

# **WORKSHOP # 5**

## **FORGING & SMITHY SHOP**



# Introduction

In order to produce the desired shape or to improve the properties of any metal, shaping is done. Shaping process may be divided in two main groups as :

- (a) cutting, and
- (b) non-cutting

Normally, the non-cutting shaping operation is referred to as mechanical working process. One such process is called **smithy or forging**.

# Introduction

- **Smithy** is defined to handle relatively small jobs only such as those that can be heated in hearth or open fire, and the work is carried out by using of hand hammers or small power hammers.
- **Forging** refers to the production of those jobs which must be heated in a closed furnace. The part of job where forging is done is termed as a forge. The work is normally performed by means of heavy hammers, forging machines, presses etc.

# Forging

- Forging is defined as the controlled plastic deformation or working of metal into predetermined shapes.
- Forging implies the use of powerful pressure from a hammer or press on metal which has been heated to its plastic range.
- The normal plastic range for steels and high-strength alloys is from about 1038°C to about 1260°C; for brasses and bronzes, from about 593°C to about 926°C; and for aluminum and magnesium alloys, from about 343°C to about 510°C

# Forging

- During forging, the material should have sufficient flow properties and work at the upper limit of the material's potential strength so as to fill the die cavity shape without resulting in cracks in the material.
- Forging is a cost effective way to produce net-shape or near-net-shape components. Virtually all metals can be forged. This makes an extensive range of physical and mechanical properties available in products with the highest structural integrity.

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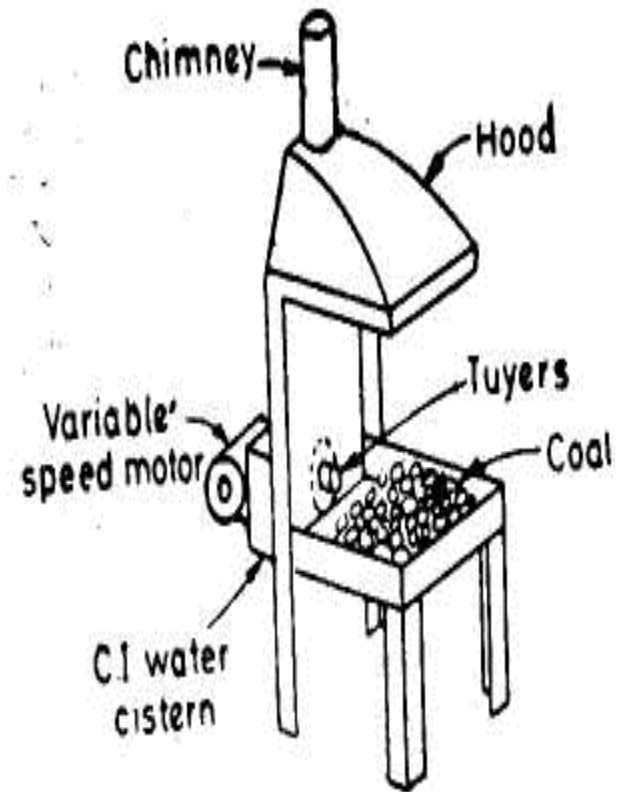
# Tools & Equipment Used in Smithy & Forging

- (a) Smith's forge
- (b) Anvil
- (c) Swage block
- (d) Hammers
- (e) Tongs
- (f) Chisels
- (g) Hardie
- (h) Fullers
- (i) Swage
- (j) Flatters
- (k) Punch and Drift
- (l) Set Hammer

# Smith's Forge or Hearth

It is used for heating purpose during the forging operation .

The structure of hearth is made of cast iron or cast steel. It has four-legged support, an hearth known as bottom, a chimney along with hood. An opening is also provided on the rear side of the structure to supply the air into the furnace. The hearth is covered by fire bricks lining. For quenching purpose, a water tank is also provided in front side of forge. Air under pressure is supplied to the furnace by the blower.

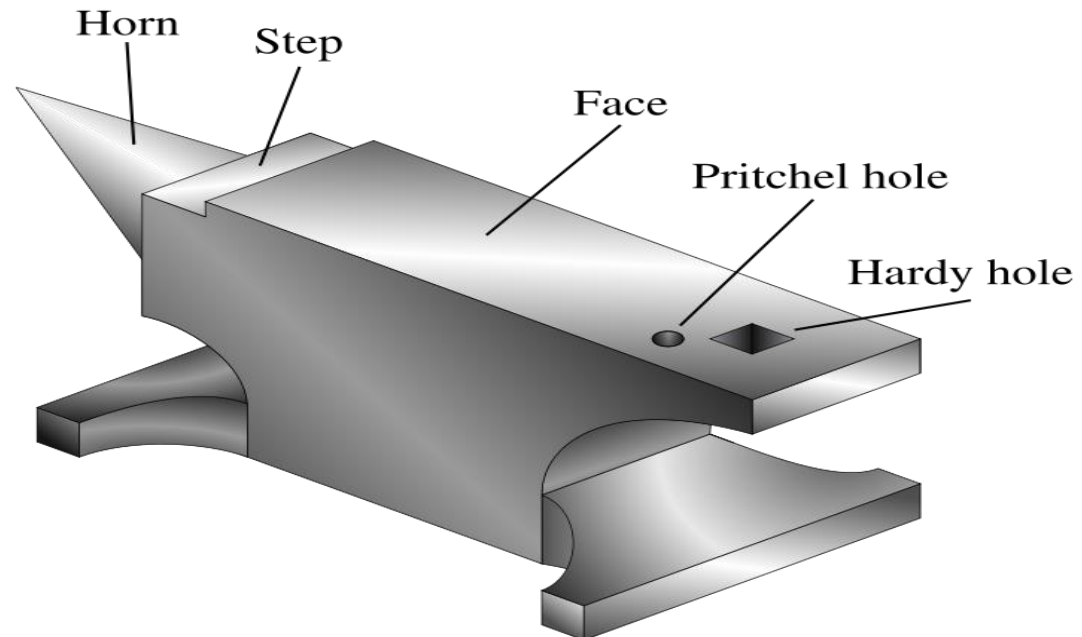


(a) Hearth.



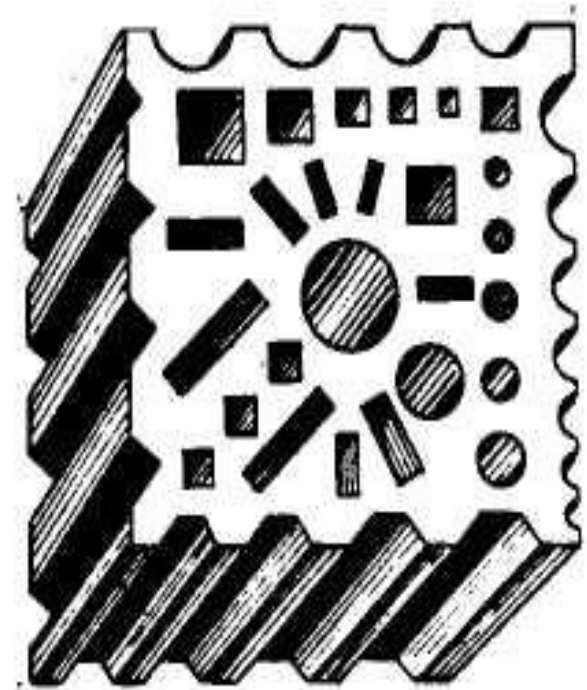
# Anvil

- The anvil is an important smiths tool. It is used for supporting the work while hot metal hammering.
- The hardie hole is of square shape and is used for holding square shanks of swages fullers etc. while the Pritchel hole is of circular shape used for bending rods of small diameter and as a die for hot punching.



# Swage Block

- It is a block of cast steel consisting of a number of slots of different shapes and sizes along its four side faces. It has through holes from top face to bottom face which vary in shapes and sizes.
- It is used for mainly squaring, sizing, heading, bending, punching and forming operations. The swage block is supported on a cast iron base. It is specified according to size of block or by weight.



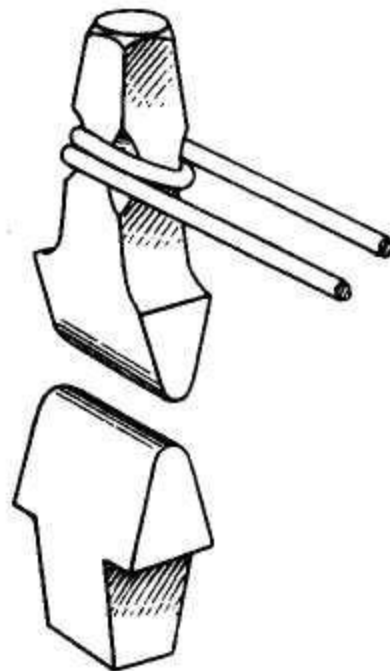
# Hardie

- It is fitted in the hardie hole provided in the tail of anvil. It has a cutting edge at the top of body. During cutting or shearing operations, chisels are used in conjunction with this bottom cutting tool. It is made by high carbon steel.



# Fullers

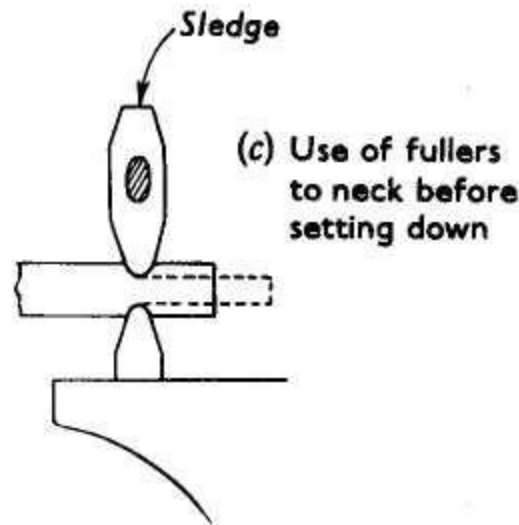
- These are also made of tool steel (high carbon steel). They are used in pairs (top and bottom). Bottom-one part of fuller is held in hardie hole of anvil with its square shape of shank. They are used for necking down or to reduce the cross section of a job. In some cases, they are also used in drawing out operation



(a) Top and bottom fullers



(b) Rounded fuller for circular work



(c) Use of fullers to neck before setting down

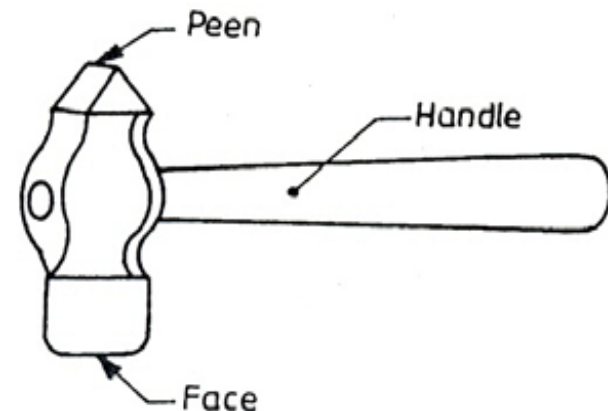
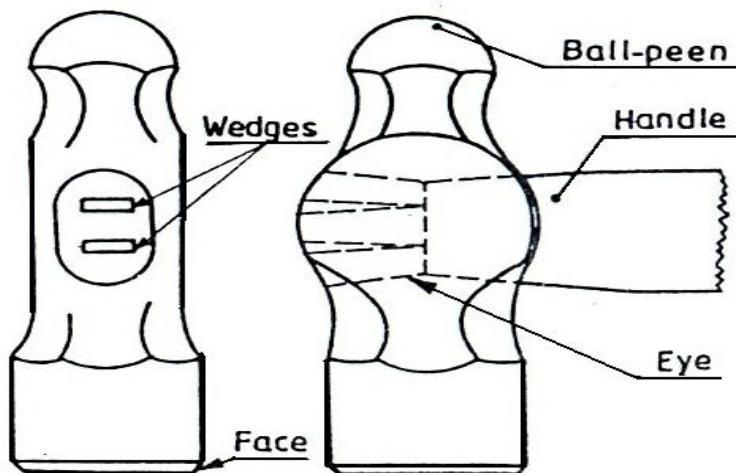
# Hammers

## Ball- Peen Hammer

Ball- Peen Hammers are named, depending upon their shape and material and specified by their weight. A ball peen hammer has a flat face which is used for general work and a ball end, particularly used for riveting.

## Cross-Peen Hammer

It is similar to ball peen hammer, except the shape of the peen. This is used for chipping, riveting, bending and stretching metals and hammering inside the curves and shoulders.



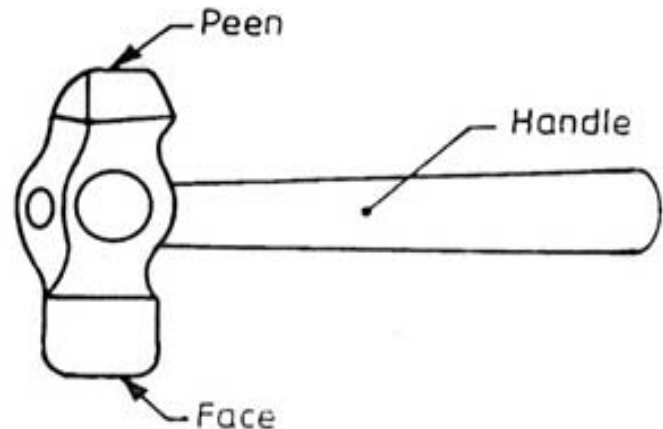
# Hammers

## Sledge Hammer

It has double faces on both ends as shown in figure. Sledge hammers are comparatively heavier than hand hammers. Therefore, they are used for heavy type of forging work when heavy blows are needed.

## Straight-Peen Hammer

This is similar to cross peen hammer, but its peen is in-line with the hammer handle. It is used for swaging, riveting in restricted places and stretching metals.



# Holding Tools

**TONGS:** The tongs are used for holding the hot metal while is being worked. These are made of mild steel. The various types of tongs commonly used for holding work are as follows:

- **a) Closed Mouth Tong:** *A closed mouth tong is used for holding thin sections.*
- **b) Open Mouth Tong:** *An open mouth tong is suitable for holding heavier stock.*
- **c) Round Hollow Tong:** *A round hollow tong is use for holding square, hexagonal and orthogonal work.*
- **d) Square Hollow Tong:** *A square hollow tong is used for holding square, hexagonal and octagonal section.*
- **e) Pick-up tong:** *A pick-up tong is used for picking up round bars, but not for holding work during forging.*



**(a) Closed mouth tong.**



**(b) Open mouth tong.**



**(c) Round hollow tong.**



**(d) Square hollow tong.**



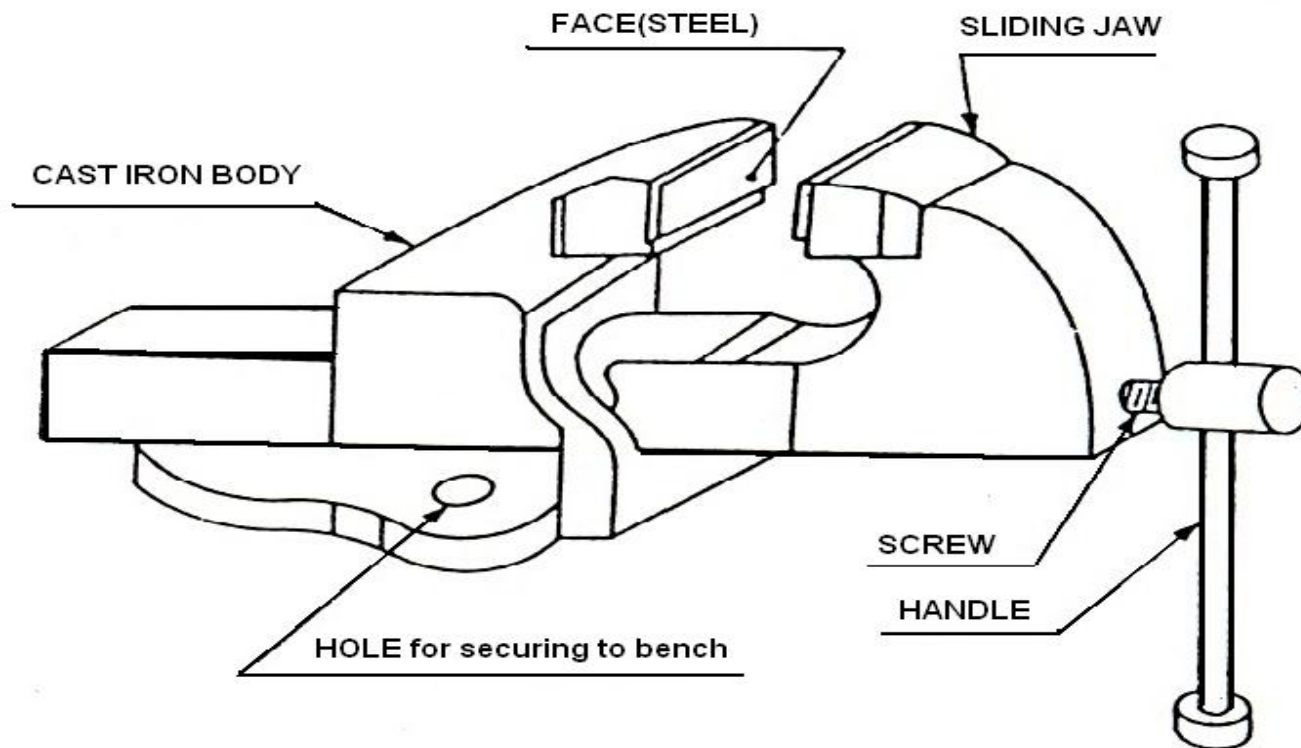
**(e) Pick-up tong.**



# Holding Tools

## 1) Bench vice:

The bench vice is a work holding device. It is the most commonly used vice in a fitting shop.



# Forging Operations

The numbers of operations are performed in a smithy shop for the formation of desired shape of object by forging. The commonly used operations are as follows:

(i) Up-Setting

(ii) Drawing down

(iii) Setting down

(iv) Bending

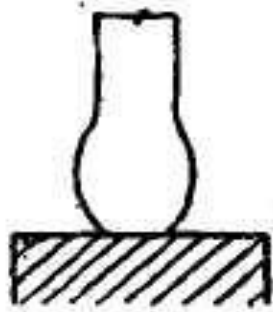
(v) Cutting

(vi) Punching

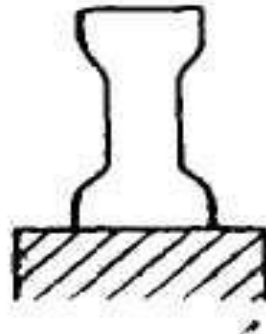
# Forging Operations

**1) UP-SETTING:** It consists of increasing the cross section of a bar at the expense of its length. In this process first of all the heating is done and then heavy blow is given by hand hammer. Up setting may be various kinds.

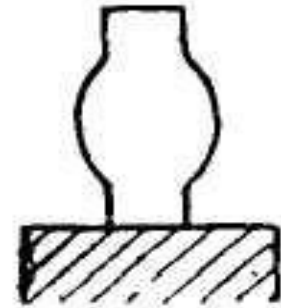
- **(a) Head Up-Setting:** *When heating is done at one end of item and pressure is applied at one end is called head up setting.*
- **(b) Full Up-Setting:** *When heating is done at both end of item and then pressure is applied at both end is called full up setting.*
- **(c) Central Up-Setting:** *When heating is done at the centre of the item and then pressure is applied at the central position is called central up setting.*



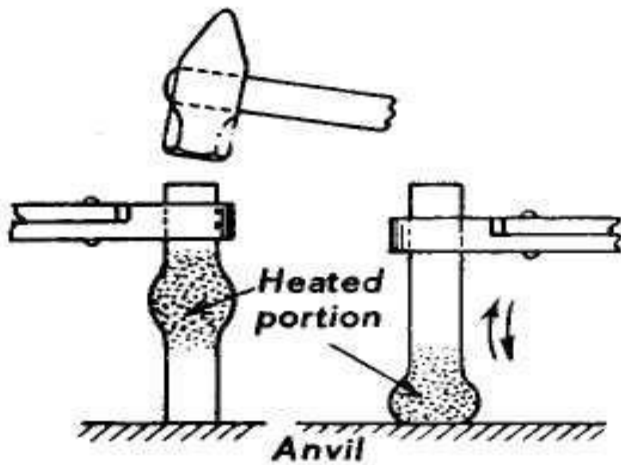
(a)



(b)

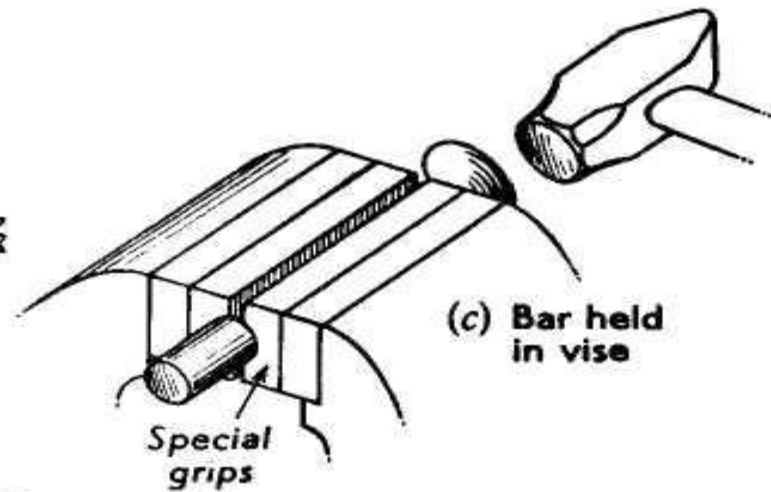


(c)



(a) With hammer

(b) Striking on anvil

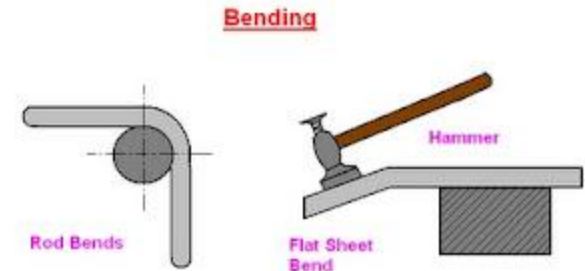


(c) Bar held in vise

# Forging Operations

**2) BENDING:** It is an important operation in forging and is very frequently used. In this process the item is heated and bent as desired.

**3) DRAWING DOWN:** In this process the length of a bar stock may increased with a corresponding decrease or reduction in its thickness, width or both of a bar stock. In other words, it is exactly a reverse process to that of upsetting or jumping.

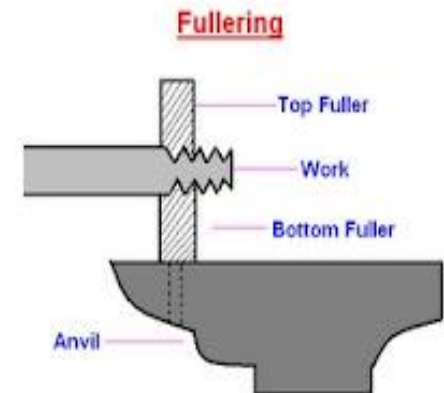
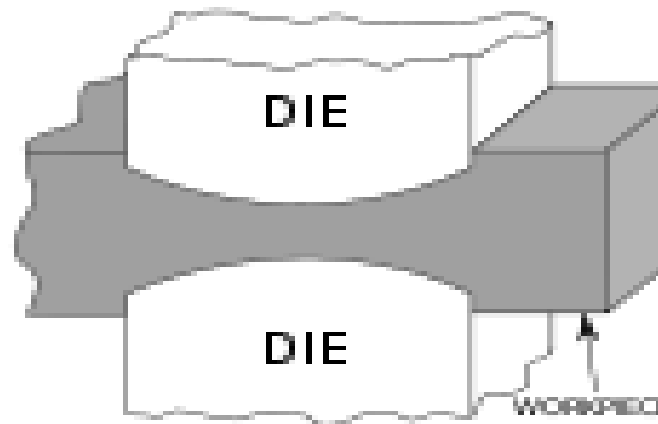


# Forging Operations

**4) Setting Down:** It is a process of local thinning down effected by set hammer. The work is usually fullered at the place where the settings down commence.

**5) Fullering :** In this operation main target is to increase the width along with a slight change in length. Fullering operation should always be started at the centre part of stock.

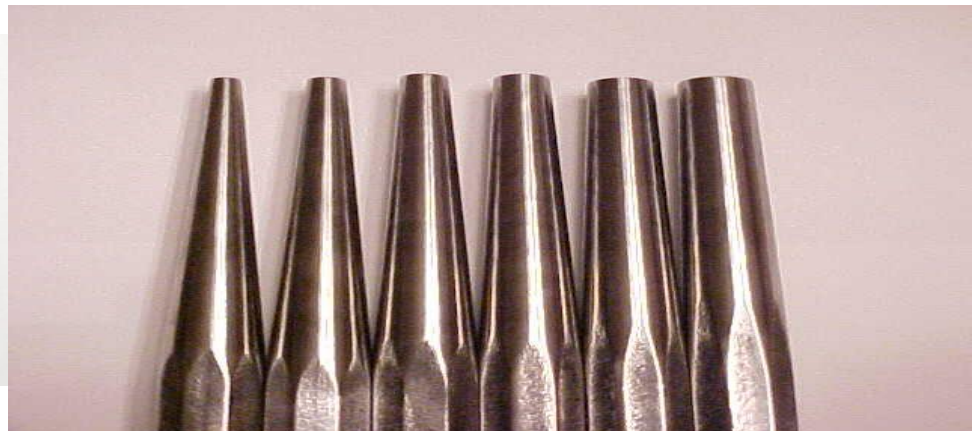
Fullers



# Forging Operations

## 6) Punching and Drifting:

- In this operation, stock of bar is placed on the pritchel hole of the anvil or over a correct hole of swages block and then a punch in hot condition is used for producing the hole. External pressure on punch is given by using hammering.
- Punching by using die, is usually followed by drifting. In this, drift as a tool is made to pass through the punched hole to produce a finished hole of a required size. Drift is also a large sized punch.



# Practical Work

## **Aim**

To make a pipe clamp by using mild steel strip.

## **Tools required**

Anvil, Hammer, sledge hammer, Tongs, smith's forge, bench vice, chisel