PAPERS COMMUNICATED

115. Directive Properties of Parabolic Reflectors.

By Kôzi SATÔ and Masaaki SASAO.

Aeronautical Research Institute, Tokyo Imperial University.

(Comm. by T. TERADA, M.I.A., Nov. 12, 1932.)

Several years ago, one of the authors measured the intensity of sound received through a conical horn with its axis set at different angles θ to the ray of sound.¹⁾ The most remarkable of the results is that the distribution of intensity as function of the angle θ mainly depends upon the wave-length of the sound, and only slightly upon the geometrical shape of the conical horn if the diameter of the opening be the same. It is a matter of interest to investigate whether a parabolic reflector has also such a property.

In the preceding paper²⁾ on parabolic reflector, its sound field has been investigated in detail as function of wave-length. As a continuation of it, the present paper deals with the directive properties of parabolic reflector.

The procedure of the experiment is similar to that of the preceding one. The shapes of the parabolic mirrors used in the experiment are of three different varieties shown in Fig. 1. Each has the same opening of 40 cm. diameter and is made of aluminium 2 cm. thick. It is made to rotate horizontally round the centre of its opening and as the receiver of sound, a small conical horn of 3 cm. diameter is placed at the focus in rigid connection with the parabolic reflector. The sound concentrated at the focus is received through the small cone and conducted through a long rubber tube to the Rayleigh disc by means of which its intensity is measured. The distance between the source and the opening of the parabolic reflector is about 600 cm. which is large compared with the diameter of the opening, so that on

Fig. 1.

 f = focal distance $f_1 = 2$ cm. $f_2 = 4$ cm. $f_3 = 8$ cm.1) Rep. Aeronaut. Res. Inst., Tôkyô Imp. Univ., **4** (1928), No. 1, 1.2) Proc., **8** (1932), 281; Proc. Physico-Math. Soc. Japan, **14** (1932), No. 7, 363-371; Rep. Aeronaut. Res. Inst., Tôkyô Imp. Univ., **7**, 2 (1932), No. 83, 19-63.

the opening, the incident wave can be treated practically as plane one. The experiment was performed in a carefully designed sound-proof chamber.

The results of the experiment are shown in Fig. 2 and Fig. 3. In the figures, the intensity of sound received is shown in polar diagrams as function of the angle (θ) between the axis of the parabolic reflector and the ray of sound.

Fig. 2 shows the directive properties of the parabolic reflector (II) for different pitches of sound c^1 , c^2 , c^3 and c^4 . For c^1 , the intensity of sound received is nearly equal for all values of θ . On the contrary, for c^4 , it is considerable only for small values of θ . The directive property increases as the wave-length decreases.

Fig. 2.

Fig. 3 shows the directive properties of the parabolic reflectors I, II, III for c^1 , c^2 , c^3 and c^4 . It can easily be seen from these figures that although the parabolic reflectors are quite different in shape, the corresponding curves for any given pitch of sound are similar to one another. Hence we can conclude that the directive property of the parabolic reflector depends only slightly upon its geometrical shape if the diameter of the opening be the same.

Lastly, the reflector (I) has been compared with respect to the directive property with the conical horn of the same opening and depth. For all the pitches used, no marked difference has been found between them.

The above experiment is referred to the property of the parabolic reflector as a receiver of sound, but by the reciprocal relation, the directive property of a receiver will be the same as that of a radiator.

If the depth and opening are given, the magnifying power of a parabolic mirror is much smaller in general than that of a conical horn¹⁾ and as for the directive property, there exists no appreciable difference between them. Therefore, as a collector or radiator of sound, the former is far inferior to the latter.

1) Rep. Aeronaut. Res. Inst., Tôkyô Imp. Univ., 7, 2 (1932), No. 83, 43.

Fig. 3.