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MULTI-DIRECTIONAL HEARING AID

Filed July 20, 1962

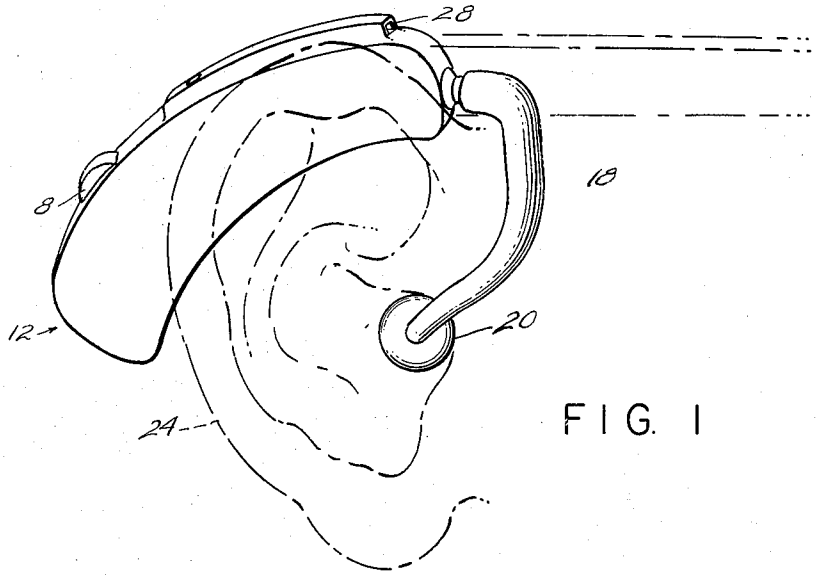

FIG. 1

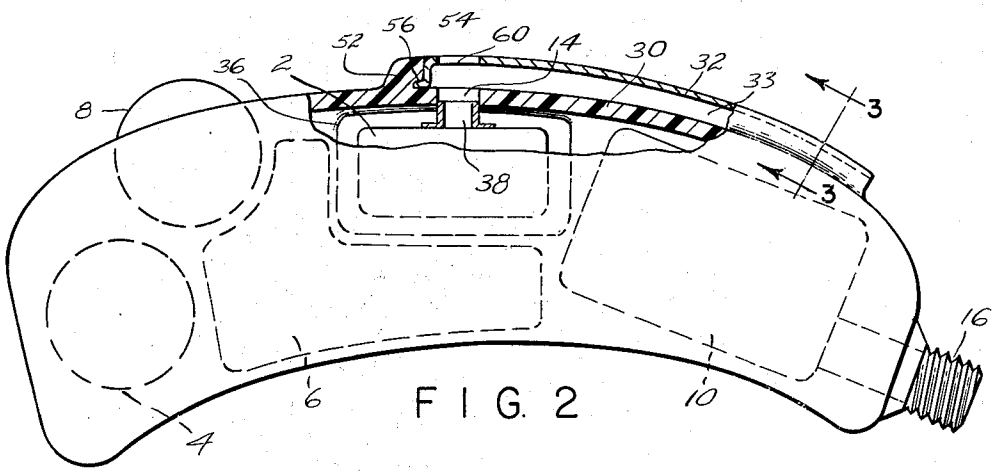

FIG. 2

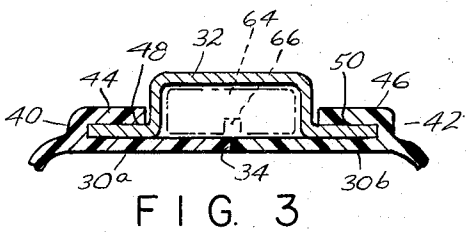

FIG. 3

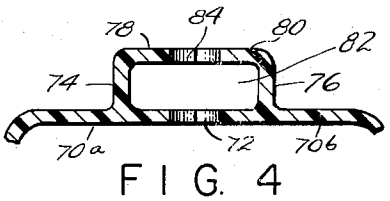

FIG. 4

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MULTI-DIRECTIONAL HEARING AID

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This invention relates to hearing aids and more particularly to "behind the ear" hearing aids.

For cosmetic reasons, there has been a decided trend to the so-called "behind the ear" hearing aids which is a single package unit supported by the wearer's ear and so shaped and sized as to be relatively inconspicuous. It is especially appealing to woman since is can be concealed by their hair. Conventionally, this type of hearing aid has an aperture on top to transmit sound pressure to its input transducer, i.e., the microphone, for conversion to electrical signals. Because of the location of the aperture and the angle at which the unit is disposed on the ear, this kind of hearing aid characteristically exhibits good response to sound coming from behind or above the wearer but relatively poorer response to sound coming from in front of the wearer. This variation in response according to direction of the sound becomes more pronounced with higher frequencies since high frequency signals are more directional than low frequency signals. Necessarily, this loss of response manifests itself in variations in overall gain to the point where for a given volume control setting the wearer may hear sounds from behind quite clearly while sounds from in front may not be loud enough to be heard distinctly. On the other hand, if the volume control is adjusted to facilitate hearing frontal sounds, the gain may be too much for rearward sounds and the latter may come through with disturbing force. As a result it is not uncommon for the wearer, consciously or unconsciously, to shift his head for frontal sounds so that the latter may be heard distinctly with a gain setting appropriate for rearward sounds. Nevertheless, at best this is a method of compensating; it does not obviate the inherent limitation of variations in response according to direction of sound.

Accordingly, the primary object of the present invention is to effect an improvement in behind the ear hearing aids which will give maximum microphone response to sounds emanating from in front of the wearer without disturbing the excellent level of response heretofore attainable for sounds originating from above or behind the wearer.

A specific object of the present invention is to maximize microphone response to frontal sounds by a structural improvement to the body of the hearing aid which does not involve or require redesigning or relocation of the component parts of the sound processing system contained within the body.

The attainment of these and other objects involves the provision of a second aperture which is oriented to sounds originating in front of the wearer. Preferably, the second aperture is disposed at about 90° to the aperture conventionally provided on the top side of the hearing aid body. The second aperture communicates with the microphone via a rearwardly extending channel which is designed so as not to attenuate audio frequency signals.

These and other objects and advantages will become apparent from the following detailed description when taken in conjunction with the accompanying drawing in which:

FIG. 1 is a perspective view showing the position of a hearing aid embodying the present invention when it is being worn;

FIG. 2 is an enlarged side view of the same hearing aid with a portion thereof shown in section to facilitate comprehension of the invention;

FIG. 3 is a cross-sectional view of the frontally directed sound channel provided according to the present invention; and

FIG. 4 is a view similar to FIG. 3 of a second form of the invention.

As is well known, hearing aids comprise principally a microphone for picking up and transforming sound waves into corresponding electrical energy derived from a battery, an amplifier for this energy, a volume control for varying the gain of the amplifier, and a receiver for transforming the amplified electrical energy into acoustical energy. Thus, the illustrated embodiment comprises microphone 2, a battery 4, an amplifier 6, a volume control wheel 8, and a receiver 10, all housed within a molded plastic hearing aid body identified generally at 12. The latter has an opening 14 (FIG. 2) on its top side which communicates with microphone 2 and a threaded hollow stud 16 at its front end which communicates with receiver 10 and is a point of attachment for a length of flexible tubing 18. The latter acts as a conduit for transmitting sound pressure from receiver 10 to a molded ear piece 20.

To the extent hereinabove described, the illustrated device is old and embodies conventional parts. For this reason and for the additional reason that they are not required to understand the invention, details of the electrical and electronic parts, the circuitry, and the manner of mounting the various components in the body 12 are omitted.

As seen in FIG. 1, when the hearing aid is supported by the wearer's ear (shown in phantom at 24), the body 12 will be disposed at an inclined angle with the hole 14 aimed generally rearwardly and upwardly. The actual angle at which the hearing aid is disposed will vary from person to person and also from one brand or model to another. However, rarely is it disposed at a flatter angle than the one shown, and often it is more nearly vertical so as to be concealed better by the wearer's ear. Accordingly, the aperture 14 imparts a sensitivity limitation to the unit, making it relatively more responsive to sounds emanating from behind and above and less responsive to sounds originating from in front of the wearer.

It has been discovered that this sensitivity limitation can be overcome by providing an auxiliary aperture 28 at the front end of the unit just above the hollow stud 16. Since the hearing aid body is generally arcuate in length as shown best in FIG. 2, the opening 28 will face forwardly and upwardly when the unit is worn in the manner shown in FIG. 1. Consequently, it is exposed fully and directly to frontal sound pressures.

Referring now to FIGS. 2 and 3, the aperture 28 is defined by the top wall 30 (FIG. 2) of the housing and the end of an inverted U-shaped channel member 32 secured to the top wall. The channel member and the top wall form a channel 33 leading from aperture 28 back to the opening 14. At this point it is to be noted that the body 12 is formed of two opposite halves cemented together along confronting edges as at 34. Accordingly, each half has a top wall section identified in FIG. 3 at 30*a* and 30*b* respectively which fit together to form the top wall 30. These top wall sections have like semi-circular slots which cooperate to define the opening 14 which communicates with the microphone. The microphone is disposed in a cavity 36 formed by the two halves and protected against shock by a hollow resilient cushion element 38 which fits into opening 14.

For the purposes of this invention the two top wall sections also are provided with ribs 40 and 42 along the sides away from their confronting edges. These ribs are of corresponding length and are provided with like

inwardly extending flanges 44 and 46 which define grooves to accept outwardly extending flanges 48 and 50 formed at opposite sides of channel member 32. At their rear ends the ribs have inwardly extending portions, one of which is shown at 52 (FIG. 2), which act as a stop for the rear wall 54 on channel member 32. These rear rib portions 52 define a common groove which receives a rearwardly extending flange 56 on the rear wall of the channel member. The channel member is held tight by the ribs so that it will not move. The grooves defined by flanges 44 and 46 are sized to make a friction fit with flanges 48 and 50. If desired, cement may be added to provide improved locking of the channel member. The channel member also has a hole 60 which is located directly in line with aperture 14. Hole 60 should be as large as the effective opening of hole 14 or cushion element 38, whichever is larger, and the latter openings are at least as large as the opening provided in the microphone itself. These conditions are necessary in order to avoid attenuation of certain audio frequencies. In practice, a typical microphone will have an aperture of about .020". For this size microphone hole it is preferred that holes 14 and 60 each have a diameter of .060"–.100". The cross-sectional area of channel 33 and its length also are sized so as to provide minimum attenuation of audio frequencies. In practice, the cross-sectional area of the channel is made slightly larger than the area of the holes 14 and 60. The shape of the cross-section of the channel between opening 28 and hole 14 is not critical, but may be circular or elliptical instead of rectangular as shown.

An incidental benefit of the invention is that it permits selective attenuation or rejection of certain frequencies which is of advantage in certain clinical cases. Attenuation may be achieved by blocking off hole 60 and reducing the cross-sectional area of the channel. Rejection or blockage of certain frequencies can be achieved by inserting an acoustical filter in the channel. Both approaches are illustrated in phantom in FIG. 3 where a block of filter material 64 adapted to absorb certain frequencies reduces the channel size to a small passage 66 desigend to attenuate still other frequencies.

It is to be noted that although the illustrated embodiment utilizes a metal member to form the sound channel for opening 28, it is well within the scope of the invention to accomplish the same result in other ways. Thus, the metal channel member could be replaced by one made of plastic. Alternately, the channel need not be formed by a separate channel element but could be molded integral with the two halves of the body. This latter form of construction is shown in FIG. 4 where the two halves of the plastic body have top wall sections 70*a* and 70*b* corresponding to the top wall sections 30*a* and 30*b* shown in FIG. 3. These wall sections have edge slots which cooperate to form a hole 72 similar to opening 14 shown in FIG. 2. Formed integral with these top wall sections are ribs 74 and 76 which support like flanges 78 and 80 respectively formed integral therewith. The wall sections and the flanges engage each other along their confronting edges and are cemented together so as to form an integral unit having a channel 82 similar to channel 33. Flanges 78 and 80 also have edge slots which define an opening 84 similar to opening 60. If desired, the mating edges of the two halves of the plastic body may be molded with ribs and grooves so as to form a tongue and groove connection for better alignment and locking.

In addition to drastically improving the performance of "behind the ear" hearing aids by extending the field of reception, the present invention has other noteworthy advantages. It is adaptable to conventional designs without drastic reconstruction and retooling. Moreover, it is available at low cost. Furthermore, it is acceptable to the wearer on other counts—being unobtrusive and adding little to the overall weight of the unit.

Obviously, many modifications and variations of the present invention are possible in the light of the foregoing teachings. It is to be understood, therefore, that the invention is not limited in its application to the details of construction and arrangement of parts specifically described or illustrated, and that within the scope of the appended claims, it may be practiced otherwise than as specifically described or illustrated.

What is claimed is:

1. A hearing aid for a human comprising, a hollow body shaped to rest on the outer ear of the wearer and containing the components of a hearing aid sound transforming and amplifying system, said components including a microphone, said hollow body having a first hole exposed to said microphone and directed rearwardly and upwardly of the wearer's ear and a second hole directed forwardly of the wearer's ear, and means defining a channel connecting said first and second holes whereby said microphone is exposed to sounds emanating from in front as well as behind of the wearer's ear.

2. A hearing aid comprising a hollow body having an upper side and a front end, said body shaped to rest on and be supported by the outer ear of a wearer with said upper side facing upward and rearward of said ear and said front end disposed above and facing forward of said ear, said body containing the components of a hearing aid sound transforming and amplifying system, said components including a microphone, said body having a first sound communicating hole in said upper side for directing to said microphone sounds emanating from above and behind said ear and a second sound communicating hole in said front end for directing to said microphone sounds emanating from in front of said ear.

3. A hearing aid comprising a hollow body having an upper side and a front end, said body shaped to rest on and be supported by the outer ear of a wearer with said upper side facing upward and rearward of said ear and said front end disposed above and facing forward of said ear, said body containing the components of a hearing aid sound transforming and amplifying system, said components including a microphone, said body having a first hole in said upper side and a second hole in said front end, said first hole communicating with said microphone whereby to deliver thereto sound emanating from above and behind said ear, said second hole facing forwardly of said ear, and means defining a channel in said body connecting said second hole and said microphone whereby to deliver thereto sound emanating from in front of said ear.

4. A hearing aid as defined by claim 3 wherein said means is an inverted U-shaped channel member attached to the top side of said body.

5. A hearing aid as defined by claim 3 wherein said means are integral with said body.

6. The combination of claim 3 wherein said channel has a cross-sectional area and length adapted to transmit audio frequency sound pressure without any substantial attenuation.

7. A hearing aid comprising a hollow body having an upper side and a front end, said body being curved and shaped to rest on and be supported by the outer ear of a wearer with said upper side facing upward and rearward of said ear and said front end disposed above and facing forward of said ear, said body containing the components of a hearing aid sound transforming and amplifying system, said components including a microphone located a substantial distance behind said front end and oriented with its diaphragm facing said upper side, said body having first and second sound apertures for said microphone, said first aperture comprising a hole in said upper side communicating directly with said microphone whereby to deliver thereto sound emanating from above and behind said ear, said second aperture comprising an opening in said front end and a channel

extending lengthwise along said body from said front end to a communicating junction with said first aperture, whereby to deliver to said microphone sound emanating from in front of said ear.

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ROBERT H. ROSE, *Primary Examiner.*