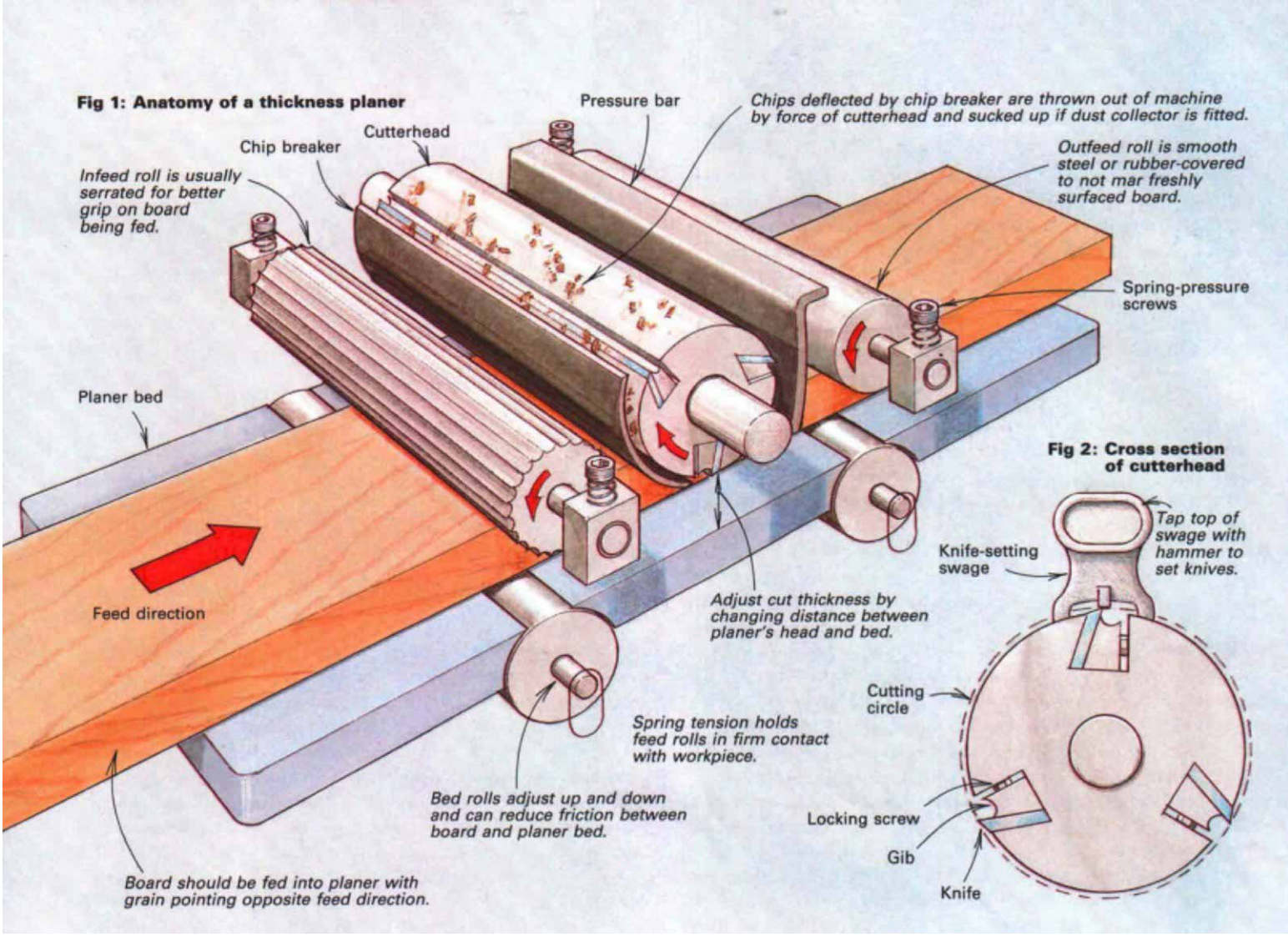


Thickness-Planer Primer

Fine-tuning is the key to smooth planing

by Alfred E. Holland, Jr. and David Kinter

There are many types of planers on the market, ranging from small hand-fed 4-in. to 6-in. models to large production machines with multiple cutterheads capable of surfacing a million feet a week. Despite differences in size and features, all planers operate on the same principles. If you understand these principles, you can adjust your planer properly to obtain consistently flat lumber that's smooth as silk. The planers we'll discuss in this article are those most commonly found in the home shop or small woodworking business—the single-cutterhead surface planer with a maximum width of 12 in. to 18 in., often called a "cabinet" or "pony" planer.

A typical planer consists of a flat bed supported by a frame, usually cast iron. The frame supports a 1½-HP to 3-HP motor that drives a multi-knife cutterhead suspended above the bed. The motor also powers a series of rolls above the bed that push wood through the machine. A board placed on the bed is grabbed by the infeed roll, which presses it flat and drives it into the spinning cutterhead. Just ahead of the cutterhead, a metal bar called the chip breaker helps break off chips raised by the cutterhead and clear shavings out of the planer. Behind the cutterhead is another bar, called the pressure bar, which also holds the wood flat against the bed. An outfeed roll behind the pressure bar pulls the wood out of the planer. Depth of cut is determined by the distance between the bed and the cutterhead arc and is controlled

by turning a crank wheel that either moves the head (containing the cutterhead and feed-roll assembly) or the bed up and down.

Unlike a handplane blade, which slices a single shaving at a pass, the multiple knives in a planer's cutterhead each take many small shavings as the board is fed past. The cylindrical cutterhead has slots in it that hold two, three or four knives The knives are held in place by locking screws, which let the knives be adjusted or removed. These screws don't bear directly against the knives, but contact knife-length bars called gibs, which distribute the pressure of the screws evenly and help curl over the wood chips sliced off by the knife.

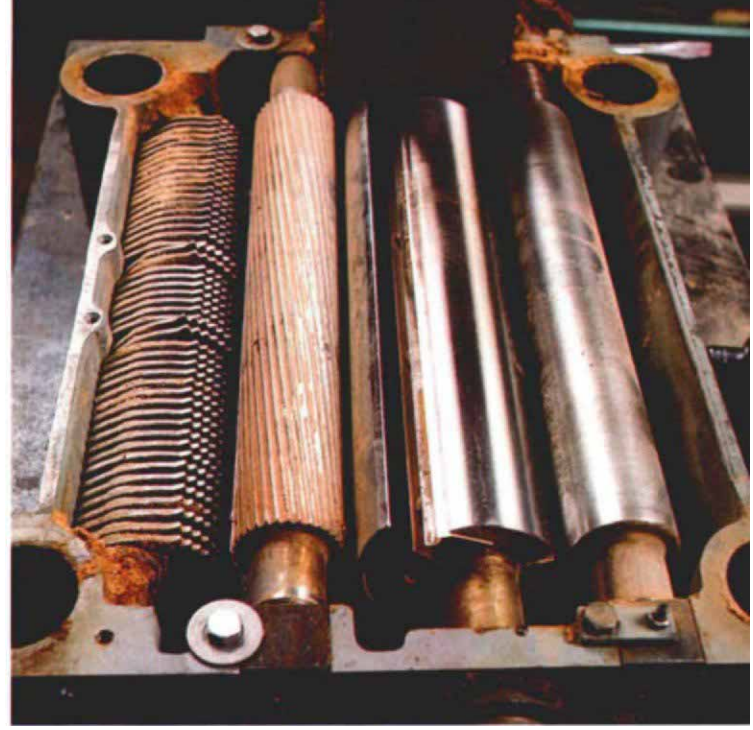
The infeed and outfeed rolls on small planers are driven by chains or belts connected via a gear-reduction box to the cutterhead. The rotational speed of these rolls determines how fast the lumber passes through the planer. The infeed roll is typically a serrated steel cylinder that grips the top surface of the rough stock fed into the planer. The outfeed roll is usually either smooth or rubber-covered steel, so it won't mar the freshly milled surface of the wood. Both feed rolls must press the stock flat against the bed to ensure a straight cut, but must also accommodate the irregular thickness of rough lumber. To achieve this, the rolls are spring-loaded and travel vertically to allow for thickness variations. Bed rolls are not usually powered and arc positioned in openings in the bed directly below the feed rolls. They reduce feed friction by lifting the board off the bed slightly.

For a smooth cut, the wood must remain flat on the bed during the cut, so the chip breaker and pressure bar are very important. Besides holding the work down, the chip breaker also directs the chips out of the machine (and into the dust collector, if one is fitted) and minimizes tearout by breaking off chips lifted by the cutterhead's cutting action. The pressure bar is a rigid steel plate adjusted to align with the lowest swing of the rotating knives, and therefore, to the thickness of the just-planed lumber. Some of the smaller machines get along without a pressure bar, but these planers usually have slower feed rates and can't remove as much material in a single pass as those with pressure bars.

More sophisticated planers employ a segmented infeed roll that can accommodate greater surface irregularities than a single serrated roll. This prevents slipping when boards of varying thicknesses are run simultaneously through the planer. The feed speed on some planers can be adjusted either by flipping a lever or changing a belt. This is a critical feature if you surface both hardwoods and softwoods, because hardwoods usually require a slower feed speed than softwoods.

Some planers are also equipped with anti-kickback fingers or pawls to prevent the cutterhead from throwing a board back at the operator. Knife-setting devices that can knock the drudgery out of changing knives are also common on more elaborate planers. These devices include jacking screws built into the cutterhead to raise or lower knife height or separate jigs that clamp the knives in the proper position while they're being locked into the cutterhead. Production-model planers usually offer a knife-grinding attachment that allows the knives to be jointed, ground and honed while they're still in the cutterhead. Most small shops, however, send their knives out for professional sharpening.

Tuning up a planer—Start by leveling the planer—both side to side and front to back. A spinning cutterhead works like a gyroscope and runs smoothest when level. When out of level, it strains against its bearings and causes excessive wear. If the floor you place the planer on is fairly level, it should be heavy enough to stay put, but we've always bolted our planers down to ensure they don't move and that each foot assumes its share of the load.

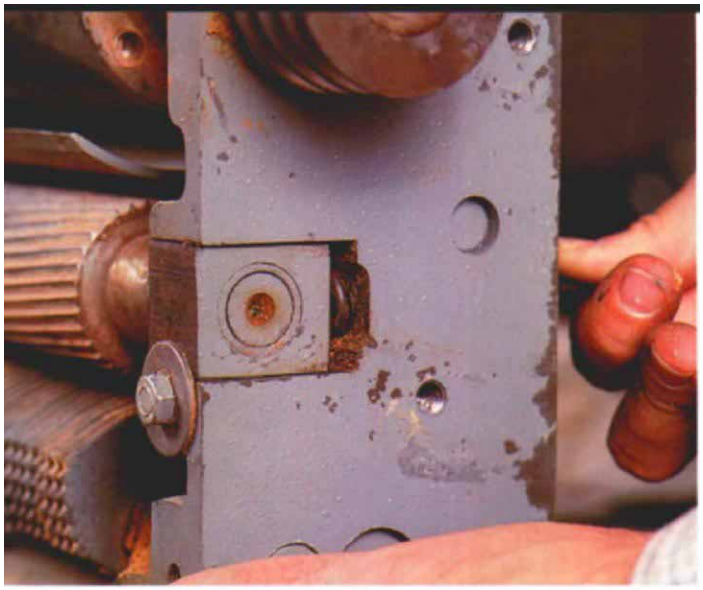


If you remove the head and turn it upside down, you can see (from left to right) the anti-kickback pawls, serrated infeed roll, chip breaker and smooth-steel outfeed roll on this Delta 13-in. planer. A pressure bar, normally located between the cutterhead and the outfeed roll, has been omitted on the Delta.

The cylindrical steel cutterhead has three slots milled in it to hold the knives. The knife-locking screws don't bear directly on knives, but distribute their pressure on wedge-shaped gibs. Each gib has a flute along its upper edge to help deflect chips.

For most adjustments, the cutterhead is the main reference surface. Its position in the frame can't be altered, so the other components must be aligned to it. First, check to see that the planer's bed is parallel to the cutterhead along its length. You can measure the distance between the bed and each end of the cutterhead with an inside caliper or pass a trued-up block of wood between the two components. Place the block under the cutterhead and reduce the thickness adjustment until the block just passes through the opening. If you feel an equal amount of drag as you pass the block through the opening at several points along the cutterhead, the head and bed are parallel. If the block sticks at one end and flies through at the other, you'll have to adjust the bed. When the bed and cutterhead are out of alignment, you might also find that the thickness adjustment is difficult to crank up or down or that you can wiggle the bed up and down or side to side. Realigning the table will likely cure these problems, too.

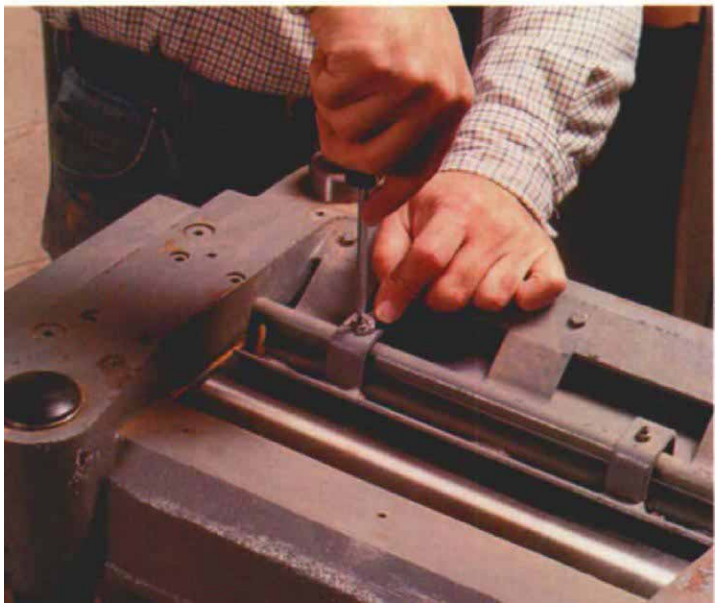
If the thickness adjustment is based on the synchronized rotation of two or more threaded rods, raising the bed's lower edge by repositioning the drive gear(s) on the end of the rod will level the table. If you have a planer bed with gibs and ways (slotted



With this Delta planer's head partially disassembled and on its side, you can see the infeed-roll pressure spring, which bears on a sliding bearing block supporting the roll's shaft. A screw on top of the head adjusts the spring's tension and how hard the roll presses down on the work. Screws at either end of the roll must be set to give equal pressure.

When the pressure of the infeed roll is set too high, the roll's steel serrations will often emboss a pattern into the planed board. If a light cut is taken, marks will usually remain.

Though it doesn't often need to be reset, the chip breaker's height is set on many planers by turning two adjusting screws that raise or lower the chip breaker relative to the cutting arc.

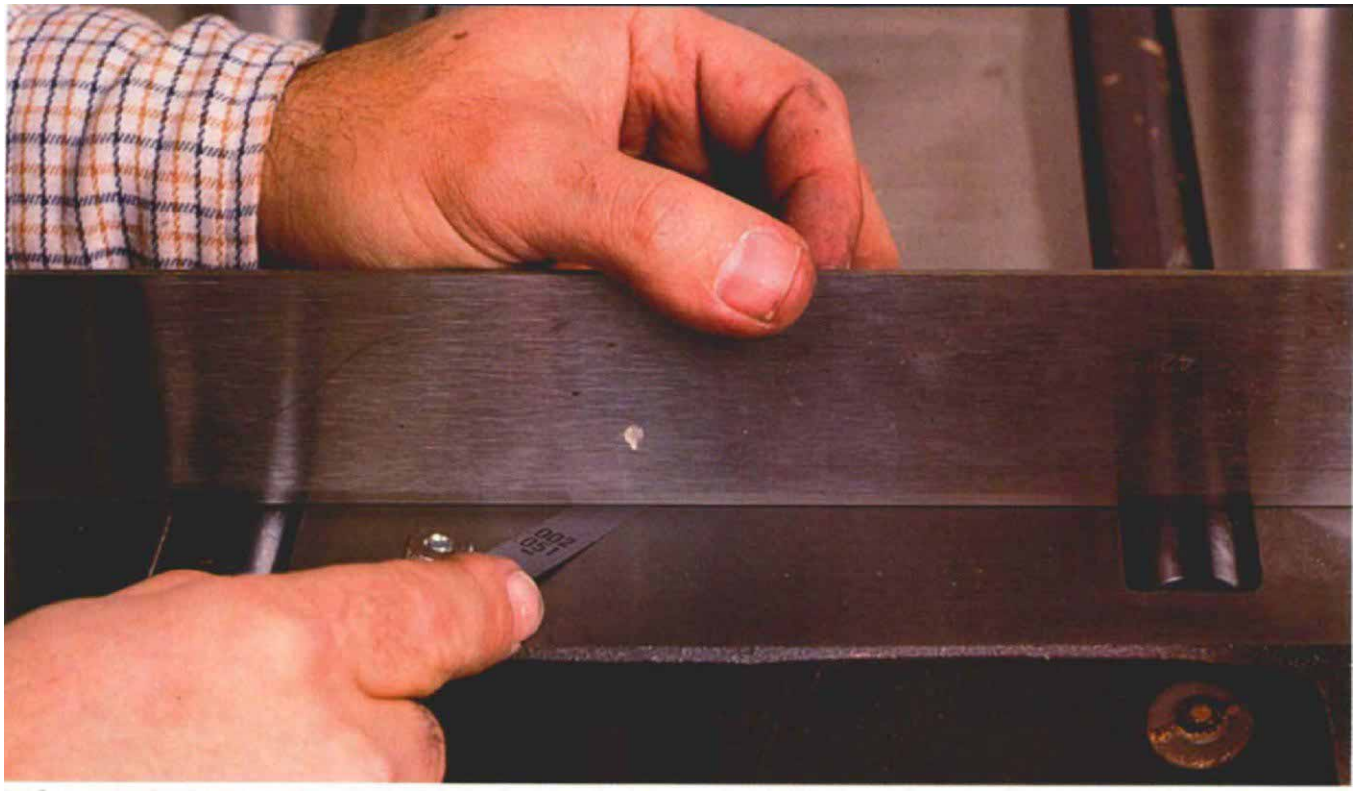


tracks), you may have to readjust the gibs in the ways by adding metal shim stock between them or by judiciously filing or scraping. If the thickness adjustment is based on two wedges that slide against each other, check for dirt between the mating surfaces. Also, file or scrape away any high spots on the surfaces. If you still can't align the bed and cutterhead, a last resort is to set the knives parallel to the bed by locking them in the cutterhead at a slight angle, but we don't recommend this as a final solution. Get a machinist to take a look at the machine first.

Feed roll adjustment—On most planers, feed rolls are set by tightening or loosening the spring-pressure screws found on top of the planer (see figure 1). The infeed setting must strike a balance—the pressure should be sufficient to move the board but not so great that the serrated roll leaves an imprint deeper than the thickness the cutterhead will plane off. Start with the springs at their lowest compression, then try a paper-thin pass. If the infeed roll slips, increase the spring pressure. Embossing can sometimes be a real problem with thin, soft stock. In this case, it's okay to raise the infeed rolls until they barely contact the wood, as long as you take thin cuts that require less feed pressure. CAUTION: Don't forget to lower the rolls before taking any heavy cuts or else a dangerous kickback could occur. The outfeed-roll pressure isn't as great as on the infeed, but it shouldn't slip on the wood or allow the wood to lift from the bed. The outfeed roll is adjusted the same way as the infeed.

Chip breaker and pressure bar—The chip breaker should be set so its bottom edge is far enough below the cutterhead arc to keep the stock from lifting off the bed. The chip breaker rarely needs adjustment. While the chip breaker's setting isn't critical, the pressure bar is another matter. If it's set too low, the workpiece will jam in the planer. If it's too high, the wood will bounce under the cutterhead, resulting in chatter or tearout. Because the adjustment is so important, we never do it until after we're sure the feed rolls arc right and the bed leveled. After thicknessing a scrap, shut the planer off, unplug it and wait for the cutterhead to come to rest. Now slip the surfaced scrap into the planer and check to see if it just slips under the pressure bar with a friction fit. This is largely a matter of feel, but with some practice you'll be able to tell if the piece is sticking or if there's too much play. If necessary, loosen the retaining bolts and adjust. After years of use, the pressure bar will wear more in the center than at the ends, so a board might jam along the edges of the bed but chatter when passed through the center. If this happens, remove the bar and file it straight or have a machinist grind it true.

Bed rolls-How you set the bed rolls depends on the kind of surfacing you do. The rougher the lumber, the higher the bed rolls must be set to reduce friction between the lumber and the bed. If the bed rolls are set too high, the workpiece passing over them may begin to vibrate, creating a rippled surface. While this won't be a problem with 8/4 maple, even a well-adjusted machine will devour thin wood with gusto. Smaller machines generally plane thin stock more successfully, because the smaller-diameter heads and closer positioning of feed rolls shortens the length of a board that can vibrate. For finishing cuts on relatively smooth surfaces, the bed rolls should be set just about dead even with the bed's surface. Measure the setting by laying a straightedge across both rolls on one side of the machine and inserting a feeler gauge between the straightedge and the bed. Settings will vary from 0 in. to 0.002 in. for finish planing and up to 0.008 in. for surfacing rough stock. The bed rolls can be quickly adjusted by



With a straightedge spanning the bed rolls, insert a feeler gauge between the straightedge and table to measure bed-roll length. Eccentric bolts at the ends of the bed-roll shafts can be turned to raise or lower each end of the roll independently. For planing thin lumber, the bed rolls can be lowered flush with the table. The planer's head has been removed for clarity.

built-in levers on some planers; on others, locking bolts must be loosened before any adjustment can be made.

The belts that drive the cutterhead and feed rolls should be checked occasionally for wear and tightened if necessary, but don't overdo it. Overtightening a belt strains bearings and shortens their lives. A good rule of thumb is that when slight pressure is applied, the belts should flex about 1/32 in. for every inch of belt between pulleys. Apply belt dressing, available in spray cans or solid sticks at auto-supply stores, a couple of times a year to reduce slipping. Chains and sprockets exposed to dust and shavings should be lubricated with graphite or other dry lubricants. If they're enclosed in a tight case, a light greasing will do.

Sharpening and installing knives—No amount of adjustment will make up for dull, improperly installed knives. Knife replacement can be tedious, but the more accurately you work, the smoother the surface your planer will produce. Unless your planer is equipped with a special knife-grinding attachment, dull knives must be removed from the head before they can be sharpened. To shorten downtime, keep an extra set of sharp knives handy to swap with the dull ones. After removing the dull knives, clean the slots in the cutterhead, removing any debris that might prevent the knives from seating properly. Use oven cleaner or a Scotch-Brite pad moistened with diesel oil to remove the accumulations of pitch and resins, then wipe the head with a damp rag and let it dry thoroughly.

If you're ambitious or own a knife-grinding setup, you can joint and sharpen your own knives. But it's difficult to get them perfectly straight, so most woodworkers we know send them out to a sharpening shop. When you get your knives back, make sure each edge has been jointed straight and hasn't been burned blue. Properly sharpened knives will have a burr on the edge that must be honed away on a water or oil stone prior to installation. Keeping the bevel flat on the stone, lightly hone each knife until its edge is smooth and shiny. It's likely the bevel will be hollow ground, so the stone will contact only the tip and heel of the bevel, thus reducing the amount of metal that must be removed to eliminate the burr. If you often surface difficult woods, like curly maple, a small bevel can be honed on the back of each knife, blunting the cutting angle slightly and giving it more of a scraping action that's less apt to lift wild grain. (For more on back beveling, see *FWW* #55, p. 74.) These dubbed-over edges are more likely to burn the stock, however, and put additional stress on the cutterhead bearings. When the honing is completed, clean the knives with mineral spirits or naptha.

Install each knife in the cutterhead with its gib and tighten the locking screws enough to hold the knife in the slot, yet leave it loose enough to be moved later on. The trick is to get all the knives to protrude the same amount from the head so each shares the cutting load equally. Otherwise, the knives will wear unevenly and the cut will be rippled. Setting the knives to exact height is best done with a dial indicator on a crow's foot base (see accompanying sidebar on p. 62) or a knife-setting gauge, which sits astride the cutterhead and references the precise knife height.

Tap each knife down into the head (or raise it up if the cutterhead is equipped with jacking screws) until all the knives protrude about 1/8 in. from the cutterhead. As you do the final tightening, each knife will scoot up a bit, but they'll all move a similar amount if everything is clean. Make sure the cutterhead will rotate without hitting anything and check that it is parallel to the bed, as described above.

If the knives aren't set correctly, the high knife will collect more residue and dull faster than the others. As it dulls, it'll heat up and melted resins from the lumber will stick to it. As soon as you notice this buildup, correct the problem. If you wait, the heat might actually anneal the cutting edge, reducing its edge-holding ability.

Operating a planer—The planer is a relatively safe machine to use, but a few words of caution are in order. Thickness planers

can only remove so much material in one pass, usually between 1/16 in and 1/4 in. Attempting to remove more will result in either a jammed or broken machine. If chips jam the feed works, don't lower the bed to remove the stock until the cutterhead has stopped turning. Never reach into a planer that's running. Never plane a board that's shorter than the distance between the feed rolls. Otherwise, the piece could lodge in the planer, only to be shattered as it bounces into the cutterhead. No matter what happens, never look into the infeed end of a running planer; a board might be kicked back by the force of the cutterhead. And always wear eye, ear and breathing protection, even when running the planer for just a few minutes at a time.

There's more to planing than just feeding boards into the machine. By itself, a planer will not make warped stock flat: One side of the wood must first be flattened on the jointer or with a handplane. If you feed a twisted, winding board into a planer, the feed rolls will flatten it out as they move it past the cutterhead, but once the roll pressure is gone, the twist will reappear in the freshly planed board. Joint each piece flat but not necessarily clean on one face; low spots that remain rough will be cleaned up by the planer. Check the board's grain direction and feed it into the planer, jointed side down, with the grain oriented as shown in figure 1. If the grain doesn't clearly run in only one direction, feed it in the most prominent grain direction, angling the board slightly through the planer. Flip the boards end for end to reverse grain direction and then plane the opposite face of each board. Removing equal amounts of material from both faces will minimize warping if the board is case hardened from kiln drying.

Knots, splits, checks—When possible, cut defects out before planing the board. Also, you can cut down on planing time by cutting parts for a project to rough length, then planing the shorter pieces flat and smooth, rather than trying to flatten a long plank along its length and cutting it later. Thin stock, especially with erratic grain, might shatter as it's being planed unless it's supported underneath by a backing board. Smaller boards can be temporarily stuck to a scrap piece of plywood with double-stick tape. Without a backing board, it's usually not possible to plane stock less than 1/8 in. thick to 1/4 in. thick.

Planer problems—One of the most common planing problems is end sniping, which results in a board that's thinner at the ends than in the middle. Sniping usually occurs because the board is not held flat on the planer bed and it rises into the cut-

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Adjusting a planer with a dial indicator

by Robert M. Vaughan

When a machinist assembles a stationary woodshop machine like a planer, he often relies on a dial indicator to check alignments and part sizes. It makes sense for woodworkers to use the same tool when adjusting machines. A dial indicator is more suited to fine work than a ruler or tape measure. My eyes find it a lot easier, for example, to see a difference of 0.016 in. as 16 divisions on the face of a dial than to see a 1/64-in. difference on a tape measure. The indicator quantifies adjustments that might otherwise be a matter of "feel," and thus makes them quicker to perform with more predictable results.

The dial indicator I've found best for most planer work has a range of 1/4 in., though indicators with a range of anywhere from 1/8 in. to 1 in. are available. The end of the shaft on most indicators has a removable tip; I keep both rounded and flat tips on hand. The ball tip is ideal for feed-roll work, while the convex tip is best for knife setting.

While of limited use on a thickness planer, a magnetic base is the most commonly used means of mounting the dial indicator and temporarily fixing it to the work area. It has an on-off switch that engages or disengages a magnetic field that holds it to any iron or steel object. An adjustable arm and swivel arrangement allows the indicator to be rigidly held in any position relative to the base. With the base attached to the side of the planer and the indicator shaft pressed against the planer's bed (perpendicular to the surface), I can crank the planer's thickness-adjusting wheel back and forth a few times to see if it raises and lowers the bed (or head) with consistent accuracy. I also can use a magnetic-base mounted indicator to quickly check the straightness of shafts, the roundness of pulleys or sheaves or the amount of free play between any two moving parts.

The cutterhead gauge base allows a dial indicator to be used for setting the depth of the knives in the cutterhead. While the base rides on the head itself, the indicator's tip rides on the blade's edge and registers its height on the dial.

Besides the magnetic base, two other bases make the dial indicator a particularly useful tool for planer adjustments. The cutterhead gauge base rests on the cutterhead and allows the end of the indicator shaft to ride directly on the edge of a planer knife. With it, you can quickly check how far each knife protrudes from the cutterhead, making sure all the knives are set at exactly the same height. The bed- and feed-roll base is a three-footed base that holds the dial indicator precisely perpendicular to a flat surface, allowing quick checks of cutterhead parallelism and feed- and bed-roll adjustment.

You can make your own cutterhead gauge base and feed-roll gauge base, as I did, from some scrap pieces of steel or aluminum and a few machine screws and nuts. The photos show how they are constructed. If you do make your own bases, make them for the particular dial indicator you plan to use, because the dimensions of various indicators are not all the same. You can also purchase commercially made bases from Powermatic Corp., Morrison Rd., McMinnville, TN 37110. They sell both a feed-roll gauge base (#2230002) and a cutterhead gauge base (#2230007) that will work on Powermatic, as well

terhead. Lowering the pressure bar to eliminate freeplay between the stock and the bed, dropping the bed rolls flush to the bed or increasing the downward pressure of the feed rolls should eliminate sniping. Also, long stock can lever itself into the cutterhead and cause sniping, so always support long boards with infeed and outfeed tables or by hand.

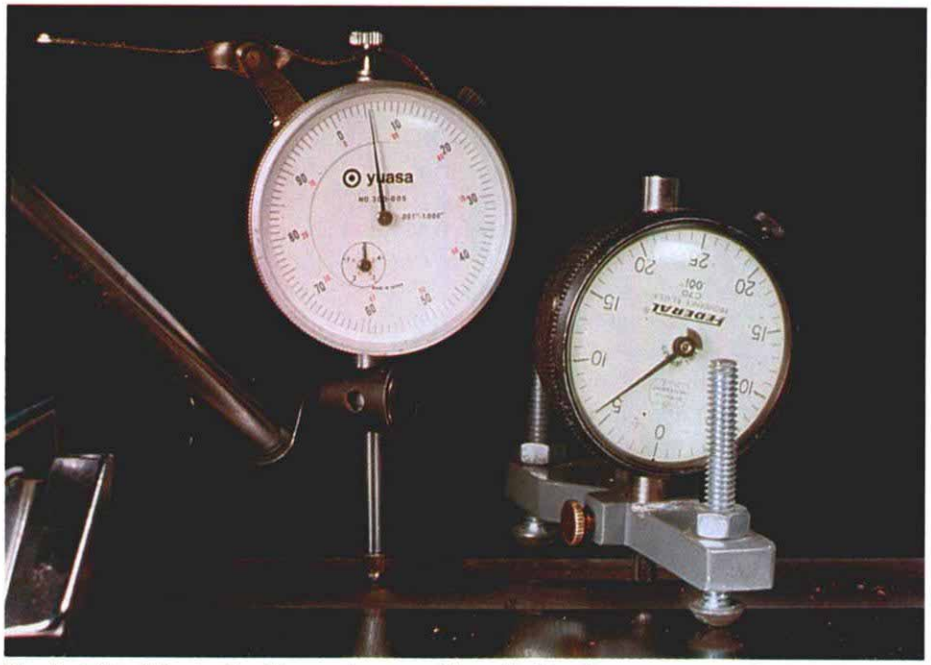
Occasionally, a board with significant variations in thickness will jam in the planer. It can sometimes be freed without shutting the planer off by butting another board against its end (or side, if skewed) and pushing the stuck piece through. Sometimes a large chip lodged between the bed and bed rolls will cause a board to stick or leave a long rut on the bottom of the board. Shut off the planer and clear the chips and any gunk that may have accumulated on the bed rolls before it ruins your lumber or your patience.

If you're not getting surfaces as smooth as you'd like from your planer, chatter may be the problem. It could be caused by an uneven knife setting and/or dull knives, too fast a feed rate or the oscillation of thin stock between the bed and cutterhead. A high knife will cut deeper and leave dozens of little troughs along the board, and as the knife dulls, it will compress the board's fibers and burnish the surface rather than slice it clean. The compressed fibers are nearly impossible to sand out.

The rate at which a board passes by the cutterhead greatly influences the quality of the planed surface: Lower feed rates will produce more closely spaced knife cuts and thus smoother surfaces. But if slow feeding doesn't agree with your production schedule, take the first passes on rough boards at a high feed rate, then slow the feed down for the finish passes. Watch it with woods that have a high resin or sugar content, such as rosewood or cherry, because they tend to burn at slower feed rates—especially if the knives are getting dull. If you can't change the feed speed, take lighter cuts on each pass.

Surfacing any type of wood with ribbon or fiddleback grain, crotch swirls and medullary ray flakes can be challenging. Just remember that a slow feed rate, thin cuts and sharp knives all help conquer wicked grain. If you take too much in a single pass or feed the board against its grain, you'll end up listening to chunks of wood tearing out and clattering through the dust collection system or bouncing off the ceiling. And, the surfaced board will look just as bad as it sounded. □

Alfred E. Holland, Jr. is a woodworker in Orangevale, Calif. David Kinter is a self-employed woodworker in Boise, Ida.



The height of the bed rolls can be set with a dial indicator mounted in a magnetic base, but a three-footed feed-roll gauge base, right, will do the job quicker. The indicator can also be flipped in the feed-roll gauge base to check the alignment of all the parts of the planer's head assembly, including the cutterhead and feed rolls.

as other, machines. Each comes with its own dial indicator and sells for about $90.

To use a cutterhead base, first mount the indicator in the base and position it so the tip touches a smooth section of the cutterhead cylinder. Rotate the indicator's movable outer dial to zero the needle. Now set it over the knife as shown in the photo on the facing page and move it back and forth slightly, perpendicular to the edge, until the dial shows its highest reading, which should be about ⅛ in. Check the knife at both ends as well as at several places along its length before locking it down and checking the next knife.

To check cutterhead parallelism, install the indicator in the feed-roll base with the tip projecting upwards. With the base positioned on the bed, rotate the cutterhead so a smooth section contacts the tip, then lake readings at several spots along the cutterhead length. The feed rolls can be checked for parallel this way too, as well as to determine if they've worn more in the middle than at the ends. If the wear is great enough, the feed rolls, or even the planer bed, may need to be re-machined. Use the indicator to check the alignment and straightness of the chip breaker and pressure bar and to recheck them after the final tightening of their locking screws to make sure they haven't shifted.

Reverse the dial indicator in the base so its shaft points down to check the bed rolls for proper adjustment and uneven wear. Zero the indicator by positioning all three base feet on the bed. Then, place the base so its feet bridge the bed-roll gap, the tip contacting the roll at its highest point. The indicator will directly measure the roll's projection above the bed. If you're getting erratic readings, examine the surface of the roll for large dips, rough spots or gunk that could cause the hand to move unpredictably. □

Robert Vaughan is a professional woodworker, with his own shop in Roanoke, Va. Other sources of dial indicators and magnetic bases include Enco Manufacturing Co., 5000 W. Bloomingdale Ave., Chicago, Ill. 60639, and L.S. Starrett Co., 121 Crescent St., Athol, Mass. 01331.