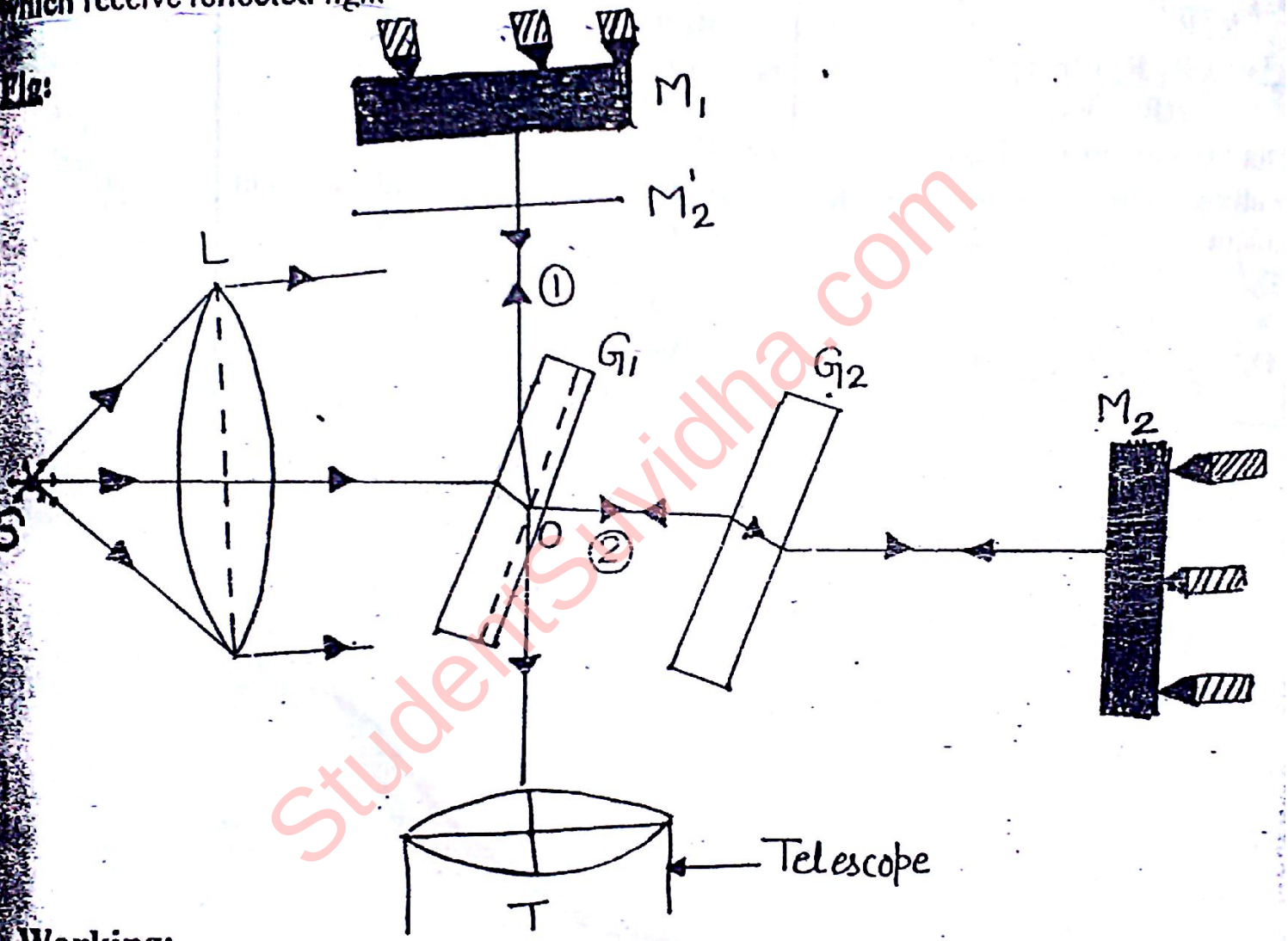
Michelson's Interferometer

Construction:-

Michelson's Interferometer consists of two highly plane ished mirror M_1 and M_2 are placed right angle to each other. There are two s plates G_1 and G_2 of the same thickness and of the same material placed allel to each other. The face of glass G_1 towards G_2 is semi silvered. The irror M_1 and M_2 provides three leveling screw with the help of these leveling rew mirror M_1 and M_2 are tilted horizontal and vertical axis so that mirror and M_2 can made exactly perpendicular to each other. T be the telescope hich receive reflected light

Fig:



Working:-

S is the source of monochromatic light. Light from the source S is allowed to fall on convex lens. It renders a parallel beam of light. When this beam of light is allowed to fall on semi-silvered surface of glass plate G_1 then the semi-silvered of surface glass plate G_1 divide the incident beam of light into two parts one being reflected and comes out in the form of ray no.1 Which moves towards mirror M_1 and other being transmitted and comes out in the form of ray no 2 which moves towards mirror M_2. Both the ray no.1 and ray no.2 incident normally on the mirror M_1 and M_2 And return in its original path and again meets at the semi silvered surface and entering in the field of view of telescope.

...tion of Glass Plate G_2:-

Now looking in the ray no.1 which passes glass plate G_1 twice where ray no.2 only once. So in the absence glass plate G_2 the two paths are not equal. So in order to equalize the two paths we take another glass plate G_2 of the same thickness and of same material placed in the path of ray no.2. Due to this nature glass plate G_2 are called compensatory glass plate.

Type of Fringe's:-

Now looking in the direction of mirror M_1 through telescope. One observe the mirror M_1 and the virtual image of M_1 and M_2 that is formed at M_2' thus Michelson's Interferometer is equivalent to air film enclosed between M_1 and M_2'. Thus the interference pattern may straight, circular or curved fringe's depends upon path difference between the reflected rays. Thus path difference between the reflected ray will be:-

$2\mu t \cos(r+\alpha) + \lambda/2 + \lambda/2 \simeq 2\mu t \cos(r+\alpha) + \lambda$

(1) Circular Fringe:-

When mirror mirror M_1 and M_2 are exactly perpendicular to each other then mirror M_1 and M_2' are exactly parallel to each other. Then air film of constant thickness is formed between M_1 and M_2' so that at a particular constant thickness radii or foci are constant so that at a particular constant thickness the interference pattern in the form of circular ring. Now the ring will appear dark or bright depends upon path difference between the two reflected rays that is

$$2\mu t \cos(r+\alpha) + \lambda$$

Now in such a case $\alpha = 0$,

For normal incidence $r = 0$,

For air film $\mu = 1$.

Then path difference between the two reflected ray will be:-

$$2t + \lambda \quad \ldots\ldots\ldots (1)$$

At a particular constant thickness ring will appear bright only when

Path diff. $= n\lambda$, or $2t + \lambda = n\lambda$ or $2t = (n-1)\lambda$, $n = 1, 2$

$= n\lambda$, $n = 0, 1, 2$

Thus ring will appear bright only when $2t = n\lambda$

And ring will appear dark only when $2t = (2n+1)\lambda/2$

(2) Curved Fringe:-

When the mirror M_1 and M_2 are not perpendicular to each other then air film of increasing thickness is formed between M_1 and M_2' Thus the shape of Fringe's depends upon path difference between the two reflected rays. When the two mirror are inclined the curve fringe are formed.