UNIT: 4
Fitting, Drilling and Grinding

STRUCTURE

FITTING

INTRODUCTION:

Fitting is a process of assembling of main machine parts. A bench work has its own importance, where parts often require a hand operation of it them to desired accuracy.

Fitting tools are

1. Marking tools
2. Cutting tools
3. Striking tools
4. Holding tools
5. Miscellaneous tools
6. Checking and measuring tools

MARKING TOOLS:

Marking out is the technique of reproducing the layout from the blue print by means of scribed lines, so that the job may be finished to the required specification. Marking tools are used in this process.

Following are the marking tools, commonly used in the fitting shop

V-block:

The V-block is made of cast iron and all the faces are machined true. The two opposite side faces have V-grooves and the two have slots. The round bars are held firmly by a U-clamp engaging in slots, which prevents the bar from rotating. The V-blocks are used for holding round bars during marking and centre drilling their end faces which are to be held between centers on lathe. It is also suitable for holding round bars while they are drill' at right angles to their axis. V-blocks are specified by length, width and height.

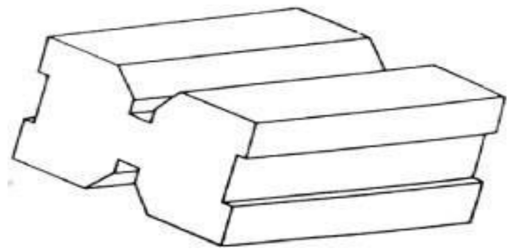


Fig 4.1 V - Block

Angle Plate:

The angle plate is made of grey cast iron and two plane surfaces at right angles to each other. It is used combination with the surface plate for supporting work in perpendicular position. It has various slots in it to enable the work to be held firmly by bolts and clamps.

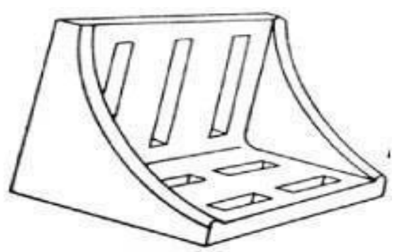


Fig 4.2 Angle Plate

Try Square:

It consists of a steel blade fitted into a steel stock of rectangular cross-section as shown in Fig. 4.3 It is used for testing the squareness of surfaces and to scribe lines at right angles to a given edge.

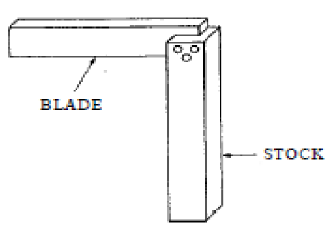


Fig 4.3 Try Square

Scriber:

The scriber as shown in Fig. 4.4, is a piece of hardened steel about 150 to 300 mm and 3 to 5 mm in diameter, pointed at one or both ends like a needle. It is held like a pencil to scribe lines on metal. The bent end is used to scribe lines in places where the straight end cannot reach. The ends are sharpened on an oilstone when necessary.

Fig 4.4 Scriber

Scribing Block or Surface Gauge:

Scribing block is an instrument used for scribing lines on vertical surfaces or transferring height from one job to another, using a scriber.

These scribing blocks can be available in two types

1. Simple scribing block
2. Universal surface gauge

Simple Scribing Block:

It consists of a cast iron sliding base, on the centre of which a steel rod (spindle) is fixed vertically as shown in fig. A steel scriber held in the holder, scriber is slide, tilt and rotate on the rod after clamping it with a set screw. It is normally used in combination with surface plate. Its specific use is in locating centers of round rods held in V-block describing straight lines on work, held firmly in its position by means of angle plate and also in drawing a number of lines parallel to a true surface.

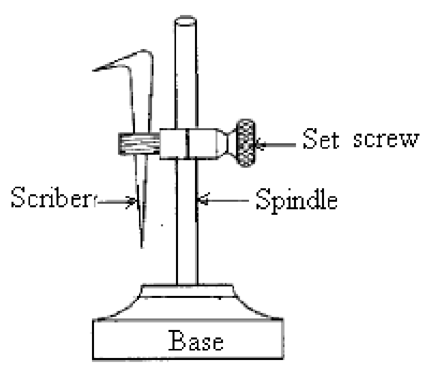


Fig 4.5 Simple Sliding Block

Universal Surface Gauge:

It consists of a cast iron base perfectly machined and planed at the top, bottom and all sides as shown in Fig 3.1.5.b. It carries a spindle, which may be set at any angle. A scriber, which may also be set at any angle or at any height is clamped to the spindle. A fine adjustment is provided by a screw (height adjustment screw) and movement of this screw swings the scriber through a small arc and so varies the height. It carries a V-shaped slot in the base, which helps to rest it on a round bar, so that the dimensions may be set off from the bar to some other part of the work.

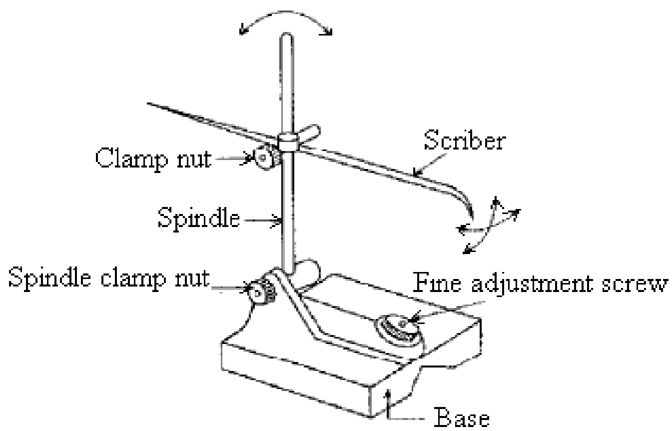


Fig 4.6 Universal Surface Gauge

It is used:

- For marking on vertical, as well as on horizontal surfaces.
- To find out the centre of around work, to align work in centre.
- To layout marking on a work of any shape.

Punches:

A punch is a primary marking tool used in bench work. It is made of cast steel. It has a serrated or knurled body to enable a firm grip by hand. One end (top called head) of it is slightly chamfered and flat, to prevent from burring while hammering and the other end carries a point ground to some included angle.

Various Types of Punches are:

Prick punch, centre punch, number punch and letter punch

Prick punch:

It has a sharper point with an included angle of 30°. It is used for marking position of lines and centers of circles to be drawn with the dividers.

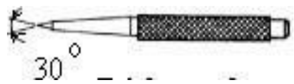


Fig 4.7 Prick punch

Centre punch:

It has a point ground to an included angle of 60° or 90°. It is used for marking the ends of work to be centered for turning in lathe, for all centers of holes, for drilling, for marking in sawing, chipping, etc.

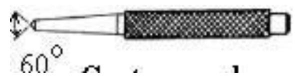


Fig 4.8 Centre punch

Number Punch:

It is used to mark numbers from '0' to '9' on work surfaces.

Letter Punch:

It is used to mark letters from 'A' to 'Z' on work surfaces.

Cutting tools:

Cutting tools plays a most important role in removing excess metal from the job to obtain desired finished part. The various cutting tools used in fitting are:

1. Chisels.
2. Hacksaws.
3. Files.
4. Scrapers.
5. Drill bits.
6. Reamers.
7. Taps.
8. Dies and stock.

Chisels:

Cold chisels are used for cutting thin sheets and to remove excess material from large surfaces. In this case the surface finish and accuracy are usually poor.

Parts of chisel: It consists of following parts

1. Head

2. Body or shank

3. Point or cutting edge

Head:

The head is tapered towards top and made tough to with stand hammer blows

Body or Shank:

The cross section of the shank is made hexagonal or octagonal to have grip while working.

Point or Cutting Edge:

The cutting edge is hardened and tempered and made to specified angle. The hardening followed by tempering makes the chisel to maintain its sharp edge.

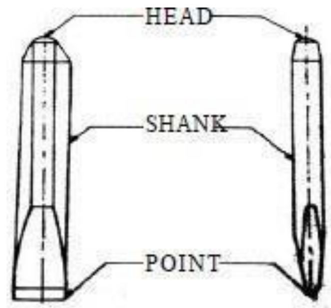


Fig 4.9 Parts of Chisel

The shape of cutting edge is required to specify the chisel. The five most important types of chisels are:

1. Flat chisel
2. Cross cut chisel
3. Half round chisel
4. Diamond point chisel
5. Side chisel

Flat Chisel:

It is most common chisel used for chipping large surface sand cutting the sheets. It is also used to part off metal after chain drilling. The length of a flat chisel varies from 100mm to 400mm and the width from 16mm to32mm.

Fig 4.10 Flat Chisel

Cross Cut Chisel:

The crosscut chisel or cape chisel is used for cutting grooves and channels and keys ways in shafts and pulleys. Its cutting edge is wider than the supporting metal to provide clearance. The length of chisel varies from 100mm to 400mm and width varies from 4mm to 12mm.

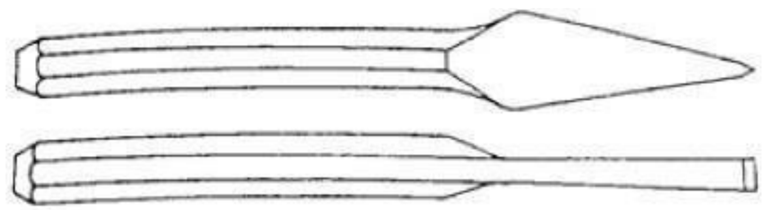


Fig 4.11 Cross Cut Chisel

Half Round Chisel:

It is particularly useful for cutting oil ways, cutting curved grooves in bearings, bosses and pulleys. They are also used for setting over pilot holes. When a hole is to be drilled a pilot hole is drilled first.

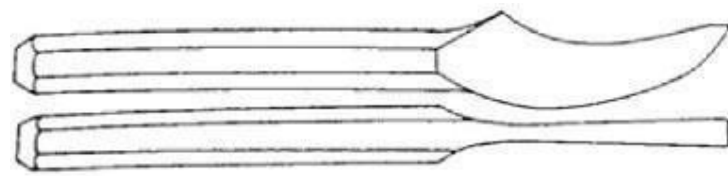
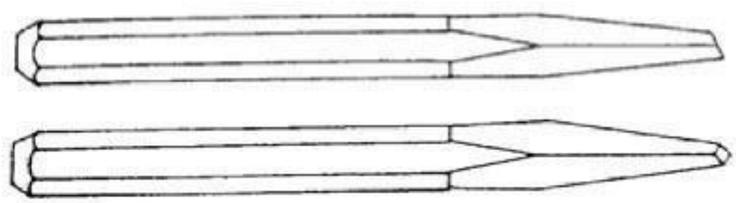


Fig 4.12 Half Round Chisel

Diamond Point Chisel:



Its edge is in the form of diamond used for cutting V- grooves, cleaning corners and squaring small holes.

Fig 4.13 Diamond Point Chisel

Side Chisel:

This is used for chipping and removing the surplus metal in rectangular slots. The shank of the chisel is bent out a little side way and vertically down again.

Fig 4.14 Side Chisel

Hacksaw:

It is a basic hand cutting tool used for cutting unwanted material. It is used for cutting metals and making recesses prepare to filing or chipping. It is also used for cutting slots and contours.

Parts of Hack saw:

It consists of the following parts.

1. Metal frame   2. Blade   3. Handle

4. Wing nut   5. Screw

The frame is made to hold the blade tightly. They are made in two types.

a) The solid frame hack saw in which the length cannot be changed.

b) The adjustable frame in which the frame can be adjusted to hold the blades of different lengths.

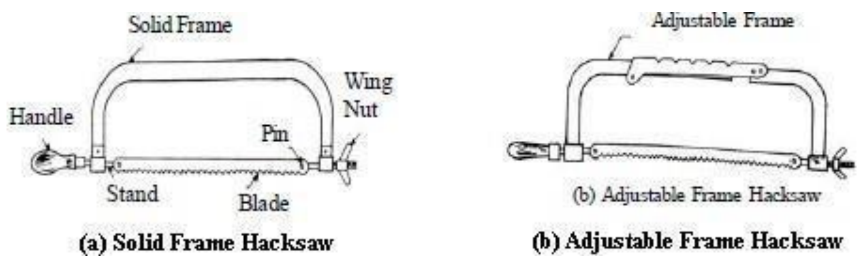


Fig 4.15 Types of Frames

Hacksaw Blade:

It is thin, narrow steel strip made of high carbon steel or low alloy steel or high speed steel. The blade has two pin holes at the ends which fits over two pins which project from the stand that slides in and out of the frame end. Tightening the wing nut at the frontend tensions the blade sufficiently to prevent it from flexing when cutting. The blade must be fitted such that teeth points away from the handle so that cut takes on the forward stroke.

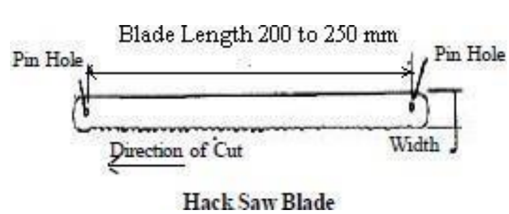


Fig 4.16 Hacksaw blade

Files:

File is a cutting tool with multiple teeth like cutting edges used for producing smooth surface. The accuracy that can be achieved from 0.2 to 0.05 mm.

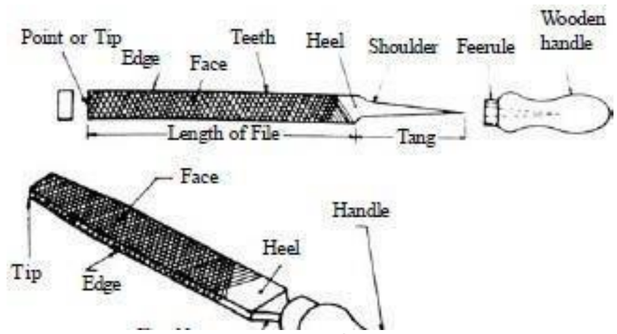


Fig 4.17 Parts of a File

Parts of the file:

1. **Tang:** It is the pointed part which fits into the wooden handle.
2. **Tip or point:** It is the opposite end of the tang.
3. **Face or side:** This is the broad part of a file with teeth cut on it.
4. **Edge:** It is the safe edge of file which has no teeth.
5. **Heel:** The heel is next to handle of the file with or without teeth.
6. **Shoulder:** The curved part of the file separating the tang from the body.
7. **Handle:** The part which is fitted to the handle made of wood.

The files of different cross section or types are needed to suit the various job operations. The most commonly used files are

1. Flat file	2.Hand File	3.Square file	4.Round file
5. Half round file	6.Triangular file	7.Knife edge file	8.Pillar file

Flat file:

This is tapered in both width and thickness used for heavy filing. This file is parallel to about two third of length, then tapers in both width and thickness.

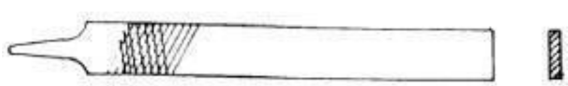


Fig 4.18 Flat File

Hand file:

This is used where flat file is not suitable for filing flat surfaces and has rectangular cross section with parallel edges throughout but thickness is tapered towards point.

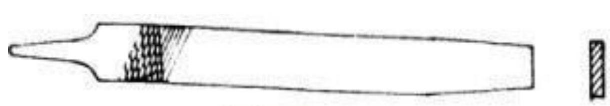


Fig 4.19 Hand File

Square file:

This is in square cross section used for filing square and rectangular holes and for finishing the bottom narrow slots.

Fig 4.20 Square file

Round file:

They are round in cross-section and usually tapered. They are used for filing circular holes, curved surfaces and finishing fillets.

Fig 4.21 Round File

Half round file:

This file is tapered double-cut and its cross-section is not a half circle but only one third of a circle. This file is used for round cuts and filing curved surfaces.

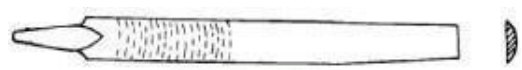


Fig 4.22 Half Round File

Triangular file:

The cross section of file is like equilateral triangle used for filing grooves, slots, holes and sharp corners.

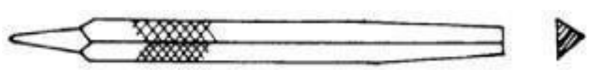


Fig 4.23 Triangular file

Knife edged file:

Its shape is like a knife used to file narrow slots, grooves and sharp corners. Its width and thickness are tapered towards point in the form of knife.

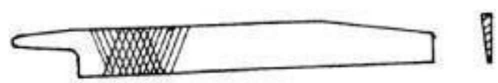


Fig 4.24 Knife edged file

Pillar file:

A pillar file is similar to hand file, it has rectangular cross section but is narrower and thicker than hand file. It has one or both uncut edges (i.e, safe edges) and is used for narrow work, such as keyways, slots and grooves.

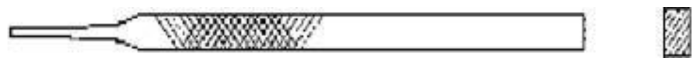


Fig 4.25 Pillar file

Needle File:

The needle files are made in sizes from 100 to 200 mm, various shapes and cuts. They are extremely delicate and are used for fine work such as pierced designs in thin metal. They are very easily broken, so care should be taken when using them.

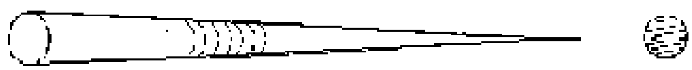


Fig 4.26 Needle File

Scrapers:

These are used to shaving off thin slices of metal to make a fine and smooth surface which is not possible with a file or chisel. This is made of good quality forged steel and its cutting edge is usually made thin, made from old files.

Parts of Scrapers

1. Cutting edge with rounded corners
2. Blade
3. Tang
4. Wooden handle.

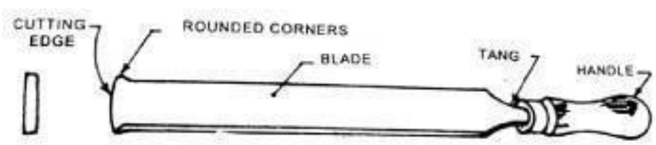


Fig 4.27 Scrapper

1. **Cutting edge with rounded corners:** The cutting edge is hardened without tempered to make hard.
2. **Blade :** The broad part of a scraper
3. **Tang:** The narrow part which fits into wooden handle.
4. **Wooden handle :** That fits into tang to have grip while scrapping

According cross section, the scrapers are classified into three types. They are

1. Flat scraper 2.Triangular scraper 3. Half round scraper.

Flat Scraper:

This type of scraper is used for scrapping plane surfaces or slots and the cutting edge at the ends of the blade is curved. The corners are rounded to prevent deep scratches on finished surface. It also helps to scrap the metal exactly at the desired spot.

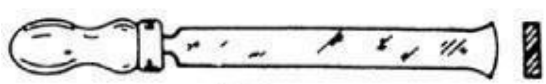


Fig 4.28 Flat Scraper

Triangular Scraper:

It has three cutting edges and is made from old triangular files used to scrap round or curved surfaces and to remove sharp corners.

Fig 4.29 Triangular Scraper

Half round Scraper:

It is used for finishing curved surfaces and chamfering holes and removing burrs.

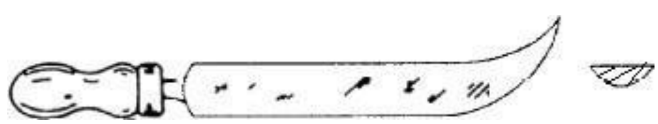


Fig 4.30 Half round Scraper

Dies and diestock:

It is a circular disc of hardened tool steel used to make external threads on a round rod or bolts with a die and stock. Die has a hole containing threads and flutes which form cutting edges.

These are mainly two types

1. Solid Die **2. Adjustable Die**

Solid Die:

It is one which has fixed dimension and cannot be adjusted for smaller or large diameter. It is used for re-cutting damaged threads and may be driven by suitable wrench.

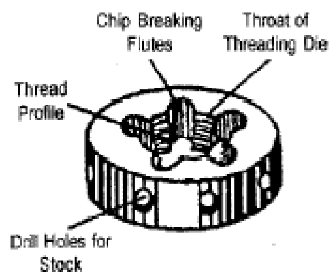


Fig 4.31 Solid Die

Adjustable Die:

It can be set to cut larger and smaller diameters. It has a split through one side and a slight adjustment is possible with the help of setscrew.

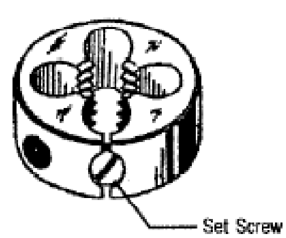


Fig 4.32 Adjustable Die

Die stock:

The tool for holding and turning the threading die is called a die-stock. It is often just called a stock. Die stocks are provided with threaded pins. When the die has been inserted into the stock the thread pins are tightened so that they engage in the drill holes of the die to hold it.

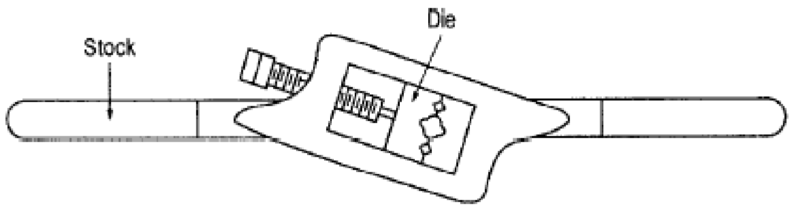


Fig 4.33 Die stock

Striking Tools:

Hand hammers are also called striking tools used to strike the job. They are made of forged steel of various sizes and shapers to suit various purposes like punching, chipping, marking, bending and riveting.

Parts of Hammer

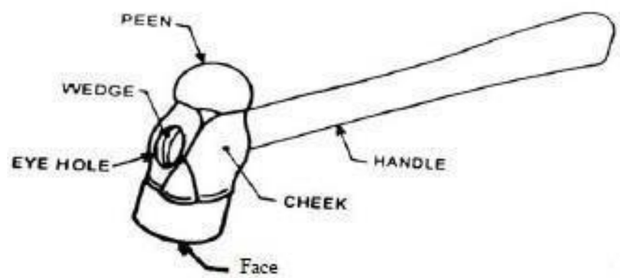


Fig 4.34 Parts of Hand Hammer

A hammer consists of four parts namely

1. Face **2.Peen** **3. Cheek** **4. Eye-hole.**

Face: It is the striking portion polished well and is given slight convexity to avoid spoilage of the surface of the metal to be hammered.

Peen: It is the other end of the head and is made into different shapes to suit various operations.

Cheek: Middle portion of the hammer head.

Eye-Hole: It is made oval or elliptical in shape to accommodate the handle.

Depending upon the shape of the peen, hand hammers are classified as

1. Ball Peen Hammer **2. Cross PeenHammer**

3. Straight Peen Hammer **4. Soft PeenHammer**

Ball Peen Hammer:

It has a flat striking face and ball shaped peen which is hardened and polished.

This hammer is chiefly used for chipping and riveting.

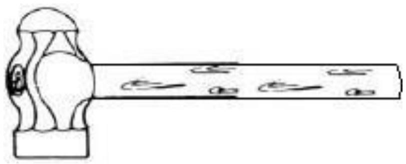


Fig 4.35 Ball peen hammer

Cross Peen hammer:

It has wedged shape peen across the eye. It is used for bending, stretching, hammering into shoulders.

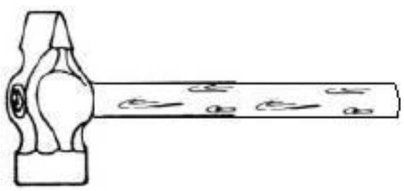


Fig 4.36 Cross peen hammer

Straight peen hammer:

This is similar to cross peen hammer except that the peen in this case is parallel to eye. It is used for stretching and peening the metal.

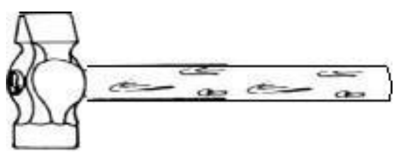


Fig 4.37 Straight peen hammer

4.3.4. Soft hammer or Mallet:

These are soft hammers used give light blows where the work surface must not be amaged. They are made of either rubber, plastic or wood.

Fig 4.38 Soft hammer or Mallet

Holding Devices or Vice:

In most of the metal cutting operations quite a large number of forces will be involved. So it is necessary that the work must be secured highly so that it does not move when subjected to the cutting forces. Therefore, holding the job is an important aspect of all metal cutting operations. A vice is a work holding device used to grip the job tightly. Different types of vices are used for various purposes. They include

1. Bench vice **2.Pipe vice** **3.Hand vice**

4. Pin vice **5.Tool maker's vice**

Bench Vice:

This is most commonly used tool for holding the work. It has two jaws one of which is fixed to the bench and other slides with the aid of square screw and a box nut arrangement. The outer end of screw carries a handle, and a collar prevents the screw from coming out of the unit while rotating. The sliding jaw moves close to the fixed jaw to hold the work and the tightening force is exerted by further rotation of handle. The working faces of jaws are serrated to give additional grip.

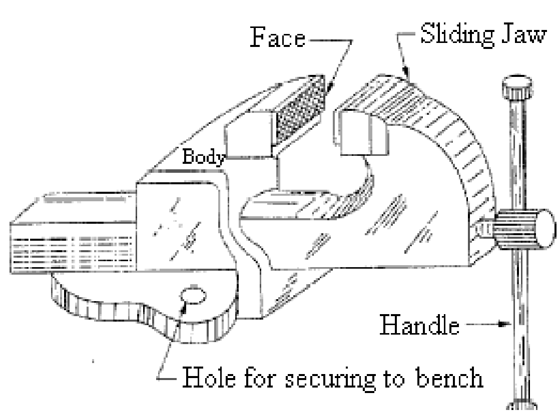


Fig 4.39 Bench Vice

Pipe Vice:

It is generally used for holding round sections, tubes and pipes etc. It has two serrated jaws, one is fixed and that is moved by rotation of handle. It is used in plumbing work and it grips the circular objects at four points on its surfaces.

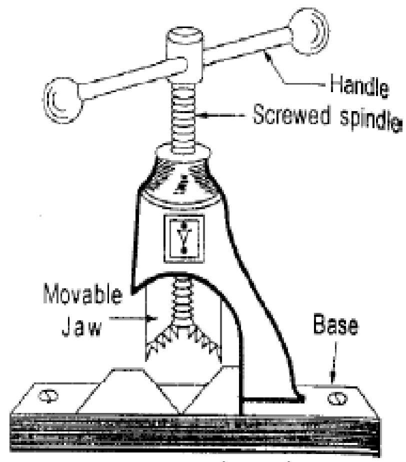


Fig 4.40 Pipe vice

Hand Vice:

It is used for gripping small objects like screw, rivets and keys when they are inconvenient to hold by the bench vice. It has two legs made of Mild steel which holds two jaws at the top and are hinged together at the bottom .A spring is provided between these legs to keep them away. The work is held between the serrated jaws by means of a wing nut and screw.

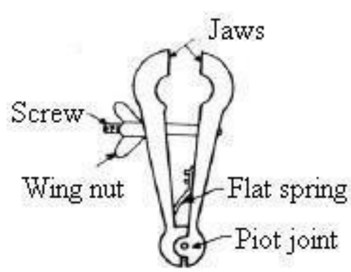


Fig 4.41 Hand vice

Pin Vice:

It is used for holding small parts such as wires, nails and pins. It consists of three jaw self centering chuck which is operated by turning the handle to hold work.

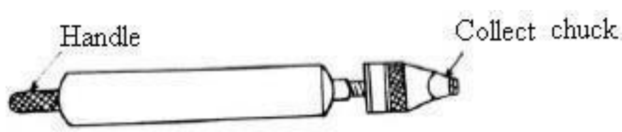


Fig4.42 Pin vice

Tool Maker's Vice:

It is a small vice made of mild steel used for holding small jobs which requires fitting or drilling. It is used by tool and die makers and silver smiths to hold small jobs.

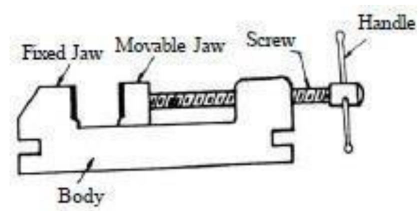


Fig 4.43 Tool maker's vice

Miscellaneous Tools:

In addition to the above tools, the following tools are widely used in fitting.

1. File Card **2. Screw driver**
3. Spanner **4. Pliers**

File Card

It is the short wire brush used to remove small chips called pins, and to clean the file. While filing these chips are deposited between the teeth of file which reduces cutting Ability and causing scratches on work piece.

Fig 4.44 File Card

Screwdriver

Screw driver is used for tightening and loosening the screws. It is made in variety of shapes to suit various job operations.

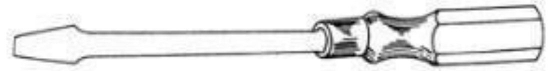


Fig 4.45 Screwdriver

Spanner

These are also called wrenches, are used for tightening or loosening nuts and bolts. The following types of spanners are widely used in fitting.

1. Single end spanner **2. Double end spanner**

2. Adjustable spanner **4. Box type spanner**

Single ended spanner:

It is provided with holding mouth at one end only and is capable of fitting to only one size of nut or bolt.

Fig 4.46 Single ended spanner

Double ended spanner:

Its openings are provided on both ends and both the openings are different sizes. Thus they are capable of fitting to two different sizes of bolts and nuts.

Fig 4.47 Double ended spanner

Adjustable spanner:

It has one fixed jaw and one movable jaw which make it adjustable to various sizes of nuts. When using this tool, the jaws should be pointed in the direction of force, which will prevent the spanner from slipping off aunt.

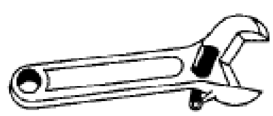


Fig 4.48 Adjustable spanner

Box type spanner:

It has closed end jaws. This voids the danger of slipping the spanner off the nut. They can be single ended as well as double ended.

Fig 4.49 Single ended Box type spanner

Pliers:

These are used for holding small jobs which are difficult to held by hand. They are used for bending and cutting the wires. The following types of pliers are most common.

1. **Cutting pliers** **2. Nose Pliers**

Cutting Plier:

A simple form of cutting plier is having two jaws at one end with serrations provided on the underside of them, which provides a firm grip of the article and further these jaws form the cutter blades near the joint used for cutting wires.

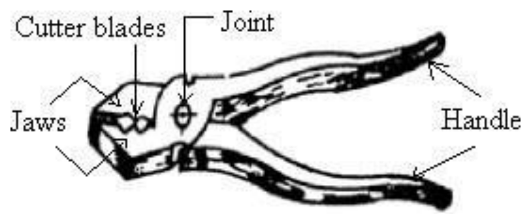


Fig 4.50 Cutting Plier

Needle Nose Plier:

This plier has thin pointed jaws. Its specific use in holding very small and intricate parts and transferring them to or from very narrow and deep places, such as in watch, electrical and radio repair work.

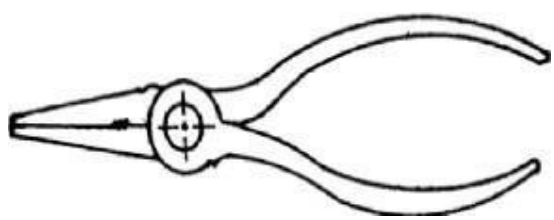


Fig 4.51 Needle Nose Plier

Checking and Measuring Instruments:

Number of checking and measuring tools are used for inspecting and measuring the dimensions of the components during their manufacture to have accurate size and shape. They are

1. Steelrule **2. Calipers** **3. Dividers**

4.Combination set **5. Bevel protractor**

Steel Rule:

It is a stiff, straight steel strip having all the faces machined true. On one of the flat faces graduations are marked in centimeters and inches. Steel rules are made 150, 300, 500 and 1000 mm long. They are used to set out dimensions.

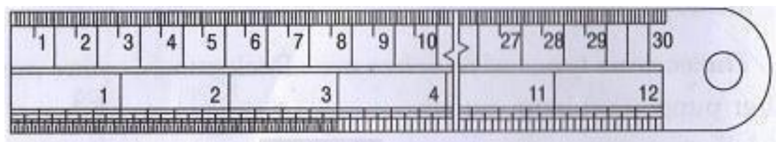


Fig 4.52 Steel Rule

Calipers:

A calipers is used to transfer and compare a dimension from one object to another or from a part to a scale or micrometer where the measurement cannot be made directly. Four types of calipers are generally used. They are

1. **Outside calipers**
2. **Inside calipers**
3. **Hermaphrodite caliper**
4. **Transfer caliper**

Outside Calipers:

An outside caliper is a two legged steel instrument with its legs bent inwards. It is used for measuring or comparing thickness, diameters and other outside dimensions. A steel rule must be used in conjunction with them if a direct reading is desired.

The outside calipers are of two types i.e., firm joint and spring type.

The firm joint calipers have two legs hinged between washers for movement.

The spring calipers have a flat curved spring instead of hinge and the legs are kept in position by an adjusting screw and nut.

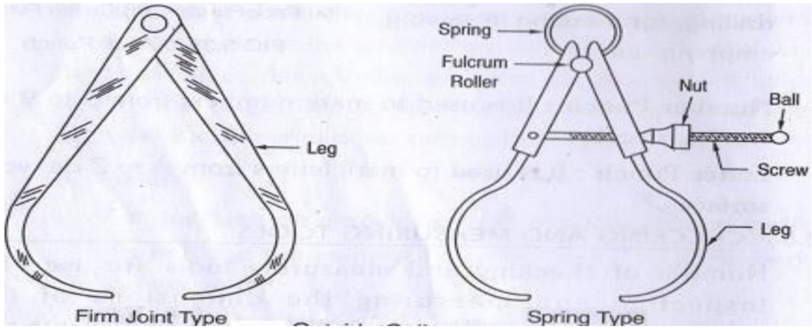


Fig 4.53 Outside Calipers

Inside Calipers:

An inside caliper is exactly similar to an outside calipers in appearance with its legs bent outwards. This is used for comparing or measuring whole diameters, distances between shoulders, or other parallel surfaces of any inside dimension. To obtain a specific reading steel rule must be used, as with the outside calipers. The inside calipers are also two types, firm joint and spring type.

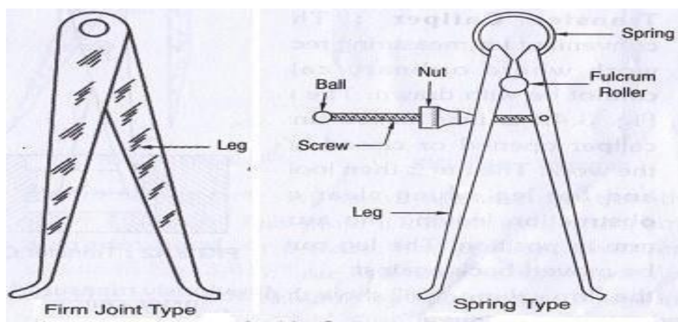


Fig 4.54 Inside Callipers

Hermaphrodite caliper:

This is sometimes called as odd leg caliper. It is made of steel tapered strip which is hinged between washers at one end. It has one pointed leg like a divider and the tip of the other leg is bent inwardly. It is used to find out of the center of a cylindrical work and for scribing lines parallel to the edge of the work.

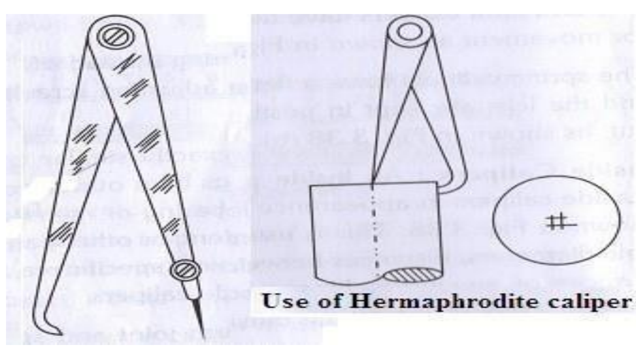


Fig 4.55 Hermaphrodite caliper

Transfer caliper:

This is convenient for measuring recessed work where ordinary calipers cannot be withdrawn. The nut is first locked and the caliper opened or closed against the work. The nut is then loosened and the leg swung clear of the obstruction leaving the auxiliary arm in position. The leg can now be moved back against the stop, where it will show the size previously measured. There may be both outside and inside calipers.

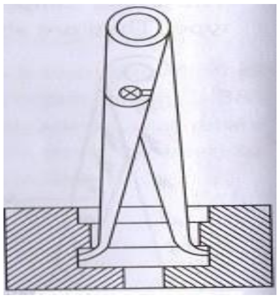


Fig 4.56 Transfer caliper

Divider:

A divider is similar in construction to a caliper excel that both legs are straight with sharp hardened points at the end. The most common type of the divider used in fitting has spring attachment. The dividers are used for measuring the distance between two points, dividing a given length in a definite ratio, drawing circles and arcs and transferring dimensions from scales to objects. Its size is measured by the greatest distance it can be opened between the legs.

A large circle or an arc having a large radius may be drawn with a tool called trammel or beam compass.

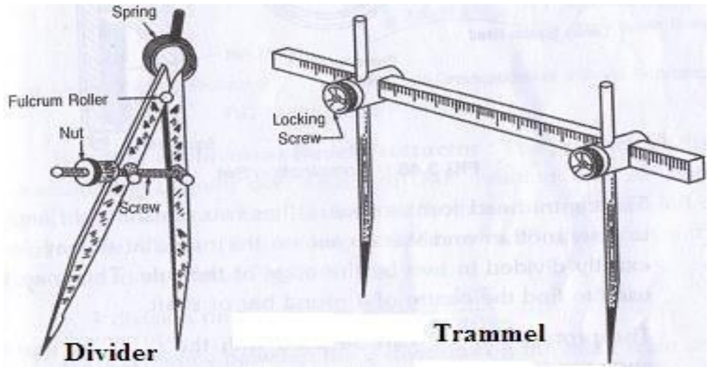


Fig 4.57 Divider and Trammel

Combination set:

It is very useful instrument frequently used in the fitting and machine shop. It combines in one instrument a square head, a centre head, and a bevel protractor. The three heads are used separately being held in, at any desired position by nuts which engage in a slot machined on the whole length of the beam at its back.

The beam (rule) of the instrument is marked either in inches or centimeters or in both for measuring the length and height where as required. Length of the rule varies from 200 to 6000mm.

The square head has one edge square to the rule, giving a right angle (90°), while the other edge form a mitre (45°). It is also provided with a spirit level. Both 90° and 45° can be tested by this head, along with the rule both ways. The vernier scale is fitted with the disc to take reading during measurement.

The centre head (centre square) has two arms at right angle to one another and it is set on the rule that this angle is exactly divided in two by the edge of the rule. This may be used to find the centre of around bar or shaft.

The protractor head can be used with the rule to measure angles or to measure the slope of a surface. It is also fitted with a spirit level to help in leveling the work of setting it an angle.

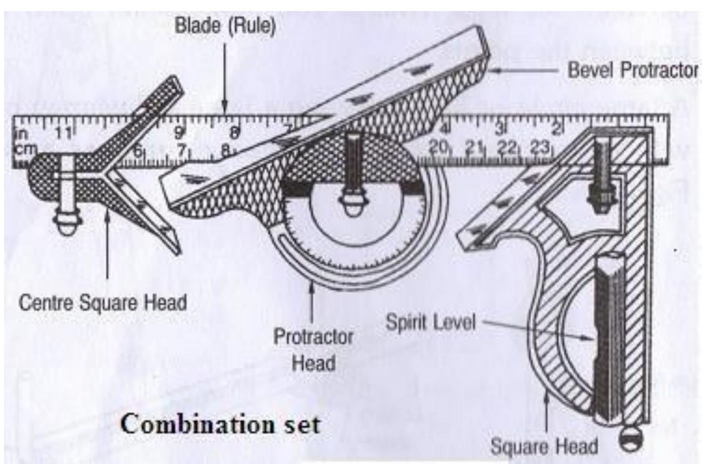


Fig 4.58 Combination Set

Bevel Protractor:

The bevel protractor, known as universal bevel protractor or vernier protractor is widely Used for measuring and testing angles, with measuring accuracy up to 5min (i.e $\frac{1}{12}$of a degree). The universal bevel protractor, consists of a base, sliding blade graduated disc (or the main scale) and vernier scale. The protractor's disc is free to rotate at the pivot and can be clamped with a nut in the base assembly. The blade can slide both ways. The vernier scale is fitted with the disc to take reading during measurement.

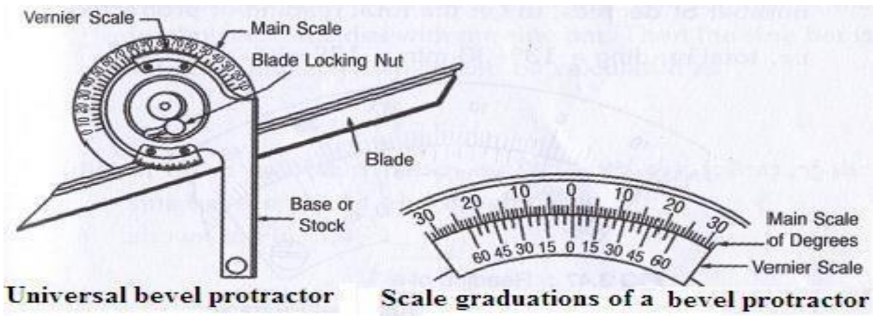


Fig 4.59 Bevel Protractor

How to take reading with the Universal Bevel Protractor:

The protractor's disc is graduated in degrees over an arc of 180°, reading 0 to 90° each way. The vernier scale has 12 divisions both to the right and left of the zero line. These 12 divisions coincides with 23 divisions on the main scale.

$$\therefore \quad \text{1 division on the vernier scale} = \frac{23^\circ}{12}$$

Difference between the 2 divisions on the main scale and one division on the vernier scale

$$= 2 - \frac{23^\circ}{12}$$
$$= \frac{1^\circ}{12}$$
$$= 5 \text{ minutes}$$

In order to take a reading from the universal bevel protractor.

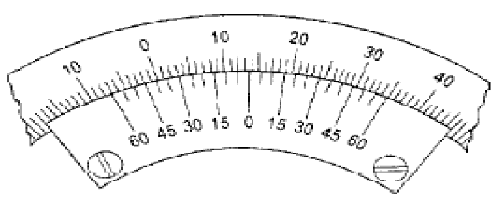


Fig 4.60 Reading in Universal Bevel Protractor

1. First, read off directly from the main scale the number of whole degrees between 0 and 0 of the vernier scale. From fig. we see the whole degrees are equal to13°.
2. Now count the number of divisions, in the same direction from zero on the vernier scale to the line which coincide with the line on the main scale, from Fig. it is 6thdivision.
3. Multiply this number by 5, i.e, 6 x 5 = 30, and this product will be the number of minutes, it should be added to the whole number of degrees, to get the total reading of protractor

   i.e. Total reading = 13°+30 min = 13°+ 30' = 13°30'

Fitting Operations:

Bench work involves a number of hand operations to finish the work to desired shape and size with required accuracy.

The main operations are as follows:

1. Chipping	**2.Filing**	**3.Scraping**	**4.Grinding**
5. Sawing	**6.Marking**	**7.Drilling**	**8.Reaming**
9. Tapping	**10. Dieing**		

Chipping:

Chipping is the process of removing thick layers of metal by cold chisels. In chipping work, the job is firmly held in a vice and the metal is removed by striking the chisel on to the job by a hammer. Chipping operation is shown in Fig.

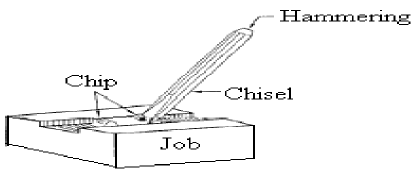


Fig 4.61 Chipping with a chisel

Filing:

Filing is usually done after chipping. It serves to remove the burr from the cuts and clean the face of the cuts and to finish the final shape of a work piece. Filing allows work to be made accurate eto0.05 mm in some cases to 0.02 mm and even to 0.01 mm.

Generally two methods are commonly used for filing:

1. **Cross filing** **2. Draw filing**

Cross filing:

The cross-filing is used for efficient removal of maximum amount of metal in the shortest possible time. During this operation the following steps may be noted:

1. The work should be held firmly in a vice with a minimum projection of the surface to be filed truly horizontal.
2. The file handle is grasped in the right hand, as shown in Fig. the end of the file handle pressing against the palm of the hand. The pressure on the work is applied by holding the end of the blade with the left hand.
3. The file must remain horizontal throughout the stroke (which should be long, slow and steady) with pressure applied only in the forward motion.
4. The file in the return stroke remains in contact with the work but the pressure is relieved from it.

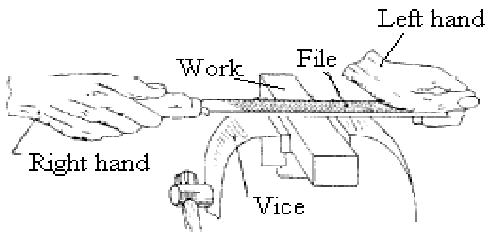


Fig 4.62 Cross Filing

Draw Filing:

The draw filing is used to remove file marks and for finishing operation. During this operation, the file is placed at right angles across the work and the file is gripped as close to the work as

Possible between two hands, especially the thumbs gripping the file, as shown in Fig. for fine cut with a flat face file should be used. It is moved lightly over the work for this purpose.

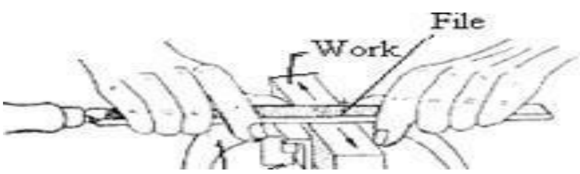


Fig 4.63 Draw Filing

Scraping:

Scraping means shaving or paring off thin slices or flakes of metal to make a fine, smooth surface. It is used for producing a truer flat surface than can be produced by machining or filing. So scraping often follows filing. During scraping, the handle of the scraper is held in the right hand with thumb and first finger pointing in the direction of cutting edge and the blade should be held in left hand, close to the cutting edge and the scraper should be held at some inclination (approximately 30°) to the work piece.

The usual procedure of scraping is to coat the top surface of a surface plate with Prussian blue or red lead. The surface to be scraped is rubbed against the surface plate. Thus the high spots on the work will be marked with the coated material. These spots are scraped, with moving the scraper in circular direction. The operation is repeated till all the high spots are removed at the entire surface becomes a perfectly smooth surface.

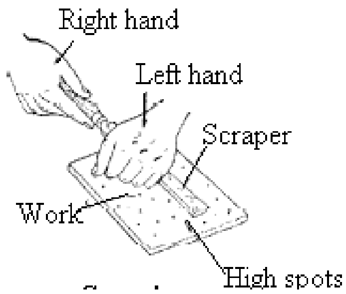


Fig 4.64 Scraping

DRILLING

Drills:

A drill is a cutting tool for making through hole in a metal piece and usually it has two cutting edges set an angle with axis. It does not produce accurate hole.

There are three types of drills.

1. **Flat drill 2. Straight fluted drill 3.Twist Drill**

Flat drill:

It is a simple drill used for producing holes in softer materials like wood and plastic. This is made of high carbon steel and has two cutting edges.

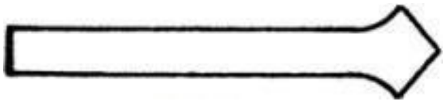


Fig 4.65 Flat drill

Straight fluted drill:

It has two cutting edges and two straight flutes used for drilling brass and non-ferrous metals.

Fig 4.66 Straight fluted drill

Twist drill:

This is most commonly used cutting tool in workshop. It has two cutting edges and two helical grooves which admits coolant and allows the chips to escape during the drilling. These are made of high speed steel.

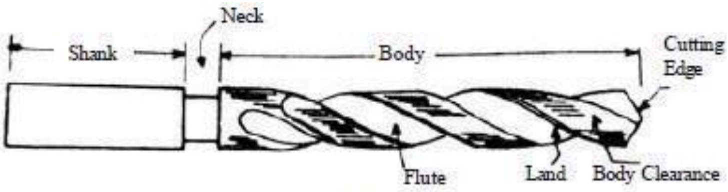


Fig 4.67 Twist drill

Reamers:

A drill does not produce accurate hole and it must be finished by finishing tool called reamer. When accurate holes with a smoother finish a required a reamer is used. Hence the reamer can only follow the drilled hole and removes very small amount of metal to make it smooth

There are two types of reamers

1. Hand Reamers **2. Machine Reamers**

Hand Reamer:

This reamer is turned by hand called hand reamer. The shank has a square tang so that a tap wrench can be used to turn the reamer in to work. These are available with straight or helical flutes.

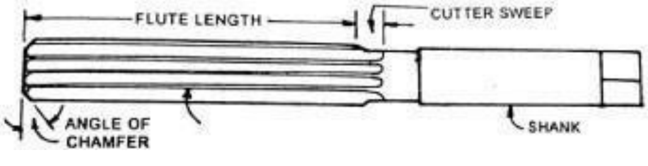


Fig 4.68 Hand reamer

Machine Reamers:

These are used to turn by the machine called machine reamers. Its shank is tapered which fits directly in the internal taper of the machine spindle. These are also available with straight shanks which are held and driven by drill chuck.

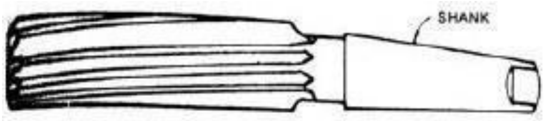


Fig 4.69 Machine Reamers

Taps and tap wrench:

A tap is a screw like tool which has threads like a bolt and three or four flutes cut across the threads which are used to produce internal threads. The edge of the thread formed by the flutes is the cutting edges. The lower part of the tap is somewhat tapered so that it can well attack the walls of the drill hole.

Hand taps are usually made in sets of three

1. Taper tap **2.Second tap** **3. Bottom tap**

Taper Tap:

In this tap about six threads are tapered and is used to start the thread, so that the threads are formed gradually as the tap is turned into the hole.

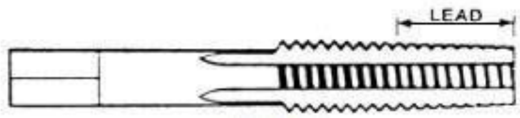


Fig 4.70 Taper Tap

Second tap:

It is tapered back from the edge about three or four threads used after taper tap. It has been used to cut the threads as far as possible

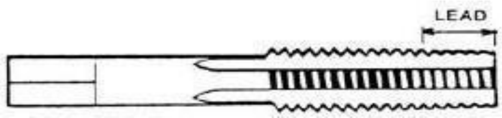


Fig 4.71 Second tap

Bottom tap:

It has full threads for the whole of its length. This is used to finish the Work prepared by the other two taps.

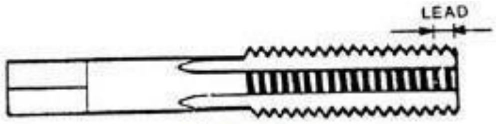


Fig 4.72 Bottom tap

Tap wrench:

The upper part of a tap consists of a shank end in a square for holding the tap by a tap wrench. This has two handles and it may be either fixed or adjustable. The adjustable wrenches may be used for taps of various sizes

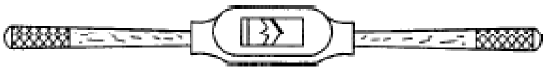


Fig 4.73 Tap wrench

Drilling Machines:

Drilling is a process of making holes in a work piece and is carried out by driving a rotating tool called "drill" into a rigidly held work piece. To accomplish the drilling two things are required i.e. drilling machine and drilling tools. A drilling machine is used for drilling holes. However it can perform operations other than drilling such as reaming, boring, lapping etc.

Types of drilling machine

1. Portable drilling machine or Electrical hand drilling machine
2. Sensitive drilling machine
3. Radial drilling machine
4. Upright drilling machine
5. Gang drilling machine

Portable drilling machine or Electrical hand drilling machine:

Portable drilling machine or Electrical hand drilling machine is a small light weight, compact ad self-contained unit that can drill holes up to 12.5 rnrn diameter.

The machine is driven by a small electric motor operating at high speed. The machine is capable of drilling holes in the work pieces in any position. The machine has only a hand feed mechanism for feeding the tool into the work piece. This enables the operator to feel how the drill is cutting and accordingly he can control the down feed pressure.

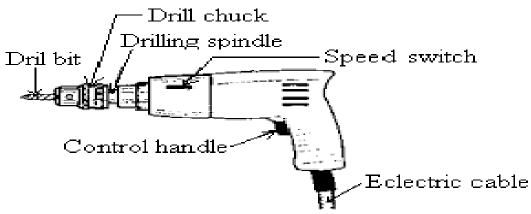


Fig 4.74 Portable drilling machine or Electrical hand drilling machine

Sensitive drilling machine:

It is a small drilling machine is mounted on a bench in which feed is hand operated and the cutting force applied is determined by sense of feel of the operator. The parts of sensitive drilling machine as shown below. It consists of a vertical column, a work table, head supporting the motor and driving mechanism, a vertical spindle for driving and rotating the drill.

The work is mounted on the work table which may be raised or lowered by the clamp to accommodate work pieces of different sizes. The driving mechanism consists of V-belt drive from machine spindle to drill spindle. Three or four speed stepped cone pulley is provided to give various speed ranges. The spindle is designed and mounted in a sleeve such that the spindle rotates and simultaneously moves up and down to provide feed for drill. This is achieved by a rack and pinion mechanism.

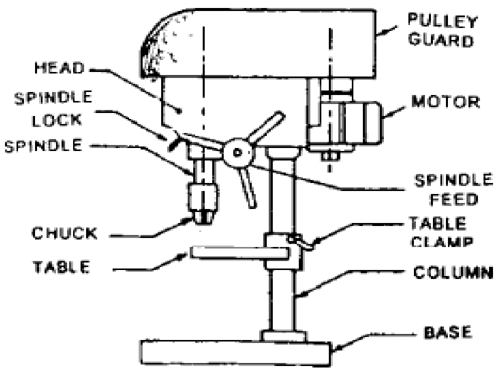


Fig 4.75 Sensitive Drilling Machine

Radial Drilling Machine:

Radial drilling machines are used for drilling heavy work pieces, where it is easier to move the drill rather than work and especially for the jobs where high degree of accuracy is required. It consists of base, column, radial arm, drill head and driving mechanism. The arm of radial drilling machine can be swing around the column to any position and angle. A wide range of spindle speeds, together with automatic feed of the spindle, makes the radial drilling machine suitable for drilling large castings. For lowering or raising the radial arm, a separate motor is provided. The work can be firmly champed on the table having T-slots. The table is fixed to the base. The radial arm and the spindle can be adjusted without disturbing the work setting.

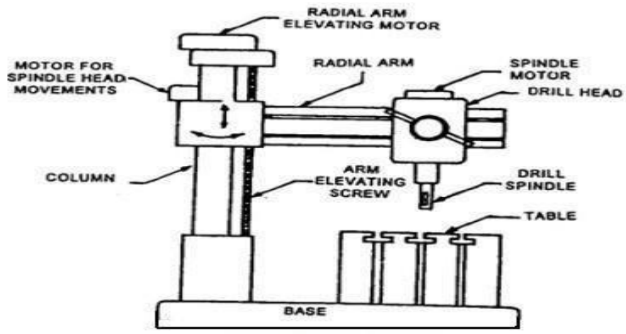


Fig 4.76 Radial Drilling Machine

Drill fittings: The following devices are used for holding the drills.

1. Drill Chuck **2. Drilling Machine Spindle**

3. Sleeves **4.Scokets**

1. **Drill Chuck:**

It is designed to hold straight shank drills of different sizes. The jaws of the chuck are tightened around the drill by means of drill chuck key. These drill chucks have standard taper shanks.

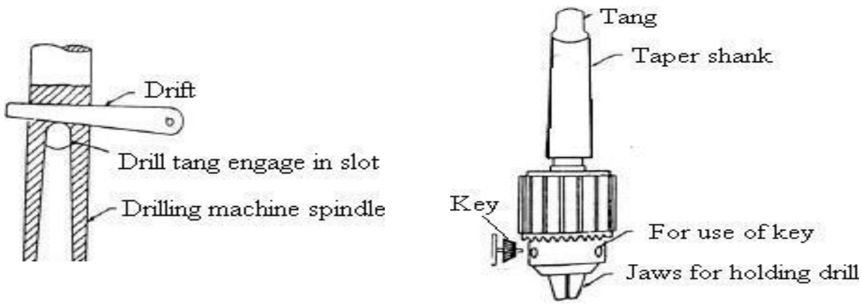


Fig 4.77 Drill Chuck

2. **Drilling machine spindle:**

These have the spindle bored out to a standard Morse taper to receive he taper shank of the tool. While fitting the tool, the shank is forced into the tapered hole and the tool is gripped by friction. Standard taper drills are directly fitted in the spindle. The drill may be removed by driving thedrift.

3. **Sleeve:**

The drill spindle is suitable for holding only one size of shank. If the taper shank of tool is smaller than the taper in spindle hole, a taper sleeve is used.

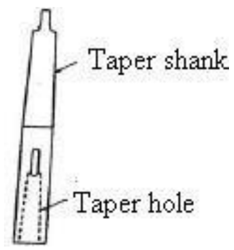


Fig 4.78 Sleeve

4. Socket:

It is used for the drilling whose taper is larger than spindle hole taper. It is much longer than sleeve. Its taper shank confirms to the spindle hole taper and fits in to it.

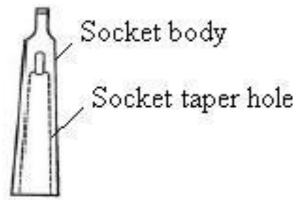


Fig 4.79 Drill Socket

Drilling Machine Operations:

The different operations that can be performed in a drilling machine are:

1. Drilling
2. Reaming
3. Boring
4. Counter boring
5. Counter sinking
6. Spot facing
7. Trepanning

Drilling:

Drilling is the operation of producing a cylindrical hole by removing metal by the rotating edge of a cutting tool called the drill. The drilling is one of the simplest methods of producing a hole. Before drilling the centre of the hole is located on the work piece by drawing two lines at right angles to each other and then a centre punch is used to produce an indentation at the centre. The drill point is pressed at this centre point to produce the required hole.

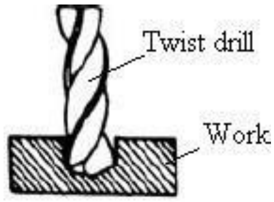


Fig 4.80 Drilling

Reaming:

Reaming is an accurate way of sizing and finishing a hole which has been previously drilled. In order to finish a hole and to bring it to the accurate size, the hole is drilled slightly undersize. The tool used for reaming is known as the reamer, which has multiple cutting edges. Reamer cannot ‘originate a hole. It simply follows the path which has been previously drilled and removes very small amount of metal.

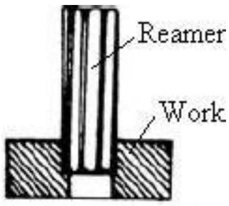


Fig 4.81 Reaming

Boring:

Boring is performed in a drilling machine for the following purposes.

- To enlarge a hole by means of an adjustable cutting tool with only one cutting edge. This is necessary where suitable sized drill is not available or where hole diameter is no large that it cannot be ordinarily drilled.
- To finish a hole accurately and to bring it to the required size.
- To machine the internal surface of a hole already produced in casting.
- To correct out of roundness of the hole.
- To correct the location of the hole as the boring tool follows an independent path with respect to the hole.

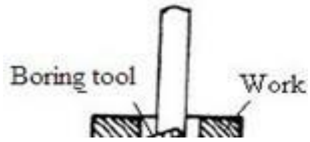


Fig 4.82 Boring

Counter Boring:

Counter boring is the operation of enlarging, the end of a hole cylindrically. The enlarged hole forms a square holder with the original hole. This is necessary in some cases to accommodate the heads of bolts, studs and pins. The tool used for counter boring is called a counter bore. The cutting edges of counter bore may have straight or spiral teeth.

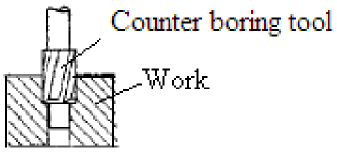


Fig 4.83 Counter Boring

Counter Sinking:

Countersinking is the operation of making a cone shaped enlargement of the end of a hole to provide a recess for a flat head screw or countersunk rivet fitted into the hole. The tool used for counter sinking is called a countersink. Standard counter sinks have 60°, 82° or 90° included angle and the cutting edges of the tool are formed at the conical surface.

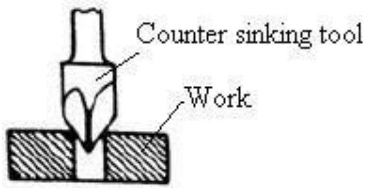


Fig 4.84 Counter Sinking

Spot Facing:

Spot facing is the operation of smoothing and squaring the surface around a hole for the seat for a nut or the head of a screw. A counter bore or a special spot facing tool may be employed for this purpose.

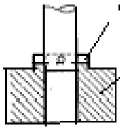


Fig 4.85 Spot Facing

Trepanning:

Trepanning is the operation of producing a hole by removing metal along the circumference of a hollow cutting tool. Trepanning operation is performed for producing large holes. Fewer chips are removed and much of the material is saved while the hole in produced.

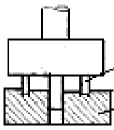


Fig 4.86 Trepanning

Grinding:

Grinding is a metal cutting operation performed by means of abrasive particles rigidly mounted on a rotating wheel. Each of the abrasive particles act as a single point cutting tool and grinding wheel acts as a multipoint cutting tool. The grinding operation is used to finish the work pieces with extremely high quality of surface finish and accuracy of shape and dimension. Grinding is one of the widely accepted finishing operations because it removes material in very small size of chips to 0.50 mm. It provides accuracy of the order of 0.000025 mm. Grinding of very hard material is also possible.

TYPES OF GRINDING:

There can be different criteria to classify grinding into different categories. On the basis of quality of grinding, it is classified as rough grinding and precision grinding.

Rough Grinding:

It involves removal of stock without any reference to the accuracy of results. Generally, rough grinding is followed by precision grinding.

Precision Grinding:

Precision grinding removes negligible amount of metal. It is used to produce finished parts and accurate dimensions.

Depending on the geometry of workpiece and the position at which workpiece is to be grind, it can be categorize as external grinding, internal grinding, surface grinding, form grinding and centreless grinding. Each of above categories can be further classified which will be explained below.

On the basis of position of mounting of a grinder it can be categorized as floor stand grinder (which can be installed on the ground); bench grinder, hand grinder, etc.

On the basis of position of spindle, it can be categorized as horizontal spindle environment in which the operation of grinding is done the grinding operation is classified as dry grinding and wet grinding. When cutting fluid is spread over the workpiece, wheel face and sides, it is named as wet grinding. The commonly used cutting fluid is soda water. Temperature of grinding zone reaches up to 2000^0 C in case of grinding of hard materials. Use of cutting fluid lowers down the temperature and so promotes wheel life. However, in case of dry grinding no coolant is used. It is generally used when workpiece material is not very hard and grinding time is also small.

Normally dry grinding produces two undesirable effects discalouration and burring which are eliminated in case of wet grinding some of the grinding machines are identified on the basis of their specific uses. Such grinders are called special purpose grinders like crank shaft grinders; piston grinder; roll grinders; cam grinders; thread grinders; way grinders and tool post grinders. These are nomenclature on the basis of their specific uses.

SHAPES AND SIZE OF A GRINDING WHEEL:

Grinding wheels are made in different shapes and sizes to adapt them for use in different types of Grinding machines and on different classes of work. These are classified in some groups on the basis of shapes and sizes. The shapes of Grinding wheels are standardized so that those commonly used in production and tool room grinding may be designated by a number or name or both. Some of the standard grinding wheels are shown below.

Straight Wheel:

Some straight wheels are shown in Figure 4.87 Types 1, 2 and 3. These are generally used for cylindrical, internal, centreless and surface grinding operations. These wheels vary in size, diameter and width of the face. All the parameters depend on the clays of work for which the wheel is used, size and power of grinding machine using the wheel.

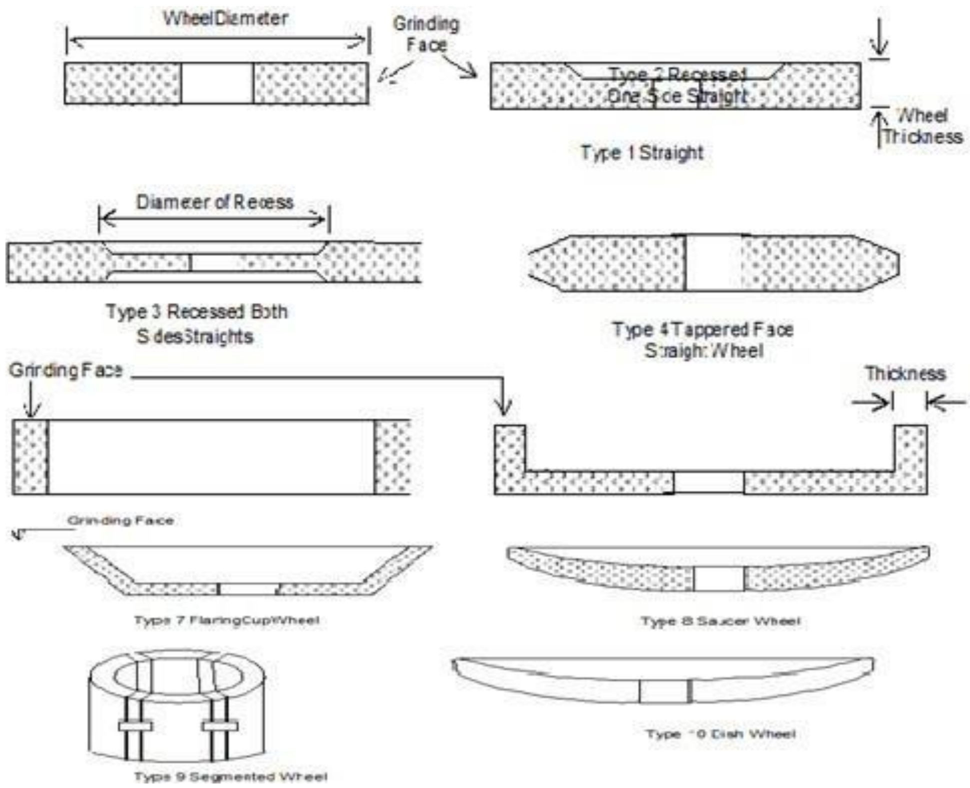


Figure 4.87 Different Types of Grinding Wheels

Tapered Face Straight Wheels:

This is Type 4 in Figure 4.87. It is also a straight wheel but its free is slightly tapered to facilitate the grinding of threads an gear teeth.

Cylindrical Wheel Ring:

Cylindrical Grinding wheel is shown in Figure 4.87 Type 5. It is used for surface Grinding, i.e. production of flat surfaces. Grinding takes place with the help of face of the wheel.

Cup Wheel:

Cup wheel shown in Figure 4.87 Type 6. It is used for grinding flat surfaces with the help of face of Grinding wheel.

Flaring Cup Wheel:

One modified Grinding wheel named as flaring cup wheel is Type 7 in Figure 4.87. It is used in grinding of tools in tool room.

Grinding Machines:

Grinding Machines are also regarded as machine tools. A distinguishing feature of grinding machines is the rotating abrasive tool. Grinding machine is employed to obtain high accuracy along with very high class of surface finish on the workpiece. However, advent of new generation of grinding wheels and grinding machines, characterised by their rigidity, power and speed enables one to go for high efficiency deep grinding (often called as abrasive milling) of not only hardened material but also ductile materials.

Conventional Grinding machines can be broadly classified as:

1. Surface Grinding Machine
2. Cylindrical Grinding Machine
3. Internal Grinding Machine
4. Tool and Cutter Grinding Machine

Surface Grinding Machine:

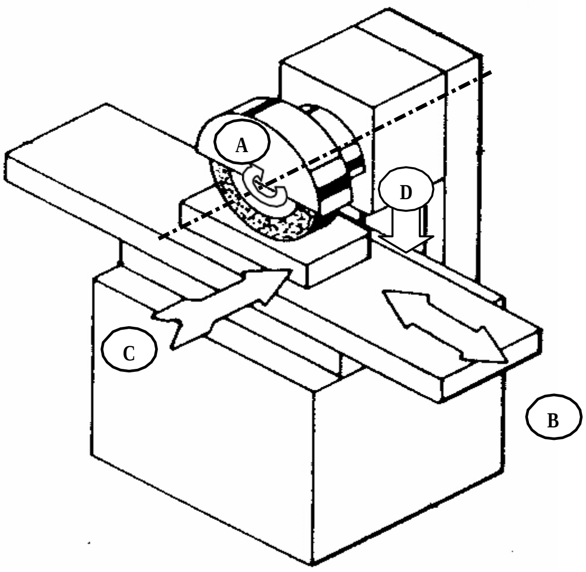
This machine may be similar to a milling machine used mainly to grind flat surface. However, some types of surface grinders are also capable of producing contour surface with formed Grinding wheel.

Basically there are four different types of surface Grinding machines characterised by the movement of their tables and the orientation of Grinding wheel spindles as follows:

- Horizontal spindle and reciprocating table
- Vertical spindle and reciprocating table
- Horizontal spindle and rotary table
- Vertical spindle and rotary table

Horizontal spindle reciprocating table grinder:

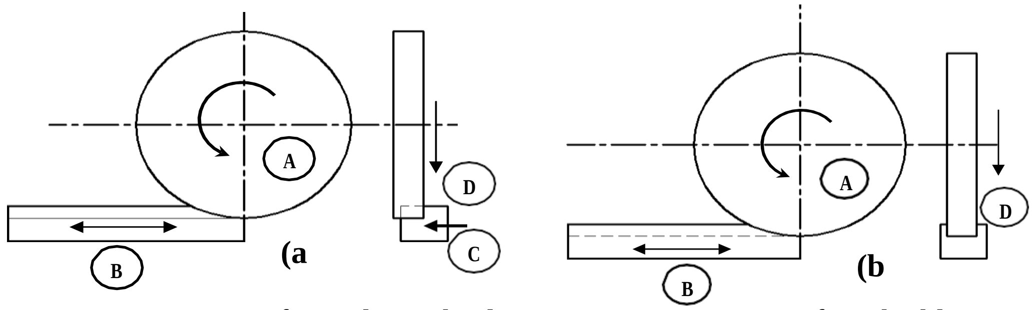
Figure 4.87 illustrates this machine with various motions required for grinding action. A disc type grinding wheel performs the grinding action with its peripheral surface. Both traverse and plunge grinding can be carried out in this machine as shown in Fig.4.88



A: Rotation of Grinding wheel B: Reciprocation of worktable

C: Transverse feed D: Down feed

Fig.4.88 Horizontal spindle reciprocating table surface grinder



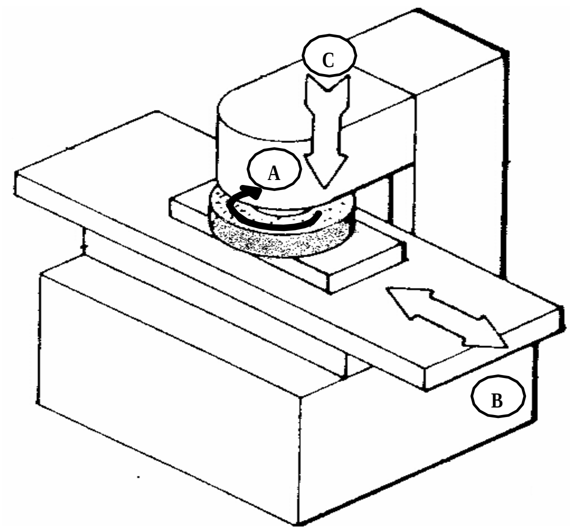
A: Rotation of Grinding wheel B: Reciprocation of worktable

C:Transversefeed D: Down feed

Fig. 4.89 Surface Grinding (a) Traverse Grinding (b) Plunge Grinding

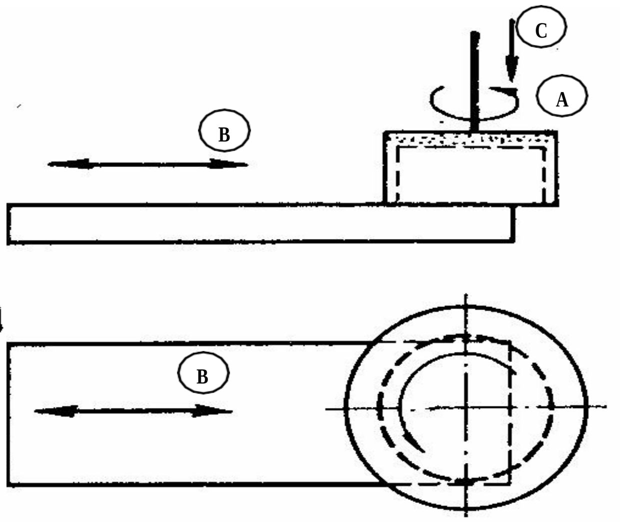
Vertical spindle reciprocating table grinder:

This Grinding machine with all working motions is shown in Fig. 4.90. The Grinding operation is similar to that of face milling on a vertical milling machine. In this machine a cup shaped wheel grinds the workpiece over its full width using end face of the wheel as shown in Fig. 4.91. This brings more grits in action at the same time and consequently a higher material removal rate may be attained than for grinding with a peripheral wheel.



A: Rotation of Grinding wheel
B: Reciprocation of worktable
C: Down feed of Grinding wheel

Fig. 4.90 Vertical spindle reciprocating table surface grinder

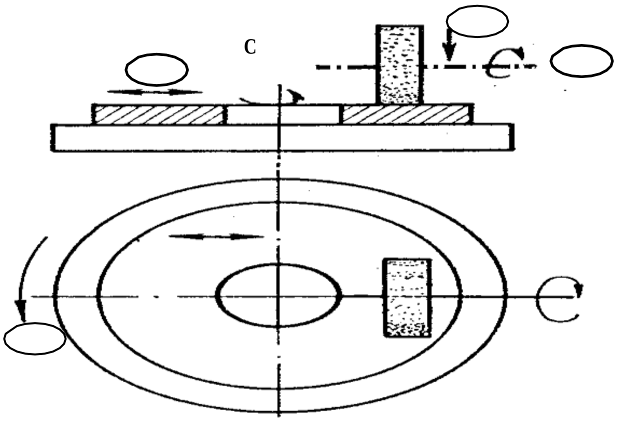


A: Rotation of Grinding wheel
B: Reciprocation of worktable
C: Down feed of Grinding wheel

Fig. 4.91 Surface Grinding in Vertical spindle reciprocating table surface grinder

Horizontal spindle rotary table grinder:

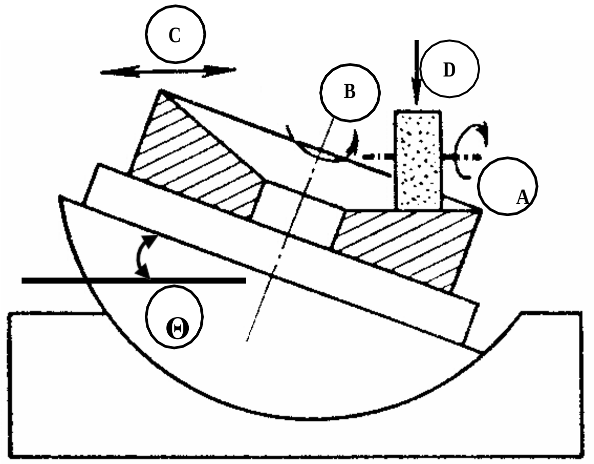
Surface Grinding in this machine is shown in Fig.4.92. In principle the operation is same as that for facing on the lathe. This machine has a limitation in accommodation of workpiece and therefore does not have wide spread use. However, by swivelling the worktable, concave or convex or tapered surface can be produced on individual part as illustrated in Fig. 4.93



A: Rotation of Grinding wheel B: Table rotation C: Table reciprocation

D: Down feed of Grinding wheel

Fig. 4.92 Surface Grinding in Horizontal spindle rotary table surface grinder

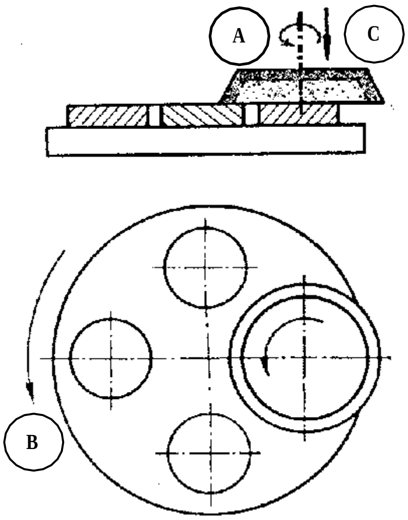


A: Rotation of Grinding wheel
B: Table rotation
C**:** Table reciprocation
D**:** Down feed of Grinding wheel
Θ: Swivel angle

Fig. 4.93 Grinding of a tapered surface in horizontal spindle rotary table surface grinder

Vertical spindle rotary table grinder:

The principle of Grinding in this machine is shown in Fig. 4.94. The machine is mostly suitable for small workpieces in large quantities. This primarily production type machine often uses two or more grinding heads thus enabling both roughing and finishing in one rotation of the work table.



A: Rotation of Grinding wheel
B: Work table rotation
C: Down feed of Grinding wheel

Fig. 4.94 Surface Grinding in vertical spindle rotary table surface grinder

Creep feed Grinding Machine:

This machine enables single pass grinding of a surface with a larger down feed but slower table speed than that adopted for multi-pass conventional surface grinding. This machine is characterised by high stiffness, high spindle power, recirculating ball screw drive for table movement and adequate supply of grinding fluid. A further development in this field is the creep feed grinding centre which carries more than one wheel with provision of automatic wheel changing. A number of operations can be performed on the workpiece. It is implied that such machines, in the view of their size and complexity, are automated through CNC.

Cylindrical Grinding machine:

This machine is used to produce external cylindrical surface. The surfaces may be straight, tapered, steps or profiled. Broadly there are three different types of cylindrical grinding machine as follows:

1. Plain centre type cylindrical Grinder
2. Universal cylindrical surface Grinder
3. Centreless cylindrical surface Grinder

Plain Centre type Cylindrical Grinder:

Figure 4.95 illustrates schematically this machine and various motions required for grinding action. The machine is similar to a centre lathe in many respects. The workpiece is held between head stock and tailstock centres. A disc type grinding wheel performs the grinding action with its peripheral surface. Both traverse and plunge grinding can be carried out in this machine as shown in Fig.4.96.

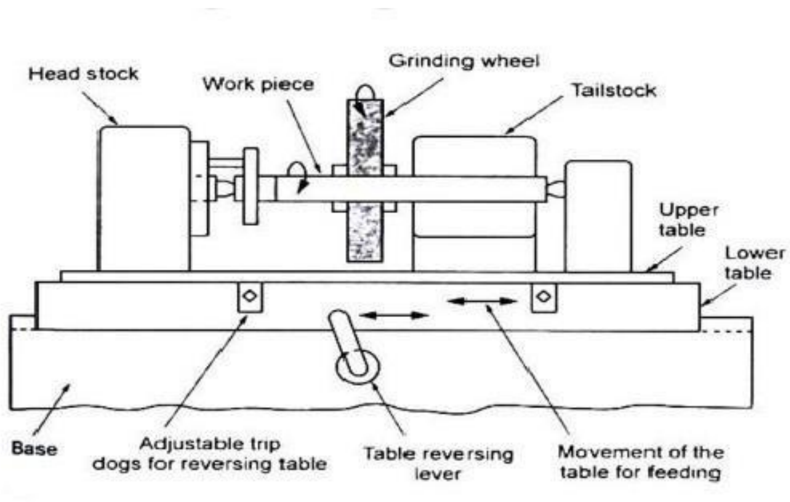
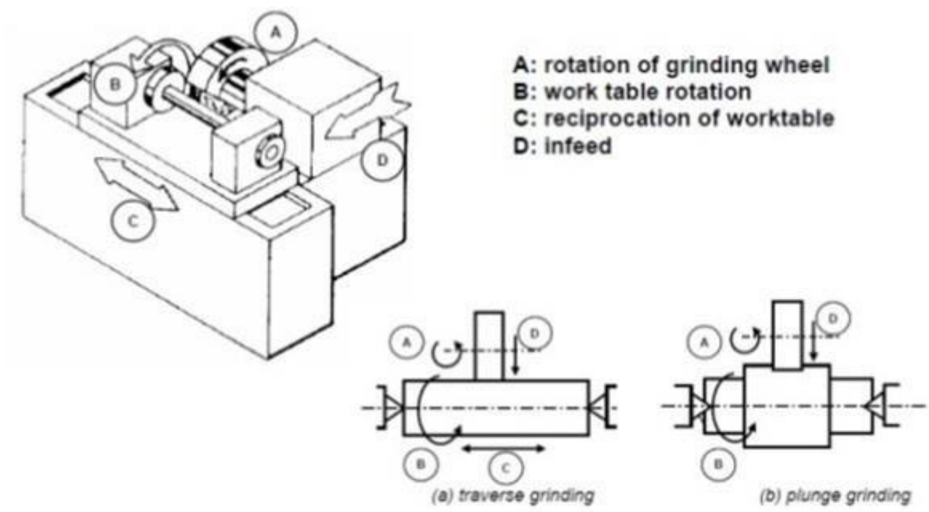


Fig. 4.95 Plain Centre Type Cylindrical Grinder

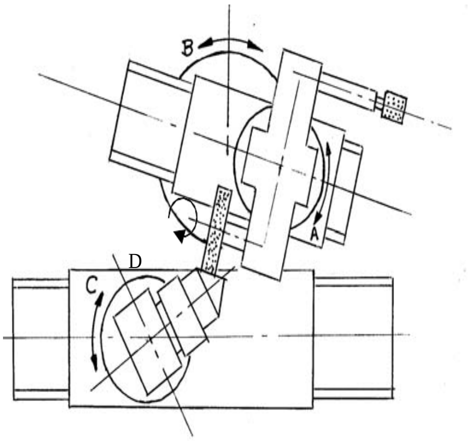


A: Rotation of Grinding wheel B: Work piece rotation
C: Reciprocation of worktable D: Infeed

Fig. 4.96 Cylindrical (a) Traverse Grinding and (b) Plunge Grinding

Universal Cylindrical Surface Grinder:

Universal cylindrical grinder is similar to a plain cylindrical one except that it is more versatile. In addition to small worktable swivel, this machine provides large swivel of head stock, wheel head slide and wheel head mount on the wheel head slide.



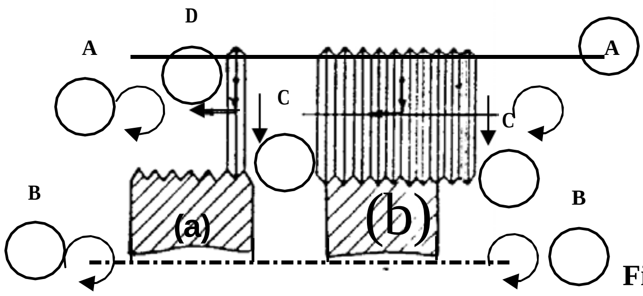
A: swiveling wheel head
B: swiveling wheel head slide
C: swiveling headstock
D: rotation of Grinding wheel

Fig. 4.97 Important features of Universal Cylindrical Grinding Machine

This allows grinding of any taper on the workpiece. Universal Grinder is also equipped with an additional head for internal grinding. Schematic illustration of important features of this machine is shown inFig.4.97.

Special application of Cylindrical Grinder:

Principle of cylindrical grinding is being used for thread grinding with specially formed wheel that matches the thread profile. A single ribbed wheel or a multi ribbed wheel can be used as shown in Fig. 4.98.

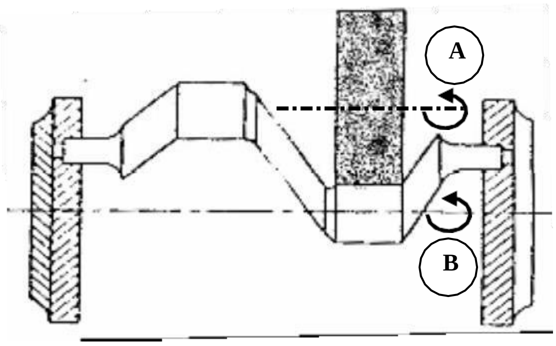


A: Rotation of Grinding Wheel
B: Rotation of Work Piece
C: Down Feed
D: Longitudinal Feed of Wheel

Fig. 4.98 Thread Grinding with (a) Single Rib (b) Multi - Ribbed Wheel

Roll grinding is a specific case of cylindrical grinding wherein large work pieces such as shafts, spindles and rolls are ground.

Crankshaft or crank pin grinders also resemble cylindrical grinder but are engaged to grind crank pins which are eccentric from the centre line of the shaft as shown in Fig.4.99. The eccentricity is obtained by the use of special chuck.



A: Rotation of wheel
B: Rotation of crank pin

Fig. 4.99 Grinding of Crank Pin

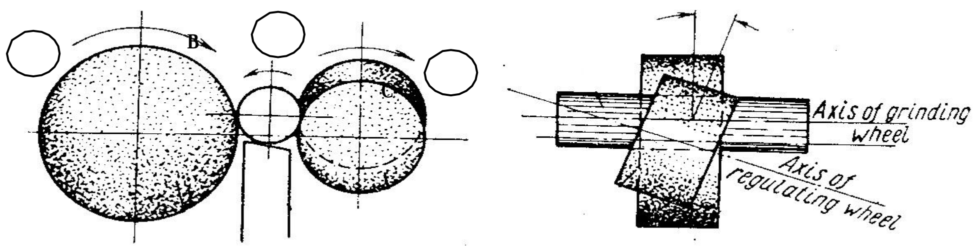
Cam and camshaft grinders are essentially subsets of cylindrical grinding machine dedicated to finish various profiles on disc cams and cam shafts. The desired contour on the work piece is generated by varying the distance between wheel and work piece axes. The cradle carrying the head stock and tail stock is provided with rocking motion derived from the rotation of a master cam that rotates in synchronization with the work piece. Newer machines however, use CNC in place of master cam to generate cam on the workpiece.

External Centreless Grinder:

This grinding machine is a production machine in which outside diameter of the workpiece is ground. The work piece is not held between centres but by a work support blade. It is rotated by means of a regulating wheel and ground by the grinding wheel.

In through-feed centreless grinding, the regulating wheel revolving at a much lower surface speed than grinding wheel controls the rotation and longitudinal motion of the work piece. The regulating wheel is kept slightly inclined to the axis of the grinding wheel and the workpiece is fed longitudinally as shown in Fig.4.100.

A

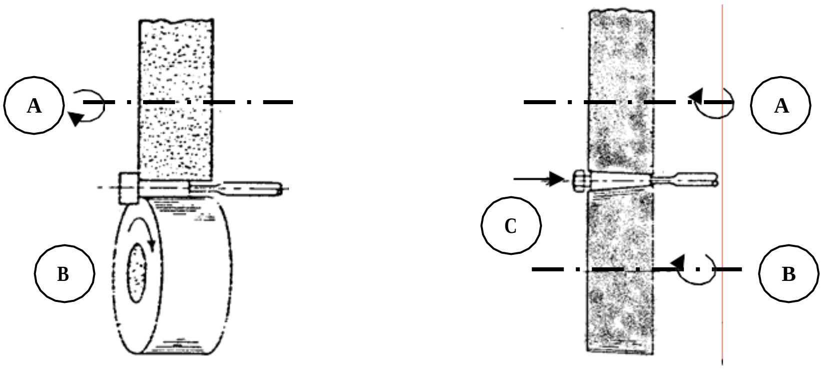


A: Rotation of Grinding wheel
B: Work piece rotation
C: Reciprocation of worktable

Fig.4.100 Centreless through feed Grinding

Parts with variable diameter can be ground by Centreless infeed grinding as shown in Fig. 4.101(a). The operation is similar to plunge grinding with cylindrical grinder.

End feed Grinding shown in Fig. 4.101(b) is used for workpiece with tapered surface.



A: rotation of Grinding wheel B: rotation of regulating wheel C: feed on workpiece

Fig. 4.101 Centreless (a) In Feed and (b) End Feed Grinding

The Grinding wheel or the regulating wheel or both require to be correctly profiled to get the required taper on the workpiece.

Tool post Grinder:

A self powered grinding wheel is mounted on the tool post or compound rest to provide the grinding action in a lathe. Rotation to the workpiece is provided by the lathe spindle. The lathe carriage is used toreciprocate the wheel head.

Internal Grinding machine:

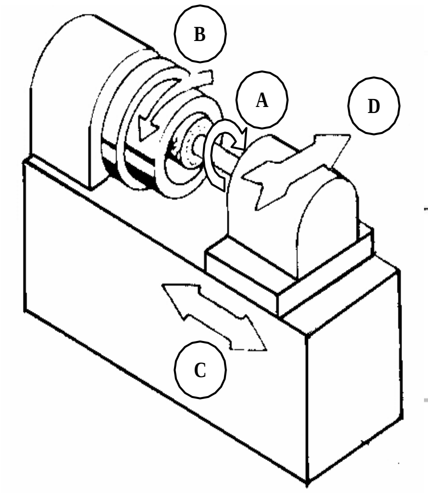
This machine is used to produce internal cylindrical surface. The surface may be straight, tapered, grooved or profiled.

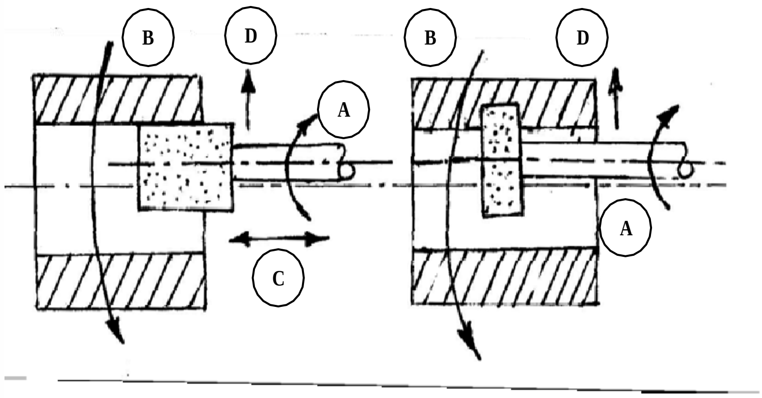
Broadly there are three different types of internal grinding machine as follows:

1. Chucking type internal Grinder
2. Planetary internal Grinder
3. Centreless internal Grinder

Chucking type Internal Grinder:

Figure 4.102 illustrates schematically this machine and various motions required for grinding action. The workpiece is usually mounted in a chuck. A magnetic face plate can also be used. A small grinding wheel performs the necessary grinding with its peripheral surface. Both transverse and plunge grinding can be carried out in this machine as shown in Fig. 4.103.



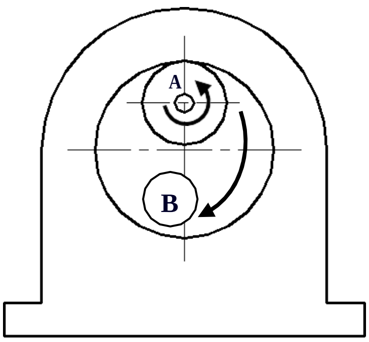


A: Rotation of Grinding wheel B: Work piece rotation
C: Reciprocation of worktable D: Infeed

Fig. 4.102 Internal Centreless Grinder Fig. 4.103 Internal (a) Traverse Grinding and (b) Plunge Grinding

Planetary Internal Grinder:

Planetary internal grinder is used where the workpiece is of irregular shape and cannot be rotated conveniently as shown in Fig. 4.104. In this machine the work piece does not rotate. Instead, the grinding wheel orbits the axis of the hole in the workpiece.



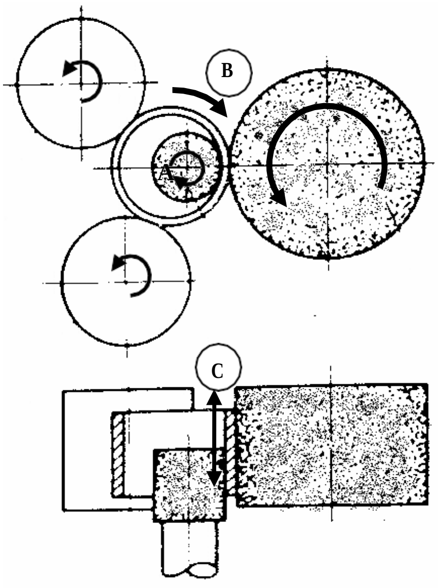
A: rotation of Grinding wheel

B: orbiting motion of Grinding

Fig. 4.104 Internal Grinding in Planetary Grinder

Centreless Internal Grinder:

This machine is used for Grinding cylindrical and tapered holes in cylindrical parts (e.g. cylindrical liners, various bushings etc). The workpiece is rotated between supporting roll, pressure roll and regulating wheel and is ground by the grinding wheel as illustrated in Fig.4.105

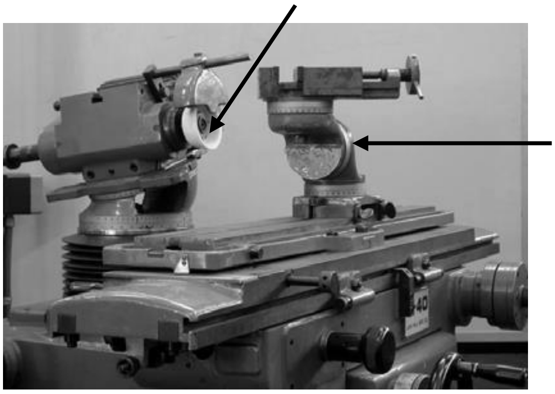


A: Grinding wheel rotation B: work piece rotation
C: wheel reciprocation

Fig. 4.105 Internal Centreless Grinding

Tool and Cutter Grinder Machine:

Tool Grinding may be divided into two subgroups: tool manufacturing and tool resharpening. There are many types of tool and cutter grinding machine to meet these requirements. Simple single point tools are occasionally sharpened by hand on bench or pedestal grinder. However, tools and cutters with complex geometry like milling cutter, drills, reamers and hobs require sophisticated grinding machine commonly known as universal tool and cutter grinder. Present trend is to use tool and cutter grinder equipped with CNC to grind tool angles, concentricity, cutting edges and dimensional size with high precision.



Tool holding 3-D vice

Fig. 4.106 Pictorial view of a tool and cutter Grinder

Abrasives:

Generally abrasive properties like hardness, toughness and resistance to fracture uniformly abrasives are classified into two principal groups :

1. **Natural Abrasives**
2. **Artificial Abrasives**

Natural Abrasives:

There are a few examples of natural abrasives which include sand stone (solid quartz); emery; corundum and diamond. Diamond is not recommended to use as abrasive due to its cost in effectiveness. However, diamond dust which is the waste of diamond dressing operation can be used as abrasives. Natural abrasive are being described below.

Sand stone is one of the natural abrasive used to make grinding stones. These are relatively soft. These cannot be used for grinding of hard material and at faster speed. Emery is a natural aluminium oxide containing 55 to 65% alumina, rest are iron oxide and impurities. If percentage of aluminium oxide is more, ranging from 75 to 95% then it is called corundum. It consists impurities as remaining amount. Both emery and corundum are harder than quartz and can have better abrasive action. Normally natural abrasives are not preferred due to presence of larger impurities and lack of uniformly in constituents. As both of these things influence the performance of grinding wheel adversely.

Artificial Abrasives:

Main artificial abrasive are silicon carbide and Aluminium Oxide. Artificial abrasive are preferred in manufacturing of grinding wheels because of their uniformity and purity. Artificial abrasives are described below. Silicon Carbide

It is also called carborundum. It is manufactured from 56 parts of silica sand, 34 parts of powdered cake, 2 pats of salt, 12 parts of saw dust in a long rectangular electric furnace of resistance type. Sand furnishes silicon, cake furnishes carbon, saw dust makes the charge porous, salt helps in fusing it. There are two types of silicon carbide abrasive, green grit with approximately 97% silicon carbide and black grit with approximately 95% silicon carbide. It is less harder than diamond and less tough than Aluminium Oxide. It is used for grinding of material of low tensile strength like cemented carbide, stone and ceramic, gray cast iron, brass, bronze, Aluminium vulcanized rubber, etc.

SHORT ANSWER QUESTIONS

1. Write the names of tools used in fitting shop.
2. Explain about universal surface gauge.
3. Draw the file and label the parts.
4. Write the types of drilling machines.
5. Write the devices used for holding the drills in drilling machines.
6. Write the names of different types of grinding wheels.
7. Write the types of conventional grinding machines.

LONG ANSWER QUESTIONS

1. Explain the tools
   a) V-Block b) Try- square c) Chisels d) Hack-saw e) Solid-die f) Tool-Makers vice.
2. Explain the various fitting operations.
3. Draw and explain the radial drilling machine.
4. Explain the various drilling operations.
5. Explain various drills and reamers used in drilling.
6. Explain any two surface grinding machines.
7. Explain any two cylindrical grinding machines.