

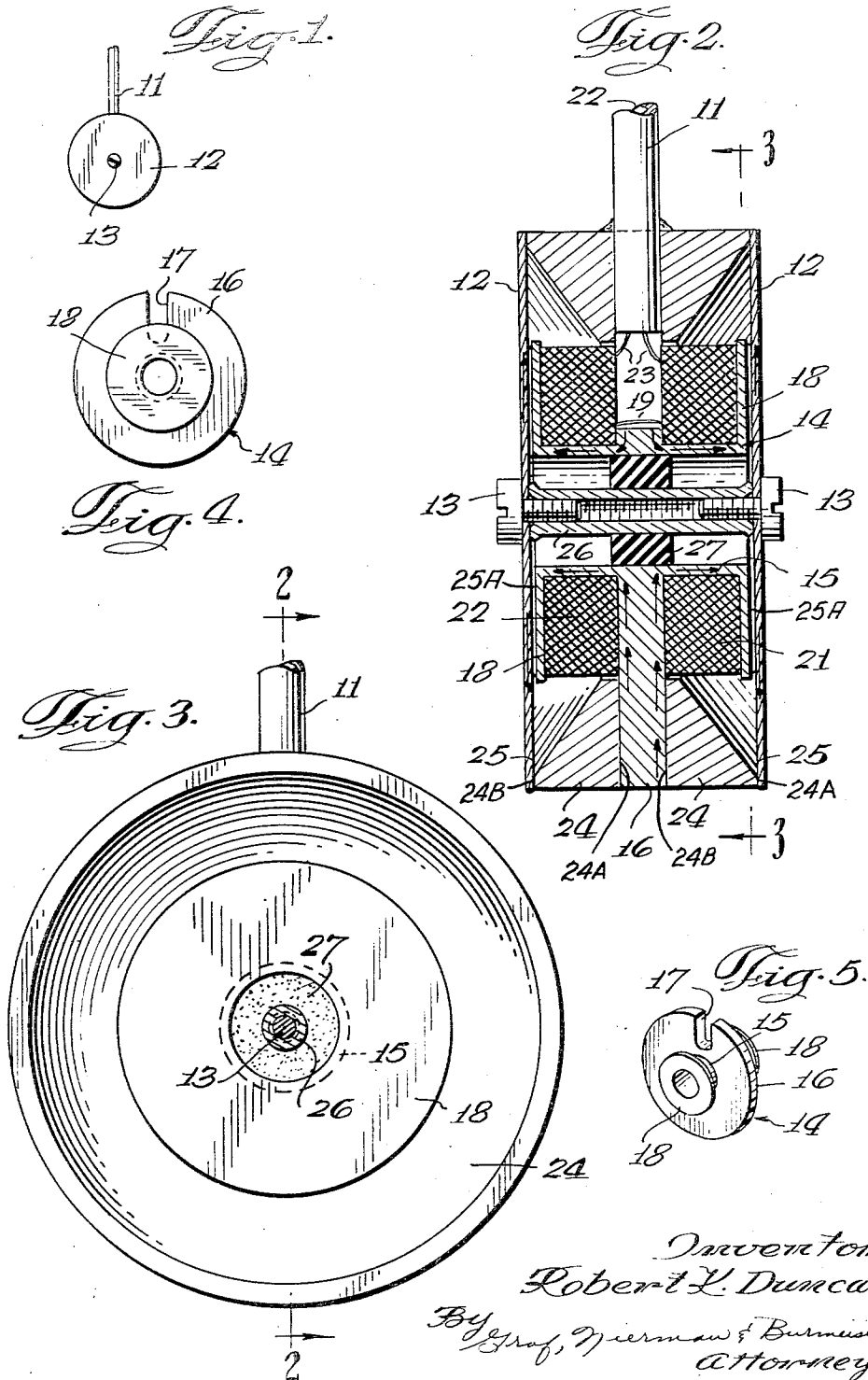
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ELECTROMECHANICAL TRANSDUCER

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ELECTROMECHANICAL TRANSDUCER

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The present invention relates to an electromechanical transducer, and more particularly to a microphone of the type commonly called a close-talking microphone for use in a facial mask.

Heretofore, it has been decided to provide facial masks with comparatively small microphones which have noise cancelling characteristics and which are impervious to moisture. To provide this impervious relationship, it has been customary to apply to a portion of the microphone a flexible moisture barrier in the form of a film. In order to compensate for ambient pressures, some provision is made to connect the interior of the microphone with the exterior of the facial mask. It has been found desirable to further minimize the difficulty of manufacture of such devices, to maintain all of their advantages, and to provide certain additional advantages, particularly in assembly and manufacture.

Therefore, it is an object of the present invention to provide an improved differential transducer of relatively small size.

Another object of the invention is to provide a small differential transducer having a small number of parts, which is economical to manufacture and assemble.

Still another object of the invention is to provide a differential transducer which is impervious to moisture and which obviates the need for a moisture barrier.

A further object of the invention is to provide an improved differential transducer which is shielded against stray magnetic fields and which also employs a unique arrangement of magnetic coils.

Still another object of the invention is to provide an improved differential transducer having two diaphragms mechanically coupled together.

A still further object of the invention is to provide a transducer structure which minimizes the danger of flux saturation.

Other and further objects of the invention subsequently will become apparent by reference to the following description taken in conjunction with the accompanying drawing, wherein:

Figure 1 is a plan view of a transducer shown in full size;

Figure 2 is an enlarged axial sectional view of the transducer of Figure 1;

Figure 3 is a sectional view taken along the line 3—3 of Figure 2;

Figure 4 is a plan view of the core member of the transducer; and

Figure 5 is a perspective view of the core member of the transducer shown in Figure 4.

A transducer, which may be employed as a microphone, constructed in accordance with the teaching of the present invention is shown full size in Figure 1. The plan view thereof shows a tube 11, a diaphragm 12, and a cap screw 13. The tube 11 carries conductors from the internal field coils, thus shielding the leads, and also serves to provide a passage to the interior of the micro-

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phone for equalizing the effects encountered when ambient pressure changes occur.

The cross-sectional view in Figure 2 illustrates certain constructional details. The microphone has a core structure 14 of ferromagnetic material. This core structure 14 is specifically illustrated in Figures 4 and 5. It has a tubular portion 15 carrying a plate at its longitudinal midpoint, referred to as an annular flange or disc 16, which is provided with a notch or recess 17. The notch or recess 17 is engaged by the tube 11 to communicate with the interior of the microphone. The core structure 14, which is of ferromagnetic material, such as iron, has two annular flanges 18 located at the ends of the tubular portion 15. The recess or notch 17, in addition to serving as a means for holding or engaging the tube 11, also serves to provide an opening for an electrical connection 19 extending between two field coils 21 and 22. The recess 17 also provides a means for the outgoing conductors 23 which pass through the tube 11. The two coils 21 and 22 have their starting wires connected together by the conductor 19, whereupon both coils are wound at the same time in the same direction.

Mounted on opposite sides of the outer portion of the central or annular flange 16 are two similar annular permanent magnetic members 24 which have poles 24A and 24B and provide the magnetic flux for the transducer. Engaging the reduced area peripheral portions of the permanent magnets 24 are the two diaphragms 12. These diaphragms 12 are soldered or sealed by suitable sealing means 25 to the permanent magnets 24, thus providing a hermetic chamber having access to external atmosphere only through the tube 11. Each of the diaphragms 12 is separated from the core structure 14 by an air gap 25A.

Each of the diaphragms 12 has a central aperture for receiving the cap screw 13 which engages a rigid non-magnetic member 26 which couples together the two diaphragms 12. At an intermediate point, the coupling member 26 carries a damping member 27 which engages the interior surface of the tubular portion 15 of the central core structure 14. The member 27 is selected to provide the desired damping characteristic to smooth out the response characteristic of the diaphragms 12. Thus, the member 27 may be of a foraminous material, such as an elastomer, having high mechanical resistance, but relatively low mass and stiffness. Other materials may also be employed for the member 27. The purpose of the member 27 is to reduce any peaks in electrical output which otherwise might occur due to mechanical resonance.

From the foregoing description, it will be noted that a microphone has been provided which has two diaphragms rigidly coupled together. The two diaphragms 12 being sealed at their peripheries by a suitable means 25 to the permanent magnets 24 provide a hermetically sealed chamber. There is no need for moisture barriers as would be the case in other types of construction. Since the diaphragms 12 are of ferromagnetic material, they together with the remainder of the structure provide a magnetic shielded housing so that the coils 21 and 22 are relatively unaffected by any stray magnetic fields. The relatively large areas presented by the flanges 18 at the ends of the tubular portion 15 of the core structure 14 reduce the danger of flux saturation in the diaphragm 12 and the central core structure. This reduces the possibility of encountering situations where the diaphragms 12 might tend to stick to the core structure when high levels of sound are present.

The unique arrangement of the magnetic field coils 21 and 22, which are wound simultaneously, and the arrangement of the permanent magnets 24 reduce the difficulty of manufacture and assembly and minimize the

number of parts required to provide an improved differential microphone having desirable noise cancelling characteristics.

The transducer here described utilizes two separate magnetic circuits. Each of the magnetic circuits includes one of the diaphragms 12, the abutting ring magnet 24, the plate 16, the portion of the tubular portion 15 of the core structure 14 from the plate to the diaphragm, and the gap 25A between the diaphragm and core structure 14. Since the diaphragms 12 are rigidly coupled at their centers by the coupling member or rod 26, the diaphragms are displaced only in response to the difference in the sound pressures on the two diaphragms, and the simultaneous movement of the two diaphragms increases the flux in one of the magnetic circuits while decreasing the flux in the other. Since the coils 21 and 22 generate currents responsive to the flux in the two magnetic circuits, respectively, and the coils 21 and 22 are connected in series, the current generated in the coil circuit is responsive to the difference in sound pressures on the two diaphragms. Further, since the two coils are connected in series opposition, currents generated by other magnetic fluxes passing through both of the coils cancel out.

Since the coils 21 and 22 are connected in series opposition to produce no current responsive to an axial flux passing through both coils, it is desirable that the no signal flux in the two magnetic circuits flow through the plate or disc 16 in the opposite direction, thus tending to cancel. This results in the output of the two coils 21 and 22 adding signal produced currents. This condition is readily achieved by positioning opposite poles of the two ring magnets 24 in abutment with the plate 16 and also with the diaphragms 12.

While for the purpose of describing and illustrating the present invention a preferred embodiment has been shown in the drawing, it is to be understood that the invention is not to be limited thereby since such variations are contemplated as may be commensurate with the spirit and scope of the invention as set forth in the accompanying claims. It is also to be noted that this application is a continuation in part of the inventor's application, Serial No. 682,424, filed September 6, 1957, entitled, "Microphone."

The invention claimed is:

1. An electromechanical transducer comprising: an air tight housing including a pair of magnetic members each having two parallel flat surfaces with opposite magnetic poles, each of said members having an opening extending between the surfaces thereof, a diaphragm sealed to the first surface of each magnetic member, and a magnetically permeable plate sealed to the second surface of each magnetic member and confronting the openings therein; a core structure disposed in the opening of each magnetic member and mounted on the plate at one end, the opposite end of each core structure confronting one of the diaphragms and being spaced therefrom by a gap; and a coil disposed about each of the core structures.

2. An electromechanical differential transducer comprising a pair of diaphragms, means abutting the peripheries of the diaphragms for mounting the diaphragms parallel to each other, a pair of magnetic circuits, each circuit including one of the diaphragms and a gap confronting the diaphragm, a coil disposed about each of the magnetic circuits for generating an electrical current responsive to the rate of change of magnitude of the magnetic flux flowing in the magnetic circuit, said coils being electrically connected in series opposition, and a rigid nonmagnetic coupling member mounted to both of the diaphragms and extending therebetween.

3. An electromechanical transducer comprising the elements of claim 2 in combination with a damping member disposed between the rigid nonmagnetic coupling member and the mounting means for the diaphragms.

4. A differential microphone comprising a magnetic circuit member having a disc at the midpoint of a tubular portion having at each end an annular flange, an annular permanent magnet mounted on each side of said disc, a pair of inductive windings mounted on said tubular portion on opposite sides of said disc, each winding extending to an annular flange, and a diaphragm mounted on each permanent magnet.

5. A differential microphone comprising a ferromagnetic member having a disc at the midpoint of a tubular portion having at each end an annular flange, an annular permanent magnet mounted on each side of said disc, a pair of inductive windings mounted on said tubular portion and each extending from said disc to the annular flange, a diaphragm mounted on each permanent magnet, a member rigidly interconnecting the centers of said diaphragms, and a damping member mounted on said interconnecting member to engage the inner surface of said tubular portion of said ferromagnetic member.

6. A differential microphone according to claim 4 wherein said disc serves to form two chambers, and a small tubular member communicating with both said chambers.

7. A differential microphone according to claim 4 wherein the peripheral portions of each diaphragm are hermetically secured to the cooperating annular permanent magnet.

8. A differential microphone comprising an integrally formed member of ferromagnetic material having a tubular portion terminating at each end in an annular flange and having at its longitudinal midpoint a disc, a pair of inductive windings mounted between said disc and said flanges, a pair of annular permanent magnets mounted on opposite sides of said disc, a pair of thin flat metal diaphragms secured at their peripheries to said pair of permanent magnets, and a nonmagnetic rod axially positioned within the tubular portion of said member and rigidly interconnecting the centers of said diaphragms.

9. The differential microphone according to claim 8 wherein said nonmagnetic rod carries at its longitudinal midpoint a damping member engaging the interior of the tubular portion of said member.

10. A differential microphone comprising an integrally formed member of ferromagnetic material having a tubular portion terminating at each end in an annular flange and having at its longitudinal midpoint a disc, a pair of inductive windings wound in the same direction between said disc and said flanges, a pair of annular permanent magnets mounted on opposite sides of said disc forming a housing having two chambers, a pair of thin flat metal diaphragms hermetically sealed at their peripheries to said pair of permanent magnets, a nonmagnetic rod axially positioned within the tubular portion of said member and rigidly interconnecting the centers of said diaphragms, said rod carrying at its midpoint a damping member engaging the interior of the tubular portion of said member, and a tube communicating with both said chambers and the exterior of said housing.

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