July 13, 1937. A. L. THURAS 2,086,649

ACOUSTIC DEVICE

Filed April 14, 1934

FIG. 1

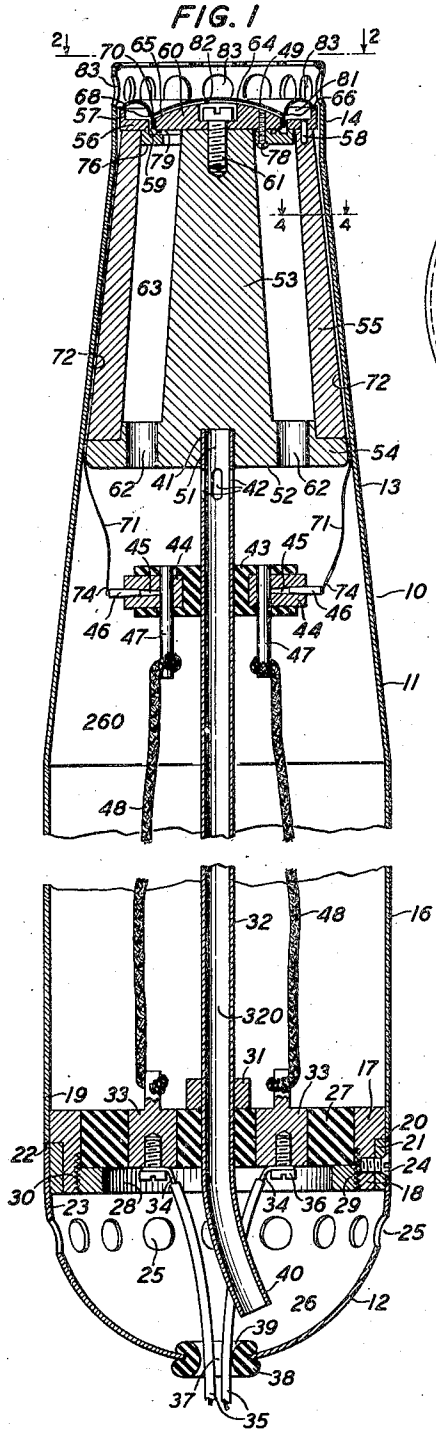


FIG. 2

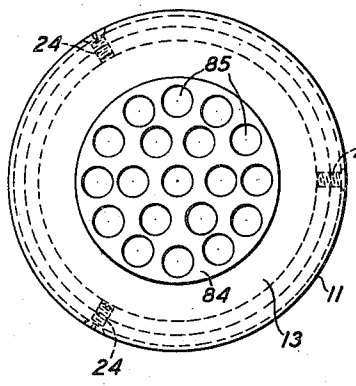


FIG. 3

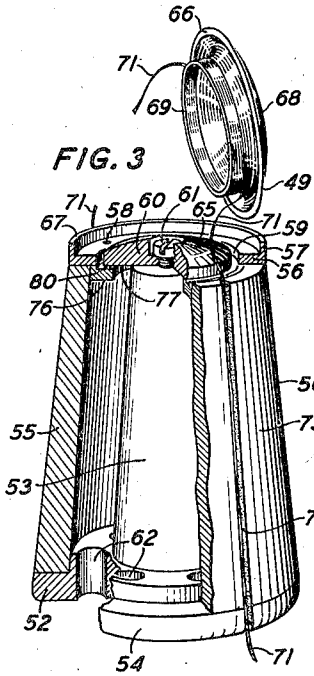


FIG. 4

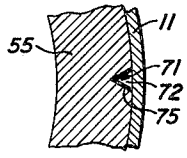
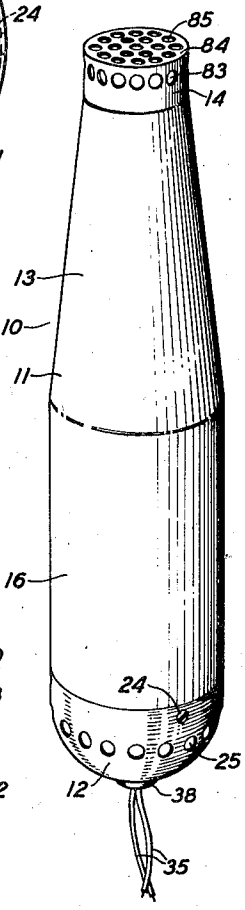


FIG. 5



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Patented July 13, 1937 2,086,649

UNITED STATES PATENT OFFICE

2,086,649

ACOUSTIC DEVICE

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Application April 14, 1934, Serial No. 720,576

16 Claims. (Cl. 179—115.5)

This invention relates to acoustic devices, and, more particularly, to transmitters or microphones of the electrodynamic type.

An object of this invention is to improve the operating characteristics and to simplify the structure of the moving coil transmitter.

A feature of this invention comprises a transmitter having a casing containing means for enhancing the response of its diaphragm to low frequency sound waves, which means maintains the transmitter magnet structure in position within the casing.

Another feature comprises a transmitter casing having end portions apertured to pass sound waves, one end portion being substantially hemispherical and the other end portion being substantially frusto-conical in shape.

A further feature comprises bringing out a lead of the coil of an electrodynamic device to a terminal by positioning a portion of its length in and preferably fastened to the defining surface of a groove or elongated recess in the magnetic structure of the device.

Still other features will be apparent from the detailed description which follows hereinafter.

A preferred embodiment of this invention comprises a casing having a substantially hemispherical end portion, a substantially frusto-conical end portion, and a substantially cylindrical intermediate portion. A diaphragm, supported on the magnet structure, is positioned in the small base of the frusto-conical end portion which provides a passage for sound waves to the front side of the diaphragm. The interior of the casing is divided into two chambers by a partition member positioned at the junction of the cylindrical and hemispherical portions. These chambers are in communication through an elongated, tubular member supported by the partition member, having one end in the hemispherical end portion and its other end pressed against the base portion of the magnet structure to hold the latter in position within the frusto-conical end portion. The hemispherical portion is provided with a plurality of apertures so that when the transmitter is placed in the sound field, sound waves of low frequency, at least, may act on both sides of the diaphragm.

A more complete understanding of this invention will be obtained from the detailed description which follows, read with reference to the appended drawing, wherein:

Fig. 1 is a cross-sectional view of an acoustic device, with a portion broken away, embodying this invention;

Fig. 2 is a plan view of the device of Fig. 1 along the line 2—2;

Fig. 3 is a perspective view of the magnet structure of the device of Fig. 1, partly broken away and partly in section, showing the manner in which the coil lead is brought out from the moving coil attached to the diaphragm;

Fig. 4 is an enlarged sectional view of a fragment of the device of Fig. 1 along the line 4—4 thereof; and

Fig. 5 is a perspective view, substantially full size, of the device of Fig. 1.

The acoustic device embodying this invention is a transmitter or microphone 10, and comprises a hollow casing, housing or enclosure 11 of metal, such as brass. The casing comprises a substantially hemispherical end portion 12, a substantially frusto-conical end portion 13 having a short cylindrical extension 14 from its small base 15, and a substantially cylindrical intermediate portion 16. Portions 13 and 16 are formed, preferably in a single piece, a ring member 17 having a depending flange portion 18, being soldered or otherwise secured to the inner surface 19 of and at the open end 20 of the cylindrical portion. The casing portion 12 is provided with a ring member 21 at its open end 22 and on its inner surface 23, the member 21 being soldered or otherwise secured thereto. The member 21 and the flange portion 18 interfit, end portion 12 being secured to the intermediate portion 16 by any suitable fastening means, for instance, screws 24. A plurality of apertures 25, preferably circular, in end portion 12, connect the space or chamber 26 defined by it with the atmosphere outside of the casing.

A disc or plate 27, of insulating material, is mounted within the member 17; makes a force-fit therewith; is gripped between a clamping or locking ring 28, exteriorly threaded at 29 for engagement with the interiorly threaded portion 30 of the flange 18, and a stop member 31 secured to the outside of an elongated, tubular member 32; and divides the interior of the casing into air chambers or spaces 26, 260. The disc contains a pair of molded-in terminals 33, to which are connected the ends 34 of conductors 35, any suitable fastening means, such as screws 36, being used. These conductors connect the microphone with a telephone, or other signaling circuit, and enter the casing through the aperture 37. A bushing 38, presenting a rounded edge 39 to the conductors, is inserted in the aperture. The tubular member 32 is open at each end 40, 41, extends through a centrally disposed opening or

passage in the plate 27, and provides a constricted passage 320 connecting the chambers 26, 260, the upper end 41 of the tubular member having a plurality of slots or openings 42 therein. A terminal block 43, of insulating material, is supported on the tubular member at a point below these slots, and contains metallic inserts 44 having recesses 45 adapted to receive terminal pin or wedge members 46. Terminal rods or pins 47 extend through the inserts 44, and are conductively connected to the terminals 33 by wire-braid or other conductors 48.

A diaphragm 49, positioned in the small extremity of the casing portion 13 is supported by a magnet structure 50, of frusto-conical external contour, which is held in the frusto-conical portion of the casing by the tubular member 32, the end 41 of which fits into a central recess 51 in the base portion 52 of the magnet structure.

The magnet structure comprises a base member 52, preferably of cobalt iron or cobalt steel, having a frusto-conical center pole 53, and an outer shoulder portion 54. A frusto-conical annulus 55, preferably of cobalt iron or cobalt steel and constituting an outer pole, is supported on the shoulder 54. A plate pole 56, preferably annular and of magnetic iron, and having an outer upwardly extending annular flange or ledge portion 57, rests on the outer pole. The plate pole is properly positioned by pins 58 that extend from the outer pole, and forms an annular air gap 59 with a dome-shaped cap member 60, preferably of magnetic iron, which is secured to the center pole by suitable fastening means for instance, bolt 61. The magnet base member 52 contains a plurality of passages or holes 62 connecting the air space or chamber 63 in the magnet structure with the chamber 260.

The diaphragm comprises a central, dome-shaped, stiffened portion 64 conforming in shape substantially to the curvature of the surface 65 of the cap member; an outer, annular, peripheral portion 66, secured by any suitable means, such as cement, shellac, or the like, to the upper surface 67 of the ledge portion 57; and an intermediate curved annulus 68, connecting the central and outer portions of the diaphragm and permitting the central portion to vibrate substantially as a piston in response to sound waves. Although the diaphragm may be of any suitable material, it is preferably of polymerized styrol. A diaphragm of this material is disclosed and claimed in A. L. Thuras et al. Patent 2,003,908, issued June 4, 1935.

A coil 69, preferably of edgewound aluminum ribbon, coated with an insulating varnish or with aluminum oxide, is secured to the underside of the diaphragm at the junction 70 of its central and intermediate portions. The coil leads 71 are brought out loosely from the coil to the ledge portion 57, being secured thereagainst by the diaphragm portion 66 or fitting into slots (not shown) in the surface 67. The leads fit into elongated grooves, channels, or recesses 72, in the outer surface 73 of the pole 55 and the member 52, and are fastened at their extremities 74 to the terminal wedge members 46. To insure that the leads do not short-circuit on the magnet, a strip 75 of insulating material is fastened, as by cement, to the defining surface of the recess in the magnet structure, and the lead may be secured to the insulating strip by cement, shellac, or insulating varnish. The coil leads, with this arrangement, may be secured to terminals remote from the coil, outside of and under the magnet structure with which the coil is associated, and within an elongated tubular enclosure for the magnet structure.

A damping plate 76, of non-magnetic material, is secured to the under-surface 77 of the magnet cap member by screws 78, being positioned under the air gap and extending between the outer and center poles. A narrow, restricted passage 79 is provided between the annular ridge 80 of the damping plate and the cap member surface 77. The passage 79 and the air gap connect the air chambers 81, 82 between the diaphragm and the magnet structure with the air chamber 63.

The cylindrical extension 14 of the casing portion 13 is provided with a plurality of spaced, circular openings 83, and is closed by a circular grid or plate 84 containing, also, a plurality of spaced, circular openings 85.

In operation, the acoustic device of this invention is placed in a sound field and sound wave energy of all frequencies has access to the front side of the diaphragm through the openings 83, 85 in the casing. Sound wave energy at the low end of the audible frequency range has access to the rear side of the diaphragm through the openings 25 in casing portion 12 and the tubular member 32. The use of such an elongated tubular member of restricted cross-section to enhance the low frequency response of a microphone is in accordance with the teachings of A. L. Thuras Patent 1,869,178, granted July 26, 1932.

Although this invention has been disclosed with reference to a specific embodiment, it will be understood that modifications therein may be made without departing from the spirit of the invention, which is to be considered, therefore, as limited in scope by the appended claims, only.

What is claimed is:

1. A microphone comprising a diaphragm, means for translating vibrations of said diaphragm into electric current impulses, and a casing for said diaphragm and means, said casing having an apertured end portion presenting an outer convex surface, a tapering end portion apertured at its smaller end, and an intermediate portion connecting said end portions, the diaphragm being positioned in the small end of the tapering portion.

2. A microphone comprising a diaphragm, means for translating vibrations of said diaphragm into electric current impulses, and a casing for said diaphragm and means, said casing having a substantially hemispherical end portion, a substantially frustro-conical end portion, and an intermediate cylindrical portion, the diaphragm being positioned in the small base of the frusto-conical portion.

3. A microphone comprising a diaphragm, means for translating vibrations of said diaphragm into electric current impulses, a casing for said diaphragm and means, said casing having an apertured end portion presenting an outer convex surface, a tapering end portion apertured to receive said diaphragm, and an intermediate portion connecting said end portions, a partition member in said casing dividing it into a plurality of chambers, and an elongated tubular member in said casing for enhancing the low frequency response of said diaphragm, said tubular member having one open end in one chamber and another open end in a second chamber and near said apertured end portion.

4. A microphone comprising a diaphragm,

means responsive to impulses of sound wave frequency attached to said diaphragm, a magnet associated with said means, an elongated casing for said diaphragm, means and magnet, said casing being open to sound waves at each end, the diaphragm being positioned in one open end, and means within said casing for enhancing the response of said diaphragm to sound waves of low frequency, said means comprising an elongated tubular member having one end adjacent the other open end of the casing, the other end of the tubular member bearing against the magnet to hold it in position in said casing.

5. A microphone comprising a diaphragm, a coil attached to said diaphragm for movement therewith, a magnet supporting said diaphragm and having an air gap in which said coil is positioned, an elongated casing open at each end for the passage of sound waves, said diaphragm being positioned in one of said open ends, a partition member in said casing near the other open end dividing the interior of said casing into a plurality of chambers, and means for enhancing the response of said diaphragm to sound wave vibrations over a portion of the frequency range, said means comprising an elongated tubular member carried by and extending through said partition member to connect said chambers, one end of said tubular member bearing against said magnet to hold it in position in said casing.

6. A microphone comprising a diaphragm, a coil attached to said diaphragm, a magnet supporting said diaphragm and having an air gap in which said coil is adapted to move when the diaphragm is vibrated, a casing for said magnet having an opening through which one side of the diaphragm is exposed to sound waves, and means entirely within the casing and on the other side of said diaphragm for enhancing the response of said diaphragm to sound waves of low frequency, said means maintaining the magnet in position in said casing.

7. A microphone comprising a diaphragm, a coil attached to said diaphragm, a magnet structure providing an air gap for said coil, said magnet structure having a frusto-conically shaped outer surface, a casing for said diaphragm, coil and magnet structure, said casing comprising a portion having a frusto-conically shaped inner surface and a frusto-conically shaped outer surface, said diaphragm being positioned in the smaller end of the frusto-conically shaped portion of the casing, said magnet structure being positioned in said casing with its small end in the direction of the small end of the casing portion, and means within said casing and bearing on the large end of said magnet structure to hold the latter in and against the casing portion.

8. An acoustic device comprising a diaphragm, a coil attached to said diaphragm, a lead for connecting said coil to a terminal member, a magnet structure providing an air gap in which said coil is positioned, and a casing fitting closely around said magnet structure, said magnet structure having a groove in its surface adjacent said casing so that said lead may be positioned between said magnet structure and casing to terminate said coil at a terminal member below said magnet structure.

9. An acoustic device comprising a diaphragm, a coil attached to said diaphragm, leads for said coil, a magnet structure having a frusto-conical outer surface and defining an air gap for said coil, and a casing for said diaphragm, coil and magnet structure, said casing having an inner surface of contour similar to that of the outer surface of the magnet and fitting closely about said magnet, said magnet outer surface containing elongated grooves to receive the coil leads so that the leads may be brought between the magnet and casing to be terminated in the casing below said magnet structure.

10. An acoustic device comprising a diaphragm, a coil attached to said diaphragm, means providing an air gap for said coil, said means comprising a magnetic base member having a projecting central portion and a peripheral portion, an annular frusto-conically shaped magnetic member supported at its larger end on the peripheral portion of the base member and extending in the same direction as said projection portion, and a plate pole member supported on the small end of said annular member and extending toward said projecting portion to form said air gap, said plate pole having an upwardly projecting flange portion to which the peripheral portion of said diaphragm is secured, and leads for connecting said coil with an electrical circuit, said leads having portions extending along the outer surface of said annular magnetic member, said annular member containing grooves in which said leads are positioned below the surface of said annular member.

11. An acoustic device comprising a diaphragm, a coil attached to said diaphragm, means providing an air gap for said coil, said means comprising a magnetic base member having a projecting central portion and a peripheral portion, an annular frusto-conically shaped magnetic member supported at its larger end on the peripheral portion of the base member and extending in the same direction as said projecting portion, and a plate pole member supported on the small end of said annular member and extending toward said projecting portion to form said air gap, said plate pole having an upwardly projecting flange portion to which the peripheral portion of said diaphragm is secured, leads for connecting said coil to an electrical circuit, said leads extending loosely from said coil to said pole flange portion and downwardly along the outer surface of the annular magnetic portion to below the face member thereof, the portions of said leads along said outer surface being positioned in grooves therein below said surface, and a casing member enclosing said means and fitting closely about the outer surface thereof.

12. An acoustic device comprising a diaphragm, a coil attached to the diaphragm, a lead for connecting said coil to an electrical circuit, a magnet structure providing an air-gap in which said coil is positioned, and a casing fitting closely around said magnet structure, said magnet structure including a pole member having an upwardly projecting flange portion to which the peripheral portion of the diaphragm is secured, said lead extending loosely from said coil to said flange portion and downwardly along the outer surface of the magnet structure, the portion of the lead along said outer surface being positioned in a groove therein below said surface.

13. A microphone comprising a diaphragm, means for translating sound vibrations of said diaphragm into electrical current impulses, and a casing for said diaphragm and means, said casing having an end portion presenting an outer convex surface containing a plurality of apertures arranged in a circle, a tapering end portion apertured at its smaller end, and an inter-

mediate cylindrical portion connecting said end portions, the diaphragm being positioned in the smaller end of said tapering portion.

14. A microphone comprising a diaphragm, means for translating vibrations of said diaphragm into electric current impulses, and a casing for said diaphragm and means, said casing having a substantially hemispherical end portion containing a sound wave passing aperture, a substantially frusto-conical end portion, an intermediate cylindrical portion, the diaphragm being positioned in the small base of the frusto-conical portion, means within the casing dividing the casing into two chambers and containing a passage, and an elongated tubular member open at each end, secured to said means and extending through said passage to connect said chambers.

15. A microphone comprising a diaphragm, means for translating current vibrations of said diaphragm into electric current impulses, a casing for said diaphragm and means, said casing having an end portion presenting an outer convex surface containing a plurality of apertures arranged in a circle, a tapering end portion apertured at its smaller end in which said diaphragm is positioned, an intermediate cylindrical portion connecting said end portions, a partition member in said casing at the junction of said cylindrical and convex surface portions, dividing the casing into two chambers and containing a passage, and an elongated tubular member in said casing for enhancing the low frequency response of said diaphragm and having an open end in each chamber, one open end being adjacent the circularly-arranged apertures.

16. An acoustic device comprising a diaphragm, means attached to said diaphragm and responsive to audio-frequency signal impulses, a magnet, an elongated casing for said diaphragm, means and magnet, the latter being positioned in one end of said casing, a partition member at the other end of said casing, and an elongated tubular member supported by said partition member and connecting the interior of the casing on the magnet side of the partition member with the atmosphere outside of the casing, said magnet having a portion containing a recess, one end of said tubular member projecting into said recess and being provided near said end with a slot connecting the interiors of the tubular member and the casing.

ALBERT L. THURAS.