# PATENT SPECIFICATION

*Convention Date (Germany): Aug. 21, 1930.*

**376,951**

*Application Date (in United Kingdom): July 15, 1931. No. 20,357/31.*

*Complete Accepted: July 21, 1932.*

COMPLETE SPECIFICATION.

## Improvements in or relating to Microphones.

We, SIEMENS & HALSKE AKTIENGESELLSCHAFT, a German Company, of Berlin-Siemensstadt, Germany, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The present invention relates to an electro-dynamic microphone with a diaphragm traversed by current (band-microphone).

In the case of the known constructions of band-microphones the entire chamber behind the band up to the immediate neighbourhood thereof is stopped with felt. The arrangement works in the following manner: In the presence of low frequencies that resonance of the band, the peak of which lies at approximately 100—200 Hz, alone becomes apparent; in the range of the medium frequencies the resonance of the coupled tone chamber then becomes noticeable which resonance depends, both as regards position and selectivity upon the felt stopping, as well as upon the manner in which the tone chamber is in communication with the outside air. The band microphones thus constructed have hitherto in general met the requirements placed upon a good transmission, but it has often become disturbingly noticeable that the high frequencies are not reproduced so well and that, owing to the varying quality of the felt stopping the reproduction of the middle frequencies varies substantially with several microphones. This is particularly disturbing in the case of mass production, as, by reason of these circumstances, it is comparatively difficult to manufacture a quantity of microphones with the same characteristics.

According to the invention, these drawbacks are avoided and the reproduction, in particular of the high frequencies, is improved by providing several resonators, preferably possessing great damping, the natural oscillations of which differ from each other. It is preferable to arrange a definite pressure chamber behind the band so as to constitute one of the resonators. Together with the band mass it is intended to produce a natural oscillation (transverse resonance) within the range of the high frequencies, for example at 4000 Hz. By means of this resonance the reproduction of the high frequencies is substantially improved; without this chamber the frequency curves would greatly decline in this range. A further improvement—for the highest frequencies of all—is brought about by the longitudinal resonance (singing effect) of the pressure chamber. The natural oscillation of the longitudinal resonance is situated at about 8000 Hz; it is the fundamental frequency of the pressure chamber open on both sides (top and bottom) behind the band. The fact that the pressure chamber is open at the ends does not affect the production of the transverse resonance, as the pressure conditions behind the centre of the band in the case of the transverse frequency are now no longer substantially influenced by the condition of the ends if the transverse resonance lies sufficiently high.

The reduction of the space behind the band, owing to the rigidity of the air-cushion, would greatly reduce the band amplitude outside the resonance range. Therefore, according to a further feature of the invention, the remainder of the former large rear chamber enclosed by the magnet limbs is coupled with the pressure chamber behind the band. Its resonance is thereby caused to come into evidence again in the range of the middle frequencies. Now, in order that the transverse resonance may nevertheless be produced in the small pressure chamber, the coupling is effected, for example, by a slot. This slot is so dimensioned that, for the frequencies emphasized by the small rear chamber, it provides a damping which does not permit the perceptible outputs of sound for this frequency range to penetrate to the large tone chamber. With high frequencies, the air, so to speak, remains stuck in the slot. This practically means an automatic uncoupling of the large tone chamber in the case of high frequencies. On the other hand, for the range of the middle frequencies, the slot damping must still be negligible with regard to the resonance range of the large tone chamber.

Instead of the slot, narrow holes may be provided which have the necessary resistance for the high frequencies.

The accompanying drawings show a constructional example of the invention.

Figure 1 is a cross-section of the microphone, and Figure 2 is a section on the line A—B of Figure 1.

In the air gap of the magnet 7, the small band 2 is arranged. Behind the small band the pressure chamber 1 is situated, which is in communication with the tone chamber 3 through the slot 4. The large tone chamber 3 is stopped with felt in the known manner, and the pressure chamber 1 is in communication with the outside air through the gauze windows 6. Broad slots 5 also form connection between the tone chamber 3 and the outside air.

The individual resonance frequencies must be so selected that holes are avoided in the frequency curve. This requirement is complied with if the individual resonators are greatly damped. The damping is realised in the known manner by felt stopping in the case of the large tone chamber. In addition to this, the apertures 5, through which the tone chamber is in communication with the outside air, increase the damping. The same applies to the small pressure chamber 1 which communicates with the outside air through the gauze window 6. The damping of the small pressure chamber 1 is further increased by the output yielded at the coupling slot 4.

The behaviour of the new band-microphone in the presence of the various frequencies of the sound occurring is shown in Figure 3. The natural oscillation of the band (curve I) is determined by the lowest frequencies. The resonance oscillation of the large tone chamber (curve 2) is very quickly superimposed upon this on the occurrence of midde frequencies. If the frequency is further increased, the large tone chamber is gradually closed off, and the transverse resonance of the small pressure chamber (curve 3) comes into play and prevents the declining of the sensitiveness at high frequencies. In the case of the highest frequencies, the longitudinal resonance of the pressure chamber finally comes into play with increasing sensitiveness (curve 4).

By the new construction, a broader frequency band and a better type-constancy is realised. Even if in the range of the middle frequencies the felt stopping has any influence, then, owing to the well-defined pressure-chamber in immediate proximity to the small band and the damping effected by the connecting slot, the influence of the felt for the higher frequencies is excluded.

Instead of the pressure chamber shown in the drawings, mechanical resonators may also be used; however, the coupling of the mechanical resonators causes difficulties under certain circumstances. The frequency characteristic of the microphone alters if it is used in another gas atmosphere, for example in a hydrogen atmosphere, which may occasionally be suitable. The transverse resonance does not vary if another medium is selected, while the longitudinal resonance, which depends upon the velocity of sound in the corresponding medium, varies substantially.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. An electro-dynamic microphone with a current conducting diaphragm, characterised by the provision of several resonators, preferably possessing great damping, the natural oscillations of which differ from each other, so that they broaden the frequency range which may be transmitted.

2. An electro-dynamic microphone according to claim 1, characterised by the fact that a pressure chamber arranged behind the diaphragm serves as one of the resonators, the natural oscillation of which lies within the range of the high frequencies.

3. An electro-dynamic microphone according to claim 2, characterised by such a dimensioning of the pressure chamber that this latter has two different resonances, namely one resonance at approximately 4000 Hz. (transverse resonance) and a second resonance (longitudinal resonance) at approximately 8000 Hz.

4. An electro-dynamic microphone according to claim 2, characterised by the fact that the pressure chamber is coupled with a larger tone chamber by a narrow slot, channels, holes or the like.

5. An electro-dynamic microphone according to claim 4, characterised by such a dimensioning of the admission apertures that the admission resistance for the high frequencies is very high, preferably infinite.

6. An electro-dynamic microphone according to claims 2 and 4, characterised by the fact that the pressure-chamber and the tone chamber are provided with holes or slots, through which the two chambers are in communication with the outside air.

7. An electro-dynamic microphone substantially as hereinbefore described with reference to the accompanying drawings.

Dated this 15th day of July, 1931.

HASELTINE, LAKE & Co.,
28, Southampton Buildings, London, England, and
19—25. West 44th Street, New York, U.S.A.,
Agents for the Applicants.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1932.

[This Drawing is a reproduction of the Original on a reduced scale.]

*Fig. 1*

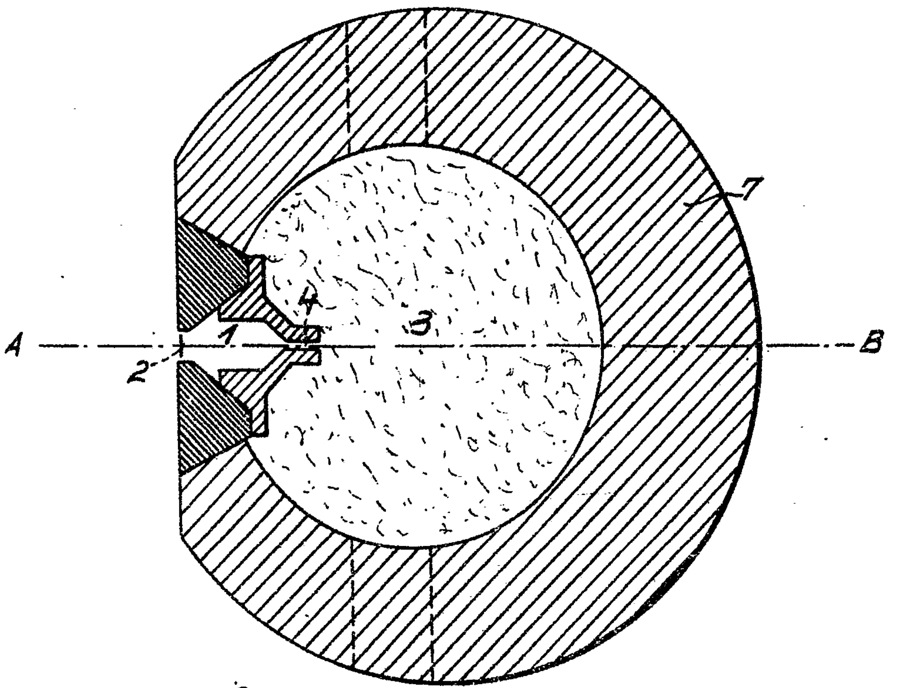


*Fig. 2*

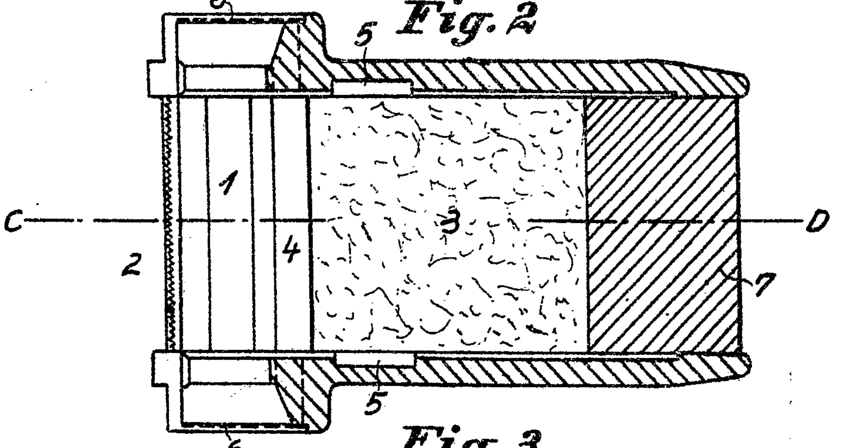


*Fig. 3*