AVIT
AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY

VINAYAKA MISSION'S RESEARCH FOUNDATION
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DEPARTMENT OF MECHANICAL ENGINEERING

34421C02-MANUFACTURING PROCESSES LAB MANUAL (R2021)

Vinayaka Nagar, Old Mahabalipuram Road,
Paiyanoor
Chennai- 603 104, Tamil Nadu, India.
Website: www.avit.ac.in.

CERTIFICATE

Name of the lab : **MANUFACTURING PROCESSES LAB**

Prepared by : G.ANTONY CASMIR

Assistant Professor (Gr-II)

Department of Mechanical Engineering, AVIT

Approved By : Dr. M.PRABHAHAR

Head of the Department

Department of Mechanical Engineering, AVIT

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SAFETY RULES

DO's

1. Wear clothes that are comfortable but close
2. Keep your hair short or wear a cap, net or hair band. Long head dresses may be a safety hazard.
3. Either roll up your overall sleeves or button up the cuffs.
4. You must wear closed-toed hard shoes in the lab. Sandals and flip-flops are not allowed.
5. Immediately report any accident even if it is small.
6. Keep machine and all equipment clean before starting the operation.
7. Keep the machine and surrounding area tidy.
8. Check that work area is clean before starting the machine.
9. Report immediately to your instructor if any mechanical or electrical fault occurs in the lab.
10. Ensure that all machine parts are in position before starting.
11. Check that chucks or clutches rotate in the correct directions before commencing cutting operations.
12. Ensure that everything is properly secure before starting the machine.
13. Ensure that feed mechanisms are not engaged before starting the machine.
14. Keep tools and cutters in boxes or cupboard when not in use.
15. Switch off the machine when the task/job is completed.
16. The manufacturing lab is a place where oil and grease usage is normal, expect clothes to get dirty and plan accordingly.

DON'Ts

1. Don't wear rings or watches while operating a machine.
2. Don't keep sharp tools in your overall clothing.
3. Don't remove metal chips/waste with your bare hand; use a brush for that purpose.
4. Don't manually lift heavy equipment. If it is necessary to do so ask a friend for help.
5. Don't lean on the machine.
6. Don't attempt to operate a machine until know how to correctly use it.
7. Don't tamper with the machine unnecessarily.
8. Don't throw things.
9. Don't walk away and leave your machine running.
10. Don't touch a switch with wet hands which may cause an electric shock.
11. Don't operate switches with gloves on which may cause malfunctions or even danger.
12. Don't place any tools or unnecessary items on the machine

STUDY OF MOULDING PROCESS

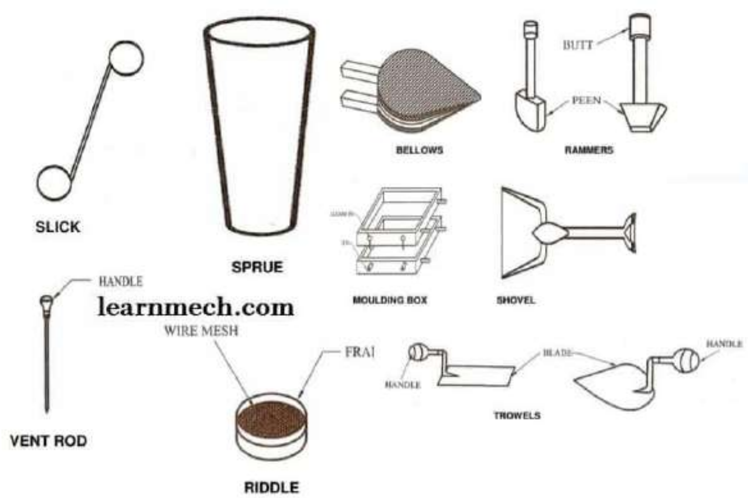
Moulding is a manufacturing process that involves shaping a liquid or malleable raw material by using a fixed frame; known as either a mold or a matrix. The mold is generally a hollow cavity receptacle, commonly made of metal, where liquid plastic, metal, ceramic, or glass material is poured.

Types of Moulding Processes

- Casting. Casting is a basic moulding process as it requires the least amount of complex technology. ...
- Injection Moulding. Injection moulding is used for creating high-quality three-dimensional objects that can be commercially reproduced. ...
- Blow Moulding.
- Compression Moulding.
- Rotational Moulding.

Components of moulding process

A mold is a hollowed out block that sets the shape of the product being made. It can be made of different materials, the most common of which are aluminum, steel, alloys and copper. It also has different components. These components include pins, bases, lifters, ejectors, guides, bushings, and alignment devices

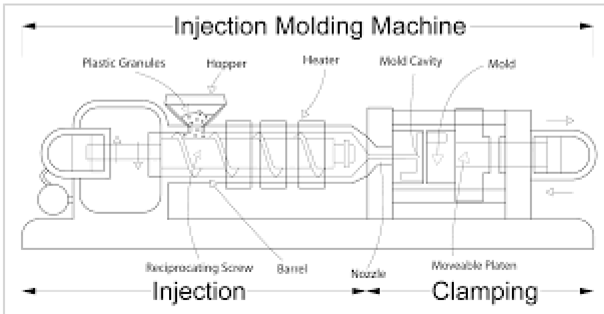


Injection moulding

Injection moulding is a manufacturing process for producing parts by injecting molten material into a mould, or mold. Injection moulding can be performed with a host of materials mainly including metals, glasses, elastomers, confections, and most commonly thermoplastic and thermosetting polymers

What are the steps of injection moulding?

There are four stages in the cycle. These stages are the clamping, injection, cooling and ejection stages.This machine works by taking plastic powder or granules and manipulating it to shape it into a part according to the requirements and dimensions. When the feed hopper receives the plastic granules, it then uses frictional action of the screw to create heat.

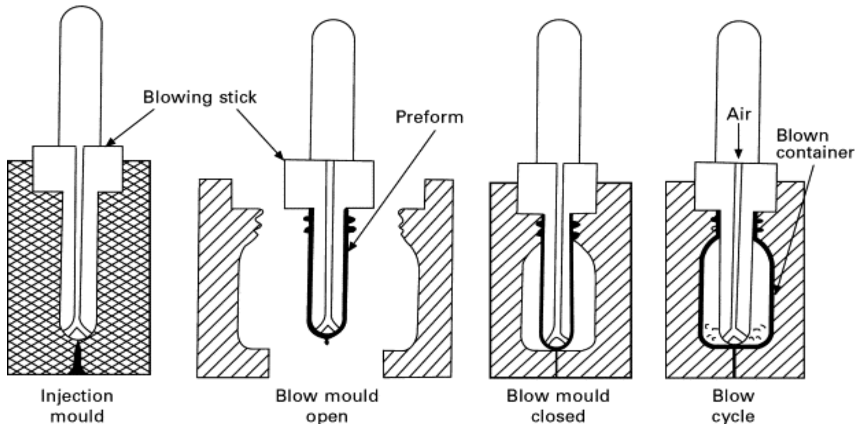


Blow Moulding

Blow molding is the forming of a hollow object by inflating or blowing a thermoplastic molten tube called a “parison” in the shape of a mold cavity. The process consists of extruding or “dropping” a parison on which female mold halves are closed. The female mold halves contain the shape of the product to be produced.

Injection blow moulding

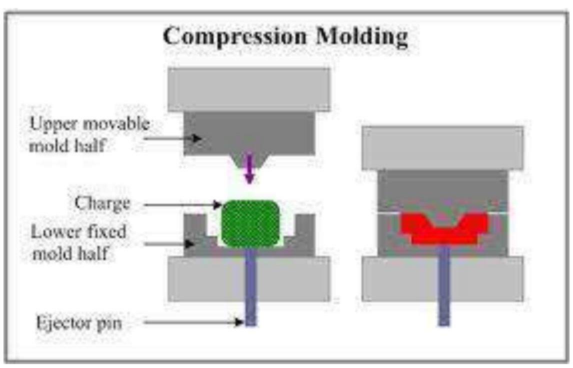
Injection blow moulding is the process where the material is melted and injected (forced) into a precisely dimensioned die until it cools and solidifies to the desired product shape. The process consists of three steps: injection, blowing, and ejection.Injection blow moulding is mainly used to produce bottles, jars, and containers in large quantities. This method is less common due to the limitations on the production rate and is preferably used for small products such as those for medical applications. Its main advantage is the ability to produce accurately complex-moulded necks. However, it suffers from the restriction to small bottles production only and low strength in the barrier



Compression molding is a process of molding in which a feeding material is placed into an open, heated mold cavity. The mold is then closed with a top plug and compressed with large hydraulic presses in order to have the material contact all areas of the mold. The charge cures in the heated mold.

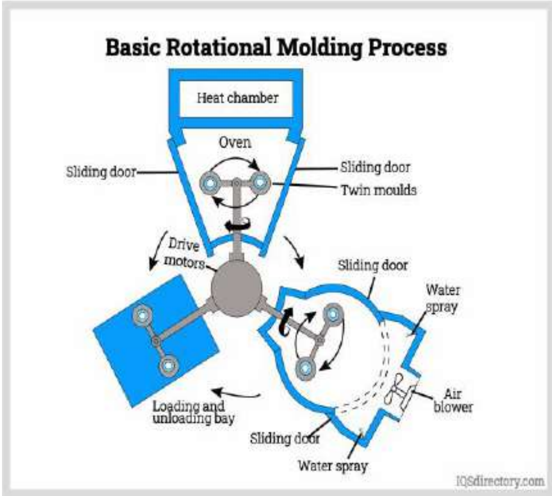
Steps of compression moulding?

- Raw Material.
- Shape (mould)
- Pressure applied.
- Temperature.
- Curing Time.



Rotational molding

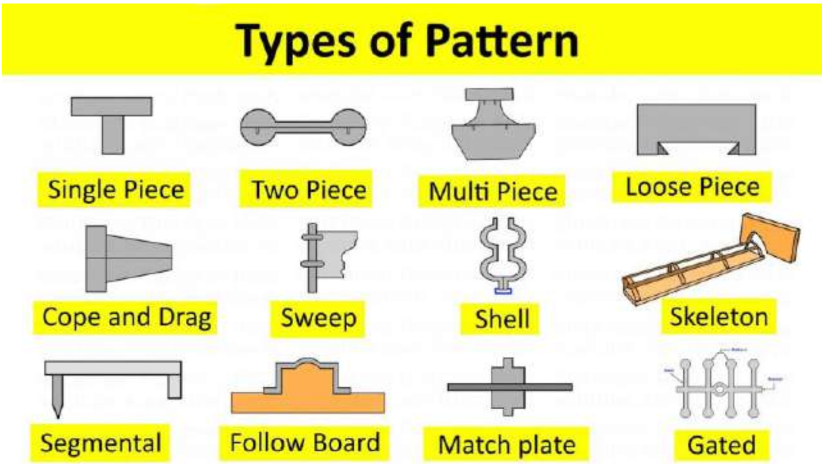
The rotational molding process is quite simple: A hollow mold is filled with powdered plastic resin. The mold begins rotating bi-axially and is transferred into an oven. The mold continues to rotate as the resin melts and coats the walls of the mold. The mold is cooled until the resin hardens into the desired shape.



The types of rotational molding equipment are clamshell machines, turret machines, shuttle machines, vertical wheel machines, rock and roll machines, and open-flame machines

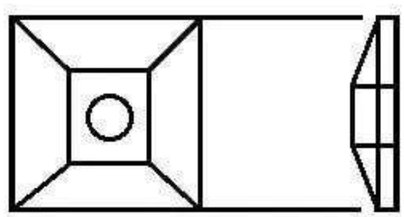
Types of pattern

- Single Piece Pattern. Single piece pattern, also called solid pattern is the lowest cost casting pattern.
- Two-Piece Pattern.
- Multi Piece Pattern.
- Match Plate Pattern.
- Gate Pattern.
- Skeleton Pattern.
- Sweep Pattern.
- Loose Piece Pattern.



1. Single-piece or Solid Pattern

This pattern made without joints, partings, or any loose pieces in its construction is called a single-piece or solid patter. These patterns are cheaper. The moulder has to cut his own runner to feed the gate and riser. The moulding operation takes more time. Hence these patterns are in limited production.

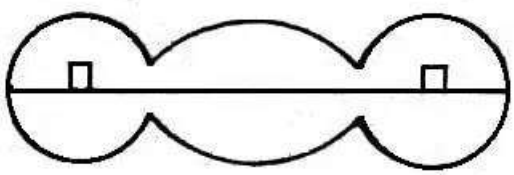


Single Piece or Solid Pattern

Solid pattern is generally used for large castings of simple shape. The simplest type of pattern is the flat-back as shown in fig. It may have few or no irregularities and it may not have a core-point.When completed, the mould cavity will be entirely in the drag or entirely in the cope. A few examples of castings that are made by making solid patters are soil tamper, stuffing-box, and glad of the steam engine.

2. Split Pattern

For casting unusual shape split patterns are used to form a mould. These types of pattern is usually made in two parts. One part will produce the lower half of the mould and the other upper half. The two parts may or may not be of the same size and shape.

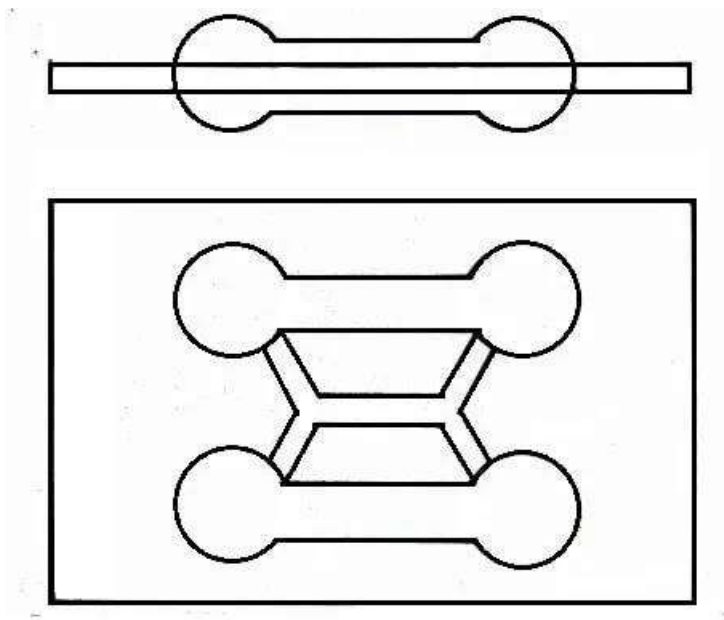


Split Pattern

These are held in their proper relative positions by means of dowel-pins. Dowl-pins are faster in one-piece and fitting at the holes bored in the other piece. The surface which the parting line or parting surface.

3. Match Plate Pattern

These types of pattern is made in two pieces. One-piece mounted on one side of the plate and the other piece on the other side of the plate called the match plate pattern. The plate can only carry a pattern or a group of patterns on its two sides in the same way.



Match Plate Pattern

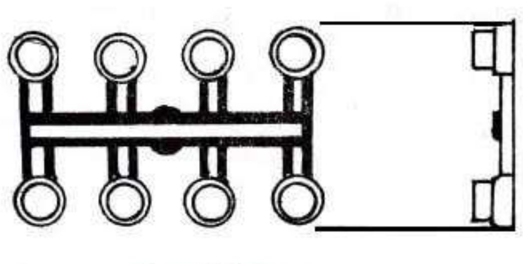
The plate is usually made of aluminium. The gate and runner are also connected to the plate with the pattern. These patterns are used where the rapid production of small and precise castings occurs on a large scale. These patterns are very favourable in machine moulding. Their manufacturing cost is quite high.

4. Cope or Drag Pattern

When quite large castings are to be made, the entire pattern becomes too heavy to be handled by anyone operator. Such types of pattern is made in two parts which are individually moulded into separate moulding boxes.

5. Gated Pattern

Gated patterns are used in the mass production of small castings. For such castings, multi-cavity moulds are prepared i.e. a single sand mould carries a number of cavities as shown in the diagram. The patterns for these castings are interconnected by gate formers.

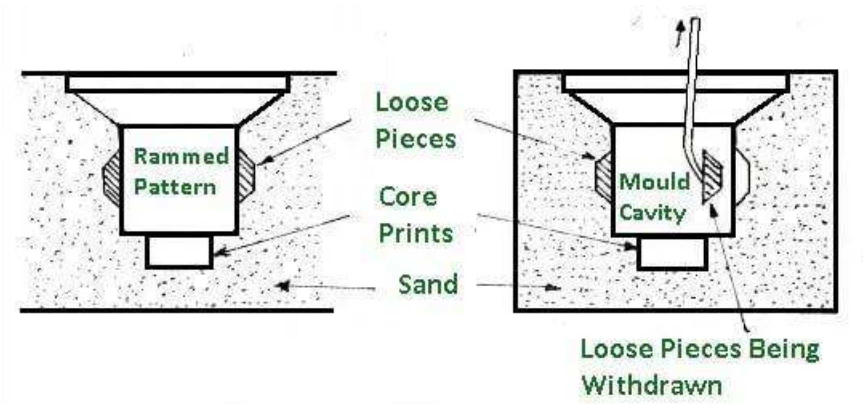


Gated Pattern

These gate formers provide suitable channels or gates in the sand for feeding the molten metal to these cavities. A single runner can be done to feed all cavities. This saves moulding time also there is uniform feeding of molten metal.

6. Loose Piece Pattern

In these types of pattern, some single piece patterns are made to have loose pieces in order to enable their easy withdrawal from the mould. These pieces make an integral part of the pattern while moulding.

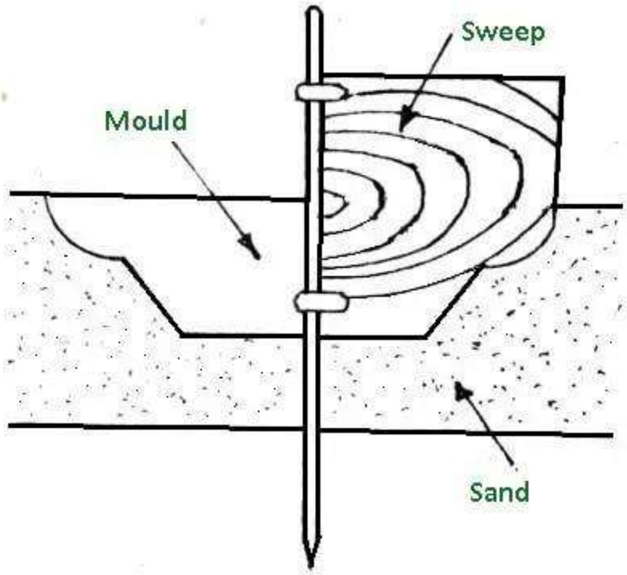


Loose Piece Pattern

After the mould is finished, the pattern is withdrawn, leaving the pieces in the sand. These pieces are later withdrawn separately through the cavity formed by the pattern as shown in the diagram.

7. Sweep Pattern

Sweep patterns are used for preparing moulds of large symmetrical castings, particularly of circular cross-section. Hence there is a large saving in time, labour, and material. The sweep pattern consists of a board that conforms to the shape of the desired casting.

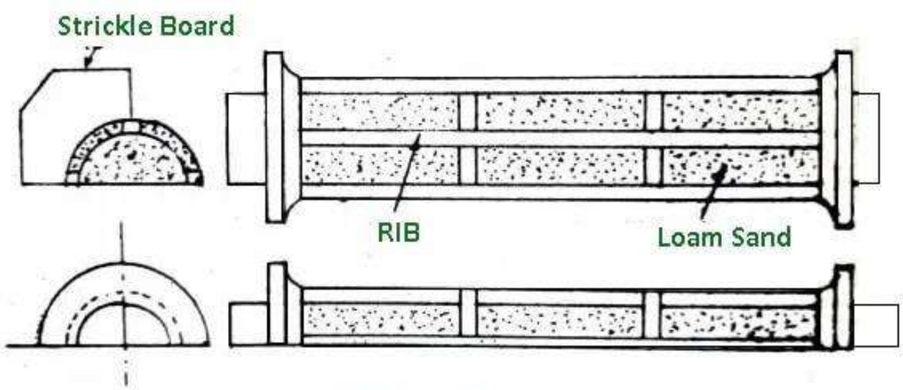


Sweep Pattern

This board is arranged to rotate about a central axis as shown in the diagram. The sand is rammed in place and the sweep board is moved around its axis rotation to give the moulding sand the desired shape. The principle advantage of this pattern is that it expensive pattern construction.

8. Skeleton Pattern

When the size of the casting is very large and only a few numbers are to be made, it is uneconomical to make a solid pattern of that size. In such cases, a pattern consisting of a wooden frame and strips is made, called a skeleton pattern**.**

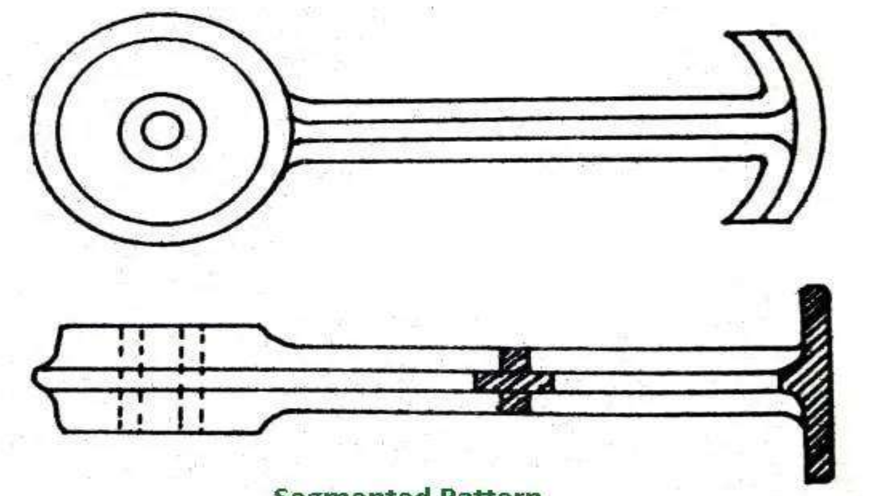


Skeleton Pattern

It is filled with loam sand and rammed. The excess sand is removed by means of a strickle. A half-skeleton pattern for a hollow pipe is shown in the diagram. Since the pipe is symmetrical about the parting line, the same pattern will serve the purpose of moulding both the halves in two different flasks. These two flasks are joined later to form the complete cavity.

9. Segmented Pattern

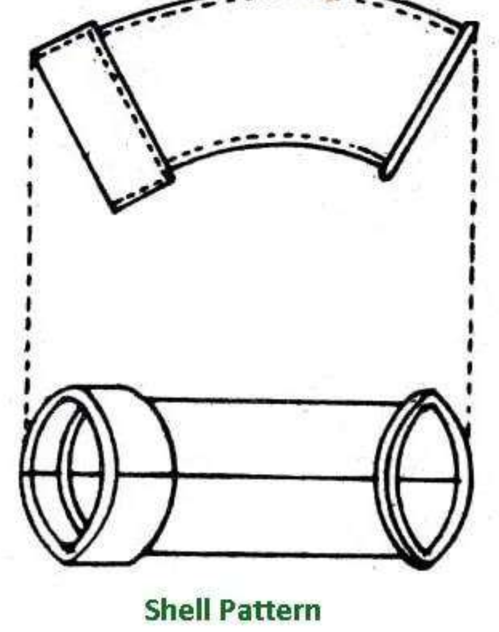
These types of pattern is used to prepare moulds of large spherical castings. Hence the use of a solid pattern of the exact size is avoided. In principle, they work like a sweep pattern. But the difference is that a segmented pattern is a portion of the solid pattern itself and the mould is prepared in parts by it.



Segmented Pattern

10. Shell Pattern

These types of pattern are largely used for drainage fittings and pipework. A typical example is shown in the diagram. The shell pattern is usually made of metal. It is mounted on a plate and parted along the centreline.



Shell Pattern

STUDY OF WELDING

Theory:

The welding in which the electric arc is produced to give heat for the purpose of joining twosurfaces is called electric arc welding.

Principle

Power supply is given to electrode and the work. A suitable gap is kept between the work and electrode. A high current is passed through the circuit. An arc is produced around the area to be welded. The electric energy is converted into heat energy, producing a temperature of 3000°Cto 4000°C. This heat melts the edges to be welded and molten pool is formed. On solidification the welding joint is obtained.

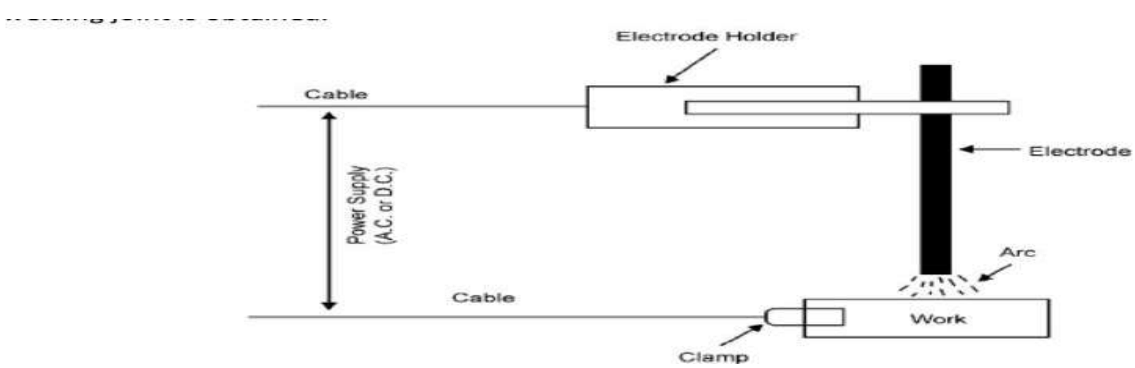


Figure 3.1: Arc Welding

Electric Power for Welding

AC current or DC current can be used for arc welding. For most purposes, DC current is preferred. In D.C. welding, a D.C. generator or a solid state rectifier is used. D.C. machines are made up to the capacity range of 600 amperes. The voltage in open circuit is kept around 45 to 95 volts and in closed circuit it is kept 17 to 25 volts. D.C. current can be given in two ways:

(a)Straight polarity welding. (b)Reverse polarity welding.

In straight polarity welding work piece is made anode and the electrode is made cathode asshown in the fig Electrons flow from cathode to anode, thus, heat is produced at the materials to be welded.

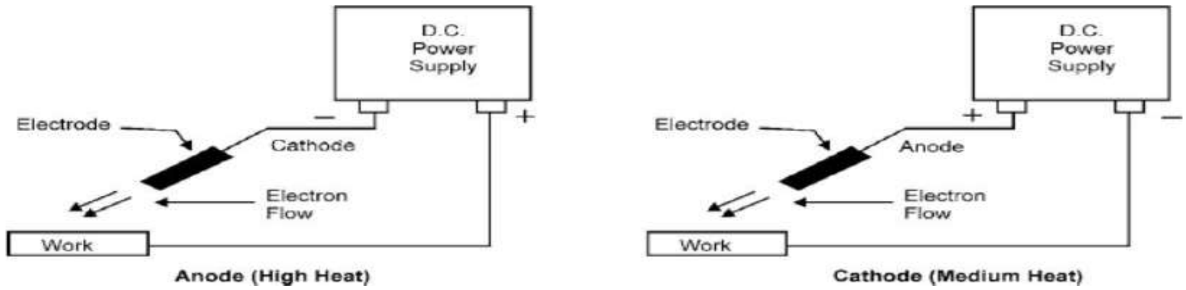


Figure: Straight Polarity Welding and Reverse Polarity Welding

In reverse polarity system the work is made cathode and the electrode is made anode. This welding is done specially for thin section. AC welding has the advantage of being cheap. Equipment used is simpler than DC welding. A transformer is used to increase the current output at the electrode. The current varies from 150 to 1000 amperes depending upon the type of work.

Effect of Arc Length

Arc length is the distance from the tip of the electrode to the bottom of the arc. It should vary from 3 to 4 mm. In short arc length, the time of contact will be shorter and will make a wide and shallow bead. The penetration is low as compared to long arc lengths.

Welding Positions

In horizontal position it is very easy to weld. But many times it is impossible to weld the jobin horizontal position. Other positions are classified as under:
(a) Flat Position,(b) Horizontal Position,(c) Vertical Position,(d) Overhead Position

Flat Position:

In flat positions the work piece is kept in nearly horizontal position. The surface to be worked is kept on upper side. The welding is done as illustrated in the Figure

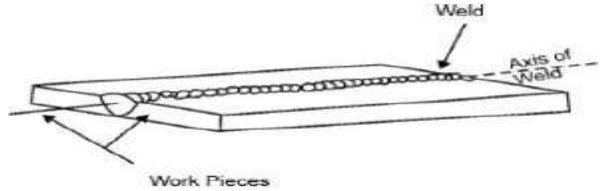


Figure: Flat Position

Horizontal Position:

In this position, the work piece is kept as in the fig. two surfaces rest one over the other with their flat faces in vertical plane. Welding is done from right side to left side. The axis of the weldis in a horizontal plane and its face in vertical plane.

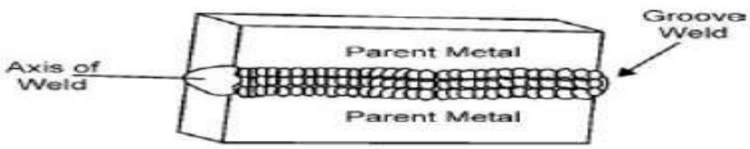


Figure :Horizontal Position

Vertical Position:

In this position, the axis of the weld remains in approximate vertical plane. The welding isstarted at the bottom and proceeds towards top. Welding process is illustrated in Figure

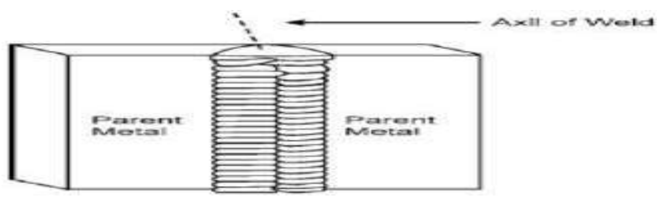


Figure: Vertical Position

Overhead Position:

As shown in the figure, the work piece remains over the head of the welder. The work piece and the axis of the weld remain approximate in horizontal plane. It is the most difficult position of welding.

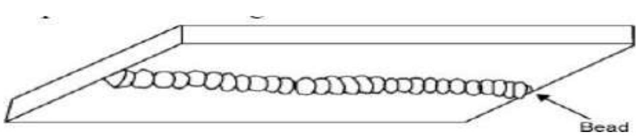


Figure: Overhead Position

Types of Electrodes

Electrodes are of two types

1. **Coated electrodes**: Coated electrodes are generally applied in arc welding processes. A metallic core is coated with some suitable material. The material

used for core is mild steel, nickel steel, chromium molybdenum steel, etc. One end of the coated core is kept bare for holding.

2. **Bare electrodes**: Bare electrodes produce the welding of poor quality. These are cheaper than coated electrodes. These are generally used in modern welding process like MIG welding.

Electrode Size

Electrodes are commonly made in lengths 250 mm, 300 mm, 350 mm, 450 mm, and thediameters are 1.6 mm, 2 mm, 2.5 mm, 3.2 mm, 4 mm, 7 mm, 8 mm and 9 mm.

Functions of Coatings:

The coating on an electrode serves the following functions:

1. To prevent oxidation.
2. Forms slogs with metal impurities.
3. It stabilizes the arc.
4. Increases deposition of molten metal.
5. Controls depth of penetration.
6. Controls the cooling rate.
7. Adds alloy elements to the joint. Specifications of electrodes.

Electrode Classification and Coding

According to ISI coding system, an electrode is specified by six digits with profile letter M.For example IS: 815-1956 These six digits & M indicate the following matter:

M: It indicates that it is suitable for metal arc welding.

First Digit: First digit may be from 1 to 8, which indicate the type of coating on the electrode.

Second Digit: It denotes the welding position for which electrode is manufactured. It varies from1 to 6.

Third Digit: It denotes the current to be used for an electrode. It is taken from 0 to 7.

Fourth Digit: Fourth digit is from 1 to 8. Each digit represents the tensile strength of weldedjoint.

Fifth Digit: It carries any number from 1 to 5. This digit denotes a specific elongation inpercentage of the metal deposited.

Sixth Digit: It carries any number from 1 to 5 and denotes impact strength of the joint.

TYPES OF JOINTS

Basic types of welding joints are classified as under:

Butt Joint

In this type of joint, the edges are welded in the same plane with each other. V or U shape is given to the edges to make the joints strong. Some examples of butt joints are shown in the figure.

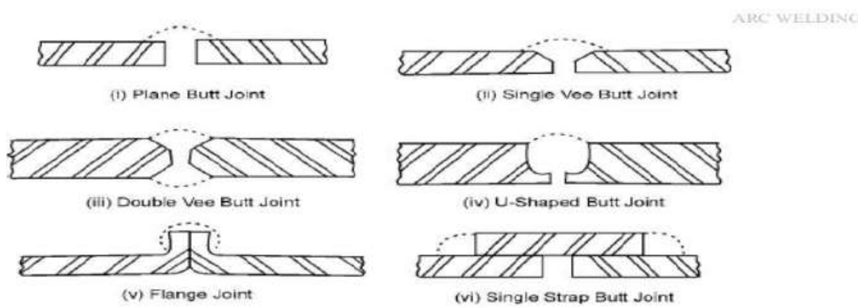


Figure: Different Types of Butt Joints

Lap Joint

This type of joint is used in joining two overlapping plates so that the corner of each plate is joined with the surface of other plate. Common types of lap joints are single lap, double lap or offset lap joint. Single welded lap joint does not develop full strength as compared to double welded lap

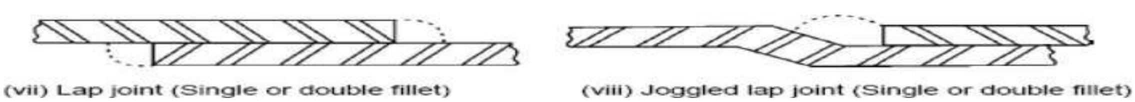


Figure: Lap joints and joggled joint

T-Joint

When two surfaces are to be welded at right angles, the joint is called T-Joint. The angle betweenthe surfaces is kept 90°.

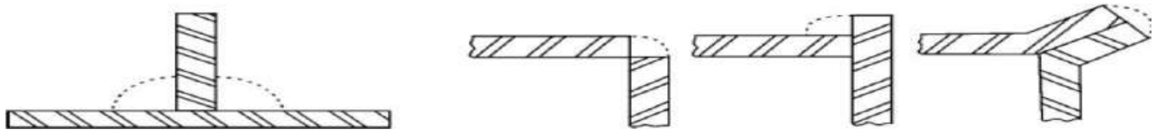


Figure: T-joint and corner Joints

Corner Joint

In this joint, the edges of two sheets are joined and their surfaces are kept at right angle to eachother. Such joints are made in frames, steel boxes, etc.

Edge Joint

In this joint two parallel plates are welded edge to edge.

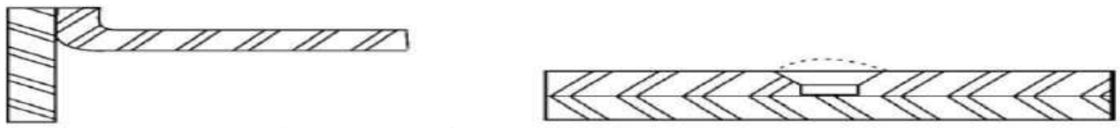


Figure 3.10: Edge joint and rivet butt Joints

Figure: Edge joint and rivet butt Joints

Plug Joint

Plug joints are used in holes instead of rivets and bolts.

STUDY OF LATHE

Machining is the process of converting the given work piece into the required shape and size with help of a machine tool. The most widely used machine tool is lathe. In simple words machining is the process of removing certain material from the work piece.

LATHE

Lathe is the machine tool which is used to perform several operations on the workpiece. Lathe is useful in making several parts which is further assembled to make new machine. Hence lathe is known as "mother of machines".

BASIC WORKING PRINCIPLE OF LATHE

In lathe, the work piece is held in the chuck, a work holding device. The cutting toolis mounted in the tool post. The chuck is rotated by means of power. When the chuck rotates, the work piece also rotates. The tool is moved against the rotating work piece by giving small amount of depth of cut. The material is removed in the form of chips. Continuous feed and depth of cut is given until the required dimensions are obtained in the work piece.

TYPES OF LATHE MACHINES

There are different types of lathe machines, they are

1. Centre lathe
2. Tool room lathe
3. Bench lathe
4. Capstan lathe
5. Turret lathe
6. Automatic lathe

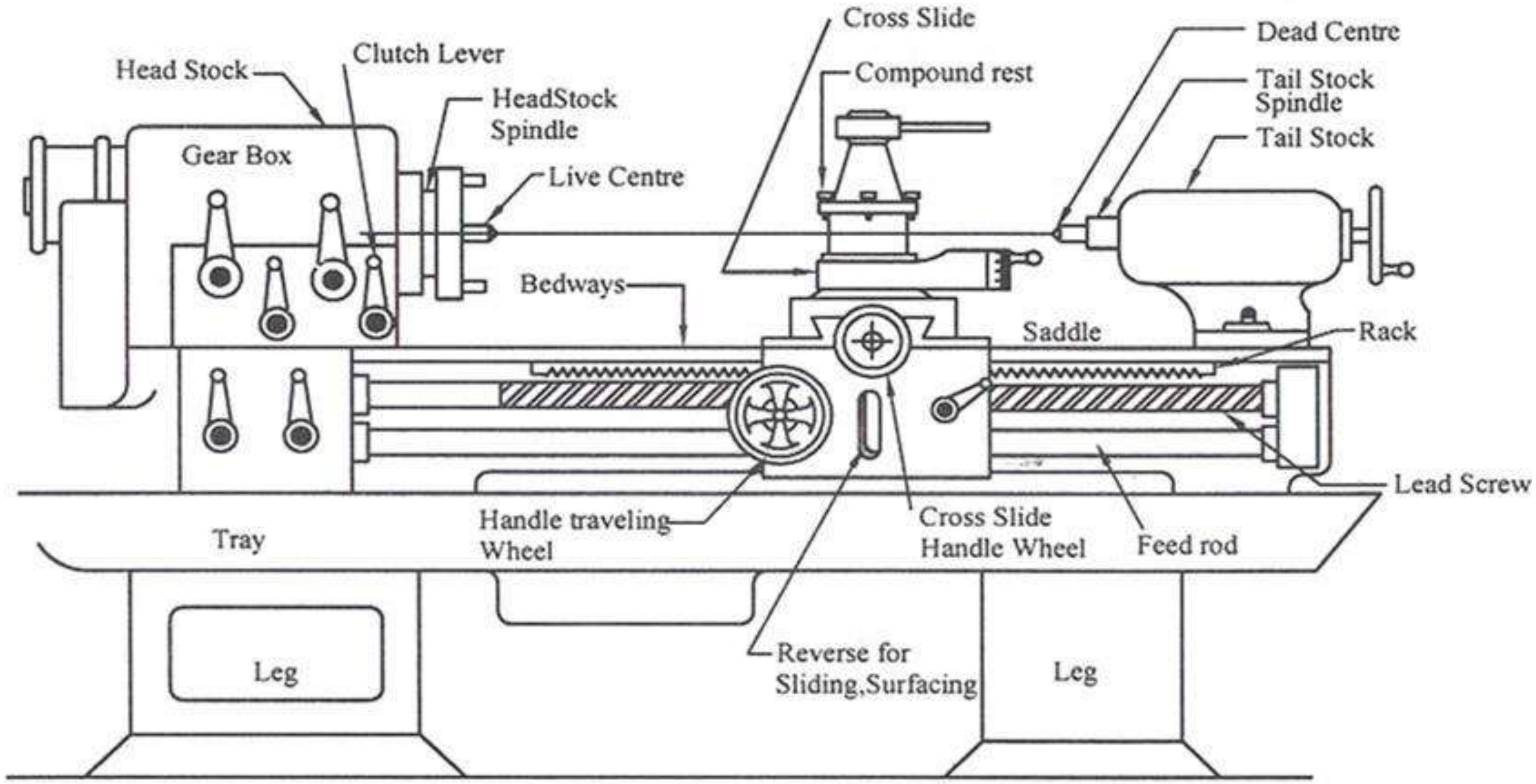


Fig. 1 The centre Lathe

DESCRIPTION OF LATHE

Lathe is a machine which has several parts in it. They are

1. ***Bed***

   It is the base of the machine. On its left side, the head stock is mounted and on its right it has movable casting known as tailstock. Its legs have holes to bolt down onthe ground.

2. ***Head stock***

   It consists of spindles, gears and speed changing levers. It is used to transmit the motion to the job. It has two types one is the headstock driven by belt and the other one is the gear driven.

3. ***Carriage***

   Carriage is used to carry a tool to bring in contact with the rotating work piece or to with draw from such a contact. It operates on bed ways between the headstock and tail stock.

4. ***Saddle***

   It is an 'H' shaped part fitted on the lathe bed. There is a hand wheel to move it on the bed way. Cross slide, compound rest, tool post is fitted on this saddle.

   a) Cross slide

      It is on the upper slide of saddle in the form of dove tail. A hand wheel is provided to drive the cross slide. It permits the cross wise movement of the tool (i.e.) movement of tool towards or away from the operator

   b) Compound rest

      It is fitted over the cross slide on a turn table. It permits both parallel and angular movements to cutting tool.

   c) Tool post

      It is fitted on the top most part of the compound rest. Tool is mounted on thistool post. Cutting tool is fixed in it with the help of screws.

5. ***Apron***

   It is the hanging part in front of the carriage. It accommodates the mechanism of hand and power feed to the cutting tool for carrying out different operations.

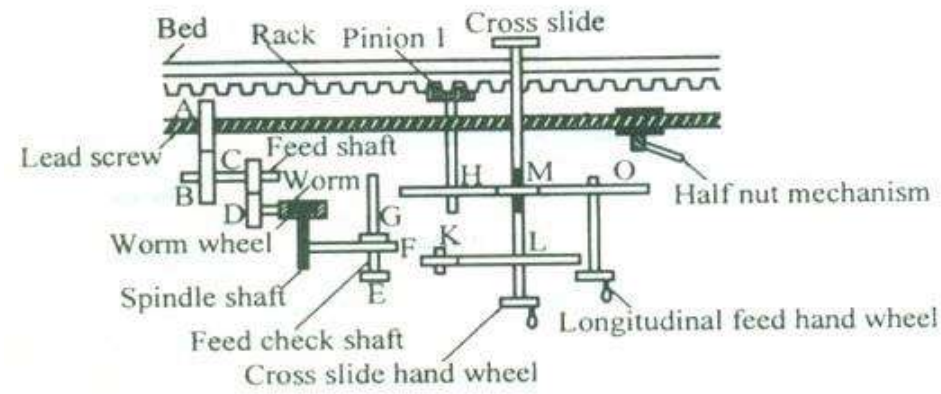


Fig. 2 Apron

6. *Lead screw*

It is a long screw with ACME threads. It is used for transmitting power for automatic feed or feed for thread cutting operation.

7. *Tail stock*

It is located at the right end of the lathe bed and it cn be positioned anywhere inthe bed. It is used for supporting lengthy jobs and also carries tool to carry out operations such as tapping, drilling, reaming.

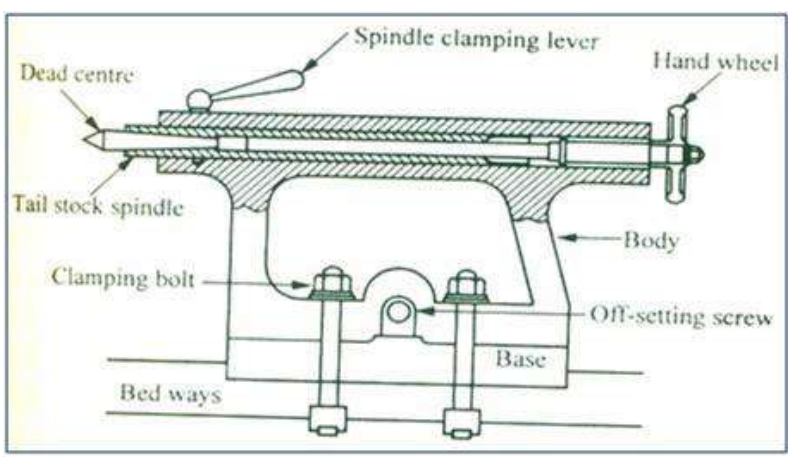


Fig. 3 Tailstock

WORK HOLDING DEVICES

1. Lathe centers

They are used to support work. It has two categories of centers. Live center is one which is fitted in the headstock spindle. Dead is another one which is fitted in the tail stock.

2. Chuck

It is a device used to hold a job. It is easily fitted on the thread cut on the end of head stock spindle. Various types of chuck are

a) Two jaw chuck b) three jaw chuck c) four jaw chuck d) collet chuck

e) Magnetic chuck

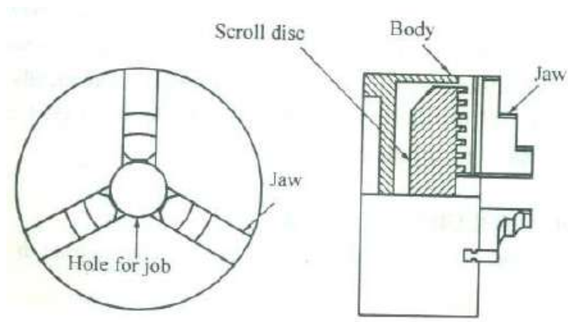


Fig. 4 Three Jaw Universal self-centering chuck

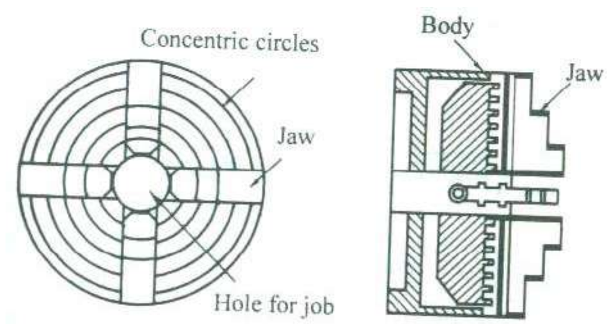


Fig. 5 Four Jaw Independent chuck

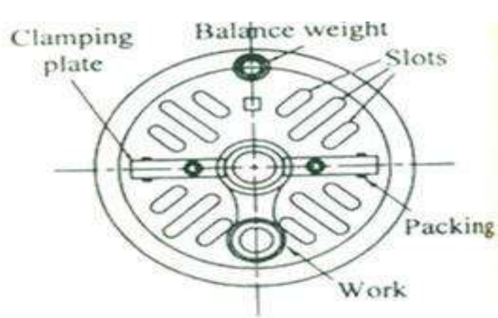


Fig. 6 Face Plate

3. Face plate
4. Catch plate
5. Lathe carriers or dog's
6. Steady rest
7. Mandrel
8. Follower rest

CUTTING TOOLS USED

For making a finished job on lathe machine, various types of cutting tools are used. One of them is single point cutting tool which is used to perform several operations on the work piece. Various types of cutting tools are

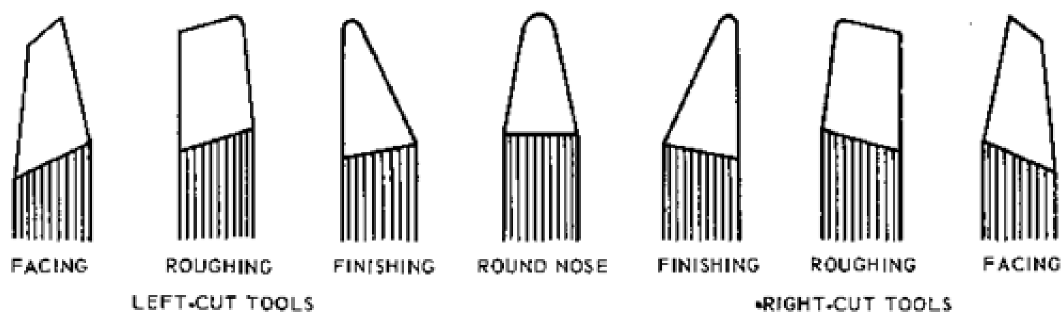


Fig. 7 Cutting Tools

1. ***Facing Tool***

   It is used for facing the longitudinal ends of the job. Its shape is like a knife.

2. ***Rough Turning Tool***

   It is used to remove excess material from the work piece in quick time. It can be used to give large depth of cut and work at coarse feed.

3. ***Finishing Tool***

   It is used for getting smooth finish on the work piece. Its point is a little more round.

4. ***Radius Tool***

   Jobs which need round cutting are done with this tool. Its type is

   a) Convex radius tool b) concave radius tool

5. ***Parting Tools***

It is used to cut the jobs into two parts. It is also used for grooving.

6. ***Form Turning Tool***

It is used for jobs which require both convex and concave turning.

7. ***Thread Cutting Tool***

It is used for making internal or external threads on the work piece. The tool nose isdesigned with a definite profile for taking threads.

8. ***Drill Tool***

It is used for making holes of various diameters on the job. Drill bit of various sizes ofdiameter are available.

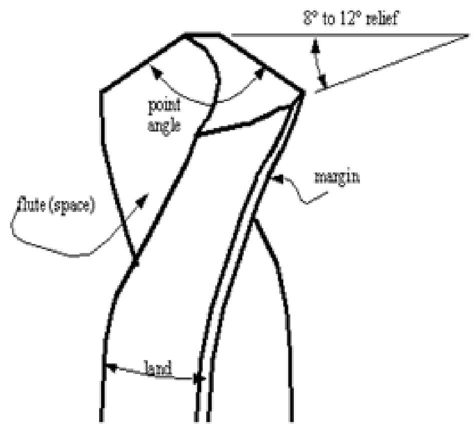


Fig. 8 Drill Tool

9. ***Boring Tool***

It used for enlarging the drill hole.

10. ***Knurling Tool***

Drawing slanting or square projecting lines on the surface of a job is known asknurling. It is used for making better grip on the surface of a job.

LATHE OPERATIONS

1. Facing
   - It is done for getting fine finish (good surface finish) on the face of the job.
   - Facing tool is set at an angle to the work piece.
   - The tool is fed from the centre of work piece towards the outer surface againstthe rotating work piece.
   - Depth of cut is low for the facing operation.

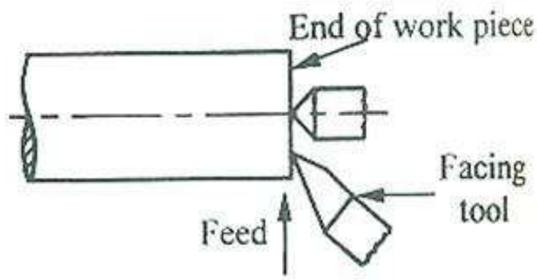


Fig. 10 Facing

2. Plain Turning

- It is done for reducing the diameter of the work piece.
- A cutting tool with 70 setting angle is used for roughing operation.
- More feed is given for rough turning while less feed is given for finishing.
- Work piece is held in chuck and tool is set to center height of the work piece.

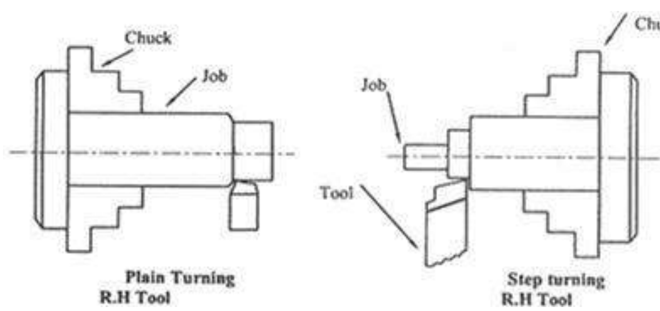


Fig. 11 Plain Turning

3. Step Turning

- It is similar to the process of turning but in this case different diameter in step of various sizes is taken on the work piece.

4. Taper Turning

- It is different from the turning operation.
- Taper is defined as uniform change in the diameter of a work piece measured along its length.

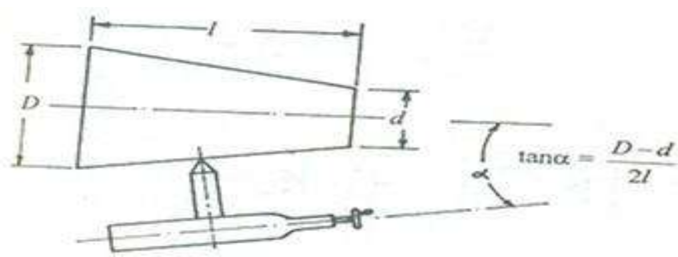


Fig. 12 Taper Turning

The angle is determined by using the formula $\tan \propto = \frac{D - d}{2l}$

Where, D – large Diameter

d – Small diameter

l – Length of taper

5. Knurling
    - It is process of making serrations on the work piece.
    - Knurling tools of different shape and size are used to make grip on the workpiece. It has two hardened steel rollers.
    - The tool is held in tool post and pressed against the rotating work piece.
    - Work piece is rotated at lower speed and small amount of feed is given.

6. Drilling
    - It is a process of making a hole on the work piece
    - Job is held in chuck while the drill is held in the tail stock sleeve.
    - Feed is given by rotating the hand wheel in the tail stock which pushes the tailstock sleeve.

CUTTING SPEED

- It is the peripheral speed of the work past the cutting tool.
- It is the speed at which metal is removed by the tool from the work piece.
- It is expressed in meter / minute.

$$\text{Cutting speed} = \frac{\pi \times \text{diameter} \times \text{R.P.M}}{1000}$$

$$= \frac{\pi D N}{1000} \, in \; m/min$$

Where, D – Diameter in mm

N – Spindle speed in rpm

FEED

- It is defined as the rate of tool travel across a surface cutting it.
- It is the distance of the tool advances for each revolution of the work piece.
- It is expressed in mm/revolution.

DEPTH OF CUT

- It is the perpendicular distance measured from the machined surface to the uncutsurface of work. It is expressed in mm.

$$\text{depth of cut} = \frac{d_1 - d_2}{2}$$

Where, d_1 = diameter of work before machining d_2 = diameter of work after machining.

STUDY OF DRILLING MACHINE

Drilling is the operation of producing circular hole in the work-piece by using a rotating cutter called Drill. The machine used for drilling is called drilling machine.

- The drilling operation can also be accomplished in lathe, in which the drill is held in tailstock and the work is held by the chuck.
- It is the simplest and accurate machine used in production shop.
- The work piece is held stationary i.e. clamped in position and the drill rotates to make a hole.

TYPES OF DRILLING MACHINE

1) Based on construction:
    1. Portable,
    2. Sensitive,
    3. Radial,
    4. up-right,
    5. Gang,
    6. Multi-spindle

2) Based on Feed:
    Hand driven
    Power driven

COMPONENTS OF DRILLING MACHINE

SPINDLE

The spindle holds the drill or cutting tools and revolves in a fixed position in a sleeve.

SLEEVE

The sleeve or quill assembly does not revolve but may slide in its bearing in a direction parallel to its axis. When the sleeve carrying the spindle with a cutting tool is lowered, the cutting tool is fed into the work: and when it's moved upward, the cutting tool is withdrawn from the work. Feed pressure applied to the sleeve by hand or power causes the revolving drill to cut its way into the work a fraction of an mm per revolution.

COLUMN

The column is cylindrical in shape and built rugged and solid. The column supports the head and the sleeve or quill assembly.

HEAD

The head of the drilling machine is composed of the sleeve, a spindle, an electric motor and feed mechanism. The head is bolted to the column.

WORKTABLE

The worktable is supported on an arm mounted to the column. The worktable can be adjusted vertically to accommodate different heights of work or it can be swung completely out of the way. It may be tilted up to 90 degree in either direction, to allow long pieces to be end or angle drilled.

BASE

The base of the drilling machine supports the entire machine and when bolted to the floor, provides for vibration-free operation and best machining accuracy. The top of the base is similar to the worktable and may be equipped with t- slot for mounting work too larger for the table.

HAND FEED

The hand- feed drilling machines are the simplest and most common type of drilling machines in use today. These are light duty machine that are operated by the operator, using a feed handled, so that the operator is able to “feel” the action of the cutting tool as it cuts through the work piece. These drilling machines can be bench or floor mounted.

POWER FEED

The power feed drilling machine are usually larger and heavier than the hand feed ones they are equipped with the ability to feed the cutting tool in to the work automatically, at preset depth of cut per revolution of the spindle these machines are used in maintenance for medium duty work or the work that uses large drills that require power feed larger work pieces are usually clamped directly to the table or base using t –bolts and clamps by a small work places are held in a vise. A depth –stop mechanism is located on the head, near the spindle, to aid in drilling to a precise depth.

SENSITIVE OR BENCH DRILLING MACHINE

- This type of drill machine is used for very light works. Fig.1 illustrates the sketch of sensitive drilling machine.
- The vertical column carries a swiveling table the height of which can be adjusted according to the work piece height.
- The table can also be swung to any desired position.
- At the top of the column there are two pulleys connected by a belt, one pulley is mounted on the motor shaft and other on the machine spindle.
- Vertical movement to the spindle is given by the feed handle by the operator.
- Operator senses the cutting action so sensitive drilling machine.
- Drill holes from 1.5 to 15mm

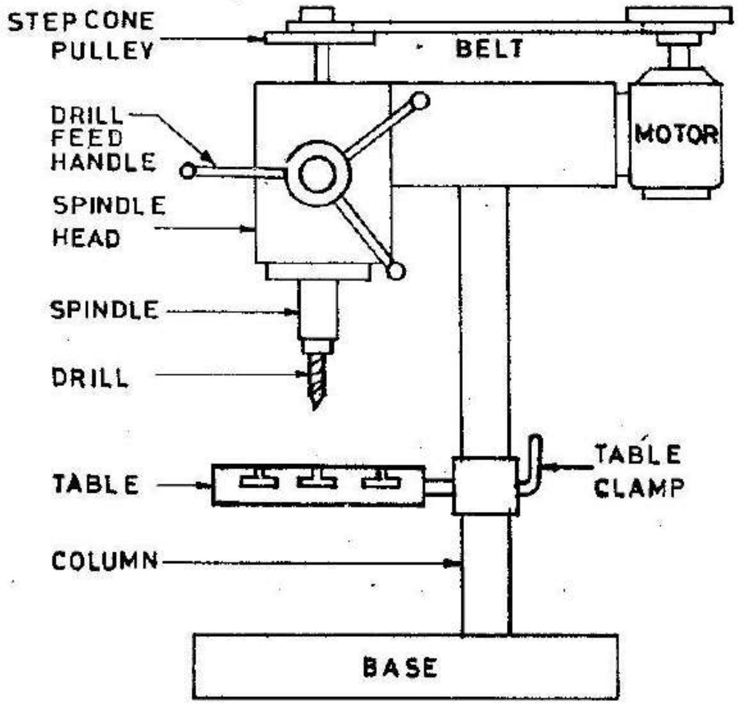


Fig.1. Sensitive Drilling Machine

UP-RIGHT DRILLING MACHINE

- These are medium heavy duty machines.
- It specifically differs from sensitive drill in its weight, rigidity, application of power feed and wider range of spindle speed. Fig.2 shows the line sketch of up-right drilling machine.
- This machine usually has a gear driven mechanism for different spindle speed and an automatic or power feed device.
- Table can move vertically and radially.
- Drill holes up to 50mm

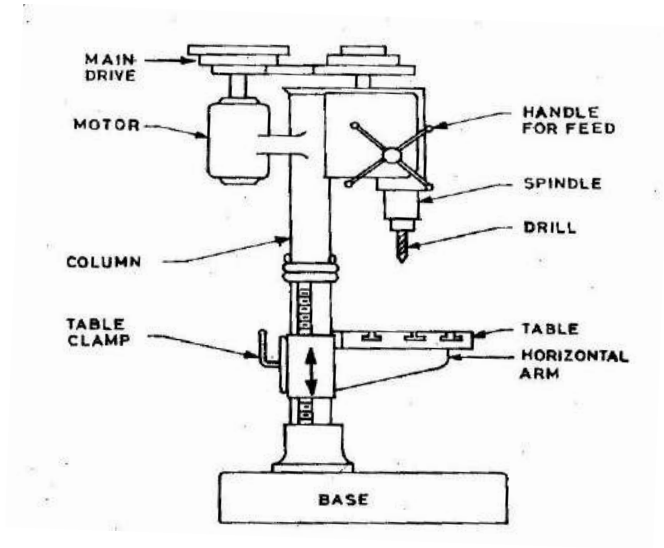


Fig.2 Up-Right Drilling Machine

RADIAL DRILLING MACHINE

- It the largest and most versatile used for drilling medium to large and heavy work pieces.
- Radial drilling machine belong to power feed type.
- The column and radial drilling machine supports the radial arm, drill head and motor. Fig.3 shows the line sketch of radial drilling machine.

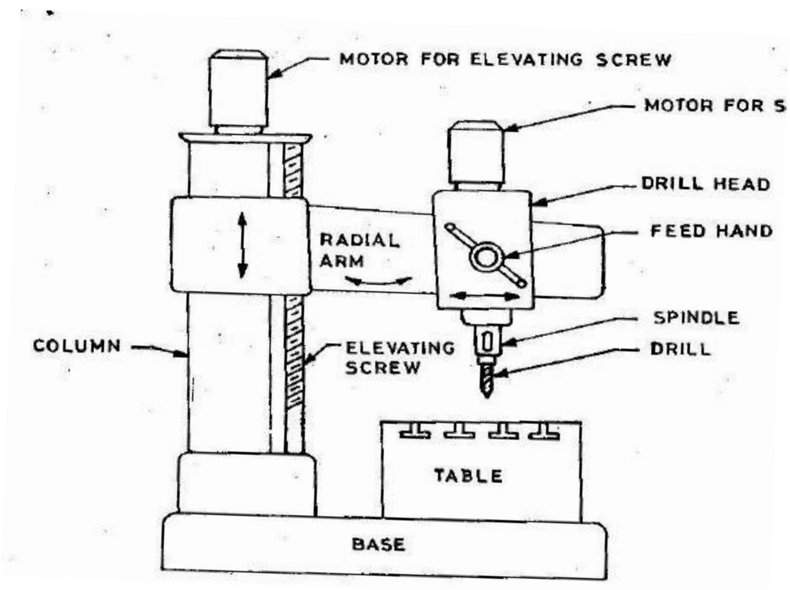


Fig. 3 Radial Drilling Machine

- The radial arm slides up and down on the column with the help of elevating screw provided on the side of the column, which is driven by a motor.
- The drill head is mounted on the radial arm and moves on the guide ways provided the radial arm can also be swiveled around the column.
- The drill head is equipped with a separate motor to drive the spindle, which carries the drill bit. A drill head may be moved on the arm manually or by power.

- Feed can be either manual or automatic with reversal mechanism.

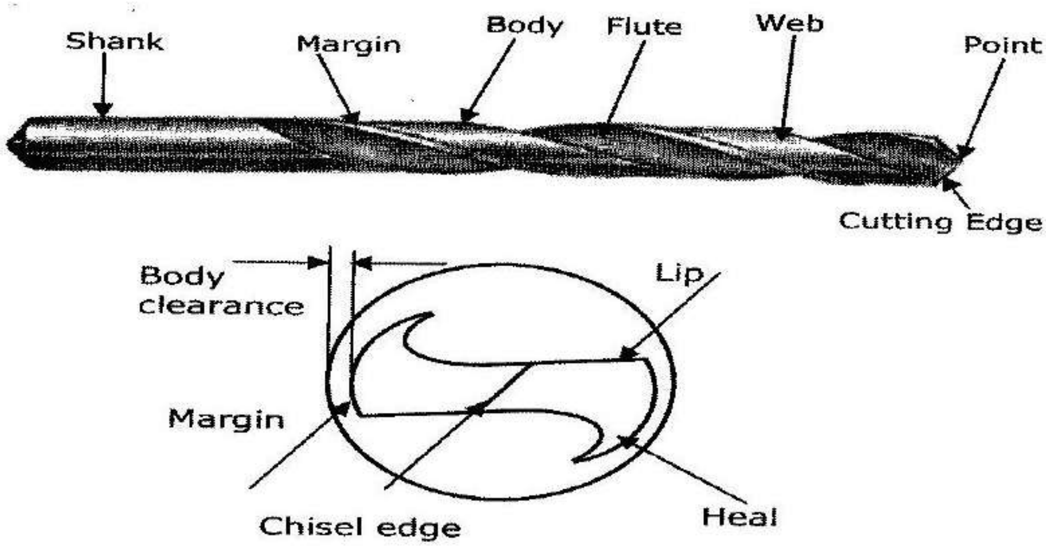


Fig. 4 Nomenclature of twist drill

TOOL HOLDING DEVICES

Fig.5 shows the different work holding. The different methods used for holding drill in a drill spindle are

- By directly fitting in the spindle hole.
- By using drill sleeve
- By using drill socket
- By using drill chuck

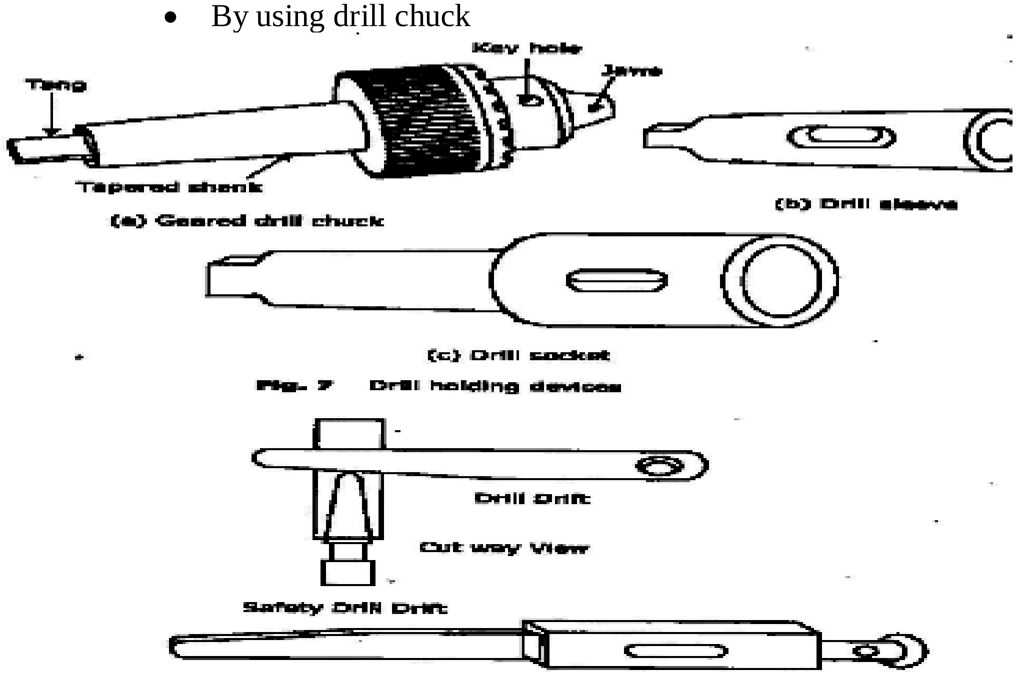


Fig. 5 **Tool Holding Devices**

DRILLING OPERATIONS

Operations that can be performed in a drilling machine are

- Drilling
- Reaming
- Boring
- Counter boring
- Countersinking
- Tapping

Drilling:

It is an operation by which holes are produced in solid metal by means of revolving tool called 'Drill'. Fig. 9 shows the various operations on drilling machine.

Reaming:

Reaming is accurate way of sizing and finishing the pre-existing hole. Multi tooth cutting tool. Accuracy of ±0.005mm can be achieved

Boring:

Boring is a process of enlarging an existing hole by a single point cutting tool. Boring operation is often preferred because we can correct hole size, or alignment and can produce smooth finish. Boring tool is held in the boring bar which has the shank. Accuracy of ±0.005mm can be achieved.

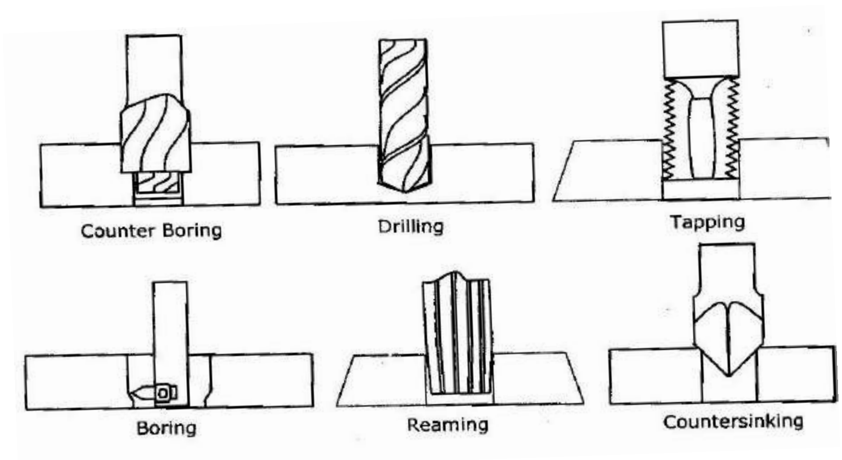


Fig. 6 Various operations on drilling machine

Counter Bore :-

This operation uses a pilot to guide the cutting action to accommodate the heads of bolts. Fig. 10 illustrates the counter boring, countersunk and spot facing processes.

Countersink:-

Special angled cone shaped enlargement at the end of the hole to accommodate the screws. Cone angles of 60°, 82°, 90°, 100°, 110°, 120°.

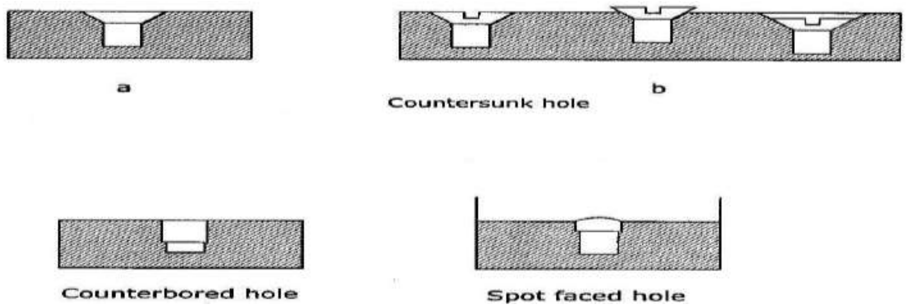


Fig. 7 Counter boring, countersunk and spot facing

Tapping:-

Tapping is the process by which internal threads are formed. It is performed either by hand or by machine. Minor diameter of the thread is drilled and then tapping is done. Fig. 11 shows the tapping processes.

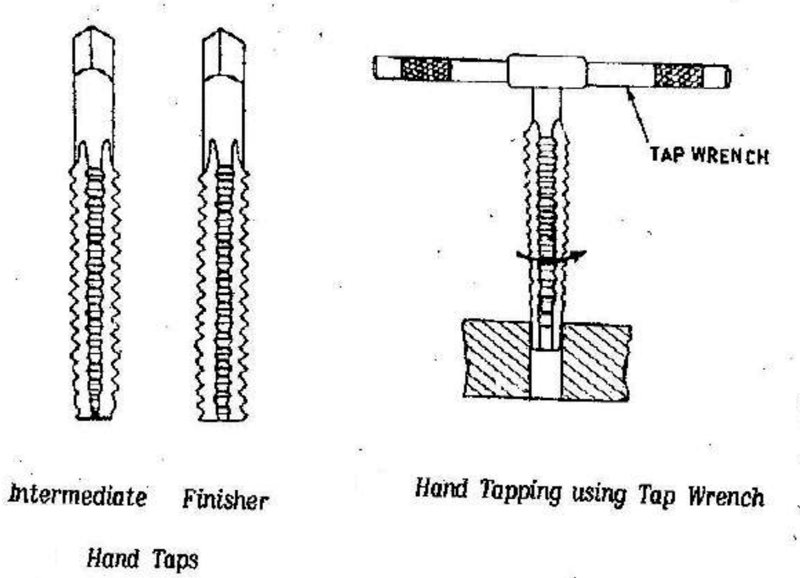


Fig. 8 Hand taps and tapping process using tap wrench

CONCLUSION

Thus, the basic functioning and mechanism of was studied.

STUDY OF MILLING MACHINE

INTRODUCTION

Milling is a machining process which is performed with a rotary cutter with several cutting edges arranged on the periphery of the cutter. It is a multiple point cutting tool which is used in conjunction with a milling machine. This process is used to generate flat surfaces or curved profile and many other intricate shapes with great accuracy and having very good surface finish. Milling machines are one of the essential machines in any modern machine shop.

BASIC MILLING PROCESS

Generally, there are two types of milling processes. These are called (a) Up milling or conventional milling process, and (b) Down milling or climb milling process.

In up milling, the direction of rotation of milling cutter and the direction of work piece feed are opposite to each other; whereas in down milling, they move in the same direction at the point of contact of the cutter and the work piece. In up milling, the thickness of chip at the start is nil and is maximum when the cutting teeth leave the surface of the work piece. In down milling, it is vice-versa. In up milling, the cutting teeth try to up root and lift the work piece from the machine table, in down milling, reverse happens. Technically, down milling is a superior process, but up milling is commonly used. Down milling is not used unless the milling machine is fitted with a backlash eliminator.
From Fig. 4.1, basic milling operation can also be understood. The milling cutter is circular and a large number of cutting edges (or teeth) are arranged along its circumference. The cutter is rotated at a speed of N r.p.m. If the cutter diameter is D, then cutting speed at the tip of teeth can be calculated as
π DN meters/minute and it should conform to the recommended values. The depth of cut is clearly shown in the figure and the thickness of the work piece will reduce by this amount in one pass. Usually, the width of the milling cutter is more than the width of the work piece; hence one pass is all that is required.
Feed of the work piece is measured in terms of mm/minute. Actually, the correct measure of feed is movement of work piece per revolution of cutter per teeth. If a milling cutter has z number of teeth and if the table feed is 'f' mm/minute, feed per rev per teeth will be f / NZ mm. It should therefore be clear that metal removal rate in milling operation is much higher than in shaping or planing operations.

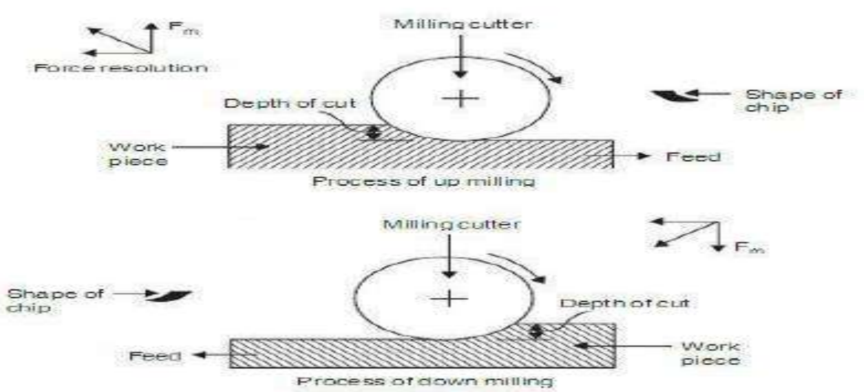


Fig. 4.1 Up and down milling processes

However, as in shaping or planing operation, the stroke length is always a little more than the length of the job, in milling operation also, the minimum table traverse required is L+ D, where L is the length of job and D is the milling cutter diameter. D /2 are the minimum overlap required on either side of job, so that the cutter becomes clear of the job.

Unlike turning, the milling process involves intermittent cutting and the chip cross-section is not uniform. The high impact loads at entry as well as fluctuating cutting force make milling process subject to vibration and chatter. This aspect has great influence on design of milling cutters.

Rotary movement to the cutters, and feed to the work piece and arrangement for clamping, automatic feed etc.

Milling machines come in three basic models:

1. Horizontal milling machines,
2. Vertical milling machines, and
3. Universal milling machines (This is also of horizontal type with a few special features).

Other configurations of the milling machine have been developed for special applications, but above three are most common.

(1).HORIZONTAL MILLING MACHINE

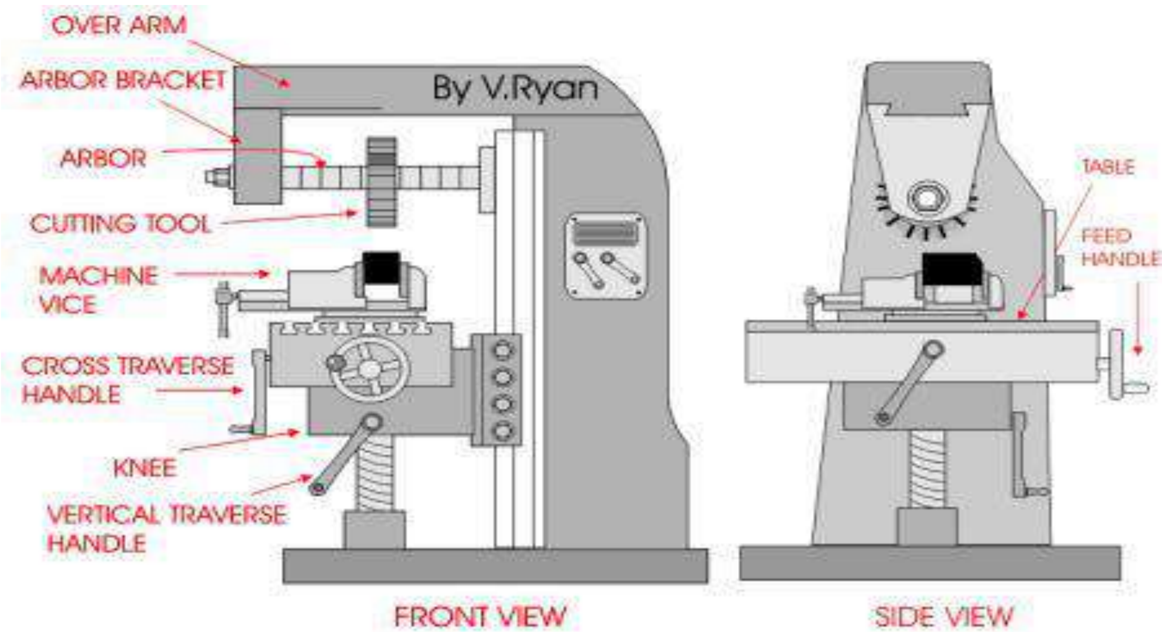
The most common type of milling machine is the horizontal knee type; so called, because of the over-hanging ‘‘knee’’ which can slide up and down the front of the machine and which carries the cross slide and the table. A diagram of the horizontal milling machine is given in Fig. 4.9.

Horizontal milling machines may be either plain or universal type. The main difference between the two is that the table of the universal type is mounted on a turn table and may be swiveled in a horizontal plane. This feature permits the cutting of helix. In addition, the standard accessories provided on the universal machine include a ‘dividing head’ for indexing. There are some other minor refinements, which make the universal horizontal machine very useful for tool room work.

The plain version of the horizontal machine is much more robust and more suitable for production work. In the diagram, the arbor on which peripheral cutters are mounted is not shown. It is fitted in the spindle nose ‘C’ and extends a little beyond arbor supporting bracket ‘B’.

The table of the horizontal milling machine can be given either hand feed or auto feed. It is also capable of being traversed at high speed.

With these features, the machine proves really useful.



2).Vertical milling machine:

The application and technique of this machine differ from that of a horizontal milling machine. It does not have an arbor and instead has a vertical spindle into which the taper shank of end mills and facing milling cutters and drills etc. can be fitted. The arrangement and movement of table are similar to the table of a horizontal milling machine. This machine used for making, flat surfaces, grooves, slots, pockets and guide ways etc. in work pieces using end mills and facing mills etc.

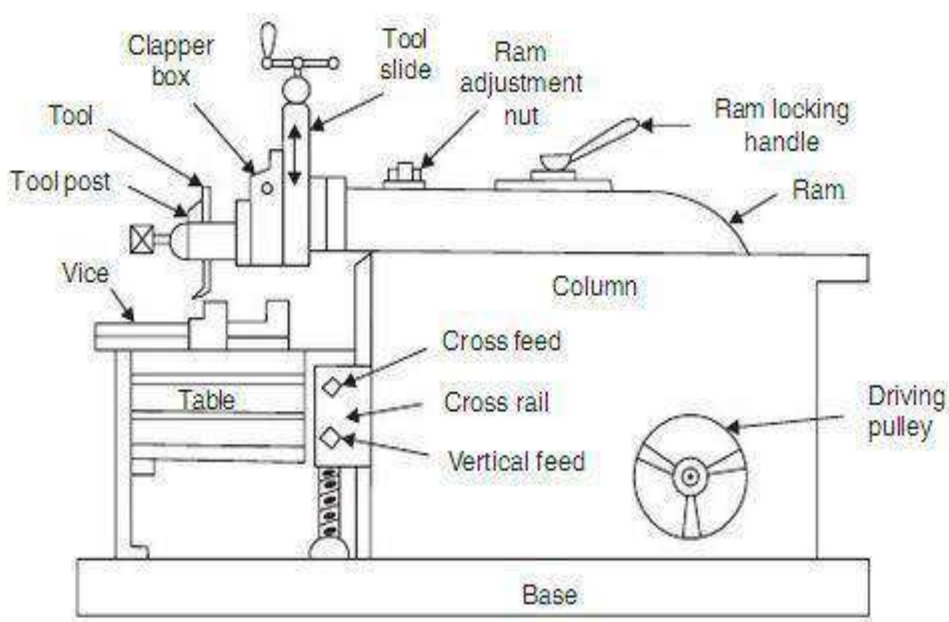
Conclusion:

There are many accessories and fittings, which, if provided greatly improve the performance and range of work which can be carried out on a milling machine.

STUDY OF SHAPING MACHINE

INTRODUCTION

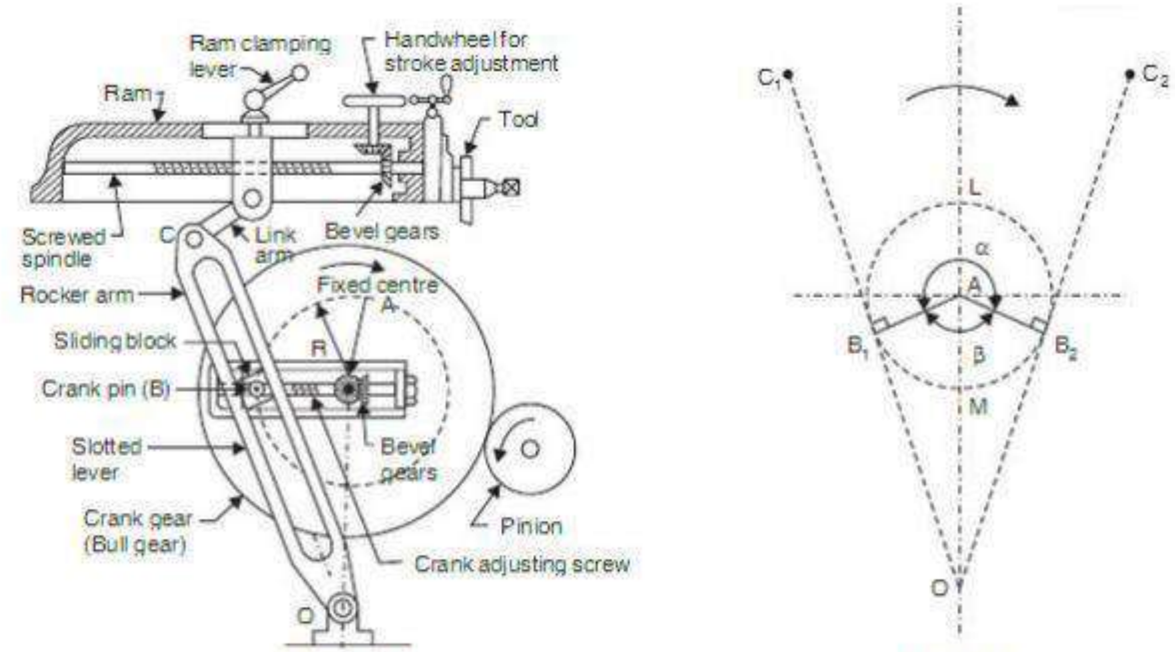
Both shapers and planers are machine tools which produce a flat surface. They are capable of machining a horizontal, vertical or inclined flat surface. They employ single-point cutting tools which are essentially similar to single-point cutting tools used on lathe. In both these machine tools, the cutting tool is subjected to interrupted cuts, the tools cuts in forward direction and is idle in the return direction. Cutting tool is in moving condition where as work piece is stationary. Small length work piece only workable in shaper these are the main difference between planer and shaper
Principle of Working



Shaper consists of a hollow machine bed made of cast iron which rests on the ground. Inside the hollow portion the machine drive mechanism is housed. This mechanism is called slotted lever quick return mechanism and it drives a horizontal ram which reciprocates in the guide ways provided on the top surface of the machine frame. In the front face of the ram, a tool post is fitted. This is a very special kind of tool post. It carries a slide which can be operated by a hand wheel and the entire tool post can be lowered or raised. Besides, the tool slide can be swiveled in a vertical plane and its inclination to the vertical (amount of swiveling) can be read off on a scale marked in degrees. The tool is inclined, when an inclined surface has to be machined. In the front portion of the base, a table is fitted. The table can be raised or lowered to vary its height. It can also be moved horizontally to left or right. A vice to hold the work piece is provided on the table top. The tool does useful work i.e., cutting only in the forward stroke of the ram. It does not cut i.e.; it is idle during the return stroke of ram. In order that while returning, the tool may not rub and spoil the strip of the metal machined in the forward stroke, a special device called the “clapper box” is provided in the tool post. It lifts the tip ofthe tool during the return stroke.

DRIVE

Since useful work is done only during the forward stroke of ram, the mechanism driving the ram is so designed that the return stroke is completed in much less time than the forward stroke. The slotted lever quick return mechanism is illustrated in Figs. 2.2(a) and 2.2(b).



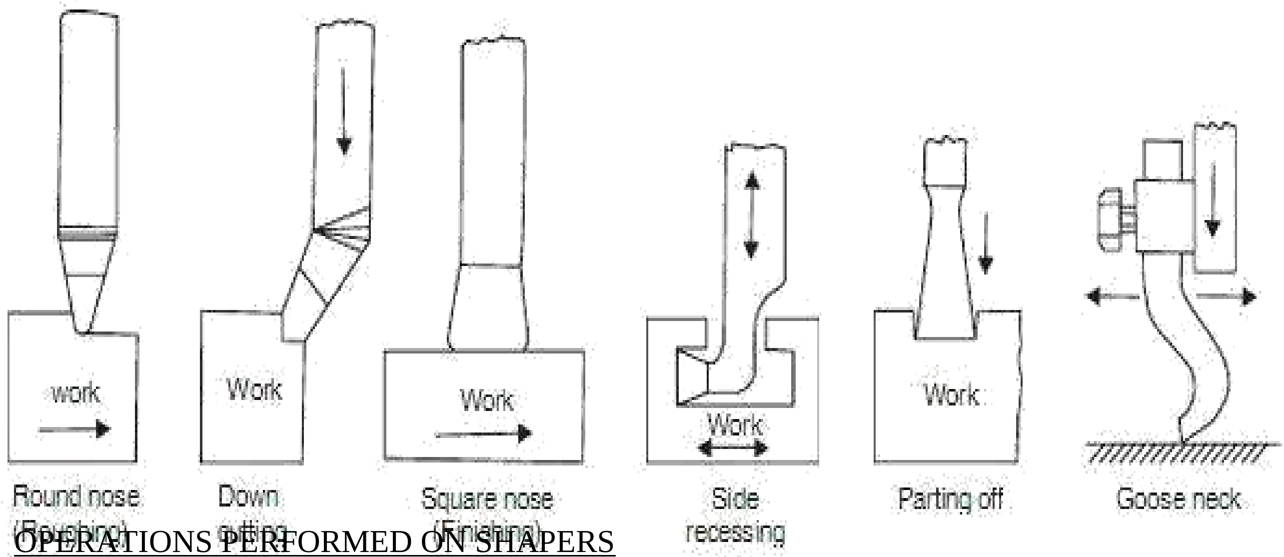
(a) Mechanism (b) Principle

The crank AB (of adjustable length R) rotates with a uniform angular speed. The crank pin B is in the shape of a die block which is free to slide inside the slot in the slotted lever OBC. This slotted lever is pivoted at O and the other end C is connected to the ram by a short link arm as shown in Fig. 2.2 (a).

When the crank AB rotates clockwise from position AB1to AB2, the ram moves forward from left to right and when it rotates from position AB2to AB1the ram returns back to its original position. Clearly the time taken to complete forward stroke is proportional to angle α(refer to Fig. 2.2 (b))and the return stroke is completed in less time which is proportional to angle β.

CUTTING TOOLS USED IN SHAPING

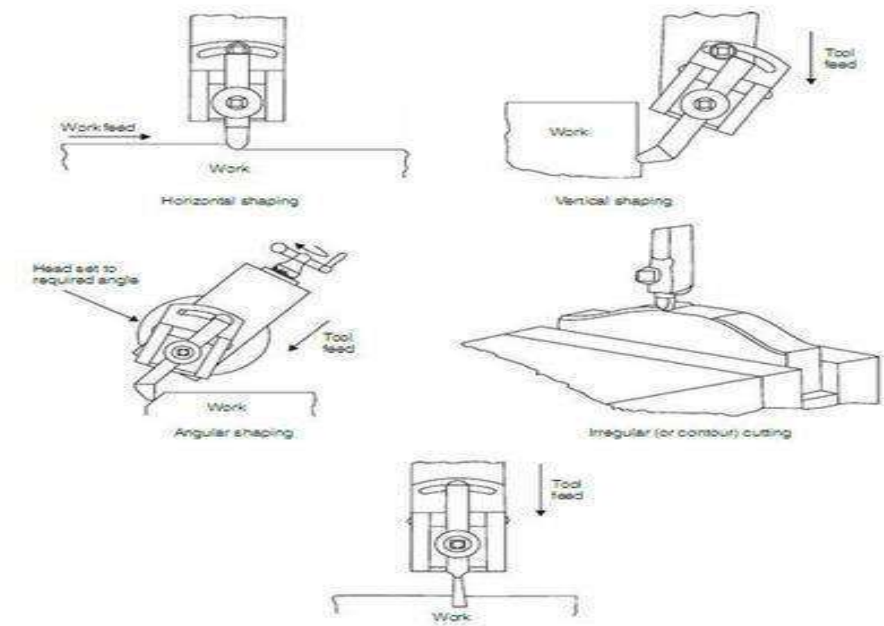
The cutting tools for shapers are generally made of H.S.S., either solid or with brazed tips. Due to interrupted cuts, tungsten carbide tools are not preferred for shaping work. These tools are made sturdy with fairly generous size for shank and tip. Various types of tools useful for shaping are shown in Fig. 2.3.



OPERATIONS PERFORMED ON SHAPERS

On a shaping machine, relatively small jobs can be machined. The size of a shaper is denoted by the maximum length of stroke of its ram and work pieces longer than the maximum stroke cannot be machined. The first step in machining a job is to mount the job on the shaper-table and clamp it tightly in the vice or on the table by means of T -bolts etc. The second step is to adjust the stroke of ram according to the length of work piece. The ram stroke is kept about 60–70 mm longer than job. The stroke can be reduced or increased by altering the length of the crank AB .

Now by changing the position of the location where short link arm is connected to the ram, the stroke is made to overlap the job, so that the stroke starts 30–35 mm before the job and covers the whole length of work piece and ends 30–35 mm beyond it. A tool is now selected and clamped in the tool post. The depth of cut is given by rotating the hand wheel and lowering the tool slide. Depth of cut is not given by raising the table height. Table height is adjusted only at the time of fixing the job according to the height of job. Feed is given by shifting the table laterally. The feed to the table can be given either manually or automatically. The feed is given during the return stroke of ram. Operations performed on a shaper can be easily understood from Fig. 2.4.



Contour cutting is a very skillful job as it calls for simultaneous operation of horizontal table feed as well as vertical hand feed of the cutting tool. It can be performed only by a very skilled operator.

Conclusion:

There are many accessories and fittings, which, if provided greatly improve the performance and range of work which can be carried out on a shaping machine.

SLOTTING MACHINE

INTRODUCTION

A slotting machine or slotter is used for cutting different types of slots and it certainly proves to be most economical. Its other uses are in machining irregular shapes, circular surfaces and other premarked profiles. Its construction is similar to that of a vertical shaper. Its ram moves vertically and the tool cuts during the downward stroke only.

TYPES OF SLOTTER

PUNCHER SLOTTER

The puncher slotter is a heavy rigid machine designed for removal of large amount of metal from large forgings or castings. The length of stroke of a puncher slotter is sufficiently large.

PRECISION SLOTTER

The precision slotter is a lighter machine and is operated at high speeds. The machine is designed to take light cuts giving accurate finish. The precision machines are also used for general purpose work and are usually fitted with whit worth quick return mechanism.

SLOTTER SIZE

The size of a slotter like that of a shaper is specified by the maximum length of stroke of the ram expressed in mm. The size of a general purpose or precision slotter usually ranges from 80 to 900 mm. To specify a slotter correctly the diameter of the table in mm, amount of cross and longitudinal travel of the table expressed in mm, number of speeds and feeds available, h.p of the motor, floor space required etc. should also be stated.

SLOTTING MACHINE PARTS

BASE OR BED

The base is rigidly built to take up all the cutting forces and entire load of the machine. The top of the bed is accurately finished to provide guide ways on which the saddle is mounted.

COLUMN

The column is a vertical member which is cast integral with the base and houses driving mechanism of the ram and feeding mechanism.

The front vertical face of the column is accurately finished for providing ways on which the ram reciprocates.

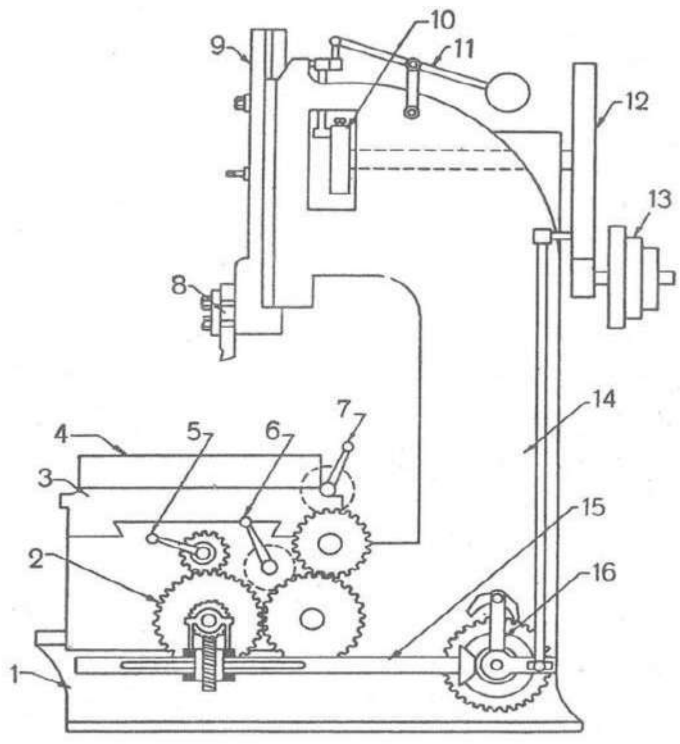


Figure: Slotting Machine

1. Base, 2. Feed gear, 3. Cross-slide, 4. Table, 5. Cross feed handle, 6. Longitudinal feed Handle, 7. Circular feed handle, 8. Tool, 9. Ram, 10. Crank disc, 11. Lever for counterbalance weight, 12. Bull gear, 13. Cone pulley, 14. Column, 15. Feed shaft, 16. Pawl actuating crank.

SADDLE

The saddle is mounted upon the guide ways and may be moved towards or away from the column either by power or manual control to supply longitudinal feed to the work. The top face of the saddle is accurately finished to provide guide ways on the base.

CROSS SLIDE

The cross slide is mounted upon the guide way of the saddle and may be moved parallel to the face of the column.

ROTARY TABLE

The rotary table is a circular table which is mounted on the top of the cross slide. The table may be rotated by rotating a worm which meshes with a worm gear connected to the underside of the table. In some machines the table is graduated in degree that enables the table to be rotated for indexing or dividing the periphery of a job in equal lumber of parts. T-slots are cut on the top face of the table for holding the work by different clamping devices.

RAM AND TOOLHEAD ASSEMBLY

The ram is the reciprocating member of the machine mounted on the guide ways of the column. It supports the tool at its bottom end on a tool head. A slot is cut on the body of the ram for changing the position of stroke.

RAM DRIVE MECHANISM

A slotter removes metal during downward cutting stroke only whereas during upwards return stroke no metal is removed. The usual types of ram drive mechanisms are

1. Whitworth quick return mechanism
2. Variable speed reversible motor drive mechanism
3. Hydraulic drive mechanism.

FEED MOVEMENTS

In a slotter, the feed is given by the table. A slotting machine table may have three types of feed movements.

1. Longitudinal

2. Cross

3. Circular

If the table is feed perpendicular to the column towards or away from its face, the feed movements termed as longitudinal. If the table is feed parallel to the face of the column the feed movement is termed as circular

WORK HOLDING DEVICES

The work is held on a slotter table by a Vise, T-bolts and clamps of by special fixtures. T-Bolts and clamps are used for holding most of the work on the table. Before clamping packing pieces are place below the work so as to allow the tool to complete the cut without touching the table.

SLOTTER OPERATIONS

The operations performed in a slotter are

1. Machining flat surfaces:
2. Machining cylindrical surfaces
3. Machining irregular surfaces and cam machining
4. Machining slots, keyways and grooves.

SLOTTER TOOLS

The tool in a slotter removes metal during its vertical cutting stroke. This changed cutting condition presents a lot of difference, in the tool shape. In a slotter the cutting pressure acts along the length of the tool. The rake and the clearance angle of a slotter tool apparently look different from a lathe or a shaper tool as these angles are determined with respect to a vertical plane rather than the horizontal. Slotter tools are provided with top rake front clearance and side clearance, but no side rake is given. The-nose of the tool projects slightly beyond the shank to provide clearance.

Conclusion:

There are many accessories and fittings, which, if provided greatly improve the performance and range of work which can be carried out on a Slotting machine.

GRINDING MACHINES

INTRODUCTION

Grinding is a process of material removal in the form of small chips by the mechanical action of abrasive particles bonded together in a grinding wheel. It is basically a finishing process employed for producing close dimensional and geometrical accuracies and smooth surface finish. However in same applications, the grinding process is also applied for higher material removal rates and is referred to as abrasive machining. Generally, in other methods of machining, the work piece is shaped by removing chips using cutting tools having designed geometry, with the tool material is harder than the work material. In such types of machining the process has the following limitations.

1) The difference in the hardness of the tool and of the work is often limited, resulting tool wear and tool failure.

2) In the process of removing materials by way of chips, a considerable amount of heat is generated which, when it exceeds a specific level, affects the tool hardness. These conditions always limit the applicable cutting speed.

TYPES OF GRINDING

Grinding is done on surfaces of almost all conceivable shapes and materials of all kinds.

Grinding may be classified broadly into two groups.

1. Rough or non-precision grinding. 2. Precision grinding.

ROUGH GRINDING

The common forms of rough grinding are snagging and off-hand grinding where the work is held in the operators hand. The work is pressed hard against the wheel, or vice -versa. The accuracy and surface finish obtained are of secondary importance.

Snagging is done where; a considerable amount of metal is removed without regard to the accuracy of the finished surface. Examples of snag grinding are trimming the surface left by sprues and risers on castings, grinding the parting line left on castings, removing flash on forgings, the excess metal on welds, cracks and imperfections on alloy steel billets.

PRECISION GRINDING

This is concerned with producing good surface finish and high degree of accuracy. Grinding in accordance with the type of surface to be ground is classified as

1. External cylindrical grinding
2. Internal cylindrical grinding
3. Surface grinding
4. Form grinding

GRINDING MACHINES

Grinding machines are broadly classified into cylindrical grinding machines, internal grinding machines, surface grinding machines and tool & cutter grinding machine, depending on the shape of the ground surface and the type of grinding they do.

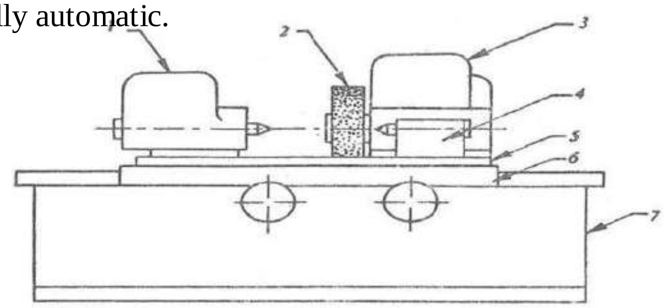
CYLINDRICAL GRINDING MACHINES

Cylindrical grinding machine is performed to remove material, to produce precise geometry, and to obtain the desired surface finish on external surfaces of round work pieces. These surfaces may be cylindrical, tapers, fillets, grooves, shoulders and other formed surfaces of revolution.

Centre type cylindrical grinding machine

Centre type grinding machine is used for single and multi-diameter shafts, especially when the concentricity must be held between diameters ground in the separate operations. In these type of machines, the work piece is supported in between the centre for stock removal.

Such machines basically consist of a bed, a wheel head (swiveling or non- swiveling type) and a tail stock. The head stock and tail stock are mounted on a swivel table which is moves to and fro in the bed guide ways. Centre type grinding machines may be manually operated, semi-automatic or fully automatic.



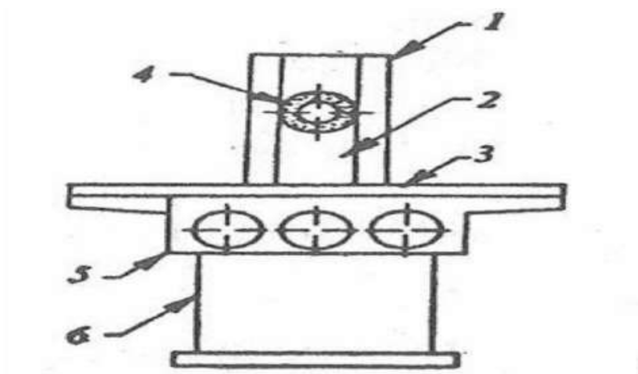
Block diagram of a plain centre-type grinder
1. Headstock, 2. Grinding wheel, 3. Wheelhead,
4. ailstock, 5. Upper table, 6. Lower table, 7. Base

SURFACE GRINDERS

Surface grinding machines are employed to finish plane or flat surfaces. They are also capable of grinding irregular, curved, convex, and concave surfaces. Conventional surface grinders may be divided into two classes: One class has reciprocating tables for work ground along straight lines, while the other covers the machines with rotating work tables for continuous rapid grinding. Surface grinders may also be classified according to whether they have horizontal or vertical grinding wheel spindles. So there may be four different types of surface grinders:

Horizontal spindle reciprocating table.

1. Horizontal spindle rotary table.
2. Vertical spindle reciprocating table.
3. Vertical spindle rotary table.



Block diagram of a horizontal spindle surface grinder
1. Column,2. Wheel head 3. Table Wheel,5. Saddle, 6. Base

Conclusion:

There are many accessories and fittings, which, if provided greatly improve the performance and range of work which can be carried out on a Grinding machine.

Ex. No: **Date:**

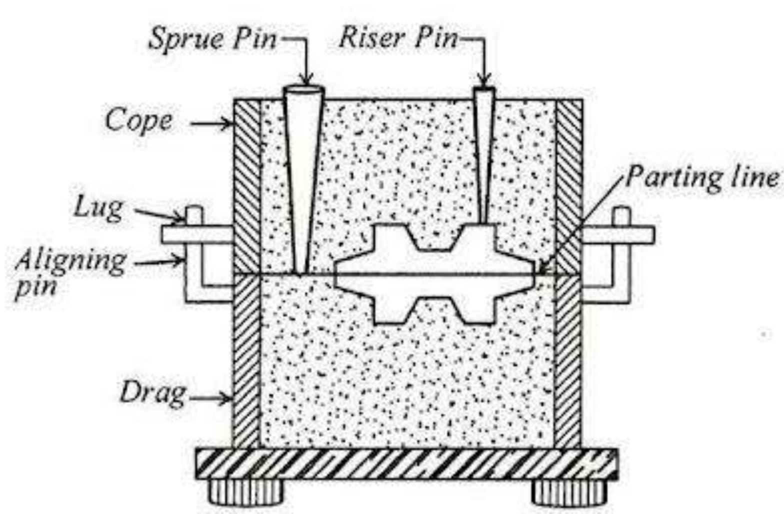
MOULD WITH SPLIT PATTERN

Aim

To make the mould for the given split pattern.

Material required

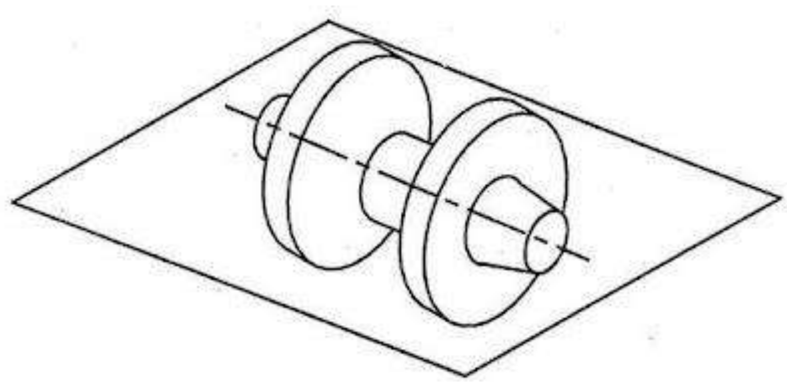
- Moulding board
- Riser pin
- Moulding box
- Sprue pin
- Green sand
- Rammer
- Trowel
- Lifter
- Riddle
- Draw spike
- Gate cutter
- Bellow
- Vent rod



Procedure

1. Place the moulding board on a horizontal surface.
2. The drag box is placed above the moulding board. Now one piece of pattern is kept at center of the drag as shown in figure.
3. The parting sand is spread before we keep the pattern.
4. Facing sand is sprinkled over the pattern to a depth of 2mm. then greensand is filled over it.
5. Proper ramming is done on the green sand to get a air free packing.
6. Excess sand is remove with strike off bar.
7. The drag is inverted upside down.
8. The cope box is place over the drag box.
9. Now the parting sand is sprinkled over the parting surface.
10. The other piece of pattern is placed over the drag pattern.
11. Facing sand is riddled over the pattern to a depth of 5mm. then riser is place over the pattern and another sprue pin above parting surface.
12. Now green sand is filled over it.
13. Ramming operation is done to get an air tight packing with strike off bar leaving it.
14. Riser pin and sprue pin gets removed from the green sand.
15. Pattern is removed gently now.
16. Gate is cut using gate cutter.
17. The vent holes are made with vent rod on the cope side.

<u>Result</u>



Thus the mould is created for the given split pattern.

Ex. No: **Date:**

ARC WELDING -LAP JOINT

Aim:

To prepare a lap joint.

Materials Required:

Mild Steel flat 100 mm X 50 mm X 5 mm.

Equipment Required:

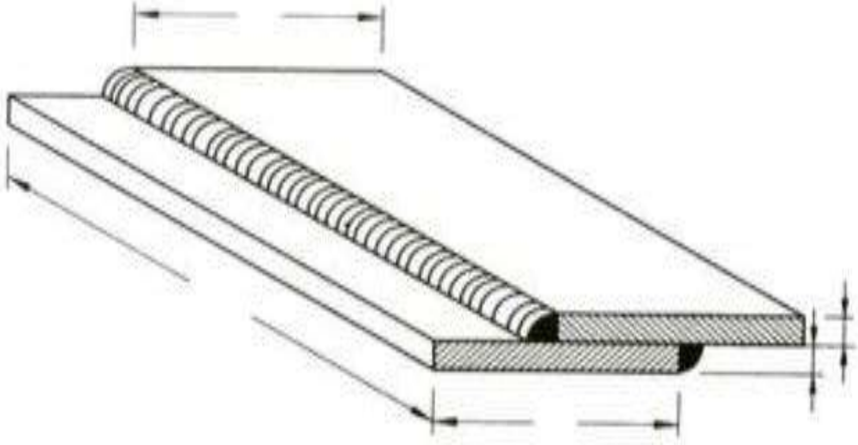
Flat, rough file, try square, step down transformer electrode holder, electric lugs, shield, goggles, gloves, electrode tongs.

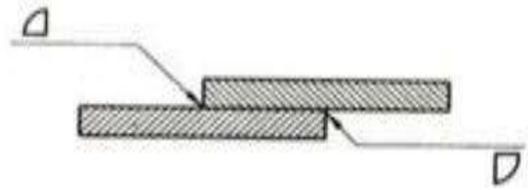
Procedure:

1. Mild steel flat is taken and it is filed using flat rough file.
2. After filing the right angles arc checked by using try square.
3. The above two steps are repeated on another work piece also.
4. The two pieces are kept one above the other in lap position.
5. Tags are made on either side of the work pieces, so that their positions are disturbedduring welding.
6. Welding is carried out, first on one side of the work pieces, allowing sufficient amount ofmetal to fill the weld puddle by slowly moving the electrode I wavy fashion.
7. After the welding is over, the slag which is formed on the top of the weld head isremoved by using chipping hammer.
8. The work pieces are reversed by holding them with tongs, and above two steps arerepeated.
9. The joint thus obtained is a lap joint.

Precautions:

1. Check the right angles of the work pieces properly using try square.
2. Tags should be made so that work pieces are not disturbed from their position
3. Arc is struck by touching the work piece with the electrode and quick removing the electrode away from the work piece. The electrode should be kept at a distance of equalto electrode diameters for maintaining the arc**.**





Result:

Lap joint has been produced by arc welding

Ex. No: **Date:**

EXTERNAL THREAD CUTTING BY USING A LATHE

AIM

To machine a work piece by facing, plain turning and external thread cutting operations using a lathe.

MATERIALS REQUIRED

- Mild steel polished round rod - □ 25 X 100 mm

TOOLS REQUIRED

- Outside Caliper
- Turning tool .
- Vernier Caliper
- External V – thread cutting tool

FORMULA

1) **Time taken for external threads:**

$$T = \frac{\text{Length of the cut}}{[\text{pitch x rpm}]} \times \text{Number of cuts}$$

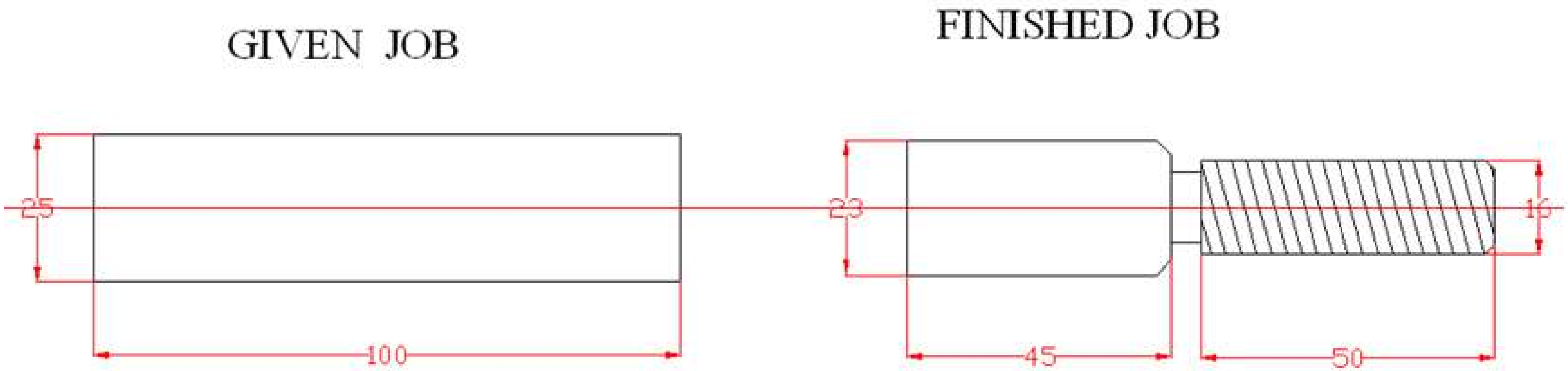
2) **Number of cuts**

$$T = \frac{25}{\text{Threads per 'cm'}} \text{ for external threads}$$

PROCEDURE

1. The given work piece is held firmly in a lathe chuck.
2. The cutting tool is set in a tool post such that the point of the Cutting tool coincides with the lathe axis.
3. The machine is switched on to revolve the work piece at the selected speed.
4. By giving Cross feed and longitudinal feed to the cutting tool, the facing and turning operations are done respectively.
5. The speed of the work piece is reduced.
6. The machine is switched off and the change gears of calculated teeth (as per calculation) are connected.
7. Again the machine is switched on.
8. The external thread cutting operation is done using external thread cutting tool by engaging thread cutting mechanism.
9. The machine is switched off.
10. The work piece is removed from the chuck and all the dimensions are measured and checked.

EXTERNAL THREAD CUTTING



ALL DIMENSIONS ARE IN mm

CALCULATION

The number of teeth on change gears is calculated using the following formula:

Driver teeth/ Driven teeth = Pitch of the work / pitch of the lead screw

RESULT

The given work piece as shown in fig. is subjected to facing, plain turning, knurling and external thread cutting operations to become a finished work piece as shown in fig.

Ex. No: **Date:**

ROUND BAR TO SQUARE HEAD IN SHAPING

Aim

To machine the given round bar into rectangular block in shaping machine

Tools Required

Round nose tool

Vernier caliper

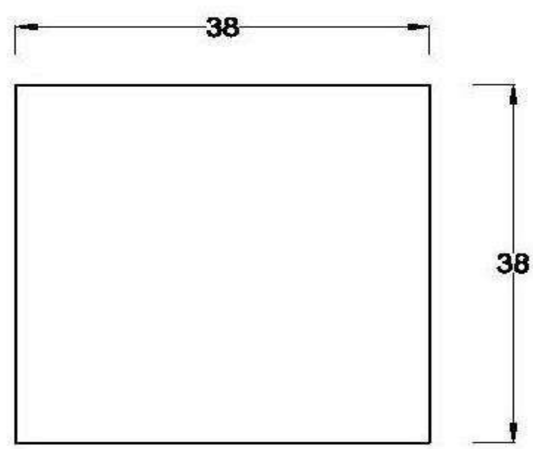
Steel Rule

Hammer, Punch, Scriber

Try square

Vernier height gauge

SQUARE HEAD SHAPING



All dimensions are in mm

Materials Supplied: Mild steel:

Tool Material: High Speed Steel (H.S.S)

Procedure

1. The given raw material rectangular block is measured. The machining allowances are noted. Then the job is coated with white chalk for marking purpose.
2. The job is position in the marking table. The vernier height gauge is set to the correct dimensions as per the part drawing dimensions
3. After, the height -- mm is corrected in the vernier height gauge; the vernier scriber is marked in the face sides of the rectangular block.
4. To identify the dimensions of the job, the marking lines are punched
5. The work piece is placed in the shaping machine work holding device in correct position. Tool is held in the head in suitable position.
6. The stroke length and initial cutting position are corrected by adjusting the ram and table manually
7. The tool is held in the tool post in vertical position
8. Now, the machine is switched ON. The tool moves over the work, the materials is removed from the work by the tool cutting force.
9. By giving cross-feed movement to the table, the total length of work is machined, after completion of one cut, the depth of cut is adjusted in the tool head. Then the next cut is taken.
10. By repeating the above same procedure, the other faces are machined to the required dimensions
11. After completion of six faces, the work is removed from the vice, cleaned and inspection is carried out. The job No / Roll No are punched in the face side of the work.

Result

The given work piece rectangular block is machined as per the dimension in the shaping machine.

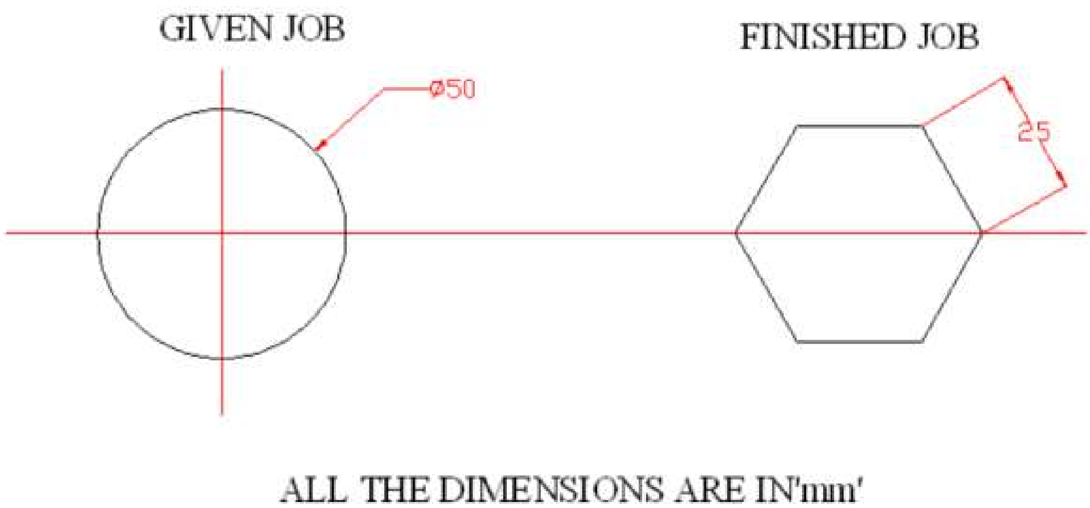
Ex. No: **HEXAGONAL BLOCK** **Date:**

Aim:

To machine a hexagon in the given work piece to the dimensions as shown in the figure Using Milling Machine

Tools Required:

- Milling Machine,
- Scriber, Divider,
- Steel Rule,
- Chalk piece,
- Bevel Protractor.



Materials Supplied: Mild steel:

Tool Material: High Speed Steel (H.S.S)

Procedure:

1. The given work piece is measured for its initial dimensions.
2. With the help of scriber, mark the hexagon dimensions in the work piece.
3. Fix the work piece in the vice of the Milling machine.
4. After fixing the work piece and the stool, allow the ram to reciprocate.
5. Start the shaping process by giving the required depth by lowering the tool.
6. Slowly increase the depth of cut and repeat the procedure to make the hexagon shape.
7. The work piece is now checked for final dimensions.

Result:

Thus, a hexagon is machined in the given work piece to the dimensions as shown in the figure using Milling Machine.

Ex. No: **Date:**

PLAIN MILLING

AIM

To perform the plain milling in a horizontal milling Machine on the given work piece for the given dimensions.

MATERIALS REQUIRED

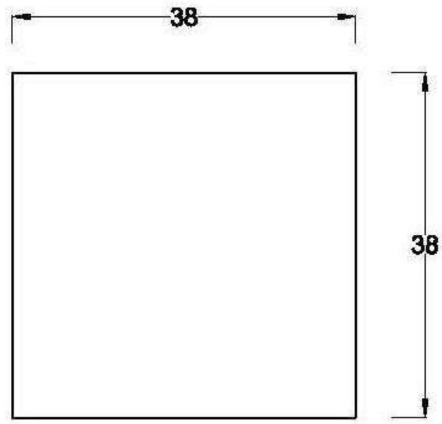
Mild steel Plate of Length 50x50 mm

TOOLS REQUIRED

Steel rule, Flat file (rough and smooth), Try square.

PROCEDURE

1. The work piece was fitted in the vice and filed to the required dimensions.
2. The squareness of the work piece was checked.
3. Drawing punches were made for milling operations.
4. The job was fitted on the radial drilling machine.
5. Milling operation is made for entire work piece to attain required dimensions.



All dimensions are in mm

Materials Supplied: Mild steel:

Tool Material: High Speed Steel (H.S.S)

RESULT

Thus the work piece for the required dimensions is obtained by performing plain milling in a horizontal milling Machine

Ex. No: **EXTERNAL KEYWAY USING MILLING MACHINE** **Date :**

AIM:

To cut a External keyway on the given specimen as per the dimensions using Milling machine.

MATERIALS REQUIRED

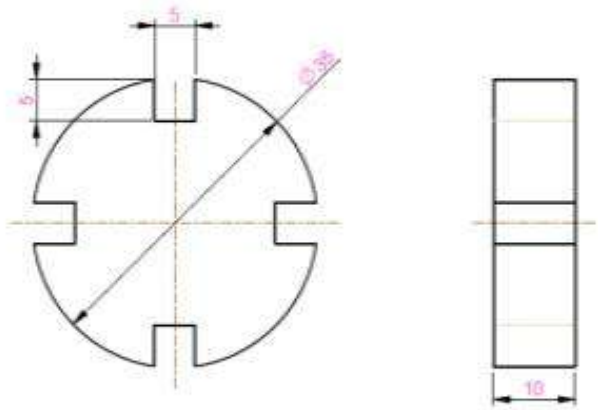
Cast iron blank of Φ 50mm x 10mm.

TOOLS REQUIRED

1. Steel rule
2. Vernier caliper (0-150mm)
3. T bolt strap
4. Spanner
5. **punch**

PROCEDURE:

1. First the given work piece is fitted on chuck and it is turned along the diameter to the required dimension are marked.
2. Then the facing operation is done on both the sides of the work piece.
3. Then the work piece is fixed in the Milling machine.
4. Indexing was done on the Milling machine.
5. By adjusting the feed hand wheel the key way are cut outer diameter of the work piece.
6. Then the same procedures are repeated for next key way.



All Dimension Are in MM

RESULT: Thus the key way is made on the work piece by slotting machine.

VIVA QUESTIONS

1. Write any ten nomenclature of plain milling cutter?

Body of cutter, cutting edge, face, fillet, gash, lead, land, outside dia, root dia, cutter angles.

2. What are the advantages of milling process?

1. It does not require a backlash eliminator.

2. Mild surface does not have built up edge.

3 .what are the down milling processes?

1. Cutter with higher rake angle can be used. This reduces power requirements.

2. Cutter wear is less because chip thickness is maximum at the start of cut.

4. List out the various milling operations?

1. Plain or slab milling. 2. Face milling. 3. Angular milling. 4. Gang milling. 5. End milling. 6. Gear cutting.

5. What does term indexing mean?

Indexing is the process of dividing the periphery of a job into equal number of divisions.

6. What are the three types dividing heads?

1. Plain or simple. 2. Universal. 3. Optical.

7. What are the different types of thread milling?

1. Thread milling by single form cutter. 2. Thread milling by multi form cutter.

8. What is the function of cutting fluids?

1. It is used to cool the cutting tool & the work piece.

2. It improves the surface finish as stated earlier.

3. It causes the chips to break up into small parts.

4. It protects the finish surface from corrosion.

5. It prevents the corrosion of work & machine.

9. What are the properties of cutting fluid?

a. High heat absorbing capacities.

b. It should have good lubricant properties.

c. High flash point.

d. It should be odourless.

e. It should be non-corrosive to work & tool.

10. State any two comparisons between plain &universal milling machine?

• In plain milling machine the table is provided with three movements, longitudinal, cross & vertical. In universal milling machine in addition to these three movements, there is a forth movement to the table. The table can be swiveled horizontally & can be fed at angles to the milling machine spindle.

• The universal milling machine is provided with auxiliaries such as dividing head, vertical milling attachment, rotary table etc. Hence it is possible to make spiral, bevel gears, twist drills, reamers etc on universal milling machine.

11. What are the other forming methods for manufacturing gears?

1. Gear cutting by single point form tool.

2. Gear cutting by shear speed shaping process.

3. Gear broaching.

4. Template method.

5. Gear milling using a formed end mill.

12. List the various type of milling attachment?

1. Vertical milling

2. Universal milling

3. High speed milling

4. Rotary

Ex. No: **Date:**

INTERNAL KEY WAY CUTTING IN SLOTTER

Aim:

To cut internal key to the required dimensions in slotting machine

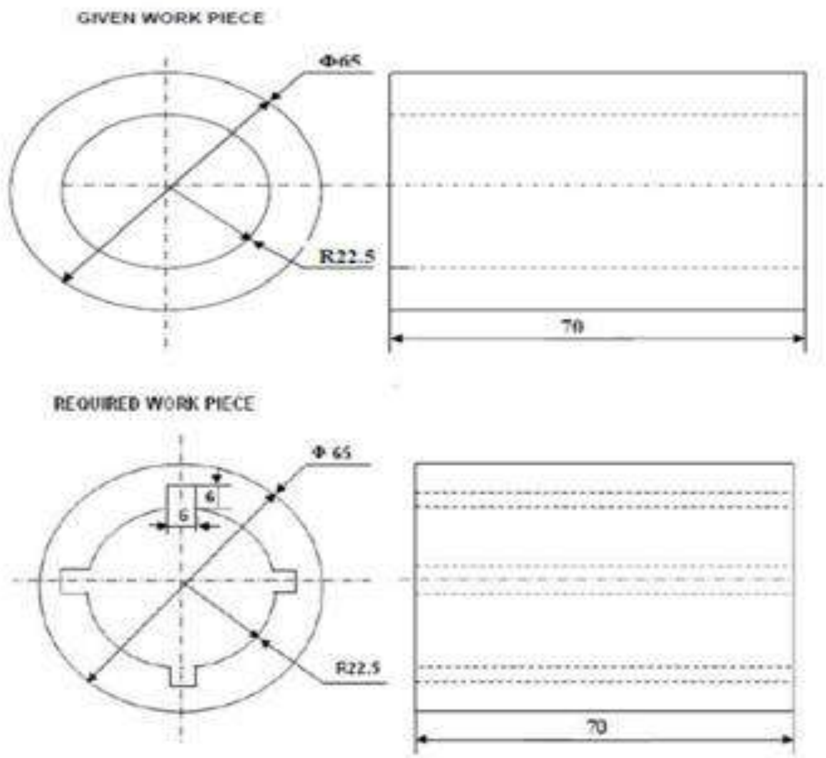
Tools Required:

1. Steel rule
2. 2. Tipped tool
3. Scriber
4. Dot punch
5. Anvil
6. Surface gauge
7. Steel rule

Procedure

1. The tool is fixed to the tool post such that the movement should be exactly perpendicular to the table.
2. The work piece is then set in the vice such that the tool is just above the work piece. Adjust the length of the stroke of the ram.
3. Slotting operation is performed and makes one slot on the work piece to the required dimensions.
4. Then bring the tool to the initial position.
5. Rotate the work table by an angle 90^{o} and continue the process for the second slot.
6. Repeat the process for the remaining slots.

Internal key way



All dimensions are in mm

RESULT: The job is completed successfully and safely.

Ex. No: **Date:**

CYLINDRICAL GRINDING

AIM:

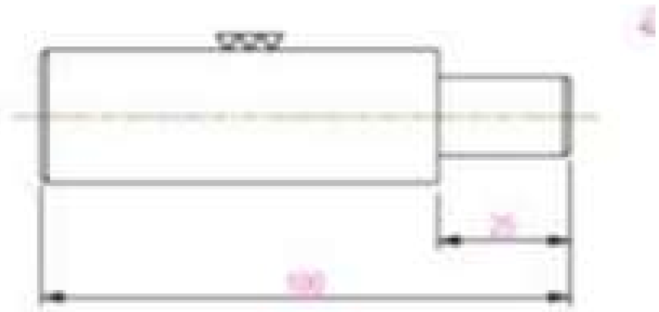
To grind the cylindrical surface of the given materials as per the given dimensions.

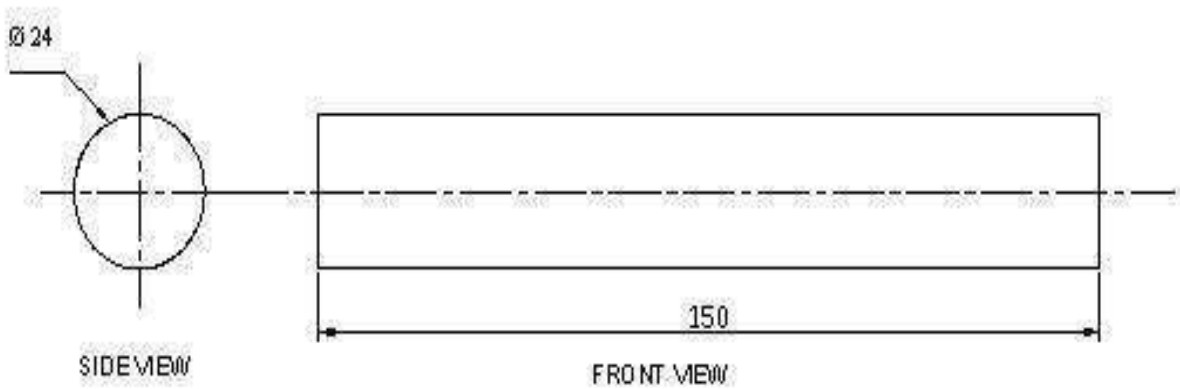
APPARATUS REQUIRED:

1. Grinding Machine
2. Grinding Wheel
3. Work Piece
4. Steel rule.
5. Outside calipers.
6. Cutting tool.

PROCEDURE:

1. The given work piece is first fitted in the chuck of the lathe.
2. By fitting the tool in tool post the work piece will be reduced to given dimensions.
3. First reduce the diameter to 23mm size then reduced the diameter to 15mm and 18mm at the middle.
4. By facing the work piece to the tool work piece is reduced to 70mm.
5. After the preliminary lathe operation, the work piece is held in the ends of the cylindrical grinder.
6. The grinding wheel is turned on and it is moved towards the work piece such that the surfaces of the cylindrical position are grinded to +-0.2mm.





RESULT

Thus the required dimension of cylindrical surface is obtained.

1. Define Grinding

Ans: A process of material removal in the form of small chips by means of rotating abrasive particles bonded together in a grinding wheel to produce flat, cylindrical or other surfaces is known as grinding.

2. Define Grinding Wheel

Ans: A wheel composed of hard and sharp edged abrasive grains held together by a bonding material and is used to finish within close tolerances on various surfaces by its abrasive action is known as grinding wheel.

3. Define Grinding Machine.

Ans: The machine tool designed for finishing within close tolerances to the flat, cylindrical or other surfaces by the abrasive action of a rotating wheel is called a grinding machine or simply grinder.

4. Name the elements which are considered in the construction of a grinding wheel.

Ans: Six important elements which are considered in the construction of a grinding wheel are as follows:

(a) Abrasive
(b) Grain Size
(c) Bond and bonding material
(d) Grade
(e) Structure
(f) Wheel shape

5. Define abrasives used in grinding wheels.

Ans: Abrasives used for making grinding wheels may be classified as follows:

1. Natural abrasives
2. Artificial abrasives.

6. Name some natural abrasives.

Ans: The commonly used natural abrasives are as follows:

1. Sand stone or quartz
2. Emery

3. Corundum
4. Garnet
5. Diamond

7. Name some artificial abrasives.

Ans:

1. Silicon carbide
2. Aluminium Carbide

8. Define grain size in connection with grinding wheel.

Ans: The abrasives are produces by grind mills. The size of grains produced by this process is called grain size.

9. Name different types of grinding wheels.

1. Built-up wheels
2. Cone and plug shape wheels
3. Mounted wheels
4. Diamond wheels

10. Define dressing of grinding wheels.

Ans: Dressing may be defined as the operation of sharpening dull abrasive grains or exposing fresh sharp grains on the face by cutting a portion of the wheel.

Ex. No: **Date:**

DRILLING, BORING REAMING AND TAPPING

AIM

To perform the drilling, Boring and Reaming in a drilling Machine on the given work piece for the given dimensions.

MATERIALS REQUIRED

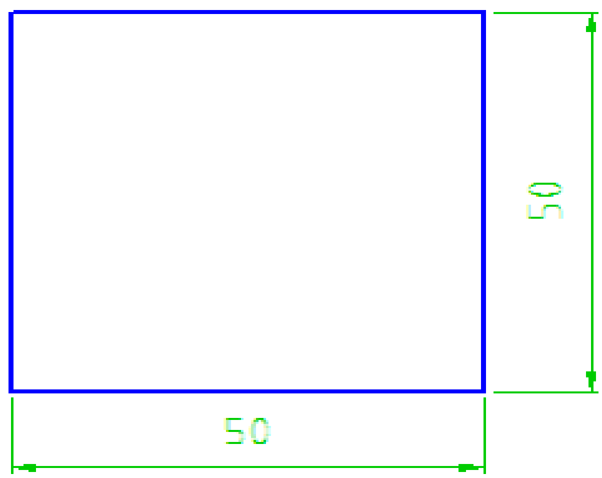
Mild steel Plate of Length 50x50 mm

TOOLS REQUIRED

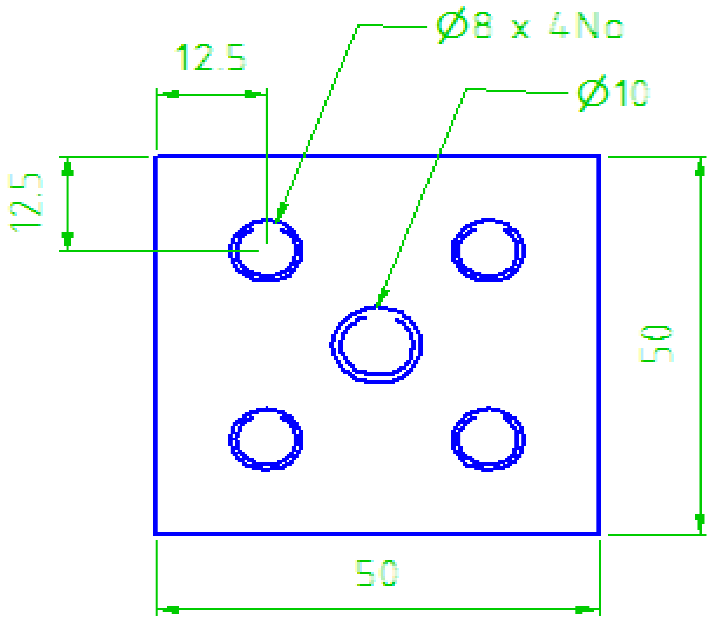
Steel rule, Flat file (rough and smooth), Drill bit (8 mm, 10 mm, 10.5 mm), Reaming tool, Try square

PROCEDURE

1. The work piece was fitted in the vice and filed to the required dimensions.
2. The squareness of the work piece was checked.
3. Drawing punches were made for various drills.
4. The job was fitted on the radial drilling machine.
5. The 10 mm & 8 mm drill bit were used for drilling in the required place and drilling operation was made on the work piece.
6. Boring was done on the 10mm hole using the boring tool.
7. Reaming was done on the 8 mm hole using the Reaming tool size of 8 mm diameter.
8. The work piece was removed from the radial drilling machine.



BEFORE MACHINING



AFTER MACHINING

All dimensions are in mm

RESULT

Thus the work piece for the required dimensions is obtained by performing drilling, Boring and Reaming in a drilling Machine.

1. What is meant by drilling?

Ans: Drilling is the process of producing hole on the work piece by using a rotating cutter called drill.

2. Mention any four specification of drilling machine?

Ans:
1. Maximum size of the drill in mm that the machine can operate
2. Table size of maximum dimensions of a job can mount on a table in square meter
3. Maximum spindle travel in mm
4. Number of spindle speed & range of spindle speeds in r.p.m.

3. List any four machining operations that can be performed on a drilling machine?

Ans:
1. Drilling
2. Counter sinking
3. Tapping
4. Trepanning

4. What are the different ways to mount the drilling tool?

Ans:
1. fitting directly in the spindle
2. By using a sleeve
3. By using a socket
4. By means of chucks

5. What is the function of cutting fluids?

Ans:
1. It is used to cool the cutting tool & the work piece.
2. It improves the surface finish as stated earlier.
3. It causes the chips to break up into small parts.
4. It protects the finish surface from corrosion.
5. It prevents the corrosion of work & machine.

6. What are the properties of cutting fluid?

Ans:
1. High heat absorbing capacities.
2. It should have good lubricant properties.
3. High flash point.
4. It should be odourless.
5. It should be non-corrosive to work & tool.