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C. S. VICKERSON
BEHIND-EAR HEARING AID

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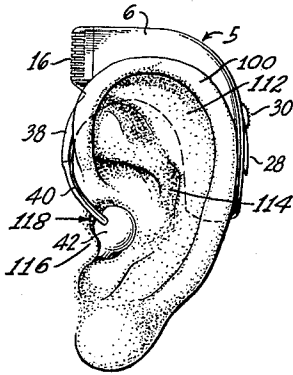


FIG. 1

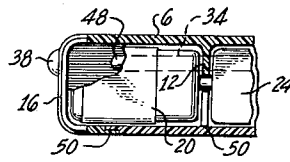


FIG. 3

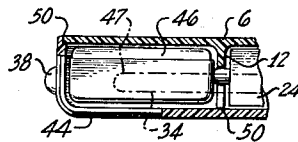


FIG. 4

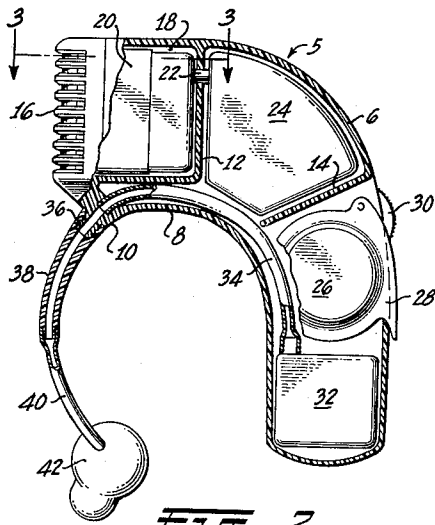


FIG. 2

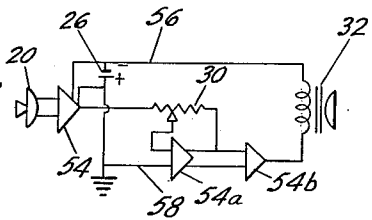


FIG. 5

INVENTOR:
CHARLES S. VICKERSON
BY *Eckhoff and Blair*
ATTORNEYS

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BEHIND-EAR HEARING AID

Charles S. Vickerson, 26 O'Farrell St.,
San Francisco, Calif.

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1 Claim. (Cl. 179-107)

This invention relates to a hearing aid and more particularly a self-contained hearing aid which is wholly supported on the ear of the wearer. Self-supporting hearing aids have been proposed in the past, but have not been fully satisfactory. On-the-ear hearing aids which have been proposed in the past generally have comprised a chamber containing the microphone, amplifier, battery, transducer and associated equipment of such configuration that they are supported by a relatively thin member over the top of the ear, the bulk of the aid lying behind the ear and portions of it extending below the lobe of the ear. Such aids have a number of defects. In the first place, it is necessary to locate the microphone at some point behind the ear canal so that the microphone is fully or partially shielded by the ear and body of the wearer. In many instances, such as in a restaurant, such an aid will do a good job of picking up sounds coming from the rear, but the wearer will be unable to hear persons sitting across from him. A further defect is that such an aid has a relative small member above the ear while the bulk of the aid is behind the ear, putting a considerable amount of pressure on the ear and leading to sore ears. Still another defect of such devices is that they are quite conspicuous when worn by women. Normal hair styles frequently come to the ear canal, but it is difficult to provide a suitable hair style which extends a substantial distance below the lobe of the ear which is necessary to conceal such devices.

In accordance with the present invention, a hearing aid device is provided which is battery operated and which is balanced on top of the ear. The device has a microphone which faces substantially forward so that sounds coming from the front of the wearer are most readily picked up and amplified. Further, the device of the present invention extends only about half-way down the height of the ear and little, if any, below the ear canal. Thus, the device is particularly inconspicuous when worn by women.

Other objects and features of advantage of the present invention will be brought out in the balance of the specification which follows.

In the drawing forming part of this application:

FIGURE 1 is a perspective view of a preferred embodiment of the present invention showing its use on a wearer.

FIGURE 2 is an enlarged view, partly in section, of the hearing aid shown in FIGURE 1.

FIGURE 3 is a partial sectional view on the lines 3-3 of FIGURE 2.

FIGURE 4 is a partial sectional view, similar to FIGURE 3, showing an alternate microphone and grill location.

FIGURE 5 is a schematic diagram of the electrical connections.

Referring now to a description of the drawing by reference characters, the hearing aid is generally designated 5 and has an arcuate case fitting between the head of the wearer and the top and rear of the helix 100 and fossa 112 of the helix of the ear of the wearer. The case has a front portion 16 extending only about as far forward as the forwardmost portion of the helix of the ear and has a bottom portion which extends down no farther behind the helix and antihelix 114 of the ear than the level of the tragus 116 of the wearer. The bottom wall of the case 8 is rounded to conform to the ear shape of the normal wearer. The case is divided internally into a

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plurality of compartments formed by a series of bulkheads 12 and 14 which serve to isolate the various components and also to strengthen the case. In the area designated 16, there is shown one or more generally horizontal openings or a grillwork permitting sound to enter. This is located immediately above the forwardmost portion of the helix 100 to permit sound to pass into the case. The rigid, hollow tube 10 passes downwardly in a generally vertical direction adjacent the forwardmost portion of the helix in the direction of the orifice of the external auditory meatus 118, the tube serving to carry sound toward the ear canal and to anchor the hearing aid in place.

In the front compartment 18 there is a microphone 20 which is positioned immediately behind the aforementioned horizontal opening in the front of the case. The microphone is provided with circuit connector 22 leading to the amplifier 24 which is in the compartment immediately behind the compartment housing the microphone. The amplifier may be of any conventional type. A suitable battery 26 and a battery holder 28 are provided. The volume control having a knob 30 extending partially out of the case for manual operation is conveniently provided with a suitable on-off switch as may be the battery holder 28. Electrical connectors also join the battery compartment and the volume control to the amplifier.

The amplified signal from the amplifier is led to the transducer 32 which is preferably located as shown near the bottom of the unit. The transducer is provided with a hollow sound-conducting tube 34 which provides communication between the transducer and the rigid, downwardly-extending tube 10 on the front of the case, whereby to convey sound from the transducer to the rigid, downwardly-extending tube. The hollow tube 34, which is preferably of a soft, resilient nature such as polyethylene, passes immediately adjacent and beneath the microphone as does the uppermost end of rigid tube 10, the latter being provided with a threaded connection 36 to which is connected a hollow, flexible tube 38 extending downwardly from the front of the case to about the level of the tragus. The lowermost end of the tube 38 has somewhat more flexible plastic tube 40 leading to the ear mold 42 which may be inserted in the ear orifice. The tube 38 can be bent with the slight application of heat and will retain the position to which it is bent so that it can be bent to secure a good fit on any particular wearer.

Although the grill is preferably located directly in front of the aid, it can be located partially on the front and partially on the side as is the grill 44 shown in FIGURE 4. In this case, the microphone may be mounted sideways in the unit as at 46 lending itself to the production of extremely compact aid.

It has been found, surprising enough, that the soft tubing confines the sound in such a manner that there is no feed-back from the amplified sound in the tube 34 to the microphone 20 despite the fact that the tube 34 passes directly beside or under the microphone. Further, the fact that the tubing forms a smooth curve prevents standing waves and/or reflections. Although the sides of the case may be made essentially flat, so that the aid can be used on either the right or the left ear, the aid can be contoured to provide a better fit with the side of the head in which case right and left-hand aids are preferably provided. The sound conducting tube may be located near the center of the device, as at 47, or may be to one side, as at 48. The case is preferably made in two mating sections for ease of assembly and servicing and may separate as in the line 50.

A suitable circuit diagram is shown in FIGURE 5. The electrical signal from microphone 20 passes to the two-stage amplifier 54. Battery supply 26 is provided with

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conductors 56 and 58 and is applied to the first stage of the output section (transistor-amplifier stage 54a) and amplified in the second stage (transistor-amplifier stage 54b) before being applied to the transducer 32. The volume control 30 is of the feedback type, which is the reason for indicating it as connecting between 54a and 54b in FIGURE 5.

Although the exact arrangement of parts shown is preferred, the exact configuration need not be employed so long as the microphone is mounted somewhere toward the front of the unit and the bulk of the unit rests on top of the ear. Thus, the position occupied by the amplifier, battery, volume control and transducer can be transposed as desired, or the amplifier and transducer may occupy the same compartment.

Obviously many modifications and variations of the invention as hereinbefore set forth may be made without departing from the spirit and scope thereof, and therefore only such limitations should be imposed as are indicated in the appended claims.

I claim:

A self-contained hearing aid adapted to be supported by the ear of the user, said aid, when in use in a normal upright position comprising:

- (a) an arcuate case fitting between the head of the wearer and the top and rear of the helix and fossa of the helix of the ear of the wearer and having a front portion extending only about as far forward as the forwardmost portion of the helix of the ear, said case having a bottom portion extending downwardly behind the helix and antihelix of the ear to a level not lower than the level of the tragus of the wearer;
- (b) a plurality of compartments in the said case formed by a series of bulkheads therein;
- (c) at least a single generally horizontal aperture at the front of said case immediately above the forwardmost portion of the helix to permit sound to pass into said case;
- (d) a rigid hollow tube on the front of the said case,

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said tube passing downwardly in a generally vertical direction adjacent the forwardmost portion of the helix in the direction of the orifice of the external auditory meatus, said tube serving to carry sound toward the ear canal and to anchor said hearing aid in place;

- (e) a microphone in the said case immediately behind the said horizontal opening in the front thereof;
- (f) an amplifier in one of the said compartments formed within the said case;
- (g) a volume control in another of the said compartments, said volume control having a control knob extending partially out of the said case for manual operation;
- (h) a transducer in another of the said compartments rearwardly of the said first compartment, said transducer having a hollow sound conducting tube providing communication between the said transducer and the said rigid downwardly leading tube on the front of the said case whereby to convey sound from the said transducer to the said rigid downwardly leading tube, said hollow sound conducting tube from the said transducer passing immediately adjacent and beneath the said microphone;
- (i) a hollow flexible tube extending from the said rigid downwardly leading tube in the front of the said case to about the level of the said tragus;
- (j) an ear mold secured to the end of the said flexible tube adjacent the said tragus for insertion in the said orifice;
- (k) and circuit connectors joining said microphone, amplifier, volume control and transducer.

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