ELECTRO HYDRAULIC AND ELECTROMAGNETIC FORMING

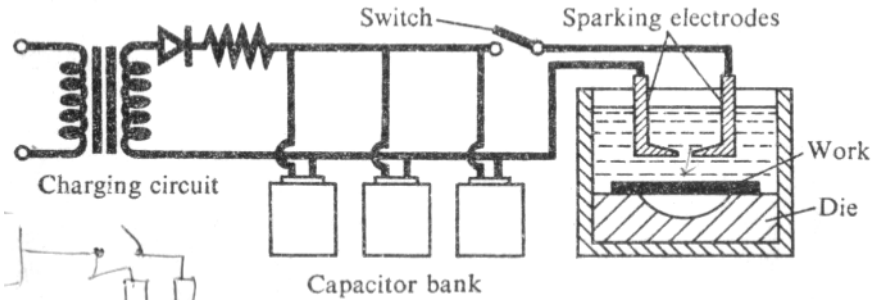

Fig. Electro Hydraulic Forming

Principle

A sudden electrical discharge in the form of sparks is produced between electrodes and this discharge produces a shock wave in the water medium. This shock wave deforms the work plate and collapses it into the die.

The characteristics of this process are similar to those of explosive forming. The major difference, however, is that a chemical explosive is replaced by a capacitor bank, which stores the electrical energy.

The capacitor is charged through a charging circuit. When the switch is closed, a spark is produced between electrodes and a shock wave or pressure pulse is created. The energy released is much lesser than that released in explosive forming.

Process Characteristics:

i) Stand off distance: It must be optimum.
ii) Capacitor used: The energy of the pressure pulse depends on the size of capacitor.
iii) Transfer medium: Usually water is used.
iv) Vacuum: the die cavity must be evacuated to prevent adiabatic heating of the work due to a sudden compression of air.
v) Material properties with regard to the application of high rates of strain.

Advantages:

i) Better control of the pressure pulse as source of energy is electrical- which can be easily controlled.
ii) Safer in handling than the explosive materials.
iii) More suitable if the work size is small to medium.
iv) Thin plates can be formed with smaller amounts of energy.
v) The process does not depend on the electrical properties of the work material.

Limitations:

i) Suitable only for smaller works
ii) Need for vacuum makes the equipment more complicated.

Applications:

They include smaller radar dish, cone and other shapes in thinner and small works.

(III) Electromagnetic forming

The electrical energy stored in a capacitor bank is used to produce opposing magnetic fields around a tubular work piece, surrounded by current carrying coils. The coil is firmly held and hence the work piece collapses into the die cavity due to magnetic repelling force, thus assuming die shape.

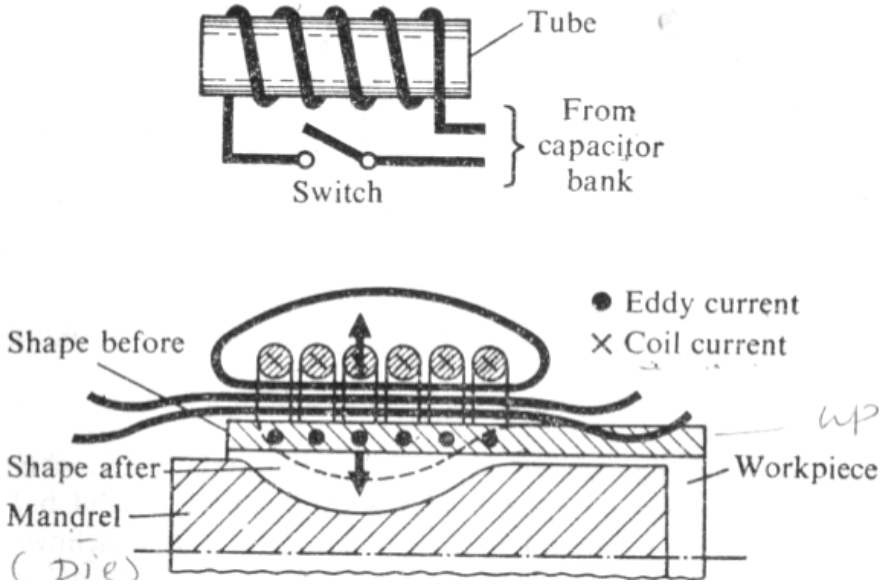

Fig. Electro Magnetic Forming

Process details/ Steps:

i) The electrical energy is stored in the capacitor bank
ii) The tubular work piece is mounted on a mandrel having the die cavity to produce shape on the tube.
iii) A primary coil is placed around the tube and mandrel assembly.
iv) When the switch is closed, the energy is discharged through the coil
v) The coil produces a varying magnetic field around it.
vi) In the tube a secondary current is induced, which creates its own magnetic field in the opposite direction.

vii) The directions of these two magnetic fields oppose one another and hence the rigidly held coil repels the work into the die cavity.

viii) The work tube collapses into the die, assuming its shape.

Process parameters:

i) Work piece size

ii) Electrical conductivity of the work material.

iii) Size of the capacitor bank

iv) The strength of the current, which decides the strength of the magnetic field and the force applied.

v) Insulation on the coil.

vi) Rigidity of the coil.

Advantages:

i) Suitable for small tubes

ii) Operations like collapsing, bending and crimping can be easily done.

iii) Electrical energy applied can be precisely controlled and hence the process is accurately controlled.

iv) The process is safer compared to explosive forming.

v) Wide range of applications.

Limitations:

i) Applicable only for electrically conducting materials.

ii) Not suitable for large work pieces.

iii) Rigid clamping of primary coil is critical.

iv) Shorter life of the coil due to large forces acting on it.

Applications:

i) Crimping of coils, tubes, wires

ii) Bending of tubes into complex shapes

iii) Bulging of thin tubes.
