Physics | Chemistry · Biology | Technics | LEYBOLD | LEYBOLD DIDACTIC GMBH

11/1987 -Me- **Instruction Sheet** **471 05**

Fresnel's Mirror with Adjustable Angle

This apparatus is used to demonstrate Fresnel's experiment on interference in an assembly of high luminous intensity. Difficulties experienced in making the right adjustment are soon overcome after a little practice and it takes only a few minutes to prepare the experiment.

Literature:
Experiment 5.3.3.1 in "New Physics Leaflets for Colleges and Universities", Volume 1 (599 952)

1 Saftey Notes

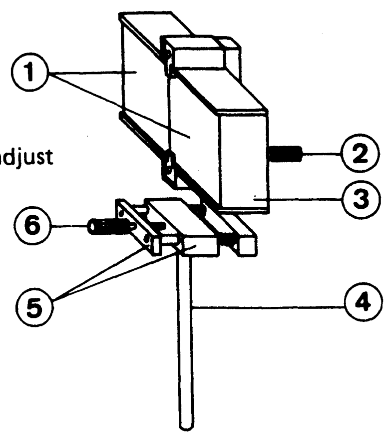
- If possible, do not touch the mirror surfaces. Clean contaminated or dusty mirror surfaces by means of lens tissue (305 00).

2 Description

The apparatus consists of two black, opaque glass plates encased by a plastic housing (7 cm x 5 cm each). The glancing incidence of light introduced in the experiment causes them to act as mirrors with good reflecting surfaces.

One of the mirrors can be inclined by the contact edge of the two mirrors by means of the knurled screw ②, enabling to adjust angles of -1° to + 3° from initial position. The negative angles are intended for experiments using one mirror only.

On the housing rear is a holder connecting Fresnel's mirror with a parallel guide. The mirror can be shifted by 8 mm max. perpendicular to the mirror surface by means of the knurled screw ⑥.



① Glass plate
② Knurled screw to adjust the mirror
③ Plastic housing
④ Rod
⑤ Parallel guide
⑥ Knurled screw for parallel guide

Fig. 1

3 Set-up and Adjustment

Additionnally required:
1 light source*, e.g.
  1 Halogen lamp housing, 12 V, 50/100 W . 450 64
  1 Halogen lamp, 12 V, 100 W 450 63
1 Voltage source, 12 V, 100 W .... e.g. 562 75
1 Adjustable slit 460 14
1 Translucent screen 441 53
1 Bench clamp 301 06
1 Small optical bench 460 43
4 Leybold bosses 301 01
1 Saddle base 300 11

For adjustment the following conditions must be met: Slit and mirror should stand in parallel. The two mirror images of the slit on the screen should be of equal width and superimpose each other. They should not be disturbed by the directly projected slit image. To fulfill this condition proceed as follows:

Fit the lamp at the end of an optical bench. Arrange the adjustable slit (slit width approx. 0.8 mm) close to the lamp and Fresnel's mirror behind the lamp. Fit the translucent screen in the sadle base at approx. 80 cm distance from the mirror (set-up as in Fig. 2a).

The interference fringes can be observed at any desired distance from Fresnel's mirror. Note, however, that with larger distance of observation the interference fringes become larger while the light intensity decreases. With the distances as indicated in Fig. 2a sufficiently large and bright interference fringes are obtained.

Carry out the experiment in a darkened room.

1. Arrange Fresnel's mirror so that at first it is not positioned in the light beam. Turn the movable half of the mirror completely back using knurled screw ② (as in Fig. 2a).

Project the image of the perpendicularly arranged lamp filament on a piece of paper at approx. 8 cm distance from the slit at the level of the mirror centre. Then remove the paper. The slit image with unsharp borders appears on the screen (Fig. 3a).

2. Turn Fresnel's mirror about its axis (Fig. 2b) until the light beams grazes the stationary mirror surface. The first mirror image of the slit appears

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*) Experiment description with the He-Ne laser see experiment 5.3.3-1 in "Physics Experiments", Volume 3 (599 942) or "New Physics Leaflets for Colleges and Universities" (599 952)

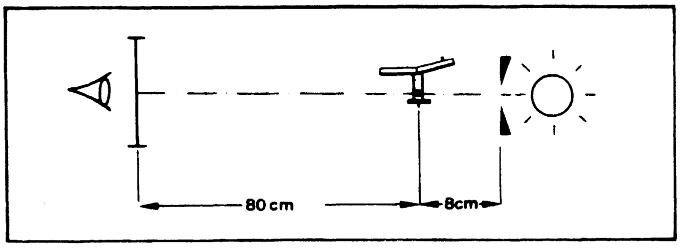


Fig. 2a ▲

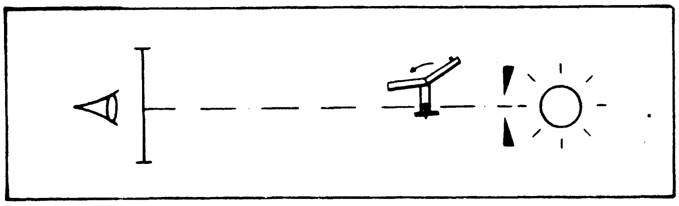


Fig. 2b ▲

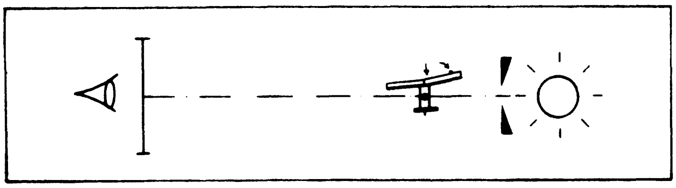
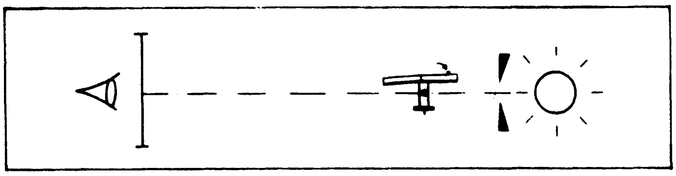


Fig. 2c ▲

Fig. 2d ▼



on the screen, where the directly projected slit image is limited on one side by a shadow edge. When making the slit width smaller (approx. 0.2 mm), both mirror-projected images show diffraction patterns caused by the mirror edges (Fig. 3 b), which are, however, not the interference fringes of Fresnel's mirror experiment.

3. Shift Fresnel's mirror with parallel guide into the light beam (as Fig. 2c) until the light beam grazes also the second mirror half.

Beside the first mirror-projected image whose distance on the screen from the directly projected image has decreased, the second mirror-projected image of the slit appears.

By shifting the mirror into the light beam the directly projected slit image is further covered and the first mirror projected image limited by two shadow edges. Also the second mirror-projected image shows interference phenomena.

Screw in knurled screw ② until the spacing between the two mirror-projected images of the slit is approx. 1 to 2 cm (Fig. 3c). Now the parallelity of the images to each other can be checked. The two mirror-projected images should also be in parallel to the directly projected image. This is achieved by turning the slit. Operate the parallel guide until the mirror-projected images have equal width.

4. To enable the mirror-projected images to overlap, the movable mirror half is inclined further in direction to the stationary half by screwing in the knurled screw ② (as in Fig. 2d). On the screen the second mirror-projected image approaches the first. Turn the knurled screw until the second slit image overlaps the first by approx. 0.5 cm. Reduce slit width to approx. 0.1 mm to 0.05 mm.

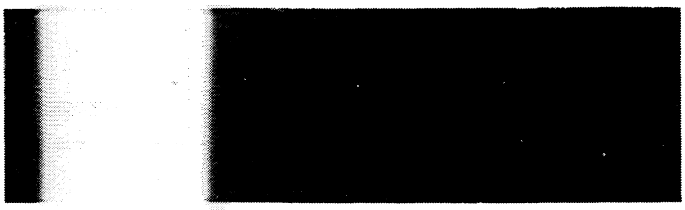


Fig. 3a ▲

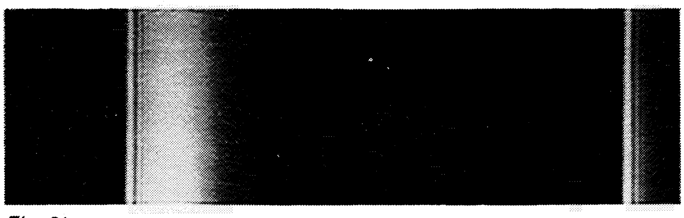


Fig. 3b ▲

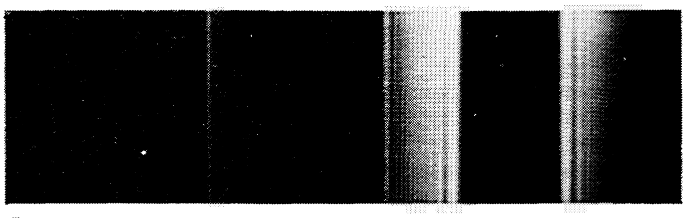


Fig. 3c ▲

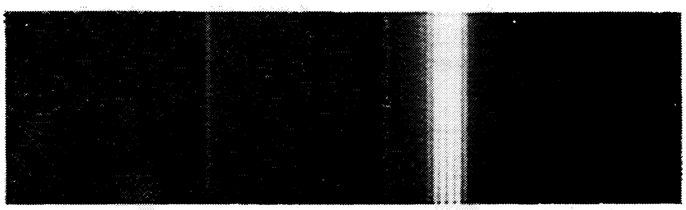
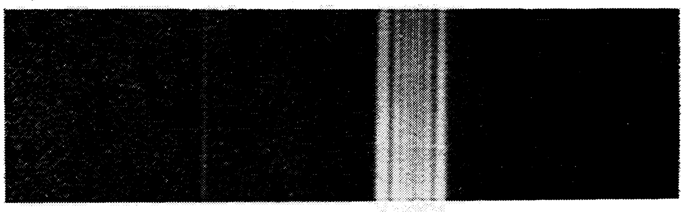


Fig. 3d ▲

Fig. 3e ▼



Now an overlapping region of coloured interference fringes appears on the screen which should be straight and equidistant (Fig. 3d). The overlapping region with the interference fringes shows weak diffraction patterns at the borders (edge diffraction).

5. Screw in knurled screw ② until the two mirror-projected images overlap completely. Now the interference fringes appearinmg on the screen are close to each other (Fig. 3e).

If the fringes are hazy this is often due to two reasons:

a) The slit width is still too great and should be further reduced.

b) The parallelity of the two mirror-projected images to the directly projected image is still insufficient and can be optimized by slightly turning the slit (as described in Section 3).