INTERFERENCE OF LIGHT with FRESNEL'S MIRRORS	Exp-1

Purpose

- By dividing up the wave-front of a beam of light at the Fresnel mirror, interference is produced. The wavelength is determined from the interference patterns.

Related topics

Wavelength, phase, Fresnel mirror, virtual light source.

Theory and Evaluation

Interference in light waves occurs whenever two or more waves overlap at a given point. An interference pattern is observed if

- The sources are coherent (they must maintain a constant phase with respect to each other).
- The sources have identical wave lengths[17].

Thanks to having two mirrors it is possible to produce two virtual light sources which then interfere with each other from a single light source.
Fresnel's idea of bringing about interference in light waves rejecting or two mirrors is depicted in Fig. 1.

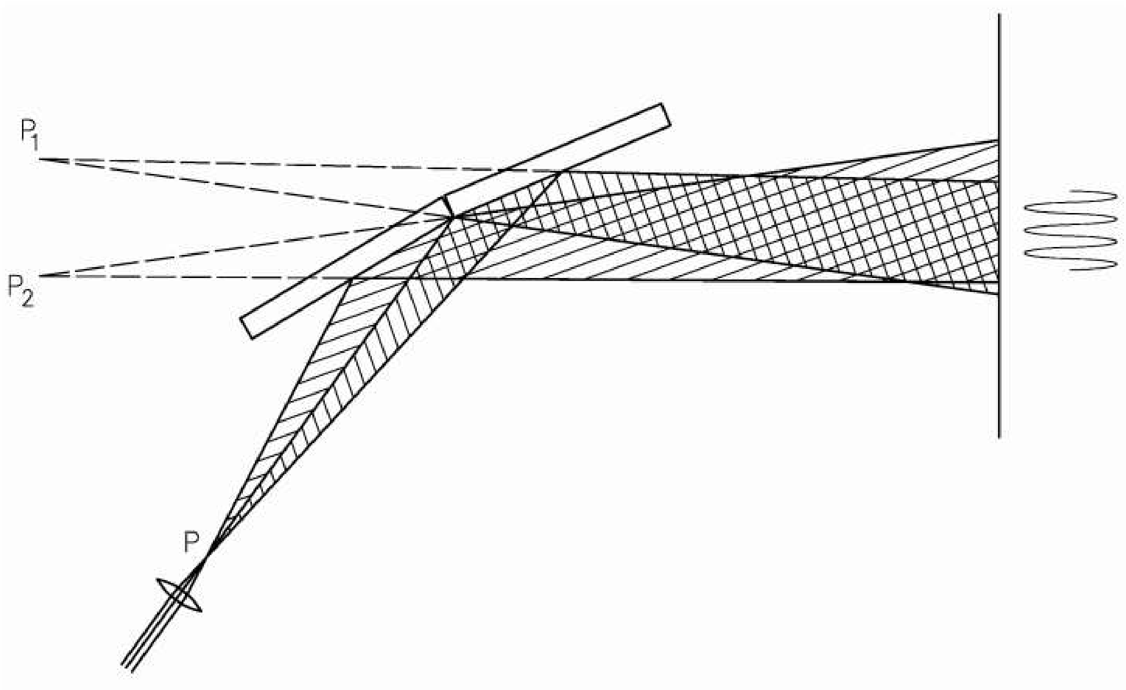

Figure 1: Operating principle of the Fresnel mirror

The light propagating from one point light source P (parallel laser beam with lens connected upstream) is rejected by two mirrors in such a manner that the two partial beams are superimposed on each other, thus causing interference. The experiment evaluation can easily be undertaken using mathematical methodology or graphically in physical terms simply by determining the separation of the two virtual point light sources P_1 and P_2 and then calculating the interference pattern as a superimposing of circular waves arising from P_1 and P_2 [5].

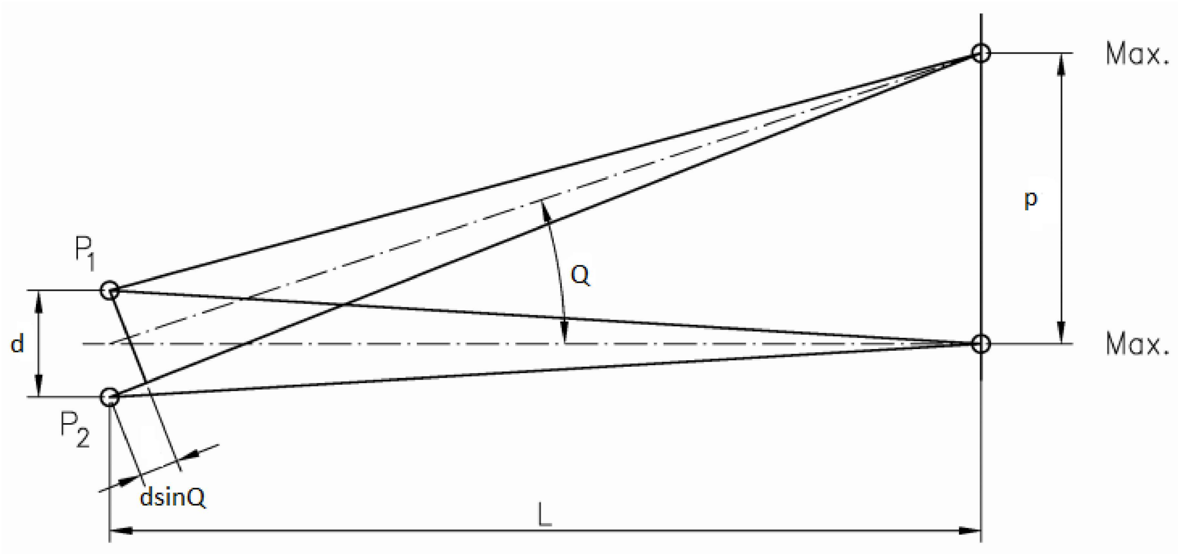

Figure 2: Intensity maxima when path difference = mλ [5]

The waves diverging from Source_1 and Source_2 overlap and interference fringes are produced in the overlapping region on the screen. The fringes are parallel lines of equal thickness.

$$\text{path difference for maxima} = d \sin Q = m\lambda$$
$$\tan Q = p/L \tag{1}$$

for small Q, $\tan Q = \sin Q = Q$ [17]

$$\frac{m\lambda}{d} = \frac{p}{L}$$
$$p = \frac{m\lambda L}{d} \tag{2}$$
$$\lambda = \frac{pd}{mL}$$

Set-up, Procedure

Caution: Never look directly into a non attenuated laser beam

1. The experimental set up for producing interference with the Fresnel mirror is as shown in Fig.3. The laser (2 cm), the lens holder and lens of focal length f = 20 mm (23.3 cm) and a mount with Fresnel mirror (43.2 cm) are mounted on the optical bench. A light surface at a distance of about 2 to 5 m is used as a screen.

2. Make sure that the movable part of the Fresnel mirror is adjusted so that the two halves of the mirror are approximately parallel. One of the two mirrors is permanently attached inside the housing while the other mirror is adjustable and can be tilted by an angle of approx. 0.5° up to +2°.

3. Adjust the laser the way that the enlarged beam of rays strikes both halves of the mirror equally. Two light spots, separated by a dark zone, should now be visible on the screen. By turning the adjusting screws of the Fresnel mirror the movable part of the mirror is tilted until these zones overlap. The visible interference pattern and its relationship to the angle of inclination of the mirrors are observed on the screen.

4. Measure, p, the distance between two bright fringe. Record your value in Table

Figure 3: The experimental set up for producing interference with the Fresnel mirror [16]

5. Mount a lens of focal length +30(cm). Now, instead of interference pattern, image of virtual source is observed on screen.
6. Measure the distance, B, between the image of virtual light sources. Record your value in Table below
7. Measure the b, distance between lens +30 and screen, record your value in Table below.