RESISTANCE WELDING

INTRODUCTION :-

Resistance welding is a group of welding process in which welding heat is obtained from resistance of the work to the flow of electric current and by the application of pressure. No filler metal or flux is added.

Types of Resistance welding :-

1) Spot welding
2) Seam welding
3) Projection welding
4) Resistance butt welding
5) Flash butt welding
6) Percussion welding.

Principle of Resistance welding :-

In resistance welding, a low voltage (typically 1 volt) and very high current (typically 15,000 A) is passed through the joint for a very short time (typically .25 sec) This high amperage heats the joint. Heat generated in resistance welding can be expressed as

$$H = I^2RT$$

where, H = Total heat generated in work, Joule.

I = Electric current, Amp.

T = Time for which electric current is passed through the joint, sec.

R = Resistance of the joint.

Resistance of the joint is composed of :-

R_1 = Resistance of the Electrodes (R_1)

R_2 = Contact resistance b/w the electrode and the workpiece.

R_3 = Contact resistance b/w two workpieces.

R_4 = Resistance of the work piece plates.

In order to obtain a sound weld and to avoid overheating of welding electrode. R_1, R_2 and R_4 should be kept as low as possible as compared to R_3.

Electrodes for Resistance welding :-

Since the electrodes in resistance welding have to carry large amount of current, pressure and also help to remove the heat from the weld zone thus preventing overheating and surface fusion of work. so the electrodes should have higher electrical conductivity as well as higher hardness. Hence copper is alloyed form is used for making Electrodes:

1) Copper ~~electrode~~ cadmium is used for welding Aluminium and Magnese.
2) Copper chromium is used for welding of mild steel and low alloy steel.

Advantages of Resistance welding :-

1) very little skill is required to operate the resistance welding machine.
2) High production rate so well used for Mass production.
3) Heating of the workpiece is confined to a very small part, which results in less distortion.
4) No filler rod and flux is needed.
5) It is possible to weld dissimilar metal as well as

metal plates of different thickness.

6) It is very economical process as there are no consumables used in this process except for electrical power.

Disadvantages of Resistance welding :-

1) Intial cost of Equipment is high.
2) Certain resistance welding operations are limited only to lap joints.
3) skilled persons are needed for maintenance.
4) Bigger job thickness cannot be welded.

Applications of Resistance welding :-

1) Joining sheets, bar & tubes.
2) Making metal furniture
3) Making fuel tanks of cars, tractors etc.
4) Making containers.
5) welding aircraft and automobile parts.

SPOT WELDING :-

Spot welding is a type of resistance welding used to weld irregular surfaces. spot welding is done on sheets upto 12 mm total thickness. spot welding does not provide continuous weld but produces spots of welding with some spacing between them., so it can't give a leak proof joint.

Spot welding is a resistance welding process in which overlapping sheets are joined by local fusion at one or more spots by the heat and pressure is applied by the electrodes one above and other below the workpieces. The heat is

The heat is generated because of the resistance to the flow of Electric current through workpiece.

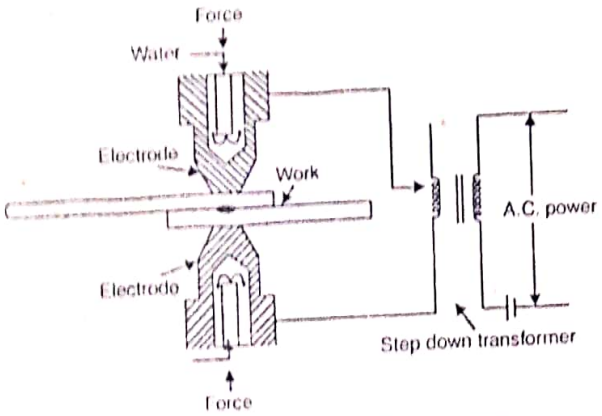


Fig. 22.1. *Principle of Spot Welding.*

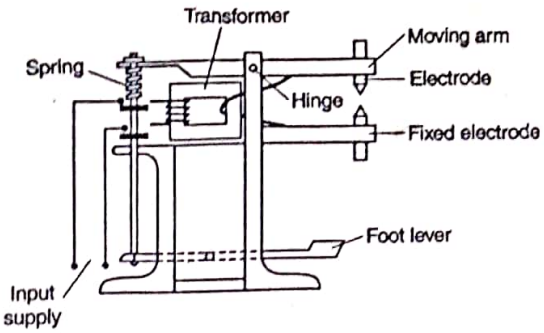


Fig. 7.2 Setup for Spot Welding

Advantages of spot welding :—

1) low cost
2) Less skilled worker can do it.
3) Higher productivity.
4) operation may be made automatic & semiautomatic.
5) No edge preparation is needed.

Applications :—

1) welding of low carbon steels, high speed steels, Al, Cu, Nickel, Nickel alloys Etc.
2) In automobile and aircraft industries.
3) Steel household furnitures.
4) Containers.

NOTE:—

Electrode Holders :—

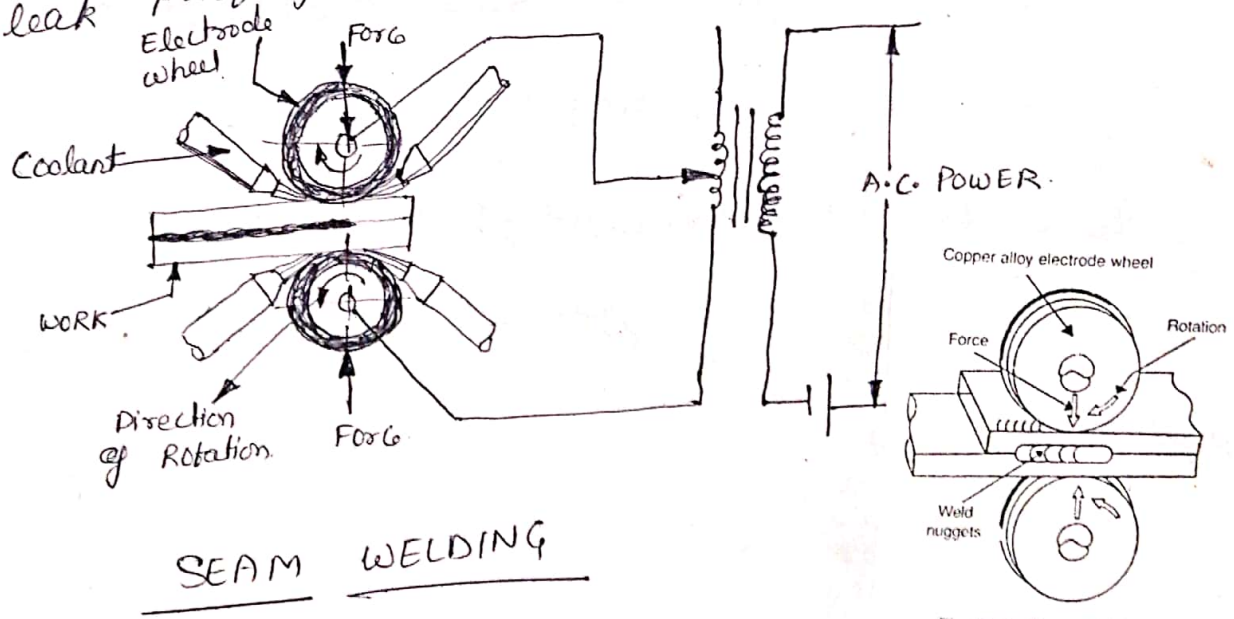
Electrode holders are mounted to the two arms of resistance welding machine. Electron holders hold the Electrode. These are made of copper based alloy having high Conductivity, high strength and rigidity.

SEAM WELDING :-

It is a resistance welding process in which overlapping sheets are joined by local fusion progressively along a part or joint by rotating the circular electrodes. Fusion takes place because of heat, which is generated, from the resistance to electric current flow through the work parts which are held together under pressure by electrodes.

In this process, wheels or circular electrodes serve as conductor for producing continuous welds. As pressure is applied, the drive is started and the welding current switched on. The overlapping surfaces of the metal are forced together as fast as they are heated. A coolent is applied to conserve the electrodes and cool the work rapidly to speed the operation.

It is different from spot welding in the sense that there is a definite spacing between two consecutive welded spots but in case of seam welding, it is a continuous welding so it can form a leak proof joint.



SEAM WELDING

Fig. 22.6. Seam Welding.

Advantages :-

1) It can produce gas tight or liquid tight joints.
2) Overlap can be less than spot or projection welds.
3) several parallel seams may be produced.

Disadvantages :-

1) Cost of equipment is high as compared to spot welding set.
2) welding can be done only along a straight or uniformly curved line.
3) It is difficult to weld thickness greater than 3mm.

Application :- It is used for welding of stainless steels, aluminium and its alloys, nickel and its alloys, Magnesium alloys etc.

PROJECTION WELDING :-

Projection welding is advancement of spot welding. when one of the sheet to be joined is provided with a number of projection to help localise the current at a predetermined spot. then, the surfaces of the workpiece are in contact with each other only at the projection.

As the current is switched on, it will pass through these projections. Because of heat produced due to resistance to the flow of electric current, these projections are melted and are pressed together to complete the weld, by pressing the upper electrode downward. the melted projections forms the weld. welding can be done at several joints simultaneously. the projections are generally very small of the order of 0.8mm and are obtained by means of embossing.

Advantages of projection welding :-

① It is possible to weld more than one spot at a given time.

2) welds may be placed closer than spot welding
3) Proper heat balance can be easily obtained. Projections are to be made in thicker plate or in the plate which is having higher electrical conductivity.
4) life of electrode is much longer than the life of electrode in spot welding.
5) Uniformity and appearance of the weld is better as compared to spot welding.

Disadvantages:-
1) Making of projections is an extra operation.
2) All projections should be of same height
3) Metals, which cannot support projections, cannot be welded satisfactorily.

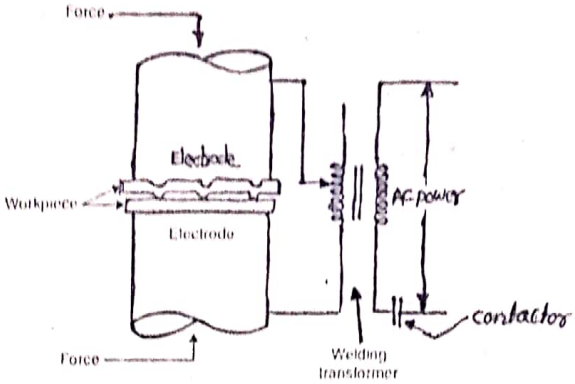


Fig. 22.8. Principle of Projection Welding

Applications:-

1) Small fastener, nut etc. can be welded to larger components.
2) It is used for welding of refrigerator condensers, joining of wire etc.
3) welding of stainless steel parts, titanium alloys, monel alloys etc

Butt WELDING

There are two types of butt welding :-

1) Resistance Butt welding or Upset butt welding
2) Flash butt welding.

1. UPSET BUTT WELDING :-

In this welding, the two pieces to be joined are held tightly together and current is applied, so that the heat is generated over the Entire area of a butting surfaces. pressure is applied through the heating period. this pressure is later on increased when the welding temperature has been reached.

The set up consists of welding pieces which act as electrode. One End is fixed and other End is movable through which pressure is applied. Both the rods (workpieces) are fixed in a frame and clamps through which Electric current is supplied when the welding temperature has been reached, the pressure is increased so that proper joint takes place. After that welding current is cutt off. Force is released when the welded joint has reached the desired temperature (normal temperature). After this workpiece are cenclamped

Applications :-

1) In wire drawing industries
2) For producing butt joints in tubes, pipes, rods etc.

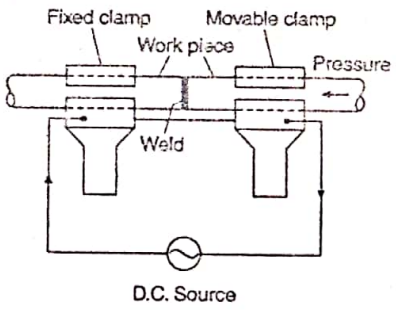


Fig. 7.6 Setup for Resistance Butt Welding

Flash Butt welding :-

Flash butt welding is similar to upset welding except the heat required for melting is obtained by means of an arc rather than the simple resistance heating.

In this welding, edges are brought together in a light contact. A high voltage starts a flashing action b/w the two surfaces. This flashing produces the welding heat. When sufficient heat is produced more pressure is applied so that sound joint takes place. After that welding current is cutt off and workpieces are unclamped.

Advantages :-

1. It consumes less welding current than upset butt weld process.
2. Flash welding offers strength factor upto 100%.
3. The process is cheap.
4. It is a faster process.

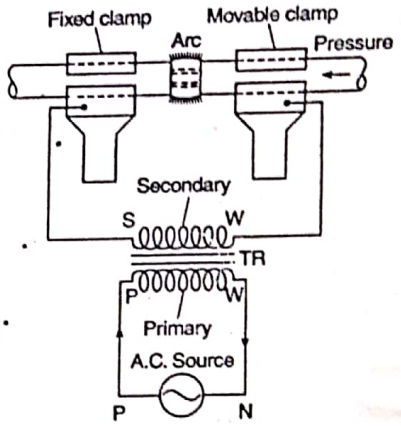


Fig. 7.5 Setup for Flash Welding

Disadvantages :-

1. Concentricity and straightness of workpieces during welding is difficult to maintain.
2. The shape of the workpieces should be similar which is not always possible.
3. Chance of fire hazards are there.
4. Flashes may cause eye trouble.

Applications :-

1. It is used for the welding of bars, rods and tubes.
2. It is used for the welding of saw blades into continuous loops, taps and reamers to alloy steel shanks.

PERCUSSION WELDING :-

In this resistance welding, welding heat is obtained from an arc produced by a rapid discharge of stored electrical energy. Pressure is applied percussively (rapidly) during and immediately following the electric discharge. The electrostatic capacitors are used to store the electrical energy.

It is a very fast method of welding. It consists of holding the parts at a small distance with their end faces opposite to each other; bringing them closer at a fast speed after switching on current, thus creating an arc between their end faces. just before they come in contact and completing the weld by applying rapid pressure.

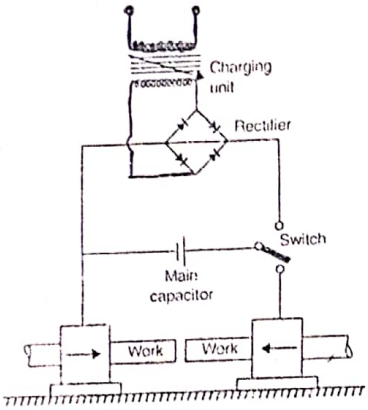


Fig. 22.11. Percussion Welding.

The use of this method is limited to very thin wires, with diameters ranging between 0.05 mm to 0.38 mm. It can also be used for joining wires of dissimilar metals such as copper to Nichrome and copper to stainless steel.

Advantages :-
i) Arc temperature is more as compared to flash butt welding.
ii) Strong joints are produced.
iii) In this process, there is no or very less upsetting.

Disadvantages :-
i) Process is limited to butt welds only.
ii) Equipment cost is quite high.
iii) the Equipment must provide with accurate holding fixtures and sensitive timing devices.

Application :-
i) It is used for welding stellite tip of tools, silver contact tips to copper, copper to Al etc.
(ii) It is used in telephone industries.
(iii) It is also used for welding fine wire leads to filament in lamps.