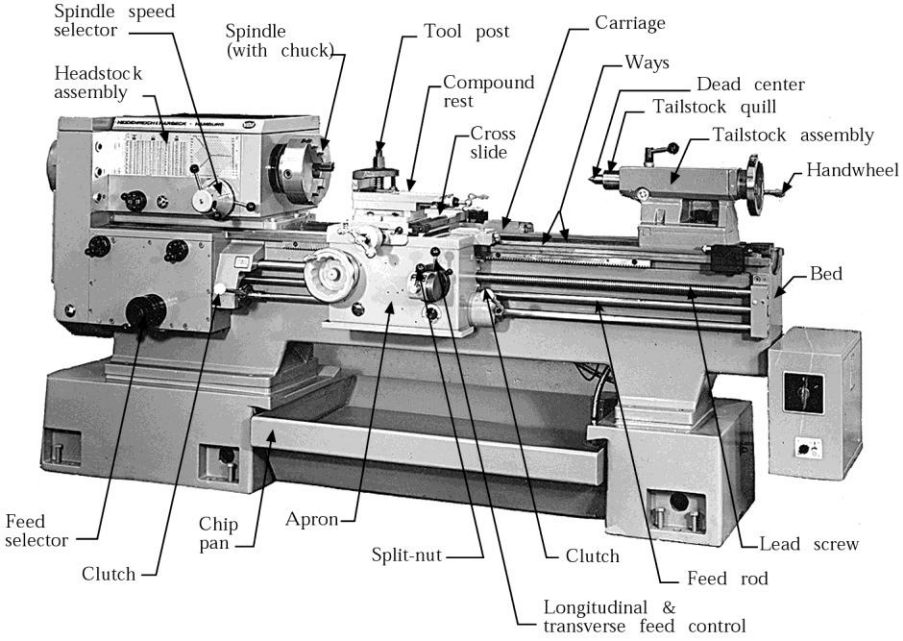
19RAC03 MANUFACTURING TECHNOLOGY

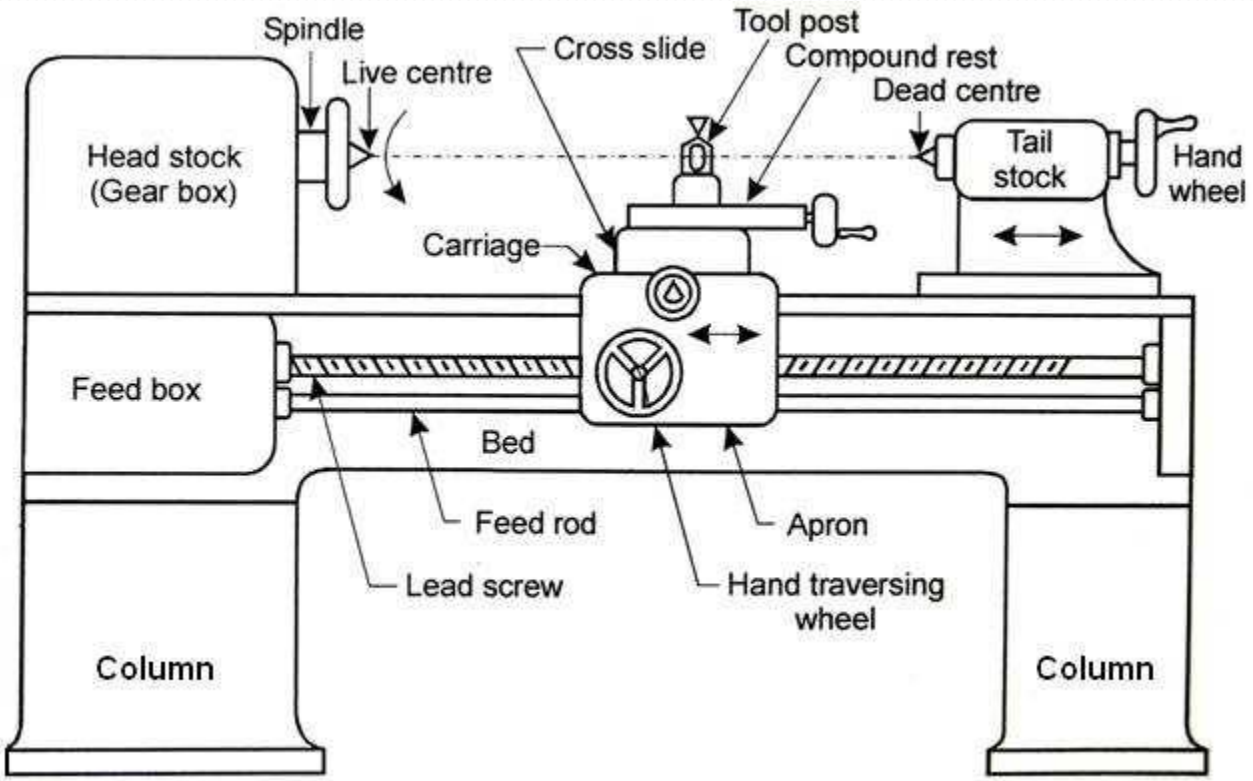
CENTRE LATHE

- Lathe is one of the oldest important machine tools in the metal working industry.
- A lathe operates on the principle of a rotating work piece and a fixed cutting tool.
- Its main function is to remove material from a work piece to produce the required shape and size.

CONSTRUCTIONAL FEATURES



Major parts of a centre lathe



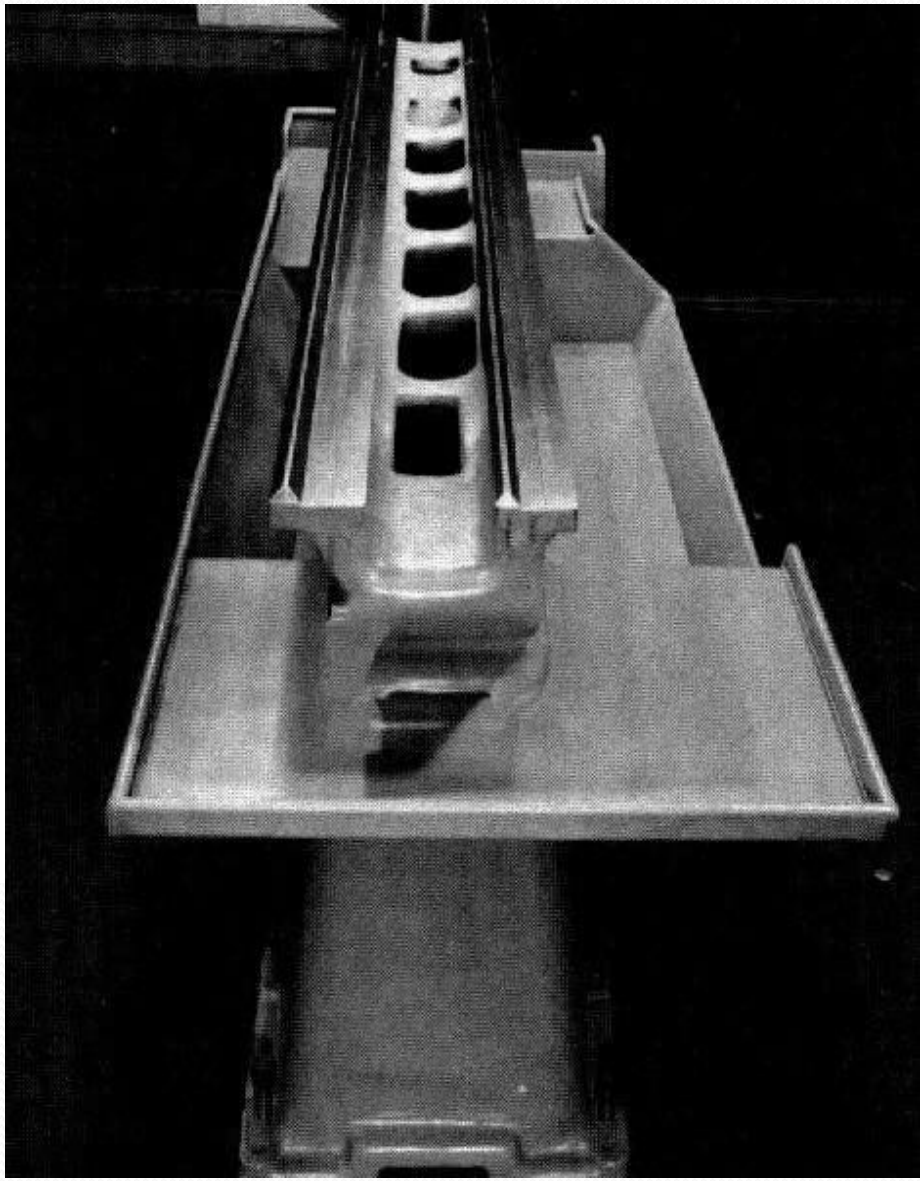
VARIOUS PARTS OF LATHE

1. Lathe Bed
2. Head Stock
3. Quick change gear box
4. Carriage
5. Cross Slide
6. Apron
7. Tail Stock
8. Automatic Feed Lever
9. Feed of an Engine Lathe
10. Shear Pins and Slip Clutches

1.Lathe Bed:-

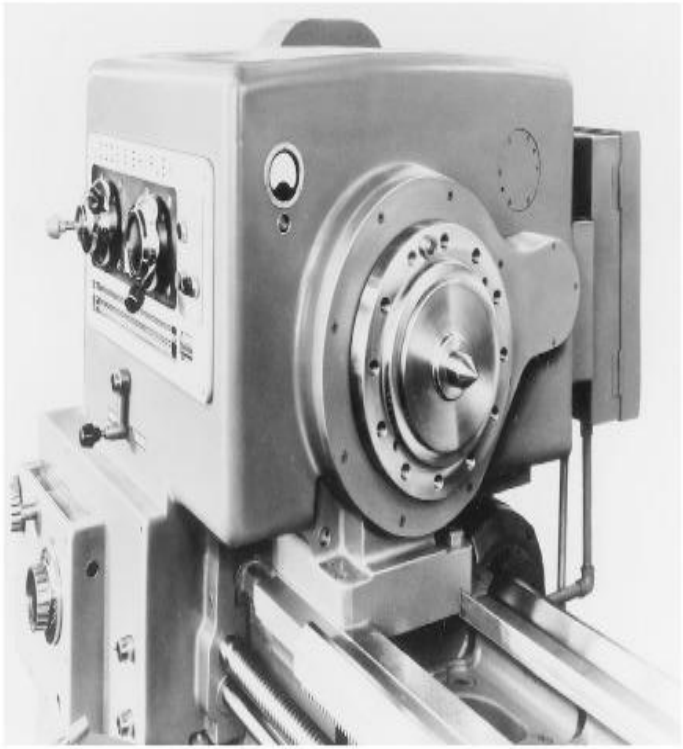
- This is heavy rugged casting made to support the working parts of lathe and also guide and align major parts of lathe.
- On top section are machined ways.

To resist the cutting force and vibration



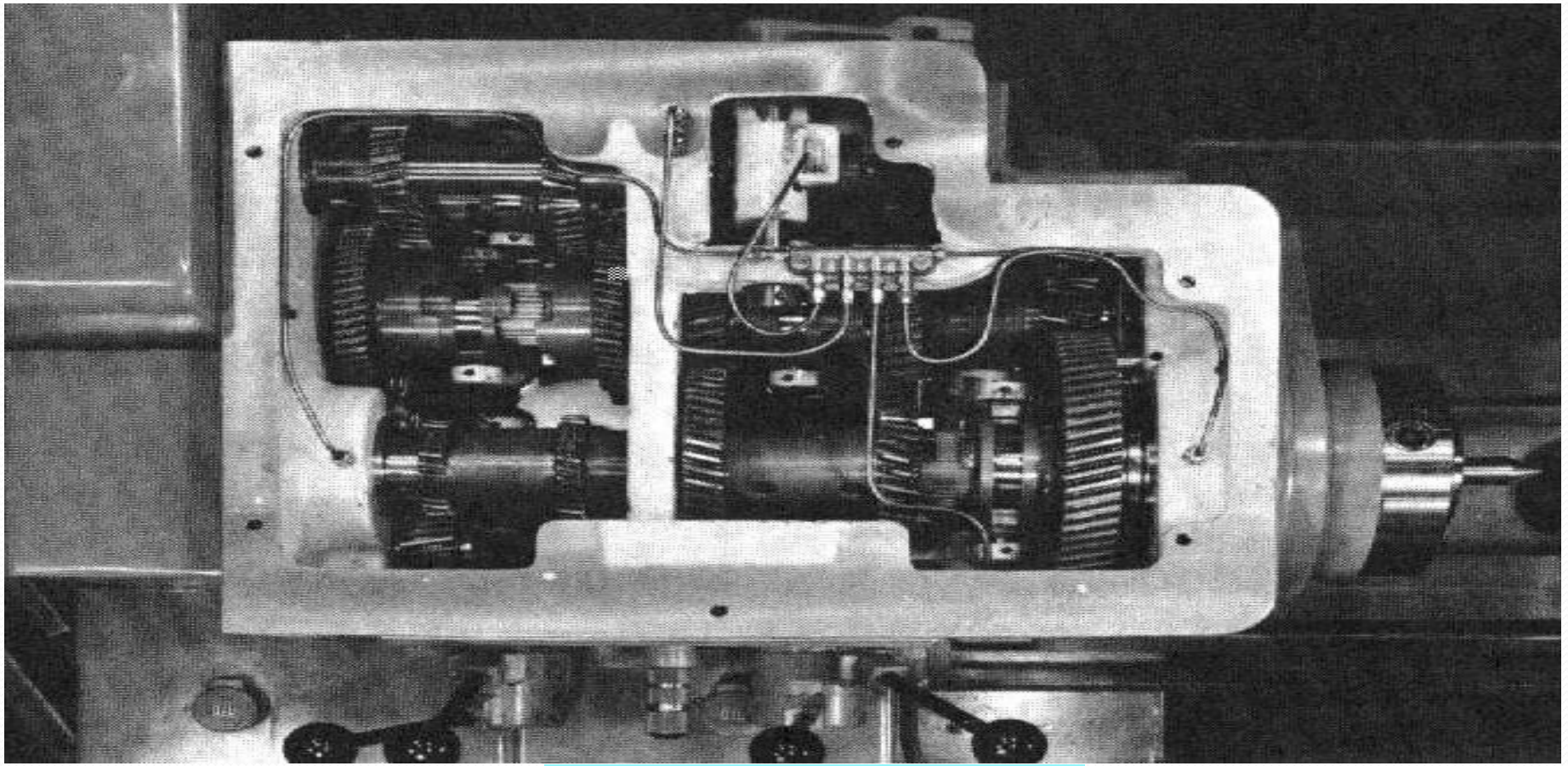
2. HEAD STOCK

- The headstock houses the main spindle,speed change mechanism, and change gears.
- The headstock is required to be made as robust as possible due to the cutting forces involved,which can distort a lightly built housing.



3. QUICK CHANGE GEAR BOX

- Contains number of different-size gears.
- Provides feed rod and lead-screw with various speeds for turning and thread-cutting operations.



TOP VIEW

CONTINUE...

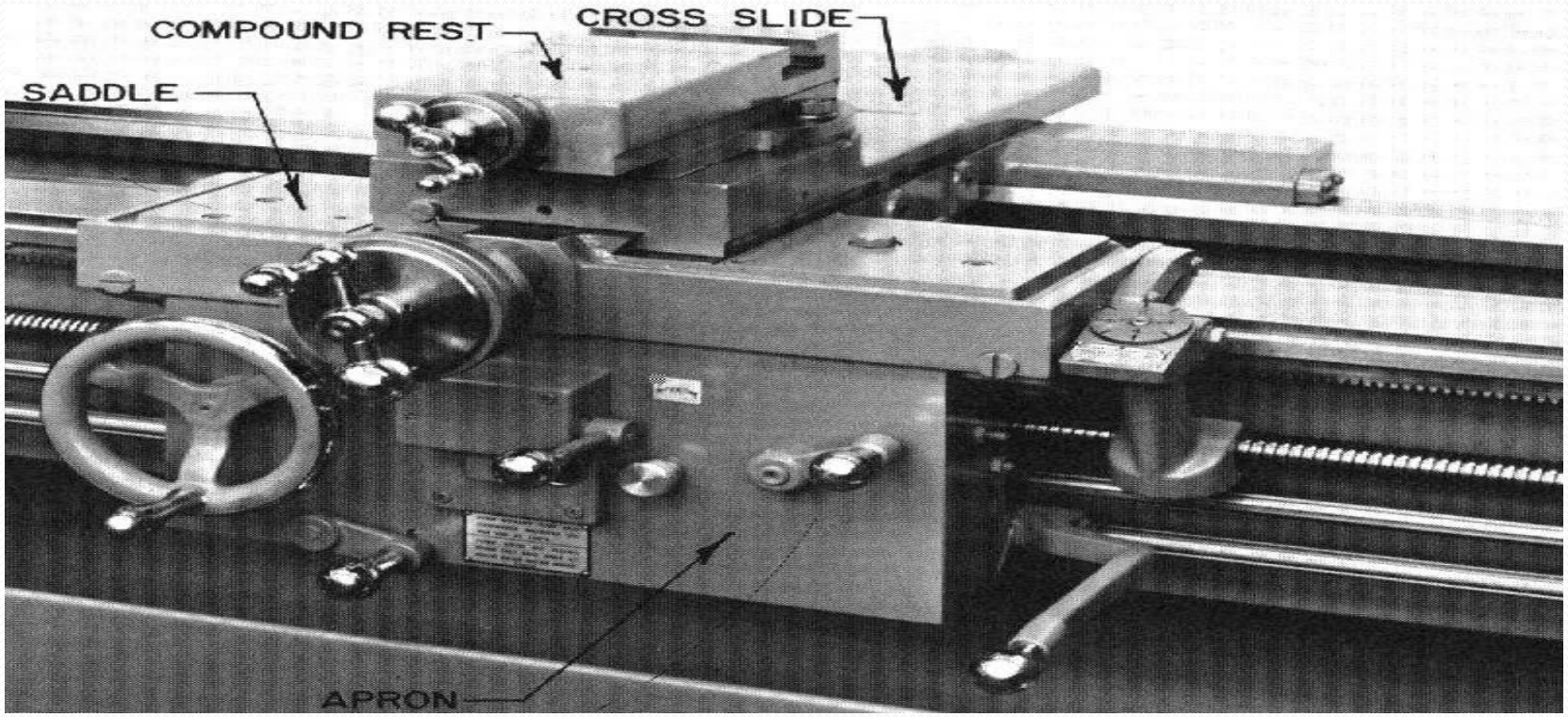
- The arrangement which are employed in feed gear boxes to obtain multispindle speeds and different rates of feeds are:

I. Sliding Gear Mechanism
II. Sliding Clutch Mechanism
III. Gear Cone And Tumbler Gear Mechanism
IV. Sliding Key Mechanism
V. Combination of any two or more of the above

- Usually two or three levers must be moved to obtain the desired combination within a given range.

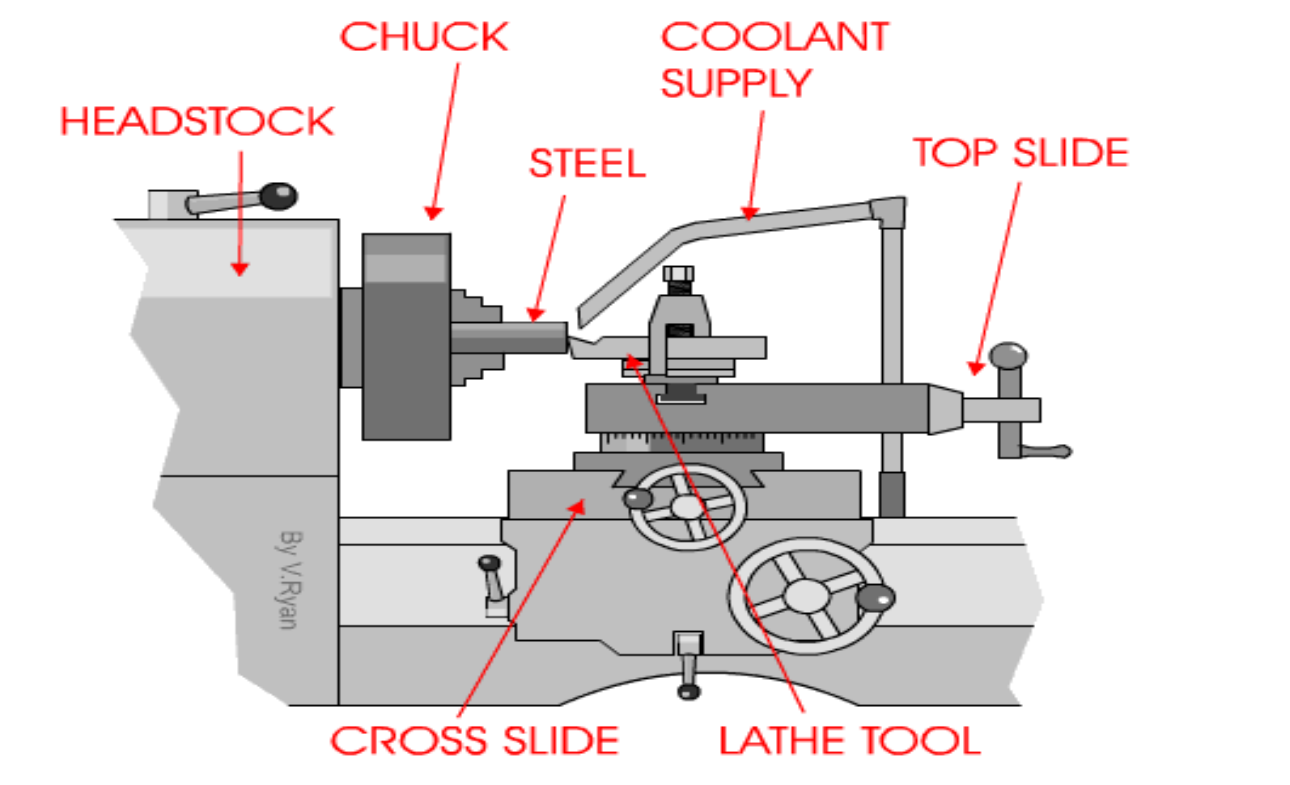
4. CARRIAGE

- Used to move cutting tool along lathe bed.
- Consists of three main parts-
  i. Saddle
  ii. Cross-slide
  iii. Apron



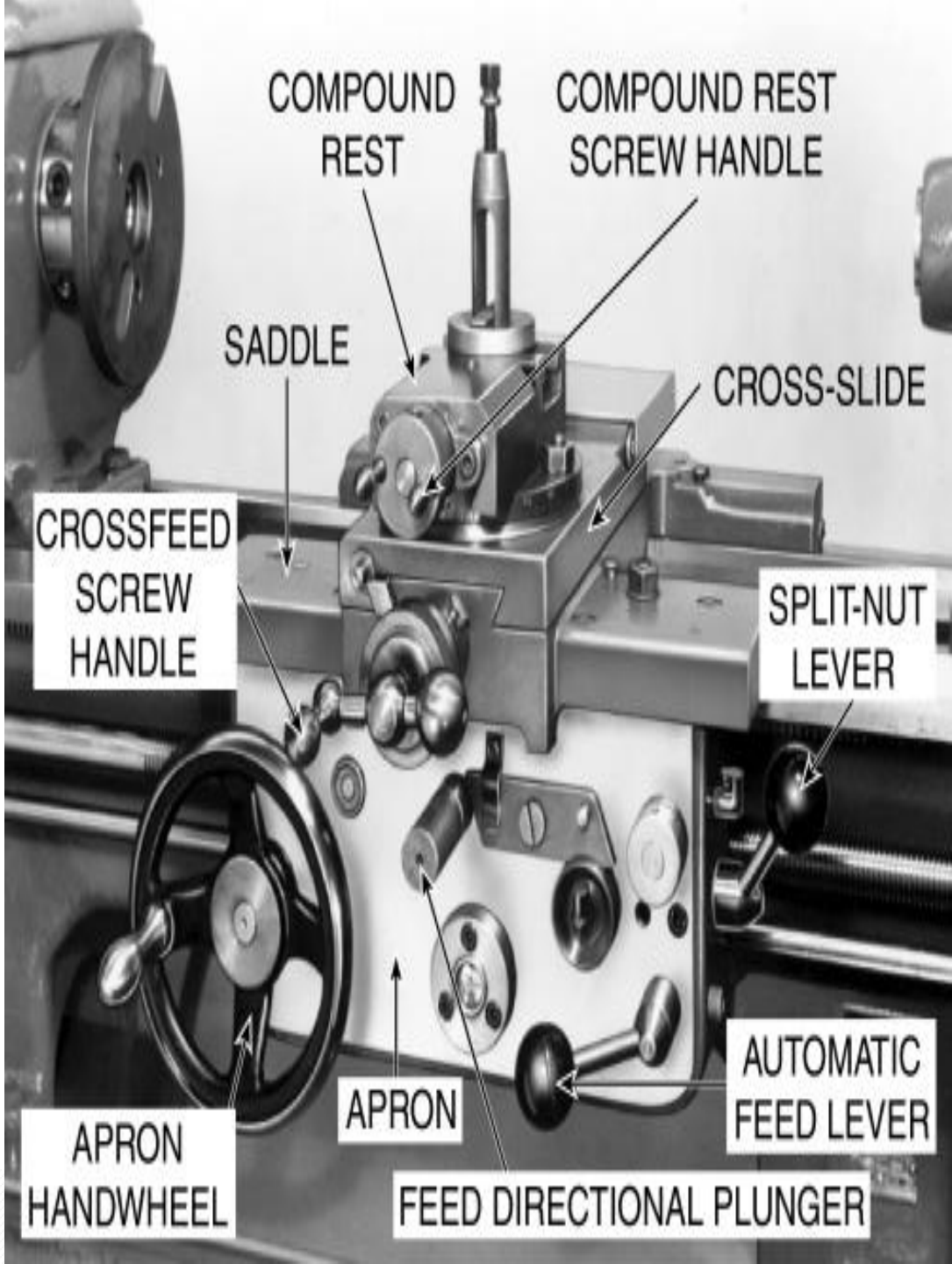
5. CROSS SLIDE

- Mounted on top of saddle.
- Provides manual or automatic cross movement for cutting tool.



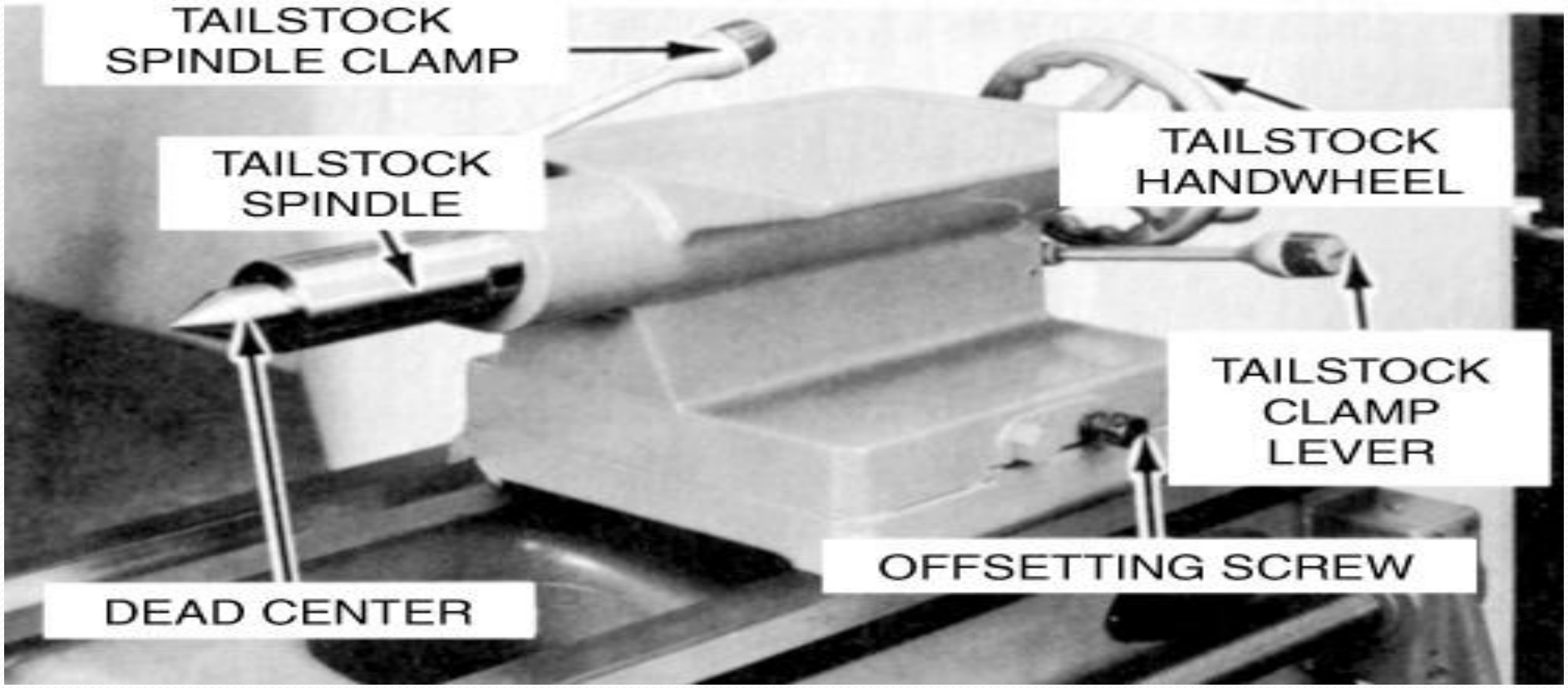
6. APRON

- Fastened to saddle.
- Houses gears and mechanism required to move carriage or cross-slide automatically.
- Locking-off lever inside apron prevents engaging split-nut lever and automatic feed lever at same time.
- Apron hand wheel turned manually to move carriage along lathe bed.



7. TAILSTOCK

- Upper and lower tailstock castings.
- Adjusted for taper or parallel turning by two screws set in base.
- Tailstock clamp locks tailstock in any position along bed of lathe.
- Tailstock spindle has internal taper to receive dead center.
- Provides support for right-hand end of work.



Specification of a lathe

- Length of bed
- Max distance b/w dead and live centres
- Type of bed i.e straight, semi gap, gap type
- Height of centers from the bed
- Swing over the bed
- Swing over the cross slide
- Width of the bed
- Spindle bore
- Spindle speed

Specification of a lathe

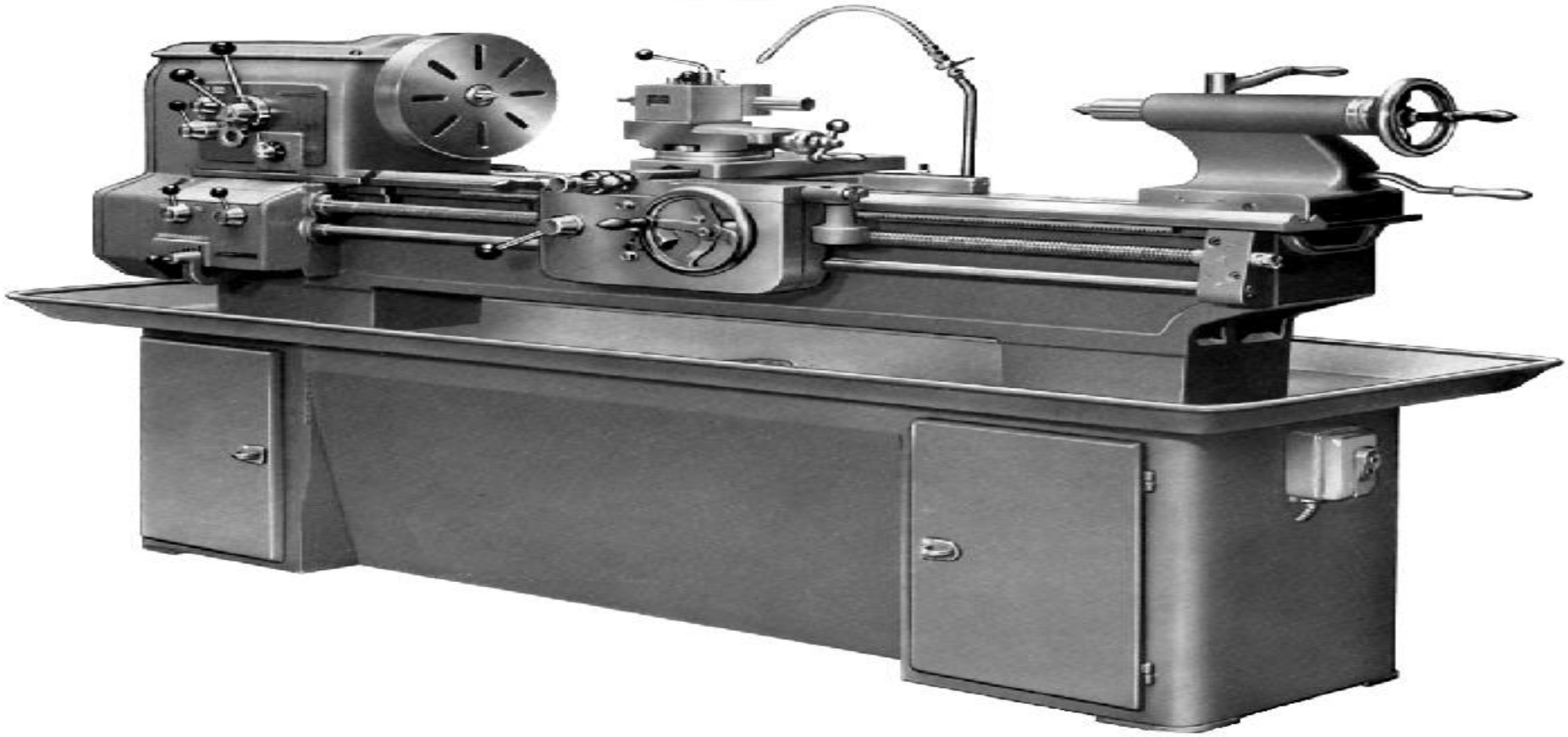
- H.P of main motor and rpm
- No. of spindle speeds
- Spindle nose diameter
- Feeds
- Floor space required

TYPES OF LATHE

1. ENGINE LATHE
2. BENCH LATHE
3. TRACER LATHE
4. TOOL ROOM LATHE
5. AUTOMATIC LATHE
6. TURRET LATHE
7. COMPUTER CONTROLLED LATHE

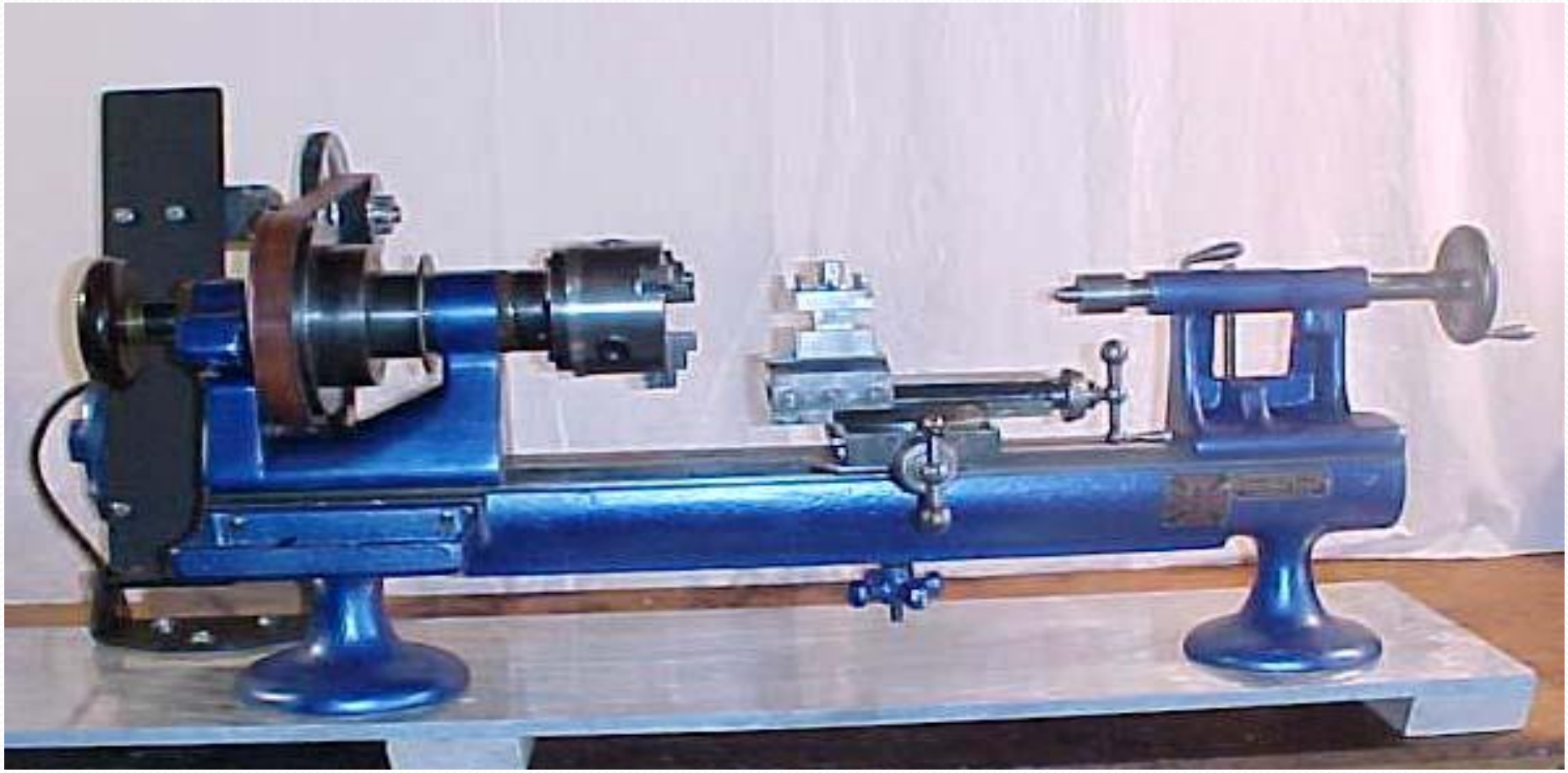
➢Engine Lathe :-

- This term ‘engine’ is associated with the lathe owing to the fact that early lathes were driven by steam engine. It is also called Engine lathe or centre lathe
- The most common form of lathe, motor driven and comes in large variety of sizes and shapes.



➢ Bench Lathe :-

- A bench top model usually of low power used to make precision machine small work pieces.
- It is used for small w/p having a maximum swing of 250 mm at the face plate. Practically it consists of all the parts of engine lathe or speed lathe.



Tool Room Lathe:-

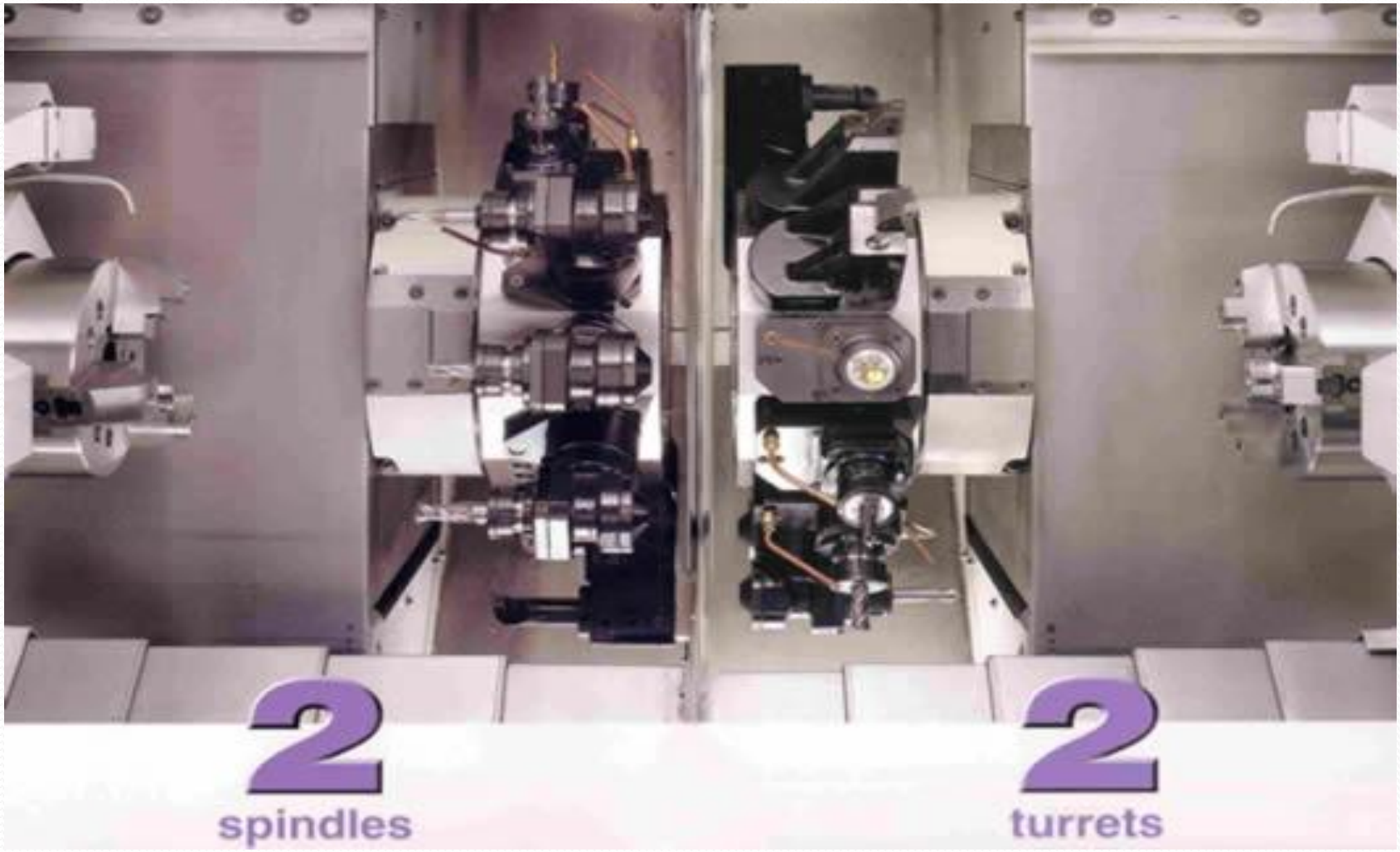
➢Automatic Lathe :-

- A lathe in which the work piece is automatically fed and removed without use of an operator.
  It requires very less attention after the setup has been made and the machine loaded.

➢Computer Controlled Lathe :-

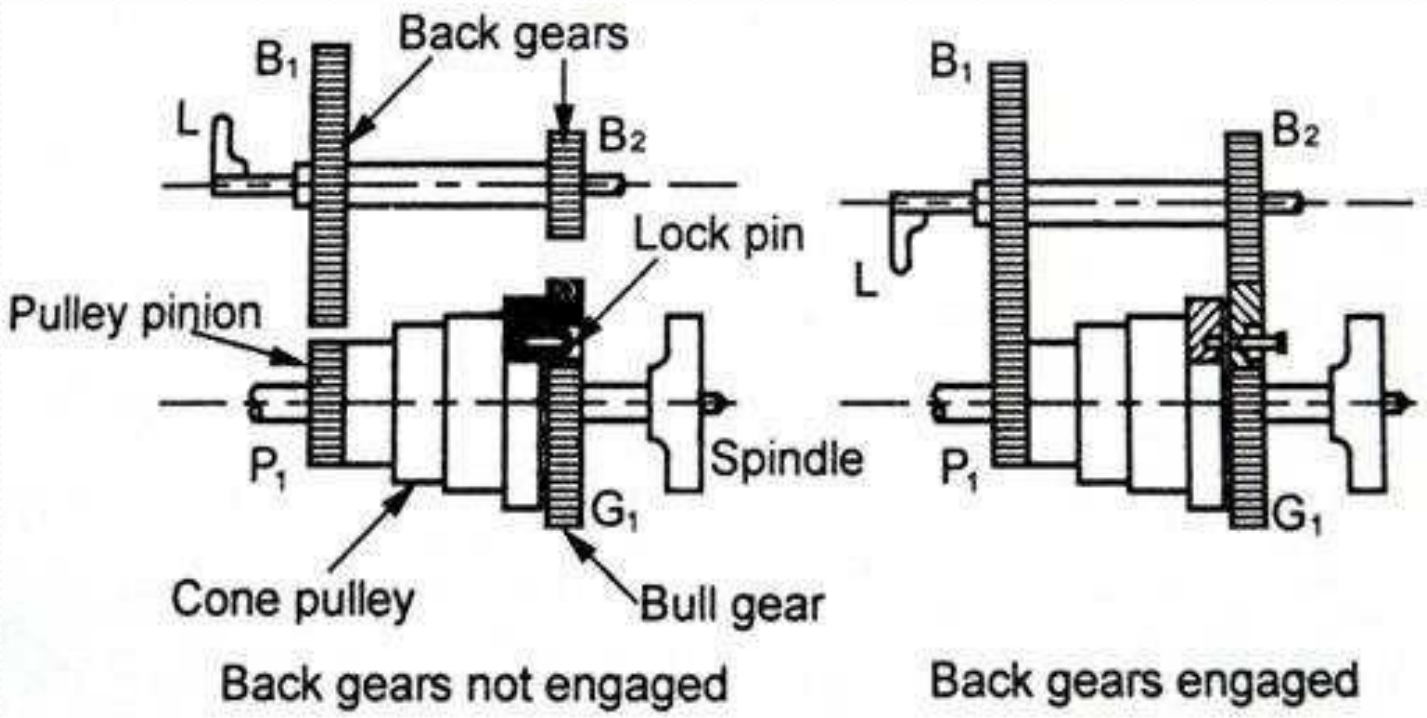
- A highly automated lathe, where both cutting, loading, tool changing, and part unloading are automatically controlled by computer coding.
- E.g. CNC Lathe M/C.(Computer Numerical Control Machine)

CNC LATHE M/C



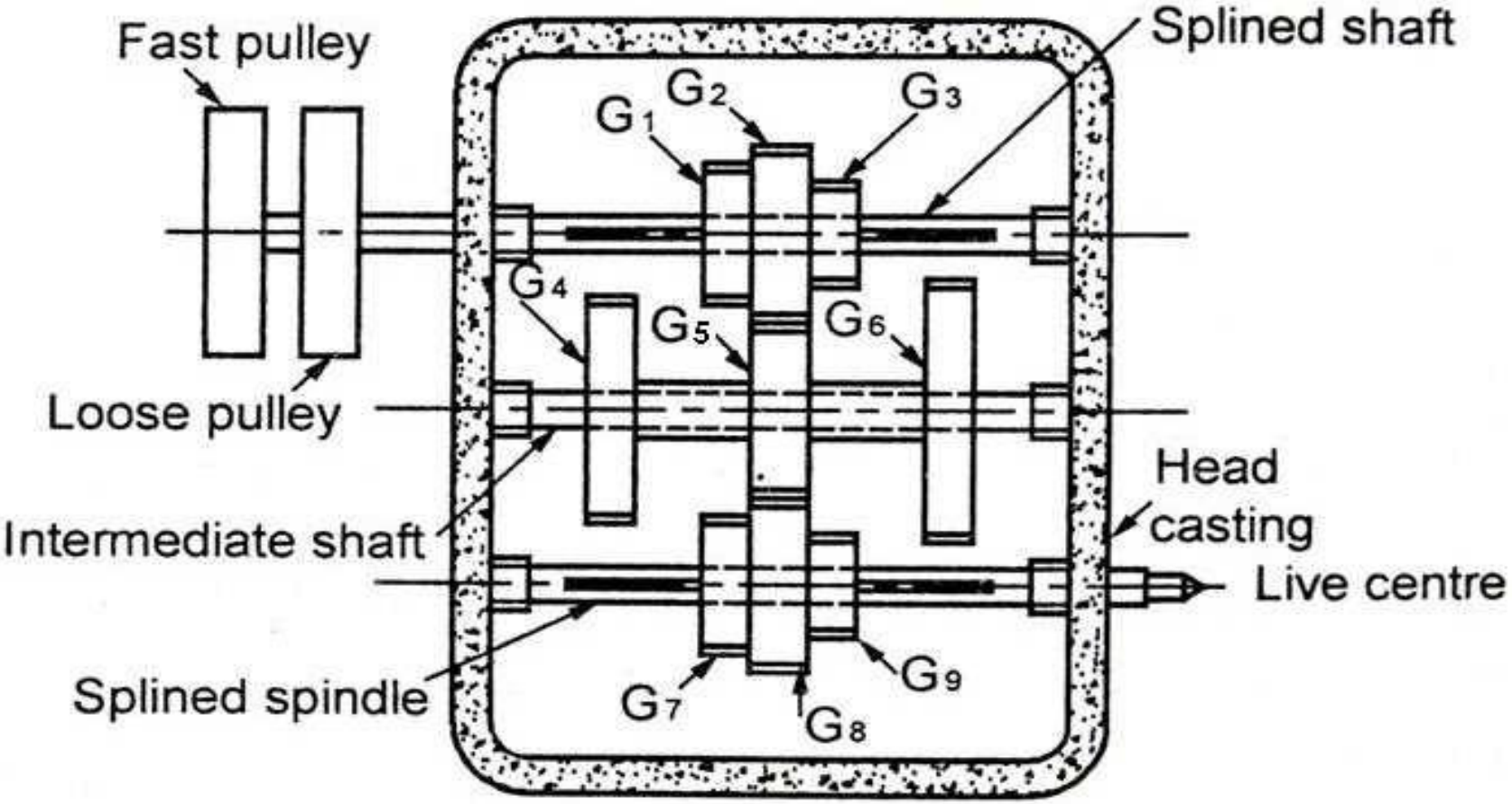
Headstock driving mechanisms

- Back geared headstock.



Mechanisms

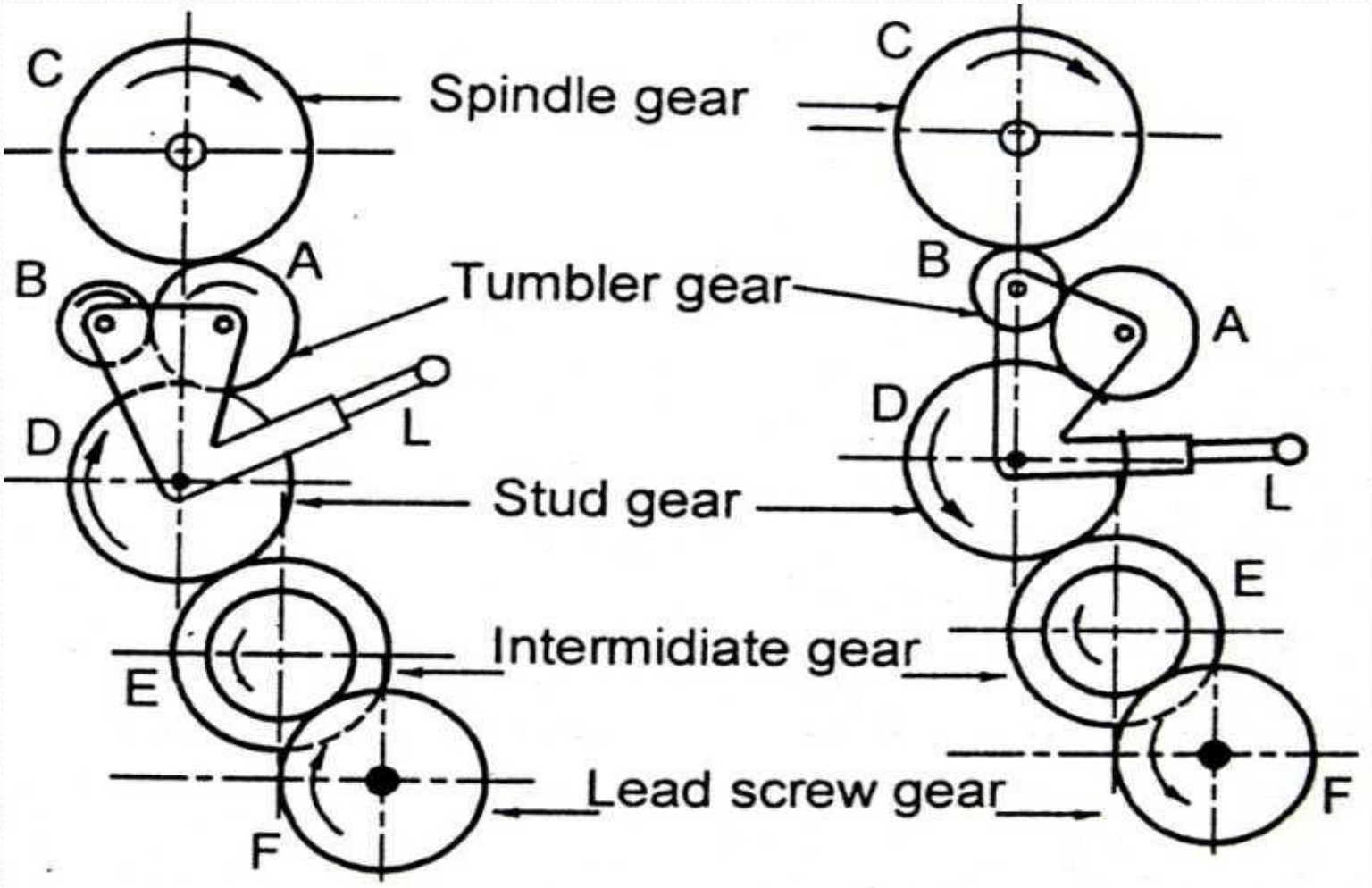
- All geared headstock.



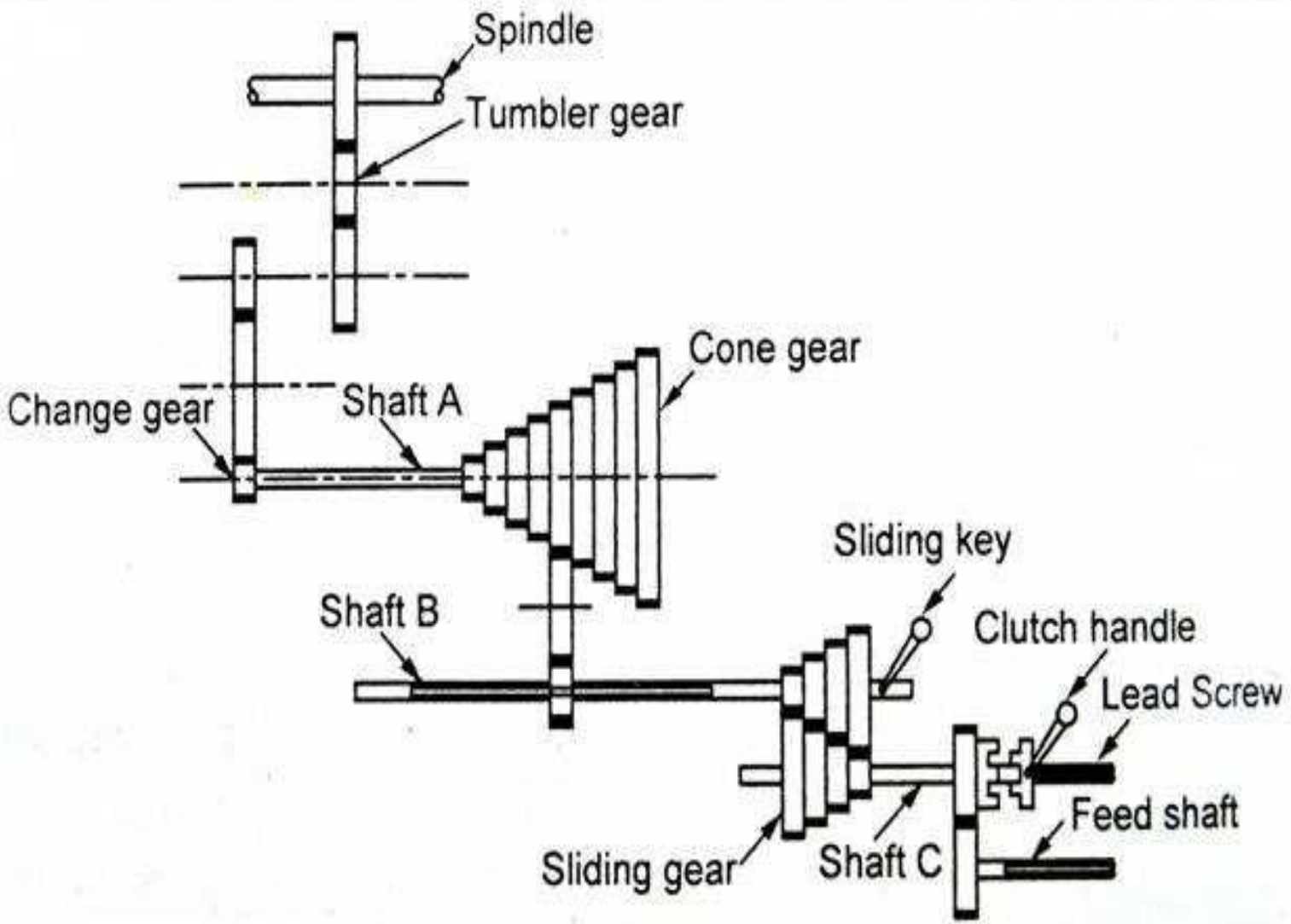
Feed mechanisms

- Tumbler gear reversing mechanism.
- Quick-change gearbox.
- Tumbler gear quick-change gearbox.
- Apron mechanism.

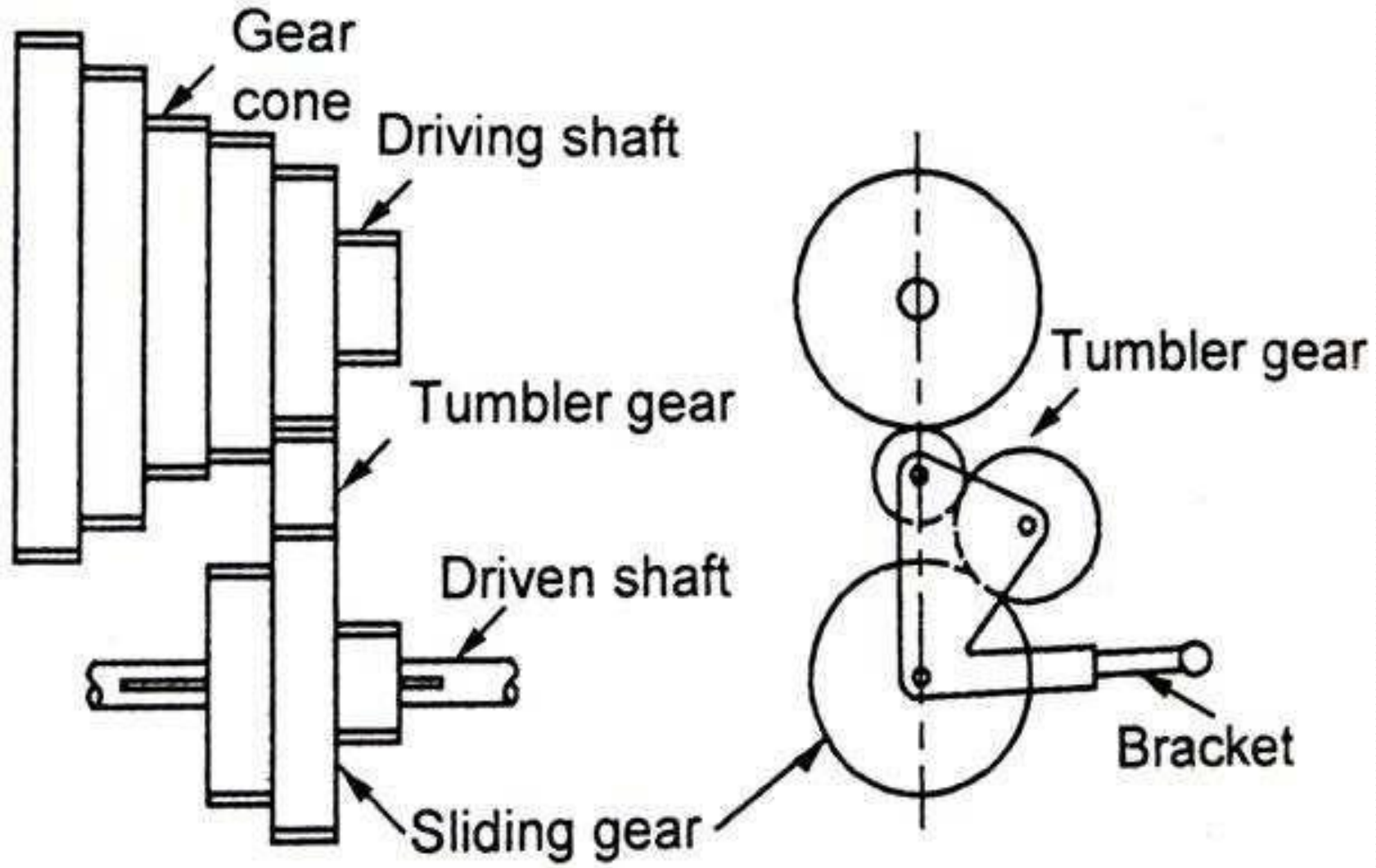
Tumbler gear reversing mechanism.



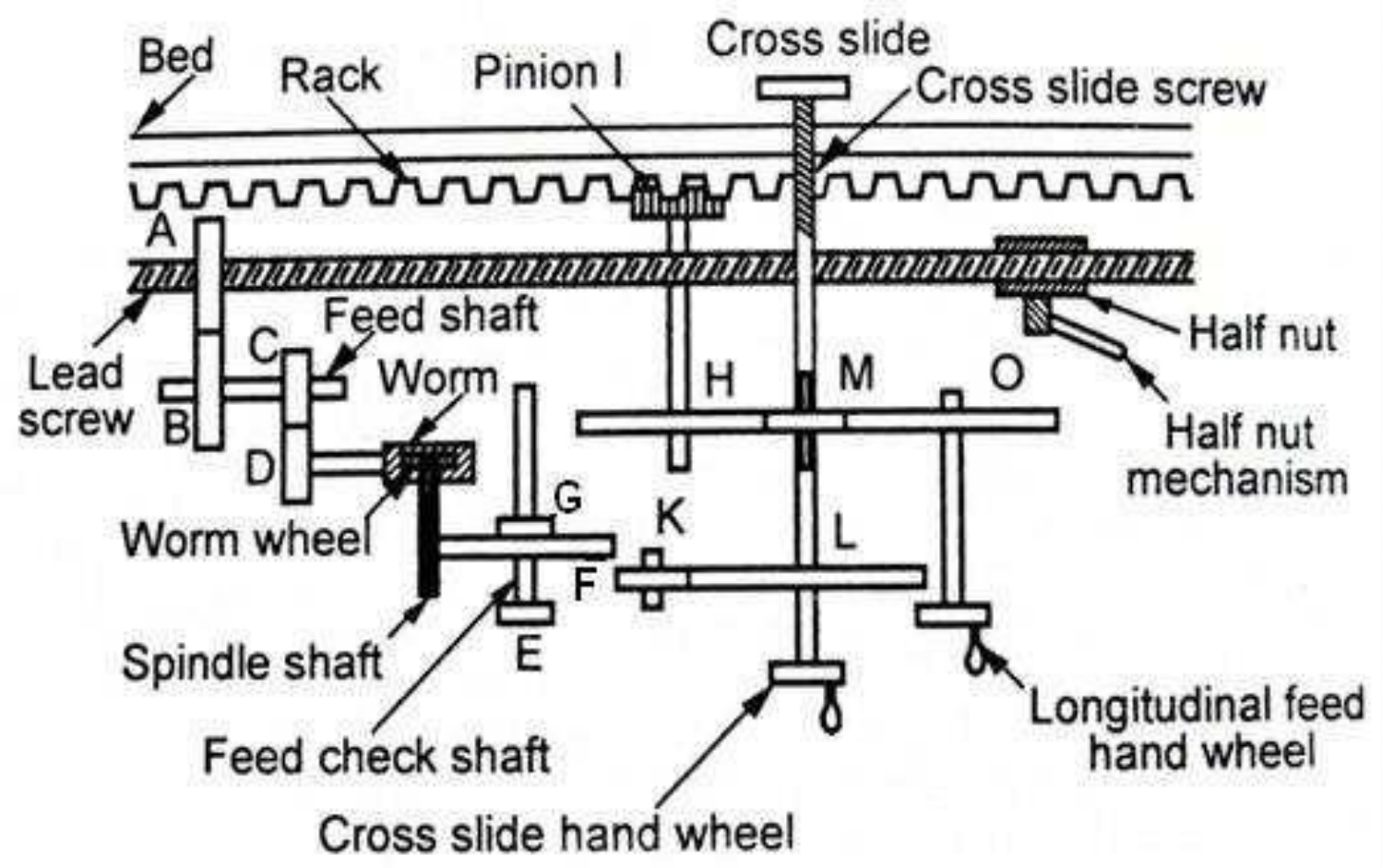
Quick change gearbox:



gearbox.


Gear
cone
Driving shaft
Tumbler gear
Driven shaft
Sliding gear
Tumbler gear
Bracket

Apron mechanism.



Work holding devices

- Chucks
- Centres
- Face plate
- Angle plate
- Mandrels
- Steady and follower rest

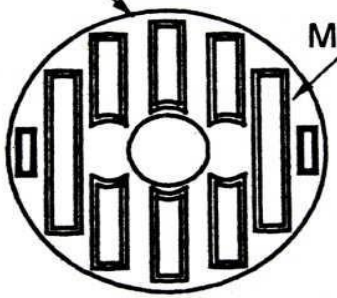
Work Holding Devices

THREE JAWS CHUCK

- **For holding cylindrical stock centered.**
- **For facing/center drilling the end of your aluminum stock**

Chuck body

Magnets

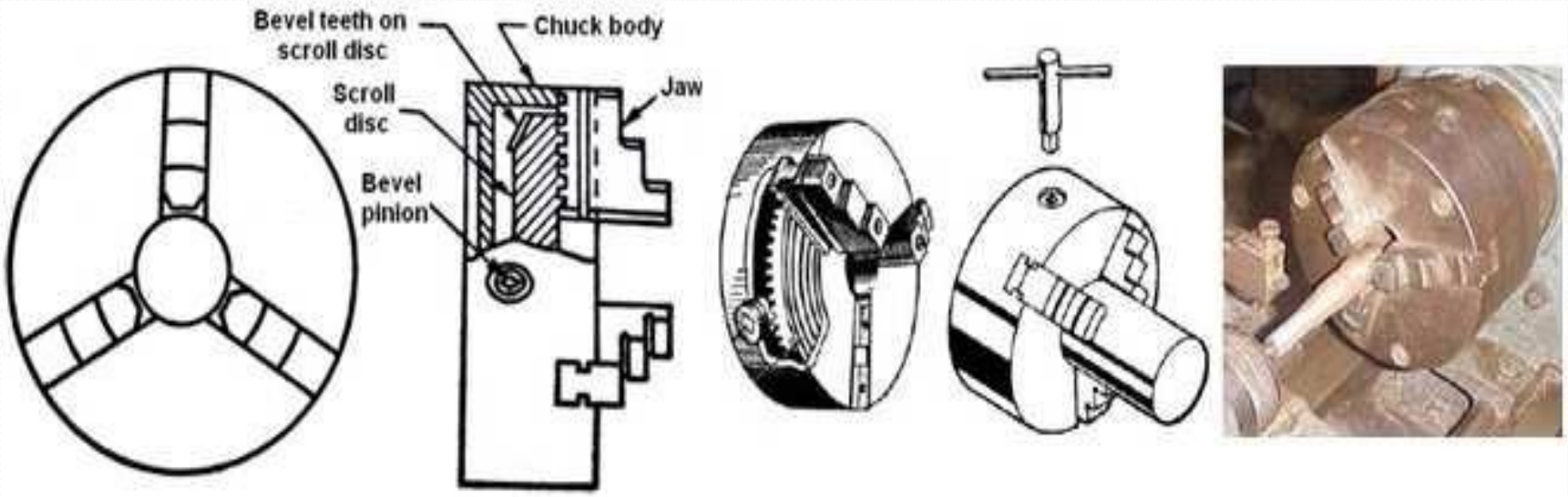


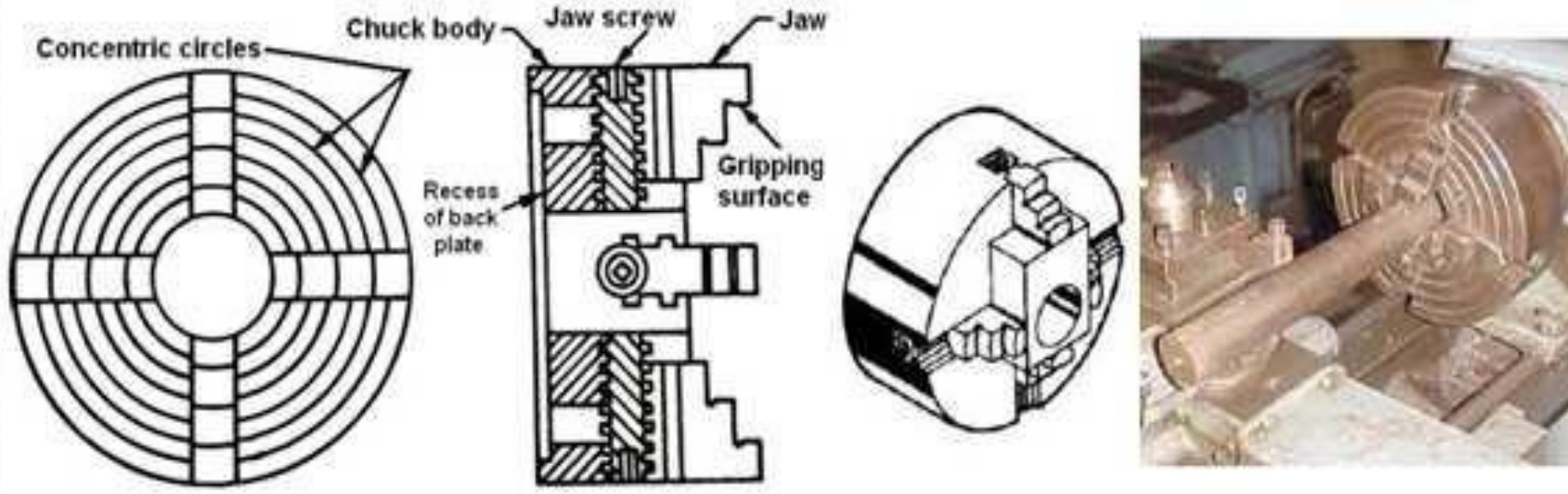
Magnetic chuck

FOUR JAWS CHUCK

- **This is independent chuck generally has four jaws , which are adjusted individually on the chuck face by means of adjusting screws**

Three jaw and Four jaw chuck



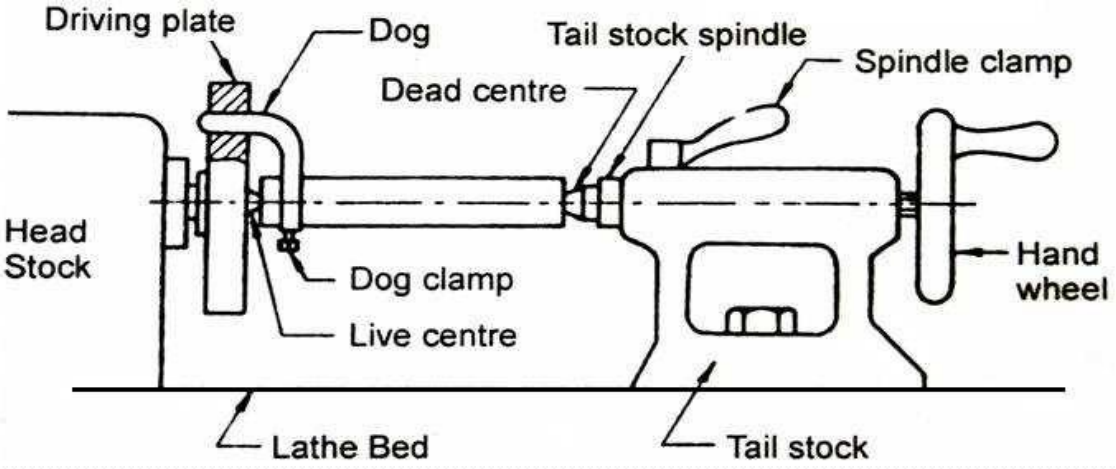


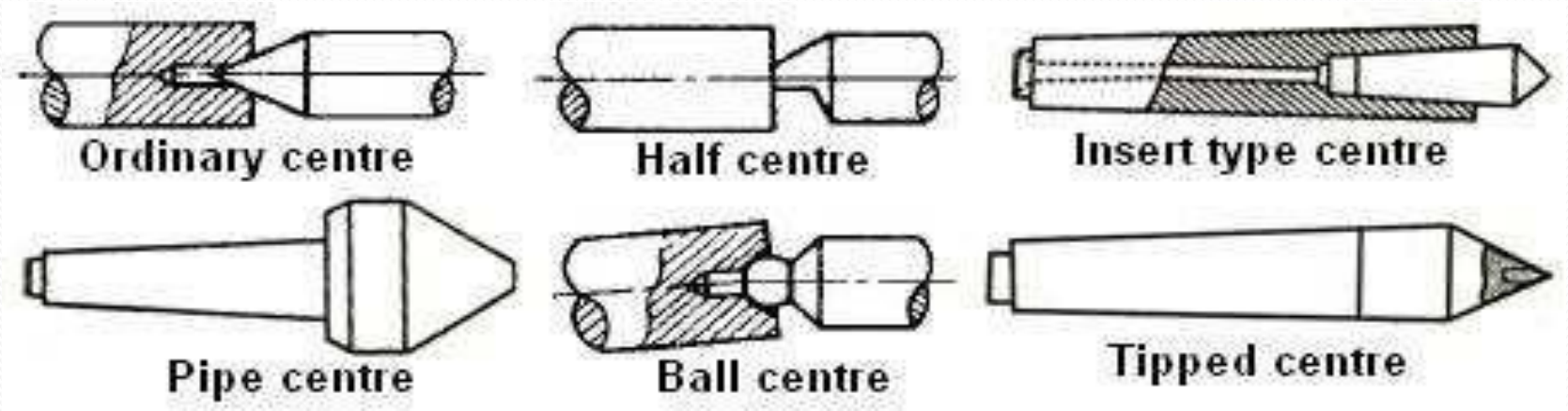
Lathe Centers

- Work to be turned between centers must have center hole drilled in each end
  - Provides bearing surface
- Support during cutting
- Most common have solid Morse taper shank 60° centers, steel with carbide tips
- Care to adjust and lubricate occasionally

Types of centres

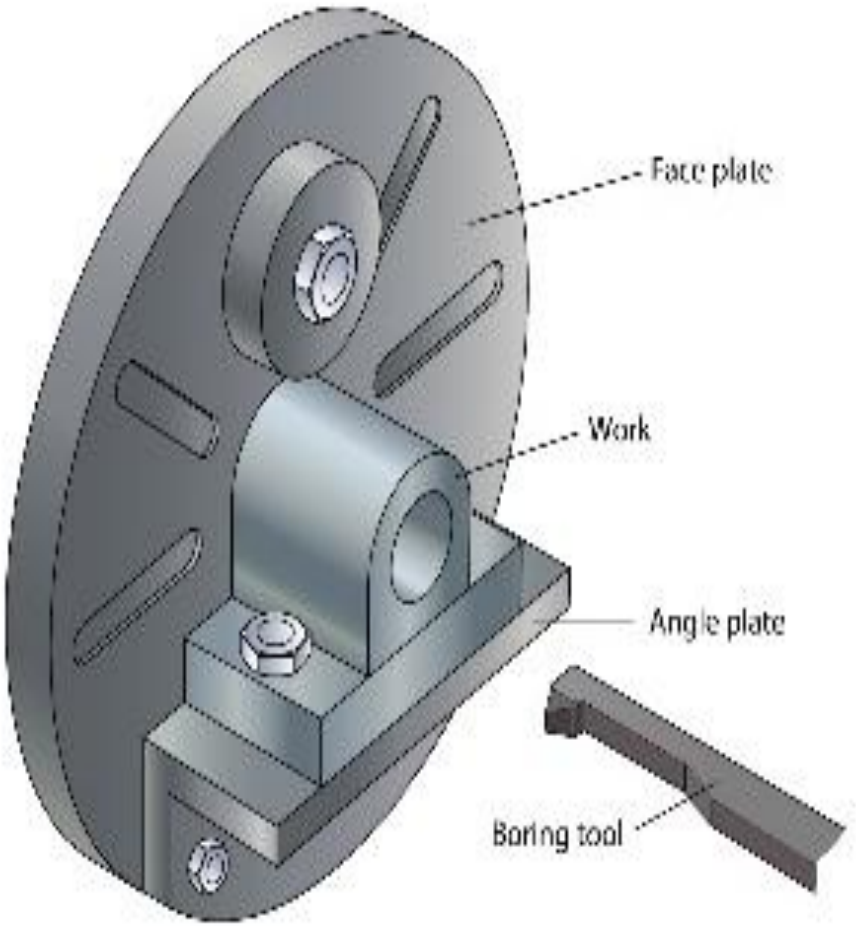
- Work held between centres



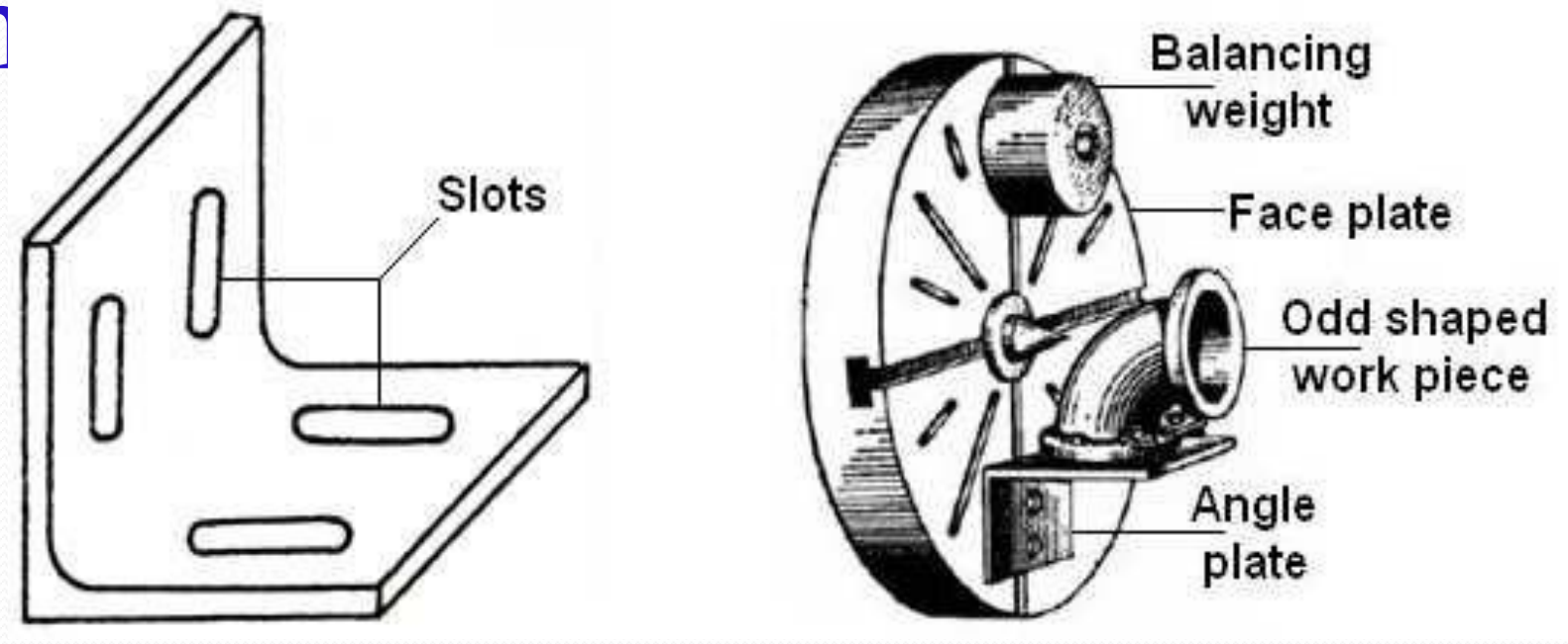


Workholding devices: Face plate

- The workpiece can be aligned on the face plate in a similar way to the four jaw chuck.
- However everything must be bolted or screwed in place.
- A clamping set can be used to attach work to the face plate.
- This can only be run at very slow speeds.



An



(a) Angle plate

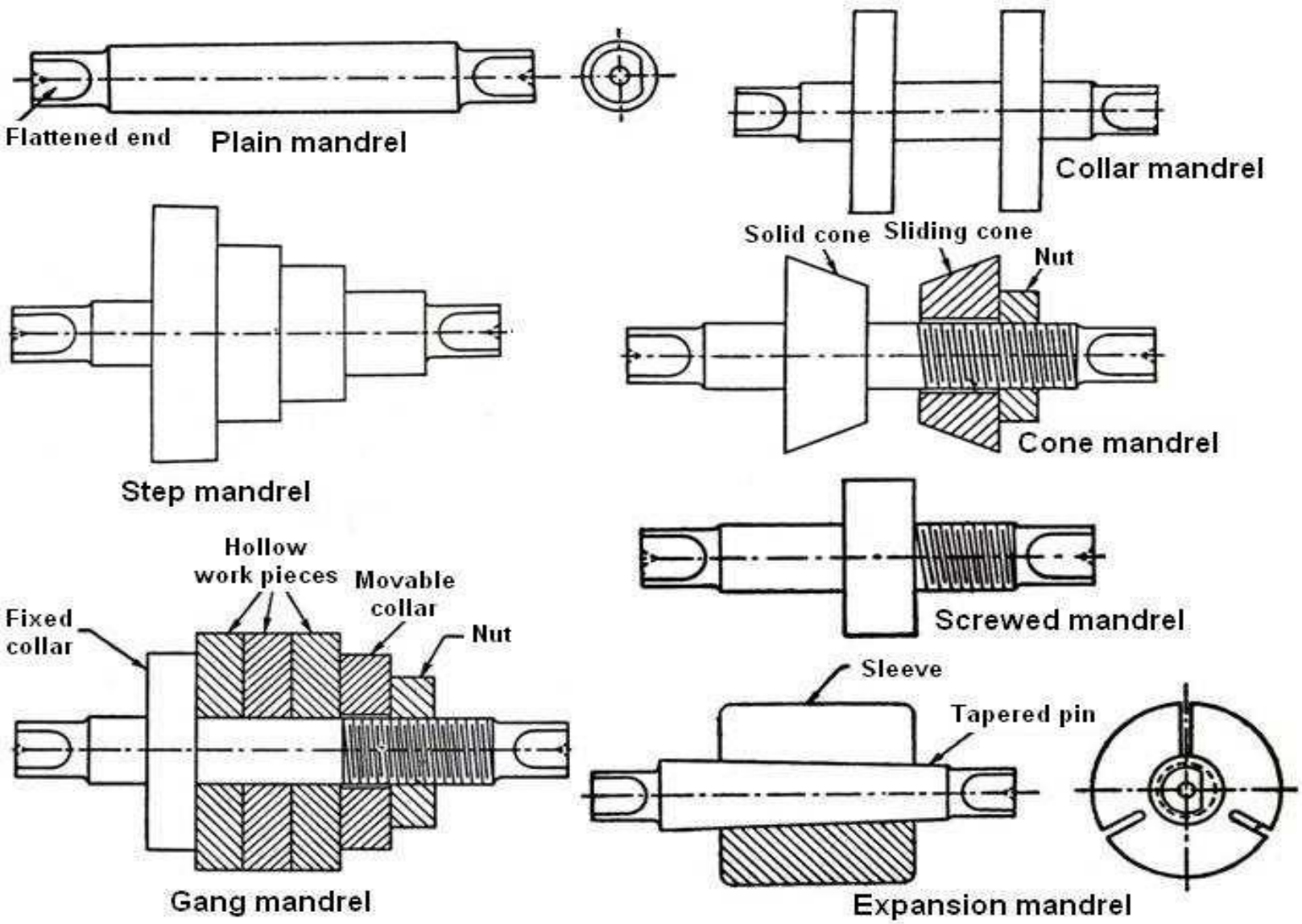
(b) Angle plate used along with face plate

WORK HOLDING DEVICE

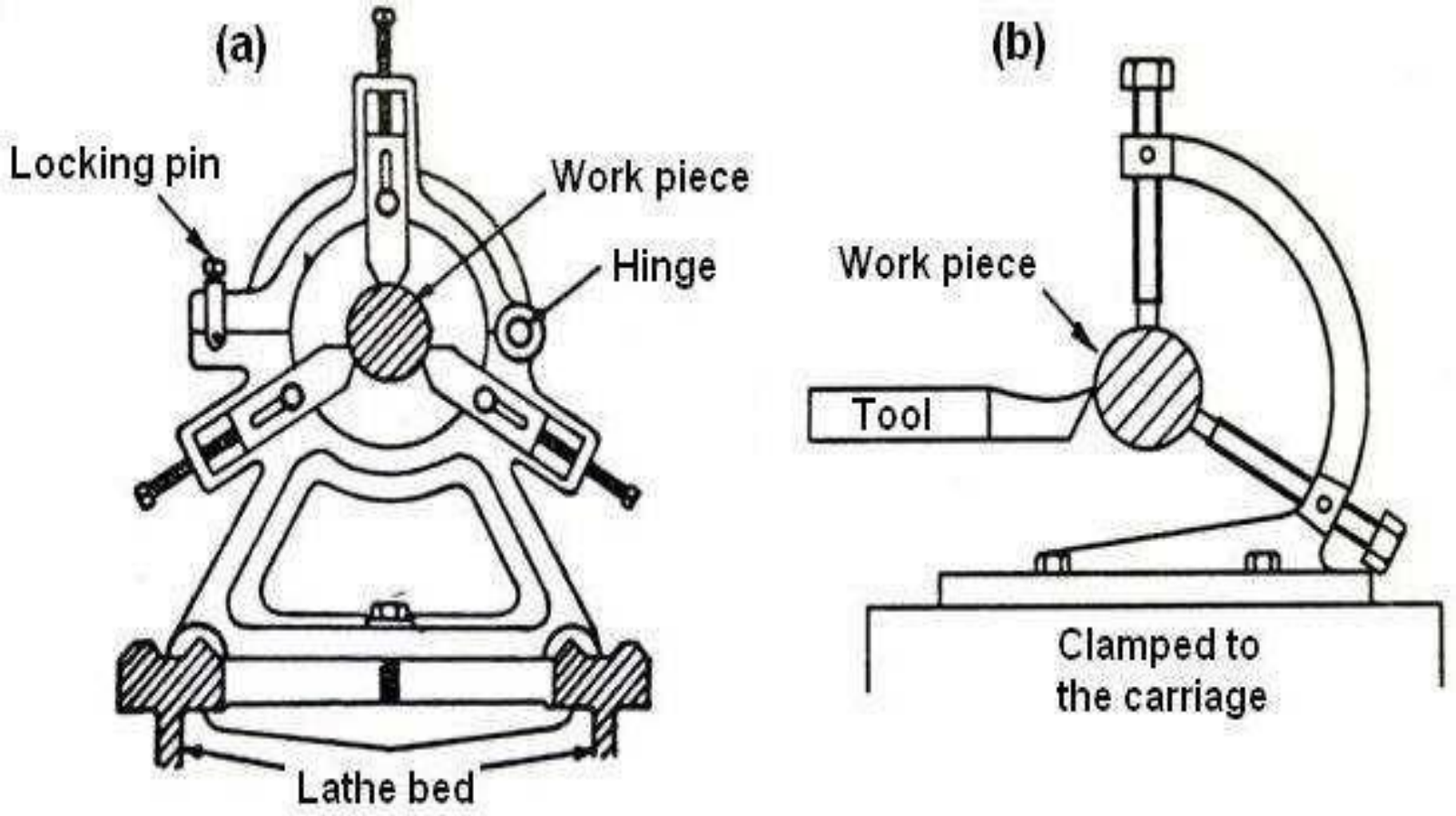
Lathe dogs :

- Lathe dogs are cast metal devices used to provide a firm connection between the headstock spindle and the w/p mounted between centers.

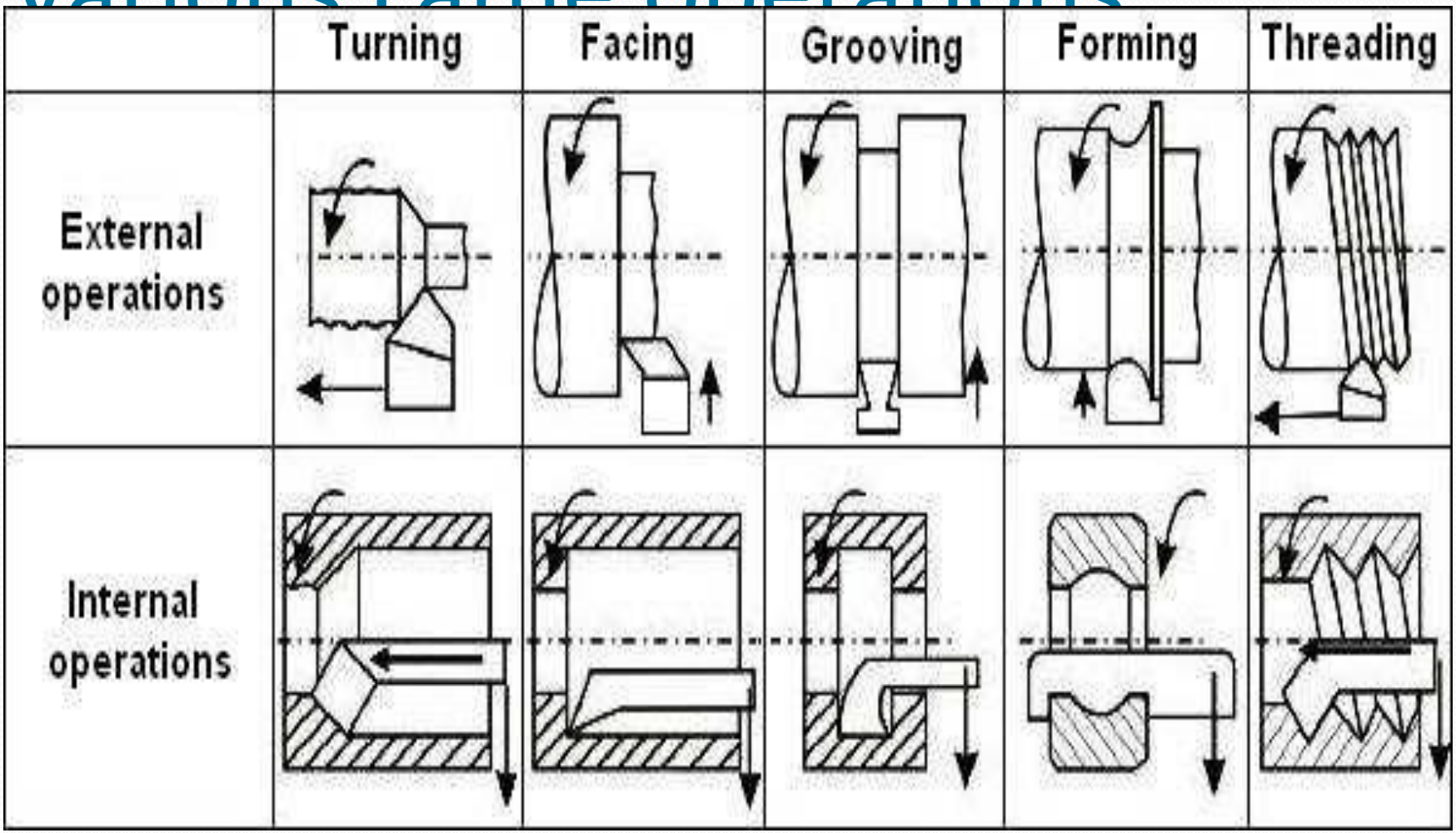
M


Flattened end
Plain mandrel
Collar mandrel
Solid cone
Sliding cone
Nut
Step mandrel
Cone mandrel
Hollow
work pieces
Movable
collar
Fixed
collar
Nut
Screwed mandrel
Sleeve
Tapered pin
Gang mandrel
Expansion mandrel

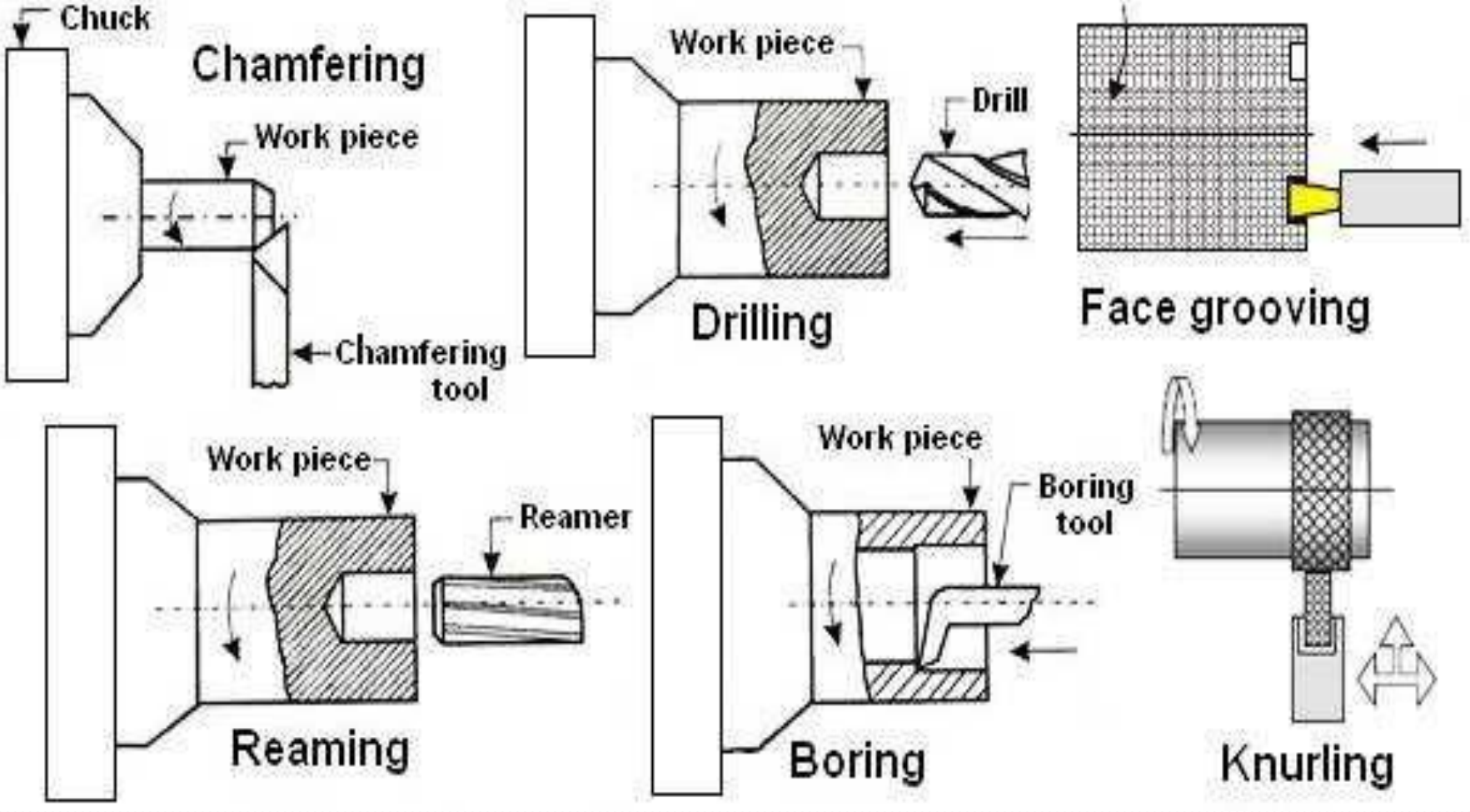
Steady rest and Follower rest



Various Lathe operations



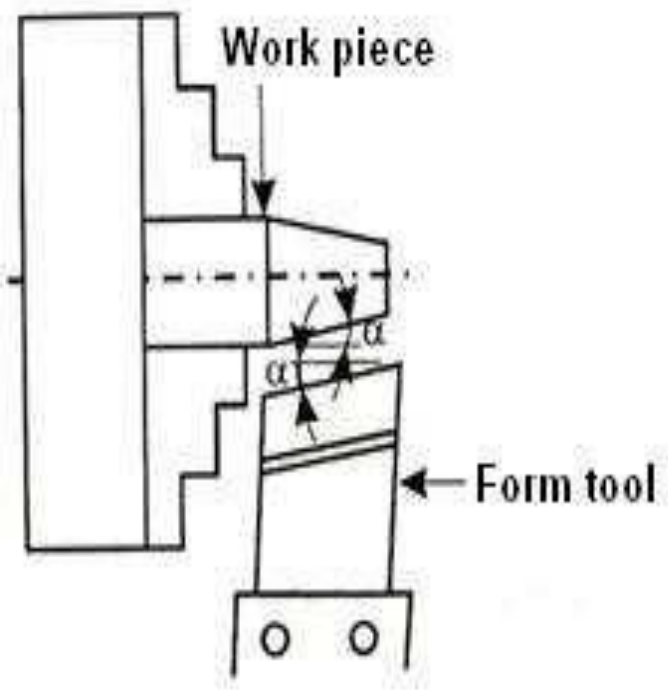
Various Lathe operations

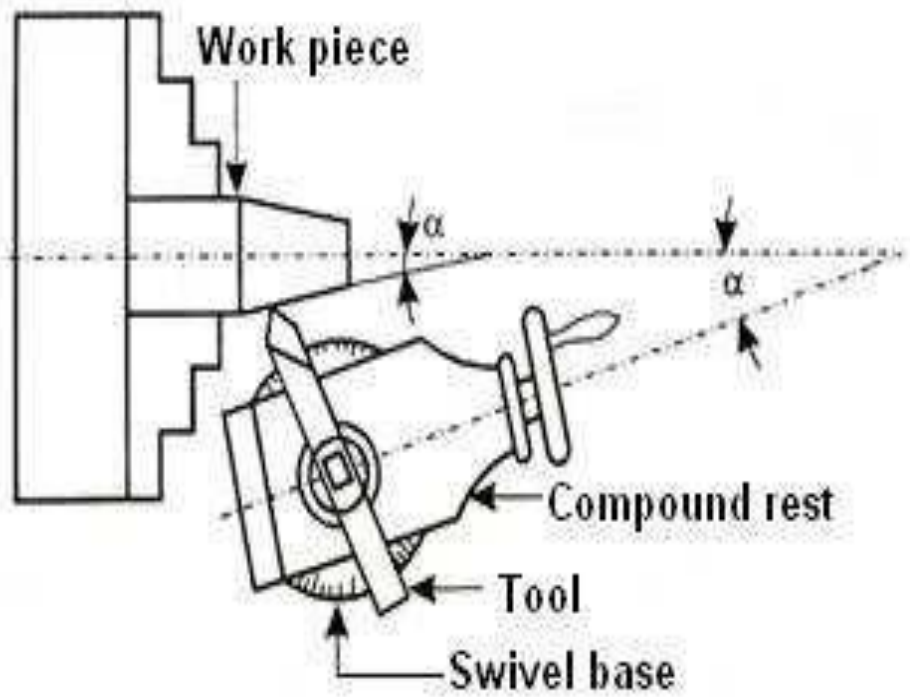


TAPER TURNING METHODS

Taper turning by a form tool

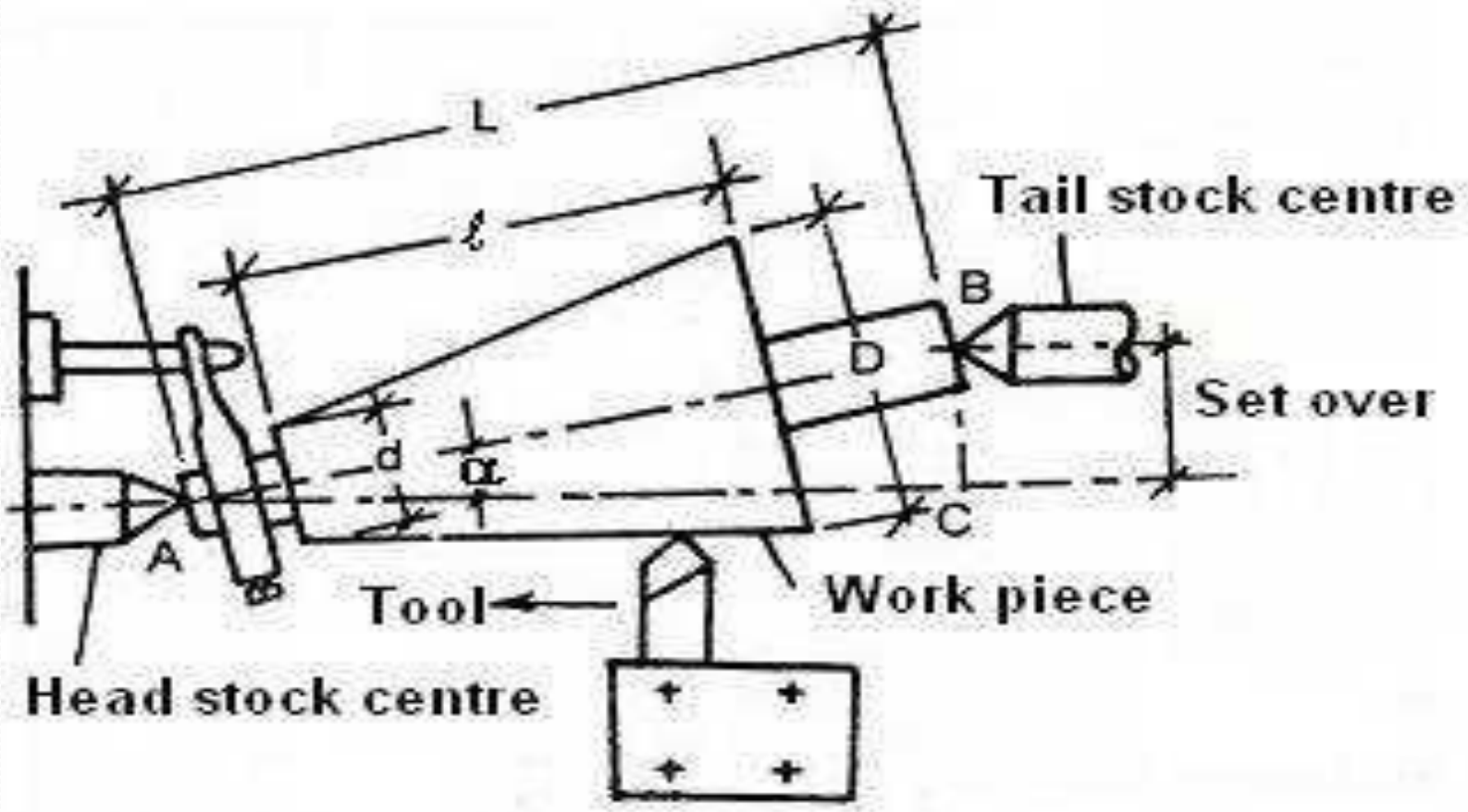
Taper turning by swiveling the compound rest





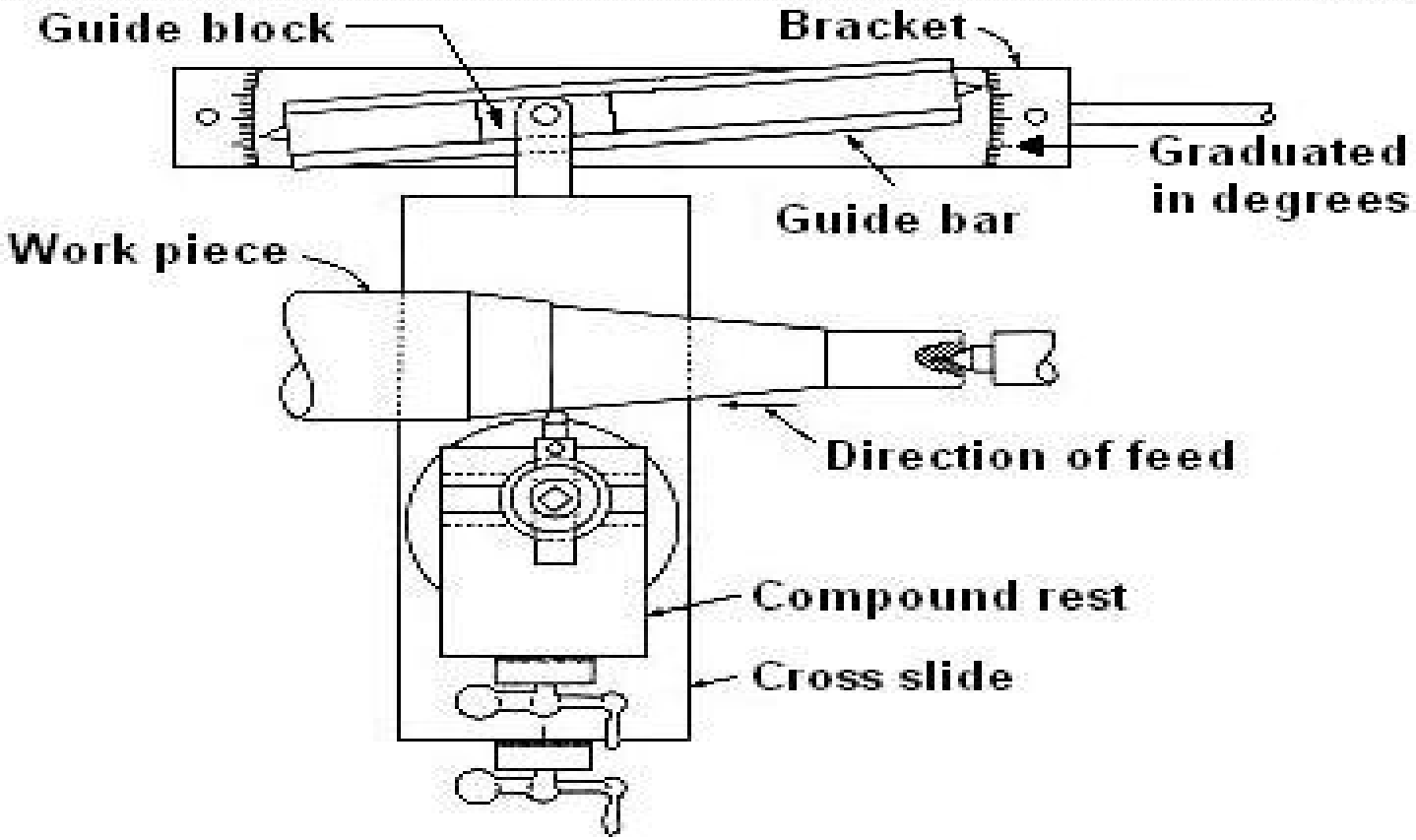
TAPER TURING METHODS

- **Taper turning by offsetting the tailstock**

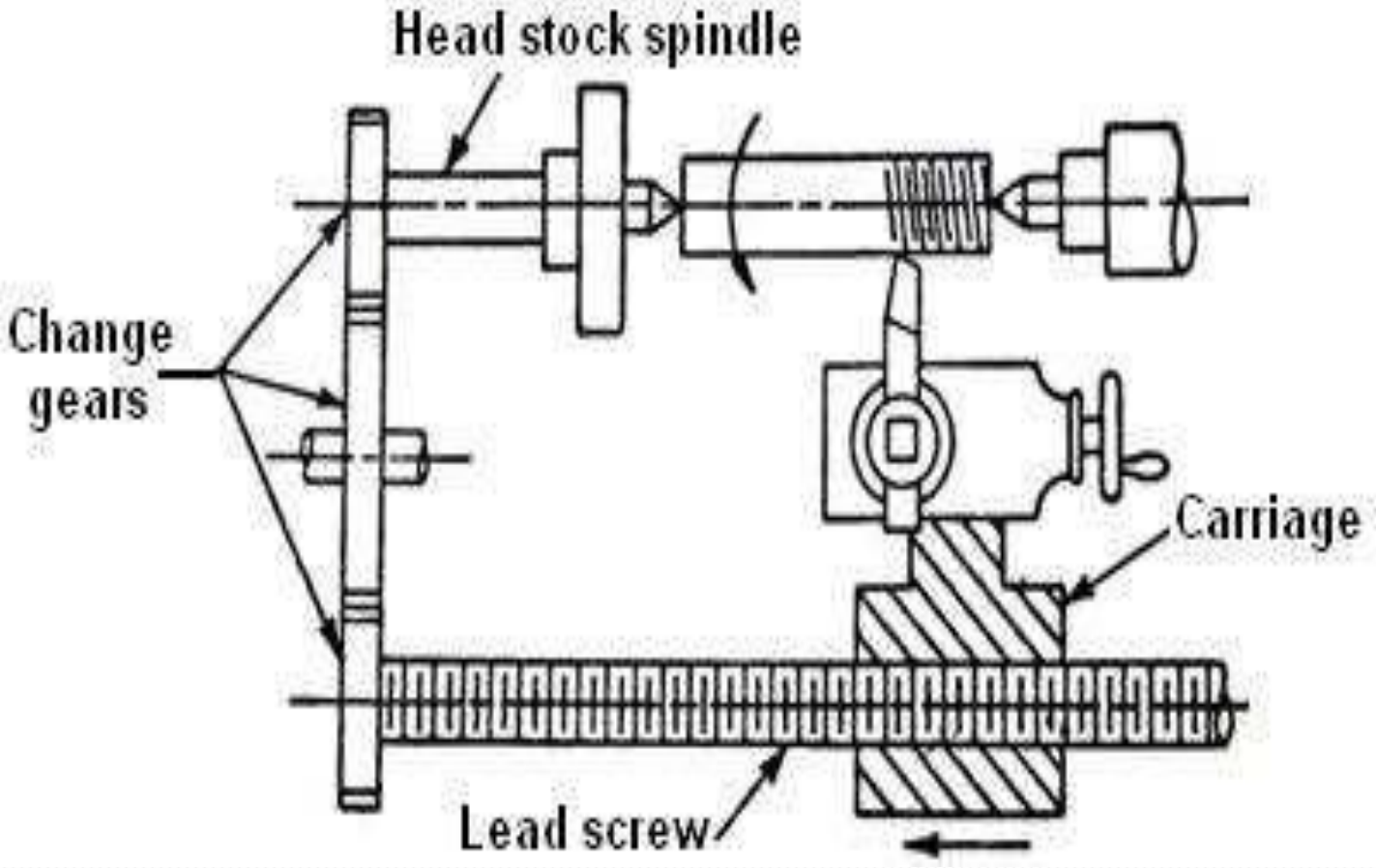


TAPER TURING METHODS

- **Taper turning by using taper turning attachment**

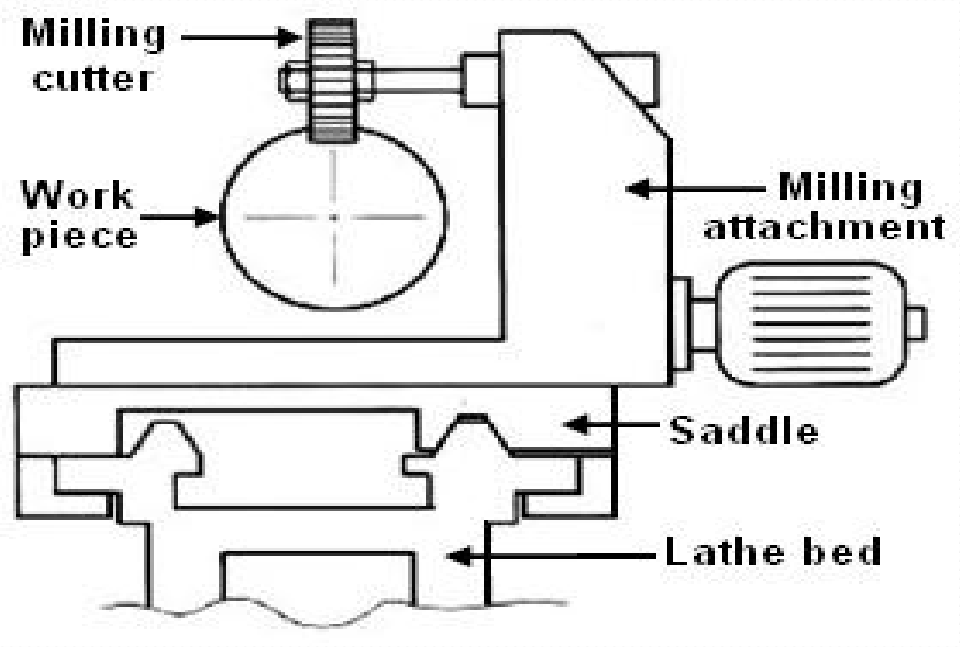


THREAD CUTTING



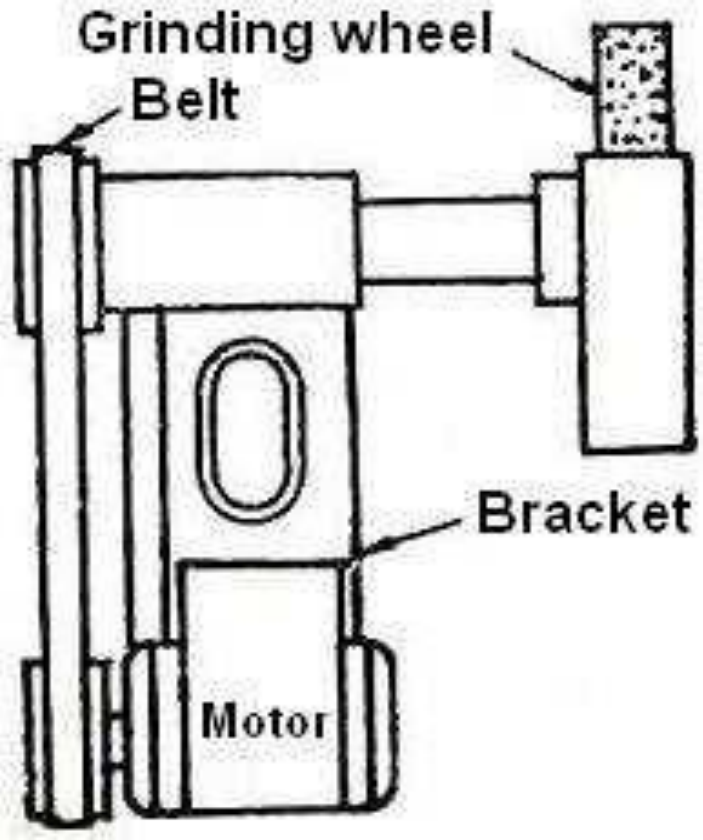
SPECIAL ATTACHMENTS

- **Milling attachment**



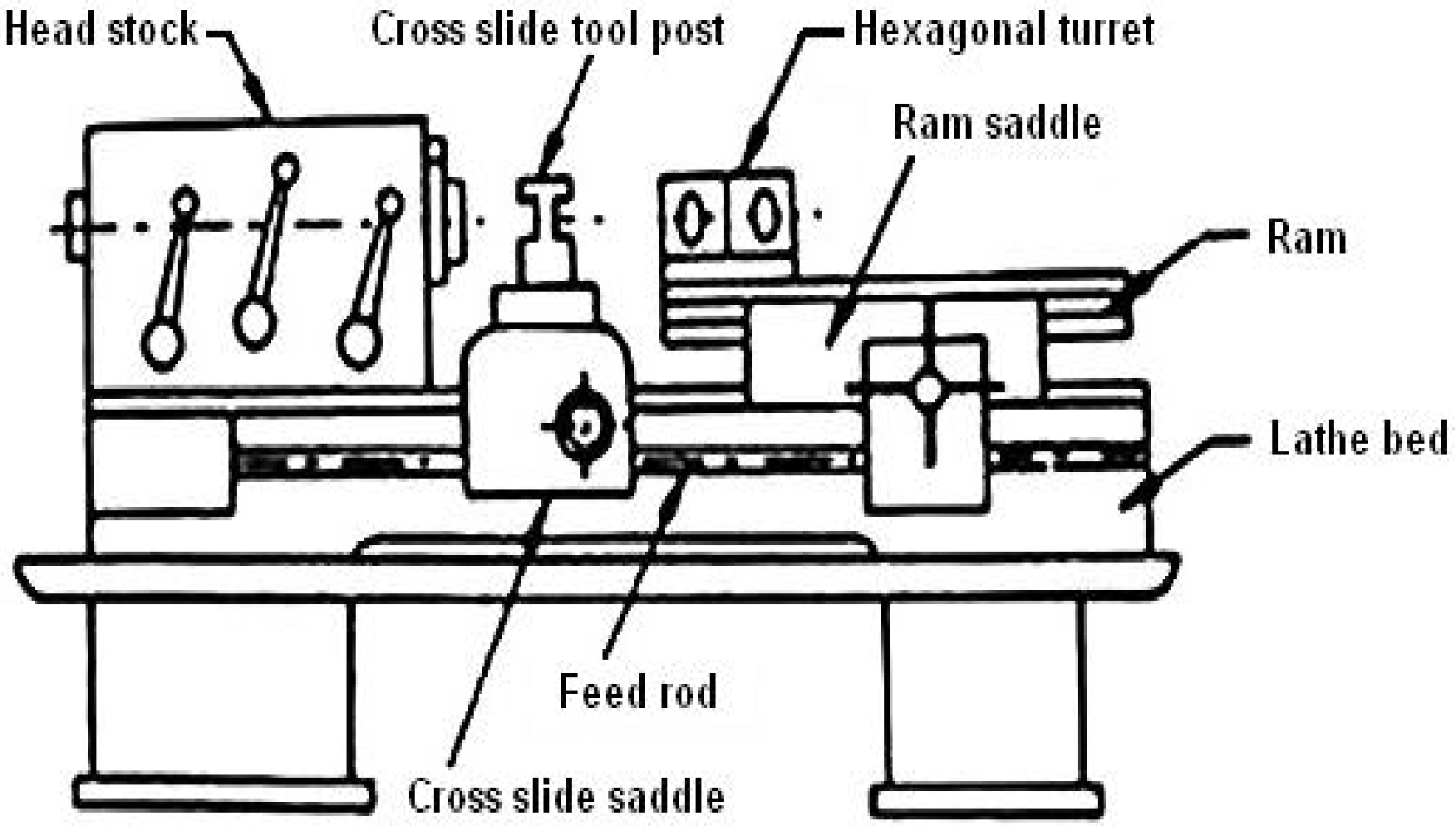
SPECIAL ATTACHMENTS

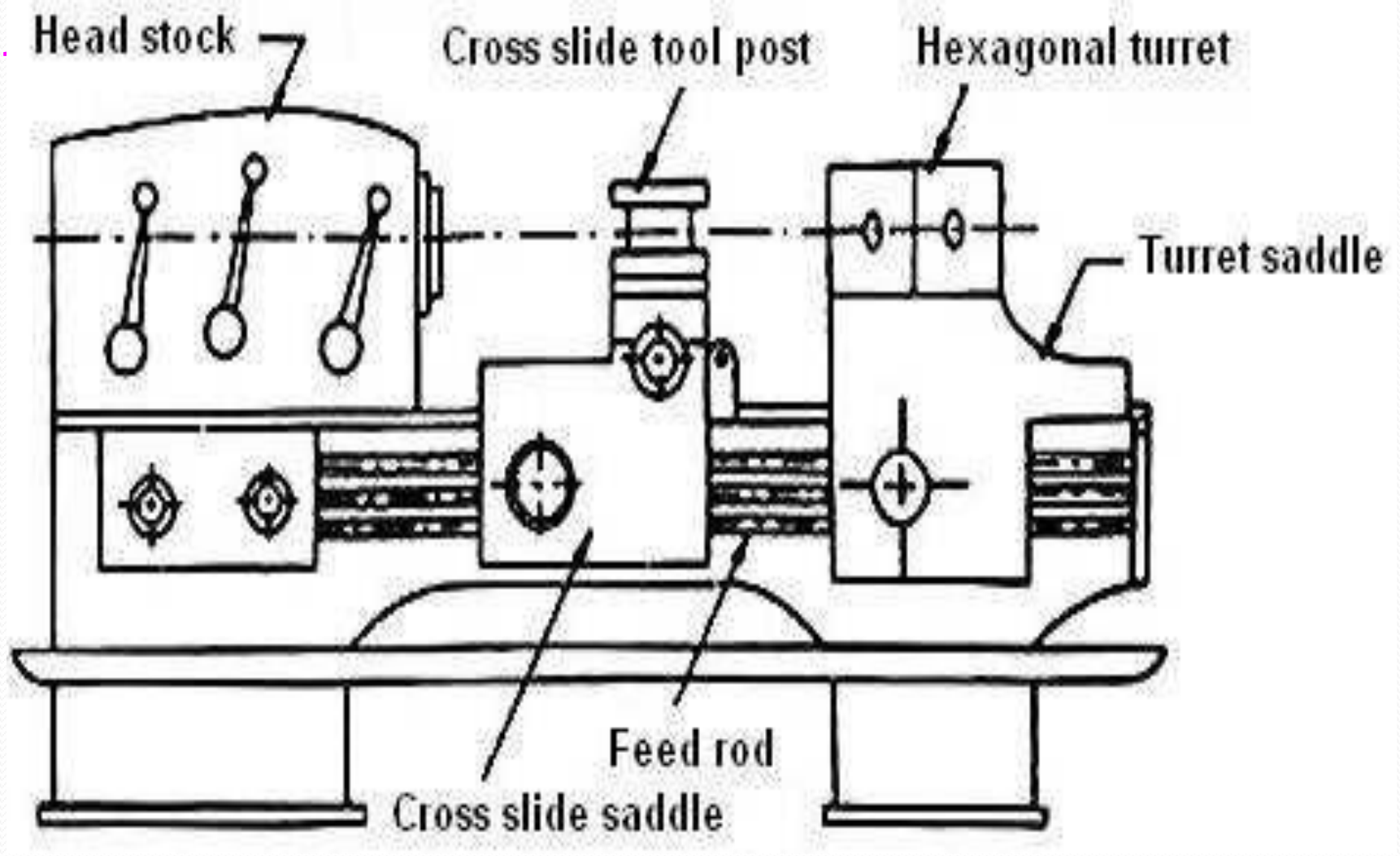
- **Cylindrical grinding attachment**



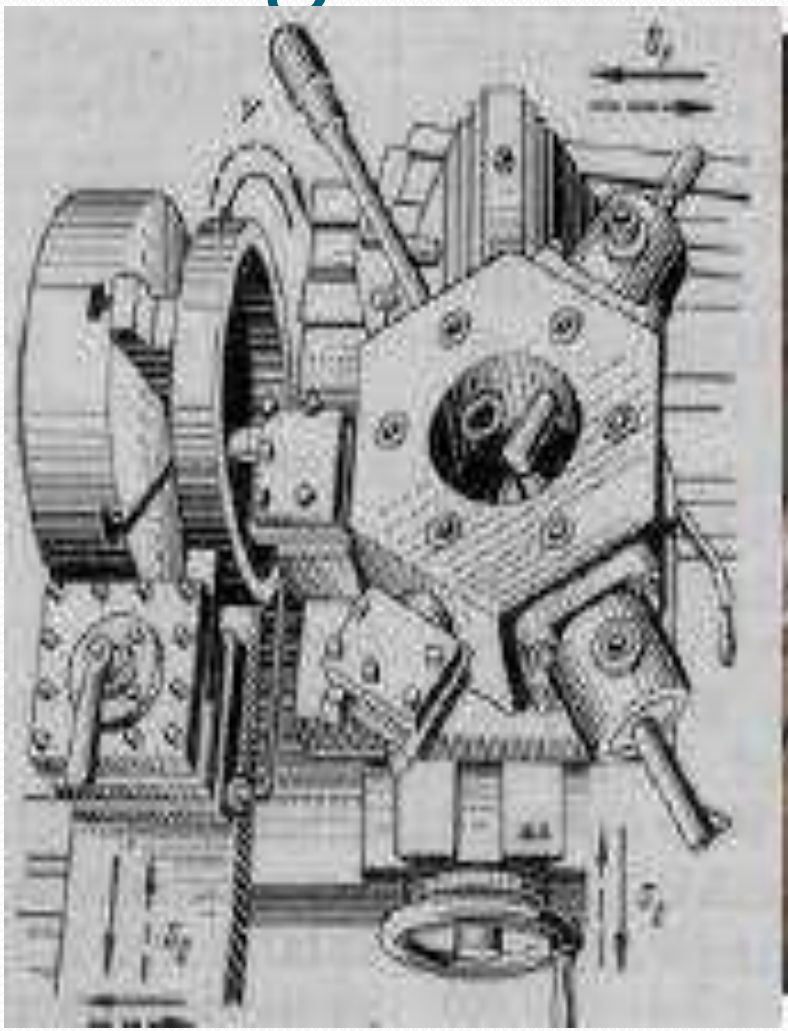
- **CAPSTAN LATHES**

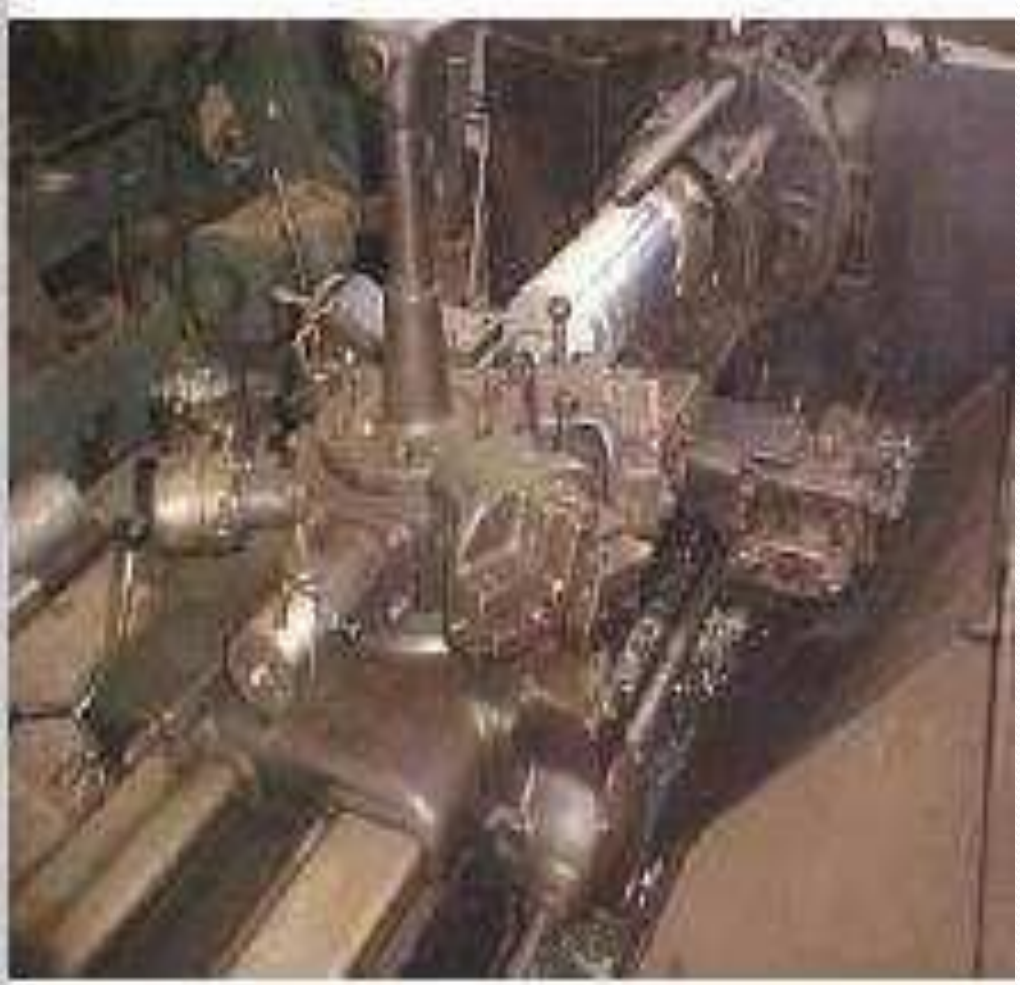
SPECIAL PURPOSE LATHES



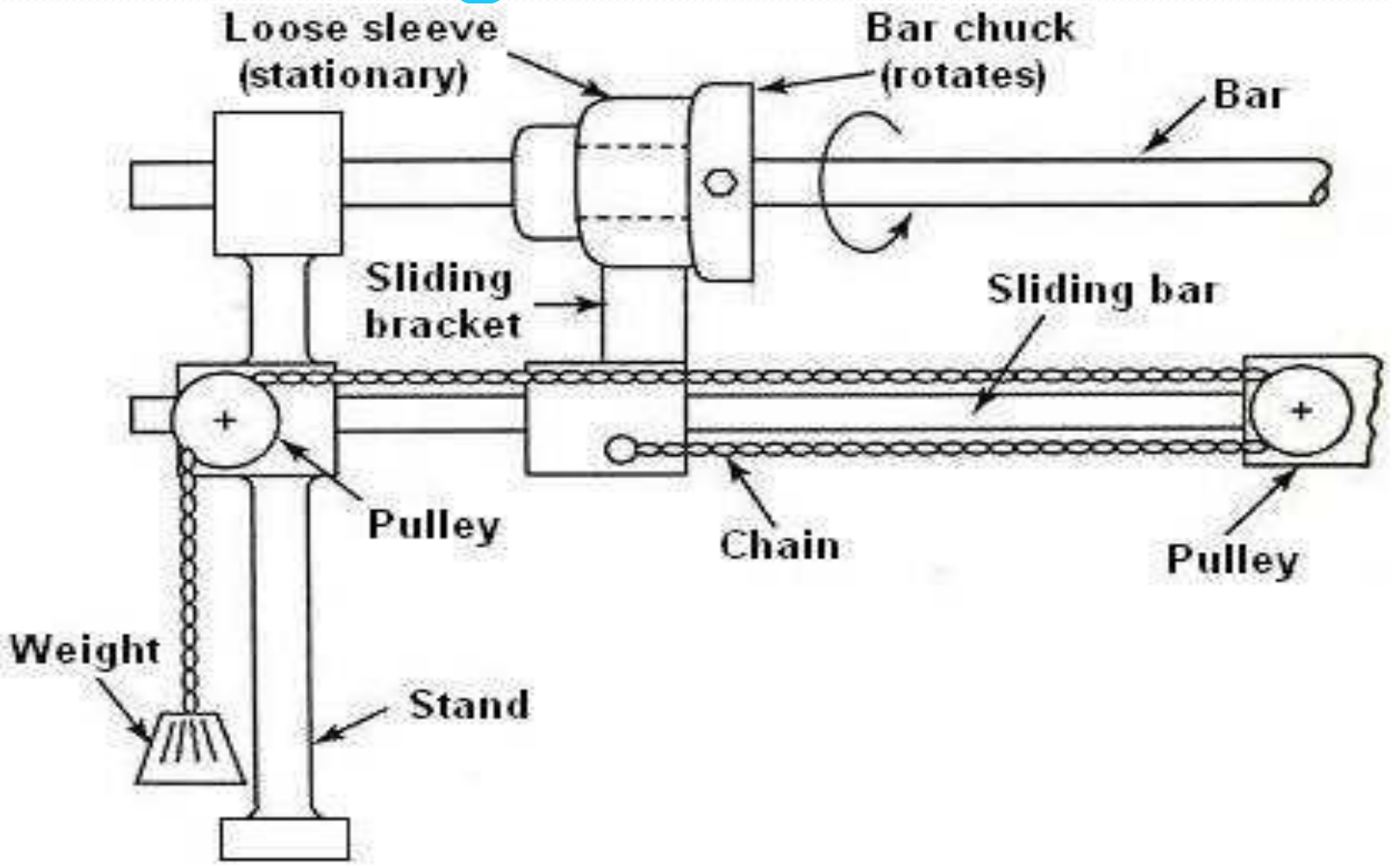

Head stock
Cross slide tool post
Hexagonal turret
Turret saddle
Feed rod
Cross slide saddle

Photographic view of a hexagonal turret

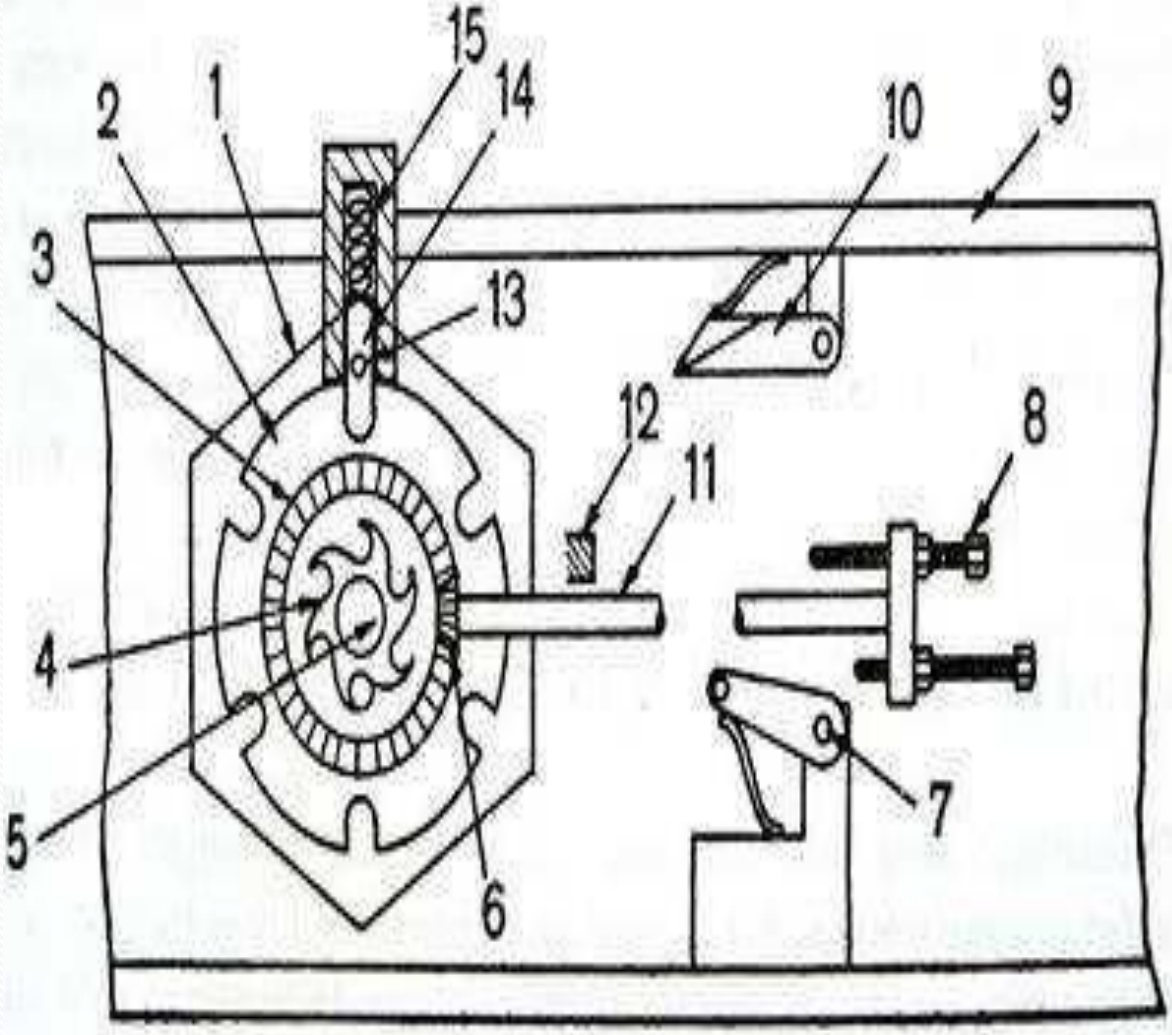




Bar feeding mechanisms



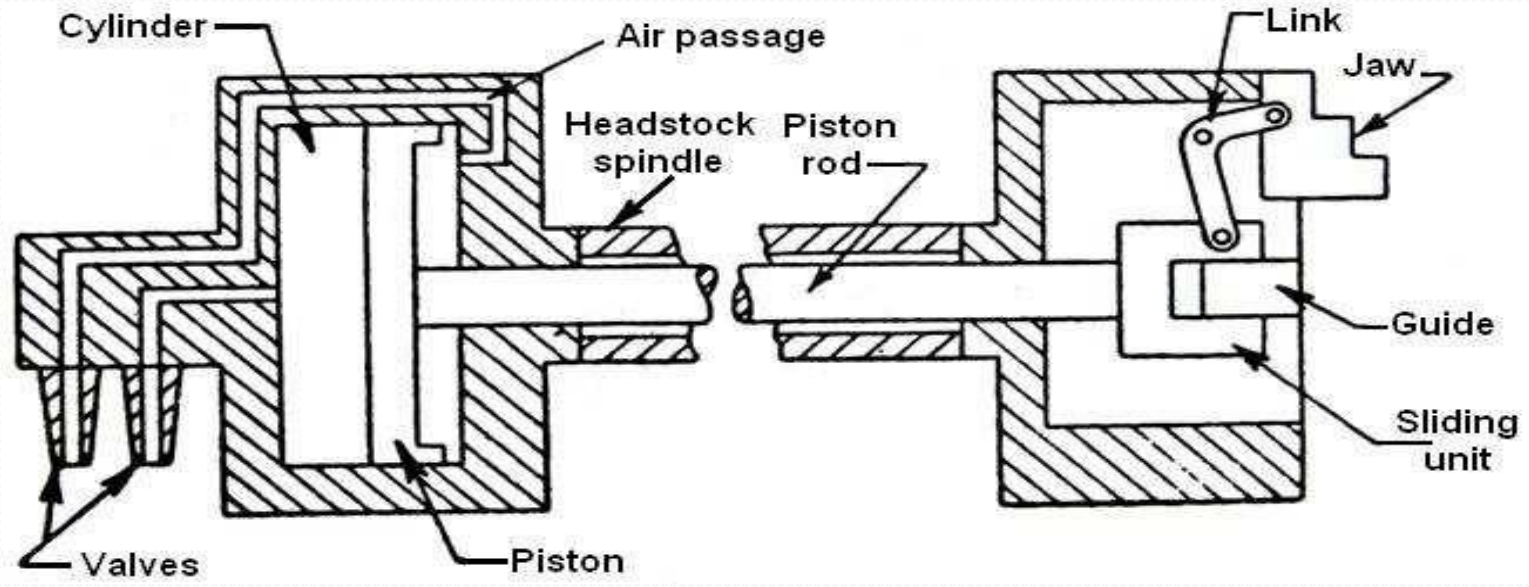
Turret indexing mechanism or Geneva mechanism



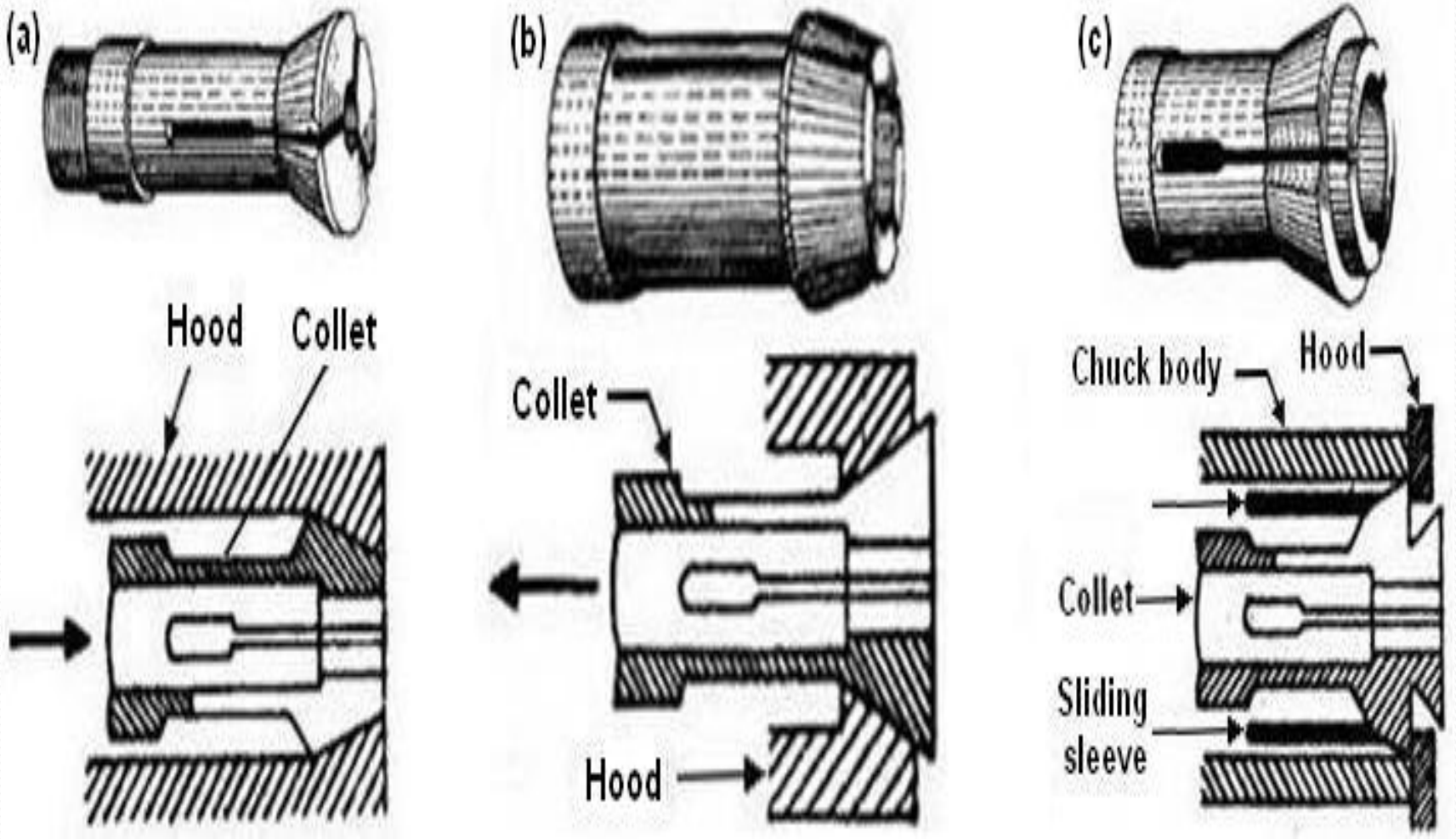
1. Hexagonal turret
2. Index plate 3. Bevel gear
4. Indexing ratchet
5. Turret spindle
6. Beveled pinion
7. Indexing pawl
8. Screw stop rods 9. lathe bed
10. Plunger actuating cam
11. Pinion shaft
12. Stop
13. Plunger pin
14. Plunger
15. Plunger spring

Work holding devices used in capstan and turret lathes

- Air operated chuck

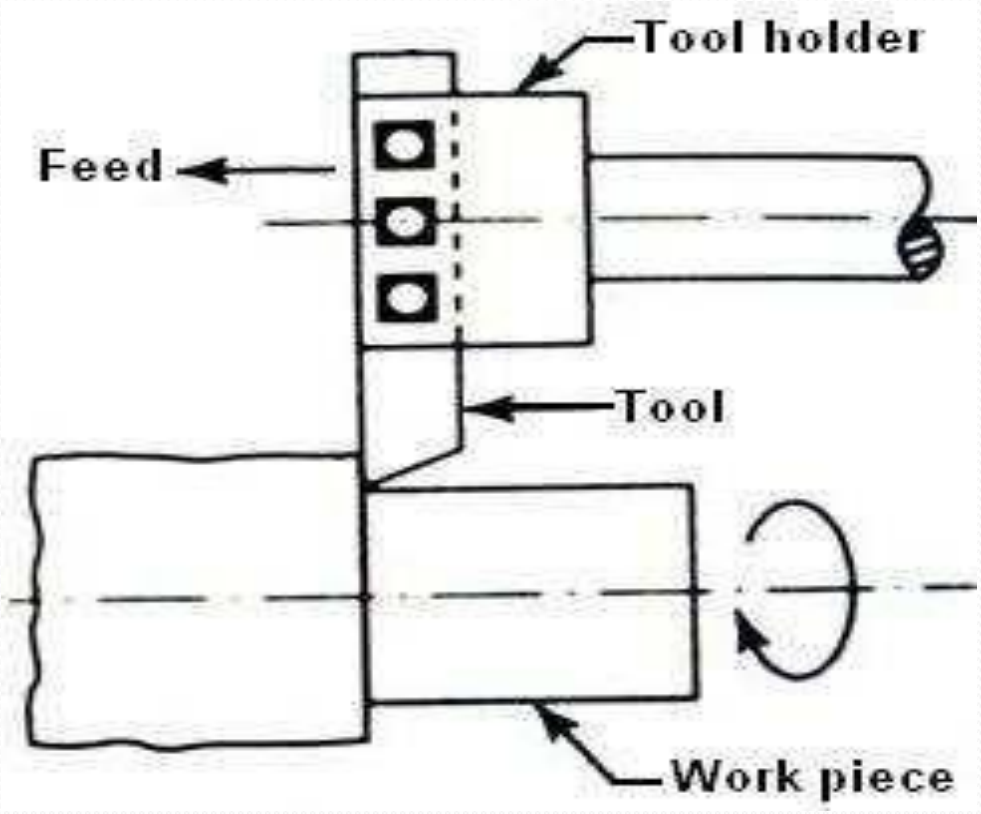


Collet chucks (a) Push out type (b) draw back type (c) Dead length type



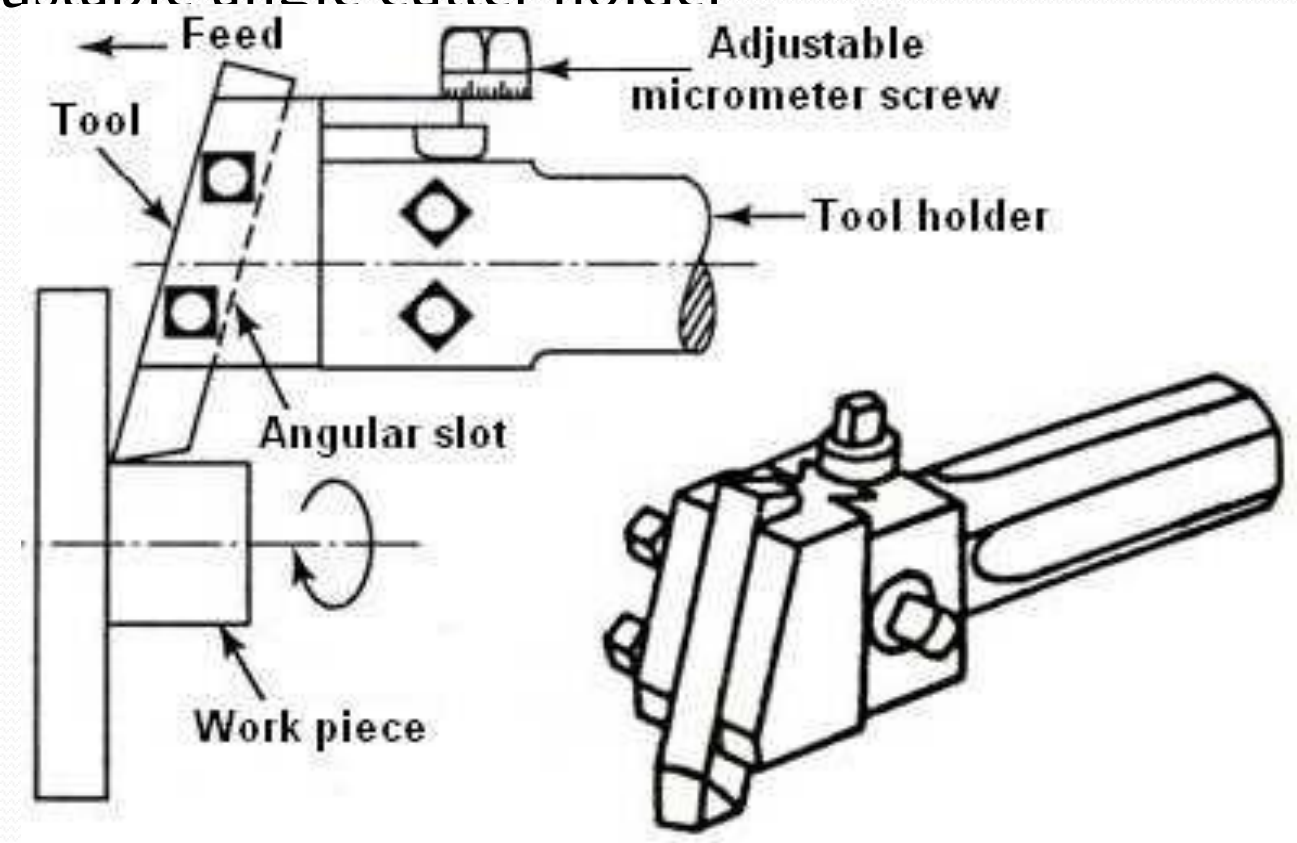
Tool holding devices used in capstan and turret lathes

- ***Straight cutter holder***



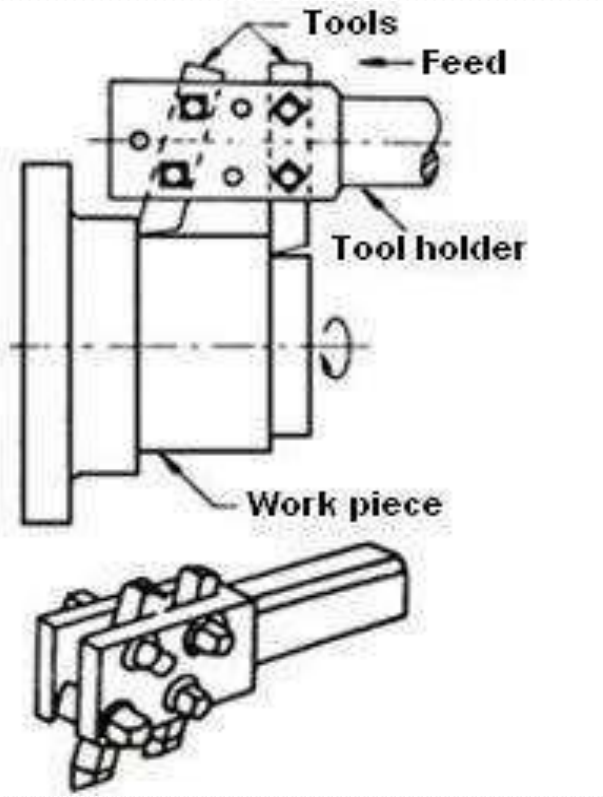
Tool holding devices

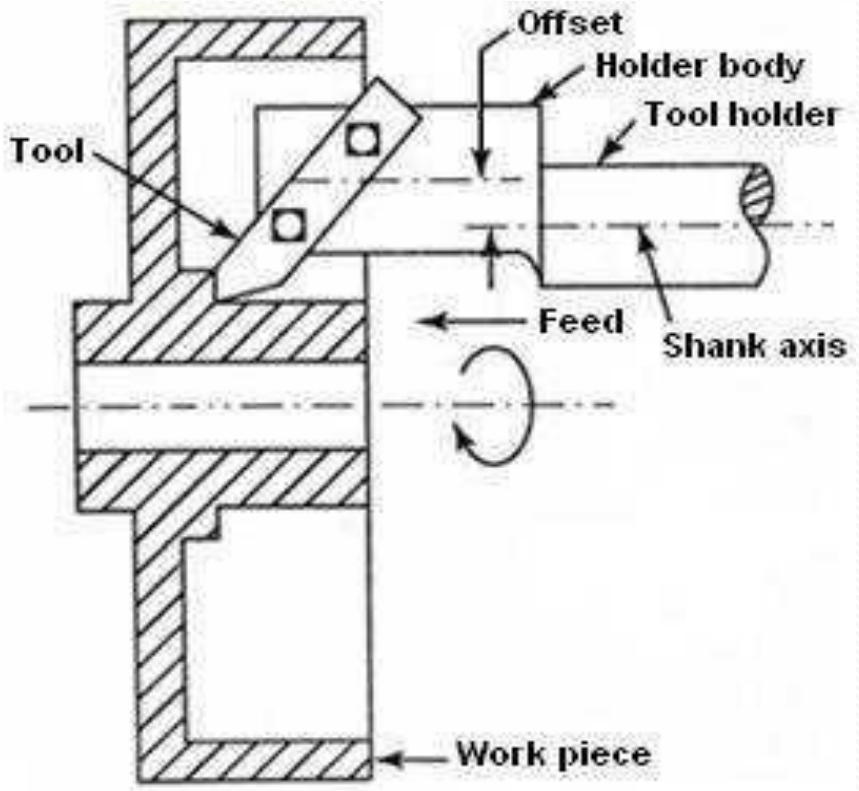
- Adjustable angle cutter holder



Tool holding devices

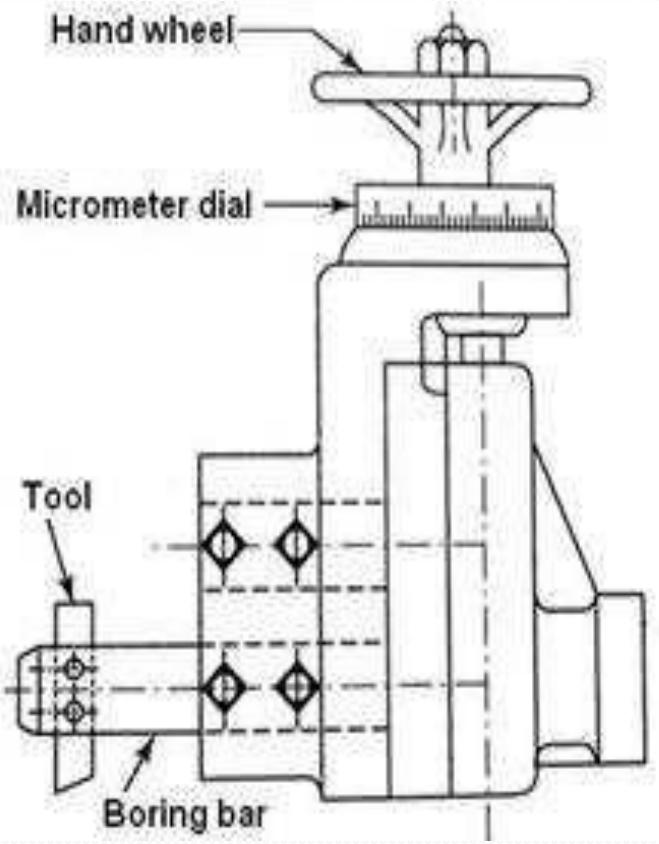
- *Multiple cutter holder and* Offset cutter holder

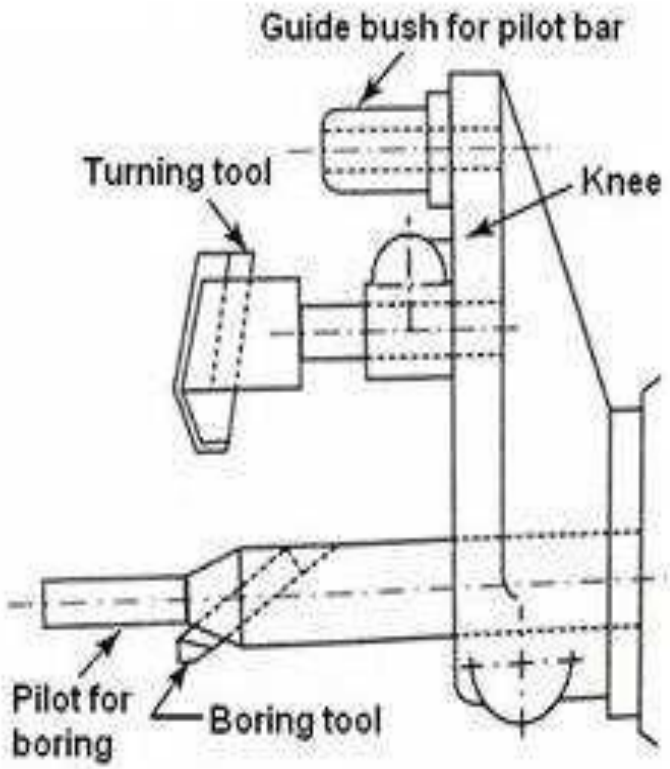




Tool holding devices

- ***Sliding tool holder and*** Knee tool holder



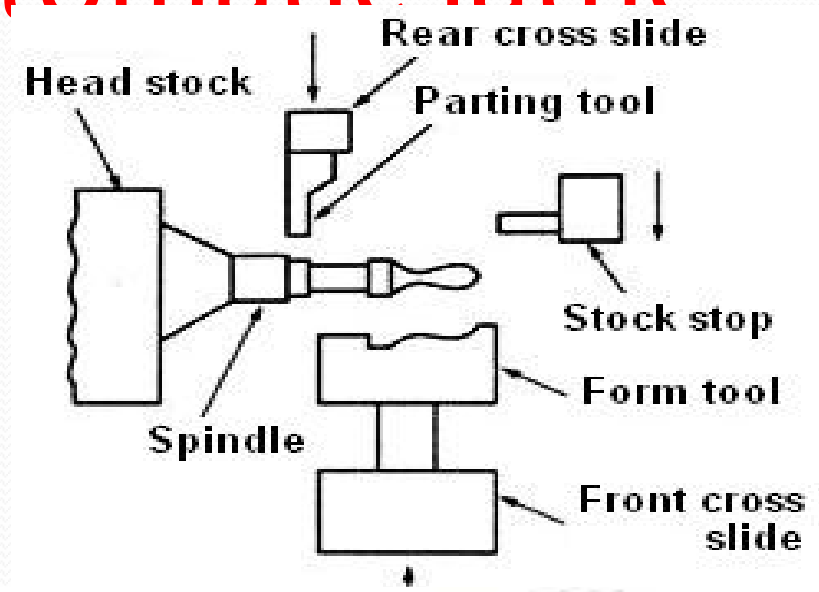


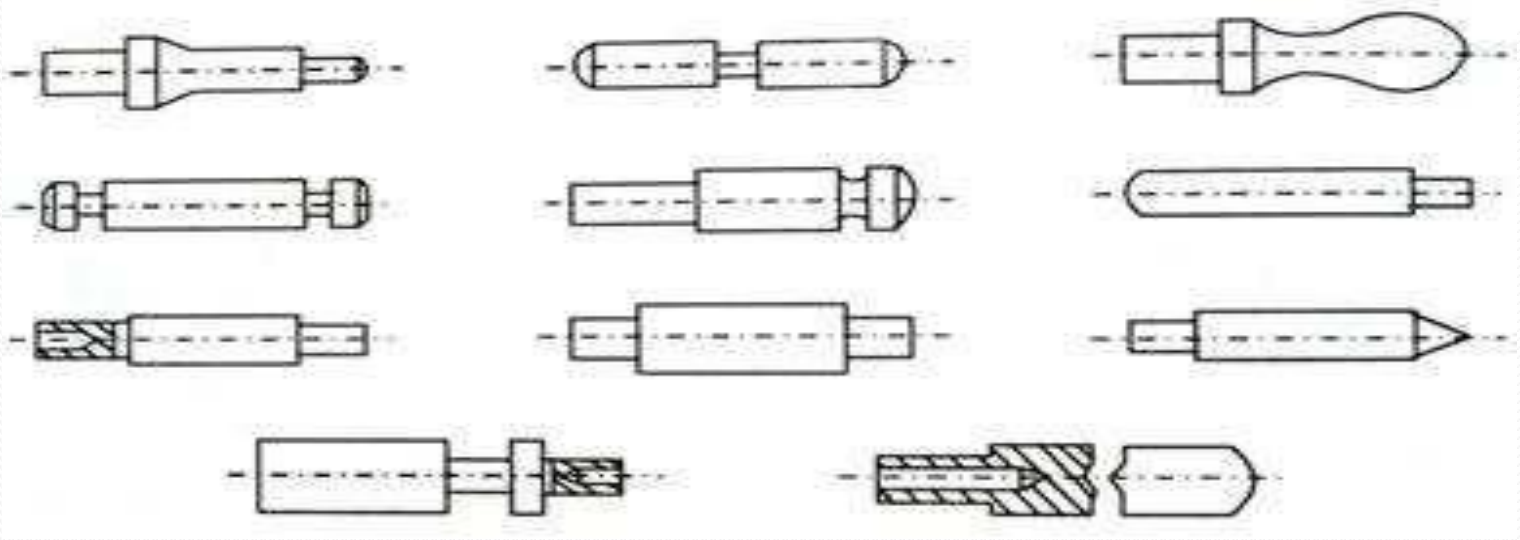
Automatic lathes

- These are machine tools in which the components are machined automatically.
- Single spindle automatic lathe
- Swiss type automatic lathe or sliding head automatic lathe
- Single spindle automatic screw cutting machine
- Multiple spindle automatic lathes

Single spindle automatic lathe

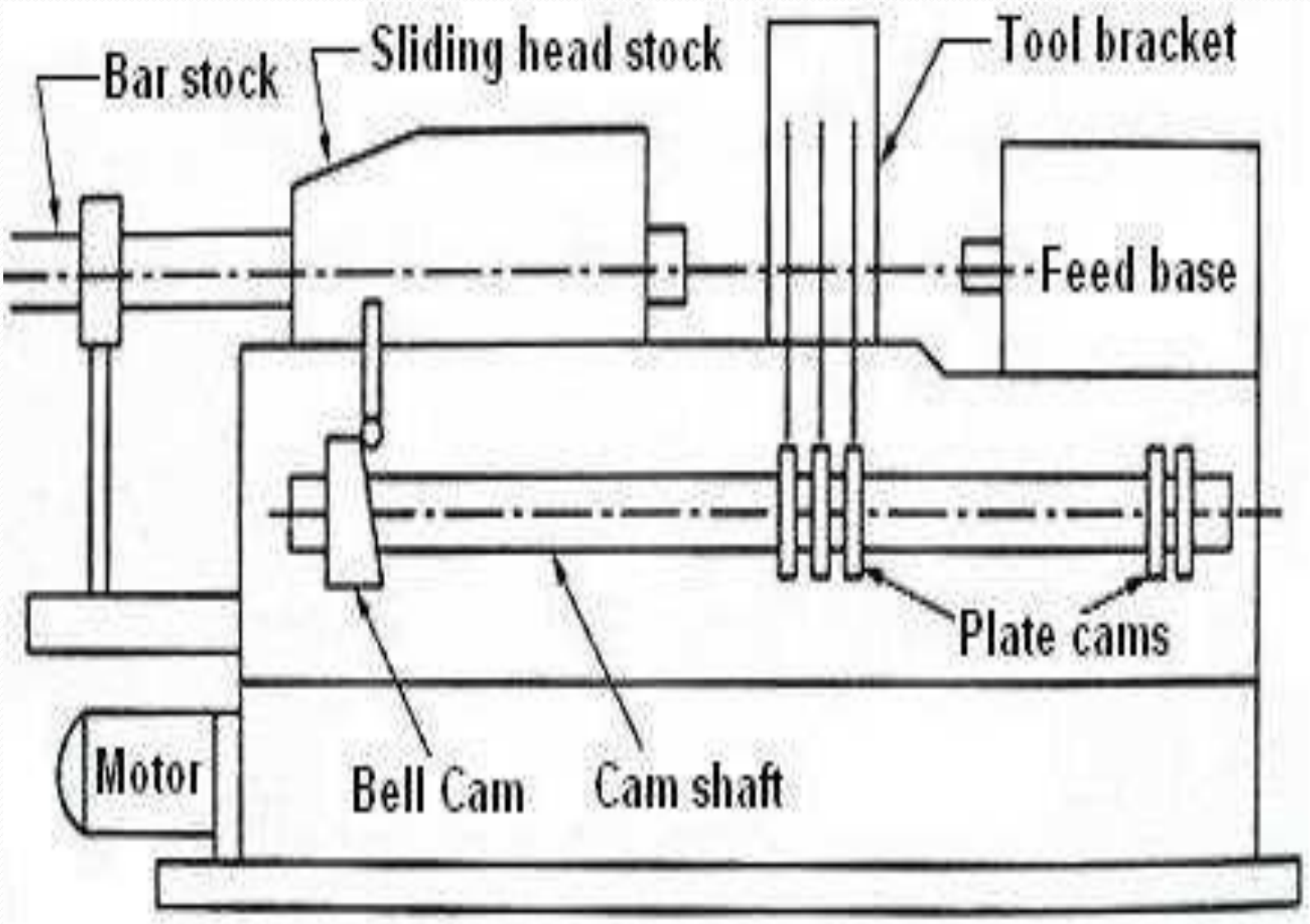
- Arrangement of tool slide



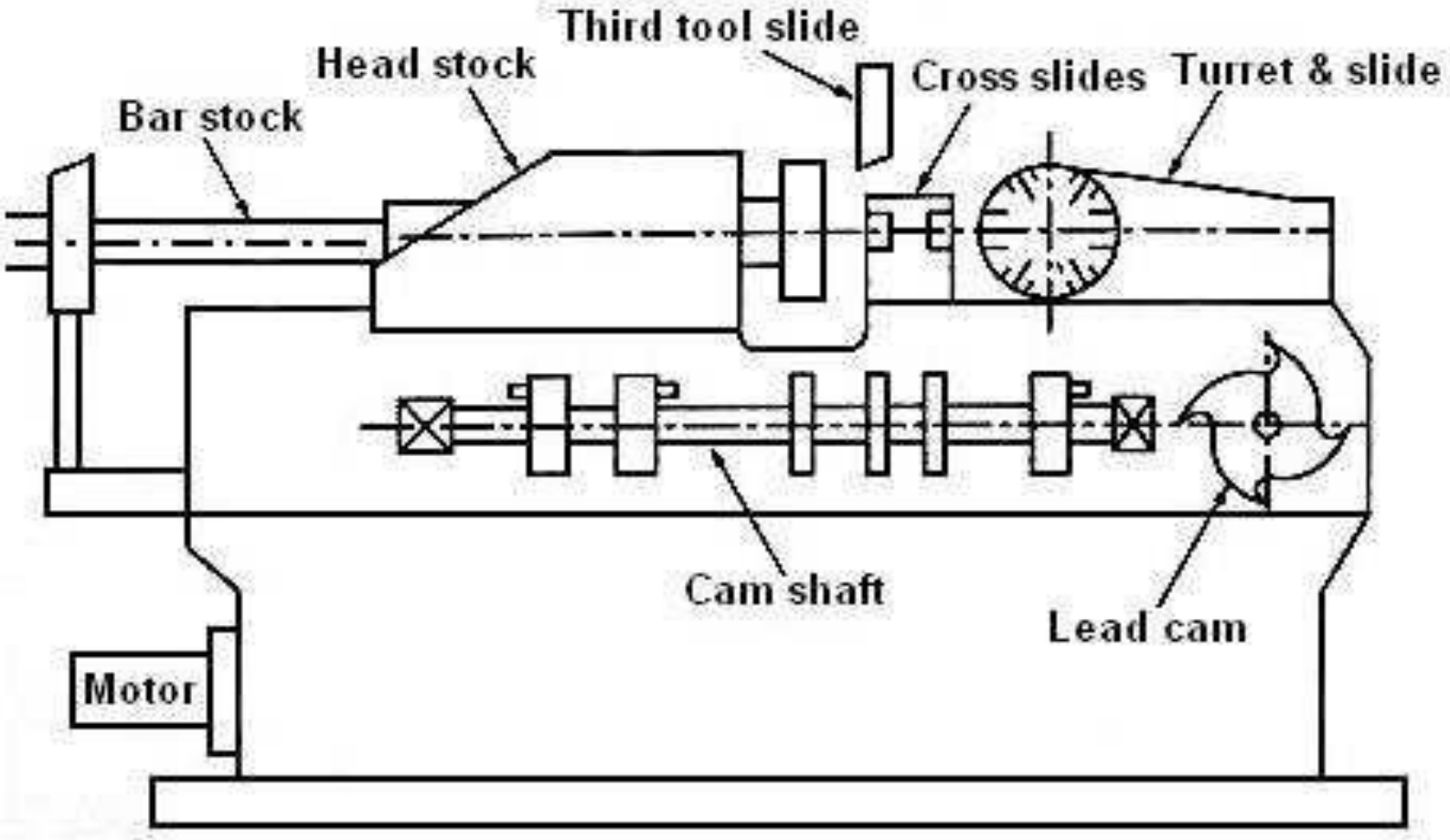


Simple parts produced on cutting off machine

SWISS TYPE AUTOMATIC SCREW MACHINE

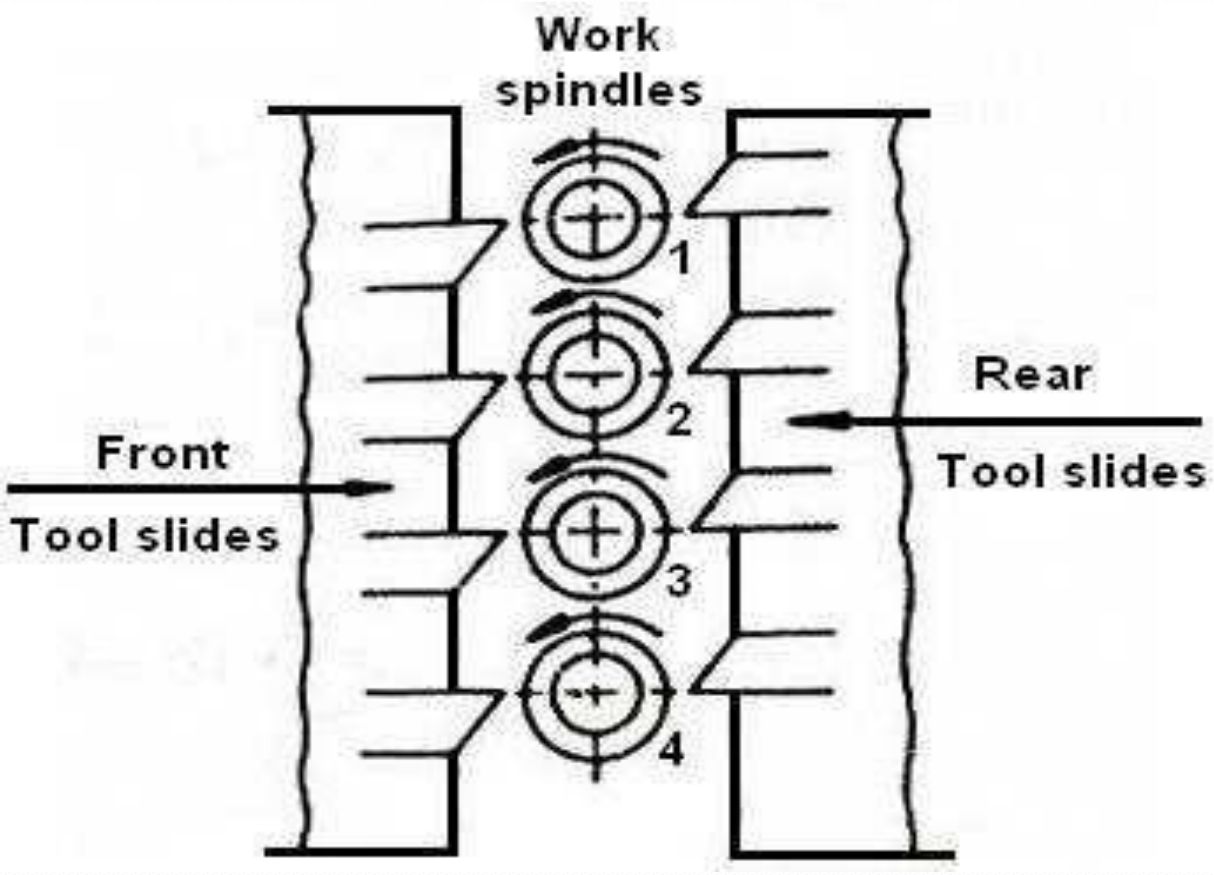


SINGLE SPINDLE AUTOMATIC SCREW TYPE MACHINE

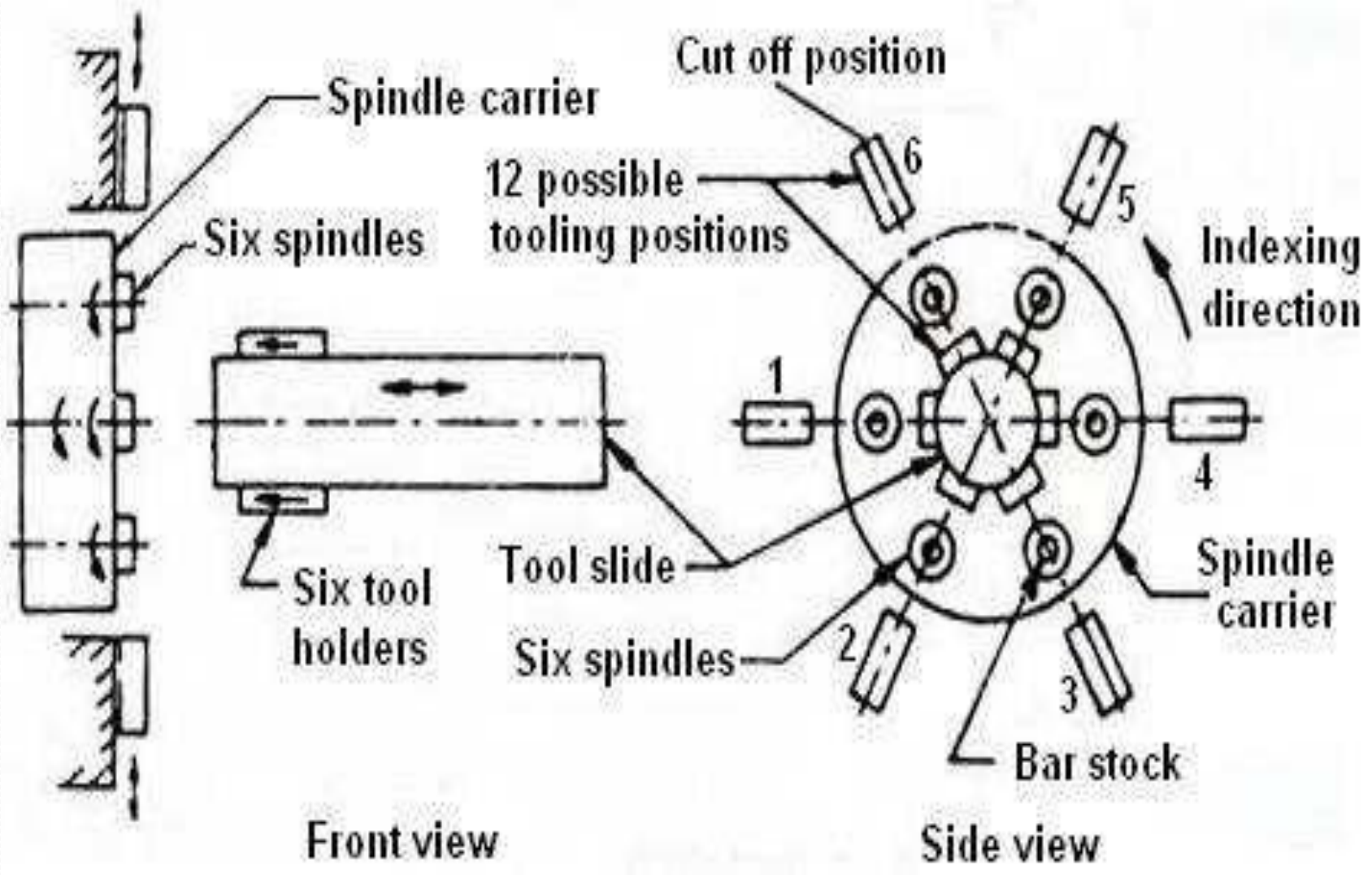


MULTI SPINDLE AUTOMAT

- Parallel Action Multi Spindle Automat



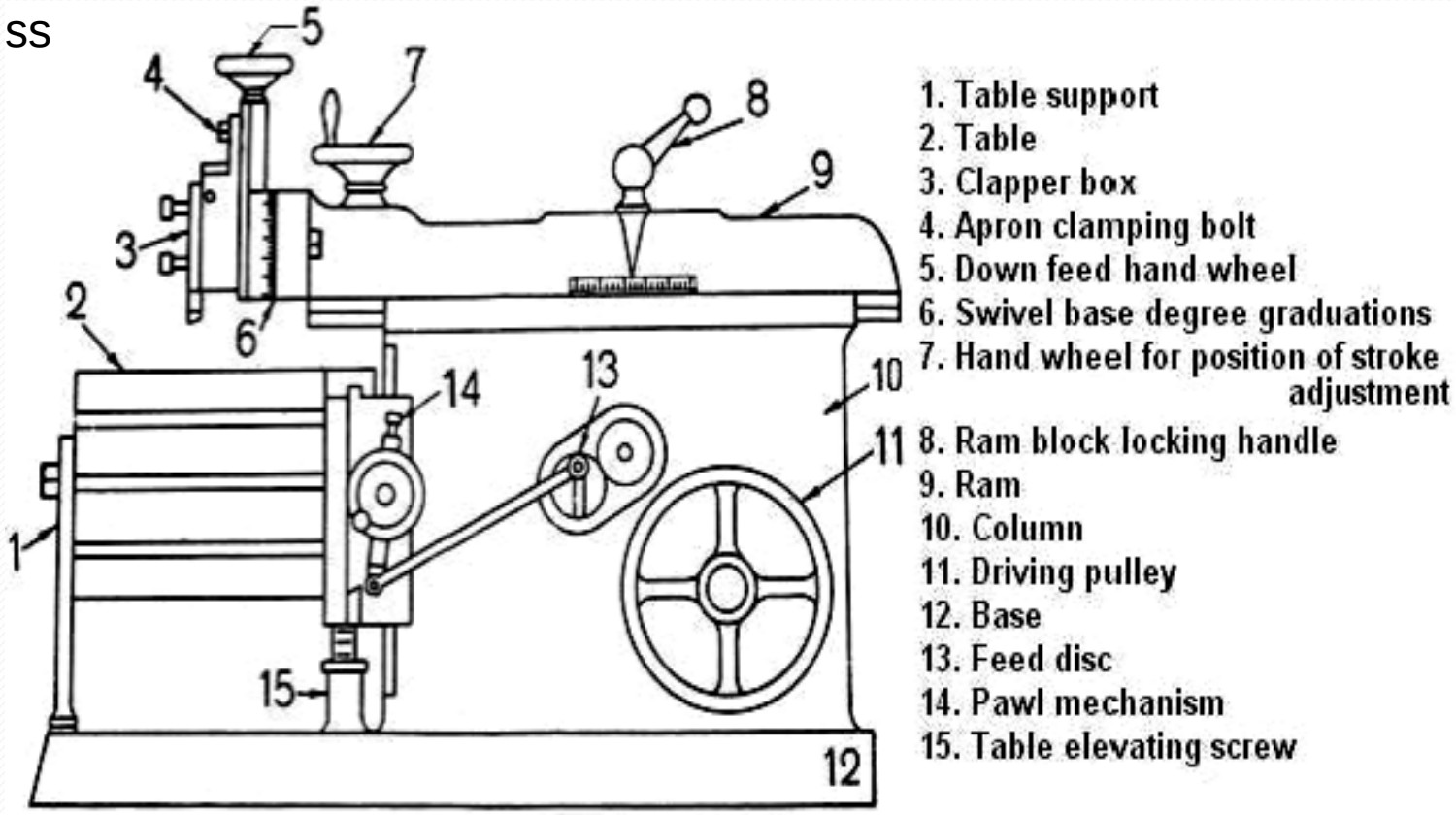
Progressive Action Multi Spindle Automat



SHAPER

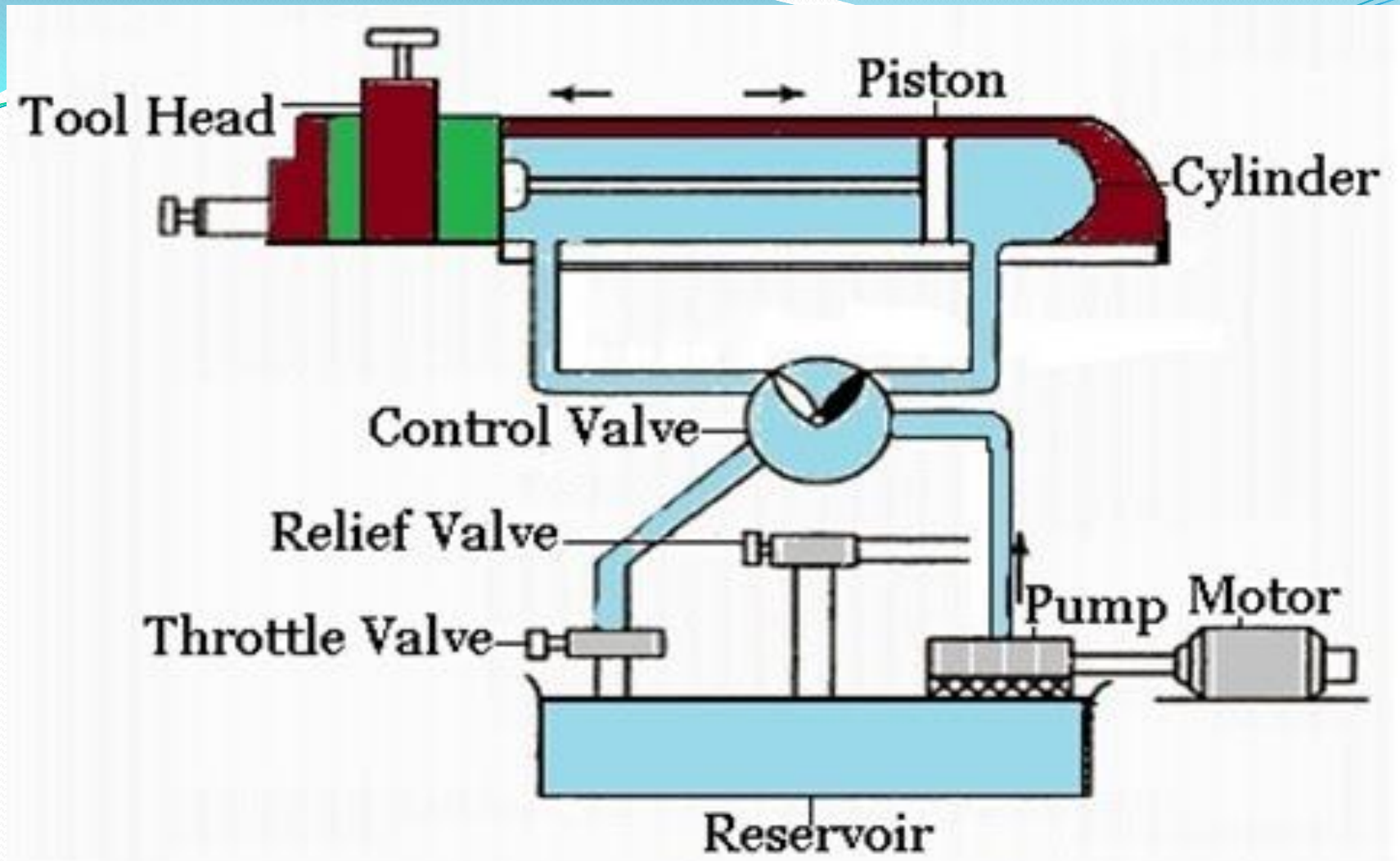
- The main function of the shaper is to produce flat surfaces in different planes.

ss

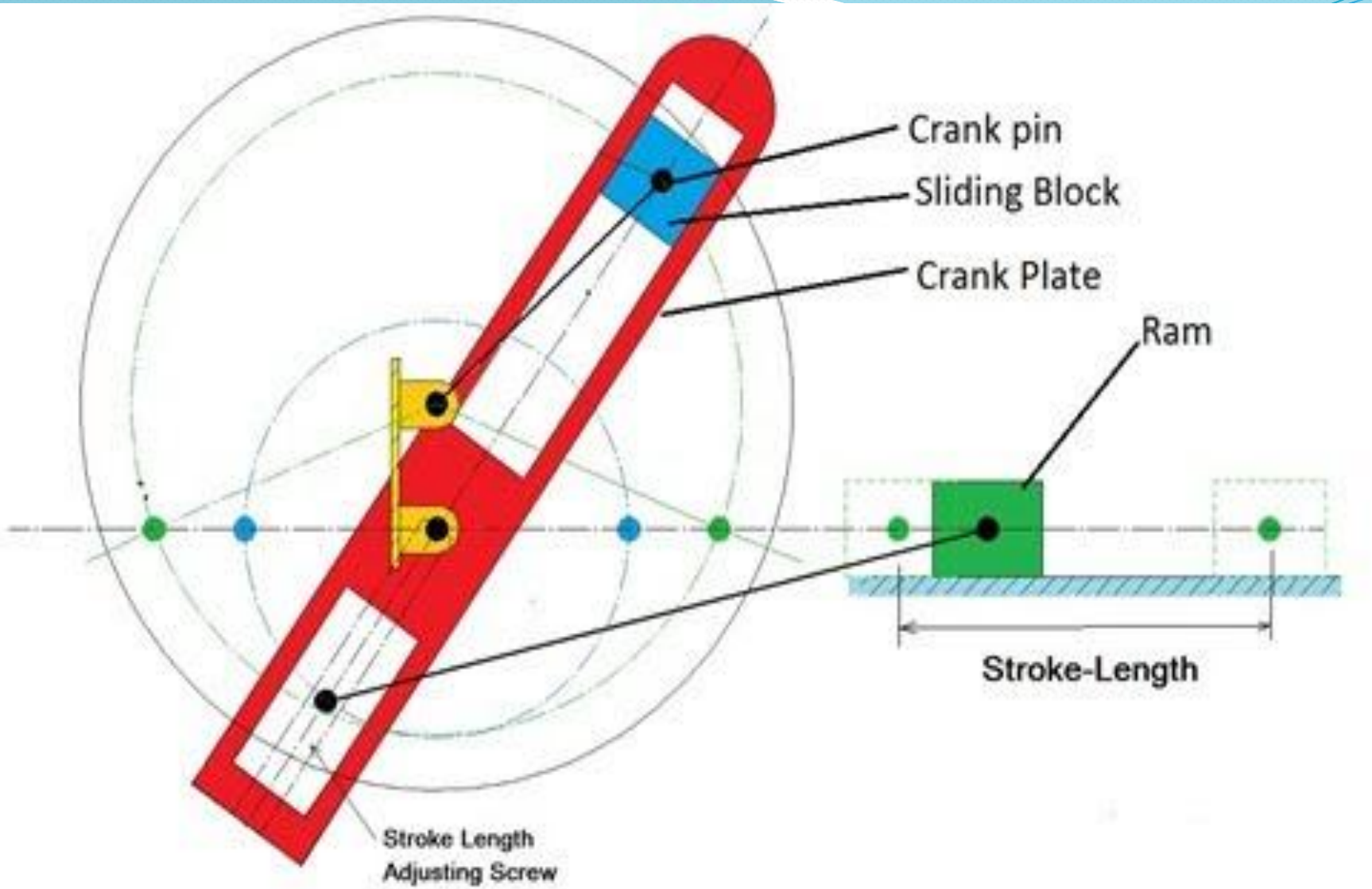


Types of quick return mechanisms are used in the shaper

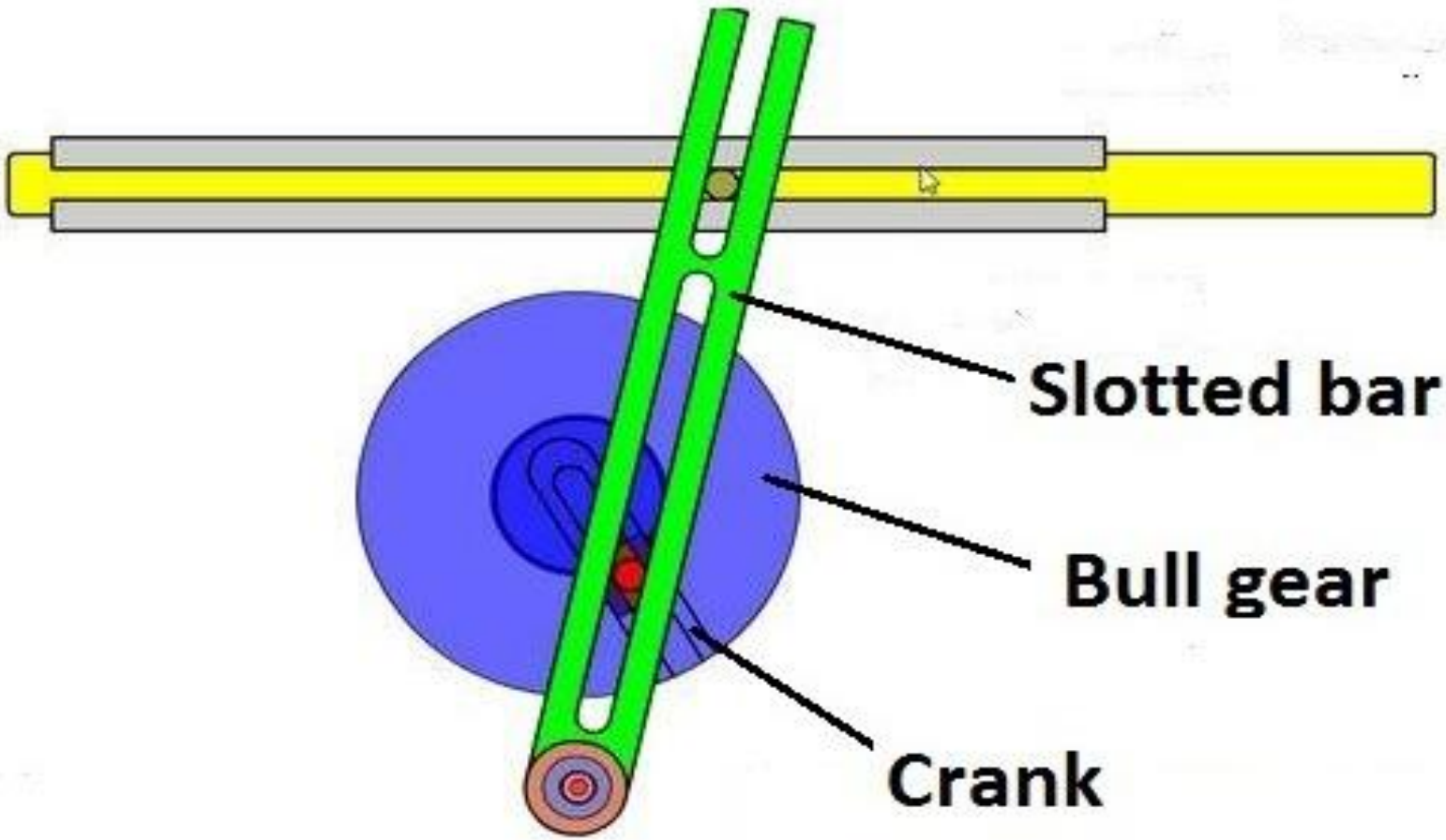
1) Crank and slotted **mechanism**
2) Whitworth **quick return mechanism**
3) Hydraulic shaper **mechanism** .



Hydraulic drive mechanism



Withworth quick return mechanism



Crank and slotted lever mechanism

DRILLING

- **Drilling** is a cutting process that uses a drill bit to cut a hole of circular cross-section in solid materials. The drill bit is usually a rotary cutting tool, often multipoint. The bit is pressed against the work piece and rotated at rates from hundreds to thousands of revolutions per minute.

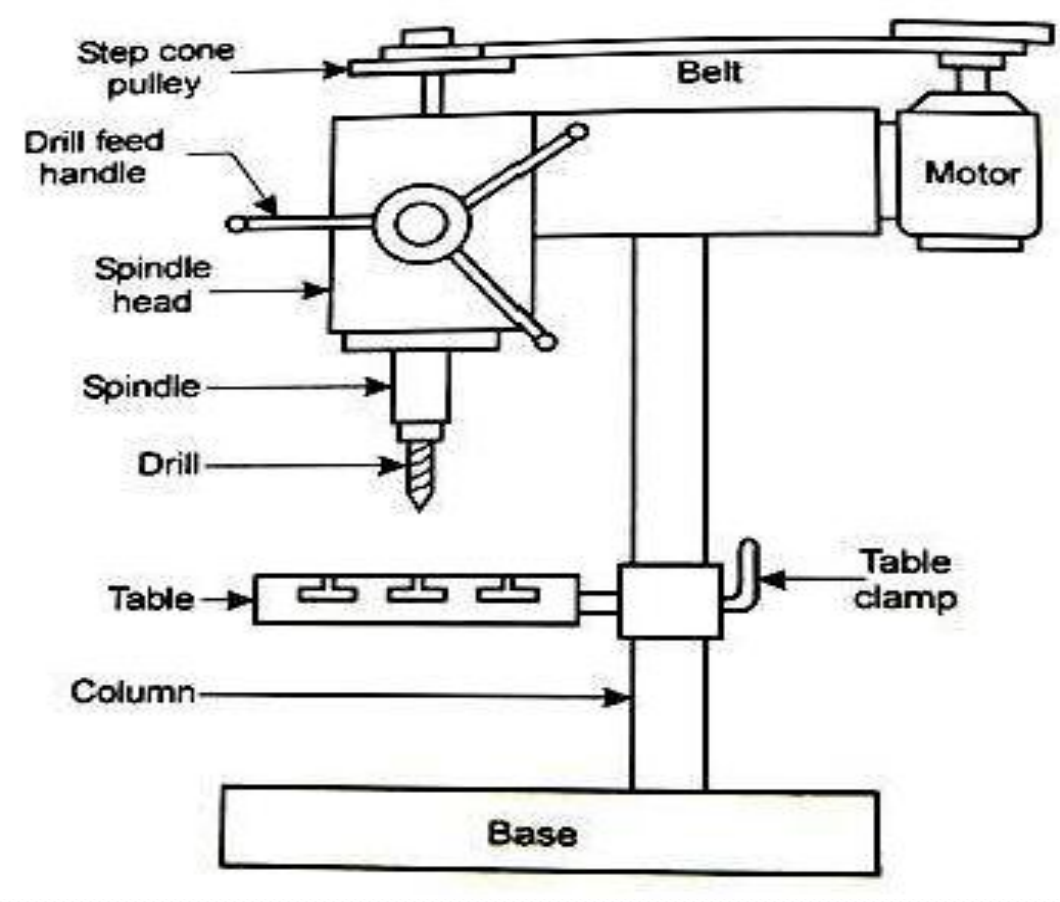
Types of drilling machine

- *The different types of drilling machine which are most commonly used are:*
  - Portable drilling machine.
  - Sensitive drilling machine (Bench mounting or table top and Floor mounting).
  - Upright drilling machine (Pillar or Round column section and Box column section).
  - Radial drilling machine (Plain, Semi-universal and Universal).
  - Gang drilling machine.
  - Multiple spindle drilling machine.
  - Deep hole drilling machine.
  - Turret type drilling machine

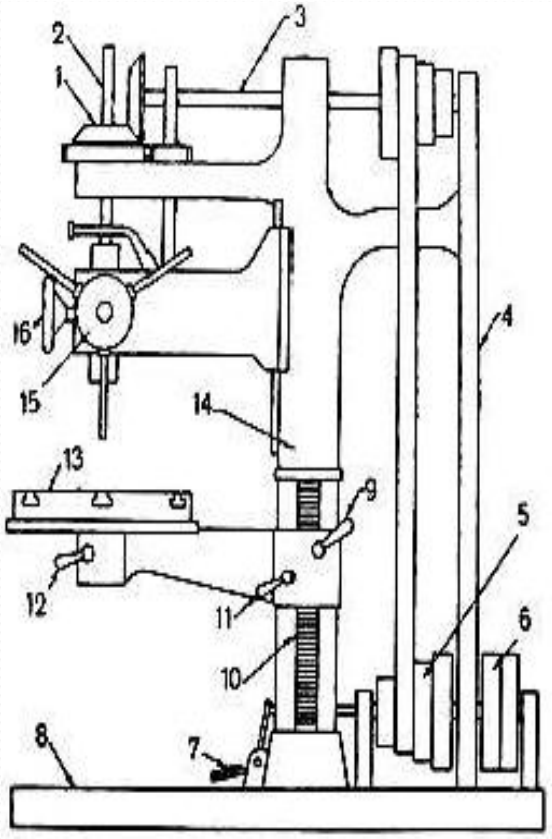
Hand drilling machine

Table top sensitive drilling machine

Floor mounting sensitive drilling machine

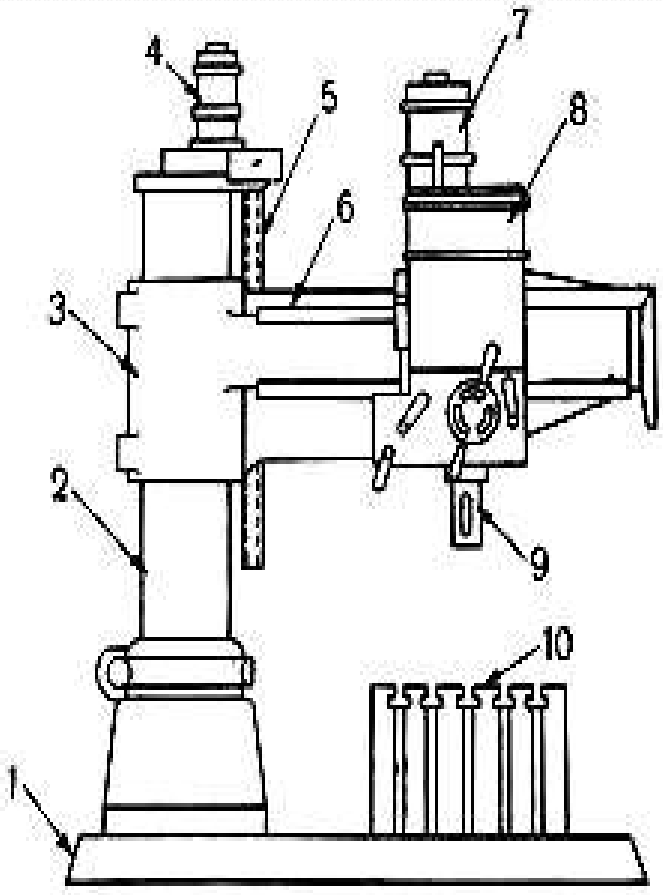


Box column section upright drilling machine



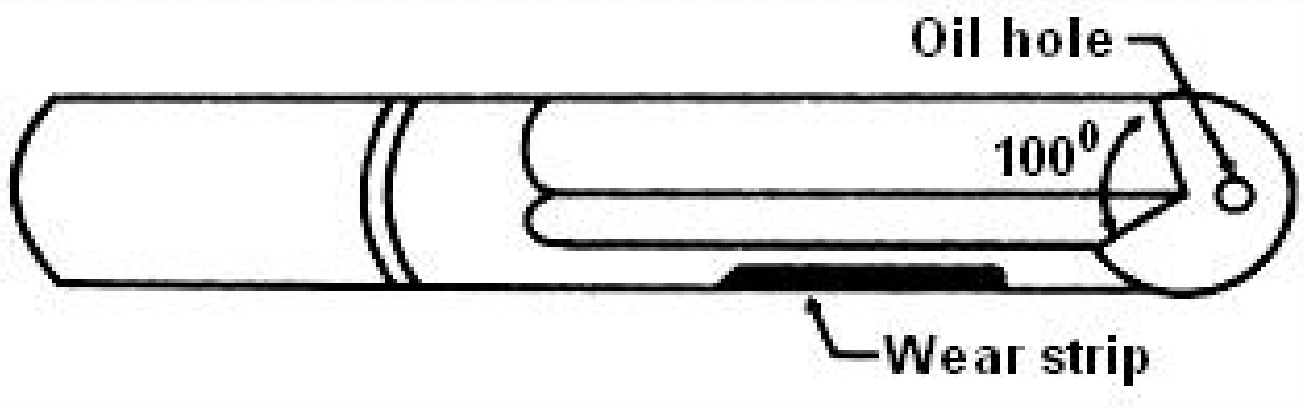
1. Bevel gear drive to spindle
2. Spindle
3. Overhead shaft
4. Back stay
5. Counter shaft cone pulley
6. Fast and loose pulley
7. Foot pedal
8. Base
9. Table elevating handle
10. Rack on column
11. Table elevating clamp handle
12. Table clamp
13. Table
14. Column
15. Handwheel for quick hand feed
16. Handwheel for sensitive hand feed

Radial drilling machine

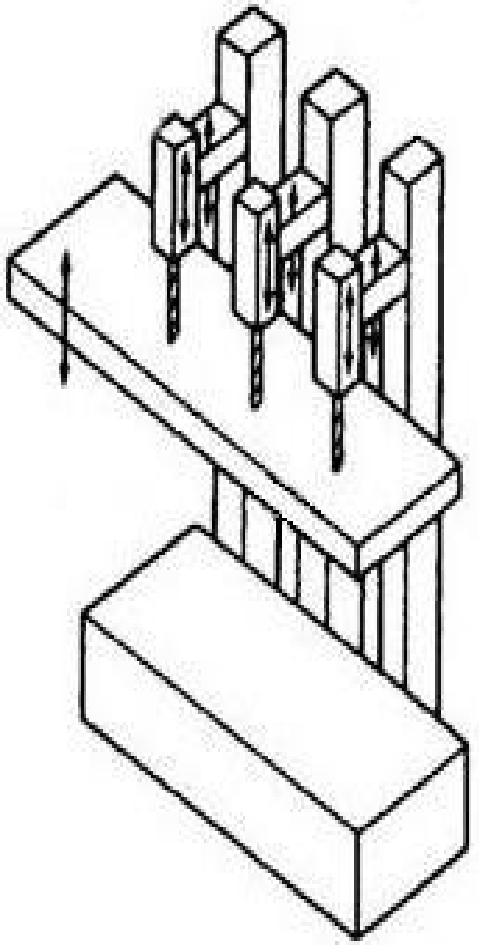


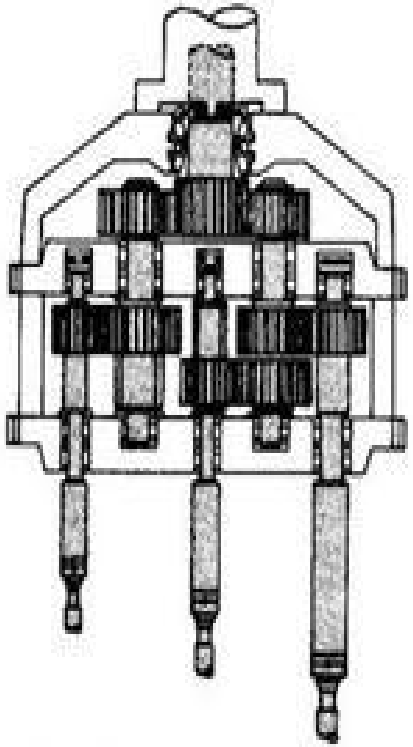
1. Base
2. Column
3. Radial arm
4. Motor for elevating the radial arm
5. Elevating screw
6. Guide ways for drill head
7. Motor for driving the drill spindle
8. Drill head
9. Drill spindle
10. Work table

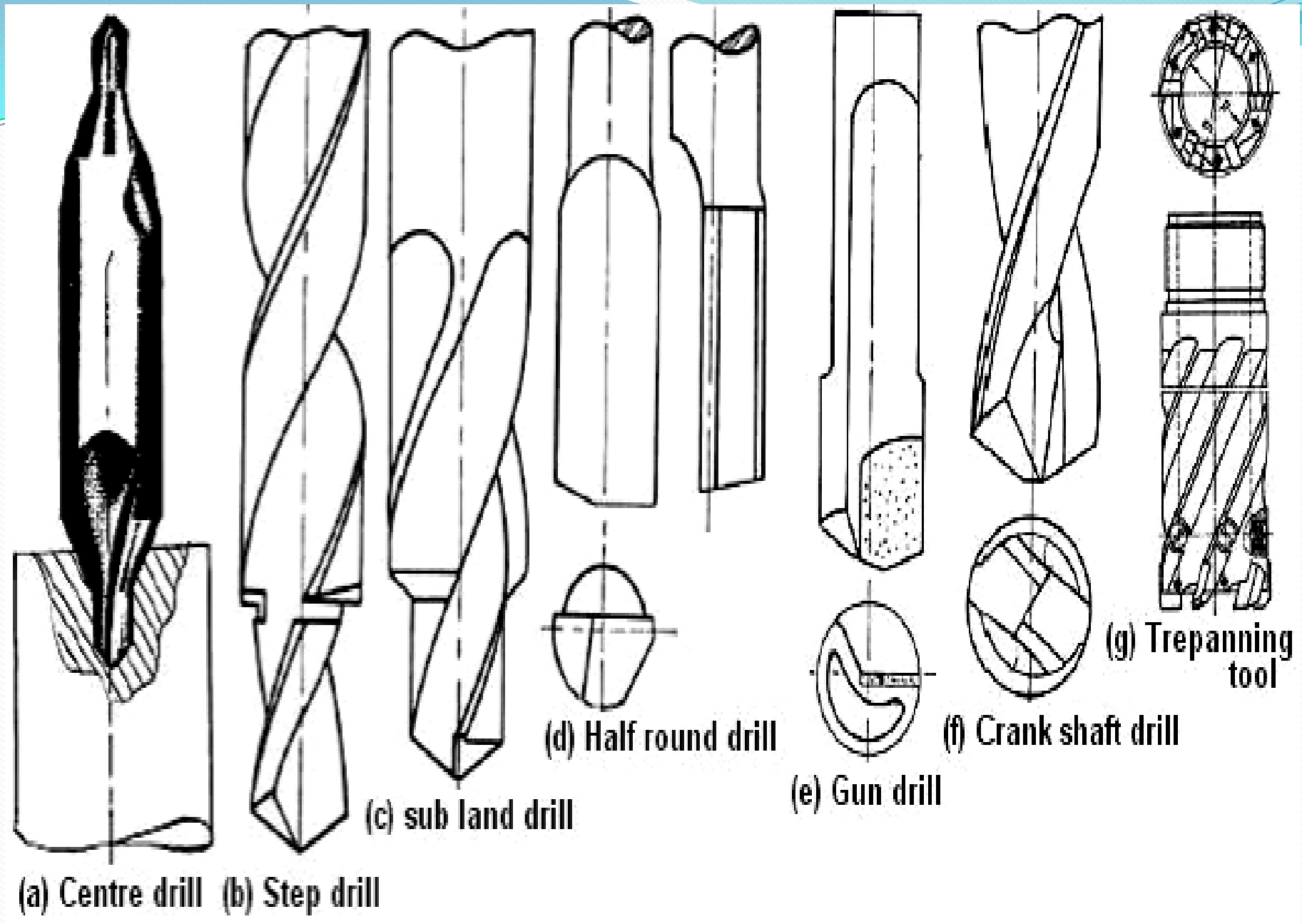
Deep hole drill



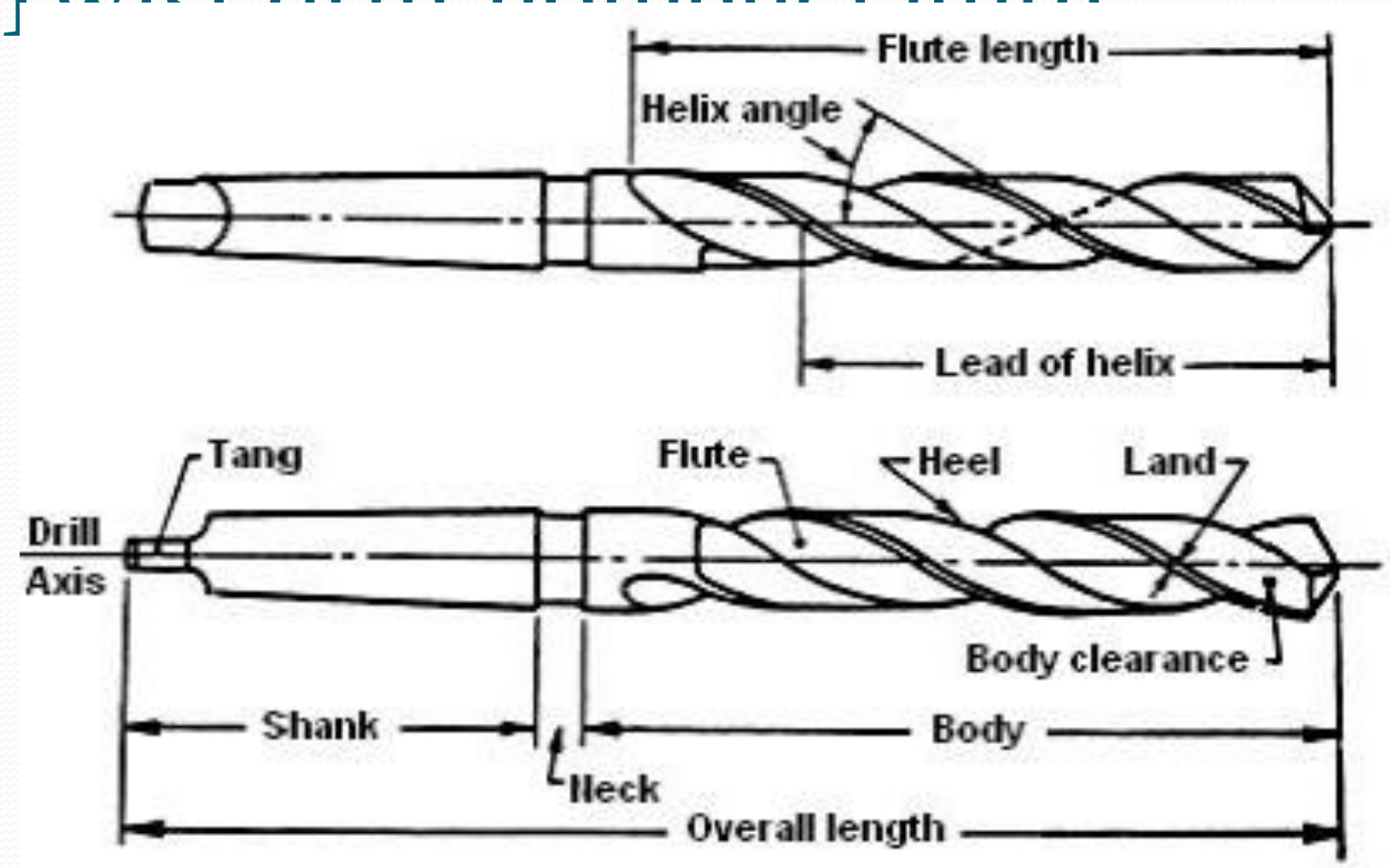
Gang drilling machine



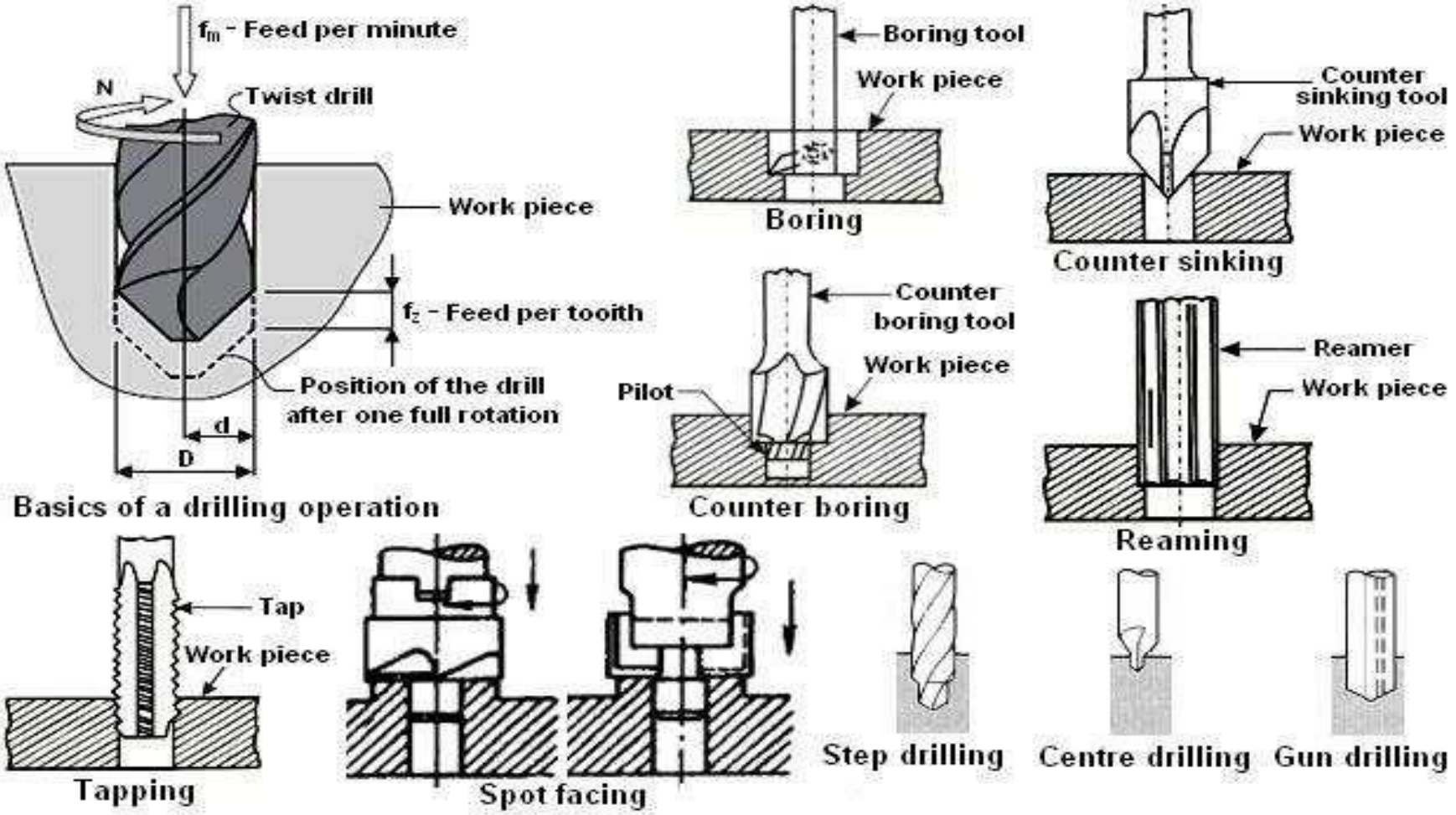



(a) Centre drill
(b) Step drill
(c) sub land drill
(d) Half round drill
(e) Gun drill
(f) Crank shaft drill
(g) Trepanning tool

Twist drill nomenclature



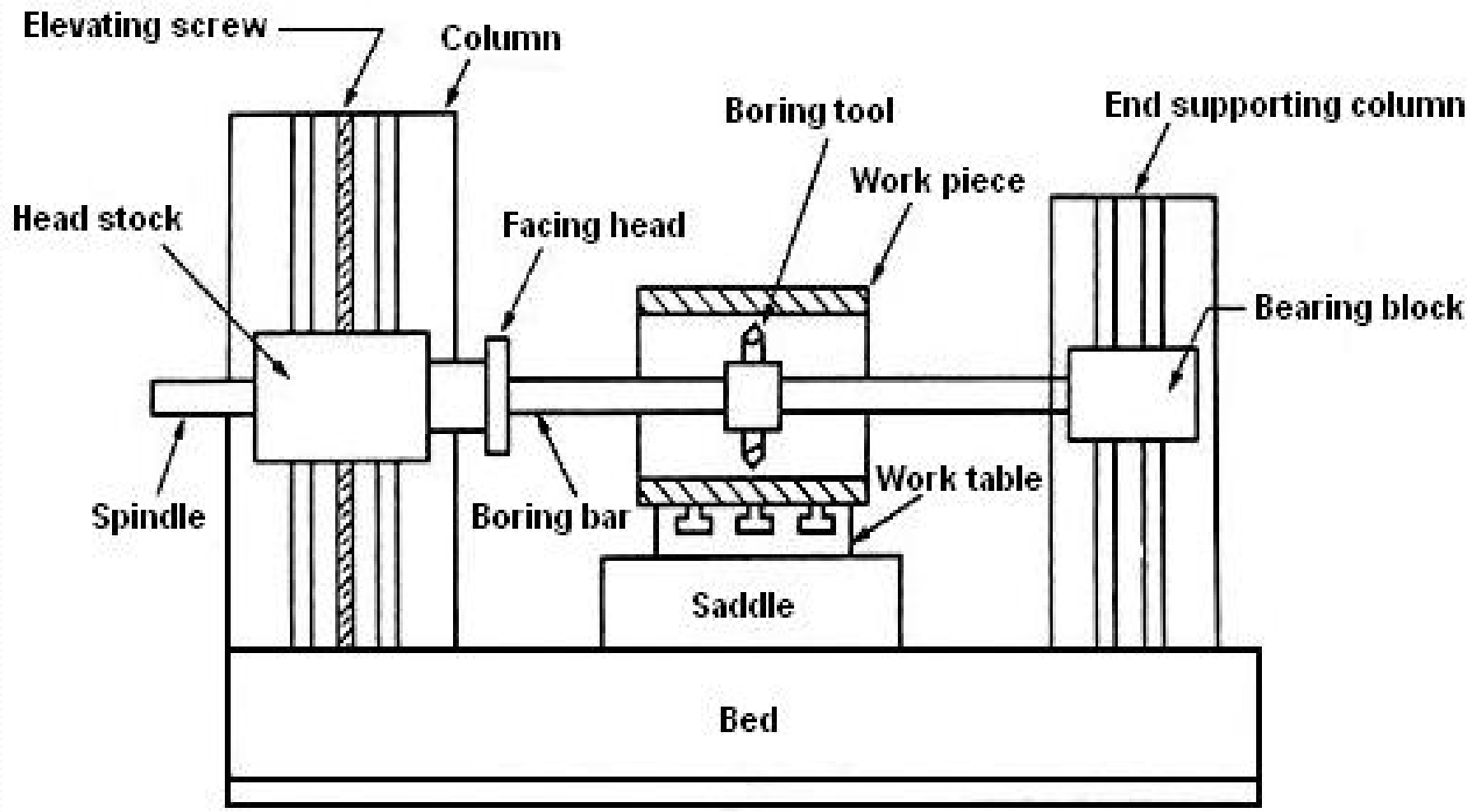
Different operations performed in a drilling machine



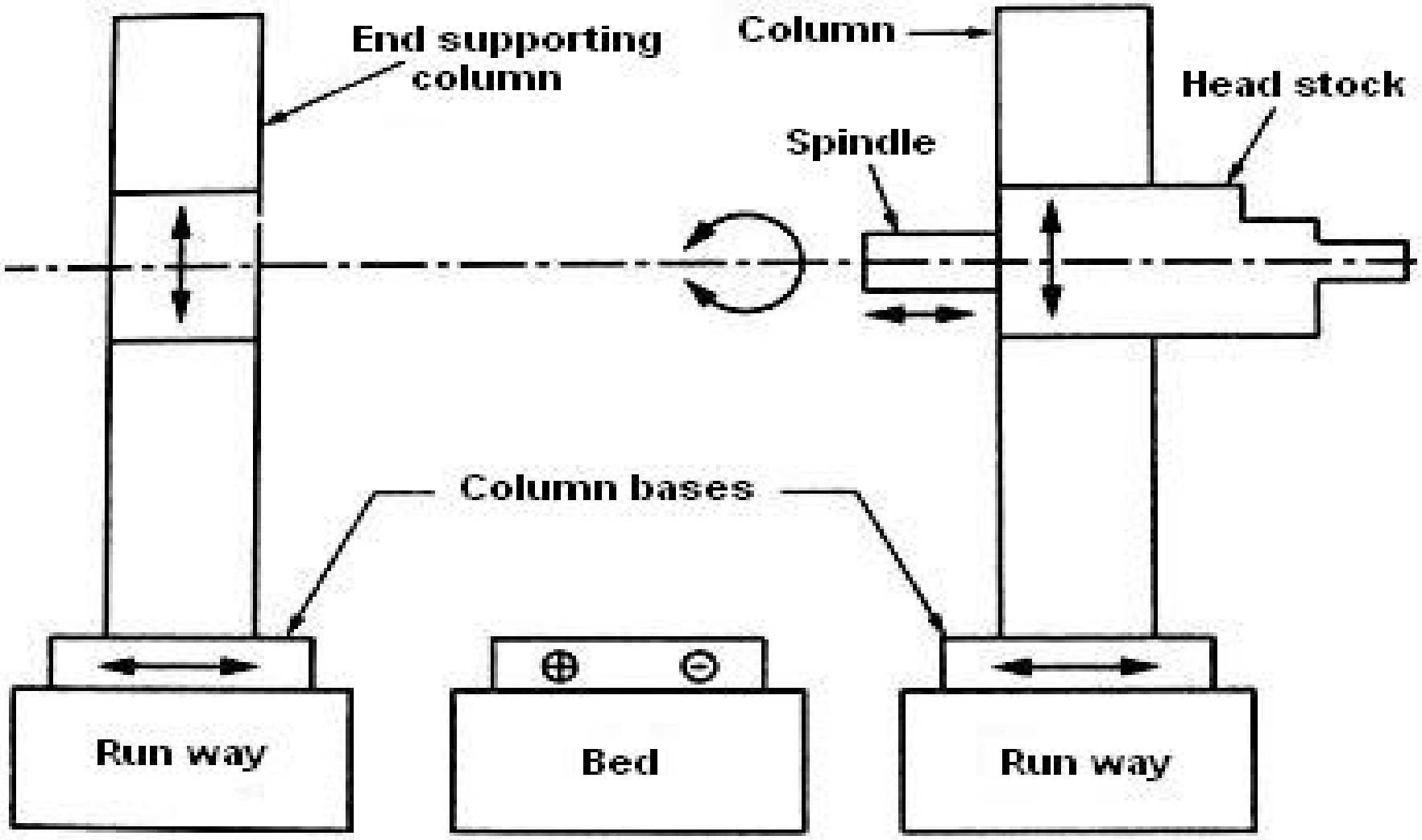
BORING

- Boring is an operation of enlarging and locating previously drilled holes with a single point cutting tool.

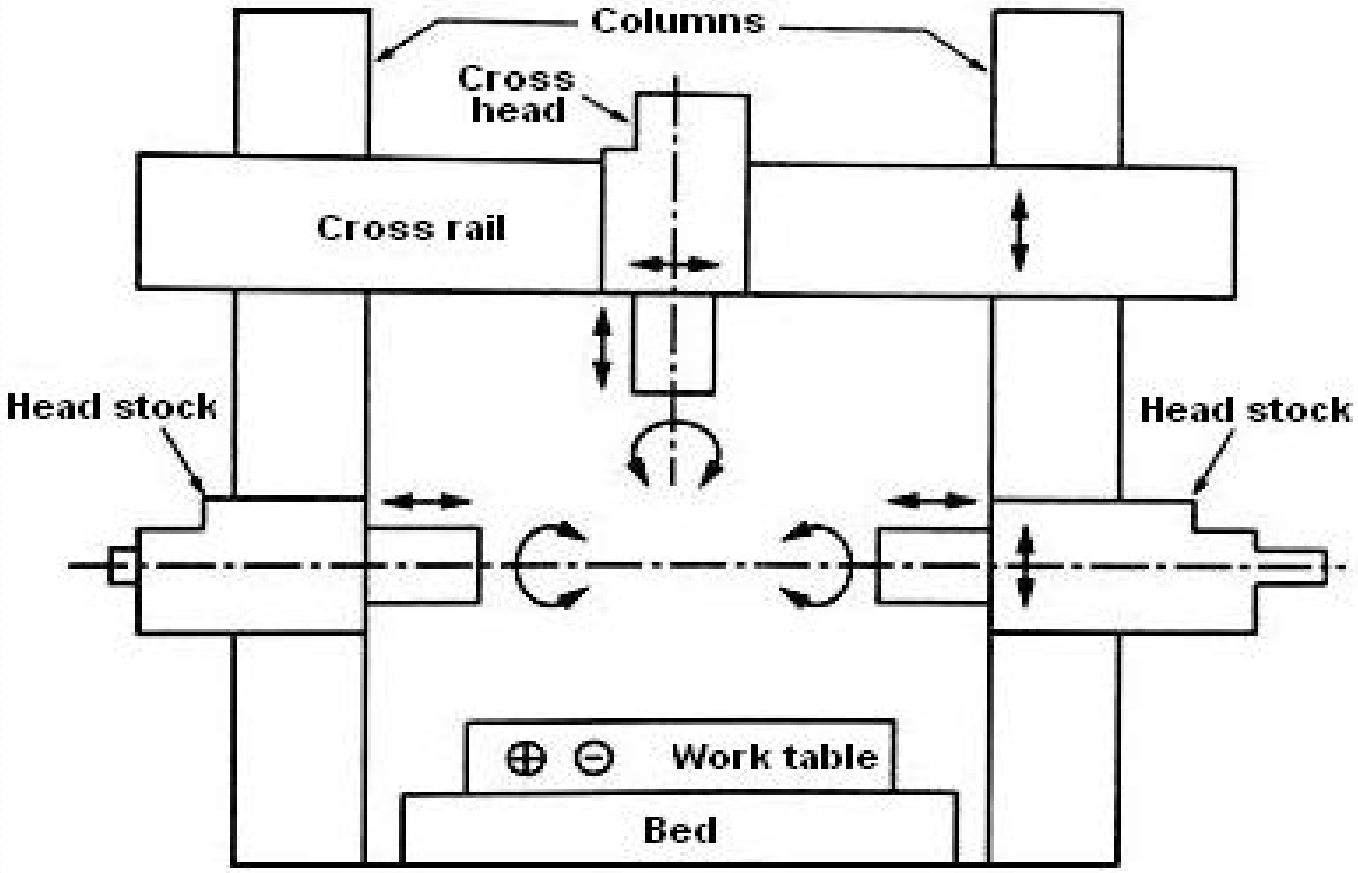
Table type horizontal boring machine



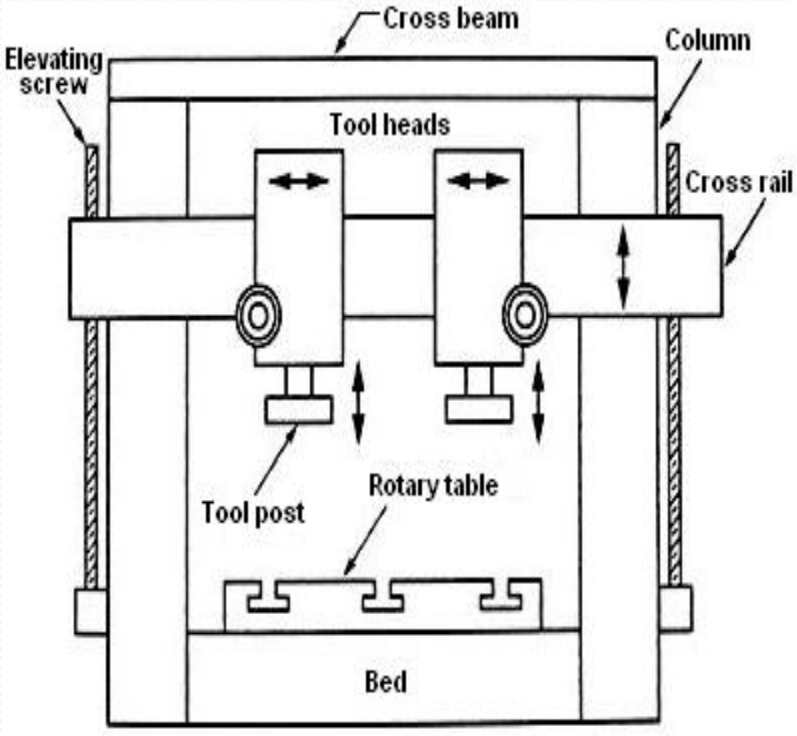
Planer type horizontal boring machine



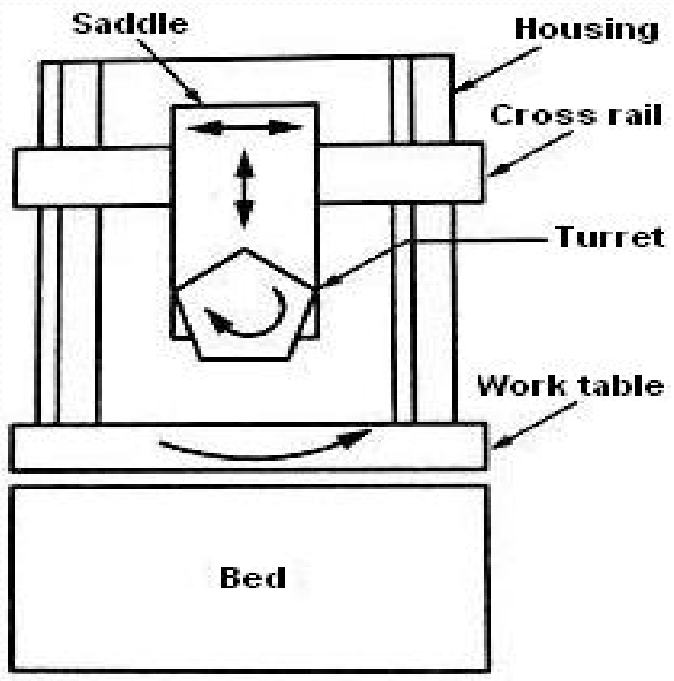
Multiple head type horizontal boring machine



Vertical boring machines

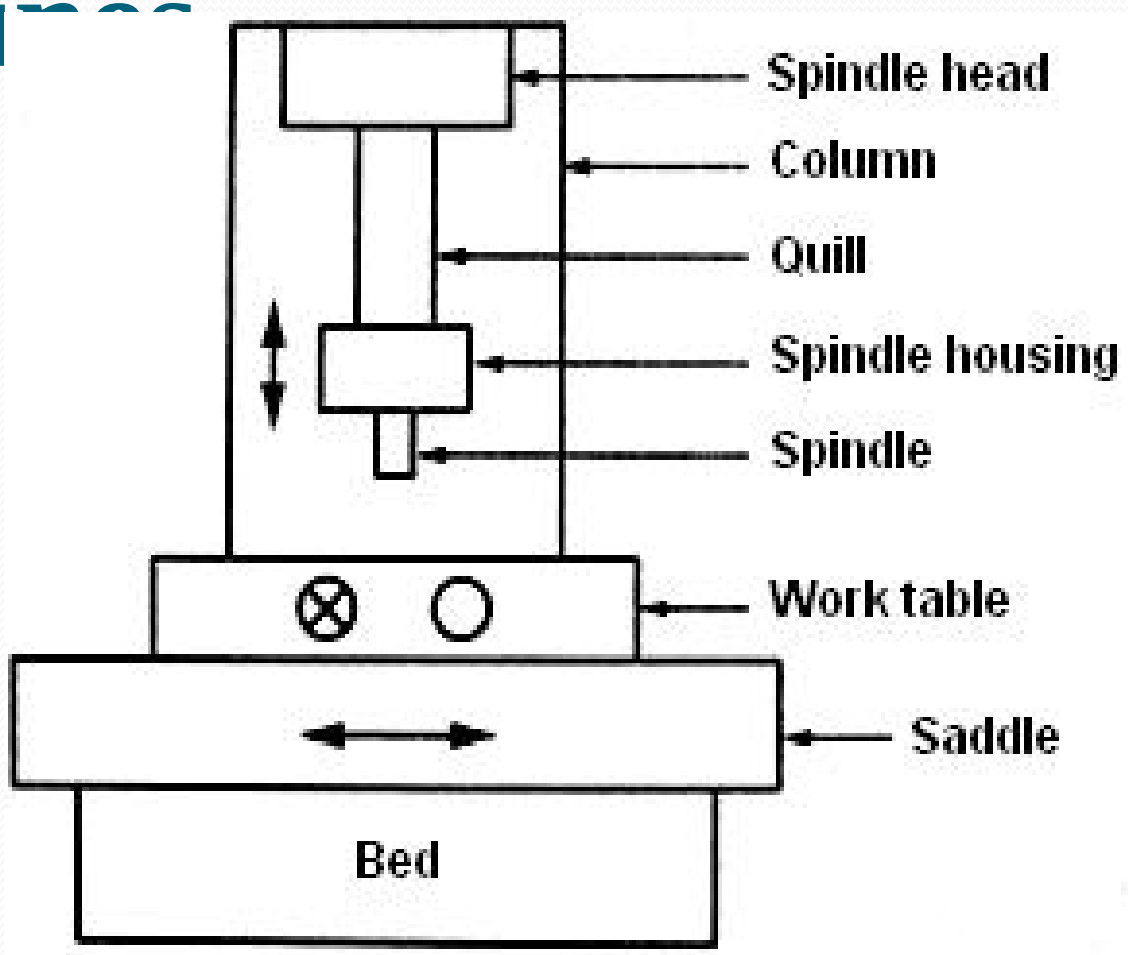


Double column vertical boring machine



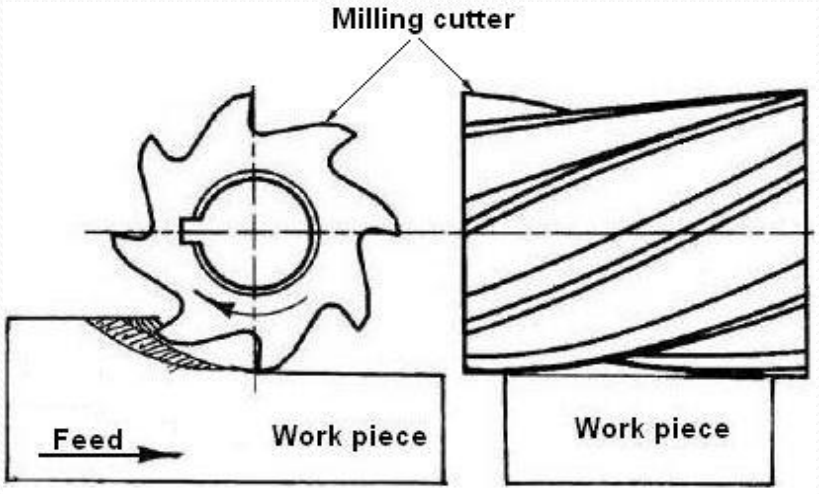
Turret boring machine

Jig borers or jig boring machines



MILLING MACHINE

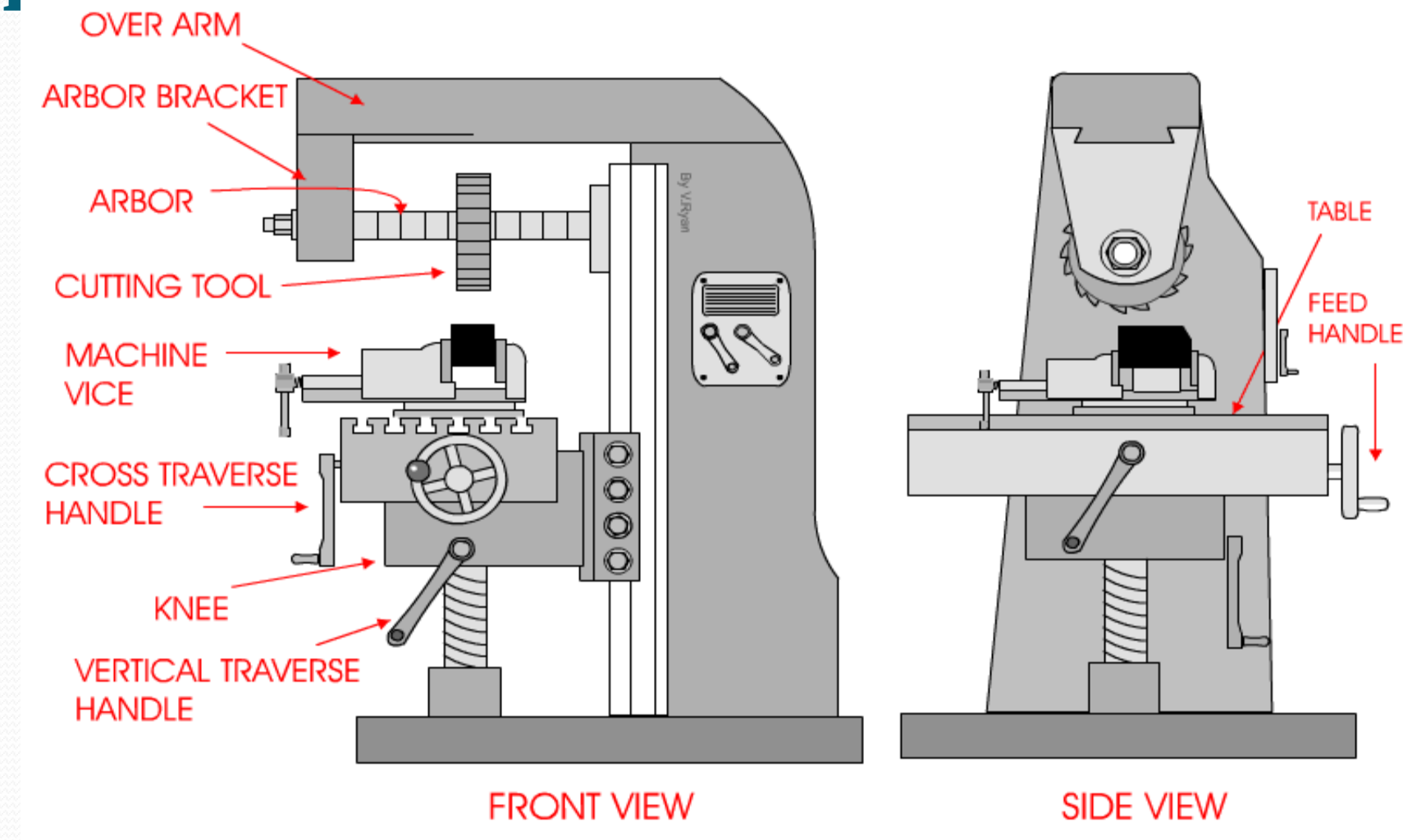
- This is a machine tool that removes material as the work is fed against a rotating cutter.
- The cutter rotates at a high speed and because of the multiple cutting edges it removes material at a very fast rate.



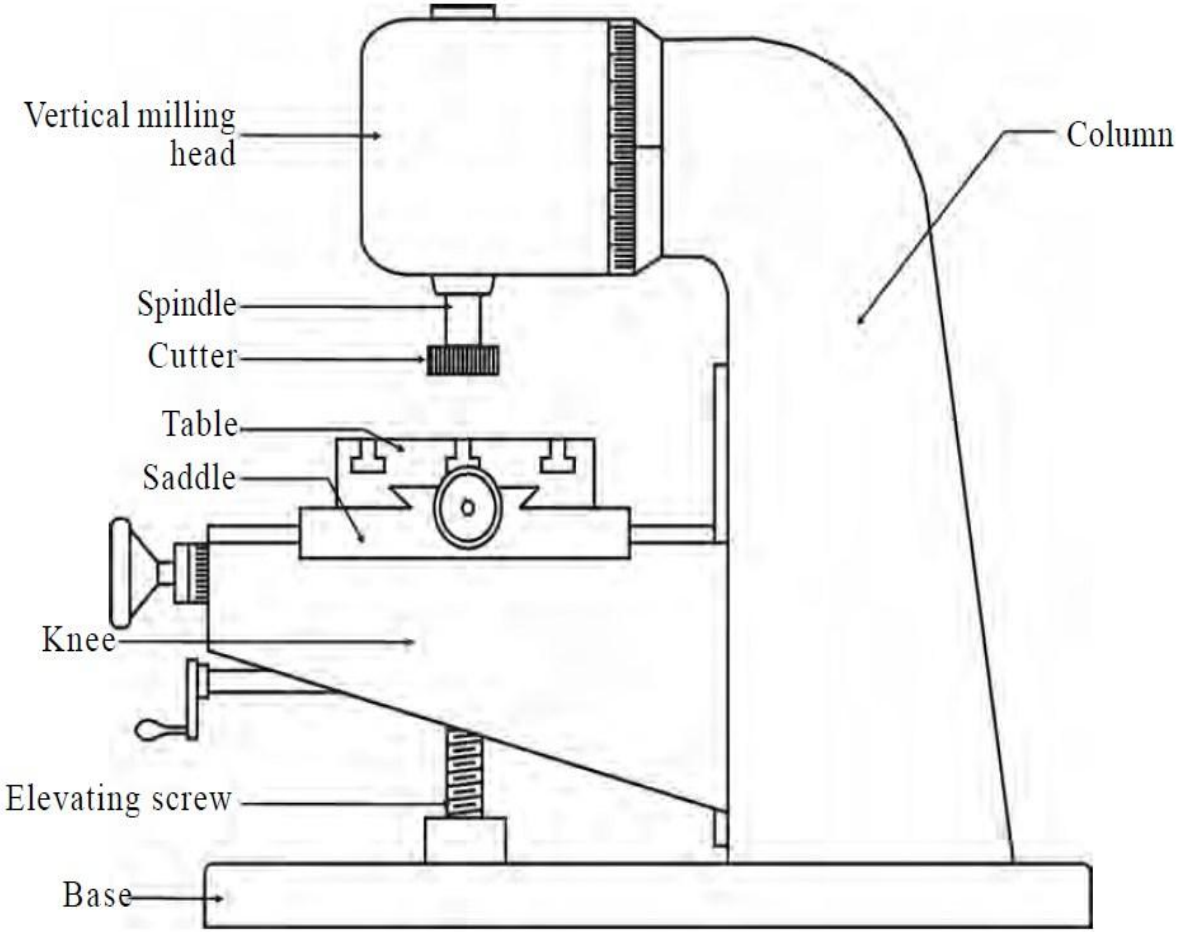
TYPES OF MILLING MACHINE

- ***Column and knee type***
  - Plain or horizontal milling machine.
  - Universal milling machine.
  - Omniversal milling machine.
  - Vertical milling machine.
- ***Manufacturing or bed type***
  - Simplex milling machine.
  - Duplex milling machine.
  - Triplex milling machine.
- ***Planer type Special type***
  - Drum milling machine.
  - Rotary table milling machine.
  - Profile milling machine.

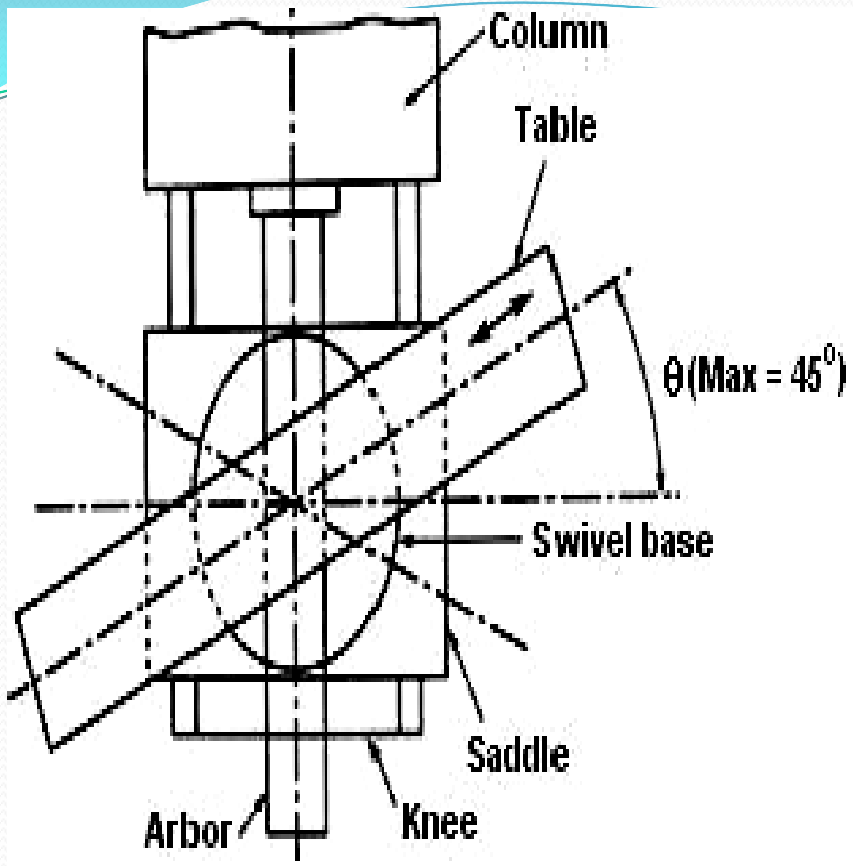
Plain or horizontal milling machine



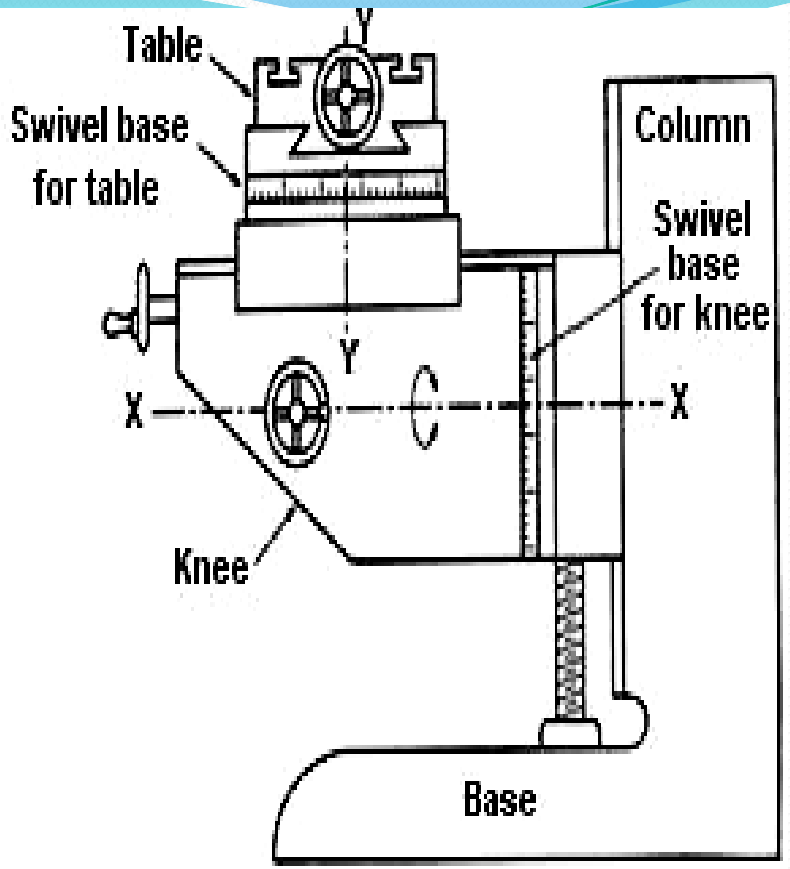
Vertical milling machine



Vertical Milling Machine

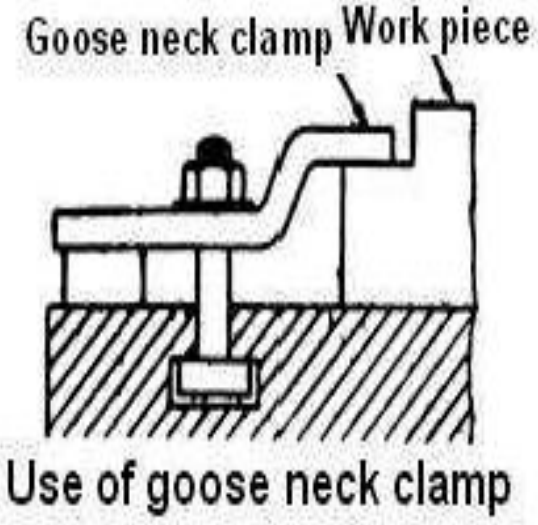


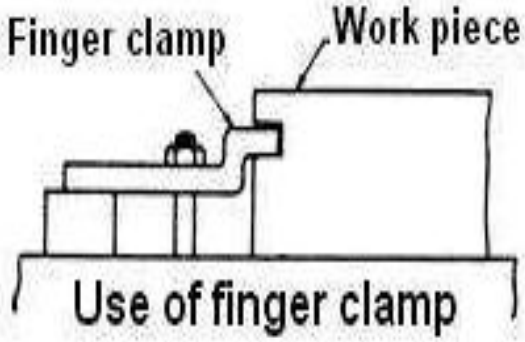
Universal milling machine

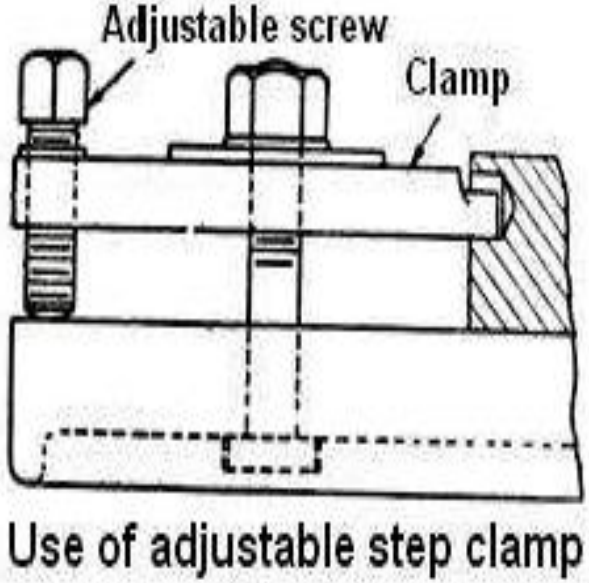


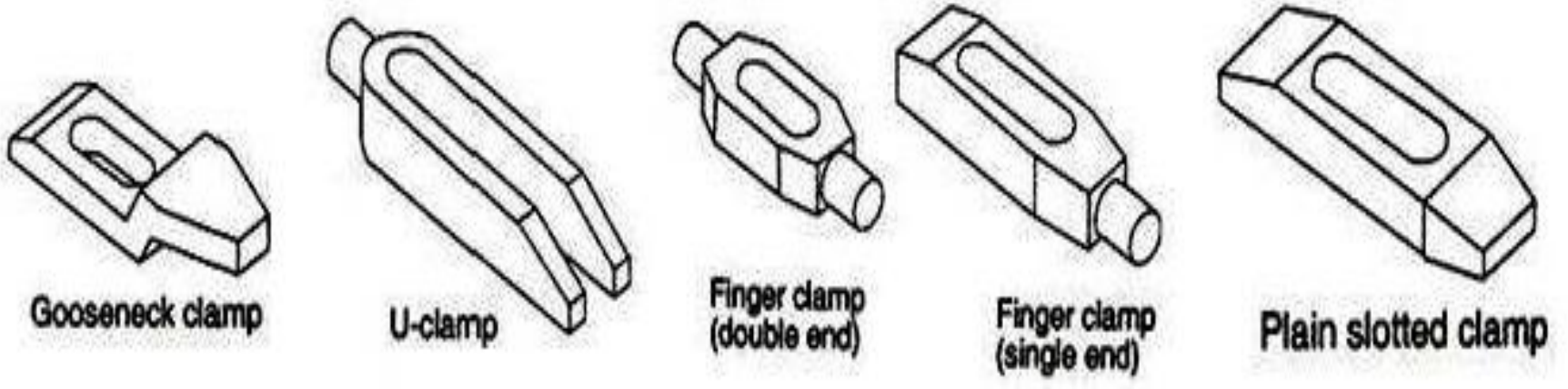
Omniversal milling machine

Work holding devices used in a milling machine









Angle Plate

Vee – Block

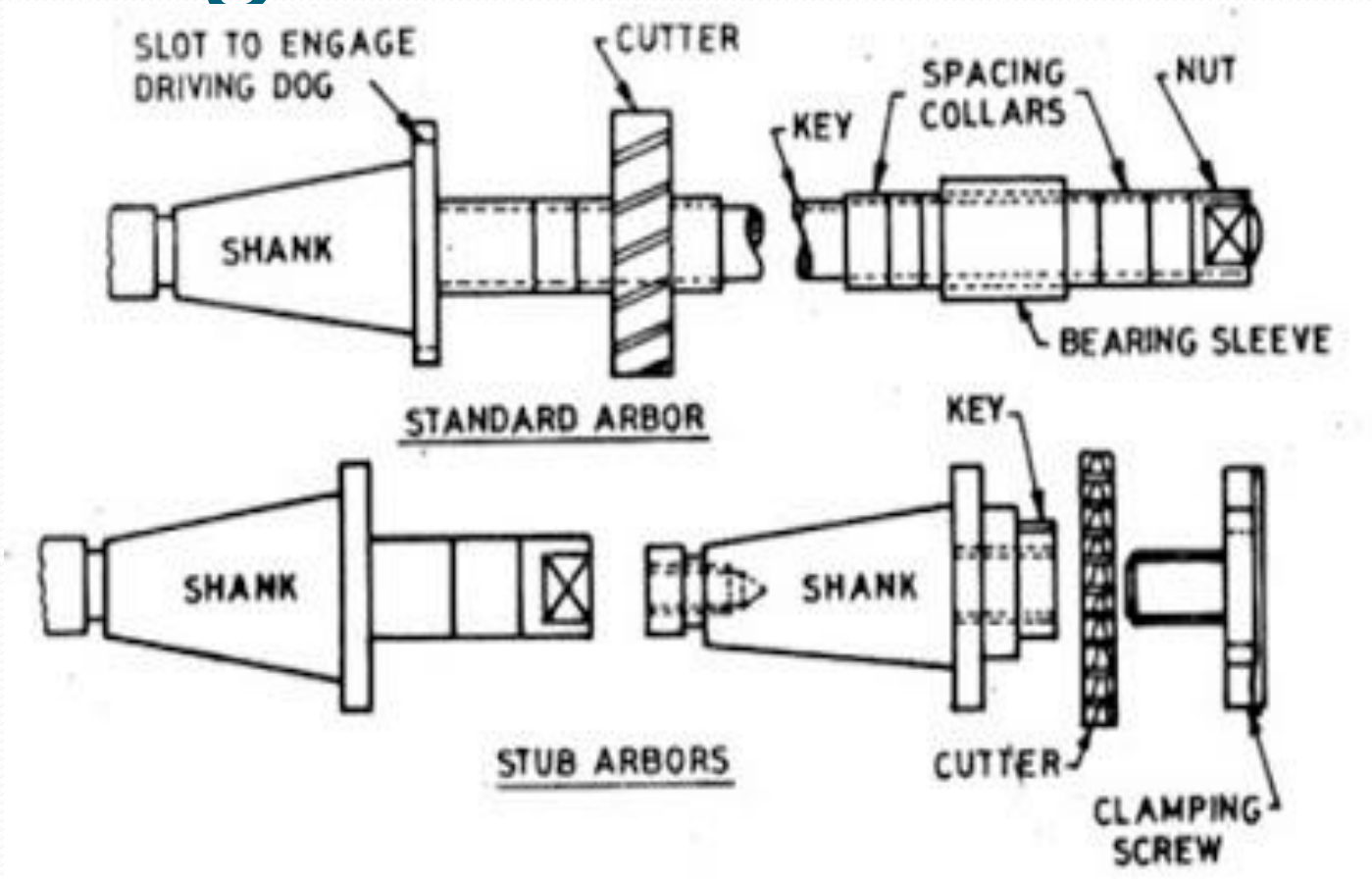
Swivel Vice

Plain Vice

Universal Vice

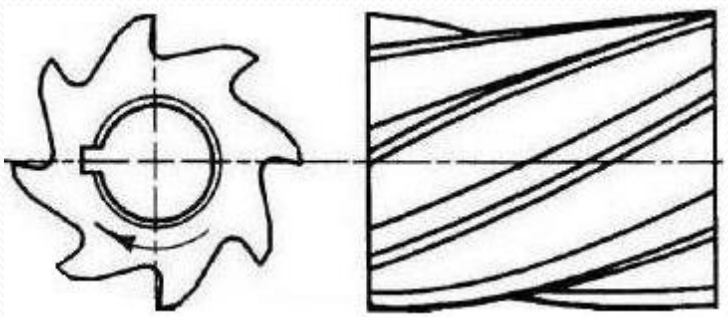
Work Holding Devices Used on Milling Machine

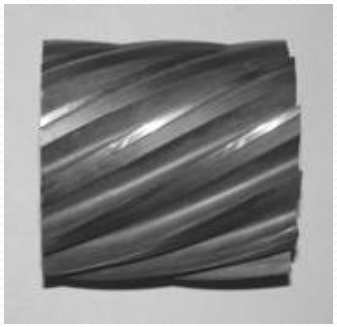
Tool holding devices used in a milling machine



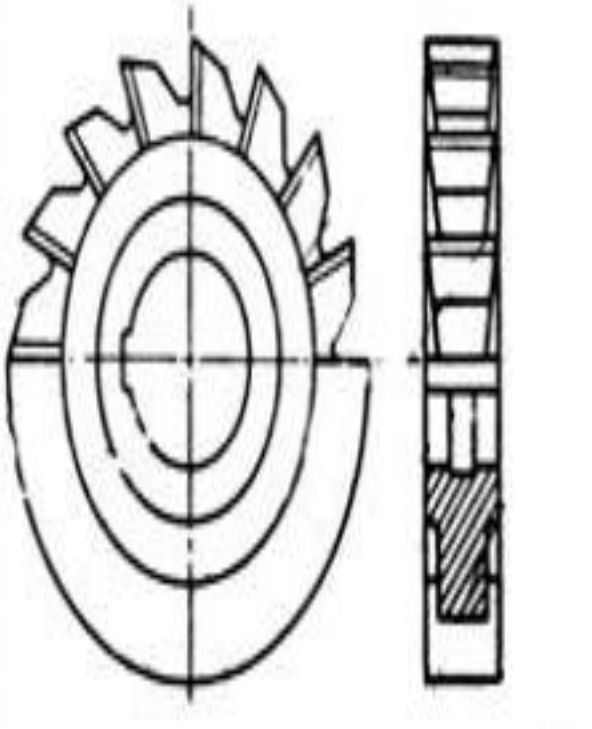
MILLING CUTTERS

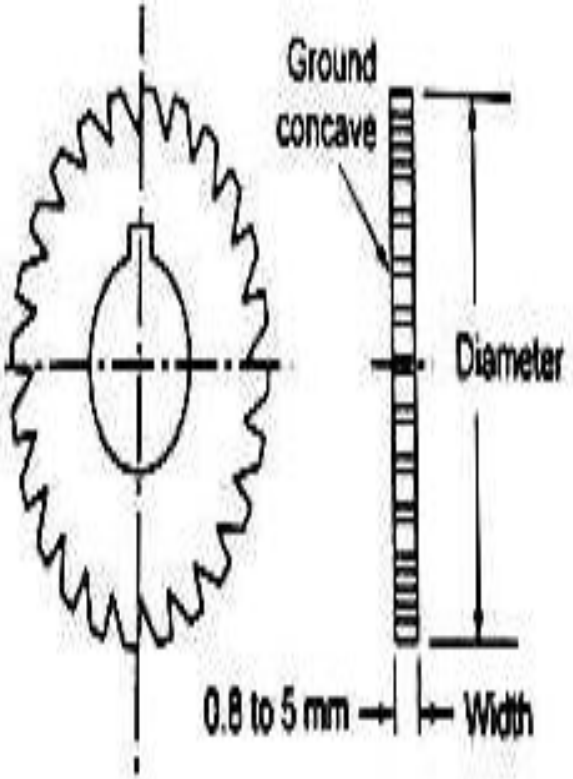
1. **Slab or plain milling cutters**



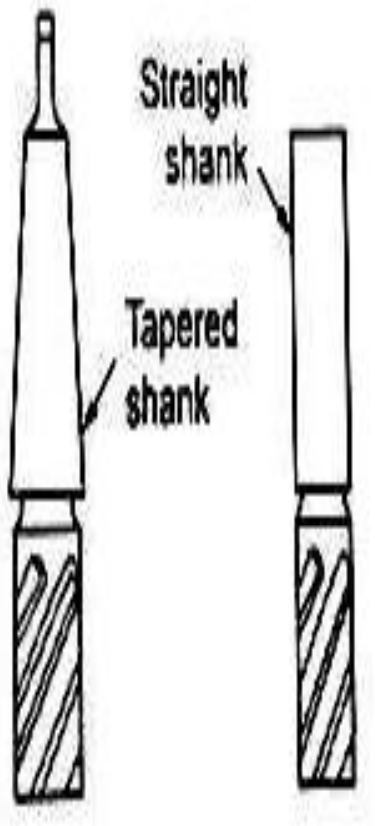


Side milling cutters



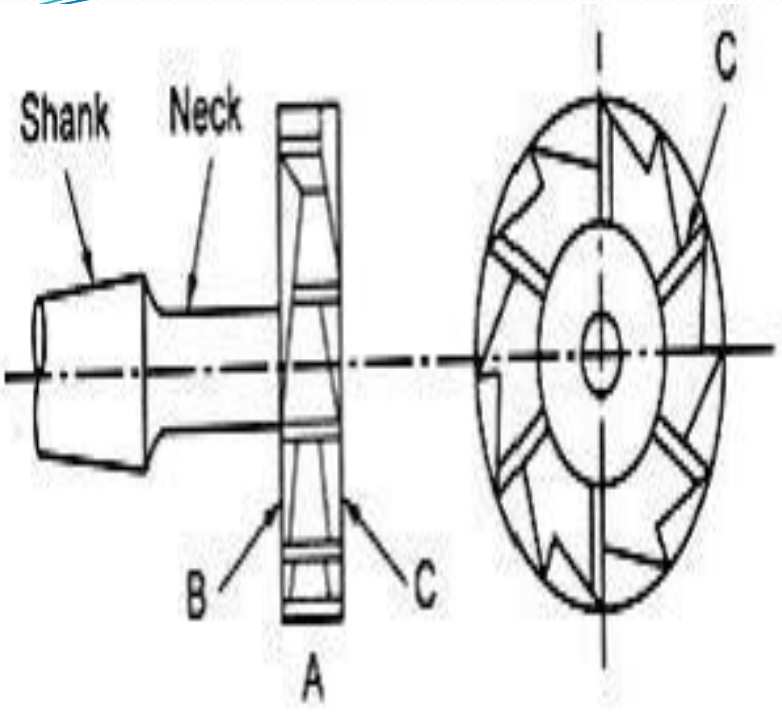


Slitting saw

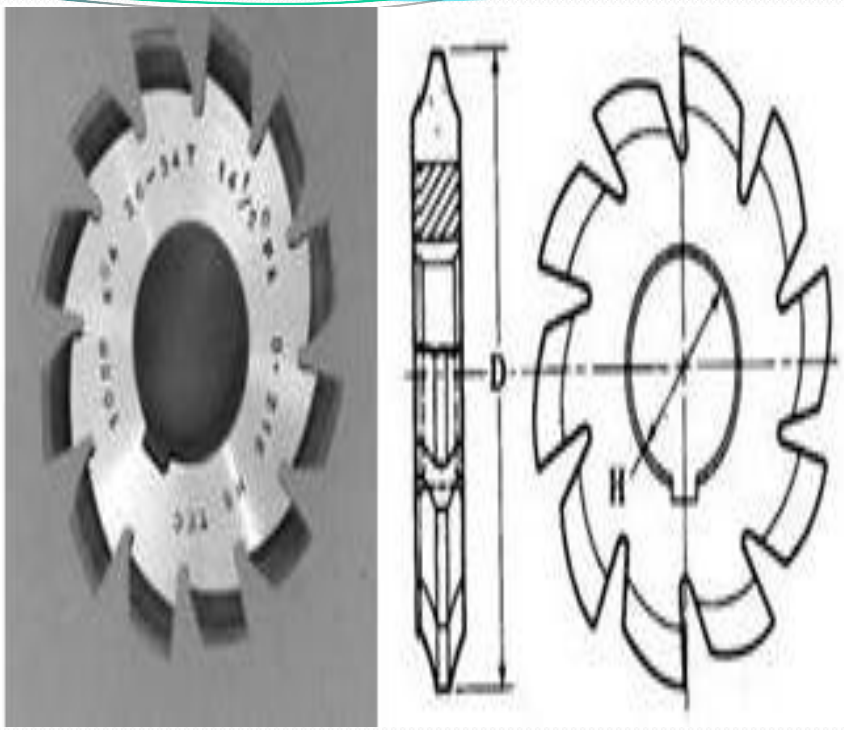


End milling cutters

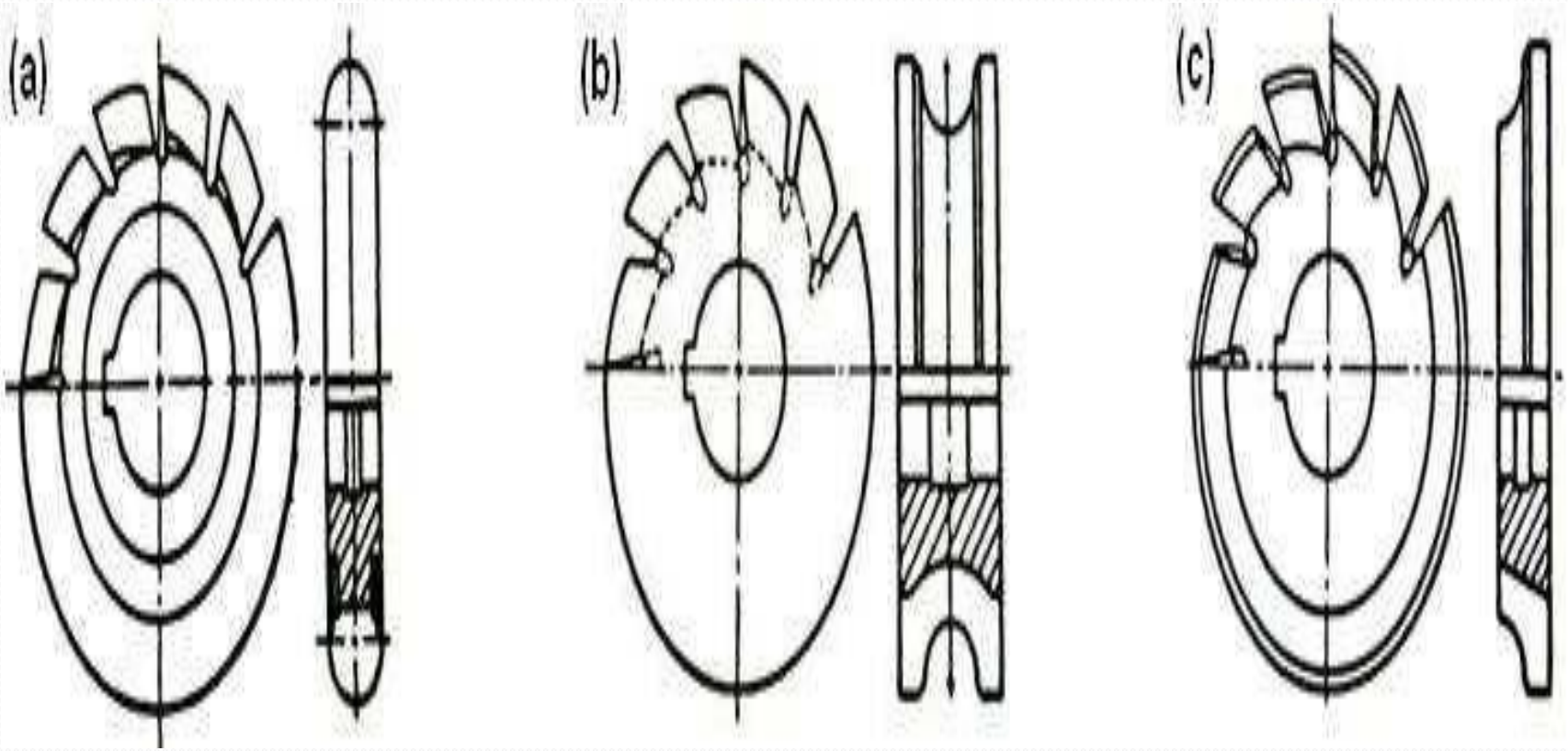
Face milling cutter



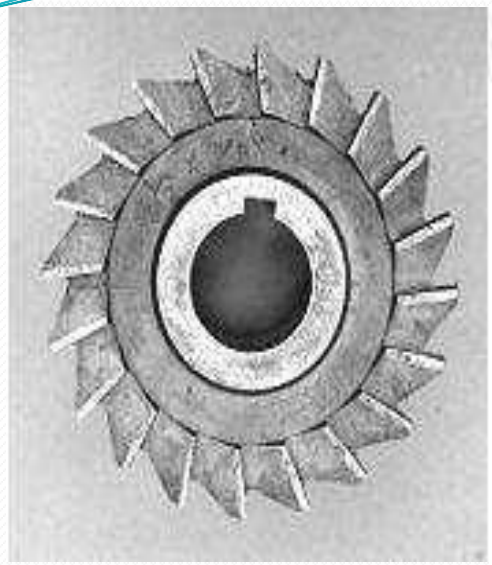
T-slot milling cutter

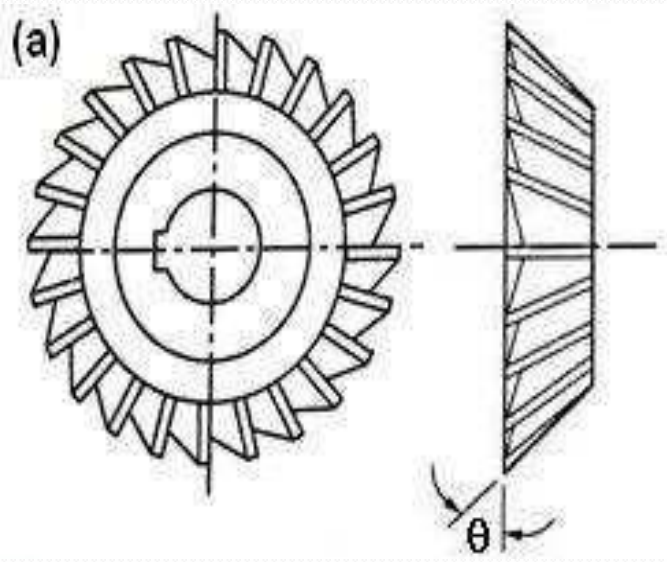


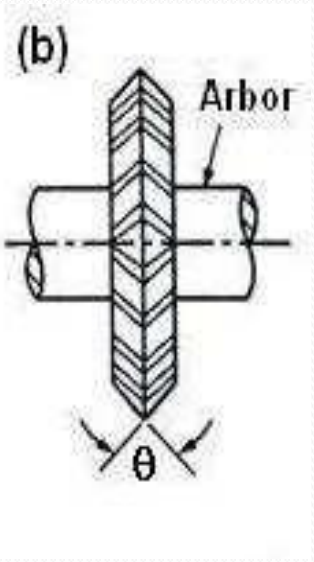
Involute gear milling cutter



Convex milling cutter Concave milling cutter Corner rounding milling cutter



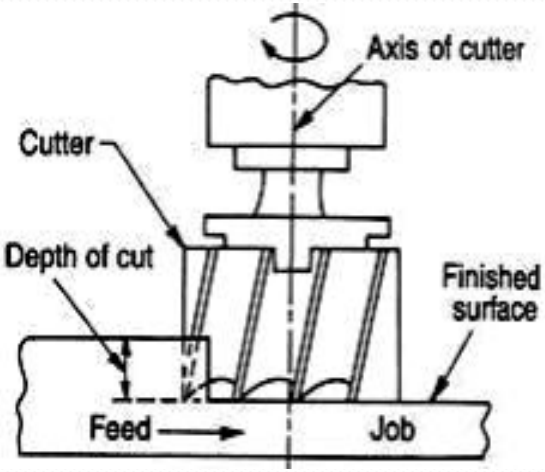


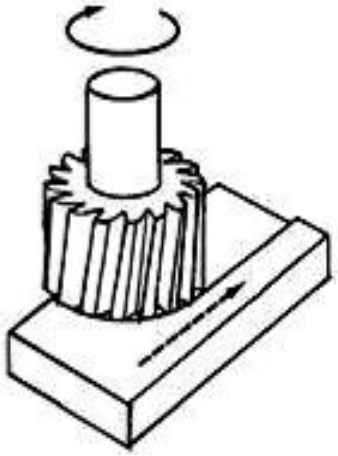


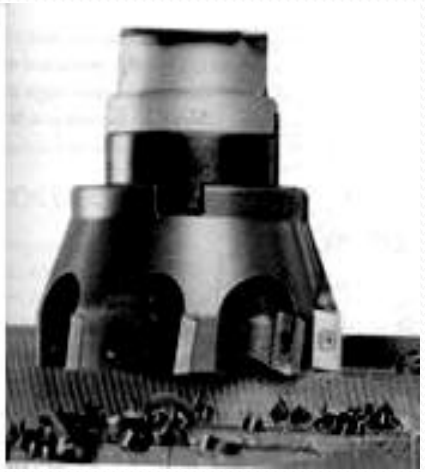
Single angle milling cutter and

Double angle milling cutter

MILLING OPERATIONS

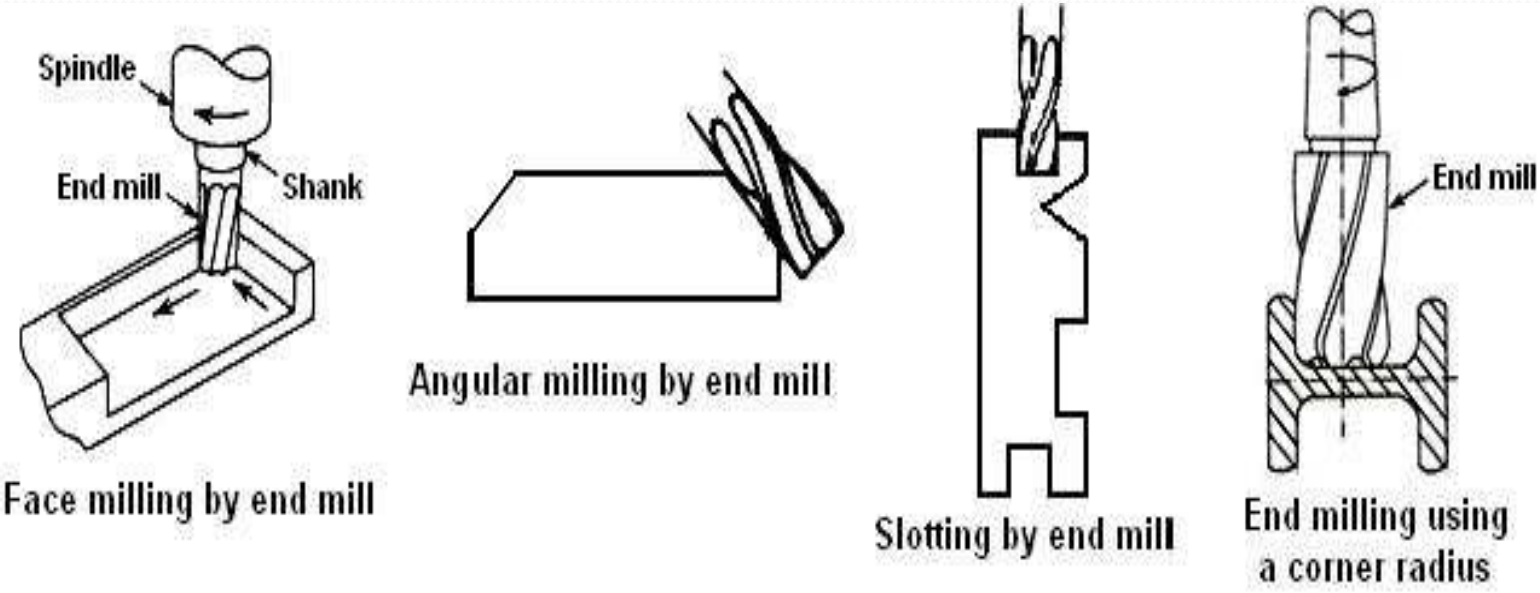


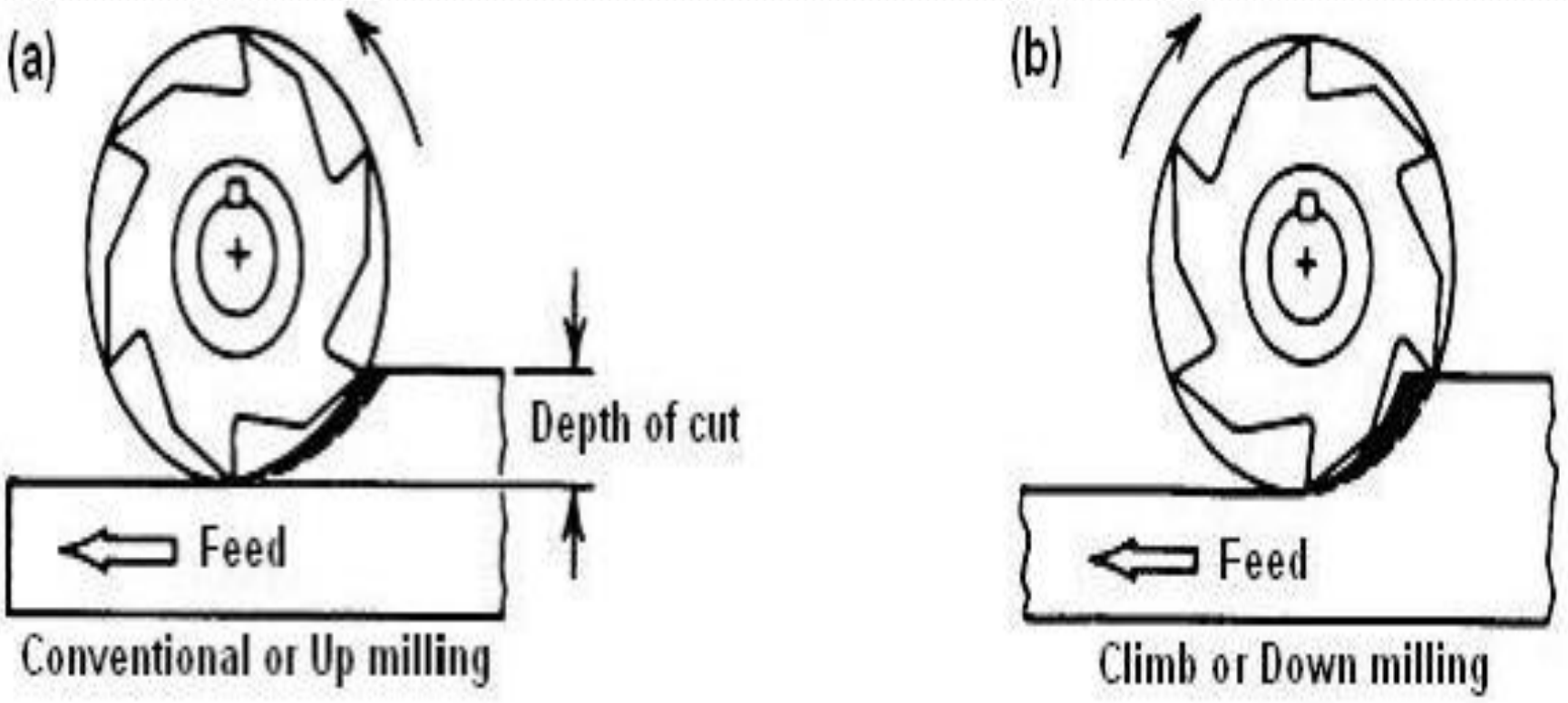


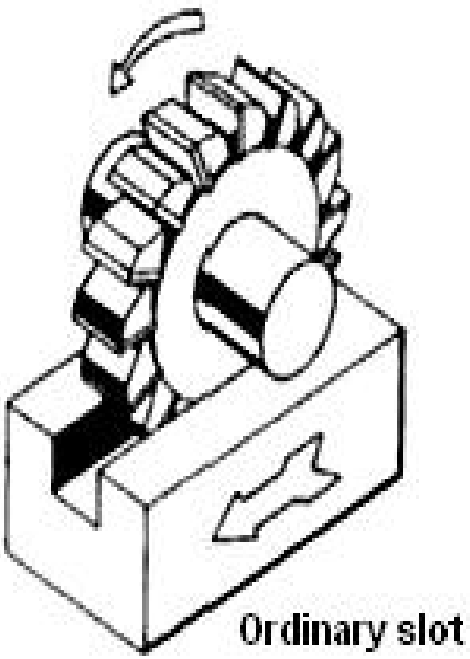


Schematic view of the face milling operation

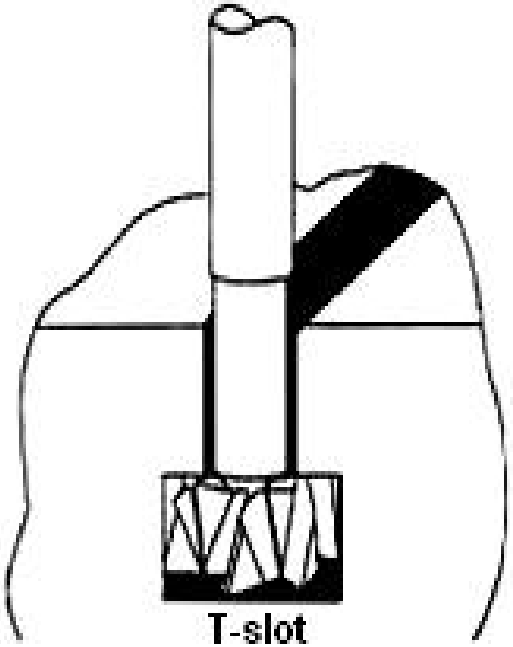
End milling


Spindle
End mill
Shank
Face milling by end mill
Angular milling by end mill
Slotting by end mill
End mill
End milling using
a corner radius

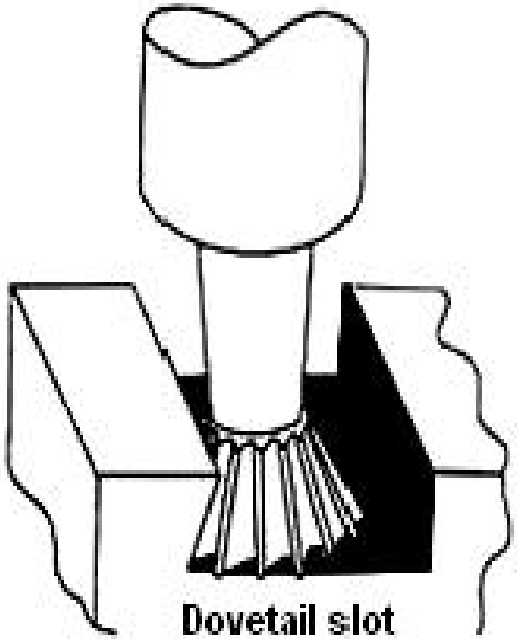

(a)
Depth of cut
Feed
Conventional or Up milling
(b)
Feed
Climb or Down milling



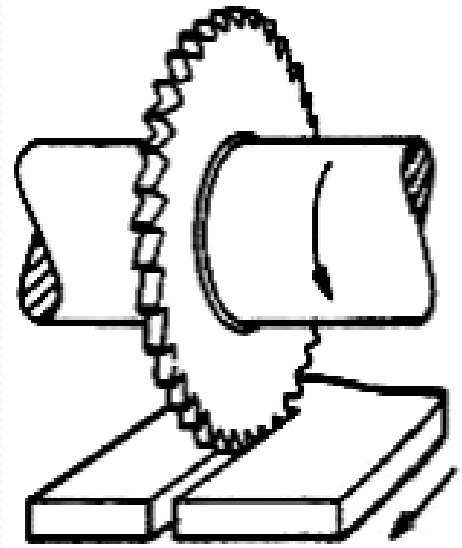
Ordinary slot



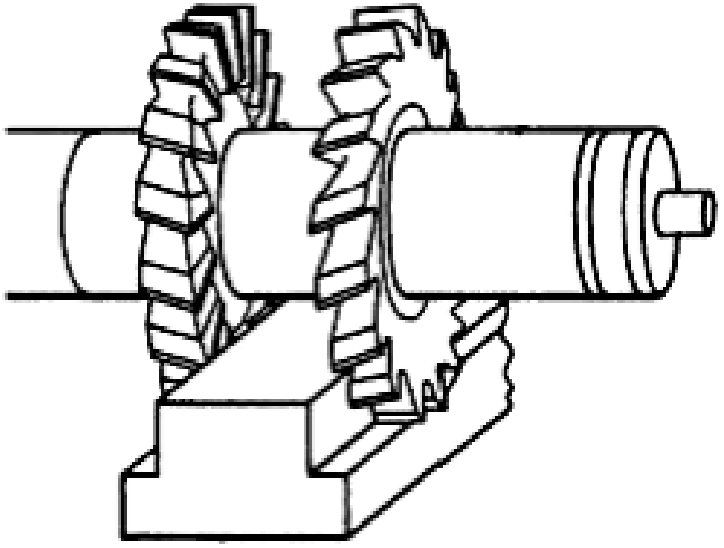
T-slot



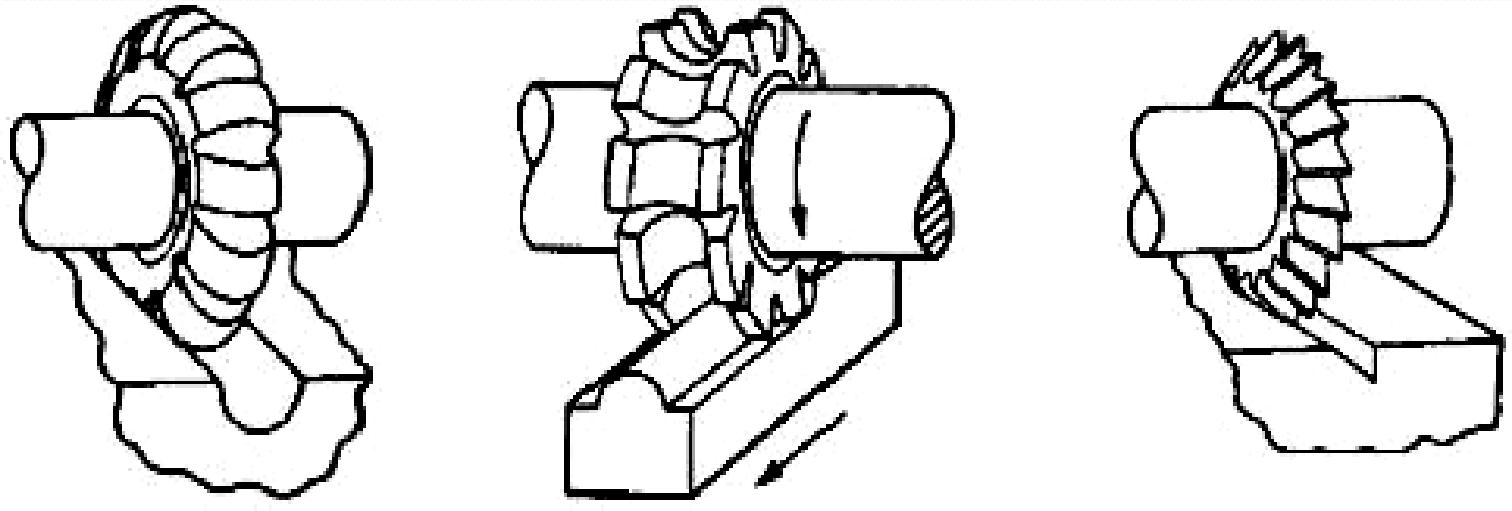
Dovetail slot



Parting by slitting saw



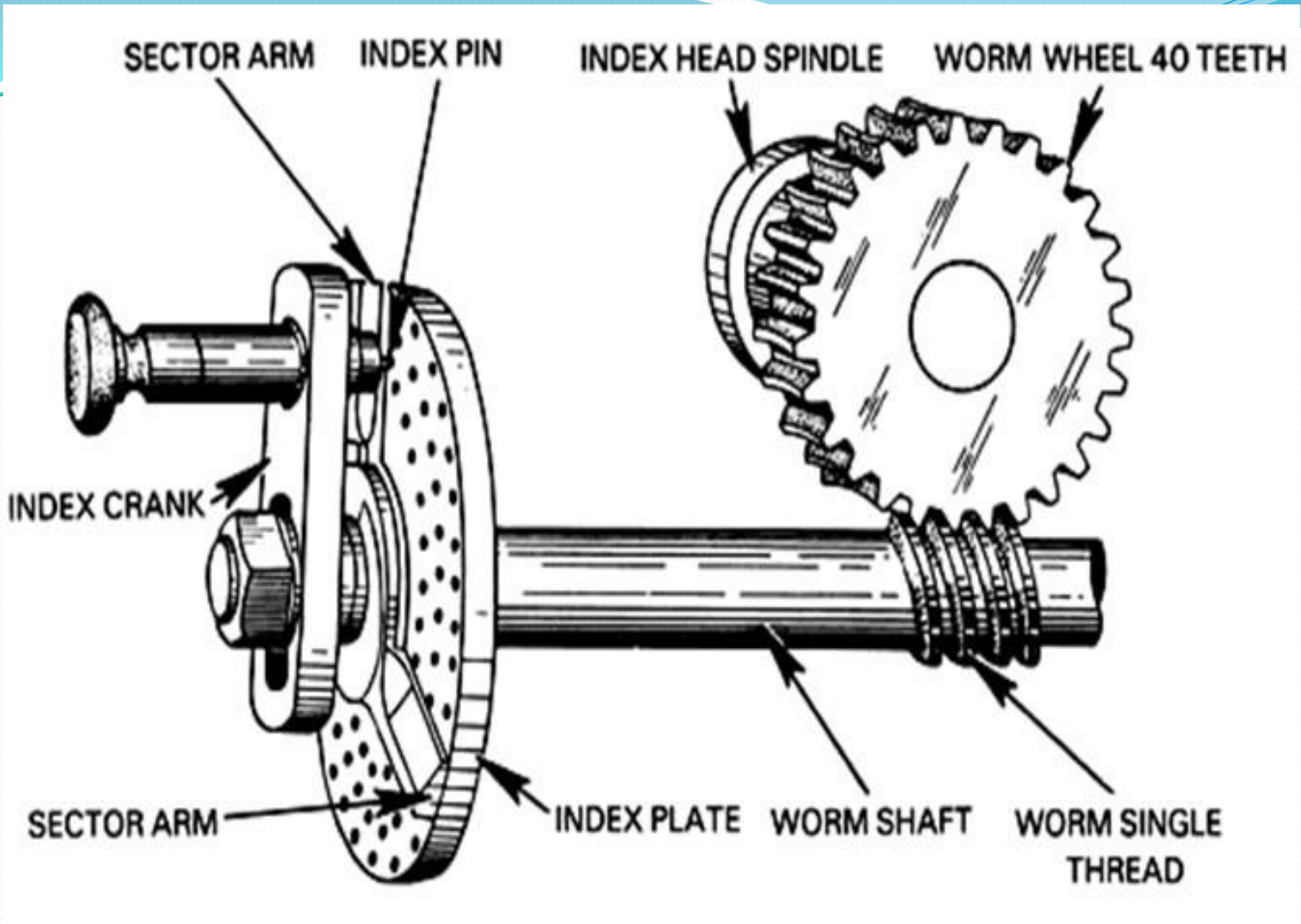
Straddle milling

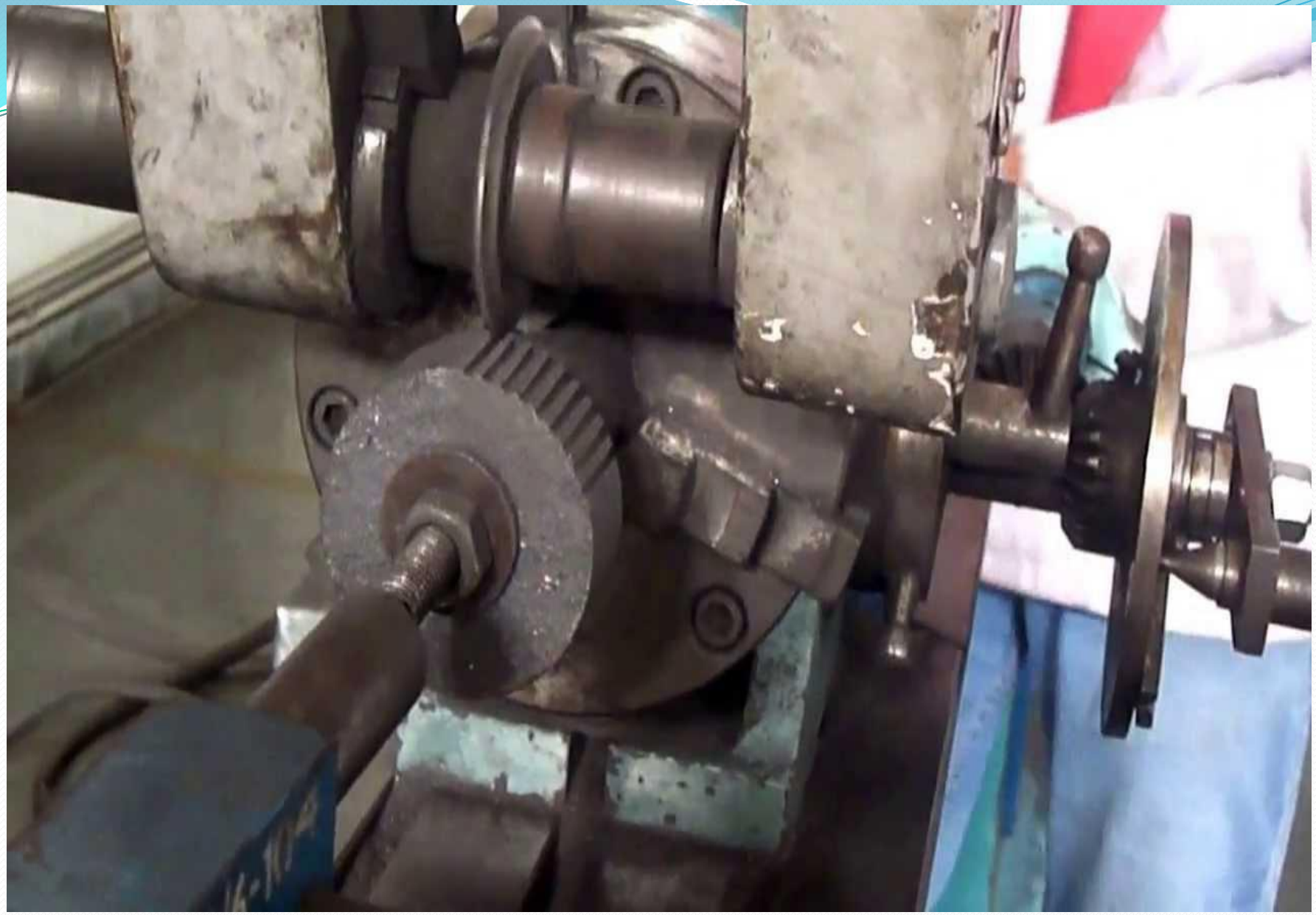


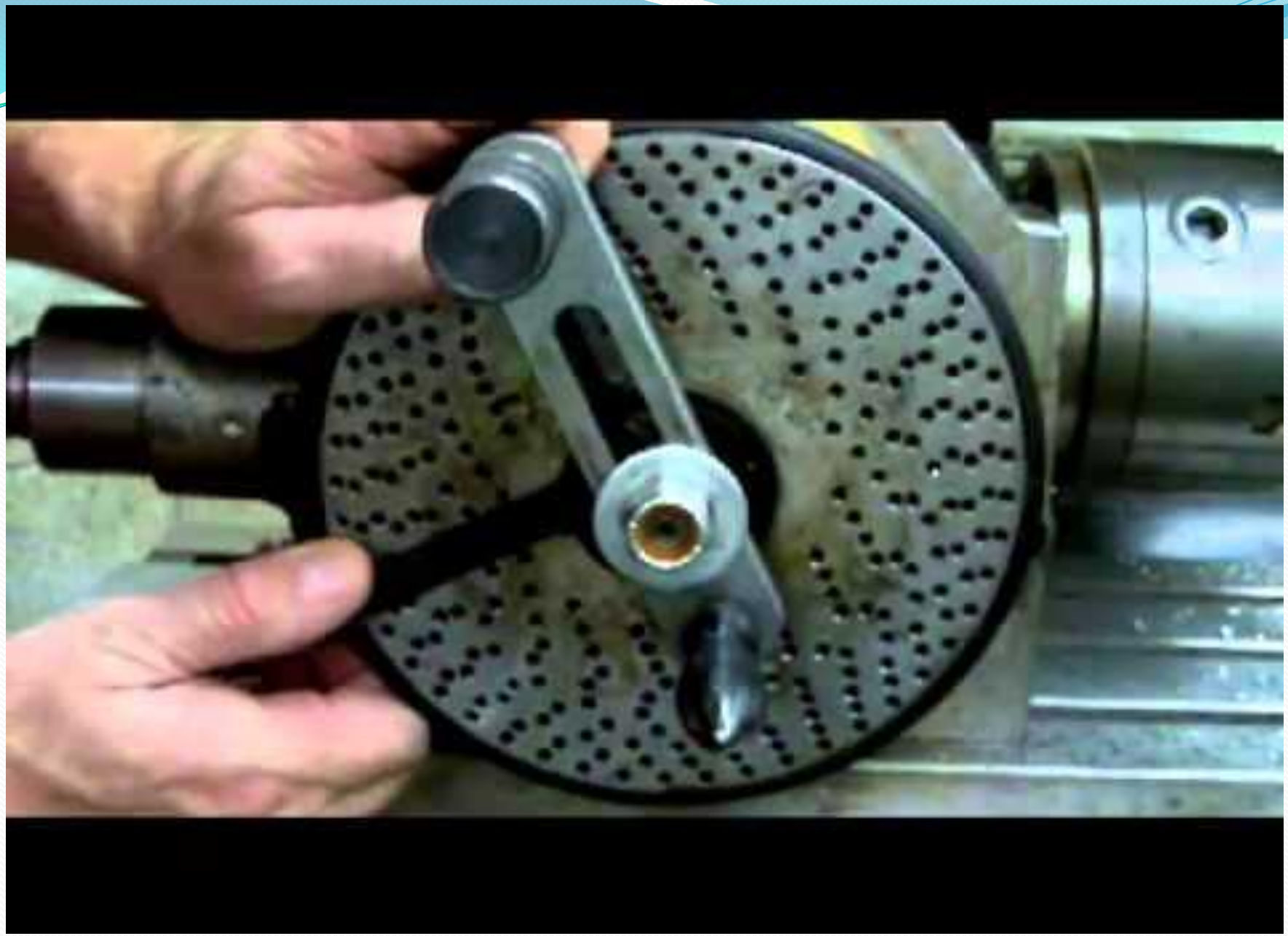
Form milling operations

Indexing of Milling Machines

- Indexing is the process of evenly dividing the circumference of a circular work piece into equally spaced divisions.
- It is used in cutting gear teeth, cutting splines, milling grooves in reamers and taps, and spacing holes on a circle.

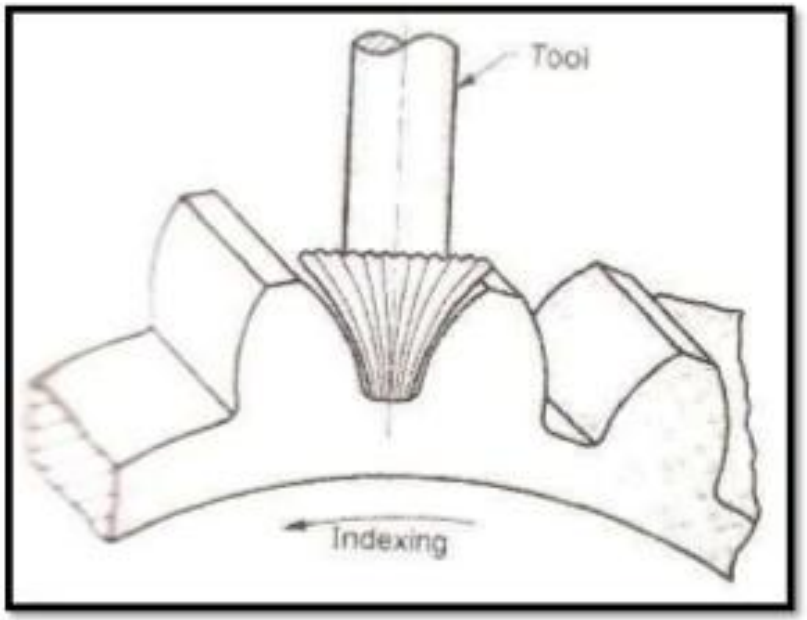

SECTOR ARM
INDEX PIN
INDEX HEAD SPINDLE
WORM WHEEL 40 TEETH
INDEX CRANK
SECTOR ARM
INDEX PLATE
WORM SHAFT
WORM SINGLE THREAD





Form milling with End Mill type Cutter :

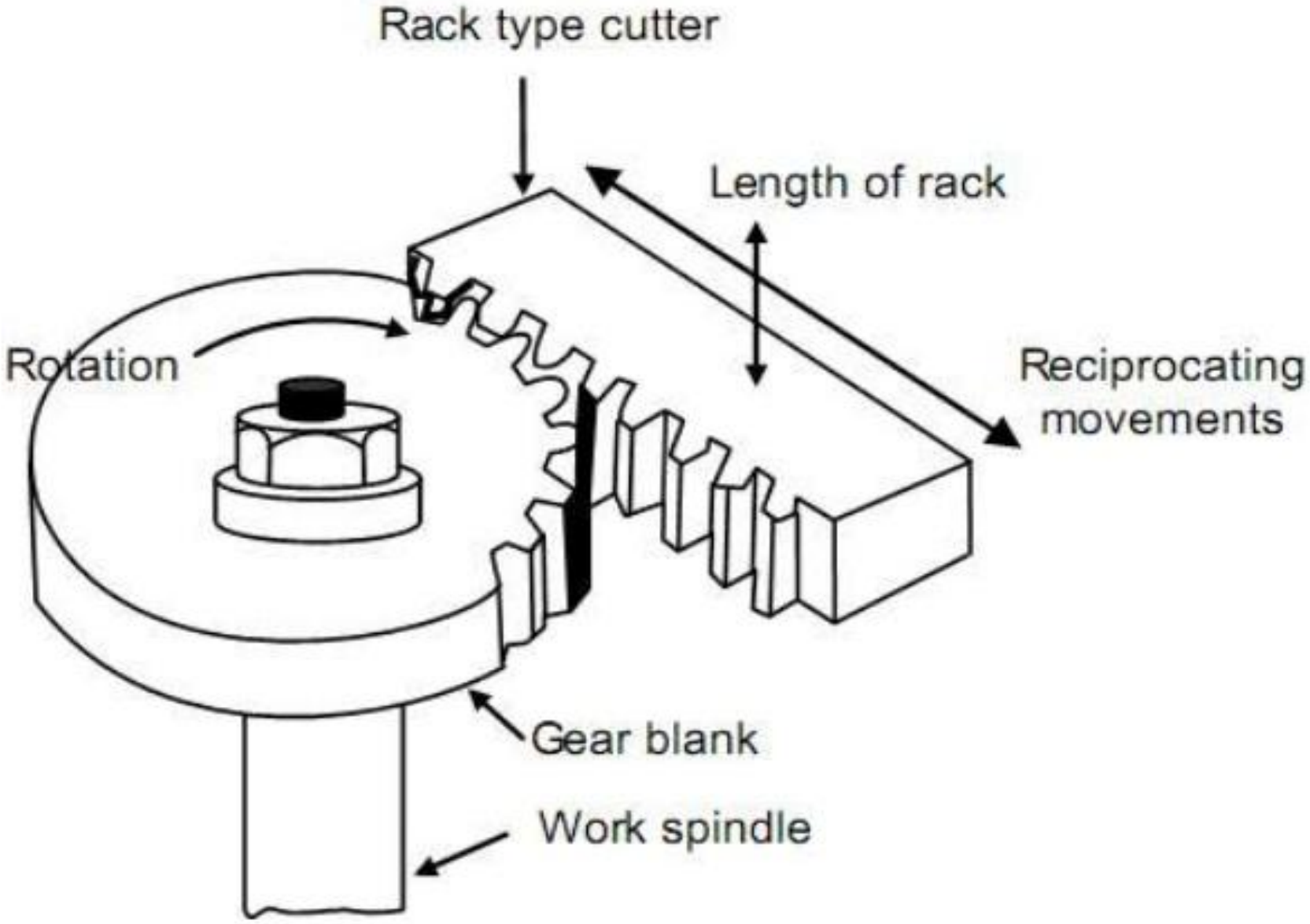
- Cutter is a **Shank** type cutter which is mounted directly on spindle of Vertical Milling Machine.
- Cutter axis is set radial with respect to gear blank.
- The blank is then indexed to the next tooth position as in case of milling with disc type cutters . It is suitable for producing pinions of large pitch.



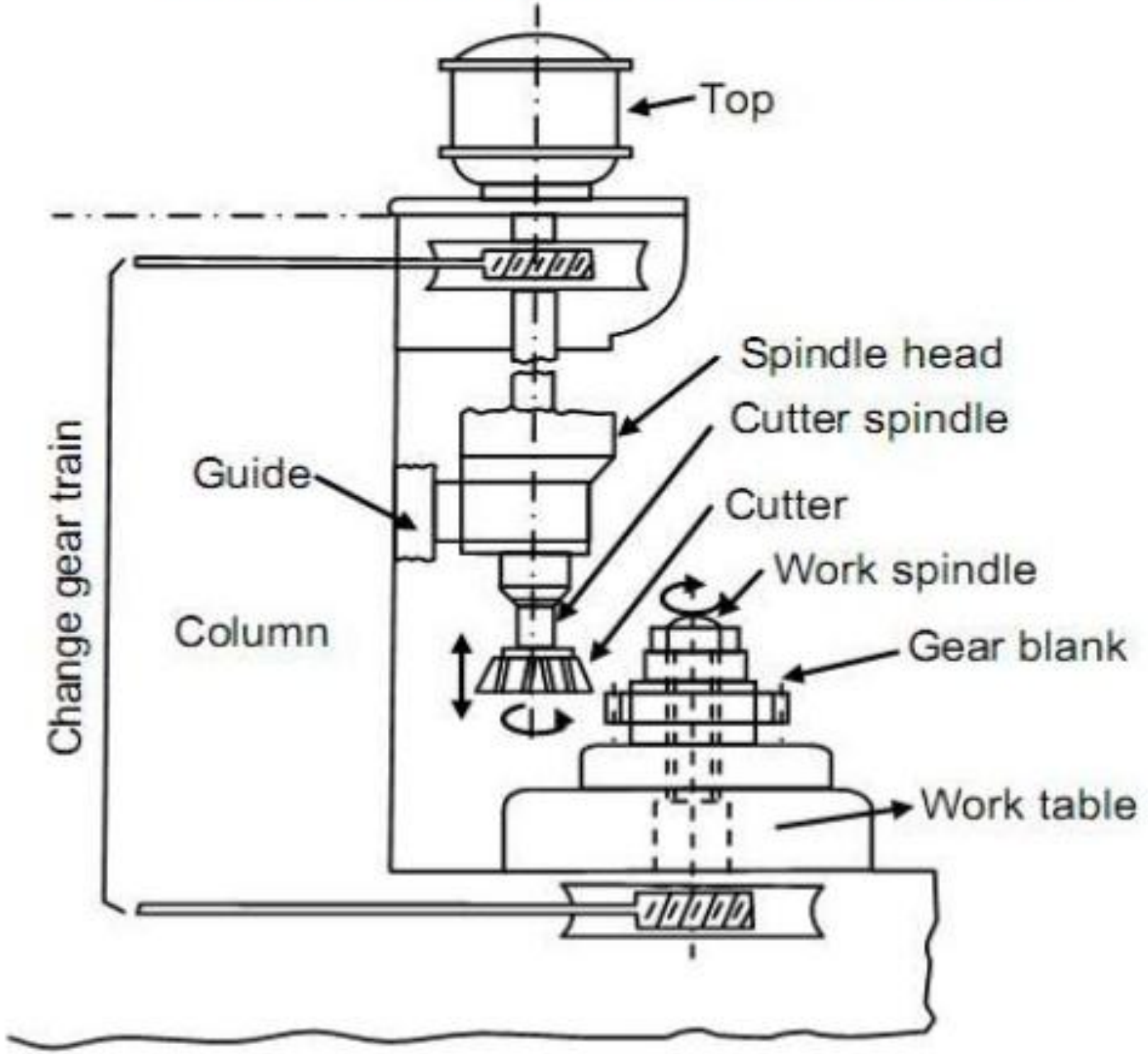
Gear Generating Processes

1. Gear Shaping
2. Gear Planning
3. Gear Hobbing

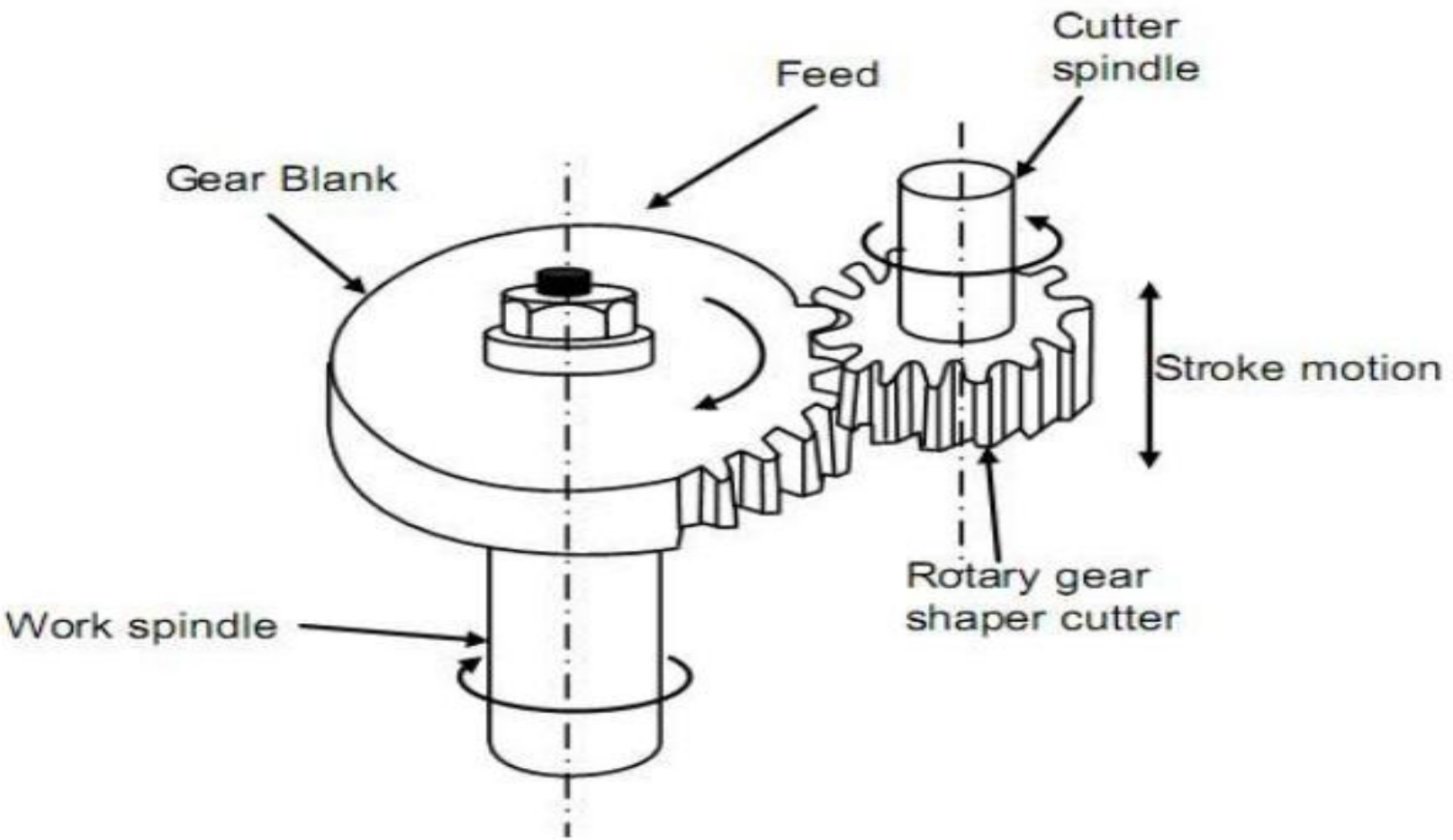
GEAR PLANING

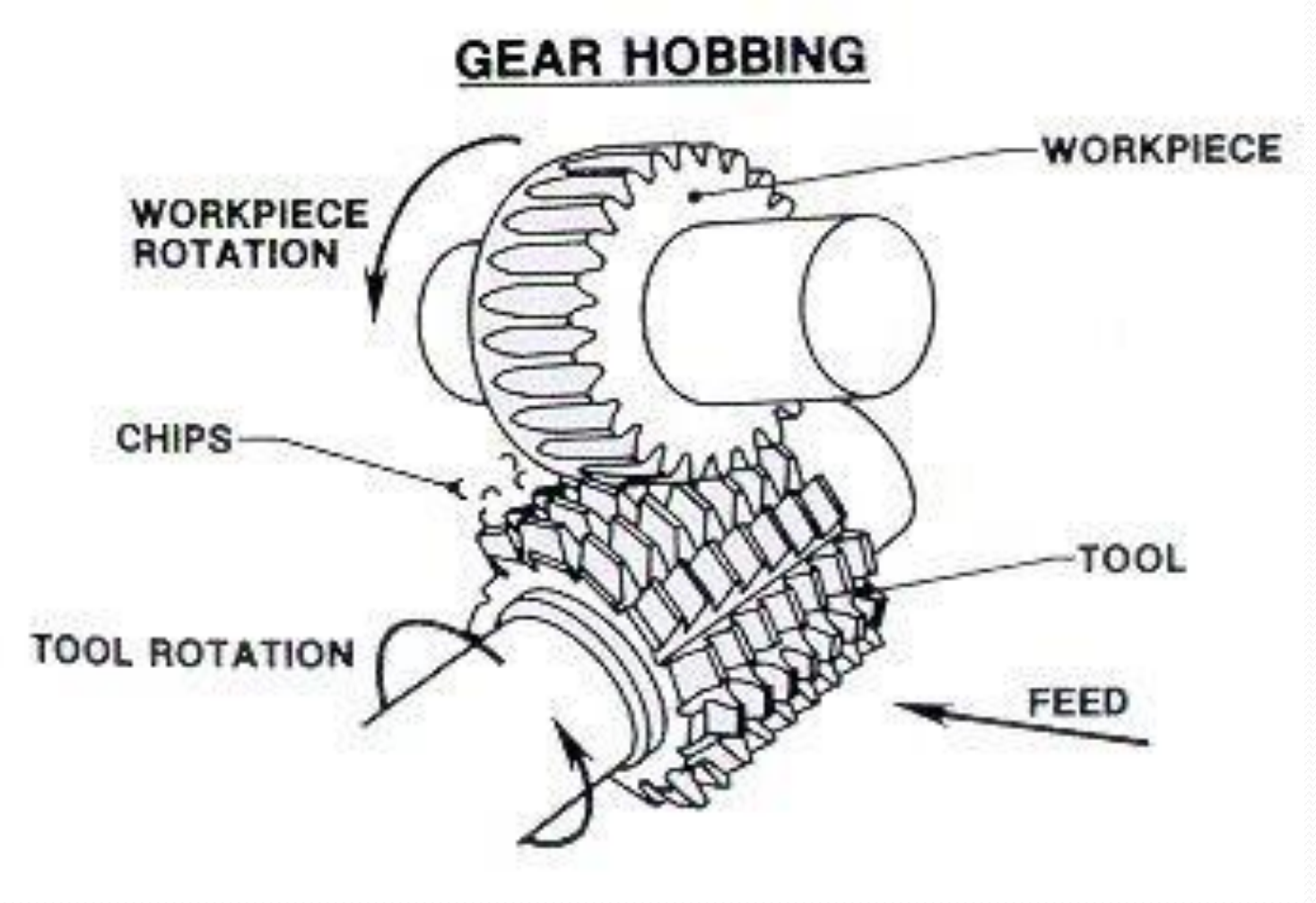


GEAR SHAPING MACHINE



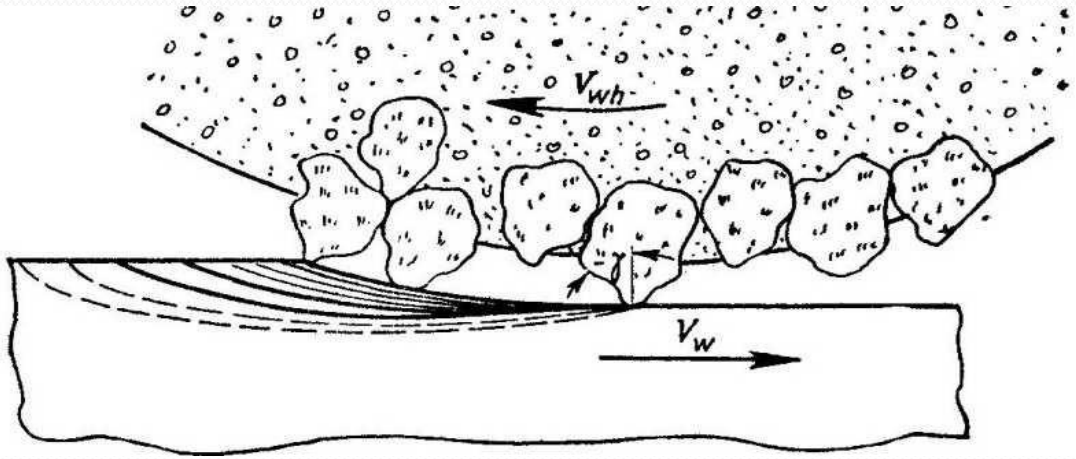
Gear Shaping



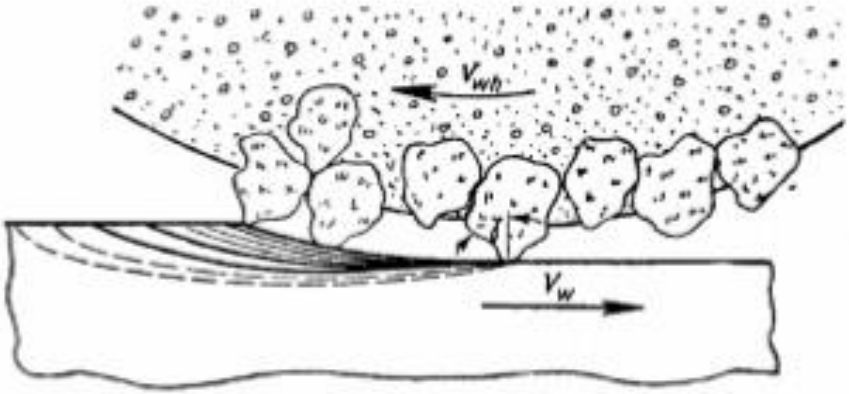

GEAR HOBBING
WORKPIECE
WORKPIECE ROTATION
CHIPS
TOOL
TOOL ROTATION
FEED

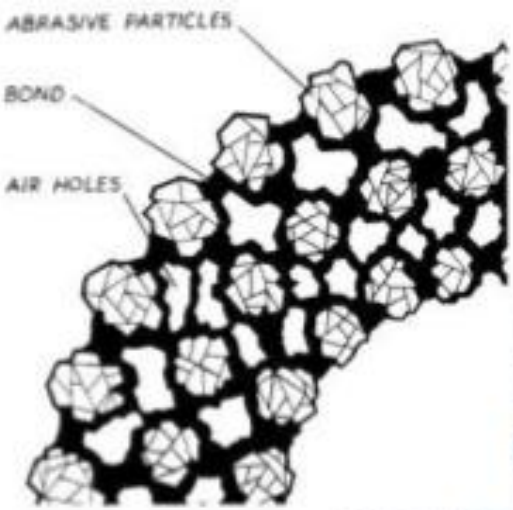
ABRASIVE PROCESSES: GRINDING

The cutting action of abrasive grits of disc type grinding wheel similar to cutting action of teeth of the cutter in slab milling.



Grinding





- Material cutting process which engages an **abrasive tool** whose cutting elements are **grains** of abrasive material known as **grit**.
- Grits are characterized by **sharp cutting points, high hot hardness, chemical stability and wear resistance**.
- The grits are held together by a suitable **bonding material** to give shape of an abrasive tool.

Grinding – Advantages & Applications

- Advantages
  - Dimensional accuracy
  - Good surface finish
  - Good form accuracy
- Applications
  - Surface finishing
  - Descaling, deburring
  - Finishing of flat as well as cylindrical surface
  - Grinding of tools and cutters and resharpening of the same.

GRINDING WHEELS

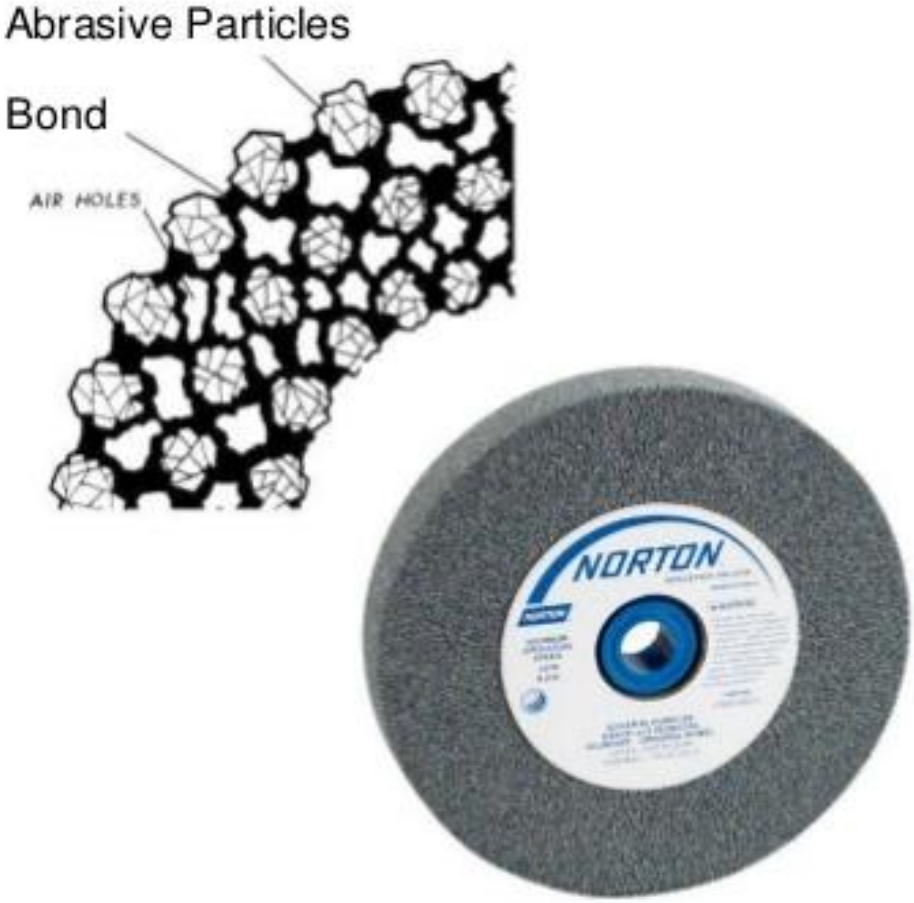
- Grinding wheel consists of hard abrasive grains called grits, which perform the cutting or material removal, held in the weak bonding matrix.

SELECTION OF GRINDING WHEEL

For grinding a job the right grinding wheel is to be selected. The selection of a grinding wheel will depend on the following factors.

- Material to be ground
- Amount of stock to be removed
- Finish required
- Area of contact
- Wheel speed
- Work speed
- Personal factor
- Method of cooling

Grinding Wheels



- Grinding wheel consists of hard abrasive grains called grits, which perform the cutting or material removal, held in the weak bonding matrix.
- A grinding wheel commonly identified by the type of the abrasive material used.

Specifications of Grinding Wheels

- **Compositional specification**
  - Type of grit material
  - Grit size
  - Bond strength of the wheel, commonly known as wheel hardness
  - Structure of the wheel denoting the porosity i.e. the amount of inter grit spacing
  - Type of bond material
  - Other than these parameters, the wheel manufacturer may add their own identification code prefixing or suffixing (or both) the standard code.

Types of abrasives

1. ***Natural abrasives*** - Emery (50 – 60 % crystalline Al_2O_3 + Iron Oxide), Sandstone or Solid Quartz, Corundum (75 - 90 % crystalline Al_2O_3 + Iron Oxide) and Diamond.

2. ***Artificial abrasives*** - Aluminium Oxide (Al_2O_3), Silicon Carbide (SiC), Artificial diamond, Boron Carbide and Cubic Boron Nitride (CBN).

Bond

- It is an adhesive substance which holds the abrasive grains together to form the grinding wheel.

- ***Types of bonds -*** *Bonds are classified into two types*

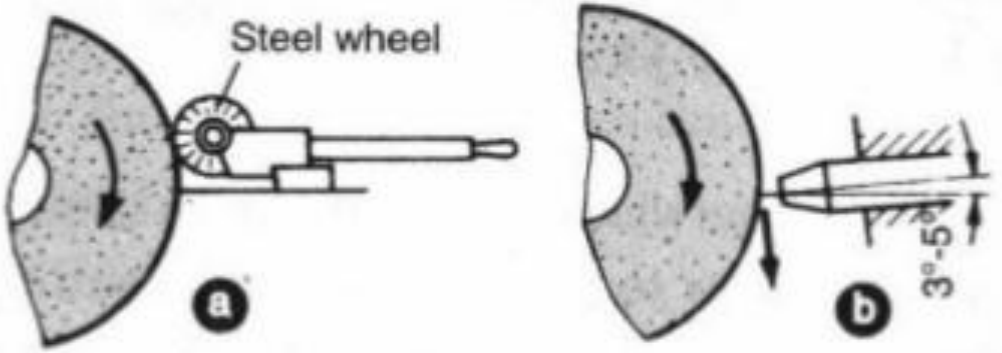
1. Organic (Resinoid, Rubber, Shellac & Oxychloride)
2. Non – Organic (Metallic, Vitrified & Silicate)

Selection of Grinding Wheel

- **Bond Material**
  - Vitrified Bond (V)
    - Wheel surface speed 2000 m/min
    - Can not be used where mechanical impact or thermal variations are like to occur.
  - Resin bond (B)
    - For operations requiring very strong wheels
    - Surface speed up to 3000 m/min
  - Shellac Bond (S)
    - Grinding fine edges on cutters
    - Making very large wheels
  - Rubber (R)
    - High finish at 5000 m/min
    - Thin wheels for wet cut-off operation.

Dressing

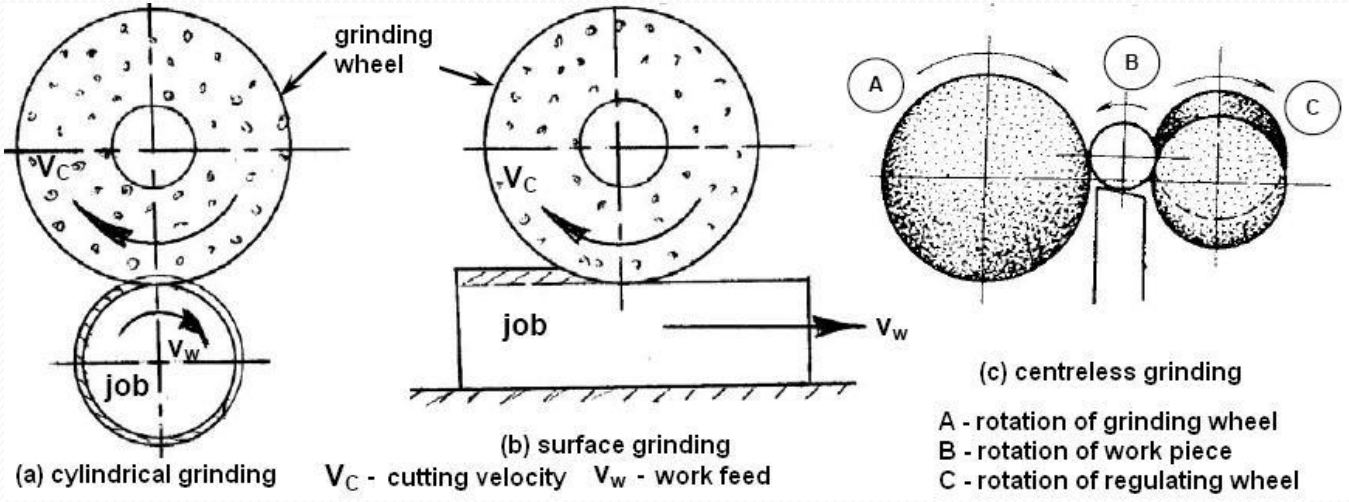
Dressing removes loading and breaks away the glazed surface so that sharp abrasive particles are again presented to the work. This is done **with** various type of dressers. A common type of wheel dresser, known **as** the star-dresser,



Dressing of grinding wheels. (*a*) Dressing with steel wheel, (*b*) dressing with diamond.

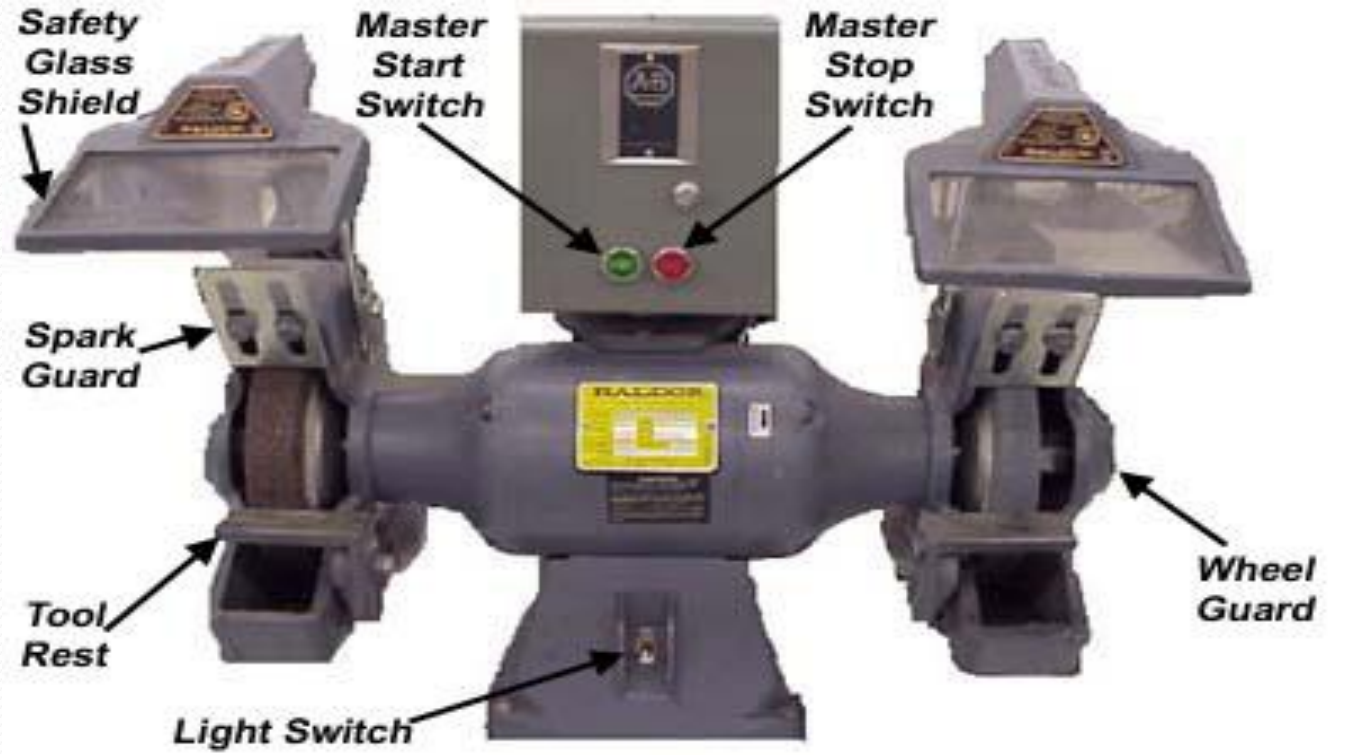
TYPES OF GRINDING PROCESS

1. Cylindrical grinding process.
2. Surface grinding process.
3. Centreless grinding process.



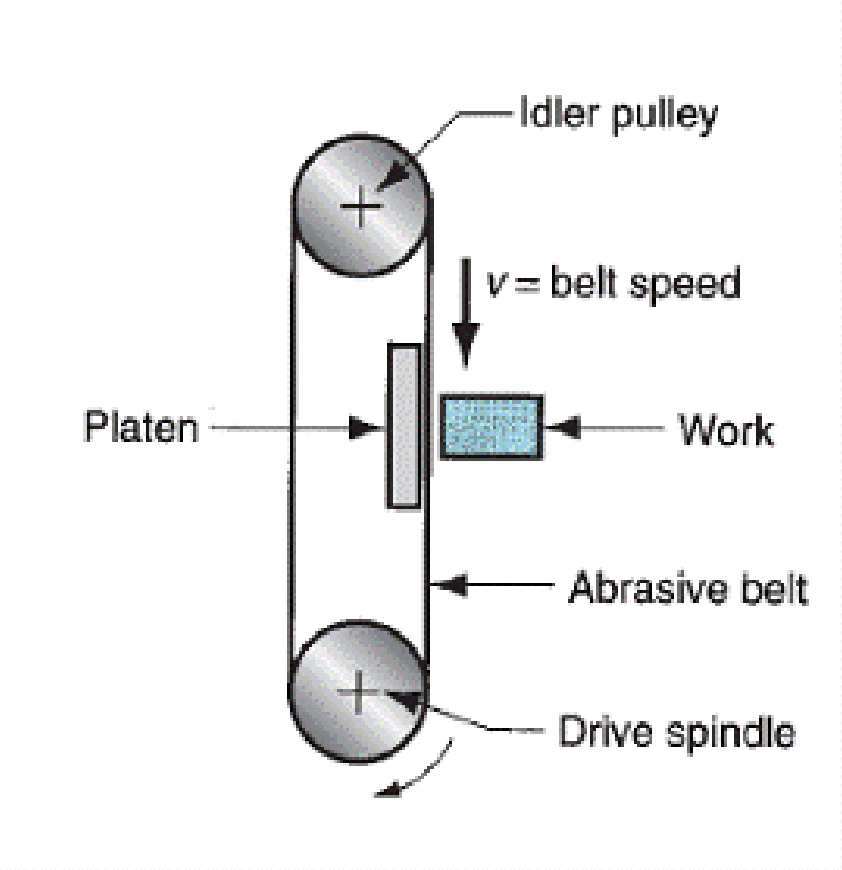
Rough Grinding Machine

1.Bench Grinder

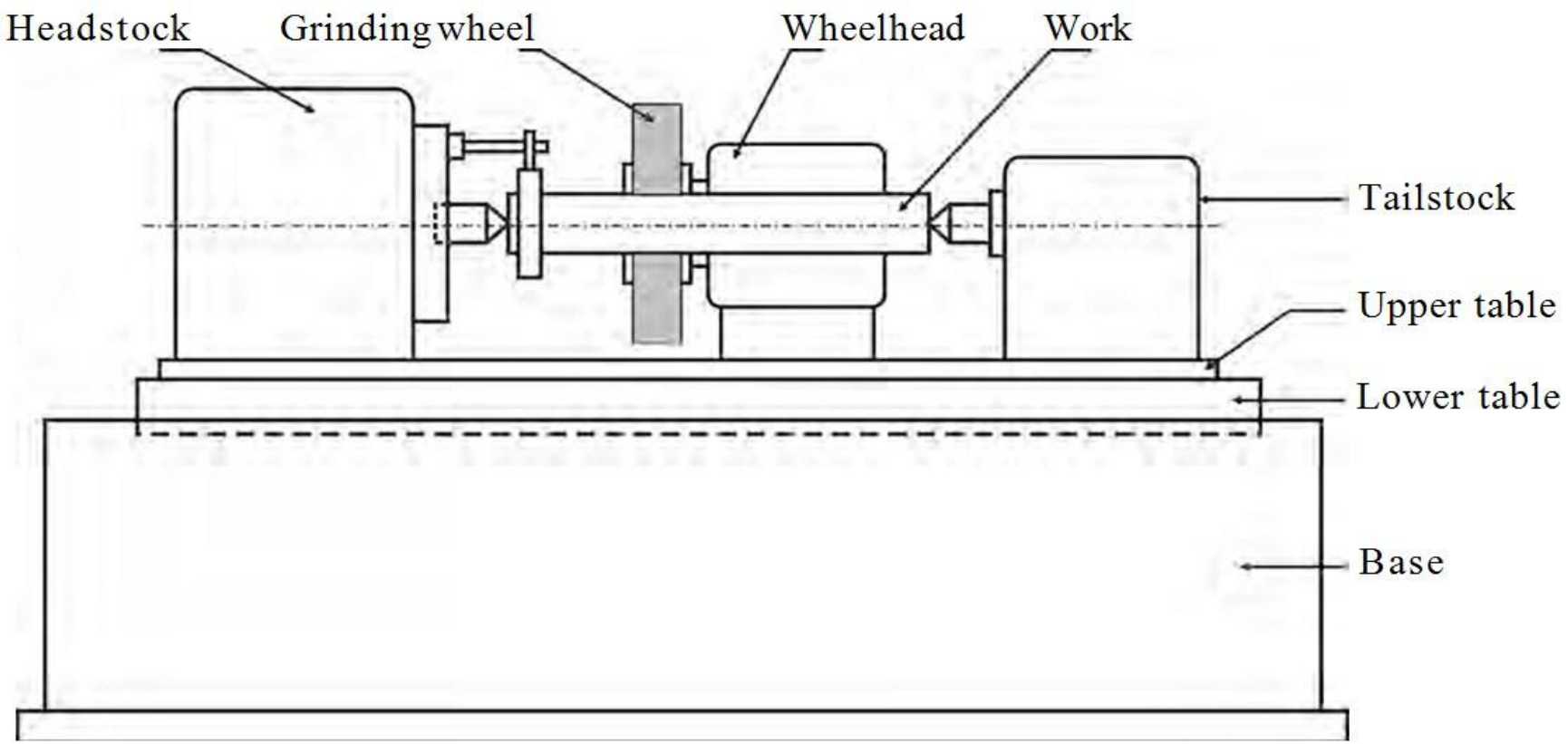


2 Portable Grinder

3.Abrasive Belt Grinding

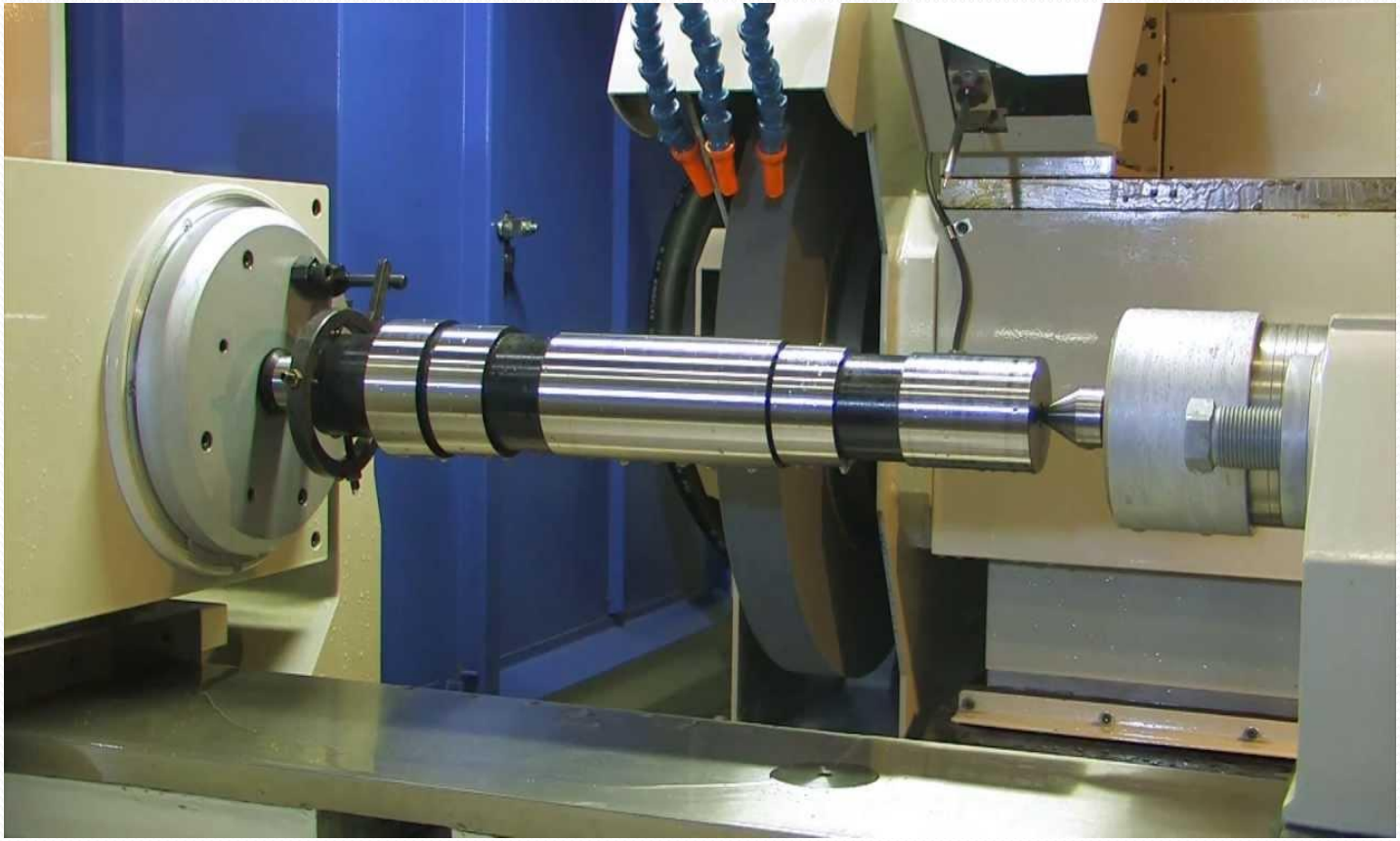


Precision Grinding Machine



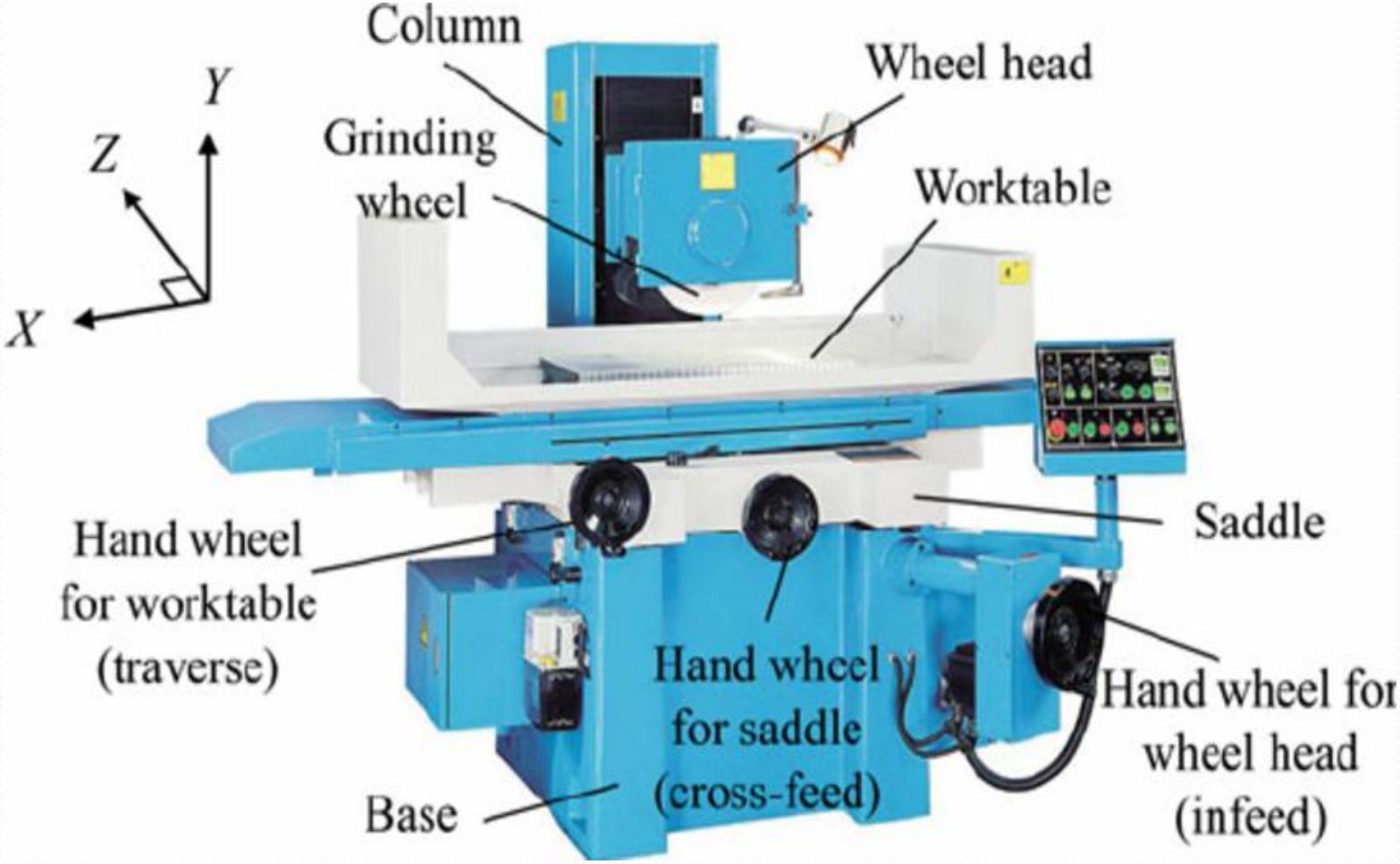
Cylindrical Grinding Machine

1.Cylindrical Grinder

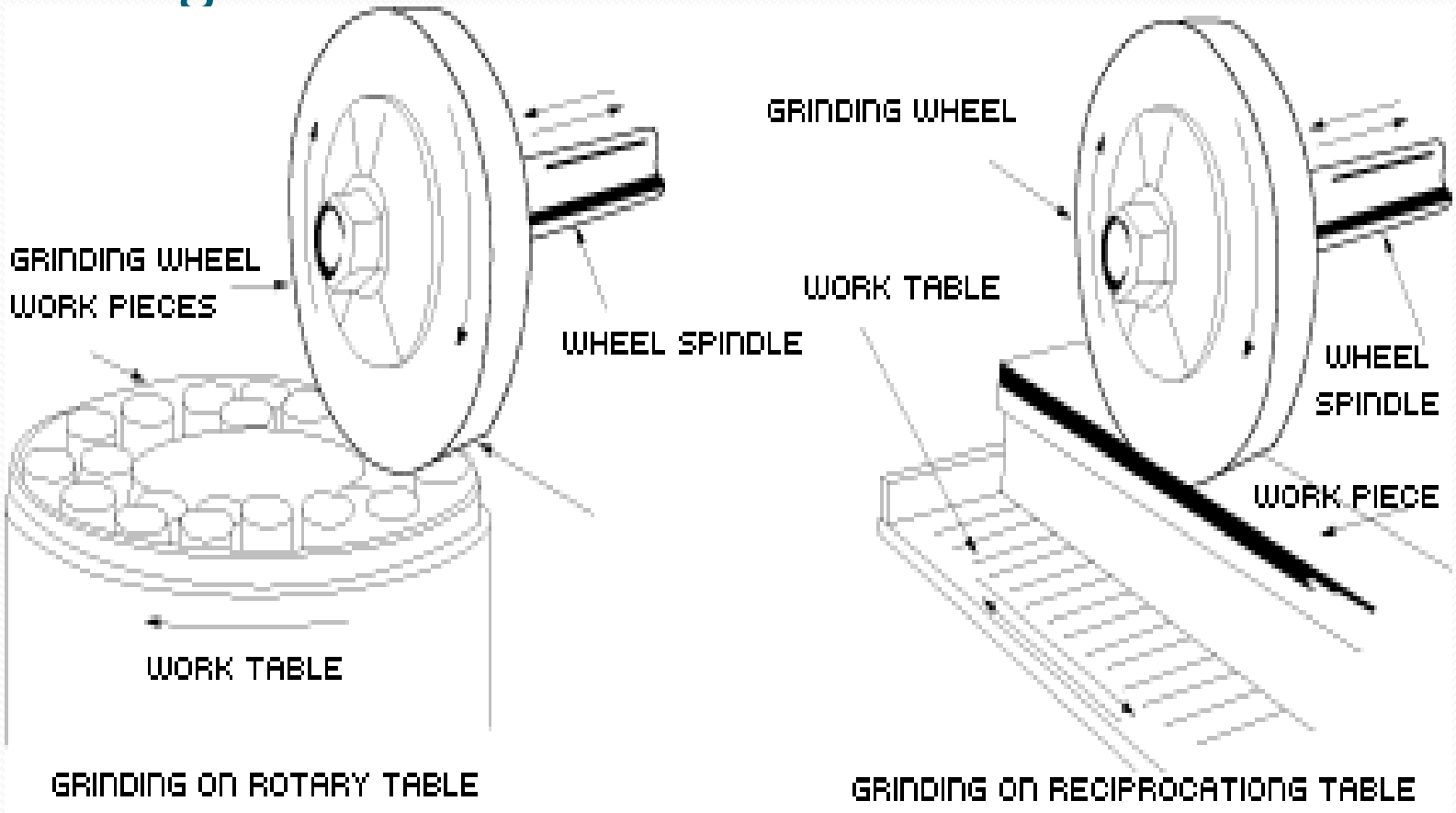


Surface Grinders

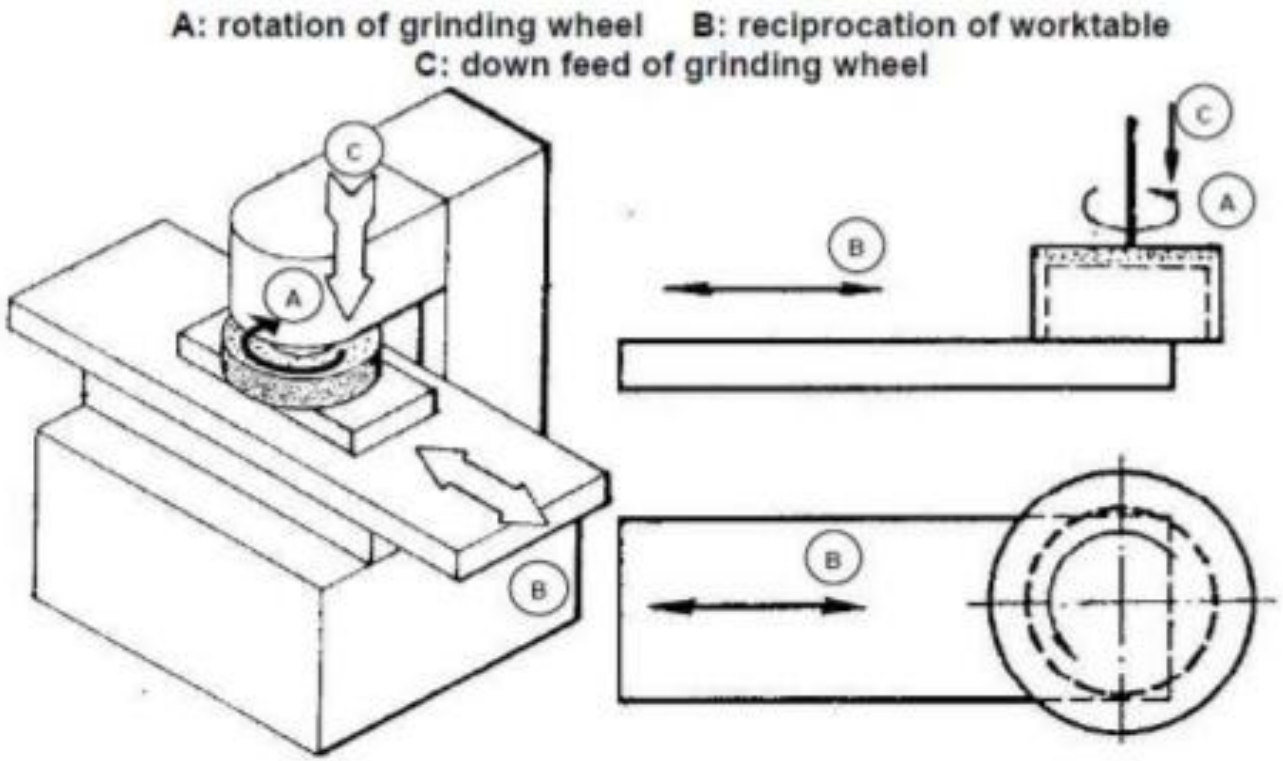
1. Horizontal Spindle Reciprocating Table surface grinding machines



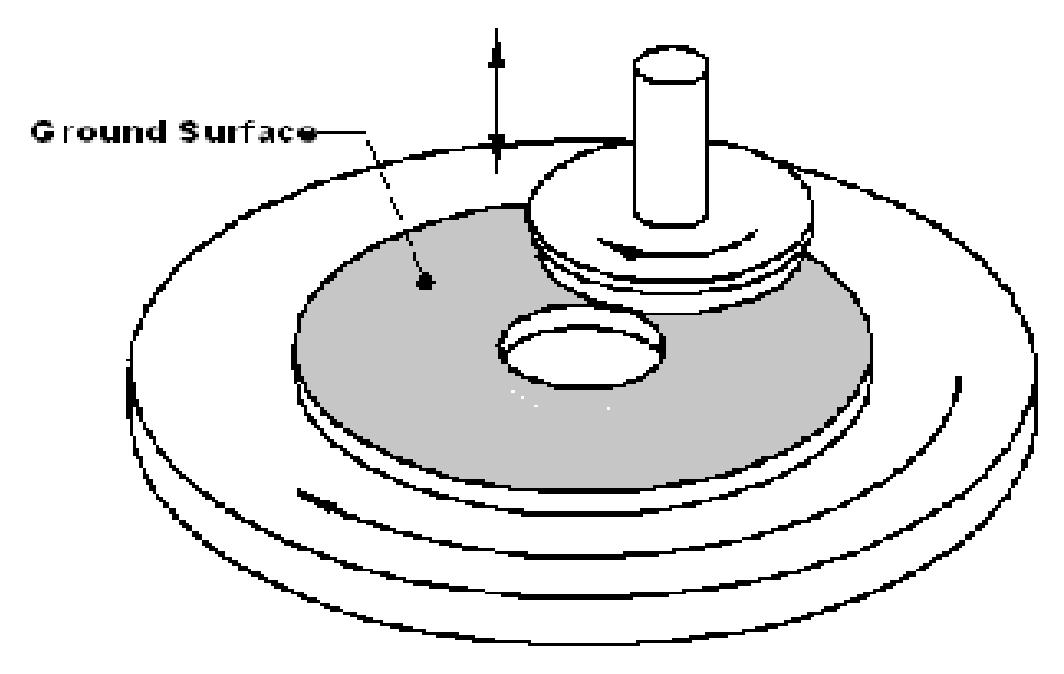
2. Horizontal Spindle Rotary Table surface grinding machines



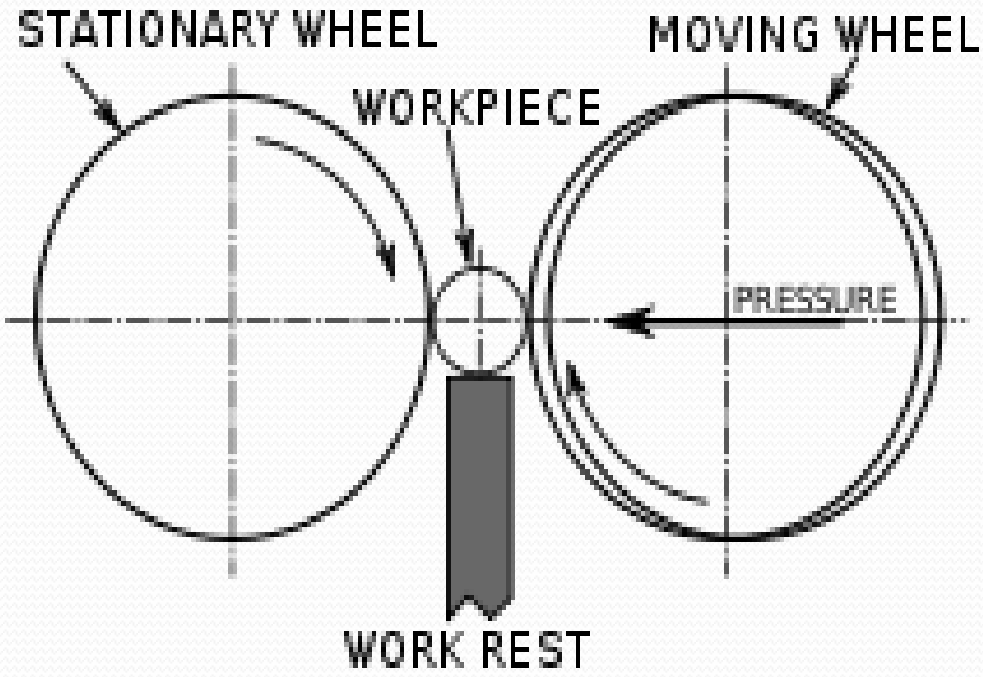
Vertical spindle and reciprocating table



Vertical Spindle Rotary Table surface grinding machines



Centreless Grinder



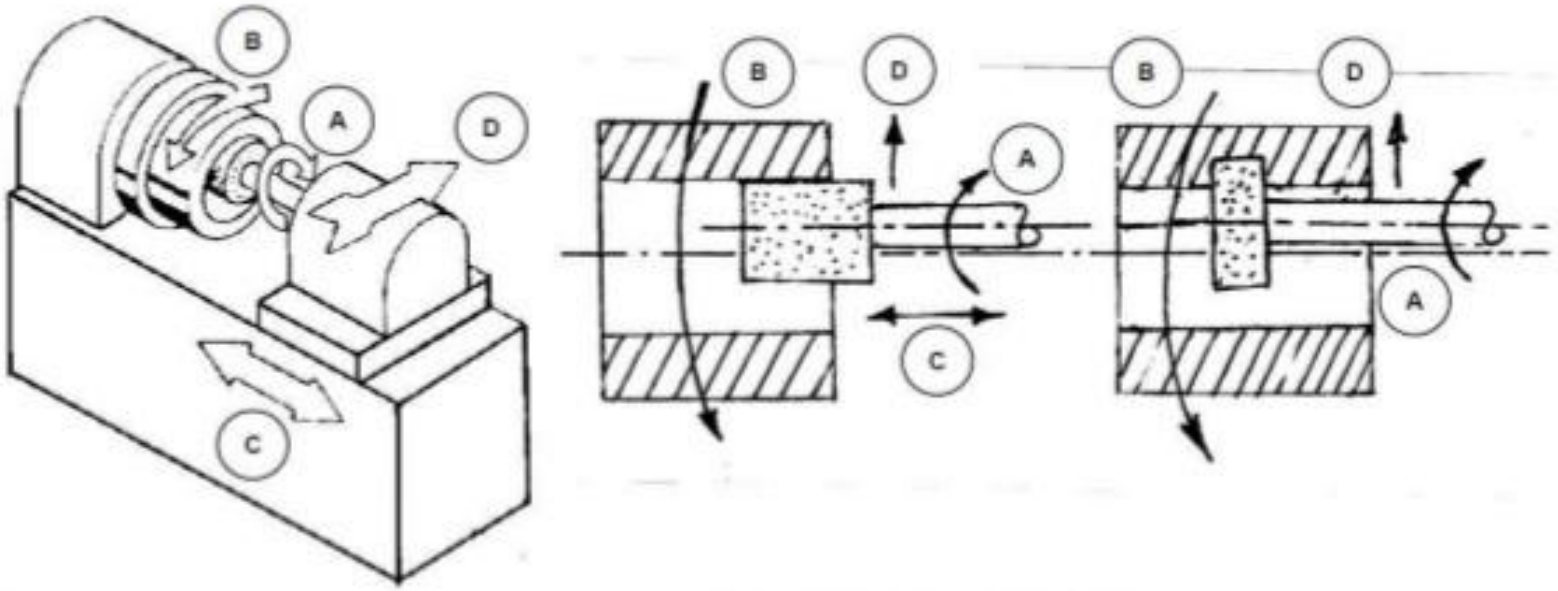
Internal Grinding

- **Internal grinding** is used to **grind** the **internal** diameter of the work piece.
- Tapered holes can be ground with the use of **internal** grinders that can swivel on the horizontal.
- Center less **grinding** is when the work piece is supported by a blade instead of by centers or chucks.

Chucking type internal grinder

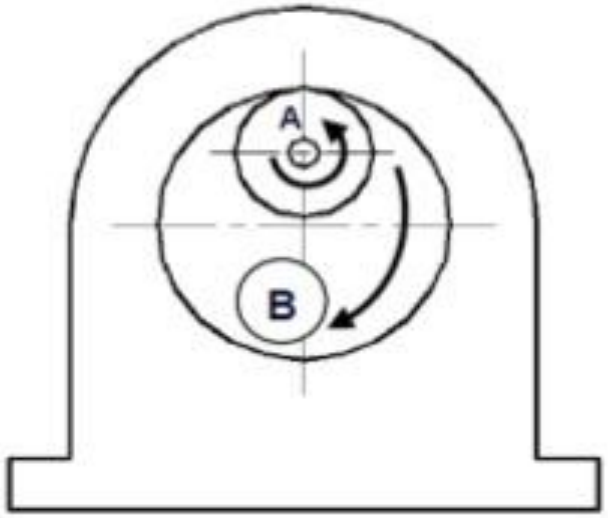
The workpiece is usually mounted in a chuck. A magnetic face plate can also be used. A small grinding wheel performs the necessary grinding with its peripheral surface. Both transverse and plunge grinding can be carried out in this machine.

A: rotation of grinding wheel
B: workpiece rotation
C: reciprocation of worktable
D: infeed

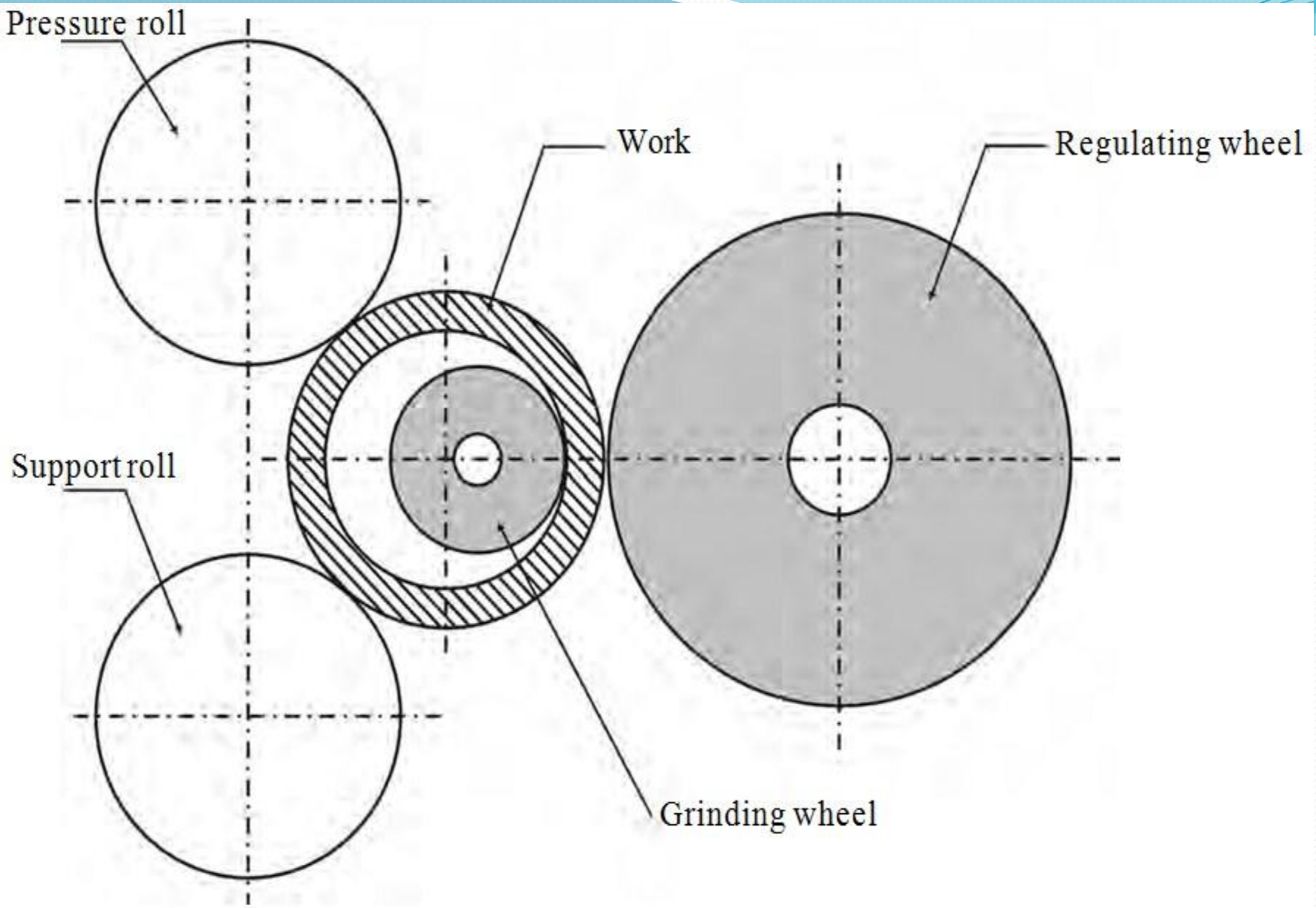


Planetary internal grinder

Planetary internal grinder is used where the workpiece is of irregular shape and can not be rotated conveniently as shown in Fig. below. In this machine the workpiece does not rotate. Instead, the grinding wheel orbits the axis of the hole in the workpiece.



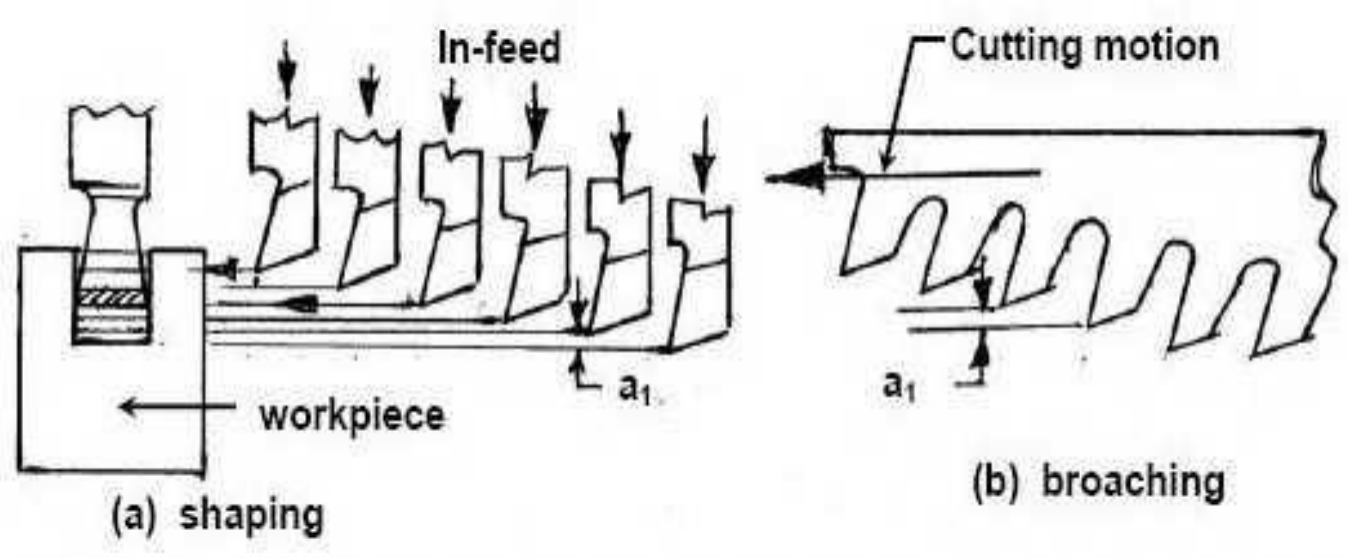
A: rotation of grinding wheel
B: orbiting motion of grinding

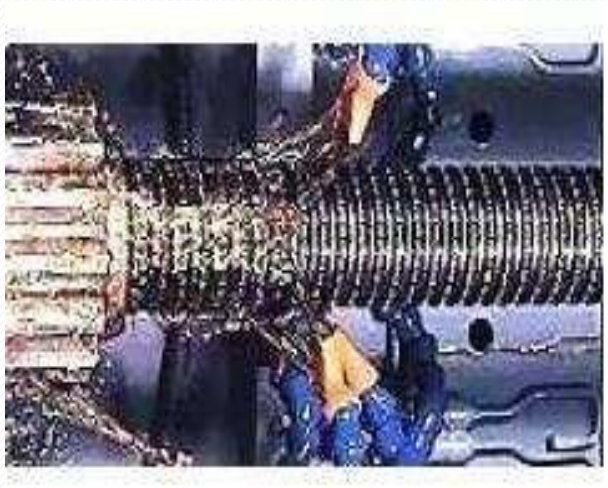


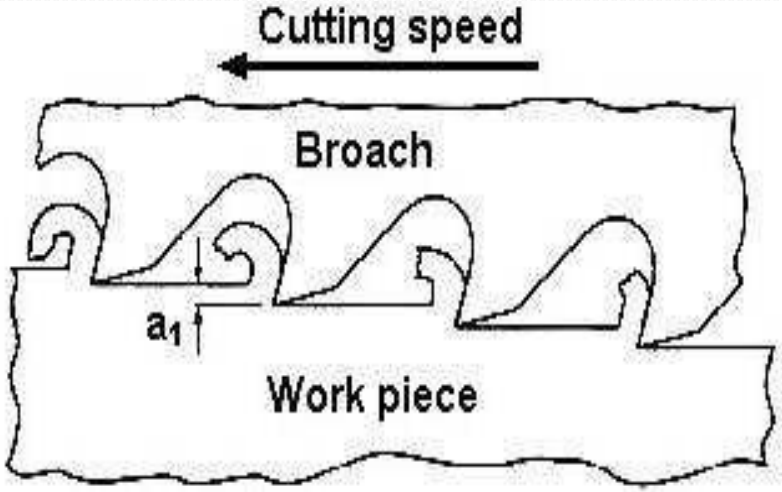
Internal Centreless Grinding

BROACHING

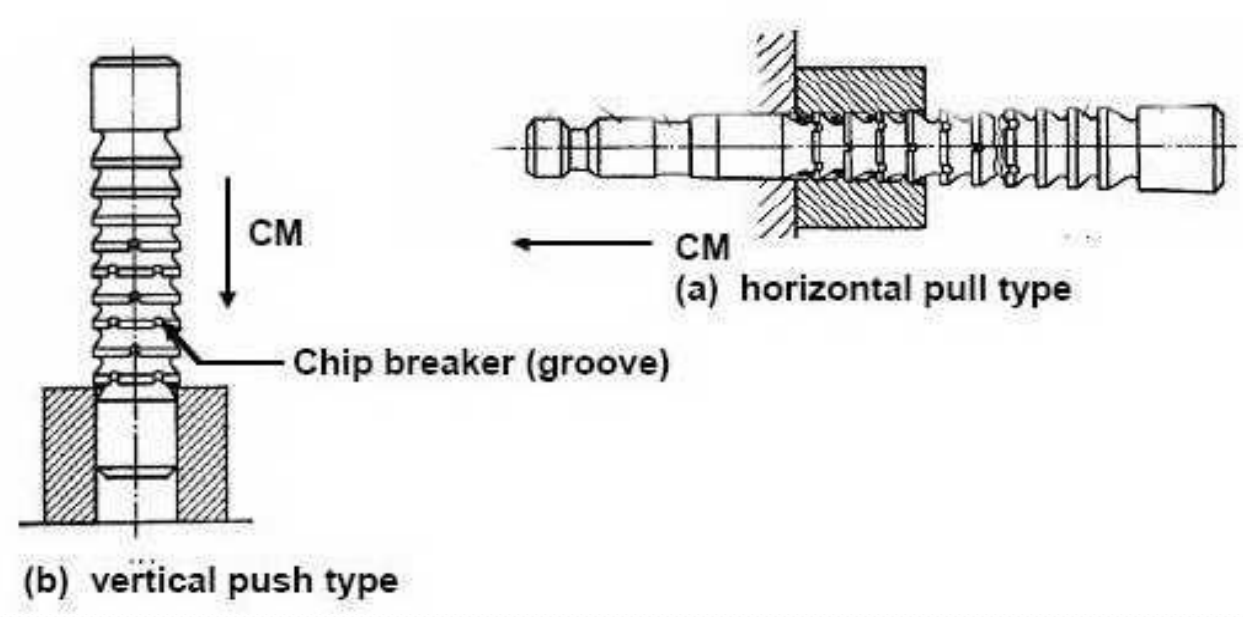
- Broaching is a machining process for removal of a layer of material of desired width and depth usually in one stroke by a slender rod or bar type cutter having a series of cutting edges with gradually increased protrusion.



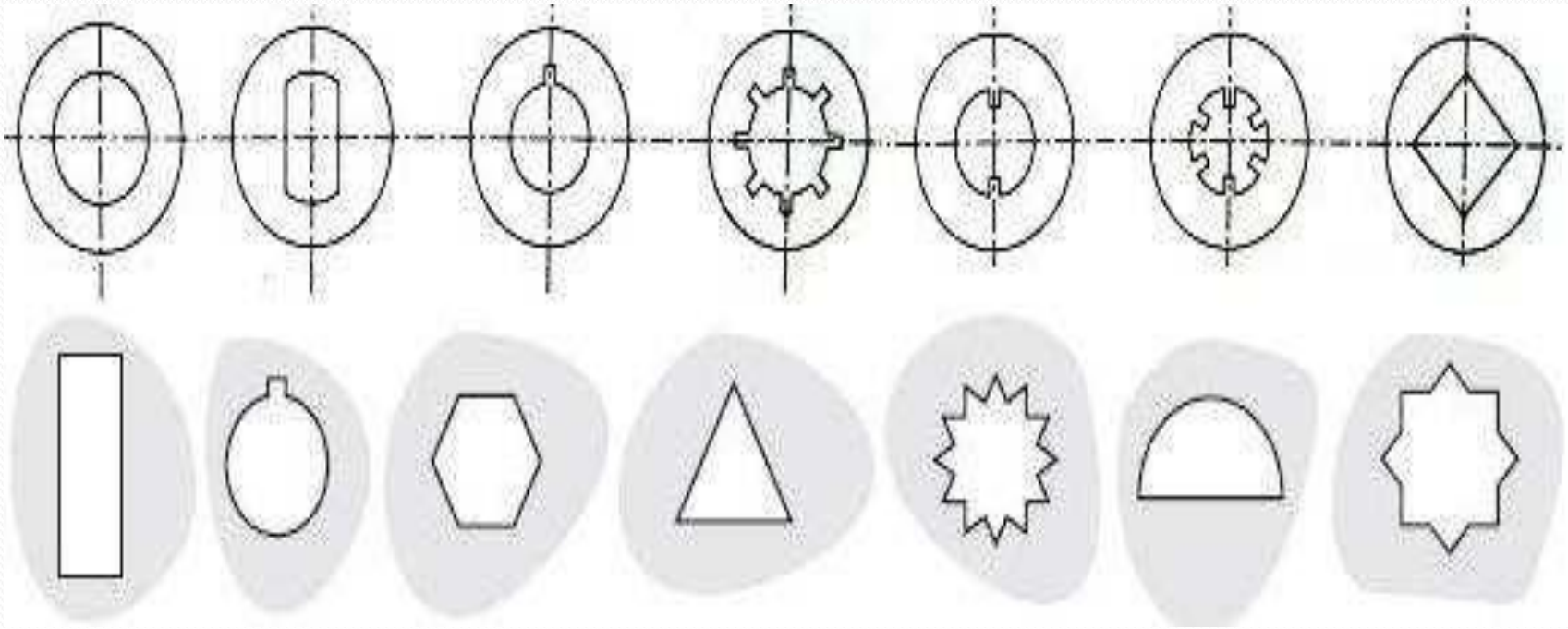




Basic principle of broaching



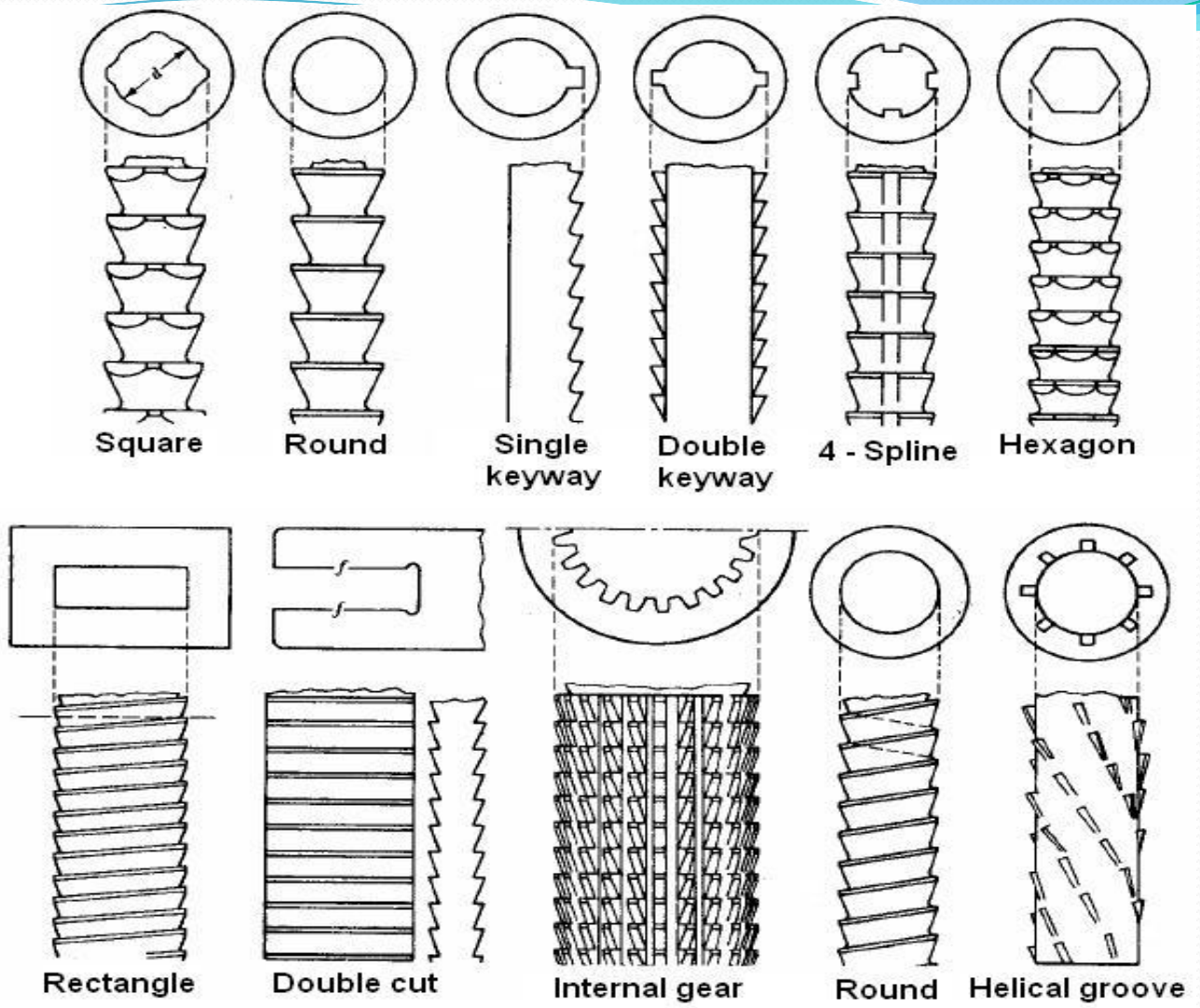
Schematic views of finishing hole by broaching



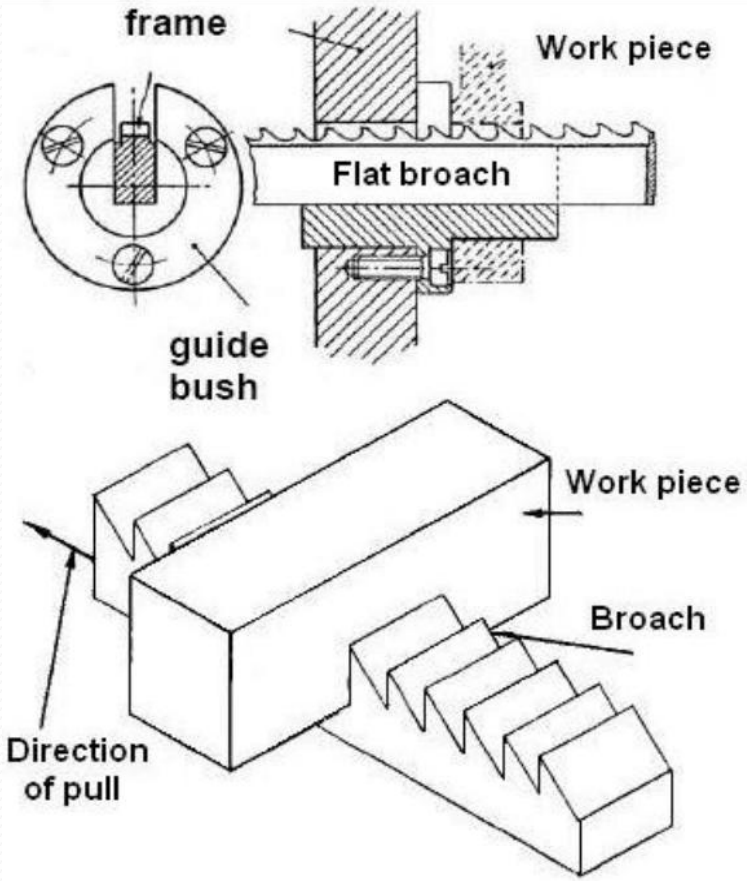
Typical examples of shapes produced by internal broaching

Different types of broaches

- Internal broaching or external broaching.
- Pull type or Push type.
- Ordinary cut or Progressive type.
- Solid, Sectional or Modular type.
- Profile sharpened or form relieved type.

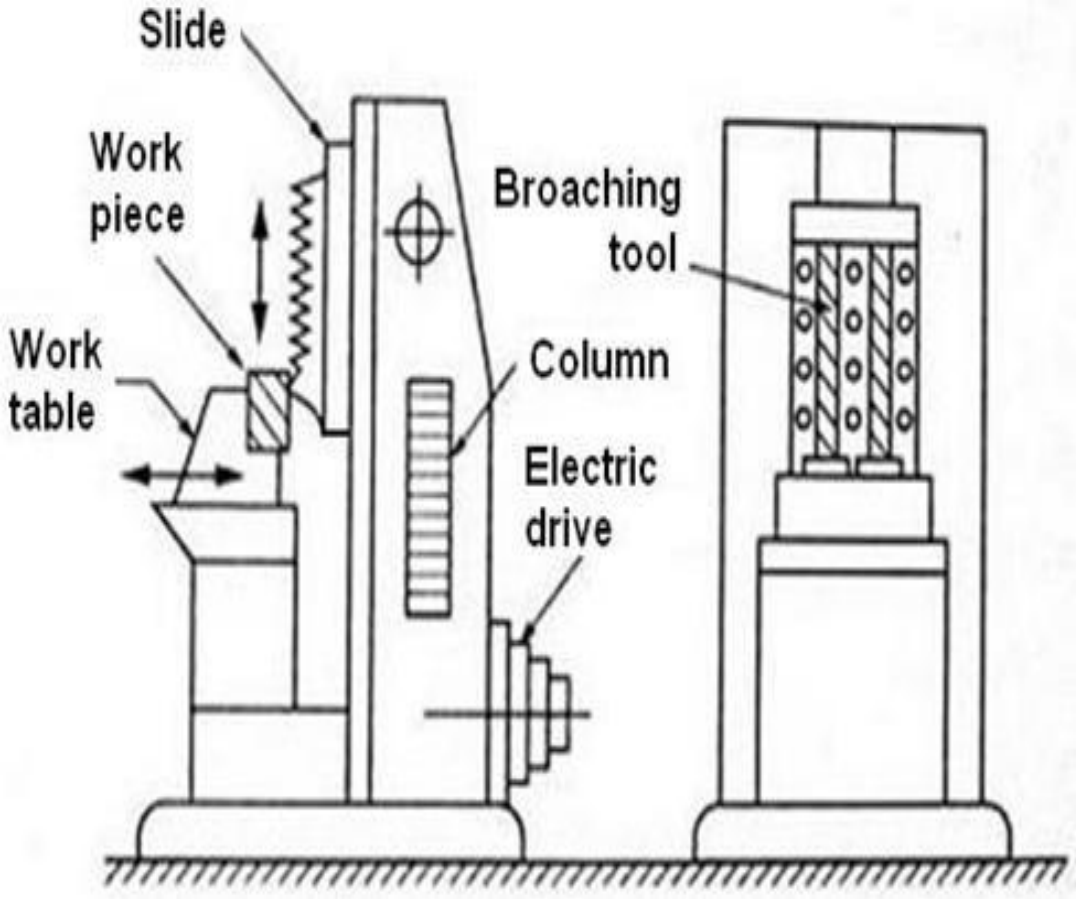


Internal broaching – tools

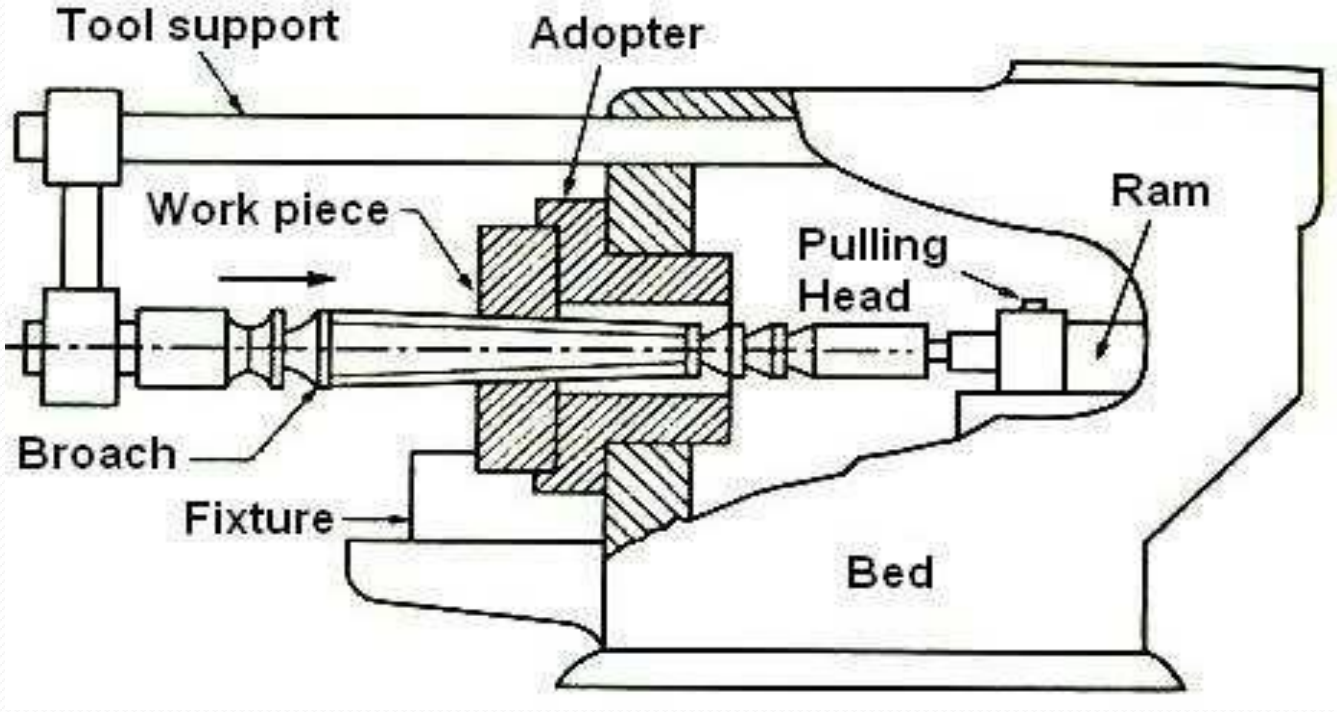


External broaching – making slot

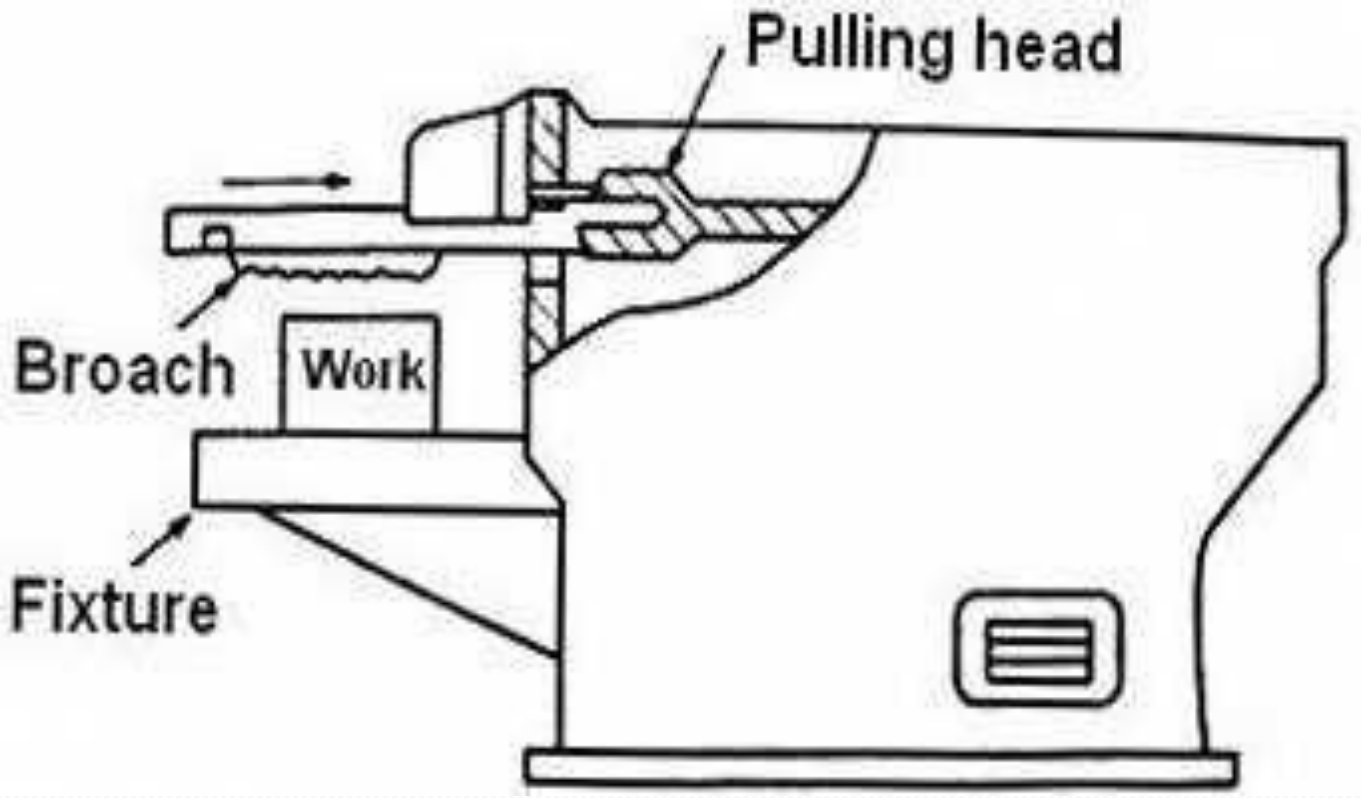
PUSH BROACHING MACHINES



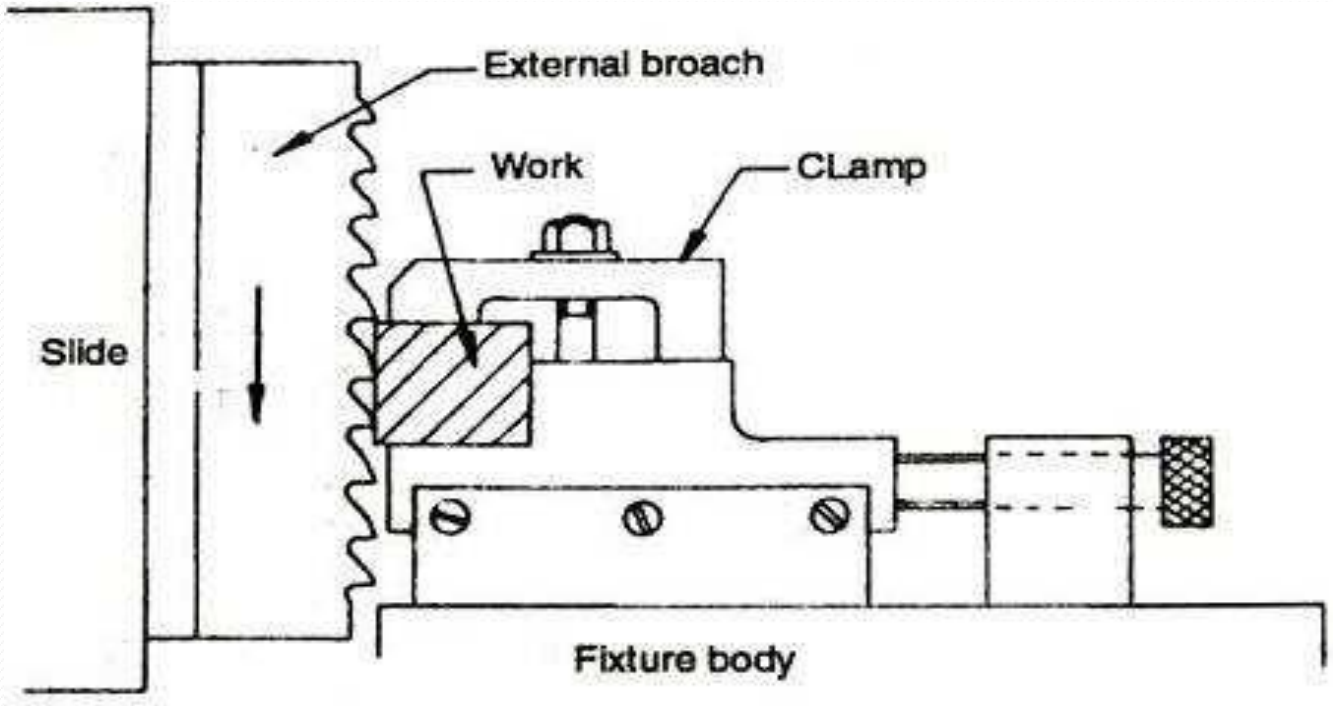
Push down type vertical surface broaching machine



Pull type horizontal internal broaching machine

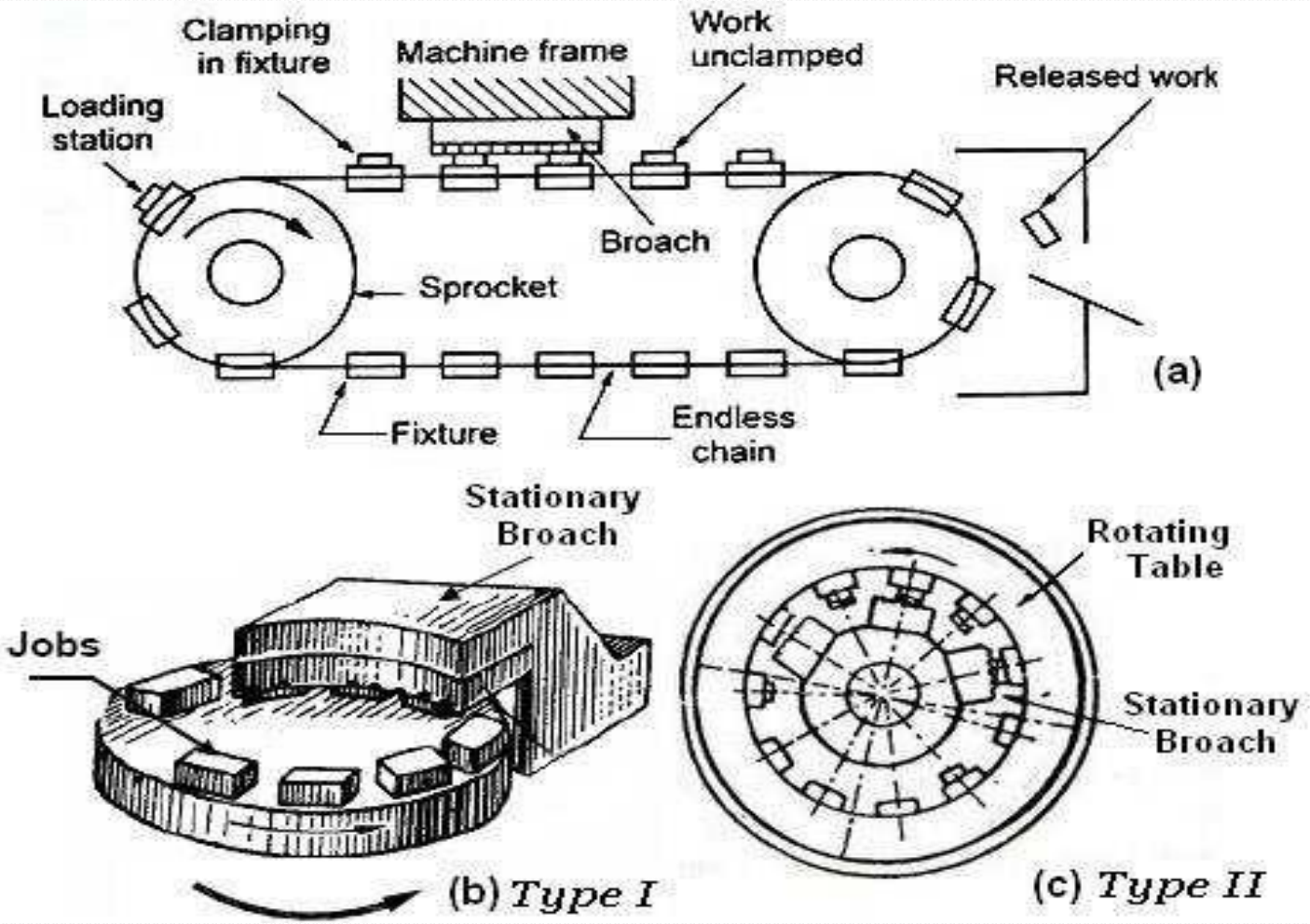


Horizontal surface broaching machine



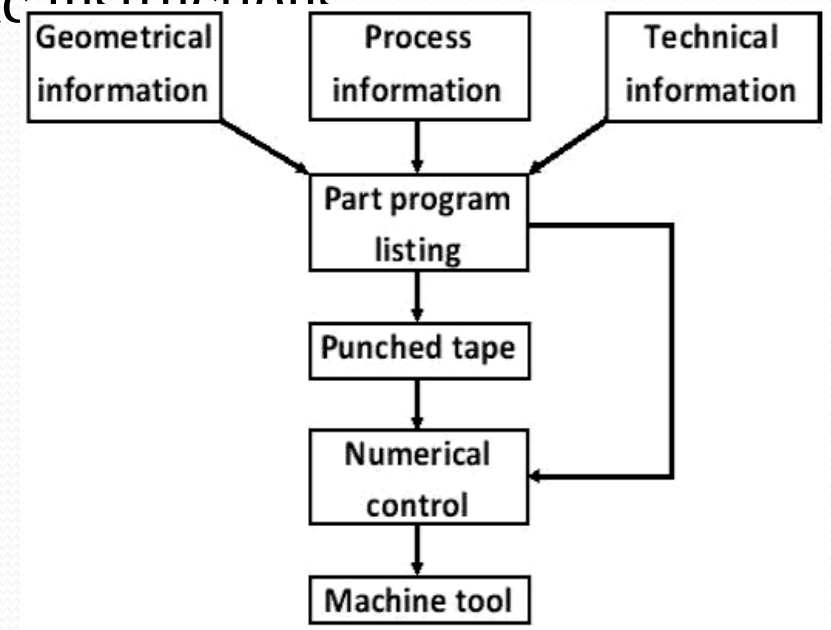
Vertical surface broaching machine

CONTINUOUS BROACHING MACHINES



NUMERICAL CONTROL MACHINE

- Numerical control of machine tools may be defined as a method of automation in which various functions of machine tools are controlled by letters, numbers, symbols and alphanumeric instructions

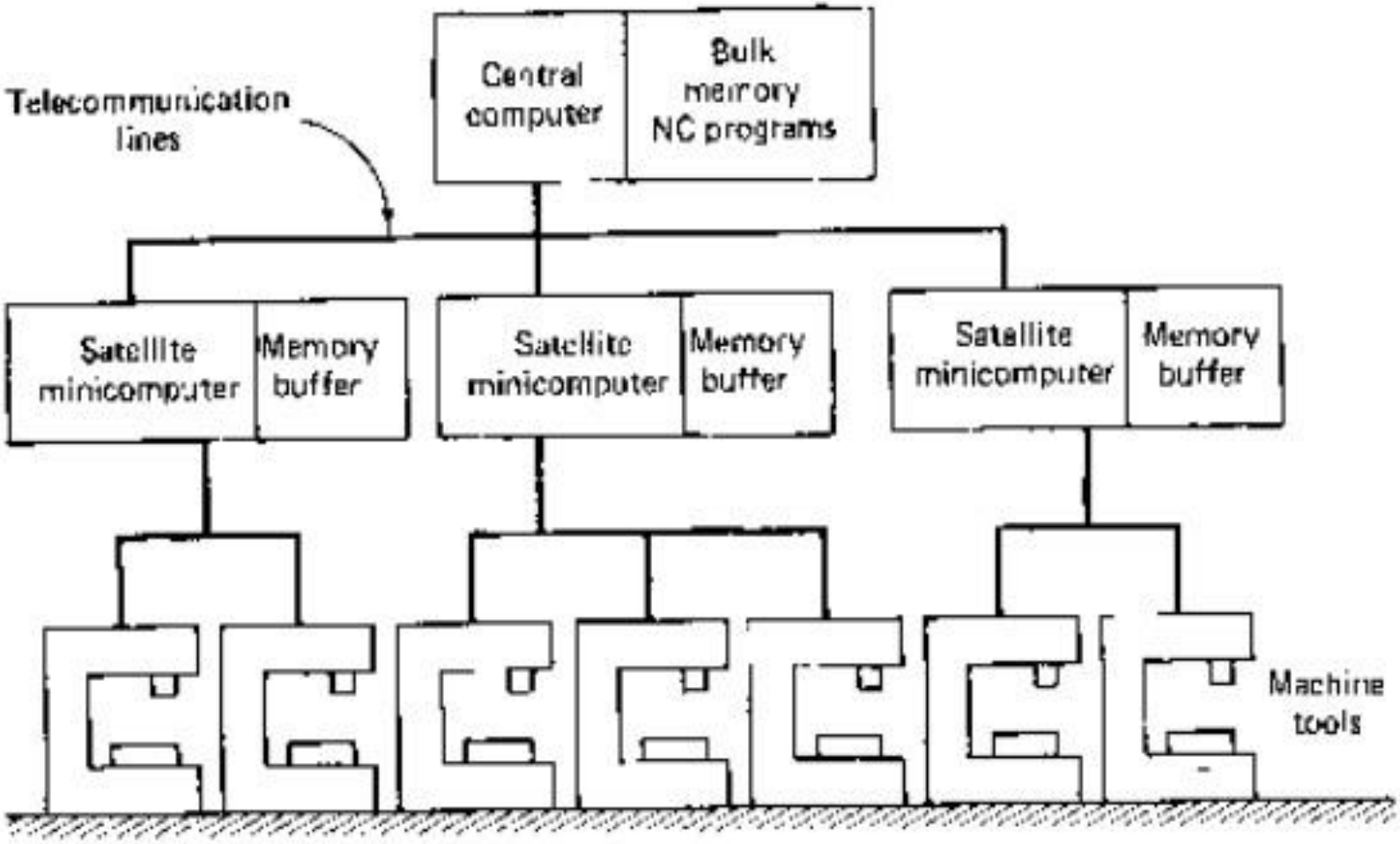


Types of NC systems

Machine controls are divided into three groups:

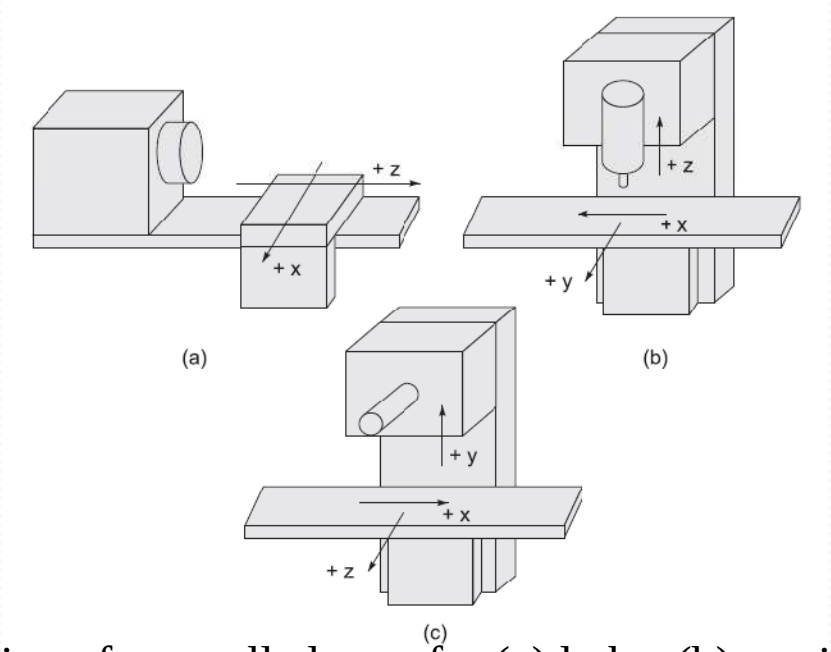
- Traditional numerical control (NC).
- Computer numerical control (CNC).
- Distributed numerical control (DNC).

Direct Numerical Control (DNC)



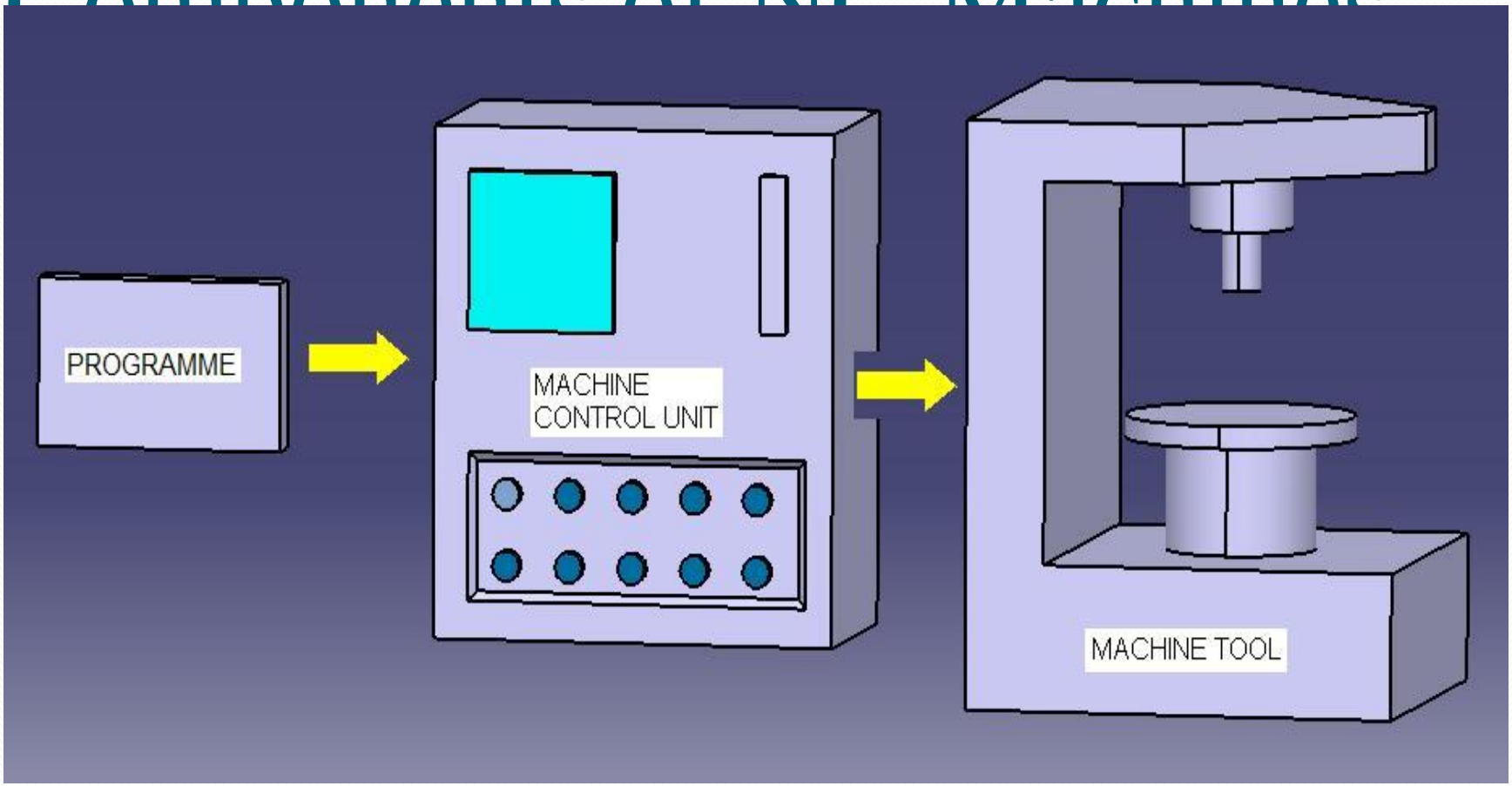
Controlled axes

- NC system can be classified on the number of directions of motion they are capable to control simultaneously on a machine tool.



Identification of controlled axes for (a) lathe, (b) vertical spindle milling machine and (c) horizontal spindle milling machine

Components of NC Machines



Classification of NC Machines Based on NC System

- *The Three major types of NC systems are:*
  - Point-to-point (PTP) system.
  - Contouring system.
  - Straight