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**UNIDIRECTIONAL CONDENSER MICROPHONE**

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**ABSTRACT OF THE DISCLOSURE**

A unidirectional condenser microphone which improves the polar diagram in the frequency region between approximately 6 and approximately 12 kc.p.s., comprising a back plate of the microphone formed with holes extending from the surface of the plate in front of the diaphragm into an acoustical impedance and from this impedance to an opening at the rear of the microphone, and the back plate formed with grooved distributed on its surface in front of the diaphragm, the holes terminating in the grooves, preferably in the crossing points of the grooves.

The present invention relates to a unidirectional condenser microphone and is concerned with the construction of the back plate of a condenser microphone consisting preferably of a diaphragm and of a back plate, which are the two electrodes being insulated from each other.

In all known unidirectional microphones of the velocity or pressure gradient type the back plate arranged behind the diaphragm consists of a plane metallic or metallized plate which has many holes.

Without the holes the compliance of the air volume between the diaphragm and the back plate would be too small. Moreover, at least some of the holes must be deep enough to reach one or more openings of the microphone case, the openings being arranged at some distance behind the area of the diaphragm, to insure that also the rear of the diaphragm may be reached by the sound waves.

In the case of unidirectional microphones, it is important that all sound waves coming from the rear will reach all points of the front and all points of the rear of the diaphragm with average coincident amplitude and phase. That must be so over the entire frequency range, where the microphone works according to the pressure gradient or velocity microphone principle.

Theoretically it is not necessary that the diaphragm will stay immovable by sound coming from the rear, but the sum of all positive and of all negative diaphragm movements must be zero.

It is one object of the present invention to provide a condenser microphone wherein a good front-to-back ratio over a wide frequency range may be obtained only, if indeed every part of the diaphragm will stay nearly immovable, when the sound is coming from the rear.

In that case, of course, all points of the front of the diaphragm may be reached very easily by the sound energy; but in order, also to lead the sound energy nearly uniformly to all points of the rear of the diaphragm, usually an air-filled chamber in the form of a short cylinder is arranged inside or straight behind the back plate of capacitive unidirectional microphones. That air-filled chamber fulfills the following tasks:

(1) Combining the sound energy coming through a small number of drilled holes or slits from openings at or near the rear of the microphone and, in that way, usually passing acoustical resistances;

(2) Distributing the sound energy to the great number of drilled holes of the back plate behind the diaphragm;

(3) Increasing the compliance of the air-volume behind

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the diaphragm which controls the stiffness of the diaphragm.

With this and other objects in view, which will become apparent in the following detailed description, the present invention will be clearly understood in connection with the accompanying drawings, in which:

FIGURE 1 is a cross-section of a known capacitive pressure-gradient microphone with a time delay device disposed behind the diaphragm;

FIG. 2 is a rear elevation thereof;

FIG. 3 is a cross-section of the condenser microphone, designed in accordance with the present invention, shown at an enlarged scale;

FIG. 4 is a front elevation of the microphone disclosed in FIG. 3; and

FIG. 5 is a cross-section of the condenser microphone capsule, disclosing a variation of the friction element.

Referring now to the drawings, the known condenser microphone in FIGS. 1 and 2 comprises a housing 1<sup>a</sup> to which the diaphragm 1 is secured and which receives a back plate 3. Inside the back plate 3 is an air-filled chamber 5. A plurality of drilled holes 4 extend from the outer surface of the back plate 3 into the chamber 5 and a small number of drilled holes 6 or, instead of that, a number of slits or other air-ducts together with an appropriate acoustical impedance 7 connect the air-filled chamber 5 with an opening 8 at the rear or at the periphery of the microphone.

It is a disadvantage of all air-filled chambers of such kind together with the described drilled holes to form a Helmholtz-resonator having a resonance frequency within the upper audio frequency range. Though it is possible to damp the resonator in order to do away with its influence on the frequency response of the microphone, nearly in all microphones of that kind the phase-shift of the resonator disturbs, within a definite frequency range, the phase shift of the sound energy coming from the backward opening to the rear of the diaphragm and, by that, disturbs the "unidirectional" characteristic of the microphone.

Therefore, the polar diagram of all known unidirectional microphones in the frequency region between approximately 6 and approximately 12 kc.p.s. has discontinuities and irregularities, due to the volume of the air-filled chamber.

Above this frequency section, due to the diameter of the microphone, usually the microphone-polar-diagram again becomes better by the influence of the sound diffraction on the diaphragm not yet being small compared with the sound-wavelength and by the influence of sound-shadowing-effects.

It is the purpose of the present invention to provide a condenser microphone not having the above-described disadvantages. The back plate of the present microphone is equipped with grooves disposed on its surface and with drilled holes ending in these grooves. By this means the sound energy which reaches the rear of the diaphragm after having passed an acoustical resistance, is conducted directly through a small number of drilled holes of rather large diameter into grooves arranged in the upper side of the back plate and being arranged straight behind the diaphragm, so that the sound energy is distributed very well to the different regions of the rear of the diaphragm.

The local arrangement, the number and the cross-section area of the grooves may be varied over a wide range. The grooves may be straight or curved. They may cross one another; but crossing is not necessary. When crossing one another, the small number of drilled holes may end in the crossing points of the grooves effecting thereby a good distribution of the sound. It is very useful, when the grooves form a line-net spreading all over the upper area of the back plate behind the diaphragm.