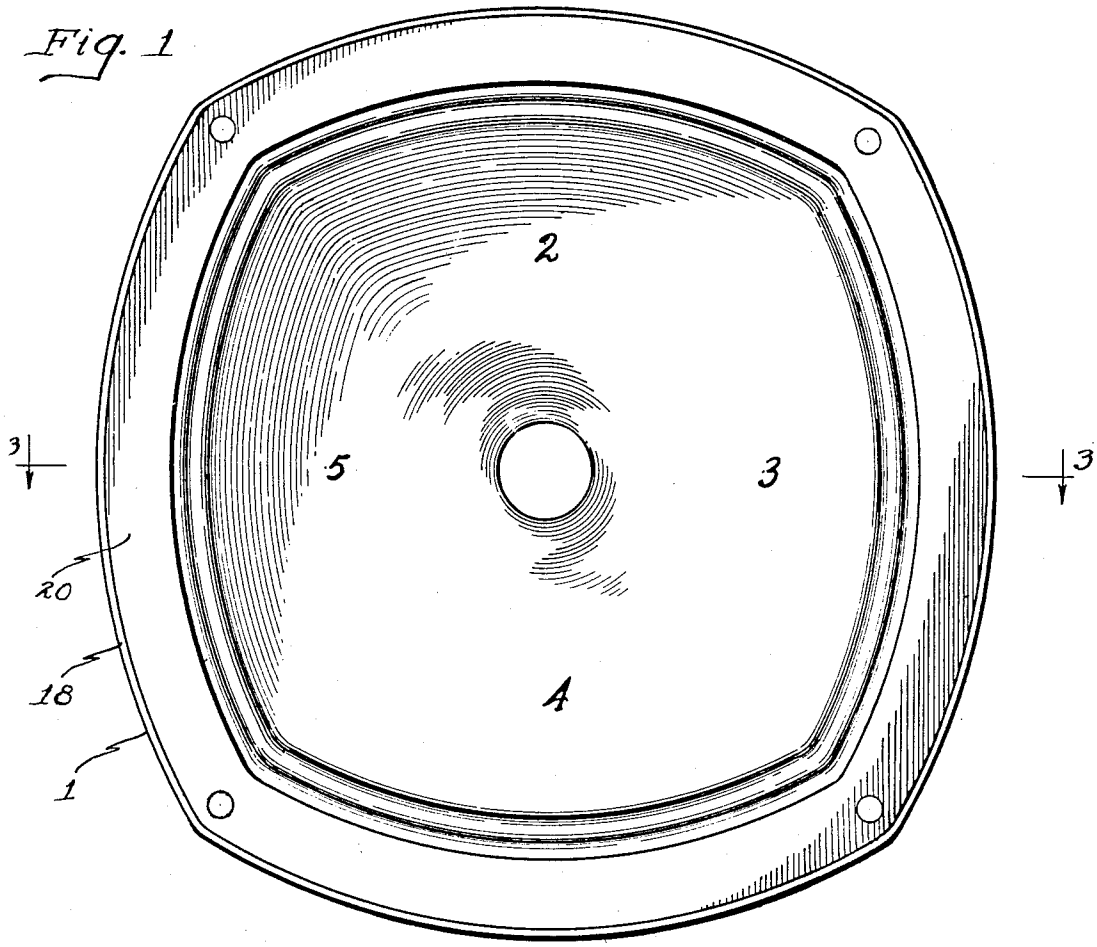
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ACOUSTICAL DIAPHRAGM

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Fig. 1



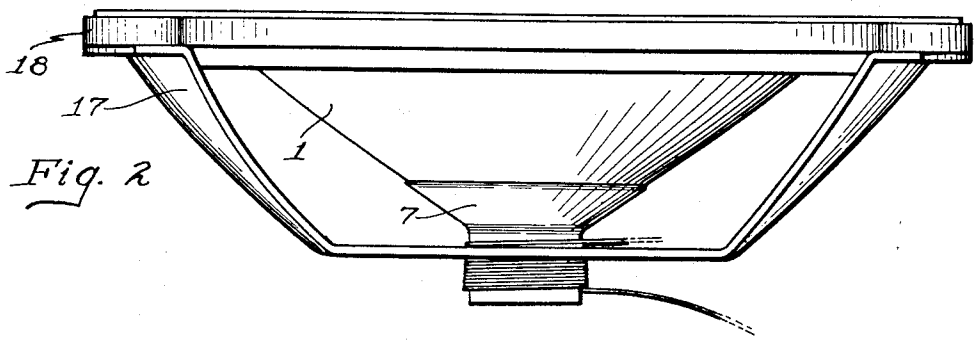


Fig. 2

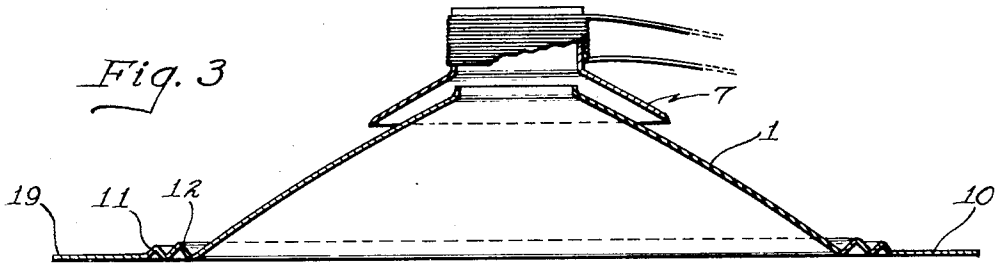
Inventor
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Fig. 3



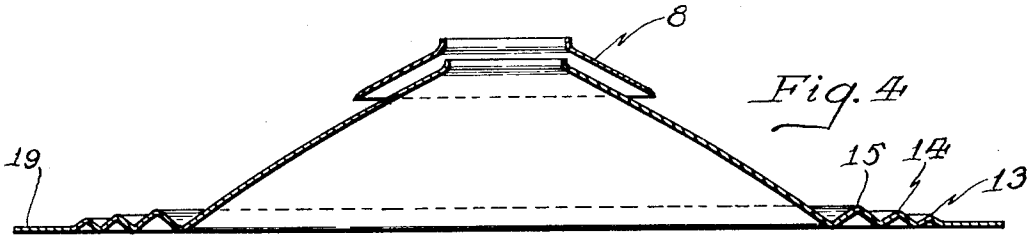
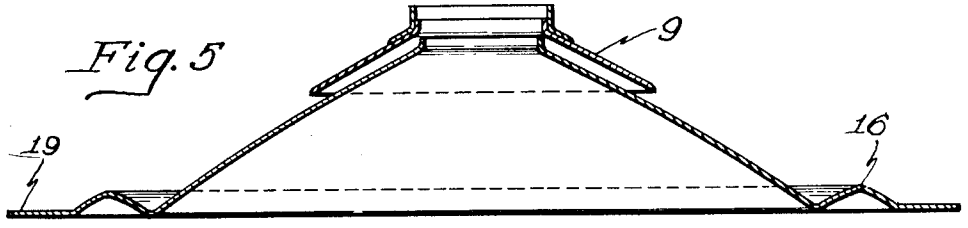


Fig. 4

Fig. 5



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2,124,834

ACOUSTICAL DIAPHRAGM

Willebald Conrad Stenger, Chicago, Ill.

Application August 17, 1936, Serial No. 96,401

7 Claims. (Cl. 181—32)

This invention relates to diaphragms of the class described in Patents Nos. 1,913,645 and 2,020,705. Such diaphragms are of a peculiar conoidal pyramidal form, and as the meeting points of the side walls are in angular relationship, the diaphragm as a whole is strengthened along definite lines extending in a radial direction. Such arrangements permit more or less independent response of these divisional portions of the diaphragm to impressed vibrations according to their relative areas, resistance to flexure and weight. That particular method of construction provides for radial reinforcements, and consequently the use of extremely light and thin moldable material for forming the diaphragm. It also has the advantage of large working area for the overall dimensions. The improved construction follows the same general plan of design as that described in the patents mentioned, but varies therefrom by the inclusion of a peculiar arched formation of the perimetrical flange of the diaphragm, and a laminated reinforcement at the center which is in some instances so formed as to provide the collar for the voice coil or actuating element now commonly used in sound reproducing equipment of radios.

The central reinforcement referred to is used for the reason that conical diaphragms frequently become faulty or collapse or buckle or tend to weakness at the vertex. This is also at the location of the voice coil or other actuating means where the shocks of impulses are strongest. Whether the diaphragm is used as a reproducer of sound or the motion of the diaphragm is used for transmission purposes the reinforcement is made separate from the diaphragm, though generally of the same material but of various sizes and strengths according to its intended use. Various qualities of tone such as brilliance and resonance as well as the more or less higher or lower register of tone and sound may be largely controlled by adjusting the resisting capacity of this part of the diaphragm. The reinforcement becomes a part of and is permanently attached to the diaphragm by the use of flexible casein cement or equivalent means.

As before mentioned, the walls of the diaphragm are arched in such manner as to have a double curvature, and the peripheral arching of the diaphragm follows a plan or formula disclosed in Patent No. 1,913,645. The varied size and altitude of the peripheral arches provide a valuable means within a wide range to meet special requirements for various degrees of sensitivity and elasticity throughout the entire musical scale.

The body of the diaphragm is formed from especially selected pulp which is strengthened and made more resilient and resistant to hard usage by applying to both sides of the diaphragm a flexible, membranous veneer made from cellulose material which may be pyroxylin, ether, and alcohol, with Venice turpentine and linseed oil added. Canada turpentine and castor oil may however be added instead.

The veneer coating preferably does not penetrate the body of the diaphragm further than necessary for an adhesion. Thus a section through the body of the diaphragm shows it to be of light material, having surface layers which afford maximum resistance to vibration and a softer, more neutral body between the surfaces. In order to attain such a result after the water has been thoroughly evaporated from a blank diaphragm, the latter is saturated with alcohol and then immediately covered with the membranous coating in a somewhat thick fluid state, and which hardens rapidly. The coating is applied by spraying and the alcohol prevents the coating from permeating the fibrous material of the diaphragm.

The curvature of the walls of the diaphragm is such that one wall preferably blends edgewise into another but at sharper curvature to form radial reinforcements where the walls meet. These reinforcements are most evident near the periphery, and disappear into circular curvature in the vicinity of the apex reinforcement.

From the foregoing it may be seen that an object of the invention is to enhance the utility of diaphragms of the class mentioned by rendering them more thoroughly responsive to sound impulses within a wide range. Another object of the invention is to provide a diaphragm responsive to tone variations and separable tones within the range required for voice and music reproductions, and to avoid losses in this respect likely to occur in many other forms of acoustical diaphragms.

The objects of the invention are accomplished by means of a construction such as illustrated in the drawings, wherein:

Figure 1 is a plan view of the diaphragm, and its supporting structure.

Figure 2 is a side view of the diaphragm.

Figure 3 is a sectional view taken on the line 3—3 of Fig. 2, but with its central reinforcement and voice coil supporting element shown spaced from the body of the diaphragm.

Figures 4 and 5 are sectional views similar to that shown in Fig. 3, showing variations of the peripheral corrugation of the diaphragm and variations of the laminated central reinforcements, which reinforcements, for the sake of clearness are shown detached from the body of the diaphragm.

For an illustration of an exact form of the diaphragm reference is made to Figs. 1, 2 and 3, wherein 1 designates a semi-conical pyramidal diaphragm, the walls 2, 3, 4, and 5 of which

gently merge in an easy curve. The diaphragm is further reinforced centrally by a collar shown in modified forms at 7, Fig. 3, 8, Fig. 4, and 9, Fig. 5. Adjacent its peripheral supporting flange 10, the diaphragm is marginally reinforced by the ripple-like radially arched ridges shown in modified forms at 11 and 12, in Fig. 3; 13, 14, and 15, in Fig. 4; and 16, in Fig. 5. While these marginal and concentric ripple-like reinforcements add rigidity to the diaphragm in one direction, they also increase its flexibility for vibration as a whole from its supporting flange 10. These annular arches are found to give highly valued increases in functional capacities of this type of diaphragm. It is thus freed for work in different areas near its periphery, and has more flexibility and elasticity as a whole by virtue of this added feature.

The supporting frame structure for the diaphragm consists of a bridge 17 which carries a ring-like structure 18 formed in outline to conform to the flat portion, 19 of the peripheral flange 10 of the diaphragm, and having a recess for receiving the flange of the diaphragm, and a cushioning gasket 20, which bears against an apertured support not shown, to which the device is attached.

Applicant's Patent No. 2,020,705 describes a diaphragm which in design is a pyramidal shell, the walls of which have a double curvature; that is, each wall is curved in both radial and annular directions. That structure is now further refined as to form, in order to perfect its acoustic effects.

The side walls of the diaphragm are of novel conoidal curvature. Successive cross sections through the diaphragm from the center toward the base are first circular and then gradually change toward a curved-sided quadrangular polygon with rounded corners. Thus the corner portions of the side walls of the diaphragm are apparent as curved ridges near the base, and disappear into uniform conical curvature at the apex.

When the diaphragm is vibrating under impressed sound waves or by motion imparted thereto at its center, the maximum amplitude of motion takes place at the center where the structure is most rigid. Where the minimum motion takes place at the peripheral flange ring, the diaphragm is flanged and corrugated in peripheral wave-like formation. These wave-like flange arches are of different altitudes, being reduced in height successively toward the outside, and naturally vibrate with the diaphragm as a whole, but presumably to some degree independently of the main body of the diaphragm according to their responsiveness to vibrations of corresponding frequency. These flange arches afford complete control of all undue over-tones and other inimical effects. With flattened arches the tones become more resonant and deep while with arches of higher altitudes the tones become more brilliant.

The peripheral arches have to do with the flexibility, sensitivity and resisting capacity of that portion of the diaphragm and are quite different in function over the customary reversed curved corrugations of many conical diaphragms. Corrugations of standard form are likely to afford too much freedom of motion of the diaphragm laterally of its axis. The peripheral arches are also arced, that is, curved outwardly from the apex to the base.

A diaphragm of the particular form herein disclosed is based on a cone of selected dimensions as to diameter of the base with reference to the distance between the base and apex. The side walls of the structure do not follow such cone form but are given a definite outward curvature according to the formula disclosed in Patent No. 1,913,645. The particular diaphragm herein disclosed is concave along its intrados outline with a curvature from the base toward the apex and this curvature is determined by first finding the center of an arch determined by the apex of the cone and the points of intersection of its side walls with the base of the cone. Then the radius of the arc forming the arch is multiplied by six to attain the radius of the particular arc which the side wall of the finished diaphragm follows. The center for this last-mentioned arc is on a line which bisects the hypotenuse, or side wall, of the cone, at right-angles thereto.

The same method is employed for determining the arcing of the circumambient arches 11 to 16, Figs. 3, 4 and 5. The altitude of the arches, both of the diaphragm as a whole, and the circumambient arches, determines the timbre and various qualities of tone of the diaphragm. With a diaphragm of the proportions illustrated, the six to one ratio for arcing the arches gives the most perfect results so far attained with this construction, although fairly good results may be attained with slightly different ratios such as may be included within the range of five to one and seven to one.

I claim:

1. An acoustical diaphragm of conical form near its center and gradually changing from such form toward its periphery into an outwardly-curved sided pyramidal form, and said diaphragm having a laminated reinforcement at its center.

2. An acoustical diaphragm of a conoidal form whose radial sections are outwardly convex and whose transverse sections are circular near the apex and outwardly-convex curved-sided polygons near the base.

3. An acoustical diaphragm of a truncated conoidal form whose radial sections are outwardly convex and whose transverse sections are circular near the apex and outwardly-convex curved-sided polygons near the base.

4. An acoustical diaphragm of double curvature comprising conoidal surfaces whose radial sections are outwardly convex and whose transverse sections taken perpendicularly to the axis are circular near its apex and outwardly-convex curved-sided polygons near its base.

5. An acoustical diaphragm of double curvature comprising conoidal surfaces whose radial sections are outwardly convex and whose transverse sections taken perpendicularly to the axis are circular near its apex and round-cornered outwardly-convex curved-sided polygons near its base.

6. An acoustical diaphragm having a conoidal surface whose base margin is an outwardly-convex curved-sided polygon and whose radial section lines are outwardly convex.

7. An acoustical diaphragm having a conoidal surface whose base margin is an outwardly-convex curved-sided polygon and whose radial section lines are outwardly convex, and having walls of substantially uniform thickness throughout said conoidal area, and being reinforced by an extra conical layer of like material adjacent the apex.

WILLEBALD CONRAD STENGER.