

**Drilling machine (portable type)**

**Objectives :** At the end of this lesson you shall be able to

- name the different types of portable drilling machines
- state their distinctive features and uses.

**Necessity**

Portable hand drills of different types are used for certain jobs which cannot be handled on stationary drilling machines.

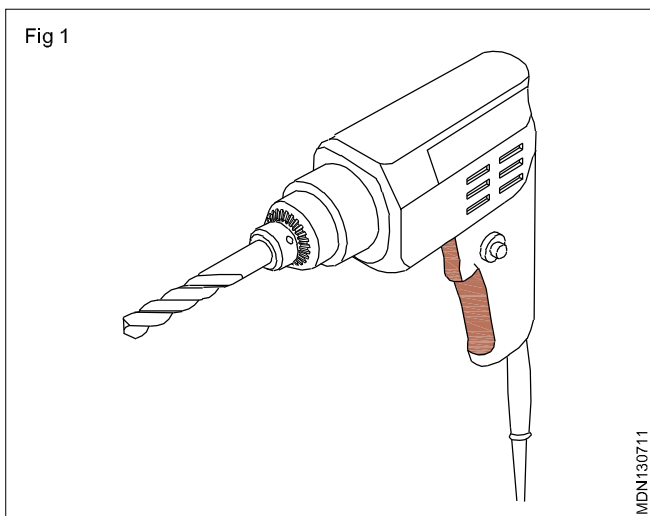
**Types**

There are two types of portable drilling machines, power operated and hand operated.

**Power Operated drilling machines**

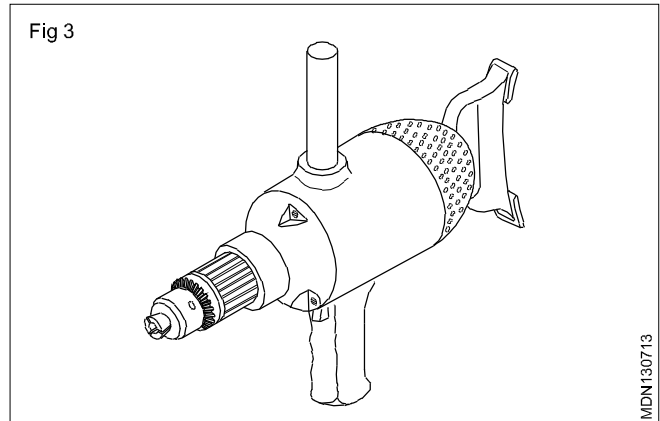
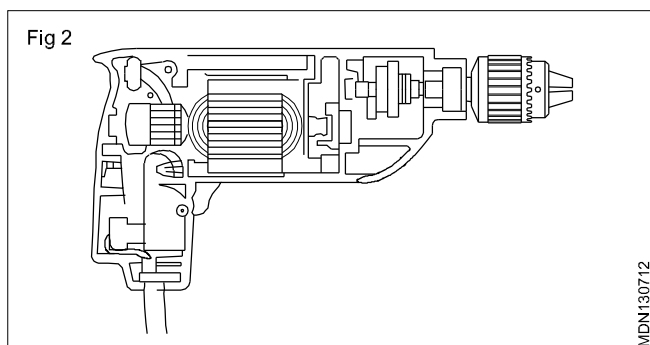
**Electric hand drill (light duty) (Fig 1)**

These are available in different forms. The electric hand drill has a small electrical motor for driving the drill. On the end of the spindle, a drill chuck is mounted. Electric hand drills used for light duty will have, usually, a single speed.



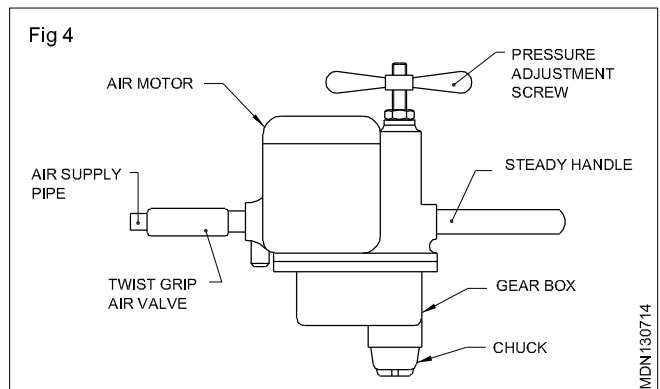
**Electric hand drill (heavy duty) (Figs 2 and 3)**

This drill has an additional feature by which the drill speed can be varied through a system of gears. This is particularly useful for drilling larger diameter holes.



**Pneumatic hand drill (Fig 4)**

This type of drill is operated by compressed air. An air driven motor is housed in the casing, and a handle is fitted along with an air pipe to operate the drill conveniently.



This drill is used where electrically operated drills are prohibited i.e. explosives factories, petroleum refineries etc.

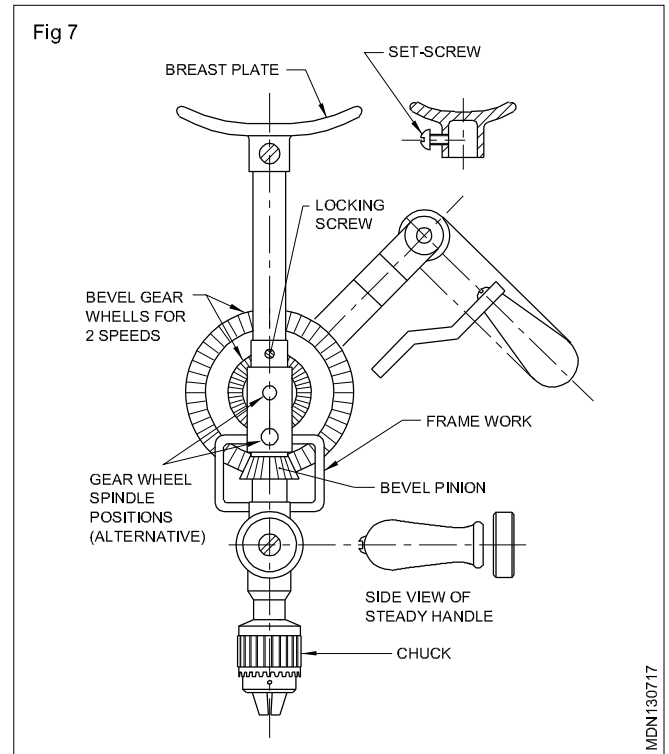
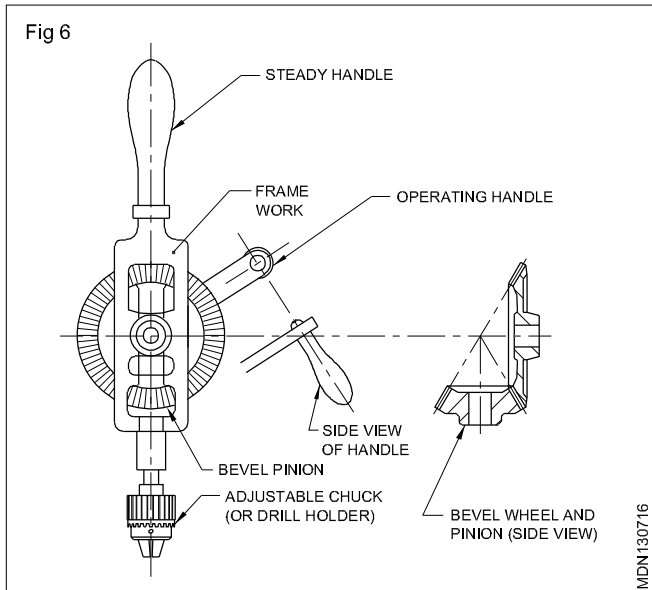
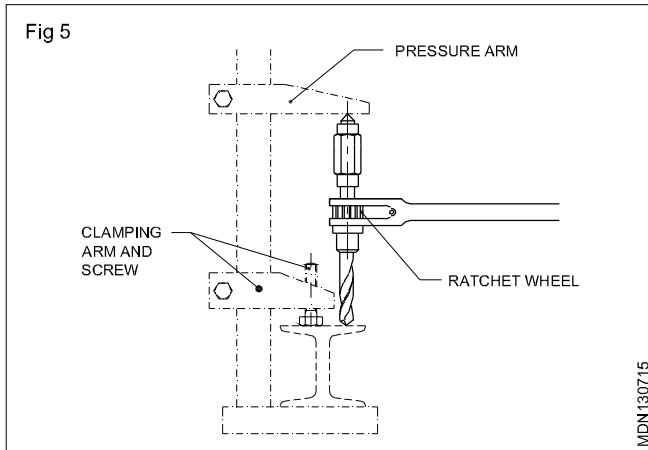
**Hand operated drilling machines**

Different types of hand operated drilling machines are shown below. They are used in structural fabrication, sheet metal and carpentry, particularly where electricity or pneumatic supply is not available.

The ratchet drilling machine (Fig 5) is commonly used in structural fabrication. Square head, taper shank drills are used on these machines.

The bevel gear type drilling machine (Fig 6) is used for drilling small diameter holes up to 6mm.

The breast drilling machine (Fig 7) is used for drilling holes of larger diameter as more pressure can be exerted. Drills between 6 mm to 12 mm can be used on these machines.



## Drilling machines (bench and pillar type)

**Objectives :** At the end of this lesson you shall be able to

- name the types of drilling machines
- list out the parts of bench type, pillar type and radial drilling machines
- compare the features of the bench type, pillar type and radial drilling machines.

The principal types of drilling machines are :

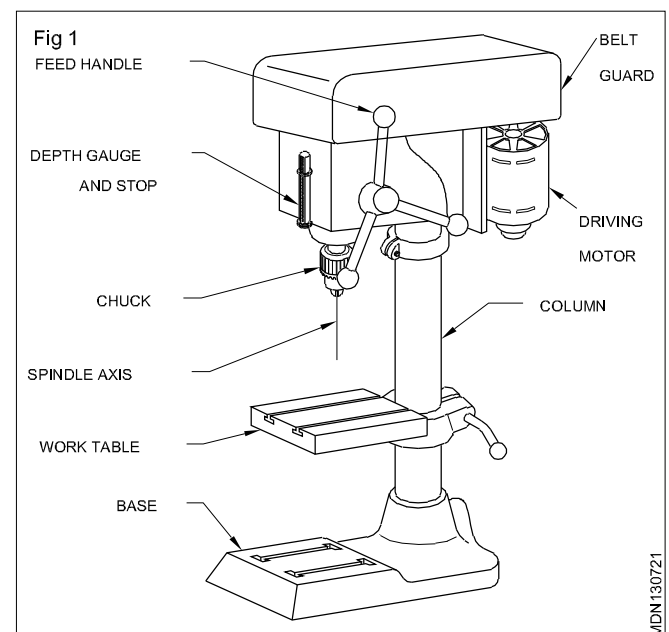
- the sensitive bench drilling machine
- the pillar drilling machine
- the column drilling machine
- the radial arm drilling machine (radial drilling machine).

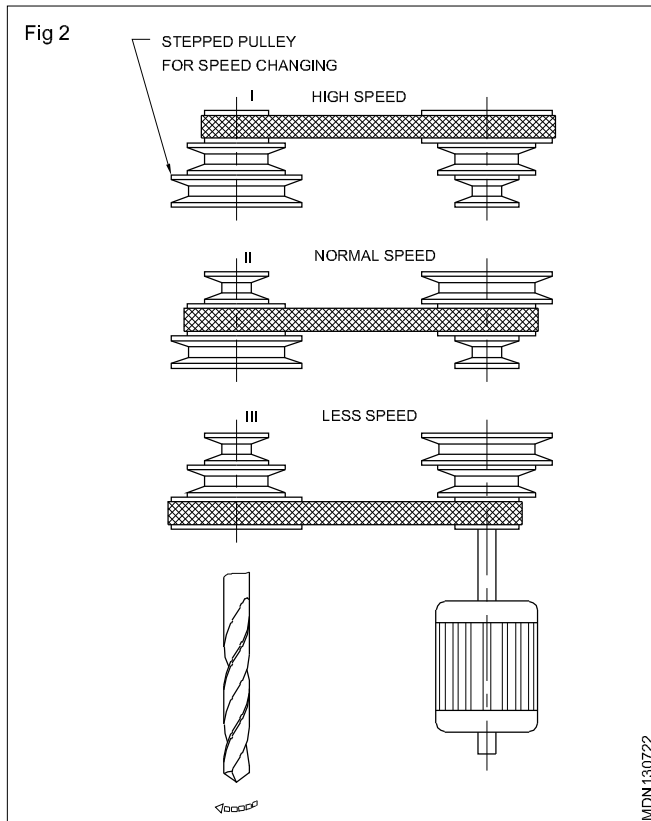
(You are not likely to use the column and radial types of drilling machines now. Therefore, only the sensitive and pillar type machines are explained here.)

### The sensitive bench drilling machine (Fig. 1)

The simplest type of sensitive drilling machines is shown in the figure with its various parts marked. This is used for light duty work.

This machine is capable of drilling holes upto 12.5 mm diameter. The drills are fitted in the chuck or directly in the tapered hole of the machine spindle.

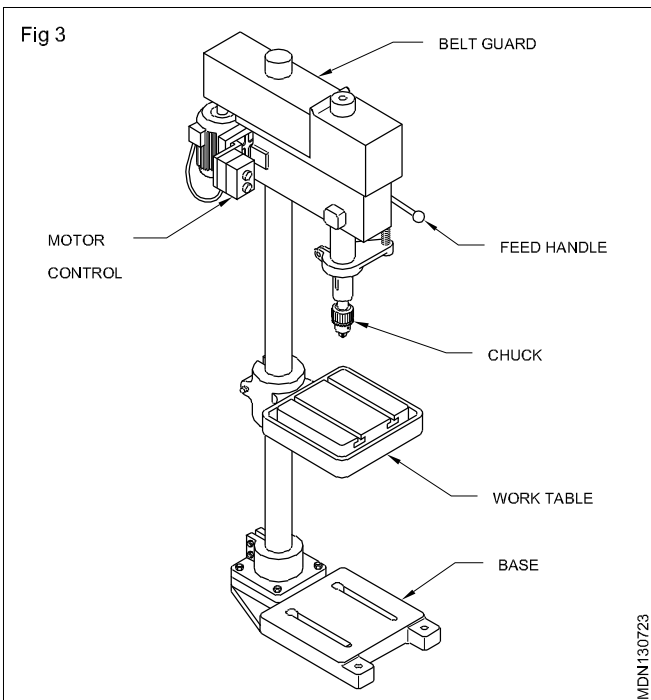




For normal drilling, the work-surface is kept horizontal. If the holes are to be drilled at an angle, the table can be tilted.

Different spindle speeds are achieved by changing the belt position in the stepped pulley. (Fig 2)

### The pillar drilling machine (Fig 3)



This is an enlarged version of the sensitive bench drilling machine. These drilling machines are mounted on the floor and driven by more powerful electric motors. They are used for heavy duty work. Pillar drilling machines are available in different sizes.

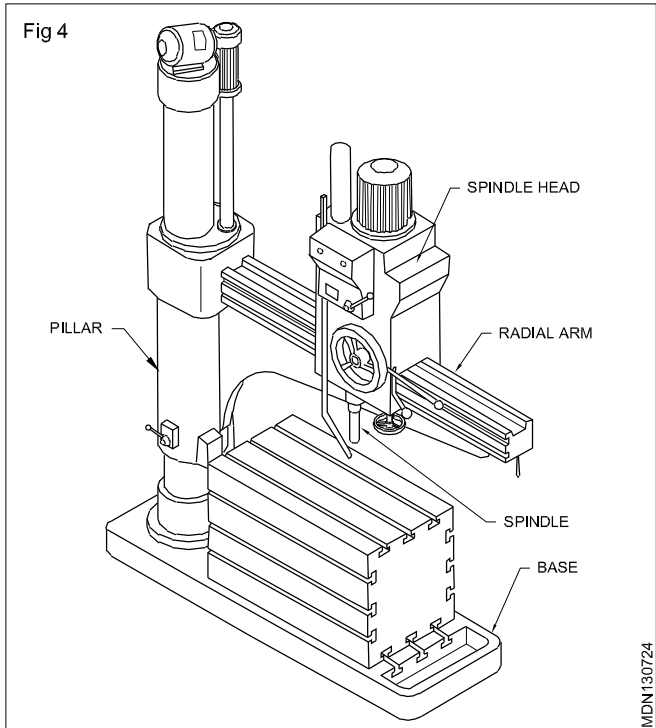
Large machines are provided with a rack and pinion mechanism for moving the table for setting the work.

### Radial drilling machines (Fig 4)

These are used to drill :

- large diameter holes
- multiple holes in one setting of the work
- heavy and large workpieces.

### FEATURES



The radial drilling machine has a radial arm on which the spindle head is mounted.

The spindle head can be moved along the radial arm and can be locked in any position.

The arm is supported by a pillar (column). It can be rotated about with the pillar as centre. Therefore, the drill spindle can cover the entire working surface of the table. The arm can be lifted or lowered.

The motor mounted on the spindle head rotates the spindle.

The variable-speed gearbox provides a large range of r.p.m.

## Cutting speed and RPM

**Objectives :** At the end of this lesson you shall be able to

- **define cutting speed**
- **state the factors for determining the cutting speed**
- **differentiate between cutting speed and r.p.m.**
- **determine r.p.m. spindle speed**
- **select r.p.m. for drill sizes from tables.**

For a drill to give satisfactory performance, it must operate at the correct cutting speed and feed.

Cutting speed is the speed at which the cutting edge passes over the material while cutting, and is expressed in metres per minute.

Cutting speed is also sometimes stated as surface speed or peripheral speed.

The selection of the recommended cutting speed for drilling depends on the materials to be drilled, and the tool material.

Tool manufacturers usually provide a table of cutting speeds required for different materials.

The recommended cutting speeds for different materials are given in the table. Based on the cutting speed recommended, the r.p.m. at which a drill has to be driven, is determined.

Calculate r.p.m

$$V = \frac{n \times d \times \pi}{1000} \text{ m/min}$$

$$n = \frac{v \times 1000}{d \times \pi} \text{ r.p.m}$$

n= r.p.m

v= cutting speed in m/min

d= diameter of drill in mm

$\pi = 3.14$

Material being drilled for HSS	Cutting speed (m/min)
Aluminium	70 -100
Brass	35-50
Bronze (Phosphor)	20-35
Cast Iron (grey)	25-40
Copper	35-45
LC/MC steel/ Alloy steel	20-30
Thermosetting plastic (low speed due to abrasive properties )	5-8

## Work - holding devices

**Objectives :** At the end of this lesson you shall be able to

- **state the purpose of work-holding devices**
- **name the devices used for holding work**
- **state the precautions to be observed while using.**

Workpieces to be drilled should be properly held or clamped to prevent them from rotating along with the drill. Improperly secured work is not only a danger to the operator but can also cause inaccurate work, and breakage to the drill. Various devices are used to ensure proper holding.

### The machine vice (Fig 1)

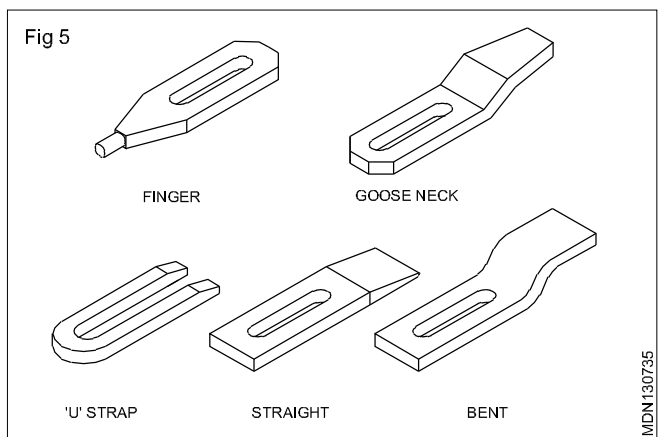
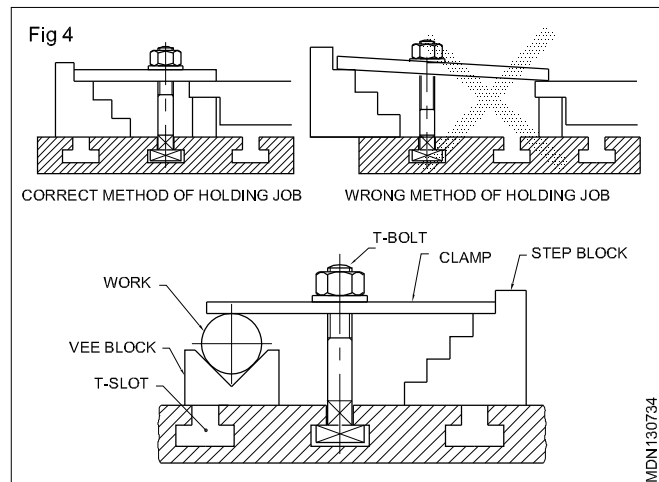
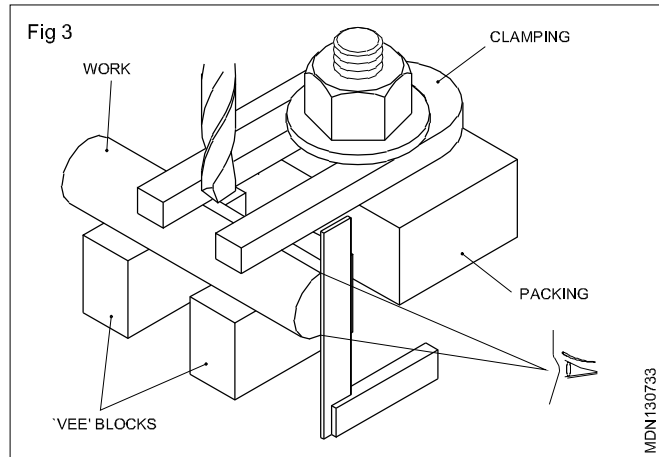
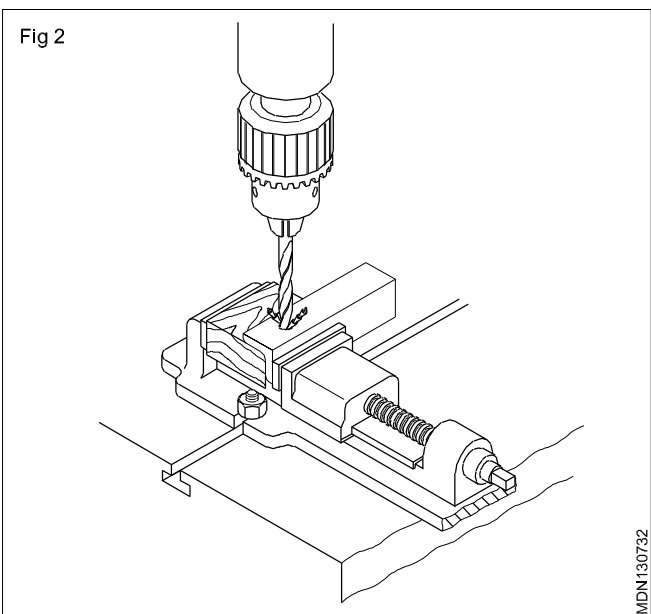
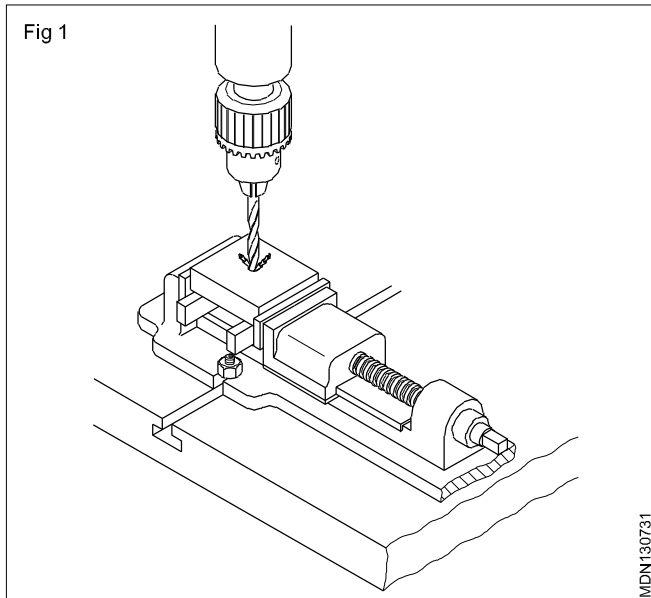
Most of the drilling work can be held in a machine vice. Ensure that the drill does not drill through the vice after it has passed through the work. For this purpose, the work can be lifted up and secured on parallel blocks providing a gap between the work and the bottom of the vice.

Workpieces which are not accurate may be supported by wooden pieces.

### Clamps and bolts (Fig 2,3,4 & 5)

Drilling machine tables are provided with T-slots for fitting bolt heads. Using clamps and bolts, the workpieces can be held very rigidly. While using this method, the packing should be, as far as possible, of the same height as the work, and the bolt nearer to the work.

There are many types of clamps and it is necessary to determine the clamping method according to the work.



## Drill - holding devices

**Objectives :** At the end of this lesson you shall be able to

- name the types of drill-holding devices
- state the features of drill chucks
- state the functions of drill sleeves
- state the function of drift.

For drilling holes of material, the drills are to be held accurately and rigidly on the machines.

The common drill-holding devices are drill chucks and sleeves and sockets.

### Drill Chuck

Straight shank drills are held in drill chucks. For fixing and removing drills, the chucks are provided either with a pinion and key or a knurled ring.

The drill chucks are held on the machine spindle by means of an arbor fitted or the drill chuck. (Fig 1)

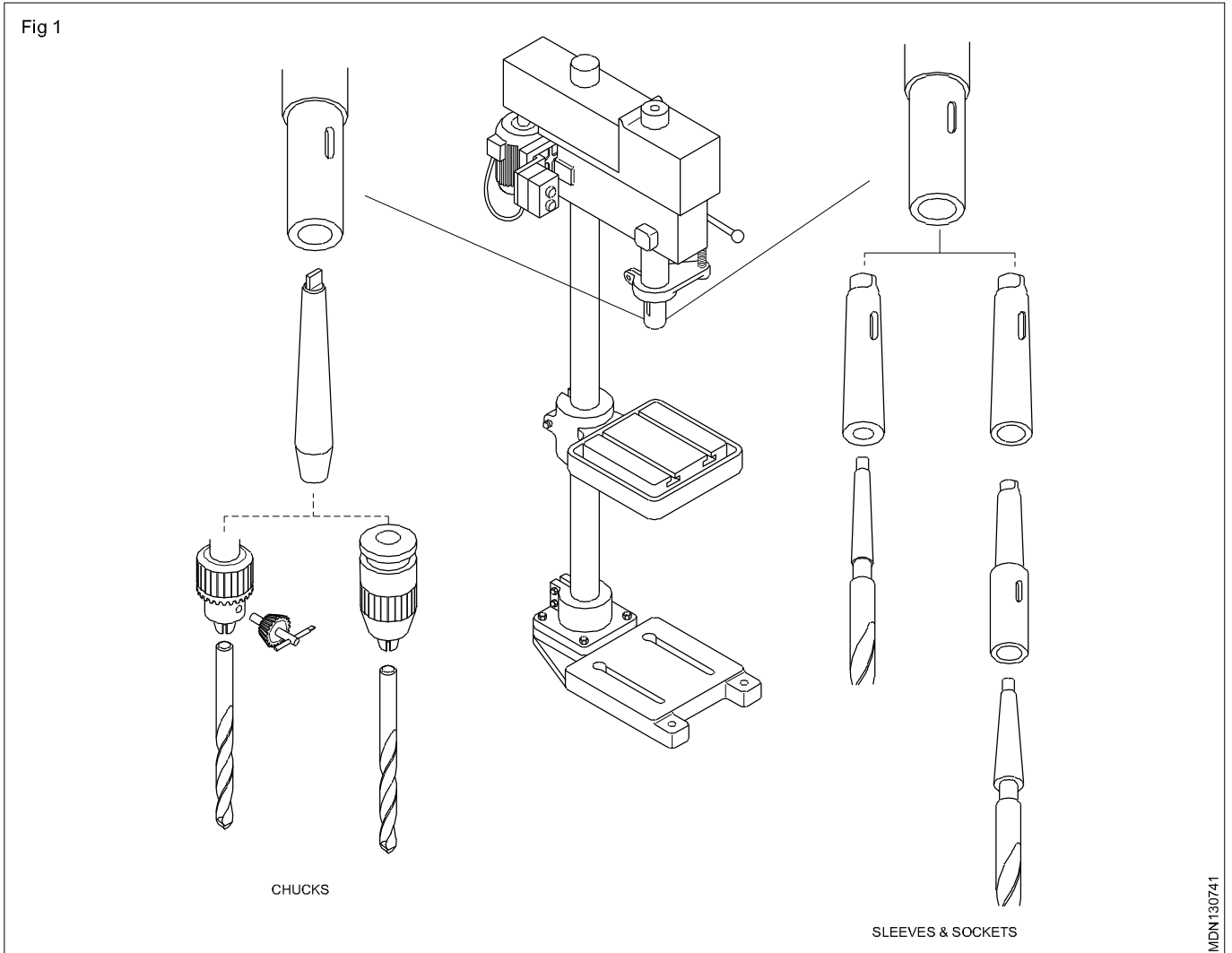
**Taper Sleeves and Sockets (Fig 1)**

Taper shank drills have a morse taper.

Sleeves and sockets are made with the same taper so that the taper shank of the drill. When engaged, will give a good wedging action. due to this reason morse tapers are called self-holding tapers.

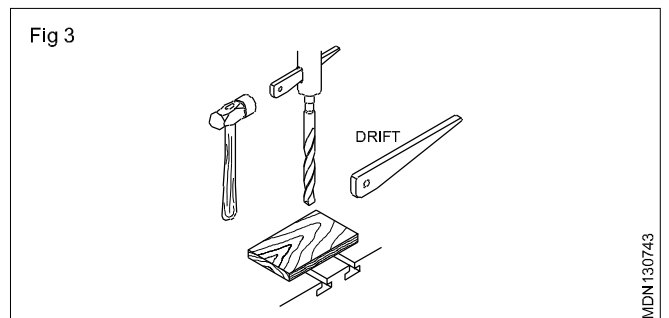
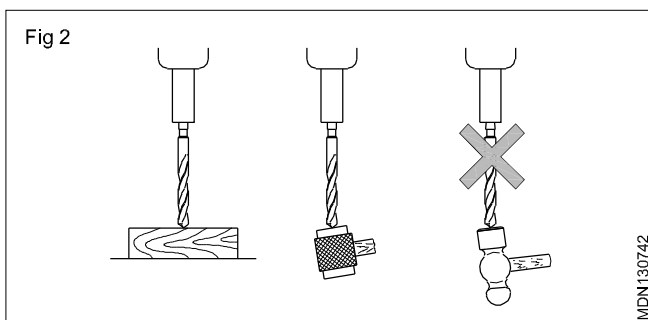
Drills are provided with five different sizes of morse tapers, and are numbered from MT 1 to MT5.

In order to make up the difference in sizes between the shanks of the drills and the type of machine spindles, sleeves of different sizes are used. When the drill taper shank is bigger than the machine spindle, taper sockets are used. (Fig 1)

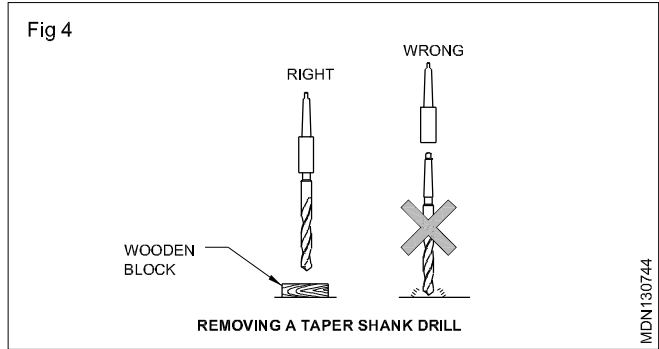


While fixing the drill in a socket or sleeves the tang portion should align in the slot (Fig 2). this will facilitate the removal of drill or sleeve from the machine spindle.

Use a drift remove drills and sockets from the machine spindle. (Fig 3)



While removing the drill from the sockets sleeves, don't allow it to fall on the table or jobs. (Fig 4)

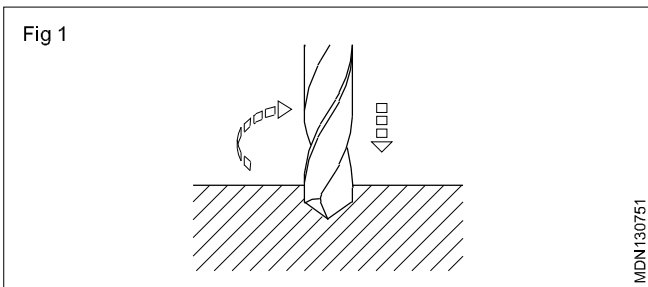


## Drill Bits

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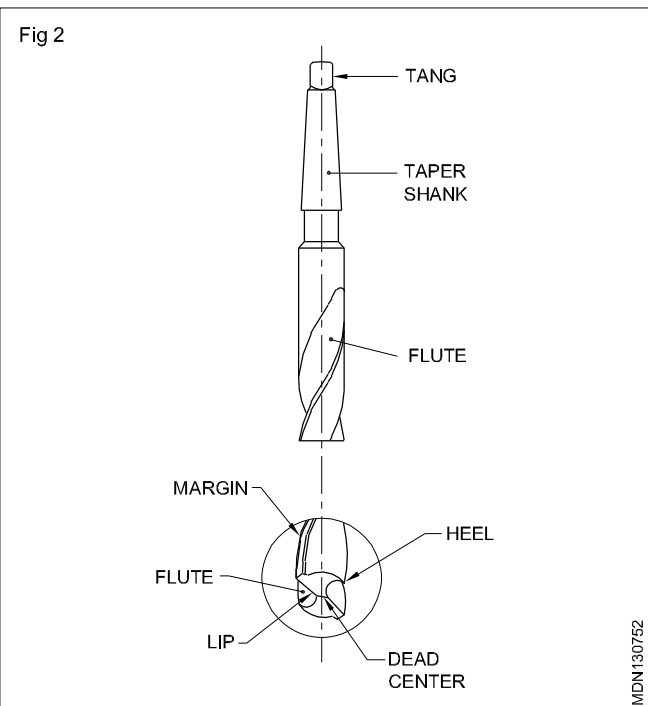
- state the functions of drills
- name the parts of a drill
- state the functions of each part of a drill.

Drilling is a process of making holes on workpieces. The drill used as a tool. For drilling the drill is rotated with a downward pressure causing the tool to penetrate into the material (Fig 1)



### Parts of a Drill (Fig 2)

The Various parts of a drill can be identified from fig. 2



### Point

The cone shaped end which does the cutting is called point. It consists of a dead centre, lips or cutting edges and a heel.

### Shank

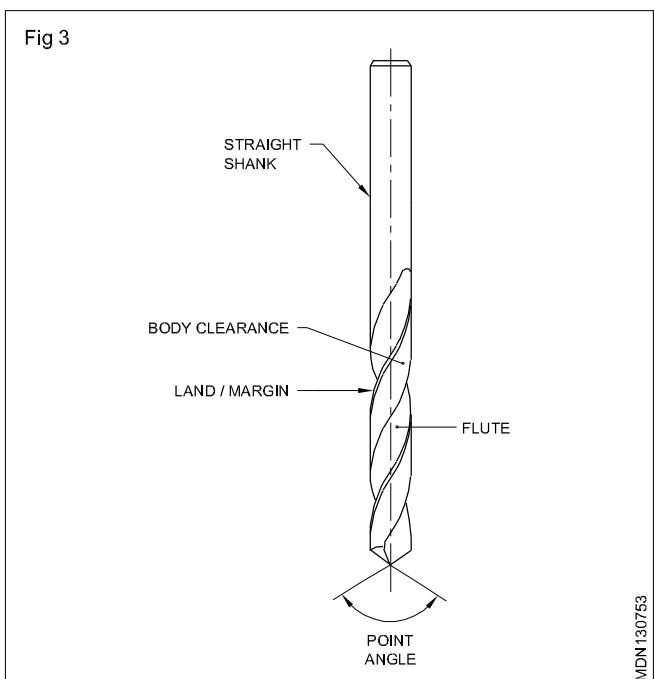
This is the driving end of the drill which is fitted on to the machine. Shanks are of two types.

Taper shanks, used for larger diameter drills, and straight shank, used for smaller diameter drills.

### Tang

This is a part of the taper shank drill which fits into the slot of the drilling machine spindle.

### Body (Fig. 3)



The portion between the point and the shank is called the body of a drill.

The parts of the body are flute, land/margin, body clearance and web.

### Flutes

Flutes are the spiral grooves which run to the length of the drill. The flutes help,

- to form the cutting edges
- to curl the chips and allow these to come out
- the coolant to flow to the cutting edge.

### Land/Margin

The land/margin is the narrow strip which extends to the entire length of the flutes.

The diameter of the drill is measured across the land margin.

### Body Clearance

Body clearance is the part of the body which is reduced in diameter to cut down the friction between the drill and the hole being drilled.

### Web

Web is the metal column which separates the flutes. It gradually increases in thickness towards the shank.

## Drill Angles

**Objectives :** At the end of this lesson you shall be able to

- list the various angles of a twist drill
- state the functions of each angle
- list the tool types for drill as per IS
- distinguish the features of different types of drills
- designate drills as per ISI recommendations.

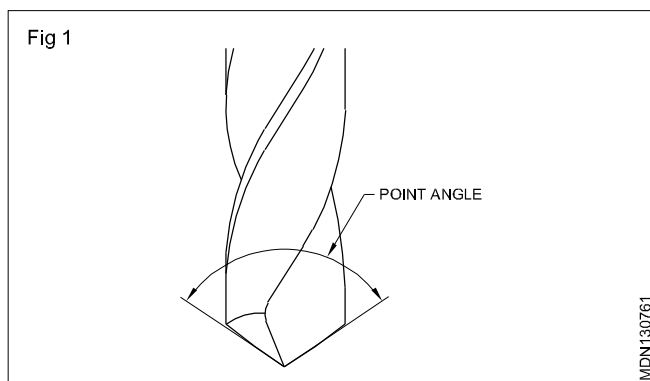
### Angles

They are different angles for different purposes. They are listed below.

Point Angle, Helix angles, Rake angle, Clearance angle and chisel edge angle.

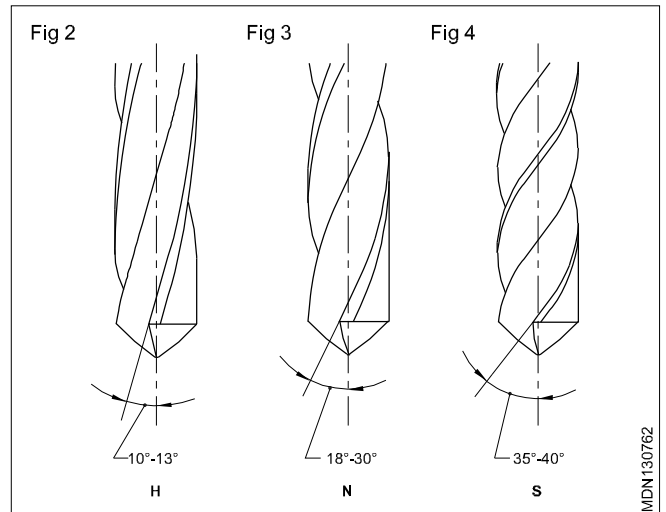
### Point Angle/Cutting Angle

The point angle of a general purpose (standard) drill is  $118^\circ$ . This is the angle between the cutting edges (lips). This angle according to the hardness of the material to be drilled (Fig 1)



### Helix Angle (Figs 2,3 and 4)

Twist drills are made with different helix angles. The helix angle determines the rake angle at the cutting edge of the twist drill.



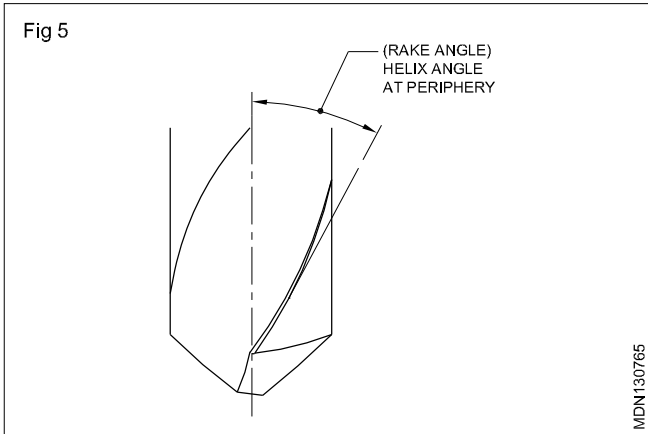
The helix angles vary according to the material being drilled. According to Indian Standards, three types of drills are used for drilling various materials.

- Type N-for normal low carbon steel
- Type H-for hard and tenacious materials
- Type S- for soft and tough materials.

The type of drill used for general purpose drilling work is Type N.



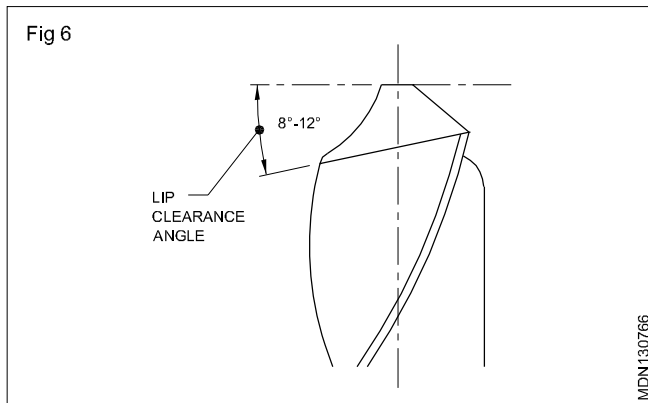
### Rake Angle (Fig 5)



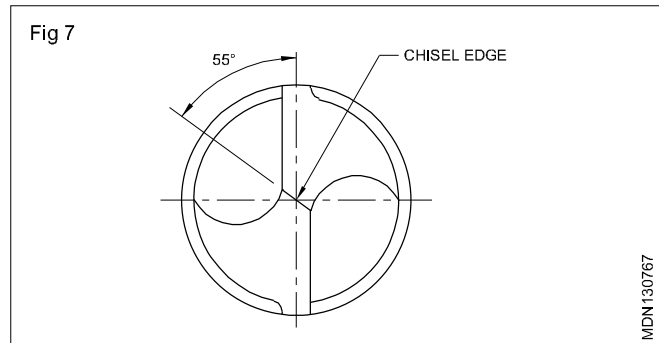
Rake angle is the angle of flute (helix angle)

### Clearance Angle (Fig 6)

The clearance angle is to prevent the friction of the tool behind the cutting edge. This will help in the penetration of the cutting edges into the material. If the clearance angle is too much the cutting edges will be weak, and if it is too small the drill will not cut.



### Chisel Edge Angle/ Web Angle (Fig 7)



This is the angle between the chisel edge and the cutting lip.

### Designation of drills

Twist drills are designated by the

- diameter

Diameter of drill      IS NO.  
 /                                    /  
 Twist drill 9.50 H - IS5101 - HS  
 /                                    /  
 Tool Type                                    Material

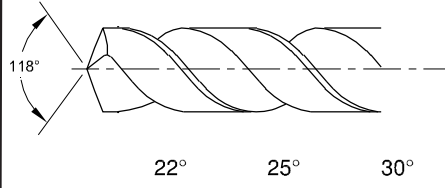
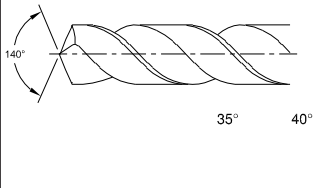
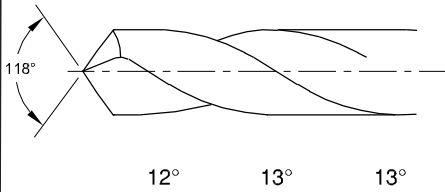
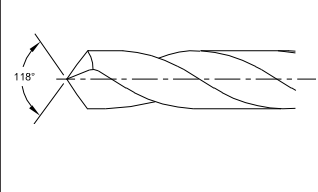
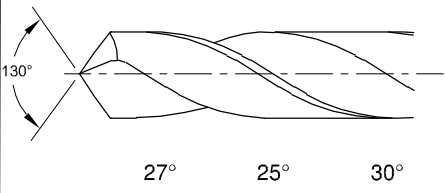
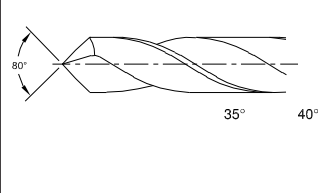
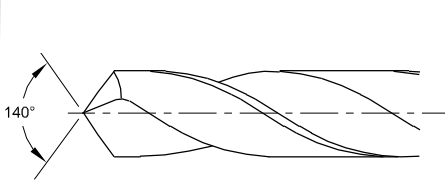
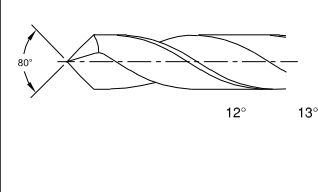
- tool type
- material

### Example

A twist drill of 9.50mm dia of tool type "H" right hand cutting and made from HSS is designated.

If the tool type is not indicated in the designation, it should be taken as type 'N' tool.

### Drills for different materials

Recommended drills					
Material to be drilled	Point angle	Helix angle d=3.2-5 5-10		Material to be drilled	Point angle Helix angle d=3.5 -5
Steel and cast steel up to 70 kgf/mm <sup>2</sup> strength Gray cast iron Malleable cast iron Brass German silver, nickel		22°	25°	Copper (up to 30 mm drill diameter) Al-alloys, forming curly chips celluloid	
Brass, CuZn 40		12°	13°	Austenitic steels	
Steel and cast steel 70.... 120 Kgfmm <sup>2</sup>		27°	25°	Moulded plastics (with thickness s>d)	
Stainless steel; Copper (drill diameter) more than 30 mm) Al-alloy, forming short - broken chips		22°	25°	Moulded plastics, with thickness s<d Laminated plastics. hard rubber (ebonite) marble, slate, coal	
				Zinc alloys	