S. Babu Reddy

UNIT-3 WELDING

A. Vinodh Kumar ① B.Tech 302

Welding :- Welding is defined as the Process of Joining two similar (or) dissimilar metallic components with the application of heat, with or without the application of Pressure and with or without the use of filler metal.

- Heat may be obtained by chemical reaction, electric arc, electrical resistance, frictional heat, sound and light energy

classification of welding Processes :-

- There are various welding, brazing and several soldering methods in use by industry today.
- classification of welding depends on the basis of (i) Source of heat, ii) Type of interaction can be listed below.

welding

1. Gas welding
   a) Air Acetylene welding
   b) oxyhydrogen welding
   c) oxy acetylene welding
   d) Pressure gas welding.

2. Arc welding
   a) carbon Arc welding
   b) Flux cored Arc welding
   c) TIG welding
   d) Plasma Arc welding
   e) Electroslag welding
   f) Stud Arc welding
   g) shielded metal Arc
   h) Submerged Arc welding
   I) MIG welding

3. Resistance welding
   a) Spot welding
   b) Projection
   c) flash Butt
   d) High frequency Resistance
   e) Seam welding
   f) Resistance Butt welding
   g) Percussion welding

4. Solid state welding
   a) cold welding
   b) Explosive welding
   c) friction welding
   d) Roll welding
   e) Diffusion welding
   f) Forge welding
   g) Ultrasonic welding

5. Thermo-chemical welding
   a) Thermit welding
   b) Atomic Hydrogen welding.

6. Radiant energy welding
   a) Electron Beam welding
   b) Laser Beam welding.

- Fusion welding Processes use heat to melt the base metals.
- Solid State welding Processes use application of Pressure alone, or a combination of heat and Pressure.

Advantages of welding:-

* A large number of metals / alloys both similar and dissimilar can be joined by welding.
* Welding can join work pieces through spots, as continuous pressure tight seams are possiable.
* A good weld is as strong as the base metal.
* welding permits considerable freedom in design.
* General welding equipment is not very costley.
* Portable welding equipments are available.
* Welding results in a good saving of material and reduced labour content of production.
* Low manufacturing costs.
* welding is also used for repairing, broken, worn (or) defective metal parts.

Disadvantages:-

* welding results in residual stresses and distortion of workpiece
* welding heat produces metallorgical changes. The structure of the welded joint is not same as that of parent metal
* welding gives out harmful radiations (light), fumes and spatter.
* For producing a good welding job, a skilled worker is a must.
* Jigs, fixtures are generally required to hold and position of the parts to be welded.

Applications:-

* Structural members of bridges and buildings etc.
* vessels of welded - plate construction e.g. steel reservoirs, boilers, pressure vessel tanks and pipelines etc.
* Fastening panels and members together into automobile bodies and in aviation industry.
* Concrete reinforcement.

Types of welded Joints:- (1@)

* Welding Produces a solid connection between two Pieces are called a "weld Joint"
* weld Joint is the Junction of the edges or surfaces of Parts That have been Joined by welding.

The following are the five basic types of Commonly used Joints.

1. Lap Joint
2. Butt Joint
3. Corner Joint
4. Edge Joint
5. T- Joint

1. Lap Joint:-

* The lap Joint is obtained by overlapping the Plates and Then welding the edges of the plates.
* The lap Joints may be single traverse, double traverse and Parallel lap Joints.
* These Joints are employed on Plates having thickness less than 3 mm.

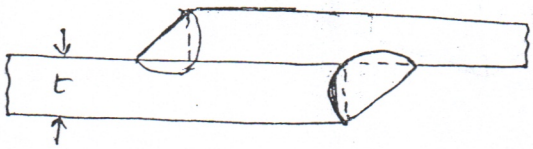
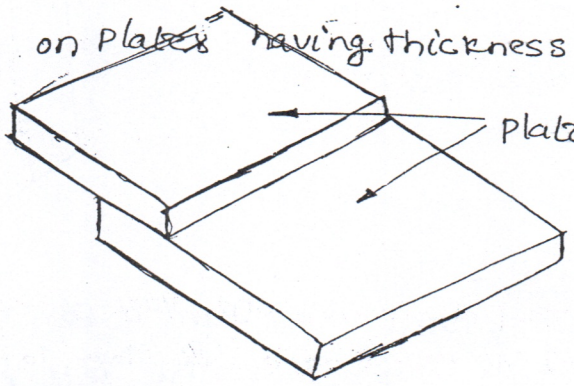


Fig: lap Joint.



2. Butt Joint:-

* In This Joint type, The Parts lie in the same plane and are Joined at their edges.
* In this type of Joints, if The plate thickness is less than 5 mm, and bevelling is not required.
* When the thickness of the plates ranges between 5 mm to 12.5 mm the edge is required to be bevelled to V (or) U - groove while the plates having thickness above 12.5 mm should have a V or U groove on both sides.

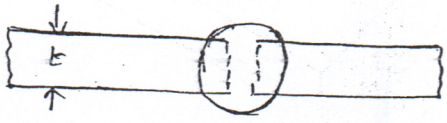
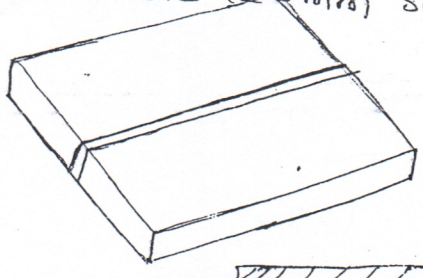
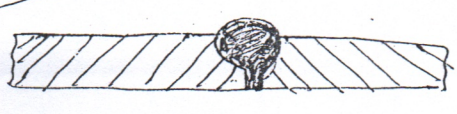


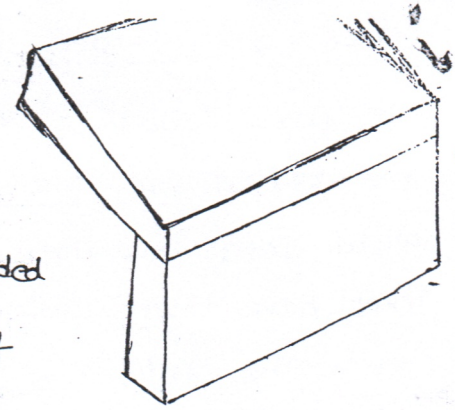
Fig: Butt Joint.





Corner Joint :-

* A corner joint is obtained by joining the edges of two plates whose surfaces are at an angle of 90° to each other.
* In some cases corner joint can be welded without any filler metal, be melting off the edges of the parent metal.
* This joint is used for both light and heavy guage sheet me



4. Edge Joint :-

* This joint is obtained by joining two parallel plates.
* It is economical for plates having thickness lessthan 6 mm.
* It is unsuitable for membess subjected to direct tension (or) bending.

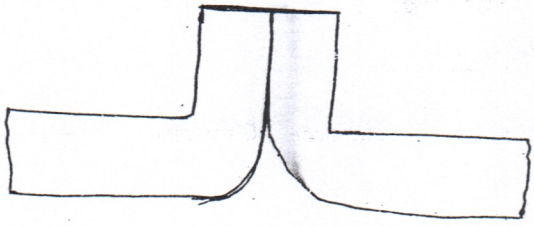
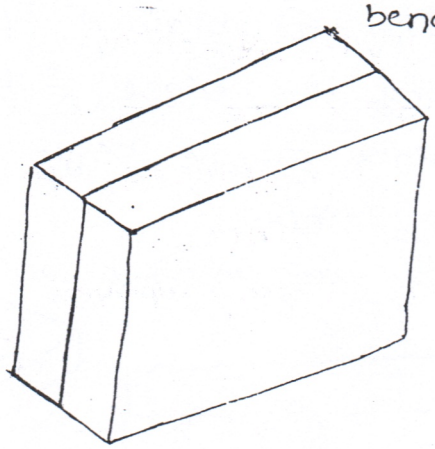


fig: Edge joint.



5. T- Joint :-

* In the T-joint, one part is perpendicular to the other in the approximate shape of the letter T.
* These joints are suitable upto 3 mm thickness.
* T-joint is widely used to weld sifferers in aircraft and other thin walled structures.

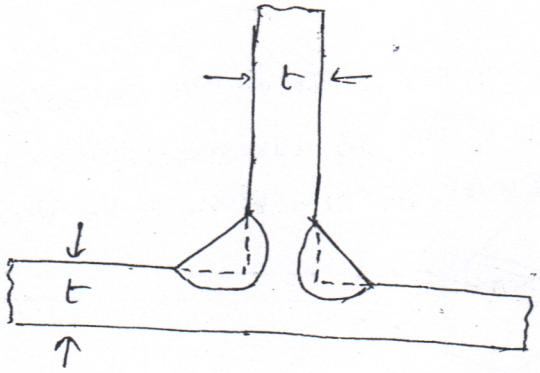
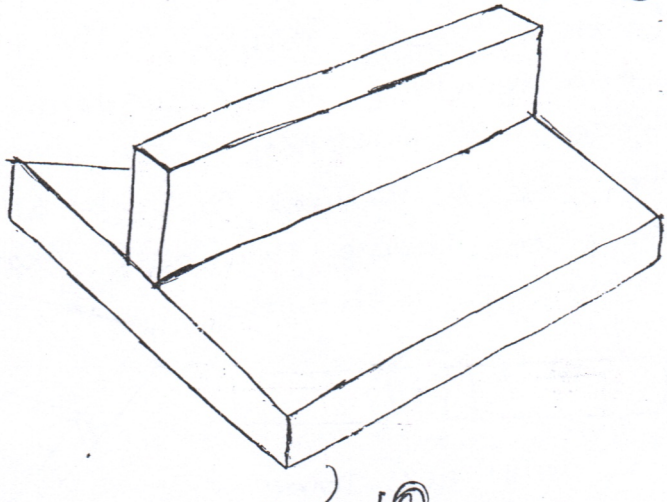
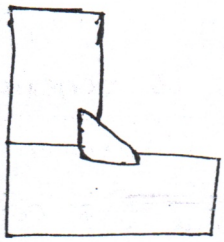


Fig: T-Joint.

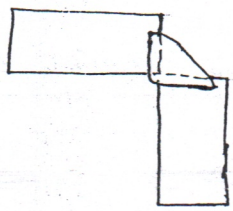


Types of welds: (2)

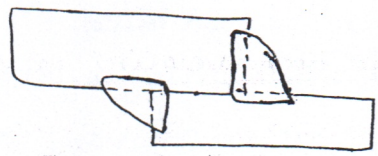
* The way in which it is welded to make a weld joint is called the weld type.
* Fillet weld is used to fill in the edges of plates created by corner, lap and tee joints.
* Filler metal is used to provide a cross section approximately the shape of a right triangle. it is the most common weld type in arc and oxyfuel welding because it requires minimum edge preparation, the basic square edges of the parts are used.



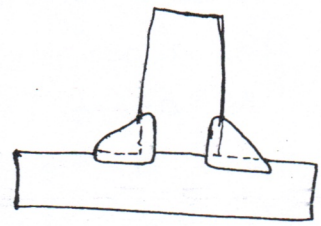
(a) Inside single fillet corner joint



b) Inside fillet corner joint



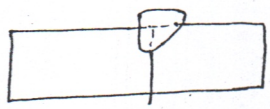
(c) Double fillet Lap joint



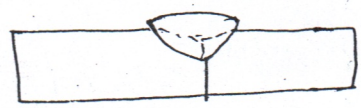
d) Double fillet T-joint.

* Groove welds usually require that the edges of the parts be shaped into a groove to facilitate weld penetration.
* The grooved shapes include square, bevel, V, U and J, in single or double sides.
* Filler metal is used to fill in the joint, usually by arc (or) oxyfuel welding.

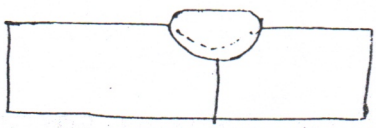
a) Square groove weld



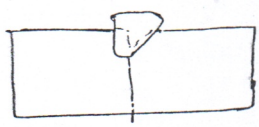
(b) Single bevel groove weld



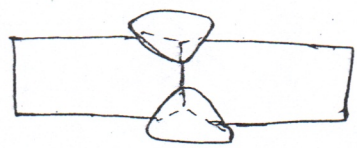
(c) Single V-groove weld



d) Single U-groove weld



e) Single J-groove weld



(f) Double V-groove weld.

* Plug welds and slot welds are used for attaching flat plates using one or more holes or slots in the top part and then filling with filler metal to heat the two parts together). (2) (6)

2(a) * Arc welding is a fusion welding process in which the metal is melted by an electric arc between an electrode and the work.

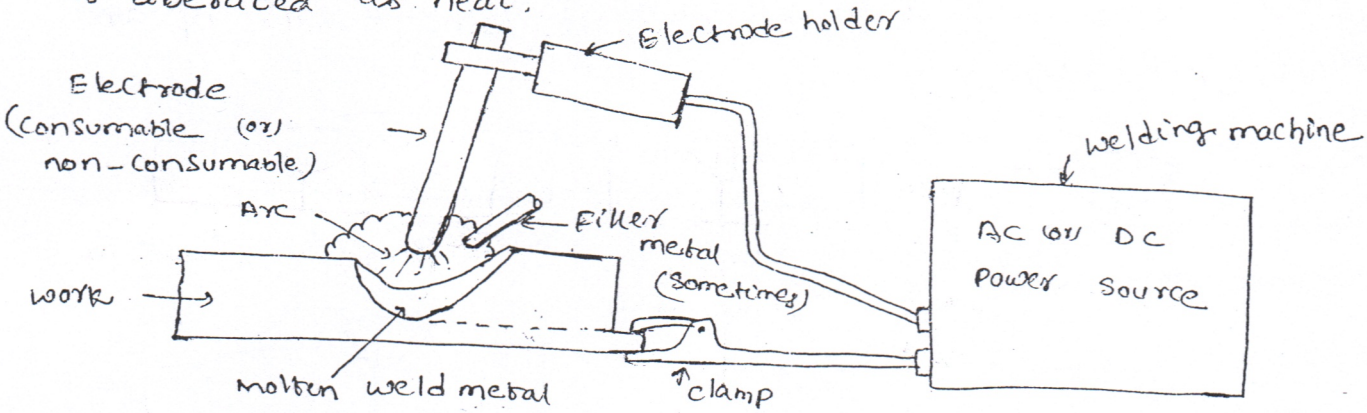
* An arc is generated between two conductors of electricity, cathode and anode, when they are touched to establish the flow of current and then seperated by a small distance.

* An arc is a sustained electric discharge through the ionized gas column (plasma) between the two electrodes.

* The electrons liberated from the cathode ~~and anode~~ move towards the anode and are accelerated in their movement. when they strike the anode at high velocity, a large amount of heat is generated.

* When the electrons are moving through the air gap between the electrodes, they collide with the ions in the ionized gas column between the electrodes. The positively charged ions, move from the anode and impact on the cathode, thus liberating heat.

* To produce the arc, the ~~Pressure~~ potential difference between the two electrodes (voltage) should be sufficient to allow them to move across the air gap. The larger air gap requires higher potential differ and here an arc, the extra energy spent crossing the air gap is liberated as heat.



* The source of electric power for an arc-welding by using two types

(a) Alternating current machines (AC)

i) Transformer

ii) Motor or engine driven alternator

(b) Direct current (DC) machines

i) Transformer with Rectifier.

ii) Motor or engine driven generator.

In AC welding, normally only transformers are used. It does not have any moving part and operates less maintenance cost and also higher efficiency. and less expensive.

In DC arc welding a generator is used to supply the required DC power. which is driven by either an induction motor running on AC or an oil engine. It is more expensive and noisy in operation.

In DC – Arc welding, if more heat is required at the work piece side; the workpiece can be made as the anode, liberating large heat near it, This is termed as Straight Polarity or) DCEN (Direct current electrode negative). This gives higher penetration.

where less heat is required in the weld zone, the Polarity could be reversed by making the workpiece negative. this termed reversed Polarity or) DCEP (direct current electrode positive). The Penetration is small.

The arc welding machines are normally specified by means of
- maximum rated open circuit voltage
- Rated current in amperes and
- duty cycle

The maximum voltage required is 40-50V at the begining. and continues welding 20-30V is sufficient. The minimum welding load voltage $V = 20 + 0.04I$ I = load current in Amperes.

The Rated current specifies the maximum current in Amperes (A) that a welding machine is capable of supplying at a given voltage it is Preferd 150, 200, 300, 400, 500, 600 A.

The duty cycle can be defined as " The Percentage of time in a 10-minute Period that a welding machine can be used at its rated output without overloading.

Required duty cycle $= T_a = \left[\frac{I}{I_a}\right]^2 T$

T = Rated duty cycle
I = Rated current
I_a = maximum current

The electrodes used for Providing heat input in arc welding in two types: The consumable and the non-consumable electrodes

When the arc is obtained with a consumable, the weld metal under the arc melts and also the tip of the electrode.

when the arc is Produced with a non-consumable electrode, The filler metal required seperatley.)

Submerged Arc - Welding:-

* Submerged arc welding is used for doing faster welding jobs.
* In this process it is possiable to use larger welding electrodes and very high currents, very high welding speed, and are able to weld plates of thickness from 75 mm to 1mm also.
* The arc is produced while the consumable electrode wire is continuously fed into the weld zone.
* The welding zone is completely covered by means of a large amount of granulated flux, which is delivered ahead of the welding electrode by means of a ~~large amount~~ welding flux hopper.
* The arc occuring between the electrode and the workpiece is completely submerged under the flux and is not visible from outside.
* The part of the flux melts and forms a slag, which covers the weld metal. The unused flux is collected and reused.
* The power source used with submerged arc welding can be either AC or DC. Both constant-voltage and constant current type machines can be effectively used. for larger electrodes a const-current power supply is prefered.
* Flux hopper is used to store the flux and controls the rate of flux deposition on the welding joint.
* The granulated flux shields and thus protects molten weld metal from atmospheric contamination. This flux cleanes weld metal and can modify its chemical composition also.

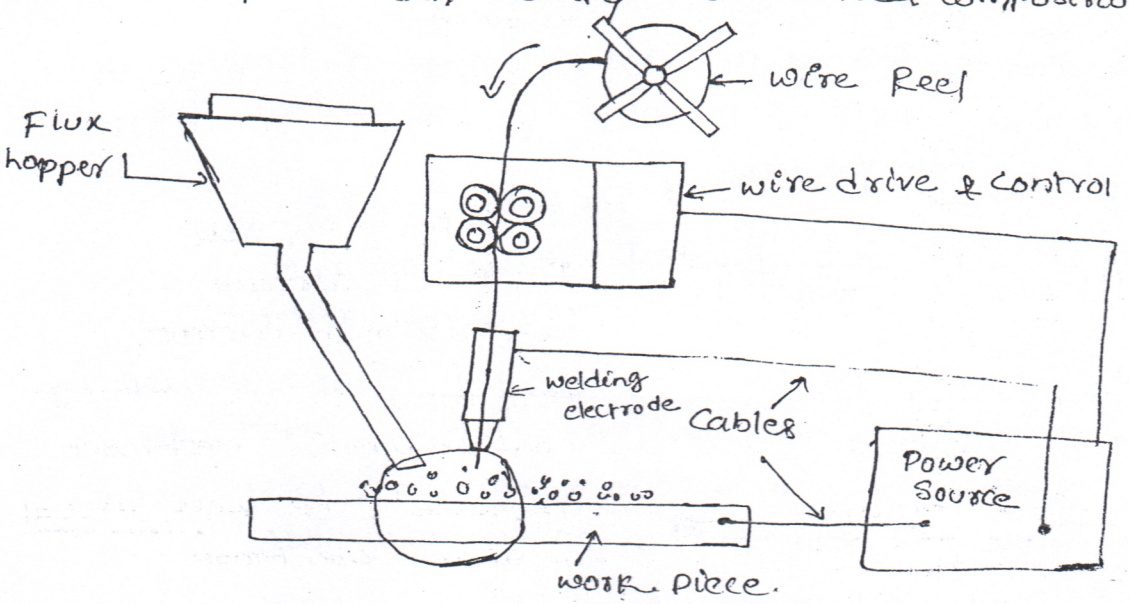


Fig.: Submerged Arc welding.

Electron Beam Welding (EBW)

* Electron beam welding is a fusion welding where the heat obtained from a concentrated beam containing primarily of high velocity electrons.
* As the high velocity electrons strike the surfaces to be joined, their kinetic energy changes to thermal energy and resulting the workpiece metal to melt and fuse.
* An electron beam welding equipment includes the following system.
  - → An electron beam gun with a high voltage power supply and controls (from 5 to 150 kV)
  - → a vacuum pumping system
  - → mechanical tooling fixtures, drives and motor controls
  - → A beam - alignment system, including optics, scanner, tape control, and tracker.
* An electron beam gun consists of a.
  a) Tungsten filament
  b) Cathode (control) electrode
  c) Anode
  d) Focusing coil
* when tungasten filament is electrically heated in vacuum to approximately 2000'c, it emits electrons.
* The electrons emitted from the heated filament carry a negative charge, are forced away by the cathode (control) electrode and are made to pass through the central hole of the anode.
* The cathode electrode (-) and anode electrode (+) concentrate and push forwards the electrons. The electrons are not free flowing but are instead greatley accelerated by the difference of potential, voltage between the cathode and anode.
* The electron beam is then focused by means of an electro magnetic focusing coil (lens). The focusing coil concentrates or spreads the electron beam to the ~~work piece~~. user's needs.
* This concentrated electron beam and focused on the w/p in a spot from 0.75 to 3 mm in diameter when strikes the workpiece. The kinetic energy of the electrons is changed into heat that is enough to melt the workpiece material.
* The greater the kinetic energy, the greater is the amount

→ The vacuum chamber is usually rectangular in shape, has heavy glass windows to permit viewing the work while the welding is in Progress.

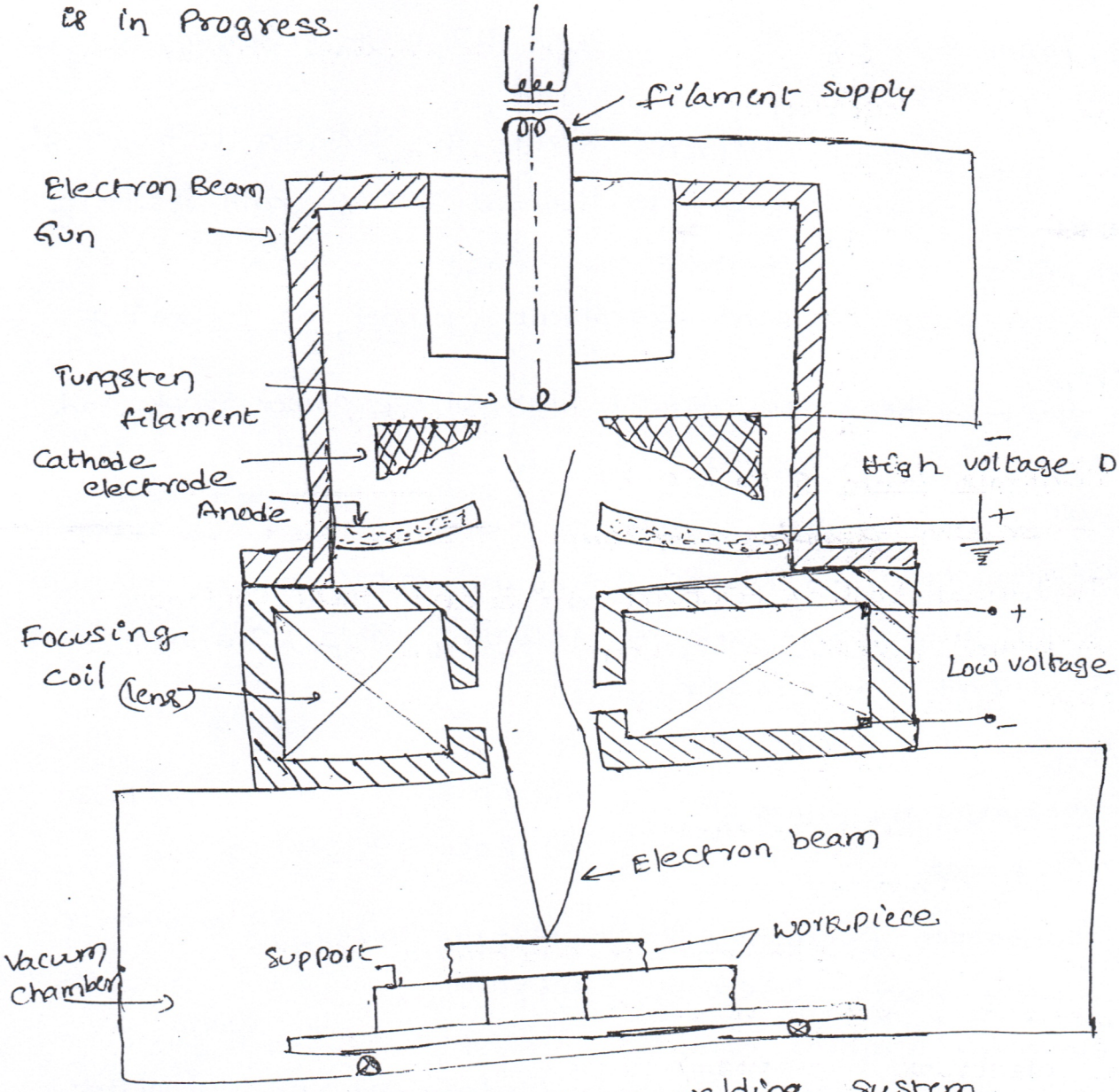


Fig: Electron beam welding system.

Advantages

→ Requires a vaccum chamber
→ uses no filler metal
→ Causes little workpiece distortion.
→ Produces excellent Penetration
→ Is easily automated
→ Permits Joining of dissimilar alloys
→ Weld zone is narrow.
→ Temperatures are very high but heat affected zone is very small.

Disadvantages

→ Initial cost of equipment is high.
→ Time and equipment is requi to create vacuum
→ Precautions are needed to prevent damage from X-rays.
→ obstructed Joints can not be welded.

Gas welding

* Gas welding is a fusion welding and it is also called as oxy-fuel gas welding, derives heat from the combustion of a fuel gas such as acetylene in combination with oxygen.
* oxyfuel gas welding is the term used to describe the group of fusion operations that burn various fuels mixed with oxygen to perform welding.

oxy-acetylene welding :-

* The oxy-acetylene welding process can be used for welding almost all metals and alloys used in engineering practice.
* The principle of oxy-acetylene welding is the ignition of oxygen and acetylene gases, mixed in a blow pipe fitted with a nozzle of suitable diameter.
* The flame is produced by the chemical reaction of acetylene and oxygen in two stages.

$$C_2H_2 + O_2 \longrightarrow 2CO + H_2 + \text{heat}$$

$$2CO + H_2 + 1.5\,O_2 \longrightarrow 2CO_2 + H_2O + \text{heat}.$$

* when the acetylene is burned in an atmosphere of oxygen an intensely heat flame with a temperature of about 3380°C is produced.
* The flame is directed by a welding torch. A filler metal is sometimes added, and pressure is occasionally applied in oxy acetylene welding between the contacting part surfaces.
* The advantages of using acetylene, instead of other fuels, with oxygen is that produces a comparatively higher temperature and also an inert gas envelop. consisting of CO_2 and water vapours which presents the molten metal from oxidation.

oxy-hydrogen welding :-

* oxyhydrogen flame is used to weld and braze metals only with low melting points like Aluminium, magnesium, lead etc.
* In oxy-hydrogen welding, if a higher temperature is obtained by increasing the oxygen supply, the flame becomes quite unsuitable for welding.

* Hydrogen is available in compressed gas cylinders. Complete combustion of hydrogen requires an oxygen-to-hydrogen ratio of 1 to 2. $2H_2 + O_2 \longrightarrow 2H_2O$

* This gas mixture produces a strongly oxidizing flame.

* The oxy-hydrogen welding is similar to oxy-acetylene welding with the difference that a special regulator is used for controlling the hydrogen gas.

* The temperature of the hottest part of an oxy-hydrogen flame suitable for welding is only about 2500°C.

3. Air-acetylene welding:-

* Air-acetylene welding is a gas welding process where heat is produced with a gas flame from the combustion of acetylene with air, without the application of pressure and with or without the use of filler metal.

* it operates on the Bunsen burner principle, i.e. the acetylene flowing under pressure through a Bunsen jet aspirates the appropriate amount of air for combustion purposes.

* Acetylene is obtained from a cylinder through a pressure regulator and hose. As the acetylene flows through the torch it draws air from the atmosphere into it in order to obtain the oxygen necessary for combustion.

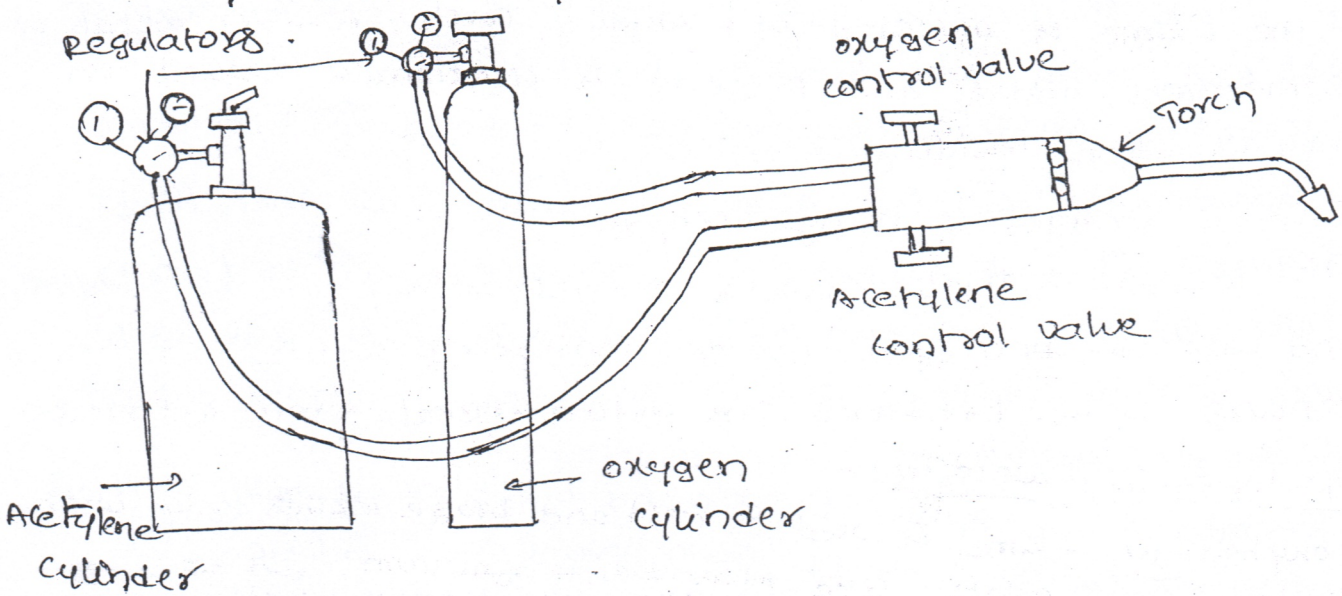


Fig:- oxy-acetylene welding equipment.

Types of flames

Following are the three types of flames of oxygen and acetylene mixture.

1. Neutral Flame:-

* when the ratio of oxygen (O_2) and acetylene (C_2H_2) are mixed equally, a neutral flame is obtained.
* In a neutral flame it is divided into a short inner cone and a longer outer envelope. The inner cone is the area where the primary combustion takes place through the chemical reaction between O_2 and C_2H_2.
* The heat of this reaction gives for about two-thirds of the total heat generated.
* The neutral flame is used to weld carbon steels, cast iron, copper, Aluminium etc.

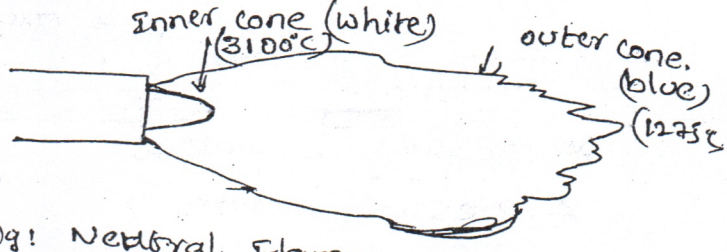


Fig: Neutral Flame.

2. Carburising flame:-

* When less oxygen is provided, part of the combustible matter is left as it is and it results in a reducing (or) carburizing flame.
* In this flame is having addition of a third phase in between the outer blue flame and the inner white cone. it is in reddish in colour. it is called acetylene feather.
* the length of acetylene feather indicates excess acetylene present.
* It is used to weld aluminum since it prevents the formation of aluminium oxide at the time of welding.
* It is also good for high carbon steels.

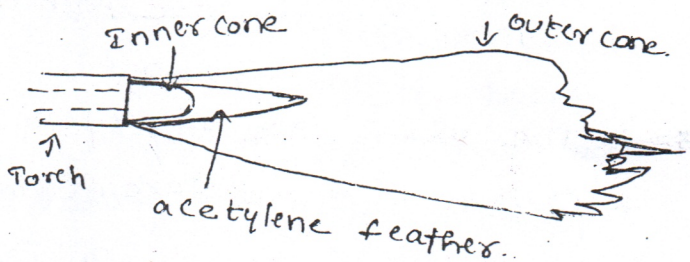


Fig: Carburising Flame

3. Oxidising Flame:-

* when oxygen is in excess, the carburizing flame is called oxidising flame.
* The flame is similar to the neutral flame with the exception that the inner white cone is small, giving rise to higher tip temperature (3300°C).

* There is an excess amount of oxygen present in the flame, which badly oxidizes the weld metal.

Fig: oxidizing flame

* Because of the burning of the metal, the weld forms foams and sparks and it also produces loud noise.
* This flame is suitable for copper, brass and bronze and zinc based alloys.

Gas welding equipment:-

For gas welding following equipments are used.

* Gas cylinders
  - oxygen gas cylinder
  - Acetylene gas cylinder
* Pressure Regulators
* Pressure gauges
* Welding Torch
* Hoses and hose fittings
* Safety devices etc.

* Gas cylinders

(a) Oxygen Gas Cylinder:-

* oxygen cylinder are painted black and the valve outlets are screwed right handed.
* The usual sizes of oxygen cylinders are 3400, 5200 and 6800 litre
* oxygen cylinders are filled at a pressure 12500 to 14000 KN/m²
* The cylinders are usually provided with fragile disc and fusible plug to relieve the pressure when it is overheating.

(b) Acetylene cylinder:-

* An acetylene cylinder is painted maroon and the valves are screwed left handed to make easy recognisation.
* The cylinder is usually filled to a pressure of 1600 to 2100 KN/m²
* The usual sizes of acetylene cylinders are 2800 and 5600 litre.
* An acetylene cylinder has a number of fusible pluges, at its bottom, designed to melt at 100°C. These plugs melt and release the pressure in case the cylinder is exposed to excessive heat.

Pressure Regulators :-

* The Purpose of using Pressure regulators is to reduce the high Pressure of the gas in the cylinder and to Produce a steady flow of a gas in varying cylinder Pressures.
* The Pressure of the oxygen and acetylene depends on the thickness of the metal to be welded.

Pressure gauges :-

* Two Pressure gauges are fitted on each Pressure regulator while one Pressure gauge shows the Pressure inside the cylinder, the other one shows the working Pressure of the fuel gas and oxygen.

Hose and hose fittings :-

→ Hoses are the rubber and fabric Pipes used to connect gas cylinders to blow pipe and are painted black or green for oxygen and red or maroon for acetylene.
→ It should be strong, durable, non-Porous and light.
→ special fittings are used for connecting hoses to equipment.

Welding Torch :-

* It is a device used for moving oxygen and acetylene in the required volume and ignited at the mouth of its tip.
* Generally two types of torches are used.
  (a) Low Pressure welding Torch
  (b) High Pressure welding Torch

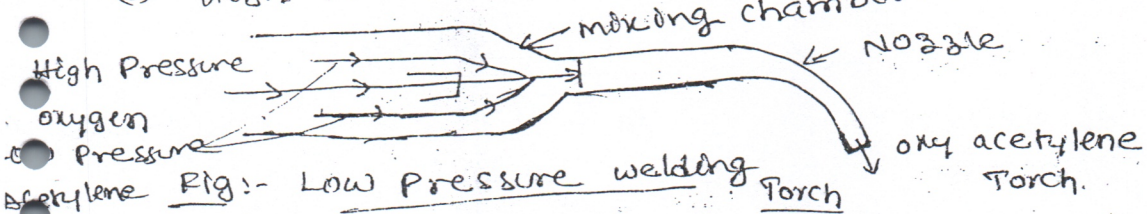


Fig:- Low Pressure welding Torch

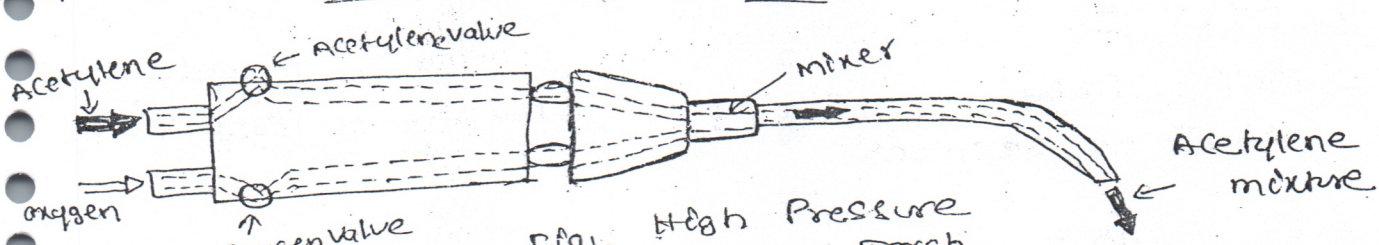


Fig:- High Pressure welding Torch.

Safety devices :-

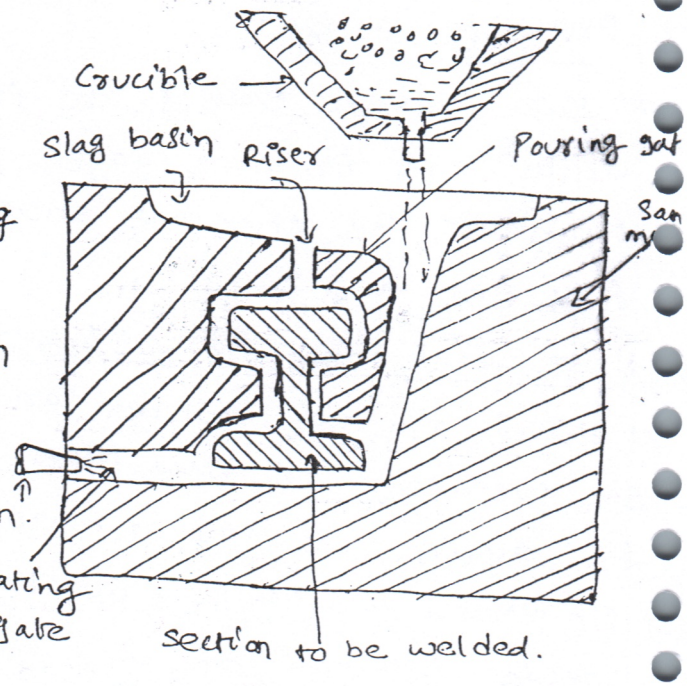
* Goggles fitted with coloured glasses should be used to Protect the eyes from harmful heat ultraviolet rays.

THERMIT WELDING :-

→ Thermit welding comprises a group of welding Processes wherein coalesence is Produced by heating with superheated liquid metal and slag resulting from chemical reaction between a metal oxide and aluminium, with or without the application of Pressure. The liquid metal acts as filler metal too.

→ The various steps involved in the non-Pressure fusion thermit welding of metal Parts

1. cleaning the joint
2. The part to be welded are to be lined up with a space allowing for contraction.
3. By using wax pattern from which the mould will be formed and this mould should Provides the Pouring gates, heating gates, and risers.
4. The mold should be preheated for removing the wax pattern and dry the mold.
5. Prepare thermit mixture in a crucible.
6. Ignite the thermit mixture and converted into a liquid molten metal.
7. Pouring the molten weld metal.
8. opening the mold and finishing the mold.



Advantages

* Can be used anywhere
* Low set up cost
* Not a highly skilled opegation
* Most suitable for welding of thick sections.

Disadvantages

* only thick sections can be welded
* This Process is not economical to weld cheap metals or light Parts.

Applications :-

* The Process is widely employed in the shipping, steel and rail road industries.

Forge welding (6)

* Forge welding is a solid-state welding process that joins two pieces of metal by heating them to a higher temperature and then hammering them together.
* The heating can be placed in a hearth to reach the welding temperature of metal, which is below its melting point.
* Forge welding between similar materials is caused by solid-state diffusion. it results in a weld that consists of only the welded materials without any filler material.
* Forge welding between dissimilar materials is caused by the formation of lower melting temperature between the materials. due to this the weld is stronger than the individual metals.
* The metal may take on a glossy or wet appearance at the welding temperature. Care must be taken to avoid overheating the metal to the point from rapid oxidation.

Advantages.

* Inexpensive equipment
* Semi-skilled operation

Limitations

* Poor joint strength
* labour intensive process (Low production rate)
* Weld quality dependent on operator's skill
* It is used when hammering is possiable) (6)

Plasma Arc welding :-

* Plasma is high-temperature ionized gas and occurs in any electric arc between two electrodes.
* The plasma arc welding is used a non-consumable tungsten electrode and a shielding gas such as argon.
* A small amount of pure argon gas flow is allowed through the inner orifice surrounding the tungsten electrode to form the plasma gas.
* Because of the squeezing action of the constraining nozzle, the arc is concentrated and straight. This constriction increases the heat contained per unit volume of the arc

* To initiate the arc in PAW, a low current arc is obtained between the electrode and the constricting nozzle, which ionizes the ~~gas~~ plasma gas flowing through the nozzle.
* The plasma gas flowing through the constriction reaches a very high temperature, and Provides and Provides a low resistance path to initiate the welding arc bln the electrod and the workpiece.
* The plasma gas is not sufficient to Protect the weld metal and shield gas is used to Protect from extreme heat and it can be argon, helium or a mixture of these two.
* The Power source used are DC with electrode negative. for better electrode life.
* The heat input is Properly controlled because of its concentration as well as uniformly deep Penetration is possiable.

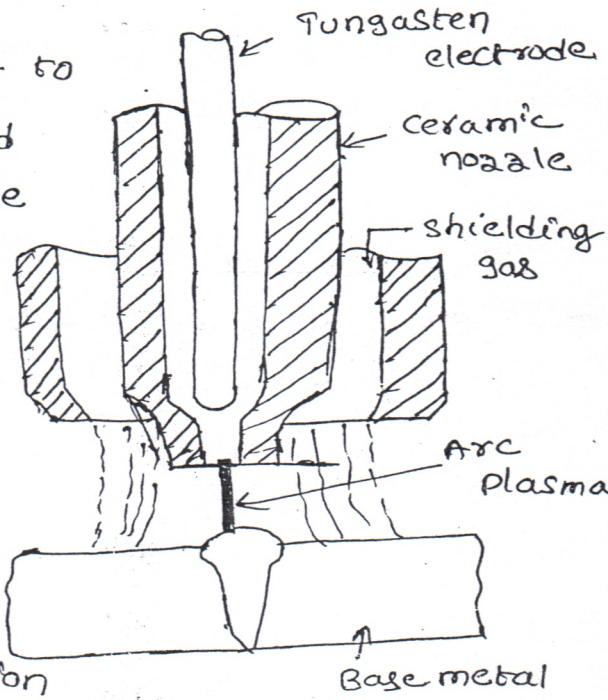


Fig: PLASMA ARC WELDING

* Greater lengths between the electrode tip and the workpiece it helps to provide filler metal rod, without the contamina of the electrode.
* Heat affected zone around the weld metal is small due to concentration of the arc.
* The welding equipment is expensive and also the nozzle surrounding the electrode needs a frequent replacement.
* The metal deposit Rates are higher than that of the Gas Tungesten Arc welding.

Resistance welding 3(a)

* Resistance welding is a fusion welding process where both heat and pressure are applied on the joint but no filler metal or flux is added.
* The heat being generated by electrical resistance to current-flow at the junction to be welded.

Principle of Resistance welding

* In Resistance welding a low voltage (typically 1V) and very high current typically (15000 A) is passed through the joint for a very short time (typically 0.25 sec).
* This high amperage heats the joint, due to the contact resistance at the joint and melts it. The pressure on the joint is continuously maintained and the metal fuses together under this pressure.
* The heat generated in resistance welding can be expressed as

$$H = I^2 R t$$

where H = The total heat generated in the work, J

I = electric current, A

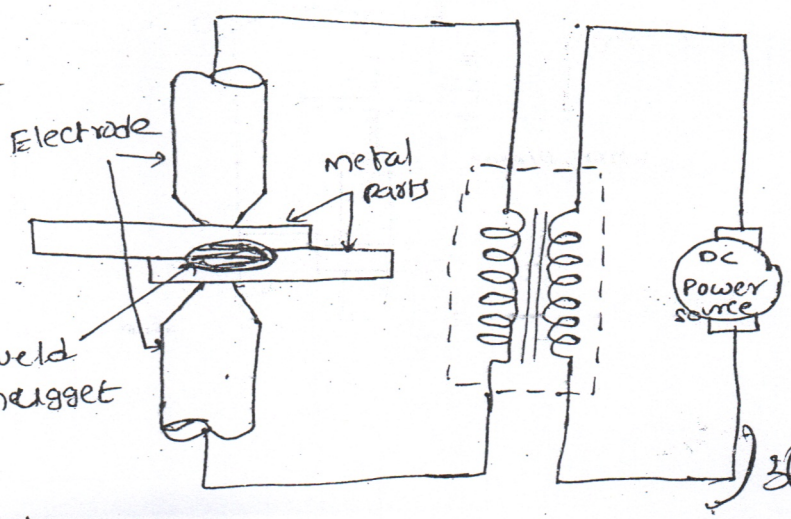
R = Electrical Resistance in ohms

t = Time for which the electric current is passing through the joint, sec.

* The amount of heat released is directly proportional to the resistance.

→ The various types of Resistance welding process are given below

* Resistance spot welding
* Resistance seam welding
* Projection welding
* Upset welding
* Flash butt welding



3(a)

Fig: Resistance ... welding ...

Resistance Spot Welding :-

* This is the most common resistance welding Process.
* This is essentially done to Join two sheet metal Jobs in a lap Joint, forming a small nugget at the interface of the two plates.
* It essentially consists of two electrodes, out of which one is fixed.
* The other electrode is fixed to a rocker arm for transmitting the mechanical force from a Pneumatic Cylinder.
* The welding cycle starts with the upper electrode moving and contacting the workpieces resting on lower electrode which is stationary.
* The workpieces are held under Pressure and only then heavy current is Passed between the electrodes.
* The area of metals in contact shall be rapidly raised to welding temperature, due to flow of current through the contacting surfaces of workpieces.
* The Pressure between electrodes, squeezes the hot metal together thus completing the weld.
* The weld nugget formed is allowed to cool under Pressure and then Pressure is released.
* Spot welding electrodes are like pointed tip (or) Truncated cones with an angle of 120°-140° are used for ferrous metal.
* Steel, brass, copper and light alloys can be Joined by this method.
* It is widely used in electronic, electrical, aircraft, automobile and home appliances industries.

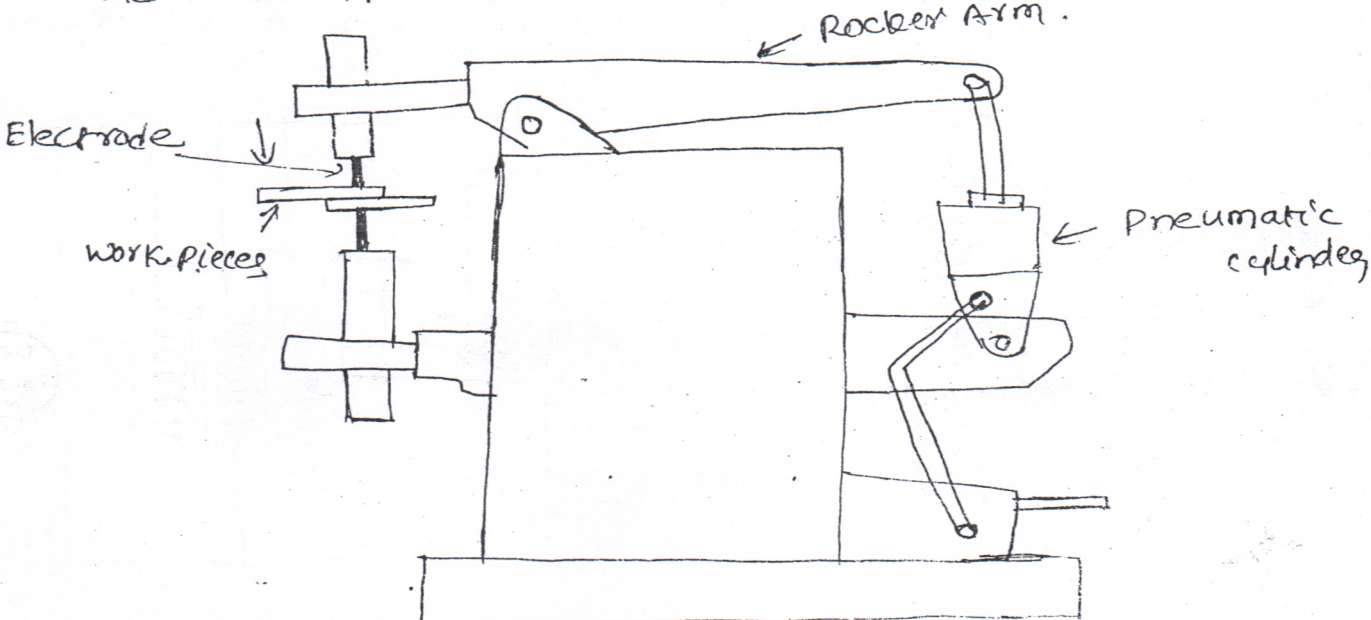
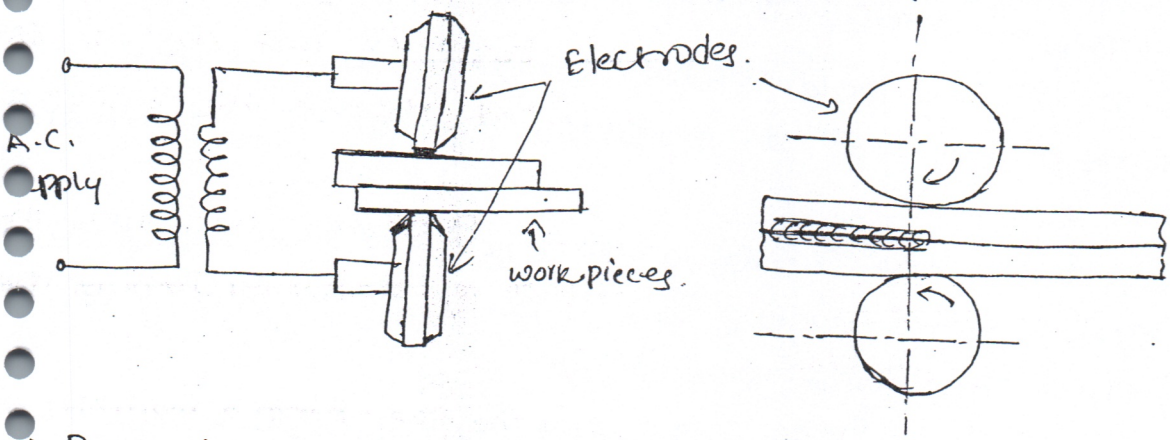


Fig:- Resistance spot welding machine.

Resistance Seam Welding

* It is a Specialized Process of Spot welding.
* Here the cylindrical electrodes are replaced by disc electrodes. The disc electrodes are continuously rotated so that the workpieces gets advanced under them while at the same time the Pressure on the joint is maintained.
* The electrodes need not be seperated at any time.
* The current is applied through the heavy copper electrodes in a series of pulses at Proper intervals.
* The timing is adjusted so that the pulses overlap each other and form a continues seam joint.
* This equipment is costly and maintenance is expensive.
* This Process is limited to components of thickness Lessthan 3mm.



Projection welding:-

* Projection welding is another variation of Spot welding. where one of the sheets to be joined is Provided with a number of Projections to help localise the current in different spots.
* Projections are little projected raised points which offer resistance during Passage of current and generating heat Those points.
* These Projections collapse under heated conditions and Pressure leading to the welding.
* These Projections can be generated by Press working or machining on one Part or by Putting some external force between two Parts.
* Members such as wire, wire ring, washer or Nut can be Put between two Parts to generate natural Projection.
* No consumables are required in Projection welding: it is widely used for fastening attachments.

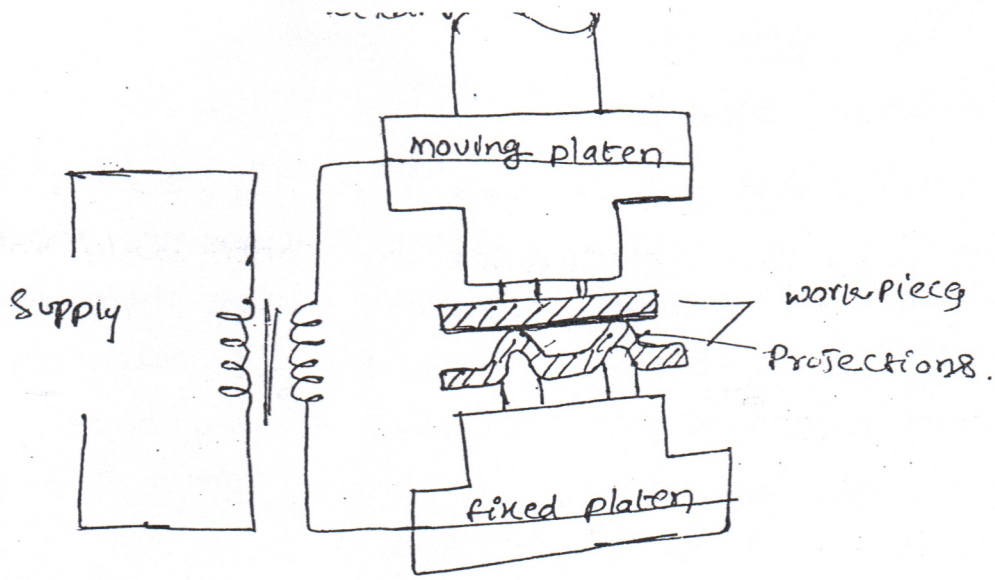


Fig:- Projection welding.

→ upset welding:-

* In upset welding, the pieces to be joined are brought together to make with each other in a butt joint.
* The two pieces are held tightly together and current is applied, so that the heat is generated through the contact are between the two plates.
* Because of the joint being under pressure, the ends of the two pieces get slightley upset. and it is useful for joining the two ends of rods or similar pieces.
* One bar is held in a fixed clamp and the other bar in a movable clamp, The clamp being electrically insulated, the one from other and being connected to a source of current.
* when the ends to be joined are brought into contact and current is switched on, The resistance at the joint causes the ends to heat up to welding temperature.

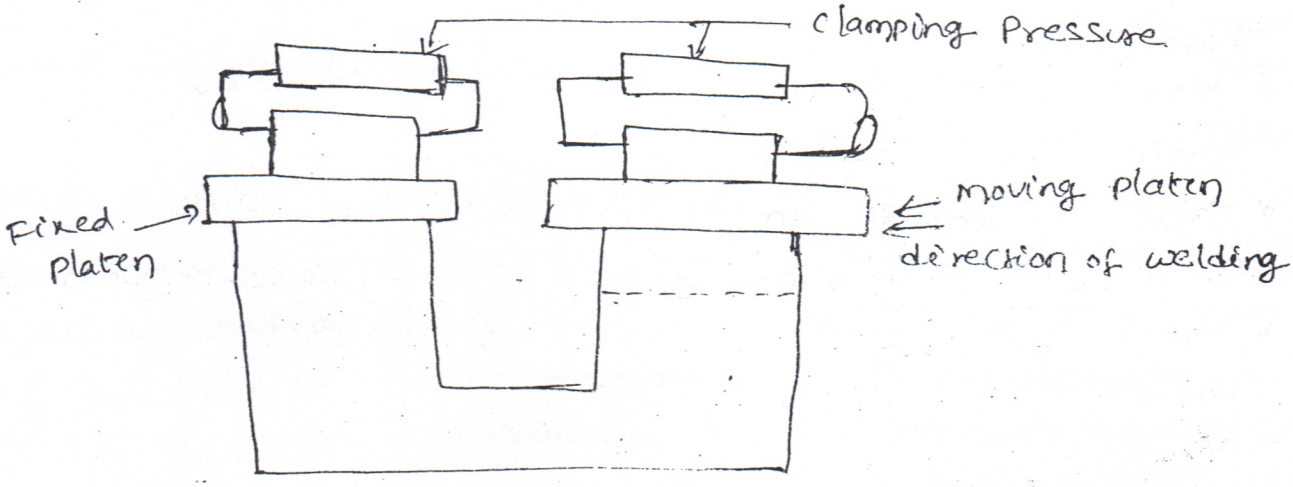


Fig:- upset welding (Butt welding)