1.3.1 MACHINE TOOL CLASSIFICATION

Machine tools may be classified under three main categories: conventional chip-making machine tools, presses, and unconventional machine tools. Conventional chip-making tools shape the workpiece by cutting away the unwanted portion in the form of chips. Presses employ a number of different shaping processes, including shearing, pressing, or drawing (elongating). Unconventional machine tools employ light, electrical, chemical, and sonic energy; superheated gases; and high-energy particle beams to shape the exotic materials and alloys that have been developed for modern technology.

1.3.1.1 CONVENTIONAL MACHINE TOOLS.

Among the basic machine tools are the lathe, the shaper, the planer, and the milling machine. Auxiliary to these are drilling and boring machines, grinders, saws, and various metal-forming machines.

1.3.1.1.1 Lathe Machine tool

A LATHE, the oldest and most common type of turning machine, holds and rotates metal or wood while a cutting tool shapes the material. The tool may be moved parallel to or across the direction of rotation to form parts that have a cylindrical or conical shape or to cut threads. With special attachments, a lathe may also be used to produce flat surfaces, as a milling machine does, or it may be used to drill or bore holes in the workpiece.

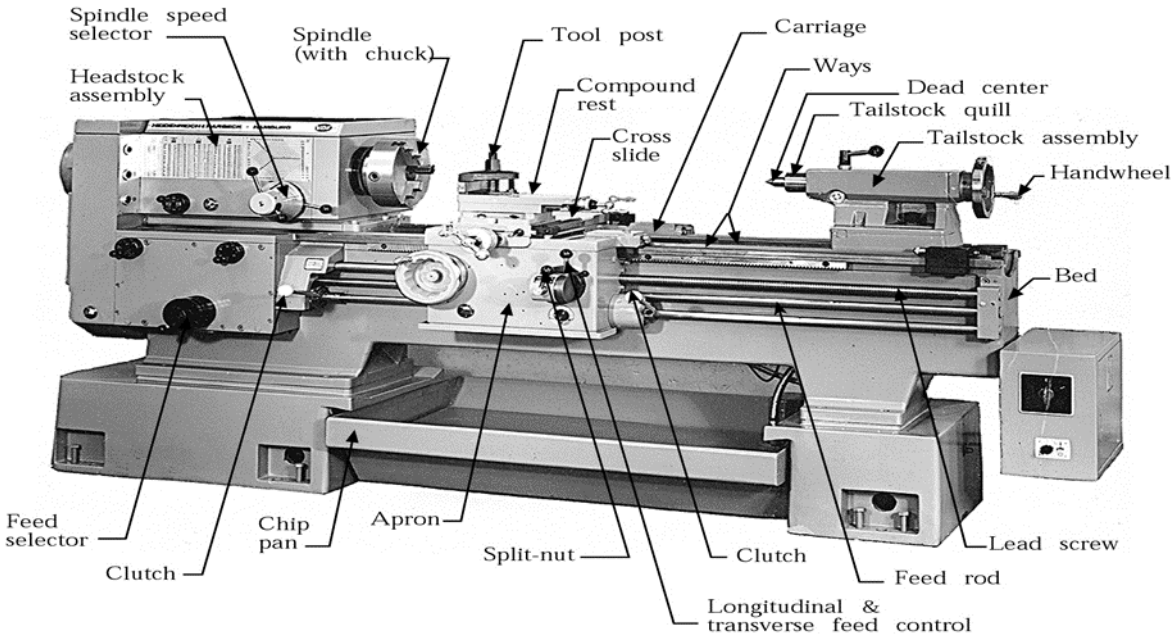
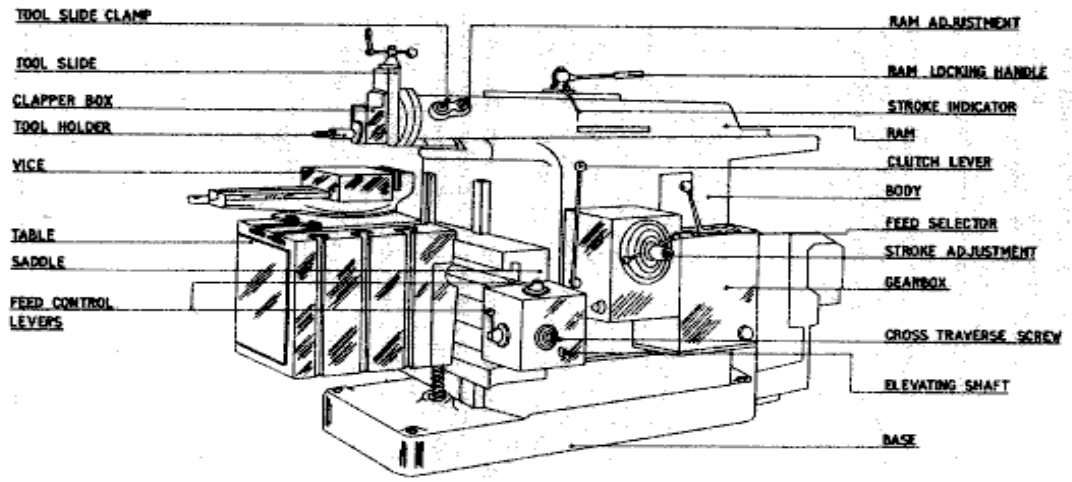


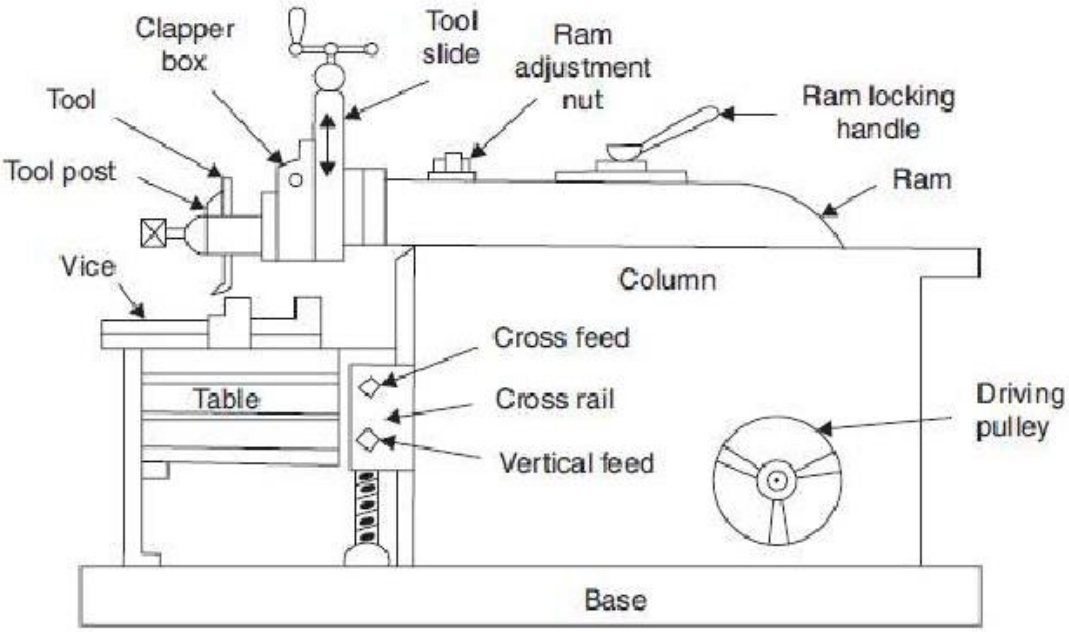
Figure 1.1: Lathe

1.3.1.1.2 Shaper Machine tool

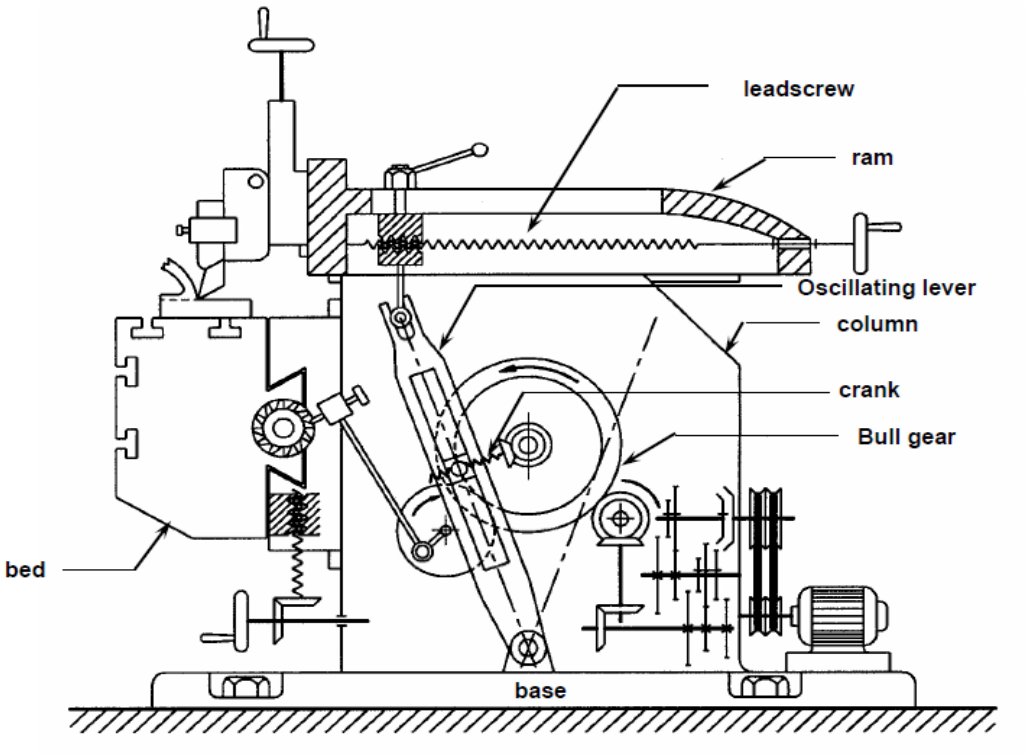
The shaper is used primarily to produce flat surfaces. The tool slides against the stationary workpiece and cuts on one stroke, returns to its starting position, and then cuts on the next stroke after a slight lateral displacement. In general, the shaper can produce almost any surface composed of straight-line elements. It uses a single-point tool and is relatively slow, because it depends on reciprocating (alternating forward and return) strokes. For this reason, the shaper is seldom found on a production line. It is, however, valuable for tool and die rooms and for job shops where flexibility is essential and relative slowness is unimportant because few identical pieces are being made.


TOOL SLIDE CLAMP
TOOL SLIDE
CLAPPER BOX
TOOL HOLDER
VICE
TABLE
SADDLE
FEED CONTROL LEVERS
RAM ADJUSTMENT
RAM LOCKING HANDLE
STROKE INDICATOR
RAM
CLUTCH LEVER
BODY
FEED SELECTOR
STROKE ADJUSTMENT
GEARBOX
CROSS TRAVERSE SCREW
ELEVATING SHAFT
BASE

1.2(a)


Clapper box
Tool slide
Ram adjustment nut
Ram locking handle
Tool
Tool post
Ram
Vice
Column
Cross feed
Table
Cross rail
Driving pulley
Vertical feed
Base

1.2(b)

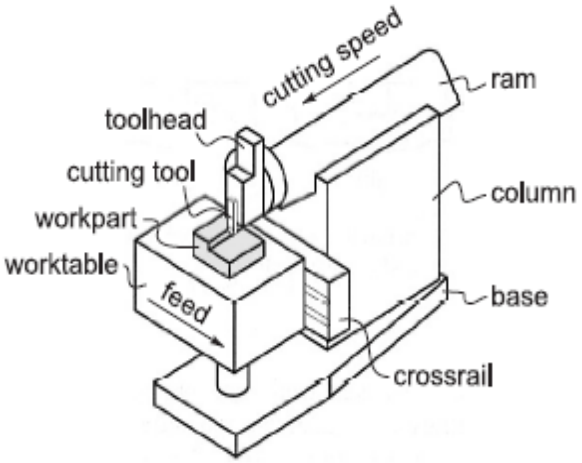


1.2(c)

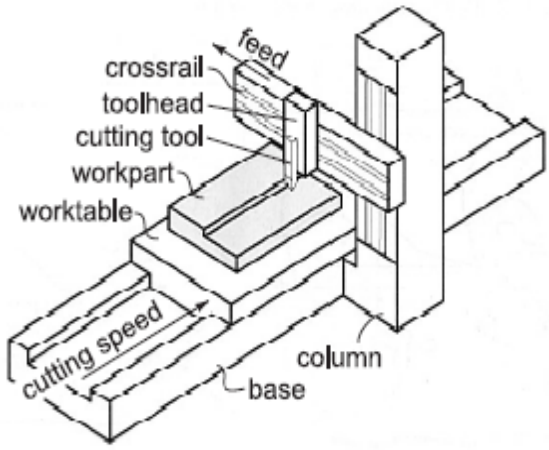
Figure 1.2: (a) (b) (c) Shaper machine tool

1.3.1.1.3 Planer Machine tool

The planer is the largest of the reciprocating machine tools. Unlike the shaper, which moves a tool past a fixed workpiece, the planer moves the workpiece past a fixed tool. After each reciprocating cycle, the workpiece is advanced laterally to expose a new section to the tool. Like the shaper, the planer is intended to produce vertical, horizontal, or diagonal cuts. It is also possible to mount several tools at one time in any or all tool holders of a planer to execute multiple simultaneous cuts.



Components of a shaper



Components of an open-side planer.

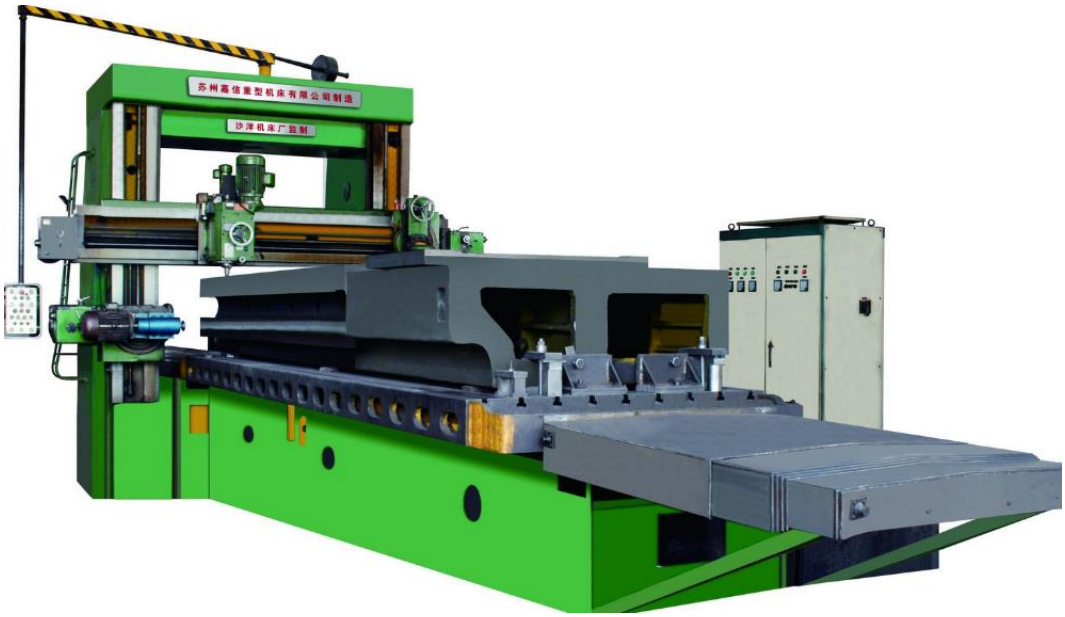
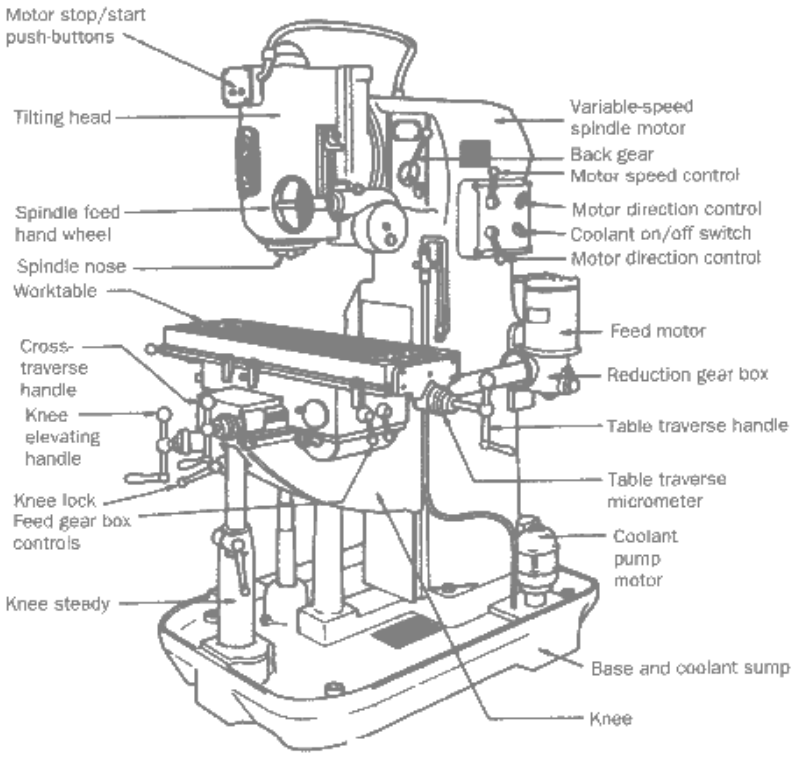


Figure 1.3: Planer machine tool

1.3.1.1.4 Milling machine tool

In a milling machine, a workpiece is fed against a circular device with a series of cutting edges on its circumference. The workpiece is held on a table that controls the feed against the cutter. The table conventionally has three possible movements: longitudinal, horizontal, and vertical; in some cases, it can also rotate. Milling machines are the most versatile of all machine tools. Flat

or contoured surfaces may be machined with excellent finish and accuracy. Angles, slots, gear teeth, and recess cuts can be made by using various cutters.



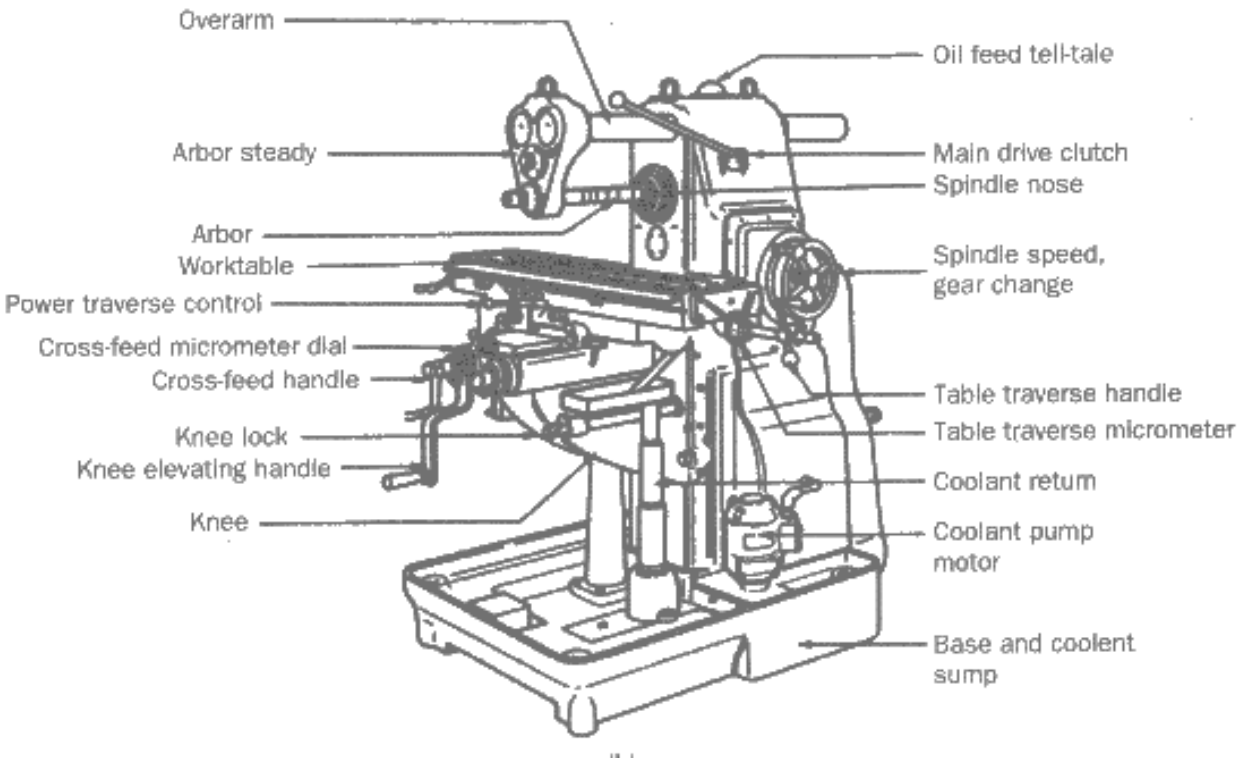
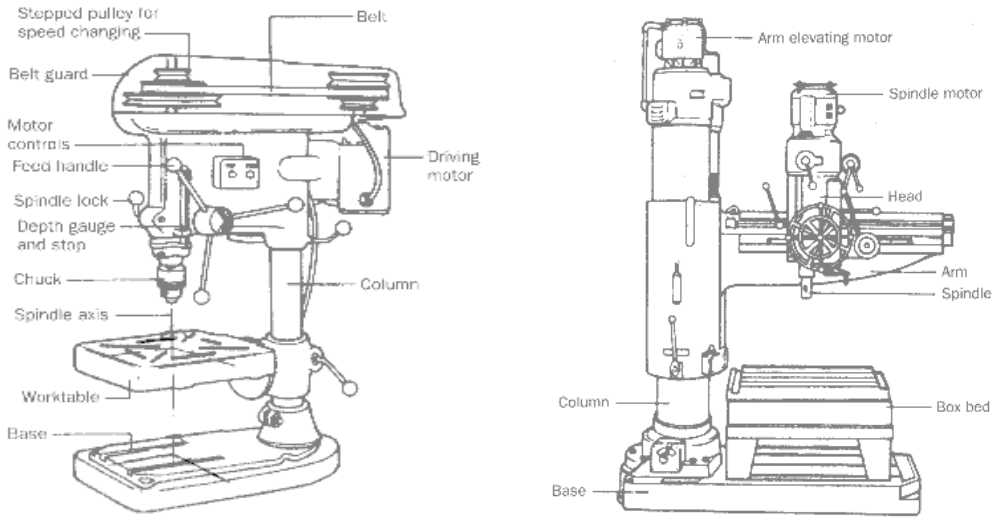


Figure 1.4: Milling Machine

1.3.1.1.5 Drilling and boring machines.

Hole-making machine tools are used to drill a hole where none previously existed; to alter a hole in accordance with some specification (by boring or reaming to enlarge it, or by tapping to cut threads for a screw); or to lap or hone a hole to create an accurate size or a smooth finish. Drilling



machines range in size and function from portable drills to radial drilling machines, multispindle units, automatic production machines, and deep-hole drilling machines. Boring is a process that enlarges holes that have been previously drilled, usually with a rotating single-point cutter held on a boring bar and fed against a stationary workpiece. Boring machines include jig borers and vertical and horizontal boring mills.

Figure 1.5: Drilling Machines

1.3.1.1.6 Grinder machine tool

Grinding is the removal of metal by a rotating abrasive wheel; the action is similar to that of a milling cutter. The wheel is composed of many small grains of abrasive, bonded together, with each grain acting as a miniature cutting tool. The process produces extremely smooth and accurate finishes. Because only a small amount of material is removed at each pass of the wheel, grinding machines require fine wheel regulation. The pressure of the wheel against the workpiece can be made very slight, so that grinding can be carried out on fragile materials that cannot be machined by other conventional devices.

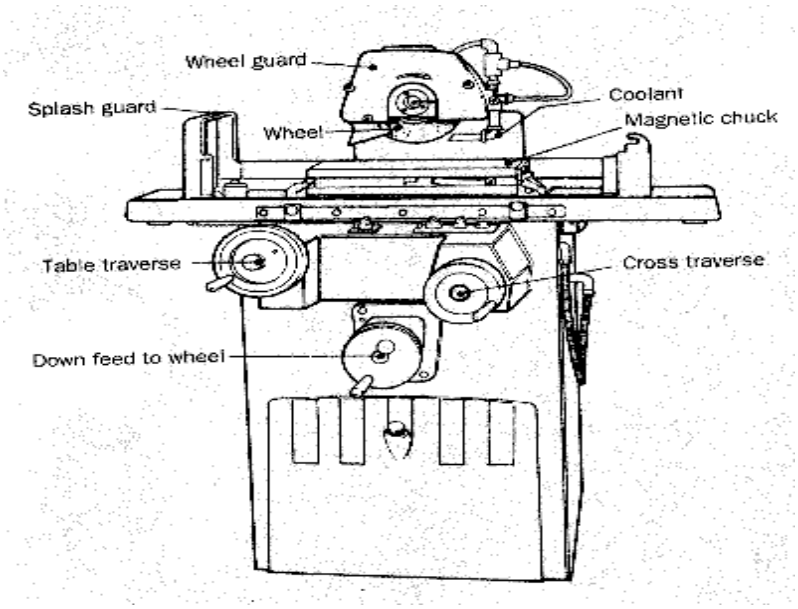


Figure 1.6: Surface grinders

1.3.1.1.7 Saws

Commonly used power-driven saws are classified into three general types, according to the kind of motion used in the cutting action: reciprocating, circular, and band-sawing machines. They generally consist of a bed or frame, a vise for clamping the workpiece, a feed mechanism, and the saw blade.

1.3.1.2 Cutting tools and fluids

Because cutting processes involve high local stresses, frictions, and considerable heat generation, cutting-tool material must combine strength, toughness, hardness, and wear resistance at elevated temperatures. These requirements are met in varying degrees by such cutting-tool materials as carbon steels (steel containing 1 to 1.2 percent carbon), high-speed steels (iron alloys containing tungsten, chromium, vanadium, and carbon), tungsten carbide, and diamonds and by such materials as ceramic, carbide ceramic, and aluminum oxide. In many cutting operations fluids are used to cool and lubricate. Cooling increases tool life and helps to stabilize the size of the finished part. Lubrication reduces friction, thus decreasing the heat generated and the power required for a given cut. Cutting fluids include water-based solutions, chemically inactive oils, and synthetic fluids.