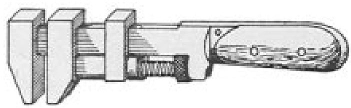
# COMMON HAND TOOLS AND THEIR PROPER USE



From Machine Shop Work
by
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## COMMON HAND TOOLS

**Simultaneous use of hand tools and machines**.
Machine shop work is usually understood to include all cold metal work in which a portion of the metal is removed, either by power-driven or hand tools, to make the piece of the required shape and size. However, there are some branches of cold metal work, such as sheet-iron work and coppersmithing that are not usually included in machine shop work.
As the hand-operated tools are much simpler, and as the operations performed with them are in every case more typical, their description and use should precede that of power-driven tools. It should be clearly understood, however, that machine shop practice involves the use of both classes at the same time. Even hand tools are not used in the same order on different classes of work; it is, therefore, impossible to describe them in the order of use. Simplicity of construction and operation will be the guide for discussing the uses of various tools.

## HAMMERS

**Classification**.
The machinist uses hammers of three shapes: ball peen, cross peen, and straight peen, Fig. 1. The ball peen is the most common; it varies in weight from 4 ounces to 3 pounds. The cross peen and straight peen hammers vary from 4 ounces to 2 pounds and are used principally in riveting. Hammers are made from a good grade of tool steel, hardened, and drawn to a blue color at the eye and a dark straw on the face and peen. The eye is elliptical in shape, and the handle is fastened by driving wedges, either wood or iron, into the end of the handle, thus spreading it to fill the eye. The handle is of hard wood, preferably hickory, and of a length suited to the weight of the hammerhead. When the handle is properly inserted, the axis of the head stands at right angles to the axis of the handle.

**Soft Hammers.**
Soft hammers are used for striking heavy blows where the steel

hammer would bruise the metal or mar the surface. They are made of rawhide, copper, or Babbitt metal, and vary in weight from 6 ounces to 6 pounds. They are subject to rapid wear, but are indispensable in setting up and taking down machinery.

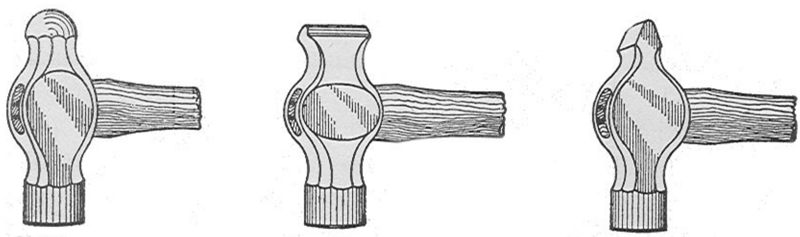


Fig. 1 Hammers

## How To Use Hammers

1. Make sure the head is fastened securely. If the handle is loose, drive the wedge farther into the handle. A loose hammer head is dangerous.
2. Grasp the hammer firmly near the end of the handle.
3. Start all work with light blows to get it started properly.

## Screw Drivers

On tool work of various kinds flat head and fillister head screws and set screws are used. Therefore it is necessary for the toolmaker to have one or more screw drivers to drive these screws or to remove them.

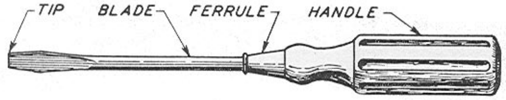


Fig. 2. Standard Screw Driver

Screw drivers are made with blades of various widths, in lengths suited to special purposes. Fig. 2 shows a regular type screw driver. The blade section is made of forged carbon tool steel, heat treated to give the hardness and toughness needed to withstand the twisting motion employed in driving a screw. Wooden handles are fastened to the blades with rivets.

The stubby ball-handle screw driver is used on jobs where there is little clearance. The handle is designed to fit the palm of the hand and to give a firm grip. With this type of screw driver it is possible to handle large size screws.

Sometimes it is necessary to make up special screw drivers for driving the largest size screws. For this purpose a piece of drill rod is used. The blade section is forged to the proper width, ground to the approximate size, then heat treated. Often a square or flat is milled on the shank so a wrench can be used for added leverage. In some cases a hole is drilled through the shank so that a steel pin or bar can be inserted to provide leverage.

## Offset Screw Drivers

This screw driver, Fig. 3, is made so that screws can be tightened or removed in places that would be inaccessible to the ordinary type of screw driver. Four blades cover eight different positions of the screw slot. A turn of only 1/8 inch is required for operation.


Fig. 3. Offset Screw Driver

## How To Use Screw Drivers

1. See that the tip of the screw driver is in good condition, the bottom squared, and the sides straight, as shown in Figs. 4 and 5.
2. With the right hand, grasp the handle. With the left hand, guide the tip into the screw slot, as shown in Fig. 6.

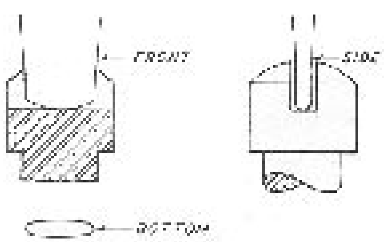


Fig. 4. Poor Screw Driver Tip

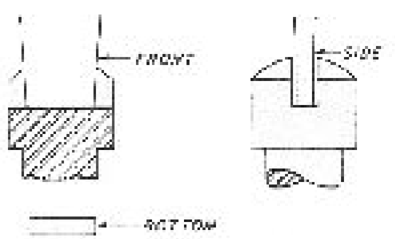


Fig. 5. Good Screw Driver Tip

3. Tightening large screws. Use a square-shanked screw driver, and with a wrench that fits the square shank, turn the screw driver. See Fig. 7. Pressure must be kept on the handle to keep the tip in the slot.

4. Do not strike the handle of the screw driver with a hard object. This will split the handle.
5. Do not use your screw driver as a wedge, or chisel.
6. Be sure that the screw driver fits the screw slot.

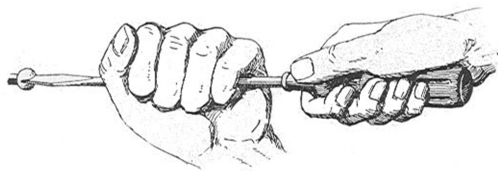

Fig. 6. Holding a Screw Driver

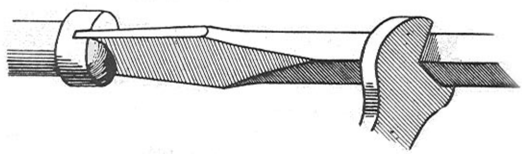

Fig. 7. Turning a Square Shank Screw Driver with an Open End Wrench

**Questions**

1. Why should a screw driver blade have parallel sides?
2. Why are screw driver blades made from carbon tool steel?
3. Why are the larger sizes of screw drivers frequently made with square blades?
4. How is a screw driver blade hardened? Why?
5. What is an offset screw driver?
6. How should a screw driver be held?
7. Why is it necessary to exert two different forces when using a screw driver, namely, turning force and a holding or pushing force?
8. What method can be used to make the tightening of large screws easier?
9. What might happen if the screw driver jumps out of the screw slot?
10. What might cause a screw driver to jump from the screw slot?

**Wrenches**

Many different types of wrenches are made for turning nuts, bolts, pipes, etc. They usually derive their names from characteristic shapes as S wrench, angle wrench; from the object they are used to turn, as pipe wrench, tap wrench; or from their construction, as spanner wrench. See Fig. 8.

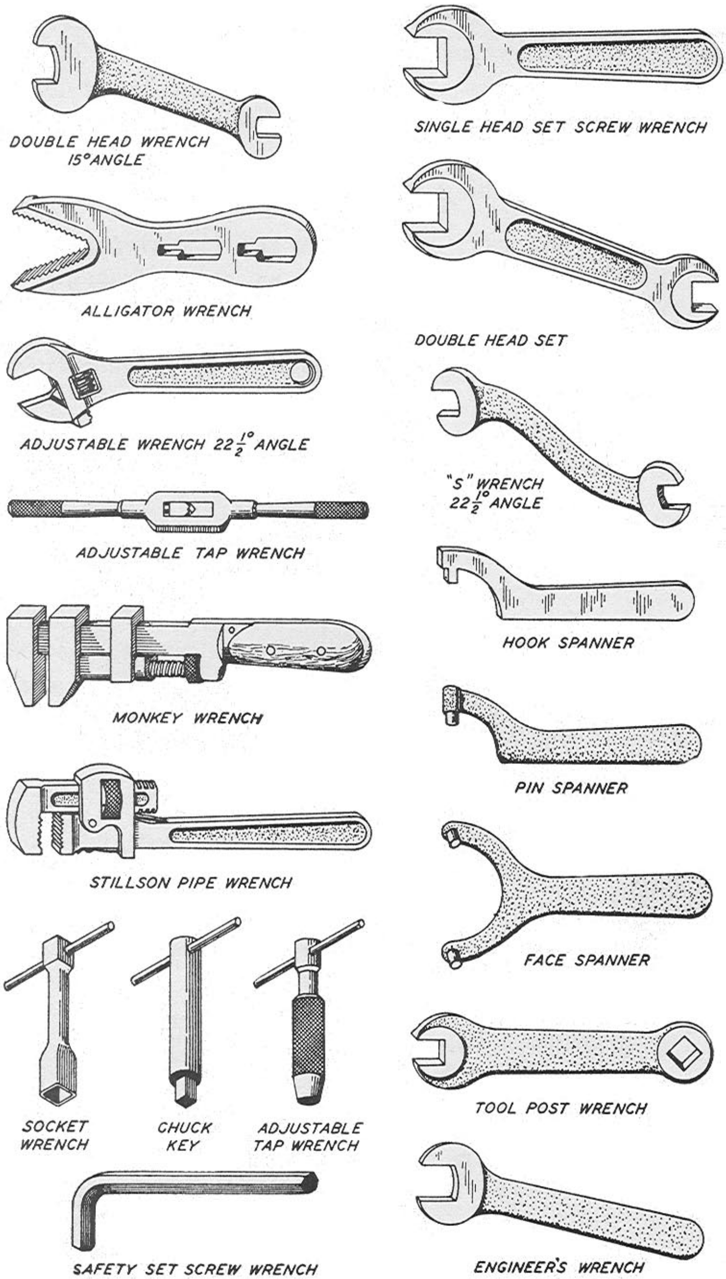


**Fig. 8. Types of Wrenches**

Whenever the correct sizes are available, the open and closed end types of wrenches are to be preferred to the adjustable wrenches. Since the wrench is a lever the mechanical advantage or the leverage secured is in proportion to the length of the handle. Usually, the handle of a solid wrench is made so that it will give all the leverage the part to be turned will probably stand. This is not so with an adjustable wrench. Hence, when a large adjustable or monkey wrench is used on a small nut or bolt, the part may be broken easily unless proper judgment is exercised.

**How To Use Open And Closed End Type~wrenches**

1. The wrench should fit closely, Fig. 9. A loose fitting wrench will round the corners of the bolt and slip badly, resulting in hand injuries.
2. A quick jerk, when tightening a bolt, or a blow with the ball of the hand when loosening a nut or bolt, Fig. 10, is often more effective than a steady pull.

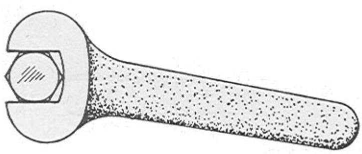

Fig. 9. Wrench Making a Good Fit

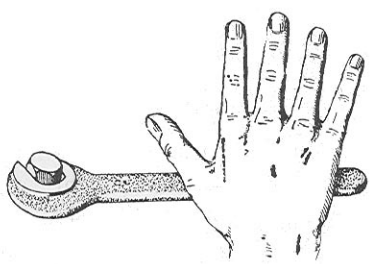

Fig. 10. Slight Bumping with Hand

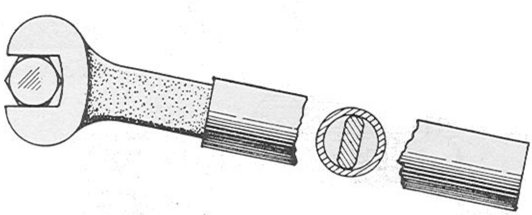

Fig. 11. Wrench with a Section of Pipe on the Handle

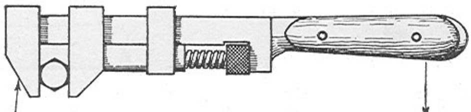


Fig. 12. Monkey Wrench

3. When doing heavy work and you are sure that the bolt and the wrench will stand the strain, you can secure greater leverage by putting a piece of pipe over the wrench handle, as shown in Fig. 11. Good judgment must be used when this is done.

## How To Use Adjustable Wrenches

1. Place the wrench on the bolt to be turned. Be sure jaws are pointed in
the direction in which the work is to be turned.
2. Adjust the jaws until they fit the part tightly, as shown in Fig. 12.

## Questions

1. Is a wrench a lever?
2. Why are wrench handles made rather short?
3. Why are open-end and closed-end wrenches to be preferred to adjustable wrenches?
4. In which direction should force be applied to the monkey wrench?
5. Should a large monkey wrench be used to turn small parts? Why?
6. Is a push or a blow more effective in loosening a tight nut?
7. How can more leverage be secured on a particular wrench?
8. Why should a monkey wrench usually not be used around any precision or production machinery?

## The Bench Vise

In order that work may be held rigidly for the performance of hand operations, the machinist uses what is termed a vise. Vises are made in a great variety of forms and sizes, but all consist essentially of a fixed jaw, a movable jaw, a screw, a nut fastened to the fixed jaw, and a handle by which the screw is turned in the nut to bring the movable jaw into position. The sectional view, Fig. 13, shows these parts clearly and also a device, present in some form in all vises, by which the movable jaw is separated from the fixed jaw when the screw is backed out of the nut.

In the machinist's vise, both jaws are made of cast iron with removable faces of cast steel. These may be checkered to provide a firm grip for heavy work, or may be smooth to avoid marking the surface of the plate operated upon. When holding soft metal, even the smooth steel jaws would mar the surface; and in such cases it is customary to use false jaws of brass or Babbitt metal, or to fasten leather or paper directly to the steel jaws to protect the work. The screw and handle are made from steel and the nut from malleable Iron.

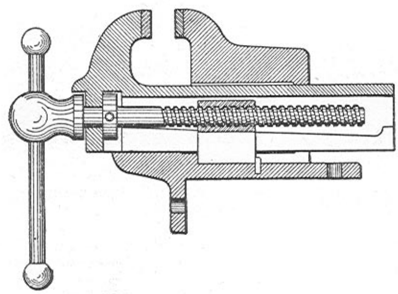

Fig. 13. Bench Vise

The common method of fastening a vise to the bench is by means of the fixed base, although a swivel base, as shown in Fig. 14, is preferable. Another type of vise in common use has a swivel jaw, which enables it to hold tapered work firmly. This swivel jaw is provided with a locking-pin, which fixes the jaws in a parallel position. The height of the vise from the floor depends somewhat on the class of work to be performed, but a general rule is to have the top of the jaws about 1 1/2 inches below the point of the elbow

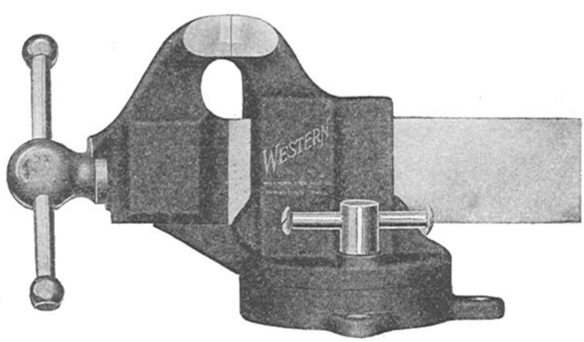


Fig. 14. A Machinist's Vise Having Solid Jaws and a Swivel Base
The slide for the movable jaw should never be used as an anvil as that will cause it to spring out of shape and bind in its guide.

when standing erect beside the vise.

The vise is indispensable to the toolmaker when filing or when laying out work.

## How To Use The Bench Vise

1. Clean the vise daily and keep the clamp screw oiled.
2. When clamping finished work on soft metals, always place a pair of soft jaws over the regular jaws. The false jaws may be made from copper, brass, lead, or leather.
3. Place a block below the work, as shown in Fig. 15, to keep it from slipping down between the jaws.
4. Use judgment in tightening the vise. Be careful not to press cylindrical pieces out of round or to crack light pieces and metals.
5. Never strike the vise handle with a hammer or other object to tighten it.
6. Never pound work on the movable jaw.

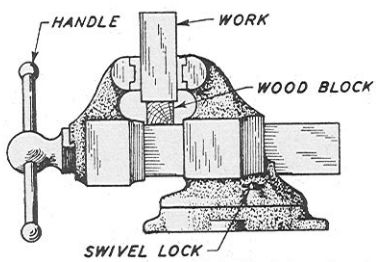

Fig. 15. Correct Way to Hold Work in a Bench Vise

## Questions

1. How are false jaws held on the regular vise jaws?
2. For what are soft, false jaws used?
3. From what materials are soft, false jaws made?
4. How can you prevent work from slipping down between the jaws?
5. Which jaw is movable; which is fixed?
6. Why should the front jaw never be used as an anvil for pounding anything?
7. Give three important directions for clamping work.

## The Hack Saw

### Hack Saw Frames.

Hack saw frames are either fixed or adjustable. They are made to take 8-, 10-, or 12-inch blades. Tension is applied to the blade to make it taut by means of a wing nut on the pistol grip type frame or by turning a threaded handle on the straight handle type. See Fig. 16.

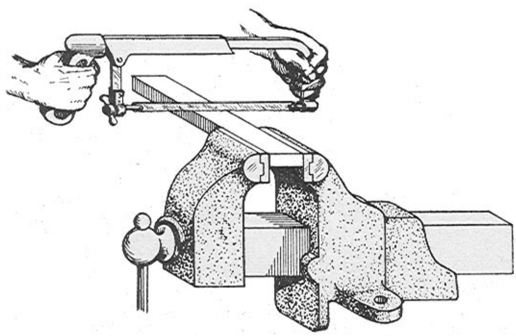

Fig. 16. Correct Position of Hands for Sawing with a Hand Hack Saw
Stock may be sawed on either the right or the left side of the vise. Sawing should be done as close to the vise as convenient.

### Hack Saw Blades.

Hack saw blades are made from high-grade steels, hardened and tempered. Since they are very hard they are also very brittle. Some blades, however, are more flexible because only the teeth are hardened, leaving the blade comparatively flexible.

### Proper Pitch.

Pitch refers to the number of teeth per inch. Sixteen pitch means 16 teeth to the inch. Pitch is always the most important factor to consider when cutting. When cutting small size stock, be sure to use a pitch which will have at least two teeth always in contact with the sawed surface. See Fig. 17.

The most important consideration in the use of the hacksaw is the selection of the proper blade. One of the chief causes of the breakage of blades is due to teeth or pitch unsuited to the work. Table 1 shows the proper pitch for various types of materials.

**How To Use The Hack Saw**

You will find the following procedures helpful in learning to use properly the hand hack saw.

1. Hold the stock to be cut securely in a vise, so that the saw will cut about 1/4 inch from the vise jaws. Cutting close to the vise

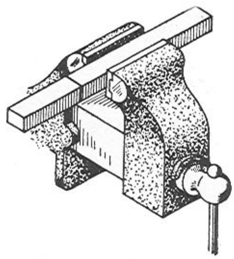

Fig. 18. Cut Parallel to Side of Vise Jaws and Near Vise Jaws

prevents the stock springing. The cut should be parallel to the side of the vise, as in Fig. 18.

2. To start the saw cut in the right place, make a small nick in the stock with the edge of a file.

3. Hold the frame handle securely in the right hand. Keep the thumb on top of handle. Hold the front end of the frame with the left hand to guide the saw and to give pressure when sawing.

4. Keep the cut straight. If the cut “runs,” turn the stock and start a new cut.

5. About sixty strokes per minute is the best cutting speed. Because the teeth point away from the operator, the forward stroke is the cutting stroke. Pressure should not be used on the return stroke.

6. If the blade breaks in a partly finished cut, start the new blade in another place. The new blade is always thicker than a worn blade; hence, the new blade will bind if used to continue an old cut.

7. Do not use oil as a hack saw lubricant in hand sawing.

**Hints On Using The Hack Saw**

1. To saw thin stock, clamp the, stock between two pieces of wood or soft steel and saw through all three pieces.

2. Four common causes that break saw blades are as follows:

**Table 1—Pitch for Various Materials**

| Pitch of Blade (Teeth per inch) | Stock to be Cut | Explanation | Correct Pitch | Incorrect Pitch |
|---|---|---|---|---|
| 14 | Machine steel<br>Cold rolled steel<br>Structural steel | The coarse pitch makes saw free and fast cutting | Plenty of chip clearance | Fine pitch<br>No chip clearance<br>Teeth clogged |
| 18 | Aluminum<br>Babbitt<br>Tool steel<br>High speed steel<br>Cast iron | Recommended for general use | Two or more teeth on section | Coarse pitch straddles work stripping teeth |
| 24 | Tubing<br>Tin<br>Brass<br>Copper<br>Channel iron<br>Sheet metal (over 18 gage) | Thin stock will tear and strip teeth on a blade of coarser pitch | Plenty of chip clearance | Fine pitch<br>No chip clearance<br>Teeth clogged |
| 32 | Small tubing<br>Conduit<br>Sheet metal (less 18 gage) | | Two or more teeth on section | Coarse pitch straddles work |

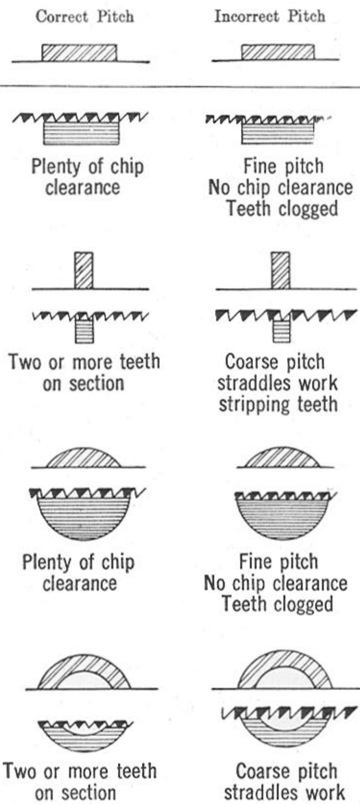

Fig. 17. Correct and Incorrect Pitch

(a) Using too coarse a blade on thin stock.
(b) Cutting at an angle, then trying to cut straight.
(c) Exerting too much pressure.
(d) Work insecurely clamped.

3. After replacing a worn blade with a new one, start a new cut because the cut of the old blade will be narrower than that of the new blade. The new blade will probably break if forced into the old cut.

4. The following suggestions are given for holding the work in the vise properly:
(a) Expose as much of the work as possible so that the maximum number of teeth may be engaged in the cutting.
(b) Be sure the work is held rigidly.

(c) Always start the cut with the least possible angle facing the thrust of the saw teeth.

The above points are especially important in cutting such shapes as angle iron or other odd shaped material.

(d) To prevent chattering, saw as close as possible to the vise where work is held.

5. Do not use excessive pressure and saw carefully when the saw is almost through the cut.

## Questions

1. Which stroke is the cutting stroke?
2. Which way should a saw blade be placed in the frame?
3. Does the saw cut on the return stroke?
4. What makes the hack saw blade rather brittle?
5. In what position should a piece of flat stock about ¼ inch by 1 inch be placed in the vise for cutting?
6. Make a sketch showing the position in which you would hold a piece of angle iron for cutting.
7. What is meant by pitch?
8. What general rules or principles can you give for selecting blades of proper pitch?