

[54] **EARPIECE FOR HEARING AID HAVING SOUND INLET FOR HIGH FREQUENCIES**

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[22] Filed: **March 13, 1970**

[21] Appl. No.: **19,271**

[52] **U.S. Cl.**.....179/107 E

[51] **Int. Cl.**.....H04r 25/00

[58] **Field of Search**.....179/107 E, 107 N, 107 S

[56] **References Cited**

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[57] **ABSTRACT**

A hearing aid includes an earpiece worn in the ear and a sound amplifier worn externally of the ear. Sound waves impinging on the ear are transmitted through an opening in the outer surface of the earpiece to an inner chamber thereof and thence through a conduit to the sound input of the amplifier. The amplified sounds are fed from the output of the amplifier through a further opening extending through a portion of the earpiece positioned in the external meatus.

**6 Claims, 5 Drawing Figures**

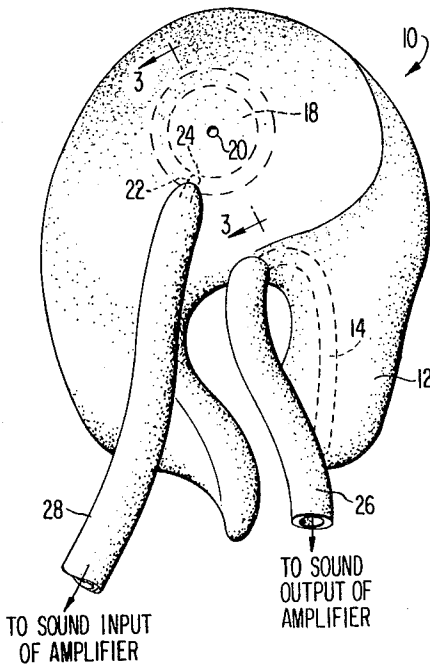


FIG1

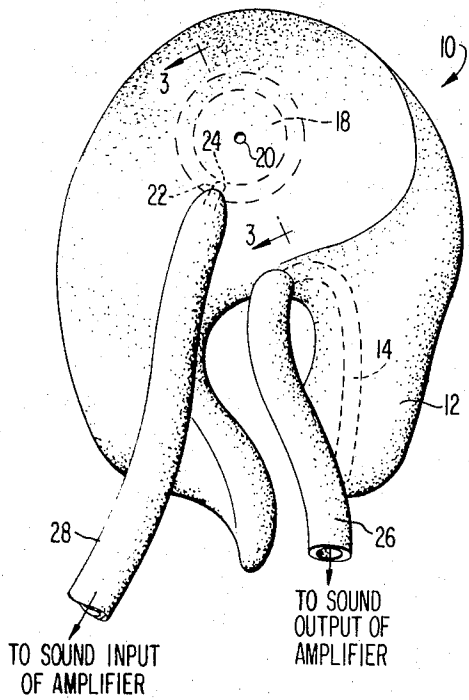


FIG2

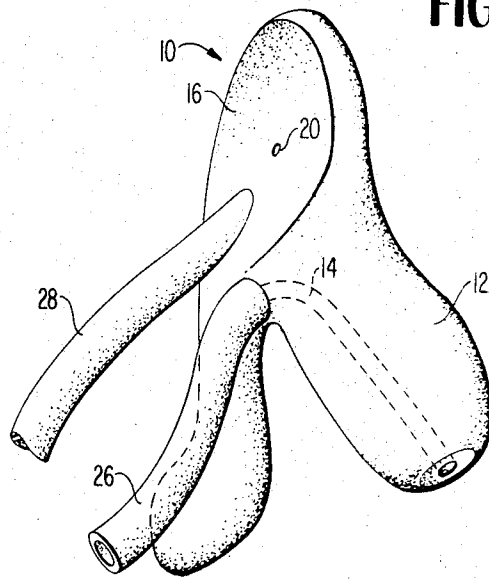


FIG3

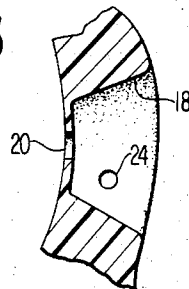


FIG4

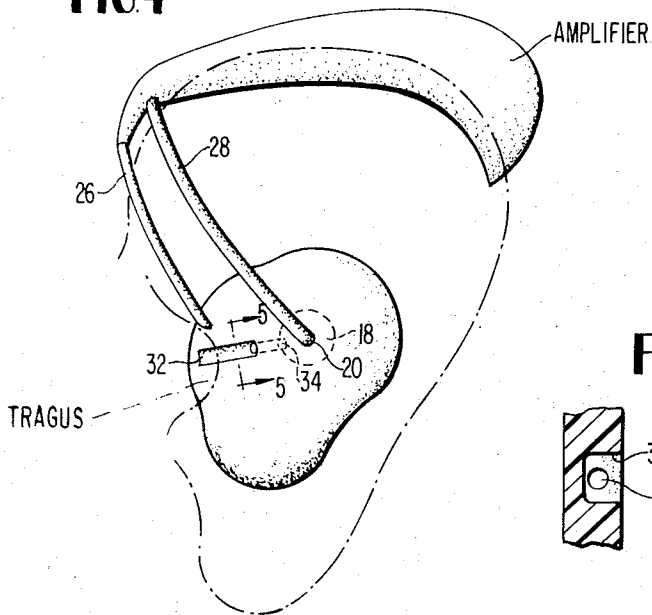
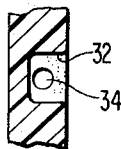


FIG5



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## EARPIECE FOR HEARING AID HAVING SOUND INLET FOR HIGH FREQUENCIES

### BACKGROUND OF THE INVENTION

Although the technology concerned with hearing aids has proliferated in the last two decades, there is a basic difficulty which, prior to the present invention, has never enjoyed a satisfactory solution. This basic problem arises from the fact that the majority of hearing deficiencies are those which are associated with the upper frequencies or short waves. In general, the lower the frequency (within the normal range of sounds), the greater is the distance that such sounds will carry. It is also the fact that the longer wave sounds tend to obscure or blot out the higher frequency sounds. The normal human ear performs a function that is not entirely understood in blending sounds of various frequencies within the normal hearing spectrum to produce with great fidelity the sounds which impinge on the ear. In general, the external ear or pinna is so formed that it converges the short wave high pitched high frequency sound waves into the external auditory meatus. The pinna does not have the ability to do this with the long wave low pitched sounds and these enter the meatus only in a direct straight line. In this manner, it is believed that the human ear functions so that the proper balance of long and short wave sounds may be heard. Known electronic hearing aids attempt to amplify only that range of frequencies in which the individual has a hearing deficiency but none achieves the balance produced by the normal human ear.

### BRIEF SUMMARY OF THE INVENTION

The present invention makes use of an earpiece which is so designed that it cooperates with the natural human ear and actually utilizes some of the functions of the external ear to achieve the desired balance between low and high frequency waves which are ultimately transmitted to the inner ear. The electronic amplifier of the present invention is worn externally of the ear and unlike the hearing aids of the prior art, receives its input through a closed conduit leading from a chamber in the earpiece. As in conventional hearing aids of the prior art, the amplified output is fed through a closed conduit to a passageway in that portion of the earpiece which is received within the external meatus and which transmits the amplified sounds directly to the inner ear.

### BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1 and 2 are inverted perspective views from slightly different angles of a preferred embodiment of an earpiece in accordance with the present invention;

FIG. 3 is a section on the lines 3—3 of FIG. 1;

FIG. 4 is a rather schematic diagram of an earpiece which is an alternative embodiment to the one shown in FIGS. 1 and 2 and showing the earpiece in place in a human ear together with the electronic amplifier and the connections between the two; and

FIG. 5 is a section on the lines 5—5 of FIG. 4.

### DETAILED DESCRIPTION OF THE INVENTION

Referring first to FIGS. 1 to 3, inclusive, of the drawings, it will be seen that the earpiece 10 is a molding preferably of a synthetic resin material and the molding includes an elongated portion 12 which extends outwardly from the remainder of the mold. This portion 12 is adapted to be received directly within the external meatus. As in conventional hearing aids of the prior art, this portion 12 includes an elongated passageway 14 through which amplified sounds from the electronic amplifier are transmitted to the inner ear.

A second portion of the earpiece molding is indicated in the drawings by the reference numeral 16. This portion has an external surface which is concave as indicated in FIG. 3. Underlying the concave surface there is an enlarged chamber 18 which opens into the outer concave surface through a small opening indicated at 20. Another passageway 22 is drilled or

otherwise formed through the earpiece mold from the outer surface thereof and opening into the chamber 18 at 24.

When the earpiece is inserted into the human ear with the elongated portion 12 received within the meatus, the portion 16 and the chamber 18 overlie the concha.

As is the case with conventional hearing aids of the prior art, the amplified sound waves from the output of the electronic amplifier are fed through a closed conduit 26 to the passageway 14. In accordance with the present invention, a second conduit 28 is connected between the passageway 22 leading to the chamber 18 and the sound input or pickup of the electric amplifier. In this way, sounds that are normally focused by the external ear are converged into the chamber 18 from which they are transmitted through the tube 28 to the input of the amplifier.

Of course the hearing aid in accordance with the present invention does nothing to revitalize destroyed cells in the organ of Corti but what it does do is converge all of the short high frequency sound waves that come to the external ear and since many of the cells in the organ of Corti are only obtunded, by amplifying these waves through the hearing aid, those sounds will again become audible. The reason for this, of course, is that these sounds are not in any way damped or obscured by the long waves as is the case with the conventional hearing aids of the prior art. Of perhaps more importance is the fact that these sounds will not be blurred into a cacaphony of unintelligible noise.

While the exact overall shape of the earpiece is not critical, it is advantageous that the surface of the mold covering the external surface of the concha should not be on a higher level than the external triangular area of the external ear. That part of the earpiece mold which covers the concha should be slightly concave on its outer surface which helps to converge the short waves to the center thereof. The concave portion of the mold should be thick enough to allow a hole to be drilled in its center so as to admit the short high frequency waves. The point of connection of the passageway leading to the tube 28 can be variously located but as shown in the drawing it is made from above and slightly posterior and on a slant downward to enter the opening in the center of the mold.

The shape of the opening or chamber 18 is not particularly critical but as shown in the drawings it is conical or bell-shaped with the large end of the cone facing inwardly of the ear. As an example of one operative embodiment, the base diameter of the cone could be of the order of one-quarter of an inch and the diameter of the opening 20 to the outside should be about 1 millimeter. The larger the opening to the outside, the more long and low pitch waves are admitted. It is entirely within the scope of the present invention, of course, to extend the size of the external opening to diameters of as much as three or four millimeters depending upon the amount of long wave sounds it is desired to admit. If a higher pitched sound is desired, it may be useful to place a perforated membrane across the opening 20 since this would create a tympanic effect and for some specific types of hearing loss, this would yield a superior result. For the average high frequency loss, however, an opening of the order of 1 millimeter in diameter is satisfactory. It is, of course, also possible to provide a shutterlike mechanism so as to make the size of the opening 20 variable to accommodate the user to various operating conditions.

Turning now to FIGS. 4 and 5 of the drawings, a slightly modified form of the invention is shown. The earpiece mold as shown in FIGS. 4 and 5 while including all of the basic structure described with reference to FIGS. 1 to 3, inclusive, includes an additional passageway between the outer surface of the mold and communicating at its innermost end with the chamber 18. This passageway includes an open channel 32 milled or otherwise formed into the outer surface of the mold in a location adjacent the tragus. This channel is connected with the chamber 18 by a further passageway 34 which is drilled or otherwise formed from one end of the channel 32 into the chamber 18. In this embodiment, the tube or conduit

28 is connected to the chamber 18 by the opening 20. The connection of the conduit 26 is the same as in the embodiment described with reference to FIGS. 1 to 3. One advantage of the embodiment shown in FIGS. 4 and 5 is that under conditions of objectionably high ambient noise level as, for example, in proximity to a passing jet plane or the like, the user can simply move the tragus with his finger to a position where it covers the channel 32 and thus cut down on the sounds transmitted to the chamber 18.

From the foregoing description, it is believed that it will be apparent to those skilled in this art that the present invention increases the range of hearing over hearing aids of the prior art and especially in individuals having a deficiency in the higher frequency range and gives a clear perception to many sounds that were formerly not understandable. It greatly reduces the interference of wind which is a very marked difficulty with hearing aids of the prior art when the receiver is positioned out in the open and unprotected by the external ear. Another advantage of the present invention is that it makes it possible for the user to converse and hear plainly nearly all voices over the telephone without any additional apparatus of any kind.

While preferred embodiments have been herein shown and described, applicant claims the benefit of a full range of equivalents within the scope of the appended claims.

I claim:

1. A hearing aid comprising in combination:

- a. an earpiece configured to be worn in the ear of the user, said earpiece including a concave outer surface overlying an open bottom chamber and an opening through said concave surface into said chamber, said earpiece also including an elongated portion which is received in the external auditory meatus while said open bottom chamber overlies a portion of the concha, said elongated portion having a central longitudinal opening to transmit sound waves to the inner ear;
- b. an electronic sound amplifier adapted to be worn externally of the ear;
- c. first conduit means connected between said chamber and

the sound input of said amplifier; and  
 d. second conduit means connected between the sound output of said amplifier and said central opening in said elongated portion of said earpiece.

2. The combination defined by claim 1 in which said first conduit is connected to said chamber through said opening and in which a second opening is formed between said chamber and the outer surface of said earpiece.

3. The combination defined by claim 2 including a further opening in the said chamber, said further opening being a channel formed in the outer surface of said earpiece in the area adjacent the tragus and a conduit formed through a portion of said earpiece between one end of said channel and opening into said chamber, so that the tragus may be pressed over said channel under conditions of objectionably high intensity noise.

4. The combination defined by claim 1 in which said open bottom chamber is substantially frusto conical.

5. An earpiece mold for use in conjunction with an electronic amplifier to form a hearing aid comprising:

- a. a first elongated portion which in use is received within the internal meatus, said portion having a passageway therethrough for transmission of amplified sound waves from the amplifier to the internal ear; and
- b. an integral second portion which in use overlies the concha, said second portion having a concave outer surface overlying an inner chamber which through a substantially pinhole sized aperture opens into said concave surface, said second portion including a passageway leading from said chamber and opening externally of said mold, said second portion cooperating with the external ear to converge high frequency sounds into said chamber for transmission to the input of the amplifier.

6. An earpiece mold as defined by claim 5 and further including a channel formed in the outer surface of the mold and located adjacent the tragus when the mold is positioned in the ear, and a further passageway connecting said chamber with one end of said channel.

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