In this experiment, two optics phenomena can be illustrated with the help of analogous experiments with water waves.
In the first part the merging of a parallel light beam in the focal point of a converging lens is demonstrated. The second part of this experiment shows the formation of a divergent light beam from a parallel light beam in a diverging lens.

Materials

from the accessory set of 11260-99

1 Holder for plane wave generator
1 Plane wave generator
1 Refraction objects, set

Method

Experiment 1 and 2:

Water waves are used to perform an analogous experiment on the refraction of a parallel light beam on passing through a converging lens and on passing through a diverging lens. The effect of the respective lens is simulated by a shallow water zone, produced with the help of a convex plate and a concave plate respectively.

Setup

The wave tray is filled with water and the convex plate from the refraction object set is placed in the wave tank as shown in Fig. 1 and the concave plate as shown in Fig. 2. The respective plate should be completely covered with water.

The plane wave generator is fixed to the exciter arm, is moved to the bottom edge of the wave tray and is carefully adjusted.

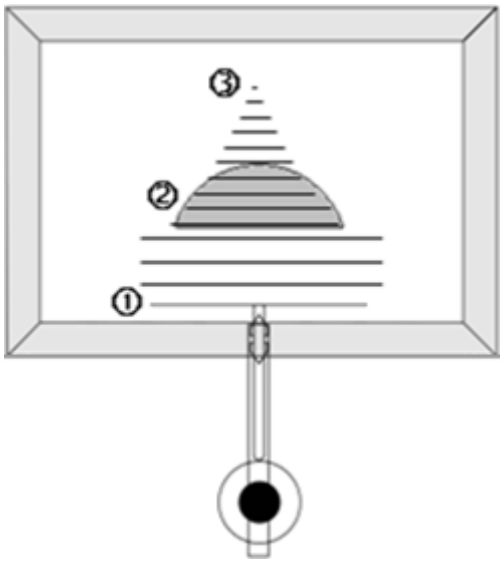

Figure 1: Experiment arrangement for the refraction of water waves at a converging lens. The wave front ① produced by the planar wave generator is refracted at the convex plate ② and merges at a focal point ③.

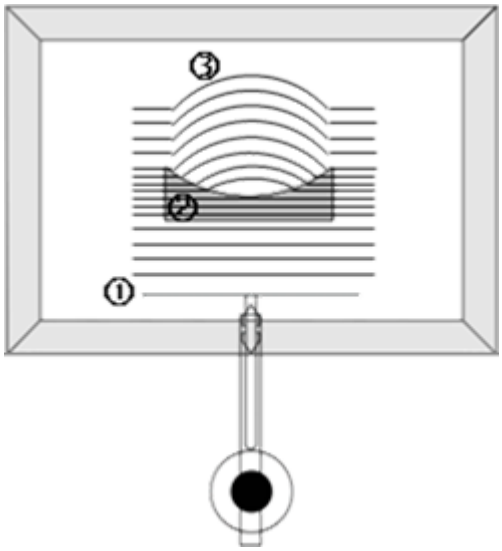

Figure 2: Experiment arrangement for the refraction of water waves at a diverging lens. The wave front produced by the planar wave generator ① is refracted at the concave plate ② and continues its path behind the plate in the form of divergent circular waves ③.

Procedure

A frequency of 15 Hz to 20 Hz is set at the ripple tank and the amplitude is selected so that a clear wave pattern can be recognised. The spray bottle is now used to pump water out of the wave tray until convergent (Experiment 1) or divergent waves (Experiment 2) can be identified behind the shallow water zone.

It is advisable to switch on the stroboscopic lighting to observe the refraction at the boundaries of the shallow water area. Δf is selected so that a slow forward movement of the waves can be seen.

Results

Experiment 1:

The plane waves leave the shallow water zone of the convex lens as circular waves. They are convergent behind the plate and merge at a focal point (Fig. 3).

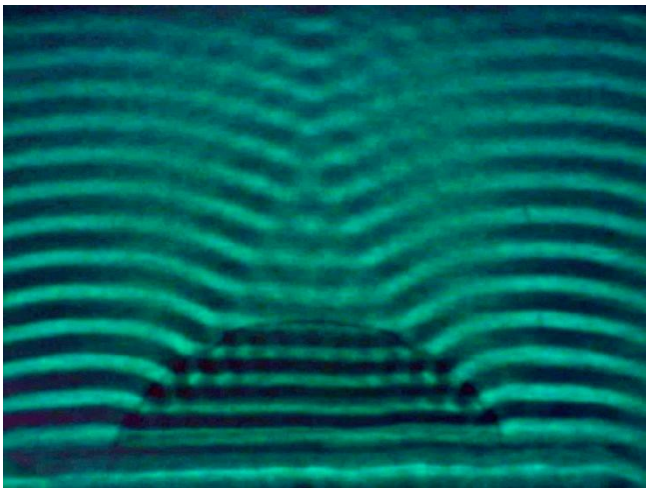

Figure 3: Snapshot as shown in Fig. 1. It can be clearly seen how the convergent circular waves merge at a focal point behind the plate.

Experiment 2:

The plane waves leave the shallow water zone of the concave lens as divergent circular waves (Fig. 4).

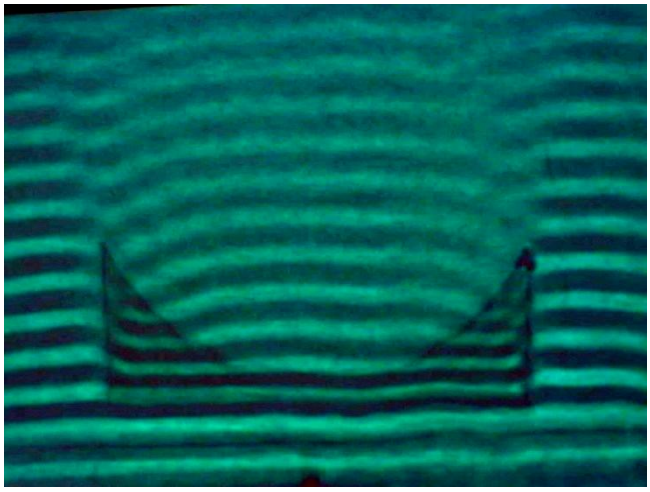

Figure 4: Snapshot as shown in Fig. 2. It can be clearly seen how the plane waves leave the concave plate as divergent circular waves. The imaginary centre of the circular waves is located in front of the concave plate.

Interpretation

Experiment 1 and 2:

Due to the rather low propagation velocity of the water waves in the shallow water zone, the water waves are refracted above the convex and concave plate in the same way as light waves are refracted in a convex or concave lens. The characteristic wave patterns are formed as a result, as can be clearly seen in Fig. 3 and Fig. 4.