

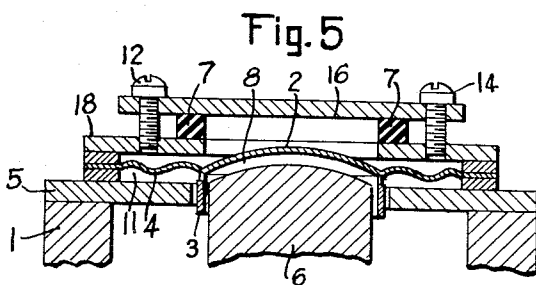
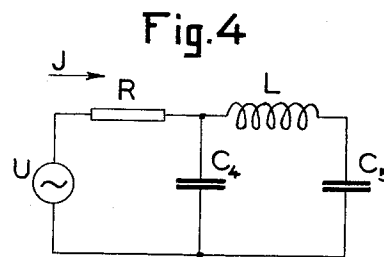
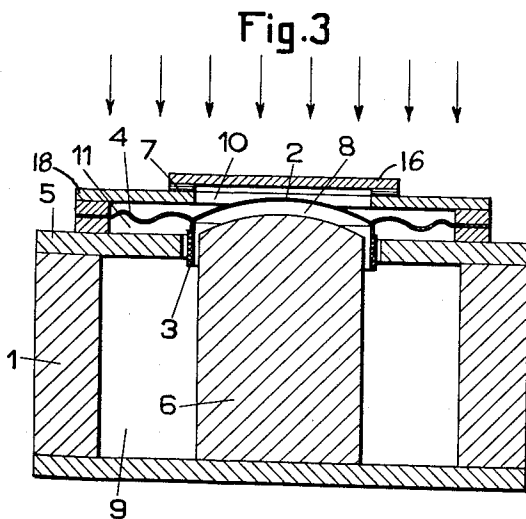
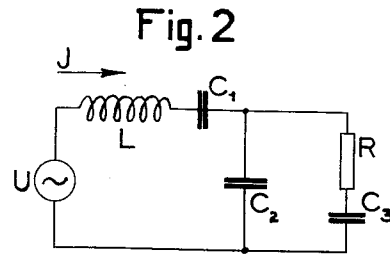
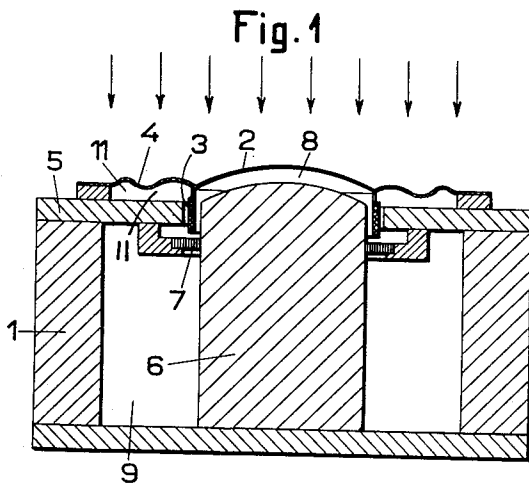
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ELECTROACOUSTIC TRANSDUCER

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ELECTROACOUSTIC TRANSDUCER

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This invention relates to microphones, and, more particularly, to improvements therein.

In certain types of electroacoustic transducers, such as dynamic microphones, the movement of the oscillating system in a desired frequency range is controlled by employing an acoustical resistance, as contrasted to other types of microphones wherein this control is achieved by the mass or stiffness of the system. Specific types of microphones which employ resistance control are the dynamic-pressure microphones employing a ribbon or a moving coil attached to the diaphragm.

In these dynamic microphones, as is well known, the mechanical oscillations of the system are transduced or converted into electrical energy by the expedient of the movement of a conductor in a constant magnetic field. The conductor movement is caused by the varying pressure of the sound field. The voltage generated as a result is proportional to the velocity of the conductor in the field. In order to generate a constant voltage at a constant sound pressure throughout a desired frequency range, it is required to control the movement of the oscillating system in that range by an acoustical or mechanical resistance. The presently known arrangement for effectuating such control is to couple an acoustical resistance by means of an air volume to one side of the oscillating system; e.g., in the case of the ribbon microphone, it is coupled to one side of the ribbon; in the case of the moving voice-coil microphone, it is coupled to one side of the diaphragm—while the other side, which may be called the front face, is exposed to the sound field to be actuated by the sound pressure.

The presently favored arrangement requires extremely precise positioning of the voice coil in a narrow gap, in order to minimize unwanted peaks and holes in the high-frequency range of the microphone. Because of the narrow gaps, the adjustment or positioning of the voice coil is a very difficult affair. Another feature of presently known dynamic microphones is that some form of protection is required between the diaphragm and the sound field, to prevent any acoustical mechanical destruction. Protective covers are used, which often form unwanted acoustical elements which adversely affect the high-frequency response.

An object of the present invention is to eliminate the adverse effects caused by protective covers for dynamic microphones.

Another object of the present invention is to simplify the manufacture of dynamic microphones.

Still another object of the present invention is to eliminate the requirement for extremely narrow gaps wherein a voice coil must be positioned.

Yet another object of the invention is to provide a novel microphone arrangement wherein the acoustical resistance employed is easily adjustable.

Still another object of the present invention is to provide a novel arrangement for dynamic microphone.

These and other objects of the present invention are achieved by providing an electro-acoustical transducer of the dynamic-pressure microphone type, wherein the acoustical resistance is removed from behind the oscillating system and is positioned instead between the sound field and the oscillating system. In other words, the acoustical resistance is interposed between the sound field and the diaphragm of the microphone.

The novel features that are considered characteristic of this invention are set forth with particularity in the ap-

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ended claims. The invention itself, both as to its organization and method of operation, as well as additional objects and advantages thereof, will best be understood from the following description when read in connection with the accompanying drawings, in which:

FIGURE 1 is a cross section of the presently known type of dynamic pressure microphone;

FIGURE 2 is a circuit diagram representing the electrical equivalent of the mechanical impedances of the microphone of FIGURE 1;

FIGURE 3 is a cross-sectional view of a microphone which embodies the present invention;

FIGURE 4 is an electrical diagram which is the equivalent of the mechanical impedances of the microphone shown in FIGURE 3; and

FIGURE 5 is a view in section of an embodiment of the invention, showing how the acoustical resistance may be made adjustable.

FIGURE 1 is a cross-sectional diagram of the presently known type of moving-coil microphone. Therein may be seen the magnet 1, which provides a constant flux field in the gap. An oscillating system comprises the diaphragm 2, with the voice coil 3 attached thereto. The voice coil is inserted in the gap provided between the magnet 1 and the center piece 6. An elastic rim 4 is also attached to the diaphragm, to support it in position, and completes the oscillating system. An annular plate 5 is employed to create the annular air gap between its edge and the center piece 6. An acoustical frictional resistance 7 is formed in the usual well-known manner, either by a felt ring or a narrow circular air gap, etc. This frictional resistance is coupled to the oscillating system via the air volume between it and the oscillating system. Air which is forced through this resistance flows into the large air volume 9, which must be acoustically isolated with respect to the surrounding sound field.

FIGURE 2 shows the electrical analog of the mechanical structure employed. "U" designates the sound-pressure source. The velocity of the oscillating system may be designated by "J." The mass of the system is represented by the inductance "L," and this mass includes the diaphragm 2 and voice coil 3. The compliance of the rim 4 is represented by the capacitor C₁, C₂ and C₃, respectively, corresponds to the compliances of the air volumes 8 and 9. Air volume 8 is that interposed between the diaphragm and the center piece 6. A resistance "R" represents the acoustical frictional resistance 7. In the frequency range wherein "R" is large compared with the impedances L, C₁, and C₃ and where the impedance of C₂ is large compared with "R," the velocity of the oscillating system becomes independent of the frequency of the driving sound pressure "U." In this frequency range, the microphone generates a voltage which is independent of the frequency of the sound pressure. The above description of the prior art is provided in order to enable a better understanding of this invention.

In accordance with the invention and as shown in FIGURE 3, the acoustical resistance 7 is arranged between the oscillating system 2, 3, 4 and the sound field. The oscillating system is coupled by means of the air volume 10 to the acoustical resistance. The reference numerals used in FIGURE 3 are identical with those used in FIGURE 1 for identically functioning parts. In the embodiment of the invention shown in FIGURE 3, the acoustical resistance is made in the form of a ring, with a cover 16 for the diaphragm being positioned on top of the ring. The ring may be made of felt or any of the other well-known materials or arrangements for providing an acoustical resistance. It may comprise a solid ring with holes therethrough.

The point to be noted in the embodiment of FIGURE

3 is that the assembly of the acoustical resistance ring and the cover for the diaphragm may be made using screws, not shown, or any other fastening device. In the prior-art system shown in FIGURE 1, once the assembly is made, it is extremely difficult to adjust the effects of the acoustical resistance to provide the desired response characteristics. The microphone must be disassembled, in effect, to enable any changes to be made. In the arrangement of the invention shown in FIGURE 3, it is an extremely simple matter by adjusting the tightness of the mounting of the acoustical resistance and cover to vary the acoustical resistance to provide a desired result. Further, by positioning the acoustical resistance between the sound field and the oscillating system in the form of a ring, as shown, the directional characteristics of the microphone are varied. That is, by the position of the acoustical resistance with reference to the diaphragm or by covering only certain areas of the diaphragm therewith, different directional characteristics may be achieved for the microphone.

FIGURE 4 shows the electrical analog of the structure shown in FIGURE 3. Again, the sound pressure is designated as "U," the resistance or acoustical resistance as "R." This time the resistance is directly in series with the sound pressure "U," instead of the position shown in FIGURE 2. The inductance "L" represents the oscillating system mass. C_4 is the compliance of the volume 10. C_5 is the compliance of the volumes 8 and 9 and of the rim 4. The velocity of the oscillating system becomes independent of the frequency or driving sound pressure "U" if "R" is sufficiently large and C_4 is sufficiently small. In the arrangement of the presently known systems is embodied in FIGURE 1, an unwanted resonant circuit is coupled to the oscillating system by the resistance 7. This unwanted resonant circuit comprises the masses formed between the voice coil 3 and the plate 5 and center piece 6 with the volume 11 which is between the elastic rim 4 and the plate. This causes unwanted peaks and holes in the high-frequency range. Moreover, the acoustical resistance "R" already has a considerable mass component in this range which increases the coupling effect. These unwanted resonances were sought to be suppressed by making the gap between voice coil and plate and the gap between the voice coil and the center piece as narrow as possible, thus seeking to introduce an additional resistive component. As a result, extremely narrow gaps are required, and the highest degree of skill and accuracy must be exercised in the manufacture of the plate and center piece and the positioning of the voice coil in between them.

In the embodiment of the invention shown in FIGURE 3, the unwanted resonance is short circuited by the air volume 9. The sole determining factor for the gaps are the requirements of the magnetic circuit, and not to also eliminate the unwanted resonant circuit. Thus, the gaps can be made wider. Thus, also, there is no requirement for accuracy for positioning the plate and center piece. The adjustment of the voice coil thus becomes easier.

It is most desirable in the design of a microphone to have the sound pressure act as directly as possible on the diaphragm. However, a protection against mechanical destruction is also required. The diaphragm covers employed for this purpose often serve to provide undesirable acoustical effects which are deleterious to the high-frequency response of the system. In accordance with the invention, these difficulties are removed. The acoustical resistance, which is interposed between the diaphragm and the surroundings, sufficiently serves to protect the diaphragm and thus eliminates the requirement for a separate cover. As previously indicated, the placing of the acoustical resistance on the exterior of the microphone enables an easy adjustment thereof to correct, in a desired manner, any frequency response characteristics of the microphone. Furthermore, by positioning the acoustical resistance in the manner shown in

FIGURE 3, for example, to shape the entrance cross section for the sound which actuates the diaphragm, the direction characteristics of the microphone are controllable.

FIGURE 5 is a view in section, illustrating how an embodiment of the invention may be made adjustable. Similar functioning structure has been applied thereto the same reference numerals as shown in FIGURE 3. The variation of the acoustical resistance in accordance with this invention may be made by varying the tension achieved by the tightening or loosening of the screws 12, 14. These screws pass through suitable openings through the cover plate 16 and are threaded into the annular plate 18. Variation of the pressure of the screws varies the dimensions or shape of the acoustical resistance material, and thereby both the value of the acoustical resistance as well as the shape of the entrance cross section for the sound which actuates the diaphragm. Accordingly, a novel, useful, and improved type of microphone has been described which also is simpler to manufacture.

I claim:

1. In an electroacoustic transducer of the dynamic type having an oscillating system actuated by the pressure of a sound field, the improvement therein comprising a protective cover for said oscillating system positioned between it and said sound field, and means forming part of said cover for coupling said sound field to said oscillating system, said means including the principal characteristics controlling acoustical resistance of said transducer.

2. In an electroacoustic transducer as recited in claim 1 wherein said principal characteristics controlling acoustical resistance includes a material providing an acoustical resistance, and said protective cover includes means for varying the pressure on said material to alter the value of said acoustical resistance.

3. In an electroacoustic transducer of the dynamic type having an oscillating system actuated by the pressure of a sound field and having a protective cover for said oscillating system positioned between it and said sound field, the improvement comprising means for coupling said sound field to said oscillating system forming part of said cover, said means comprising a ring of acoustical material in said cover, said ring comprising the principal characteristics controlling acoustical resistance of said electroacoustic transducer, said protective cover further including means for varying the pressure on said material to alter the value of said acoustical resistance.

4. In an electroacoustic transducer of the dynamic type having an oscillating system actuated by the pressure of a sound field, the improvement therein comprising a cover for said oscillating system interposed between said sound field and said oscillating system, means for supporting said cover over said oscillating system including a ring of acoustical resistance material, said ring of material comprising the principal characteristic controlling acoustical resistance for said transducer, and means for tightening said cover on said ring for varying the value of said acoustical resistance accordingly.

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