Starting Out
Simple bookcase joints

by Roger Holmes

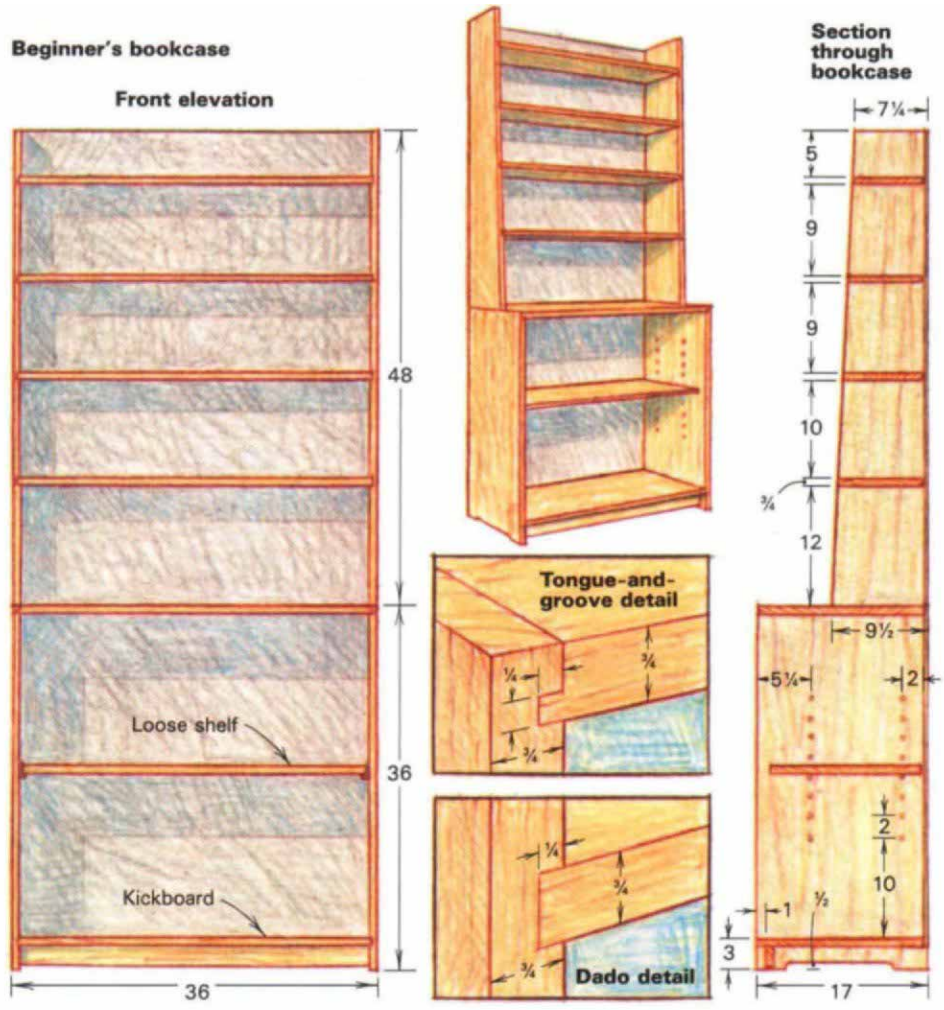
I can't remember the last time I rented a house with bookshelves (or enough closets for that matter, but I own a lot more books than shirts). So for years I've lived with makeshift shelves—planks on bricks and brackets, planks wedged into alcoves. Confronted with another shelfless house recently, I finally decided to make some permanent shelves that could move with me from house to house. The result, a stack of two simple boxes, one shallow, one deep, is shown in the drawing at right.

Boxes—called carcases in traditional parlance—are the cabinetmaker's basic building blocks. Stripped down to essentials, most casework isn't much more than a box-like container, usually filled with boxy drawers. In fact, most of the furniture in my house is made of simple rectangular boxes. For example, scale down the shallow box shown on top in the drawing for a spice rack or knickknack shelves; add a mirrored door and you've got a medicine cabinet. Slide a stack of smaller boxes into the deep bottom box and you've got a chest of drawers (I'll show how to do this in a subsequent article).

I made my boxes of pine, tailoring the depth of the upper box to the width of the boards I had on hand. I started with 10-in. wide boards for that box, but tapered the sides to add a little stability and to break the monotony of all those rectangles. The wider sides, top and bottom of the lower box had to be edge-joined and glued up.

Box joinery can be as simple or as complex as your skill and patience permit. Anybody can nail a butt joint together, and for some things that's joint enough. Secret mitered dovetails are at the other end of the scale, and I don't know many people who use them regularly. For my bookshelves, I wanted more strength than a simple nailed butt joint would give, but I didn't want to spend a lot of time getting it. The upper box, therefore, was put together entirely with dadoes—strong, easily cut joints in which the full thickness of each shelf end is housed in a groove in the side. (If you want adjustable shelves, just dado the top and bottom shelves and support the others on dowels as shown for the adjustable shelf in the lower box.)

Because the lower box had to have a flush, flat top, the top couldn't be dadoed into the sides. You could nail the ends of the top in rabbets in the sides, but the tongue-and-groove shown in the drawing locks together, which makes the joint stronger and much easier to assemble. The carcase bottom dadoes into the sides. Eighth-inch tempered Masonite backs strengthen both boxes, an important factor if you want adjustable shelves in the upper box. Whether you nail the back



over the back edges or into a rabbet affects only the looks, not the strength. I reinforced all the joints with finishing nails; screws would add even more strength. If the joints fit snugly and the boxes have backs, simply gluing them will be enough.

The carcase joints I've described can be cut by hand or machine. I'll explain the hand methods here, and the router and tablesaw alternatives on p. 58.

First prepare the parts. Flatten, thickness and glue up the boards, either by hand as described in the first article of this series (*FWW* #48, pp. 46-51) or with a jointer and thickness planer. Try to make all the parts at least ¾ in. thick. The exact thickness of the shelves of the upper box and the bottom of the lower box depends on the width of the dadoes. I cut a test dado in scrapwood and thicknessed the boards to fit it snugly. Tight joints present a dilemma: The tighter the joints, the stronger the box, but the harder it will be to glue up. You should have to apply some pressure to assemble a joint dry, but you shouldn't have to hammer it home. If anything, make the shelves too thick for now—it's easier to make a board thinner than to shim a loose joint.

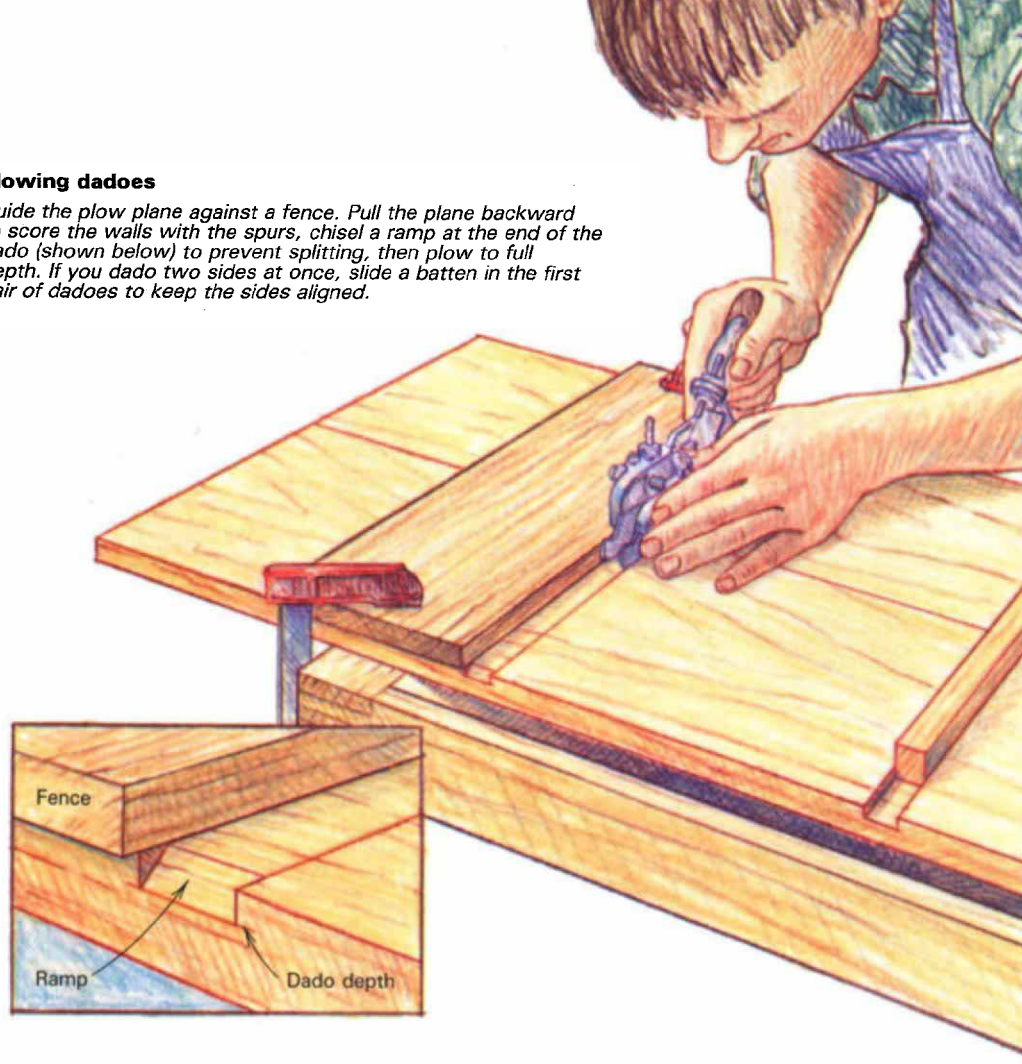
Next rip the boards to width and crosscut them to length. (Since the back is let into a rabbet in both boxes, the shelves have to be narrower than the sides, so that their back edge will be flush with the bottom of the rabbet.) Mark the good face and good edge. From now until you cut the joints, the top and bottom of the lower box are worked in the same way as the shelves of the upper box, so I'll just lump them all together and call them shelves.

The ends of all the shelves should be square to their edges, and the shelves should all be the same length. Your tablesaw or radial-arm saw may be very accurate, but mine leave the pieces slightly off, so I finish the job with a jointer plane. Stack the shelves so you can pick out the shortest one to square up first.

Planing end grain isn't particularly difficult, and the techniques are similar to those for planing edges (again, see *FWW* #48). Check the end against the good edge with a framing square or a try square, and mark the high corner. Put the board end-up in the face vise. If the board is short enough, position the end only a couple of inches above the bench to cut down on chatter. Adjust the plane to take a thin shaving, then plane in from the high corner—to avoid splintering the edge, don't run the plane off the far corner. Unless your saw is way out of whack, a couple of shavings should square the end to the good edge. The end needn't be dead square to the face, but if it's too far off, the joint won't be as strong. With the shortest shelf square, use it as a template for the rest, stacking it and the next shelf, then feeling with your fingertips for discrepancies in the ends. Square the box sides the same way.

Plowing dadoes

Guide the plow plane against a fence. Pull the plane backward to score the walls with the spurs, chisel a ramp at the end of the dado (shown below) to prevent splitting, then plow to full depth. If you dado two sides at once, slide a batten in the first pair of dadoes to keep the sides aligned.



Before I cut any of the dadoes, I pencil in their positions on the sides. Place the good edges of the paired sides together, ends flush, and simultaneously mark the locations of both walls of each dado on the two inside faces to ensure that the shelf spacing is exactly the same on both. Extend these marks across each inside face with a framing square, holding the square against the good edge. Also dearly mark the bottom of the inside face of each side. The spacing shown in the drawing on the facing page accommodates most of my books, but alter it to suit yours.

The depth of the dado isn't critical, but it shouldn't be more than half the side's thickness. A deeper dado would be stronger, but too hard to assemble. One-quarter to one-third the thickness of the side is plenty. Scribe the dado depths on the edges with a marking gauge.

Dadoing by hand is satisfying work if you're not in a hurry. You'll need a plow plane—a straightforward tool that requires a little practice. A simple metal plow plane consists of a handle attached to one of two fairly thin runners that form the body. The handled runner holds the blade and is fitted with two bars on which the other runner slides. The outer faces of the runners are set flush with the edges of the cutter, which can be one of a variety of widths. A fence, which also fits on the bars, can guide the plane along the edge or end of the work. I've had good luck plowing easy-to-work woods like pine or mahogany; harder woods are tough going. Most mail-order tool companies carry simple plow planes or slightly more complicated, and more expensive, combination planes. Prices vary—from $60 to well over $100—so shop around. The plane shown above is a Stanley #45, a more complicated molding plane that can also be used as a plow plane. I got lucky and picked it up at a garage sale for $25.

To set up the plane, make sure that the blade is razor-sharp and that the outside faces of the runners are flush with the edges of the blade. When plowing across grain, use the small spurs housed ahead of the cutter in each of the runner faces. They

score the wood, which keeps the fibers from splintering on either side of the dado. The spurs should be knife-sharp and long enough to score the wood cleanly, but not so long that they tear it.

Narrow box sides are easily dadoed in pairs. Place a pair on the benchtop, inside faces up, bottom ends aligned, good edges butted together. Then clamp a wooden straightedge across them, flush with the mark for the first dado wall. Set the plane on the far edge, tight to the fence, and draw it carefully back toward you to scribe the walls with the spurs without engaging the cutter. Then chisel a ramp in the waste at the end of the dado to prevent splintering. The first few strokes establish the dado, so make them carefully—set a shallow depth of cut and keep the plane tight against the fence and perpendicular to the board's face. After two or three strokes the plane will follow its own path, so you can remove the straightedge. Most plow planes have depth stops, but I use mine only for a rough gauge; when I get down to the scribe marks on the edges, I check the depth of the groove with a steel ruler. Slide a piece of scrap into both dadoes to keep the sides aligned, and reset the fence for the next cut.

Plow-planing takes practice, so dado a few pieces of scrap before tackling the real thing. The fussiest adjustment is aligning the edges of the cutter, the faces of the runners and the spurs to cut the dado walls cleanly. As you become familiar with the tool, you'll develop little dodges to make the job more accurate and efficient.

Tongue-and-groove corner joints are not much more difficult to cut than dadoes, just a little more time-consuming. I make the tongue about one-quarter to one-third as thick as the board, whichever matches the plow-plane cutter, router bit or dado head to be used for cutting the groove. The top and bottom of the lower box are the same length as the upper-box shelves, so the length of the tongue (the groove depth) is the same as the depth of the dadoes.

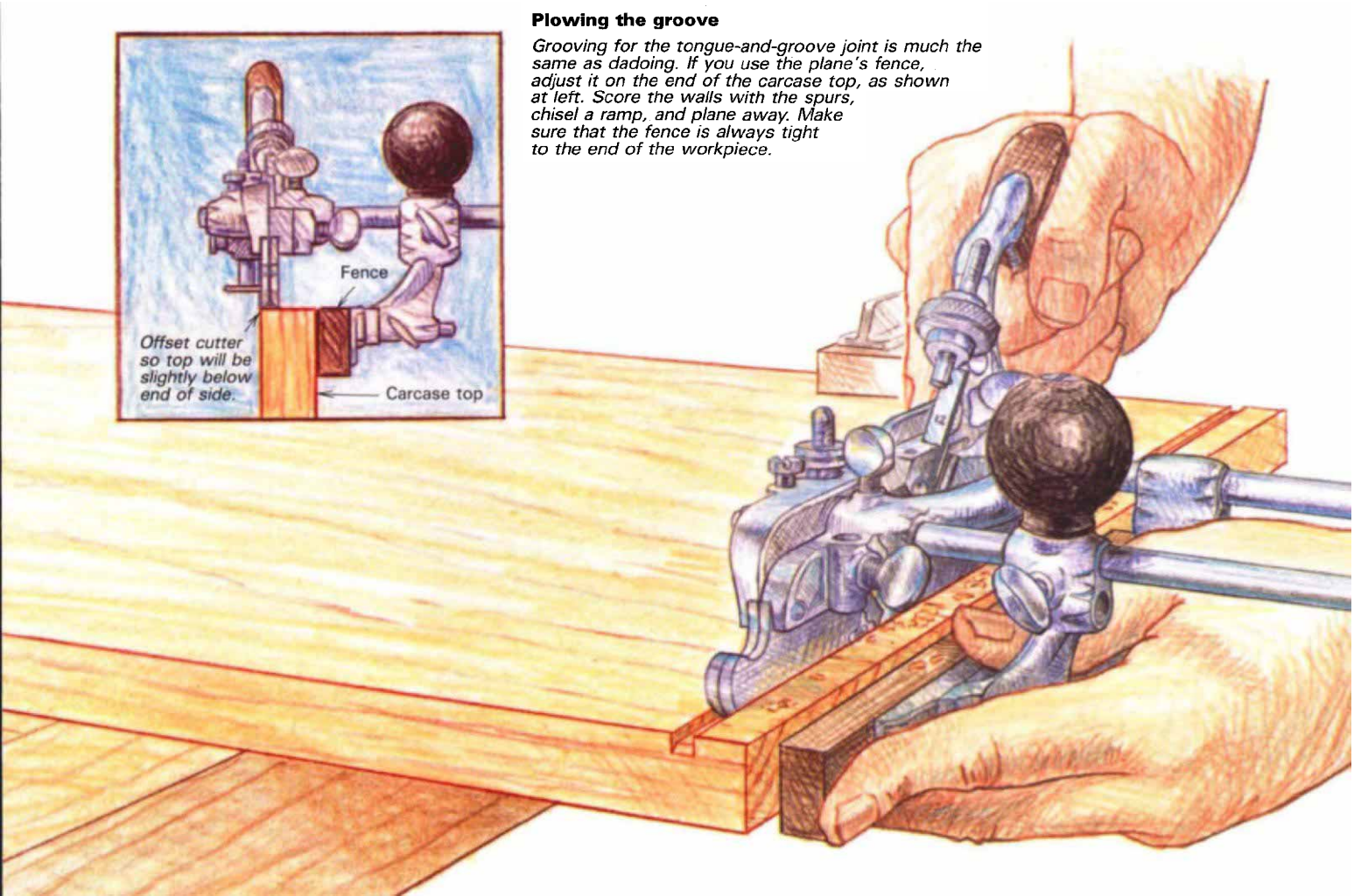
Make the groove first—it's easier to plane the tongue to fit it than vice versa. Since the tongue has a shoulder, you can make the groove just slightly deeper than the tongue length to avoid having the tongue bottom out at assembly. I plow the groove by running the plane's fence attachment against the end of the side. You could also run the plane against a clamped-on fence as you did for the dadoes. Make sure that there are no high spots on the bottom of the groove that would keep the joint from going together completely.

The tongues, created by rabbeting the ends of the top, should fit snugly in their grooves. I cut them with a rabbet plane, a narrow plane with a blade that extends completely across the sole and with faces perpendicular to the sole. One face has a spur like that on the plow plane. (You can also rabbet with a plow plane or a shoulder plane.)

First gauge the shoulder line and tongue thickness on the ends. Use a cutting gauge (a marking gauge with a small knife instead of a pin) if you've got one, because it makes a cleaner line across grain. Position the top on the bench and clamp a wooden straightedge fence on the shoulder line to guide the plane. Alternatively, set the plane's adjustable fence to run against the end of the board. Make sure that the blade and spur are sharp, and that the blade is flush with the spur face—if it's shy of the face, the rabbet will be stepped; if it's proud of the face, the shoulder will be ragged. Draw the plane backward as before to scribe the shoulder with the spur, make a ramp at the far end of the rabbet to prevent tearout, then plane away. When I'm close to the gauge lines, I try the tongue in the groove and

Plowing the groove

Grooving for the tongue-and-groove joint is much the same as dadoing. If you use the plane's fence, adjust it on the end of the carcase top, as shown at left. Score the walls with the spurs, chisel a ramp, and plane away. Make sure that the fence is always tight to the end of the workpiece.



Rabbeting the tongue

As when dadoing, score the rabbet with the spur and chisel a ramp in the waste before planing. Keep the fence tight to the end, and the plane's machined spur face perpendicular to the work.

take the final cuts to fit the joint with a sharp, finely set shoulder plane.

Cutting the rabbets for the backs is the final bit of joinery required. I cut them just slightly deeper than the ⅛-in. back and about three-quarters the thickness of the sides. I rabbeted only the sides of the boxes, and butted all the horizontal pieces against the back. Rabbet the top of the lower box if you want to hide the top edge of the back. Because the rabbet runs parallel to the grain, you needn't knife the shoulder line or use the spur cutter. If you're tapering the bookcase sides, do it now.

To make sure everything fits, put the boxes together dry before gluing up. If the shelves are all the same thickness, dry assembly should go quickly. If they're not, now is the time to fit them individually to the dadoes. I thin the ends with a sharp, finely set jointer plane, planing with or across the grain. Be careful not to take too much off—if you're not confident with the plane, it might be better to sand off tiny amounts. You should be able to assemble the joints by hand, though it may take some wiggling to get the ends to seat all along the length of the dado. If you're fitting the joints individually, mark the end/dado pairs clearly.

When you're sure the boxes will go together, clear a space in the shop and organize the things you'll need for gluing up. You should have at least two pipe clamps and a pair of stout cauls for each box—scrap hardwood at least 1 in. by 3 in. and just a bit longer than the width of the sides will do. Plane a slight crown in the cauls for the wide sides; pressure on the ends will produce pressure in the middle. I use a white glue like Elmer's Glue-All because it sets up more slowly than yellow glue.

I lay the parts on the bench to spread the glue, then build up from a side on the floor. Protect the surface by laying the side on a dean piece of plywood or particleboard. Spread glue in all the dadoes (and grooves) in one side with a stick or a flux brush (available at most hardware stores), making sure that the dado walls are covered. Then stick the shelves in place. Align the back edges and the rabbet before you push the ends home—it's impossible to slide an end sideways in a tight joint. Work quickly, seating each end as best you can, but don't worry if they don't go down completely; you'll pull the joint tight with damps in a minute.

When the shelves are housed in the first side, glue the second and push it down on the shelf ends, aligning the back edges and the rabbets before driving the joints home. The second side is harder to wiggle into place—a shelf or two always wants to pop out. So I get them started, then drive them down with a hammer padded by a thick hardwood block. As you've already made sure all the joints fit, you shouldn't have any nasty surprises.

Now draw the joints tight with clamps. Getting two damps and two cauls in place on a shelf all by yourself is exasperating—enlist a friend if you can. If you can't, figure it out dry beforehand. The top of the lower box is easier to pull tight because you can rest the damps on it. Tight joints usually will stay in place after you've

Gluing up

Getting the shelves started in the second-side dadoes can be trying. When you've succeeded, drive them home with a hammer and wooden block.

Squaring up

Measure across the carcase diagonals to check for squareness. Adjust the clamps slightly to pull the carcase square.

pulled them home; if they don't, just leave the clamps on while the glue dries.

Check the squareness of the box by measuring diagonally from corner to corner. If the diagonals aren't equal, you can adjust by pulling across the longer diagonal by hand or with a clamp (on wide boxes, clamp front and back to keep the box from twisting). Sometimes just perching the box on the floor on one corner and leaning into the diagonal corner will correct the problem—don't lean too hard, though.

When all the joints are pulled tight, carefully set the box on its side on the floor for nailing. Nails help keep the joints tight while the glue sets, and they add a certain amount of strength, particularly if the joints are at all loose. (If the joints are less than a friction fit, I'd reinforce them with screws.) Check for squareness, then drive in some finishing nails at a slight angle. Flip the box over and nail the other side.

If you're adding a back, do it now before the glue sets. A square, well-fitted back will help square up most boxes. Flush any uneven joints between shelf edges and rabbets with a chisel or plane. I painted the inside face of the back before assembly. To assemble, run a bead of glue down the rabbets and across the edges of the shelves—not too much or it will squeeze out—and nail the back in place. If the box is out of square, nail along one side first, then force the other side square as you nail it down. For extra strength, I nailed a 1-in. by 2½-in. kickboard to the sides and bottom as shown on p. 54.

Let any squeezed-out glue set to a rubbery consistency, then pare it off with a sharp chisel. If you don't want to hang around waiting, swab off squeeze-out with a damp rag, but remember that finish won't take on those areas without thorough sanding. When the glue is dry, flush off the joints with a sharp plane. I chamfered the edges and corners of the boxes with a piloted chamfer bit and router; files and a block plane will do the job as well, if more slowly. The floors in our house are like roller coasters, so I routed out a segment of the bottom ends of the lower-box sides to make four small feet. A coping saw and spokeshave would work, too.

Adjustable shelves perch quite adequately on ¼-in. dowel shelf pegs. I made a Masonite template for the holes in the lower box; resting it on the bottom and flush with the back ensured that the holes would be in the same locations on each side. A piece of tape wrapped around the twist drill or auger bit serves as a dandy depth gauge to keep you from inadvertently drilling through the sides. I chamfered the holes with a countersink bit because I think it looks nice and it makes inserting the dowels easier.

Like all simple, quick projects, this one took me about twice as long as I had expected, so I was in no mood to apply a complicated finish. Which was just as well, because I think film finishes (varnishes and lacquers) generally make pine look terrible. A couple of coats of Johnson's Paste Wax seem to protect the surfaces well enough, and I could enlist the whole family's help in putting it on. □

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Machines do it, too

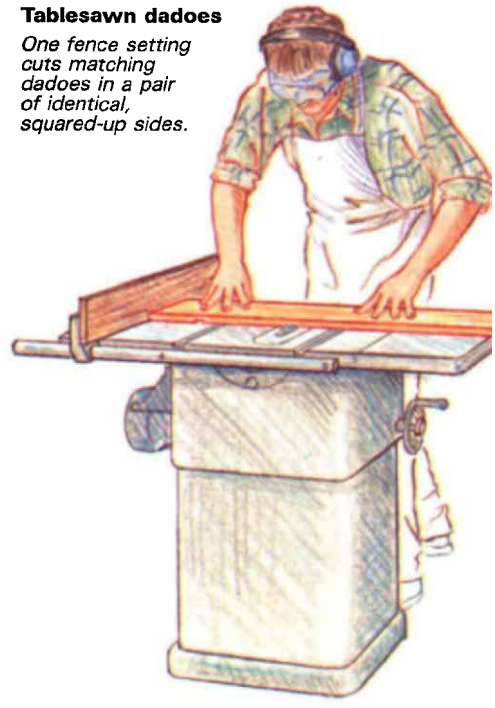
Dadoes: To dado the sides on a tablesaw, set up the dado head to match the thickness of the shelves (or you can thickness the shelves to match the dado). Dado a piece of scrap and try the shelves. I fine-tune the dado width by adding donut-shaped paper shims of various thicknesses between the cutters. Set the depth for about one-third the thickness of the side.

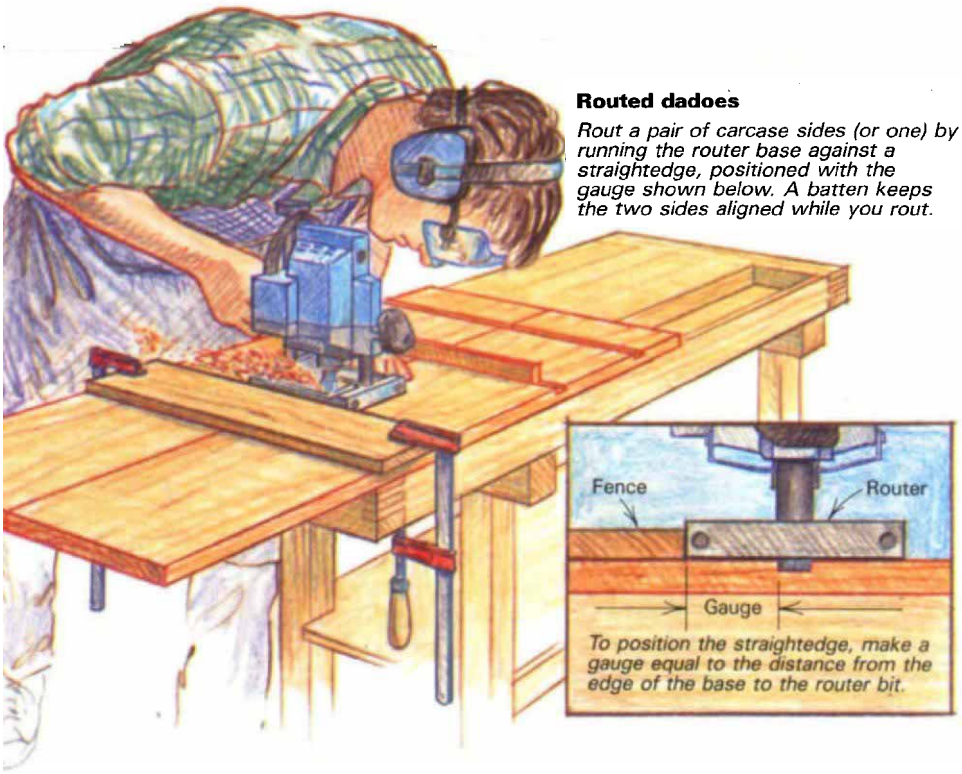
I run the ends of the sides against the rip fence to cut the dadoes—one setting cuts the two dadoes for each shelf. I find this a faster method than using a miter gauge, and it ensures that the shelves are square to the ends. Use a miter gauge for dadoing boards less than 6 in. wide, and for dadoes in the middle of sides too long to be passed against the fence.

With the dado head set up and the fence positioned for the bottom shelf, dado both carcase sides. Most saw guards have to be removed for dadoing, so work carefully, keeping your hands well clear of the blade. Narrow boards can be tricky because there isn't much surface bearing against the fence. I find that placing my right hand near the fence as shown in the drawing below helps overcome any tendency of the board to pivot during the cut. If you're at all uneasy with this procedure, use a miter gauge to steady the board. Push the board's inside face down

Tablesawn dadoes

One fence setting cuts matching dadoes in a pair of identical, squared-up sides.





Routed dadoes

Rout a pair of carcase sides (or one) by running the router base against a straightedge, positioned with the gauge shown below. A batten keeps the two sides aligned while you rout.

To position the straightedge, make a gauge equal to the distance from the edge of the base to the router bit.

on the table so the dadoes will be uniformly deep. (Waxing the table and fence also helps.) After cutting the first pair of dadoes, reset the fence and cut the next pair and so on. (If you're making adjustable shelves, dado for the top shelf now and you're done.)

I work off one end to about the middle, then work from the other end. If the sides are square, this shouldn't cause any problems. Most tablesaws can clear up to 24 in. between the blade and fence, so this procedure will work for bookshelves up to 4 ft. tall.

Dadoes can be routed by guiding the router base against a straightedge. First make a gauge for positioning the fence, as shown in the drawing above. Narrow sides can be routed in pairs. Lay them inside-faces-up on a flat surface, aligned and tight together. Clamp the straightedge below and parallel to the first dado, positioning it with your scrapwood gauge. Rout the first dado, slide a scrapwood batten into the grooves to keep the sides aligned, and repeat the procedure for the next dado. If your router base is round, always run the same spot against the fence unless you're sure the base is concentric with the bit.

With a little thought, you can figure out various easily made jigs to speed up the process. Without them, however, I think the tablesaw is faster—it's a ready-made jig for positioning the cuts.

Grooves: On the tablesaw, set up the dado head to the right thickness and height, and run the end of the side against the fence as for dadoing. Position the groove slightly farther from the end than the thickness of the top so you have only to plane off a little end grain to clean up the joint after assembly. If you rout the groove, guide the router base against a clamped-on fence as for dadoing, or use the adjustable fence that comes as an accessory on most routers.

Tongues: You can rout the rabbet that creates the tongue by running the router base against a straightedge as for routing a dado. Rabbet a piece of scrap exactly the same thickness as the top to check bit depth. The tongue should be a snug fit in the groove, as for dadoes.

The drawback of this method is that if the top isn't uniformly thick, the tongue won't be either. The tablesaw method shown below overcomes this problem. Set up the saw with a single sharp crosscut or combination blade. Cut the shoulder first, running the end against the fence, the outside face down on the table. Make the same cut in several pieces of scrap to use for setting up the second cut.

For this second setup, the distance between the fence and the blade should equal the tongue's thickness, which eliminates the need for uniform thickness. Adding a tall wooden fence to the rip fence will help you keep the top perpendicular to the table. Few boards are dead flat, so I clamp a wide feather board to the saw table, positioned so the pressure it exerts will push the top flush to the fence for several inches on both sides of the blade. Test the setup on the scrap, then cut the real thing. (Stand to one side as you complete the cuts, in case the saw kicks the waste back.) —*R.H.*

Tablesawn tongues

Lay the workpiece flat on the table for the first cut. Run it end-up against the fence as shown here for the second.