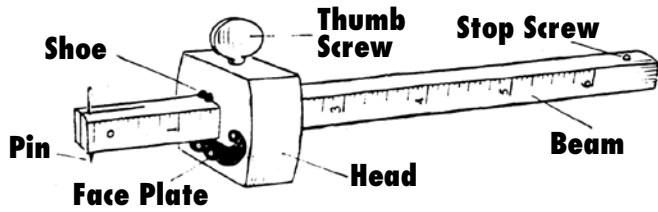


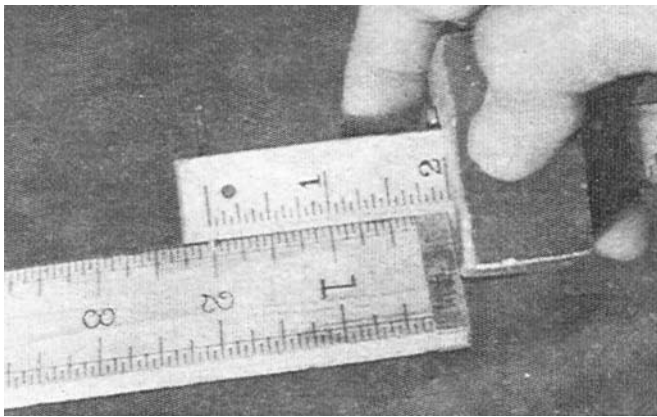


## Woodworking Tools and Machinery



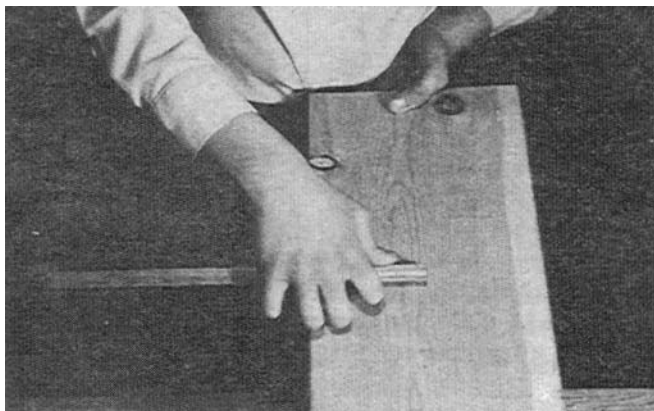
### Marking Gauge

A marking gauge is used to mark a uniform width on a board. The steel combination square discussed in Unit II can be used for the same purpose.



To use the marking gauge, set the pin the desired distance from the face of the head and check with a rule. It is better not to rely upon the measurements on the gauge, because the pin may become bent, which will alter the measurement. When the correct dimension is found, tighten the thumb screw and measure again. The pin must be kept sharp.

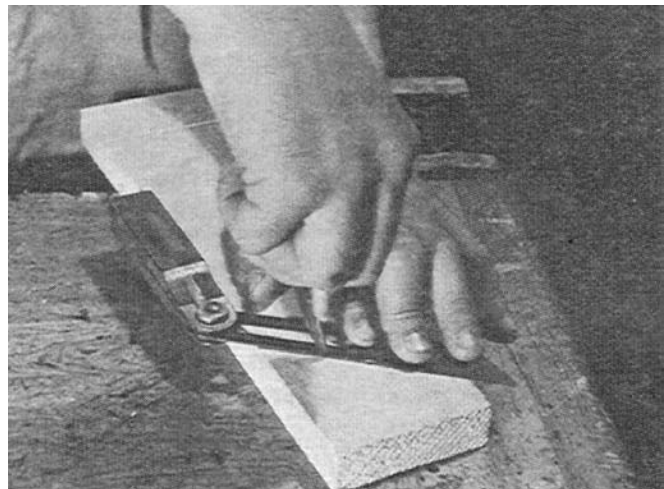
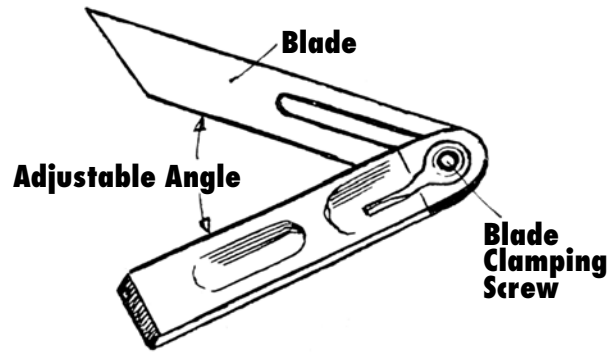
When marking, push the gauge forward. Roll the gauge slightly clockwise so both the beam and pin point touch the wood. Held in this manner, you



can observe the point at all times. The head must be held tightly against the work edge of the wood. Hold the gauge as you would a ball, then move the thumb toward the pin to distribute the pressure between the pin and head. Some people use the gauge by drawing it toward the body. In either case, be careful to keep the face firmly against the edge of the wood.

### T Bevel

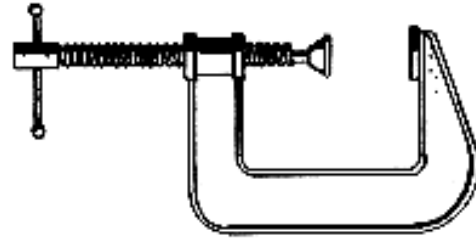
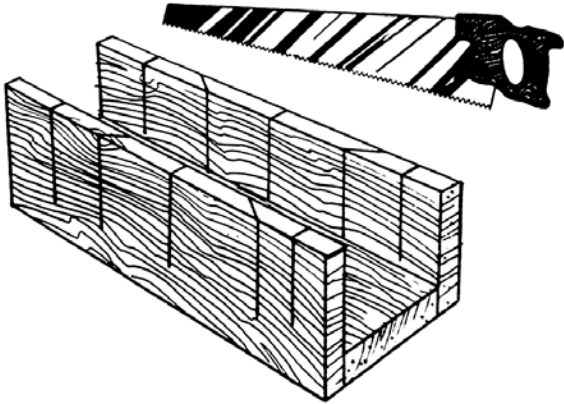
The T bevel is used for laying out miters; testing mitered ends, beveled or chamfered edges; or duplicating lines drawn at some angle. Mitered corners of picture frames and bevel siding are examples of ways the T bevel can be used for measuring and cutting angles.





## Miter Box

This simple miter box is used to cut wood stock accurately at 45- and 90-degree angles. Other miter boxes can be adjusted to any angle. The wood is placed in the bottom of the box, then the saw is placed in the saw cuts. This gives a rapid and accurate method of cutting.



**C-Clamp**

## Clamps

Clamps are essential tools to many woodworking operations. They are used to hold wood pieces together while you work on them and they are used in gluing, to hold your wood pieces under pressure while the glue dries.

There are several different kinds of clamps:

**C-Clamps** were discussed in Unit I. They are rather small, c-shape devices with an adjustable bolt at one end. They are commonly used to clamp boards together when boring holes, gluing wood pieces together, or making a saw guide. To hold two pieces of wood together or to apply pressure to wood for gluing, tighten the bolt. It is possible for wood to become dented when using the c-clamp, so remember to use a piece of scrap material between your good board and the clamp to prevent dents.

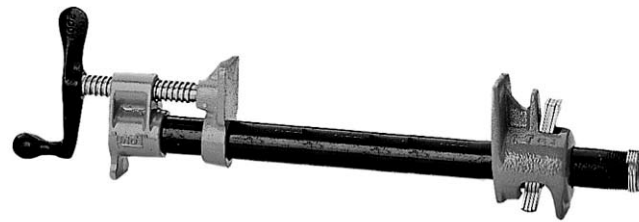
**Handscrew Clamps** are designed to do jobs too large for the c-clamp to do. They have two long, parallel bolts which are adjusted separately. To hold two pieces of wood together or to apply pressure for gluing, screw the bolts in opposite directions.

**Pipe Bar** and **Adjustable Clamps** vary in length according to intended use. These clamps adjust to fit the size of your wood by moving the adjustable stop back and forth along the bar. Pressure is applied by the crank screw.

The **Adjustable Bar Clamp** is commonly called a cabinet clamp. It may be used for the same purposes as the pipe bar clamp.



**Handscrew Clamp**



**Pipe Bar Clamp**

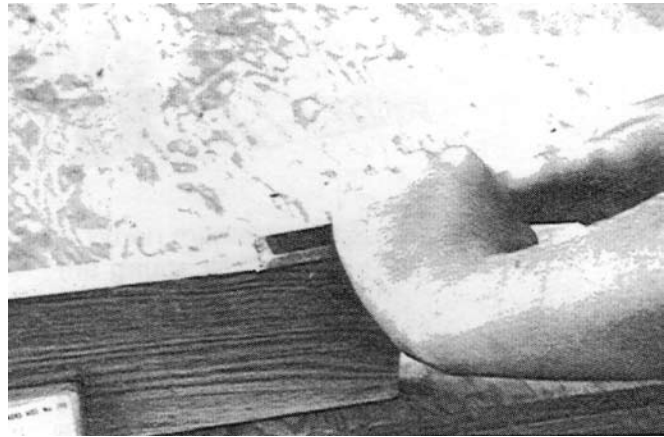
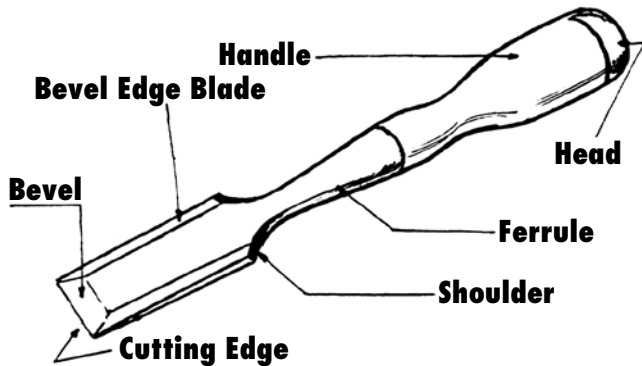


**Quick Clamp**



## Wood Chisel

Chisels are used for removing unwanted strips of wood. They are made in various blade widths, ranging from  $\frac{1}{8}$  to 2 inches, and there are different types of chisels available at various prices.



**Always push the chisel away from you. Keep both hands behind the cutting edge.**

Depending on the density of the wood and the cut being made, chisels are operated either entirely by hand pressure or by pounding the end with a mallet or hammer. Hand pressure may be adequate when there is little material to remove and a good, smooth cut is needed. Pounding pressure is applied when making marking cuts and when removing large chunks of wood material. When pounding a chisel head, it is advisable to use a wooden, rubber, rawhide, or plastic mallet. When possible, chisel cuts should be made with the grain of wood. Cutting across the grain tears the wood away, leaving uneven areas and splinters.

Buy a chisel made of good steel. A chisel made of poor metal cannot hold an edge and becomes a dangerous tool. Chisels purchased in sets of varying sizes are economical, but if you can buy only one chisel, buy a  $\frac{3}{8}$ " because it is suitable for most woodworking jobs you will be doing.

### Using the Wood Chisel

Guide the chisel with one hand, and apply the moving power with the other. Always push the chisel away from you, keeping both hands behind the cutting edge.

To cut with the grain of the wood, hold the chisel with the beveled edge up for a fine cut and with the beveled edge down for a rough, heavy cut.

To cut across the grain of the wood, grasp the

## Safety Notes for Using Chisels

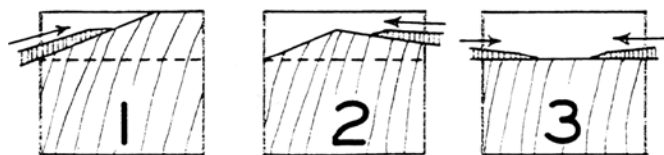
**Keep chisel edges sharp. Dull chisels are hard to use and can slip and cause dangerous accidents.**

**Always push the chisel away from your body, never toward you.**

**Place all work on a table or workbench. Never hold it in your hand.**

blade of the chisel between the thumb and the first two fingers of one hand to guide the chisel and act as a brake while pushing with the other hand.

To avoid splintering the corners, cut from each edge toward the center. Remove the center portion last.





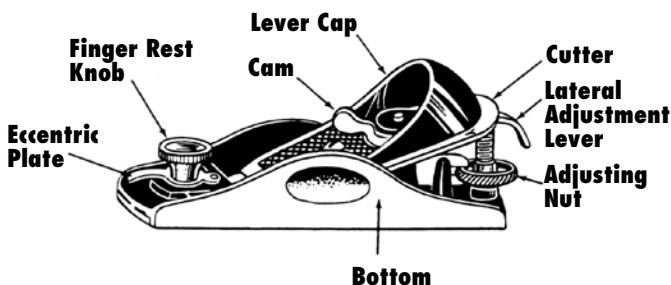
## Woodworking Tools and Machinery (continued)

### Planes

Planes are used for smoothing wood surfaces so that little or no sanding is necessary. They are available in two materials, wood and metal. There are several different kinds of planes, each serving a different function. Five common ones are discussed in this unit. They are the **block**, **jack**, **smooth**, **fore**, and **jointer** planes. The two most important to the home shop woodworker are the block and jack planes, because they can serve many functions. Remember, the cutting edge is very sharp so BE CAREFUL!

#### Block Plane

The block plane is the smallest and the most practical plane for the young woodworker. It is 4 to 5 inches long, which makes it easy to hold, and can easily be carried about in a tool box, which makes it handy. It can be used for almost any job but is an ideal tool to finish work. Because of the low blade angle, the block plane also is used for fine work and cutting across end grain. It also works well to cut chamfers and bevels.



To assemble the plane, place the plane iron (cutting blade) in the body of the plane, bevel side up. Position the lever cap and tighten the screw.

#### Adjusting the Block Plane

To check the adjustment, turn the plane upside down and sight along the bottom. The blade should project through evenly and just about the thickness of a sheet of paper.

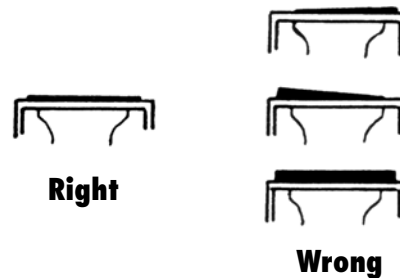
Turn the adjusting knob clockwise to push the plane iron out. To pull the plane iron in, turn the knob to the left until the blade is in proper position. Then turn it clockwise until it starts to push the plane iron out. The plane iron will stay in the right place when the plane is used.

To adjust for an even blade, loosen the lever cap screw. Turn the plane over and sight along the bottom.

Press the plane iron to the right or left until it is even. Tighten the lever cap screw.

#### Smooth Plane

This is a short plane, usually 5½" to 10" long, used for cutting smooth, glasslike surfaces. It stays adjusted to produce an extremely thin and fine shaving.

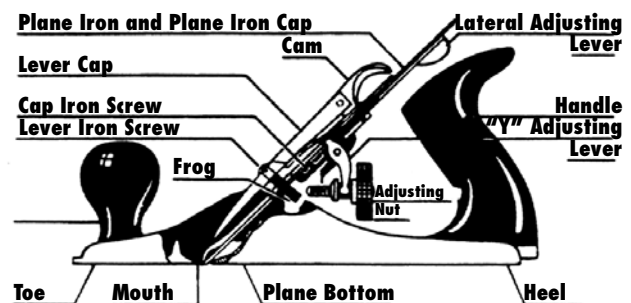


Notice how the plane bottom ends at the heel. This is a characteristic of smooth planes.

This tool works well for rough or preliminary planing as well as for planing end grain, chamfers, and other edge shaping.

#### Jack Plane

This medium-size plane, about 11" to 15" long, can be used for almost any job. It can be used for planing a door, truing a wood surface, or beveling the edge of a surface. Because of its longer bottom, the plane does less riding up and down on uneven surfaces, therefore cutting off the top of high, uneven spots until the surface becomes straight and even.



#### Fore Plane and Jointer Plane

These planes are ideal for cutting an edge or a surface perfectly straight. Fore planes are usually 18" long and the jointer plane 22" to 24" long. Their long lengths enable them to ride over bumps and hollow places, producing a smoothly cut surface.



## Assembling Smooth, Jack, Fore, and Jointer Planes

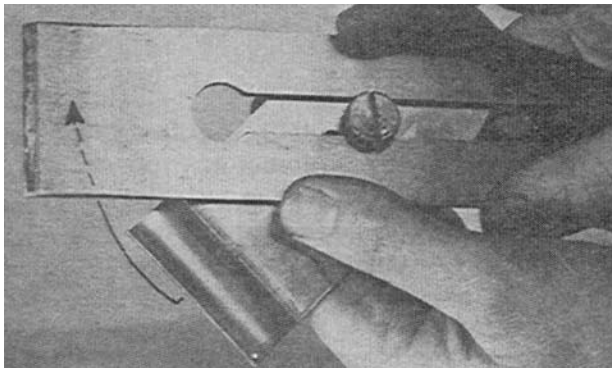
In assembling the block plane, the plane iron (blade) was placed in the plane with the bevel up. These planes are different. First, they have a plane iron cap. Second, the plane iron (blade) is placed in the plane with the bevel down. To assemble these planes, hold the plane iron cap crosswise the plane iron, bevel down. Slip the cap screw through the round hole in the plane iron and slide it up the slot (A). Then rotate the cap so it is straight with the plane iron.

Move the plane iron cap forward to a position about  $\frac{1}{16}$ " from the cutting edge (B). Be very careful. Do not let the cap slip over the cutting edge. This will dull the blade.

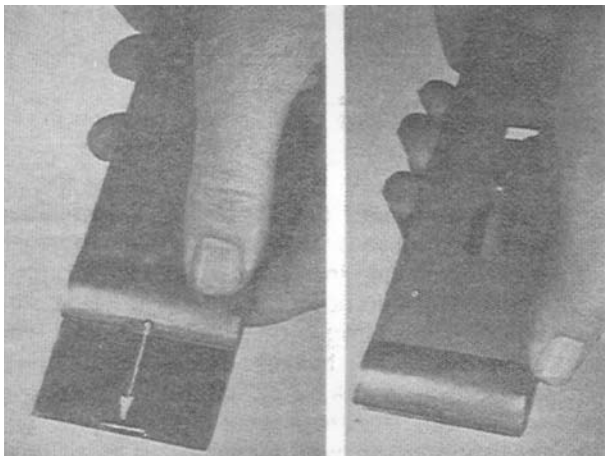
After making this adjustment, use a screwdriver or lever cap to tighten the cap screw to hold the pieces together (C).

Carefully place the plane iron and cap, with the cap side up, in position over the cap iron screw (D).

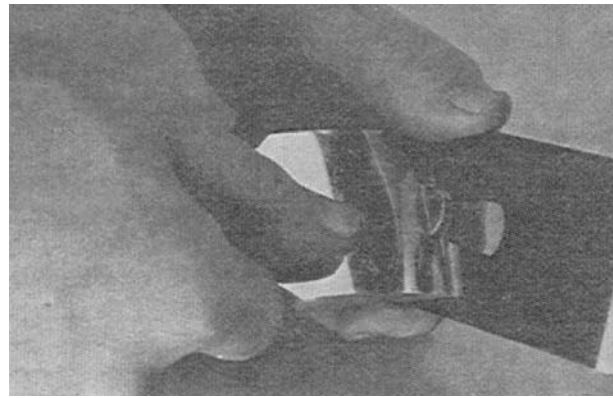
Place the lever cap in position and lock it in place using the cap cam (E). If too loose or too tight, adjust the cap iron screw slightly.



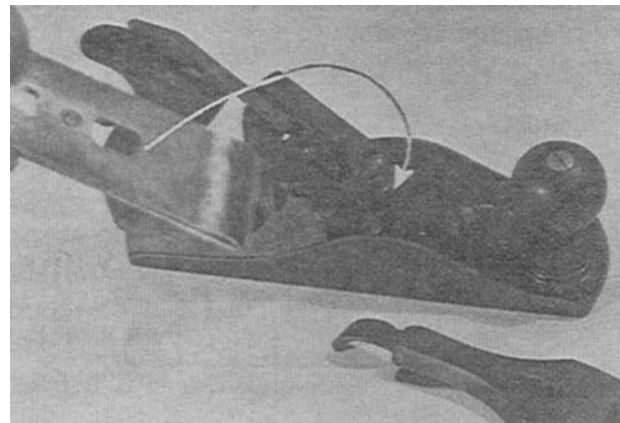
A



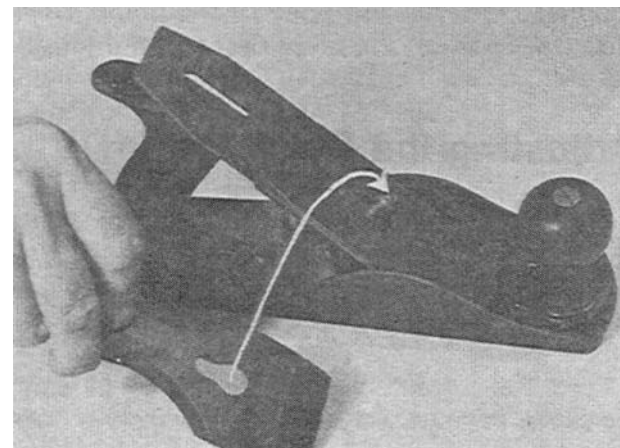
B



C



D



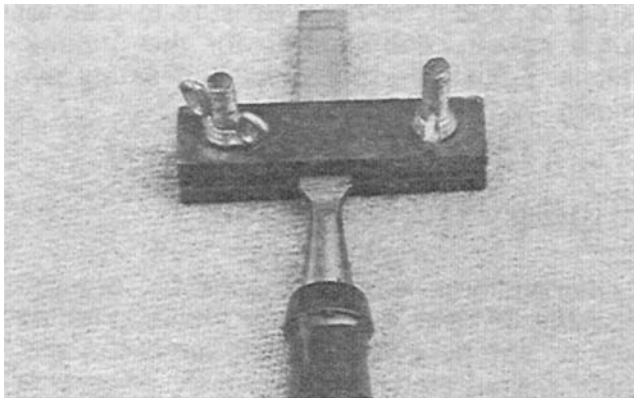
E



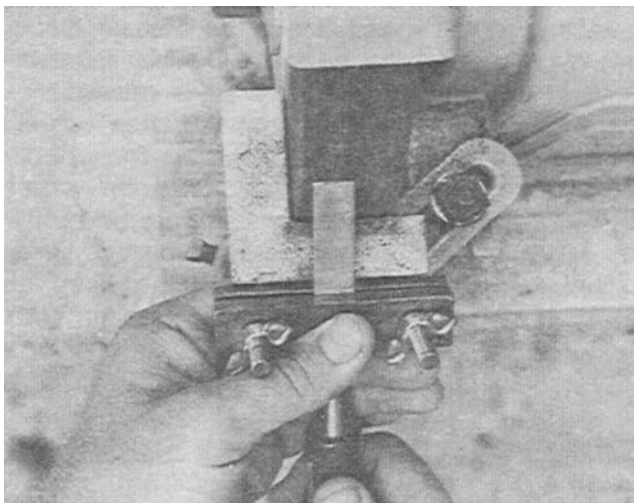
## Sharpening Wood Chisels and Plane Irons

Wood chisels and plane irons are whetted on the oil stone to give a very sharp cutting edge. When the cutting edge is nicked or the angle is incorrect, it is time to grind it. A grindstone is desired for this, but a fine grit emery wheel can be used. In either case, the grinding wheel should turn toward the chisel. Dip the chisel or plane iron frequently in water to prevent overheating.

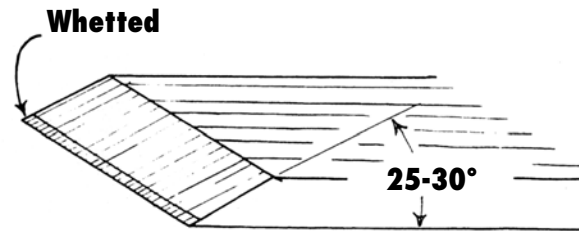
The cutting edge should be straight and square with the sides of the chisel or plane iron. You may desire a clamp to grip the chisel and rest against the grinder guide for accurate positioning.



**A clamp to hold the chisel or plane iron for grinding.**



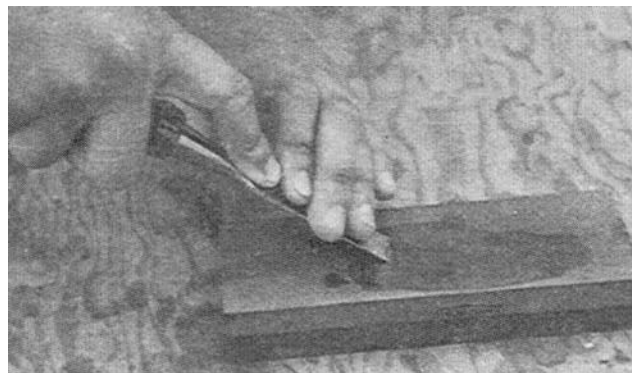
**Chisel in position on grinder. Move chisel or plane iron across the face of the wheel from side to side. Caution: wear goggles unless wheel is guarded with eye shields.**



A bevel too short and thick will not enter the wood easily. A bevel too long and thin is weak and will nick easily.

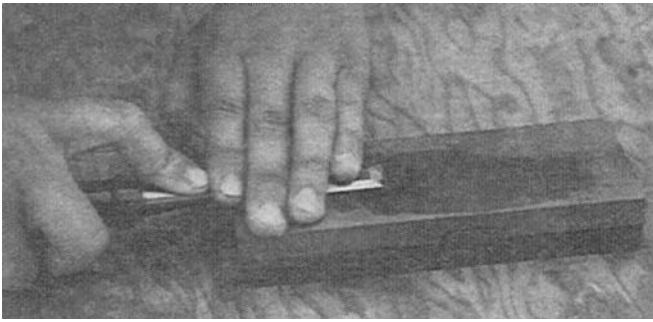
After proper grinding, whet the chisel or plane iron on the oil stone for a very sharp cutting edge.

Apply enough oil to the stone surface to keep it moist. The oil prevents particles of steel from filling the pores of the stone. When the pores are filled, the stone does not cut well. Wipe off the oil before putting the stone away.



Place the chisel or plane iron on the fine grit oil stone with the bevel flat on the surface. Raise the handle slightly 5 degrees or less, so you whet only the forward part of the bevel.

Move the chisel or plane iron with a circular motion back and forth lengthwise on the oil stone several times. The circular motion permits you to use the entire top of the stone so it wears evenly.



## Safety Notes for Using Plane Irons

**Make sure the cutting edge on plane irons stays sharp. Dull blades can be dangerous.**

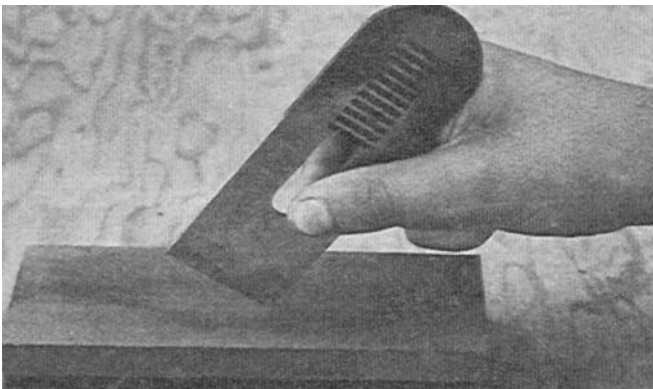
**Make sure the work to be planed is securely fastened or held with a clamp to avoid slippage.**

After whetting the bevel edge on the oil stone, remove the wire or feather edge. Turn the chisel over and hold the flat side flat on the oil stone. Move the chisel back and forth a couple of times in this position.

Now look at the cutting edge. If you see a nick or a shiny edge of bluntness, whet both sides again. Make a small cut in a piece of wood before taking a final look.

Use dulls the cutting edge. When it becomes dull, sharpen by whetting as described. The whetting process can be repeated until the bevel becomes too short and thick. Then, grind for the correct angle.

Plane marks show less on a finished surface if the corners of the plane iron are slightly rounded. This can be accomplished by additional honing at the edges or just stroking the corner in a circular motion as illustrated.



## Power Tools

### Bench Grinder

The bench grinder is used for sharpening woodworking tools. Chisels, plane irons, and screwdrivers can all be sharpened on the bench grinder. The simplest kind of grinder is turned by hand, but most of today's grinders are operated by electricity. This grinder is mounted on a bench and is equipped with a grinding wheel, wire brush wheel, and buffing wheel.

There are several different types of grinders. Your parent or leader may be able to explain them in further detail. Anyone interested in buying a grinder should compare cost, size, and quality of the various types. Ask your parent or leader for help. Be sure to look for sturdy construction, guards for the grinding wheels, adjustable tool rests, and safety eye shields.

### Grinder Wheel Dressing

The grinding wheels should be dressed regularly to keep the wheels round, grinding surface flat or even, and to remove glaze. Either a steel cutter wheel dresser or carbide wheel dresser can be used.

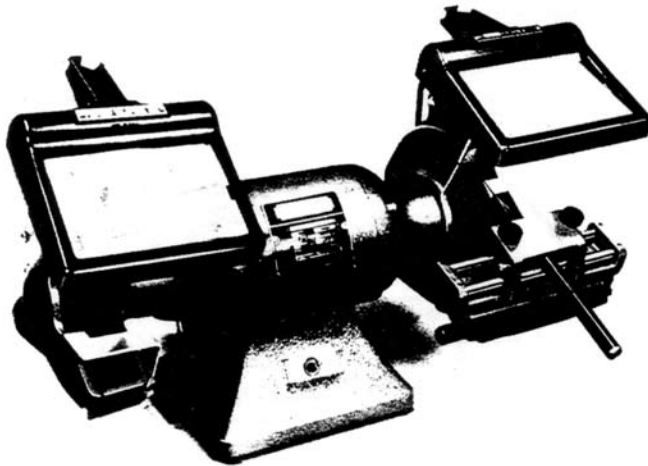
Support the dresser on the tool rest and hold it firmly against the grinding wheel while it is operating at full speed. Move the dresser back and forth across the surface. Do not remove more of the grinding wheel than is necessary. Exert just enough pressure on the steel wheel dresser so that the dresser is cutting the wheel. If you see sparks when using the steel dresser wheel, apply more pressure. When the proper pressure is exerted on a carbide wheel dresser, there are sparks at the area of contact between the dresser and the wheel.

### Grinder Operation and Safety

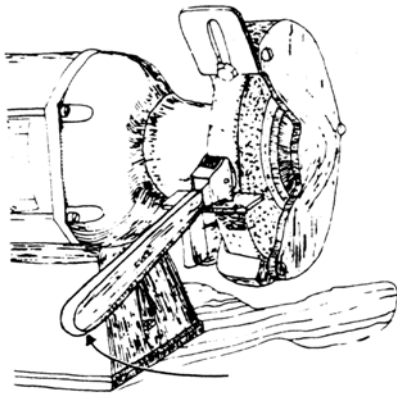
- It is important to protect your eyes when operating a high speed grinder. Pieces of metal and abrasive wheel particles fly from the grinding wheel when it is in use. These particles may injure unprotected eyes. Provide yourself with a pair of safety goggles and use them.



- Operate the wheel only at speeds recommended by the manufacturer.
- Keep the tool rest adjusted and close to the grinding wheel. The distance from the wheel should not exceed  $\frac{1}{8}$ ".
- Keep the grinding wheel round with the proper shaped working face by frequent dressing.
- Do not exert a side pressure on the grinding wheel by making a heavy cut on the side of the wheel.
- Do not grind with the wheel before it has reached operating speed or while it is coasting to a stop.
- Whenever possible, avoid standing directly in line of the grinding wheel rotation.



**Bench grinder self-contained**



**Dressing a grinding wheel**

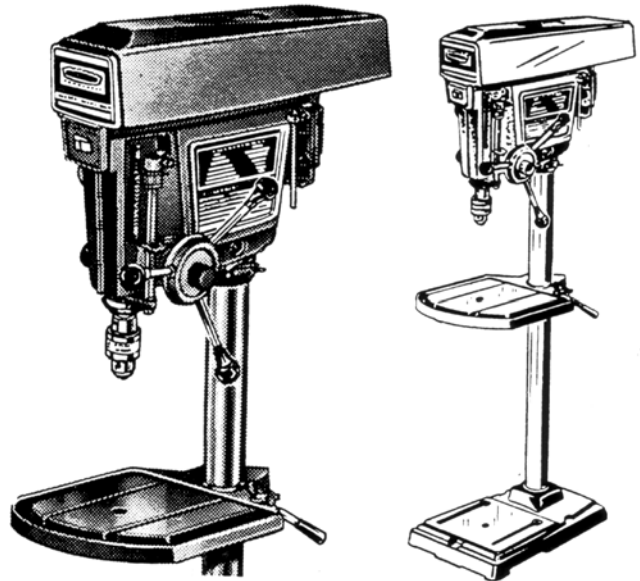
## Drill Press

The drill press is a power machine that has many uses. With proper attachments, it can be used for drilling, routing, sanding, mortising, shaping, carving, cutting dovetails, buffing, wire brushing, and grinding.

There are two basic types of drill presses: the **bench** type and the **upright** type. These are basically the same, the difference being in the mounting. As the name suggests, the benchtype drill press is mounted on a work bench and the upright type is mounted on a pedestal which stands on the floor.

Drill presses come in a number of sizes and use a wide variety of bits. Those most commonly found in shops have the capacity to drill holes up to 1 inch in diameter, using the proper bits.

If you have the machine, study the operator's manual and instruction book.







## Belt Sander

A belt sander quickly sands large surfaces such as floors, walls, and planks. It can erase scratches or smooth uneven workmanship. The belt sander also works well on furniture made of solid lumber, but it is not suited to sanding furniture made from veneer plywood.

The cutting action is done by a sanding belt which runs over two pulleys. The work capacity of this sander depends upon its size and belt speed. These are either noted on the machine itself or in the literature that accompanies the machine. For very small pieces of wood, the belt sander may not be a safe tool to use.

The **size** is listed as the width of the belt that fits the sander. Common belt sizes are 3 x 18, 3 x 21, 3 x 24, 4 x 21, and 4 x 24 inches. Generally, the larger the sander, the greater the work capacity.

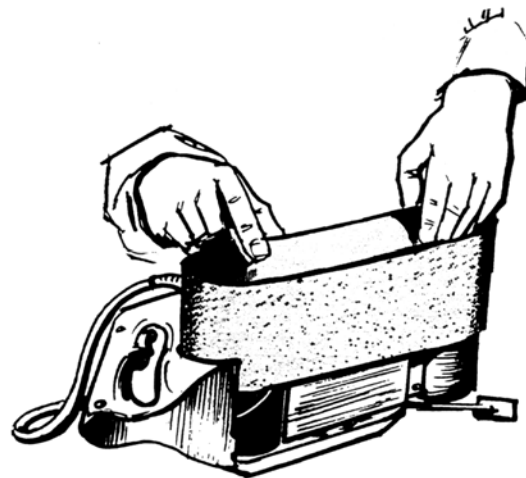
The **speeds** of the belts on different models range from 900 to 1,600 surface feet per minute (SFPM). The greater the SFPM, the greater the work capacity of the machine and the swiftness of the sander.

**Belt changing.** To change a sander belt, consult your instruction book. It is a simple operation to do. If you are buying a sander, ask the salesman to demonstrate belt changing, then try it yourself.

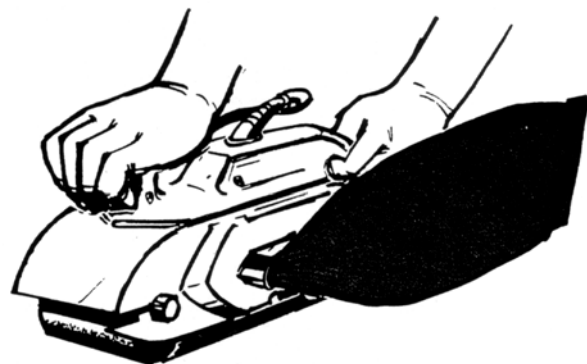
**Dust collection.** A belt sander produces large quantities of dust and waste from the work surface, so a system of dust collection is recommended. You can use a built-in dust bag, a bag bought separately that can be attached as required, or a flexible accessory hose that connects to a vacuum cleaner.



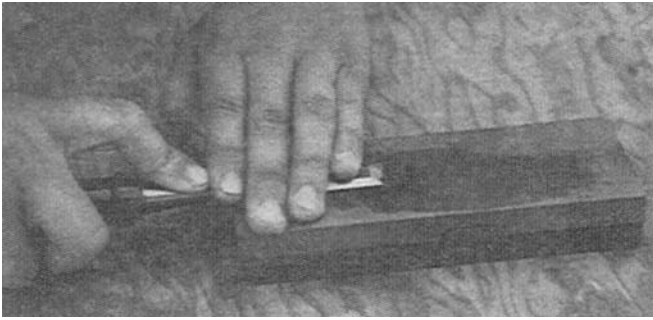
**Belt Sander**



**Changing the Belt**



**Accessory Dust Bag**



## Safety Notes for Using Plane Irons

**Make sure the cutting edge on plane irons stays sharp. Dull blades can be dangerous.**

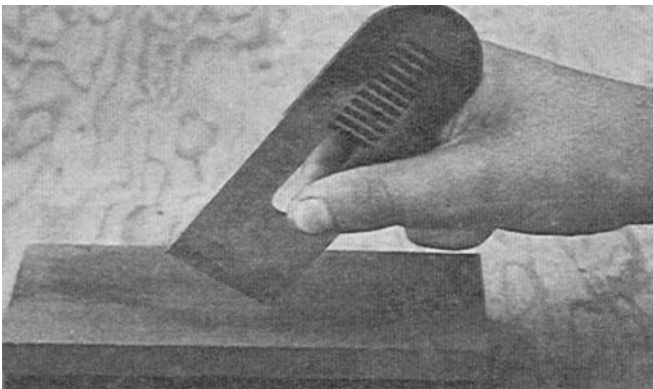
**Make sure the work to be planed is securely fastened or held with a clamp to avoid slippage.**

After whetting the bevel edge on the oil stone, remove the wire or feather edge. Turn the chisel over and hold the flat side flat on the oil stone. Move the chisel back and forth a couple of times in this position.

Now look at the cutting edge. If you see a nick or a shiny edge of bluntness, whet both sides again. Make a small cut in a piece of wood before taking a final look.

Use dulls the cutting edge. When it becomes dull, sharpen by whetting as described. The whetting process can be repeated until the bevel becomes too short and thick. Then, grind for the correct angle.

Plane marks show less on a finished surface if the corners of the plane iron are slightly rounded. This can be accomplished by additional honing at the edges or just stroking the corner in a circular motion as illustrated.



## Power Tools

### Bench Grinder

The bench grinder is used for sharpening woodworking tools. Chisels, plane irons, and screwdrivers can all be sharpened on the bench grinder. The simplest kind of grinder is turned by hand, but most of today's grinders are operated by electricity. This grinder is mounted on a bench and is equipped with a grinding wheel, wire brush wheel, and buffing wheel.

There are several different types of grinders. Your parent or leader may be able to explain them in further detail. Anyone interested in buying a grinder should compare cost, size, and quality of the various types. Ask your parent or leader for help. Be sure to look for sturdy construction, guards for the grinding wheels, adjustable tool rests, and safety eye shields.

### Grinder Wheel Dressing

The grinding wheels should be dressed regularly to keep the wheels round, grinding surface flat or even, and to remove glaze. Either a steel cutter wheel dresser or carbide wheel dresser can be used.

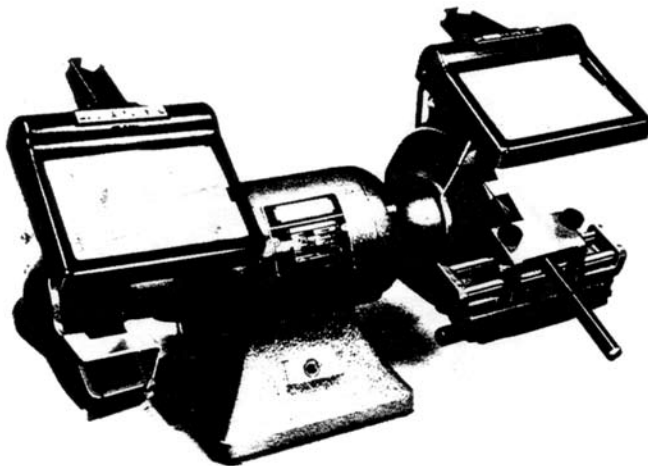
Support the dresser on the tool rest and hold it firmly against the grinding wheel while it is operating at full speed. Move the dresser back and forth across the surface. Do not remove more of the grinding wheel than is necessary. Exert just enough pressure on the steel wheel dresser so that the dresser is cutting the wheel. If you see sparks when using the steel dresser wheel, apply more pressure. When the proper pressure is exerted on a carbide wheel dresser, there are sparks at the area of contact between the dresser and the wheel.

### Grinder Operation and Safety

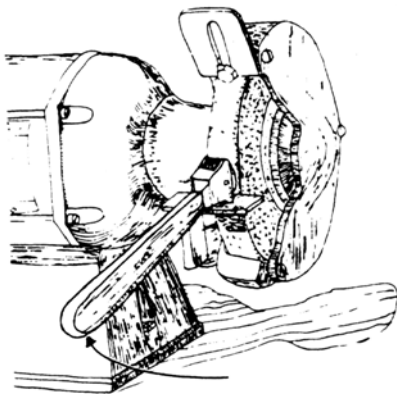
- It is important to protect your eyes when operating a high speed grinder. Pieces of metal and abrasive wheel particles fly from the grinding wheel when it is in use. These particles may injure unprotected eyes. Provide yourself with a pair of safety goggles and use them.



- Operate the wheel only at speeds recommended by the manufacturer.
- Keep the tool rest adjusted and close to the grinding wheel. The distance from the wheel should not exceed  $\frac{1}{8}$ ".
- Keep the grinding wheel round with the proper shaped working face by frequent dressing.
- Do not exert a side pressure on the grinding wheel by making a heavy cut on the side of the wheel.
- Do not grind with the wheel before it has reached operating speed or while it is coasting to a stop.
- Whenever possible, avoid standing directly in line of the grinding wheel rotation.



**Bench grinder self-contained**



**Dressing a grinding wheel**

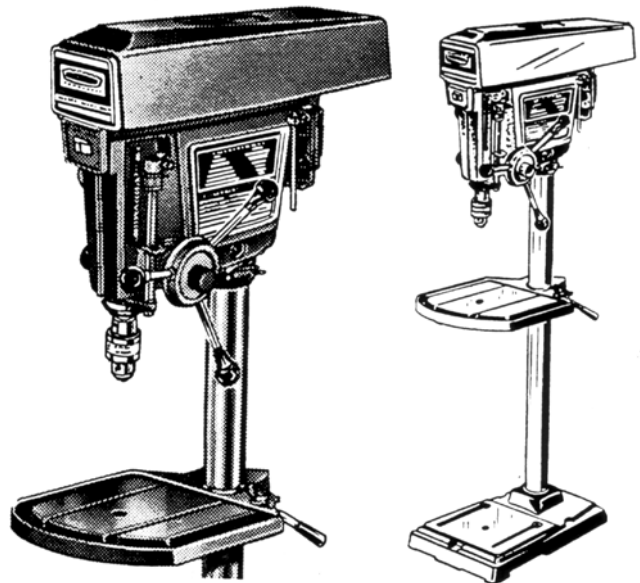
## Drill Press

The drill press is a power machine that has many uses. With proper attachments, it can be used for drilling, routing, sanding, mortising, shaping, carving, cutting dovetails, buffing, wire brushing, and grinding.

There are two basic types of drill presses: the **bench** type and the **upright** type. These are basically the same, the difference being in the mounting. As the name suggests, the benchtype drill press is mounted on a work bench and the upright type is mounted on a pedestal which stands on the floor.

Drill presses come in a number of sizes and use a wide variety of bits. Those most commonly found in shops have the capacity to drill holes up to 1 inch in diameter, using the proper bits.

If you have the machine, study the operator's manual and instruction book.





## Belt Sander

A belt sander quickly sands large surfaces such as floors, walls, and planks. It can erase scratches or smooth uneven workmanship. The belt sander also works well on furniture made of solid lumber, but it is not suited to sanding furniture made from veneer plywood.

The cutting action is done by a sanding belt which runs over two pulleys. The work capacity of this sander depends upon its size and belt speed. These are either noted on the machine itself or in the literature that accompanies the machine. For very small pieces of wood, the belt sander may not be a safe tool to use.

The **size** is listed as the width of the belt that fits the sander. Common belt sizes are 3 x 18, 3 x 21, 3 x 24, 4 x 21, and 4 x 24 inches. Generally, the larger the sander, the greater the work capacity.

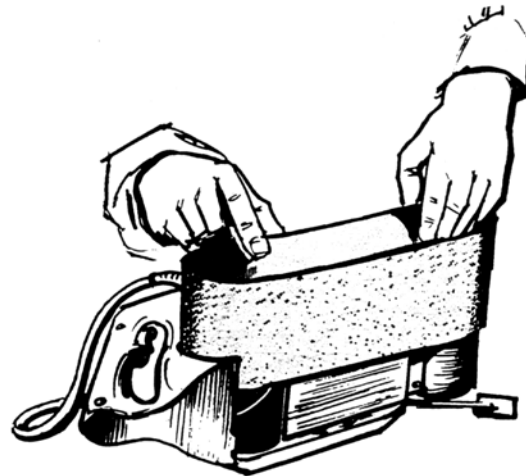
The **speeds** of the belts on different models range from 900 to 1,600 surface feet per minute (SFPM). The greater the SFPM, the greater the work capacity of the machine and the swiftness of the sander.

**Belt changing.** To change a sander belt, consult your instruction book. It is a simple operation to do. If you are buying a sander, ask the salesman to demonstrate belt changing, then try it yourself.

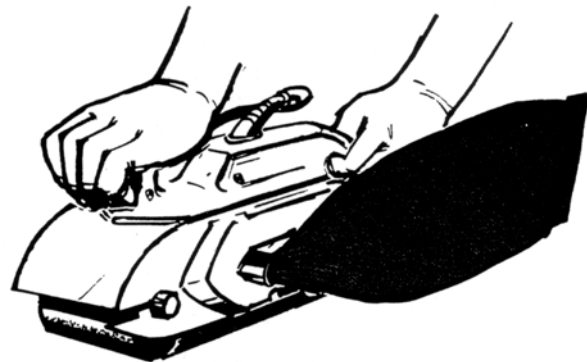
**Dust collection.** A belt sander produces large quantities of dust and waste from the work surface, so a system of dust collection is recommended. You can use a built-in dust bag, a bag bought separately that can be attached as required, or a flexible accessory hose that connects to a vacuum cleaner.



**Belt Sander**



**Changing the Belt**



**Accessory Dust Bag**