

Drilling Machine

(i) Drilling is an operation through which holes are produce in solid metals.

(ii) The process of making hole is done by the help of a tool which is known as drill tool.

(iii) In drilling operation it is not possible to produce a perfectly true hole with accurate dimensions and surface finish. So, it can be considered as roughing operations.

Q-1 classify drilling machines.

Ans Classification of drilling machine :-

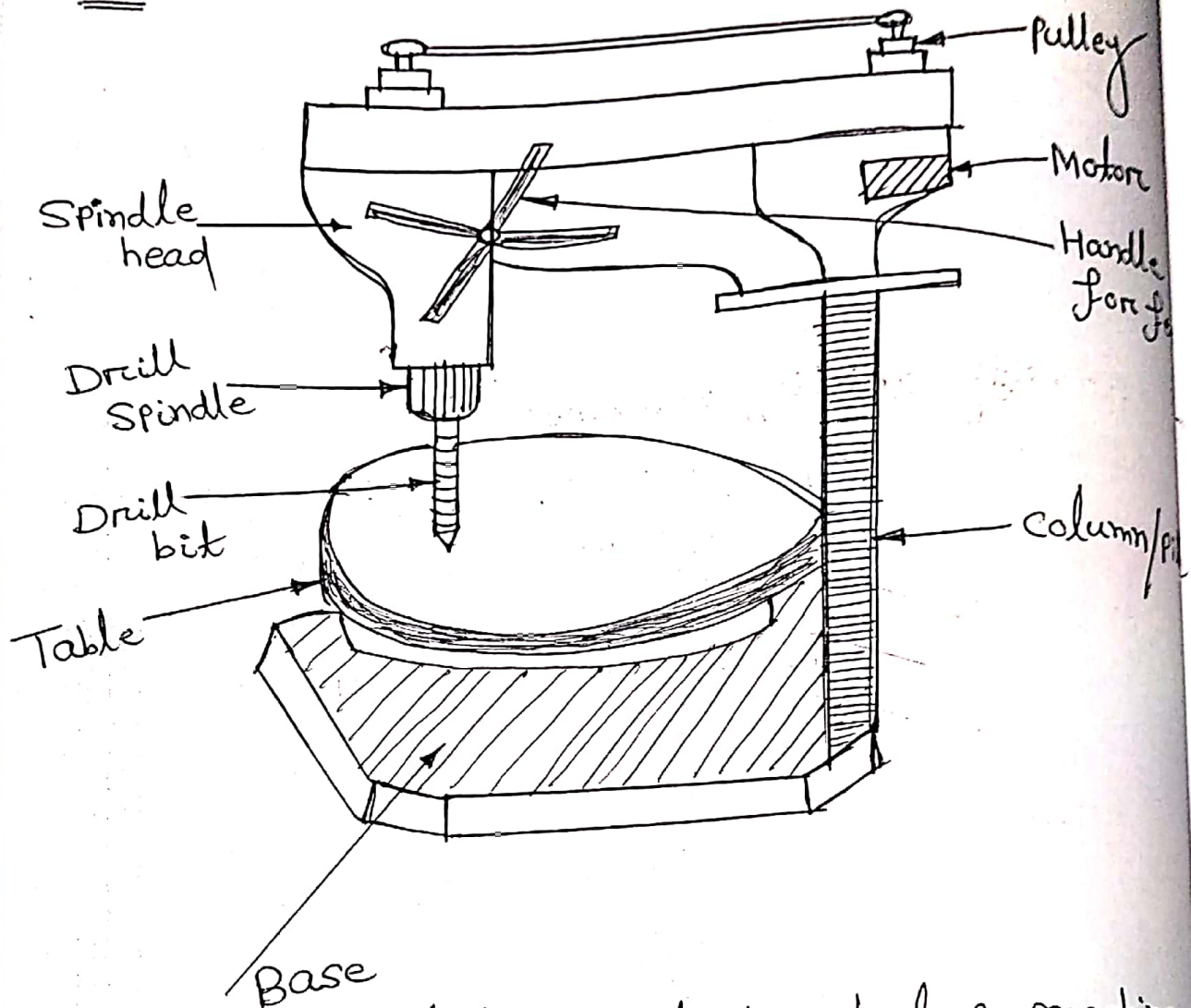
- (1) Portable drilling m/c
- ✓ (2) Sensitive drilling m/c or Bench drilling m/c
- ✓ (3) Upright drilling m/c or pillar drilling m/c
- ✓ (4) Radial drilling m/c
- (5) Gang drilling m/c
- (6) Automatic drilling machine.
- (7) Deep hole drilling machine.
- (8) Multiple spindle drilling m/c.

Note In our syllabus, there are only 3 type of drilling machine is to be studied.

- (a) Sensitive or Bench drilling m/c
- (b) upright or pillar drilling m/c
- (c) Radial drilling machine.

Q-2 Explain the construction & working of Bench drilling m/c.

Ans



* It is a light, simple bench type machine used for light duty working.

* The machine can hold drills up to 12.5mm diameter.

The major components of bench type drilling m/c are

- (1) Base
- (2) Column
- (3) Table
- (4) Drill Spindle
- (5) Drill bit.

Construction Parts

Base:- The base provided support and rigidly to the entire structure of the machine. It is made of cast iron & having a fixed table over it.

Column:-

- (i) The column or pillar is a supporting structure for the table, spindle head and other part of the machine.
- (ii) The column carries a swivelling table.
- (iii) At the top of the column is provided with a motor which act as a drive mechanism for the system.

Table:-

- (i) The table of the drilling m/c supports the workpiece and other clamping devices like drill jigs.
- (ii) By loosening the table clamping handle the table can be adjusted up & down on the column with respect to the drill.

Drill Spindle:-

- (i) The various mechanism of the spindle head powered by the help of motor through belt & pulleys.
- (ii) The top of the column is provided with V-belt running over two pulleys.
- (iii) one of these pulleys mounted over the motor shaft & other is mounted on the spindle head.
- (iv) No gears are used in this drive arrangement.
- (v) Vertical movement of the spindle is given through the feed handle. by rack & pinion arrangement.

Drill bit:-

- (i) Various types of drill bit can be used for drilling purpose according to the requirement.
- (ii) Generally Twist drill are used for drilling operation. It made from HSS & High carbon Steel.

Working Principle

(i) When the switch is on of motor, the motor shaft starts revolving.

(ii) Then the power is transmitted through the V-belt which is mounted on the pulley to the other pulley which is mounted on the spindle head.

(iii) Thus the spindle starts rotating & the drill tool also rotates. by the help of the handle we can give feed.

(iv) The handle is mounted on the ^{pinion} shaft which is connected to a rack which moves longitudinally.

(v) Different spindle speeds can be obtained by shifting the V-belt to the different pairs of driving & driven pulleys.

(vi) While the motor rotates on the same speed.

(vii) There is no arrangement of automatic feed in this machine.

Q-3 With a neat sketch explain the function of pillar drilling machine.

Ans

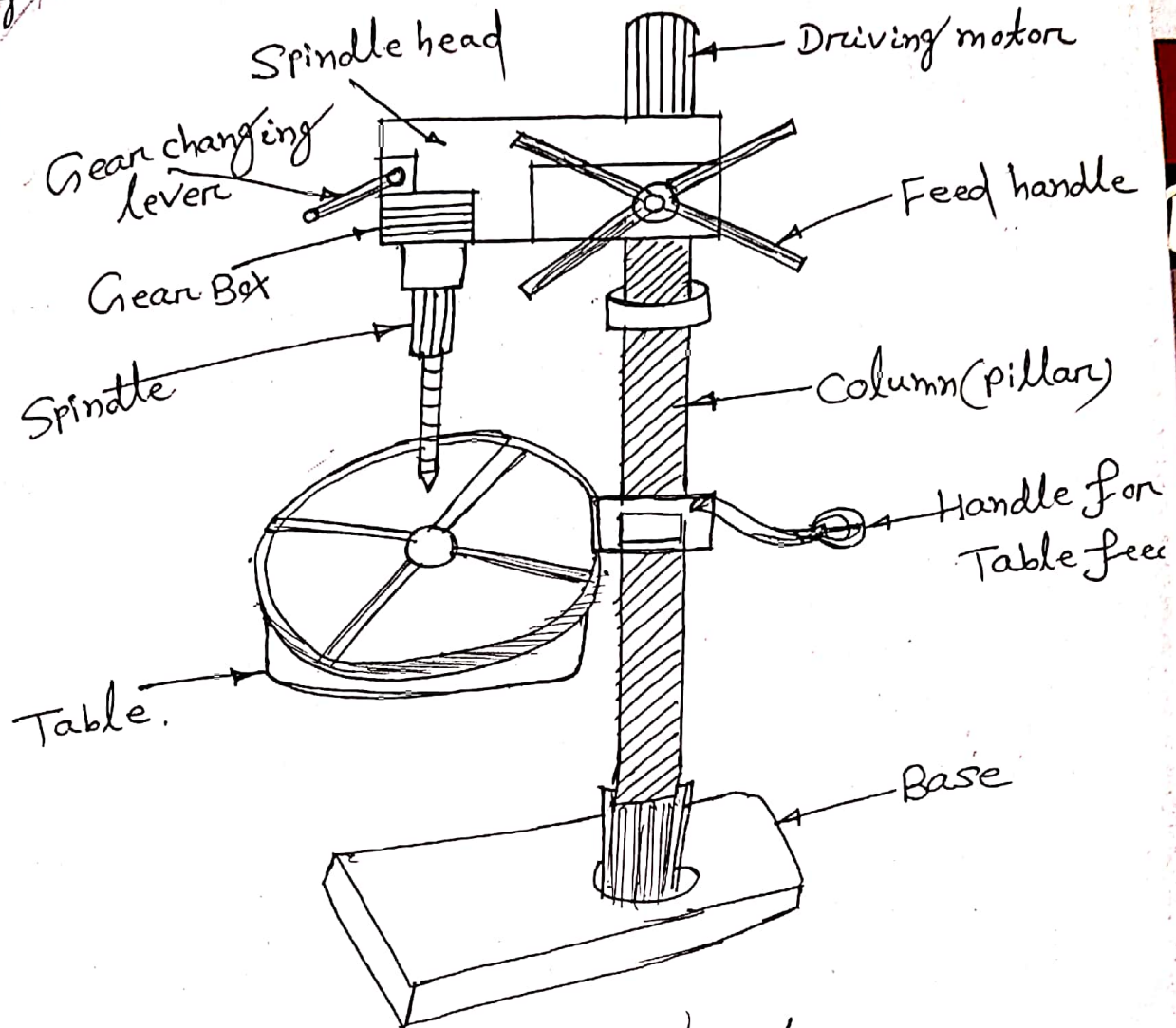
(i) The pillar drilling m/c is used for heavy work and has back gearing arrangement as lathe.

(ii) It is coming under up-right drilling machine.

(iii) It especially differs from a sensitive drilling machine in its weight, rigidity, power feed and wide range of spindle speed.

(iv) It can give speed ranging from 75 to 3500 r.p.m. So obtain this speed range

gear box is used instead of belt arrangement.



It consist of following parts.

- (1) Base
- (2) Pillar
- (3) Table
- (4) Spindle
- (5) Drill bit
- (6) Drive Arrangement.

Base:- The base of pillar drilling machine is made of heavy casting supports the pillar & spindle head.

Pillar/column:- The pillar is a hollow pipe of casting made of cast iron. It rest from the base & supports the spindle head & table. Here rack & pinion gear present. So, that the table

can be raise or lower depending upon the work piece requirement.

Table:-

- (i) The work table is supported by the pillar of a drilling machine.
- (ii) The pillar facilitates the swinging of table to any position & in combination with the rotary movement of the table.
- (iii) The tables are generally having slots on it to hold the work piece.

Drive Arrangement:-

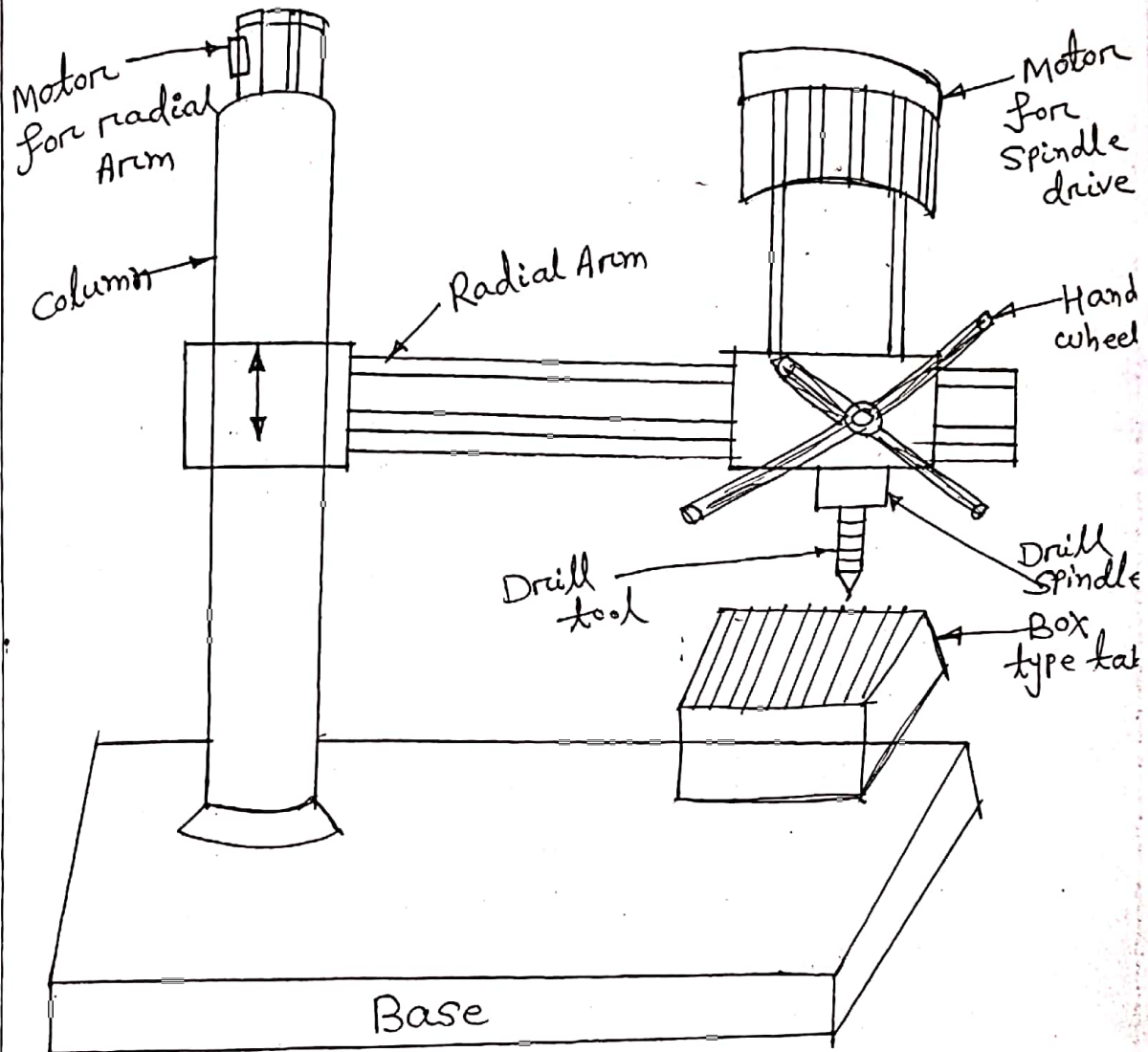
A Gear box is used instead of belt drive for better power transmission.

Drill Spindle:-

- (i) The spindle is made of alloy steel.
- (ii) It rotates the drill & here power feed is given to the spindle for heavier work.
- (iii) It has driven mechanism for changing speeds & feeds and thus a large no. of drill spindles are available to drill different kinds of job.

Q-4 With block diagram explain the construction & working of a radial drilling machine.

Ans The radial drilling machine is used for too large and heavy drill hole.



Base:-

- (i) The base is made box type of cast iron or
- (ii) The base carries the column & it may be bolted on bench with the base.
- (iii) The base must be strong enough to give sufficient rigidity & support to the whole structure & other parts.

Column:-

The column is cylindrical & used to support the radial arm. It is made highly rigid and perfectly round in cross-section.

Table:-

The table is attached to the column to support small work piece. If the work piece is very large, it may be directly clamped on to the base. The table is also provided with a table support for increasing its rigidity.

Radial Arm:-

The Arm radially outward is attached to the column and carries drilling head and the driving motor. The Arm can be moved up or down with the help of rack & pinion arrangement.

Spindle Head:-

The spindle head is mounted on the arm. It can be moved along the arm with the help of the transverse head wheel and can be locked at any desired position.

It carries the change gears & control for spindle speed & feed.

Working operation

- (i) A separate motor is provided for elevating & lowering the radial arm and can also be swiveled round the column to any desired angle.
- (ii) Clamping levers are provided for locking the arm at desired height. The spindle head is mounted on the arm which can slide horizontally.

on the radial arm.

(iii) These adjustment of the arm & drilling head permit the operator to locate the drill quickly any point of the work.

(iv) powerful drives are geared directly into the head of the machine and a wide range of power feed are available.

Q-5 Write the basic principle of Boring.

Ans It is the process of enlarging a hole that has already been drilled.

* Boring is used to achieve greater accuracy of the diameter of a hole.

Example This process is used in large & heavy parts such as engine frames, steam engine cylinders etc.

Q-6 Difference between Boring and drilling.

Ans Boring:-

(i) It is the process of enlarging a hole that is already ~~is~~ in the material. This hole made by drilling.

(ii) Boring concerns the internal diameter and the surface of a hole rather than the depth of the hole.

(iii) Boring is done using a boring bar; which is a heavy metal bar with the tool fixed at the end.

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Drilling

(i) Drilling is the cutting process of a material using a specially designed rotating cutting tool called a drill bit.

(ii) The holes are produced by the drilling are always cylindrical in drilling process is simple.

(iii) The drill bit is rotated by a drill and pressed against the material, where the tip of the drill bits cuts away the layers of material. By continually pressing against the material, a hole of a desired length can be created.

BROACHING

Q-1 Define Broaching.

Ans It is a method of removing metal by pushing or pulling a cutting tool called a broach which cuts in fixed path.

* The tool may be pulled or pushed through the surfaces to be finished.

* Surface finished by broaching may be flat or contoured and may be either internal or external.

* A broach is a multiple edges cutting tool that has successively higher cutting edges along the length of the tool.

Q=2 Write down types of Broaching.

Ans Types of Broaching

It may be classified in various ways according to :-

1. Type of operation → Internal & external
2. Method of operation → Push & pull
3. Type of Construction → Solid, overlapping tooth, rotor cut, inserted tooth.

According to our Syllabus Push & pull broaching Study.

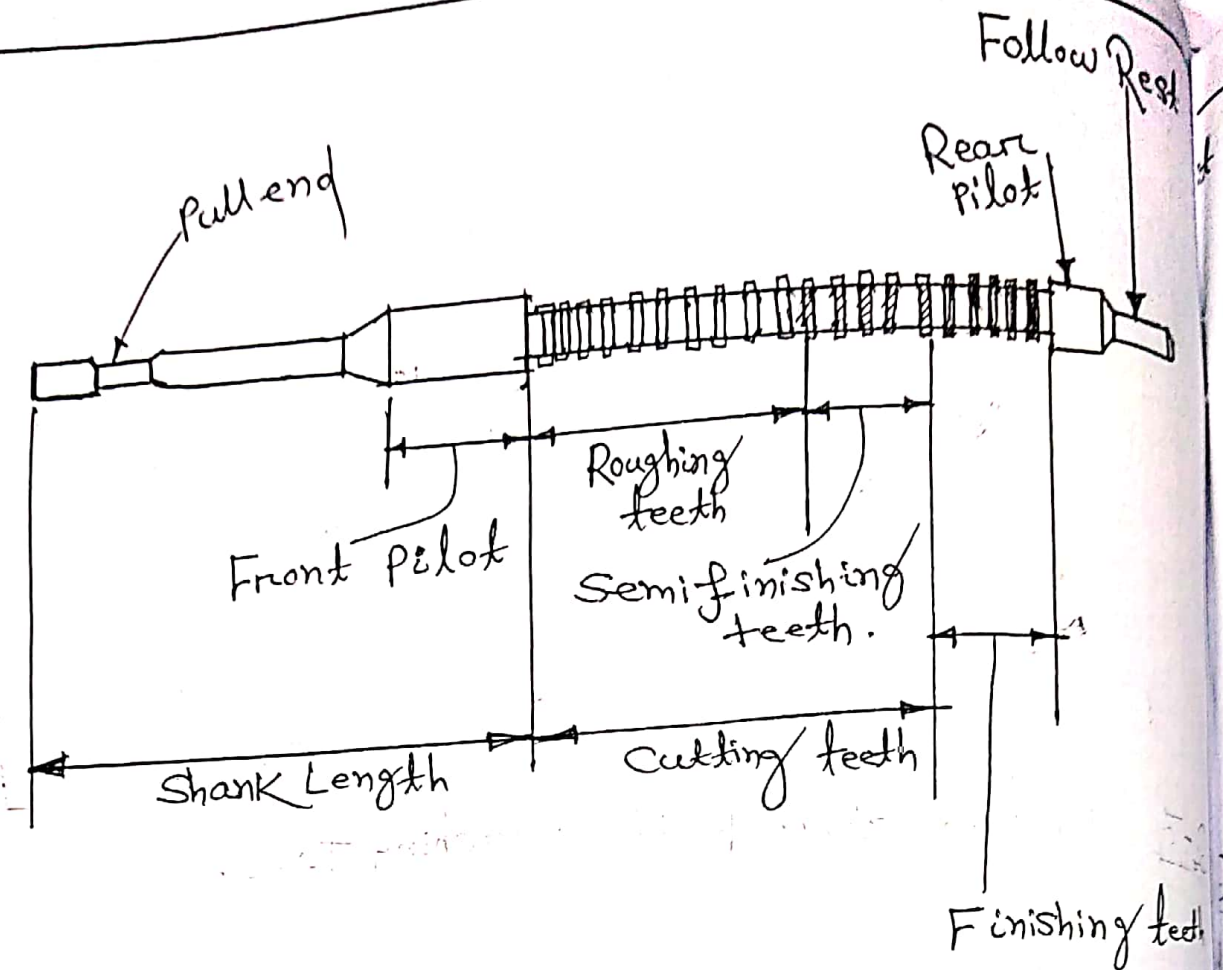
Q=3 Explain about Pull broaching Tool.

Ans Pull Broaching Tool

(i) In Pull broach; the tool is entirely in tension & long slender broaches are possible, having a large no. of teeth.

(ii) In pull broaching methods; the work is held stationary and the broach is pulled through the work. Broaches are held in a special head. Pull broaching is used mostly for internal broaching but it can do some surface broaching.

(iii) Ordinary cut broaches for machining previously drilled or bored holes consist of different elements, which are discussed below.



Pull end:-

This is designed to permit engagement of the broach with the broaching machine through the use of a puller ~~head~~ head.

Front pilot

This centres the broach in the hole before the teeth begins to cut.

Roughing & Semi-finished teeth

They Remove most of the stock in the hole.

Finishing Teeth:-

They are for sizing the hole and must have the shape required the finished hole.

Rear Pilot & Follow Rest

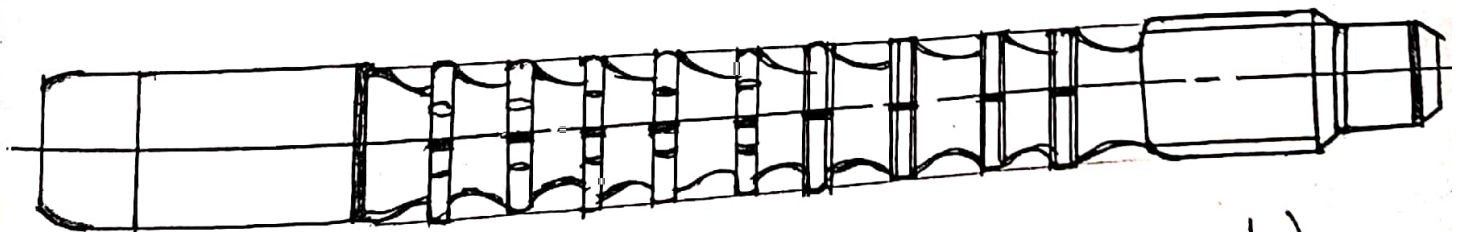
They support the broach after the last tooth leaves the hole.

* Push Broaching:-

(i) A push broach is one that is designed to be pushed through the workpiece by special press or push broaching machining. Because of the tendency to bend under compressive loads, the push broach must be short which means, less material can be removed for each pass of the tool.

(ii) In this broaching, the work is held stationary and the broach is pushed through the work.

(iii) Hand & hydraulic arbor presses are popular for push broaching. This method is used mostly for sizing holes and cutting keyways.



(Figure of push Broach)

Q-4 What are the advantages of Broaching?

Ans Advantages

- (1) Rate of production is very high. With properly applied broaches, fixtures and machined, more pieces can be turned out per hour by broaching than by any other means.
- (2) Little skill is required to perform a broaching operation.
- (3) High Accuracy and a high class of surface finish is possible.
- (4) Both roughing and finishing cuts are completed in one pass of the tool.
- (5) The process can be used for either internal or external surface finishing.
- (6) Any form that can be reproduced on a broaching can be machined.

Broaching Application

Broaches are used for high production and for finishing high surfaces.

Q-1 Define Grinding.

Ans Grinding is a metal cutting operation performed by means of a rotating abrasive wheel that acts as a tool. This is used to finish workpiece with which must show a high surface quality.

Q-2 Significance of grinding operations.

- Ans
- (i) Grinding operations are always carried out by the help of grinding wheel.
 - (ii) These grinding wheel is made of abrasive particles.
 - (iii) By the help of grinding operation, we can get required shape & size of the workpiece.
 - (iv) Grinding operation is mostly used for finishing operation in which very small amount of material is removed.

Q-3 Describe the Grinding wheel material in shortly

Ans Different types of Grinding wheel material is discussed below.

(1) Abrasive materials

Grinding wheel is made of abrasive particles. The abrasive particles are the extremely hard materials which perform the cutting operation.

It is two types.

- (a) Natural type
- (b) Artificial type.

* Natural type abrasives are directly obtained from mines.

Ex:- Sand Stones, diamond, granites etc.

* Artificial type abrasives are manufactured under controlled condition in a closed electric furnaces.

Ex: Al_2O_3 (Aluminium oxides)
 SiC (Silicon Carbide)
CBN (cubic boron Nitride)

Aluminium oxide (Al_2O_3)

(i) It is the most use material for the abrasive wheel.

(ii) It is made by impure Aluminium oxide i.e. bauxite which is mixed with coke & iron chips. This mixture is charge into furnace & heavy current pass through it.

(iii) Due to this a block of Aluminium oxide is formed.

(iv) The wheel which is made of Al_2O_3 may be grey or white in colour.

Silicon Carbide (SiC)

(i) It is made of silicon dioxide, coke, sawdust & salt.

(ii) The silicon dioxide is combined with the carbon of coke to form silicon carbide.

(iii) The salt vapourises to form chlorides & help to removes the impurities.

(iv) The saw dust burns of provide porosity for escaping of gases. After the reaction completed the furnace is cool down & SiC is obtained.

Saw dust means \rightarrow wood dust.

CBN

CBN grinding wheels are used to grind hardened & difficult material. These have long life & high grinding ratio. It provides better surface finish & good quality of surface.

(2) Bonding material

Bond is that materials that holds the abrasive grain together enable the mixture to be kept in desire shape in the form of a wheel.

Different bonding materials are :-

Silicate bond:-

Its base material is silicate of Soda. The process of mixing, moulding, drying are done ~~in the~~ ~~in very~~ lower temperature.

Wheel posses this type of bond in light grey in colour

Oxy chloride bond:-

It is a mixture of oxide and chloride of magnesium. The mixing, moulding & drying are done it provides a cool cutting action.

Rubber bond:- This bond is used for thin cutting of wheels.

Resinoid bond:-

The Resinoid bond is made from synthetic resins which is enough strong & flexible

⇒ It is used for precision grinding.

⇒ It is manufactured from a mixtures of abrasive grains, synthetic resins & some compounds. Here a constant temp. of about 200° is maintained in the furnace.

Q-4 what do you mean by Grit, Grade & Structure of grinding wheel.

Ans Grit denotes the approximate size of abrasive particles & gives an idea about the quality of grinding wheel.

There are two types of Grit.

(a) Coarse grit

(b) Fine grit.

Coarse grit

This wheels are used for removing the stock at faster rate for roughing action. It is more suitable for grinding soft & ductile material where Fine grits are more suitable for hard & brittle material.

Grade

The grade indicates the strength of the bond. Wheels made from the abrasive which is easily broken away is known as soft grade.
→ it has low strength.

The wheels which strongly ~~rate~~ is made of hard grade. It is of high strength.

Structure

Structure of wheel refers to the gap ~~or~~ void between the abrasive particle.

Q-5 Explain the manufacturing process of a grinding wheel.

Ans Steps involved in the manufacture of grinding wheels are:-

(1) Reduce the abrasive material to small size using roll and jaw crushers.

(2) Remove iron compounds with the help of a magnetic separator.

(3) Wash the material to remove dust etc.

(4) Grade the abrasive material grains by passing ~~from~~ them over vibrating standard screens.

(5) Select proper sized grains.

(6) Mix grains with bonding material, mould or cut the wheel to proper shape and heat. This procedure varies considerably according to the type of bond used.

(7) These wheels are then brushed & tested.

Q-6 State the selection criteria for grinding wheel.

Ans The proper selection of grinding wheel required as per following factors.

(1) Properties of material to be machined. i.e. its hardness, toughness, strength etc.

(2) Quality of surface finished required.

(3) Dimensional accuracy required.

(4) Method of grinding i.e. wet or dry.

(5) Size & type of machine.

(6) Type of grinding to be done.

(7) Speed & feed of wheel.

(8) Relative size of wheel & job.

Q-7 Specification of Grinding wheel with example.

Ans Specification of grinding wheel:-

The Indian standard marking system for grinding wheels (IS 551-1954) has been prepared with a view establishing a uniform system of marking of grinding wheels to designate their various characteristics, to give a general indication of the hardness & grit size of any wheel as compared with another.

Each marking shall consist of six symbols.
i.e. WA 46 K 5 V 17.

Example A Grinding wheel carrying the marking 250x25x~~30~~WA 46 K 5 V 17 will conform to the following specification.

~~W~~ wheel dia. = 250 mm

Thickness of wheel = 25 mm

~~30~~ ~~mm~~

W = Manufacture prefix to abrasive.
It is ~~optional~~ optional. Here it denotes white.

A = Abrasive (Al_2O_3)

46 = It is grain size (medium)

5 = It is represent a dense structure.

V = Standard bond.

17 = It is the suffix denoting the bond type of manufacture.

Q-7 Explain about Surface Grinder.

Ans Surface Grinder :-

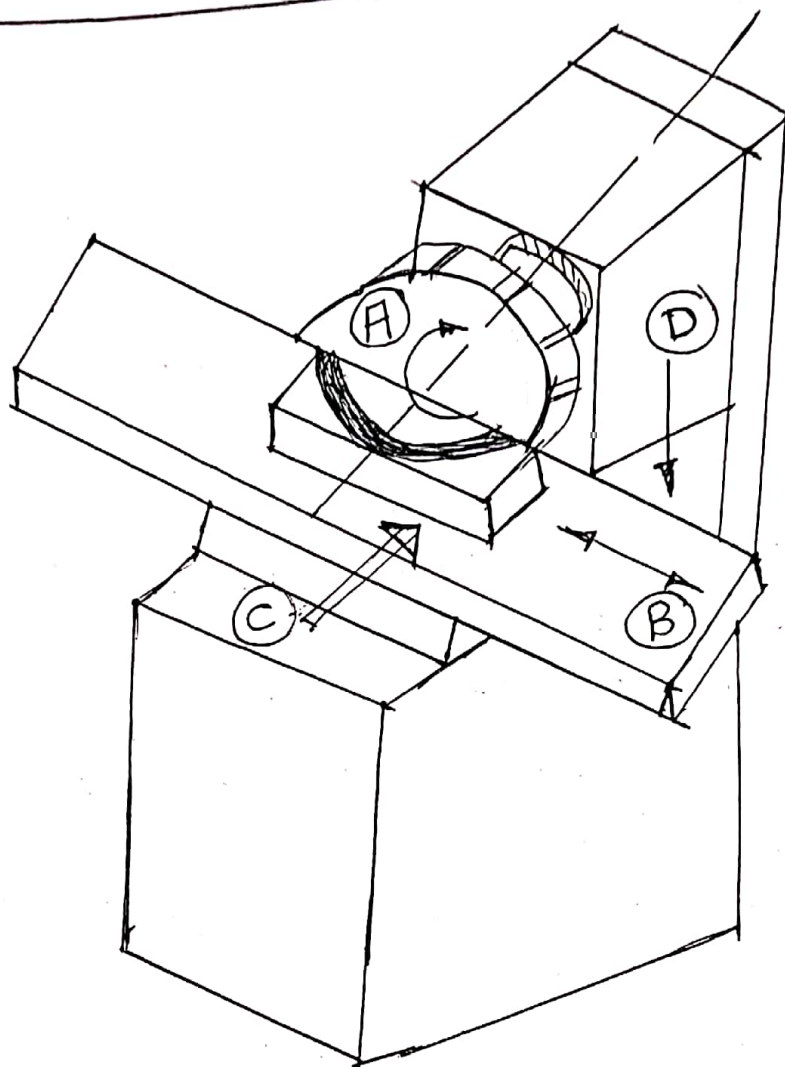
This machine mainly used to grind flat surfaces. However some type of surface grinders are also capable of producing contour surface with formed grinding wheel.

⇒ Basically there are four type of surface grinding machines characterised by the movement of their tables and the orientation of grinding wheel spindles as follows:

- (a) Horizontal spindle & reciprocating table.
- (b) Vertical spindle & reciprocating table.
- (c) Horizontal spindle & rotary table.
- (d) Vertical spindle & rotary table.

Horizontal spindle & Reciprocating table

This m/c with various motions required for grinding action. A disc type grinding wheel performs the grinding action with it's peripheral surface.

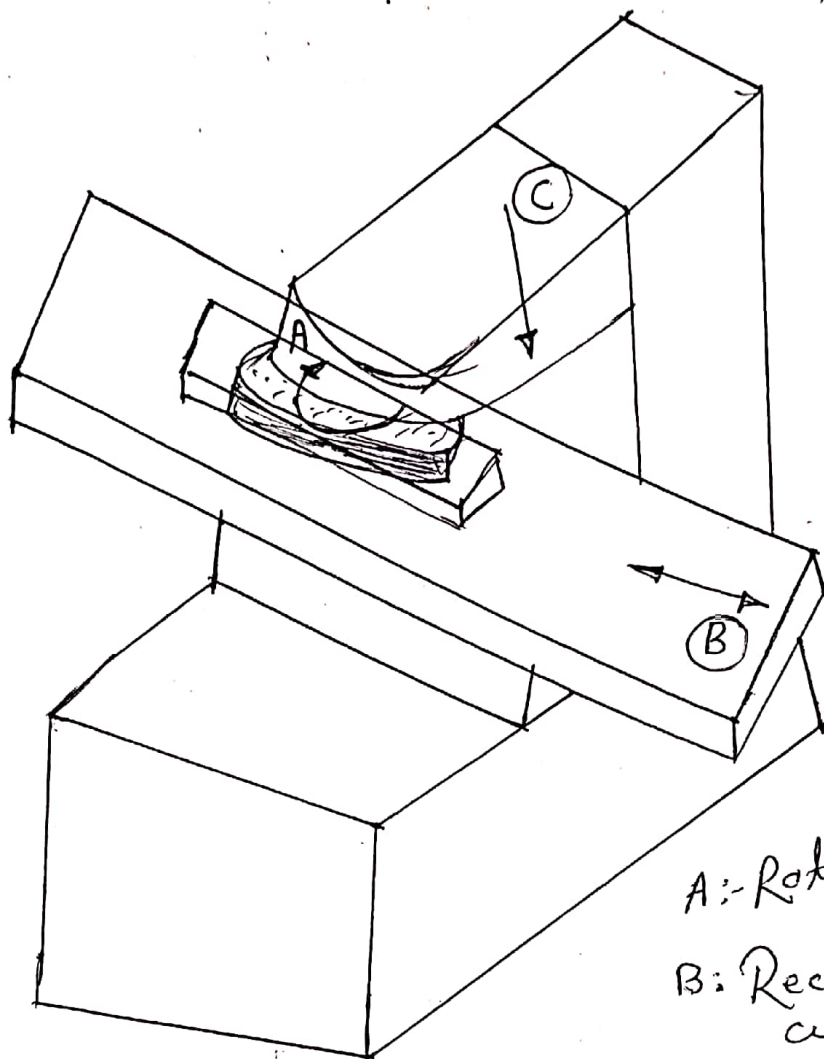


- A : Rotation of grinding wheel.
- B : Reciprocation of worktable.
- C : Transverse feed.
- D : Down feed.

Vertical spindle reciprocating table grinder

This grinding m/c with all working motions is shown in figure. The grinding operation is similar to that of face milling. In this m/c a cup shaped wheel grinds the workpiece over its full width using end face of the wheel. This brings more grits in action at the same time & consequently a higher

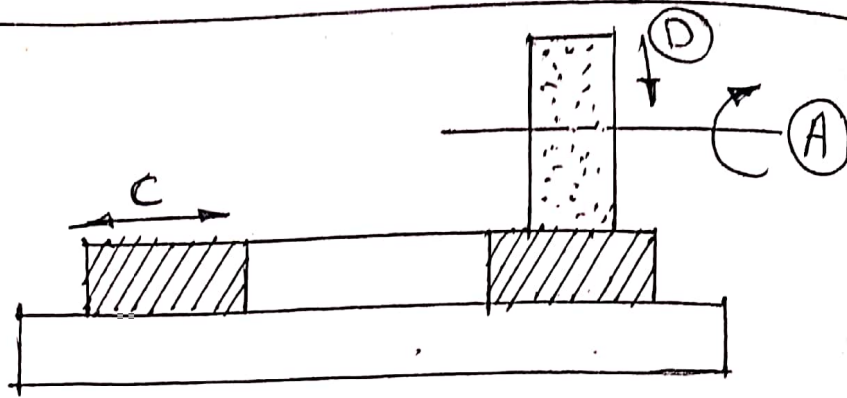
material removal rate may be attained than for grinding with a peripheral wheel.



- A:- Rotation of grinding wheel
- B: Reciprocation of worktable
- C: Down feed of grinding wheel

Horizontal spindle rotary table grinder

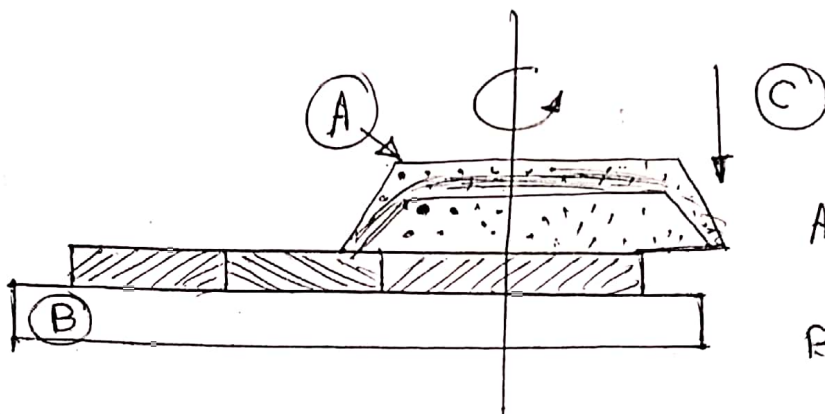
This m/c has a limitation in accommodation of workpiece & therefore does not have wide spread use. However by swivelling the worktable tapered surface can be produced on individual part as in figure.



- D: Down feed of grinding wheel
- C: table reciprocation
- A: Rotation of grinding wheel:

Vertical spindle rotary table grinder

This machine is mostly suitable for small workpieces in large quantities. This primarily production type machine often uses two or more grinding heads thus enabling both roughing & finishing in one rotation of the work table.



- A: Rotating grind wheel
- B: Work table rotation
- C: Down feed grinding wheel

Q-8 Shortly write about cylindrical grinding m/c.

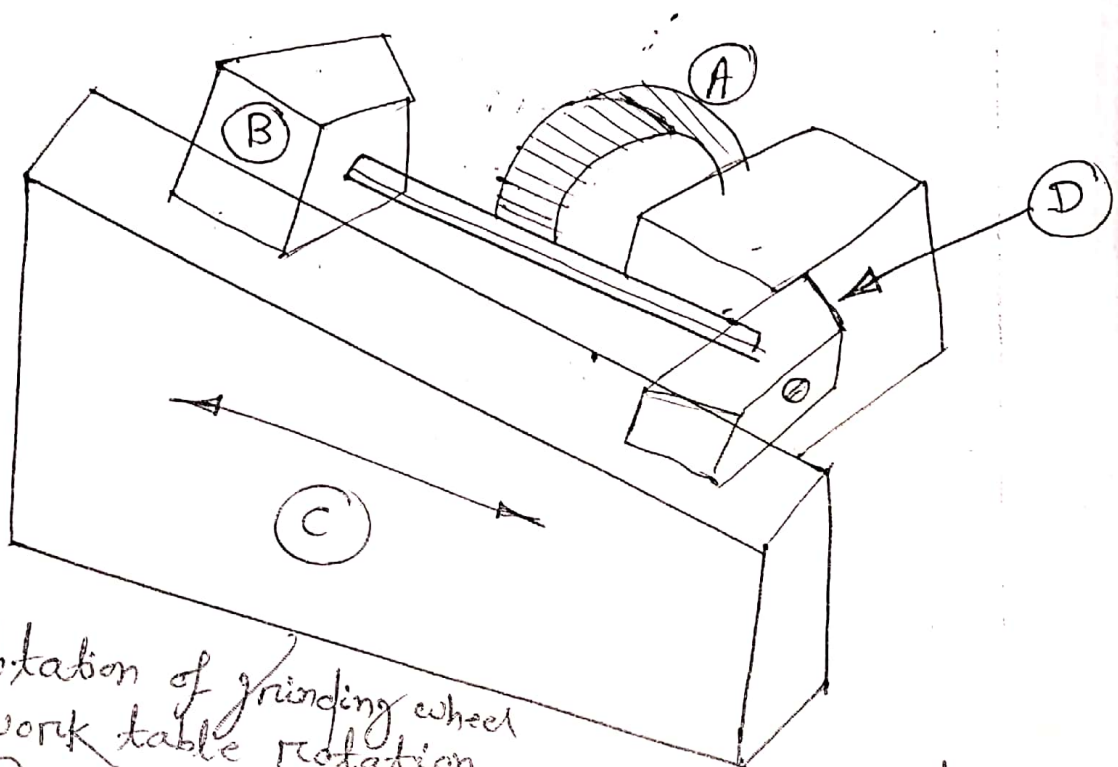
Ans Cylindrical grinding m/c

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 m/c as follows.

- (1) Plain centre type cylindrical grinder
- (2) Universal cylindrical grinder
- (3) Centreless cylindrical grinder.

Plain centre type cylindrical grinder :-

This machine is similar to a centre lathe in many respects. The w/p is held between head stock & tail stock centres. A disc type grinding wheel performs the grinding action with its peripheral surface.



A :- Rotation of grinding wheel

B :- work table rotation

C :- Reciprocation of worktable

D :- Feed

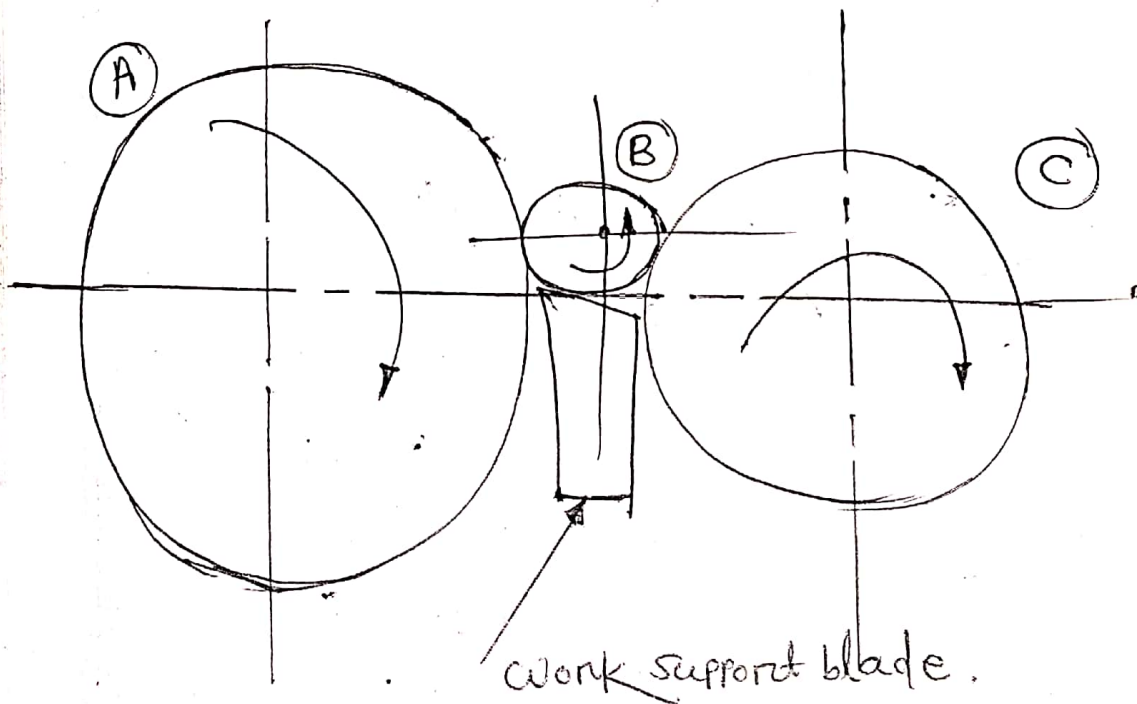
Q-9 Explain Centreless Grinder. [5 Mark]

Ans := Centreless Grinder

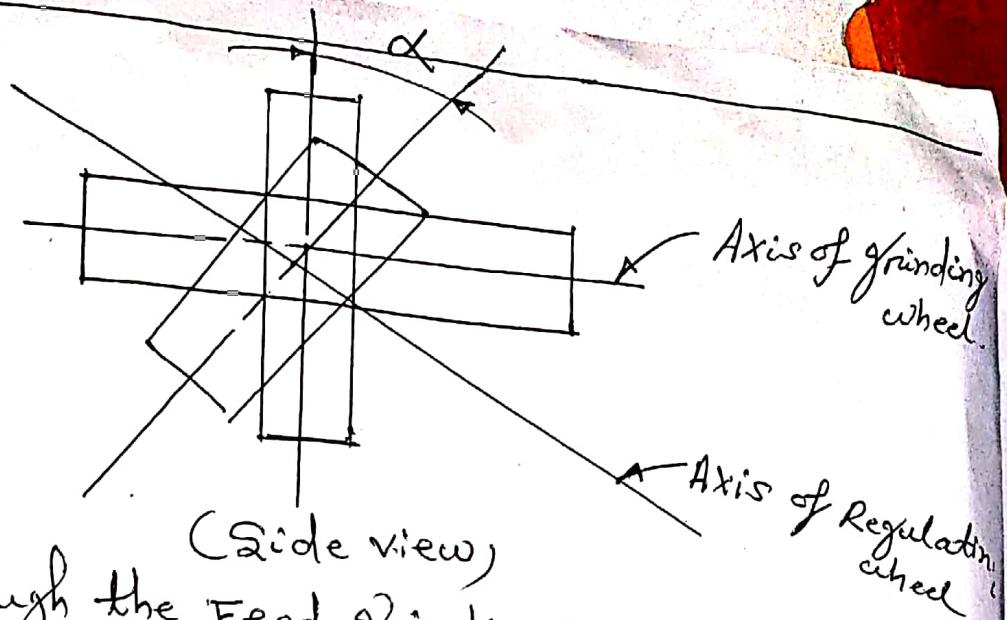
(i) Centreless grinding is performed on workpieces which do not have centres such as piston valves, rings, tubes, belt & rollers for bearings etc. Centre grinding can be done both external & internal surfaces.

External Centreless Grinder

This grinding m/c is a production m/c in which out side diameter of the w/p is ground. The workpiece is not held between centres but by a work support blade. It is rotated by means of a regulating wheel & ground by the grinding wheel.



A: Grinding wheel rotate
B: work piece rotate
C: Regulating wheel.



Through the Feed grinding:-

In this type, the workpiece rest on a blade & passed between two abrasive wheels. The two wheels are grinding wheel & regulating wheel. The regulating wheel is rubber, bonded abrasive to rotate the work at it's own rotation at speed. The axial movement of the work is obtained by fitting the regulating wheel downward at the feeding end.

Infeed grinding:- If the workpiece is of irregular profile and it can't be rotated between the wheels. At first regulating wheel is shifted. The workpiece is on the work rest blade. Then the regulating wheel is advanced towards the grinding wheels. When the grinding is completed the regulating wheel is shifted again & the finished workpiece is taken out.

End feed grinding

In this method both the grinding & regulating wheels are tapered & tapered w/p is produced.

The work piece is fed from one side until it reaches the stop.

Internal centreless grinding

In internal centreless grinding wheel, the work is supported by three rolls. These rolls are regulating roll, pressure roll & supporting roll. The grinding wheel contacts the inside diameter of workpiece directly opposite the regulating roll. ~~The pressure roll is mounted as scoring~~

