

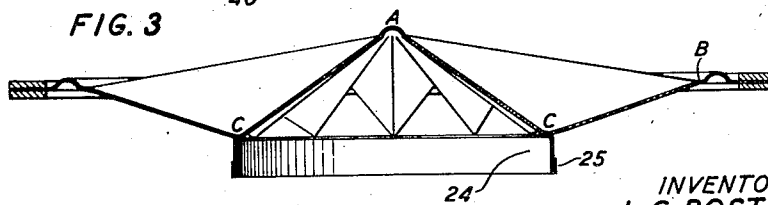
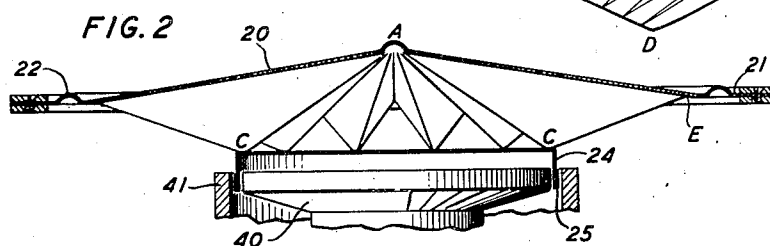
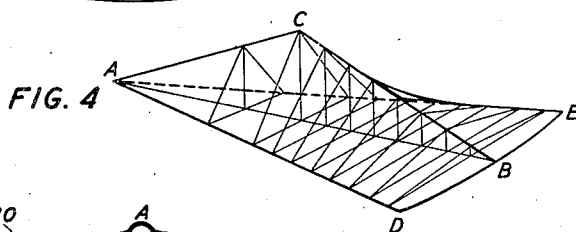
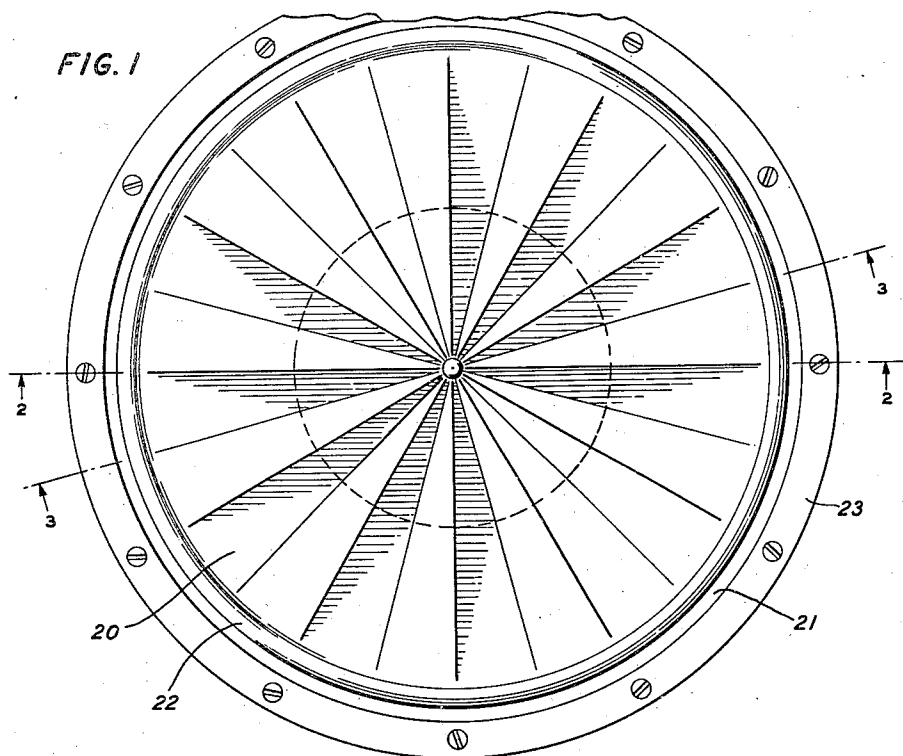
July 4, 1933.

L. G. BOSTWICK
SOUND TRANSLATING DEVICE

1,917,013

Filed Dec. 27, 1930

3 Sheets-Sheet 1



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FIG. 5

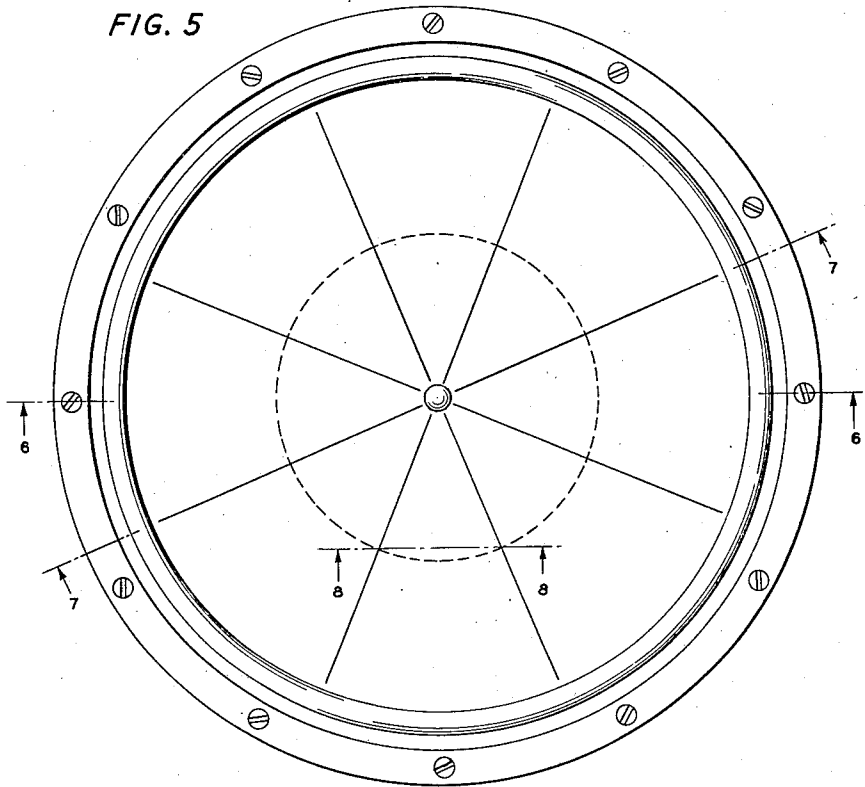


FIG. 6

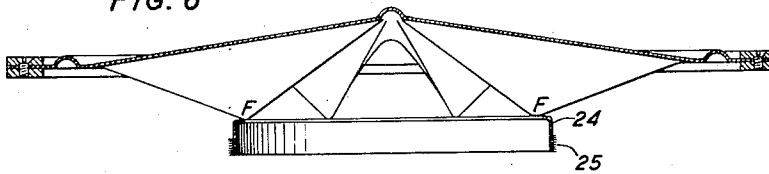


FIG. 7

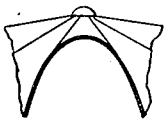
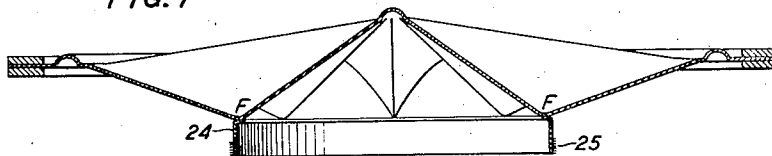


FIG. 8

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FIG. 9

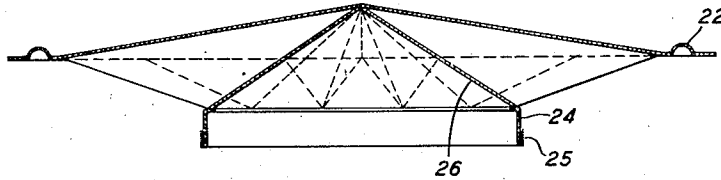


FIG. 10

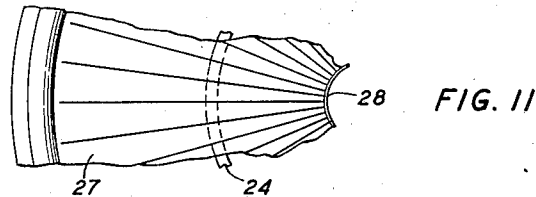
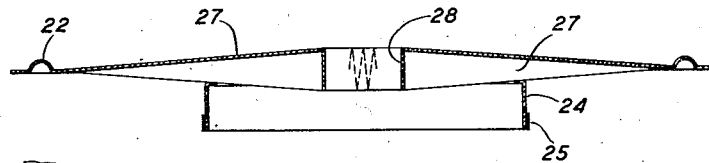


FIG. 11

FIG. 12

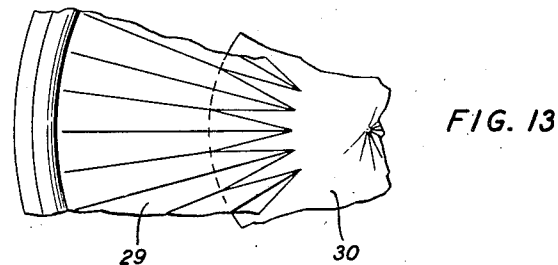
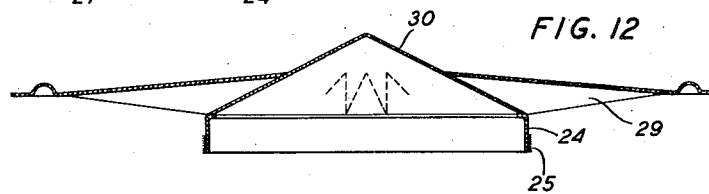


FIG. 13

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UNITED STATES PATENT OFFICE

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SOUND TRANSLATING DEVICE

Application filed December 27, 1930. Serial No. 505,068.

This invention relates to sound translating devices and more particularly to pleated diaphragms for moving coil actuated loud speakers.

5 An object of this invention is to translate sound uniformly and with relatively high efficiency over a wide frequency range.

Another object of this invention is to facilitate the attachment of a driving coil to a
10 pleated diaphragm.

In accordance with a feature of this invention a pleated diaphragm is so formed that it will vibrate as a piston throughout the lower
15 portion of the audio-frequency spectrum approximately up to the frequency at which the radiation resistance approaches a constant and will break up above this frequency in such manner that a uniform response and
20 efficiency will be obtained throughout a wide frequency range.

In accordance with another feature of this invention a pleated diaphragm is so formed and so associated with a driving coil that the ratio of the diaphragm stiffness to the
25 diaphragm mass will be large.

In accordance with still another feature of this invention a pleated diaphragm is so formed that no confined air chamber will be present between the diaphragm and the associated magnetic structure.
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These and other features of this invention will be more clearly understood from the following detailed description with reference to the accompanying drawings in which:
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Fig. 1 is a plan view of one embodiment of a diaphragm made in accordance with this invention and a mounting therefor;

40 Figs. 2 and 3 are cross-sectional views along lines 2—2 and 3—3 respectively of Fig. 1;

Fig. 4 is a perspective view of a single pleat (inverted) of the diaphragm illustrated in Figs. 1 to 3 showing the development of
45 the surface thereof;

Fig. 5 is a plan view of another embodiment of a diaphragm made in accordance with this invention and the mounting therefor;
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Figs. 6, 7 and 8 are cross-sectional views

along lines 6—6, 7—7 and 8—8 respectively of Fig. 5;

Figs. 9 and 10 are diametral cross-sectional views of other embodiments of diaphragms made in accordance with this invention;
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Fig. 11 is a fragmentary plan view of the diaphragm shown in cross-section in Fig. 10;

Fig. 12 is a diametral cross-sectional view of another diaphragm made in accordance with this invention; and
60

Fig. 13 is a fragmentary plan view of the diaphragm shown in cross-section in Fig. 12.

Referring now to the drawings, the acoustic diaphragms of this invention comprise a rigid central portion 20 having radially extending pleats, a peripheral portion 21, and an annular flute or trough portion 22 connecting the central portion 20 and peripheral portion 21. The portions 21 and 22 are preferably integral with the central portion 20, although they may be separate portions suitably secured together. The peripheral portion 21 is clamped between mounting rings 23 or otherwise suitably attached to a supporting member. The trough portion 22 serves as a yielding link between the central portion 20 and the peripheral portion 21 so that little restraint is offered to relatively large movements of the periphery of the central portion substantially parallel to the central axis of the diaphragm. The central portion 20 is adapted to vibrate as a whole, analogous to a piston, over the lower portion of the audio-frequency spectrum, that is approximately up to the frequency at which the radiation resistance of the diaphragm approaches a constant. Beyond this frequency the diaphragm breaks up and operates as a wave transmission device.
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In accordance with this invention the central portion 20 of the diaphragm is so formed and proportioned that it breaks up in a manner such that a uniform response and efficiency are obtained throughout substantially the entire range of frequencies it is desired to translate.
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In the embodiment of the invention shown in Figs. 1 to 4 inclusive, the pleats constituting the central portion 20 of the diaphragm, are substantially pyramidal in outline and
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are so formed that any right section thereof perpendicular to the ridge of the pyramidal pleat is a triangle. The development of the pleats will be evident from Fig. 4 wherein a plurality of parallel right sections through a single pleat of a diaphragm in accordance with this invention are shown. The several sections are formed by passing parallel planes through the pleat perpendicular to the plane ADE and also perpendicular to the plane ACB which bisects the plane figure ADE and is perpendicular thereto. The projections of the pleats upon planes parallel to the plane ACB, as shown in Figs. 2 and 3 are triangles and in a preferred embodiment as illustrated are substantially isosceles triangles, that is, the ridges AC and CB are of equal length. In diaphragms of this construction the conical chamber bounded by the points A and C communicate with the free atmosphere through the open spaces between the pleats so that free ingress and egress of air is allowed. This reduces the stiffness of the air chamber at the rear of the diaphragm and results in an improved diaphragm operation. Furthermore, it is evident from this construction that since the central portion within a cone passing through points A and C is cut away, the mass of the diaphragm is relatively low in comparison with pleated diaphragms known heretofore in the art, for example, of the type shown by Lumiere Patent 986,477. The flanged metallic ring 24 is affixed to the apex C of each of the pleats and serves to reinforce the central portion of the diaphragm 20 and also serves as a mounting for an annular driving coil 25. The coil 25, which may comprise a flat ribbon conductor wound edgewise and cemented or otherwise suitably affixed to the ring 24, is adapted to reciprocate in an annular air gap formed by concentric pole pieces 40 and 41 of a permanent or an electromagnet.

In another embodiment of this invention illustrated in Figs. 5 to 8 inclusive, the central portion 20 of the diaphragm comprises a plurality of radially extending dome shaped pleats. The pleats are similar to those in the embodiment of this invention shown in Figs. 1 to 4 inclusive and are so formed that any section, such as shown in Fig. 8, substantially parallel to the central axis of the diaphragm and perpendicular to the radius coincident with the center of each pleat is an arc. In a preferred form each section is substantially sinusoidal. The projection of each pleat upon a diametral plane passing through the apex F of the pleat is a triangle and preferably an isosceles triangle. The diaphragm is actuated by the driving coil 25 suitably affixed to a ring 24 secured to the apices F of the pleats.

In another embodiment of this invention shown in Fig. 9, the pleats constituting the

central portion of the diaphragm are similar to those illustrated in Figs. 1 to 4 inclusive and the rigidity of the diaphragm is increased by a reinforcing cone 26 rigidly affixed to the inner ridges of the pleats. A ring 24 is suitably attached about the periphery of the cone 26 and serves as a support for the driving coil 25.

In the embodiment of the invention illustrated in Figs. 10 and 11 the diaphragm comprises a radially pleated portion 27 and a hollow cylindrical reinforcing sleeve 28, the opening in said sleeve serving as a path for the egress and ingress of air. A ring 24 is suitably affixed to the pleats 27 intermediate the ends thereof and supports a driving coil 25.

In still another embodiment of this invention shown in Figs. 12 and 13 the diaphragm comprises a radially pleated portion 29 and a conical portion 30. The radial pleats constituting the portion 29 are chamfered to fit closely with the conical portion 30 and are suitably affixed thereto, such as by a cement. The ring 24 carrying the driving coil 25 is attached to the base of the conical portion 30.

It has been found advantageous to make the mechanical impedance of the diaphragm substantially equal to the mechanical motion-al resistance at some frequency between the lowest frequency it is desired to reproduce and the frequency at which the diaphragm ceases to vibrate as a whole. The preferred range is between 100 and 400 cycles. This feature and the several advantages thereof are discussed more fully in my copending application, Serial No. 486,381, filed October 4, 1930.

What is claimed is:

1. A sound translating device comprising a pleated diaphragm, a ring member affixed to said diaphragm intermediate its center and edge for reinforcing it, and actuating means attached to said ring member.
2. A sound translating device comprising a pleated diaphragm, a ring member affixed to said diaphragm at points substantially midway between its center and edge for reinforcing it, and means mounted on said ring member for driving said diaphragm.
3. An acoustic diaphragm having a pleated portion comprising a plurality of radially extending substantially triangular pyramidal pleats, the projection of each pleat on a diametral plane passing through the radius coincident with the longitudinal axis of the pleat being an isosceles triangle.
4. An acoustic diaphragm comprising a plurality of substantially triangular pyramidal radially extending pleats, any right section of each pleat parallel to the central axis of the diaphragm and perpendicular to a radius coincident with the longitudinal axis of said pleat being a triangle.

5. An acoustic diaphragm comprising a plurality of substantially triangular pyramidal radially extending pleats, any right section of each pleat parallel to the central axis of the diaphragm and perpendicular to a radius coincident with the center axis of said pleat being an isosceles triangle.

6. An acoustic diaphragm in accordance with claim 4 in which the projection of each pleat upon a diametral plane passing through the center axis of the diaphragm and through a radius coincident with the longitudinal axis of the pleat is a triangle.

7. An acoustic diaphragm in accordance with claim 4 in which the projection of each pleat upon a diametral plane passing through the center axis of the diaphragm and through a radius coincident with the longitudinal axis of the pleat is an isosceles triangle.

8. An acoustic diaphragm comprising a plurality of pyramidal dome shaped radially extending pleats.

9. An acoustic diaphragm comprising a plurality of dome shaped radially extending pleats, the projection of each pleat on a diametral plane passing through the central axis of the diaphragm and through a radius coincident with the longitudinal axis of the pleat being a triangle.

10. An acoustic diaphragm in accordance with claim 9 in which the projection is an isosceles triangle.

11. An acoustic diaphragm comprising a plurality of radially extending dome shaped substantially triangular pyramidal pleats.

12. A sound translating device comprising a diaphragm having a plurality of radially extending substantially pyramidal pleats, and means attached to the apices of said pyramidal pleats for driving said diaphragm.

13. A sound translating device comprising a diaphragm having a plurality of radially extending substantially pyramidal pleats, the projection of each pleat upon a diametral plane passing through the central axis of the diaphragm and through a radius coincident with the longitudinal axis of said pleat being an isosceles triangle, a rigid annular member attached to the apices of said

pyramidal pleats, and actuating means connected to said annular member.

14. An acoustic diaphragm comprising a rigid, radially pleated portion, the projection of each pleat on a diametral plane passing through a radius coincident with the longitudinal axis of the pleat being a triangle, and any right section of said pleat perpendicular to said diametral plane being a triangle, a peripheral portion, and a trough portion intermediate said pleated and said peripheral portions and integral therewith.

15. A sound translating device comprising a vibratory element including a pleated diaphragm, and means for actuating said diaphragm, the mechanical motional resistance at said means being substantially equal to the motional impedance of said diaphragm at a frequency between 100 and 400 cycles.

16. An acoustic diaphragm including a rigid portion comprising a plurality of pyramidal dome-shaped radially extending pleats; a peripheral portion, and a relatively flexible portion intermediate said rigid and peripheral portions.

17. A sound translating device comprising a diaphragm having a plurality of pyramidal dome-shaped radially extending pleats, and actuating means for said diaphragm connected to the apices of said pleats.

18. A sound translating device comprising a diaphragm having a plurality of pyramidal dome-shaped pleats, an annular member secured to the apices of said pleats, and driving means mounted on said annular member.

19. An acoustic diaphragm comprising a plurality of radially extending pleats, right sections of which perpendicular to a radius coincident with the longitudinal axis of said pleats are substantially sinusoidal.

20. A sound translating device comprising a diaphragm having pyramidal sinusoidally arched pleats, and means for actuating said diaphragm secured to the apices of said pleats.

In witness whereof, I hereunto subscribe my name this 18th day of December, 1930.

LEE G. BOSTWICK.