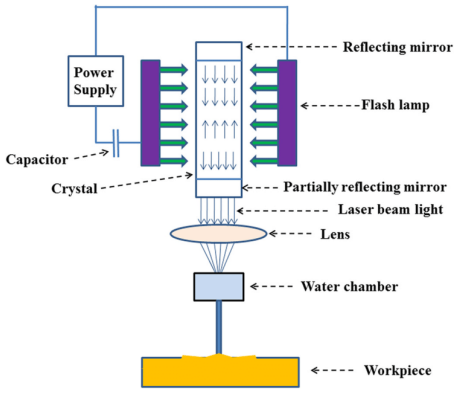

LASER BEAM MACHINING (LBM)

The word LASER stands for "Light Amplification using Stimulated Emission of Radiation". Laser provides intense and unidirectional beam of light ; this light is coherent in nature. The machining by which a laser beam removes material from the surface being worked *involves a combination of the melting and evaporation processes.* However with some materials the mechanism is purely one of evaporation.

Principle and Working :

The principle utilised in LBM is that under proper conditions light energy of a particular frequency is utilised to stimulate the electrons in an atom to emit additional light with exactly the same characteristics of the original light source.

Fig. shows the set-up for Laser Beam Machining. The laser beam is focused with the help of the lens and the workpiece is placed near the focal point of the lens. A short pulse of laser melts and vaporises the material. The explosive escape of the vaporised metal helps in removing most of the molten metal from the hole as tiny droplets. Any of the molten metal not removed will be resolidified along the walls of the hole.

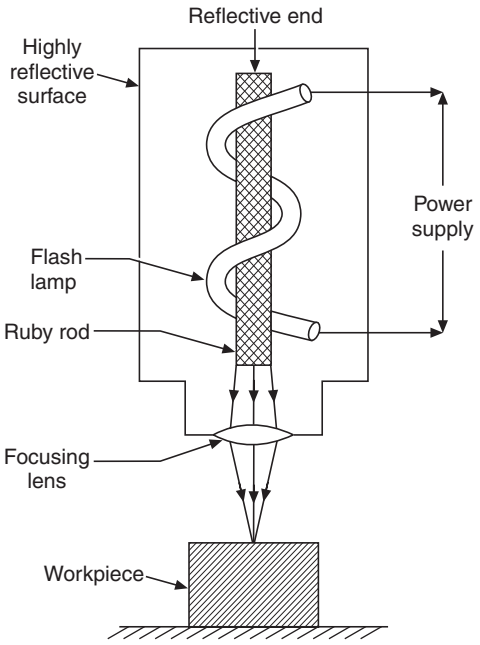

Fig. Laser Beam Machining (LBM).

Characteristics of LBM :

- *Tool* : High powered focused laser beam.
- *Workpiece materials :* Any material.
- *Process parameters :* Power intensity of laser beam, focused diameter of laser beam and melting temperature of workpiece material.
- *Material removal :* Melting and vaporisation.
- *Medium :* Air.

Advantages :

1. No mechanical contact between the tool and the work.
2. The beam can be projected through a transparent window.
3. The laser can be used with materials sensitive to heat shock such as ceramics.
4. The workpiece is not subjected to large mechanical forces.

5. The laser operates in any transparent environment including air, inert gas, vacuum and even certain liquids.
6. Can be effectively used for welding of dissimilar metals as well.
7. Very small holes and cuts can be made with fairly high degree of accuracy.
8. Any material can be easily machined irrespective of its structure and physical and mechanical properties.

Disadvantages :

1. The laser system is quite inefficient.
2. Low production rate.
3. High capital investment required.
4. Its application is limited to only thin sections and where a very small amount of metal removal is involved.
5. Cannot be effectively used to machine highly heat conductive and reflective materials.
6. Highly skilled operators are needed.

Applications :

1. Trimming of sheet metal plastic parts and carbon resistors.
2. Cutting or engraving patterns on thin films.
3. Drilling small holes (upto 0.005 mm dia.) in hard materials like tungsten and ceramics.
4. Cutting complex profiles on thin and hard materials, *viz.,* films for making ICs.
   - Laser drilled holes exhibit a taper and also lack a high degree of roundness. Holes larger than 1.25 mm cannot be drilled because the power density decreases. Hence *laser cutting is more often used than laser drilling.* In a laser cutting operation a high velocity gas jet is used in conjunction with the laser beam. The gas jet helps to rapidly remove the metal from the hole.