Nov. 21, 1967 B. E. McDERMAID 3,354,271

SEALED HEARING AID

Filed Feb. 28, 1964

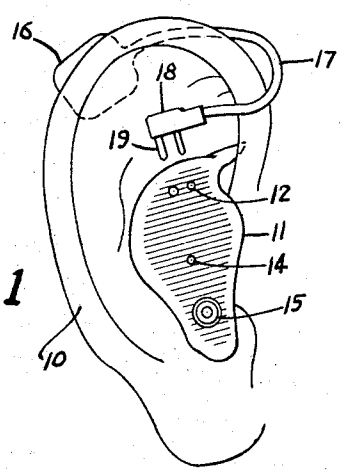


FIG. 1



FIG. 2

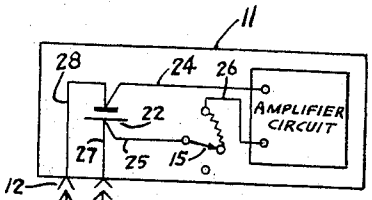


FIG. 3

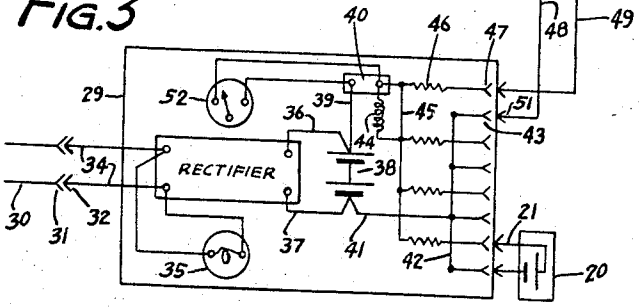


FIG. 4

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United States Patent Office 3,354,271 Patented Nov. 21, 1967

3,354,271

SEALED HEARING AID

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Filed Feb. 28, 1964, Ser. No. 348,068
3 Claims. (Cl. 179—107)

ABSTRACT OF THE DISCLOSURE

A self-contained hearing aid in a case which may be placed within the human ear. The hearing aid contains provision for insertion of a polarized plug from an external power source or from a charging circuit which is adapted to charge the hearing aid while it is in use.

Background of the invention

This invention relates to hearing aids and specifically to a hearing aid in which the power source is sealed into the case and is of the rechargeable type. The novelty of this particular structure resides in the fact that the circuit and arrangement is such that the battery within the hearing aid may be charged while the hearing aid is in use as a hearing aid. This is accomplished by having the battery charging circuit and the hearing aid using the battery connected in parallel to each other and is further enhanced by a charging circuit which employs structures within it that eliminate the hum normally associated with a rectified alternating current charging source.

Historically, hearing aids have been moving in the direction of smaller and smaller components and ones which are less and less obvious to the casual observer, beginning with fairly inconspicuous wires leading to small ear plug type receivers from a clothing supported container for the power source and amplifier. Later, as smaller components were evolved they were placed in spectacles and in small devices supported on the ear and the like. This general trend has led to what are known as ear mold hearing aids. Ear mold hearing aids are units constructed to fit in the ear of a particular user, molded in much the same way as dentures are molded to fit the cavity in which it is placed for use. After the basic mold is cast for a particular person the mold is hollowed out as much as the shape of the mold allows in order to receive the hearing aid circuit within it. The size and shape of potential cavities inside of such ear mold varies of course with the size and shape of the ear in which the mold fits. In general, however, these ear mold cases are more restricted than other forms.

In hearing aids of the type supported behind the wearer's ear or in eye glasses having oversized temples which receive the hearing aid structure, it was quite possible to make a battery drawer that could be pulled out so that fresh batteries could be inserted in it as desired. Batteries used in such aids could either be of the dry cell type or the rechargeable type which are now becoming so popular. In the latter case, the batteries not being used are placed on a charger to be revitalized. With the advent of the ear mold type of hearing aid, however, the cavity that can be provided within the hearing aid case is so restricted as to make a removable battery drawer impractical. In many cases it is totally impossible. Accordingly, the only way these devices can be made is with a rechargeable battery that is sealed in the unit. Because the mechanism is sealed inside the case, the battery must be connected to a source of charging power while it remains in the case. This is accomplished through an opening in the case which, with an opening for sound to reach the microphone of the hearing aid, provide the only access to the inside of the case. The ear mold type

of hearing aid has been provided in the past, but heretofore it was constructed in such a way that the charging circuit was usable only when the hearing aid was turned off. In addition, the charging structures provided for the hearing aid were of such a nature that the hearing aid could only be charged when removed from the ear of the user, at least from a practical point of view. The structure of this invention avoids these difficulties.

Furthermore, rechargeable batteries while generally speaking are desirable, have one drawback which is a wide variation in discharge time characteristic. Regardless of how carefully these batteries are made, there can be a substantial variation in the length of time during which they can supply useful energy to operate a hearing aid. For example, some may discharge in as little as five hours while others may run hearing aids satisfactorily for nine or ten hours. Accordingly, it is quite possible for a sealed in battery in a hearing aid to be inadequate during a normal day's use without some period of recharging during the day. The invention herein presented solves this problem also.

Accordingly, it is the main object of this invention to provide a novel sealed hearing aid structure.

It is a further object to provide a sealed hearing aid in which an external source of power may be applied while the aid is in use.

It is a further object of this invention to provide an improved hearing aid structure of the sealed in battery type in which use of the hearing aid may continue while the battery in the aid is being charged.

It is a still further object of the invention to provide a hearing aid structure charging device in which fidelity of sound reproduction by the hearing aid is not altered while charging is taking place.

It is yet another object of this invention to provide an external emergency source of power for sealed hearing aids.

Other and further objects of the invention are those inherent and apparent in the apparatus as described, pictured and claimed.

To the accomplishment of the foregoing and related ends, this invention then comprises the features hereinafter fully described and particularly pointed out in the claims, the following description setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principles of the invention may be employed.

The invention will be described with reference to the drawings in which corresponding numerals refer to the same parts and in which:

FIGURE 1 illustrates the hearing aid device in place in an ear with one form of external power source positioned as it would be in use except the connector is not engaged;

FIGURE 2 is a modified form of external power source;

FIGURE 3 is a wiring diagram showing the charging unit and hearing aid structure and external power source interconnected in a manner as if in actual use; and

FIGURE 4 is a plan view of the charging unit with several different interconnections between the unit and batteries to be charged drawn to a reduced scale in comparison to FIGURES 1 and 2 with portions of electrical leads eliminated to conserve space; broken lines illustrate a location of the place where an external power source could be placed for recharging.

Referring first to FIGURE 1, a representation of an ear as shown at **10** within which is supported an ear fitting molded hearing aid case **11**. The hearing aid case is sealed with the exception of the opening for the connector means as at **12** and the opening **14** which permits

access of sound to the microphone. A combination off-on switch and volume control 15 permits the operator to control his hearing aid. These are all the visible parts of the hearing aid as it is normally used.

Whenever the hearing aid is used, more or less constantly, for a period in excess of five to ten hours, the battery sealed in the case of the hearing aid is incapable of continuing to supply necessary power to the hearing aid circuit. Under these circumstances a separate battery may be used as an external power source. In one form this external power source is the encapsulated battery, the case of which appears at 16 tucked behind the ear 10. Any suitable wiring 17 connects the battery to a polarized connector 18. Any form of polarized connector my be used and is here shown as having prongs 19 with the one to which the lead line extends larger than the other prong. Contrarily, the connector opening from which lead line to the numeral 12 extends is smaller than the other opening. By this structure, the connector 18 may be associated with the hearing aid connector 12 in only one way. In this manner it is assured that the battery external power source will be connected into the circuit in the same manner as the battery encapsulated in the case 11.

In FIGURE 2 a different form of encapsulated battery is shown with the case 20 and the connector prongs 21. In this form the wires are eliminated. Again the connector prong to which the lead line 21 extends will be observed to be of a larger diameter than the other prong, whereby the encapsulated battery will again be polarized with respect to the circuit of the hearing aid. As these units are illustrated approximately full size, it is clear that one or more of these batteries may be carried in a pocket or purse with ease. At any time the battery sealed within case 11 becomes too weak to operate the hearing aid normally, an outside power source such as the encapsulated battery unit 16 or the encapsulated battery 20 may be engaged in the polarized plug 12 and thereby supply another five to ten hours of useful life to the hearing aid.

In FIGURE 3 the internal circuit of the hearing aid which has its case designated 11 and is represented by the lines surrounding the hearing aid is novel in only one respect. The amplifying circuit of the aid, for example, is not claimed to be inventive in this instance and is represented simply by the square bearing the legend "Amplifier Circuit." The sealed in battery represented by the customary symbol and identified as 22 is connected to the hearing aid circuit via any suitable electrical circuit components such as leads 24 and 25, the switch 15 and the circuit member or lead 26. The battery is also connected to its polarized connector 12 by any suitable circuit members such as leads 27 and 28.

Also shown in FIGURE 3 is the charger having a suitable case 29 within which is the main charging unit such as a rectifier of any suitable sort here represented simple by an oblong and bearing the legend "Rectifier." The rectifier is connected to an ordinary source of power diagrammatically represented at 30 as being the leads from a 120 volt 60 cycle AC source and connected to a female outlet 31 into which is plugged the male outlet 32 of the connecting cord 34 which leads to the rectifier. A pilot light 35 is connected in parallel across rectifier power leads so that it will glow whenever the rectifier is in use.

The DC terminals of the rectifier are connected by suitable circuitry components such as leads 36 and 37 to a pair of batteries 38. Batteries 38 are connected in series with each other to provide a voltage double that of a single battery such as used in hearing aids. The balance of the charger circuit is connected in parallel in effect to the charging unit.

Lead member 39 for example extends from the negative side of the battery to an ammeter shunt 40 and a similar circuit lead 41 connected to the positive side of the battery to the positive buss bar 42 which in turn is connected to a series of positive half of polarized connectors such as that indicated at 43 by relatively narrow V marks. Shunt 40 is connected by way of a resistance coil 44 to a negative buss 45 which in turn is connected via a series of voltage dropping resistors 46 to the negative halves of polarized connectors represented by the relatively broad V marks such as the one 47. Leads such as those represented at 48 and 49 are supplied with polarized male connectors such as the narrow V marks representing negative ones at 50 and 51 for lead 48 which match female negative connectors 12 and 43, for example. The lead 49 is provided with broad V connector symbol to match the polarized connector half 47 and the other half of polarized connector at hearing aid 11. With the switch 15 closed, or turned "on" or open "off" and the rectifier charging unit plugged into a source of electrical energy, the hearing aid battery is charged. Simultaneously the hearing aid may be used if switch 15 is turned "on" as shown, as for example in a hotel room or at home where a source of AC power is available.

A suitably calibrated meter works 52 is connected across the shunt 40. Battery 20 such as the one shown in perspective in FIGURE 2, is shown diagrammatically with its larger polarized terminal 21 engaged with the matching female terminals of the charging unit connected to negative buss 45 for simultaneous charging. Thus, the charger 29 may be used to charge up external power sources such as the ones 16 and 20 as well as charging the battery within the hearing aid 11 itself. Because of the batteries 38 being connected across the rectifier within the charging unit 29, the usual hum associated with a rectifying charging unit is not experienced by the user of the hearing aid if he is simultaneously charging the battery in his unit and using the batteries 38 as a source of power for his hearing aid.

Voltage dropping coils 43 and 46 simply serve to prevent the power from batteries 38 being more than that necessary to both charge batteries and to operate the hearing aid. In a relatively fixed physical situation as when riding in an automobile, for example, the hearing aid could be plugged into the charger unit 29 even though the latter was not connected to a source of power and the batteries 38 used as an auxiliary source of power for the hearing aid. Some charging of the battery 22 would also occur. When at home or in a hotel room the user could for example use the hearing aid in listening to the radio or watching TV or carrying on a conversation and be charging the battery of the hearing aid simultaneously.

The latter situation is illustrated in FIGURE 4, where the charging unit 29 is shown connected by cord 32–34 to a fixed source of electrical energy such as a wall plug. Although not shown in the diagram, leads 32–34 may be connected to charger 29 by a removable plug 53. Simultaneously, the leads 48 and 49 may connect the hearing aid 11 to the charging unit.

By way of illustration a second hearing aid designated 54 is shown connected by a suitable flexible connector 55 to another one of the charging outlets of the charger. Also illustrated as on charge is an external power source such as the encapsulated battery 16. At 20 is shown in broken lines a representation of how an external power source such as the unit 20 would be put into a polarized connector on a charger for charging. There is no essential difference between the external power source 16 and 20. It is simply a matter of aesthetics as to which a user would prefer in the way of an external power source.

It is clear that the structure described herein is capable of providing the user with a constantly available source of power even of he is very demanding in his use of the battery in his hearing aid. By carrying two or more external power sources 16 or 20 on his person at all times, he is assured of an active source of power for a

period of time as long as anyone is likely to demand. It does require connecting these units up to the charger when an opportunity presents itself to do so, so that they are in a freshly charged condition when their energy is required.

It is apparent that many modifications and variations of this invention as hereinbefore set forth may be made without departing from the spirit and scope thereof. The specific embodiments described are given by way of example only and the invention is limited only by the terms of the appended claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A hearing aid comprising: a molded case adapted to be completely supported by a human ear; an amplifier circuit, control switch, polarized connector adapted to be connected to an external power source, and a first rechargeable battery all within said case; a set of electrical circuit conducting members interconnecting said battery with said polarized connector; and a second group of conducting circuit members interconnecting said battery, said switch and said hearing aid circuit in such a manner that said hearing aid circuit is operable simultaneously with charging of said first battery by power supplied through said polarized connector.

2. The structure of claim **1** which further comprises an external power source including a rectifier; means for connecting said rectifier to a source of alternating current; a plurality of chargeable batteries connected to said rectifier; a polarized connector; electrical circuit means for simultaneously supplying charging energy to said first

battery and operating power to said hearing aid circuit, said circuit means interconnecting said polarized connector and said chargeable batteries, said electrical circuit means including voltage reducing means; and an elongated flexible electrical connecting element having each end equipped with a polarized connector, one for engaging the polarized connector of said hearing aid and the other for engaging the polarized connector of said external power source.

3. The structure of claim **1** which further comprises an external power source including a rectifier, means for interconnecting said rectifier and the polarized connector of said hearing aid and for simultaneously supplying charging energy to said first battery and operating power to said hearing aid circuit, and means connected between said rectifier and said interconnecting means for suppressing rectifier hum.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,354,271 November 21, 1967

Bernard E. McDermaid

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 57, for "simple" read -- simply --;
column 6, line 23, for "3,061,698" read -- 3,061,689 --.

Signed and sealed this 18th day of June 1968.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents