United States Patent

[11] 3,598,928

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[54] IN EAR HEARING AID WITH REMOVABLE MOUNTING PLATE ASSEMBLY
7 Claims, 7 Drawing Figs.

[52] U.S. Cl. ..... 179/107 E, 200/166 PC
[51] Int. Cl. H04r 25/02
[50] Field of Search ..... 179/107 R, 107 E, 107 BC, 107 H, 107 S, 178, 179; 317/101 CC; 200/166 PC, 168 C

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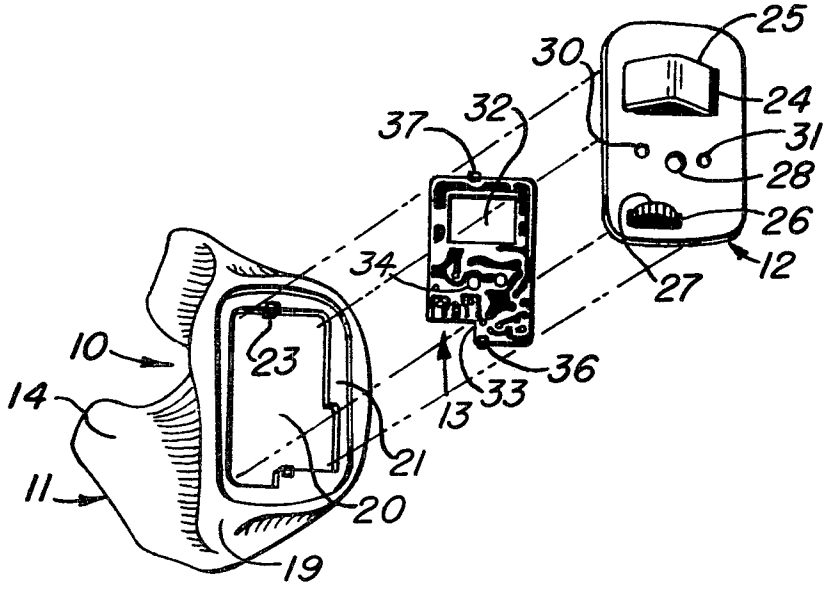
ABSTRACT: A customized hearing aid configurated in part to conform actuarately to the contours of the ear canal of a person using the aid, and adapted to be contained entirely within his ear. The hearing aid includes a hollow casing having a customized body portion molded to conform to the users ear and provided along one side with a face having a standardized opening therein, it further includes a mounting plate assembly comprising a cover plate and a circuit board secured thereto and standardized to seat within such opening in the face of the casing, and it also includes contact retainers carried by the mounting plate assembly and respectively cooperative with terminals attached to the casing to releasably secure the assembly thereto in a mechanical sense and, at the same time, electrically connect a speaker element mounted within the casing to the amplifier and microphone elements carried by the faceplate and circuit board assembly, thereby enabling a customized hearing aid that is inoperative because of any one of the usual repair problems to be returned to the user in operative condition in a matter of moments simply by removing the standard cover plate and circuit board assembly from the casing and replacing it with another such assembly.



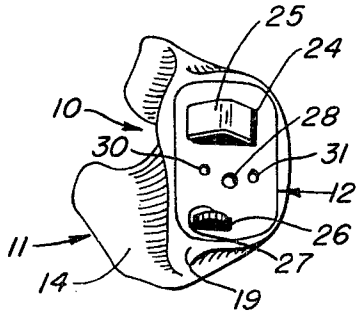


Fig. 1

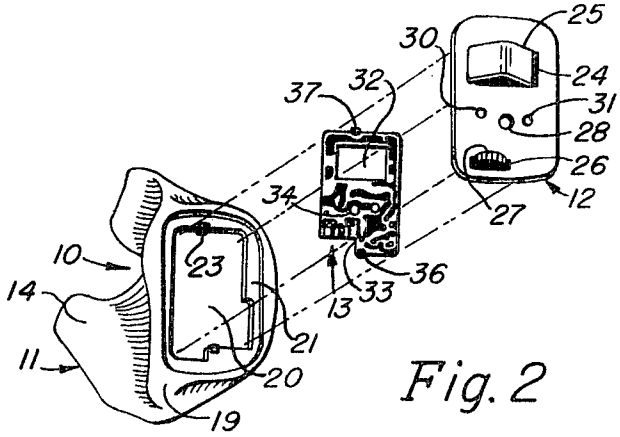


Fig. 2

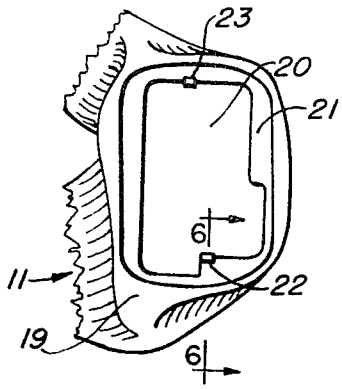


Fig. 3

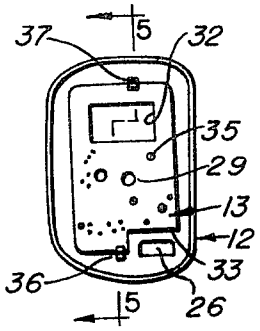


Fig. 4

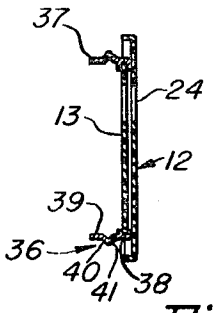


Fig. 5

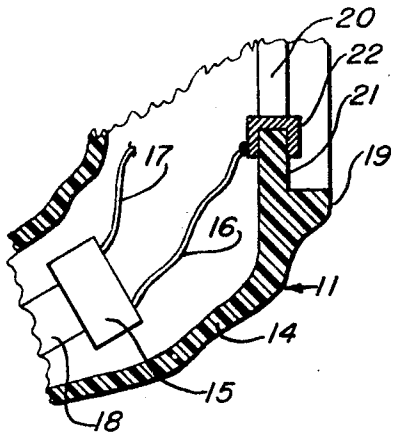


Fig. 6

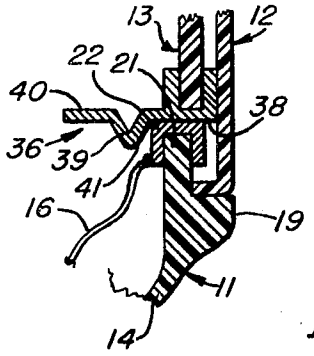


Fig. 7

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IN EAR HEARING AID WITH REMOVABLE MOUNTING PLATE ASSEMBLY

This invention relates to a hearing aid and, more particularly, to a customized hearing aid that is specially formed to fit the contours of the ear canal of a user and to be carried entirely within the confines of his ear.

Hearing aids, like other mechanisms and devices, often need repair, and because of their technical character and especially the small size thereof repair is often difficult to accomplish except by carefully trained technicians which are not so numerous that they are to be found at all of the retail sales and service centers for hearing aids. With standardized hearing aids worn essentially along the outside of the ear the severity of the repair problem is minimized somewhat because the user may rent or borrow a replacement aid (sometimes known as "loaners") to use during the interim that his own defective aid is being repaired.

However, with customized hearing aids, which are located almost entirely within the ear of the user and are sometimes referred to as "all-in-the-ear" hearing aids, this procedure cannot be fully realized because each aid is personal to the user in the sense that it is carefully molded or otherwise formed to tightly fit the contours of his ear and ear canal. Evidently then, the use of a loaner or substitute is not completely satisfactory because if it is available at all it would not be physically comfortable to wear and would be quite prone to produce whistling or howling noise because of its lack of good fit with the ear canal of the user. With customized hearing aids then, it has been common for the user to experience great inconvenience whenever his hearing air malfunctions and requires repair.

In view of the foregoing an object, among others, of the present invention is to provide an improved hearing aid that can be quickly and easily repaired by means of components interchange by relatively inexperienced personnel without the use of tools or any special equipment. Another object of the invention is that of providing an improved customized hearing aid adapted to be worn within the ear of a user, and which aid has a casing component that is specially made and configurated to conform to the ear canal and general ear contours of the user, and also has standarized components constituting substantially all of the functional circuit elements of the hearing aid and which standardized components are readily removed from the casing component and replaced with their equivalent, thereby providing a means for repairing in a moment and while the customer waits the vast majority of the malfunctioning elements of hearing aid.

Still another object is in the provision of an improved customized hearing aid of the character described in which the standardized components thereof snap into the customized casing component when assembling the hearing aid and snap-release therefrom when disassembling the aid; the customized casing component being equipped with fixed terminals electrically connected with circuit elements mounted within the casing component, and the standardized, removable components being equipped with resilient or springlike contact retainers electrically connected with circuit elements carried by the standardized components and respectively cooperative with the terminals of the casing to mechanically secure the standardized components thereto and, at the same time, establish an electrical connection between the contact retainers and terminals. Additional objects and advantages of the invention, especially as concerns particular features and characteristics thereof, will become apparent hereinafter.

An embodiment of the invention is illustrated in the accompanying drawing in which:

FIG. 1 is a perspective view of an assembled hearing aid embodying the present invention;

FIG. 2 is an exploded perspective view illustrating in spaced-apart relation the main components comprising the assembled hearing aid shown in FIG. 1;

FIG. 3 is a broken top plan view of the casing component of the hearing aid with the mounting-plate assembly removed;

FIG. 4 is a bottom plan view of the mounting plate assembly which includes both an outer mounting plate component and inner circuit board component carried thereby;

FIG. 5 is a vertical sectional view taken along the line 5–5 of FIG. 4;

FIG. 6 is a enlarged, broken vertical sectional view taken along the line 6–6 of FIG. 3; and

FIG. 7 is an enlarged vertical sectional view generally similar to that of FIG. 6 but showing the mounting plate assembly in position on the casing.

As indicated hereinbefore, the present invention is particularly concerned with customized hearing aids which are intended to be inserted into the ear canal of the user and, therefore, require a casing component that is at least in part custom made to conform to the contours of the user's ear canal. Such hearing aids are sometimes referred to as "all-in-the-ear" hearing aids, and they are quite personalized in the sense that the casing component thereof is specially constructed to closely fit the contours of the particular individual being provided with the aid. In the usual case, the required fit is obtained by first taking an impression of the interior of the user's ear and ear canal, thereafter making a mold from the impression, and finally forming the casing from such mold. It may be observed that the technique for fabrication of such custom-made casings for hearing aids is old and well known in the art and per se forms no part of the present invention. However, the casing component insofar as it is concerned with the present invention will be described.

An entire customized hearing aid is shown in FIG. 1 in its assembled condition and in FIG. 2 with the components thereof oriented in spaced-apart relation. Such hearing aid is denoted in its entirety with the numeral **10**, and it includes the aforementioned custom-made casing component **11**, and outer cover or mounting plate component **12**, and an inner circuit board component **13** adapted to be secured to the plate **12** as shown best in FIGS. **4**, **5** and **7**. The casing **11**, as heretofore stated, is custom made so as to fit the ear contours of the particular user of the hearing aid, ans it may be formed conventionally, usually of a thermosetting plastic material. As shown in FIGS. **1**, **2** and **6**, the interior of the casing **11** is hollow and the customized body thereof includes an elongated portion **14** intended to project for a considerable distance into the ear canal of the user.

Mounted within that hollow projection **14**, which has an opening at its outer extremity, is a speaker element by means of which amplified sound is transmitted along the ear canal of the user. The speaker is a conventional element and includes a head **15** through which the electric connections are made via thin wire conductors **16** and **17**, and an elongated hollow transmission tube **18** extending along the interior of the casing projection **14** to the open end thereof. The speaker **15**, **18** is ordinarily encapsulated in a resilient material such as rubber which both protects the element and attenuates extranious sound.

The casing **11** is provided with an outer face **19** having a large central opening **20** therein defined and bordered by a downwardly stepped ledge **21** dimensioned to accommodate the mounting plate assembly **12**, **13** so that the outer surface thereof effectively forms a continuation of the face **19** of the casing, as shown in FIGS. **1** and **7**. Referring to FIGS. **3** and **6**, it will be observed that a pair of U-shaped terminals **22** and **23** are secured to the ledge **21** at spaced-apart locations therealong which, in the specific embodiment of the invention being considered, are along the opposite ends of the openings **20** and are slightly offset from the center thereof in opposite directions for the reasons explained hereinafter. The terminals **22** may be formed of various materials such as spring steel coated or plated with gold to provide a good electric conductor, and they simply slip over the ledge **21** and are clamped thereto by their inherent resilience. However, a more positive securance of the terminals to the ledge may be afforded if this

is desired, as by means of an inadhesive bond therebetween. The conductors **16** and **17** are respectively soldered or otherwise connected electrically to the terminals **22** and **23**.

The shape and size of the opening **20** and ledge **21** thereabout is fixed or established for all hearing aids **10**, thereby enabling standardized cover plates **12** to be seated therein irrespective of the particular custom shapes or contours of the casing **11**. Accordingly, the cover plate **12** is shaped and dimensioned to fit the standardized opening **20**, **21**, and it is a thin planar component, as is most evident in FIGS. **5** and **7**. Adjacent one end, the plate **12** is provided with an opening or void **24** of relatively large dimensions in which is pivotally mounted a switch-battery holder **25** movable through the plane of the plate from a completely closed inner position shown in FIGS. **1** and **2** in which the hearing aid is "off" or inoperative to a first outer position in which the hearing aid is "on" or operative, and finally to a second outer position in which the small energizing cell or battery carried by the member **25** is exposed and can be removed for replacement.

Adjacent its opposite end, the plate **12** is provided with a smaller opening or void **26**, and a volume control knob **27** projects therethrough so as to be conveniently available for adjustment by the user of the hearing aid. Centrally, the plate **12** has a small circular opening or port **28** associated with a microphone or pickup **29** (FIG. **4**) that receives the sound energy to be amplified by the hearing aid and then transmitted to the inner ear via the speaker **15**, **18**. Adjacent the port **28** are a pair of smaller openings **30** and **31** the first of which is adapted to receive a screw used to mechanically attach the circuit board **13** to the plate **12**, and the second of which is adapted to pass a screwdriver therethrough to accommodate adjustment of a variable resistance (not shown) in the power circuit of the hearing aid.

The circuit board **13** is simply a printed circuit board having most of the conductors printed or otherwise formed along one side thereof, as shown in FIG. **2**, such side being in contiguous relation with the plate **12** when the board **13** is secured thereto. Most of the circuit components associated with the conductors are mounted upon the opposite side of the board **13**, as is indicated in FIG. **4**, including the aforementioned audio pickup or microphone **29**. Adjacent its upper end, the board **13** has a relatively large opening or void **32** formed therein that corresponds dimensionally to the opening **24** in the plate **12** and is adapted to cooperate therewith and with the movable switch-battery holder **25**. Along its lower edge the board **13** has a cutout or notched area **33** that accommodates the volume control knob **27** and provides a mounting therefor (the volume control and knob **27** disassociated from the board **13** in FIG. **2**). In this same respect, it may be observed that for purposes of convenience and simplification certain of the circuit components are omitted in FIGS. **5** and **7** and omitted in part in FIGS. **2** and **4**. However, as respects the circuitry and the association thereof with the board **13** and plate **12**, it may be considered completely conventional and, for example, such an arrangement is sold by Phonic Electronics, Inc. of Concord, California under the brand name "Concordette."

The board **13** also has a central port **34** alignable with the sound port **28** in the plate **12** when the plate and board are secured to each other by means of a screw **35** (FIG. **4**) that extends through the opening **31** in the plate **12** and into an opening provided therefore in the board **13**. Attached to the board **13** at spaced-apart locations therealong are a pair of contact retainers **36** and **37** each of which has a U-shaped end portion **38** (FIG. **7**) adapted to slip over and resiliently grip the board **13**. As in the case of the terminals **22** and **23**, the contacts **36** and **37** may be spring steel elements plated with gold so as to form a good electric connection with the appropriate printed conductors along the board **13** and with the respective terminals **22** and **23** when in engagement therewith, as shown in FIG. **7**. The inherent resilience of the contact retainers **36** and **37** may be relied on to firmly anchor the same to the board **13**, or other suitable means may be used to reinforce such anchorage such as rivets, soldering, and the like.

As is most evident in FIG. **7**, the contact retainers have a retention segment **39** projecting laterally outwardly so as to underlie the associated terminal and thereby mechanically anchor or constrain the mounting plate assembly comprising the plate **12** and board **13** in position within the casing **11**, as shown in FIGS. **1** and **7**. Since it is necessary to remove such assembly and replace the same from time to time, each such retention segment **39** is provided with a cam surface **40** that is operative to displace the contact inwardly to enable the segment **39** to move past the terminal during insertion of the assembly into the casing. Analogously, a cam surface **41** is also provided along each segment **39** to facilitate removal of the assembly from the casing by displacing the contact inwardly as the assembly is withdrawn from the casing.

From the foregoing, it will be evident that a defective or inoperative hearing aid **10** can be quickly and easily repaired without tools and by inexperienced and untrained personnel simply by grasping the plate **12**, as by means of the switch **25** affixed thereto, and pulling the plate outwardly from the casing. Sufficient force applied in this manner simply cams the contacts **36** and **37** inwardly to permit the same to pass over the respectively associated terminals **22** and **23**. The withdrawn and defective assembly comprising the plate **12** and board **13** is simply replaced by a new assembly which is snapped into position by application of a compressive force applied across the casing **11** and assembly sufficient in magnitude to cause the contacts **36** and **37** to be cammed inwardly and thereby pass over the terminals **22** and **23**.

The contact retainers **36** and **37** not only connect the assembly **12**, **13** to the casing **11** mechanically, they also electrically connect the terminals **22** and **23**, and therefore the speaker **15**, **18** to the amplification circuit. Accordingly, it is unnecessary to electrically connect by solder means or otherwise any of the lead wires or conductors of the hearing aid circuit during such removal and replacement of the cover plate **12** and circuit board **13** attached thereto. Evidently, the repair of any particular hearing aid **10** can be accomplished quickly and easily while the user waits, thereby obviating all immediate service problems, eliminating the need for loaner aids to accommodate the user during long-interval repair periods, and reducing to a negligible consideration the time that must be invested by users for necessary repair of their hearing aids.

The terminals **22** and **23** are offset in opposite directions relative to the centerline of the cover plate **12**, and such offset is advantageous in that it permits the cover plate and circuit board **13** to be tipped or canted slightly during insertion and removal thereof from the casing, thereby facilitating movement of the contact retainers **36** and **37** past the ledge **21**. It may also be noted that the contact retainers **36** and **37** tend to be clamped in position by being confined between the juxtaposed plate **12** and board **13**.

While in the foregoing specification and embodiment of the invention has been described in considerable detail for purposes of making a complete disclosure thereof, it will be apparent to those skilled in the art that numerous changes may be made in such details without departing from the spirit and principles of the invention.

What I claim is:

1. In an electric hearing aid, a casing having a hollow interior provided therein with a circuit element equipped with a plurality of conductors and having also along one side thereof a face provided with a relatively large opening adapted to seat a mounting plate assembly therein, a mounting plate assembly equipped with circuit elements requiring connection with said first-mentioned element via the conductors thereof and being seated within said opening, a plurality of terminals respectively connected with said conductors and being fixedly secured to said casing at predetermined locations adjacent said opening thereof, and a plurality of contact retainers respectively connected with certain of said second-mentioned circuit elements and being fixedly secured to said mounting plate assembly at predetermined locations respectively aligned with said terminals and being in engagement therewith, said contact retainers both releasably securing said mounting plate as-

sembly mechanically to said casing and electrically connecting said second-mentioned elements to said first-mentioned element via said terminals and conductors.

2. The hearing aid of claim 1 in which said casing is provided with a ledge along said opening offset inwardly from said face and adapted to seat said mounting plate assembly thereon, said terminals being secured to said casing along said ledge at spaced-apart locations, each of said contact retainers being a resilient device having a laterally projecting segment underlying said ledge when said mounting plate assembly is seated thereon.

3. The hearing aid of claim 2 in which said terminals comprise a pair thereof respectively located along opposite ends of said opening and offset in opposite directions relative to a centerline therethrough.

4. The hearing aid of claim 2 in which each of said contact retainers is provided with oppositely oriented cam surfaces adjacent the projecting segment thereof to displace the same over said ledge during insertion and removal of said mounting plate assembly from said casing.

5. The hearing aid of claim 4 in which each of said terminals is a U-shaped member grippingly engaging said ledge.

6. The hearing aid of claim 5 in which said mounting plate assembly includes a cover plate generally aligned with the face of said casing and a circuit board attached to said cover plate, said contact retainers being secured to said circuit board.

7. The hearing aid of claim 6 in which each of said contact retainers has a U-shaped base grippingly engaging said circuit board.