

RESISTANCE WELDING

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INTRODUCTION

- ✘ **Resistance Welding** is a welding process, in which work pieces are welded due to a combination of a pressure applied to them and a localized heat generated by a high electric current flowing through the contact area of the weld.
- ✘ Developed in the early 1900's
- ✘ RW does not **requiring the following**:
 - + Consumable electrodes
 - + Shield gases
 - + Flux

Metals May Be Welded By Resistance Welding

- ✘ Low carbon steels - the widest application of Resistance Welding
- ✘ Aluminium alloys
- ✘ Medium carbon steels, high carbon steels and Alloy steels (may be welded, but the weld is brittle)

ADVANTAGES OF RESISTANCE WELDING

- × High welding rates
- × Low fumes
- × Cost effectiveness
- × Easy automation
- × No filler materials are required
- × Low distortions

DISADVANTAGES OF RESISTANCE WELDING

- ✗ High equipment cost;
- ✗ Low strength of discontinuous welds;
- ✗ Thickness of welded sheets is limited - up to 1/4" (6 mm);

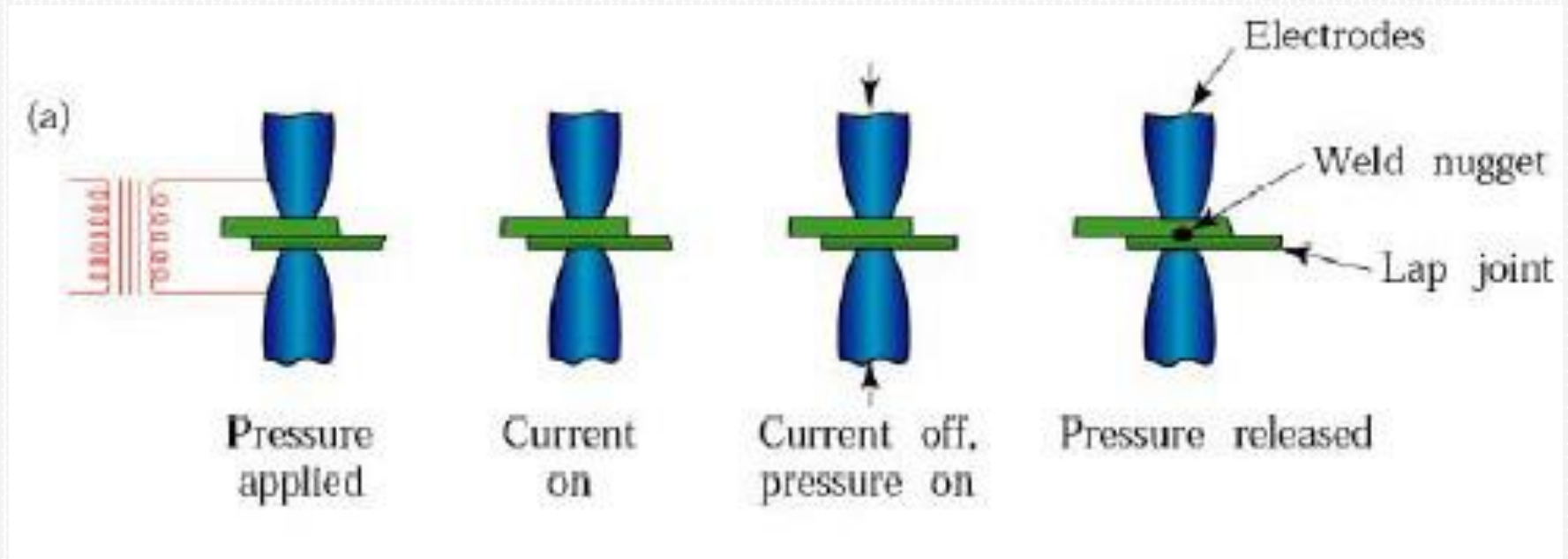
RESISTANCE WELDING

- ✗ SPOT WELDING
- ✗ SEAM WELDING
- ✗ PROJECTION WELDING
- ✗ STUD WELDING
- ✗ FLASH WELDING
- ✗ UPSET WELDING
- ✗ PERCUSSION WELDING
- ✗ HIGH FREQUENCY RESISTANCE WELDING

SPOT WELDING

- ✘ Spot weld is probably the most common type of resistance welding.
- ✘ The material to be joined between two electrode, pressure is applied, and the current is on.
- ✘ RSW uses the tips of two opposing solid cylindrical electrodes
- ✘ Pressure is applied to the lap joint until the current is turned off in order to obtain a strong weld

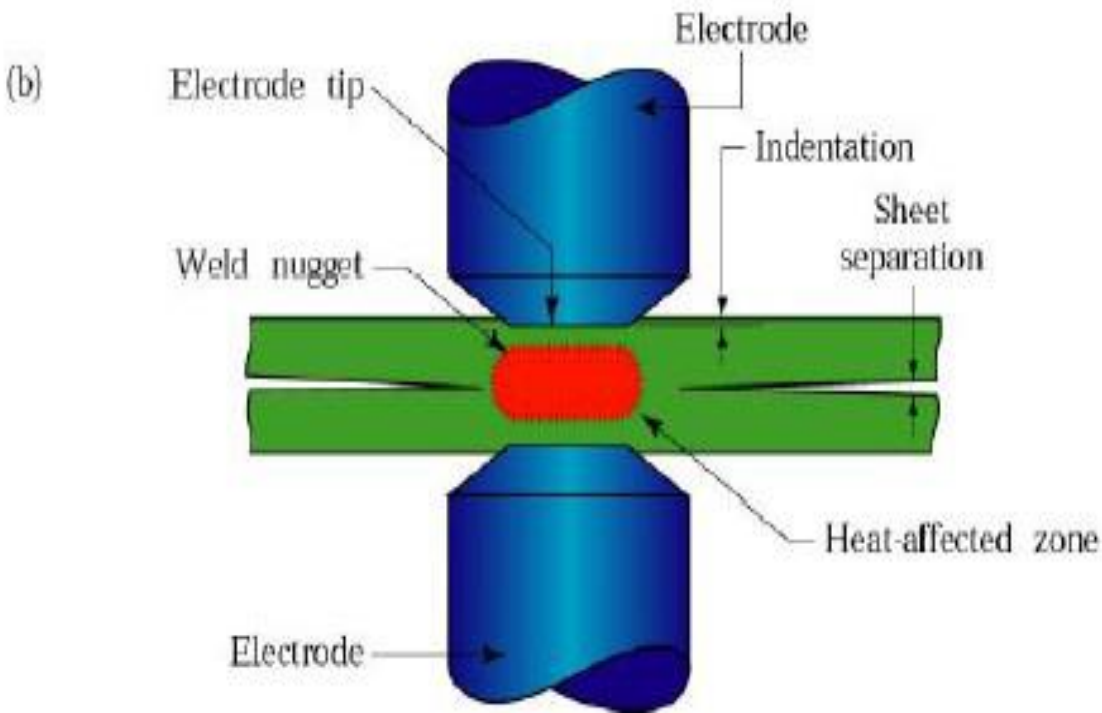
SPOT WELDING



Sequence in the resistance spot welding

SPOT WELDING

- RSW uses the tips of two opposing solid cylindrical electrodes
- Pressure is applied to the lap joint until the current is turned off in order to obtain a strong weld



Cross-section of a spot weld, showing the weld nugget and the indentation of the electrode on the sheet surfaces. This is one of the most commonly used processes in sheet-metal fabrication and in automotive body assembly

THE RULE OF SPOT WELDING

- ✘ Spot welding may be done on material as low as 0,0001” in thickness
- ✘ And in joint having member as heavy as one inch.
- ✘ The bulk of resistance welding is confined to metals that are less than $\frac{1}{4}$ “ in thickness.

SPOT WELDING TYPES

- ✘ Single spot Welding Machine
- ✘ Multi-Spot Welders

SINGLE SPOT WELDING



- × Simple Machine
- × Most common
- × Has a two long each holding a single electrode with the upper arm providing the moving action

Single spot welding

CONDITIONS OF SPOT WELDING

A Condition

- ✘ Smaller electrode - On High conductivity metals
- ✘ Larger electrode - On Low conductivity metals

B condition

- ✘ Using a high thermal resistance electrode - On High conductivity metals
- ✘ Using a high thermal resistance electrode - Tungsten and molybdenum

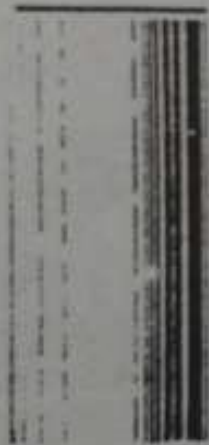
C condition

- ✘ Increase the thickness of the higher conductivity metals - Better secure heat balance

ELECTRODE



DOMF



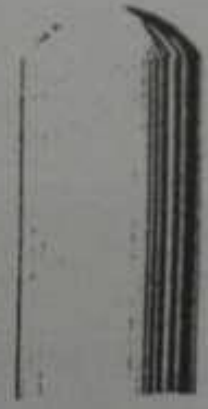
FLAT



ECCENTRIC



TRUNCATED



RADIIS

Fig. 5-6. Types of electrode faces.

PRIMARY FUNCTIONS OF ELECTRODE

- ✘ Conduct the required heat to the weld zone
- ✘ Transmit the necessary force to the weld area
- ✘ Help the dissipate the heat from the weld zone
- ✘ Most electrodes for spot welding are made of low resistance copper alloy

MULTIPLE SPOT WELDING

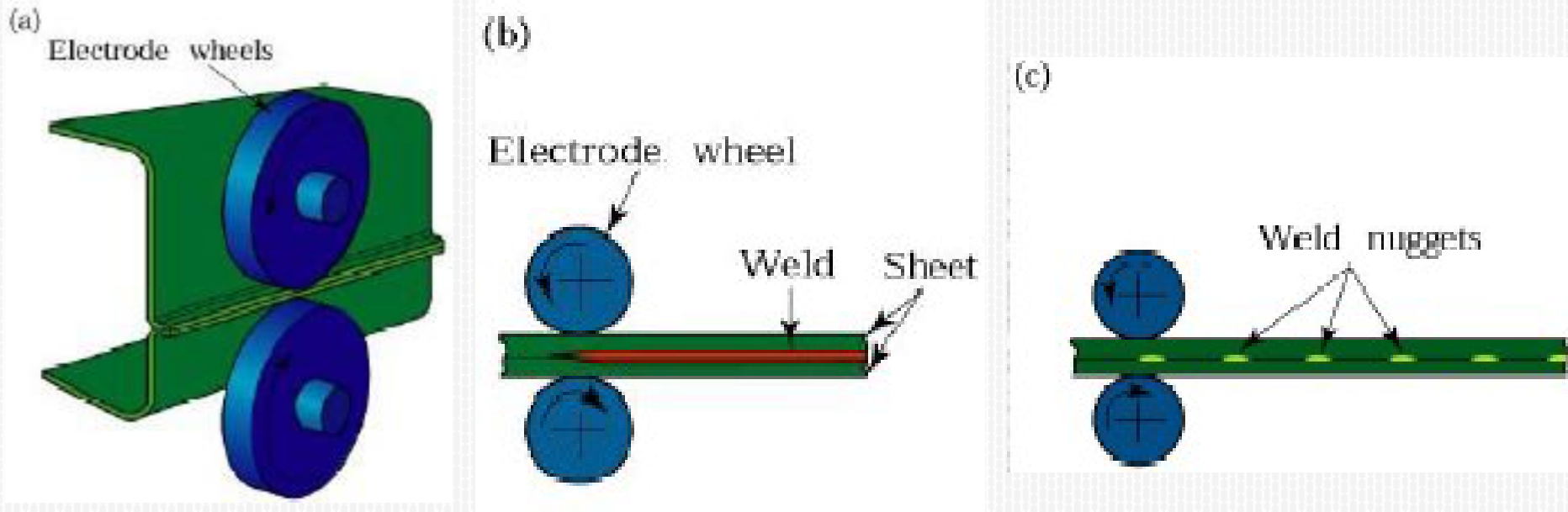


Have a series of hydraulically or air operated welding guns mounted in a framework or header but using a common mandrel or bar for the lower electrode.

SEAM WELDING

- ✘ RSEM is modification of spot welding wherein the electrodes are replaced by rotating wheels or rollers
- ✘ The electrically conducting rollers produce a spot weld
- ✘ RSEM can produce a continuous seam & joint that is liquid and gas tight

SEAM WELDING



- (a) Seam-Welding Process in which rotating rolls act as electrode
- (b) Overlapping spots in a seam weld.
- (c) Roll spot weld

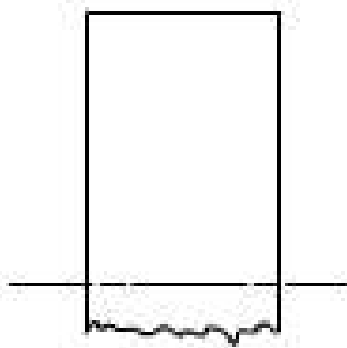
SEAM WELDING



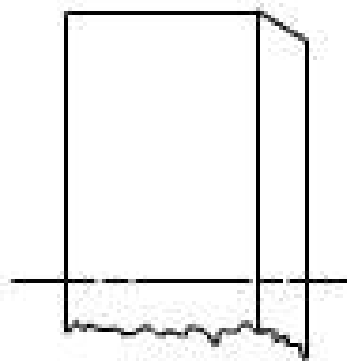
Seam Welding is high speed and clean process, which is used when continuous tight weld is required (fuel tanks, drums, domestic radiators).

ELECTRODES

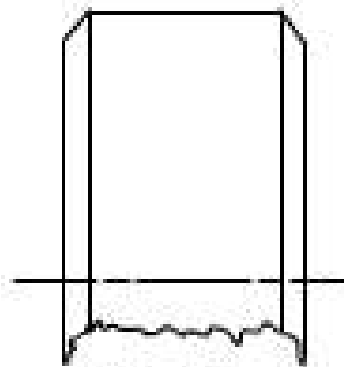
- ✘ Electrodes for seam welders are disk shaped rollers with different face contours. The face of the rollers may be straight, beveled, or concave.
- ✘ The straight and double beveled edge is used where there sufficient clearance on both side of the work.



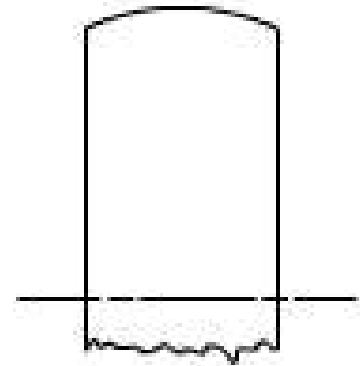
Flat
Electrode



Single
Bevel



Double
Bevel



Curved
Faced

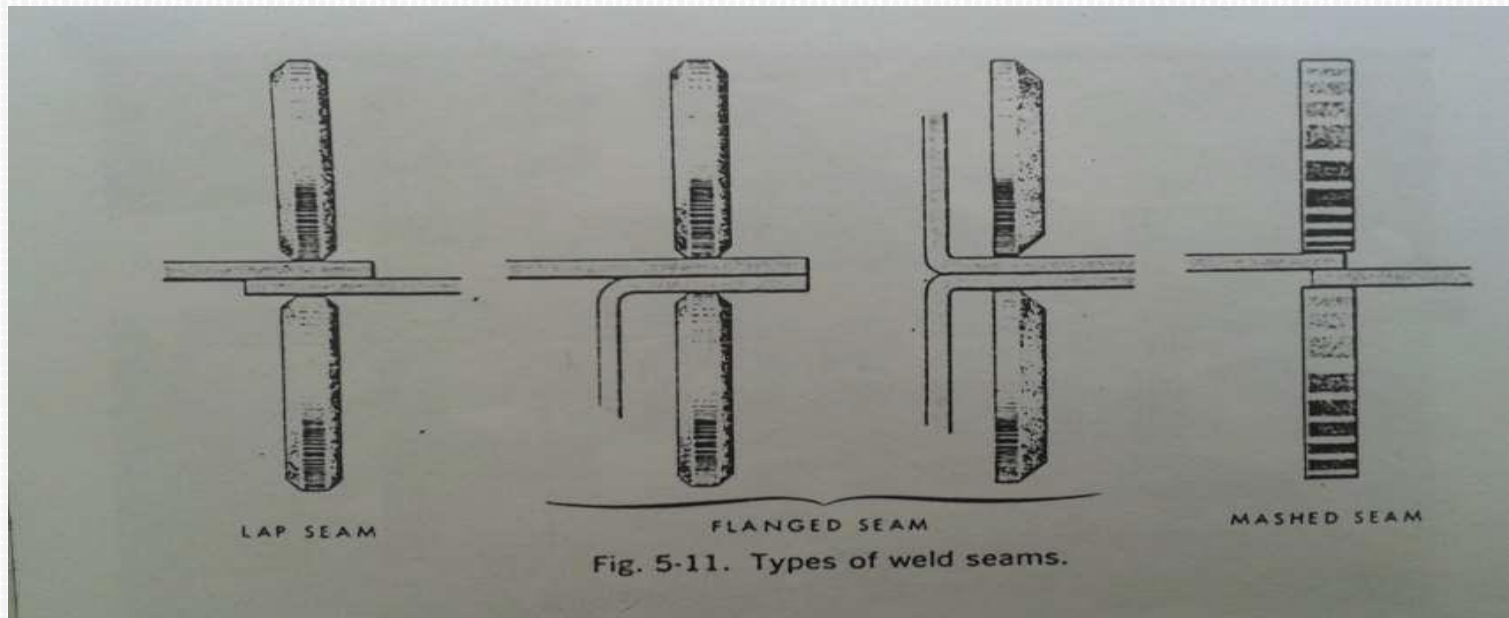
CURRENT

The current Value for seam welding is contingent on several variables:

- ✗ Type of materials
- ✗ Welding speed
- ✗ Thickness of the joint
- ✗ Used of water cooling

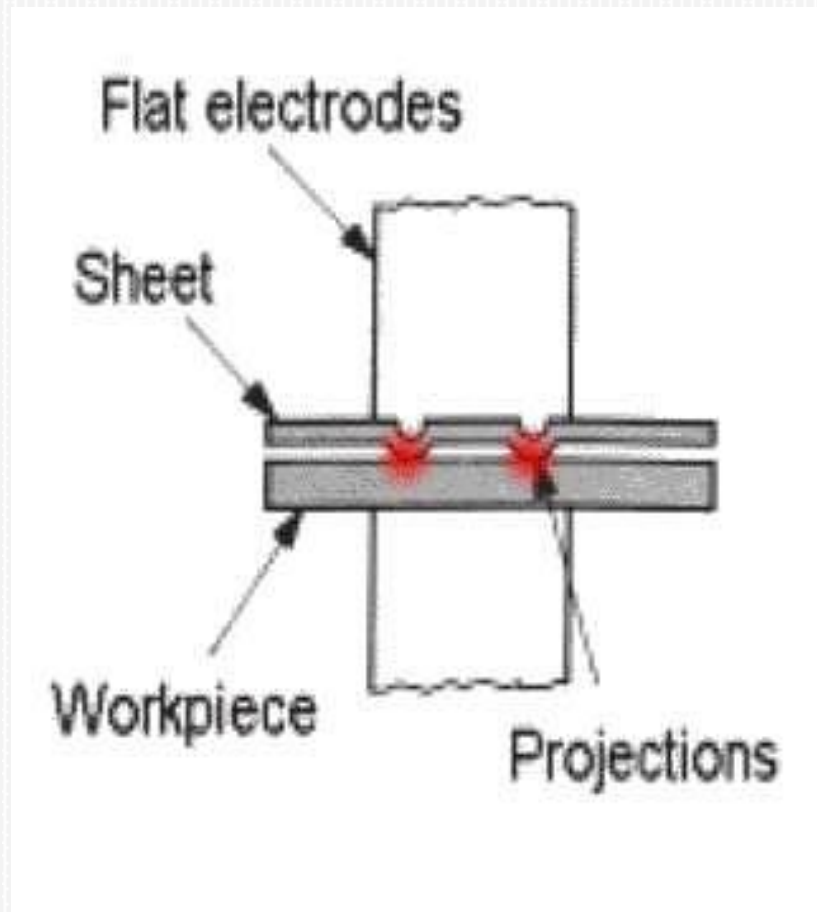
TYPES OF WELD SEAMS

- ✘ **Mashed Seam** - Join light gauge sheet metal with thickness less than 1/16 ”
- ✘ **Flanged Seam** - The Flange Joint Is Frequently Employed In Fastening Tops And Bottoms To containers.
- ✘ **Lap Seam** - The width of the lap for a strong quality weld is usually held at about 1 ½ times the thickness of the sheets.



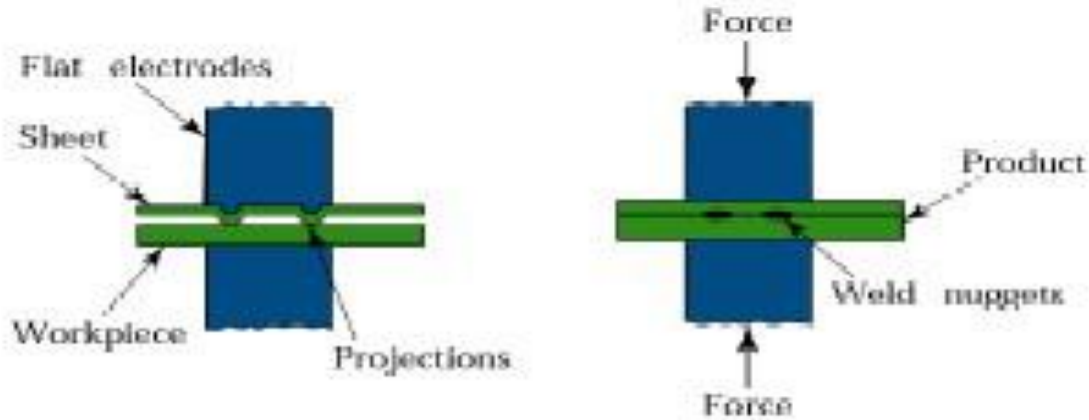
PROJECTION WELDING

- ✗ RPW is developed by introducing high electrical resistance at a joint by embossing one or more projections on the surface to be welded.
- ✗ Weld nuggets are similar to spot welding.

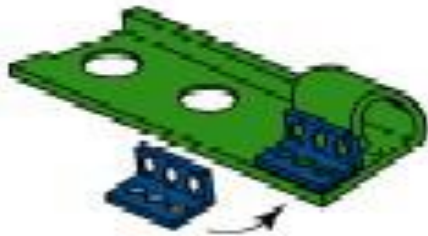


PROJECTION WELDING

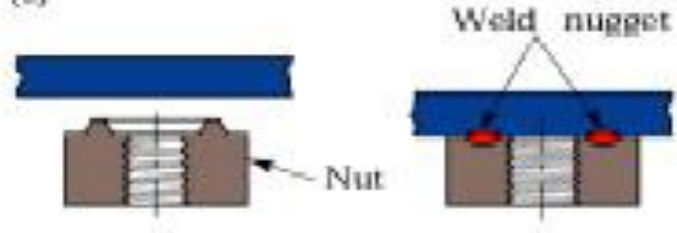
(a)



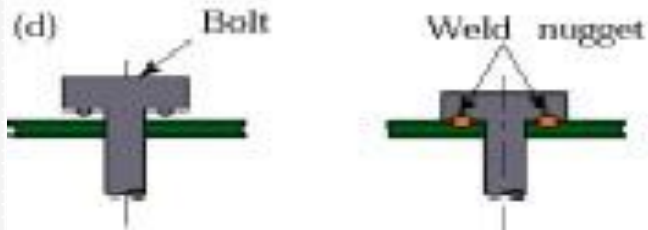
(b)



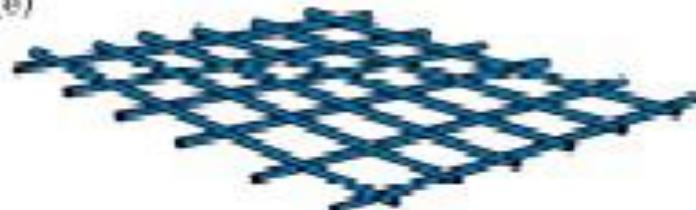
(c)



(d)

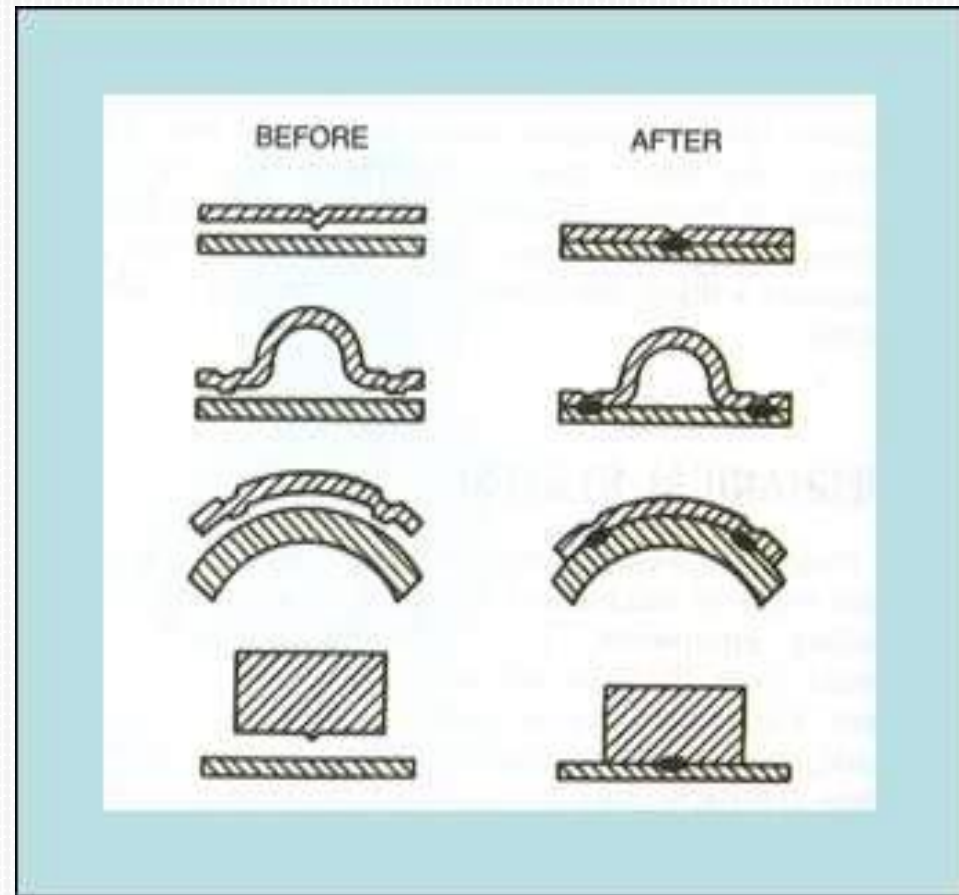


(e)



PROJECTION WELDING

- The electrodes exert pressure to compress the projections.
- Nuts and bolts can be welded to sheet and plate by this process.
- Metal baskets, oven grills, and shopping carts can be made by RPW.



ELECTRODE

- ✗ Flat Area - Electrode is flat and large enough
- ✗ Irregular Area - Electrode is Shaped

METALS ADAPTABLE FOR PROJECTION WELDING

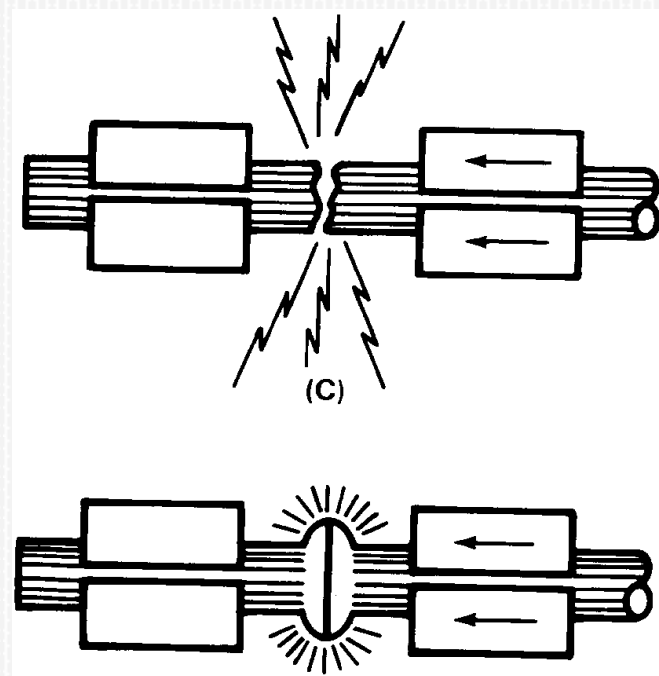
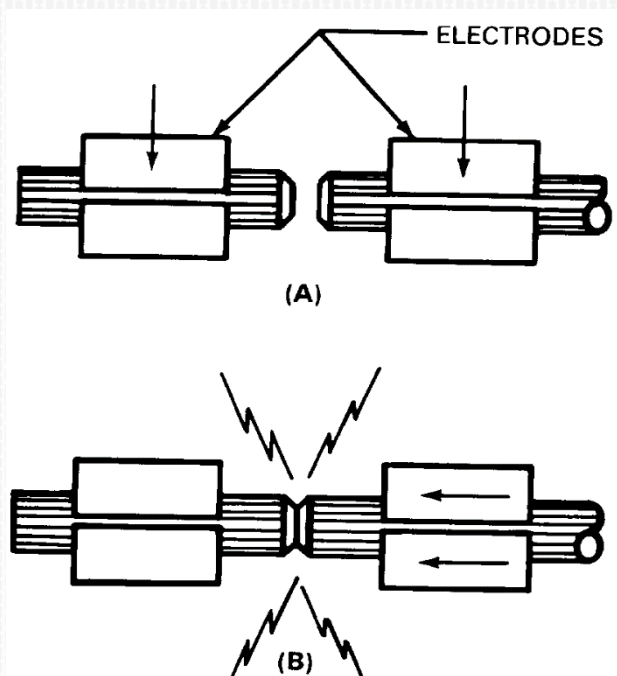
- ✘ Not all metals can be projection welded.
- ✘ Brass and copper as a rule do not lend themselves to projection welding because the projections collapse too easily under pressure.
- ✘ Aluminium projection welding is generally limited to extruded parts.
- ✘ Galvanized sheet steel, tin plate, and stainless steel as well as most other thin gage steel can be successfully projection welded.

ADVANTAGES

- ✘ The Advantage of projection welding is that electrode life is increased because larger contact surfaces are used.
- ✘ A very common use of projection welding is the use of special nuts that have projections on the portion of the part to be welded to the assembly.

FLASH WELDING

- ✘ Heat is generated from the arc as the ends of the two members contact
- ✘ An axial force is applied at a controlled rate
- ✘ Weld is formed in plastic deformation



BASIC STEPS IN FLASH WELDING

- (1) Position the parts in the machine.
 - (2) Clamp the parts in the dies (electrodes).
 - (3) Apply the flashing voltage.
 - (4) Start platen motion to cause flashing.
 - (5) Flash the normal voltage.
 - (6) Terminate flashing.
 - (7) Upset the weld zone.
 - (8) Unclamp the weldment.
 - (9) Return the platen and unload.
- ✘ The above slide illustrates these basic steps. Additional steps such as preheat, dual voltage flashing, post-heat, and trimming of the flash may be added as the application dictates.

ADVANTAGES

- ✘ Flexible cross sectioned shapes
- ✘ Flexible positioning for similar cross section parts
- ✘ Impurities can be removed during upset acts
- ✘ Faying surface preparation is not critical except for large parts
- ✘ Can weld rings of various cross sections
- ✘ Narrower heat-affected zones than those of upset welds

LIMITATIONS

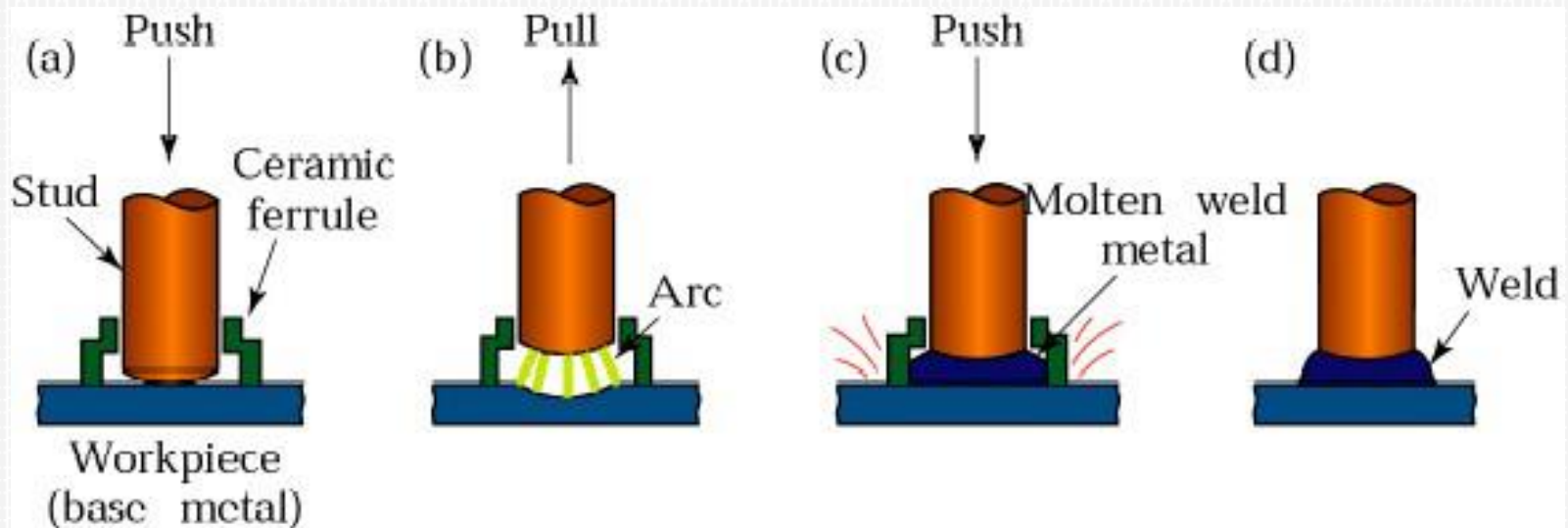
- ✘ Produce unbalance on three-phase primary power lines
- ✘ The ejected molten metal particles present a fire hazard
- ✘ Require special equipment for removal of flash metal
- ✘ Difficult alignment for work pieces with small cross sections
- ✘ Require almost identical cross section parts

APPLICATIONS

- ✗ Wheel Truck Rims
- ✗ Ball Bearing Raceways
- ✗ Bar Welding
- ✗ Strip Welding During Continuous Processing
- ✗ Pipelines

STUD WELDING

- ✗ Small part or a threaded rod or hanger serves as a electrode
- ✗ Also called as Stud arc welding
- ✗ Prevent oxidation to concentrate the heat generation
- ✗ Portable stud-welding is also available



The sequence of operation in stud welding, which is used for welding bars threaded rods and various fasteners onto metal plates

UPSET WELDING

- ✗ Is refer to as butt welding. In this process the metals to be welded are brought into contact under pressure an electric current is passed through them, and the edges are softened and fused together

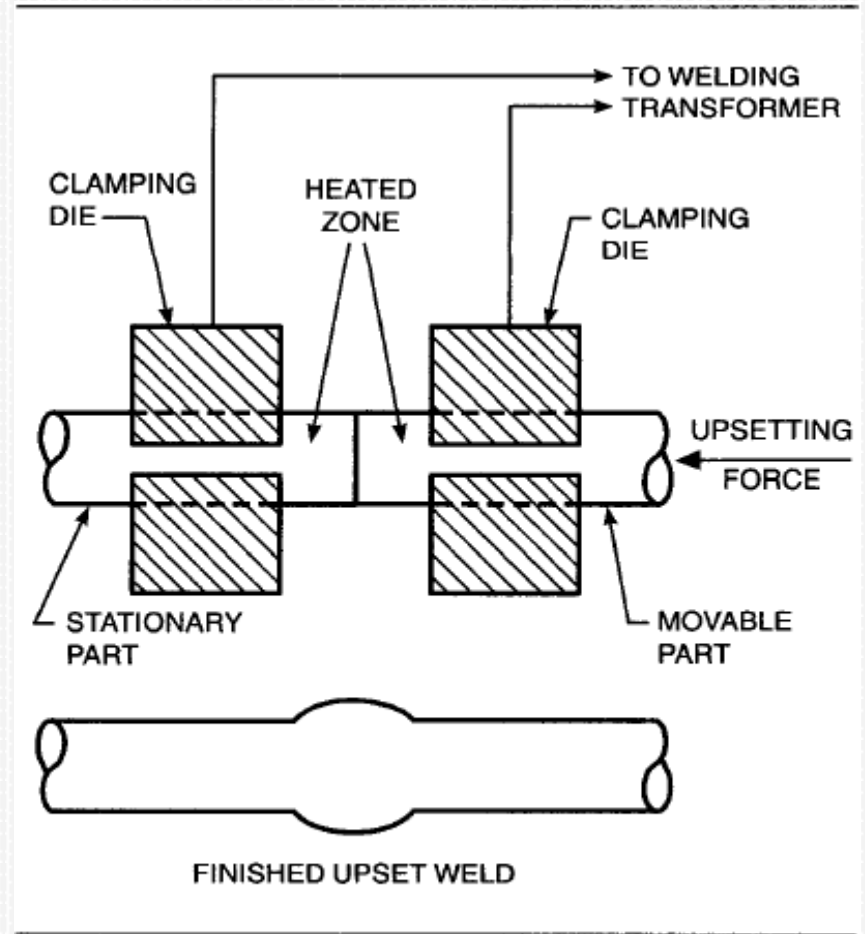


Figure U-4—General Arrangement for Upset Welding of Bars, Rods, and Pipes

UPSET WELDING

- ✘ Upset welding (UW) is a resistance welding process that produces coalescence over the entire area of faying surfaces, or progressively along a butt joint, by the heat obtained from the resistance to the flow of welding current through the area where those surfaces are in contact. Pressure is used to complete the weld.
- ✘ With this process, welding is essentially done in the solid state. The metal at the joint is resistance heated to a temperature where recrystallization can rapidly take place across the faying surfaces. A force is applied to the joint to bring the faying surfaces into intimate contact and then upset the metal. Upset hastens recrystallization at the interface and, at the same time, some metal is forced outward from this location. This tends to purge the joint of oxidized metal.

UPSET VELOCITY

- ✘ Higher Velocity Helps extrude Centre line Oxides Out
 1. Oxides Are Present Because Melting Points are high
 2. Oxides Tend to Solidify or Harden and Get entrapped at the Interface
 3. Rapid Velocity Helps Get Them Moving

ADVANTAGE & DISADVANTAGE

Advantages

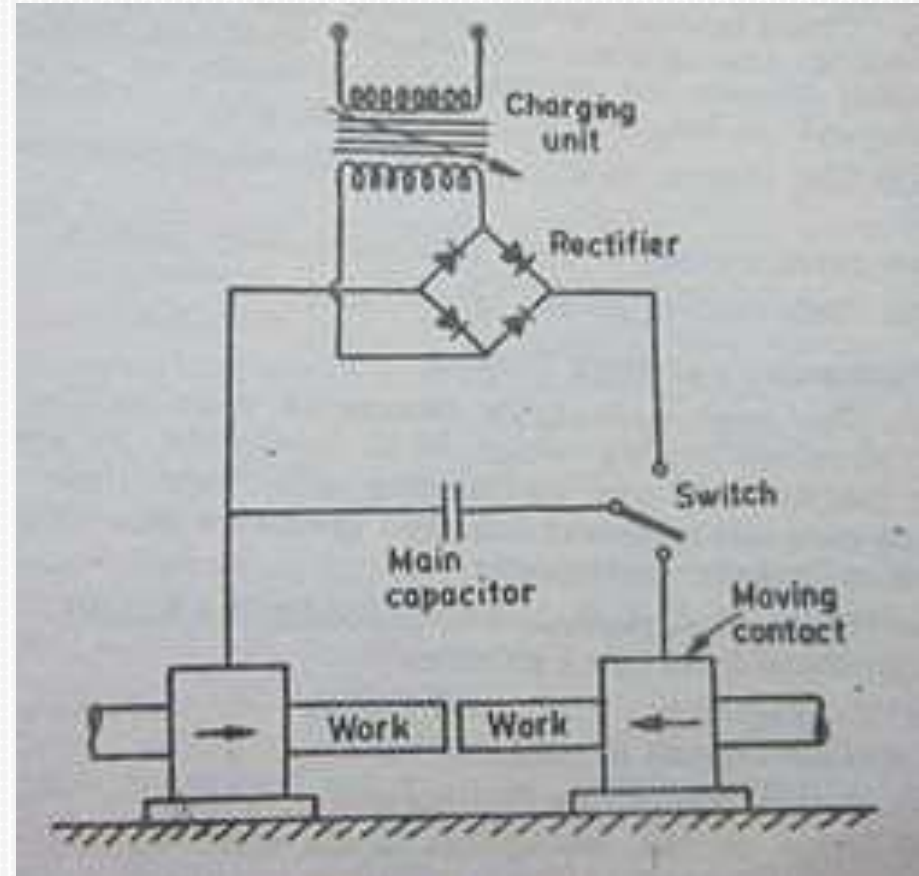
- Keeps Heat at Centre Line During Upset
- Keeps Oxides Fluid
- Aids In Forcing Oxides Out

Disadvantages

- Excess Heating Can Produce Excess Upset
- More HAZ Fiber Turn Up

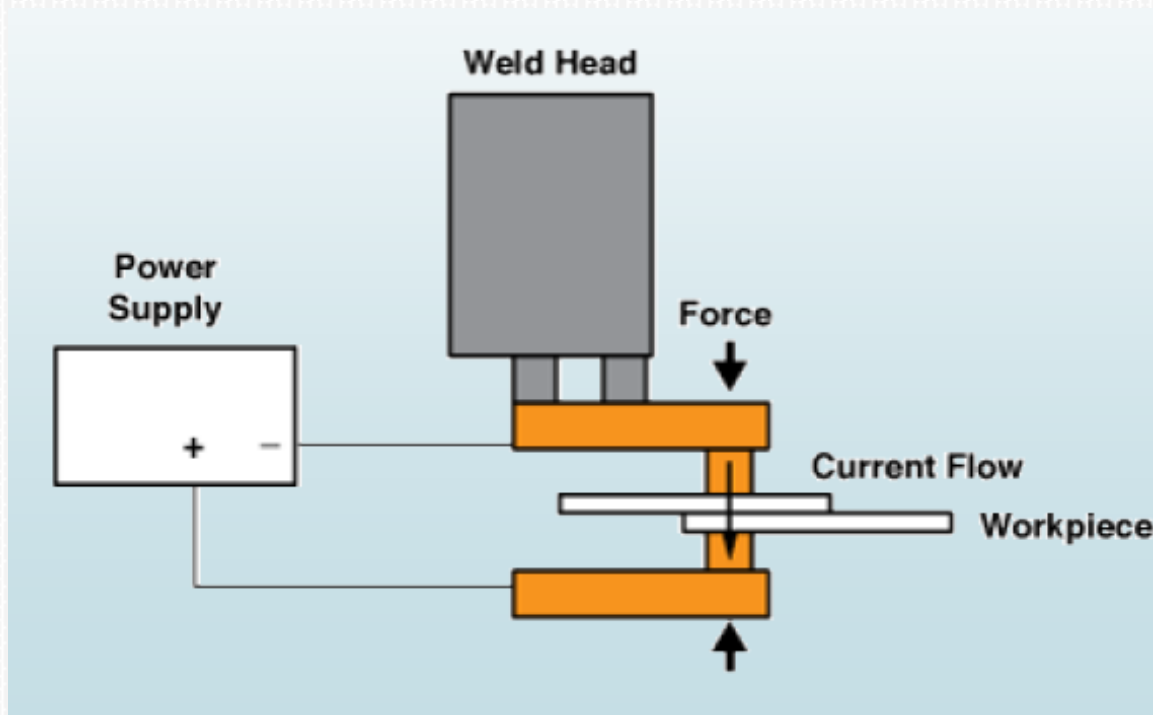
PERCUSSION WELDING (PEW)

- ✘ Percussion welding is a process in which heat is produced from an arc that is generated by the rapid discharge of electrical energy between the workpiece and followed immediately by an impacting force which weld the pieces together.



PRINCIPLE OF OPERATION

- ✘ The arc is started by bringing the workpieces into light contact with each other. On some equipment the arc started by superimposing an auxiliary high frequency AC voltage on a low-voltage direct current.



ADVANTAGES AND DISADVANTAGES

ADVANTAGES

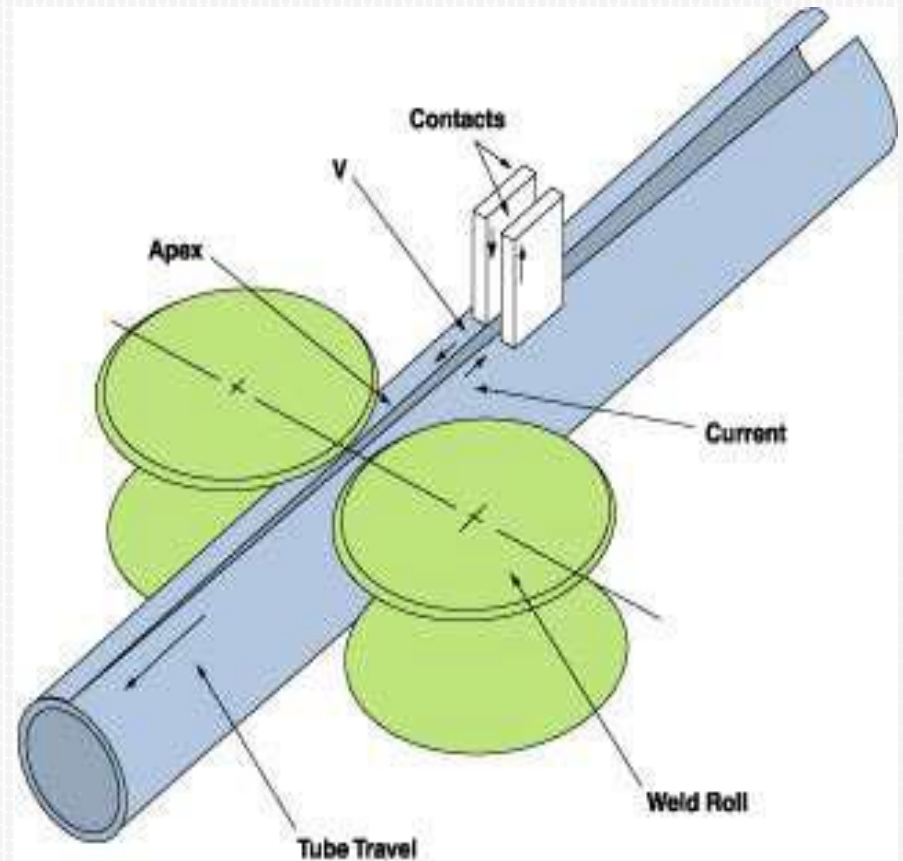
- ❖ The percussion process is that heat penetration is shallow around 0.010 inch
- ❖ The process possible to weld stellite tips to bronze or stainless steel valve stems or an aluminium fixture to stainless steel or cooper without affecting their metallurgical properties.
- ❖ The process is often used in welding wire, bar, and tubing

DISADVANTAGES

- ❖ The process has somewhat restricted applications
- ❖ The process generally confined to butt welded
- ❖ If used on larger section the arc fails to distribute itself evenly over the entire surface and un-welded spots result in the joint

HIGH FREQUENCY RESISTANCE WELDING (HFRW)

- ✘ HFRW employs a high frequency current to generate the required heat for bonding edges of metal



PRINCIPLE OF OPERATION

- ✘ The process is based on the use of current that reverses at a high rate- 450,000 Hertz (cycles) as compared with the line frequency of 60 Hertz (cycles).
- ✘ Power supply for HFRW consist of a 60 to 560 kw radio frequency transmitter. The transmitter equipped with a rectifier.

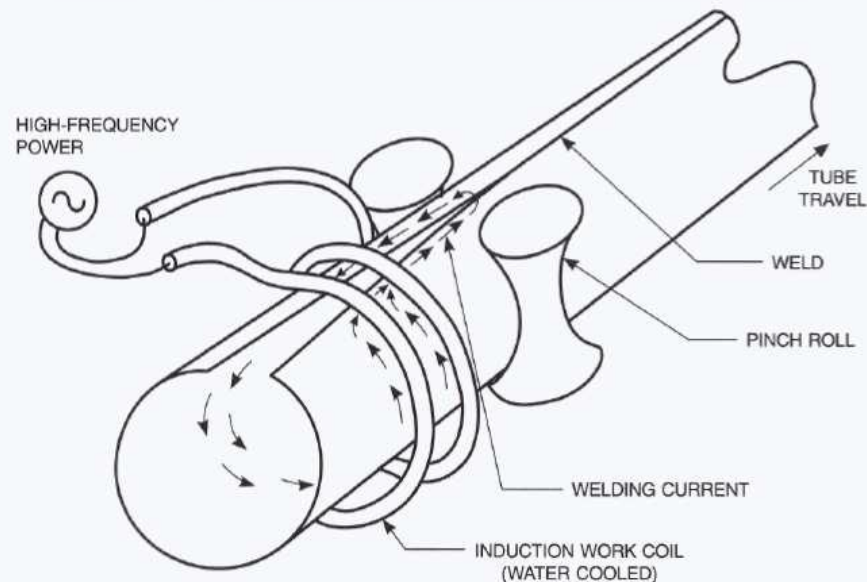


Figure I-7—Induction Upset Welding of Tube Showing Induction Work Coil

APPLICATION

- ✘ The process has wide application in fabricating tubes, pipes, structural shapes, heat exchanger, cable sheathing, and other parts where high speed is required
- ✘ The process can welded ferrous and nonferrous materials in thicknesses ranging from 0.004 inch to ½ inch in thickness.

Thank
you

