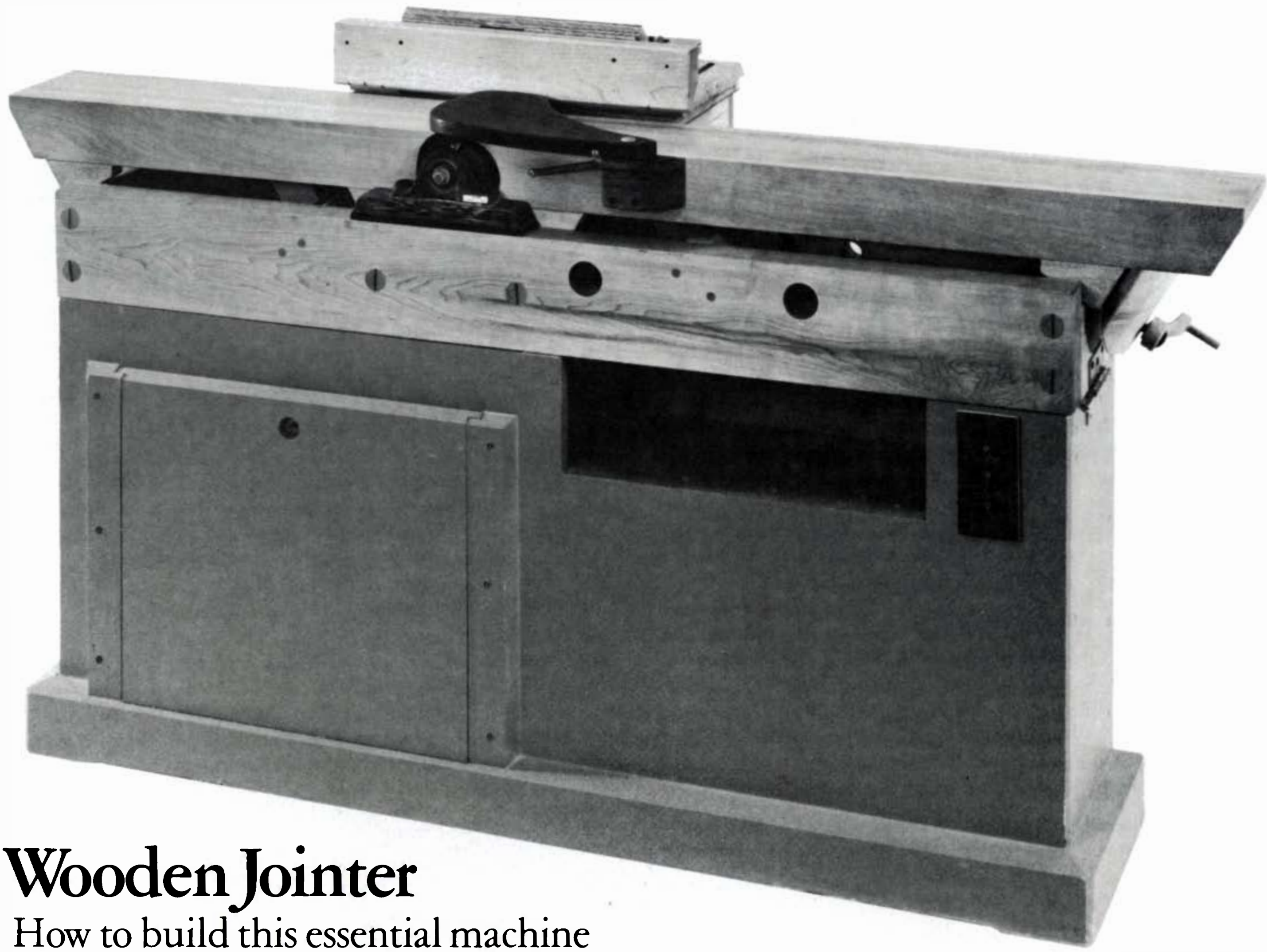


Wooden Jointer

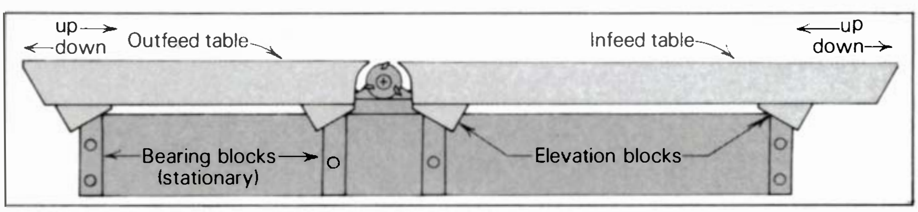
How to build this essential machine

by Galen Winchip

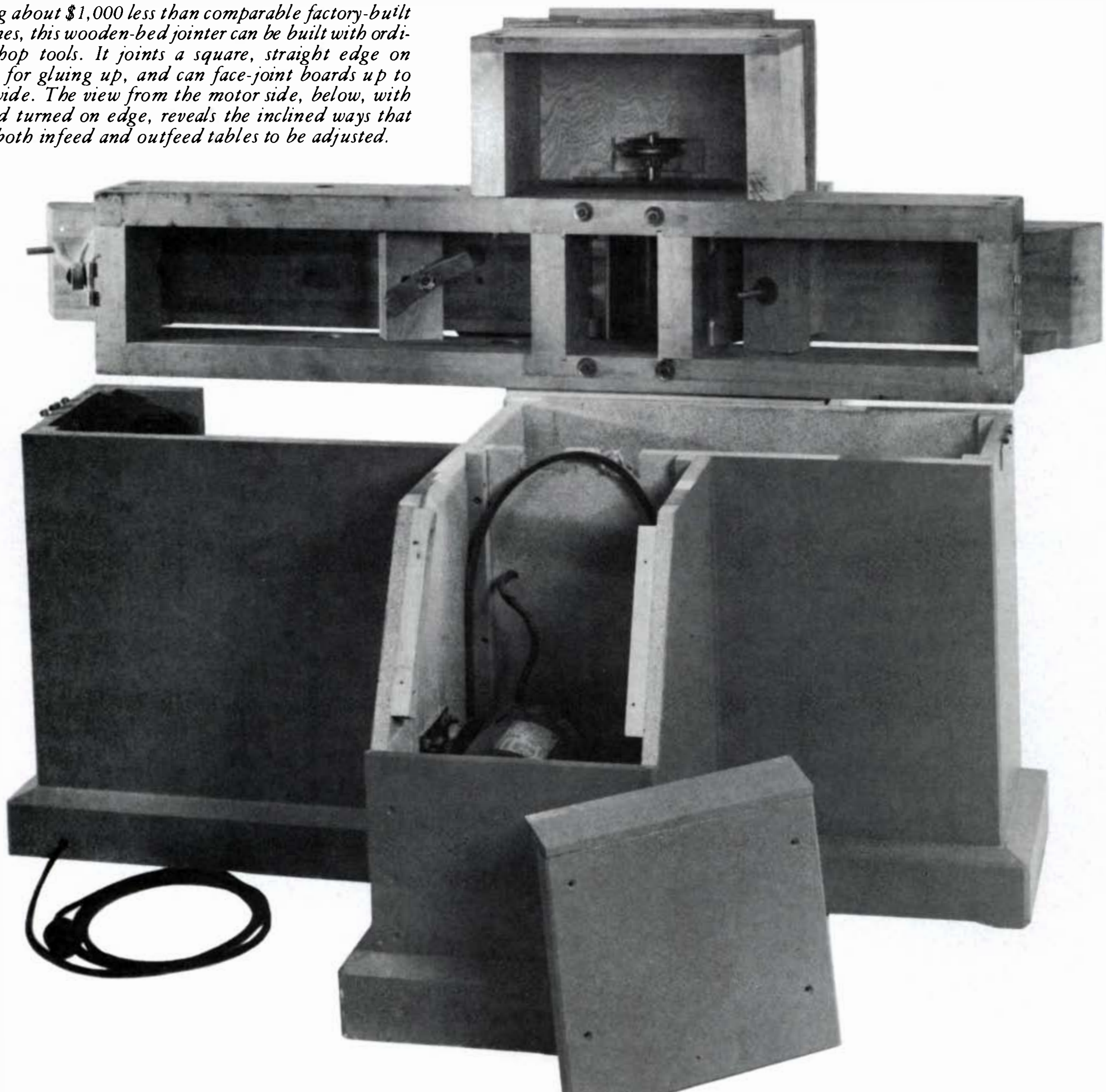
Seven years ago I walked into a local hardware store to buy an odd assortment of stuff. "What are you going to make?" asked the quizzical gentleman waiting on me. "A wooden jointer," I replied, trying to sound confident. He was both astonished and skeptical, and did his best to persuade me to buy the jointer on display in the store. Despite his warning that a jointer is a precision tool and not the kind of thing you just throw together in your shop, I bought the items on my list and thus embarked on my first tool-building venture.

That first jointer worked, but it left several things to be desired. So I determined to make a jointer that would perform as well as a commercial model. I subsequently tested five designs, each one simpler, more reliable and more precise than the one before. Finally, I arrived at the design for the jointer shown here. It requires no exotic, hard-to-find hardware or materials, and it doesn't call for any tricky methods of construction. Its performance rivals that of an industrially produced machine, though its price (about $350) is considerably less, and its feel and appearance are friendlier. I've been using this jointer for about 18 months, taking it from one job site to another, and I'm very happy with its design and with the results it produces.

Like certain of its industrial-duty, cast-iron counterparts, my wooden jointer incorporates four sets of inclined ways or wedge-shaped bearing blocks. As shown below, these provide the means for raising and lowering the tables. The wedges on the bottom of each table (elevation blocks) ride up and down on the stationary ways (bearing blocks) attached to the frame assembly. This system is especially suitable for a wooden jointer because it supports each bed at four points, two at each end, eliminating the possibility of drooping tables and providing very



Costing about $1,000 less than comparable factory-built machines, this wooden-bed jointer can be built with ordinary shop tools. It joints a square, straight edge on boards for gluing up, and can face-joint boards up to 6 in. wide. The view from the motor side, below, with the bed turned on edge, reveals the inclined ways that allow both infeed and outfeed tables to be adjusted.



stable working surfaces. I've jointed a lot of long, heavy stock with this machine, and found it can easily cut a true edge on an 8/4 board, 8 ft. long and 10 in. wide.

The cutterhead is the heart of the machine, so you should get one that is well-balanced and perfectly round (square cutterheads are dangerous) and that has been turned and milled from a single piece of bar stock. It should have a cutting arc of about 3 in. and a hefty shaft, ¾ in. in diameter. Mine was turned and milled by a machinist friend, who got the shaft too small for my liking. I'll soon make a new one with a ¾-in. shaft, which will minimize vibration and increase durability. You can have a machinist do this work for you as I did, or you can buy a cutterhead as a replacement part from a woodworking-machinery distributor. The cutterhead shaft runs in two self-aligning, ball-bearing pillow blocks, which you can get at any well-stocked industrial-supply or farm-supply store.

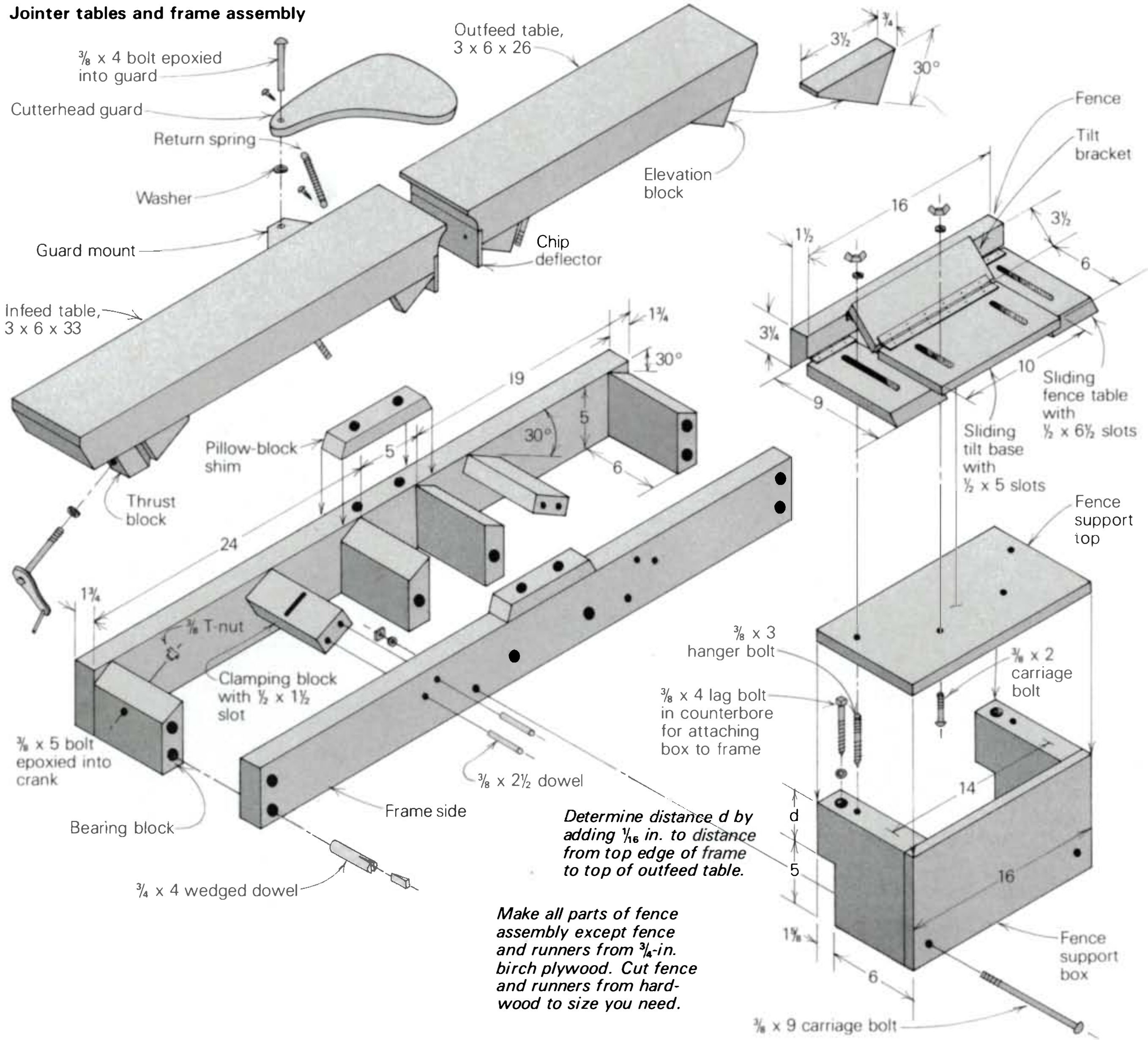
For driving the cutterhead, use a 1-HP or 1½-HP, 3,600-RPM motor. Select a pair of pulleys that will turn the cutterhead about 5,000 RPM (about 4,000 surface feet per minute).

The infeed and outfeed tables are laminated from quartersawn, face-glued boards. I used ¾-in. beech, but maple or another hard, heavy wood would do. Since the finished tables are 3 in. thick, you should rip the laminae to a rough width of around 3¼ in. to allow for a preliminary and a final surfacing of both sides. Use yellow (aliphatic resin) glue, and allow the tables to sit for several weeks before initial surfacing. The gluelines need time to cure thoroughly, and the laminated slabs need time to stabilize.

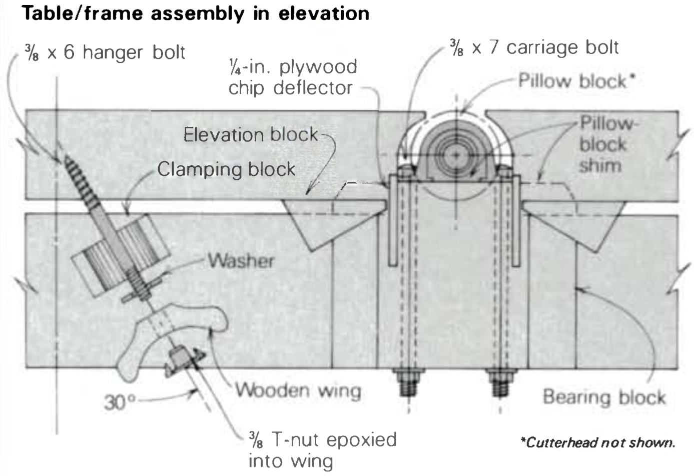
The tables shown here are proportioned to my own preferences: the infeed table is 10 in. longer than the outfeed because I find this easier for jointing long, heavy stock. But you can make them of equal length, as is common practice, or you can experiment to learn what suits you best. The same holds true for the dimensions of the fence. You can make one fence for the kind of work you do most, or you can make several of different sizes for different jobs. Since you're making your own, you aren't limited by what some manufacturer decides is the average size.

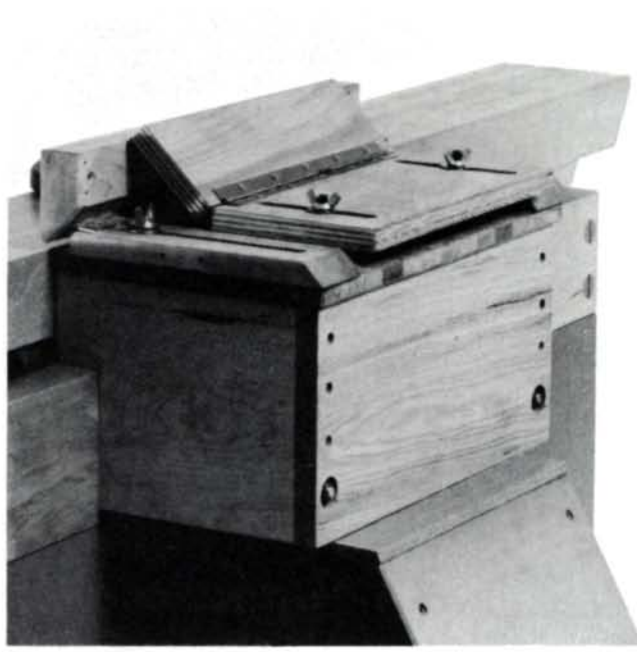
The jointer frame consists of two sides and three sets of blocks—two pairs of bearing blocks and a pair of clamping

Jointer tables and frame assembly



Table/frame assembly in elevation

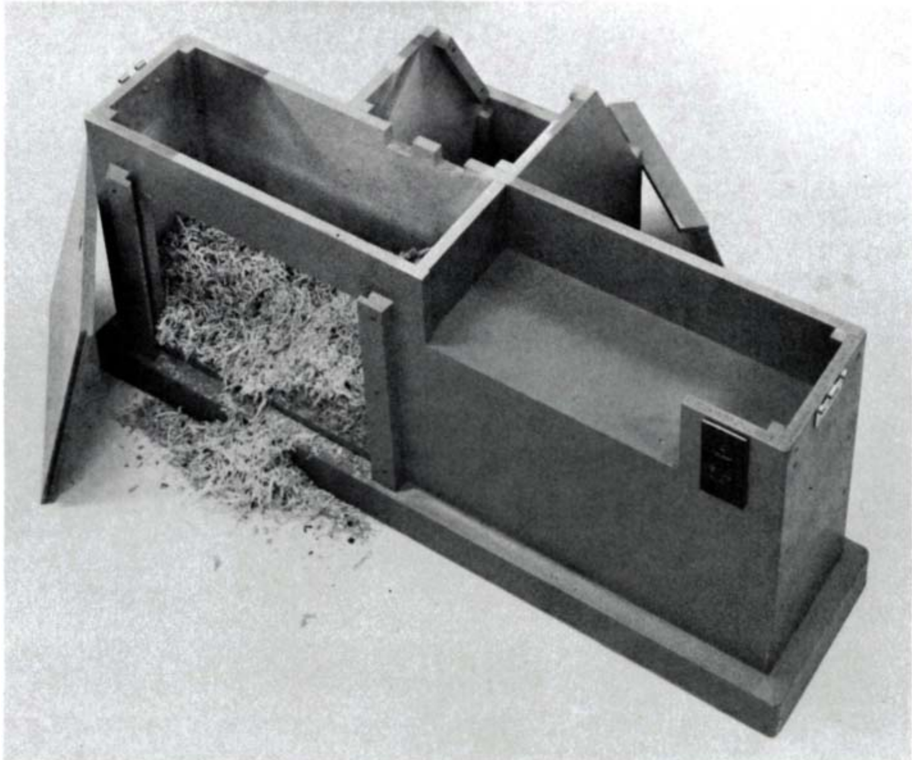




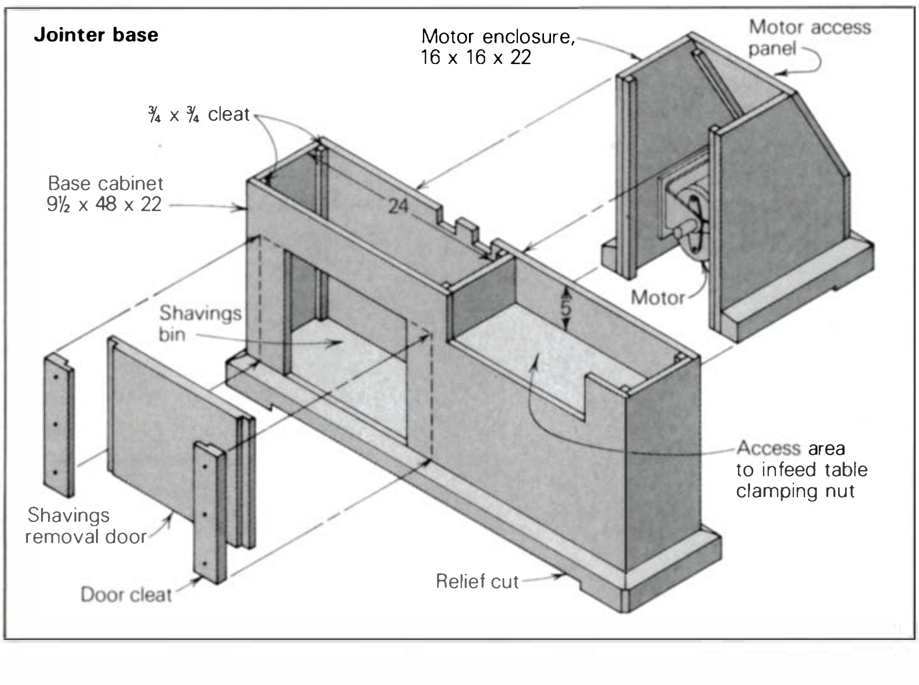
Tilting fence assembly consists of a sliding table, a sliding tilt base, a tilt bracket and a fence, which can vary in size to suit the needs of the operator. Removing the fence-support top gives access to V-belt and arbor pulley.

blocks. The top edges of the bearing blocks are beveled at 30°, and the clamping blocks are slotted for clamping bolts. The clamping blocks, though not beveled, are set at a 30° angle to the top of the frame. The drawing (facing page) dimensions and locates these parts. Make sure when cutting duplicate parts that their dimensions and angles are precisely the same. This can be done by ripping and beveling a single board and then crosscutting identical parts to finished length. All the blocks must be oriented at a true 90° to the frame sides, and the clamping blocks ought to be positioned as close as possible to the center bearing blocks. The outer bearing blocks should be flush with the ends of the frame sides.

To add strength and to help position the parts during clamping, I cut narrow tenons on the bearing blocks and dadoes in the frame sides to house them. But you need not go to this trouble to get similar results—just clamp the frame sides together with the bearing and clamping blocks between, and then tap them into their exact positions with a mallet. This done, tighten the clamps, and bore for dowels through the frame sides into the blocks as shown in the drawing (¾-in. dia. holes for the bearing blocks, ⅜-in. dia. holes for the clamping blocks). The dowels will let you place the parts accurately when gluing up and will reinforce the frame assembly. The ¾-in. dowels are slotted and wedged. Since you're gluing end grain to long grain, epoxy is best; size the end grain before gluing and clamping. When the glue has set, sand the dowels flush with the frame sides.



Particleboard base contains separate compartments for the motor and for chips and shavings. Door to shavings bin slides up and down in rabbeted cleats. Opening in side under the infeed table gives quick access to the wing nut that must be loosened for making changes in depth of cut. The T configuration of the base concentrates the machine's weight on three points, eliminating the need to level it to the floor.



The base, which you'll probably want to make while your table laminations are aging, is of ¾-in. high-density particleboard. Plywood will suffice, but it's more expensive and not as rigid or heavy. With a plan view that resembles a T, the stand is constructed using corner cleats, screws and yellow glue. This type of base has several advantages. One is that the motor is enclosed in a separate compartment, protected from dust and shavings. Another is that the shavings, being contained in a single bin, are easily removed. A third advantage of the T configuration is that the weight of the machine and the base rests on the three extreme points, and thus leveling is never required.

Surfacing the tables is easy if you have access to a thickness planer and a jointer wider than the one you're making. If you can't find a friend who'll let you use his, or a school shop where you can do this work, you'll probably have to pay to have it done at a local millwork or cabinet shop. You could even do it with hand planes, winding sticks and a straightedge, but you must be very patient to get the results required.

Begin by jointing one face of each table, being careful to take light cuts and to avoid sniping the ends. Then run both tables through the thickness planer for several light passes to bring them within ⅛ in. of their finished thickness. Again, be careful to set the planer's bedrolls properly to prevent snipe on the final pass.

Now place both tables upside down on a perfectly flat surface, butt them end to end, and separate them about 2 in. Get two small boards, each about 9 in. long, 2 in. wide and exactly ¾ in. thick, and put one across the outer edge of each table. Place the frame assembly upside down on the two boards, which will hold the frame ¾ in. above the bottoms of the tables. Position the frame and tables relative to one another, and check the spacing between the two tables to make sure there's room for the rotating cutterhead. Apply some yellow glue (or epoxy) to the top edges of the elevation blocks, and slide them into place between the inclined surfaces of the bearing blocks. Since the angles are complementary, the fit should be perfect. When installing the elevation blocks, don't wedge them too tightly under the bearing blocks; just bring the mating surfaces into light, uniform contact. If all eight elevation blocks are not exerting equal pressure against the bearing blocks, the tables will rock.

Securing the tables to the frame is accomplished by two ⅜-in. by 6-in. hanger bolts. The wood-thread ends are screwed at a 60° angle into the table bottoms. The machine-thread ends pass through the slots in the clamping blocks and are retained by homemade wing nuts (optional on the outfeed table). These have wood bodies with T-nuts epoxied into their centers. After the glue holding the elevation blocks in place has thoroughly dried, remove the frame assembly and bore angled pilot holes in the tables for the hanger bolts and screw them into place. Long hanger bolts are used in stairway handrailing; if you can't find any, buy a couple of long lag bolts, cut their heads off and die-cut National Coarse machine threads onto their unthreaded shoulders.

Now you can put the tables onto the wedged ways and clamp them in place with the wing nuts. Loosen each nut slightly and check to see that each table rides freely up and down the inclines and that there is no rock or play anywhere. If you detect any rocking, carefully remove a small amount of wood from the bearing surface of the opposite elevation block and check again.

When the tables fit and slide correctly, return the whole assembly (frame and tables) to your flat reference surface. With both tables resting flat on this surface, tighten the clamping nuts. Now take the whole thing back to wherever you did your initial jointing and surfacing, place your jointer upside down on the borrowed jointer and surface both tables in a single pass. Take a very light cut (1/32 in. or less) and check down the length of both tables at once with an accurate straightedge. If they are truly straight and in the same plane, you can take your jointer back to your shop and continue construction. If not, find the source of the error (it could be in the iron machine), eliminate it and take another light cut the full length of both beds. Remove as little stock as possible, since you may want to surface the tables again in the future, should they warp out of true or their surfaces get badly gouged and pitted.

Surfacing complete, trim the tables to final width and cope an appropriately curved area where each table will extend over the cutterhead. The bandsaw is best for this. Don't cut the arcs so the blade exits on the top surface of the table, but rather so it exits on the end, about 3/16 in. below the top. This will produce a little land that makes the ends of the tables stronger, and leaves the straight lines across the tables intact. Keep the throat opening narrow.

The elevating mechanism for the infeed table consists of a ⅜-in. by 5-in. bolt epoxied into a wooden crank, a thrust block glued to the bottom of the infeed table and a T-nut countersunk into the end bearing block. The ⅜-in. National Coarse bolt has 16 threads per inch. Because the bolt moves the table up and down a 30° incline, and the sine of 30° equals 0.5, one revolution of the crank will move the table 1/32 in. vertically, a handy reference. You could mount a depth-of-cut indicator on one of the bearing blocks.

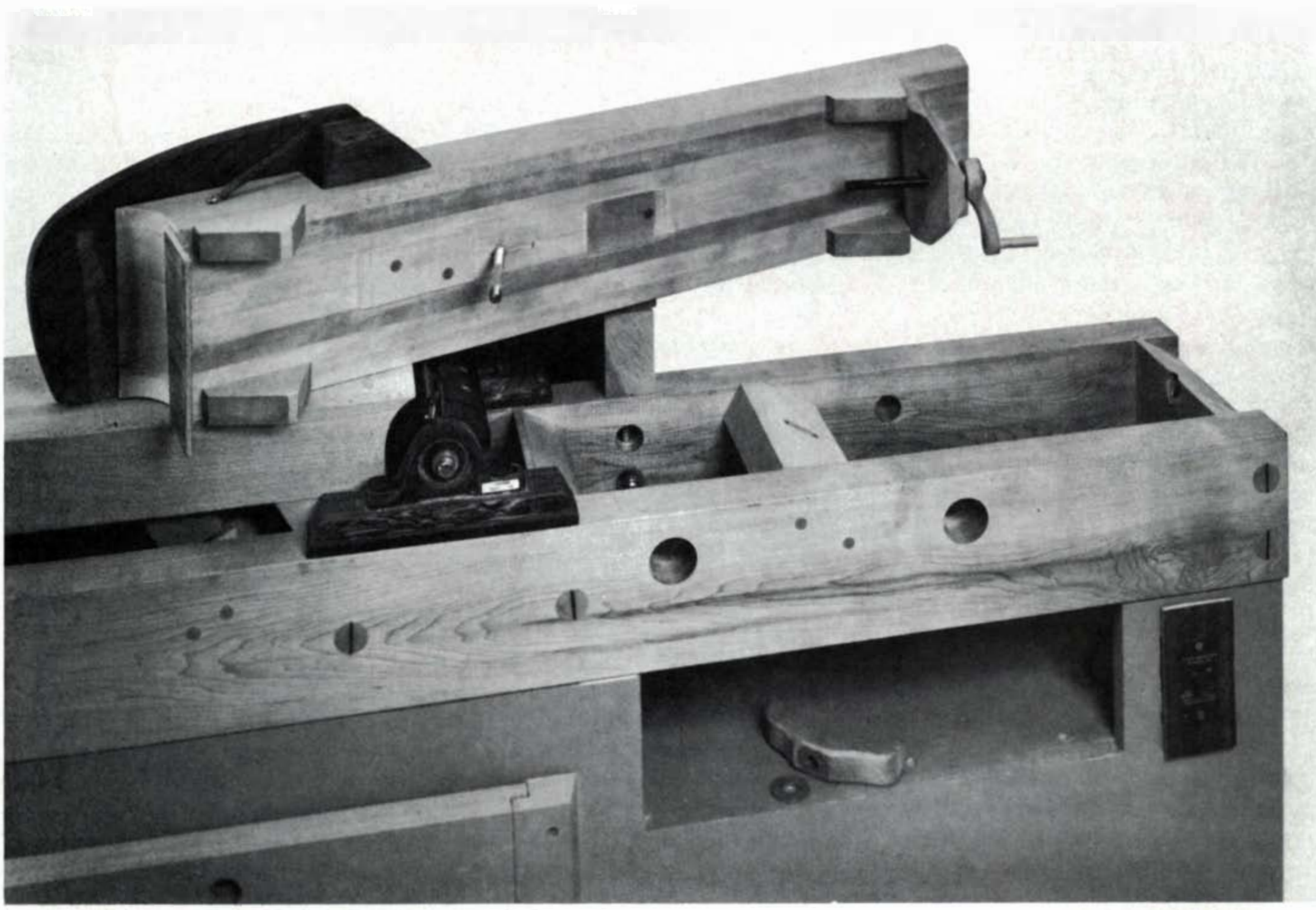
To change depth of cut, back off the clamping nut just enough to free the table, turn the crank to raise or lower it and retighten the nut. Excessive torque isn't necessary to hold the tables securely on their ways. For making the fine adjustments on the outfeed table, I keep the nut snug and smartly strike the end of the table with a wooden mallet to raise it slightly, or strike the end of the frame to lower it—similar to the way you tune a wooden handplane. Since the nut stays tight, you seldom need access to it. Mine doesn't even have wooden wings attached; I use a wrench when it needs adjusting.

To install the cutterhead, first dimension a pair of pillow-block support shims, which will hold the cutterhead at the proper height. Fiddle with the thickness of each shim to level the cutterhead with the tables. Screw the shims into place, replace the cutterhead and pillow blocks and mark the centers for four holes to be drilled through the shims and frame sides. The diameter of the holes should be slightly larger than the ⅜-in. carriage bolts that will hold the pillow blocks in place. These bolts may have to be retightened from time to time, because seasonal shrinkage might loosen them. For safety, use self-locking nuts.

The fence assembly is mounted on a three-sided hardwood box. Its sides are notched to fit over the edge of the frame side, and it is held in place by two carriage bolts and two lag bolts. The plywood top of the fence-support box should sit about 1/16 in. higher than the level of the outfeed table. This clearance allows the fence table to slide freely across the jointer beds.

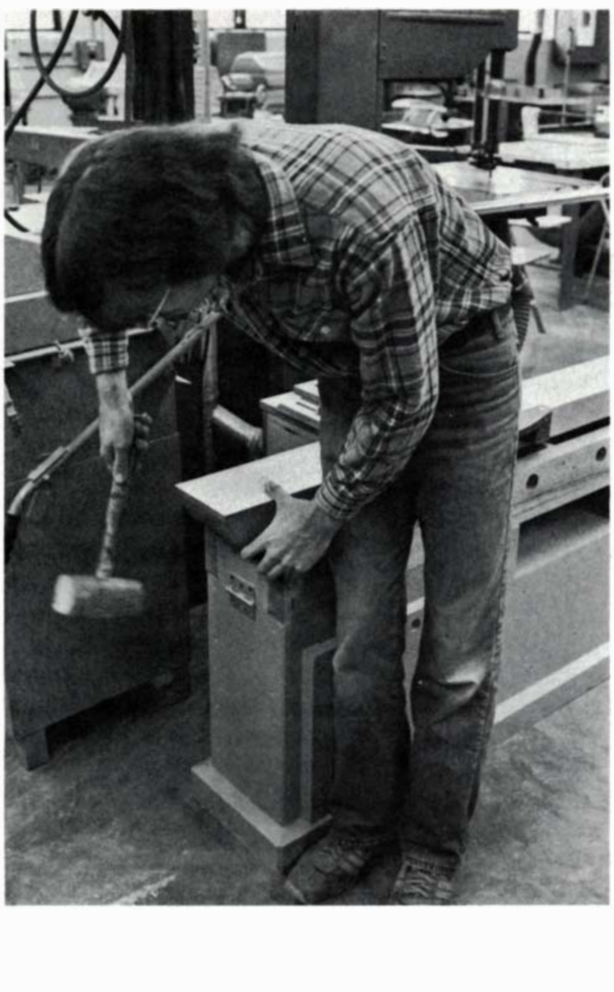
The fence itself can be made to any reasonable size, though its dimensions need not change those of the sliding fence table or the hinged tilting bracket and base. To make the table and tilting brackets, get some good ¾-in. birch plywood, and cut the three pieces to the sizes shown in the drawing on p. 46. Then cut two slots in the sliding table and two in the tilting bracket base. For hinging the parts together, you can cut a continuous hinge into three lengths or use three pairs of butt hinges. You may want to attach hardwood sled-type runners to the sides of the sliding table, as I have done. These will wear longer than plywood and will look better. Depending on the diameter of your arbor sheave, you might have to cove out an area on the underside of the fence support top to keep the belt from rubbing the wood. The fence table is locked in place by two wing nuts screwed onto ⅜-in. hanger bolts that extend through the table slots. The tilting bracket base is secured also by wing nuts screwed onto carriage bolts that extend through the fence table.

The cutterhead guard must be made of a sturdy hardwood (I used padauk). You may alter its standard shape as you please, so long as it moves easily away from the fence when stock is pushed against it and so long as it covers the unused portion of the rotating knives. The guard has a ⅜-in. bolt epoxied to it, and this bolt pivots in a hole in a mounting block that is screwed to the sides of the infeed table. A washer on the bolt between the mounting block and the bottom of the guard will ensure that the guard swings just clear of the jointer beds. A small tensioning spring holds



A look underneath the infeed table shows the positions of elevation blocks, clamping stud (hanger bolt) and thrust block, which contains elevation screw and crank. In the jointer frame underneath, you can see the inclined bearing blocks (ways), the slotted clamping block and the large wooden wing nut. The unfilled holes in the side of the frame remain from author's earlier experiment with a different means of securing the table to its ways. They have nothing to do with the existing arrangement.

Staff



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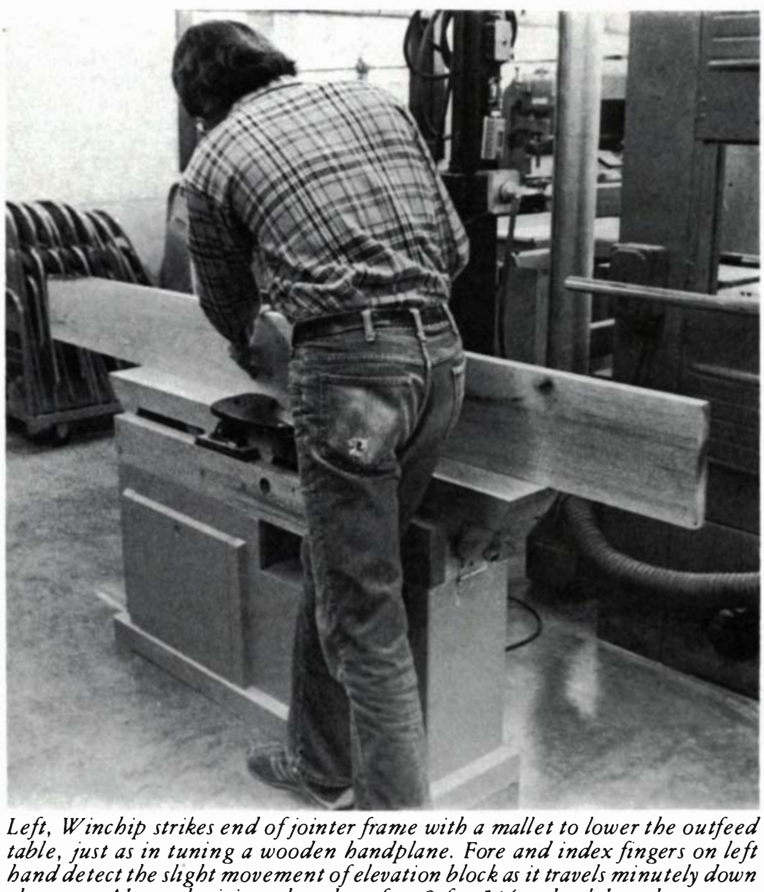

Left, Winchip strikes end of jointer frame with a mallet to lower the outfeed table, just as in tuning a wooden handplane. Fore and index fingers on left hand detect the slight movement of elevation block as it travels minutely down the ways. Above, he joints the edge of an 8-ft., 5/4 red oak board.

the guard against the fence and against the stock being jointed.

I finished the machine with Watco oil and waxed the tops of the tables and the sliding surfaces on the wedged ways. The base I painted grey. No finish, however, makes wood completely impervious to moisture—I had to make slight adjustments in the outfeed table as its thickness changed minutely with the seasons. To correct any rocking or droop that might develop, insert paper shims between the bearing and elevation blocks. To spring-joint boards for gluing up panels, you could shim up the two inner elevation blocks on the outfeed table so that it slopes down from the cutterhead. A couple of pieces of notebook paper would be about right. Remember that the orientation of the outfeed table (both its angle and its height) determines whether the jointed edge will be slightly concave or slightly convex. If the table is high in relation to the knives, the jointed surface will be convex; if low, it will be concave. Also, it's a good idea to check the tables occasionally for proper alignment. Crank the infeed table up to the exact height of the outfeed table and then lay your straightedge across both beds. If there's any deviation from a true plane, remedy the error with paper shims between the bearing and elevation blocks.

Having spent quite a few years working in university wood shops, I'll be first to admit that industrial-duty machine tools offer greater built-in precision than shop-made machines. But the differences are small, and the advantages of being able to build your own machines are great. My first woodworking machines were home-workshop quality and were far inferior in terms of precision and stability to the shop-built ones I now use. Experience has taught me that good work depends as much on the skills of the craftsman and his sensitivity to factors that affect accuracy as on the built-in precision of his machinery. I have often observed students getting less than satisfactory results using good tools simply because they believed that machines should do accurate work in spite of the operator. The truth is, of course, that the operational skills and intuitive understanding of the craftsman are necessary to the precise work cabinetmaking demands. □

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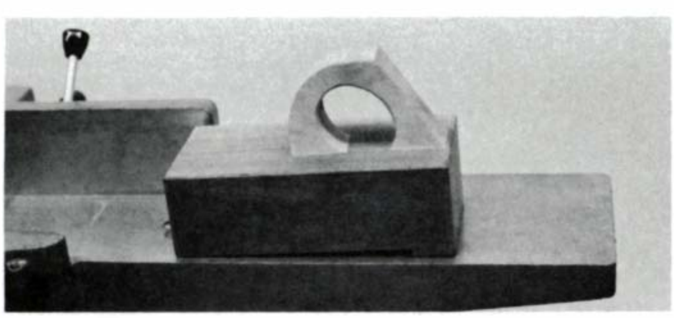
Jointer safety

Some of the nastiest woodworking accidents result from careless or improper use of the jointer. A cutterhead rotating at 5,000 RPM looks seductively harmless; with its knives blurred into invisibility, all you see is a shimmering steel cylinder. Yet jointers regularly gobble up fingers, thumbs and sometimes hands. Surgical restoration is almost impossible—repairing tissue lost to a jointer is like trying to remake an original board from a pile of shavings. Such a nightmare can be avoided by being careful every time you use the jointer.

Before switching the machine on, make certain that the knives are firmly tightened in place. A loose knife can grab the work or come flying out of the cutterhead at high speed. Never use a jointer unless the cutterhead guard is in place. Even with the guard in place, large chips can be hurled from the machine with enough force to injure eyes. So always wear your safety goggles when jointing stock. Some jointers are equipped with a rabbeting table, and you must remove the guard to use this feature. But a jointer is not the best machine for rabbeting. It's better to use your table saw or spindle shaper or router. They do this job more safely and more efficiently. Though most jointers will cut as deeply as ¼ in. or more, you shouldn't take a cut any deeper than ⅛ in. in a single pass. You risk injury from kickback when taking too deep a cut, and you put unnecessary strain on the motor.

When jointing the edge of a board, keep your fingers well away from the table surface. When face-jointing stock, even



thick stock, always use a push-block. Stock shorter than 12 in. should not be machine-jointed, so if your finished pieces will be less than a foot long, joint the longer board before you cut it up. For jointing stock thinner than ½ in., you should make a massive push-block, like the one shown below made by John Alcock-White for jointing one face of the ⅜-in. stock he laminates for bandsaw boxes. The block should be as wide and as long as the stock being jointed, and 4 in. to 6 in. thick.

Used over a long time for repetitive operations, the jointer's incessant drone can lull the operator into inattention. In such a semiconscious state, an accident is liable to happen. So be especially vigilant when your work is boring and perfunctory.

Posture and stance are also important. Learn to feed stock across the tables without overreaching and losing your balance. Adopt a posture that will allow you to exert consistent downward and horizontal pressure on the stock. This not only contributes to safety, but also affects the results of your work. When feeding, allow the machine to cut at its own pace. Don't force work into the cutterhead, or try to hurry the board across the tables. A slow to moderate feed rate is best, though pausing or creeping along during a cut can score the surface of the wood and overheat the knives.

The knives should be kept sharp, and should all be maintained at the exact height. You can touch up the edges periodically with the judicious use of a slipstone, but when knives are knicked or dulled beyond reason, you should have them reground. Instruct the person doing this to remove the same amount of steel from each knife. Improperly ground knives will put the cutterhead out of balance, which causes vibration and can lead to an accident, and will definitely bring about premature bearing failure. When sharpening, maintain the original bevel angle. If you try to hone or grind a secondary bevel on the edges, the result will be increased noise and vibration, and decreased cutting efficiency.

Constant alertness, common sense and a knowledge of cutterhead dynamics are the best safeguards against accidental injury. Used properly, a machine jointer makes a woodworker's task immeasurably lighter and introduces a high degree of precision into the work. For more on using jointers, see *FWW* #19, Nov. '79, p. 93, and p. 18 of this issue. —*J.L.*