

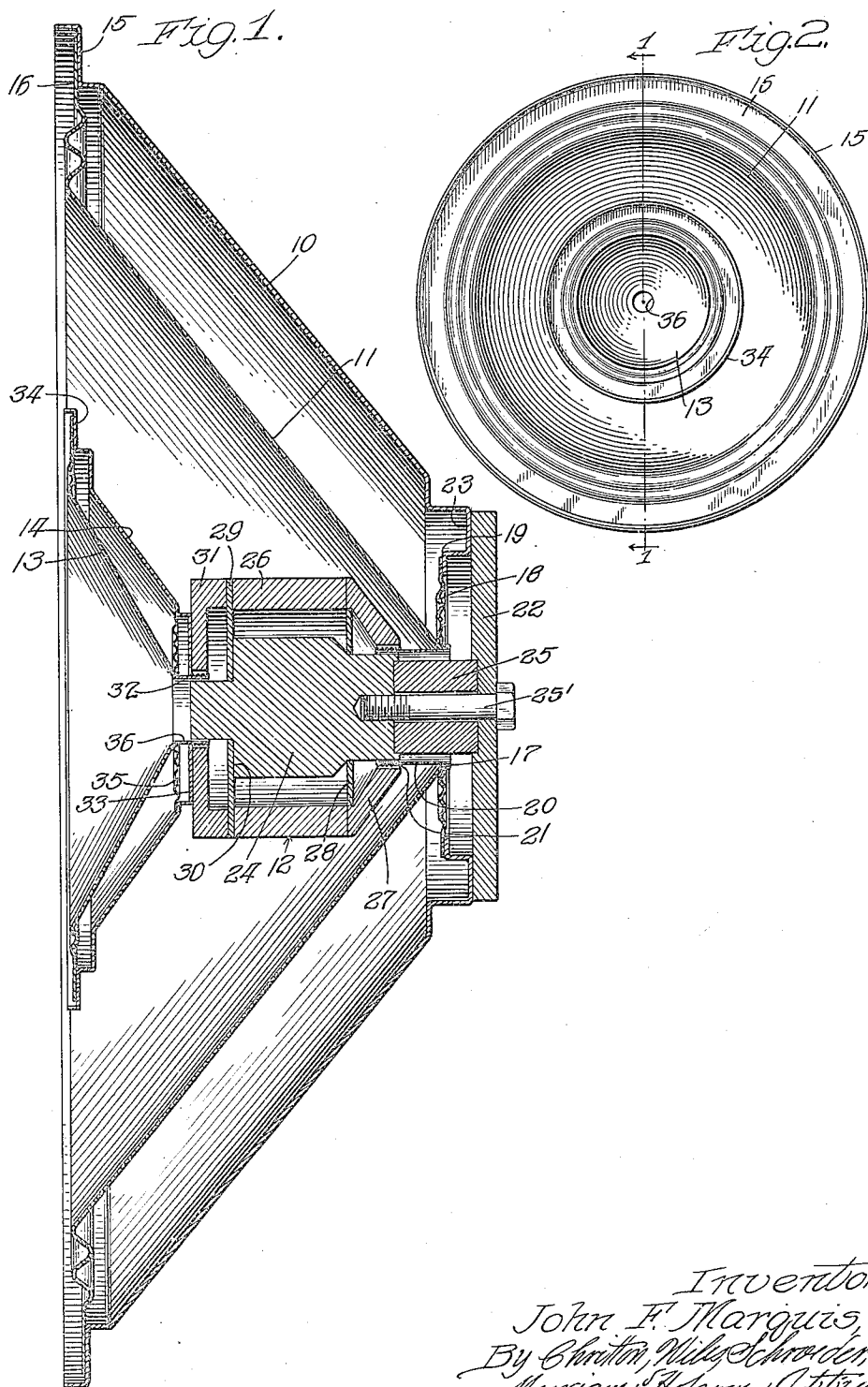
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J. F. MARQUIS

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DOUBLE DIAPHRAGM LOUDSPEAKER

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Inventor:
John F. Marquis,
By Clinton Wiley Schroeder,
Merriam, Rogers, & Fittys

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DOUBLE DIAPHRAGM LOUD-SPEAKER

John Firth Marquis, St. Charles, Ill., assignor to
Operadio Manufacturing Co., St. Charles, Ill., a
corporation of Illinois

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More particularly the invention relates to a loud speaker embodying large and small diaphragms in co-axial arrangement, and it is the general object of the invention to provide a new and improved loud speaker of this type.

It is another object to provide a new and improved loud speaker of the inverted type, that is with the magnet and voice coil elements supported from the rear of a conical housing, and embodying large and small diaphragms.

Another object is to provide a new and improved loud speaker of the inverted type in which large and small diaphragms are co-axially arranged.

Another object is to provide a new and improved loud speaker with two diaphragms and two voice coils associated with a single magnet structure.

Another object is to provide such a device with a magnetic circuit including two voice coil air gaps in series relation and means for by-passing a portion of the magnetic flux around one air gap.

Another object is to provide a loud speaker having first and second diaphragms with voice coils sensitive to different audio frequency ranges, and preferably with a magnetic circuit having the voice coils arranged in series relation therein.

Other objects and advantages will become readily apparent from the following detailed description, taken in connection with the accompanying drawings, in which:

Fig. 1 is a vertical axial section through a preferred form of the invention.

Fig. 2 is a front view thereof on a reduced scale.

While the invention is susceptible of embodiment in many different forms, I have shown in the drawings and shall herein describe in detail one such embodiment, with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiment illustrated. The scope of the invention will be pointed out in the appended claims.

In the form selected for purposes of disclosure, the invention comprises a frusto-conical housing 10, a large conical diaphragm 11, a magnet structure 12, a small conical diaphragm 13, and a frusto-conical housing 14, for the small diaphragm. The housing 10 has a mounting flange 15 around its forward edge (left hand edge in Fig. 1) to which the peripheral edge 16 of the diaphragm 11 is secured by an adhesive or other

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suitable means. The diaphragm 11 has a central aperture at its rear end surrounded by a flange 17, and is preferably supported and centered by a flexible diaphragm 18, the outer edge of which is secured to a flange 19 formed integrally with the housing 10. A tubular member 20 is secured to the flange 17 of the diaphragm 10 and extends concentrically therewith and forwardly therefrom to support a voice coil 21.

The magnet structure or motor 12 is positioned forwardly of the diaphragm 10 and in the preferred form of the invention is supported exclusively by means extending through the aperture in the diaphragm and secured to the rear wall of the housing 10. As shown, the housing 10 has a circular steel mounting plate 22 at the rear thereof and which is welded or otherwise suitably secured to an annular flat portion 23 of the housing. The magnet structure includes a cylindrical pole piece 24 of steel, or other magnetic material, and this pole piece is supported exclusively from the plate 22 by means of a cylindrical non-magnetic member 25 and a bolt 25'. Preferably the member 25 is countersunk into the parts 24 and 22 to insure proper alinement thereof and to center the pole piece accurately with respect to diaphragm 11 and voice coil 21.

As shown in the drawings the magnet structure is of the permanent magnet type although various features of the invention may be embodied as well in those of the electromagnet type. In addition to the pole piece 24, it includes an annular permanent magnet member 26 which is preferably of an alloy or material known as Alnico V or other suitable magnetic material. A centrally apertured conical end or gap plate 27, of steel, is secured to the right hand end of magnet 26 as viewed in Fig. 1 and extends to a position surrounding the right hand end portion of the pole piece 24 so as to leave an annular air gap therebetween in which the voice coil 21 is positioned. A ring 28, of non-magnetic material such as brass, is secured tightly to the inner wall of gap plate 27 and to the pole piece 24 to center the gap plate and to support the right hand portion of the magnet on the pole piece.

At its left hand end the magnet member 26 is supported on the pole piece by means of an apertured metal plate 29 which is secured to the end face of the member and to an annular shoulder 30 on the pole piece. This plate is preferably of magnetic material, such as steel, for a purpose hereinafter more fully set forth. A centrally apertured end or gap plate 31 is secured to the left hand face of plate 29 and extends to a position

surrounding a left hand end portion of the pole piece 24 (which is of reduced diameter) so as to leave an annular air gap 32 therebetween.

As illustrated in Fig. 1, the smaller housing 14 and the diaphragm 13 which is located therein, are positioned co-axially of the larger housing 10 and in front of (to the left in Fig. 1) the magnet structure, but preferably do not project beyond the face of the housing 10. Housing 14 has an apertured and integral wall 33 which is secured to the gap plate 31. The conical diaphragm 13 is supported at its periphery on a flat annular flange 34 on the housing, to which it is suitably secured. A flexible diaphragm 35 supports and centers the small end of diaphragm 13 on the housing 14. A thin tubular member 36 is secured to the small end of the diaphragm 13 and extends concentrically therefrom and into the air gap 32 wherein it supports a voice coil 37.

As is readily apparent the invention combines in a single structure, a large diaphragmed speaker with a voice coil sensitive to a lower range of audio frequencies and a small diaphragmed speaker with a voice coil sensitive to a higher range of audio frequencies, and supports the diaphragms and magnet structure within and exclusively from an external housing by means passing through the rear voice coil. This construction eliminates the need for arms or other supporting means across the front of the speaker and at the same time provides a compact unit.

The magnet structure 12 and the association of two voice coils therewith is also believed highly advantageous. As illustrated herein, a single permanent magnet is used in association with two air gaps in series relation and in order to reduce the amount of magnetic flux passing through the air gap of the smaller voice coil without reducing that passing through the other air gap, a magnetic shunt is provided around the first mentioned air gap in the form of the plate 29. This plate is so designed as to carry a desired portion of the total magnetic flux flowing in the magnetic circuit and thereby cut down the flux flowing through air gap 32. Thus the member 29 diverts a certain very definite amount of flux around the high range voice coil or gap in such a way as to balance the magnetic structure and allow sufficient total flux for the low range voice coil to obtain maximum efficiency of operation. The parts 26, 27 and 31 together form an annular magnet device or member which in association with the pole piece form the magnetic circuit in which the air gaps are included in series relation.

I claim:

1. A device of the character described comprising, in combination, a conical housing having supporting means at its forward end and a rear wall, a magnet pole piece positioned in said housing and extending forwardly from and supported exclusively by the rear wall thereof, an annular magnet device surrounding a portion of said pole piece and supported concentrically thereon to form a magnetic circuit therewith having forward and rear voice coil air gaps therein and around longitudinally spaced portions of said pole piece, a larger conical diaphragm supported within said housing and carrying a voice coil positioned in the rear voice coil air gap, a smaller conical diaphragm positioned centrally of said housing and in front of said pole piece, a voice coil on said smaller diaphragm positioned in the forward air gap, means supporting said smaller diaphragm from the front portion of said magnet device, and means for by-passing a portion of the mag-

netic flux in the magnetic circuit around the forward air gap.

2. A device of the character described comprising, in combination, a housing having supporting means at its forward end and a rear wall, a magnet pole piece positioned in said housing and extending forwardly from and supported by the rear wall thereof, an annular magnet device surrounding a portion of said pole piece and supported concentrically thereon to form a magnetic circuit therewith having forward and rear voice coil air gaps therein in series relation and around longitudinally spaced portions of said pole piece, a larger diaphragm supported within said housing and carrying a voice coil which is sensitive to a lower audio frequency range and is positioned in the rear voice coil air gap, a smaller diaphragm positioned centrally of said housing and in front of said pole piece, a voice coil on said smaller diaphragm positioned in the forward air gap, means supporting said smaller diaphragm from the front portion of said magnet device, and means for by-passing a portion of the magnetic flux in the magnetic circuit around the forward air gap.

3. A device of the character described having, in combination, a housing having supporting means thereon and a mounting plate centrally of a rear portion thereof, a magnet pole piece positioned in said housing and extending forwardly from and supported by said mounting plate, an annular magnet device surrounding a portion of said pole piece and supported thereon to form a magnetic circuit therewith having forward and rear voice coil air gaps therein and around longitudinally spaced portions of said pole piece, a diaphragm supported within said housing and carrying a voice coil positioned in the rear voice coil air gap, a second diaphragm positioned centrally of said housing and in front of said pole piece, a voice coil on said second diaphragm positioned in the forward air gap, and means supporting said second diaphragm from the front portion of said magnet member.

4. A device as defined in claim 3 having an apertured member of non-magnetic material surrounding said pole piece adjacent the rear voice coil air gap and supporting the adjacent end of said annular member, an apertured member of magnetic material surrounding said pole piece adjacent the other end thereof and engaging said annular member to support said member and form a magnetic path shunting the forward air gap.

5. A device of the character described having, in combination, a housing having supporting means thereon and a mounting plate centrally of a rear portion thereof, a magnet structure forming two voice coil air gaps, means in part extending through one of said air gaps supporting said magnet structure exclusively on said mounting plate, a diaphragm supported within said housing and carrying a voice coil positioned in one of said air gaps, a second diaphragm positioned in said housing and carrying a second voice coil positioned in the other air gap and means carried by said magnet structure supporting said second diaphragm.

6. A device of the character described having, in combination, a housing, a magnet structure comprising a pole piece and an annular member surrounding a portion thereof and shaped to form voice coil air gaps spaced apart longitudinally of the pole piece, a first diaphragm supported on said housing and carrying a voice coil positioned in one

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of said air gaps, a second diaphragm supported within said housing and carrying a voice coil positioned in the other air gap, and means by-passing a portion of the flux around one of said air gaps.

7. A loud speaker having, in combination, a centrally apertured diaphragm, a supporting housing therefor disposed at the back of the diaphragm, a magnet structure positioned in front of the diaphragm and having an axial pole, means extending from said pole through the central aperture of the diaphragm and constituting the sole support of the magnet by rigidly connecting the pole to the housing, a second diaphragm, and means carried on said magnet structure supporting said second diaphragm in the forward portion of said housing.

8. A loud speaker having first and second diaphragms carrying voice coils sensitive to different audio frequency ranges and a magnetic structure comprising a pole piece, a member co-operating with the pole piece to form a magnetic circuit having two air gaps in series relation in which both voice coils are positioned, and means forming a metal conducting path by-passing a portion of the flux in the magnetic circuit around

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one of the voice coils whereby to divert a certain amount of flux around the air gap associated with the last mentioned voice coil and thereby balance the magnetic structure.

9. Apparatus of the character claimed in claim 8, wherein the voice coil which is partially by-passed is sensitive to a higher audio frequency than is the other voice coil.

JOHN FIRTH MARQUIS.

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