Lecture on Machine Tools

Prepared By :

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Centre Lathe

BASIC COURSE INFORMATION

Course Title	Machine Tools
Course Code	IPE- 431
Credits	03
CIE Marks	90
SEE Marks	60
Exam Hours	2 hours (Mid Exam) 3 hours (Semester Final Exam)
Level	7th Semester

Course Learning Outcomes (CLOs):

CLO 1

Understand functions of various Machines and Cutting Tools used in Manufacturing Process

CLO 2

Identify and select appropriate cutting tools and tool materials for different machining operations.

CLO 3

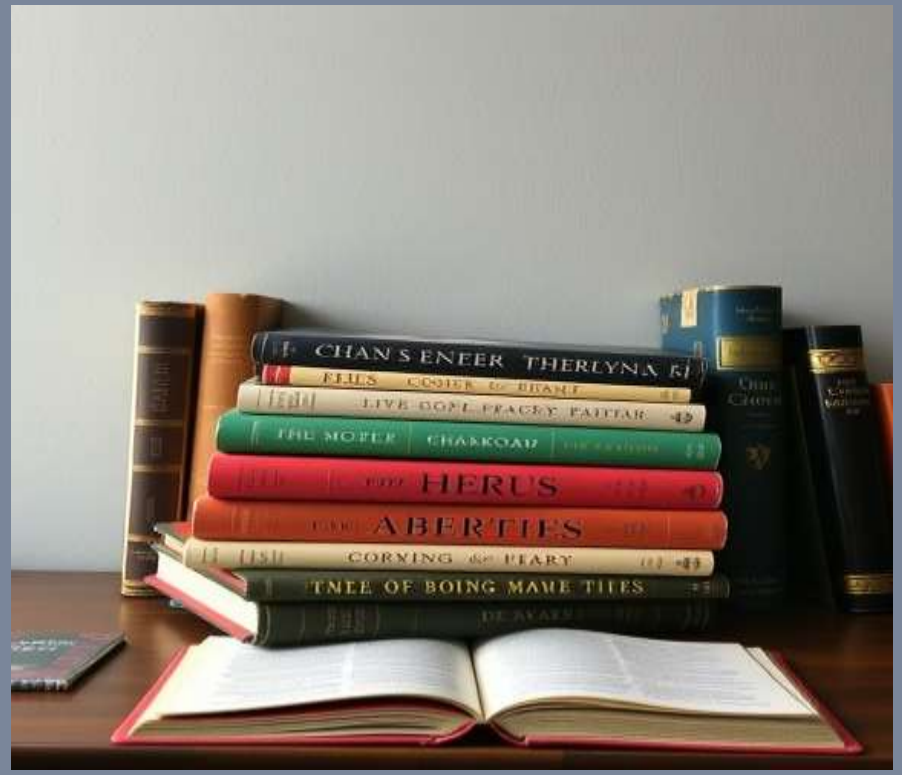
operate machine tools safely and efficiently, following safety protocols and best practices.

CLO 4

Develop and implement basic machining processes for the production of simple components.

Reference Books:

1. "Machine Tool Design" by N K Mehta
2. "Design and Machine Tools" by S K Basu and D K Pal
3. "Machine Tools Handbook: Design and Operation" by P H Joshi



Serial No	Course Content	Hours	CLOs
01.	Workshop Tools	04	CLO 1, CLO 2
02.	Lathe Components, Classification, Operation	08	CLO 2, CLO 3
03.	Milling Classification, Components, Cutting Tools, Operations, Shaper Machine Functions and Types and applications	14	CLO 2, CLO 3
04.	Grinding Machine (Working Principle, Types, Surface, Gear, Tool & Cutter Grinder), Drilling Machine (Introduction, Working Principle, Construction)	08	CLO 1,CLO 3,CLO 4

ASSESSMENT PATTERN
CIE- Continuous Internal Evaluation (90 Marks)

Bloom's Category Marks (out of 90)	Tests (45)	Assignments(10)	Class Test (20)	Quiz(5)	External Participation in Curricular/Co-Curricular Activities (10)
Remember	5		10	05	
Understand	5	05	10		
Apply	10				**10**
Analyze	15				
Evaluate	10				
Create		**05**			

SEE- Semester End Examination (60 Marks)

Bloom's Category	Test
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	10

Week No.	Topics	Teaching Learning Strategy	Assessment strategy	Alignment To CLO
1.	Workshop Tools (Forging Tools)	Lecture, PPT	Quiz, Written exam, CT	CLO 1
2.	Workshop Tools (Fitting Tools)	Lecture, Video Presentation, PPT, Problem Practice	Quiz, Written exam, CT	CLO 1
3.	Lathe Components	Lecture, PPT, Video Presentation	Assignment, Quiz, Written exam, CT	CLO 1, CLO 2
4.	Lathe Classification	Lecture, Problem Practice, Video Presentation, PPT	Assignment, Quiz, Written exam, CT	CLO 2

Week No.	Topics	Teaching Learning Strategy	Assessment strategy	Alignment To CLO
5.	Lathe Operation	Lecture, Video Presentation, PPT	Quiz, Written exam, CT	CLO 2, CLO 3
6.	Lathe Operation	Lecture, Video Presentation, PPT, Problem Solving	Quiz, Written exam, CT	CLO 3
7.	Milling Classification	Lecture, Oral Presentation, Video Presentation, PPT	Assignment, Quiz, Written exam, CT	CLO 2
8.	Milling Components	Lecture, Oral Presentation, Video Presentation, PPT, Problem Practice	Assignment, Quiz, Written exam, CT	CLO 3

Week No.	Topics	Teaching Learning Strategy	Assessment strategy	Alignment To CLO
9.	Milling Components	Lecture, Oral Presentation, PPT	Quiz, Written exam, CT	CLO 3
10.	Milling Cutting Tools	Lecture, PPT	Assignment, Quiz, Written exam, CT	CLO 2,CLO 3
11.	Milling Operations	Lecture, Oral Presentation, PPT	Assignment, Quiz, Written exam, CT	CLO 3
12.	Shaper Machine Function and Types	Lecture, PPT, Problem Solving	Assignment, Quiz, Written exam, CT	CLO 2,CLO 3

eek No.	Topics	Teaching Learning Strategy	Assessment strategy	Alignment To CLO
13.	Shaper Mechanism and applications	Lecture, Oral Presentation, Video Presentation, PPT	Assignment, Quiz, Written exam, CT	CLO 1
14.	Grinding Machine (Working Principle, Types)	Lecture, Oral Presentation, Video Presentation, PPT	Assignment, Quiz, Written exam, CT	CLO 3, CLO 4
15.	Grinding Machine (Surface, Gear, Tool & Cutter Grinder)	Lecture, Oral Presentation, Video Presentation, PPT	Assignment, Quiz, Written exam, CT	CLO 3, CLO 4
16.	Drilling Machine (Introduction, Working Principle, Construction)	Lecture, Oral Presentation, Video Presentation, PPT	Assignment, Quiz, Written exam, CT	CLO 3, CLO 4

Week	Topic	Page No.
1	Workshop Tools (Forging Tools)	13-26
2	Workshop Tools (Fitting Tools)	27-40
3	Lathe Components	
4	Lathe Classification	
5	Lathe Operation	
6	Lathe Operation	
7	Milling Classification	
8	Milling Components	
9	Milling Components	
10	Milling Cutting Tools	
11	Milling Operations	
12	Shaper Machine Function and Types	
13	Shaper Mechanism and applications	
14	Grinding Machine (Working Principle, Types)	

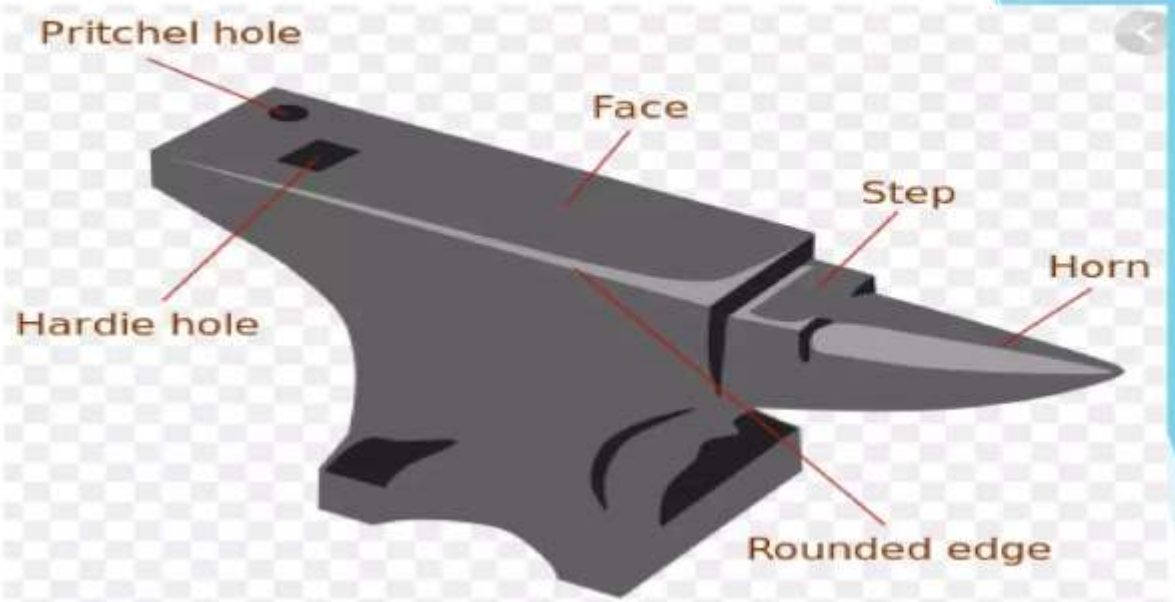
MACHINE TOOL

- Machines used for carrying out metal cutting operations or finishing operations to impart the desired shape
- Power driven machine
- Functions – to hold, support , guide, work piece & tool
- To give motion to w/p & tool with desired speed

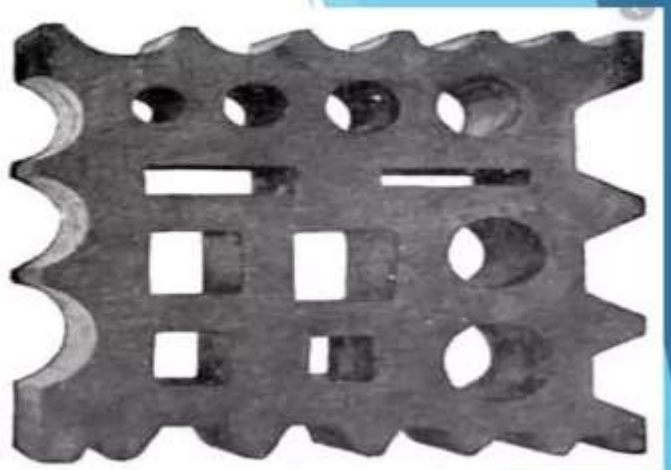
Smithing and forging tools

1. Anvil

- Pritchel hole is used for bending rod of smaller diameter and a die for hot punching.
- Hardie hole is used for holding square shanks of various fittings.



2. Swage block: used mainly for squaring, sizing, heading, bending and forming operations.



3. Hammer

1. **Hand hammer** (used by the smith himself): weight varies between 0.5 to 2 kg. eg. Ball peen hammer, straight peen hammer and cross peen hammer
2. **Sledge hammer** (used by the striker): weight varies between 4 to 10 kg.

Ball peen hammer

cross peen hammer

straight peen hammer

Sledge hammer

4. Tongs

Used for holding the hot forged work.

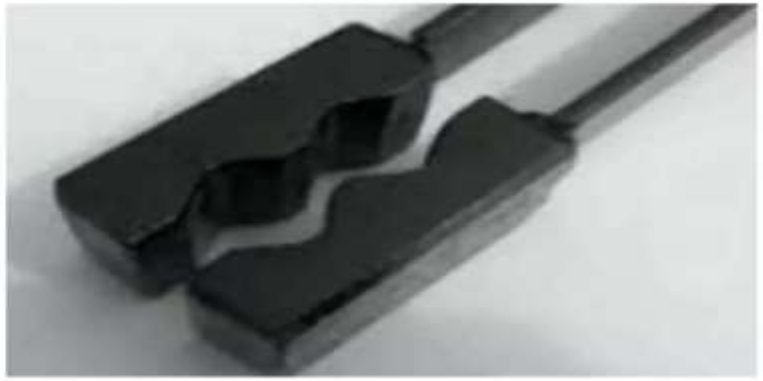
Rivet or ring tong

Gad tong

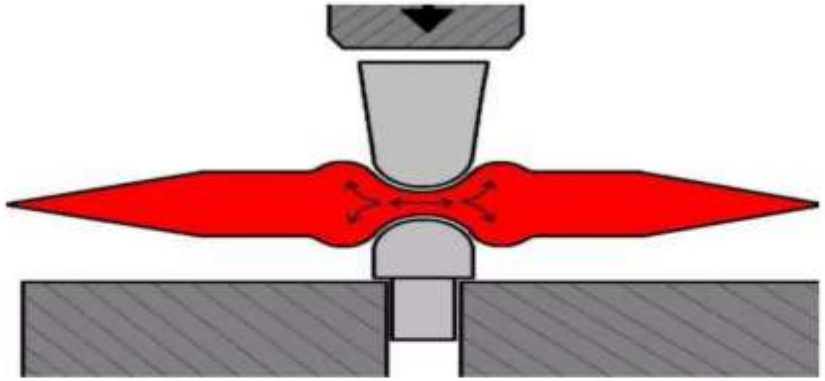
Flat tong

Straight lip fluted tong

5. Swages: are used for work which has to be reduced and finished to round, square or hexagonal form.



6. Fullers: are used for necking down a piece of work.



Top fuller

7. Hot chisel

Used for cutting metals and for nicking prior to breaking.

8. Punch and drift

A punch is used for making holes in metal parts when it is at forging heat, and holes are opened out by driving through a larger tapered punch called drift.

Punch

Drift

FITTING TOOLS

What is fitting?

Fitting means preparing matching parts to touch or join each other in such a way that one will turn inside of another and one will slide upon another or the part hold tightly together.

Processes in the fitting shop

- **Marking and measuring**
- **Sawing**
- **Filing**
- **Drilling**
- **Reaming**
- **Dieing**
- **Tapping**

Fitting shop tools

Classification:

- **Marking, measuring and testing tools**
- **Cutting tools**
- **Holding tools**
- **Striking tools**

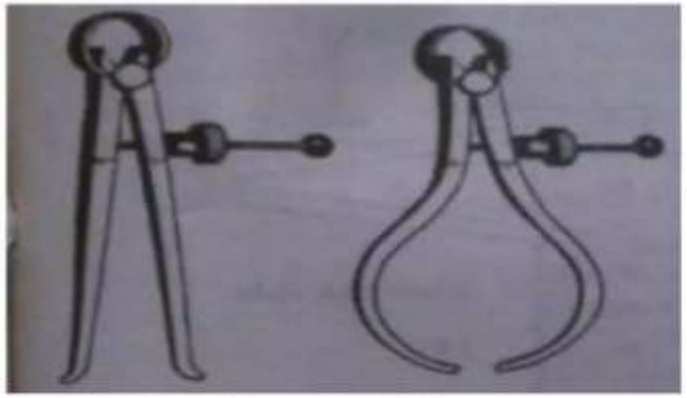
Marking, measuring and testing tools

This type involves steel rule, meter rod, trisquare, scribber, divider, calliper, surface gauge, drill gauge. Combination set, V-block, surface plate.

- A **scriber** is a hand **tool** used in metal work to mark lines on workpieces, prior to machining.

A scriber compass/divider

scriber



Spring callipers

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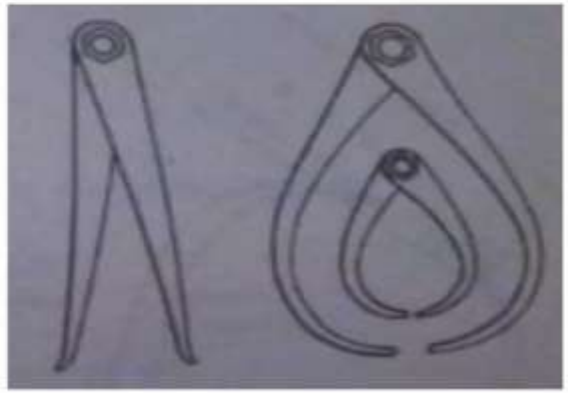


Firm joint callipers

- These callipers are used for indirect measurements.

Cutting tools

This type involves files, drills, taps, dies, reamers, hack saw, chizzles

Sawing

A saw is a tool for cutting wood or other material. it consist of a blade with the cutting edge toothed. The teeth of the saw are each bent to specific angle and this angle is called "set".

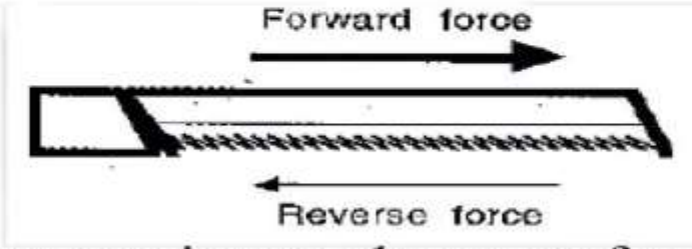
TYPES OF SAW

Hand saws: Hand saw is used manually for cutting operations.

Mechanically powered saw: Mechanically powered saws mechanically move the teeth past the material while the saw itself is held stationary.

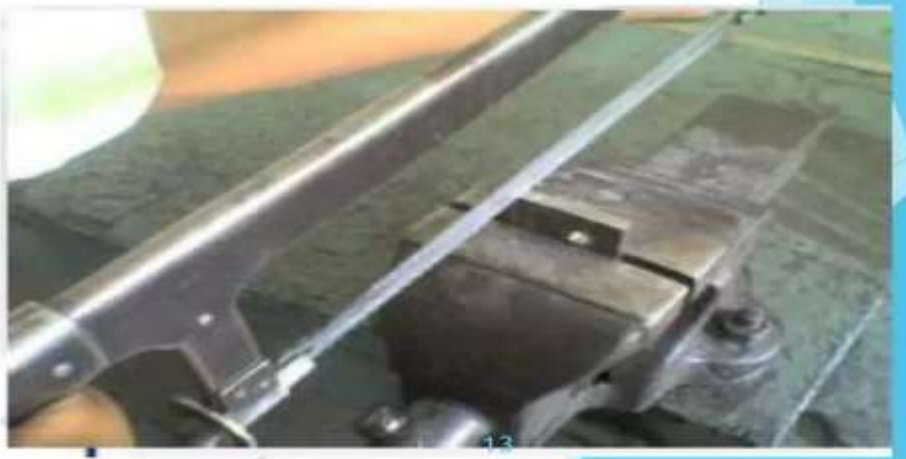
- Sawing is done to produce thin cuts. Hack Saw is a chief tool used, which is available in different types and sizes depending on the length of the blade and its cuts.

- Normal dimensions of a blade = 250x12 mm^2
- Hacksaw teeth are specified by its pitch (pitch = distance b/w two successive troughs or crusts.)



- Pitch of the teeth should give maximum clearance for the chips and avoid clogging. (Normal pitch = 1.5mm)
- Sawing too sharply over a corner will result in teeth being torn off.
- Water is used as coolant during sawing to take out heat generating during cutting. It enhances blade life.

Mechanically powered saw

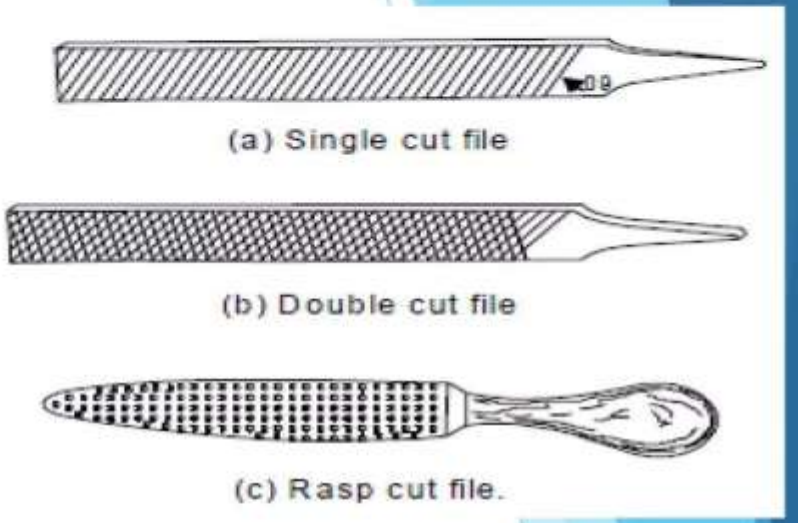


Filing

Cutting of a metal surface by using a specially designed tool, called a file. A **file** (or **hand-file**) is a hand tool used to shape material by ***abrasion***.

Classification of files

- Shape (Flat, round, square etc)
- Grade (Rough, Bastard, Smooth etc)
- Cut (Single cut, Double cut, Rasp cut etc)
- Length (Ranging from 4-18'')


(a) Single cut file

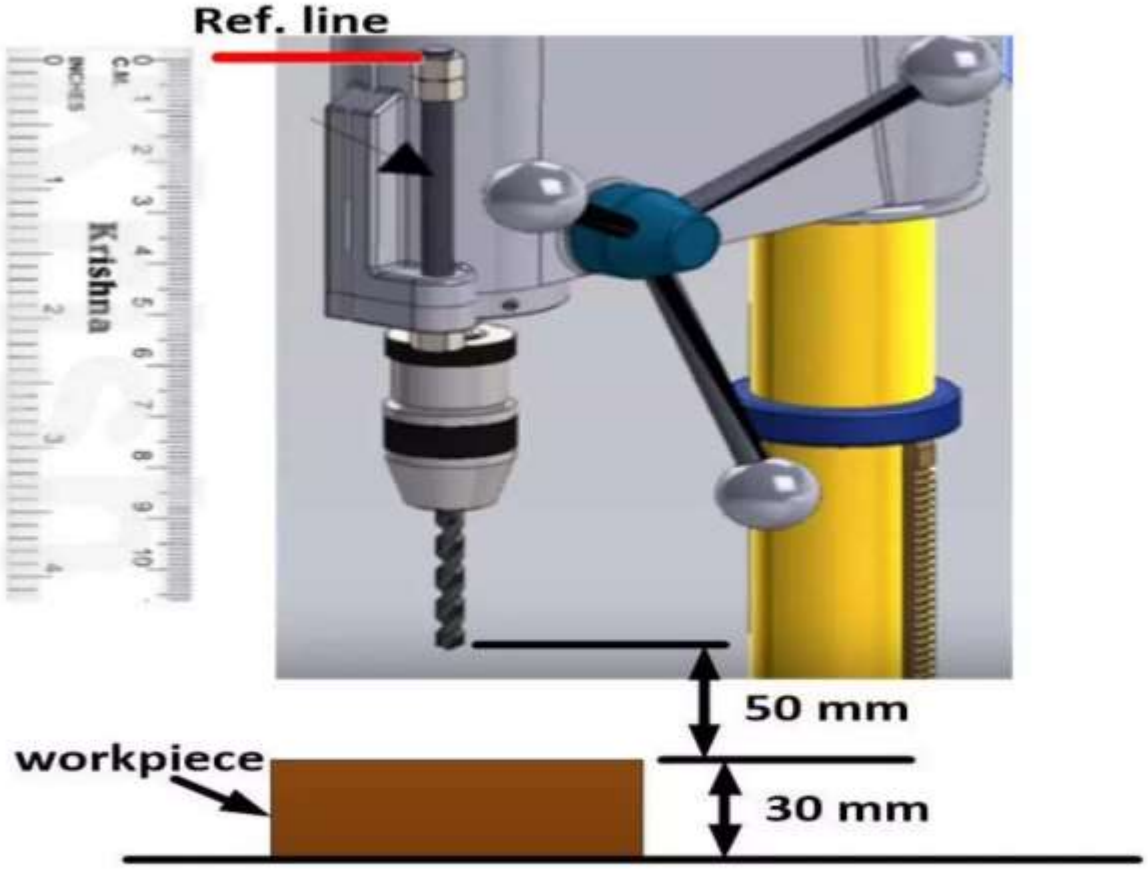
(b) Double cut file

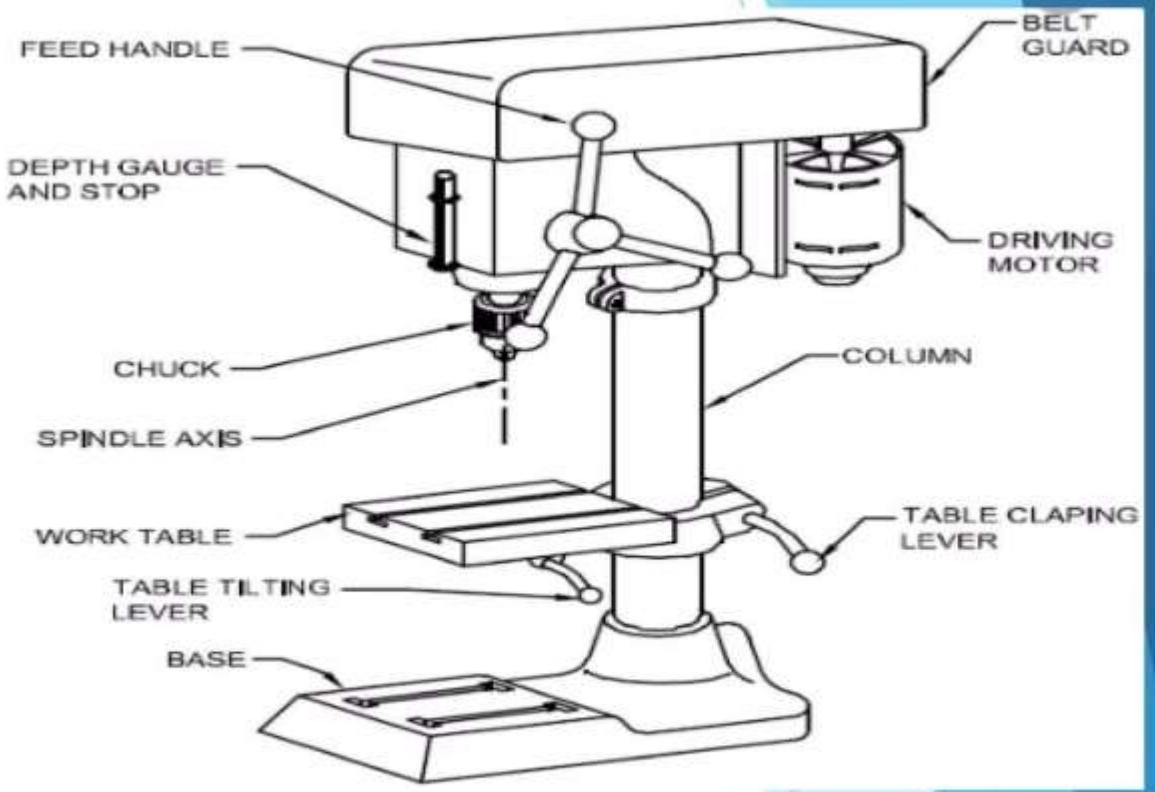
(c) Rasp cut file.

- Files have forward-facing cutting teeth, which means that the file cuts effectively only when pushed over the work piece. Pulling a file over a work piece or scraping a file back and forth is ineffective and will reduce the life of the file.
- The grooves in a file may become clogged during use, causing the file to lose its cutting ability.
- Files should always be used with a handle, otherwise the naked tang can injure the operator.

Drilling

A tool or machine with a pointer for making holes of different diameter.



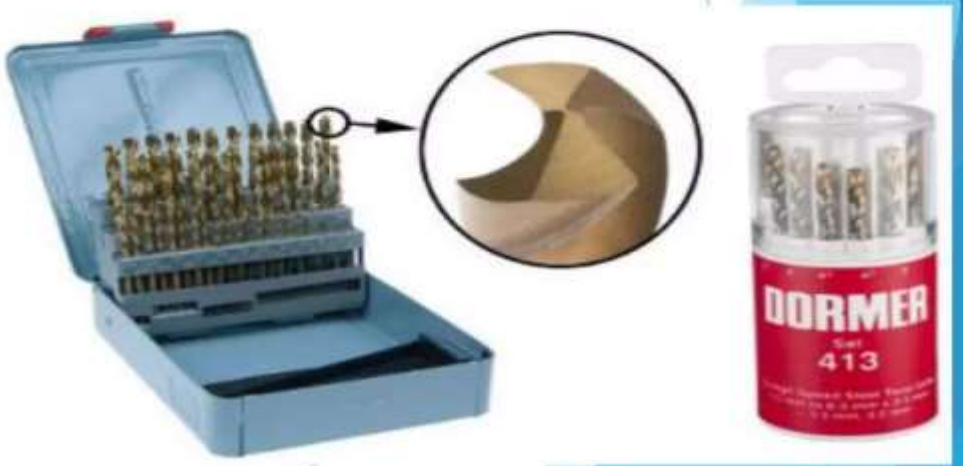


Sensitive drilling machine
or
Bench mounted pillar drilling machine

Instruments Use for Drilling

1. Drill Chuck
1. Drill Chuck Key
1. Drill Drift
1. Sleeve OR Socket
1. Shank Twist Drill

Drill Chucks & MT Arbour



Twist Drill Sets

STEPS OF DRILLING

Step 1. Use a scribe to scratch a line on piece where we wanted hole.
Step2. Use a ***center punch*** and a hammer to mark the spot because the punch mark will hold the tip of the drill in place until it begins to cut the metal.
Step 3. Drilling deep or large holes, it is best to drill a small reference hole first.
Step 4. We will find a burr on the back surface of drill hole. This can be removed by lightly drilling the back side of the hole.

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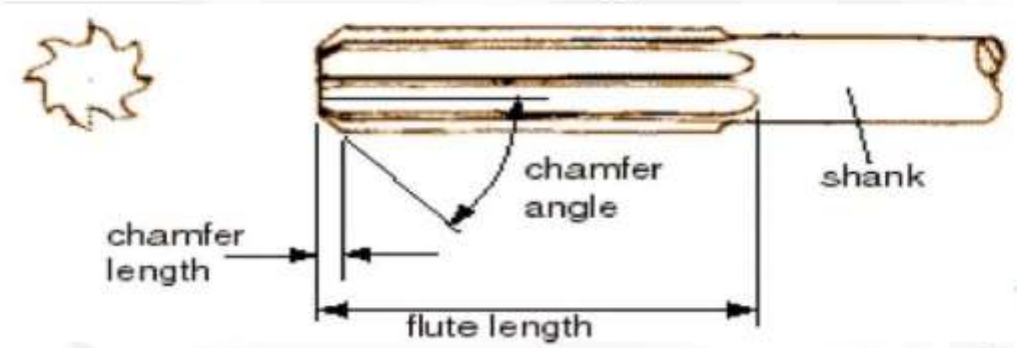
- The ***prick punch***, which is used for indentation marks. It is used to make small punch marks on layout lines in order to make them last longer.
- The ***centre punch***, which is used for locating centre for indentation mark for drilling purposes.

REAMING

Reaming is a process which *slightly enlarges a pre-existing hole*. Several cutting edges are arranged around a central shaft. Its purpose is to finish the internal diameter of the hole.

Reaming



Parts of reamer

Types of Reamers

1. Straight Reamer
2. Right Spiral Reamer
3. Left spiral Reamer
4. Machine Reamer
5. Chucking Reamer
6. Hand Reamer
7. Expanding Reamer
8. Taper Reamer

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Dieing

Die = Tool used to cut ***external threads*** on bars and tubes.

- Consist of a nut having portions of its thread circumference which are shaped to provide cutting edges.
- Die is screwed on to the bar upon which the threads are to be cut.

- The action of dieing a thread is very similar to that of tapping except that it is more difficult to start the die square.
- Great care in necessary in starting the die so that the threads are not cross each other.

Die

Die Stocks

Precautionary Measures for dieing

- The die should be rotated in both the direction at the same time so that the threads are cleared from chips. The die is pressed onto the end of the bar to help the commencement of cutting.
- The action is assisted by chamfering off the end of the bar for a distance equal to about two threads.
- The threads should be supplied with some form of cutting oil.

Tapping

Tapping is essentially the ***internal threading*** of a hole. This may either be achieved by Hand tapping by using a set of taps.

Classification of taps

- Taper
- Plug
- Bottom

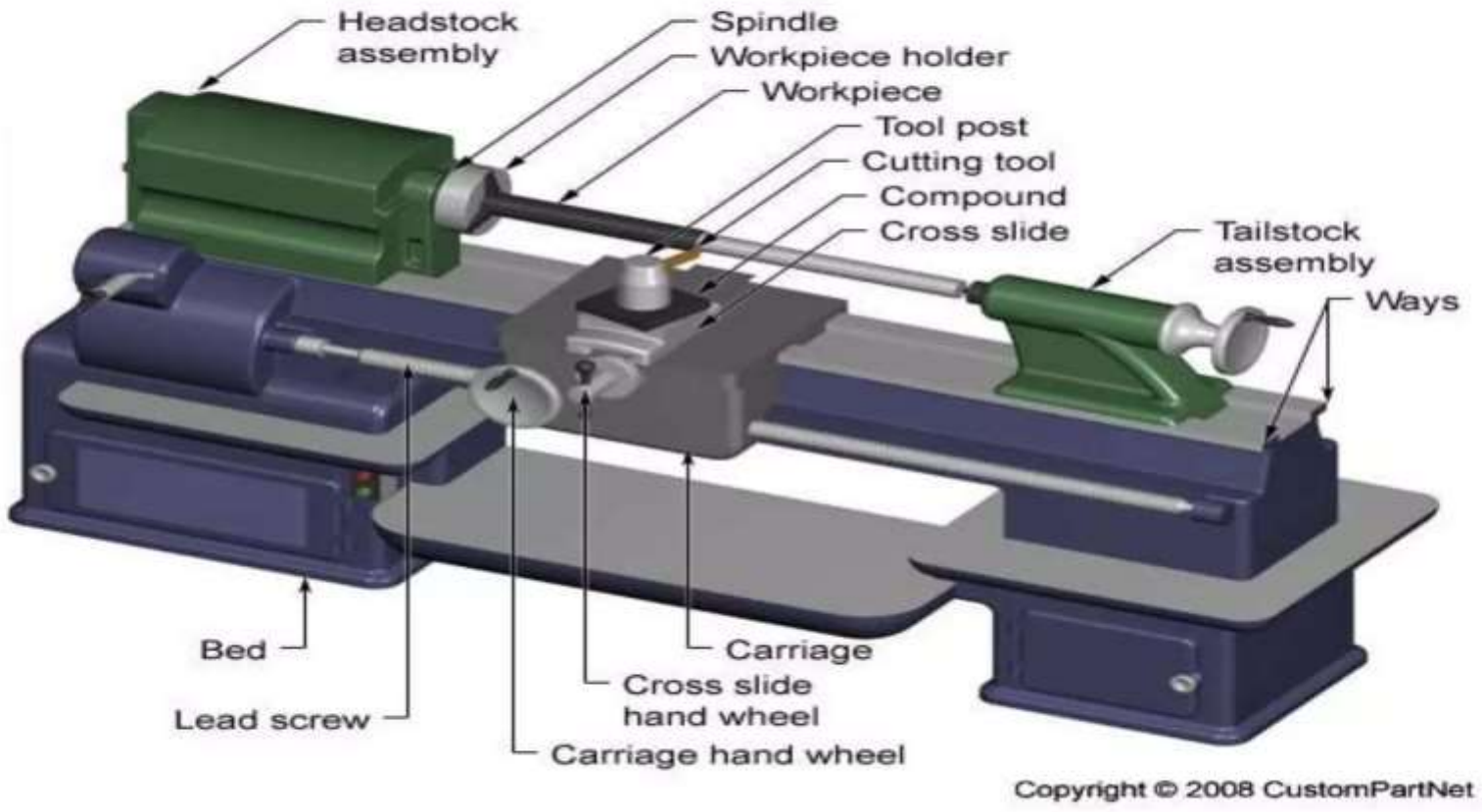
❖ To hold a tap adjustable tap handle is used This is used for internal threading in the same manner as the die is used.

LATHE

FIRST machine tool for metal cutting
Egypt
Jan verbruggen-1772-U.K.
Henry mandslay-1783

Lathe is a machine, which removes the metal from a piece of work to the required shape & size

LATHE


Headstock assembly
Spindle
Workpiece holder
Workpiece
Tool post
Cutting tool
Compound
Cross slide
Tailstock assembly
Ways
Bed
Lead screw
Carriage hand wheel
Cross slide hand wheel
Carriage
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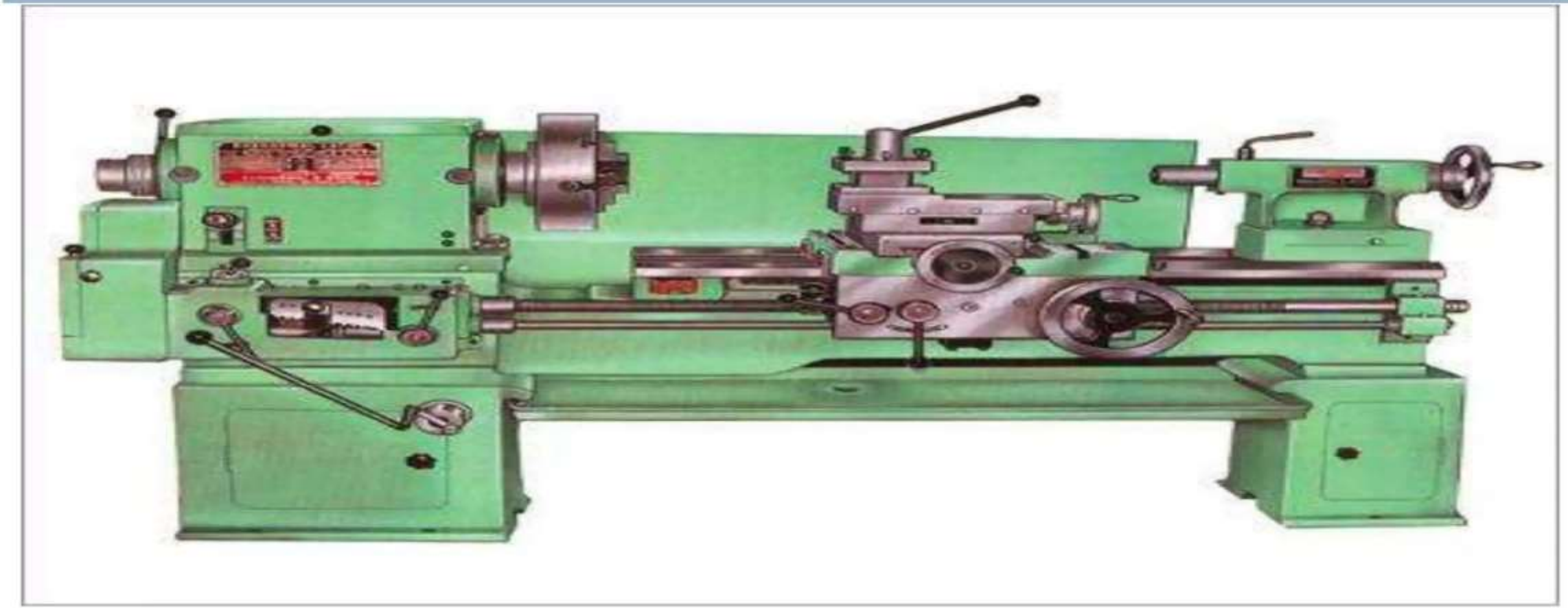
BASIC ELEMENTS OF LATHE

- BED
- HEAD STOCK
- TAIL STOCK
- CARRIAGE
- SADDLE

CROSS SLIDE, COMPOUND REST, TOOL POST, APRON

- FEED MECHANISM

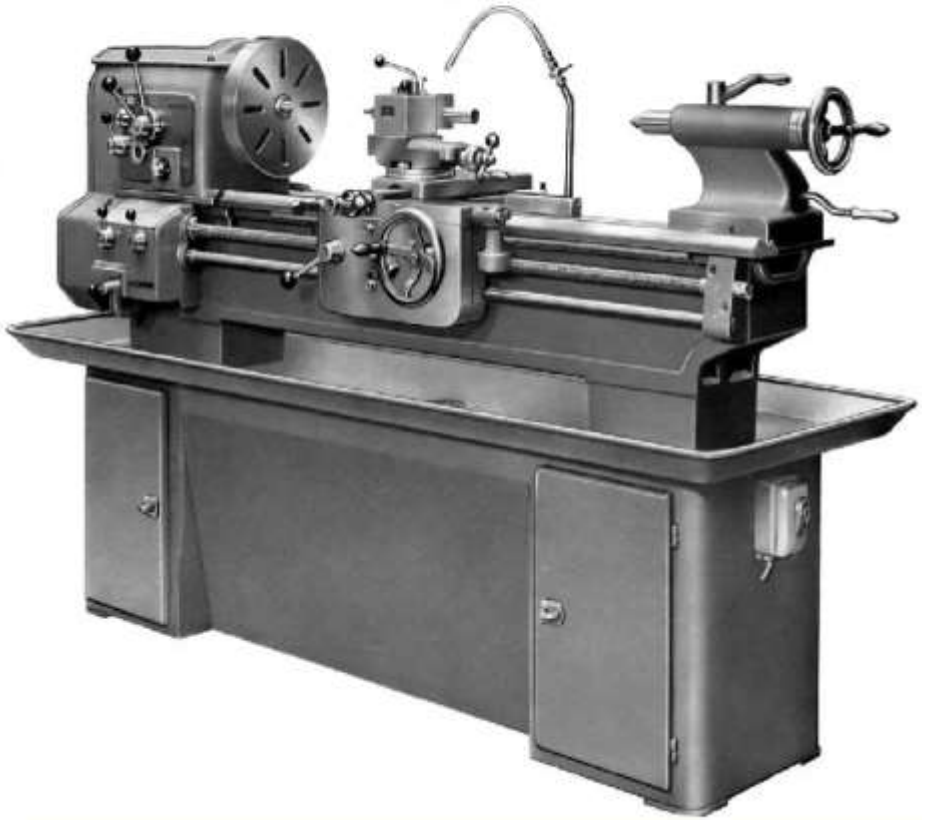
LATHE



Types of Lathe

Engine Lathe

- The most common form of lathe, motor driven and comes in large variety of sizes and shapes. Not production lathe, found in school shops.



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Types of Lathe

Bench Lathe

- A bench top model usually of low power used to make precision machine small work pieces.

Types of Lathe

Tracer Lathe

- a lathe that has the ability to follow a template to copy a shape or contour

Types of Lathe

Automatic Lathe

A lathe in which the work piece is automatically fed and removed without use of an operator.

Types of Lathe

—Turret Lathe

- lathe which have multiple tools mounted on turret either attached to the tailstock or the cross-slide, which allows for quick changes in tooling and cutting operations.

Types of lathe

Computer Controlled Lathe

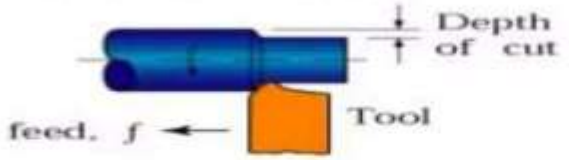
– A highly automated lathe, where both cutting, loading, tool changing, and part unloading are automatically controlled by computer coding.

LATHE OPERATION

- **Turning:** produce straight, conical, curved, or grooved work pieces
- **Facing**: to produce a flat surface at the end of the part or for making face grooves.
- **Boring:** to enlarge a hole or cylindrical cavity made by a previous process or to produce circular internal grooves.
- **Drilling:** to produce a hole by fixing a drill in the tailstock
- **Threading:** to produce external or internal threads
- **Knurling:** to produce a regularly shaped roughness on cylindrical surfaces

LATHE OPERATION

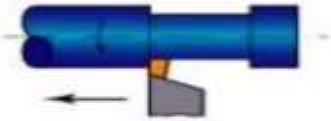
(a) Straight turning



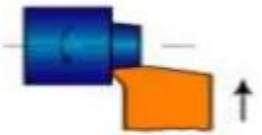
(b) Taper turning

(c) Profiling

(d) Turning and external grooving

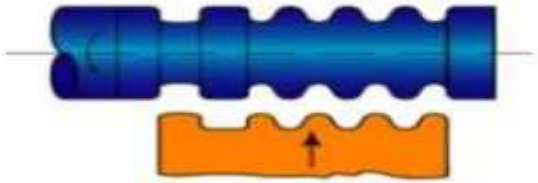


(e) Facing



(f) Face grooving

(g) Cutting with a form tool

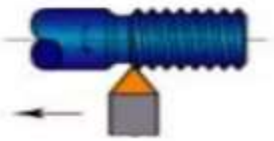


(h) Boring and internal grooving

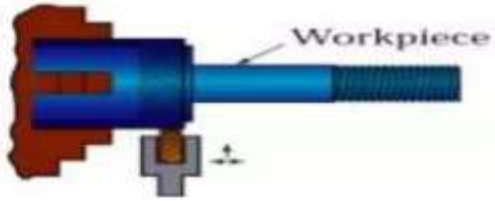
(i) Drilling

(j) Cutting off

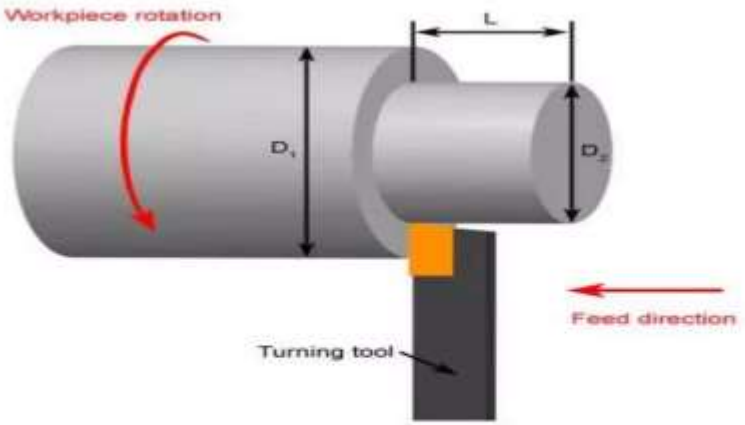
(k) Threading



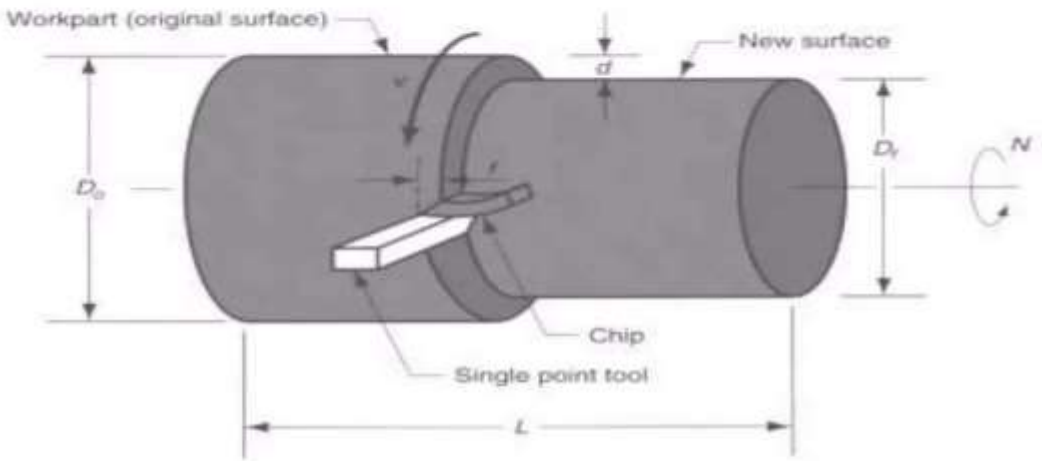
(l) Knurling

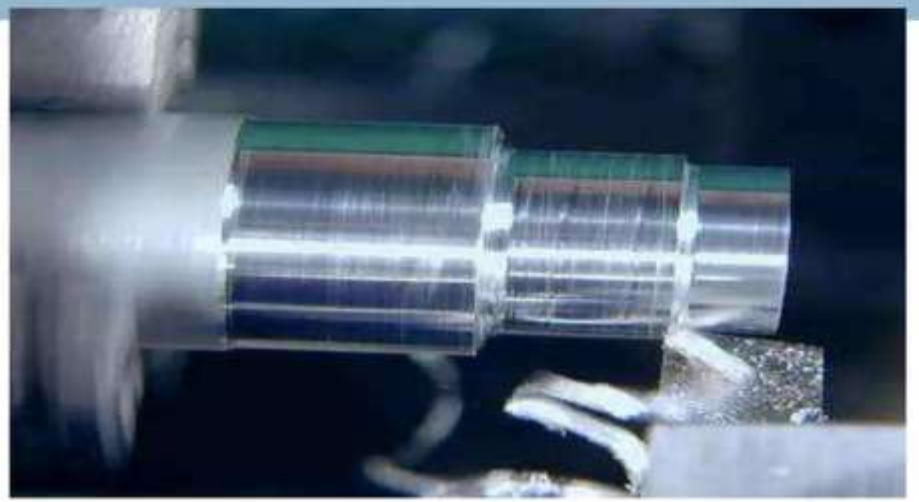


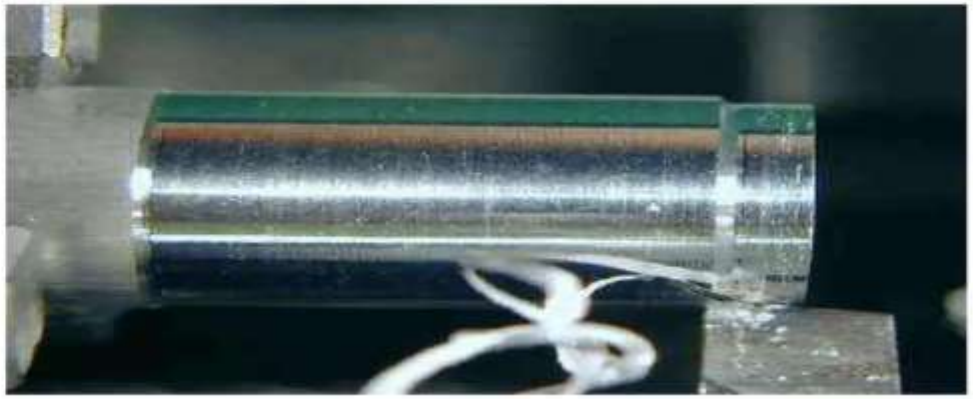
FACING & TURNING



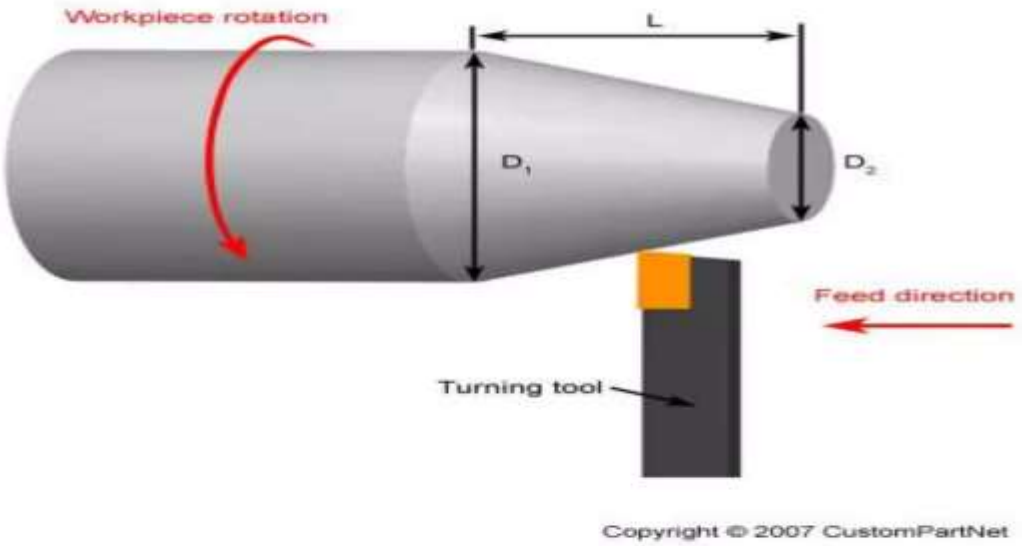
STEP TURNING



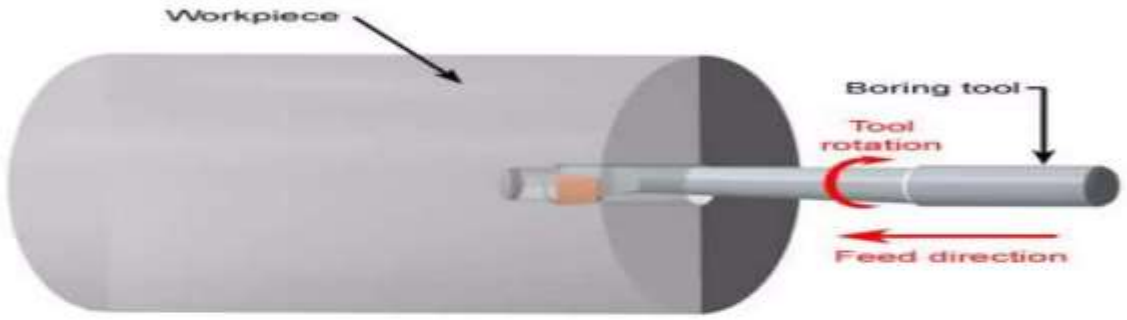




TAPER TURNING

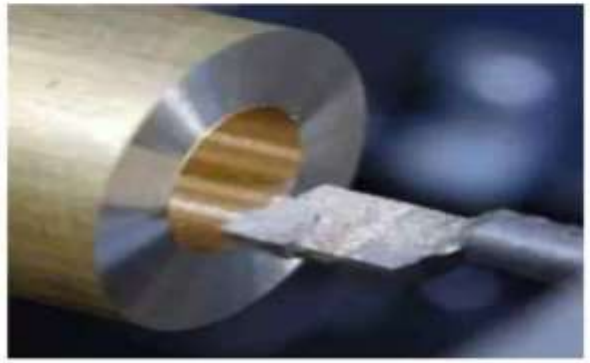


DRILLING

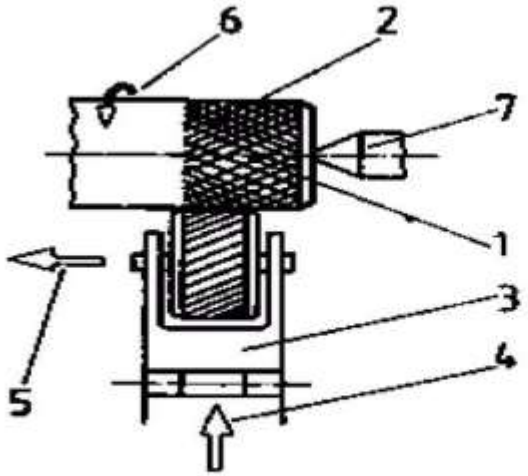


DRILLING

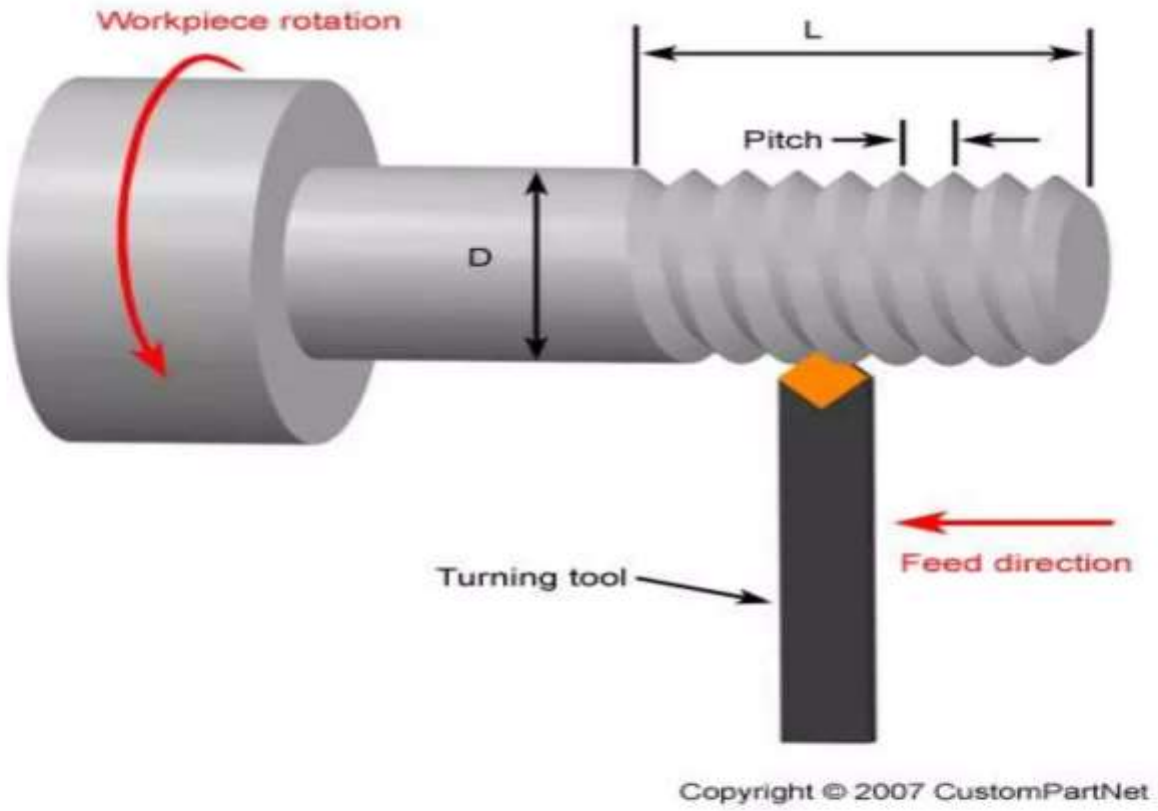
BORING



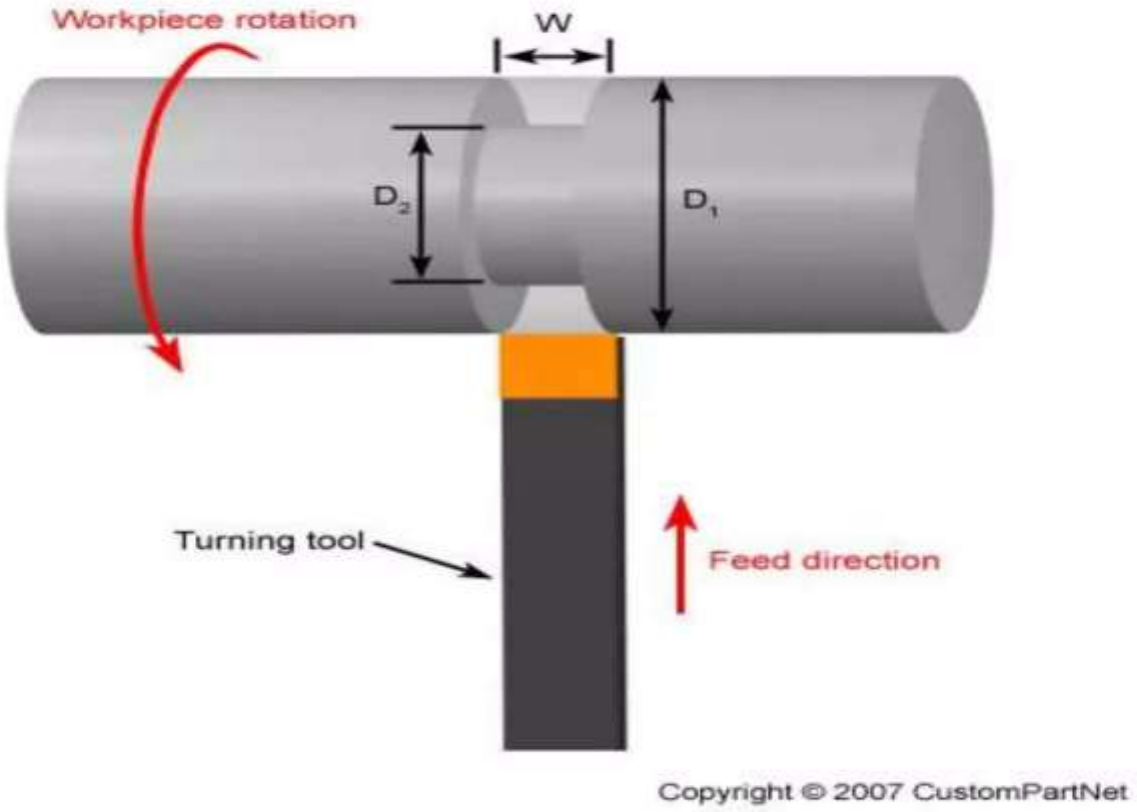
KNURLING



THREADING


Workpiece rotation
L
Pitch
D
Turning tool
Feed direction
Copyright © 2007 CustomPartNet

GROOVING


Workpiece rotation
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D2
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Turning tool
Feed direction
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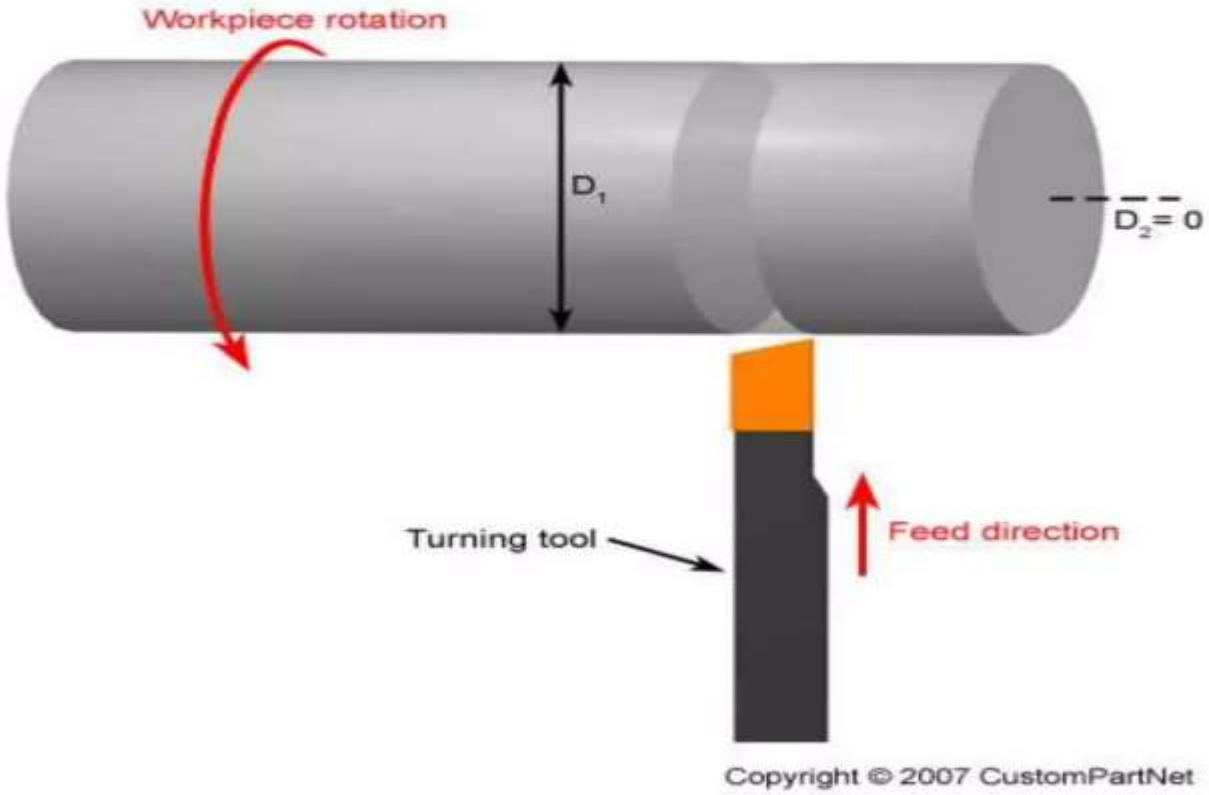
PARTING OFF


Workpiece rotation
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Feed direction
Copyright © 2007 CustomPartNet

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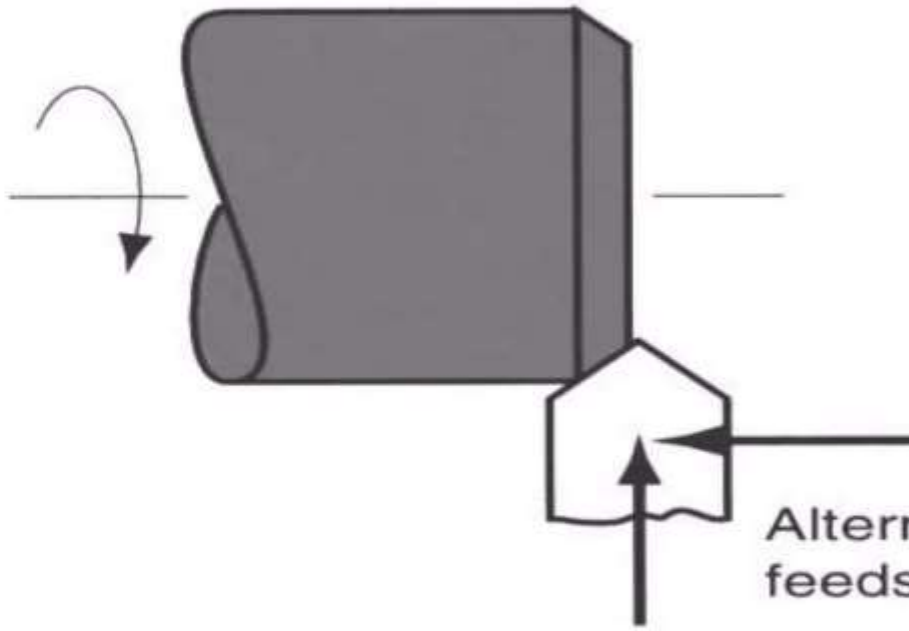


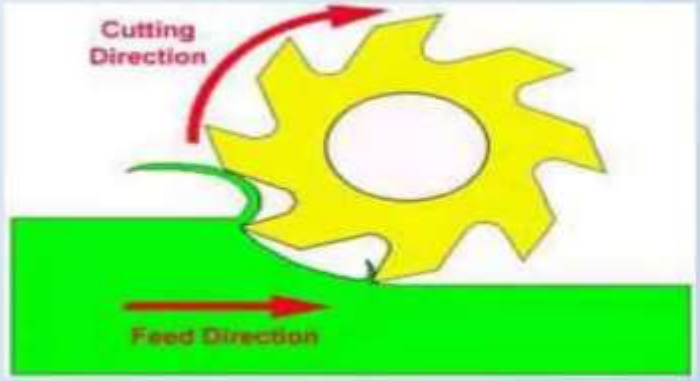
(e)

Milling Machine

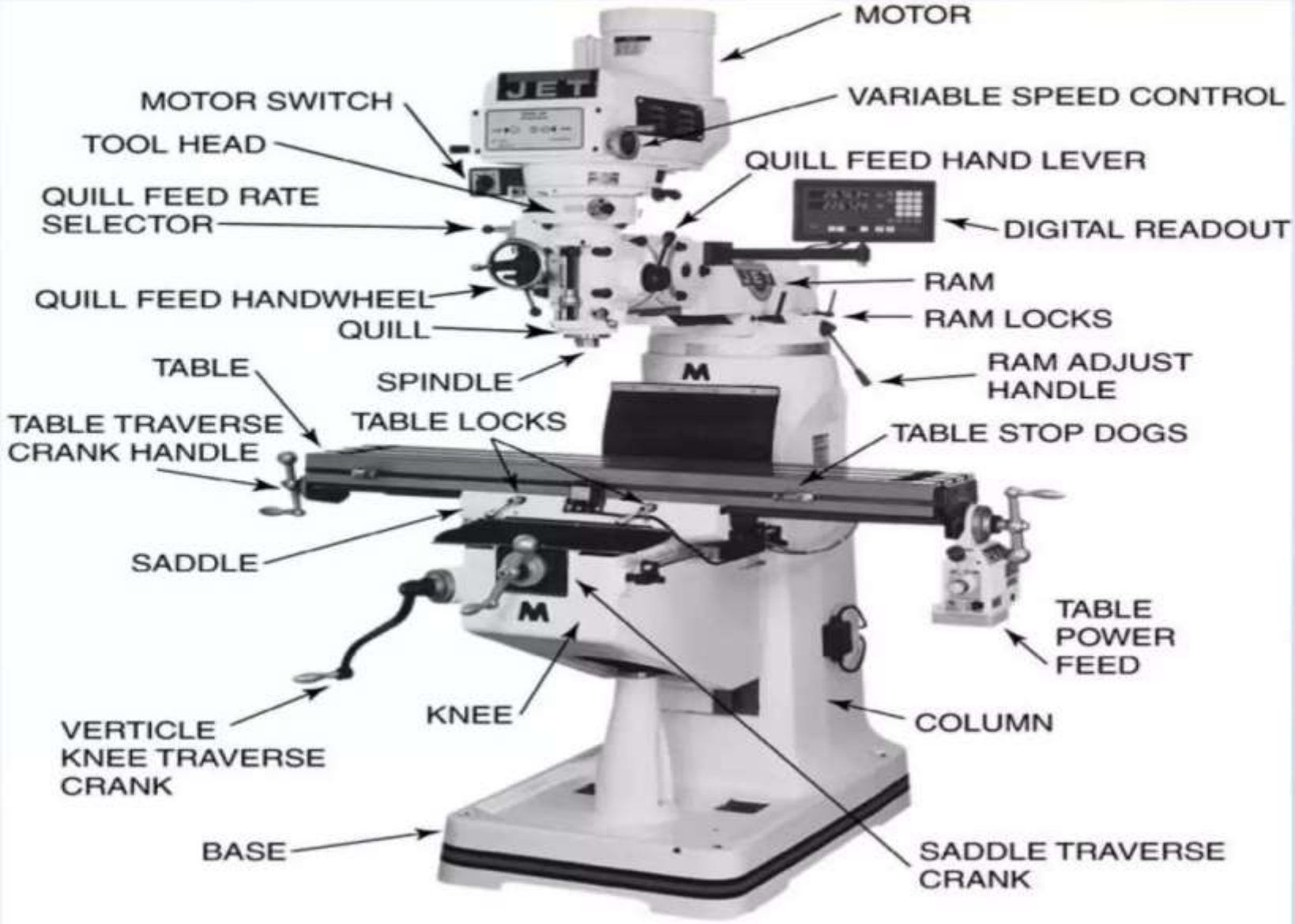
- **Milling Machine**
- A device that rotates a **circular tool** that has a number of cutting edges symmetrically arranged about its axis.
- The workpiece is commonly held in a vise or similar device clamped to a table that can move in three perpendicular directions.

Milling Process

- **Milling Process**
- Milling is the process of machining using **rotary cutters** to remove material by advancing a cutter into a work piece.
- This may be done varying direction on one or several axes, cutter head speed, and pressure.



Labelled Diagram



Types of Milling Machine

- Horizontal Milling Machine
- Vertical Milling Machine

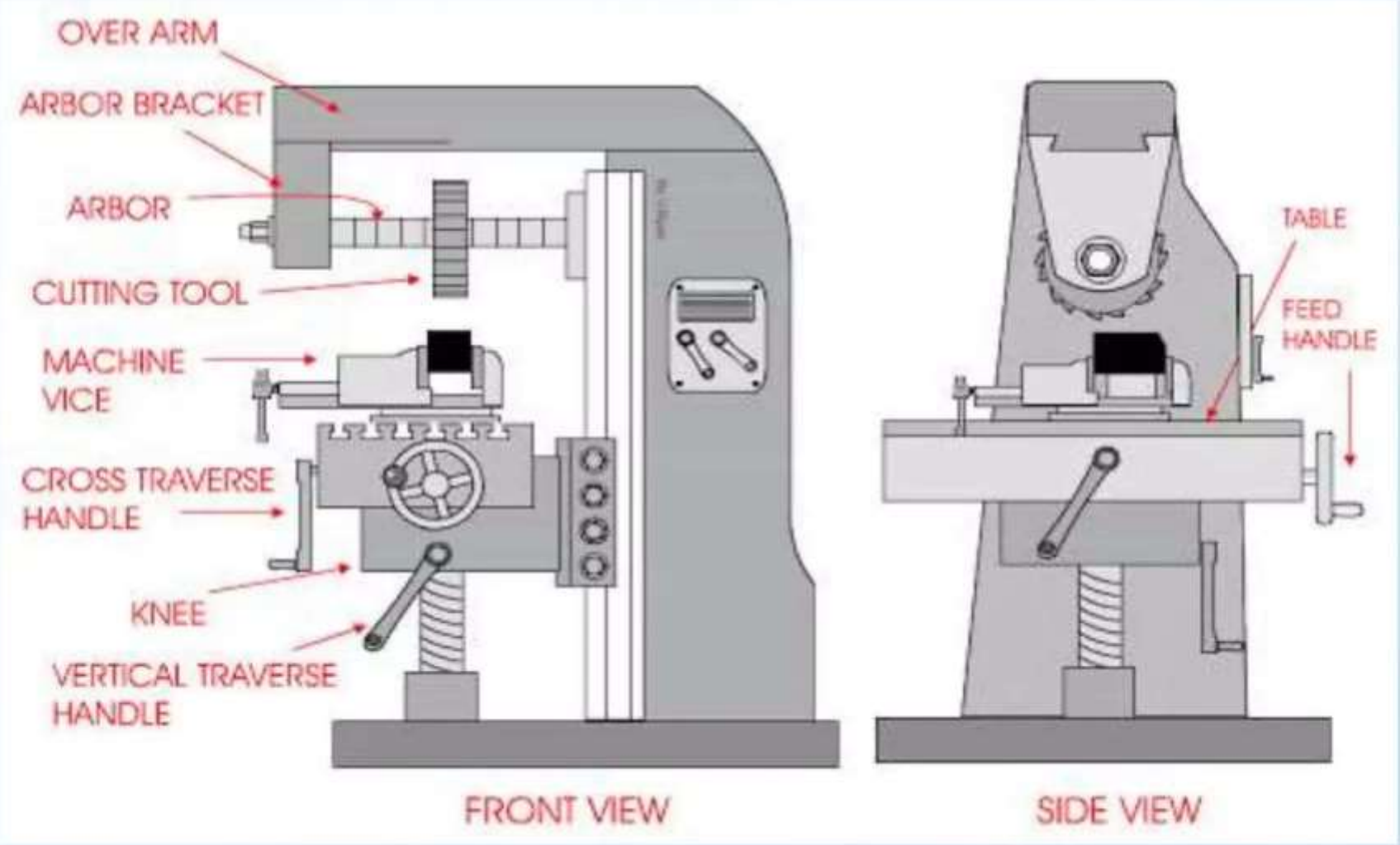
Structural Classification

1. Bench Milling Machine
2. Cantilever Milling Machine
3. Ram type Milling Machine
4. Gantry Milling Machine
5. Plane Milling Machine
6. Copy Milling Machine
7. Lifting table Milling Machine
8. Rocker Milling Machine
9. Bed type Milling Machine

Horizontal Milling Machine

- Milling head can be adjusted manually by 45 degree
- The spindle sleeve can be manually micro-injected
- Workable X,Y,Z three way monetarized speed
- The rectangular guide rail has good strength and stability
- Has less accuracy

Labelled Diagram of Horizontal MM

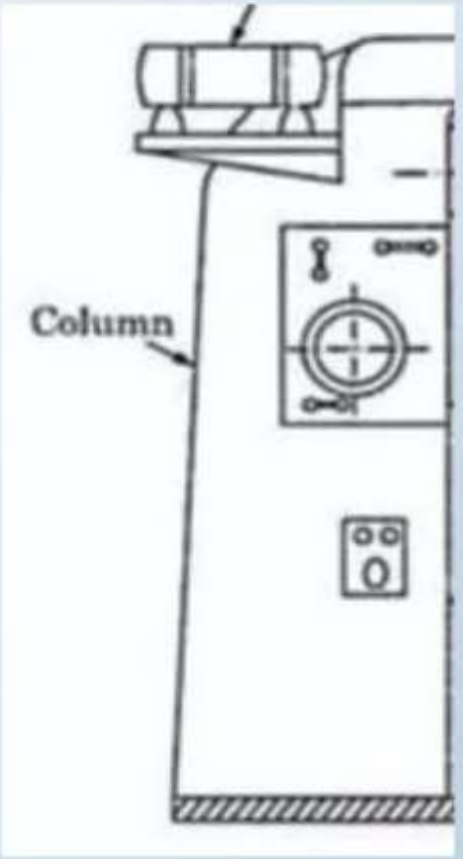


Parts of Horizontal Milling Machine

1. Column
2. Knee
3. Saddle
4. Table
5. Arbor
6. Base
7. Spindle
8. Spindle Reverse Lever
9. Spindle Speed Selection Lever
10. Spindle Clutch Lever
11. Feed Rate Selection Lever
12. Motor Start and Stop Buttons

Description of Parts

- **Column**
- The column houses the spindle, the bearings, the gear box, the clutches, the shafts, the pumps, and the shifting mechanisms for transmitting power from the electric motor to the spindle at a selected speed.



Description of Parts

- **Knee**
- Knee is the first moving part of milling machine. If is mounted on the column and moves along the slideways situated over the column. It is made by cast iron and moves vertically on slideways It moves up and down on sideways which change the distance between tool and workpiece It is driven by mechanically or hydraulically.

Description of Parts

- **Saddle**
- The saddle consists of two slideways, one on the top and one at the bottom located at 90º to each other, for providing motions in the X or Y axes by means of lead screws.
- The main function of it is to provide motion in horizontal direction to work piece

Description of Parts

- **Table**
- The table is mounted on top of the saddle and can be moved along the X axis. On top of the table are some T-slots for the mounting of workpiece or clamping fixtures.
- It can provide three degree of freedom to work piece.

➢ It provides vertical motion by moving the knee up and down.

➢ It provides horizontal motion by the feed screw.

➢ It provides horizontal (transverse) motion by moving the saddle.

Description of Parts

- **Arbor**
- It is a mechanical part on which is used as extension part of the spindle in horizontal milling machine. It is fitted on the spindle whenever required. It holds the tool and moves it in correct direction.

Description of Parts

- **Arbor Support**
- This are used to support arbor at right place. One end of this support is jointed at the overhanging arm and another is jointed with arbor.

Description of Parts

- **Spindle**
- The spindle holds the tool and provides the actual tool rotation.
- It is motor driven and drives the tool. It has a slot on the front end of it. The cutting tool fix in that slot.

Description of Parts

- **Spindle Reverse Lever**
- The position of this lever determines the spindle direction. The three positions of the handle are,
  - In
  - Middle
  - Out
- The middle position is the neutral position. Never move the spindle reverse lever when the spindle is turning.

Description of Parts

- **Overhanging arm**
- It is situated over the column on horizontal milling machine. It is overhang over the column surface and other end supports the arbor. It is made by cast iron.

Description of Parts

- **Spindle Speed Selection Lever**
- The spindle speed selection lever is used to change the spindle R.P.M. setting. This type of machine has a geared head so the spindle speed can only be changed when the spindle is stopped.

Description of Parts

Spindle Clutch Lever

- The spindle clutch lever engages the spindle clutch to the motor. By manipulating the spindle clutch lever the operator can start and stop the spindle.

Description of Parts

- **Feed Rate Selection Lever**
- The feed rate selection lever is used to change the feed rate setting. The feed rate settings are expressed in inches per minute.

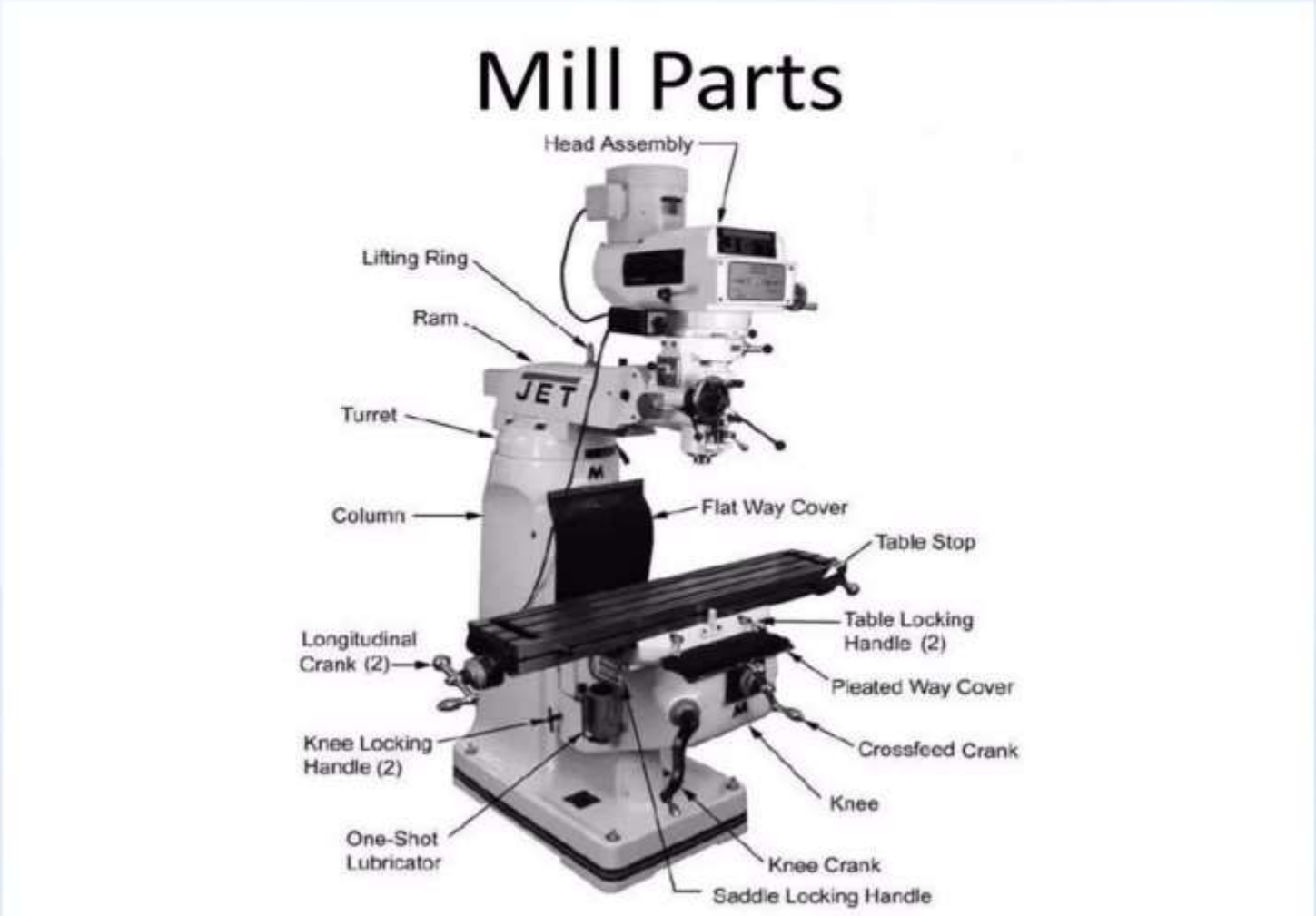
Description of Parts

- **Motor Start and Stop Buttons**
- The motor start and stop buttons control the power to the main motor for the machine

Vertical Milling Machine

- The vertical milling machine is a precision tool used for shaping and fabrication by the removal of stock typically from metallic work pieces.
- Workable X,Y,Z three way monetarized speed
- The rectangular guide rail has good strength and stability
- Has more accuracy

Labelled Diagram of Vertical MM

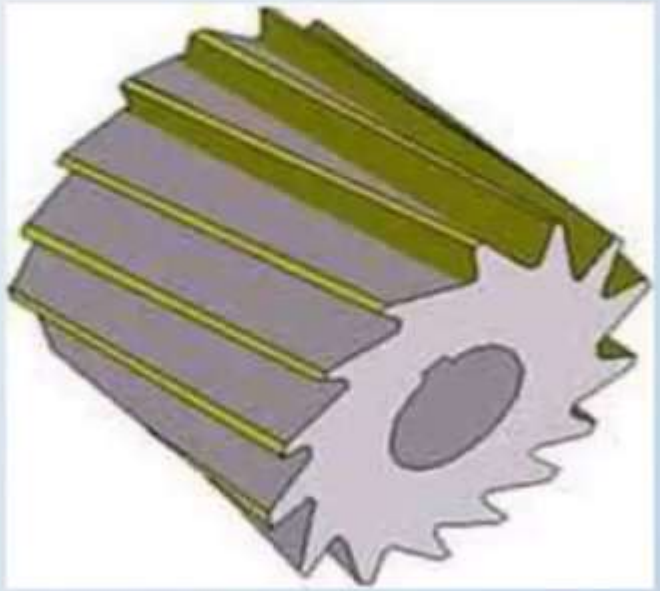


Cutting Tools

- **Cutting Tools for Horizontal Milling**

Slab Mills

- For heavy cutting of large and flat surfaces.

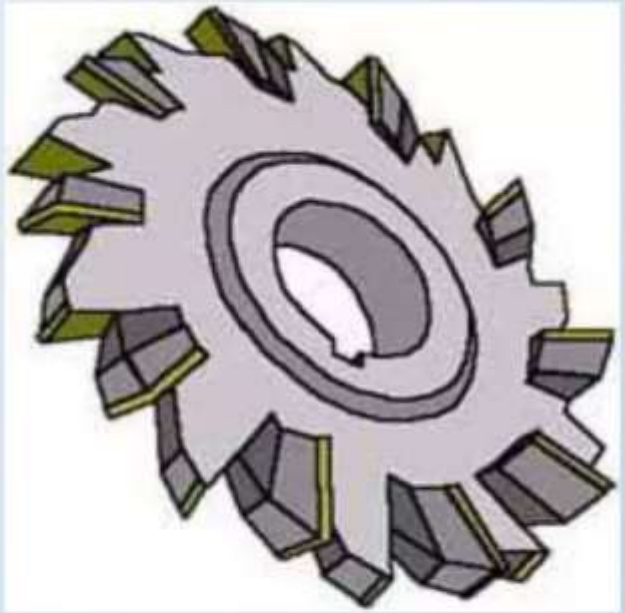


Cutting Tools

- **Cutting Tools for Horizontal Milling**

Side and Face Cutters

- This type of cutters has cutting edges on the periphery and sides of the teeth for cutting shoulders and slots

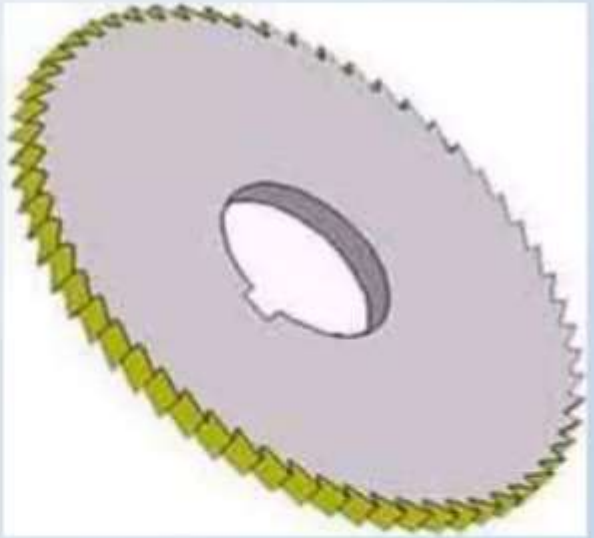


Cutting Tools

- **Cutting Tools for Horizontal Milling**

Slitting Saws

- For cutting deep slots or for parting off.

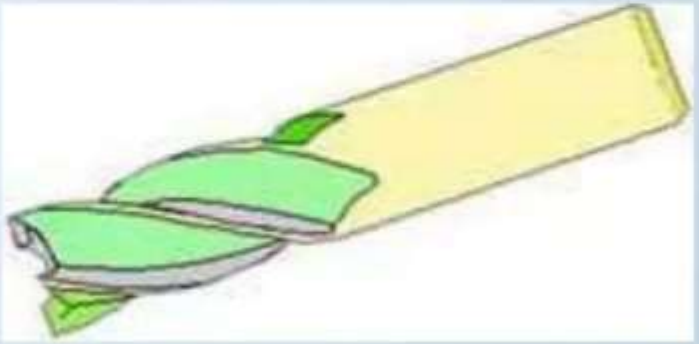


Cutting Tools

- **Cutting Tools for Vertical Milling**

End Mills

- Commonly used for facing, slotting and profile milling.

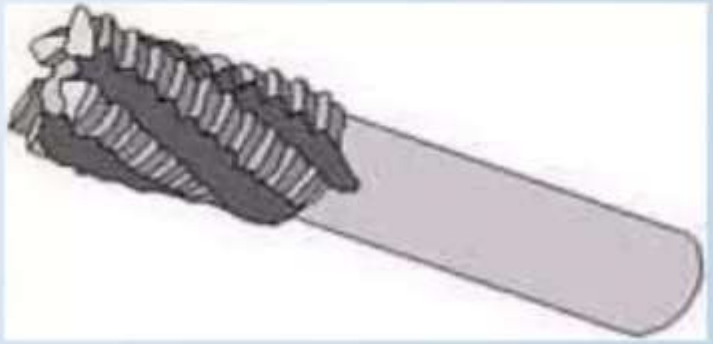


Cutting Tools

- **Cutting Tools for Vertical Milling**

Rough Cut End Mills

- For rapid metal removal.

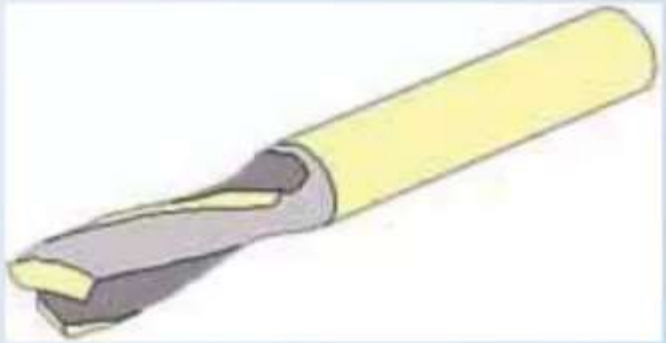


Cutting Tools

- **Cutting Tools for Vertical Milling**

Slot Drills

- For producing pockets without drilling a hole before hand.

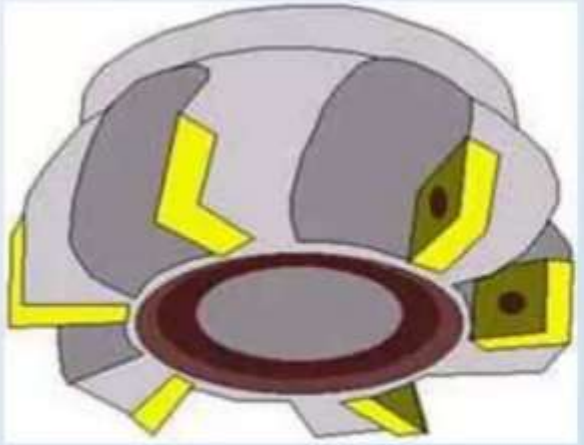


Cutting Tools

- **Cutting Tools for Vertical Milling**

Face Milling Cutters

- Used For heavy cutting.



Cutting Tools

- **Cutting Tools for Vertical Milling**

Involute gear cutter

- There are 7 cutters (excluding the rare half sizes) that will cut gears from 12 teeth through to a rack (infinite diameter).

Cutting Tools

- **Cutting Tools for Vertical Milling**

Hobbing cutter

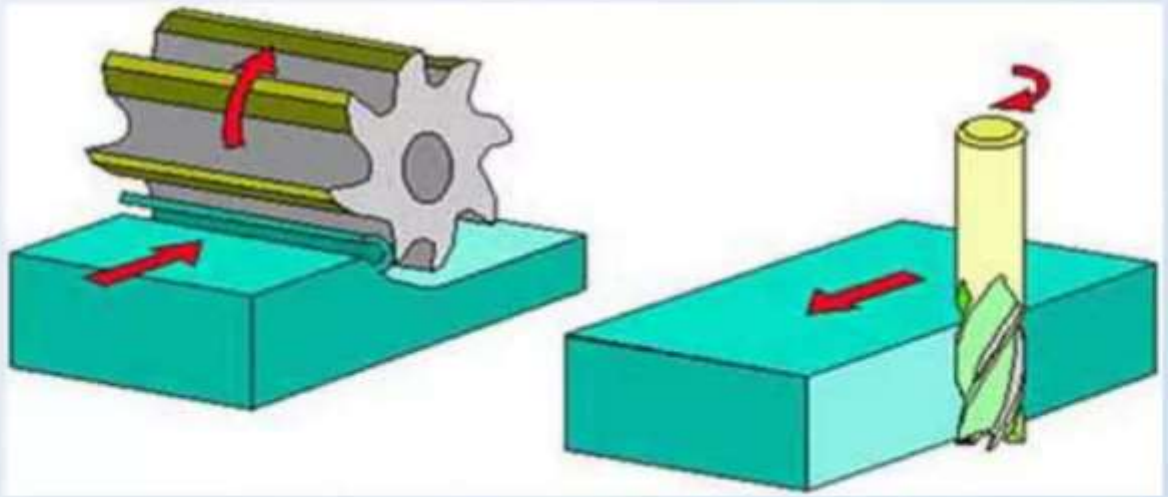
- These cutters are a type of form tool and are used in hobbing machines to generate gears.

Milling Operations

- Plain Milling Operation
- Face Milling Operation
- Side Milling Operation
- Straddle Milling Operation
- Angular Milling Operation
- Gang Milling Operation
- Form Milling Operation
- Profile Milling Operation
- End Milling Operation
- Saw Milling Operation
- Milling Keyways, Grooves and Slot
- Gear Milling
- Helical Milling
- Cam Milling
- Thread Milling

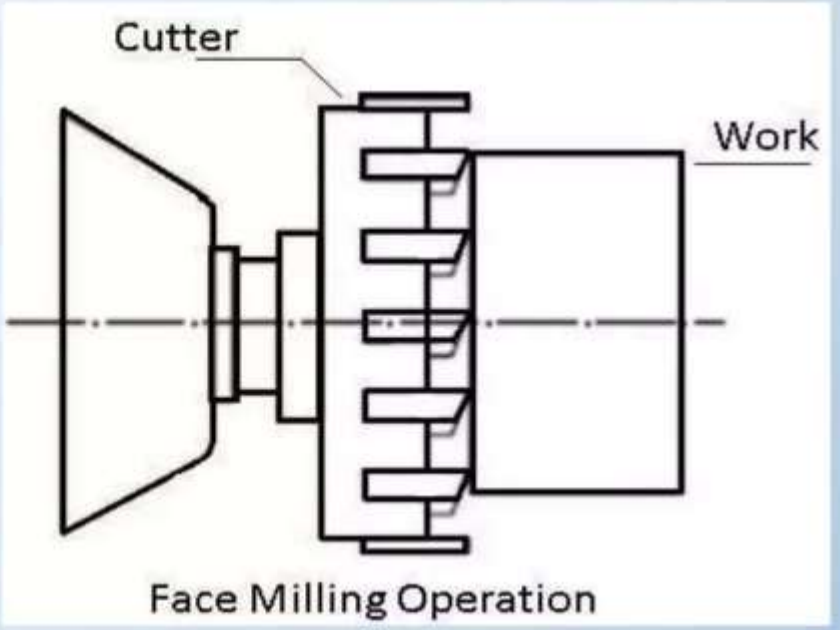
Milling Operations

- **Plain Milling**
- Plain milling is the milling of a flat surface with the axis of the cutter parallel to the machining surface. It can be carried out either on a horizontal machine or a vertical machine.



Milling Operations

- **Face Milling**
- The face milling is the simplest milling machine operations.
- This operation is performed by a face milling cutter rotated about an axis perpendicular to the work surface.
- The operation is carried in plain milling, and the cutter is mounted on a stub arbor to design a flat surface.
- The depth of cut is adjusted by rotating the crossfeed screw of the table.



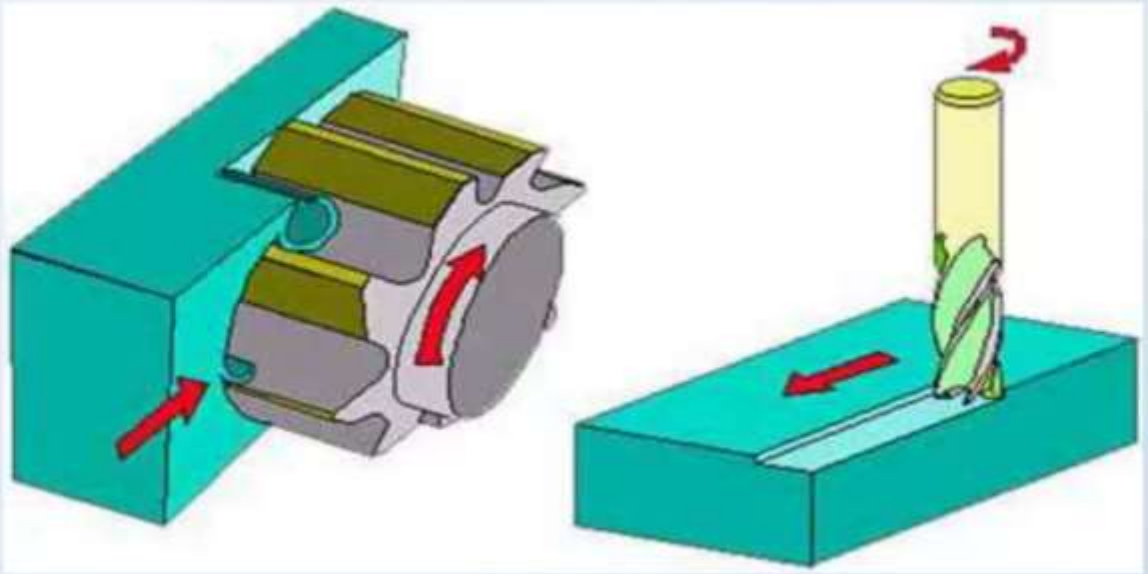
Face Milling Operation

Milling Operations

- **Side Milling**
- The side milling is the operation of producing a flat vertical surface on the side of a workpiece by using a side milling cutter.
- The depth of cut is set by rotating the vertical feed screw of the table.

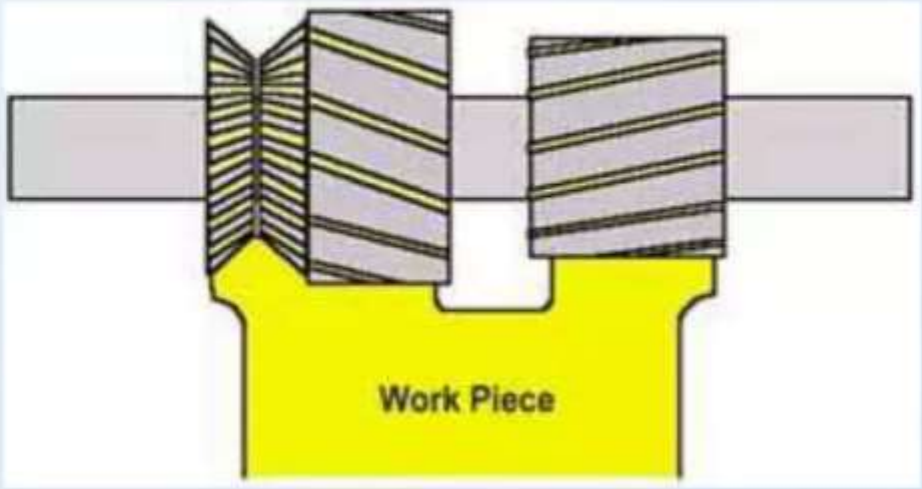
Milling Operations

- **End Milling**
- End Milling is the milling of a flat surface with the axis of the cutter perpendicular to the machining



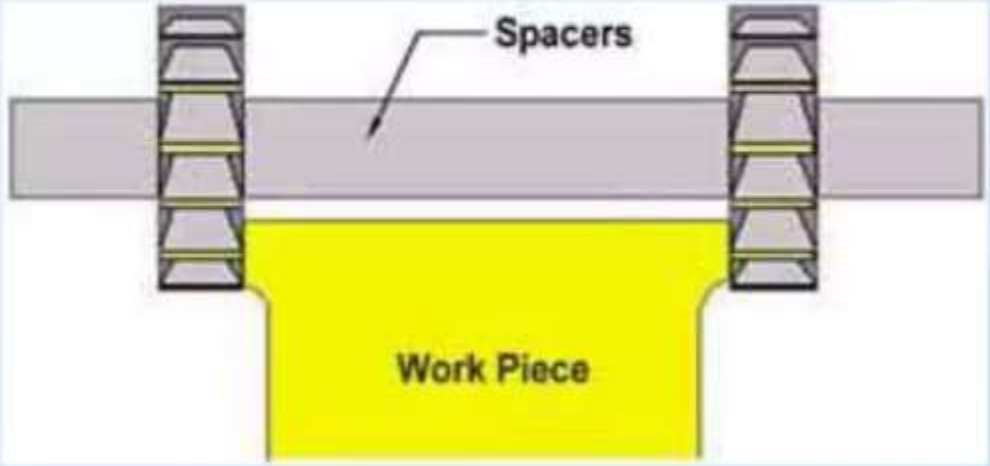
Milling Operations

- **Gang Milling**
- Gang milling is a horizontal milling operation that utilizes three or more milling cutters grouped together for the milling of a complex surface in one pass. As illustrated in figure 18, different type and size of cutters should be selected for achieving the desire profile on the workpiece.



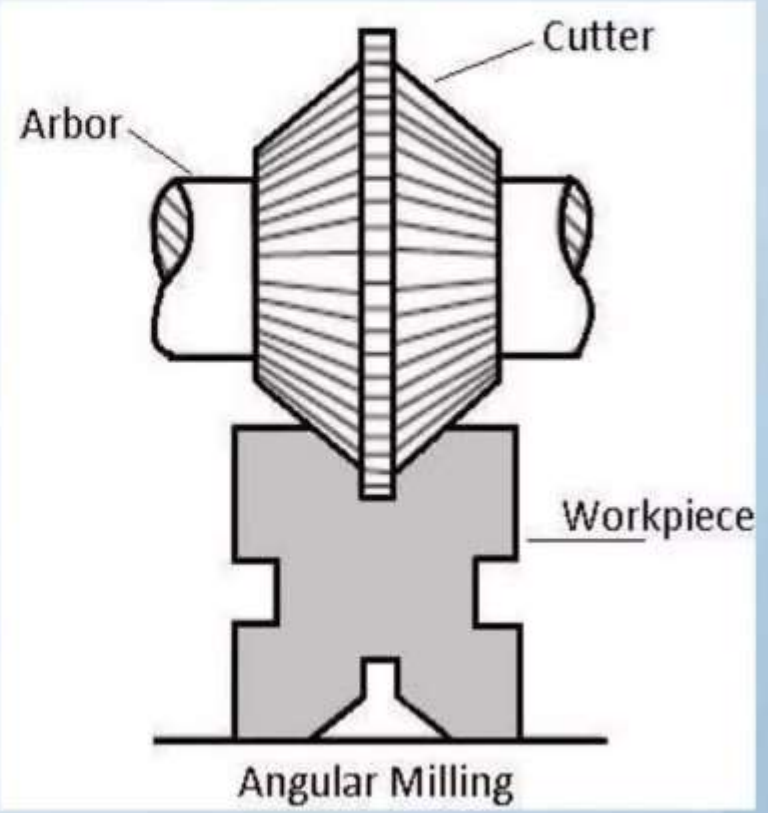
Milling Operations

- **Straddle Milling**
- In straddle milling, a group of spacers is mounted in between two side and face milling cutters on the spindle arbor as shown in figure 19. for the milling of two surfaces parallel to each other at a given distance.



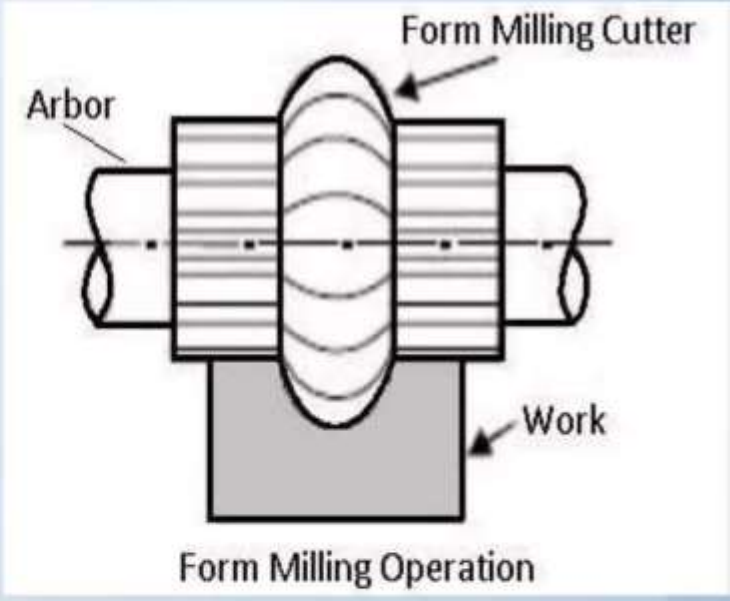
Milling Operations

- **Angular Milling**
- The angular milling is the operation of producing an angular surface on a workpiece other than at right angles of the axis of the milling machine spindle.
- The angular groove may be single or double angle and may be of varying included angle according to the type and contour of the angular cutter used.
- One simple example of angular milling is the production of V-blocks.



Milling Operations

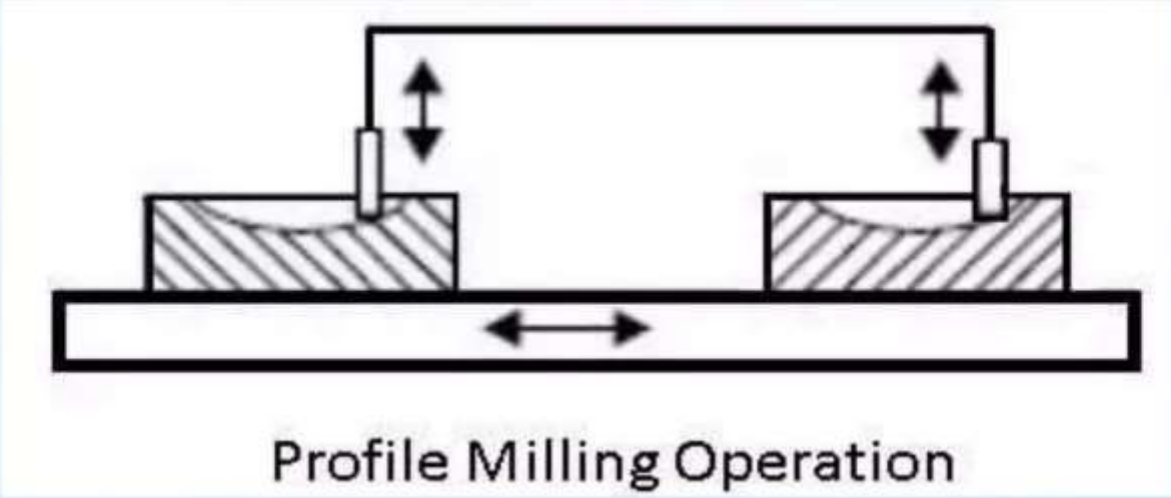
- **Form Milling**
- The form milling is the operation of producing the irregular contour by using form cutters.
- The irregular shape may be convex, concave, or of any other shape. After machining, the formed surface is inspected by a template gauge.
- Cutting rate for form milling is 20% to 30% less than that of the plain milling



Form Milling Operation

Milling Operations

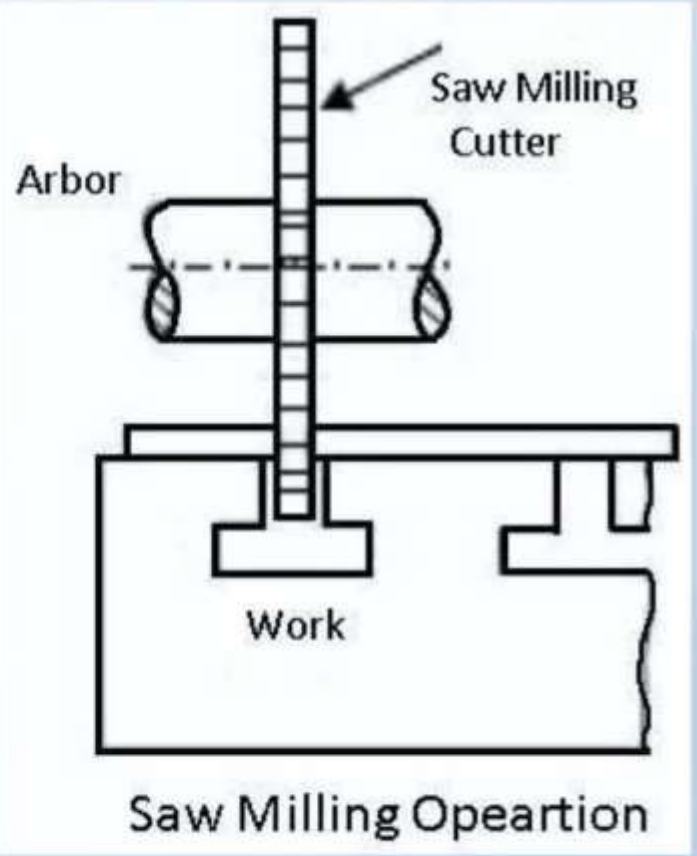
- **Profile Milling**
- The profile milling is the operation of reproduction an outline of a template or complex shape of a master dies on a workpiece.
- Different cutters are used for profile milling. An end mill is one of the widely used milling cutters in profile milling work



Profile Milling Operation

Milling Operations

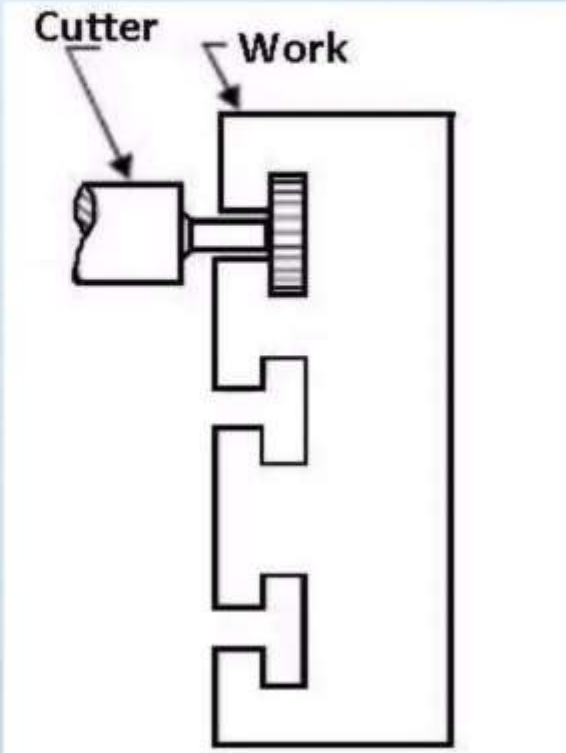
- **Saw Milling**
- Saw-milling is the operation of producing narrow slots or grooves on a workpiece by using a saw-milling cutter.
- The saw-milling also performed for complete parting-off operation.
- The cutter and the workpiece are set in a manner so that the cutter is directly placed over one of the T-slots of the table.



Saw Milling Opeartion

Milling Operations

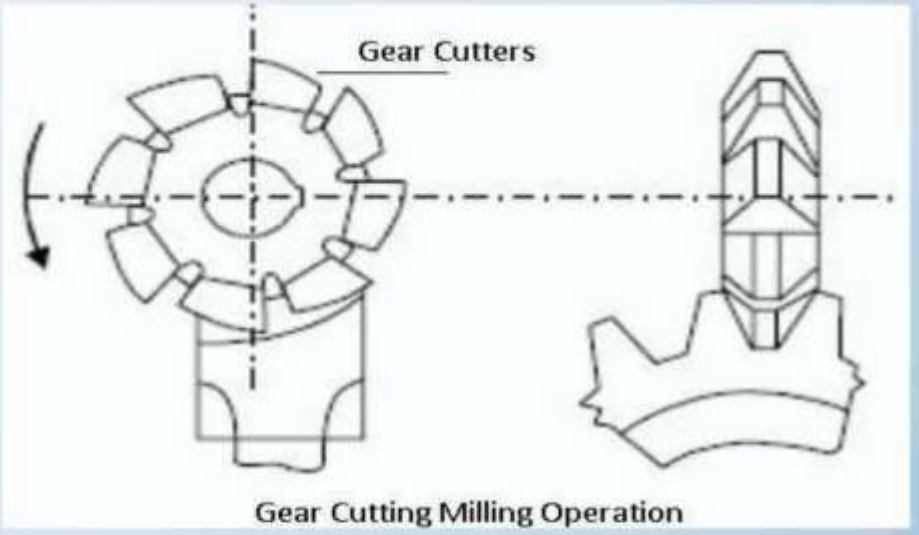
- **T-Slot Milling**
- A dovetail slot or T-slot is manufactured by using special types of cutters designed to give the required shape on the workpiece.
- The second slot is cut at right angles to the first slot by feeding the work past the cutter.
- The cutter is set exactly at the center line of the workpiece and then the cut is taken.



T-Slot Milling Operation

Milling Operations

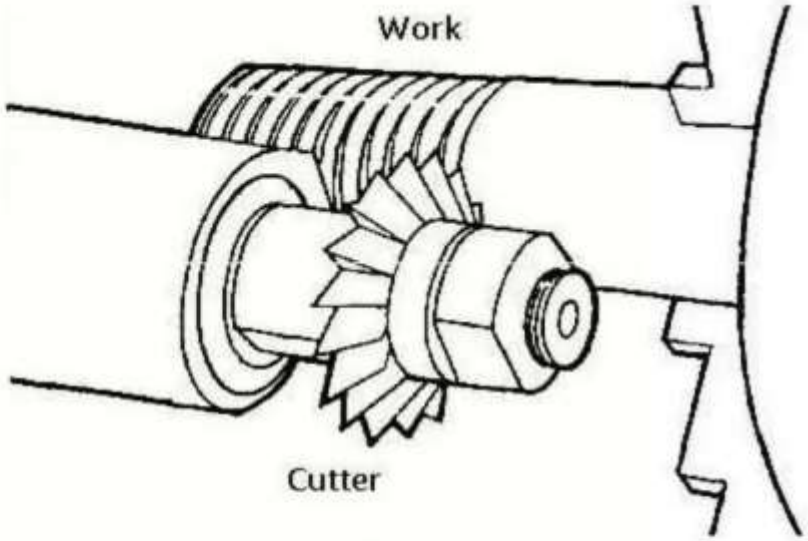
- **Gear Cutting**
- The gear cutting operation is performed in a milling machine by using a form-relieved cutter. The cutter may be a cylindrical type or end mill type.
- The cutter profile fits exactly with the tooth space of the gear.
- Equally spaced gear teeth are cut on a gear blank by holding the work on a universal diving head and then indexing it.



Gear Cutting Milling Operation

Milling Operations

- **Helical Milling**
- The helical milling is the operation of producing helical flutes or grooves around the periphery of a cylindrical or conical workpiece.
- The operation is performed by rotating the table to the required helix angle. And then by rotating and feeding the workpiece against rotary cutting edges of a milling cutter.
- Production of the helical milling cutter, helical gears, cutting helical grooves or flutes on a drill blank or a reamer.



Helical Milling Operation

Milling Operations

- **Cam Milling**
- The cam milling is the operation of producing cams in a milling machine by the use of universal dividing head and a vertical milling attachment. The cam blank is mounted at the end of the dividing head spindle and an end mill is held in the vertical milling attachment.
- The axis of the cam blank and the end mill spindle should always remain parallel to each other when setting for cam milling. The dividing head is geared to the table feed screw so that the cam is rotated about its axis while it is fed against the end mill. The axis of the cam can be set from 0 to 90° in reference to the surface of the table for obtaining a different rise of the cam.

Milling Operations

Thread Milling

- The thread milling machine operations are used to produce threads by using a single or multiple thread milling cutter. Thread milling operation is performed in special thread milling machines to produce accurate threads in small or large quantities.
- The operation requires three driving motions in the machine. One for the cutter, one for the work and the third for the longitudinal movement of the cutter

Difference between Vertical & Horizontal MM

Vertical Milling

1. In a vertical milling machine, a spindle axis is aligned vertically
2. It is cheaper in price.
3. We get a poorer surface finish.
4. Vertical milling machine reduces the tool life

Horizontal Milling

1. Here, a spindle axis is placed in a horizontal direction.
2. A horizontal milling machine is a little bit costly.
3. By using a horizontal milling machine, you will get the best surface finishing.
4. Horizontal Milling Machines help to increase the tool life.

Difference between Vertical & Horizontal MM

Vertical Milling

1. This machine requires a smaller area.
2. In the vertical milling machine, we don't get proper removal of chips
3. Its working capacity is low.
4. This type of machine is less powerful and are lighter in weight.

Horizontal Milling

1. A horizontal milling machine requires a bit larger area.
2. In a horizontal milling machine, chips are removed and thrown away from the machine properly and easily.
3. It can do the work of 3 or 4 vertical milling machines easily.
4. It is heavier in weight and more powerful than vertical milling machines.

INTRODUCTION

- The shaper is reciprocating type of machine tool primarily to produce flat surfaces. These surfaces may be horizontal, vertical or inclined.

- It can produce any surface composed of straight line elements.

FUNCTION

The shaper is a machine tool used primarily for-

- Producing a flat or plane surface which may be in a horizontal, vertical or angular plane.
- The tool reciprocates over the work. During the forward stock of the tool, it removes metal from work piece. At the end of return stroke the feed operators to move the table and work to the desired amount.

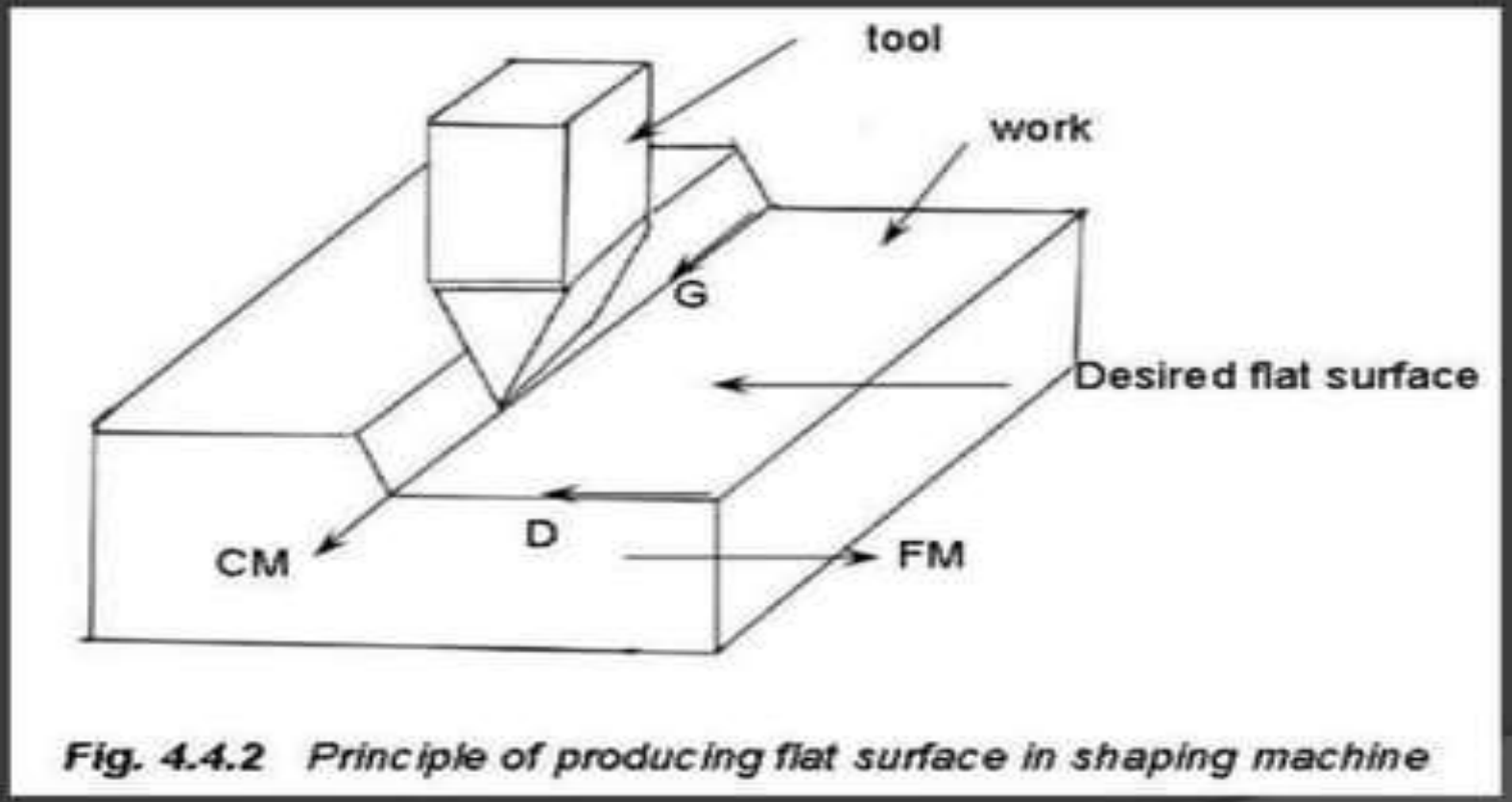


Fig. 4.4.2 Principle of producing flat surface in shaping machine

TYPES OF SHAPER

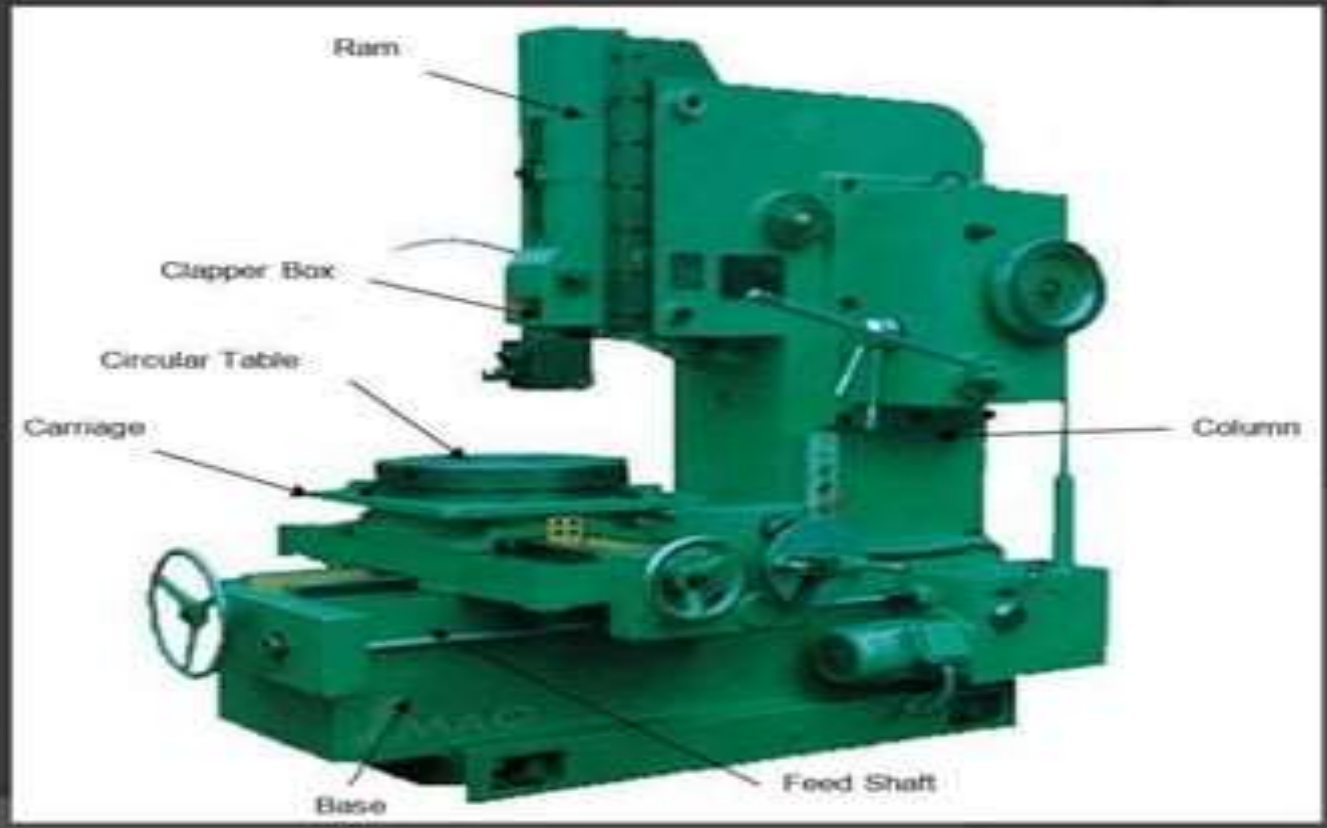
- **Shapers are classified in number of ways depending upon the general feature of design or the purpose of which they are intended.**

Shapers are classified under following headings.

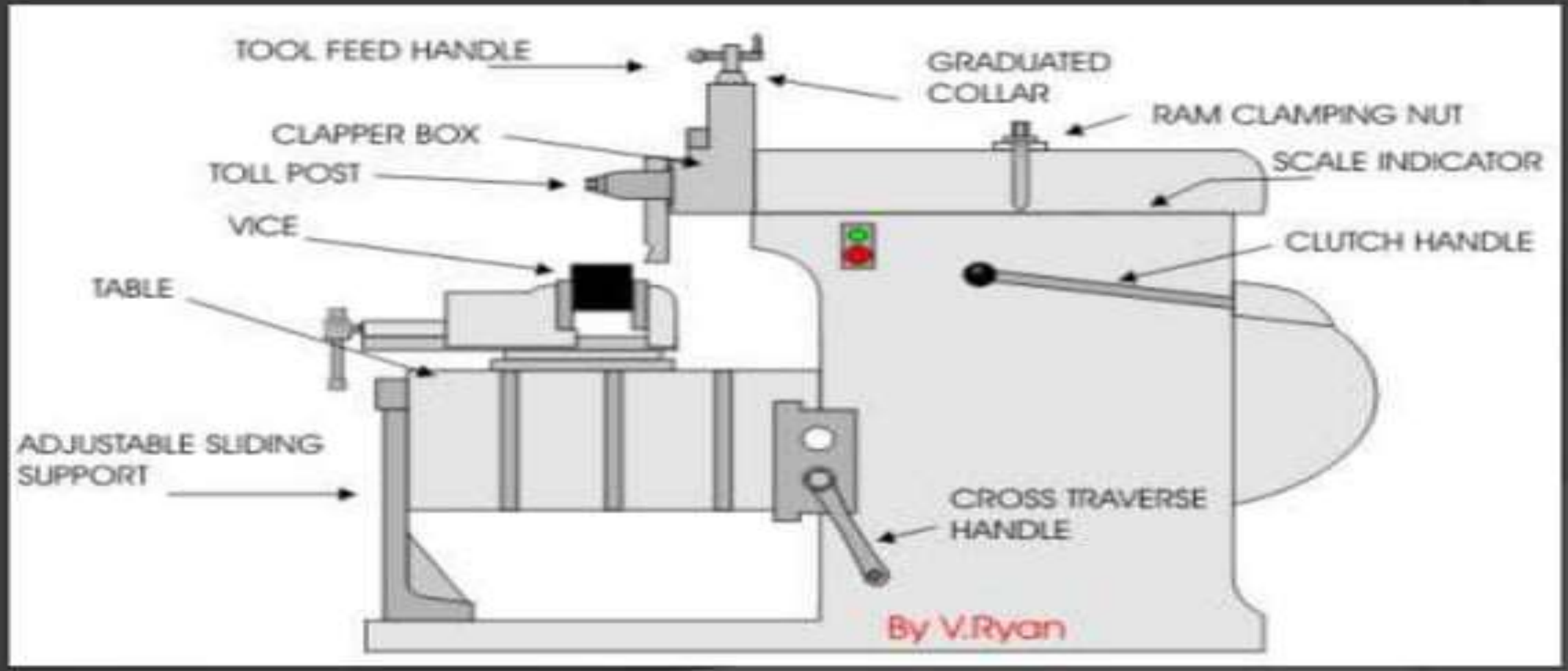
1) According to the type of mechanism used –
   a)Crank type b)Geared type c)Hydraulic type
2) According to the position and travel of ram-
   a)Horizontal type b)Vertical type
3) According to type of design of table-
   a)Standard shaper b)Universal shaper

- **Crank shaper: Shapers** whose ram reciprocates with the help of a crank mechanism
- **Geared shaper:** The ram reciprocates with spur gear mechanism. this type of shaper carries a rack under the ram for to and fro motion.
- **Hydraulic shaper:** the movement of the ram is provided by hydraulic pressure

- **Horizontal shaper:** The ram reciprocates in horizontal direction.
- **Vertical shaper:** The ram reciprocates in vertical direction. It is also known as slotter.



Principal parts of shaper



- **RAM**- The ram is driven back and forth in its slides by the slotted link mechanism. The back and forth movement of ram is called stroke and it can be adjusted according to the length of the workpiece to be-machined.
- **TABLE**- It is a void container casting by machined T-slots on the top and sides. Vise is generally fixed on the top of the table to hold workpiece.
- **CLAPPER BOX**- The shaping machine usually cuts on the forward stroke and does not on the backward stroke. So its not required for the tool to be in contact with the work piece when its on the backward stroke. This is ensured by the Clapper box, a device which is hinged to the ram. The lifting of the cutting tool by the clapper box ensures longer tool life and also accidental scratch or other machining defects on the work piece/final product.

- **TOOL HEAD**- It has tool post with tool holder that hold cutting tool. Tool slide is moved up and down by feed screw to regulate correct depth of cut.
- **CROSS RAIL**- It permits vertical and horizontal movement of table. Cross feed mechanism is attached to cross rail.
- **SADDLE**- It carries the work table. Crosswise movement of saddle causes the work table to move sideways.

QUICK RETURN MECHANISM

- The return stroke allow the ram to move at a faster rate to reduce the idle time which is known as **Quick Return Mechanism**.
- The reciprocating movement of ram and quick return mechanism of the machine are obtained from

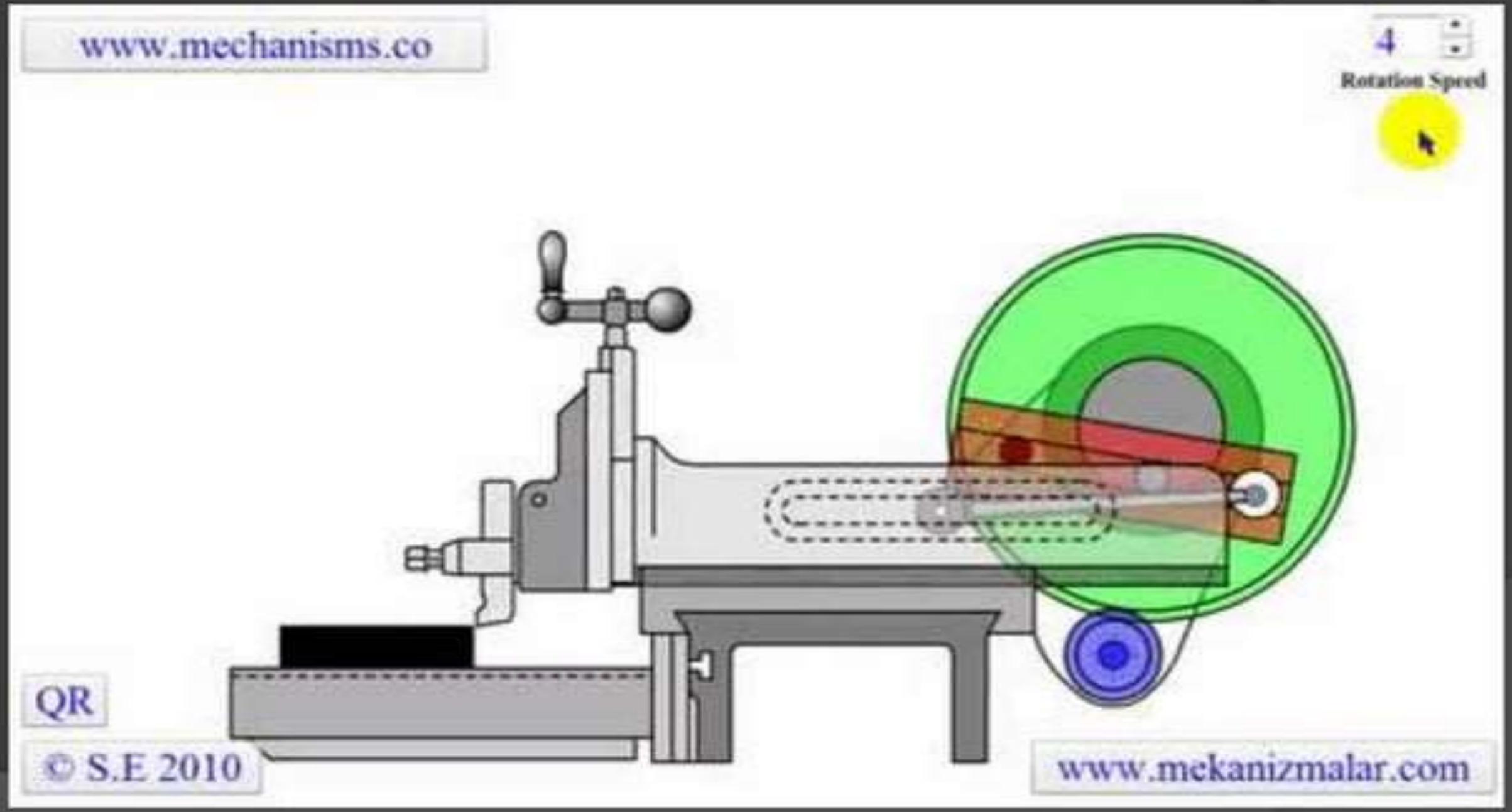
  (i) Crank and Slotted link mechanism

  (ii) Whitworth quick return mechanism

  (III) Hydraulic Shaper Mechanism

Crank and Slotted link mechanism

- It is simple and compact. It converts rotary motion of the electric motor and gear box into the reciprocating motion of the ram.
- **Bull gear** is driven by a **pinion** which connects to the motor shaft through gear box.
- The bull wheel has a **slot**. The crank pin A secured into this slot, at the same time it can slide in the slotted crank B.


www.mechanisms.co
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Rotation Speed
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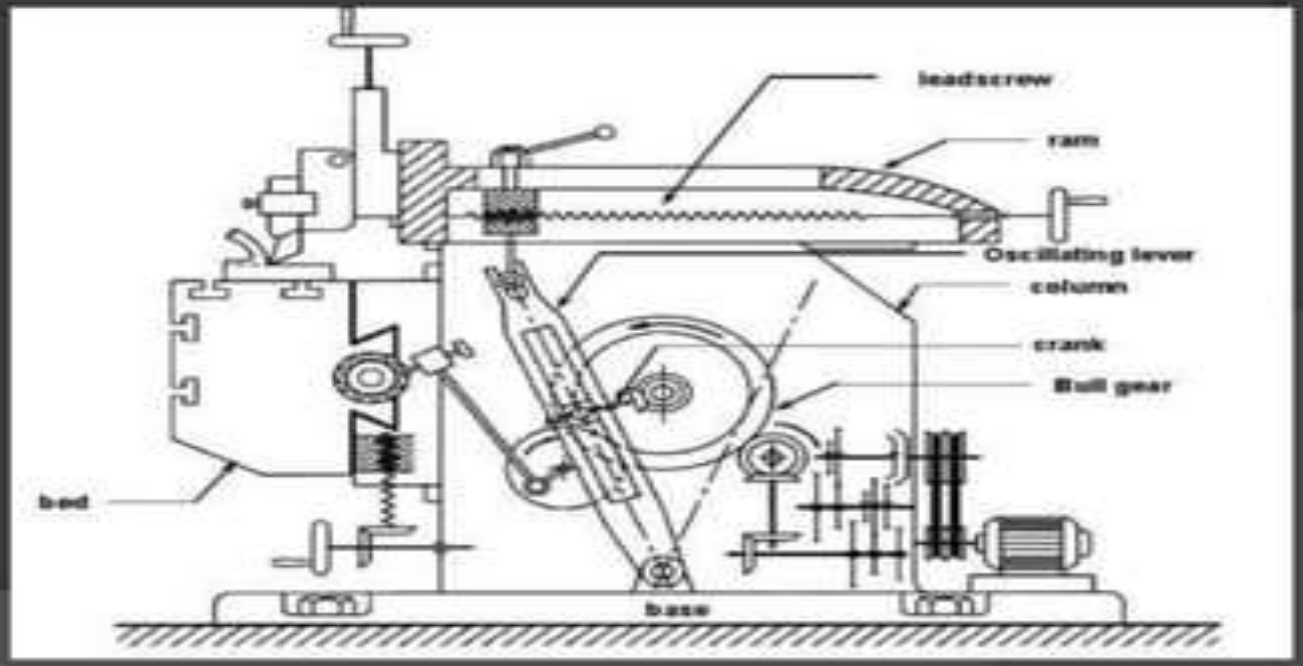
- As the bull gear rotate cause the crankpin A also to turn and side by side slides through the slot in the slotted crank B.
- This makes the slotted crank to oscillate about its one end C.
- This oscillating motion of slotted crank (through the link D) makes the ram to reciprocate.

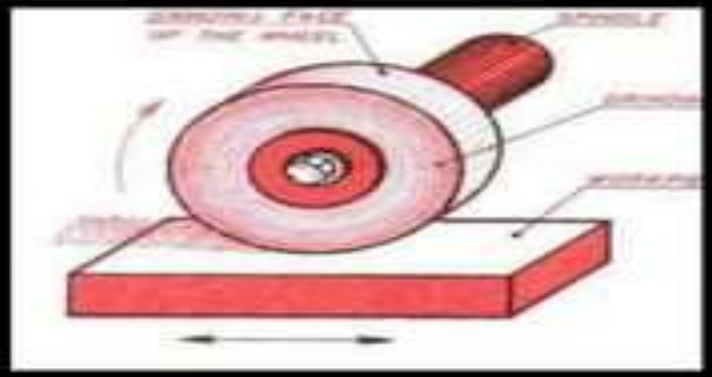


APPLICATIONS

- Machining horizontal surfaces
- Machining vertical surfaces
- Machining angular surfaces
- Cutting Slots, grooves and keyways
- Machining irregular surfaces
- Machining splines/Cutting gears

PRINCIPLE OF GRINDING

- The work piece is fed against a constantly rotating abrasive wheel so that a thin layer of material is removed from the it.
- Work piece is fed against the rotating abrasive **wheel**.
- Due to action of rubbing or friction between the abrasive particles and work piece material is removed.... Types of **Grinding** On the basis of quality of **grinding**, it is classified as rough **grinding** and precision **grinding**.



WORKING PRINCIPLE

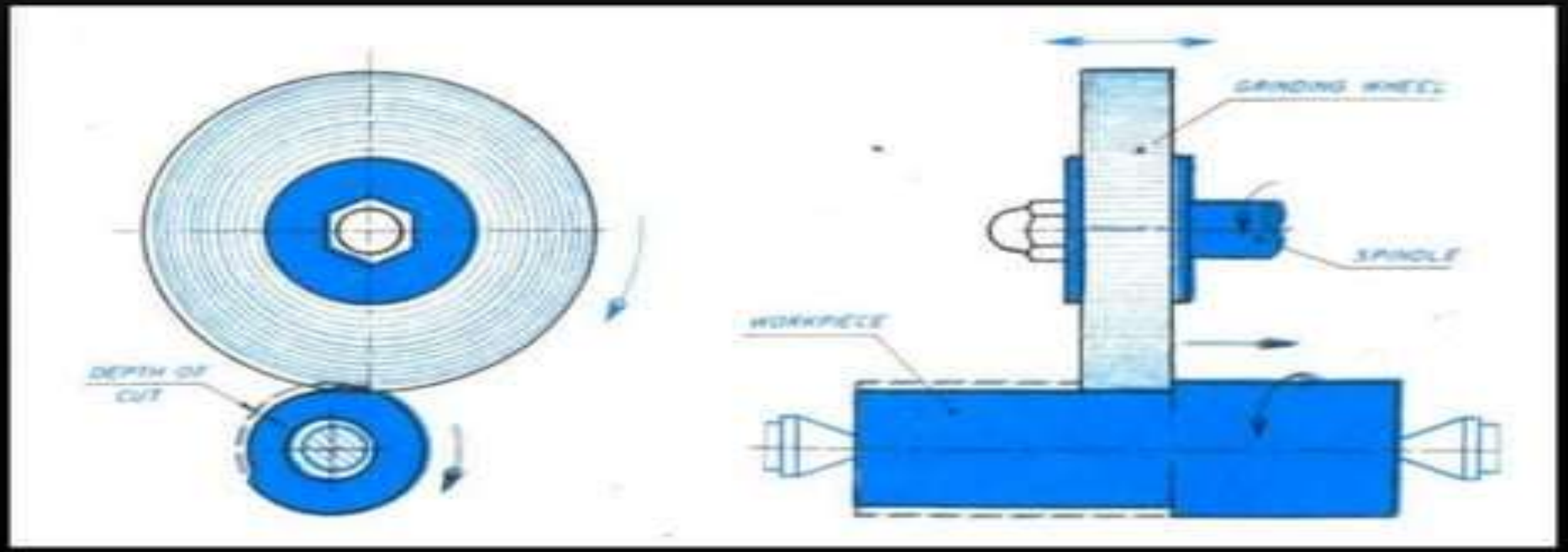


Fig. Working Principle

INTRODUCTION

- A grinding machine, often shortened to grinder, is any of various power tools or machine tools used for grinding, which is a type of machining using an abrasive wheel as the cutting tool. Each grain of abrasive on the wheel's surface cuts a small chip from the work piece via shear deformation.
- Grinding is used to finish work pieces that must show high surface quality (e.g., low surface roughness) and high accuracy of shape and dimension. As the accuracy in dimensions in grinding is on the order of 0.000025 mm, in most applications it tends to be a finishing operation and removes comparatively little metal, about 0.25 to 0.50 mm depth. However, there are some roughing applications in which grinding removes high volumes of metal quite rapidly. Thus, grinding is a diverse field.

- The grinding machine consists of a bed with a fixture to guide and hold the work piece, and a power-driven grinding wheel spinning at the required speed. The speed is determined by the wheel's diameter and manufacturer's rating. The user can control the grinding head to travel across a fixed work piece, or the work piece can be moved while the grind head stays in a fixed position.
- Fine control of the grinding head or tables position is possible using a vernier calibrated hand wheel, or using the features of numerical controls.
- Grinding machines remove material from the work piece by abrasion, which can generate substantial amounts of heat. To cool the work piece so that it does not overheat and go outside its tolerance, grinding machines incorporate a coolant. The coolant also benefits the machinist as the heat generated may cause burns. In high-precision grinding machines (most cylindrical and surface grinders), the final grinding stages are usually set up so that they remove about 200 nm (less than 1/10000 in) per pass - this generates so little heat that even with no coolant, the temperature rise is negligible.'

GRINDING PROCESS

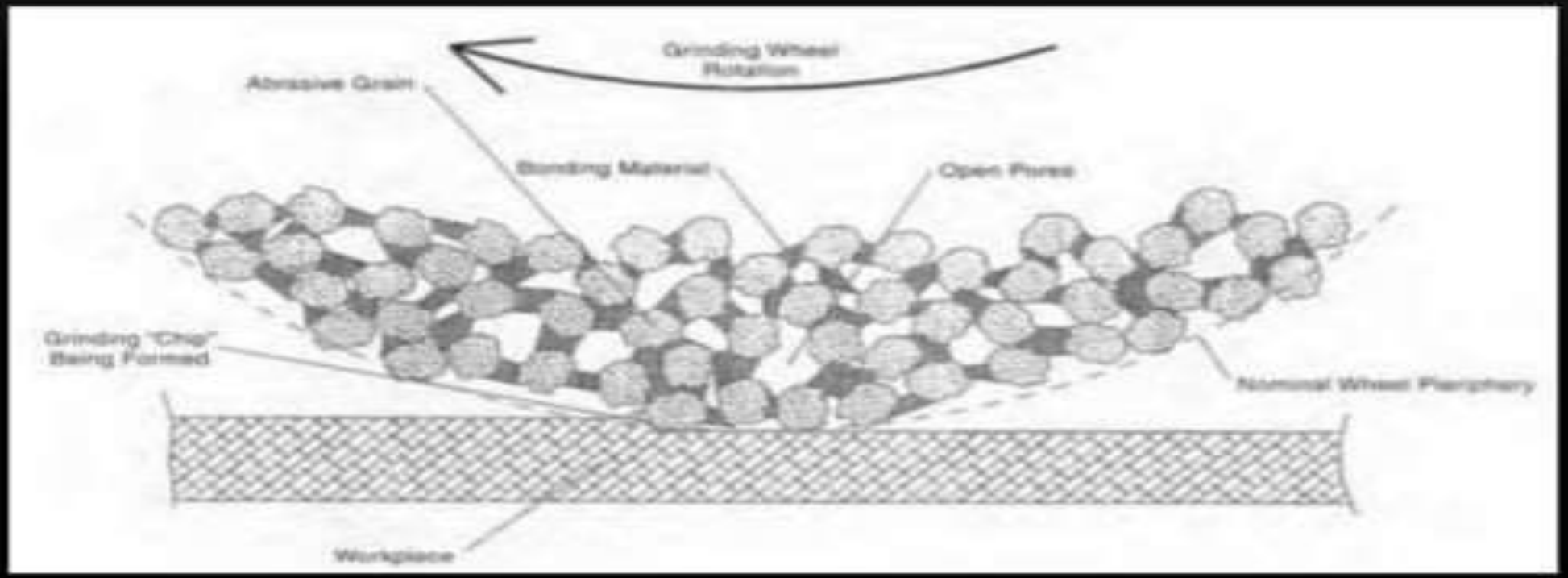


Fig. Grinding Process

TYPES OF GRINDING MACHINE

- Belt grinder
- Bench grinder
- Cylindrical grinder
- Surface grinder
- Tool and cutter grinder
- Jig grinder
- Gear grinder
- Centreless grinder
- Planetary internal grinder

BELT GRINDER

- Belt grinder, which is usually used as a machining method to process metals and other materials, with the aid of coated abrasives. Sanding is the machining of wood; grinding is the common name for machining metals. Belt grinding is a versatile process suitable for all kind of applications like finishing, deburring, and stock removal

Fig. Belt Grinder

BENCH GRINDER

- Bench grinder, which usually has two wheels of different grain sizes for roughing and finishing operations and is secured to a workbench or floor stand. Its uses include shaping tool bits or various tools that need to be made or repaired. Bench grinders are manually operated.

Fig. Bench Grinder

CYLINDRICAL GRINDER

- Cylindrical grinder, which includes both the types that use centers and the centreless types. A cylindrical grinder may have multiple grinding wheels. The work piece is rotated and fed past the wheel(s) to form a cylinder. It is used to make precision rods, tubes, bearing races, bushings, and many other parts.
- It is a process of grinding curved surfaces.
- Surface may be straight or tapered.
- Work piece is mounted on two centers, one is tailstock centre and the other is headstock centre.
- Head stock center may or may not revolve.

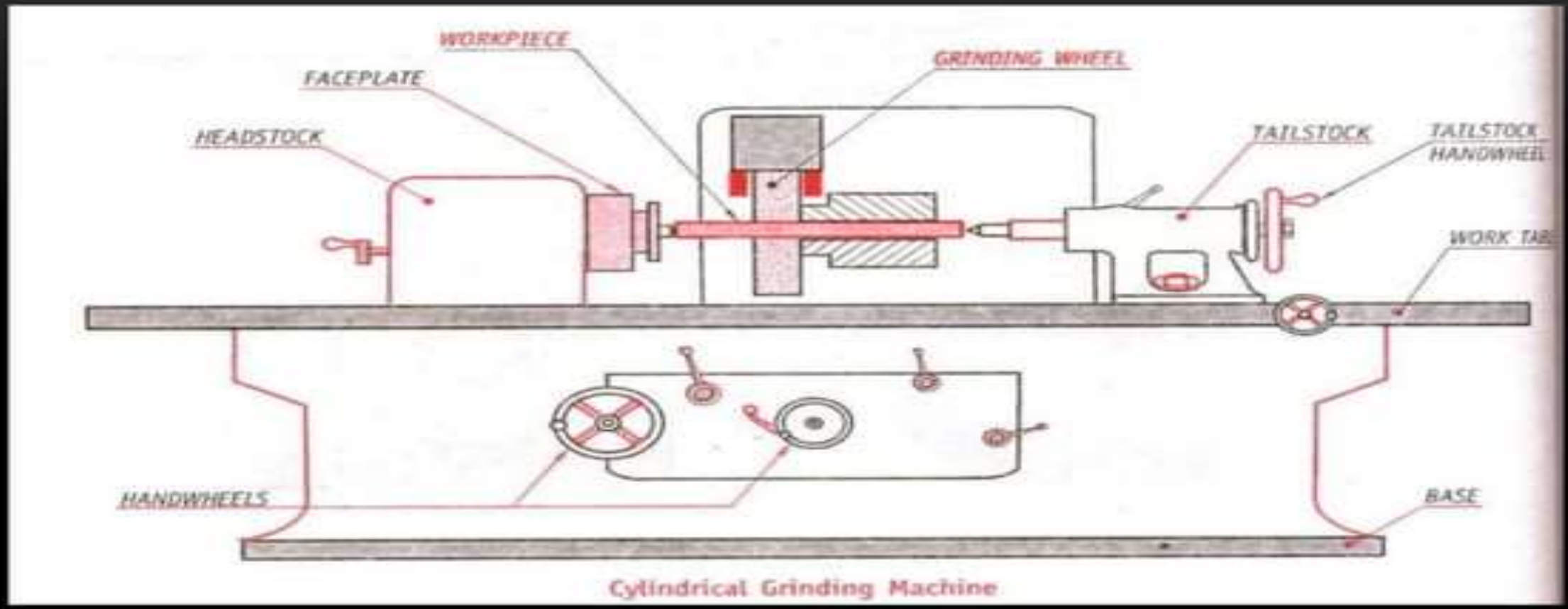


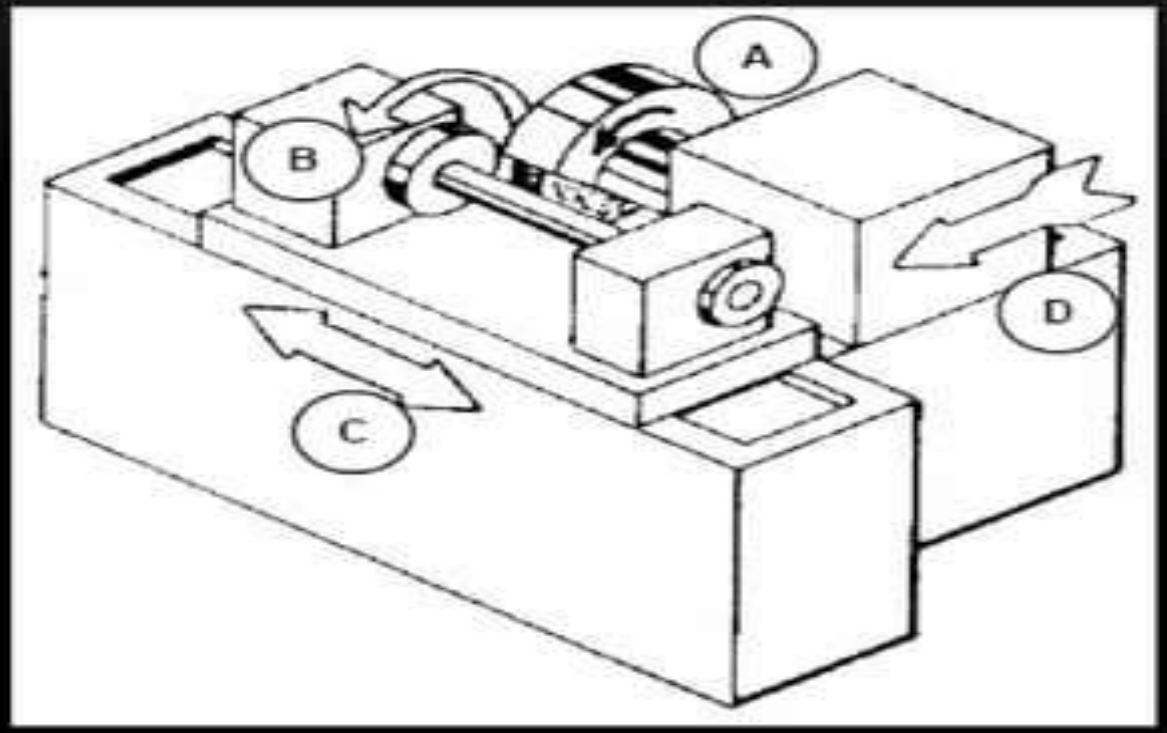
Fig. Cylindrical Grinder

- Centreless grinding is a machining process that uses abrasive cutting to remove material from a workpiece Centreless grinding differs from centered grinding operations in that no spindle or fixture is used to locate and secure the workpiece the workpiece is secured between two rotary grinding wheels, and the speed of their rotation relative to each other determines the rate at which material is removed from the workpiece
- This machine is used to produce external cylindrical surface. The surfaces may be straight, tapered, steps or profiled. Broadly there are three different types of cylindrical grinding machine as follows:

    1. Plain center type cylindrical grinder
    2. Universal cylindrical surface grinder
    3. Centreless cylindrical surface grinder

PLAIN CENTER TYPE CYLINDRICAL GRINDER

- Figure illustrates schematically this machine and various motions required for grinding action. The machine is similar to a center lathe in many respects. The workpiece is held between head stock and tailstock center. A disc type grinding wheel performs the grinding action with its peripheral surface. Both traverse and plunge grinding can be carried out in this machine as shown in Fig.



A: rotation of grinding wheel

B: work table rotation

C: reciprocation of worktable

D: infeed

Fig. Plain centre type cylindrical grinder

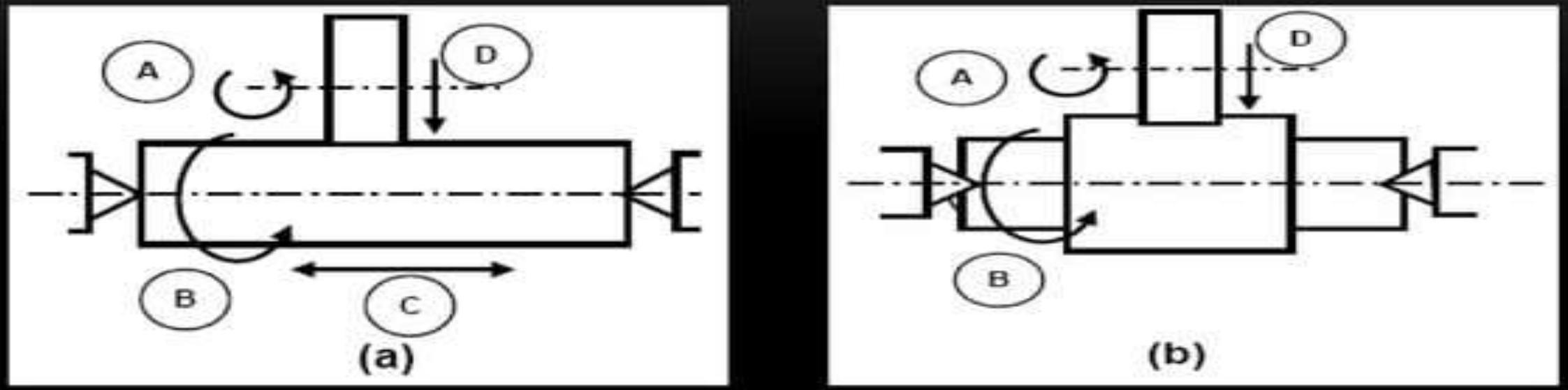


Fig. Cylindrical (a) traverse grinding and (b) plunge grinding

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

UNIVERSAL CYLINDRICAL SURFACE GRINDER

- Universal cylindrical grinder is similar to a plain cylindrical one except that it is more versatile. In addition to small worktable swivel, this machine provides large swivel of head stock, wheel head slide and wheel head mount on the wheel head slide.
- This allows grinding of any taper on the workpiece. Universal grinder is also equipped with an additional head for internal grinding. Schematic illustration of important features of this machine is shown in Fig.

SURFACE GRINDER

- Surface grinder which includes the wash grinder. A surface grinder has a "head" which is lowered, and the work piece is moved back and forth past the grinding wheel on a table that has a permanent magnet for use with magnetic stock. Surface grinders can be manually operated or have CNC controls. Rotary surface grinders or commonly known as "Blanchard" style grinders, the grinding head rotates and the table usually magnetic but can be vacuum or fixture, rotates in the opposite direction, this type machine removes large amounts of material and grinds flat surfaces with noted spiral grind marks. Used to make and sharpen; burn-outs, metal stamping die sets, flat shear blades, fixture bases or any flat and parallel surfaces.
- It is machine basically used to grind flat surface.
- Job is mounted to a table which moves longitudinally as well as in transverse direction.
- Manual feed or power feed.
- Protective guard for safety.
- Internal pump and piping arrangement for coolant
- Work piece can clamped in two ways
  - Manual clamps.
  - Magnetic chuck.

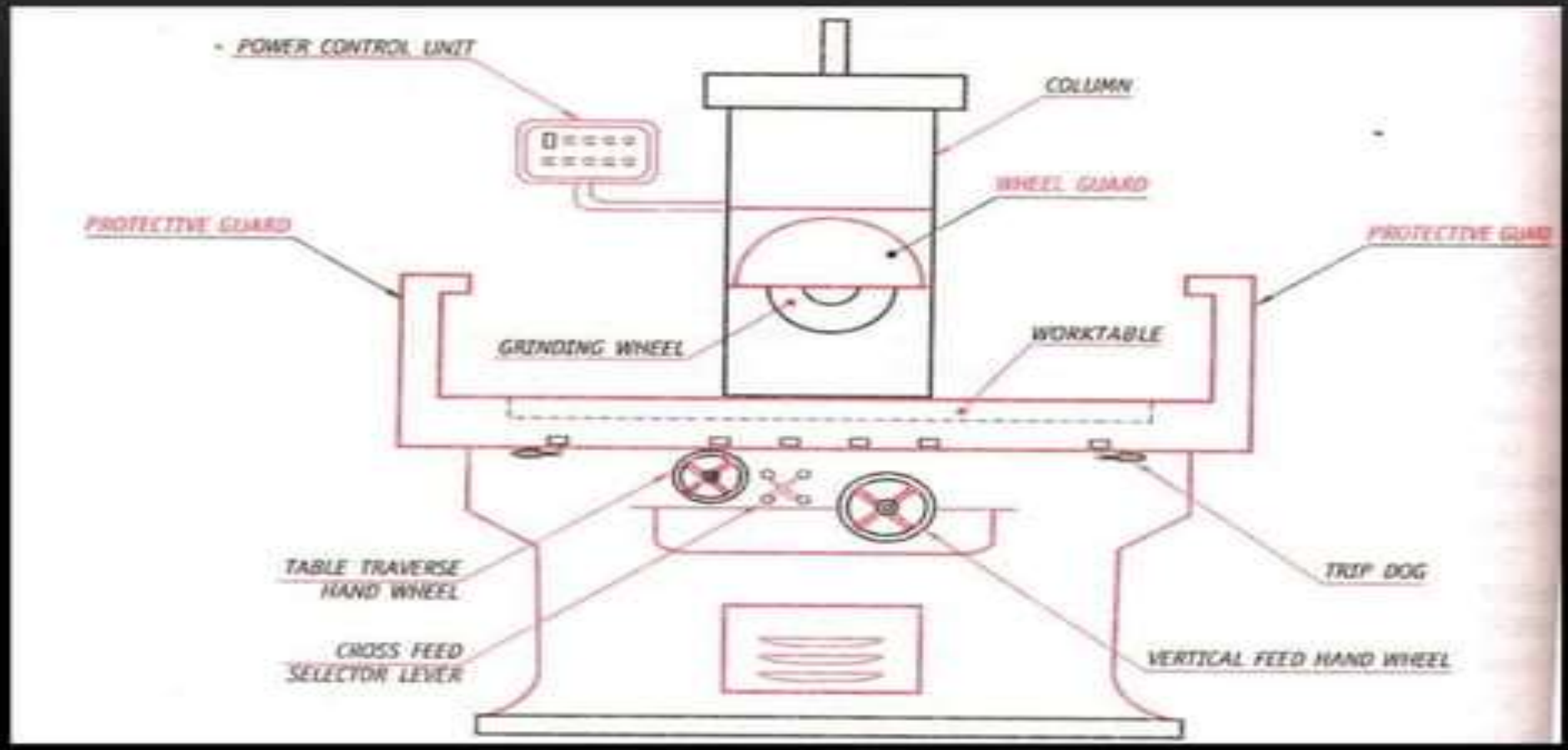
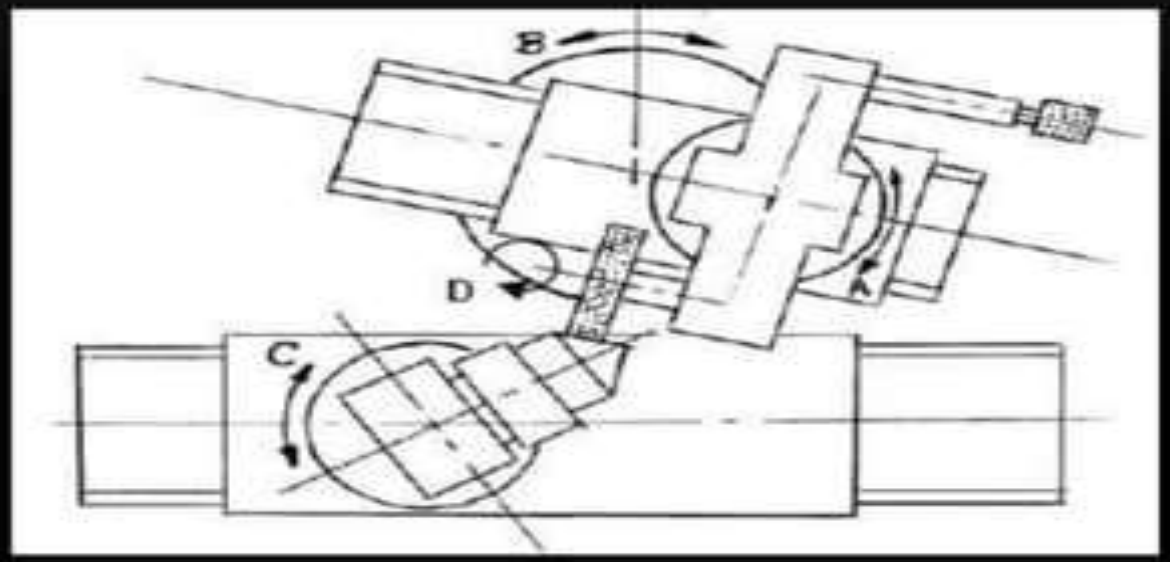


Fig. Surface Grinder



A: swiveling wheel head

B: swiveling wheel head slide

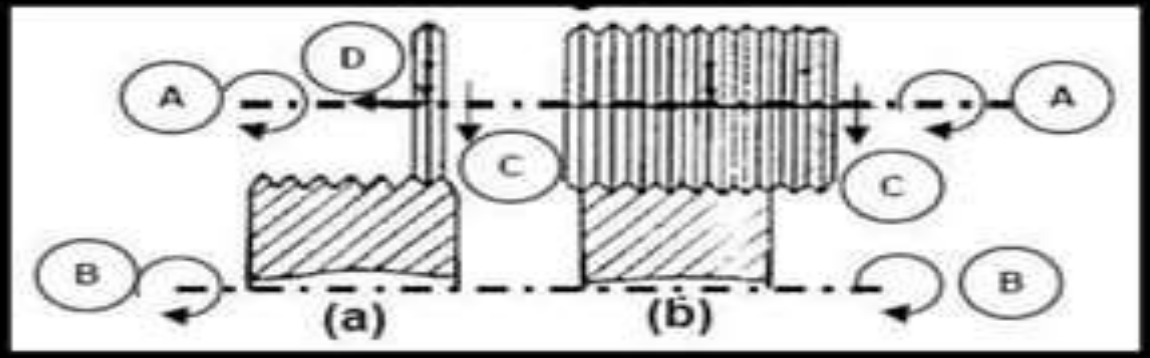
C: swiveling head stock

D: rotation of grinding wheel

Fig. important features of universal cylindrical grinding machine

SPECIAL APPLICATION OF CYLINDRICAL GRINDER

- Principle of cylindrical grinding is being used for thread grinding with specially formed wheel that matches the thread profile. A single ribbed wheel or a multi ribbed wheel can be used as shown in Fig. 6.22.



A: rotation of grinding wheel

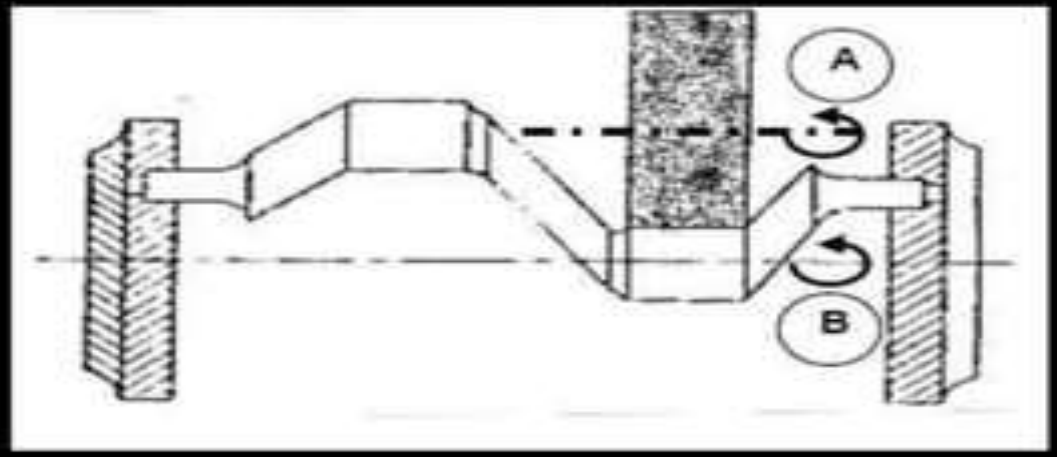
B: rotation of workpiece

C: Down feed

D: Longitudinal feed of wheel

Fig. *Thread grinding with (a) single rib (b) multi-ribbed wheel*

- Roll grinding is a specific case of cylindrical grinding wherein large work pieces such as shafts, spindles and rolls are ground.
- Crankshaft or crank pin grinders also resemble cylindrical grinder but are engaged to grind crank pins which are eccentric from the centre line of the shaft as shown in Fig. 6.23. The eccentricity is obtained by the use of special chuck.



A: rotation of wheel

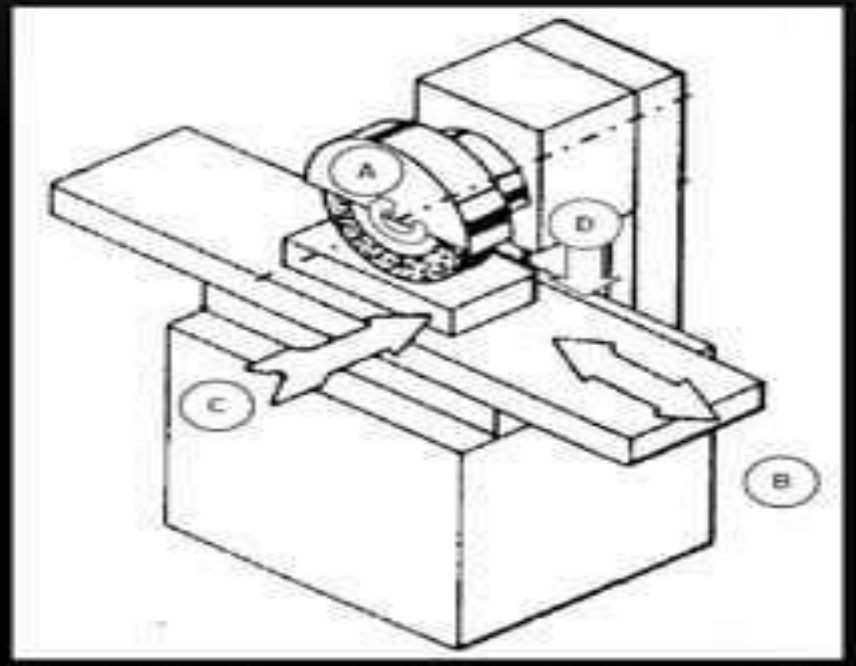
B: rotation of crank pin

Fig. Grinding of crank pin

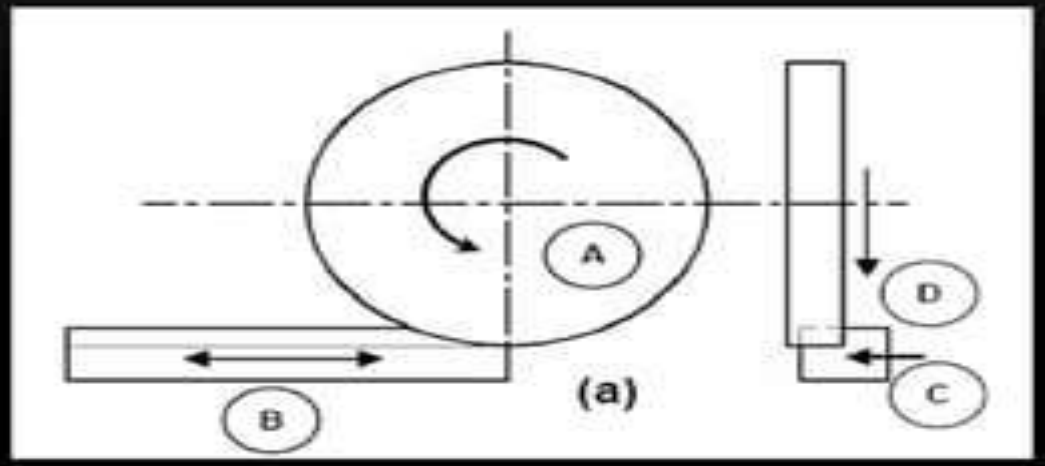
- Basically there are four different types of surface grinding machines characterized by the movement of their tables and the orientation of grinding wheel spindles as follows:
  - Horizontal spindle and reciprocating table
  - Vertical spindle and reciprocating table
  - Horizontal spindle and rotary table
  - Vertical spindle and rotary table

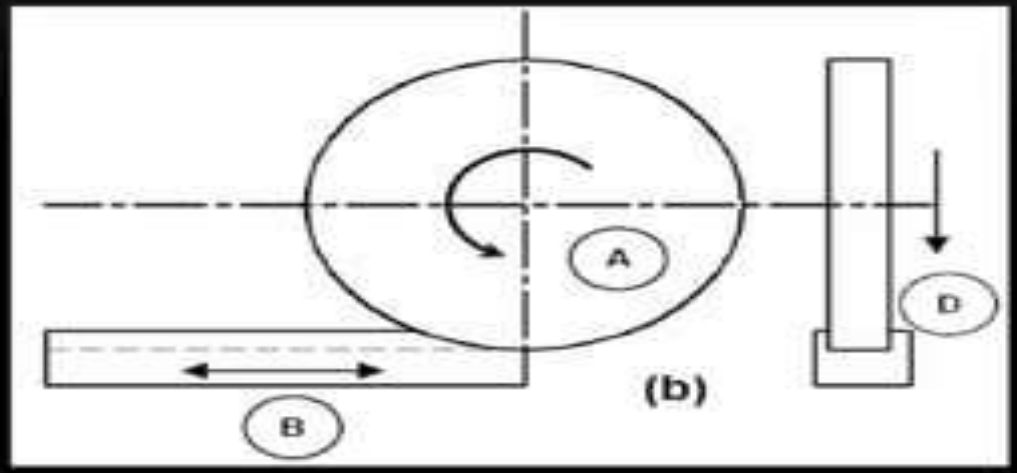
HORIZONTAL SPINDLE RECIPROCATING TABLE GRINDER

- illustrates this machine with various motions required for grinding action. A disc type grinding wheel performs the grinding action with its peripheral surface. Both traverse and plunge grinding can be carried out in this machine as shown in Fig.



A: rotation of grinding wheel, B: reciprocation of worktable, C: transverse feed, D: down feed





A: rotation of grinding wheel B: reciprocation of worktable C: transverse feed D: down feed Fig. Surface grinding (a) traverse grinding (b) plunge grinding

VERTICAL SPINDLE RECIPROCATING TABLE GRINDER

- This grinding machine with all working motions is shown in Fig. 6.14. The grinding operation is similar to that of face milling on a vertical milling machine. In this machine a cup shaped wheel grinds the workpiece over its full width using end face of the wheel as shown in Fig. 6.15. This brings more grits in action at the same time and consequently a higher material removal rate may be attained than for grinding with a peripheral wheel.
- The face of a wheel (cup, cylinder, disc, or segmental wheel) is used on the flat surface. Wheel-face grinding is often used for fast material removal, but some machines can accomplish high-precision work. The workpiece is held on a reciprocating table, which can be varied according to the task, or a rotary-table machine, with continuous or indexed rotation. Indexing allows loading or unloading one station while grinding operations are being performed on another.

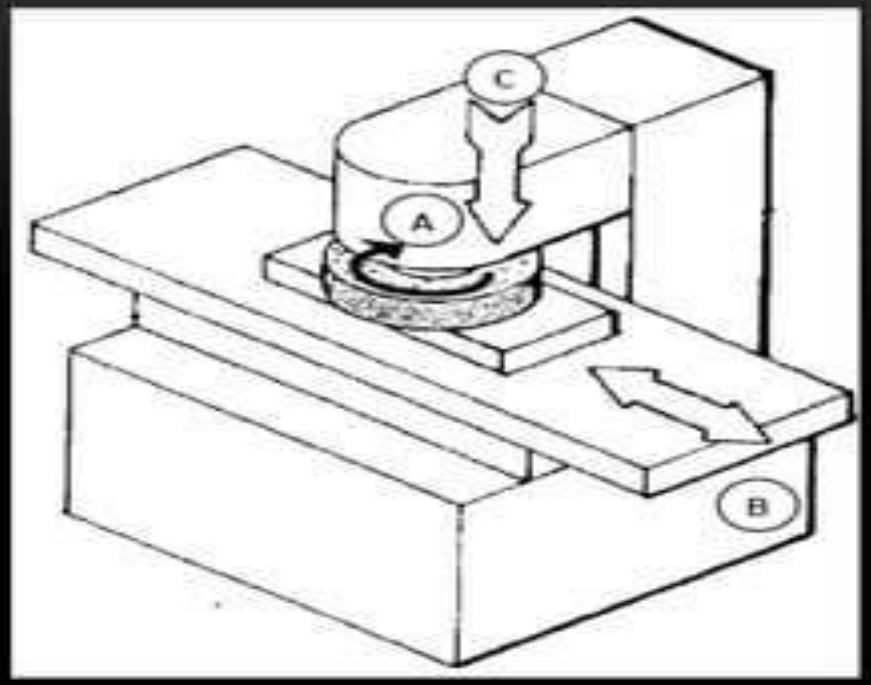


Fig. Vertical spindle reciprocating table surface grinder

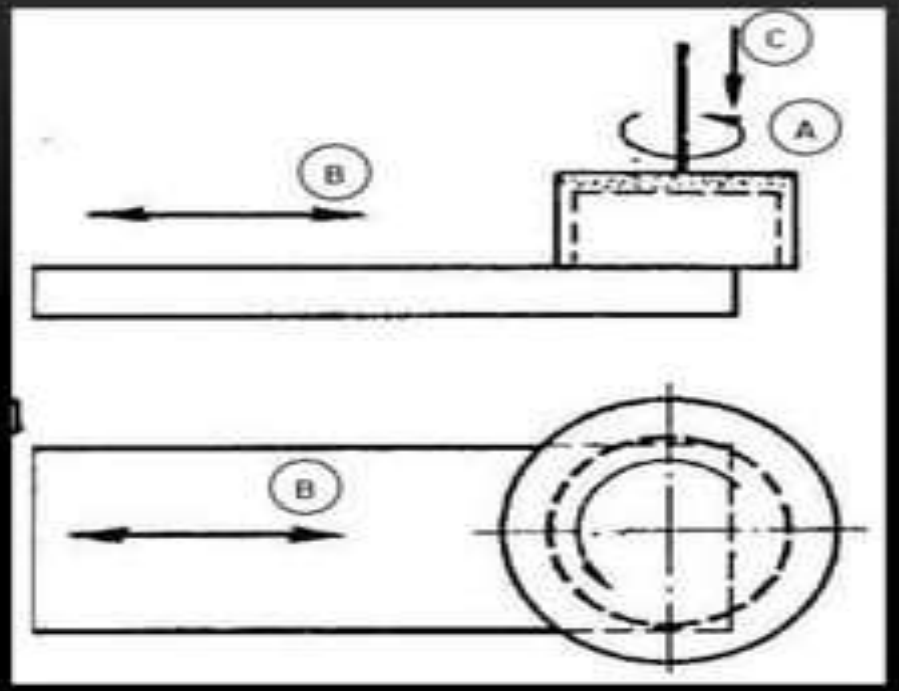
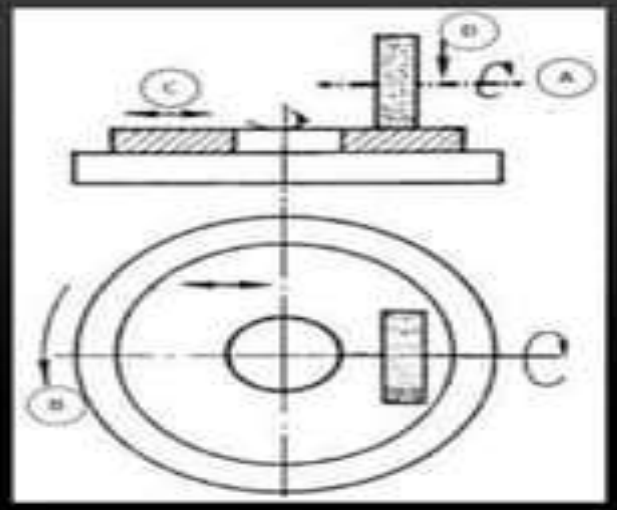


Fig. Surface grinding in Vertical spindle reciprocating table surface grinder

A: ROTATION OF GRINDING WHEEL B: RECIPROCATION OF WORKTABLE C: DOWN FEED OF GRINDING WHEEL

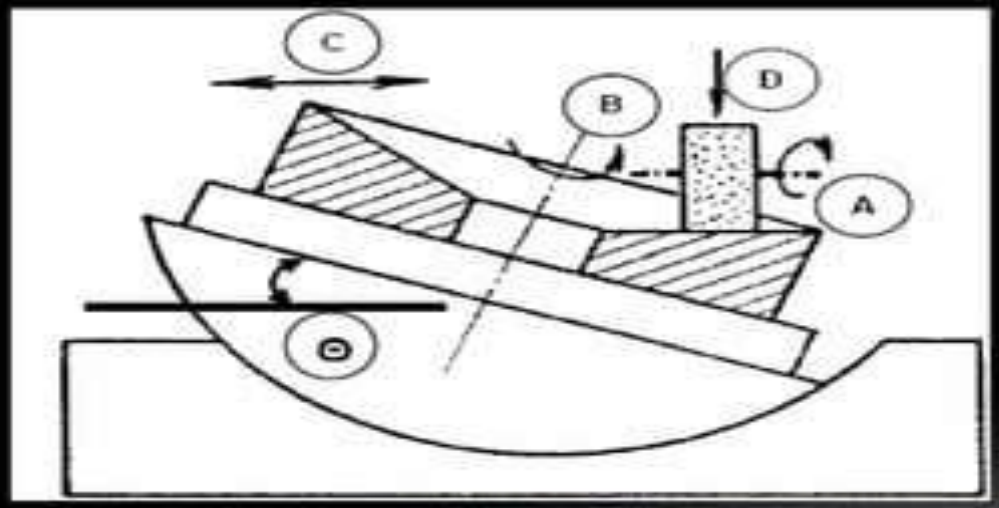
HORIZONTAL SPINDLE ROTARY TABLE GRINDER

- Surface grinding in this machine is shown in Fig. 6.16. In principle the operation is same as that for facing on the lathe. This machine has a limitation in accommodation of workpiece and therefore does not have wide spread use. However, by swiveling the worktable, concave or convex or tapered surface can be produced on individual part as illustrated in Fig .
- The periphery (flat edge) of the wheel is in contact with the workpiece, producing the flat surface. Peripheral grinding is used in high-precision work on simple flat surfaces; tapers or angled surfaces; slots; flat surfaces next to shoulders; recessed surfaces; and profiles



A: rotation of grinding wheel
B: table rotation
C: table reciprocation
D: down feed of grinding wheel

Fig. Surface grinding in Horizontal spindle rotary table surface grinder

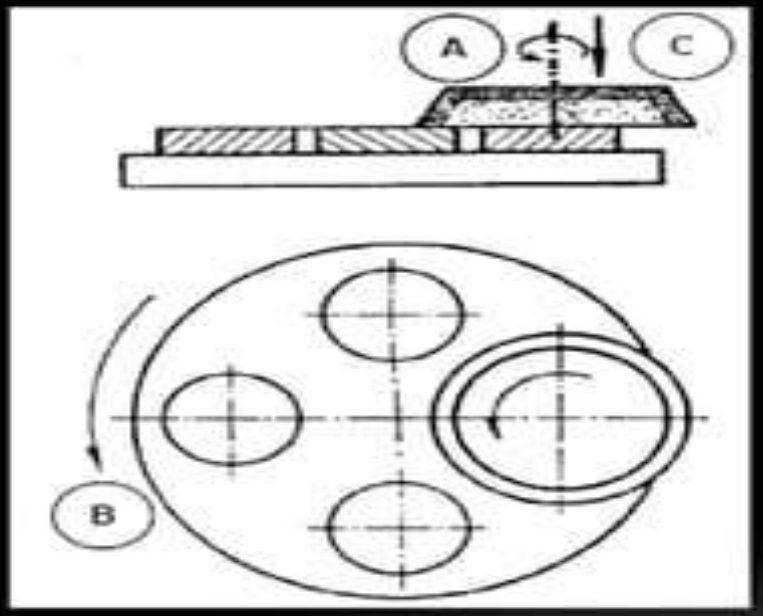


A: rotation of grinding wheel
B: table rotation
C: table reciprocation
D: down feed of grinding wheel
Θ: swivel angle

Fig. Grinding of a tapered surface in horizontal spindle rotary table surface grinder

VERTICAL SPINDLE ROTARY TABLE GRINDER

- The principle of grinding in this machine is shown in Fig. The machine is mostly suitable for small work pieces in large quantities. This primarily production type machine often uses two or more grinding heads thus enabling both roughing and finishing in one rotation of the work table.



A: rotation of grinding wheel

B: work table rotation

C: down feed of grinding wheel

Fig. Surface grinding in vertical spindle rotary table surface grinder

TOOL AND CUTTER GRINDER

- A tool and cutter grinder is used to sharpen milling cutters and tool bits along with a host of other cutting tools.
- It is an extremely versatile machine used to perform a variety of grinding operations: surface, cylindrical, or complex shapes. The image shows a manually operated setup, however highly automated Computer Numerical Control (CNC) machines are becoming increasingly common due to the complexities involved in the process.
- Tool and cutter grinder and the D-bit grinder. These usually can perform the minor function of the drill bit grinder, or other specialist tool room grinding operations.

Fig. Tool and Cutter Grinder

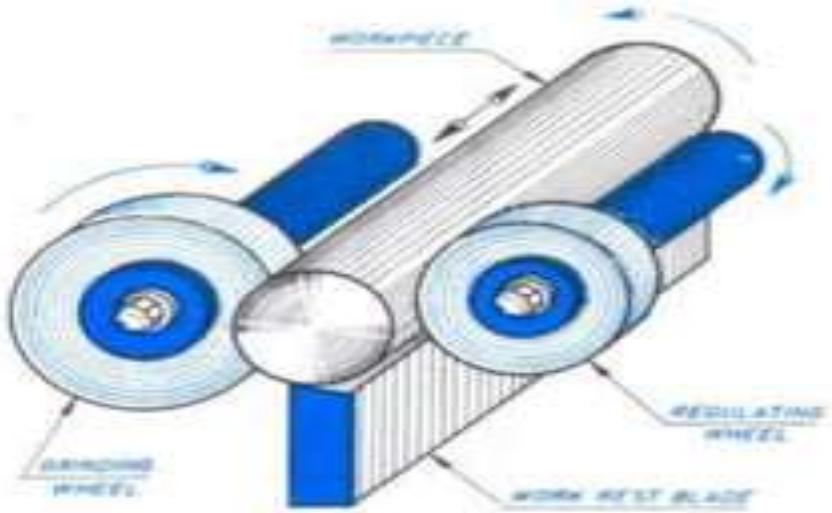
GEAR GRINDER

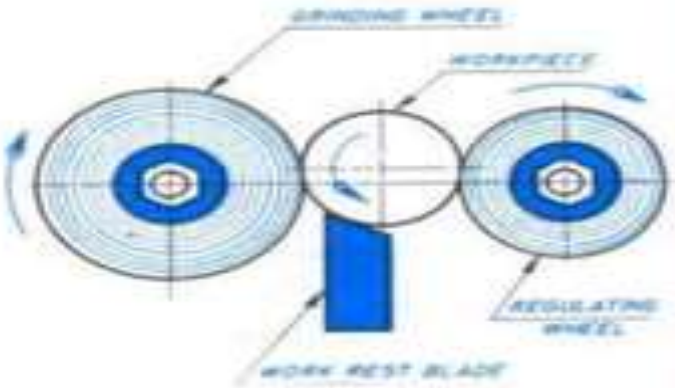
- Gear grinder, which is usually employed as the final machining process when manufacturing a high-precision gear. The primary function of these machines is to remove the remaining few thousandths of an inch of material left by other manufacturing methods (such as gashing or hobbing).
- **Gear cutting** is any machining process for creating a gear. The most common gear-cutting processes include hobbing, broaching, milling, and grinding. Such cutting operations may occur either after or instead of forming processes such as forging, extruding, investment casting, or sand casting.
- Gears are commonly made from metal, plastic, and wood. Although gear cutting is a substantial industry, many metal and plastic gears are made without cutting, by processes such as die casting or injection molding. Some metal gears made with powder metallurgy require subsequent machining, whereas others are complete after sintering. Likewise, metal or plastic gears made with additive manufacturing may or may not require finishing by cutting, depending on application

Fig. Gear Grinder

CENTRE LESS GRINDING MACHINE

- It is used to grind curved surface work piece which are long and slender.
- Work piece rests on a work-rest blade and is backed by a second wheel called as regulating wheel.
- Grinding wheel pushes the work piece down the work-rest blade against the regulating wheel.

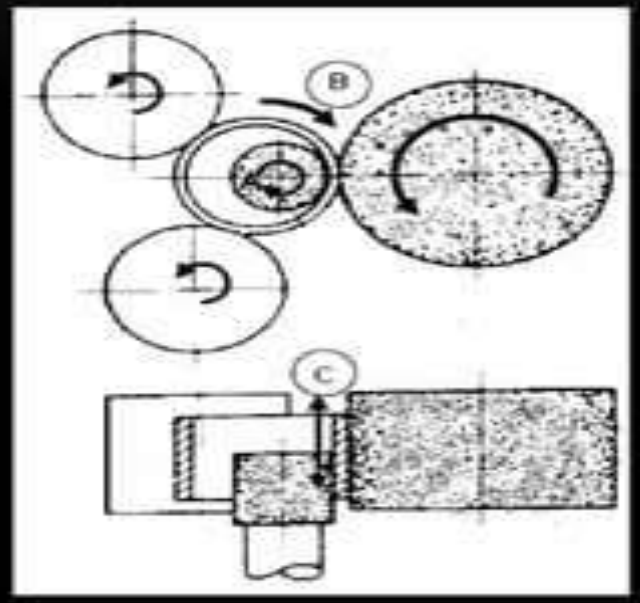




Centreless Grinding Principle
Fig. 6.19

CENTERLESS INTERNAL GRINDER

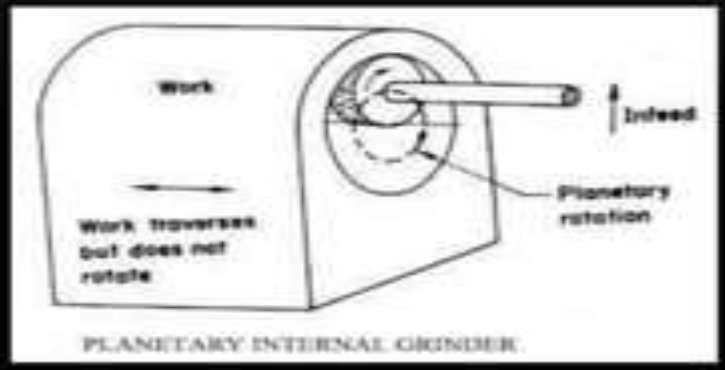
- This machine is used for grinding cylindrical and tapered holes in cylindrical parts (e.g. cylindrical liners, various bushings etc). The workpiece is rotated between supporting roll, pressure roll and regulating wheel and is ground by the grinding wheel as illustrated in



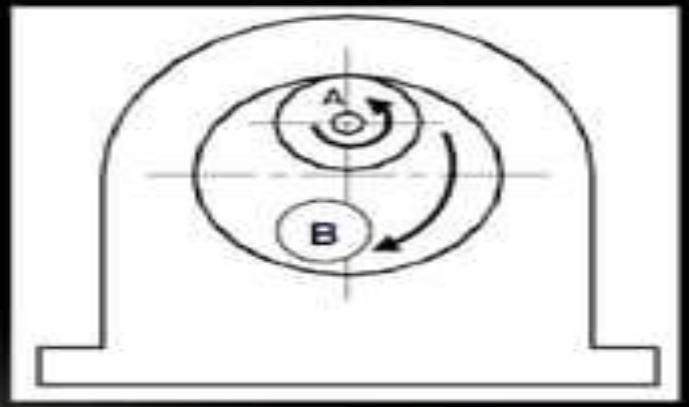
A: grinding wheel rotation B: workpiece rotation
C: wheel reciprocation

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.



PLANETARY INTERNAL GRINDER



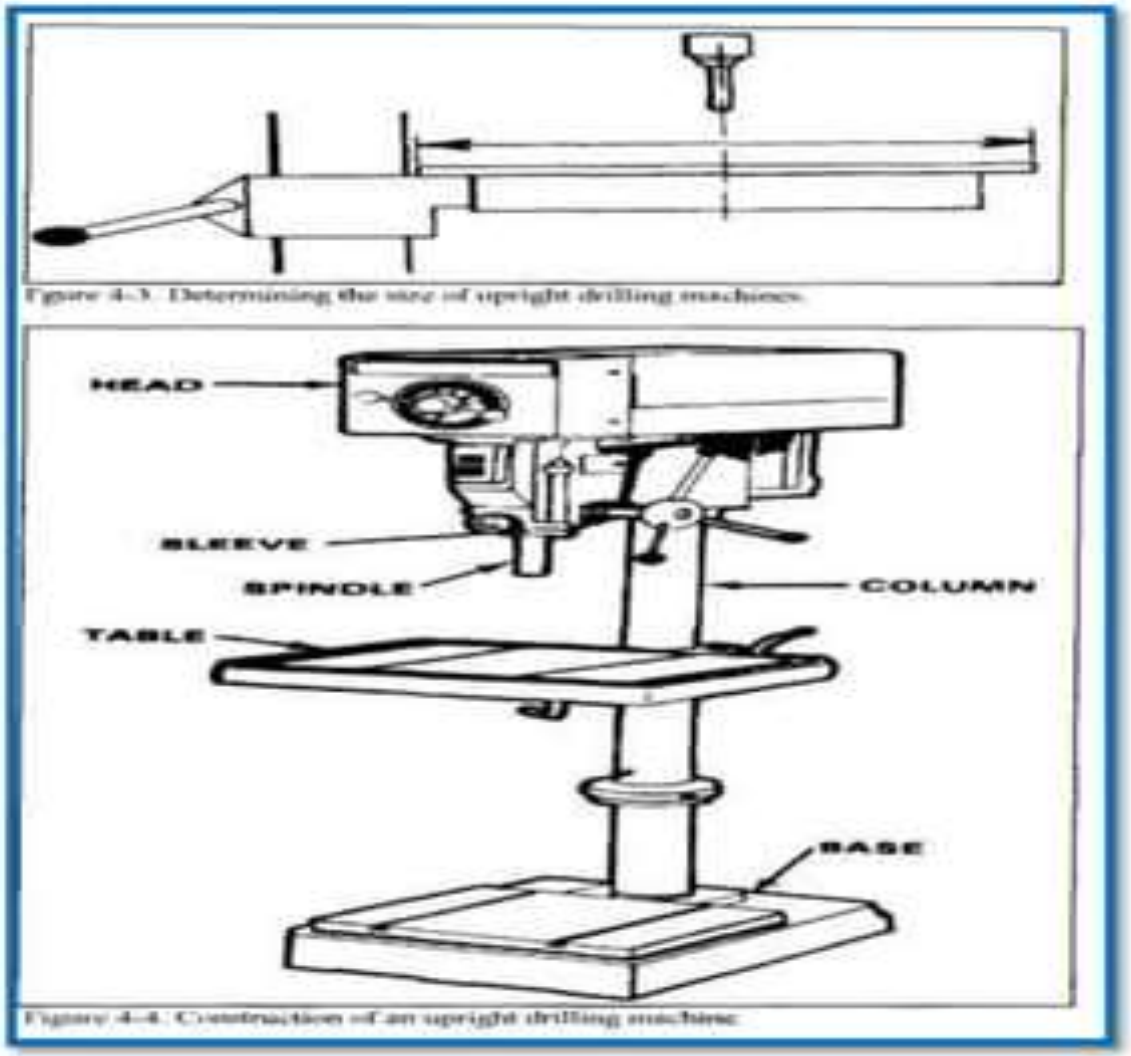
DRILLING MACHINE

Content

- Introduction
- Working Principle
- Construction
- Specification For Portable Drilling Machine
- Types Of Drilling Machine
- Operation Of Drilling Machine

INTRODUCTION

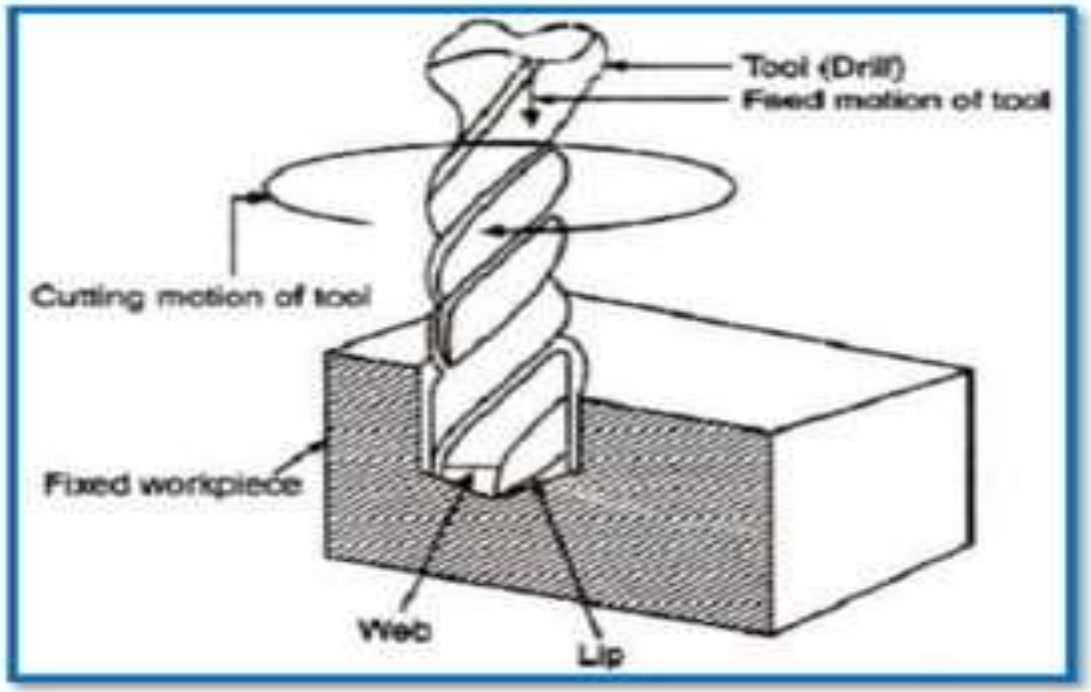
- The drilling machine or drill press is one of the most common and useful machine employed in industry for producing forming and finishing holes in a work piece. The unit essentially consists of:
- 1. A spindle which turns the tool (called drill) which can be advanced in the work piece either automatically or by hand.
- 2. A work table which holds the work piece rigidly in position.



WORKING PRINCIPLE

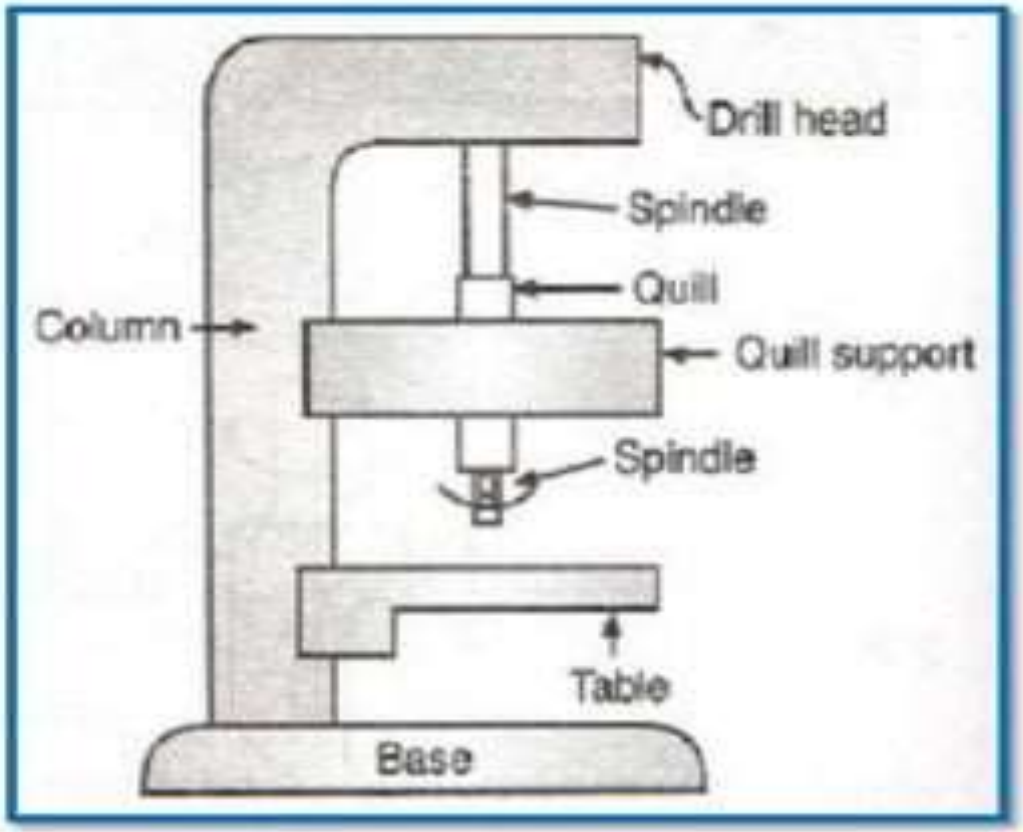
- The rotating edge of the drill exerts a large force on the work piece and the hole is generated. The removal of metal in a drilling operation is by shearing and extrusion.

- **Use**:- Drilling machine is used to drill blind and through holes in work pieces.



CONSTRUCTION

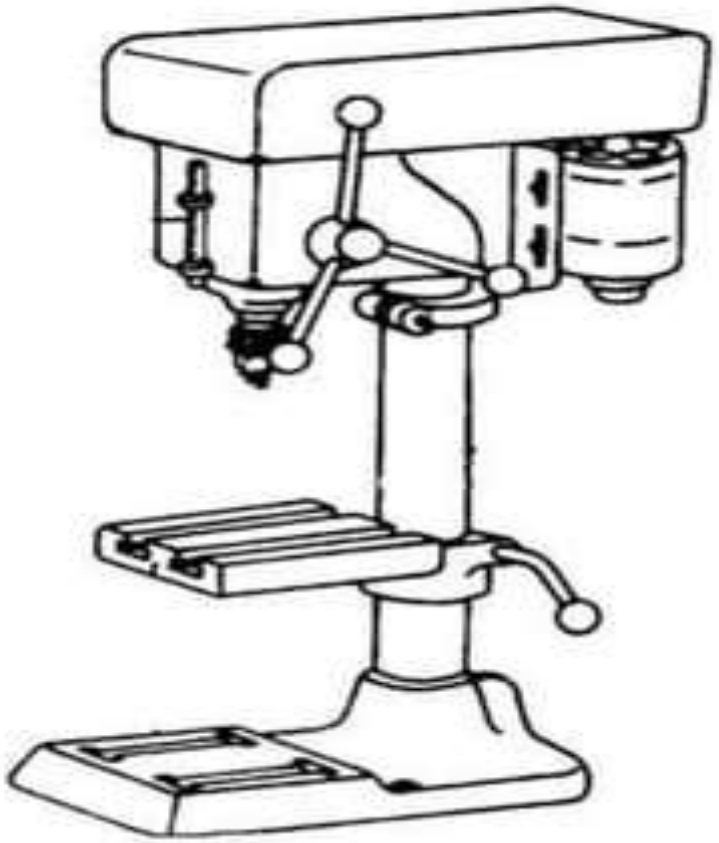
- The machine has only a hand feed mechanism for feeding the tool into the work piece.
- This enables the operator to feel how the drill is cutting and accordingly he can control the down feed pressure.
- Sensitive drill presses are manufactured in bench or floor models, *i.e.*, the base of machine may be mounted on a bench or floor.
- The main operating parts of a sensitive machine/drill press are Base, Column, Table, and Drill Head.



CONSTRUCTION

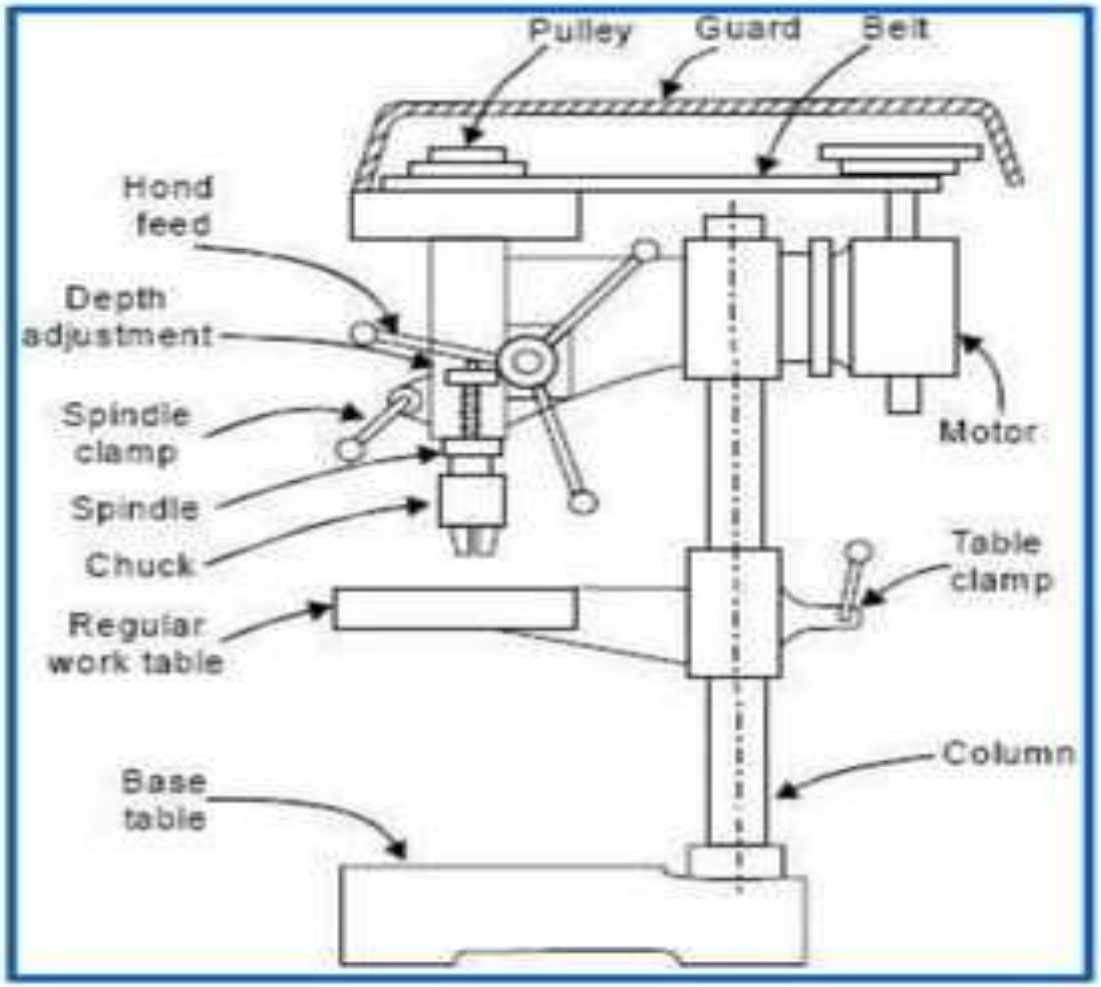
- **Bench Drilling Machine** :- The simplest type of sensitive drilling machine is shown in figure. This is used for light duty drilling work. This machine is capable to drill hole up to 12.5mm diameter

1. **Motor** :- An electric motor supplies the required driving force to stepped pulley.
2. **Base** :- Base is the bottom part of machine in which the column is fitted upright.
3. **Feed handle** :- Handle is provided to feed the drill in to the work piece. A rake and pinion mechanism is provided to drive the chuck.



CONSTRUCTION

- **4.Column:-** Column is the main cylindrical part of drill machine on which the other components are mounted.
- **5.Belt guard:-** Belt guard is provided to cover the belt and pulley drive mechanism to minimize the hazard of accident.
- **6.Chuck:-** Chuck is provided to hold the drill of different sizes up to 6.5 mm. Drill size of more than 6.5 mm are to be fitted directly in the Morse taper of spindle
- **7.Work Table:-** Work pieces are mounted and held in position by the table. This table can be tilted for drilling at an angle.



SPECIFICATION FOR PORTABLE DRILLING MACHINE

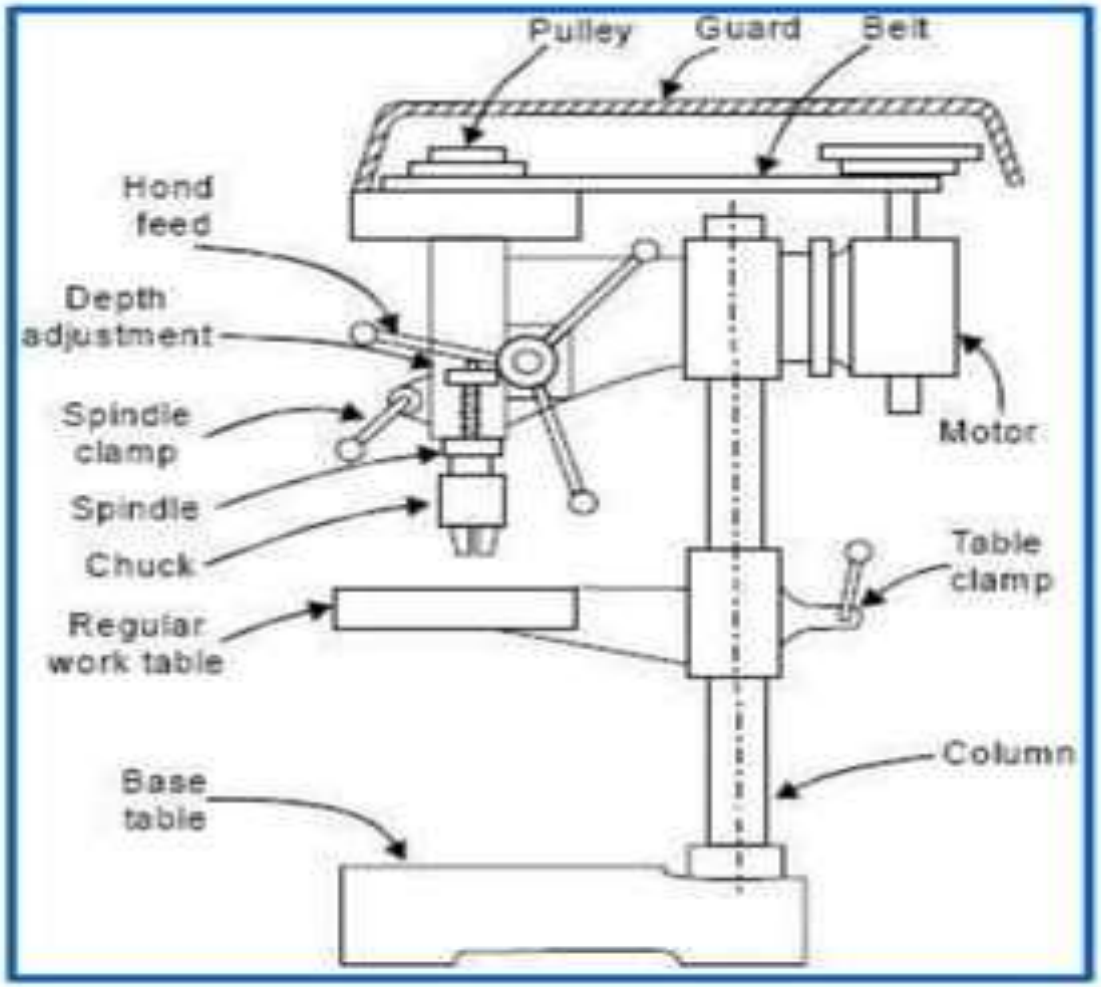
DESCRIPTION	SPECIFIED
CAPACITY •Drilling Capacity in Steel of 60 Kg/mm²Tensile Strength •Tapping Capacity in Steel of 60 Kg/mm² Tensile Strength	50 mm(min.) 50 mm(min.)
SPINDLE •Spindle feed traverse •Spindle Morse Taper •Spindle Ovality	350 mm(min.) MT5/MT 6 0.005(max.)
SPINDLE SPEED AND FEEDS •Spindle Speeds (Range)(Approx.) •Number of Speed steps •Feed range (Approx.) •Number of feed steps	16 – 800 RPM 15(min.) 0.05 - 0.5 mm/rev 6(min.)

SPECIFICATION FOR PORTABLE DRILLING MACHINE

TRAVERSES	
•Vertical Travel of Arm (Min)	2400mm(min.)
•Range of Swing of Arm	0-360 Deg.
•Traverse of column in bed	1200mm(min.)
DISTANCES	
•Swing Radius of drilling spindle	2250 mm(min) 1420 mm(Max.)
•Farthest Distance of Spindle end from floor when horizontal drilling	2700mm(min)
•Lowest Distance of Spindle end from floor when horizontal drilling	300 mm (max)

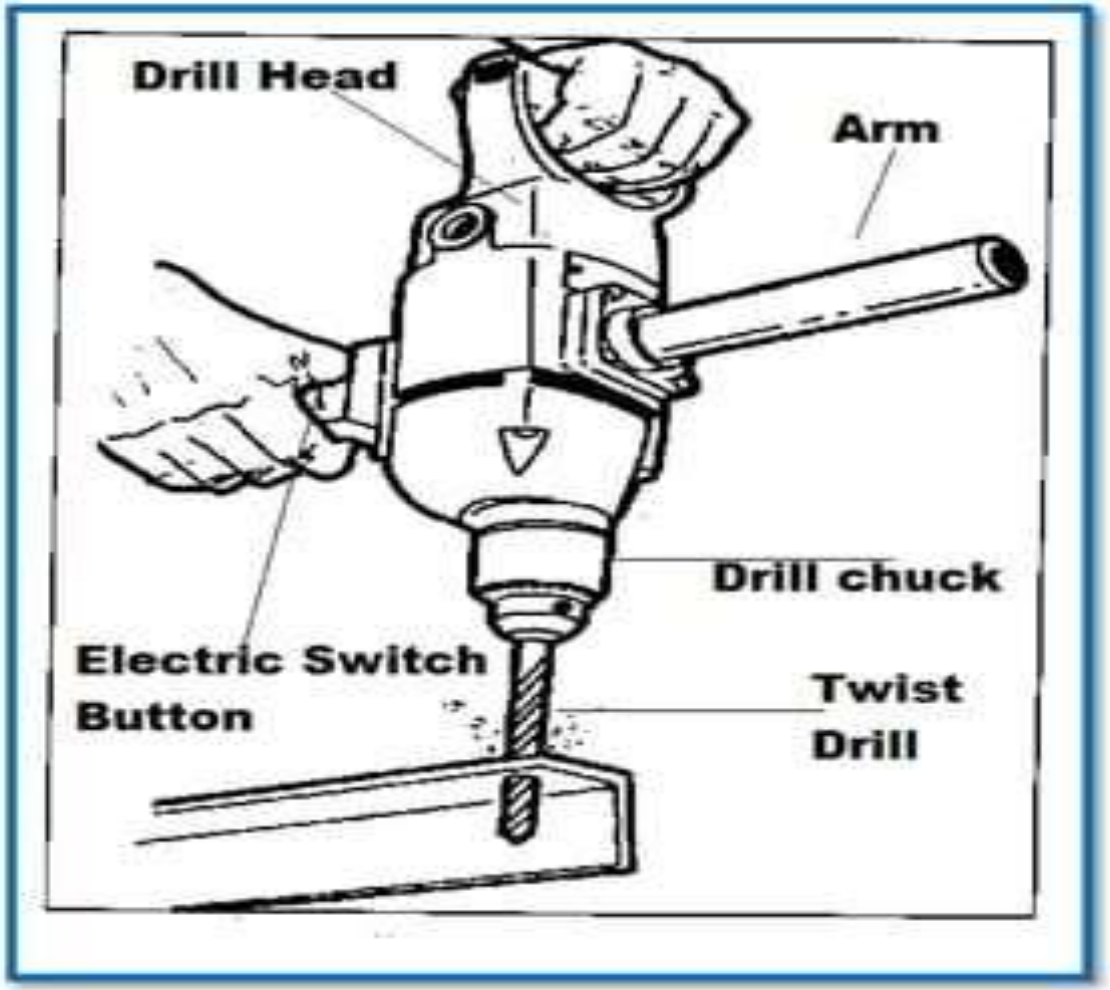
TYPES OF DRILLING MACHINE

- 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



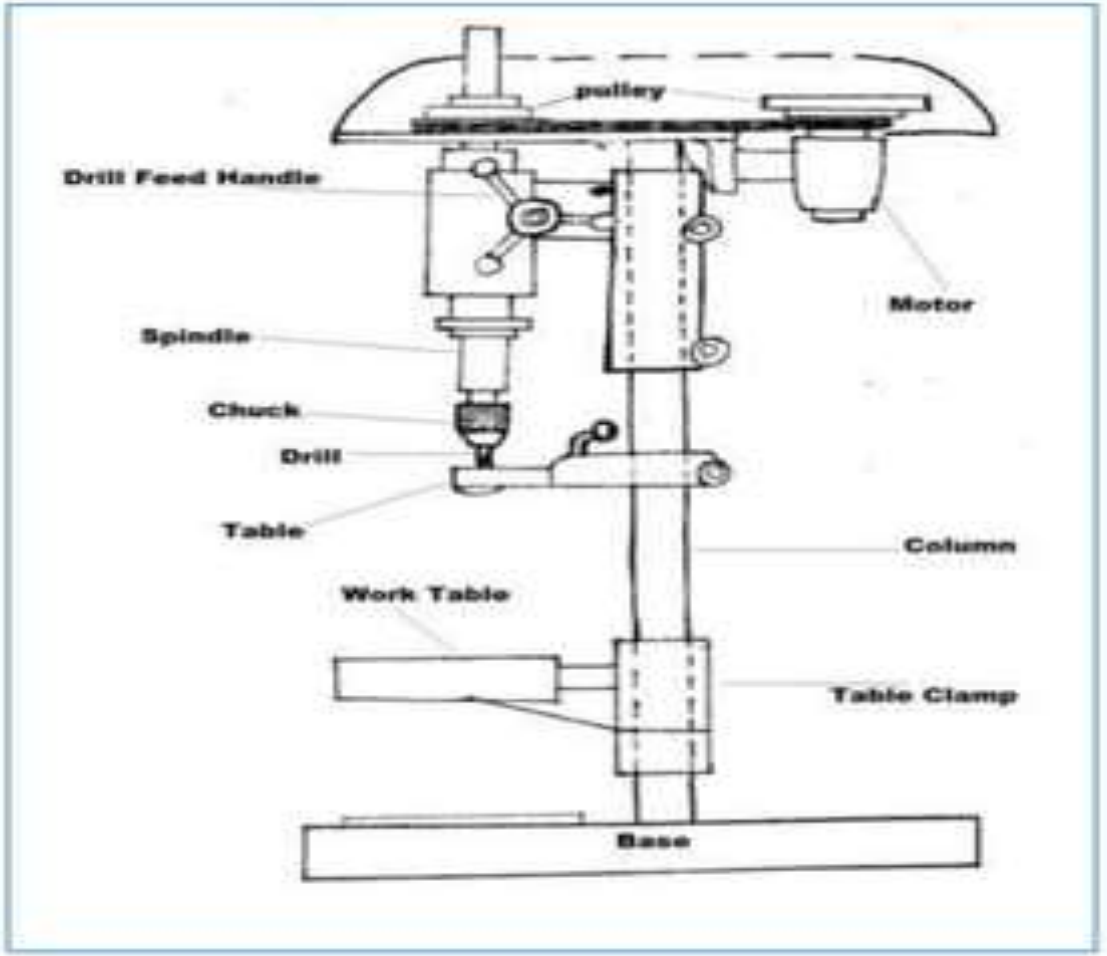
PORTABLE DRILLING MACHINE

- It is a very small, compact and self contained unit carrying a small electric motor inside it.
- It is very commonly used for drilling holes in such components that cannot be transported to the shop due to their size or weight or where lack of space does not permit their transportation to the bigger type of drilling machine.
- In such cases, the operation is performed on the site by means of the portable electric drill.



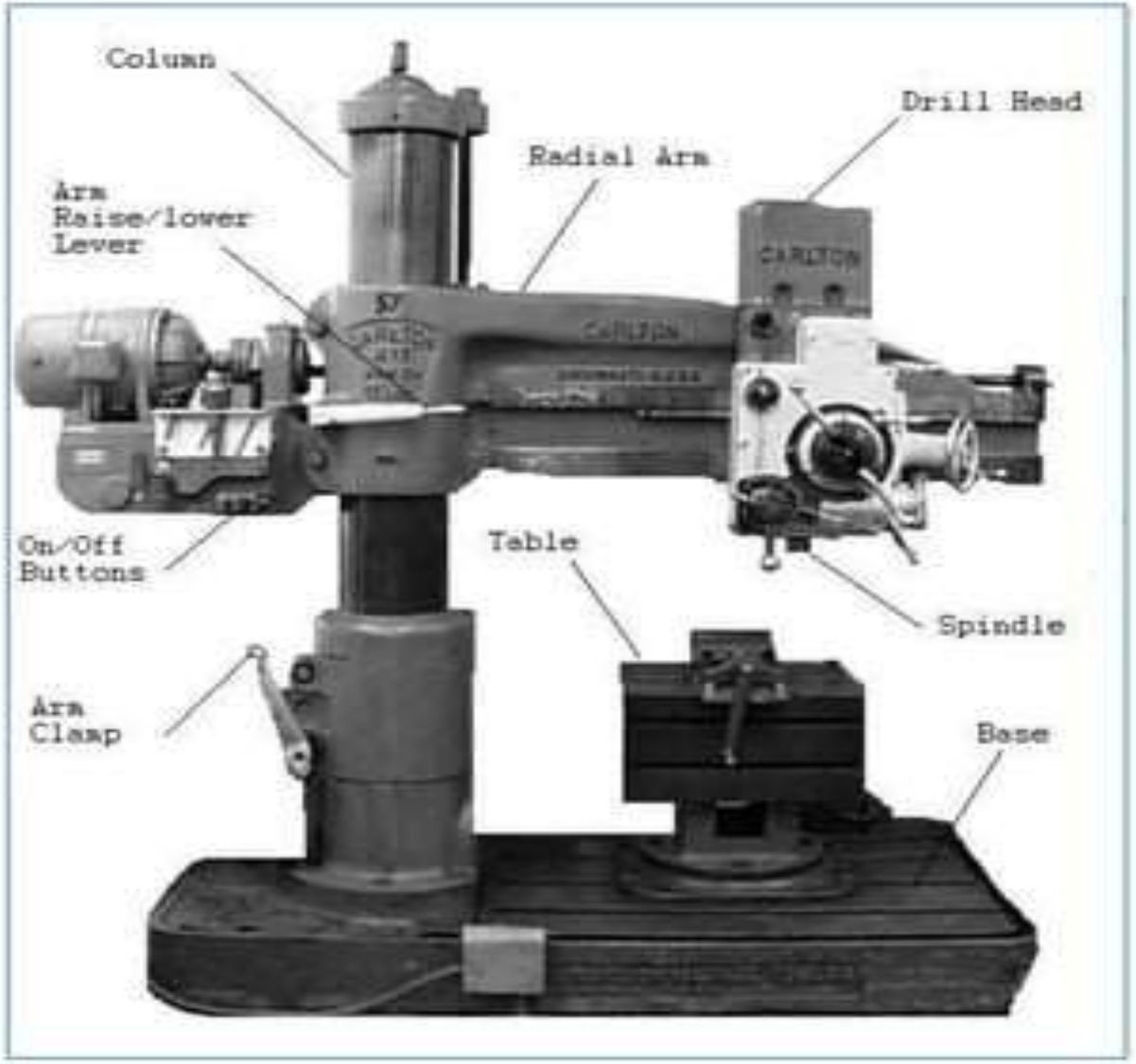
Sensitive or Bench Drill

- This type of drilling machine is used for very light work.
- Its construction is very simple and so is the operation .
- It consists of as shown in fig. of a cast iron having a fixed table over it.



Radial Drilling Machine

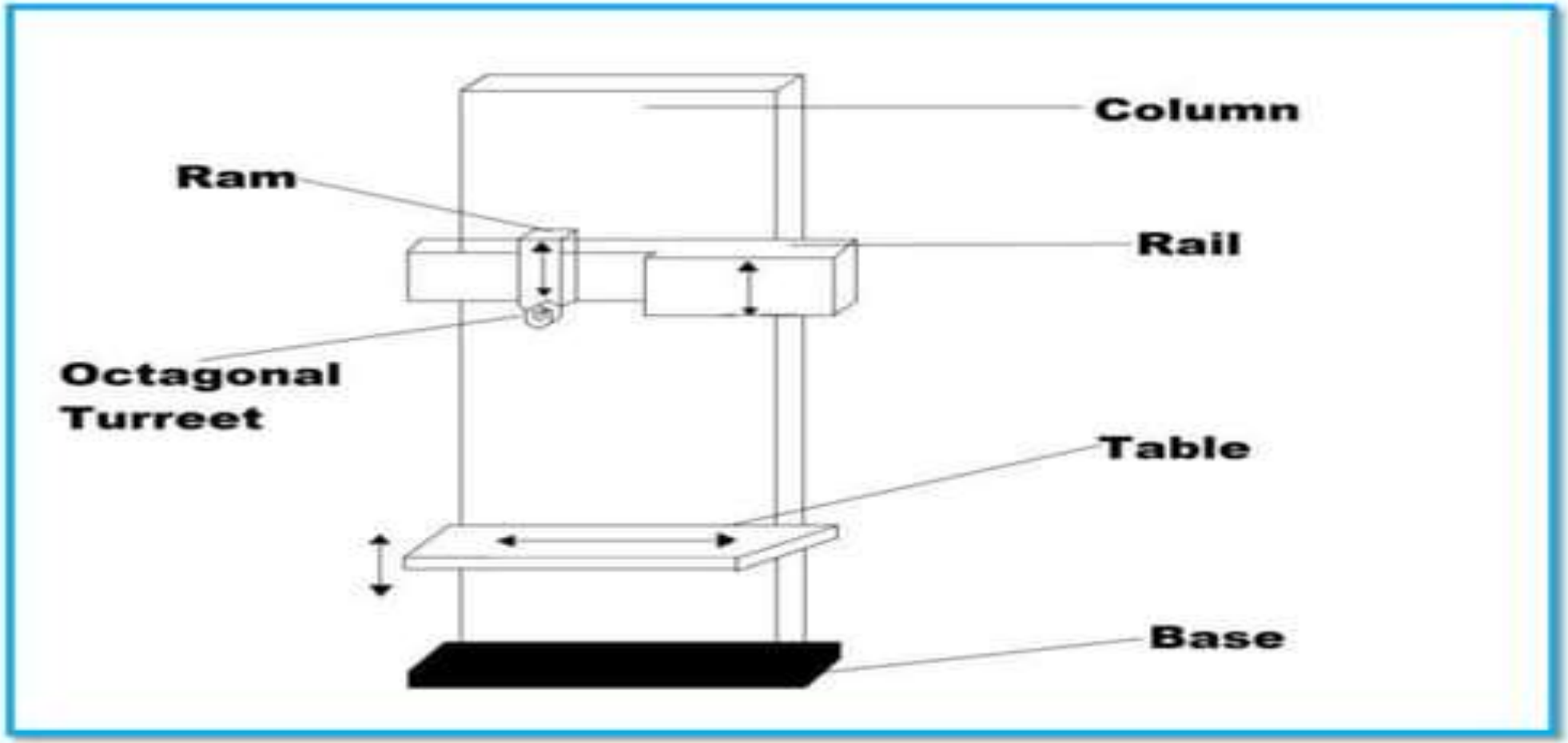
- This machine is very useful because of its wider range of action.
- Its principal use is in drilling holes on such work is difficult to be handled frequently.
- With the use of this machine, the tool is moved to the desired position instead of moving the work to bring the latter in position for drilling.



Gang Drilling Machine

- It is nothing but a type of multiple spindle drilling machine, in which the spindles are arranged in a row.
- These spindles may be driven either separately or collectively.
- This machine is very useful when the nature of work is such that a number of operations like drilling, reaming, counter boring and tapping, etc. are to be performed in succession on it.

Turret Type Drilling Machine Line Diagram



OPERATION OF DRILLING MACHINE

- Drilling
- Reaming
- Boring
- Counter Boring
- Counter Sinking
- Spot Facing
- Tapping

OPERATION OF DRILLING MACHINE

- **Drilling :-** It is the main operation done on this machine. It is the operation of producing a circular hole in a solid metal by means of a revolving tool called drill.
- **Boring :-** It is an operation used for enlarging a hole to bring it to the required size and have a better finish.
- **Counter sinking :-** It is the operation used for enlarging the end of a hole to give it a conical shape for a short distance.

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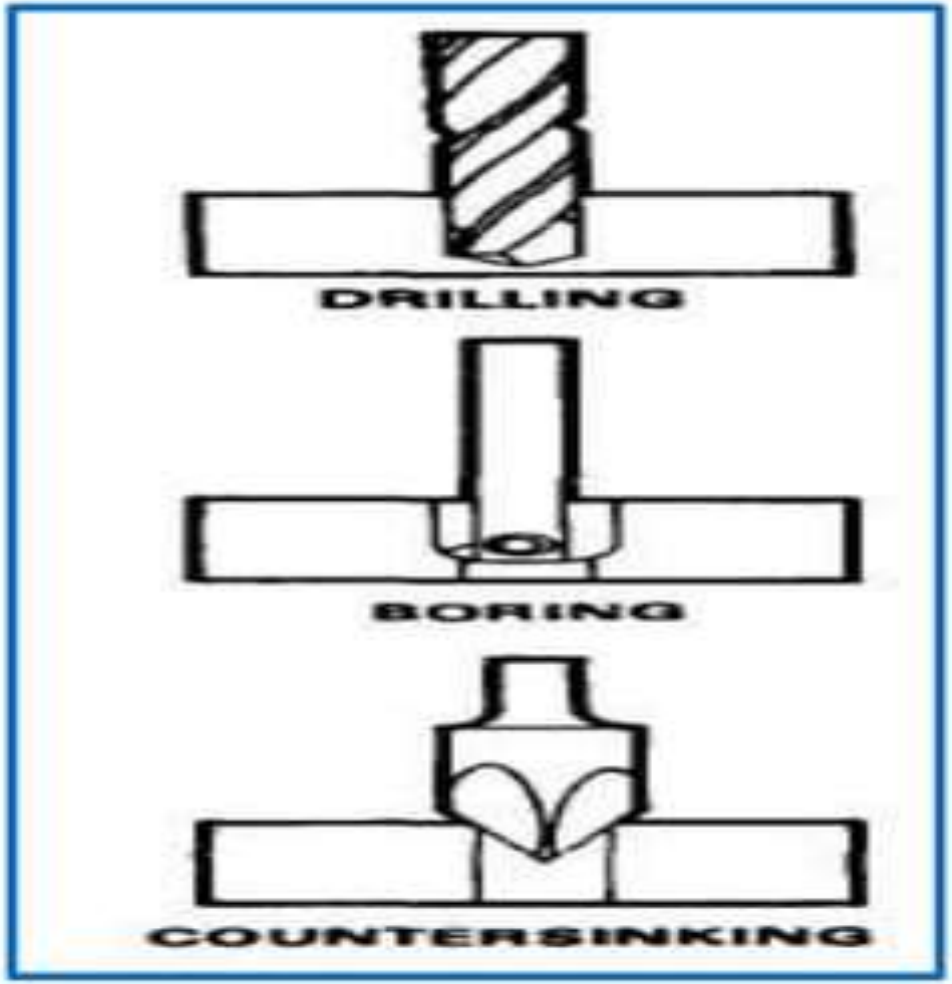
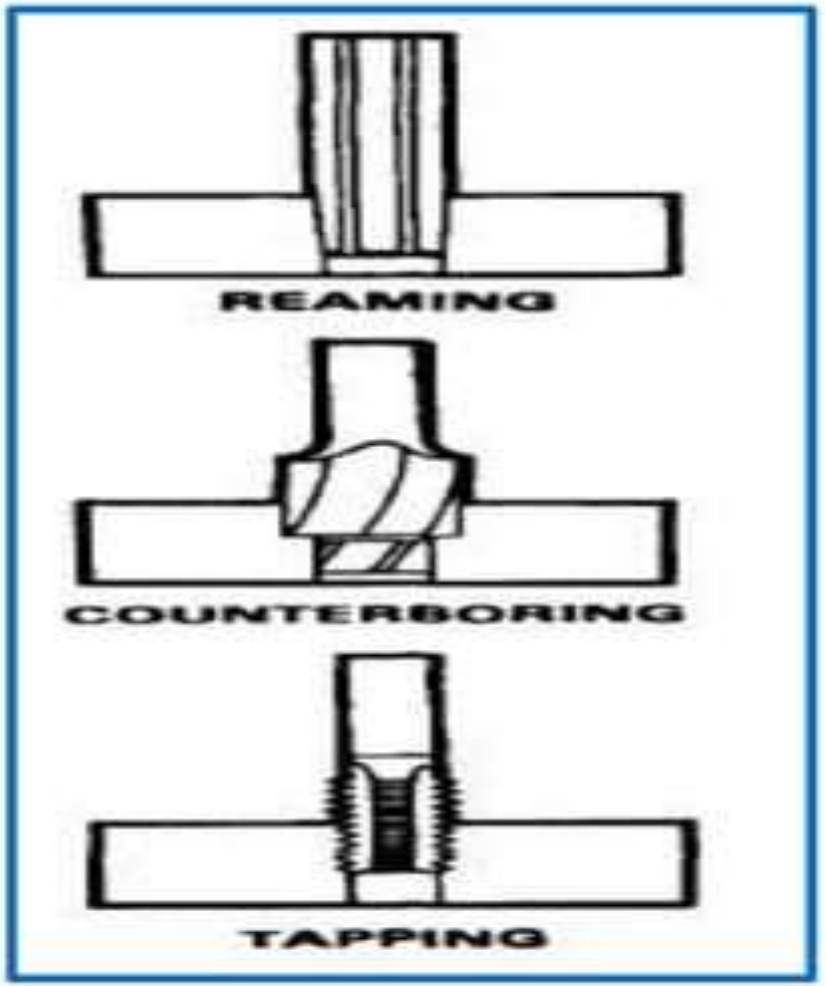


OPERATION OF DRILLING MACHINE

- **Reaming :-** It is the operation of finishing a hole to bring it to accurate size and have a fine surface finish . This operation is performed by means of a multi tooth tool called reamer.
- **Counter boring :-** This operation is used for enlarging only a limited portion of the hole is called counter boring .
- **Tapping:-** It is the operation done for forming internal threads by means of the tool called tap.




Thank You