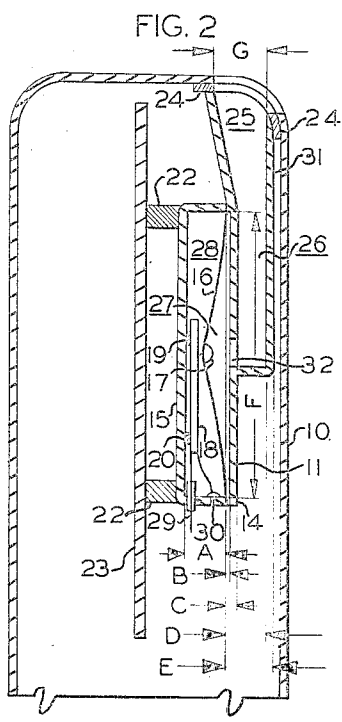
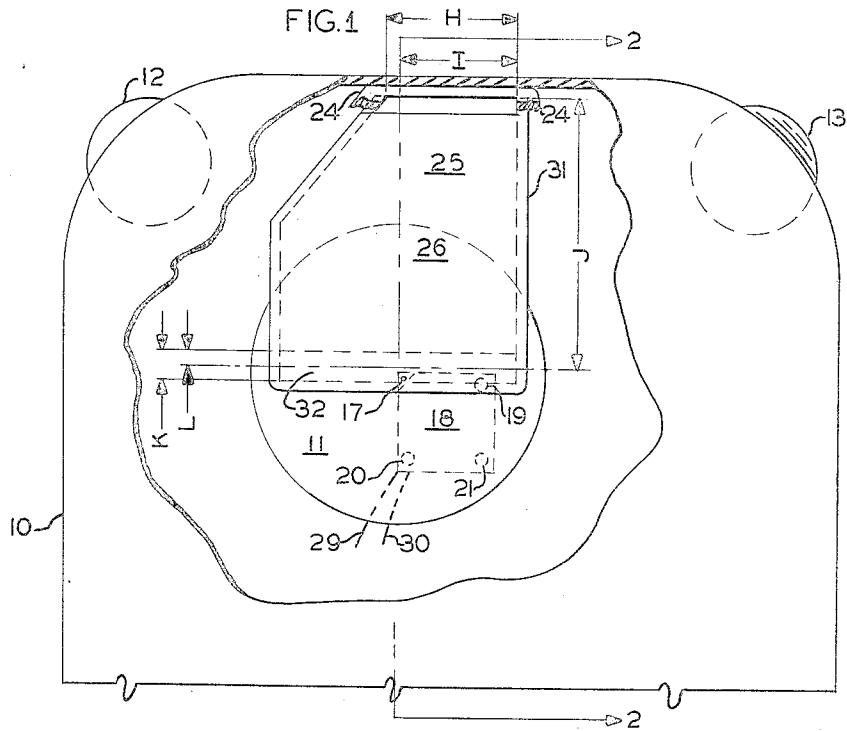


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HEARING AID MICROPHONE

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HEARING AID MICROPHONE

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This invention relates to hearing aid systems, and more particularly to such systems of the electronic type embodying a sound translator or microphone, an electronic amplifier, and a sound reproducing unit. It is a primary object of this invention to provide a system of this type in which a substantial improvement in performance is effected.

In the usual hearing aid systems, a customary practice is to support the sound translator or microphone by its back portion on a form of cushioning or sound-dampening material. External sounds impinge upon the microphone through a grille covered opening in the front of the case. Much discomfort and annoyance have been experienced by users as a result of noises produced by pieces of clothing material rubbing together in the vicinity of the microphone grille opening and by outer garments of clothing touching or rubbing the hearing aid case. The noises produced by pieces of clothing rubbing together are transmitted to the microphone by air conduction; the case noises are transmitted to the microphone by (a) conduction through the case to the grille and thence by air to the microphone, and (b) conduction through the case to the microphone mounting and thence into the microphone by virtue of the pick-up characteristics of the back side of the microphone. These noises, which are of various intensities and tones, impair intelligibility due to consequential interference with desired sounds and are of themselves of no value to the user. Therefore, a reduction or elimination of clothing-induced noises would be beneficial to users of hearing aids, and a system of affording such a reduction would be a meritorious contribution to the hearing aid art.

It is therefore an object of this invention to provide an improved hearing aid system in which is afforded a greater degree of utility than in previous systems by virtue of a novel means of reducing the introduction of extraneous noises.

It is a further object of this invention to incorporate in a hearing aid an improved acoustical system in conjunction with the microphone thereof, thereby to exclude, to a great extent, undesired clothing-generated noises without detrimental effect on the reproduction of desired sounds.

In the use of hearing aid systems, a widespread practice of users is to wear the case, containing the microphone, in a front pocket of an intermediate garment of outer clothing, as for example a shirt or a vest. Some degree of sound muffling occurs due to the impedance to sounds

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offered by the front of the pocket covering the microphone grille. If the wearer places another garment, such as a coat, over the intermediate garment, the additional layer of cloth further muffles desired sounds, usually to such an extent as to impair intelligibility.

Therefore, it is another object of this invention to incorporate in a hearing aid an improved acoustical system in conjunction with the microphone thereof, by the use of which system the transmission of desired sounds to the microphone is improved.

In some forms of hearing aid systems, the microphone is located in a case wherein the electronic system controls are situated. These controls of necessity must be readily accessible to the user, and for this purpose, openings in the case are provided for control knobs. In actual usage, sounds not only impinge on the microphone through the grille openings, but a sound path to the microphone also exists through the control knob openings. This multiplicity of paths of the microphone produces a directional effect on incoming sounds. Thus, the user finds his hearing aid susceptible to sounds emanating from undesired directions. At the same time, cancellation of certain frequency components results, and the quality of sound reproduction is considerably impaired. Therefore, still another object of this invention is to provide an improved hearing aid system in which a multiplicity of paths of sound to the microphone is effectively eliminated.

In hearing aid systems, the microphone in use may not provide uniform response to the various tone components of impinging sounds, since emphasis in hearing aid design is often placed on space and weight considerations, rather than on fidelity of reproduction. It is, therefore, still another object of this invention to provide an improved acoustical system for a hearing aid, the use of which system affords improved fidelity of sound reproduction while making little or no addition to space and weight requirements.

The features of the present invention, which are believed to be novel are set forth with particularity in the appending claims. The present invention, both as to its organization and manner of operation, together with further objects and advantages thereof, may best be understood, however, by reference to the following description taken in connection with the accompanying drawing in which:

Fig. 1 shows a fragmentary cut-away plan view of a portion of a hearing aid unit incorporating

an improved acoustical system in accordance with the present invention; and

Fig. 2 shows a partial section along the line 2—2 of Fig. 1.

In Fig. 1, the illustrated fragmentary view shows a hearing aid unit 10 embodying an improved microphone assembly or microphone 11. The customary tone control 12 and volume control 13 are provided and may be connected in any well-known manner to the control circuits of the associated amplifier (not shown). In accordance with this invention, sound waves pass into microphone 11 solely through an opening in the top portion of the outer periphery of hearing aid case 10.

In Fig. 2, there is illustrated a side elevation in transverse section of the unit of Fig. 1, incorporating the housing portions 14 and 15 of microphone 11, the microphone diaphragm 16, drive pin 17, translating device such as piezo electric element 18 and piezo electric element supports 19, 20 and 21, (see Fig. 1). Microphone 11 is enclosed within the hearing aid case 10 and is glued to a circular mounting pad 22 of resilient material which is in turn glued to the hearing aid electronic amplifier chassis 23. In addition, the microphone is supported by a rectangular mounting pad 24, of resilient material; this latter pad being mounted in the peripheral opening of case 10, as shown. From the top opening in the outer periphery of the hearing aid case 10, sound waves pass through a rectangular funnel or other suitably shaped member 25, through a rectangular channel 26, through a rectangular aperture 32 and into a cavity 27. These waves impinge on diaphragm 16 and cause sympathetic vibrations to be set up in diaphragm 16. Square-shaped piezo electric element 18 is mounted within a cavity 28, by glueing or otherwise fastening three of its four corners to mounting pads 19, 20 and 21 respectively, which pads are in turn glued or fastened to the inner wall of portion 15 of microphone 11; the free, fourth corner of element 18 being in direct mechanical connection with the center of diaphragm 16 by means of drive pin 17. Piezo electric element 18 is thereby physically distorted in accordance with incoming sound variations and produces correspondingly variable electrical potentials at output leads 29 and 30. These varying electrical potentials are then impressed on the input terminals of a conventional electronic amplifier (not shown) and thence to the ear piece or receiver (not shown) for conversion to amplified sound variations. It is apparent that other types of sound transducer elements; for example, a carbon button element or an electromagnetic element, may be used to perform the exact function here realized by the piezo electric element 18. It is also apparent that other cross sections, as circular for example, will properly function for funnel 25, channel 26 and aperture 32.

In the construction of microphone 11, portions 14 and 15 preferably are formed of a malleable metal, such as aluminum or brass, having a cross section of appreciable dimensions, one-sixteenth of an inch for example, in order that the microphone walls shall be opaque to sounds impinging on the outer surfaces of microphone 11. Sound entry to the diaphragm is limited to the passage defined by funnel 25, channel 26 and aperture 32. Portion 15 of microphone 11 is in the shape of a hollow cylinder, closed on one end. Portion 14 of microphone 11 is also in the shape of a hollow cylinder,

der, closed at one end, but having a structure 31 formed integrally therewith and extending radially from the top-front part of portion 14. Structure 31 contains sound funnel 25 and channel 26; the axes of which are substantially parallel to the plane of portion 14 of microphone 11. Diaphragm 16 is preferably a cone constructed of aluminum foil or other suitable material and having a peripheral rim by means of which it is supported between the adjacent rim portions of members 14 and 15.

Cavities 27 and 28 are of such dimensions as to provide the optimum frequency response characteristic commensurate with practical space and weight factors of the complete unit. Cavity 28 has a resonant characteristic dependent on its volume, the stiffness and mass of diaphragm 16, and the stiffness and mass of piezo electric element 18. Cavity 27 is open to free air through aperture 32, channel 26 and funnel 25. The size of cavity 27 operates in conjunction with the size of aperture 32, the length and cross section of channel 26 and the slant height and cross section of funnel 25 to produce resonant and frequency selective effects. In practice, therefore, empirical adjustment can be made in a manner well known to the art, whereby the resonant and frequency selective effects operate to provide a substantially uniform frequency response characteristic for microphone 11. The following dimensions have been found suitable in one specific application of the invention and are presented by way of example only: All dimensions are in inches.

A=.140	G=.175
B=.010	H= $\frac{1}{2}$
C=.045	I= $\frac{7}{16}$
D=.145	J=1.060
E=.180	K=.100
F=1.090	L=.050

In use, sound entry is limited to funnel 25 and channel 26 because the sound-opaque heavy outer walls of microphone 11 preclude the possibility of transfer of sound or mechanical dimensional variations to diaphragm 16 by distortion of the microphone case portions 14 and 15. The sound cushioning mounting for microphone 11, embodied in the resilient mountings 22 and 24, insulate microphone 11 from vibration of the hearing aid case 10. Therefore, vibration, such as that caused by rubbing contact with clothing, is substantially precluded from transmission to the microphone diaphragm 16. Also, as sound entry is limited solely to funnel 25, channel 26 and aperture 32, there can be no multiplicity of sound paths to the microphone diaphragm 16 which might exist as a result of other openings in hearing aid case 10, and directional and cancelling effects are thereby averted. Further, since the sole opening to diaphragm 16 is through cavity 27, aperture 32, channel 26, and funnel 25, muffling effects of a pocket or outer garments of clothing, where the aid is worn in the user's pocket, will be substantially reduced, since free air space usually will exist in the vicinity of the top of hearing aid case 10, and sound entry to this free air space will be through a relatively large area of clothing. Finally, since the dimensions of cavity 28, cavity 27, aperture 32, channel 26 and funnel 25 are established for optimum frequency response in microphone 11, improved fidelity is attained over prior devices having, for example, cavity 28 only.

It is contemplated that a piece of felt, or flannel,

nel, or other acoustic damping material be disposed within funnel 25 for the purpose of deemphasizing peaks in the frequency response characteristic of microphone 11, thereby to prevent overloading of the electronic amplifier (not shown) and to substantially eliminate resulting inter-modulation products.

While a particular embodiment of the present invention has been shown and described, it is apparent that changes and modifications may be made without departing from this invention in its broader aspects, and, therefore, the aim in the appended claims is to cover such changes and modifications as fall within the true spirit and scope of this invention.

I claim:

1. A hearing aid for amplifying and reproducing sound waves comprising: a case including a front portion, a back portion and an enclosing edge portion provided with a sound-admitting aperture which is located solely in the top-peripheral portion of said case and which has a length less than that of said top portion; a microphone assembly within said case including a housing having a sound admitting aperture and including a diaphragm in spaced parallel relationship with said front case portion and in registration with said housing aperture; a closed sound directing conduit member having a pair of openings registering respectively with and extending between said apertures of said case and said housing and constituting the sole sound passage to said diaphragm; and support means for supporting said microphone assembly within said case and for substantially acoustically insulating said microphone assembly therefrom.

2. A hearing aid for amplifying and reproducing sound waves comprising: a case including a front portion, a back portion and an enclosing edge portion provided with a sound-admitting aperture which is located solely in the top-peripheral portion of said case and which has a length less than that of said top portion; a microphone assembly within said case including a housing having a sound-admitting aperture and including a diaphragm in spaced parallel relationship with said front case portion and in registration with said housing aperture; a closed funnel-shaped sound directing conduit member having a pair of openings registering respectively with and extending between said apertures of said case and said housing and constituting the sole sound passage to said diaphragm; and support means for supporting said microphone assembly within said case and for substantially acoustically insulating said microphone assembly therefrom.

3. A hearing aid for amplifying and reproducing sound waves comprising: a case including a front portion, a back portion and an enclosing edge portion provided with a sound-admitting aperture which is located solely in the top-peripheral portion of said case and which has a length less than that of said top portion; a microphone assembly including a substantially sound opaque housing having a sound-admitting aperture and including a diaphragm in spaced parallel relationship with said front case portion and in registration with said housing aperture; a closed sound directing conduit member having a pair of openings registering respectively with and extending between said apertures of said case and said housing and constituting the sole sound passage to said diaphragm; and support means for supporting said microphone assembly within said case and for substantially acoustically insulating said microphone assembly therefrom.

4. A hearing aid for amplifying and reproducing sound waves comprising: a case including a front portion, a back portion and an enclosing edge portion provided with a sound-admitting aperture which is located solely in the top-peripheral portion of said case and which has a length less than that of said top portion; a chassis supported within said case; a microphone assembly supported on said chassis and substantially acoustically insulated therefrom and from said case, including a housing having a sound-admitting aperture and including a diaphragm in spaced parallel relationship with said front case portion and in registration with said housing aperture; and a closed sound directing conduit member having a pair of openings registering respectively with and extending between said apertures of said case and said housing and constituting the sole sound passage to said diaphragm.

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