Nov. 7, 1950 W. A. SCHWALM 2,529,228

DAMPER FOR HEARING AIDS

Filed April 26, 1947

Fig. 1

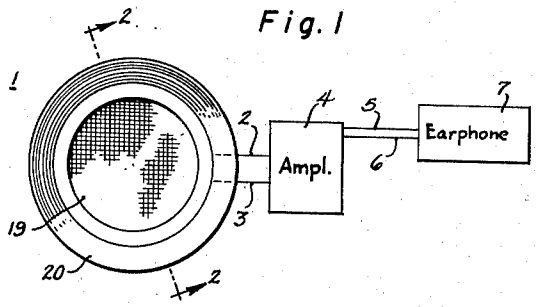


Fig. 3

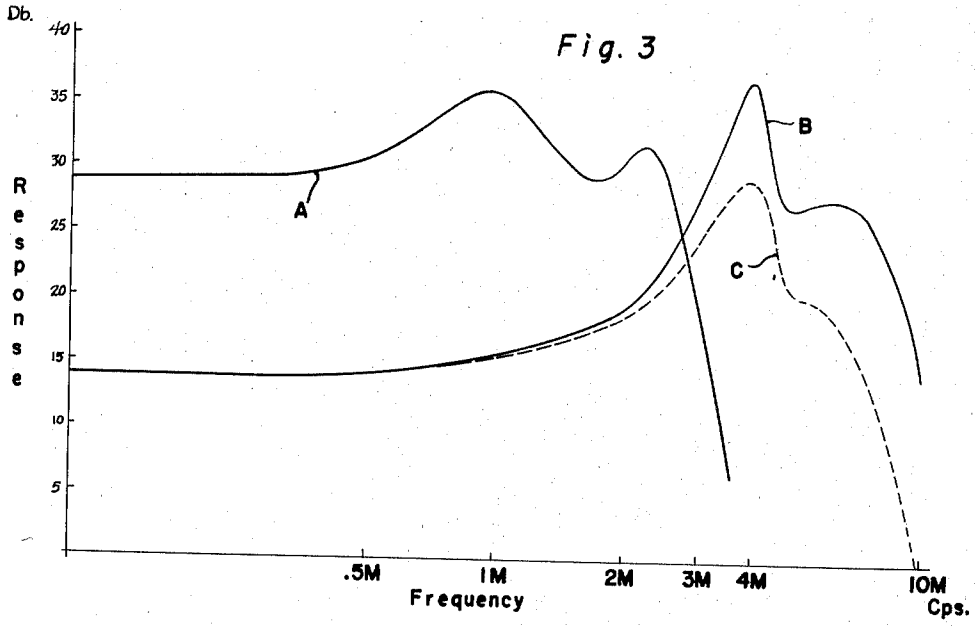
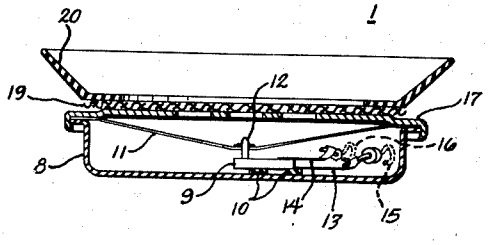


Fig. 2



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DAMPER FOR HEARING AIDS

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1 Claim. (Cl. 179—180)

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This invention relates to hearing aid apparatus and more specifically to the construction of microphones for such apparatus.

As a result of the mass and stiffness characteristics of the transducing elements included in a hearing aid microphone those elements tend to resonate at relatively high audio frequencies in the order of 4000 cycles per second. Such resonance causes the microphone to emphasize sounds in that region, which is outside the range of frequencies required for intelligible reproduction of speech, and satisfactory reproduction of sounds in general. Further, because of inherent structural dimension limitations, the frequency response band for the hearing aid earphone of the magnetic type is usually limited at its upper extremity to frequencies in the order of 2500 cycles. With the microphone producing maximum response at 4000 cycles, and the earphone failing to reproduce any sounds beyond 2500 cycles, a very unsatisfactory operating condition is liable to exist. This condition arises because the operator adjusts his hearing aid volume control so that he may hear satisfactorily the sounds within the band of frequencies to which his earphone responds. Under these operating conditions sounds in the region of maximum response of the microphone will very likely be at such a high audio level that they will overload the final amplifier stage in the hearing aid. This is particularly true because of the small dynamic range of the sub-miniature tubes necessarily utilized in hearing aids. Such overloading produces distortion. In addition cross-modulation will occur and spurious modulation products will appear within the pass band of the earphone. Such spurious sounds tend to mask the desired sounds and the performance of the hearing aid is impaired. This condition of overloading in the final amplifier as a result of high frequency sounds not audible through the earphone is likely to be very prevalent because such high frequency sounds are produced by the rattling of paper and other very common noise sources.

Therefore, it is an object of this invention to provide an improved hearing aid.

A further object of the present invention is to provide improved hearing aid apparatus in which the reproduction of undesired noise signals is minimized.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claim. The present invention itself, both as to its organization and manner of operation, together with further objects and

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advantages thereof may best be understood by reference to the following description taken in connection with accompanying drawings in which:

Figure 1 is a diagram partially in block form of a hearing aid incorporating the present invention.

Figure 2 is a cross-sectional view taken on line 2—2 in Figure 1 with certain parts omitted, and

Figure 3 is a graph showing frequency response characteristics of certain elements of the device shown in Figure 1.

In Figure 1, briefly, sounds impressed on microphone 1 are transformed to electrical impulses and those impulses are transmitted over conductors 2 and 3 to amplifier 4 where the impulses are amplified in conventional fashion and then conducted over conductors 5 and 6 to earphone 7 where the original sounds are reproduced.

In Figure 2, microphone 1 includes case 8 of rigid material, such as metal, crystal 9 of Rochelle salts, or the like, possessing piezo-electric properties, support 10 of electrical insulating material separating crystal 9 from case 8, diaphragm 11, preferably conically shaped, flexible in the region of the edges thereof and supported about the periphery of case 8, and drive rod 12 of rigid material connected at one end to the center of diaphragm 11 and at the other end to crystal 9, adhesive material being used to bond the ends of rod 12 to the respective driving and driven elements. Conductor 13 is in electrical contact with one surface of crystal 9 and conductor 14 is in contact with the opposite side of crystal 9. Conductors 13 and 14 connect the respective crystal surfaces to terminals 15 and 16, respectively, terminal 15 being insulated from case 8 and terminal 16 being connected to case 8. Perforated cap 17 is of substantially rigid material and is clamped over the edges of case 8 to protect diaphragm 11 from direct physical pressure. Damping layer 19 is of an acoustically resistive cloth. This cloth covers cap 17 and is secured thereto by means of an adhesive. A flange 20 of rubber or other resilient material may be provided around the periphery of microphone 1 to provide means for resiliently supporting the microphone in a hearing aid case.

As has been indicated, hearing aid microphones normally have their maximum response at a frequency outside the range of frequencies reproduced by the hearing aid earphone. In the past, this undesirable frequency characteristic has simply been accepted and tolerated.

In Figure 3, curve A shows the normal frequency response characteristic for a hearing aid earphone. It will be noted that the response of the earphone drops off sharply in the region of 2500 cycles. Curve B indicates the frequency response characteristics of a conventional hearing aid microphone not embodying applicant's invention. It will be noted in that figure that the response of the microphone is very sharply increased in the region of 4000 cycles. Curves A and B indicate very clearly that sounds having frequencies in the region of 4000 cycles will cause a relatively high level of output from the microphone but they will not be reproduced by the earphone. The possibilities of overloading the final stage of amplification in the hearing aid with sounds having frequencies in this range is also clearly evident.

Curve C is drawn to the same scale as curve B and shows the effect of adding the resistive cloth to the conventional microphone. It will be noted that the peak at 4000 cycles has been reduced several decibels in amplitude, whereas the response at the lower frequencies has not been reduced. The ultimate effect of such a reduction in the sensitivity of the hearing aid microphone to paper noises and other undesirable sounds in the region of 4000 cycles is to reduce substantially the spurious noises appearing within the frequency response band of the earphone, and clarity of reproduction in the hearing aid unit as a whole is substantially increased.

The cloth chosen for damping the microphone response at high frequencies should have a large damping effect at those high frequencies but low damping at low frequencies which dictates the use of a cloth which is tightly woven, preferably from some soft thread. The impedance of such cloth is purely resistive and the damping effect increases directly with the frequency of the sound applied to the cloth so that little or no attenuation occurs at the low frequencies within the response region of the earphone, whereas the undesired noises in the region of 4000 cycles are severely attenuated.

It is within the scope of the present invention to use damping materials other than cloth woven from animal or vegetable fibres as long as that material has the prescribed characteristics of low attenuation at low frequencies and high attenuation at high frequencies.

While particular embodiments of the present invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspects, and, therefore, the aim in the appended claim is to cover all such changes and modifications as fall within the true spirit and scope of this invention.

I claim:

A hearing aid system comprising: a microphone for producing audio-frequency signals in response to impinging sound waves and having a peak response at a predetermined natural mechanical resonance frequency; an amplifier coupled to said microphone for amplifying said signals; a sound reproducer coupled to said amplifier to convert said amplified signals into intelligible sound and having a response range substantially excluding said predetermined frequency, whereby components of said waves at said predetermined frequency tend to overload said amplifier and produce cross-modulation with components of said waves of frequencies within said reproducer response range; and an acoustic damper of tightly woven soft cloth fibers supported in the path of said sound waves for reducing said peak response to minimize said cross-modulation and the resultant distortion of said reproduced sound.

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