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RESISTANCE WELDING

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22.1 INTRODUCTION

(a) Definition

Resistance welding is a group of welding processes 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.

(b) Types of Resistance Welding

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

22.2 PRINCIPLE OF RESISTANCE WELDING

In resistance welding, a low voltage (typically 1 volt) and very high current (typically 15000 A) is passed through the joint for a very short time (typically .25 sec.). This high amperage heats the joint because heat generated in resistance welding can be expressed as :

$$H = I^2 RT$$

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

I = Electric current, Amp.

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

R = Resistance of the joint.

Resistance of the joint is composed of :

- ❖ Resistance of the electrodes (R_1).
- ❖ The contact resistance between the electrode and the workpiece (R_2).
- ❖ The contact resistance between the two workpieces (R_3).
- ❖ The resistance of the work piece plates (R_4).

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 .

22.3 HEAT BALANCE

One of the very important factor in the resistance welding process is the transfer of heat. The proper fusion can be obtained only if there is proper heat balance.

- ❖ If one plate is thicker than the other then use thicker electrode for thicker sheet and thin electrode for thin sheet because more heat flows if area of contact is more.
- ❖ If two plates have different thermal conductivity, it is necessary to provide an electrode contact area that is smaller near the higher conductivity metal.

22.4 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 in alloyed form is used for making electrodes.

- ❖ Copper cadmium is used for welding of Al and Mg.
- ❖ Copper chromium is used for welding of mild steel and low alloy steel.

22.5 ADVANTAGES OF RESISTANCE WELDING

- ❖ Very little skill is required to operate the resistance welding machine.
- ❖ High production rate so well suited for mass production.
- ❖ Heating of the workpiece is confined to a very small part, which results in less distortion.
- ❖ No filler rod and flux is needed.
- ❖ It is possible to weld dissimilar metals as well as metal plates of different thickness.
- ❖ Semi-automatic equipments are available.
- ❖ There are no consumables used in this process except for the electrical power and a relatively small electrode wear. As a result, it is a very economical process.

22.6 DISADVANTAGES OF RESISTANCE WELDING

- ❖ The initial cost of equipment is high.
- ❖ Certain resistance welding operations are limited only to lap joints.
- ❖ Skilled persons are needed for maintenance.
- ❖ Bigger job thicknesses cannot be welded.

22.7 APPLICATIONS OF RESISTANCE WELDING

- ❖ Joining sheets, bars and tubes.
- ❖ Making metal furniture.
- ❖ Making fuel tanks of cars, tractors etc.
- ❖ Making containers.
- ❖ Welding aircraft and automobile parts.

22.8 SPOT WELDING

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 generated because of the resistance to the flow of electric current through workpiece.

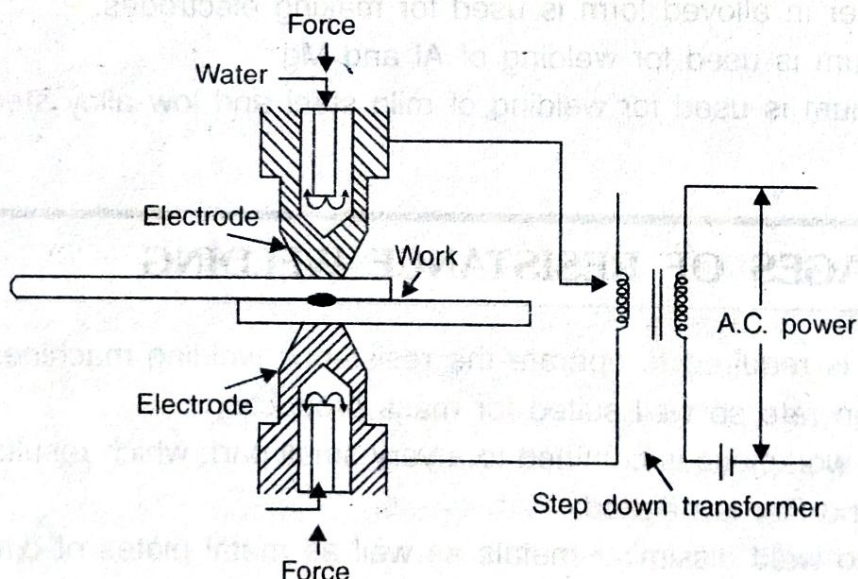


Fig. 22.1. Principle of Spot Welding.

Procedure

1. The job should be clean. It should be free from grease, dirt, paint, scale, oxide etc.
2. Clean the electrode tip surface. Very fine emery cloth may be used for routine cleaning.
3. Water is kept running through the electrodes in order to cool the weld and avoid the electrodes from getting overheated.

4. Proper welding current has been set on the current selector switch.
5. Proper time has been set on weld timer.
6. Electrodes are brought together against the overlapping workpieces and pressure is applied so that the surfaces of the two workpieces come in physical contact with each other.
7. Welding current is switched on for a definite period of time.
8. As the current passes, a small area where the workpieces are in contact is heated and spot weld takes place. The temperature of this weld zone is approx. 815°C to 930°C .
9. After the welding takes place, the welding current is cut off. Extra electrode force is then applied or the original force is prolonged. Hold until the metal cools down and gains strength.
10. After that, electrode pressure is released to remove the spot welded workpieces.

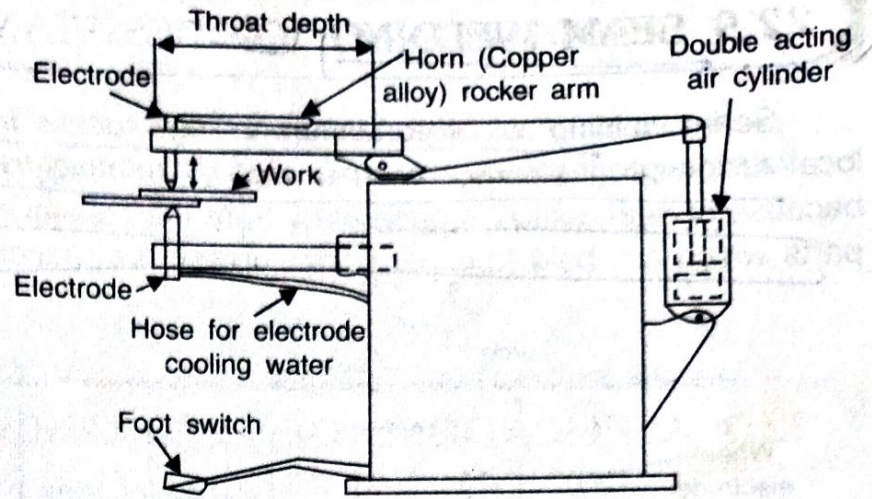


Fig. 22.2. Spot Welding Machine.

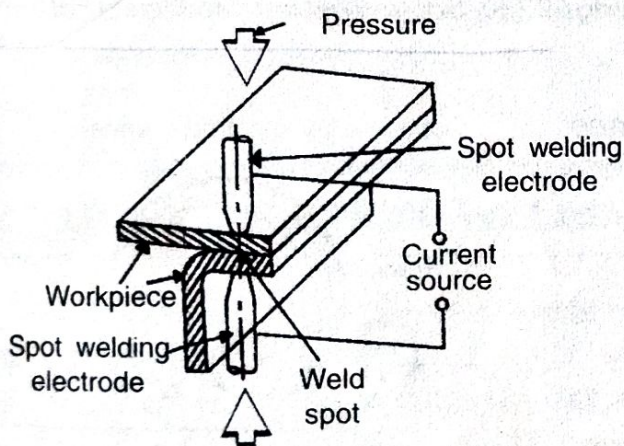


Fig. 22.3 (a). Direct Spot

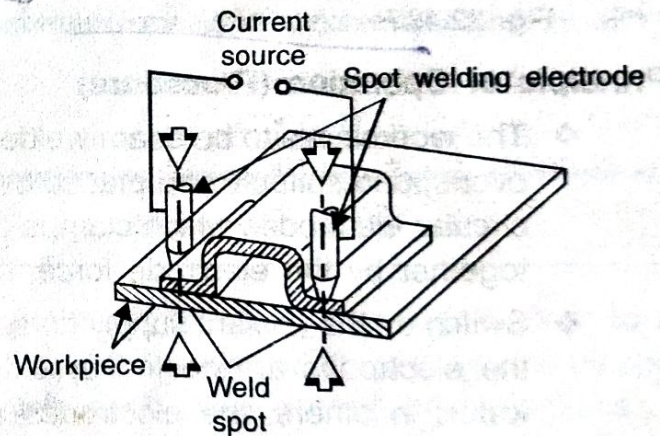


Fig. 22.3 (b). Indirect Spot Weld.

Advantages of Spot Welding :

- ❖ Low cost.
- ❖ Less skilled worker can perform this welding.
- ❖ Higher productivity.
- ❖ Operation may be made automatic or semiautomatic.
- ❖ No edge preparation is needed.

Application of Spot Welding :

- ❖ Welding of low carbon steels, high speed steels, stainless steels, Al, Cu, nickel, nickel alloys etc.
- ❖ In automobile and aircraft industries.
- ❖ Steel household furnitures.
- ❖ Containers.

22.9 SEAM WELDING

Seam welding is a resistance welding process in which overlapping sheets are joined by local fusion progressively along a 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.

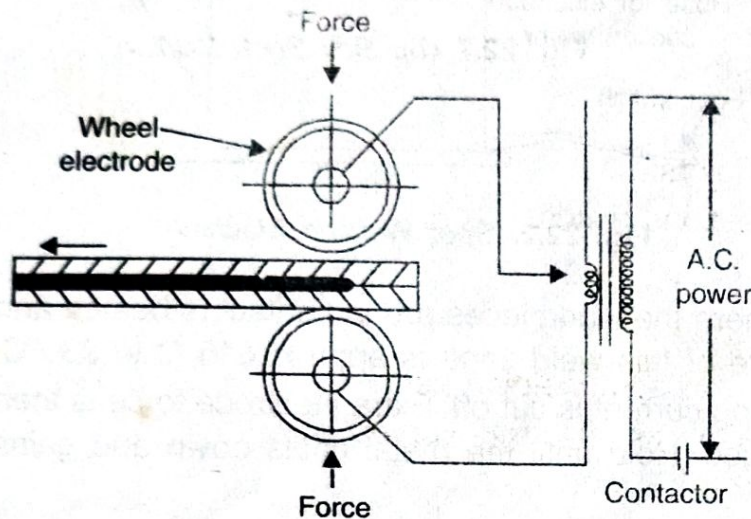


Fig. 22.4. Principle of Seam Welding.

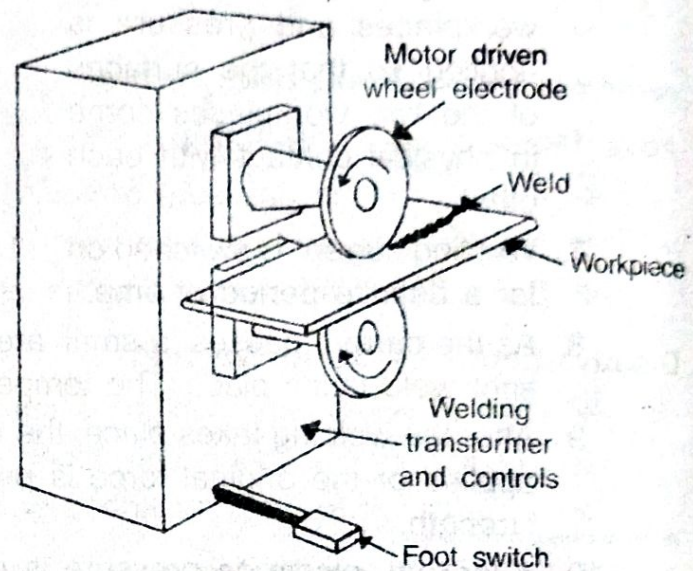


Fig. 22.5. Seam Welding Machine (Set up).

Principle of Operation (Procedure)

- ❖ The workpieces to be seam welded are cleaned, overlapped suitably and placed between the two circular electrodes which clamps the workpieces together by the electrode force.
- ❖ Switch on the coolant supply (in some machines, the electrodes are cooled by external spray of water; in others, the electrodes are cooled by refrigerant fluid that flow inside the working electrodes).
- ❖ Switch on the current supply. As the first current impulse is applied, the power driven circular electrodes are set in rotation and the workpieces steadily move forward.
- ❖ If the current is put off and on quickly, a continuous fusion zone made up of overlapping nuggets is obtained. It is known as stitch welding.
- ❖ If individual spot welds are obtained by constant and regularly timed interruption of the welding current, the process is known as roll (spot) welding.

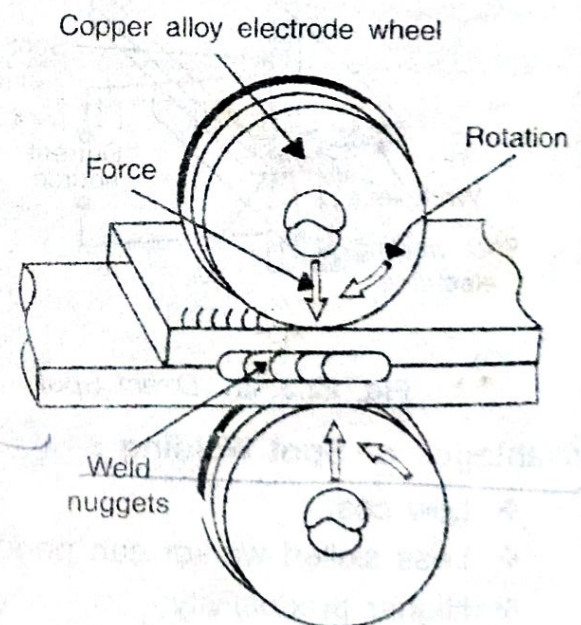


Fig. 22.6. Seam Welding.

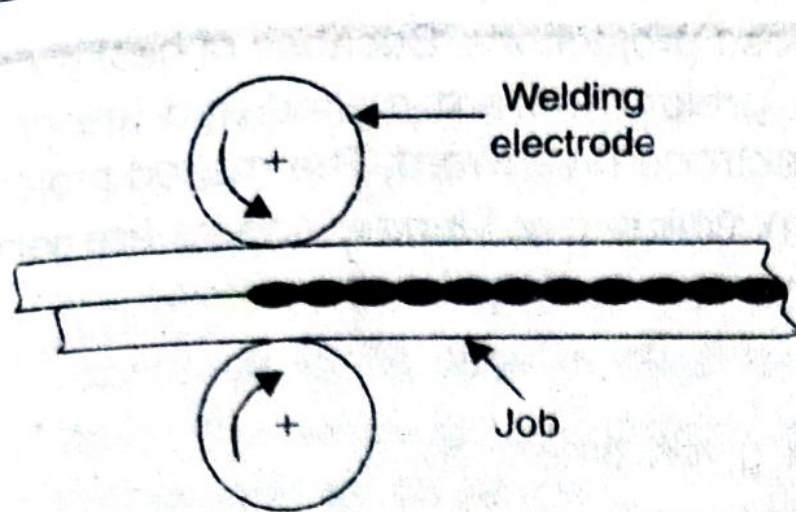


Fig. 22.7 (a). *Stitch Welding.*

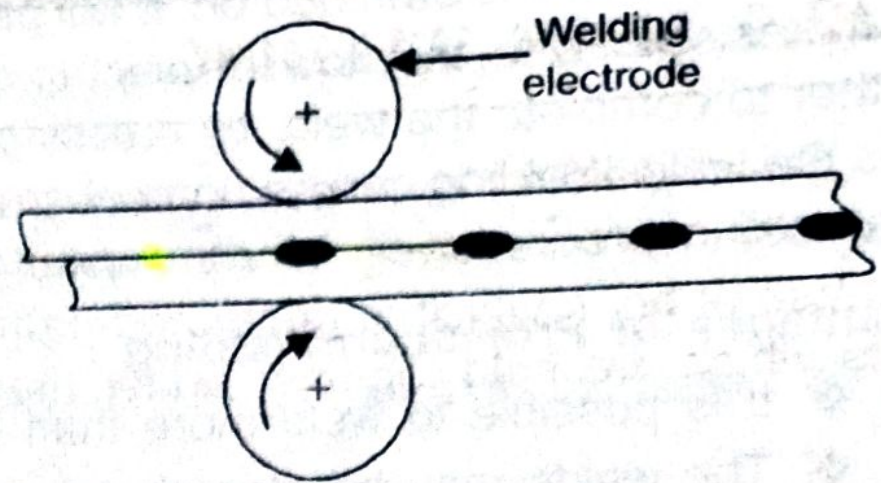


Fig. 22.7 (b). *Roll Spot Welding*

Advantages of Seam Welding :

- ❖ It can produce gas tight or liquid tight joints.
- ❖ Overlap can be less than spot or projections welds.
- ❖ Several parallel seams may be produced.

Disadvantages of Seam Welding :

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

Applications of Seam Welding :

- ❖ It is used for welding of stainless steels, aluminium and its alloys, nickel and its alloys, magnesium alloys etc.