Feb. 13, 1934. H. E. SCHOENHUT 1,947,362

DIAPHRAGM

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Fig. 1.

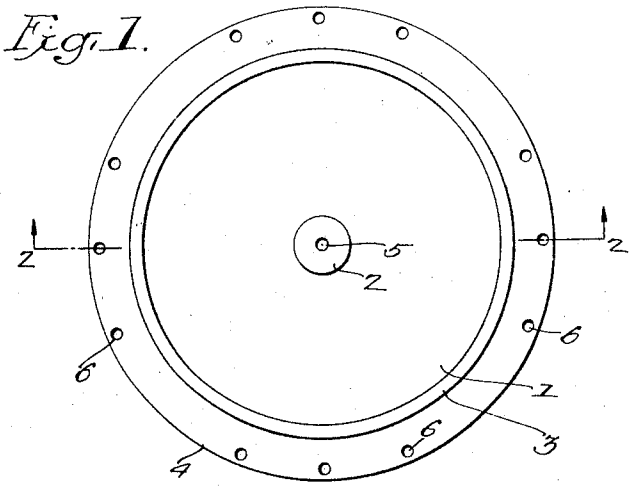


Fig. 2.

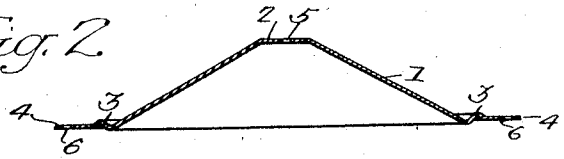


Fig. 3.

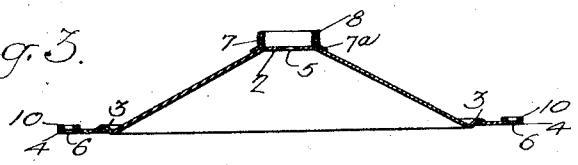
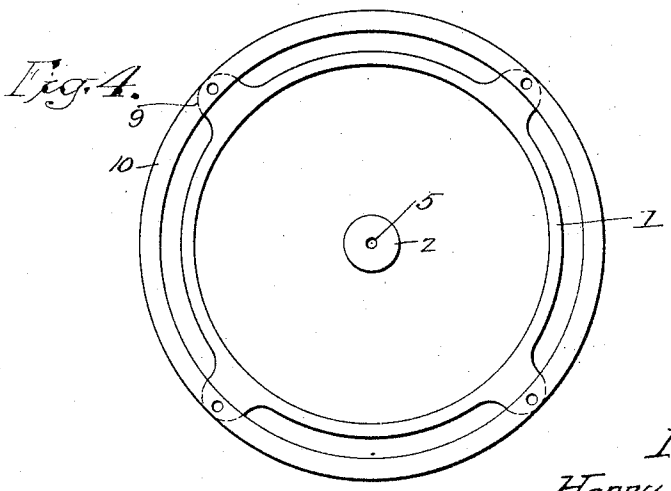


Fig. 4.



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Fig. 5.

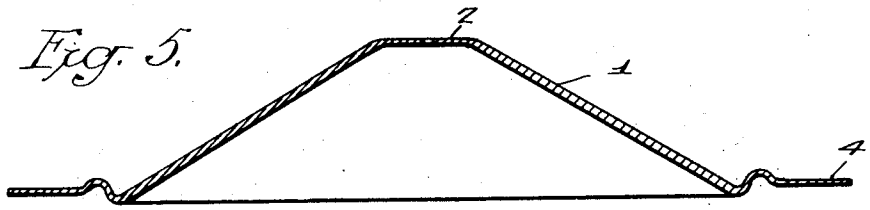


Fig. 6.

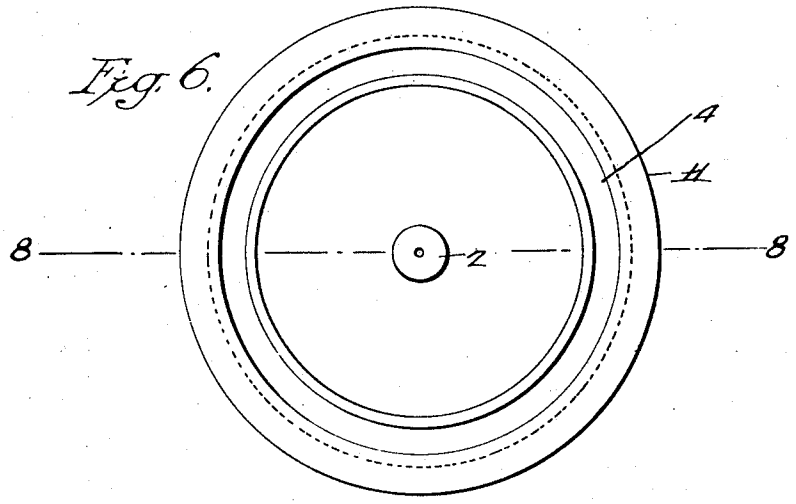


Fig. 7.

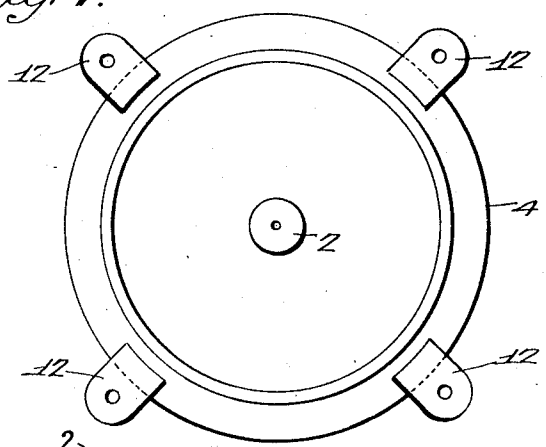
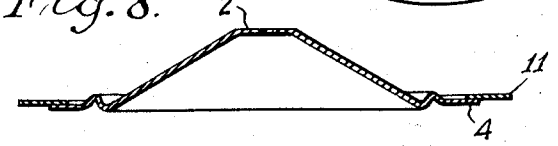


Fig. 8.



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Patented Feb. 13, 1934 1,947,362

UNITED STATES PATENT OFFICE

1,947,362

DIAPHRAGM

Harry E. Schoenhut, Philadelphia, Pa.

Application January 23, 1930. Serial No. 422,764

2 Claims. (Cl. 181—32)

This invention relates primarily to improvements in sound reproducers, and more particularly to improvements in the diaphragms of reproducers of the type employed in radio receiving apparatus.

An object of the invention is to provide a diaphragm of simple and relatively inexpensive construction that will be highly efficient in operation and shall possess certain desirable characteristics not present in commercial diaphragms of a similar type.

A more specific object of the invention is to provide a seamless conical or other shaped diaphragm of paper.

A further object of the invention is to provide a seamless paper diaphragm of a desirable rigidity and strength having integral means of sufficient resilience to afford the freedom of movement necessary for the sound reproducing function.

A still further object of the invention is to provide a seamless paper diaphragm adapted for use with sound reproducers of the electrodynamic type.

The invention further resides in the novel method of manufacture and in certain structural details hereinafter set forth and illustrated in the attached drawings, in which:

Figure 1 is a face view of a diaphragm made in accordance with my invention;

Fig. 2 is a section on the line 2—2, Fig. 1;

Fig. 3 is a section similar to that of Fig. 2 illustrating the diaphragm with the voice coil and rim attached;

Fig. 4 is a plan view similar to Fig. 1 showing a modified form of diaphragm;

Fig. 5 is a transverse sectional view illustrating a desirable embodiment of my invention;

Figs. 6 and 7 are face views of diaphragms illustrating still other modifications within the scope of the invention, and

Fig. 8 is a section on the line 8—8, Fig. 6.

With reference to the drawings, my diaphragm may comprise in a preferred form a truncated conical section 1 having an integral web 2 extending across the apex end and at the base of the cone one or more corrugations or ribs 3. In the present instance, the diaphragm is extended beyond the rib 3 to provide a rim 4 integral with the other portions of the diaphragm. As illustrated, the web 2 is centrally apertured at 5 to provide a means for attaching the diaphragm to a relatively fixed part of the reproducer structure, and apertures 6 are also provided in the rim 4 for a similar purpose.

A diaphragm of this type is adapted to have attached at the apex end a diaphragm-actuating coil 7 which in assembly occupies a position within a restricted gap between energized pole pieces, the coil 7 being energized from the signal source and by reason of the variable character of the energizing current oscillating within the electric field and thereby effecting an audible reproduction of the signal through the resultant movement of the diaphragm. In the present instance, the coil 7 is supported upon a cylindrical form 8 which is secured by means of radially projecting tongues 7*a* and a suitable adhesive to the apex end of the cone, as clearly illustrated in Fig. 3. Where the apex end of the diaphragm is fixed by means for example of a screw passing through the aperture 5, to a stationary part of the reproducer structure, it is essential that the web 2 be sufficiently flexible to permit oscillation of the coil 7 and of the conical portion of the diaphragm as described. In order to provide this resilience in the web 2 and at the same time maintain a desirable rigidity in the conical portion 1, I prefer to make the web portion 2 of lesser thickness than the conical portion 1, see Fig. 5. Where the rigidity of the conical portion is sufficient to prevent undesirable movements in the diaphragm as a whole, the reinforcing rib 3 may be eliminated. This rib, however, is in most instances desirable as tending to prevent weaving actions or irregular movements in the cone, and also as adding flexibility for movement of the cone in normal operation. Where the rim 4 is directly secured to a stationary part of the reproducer, I prefer to make this portion also of lesser thickness than the conical portion 1, see Fig. 5, thereby to provide for relatively free movement of the diaphragm under the action of the coil 7. In some instances, in order to increase the flexibility, the circular rim may be replaced by a plurality of integral lugs 9 projecting from the base of the cone or from the rib 3, as illustrated in Fig. 4. Or the rim 4 and lugs 9 may be replaced as securing elements by a non-integral annulus 11, Fig. 6, or lugs 12, Fig. 7, of a flexible material such as a fabric or soft leather, and in such instance the integral rim 4 simplifies the attachment of the non-integral elements by affording a flat surface to which said elements may be readily attached by adhesive or other means. In any case, it has been found useful to secure to the rim portion 4 or to the lugs 9 a relatively rigid ring 10 which may be made

of fibre or similar strong and light material.

I have discovered that with the proper materials and by a procedure hereinafter set forth, a diaphragm of the aforedescribed character may be formed integrally from sheet paper, and when so made will possess in pronounced degree the desirable characteristics of strength, rigidity, lightness of weight, and, in the desired parts, of flexibility. Such a diaphragm is simple and relatively inexpensive to manufacture and is not subject to material change with atmospheric variations.

In the manufacture of the diaphragm, I have found suitable as the base material a long fibre, relatively strong paper of good quality that is capable of withstanding without rupture the strains of a dieing operation in which the paper is shaped from its original flat form to the desired conical or other configuration. In this operation, the paper is first moistened to a degree permitting a relative movement of the fibres to an extent permitting the paper sheet as a whole to conform to the new shape without rupture or undue weakening at any point. It is essential for best results that the paper shall be extremely uniform as to texture and thickness so that in the dieing operations the modification in the structure of the paper itself shall take place with substantial uniformity throughout the entire sheet. I prefer to leave the apex web 2 and the rim portion 4 or lugs 9 in their original thickness during the dieing operation, these parts subsequently being reduced in thickness by abrasion or scraping or by other suitable means to afford them the desired resiliency. In view of the fact, however, that these portions are not subjected to the maximum strains in the dieing operation, they may have the reduced thickness prior to the dieing operation. In some instances, the desired flexibility in these parts may be obtained in a diaphragm or uniform thickness throughout.

For best results, heated dies are employed which not only shape the diaphragm but in effect iron it and set it in the desired form. The heated dies also effect a relatively rapid drying of the material in the mold.

I have found that under proper conditions of moistness and with the proper grade and quality of paper a seamless conical or other shaped diaphragm is obtainable by this method, the surface of which is substantially smooth and free from wrinkles, and which possesses all the desirable charactetristics set forth above.

It will be understood that the diaphragm may take a variety of shapes other than that illustrated, and may be provided with such reinforcing ribs or corrugations as may be found desirable.

I claim:

1. A diaphragm comprising a seamless truncated conical portion of paper and an integral web extending across the apex end thereof, said web being relatively flexible as compared to the conical portion.

2. A diaphragm comprising a seamless truncated conical portion of paper and an integral web of lesser thickness than the material of the cone extending across the apex end of the latter.

HARRY E. SCHOENHUT.