- The joint or land becomes too wide (over 1/16″).
- Nicks develop or the knives becomes uneven.

On larger jointers there is a knife-grinding attachment that is a detachable part of the machine. The knives can be ground without removing them from the machine. On smaller machines the knives or the entire cutterhead must be removed to do the grinding. If a surfacer or planer that has a grinding attachment is available, this machine can be used for grinding jointer knives. However, this method should be used only when the planer knives themselves are to be sharpened. Otherwise, resetting the planer knives may cause difficulties. To sharpen, remove one planer knife, place all jointer knives in a line, and grind as a single knife.

Several different machines can be used to grind jointer knives that have been removed from the cutterhead. In each case a wood jig must be constructed to hold the knives. If a two-wheel grinder is to be used, cut a groove at 35 to 36 degrees in the edge of a hardwood piece. Install a wood screw at either end that can hold the knives firmly in place. Dress the grinding wheel. Adjust the tool rest so that the bevel of the knives will be ground at approximately 35 degrees. Clamp a guide block to the tool rest to make sure the grinding is straight along the length of the knife. Fig. 24-42.

Make a single light cut by moving the knife slowly from one side to the other. Check the edge to make sure it is ground to a single bevel. When this is done, grind the other knives. Make sure that each knife is ground the same amount so that all will weigh the same. Otherwise there will be excessive vibration when the cutterhead is revolving at high speeds. After grinding, light honing on the back edge will remove the burr.

If the grinding is to be done on a drill press with a cup wheel, the [illegible]e should be cut in one corner of the [illegible]d jig. The knife is mounted with the bevel up. Fig. 24-43. The same jig can be used to grind the knives on a circular saw that has an abrasive wheel mounted on the arbor. With this method the bevel is turned toward the edge of the jig. Fig. 24-44.

Changing or Resetting Jointer Knives

Removing and replacing jointer knives must be done with great care. If not, the jointer will not operate smoothly or produce a good surface. Before working on the machine, remember to turn off the power both at the machine and at the master switch. Remove the fence and guard, and move the infeed table as far away as possible so that you can work at the cutterhead freely. To remove the knives, loosen the set screws or bolts that are part of the *knife bar* or *throat piece* (the clamp that holds the knives tightly in the cutterhead). Lift out the knife first and then the throat piece. Turn the head to the next position and repeat this process.

To replace and reset the knives, reverse the process. Insert the throat piece first and then the knife, with the bevel toward the outfeed table. Use a straightedge on the outfeed table as a guide to set all knives to the same height. One of the best methods of doing this is to use a U-shaped or straight magnet as a straightedge. Place a stop block across the front table and then slide the magnet against it. Fig. 24-45. It is a good idea to have an index mark on the magnet. This mark should be in line with the cutting edge of the knife at its highest point. With the knife in the slot and the throat piece loosened, allow the magnet to hold the knife up to the required level. Then tighten one set screw or bolt just enough to hold. Move the magnet to the other end of the knife and repeat.

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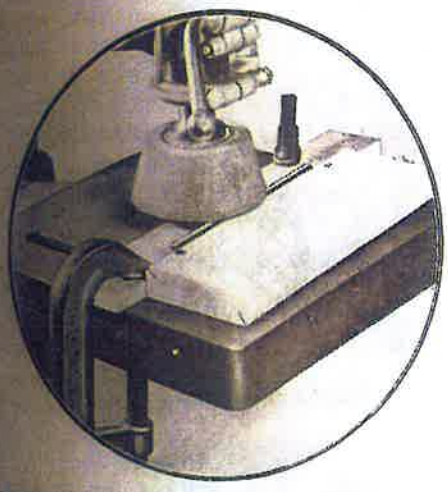
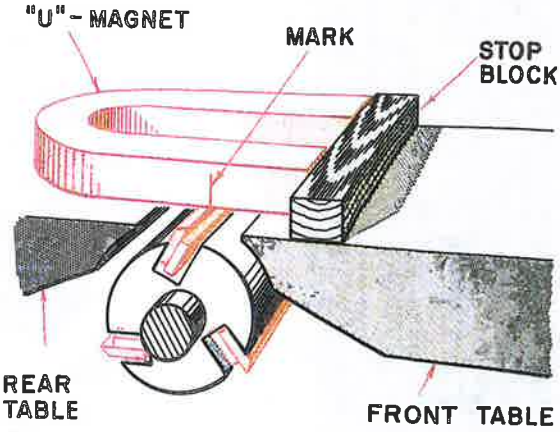
24-42. Grinding jointer knives on a two-wheel grinder. Note the guide block that is clamped to the tool rest to control the grinding.



24-43. Grinding jointer knives on a drill press. As in Fig. 24-42, a stop block controls the grinding. This one is clamped to the table.

24-44. Grinding jointer knives on a circular saw. The wood jig should be clamped to the miter gage and moved back and forth across the abrasive wheel.

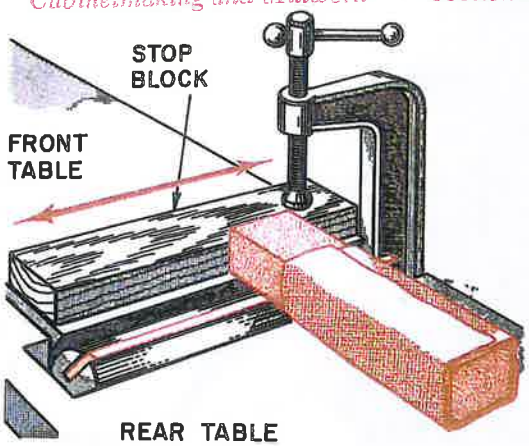


24-45. The magnet will hold the jointer knife at exactly the same height as the rear table. The back of the bevel should clear the cutterhead itself by about 1/16".

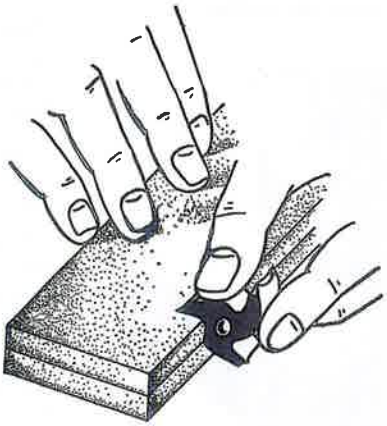
Reset the other knives in a similar manner. Make sure you move the magnet from one side to the other so that the knives are the same height along the entire cutterhead.

On some machines the knives can be moved up or down with set screws that are part of the cutterhead itself. With this type of machine a steel bar is used as a positive setting stop. By using screw lifters, raise the knife ends to the correct height and lock them in place. Fig. 24-46. After all knives are in place, tighten the remaining screws or bolts lightly. Then rotate the cutterhead by hand to check the knives. Tighten all screws or bolts again to be sure the knives are held firmly in place. Then recheck with a straightedge to make sure all knives are the same height. Move the infeed table back to the correct position.

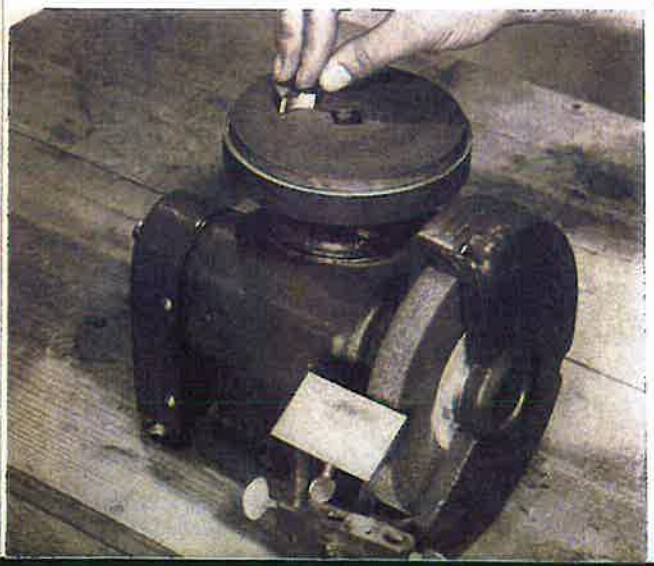
24-46. Adjusting the height of the knives by turning a set screw. Another knife and throat piece are shown ready to be installed in the next position on the cutterhead.



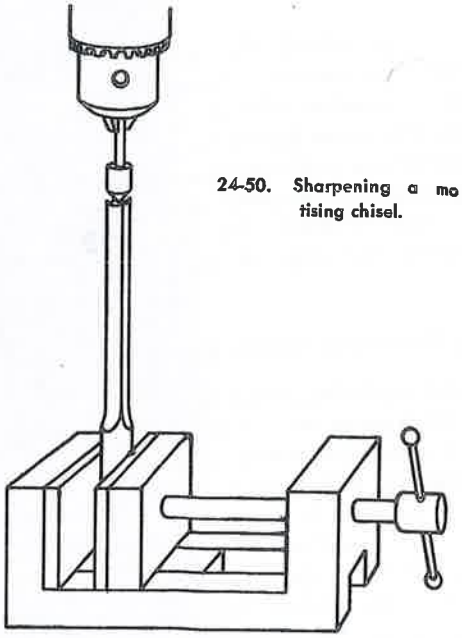
24-47. Place the stone on the rear table as shown. Remember that the cutterhead is revolving at high speed. KEEP YOUR FINGERS AWAY FROM THE KNIVES AND HOLD THE ABRASIVE STONE FIRMLY. DON'T LET IT SLIP OUT OF YOUR HAND.



24-48. Honing the face of a shaper cutter.



24-49. The blade faces of a molding head can be honed as shown here.



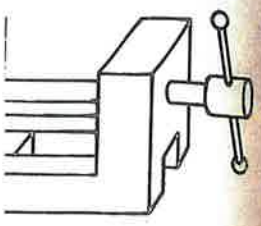
24-50. Sharpening a mo tising chisel.

After the jointer knives have beer sharpened and reset, it is wise to join the knives so they are exactly the same height. Cover all but about one-fourth the length of a large abrasive stone with wax paper. Place the stone on the rear table with the exposed section over the knives. Clamp a wooden stop blo to the front table to help guide the e Lower the table until the stone barely touches the knives. Fig. 24-47. Turn or the power. When the cutterhead is re volving, move the stone slowly from one side to the other. A true cutting circle will result. Be sure to joint the entire length of the knives. The joint or land (sometimes called the *heel*) should not be wider than 1/32". After jointing, re place the fence and guard.

Router Bits and Shaper Cutters

In sharpening these tools, it is im portant not to change the shape of the cutting edge. Therefore most grinding

24-50. Sharpening a mortising chisel.



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Shaper Cutters

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s of a molding head can be
as shown here.

and honing should be done on the face of the tool. To sharpen bits for a portable router you need an accessory for holding the bits. Fasten a small cup-shaped abrasive wheel to the collet of the router to do the grinding.

The face of a shaper bit can be ground on a small grinding wheel. Honing is done as shown in Fig. 24-48. A slipstone can be used to touch up the beveled cutting edge but, remember, take care not to change its shape.

Molding-head Cutter Blades

The individual blades of a molding head can be honed on their front face. Fig. 24-49. The beveled edge can be touched up with a slipstone.

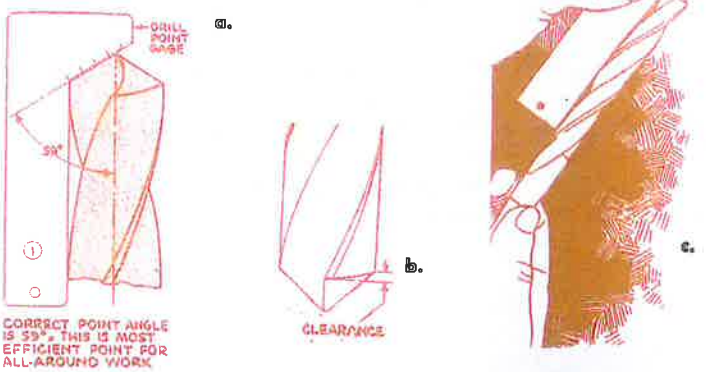
Mortising Chisel

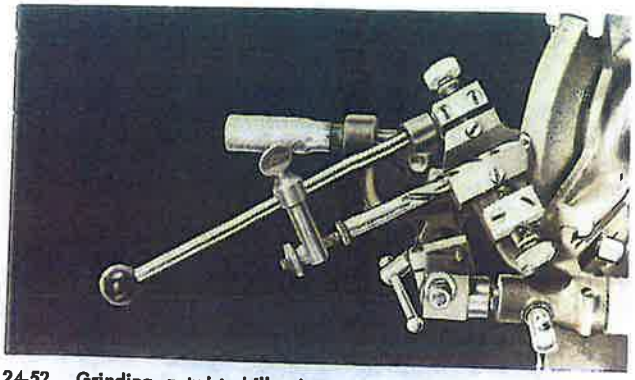
To sharpen a mortising chisel, install a conical-shaped wheel in the chuck of the drill press or lathe. Grind the inside bevel. Then hone the outside, holding the abrasive stone flat against the sides to remove any burr. Fig. 24-50.

Sharpening a Twist Drill

A correctly sharpened twist drill must have a point angle of 59 degrees on either side of the axis. The lips must be the same length, and there must be enough lip clearance (or relief behind the cutting edge) so that the tool can cut into the material. A lip clearance of 8 to 12 degrees is considered right for ordinary work. To grind a drill, hold the shank in one hand and the point between the thumb and forefinger of the other

24-51 (a). The correct point angle is 59 degrees on either side of the axis, or an included angle of 118 degrees. (b). Notice the clearance behind the cutting edge. (c). Check the angle and length of the cutting edge with a drill gage.





24-52. Grinding a twist drill using a drill grinding attachment.

hand. Hold the drill in a horizontal position at an angle of 59 degrees to the grinding wheel. Grind the cutting edge on the face of the wheel. Then rotate the drill clockwise, at the same time swinging the shank down in an arc of about 20 degrees. Grind a little off both sides. Continue to grind and test the point until the cutting edges are sharp and both are the same length. Fig. 24-51. Usually one or two light twists on both lips will bring the drill to a sharp point.

A drill-grinding attachment is available on some grinders. With this anyone can do an excellent job of sharpening a drill. The grinding is done on the face of the wheel. The drill is clamped in a V groove, and the grinder is turned on. Then an adjustment is made so that the cutting edge of the tool touches the wheel. The handle is rotated to grind one lip. The drill is then reversed in the holder and the other lip is ground. The micrometer setting insures evenly ground lips. Fig. 24-52.

ck that has been glued up.

st for thickness, and

GS

for the planer is to osts, and other furni- the stock has been e, joint two adjacent er. Mark number 1 on the working face and ie working edge. To k and reduce it to cor- the machine to about ize. Place the working bed and the working , and feed all pieces ine. Return all stock to achine and place it on riginal position. Then a quarter turn to the ie surfacing. Adjust the econd cut and surface inal size.

TOCK

k must be planed, it is a backing board. This k 3/8″ or less in thick- hat the backing board nd at least 3/4″ thick.

SURFACER-PLANER

Maintenance

- Make sure the planer knives are sharp. Grind and joint as necessary. (See Unit 24.)
- Check to see that the bed moves up and down easily. If there is too much wear and "play," the *gibs* must be tightened. (A gib is shown in Fig. 25-4.)
- Make sure the feed rolls are clean. If they are coated wth pitch, clean them off with a rag soaked in benzine.
- Adjust the knives, chip breaker, and pressure bar to the manufacturer's specifications.
- Make sure the dust-collection system is not overloaded and is working properly.

Lubrication

- Use S.A.E. No. 40 lubricating oil on the infeed- and outfeed-roll bearings.
- Use S.A.E. No. 10 lubricating oil on the table gibs.

Safety

- Familiarize yourself with the stop switch, elevating handwheel, and brake (if any) so that you can stop the machine quickly.
- Check the wood for defects such as large knots that might cause the board to split under pressure.
- Never surface painted or varnished stock. In fact, used lumber of any kind should not be surfaced.
- Make sure that the board to be surfaced has one true surface.
- The shortest board that should be run through the machine should be 2″ longer than the distance between the infeed and outfeed rolls.
- Always stand to one side of the table, never directly in line with the stock.
- Try to determine grain direction and feed into the machine so that the cutting will be done with the grain.
- As the feed rolls take hold of the stock, allow the machine to do the work. Take your hands off the board.
- If a board gets stuck in the machine, turn off the machine. Then lower the bed.
- Never stoop down to watch a board being surfaced.
- Be especially careful of your fingers when surfacing a short board. Sometimes the infeed rolls will tip the board up and then down quickly so that the fingers get pinched between the table top and the stock.
- If the stock is long, get someone to help you take the stock off as it leaves the machine.

Place the backing board on the bed and then put the thin stock on it. Adjust for the correct depth of cut, taking into consideration the thickness of the backing board. Then run the two boards together through the surfacer.

Planer Hints

If a clip or snipe appears at the beginning of a board:

- The pressure bar may be set too low.
- The chip breaker may be set too high.
- The upper infeed sectional roll may be set too high.
- The lower infeed roll may be set too high.
- Spring tension may be too light on the pressure bar.

If a clip or snipe appears on the end of lumber:

- The pressure bar may be set too high; it may not be even with the cutting circle.
- The lower outfeed roll may be set too high.
- The upper outfeed roll may be set too low.
- The lumber may not be butted.
- The grain may be running against the knives.

If knives tear out the lumber:

- The feed may be too fast.
- The joint on the knives may be too heavy.
- Moisture content of the stock may be too high.

CIRCULAR SAW

Maintenance

- Keep all working parts free from sawdust and other substances that might have an abrasive effect on the parts.
- Clean out the sawdust from the base at regular intervals.
- Check the V belts to make sure they are in good condition. Avoid oil, grease, and other substances that would ruin the rubber.
- Keep the belts just snug enough to operate smoothly without slipping.
- Make sure the pulleys are aligned and tight on the shafts. If necessary to align them, use a narrow board with a double bevel on one edge as a guide.
- Make sure all safety devices operate easily, especially the guard.
- Make sure the fence is parallel to the saw blade. This can be checked by aligning the fence with the miter-gage slot. If the fence isn't parallel, check the manufacturer's instructions for correcting it.
- Raise the saw blade to the highest position and check the angle between the table top and the blade. Make sure the combination square is against the blade and between the teeth. If the blade is not perpendicular when set on zero, reset following manufacturer's instructions.
- Keep all machine surfaces, such as the table top, free of rust or corrosion.
- Set the miter gage at the 90-degree position and check with a combination square against the blade to make sure that gage and blade are at right angles. If not, readjust the miter gage. Also check the 45-degree positions right and left to make sure they are accurate.
- Make sure the insert plate is in good condition. Replace it if necessary.

Lubrication

- Clean out all moving parts with a whisk broom or brush, then lubricate with oil or a good grade of ball-bearing grease. Don't over-lubricate since that would just collect dust. Wipe off excess oil or grease, being careful not to get any on the belt.
- Lubricate sliding ways of trunnion brackets with powdered graphite.
- Motor bearings are sealed and require no further lubrication.

performing practically any standard operation. Fig. 26-7. It is fitted to the side of the table top.

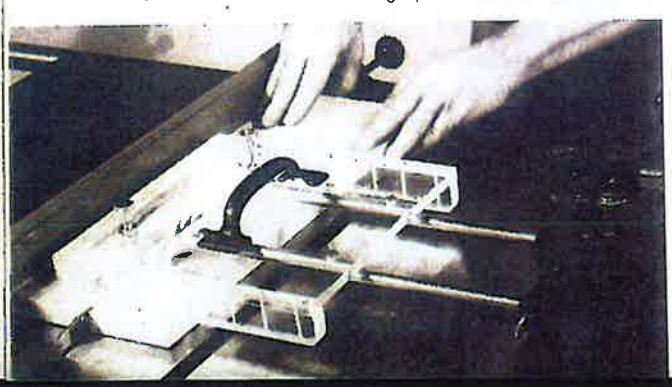
A *splitter*, a piece of metal directly behind the blade, is used to keep the saw kerf open; this prevents the wood from binding on the blade and causing kickback. It is especially important to use the splitter for all ripping operations. Many splitters are equipped with metal fingers or hold-downs that provide added anti-kickback protection.

Commercial Accessories

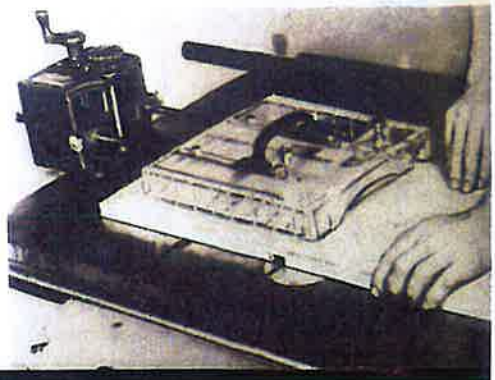
There are five common accessories available for the circular saw:

- A *dado head*, for cutting wide grooves and dadoes. There are several types but the most common is a set of blades and chippers. Fig. 26-8.

26-7(a). Using a plastic guard while ripping. This transparent guard can be used for all standard cutting operations.



26-7(b). Cutting a dado with the guard in position.



BAND SAW

Maintenance

- Clean the band saw tires periodically to remove dust, pitch, and gum. Use a rag soaked in benzine.
- Replace the tires when they become worn
- Make sure the belts are in good condition.
- Check the blade for sharpness and to see if it has sufficient set to prevent binding.
- Make sure the guide blocks and rollers are in good condition and properly adjusted.
- Replace the throat plate, if worn.
- Make sure the table tilts easily and that the pointer on the tilt gage is accurate.

Lubrication

- Use S.A.E. 20 oil on slide ways of the upper wheel bracket trunnions and adjusting screw.
- Also oil the screw for adjusting table tilt.
- Keep oil and grease away from the bandsaw tires as this would soon ruin them.

Safety

- Check the stock to make sure it is free of nails before cutting.
- Adjust the sliding bar or post so that the upper guide is about 1/4" above the work. If the guide is too high, the blade will not have the proper support.
- Never allow anyone to stand to the right of the saw. If the blade broke, it could fly out in that direction.
- Make sure the saw blade has proper tension and that the teeth are pointing down.
- Avoid backing out of a cut as this could pull the blade off the wheels.
- Never attempt to cut round stock without a holding jig. It will roll out of your hands as the saw starts the cut.
- Hold the stock firmly on the table to do the cutting.
- Never cut a curve of small radius with a wide blade unless you first make relief cuts.
- If you hear a rhythmic click as the wood is being cut, this usually indicates a cracked blade. Stop the machine and inspect.
- If the blade breaks, shut off the power and stay away from the machine until it comes to a complete stop. Never try to free the blade while the wheels are still turning.
- Never have your fingers or arms in line with the blade.
- Use a helper to handle long stock. Remember that the operator should do all the pushing.
- Keep a well balanced stance as you do the cutting.
- Never try to pick pieces of wood out of the table slot while the saw is operating.

move the pin or set screw at the end of the blade slot. Now release the tension on the upper wheel and remove the blade. Fig. 28-8. If the blade is to be stored, wipe it with an oily rag to prevent rusting. To fold the blade, grip it with the back toward you and the teeth away from you. Place your right hand on the blade with the thumb up and the left hand with the thumb down. Hold the blade firmly. Now rotate the right wrist to turn the thumb down and the left wrist to turn the thumb up. As you twist, the blade will coil into three loops. Fig. 28-9. Tie the blade with a string or fasten it with masking tape.

If a wider blade is to be placed on the band saw, loosen the blade guides, then release the ball-bearing blade support and move it back. Slip the new blade through the table slot and over the wheels, with the teeth pointing toward the table. Turn the tension handle to apply a small amount of tension to the blade. Now rotate the lower wheel by hand to see if the blade stays in the approximate center of the wheels. As necessary, tilt the upper wheel slightly in one direction or another until the blade stays in the center of the wheel (tracks properly). If the blade does not track properly, it may ride against the guides and ruin them in a hurry. Now tighten the upper wheel until the blade is taut. For a 1/8" to 1/4" blade, the tension is correct when some pressure at the center

MAINTENANCE

- Check the sharpness of the blade or knives.
- Check the condition of the belt, if any.
- See that the guards operate easily.
- Check the tool for a broken plug or switch, bad connector, or poor insulation on the core.
- Keep the air passages clear.

LUBRICATION

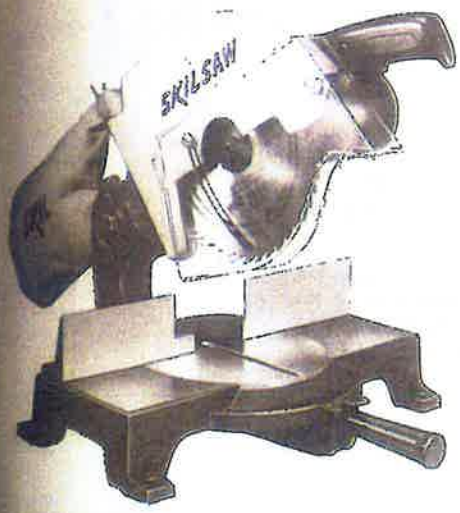
- Motors on most portable tools have sealed bearings that require no further lubrication.
- Use S.A.E. 20 bearing oil or the best grade of non-detergent motor oil for any places that need oiling. Be sure to clean out the oil holes before adding the oil. Add no more than four or five drops.

SAFETY

- MAKE SURE THE SWITCH IS IN THE "OFF" POSITION BEFORE CONNECTING ANY POWER TOOL TO THE POWER SUPPLY.
- Never run a tool where there is any chance of explosion or fire due to the presence of naphtha, gasoline, benzine, or any other explosive or inflammable substance.
- Never wear loose clothing that might become tangled in the fast-turning parts.
- Keep your fingers away from blades and cutters.
- Turn off the motor immediately after finishing the cut.
- Disconnect the cord plug from the power outlet before making adjustments or replacing a blade or cutter.
- Make sure your hands and feet are dry when using a portable tool.
- Be sure the tool is properly grounded.
- If an extension cord must be used, make sure it is 12-gage wire or heavier for lengths up to 100′ and 10-gage or heavier for lengths up to 150′.

cutting panels of plywood, hardboard, and other sheet materials. To locate the position of the cut, either mark a line across the back of the panel or use the scale that is attached to the base of the rack. Place the panel so the good surface is toward the rack. Turn the saw on and pull it down to do the cutting. A spring tape attached to the saw will help raise it after the cut.

30-10. A power miter saw.



BAYONET SAW

The bayonet saw (saber, sabre, or hand jig) is most useful for cutting internal and external curves on-the-job. Fig. 30-11. The saw, which operates like a scroll saw but has the advantage of being portable, is relatively easy to use. It is particularly useful for internal keyholing or

30-11. Parts of a bayonet or hand jig saw.

outfeed table. Raise the table
aightedge rests evenly on the
Always replace the guard after
ng this adjustment.

osition. If the rear table
st release the lock handle
the jointer. Then lower
o that the top is well be-
he cutting circle. This is
any slack in the screw
l adjustment is made.
edge over the rear table
ise the table until it is at
ne height as one knife.
k at the middle and at
this knife. Repeat this
her knives to make sure
same distance.
r table is adjusted, lock
f the knives are out of
ed sharpening, see Unit
ually no need to change
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with a fixed rear table,
can usually be adjusted
ith a handle at the front
st below the cutter head.

Depth of Cut

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JOINTER

Maintenance

- Hone jointer knives frequently.
- Grind and reset knives when necessary. See Unit 24.
- Make sure the guard is used and that it operates freely.
- Check the alignment of the tables to make sure they are level and not twisted.
- See that the fence operates properly.
- Adjust the outfeed table or cutter head so that both are the same height (except for special operations).
- Check the pointer on the depth scale on the infeed table to make sure it indicates the correct depth of cut.

Lubrication

- Sliding members and table control screws should be oiled with lubricating oil.
- Most jointers have sealed bearings on the cutter head and motor.

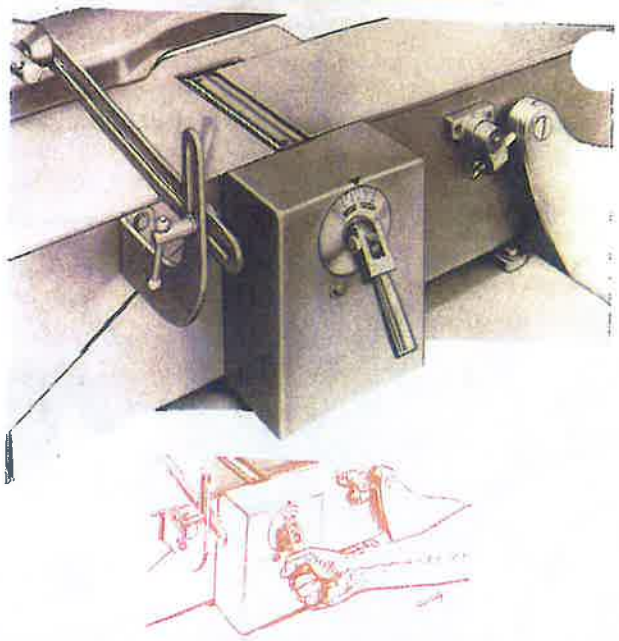
Safety

- Check the stock carefully before surfacing to make sure it is free of knots and other defects.
- Trying to surface short pieces (less than 12") is a trap that is sure to lead to injury. Avoid it. Use hand tools for small wood parts. What happens when you attempt to surface short pieces? As the stock starts over the cutter head, the corner is very likely to catch, throwing the wood out of your hand and allowing your fingers to drop into the revolving cutter.
- Use the safety guard at all possible times. (On some jointers the guard can't be used when cutting a rabbet.)
- Check to see that all parts of the machine are locked securely.
- Use a push block when jointing a thin piece or when face planing.
- Hold the board firmly against the fence and the table.
- The maximum depth of cut should be 1/8".
- Always stand to the left of the machine.
- Never plane the end grain of narrow stock (less than 10").
- Plane with the grain.
- Keep your fingers away from the revolving cutter head.

special pointer and scale can be used for this adjustment. However, it is a good idea to check for accuracy. One way to do this is to adjust the front of the table to a 1/8" cut, as shown on the depth scale, then joint the edge for a short distance. Then check to see if this is exactly 1/8". Never make a cut deeper than 1/8". The average depth of cut is about 1/16". Only 1/32" should be removed for a finish cut.

Adjusting the Fence

For most operations the fence should be at an exact right angle to the table.



31-8. With the fixed outfeed table, the cutter head can be adjusted up or down a few thousandths of an inch in either direction. With the dial adjustment, as many as five honings are possible without changing the knives.

SHAPER

Maintenance

- Keep cutters clean and properly sharpened. Sharpen on the front face only, never on the contour shape.
- Check the belt for condition and tension. Keep the belt just tight enough to prevent it from slipping.
- Clean out the sawdust from the operating mechanism at regular intervals.
- Make sure the fence adjustments operate easily.

Lubrication

- Use S.A.E. No. 20 machine oil to lubricate elevating shaft, bevel gears, and column.

Safety

- Whenever possible, install the cutter so that the *bottom* of the stock is shaped. In this way, the stock will cover most of the cutter and act as a guard.
- Adjust the spindle for correct height and then lock in position. Rotate the spindle by hand to make sure it clears all guards, fences, etc.
- Check the direction of rotation by snapping the switch on and off; watch as the cutters come to rest. ALWAYS FEED AGAINST THE CUTTING EDGE; THAT IS, FEED THE WORK INTO THE CUTTERS IN THE DIRECTION OPPOSITE TO CUTTER ROTATION.
- Use spindle ring guards, jigs, and other clamping devices whenever possible.
- Never shape pieces narrower than 2" and shorter than 10" without the use of jigs to hold these small pieces on a larger surface.
- If you don't have a miter gage to steady the work, stock must be at least 10" wide when shaping end grain.
- Keep your hands at least 4" away from the cutter at all times.
- Do not set spring hold-down clips too tightly against the work. Use just enough tension to hold the work against the fence.
- Examine the stock carefully before cutting to make sure it is free of defects. Never cut through a loose knot or stock that is cracked or split.
- Hold the stock down and against the fence with your hands on top of the material, yet out of range of the cutters.
- Always use a depth collar when shaping irregular work. Put a guide pin in the table to start the cutting.
- For contour work, when depth collars and a guide pin are used, the operator must swing the work into the cutters. It is a good idea to keep the stock in motion in the direction of feed.

Small grooving saws can be used on the shaper for making many kinds of joint cuts. For example, two or more saws with proper spacing collars can be used for making tongue-and-groove joints.

The *three-knife safety cutter head* is very similar to a molding head used on the circular saw or radial-arm saw, except it is smaller in diameter. Fig. 32-4. With this cutter head, the same molding knives used on the saw can be used on the shaper.

Large-diameter carbide-tipped cutters are used for many operations. Fig. 32-9. These three-ring cutters range from 2 15/16" to over 5" in diameter with a 3/4" bore. Fig. 32-10. Many of these cutters can be used on a shaper with a 1/2" spindle by using T-bushings.

Cutters are also available as sets that require the use of shims and rub bearings.

Sometimes, a complicated shape is produced by using two or more cutters. It is good practice to sketch the exact design of the cut on the end of a piece of scrap stock of the same thickness as the piece to be machined. Then check the cutter against this piece to make sure they match. Make a trial cut on a piece of scrap before machining the workpiece.

33

ısing a shaper fence. The table
to accept the fence hold-down

olded edge on a plaque using
ıll guide at the end.

33-2. A 1 1/2-horsepower plunge cut router. It allows starting the job without having to lift or tilt the router. See Fig. 33-4 for a standard router.

Portable Router

The portable router has a motor that is adjustable up and down in a base. Fig. 33-4. The size is determined by the horsepower of the motor and the maximum size of the router bit shank that can be used. Most routers have motors that range from 1/4 to 2 1/2 HP with speeds from about 18,000 to 30,000 r.p.m. A collet (or split) chuck attached to the end of the motor holds the cutting tools. Smaller routers are equipped with a 1/4″ collet, while larger ones will handle bits with shanks up to 1/2″. Fig. 33-5.

ROUTER

Maintenance

- Keep all bits sharp. Grinding can be done by hand or with a grinding fixture that attaches to the router. Grind the underside of the lip of the bit.
- Keep the air vents free from sawdust.
- Check the brushes periodically and replace them immediately if worn away.

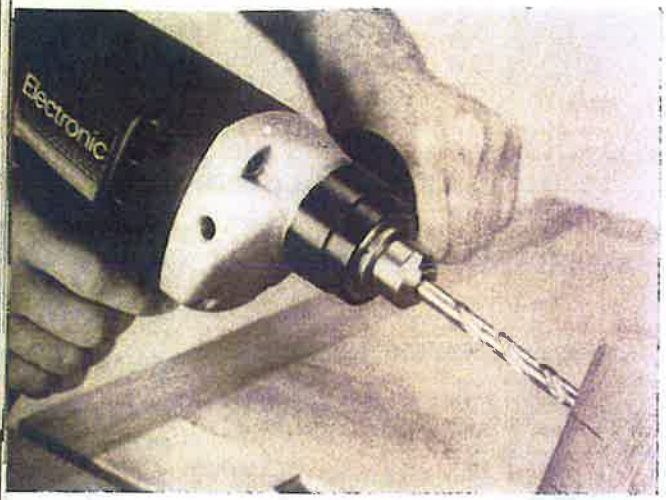
Lubrication

- Ball bearings on the motor shaft are grease-sealed to last the lifetime of the bearings. No further lubrication is required.

Safety

- Make sure the router is properly grounded. Most come equipped with a three-wire cord that will fit directly into corresponding grounding receptacles. An adapter for grounding a two-wire receptacle is usually furnished with the tool.
- Turn off the motor when not in use.
- Disconnect the plug from the power circuit when changing bits.
- Hold the portable tool firmly but lightly in your hands.
- Never turn on the power until you are in a working position.
- Make sure the bit is properly installed before turning on the power.
- Never put anything into the ventilating holes of the router.

33-3. The shaped edges of this coffee table were cut on a router.

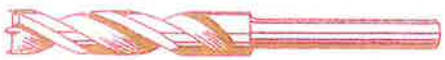


34-8. This portable drill has a shockproof plastic housing. The twist drill is titanium-covered steel.

34-9. This cordless electric drill has a self-contained battery in the handle. One battery charge from the unit shown at right is enough for drilling up to 300 holes, 1/8" in size.

34-10. Twist drills of several sizes. Note that some have smaller shanks so that holes larger than the portable drill's normal capacity can be drilled.

34-11. Spur machine bit.



DRILLING AND BORING MACHINES

Maintenance

- On machines with step pulleys, check the belt tension. The belt should be just tight enough to prevent it from slipping, no tighter.
- Make sure the correct chuck key is available.
- Check the quill-return spring. It should have light tension.
- Excessive tension prevents sensitive drilling and causes pinion-gear breakage.
- Keep drills and auger bits properly sharpened.
- Keep motor and spindle pulley set screws tight to prevent scoring the motor shaft and spindle.

Lubrication

- Cover the outside surface of the quill with powdered graphite.
- Light ball-bearing grease applied to the spindle spline maintains spindle lubrication and eliminates noise.

Safety

- Make sure the stock is clamped properly before drilling or boring.
- Never attempt to use a hand auger bit. Use only drills and bits designed for machine use.
- Always position the hole in the center of the table beneath the drill and place a piece of wood beneath the work to keep from drilling holes in the table.
- Use a brush to keep the table free of sawdust.
- Never try to stop the machine by taking hold of the chuck after the power is off.
- On deep cuts, back out often to clean out the hole.

Two types of chucks are available, but most are of the *geared type* that require a special key for opening and closing. The other type, called a *hex key chuck*, requires an Allen wrench to open and close it.

One problem in using a portable drill with a metal housing is the danger of

36-2. Three materials are needed to produce coated abrasives.

SANDING MACHINES

Maintenance

- Make sure the operating controls turn easily.
- Check the belt, disk, or sleeve to make sure the abrasive cloth or paper is not worn. Replace as necessary.
- Make sure the cloth or paper is attached properly. On belt sanders, the arrow on the belt indicates the direction of rotation.
- Maintain proper motor-belt tension.
- Keep the sander clean. When necessary, take it apart and remove all sawdust from operating parts. Make sure air vents are not plugged.

Lubrication

- Use S.A.E. No. 20 machine oil for lubricating.
- For the stationary abrasive belt sander, lubricate the idler drum bearing, belt-tension knob screw, and tracking-handle screw.
- For the stationary disk sander, lubricate the spindle bearing when needed.
- Check portable machines for any oil holes. Lubricate, if necessary.

Safety

- Use only light pressure—just enough to hold the work against the abrasive.
- Wear goggles when disk sanding.
- Remove sawdust from around the machine to prevent a fire hazard.
- Sand parallel with the grain whenever possible, to obtain a smooth finish.
- Sand only dry wood.
- Use a fixture to hold small pieces of wood when machine sanding.

Garnet

Garnet (almandite) is another natural material that makes a good abrasive both for hand and machine sanding. It is a good deal harder than flint and the grains are narrow wedge shapes. Garnet, which is reddish-brown, is widely used in woodworking, principally for finish sanding.

Aluminum Oxide

Aluminum oxide is much harder than garnet, with a grain shape of wide wedges. It is a synthetic product of the electric furnace and is made by purifying bauxite (an ore of aluminum) to a crystal form, then adding small amounts of other materials for toughness. When aluminum oxide comes out of the furnace, it is in large chunk form. If it is to be used for the woodworking trades, the crushing technique is varied to produce a sharper grain than that generally used for metalworking. Aluminum oxide is brown and is considered an excellent abrasive for sanding harder woods.

Silicon Carbide

Silicon carbide, another product the electric furnace, has grains that are sharp wedge shapes. It is greenish-black and iridescent, and is not only the hardest but the sharpest of the synthetic abrasives. Silicon carbide is the ideal abrasive for fibrous woods, plastic, enamel, and other relatively soft materials. Commonly it is used in the finishing process. Though harder, it is not as tough and durable as aluminum oxide.

Crushing and Grading

All abrasives are crushed and graded by the same method. The crushed particles are separated into grade sizes by passing them through a series of very accurately woven silk cloth screens. The

WOOD LATHE

MAINTENANCE

- Keep all lathe tools properly ground.
- Check the condition of the lathe centers. Grind or replace as necessary.
- Keep headstock and tailstock spindles wiped clean of sawdust and dirt.
- Make sure all adjustments on the tool rest and tailstock operate freely.
- Always remove the live center to drive it into the stock with a mallet.

LUBRICATION

- On variable-speed lathes, use S.A.E. No. 20 oil on counter shaft, bracket screw, variable-speed drive screw, dovetail ways, variable-speed pulley shaft, and tailstock quill adjusting screw.
- On belt-driven lathes, use S.A.E. No. 20 oil on beds, ways, tailstock, quill, and adjusting screws.
- Motors usually have sealed bearings that require no lubrication.

SAFETY

- Never wear loose clothing or a tie.
- Wear goggles or a face shield.
- Check the wood to make sure it has no defects that would cause it to break when turning.
- Check all glue joints before mounting the stock. A weak joint may come apart when revolving at high speeds. Make sure glued-up stock is completely dry before turning.
- Fasten stock securely between centers. Make sure the tailstock is locked before turning on the power.
- Adjust the tool rest as close to the stock as possible. Then revolve the stock by hand to make sure it clears the rest.
- Always stop the lathe before making any adjustments such as changing the position of the tool rest.
- Run all stock at the slowest speed until it is rounded.
- For stock over 6" in diameter, maintain slower speed; from 3" to 6", medium speed; under 3", faster speeds.
- Hold turning tools firmly in both hands.
- Keep the tool rest as close to the work as possible. At intervals, stop the lathe and readjust.
- Make sure the stock is firmly fastened to the faceplate before turning.
- Remove the tool rest when sanding or polishing. If you don't, your fingers may get caught between the tool rest and the stock.

37-2(b). This automatic lathe is turning the posts for beds like that shown in Fig. 37-2(a). The operator has only to fill the hopper with pieces of stock. The lathe automatically centers each piece. Then a series of shaper-like knives, revolving at high speed, moves toward the work which is turning at slow speed. After the piece is turned, it drops into a container to be removed later by the same operator. Once the setup is made, one operator can take care of several machines.

length, the distance between centers, and the overall length. A typical diameter is 12", with an overall length of 57". Swing is twice the distance from line center to the bed. A gap-bed lathe may have a swing over the bed of 12" and a swing over the gap of 15½", with 4" thick stock. Fig. 37-3. This feature makes it possible to do larger faceplate turning on the inside of the lathe.

A lathe may be belt-driven (using step pulleys), it may have a variable-speed pulley, or it may have a direct-drive motor. The speed ranges depend on the drive arrangement. For example, the gap-bed lathe in Fig. 37-3 has a variable-speed control drive which allows it to turn at any speed from 340 r.p.m. for turning rough wood, up to 3200 r.p.m. f

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