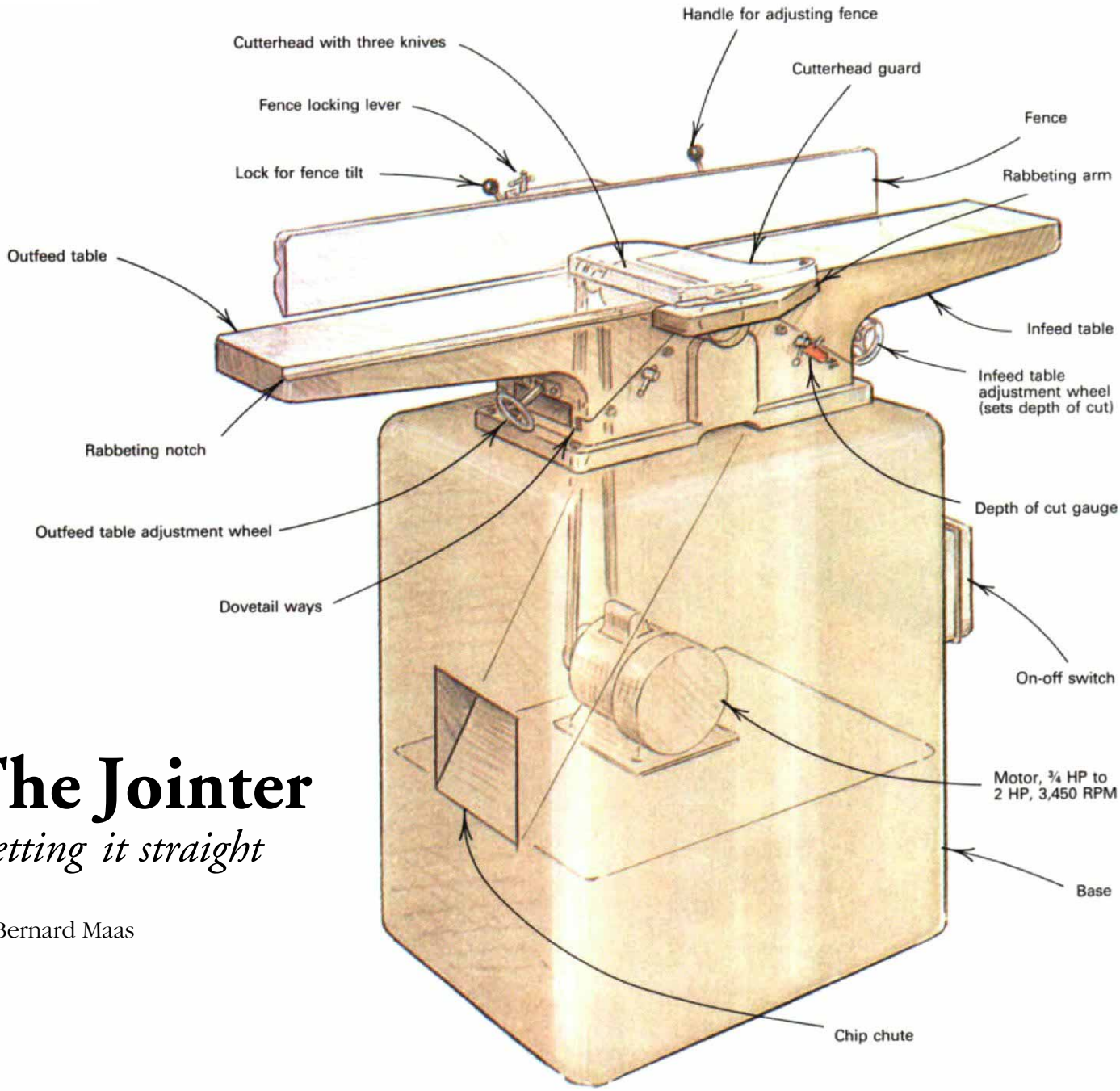
Fig. 1: Jointer



The Jointer

Getting it straight

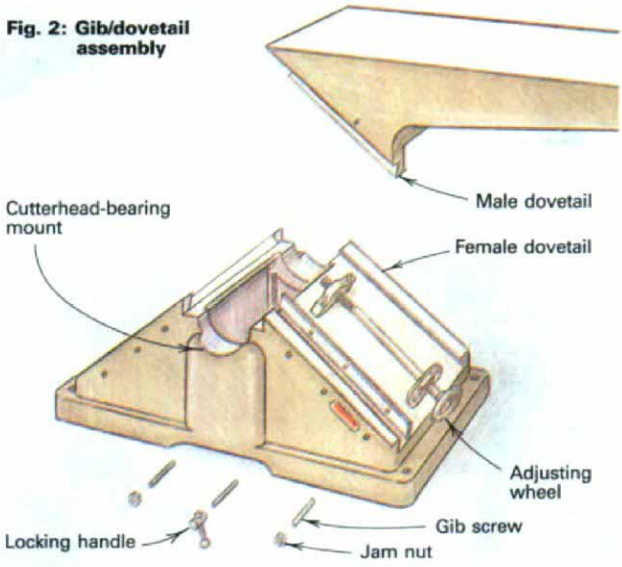
by Bernard Maas

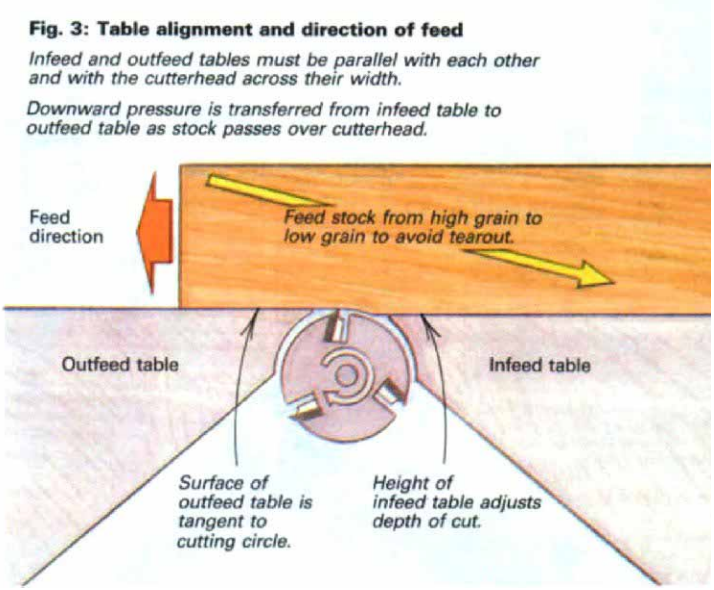
A properly tuned up jointer is essential for precision woodworking. Without the jointer to machine a straight, true and square edge or flatten a rough, irregular surface, the other tools in the shop can't fulfill their potential for precision work. If you want to pull straight, flat boards out of the planer, you must start with a jointer-trued surface facedown on the planer table. If the stock is bowed or twisted going into a planer, the feed rolls will clamp it flat during the cut, but the wood will pop back to its old shape on the outfeed. A tablesaw is even more dependent on a jointer; without a straight edge to run against its fence, a tablesaw cannot be safely used. And, of course, when edge gluing boards, that last pass on the jointer guarantees a perfect joint. Even after the panels are glued up, the jointer can be of service, cutting rabbets for joinery and chamfering edges for a finishing touch.

A jointer is a simple machine. It consists of a two-, three- or four-blade cylindrical cutterhead, infeed and outfeed tables and a fence, as shown in figure 1 above. However, this simplicity belies the machine's complex geometry. The infeed and outfeed tables must be perfectly flat and parallel with each other and, across their width, parallel with the axis of the cutterhead, as shown in figure 3 on the facing page. The knives must be installed in the cutterhead so that they all protrude the same distance and the highest point of their arc is tangent to the plane of the outfeed table. If the various components are not properly aligned, the jointer cannot machine a straight and true surface and it therefore becomes practically useless. So, before I get into the specifics of its operation, I'll discuss the jointer itself—its parts, maintenance and adjustment.

Jointer anatomy—Jointers range in size from 4-in.-wide hobbiest models up to 24-in.-wide cast-iron monsters used in mills. The size

Drawings: Roland Wolf





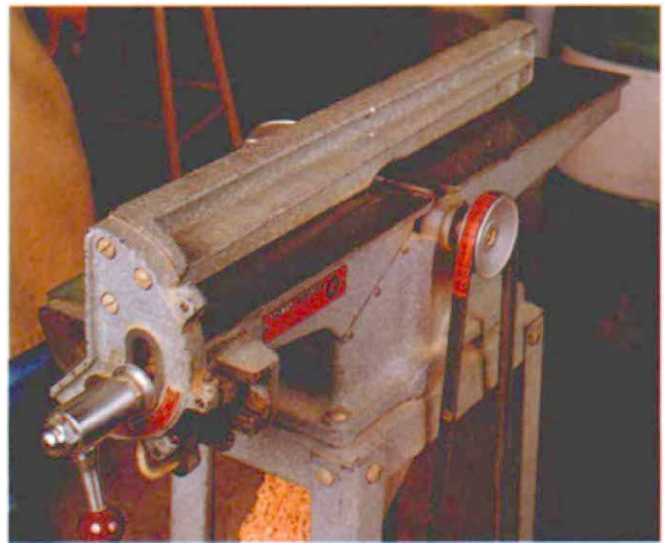
designates the maximum width of the cut the machine can make, based on the length of the knives and the cutterhead cylinder, which in turn dictates the width of the tables. If you walked into a small- to medium-size cabinet shop, you'd most likely find a 6-in.- or 8-in.-wide jointer with a total table length of 4 ft. to 6 ft. Narrower models aren't wide enough to be much good for flattening surfaces of boards and their correspondingly shorter tables don't provide enough support for accurately edge jointing long pieces. The 6-in.- and 8-in.-wide machines strike a balance between performance and cost; their tables are long enough for accurately edge jointing long boards, wide enough to allow some surfacing of boards, and they range in price from $400 to $1,200. As the table width increases, so does the size of the motor and the weight and price of the tool. Most 12-in. jointers qualify in all respects as heavy-duty industrial machinery.

Mid-size jointers generally have a -HP to 2-HP, 3,450-RPM motor that drives the cutterhead between 4,000 RPM and 5,000 RPM with pulleys and a V-belt. To keep your jointer running smoothly, you should periodically check the cutterhead for bearing wear, the V-belt for wear and the pulleys for alignment. The cutterhead bearings should have a solid feel and turn silently. Wobbles, vibrations and grating noises are obvious signals that the bearings should be replaced. As with an automobile fan belt, it's important that the jointer belt is not frayed or nicked. Check the pulley alignment by placing a straight edge flat against the outer rim of one of the pulleys. If they're in line, the straight edge will just contact the rim of the other pulley. Adjust, if necessary, as indicated in your owner's manual. Out-of-line pulleys will not only lead to premature belt failure, but the continuous uneven pressure could eventually erode the arbor hole in the pulley until it won't stay on its shaft.

Depth of cut is regulated with either a lever or handwheel that raises or lowers the infeed table. The distance between the top of the infeed table and the highest point of the cutting arc determines the depth of cut. On some jointers the outfeed table adjusts up and down like the infeed table, which can be handy when replacing knives and aligning the tables.

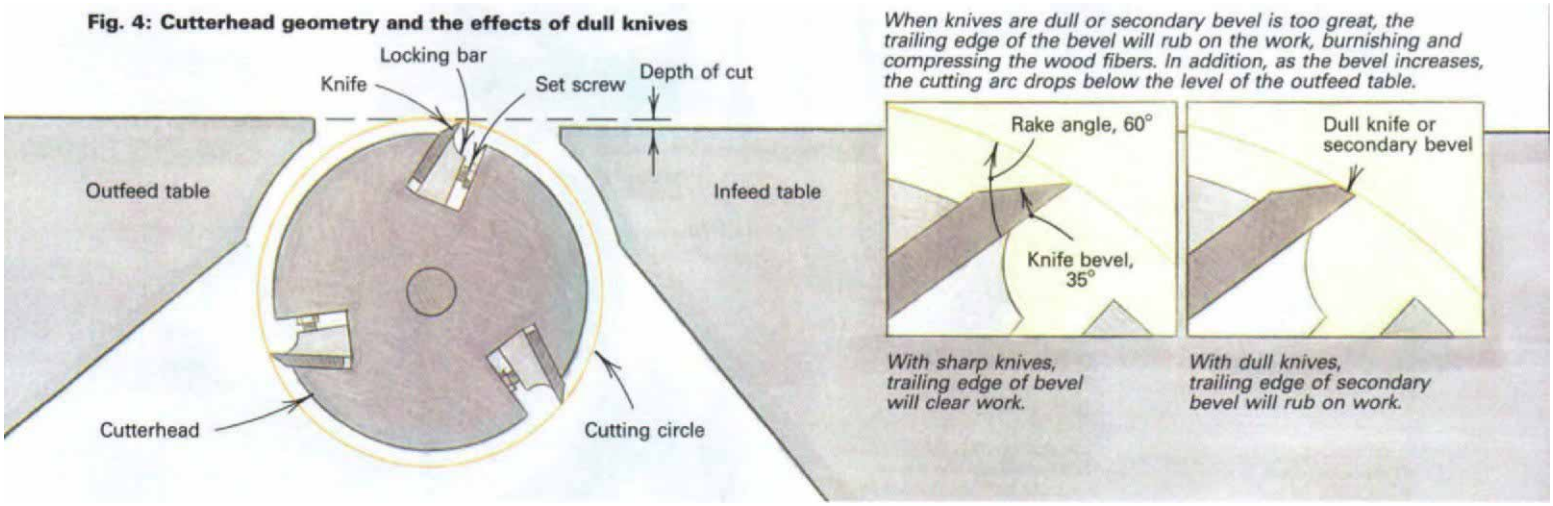
For edge jointing, the fence is usually set 90° to the table. This ensures that the edge being machined will be square with the surface that's run against the fence. The top photo at right shows the type of fence most commonly found on high-quality jointers. This

The Rockwell fence, above, is typical of the center-mount fences found on most 6-in. and larger jointers. The fence is attached to a casting that covers the cutterhead pulley and the exposed knives behind the fence. The lever on the casting unlocks the fence's movement across the tables and the smaller lever unlocks the fence to set its tilt. A plunge pin is a positive stop for 90° and 45°. The knob attached to the fence itself is a handhold for adjusting the fence.



Another common type of fence slides in a channel in the front end of the infeed table. The knob operates a socket wrench that can be slipped over one nut to adjust the tilting mechanism or over another nut to control the side-to-side movement of the fence.

Fig. 4: Cutterhead geometry and the effects of dull knives



If adjusting the gibs fails to correct a table sag or tilt, brass or paper shims can be inserted as shown to lift the table.

fence usually has a positive stop for both 90° and 45°, and the casting supporting the fence doubles as a guard to cover the cutterhead behind the fence. The most common fence on smaller and/or less expensive jointers slides along a bar or track at the front of the infeed table (see the bottom photo on the previous page). Before buying a jointer with this fence, make sure the tilting lock and the side-to-side lock are separate from one another or you will have to reset the fence to 90° each time you move it. It's a good idea to move the fence from time to time to ensure even wear along the entire width of the knives. I like to save 1 in. or 2 in. at the rear of the knives so I have a pristine edge for those final clean-up cuts.

The blade guard is a cast-metal fixture that rotates on a spring-loaded pivot in the infeed table and covers the exposed portion of the cutterhead. Make sure the tension on the spring is great enough to swing the guard up against the fence after the trailing end of the work passes over the cutterhead. Woodworkers can argue all day about the pros and cons of tablesaw guards, but there's no good reason not to use a jointer guard. It's simple and it works.

Aligning the tables—New jointers should come from the factory with their tables parallel to each other and the cutterhead. However, because this alignment is so crucial to a jointer's performance, it's prudent to recheck it anytime the tool is moved or knives are replaced. In the university shop where I teach, I occasionally catch a student using the outfeed table as a seat. After my blood pressure has gone back down, I check the table for sagging (drooping front to rear) and tilting (angling side to side).

To check table alignment, raise the infeed table to the same height as the outfeed table and hold a reliable straightedge, at least 3 ft. long, near one side of the infeed table. If all is well, the straightedge will contact both tables along its full length and no light will show beneath it. Repeat this on the forward side of the tables. If light shows on one side and not the other, there's tilt. If light shows at the rear of the outfeed table and not at the front, it indicates sag. A gap of even a few thousandths of an inch is a problem.

If adjustments are needed, check your owner's manual for the recommended procedure. Don't panic if that doesn't work. The instructions for the 8-in. Rockwell in our shop call for a detailed readjustment of the gibs, which are the keys that fit in the dovetail ways that the table moves along (see figure 2 on the previous page). This has never worked for me. What does work is loosening the gibs, lifting the end of the table and inserting a few shims until everything is back where it should be, as shown in the photo at left. Brass shim stock is ideal, but matchbook covers and index cards are okay and they'll last for years.

Changing the knives—Because of the precision required, some woodworkers dread their first knife change so much that they put it off indefinitely. The knives continue to cut, but they develop a secondary bevel as they dull, as shown in figure 4 above. When this secondary bevel gets to be larger than about $\frac{1}{64}$in., it no longer provides adequate clearance and begins to rub against the wood fibers behind the cut, burnishing and compressing them so they will not glue or finish reliably. You can avoid this by changing the knives when you see a heel forming behind the cutting edge. By the way, honing dull knives with a sharpening stone while the knives are still in the machine will only enlarge the secondary bevel and increase the burnishing problem; it is not a substitute for changing knives. Some books and instruction manuals recommend honing a minute secondary bevel, *as the last step when installing sharp knives,* in order to extend cutting edge life. However, it should be noted that if the honed bevel is too large, you will have the same burnishing problem as with dull knives (see figure 4).

Unless you're experienced at precision-grinding, send your knives out to be professionally sharpened, and keep a spare set of sharp knives on hand to avoid downtime. The knives should come back to you ground with a single bevel of about 35°. Repeated sharpening will reduce the height of the knives. Be careful: Eventually the lock bar may not be able to grip the knife solidly. To avoid a dangerous situation, check your manual or contact the manufacturer for minimum knife height. One more thing to be aware of: Most manufacturers warn that removing all the knives at once and then replacing them one at a time can dangerously stress

the cutterhead. Instead, remove a single knife, replace it with a freshly sharpened one and tighten it down completely before removing the next knife.

The basic strategy of installing knives is simple. The knife is inserted into the cutterhead slot and held firmly, but not too tightly in place, with two or three set screws. At this time, the knife should be parallel with and slightly higher than the outfeed table when the cutterhead is rotated so the cutting edge is at top-dead center. Then, with the cutterhead set at top-dead center, push the knife down until it just brushes a straightedge extending off the outfeed table, as shown in the photo below. When the knife is in line with the outfeed table along its entire length, secure it by tightening down all the set screws.

Simple enough, right? Well, yes, except for the tendency of the knife to devilishly squirm a hair's breadth out of alignment as the set screws are tightened. This tendency can be reduced by tightening the middle set screw first and then alternately tightening the other screws as you work out to the ends. One improvement on the basic system for aligning the knives is to use a piece of ¼-in. or thicker Plexiglas, which spans the width of the cutterhead, instead of a straightedge. This lets you set the height of the knife all along its length in one step. Somewhat more effective is the "Magna-Set," available from Uniquest Corp., 585 W. 3900 South, Suite 6, Murray, Utah 84123; (800) 331-1748. This device has magnets that grip the knife and hold it in alignment while the set screws are tightened. I've found this to be the best solution so far, but even it can be humbled by the proclivity of the knife to squirm as the lock bar is tightened.

Using the jointer—A jointer demands respect! Read your instruction manual and heed its safety warnings. Never run anything shorter than 10 in. through a jointer. Short pieces can tip into the jointer's throat and be kicked back by the cutterhead, potentially exposing hands to serious injury, Likewise, be wary of face jointing thin stock. It chatters, is difficult to feed and may creep uncontrollably under the guard and fence. When edge jointing narrow stock, anything that doesn't stand as tall as the fence, take special care to keep your fingers clear of the cutterhead; nipped fingertips from inadvertently dragging them over the cutterhead are one of the most common injuries in the woodshop. Use push sticks whenever possible, and maintain your balance when feeding stock. You should never be pushing so hard or leaning on the work so much that your hands would be in danger should the piece kick back. Even standing idle, a jointer cutterhead, with its razor-sharp knives, smacks of potential danger, so keep the guard in place.

Work is always fed from the right at a moderate rate. Rate of feed is important: If it's too fast, scallops appear; too slow and burn spots show. Feed pressure is in three directions: sideways against the fence to ensure a square cut, downward to eliminate vibration and chatter and forward to advance the lumber. At the outset, both hands bear against the work on the infeed table. As the work passes over the cutterhead, you must transfer your downward pressure to the outfeed table with your left hand and continue the pressure on the outfeed table as you finish the cut to ensure that the flat plane being created on the underside of the work is parallel with the plane of the outfeed table. As you transfer the pressure, you should maintain a constant feed rate because abrupt slowdowns or complete stops will show on the finished surface.

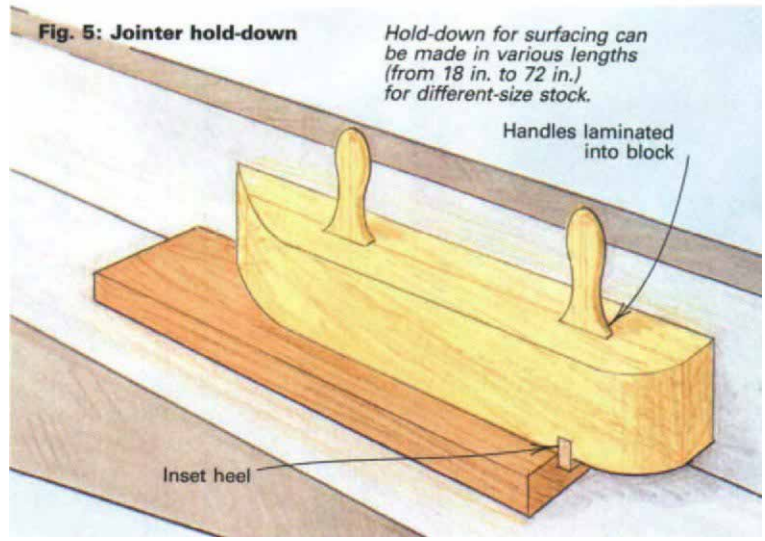
Whenever possible, feed the lumber into the jointer so the cutterhead will be cutting with the grain, as shown in figure 3 on p. 63. Of course, this is the ideal grain picture. Quite often, the grain direction will reverse somewhere along the board. If so, take your best guess and run the piece slowly at a moderate depth of cut. If there's too much grain tearout, reverse the board and make another pass to see if there's any improvement. Tearout can be minimized, and often eliminated, by reducing the depth of cut and drastically slowing the feed rate to a creep over the problem area.

Finally, keep in mind that jointing opposite faces or edges doesn't ensure that they are parallel. For parallelism, true up one face with the jointer, and then run the board through a thickness planer with the flattened face on the table. The same principle holds true for edges. Straighten one edge on the jointer and run this edge against the tablesaw fence as you rip the board to width. If you rip the board 1/32 in. to 1/16 in. wide, you can clean off the saw marks with a single pass on the jointer.

Surfacing—To true up a face, line up the fence with the far end of the knives to allow maximum width of cut. This means full knife exposure because a wide workpiece forces the guard completely aside; so before you begin, see that the blade guard functions properly and you have a solid, reliable hold-down. Figure 5 below shows a hold-down I designed for this purpose. I keep several sizes for different lengths of stock in the university's shop and they've given reliable and safe service for more than 10 years.

If the board is bowed or cupped, it's best to flatten the concave

To set the knife height, hold a straightedge on the outfeed table and rotate the cutterhead back and forth. Adjust the knife height until it just brushes the straightedge. Set the height at both ends of the cutterhead and then tighten the set screws, beginning with the center one and moving out to both ends. This reduces the chance of the knife squirming out of alignment as the set screws are tightened.



side, which allows the workpiece to rest on its "ears" or corners. If you must joint the convex side, flatten the center or high point first. Don't rock the piece over the cutterhead or you'll end up either tapering the work or planing the curve.

Set the infeed table for a cut of 1/32 in. to 1/16 in. and no more! You'll be cutting maximum width and you don't want to lug down the motor. In addition, if you have to use excessive feed force, you increase your chances of slipping. With the heel of the hold-down firmly against the butt end of the stock and with a firm grip on the handles, feed the lumber at a slow to moderate rate over the knives. If the board is twisted, tip it so you're planing down the high corner. Don't let the work tip or rock, but keep it steady and on line. As a flat area is created, press it snug to the outfeed table. Check the surface after each cut to make sure you're removing the high spots. The planed area should increase with successive passes. With bowed boards be careful not to force the bow down as the board passes over the cutterhead or you'll be planing the curve instead of eliminating the high spots.

Experienced woodworkers sometimes surface boards that are wider than the jointer knives by working alternately from both edges of the boards. It's kind of a hit-and-miss process, but with a little practice you can flatten a board up to twice the width of the jointer. Don't worry about perfectly matching the opposing cuts; as long as the board will lie flat, the planer will clean up the job.

Edge jointing—When your properly flattened boards emerge from the thickness planer, they'll have straight, parallel faces. Next, you'll want to establish an edge that is square with the freshly planed faces and straight along the length of the board. For most edge jointing, set the fence exactly 90° to the tables with a square. The exceptions to this would be intentionally beveling an entire edge to a specific angle or chamfering an edge (planing a small bevel along the edge). In these cases, set the angle of the fence with an adjustable bevel square that's been set with a protractor.

If the edges of the boards are nowhere near straight, work the concave edge whenever possible, just as when surfacing. If the convex edge must be worked, go after the high point of the curve first. On extremely arched edges, it might save time to snap a chalkline lengthwise on the face of the board so you can bandsaw it as close to straight as possible before jointing.

The most common error when edge jointing is not holding the trued face tightly against the fence all the way through the cut. Attention to this is even more critical when making beveled or chamfered cuts because the face has a tendency to slide off the angled fence. If your fence tilts in both directions, you can reduce the sliding by tilting the fence so that it creates an acute angle with the table instead of an obtuse angle.

There is one other exception to the rule of setting the fence to 90° for edge jointing. In production shops, it's fairly common to set the fence a couple of degrees out of square when jointing boards to be glued up for doors and panels. As the boards are glued up, the face that was run against the fence is alternated from the front to the back of the panel on each adjacent board. This method results in a flat panel because combining the two angles will always add up to 180° This technique works fine in a production situation in which panels are glued up from 2-in.- to 3-in.-wide boards without concern for grain match. In this instance, the panels all tend to match because they're all random. However, if grain match is important, jointing from alternating faces might force you to joint an edge against the grain, which could result in tearout. That's why most specialty and one-of-a-kind shops set the fence at precisely 90°; the boards can then be arranged for the optimum grain match and their edges jointed from whichever face will allow the least chance of tearout. □

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Sources of supply

The following companies manufacture mid-size jointers.

Busy Bee Machine Tools Ltd., 475 N. Rivermede Rd., Concord, Ont., Canada L4K 3R2
Delta International, 246 Alpha Dr., Pittsburgh, PA 15238
Farris Machinery, 2315 Keystone Dr., Blue Springs, MO 64015
Grizzly Imports Inc., Box 2069, Bellingham, WA 98227
Hitachi Power Tools, 4478-E Park Dr., Norcross, GA 30093
Jet Equipment and Tools, Box 1477, Tacoma, WA 98401
Lobo Power Tools, 9034 Bermudez St., Pico Rivera, CA 90660
Makita USA, 14930 Northam St., La Mirada, CA 90638-5753
Mini Max, 5933-A Peachtree Industrial Blvd., Norcross, GA 30092
Powermatic, Morrison Road., McMinnville, TN 37110
Ryobi America Corp., 1433 Hamilton Parkway, Itasca, IL 60143
Sears Power Tools, Sears Tower, Chicago, IL 60684
Shopsmith Inc., 3931 Image Dr., Dayton, OH 45414
Sunhill-Nic Inc., 1000 Andover Park E., Seattle, WA 98188
TCM Industries Inc., 322 Paseo Sonrisa, Walnut, CA 91789
Wilke Machinery Co., 120 Deny Court, York, PA 17402

Jointing beyond the basics

Rabbeting: There are a number of tools to cut a rabbet, including handplanes, routers, dado sets on the tablesaw and high-speed shapers, but when the rabbet runs with the grain, my choice of tools is the jointer. It's easy to set up and it gives crisp and clean results.

Sadly, not all jointers are equipped for rabbeting. In order for a jointer to have this capability, an arm is either bolted to or cast as part of the infeed table to support the work as it's passed over the near end of the knives. A notch (or rabbet) milled into the outfeed table allows the unrabbeted portion of the work to clear the outfeed table, as shown in the photo on the facing page. In addition, the knives should be installed so their ends all extend the same distance beyond the end of the cutterhead.

To set the width of the rabbet, measure from the near end of the knives to the fence. Set the infeed table for a 1/16-in.-deep cut and feed the workpiece into the knives. For each succeeding pass, increase the depth of cut by 1/16 in. or less until you reach the desired depth. The rabbet's maximum depth is limited by the notch in the outfeed table; its maximum width is limited only by the length of the knives. Because the guard must be removed for rabbeting, extra care should be taken with this operation. To ensure adequate hand clearance, the stock should be at least 6 in. wide. If the rabbeted piece must be narrower than 6 in., rabbet a wider piece and then rip it to the narrower width.

End-grain jointing: Many experts advise against jointing endgrain because the hardness of endgrain dulls knives and also increases the danger of the piece tipping into the jointer's throat and being kicked back by the cutterhead. While there's no doubt that endgrain is harder on knives than side grain, a tight knot is also rough on knives. The likelihood of kickback is not really due to grain orientation; the chances of kickback would increase if the end-grain section wasn't long enough so the panel could be held tightly to the infeed table to prevent the leading edge from tipping into the throat.

I believe that end-grain jointing can be a reasonably safe alternative to the hours of tedious sanding required to remove every last burn and saw mark from the stubborn endgrain on wide, glued up panels. But end-grain jointing is only safe if the following criteria are met: the panels are at least 18 in. wide across the grain and tall enough to generously clear the height of the fence; very light cuts are taken (1/32 in. or less); and the endgrain of the panel is held firmly to the infeed table until the leading edge has passed over the cutterhead and is supported by the outfeed table.

If these precautions are taken, the endgrain will come through the jointer clean and crisp. However, when the trailing edge hits the knives, the unsupported grain at the back side of the panel will split out. Figure 6 above shows three methods to avoid this. Keep in mind that end-grain cuts are only for cleanup. If you take more than one or two passes, you risk trimming the end out of square with the edges.

Cheap tricks: Following are some quick fixes that add a touch of detailing to a job and give it that million-dollar look of meticulous hand-crafting. For instance, if you're putting up a set of shelves, a simple 1/8-in. chamfer on the edges turns square-nose carpentry into cabinetry. Set the jointer fence to 45° and run both edges through—total time is 45 seconds! Use the same approach to create quickie moldings, cabinet door stops and so on. It's an easy way of softening a corner and the effect is both visual and tactile.

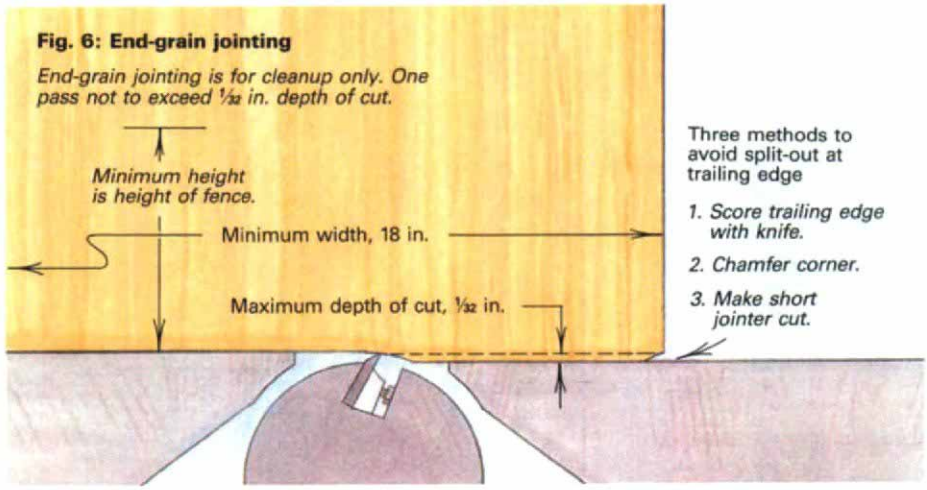
Drawer problems? Perhaps you built them last winter when household moisture was low. When summer brought heat and humidity, your once carefully fit drawers wouldn't budge. The jointer can remedy this in a few minutes.

If the width of your jointer matches or exceeds the height of your too-tight drawers, the fix is easy. Treat the side of the drawer as though you are surfacing lumber. Protect your corner joints by following the rules for preventing split-out when end-grain jointing. Set the jointer for an absolute minimal cut and pass the drawer through. Let the rear of the drawer be the trailing edge, just to be on the safe side. Check for fit and repeat the process if needed.

Are the drawers too high? Use the rabbet setup procedure. Slide your fence forward until the distance between it and the near end of the knives is equal to the thickness of the drawer sides. In turn, pass all four edges (tops or bottoms) of the drawer sides through the jointer. Feather away any cross-grain ragging with sandpaper.

If you're building a cabinet with a door, rabbet the forward faces of the top and bottom boards with the jointer before you assemble the carcase. A 1/4-in.-deep rabbet slightly wider than the thickness of the door should do. The upper and lower rabbets will not only serve as door stops, but also prevent dust intrusion.

While you're working on that cabinet, consider using a continuous piano hinge to hang the door. You can't beat it for strength or the jewel-like detailing of the long, polished barrel. The problem with a piano hinge is mounting it perfectly straight, but if you've got a jointer that can cut rabbets, you've got the solution. Before the carcase is assembled, rabbet both the hinged side of the cabinet and the door edge to just fit the hinge leaf. Be sure to let the entire barrel protrude beyond the door and frame. Now, here's the trick: When you're locating the screw holes with the awl, punch them off center, toward the rear of the rabbet. Then, as the hinge is screwed down, it will be drawn tightly to the wall of the rabbet and be dead on line. —*B.M.*



The rabbeting arm supports the board, and the notch in the outfeed table lets the unrabbeted portion of the board go by. Here the author is on his third pass; when rabbeting, the infeed table is lowered an additional 1/16 in. for each successive pass.