Oct. 24, 1933. V. A. SCHLENKER 1,931,886

ACOUSTIC APPARATUS

Filed Aug. 30, 1926

Fig.1

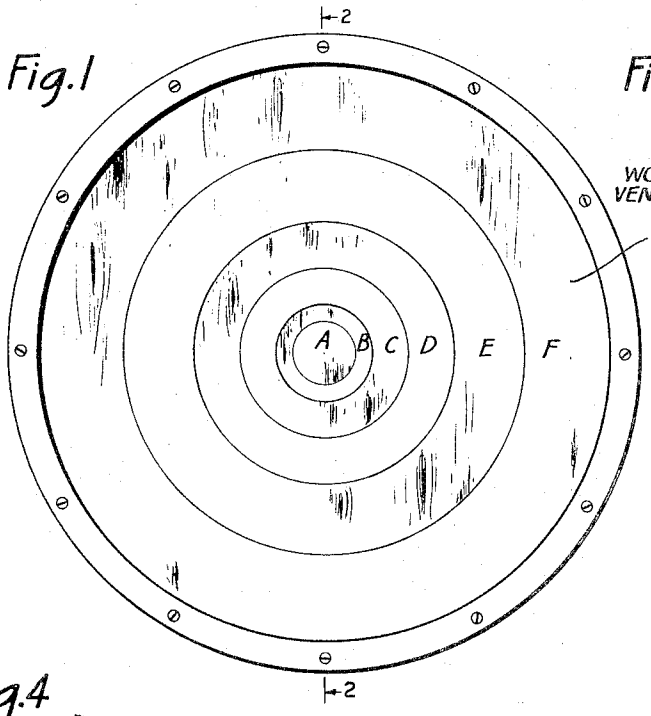


Fig.2

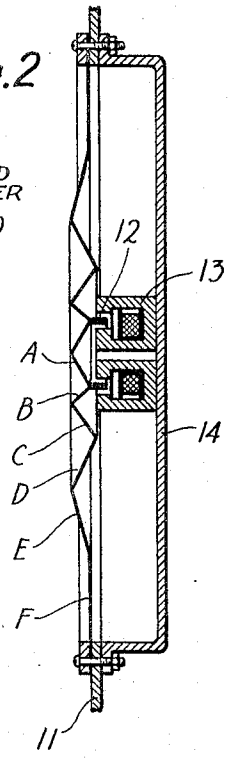


Fig.4

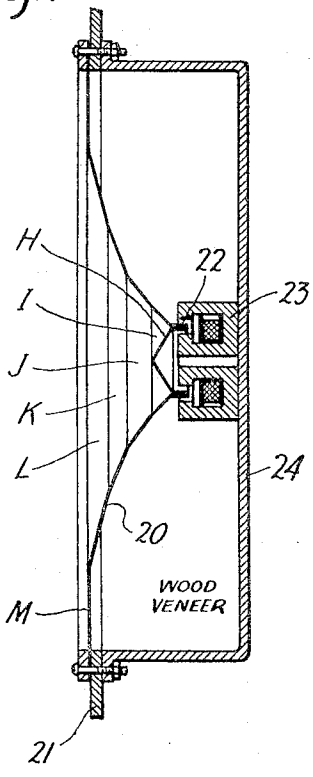


Fig.5

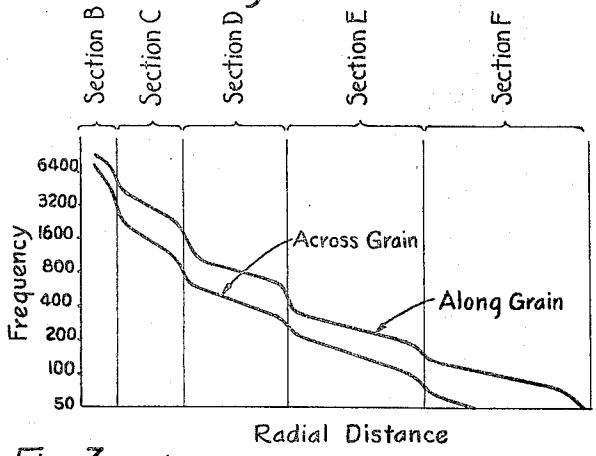
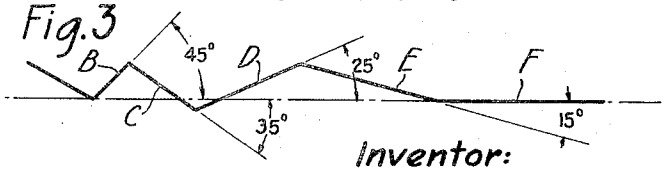


Fig.3



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UNITED STATES PATENT OFFICE

1,931,886

ACOUSTIC APPARATUS

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Application August 30, 1926. Serial No. 132,404

7 Claims. (Cl. 181—32)

This invention relates to acoustic apparatus and particularly to direct acting diaphragms for reproducing sound waves or for converting sound waves into mechanical or electrical vibrations.

An object of this invention to the reproduce sound waves of speech and music with clarity, naturalness and pleasing effect.

In a preferred embodiment, this invention comprises a diaphragm of wood veneer consisting of a series of conical sections joined at their edges, the angles between sections increasing from the center of the diaphragm to the periphery. The central conical section is preferably of comparatively small diameter and driven at several points on its circumference so that it vibrates as a whole with a plunger action.

The effect of progressively varying the angle between the sections in the above described manner is to make the diaphragm stiffer with respect to lateral motion at the center than at the edge so that the high frequency waves are efficiently radiated by the central portion and the low frequency waves by the outer portion. The stiffness of the wood veneer diaphragm in the direction of the grain is many times the stiffness at right angles to the grain, for example, for mahogany the stiffness ratio is about 30 to 1. Therefore a circular diaphragm of wood veneer is equivalent to an oval or elliptical diaphragm and the resulting effect is to eliminate resonance, giving a smooth response characteristic practically free from sharp peaks.

Obviously the feature of varying the angle between the conical sections may be applied to diaphragms of other materials and to ones either circular or elliptical in form, but since, in general, a circular diaphragm is the most economical to construct, the embodiment described above is preferred.

This invention can be more readily understood by reference to the following detailed description in connection with the drawing in which:

Fig. 1 is a front view of one embodiment of the invention;

Fig. 2 is a sectional view taken on line 2—2 of Fig. 1;

Fig. 3 is a detailed sectional view of the diaphragm of Fig. 1 illustrating the manner in which the angle between the sections is varied;

Fig. 4 is a sectional view of a modification of the invention; and,

Fig. 5 is a diagram showing graphically the effect of using a grained material.

Referring first to the embodiment shown in Figs. 1, 2 and 3, there is shown a direct acting wood veneer diaphragm 10 supported at its periphery by a rigid support or wall 11. The diaphragm consists of a plurality of conical sections A, B, C, D, E and a flat annular section F. The sections are preferably formed by joining the edges of adjacent sections together with glue or other suitable material, although the diaphragm may also be formed by bending a single piece of material to provide concentric conical sections as shown in cross-section in Fig. 2. The central section A is small in diameter and has a sharp angle at its apex giving a rigid structure which vibrates as a whole with a piston action. The portions B, C D and E are frusto-conical sections, alternate ones being arranged in opposite directions, giving a diaphragm which has a small lateral dimension so that it occupies little space. As illustrated in Fig. 3, the angle between the surface and the base of each section decreases progressively as one proceeds from the center section. In other words, the angle between the surfaces of successive sections increases. This gives a plurality of zones decreasing in stiffness toward the periphery of the diaphragm. The outer section F is a substantially flat ring clamped at its periphery to the support 11. The effect of varying the angle between the sections is to make the central sections more stiff for lateral vibrations than the outer sections so that the higher frequency waves are efficiently radiated by the inner sections and the lower frequencies by the outer.

The central cone A is driven by a motor unit 13 which is supported by a bracket 14 bridging the opening in the support 11. The motor unit is of the moving coil type having an annular coil 12 attached to the periphery of the section A.

Obviously other driving means may be employed. For example, the cone may be driven by a rod attached to the periphery of the section A by means of a spider arrangement, for example as shown in British Patent 263,411, accepted December 22, 1926.

As previously explained the effect of using a grained material such as wood veneer is to eliminate the resonance peaks by making the propagation constant of the diaphragm in one direction different from that in the other. This action is best illustrated by reference to Fig. 5, which represents the distance waves are propagated with a given loss plotted against frequency, one curve showing the distance along the grain and the other across the grain. It will be noticed that the propagation distance for a given frequency is appreciably greater along the grain than across

the grain. The result is that the vibrations spread in elliptical formation thus preventing a symmetrical wave propagation which would produce resonance at certain frequencies due to reflection from the edge of the diaphragm.

In the modification shown in Fig. 4 the conical sections I, J, K and L all extend in the same direction giving a bell shaped cone with a reentrant central conical section H. A flat annular section M is joined to the larger end of the section L and extends outwardly therefrom. This diaphragm 20 is supported at its periphery by a rigid support or wall 21 and is driven by a motor element 23 having a moving coil 22 attached to the periphery of the central section H, in a similar manner to the arrangement shown in Fig. 2. The motor element 23 is supported by a bracket 24.

In both modifications it is desirable that the supporting structure 11 or 21 extend for considerable distance around the diaphragm to act as a baffle for preventing sound waves generated at the back of the diaphragm from neutralizing those produced at the front.

What is claimed is:

1. An acoustic diaphragm of uniform thickness having a plurality of zones of varying transmission characteristics, the material of said diaphragm having a greater degree of stiffness in one direction than in the other.

2. An acoustic diaphragm comprising a plurality of conical sections joined at their edges, the angles between said sections progressively increasing uniformly toward the periphery of the diaphragm, the angular difference between adjacent sections being approximately ten degrees.

3. An acoustic diaphragm according to the preceding claim composed of material having a greater stiffness in one direction than in the other.

4. An acoustic device comprising a diaphragm of thin sheet material composed of a plurality of concentric conical sections united at their bases, said material having a greater degree of stiffness in one direction than in another, whereby the propagation constant of the diaphragm is different in the one direction from that in the other, and means attached to the base of one of the conical sections for driving said diaphragm.

5. An acoustic device comprising a diaphragm of fibrous material, said material being inherently stiffer in one direction than in the other, said diaphragm comprising a central conical portion surrounded by a plurality of conical annular portions and a flat annular portion.

6. An acoustic device comprising a diaphragm of fibrous material, said material being inherently stiffer in one direction than in the other, said diaphragm comprising a central conical portion surrounded by a plurality of conical annular portions and a flat annular portion, and means secured to the base of said central conical portion for driving said diaphragm.

7. An acoustic device comprising a diaphragm of wood veneer, said diaphragm comprising a conical central portion surrounded by a plurality of annular conical portions, and a flat annular portion, the heights of said annular conical portions decreasing toward the periphery of the diaphragm.

VESPER A. SCHLENKER.