

May 15, 1956

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2,745,508

MICROPHONE SUPPORT

Filed Sept. 11, 1952

2 Sheets-Sheet 1

FIG. 1.

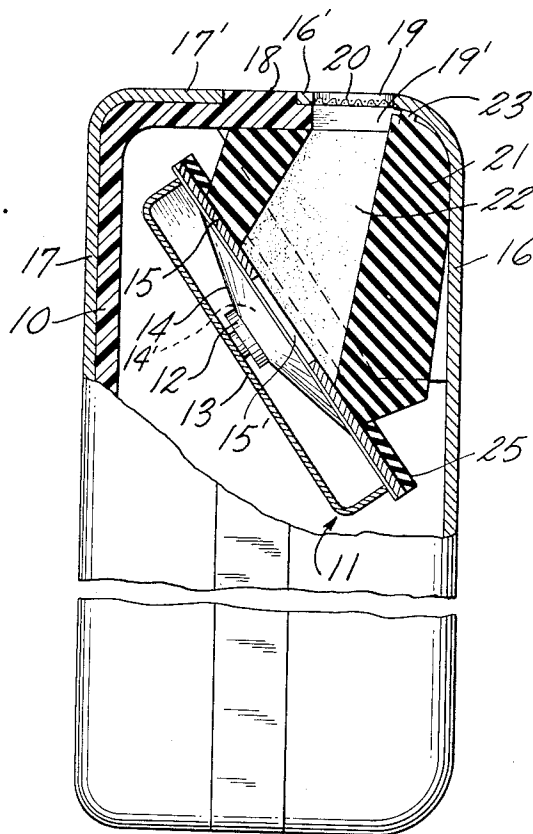
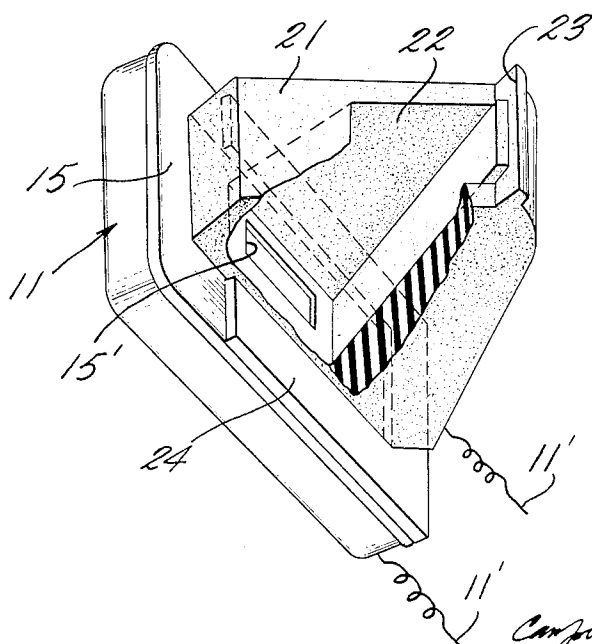


FIG. 2.

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FIG. 3.

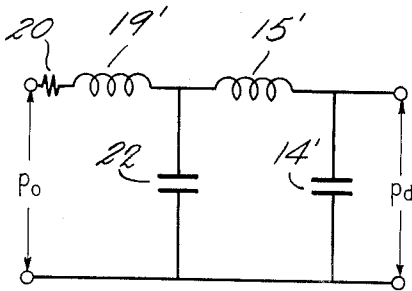


FIG. 4.

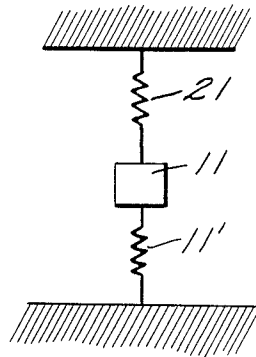
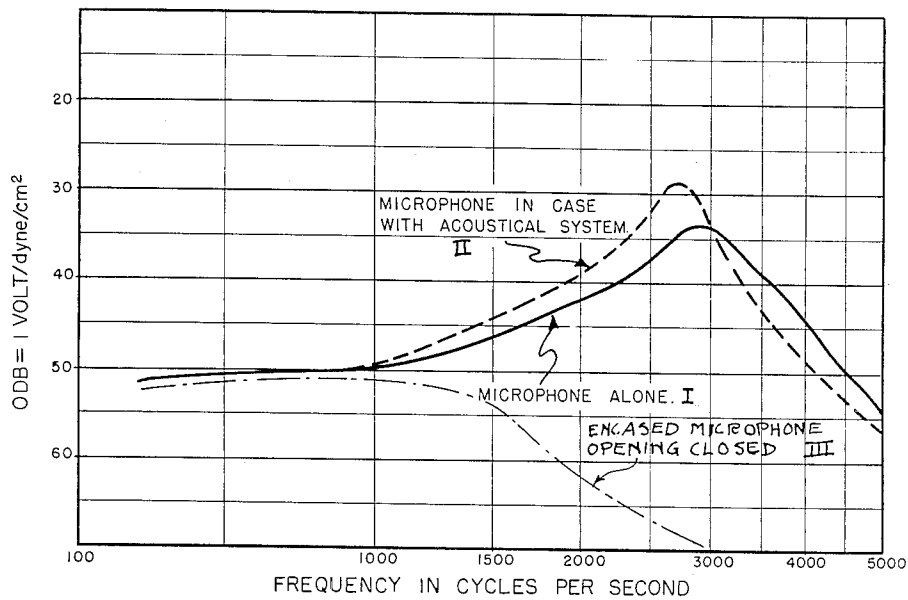


FIG. 5.

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MICROPHONE SUPPORT

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2 Claims. (Cl. 181—31)

This invention relates to a microphone support, and has particular reference to an acoustically efficient mounting arrangement for a hearing aid microphone, although the invention is not limited to that use.

One of the problems encountered by the manufacturer of a wearable hearing aid is the disturbing effects on the wearer of the hearing aid caused by clothing friction on the instrument and local shocks and vibrations. Efficient conduction of sound to the microphone without impairment by these disturbances has been attempted by acoustically insulating the microphone from extraneous noises, but this attempt results in only partial improvement and is accompanied by a material drop in acoustic efficiency. For example, mounting of the microphone sound receiving aperture along the edge, such as the top edge of the instrument with a right angle turn of the acoustic passage to the sensitive element of the microphone has been attempted, but the resulting transmission losses are too large to justify the advantage of decrease in clothing friction noises.

In accordance with the present invention, a compliant mechanical mounting for a microphone is provided which renders the microphone substantially and effectively immune to vibrations of the instrument casing whether due to external causes, such as clothing friction or pressures on the casing causing internal shocks or vibrations.

More particularly, the microphone mounting means of this invention is a resilient sound attenuating assembly which affords an acoustic seal for the microphone, so that sound pressures from inside the instrument casing or any other source except those desired sounds from outside of the casing will be greatly attenuated at the microphone diaphragm, while at the same time, the acoustic compliances and masses are so arranged that a desirable relation between frequency and pressure transmission characteristics between the outside sound field and the diaphragm of the enclosed microphone is obtained.

In a preferred embodiment of the invention, the microphone is mounted at an angle in the casing of the instrument and its diaphragm communicates with a sound-receiving opening, preferably located on one edge of the instrument casing, and so shaped as to provide an acoustic network which effects sound pressure amplification between the sound-receiving opening and the microphone diaphragm.

It will be seen that the microphone mounting means of this invention, in addition to substantially immunizing the microphone to unwanted sounds due to external and internal vibrations and pressures, enhances the acoustic efficiency of the microphone without in any way impairing its free pick-up fidelity.

For a more complete understanding of the invention, reference may be had to the accompanying drawings, in which:

Figure 1 is a cross-section through a hearing aid instrument casing, taken through the microphone and the sound-receiving opening leading thereto, and showing the mounting means of this invention;

Fig. 2 is a perspective view of the microphone and

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its resilient acoustic suspension before mounting in the instrument casing;

Fig. 3 is an electrical analog of the acoustical system of this invention as illustrated mechanically in Fig. 1;

Fig. 4 is an equivalent mechanical diagram; and

Fig. 5 shows frequency response curves for the microphone in the acoustical system of this invention as compared to the free microphone, without the system of this invention.

Referring to Fig. 1 of the drawings, numeral 10 designates the chassis frame of a hearing aid instrument, for example. The frame 10 may be of molded plastic such as a phenolic or acrylic resin, and houses the microphone 11 in addition to the amplifier, dry cells and other electrical components forming no part of the present invention and therefore not shown. It will be understood that the microphone 11 is suitably connected by wires 11' in the hearing aid circuit and picks up sounds, which are amplified and then transmitted to a suitable receiver which conducts the sounds to the inner ear by air or bone conduction, as the case may be.

The particular microphone shown in Figs. 1 and 2 by way of example is of the piezo-electric type in which the cantilever-mounted crystal 12 is secured at one end to the bottom of metal housing 13 and at its free end to the center of the conical diaphragm 14 which is clamped at its edge between the housing 13 and the wall means in the form of a cap plate 15 having a central opening 15' opposite the center of the diaphragm 14. The structure of the microphone 11 as shown is conventional and it is to be understood that equivalent microphone structures may be employed with equal facility.

The instrument chassis frame 10 is provided with front and back cap plates 16 and 17, respectively, which may be of flanged sheet metal removably secured to chassis frame 10, which is recessed along its edges so that the flanges 16' and 17' thereof lie flush with the intervening surface 18 of the chassis frame 10, as shown.

The overlapping flange 16' of the front cap plate 16, preferably at the top edge of the instrument casing, is provided with a sound-receiving opening 19, across which extends the cloth mesh screen 20, which serves both to protect the sound-receiving opening against entry of dust and extraneous objects, and also to provide a certain acoustic resistance for control of the frequency response of the system, in a manner to be described. The sound-receiving opening 19 in flange 16' registers with corresponding opening 19' in chassis frame 10.

Secured by cement or other suitable means to the interior surface of the chassis frame 10 around the sound-receiving opening 19' therein is a compliant tubular mounting 21 which supports the microphone 11 at its free end to which the microphone 11 is suitably secured by its cap plate 15, such as by rubber cement, for example.

The microphone mounting 21 is of the peculiar shape shown in Figs. 1 and 2 and is molded of resilient material, preferably of soft rubber or equivalent rubbery material having the property of soft rubber, such as certain of the synthetic rubbers, polyethylene, "Thiokol," or the like. The mounting 21 is shaped so as to fit the cavity in the chassis frame 10 and the sound transmitting passage 22 therethrough registers at one end with the sound-receiving opening 19' in chassis frame 10 and at the other end with the opening 15' in the microphone cap plate 15.

The compliant mounting 21 is provided with a flange 23 which cushions the metal cap plate flange 16' so as to provide a good acoustic seal at that point, with the microphone suspended freely on the opposite end of the mounting 21, so that air-borne sounds from inside the instrument casing are more attenuated in reaching the

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microphone diaphragm 14. The opening 15' defined by the wall means 15 is smaller than, i. e., constricted with respect to the mouth of the passage 22 in the compliant mounting 21.

Preferably, the microphone 11 is mounted at an angle to the plane of the casing, such as an angle of 45°, although it will be understood that the angle is immaterial and may vary between 90° and, say, 75° in either direction, depending upon the space and other requirements of the particular instrument. In the illustrated example, the 45° mounting of the microphone 11 affords a generally tapering shape for the mounting 21 and a tapering shape for the air filled sound transmitting passage or cavity 22 in the plane of Fig. 1, although it is of uniform width at right angles to the plane of Fig. 1, as is indicated in Fig. 2. The diaphragm 14 and the microphone face plate 15 bound an air filled cavity 14'.

In operation of the microphone mounting means of this invention, the compliance of the rubber mounting 21 together with the mass of the microphone 11 suspended thereon comprise a mechanical filter or shock absorber. The electrical analog of the acoustical system is shown in Fig. 3 with the corresponding elements of the physical assembly as indicated in Fig. 1, by the same reference characters. Thus, the resistance afforded by the cloth mesh screen 20 serves to damp out unwanted peaks in the acoustic transmission characteristic and control the rate of cut-off above the limiting frequency of the network. Capacitances 22 and 14' represent the respective acoustic compliances of the same numerically identified cavities, while reactances 15' and 19' represent the acoustic masses of the corresponding microphone sound-receiving opening and casing sound-receiving opening 15', with P_o and P_d representing the input and output sound pressures. The acoustical masses and compliances are preferably adjusted, by appropriate dimensioning of the parts, so that transmission is free up to a cut-off point at or above 3,000 cycles per second.

The equivalent mechanical diagram of the system of this invention is shown in Fig. 4, wherein 21 represents the compliance of the rubber mounting, 11' the compliance of the electrical connecting wires, and 11 the mass of the suspended microphone. The effective mass of the microphone 11 may be increased by the addition of the U-shaped lead plate 24 to the microphone cap 15, as shown in Fig. 2. This added mass 24 increases the attenuation of the system to shock vibrations from the instrument casing through the chassis 10. The mass of the microphone 11, to which may be added the mass of lead plate 24, and the compliance 11' and 21 are made as large as is practically possible in order to reduce transmitted vibration from the instrument casing to the microphone 11.

Acoustic insulation of the diaphragm may be increased by providing a soft rubber flange 25 on the free end of the rubber mounting 21, the perimeter of flange 25 being of the same shape and dimensions as microphone cap 15, as shown in Fig. 1. Flange 25 serves to increase the acoustic insulation of the microphone, so that airborne sound from inside the instrument case is more attenuated in reaching the microphone diaphragm. If the lead plate 24 is used, it may be placed under flange 25.

The effectiveness of the microphone mounting of this invention is clearly illustrated by the frequency response curves of Fig. 5, the solid line curve being the response of the microphone 11 alone with a constant pressure input of one bar and the dotted line curve being the response of the microphone 11 suspended on the compliant mounting as shown in Fig. 1, with the same one bar input, thereby showing that the mounting of this invention materially improves the response characteristics of the microphone, by providing acoustic amplification.

The dot-and-dash line curve III of Fig. 5 and en-

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titled "Encased microphone opening closed," illustrates the effectiveness of the acoustic noise suppression seal. This response is measured in the same manner as the encased microphone (dotted line curve II), except that the sound receiving opening 19 is blocked. The loss in response between the systems curves II and III indicates the suppression of sounds originating at any other point except outside of opening 19. Suppression occurs most effectively in the region above about 1500 cycles per second, which is the most important frequency range from the standpoint of minimizing clothing and other extraneous noises.

Although a preferred embodiment of the invention has been illustrated and described herein, it is to be understood that the invention is not limited thereby, but is susceptible of changes in form and detail within the scope of the appended claims.

I claim:

1. In an acoustic system for use with a microphone unit, in combination with a casing having a sound-receiving opening therein, said opening affording an acoustic mass, divergent first wall means of resilient material attached to the casing around said opening and defining an inwardly enlarging passage the smaller end of which is in communication with said opening and affording an acoustic compliance, and second wall means defining a constricted opening adjacent the larger end of said passage and affording an acoustic mass, said second wall means being adapted to receive a microphone unit having a cavity adapted to be placed in communication with said constricted opening on the other side thereof from said passage, said first and second wall means and said microphone unit being suspended in cantilever fashion from the casing, whereby said acoustic compliances and masses comprise an acoustic network for modifying the frequency-pressure characteristics of sound entering the casing opening.

2. In an acoustic system for use with a microphone unit, in combination with a casing having a sound-receiving opening therein, said opening affording an acoustic mass, divergent first wall means of resilient material attached to the casing around said opening and defining an inwardly enlarging passage the smaller end of which is in communication with said opening and affording an acoustic compliance, second wall means defining a constricted opening adjacent the larger end of said passage and affording an acoustic mass, said second wall means being adapted to receive a microphone unit having a cavity adapted to be placed in communication with said constricted opening on the other side thereof from said passage, said first and second wall means and said microphone unit being suspended in cantilever fashion from the casing, whereby said acoustic compliances and masses comprise an acoustic network for modifying the frequency-pressure characteristics of sound entering the casing opening and screen means in the path of sound transmission from the said opening in the casing to the microphone unit for adding series resistance to said acoustic network.

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