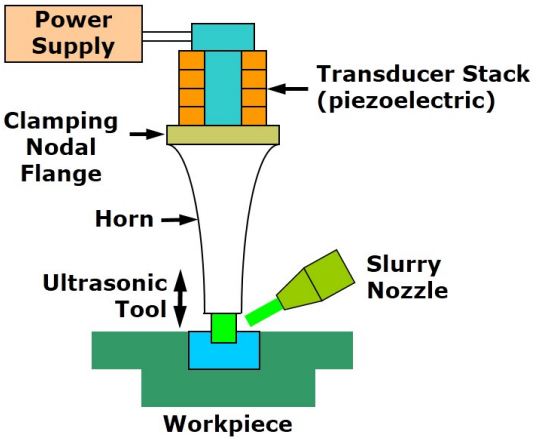

ULTRASONIC MACHINING (USM)

Ultrasonic machining *is a process in which material is removed due to the action of abrasive grains.*

Principle and Working : Refer to Fig.

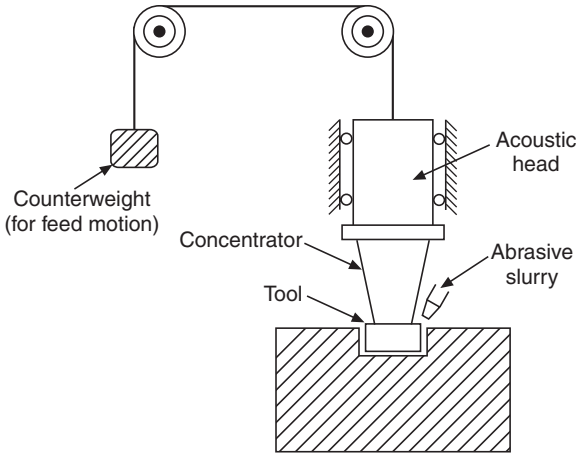

Fig. Ultrasonic Machining (USM).

The abrasive particles are driven into the work surface by a tool oscillating normal to the work surface at high frequency. The tool is made of soft material, oscillated at frequencies of the order of 20 to 30 kHz with an amplitude of about 0.02 mm. It is pressed against the workpiece with a load of a few kg and fed downwards continuously as the cavity is cut in the work. The tool is shaped as the approximate mirror image of the configuration of the cavity desired in the work.

The *acoustic head* consists of a high frequency generator, a magnetostrictive transducer which converts mechanical motion into high vibration and transmits it to the tool. The counter-weight with rope and pulley arrangement provides the feed mechanism and is designed to apply the working force during machining.

Characteristics of USM :

- *Tool materials :* Brass and mild steel.
- *Work materials :* Hard and brittle materials like semiconductors, glass and ceramics.
- *Process parameters :* Frequency, amplitude, grain size, slurry concentration and feed force.
- *Material removal :* Fracture of work material due to impact of grains.
- *Abrasive :* Aluminium oxide, silicon carbide and boron carbide.
- *Grain size :* Mesh-size 100-800.
- *Gap* : 0.2 to 0.5 mm.

Advantages :

1. Noiseless operation.
2. Low metal removal cost.
3. Extremely hard and brittle materials can be easily machined.
4. Operation of the equipment is quite safe.
5. Highly accurate profiles and good surface finish can be easily obtained.
6. Because of no heat generation in the process, the physical properties of the work materials remain unchanged.
7. The machined workpieces are free of stresses.

Disadvantages :

1. High tooling cost.
2. Low metal removal rate.
3. The size of the cavity that can be machined is limited.
4. High power consumption.
5. The initial equipment cost is higher than the conventional machine tools.
6. The process is unsuitable for heavy metal removal.
7. For maintaining an efficient cutting action the slurry may have to be replaced periodically.
8. It is difficult to machine softer materials.

Applications :

1. Several machining operations like turning, threading, grinding, milling etc.
2. Machining of hard to machine and brittle materials.
3. Dentistry work—to drill fine holes of desired shape in teeth.
4. Tool and die making, specially wire drawing and extrusion dies.