Chapter 11

PLANING MACHINES

After studying this chapter, you will be able to:

- Identify the various types of planing machines.
- Explain how planing machines operate.
- Describe the industrial applications of planing machines.

Planing machines are designed to machine horizontal, vertical, and/or angular planed flat surfaces. These machines are classified into several categories.

SHAPER

The ***shaper*** has a single point cutting tool that moves back and forth over the work. Being too slow for modern production techniques, most work formerly done on a shaper is now performed by other machine tools, Fig. 11-1. However, the shaper is still found in some jobbing and specialty machine shops because it is easily and inexpensively tooled for some one-of-a-kind jobs.

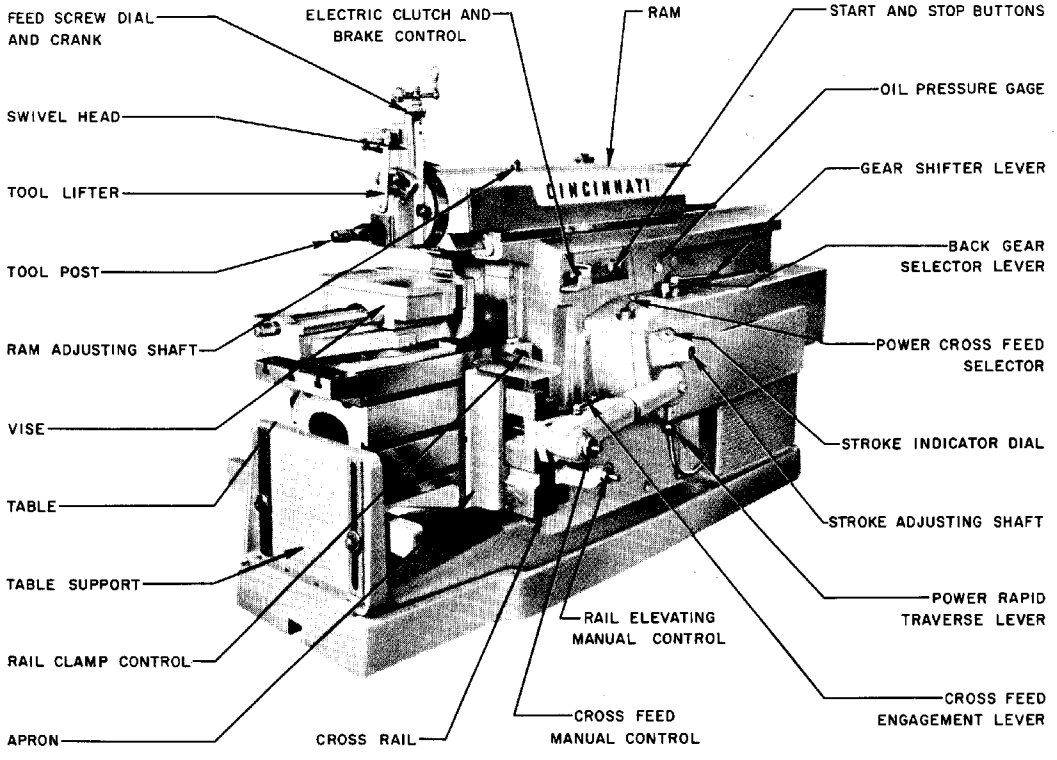

Fig. 11-1. Study various parts of shaper. (The Cincinnati Shaper Co.)

On a shaper, the work is stationary and the single point cutting tool moves against it, Fig. 11-2. While primarily used to machine flat surfaces, a skillful machinist can manipulate it to cut curved and irregular shapes, slots, grooves, and keyways. Work is usually mounted in a vise, Fig. 11-3.

As with any machine tool, carefully examine a shaper to be sure it is in safe operating condition. The machine should also be lubricated according to the manufacturer's specifications.

SAFETY NOTE! Never attempt to operate these machines while your senses are impaired by medication or other substances.

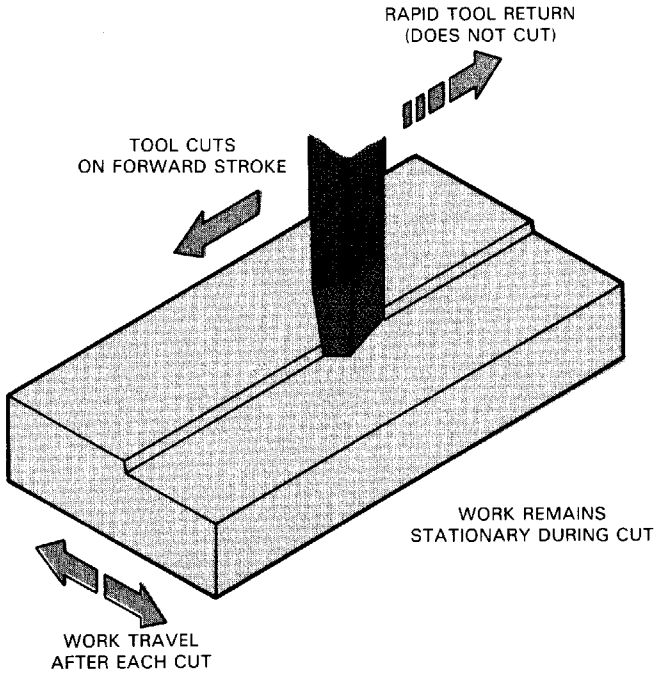

Fig. 11-2. Diagram shows how a shaper operates. Work is stationary and cutting tool moves against it.

SHAPER SIZE

Shaper size is determined by the maximum length of material the tool can machine in one setup. See Fig. 11-4. For example, a 20 in. (500 mm) shaper has a ***stroke*** (distance cutting tool travels) that is sufficient to machine a surface 20 in. (500 mm) long.

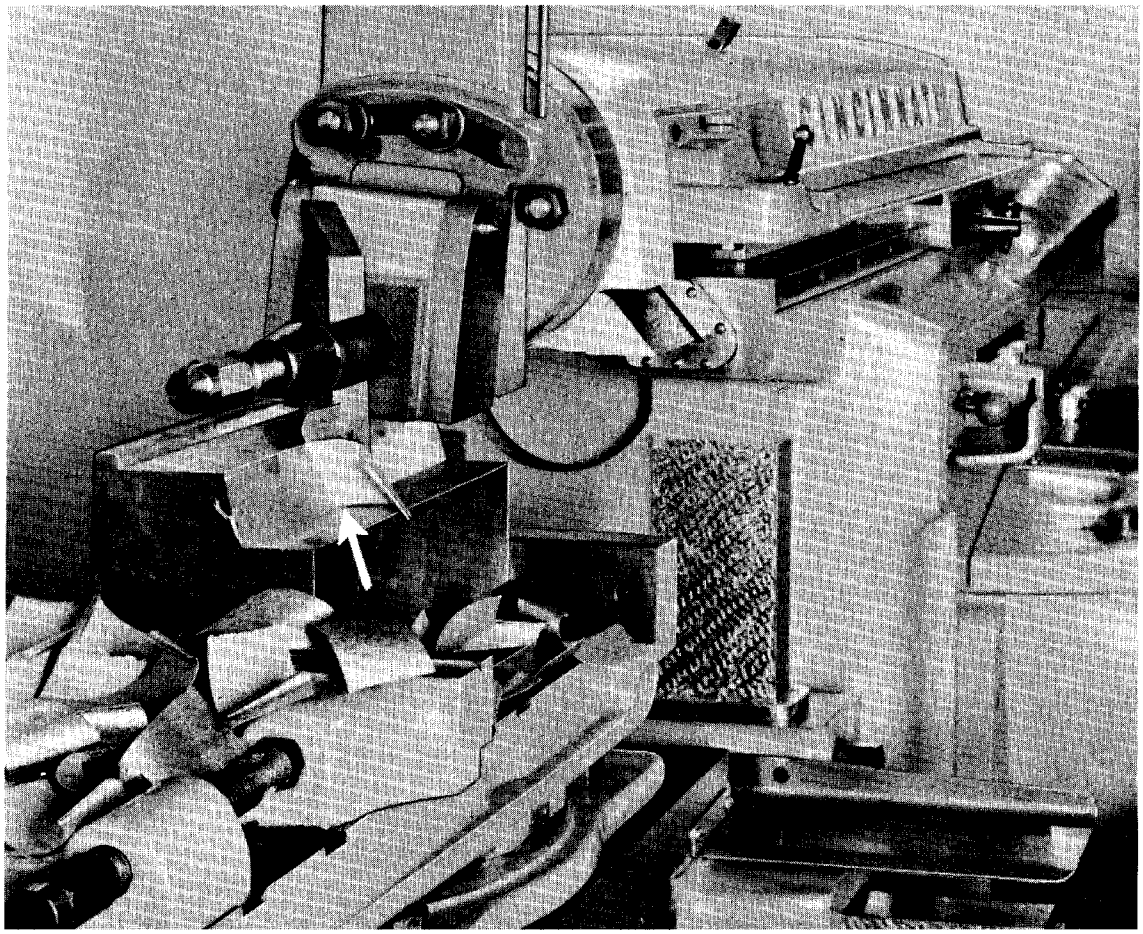

Fig. 11-3. With work held in a vise, shaper is making a cut that is 2 in. (50 mm) deep and 1/32 in. (0.8 mm) thick. (The Cincinnati Shaper Co.)

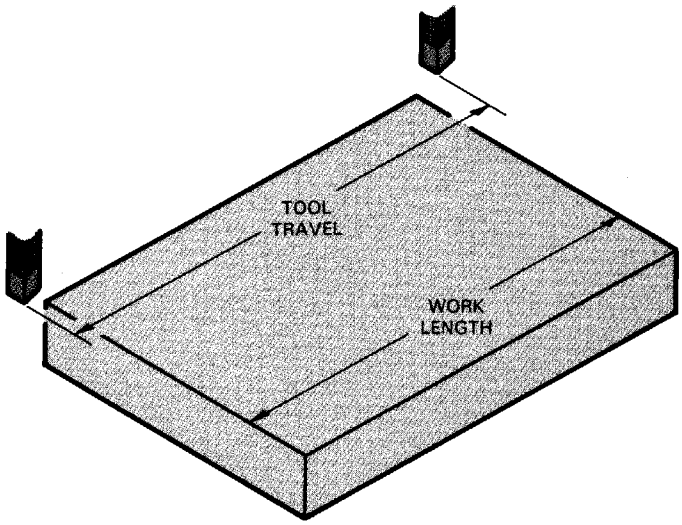

Fig. 11-4. Shaper size is determined by maximum work length that can be machined in one pass.

Mounting work on shaper

The position of the vise is important when using a shaper. It should be positioned so the machining can be done in the shortest possible time. Assuming that the cutter is making the same number of strokes per minute, the setup shown in Fig. 11-5A will permit the work to be done in about a third of the time needed to machine the work in the setup in Fig. 11-5B.

Avoid excessive tool and slide overhang, Fig. 11-6. The resulting "chatter" will cause a very rough finish.

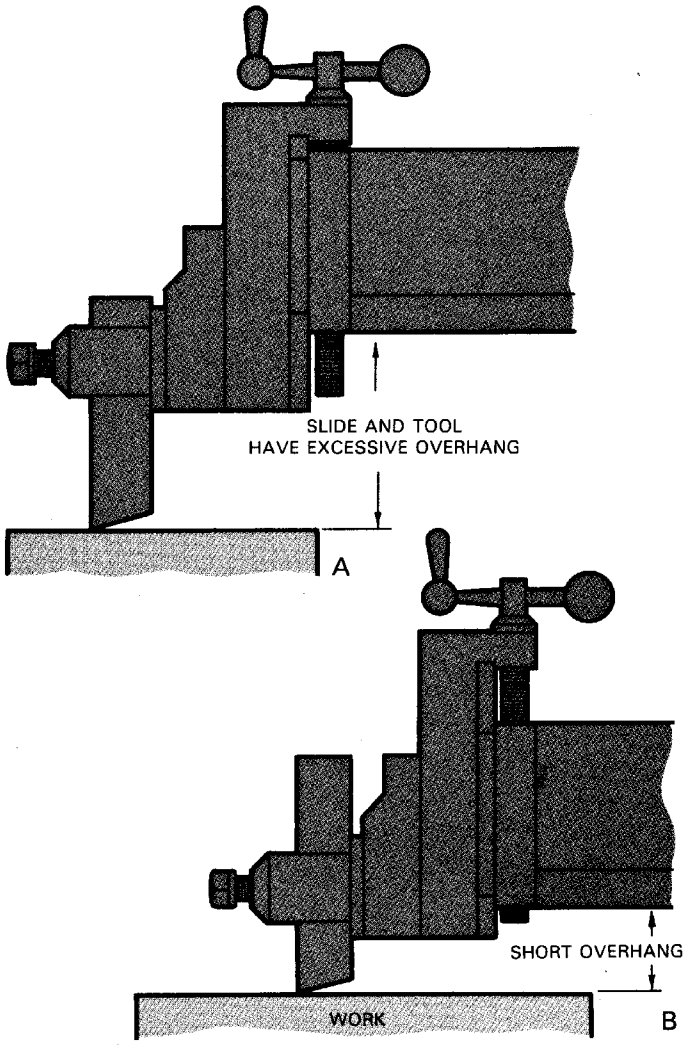

Fig. 11-6. Avoid excessive overhang of slide and/or cutting tool. A—Excessive overhang causes chatter, producing a rough finish. B—Keep slide up and a short grip on tool for increased rigidity.

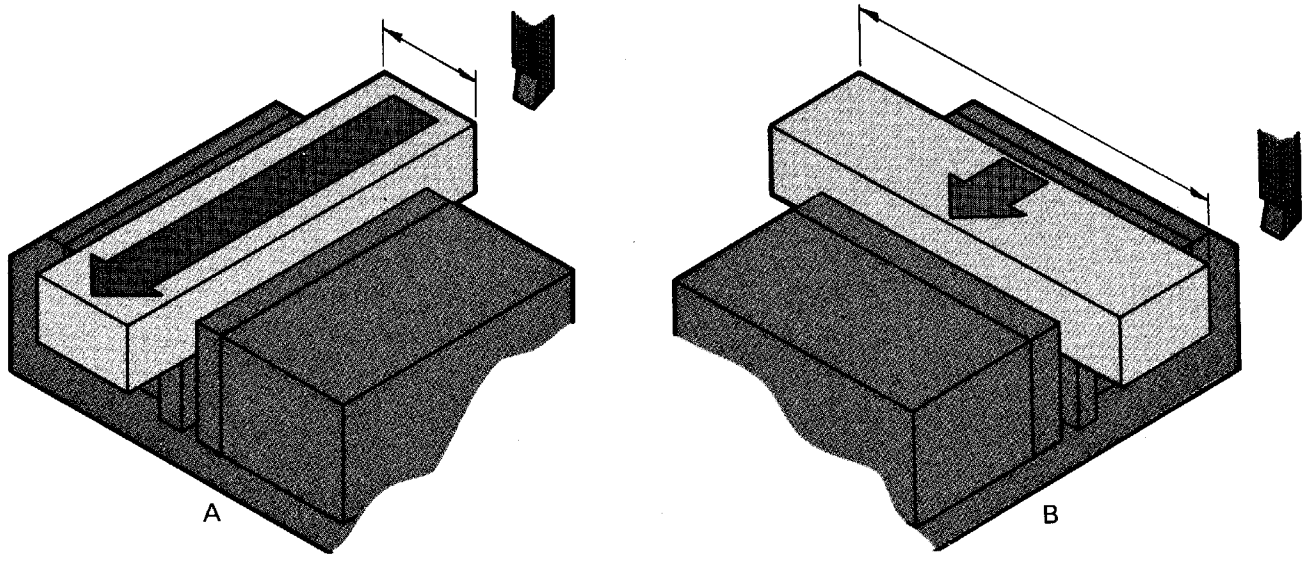

Fig. 11-5. Position work in vise so it can be machined in shortest amount of time. A—Proper setup. B—This setup will take approximately two times longer to machine than other setup.

The cutting stroke of the machine should be adjusted to work as shown in Fig. 11-7. Make the adjustments as recommended by the machine's manufacturer.

Shaper cutting speed and feed

The ***shaper speed*** is the number of cutting strokes the ram makes per minute. The ***shaper feed*** is the distance the work travels or moves after each cutting stroke. Generally, the following should be observed:

1. The harder the metal or the deeper the cut, the SLOWER the cutting speed.
2. The softer the metal or the lighter the cut, the FASTER the cutting speed.
3. Coarse feed, deep cut, and slow cutting speed for the roughing cut.
4. Fine feed, light cut, and fast cutting speed for the finishing cut.

Cutting tool shape is determined by the material being machined and the degree of finish desired. The tool shapes shown in Fig. 11-8 are recommended for mild steel.

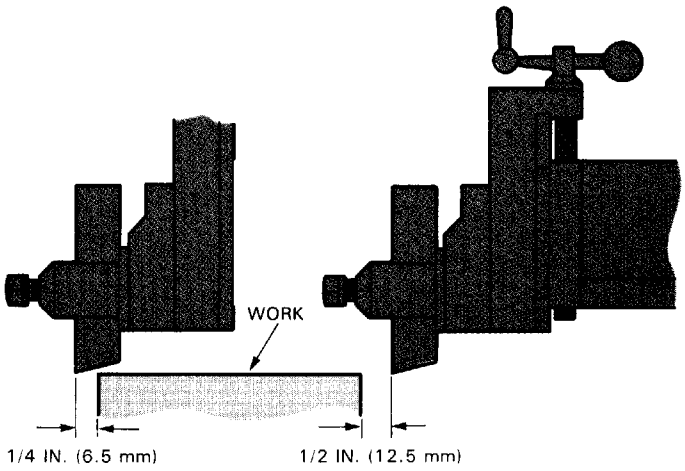

Fig. 11-7. The 1/4 in. (6.5 mm) allowance at end of stroke provides ample chip clearance, while 1/2 in. (12.5 mm) allowance permits cutter to drop back into cutting position for next stroke.

SLOTTER

The chief difference between a shaper and a ***slotter*** is the direction of the cutting action, Fig. 11-9. The slotting machine is classified as a VERTICAL SHAPER. It is used to cut slots, keyways (both internal and external), and to machine internal and external gears, Fig. 11-10.

The vertical shaper and the manner in which it cuts are shown in Figs. 11-11 through 11-13.

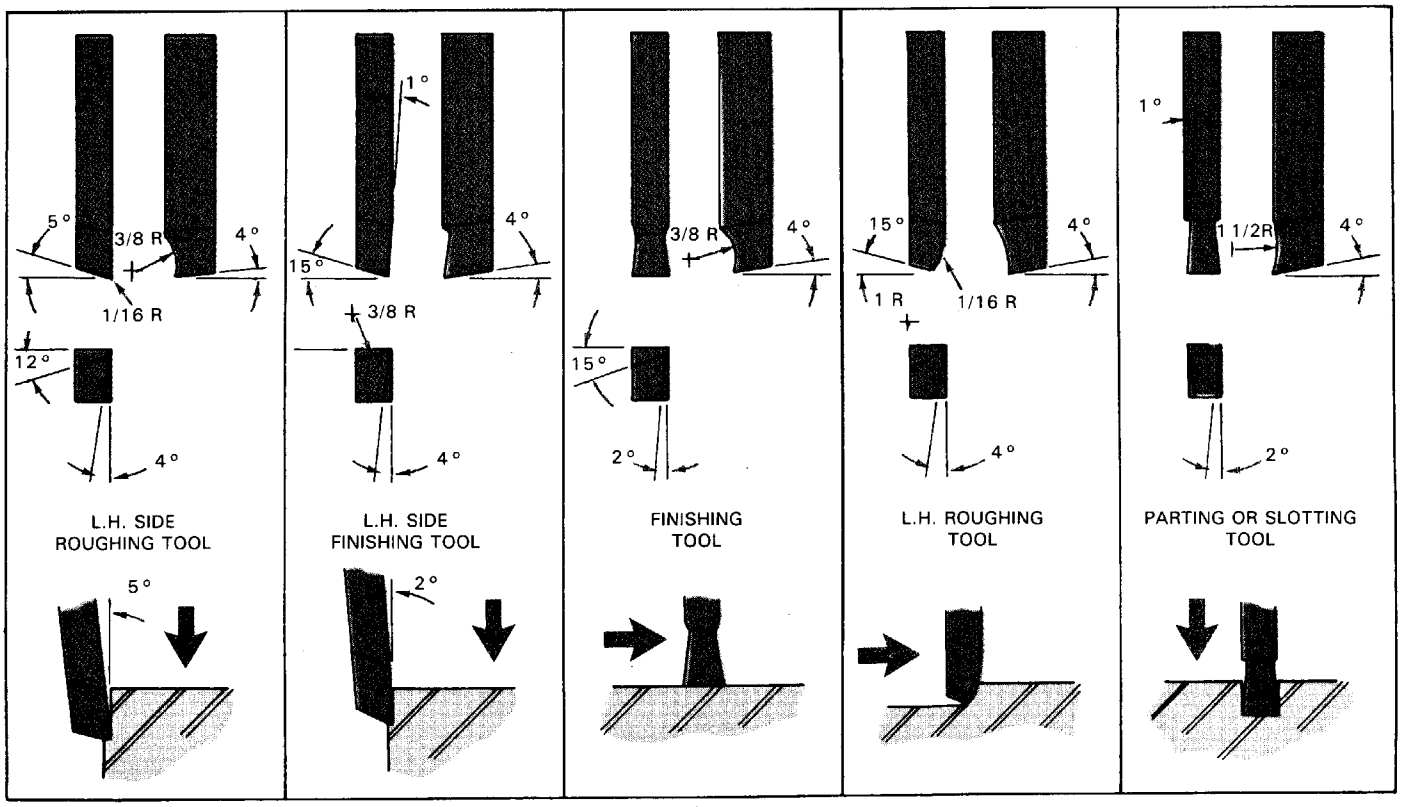

Fig. 11-8. Note cutting tool shapes recommended for machining mild steel.

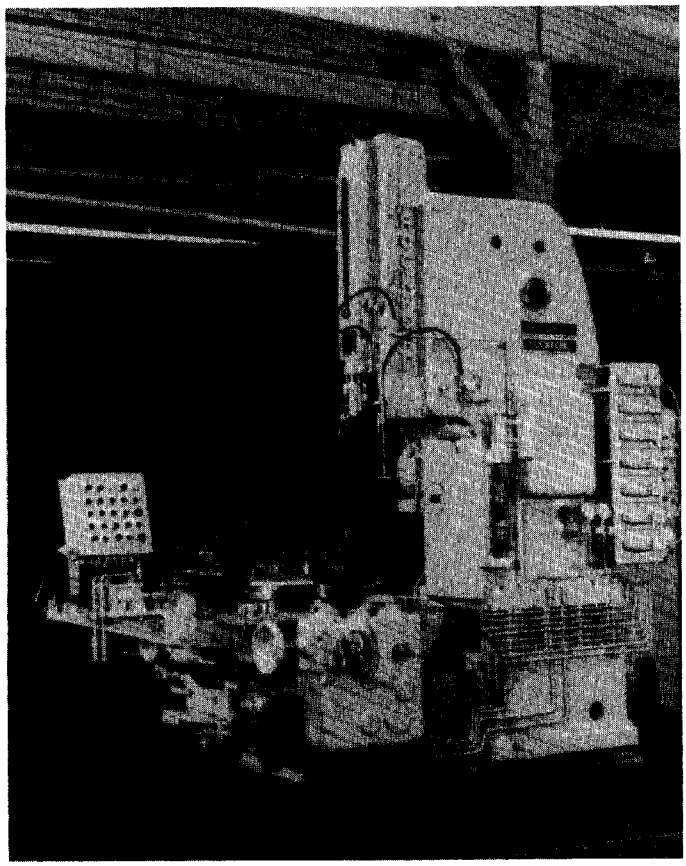

Fig. 11-9. This is a modern slotter or vertical shaper. (Ex-Cell-O Manufacturing Systems Co.)

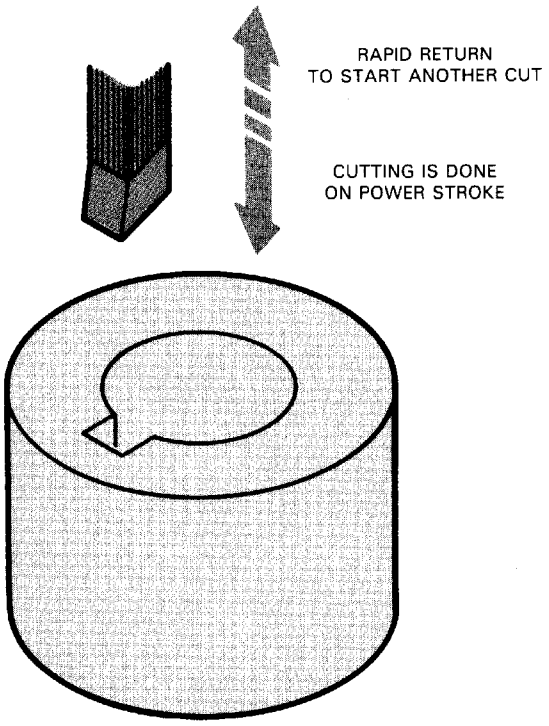

Fig. 11-11. Diagram shows slotter or vertical shaper operation. Slotter, unlike shaper, moves vertically rather than horizontally and work is held stationary.

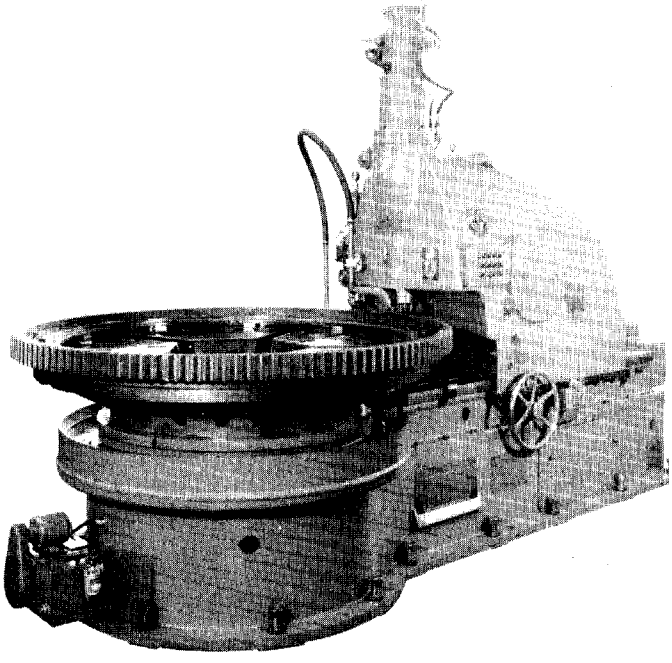

Fig. 11-10. Vertical gear shaper is cutting a 120 in. (3050 mm) external gear. (Fellows Gear Shaper Co.)

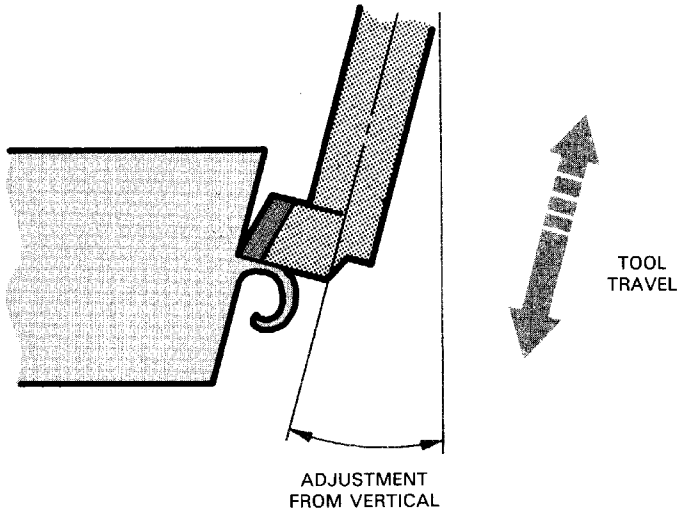

Fig. 11-12. Cutting head of a slotter can also be adjusted to make angular cuts.

PLANER

The ***planer*** differs from the shaper in that the WORK travels back and forth while the cutter remains stationary, Figs. 11-14 and 11-15. A planer can handle work that is too large to be machined on most milling machines. Planers are large pieces

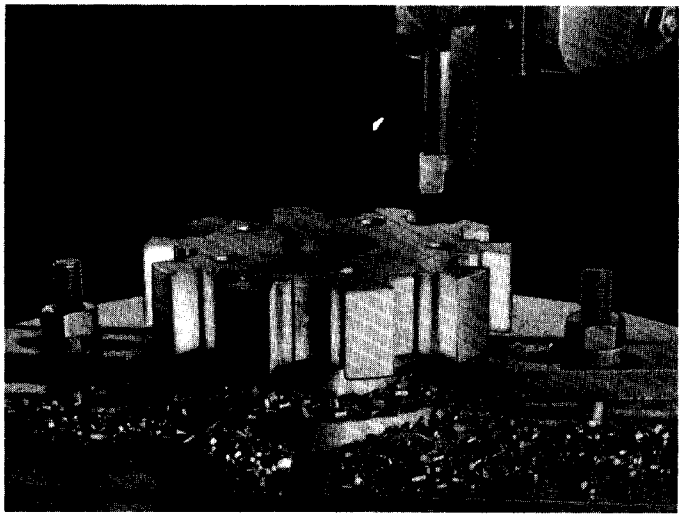

Fig. 11-13. Job is being machined on a slotter.

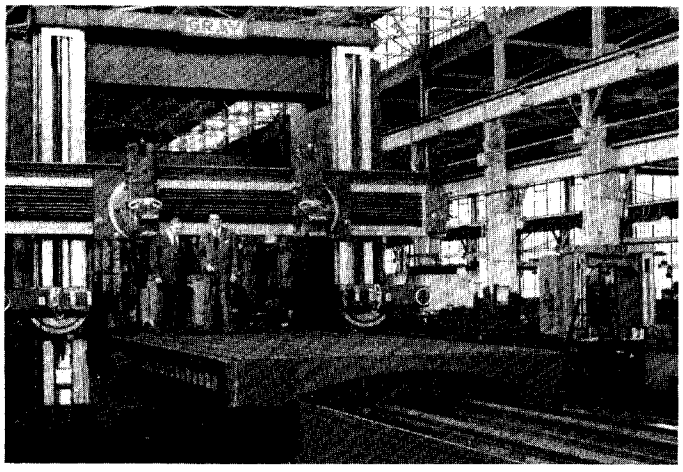

Fig. 11-14. This 144 in. by 126 in. by 40 ft. (3.6 m x 3.2 m x 12.2 m) double housing planer has two cutting heads. People add perspective to machine's size. (G.A. Gray Co.)

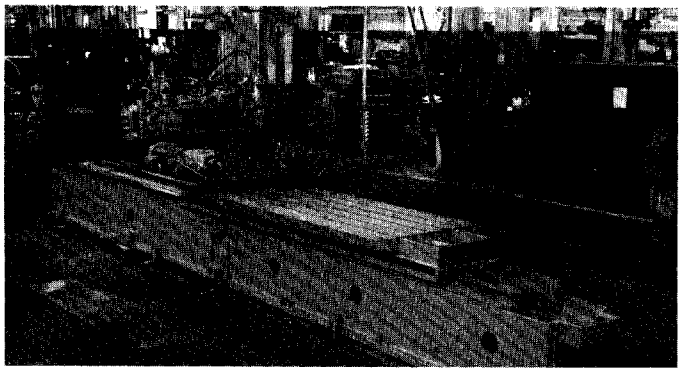

Fig. 11-15. This is a 42 in. by 42 in. by 10 ft. (1.05 m by 1.05 m by 3.0 m) open side hydraulic planer. (Ex-Cell-O Manufacturing Systems Co.)

of equipment. Some are large enough to handle and machine work up to 20 ft. (6.1 m) wide and twice as long, Fig. 11-16.

BROACHING

Broaching is similar to shaping, but instead of a single cutting tool advancing slightly after each stroke, the broach is a long tool with MANY teeth. See Fig. 11-17.

Broaching machines are designed to push or pull this multitooth cutting tool across the work, Fig.

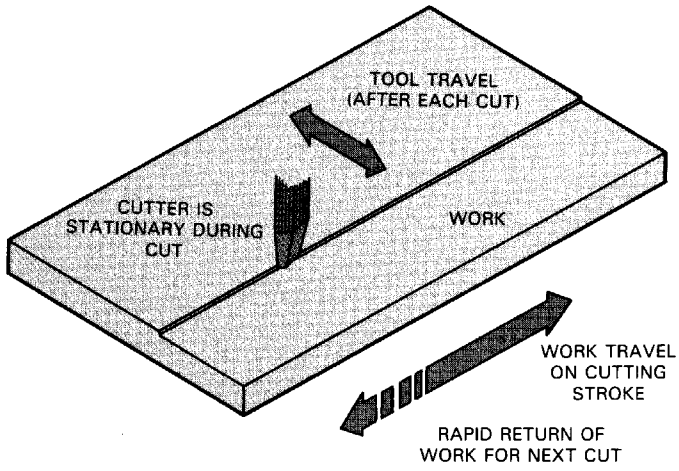

Fig. 11-16. Diagram shows how a planer works. The tool(s) remain stationary while work moves against it.

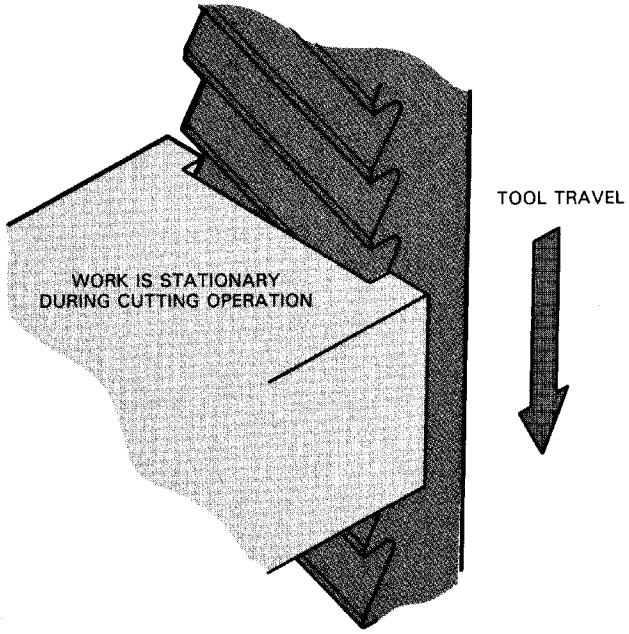

Fig. 11-17. Diagram shows how a broach operates. A multitooth cutting tool moves against work. Operation may be on a vertical or horizontal plane.

11-18. Each tooth on the ***broach*** (cutting tool) removes only a small portion of the material being machined, Fig. 11-19.

Roughing, semifinishing, and finishing teeth are usually on the same broach, Fig. 11-20. The machining operation can be completed in a single pass.

When properly employed, broaching can remove material faster than any other machining technique. Small parts can often be stacked and shaped in a single pass of the tool, Fig. 10-21. Larger units, such as auto engine blocks, may require several passes to machine all surfaces of the part.

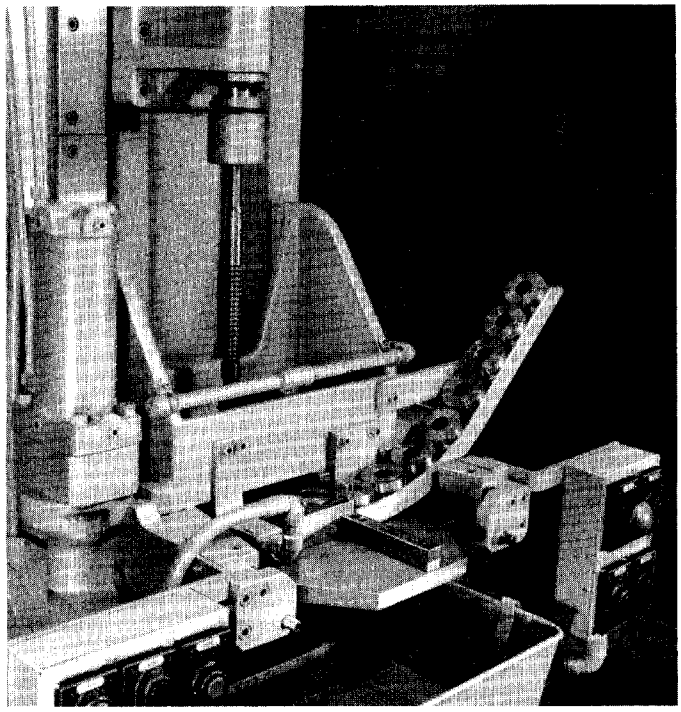

Fig. 11-18. Work is moving into position on modern broaching machine. (Sunstrand Corp.)

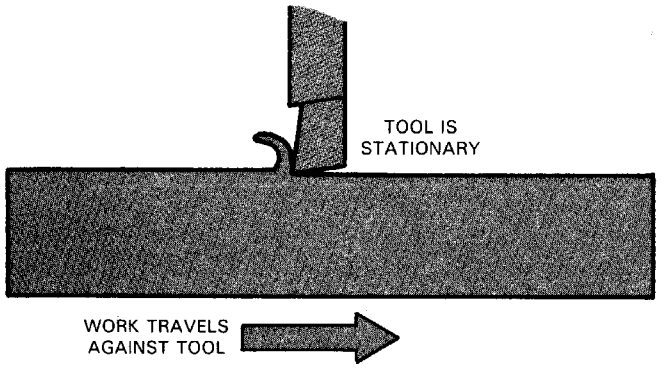

Fig. 11-19. Each tooth, on a broaching tool, removes only a small portion of material being machined.

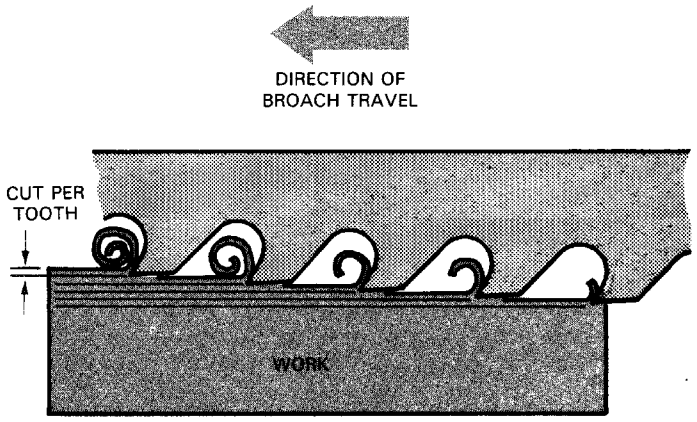

Fig. 11-20. Drawing shows a greatly shortened section of internal broaching tool and a cross section of splines it cuts. Pilot guides cutter in work. Each cutting tooth increases slightly in size until specified size is attained.

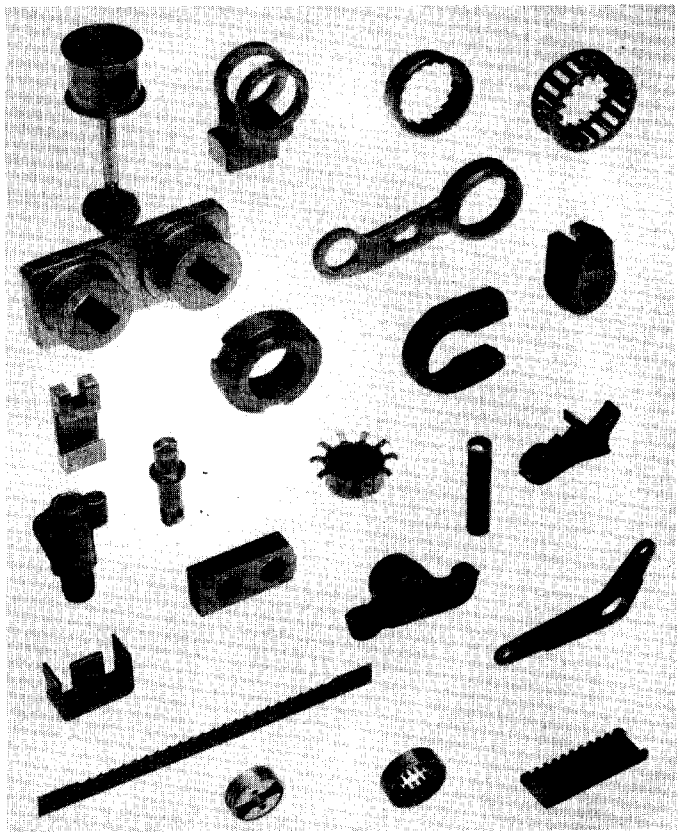

Fig. 11-21. These are some typical parts machined by broaching. (LaPoint Machine Tool Co.)

Consistently close tolerances can be maintained by broaching. While surface finishes produced are smooth compared to many other machining processes, they can be further improved by providing ***burnishing*** (noncutting) elements to the finishing end of the broach.

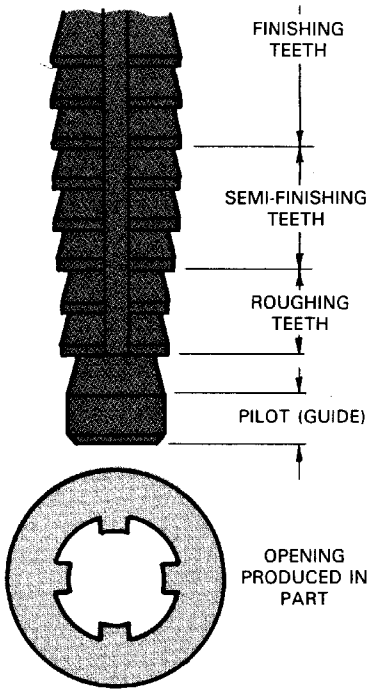

Fig. 11-22. Note typical broaching tool.

Broaching machines are available in vertical and horizontal configurations and in many sizes. Some are fitted with dual rams. Work requiring multiple broaching passes can be transferred from one ram to the other to reduce handling time, Fig. 11-22.

TEST YOUR KNOWLEDGE—Chapter 11

Please do not write in the text. Place your answers on a separate sheet of paper.

1. The shaper is a machine used to machine _____ surfaces.
2. How is shaper size determined?
3. The cutting tool on the shaper:
   a. Is stationary and the work moves against it.
   b. Moves across the work which is stationary.
   c. Is moved across work which, in turn, moves at a slower speed in opposite direction.
   d. All of the above.
   e. None of the above.
4. With a harder metal or a deeper cut, the cutting speed should be _____.
5. With softer metal or a lighter cut, the cutting speed should be _____.
6. Use _____ feed, _____ cut, and _____ cutting speed for the roughing cut.
7. Use _____ feed, _____ cut, and _____ cutting speed for the finishing cut.
8. The vertical shaper is also known as a _____.
9. When is a planer needed to machine work?
10. The cutting tool on a planer:
    a. Is stationary and the work moves against it.
    b. Moves across the work which is stationary.
    c. Is pulled or pushed across the work.
    d. All of the above.
    e. None of the above.
11. How does broaching differ from other planing machines?
12. What is unique about the cutting tool used on a broaching machine?

RESEARCH AND DEVELOPMENT

1. Prepare a term paper on the history and development of planing machines.
2. If your shop has a shaper, overhaul it. Repaint the machine after all mechanical repairs are made.
3. Construct a model of a broaching tool for machining a flat surface.
4. Secure samples of work that has been shaped by broaching.