

SPECIFICATION

Electret microphone

- 5 This invention relates to a condenser microphone employing an electret as a diaphragm, and more particularly to an electret microphone which is reduced in a size in a direction perpendicular to the diaphragm.
- 10 In condenser microphones an impedance converter is housed in the microphone capsule so as to provide decreased output impedance, and in conventional electret microphones the impedance converter is disposed behind a
- 15 back electrode plate. This imposes severe limitations on the reduction of the size of the microphone in the direction perpendicular to the diaphragm. Accordingly, efforts have been made to reduce the size in the radial direction
- 20 of the diaphragm for miniaturization of the microphone; however, reducing the diameter of the diaphragm leads to the defects of reduced tone quality and sensitivity. The prior art microphone is thus thick and hence is not
- 25 suitable for use, for example, attached to a tiepin, because it greatly protrudes from a necktie. Further, when a non-directional microphone is attached to the tiepin, sounds are muffled in the microphone to provide de-
- 30 graded articulation and when the user is silent, the microphone catches surrounding noises.

An object of the invention is to provide a thin electret microphone.

- 35 Another object of this invention is to provide a miniature electret microphone which is excellent in tone quality and high in sensitivity.

- 40 Another object of this invention is to provide a thin, unidirectional electret microphone.

- According to the invention an electret microphone comprises a cylindrical capsule having an end wall forming a front plate which is provided with an aperture for introducing
- 45 sound into the capsule, an electret diaphragm disposed in the capsule adjacent and in opposing relation to said front plate, a back electrode plate disposed adjacent to said diaphragm in opposition relation thereto, a ring-shaped back electrode holder the outer wall of
- 50 which is disposed coaxially with the capsule and an impedance conversion element for converting the microphone output into a low impedance signal, characterized in that a side wall of said ring-shaped back electrode holder
- 55 is provided with a recess cut into said wall from the outer peripheral surface of the wall, a notch is formed in the cylindrical wall of the capsule in opposing relation to said recess,
- 60 and the impedance conversion element is disposed in said recess, said impedance conversion element having an input terminal which is connected to the back electrode plate and an output terminal which is led out of the
- 65 capsule through the notch.

In the accompanying drawings:—

Figure 1 is a cross-sectional view showing one example of an electret microphone in accordance with the invention;

- 70 *Figure 2* is a plan view of a back electrode holder forming part of the microphone shown in *Fig. 1*;

Figure 3 is a sectional side elevation of the holder of *Fig. 2*;

- 75 *Figure 4* is a cross-sectional view of a capsule forming part of the microphone shown in *Fig. 1*;

Figure 5 is a perspective view of a shield plate forming part of the microphone shown in *Fig. 1*;

- 80 *Figure 6* is a cross-sectional view illustrating an example of a unidirectional electret microphone in accordance with the invention; and

- 85 *Figure 7* is a cross-sectional view showing a modified form of the electret microphone in accordance with the invention.

- With reference to *Fig. 1*, numeral 11 indicates a capsule, which is a cylindrical member made, for example from aluminium or like
- 90 metal as is the case with the prior art. One end face of the capsule 11 forms a front plate 12 having a centrally disposed hole 13 for allowing sound from the front of the capsule 11 to pass into the capsule. A dust proof
- 95 cloth 14 is stuck on the front of the front plate 12 in a manner to cover the central hole 13.

- In the capsule 11 there is disposed an electret diaphragm 16 mounted on a ring 15, which is in contact with the front plate 12. The diaphragm 16 is a polarized dielectric film, which is deposited with a metallic foil all over one surface on the side of the ring 15. A back electrode plate 18 is placed in opposing
- 105 relation to the diaphragm 16 with a ring-shaped spacer 17 interposed therebetween, the spacer 17 being held in contact with the marginal portion of the diaphragm 16. The back electrode plate 18 is supported by a
- 110 back electrode holder 19. The open end of the capsule 11 is closed by a shield plate 22 at the rear of the back electrode holder 19, and the rear end portion of the capsule 11 is turned over the back of the holder 19. As a
- 115 result of this the diaphragm 16, the back electrode plate 18, the back electrode holder 19 and the shield plate 22 are mechanically fixed in the capsule 11.

- An impedance conversion element 24 is
- 120 housed in the peripheral wall of the back electrode holder 19. For example, as shown in *Figs. 2 and 3*, the back electrode holder 19 is a relatively thick cylindrical member formed from a synthetic resin and has an open ended
- 125 recess or slot 25 formed in its peripheral wall which receives the impedance conversion element 24. The inner periphery of the back electrode holder 19 is eccentric with respect to the outer periphery so that the portion of
- 130 the peripheral wall having the slot 25 formed

therein is thicker than the wall portion diametrically opposite thereto. The inner peripheral surface of the back electrode holder 19 has formed therein an annular stepped portion 26 on the side of the diaphragm 16, and the back electrode plate 18 is snugly fitted in the stepped portion 26. The back electrode plate 18 has formed therein ventilating holes 27, which permits intercommunication of a rear compartment 28 defined between the back electrode 18 and the shield plate 22 with the space between the back electrode plate 18 and the diaphragm 16.

The impedance conversion element 24 acts to convert a high impedance signal into a low impedance one and usually takes the form of a circuit which is composed of a field effect transistor and a resistance element and fabricated as an integrated circuit; and the impedance conversion element 24 may be the same as that heretofore employed in this kind of microphone. An input terminal 29 of the impedance conversion element 24 is connected, as by spot welding, to the underside of the back electrode plate 18. The slot 25 is formed to extend to the stepped portion 26, so that the slot 25 communicates with the inside of the back electrode holder 19 where the input terminal 29 is led to the inside of the back electrode holder 19 along the back electrode plate 18. The stepped portion 26 has formed therein a groove 30 for receiving part of the input terminal 29. In practice, the back electrode plate 18 is placed on the holder 19, with the impedance conversion element 24 connected to the back electrode plate 18, and the impedance conversion element 24 is placed in the slot 25. An output terminal 31 of the impedance conversion element 24 is led out of the capsule 11, without touching it, through a notch 32 made in the side of the capsule 11, the notch being in opposing relation to the slot 25. The notch 32 as shown in Fig. 4, extends from the rear end of the capsule 11 to the vicinity of the front plate 12. An adhesive material is packed in the slot 25 to fix therein the impedance conversion element 24 and prevent air in the rear compartment from escaping through the slot 25.

The shield plate 22 has a lug 34 formed integrally therewith and which extends from one part of its marginal edge substantially at right angles, as shown in Fig. 5. The lug 34 is located against a side wall of the impedance conversion element 24 and faces the notch 32. The shield plate 22 is connected to an earth terminal 37 of the impedance conversion element 24, by pressing the terminal 37 into a narrow notch 36 formed in the lug 34 and extending down from the upper end of the lug. The lug 34 and the output terminal 31 of the impedance conversion element 24 are spaced apart so as not to make contact with each other.

In the conventional electret microphone, since the impedance conversion element 24 is placed in the rear compartment 28, there is a limit to the reduction in size of the microphone in a direction perpendicular to the diaphragm 16. In the present electret microphone however, the impedance conversion element 24 is housed in the peripheral wall of the back electrode holder 19, so that the microphone can be reduced in size in the direction perpendicular to the diaphragm 16; namely the microphone can be made thinner by the thickness of the impedance conversion element 24. As compared with the conventional electret microphone of an equal bulk, the microphone of this invention can be reduced in thickness and the diameter of the diaphragm 16 increased thereby, providing excellent tone quality and stable sensitivity. That is, since the diameter of the diaphragm 16 is large, there is no particular need for making the spacer 17 thinner for enhancement of the sensitivity, and the sensitivity becomes very stable and high; furthermore, respective parts need not be produced to tightly restricted dimensional tolerances and hence are easy to fabricate and assemble. On top of that, this invention meets a recent demand for thin microphone which have a shell length in the axial direction of the microphone capsule. The microphone of this invention is so thin that, for example, when attached to a tiepin, it does not greatly protrude and hence is neither a nuisance nor unsightly.

The directivity of the above said microphone can be made unidirectional with such an arrangement, for example, as shown in Fig. 6, in which parts corresponding to those in Fig. 1 are identified by the same reference numerals. The arrangement of Fig. 6 is identical with that of Fig. 1 except that the shield plate 22 has formed therein, for example, a plurality of sound holes 38 to permit the communication therethrough of the rear compartment 28 with the outside and in that a damper cloth 39 is inserted in the rear compartment 28. When the damper cloth 39 is relatively thin, it may also be stuck on the shield plate 22 in a manner to cover the sound holes 38. The damper cloth 39 may be non-woven fabric, porous urethane of excellent air-permeability, loosely woven, air-permeable felt or the like.

With such an arrangement as depicted in Fig. 6, sounds reach the diaphragm 16 though the central hole 13 from in front of the microphone and through the sound holes 38 and the ventilating holes 27 from behind. The sounds entering the microphone from behind are damped by the damper cloth 39 down to a suitable magnitude, thereby to provide the uni-directionality. With a thin microphone having a large diameter diaphragm. With a thin microphone having a large diameter diaphragm, the level of the low sound

range does not drop and sounds are muffled in the microphone, resulting in degraded articulation in some cases. A unidirectional microphone is free from such a defect. Further,

- 5 when used, for example, attached to a tiepin, the uni-directional microphone hardly catches surrounding sounds due to its uni-directionality whilst the user is silent.

Turning now to Fig. 7 in which parts corresponding to those in Fig. 1 are marked with the same reference numerals, it is desirable to keep the air pressure in the capsule 11 equal to the outside air pressure at all times by interposing between the back electrode holder 10 19 and the shield plate 22 a ring-shaped cushion 21 which is air-permeable to such an extent as not to have any accoustical influence. In this case, if the cushion 21 is made of an elastic material, then the capsule 11 20 and the shield plate 22 elastically contact so that when the capsule 11 is staked, the internal structure is held stable. It is also possible to use a cushion which is not air-permeable but elastic, in which case the interior surface of the shield plate 22 is roughened to permit an air flow between the inside of the capsule 11 and the outside. Also it is possible to wrap the impedance conversion element 24 in an elastic sheet 41 such, for example, as a rubber sheet and fit the wrapped element 24 30 in the slot 25, whereby to prevent air leakage from the rear compartment 28 through the slot 25.

In an experimental version, the capsule 11 35 was about 9.5mm in diameter and about 2.5mm in thickness, the back electrode holder 19 was about 1.2mm in thickness, the slot 25 was 3.2mm in width and four holes 0.8mm in diameter were formed as the sound 40 holes 38 and excellent unidirectionality was obtained.

CLAIMS

1. An electret microphone comprising a 45 cylindrical capsule having an end wall forming a front plate which is provided with an aperture for introducing sound into the capsule, an electret diaphragm disposed in the capsule adjacent and in opposing relation to said front plate, a back electrode plate disposed adjacent to said diaphragm in opposing relation thereto, a ring-shaped back electrode holder the outer wall of which is disposed coaxially with the capsule and an impedance conversion element for converting the microphone output into a low impedance signal, characterized in that a side wall of said ring-shaped back electrode holder is provided with a recess cut into said wall from the outer peripheral surface of the wall, a notch is formed in the cylindrical wall of the capsule in opposing relation to said recess, and the impedance conversion element is disposed in said recess, said impedance conversion element having an 65 input terminal which is connected to the back

electrode plate and an output terminal which is led out of the capsule through the notch.

2. An electret microphone according to Claim 1, wherein said back electrode holder 70 has an inner periphery which is eccentric with respect to the outer periphery so that the portion of the side wall of the holder in which said recess is formed is thicker than the portion of the side diametrically opposite 75 thereof.

3. An electret microphone according to Claim 1, wherein a ring-shaped stepped portion is formed in the inner peripheral surface of the back electrode holder on the side of the 80 diaphragm, wherein the back electrode plate is urged against the ring-shaped stepped portion and held by the back electrode holder, wherein the recess is formed to partly extend to the ring-shaped stepped portion so that the 85 recess and the inside of the back electrode holder communicate with each other, and wherein the input terminal of the impedance conversion element is led to the inside of the back electrode holder through the partly extending portion of the recess. 90

4. An electret microphone according to Claim 3, wherein the input terminal of the impedance conversion element is led to the inside of the back electrode holder along the 95 back of the back electrode plate.

5. An electret microphone according to Claim 3, wherein a groove is formed in the ring-shaped stepped portion for receiving one part of the input terminal of the impedance 100 conversion element.

6. An electret microphone according to Claim 1, wherein a shield plate is disposed behind the back electrode holder to cover it, and wherein the rear end portion of the capsule is bent to be urged against the back of the shield plate. 105

7. An electret microphone according to Claim 6, wherein the shield plate has a lug formed integrally therewith to extend from 110 one portion of its marginal edge at right angles, the lug being disposed adjacent a side wall of said impedance conversion element and facing the notch in the cylindrical wall of the capsule, and wherein a ground terminal of the impedance conversion element is connected to the lug. 115

8. An electret microphone according to claim 7, wherein a notch is formed in the lug to extend down from its upper end for receiving the earth terminal of the impedance conversion element. 120

9. An electret microphone according to claim 5, wherein the shield plate has formed therein sound holes for introducing sounds 125 into the capsule from behind, and wherein a damper cloth is disposed between the shield plate and the back electrode plate.

10. An electret microphone comprising the combination and arrangement of parts 130 substantially as hereinbefore described with



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range does not drop and sounds are muffled in the microphone, resulting in degraded articulation in some cases. A unidirectional microphone is free from such a defect. Further, when used, for example, attached to a tiepin, the uni-directional microphone hardly catches surrounding sounds due to its uni-directionality whilst the user is silent.

Turning now to Fig. 7 in which parts corresponding to those in Fig. 1 are marked with the same reference numerals, it is desirable to keep the air pressure in the capsule 11 equal to the outside air pressure at all times by interposing between the back electrode holder 19 and the shield plate 22 a ring-shaped cushion 21 which is air-permeable to such an extent as not to have any acoustical influence. In this case, if the cushion 21 is made of an elastic material, then the capsule 11 and the shield plate 22 elastically contact so that when the capsule 11 is staked, the internal structure is held stable. It is also possible to use a cushion which is not air-permeable but elastic, in which case the interior surface of the shield plate 22 is roughened to permit an air flow between the inside of the capsule 11 and the outside. Also it is possible to wrap the impedance conversion element 24 in an elastic sheet 41 such, for example, as a rubber sheet and fit the wrapped element 24 in the slot 25, whereby to prevent air leakage from the rear compartment 28 through the slot 25.

In an experimental version, the capsule 11 was about 9.5mm in diameter and about 2.5mm in thickness, the back electrode holder 19 was about 1.2mm in thickness, the slot 25 was 3.2mm in width and four holes 0.8mm in diameter were formed as the sound holes 38 and excellent unidirectionality was obtained.

CLAIMS

1. An electret microphone comprising a cylindrical capsule having an end wall forming a front plate which is provided with an aperture for introducing sound into the capsule, an electret diaphragm disposed in the capsule adjacent and in opposing relation to said front plate, a back electrode plate disposed adjacent to said diaphragm in opposing relation thereto, a ring-shaped back electrode holder the outer wall of which is disposed coaxially with the capsule and an impedance conversion element for converting the microphone output into a low impedance signal, characterized in that a side wall of said ring-shaped back electrode holder is provided with a recess cut into said wall from the outer peripheral surface of the wall, a notch is formed in the cylindrical wall of the capsule in opposing relation to said recess, and the impedance conversion element is disposed in said recess, said impedance conversion element having an input terminal which is connected to the back

electrode plate and an output terminal which is led out of the capsule through the notch.

2. An electret microphone according to Claim 1, wherein said back electrode holder has an inner periphery which is eccentric with respect to the outer periphery so that the portion of the side wall of the holder in which said recess is formed is thicker than the portion of the side diametrically opposite thereof.

3. An electret microphone according to Claim 1, wherein a ring-shaped stepped portion is formed in the inner peripheral surface of the back electrode holder on the side of the diaphragm, wherein the back electrode plate is urged against the ring-shaped stepped portion and held by the back electrode holder, wherein the recess is formed to partly extend to the ring-shaped stepped portion so that the recess and the inside of the back electrode holder communicate with each other, and wherein the input terminal of the impedance conversion element is led to the inside of the back electrode holder through the partly extending portion of the recess.

4. An electret microphone according to Claim 3, wherein the input terminal of the impedance conversion element is led to the inside of the back electrode holder along the back of the back electrode plate.

5. An electret microphone according to Claim 3, wherein a groove is formed in the ring-shaped stepped portion for receiving one part of the input terminal of the impedance conversion element.

6. An electret microphone according to Claim 1, wherein a shield plate is disposed behind the back electrode holder to cover it, and wherein the rear end portion of the capsule is bent to be urged against the back of the shield plate.

7. An electret microphone according to Claim 6, wherein the shield plate has a lug formed integrally therewith to extend from one portion of its marginal edge at right angles, the lug being disposed adjacent a side wall of said impedance conversion element and facing the notch in the cylindrical wall of the capsule, and wherein a ground terminal of the impedance conversion element is connected to the lug.

8. An electret microphone according to claim 7, wherein a notch is formed in the lug to extend down from its upper end for receiving the earth terminal of the impedance conversion element.

9. An electret microphone according to claim 5, wherein the shield plate has formed therein sound holes for introducing sounds into the capsule from behind, and wherein a damper cloth is disposed between the shield plate and the back electrode plate.

10. An electret microphone comprising the combination and arrangement of parts substantially as hereinbefore described with



reference to Figs. 1-5 of the accompanying drawings.

11. An electret microphone comprising the combination and arrangement of parts substantially as hereinbefore described with reference to Fig. 6 of the accompanying drawings.

12. An electret microphone comprising the combination and arrangement of parts substantially as hereinbefore described with reference to Fig. 7 of the accompanying drawings.

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