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HEARING AID WITH ADJUSTABLE SOUND INLET MEANS

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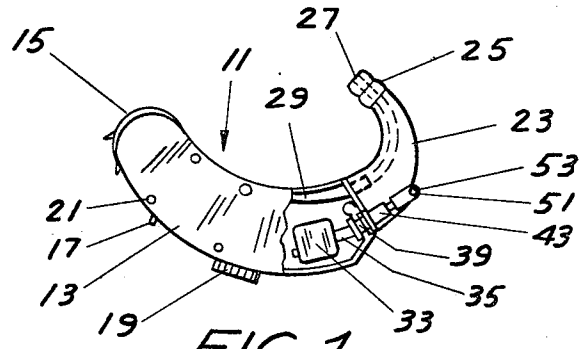



FIG. 1

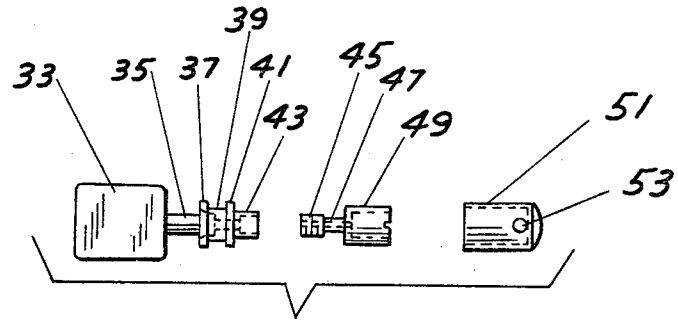



FIG. 2

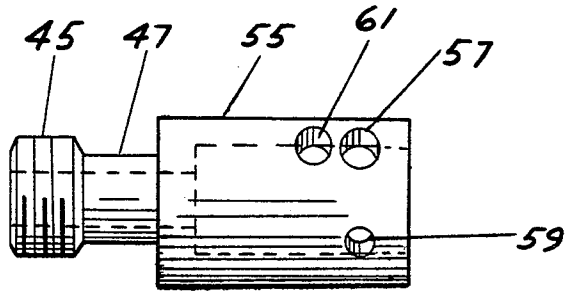



FIG. 4

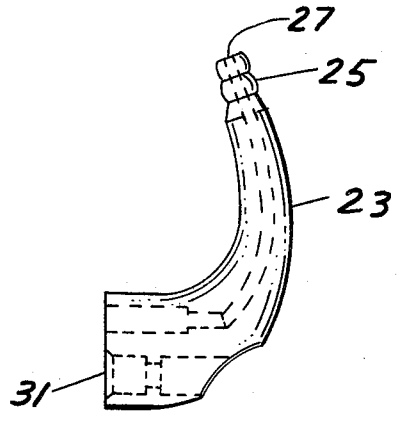



FIG. 3

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# HEARING AID WITH ADJUSTABLE SOUND INLET MEANS

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## ABSTRACT OF THE DISCLOSURE

This invention relates to a hearing aid and more particularly to a self-contained, behind the ear type hearing aid wherein the direction of the sound inlet opening may be changed by the wearer so as to improve his hearing ability while eliminating unwanted or unnecessary noises.

In hearing aids which are supported on the external ear, the sound inlet openings have normally been placed behind the ear, with the result that the wearer received sounds preferentially from the rear of his head. An example of such an aid is disclosed in Erickson U.S. Patent No. 2,882,348. Such arrangements were not completely satisfactory however because, while sound quality from behind the head was adequate, the reception of sounds from in front of the head was handicapped. Since human beings normally look toward the general direction of the source of a sound to which they are listening, such as a person speaking, the diminution of ability to satisfactorily hear such sounds proved annoying to the listeners as well as the speakers.

As one suggestion for correcting this deficiency, it was proposed to place the sound inlet opening in front of the ear so that there would be direct response to sounds which emanated from in front of the wearer. Devices for performing this function are disclosed in Vickerson U.S. Patent No. 3,045,073 and Guttner et al. U.S. Patent No. 3,209,080. Although devices such as these did provide a significant improvement, it was soon discovered that the concept of capturing the sound from forward of the hearing aid wearer presented a still new set of problems.

In prior hearing aids in which the sound inlet opening is forward of the wearer's ear, flow of air past the ear causes a whistling in the microphone of the aid which brings considerable discomfort to the wearer. Further, while the wavelength of sound is such as to cause considerable diffusion, it is desirable to simulate the directional characteristics of the ear to as great an extent as is feasible.

Accordingly, it is an object of this invention to provide a hearing aid which provides a directional response which approximates that of the ear while at the same time permitting attenuation of unwanted affects.

It is also an object to provide a hearing aid which can be worn on either ear of the wearer while producing an equal quality of sound regardless of the ear upon which it is worn.

Another object of the invention is to provide a means by which the hearing aid wearer may use the aid in comfort even when moving at a relative velocity to adjacent air.

It is an object hereof to provide a means for eliminating wind whistle when air is moving past the hearing aid user at a relatively high speed, such as when riding in an open car.

Another object of the invention is to provide an improved hearing aid in which the wearer may change the acoustic quality and frequency response by a mechanical



means which may be manually adjusted to his preference,

It is a further object of this invention that such means may also assist in regulating volume.

These and further objects and advantages of the invention will become obvious upon reference to the following specification, claims and drawings, wherein:

FIGURE 1 is a perspective view of a preferred embodiment of the invention, partially in section, showing the relationships of the parts in the appaartus;

FIGURE 2 is an exploded view of the sound inlet mechanism showing the details of the parts;

FIGURE 3 is a view of the hearing aid carrier which is utilized in this embodiment of the invention; and

FIGURE 4 shows a modification of one member of the sound inlet mechainsm.

Referring now to the details of the drawings, a hearing aid constructed according to the invention is shown generally at **11** in FIGURE 1, having a case **13** with an openable battery compartment **15**, an on-off switch **17**, and a volume control **19**. The case **13** contains the usual microphone, amplifier, battery, and receiver, and may be opened for access to such components by means of screws **21**. A carrier **23**, which holds the aid on the ear of the wearer, is attached to the case **13** by means to be described later. The carrier is molded to have a suitable connection joint **25** for attachment of a tube and earpiece (not shown). Sound is transmitted to the earpiece through sound channel **27** in carrier **23**. Sound channel **27** receives sound transmissions from a sound tube **29** which is inserted into the channel and extends through the case **13** from a receiver (not shown).

As shown in FIGURE 3, carrier **23** has a second channel **31** extending through a portion thereof which holds the sound inlet apparatus.

Referring again to FIGURES 1 and 2, a microphone **33** is disposed in the case **13** at a point near the mating surface of the case and carrier **23**. A section of tubing **35** connects the microphone with an inner sound inlet tube **39** which carries integral flanges **37** and **41** thereon. Tubing **35** is made of a highly flexible material, such as rubber, so as to avoid mechanical coupling of the microphone to the main structure or to other components.

The flanges **37** and **41** on the inner sound inlet tube **39** mate with similarly shaped receptive openings in the inner surfaces of the case **13** so as to hold tube **39** in a fixed position therein. A short extension **43** of tube **39** fits into channel **31** in carrier **23** at the point where the carrier **23** and case **13** meet. The free end of extension **43** extends into the channel up to the point of a small constriction in the channel which is shown in FIGURE 3.

An outer sound inlet tube **49** is inserted into the outer end of channel **31**. The tube **49** has a reduced portion **47** with a threaded end **45** which extends into extension **43** and mates with an internal thread therein. The threaded end **45** and the reduced portion **47** easily pass through the constriction in channel **31** allowing the larger section of tube **49** to abut the constriction. Thus, when means **43** and **45** are threadably mated, the carrier **23** is firmly held against case **13**. If desired, a small slot or kerf may be manufactured in the free end of tube **49** to facilitate the mating of extension **43** and the threads **45**.

According to the invention, a cap or closure member **51** is installed in the outer end of channel **31** so as to fit over the free end of the outer sound inlet tube **49**. The cap **51** is provided with a diametral sound inlet opening **53** which is outboard of the free end of tube **49** when the cap is inserted into channel **31**.

In normal usage, the hearing aid is placed with the carrier **23** over the ear of the wearer with a tube and earpiece (not shown) connected to sound channel **27** in carrier **23** and in place to deliver sound to the ear canal.

The sound inlet opening **53** in the cap **51** is then adjusted or positioned to open on the side of the carrier away from the head and with the axis of the opening parallel to the axis of the ear canal but in front of the ear, so as to enable the wearer to hear best the sounds which originate from in front of and beside him, thereby affording a close duplication of normal hearing.

It is a feature of the invention that the cap **51** may be rotated so as to change the axis of opening **53** manually or by inserting a suitable pointed tool into the opening and guiding the cap to a new position. Thus, by rotating the cap 180 degrees, the hearing aid may be worn with the same quality of sound reception on the other ear. In addition, if the wearer desires to prevent a rapidly moving air flow from causing a whistling in his hearing air, he may guide opening **53** to a position adjacent to rather than away from his head. This allows a high quality of sound reception, while at the same time eliminating the whistle. Upon decrease in air speed, such as in the stopping of an open car, the wearer can then quickly and easily return the opening **53** to its normal position.

In the device described, it is a still further feature of the invention that it is possible to vary the acoustic quality and volume of the hearing aid to suit the needs of the user by adjusting the size of the sound inlet opening **53**. An embodiment of the invention capable of conveniently accomplishing this is shown in FIGURE 4. Referring to that figure, a modification of the outer sound inlet tube is shown having an elongated portion **55** with a reduced portion **47** and a threaded portion **45**. On the free end of the sound inlet tube **55**, three apertures **57**, **59** and **61** are shown. When the cap **51** is placed over the tube **55**, it may be so placed that the opening **53** is outboard of the free end of the tube **55** or it may be guided so as to cooperate in the passage of sound to the microphone through a selected one of the apertures **57**, **59** or **61** which are preferably of various sizes. The selection of the aperture and the concentricity or degree of concentricity of opening **53** therewith depends upon the desires of the wearer with respect to acoustic quality desired and the volume transmitted to the microphone.

From the foregoing, it will be evident that this invention provides unique sound perception arrangement in a hearing aid which provides an optional quality of sound reception. As should be further evident, the sound reception is simply and readily adjusted to suit the specific needs and desires of the wearer. The described illustration of the hearing aid apparatus is susceptible to various modifications and changes within the spirit of the invention, including, of course, those of dimensioning, shape, and mechanical equivalents and expedients.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

**1.** A hearing aid including a battery, receiver, amplifier and microphone means therefor, sound conducting means connected to said microphone means, and sound



inlet means having at least one sound admitting aperture adjustable in position to face in any of a selected plurality of directions, said sound conducting means being connected to said sound inlet means for transmission of sound from said aperture to said microphone means.

**2.** A hearing aid as set out in claim **1** wherein said sound conducting means comprises hollow conduit means and wherein said aperture is provided in a closure member mounted on the end of said conduit means.

**3.** A hearing aid as set out in claim **2** wherein said closure member comprises a cylindrical cap mounted for rotation about its axis, said aperture being formed in the cylindrical wall of said cap whereby rotation of said cap causes the direction of said aperture to change.

**4.** A hearing aid as set out in claim **3** wherein the aperture in said cap is selectively adjustable into communication with a plurality of apertures associated with said conduit means.

**5.** A hearing aid as set out in claim **2** wherein said amplifier and microphone means are mounted in a case, a carrier mounted on said case for holding said case behind the ear of a wearer of said hearing aid, said conduit means extending through said carrier and said sound inlet means being mounted for movement thereon, said carrier having a sound outlet passage connectible to the ear of the wearer.

**6.** A hearing aid as set out in claim **5** wherein said carrier is curvate, said sound outlet passage and said conduit means extending through said carrier being adjacent one another at the point of connection of said carrier to said case, said sound inlet means being mounted closer to said case than the terminal end of said carrier.

**7.** A hearing aid as set out in claim **3** wherein said conduit means contains a plurality of apertures in its wall and the aperture in said cap is rotatable into concentric and eccentric relationships therewith.

**8.** In a hearing aid, a case to hold amplification circuitry, a carrier attached to said case for holding said case behind the ear of a wearer of said hearing aid, sound inlet means in said carrier for capturing and transmitting sound to said amplification circuitry, and means for rotating the axis of said sound inlet means from one side of said carrier to the opposite side of said carrier.

**9.** A hearing aid as set out in claim **8** wherein said sound inlet means includes a passage in said carrier, conduit means extending through said passage into said case, and a cylindrical cap mounted for rotation on said conduit means and partially enclosed in said carrier, said cap having an aperture in its cylindrical wall adjustable by rotating said cylindrical cap on its axis, said carrier including a sound outlet passage.

**10.** A hearing aid as set out in claim **9** wherein said conduit means contains a plurality of openings selectively alignable with the aperture in said cap.


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