LECTURE NOTES

ON

MANUFACTURING TECHNOLOGY

PREPARED BY

MR. RANJAN KUMAR NAYAK

(DEPT. OF MECHANICAL ENGG.)

GOVERNMENT POLYTECHNIC, PURI

UNIT-I

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TOOL MATERIAL

There are many types of cutting process done in different condition. In such condition along with the general requirements of the cutting tool, they need some unique properties. TO achive this properties the cutting tools are made up different material. The material choosen for a perticular application depends on the material to be machined, type of machining, quantity and quality of production.

According to the material used the tools are classified in to

1. carbon tool steel
2. High speed steel tool (HSS)
3. cementide carbide tool
4. ceramic tools
5. cubic boron nitride tool
6. Diamond tool

① carbon tool steel :-

→ carbon tool steel is one of the inexpensive metal cutting tools used for low speed machining operation.

→ This plane carbon steel cutting tool have the composition of 0.6% to 1.5% carbon and very small amount of less than 0.5% of manganese, silicon.

→ other metal like cromium (cr), vanadium (v) are added to change the grain size and hardness.

→ High carbon steels are abrasion resistance and have the ability to maintain sharp cutting edge.

→ carbon tool steel makes good machinability.

→ This material losses their hardness rapidly at a temperature about above 250°C. Therefore it can not used high temp. application It does not prefer in a modern machining operation.

uses

→ carbon tool steel used in twist drill tools, mining tools, turning tools used for soft material. such as:- brass, Aluminium, Magnesium.

② High speed steel (HSS) :-

→ This is a high carbon steel with a significant amount of alloying element. such as tungsten, molybedrum, chromium etc. to improve hardenability, toughness and wear resistance it gives a higher metal removal rate.

→ It losses its hardness at a moderate temp. about 650°c, therefore a coolant should be used to increase tool life.

→ It can use many times by resharpening. some surface treatment is done on the HSS to improve it's properties.

→ surface treatment used in the edges
- super finishing - reduce friction
- nitriding - increase wear resistance
- chromium electroplating - reduce friction
- oxidation - reduce friction.

T-4-1 HSS

tungsten - 18%.
chromium - 4%.
Vanadium - 1%.
0.5% - 0.8% - carbon

uses

→ HSS tools are used in :-
- Drilling tools
- Milling cutter tools
- single point lathe tools
- Broaches

③ cementate carbide tool :-

→ The cementate carbide cutting tool is produced by powder metallurgy technique.

→ It consist of tungsten, tantalum and titanium carbide with cobalt as a binder.

→ when the binders are nickel or molybednum it is called cermet.

→ cementate carbide tools are extremely hard, they can withstand very high speed cutting operation.

→ carbide tools does not loose their hardness up to 1000°c.

uses

→ These tool materials are used for machining of cast iron and alloy steels.

④ ceramic tool :-

→ Most common ceramic materials are aluminium oxide and silicon nitride.

→ powder of ceramic material compacted in insert shape then sintered at a high temperature.

→ ceramic tools are chemically inert hard and possesses, resistance to corrosion.

→ They have high compressive strength.

→ They are stable up to 1800°C.

→ They are 10 times faster than HSS.

→ The friction between the tool face and chip are very low and possesses a low heat conductivity. usually no coolant are required.

→ They provide very excellent surface finish.

uses

→ These tool materials are used for turning and boaring operation at high speed.

⑤ cubic boron nitride (CBN) :-

→ It is the second hardest material after diamond.

→ They are generally used in hard machines.

→ They offer high resistance to abrasion and use as an abrasive in grinding wheels.

→ sharp edges are not recomended.

⑥ Diamond tools :-

→ It is the hardest material known and it is also expensive

→ It possesses. very high thermal conductivity and melting point.

→ Diamond tool offers excellent abrasion resistance, low friction co-efficient and low thermal expansion.

→ It is used in machining very hard material · such as carbides, nitrides, glass etc.
→ Diamond tools gives a good surface finish and dimensional accuracy.
→ They are not recomended for machining steel.

28.2.23

UNIT- 2

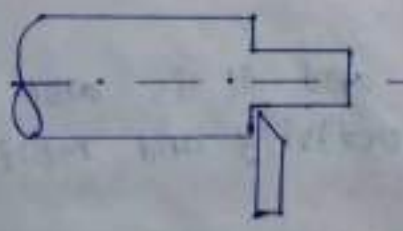
Cutting TOOLS

In machining a cutting tool or cutter is any tool which is used to remove the material from the workpiece by means of shear difference.

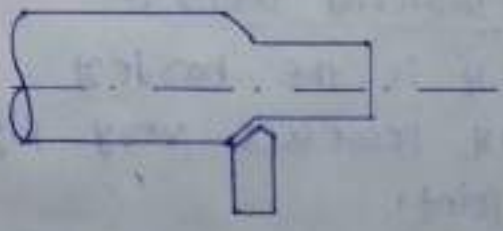
cutting tool must be made of a material harder than the material which is to be cut and the tool must be to withstand and heat generated in the metal cutting process.

The angle of cutting facer is also important, also the tool must have a specific geometry and clearance angles designed so that the cutting edge can contact the workpiece surface.

orthogonal cutting



Oblique cutting



④ Difference between orthogonal cutting and oblique cutting.

Orthogonal cutting	Oblique cutting
i) The cutting angle of the tools makes a right angle to the direction of motion or perpendicular to the workpiece.	i) The cutting angle of the tool does not make right angle to the direction of motion or lesser than 90°.
ii) The flow of the chip is perpendicular to the cutting edge.	ii) The flow of the chip is not perpendicular to the cutting edge.
iii) The tool has lesser cutting life.	iii) The tool has higher cutting life.
iv) The shear forces per unit area is high. which increases the heat per unit area.	iv) The shear forces per unit area is low. which decreases the heat per unit area.
v) In orthogonal cutting the surface finish is poor.	v) In oblique cutting the surface finish is good.
vi) cutting edge is longer than the edge of the cut.	vi) cutting edge may or may not be longer than the edge of cut.
vii) orthogonal cutting only two components of force are consider cutting post and thrust force which can be represented by a 2D co-ordinate system.	vii) In oblique cutting three components of force are consider cutting post, thrust force and radial force which can not represented by 2D co-ordinate. It used a 3D co-ordinate to represent the forces acting during cutting. so it is known as 3D cutting.
viii) Two mutually perpendicular cutting forces act on the workpiece	viii) Three mutually perpendicular forces are involved.

→ orthogonal cutting uses a wedge shape tool in which the cutting ~~tool~~ edge is perpendicular to the direction of cutting speed.

→ Shear plane:-

As the tool is forced in to the material the chip is formed by shear deformation along a plane is called shear plane.

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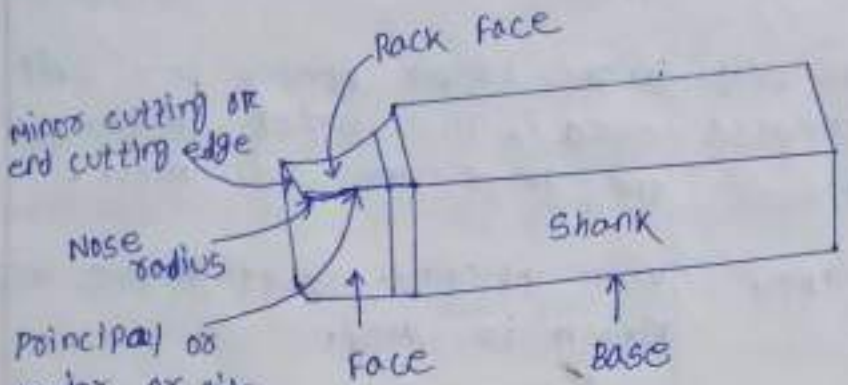
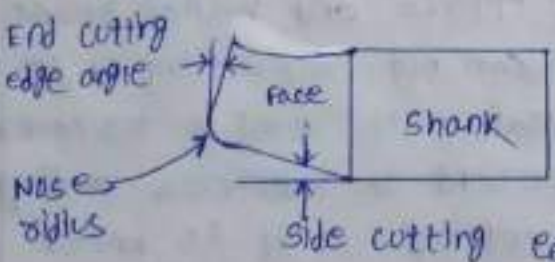
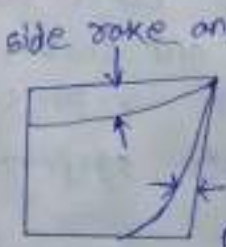
The geometry of lathe M/c or cutting tool geometry



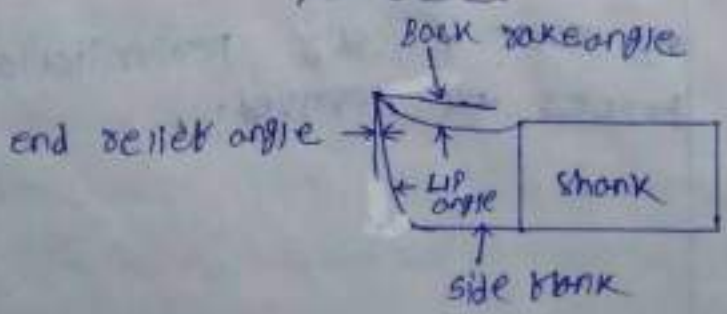
Top view



Front view



Side view



Cutting Tools

The tools used for different machining operations is called cutting tools. such as drilling, milling and lathe operations.
it is of two types. (i) single point cutting tools
(ii) Multipoint cutting tools.

(i) single point cutting tools :-

As the name indicated a tool that has a single point for cutting purposes is called single point cutting tool.
It is generally used in the lathe machine and shaper machine etc.

(ii) Multi point cutting tools :-

A tool that has multi point cutting edge for cutting purposes is called multi point cutting tools.
It is generally used in the milling machine, drilling machine, Hacksaw blade, ~~etc~~ broaching etc.

3/3/23

Back rake angle :-

It is the angle between the line parallel the tool axis passing through the tip and rake face.
→ The angle is measured in a plane perperpedicular to the base.
→ It is of three types (i) +ve rake angle
(ii) - ve rake angle
(iii) zero rake angle

(i) +ve rake angle :-

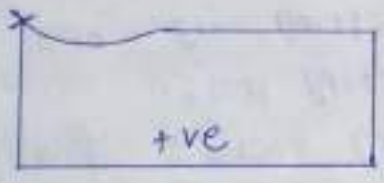
- +ve rake angle is used for the machining of ductile materials.
- By using +ve rake angle for the machining ductile materials tool life is increased.

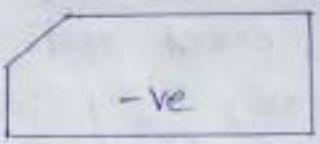
(ii) -ve rake angle :-

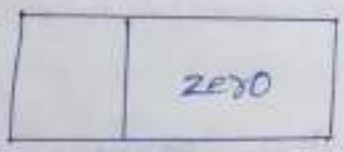
- By producing -ve back rake angle, energy required to overcome the friction which increase power requirment in machining for which it is used for machining.
- But negative back rake angle is provided for stability and increase tool life.
- -ve back rake angle is used for machining of hard and brittle materials.

(iii) zero rake angle :-

- It is also used for machining of hard and brittle material.







Side cutting edge angle :-

- It is the angle between the side cutting edge and the line extending the shank and parallel to the tool axis.

- Normally the value of side cutting edge angle 15-30°.
- By increasing side cutting edge angle tool wear and tear decreases hence tool life increases.

Side rake angle :-

- It is the angle between the rake face and the line passing through the tip and perpendicular the tool axis.
- It is measured in a plane perpendicular to the base.
- Normally this angle varies between 15°-30°.

Side relief angle :-

- It is the angle between the side flank and the line passing through the tip perpendicular to the base.
- The angle varies in the range of 5° to 15°.
- The angle is measured in a plane perpendicular to the base.

End relief angle :-

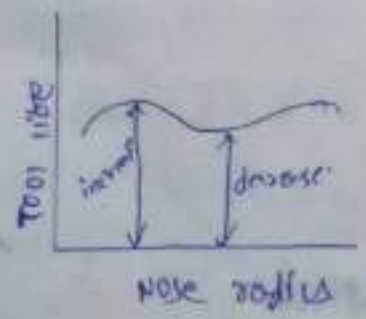
- It is the angle between the end flank and the line passing through the tip perpendicular to the base.
- The angle is measured in a plane perpendicular to the base plane.
- The angle varies in the range of 5°-to 15°,

End cutting edge angle :-

- It is the angle between the end cutting edge and the line passing through the tip perpendicular to the tool axis.
- Angle is measured in a plane parallel to the base plane.
- The angle varies in the range of 8°-15°.

Nose radius :-

- The larger nose radius gives better surface finish.
- Increase in nose radius improves the tool life, so that higher cutting speed can be achieved.



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Machining process parameters

1. Cutting speed (V) = $\frac{\pi DN}{1000}$ m/min
2. Feed (f)
3. Depth of cut
4. Machining time ($t_m = \frac{L}{fN}$)
5. Metal removal rate (MRR)

① Cutting speed :-

It is defined as the speed at which the metal is removed by the tool from the workpiece. It is denoted by 'V'.

$$V = \frac{\pi DN}{1000} \text{ m/min}$$

where, V = cutting speed of tool
D = Diameter of the workpiece
N = No. of revolution of the workpiece.
unit = m/min

② Feed :-

It is defined as the distance advanced by the tool for each revolution of the workpiece.

unit = mm/revolution

$$f = \frac{L}{T_m N}$$

where, L = Length of workpiece
T_m = Machining time
N = No. of revolution of workpiece.

③ Depth of cut :-

It is the perpendicular distance measured from the machined surface to the unmachined surface of the workpiece.

$$\text{Depth of cut} = \frac{D-d}{2}$$

where, D = diameter of unmachined surface

d = diameter of machined surface.

It's unit is meter.

④ Machining time :-

It is the time required for machining of the workpiece.

- It depends on speed, feed and length of the workpiece.

$$T_m = \frac{L}{fN}$$

where, L = length of workpiece

N = No. of revolution of workpiece

T_m = machining time

f = feed of tool.

⑤ Metal removal rate :- (MRR)

It is the volume of material remove per unit time.

It depends on speed, feed and depth of cut.

$$MRR = \pi D \times d \times f \times N$$

where, D = diameter of workpiece

d = depth of cut

f = feed

N = revolution of the workpiece.

unit = mm^3/min

Cutting tools

Cutting action of various cutting tools

① Chisel
② Hacksaw
③ Dies
④ Reamer

Shape - Hexagonal, octagonal
Made up - HSS, CVS

① **Chisel :-**

It is a cutting tool used for removing of excess material from the surface of workpiece by the use of hammer.

Chipping :-

It is the process of removing excess material from the surface of workpiece with the help of chisel and hammer.

Parts of the chisel :-

- Head
- Body
- Point or cutting edge.

Types of chisel :-

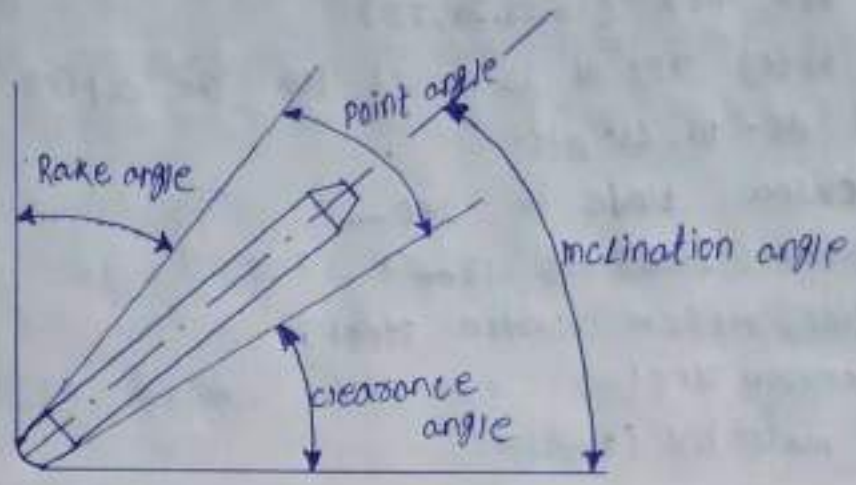
(i) **Flat chisel :-** It is used to remove metals from large flat surface of weld joints and castings.

(ii) **Cross cut chisel :-** Cross cut chisels are used for cutting key ways, grooves and slots.

(iii) **Half round chisel :-** It is used for cutting curved grooves or grooves of oil bearing.

(iv) **Diamond point chisel :-** Diamond point chisel is used for squaring materials at the corners and joints.

③ Punching or wave chisel :- It is used for separating metals after chain drilling.



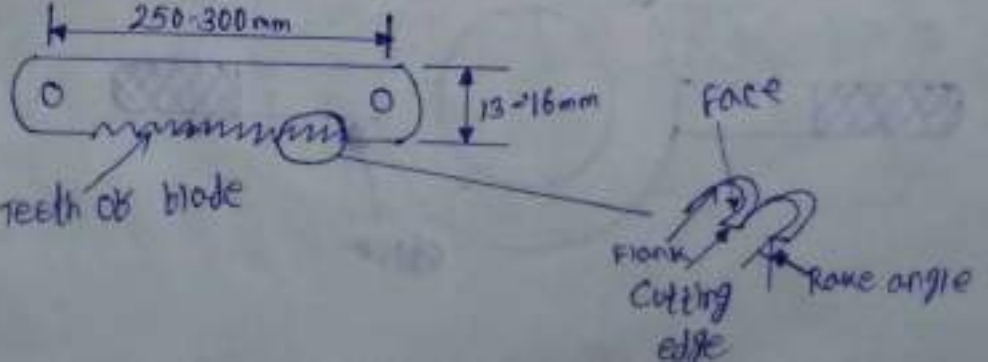
chisel angle

Material to be cut	point angle	angle of inclination
High carbon steel	65°	39.5°
cast iron	60°	37°
Mild steel	55°	34.5°
Brass	50°	32°
Copper	45°	29.5°
Aluminium	30°	22°

$$\text{inclination angle} = \frac{\text{point angle}}{2} + 7$$

② Hacksaw blade :-

It is a multipoint cutting tool used for cutting of materials. such as iron, copper, Al, wood

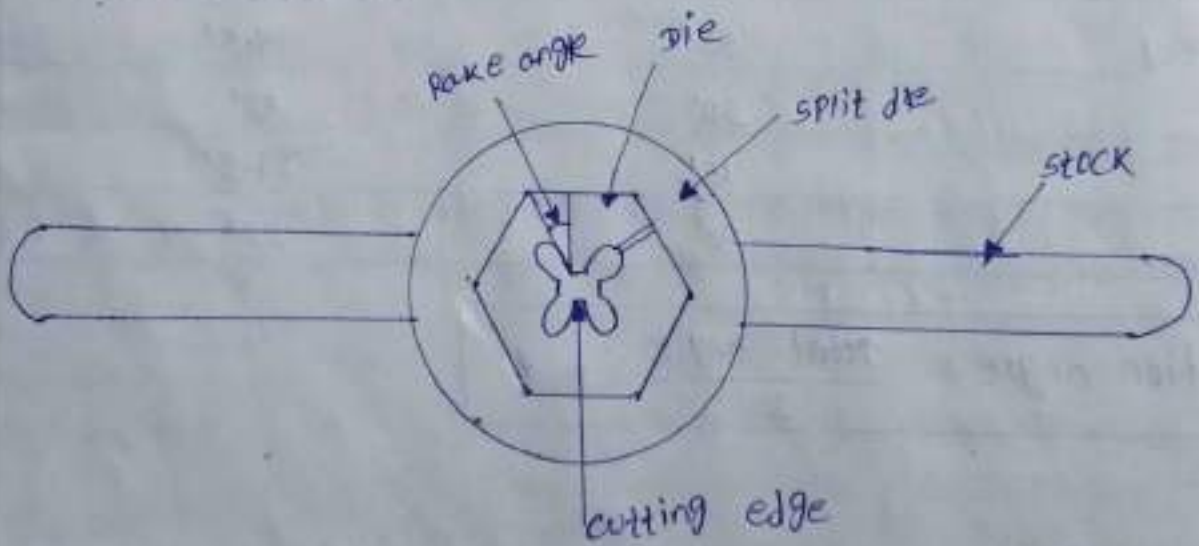


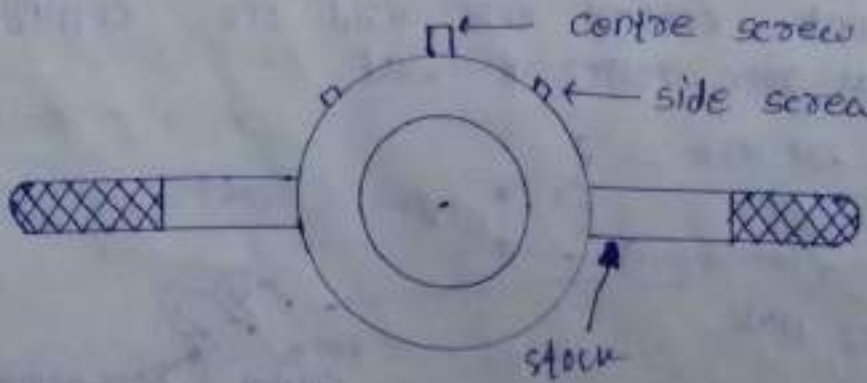
→ Its thickness varies from 0.63 to 0.8mm
→ It is made of HSS, HCS
→ TPI - Threads per inch (14, 18, 24, 32)
Hacksaw blade having TPI 14 is used for the cutting of soft material. such as - Al, Cu etc.
→ Length of hacksaw blade is 250 mm.
→ Width of hacksaw blade is 13 mm.
→ TPI 18 - Mild steel, Medium carbon steel.
→ TPI 24 - Low carbon steel
→ TPI 32 - Hard material (tungston,

③ Die :-

It is a cutting tool having threaded hole and used for making external threads on cylindrical parts.
→ It is made of high speed steel.

Types of Die





Types of die

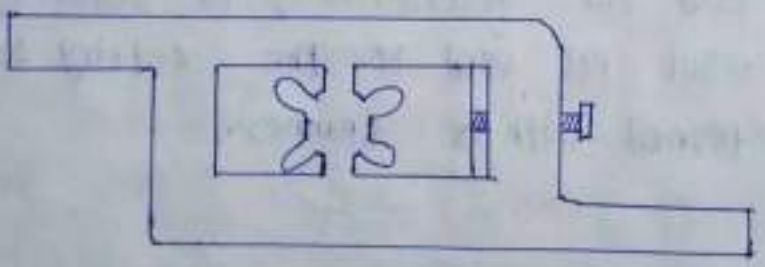
① circular split die
② Half die
③ Adjustable two plate die
④ solid die.

① circular split die

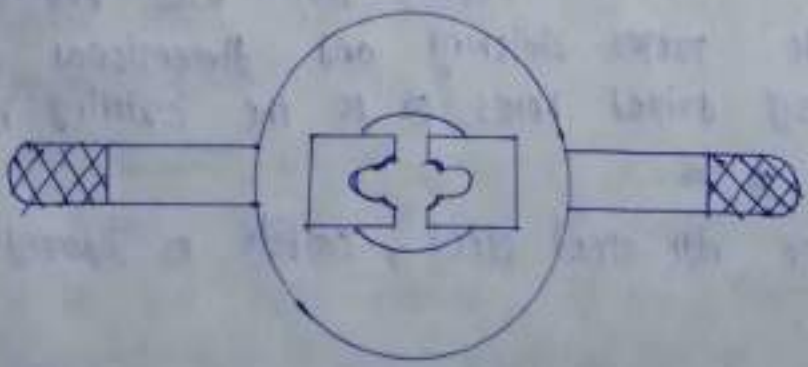
This has a slot cut to permit side variation in size. Most variation can be made by using adjustable screws.
- This permits increasing or decreasing depth of cut.
- The type of die stock is called button pattern stock.

② Half die

- Half dies are stronger in construction and adjustable can made easily to increase or decrease depth of cut.

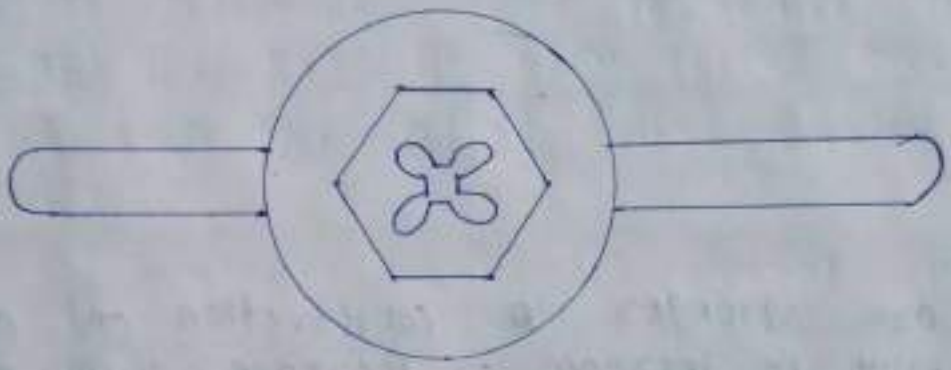


③ Adjustable two plate die



- This is another type of two piece die similar to the hair die.
- This provides better adjustment than the split die.
- The two die halves are held securely in a collar by means of a threaded plate (guide plate) which also acted as a guide while threading.
- The guide plate is tightened after placing the die in the collar.
- Thus the die pieces are correctly located and rigidly held.

(iv) Solid die



- This die is used for reconditioning or repairing of the damaged threads. But not used for the cutting of new thread.
- The die nut is turned with a spanner.

(v) Reamer :-

- Reamer is a multi point cutting tool used for enlarging holes to provide proper finishing and dimensional accuracy, to the previously drilled holes or to the existing holes made by the drilling.
- It is made of high speed steel, carbide or diamond.

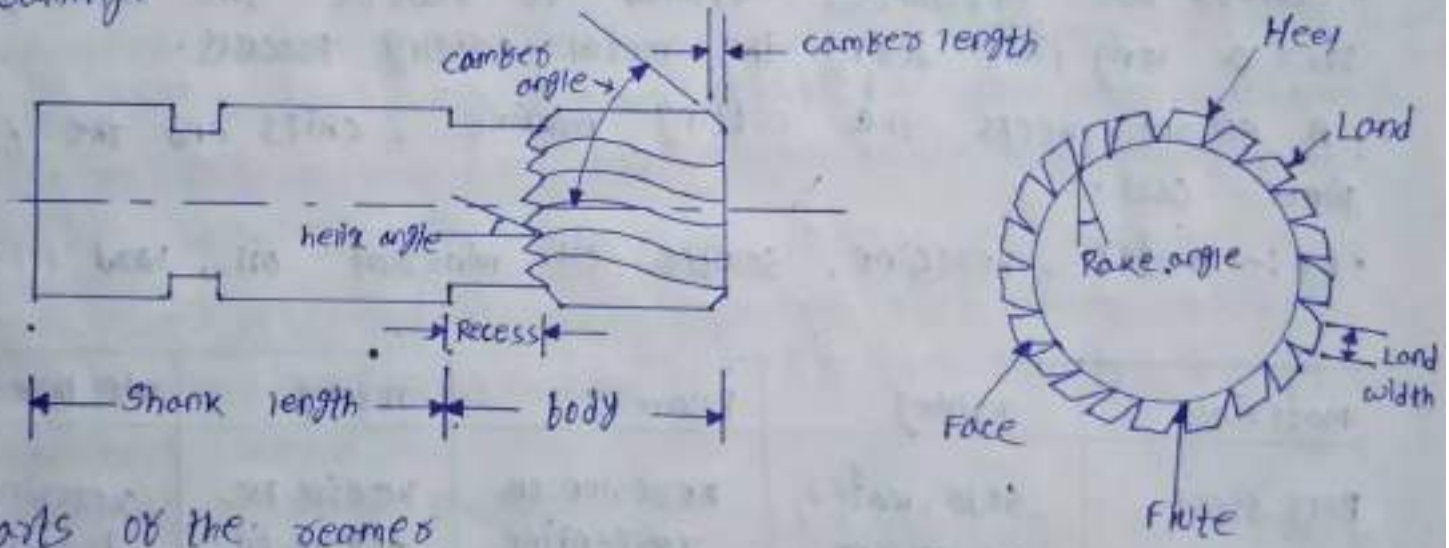
Advantages of reaming

- High quality surface finish
- Dimentionary accuracy to close limit
- Small holes which can not be other process, can be finished.

Classification of reamer

Reamers are classified as two types: (i) hand reamer
(ii) machine reamer

- Hand reamer is done manualy and machine reamer is fitted on the spindle of machine tools and rotated for reaming.



Parts of the reamer

Body :- The portion of the reamer extending from the entering end of the reamer to the commencement.

Recess :- The portion of the body which is reduce the diameter below the cutting edge. Pilot or guide diameter is called recess.

Shank :- The portion of the reamer which is held and driven is called shank. It can be tapper or parallel.

Heel :- It is the edge formed by the intersection of the surface relief by the provision of a secondary clearance and flute.

Cutting edge :- The edge formed by the intersection of face and circular land is called cutting edge.

Rake angle :- The angle in a diameter plane formed

Helix angle :-

15.03.23

Coolant and lubricants

Coolant :-

- Coolants are substances applied to reduce the heat generated over a long time during the metal cutting process.
- A coolant keeps the cutting machine, chips and the cut-piece cool.
- Ex :- water, kerosine, soluble oil, mineral oil, lard oil.

Materials	Drilling	Reaming	Turning	Die threading
Alloy steel	Soda, water or kerosie	Kerosine or Turpentine	Kerosie or soluble oil	Kerosine or turpentine
Copper	Kerosine or dry	lard oil or kerosine	Soluble oil or kerosine	lard oil or dry
Cast iron	Dry	Dry	Dry	Dry
MS	Soluble oil	Dry	Soluble oil	lard oil

Advantages of cutting fluid or coolants :-

- To carry away chips.
- To dry away scale and dirt.
- To improve surface finish.
- To increase tool life.
- Improve machinability.
- Reduce machining forces.

Lubricant :-

Lubricants are substances used to reduce friction between two mating parts.

- It helps in reducing heat generated during the machining process.
- Machines which requires lubrication systems are lathe, drilling, milling, shaping machine etc. and the parts which requires the lubrication system are side wedge, gear box, spindle, bearings etc.

Purpose of lubrication / advantages :-

- To reduce friction
- prevents wear
- cool the moving parts
- prevent corrosion
- improve machine efficiency

Types of lubrication system :-

Lubricants are classified according to their states

(i) solid lubricants.

(ii) semi solid lubricant

(iii) Liquid lubricant

(i) Solid lubricants :-

→ These are the lubricants which are used where oil film can not be maintain because of pressure and temperature.

→ Ex - Graphite, molybednum, die sulphide etc.

(ii) Semi solid lubricants :-

→ These are the lubricants which are used where slow speed heavy, pressure exists.

→ Greases. (Ex)

(iii) Liquid lubricants :-

→ These are the lubricants which are used where oil film maintain with high speed and heavy pressure.

→ Ex - Mineral oil, animal oil, synthetic oil.

→ For industrial use commonly used lubricants are turbine oil, hydraulique oil, gear oil, compressor oil, spindle oil etc.

(*) Properties of lubricant :-

→ Viscocity - → It is the property of lubricant that provides registance of the oil to flow.

→ The oil used as lubricant must have sufficient viscocity.

→ Oiliness - → The ability of the oil to wet the metalic surface is called oiliness.

→ Lubricants having good oiliness prevents the breakdown of the oil film and reduce the wear.

→ Flash and fire point - » Flash point is the lowest temp. at which an oil gives up sufficient vapours. or it is a temp. of the oil at which it starts evaporating.

» it is the temp. of the oil at which it starts burning. i.e fire point.

» Flash point and fire point of the lubricant should be high.

→ pour point - » it is the temp. at which an oil will cease to flow, when cooled.

» Lubricants should have low pouring point.

UNIT - 3

LATHE MACHINE

A lathe machine is a machine tool that removes an desired materials from a rotating workpiece in the form of chips with the help of a single point cutting tool that traversed approved the work and can be fed deep in to the work.

It is one of the most versatile and widely used machine tool in the world.

⊛ Classification of lathe machine

Lathe machine are classified according to the use :-

1) Engine lathe or center lathe
2) speed lathe
3) Turrent lathe
4) capstan lathe
5) Bench lathe
6) Tool room lathe

working poinciple of lathe machine

→ A lathe machine works on the principle of a rotating workpiece and the cutting action take place against a fixed cutting tool.

→ The workplece is held between two rigid supports called chuck (live center) and dead center.

→ Lathe removes on desired material from a rotating work-piece in the form of chips with the help of tool which move against the work.

→ The cutting operations are perform with the cutting tool feed either parallel or a right angle to the axis of work.

→ It can also bed at an angle relative to the axis of the work for machining tappers and angles.

Various parts of lathe machine

The lathe machine consists of the following many parts :-

1) Bed
2) Head stock
3) Tail stock
4) Carriage - saddle, cross-slide, compound rest, Tool post, Apron.

(1) Bed :-

→ The bed of lathe machine is the base on which all the other parts of the lathe machine are mounted.
→ The bed is made up of cast iron and is supported on broad box section columns.
→ Its upper surface is proved with guiding and sliding surfaces. The bed consists of heavy metal slides running length wise with ~~wedge~~ or 'v' form up on them. The outer guide ~~wedge~~ ways provide bearing and sliding surfaces for the carries and inner way for the tail stock.
→ Three measure units which is mounted in the bed are head stock, tail stock and the carriage

(2) Head stock :-

The head stock is present on the left end of the bed. The main function of the head stock is to transmit power to the different part of the lathe.
→ It support the main spindle in the bearing and rotating Shaft also house necessary transmission mechanism.
→ Accessories mounted on the head stock spindle are on (1) Three jaw chuck, (2) Four jaw chuck, (3) collect chuck, (4) base plate, (5) magnetic chuck.

05.04.23

(3) Tail stock :-

→ The tail stock is a movable casting located in the right side of the lathe machine opposite to the head stock. It consists of the dead center, adjusting screw and the hand wheel.

→ The body of the tail stock is adjustable on the base which is mounted on the guide ways of the bed and can be moved.

→ The basic function of tail stock is
i) to support the other end of the work when being machined.
ii) to hold a tool for performing operations like drilling, reaming, tapping etc.

(4) Carriage :-

→ The carriage is located between the head stock and tail stock.

→ The basic function of the carriage is to support, guide and feed the cutting tool against the rotating jaw during operation.

→ It mainly consists of five main parts
i) Saddle
ii) cross-slide
iii) compound rest
iv) Tool post
v) Apron

(ii) Saddle → It is an edge shaped casting mounted on the top of the apron. It provides supports to the cross-slide, compound rest and tool post.

(iii) Cross-slide → It is provided with a female dovetail on one side and assembled on the top of the saddle with its male dovetail. The top surface of the cross-slide is provided with T-slots to enable the fixing of the rear or coolant attachment.

(iii) Compound rest → Compound rest is present on the top of the cross slide. It supports the tool post and cutting tool in its various positions. It is necessary for turning angles, and boaring ~~soft~~ tappers.

(iv) Tool post → The tool post is mounted on the compound rest and is used to hold various cutting tool holders. The holders rest on a wedge which is shaped on the bottom to fit in to a concave shaped ring, which permits the height of the cutting edge to be adjusted by tilting the tool. It gets its movement by the movement of the saddle by the cross-slide.

There are three types of tools post which are commonly used (i) Ring and rocker tool post

(ii) Quick change tool post

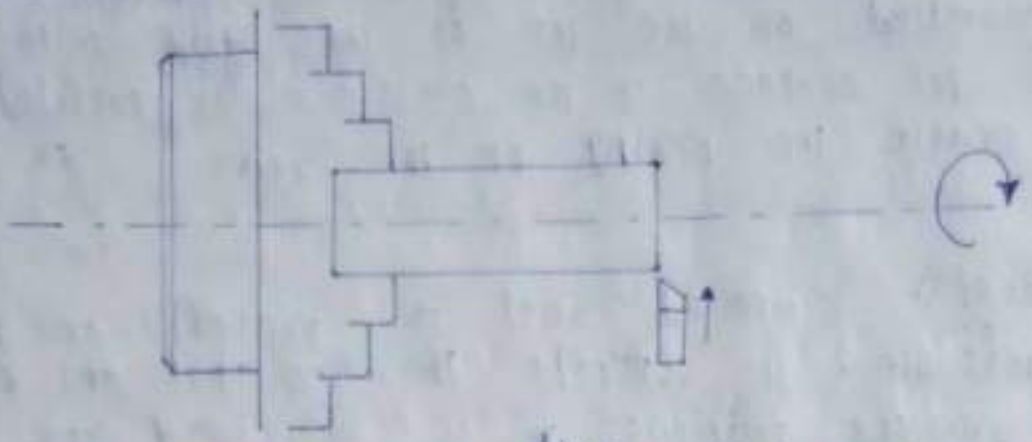
(iii) Square headed tool post.

(v) Apron → The apron is fastened to the saddle and hangs over the front of the bed. It consists of the gears and clutches for transmitting motion from the feed rod to the carriage and the split nut which engadges with the lead screw during cutting threads.

11-04-2023

Lathe operations

① Facing



It is an operation of reducing the length of the workpiece by feeding the cutting tools perpendicular to the lathe axis.

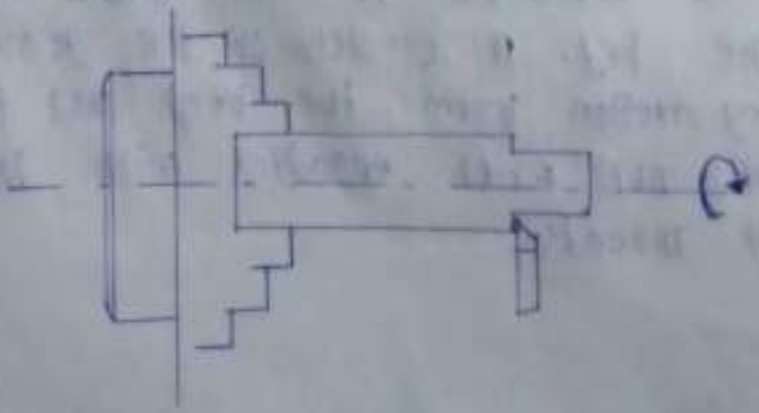
This operation produces flat surfaces on the end of the workpiece.

② Turning

It is an operation of removing excess materials from the surface of a workpiece to produce a cylindrical surface of desired shape and size.

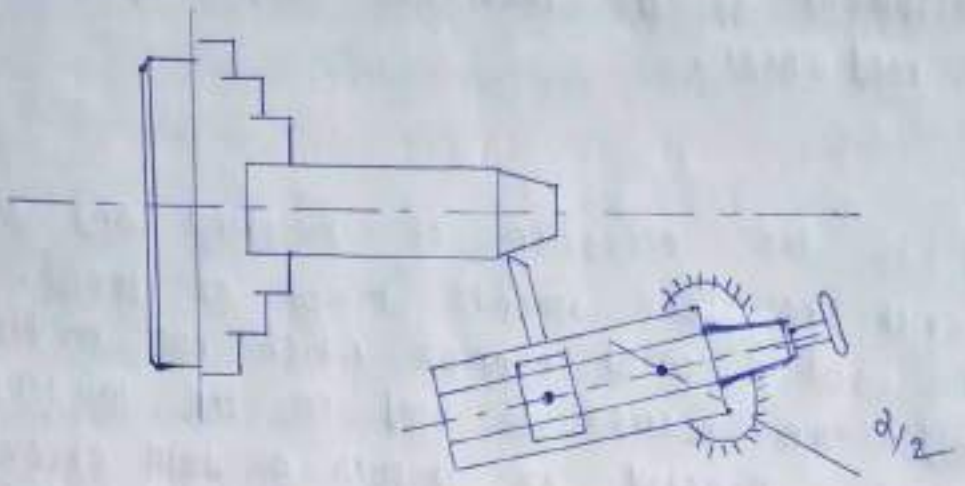
During this operation feed is moved along the axis of rotation of the chuck. It reduces the diameter of the cylindrical workpiece.

a) Step turning :-



It is an operation of producing two or more different diameter on a workpiece by using cutting tools.

b) Taper turning :-



Taper turning is a lathe operation that produces a conical surface by gradual reduction in diameter from a cylindrical workpiece.

Large tapers are produced by angular setting or by swivelling the compound rest at the required angle or by offsetting tail stock assembling or by taper turning attachment.

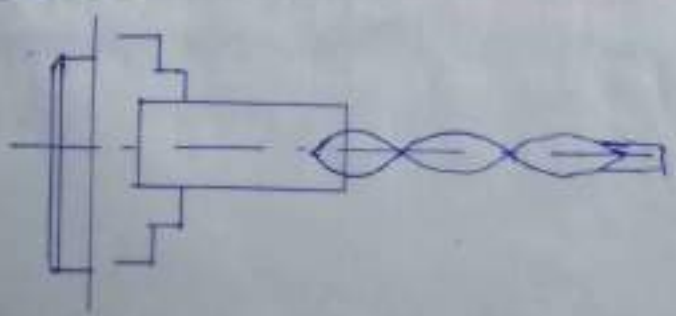
Let, D = large diameter of the work piece

d = smaller diameter of the workpiece

l = length of the taper

Taper angle $\Rightarrow \tan\frac{\alpha}{2} = \frac{D-d}{2l}$

③ Boring

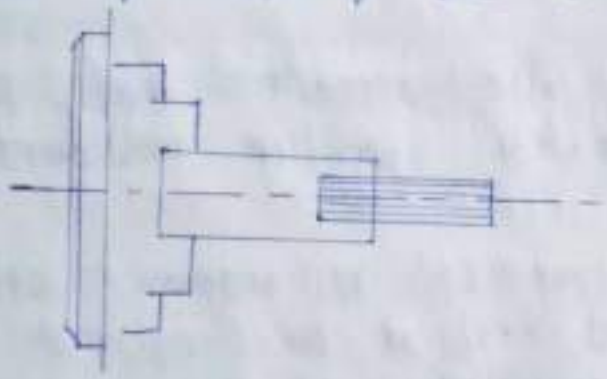


Drilling is the operation of producing a cylindrical whole in a workpiece. The workpiece is revolving in a chuck or a face plate and the drill is held in the tail stock or drill holder or drill chuck. and the feed is provided by the movement of the tailstuck spindle by rotating tailstuck hand wheel.

④ Reaming:

Reaming is the operation of finishing and sizing a whole which has been already drilled or bored.

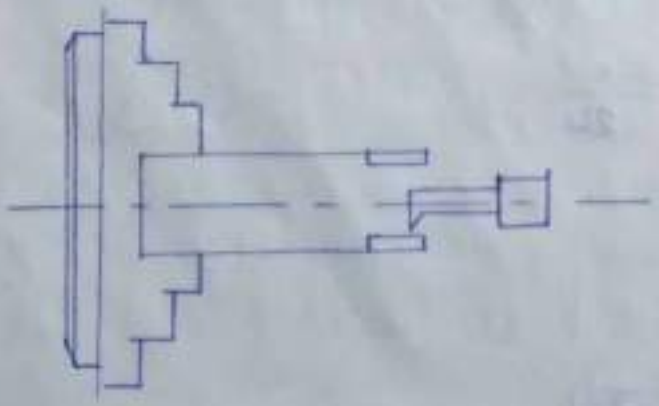
The tool used is caned reamer which has multiple cutting edge. The reamer is held on the tail stuck spindle either directly or through a drill chuck and advanced by rotating the tail stuck hand wheel.



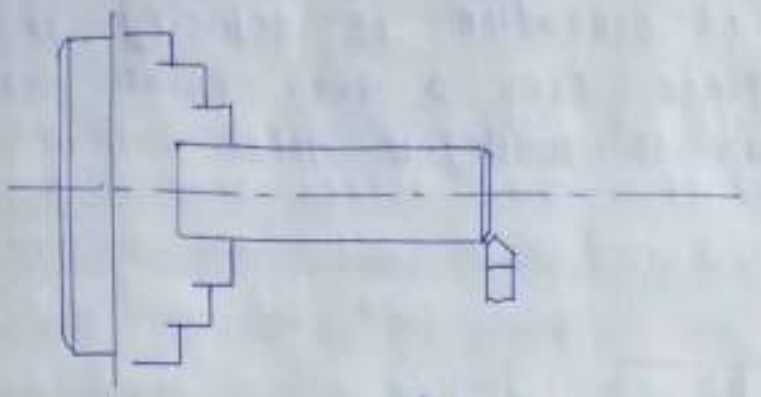
Boring

Boring is the operation of enlarging previously drilled holes.

It can't produce a hole but it can enlarge existing holes.



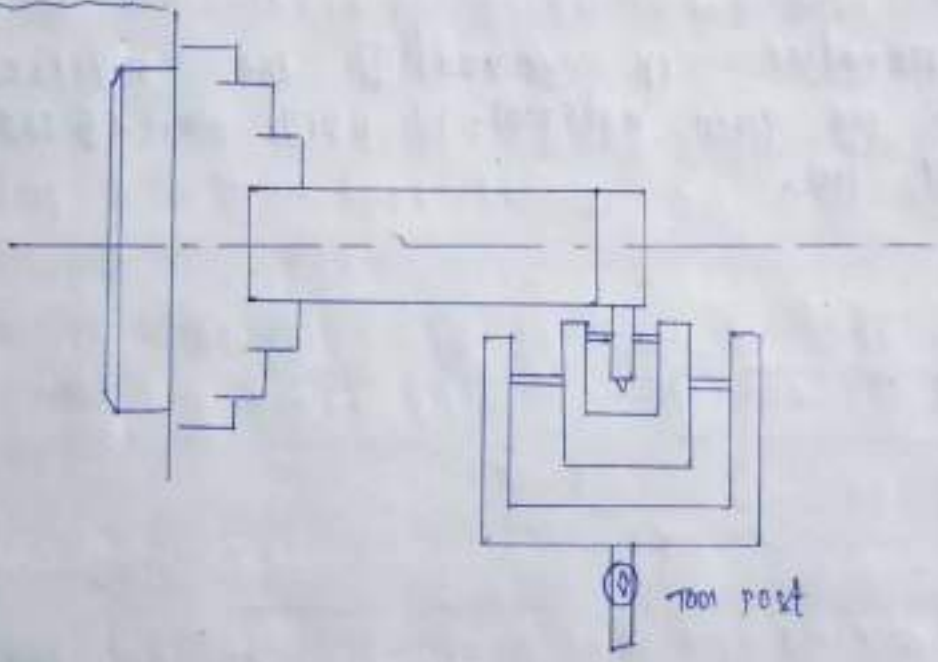
⑥ Chamfering



It is the operation of getting a bivelled surface at the edge of a cylindrical workpiece.

This operation is done incase of bolt ends and shaft ends. chamfering on bolts helps the screw nut easily.

⑦ knurling

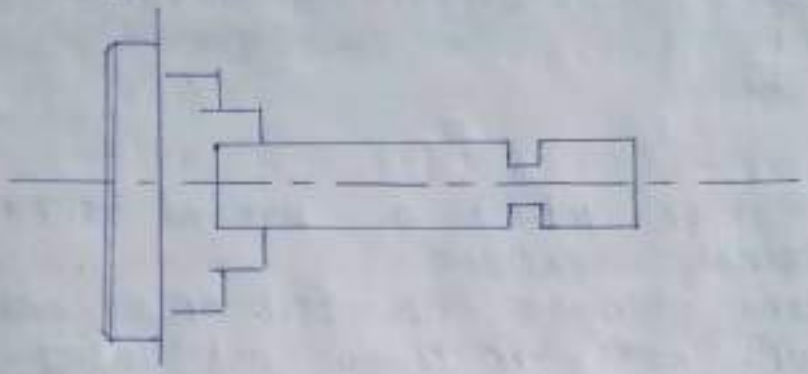


It is the process of making indentation on the surface of a workpiece by using knurling tool. The knurling operation is done to provide a better grip to the workpiece.

The knurling tool is pressed against the workpiece to perform the knurling operation.

⑧ Grooving

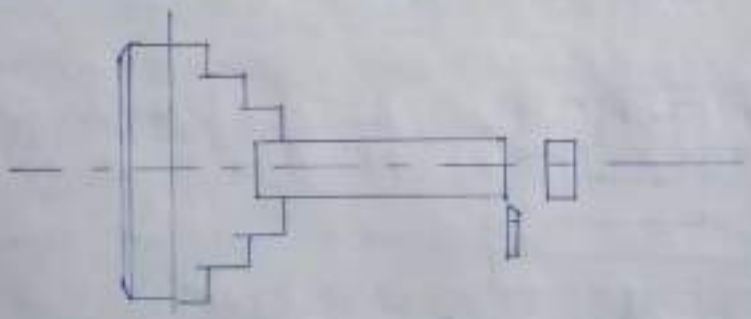
It is the process or operation of reducing the diameter of the workpiece over a very narrow surface. Grooving tool is similar to parting-off tool.



⑨ Parting off

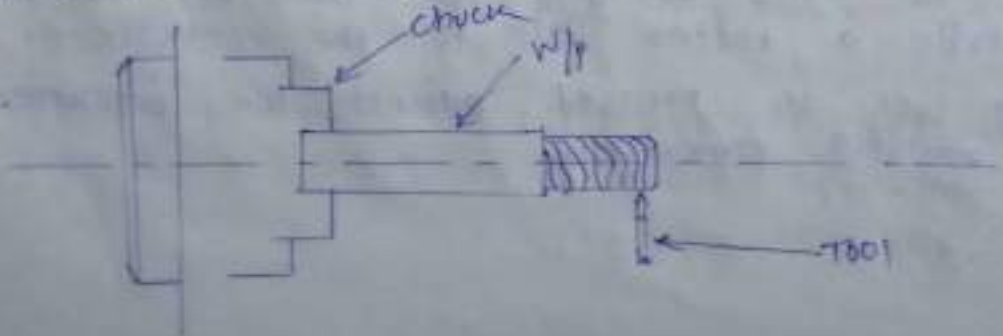
12.04.23

It is the operation of separating the required workpiece from the given material. by using parting off tools or grooving tools



⑩ Threading

It is the process of cutting helical groove over a cylindrical workpiece.



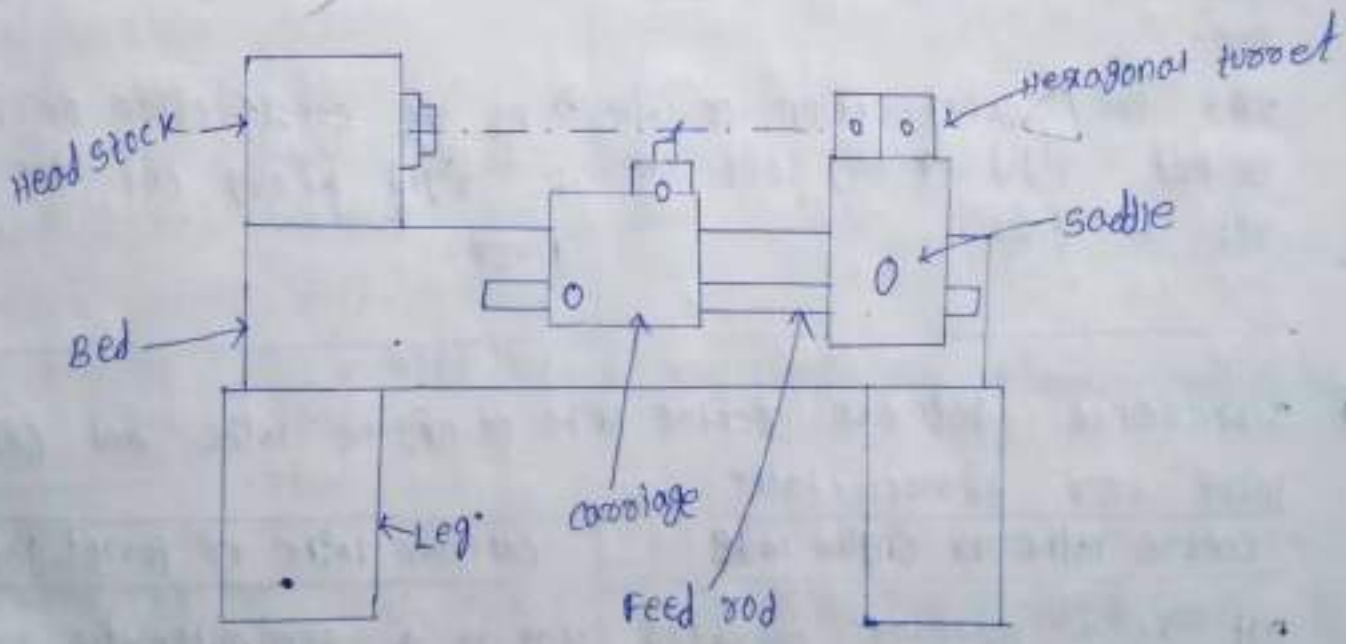
internal and external threads can performed by using threading tools on cylindrical workpiece.

Capstain and turret lathe

→ The capstain and turret lathe are the modified version of the center lathe, in which tail stock is replaced by the hexagonal turret, which can hold six cutting tools.

→ It is used to manufacture large no. of products in the minimum time.

→ It is a semi automatic lathe machine used for the repeatative production with the help of hexagonal turret means multiple cutting operation can be perform with the use of separate cutting tools.



18.04.23

2) Difference between capstain and turret lathe.

Capstain lathe	Turret lathe
• It is a right duty machine.	• It is a heavy duty machine.
• Turret head is mounted on the ram and the ram is mounted on the saddle.	• The turret head is mounted on the saddle and the saddle slides over the bed ways.
• The saddle will not move during machining.	• The saddle is moved along with the turret head during machining.
• The length wise movement of turret is less.	• The length wise movement of turret is more.
• Short workpiece only can be machined.	• Long workpiece can be machined.
• It is easy to move the turret head as it slides over the ram.	• It is difficult to move the turret head along with saddle.
• As the construction of lathe is not rigid heavy cut can not be given.	• As the construction of lathe is rigid heavy cut can be given.

3) Difference between centre lathe or engine lathe and capstain lathe or turret lathe.

centre lathe or engine lathe	capstain lathe or turret lathe
• It is a manually operated lathe.	• It is a semiautomatic lathe.
• It has only one tool post and tool changing time is more.	• Front and rear tool post are available and tool changing time is less.

• It has tail stock.	• It has turret head instead of tail stock.
• only one tool can be fitted in the tail stock.	• six different tools can be fitted in the turret head.
• NO of speeds is less.	• NO of speeds is more.
• The machine should be stopped for changing tool.	• Tool can be changed without stopping the machine.
• It is not suitable for mass production.	• It is suitable for mass production.
• Tool changing time is more.	• Tool changing time is less.

The lathe consist of bed, head stock, turret saddle, cross slide and saddle.

① Bed :-

→ Bed is a long box type casting with accurate guide ways on which carriage and turret saddle are mounted. The bed is designed to ensure strength, rigidity and alignment under heavy duty services.

→ carriage is mounted over the bed and travells longitudinaly

② Head stock :-

→ The head stock is made up of large casting and is located at the left hand side of the bed. There are different types of head stock in capstain and turret lathe are used.

i) stepped cone pulley driven head stock.

ii) Electric motor driven head stock.

iii) All geared head stock.

→ In heavy duty turret lathe are equipped ~~is usually~~ with two types of carriage. such as

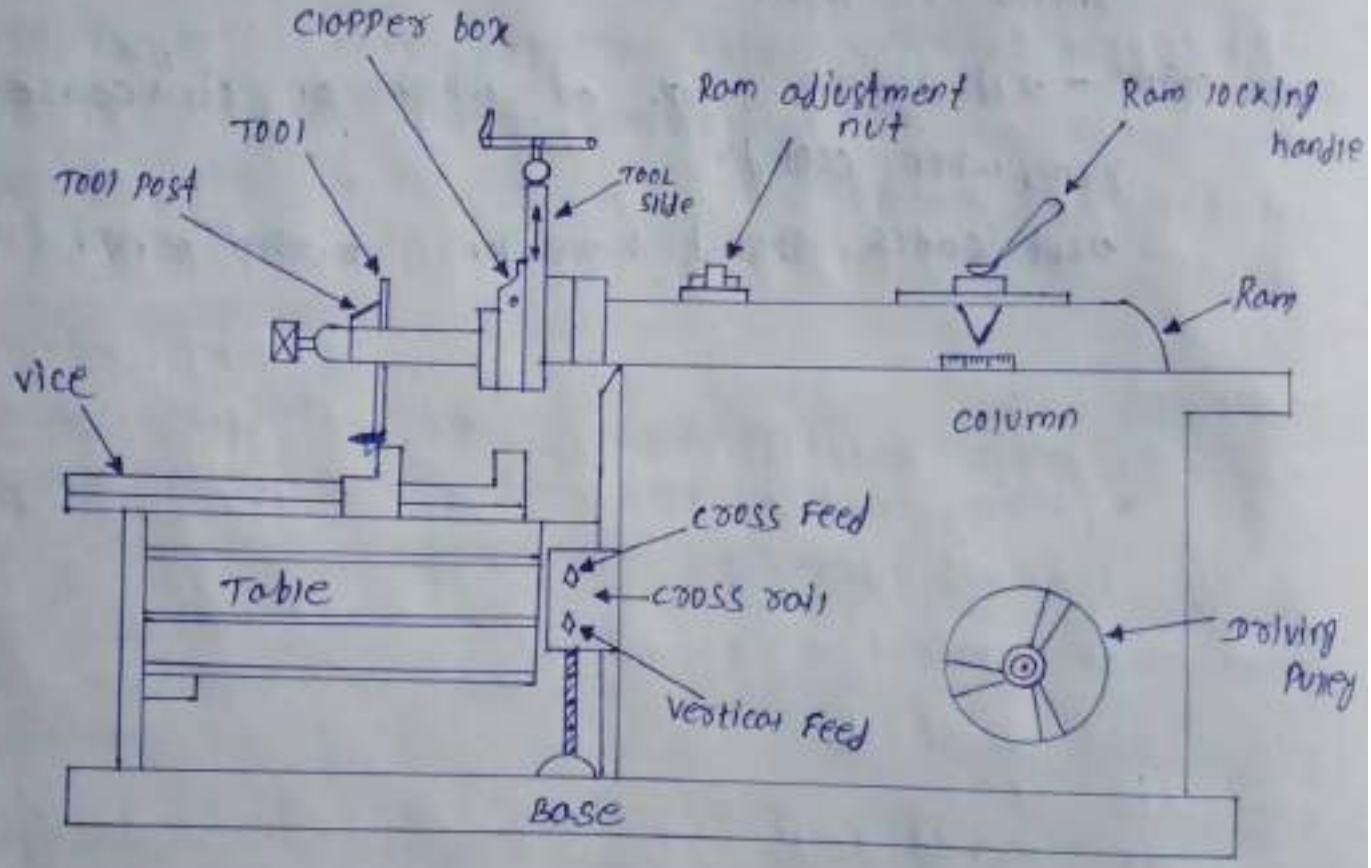
(i) conventional type carriage.

(ii) side hung type carriage.

UNIT- 4

SHAPER

17.03.23



The shaper is a reciprocating type machine tool, which removes material from the workpiece only forward stroke of the ram with the help of single point cutting tool and its return stroke is ideal.

Shaper machine is used for machining of horizontal surface, vertical surface, angular flat surface etc.

21.03.23

Parts of Shaper machine

1. Base
2. Column
3. Cross rail
4. Table
5. Ram
6. Clapper box

① Base :-

The base is the most important part of the shaper machine because it holds on the loads of machine.

- It is made of cast iron.
- It absorbs vibration and other force while performing machining operations.

② Column :-

The column is mounted on the base which is also made up of cast iron.

- It supports the ram which is moving forward and backward direction while operation.
- It also covers the driving mechanism.

③ Cross rail :-

It is mounted on the column on which saddle is mounted.

- The vertical movement and horizontal movement is given to the table by rising or lowering the cross rail using the elevating screw and by moving the saddle using the cross feed screw.

④ Table :-

It is mounted on saddle. The table can be moved crosswise by rotating the cross feed screw and also vertically by rotating the elevating screw.

- It is box like casting having surfaces is provided with

T-slots for clamping the work.

⑤ Ram :-

The ram reciprocates in the guide ways provided on the top of the column.

- It carries the tool head in which single point cutting tool is attached.
- The forward stroke of the ram perform cutting operation and the return stroke remains ideal.
- The feed or depth of cut of tool is given by down feed screw or down feed hand wheel.

⑥ Clapper box :-

It is a box which is provided with tool post for to hold the cutting tool.

- It is mounted on the tool head which is mounted on the ram.

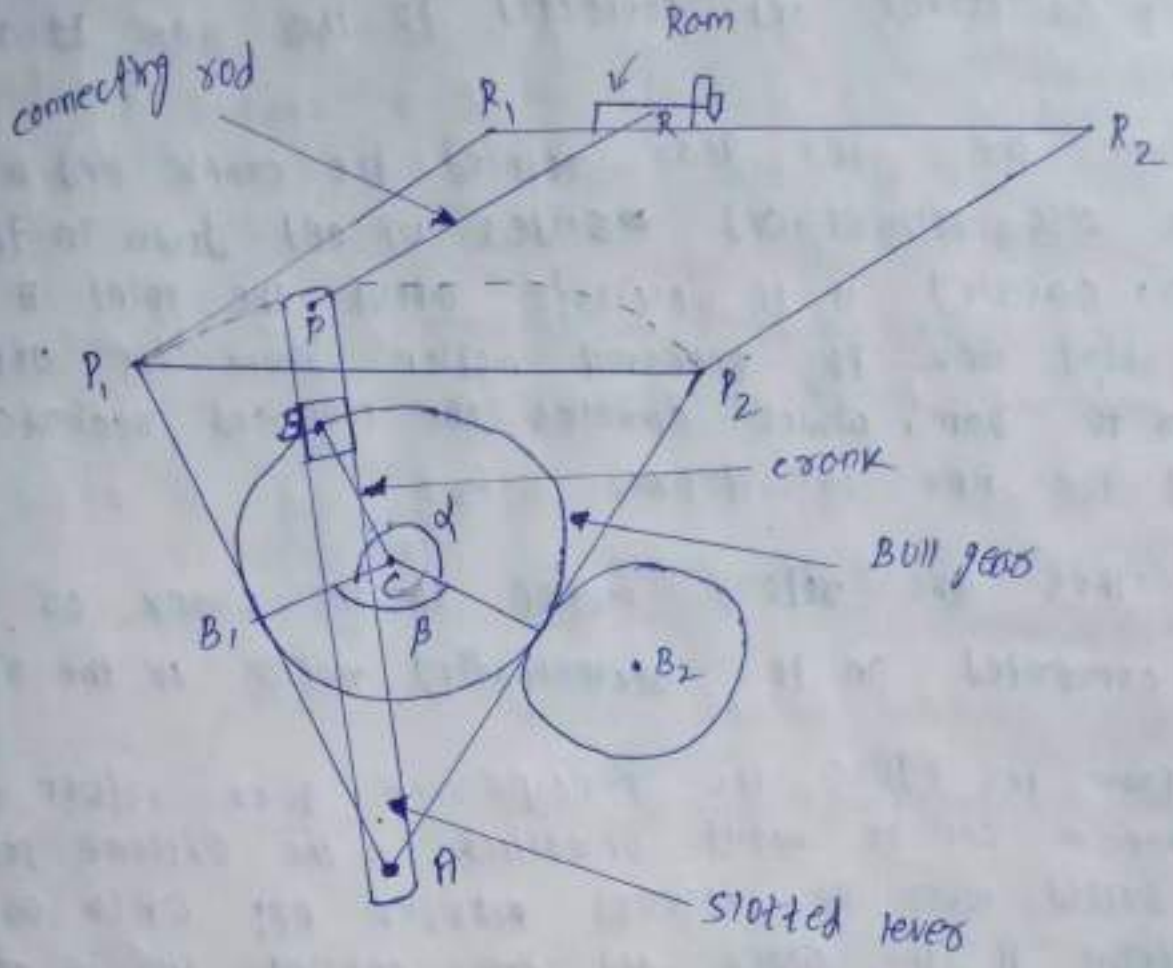
Working principle of shaper machine

The shaper works on the principle of quick return motion mechanism.

The tool is held by ram and work piece is fixed over table. When we switch 'ON' the power, the ram reciprocates with respected to the table that means the cutting tool cuts the workpiece in forward direction. and when the ram returns no cutting action takes place.

The cutting process takes place at low speed of ram and return stroke takes places at high speed of ram movement.

Slider crank and slotted lever mechanism



A shaper normally cuts only in forward stroke of the ram and return stroke remains ideal. The time consumed for the return stroke is wastage (being non-effective) that should be minimized. This can be achived by making shaper to complete its return stroke quicker than forward stroke.

An electric motor drives the pinion at an angular uniform speed, which drives bull gear. The crank is ~~centre~~ connected in the bull gear and is adjusted by screw mechanism.

The crank rotates at a uniform angular speed with the bull gear about fixed centre C. A sliding block is attached to the crank-pin at B which is fitted with

slotted lever. The bottom end of which is pivoted to the base at 'A' of the shaper. while the upper end P is forked and connected to the ram by a short link.

When the bull gear rotated the crank and a sliding block also rotates and slides up and down in the slotted lever, causing it to oscinate about the point A and the short link PR transmit motion from the slotted lever to ram, which carries the tool and reciprocating along the line of stroke R_1-R_2.

Thus the rotary motion of the crank or bull gear is converted in to reciprocating motion of the ram.

22.03.2

From the figure the principle of quick return motion mechanism can be easily understood. in the extreme position the slotted lever AP occupies position AP_1 which are tangential to the crank and the cutting tool is at the end of the stroke.

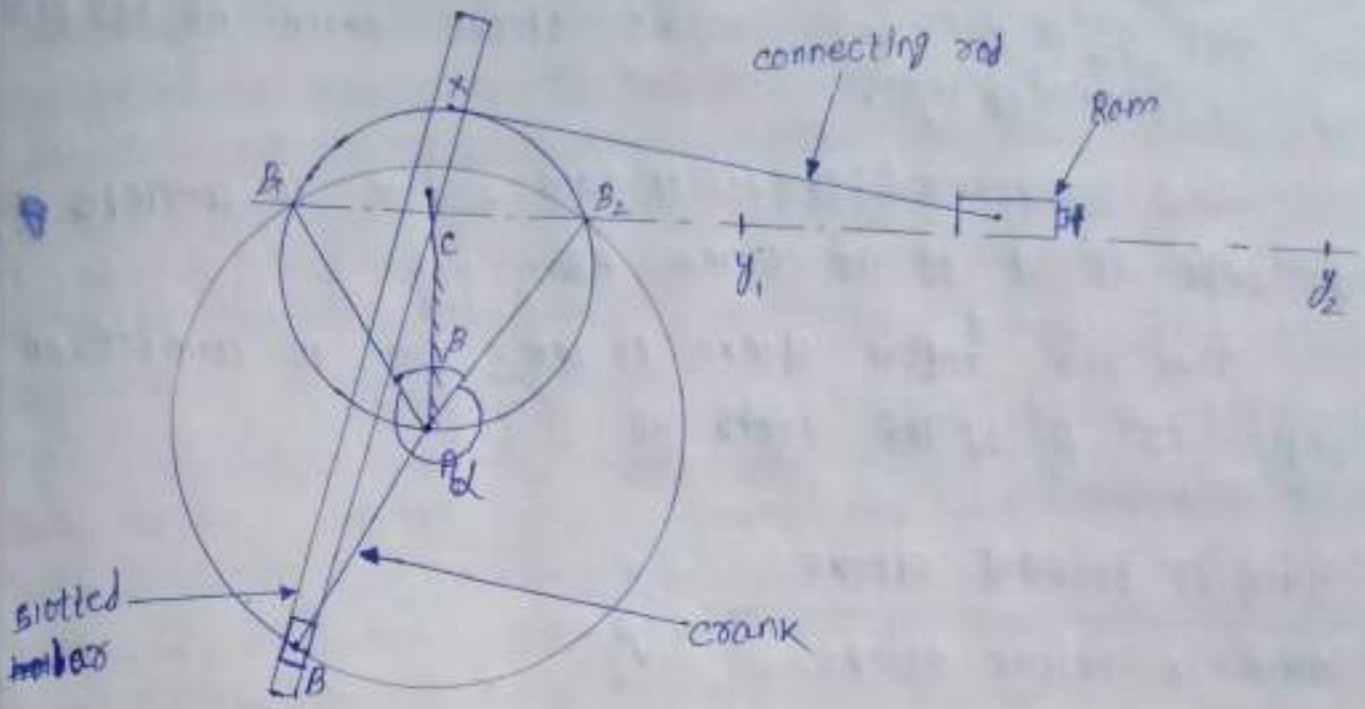
The forward or cutting stroke occures when the crank rotates from the position CB_1 to CB_2 through an angle of α in clockwise direction and the ram moves from the point R_1 to R_2.

The backward or return stroke occures when the crank rotates from the position CB_2 to CB_1 through an angle of β in clockwise direction. since the crank rotates at uniform speed.

$$\frac{\text{Time of cutting speed}}{\text{Time of return stroke}} = \frac{\alpha}{\beta}$$

$$\Rightarrow \frac{\alpha}{360-\alpha} = \frac{360-\beta}{\beta}$$

White worth Quick Return motion Mechanism



As shown in the figure the link AC is fixed and the crank AB rotates about the center A with uniform angular velocity. The sides B is mounted at the end of the crank 'AB' which slides inside the slotted bar. The slotted bar is pivoted at 'C' and rotates about the point 'C'. At the end of the slotted bar, a connecting rod is attached which is connected to the ram and converts rotary motion to the reciprocating motion. The ram reciprocated and a cutting tool mounted on it.

principle of operation

For forward stroke the crank AB moves from point B_2 to B_1 in a clockwise direction. and the same time point 'x' on connecting rod moves from the point B_1 to B_2 in a clockwise direction and the ram moves in forward direction from y_1 to y_2. In forward stroke the crank AB completed an angle of 'α'.

For return stroke the crank AB moves from point B_1 to B_2 in clockwise direction and the same time point 'x' on the connecting rod moves from the point B_2 to B_1 in clockwise direction and the ram moves in reverse direction from the point y_2 to y_1. For reverse stroke crank AB has completed an angle of 'β'.

Time for forward stroke of ram = time to complete an angle of α by the crank AB.

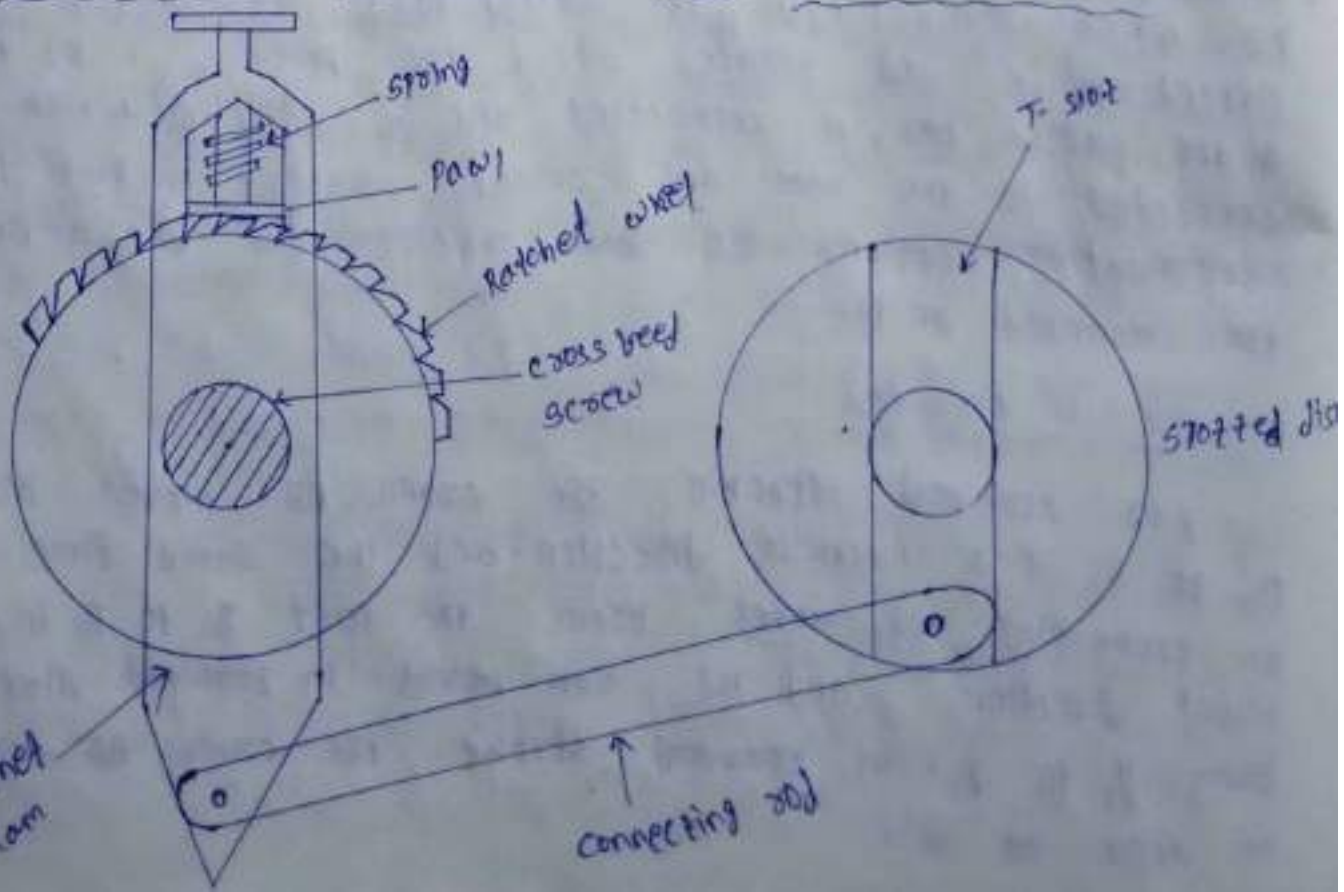
Time for return stroke of ram = time to complete an angle of β by the crank AB.

$$\frac{\text{Time of forward stroke}}{\text{Time of return stroke}} = \frac{\alpha}{\beta}$$

$$\Rightarrow \frac{\alpha}{360-\alpha} = \frac{360-\beta}{\beta}$$

24.03.23

Table Feed Mechanism of Shaper Machine



It consist of a slotted disk which carries a T-slot as shown in figure. in this slot is connected to the connecting rod by an adjustable pin and other end of the connecting is attached to the lower end of the ratchet arm of the pawl mechanism. The rocker arm or ratchet arm swings about the crossfeed screw and its operant carries pawl mechanism as shown in the figure. The lower end of the pawl provided on one side. This arrangement helps the power feed to operate in either direction, but the same should be set to operate during the return stroke only. otherwise the mechanism will be subjected to severe stress.

variation in the feed can be provided by varying the distance between the disc centre and the centre of the adjustable pin. Larger the distance greater will be the feed and vice versa. The amount of feed to be given depends upon the type of finish required on the job.

For rough finish or machining heavier cuts are employed thus a coarse feed is need. Against this finer feed is employeed in finishing operation.

The slotted disk at its back carries a spurk gear which is driven by the bull gear. As the disk rotates this causes the conneting to reciprocates which swings rocker arm about the crossfeed screw to move the pawl over one or more teeth. That transmit an intermittent motion to the Cross feed screw which moves the table.

classification of shaper machine :-

* Basic type :-
  1. Horizontal shaper
  2. vertical shaper
  3. Traveling head shaper

* According to the cutting action :-
  1. Push type shaper
  2. Draw type shaper

* According to the table design :-
  1. standard shaper
  2. universal shaper

* According to the driving mechanism :-
  1. crank type shaper
  2. Gear type shaper
  3. Hydraulic shaper

specification of shaper

1. Types of shaper machine (Table travel horizontal, vertical)
2. Types of working :- Flat, T-slot, key way, grooving, dovetail cut.
3. Mechanism of shaper machine :-
   - (a) crank & slotted lever quick return motion mechanism.
   - (b) White worth quick return mechanism
   - (c) Hydraulic mechanism.

④ Stroke length of ram :- 18", 24", 36", 54"
⑤ Working surface of table :- 24" x 10",
(. . 36" x 12"

⑥ Ram speed :- 12, 24, 40 etc stroke per min.
⑦ Tool head traversed distance :- 4", 6", 8", 10" etc.
⑧ Motor drive :- 3 HP, 4HP, 5 HP etc, 220V, 415 V, AC.
⑨ Power transmission :- Gear, belt etc.

⑩ Application of shaper machine

- To generate straight and flat surface.
- To make gear teeth.
- To make dovetail slides.
- To make internal splines.
- To make key ways in pulleys or gears.

UNIT - 6

MILLING MACHINE

Milling machine is machine tool in which workpiece is feed against a rotating multipoint cutting tool.

→ The cutting tool rotates at a high speed and is provided with many cutting edges to remove the metal at a very fast rate. The machine can also holds or more no. of cutters at a time which are mounted in the arbor.

→ In mining operation the metal is removed by feeding the workpiece against the cutter which removes the metal in the form of chip.

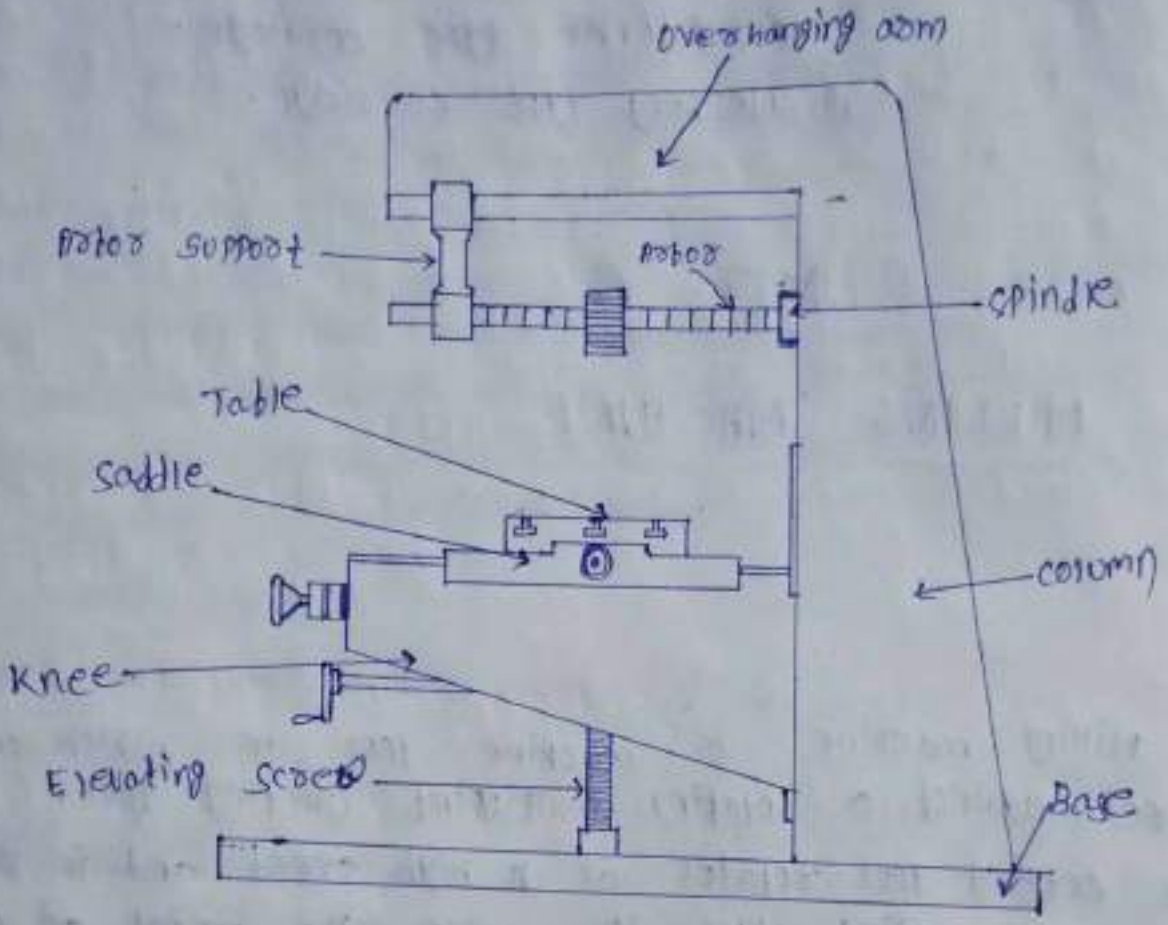
20.04.23

Parts or components of a mining machine

Generally column and knee type machine (mining) is consider as a typical mining machine. principal parts of a typical mining are :-

1. Base
2. column
3. knee
4. overhanging arm
5. saddle
6. Table
7. Arbor
8. spindle

Base :-



1. Base :-

On base all the parts of milling machine including column are provided. It supports all the loads and vibrations of the machine. It is made up of gray cast iron.

2. Column :-

It is a type of rigid vertical long box. It houses driving mechanism of spindle, table knee is also fixed to the guide way of the column.

3. Knee :-

It houses the feed mechanism of table and other controlling devices. It can be adjusted at different height on the column by the elevating screw.

4. Over hanging arm :-

It is mounted on the column and serves a bearing supports for the arbor. This arm is adjustable so that the bearing support may be provided near to the milling cutter. There can be more than one bearing support to the arbor.

5. Saddle :-

Saddle is placed at the top of the knee on which guide ways ~~are~~ is provided for the movement of table.

6. Table :-

Table rests on the saddle and ~~which~~ consist of T shaped slots for clamping the work piece. Movement of the table is given by table feed hand wheel. on some table there is vice provided for clamping the work piece.

7. Arbor :-

It holds rotating milling cutter rigidly and mounted on the spindle. Sometimes arbor is supported at maximum distance from support or overhanging arm it is called stub arbor.

8. Spindle :-

Spindle is projected from the column face and provided with a tapper hole to accommodate the arbor. performance of a mining machine depends on the accuracy, strength and rigidity of the spindle.

Spindle also transfer power to arbor through belt or gear by mechanism.

(*) Classification of mining machine

Mining machine can be classified in 10 different categories depending upon their construction, specification and operations.

(i) Column and knee type mining machine

(a) Hand mining M/c
(b) Plain mining M/c
(c) Universal milling M/c
(d) Omniversal mining M/c
(e) Vertical mining M/c

(ii) Fixed bed type mining Machine

(a) Simplex mining M/c
(b) Duplex mining M/c
(c) Triplex mining M/c

(iii) Planner types mining machine

(iv) Special purpose mining machine

(a) Rotary table mining M/c
(b) Profile mining M/c
(c) Planetary mining M/c
(d) NC / CNC mining M/c
(e) Pentograph mining M/c

21.04.23

Milling cutters

Milling cutters are revolving tools having several multi point cutting edges or identical form equally spaced on the circumference of the cutter. Generally the material used for milling cutter is high speed steel. All cutters have two types of cutting teeth. (i) spiral teeth
(ii) straight teeth

Milling cutters are classified according to their use

1. Plain / slab milling cutter
2. Side milling cutter
3. End milling cutter
4. T-slot milling cutter
5. Angular milling cutter
6. Form milling cutter

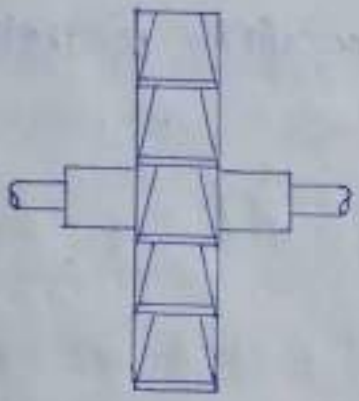
(1) Plain milling cutter :-

It is cylindrical in shape and have cutting teeth on the periphery only. These cutters are used for the production of flat surfaces parallel to the rotation of the spindle. The cutter teeth may be straight or helical according to the size of cutter.

→ It does not carry cutting edges on its side. If more width of cutting is required it becomes a slab mining cutter.

→ The helix angle of slab mining cutter may varies from 45° to 60°. This helical provides better shearing and good surface finish.

② Side mining cutter :-



→ Side mining cutters have teeth on its periphery and also one or both of its sides. These cutters are employed for removing metal from the side of a workpiece.

→ These are available from 50mm to 200mm in diameter and width of the cutter ranging from 5m to 32mm.

③ End mining cutter :-

25.04.23

→ End mining cutters have cutting teeth on the end as well as on the circumference of the cutter.

→ The teeth on circumference may be straight or helical and the helics may be left hand or right hand.

→ These cutters are used for light mining operations such as cutting slots, machining accurate holes, profile milling, narrow flat surface etc.

④ T-slot mining cutter :-

→ T-slot mining cutters are special form of end mills cutter for production of T-slots.

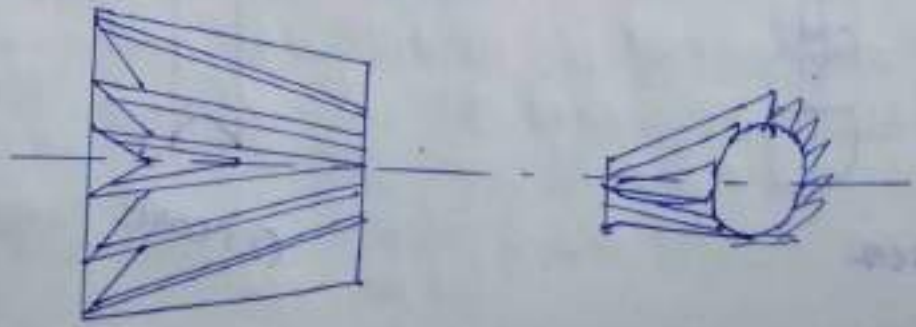
→ The tooth are provided on the periphery as well as on both sides of the cutter.

⑤ ~~Metal or~~ Angular mining cutter :-

→ Angular mining cutters may be of single or dubble ~~cut~~ angular cutters and are used for machining angles other than 90°.

→ The cutting edge of the angular mining cutter are formed at the conical surface around the periphery of the cutter.

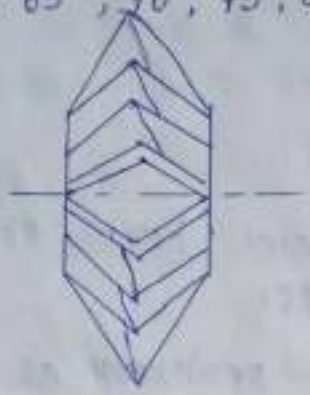
→ These mostly used in mining V grooves, dovetail slots, knotches and other angular surfaces.



Double angular milling cutter :-

→ These cutters are two angular faces which join together to form 'V' shaped teeth.

→ The cutters are available in different included angles of 55°, 60°, 65°, 70°, 75°, 80°, 85°, 90°

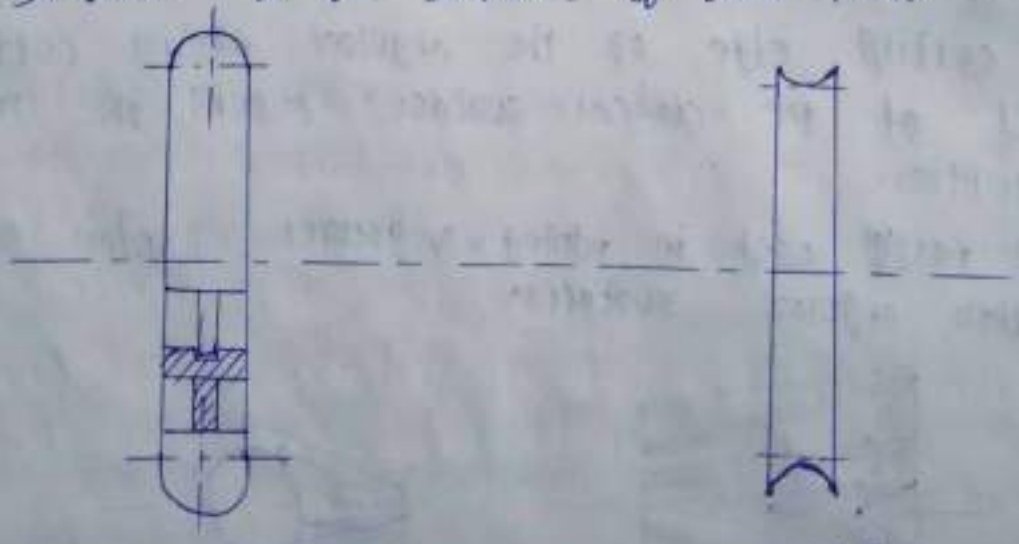


⑥ Form milling cutter :-

→ These cutters are used for making different irregular shapes on the surface of workpiece.

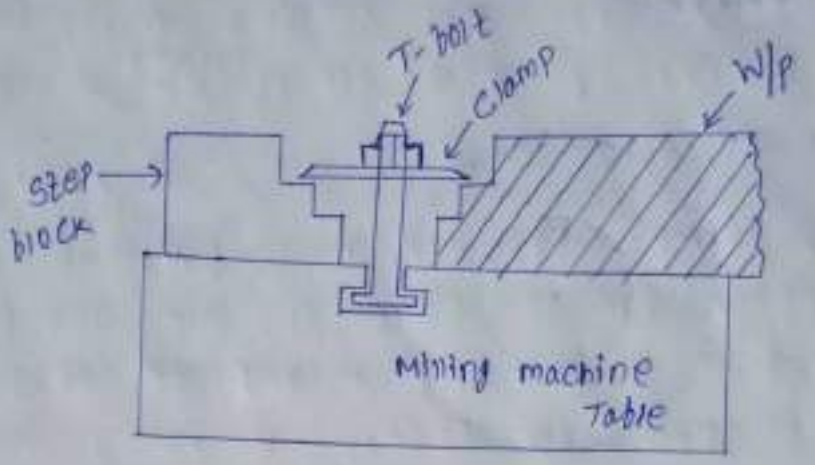
→ It is of two types (i) convex milling cutter
(ii) concave milling cutter

(i) convex milling cutter :- The convex milling cutter have teeth curved outward on the circumference to form the contour of the semi circle. It is used for producing concave surface on the surface of work-piece.



ⓐ T-bolt and clamp :-

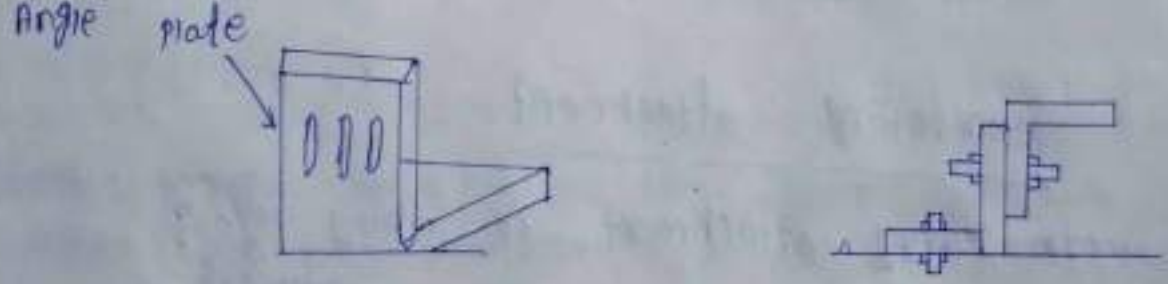
Bulky workpieces of irregular shape and size are directly clamped on a table with the help of T-bolt and clamp.



→ Different design of clamp used for different type of work.

→ The diameter of t-bolt generally ranges from 15-20 mm.

ⓑ Angle plate :-

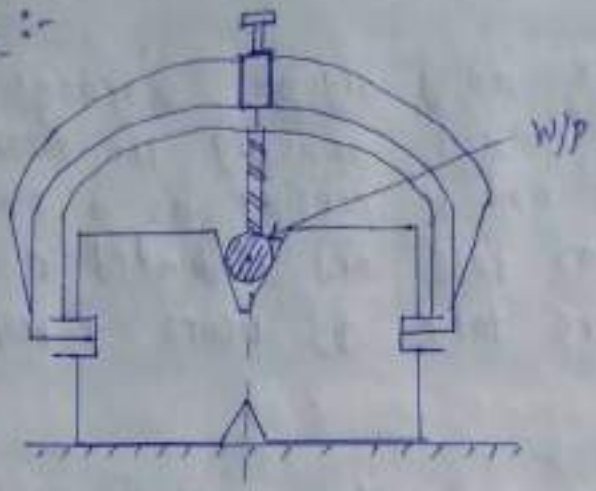


When work surface are to be machined at right angle, angle plates are used for supporting the work.

→ These plates are usually made of cast iron having two faces right angle to each other.

→ The faces are accurately finished and are provided with holes and slots for clamping the workpiece.

© V-block :-



→ V-blocks are used for holding circular bars or rods or circular workpieces. The work may be supported on two or three blocks and clamped against them by strap and bolt.
→ The blocks are clamped on the machine table by strap and bolt.
→ V-blocks are provided with tong at its base which feeds in to the T-slots of the table and prevents the block from any sideway movement.

(d) Vices :-

The commonly work holding devices for the mining machine are vices. There are different types of vices are use in mining machine.

(i) Plain vice
(ii) Swivel vice
(iii) Universal vice

Plain vice :-

The plain vice is directly bolted on mining machine table is the most common typed of vice used for the mining operation. The base of the vice carries slots to accomodate T-bolts to ~~feed~~ fix the vice on the table. work is clamped between fix jaw and movable jaw.

Swivel vice :-

Swivel vice is used for mining angular surfaces in relation to a straight surface without removing the work from the vice. In construction it may be consider as a plain vice which is mounted on a circular base and graduated in degrees. The base is clamped on the table by means T-bolt.

Universal vice :-

It can be swivelled in a horizontal plane similar to swivel vice and can also be tilted in any vertical position for angular cut. The vice is not rigid in construction and is used in tool room work. It enables the ~~neat~~ mining of various surfaces without removing the workpiece.

① Types of Mining ~~operations~~

② Differentiate between upmining and down mining.

Up mining	Down mining
	
(i) The metal is remove in the form of chip by a cutter rotating against the direction of travel of the workpiece.	(i) The metal is removed by a cutter rotating in the same direction of the movement of the workpiece.
(ii) In this type of mining the chip thickness is minimum at the starting of the cut and maximum at the end of the cut.	(ii) In this type of mining the chip thickness in maximum at the starting of the cut and minimum at the ~~start~~ end of the cut.

iv) cutting force applied in up milling tends to lift the workpiece from work table.

v) Rough surface finish is produced due to the opposite forces acting on the workpiece.

vi) cutting force required for up milling is more than the down milling. Hence more power is consumed.

vii) In upmilling tooth experiences gradual loading as contact start with 0 chip load.

viii) In upmilling no chipping action occures on the teeth of the cutting tool due to gradual contact hence tool wear rate is relatively low.

iv) cutting force applied in the down milling tends to press the workpiece rather than lifting up.

v) smooth surface finish is produce due to the similar type of force acting on the w/p.

vi) cutting force required for down milling is less hence less power is consumed.

vii) In down milling tooth experience impact loading as tooth engages suddenly with maximum chip load.

viii) Due to impact loading chipping occures and it may cause notch way thus tool wear rate is relatively high.

28.04.23

Milling M/c operations

1. Plain milling
2. Face milling
3. Side milling
4. End milling
5. Straddle milling
6. Gang milling
7. Angular milling
8. Form milling

① Plain milling :-

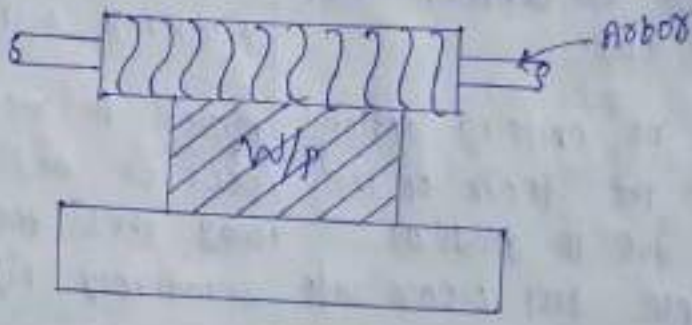
→ In plain milling the axis of rotation of the cutter is horizontal to the workpiece.

→ The plain milling is the most common type of milling machine operations which is used to produce plain and flat surface parallel to the axis of rotation of a plain milling cutter.

→ The operation is also known as slab milling.

→ To perform the operation the work and the secured properly on the machine.

→ The depth of cut is set by rotating the vertical feed screw of the table.

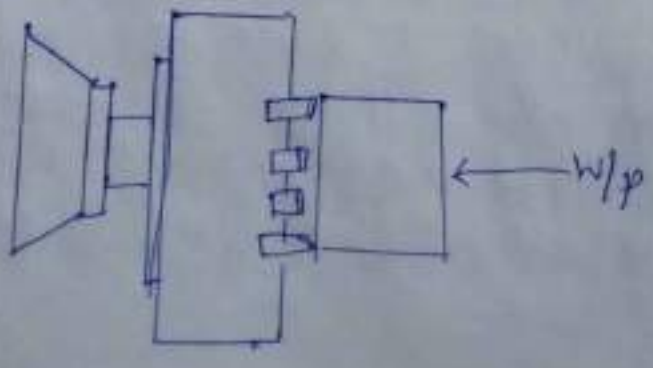


② Face milling :-

→ The face milling is the simplest milling machine operations which is performed by a face milling cutter rotates about an axis perpendicular to the work surface.

→ The depth of cut is adjusted by rotating the cross feed screw of the table.

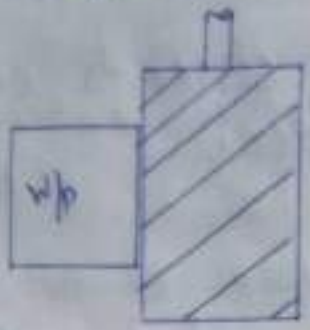
→ The cutting tool is mounted on a stub arbor of machining of flat surface.



③ Side mining :-

→ side mining is the operation of producing a flat vertical surface in the side of the workpiece by using a side mining cutter.

→ The depth of cut is set by rotating the vertical feed screw of the table.

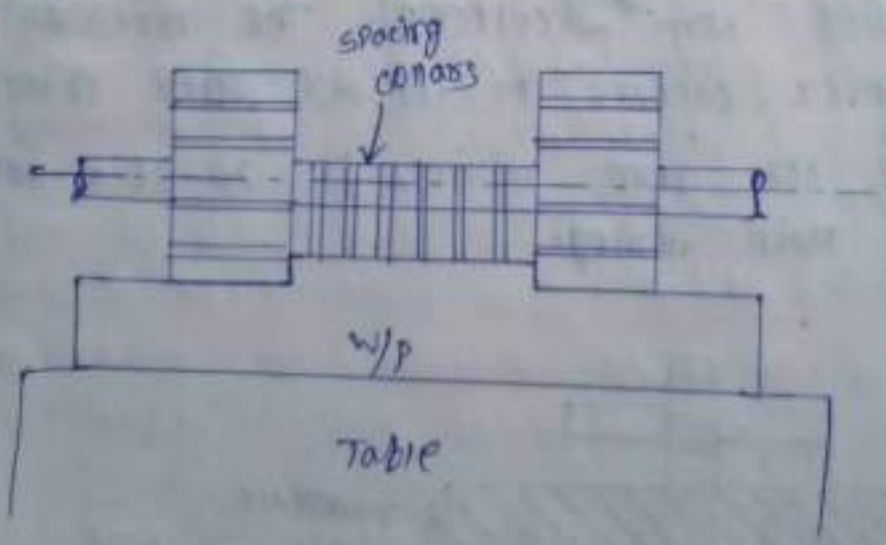


④ Straddle mining :-

→ It is the operation of producing a flat vertical surface on the both side of the workpiece by using two side mining cutters mounted on the same arbor.

→ Distance between the two cutters is adjusted by using suitable spacing collar.

→ Straddle mining is commonly used to design a square or hexagonal surface.

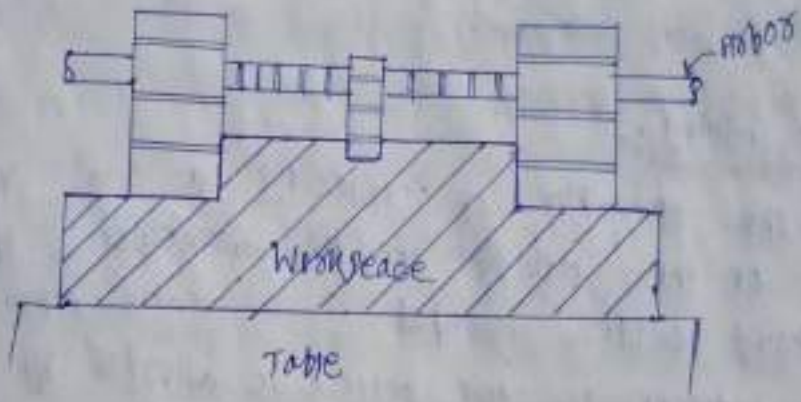


⑤ Gang milling :-

→ Gang milling is the operation of machining several surfaces of the workpiece simultaneously by feeding the table against a no. of cutters having same or different diameters mounted on the arbor of the machine.

→ This method saves much of machining and is widely used in repeatative work.

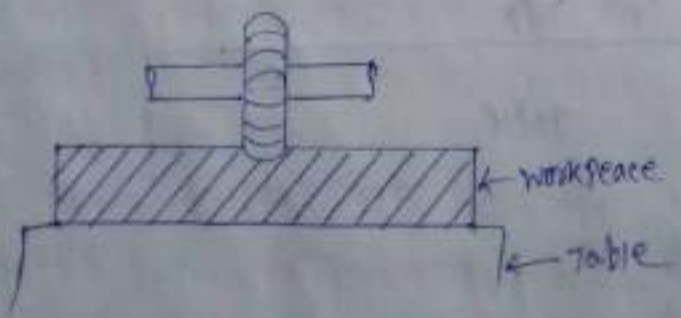
→ Cutting speed of a gang milling cutter is calculated from the cutter of largest diameter.



⑥ Form milling :-

→ Form milling is the operation of producing irregular contour by using form cutters. The irregular shape may be convex, concave or of any other shape.

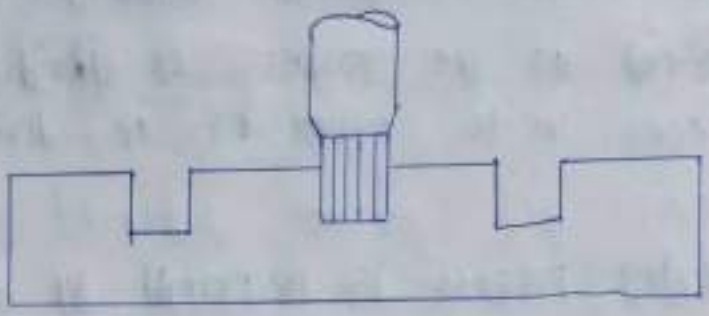
→ Cutting rate for form milling is 25-30 % less than that of the plain milling.



⑦ End milling :-

→ End milling is the operation of producing which may be vertical or horizontal and also used for the production of slots, grooves and key ways

→ A vertical milling machine is more suitable for end milling operation



→ cutting action takes place both in face as well as the side of the cutter

⑧ Angular milling :-

→ The angular milling is the operation of producing an angular surface on a workpiece.

→ The angular groove may be single or duble angle according the type and contour of the angular cutter used.

2.5.23

Indexing :-

The process of deviding the circumberence of a circular workpiece in to equary spaced divisions in order to perform machining operations. Such as gear teeth cutting, splines, grooves etc is caned indexing. 3.3.23

It is defined as the process of dividing the ~~circ~~ periphery of a workpiece in to equal no. of divisions is caned indexing.

This indexing process is performed by using the device or a machine is caned dividing head.

There are two types of dividing heads is used for the indexing process.

(i) plain deviding head

(ii) universal dividing head

Dividing head 10.05.23

The machine which is used for the purpose of indexing is caned deviding head. There are different types of deviding head which is used in miling machine for the proper indexing are

(i) plain deviding head.

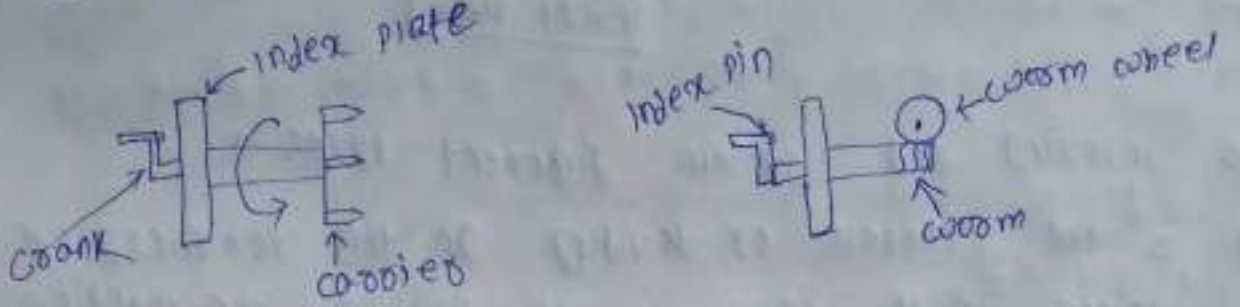
(ii) universal deviding head.

(i) plain deviding head :-

In plain deviding the workpiece is held in between two centres. one on the deviding head spingle and other on the tailstock. For locking the spindle in its position

a hand lever is used. The spindle can be rotated by means of hand provided one the left hand side of the deviding head. and the second type of plain deviding head are worm and worm wheel.

In this deviding head index plate moment is obtained due to worm which is rotated by hand.

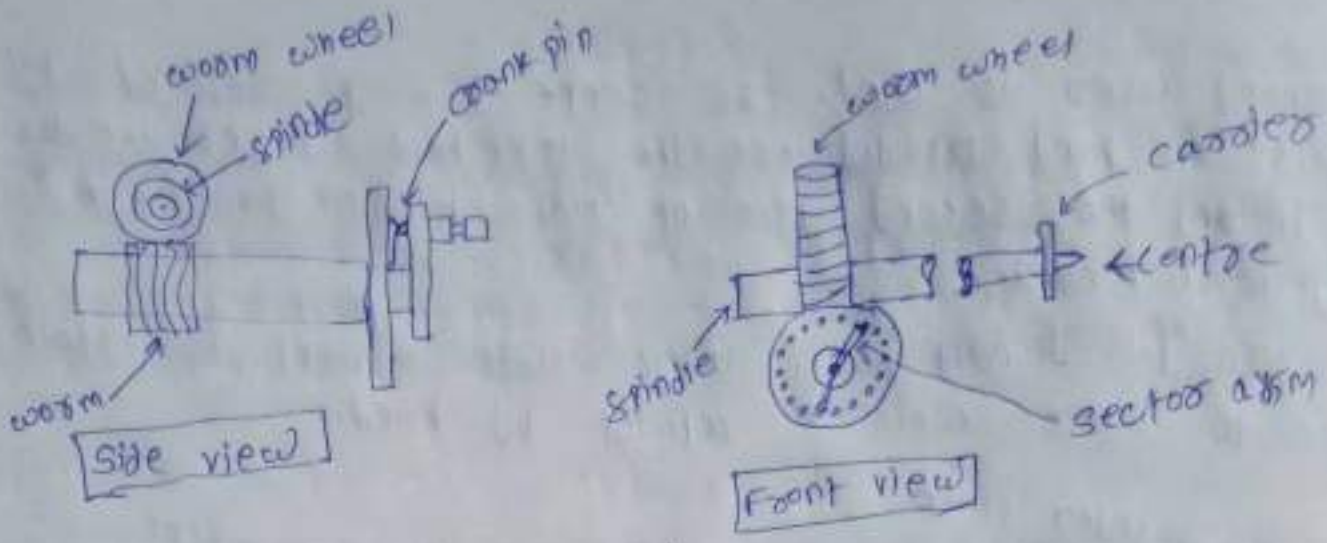


(ii) universal deviding head :-

This type of deviding head is very useful for indexing the workpiece. It consist of robust body and worm drive is enclosed in it which has worm and wormwheel. In this deviding head a spindle carries a worm wheel which mases with the worm and worm carries a crank at its outer end and a index pin is fitted to the clamp which has spring loaded plunger. which can slides radially along a slot provided in the crank.

The plunger can slide to adjust the pin position along a desired whole circle on the index plate. The spindle can be tilted at any angle between horizontal and vertical directions.

The indexing can be acquired by turning the handle to insert the locating pin inside a desired hole circle. Due to which it rotates the worm wheel in to desired positions and the workpiece which is connected to the worm wheel provides proper divisions on its periphery. for machining.



① What is indexing and explain different types?

Ans: Indexing is the process of deviding on the periphery of the workpiece in to equal no. of division. The machine which is used machining or indexing is called dividing head. There are different types of indexing which is used in milling machine are

ⓐ Simple indexing.
ⓑ Compound indexing.
ⓒ Differential indexing.

ⓐ Simple indexing:-

In this method of indexing the workpiece is rotated by turning the crank. When the crank is rotated the worm shaft is also rotated and causing the worm wheel to drive the spindle in proper rotation. As the spindle rotates the workpiece which is attached by suitable holding device is also rotates.

The angle through which the workpiece rotates for each revolution of the crank depends on the velocity ratio between the worm and worm wheel.

The worm wheel as 40 teeth. 40 revolution of the crank will make the worm wheel to complete one full turn or 360°. That means 40 revolution of crank makes the w/p to rotate 1 revolution. and the machining operation will be completed in one revolution of the workpiece. For making N no. of division on workpiece the crank has to rotate $\frac{40}{N}$ revolutions.

For 2 division on w/p the crank has to rotate $\frac{40}{2}$ turn.

For 10 division on w/p the crank has to rotate $\frac{40}{10}$ turn.

(6) Compound Indexing :-

→ compound indexing mean we are giving motion on two components.
→ When the number of divisions required is outside the range of simple indexing, and then compound indexing used.
→ It include two separate simple indexing :-
- Turn the crank in one direction.
- Turn the crank and index plate both same or reverse direction.

Formula => $\frac{40}{N} = \frac{n_1}{N_1} \pm \frac{n_2}{N_2}$

16.09.

GRINDING

Grinding is the process of removing material from the surface of a workpiece in the form of small chips by the abrasive action of revolving wheel on the surface of a workpiece.

Abrassive - Natural :- sand, emery
Artificial :- silicon carbide, Aluminum oxide (Al_2O_3)

Bond - vetrified bond
Rubber bond
silicate bond
oxy chloride bond

Abrassive :-
Abrassive is a hardened material used for making grinding wheels. There are two types of abrassive.
(i) natural abrassive
(ii) artificial "

Bond :-
A bond is a material that holds the abrassive grain and forms the wheel. The most common used bond for manufacturing grinding wheel are :-
(i) vetrified (V)
(ii) rubber (R)
(iii) silicate (S)
(iv) oxy chloride (O)

* An abrasive is a material or a mineral that is used to shape or finish a w/p through rubbing which leads to part of the w/p being worn away.
uses - polishing, honing, grinding, lapping etc.

Specification of a grinding wheel:-

W C 45 O 13 R 25

W - manufacturing symbol

C - Abrassive type { silicon carbide - C
Al_2O_3 - A

45 - Grain size - coarse grain (10-20)
medium grain (30-50)
Fine grain (80-100)

(Aug.13) O - Grade - soft grade (A-I)
Medium grade (J-P)
High grade (Q-Z)

13 - structure - open structure (1-4)
Dense structure (9-13)

R - Bond nature - vetrified (V)
- Rubber (R)
- silicate (S)
oxy chloride (O)

25 - Manufacturing reference no.

Methods of Grinding ⌐ External cylindrical
Internal cylindrical

(1) Surface grinding

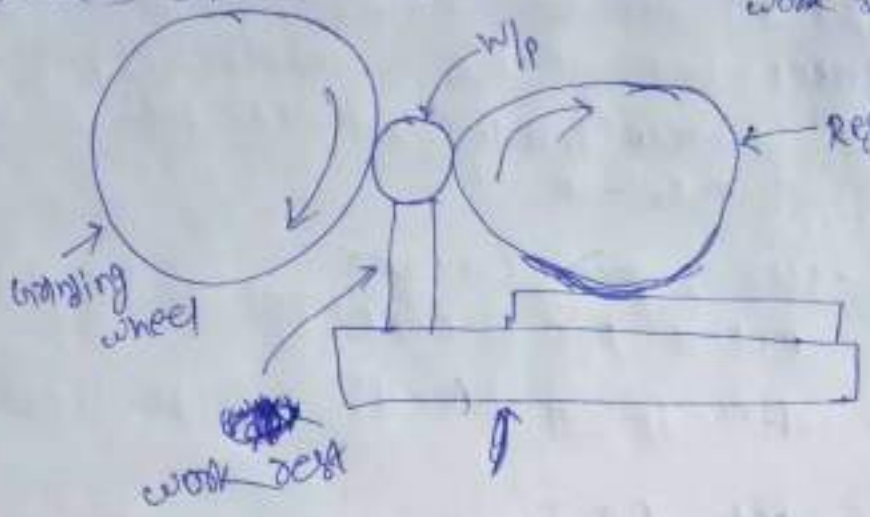
(i) Reciprocating

(ii) Rotary

It produces flat surfaces & the work may be grounded by either the periphery or by end face of the grinding wheel.

(2) cylindrical grinding

(iv) Centreless grinding wheel :- It is a method of grinding ~~vertical~~ external and internal cylindrical surfaces in which the work is supported among a regulating wheel, a grinding wheel & a work rest blade.



End feed - Tapped section
Through feed - long section
In feed -

(v) cylindrical grinding

It is used for to grinding a long cylindrical bar.

UNIT- IO

(*) Surface finishing 17.5.23

There are different types of surface finishing operation

(i) Lapping → M/c lapping, Hand lapping
(ii) Honing
(iii) Super finishing

(i) Lapping :-

It is a machining process used for improving the surface finish by reducing roughness, ~~waviness~~ and other irregularities on the surface.

very thin layer of metal are removed in lapping process. (0.005 - 0.01 mm)

→ Abrassive powders such as - emery, iron oxide, chromium oxide etc mixed with lubricants and produces a special type of past which is used in lapping.

→ It can be perform in two ways. hand lapping and M/c lapping.

→ In hand lapping process the w/p is rubbed over the lapping plate in between which abrassive particles mixed with lubricant is provided.

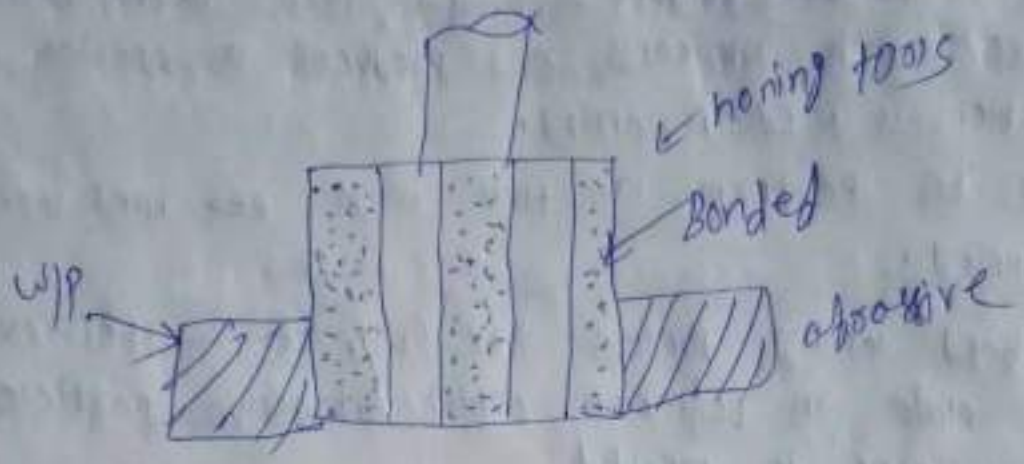
→ In machine lapping the lapping plate motion is provided by the machine.

(ii) Honing :-

It is an abrassive machining process used to finish the cylindrical surface of a metal by rubbing action of honing tools called hum and the work surface in a controlled path.

→ Honing is mainly used for surface finishing of internal cylindrical surfaces, pin holes, boring etc.

→ The machine used for honing operation is called honing m/c.



→ Honing uses small bonded abrasive for super abrassive sticks mounted in a fixture that rotates and reciprocated when applied to the surface or bore being finished.

→ Honing machines are metal abrading tools ~~are~~ that provides correction of diameter, shape, surface finish, position and tolleroance of bores.

→ According to the types of machine this machine can be classified in two types. (i) Horizontal spindle m/c
(ii) vertical spindle m/c.

→ Horizontal spindle honing machine mostly are used for machining of long cylindrical bars, ~~vertical~~

→ vertical spindle honing m/c are used for longer or heavier ones.

→ vertical honing m/c are also made with multiple spindle so that several hole may be machined at once as in automobile cylinder.

Application of honing and lapping :-

→ It is used for the production of dies and molds.
→ For finishing of gears.
→ For finishing of tapped valve and valve sheets.
→ For cylinder block of IC engine.
→ For finishing of pump and spray nozzles.
→ compressor parts.
→ Measuring instruments.
→ optical lense.
→ crank shaft.

~~Honing~~

Lapping	Honing
) It uses loose abrasive mixed with lubricants for finishing.	) It used bonded abrasives for finishing.
) It is used for flat and smooth surface finish.	) It is used for sizing and finishing the holes.
) Slow metal removal plate.	) Metal removal rate is slightly high.

(iii) Superfinishing :-

→ It is also called as microfinishing is a finishing process that uses fine grit abrasive to refine the surface of a metal component to an extremely fine surface.
→ The surface finish process remove the amorphous surface layer thus increases the life of a part

by decreasing wear and tear while achieving better sealing capability.

→ This machine are used to produce a very highly polished mirror finishing with high geometric accuracy.

Applications

→ automobile pistons.
→ crank shaft journals.
→ cam shaft.
→ crankpin bearing.
→ all type of rollers and bush bearing.
→ clutch faces, brake drums.

UNIT-9

DRILLING

Types of drilling m/c :-

1) Portable drilling m/c.
2) Bench drilling m/c.
3) Upright drilling m/c.
4) Gang drilling m/c.
5) Radial drilling m/c.

18.5.23

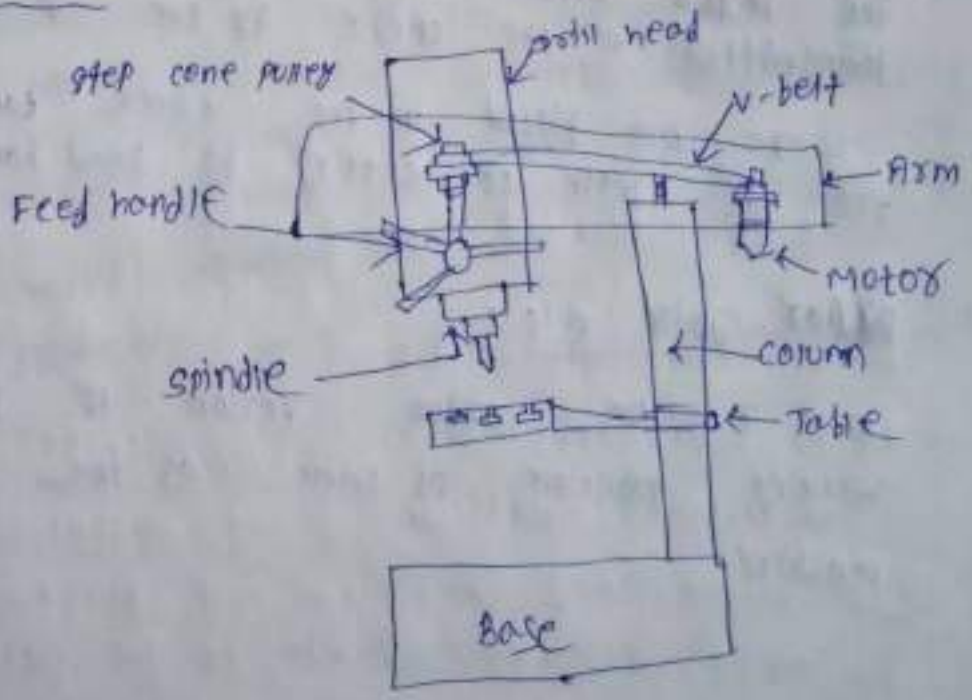
Drilling:-

It is a process of making holes or enlarging holes in a workpiece by forcing and rotating a tool called drill. The drill is held in a chuck which is fitted in the spindle and driven by the motor.

→ The drilling machine broadly classified in

(i) Portable drilling m/c
(ii) Bench drilling m/c.
(iii) Upright drilling m/c
(iv) Radial drilling m/c
(v) Gang drilling m/c
(vi) Pillar drilling m/c

Bench drilling m/c :-



It is a type of drilling m/c which is used for the machining or drilling of light jobs. It is designed for drilling small holes at a very high speed.

This type of drilling m/c normally is fixed on the surface of a bench or on a surface by nut and bolt. It can handle drills up to 15.5 mm.

It consist of several parts such as

1. base
2. table
3. column
4. drill head
5. spindle drive mechanism.
6. Feed handle.

The base consist of cast iron body which holds all the loads and strength of the machine. The table can be adjusted in the column according to the requirement.

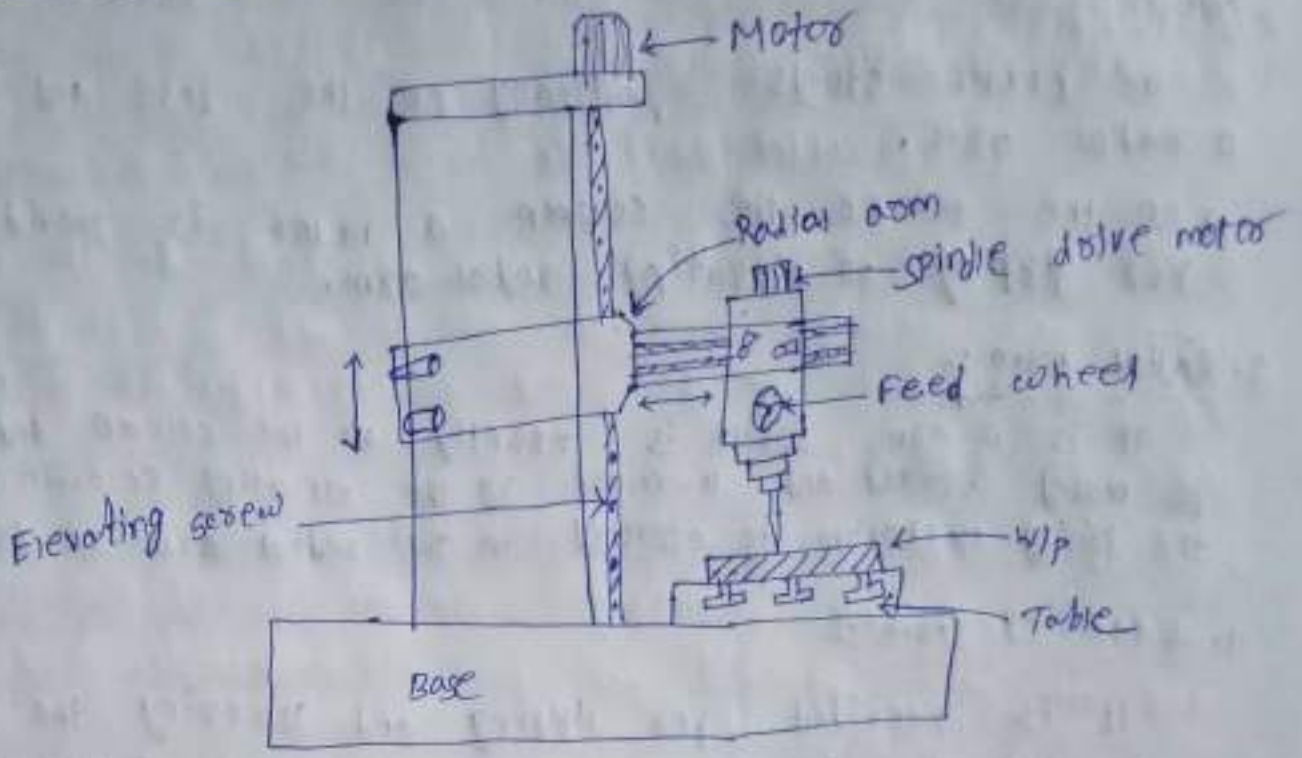
The Arm contains all the driving mechanisms to drive the spindle. In which the power supplied to the motor rotates step cone pulley. From which power transmitted to the spindle by the 'V' belt.

The drill fitted in the chuck can be adjusted for the depth of cutting by feed hand wheel.

Radial drill m/c :-

It is the larger version of bench drilling m/c. working principle of some of the bench drilling machine.

Radial drill machine :-



Radial drilling m/c is used for making holes in heavy and large workplece because the large and heavy w/p can not move much and hence the radial arm can be moved to any positions so heavy and large w/p can be machined easily without moving ~~the piece~~.

The ~~consi~~ different parts of a radial drilling machine are:-

1. Base
2. column
3. Radial arm
4. elevating screw
5. Table
6. Drill head

1. Base :-

The base is made up of cast iron and it can withstand vibrations. It may be mounted on the floor

and supports all other parts of the machine.

2. Column :-

The column stands vertically on the base and also a radial arm.

→ on the top of the column a motor is provided for lifting or elevating radial arm.

3. Radial arm :-

It is a arm which is mounted on the column and can be moved upward and downward by the elevating screw. All the driving mechanism is attached in the radial arm for driving h

4. Elevating screw :-

It is provided for lifting and lowering the radial arm which is driven by a motor placed at the top of the column.

5. Table :-

It is provided for holding the w/p by the suitable holding device.

6. Drill head :-

It contains all the driving mechanism for rotating the spindle and also can move forward and reverse for proper positioning of drill on the workpiece.

working principle

when power supply is given to the motor the spindle rotates hence it is connected with the motor. The radial arm is adjusted for the proper positioning by rotating the elevating screw by a

motor. The w/p is placed on the table by a suitable holding device and can be adjusted for proper drilling by moving driving head.

The feed of the w/p is provided manually by a feed hand wheel, which is on the driving head.

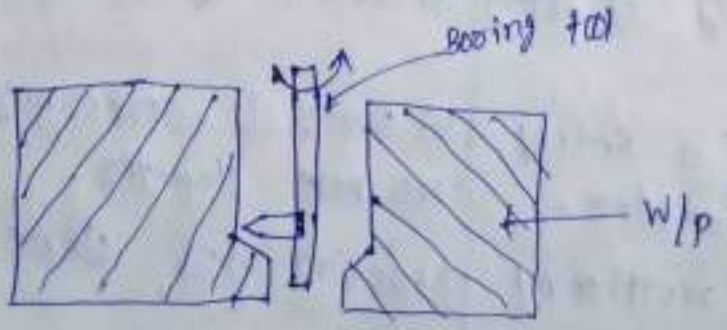
The drill head contains a driving mechanism which rotates spindle by a spindle drive motor fitted on the top of the driving head.

Advantages

- Longer and heavier w/p can be machined.
- Drill head can be raised or lowered and can be moved around the column.
- Suitable for large diameter holes and deep holes.
- Drill head can move rapidly but w/p remains clamped.

Boring

Boring is the operation of enlarging the existing holes which is previously formed in casting or drilling with the help of a single point cutting tool either by revolving the tool or the workpiece itself.



Principle of boring :-

There are two machines which are used for boring operation. (i) Vertical boring M/c

(ii) Horizontal boring M/c

→ In vertical boring M/c the w/p held on the machine table and rotates while the tool is fed parallel to the axis of rotation of the work or perpendicular to the axis of rotation.

→ In horizontal boring M/c the w/p is held on a machine table and kept stationary when the boring tool revolves and can move forward and backward parallel to the axis of rotation.

(*) Drilling	Boring
1) Drilling operation is performed to originate a hole.	1) Boring operation is performed to enlarge a hole diameter.
2) Drilling is the first phase of hole machining.	2) Boring cannot be performed if there is no drilled hole or hollow part.
3) Axial length of the hole can be increased by drilling operation.	3) Length of the hole can not increased by boring.
4) Hole diameter is limited to the drill diameter.	4) Boring is performed to increase the hole diameter.
5) Drilling uses multi point cutter.	5) Boring uses single point cutting tool.
6) A tapped hole can't be created in drilling.	6) Tapped hole can be created by boring.

7. chip flow is not uniform.	7. chip flow is uniform.

25.5.23

~~Broaching~~ Broaching

Broaching is defined as the process of surface finishing in which metal is removed from the surface of a workpiece by using a multipoint cutting tool called broach.

Classification of broaches :-

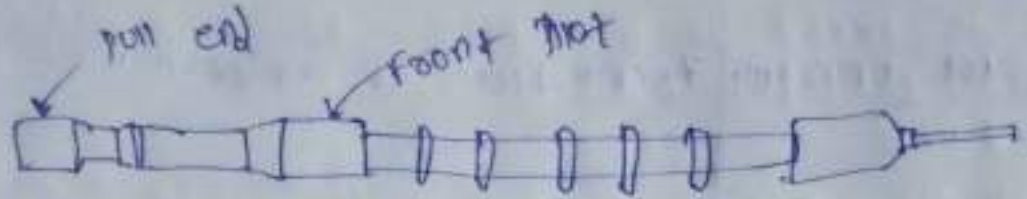
*) According to type of broach
- internal
- External

*) According to the method of operation
- push
- pull

Pull broaching

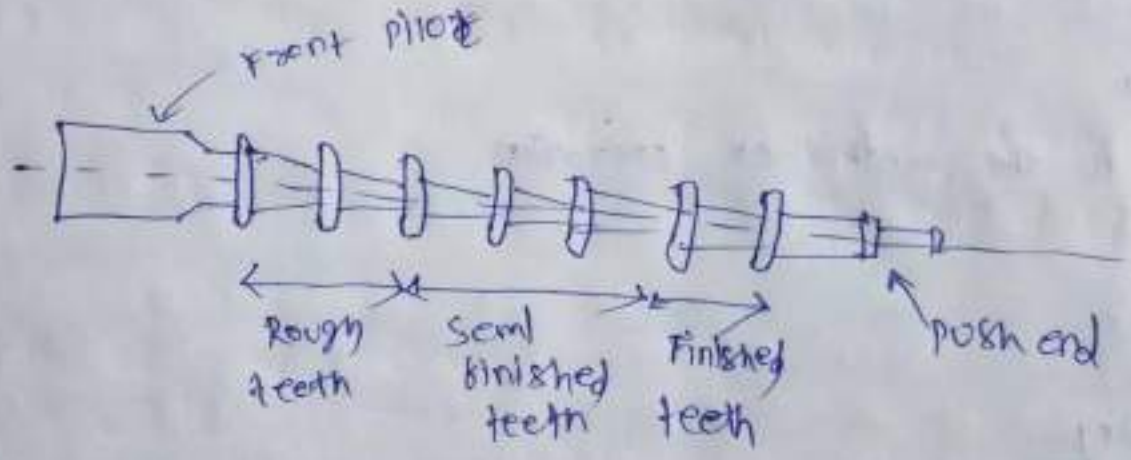
It is the broaching operation in which the cutting tool called broach is pulled against the w/p for providing surface finishing or to remove material from the surface of w/p.

- Due to pull broaching the cutting tool will comes under tensile load. so it will not bend during cutting operation.



Push broaching :-

→ In push broaching the cutting tool called broach is pushed through the wip during broaching operation.
→ Due to push type broaching the cutting tool may bend due to the compressive load.
→ so that its length is smaller than pull type of broaching tool.



Principle of broaching operation

Broaching is a metal removal process in which metal is removed from the surface of a wip by using multipoint cutting tool called broach.

→ The broach is held in the ram and it is either of push type and pull type and

the w/p is kept on the table and machining operation is performed by using the moment of broach.

- It is of two types.
- The broaching opⁿ can be performed in two ways one is pull type broaching, second is push type broaching.
- It is used for the machining of keyways, splines, square, rectangular and polygon holes, internal gears.
- The broach has three types of teeth.
  i) Rough teeth
  ii) semifinished teeth
  iii) finished teeth

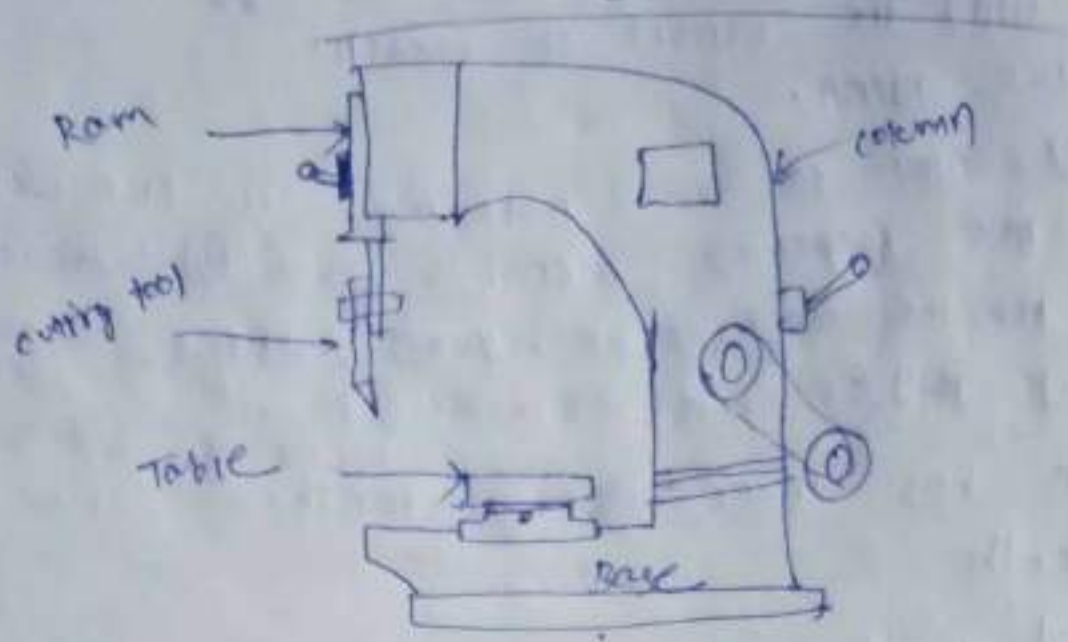
Advantage

- Fast and simple process
- High degree of accuracy and finish is possible.
- Machining process is completed with one stroke open.
- cutting temp and tool wear is low.

According to the construction the broaching m/c may be classified in :- i) horizontal type
ii) vertical type

unit: 7

Slotter



-) It is a reciprocating type m/c tool.
-) This is also called vertical shaper.
-) In this m/c the ram reciprocates vertically.
-) metal is removed during downward stroke.

Parts of slotting m/c

-) Ram and drive mechanism
-) slotted link and drive mechanism
-) Ram
-) Base
-) Tool head
-) cross side
-) saddle.

•) slotter m/c is a m/c which is used to remove metal from the surface or wip by using single point cutting tools.

•) It is also called as vertical shaper but in vertical shaper the tool head can be tilted to certain angle but in slotter m/c the tool head is fixed in the ram.

•) It consist different parts such as :- Base, column, Ram, rotating table, x, Table feed mechanism.

In slotter m/c the ram reciprocates in which the cutting tool is mounted is also reciprocates.

Base

•) It is heavy and robust construction
•) made up of cast iron.

Table

Table is graduated in degrees so indexing can be done.
operated manually or by power.
Movement of table can be rotary or reciprocating.

Tool head

No swiveling along vertical or horizontal axis.

unit-5

Planner machine

Planner m/c is a m/c which is used for the machining of heavy and rigid w/p by using single point cutting tool. which is fixed and the table reciprocates. The surface can be machined horizontally, vertically or at an angular positions it consist of different parts such as :-

- Bed
- Table
- column
- cross rail
- Tool head