserted into two sections of pipe to bend it to a perfect 90° angle. A friend applied more heat as the metal was being stretched to prevent cracking. After cooling, a section about 4 in. past the first bend was heated cherry red and bent away from the first to complete the crank (figure 6).

The wooden flywheel—The next task was to make a belt-driven flywheel to turn the crank. My power source was an ancient electric washing-machine motor of $\frac{1}{8}$ HP. I assumed that it turned at a standard 1,725 RPM. As large a flywheel as practical would give the poor little drive motor a hefty mechanical advantage. I formed the wheel from three plywood discs, the two outer ones of $\frac{1}{2}$ -in. plywood scribed to a 24-in. circle and the inner one of $\frac{3}{8}$ -in. plywood scribed to a 23 $\frac{3}{8}$ -in. circle. Then I bored a 1-in. hole in the center of each disc, spread glue over the mating surfaces of the discs and used the 1-in. shaft to align them while I nailed them together, evenly spacing the nails on concentric lines for balance.

The crank was fastened to the completed flywheel with two

U-bolts fashioned from $\frac{1}{4}$ -in. threaded rod. It took about 40 minutes of wedging, bolt tightening and loosening, and fiddling to get the wheel to run true. Once it did, I smeared a lot of epoxy into the cracks and crevices. This seemed to help hold it in alignment, as it continues to run true.

The two pillow-block bearings were installed on the shaft, and support members were added to carry the shaft and motor. The flywheel was mounted so that the throw from the crank was properly aligned beneath the lower arm. I fastened a 1-in. takeup bearing to a short section of $\frac{1}{2}$ -in. steel pipe and pinned it in place with a small $\frac{1}{16}$ -in. bolt (figure 7).

Adjusting the stroke—With the blade tightened and the arms braced at the upper limit of their stroke, I raised the crank to its upper limit also. On the lower arm I temporarily bolted into place a U-shaped piece of $\frac{1}{4}$ -in. by 1-in. flatbar and set the takeup bearing (crank bearing) and pipe throw-rod in place. The pipe was then cut to a length that bridged the gap between the bearing and the U-shaped bracket. Then I welded the throw-rod into position at both ends.

Installing the motor—The completed throw-rod was mounted on the crank and bolted into the lower arm. I turned the flywheel by hand and moved the arms up and down to continue the motion. I bolted a piece of $\frac{1}{4}$ -in. by 2-in. steel flatbar about 4 in. long to the wheel to counterbalance the rotating weight of the crank. A 2-in. pulley was mounted on the motor, which was bolted to a $\frac{3}{4}$ -in. plywood base. Part of the bracket and the crank-rod bearing had to be dismantled to install the V-belt. This done, the motor was drawn tight against the belt, and I temporarily nailed the base down. With the motor running and the large pulley spinning, I used a small turning gouge to put a mild bevel on the insides of the flywheel pulley groove. Then I repositioned the motor in order to draw the belt up tight.

I let the saw run for a couple of hours while the pieces wore together. A periodic shot of heavy gear oil on the rubbing surfaces and in the oil holes helped considerably. I tacked small flaps of leather over the holes to keep out dirt and grit.

The table—I made the table from a piece of 1 $\frac{1}{4}$ -in. plywood flooring, screwing it in place on the frame, square with the sides of the blade. I fastened two butt hinges to one side of

the frame and to the table. If I need to cut stock at an angle, I remove the mounting screws and pivot the table until the desired angle is achieved. Wedges and a small turnbuckle can be used to hold the table in place. A larger table can be fastened to the existing table for cutting large stock.

Tuning—I had to make sure that the blade ran true on its up-and-down course (viewed from the front). Turning the flywheel slowly by hand revealed that the blade had some side-to-side movement which was caused, I found, by the upper blade bracket being a little crooked. I cured the problem by turning the bracket around and moving the blade over a bit on reassembly.

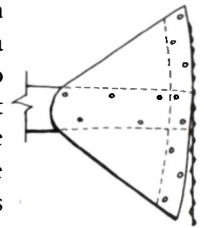
With a 2-in. drive pulley on the motor and a 24-in. flywheel, the saw produces 144 strokes per minute. While this is a little slow for efficiency's sake, that's about all the little $\frac{1}{8}$ -HP motor can handle without tripping its breaker. A $\frac{1}{2}$ -HP motor with a 3-in. or 4-in. pulley (or a smaller flywheel) would give a better turn of speed. But I have no trouble zipping through a heavy chunk of 8-in. by 12-in. timber. A piece of wood 8 in. thick is about the upper limit simply because the 11-in. stroke on a 20-in. blade leaves only about 8 in. for the wood being cut on the table. A longer blade or a shorter stroke would provide for a greater depth of cut.

Blades—When I designed this particular saw, I decided to use a standard 20-in. pruning-saw blade, available at almost any hardware store. The one difficulty with pruning-saw blades is that they are fairly wide and are designed to cut in both directions. This is fine for cutting firewood, but not very good for precision cutting where greater control is needed. Short sections of a band-saw blade would cut more precise-

ly. Woodcraft Supply (313 Montvale Ave., Woburn, Mass. 01888) supplies blades of any length. I would choose a blade from $\frac{1}{2}$ in. to $\frac{3}{4}$ in. wide with three or four teeth per inch.

Because band-saw blades are thinner and cut in only one direction they don't catch and hold on the upstroke. Those needing very narrow blades should think about shaving the arms down a bit near the ends and using lightweight blade brackets and a lightweight tensioner. This will reduce the oscillating mass and thus reduce the strain on thinner blades.

Ripping and resawing—A walking-beam saw designed for ripping usually has a moderate throat, and the blade is set at 90° to the arms. The arms must be club-shaped at the ends with a radius sawn around those ends so that the blade stays vertical and in the same plane as it moves up and down. Pins driven into the ends of arms hold the blade instead of blade brackets and the blade flexes around the ends of the arms, just as it would on the wheels of a band saw.



The walking-beam saw is cheap to make and operate, very quiet to run, and fairly efficient. As with any cutting tool, safety precautions are advised. The greatest danger seems to lie in having the workpiece wrested from your grasp and then attempting to grab it back instead of turning the machine off. Practice, a moderate speed, a sharp, thin blade and some common sense will go a long way toward making your experience with this saw a pleasant and rewarding one. □

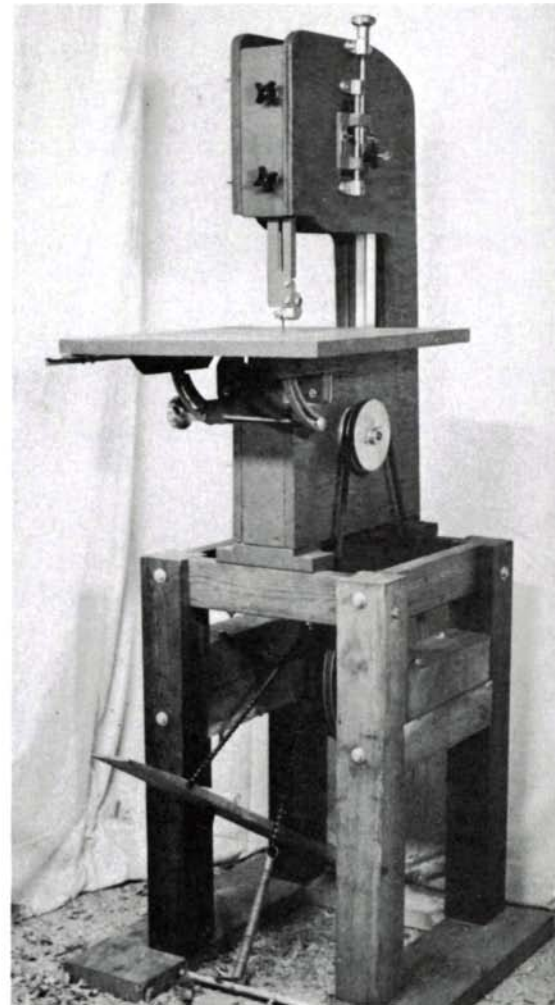
Mark White, 40, teaches arctic house construction and boat-building at Kodiak (Alaska) Community College.

Treadle Band Saw

With a kit and plans for a 12-in. band saw supplied by Gilliom Mfg. Co. (1109 N. 2nd St., St. Charles, Mo. 63301) and a number of scavenged parts, Andrew Maier of East Orange, N.J., built a treadle-powered band saw that has now been in use in a high-school shop for over a year. Intrigued by Richard Starr's foot-powered lathe (*FWW* #15, March '79, pp. 65-66) that uses a five-speed gear cluster to achieve different operating speeds, Maier decided that the same drive mechanism could be adapted for use with a band saw. Friends discouraged the idea, saying that he'd never be able to develop and sustain enough muscle power to cut stock of usable dimensions. But Maier carried through his scheme, getting parts for the drive system from a used bicycle shop and an auto junkyard, where he bought a Volkswagen flywheel and front-wheel bearings for the drive shaft. The finished machine, he says, will cut rapidly and smoothly through stock 2 in. thick and smaller, but it's slow going through pieces 4 in. thick or more. Maier is very happy with how the machine has performed in its first year of service and with how well it's stood up under use by his students. □



Maier's band saw, right, has frame, housing, column and table made entirely of wood. So this saw can be foot driven, a threaded-rod drive shaft fits into tapered roller bearings (above), which are mortised into cross members in frame. Drive pulley, flywheel and five-speed sprocket cluster were all purchased as used parts. It can, of course, be equipped with an electric motor.





Rhinebeck

by John Lively

Considered the world's largest and most prestigious commercial crafts exhibit, the Northeast Craft Fair (June 23-29, 1980) at Rhinebeck, N.Y., attracted wholesale buyers from across the country. Representing galleries, craft stores and department stores, the buyers had the first two days of the fair to themselves, before a day of rest and then three frantic days of retail sales. Of the 500 artisans participating in the juried show, 75 were woodworkers. For many of them Rhinebeck is the ultimate marketplace for the \$20 item (one booth reported selling \$1,200 in cutting boards alone). At the other end of the scale, pieces of high craft with price tags approaching \$10,000 found buyers and attracted custom commissions. A sampling of the work is shown here.

By the end of the fair, none of the woodworkers I spoke to was disappointed by the amount of business done; most found sales up considerably from last year, and those new to the show were surprised by the buyers' enthusiasm. One woodworker com-

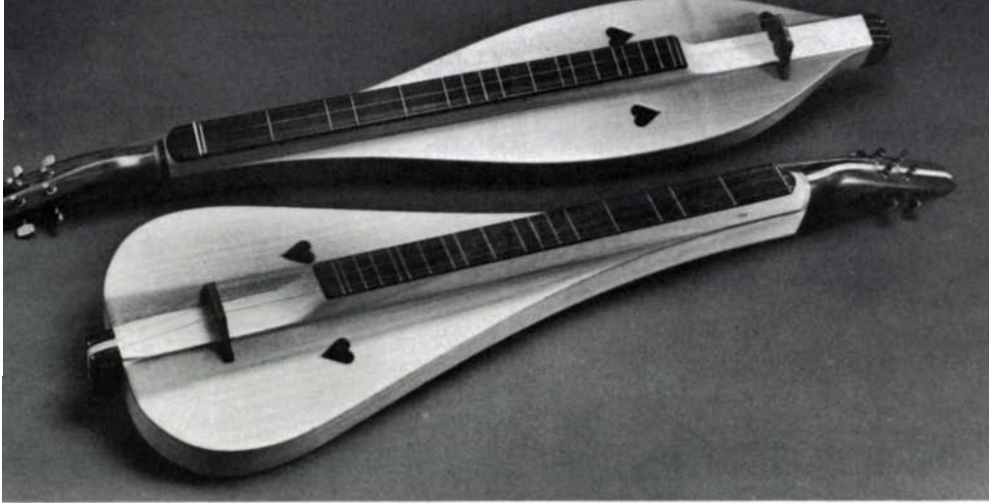
mented, "What I like about this craft fair is that we're all pretty much obligated to one another and to the buyers to stick with our original prices. There's no dickering and quibbling; everything's straightforward and direct." It's profitable as well, and for several woodworkers, it's the only show they'll participate in this year—the fair produced enough orders for 12 months of work. Apart from its commercial value, the Rhinebeck fair gives exhibitors the opportunity to view one another's work and to indulge in the usual amount of shop talk. For many it was a chance to renew old acquaintances. The quality and variety of the work has been increasing every year, and Rhinebeck regulars agreed that woodworkers made an especially strong showing this year.

Sponsored by American Craft Enterprises (an arm of the American Craft Council), the Rhinebeck show is one of three annual events. Forthcoming in early 1981 are two shows—the Winter Market of American Crafts (Feb. 18-22) in Baltimore, Md., and the Dallas Craft Market (March 19-22). Application deadlines are Oct. 1, 1980 for the Baltimore show and Nov. 1, 1980 for the Dallas show. For complete information write American Craft Enterprises, Inc., Box 10, New Paltz, N.Y. 12561. □

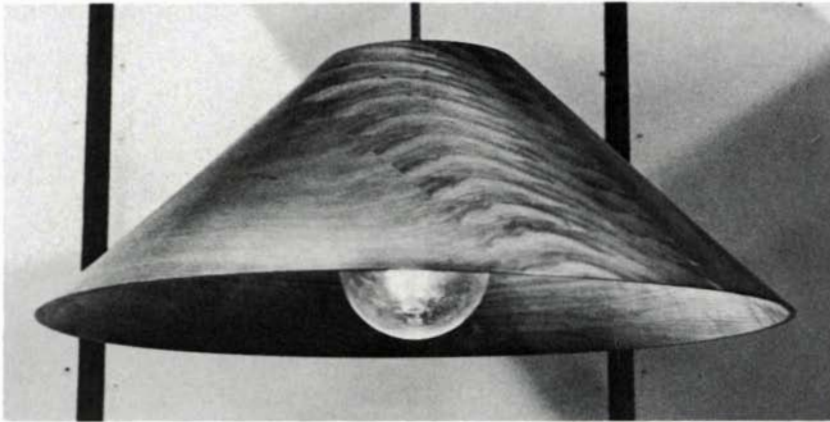
Hap Sakwa of Los Osos, Calif., turned this delicate, porcelain-like bowl from a wild lilac root burl. Sakwa tries to harmonize his own ideas of shape with the natural strengths and weaknesses of the material, whose very flaws become integral to the form each bowl finally takes. Photo: Bob Barrett.

Michael Coffey's chair, below, is sculpted from stacked mozambique. Bare-faced mitered dovetails hold the stacked segments of the back together. Viewed from the rear (right), this chair presents a striking posture, as its oblique pedestal sweeps decisively from seat to base. Coffey works and lives in Poultney, Vt.

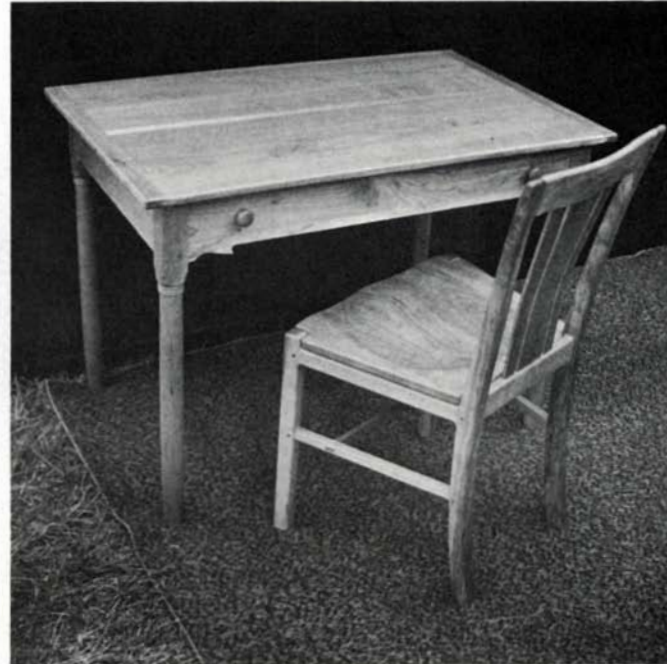




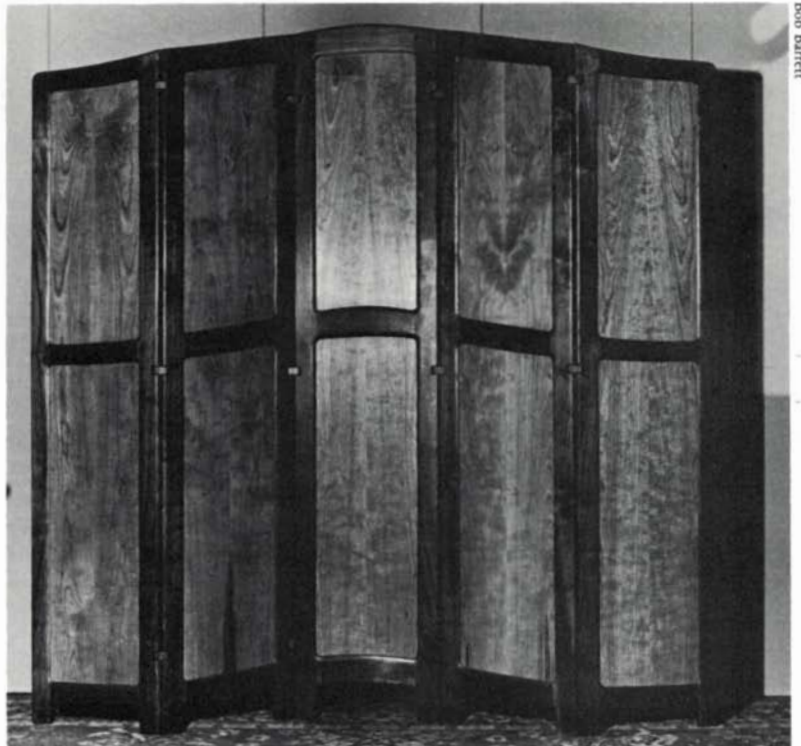
We usually think of a dulcimer as an unassertive instrument, meant to accompany plaintive verses and wailing voices. Not so those built by Robert Hutchinson, of Pittsburgh, Pa., who has succeeded in making the dulcimer both loud and brassy. Hutchinson plays his own dulcimer in a band and says it makes a solid, strong contribution to the overall sound. His dulcimers can produce more twang at higher volume because they incorporate thicker wood (usually $\frac{3}{32}$ -in. poplar), a high, floating bridge that sits directly on the soundboard and an elevated fretboard. Photo: Bob Barrett.



Stacked and turned lampshade, above, is a production item from Hardwood Geometrix, a small shop in Burlington, Vt., run by Mike Delaney and Richard Loveless. Made from bandsawn, slipmatched strips, the thin shade is surprisingly strong and flexible, and used with the proper bulb gives off a warm and pleasant glow. Desk and chair, right, were made by James Probert of Montague Center, Mass. Of solid cherry, the desk is 40 in. long, 25 in. wide and 28½ in. high. With its turned legs, square posts and simple pulls it resembles a Shaker piece. The chair, also in cherry, is exceptionally comfortable despite its austere appearance. Its tenon pegs and screw plugs are square and have been left proud, with chamfered edges. Simplicity of design emphasizes the thoughtful construction and the faultless oil finishes of both pieces.



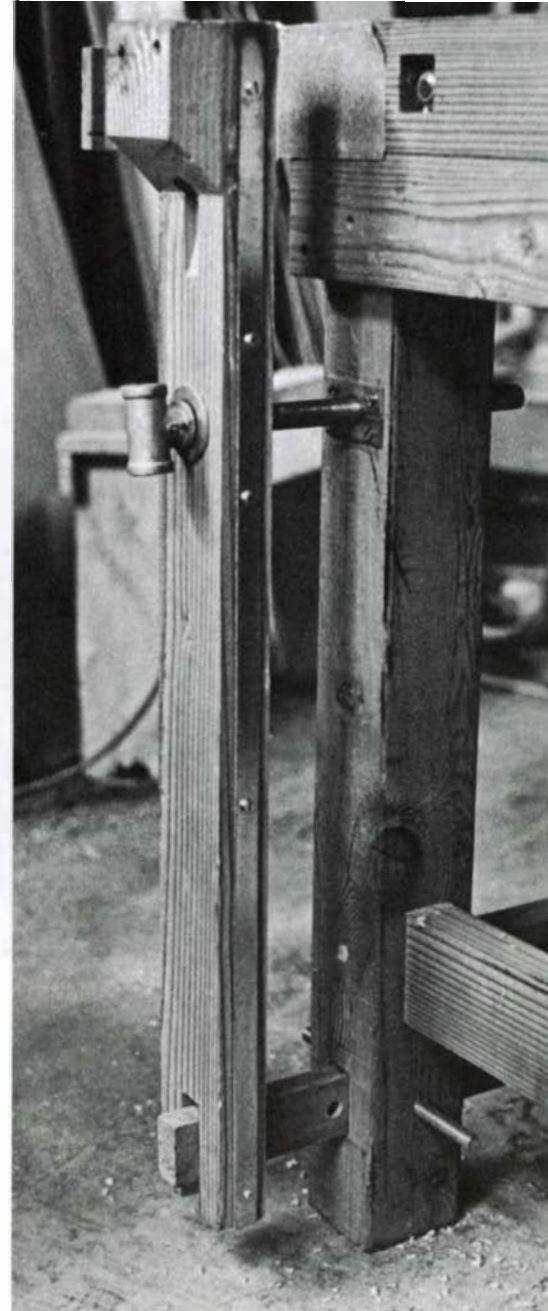
The folding screen by Steven Mackintosh, of Deansboro, N.Y., has walnut frames and solid cherry panels that fit in rabbets on the reverse side and are secured with applied moldings. All frame members are splined together, and their inner edges have been gently rounded by hand. The two-way hinges were made following Tim Mackaness' description (FWW #10, Spring '78, p. 69).



Bob Barrett



Three leg vises and three rows of dog holes give Schuldt's bench large holding capability. Side view of leg vise, right, shows threaded rod, pivot foot and steel strap stiffener.



A Softwood Workbench

Leg vises keep it versatile and affordable

by Ted Schuldt

A few years ago when I was beginning to get involved with woodworking as a hobby, I was awed by those \$600 European workbenches sold by the purveyors of fine woodworking tools. I wished I could afford one but knew I would have to find a substitute. Someday I may build a hardwood bench such as described by Tage Frid (*FWW* #4, Fall '76), but until then I'll get by well enough with a bench made of common materials from a straightforward design that you can adapt to suit yourself.

Before determining the dimensions of your bench, evaluate your needs and the size of your shop. I chose a length of 60 in. because of space restrictions and a width of 27 in. to provide enough workspace to assemble casepieces. After determining the required dimensions, begin by making the bench top.

All the wood used in this bench is fir, readily available at any lumberyard. The bench top is made of 2x4s set on edge. Take extra care in selecting the pieces for the top. They should be straight, and the edges that will be the top should be as free of knots as possible. Most dimensioned lumber has rounded edges, so rip off enough of the edge to get the corners square to provide for a smooth, flat surface when the boards are glued up. Select the two best 2x4s in which to cut

the bench-dog slots. Set a dado head for $\frac{3}{4}$ -in. depth and $\frac{3}{4}$ -in. width and cut parallel dados 3 in. apart at an angle of 86° . Also space a short row of slots across the width of the bench near one end. Slant the holes toward the vise to force the dog into the slot when it's under pressure.

Before gluing up the top, drill holes in each of the 2x4s for the two threaded rods used to reinforce the top. I glued up the 2x4s in pairs, then in fours, then in eights, then I added one more to make two halves each of nine pieces.

Then I took the two halves to a high-school woodshop and ran them through a thickness planer. You could plane these by hand, but I took the more expeditious way to the end result. With the two halves completed, run two $\frac{1}{2}$ -in. Redi-Bolt threaded rods through the predrilled holes to join the two halves of the top and to reinforce the glue joint. Mortise out enough of the outside pieces to countersink the washers and nuts of the rods. As the top dries from the 17% moisture content of kiln-dried dimension lumber, the nuts will have to be tightened. Depending on the length of your bench, you may want to install a third or fourth rod.

Next work on the legs. In positioning the legs, the center of the legs must line up with the center of the bench dog slots. Chop through mortises in the 4x4 legs for the stretcher tenons

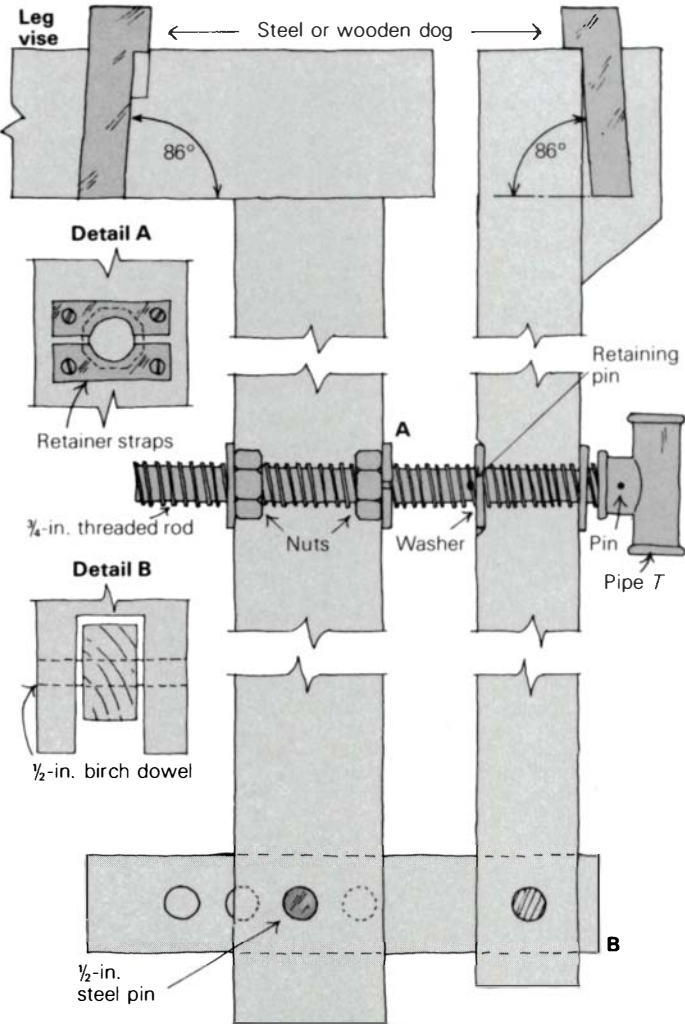
and the vise positioners. I cut these by drilling holes at opposite corners of the mortise and cutting out the waste with a saber saw to within $\frac{1}{32}$ in. of the line and cleaning up with a chisel. Now, drill a $\frac{1}{16}$ -in. hole for the vise screw in three of the legs and mortise out just enough to countersink a $\frac{3}{4}$ -in. nut at both ends of the hole. Also drill for a $\frac{1}{2}$ -in. draw pin for each mortise in the leg. Cut tenons on the stretchers, fit, drill holes for the draw pins $\frac{1}{8}$ in. off center to pull the tenons into the joint and then glue up the leg assembly and pin the tenons with $\frac{1}{2}$ -in. birch dowels.

To fasten the top to the legs, drill a $\frac{3}{8}$ -in. hole down through the top into the end rails in four places. Drill a 1-in. hole to intersect the above hole and set into it a cylindrical “washer”—a short piece of pipe or electrical conduit. This will keep the captured nut from indenting the wood. Countersink the bolt in the top enough to cover the head with a wood plug. Now come the leg vises. I made mine out of 2x4s stiffened by two $\frac{1}{8}$ -in. by $\frac{3}{4}$ -in. steel straps screwed into grooves on their edges. If I had it to do over again, I would make the vises out of 4x4s. Make the vise positioner (pivot foot), and fit it onto the end of the vise so it will pivot on a $\frac{1}{2}$ -in. dowel pin. The vise screw is $\frac{3}{4}$ -in./10 Redi-Bolt threaded rod. It comes in 36-in. lengths, so each vise screw is 12 in. long. Screw the rod into the two nuts mortised into the leg and use it to line up the hole in the vise for the screw, then bore it to a 1-in. diameter. The nut nearest the vise must be restrained from coming out as the vise is tightened. This is done with a retainer made of steel straps filed to allow the rod to pass through. The retainers are screwed to the leg. The nut on the other side can be secured with a piece of $\frac{1}{8}$ -in. hard-board because it's under no stress.

With the vise screw and vise in place, drill $\frac{1}{2}$ -in. holes in the pivot foot so that the leg is perpendicular to the bench top at jaw spacings for common thicknesses of lumber ($\frac{3}{4}$ in., 1 $\frac{1}{2}$ in., 2 $\frac{1}{2}$ in., 3 $\frac{1}{2}$ in.) or whatever spacings suit your needs. Placing the holes too close together, however, will weaken the pivot foot, which takes considerable stress as it keeps the vise jaws as parallel as possible. I glued sandpaper to the jaws of one vise but it did not significantly improve its holding power. The bench dog slots can now be drilled and chiseled out in the end grain of the leg vise if you use a 4x4; but if you use a 2x4, make the slot using a dado cut into the end of the 2x4 and glue a 2x4 block to the back of the leg to house the slot. Again, incline the slots at 86° toward the bench top to ensure proper clamping dynamics.

A handle can be made for the threaded rod by screwing a $\frac{1}{2}$ -in. T-pipe fitting onto it. Secure this by drilling a hole through the T and the vise screw and pin them together with a nail or hardened steel pin. The pitch of #10 threads makes for slow going, but I can get the holding power I need using my hands on the T without using a long handle for leverage. I pinned the threaded rod just on the inside of the vise jaw so that the jaw opens when the rod is loosened.

I made bench dogs in two sets of four out of some scrap oak flooring. One set sticks $\frac{1}{2}$ in. above the bench top, and the other sticks up 1 in. for larger pieces. I drive the bench dogs in with a rubber hammer and out by using a short rod and hammer from underneath the bench. If you don't like the idea of driving the dogs in and out, you may want to dimension them to an easy fit and equip each with a bullet catch to hold them in place (*FWW* #15, March '79, p. 20). The tool tray is held on by two lag bolts, and a support for long pieces



Bill of materials		
Quantity	Length	Item
1	12 ft.	4x4 fir
13	10 ft.	2x4 fir
2	4 ft.	$\frac{1}{2}$ -in. birch dowels
1	3 ft.	$\frac{3}{4}$ -in. threaded rod w/nuts and washers
2	3 ft.	$\frac{1}{2}$ -in. threaded rod w/nuts and washers
4	4 in.	$\frac{3}{8}$ -in. hex bolts w/nuts and washers
3		$\frac{1}{2}$ -in. T-pipe fittings
1	5 in.	1-in. pipe or conduit (sawn into four 1-in. lengths)
2	2 in.	$\frac{1}{4}$ -in. lag bolts and washers
2	3 ft.	$\frac{1}{8}$ -in. by $\frac{3}{4}$ -in. steel strap
1		qt. yellow glue

of lumber is made using $\frac{3}{4}$ -in. dowel in a 2x4 screwed to the legs of the bench.

This bench has given good service for two years now. I have not had the courage to bear down on any of the vises just to see how much it takes to break one. But none has ever failed to hold a workpiece firmly. Fir might not be the best material for a bench top, but it's inexpensive and can be resurfaced easily with a hand plane and scraper. The bench is very heavy, and this gives it good stability when all my weight is put into planing a piece. It is versatile too, but best of all it would cost less than \$100 to build today. □

Ted Schuldt, a minister and amateur woodworker, lives in Toledo, Wash.

A Shoulder Vise and Clamping Dogs

Attachments make a table a workbench

by R. J. Silvestrini

Tage Frid's workbench (*FWW* #4, Fall '76) offers two features I had long sought—a shoulder vise with its jaw unobstructed by the usual screw and guide bars (it can grip irregular objects, as well) and a tail vise with a traveling dog. Since my workbench has a radial arm saw mounted on one end of it and I don't have room for another bench in my shop, I chose to adapt these two features to the bench I already had.

After studying Frid's plans, I decided that the shoulder vise could be made separately and then attached. But the tail vise was a different story. I wanted its traveling dog so I could hold long workpieces on my bench, but I really didn't need the vise jaws, and besides, my radial arm saw was sitting right where these would go. I resolved this dilemma by doing away with the vise part of the system and rigging a traveling dog in a sliding, screw-driven housing. This mechanism, together with a row of dog holes, could be mounted on the edge of my bench top in one long unit. I decided to make all of these components—the shoulder vise and the bench-top clamping system—so they could be removed later on, should I want to mount them on a new bench.

For the shoulder vise, I followed Frid's design, making necessary changes where I had to. I used an acme-threaded bench

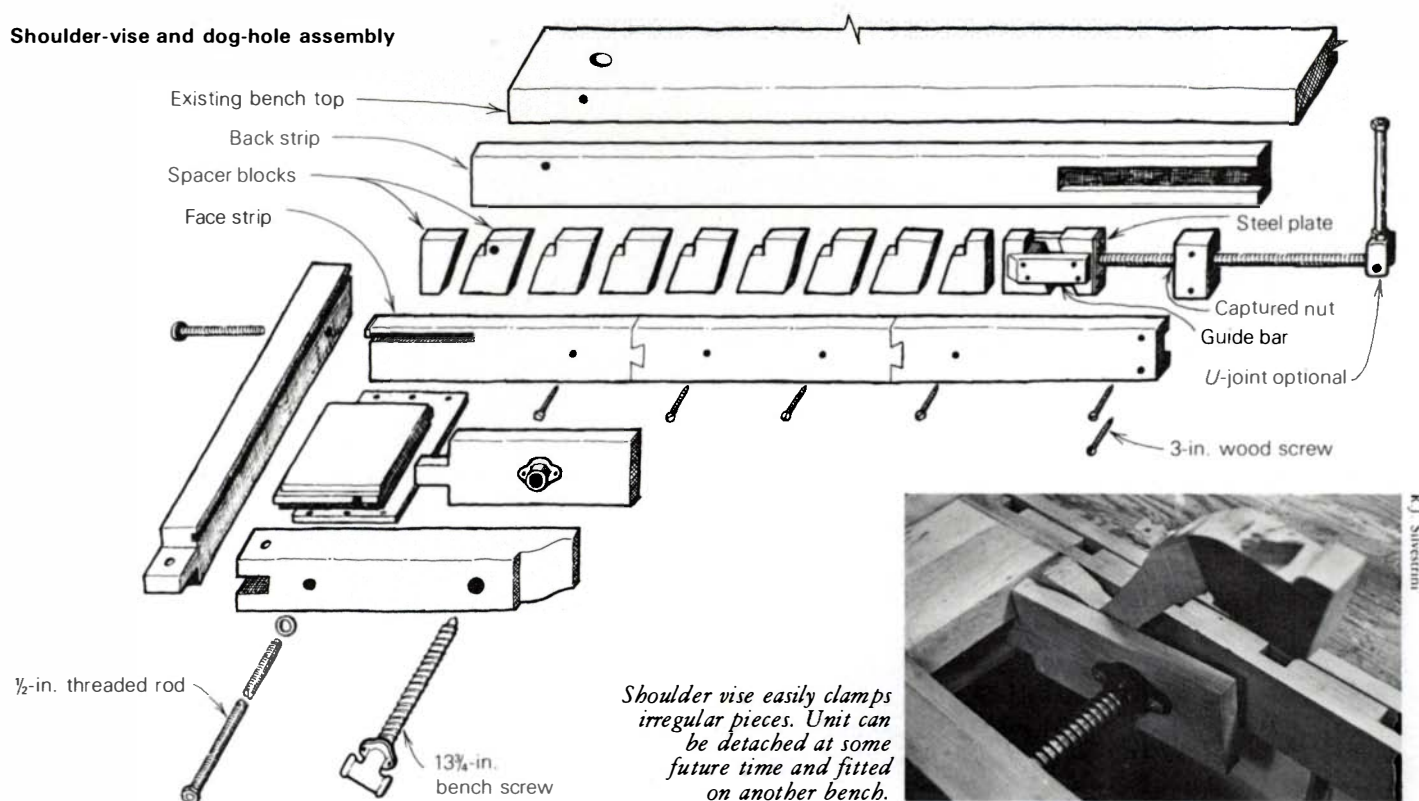
EDITOR'S NOTE: Plans for Tage Frid's workbench are available for \$6 from the Taunton Press, Box 355, Newtown, Conn. 06470. For more on workbench design see Donald McKinley's article in *FWW* #16, May '79, pp. 72-75.

screw (from Woodcraft Supply Corp., 313 Montvale Ave., Woburn, Mass. 01888) for the vise jaw. To hold the cantilevered arm in place and keep it from being pushed outward as the vise is tightened, I used a ½-in. threaded rod, which is passed through the arm and spacer block and secured by a captured nut let into the top of the bench.

I departed from Frid's design when making the row of dog holes and the moving housing that opposes them. Instead of cutting the slots in a solid strip as Frid does, I cut a lot of parallelogram-shaped spacer blocks (angled 4° off the perpendicular so the dog would be canted appropriately) and sandwiched them between two strips 3 in. wide and as long as the bench. Each block is 4⅞ in. wide, and to make the holes, I spaced the blocks 1⅞ in. apart. The little slots in the front of each hole (Frid chisels these in by hand) which accommodate the head of the dog, I easily cut by elevating the blade on my radial arm saw and using a 3-in. high fence.

I designed the sliding dog housing after having looked at a drawing of a similar one made by David Powell of Leeds Design Workshops in Easthampton, Mass. While his uses a lot more hardware, I made mine with a minimum of metal parts by connecting two spacer blocks with a pair of wooden bars. These bars serve also to guide the housing as it travels, riding in grooves cut into the two strips that form the back and face sides of the dog unit. These grooves should be long enough to allow the slide to travel about 7½ in., approximately 1½ times

Shoulder-vise and dog-hole assembly



the distance between dog holes. The threaded rod is attached to the slide by means of a metal plate, which is drilled in its center to receive a $\frac{1}{8}$ -in. bolt. The threaded end of this bolt is epoxied into a hole drilled in the end of the $\frac{1}{2}$ -in. threaded rod. Before attaching the plate to the slide with wood screws, the slide must be counterbored to accommodate the head of the $\frac{1}{8}$ -in. bolt.

The last piece of the slide assembly to make is the block that holds a $\frac{1}{2}$ -in. captured nut in which the threaded rod turns to advance or retract the slide. Once all the pieces are

cut, the spacer blocks are glued to the back strip. Then the face strip is attached. I made a separate face strip to be attached only with screws to cover the part of the unit that's involved in the slide mechanism. This gives me access to the guts of the thing if it needs tuning or repair. When the system is complete, it's affixed to the edge of the bench top with 3-in. wood screws that are countersunk into the face strip. □

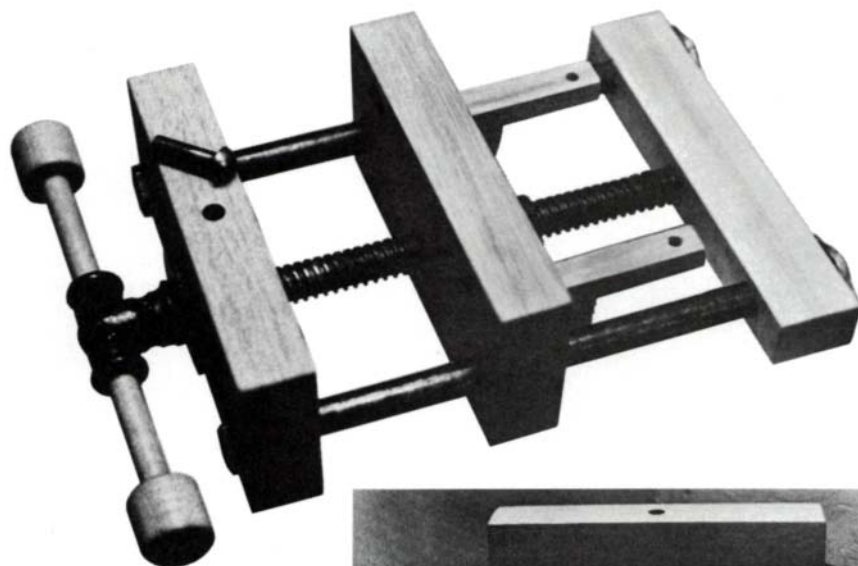
R. J. Silvestrini, 56, is president of an industrial equipment distribution company in Huntington, W. Va.

Wooden Vise

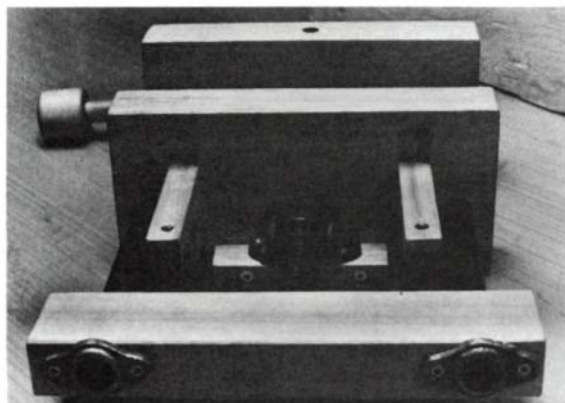
by G. Barry Ellis

The jaws, the screw, the guide rods and the handle of early vises were all made of wood. Modern vises like the one I will describe here have a metal screw, nut and rods, which you can buy from catalog supply houses or find used in a second-hand store. The jaws must be strong and durable. Many species of wood will work, but I think green ash, maple, beech (the traditional choice) and pecan are best. The size and shape of the jaws will depend on your requirements. Most European vises have relatively shallow throats and thick jaws, a combination that produces great clamping pressure and is suitable for use with bench-top clamping systems. If, however, you need large holding capacity in a vise with only moderate clamping pressure, then a wooden-jaw vise modeled after North American steel vises will do the job.

The jaws need to be a matching pair. On my vise they are 12 in. long, 6 in. wide and a full 2 in. thick. For proper alignment, the two jaws should be clamped together when drilling the holes for the screw and the guide rods. I use $\frac{1}{2}$ -in. black pipe for the guide rods and standard pipe nuts for attaching the rods to the front jaw. This requires threading the pipe 2 in. along its length on the front end and about $\frac{3}{4}$ in. at the back where it screws into the drag bar, a horizontal piece of wood or metal that holds the trailing ends of the guide rods and screw in alignment. The length of the guide rods is determined by the length of the screw you use and by how they are attached to the front jaw and to the drag bar. If you make



Wood-jaw vise with steel bench dog, above, can be made with standard hardware items. The front jaw is attached to the guide rods by two pairs of pipe nuts. Rear view of vise, right, shows how guide rods are affixed to drag bar by means of pipe flanges. Braces dadoed into rear jaw provide added strength and stability.



Deck Glenn

your drag bar out of wood, you can fit it with threaded flanges and screw the guide rods into them as shown above. Keep in mind that the two guide rods should be slightly higher than the screw to prevent a workpiece from resting on an oily screw. And when you attach the rods to the front jaw by means of two pairs of nuts, you must recess the two nuts on the inside of the jaw so the vise will close completely.

The rear jaw of the vise can be secured to the edge of your bench with lag bolts or with machine-thread bolts screwed into barrel nuts let into the bench top from underneath. In either case, you must counterbore the rear jaw for the bolt heads. For extra strength

you can dado the backside of the rear jaw to receive a pair of braces that fasten to the underside of the bench. The addition of a bench dog is easy once the vise is affixed to your bench. Just bore a hole directly above the screw (or several of them if you want to use more than one dog at a time) into the top of the front jaw. For the dog I use a steel pin with a head on it and file a flat on one side of the head where it will contact the workpiece. Another hole bored in the side of the jaw holds the dog when it's not in use. □

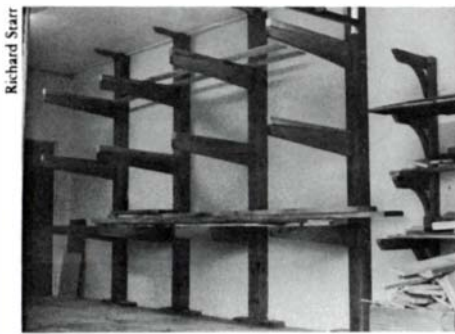
G. Barry Ellis, of Calgary, Alta., is a workshop specialist who writes for Canadian newspapers.

Post-and-Spar Lumber Rack

by Richard Starr

The storage rack I designed for the junior-high-school woodshop where I teach consists of four units like the one in the photo below, set on 4-ft. centers. Each unit has three oak spars, through-mortised and pegged into 6x6 fir uprights. The 40-in. spars are tapered to add capacity to the next lower storage area and neatness to their appearance. The mortises were chopped very tight, and each spar was driven in with a sledge hammer. There is a ½-in. shoulder at the top and bottom of each tenon.

The uprights of the rack are mounted against a concrete-block wall, but not sup-



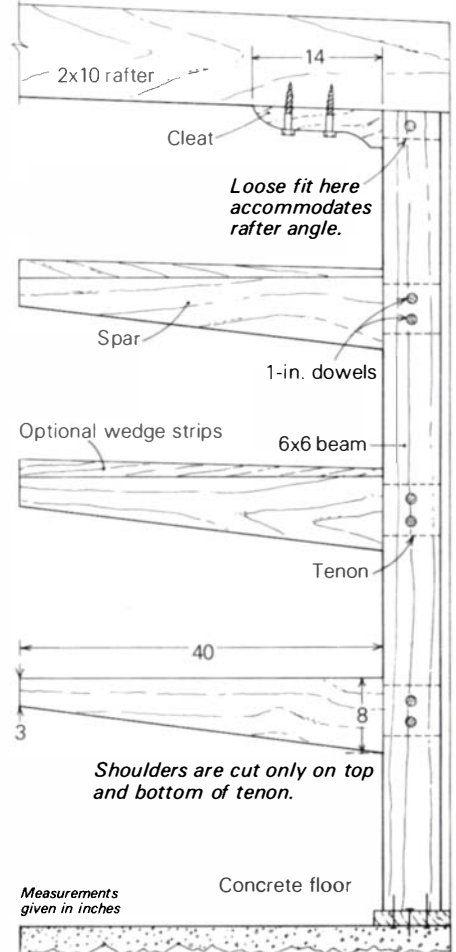
Post-and-spar lumber rack has large capacity and great inherent strength. Wedge-shaped strips added to top edges of spars cant the load backwards, reducing the likelihood of lumber falling off the rack accidentally.

ported by it. Their main strength comes from tying them into the rafters of the building using the little cleats shown in the drawing. The cleats are cut from 2-in. oak, open-end mortised into the upright and pinned with a 1-in. dowel. Carriage bolts hold the cleats to the rafters. Before being erected, the bottom end of each 6x6 was nailed to a 2x6 block, then the 2x6 was nailed to the concrete floor. This locates and stabilizes the bottom end.

The advantage of a cantilevered woodrack is that you can approach it from three sides. It is easy moving wood around to find the one piece you need and quick to load up with new material when it arrives. The capacity of this thing is enormous. If you load it with 16-ft. boards to a depth of about 26 in. per shelf (compensating for the taper in the spars), you get about 5,550 bd. ft. Of course it's less if you sticker your wood, but more if you allow for overhang over the ends of the thing, which are 16 ft. apart. We've never fully loaded the top shelf, but with the bottom two spars loaded solid with pine, there is no sign of flexing in the uprights or in the spars. I'm sure the rack could be loaded to the brim with unstickered hardwood, if the building itself could take it. If the rack were to hang in a frame building, I'd think over the scantlings of the entire structure. □

Richard Starr lives in Thetford Center, Vt.

Post-and-spar lumber rack



Double-Top Workbench

Design increases workspace and clamping capability

by Ramon Sanna

With its tail vise and shoulder vise, the Scandinavian-style cabinetmaker's bench (*FWW* #4, Fall '76) offers a number of ways to hold a workpiece, and its design is well suited to most shop operations. But for those of us who like to have a lot of room on our benches—room for project parts and for tools—a larger work surface is desirable. Without sacrificing any of the clamping features of the Scandinavian bench, I designed mine with two tops, four rows of dog holes, a center tool well and three vises. This gives me a work surface that's a full 28 in. wide, in addition to an out-of-the-way place to keep all the hand tools I'm using at a given time.

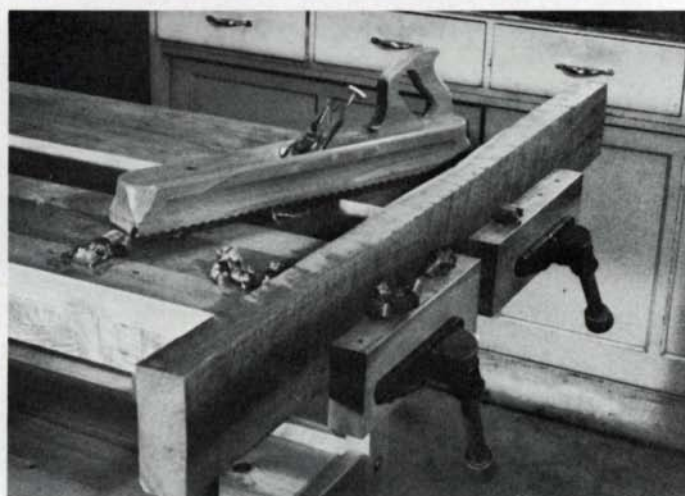
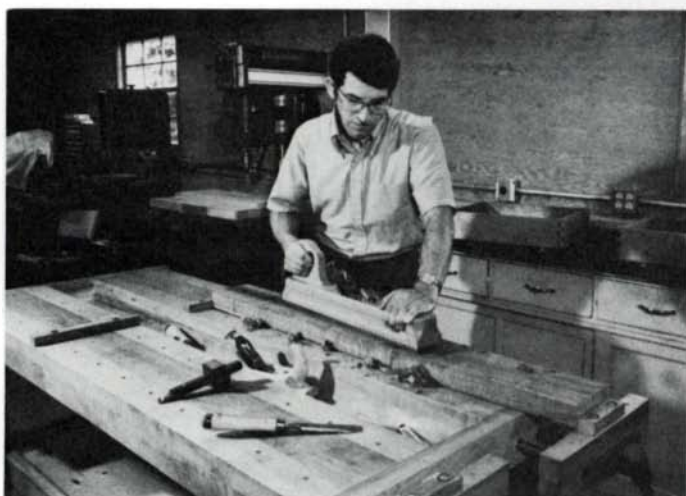
Each top is glued up from five pieces of 8/4 maple, three boards for the work surface and two for the aprons. Edge-joined with ¾-in. thick splines, each top surface measures 11 in. wide, just right for being surfaced to 1 ¾ in. thick on my Parks 12-in. planer. The aprons are also splined to the underedges of the tops, which gives them a finished thickness of

4 ¼ in. The center aprons are rabbeted on their bottom outer edges to receive the tool tray, which separates the tops and provides a 6-in. wide well between them (see drawing). Finally, each end of the bench is fitted with a facing board 28 in. by 4 ¼ in. These facing boards are joined to the bench tops with ¾-in. thick splines and are best attached by bolts and barrel nuts, one pair for each apron, two pairs for each top. The counterbores for the bolt heads can be plugged. When the tandem top is finished, it's mounted onto a single base frame.

Instead of using the conventional rectangular bench dogs, I bored two rows of ⅝-in. diameter holes in each top and counterbored the undersides of each hole 2 ¼ in. to accept a ⅝-18 short-prong T-nut. These are available from the Sharon Bolt and Screw Co., 60 Pleasant St., Ashland, Mass. 01721 (#TN-355Q). Using horizontal counterbored bench stops made of pine (see photos), I can securely hold workpieces of almost any size and shape by bolting the bench stops into any

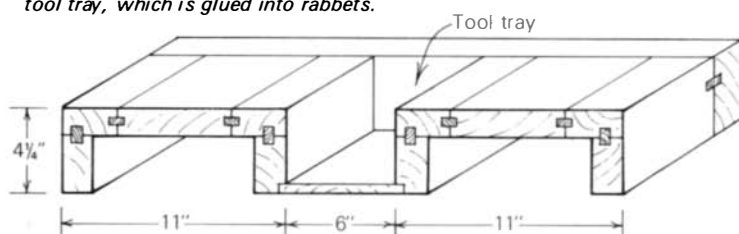


Right, Sanna's workbench with three vises, tool well and storage shelf beneath is spacious and sturdy. The bench and tail-vise jaws have a total of 56 dog holes, each containing a T-nut. Tail vise, below left, clamps board to bench top. Stops are bolted into place rather than just slipped into holes. Both tail vises, below right, can hold a single long piece, or with stops on both vises, they can become part of a four-point clamping system.

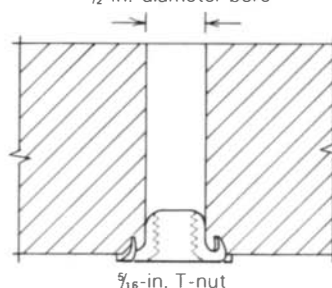


Section through bench top

Facing boards are bolted onto each end of bench top and held firmly by barrel nuts let into underside of top. All other parts are splined together, except for tool tray, which is glued into rabbets.



1/2-in. diameter bore



To secure the T-nuts, you should drill a couple of small holes in their flanges and brad them to the underside of the top.

of the 56 T-nuts in the two tops. These serve also as hold-downs for jigs and other fixtures.

The two tail vises, also bored and equipped with T-nuts, can be used as part of the bench-stop system or as woodworking vises. Because they are both on the same end of the bench, I can use them together to clamp a long board edge up, something the Scandinavian bench won't do at all. Rather than making a shoulder vise of the kind Tage Frid recommends, I got an ordinary woodworker's vise with a steel dog and mounted it on the front of the bench (opposite the end with the tail vises). I can use the dog in conjunction with the bench

stops or use the vise to hold long cumbersome pieces like doors.

Since my tool well is in the middle of the bench, I can work on both sides of my bench and always be within easy reach of my tools. Though it takes more time to bolt the stops into place than it does to slip a dog into its slot, I find this disadvantage to be offset by the increased versatility and firm clamping capability of the bench-top system. The more I use my bench, the more I am convinced that it's the most important tool in my shop. □

Ramon Sanna, 34, of Madison, Wis., is an amateur woodworker.

Bigfoot Tool Rack

by Ted Wick

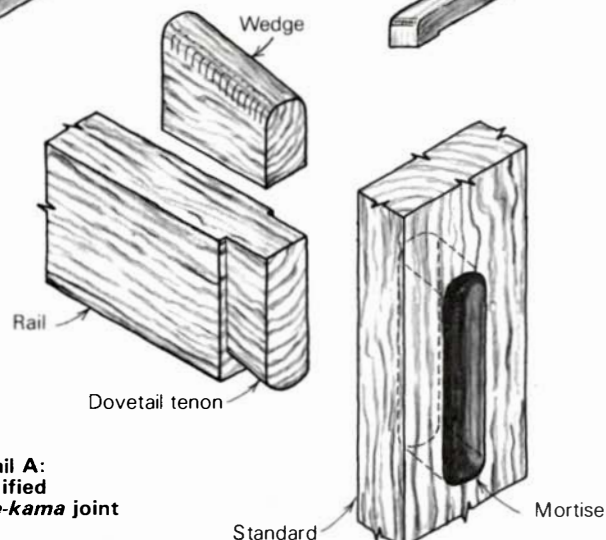
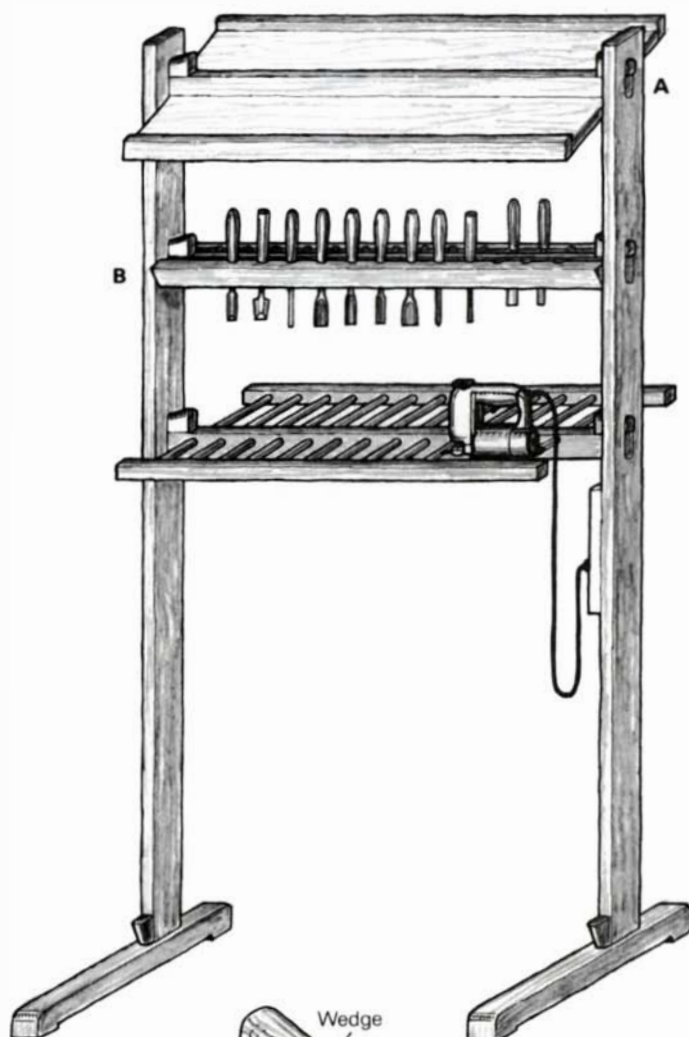
A simple way to get your hand tools within easy reach of your workbench is to design and build a free-standing tool rack. I didn't have enough space in my shop for a wall-hung tool cabinet, which lacks the convenience of portability, so I made "Bigfoot," a tool rack with long feet for stability and an upper structure that can be adapted to changing needs as time goes by. To attach the crossmembers to the uprights, I adapted a Japanese joint called *sake-kama*, a modified through-dovetail joint held tight with a wedge, as shown in detail A. I used this assembly so I would be able to knock the rack apart easily and alter its brackets to accommodate changes and additions to my hand-tool collection. I used no glue or fasteners on Bigfoot so these future alterations would be easy to make. You can increase the capacity of the rack simply by using longer crossmembers or by adding more shelves and racks.

For the bottom rack, I made something that resembles a round-rung ladder lying flat. Between its rungs it holds mallets, squares and other tools with large heads and narrow shafts, and its design lets dust and shavings fall right through to the floor. I also keep all of my electric hand tools on this lower shelf, where they can remain plugged into the six-outlet fixture I've attached to the right-hand standard below shelf level. I like being able to use these tools right when I need them, without having to plug them in and then unplug them when the operation is finished. Their cords drop neatly behind the bench when they're not in use.

The middle rack, for my chisels and gouges, is a compound piece that works much better than a strip of wood with holes bored into it. My basic design is shown in detail B. I began with a board $1\frac{1}{2}$ in. square and bored $\frac{3}{4}$ -in. diameter holes on 3-in. centers all the way down its length. Then, setting my sawblade at an angle of about 75° , I ripped this board in two. These two halves, their slots staggered, were then joined with $\frac{3}{8}$ -in. dowels to a 1-in. by $2\frac{1}{2}$ -in. center strip so that there was a $\frac{3}{8}$ -in. gap remaining between the center strip and the two strips with the half-round slots in them. The gap, in conjunction with the angle, serves to accommodate the tapered sockets and handles of the chisels, holding them always perpendicular to the rack and keeping them from flopping around in their holes and damaging their edges by scraping against each other.

The top crossmember is a shelf for planes, spokeshaves and the like. The edges of the shelf are lipped, with the crossmember down the center. The back shelf is located high on the crossmember, while the front-shelf is located at a low position on its front. The shelf is angled slightly towards the front; this elevates the tools on the rear half of the shelf and makes getting at them easier. □

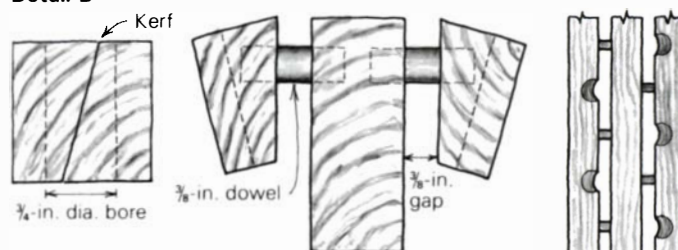
Ted Wick, 43, an amateur woodworker, is campus chaplain at Pacific Union College, Angwin, Calif.



Detail A:
Modified
sake-kama joint

Top of mortise is angled to accommodate wedge; bottom of mortise is angled in the same direction to house dovetail on tenon.

Detail B

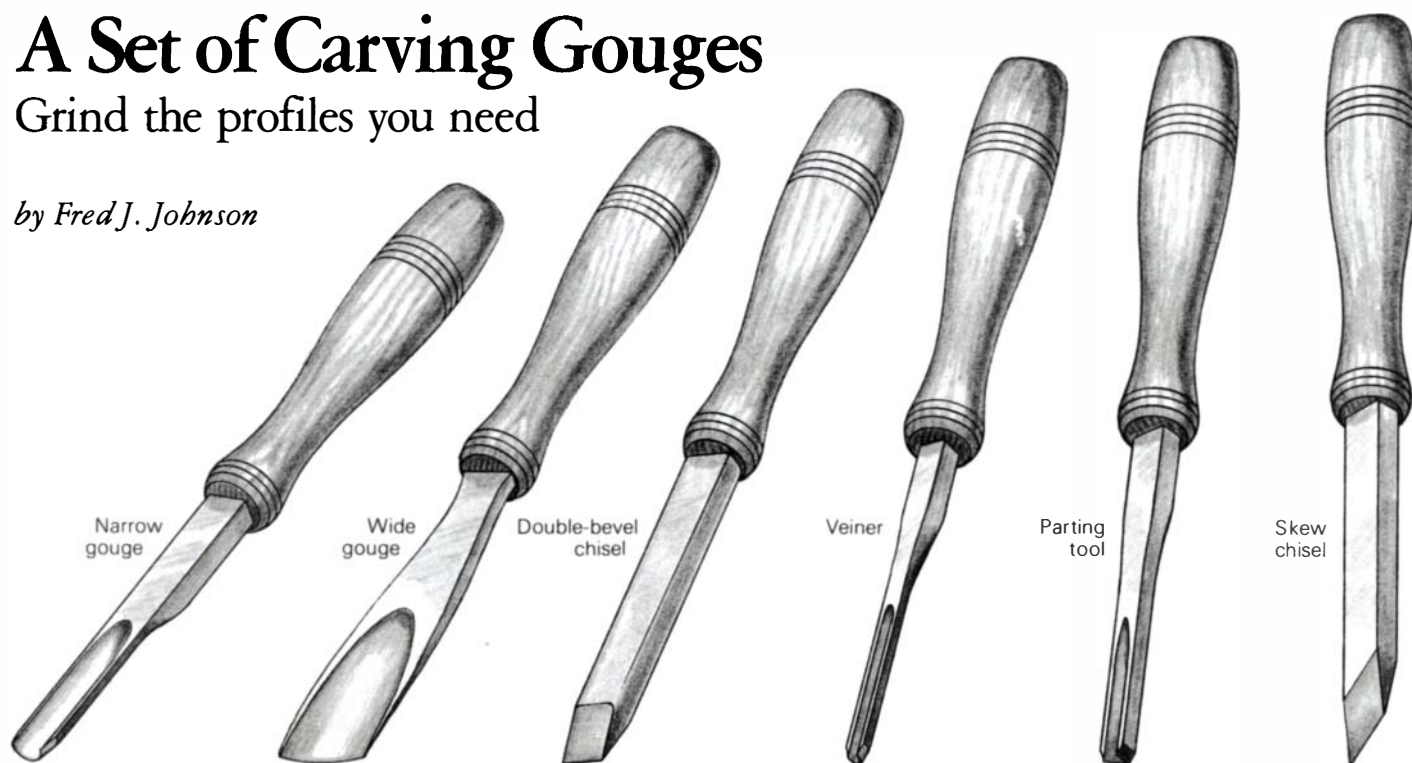


When ripping $1\frac{1}{2}$ -in. square stock at 75° bevel, set fence so kerf passes through the center point of section, producing two equal trapezoidal pieces. These are then connected to center strip with $\frac{3}{8}$ -in. dowels.

A Set of Carving Gouges

Grind the profiles you need

by Fred J. Johnson



About six years ago I reached that stage in my furniture making where I wanted to stop whittling and start carving. I had read and reread A. W. Marlow's *Fine Furniture for the Amateur Cabinetmaker*, and wanted to do what Marlow described. The only thing I lacked was a set of carving tools, which I couldn't afford, so I decided to make my own. Here is how I went about it.

Before starting to grind, I had to decide what tools to make. The 1974 Woodcraft catalog listed 116 different tools in their "professional" category; there are 148 now. This was confusing. So I reread Marlow again, looked at all of the pictures and sat down to design the set of tools I would need.

My gouges would have to outline scrolls and spirals with fair, sweet curves. This would require their edges to be arcs of circles. With a compass and a circle template, I laid out a series of increasingly smaller arcs spaced at regular intervals (drawing, bottom right). I had previously learned that any arc of greater diameter than 12 in. could be cut with a series of short, straight lines. I ended up with 21 diameters and decided to make 24 gouges, the extra three being narrow duplicates of the 2-in., 1-in., and ½-in. curves for removing backgrounds. These diameters refer to the cross section of the gouge at its edge, not to its width. The wide, flat gouges are often called "sweeps," the small, tight ones, "veiners." The rest of the set would consist of two V-shaped parting tools (one 60° and one 90°), five sizes of single-bevel chisel (¾ in., ½ in., ⅜ in., ¼ in. and ⅛ in.), two double-bevel chisels (½ in. and ⅜ in.), and a ⅜-in. skew chisel, 34 tools in all. I already had two shallow bent gouges that I had used in gunstocking. I bought enough steel for three extra blanks, so if the need for a particular shape arose, I could grind it. So far, I've found the set to be entirely adequate.

A friend who knows about metals recommended oil-hardening tool steel. It will crack and deform less with quenching and is easier to harden than some of the other choices. The only oil-hardening tool steel that we could locate in small quantities was the precision-ground stock that is sold

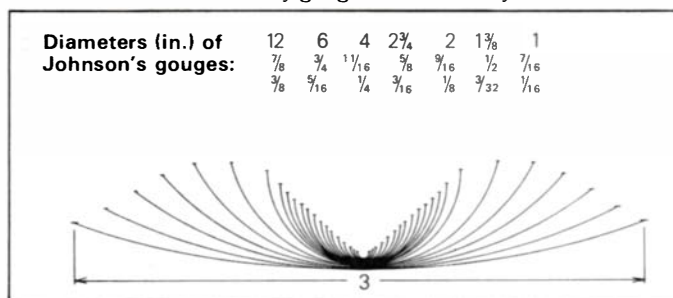
in metalworking tool supply houses for making tools and dies. It comes in a wide variety of rectangular cross sections, in a dead soft state. I already had a ⅛-in. by 1-in. by 6-in. length of this material, so I made a gouge with a 6-in. diameter cutting edge to try out the process. It came out just fine.

I decided to go ahead. I bought a Sears grinder on sale with an extra 6-in. by ½-in. carborundum wheel and a wheel-dressing stick. The steel sold locally came in 18-in. and 36-in. bars, and since two cuts would make three blanks out of the 18-in. length, that's the size I bought—eleven bars of it. The current price would be about \$10 per bar, maybe \$3.50 per tool.

Shaping the steel — The procedure consists of these steps: saw the bars apart; shape the steel and grind the steel; finish-grind, file and stamp; harden and temper; clean up and maybe polish the steel; make and attach the handles; and sharpen. It's time-consuming only because there are so many tools in a set.

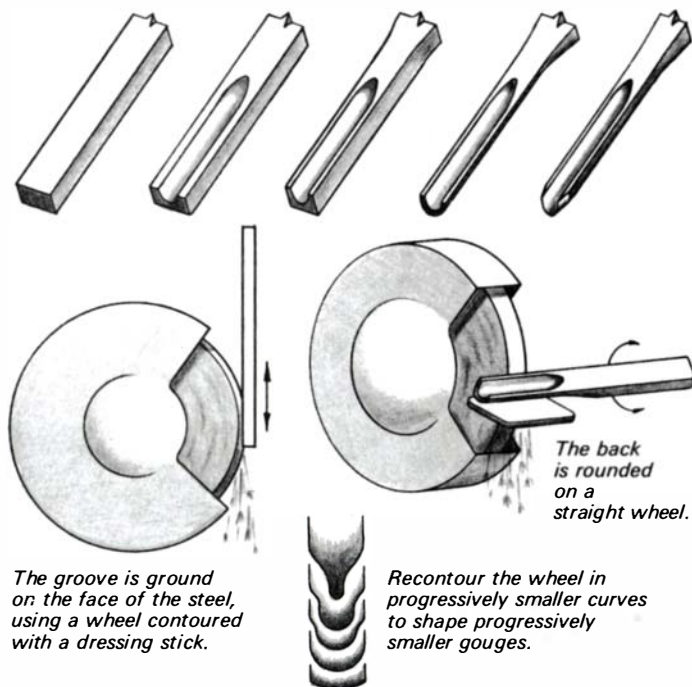
You need a template for each gouge. For the large sizes above 1½ in. in diameter, cut templates from cardboard. Save both the inside and the outside of the arc. The concave part is for checking the curvature of the wheel, and the convex part is for checking the tools. For the smaller arcs, use a draftsman's circle template like Pickett No. 1200, about

The cross sections in a set of gouges are a series of 21 circular arcs.

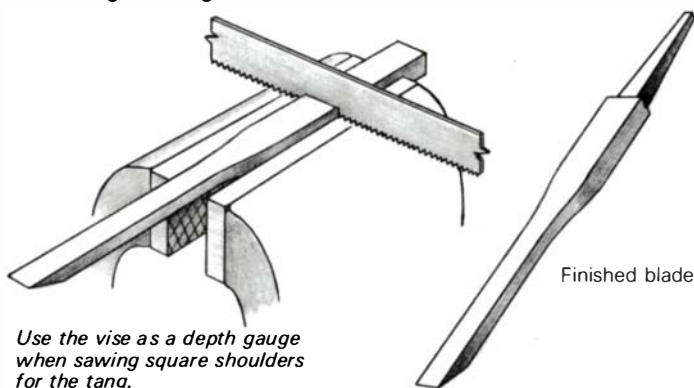


\$1.50. Cut it apart on the center marks so that you have semi-circles. Dress a $\frac{3}{4}$ -in. wide, 60-grit wheel to the required curvature for the largest diameter and after grinding, progressively re-dress the wheel to the next smallest size. Dressing a grinding wheel is like scraping on the lathe. Rest the dressing stick on the tool support and press it gently against the wheel. Keep the stick moving and check only after turning the grinder off. Resist the urge to touch the template to a spinning wheel. If the wheel seems to run forever after you turn it off, slow it down with the dressing stick. When you get to the $\frac{1}{2}$ -in. tools, switch to the $\frac{1}{2}$ -in. grinding wheel—not as much material to remove.

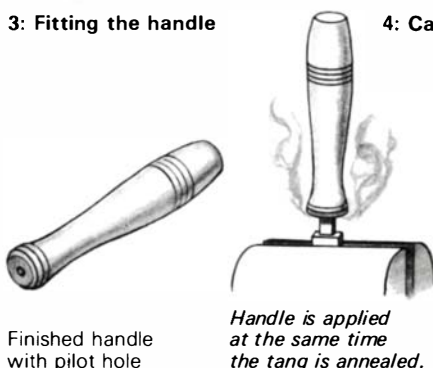
1: Steps in shaping a gouge



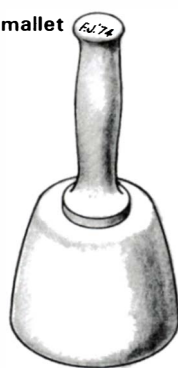
2: Sawing the tang



3: Fitting the handle



4: Carver's mallet



Grind the hollow of each gouge by holding the steel vertical, tang end up (figure 1). Start at the bottom and grind a shallow groove. Then lower the steel to extend the groove toward the tang. Slide the steel up and down on the wheel, keep it moving, and don't use a lot of pressure. Keep the groove centered on the steel and parallel to its sides. Narrow, deep grooves are far easier to grind than wide shallow ones.

Now you need to decide how long to make the groove. Most commercial tools are forged. It is just as easy to stamp a long groove as a short one; thus the groove usually runs almost to the tang. You can grind your tools this way, but I made the grooves of mine only about $1\frac{1}{2}$ in. long for three reasons. First, it saved grinding and wheel-dressing time. Second, I will never sharpen that much steel away in my life-time. Third, and most important, a tool is more comfortable to hold and easier to control with the left hand if its shaft is rectangular with nicely rounded corners.

After the blank is ground to the proper width and depth, check its curvature with the circle template held against the bottom end of the groove. Keep in mind the way gouges are sharpened. Most have a large bevel on the outside, a few have all of the bevel on the inside, and some are in between. The outside bevel is convex, not straight and not hollow ground. Then there is a smaller bevel on the inside, put there during sharpening. This is no accident—the double bevel makes the tool easier to control, and its edge more durable. The way each gouge is to be sharpened will determine the diameter of the groove that you grind. A fully sharpened tool with a profile of $\frac{1}{6}$ -in. diameter may start with a groove of $\frac{3}{32}$ in.

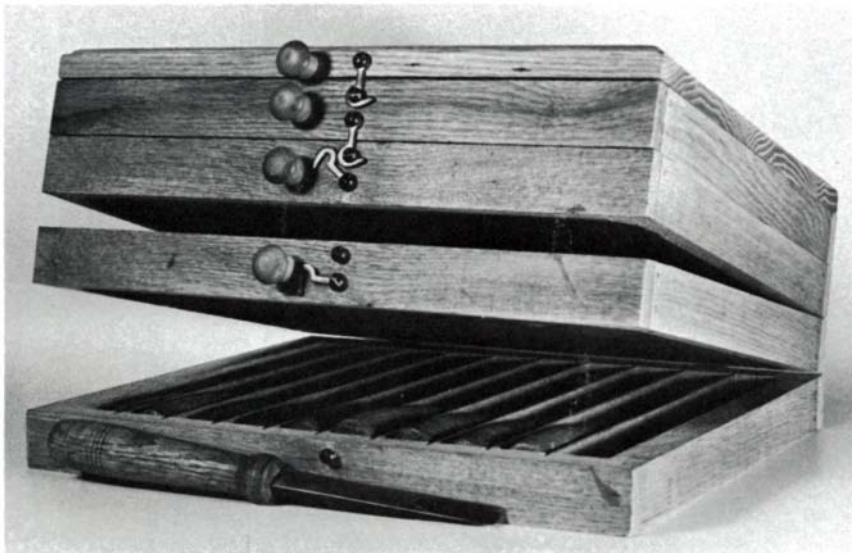
After you grind each groove, shape the grinding wheel to the next smaller size. Contouring the wheel is easy, but messy—wear a mask to keep from breathing the dust, and vacuum it up promptly. When finished with the gouges, re-shape the wheel to the angles chosen for your parting tools.

After you have put the groove in the face of each gouge, veiner and parting tool, clean them up with files. This is especially important for the parting tools if a sharp angle rather than a radius is wanted at the bottom of the groove.

Next, round off the back of each gouge to match the curve of the front. This is done by first hogging off the corners and then by rolling the blank in your hands while moving the steel back and forth across a straight wheel. Hold the gouge horizontal, 90° to the wheel, and keep it moving with a light touch. Check it often, then file everything smooth and grind each gouge to an almost finished edge. Make the straight chisels by grinding and filing their sides to the required width and thickness. Then grind the desired bevels and clean up with files. But don't make the cutting edges sharp enough to cut yourself with until the very last step.

Now the tools are ready for forming tangs. A $1\frac{1}{2}$ -in. tang that is $\frac{3}{16}$ in. by $\frac{1}{4}$ in. at the base and tapers to about $\frac{1}{16}$ in. by $\frac{1}{8}$ in. at the tip will do. Lay out on all four sides of the steel, clamp it in the protected jaws of a vise and hacksaw to the required depth on all four sides (figure 2). This will make a square shoulder for the handle to abut. Grind the tang to the approximate dimensions on a coarse wheel and finish with a coarse file. Keep in mind when handling and clamping tool blanks that they are soft and easily scratched.

Put as much finish on the tools as your sense of fitness demands. At least, round the edges and smooth the surfaces. Rust forms more readily on a rough surface than on a smooth or polished one. I marked each of my gouges with the diam-



Johnson's tool case holds 40 carving tools. Right, piecrust table carved with them.



eter of the cutting edge, using a set of number stamps and stamping near the handle.

Hardening and tempering — Each bar of oil-hardening tool steel comes in an envelope with hardening and tempering instructions printed on it. Heat-treating specialists (look under Heat Treating—Metals in the Yellow Pages) will harden and temper this many tools for about \$20, their minimum. Tell them what kind of steel you have and the hardness you want. But there is no magic to heat-treating, just temperature control, and you can do it yourself.

First heat the metal to 1,450°F to 1,500°F, then quench in hot oil (120°F to 140°F). Motor oil will do, but be ready to put a lid on the oil if it catches fire; proper quenching oil has a higher flash point. Don't let the tools get hotter than 1,500°F and don't leave them at that temperature. You can buy temperature-indicating pellets (about \$3.50 for 20) or crayons (about \$3.50 each) from the supplier who sold you the steel. Quench by plunging the tool straight down into the oil, then move it around, keeping it under the surface. Plunging vertically minimizes distortion. Your heat source might be a forge, an acetylene torch, a kiln or a heat-treating oven. Unless you have experience with a torch, don't heat the tools directly. Put them in a small firebrick oven or on a steel plate and heat everything, being careful not to get above 1,500°F.

Clean the oil off the tools and wire-brush them. Then temper according to the instructions that came with the steel. Most carving tools are tempered in the range of 56 to 60 on the Rockwell C-scale. I followed directions to obtain 57 Rockwell for my tools. The harder they are, the better the edge. If they are too hard, though, the edge breaks off. If they are too soft, they won't stay sharp. The instructions specify a tempering time of one hour at 400°F to get about 60 Rockwell, at 500°F for 58 Rockwell, and 550°F for 56 Rockwell. This can be done in your kitchen oven, but unless you know that its thermostat is correct, use temperature-indicating pellets or crayons. Now you can smooth, buff and polish to your heart's content.

Handles — I turned handles out of scrap oak (railroad dunnage) that was thoroughly dried. I made them 5 in. long when finished. You can make them any shape you like, and

out of any wood that is strong and appeals to you. They are your tools and your hands, so experiment to find what feels good. Make some prototypes and try them out.

To mount the handles, drill a pilot hole in the wood and clamp one of the blades in a metalworking vise with all of the tang pointing up (figure 3). Heat the tang with a propane torch until it is red hot. Press the handle firmly down on the tang. Stop short of the shoulder by $\frac{1}{16}$ in., remove the handle and let it cool. You may have to heat the tang more than once to get the handle on. When the tool is cool, clamp it firmly in the vise and drive the handle down against the shoulders. Heating the tang serves two purposes. It anneals the tang so that it is not brittle and subject to snapping off, and it fire-hardens the handle hole. To get a handle off requires quite a tug. If you ever have a handle loosen, put some plaster of Paris into the hole. That will mount the blade firmly again. I varnished one handle and found that I preferred the feel of the raw wood. Since your tools will have a reasonably well-formed edge on them, ground before they were hardened, they will be easy to sharpen.

There are really two more things to do before you can consider your toolmaking project complete. One is to make a carver's mallet (figure 4) and the other is to make a case to hold the carving tools (photo, above left). I made a case for forty tools that consists of four trays of ten compartments each, plus a cover. They are all hinged together on the back and latched on the front with small brass hooks. The sides of the trays have rabbets for $\frac{1}{8}$ -in. hardboard bottoms and slots for hardboard dividers. A handle screwed to the top finishes the case.

I discovered why carvers use round mallets the first time I tried to use a square-faced one. You don't have to look at them when you strike. A square head glances off if the angle is not just right. I turned light and heavy mallets out of oak and they seem to hold up well. The head of the mallet should curve a little from the top to the handle for the same reason that it is round. I enjoy and treasure my tools very much. They suit my carving needs and they give me a feeling of pride and satisfaction because I made them. □

Fred Johnson works as a package designer and makes furniture for his home in Long Beach, Calif.

A Joiner's Tool Case

Wooden box holds all the essentials

by Tony Taylor

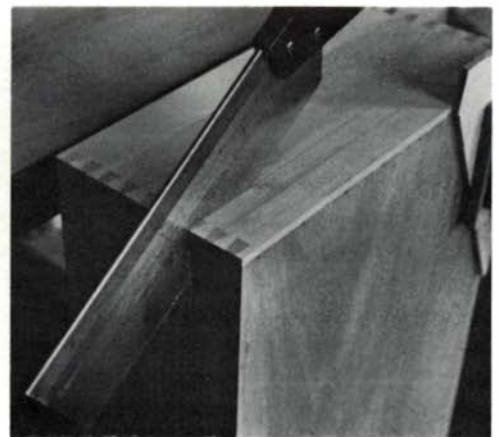
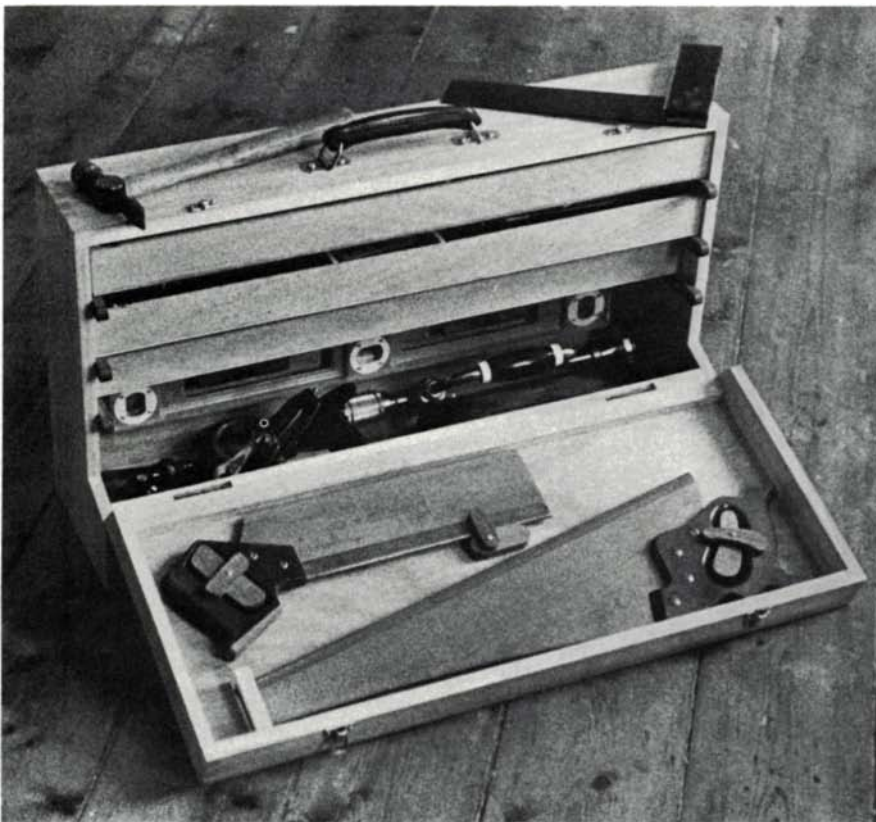
A few years ago I worked alongside a joiner who impressed on me the advantages of carrying your tools in a wooden case. His own case was a masterpiece of inventiveness and caught the eye of every visitor to our work site. The number of items he kept in this case amazed me. In addition to a full range of hand tools, he could produce on request just about anything the rest of us didn't carry—spare knife blades, chalk and line, scissors, tweezers, knife, fork and spoon, and, in case he worked overtime, toothbrush and paste, razor and aftershave and a corkscrew. Not everyone may feel the need to be so readily equipped for the contingencies of the working day, but those who regularly work away from the shop are familiar with the need to carry an organized tool kit.

My finished tool case weighs 16 lb. unloaded and up to 55 lb. when full, so don't count on walking to work if you make one of similar size. Strength of construction is vital; your tool case may have to withstand rough handling. So unless you can guarantee its safety, I would advise against making anything too fancy. A simple, well-made case will give years of service and will protect your tools. Because each tool has its own place, it's easy to find, and you'll notice if any are

missing at the end of the day. Furthermore, an attractive, well-made case will always get the attention of prospective clients and employers, and it will serve as a good example of your work.

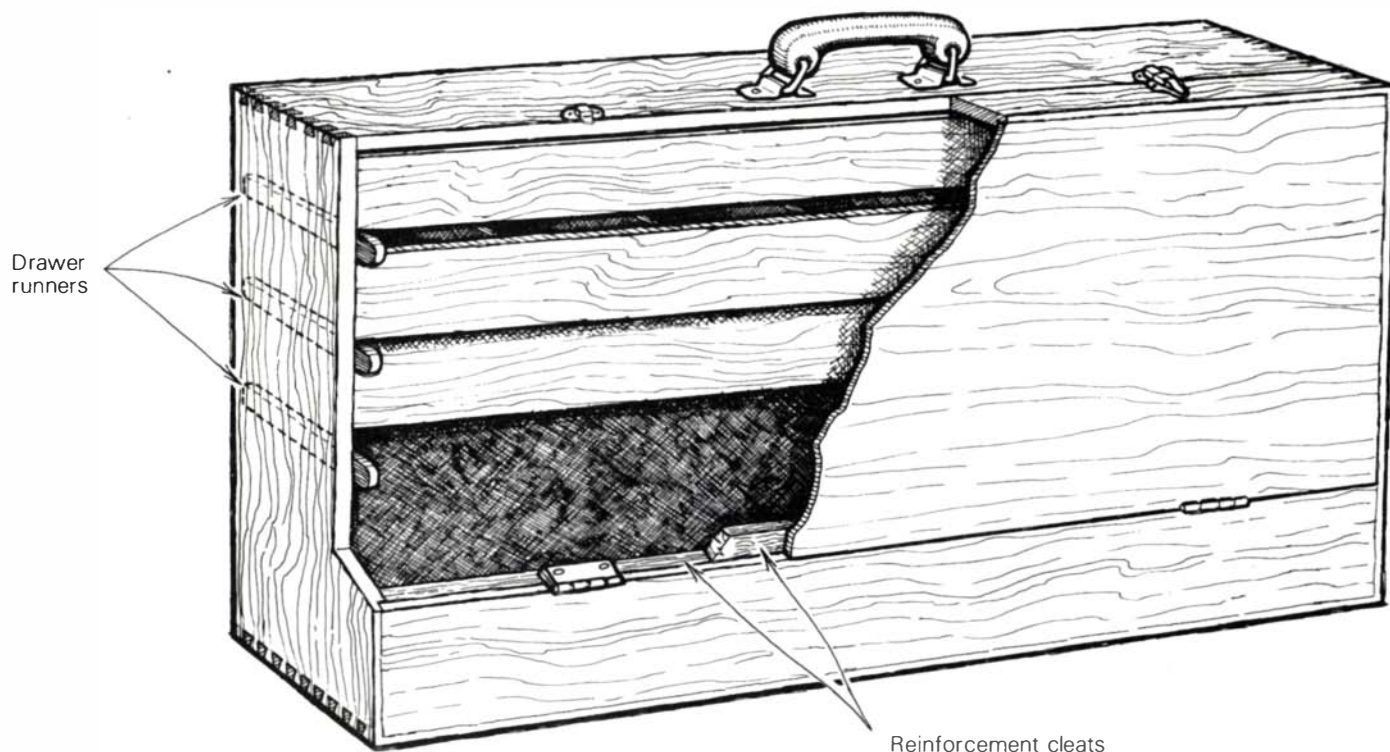
Whether you plan to build a fine showpiece or a simple plywood box, careful planning is essential. List on paper all the tools you want to carry and sort them into categories according to size and usefulness. The saws can fit into the lid, where they lie flat and are easy to reach; a square can fit in here as well. Small tools fit easily into removable drawers or trays. Divide the drawers into separate compartments for chisels, files, brace bits and screwdrivers. Allow extra drawer space for mortise gauges, marking tools, measuring tape, drill bits and punches. My spirit level hangs on blocks glued to the back panel underneath the lowest drawer. This leaves the larger, heavier tools—oilstone, planes, hand drill, brace, pump screwdriver, coping saw and hammer—to lie in the bottom of the case.

The carcass is made of $\frac{3}{8}$ -in. thick pine boards dovetailed together. Front and back panels are of $\frac{1}{4}$ -in. plywood. The depth of the lid must be determined before you lay out the

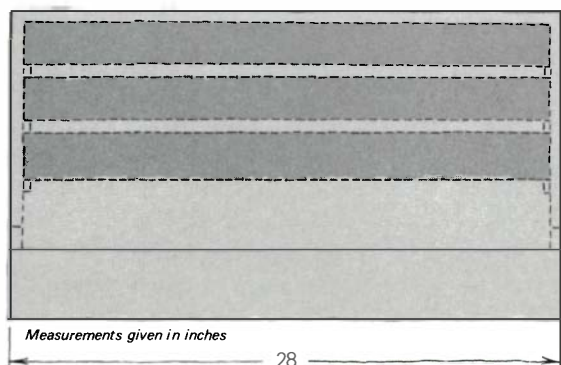


A sturdy tool case puts everything in its place for on-site work, with three drawers for small hand tools, saws inside the lid, and a storage compartment below for large, heavy tools. Top right, a tenon saw starts the cuts in the two upper corners and makes the beveled cut through the face of the front panel to form the lid. Note that the kerf neatly divides a dovetail pin. Once the corners and the panel have been cut, a portable jigsaw finishes the cuts along the sides and top. The lid will fall away as shown, lower right.

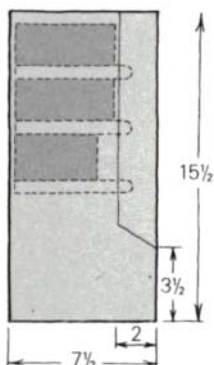
Wooden tool case



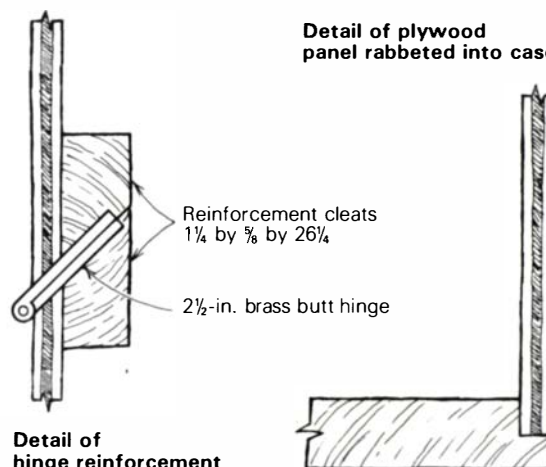
Front elevation



Side elevation



Detail of plywood panel rabbeted into case



Bottom drawer is not as wide as two top drawers. This provides easy access to large tools stored in compartment below.

dovetails so the sawcut that will separate the lid from the case will pass through the middle of one of the pins. It's best to glue the plywood panels into rabbets cut in the carcase rather than to fit them into grooves. The latter way may seem stronger, but will rob space from the inside of the case. Remember to allow for the rabbet when laying out the dovetails.

With the carcase glued up and the panels glued in place, the box is now completely enclosed. So the next step is to saw off the lid. Mark the depth of the lid with a gauge, and then make the first cut along the front plywood panel using a tenon saw. Cut from the outside edges of the panel towards the center, gradually lowering the angle of the saw as the cut proceeds. Complete the cut down the beveled line on the carcase sides. Next, saw in from the top corners so the kerfs will pass through a dovetail pin and will end at the beveled line on the carcase side and at the center of the top of the case. At this point the lid will fall free. Some cleaning up of the sawn edges will be necessary, but it should be kept to a minimum or else the gap between case and lid will be too wide.

Before fitting the hinges, the sawn edges of the front plywood panel must be reinforced and made thicker by gluing in

two pieces about $\frac{3}{8}$ in. thick and $1\frac{1}{4}$ in. wide. Install the hinges at this stage and then remove the lid from the case, to work on each part separately. To fit the saws into the lid, cut contoured blocks to fit inside the saw handles. These should be $\frac{1}{16}$ in. thicker than the saw handles. When they are glued into position, screw on the latches. It may be necessary to provide holders or rests for the blades of the saws to hold them in position.

Using butt joints throughout, I made the drawers from $\frac{1}{4}$ -in. plywood with $\frac{1}{8}$ -in. plywood bottoms. You may prefer using solid wood with delicate dovetails. To permit easy access to the bottom compartment of the case, I made the lowest drawer 1 in. narrower than the upper two. The drawers slide on hardwood runners screwed to the sides of the carcase. The runners extend beyond the drawer fronts to allow the drawer to be pulled out farther than would otherwise be possible. When fitting the insides of the drawers for partitions, cut more dados than required; this will let you arrange things differently should the need arise in the future. □

Tony Taylor, 25, is a cabinetmaker and writer in London.

Sawhorses

Basic design adapts to several workshop tasks

by Sam Allen

“You can judge a man by his sawhorse” was a remark made often by a carpenter I once knew. When he was foreman on a job site, he would have job applicants build a pair of sawhorses. The one who built the best pair got the job. A craftsman who takes pride in his work wants his tools to reflect that pride. But what usually happens with sawhorses is that a temporary pair gets thrown together for use on a particular job, then becomes a permanent fixture in your shop. Why not take time now to build a sturdy, good-looking pair of sawhorses that you can be proud to own?

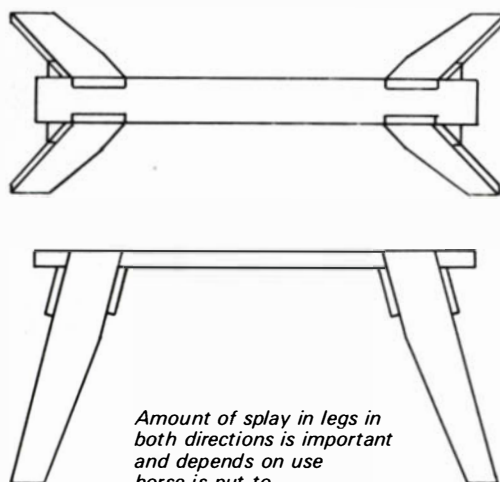
Construction—To build a basic pair of sawhorses you’ll need one 8-ft. 2x6, three 8-ft. 1x6s plus a few 1x6 scraps for braces. Fir or pine is the usual choice because of its strength and light weight. All operations in sawhorse construction can be performed with hand tools, but power tools make the job faster and easier.

Start by cutting two 42-in. long pieces of 2x6 for the saddles. Some people prefer to use a saddle 48 in. long, but the 42-in. length is handier for working on doors and still gives plenty of support to a 4x8 sheet of plywood. Next cut eight legs 28 in. long from the 1x6 stock. Once the sawhorses are assembled, the legs will be trimmed to give an overall height of 24 in. Taper the legs on one edge starting full width at a point 8 in. from the top and tapering down to $3\frac{1}{2}$ in. at the bottom. This makes the horse lighter and more stable.

When the legs are done, cut the gains (notches) in the saddle to receive them. This is probably the most critical part of making sawhorses. The gains are cut on a compound angle, and much of the strength of the sawhorse depends on a good fit. Use a steel square to mark the angles. Make the first mark $3\frac{1}{2}$ in. from the end of the saddle. Place the square on the edge of the 2x6 so the 3-in. mark on one leg and the 12-in. mark on the other line up with the face corner of the 2x6, and

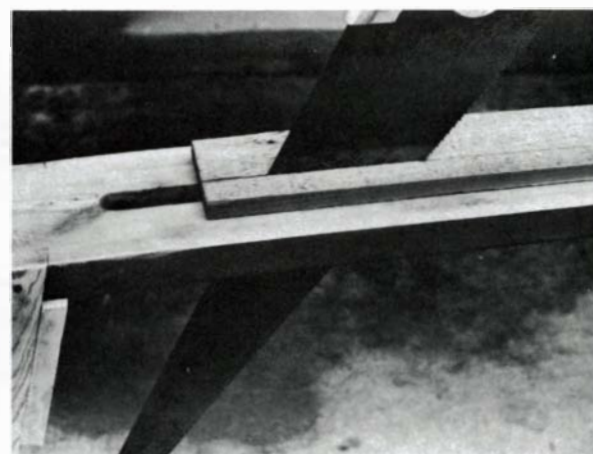


With legs of pine and saddle of fir, sawhorse is both sturdy and attractive.



General-purpose horse

Painter's horse



Left, legs are sawn flush with saddle after they're secured in place and braces are attached. You can add a central slit, above, for ripping boards of any length using a handsaw.

scribe a 4:1 (75°) slope. Line up a 1x6 leg with this slope and use its opposite edge to make a second mark. This gives you the lengthwise slope of the leg. Now determine the spread of the legs across the width. There are two dimensions in common use. For a sawhorse used in house framing, the spread should be 14 in., as this allows it to be carried between studs that are on 16-in. centers. A 20-in. spread is better for finish work and shop use because of the added stability.

Mark the gains for this angle on top of the 2x6 by scribing a line $\frac{3}{4}$ in. in from the edge between the two marks previously made. On the bottom make a line that will vary according to the spread you choose. For the 14-in. spread, it should be $\frac{1}{2}$ in. in from the edge; and for the 20-in. spread, $\frac{3}{8}$ in.

Using a handsaw, cut along the marks on the edge of the 2x6. Stop cutting when the teeth touch the lines on the top and bottom of the 2x6. Now make parallel sawcuts about $\frac{1}{2}$ in. apart between the first two cuts, stopping at the top and bottom lines also. Use a chisel to clean out the gain. Cut the leg braces from the leftover pieces of 1x6. Hold a piece in position and mark the angles of the legs on it, making sure the legs are spread to the correct degree and the angles are equal. Use this as a pattern to cut the rest of the braces. Bevel the top of each brace so it will fit flush under the saddle. After the braces have been fastened with glue and nails, trim the legs flush with the top of the saddle using a handsaw.

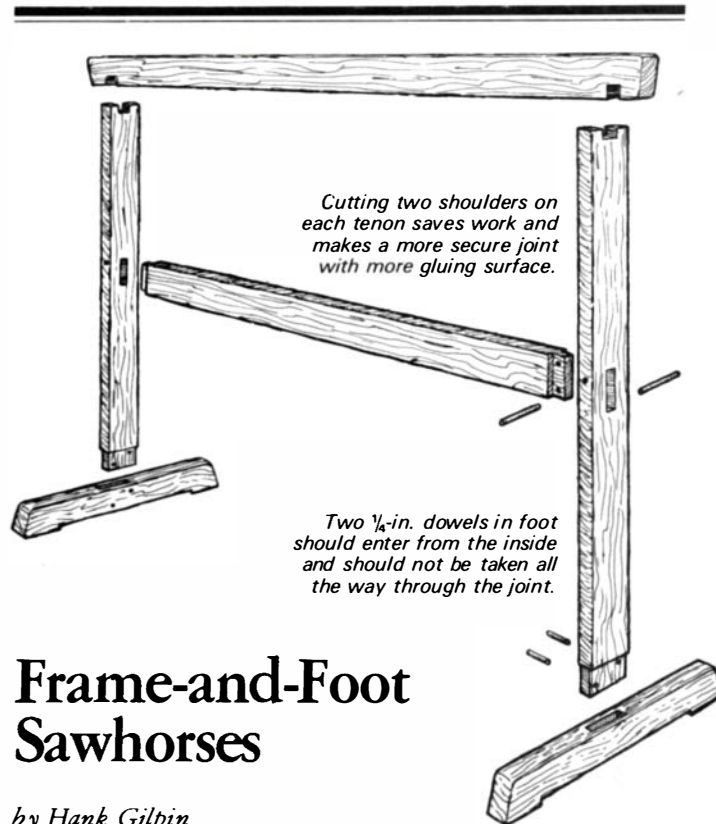
With the horse standing on a flat surface, measure the distance from the top of the saddle to the ground. Set a scribe for the difference between this measurement and 24 in. Scribe around each leg to get a cutting line that will allow the legs to sit flat. Chamfer and sand all the corners and edges to avoid possible splinters and cuts, then finish with oil.

Lowboy—A short sawhorse (usually about 12 in. high) called a lowboy is often used in cabinet shops for elevating furniture and cabinets to a convenient working height. It's especially useful when fitting drawers and cabinet doors. Sometimes a 2x8 is used for the saddle to give a larger area of support to the cabinet.

Ripping horse—If you do a lot of ripping with a handsaw, you'll appreciate this horse. A 1-in. wide slot is cut in the center of a standard sawhorse saddle. Stop the slot at the point where the legs attach so the joint won't be weakened. To use this sawhorse, place the board to be ripped on the horse with the cutting line over the slot and the end of the board about 8 in. from the slot end. Put the sawblade through the slot and start ripping. When the blade reaches the end of the slot, move the board forward and begin ripping again.

Painter's sawhorse—When you're painting something supported on sawhorses, invariably some of the paint will drip down the edge of the work and land on the saddle of the sawhorse. Then it seeps between the saddle and the work and leaves a mark on the back of the object. If the object being painted has two sides that show, a door for example, this is not good. A narrow point of contact between the work and the sawhorse will help solve this problem.

Make the painter's sawhorse out of 1x6s. The saddle is a 1x6 turned on edge. On top of the saddle nail a $\frac{3}{4}$ -in. by $\frac{3}{4}$ -in. strip, which can be changed whenever it gets coated with a lot of paint drips. To reduce further the point of contact with the work, the top strip can be beveled so that only a



Frame-and-Foot Sawhorses

by Hank Gilpin

For supporting cabinets and carcasses while you're working on them, for laying out cuts in long boards and for various other jobs around the shop, here's a sawhorse (basically a frame on two feet) that is light and strong, yet stores easily without taking up a lot of space. I made mine out of red oak (only because I had a large quantity on hand), but you can make them out of almost any wood you choose. All the pieces are $1\frac{1}{2}$ in. thick and $2\frac{1}{2}$ in. wide, except for the foot, which is $1\frac{1}{2}$ in. wide. The uprights are through-tenoned into the feet and secured with glue and a couple of $\frac{1}{4}$ -in. pegs. To receive the stretcher, I chopped through-mortises in the uprights. The tenons, all of which I cut long to use the same saw setting, were trimmed to length after assembly. They are pinned also with $\frac{1}{4}$ -in. dowels, though wedges would do as well. Both of the uprights and the saddle member are notched to make a secure double-lap joint, which can be pinned or not.

These horses can be made quickly and in quantity with a minimum of materials and fuss. I have a couple dozen of them. They travel well, taking up much less space than conventional four-leg horses, and they nestle together neatly when not in use. □

Hank Gilpin, 34, makes cabinets and furniture in Lincoln, R.I.

small point is left on top. However, this may be undesirable if the underside of the work has been freshly painted, because the point will cut into the paint.

Because of the narrow saddle, you can't cut gains for the legs. Cut the ends of the legs to the appropriate angle so they can be butted against the sides of the saddle. Notch the leg braces so they will extend part way up the saddle.

Padded saddle—If your sawhorses are to be used with finished pieces, you can avoid scratches by padding the saddle. A strip of carpet is one of the best pads. Glue it down or fold it over the edges and tack it to the underside. □

Sam Allen, 28, builds furniture in Provo, Utah.

Keeping Quality in Production Runs

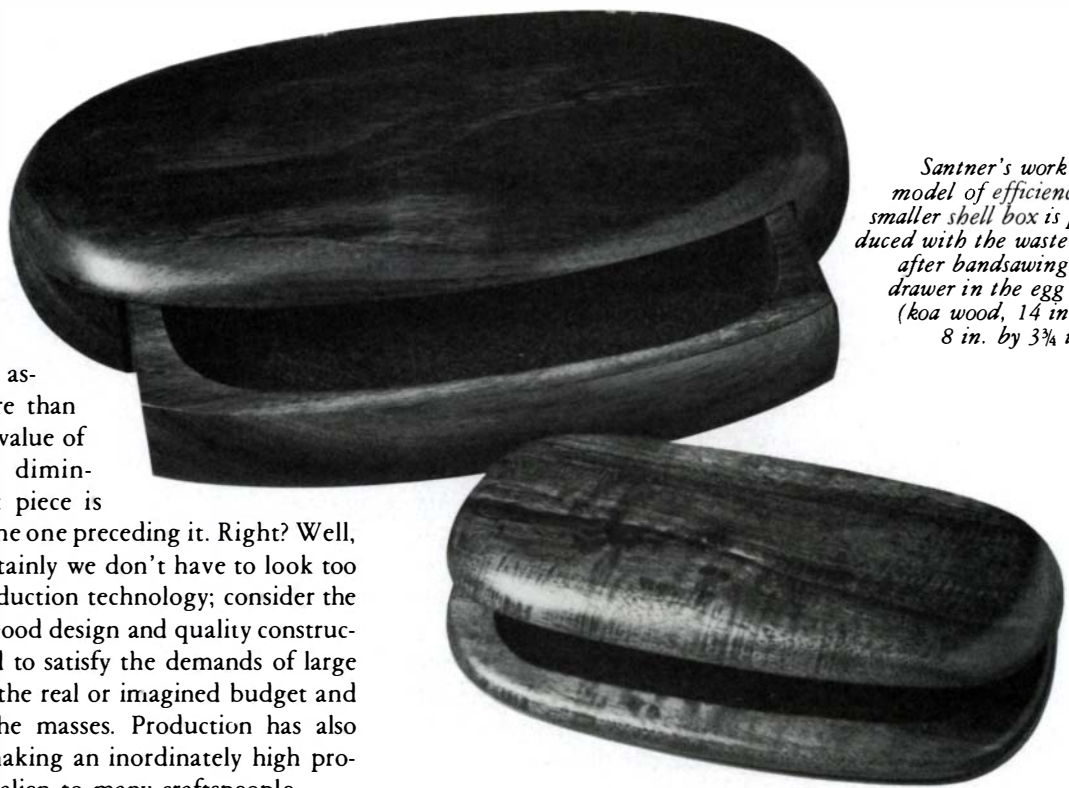
The efficient use of space, waste and technology

by Dean Santner

Production, production craft, limited production, craft multiples—let's face it, none of these terms has a very good connotation for those of us involved in craft work. The assumption is that when more than one of a piece is made, the value of the original automatically diminishes, and each subsequent piece is just as bad as or worse than the one preceding it. Right? Well, to be honest, probably. Certainly we don't have to look too far to find the abuses of production technology; consider the tools we often have to use. Good design and quality construction are frequently sacrificed to satisfy the demands of large production runs and to suit the real or imagined budget and the uneducated tastes of the masses. Production has also become synonymous with making an inordinately high profit, which is distasteful and alien to many craftspeople.

But does production have to mean poor design and shoddy construction? European countries have shown otherwise. Quality production can be seen in the sensitive designs and careful construction of wood furniture in many Scandinavian shops. The technically ingenious and innovative designs of the modern Italian furniture manufacturers make quality work possible, not in spite of production techniques, but because of the access to a technology not easily available to one-of-a-kind applications. The product and not the process can and should be the principal concern of any production process. Unfortunately in our quest for original, museum-quality craft pieces, we believe that producing in quantity detracts from quality and that the craftsworker is demeaned in the process. I don't feel this attitude is justified, unless, of course, we are actually producing poor work. I'm not saying quantity production can or should replace the one-of-a-kind approach to craft. It can't and it shouldn't try. There is a need for both one-of-a-kind and quantity craft production, yet the worth of the latter has been largely unrealized.

Except for a brief period when I made one-of-a-kind furniture pieces, for the last ten years my shop has addressed itself almost exclusively to the design, development and production of original craft multiples of functional wood accessories. It's my experience that because of a number of advantages associated with production, a small, efficiently operated shop with good equipment and sensitive people who are sympathetic to the same quality and design concepts can produce work of exceptional character, worthy of craft recognition. I believe that this can be done while imparting personal dignity and pride of workmanship to those involved. And although I haven't been able to prove this point yet, I believe it can be done with a reasonable profit for everyone involved.



Santner's work is a model of efficiency—smaller shell box is produced with the waste left after bandsawing the drawer in the egg box (koa wood, 14 in. by 8 in. by 3¼ in.).

Our shop produces a limited variety of designs for boxes (like the ones shown above), cutting boards, hand mirrors, wine racks and conceptual-style toys. All items are designed for production in quantities ranging from several pieces over a period of years to hundreds within the same year, depending variously on the degree of technical complexity, public demand and the maximum amounts we choose to make in a given period. Whether in large quantities or small, we are responsible for all we produce, from conception to packaging.

People—The people who work with me are the main element in the work we are able to accomplish. Currently we are a highly skilled group of five full-time co-workers and a part-time independent accountant, all functioning as a team during working hours. Each person in the group is sensitive to fine craft and to the other workers. Responsibility for the smooth operation of specific areas of the business is divided among us all. Each person takes on as many operations and duties as his or her training and skill will allow.

Since boredom is the biggest threat to quality in a quantity run, it is important that each of us has the skill to trade duties with someone else to sustain interest at each stage of each piece. Still, as in any quality work, personal discipline is necessary. New people must make a commitment to the group and to our procedures. If they focus only on the repetitive nature of what we are doing, they miss what the shop represents and therefore don't do their best work, aren't particularly interesting to work with and don't last very long. We select new employees by a group vote, following a group discussion.

Work schedules are organized so each person in the shop has as much personal time as possible, and at present most

everyone has important outside interests in one-of-a-kind woodworking, fine art or in starting another business. The stability of our shop helps to sustain these diverse activities. We work a four-day week for the first nine months of the year and five or more days during the last three months. After-hours use of shop facilities is encouraged for individual work and is considered part of the pay. Our pay scale is considered high for a craft shop; however, everyone agrees that it's more than money that keeps us working as hard as we do.

Facilities—Except for the initial kiln-drying of lumber and the occasional use of a wide belt sander, all the production details of each design are done under our complete control within our shop. The shop space is a 2,900-sq. ft. building, 23 ft. wide and divided into a 66-ft. long machine room, a 17-ft. assembly room, a 20-ft. finishing and shipping room and an office. Lumber is stored in cantilevered racks at the front of the machine room near an overhead door. The shop and equipment were purchased with our designs in mind, and although twice as much space wouldn't be too much, careful organization of space and procedures has created an efficient, comfortable and safe working environment. Most of the machines are set along the wall, which allows more space for traffic. Only the jointer, planer and table saw are placed out from the wall, and these are angled to maximize infeed and outfeed space. The machine room can easily handle four of us working at one time. Up to six different designs are under production at once, so if a bottleneck develops, it can be alleviated simply by working on a different design in another area of the shop. All changes in equipment or structural elements of the building are tested first using a scale model. Planning went into such things as the use of natural light (there are six skylights, and more to come), point-source lighting where inspection is required, wall and underground power to machines, compressed-air outlets and an atmosphere-recycling dust-collection system. The shop is thoroughly cleaned every day for fire safety as well as for comfort and appearance. Small tools are not misplaced in piles of sawdust, and we can all concentrate on the work at hand.

Thus, concerns for efficiency, comfort and safety often prove interrelated. A dust-collection system that is atmosphere-recycling, for instance, helps maintain consistent temperature and humidity, which are controlled not only for comfort, but also for optimum stock storage, gluing and finishing. So with many machine accessories. After a bad accident on the table saw, we bought an automatic suspension-style feeder that can also be used on the jointer and shaper. The advantages are higher yield from our stock, cleaner joints, and faster, easier, and safer operation. And because it sits right over the blade or cutter, there's less noise.

Access to technology—Combining recent technological developments, particularly in carbide cutters and in abrasives, with the more established woodworking techniques has enabled us to produce our designs more efficiently without compromising their quality. In some cases, new technologies have inspired new designs or design improvements.

While it might be obvious why one would be interested in new technology, it's not so obvious how to obtain it or to decide whether it's worth using. First, you must know what's available and the technical language to order it. Writing to the largest manufacturers in the fields you are interested in

and asking for information packets is a good way to start. But often you must then be able to place an order in sufficient quantities to make it worthwhile for the manufacturer. Here is an important advantage of being a shop committed to the long-term production of a limited number of designs.

For example, three years ago we became aware of a new abrasive product, zirconia alumina, that is extremely aggressive, sharpens itself, has long life, and resists heat deterioration and burnishing. On further study we learned of a few drawbacks: It is limited to only three flexibilities, is offered only in a very heavyweight backing, and is much more expensive than the more commonly used aluminum oxide, garnet and silicon carbide. Then we learned that because it's not a stock item you must meet the industrial basic unit quantities. Because we are a production shop and could foresee using some kind of abrasive in quantity, we were able to try this product. We ordered one unit of 20 belts for our stroke sander (100 grit, open coat, Q flex, Y-weight cloth). The cost was about 40% more than for aluminum oxide, but the zirconia has lasted more than three times as long. Now we use zirconia on all our abrasive machines, except for finish sanding, because it's not available in finer grits. (Norton Co., Troy, N.Y. 12181 manufactures zirconia-based products.)

Another recent discovery has replaced steel wool in our finishing room. We dunk most of our products in Danish oil and allow them to dry on wire racks (reclaiming the dripping finish in a pan at the bottom if it's suitable for re-use) in 65° to 70° temperatures for 12 to 16 hours. We then rub two coats of polymerized tung oil into the surface, allowing 4 hours drying time between coats. After another 4 to 16 hours the heavy oil finish dries, leaving the grain raised and the surface bubbled and rough. Instead of hand rubbing with steel wool, we use a series of nylon discs (called Bear-Tex and produced by Norton), which are impregnated with fine silicon-carbide or aluminum-oxide chips. Mounted on a 3,200-RPM shaft, they scrub off the excess oil but are not aggressive enough to sand the wood. Next we apply a coat of carnauba wax and

Santner's shop is not large, but it's carefully laid out. Most of the machines are along the walls. Only the planer, table saw and jointer are in the center, each angled to the others to maximize infeed and outfeed space. Four people can easily work at once in the 66-ft. by 23-ft. machine room.

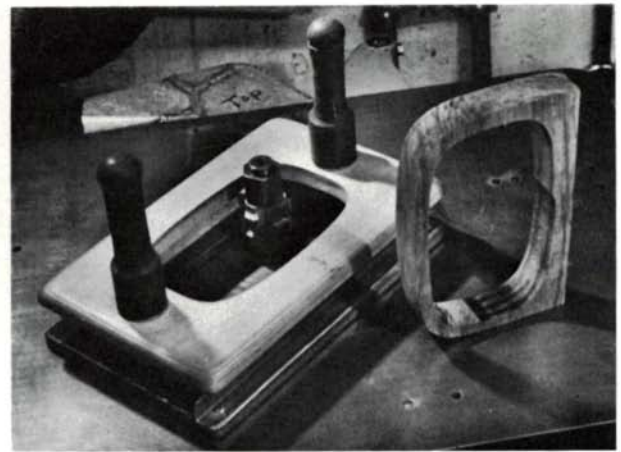




1. Because the designs are already known, it is most efficient to mill the stock to blanks as soon as the lumber shipment has been checked for moisture content and drying stresses. The blanks can then be stacked in space-saving, fire-safe piles and left to reach equilibrium moisture content with the shop atmosphere. Here a 3-roll, 8-speed automatic feeder by Forest City, which can also be used on the jointer and shaper, helps to rip egg-box blanks safely, quickly and cleanly. The saw is a dual-arbor 16-in. Yates American with 5 HP per arbor. There's a 32-tooth carbide, glue-joint-ripping blade on one arbor and a 60-tooth crosscut blade on the other.



2. A Plexiglas template (Plexiglas allows defects to be seen and avoided) is used to mark band-saw cuts on the 8/4 drawer blanks. The cuts produce what will be the center carcass lamination, the drawer (the saw kerf will be glued back together and clamped with motorcycle inner tubes) and a central waste piece, which is used to make another design, the shell box. Drawer and carcass member are numbered and later rejoined to maintain continuity of figure.



3. The insides of the drawers are shaped to identical size with a shaper jig before rabbeting the lower edge for press-fitted drawer bottom. Handles screw down to clamp drawer blank in place. Heavy $\frac{3}{8}$ -in. steel base (laminated with Masonite to slide easily on shaper table) dampens vibration as precision-ground cutout is guided around fixed shaper collar. An adjustable angle-iron indexer for positioning the drawer blank also acts as a scatter shield. The segmented carbide cutter is quieter than standard cutters.

allow it to harden for 12 to 36 hours. Then it is buffed at high speed with non-impregnated soft nylon (also made by Norton) leaving a lustrous but not glossy finish.

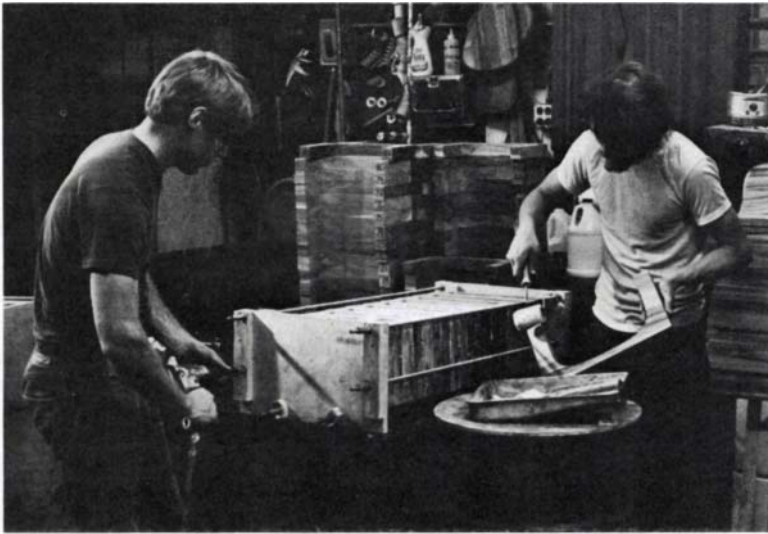
Over the years we have kept careful records of what new technology has worked for us or why it didn't and what might be changed to improve it. Abrasive manufacturers in particular are interested in this kind of feedback, and specialized sales representatives can be very helpful in suggesting and sometimes engineering products that suit your needs. The important thing is to do your homework first, acquire the basic knowledge of the product, and go back to the manufacturer with specific experiences and requirements.

Design and construction—Because our shop makes a commitment to each design, long-term refinement is possible. It is a continuous, slow, and carefully thought-out process, making the most of available resources in balance with the realities of being in business. Once again, superficially conflicting concerns, like quality and efficiency, turn out to be compatibly interrelated. For instance, we make our freeform

cutting boards in only six basic shapes that over the years have proven the most practical and the most aesthetically pleasing. These shapes have also been developed to make maximum use of stock: The free-form templates are paired to fill various standard rectangular blanks.

Commitment to a limited number of designs also makes possible the long-term refinement of construction techniques. Quality equipment, custom bits and special one-piece cutters (which are safer and faster to set up) can be purchased and amortized over an extended period of anticipated return. Specialized jigs, fixtures, clamps and tools can be devised not only to expedite the construction process, but also to improve working tolerances and quality and to increase safety. Waste and cutoffs can be used to maximum advantage by designing new items out of predictable leftovers.

The egg box, whose production is illustrated above, is one of our first production designs, and it still has strong appeal after 10 years. I was impressed with the simple beauty of Art Carpenter's bandsawn boxes and the shapes Wendell Castle gets out of laminated wood. Starting with a few prototypes,



4. Parts are selected according to figure, and 4/4 top and bottom are glued to 8/4 carcass center. Using aliphatic resin glue for joint elasticity, the gluing surfaces are sized (precoated for maximum fiber penetration) and stacked in specially made egg-box clamp. Pressure applied evenly through threaded rods achieves optimum 0.002-in. glue line.



5. Because there are fewer and easier machine setups, the rest of the production run is divided into smaller groups so more attention can be given each box. Drawers are fitted to their carcasses and, after bandsawing the outline and rounding it over on the shaper, the top and bottom surfaces are crowned on the stroke sander. A padded, graphite-covered hand platen is used first, then a graphite-coated glove.



6. At the pneumatic sander, far left, the surface is smoothed, first with 50-grit at 12 lb. to 15 lb. of pressure, then with 120-grit at 6 lb. to 8 lb., and then with 240-grit at 4 lb. to 6 lb. The shape of the box, carefully chosen abrasive products and their backing, and the use of a tire pressure gauge make possible the radical increments in grit. Adjustable dust-collection intake and point-source lighting add to the comfort and accuracy of this operation. Left, sharp edges are sanded by hand before final sanding (to 500-grit) on Vonnegut flap sander.

the initial run was seven boxes of black willow. Since then the egg box has been made in eastern walnut, claro walnut, cherry, Tennessee cedar, butternut, African naga, California oak, elm, shedua and most recently Hawaiian koa. The design has undergone refinements that typify the interrelationship of design and construction improvements. The first drawers, for instance, were hogged out of solid wood. Not only was this time-consuming and wasteful, but the resulting drawer tended to warp and stick closed. We tried bandsawing out the whole center of the drawer and inserting a plywood bottom, which was faster, but the hardwood drawer sides would contract around the unyielding plywood bottom, cup and still stick closed. Shaving down the back of the drawer to clear the inside of the carcass only made the drawer too loose, on being pulled out, to remain in its track. The solution we have developed is to use 3/4-in. thick sugar pine for the bottom. It is press-fitted and glued into a rabbet in the bottom of the hardwood drawer sides, and because it is solid wood and more yielding than the hardwood, it expands and contracts compatibly with the sides.

The waste from the insides of the drawers accumulated until

we could hardly move through parts of the shop. Finally we conceived of the shell box (photo, p. 80), made by resawing this waste, hollowing out the halves and hinging them back together. The corners of the rectangular blank from which the egg box is bandsawn were more pieces of waste until we designed a segmented toy snake, and now we use those too.

I can't honestly say that I'm proud of every single box we've made over the last ten years. But, having put the necessary time and effort into the egg box, we have been able to refine the design and technique to where only a small percentage is unusable. The screening for quality begins with the rough wood. For a variety of reasons, units or parts of units will fall out of production along the way. The final product is also inspected, and only about 50% of the finished output can be considered gallery quality. Those of unusual quality we prefer to sell directly and that way are assured that the customers know and appreciate what they are buying. □

Dean Santner Woodworking is located in Emeryville, Calif. Santner is available as a design and production consultant.

SOURCES OF SUPPLY

Combination machines, domestic and imported

Although most woodworkers set up shop with a painstakingly accumulated collection of new and used machinery, a carefully chosen combination machine might be a better way to go. Price and quality aside, space constraints alone can necessitate having one machine that performs the functions of several. When newfangled electricity came to the cabinet shop early in this century, the result was a profusion of cutters and blades run by a series of jackshafts growing out from a single, enormous motor. The American woodworking industry soon found single-function machines, each with its own motor, to be more efficient and flexible. As a result, the combination machine became almost exclusively a hobbyist's machine. The one design that succeeded, now made by Shopsmith and Super Shop, is basically a lathe whose headstock incorporates a variable-speed mechanism and a quill feed. A table attached on top converts the lathe into a table saw, disc sander or horizontal borer. With the lathe ways swung up vertical, it's a drill press. Accessories can be mounted, taking power from the headstock, to add a band saw, jigsaw, jointer and (in the case of the Super Shop) a milling machine.

The situation is different in Europe. Limited space in crowded cities and old buildings has forced cabinetmakers there to stay with the combination idea, and the machinery industry has continued to refine it. Several European firms make lightweight combination machines for the hobby market. Austria's Emco-lux, for example, makes a machine which in its upright position is a band saw and in horizontal position is a table saw. The most common design, however, uses a stationary motor mounted under the main table to power a circular saw (whose arbor usually does not tilt), a jointer and a

thickness planer. In some versions a spindle emerges from the side with a compound-action table for horizontal boring and slot mortising. In others the motor belts to a vertical shaft for spindle shaping. Machines of this design range from the 110-lb. Lurem Compact to the 2,910-lb. Steton #1, available with 20-in. wide, cast-iron planer/jointer beds. None of these machines has infinite variable speeds; multiple speeds are provided by step pulleys. They do have in common with the Shopsmith and Super Shop the advantage that the main table and some of its fences and jiggling facilities can be used in the operation of more than one mode.

The notes, specifications and prices on the following pages have been compiled from the manufacturer's literature and include only machines made or distributed in America. Specifications for the combination planer/jointers made by Inca, Makita and Parks, as well as for the Belsaw planer/rip-saw/molder, can be found in our report on thickness planers, *FWW* #17, July '79. We expect to compare radial arm saws, which some woodworkers use for operations in addition to sawing, in a future issue.

Our next machinery survey will be about medium-sized table saws, with blades from 10 in. to 16 in. As always, we need advice from readers. What table saw do you have, how long have you had it, what kind of work do you mostly do with it? Is the saw big enough, heavy enough, powerful enough, rigid enough? Did it perform satisfactorily at first, or have you had to modify it? Are the rip fence and crosscut guides easy to set, are they tight and accurate? How about guards—do they protect your hands, or were they so awkward that you took them off? Did you get what you paid for?

Lurem 210

France

42 in. by 36 in. by 34 in. on steel-rolling stand. 1½-HP single-phase or 2 HP 3-phase motor; 3 speeds. Five modes, plus tenoning carriage; 600 lb.; \$3500. (\$5.83/lb.).

Thickness planer: Max. width, 8 in.; max. thickness, 6½ in. Two knives, 6,000 RPM. Auto-feed, 22 FPM. Cast iron table, 17½ in. by 8¼ in.

Jointer: Max. width, 8 in. Cast iron table, 47½ in. long.

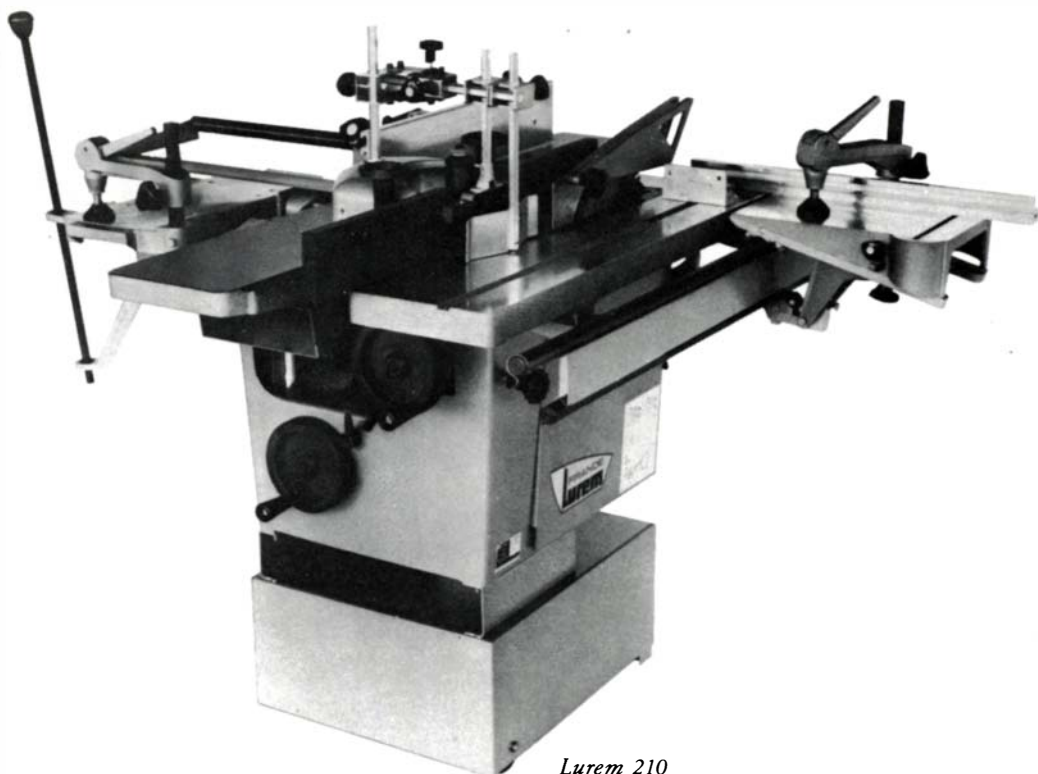
Table saw: 10-in. blade, 4,300 RPM. Aluminum table, 13 in. by 34 in.

Horizontal borer/mortiser: ½-in. chuck, 3,000/6,000 RPM. Single-lever-adjust table feed and cross travel.

Spindle shaper: 1-in., ¾-in. or ½-in. spindle can be oriented vertically, horizontally or tilted; 3,000/6,000 RPM.

Also available: Lurem 260, which is the same as the 210, except it has a 10-in. planer/jointer, a cast iron saw table and a larger and/or second motor available. It weighs 800 lb. and costs \$4,700.

Distributors: Same as for Compact, p. 86.



Lurem 210

Pinheiro UIR 350

Portugal

76 in. by 72 in. by 56 in.; cast-iron tables, enclosed steel base. Two motors, each 3 HP or 4 HP. Five modes, plus tenoning carriage; 1,763 lb.; \$4,750. (\$2.69/lb.).

Thickness planer: Max. width, 14 in.; max. thickness, 6 in. Three knives, 5,000 RPM. Auto-feed, 33 FPM.

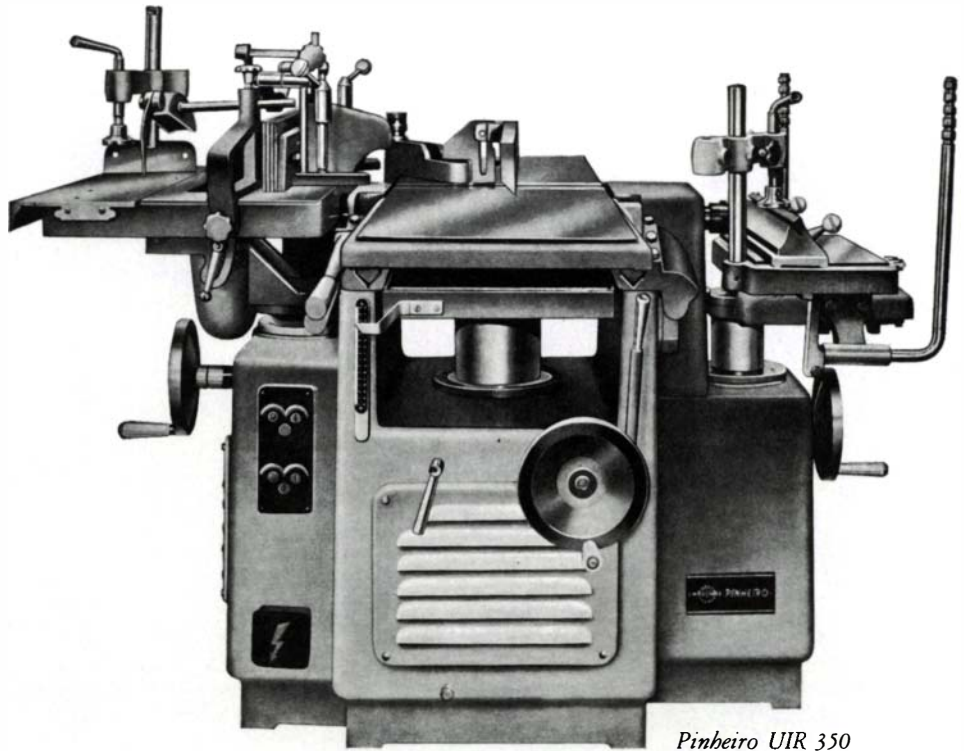
Jointer: Max. width, 14 in.; table, 72 in. long, lever adjust.

Table saw: 12-in. blade, 5,000 RPM. Runs off planer/jointer motor. Table, 33 $\frac{3}{8}$ in. by 19 $\frac{1}{4}$ in., tilts to 30° and is raised and lowered by handwheel for depth of cut. Crosscut carriage with hold-down.

Horizontal borer/mortiser: $\frac{3}{4}$ -in. chuck, 5,000 RPM. Table, 18 $\frac{3}{8}$ in. by 8 $\frac{7}{8}$ in., with hold-down. Handwheel-adjusted height, lever-operated travel. Knife-grinding fixture, standard.

Spindle-shaper: 1 $\frac{3}{16}$ -in. spindle, 6,000 RPM. Uses table-saw table, fences and tenoning carriage.

Distributor: Henry Weigand Corp., Box 831, Claremont, N.H. 03743.



Pinheiro UIR 350

Steton #1

Italy

84 $\frac{3}{4}$ in. by 82 in. by 40 in.; cast-iron tables and enclosed steel stand. Two motors, 3 $\frac{1}{2}$ HP and 3 $\frac{1}{2}$ 1/4 HP. Five modes, with tenoning carriage; 2,535 lb.; \$5,500. (\$2.17/lb.).

Thickness planer: Max. width 16 in.; max. thickness, 8 in. Three knives, 3,100 RPM. Auto-feed 20/40 FPM.

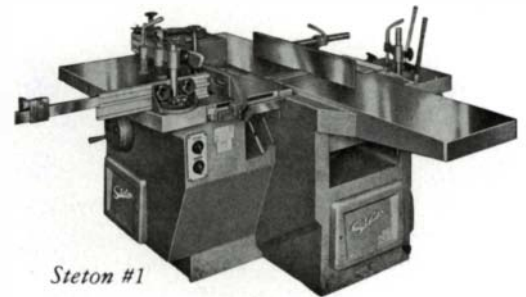
Jointer: Max. width 16 in. Table, 84 $\frac{3}{4}$ in. long.

Table saw: 12-in. blade, 3,100 RPM. Arbor is raised and lowered for depth of cut, but does not tilt (nor does table).

Horizontal borer/mortiser: $\frac{3}{4}$ -in. chuck, 3,100 RPM. Table, 20 in. by 10 $\frac{1}{2}$ in. Knife-grinding fixture, standard.

Spindle shaper 1 $\frac{3}{8}$ -in. diameter, 1,400/2,800 RPM.

Also available: Model with 20-in. planer/jointer (2,910 lb., \$5,800).



Steton #1

Steton #5

Italy

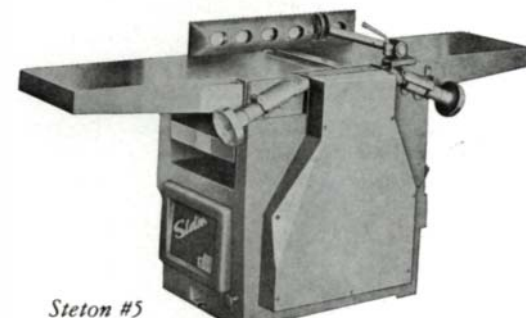
64 $\frac{1}{4}$ in. by 34 in. by 37 $\frac{1}{8}$ in.; cast iron tables and enclosed steel base. 2-HP motor, 5,000 RPM. Three modes; 1,014 lb.; \$3,500. (\$3.45/lb.).

Thickness planer: Max. width, 10 in.; max. thickness, 8 in. Three knives. Auto-feed, 23 FPM.

Jointer: Max. width, 10 in. Table, 62 in. long.

Horizontal borer/mortiser: $\frac{1}{2}$ -in. chuck. Table, 15 $\frac{1}{4}$ in. by 7 $\frac{1}{2}$ in. Knife-grinding fixture, standard.

Also available: 12-in. planer/jointer (1,080 lb., \$3,800), larger sizes up to 20 in.



Steton #5

Steton #8

Italy

60 $\frac{1}{4}$ in. by 30 $\frac{3}{4}$ in. by 39 $\frac{3}{8}$ in.; cast-iron tables and enclosed steel base. Two motors, 4 HP and 4 $\frac{1}{2}$ HP (two speeds). Two modes, with tenoning carriage; 1,642 lb.; \$2,350. (\$1.43/lb.).

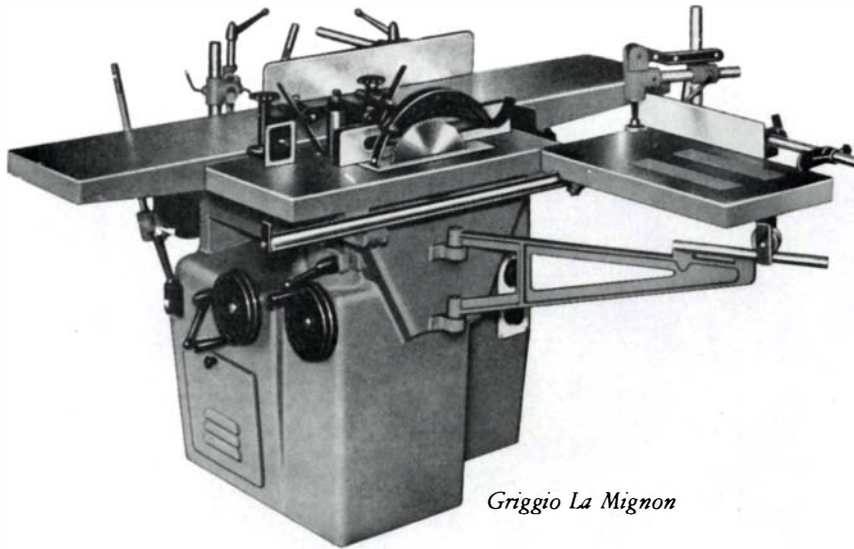
Table saw: 16-in. blade. Arbor is raised and lowered for depth of cut but does not tilt (nor does table). Table, 48 in. by 21 $\frac{1}{4}$ in. Sliding crosscut table, 55 $\frac{1}{2}$ in. by 22 in.

Spindle shaper: 1 $\frac{1}{2}$ in. spindle, 3,200/6,400 RPM.

Distributor: (for all Steton models) Henry Weigand Corp., Box 831, Claremont, N.H. 03743.



Steton #8



Griggio La Mignon

Griggio G&C La Mignon *Italy*

Cast-iron tables, enclosed steel base. Two motors, each 2½ HP. Five modes, with tenoning carriage; 1,403 lb.; \$5,000. (\$3.56/lb.).

Thickness planer: Max. width, 12 in.; max. thickness, 8 in.; Three knives, 4,500 RPM. Automatic feed, 23 FPM.

Jointer: Max. width, 12 in.; table, 64½ in. long.

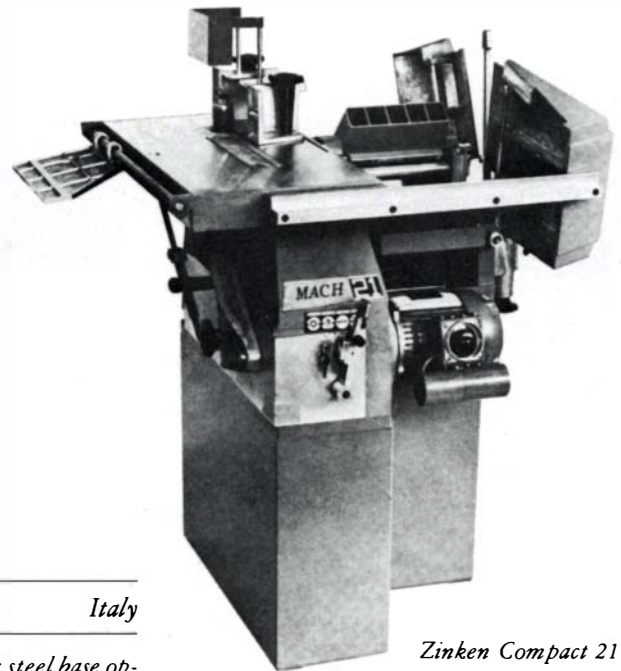
Table saw: 10-in. blade, 3,800 RPM. Arbor is raised and lowered for depth of cut, but does not tilt (nor does table). Table, 26 in. by 12 in. Crosscut table with hold-down.

Horizontal borer/mortiser: ¾-in. chuck, 3,800 RPM. Table, 16 in. by 8 in., with hold-down.

Spindle shaper: 1½-in. spindle, 4,800 RPM (3,500/7,000 RPM available). Uses table-saw table, fences and tenoning carriage.

Also available: Models with 10-in. planer/jointer (\$3,350) and with 14-in. planer/jointer (\$6,000).

Distributor: Henry Weigand Corp., Box 831, Claremont, N.H. 03743.



Zinken Compact 21

Zinken Compact 21 *Italy*

35½ in. by 31½ in. by 19¼ in.; steel base optional. Cast-aluminum body, cast-iron tables, covered with stainless steel. 1½-HP single or three-phase motor, three speeds through belted pulleys; lever changeover. Five modes, plus tenoning carriage; 220 lb.; \$1,750. (\$7.95/lb.).

Thickness planer: Max. width, 8¼ in.; max. thickness, 4½ in. Three knives, 4,600 RPM. Auto-feed, 23 FPM.

Jointer: Max. width, 8½ in. Table, 27½ in. long.

Table saw: 8-in. blade, 3,500 RPM. Table, 27½ in. by 17¼ in., tilts 45°. Crosscut table with cam-action hold-down.

Horizontal borer/mortiser: ⅝-in. chuck, 4,600 5PM. Table with cam-action hold-down moves 4 in. (depth) by 5 in. (cross feed).

Spindle shaper: 1-in. spindle, 8,000 RPM.

Accessories: Sliding crosscut table, 19½ in. by 9½ in., for use also with shaper (\$230).

Distributor: Henry Weigand Corp., Box 831, Claremont, N.H. 03743.

Lurem Compact *France*

40 in. by 30 in. by 20 in. (plus wood stand). 1¼-HP motor, 3 speeds through belted pulleys. Five modes, plus tenoning carriage; 110 lb.; \$2,800. (\$25.45/lb.).

Thickness planer: Max. width, 6 in.; max. thickness, 3½ in. Two knives, 7,000 RPM. Auto-feed, 18 FPM.

Jointer: Max. width, 6 in. Cast-iron tables, 33½ in. long.

Table saw: 8-in. blade, 5,700 RPM. Aluminum table, 18½ in. by 18½ in. Lever-adjust blade height. Tilting arbor on lever-locked trunnion. Sliding crosscut carriage with work hold-down.

Horizontal borer/mortiser: ½-in. chuck, 3,500/7,000 RPM. Handwheel-adjust table height; single-lever-adjust table feed and cross-travel; cam-action hold-down.

Spindle shaper: 1-in. ¾-in. or ⅝-in. spindle can be oriented vertically, horizontally, or tilted; 5,700 RPM.

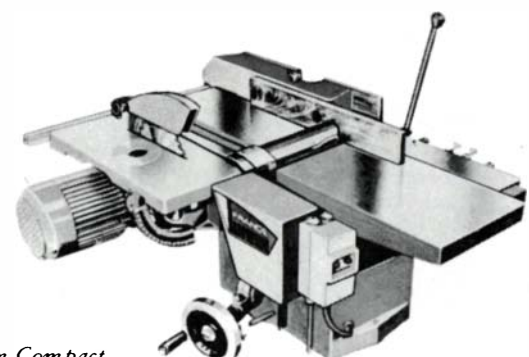
Accessories: Sanding disc, sanding drum, knife grinder, table-saw extension bars.

Distributors: E.W. Gunderson, 726 S. Keeneway Dr., Medford, Ore. 97501; Henry Weigand, Corp., Box 831, Claremont, N.H. 03743; International Woodworking Equipment Corp., 11665 Coley River Circle, Fountain Valley, Calif. 92708.

Machine modes

■ Standard
□ Accessory

	Thickness planer	Jointer	Table saw	Horizontal borer	Slot mortiser	Spindle shaper	Lathe	Drill press	Disc sander	Band saw	Jigsaw	Overarm router	Belt sander	Milling machine
Emcostar	□	□	■	□	□	□	□	■	■	■	■	■	■	■
Emcostar Super	□	□	■	□	□	□	□	■	■	■	■	■	■	■
Griggio	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Lurem Compact	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Lurem 210	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Pinheiro UIR 350	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Shopsmith	□	□	■	■	■	■	■	■	■	■	■	■	■	■
Steton #1	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Steton #5	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Steton #8	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Super Shop	□	□	■	■	■	■	■	■	■	■	■	■	■	■
Zinken Compact	■	■	■	■	■	■	■	■	■	■	■	■	■	■



Lurem Compact

Emcostar

Austria

28 in. by 23 in. by 26 in. (31 in. high in band-saw mode). Aluminum tables, plastic housings. $\frac{1}{2}$ 1/4-HP motor, 1,500/3,000 RPM. Five modes; 97 lb.; \$995. (\$10.26/lb.).

Table saw: 8-in. blade. The table, 14 $\frac{1}{8}$ in. by 12 in., is raised and lowered to adjust depth of cut and tilts on trunnions.

Band saw: 5 $\frac{1}{8}$ -in. throat; 4 $\frac{3}{4}$ in. depth of cut; max. $\frac{3}{8}$ -in. blade. Table, 10 in. by 8 in.

Jigsaw/fretsaw: $\frac{1}{2}$ -in. stroke; uses table-saw table.

Disc sander: 6 $\frac{1}{8}$ -in. dia. Table, 7 in. by 9 in.

Belt sander: 31 $\frac{1}{8}$ in. long by 1 $\frac{1}{2}$ in. wide; 21/42 FPM.

Accessories: Jointer/planer: max. width 8 in.; max. thickness, 2 $\frac{1}{4}$ in.; table, 26 $\frac{3}{4}$ in. long; auto-feed, 12 FPM (\$895). Lathe, 19 $\frac{1}{4}$ in. between centers; 9-in. swing (\$130). Mortiser, $\frac{1}{2}$ -in. chuck; table, 6 in. by 16 in., 4-in. travel (\$230).

Also available: Emcostar Super, fewer modes, but larger: $\frac{3}{4}$ 1 $\frac{1}{10}$ HP motor; 10-in. table-saw blade with 21 $\frac{3}{8}$ -in. by 15 $\frac{3}{4}$ -in. table, and 8 $\frac{1}{8}$ -in. band saw with 13 $\frac{1}{8}$ in. by 10 $\frac{1}{8}$ -in. table (136 lb.; \$1,395).

Distributor: Emco-lux, 2050 Fairwood Ave., Columbus, Ohio 43207.

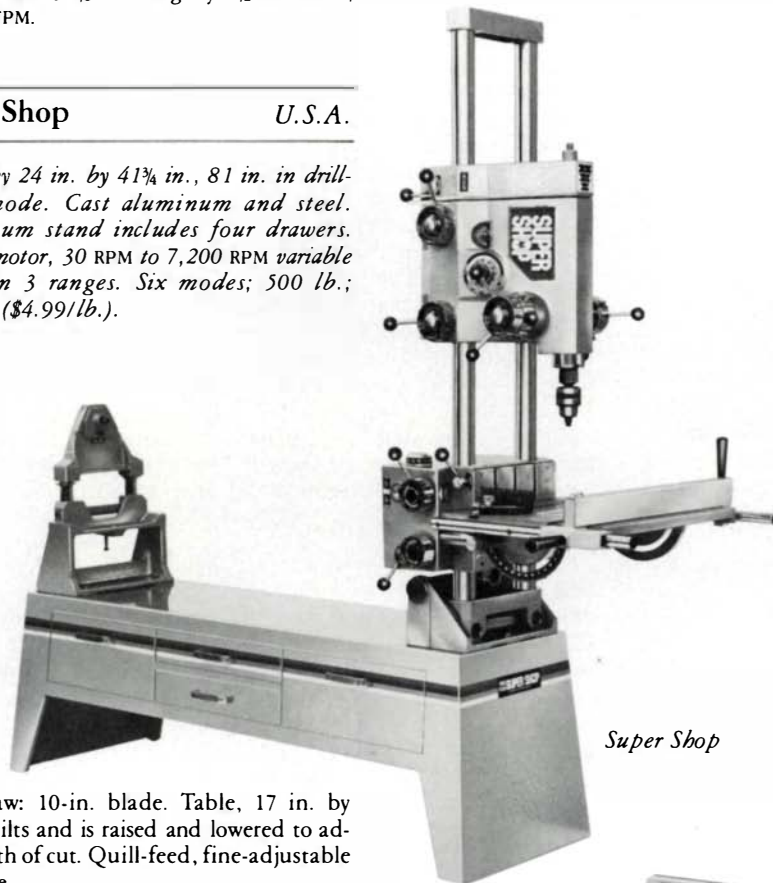


Emcostar

Super Shop

U.S.A.

69 in. by 24 in. by 41 $\frac{1}{4}$ in., 81 in. in drill-press mode. Cast aluminum and steel. Aluminum stand includes four drawers. 1 $\frac{1}{2}$ -HP motor, 30 RPM to 7,200 RPM variable speed in 3 ranges. Six modes; 500 lb.; \$2,495. (\$4.99/lb.).



Super Shop

Table saw: 10-in. blade. Table, 17 in. by 21 in., tilts and is raised and lowered to adjust depth of cut. Quill-feed, fine-adjustable sawblade.

Lathe: 34 in. between centers; 17-in. swing over tubular-steel ways.

Drill press: $\frac{3}{8}$ -in. chuck; 17 in. from spindle to column; max. 31 in. from table to spindle; 5-in. quill travel, $\frac{3}{8}$ -in. chuck. Uses tilting saw table with rip fence and miter gauge for jiggling.

Horizontal borer: Same as drill press, except stock may be of unlimited length.

Disc sander: 12-in. diameter. Quill feed.

Overarm shaper/router: R-8 taper chuck handles $\frac{1}{16}$ -in. to $\frac{3}{4}$ -in. bits.

Accessories: Metal lathe equipment (6-in., 4-jaw chuck; 6-in., 3-jaw chuck; power feed; compound tool rest) \$319.

Soon to be available: Vertical milling equipment, 6-in. jointer, molding machine, 12-in. planer, 15-in. band saw.

Distributor: Fox Industries, Inc., 11000 Hampshire Ave., S. Bloomington, Minn. 55438.

Shopsmith

Shopsmith

U.S.A.

71 in. by 19 in. by 41 $\frac{1}{2}$ in., 76 $\frac{1}{4}$ in. high as drill press; on steel stand with casters. 2 HP motor, 700 RPM to 5,200 RPM variable speed through Reeves drive system (photo, p. 80). Five modes; 195 lb.; \$995. (\$5.10/lb.).

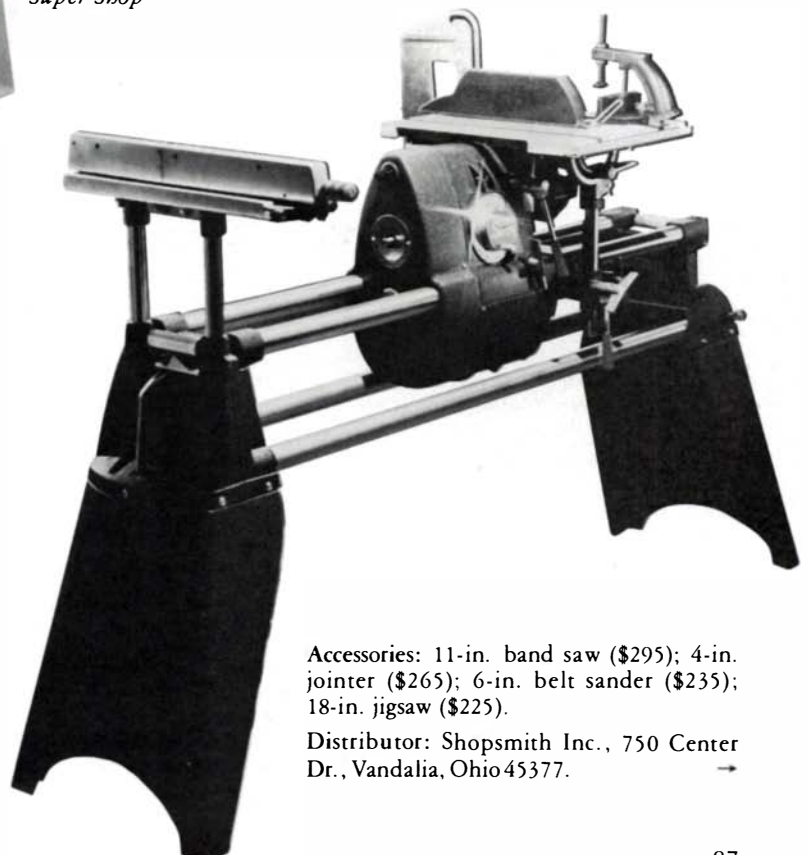
Table saw: 10-in. blade. Table, 18 $\frac{3}{8}$ in. by 14 in., tilts and is raised and lowered on rack and pinion to adjust depth of cut. Quill-feed, fine-adjustable sawblade.

Lathe: 34 in. between centers; 16 $\frac{1}{2}$ -in. swing over tubular-steel ways. Tool rest has rack-and-pinion height adjustment.

Drill press: $\frac{1}{2}$ -in. chuck; 16 $\frac{1}{2}$ in. from spindle to column; max. 26 in. from table to spindle; 4 $\frac{1}{4}$ -in. quill travel. Uses tilting saw table with rip fence and miter gauge for jiggling.

Horizontal borer: Same as drill press, except stock may be of unlimited length.

Disc sander: 12-in. diameter. Quill feed.



Accessories: 11-in. band saw (\$295); 4-in. jointer (\$265); 6-in. belt sander (\$235); 18-in. jigsaw (\$225).

Distributor: Shopsmith Inc., 750 Center Dr., Vandalia, Ohio 45377.

READERS' COMMENTS ON THE SHOPSMITH

EDITOR'S NOTE: Last March we invited *Fine Woodworking* readers to comment on combination machines they have used, and we had hoped to pass along reader evaluations of the machines listed on the previous pages. We got a lot of letters, but they were all about the Shopsmith, which has been made and sold in this country for more than 30 years. We'd welcome advice and comments, positive and negative, from woodworkers who own or have used other combination machines, for publication in a future issue.

Most of the Shopsmith owners are happy (one called it "the engineering marvel of the century"). Their most common complaint was that the saw table is too high and too small. Changing modes seems no problem for most owners, or at least they tolerate the nuisance in exchange for the space-saving advantages. Some craftsmen bought their Shopsmith for hobby use and continued to rely on it when the hobby became a full-time business. But most have found it inadequate for professional work—too small, too light and underpowered. Excerpts from the reader mail follow.

* * *

The basic Shopsmith, purchased in 1948, has been the mainstay of my hobby for 32 years. I've added the jointer and the band saw and they have proved sturdy, accurate and easy to adjust. If I had more shop space, separate tools would have been more convenient, but compactness and convertability have been a necessity. I have increased the large capacity of the lathe by turning hardwood billets and fitting them into the tubular ways. I can turn 36-in. bed posts, the machine being adequately rigid and stable. The Shopsmith does not lend itself to being fit with a dust collection system. If anyone has licked this problem, I would love to learn the secret.

—David E. Price, Baltimore, Md.

Variable speed and quill feed, plus ability to use the rip fence and miter gauge in every mode, offer endless possibilities.

—Billy Hill, Orange Park, Fla.

It makes the finest disc sander possible, a very handy and versatile drill press, an excellent horizontal boring machine, a rather shaky lathe and an undersized and underpowered table saw.

—Evan Burkhardt, Bethlehem, Pa.

Being able to "borrow" the machine settings from one mode to the next is good. For example, you can replace the table-saw blade with a chuck and drill at the right angle to the cut just made—helpful in doweling miter joints. But changing modes is a nuisance. The change can be completed as fast as the manufacturer states but the machine settings cannot. Many settings must be duplicated with fences, arbors and tables.

—Robert L. Koch, Tarkio, Mo.

At the time I purchased the Shopsmith three years ago, there was a significant savings compared to buying individual tools. However, I do not see that advantage in making the comparison today. The primary advantage to me as a hobbyist is the minimal space required by the multipurpose tool. In terms of innovative design features, manufacturing quality and service, I doubt Shopsmith can be beaten. The two drawbacks I have found are lack of power for some operations and table rigidity. It is not a machine for heavy-duty work. . . . Though the changeovers are extremely quick and easy, there are many times when a quick operation must be done in the middle of an elaborate setup.

—J. Robert Icard, Winston-Salem, N.C.

The saw table is too small. The rip fence and miter gauge are not accurate, and with age they tend to creep off settings. The saw guard is pretty good and could be left on all the time as blades can be changed with it in place. But you can't see your cut when it's in place. No major complaints on the other modes. It is not a production machine; it is a hobbyist's tool and nothing more. On the whole I still think it's great.

—Robert J. Hehre, Wellesley, Mass.

A serious criticism is that the advertising is aimed at the beginner when it is certainly not a tool for the naive. For instance, the table-saw setup requires five separate locking operations: arbor setscrew, quill advance, headstock clamp, table lateral adjustment and vertical adjustment. Thus unusual attention to setup detail is necessary for safe operation. I will never feel safe with one setscrew holding a saw-blade in place.

Also the quality is expensive. For the price of a new Shopsmith I have managed to purchase used, over the last 2½ years, a 10-in. table saw, a 6-in. jointer, a 36-in. lathe, a heavy-duty shaper (all Delta/Rockwell) and a lever-crossfeed horizontal end mill. I've kept my Shopsmith, though, because it is easily moved about the shop and even fits into the back of my Volvo station wagon, making it convenient to use on the job site.

—W. Hugh Vance, Galveston, Tex.

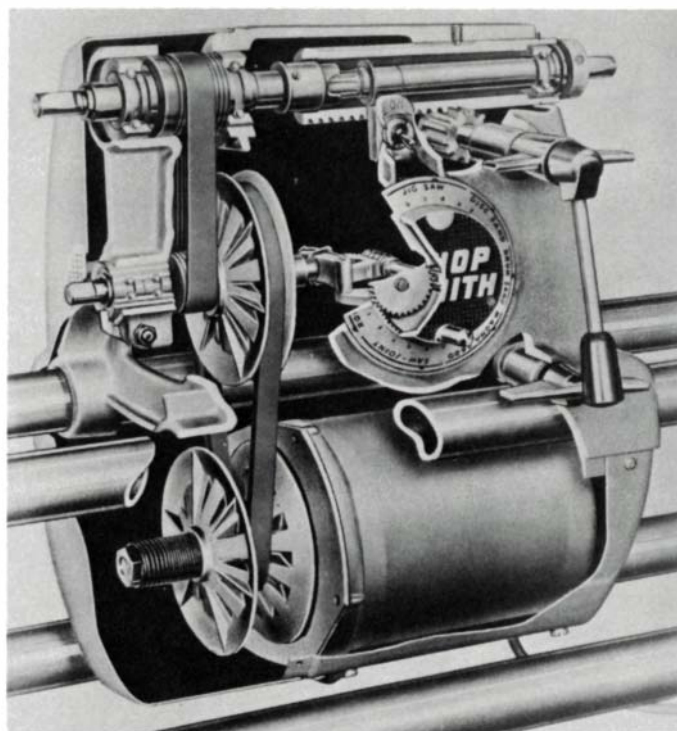
Within reason, I have found no inadequacies. Some advertising exaggeration, sure. Deception, no. For example, I would not attempt to saw a 4x8 plywood panel as they frequently illustrate. I tried and thought it dangerous. . . . In tight quarters, a multipurpose machine is the only answer to retaining flexibility. If I had more room, instead of buying separate machines I would probably use my accessories (I have a full set) on separate stands with separate drives.

Spending several hours on careful adjustments pays off handsomely. The alloy nuts and bolts hold firmly and rarely need readjustment. Limitations are few. When using universal arbors, the blade locknut interferes with the trunnion support bar for a 45° cut; thus limiting one to Shopsmith blades, or limiting the depth of cut. Likewise, inability to tilt the saw table to the left is somewhat annoying. Incidentally the small table is not a limitation for me since I've learned to reverse the miter gauge in cutting wide boards and use the runner on large panels. All in all, my Shopsmith has performed dependably for 27 years.

—J.W. Pochomis, Harbeson, Del.

. . . with equal to or better accuracy than separate machines. I still find new and more efficient uses for the machine. To sum it up as objectively as I can—the Shopsmith is monumental testimony to the ingenuity of humans. Someone should include one in a time capsule somewhere.

—Fred J. Dye, Lafayette, Colo.



Shopsmith's variable-speed mechanism: dial effectively increases or decreases pulley diameter.

The Dial Indicator

by R. Bruce Hoadley

An indispensable tool in our shop is a dial indicator with a magnetic base. Although this tool is usually associated with metalworking, we routinely use it for a host of jobs, from aligning equipment and setting up cutterheads to precise measuring of wood samples and deflection in joints.

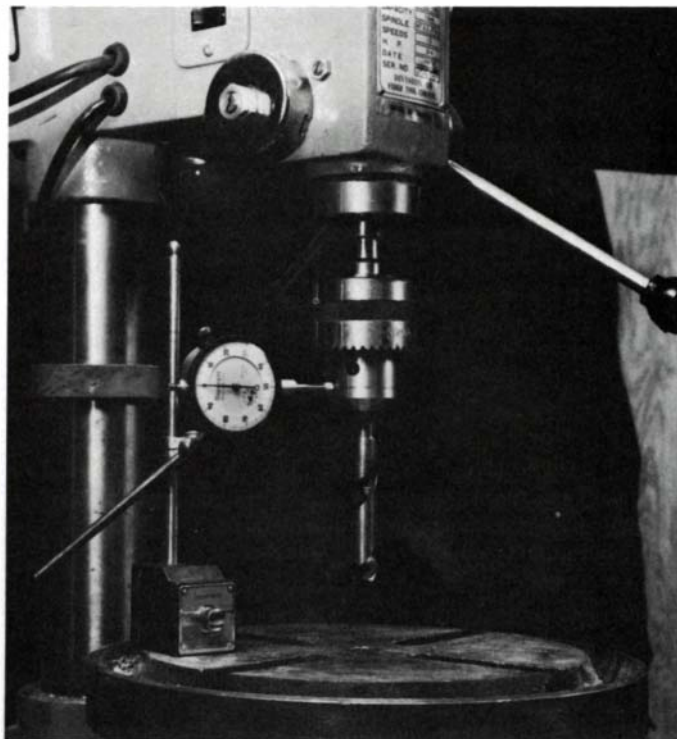
The dial indicator works by coupling a plunger-type spindle through internal gearing to a sweep hand. When the instrument is held firmly in position, any slight in-and-out movement of the spindle results in greatly magnified movement of the hand around the dial. The spindle is lightly spring-loaded so its tip will follow variations in the surface it contacts, and it can be fitted with a variety of contact points for special situations. Our instrument has a full inch of spindle travel, and its dial is graduated in units of 0.001 in. Indicators are made with greater accuracy, but the trade-off is a smaller measuring range.

The indicator comes with a universal-jointed arm that holds it in virtually any position relative to its magnetic base, which can be demagnetized by the push of a button. When the button is "off," the base retains only a whisper of magnetism, just enough so it will rest snugly against a steel surface. Once in position, the magnet is turned "on," whereupon it locks with about 50 lb. of force.

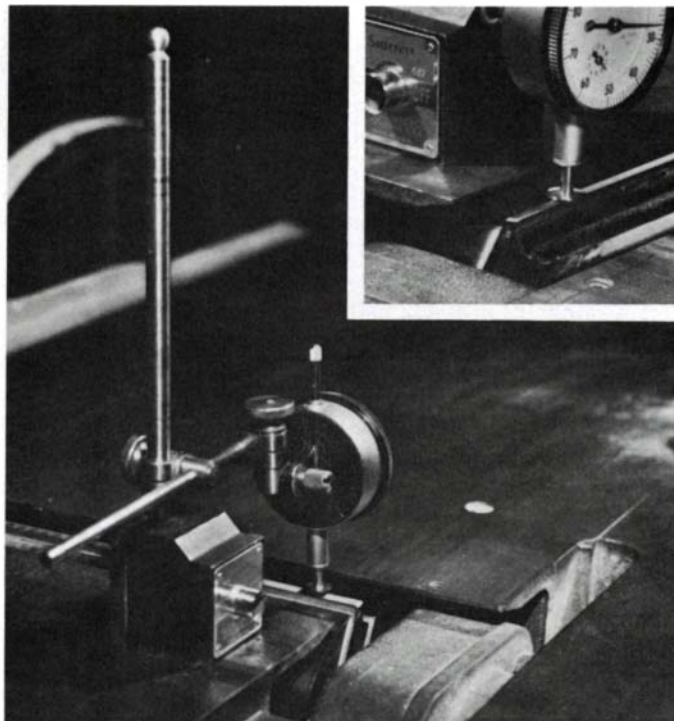
When the base is locked to a drill-press table and the indicator positioned perpendicular to the quill, the trueness of quill rotation can be measured. Similarly, measuring against the shank of a drill will reveal whether the chuck is centered. Out-of-round, out-of-center and bent shafts and mandrels of all kinds can be checked this way. By setting the base on the outfeed table of a jointer, the height of each knife can be gauged, and measuring across to the infeed table will tell whether the two tables are parallel. A hand-plane iron could be set in the same way. The indicator is invaluable in setting the bedrolls, outfeed roll and pressure bar of a thickness planer. On a table saw, the indicator will measure tooth height as well as set. Of course, the machinery must be electrically disconnected and revolved by hand. Never attempt to gauge cutting edges at operating speeds.

By setting up on a flat surface such as a saw or jointer table, the indicator becomes a comparator-type of measuring device. It will check the diameters and roundness of dowel pins, or the thickness of veneers. The magnetic base also has angled surfaces which will lock against a cylindrical shaft, and because of its weight the base will set firmly against a flat wooden surface as well. By laying an accurate metal bar across a large flat surface, the surface can be "scanned" to gauge overall flatness and locate irregularities. The base holder by itself also has many uses around the shop. Locked to the saw table, it makes a convenient end-stop for crosscutting multiple pieces. I often use it to position an air hose or to hold excess electric cord out of the way.

Dial indicators are quite similar among reliable brands, although a variety of backs are available for mounting to different holding devices. A good indicator costs between \$40 and \$80, and a magnetic base is about \$40. □



The dial indicator easily measures minute variations—here, it is set up for checking chuck concentricity on a drill press. With the dial's spindle bearing against the quill, it will measure bearing runout. Setting it against the shank of a bit will tell whether the bit is centered or bent.



The dial indicator can also gauge surface flatness—here, it checks the height of a jointer knife. Revolving the cutterhead by hand will tell whether all the knives are cutting the same circle. Moving the indicator across a knife will show whether it is parallel from end to end. The spindle can also be extended to the infeed table to check if infeed table and outfeed table are parallel.

SAWDUST, LTD. Resident sculptor enhances custom-furniture shop

The patience to build a reputation slowly, dedication to quality and insistence on in-shop and client communication have made Tom and Dale Kelly's Sawdust, Ltd. in Atlanta, Ga., a successful custom-design furniture business dealing with retail clients, interior designers and architects. An unusual advantage is their collaboration with resident wood sculptor Tom Williams.

The Kelly brothers attended the University of Florida, Tom in advertising and Dale in business and management. Their orientation toward woodworking came from their father, a cabinetmaker. Sawdust was formed in 1970 when Dale felt they could produce a higher-quality product than the one he was employed to assemble for a retail chain store. The business was incorporated one-and-a-half years later and currently employs an additional five craftsmen who are trained to handle work of progressive difficulty. Production has broadened from its beginnings with plastic-laminate Parsons tables to the design and construction of contemporary furnishings and installations in various materials. The Kellys estimate that 75% of their business is with interior designers and 25% with retail customers.

Williams, who became associated with Sawdust three years ago, studied sculpture at the University of Oregon and worked in Portland before coming to Atlanta. He rents Sawdust's workroom space, collaborating with them as well as doing his own sculpting, which includes free-standing pieces, doors for shops and residences, and figures. His free-flowing textures adapt themselves well to Sawdust's contemporary lines.

"We emphasize quality and service," Dale says. "Our success lies in listening to what our clients want rather than forcing our ideas and designs on them." Work with clients begins at the blueprint stage, if possible, or with existing structures and furnishings. Architectural work can be handled in two ways—by following the architect's specifications, or by studying the blueprints and offering ideas on furnishings, built-ins and their placement. They visit the home or office to get a feel for the existing furnishings so that their designs will blend and be functional.

During a preliminary conference with the designer and client, the client is offered a choice of materials including

hardwoods, veneers, metal laminates, plastic laminates, glass, fabric, inlays and custom hardware. Completed works in the 20-ft. by 60-ft. showroom provide visiting clients with a basis for new ideas, and speculation pieces that are sold are soon replaced.

Organization is important in formulating the bid and presentation, as well as in following through on the job. A record is kept of every completed job with a detailed analysis, including the bookkeeper's record of the costs of time and materials, quality of work done and handling of unusual aspects. "This enables us to produce the right product at the right price," Tom says. Their aim is a 25% profit, though sometimes it is less.

Tom and Dale confer on the job specifications and feasibility. Williams participates when his designs and work will be included. The workman assigned to the job also may have suggestions. Together they outline the task, trying to anticipate and solve possible problems before production begins. The shop makes detailed drawings, both to help the client visualize the finished product and to guide the workman. "Because we back our work, we try to stay in-house to ensure quality control and communications during production," Tom says. "Drawings answer a lot of questions, but not all. Collaboration prevents hassles." Service includes delivery and installation. Possible installation problems, like fitting around corners and up stairwells, are foreseen and eliminated in the plans.

An interior designer sometimes must convince clients that custom work is available within a budget. Working with interior designer Esther Booth, Sawdust and Tom Williams designed and produced furnishings and a front door for a home then under construction in Johnson City, Tenn. Booth brought the blueprints and furniture plan to the first meeting with Tom Kelly, listing the client's budget, completion date and requirements for design, size and materials. These included a buffet, a game table that also could be used for meals and a dining table that would seat eight and expand to seat twelve.

Tom and Dale discussed the requirements, and at a second meeting with Booth and the client proposed an 81-in. wall-hung buffet with a brass reveal and flush doors, concealing drawers and ad-

justable shelving for silver and linens. For the 3-ft. square game table, the client selected cane with a cream polyurethane finish to blend with existing furnishings. The walnut dining table would have triangular legs capped in brass, with two additional legs to support the center when the table was expanded. Booth ordered 12 unfinished chairs from another source, to be stained and lacquered by Sawdust; brass caps were added to the armchairs to coordinate with the brass reveal, the table-leg caps and a brass and chrome lighting fixture.

On a visit to the showroom, the client was impressed with Williams' work and commissioned a front door. Says Williams, "The plans showed the door 6 in. to 8 in. from an external projecting wall. So I designed lines to flow away from the wall. I made one sketch of the door itself and another of it in the context of the house, suggesting Honduras mahogany for its stability, a simple bronze latch and natural stain to add warmth to the house's grey tone."

Sometimes leads develop through Williams' work first, and subsequently involve construction by Sawdust. On the recommendation of friends, clients needing a buffet, two night stands and a movable TV stand came to Williams. They saw the showroom, where they were particularly impressed with an office desk, and Williams went to their house. Williams did sketches for the pieces, then consulted with Tom and Dale on the construction. The buffet, modeled after the office desk (photo, top right), included four doors with hidden locks, rounded corners, adjustable shelves and touch latches. Mounted on the four door fronts were individual sculptures in walnut by Williams. The construction, done by shopworker Dave Hix, included a core of cabinet-grade birch plywood with poplar corners, a base and top of American black walnut, a brass reveal at top and base, and tamboured sides and front.

Tom and Dale remember the early years as lean. "We felt it was important to build our reputation and produce quality work, so sometimes jobs were done at or below cost," Tom says. "There was no advertising, just word-of-mouth. We feel our policy paid off." □

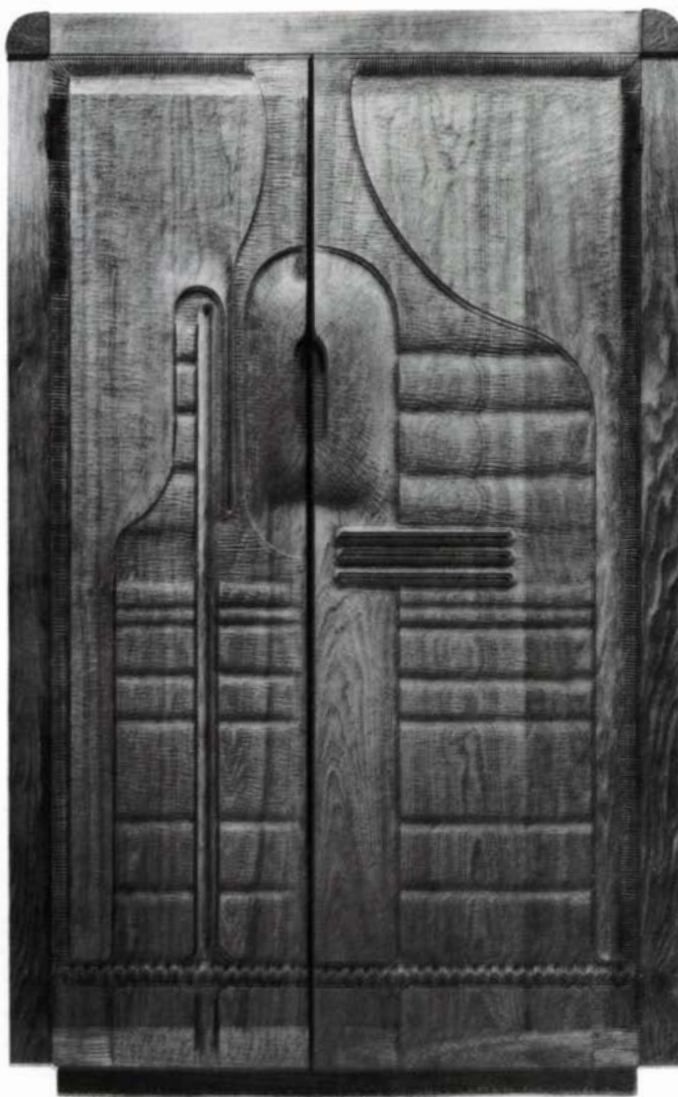
Barbara Schneider is a freelance journalist based in Atlanta, Ga.

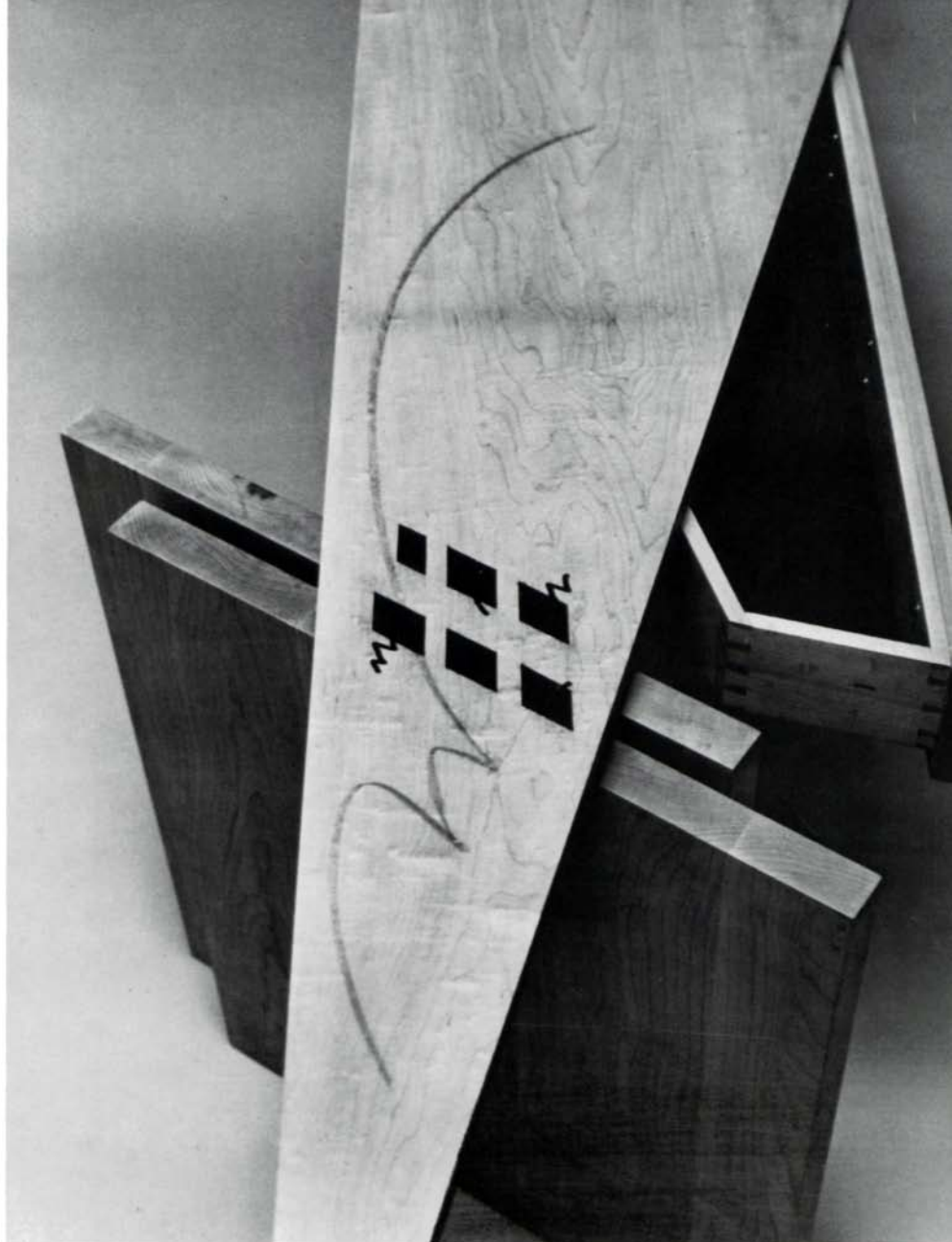
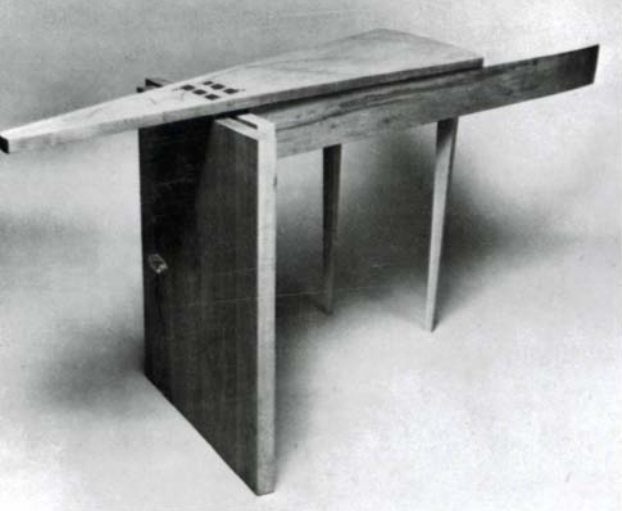


Success at Sawdust, Ltd. depends on turning out pieces like this \$3,800 office desk, with solid walnut top, carved panels and applied tambour face.



Showing close cooperation between sculptor and cabinetmakers, this armoire is made of solid teak and teak veneer over birch plywood. Designed by Tom Williams, who also did the carving, this was a speculation piece that generated an order for the matching night-tables, below left. The armoire, 48 in. by 18 in. by 80 in., sold for \$3,800 and the night-tables for \$475 apiece.





Decoration vs. Desecration

On the artistic fringe of cabinetmaking, craftsmen sometimes run hard against the question of decoration. Here you've labored many hours to produce a flawless surface, pristine, more than perfect—suddenly, it seems too precious, untouchable. Yet it's just like everyone else's sanded wood, so where is the individuality of the maker? Where in the usual cabinetmaker's vocabulary is a way to put your own mark on the work?

Wendy Maruyama of Rochester, N.Y., built this maple writing table (5 ft. long) during her master's degree work at the School for American Craftsmen, in which she'd concentrated on the relationships between structure and function, technique and decoration. After blind-tenoning the two vertical planes into the top, she painted purple images of the tenon ends where they'd be if she had taken them through (photo, above). Then, the piece assembled but not yet finished, she added the squiggly line in green crayon to decorate the white wood and at the same time graphically express its function: a writing table. Photos: Ron Sauter.

On the other side of the question, Garry Bennett of Oakland, Calif., made this showcase cabinet (photo, left) in order to desecrate it. The case is padauk, 6 ft. high, with a lighted panel behind the curved glass and an intricate system of catches and locks hidden inside. Bennett came to furniture making by way of sculpture and metalwork, and most of his pieces are rather gaudy. He designed this one to be a refined comment on crafts processes and router-bit aesthetics, and from the start planned to make the precious thing less precious by driving a nail into it. When the cabinet was finished, however, Bennett admits he didn't want to follow through. "I liked it too much," he says, "but I had to stay with my plan." So he hammered a few practice nails into padauk scrap, took a deep breath, and whacked the nail you see into the cabinet door. Photo: Schopplein Studio.