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HEARING AID VENT TUBE

Filed March 2, 1966

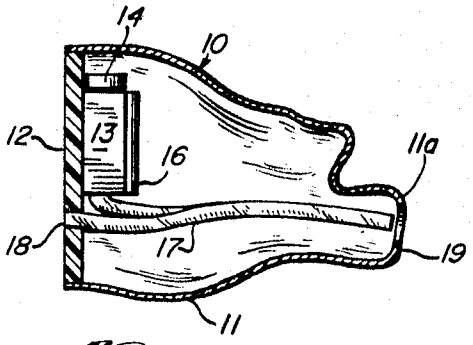


Fig. 1

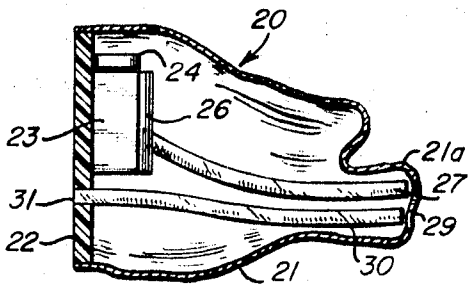


Fig. 2

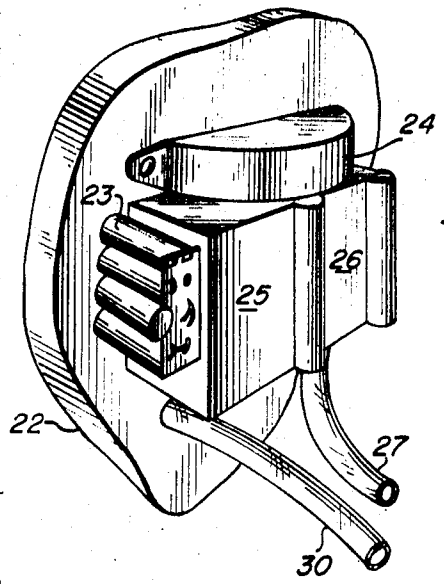
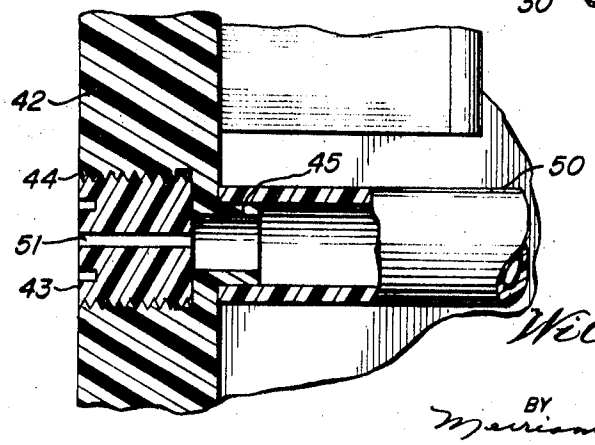


Fig. 3

Fig. 4



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HEARING AID VENT TUBE

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ABSTRACT OF THE DISCLOSURE

A hearing aid device including a flexible vent tube communicating the auditory canal of the ear with the ambient atmosphere whereby the pressure on either side of the device may be equalized while providing a vent tube that can be cleaned without dismantling the device and which will not increase the acoustical feedback in said device.

This invention relates to hearing aids and particularly self-contained electronic hearing aids of the type worn entirely in the ear.

One type of hearing aid now in use fits within the concha of the outer ear and extends into a portion of the external auditory canal. This instrument has the advantage over other hearing aids in that it is less conspicuous and less cumbersome and difficult to clean and operate.

The self-contained hearing aid includes a flat cover plate whose periphery is shaped to the contour of the concha. All or nearly all the miniaturized electronic components of the amplification system are mounted on the inner face of the cover plate. The cover plate is secured to a housing portion of the device which may be formed to the shape of the concha and auditory canal.

The snugly fitting housing portion not only provides an effective seal for the transmission of sound by air conduction but also provides a degree of sound transmission by bone conduction since the housing makes effective contact with the ear bones located adjacent to the auditory canal.

Generally, the components mounted on the inner face of the cover plate include a microphone, an amplifier, a receiver, a power supply such as a battery, and a sound tube extending from the receiver to the tip of the instrument positioned in the auditory canal. The amplified sound is carried through the sound tube to the tip of the instrument and transmitted to the inner ear. The remaining interior of the instrument may be filled with a sound-absorbing elastomeric material to help improve the acoustical effectiveness of the instrument.

One of the primary purposes for designing the device to conform to the contour of the concha and auditory canal is to eliminate, or at least hold to a minimum, the leakage of air into the ear. Air leakage between the skin and surface of the instrument has been found to be a major cause of acoustical feedback and must be eliminated or reduced substantially for efficient sound amplification and wearer comfort.

If, however, the instrument entirely eliminates the passage of air, a pressure differential between the ambient atmosphere and the inner ear may cause discomfort to the wearer and could possibly cause further hearing impairment.

It has also been found that wax build-up at the tip of the instrument can greatly reduce the instrument's effectiveness. Previous solutions to this problem have been to either remove the instrument entirely and disassemble it for cleaning or to provide a filter at the tip to prevent the wax from clogging the sound tube. Both solutions have disadvantages. In the former case, the wearer is deprived of the use of the hearing aid and, in the other, the filter may become obstructed by wax and require cleaning.

It is an important element of the present invention to provide such instruments with an additional outlet on the cover plate in order to allow air to pass to or from the ambient atmosphere through a vent tube in the instrument and from or to the auditory canal to equalize the pressure. A further significant advantage of the present invention is that it provides an easy method for removing wax from either the sound tube or the vent tube.

With the present invention, a Y-shaped tube is included in the interior of the instrument. One branch of the Y extends from an outlet in the cover plate and the other branch extends from the receiver mounted on the inner face of the cover plate. Both branches meet at the trunk of the Y which then extends to the tip of the instrument in the auditory canal. With the Y-shaped tube of the present invention, the sound emanating from the receiver is transmitted to the inner ear along the same trunk that serves to equalize the pressure between the ambient atmosphere and the inner ear. If and when the trunk portion of the Y tube becomes clogged with wax, the wearer need simply to poke out the obstruction with a simple prod.

Allowing air to pass from outside the instrument into the auditory canal may increase the acoustical feedback. This, however, can be controlled by reducing to a minimum the size of the opening in the cover plate.

Since it is economically more efficient to make components of the instrument on a mass production rather than a custom basis, it is another feature of the present invention that the cover plate be provided with a threaded opening so that a threaded plug having the desired sized opening therethrough can be threadably received in the cover plate. This design will allow the selection of a uniform tube size since the size of the opening will be controlled by the threaded plug.

Referring to the drawings:

FIGURE 1 is a cutaway view of a self-contained hearing aid showing the use of the Y-shaped tube.

FIGURE 2 is a cutaway view of an alternative embodiment of the present invention.

FIGURE 3 is a fragmentary isometric view of the alternative embodiment shown in FIGURE 2.

FIGURE 4 is an enlarged cross-sectional view of an alternative embodiment of the present invention.

Referring first to FIGURE 1, there is shown a hearing aid **10**, the outer surface of which is composed of a housing **11** having a tip portion 11_a, and a cover plate **12**. The cover plate is shaped to the contour of the concha of the outer ear (not shown). The housing **11** and tip portion 11_a are shaped to the bowl and auditory canal of the ear.

Shown mounted on the cover plate **12** is microphone **13**, battery **14** and receiver **16**. Emanating from receiver **16** is an outlet (not shown) to which one branch of Y tube **17** is attached. The other branch of Y tube **17** is received in opening **18** provided through the cover plate **12**. The Y tube **17** extends through the housing **11** and terminates at the tip 11_a. Tip 11_a is provided with outlet **19** for the transmission of the amplified sound to the inner ear and to facilitate the equalization of pressure on either side of the instrument **10**.

In the preferred embodiment of the present invention the hearing aid **10** is composed of an electroformed metal or plastic housing having a substantially uniform thickness throughout. A housing having a wall thickness of approximately .014" has been found to possess sufficient structural strength to support the various components included therein. For the electroformed metal housing, the preferred base for the housing is of a copper or nickel. The base may then be electrocoated with gold or other noble metal to resist corrosion.

Also, in this embodiment, it is preferred that all the miniaturized electronic components be mounted on the cover plate **12** in order to reduce acoustical feedback and to enable the removal and insertion of the cover plate into the housing without crimping or damaging the electrical leads or components. Of course the present invention is equally applicable with those instruments in which all the components are not mounted on the cover plate.

Shown in FIGURES 2 and 3 is an alternative embodiment of the present invention. The hearing aid **20** has a cover plate **22** on which the microphone **26**, amplifier **23**, receiver **25** and power supply **24** are mounted. Sound tube **27** is connected at one end to an outlet (not shown) in the receiver **27** and at the other end to the tip 21_a, of the housing **21**. An outlet **29** is provided in the tip 21_a, for the transmission of sound to the inner ear. Vent tube **30** extends through the opening in the cover plate **22**.

In FIGURE 4 is shown a refinement of the subject invention. The cover plate **42** is provided with a threaded opening **44** therethrough said threaded opening **44** having a peripheral flange **45** extending therefrom on the inner face of cover plate **42**. A threaded plug **43** having an aperture **51** therethrough, said aperture of a diameter substantially smaller than the opening **44** is threadably received in threaded opening **44**. One end of vent tube **50** is shown secured to flange **45**. The other end of vent tube **50** extends to the tip of the housing (not shown).

Because venting the instrument increases the acoustical feedback somewhat, it is important that the size of the opening in the cover plate be held to a minimum while still performing its function of equalizing the pressure on either side of the instrument. With the present invention, a vent tube of standard diameter and length can be supplied with the instrument. Likewise, the threaded opening in the cover plate and the flange thereto can be standardized. The size of the opening **50** in the threaded plug can vary in order to meet the particular needs of the wearer.

In a specific embodiment of the present invention, the receiver is the Knowles Model BC 1520. Because there is a direct acoustical relationship between the frequency response and the length and diameter of the sound tube, a #17 tube, 1.75" in length has been found to provide the proper acoustical response with this particular receiver.

Obviously, with other receivers, the length and diameter of the tube may have to be changed for best results. The length of the tube may require that the sound tube be bent to some degree in order to fit the entire tube into the instrument. It is suggested that the tube be made to travel a tortuous path before terminating at the opening in the tip of the housing. This will also help to reduce acoustical feedback.

The sound or vent tube may be of a soft material, such as butyl or vinyl. However, such materials act to partially absorb the emitted sound. Sound absorption can be reduced using metallic tubing while retaining the desired frequency response.

The preceding description has been given for clearness of understanding only, it being understood that obvious modifications can be made while still remaining within the scope of the present invention.

What is claimed is:

1. In a self-contained hearing aid having a cover plate, a housing portion conforming to the concha and auditory canal of the ear for frictional engagement therein, a group of miniaturized components including a receiver, amplifier, microphone and power supply, and a flexible sound tube extending from said receiver to an outlet in the tip of said housing, the improvement comprising a flexible vent tube extending from an opening in said cover plate to said outlet in the tip of the housing, said flexible vent tube and said flexible sound tube joined to form a Y-shaped tube, the trunk of said Y-shaped tube extending to said outlet in the tip of said housing whereby the pressure is equal on either side of said self-contained hearing aid and said flexible vent tube may be cleaned by the insertion of a prod through said opening in the cover plate.

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