

Ch-3 Drilling Machine



Subject:- MP
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What is Drilling?

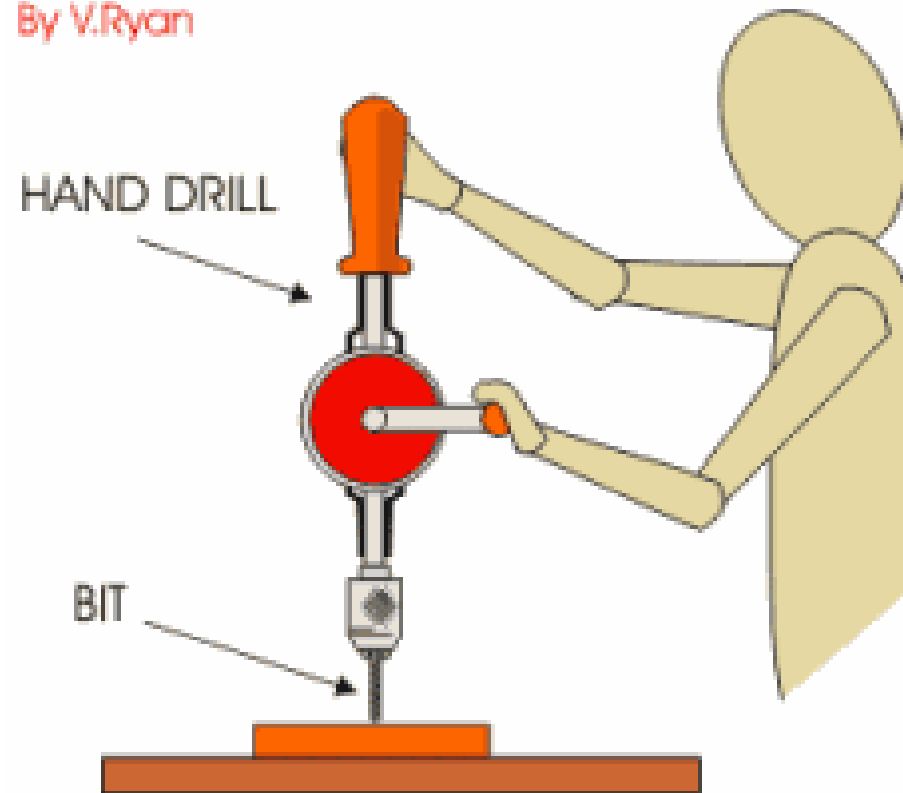
What is Drilling?

- Drilling is the operation of producing circular hole in the work-piece by using a rotating cutter called DRILL.
- Drilling is an operation of making a circular hole by removing a volume of metal from the job by cutting tool called drill.
- The drilling operation can also be accomplished in lathe, in which the drill is held in tailstock and the work is held by the chuck.
- The most common drill used is the twist drill.



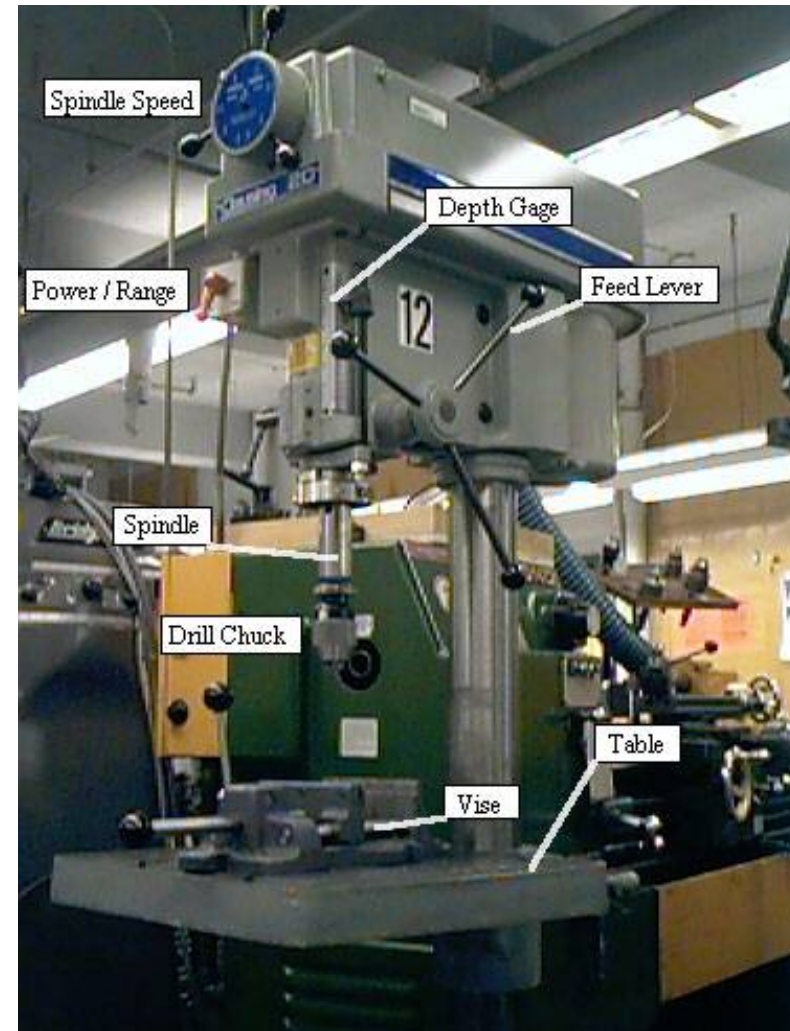
HOW TO USE A HAND DRILL

By V.Ryan



Drilling Machine

- A drilling machine is a machine tool designed for drilling holes in metals.
- It is one of the most important and versatile machine tools in a workshop.
- Besides drilling round holes, many other operations can also be performed on the drilling machine such as counter-
 - ✓ boring,
 - ✓ countersinking,
 - ✓ honing,
 - ✓ reaming,
 - ✓ lapping,
 - ✓ sanding etc.



CONSTRUCTION OF DRILLING MACHINE

- Drilling machine consists of following parts

1. Base
2. Pillar
3. Main drive
4. Drill spindle
5. Feed handle
6. Work table

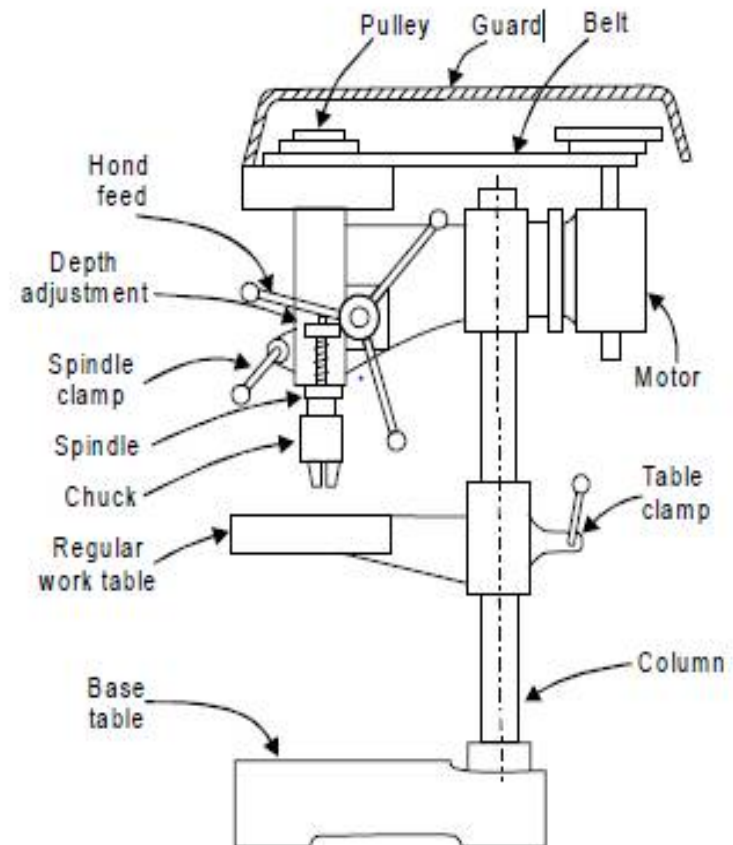
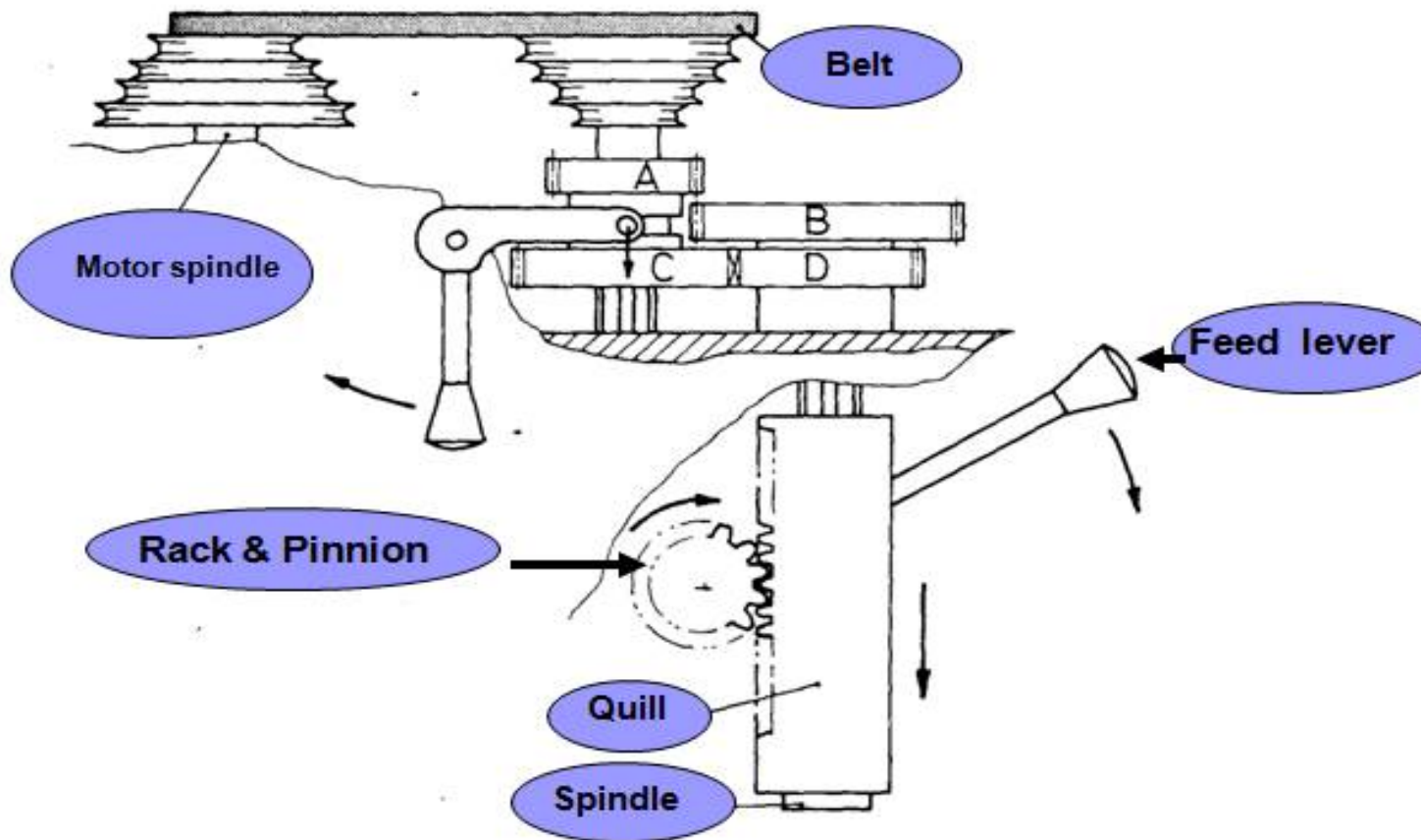


Fig. 22.1 Construction of drilling machine

Belt drive system



Types of Drilling Machine

Drilling machines are classified on the basis of their constructional features, or the type of work they can handle. The various types of drilling machines are:

- (1) Portable drilling machine
- (2) Sensitive drilling machine
 - (a) *Bench mounting*
 - (b) *Floor mounting*
- (3) Upright drilling machine
 - (a) *Round column section*
 - (b) *Box column section machine*



Types of Drilling Machine

(4) Radial drilling machine

(a) *Plain*

(b) *Semiuniversal*

(c) *Universal*

(5) Gang drilling machine

(6) Multiple spindle drilling machine

(7) Automatic drilling machine

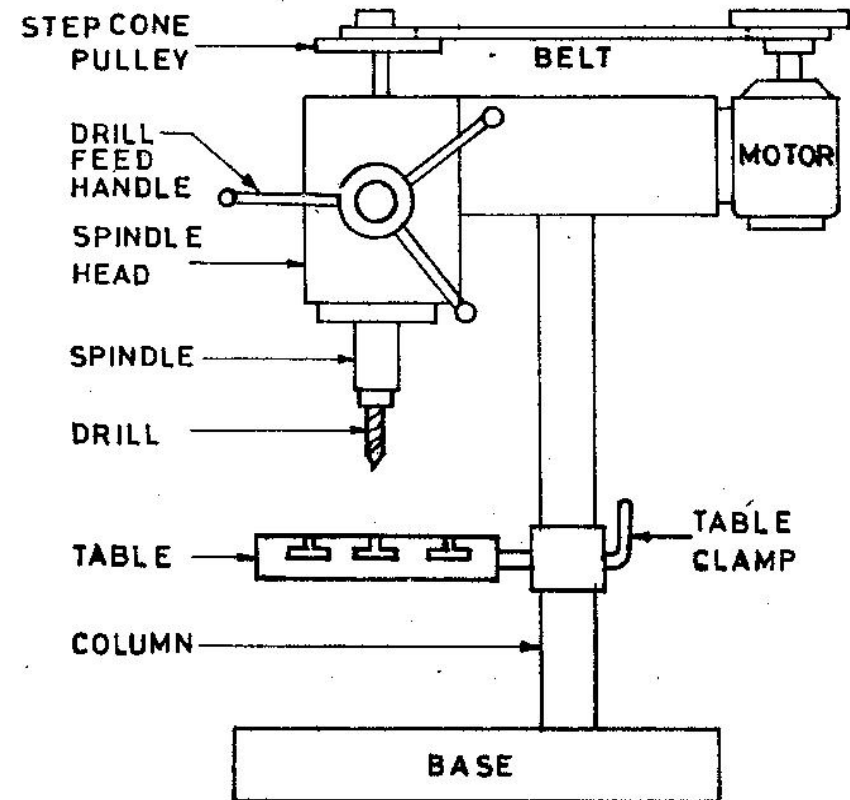
(8) Deep hole drilling machine

(a) *Vertical*

(b) *Horizontal*

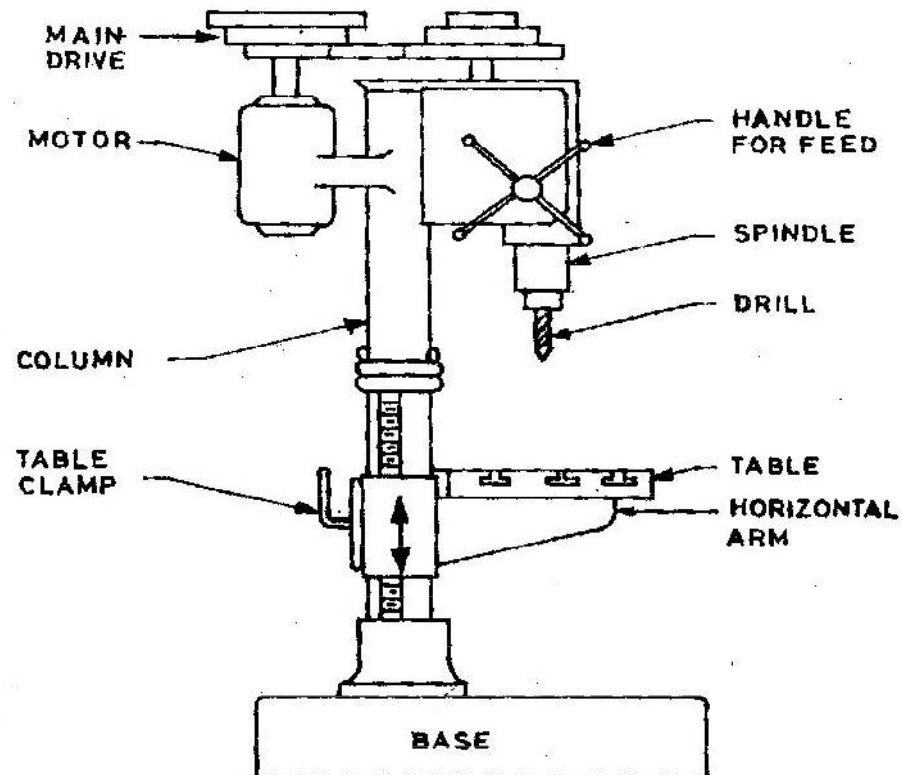
Sensitive Drilling Machine

- Drill holes from 1.5 to 15mm
- Operator senses the cutting action so sensitive drilling machine



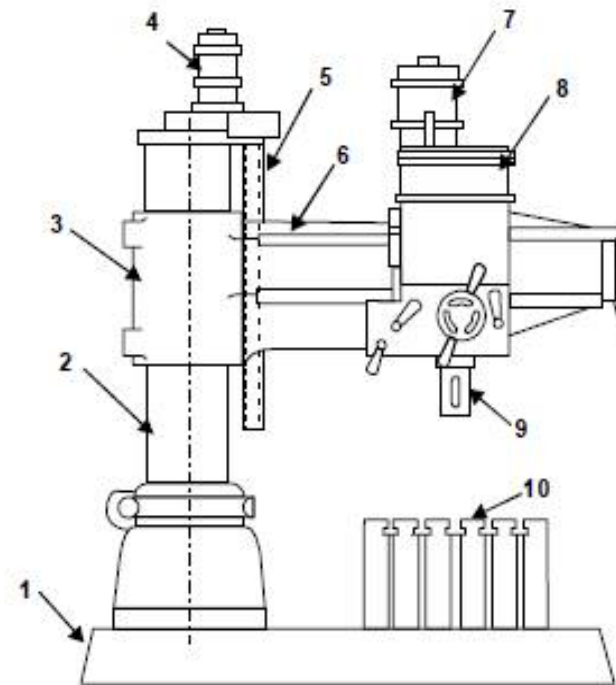
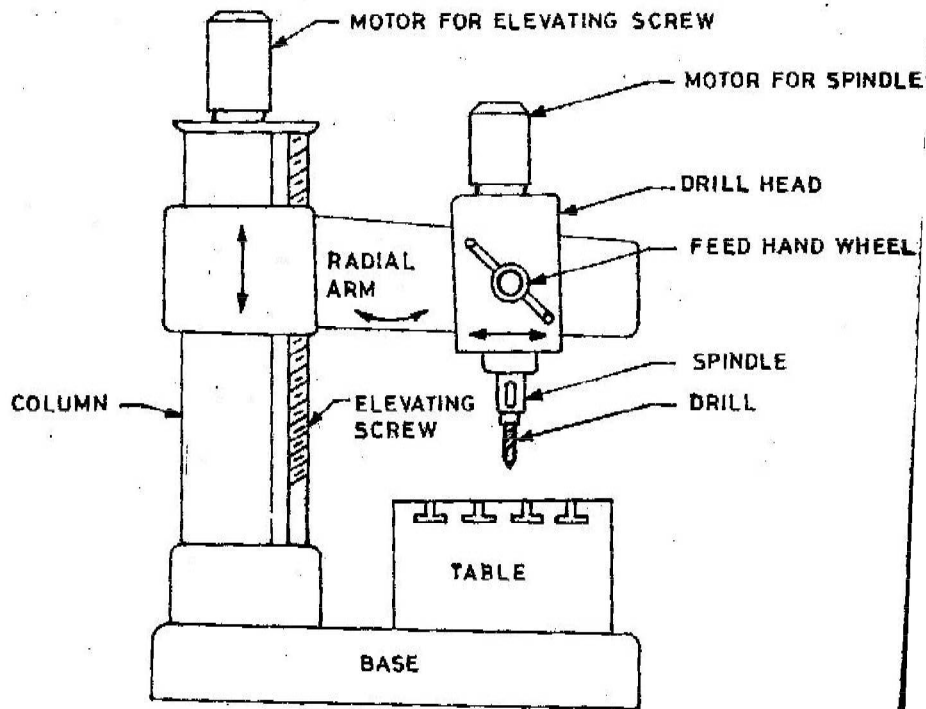
Up-Right Drilling Machine

- Drill holes up to 50mm
- Table can move vertically and radially .



Radial Drilling Machine

- It is the largest and most versatile used for drilling medium to large and heavy work pieces.



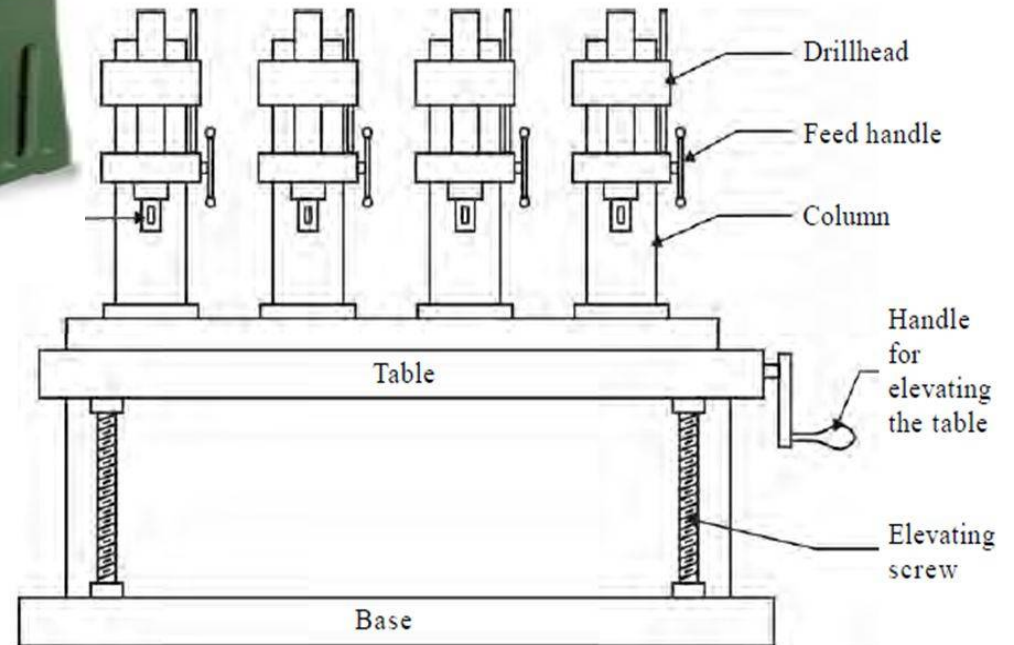
Parts name

- | | |
|----------------------------|------------------------------------|
| 1. Base | 6. Guide ways |
| 2. Column | 7. Motor for driving drill spindle |
| 3. Radial arm | 8. Drill head |
| 4. Motor for elevating arm | 9. Drill spindle |
| 5. Elevating screw | 10. Table |

Fig. 22.2 Radial drilling machine



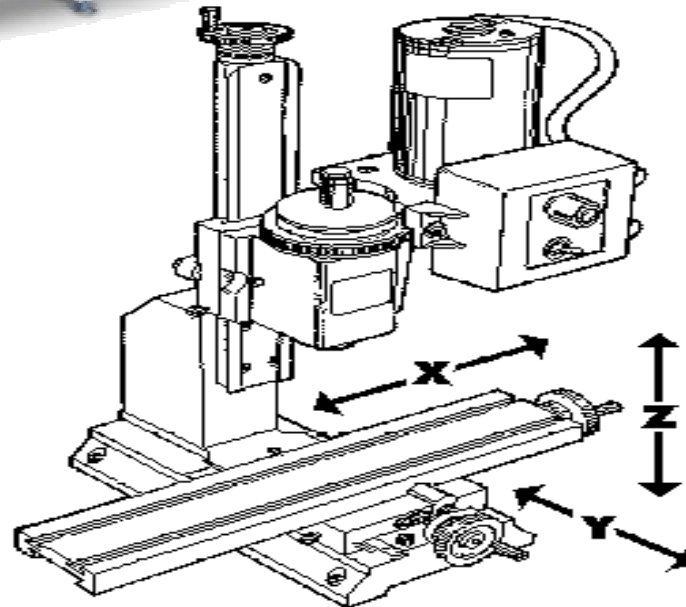
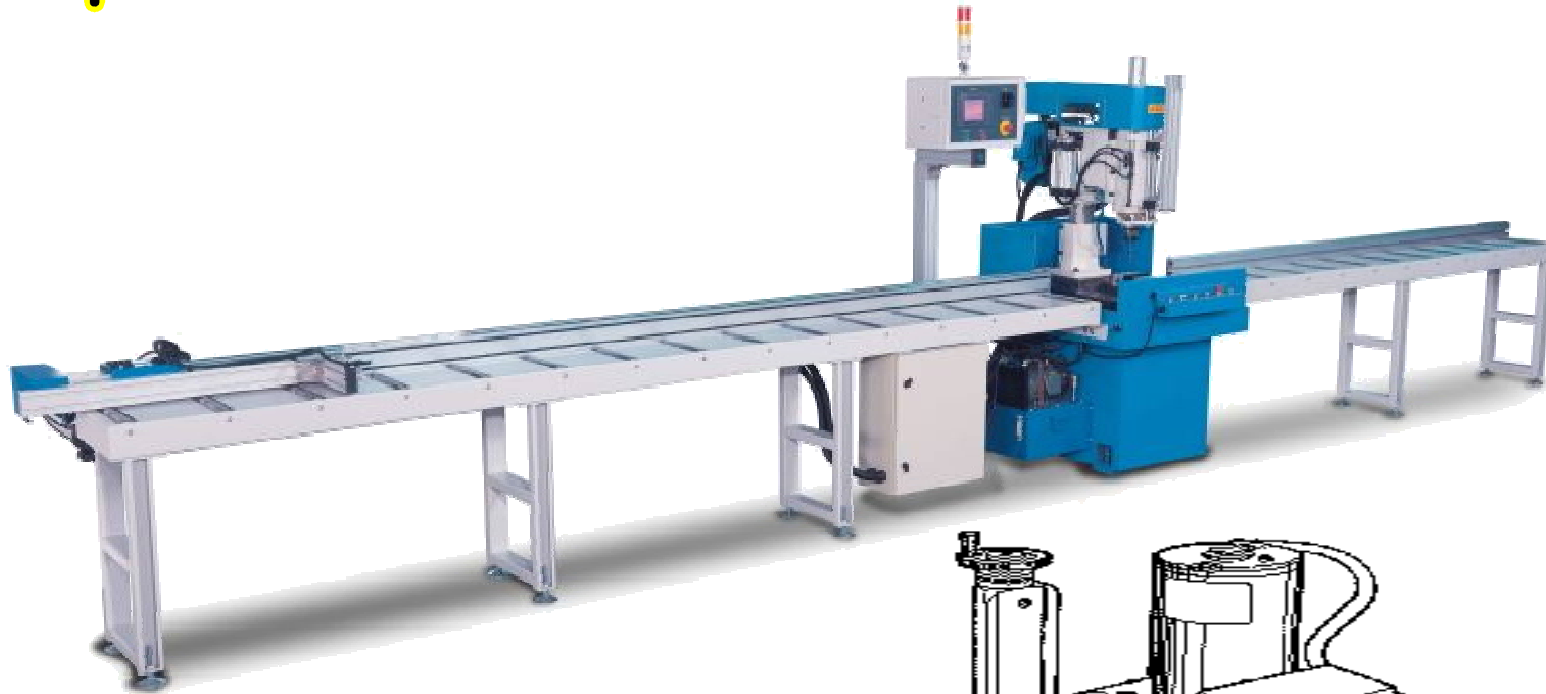
Gang drilling machine



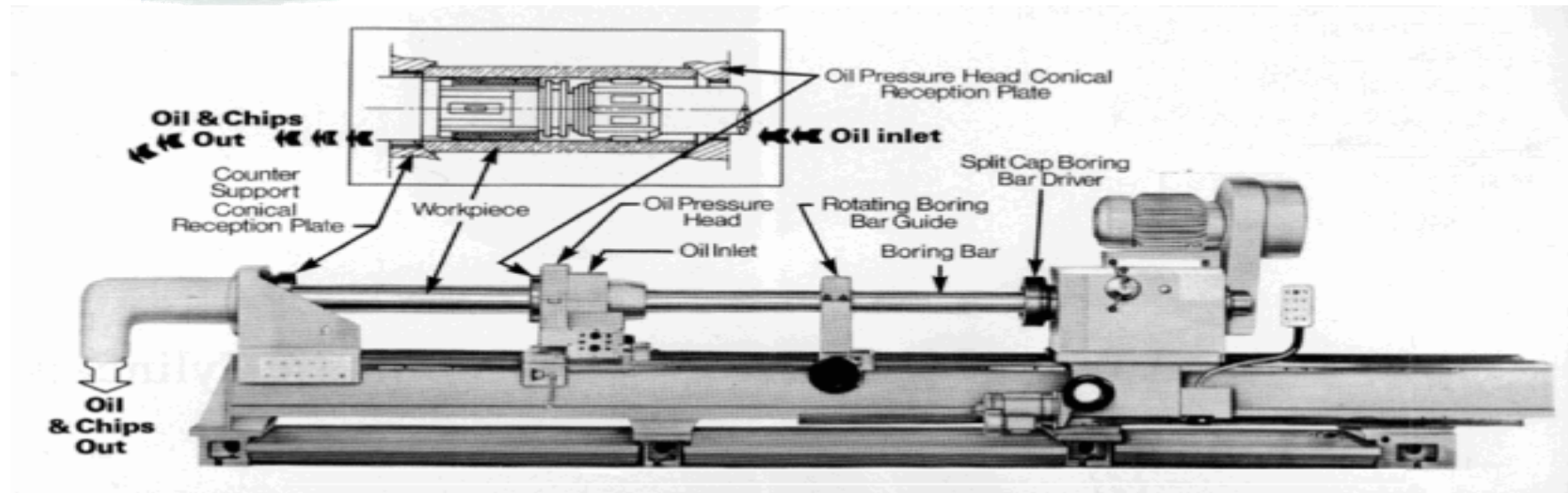
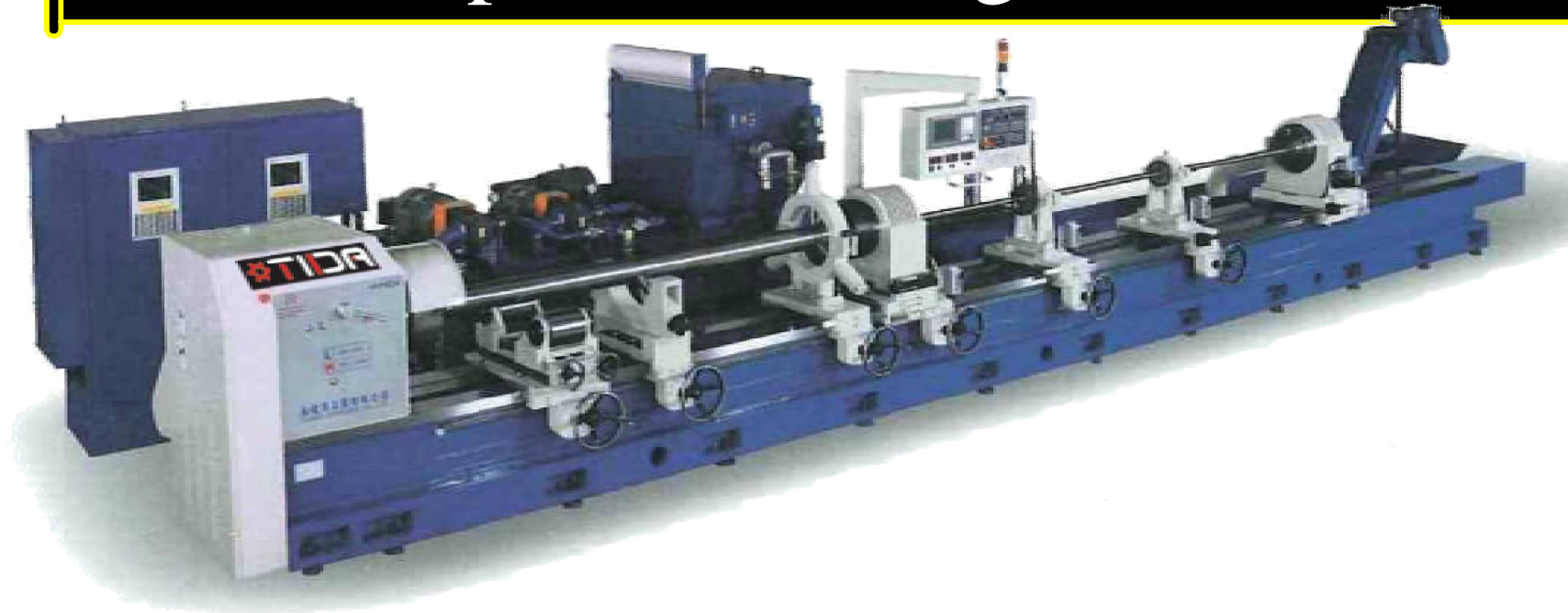
Multiple spindle drilling machine



AUTOMATIC Drilling machine



Deep hole drilling machine



Drilling machine operation

1. Drilling
2. Reaming
3. Boring
4. Counter boring
5. Countersinking
6. Spot facing
7. Tapping
8. Lapping
9. Grinding
10. Trepanning.

Reaming

- It is a process of *smoothing* the surface of drilled holes with a tool.
- Tool is called as reamer.
- Initially a hole is drilled slightly smaller in size.
- Drill is replaced by reamer.
- Speed is reduced to half that of the drilling.

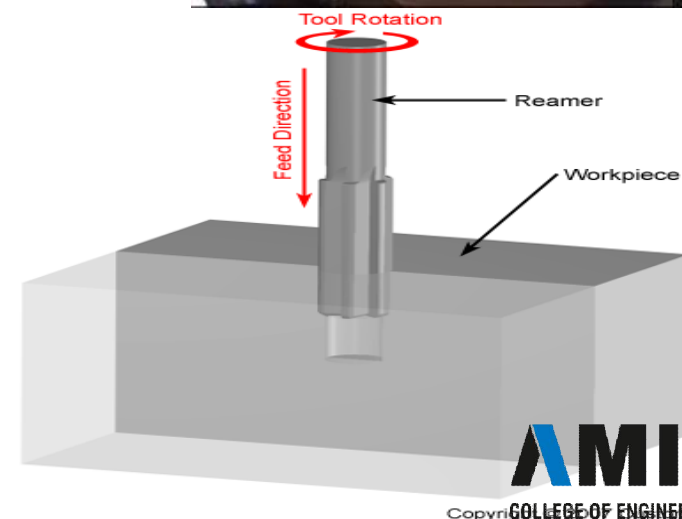
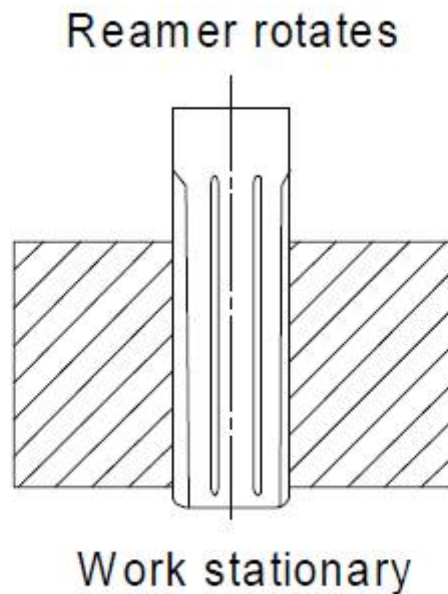


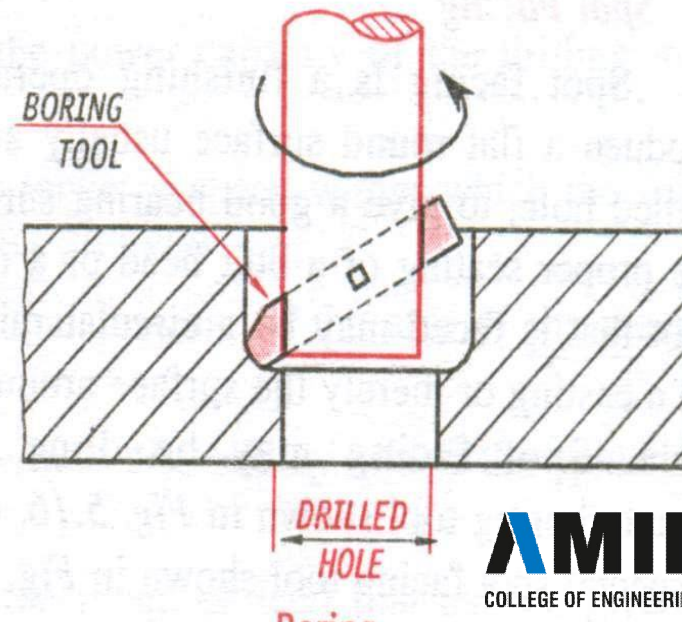
Fig. 22.7 Reaming operation

Boring

- It is process carried on a drilling machine to increase the size of an already drilled hole.
- Initially a hole is drilled to the nearest size and using a *boring* tool the size of the hole is increased.

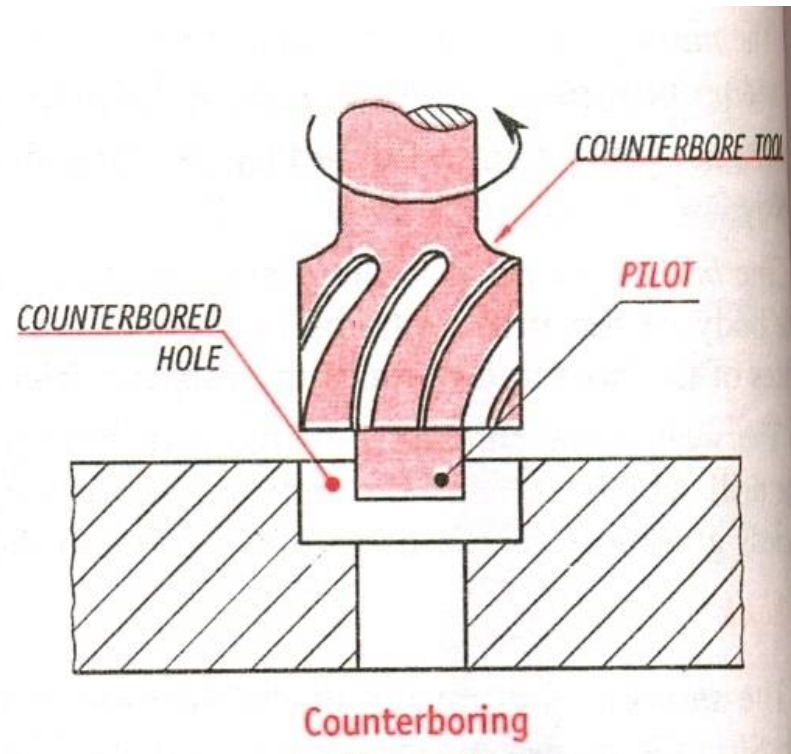


Boring



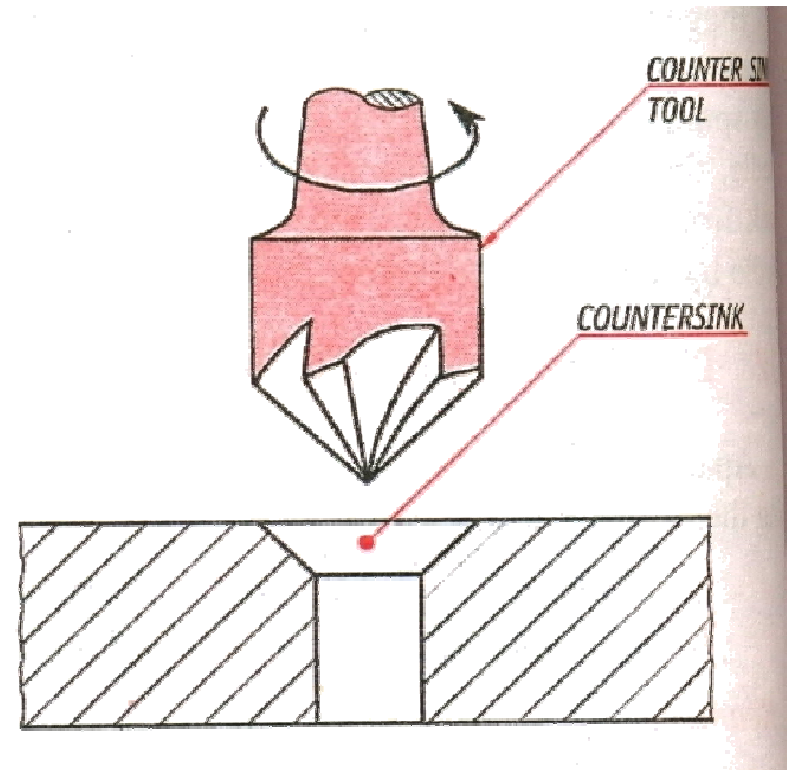
Counter Boring

- This process involves increasing the size of a hole at only one end.
- Cutting tool will have a small cylindrical portion called *pilot*.
- Cutting speed = two-thirds of the drilling speed for the same hole.

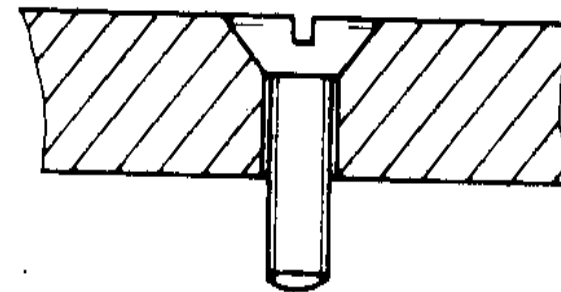
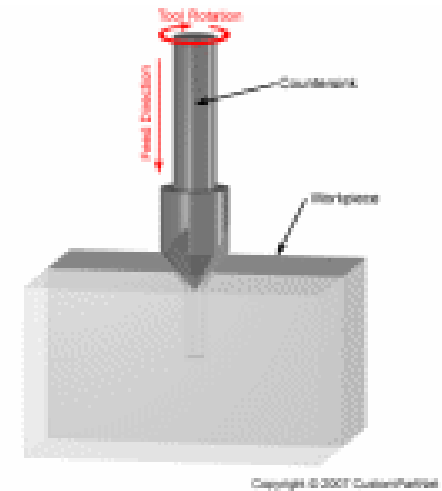


Counter sinking

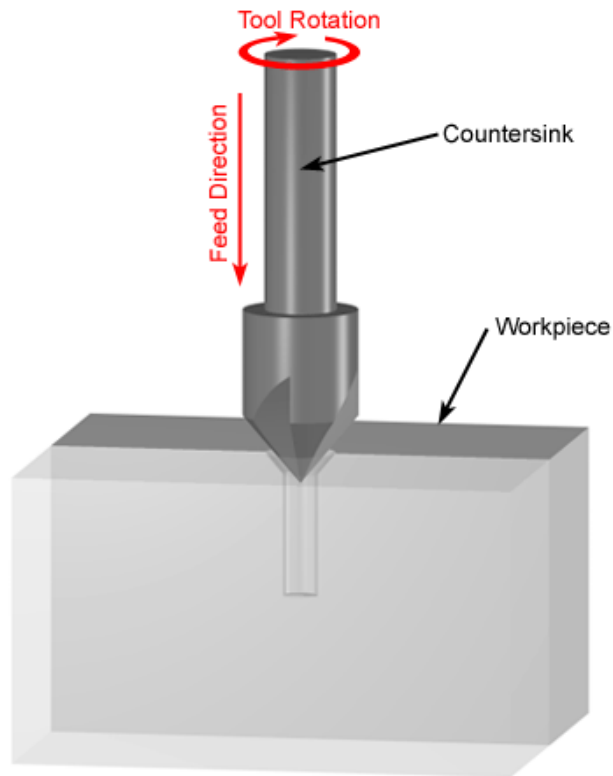
- Counter-sinking operation is shown in Fig.
- This is the operation of making a cone shaped enlargement of the end of a hole, as for the recess for a flat head screw.
- This is done for providing a seat for counter sunk heads of the screws so that the latter may flush with the main surface of the work.



Counter sinking



Counter sinking tool

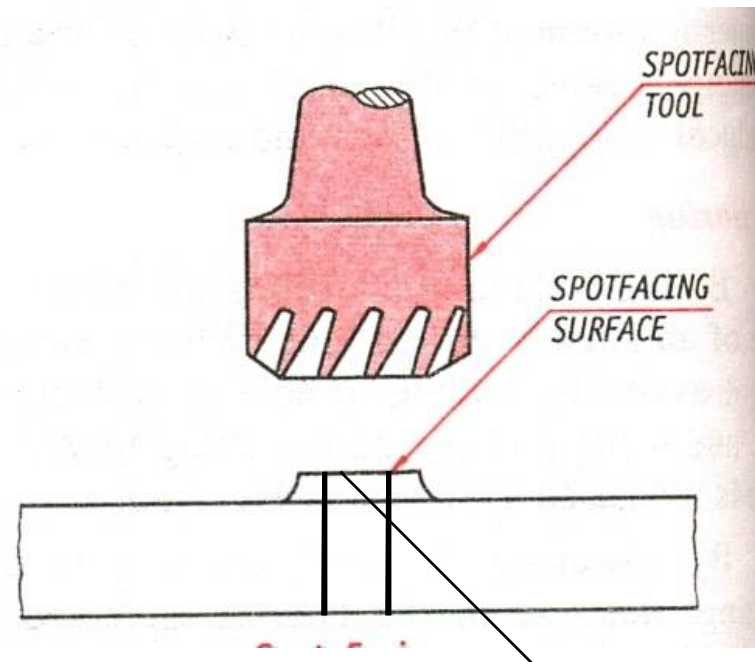


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Spot Facing

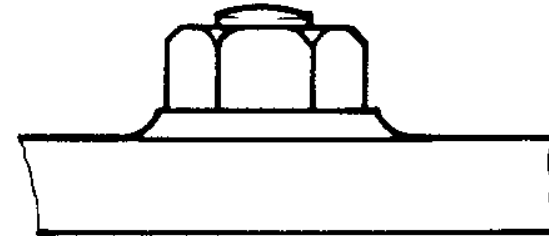
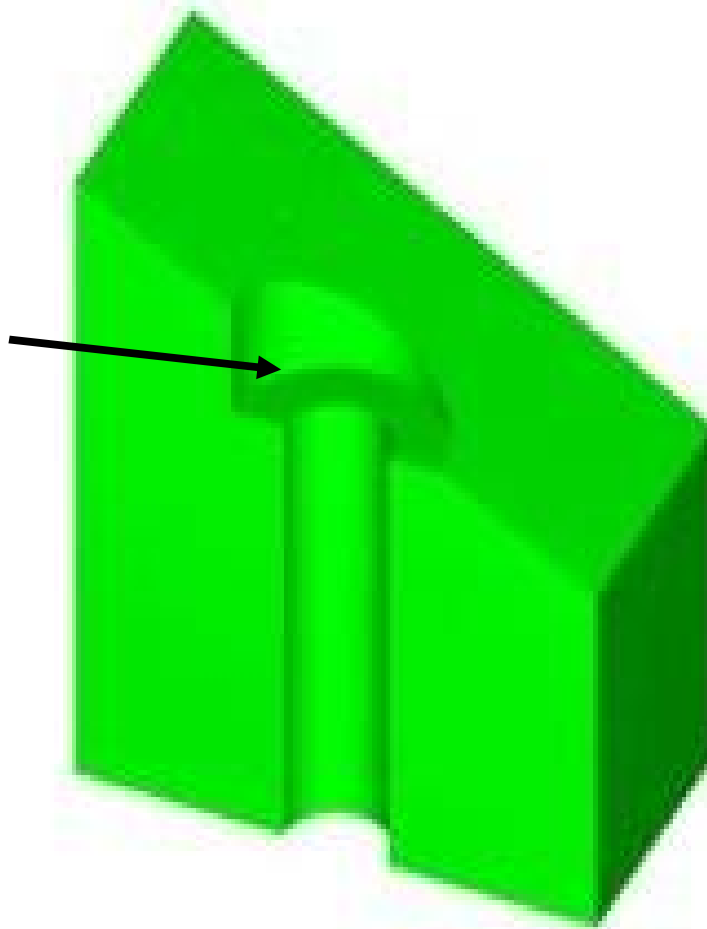
- It is a finishing operation to produce flat round surface usually around a drilled hole, *for proper seating of bolt head or nut.*
- It is done using a special spot facing tool.



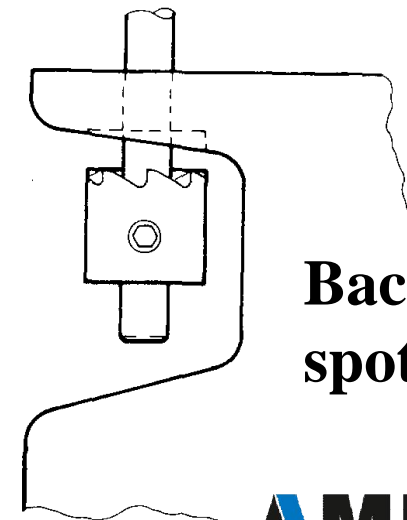
Sport Facing

Making a sloped surface flat

spotface



To seat a nut



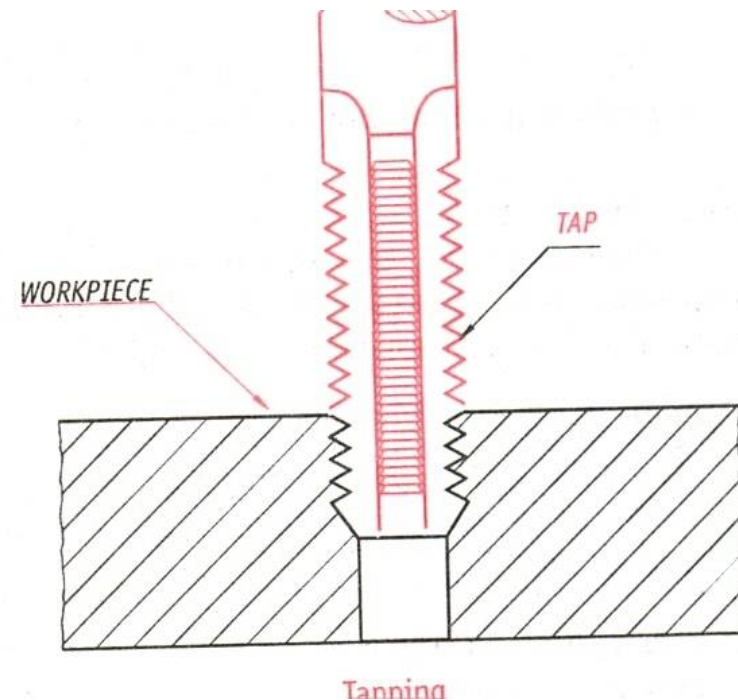
Back
spotface

Sport Facing Tool



Tapping

- Process of cutting internal threads with a thread tool called as *tap*.
- **Tap** is a fluted threaded tool used for cutting internal thread
- Cutting speed is very slow.



Size of Drill Machine

- Different parameters are being considered for different types of drilling machines to determine their size.
- The size of a portable drilling machine is decided by the maximum diameter of the drill that it can hold.
- The sensitive and upright drilling machines are specified by the diameter of the largest workpiece which can be centered under the drill machine spindle.
- A radial drilling machine is specified by the length of the arm and the diameter of the column. To specify a drilling machine completely, following other parameters may also be needed:
 1. Table diameter
 2. Number of spindle speeds and feeds available
 3. Maximum spindle travel
 4. Morse taper number of the drill spindle
 5. Power input
 6. Net weight of the machine
 7. Floor space required, etc.

Size of Drill Machine

The cutting speed in a drilling operation refers to the peripheral speed of a point on the surface of the drill in contact with the work. It is usually expressed in meters/min. The cutting speed (C_s) may be calculated as:

$$C_s = ((22/7) \times D \times N)/1000$$

Where, D is the diameter of the drill in mm and
N is the rpm of the drill spindle.

Size of Drill Machine

The feed of a drill is the distance the drill moves into the job at each revolution of the spindle. It is expressed in millimeter. The feed may also be expressed as feed per minute. The feed per minute may be defined as the axial distance moved by the drill into the work per minute. The feed per minute may be calculated as:

$$F = F_r \times N$$

Where, F = Feed per minute in mm.
 F_r = Feed per revolution in mm.
 N = R.P.M. of the drill.

Tapping Tool

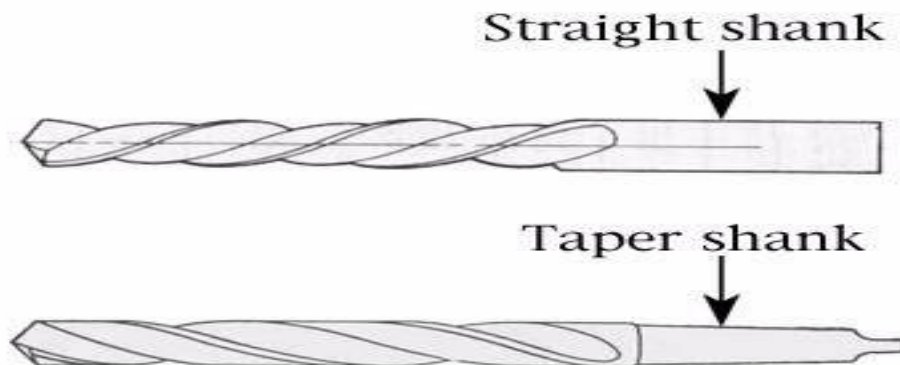


Drill Bit

- The twist drill or **drill bit** is made from High Speed Steel, tempered to give maximum hardness throughout the parallel cutting portion.
- Flutes are incorporated to carry away the chips of metal and the outside surface is relieved to produce a cutting edge along the leading side of each flute.

Twist drill

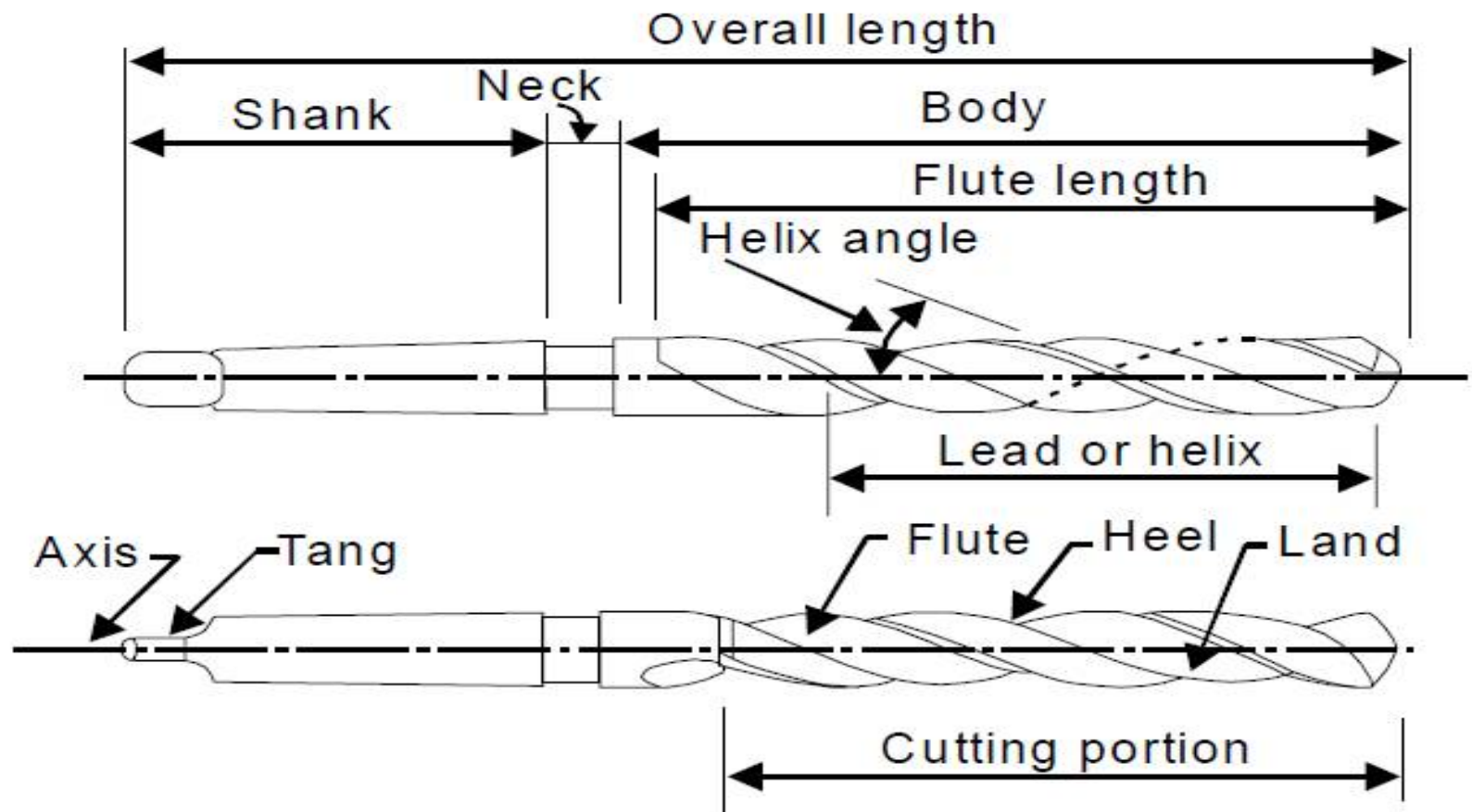
- Twist drills are available with parallel shanks up to 16mm diameter and with taper shanks up to 100mm diameter and are made from high-speed steel.
- Standard lengths are known as jobber-series twist drills, short drills are known as stub series, and long drills as long series and extra long series.
- Different helix angles are available for drilling a range of materials



Fit in chuck

Fit direct into spindle

Drill Bit Features

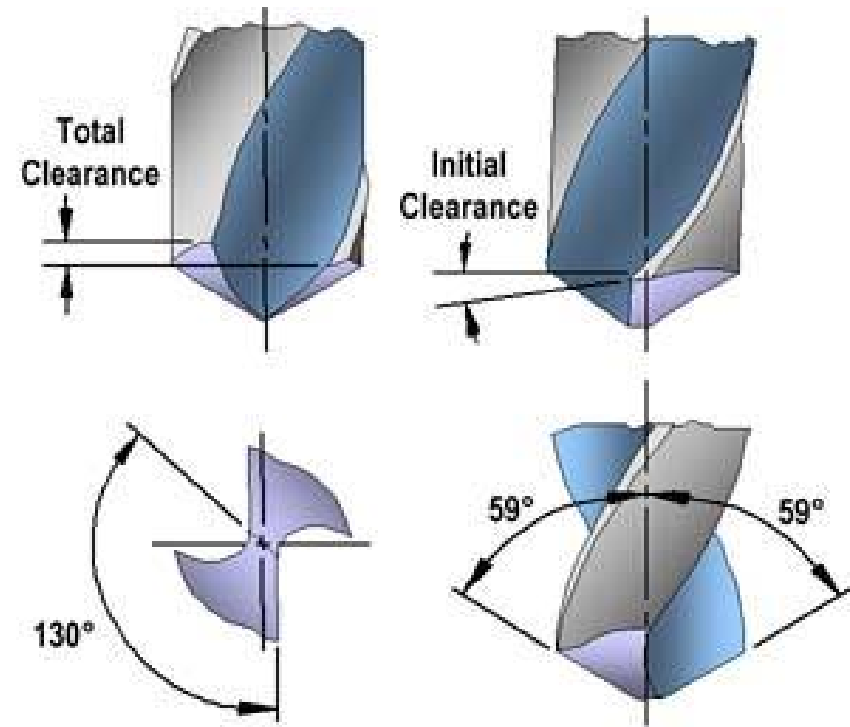


Drill Material

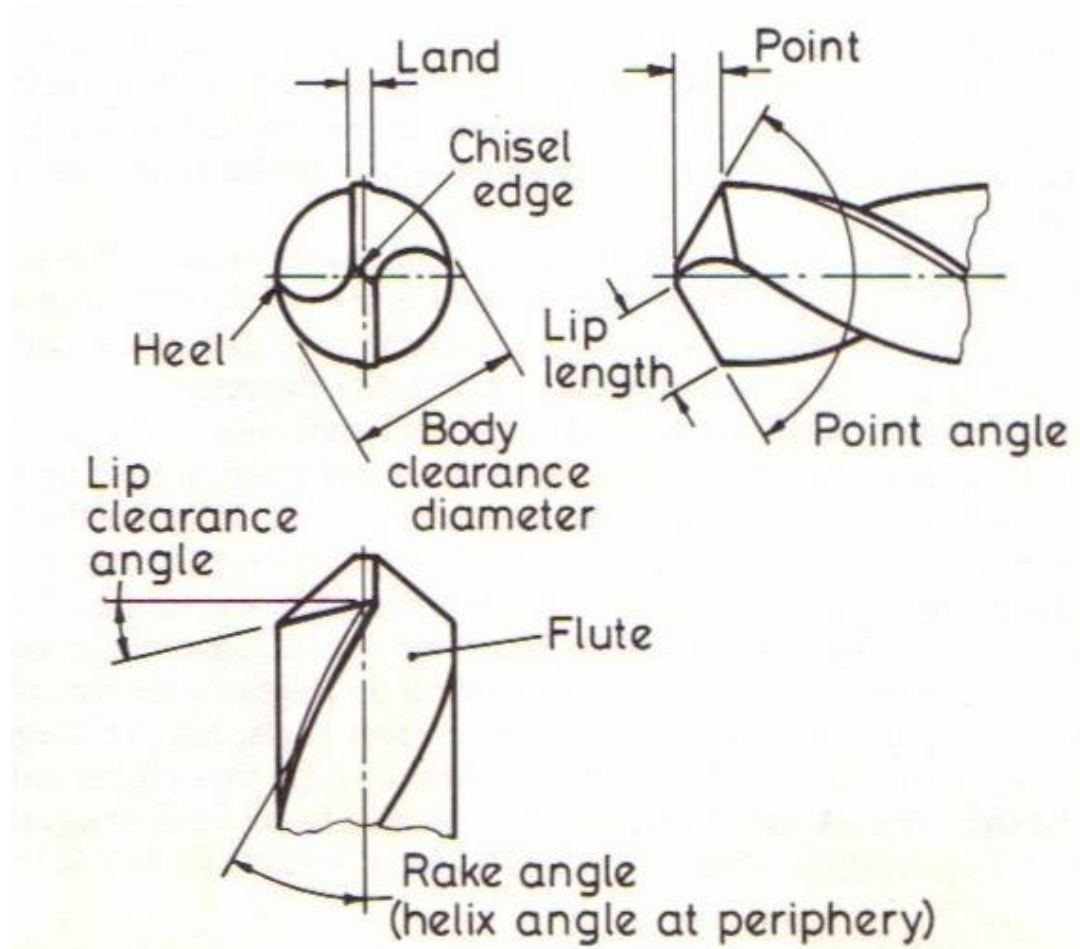
Drills are made up of high speed steel. High speed steel is used for about 90 per cent of all twist drills. For metals more difficult to cut, HSS alloys of high cobalt series are used.

Drill Bit Features

- The point of the drill is ground to an angle of 118 degrees
- each side is ground back to give "relief" of about 12 degrees to each cutting edge as shown

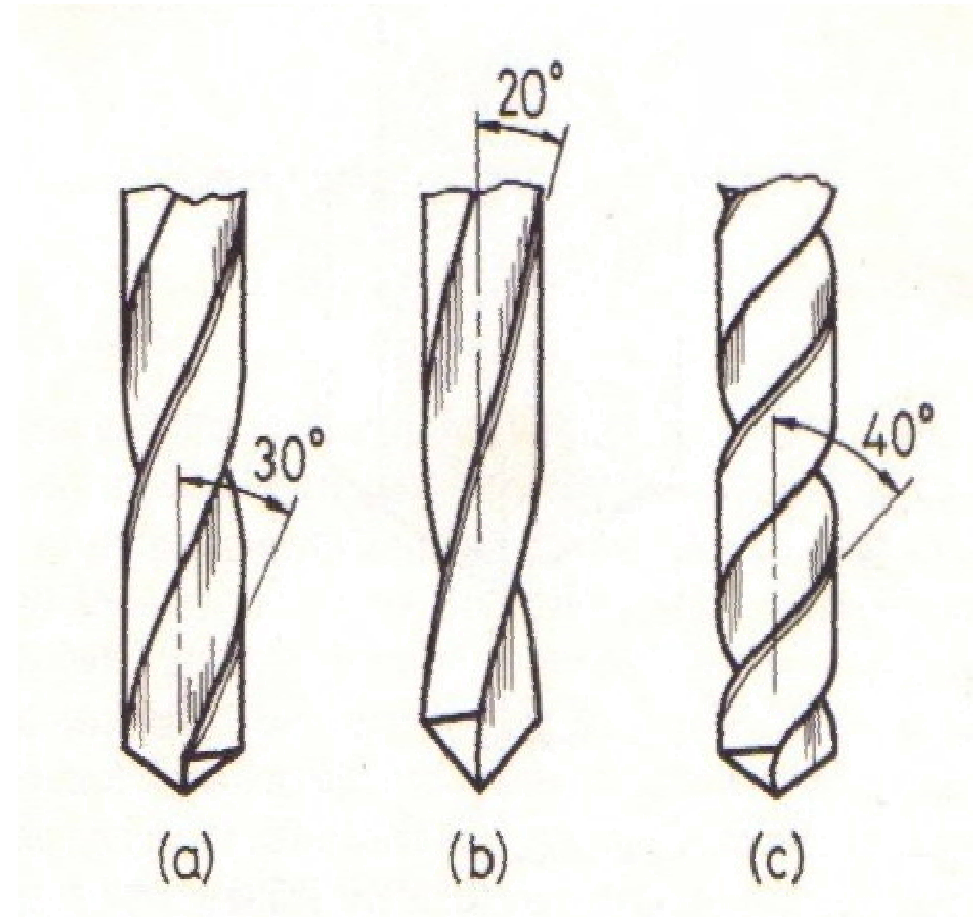


The nomenclature of the twist drill is shown



Twist drills - Helix Types

- The helix angle of the twist drill is the equivalent of the **rake angle** on other cutting tools and is established during manufacture.
- The standard helix angle is 30 degrees, which, together with a point angle of 118° , is suitable for drilling **steel and cast iron**.



Drill Bit

Screw Machine Length



Jobbers Length



Taper Length



Extension/Extra Length



Longboy



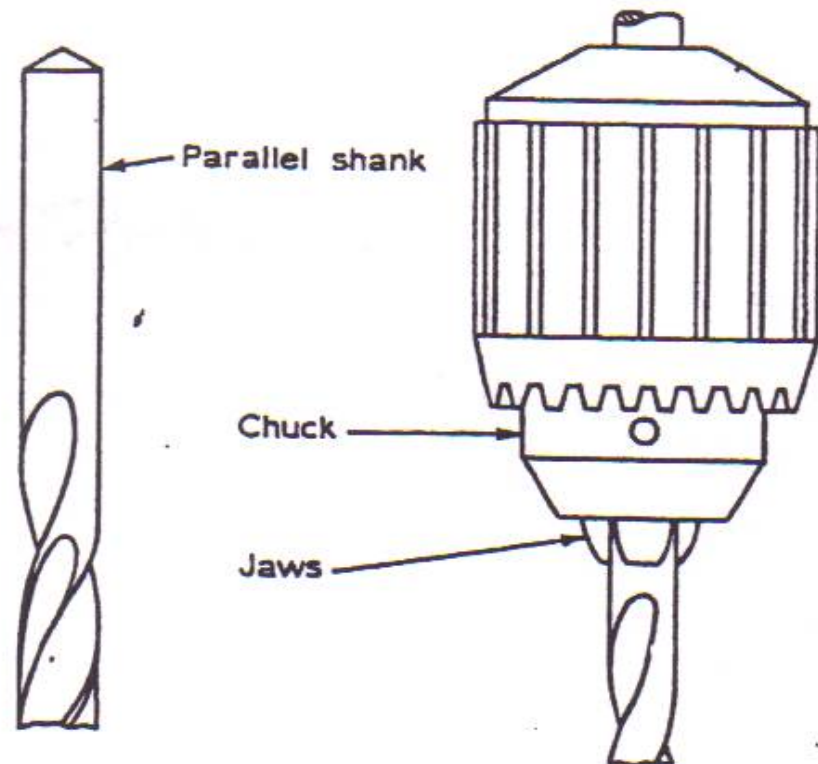
Drill Bit



Tool Holding

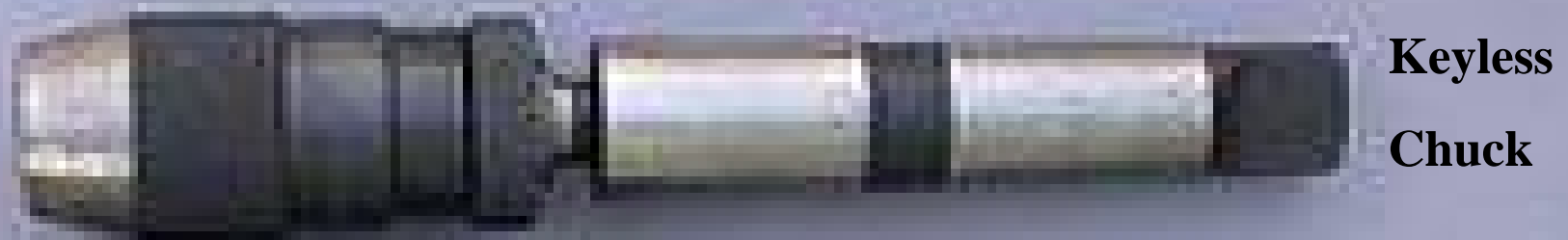
- Drills and similar tools with parallel shanks are held in a drill chuck.
- By rotating the outer sleeve, the jaws can be opened and closed.
- To ensure maximum grip, the chuck should be tightened using the correct size of chuck key. This prevents the drill from spinning during use and chewing up the drill shank.

parallel shank drill



Drill bit is only gripped by the shank

Drill Chuck



Keyless
Chuck

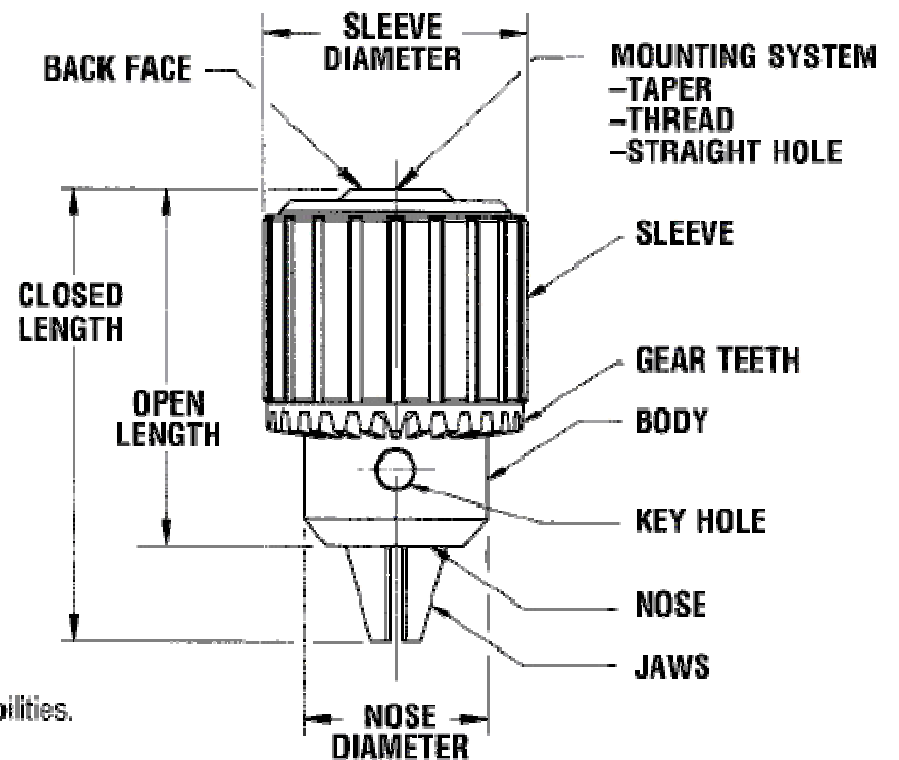
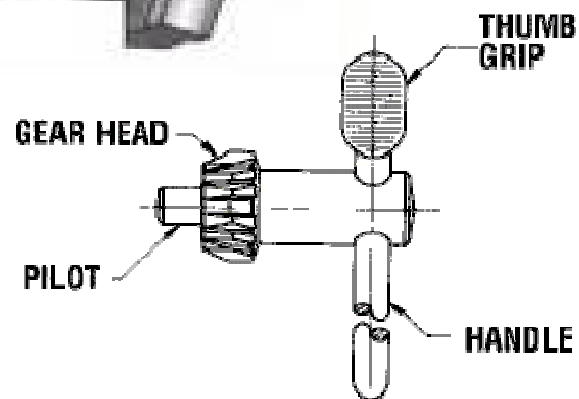
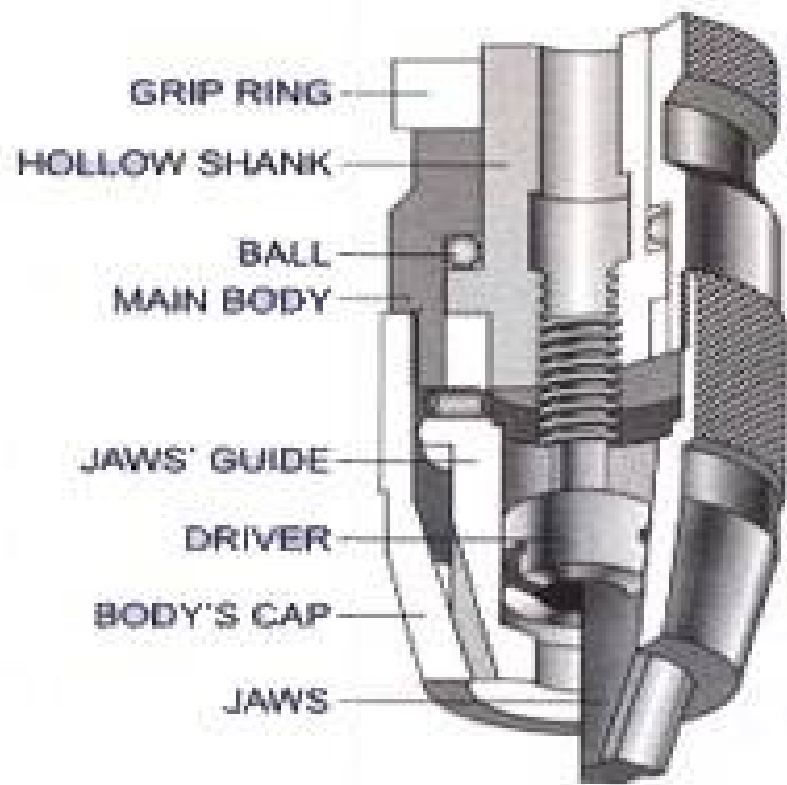


Chuck

Morse Taper



Chuck Key



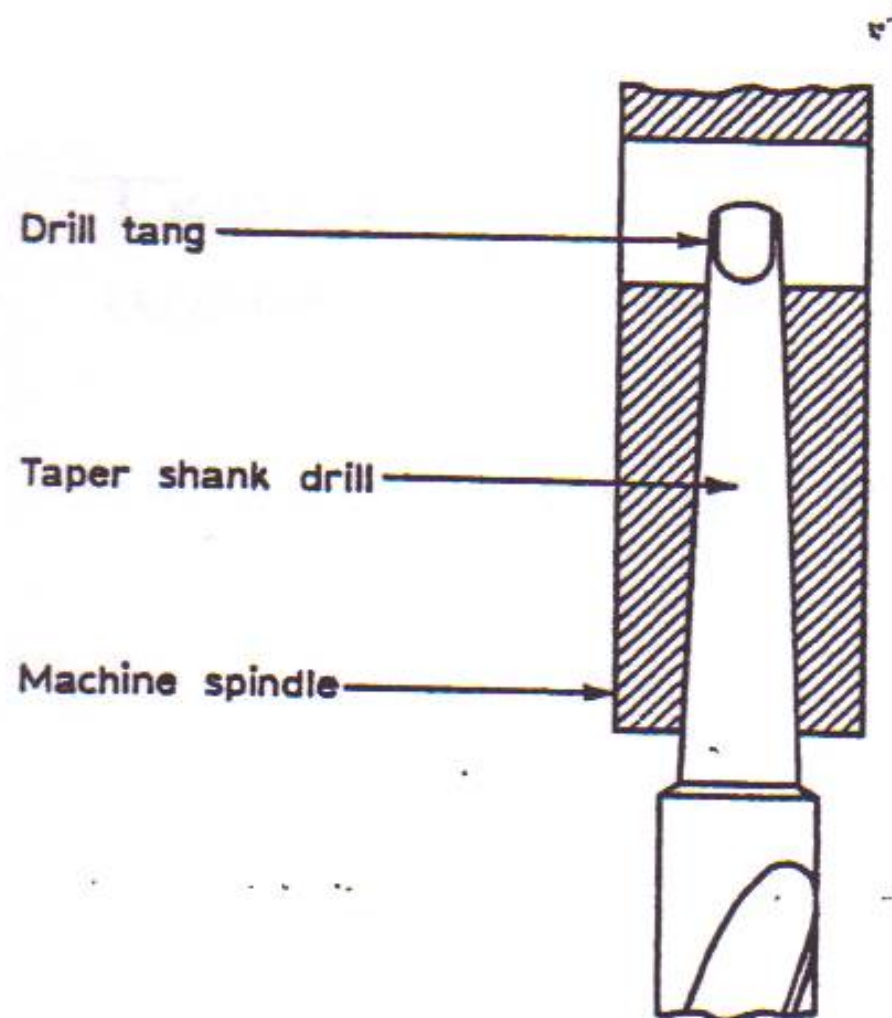
*Mounting system may have retaining screw capabilities.

Tool Holding

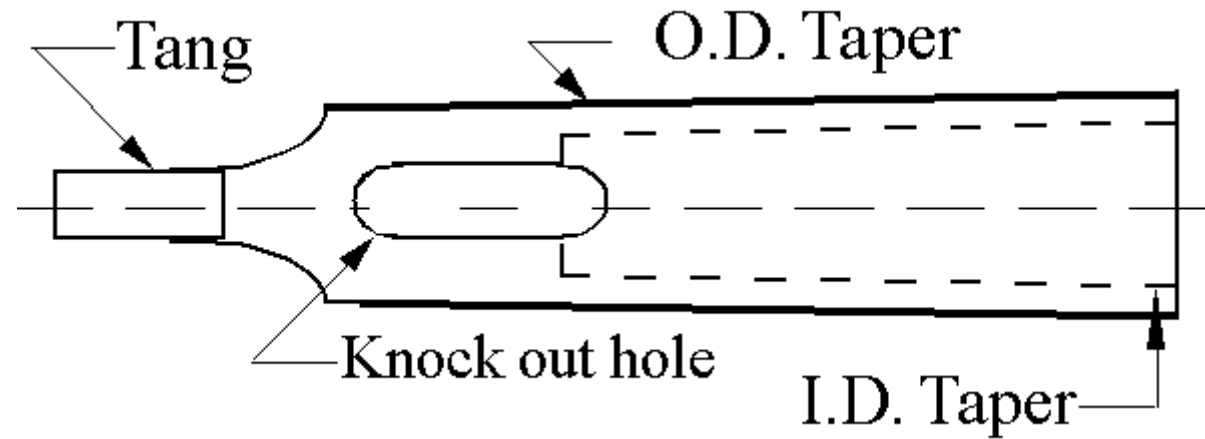
- The chuck is fitted with a Morse-taper shank which fits into a corresponding Morse taper in the spindle.
- The size of Morse taper is identified from smallest to largest by the numbers 1, 2, 3, 4, 5, and 6. The included angle of each taper is different but is very small, being in the region of 3 degrees.
- If the two mating tapered surfaces are clean and in good condition, this **shallow taper is sufficient to provide a drive between the two surfaces.**
- At the end of the taper shank, two flats are machined, leaving a portion known as the tang. This tang fits in a slot on the inside of the spindle and its main purpose is for the removal of the shank.
- Drills are also available with Morse-taper shanks which fit directly into the spindle without the need for a chuck.

Tool Holding

Holding taper shank drills



Morse Taper Sleeve



Drill Drift

- To remove a shank from the spindle, a taper key known as a drift is used.



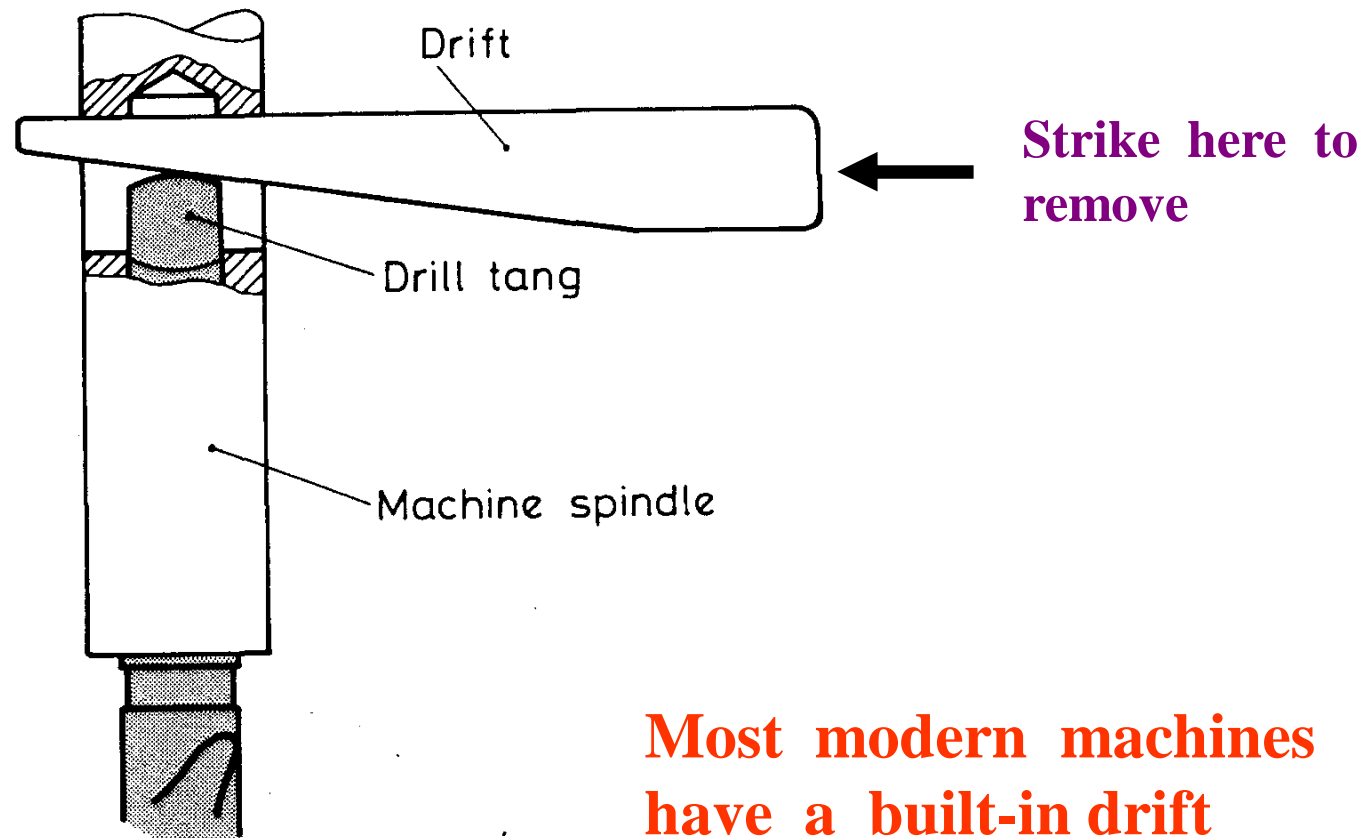
- For quickly removing taper shank drill or reamers from sleeves or sockets

- Hardened and ground

- Black oxidized finish

Using the drill drift

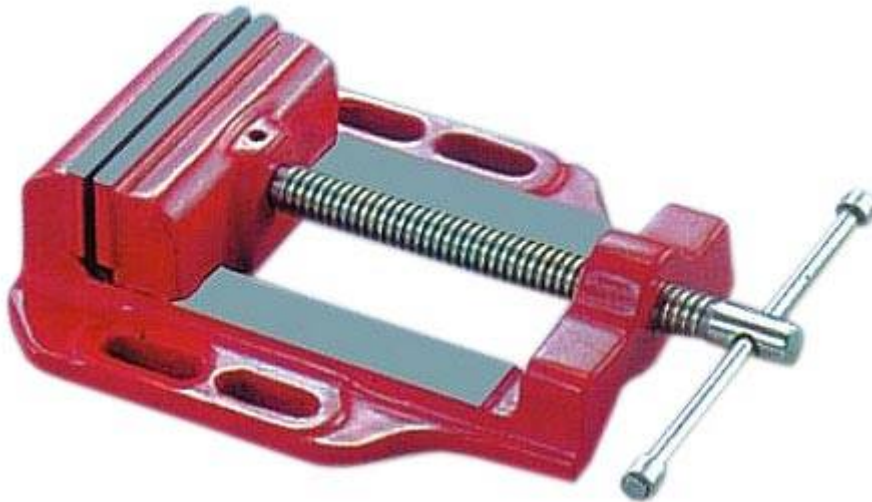
- The drift is inserted through a slot in the spindle



**Most modern machines
have a built-in drift**

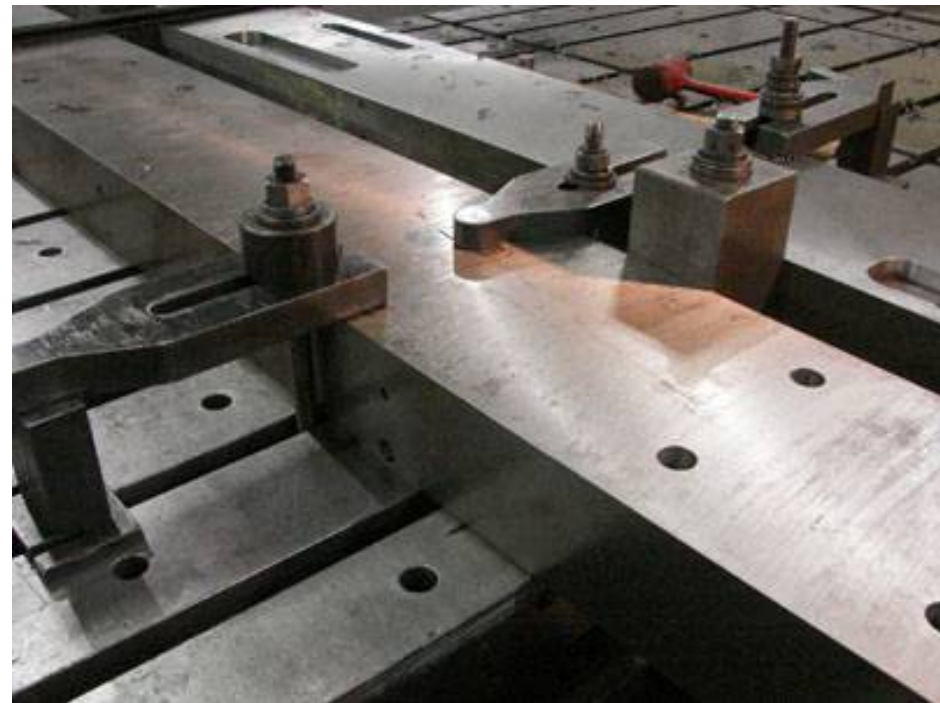
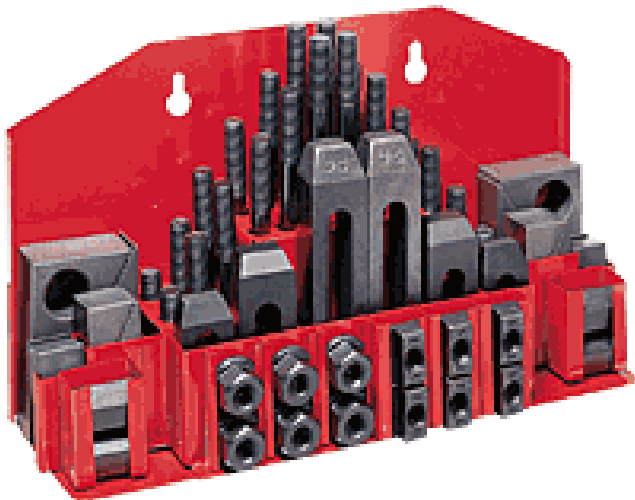
Drilling Machine Vice

- The **Machine Vice** has slots in the side of the base of the vice which enable the user to screw the **Machine Vice** to the **Drilling Machine** table.



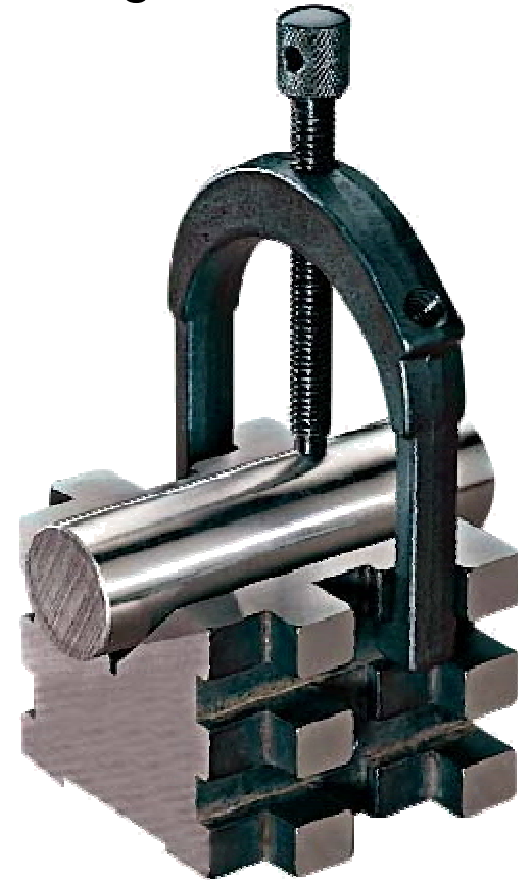
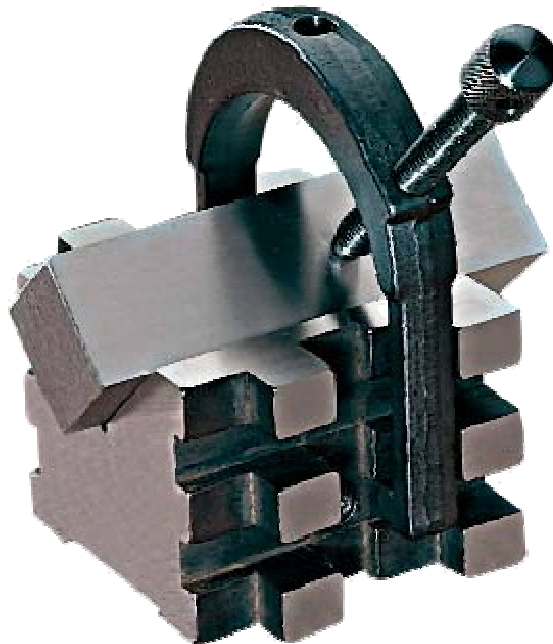
Direct Clamping

Clamping set



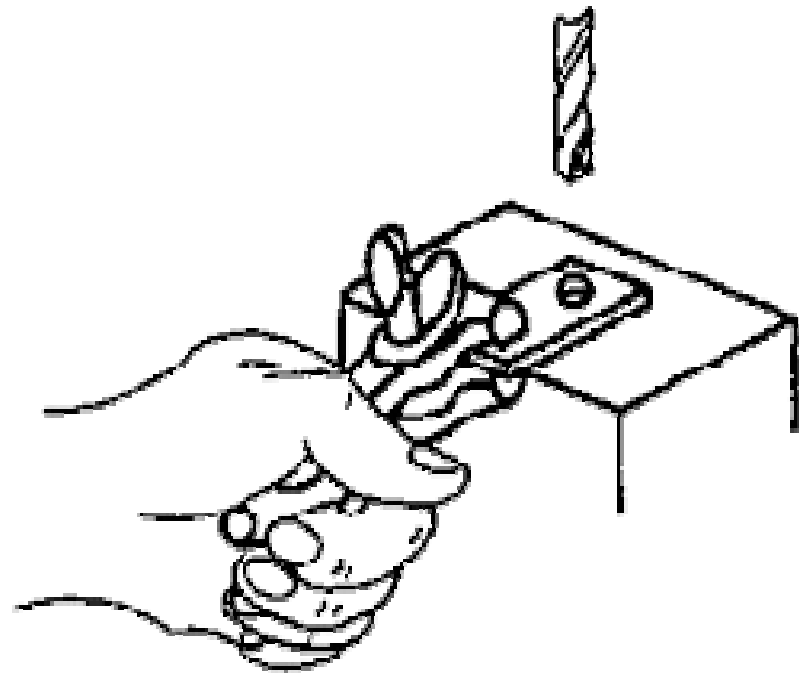
Vee Blocks & Clamps

- used when drilling round bar



Hand Vice

- used on drilling machine to clamp sheet metal



QUESTIONS

1. State the working principle of a drilling machine.
2. Explain principal parts of the drilling machine and sketch the mechanism of a drilling machine.
3. Give the classification of drilling machines.
4. How will you specify a drilling machine?
5. What operations can be done on a drilling machine? Discuss them with diagrams.
6. With the help of a line diagram, describe the construction of radial drilling machine.
7. List the devices commonly used for holding the work on a drilling machine, and describe any three.
8. Define cutting speed, feed and machining time for drilling.
9. Sketch a twist drill and name its different parts.
10. What is boring? Sketch a boring tool.
11. What is the function of flutes on a twist drill bit? Why are straight flute drills used for nonferrous materials and metal?
12. Draw suitable figure for a drill bit showing:
(i) point (ii) lip clearance (iii) point angle (iv) flute (v) margin and (vi) body clearance
- 13 Write short notes on following:
(i) Drilling (ii) Boring, (iii) Reaming (iv) Tapping (v) Counter boring (vi) Counter sinking
14. Explain various types of operations performed on a drilling machine by neat sketches.
15. Define the following terms used in drilling operation. *(i) Cutting speed (ii) Feed*