

Aug. 30, 1932.

C. ZWIKKER

1,874,733

DEVICE FOR DIRECTING SOUND

Filed Nov. 1, 1929

2 Sheets-Sheet 1

Fig. 1 *Fig. 2* *Fig. 3* *Fig. 4*

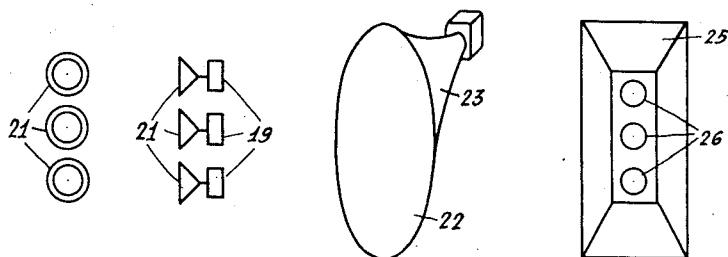


Fig. 5 *Fig. 6* *Fig. 7*

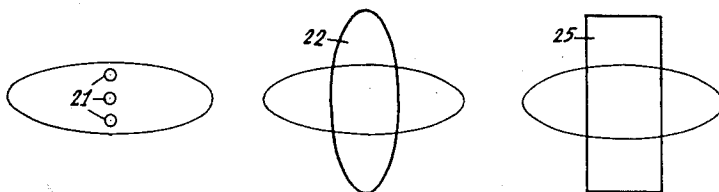
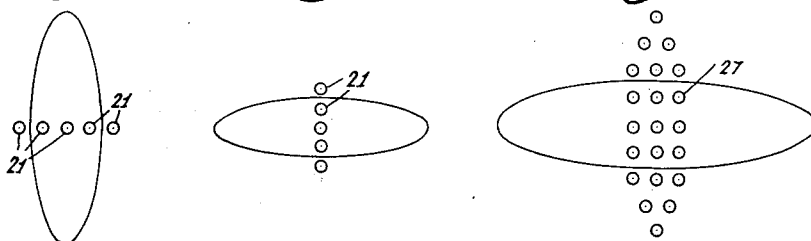


Fig. 8 *Fig. 9* *Fig. 10*



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Fig. 11

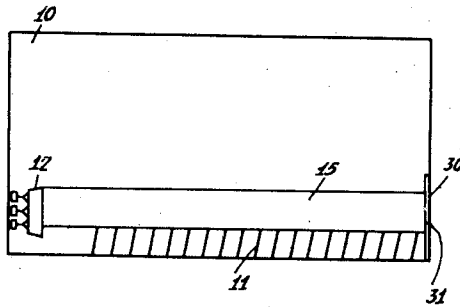


Fig. 12

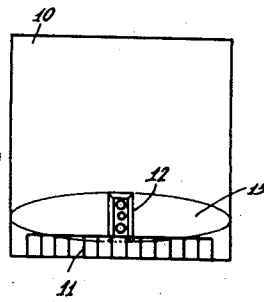
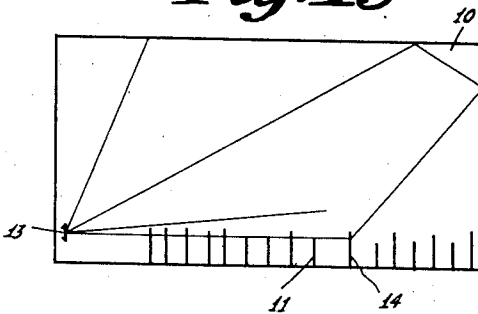


Fig. 13



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DEVICE FOR DIRECTING SOUND

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When sounds are sent out into large auditoriums it is very important that they should be directed efficiently. A source of sound which radiates sounds equally towards all sides will be little effective in connection with the purpose indicated as only a very slight portion of the energy radiated reaches the hearer and a further difficulty, particularly when sending out in enclosed spaces, consists in that the sounds not radiated directly towards the hearer are reflected by the walls of the room and often reach the said hearer slightly later than the sound waves directly originated by the source of sound. This latter difficulty is not to be undervalued in connection with speeches which are sent out because it often results in that the hearer understands the spoken word very poorly.

According to the process of the invention the sound radiating surface has an oblong shape and has its long axis arranged at right angles to the plane which it is desired essentially to cover with the sound emitted. It has been found that the oblong sound radiating figure emits a sound beam having an oblong section the long axis of which is at right angles to the long axis of the sound radiating figure.

In the case of a crowd gathered on a square or in a hall for example, it is important in connection with directing that a plane at the height of a man and parallel to the square or to the floor of the hall should be covered with the sound. According to the invention, it is therefore necessary that the oblong figure should be arranged such that its long axis is vertical so that the sound is emitted according to a wide flat beam (consequently covering essentially the horizontal plane at the height of a man).

The process presents great advantages both in the case of sending out in open air and in enclosed spaces because the sounds can be emitted from a point uniformly along a wide surface without much of it being lost in any direction. In enclosed spaces the advantage is moreover obtained in that the sound waves outside the said beam are so feeble that their reflection is no longer troublesome.

The oblong figure of the sound radiating body may be obtained by a plurality of sound radiating surfaces being arranged according to an oblong figure. As an alternative, the source of sound may be caused to cooperate with a funnel or horn having a mouth opening of oblong shape.

The acoustic device according to the invention adapted to emit the sounds in a directional manner may comprise a plurality of diaphragms movable in phase and arranged according to an oblong figure. It may be constituted by a source of sound which cooperates with a horn or funnel having a mouth opening of oblong shape. If it is desired to emit sounds throughout a substantially horizontal region, the device will be so arranged that the long axis of the oblong sound radiating surface occupies a vertical position.

The invention will be more clearly understood by reference to the accompanying drawings in which:

Figures 1, 2, 3 and 4 are projections of the different forms of construction of the acoustic device according to the invention.

Figures 5, 6 and 7 are diagrams of the beams emitted by the various constructions.

Figures 8, 9 and 10 show different groupings of vibrating members and the beams thereby emitted.

Figures 11, 12 and 13 are diagrams relative to the emission of sound in enclosed spaces.

Referring to Figure 11, an enclosed space contains an auditory 11. A speech is sent out by means of an acoustic device 12. Figure 13 shows the same enclosure 10 with the same auditory 11 and in the said room is likewise arranged an acoustic device 13 which, however, differs in construction from the device 12. By the device 13 the sounds are radiated towards all directions. Part of these sounds will reach, for example, the hearer 14 directly but another part will arrive on the spot after some wanderings and reflection so that the hearer 14 will hear these parts of the sound in short sequency, for example $\frac{1}{8}$ second after one another, which is often just sufficient to make it poorly understood.

The device 12 emits the sounds according to a beam the section 15 of which is shown in Figure 12. This section has an oblong shape which allows all the hearers present in the hall to understand the sound emitted readily. The sound waves outside the beam will have such a feeble intensity that their reflection is no longer troublesome. The beam of oblong section as shown in Figure 12 is obtained by the sound radiating surface being given an oblong shape, said surface having its long axis arranged at right angles to the long axis of the plane which it is desired essentially to cover with the sound to be emitted. The figure of oblong shape may be obtained by a plurality of sound radiating surfaces 21 (Figures 1 and 2) being arranged according to an oblong figure. These surfaces may be constituted, for example, by diaphragms 21 actuated by magnet systems 19. Referring to Figure 1, the said figure has approximately the shape of a straight dash. As an alternative, the source of sound may be caused to cooperate with a funnel or horn having a mouth-opening of oblong shape, as shown for example in Figure 3 in which the mouth-opening 22 of the horn 23 is elliptical. Figure 4 shows a funnel 25 of rectangular section cooperating with three sound radiating surfaces 26, for example diaphragms of loudspeakers, said surfaces being arranged according to an oblong figure. Figures 5, 6 and 7 show the sections of the beams with the various sound radiating surfaces shown in Figures 1, 3 and 4. It may be noticed that the said beams proceed at right angles to the long axes of the sound radiating surfaces.

Figures 8 and 9 show some further combinations and positions of sound radiating surfaces.

Figure 10 shows diaphragms 27 which are arranged according to an oblong figure and emit as such a beam of elongated shape.

Reverting to the device 12 shown in Figure 11, the very efficient manner in which the sound energy is utilized in this case is pointed out. If it is desired to prevent the beam 15 from reflecting against the wall 30 and thus from being troublesome to the auditory, the said wall may be provided with a sound damping body 31, for example, a heavy curtain.

I claim:

An acoustical system for reproducing sound comprising a row of sound reproducing elements arranged in vertical alignment so as to produce a horizontal fan-shaped propagation of sound waves, and a pair of shorter vertically aligned rows of sound reproducing elements arranged adjacent to the first mentioned vertical alignment of sound reproducing elements, one of said shorter rows of sound reproducing elements being located at each side of the first mentioned vertical row of sound reproducing elements.

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