MANUFACTURING TECHNOLOGY

BY

GYANENDRAMOHAN DAS

UNIT – I

CUTTING TOOLS AND CUTTING MATERIALS

- A cutting tool is subjected to static and dynamic forces, high temperature, wear and abrasion. To get reasonable tool life, the tool material should meet following requirements:
- 1. Hot hardness 2. Wear and abrasion resistance. 3.Impact toughness.

CUTTING TOOL AND ITS TYPE

- The tools which are used for the purpose of cutting the metals in the desired shape and size are called cutting tool.
- 1. Single Point Cutting Tool
- 2. Multi Point Cutting Tool

- The cutting tools may also be classified according to the motion as follow:
- 1. Linear motion tools
- 2. Rotary motion tools
- 3. Linear and Rotary motion tools

VARIOUS TYPES OF SINGLE POINT CUTTING TOOLS AND THEIR USES

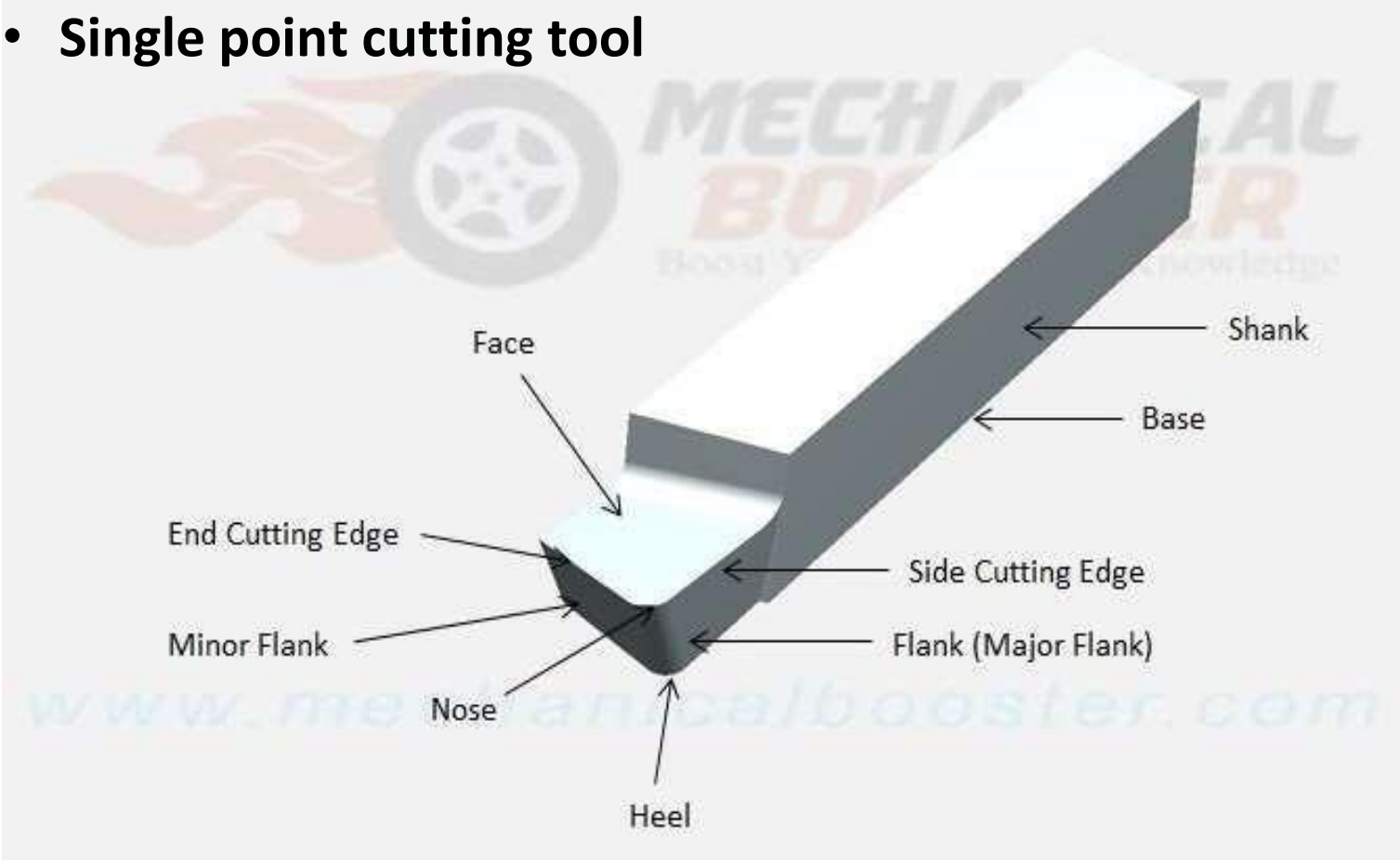
- **Tools for Lathe machines:**
- 1. Turning tool
- 2. Facing tool
- 3. Chamfering tool
- 4. External threading tool
- 5. Internal threading tool
- 6. Boring tool
- **Tools for Planers:**
- 1. Straight and Bent Roughing Tools
- 2. Straight Beck, Round Nose and Goose Neck Tools

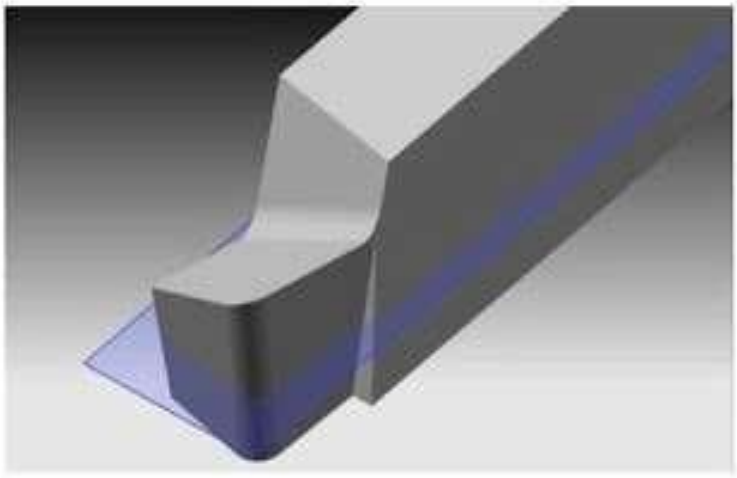
Tools for shapers

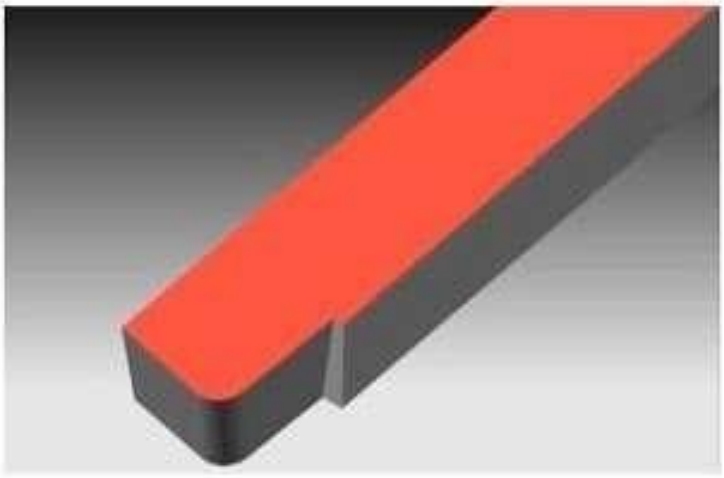
- 1. Round nose roughing tool
- 2.Down cutting tool
- 3. Square nose finishing tool
- 4. Side recessing tool
- 5. Parting off tool
- 6. Goose neck tool

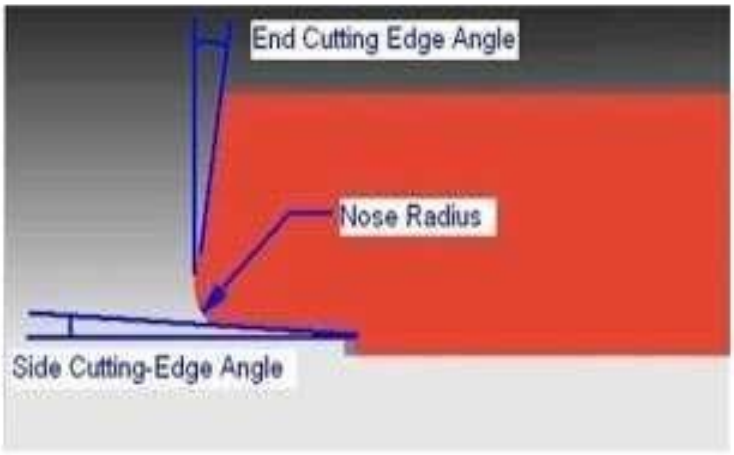
IMPORTANT TERM RELATING TO SINGLE POINT CUTTING TOOL

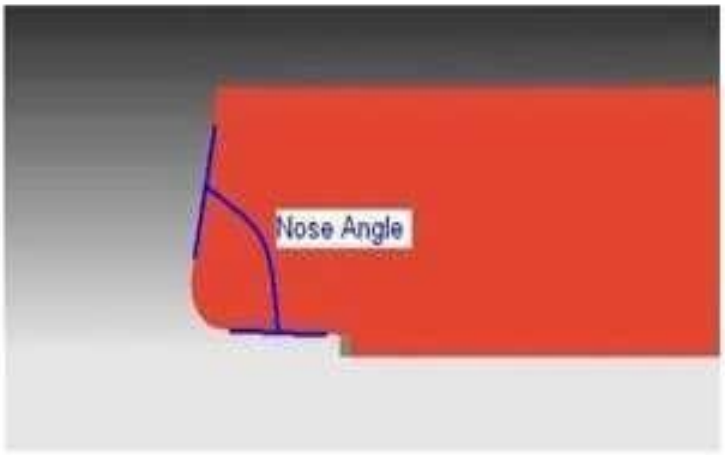
- **Single point cutting tool**

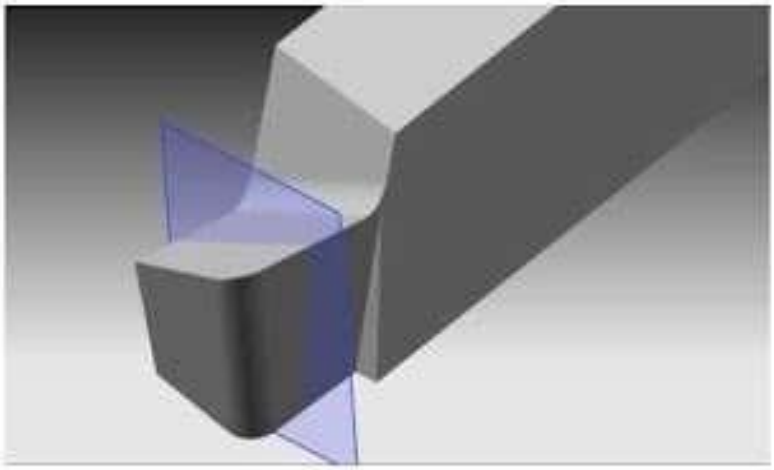


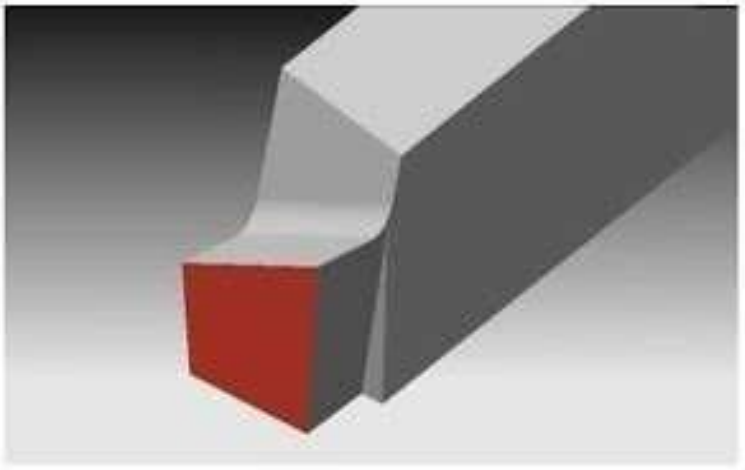


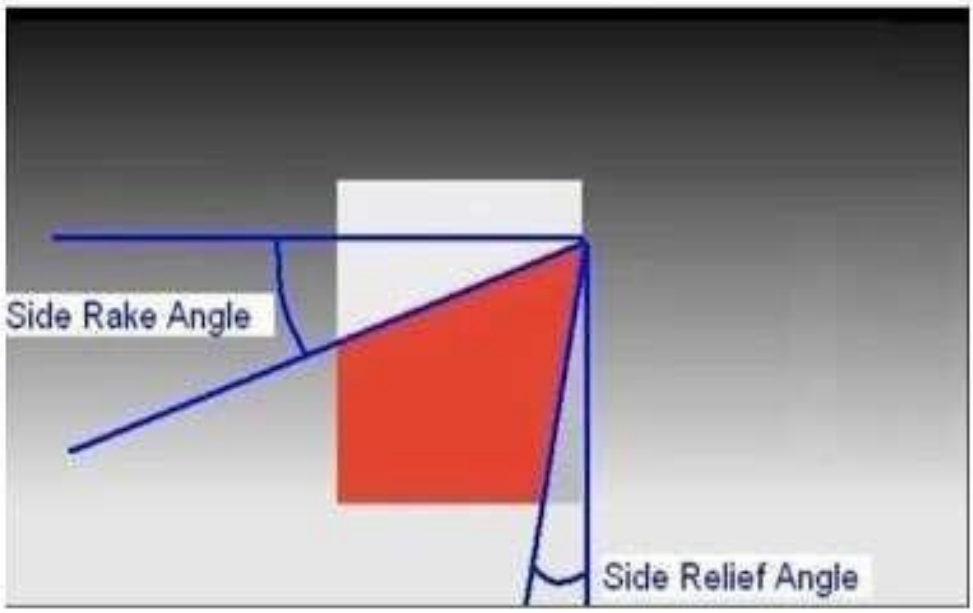



End Cutting Edge Angle
Nose Radius
Side Cutting-Edge Angle


Nose Angle






Side Rake Angle
Side Relief Angle

1. Shank
2. Flank
3. Face
4. Heel
5. Nose
6. Neck
7. Cutting edge

Angles

The various angles of the single point cutting tool have great importance. Each angle has its own function and speciality.

TOOL SIGNATURE

The shape of a tool is specified in a special sequence and this special sequence is called tool signature. The tool signature is given below

1. Back rake angle
2. Side rake angle
3. End relief / Clearance angle
4. Side relief / Clearance angle
5. End cutting edge angle
6. Side cutting edge angle
7. Nose radius

EFFECT OF HEAT PRODUCED DURING METAL CUTTING

- It reduced the tool life
- It reduced the surface finish
- It causes the welding of chips with the face of tool
- Repeated replacement of tools occurs which increases the cost

CUTTING SPEED

Cutting speed of a cutting tool may be defined as the speed at which the cutting edge passes over the material.

FEED

- Feed of a cutting tool may be defined as the distance through which the tool advances in to or along work piece each time the tool passes a certain position in its travel over the surface.

DEPTH OF CUT

- Depth of cut may be defined as the perpendicular distances measured from the machined surface to the un cut surface of the work piece.

PROPERTIES OF THE CUTTING TOOL MATERIALS

- It should be harder then the cutting material of work piece
- It should be tough
- It should be cheap
- It should be high resistant to wear to ensure longer tool life
- It should be able to be fabricated and shaped easily.

CUTTING TOOL MATERIAL

- HIGH SPEED STEEL
- HIGH CARBON STEEL
- TUNGSTEN CARBIDE
- CEMENTEDCARBIDS
- STELLITE
- CERAMIC CUTTING MATERIALS
- DIAMOND

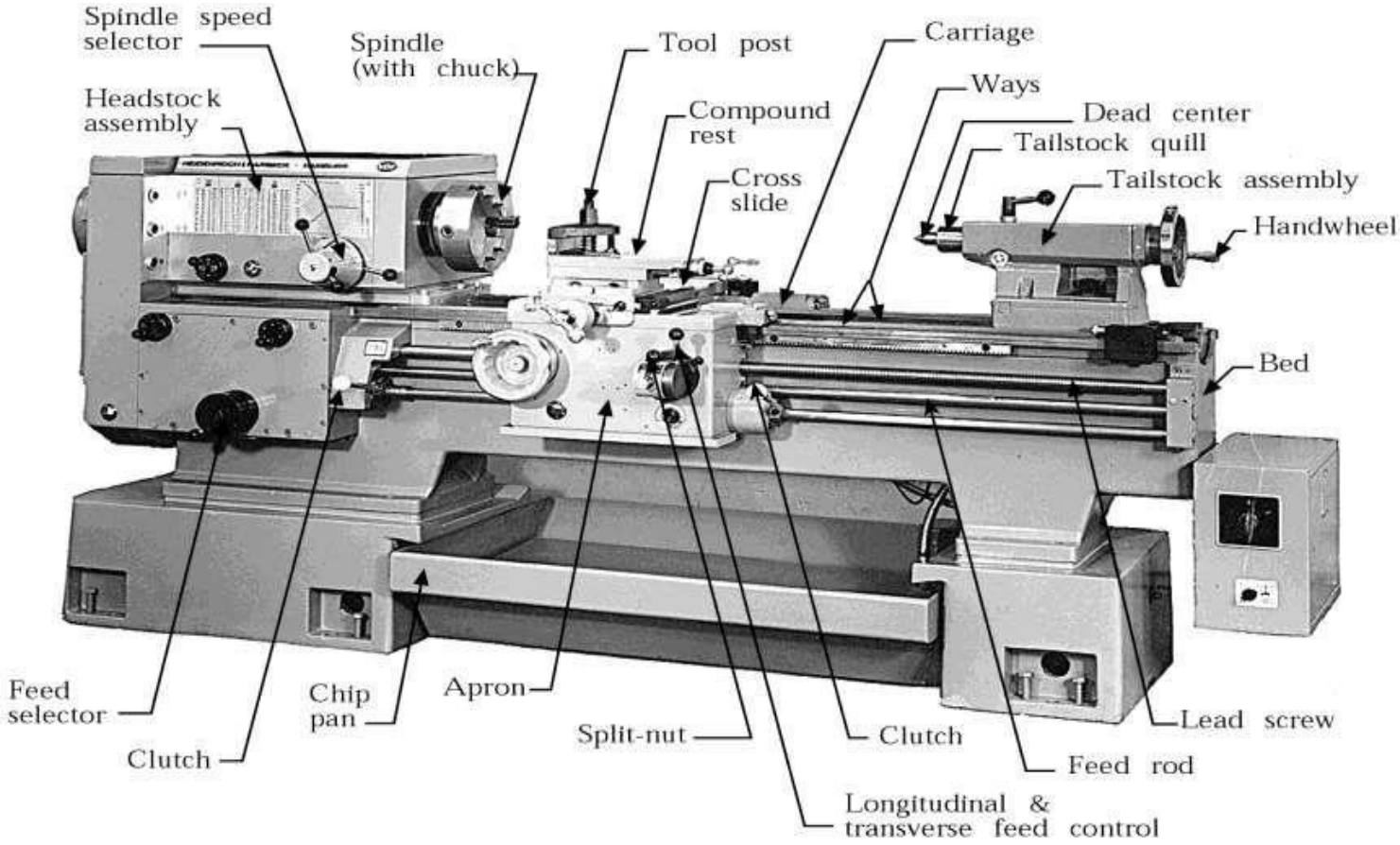
UNIT-II

LATHE

- Lathe is a machine, which removes the metal from a piece of work to the required shape and size.
- Lathe is one of the most important machine tools in the metal working industry. A lathe operates on the principle of a rotating workpiece and a fixed cutting tool.

FUNCTION OF LATHE

- Lathe is to remove excess material in the form of chips by rotating the work piece against a stationary cutting tool


Spindle speed selector
Spindle (with chuck)
Tool post
Carriage
Headstock assembly
Ways
Compound rest
Dead center
Tailstock quill
Cross slide
Tailstock assembly
Handwheel
Bed
Feed selector
Chip pan
Apron
Split-nut
Clutch
Lead screw
Clutch
Feed rod
Longitudinal & transverse feed control

MAIN PART OF LATHE

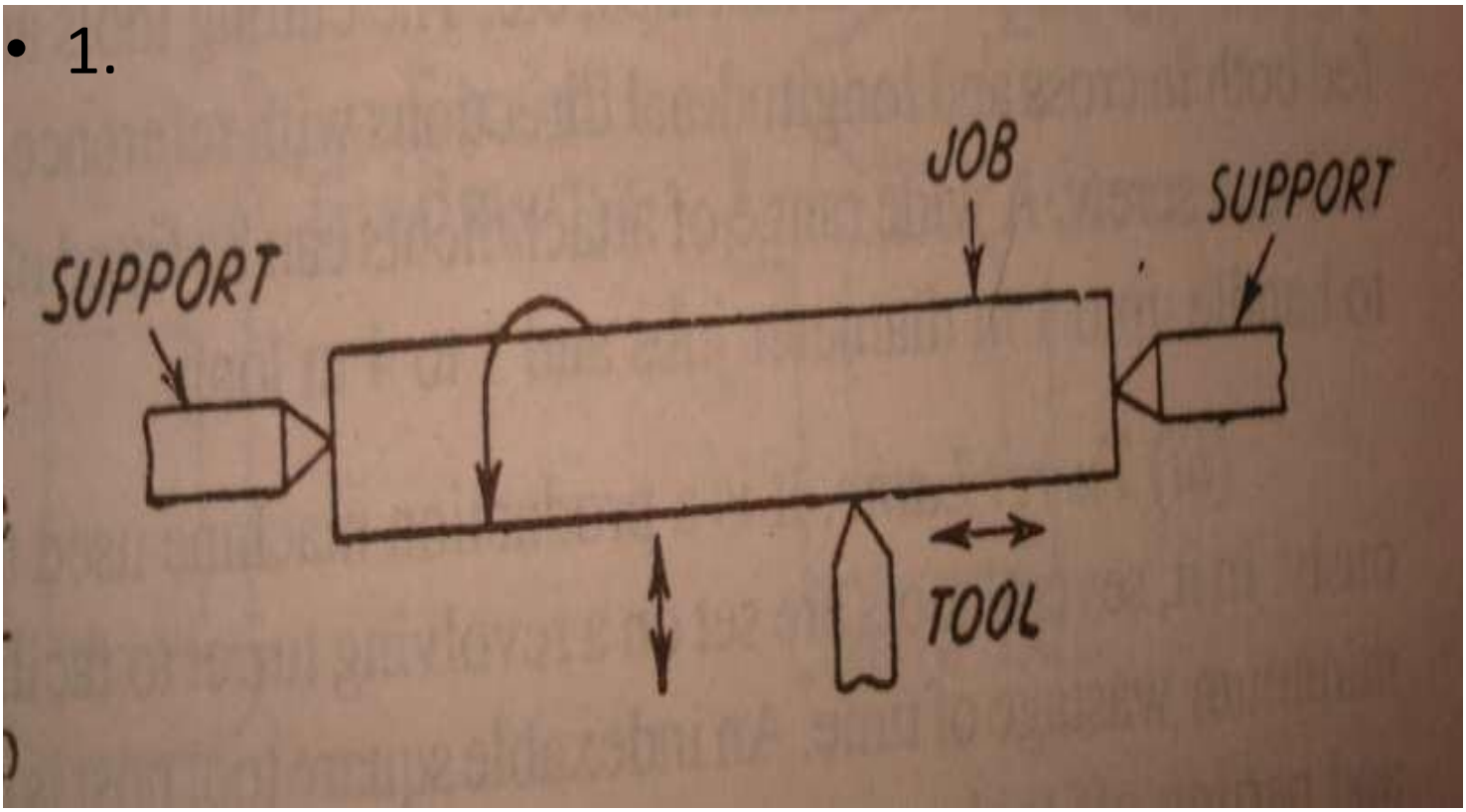
Lathe Machine is also known as "**Centre Lathe**", because it has two centres between which the job can be held and rotated.

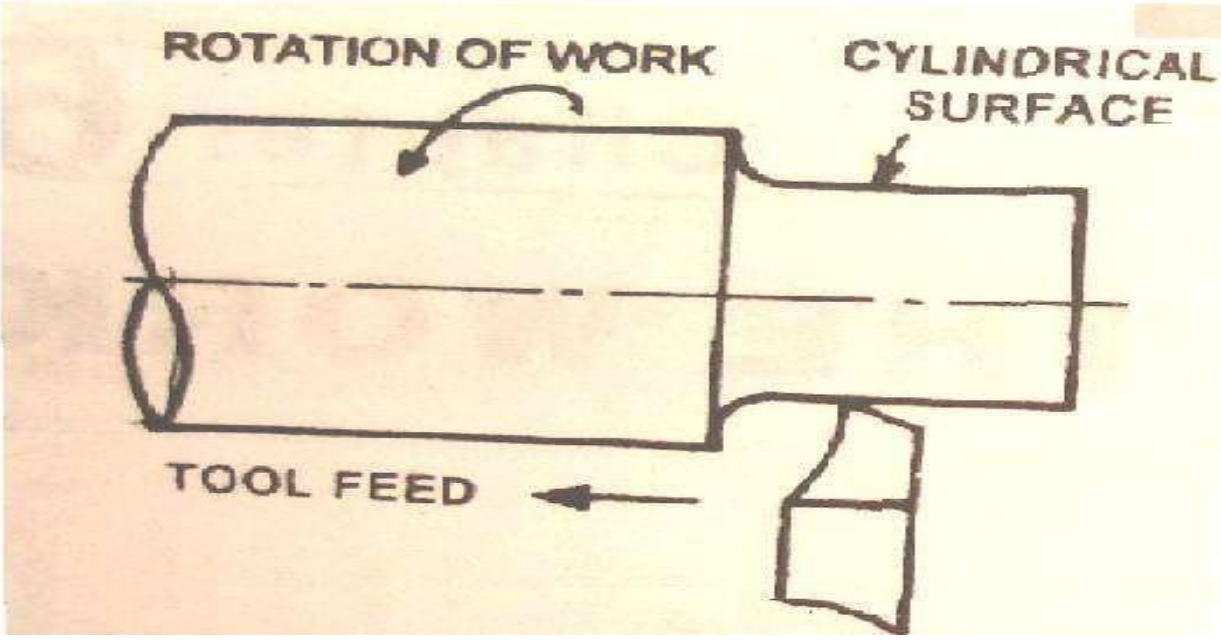
The main parts of centre lathe are:

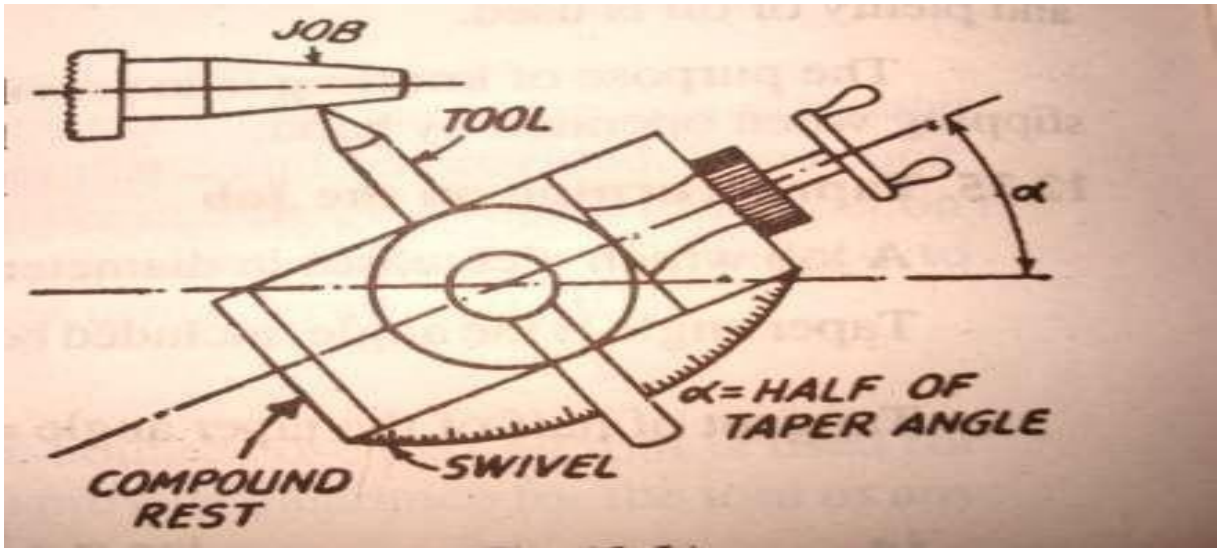
1. Bed
2. Head stock
3. Tailstock
4. Carriage
5. Feed mechanisms

Working Principle of Lathe

- 1.




ROTATION OF WORK
CYLINDRICAL SURFACE
TOOL FEED


JOB
TOOL
α
α= HALF OF TAPER ANGLE
COMPOUND REST
SWIVEL

WORKING PRINCIPLES OF LATHE

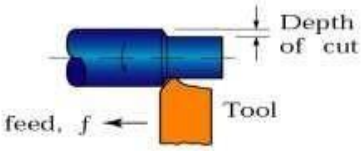
- It holds the work between two supports called centres.
- Chuck or Face plate is also used for holding the work.
- Chuck or face plate is mounted on machine spindle
- Cutting tool is held and supported on a tool post.
- Movement of the job is rotation about spindle axis
- Tool is fed against the revolving work
- Movement of the tool is either parallel to or at any inclination to the work axis

TYPES OF LATHE MACHINE

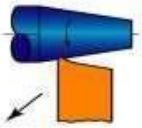
1. Speed lathe
2. Engine or centre lathe
3. Bench lathe
4. Tool room lathe
5. Capstan and turret lathe
6. Automatic lathe
7. Special purpose lathe

LATHE OPERATIONS

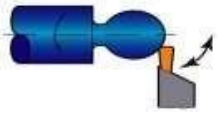
(a) Straight turning



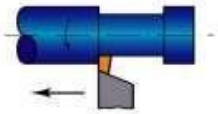
(b) Taper turning



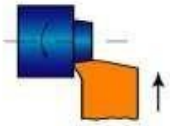
(c) Profiling



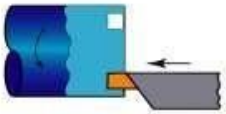
(d) Turning and external grooving



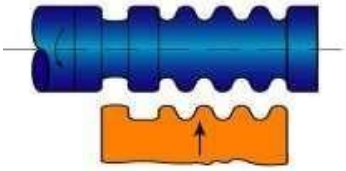
(e) Facing



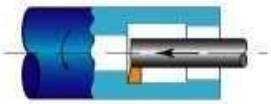
(f) Face grooving



(g) Cutting with a form tool

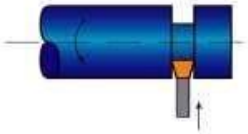


(h) Boring and internal grooving

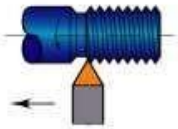


(i) Drilling

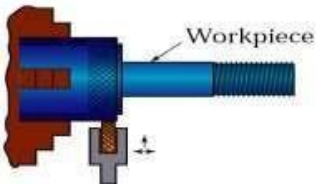
(j) Cutting off



(k) Threading



(l) Knurling



LATHE ACCESSORIES

1. Centres
2. Lathe dog or carrier
3. Chucks
4. Collets
5. Face plates
6. Driving plate
7. Angle plate
8. Mandrels
9. Rests
10. Milling attachment
11. Taper turning attachment.

ADVANTAGES OF LATHE MACHINE

- Greater production over a given period.
- More economy in floor space.
- Improvement in accuracy.
- Floor space maintenance and inventory requirements are reduced.
- More consistently accurate work than turrets.
- More constant flow of production.
- Scrap loss is reduced by reducing operator error.
- During machine operation operator is free to operate another machine/ can inspect completed parts.

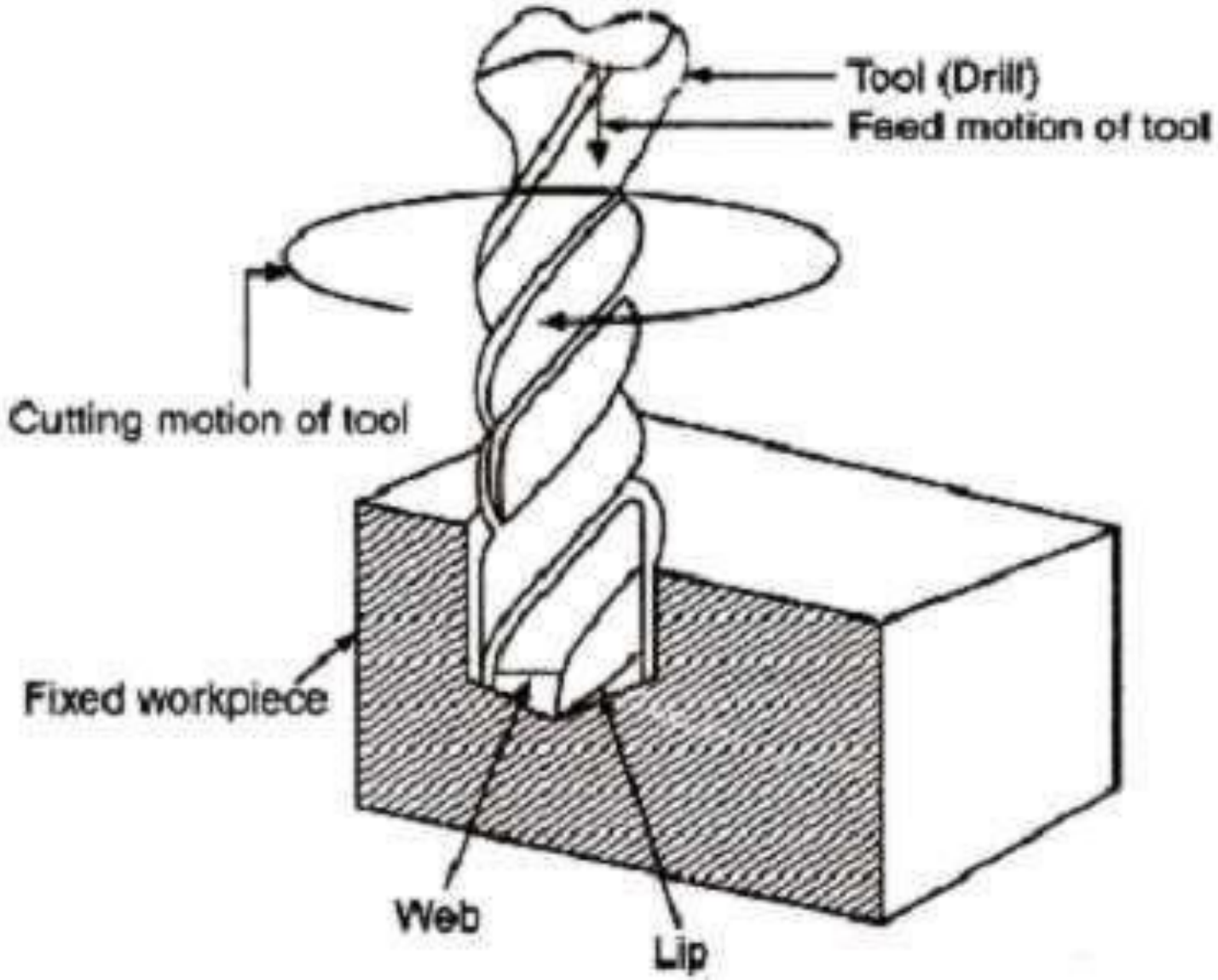
UNIT – III

DRILLING

- The drilling machine or drill press is one of the most common and useful machine employed in industry for producing forming and finishing holes in a work piece.

- **WORKING PRINCIPLE OF DRILLING**

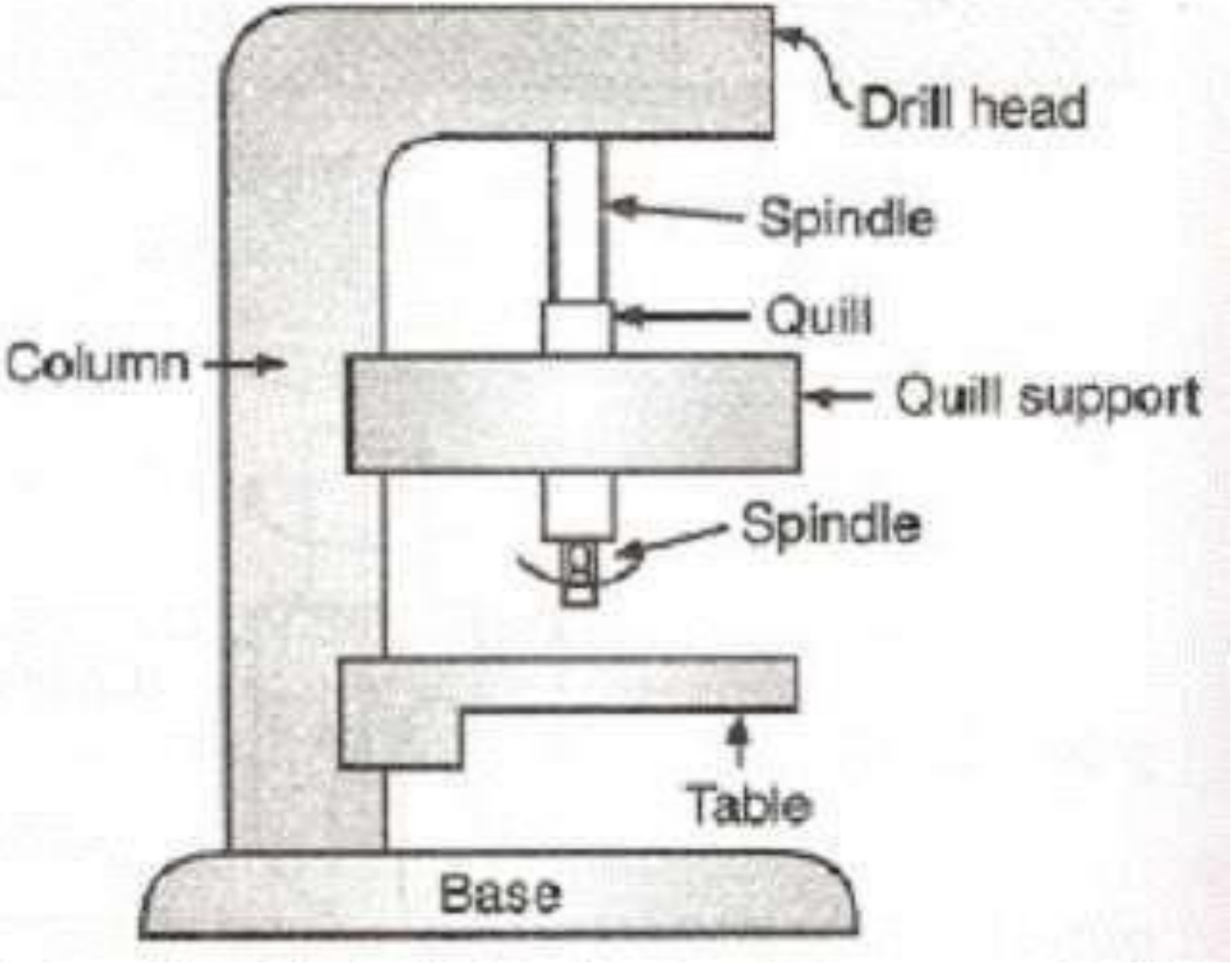
The rotating edge of the drill exerts a large force on the work pieceand the hole is generated. The removal of metal in a drillingoperation is by shearing and extrusion.


Tool (Drill)
Feed motion of tool
Cutting motion of tool
Fixed workpiece
Web
Lip

MAIN PARTS OF DRILLING MACHINE

The machine has only a hand feed mechanism for feeding the tool into the work piece. This enables the operator to feel how the drill is cutting and accordingly he can control the down feed pressure. Sensitive drill presses are manufactured in bench or floor models.

1. Base
2. Column
3. Adjustable table
4. Spindle
5. Head
6. Drill chuck


Drill head
Spindle
Quill
Column
Quill support
Spindle
Table
Base

TYPES OF DRILLING MACHINE

- Portable Drilling Machine
- Sensitive or Bench Drill
- Upright Drilling Machine(Single Spindle)
- Upright Drilling Machine(Turret Type)
- Radial Drilling Machine
- Multiple Spindle Drilling Machine
- Deep Hole Drilling Machine
- Gang Drilling Machine
- Horizontal Drilling Machine
- Automatic Drilling Machine

OPERATION OF DRILLING MACHINE

- Drilling
- Reaming
- Boring
- Counter Boring
- Counter Sinking
- Spot Facing
- Tapping
- Core drilling
- Buffing
- Step drilling
- Grinding
- Countersinking

UNIT – IV

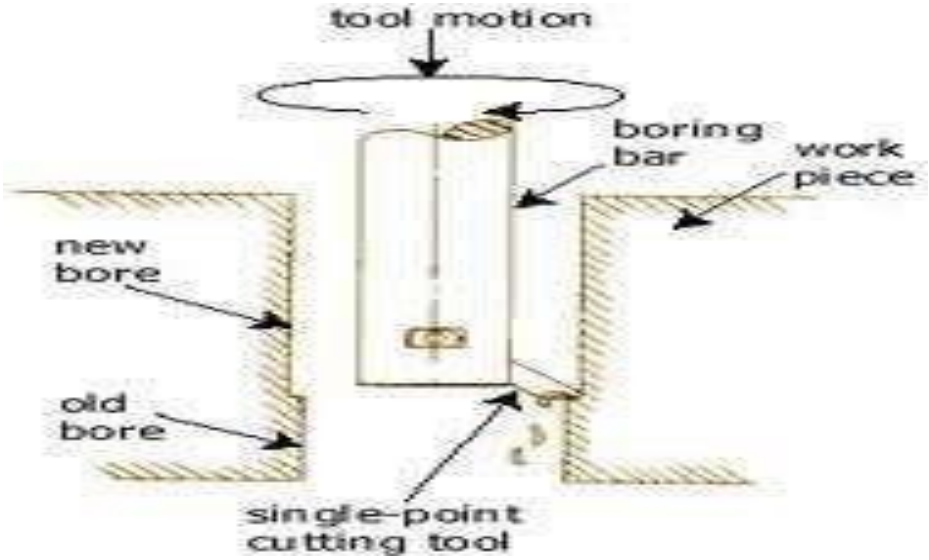
BORING

Boring is a process of producing circular internal profiles on a hole made by drilling or another process. It uses single point cutting tool called a boring bar. In boring, the boring bar can be rotated, or the work part can be rotated. Machine tools which rotate the boring bar against a stationary work piece are called boring machines (also boring mills).

Boring can be accomplished on a turning machine with a stationary boring bar positioned in the tool post and rotating work piece held in the lathe chuck as illustrated in the figure. In this section, we will consider only boring on boring machine.

PRINCIPLE OF BORING

In horizontal boring machine, the work piece is held on the machine table and kept stationary, while boring tool revolves. At the same time, the tool may be moved forward or backward in a direction parallel to its axis of rotation and can also be offset in a direction perpendicular to its axis of rotation.



CLASSIFICATION OF BORING MACHINES

1. Horizontal boring machine
2. Vertical boring machine
3. Jigs boring machine
4. Special purpose boring machine

HORIZONTAL BORING MACHINE

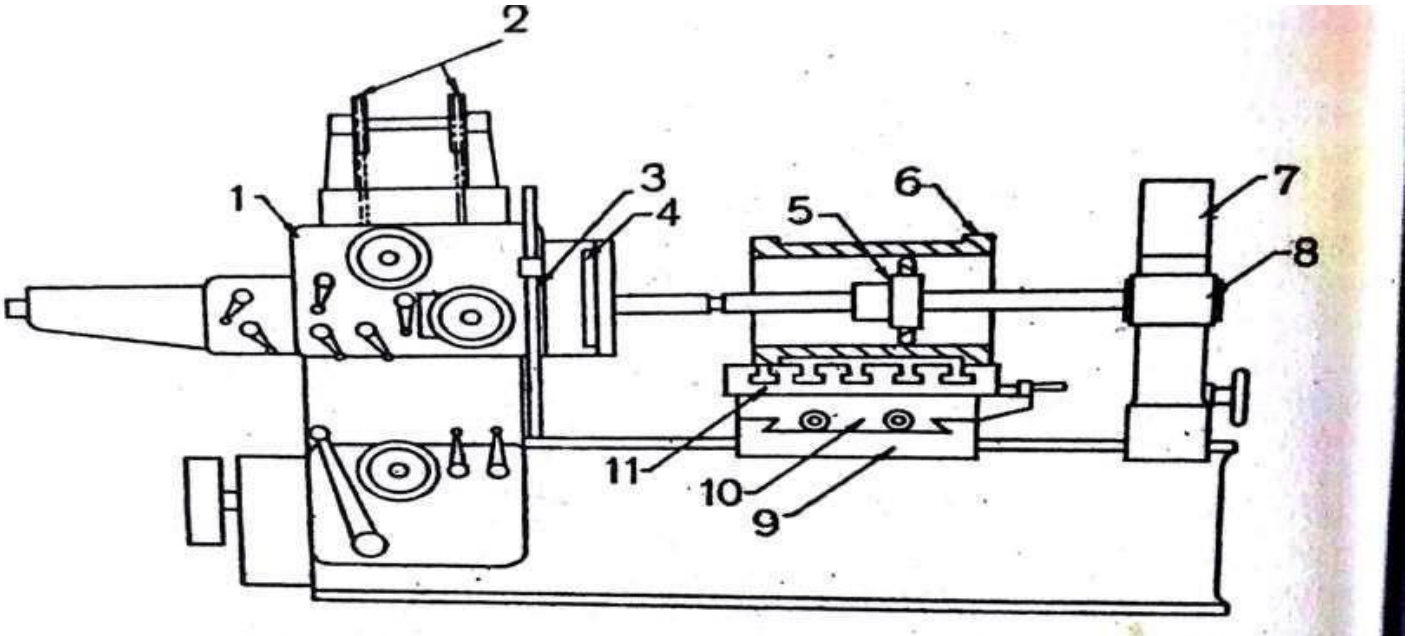


Figure 6.1 Horizontal boring machine

1. Headstock, 2. Pulley for counter balancing weight of headstock, 3. Headstock elevating screw, 4. Boring head, 5. Boring cutter on boring bar, 6. Work, 7. End supporting column, 8. Bearing block, 9. Saddle, 10 Cross-slide, 11. Table.

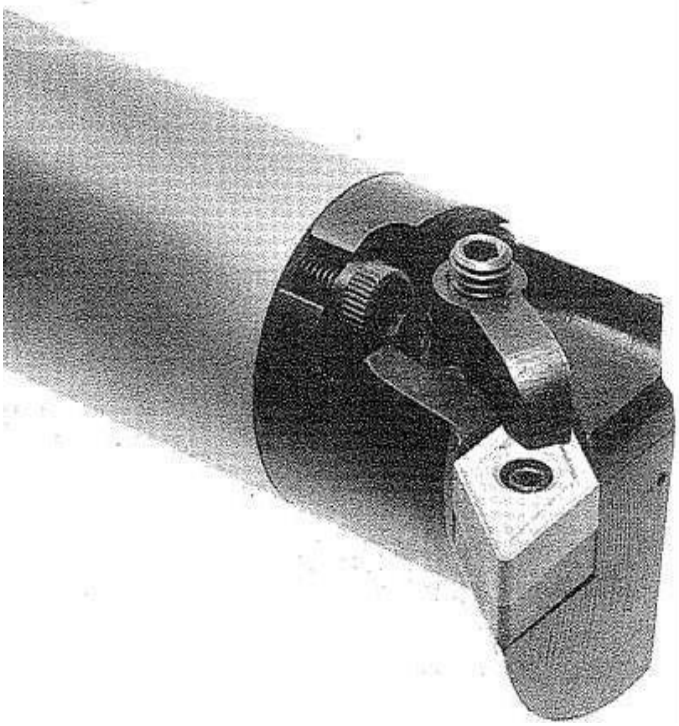
1. Bed
2. Saddle
3. Table
4. Base
5. Column
6. Headstock
7. End support column

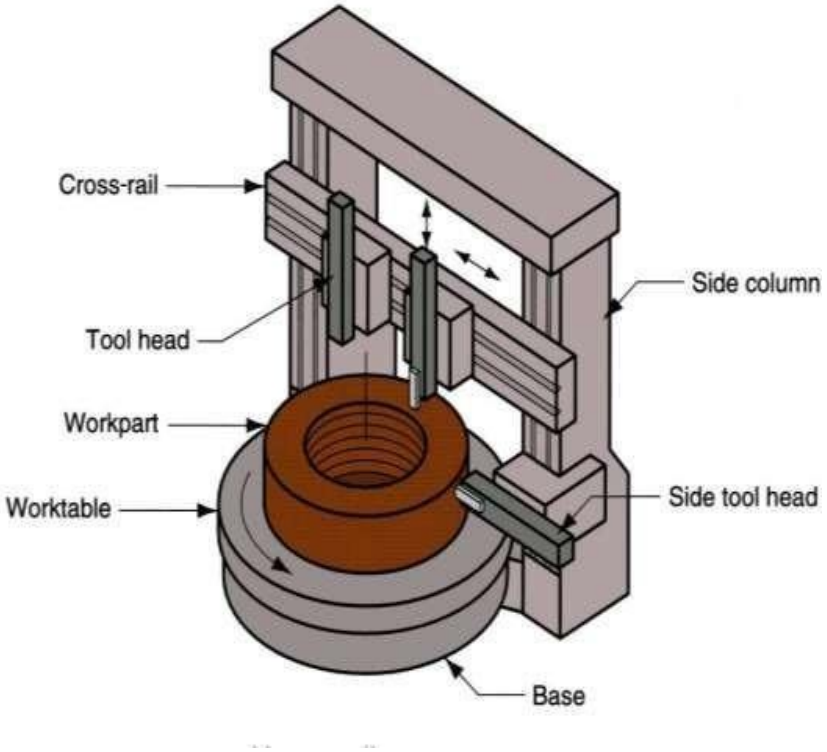
VERTICAL BORING MACHINE

A vertical boring mill is used for large, heavy work parts with diameters up to 12 m. The typical boring mill can position and feed several cutting tools simultaneously. The work part may be mounted on arotating worktable.

VERTICAL BORING MACHINE

- Boring bar made by cemented carbide





CUTTING TOOLS FOR BORING

The typical boring bar is shown in the figure. When boring with a rotating tool, size is controlled by changing the radial position of the tool slide, which hold the boring bar, with respect to the spindle axis of rotation. For finishing machining, the boring bar is additionally mounted in an adjustable boring head for more precise control of the bar radial position.

1. Forged tool
2. Inserted teeth boring tool
3. Boring tool bit in boring bar

Boring bar with indexable carbide insert (*Left*), and adjustable boring head with accessories (*Right*).

BORING OPERATIONS

- Internal taper boring
- External taper boring
- Necking or cutting off
- Boring a large diameter
- Boring a small diameter
- Spot facing
- Reaming
- Counter boring
- Threading
- Facing
- Trepanning
- Milling

UNIT – V

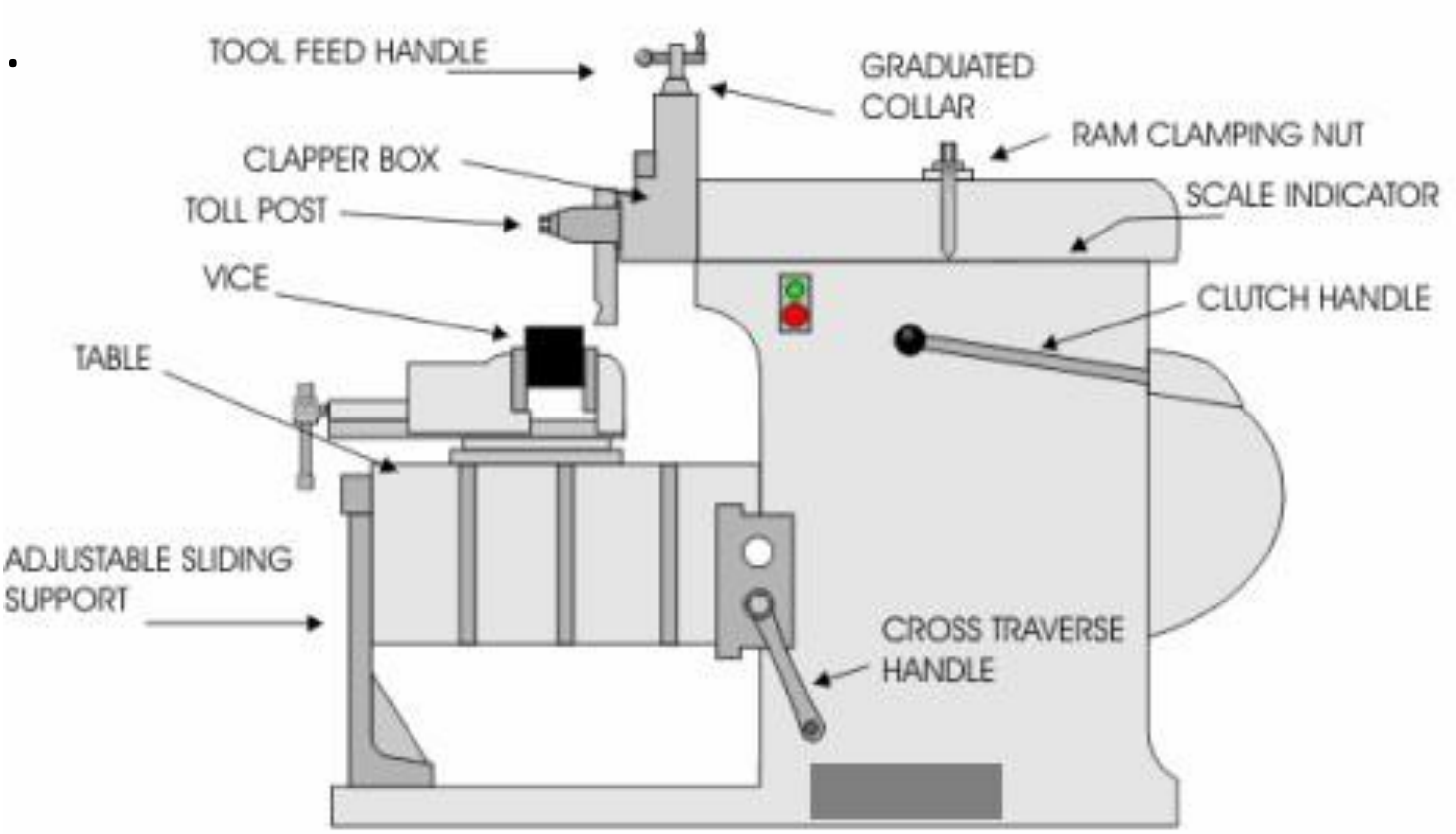
SHAPING, PLANNING AND SLOTTING

SHAPING

Shaping or shaper machine is a reciprocating type of machine tool used for producing small flat surfaces with the help of a point cutting tool which reciprocates over the stationary work piece.

A shaping machine is used to machine surfaces. It can cut curves, angles and many other shapes. It is a popular machine in a factory workshop because its movement is very simple although it can produce a variety of work. They are less common in school workshops, perhaps because of their moving parts which present a high risk.

DESCRIPTION OF SHAPER MACHINE



MAIN PARTS OF SHAPER MACHINE

- Base
- Column
- Cross rail
- Saddle
- Table
- Ram
- Tool head
- Shaper head

CLASSIFICATION OF SHAPER MACHINE

- Crank shaper
- Geared shaper
- Hydraulic
- Horizontal shaper
- Vertical shaper
- Travelling head shaper
- Plain shaper
- Universal shaper
- Push cut type shaper
- Draw type shaper

WORKS ON SHAPER MACHINE

- Shaping a vertical grooves
- Shaping horizontal flat surfaces
- Shaping a dovetail slide
- Shaping flat inclined surfaces
- Shaping v-block
- Shaping a jib and guide jib
- Shaping a curved surface

PLANER

The machine tool for planning is a *planer*. Cutting speed is achieved by a reciprocating worktable that moves the part past the single-point cutting tool. Construction and motion capability of a planer permit much larger parts to be machined than on a shaper.

CLASSIFICATION OF PLANING MACHINE

1. Standard or double housing planer
2. Open side planer
3. Pit type planer
4. Edge or plate planer
5. Divided table planer
6. Universal planer