April 13, 1937. H. C. HARRISON 2,077,170

ACOUSTIC DEVICE

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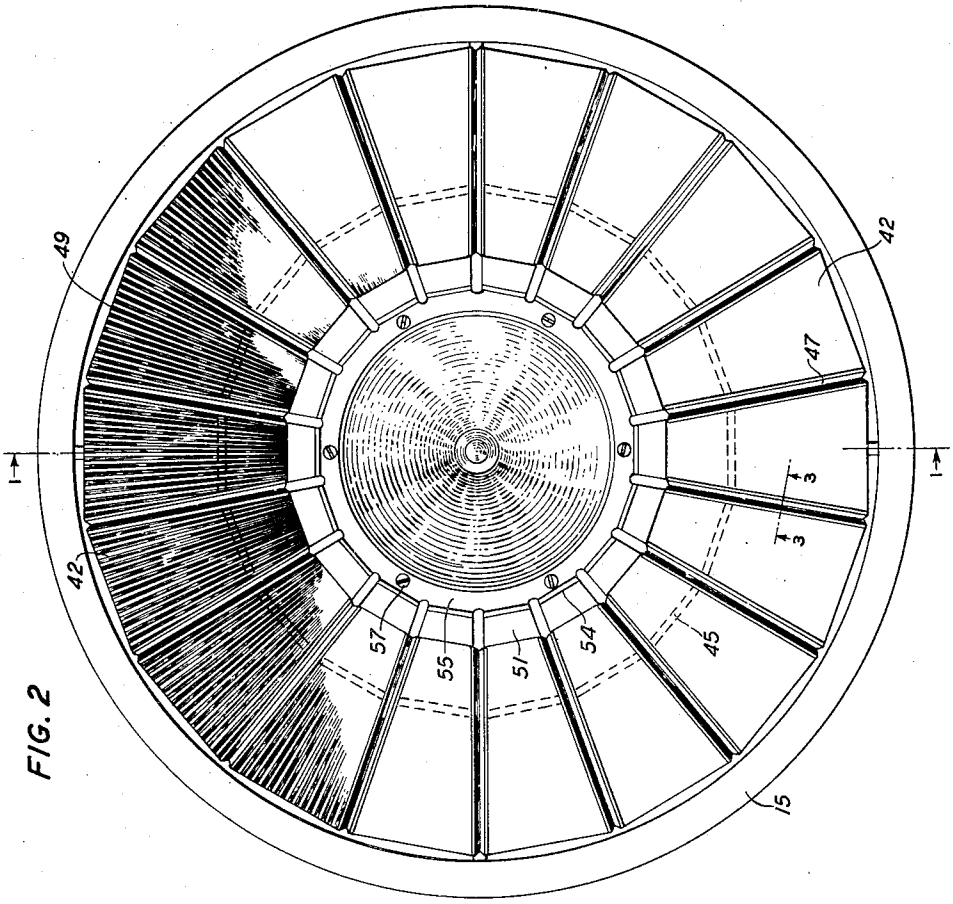

FIG. 2

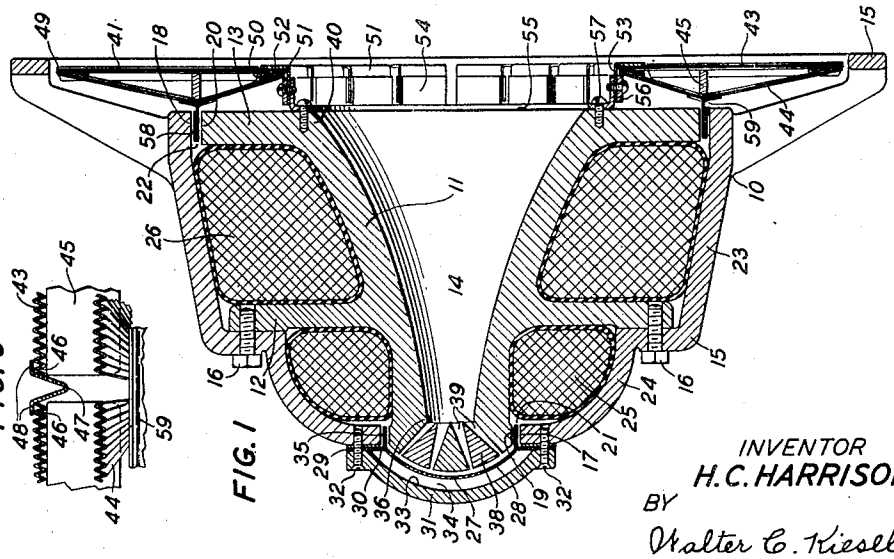

FIG. 1

FIG. 3

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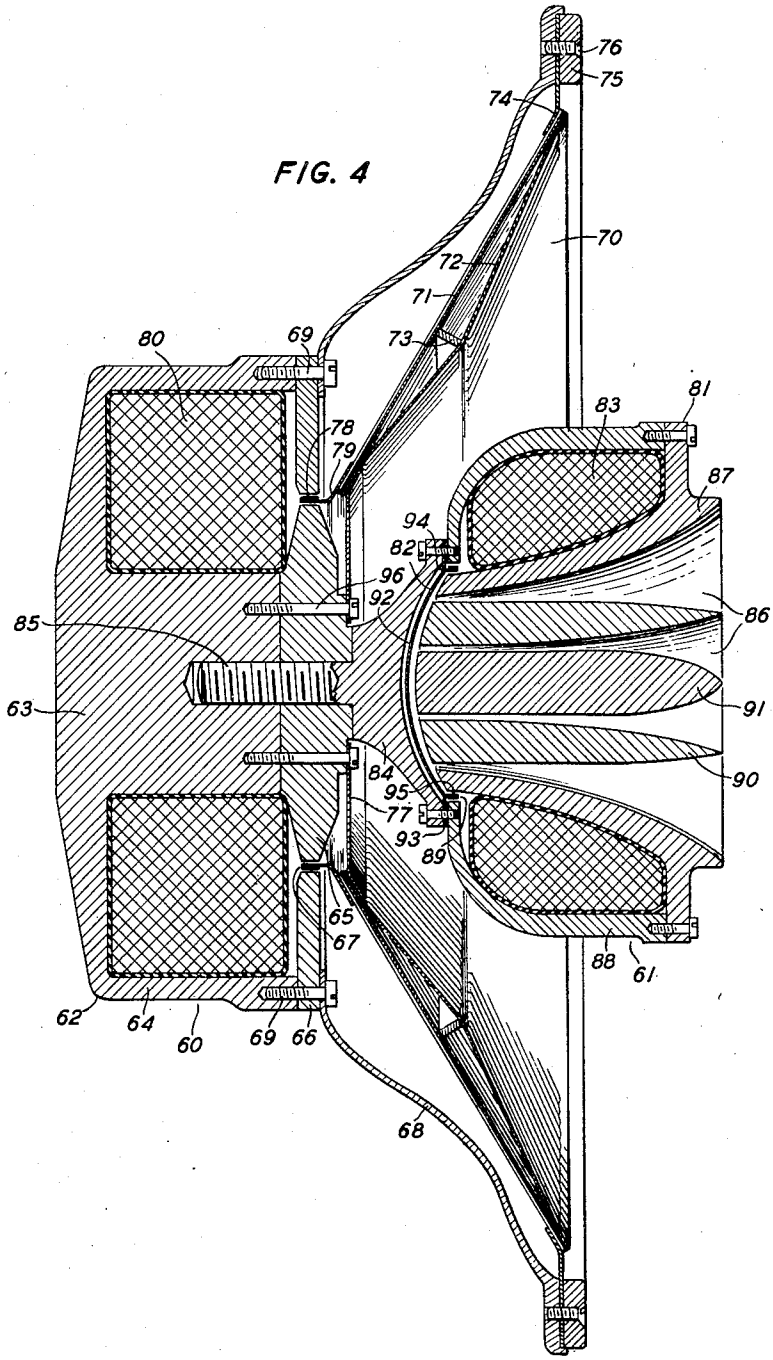
FIG. 4



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ACOUSTIC DEVICE

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20 Claims. (Cl. 181—32)

This invention relates to acoustic devices and, more particularly, to loud-speakers and a diaphragm and structure therefor.

The object of this invention is to translate sound waves efficiently and with fidelity to the original over the audible frequency range.

A feature comprises a diaphragm that has inner and outer peripheral portions, at the inner of which only is a support provided.

A further feature comprises a diaphragm having inner and outer peripheral portions, the outer one of which is free and unsupported and the other of which is supported as on a hinge.

Another feature comprises a diaphragm having inner and outer peripheral portions and comprising a plurality of rigid segments.

Still another feature comprises a diaphragm having inner and outer peripheral portions and having sound radiating strips secured together at and spaced apart intermediate the peripheral portions.

A further feature comprises a diaphragm having inner and outer peripheral portions, the diaphragm being supported as on a hinge at its inner peripheral portion and being actuated intermediate its peripheral portions.

Still another feature comprises the combination of a diaphragm for reproducing sound wave frequencies above a predetermined frequency and a diaphragm of the type referred to hereinabove.

Other and further features will be evident from the detailed description which follows hereinafter.

A more complete understanding of this invention will be obtained from the detailed description which follows taken in conjunction with the appended drawings, wherein:

Fig. 1 is a cross-sectional view of a loud-speaking device embodying the invention;

Fig. 2 is a front elevational view of the device of Fig. 1;

Fig. 3 is a sectional view along the line 3—3 of Fig. 2 of a fragment of the annular diaphragm of the device of Figs. 1 and 2; and

Fig. 4 is a cross-sectional view of another loud-speaking device embodying the invention.

The acoustic device of Figs. 1 to 3 is a unitary combination of a direct acting sound reproducer and a horn type sound reproducer in which a common magnetic structure is employed. The magnetic structure 10 comprises a substantially annular central member 11 having laterally extending fin or plate-like annular portions 12, 13 and containing a central passageway 14, and an outer frame or shell member 15, secured to the marginal portion of the portion 13 by suitable fastening means, such as the screws 16, and having annular planar portions 17, 18 in spaced relation to the annular planar portions 19, 20 of the member 11 to define annular air-gaps 21, 22. The substantially annular recess defined by the portions 12, 13 and the frusto-conical portion 23 or the member 15 and that defined by the arcuate portion 24 of member 15 and the member 11 contain magnetizing windings 25, 26. A diaphragm 27 having a central, stiffened dome or central portion 28, an outer peripheral portion 29, and an intermediate flexible portion 30, is secured to the frame member by the clamping plate 31 and screws 32, the plate 31 having its inner surface 33 of curvature similar to that of the diaphragm and juxtaposed thereto to form an air chamber 34. An annular coil 35, which may be of edge wound ribbon conductor, is secured to the diaphragm at the junction of its central and flexible portions, and disposed in the air-gap 21. The passasgeway 14 flares outwardly in two directions from a constricted or throat portion 36, and provides a sound chamber adjacent the coil side of the diaphragm, which chamber contains a plug member or members 38 defining concentric annular passages or paths 39 for sound waves radiated by the diaphragm. It is evident that the magnetic structure embodies a horn into which the diaphragm 27 is adapted to radiate.

At the mouth portion 40 of the passageway, which, if desired, may vary exponentially in cross-sectional area with distance from the throat portion 36, is mounted a direct acting diaphragm 41. This diaphragm is substantially annular, and comprises a plurality of radially arranged, rigid, substantially trapezoidal, triangular-sectioned segments or elements 42. Each section comprises a pair of trapezoidal-shaped strips 43, 44, which may be of a light-weight high-strength material such as duralumin, preferably provided with corrugations or flutings extending between the bases of the strips. The strips are secured together at their bases, but spaced apart intermediate their bases by a rigid strut or spacer 45 fastened to the strips, in any suitable manner, for instance, with cement. The segments are connected together along their adjacent lateral edges 46 by connectors or hinge members 47, substantially V-sectioned and having lateral flange portions 48 cemented to the strips 43. The diaphragm is free of support or restraint at its outer periphery or edge 49. At its inner periphery or edge 50 it is supported as on a hinge. Substantially L-shaped hinge members 51 of suitable flexible or resilient

material, such as phosphor bronze, have an angular portion 52 suitably secured as by cement to the inner end of a diaphragm segment, and another angular portion 53 fastened between a flanged portion 54 of a ring member 55 and a clamping bar 56. The member 55 is secured to the magnetic structure, for instance, by screws 57, and provides a support for the diaphragm 41 in concentric relation with the small diaphragm at the other end of the horn passageway. An annular driving coil 58 is attached to the diaphragm 41 by means of a coil form 59 substantially along the line of the spacers 45.

In operation, the direct acting diaphragm reproduces the frequency range below about 1000 cycles per second and the diaphragm radiating into the horn reproduces the frequency range above about 1000 cycles per second.

The device of Fig. 4 comprises a low frequency loud-speaker unit 60, that is, a loud-speaker adapted to reproduce most efficiently sound waves below about 1000 cycles per second and a high frequency loud-speaker unit 61, that is, a loud-speaker adapted to reproduce most efficiently sound waves above about 1000 cycles per second.

The loud-speaker unit 60 comprises a magnet structure 62 having a central cylindrical pole 63 and an outer annular pole 64, a center circular pole member 65 and an outer annular plate pole member 66, the pole members defining an annular air-gap 67. The pole member 66 and the sheet metal frame member 68 are secured in position by screws 69. A rigid, frusto-conical, triangular-sectioned diaphragm 70 is positioned within the frame member. It comprises two annular frusto-conical strips 71, 72 of a light-weight high-strength material, such as duralumin, secured together at their edges, and spaced apart intermediate their edges by a strut or spacer 73. The strips are preferably corrugated or fluted, the corrugation extending between the edges. The diaphragm is flexibly supported at its larger or outer periphery by an annulus 74 of flexible material clamped to the frame member by the ring 75 and screws 76. At its small or inner periphery, the diaphragm is secured to an annular disc or spider 77 of resilient material, secured against the center pole member by screws 96 which also secure the center pole member to pole 63. A driving coil 78 is disposed in the air-gap 67 and is mounted on a rigid coil form 79 affixed to the diaphragm at its small periphery or edge. Field coil 80 is provided for magnetizing the magnet structure.

The unit 61 comprises a combined horn and magnet structure 81, a diaphragm 82, a field coil or magnetizing winding 83, and a cover member or plate 84 having an extension 85 projecting through pole member 65, threading into the pole 63, and supporting the unit centrally of the unit 60. The magnet structure comprises a central member 87 and an outer shell or frame member 88 defining an air-gap 89. The member 87 has a sound wave passage leading from the diaphragm divided into concentric annular flaring passageways 86 by partition or plug members 90, 91. The diaphragm is preferably of a light-weight high-strength material, such as duralumin, having a central stiffened or dome portion 92, an outer peripheral clamped portion 93 and an intermediate flexible portion 94. A driving coil 95, of edge wound ribbon conductor, is attached to the diaphragm at the junction of its central and intermediate portions.

While this invention has been described with reference to various specific embodiments, it is to be understood, of course, that it is not limited thereto but by the scope of the appended claims only.

What is claimed is:

1. An acoustic device comprising a diaphragm having a plurality of radially arranged rigid segments hinged together along adjacent edges.

2. An acoustic device comprising a substantially annular diaphragm having a plurality of trapezoidal-shaped rigid portions.

3. An acoustic device comprising a substantially annular diaphragm having a triangular cross-section.

4. An acoustic device comprising a substantially annular diaphragm having a triangular cross-section, said diaphragm including strips of material containing corrugations extending between the inner and outer edges of the diaphragm.

5. An acoustic device comprising a substantially annular diaphragm having a plurality of trapezoidal-shaped rigid portions, said portions being hinged together along adjacent edges.

6. An acoustic device comprising a diaphragm having inner and outer peripheral portions and being unrestrained in movement at its outer portion and hinge-supported at its inner portion.

7. An acoustic device comprising a magnetic structure having an air-gap, a substantially annular diaphragm unrestrained in movement at its outer periphery and supported as on a hinge at its inner periphery, and a coil attached to said diaphragm intermediate its inner and outer peripheries and disposed in said air-gap.

8. An acoustic device comprising a substantially annular diaphragm supported at its inner periphery by a plurality of hinge-like members.

9. An acoustic device comprising a substantially annular diaphragm having a plurality of segments, and a hinge-like supporting member for each of said segments at the inner periphery of said diaphragm.

10. In combination, a diaphragm, a horn into which said diaphragm radiates, a second diaphragm concentric with said first diaphragm and having inner and outer edge portions, and means attached to said horn about the mouth thereof for supporting the second diaphragm at its inner edge-portion.

11. In combination, a diaphragm having a central stiffened portion, an outer peripheral portion and an intermediate flexible portion, a coil attached to said diaphragm at the junction of said central and flexible portions, an annular rigid diaphragm, a coil attached to said annular diaphragm intermediate the inner and outer peripheries thereof, and means intermediate said diaphragms defining magnetic air-gaps for said coils and a sound wave passageway from said first-mentioned diaphragm to the opening in said annular diaphragm.

12. In combination, a diaphragm for reproducing the high sound wave frequencies having a central stiffened portion, an outer peripheral portion and an intermediate flexible portion, a coil attached to said diaphragm at the junction of said central and intermediate portions, and a substantially annular rigid diaphragm for reproducing the low sound wave frequencies defined by strips secured together at the inner and outer peripheries of the diaphragm and spaced apart intermediate such peripheries.

13. An acoustic device comprising a diaphragm,

means defining a passageway into which said diaphragm is adapted to radiate, said passageway having a restricted portion expanding into a sound chamber adjacent the diaphragm and expanding outwardly to a mouth portion, means in said sound chamber dividing it into a plurality of sound wave paths, an annular diaphragm with its central opening in alignment with the passageway mouth portion, said diaphragm being free of restraint at its outer periphery and supported at its inner periphery, and means for actuating said diaphragms.

14. An acoustic device comprising an annular diaphragm having a plurality of segments, means connecting said segments along adjacent edges, and a supporting member for each of said segments at the inner periphery of said diaphragm.

15. An acoustic device comprising a diaphragm having a plurality of segments, and an individual supporting member for each segment at the inner periphery of the diaphragm.

16. An acoustic device comprising an annular rigid diaphragm defined by corrugated strips secured together at the inner and outer peripheries of the diaphragm and spaced apart intermediate such peripheries.

17. An acoustic device comprising an annular rigid diaphragm having a pair of sound radiating strips secured together at and spaced apart intermediate the peripheries of said diaphragm, one of said strips defining a substantially flat sound radiating surface.

18. An acoustic device comprising an annular diaphragm, and means for supporting said diaphragm at its inner periphery only.

19. An acoustic device comprising an annular diaphragm, means for supporting said diaphragm at its inner periphery only, and means for actuating said diaphragm intermediate its peripheries.

20. An acoustic device comprising a diaphragm having inner and outer peripheral portions and means supporting said diaphragms at its inner peripheral portion only.

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