WORKSHOP MANUAL

DEPARTMENT OF MECHANICAL ENGINEERING

Name of subject : Work Shop-II

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CARPENTARY

INTRODUCTION:

Wood work or carpentry deals with making joints for a variety of applications like doorframes, cabinet making furniture, packing etc.,

Timber:-

Timber is a name obtained from well grown plants or trees. The timber must cut in such a way that the grains run parallel to the length. The common defects in timber are knots, wet rot, dry rot etc.,

Market sizes of timber:-

Timber is sold in market in various standard shapes and sizes. They are:-

Log:-

The trunk of a tree, which is free from branches.

Balk:-

The log sawn to have roughly square cross section.

Post:-

A timber piece, round or square in cross section with more than 275 mm in width, 50 to150 mm in thickness and 2.5 to 6.5 mts length.

Board:-

A sawn timber piece, below 175 mm in width and 30 mm to 50 mm in thickness.

Reapers:-

Sawn timber pieces of assorted and nonstandard sizes, which don't conform to the aboveshapes.

WORK HOLDING TOOLS:

Carpentry vice:-

It is a work holding device. When handle vice is turned in a clockwise direction, the sliding jar forces the work against the fixed sawn. The greater the force applied to the handle, the tighter to the work held.

Bar clamp:-

It is a rectangular (or) square block with V-groove on one or both sides opposite to each other. It holds cylindrical work pieces.

C-Clamp:-

This is used to hold work against an angle plate or V-block.

MARKING AND MEASURING TOOLS:

Try square:-

It is used for marking and testing the square ness of planed surfaces. It consists of a steel blade, fitted in a cast iron stock. It is also used for flatness.

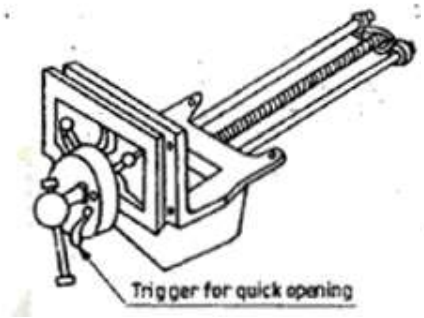
The size of a try square usedfor varies from 150 mm to 300 mm, according to the length of the blade. It is less accurate when compared to the try square used in fitting shop.

Fig : 1 steel rule

fig: 2 marking Gauge

Fig: 3 steel tape

fig: 4 Try square



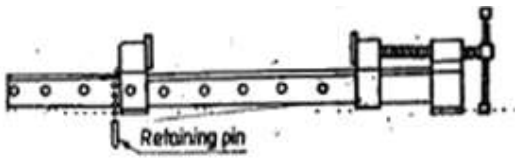


Fig: 5 corpenter vice

Fig: 6 Bar clamp

Fig: 7 metal jack plane

Fig: 8 compass and divider

Marking gauge:-

It is a tool used to mark lines parallel to the edges of wooden pieces. It consists of a square wooden stem with a riding wooden stock on it. A marking pin, made of steel is fitted on the stem. A mortise gauge consists of two pins. In these it is possible to adjust the distance between the pins, to draw two parallel lines on the stock.

Compass and dividers:-

This is used for marking circles, arcs, laying out perpendicular lines on the planed surfaceof the wood.

CUTTING TOOLS:

Hack saw:-

It is used to cross cut the grains of the stock. The teeth are so set that the saw kerfs will be wider than the blade thickness. Hard blades are used to cut hard metals. Flexible blades are having the teeth of hardened and rest of the blade is soft and flexible.

Chisels:-

These are used for removing surplus wood. Chisels are annealed, hardened and temperedto produce a tough shank and a hard cutting edge.

Rip saw:-
It is used for cutting the stock along the grains. The cutting edge of this saw makes a sleeperangle about 60o whereas that saw makes an angle of 45o with the surface of the stock.

Tenon saw:-
It is used for cutting tenons and in fine cabinet works. The blade of this saw is very thin and so it is used stiffed with back strip. Hence, this is sometimes called back saw. The teeth shapes similar to cross cut saw.

DRILLING AND BORING TOOLS:

Auger bit:-
It is the most common tool used for boring holes with hard pressure.

Gimlet:-
This is a hand tool used for boring holes with hand pressure.

Hand drill:-
Carpenters brace is used to make relatively large size holes, whereas hand drill is used for drilling small holes. A straight shank drill is used with these tools. It is small light in weight and may be conveniently used than the brace. The drill is clamped in the chuck.

Fig: 9 cross cut saw Fig: 10 Tenon saw Fig: 11 compass saw

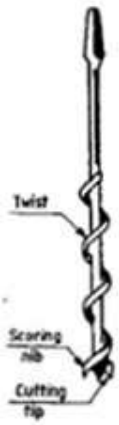
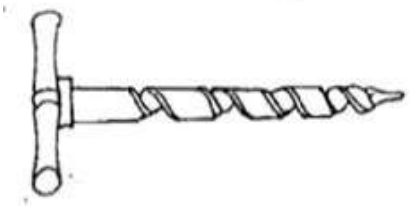


Fig: 12 Chisels Fig: 13 Carpenter's brace Fig: 14 Auger bit



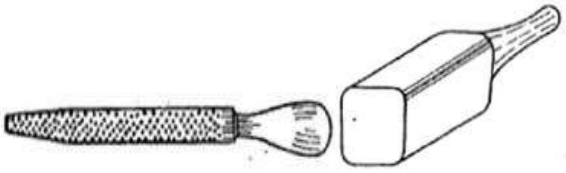


Fig: 15 Gimlet Fig: 16 wood rasp file Fig:17 Mallet

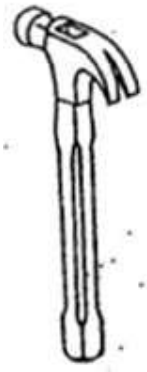


Fig: 18 Hand drill Fig: 19 Trammel Fig: 20 Claw hammer

MISCELLANEOUS TOOLS:

Ball peen hammer:-
It has a flat face, which is used for general work and a ball end is used for riveting.

Mallet:-
It is used to drive the chisel, when considerable force is to be applied, steel hammer should not be used for these purpose, as it may damage the chisel handle. Further, for better to apply a series of light taps with the mallet rather than a heavy single blow.

Claw hammer:-
It is a striking flat at one end and the claw at the others. The face issued to drive nails into wood and for other striking purpose and the claw for extracting nails out of wood.

Pinches:-
It is made of steel with a hinged and is used for pulling out small nails from wood.

Wood rasp file:-
It is a finishing tool used to make the wood smooth, remove sharp edge finishing fillets and other interior surfaces. Sharp cutting teeth are provided on its surface for the purpose.This file is exclusively used in wood work.

CARPENTRY SECTION

T-LAP JOINT

EXPERIMENT NO: 1 **DATE:**

Aim: - To make a T- lap joint

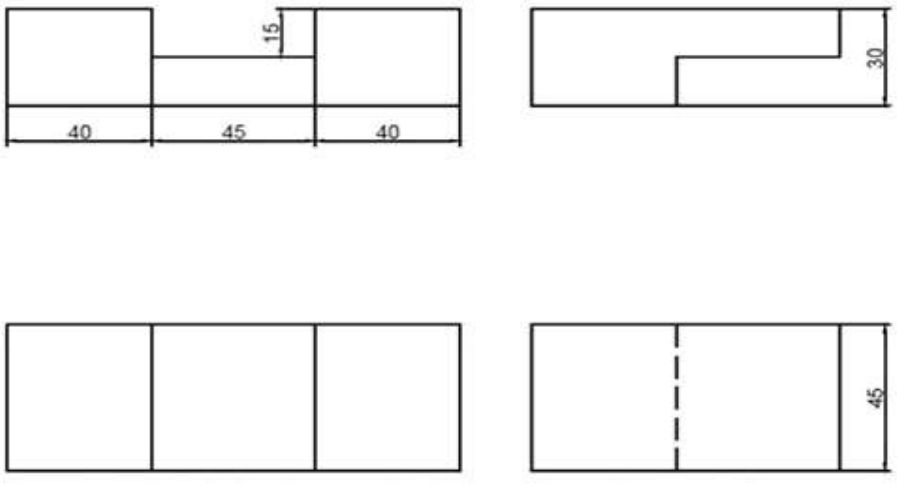
Tools required: -

- Carpenter's vice
- Steel Rule
- Try square
- Jack plane
- Scriber
- Cross cut saw
- Marking gauge
- Firmer chisel
- Mallet
- Wood rasp file and smooth file

Material required: - Wooden pieces of size 50 x 35 x 250 mm–2 Nos.

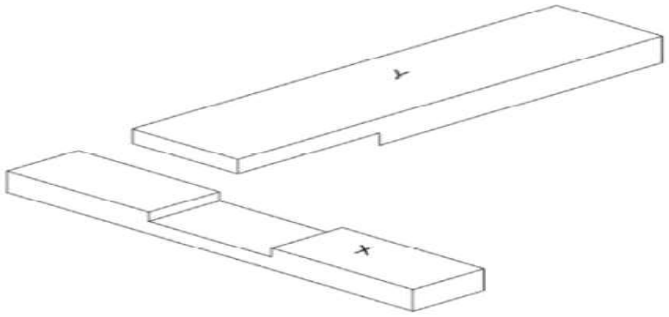
Sequence of operations: -

- Measuring and Marking
- Planning
- Check for squareness
- Removal of extra material
- Sawing
- Chiseling
- Finishing



T-LAP JOINT

ALL DIMENTIONS ARE IN MM



T-LAP JOINT

Procedure: -

- The given reaper is checked for dimensions.
- They are planed with jack plane and checked for straightness.
- The two surfaces are checked for squareness with a try square.
- Marking gauge is set and lines are marked at 30 and 45 mm to mark thethickness and width of the model respectively.
- The excess material is first chiseled with firmer and then planned to correctsize.
- The mating dimensions of the parts X and Y are then marked using steel ruleand marking gauge.
- Using the crosscut saw, the portions to be removed are cut in both the pieces,followed by chiseling.
- The ends of both the parts are chiseled to the exact lengths.
- The fine finishing is given to the parts, if required so that, proper fitting isobtained.
- The parts are fitted to obtain a slightly tight joint.

Safety precautions: -

- Loose cloths are to be avoided.
- Tools to be placed at their proper placed.
- Hands should not be placed in front of sharp edged tools.
- Use only sharp tools.
- Care should be taken, when thumb is used as a guide in cross

cutting andripping.

- Handle while chiseling, sawing and

planning with care.7.

Result: - T- lap joint is made as per the required dimensions.

CARPENTRY SECTION

DOVETAIL LAP JOINT

EXPERIMENT NO: **DATE:**

Aim: - To make a Dovetail lap joint from the given reaper of size 50 x35 x250 mm.

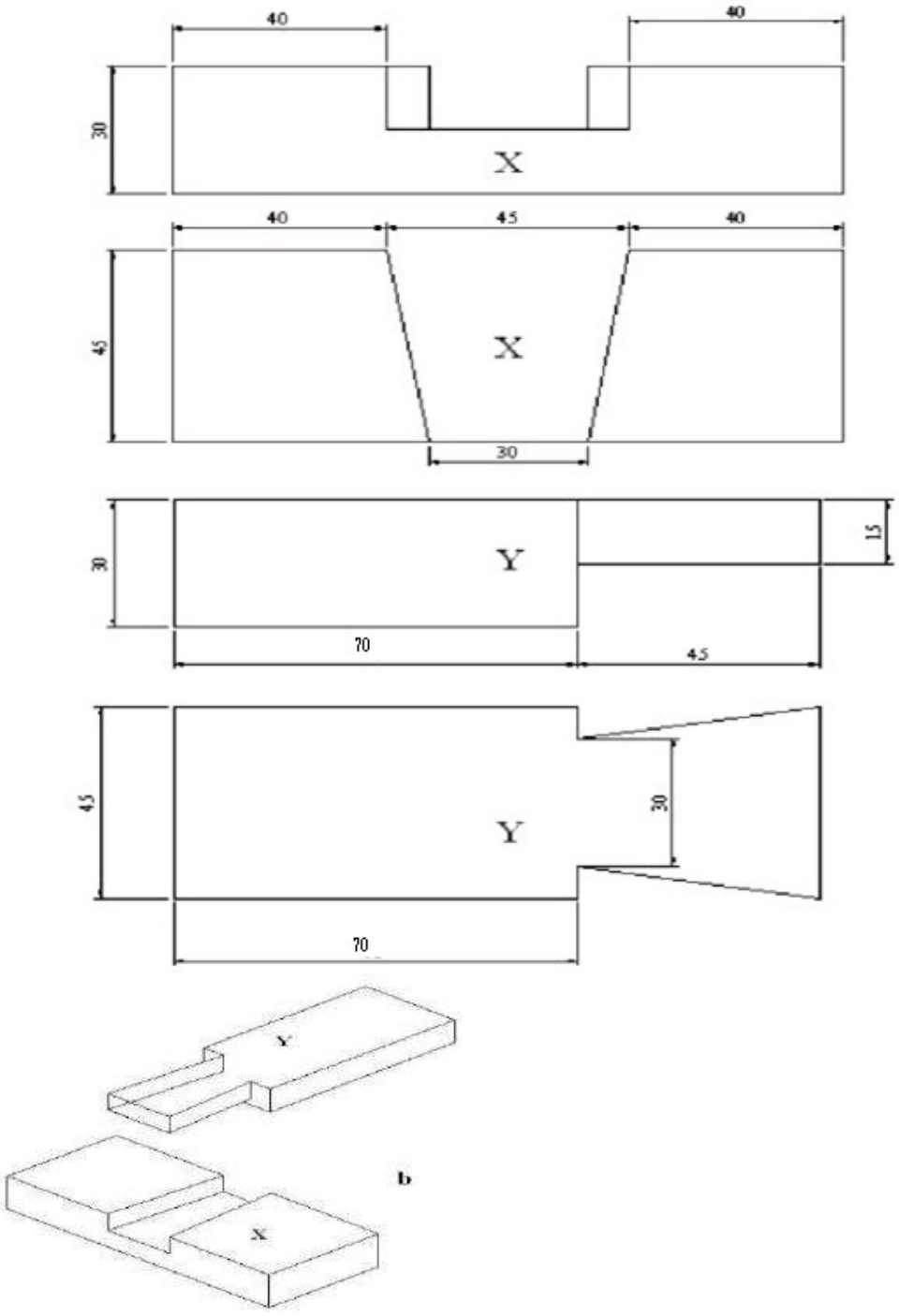
Tools required: -

- Carpenter's vice
- Steel Rule
- Try square
- Jack plane
- Scriber
- Cross cut saw
- Marking gauge
- Firmer chisel
- Mortise chisel
- Mallet
- Wood rasp file and smooth file

Material required: - Wooden pieces of size 50 x 35 x 250 mm–2 Nos.

Sequence of operations: -

- Measuring and Marking
- Planning
- Check for square ness
- Removal of extra material
- Sawing
- Chiseling
- Finishing



DOVETAIL LAP JOINT

Procedure: -

- The given reaper is checked for dimensions.

- They are planed with jack plane and checked for straightness.
- The two surfaces are checked for square ness with a try square.
- Marking gauge is set and lines are marked at 30 and 45 mm to mark thethickness and width of the model respectively.
- The excess material is first chiseled with firmer chisel and then planned tocorrect size.
- The mating dimensions of the parts X and Y are then marked using steel ruleand marking gauge.
- Using the crosscut saw, the portions to be removed are cut in both the pieces,followed by chiseling.
- The ends of both the parts are chiseled to the exact lengths.
- The fine finishing is given to the parts, if required so that, proper fitting isobtained.
- The parts are fitted to obtain a slightly tight joint.

Safety precautions: -

- Loose cloths are to be avoided.
- Tools to be placed at their proper placed.
- Hands should not be placed in front of sharp edged tools.
- Use only sharp tools.
- Care should be taken, when thumb is used as a guide in cross cutting andripping.
- Handle while chiseling, sawing and planning with care.

Result: - Dovetail lap joint is made as per the required dimensions.

FITTING

INTRODUCTION:

Machine tools are capable of producing work at a faster rate, but there are occasions when components are processed at a bench. Sometimes it becomes necessary to replace or repair a component that must fit accurately with one another or reassemble. This involves a certain amount of hand fitting. The assembly machine tools, jigs, gauges etc., involves certain amount of bench work.

FITTING TOOLS:

Holding tools:-

- Bench vice

- V-block with clamp
- C-clamp

Bench vice:-

It is a work holding device, when vice handle is turned in a clockwise direction the sliding jaw forces the work against the fixed jaw, the greater the force applied to the handle, the tighter is the work held.

- **block with clamp:-**

It is a rectangular (or) square block with v-groove on one or both sides, opposite to each other. It holds cylindrical work pieces.

C-clamp:-

This is used to hold work against an angle plate or v-block.

MARKING AND MEASURING TOOLS:

- Surface plate
- Try square
- Angle plate
- Scriber
- Universal scribing block
- Odd leg caliper
- Divider
- Calipers
- Dot punch
- Vernier caliper

Surface plate:-

It is used for testing flatness of work piece, for marking out small works.

Fig: 1 Bench wise

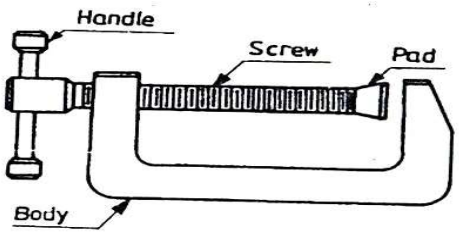


Fig: 2 V- Block

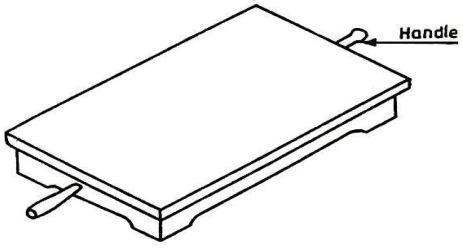


Fig: 3 C – Clamp

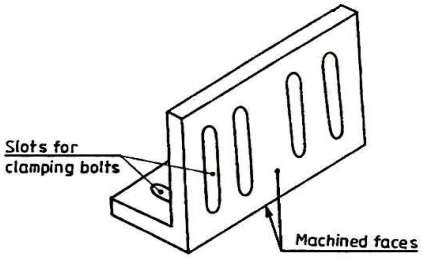


Fig: 4 Surface plate

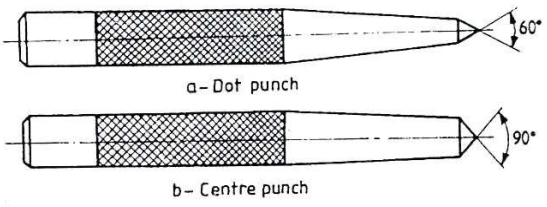


Fig: 5 Angle plate

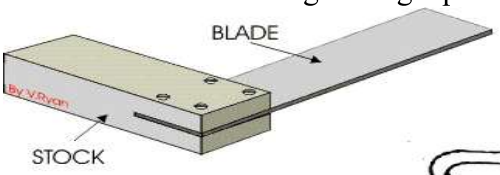


Fig: 6 Dot punch

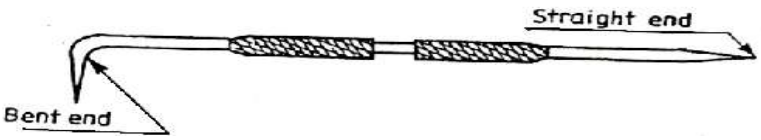


Fig: 6 try square

Fig: 7 scriber

Combination cutting pliers: -

This is made of tool steel and is used for cutting as well as for ripping work.

Taps and die holders: -

Tap and wrenches are used for cutting internal threads in a drilled hole.

Dies and die holders:-

They are used for making external threads. Dies are made either solid (or) split type.

TYPES OF FILES:

Hand file:-

It is a rectangular in section tapered in thickness but parallel in width.

Flat file:-

Rectangular in section and tapered for $1/3^{rd}$ length in width and thickness.

Square file:-

Square in section and tapered for $1/3^{rd}$ length on all sides.

Half round file:-

It has one flat face, connecting by a curved (surface) face & tapered for $1/3^{rd}$ length.

Round file:-

Circular in cross section and tapered for $1/3^{rd}$ length, it has double cut teeth.

WELDING

INTRODUCTION

Welding is the process of joining similar metals by the application of heat, with orwithout application of pressure or filler metal, in such a way that the joint is equivalent in composition andcharacteristics of the metals joined. In the beginning, welding was mainly used for repairing all kinds ofworn or damaged

parts. Now, it is extensively used in manufacturing industry, construction industry(construction of ships, tanks, locomotives and automobiles) and maintenance work, replacing rivetingand bolting, to a greater extent.

The various welding processes are:

- Electric arc welding,
- Gas welding
- Thermal welding
- Electrical Resistance welding and
- Friction welding

However, only electric arc welding process is discussed in the subject point of view.

Electric arc welding

Arc welding is the welding process, in which heat is generated by an electric arc struck betweenan electrode and the work piece. Electric arc is luminous electrical discharge between two electrodes through ionized gas.

Any arc welding method is based on an electric circuit consisting of the following parts:

- Power supply (AC or DC);
- Welding electrode;
- Work piece;
- Welding leads (electric cables) connecting the electrode and work piece to the power supply.

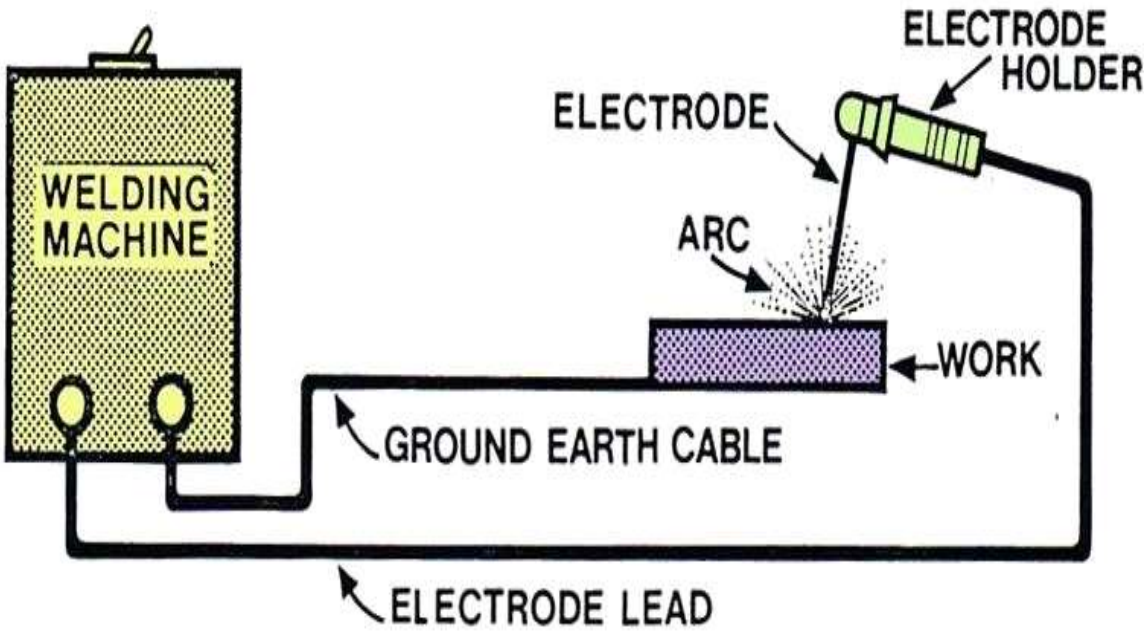


Fig:1 Arc welding set up

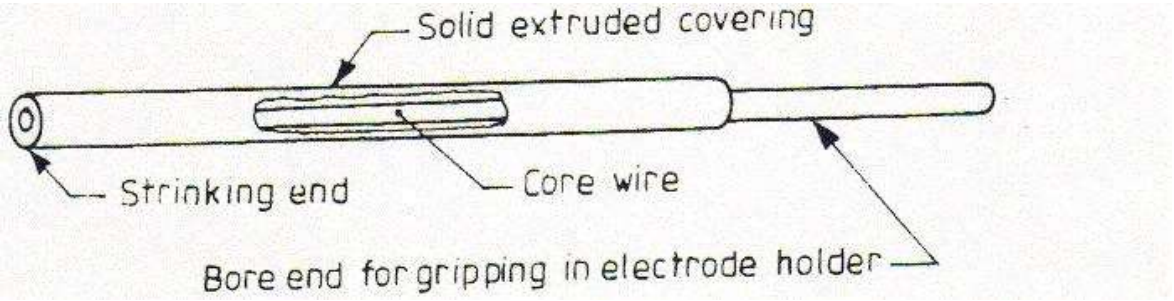


Fig :2 parts of an electrode

Electric arc between the electrode and work piece closes the electric circuit. The arc temperature may reach 10000°F (5500°C), which is sufficient for fusion the work piece edges and joining them. When a long joint is required the arc is moved along the joint line. The frontedge of the weld pool melts the welded surfaces when the rear edge of the weld pool solidifiesforming the joint.

Transformers, motor generators and rectifiers' sets are used as arc welding machines. These machines supply high electric currents at low voltage and an electrode is used to produce the necessary arc. The electrode serves as the filler rod and the arc melts the surface so that, themetals to be joined are actually fixed together.

Sizes of welding machines are rated according to their approximate amperage capacity at60% duty cycle, such as 150,200,250,300,400,500 and 600 amperes. This amperage is the rated current output at the working terminal.

Transformers

The transformers type of welding machine produces A.C current and is considered to be theleastexpensive. It takes power directly from power supply line and transforms it to the voltage required for welding. Transformers are available in single phase and three phases in the market. **Motor generators**

These are D.C generators sets, in which electric motor and alternator are mounted on the same shaft to produce D.C power as pert the requirement for welding. These are designed to produce
D.C current in either straight or reversed polarity. The polarity selected for welding dependsupon the kind of electrode used and the material to be welded.

Rectifiers

These are essentially transformers, containing an electrical device which changes A.C into D.Cby virtue of which the operator can use both types of power (A.C or D.C, but only one at a time).In addition to the welding machine, certain accessories are needed for carrying out the welding work.

Welding cables

Two welding cables are required, one from machine to the electrode holder and the other, from the machine to the ground clamp. Flexible cables are usually preferred because of the case of usingand coiling the cables. Cables are specified by their current carrying capacity, say 300 A,400 A, etc.

Electrodes

Filler rods are used in arc welding are called electrodes. These are made of metallic wire called core wire, having approximately the same composition as the metal to be welded. These are coated uniformly with a protective coating called flux. While fluxing an electrode; about 20mmof length is left at one end for holding it with the electrode holder. It helps in transmitting full current from electrode holder to the front end of the electrode coating. Flux acts as an insulator of electricity. In general, electrodes are classified into five main groups; mild steel, carbon steel,special alloy

steel, cast iron and non-ferrous. The greatest range of arc welding is done with electrodes in the mild steel group. Various constituents like titanium oxide, potassium oxide, cellulose, iron or manganese, Ferro silicates, carbonates, gums, clays, asbestos, etc., are used as coatings on electrodes. While welding, the coating or flux vaporizes and provides a gaseous shield to prevent atmospheric attack. The size of electrode is measured and designated by the diameter of the core wire in SWG andlength, apart from the brand and code names; indicating the purpose for which there are most suitable

Electrodes may be classified on the basis of thickness of the coated flux. As

- Dust coated or light coated
- Semi or medium coated and
- Heavily coated or shielded

Electrodes are also classified on the basis of materials, as

- Metallic and
- Non-metallic or carbon

Metallic arc electrodes are further sub-divided into

- Ferrous metal arc electrode (mild steel, low/medium/high carbon steel, cast iron, stainlesssteel, etc)
- Non-ferrous metal arc electrodes (copper, brass, bronze, aluminum, etc).

In case of non-metallic arc electrodes, mainly carbon and graphite are used to make theelectrodes.

Fig :3 Electrode holder

Fig :4 Ground Clamp

Fig :5Wire brush

Fig :6Chipping hammer

Fig :7Hand gloves

Fig :8Face shield

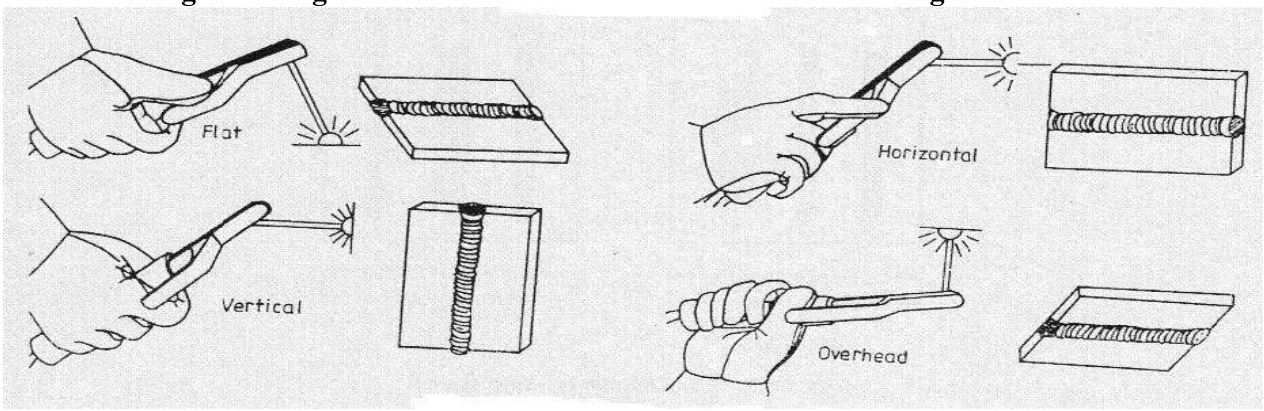


Fig :9Weld positions

WELDING TOOLS

Electrode holder

The electrode holder is connected to the end of the welding cable and holds the electrode. Itshould be light, strong and easy to handle and should not become hot while in operation. Figure shows one type of electrode holder. The jaws of the holder are insulated, offering protectionfrom electric shock.

Ground clamp

It is connected to the end of the ground cable and is clamped to the work or welding table to complete the electric circuit. It should be strong and durable and give a low resistance connection.

Wire brush and chipping hammer

A wire brush is used for cleaning and preparing the work for welding. A chipping hammer is used for removing slag formation on welds. One end of the head is sharpened like a cold chisel and the other, to a blunt, round point. It is generally made of tool steel. Molten metal dispersed around the welding heads, in the form of small drops, is known as spatter. When a flux coated electrode is used in welding process, then a layer of flux material is formed over the welding bead which

contains the impurities of weld material. This layer is known as slag. Removing the spatter and slag formed on and around the welding beads on the metal surface is known as chipping.

Welding table and cabin

It is made of steel plate and pipes. It is used for positioning the parts to be welded properly. Welding cabin is made-up by any suitable thermal resistance material, which can isolate thesurrounding by the heat and light emitted during the welding process. A suitable draught shouldalso be provided for exhausting the gas produced during welding.

Face shield

A face shield is used to protect the eyes and face from the rays of the arc and from spatter or flying particles of hot metal. It is available either in hand or helmet type. The hand type isconvenient to use wherever the work can be done with one hand. The helmet type though notcomfortable to wear, leaves both hands free for the work.

Shields are made of light weight non-reflecting fiber and fitted with dark glasses to filter out the Harmful rays of the arc. In some designs, a cover glass is fitted in front of the dark lens to protectit from spatter.

Hand gloves

These are used to protect the hands from electric shocks and hot spatters

TECHNIQUES OF WELDING

Preparation of work

Before welding, the work pieces must be thoroughly cleaned of rust, scale and other foreign material. The piece for metal generally welded without beveling the edges, however, thick workpieceshould be beveled or veed out to ensure adequate penetration and fusion of all parts of the weld. But, in either case, the parts to be welded must be separated slightly to allow better

penetration of the weld. Before commencing the welding process, the following must beconsidered

- Ensure that the welding cables are connected to proper power source.
- Set the electrode, as per the thickness of the plate to be welded.
- Set the welding current, as per the size of the electrode to be used.

WELDING POSITIONS

Depending upon the location of the welding joints, appropriate position of the electrode andhand movement is selected. The figure shows different welding positions.

Flat position welding

In this position, the welding is performed from the upper side of the joint, and the face of the weld is approximately horizontal. Flat welding is the preferred term; however, the same positionis sometimes called down hand.

Horizontal position welding

In this position, welding is performed on the upper side of an approximately horizontal surfaceand against an approximately vertical surface.

Vertical position welding

In this position, the axis of the weld is approximately vertical as shown in figure.

Overhead position welding

In this welding position, the welding is performed from the underside of a joint

WELDING

Lap joint

EXPERIMENT No:

Aimof the experiment

To make a double lap joint, using the given mild steel pieces and by arc welding.

Material used: Two mild steelpieces of 100X40X6 mm.

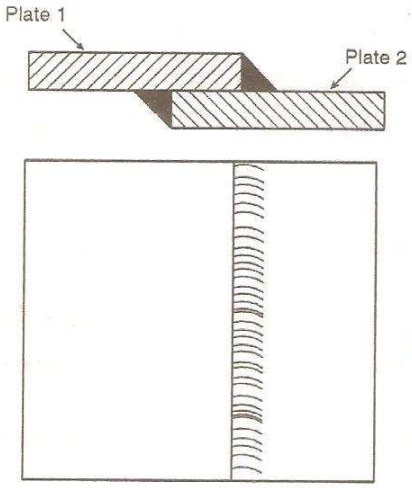
Tools and equipment used

- Arc welding machine,
- Mild steel electrodes,
- Electrode holder,
- Ground clamp,
- flat nose Tong,
- Face shield,
- Apron,
- Hand gloves,
- Metallic work Table,
- Bench vice,

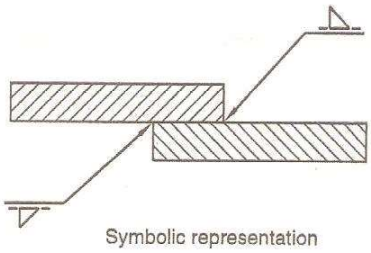
- Rough flat file,
- Try square,
- Steel rule,
- Wire brush,
- Ball peen hammer,
- Chipping hammer.

Operations to be carried out

- Cleaning the work pieces
- Tack welding
- Full welding
- Cooling
- Chipping
- Finishing



Representation of lap joint



Symbolic representation

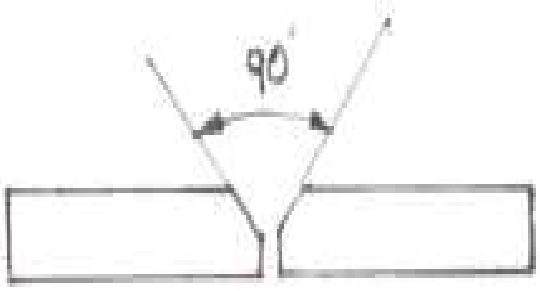
EXPERIMENT No:

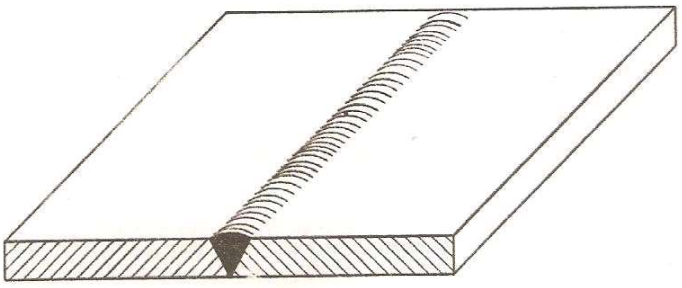
Aim Of the Experiment: preparation of butt joint as shown in figure using shielded metal arc welding process.

Material required: 2m.s flat pieces of given size.

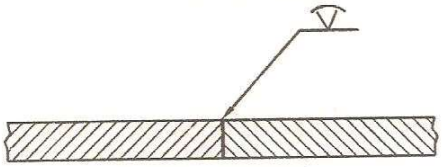
Tools required:

- welding transformer,
- connecting cables,
- electrode holder,
- ground clamp,
- electrodes,
- hipping hammer,
- Welding shield etc.





Representation of single V butt joint



Symbolic representation

GAS WELDING

Introduction: A very hot flame is produced by burning of the mixture gases coming through the torch tip. The edges to be welded are heated up to melting and a filler metal is also added to t he melted parent metal to fill t he cavit y to complete the welding. This molten metal mixture when solidifies on cooling forms a welded joint. Many combinations of gases are used in gas welding, but the mixture of oxygen and acetylene is most commonly used. The working of the gas welding is shown in figure 1.

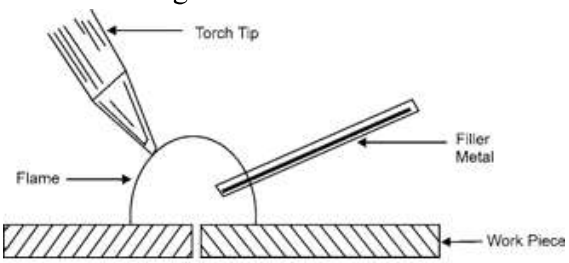
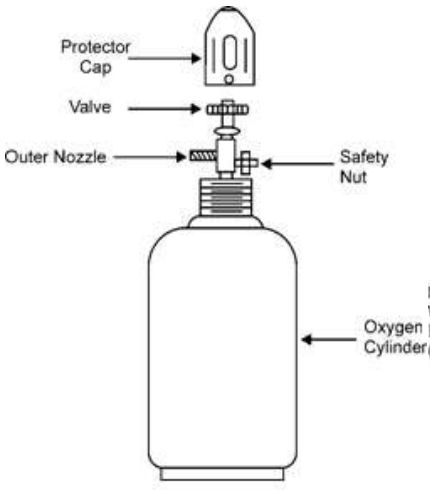


Fig 1: Working principle of gas Welding

Gas Welding Equipment

Details of Gas welding equipment are as under:

- **Oxygen Cylinder:** As shown in Fig 6. Cylinder is made up of steel in capacity range 2.25 to 6.3 m^3. The cylinders are filled with oxygen at about 150 kg/cm2 at 21°C. A safety valve is also provided on it. The cylinder can be opened or closed by a wheel which operates a valve. A protector cap is provided on the top of a cylinder to safeguard the valve.



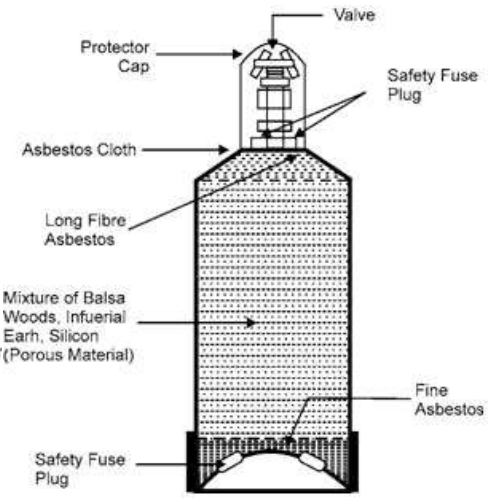


Fig 2: Oxygen Cylinder **Fig 3: Acetylene Cylinder**

- **Acetyl ene Cylinder:** As shown in Fig. 7. Acetylene cylinders are also made up of steel. Gas is filled at a pressure of 18-20 kg/cm^2. The capacity of the cylinder

is about 10m3. Regulator valve and safety valve are mounted on cylinder. Safety plugs are also provided on the bottom of the cylinder. When filled into the cylinder, the acetylene is dissolved inacetone.

- **Regulator:** Regulator is used to control the flow of gases from high pressurecylinder. A simple type of regulator is shown in the Fig. 4.

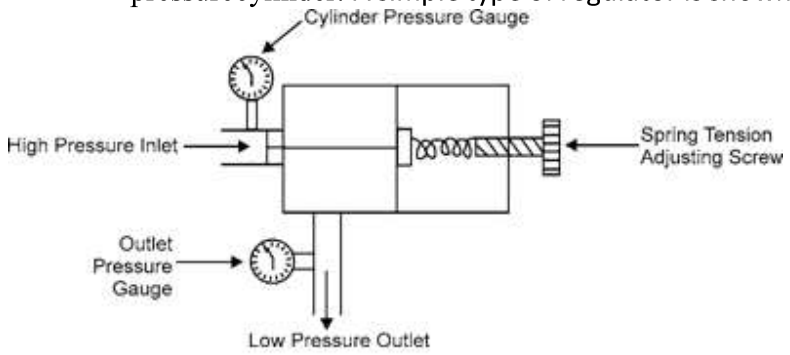


Fig 4: Regulator

- **Hoses:** In oxy-acetylene gas welding the oxygen and acetylene are carried from the oxygen and acetylene cylinders to the welding torch through hoses. The color coding is used to identifying the hose carrying the gas. The hose having blue color carries oxygen and red color is used for acetylene hose. These hoses are shown in figure 5.

Fig 5: Hoses

- **Welding Torch:** Torch is a device used to mix acetylene and oxygen in the correct proportion and the mixture flows to the tip of the torch. Refer Fig. 6. For different types of jobs, different tips are used. The size of the tip is specified by the diameter of outlet hole. More than one hole is also provided in tips. The tip is screwed or fitted on the front end of the torch. There are two types of torches:
  - Low pressure or injector torches

- Medium pressure or equal pressure torches

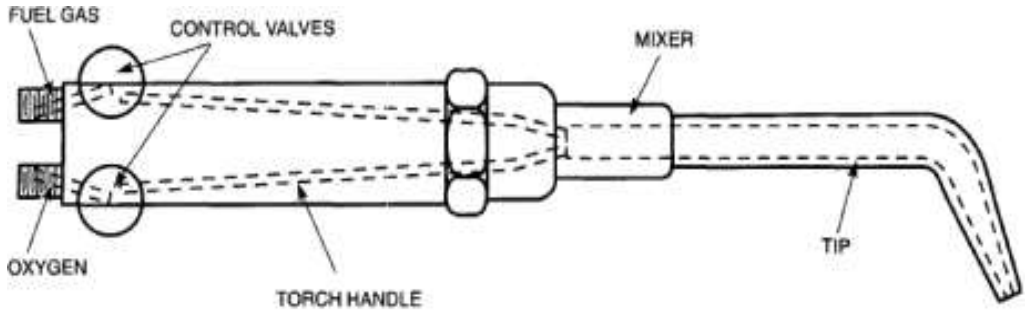


Fig 6: Welding Torch

- **Low Pressure or Injector Torch:** These torches are designed to use acetylene at low pressure. The pressure is kept very low up to 0.7 kg/cm^2. But the oxygen pressure is very high.
- **Medium Pressure or Equal Pressure Torch:** In this type of torch the acetylene is taken at a pressure equal to 1 kg/cm^2, the oxygen is always supplied at high pressure. Both types of torches are provided with two needle valves. One regulates the flow of oxygen and the second valve controls the flow of acetylene. A mixing chamber is provided to mix the gases.
- **Goggles:** Gas flames produce high intensity light & heat rays, which are harmful to naked eye. To protect the eyes from these rays, goggles are used. Goggles also protect the eyes from flying sparks. The goggles are shown in figure 7.

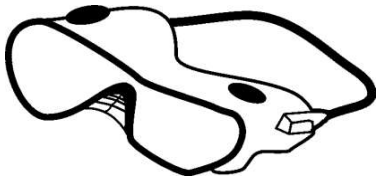


Fig. 7:
Goggle
s

- **Lighter:** For starting the flame, the spark should be given by a lighter. Match sticks should not be used, as there is risk of burning hand.
- **Fire Extinguishers:** Fire extinguishers are used to prevent the fire that may break out by chance. Sand filled buckets and closed cylinders are kept ready to meet such accidents.

Oxy-acetylene Welding Process

The process of oxy-acetylene welding can be used for almost all metals and alloys for engineering purposes. A high temperature flame (3500°C) can be produced by this method. There are two systems of oxygen-acetylene welding.

- **High Pressure System:** In this process the oxygen and acetylene are taken for usefrom high pressure cylinders.

- **Low Pressure System:** In this system oxygen is taken from high pressure cylinder andthe acetylene is produced by the action of Calcium carbide and water.

$$CaC2 + 2H2O = Ca(OH)2 + C2H2$$

A very hot flame is produced by burning of the gases coming through the torch tip. The edges to be welded are heated up to melting. A filler metal is also added to complete the welding. This molten metal mixture when solidifies on cooling forms a welded joint.

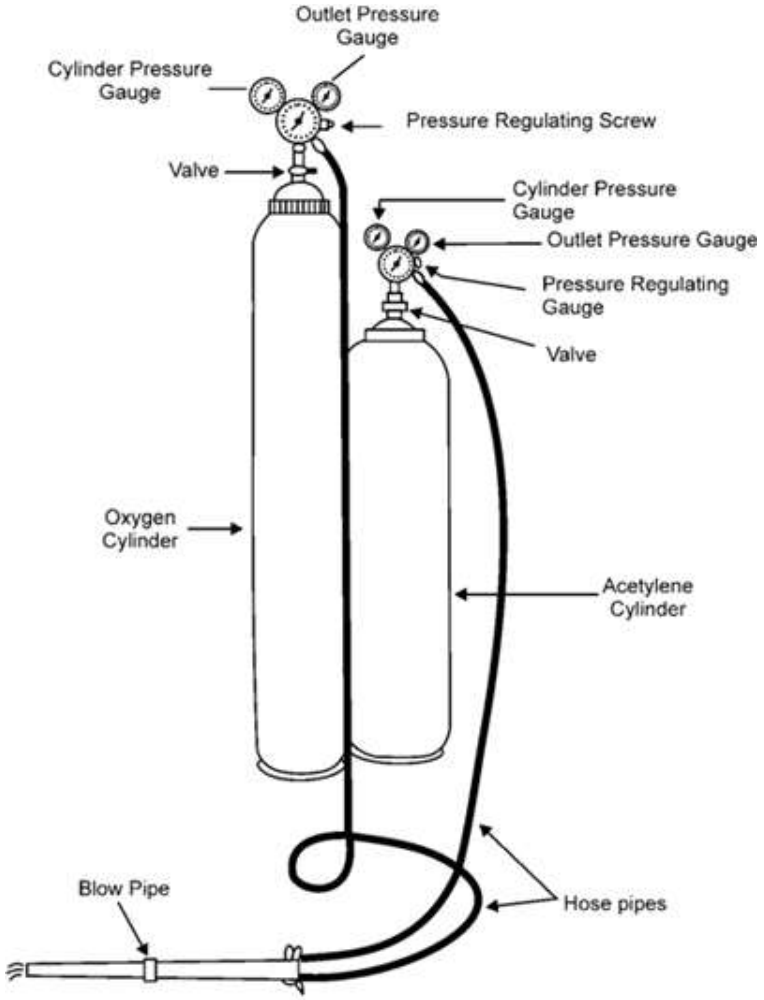


Fig 7A: Oxy- Acetylene Gas Welding Set Up

Oxygen cylinder and

acetylene cylinder are filled with gases. Both the cylinders are attached with pressure gauges, regulators and cylinder valves. The cylinder containing oxygen is painted black whereas the acetylene cylinder is painted maroon. Hose pipes, are provided with each cylinder. These pipes or hoses are connected to welding torch.

To start welding, the acetylene control valve is turned first. When acetylene comes out of the nozzle, it should be ignited with spark lighter. It will give a yellow-colored smoke flame. Afterit, oxygen cylinder valve is opened and supply is increased until a most suitable flame is

obtained. Then t h e flame is focused on the edges to be welded. Flux and filler metal are also used. The edges and filler metal melt and a joint are formed after cooling of the molten metal. The chemicals which deoxidize the metal surface and provide inert atmosphere around the molten metal are known as fluxes. The main function of flux is given below:

- To prevent oxides on the hot surfaces.
- To reduce the viscosity of molten metal.
- It maintains a steady arc in case of arc welding.

Fluxes are available as liquid, powder, paste and gas. Powder flux is sprinkled on the surfaces to be welded or the filler rod is dipped into the powder. Liquid & paste fluxes are sprayed on the surfaces to be welded. Gas fluxes are used to form inert atmosphere around the joint to be welded.

We can obtain different types of flames according the requirement. There are three types of flames which are used for various purposes.

Types of Gas Flames

- **Oxidizing Flame:** When the volume of oxygen gas is more than the volume of acetylene mixed into the torch. This flame is used for welding brass and is also usedfor cutting the metals.
- **Carburising Flame:** When the volume of acetylene mixed is more than oxygen,carburising flame is formed. This flame is used for welding nickel, monel etc.
- **Neutral Flame:** It is known as balanced flame. Oxygen and acetylene gases are mixedin equal volumes. Neutral flame is used for normal welding of steel, cast iron etc.

These flames are shown in figure 8.

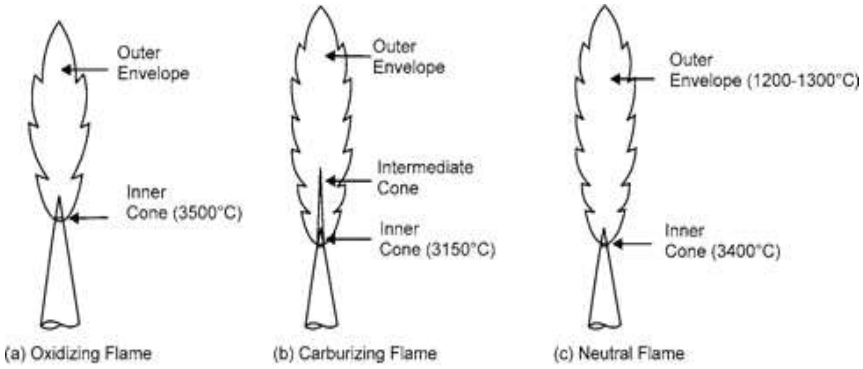


Fig 8: Types of Flames

Applications

Oxy-acetylene welding is particularly used for sheet metal work. All the metals can bewelded with proper filler metals. Same equipment may be used for cutting purposes.

Advantages of Oxy-acetylene Welding

The main advantages of oxy-acetylene welding are given below:

- Equipment is cheap as compared to other welding process.
- It can be used for welding of all types of metals.
- Maintenance of equipment is very less.
- It is a portable process.
- It can be used for cutting of metals of small thickness.
- It is specially used for sheet metal work.

Disadvantages

- It takes long time for heating the job as compared to the arc welding.
- The heat affected area is more.
- This is prone to corrosion and brittleness.
- Gases are expensive and difficult to store.

Gas Welding Techniques

There are two types of gas welding t e c h n i q u e s :

- Left ward welding
- Right ward welding

- **Left Ward Welding:** In this welding the tip of the torch is held at 60 to 70° to the plates. And the filler rod is inclined at 30 to 40° in opposite direction. In this method, the plate edges are heated immediately after the molten metal. The

torch tip and filler rod are moved slowly in the direction towards left. The technique is illustrated in the Fig.9.

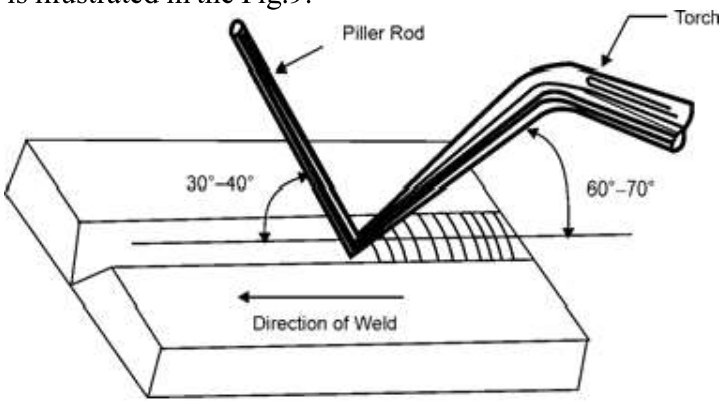


Fig 9: Leftward Welding

Right Ward Welding: In right ward welding the torch is kept at 40 to 50° to the job to be welded. Torch is moved towards right as shown in the Fig. 10. Right ward welding is done for heavy sections only.

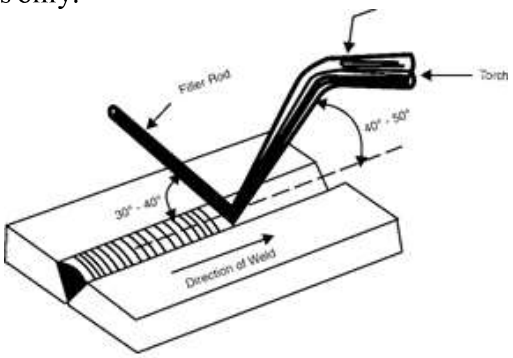


Fig 10: Rightward Welding

Filler: The rod which provides additional metal in completing the welding is known as filler.The compositionof filler metal should be the same as that of the metals to be welded.

Difference between High Pressure and Low Pressure Gas Welding

High Pressure Welding	*Low Pressure Welding*
1. Acetylene is available in cylinders	1. Acetylene is generated by the action of water and Calcium Carbide.
2. Pressure is very high in the acetylene cylinder. Minimum Pressure is 18 kg/cm^2 Pressure regulators are used on both cylinders	2. Pressure is low. It ranges from 0.03 to 0.14 kglcm^2. No need of pressure regulator on acetylene cylinder
3. Oxygen and acetylene gases are mixed in mixing chamber used for heavy work.	3. Injector is used to mix acetylene with oxygen used for light work.

Safety Precautions in Gas Welding

The following safety precautions must be observed while working in welding shop:

- Always handle the gas cylinders with care.
- The adjusting screw on the regulator must be fully released before opening a cylindervalve.
- Never use matchsticks for lighting a torch.
- Never lubricate the regulator valve with oil or grease, it may cause explosion.
- Always use goggles while working.
- Proper ventilation must be provided in the shop.
- Acetylene cylinders should be stored in up right position.
- Do not open acetylene cylinders near sparks or fire.
- Never remove torch tips with pliers.
- The cylinder should be leakproof.
- Always use protective caps over the valves.
- Keep in mind the location of the fire extinguishers.

SMITHY

- 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 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^{0}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

- 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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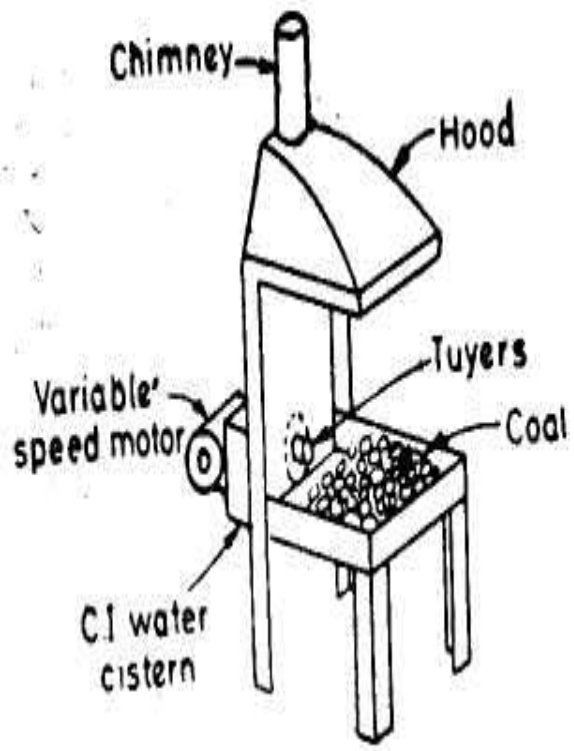
Tools & Equipment Used inSmithy & Forging

- (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



(a) Hearth.

It is used for heating purpose during the forging operation .

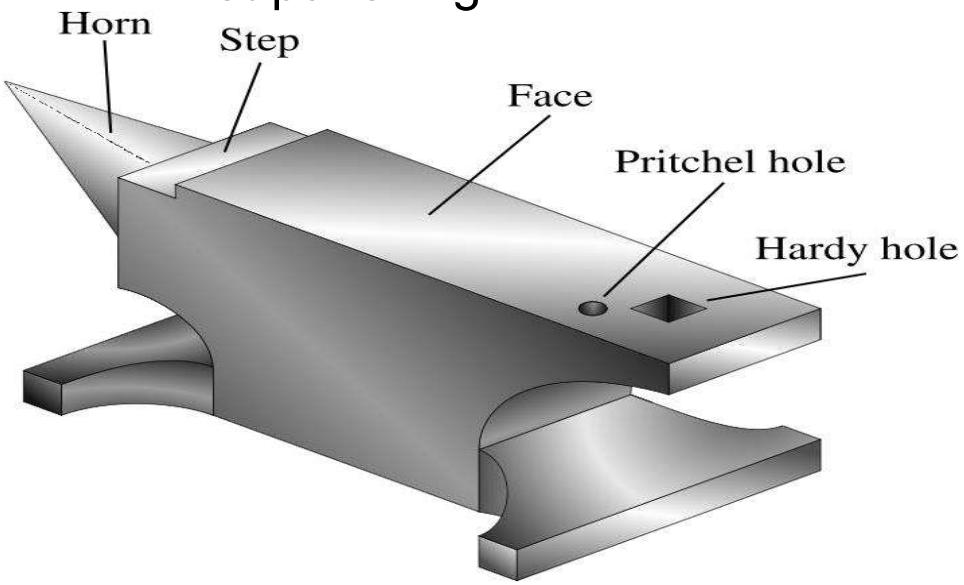
The structure of hearth is made of cast iron or cast steel. It has four-legged support, an

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.

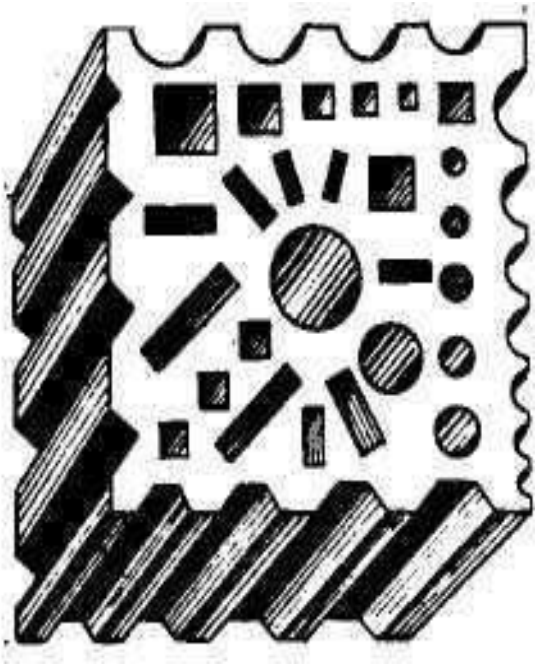
Anvil

- 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

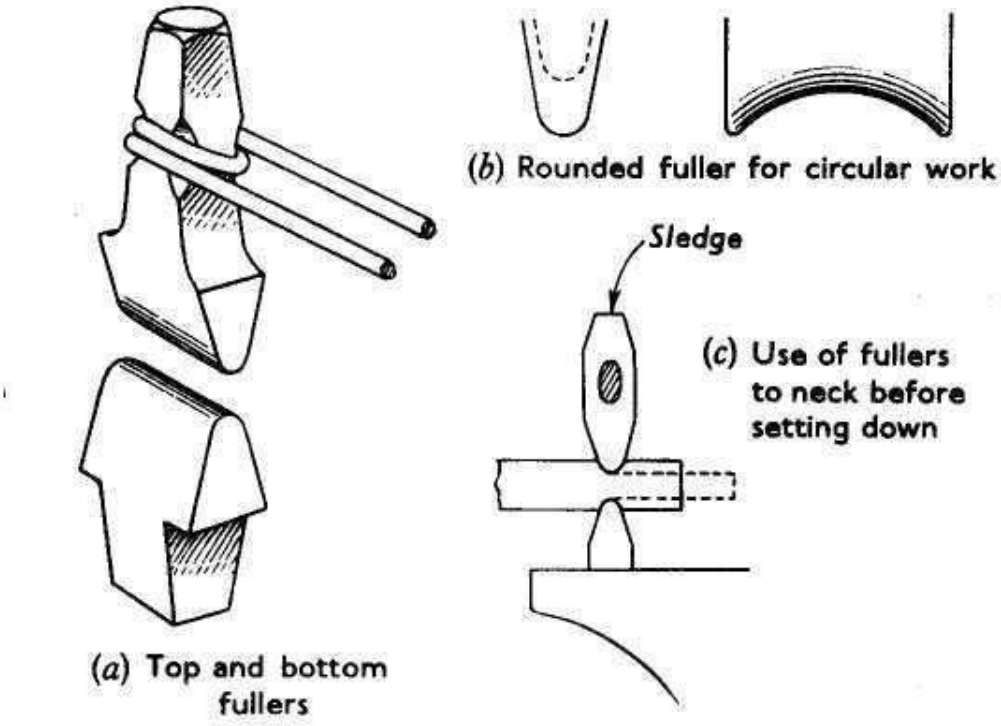


- It is a block of cast steel consisting of a number of slots of different shapes and sizes along its four side faces.

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.

- 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.



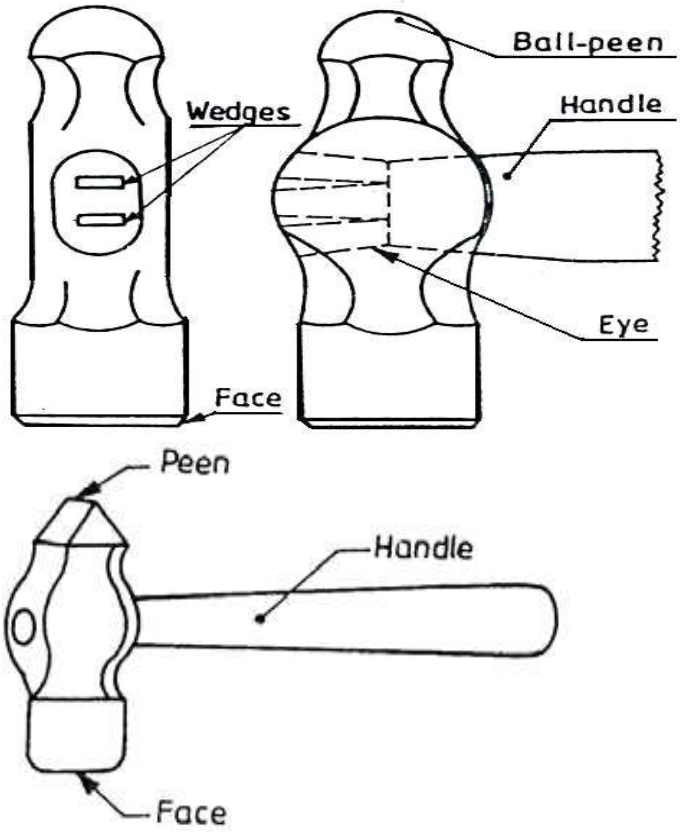
- These are also made of tool steel (high carbon steel). They are used in pairs (top and bottom). Bottom-one part of fuller is held in hardie hole of anvil with its square shape of shank. They are used for necking down or to reduce the cross section of a job. In some cases, they are also used in drawing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

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.



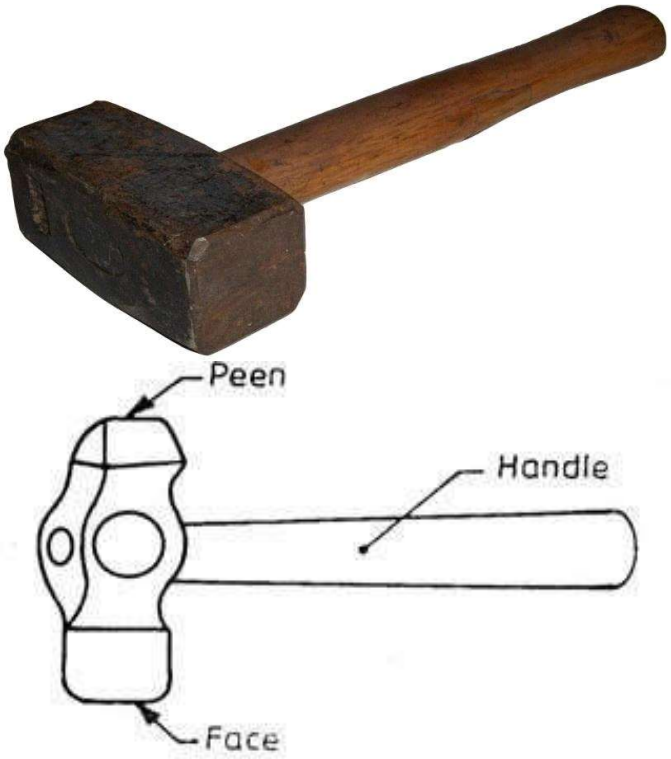
Sledge Hammer

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.



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 holdingthin sections.*
- ***b) Open Mouth Tong:*** *An open mouth tong is suitable for holding heavier stock.*
- ***c) Round Hollow Tong:*** *A round hallow tong is use for holdingsquare, hexagonal* and orthogonal work.
- ***d) Square Hollow Tong:*** *A square hollow tong is used for holdingsquare,* 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.

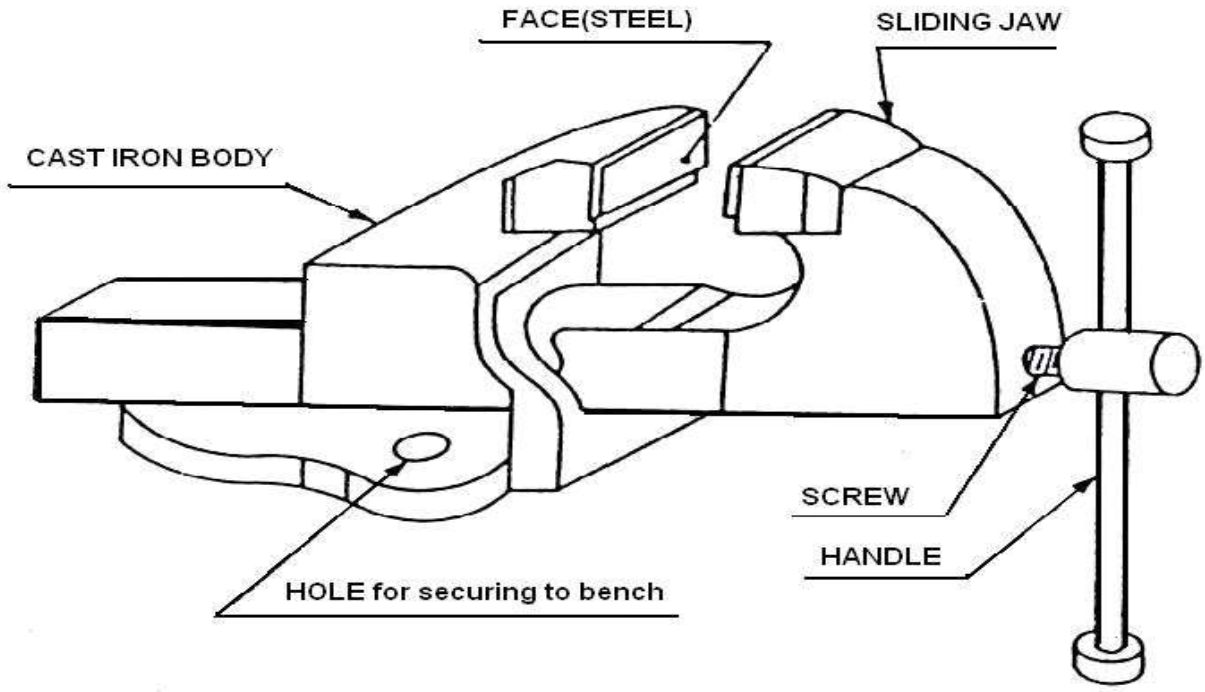
(d) Square hollow tong.

(e) Pick-up tong.

HOLDING TOOLS

Holding Tools

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



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:

- Up-Setting (ii) Drawing down

(iii) Setting down (iv) Bending

(v) Cutting (vi) Punching

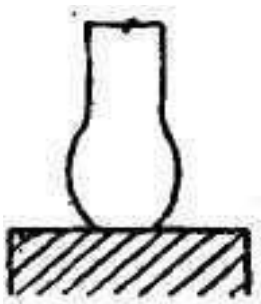
- **UP-SETTING:** It consists of increasing the cross section of a bar at the expense of its length. In this process first of all the heating is done and then heavy blow is given by hand hammer. Up setting may be various kinds.

- ***(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.

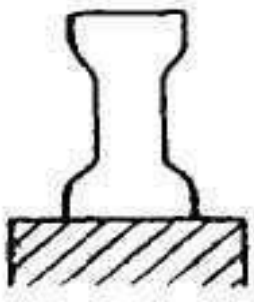
- ***(b) Full Up-Setting:*** *When heating is*

done at both end of item and then pressure is applied at both end is called full up setting.

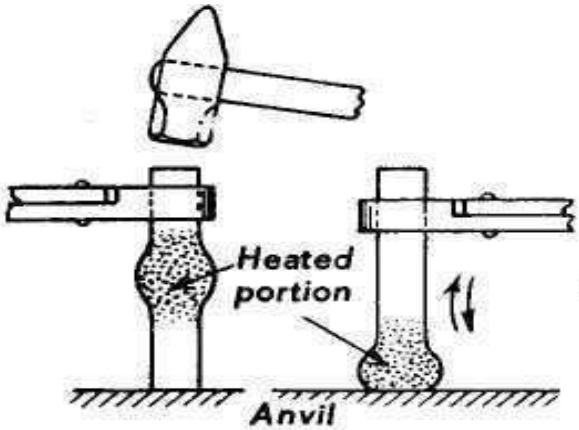
- ***(c) Central Up-Setting:*** *When heating is done at the centre of the item and then* pressure is applied at the central position is called central up setting.



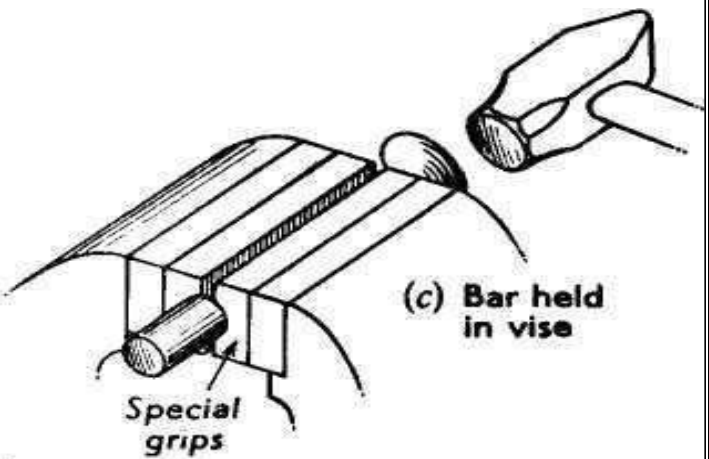
(a)



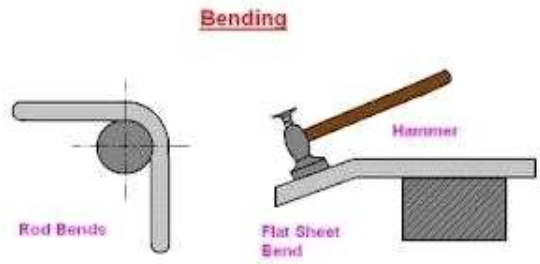
(b)



(a) With hammer (b) Striking on anvil



(c) Bar held in vise



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

- **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.

- **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.

- **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

- **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 punchis 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.