Aug. 16, 1932. J. B. HAWLEY 1,872,081

SOUND RADIATOR

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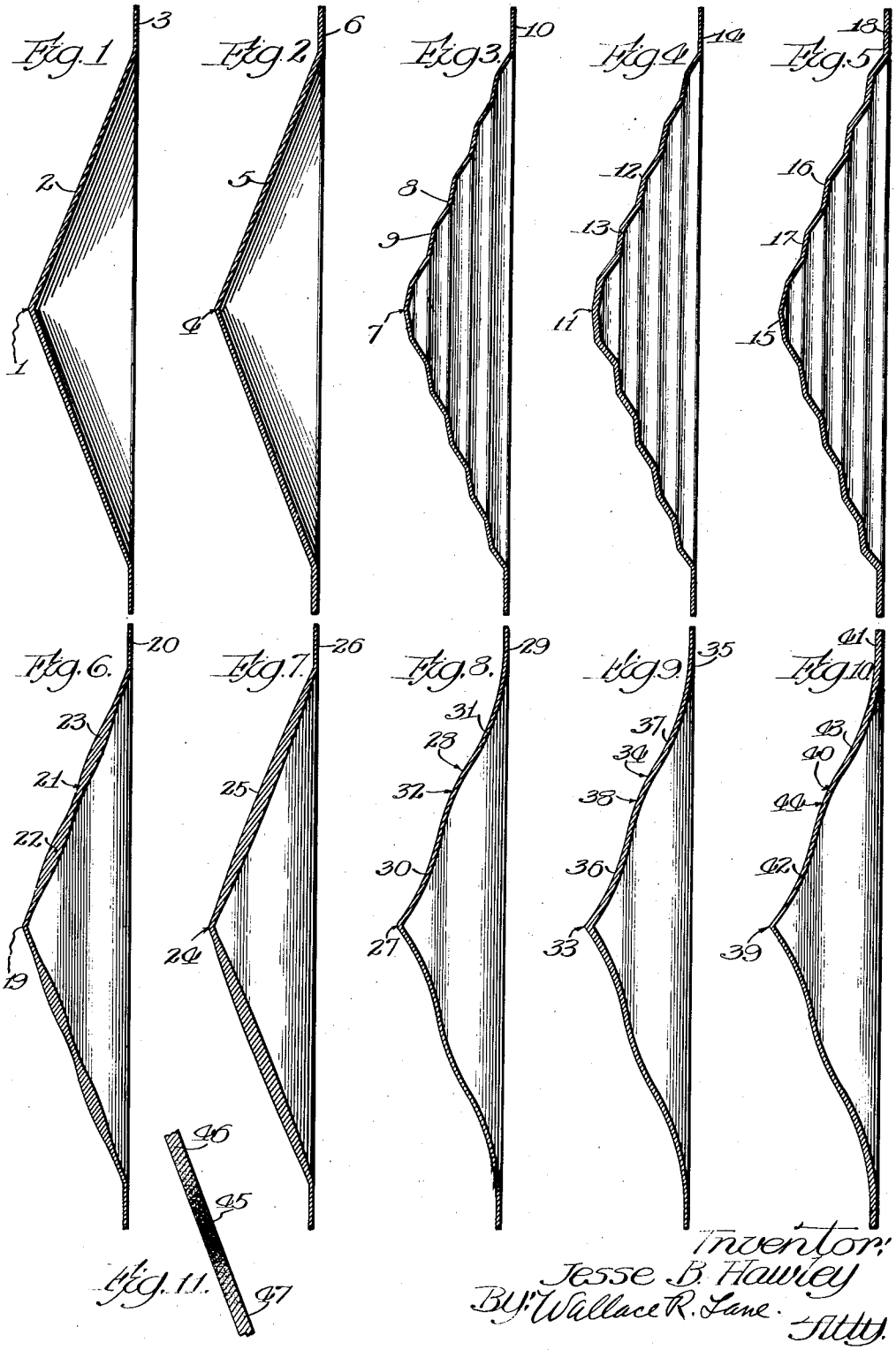

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SOUND RADIATOR

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The present invention relates to sound radiating or emitting devices preferably of the diaphragmatic type.

Among the objects of the invention is to provide a novel diaphragmatic sound radiating device having characteristic variants, such as in the thicknesses, densities and contours of the material of the member whereby sound waves may be efficiently emitted and radiated with substantial uniformity of volume and amplitude of sound waves for all of the audible range of sound and tones, thus operating as efficiently and effectively for high frequency sounds as for low frequency sounds, and conversely, and for sounds remote from the fundamental tone of such a device.

In the specific embodiments selected to illustrate the invention, the member is shown as of conical form and varying in thickness radially, either toward or from the apex, or varying in contour as by making the surfaces or body of the member of wave shape, ridged or bulged, so as to facilitate propagation of waves in a radial direction or along geometrical elements of the cone and to resist transverse transmissions of waves, or the varying of the density of the material of which the member is formed, or combining any two or more of these characteristics.

The invention comprehends other objects, advantages, capabilities and features as will later appear and are inherently possessed thereby.

Referring to the drawing, Figures 1 to 10 inclusive are transverse sectional views taken through different selected embodiments of the invention showing the application of the various characteristics mentioned.

Fig. 11 is a fragmentary sectional view of any part of any of the forms mentioned, showing the application of variation in density of material.

Referring now more in detail to the drawing, the embodiment shown in Fig. 1 is in the form of a cone having an apex 1, a body portion 2 and a rim or base portion 3. In this form the material is thicker at the apex than at the rim and varies or tapers from the apex toward the rim.

The cone shown in Fig. 2 has an apex 4, a body portion 5 and a rim portion 6, the body portion increasing in thickness from the apex towards the rim.

In the form shown in Fig. 3, the material may be of uniform thickness the member having an apex 7, a body portion 8 having a number of bulges or undulated portions 9 and a rim portion 10. In this construction, it will be noted that the ribs or undulations 9 are preferably of annular or ring form. It will be also apparent that when the actuating energy is applied at a point such as the apex 7, propagation of waves will be transmitted along the geometrical elements or radially therefrom toward the rim by way of the undulations, the latter facilitating the travel of such waves, but offering a resistance to and preventing transmission of waves laterally or transversely to such geometrical elements. In other words, this form of diaphragm will give a stiffness in a direction transverse to any of the radii thereof.

The form of device shown in Fig. 4 has an apex 11, a body portion 12 having undulations 13, and rim portion 14. This device is of the same construction as that shown in Fig. 3, with the exception that the material decreases in thickness from the apex 11 to the rim 14 thereof.

In Fig. 5, the device has an apex 15, a body portion 16, having undulations 17, and a rim portion 18. This construction is the same as that shown in Figs. 3 and 4 with the exception that the material increases in thickness from the apex towards the rim thereof.

The diaphragm member shown in Fig. 6 has an apex 19, a rim portion 20 and a body portion 21 having a number of thickened portions 22 and 23, the contour or the surfaces of this member being in the form of waves or the like by varying the thickness of the material to give such surface portions such contour.

The construction shown in Fig. 7 has an apex 24, a body portion 25 and a rim portion 26. The body portion varies in thickness so as to give a long wave form or contour to the surfaces of this member. This device is similar to that shown in Fig. 6 with the exception

that the thickened portion is of longer wave length than that of Figure 6.

In Fig. 8 the member has an apex 27, a body portion 28 and a rim portion 29. The body portion is undulated to form troughs 30 and 31 and a crest 32 of annular form as clearly shown. In this device the thickness of the material may be of uniform thickness if desired. By undulating the body portion, the sound may be transmitted or propagated radially and freely while at the same time resisted in a transverse direction.

The device shown in Fig. 9 is similar to that shown in Fig. 8 and has an apex 33, a body portion 34 and a rim portion 35. The body portion has undulations to provide troughs 36 and 37 and a crest 38. These troughs and crest are of annular or ring form so as to facilitate the transmission of waves in a radial direction or along the geometrical elements of the cone yet preventing the transmission of such waves in a transverse or lateral direction. This form is like that of Fig. 8 with the exception that the material decreases in thickness from the apex 33 to the rim 35.

In Fig. 10 the article is shown with an apex 39, a body portion 40 and a rim 41. The body portion is provided with annular troughs 42 and 43 and a crest 44. This construction is the same as that shown in Figs. 8 and 9 with the exception that the material increases in thickness from the apex 39 to the rim thereof.

In each and all of the forms above described, the material may also vary in density as shown in Fig. 11. Fig. 11 is a fragmentary sectional part of any one of the forms mentioned, and has a portion 45 of great density and portions 46 and 47 of comparatively less density. The density of the material may be varied at different loci or areas as desired, such as by having annular portions similar to the ribs of Figs. 3, 4 and 5 or the increased thickened portions of Figs. 6 and 7 or the undulated portion of Figs. 8, 9, and 10, so that nodal points will be established at given loci such as the more dense points or areas 45 and the less dense points or areas 46 and 47 may be freer to vibrate to give the necessary amplitude to the cone or sound fundamental to that part of the device.

The cones illustrated may be either of the type that has the rim portion clamped or secured and the apex part the point to which an actuating element of any suitable type may be connected to initiate the sound waves, or they may be of the free edge type whereby the rim is either suspended by flexible elements or wholly out of contact with any support, and the whole cone supported by means of the actuating element that may be connected to the point or apex of the cone.

The material of these diaphragmatic members is preferably of a fibrous nature with the fibres thereof disposed in accretions and interlaced so as to form an integral and seamless sound radiating and emitting member.

The geometrical points of the members in the different planes normal to the axis of the cone or the like are at different distances from a given or datum plane also normal to the axis. This datum plane may be at the base of the cone, or at the apex point, or outside. The cone shape is merely illustrative and the invention may comprehend a generally flat member, in which case the points of the different planes cutting the undulated or wave shaped parts and the tapered portions would therefore be at different distances from the datum plane. The trace of the cutting plane would, in the forms selected to illustrate the invention be circular but the invention is not limited to circular forms but the member may be polygonal, whether regular or irregular, and may be non-circular, as oval, elliptical and so forth. In each case, the section or cutting planes, whether cutting undulations or wavy generally flat members, or cutting conical, conoidal, pyramidal or other forms, would have the points of each cutting plane at a different distance from the given or datum plane than of any other such plane. By trace is meant the locus of the points common to the cutting plane and the surface of the member, be it the inner or outer surface, or the front or back surface.

While I have herein described and upon the drawing shown various illustrative embodiments of the invention, it is to be understood that the latter is not limited thereto but may comprehend other constructions, arrangements of parts, details, and features without departing from the spirit thereof.

Having thus disclosed the invention, I claim:

1. A sound radiator, comprising a fibrous diaphragmatic member having a locus for the application of energy to effect a radiation of sound from said member, said member varying in thickness and density in directions radiating from said locus.

2. A sound reproducing diaphragm comprising a cone-shaped body composed of deposited fibrous pulp, the fibers of which have been initially deposited in the form of said body, said fibers being arranged in interlaced accretions and normally free of internal stresses which may tend to change the form or shape of the cone-shaped body as originally formed.

3. A sound reproducing diaphragm comprising a cone-shaped body and an integral basal flange, said body and said flange being composed of deposited fibrous pulp, the fibers of which have been initially deposited in the form of said body, said fibers being arranged in interlaced accretions and normally free of internal stresses which may tend to change the form or shape of the cone-shaped body as originally formed.

4. A sound reproducing diaphragm comprising a cone-shaped body which is of substantially uniform thickness in a plane normal to the axis of the cone, said body being composed of accretions of interlaced fibers which have been initially deposited in the form of said body and are normally free of internal stresses that would tend to change the form or shape of the cone-shaped body as originally formed, the fibers being arranged to provide a cellular construction in said body.

5. A sound reproducing diaphragm comprising a cone-shaped body and an integral basal flange, composed of accretions of interlaced fibers which have been initially deposited in the form of the body and flange, said body being normally free of internal stresses that would tend to change the form or shape of the cone-shaped body as originally formed, the fibers of the body being arranged to provide a cellular construction therein, said body being of substantially uniform thickness in a plane normal to the axis of the cone.

6. A sound radiating device comprising a diaphragmatic member constructed of accreted fibers and having a point where energy may be applied for causing sound waves to proceed from said member, the accreted fibers being so arranged as to provide a body of wave-form in a radial direction from said point and approximately free of any strain which may tend to change the positions of the accreted fibers as originally deposited.

7. A sound radiating device comprising a diaphragmatic member of approximately conoidal form constructed of accreted fibers so arranged as to provide a series of annular areas of different wall thicknesses and for facilitating propagation of waves in radial directions, the accreted fibers being approximately free of any strain which may tend to change their positions as originally deposited.

In witness whereof, I hereunto subscribe my name to this specification.

JESSE B. HAWLEY.