

[54] **HEARING AID EAR PIECE**
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[58] Field of Search 179/182 R, 107 H,
179/107 E, 107 S, 107 R; 181/23

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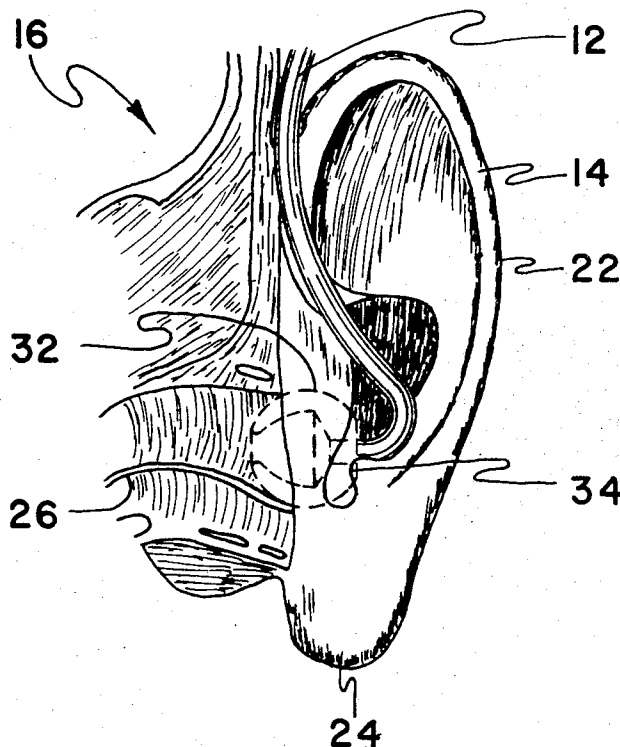
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[57] **ABSTRACT**

A relatively light weight plastic ear piece having a spherical configuration as positioned in the interior portion of the concha behind the tragus over the auditory canal orifice. The diameter of the ear piece is large enough to permit snug engagement between the tragus and concha while preventing it from wedging in the auditory canal, so that a clearance exists between the canal and the atmosphere to prevent pressure differentials therebetween.

9 Claims, 6 Drawing Figures



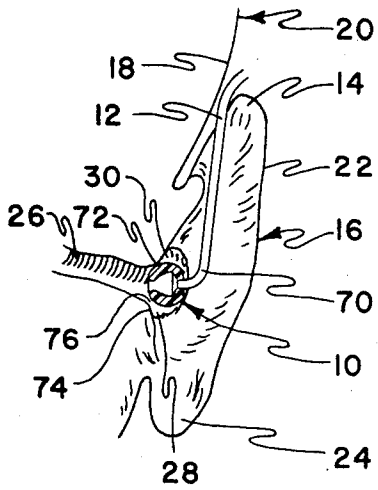


FIG. 1

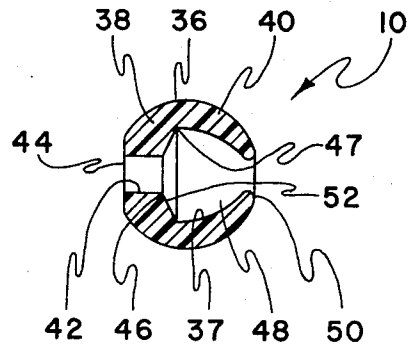


FIG. 2

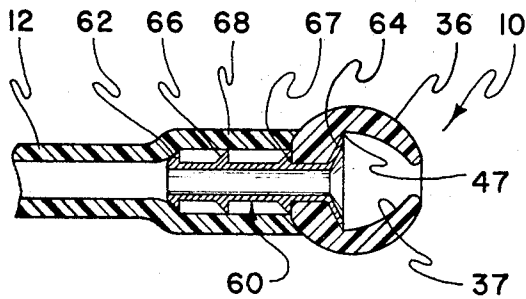


FIG. 3

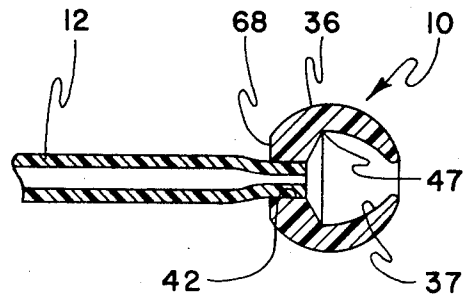


FIG. 4

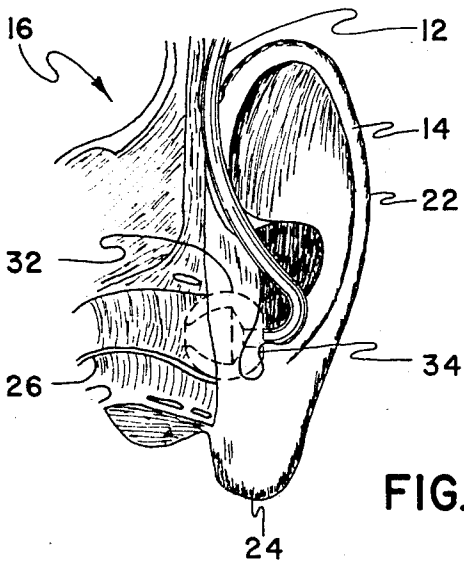


FIG. 5

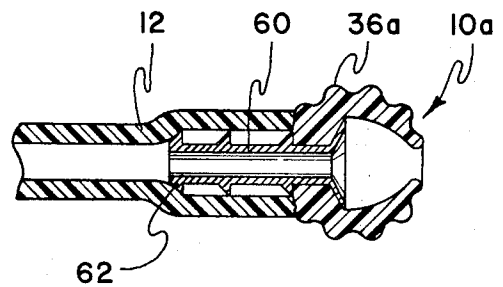


FIG. 6

HEARING AID EAR PIECE

BACKGROUND OF THE INVENTION

This invention relates to hearing aids, and more specifically, to an improved ear piece for use in hearing aids.

Hearing aids of the type utilized to assist a person having impaired hearing to hear properly have improved greatly since their inception, to such a degree that they are widely accepted today. One general type of hearing aid utilizes a receiver which directs and/or amplifies the sound through a tube to an ear piece inserted or wedged into the auditory canal. It is this type of hearing aid to which this invention particularly pertains.

A principle disadvantage of existing equipment of the type just noted is the tendency to create and build up mental as well as physical discomfort and/or fatigue as a result of periods of long uninterrupted use. In addition, many people who would be greatly benefited by the use of such a device resist using them because of their affect on the user's appearance. Present equipment known or in use provides for insertion of a substantial portion of the ear piece beyond the inner portion of the concha and tragus and directly into the auditory canal to seal the canal off from external interference noises so that the highest efficiency in performance of the device itself is utilized. Other types of hearing equipment such as stethoscopes provide a tension means to the ear piece to force the same against and completely cover the auditory canal. These latter devices such as stethoscopes are not intended for long periods of use, and hence the comfort and appearance factors are distinctly secondary.

With respect to the ear pieces which are inserted into the auditory canal, several stages of discomfort and stress arise. First, the user, depending on his conditioning, has the immediate discomfort of a foreign object inserted in and blocking a normally open body passageway. This alone will eventually create fatigue through long use. This fatigue factor is similar to that experienced by a person not accustomed to eye glasses who wears sun glasses for long periods of time. Furthermore, the complete sealing-off of the auditory canal for long periods of time develops tension within the user, to the point that he will discard the hearing aid at the expense of reduced hearing ability, merely for the sake of comfort. Secondly, since the auditory canal is sealed off from the atmosphere, pressure differentials may build up in the canal relative to the atmosphere. This requires the periodical momentary removal of the ear pieces in order to equalize this pressure differential. The pressure differential increases the user's discomfort and fatigue while the periodic removal is cumbersome and disconcerting.

Another principal disadvantage to existing hearing aid ear pieces is the reverberation characteristics of sound which they transmit through a completely closed tube. That is, sounds introduced to the auditory canal tend to reverberate. Since an ear piece wedged therein and blocking the canal prevents dissipation, discomforting and interfering noises are introduced to the user. Furthermore, such equipment necessitates a more-or-less total dependence by the user on the hearing device as the sole source of sound. Many users are capable of limited hearing and desire to use a hearing

aid only to complement their limited hearing. Existing equipment of the type under discussion blocks all external sound from the auditory canal and thereby forces the user to rely solely on a hearing device. This only increases the eventual dependence of the user's natural abilities on the hearing device. Thus, there is a need for a new and improved ear piece which provides equally good or even better performance than those existing, while materially reducing the adverse side effects such as fatigue, discomfort and attraction from the user's appearance.

SUMMARY OF THE INVENTION

This invention provides a new and improved ear piece which greatly reduces many of the disadvantages of the prior art. In accordance therewith, a relatively light-weight hollow ear piece includes a generally spherical exterior portion which is positioned over the outer orifice of the auditory canal. The ear piece includes a pair of openings, one of which is connected to the sound tube, and the other of which is positioned in alignment with the canal orifice. The size of the ear piece is sufficiently large to prevent the ear piece from appreciably entering or being wedged in the canal, while at the same time enabling it to be seated snugly over the entrance to the canal without blocking the same, and held in place between the walls of the concha and tragus. Means are provided to maintain a clearance between the canal and atmosphere to prevent the build-up of any pressure differential between the atmosphere and internal portion of the canal.

One important aspect of this invention is the overall light-weight quality of the ear piece which greatly reduces and retards any fatigue or tension build-up, even over prolonged periods of use. In addition, by seating the ear piece over the auditory canal between the concha and tragus walls without any wedging engagement of the ear piece in the auditory canal, the user experiences even further comfort and, additionally, is not totally dependent on the hearing device as the sole source of sound. That is, the user can utilize natural hearing to complement the amplified sound from the hearing aid sound tube since the ear piece provided by this invention does not seal off the auditory canal entirely from the atmosphere.

Accordingly, in accordance with the invention external and unamplified sound is introduced to the auditory canal in two ways. It is directly introduced to the auditory canal through the clearances provided around the periphery of the ear piece, which also prevent differential pressure build-up between the auditory canal and atmosphere. Sound is also indirectly introducable to the auditory canal through the ear piece itself, as a result of its light-weight construction; i.e., although the ear piece is shaped to act as a speaker for the sound transmitted through the tube, it is not intended as an acoustical insulator. Its preferred material has qualities which permit natural unamplified sound to penetrate it and pass into the auditory canal. Hence, by providing a device which permits the amplified sound to be reduced to a level which when combined with the natural ability of the user permits adequate hearing, fatigue and tension build-up are retarded even more.

In a preferred aspect, the ear piece is slightly dimpled to permit one or more finite passageways from the auditory canal to the atmosphere to prevent differential pressure build up. These clearances in addition to the foregoing also permit the dissipation of sound reverberations.

An additional aspect of this invention provides a quick and simple means for connecting the ear piece to the sound tube, permitting its removal therefrom for cleaning or replacement. Thus, this invention provides an extremely light-weight, inexpensive ear piece construction which permits the user the choice of total reliance on the hearing device or its use to complement his natural ability. In addition, the ear piece is not wedged in the auditory canal, thereby greatly reducing the rapidity of tension and fatigue build-up in accordance with the prior art. By snugly seating the ear piece between the concha and tragus walls, it is possible to provide an ear piece construction having a size significantly smaller than those presently existing, thereby greatly reducing its affect on the user's appearance.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary cross-sectional view of a human ear and auditory canal showing the ear piece provided by this invention nestled over the outer orifice of the auditory canal;

FIG. 2 is an enlarged cross-sectional view of the ear piece provided by this invention;

FIG. 3 is an enlarged cross-sectional view of the ear piece shown in FIG. 2 connected to the sound tube in accordance with one embodiment of this invention;

FIG. 4 is an enlarged cross-sectional view of the ear piece shown in FIG. 2 connected to the sound tube in accordance with an alternative embodiment of this invention;

FIG. 5 is a fragmentary elevational view of a human ear showing the sound tube and ear piece seated over the auditory canal in accordance with this invention; and

FIG. 6 is a cross-sectional view similar to FIG. 3 showing an alternative ear piece construction.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring generally to the drawings, the hearing aids to which this invention pertains include an ear piece 10 connected to a sound tube 12 which is generally shaped to fit snugly between the upper helix portion 14 of an external ear 16 and the side 18 of the user's head 20. From there, tube 12 is connected at its other end to a receiver and amplifier (not shown) which is conventional. These amplifiers may vary from one attached behind the ear to one secured in the user's pocket or, if the user wears glasses, it is many times concealed within the frame at a point adjacent the ear.

Referring now specifically to FIGS. 1 and 5, the external ear 16 is shown comprised of the familiar large outer helix 22 terminating into the ear lobe 24. In general, it may be said that the outer helix is for receiving the directing sounds inwardly past the concha 30, tragus 32 and anti-tragus 34, into the auditory canal 26 which transmits the sound into the inner ear (not shown). The auditory canal includes an outer orifice 28

at its terminus with the outer ear, such orifice constituting the entry to the canal.

Referring now to FIG. 2 in detail, the preferred ear piece 10 is shown to have a generally spherical configuration. The ear piece is hollow having an inner wall 36 and outer wall 37. It is essentially comprised of two portions, a connector portion 38 and a sound chamber portion 40. Connector portion 38 includes a passageway 42 having an outer opening 44 and an inner opening 46 to the sound chamber 48. Sound chamber 48 in addition to opening 46 includes an outer opening 50 which is aligned with the auditory canal when the ear piece is properly positioned.

The preferred configuration of sound chamber 48 provides for a general equality in the diameter of openings 44, 46 and 50, with the diameter of sound chamber 48 expanding rapidly from opening 46 to a maximum diameter 47 and then decreasing gradually to opening 50. This creates an ideal sound chamber for sounds received through passageway 42, in that they expand in all directions once they are introduced into the sound chamber. However, the inner walls 36 of chamber 48 act as rebounders which focus the sound at opening 50 whereupon it is introduced in a concentrated effect into the auditory canal.

Preferably, ear piece 10 is comprised of a plastic ball or bead which is either transparent or pigmented with a natural skin color. In order to prevent the ear piece from being wedged in the auditory canal, in accordance with this invention a spherical configuration of ear piece 10 has been found to be extremely practical. This permits orifice 50 to be sized appropriately for focusing the sound being transmitted therethrough into the canal while at the same time allows the outside diameter to rapidly enlarge to a cross-sectional dimension of sufficient magnitude to prevent the ear piece from being wedged into the canal; furthermore, this is accomplished without requiring an ear piece of such a size that it detracts from the appearance of the user.

It will be appreciated that the dimensional characteristics of the elements of the ears of a human being vary from person to person. In response to this realization, I have found that according to this invention, the preferred size of ear piece 10 ranges between one-fourth inch to one-half inch in diameter. By varying the size of the ear piece within this range by increments of one thirty-second of an inch, a sufficient flexibility in size is provided to accurately fit practically anyone merely by selecting the proper size from the eight possible alternatives.

Referring now specifically to FIG. 3, one aspect of this invention provides a coupling 60 for connecting ear piece 10 to the tubing 12. The tubing itself is preferably comprised of a transparent pliable plastic in order that it be easily shaped to follow the necessary contour from the ear piece up to and behind the upper helix portion 14 of the ear. A No. 13 pliable transparent plastic tubing has been found to provide both good sound transmission and adequate pliability. Coupling 60 is preferably tubular in shape and includes a saw-tooth (or like annular-form) projection 62 and 64 at each end thereof with a pair of projections 66, 67 intermediate its ends. Projection 64 at the outer end of coupling 60 is preferably larger than projections 62, 66 and 67 and is shaped to match the contour of inner wall

portion 52 of sound chamber 48 adjacent opening 46, to permit coupling 60 to be embedded within passageway 42 with projection 64 in abutment against the wall of sound chamber 48. The longitudinal distance between projection 64 and the first intermediate projection 67 is equal to the longitudinal length of passageway 42 so that the first intermediate projection 67 abuts against outer wall 36 to anchor ear piece 10 to coupling 60. The second intermediate projection 66 and inner end projection 62 have a diameter in excess of the inner diameter tube 12 so that when coupling 60 is inserted into the outer end of tube 12, the projections 62 and 66 force the pliable tubing to become enlarged, creating a tight wedge connection between tubing 12 and coupling 60.

Referring to FIG. 4, an alternative embodiment is shown for connecting tube 12 to ear piece 10 and consists simply of squeezing the outer end 68 radially inwardly to cause it to neck down so that it can be squeezed into passageway 42. The resilient tendencies of a pliable plastic tubing are sufficient to produce a positive friction fit between ear piece 10 and tubing 12, although of course this joint may be positively secured if desired, as by adhesives or heat welding. It will be appreciated that one advantage of the utilization of a coupling such as that described over the form shown in FIG. 4 is that the squeezing of outer end 68 of tubing 12 reduces the cross sectional area of the flow passageway thereby acting as a sound resistor. However, the utilization of a coupling does add some weight to the over-all combination and hence its choice of use will depend on part on the design objectives; i.e., the degree of hearing difficulty of the user as opposed to any additional discomfort which might be introduced by the use of a coupling.

In either event, the couplings described can quickly be disconnected to permit replacement of the ear piece or easier access for cleaning.

Referring now to FIGS. 1 and 5, the operation of ear piece 10 will be described in detail. Preferably, tubing 12 includes an immediate 90° bend 70 in those instances wherein it is directed toward the upper helix portion of an ear, so that ear piece 10 can be mounted within the outer ear with opening 50 in general alignment with the axis of auditory canal 26. Ear piece 10 is positioned within the outer ear between the wall portions of the concha 30 that is shown in FIG. 1 and the tragus 32 as shown in FIG. 5. The magnitude of the cross-sectional diameter of ear piece 10 defined above is such that the ear piece is seated lightly but snugly between walls of the concha and tragus so that it will generally remain in the position in which it is seated. On the other hand, the magnitude of the maximum cross-sectional diameter of the ear piece prevents it from being wedged into auditory canal 26 under normal circumstances. Due to the spherical configuration of the preferred embodiment, it will be appreciated that opening 50 of the ear piece 10 may lie slightly within auditory canal 26. However, the important consideration in terms of tension and fatigue is that it is not wedged therein.

Under normal circumstances, outer orifice 28 of auditory canal 26 does not lie in a perpendicular plane. Normally, its upper peripheral portion 72 is not in vertical alignment with its lower peripheral portion 74.

This will generally provide a clearance or passageway 76 between some portion of the outer wall 36 of ear piece 10 and some peripheral portion of orifice 28, so that the auditory canal is in open communication with the atmosphere as shown in FIG. 1. This is desired for two reasons. First, it permits a release passageway for any differential pressure which may otherwise build up between the pressure in the auditory canal and the atmospheric pressure. Without such a relief, stress and tension are expedited. Secondly, amplified sound will in some instances set up reverberations within the auditory canal causing vibratory noise within the canal which decreases the hearing efficiency to the inner ear. By providing some clearance or passageway between the auditory canal and the outer atmosphere, these reverberations will be dissipated. Thirdly, the provision of a clearance or passageway permits the user of a hearing device in accordance with this invention to complement the amplified sound from the hearing aid with the addition of natural unamplified sound. In many instances, the hearing difficulty of a user is not complete such that he is totally dependent on the utilization of a hearing device. In these instances, the decibel magnitude of amplification can be reduced so that the total complement of amplified and unamplified sound is adequate for normal hearing. The reduction in decibel magnitude is but another factor in retarding the time build-up of stress or fatigue through the utilization of a foreign object such as an ear piece in the human ear.

Referring now to FIG. 5, the tragus 32 is shown in some detail in order to illustrate how the ear piece 10 is snugly seated between the tragus and concha 30. The tragus also acts as a partial shield of ear piece 10, thereby reducing the adverse effects of its appearance to the user. In some instances, depending on the physical anatomy of the user, the anti-tragus 34 will also shield portions of ear piece 10 and in some instances may provide a portion of the seating surface within which ear piece 10 is engaged.

Referring now to FIG. 6, an alternative embodiment is shown wherein the same concepts of the invention as described are utilized. FIG. 6 is similar to FIG. 3 and like numerals designate like parts. Tubing 12 and coupling 60 are identical to those described previously. The alteration shown in this embodiment is an ear piece 10a similar dimensionally to ear piece 10 described above except for the contour of its outer surface 36. The outer surface 36a shown in FIG. 6 has a dimpled uneven surface. The utilization of a dimpled outer surface 36a is preferred in those applications wherein the normal clearance 76 between the auditory canal and outer atmosphere may be insufficient. That is, it may be insufficient to provide relief to differential pressure build-up or audio reverberations where the unique physical characteristics of the user might be different than normal. The use of a dimpled outer surface of ear piece 10a increases the cross-sectional flow area of the passage or clearance 76 thereby providing a greater relief passageway. It will also be appreciated that in some instances, the outer orifice 28 of auditory canal 26 may be vertically aligned so that the normal clearance 76 described above is not provided. By utilizing an ear piece 10a having a dimpled outer surface 36a, the requisite clearance is provided.

It should also be noted that according to the unique size and shape of the ear piece provided by this invention, and the normal shaping of the inner concha portion 30 and tragus 32 of a human ear, the ball or bead-like shape of the ear piece can be snugly positioned between the tragus and concha in more than one position with respect to outer orifice 28 of auditory canal 26. This permits the user to provide more or less clearance between the outer wall 45 of ear piece 10 and outer orifice 28 of auditory canal 26 to permit a range of comfort. If the user must depend almost entirely on the hearing device, then ear piece 10 will be positioned at its maximum innermost position. On the other hand, as the dependency on the hearing device is reduced, the ear piece will be positioned increasingly more outwardly from the walls of the canal orifice. Indeed, there may many times be a substantially annular clearance between the outer wall 36 of ear piece 10 and the periphery of the canal orifice 28.

Although several embodiments have been shown and described in detail, it will be obvious to those having ordinary skill in this art that the details of construction of these particular embodiments may be modified in a great many ways without departing from the unique concepts presented. It is therefore intended that the invention be limited only by the scope of the appended claims rather than by particular details of construction shown, except as specifically stated in the claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows.

1. In a hearing aid device having means for receiving and amplifying sound external to the ear for transmission through a sound tube connected at one end to said means and at the other end to an ear piece, the improvement comprising: a hollow spherical ball shaped ear piece having a pair of aligned openings, one of which is connected to said sound tube; said ear piece having a diameter of sufficient magnitude to prevent said ear piece from being wedged into a normal auditory canal, but receivable within the inner portion of the concha with portions of the ear piece positioned behind and engaged snugly with the tragus so that said ear piece is positionable to fit snugly between the walls of the concha and tragus across the auditory canal orifice with said other of said openings positioned at the outer orifice of the auditory canal; said spherical ball-shaped ear piece being non-complementary with the outer orifice of a normal auditory canal whereby means defining a passageway exists at some point along the periphery of said orifice when said ear piece is positioned between the concha and tragus to prevent the build-up of pressure differentials between the atmosphere and the inner portions of said auditory canal.

2. The improved hearing aid device according to claim 1 wherein the outer surface of said ear piece includes one or more depressions, said depressions defining at least a part of said clearance between said audito-

ry canal and the atmosphere when said ear piece is positioned over the outer orifice of the auditory canal.

3. The improved hearing aid device according to claim 1 wherein said hollow ear piece includes a sound chamber having a maximum cross-sectional dimension greater than that of said other opening, the contour of said chamber acting to concentrate the sounds received therein from said one opening to said other opening.

4. The improved hearing aid device according to claim 3 wherein the cross-sectional diameter of said sound chamber increases rapidly from said one opening to said maximum dimension, thereafter decreasing less rapidly to said other opening, said sound chamber terminating in said other opening.

5. The improved hearing aid device according to claim 3 wherein said ear piece also includes a portion defining a passageway from said one opening to said sound chamber, said passageway having a diameter less than the outer diameter of said sound tube.

6. The improved hearing aid device according to claim 5, further including a coupling means for connecting said ear piece to said tube, said means having a tubular configuration, the outer surface of which includes a plurality of longitudinally spaced projecting ribs, a portion of said coupling means being positioned in said ear piece passageway and another portion thereof being positioned in the end of said sound tube to provide a positive connection between said tube and ear piece.

7. The improved hearing aid device according to claim 1 wherein said hollow spherical configuration has an outer diameter between one quarter (0.25) and one half (0.50) of an inch inclusive.

8. The improved hearing aid device according to claim 1 wherein said ear piece is comprised of a lightweight plastic material, whereby the same is conducive to the transmission of natural sounds from the atmosphere into the auditory canal when positioned thereover.

9. An ear piece for use with a hearing aid device, comprising a generally hollow spherical ball-shaped element having a pair of aligned openings, means at one of said openings for connecting the ear piece to said hearing device, said ear piece having a diameter of sufficient magnitude to prevent the ear piece from being wedged into a normal auditory canal but of small enough magnitude to be receivable snugly within the inner portion of the concha and positioned at least partially behind and in contact with the tragus with said other of said openings positioned at the outer orifice of the auditory canal, said ball-shaped element being non-complementary with the outer orifice of a normal auditory canal whereby means defining a passageway exists at some point along the periphery of said orifice when said ear piece is positioned between the concha and tragus to prevent the build-up of pressure differentials between the atmosphere and the inner portions of the auditory canal.

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