Laser Interferometer

It is possible to maintain the quality of interference fringes over longer distance when lamp is replaced by a laser source. Laser interferometer uses AC laser as the light source and the measurements to be made over longer distance. Laser is a monochromatic optical energy, which can be collimated into a directional beam AC. Laser interferometer (ACLI) has the following advantages.

- Highrepeatability
- Highaccuracy
- Long range opticalpath
- Easyinstallations
- Wear andtear

Schematic arrangement of laser interferometer is shown in fig. Two-frequency zeeman laser generates light of two slightly different frequencies with opposite circular polarisation. These beams get split up by beam splitter B One part travels towards B and from there to external cube corner here the displacement is to the measured.
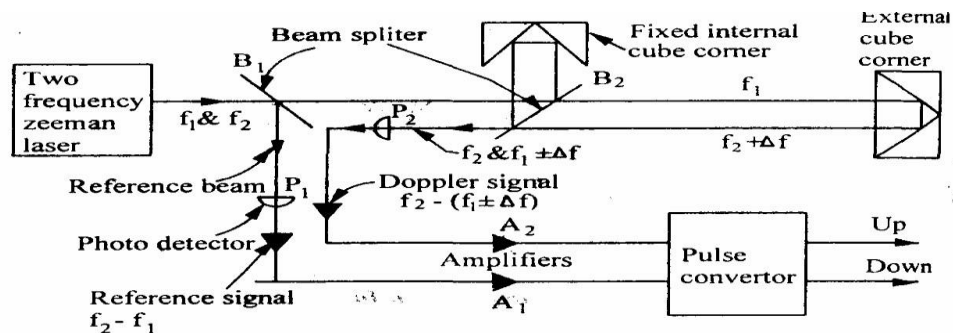

Fig 4.8 Laser Interferometer

This interferometer uses cube corner reflectors which reflect light parallel to its angle of incidence. Beam splitter B2 optically separates the frequency J which alone is sent to the movable cube corner reflector. The second frequency from B2 is sent to a

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fixed reflector which then rejoins f1 at the beam splitter B2 to produce alternate light and dark interference flicker at about 2 Mega cycles per second. Now if the movable reflector moves, then the returning beam frequency Doppler-shifted slightly up or down by Δf.

Thus the light beams moving towards photo detector P2 have frequencies f2 and $(f1 \pm \Delta f1)$ and P2 changes these frequencies into electrical signal. Photo detector P2 receive signalfrombeamsplitterB2andchangesthereferencebeamfrequenciesf1andf2into electrical signal. An AC amplifier A separates frequency. Difference signal f2 – f1 and A2 separates frequency difference signal. The pulse converter extracts i. one cycle per half wavelength of motion. The up-down pulses are counted electronically and displayed in analog or digital form.

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MichelsonInterferometer

        Michelson interferometer consists of a monochromatic light source a beam splitter and two mirrors. The schematic arrangement of Michelson interferometer is shown in fig. The monochromatic light falls on a beam splitter, which splits the light into two rays of equal intensity at right angles. One ray is transmitted to mirror M1 and other is reflected through beam splitter to mirror M2,. From both these mirrors, the rays are reflected back and these return at the semireflecting surface from where they are transmitted to the eye. Mirror M2 is fixed and mirror M1 is movable. If both the mirrors are at same distance from beam splitter, then light will arrive in phase and observer will see bright spot due to constructive interference. If movable mirror shifts by quarter wavelength, then beam will return to observer 1800 out of phase and darkness will be observed due to destructive interference
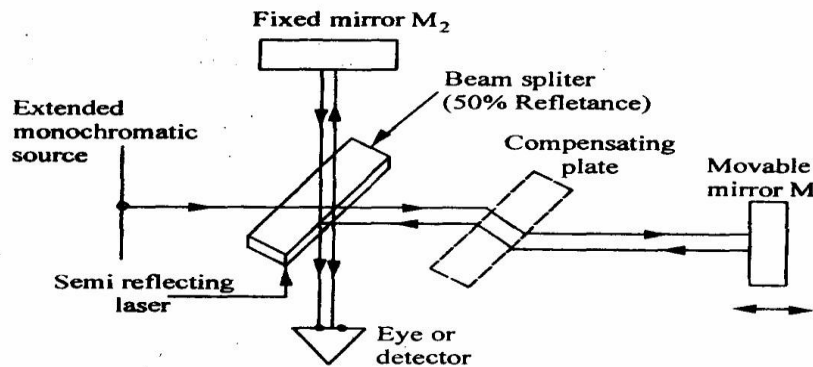

Fig 4.9 Michelson Interferometer

Each half-wave length of mirror travel produces a change in the measured optical path of one wavelength and the reflected beam from the moving mirror shifts through 360° phase change. When the reference beam reflected from the fixed mirror and the

        beam reflected from the moving mirror rejoin at the beam splitter, they alternately reinforce and cancel each other as the mirror moves. Each cycle of intensity at the eye represents l/2 of mirror travel. When white light source is used then a compensator plate

is introduced in each of the path of mirror M1 So that exactly the same amount of glass is introduced in each of thepath.

To improve the Michelson interferometer

(i) Use of laser the measurements can be made over longer distances and highly accurate measurements when compared to other monochromaticsources.

(ii) Mirrors are replaced by cube-corner reflector which reflects light parallel to its angle ofincidence.

(iii) Photocells are employed which convert light intensity variation in voltage pulses to give the amount and direction of positionchange