Dec. 31, 1940. W. F. KANNENBERG 2,226,934

ACOUSTIC DEVICE

Filed Sept. 24, 1938

FIG. 1

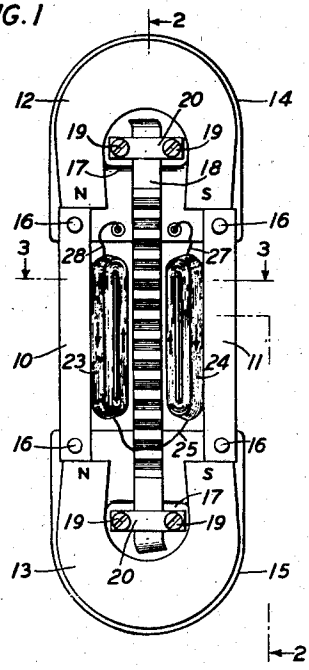


FIG. 2

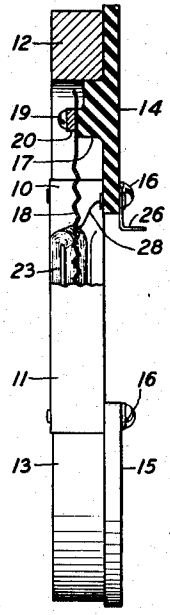


FIG. 3

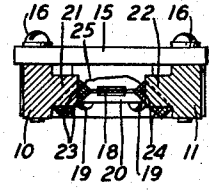


FIG. 4

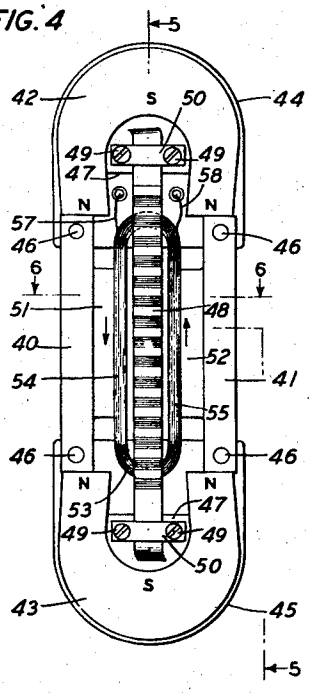


FIG. 5

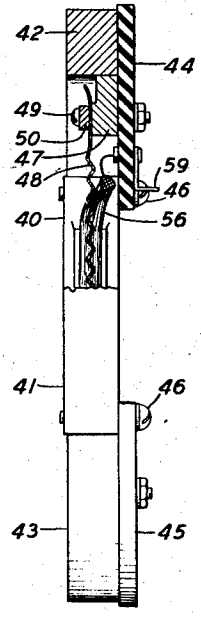
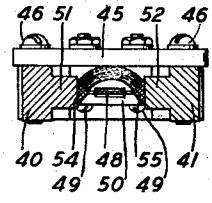


FIG. 6



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2,226,934

ACOUSTIC DEVICE

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Application September 24, 1938, Serial No. 231,487

17 Claims. (Cl. 179—119)

This invention relates to acoustic devices and more particularly to acoustic transmitters of the type commonly referred to as ribbon microphones.

Ribbon microphones comprise in general, a light-weight diaphragm in the form of an electrically conductive strip or ribbon disposed in a magnetic field of a suitable magnetic structure. Vibrations of the ribbon or strip in accordance with sound waves impinging therein result in the generation of corresponding electromotive forces in the ribbon and a circuit of which it forms a part.

In such microphones, the impedance of the ribbon diaphragm and the circuit of which it forms a part is quite low and necessitates the use of a transformer of high step-up ratio for obtaining a satisfactory matching of the impedance of the microphone to that of the grid or input circuit of an associated amplifier to which the output of the amplifier is supplied.

One object of this invention is to facilitate the attainment of a satisfactory impedance matching between a transmitter such as a ribbon microphone and the input or grid circuit of an amplifier associated therewith.

Another object of this invention is to improve the structure and performance of ribbon microphones.

In accordance with one feature of this invention, a ribbon microphone comprises a magnetic diaphragm vibratile in the field of a magnet structure, and current carrying means, such as a coil or coils, associated with the magnet structure so that vibrations of the diaphragm produce variations in the flux linkages of the coil or coils whereby an electromotive force is induced therein.

In accordance with another feature of this invention, the output coil or coils of the microphone comprise a great number of turns of extremely fine wire whereby a high impedance, enabling satisfactory impedance matching with the input circuit of an associated amplifier, is attained.

The invention and the foregoing and other features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawing in which:

Fig. 1 is a front elevational view of a ribbon microphone illustrative of one embodiment of this invention;

Fig. 2 is a side view, partly in section, along line 2—2 of Fig. 1, of the ribbon microphone shown in Fig. 1;

Fig. 3 is a sectional view taken on line 3—3 of Fig. 1;

Fig. 4 is a front elevational view of a ribbon microphone illustrative of another embodiment of this invention;

Fig. 5 is a side view, partly in section, along line 5—5 of Fig. 4, of the microphone shown in Fig. 4; and

Fig. 6 is a sectional view taken along line 6—6 of Fig. 4.

Referring now to the drawing, in the embodiment of the invention shown in Figs. 1, 2 and 3, 10 and 11 denote elongated members or pole-pieces of magnetic material mounted in spaced parallel relation and extending between and abutting the pole-faces of two permanent magnets 12 and 13 of generally horseshoe form.

The members 10 and 11 are secured at each end to support members 14 and 15 by fastening means such as screws 16. The members 14 and 15 are of non-magnetic material and are preferably of electrical insulation. Each of the support members 14 and 15 has an integral projection or boss 17 interfitting with one of the magnets 12 or 13. The magnets, as shown, are held in place by these bosses and the magnetic attraction to members 10 and 11. If desired, other fastening means, such as screws, bolts, clamps or the like may also be employed between magnets 12 and 13 and members 14 and 15, respectively.

The bosses 17 serve also as anchoring blocks for the ends of the diaphragm 18, which may be a strip or ribbon of permalloy or other suitable magnetic material and preferably is corrugated throughout the major portion of its length. Permalloy may be defined as an alloy containing nickel to the extent of 30 per cent or more, balance chiefly iron, and having the characteristic property of high initial permeability. Other materials, such as molybdenum, may be added to the alloy in small quantities in order that it may be better worked into a thin ribbon. The ribbon may be of the order of one quarter mil in thickness and secured to bosses 17 by screws 19 and clamping strips 20.

As shown clearly in Fig. 3, the members or pole-pieces 10 and 11 have inwardly projecting reduced portions 21 and 22, respectively. Elongated output or sound current coils 23 and 24 are secured respectively to the portions 21 and 22 by cement or other suitable means. Each coil has one long side on the face of a pole-piece opposite the edge of the ribbon 18 and slightly spaced therefrom. In other words, these coil portions occupy the portion of the air-gap ad-

jacent the portions 21 and 22 of the pole-pieces 10 and 11 with the ribbon between them. The other long sides of coils 23 and 24 may be secured to the sides of the pole-pieces outside of the principal air-gap.

The coils may be connected together by a suitable conductor 25 and to terminals, one of which is shown at 26, by conductors 27 and 28. The coils preferably comprise a large number of turns, for example, over one thousand, of very fine wire such as No. 44 B and S gauge, or smaller.

The magnets 12 and 13 have like poles in contact with members 10 and 11, respectively, as indicated by the letters N and S in Fig. 1. The lines of magnetic force in the space between the pole-piece members 21 and 22 are concentrated by the magnetic ribbon 18.

Sound waves impinging on the diaphragm 18 cause it to vibrate and shift the concentrated lines of force relative to the portions of coils 23 and 24 in the air-gap. A voltage is induced in each of the many conductors of the coil portions in accordance with the diaphragm vibrations. The coils 23 and 24 are so wound and connected that these voltages are additive. In view of the high impedance of the coils 23 and 24 the output may be fed directly to an amplifier, not shown.

The embodiment of the invention illustrated in Figs. 4, 5 and 6 is generally similar to that shown in Figs. 1, 2 and 3. Elements of Figs. 4, 5 and 6 corresponding to those of Figs. 1, 2, and 3 are designated by the reference character used in the latter figures, increased by 30.

The magnetic corrugated, ribbon diaphragm 48 is mounted between the parallel elongated pole-pieces 40 and 41 and has its end portions secured to blocks 47 of magnetic material, as by clamping strips 50 and bolts 49. The blocks 47 may be affixed to the non-magnetic, and preferably insulating, support members 44 and 45 by the bolts 49 and provide a path of low reluctance between the ends of the ribbon diaphragm 18 and the magnets 42 and 43.

An elongated output or sound current coil 53 has its long sides 54 and 55 secured to a face of each of pole-piece portions 51 and 52, respectively, by cement or other suitable means. Each end of the coil 53 may be offset as shown at 56 in Fig. 5 to prevent interference with the ribbon 48. The coil 53 may be connected to suitable terminal means by conductors 57 and 58, which may be integral extensions of the coil. One such terminal means is shown at 59. Coil 53, as coils 23 and 24, preferably comprises a large number of turns of very fine wire.

It will be noted that in the embodiment shown in Figs. 4, 5 and 6, as compared with that of Figs. 1, 2 and 3, but one output coil is provided and that the blocks 47 around which the magnets are fitted, are of magnetic material.

The magnets 42 and 43 are magnetized with like poles at each end and with the opposite pole in the middle as indicated by the letters N and S in Fig. 4. The lines of magnetic force are concentrated in the region occupied by coil sides 54 and 55 by the magnetic ribbon 48 and the pole-piece portions 51 and 52. Vibrations of the ribbon in response to sound waves generate additive voltages in the two coil portions 54 and 55.

It is to be understood that the embodiments of the invention shown and described are but illustrative and are not to be taken as limiting the scope of the invention which is defined by the appended claims only.

What is claimed is:

1. An acoustic device comprising a magnetic structure, spaced pole-pieces attached to said structure, current carrying means having a portion between said pole-pieces, and a ribbon diaphragm of magnetic material also between the pole-pieces.

2. An acoustic device comprising a structure including magnet means, spaced pole-pieces and support means, sound-current coil means having elongated portions fixed to said pole-pieces, and a ribbon diaphragm of magnetic material attached at its ends to said structure and extending between and in the same direction as the elongated coil portions.

3. An acoustic device comprising a magnetic structure having pole-pieces, said pole-pieces having planar, parallel surfaces, coil means having portions adjacent said surfaces, and a ribbon diaphragm of magnetic material extending between said coil portions.

4. An acoustic transmitter comprising a pair of spaced parallel pole-pieces, magnetic means coupled to said pole-pieces, current carrying means comprising turns of fine wire and having portions thereof fixed to said pole-pieces and located therebetween, and a ribbon diaphragm of magnetic material mounted between the coil portions.

5. An acoustic transmitter comprising a magnetic structure having spaced parallel pole-pieces, a ribbon diaphragm of magnetic material mounted between said pole-pieces, and coil means having portions thereof fixed to said pole-pieces adjacent the diaphragm, said coil means comprising at least one thousand turns of wire having a cross-sectional area of less than four circular mils.

6. Magnetic circuit means for an acoustic transmitter comprising magnet means, pole-piece means, and a ribbon diaphragm of permalloy about 0.25 mil in thickness in cooperative relation with said pole-piece means.

7. An acoustic transmitter comprising a magnetic structure, voice coil means, and a ribbon diaphragm of molybdenum permalloy mounted in operative relation to said structure and coil means.

8. An acoustic transmitter comprising spaced parallel pole-pieces defining an air-gap, permanent magnets, connecting means of non-conducting, non-magnetic material attached to ends of the pole-pieces and positioning the magnets in contact with said ends, current coils one on each pole-piece and each having a portion thereof fixed on the air-gap bounding face of a pole-piece, and magnetic field distorting means comprising a sound responsive ribbon of magnetic material attached at its ends to the connecting means and positioned in the air-gap between said portions of said coils.

9. An acoustic transmitter comprising a magnetic structure having spaced parallel pole-pieces, coil means having portions thereof attached to the pole-pieces, and a ribbon diaphragm of magnetic material magnetically in circuit with said magnetic structure and mounted for vibration between said pole-pieces.

10. An acoustic transmitter comprising a magnetic structure including magnet means, pole-pieces attached to said magnet means, a ribbon diaphragm of magnetic material also attached to the magnet means and cooperating with the pole-pieces to define a magnetic circuit network in-

cluding elongated air-gaps, and coil means having portions thereof in said air-gaps, said portions being fixed to the pole-pieces.

11. An acoustic transmitter comprising a magnetic structure having spaced parallel pole-pieces, a ribbon diaphragm of molybdenum permalloy attached to the magnetic structure, extending between and parallel to the pole-pieces, and a pair of coils attached to the magnetic structure one on either side of the ribbon, and each having a portion thereof located between the ribbon and the magnetic structure.

12. An acoustic transmitter comprising a magnetic structure having spaced parallel pole-pieces, coil means having spaced portions thereof between and attached to the pole-pieces, and a diaphragm comprising a thin ribbon of permalloy attached at each end to the magnetic structure and located in the space between said coil portions.

13. An acoustic transmitter comprising a pair of permanent magnets mounted in spaced relation and having a pair of spaced parallel pole-pieces therebetween, an elongated coil having spaced parallel sides, one fixed on each pole-piece, and a ribbon diaphragm of magnetic material mounted between the parallel sides of the coil.

14. An acoustic transmitter comprising a pair of spaced parallel pole-pieces, magnet means attached to said pole-pieces, a ribbon diaphragm of magnetic material between said pole-pieces and magnetically connected to the magnet means, and a voice coil having portions thereof fixed to each pole-piece adjacent to, but spaced from the diaphragm, said magnet means being so poled that the pole-pieces are each of the same magnetic polarity.

15. An acoustic device comprising a pair of magnets having poles of opposite polarity, a pair of magnetic members magnetically connecting like poles of said magnets, a magnetic diaphragm between said magnetic members, and a coil having a portion in the magnetic field between said diaphragm and one of said magnetic members.

16. An acoustic device comprising a pair of magnets having end portions of like polarity, magnetic members connecting corresponding ends of said magnets, a magnetic diaphragm between said magnetic members, magnetic means coupling spaced portions of said diaphragm to said magnets, and a coil having a portion between said magnetic members.

17. An acoustic device comprising a magnetic structure, an elongated diaphragm of magnetic material, said structure having at least two spaced parallel portions, and sound current coil means having spaced portions thereof between and attached to said spaced parallel portions of the magnetic structure, said vibratile element being located between the spaced portions of the coil means.

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