Feb. 2, 1954 G. E. GUSTAFSON ET AL 2,668,197

WEARABLE ELECTRONIC HEARING AID

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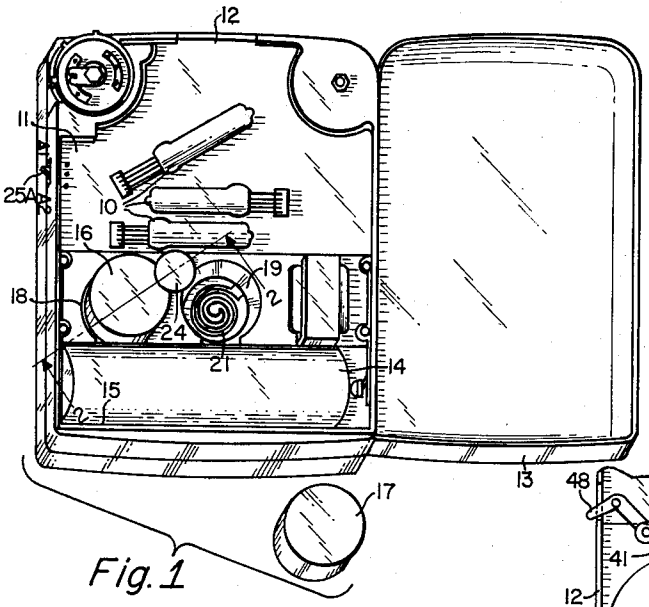


Fig. 1

Fig. 2

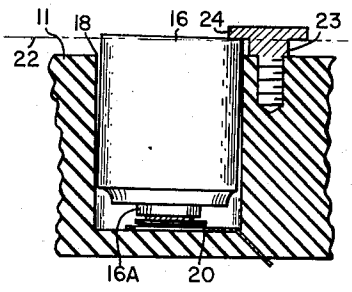


Fig. 3

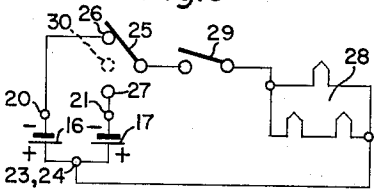


Fig. 4

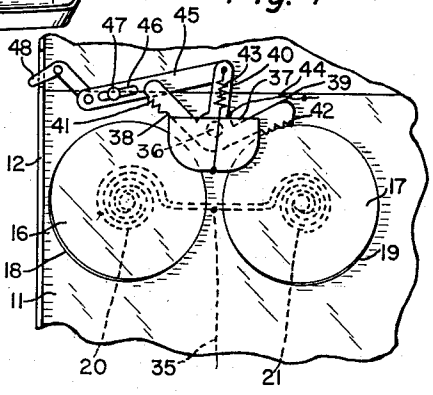


Fig. 5

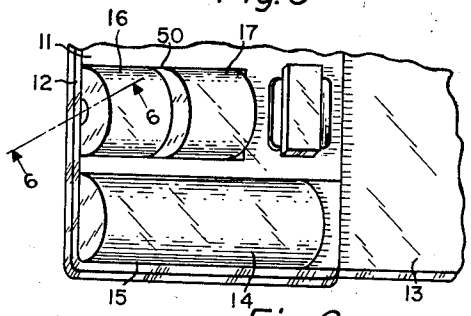


Fig. 6

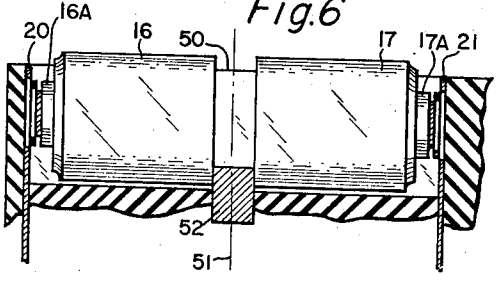
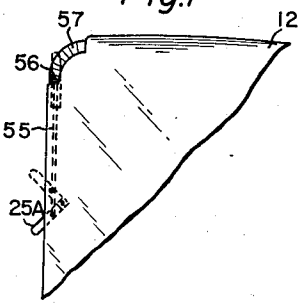


Fig. 7



GILBERT E. GUSTAFSON
BYRON R. CRISWELL
INVENTORS

BY Francis W. Crotty

THEIR ATTORNEY

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WEARABLE ELECTRONIC HEARING AID

Gilbert E. Gustafson, River Forest, and Byron R. Criswell, Waukegan, Ill., assignors to Zenith Radio Corporation, a corporation of Illinois

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This invention relates to hearing aids of the type in which a microphone, signal amplifier and batteries for powering the amplifier are contained within a unitary case. In constructing such an instrument, important consideration must be given to the comfort and convenience of the user as well as to the performance of the device. Inasmuch as the entire instrument must be worn on the person, its physical size and weight relate directly to comfort and consequently, design trends are directed toward physically smaller and lighter weight instruments.

A unitary type hearing aid may be materially reduced in size and weight by decreasing the size of its batteries, but decreased battery size is inevitably accompanied by shorter battery life and the need for replacement becomes more frequent. This problem is not nearly as serious for the B-battery which supplies space current to the several amplifier tubes as it is for the A-battery that provides filament current which is much greater than the space current.

With regard to the A-battery, a conventional dry-type unit is characterized by an output voltage which decreases gradually with age. As the end of the useful life of the battery approaches, the user of the hearing aid is warned by a noticeable reduction in volume over a period of operation because the filament current drawn by the amplifier tubes decreases with the gradual falling off of the output voltage of the A-battery.

There is now available a mercury-type battery which is physically smaller than a dry cell of comparable life. In operation, as the mercury battery nears the end of its useful life, the output voltage remains substantially constant and suddenly drops below the minimum value required by the filaments of the amplifier tubes. Hence, the hearing aid instrument ceases to function abruptly without the benefit of any warning whatsoever to the user and that is obviously a great inconvenience.

Whatever type of A-battery is chosen, the contingency of battery failure is ever present and that, heretofore, has been one of the greatest inconveniences to hearing-aid users. Such persons generally rely heavily on the assistance afforded by their instruments and find themselves seriously handicapped when temporarily deprived of this help due to battery failure. Of course, this is only a temporary loss but experience with instruments incorporating the subject invention establishes the fact that such persons are aided immeasurably if given protection against even the temporary loss of their instrument otherwise necessitated by battery failure.

Many persons, both men and women, find it desirable to carry their hearing aid concealed under their clothing and, in the past, they had to retire to a private room in order to replace a battery after one had become exhausted. The present invention overcomes the embarrassment that such a procedure entails.

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It is an object of this invention, therefore, to provide a hearing aid which is small in size, light in weight and more convenient to the user from the standpoint of battery failure and replacement.

It is another object of the invention to provide a novel battery arrangement for a hearing aid.

A further object of the invention is to provide a novel battery arrangement for a hearing aid which obviates the aforementioned disadvantage incident to the use of a mercury-type cell.

In accordance with the invention, a wearable electronic hearing aid comprises a casing adapted to be worn by a person. An audio-signal translating circuit is contained within the casing and includes at least one electron-discharge tube of the miniature type and a battery as a source of space current for the tube. The hearing aid further includes a pair of similar batteries positioned in the casing with their axes parallel and with like terminals adjacent one another. A locking member of electrically conductive material is positioned essentially between the pair of batteries and simultaneously mechanically engages a minor portion of adjacent terminals of these batteries releasably to retain them in position within the casing and concurrently to provide an electrical connection to the pair of batteries. A filament circuit is provided for the electron-discharge tube and includes the locking member and a switch which has a first operating position in which one of the pair of batteries supplies current to the filament circuit and a second operating position in which the other of the pair of batteries serves as the filament supply. A switch actuator is provided for displacing the switch with respect to the afore-described operating positions selectively to include a particular one of the batteries in the filament circuit.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The present invention itself, both as to its organization and manner of operation, together with further objects and advantages thereof may best be understood by reference to the following description taken in connection with the accompanying drawings in which:

Fig. 1 is a perspective view of a unitary hearing aid in accordance with the present invention with the case open and one of the A-batteries removed;

Fig. 2 is a cross-sectional view taken along line 2—2 of Fig. 1;

Fig. 3 represents schematically, a portion of the electrical circuit connections for the instrument of Fig. 1;

Fig. 4 is a plan view of a portion of a hearing aid embodying a modified battery arrangement;

Fig. 5 is a perspective representation of a further battery arrangement;

Fig. 6 is a cross-sectional view taken along line 6—6 of Fig. 5; and,

Fig. 7 shows a plan view of a portion of a hearing aid which includes another feature of the invention.

With reference now to Fig. 1, the wearable electronic hearing aid there represented is of the unitary type and is comprised of a casing 12 adapted to be worn by a person. The audio-signal translating circuit of the hearing aid includes electron-discharge tubes 10 of the miniature type supported on one section of a chassis 11 of insulating material enclosed within case 12. A back cover 13 is hinged to case 12 and is shown in open position to reveal the several elements of the amplifier, in particular, its operating batteries. The instrument includes a pair of similar, cylindrically-shaped A-batteries 16 and 17 received by a pair of generally similar, cylindrical battery wells or compartments 18 and 19 formed in a section of chassis 11 having a thickness greater than that of the section carrying tubes 10. One battery 16 is shown in position in well 18 while the other A-battery 17 is shown removed from its well 19. When batteries 16 and 17 are in their positions within wells 18 and 19, their axes are substantially parallel and like terminals are adjacent one another. Each is capable of supplying electrical energy to the filament circuit of the hearing-aid amplifier and each has an outside diameter slightly less than the inner diameter of the wells as may be observed in Fig. 2. This size relationship allows displacement of an A-battery in a direction normal to the axis of its well and, as will be pointed out with greater particularity hereinafter, such movement is of importance when the battery is being put into or taken out of the well.

The wells 18 and 19 extend from front to back or transversely of the case 12 and have an effective depth which is less than the length of the A-batteries. This is, when a battery is seated within a well, it projects therefrom a small amount in order to facilitate removal of the battery when necessary.

The chassis 11 is also provided with a third compartment 15, and a B-battery 14 positioned within this compartment furnishes anode current for tubes 10 in a known manner.

An electrically-conductive contact-spring is seated at the bottom of each well 18 and 19, spring 20 being shown in Fig. 2 and spring 21 being shown in Fig. 1. These springs constitute means for biasing each of the batteries toward a common plane represented in Fig. 2 by the dash-dot line 22 displaced from the surface of the chassis 11, that is, the bias of the spring tends to eject each battery from its well. Each spring forms an electrical contact for one terminal of each battery; as illustrated for battery 16, spring 20 engages a central terminal 16A electrically insulated from the case proper of the battery while the case constitutes the other terminal thereof.

An electrically-conductive retaining or locking member having a body portion 23 is threaded into an aperture of chassis 11 to be supported essentially between wells 18 and 19. This member also includes a disc-shaped head portion 24 overlying each of the wells for engagement with the cases of the A-batteries. The overlap of head 24 is slightly less than the amount by which a battery may be displaced normal to the axis of its well so that the battery may be moved clear of head 24 and be easily taken out of the instrument. The head portion 24 also serves as a common electrical contact for the battery cases which constitute adjacent, like terminals of the batteries and releasably retains the batteries within wells 18 and 19 against the bias of springs 20 and 21.

The filament circuit for tubes 10, as represented in Fig. 3, includes a switch, having a movable arm 25 and contacts 26 and 27, and also includes the conductive locking member 23, 24. The switch has a first operating position in which arm 25 engages contact 26 so that A-battery 16 supplies current to the filaments 28 of tubes 10 and a second operating position in which the arm 25 engages contact 27 to permit the other A-battery 17 to supply current to the filaments. An on-off switch 29 is provided in series with switch arm 25 and tube filaments 28 for selectively energizing the hearing-aid amplifier.

A switch actuator 25A is mechanically coupled with switch arm 25 and extends from the side of case 12, as shown in Fig. 1. In using the instrument, A-batteries are inserted into each well 18 and 19 and actuator 25 is manipulated to complete a filament circuit for tubes 10 through one of such batteries. With continued use of the instrument, this particular A-battery becomes exhausted and at that time actuator 25 is shifted to complete the filament circuit through the other A-battery. Thus, normal operation of the hearing aid is maintained even though there has been a failure of an A-battery and the user has an opportunity to procure a new cell while he operates the instrument from the alternate filament source. It is apparent from the foregoing discussion that exhausted batteries may be replaced with ease by virtue of the manner in which they are retained in wells 18 and 19.

Instead of using an on-off switch 29, the filament-source selector may be provided with a third position in which the filament circuit is interrupted. For example, there may be an off position, designated 30, made available for arm 25.

Fig. 4 represents another modification in which switching between the available A-batteries is carried out by a movable battery contact. In this case, contact springs 20 and 21 are electrically connected together and a lead 35 constitutes a common connection from the tube filaments to the A-batteries. A retaining member of insulating material is positioned similarly to element 23, 24 of Fig. 1 and includes a shaft or body portion 36 of reduced diameter and a head portion 37 in the form of an incomplete disc.

An electrical contactor, having a pair of arms 38 and 39 forming an obtuse angle with one another, is rotatable on shaft 36 and a third arm 40 of the contactor extends along the bisector of this angle. Arm 38 includes a serrated, battery-case-engaging surface 41 and a similar surface 42 is provided on arm 39. The angle between arms 38 and 39 is such that the contactor is movable between the case terminals of batteries 16 and 17. A toggle spring 43 extends between the free end of arm 40 and the extremity of member 37 farthest from arm 40. The spring is arranged to bias either of the surfaces 41 or 42 into engagement with batteries 16 and 17, respectively. A flexible electrical connection 44 extending from contactor 38, 39, 40 completes the filament circuit for tubes 10.

An actuating link 45 is pivoted at one end to the free end of arm 40 and is slidably and rotatably mounted on a stud 47 by means of a slot 46. The other end of link 45 is pivoted to an actuating arm 48, in turn pivoted to chassis 11, and the free extremity of arm 48 extends through a side slot in case 12. By operating arm 48, contactor 38, 39, 40 is displaced from engagement with one of the A-battery cases into engagement with the other.

The physical arrangement of the A-batteries shown in the fragmentary view of Fig. 5 differs from that of Figs. 1–3 in that the batteries are not only parallel but also are in axial alignment with like or case terminals adjacent one another. As more clearly represented in Fig. 6, the springs 20 and 21 are positioned at opposite extremities of a recess 50 and serve to engage physically and electrically with the contacts 16A and 17A of the batteries, and to bias the batteries toward a common plane between the batteries indicated by a dash-dot line 51. An electrically-conductive retaining member 52 is positioned within recess 50 in plane 51 to define the individual wells for the batteries. The member 52 engages only a small edge portion of the batteries and removal and insertion of the batteries is essentially as described in connection with the arrangement of Figs. 1–3. The electrical connections may also be identical and need not be described in detail.

The feature of the invention illustrated in Fig. 7 provides a reminder to the user when he has exhausted one cell and is operating his hearing aid on the remaining one. For this purpose a link 55 is pivoted to selector-switch-actuator 25A and is slidably supported within case 12. An indicator element or finger 56 is mechanically coupled with link 55 in the vicinity of volume-control knob 57 of the hearing-aid amplifier. The element 56 is preferably constructed of a soft material such as thin leather which, although disposed adjacent knob 57, does not interfere with manipulation of the knob. When actuator 25A is in its full line position, indicator element 56 is substantially within the confines of case 12. After the particular filament battery has become exhausted, switch 25 is operated to bring the other A-battery into service. The displacement of arm 25A to its alternative position, shown in dash-dot lines, causes the indicator element to be displaced to a position shown in dash-dot outline, in which a portion thereof extends slightly beyond the outer periphery of knob 57. Accordingly, when the user operates the knob he is constantly reminded by the presence of finger 56 that one of the A-batteries has been exhausted. It is apparent that element 56 may be arranged to provide only a visual indication if desired.

While particular embodiments of the present invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from this invention in its broader aspects, and therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of this invention.

We claim:

1. A wearable electronic hearing aid comprising: a casing adapted to be worn by a person; an audio-signal translating circuit within said casing including at least one electron-discharge tube of the miniature type; a battery included in said circuit as a source of space current for said tube; a pair of similar batteries positioned in said casing with their axes parallel and with like terminals adjacent one another; a locking member of electrically conductive material positioned essentially between said pair of batteries for simultaneously mechanically engaging a minor portion of adjacent terminals of said pair of batteries to releasably retain said pair of batteries in position within said casing and for concurrently making electrical connections to said pair of batteries; a filament circuit for said tube including said locking member and a switch having a first operating position in which one of said pair of batteries supplies current to said filament circuit and having a second operating position in which the other of said pair of batteries supplies current to said filament circuit; and a switch actuator for actuating said switch with respect to said operating positions selectively to include a particular one of said batteries in said filament circuit.

2. A wearable electronic hearing aid comprising: a casing adapted to be worn by a person and enclosing a pair of generally similar battery wells as well as a third battery compartment; an audio-signal translating circuit within said casing including at least one electron-discharge tube of the miniature type; a battery positioned in said third compartment and included in said circuit as a source of space current for said tube; a pair of similar batteries positioned in said pair of wells with their axes parallel and with like terminals adjacent one another; an electrically-conductive spring seated in each of said pair of wells in electrical contact with the battery received thereby and tending to eject the battery from the well; a locking member positioned essentially between and simultaneously mechanically engaging said pair of batteries releasably to retain said batteries within their wells against the action of said springs; a filament circuit for said tube including a common connection for said like terminals and a switch having a first operating position in which one of said pair of batteries supplies current to said filament circuit and having a second operating position in which the other of said pair of batteries supplies current to said filament circuit; and a switch actuator for actuating said switch with respect to said operating positions to include a particular one of said batteries in said filament circuit.

3. A wearable electronic hearing aid comprising: a casing adapted to be worn by a person and enclosing a pair of generally similar, cylindrical A-battery wells extending normal to the front face of said casing as well as a third battery compartment; an audio-signal translating circuit within said casing including at least one electron-discharge tube of the miniature type; a battery positioned in said third compartment and included in said circuit as a source of space current for said tube; a pair of similar, cylindrical A-batteries positioned in said pair of wells with their axes parallel each of said A-batteries having an outside diameter less than the diameter of its respective well to allow displacement of each battery in a direction normal to the axis of its well by a certain amount; an electrically-conductive spring seated in each of said pair of wells in electrical contact with the battery received thereby and tending to eject the battery from the well; a locking member overlying each of said wells by a distance less than said amount for simultaneously mechanically engaging said pair of batteries releasably to retain said batteries within their wells against the action of said springs; a filament circuit for said tube includ-

ing a switch having a first operating position in which one of said pair of batteries supplies current to said filament circuit and having a second operating position in which the other of said pair of batteries supplies current to said filament circuit; and a switch actuator for selectively actuating said switch with respect to said operating positions.

4. A wearable electronic hearing aid comprising: a casing adapted to be worn by a person and enclosing a pair of generally similar, cylindrical A-battery wells of a given effective depth extending normal to the front face of said casing as well as a third battery compartment; an audio-signal translating circuit within said casing including at least one electron-discharge tube of the miniature type; a battery positioned in said third compartment and included in said circuit as a source of space current for said tube; a pair of similar, cylindrical A-batteries having a length greater than said effective depth of said wells positioned in said pair of wells with their axes parallel each of said A-batteries having an outside diameter less than the diameter of its respective well to allow displacement of each battery in a direction normal to the axis of its well by a certain amount; an electrically-conductive spring seated in each of said pair of wells in electrical contact with the battery received thereby and tending to eject the battery from the well; a locking member overlying each of said wells by a distance less than said amount for simultaneously mechanically engaging said pair of batteries releasably to retain said batteries within their wells against the action of said springs; a filament circuit for said tube including a switch having a first operating position in which one of said pair of batteries supplies current to said filament circuit and having a second operating position in which the other of said pair of batteries supplies current to said filament circuit; and a switch actuator for selectively actuating said switch with respect to said operating positions.

5. A wearable electronic hearing aid comprising: a casing adapted to be worn by a person and enclosing a pair of generally similar, cylindrical A-battery wells extending normal to the front face of said casing as well as a third battery compartment; an audio-signal translating circuit within said casing including at least one electron-discharge tube of the miniature type; a battery positioned in said third compartment and included in said circuit as a source of space current for said tube; a pair of similar, cylindrical A-batteries positioned in said pair of wells with their axes parallel and with like terminals adjacent one another, each of said A-batteries having an outside diameter less than the diameter of its respective well allowing displacement of each battery in a direction normal to the axis of its well by a certain amount; an electrically-conductive spring seated in each of said pair of wells in electrical contact with the battery received thereby and tending to eject the battery from the well; an electrically-conductive locking member overlying each of said wells by a distance less than said amount for simultaneously mechanically engaging said pair of batteries releasably to retain said batteries within their wells against the action of said springs and to complete an electrical connection with said adjacent terminals of said batteries; a filament circuit for said tube including a switch having a first operating position in which one of said pair of batteries supplies current through one of said springs and said locking member to said filament circuit and having a second operating position in which the other of said pair of batteries supplies current through the other of said springs and said locking member to said filament circuit; and a switch actuator for selectively actuating said switch with respect to said operating positions.

6. A wearable electronic hearing aid comprising: a casing adapted to be worn by a person and enclosing a pair of generally similar battery wells as well as a third battery compartment; an audio-signal translating circuit within said casing including at least one electron-discharge tube of the miniature type; a battery positioned in said third compartment and included in said circuit as a source of space current for said tube; a pair of similar batteries positioned in said pair of wells with their axes parallel; an electrically-conductive spring seated in each of said pair of wells in electrical contact with the battery received thereby and tending to eject the battery from the well; a locking member for simultaneously mechanically engaging said pair of batteries releasably to retain said batteries within their wells against the action of said springs; a filament circuit for said tube including a switch having a first operating position in which one of said pair of batteries supplies current to said filament circuit, a second operating position in which the other of said pair of batteries supplies current to said filament circuit and a third position in which said filament circuit is interrupted; and a switch actuator for selectively actuating said switch with respect to said operating positions.

7. A wearable electronic hearing aid comprising: a casing adapted to be worn by a person and enclosing a pair of generally similar battery wells as well as a third battery compartment; an audio-signal translating circuit within said casing including at least one electron-discharge tube of the miniature type; a battery positioned in said third compartment and included in said circuit as a source of space current for said tube; a pair of similar batteries positioned in said pair of wells with their axes parallel; an electrically-conductive spring seated in each of said pair of wells in electrical contact with the battery received thereby and tending to eject the battery from the well; a locking member for simultaneously mechanically engaging said pair of batteries releasably to retain said batteries within their wells against the action of said springs; a filament circuit for said tube including a switch having a first operating position in which one of said pair of batteries supplies current to said filament circuit and having a second operating position in which the other of said pair of batteries supplies current to said filament circuit; a switch actuator for selectively actuating said switch with respect to said operating positions; and an indicator element mechanically coupled to said switch actuator for indicating which of said batteries is coupled with said tube.

GILBERT E. GUSTAFSON.
BYRON R. CRISWELL.

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