

June 14, 1932.

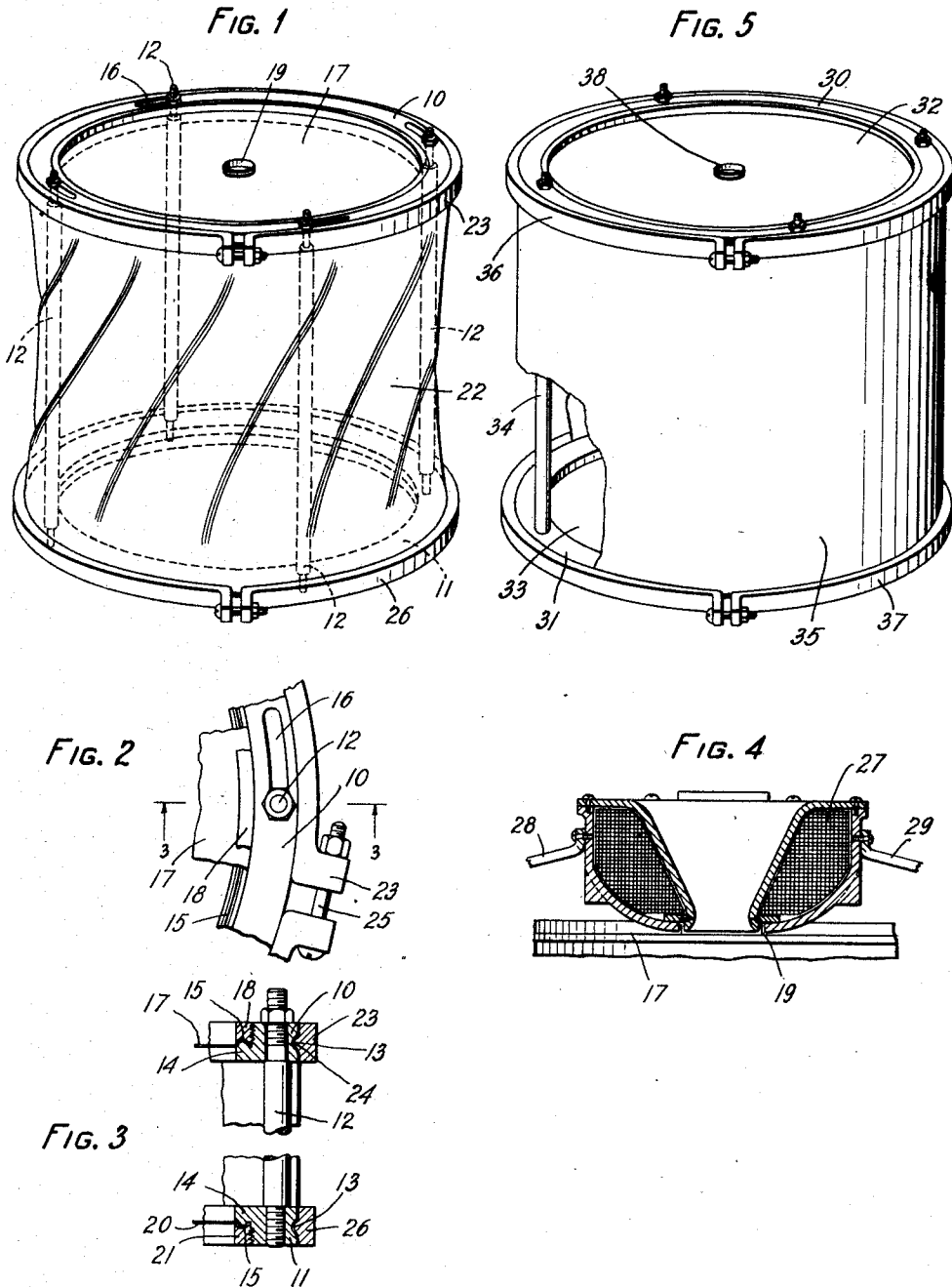
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1,862,552

ACOUSTIC DEVICE

Filed Aug. 2, 1928

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

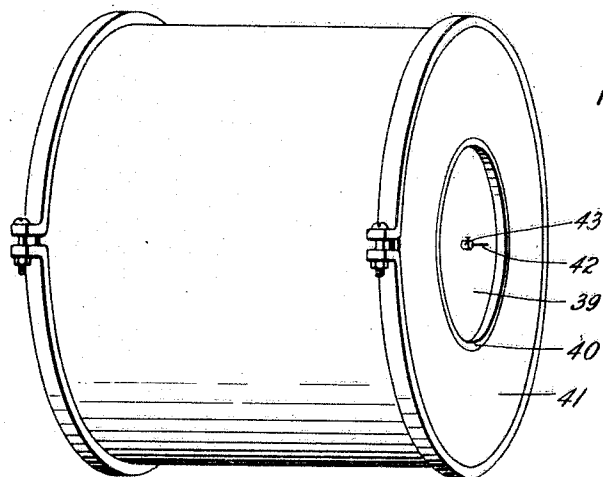


FIG. 6

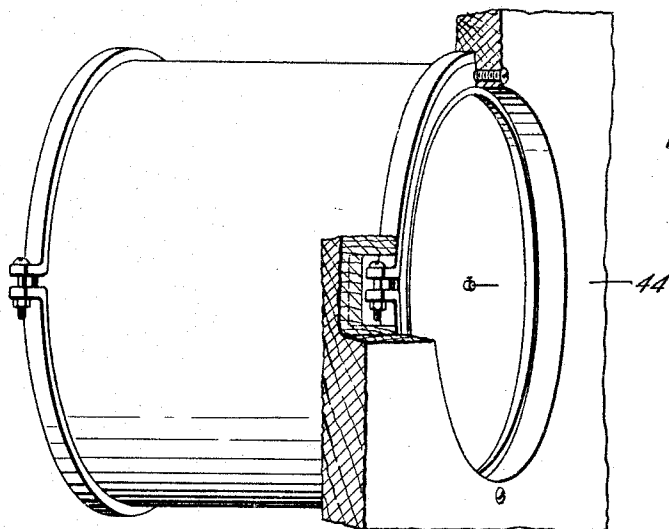


FIG. 7

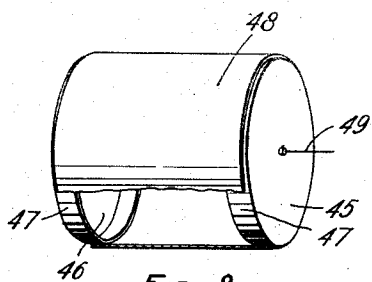


FIG. 8

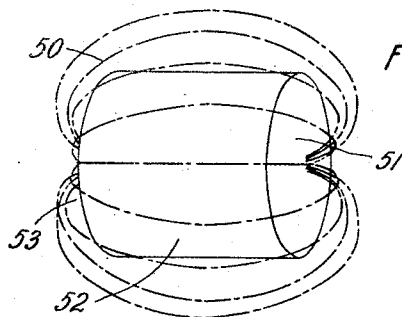


FIG. 9

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ACOUSTIC DEVICE

Application filed August 2, 1928. Serial No. 296,970.

This invention relates to acoustic devices and more particularly to large sound radiators acting directly upon the surrounding air.

An object of the invention is to efficiently radiate sound energy to the air in all directions.

A feature of the invention relates to a sound radiator in which the resultant wave front in air external to the radiator is substantially spherical.

In accordance with one embodiment of the invention the sound radiator comprises a pair of circular rings spaced apart by rigid struts or posts. A vibratile membrane or diaphragm of light material is stretched and clamped in each circular ring and a cylindrical vibratile membrane encloses the space between the circular rings. The cylindrical membrane may be stretched longitudinally and cylindrically and clamped to the circular rings. A suitable driving element is coupled to one of the end stretched diaphragms to impart vibratory energy to the whole surface of the radiator by the transmission of energy through the confined air in the chamber surrounded by the cylindrical stretched membrane and the two end membranes. The stretched membranes will therefore vibrate so that the resultant wave front transmitted to the air external to the whole radiator will be approximately spherical.

Another feature of the invention is an acoustic system in which a plurality of vibrating walls of a sound radiator are acoustically and mechanically coupled together and in which each vibrating wall has an individual resonance peak, the driving and driven end walls having their resonance peaks at closely related points and the cylindrical wall having its resonance peak at a point which may be determined by the relationship of the velocity of air in the enclosed space of the acoustic device and the propagational velocity in the cylindrical wall. The result of this construction is a response characteristic for the sound radiator which is more uniform over the range of important speech frequencies and an increase in the efficiency of the sound transmitted to the air.

These and other features of the invention

will be more fully understood from the following detailed description and the accompanying drawings in which:

Fig. 1 is a perspective view showing the construction of a drum type sound radiator made in accordance with this invention;

Fig. 2 is an enlarged fragmentary plan view of the supporting ring assembly of Fig. 1;

Fig. 3 is a cross-sectional view of a portion of Fig. 1 taken on the line 3—3 of Fig. 2;

Fig. 4 is an enlarged cross-sectional view of one end of the sound radiator showing an electromagnetic means for driving the movable coil attached to the stretched diaphragm;

Fig. 5 is a perspective view of a modified form of the invention with a portion cut away to show the detail construction;

Fig. 6 shows in perspective another form of the invention in which one of the end walls is replaced by a small plunger type diaphragm and a baffle;

Fig. 7 shows the method of supporting the drum type radiator of this invention in an apertured wall or baffle;

Fig. 8 is another modification of the invention in which the end walls and enclosed wall are made of semi-rigid material; and

Fig. 9 shows graphically the shape of the wave front imparted to the air by the drum type radiator of this invention.

Referring to Fig. 1, the sound radiator comprises two end metallic ring members 10 and 11 which are spaced apart by equally spaced struts or up-right members 12 to form the supporting frame for the sound radiating surfaces. Each of the ring members is provided with a circumferential groove 13, shown in Fig. 3, and an inwardly projecting annular flange 14 having a curved bearing surface 15. These rings are supported in spaced relation by the struts 12 being securely threaded in the ring member 11 and the reduced portion of the other end of the struts 12 extending through a slot 16 in the ring member 10. The shoulder formed by the reduced portion of the strut or post forms a seat for the ring member 10. A diaphragm

17 preferably of aluminum alloy having low mass and high tensile strength is stretched across the ring member 12 and is rigidly held in the ring by the threaded ring insert 18 which clamps the diaphragm between the co-operating curved surfaces of the insert 18 and the flange 14 and maintains the diaphragm under uniform and permanent tension. This diaphragm may be suitably driven by a movable coil 19 attached to the center thereof. A similar diaphragm 20 is clamped to the ring member 11 by the ring 21. These diaphragms form the end vibrating walls of the acoustic radiator. A cylindrical diaphragm 22 of aluminum alloy or other material suitable for a radiating surface surrounds the two end ring members 10 and 11 and the up-right members 12 to form an enclosing wall of the device and is fastened to the ring member 10 by the clamping ring 23 which carries a ridge 24 which fits into the groove 13 on the ring member 10 and securely holds the cylindrical diaphragm 22 in position by the screw bolt 25. A similar clamping ring 26 fastens the cylindrical diaphragm to the ring member 11 after the diaphragm 22 has been tensioned uniformly over the whole circumference of the ring. This arrangement forms an efficient sound radiator in which the end walls and the cylindrical wall vibrate to impart sound waves to the air and in which one surface is driven by an external vibrating motor element to drive the other surface through the transmission of energy to the confined air in the chamber so that the wave shape imparted to the air external to the device is substantially spherical and the sound is transmitted in all directions.

In order to stretch the cylindrical diaphragm 22 circumferentially as well as longitudinally, the ring member 10 is provided with the slots 16 through which the ends of the struts 12 project so that the ring member 10 may be rotated a sufficient distance to stretch the cylindrical diaphragm 22 circumferentially. When the desired tension is secured the nuts carried by the struts 12 may be tightened to maintain the ring 10 in its oriented position. Fig. 4 shows a suitable electromagnetic driving element 27 having its poles formed to provide a narrow annular gap which surrounds the coil 19 attached to the diaphragm 17 and may be supported from the ring member 10 by the arms 28 and 29. It will be seen that when electrical energy is applied to the movable coil 19 carried by the diaphragm 17, the diaphragm will vibrate in accordance with the variations in electrical energy supplied to the coil. The movement of the diaphragm 17 causes the confined air within the walls of the device to expand and contract and thereby impart vibration to the cylindrical diaphragm 22 and the end diaphragm 20 so that wave energy is transmitted to the air in all directions.

The sound radiator shown in Fig. 5 is similar to the sound radiator shown in Fig. 1 except that the ring members 30 and 31 are of similar construction and support the diaphragms 32 and 33. The ring members 30 and 31 are spaced apart by the struts or up-right posts 34. A cylindrical diaphragm 35 is clamped to the ring members 30 and 31 by the clamping rings 36 and 37. In this construction the cylindrical diaphragm 35 is stretched only in a longitudinal direction. A movable coil 38 is attached to the diaphragm 32 in any suitable manner. The coil may be driven by any suitable means for example that shown in Fig. 4.

The sound radiator shown in Fig. 6 is substantially the same as the construction described in Fig. 5 except that the diaphragm 32 is replaced by a small plunger type diaphragm 39 and a baffle member 41. The diaphragm may be uniformly stretched in any desirable manner and maintained in position by the ring insert 40 carried by the baffle member 41. The diaphragm 39 may be suitably driven by a pin drive element 42 attached to the diaphragm by the socket 43.

In Fig. 7 the sound radiator which is similar to the construction described in Fig. 5 is shown supported by an apertured wall or baffle board 44 which serves to separate the sound waves given off by the end walls of the sound radiator. It will be readily apparent how the devices shown in Figs. 1 and 5 may be mounted on a baffle board as shown in Fig. 7. Instead of mounting the devices of Figs. 1 and 5 on a baffle board they may be suspended from a ceiling or hook or supported by the frame for the driving means.

The sound radiator shown in Fig. 8, while embodying the same principles of radiation as the other devices heretofore described, is constructed of relatively light and semi-rigid material such as wood, paper, impregnated fabric, metal or the like, to produce a light drum type sound radiator without the use of a supporting frame-work of large mass. In this construction the end walls 45 and 46 have a flange 47 which strengthens the walls 45 and 46 and forms a surface to which the cylindrical diaphragm 48 may be attached by any suitable adhesive substance. The sound radiator shown in Fig. 8 may be driven by any suitable electromagnet having its armature attached to the wall 45 by the pin 49. This construction forms a relatively light drum type sound radiator which may be suspended and supported by the armature of the electromagnet which imparts driving force to the sound radiating surface.

The acoustic system of the vibrating walls of the sound radiator which are acoustically and mechanically coupled together forms three radiating surfaces which may be designed so that the resonance peaks of all

the surfaces may be at various positions throughout the range of speech frequencies so that the composite response characteristic of the whole radiator will be more uniform
5 and have a high efficiency over the whole acoustic range. The resonance peaks of the end walls will be relatively close together due to the mass of the end walls being approximately the same, while the resonance
10 peak of the cylindrical wall may be determined by the velocity of the air within the chamber and the propagational velocity in the wall of the cylinder. The wave front imparted to the air external to the device
15 will be of substantially spherical form as shown in Fig. 9 in which the lines 50 represent the wave shape imparted to the air when the end wall 51 of the drum type sound radiator is driven by external means to force
20 the confined air within the drum to transmit similar vibrations to the cylindrical wall 52 and the end wall 53.

While an electromagnetic type of electrodynamic drive is shown for driving some of
25 the devices described herein it will be understood that any well known driving means may be used for any of the devices.

What is claimed is:

1. An acoustic device comprising a pair
30 of parallel stretched membranes and a cylindrical stretched membrane coupled together to form a confined air chamber therebetween, said cylindrical membrane being stretched longitudinally and circumferentially.

35 2. An acoustic device comprising a pair of ring members, a plurality of supporting members maintaining said ring members in spaced relation, a stretched diaphragm clamped in each of said ring members, a
40 cylindrical stretched diaphragm clamped to the periphery of each of said ring members, and means for stretching said cylindrical diaphragm in two directions.

3. An acoustic device comprising a pair
45 of ring members, a plurality of supporting members maintaining said ring members in spaced relation, a stretched diaphragm clamped in each of said ring members, and a stretched cylindrical diaphragm clamped
50 to the periphery of each of said ring members, one of said ring members and said supporting members cooperating to stretch said cylindrical diaphragm circumferentially.

In witness whereof, I hereunto subscribe
55 my name this 18th day of July, 1928.

VESPER A. SCHLENKER.