Dec. 30, 1941. N. BLOUNT 2,267,808

ELECTROMAGNETIC DEVICE

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FIG. 1

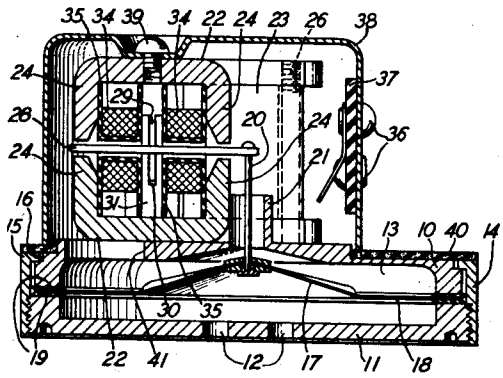
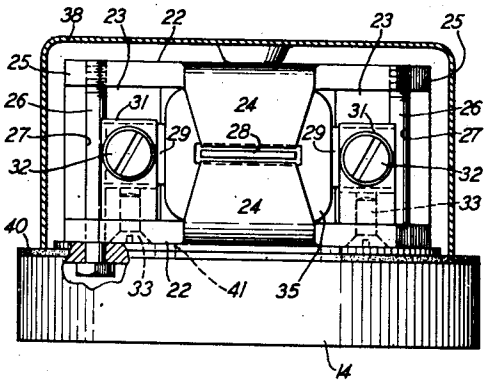


FIG. 2



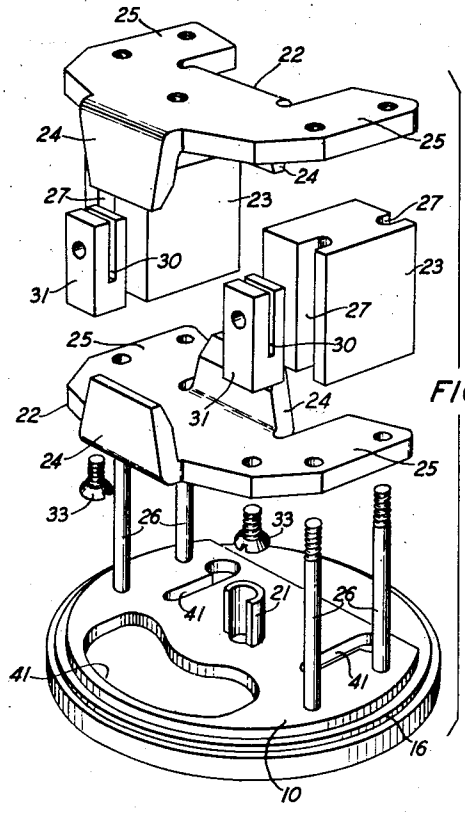


FIG. 3

INVENTOR
N. BLOUNT

BY

Walter C. Kiesel

ATTORNEY

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ELECTROMAGNETIC DEVICE

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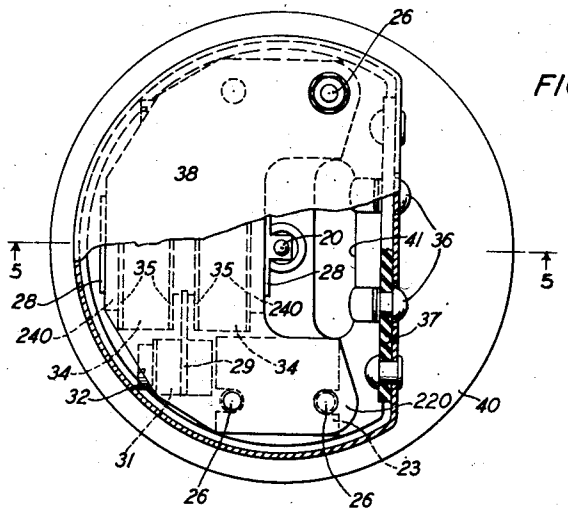


FIG. 4

FIG. 5

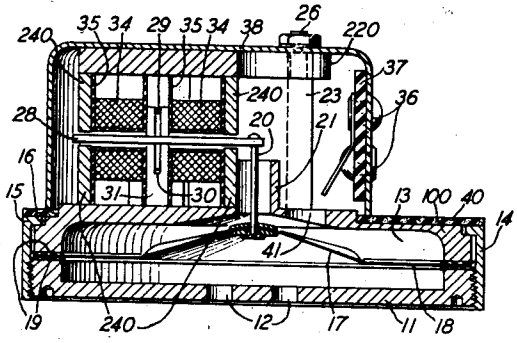


FIG. 6

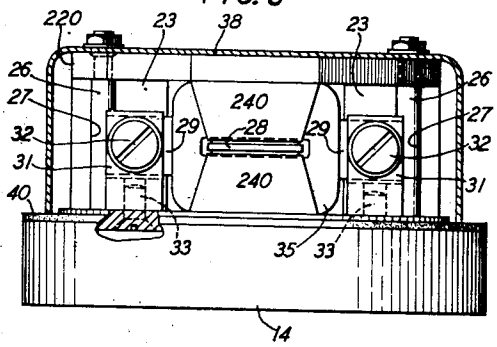
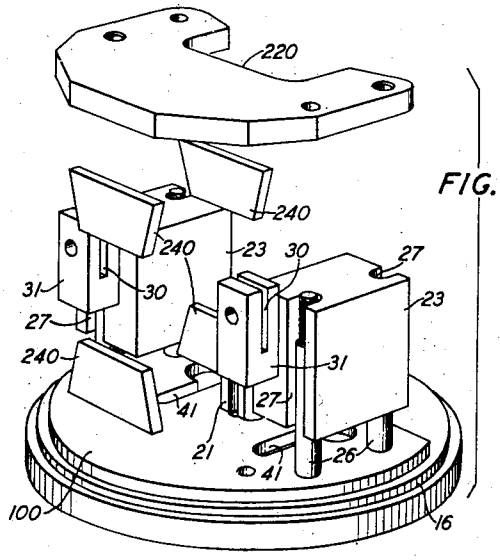


FIG. 7



INVENTOR
N. BLOUNT
BY
Walter C. Kiesel
ATTORNEY

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UNITED STATES PATENT OFFICE

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ELECTROMAGNETIC DEVICE

Nelson Blount, Maplewood, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application September 27, 1939, Serial No. 296,823

4 Claims. (Cl. 175—339)

This invention relates to electromagnetic devices and more particularly to electromagnets for transmitters and receivers of the balanced armature type.

One object of this invention is to improve the efficiency and operating characteristics of electromagnetic acoustic devices. More specifically, one object of this invention is to obtain a uniform and high response characteristic for transmitters and receivers of the balanced armature type.

Another object of this invention is to simplify the structure and thereby to facilitate the manufacture of electromagnetic acoustic devices.

A further object of this invention is to enable the attainment of substantially identical operating characteristics for a multiplicity of transmitters and receivers of the balanced armature type.

Still another object of this invention is to prevent variation of the air-gaps in the magnetic system of balanced armature acoustic devices by shocks such as may be occasioned by dropping or striking such devices.

In one illustrative embodiment of this invention, an electromagnetic acoustic device, which may be utilized as both a transmitter and a receiver, comprises a foundation member or plate, a diaphragm mounted thereon and a balanced armature magnetic system operatively connected to the diaphragm, the magnetic system including pole-pieces, magnet means for producing a flux between the pole-pieces and a vibratile armature.

In accordance with one feature of this invention, the pole-pieces comprise magnetic members each having a pair of flanges intermediate the ends thereof and portions extending outwardly from opposite sides of the flanged portions, the flanges on the two members being in juxtaposition and defining a pair of gaps into which the armature extends. The magnetic members are maintained in spaced relation by a pair of short bar permanent magnets which are clamped between these members and are located on opposite sides of the flanges, like poles of the magnets engaging the same magnetic member whereby two magnetic circuits having a common branch, through the flanges and air-gaps, are obtained.

In accordance with another feature of this invention, the magnetic system is supported as a unit from the foundation member and means for supporting the armature are mounted on one of the magnetic members independently of the foundation member so that if the device is dropped or otherwise subjected to physical shocks relative movement between the armature and the pole-pieces is minimized or prevented.

In accordance with still another feature of this invention, the foundation member is provided with a tubulature defining a restricted aperture in communication with the chamber between the diaphragm and the foundation member and cooperating therewith to define an acoustic network enhancing the response of the device at certain frequencies.

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 drawings in which:

Fig. 1 is a side view in section of a balanced armature acoustic device illustrative of one embodiment of this invention;

Fig. 2 is an end view, partly in section, of the acoustic device shown in Fig. 1;

Fig. 3 is an exploded view in perspective illustrating the construction and assembly of the magnetic system of the device shown in Figs. 1 and 2;

Fig. 4 is a top view of an acoustic device illustrative of another embodiment of this invention, a portion of the casing or cover being broken away to show the internal structure more clearly;

Fig. 5 is a side view in section along line 5—5 of Fig. 4;

Fig. 6 is an end view partly in section of the device shown in Figs. 4 and 5; and

Fig. 7 is an exploded view in perspective showing the assembly and construction of the magnetic system in the device illustrated in Figs. 4, 5 and 6.

Referring now to the drawings, the electromagnetic device shown in Figs. 1 to 3, which may be utilized as either a transmitter or a receiver, comprises a circular, dished foundation member or plate 10, preferably of a non-magnetic material such as brass, and a cover or face plate 11 having therein a plurality of apertures 12 and defining a chamber 13 with the foundation member or plate 10. The cover or face plate 11 is secured to the foundation member 10 by a clamping ring 14 having a flange 15 extending into a peripheral groove 16 in the foundation member. Mounted within the chamber 13 is a diaphragm having a central, dished relatively rigid portion 17 and a flexible outer portion 18 which is clamped at its periphery between foundation member 10 and cover 11. Preferably sealing washers 19, for example of fiber, fibrous or resil-

ient material, are provided adjacent the clamped portion of the diaphragm to form a moisture-proof joint between the diaphragm and the foundation and cover plates.

Impulses may be transmitted to or from the diaphragm through a connecting pin or rod 20 which is affixed to the center of the diaphragm and extends through a tubulature 21 integral with the foundation member or plate 10. The foundation member is provided also with a plurality of apertures 41 of predetermined areas the purpose of which will be described hereinafter.

The diaphragm is actuated by, or conversely actuates, an electromagnetic system seated on the foundation member, which comprises a pair of formed substantially identical, U-shaped magnetic members 22 and a pair of equal short bar magnets 23. Each of the magnetic members 22, as shown clearly in Fig. 3, comprises a pair of parallel pole tips or flanges 24 and arms 25 extending from opposite sides of the tips or flanges 24. The arms 25 abut opposite ends of the magnets 23 which space the members 22 in parallel relation with the tips or flanges of one member 22 opposite and aligned with those of the other whereby two identical air-gaps are formed. Like poles of the magnets 23 abut the same magnetic member 22 so that two magnetic circuits of substantially the same reluctance and magnetomotive force having a common branch, through the pole tips 24 and the air-gaps, are formed.

The ends of the magnets 23 are ground so that air-gaps of the desired length are formed between the juxtaposed pole tips 24. The magnetic members 22 are securely clamped against the magnets 23 by non-magnetic bolts 26 which extend through apertures in the foundation member or plate 10, as shown in Fig. 2. Preferably the magnets 23 are provided with longitudinal grooves 27, as shown in Fig. 3, in which the bolts 26 are fitted and thereby position the magnets with respect to the foundation member or plate 10.

Extending between the pole tips 24 with its ends located in the air-gaps between juxtaposed pole tips is a magnetic armature 28 which is pivotally mounted at its center between non-magnetic supports 29 and has one end affixed to the connecting pin or rod 20. The supports 29, which may be for example, phosphor bronze strips, are notched at their adjacent ends to engage the sides of the armature, are fitted in slots 30 in parallel non-magnetic support blocks 31 and are locked in place in the slots as by screws or bolts 32 threaded into the blocks 31. The blocks 31 in turn are affixed to the lower magnetic member 22 as by screws 33 threaded into the blocks.

After the magnetic members 22, magnets 23, armature 28 and support blocks 31 have been affixed in position, adjustment of the gaps between the armature and the pole tips 24 may be effected, if necessary, by slightly bending the members 22 at regions between the pole tips 24 and magnets 23 to impart a slight set thereto. It will be noted that the armature 28 is definitely positioned with respect to the lower magnetic member 22 and is mounted separate from the foundation member 10. Hence, if the device is dropped or otherwise subjected to shocks, the armature cannot shift other than parallel to the lower magnetic member 22 and the desired gaps between the armature 28 and the pole tips 24 are maintained whereby the operating characteristics of the device are maintained unaffected.

The armature 28 is encompassed by a pair of coils 34 carried by insulating forms or bobbins 35 positioned between the flanges or pole tips 24. Electrical connection may be established to the coils 34 through suitable conductors, not shown, connected to terminals 36 mounted on an insulating block 37 affixed to a cover or casing 38. The cover or casing 38 may be affixed to one of the magnetic members 22 by a single screw 39 and preferably is seated upon a gasket 40, for example of rubber, whereby a moisture-proof and acoustically sealed enclosure for the magnetic system is provided.

The tubulature 21 provides a restricted passageway of definite and predetermined acoustic impedance coupling the chamber between the rear surface of the diaphragm and the foundation member 10 and the chamber within the casing or cover 38. The impedances of these chambers and passageways 41 and 21 are effective upon the diaphragm and the acoustic constants of these impedance elements may be utilized to control the output characteristic of the device and to assure a uniform output throughout a wide range of frequencies. In a particular embodiment, the constants may be made such as to compensate for a falling off of the response at the higher frequencies, or stated another way, to enhance the response at these frequencies, whereby the range of frequencies translated with substantial uniformity by the device is extended and faithful transmission or reproduction results.

Although the invention is not limited thereto, the following materials have been found to be particularly satisfactory for the magnetic elements. The magnets 23 may be of an alloy comprising 53 per cent iron, 20 per cent nickel, 10 per cent aluminum, 12 per cent cobalt and 5 per cent copper. An alloy of this composition has a very high coercive force in proportion to remanence and enables the use of very short bar magnets. The armature 28 may be of an alloy comprising 3.8 per cent molybdenum, 78 per cent nickel and remainder iron and the magnetic members 22 may be of an alloy comprising 45 per cent nickel and remainder iron.

It will be appreciated that electroacoustic devices constructed in accordance with this invention may be assembled expeditiously and manufactured in quantity and at low cost. A minimum of adjustment of parts is entailed and the same operating characteristics can be obtained for a large number of instruments. Furthermore, inasmuch as very short magnets may be employed and these may be spaced but short distances from the pole tips 24, very little magnetic leakage occurs and a high concentrated flux is obtained in the air-gaps whereby a high efficiency obtains.

The embodiment of this invention illustrated in Figs. 4 to 7 is generally similar in construction to that shown in Figs. 1 to 3 and described heretofore, the principal differences residing in details of the magnetic structure. As shown clearly in Fig. 7, the pole tips 240 are fabricated separately. Two of these pole tips are affixed, as by welding, in parallel relation to the magnetic member 220. The other pair of pole tips 240 are affixed, as by welding, in parallel relation to an intermediate portion of the foundation member 100, which in this case is of magnetic material. The support blocks 31 for the armature 28 are affixed to the foundation member by screws 33 so that the armature is definitely and fixedly located with respect to the pole tips 240 affixed to the foundation member and the relation of

these parts will not be disturbed if the device is subjected to physical shocks.

As illustrated in Figs. 5 and 6, the cover or casing 38 may rest upon the magnetic member 220 and may be clamped in position by two of the bolts 26.

Although specific embodiments of this invention have been shown and described, it will be understood that they are but illustrative and that various modifications may be made therein without departing from the scope and spirit of this invention as defined in the appended claims.

What is claimed is:

1. An electromagnetic device comprising a foundation member, a pair of spaced magnetic members having juxtaposed pole tips defining an air-gap, permanent magnet means associated with said magnetic members, means securing said magnetic members and said magnet means to said foundation member, an armature extending into said air-gap, and means fixed solely to one of said magnetic members supporting said armature in fixed relation to the pole tips of said one magnetic member and including a rigid member, means rigidly fixing said rigid member to said one magnetic member independently of said securing means and said foundation member and a support carried by said rigid member and engaging said armature.

2. An electromagnetic device comprising a foundation plate, a magnetic member seated on said plate, a second magnetic member, magnet means between said members and spacing said members in parallel relation, means clamping said magnetic members and magnet means to said foundation plate, said magnetic members having juxtaposed flanges defining an air-gap, an armature having a portion in said air-gap, and a supporting system for said armature mounted solely on said first magnetic member, said system including a pair of rigid members fixedly secured to said first magnetic member independently of said clamping means and said foundation plate and a pair of oppositely extending supports affixed to said rigid members and engaging said armature.

3. An electromagnetic device comprising a foundation plate, a magnet structure including a pair of magnetic members and a pair of bar magnets spacing said members and having opposite ends in abutting relation therewith, each of said magnetic members having a pair of flanges projecting between said magnets, the flanges on said members being in juxtaposition and defining a pair of air-gaps, means securing said magnetic members and magnets to said foundation plate, an armature extending into said air-gaps, and means supporting said armature consisting of a pair of blocks fixedly secured to one of said members on opposite sides of said armature independently of said securing means and a pair of supports fixed to said blocks and engaging said armature.

4. An electromagnetic device comprising a foundation plate, a magnetic member seated on one surface of said plate and having a pair of flanges intermediate its ends terminating in substantially coplanar pole faces, a pair of bar magnets abutting said magnetic member adjacent the ends thereof, a second magnetic member seated against said magnets and having a pair of flanges in juxtaposition to said first flanges and defining a pair of air-gaps therewith, an armature having its ends in said air-gaps and having one surface parallel to said pole faces, means clamping said magnetic members and said magnets to one another and to said foundation plate, and means supporting said armature from said first magnetic member independently of said clamping means and separate from said plate, said supporting means including a pair of blocks on opposite sides of said armature and rigidly affixed to said first magnetic member and a pair of supports affixed to said blocks, extending toward each other and engaging said armature.

NELSON BLOUNT.