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Carlson et al.

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[54] **ACOUSTIC TRANSDUCER WITH IMPROVED ELECTRODE SPACING**

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[22] Filed: **Feb. 16, 1990**

Related U.S. Patent Documents

Reissue of:

[64] Patent No.: **4,730,283**
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Appl. No.: **907,498**
Filed: **Sep. 15, 1986**

[51] **Int. Cl.**[5] **H04R 19/00**

[52] **U.S. Cl.** **367/181**; 367/170; 381/191

[58] **Field of Search** 367/140, 170, 173, 174, 367/181, 188; 381/113, 116, 174, 191; 310/324, 351, 349, 350, 353, 800

[56] **References Cited**

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[57] **ABSTRACT**

An acoustic transducer with an improved electret assembly mounting for providing spacings between the fixed and movable electrodes, and having as one feature the lowering of the undesired capacitance therebetween.

12 Claims, 1 Drawing Sheet

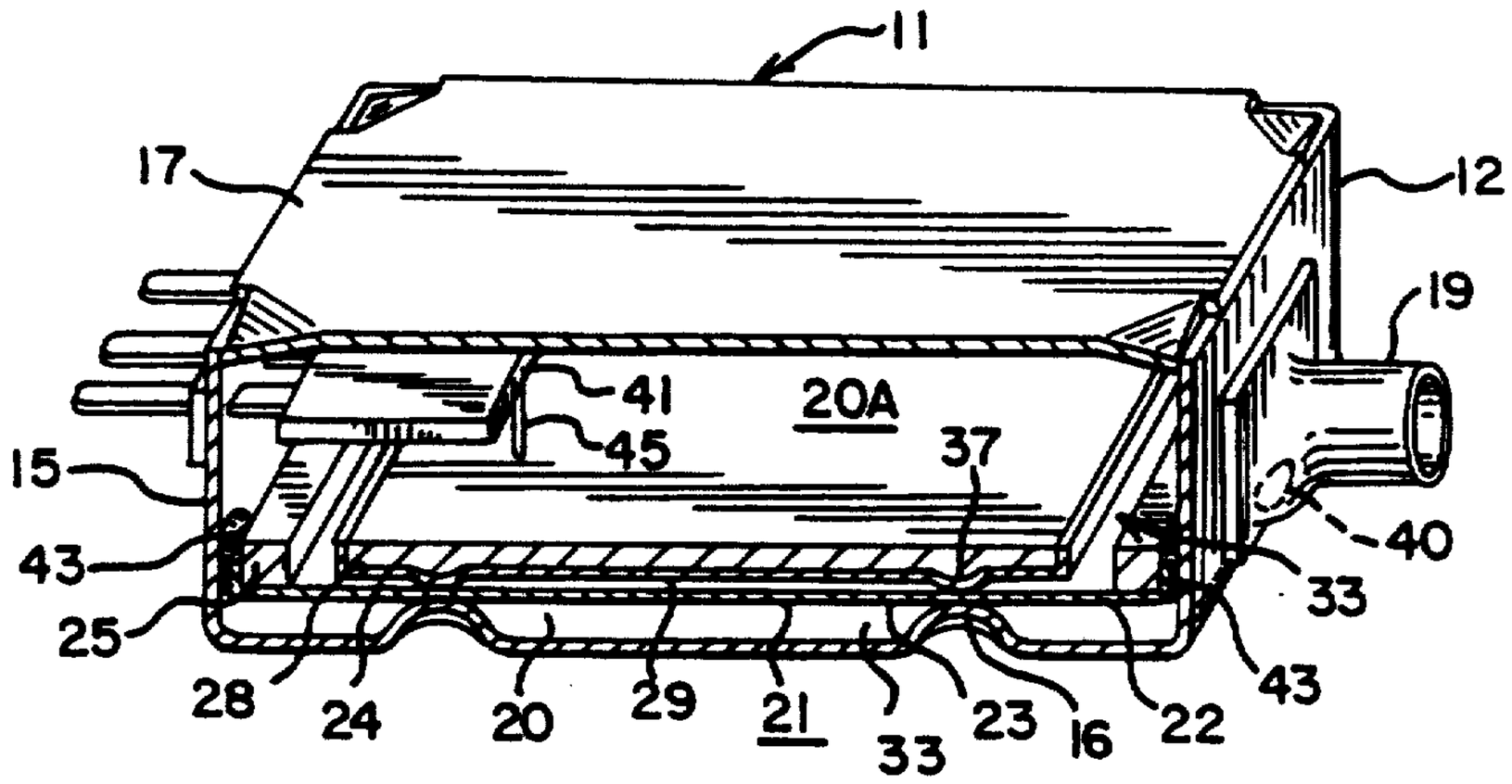


FIG_1

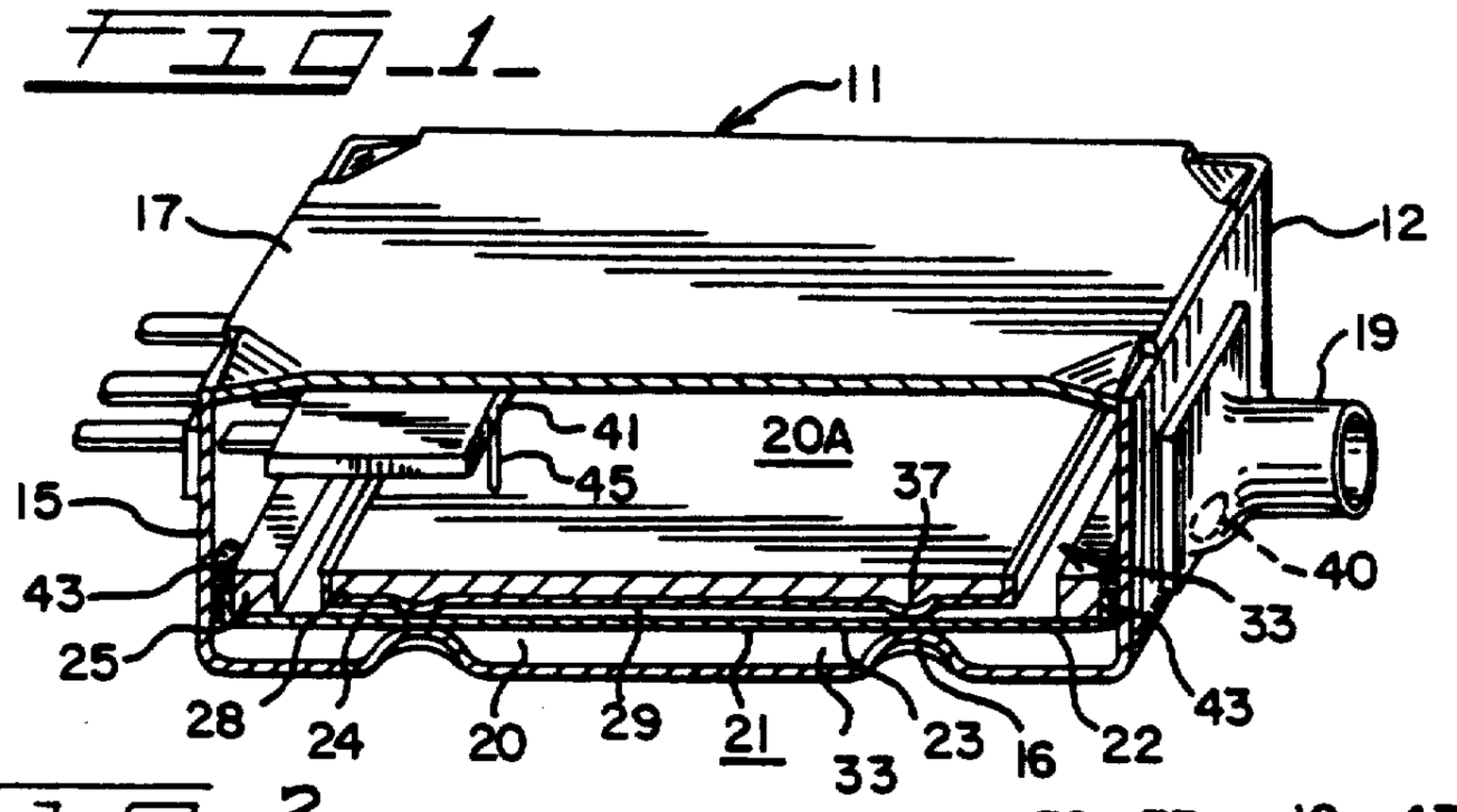


FIG_2

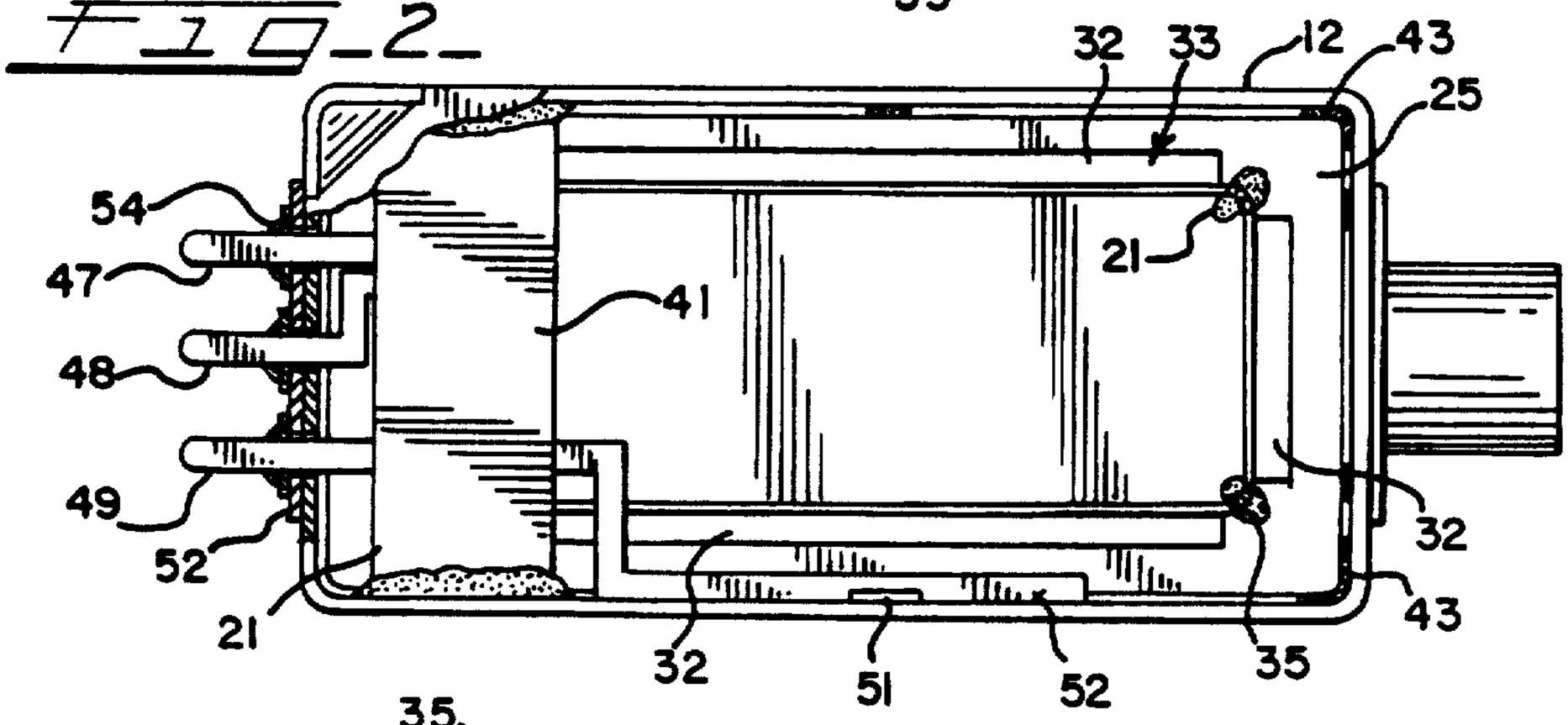


FIG_3

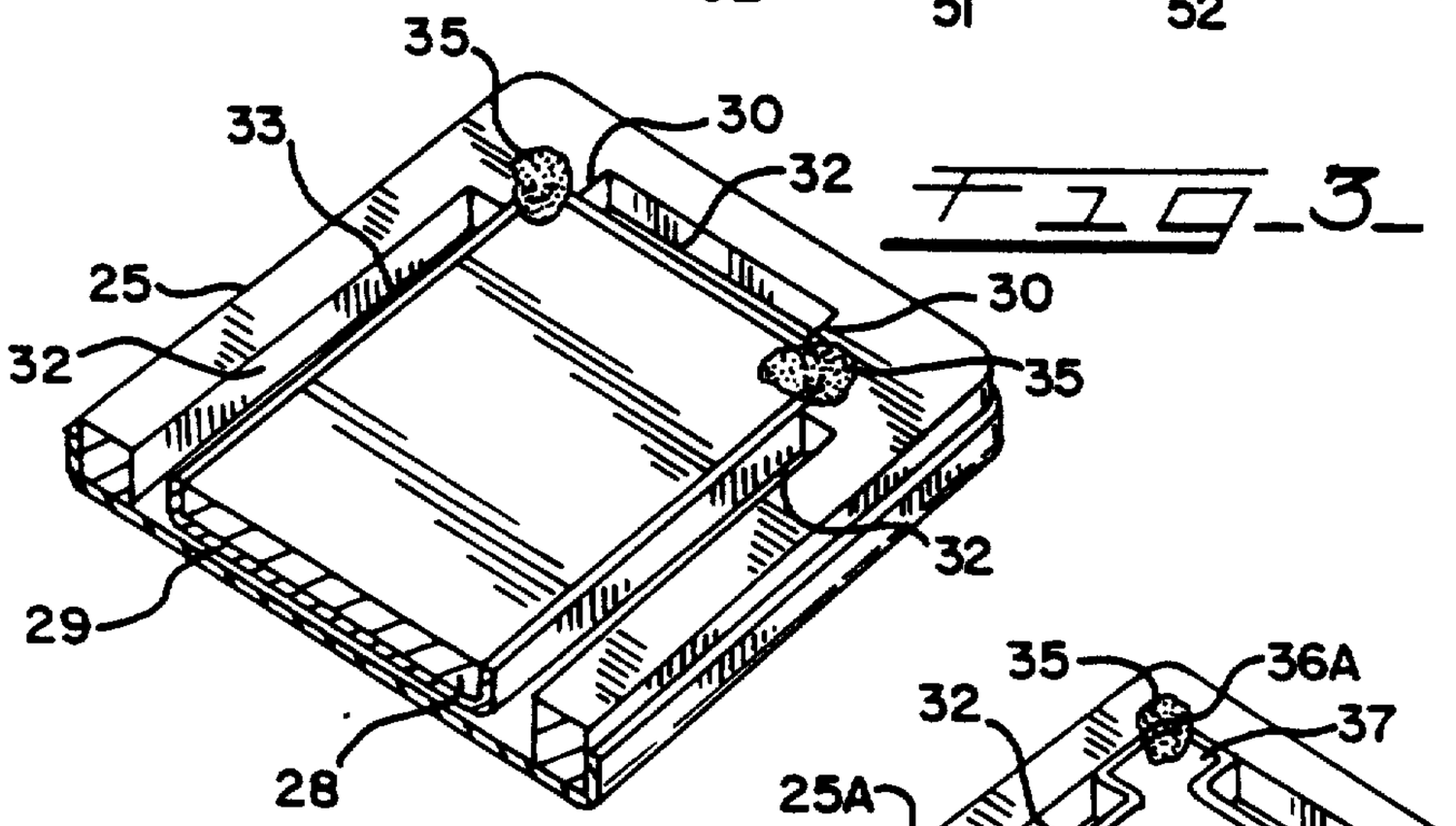
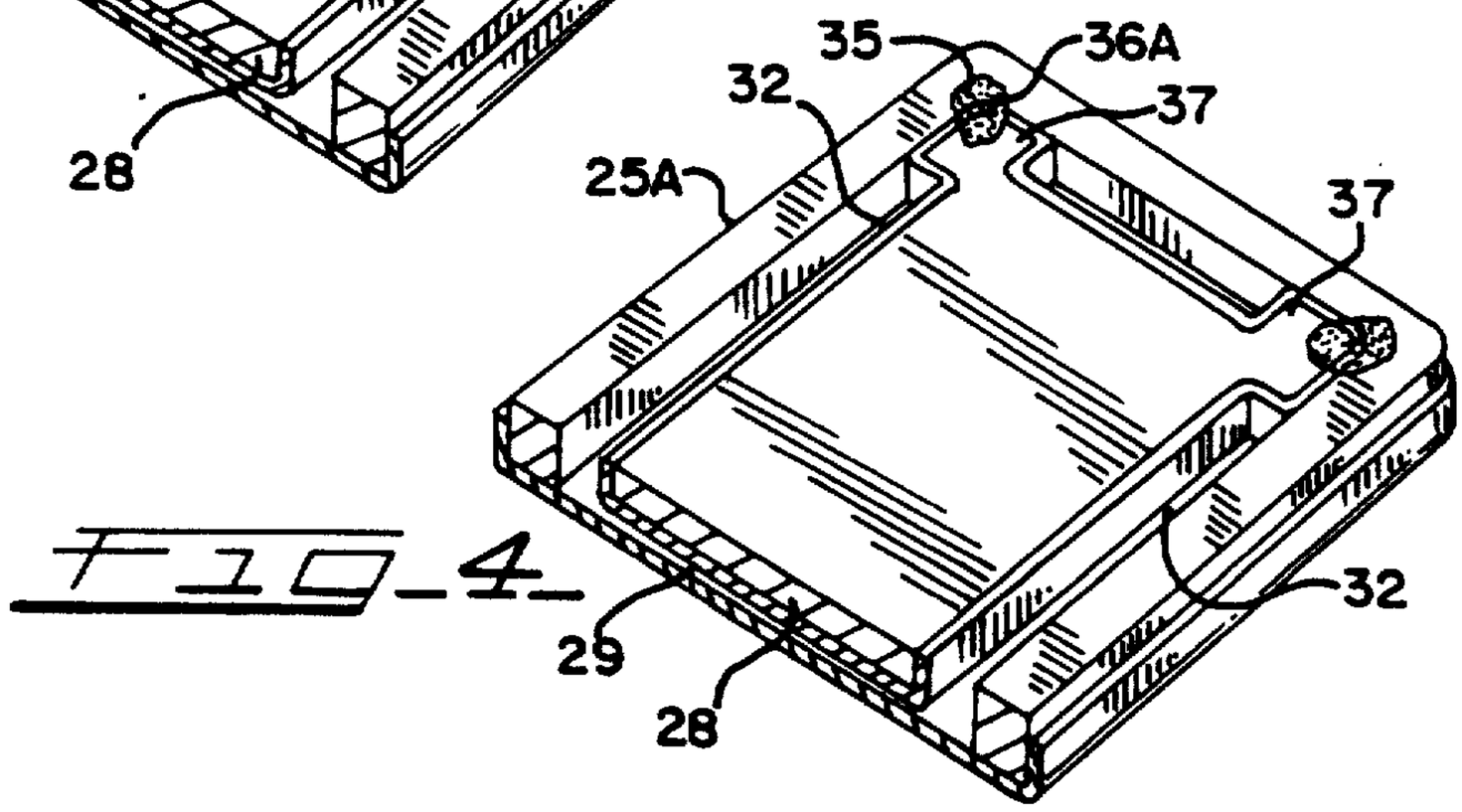


FIG_4



ACOUSTIC TRANSDUCER WITH IMPROVED ELECTRODE SPACING

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

BACKGROUND OF THE INVENTION

The present invention is related to U.S. Pat. No. 4,063,050 entitled "Acoustic Transducer with Improved Electret Assembly" issued to E. V. Carlson and M. C. Killion and assigned to the same assignee as the present invention. The disclosure of said patent is incorporated herein by reference.

The invention relates to an acoustic transducer of the type comprising an electret assembly including a diaphragm positioned adjacent a backplate having an electret film formed thereon. The electret assembly is mounted within a case to form acoustic chambers on opposite sides of the diaphragm. The case includes a channel for permitting the external acoustic signal to enter into one of the acoustic chambers to enable the diaphragm to respond thereto. Openings are provided to permit the air pulsations created by the vibrations of the diaphragm to pass from one to the other acoustic chamber.

The electret comprises a dielectric film deposited on a backplate. The backplate includes protrusions which rest on support posts formed in the case to selectively space the dielectric film from the diaphragm. The electret assembly including the diaphragm and backplate are conveniently mounted on support posts formed in the case. The diaphragm extends across the interior of the case and separates the case into essentially two chambers.

The electret dielectric film is connected to suitable electronic circuitry to thereby permit electroacoustical interaction of the diaphragm and electret to provide an electrical signal representative of the acoustic signal. As is known, the converse operation may be provided by the transducer in that an electrical signal may be applied to the electret to cause the diaphragm to vibrate and thereby develop an acoustic signal which can be coupled out of the acoustic chamber.

SUMMARY OF THE INVENTION

The present invention is an improvement over the electret assembly disclosed in above-cited U.S. Pat. No. 4,063,050. In the present invention, the backplate and the included dielectric film surface are mounted in the opening of a support ring which in turn is mounted to the walls of the case. The backplate and dielectric film which form a charged fixed electrode are positioned within the support ring to provide a spacing between the edges of the backplate and the diaphragm. The spacing lowers undesired capacitance between the backplate electrode and the metalized diaphragm, which forms a movable electrode. The spacing also provides a means or way for the air between the diaphragm surface and the dielectrical material surface to escape into the other chamber of the case.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other features, objects and advantages of the present invention will be apparent from the following more particular description of the preferred

embodiment of the invention as illustrated in the accompanying drawings wherein:

FIG. **1** is an isometric view, partially in cross section, of an electret transducer in accordance with the invention;

FIG. **2** is a plan view of case of FIG. **1** with portions thereof removed to show the mounting of the diaphragm support ring to the case, and of the backplate to the support ring;

FIG. **3** is an isometric view further illustrating the mounting of the backplate to the support ring; and

FIG. **4** shows an alternative embodiment of the support ring and the backplate.

DESCRIPTION OF THE INVENTION

Referring to FIGS. **1**, **2** and **3**, the electret transducer **11** of the invention comprises a cup-like case, casing or housing **12** which, in the embodiment shown, has rectangular shaped walls **15**. A mating cover or top **17** which comprises a generally flat plate fits atop the walls **15** and is cemented thereon to close the case **12**. An acoustical signal input tube **19** mounted to case **12** communicates to the interior of case **12** through an acoustical opening, indicated generally as numberal **40** in end wall **15**, and more particularly with acoustic chamber **20** formed in case **12**. An electret transducer assembly **21** is mounted in case **12**. The transducer assembly is generally of the type described in U.S. Pat. No. 4,063,050, cited above.

Electret assembly **21** includes a diaphragm **22** having a plate or flat portion **23** which extends across the relatively flat bottom or lower surface of case **12** and defines a lower acoustic chamber **20**.

Diaphragm **22** may be of polyethylene terephthalate, commonly available under the trademark MYLAR, or of any similar material. The plate portion **23** of diaphragm **22** may be coated with a metallizing layer of conductive material **24**, which may be evaporated on its surface. Diaphragm **22** comprises the movable electrode of the electret assembly **21**.

A backplate **28**, which has an dielectric film coating **29** thereon, is mounted in a support ring **25**. Note that the relative thickness of film coating **29** is exaggerated in the drawings. The backplate **28** is rectangular in configuration with rounded corners and is mounted in the rectangular opening **32** of a support ring **25** (see FIGS. **2** and **3**). The dimensions of the backplate are slightly smaller than the opening **32** of the support ring **25** for purposes to be explained. Backplate **28** comprises the fixed electrode of the electret assembly **21**.

The support ring **25** is also rectangular in configuration, and its outer edges conform to the interior dimensions of the walls **15** of case **12**. The support ring **25** is secured to the interior surface of the walls **15** such as by a bead of adhesive **43**. The support ring **25**, backplate **28** and diaphragm **22** define an upper acoustic chamber **20A** in case **12**.

The interior of the rectangular support ring **25** includes inwardly extending shoulders **30** with a curved inside rim to receive or conform to the rounded corners of the backplate **28**. The backplate **28** thus is positioned within the opening of the support ring **25** and secured thereto by a nodule of cement **35** placed at the corner shoulders **30**.

Projections or bumps **37** are provided on the lower surface of the backplate **28**, as in the above cited patent, which define the relative spacing of the backplate to the

diaphragm **22**. The projections **37** cooperate with protrusions **16** in the facing portion of the case **12** to provide a reference for locating the assembly within the case **12**. As described in the cited U.S. Pat. No. 4,063,050, the supporting posts **16** are formed as patterned indentations or discrete posts mounted in a pattern at the bottom or interior lower surface **33** of case **12**. Posts **16** in the selected pattern configuration, align with corresponding protrusions **37** on the backplate **28** and are utilized to support and position the electret assembly **21** within the case **12**. The posts **16** also accurately define the dimensions of the acoustic chamber **20** which is formed between the diaphragm **22** and the bottom of case **12**.

In assembly, the diaphragm **22** is positioned adjacent to the backplate **28**. As explained above, the spacing between the diaphragm plate portion **23** and the planar portions of backplate **28** is controlled by the protrusions **37** on backplate **28**. The electret assembly or subassembly **21** comprising the backplate **28** and diaphragm **22** can then be inserted into the case **12** to rest on the posts **16** on the bottom of the case to thus form the acoustic chamber **20**, as noted above.

A non-conductive ceramic plate **41** for containing or supporting the electronic circuitry is mounted within case **12** by suitable bracing and or cementing. One edge of plate **41** is mounted in the case **12** by means of the relatively rigid electrical terminals **47**, **48** and **49** each of which have a portion affixed to plate **41** and an opposite portion which extends as by cementing to terminal pads **54** on the insulating board **52** mounted to wall **15** of case **12**. The ends of the electrical terminals **47**, **49** and **51** which are affixed to plate **41**, also connect to the associated electronic circuitry, as disclosed in U.S. Pat. No. 4,063,050 which circuitry is mounted on plate **41**. Numeral **51** indicates a grounding tab formed on diaphragm **22** for electrically connecting with terminal **49**; and, reference numeral **52** indicates a weld point from terminal **49** to the case **12**. Numeral **45** indicates a connection of backplate **28** to plate **41**.

Importantly, and as mentioned above, in the present invention the spacing **32** is formed between the backplate **28** and support ring **25**. The backplate **28** is smaller than the opening **33** of support ring **25**. Thus other than at the corners, or at other selected supports, where the backplate **28** is affixed to the support ring **25**, such as by cementing; the spacing **32** is formed around the backplate and the support ring. In previous constructions, and in contrast to the present invention, the material of the diaphragm **22**, which forms the movable electrode, closely surrounds the sides of the backplate. This close spacing forms a capacitor that is in shunt with the movable portion **23** of the diaphragm **22**, which is responsible for the function of the device. This parasitic capacitor shares the charge with active portion **23** of the diaphragm **22** thus reducing the signal voltage available as an output to the associated amplifier. In the present invention, the spacing **32** is provided between the edge of the backplate **28**, fixed electrode and the diaphragm **22**, movable electrode, to lower the undesired parasitic capacitance. Spacing **32** also provides a means for the air trapped between the diaphram surface and backplate electret surface to escape into the larger acoustical chamber **20A** of the transducer case **12**.

A second embodiment of the invention is shown in FIG. **4** wherein the inside corners **36A** of the support ring **25A** form a 90° angle. In this embodiment, the backplate **28A** is again smaller than the opening in support ring **25A** and includes wings or extensions **37** on the corners thereof which conform to and abut the corners **36A** of the support ring **25A**. The backplate **28A** is secured to the support ring **25A** by a nodule of cement **35A** placed at each of the corners of the support ring and the backplate to form the spacing **32**.

While the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention.

We claim:

[1. An acoustical transducer, comprising in combination, a case having a top, bottom and side walls; and electret assembly including a diaphragm having peripheral portions and a central vibratable plate portion forming a movable electrode, a diaphragm support ring having an opening thereon mounted in said case, the peripheral portions of said diaphragm being mountable to said support ring, a backplate mounted within the opening of said support ring to form a spacing between the backplate and the support ring, said backplate having a surface comprising a fixed electrode and cooperating with the diaphragm movable electrode to develop a signal, an acoustical chamber formed between the electret assembly and the bottom of said case, a second chamber formed between said assembly and the top of said case, said spacing between the backplate and the support ring lowering the capacitance between said electrodes, and said spacing enabling air movement between said chambers.]

[2. An acoustical transducer, comprising in combination, a case having a top, bottom and side walls; an electret assembly including a diaphragm having peripheral portions and a central vibratable plate portion having a conductive material thereon, a diaphragm support ring having an opening thereon mounted in said case, the peripheral portions of said diaphragm being mountable to said support ring, a backplate mounted within the opening of said support ring to form at least one spacing between the backplate and the support ring, an electret material, said backplate having a surface on which is electret material is positioned, said electret material cooperating with the diaphragm to develop a signal, support posts on the interior surface of the bottom of the case, protrusions on the surface of the backplate and aligned with said support posts for supporting the electret assembly in the case in spaced relation to the bottom of the case, an acoustical chamber formed between the electret assembly and the interior surface of the bottom of said case, a second chamber formed between said assembly and the top of said case, the spacing between the backplate and electret material and the support ring lowering the capacitance therebetween and hence the undesired capacitance affecting the electret assembly, and the spacing also providing a channel for air between the diaphragm and the electret material to escape into the second chamber of said casing.]

[3. An acoustical transducer as in claim 2 wherein said spacing extends substantially around said backplate.]

[4. An acoustical transducer as in claim 2 wherein said diaphragm includes a flange on its periphery, said flange conforming to the wall surface of the support ring, and means for adhering said flange to said ring.]

[5. An acoustical transducer as in claim 2 wherein the support ring includes shoulders or projections ex-

tending into said opening, and said backplate is affixed to said shoulders to provide said at least one spacing between the backplate and said ring.]

[6. An acoustical transducer as in claim 2 wherein said backplate includes wings or projections extending outwardly from the edges of said backplate for affixing said backplate to said support ring to form said at least one spacing.]

7. An acoustical transducer comprising, in combination: a case; a diaphragm having peripheral mounting portions and a central vibrating plate portion forming a movable electrode, the peripheral mounting portions of said diaphragm being sealed in said casing to define separate first and second acoustic chambers on opposite sides thereof; backplate support means having an opening; a backplate in said second acoustic chamber confronting said diaphragm in close but spaced relation thereto, said backplate being mounted within said opening of said support means and secured thereto at spaced points and being unsecured thereto and spaced from the support means and casing between said spaced points of securement, said spacing between the backplate and support member and casing between said spaced points of securement extending substantially around the entire periphery of said backplate so as to substantially lower the capacitance between said backplate and the peripheral mounting portions of said diaphragm, the side of said backplate facing away from said diaphragm being spaced from a confronting side of said case to define a relatively large space communicating with the space between said backplate and diaphragm and constituting the major portion of the volume of said acoustic chamber on one side of said diaphragm, said backplate having a layer of electret material thereon and cooperating with said diaphragm to generate a signal therebetween upon movement of said diaphragm relative to said backplate or the diaphragm being moved relative to the backplate when a signal is applied therebetween; and a pair of electric terminals respectively coupled to said backplate and diaphragm for coupling a signal to or from the same.

8. An acoustical transducer as in claim 7 wherein there are support posts on the interior surface thereof upon which posts said diaphragm seats and protrusions on the surface of said backplate contacting said diaphragm outwardly of said central portion thereof and aligned with said support posts for supporting said diaphragm in an initial given spaced relation to the backplate.

9. An acoustical transducer as in claims 7 or 8 wherein said support means is a ring surrounding said opening therein, said diaphragm includes a flange on its periphery, said flange conforming to said peripheral surfaces of said support ring, and including means for adhering said flange to said ring.

10. An acoustical transducer as in claims 7 or 8 wherein said support means is a ring surrounding said opening therein, said support ring includes shoulders extending into said opening, and said backplate is affixed to said shoulders to provide said spacing between said backplate and said ring.

11. An acoustical transducer as in claims 7 or 8 wherein said support means is a ring surrounding said opening therein, said backplate includes projections extending outwardly from the edges of said backplate for affixing said backplate to said support ring and to form said spacing between said support ring and backplate.

12. An acoustical transducer as in claims 7 or 8 including port means for communicating sound between the outside of said case and said first acoustic chamber.

13. An acoustical transducer comprising, in combination: a case; a diaphragm having peripheral mounting portions and a central vibrating plate portion forming a movable electrode, the peripheral mounting portions of said diaphragm being sealed in said casing to define separate first and second acoustic chambers on opposite sides thereof; backplate support means having an opening; a backplate in said second acoustic chamber confronting said diaphragm in close but spaced relation thereto, said backplate being mounted within said opening of said support means and secured thereto at spaced points and being unsecured thereto and spaced from the support means and casing between said spaced points of securement, the side of said backplate facing away from said diaphragm being spaced from a confronting side of said case to define a relatively large space communicating with the space between said backplate and diaphragm and constituting the major portion of the volume of said acoustic chamber on one side of said diaphragm, said spacing between said backplate and support means and casing effecting communications between the space between said diaphragm and backplate and said relatively large space on the opposite side of said backplate to reduce back pressure on said diaphragm in said second acoustical chamber; said backplate having a layer of electret material thereon and said cooperating with said diaphragm either to generate a signal therebetween upon movement of said diaphragm relative to said backplate or the diaphragm being moved relative to the backplate when a signal is applied therebetween; and a pair of electric terminals respectively coupled to said backplate and diaphragm for coupling a signal to or from the backplate and diaphragm.

14. The transducer of claim 7 wherein said case has support posts on the interior surface thereof upon which posts said diaphragm seats, and protrusions on the surface of the backplate contacting said diaphragm outwardly of the central portion thereof and aligned with said support posts for supporting the diaphragm in an initial given spaced relation to the backplate.

15. An acoustical transducer as in claims 7 or 8 wherein said support means is a support ring surrounding said opening therein, said diaphragm includes a flange on its periphery, said flange conforming to the wall surface of the support ring, and means for adhering said flange to said ring.

16. An acoustical transducer as in claims 7 or 8 wherein said support means is a ring surrounding said opening therein, said support ring includes shoulders or projections extending into said opening of said ring, and said backplate is affixed to said shoulders to provide said spacing between the backplate and said ring.

17. An acoustical transducer as in claims 7 or 8 wherein said support means is a ring surrounding said opening therein, said backplate includes projections extending outwardly from the edges of said backplate for affixing said backplate to said support ring and to form said spacing between said support ring and backplate.

18. An acoustical transducer as in claims 7 or 8 including port means for communicating sound between the outside of said case and said first acoustic chamber.

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