SOLID STATE WELDING
(AUTOGENOUS WELDING)

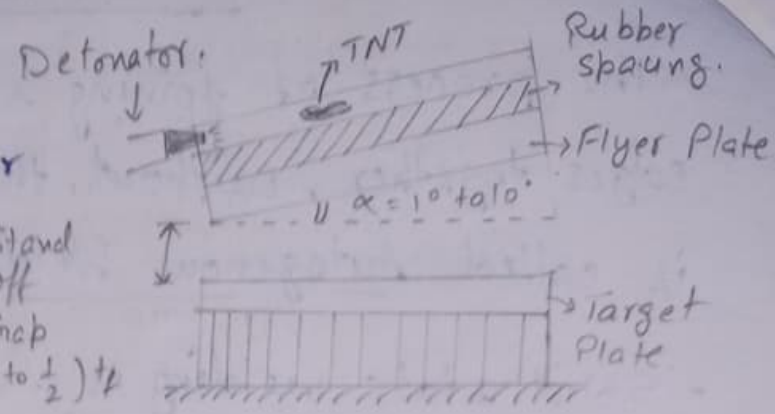
- The process of joining similar metals by melting the edges together, without the addition of filler metal, is called Autogenous Welding.

- Solid state welding is a welding process, in which two work pieces are joined under a pressure providing an intimate contact b/w them and at a temp. essentially below the melting point of the parent material.
  - Weld (bonding) is free from microstructure defects.
  - Mechanical properties of the weld are similar to those of the parent metals.
  - No consumable materials (filler material, fluxes, shielding gases) are required.
  - Strongest weld.
  - Dissimilar metals may be joined.
  - Metals can be welded to non-metals.
  - Expensive equipment.

Various Solid-state welding processes are.
- Explosive Welding.
- Ultrasonic Welding.
- Friction Welding.
- Forge Welding.
- Diffusion Welding.

(12) EXPLOSION WELDING:

In explosion welding, detonation of explosives are used to accelerate a part to move towards the other plate at a fast rate, so that the impact creates the joint.



- Two w/p which are to be welded; one will be fixed and other is having linear moment
  Target plate — flyer plate.
- Low detonation velocity (2.4 to 3.6 km/s) explosives is spread on the flyer plate. Using this, flyer plate can be forced on the target plate with a maximum impact force.
- At the contact surface due to plastic or permanent deformation, there is a possibility of formation of joint.
- After welding, a separate layer is formed at the interface of the w/p called CLAD.
- Flyer plate is maintained at some distance from target plate to gain the momentum.
- Flyer plate is making some angle of inclination 10-15° avoid bending stress during welding.
- Used in large and open areas for defence purpose.
- By this process very large and heavy plates can be welded very strongly and easily.

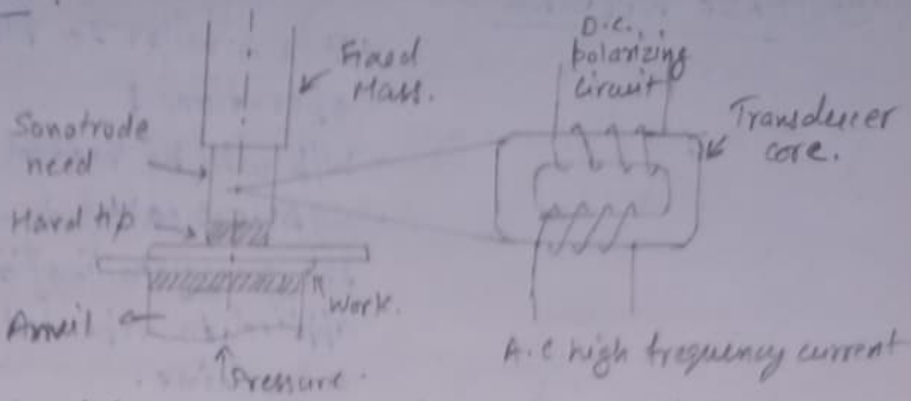
Application:
- CLADDING of the objects in ship building.
- Joing of dis-similar material. [Titanium to aluminium] [Steel to aluminium]
- Joining of tubes to tube sheet of heat exchangers.

Explosives: TNT (trinitrotoluene), Ammonium nitrate (NH_4NO_2), Dynamite.

ULTRASONIC WELDING:

Thickness < 1-2 mm. (foil, strips)

Frequency → 10 KHz to 75 KHz.

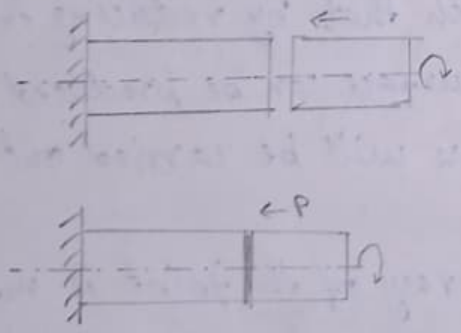


- Ultrasonic Welding will join similar or dissimilar metals by applying a high frequency vibratory energy to overlapping metal plates at the area to be joined.
- No flux, electric current, filler metal or heat is applied.
- The oscillating shear stress causes plastic deformation at the interface of the two component, breaking up oxide films and contaminants and thus allowing good contact and producing a strong solid-state bond.

Applications

- Used in fabrication of diodes & transducers in electronic industry.
- fabrication of keys in automobile industry.
- Welding aluminium wires and sheets (foil).
- Used in bimetallic junction.

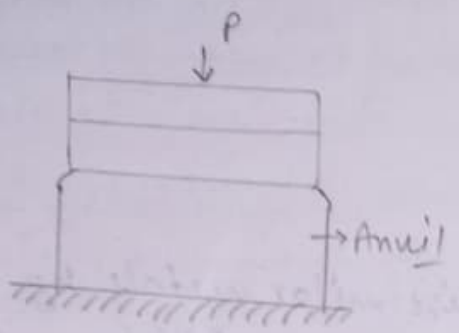
(3) FRICTION WELDING:



- Used for joining of the objects end to end to produce a solid joint.
- Two w/p's which are to be welded one will be fixed & other is having rotational & linear moment.
- By making the contact of rotating object with fixed object, due to friction heat will be generated.
- After getting sufficient amount of heat by stopping the rotation, axial pressure can be applied to produce the co-axial joint b/w the two ends.
- generally used for Axis-symmetric objects only.

Applications: Drill bit, Axle & Hub - Pipes & Valves.

(4) FORGE WELDING :

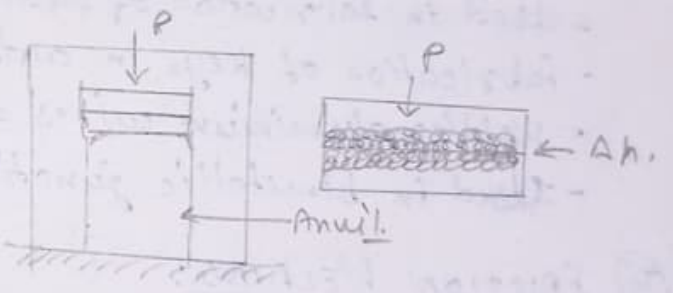


- It is similar to blacksmithy forging operation.
- W/p will be heated inside the furnace.
- w/p is heated to a temp. slightly below the recrystallisation temp. and force is applied in repeated blows manually or by a machine.
- For low carbon steel, flux is needed to prevent oxide formation.
- Flux used is borax or silica sand.
- Accuracy & strength of the joint depends on the skilled level of the operator.
- The forge welding operation is very slow and includes lots of labour and skill.

Application :

Generally used in village level agriculture application.

(5) DIFFUSION WELDING :



- Two w/p are in contact with each other.
- By applying heat & press. simultaneously at a slow rate at the ~~mon~~ contact of the two w/p.
- Grains will be diffused with each other such that by reducing the voids b/w two w/p's. A single bonded surface can be produced.
- To minimize oxide formation, this process will be carried out under vacuum.
- It is a slow rate of process & the accuracy of the joint is more.

Application :

- Fabrication of composite Laminates.
- Joining of metals to ceramic.