

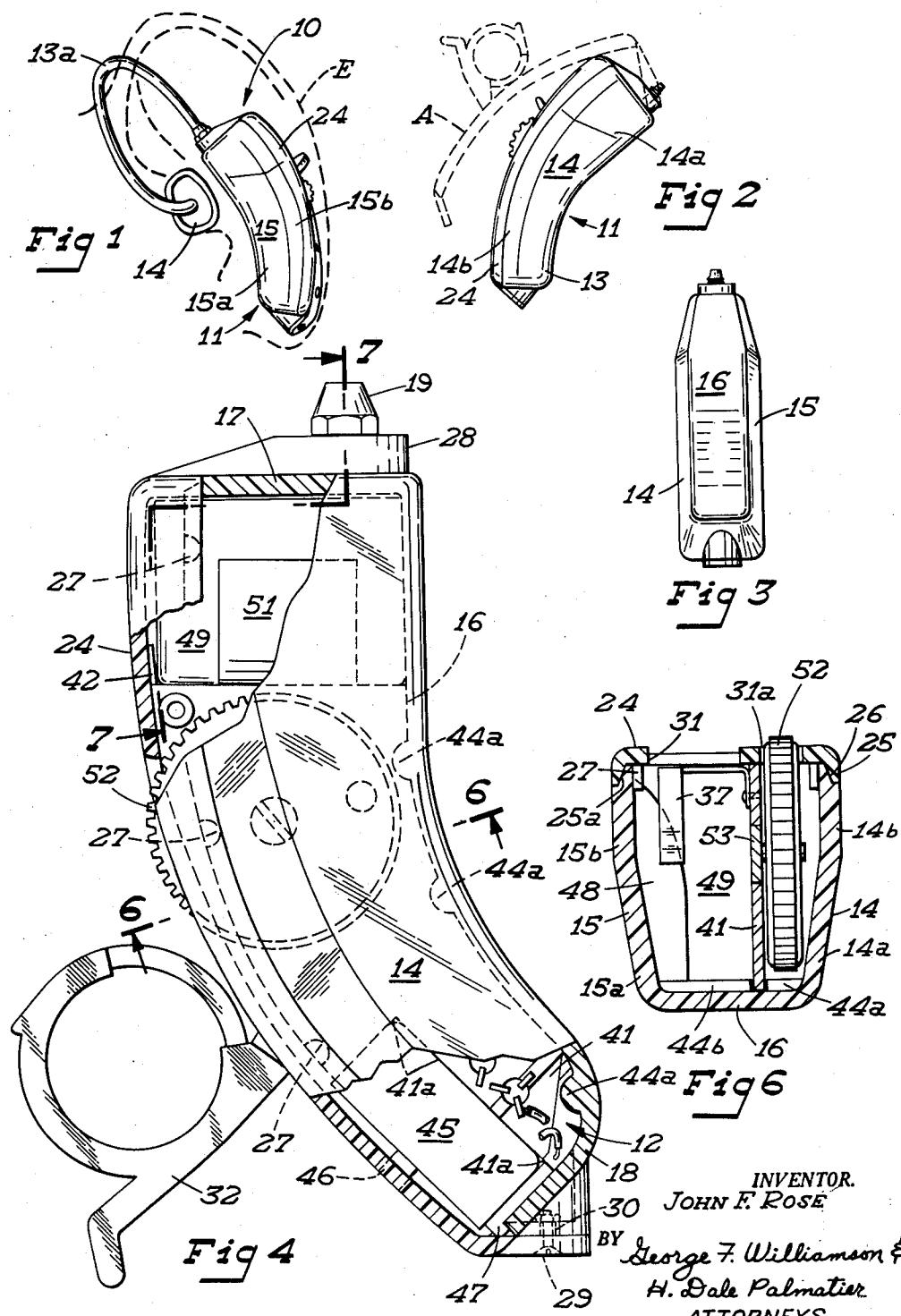
April 24, 1962

J. F. ROSE
ACOUSTICAL DEVICE

3,031,537

Filed June 2, 1960

2 Sheets-Sheet 1



April 24, 1962

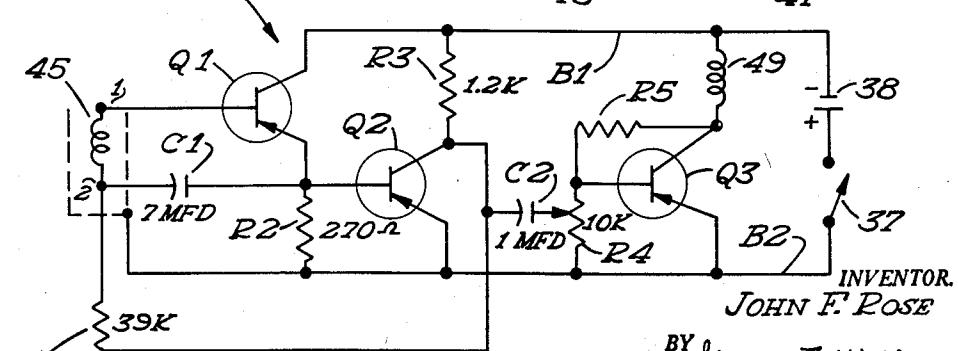
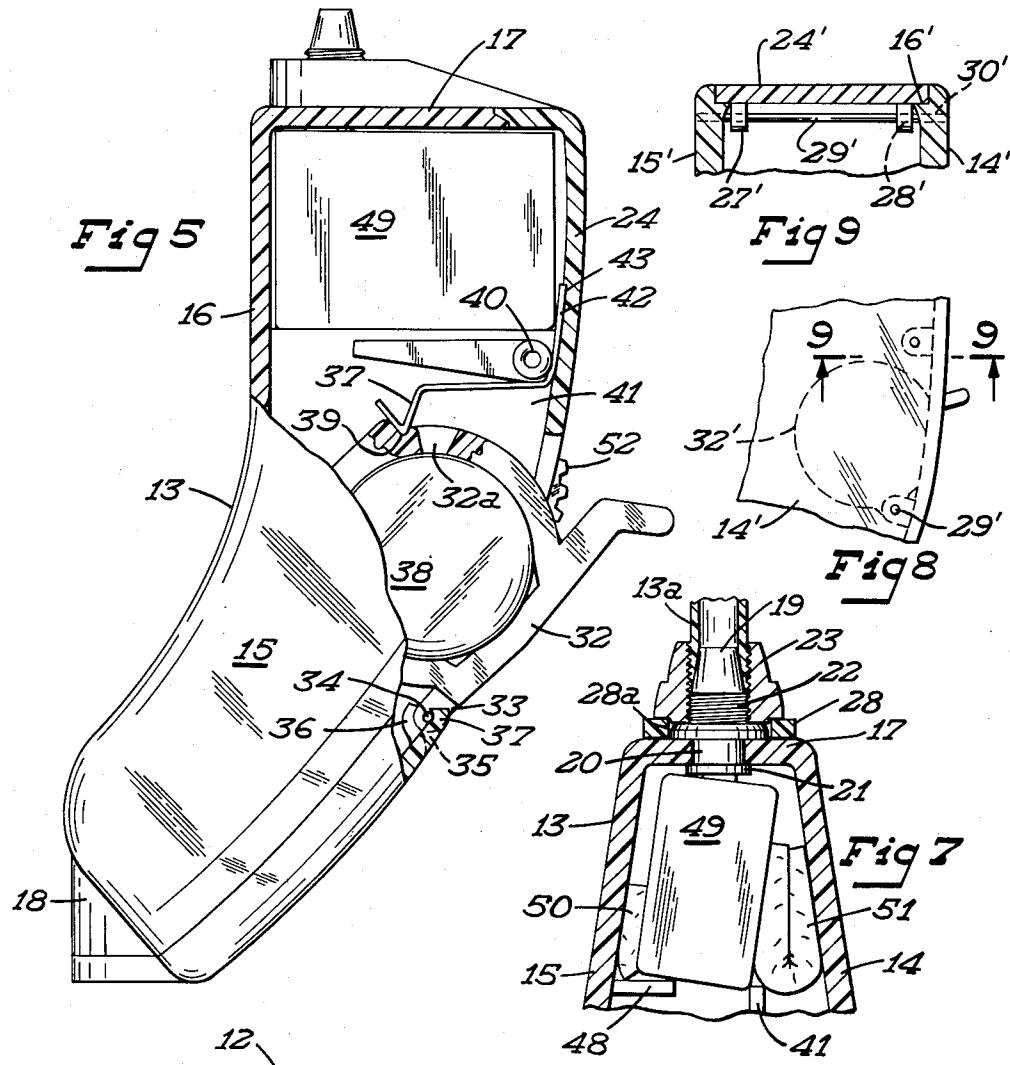
J. F. ROSE

3,031,537

ACOUSTICAL DEVICE

Filed June 2, 1960

2 Sheets-Sheet 2



R1 Fig 10

BY George F. Williamson &
H. Dale Palmatier
ATTORNEYS

1

3,031,537

ACOUSTICAL DEVICE

John F. Rose, Minneapolis, Minn., assignor to Maico Electronics, Inc., Minneapolis, Minn., a corporation of Minnesota

Filed June 2, 1960, Ser. No. 33,468
11 Claims. (Cl. 179—107)

This invention relates to hearing aids and more particularly relates to a hearing aid of the type to be worn in a concealed position behind a person's ear.

An object of this invention is to provide a new and improved hearing aid of simple and inexpensive construction and operation.

Another object of this invention is the provision of a novel hearing aid of the type to be worn behind a person's ear and being constructed to prevent perspiration from entering the housing and damaging the vital components of the hearing aid circuitry while still permitting ready and easy access into the housing to facilitate servicing and maintenance of the circuitry.

Still another object of my invention is to provide an improved and novel hearing aid casing for a behind-the-ear type aid and which is provided with a cover which is removably secured by a minimum number of fasteners. These and other objects and advantages of our invention will more fully appear from the following description made in connection with the accompanying drawings wherein like reference characters refer to the same or similar parts throughout the several views and in which:

FIG. 1 is an elevational view of one side of the invention in complete assembly adapted for application to a person's ear which is shown in dotted lines in the views;

FIG. 2 is an elevational view of the opposite side of the invention, shown with the sound tube removed and showing in dotted lines the manner in which the cover may be removed;

FIG. 3 is a front elevational view of the invention;

FIG. 4 is an enlarged side elevational view with a portion of the housing being broken away and shown in section for clarity of detail;

FIG. 5 is an enlarged elevational view of the opposite side compared to that shown in FIG. 4, and being partly broken away to show interior and clarity of detail;

FIG. 6 is a detail section view taken approximately at 6—6 in FIG. 4 with the structure in the background deleted for clarity of detail;

FIG. 7 is a detail section view taken approximately along a broken line as indicated at 7—7 in FIG. 4;

FIG. 8 is a detail elevational view of a modified form of the invention;

FIG. 9 is a detail section view taken approximately at 9—9 in FIG. 8; and

FIG. 10 is a schematic circuit diagram of the amplifier circuit which is used in the invention.

One form of the invention is shown in FIGS. 1—7 and 10 and is shown in general in FIG. 1. The behind-the-ear hearing aid 10 includes a housing 11 containing a hearing aid circuit indicated in general by numeral 12 and hereinafter more fully described, a support and sound-transmitting tube 13a on the end of which is mounted an ear tip 14 to fit into the auditory canal of the human ear.

The housing 11 which contains the hearing aid circuitry 12 is of two part construction and includes an elongate receptacle 13 which is normally oriented in a generally upright position as is shown in FIG. 1 when the hearing aid is worn on a person's ear E, and the receptacle 13 has imperforate and integrally formed sidewalls 14 and 15, a front wall 16, and upper and lower end walls 17 and 18 respectively. It will be noted that the forward portions 14a and 15a of the sidewalls are oriented in converging

2

relation in a forward direction so as to generally follow the converging relationship between the pinna of the person's ear and the adjacent portion of the head. The rear portions 14b and 15b of the sidewalls are oriented in substantially parallel relation with respect to each other and are obliquely oriented with the forward portions 14a and 15a of the sidewalls so that the rear portions of the sidewalls diverge away from the head and away from the pinna of the ear and the rear edge portions of the sidewalls are thereby maintained in spaced relation with any portion of the head and ear. The integral and imperforate construction of the receptacle 13 is important when it is remembered that the delicate hearing aid circuitry 12 may be damaged and rendered inoperative by perspiration from the person's head or ear. The upper end wall 17 has a tube connector 19 sealed therein at the time the receptacle 13 is molded of a substantially rigid plastic material. The tube connector 19 has a hollow base 20 which extends through the upper receptacle end wall 17 and a flange 21 on the inner end of the base bears against the inner side of the wall 17 and the connector 19 is also provided with an externally threaded portion 22 which threadably receives a nut 23. The upper portion of the nut engages the sound tube 13a and holds the sound tube on the connector 19.

The housing 13 also has a cover 24 which overlies the open rear side of the receptacle 13. The cover 24 has a forwardly extending peripheral lip 25, the inner surfaces 25a of which are obliquely oriented to match the beveled edges 26 of the receptacle sidewalls and upper end wall. The cover 24 also has a plurality of inwardly projecting tabs 27 formed integrally thereof and extending inwardly along the inner side of the sidewalls 14 and 15 to cooperate with the inturned lip portion 25 of the cover in clamping the receptacle sidewalls and preventing any inward or outward movement of these sidewalls 14 and 15. It will be seen that the receptacle sidewalls are relatively thin and are without any substantial amount of internal bracing or reinforcing so that the sidewalls are of a delicate and flexible nature, but the operation of the lip portion 25 and the tabs 27 rigidifies the receptacle sidewalls when the cover is assembled with the receptacle. The cover has a forwardly extending arm portion 28 at the upper end thereof which is provided with an enlarged aperture 28a to receive the tube connector 19 therein. The arm 28 is clamped by the nut 23 so as to be held in stationary condition. It should be therefore noted that the nut 23 has the dual function of holding the cover in position and also holding the sound tube on the connector 19.

The bottom end of the cover is secured to the receptacle by a screw 29 which fits into a threaded bushing 30 in the receptacle.

The cover 24 also has a pair of elongated slot openings 31 and 31a. The slot 31 receives the battery drawer 32 for outward and inward swinging movement, and the battery drawer 32 has a mounting arm 33 with a pivot 34 formed integrally thereof. The mounting portion 33 extends into an end slot portion 35 and fits against a retaining lip 36 formed integrally of the cover and adapted to retain the pivots 34 against inward projections 37 on opposite sides of the mounting 33. The battery drawer 32 has an opening 32a through one side thereof and adapted to receive a spring contact 37 to connect the spring contact and the circuitry 12 with the battery 38. A detent or recess 39 in the outer surface of the battery drawer 32 adjacent the opening 32a receives the spring 37 to restrain the battery drawer 32 from swinging out of the slot 31 and to hold the contact 37 out of engagement with the battery so as to maintain the circuit in an "off" condition.

The spring contact 37 is mounted by means of a rivet 40 on a printed circuit board 41 and another portion of

the spring defines a tab 42 which normally bears against the inner side of the cover at a correspondingly shaped recess 43 in the cover so that the cover and spring hold the upper portion of the printed circuit board in a predetermined position with respect to the cover. The cover and spring urge the printed circuit board forwardly against the forward wall 16 of the receptacle so as to maintain the forward edge of the printed circuit board between the spaced lugs 44a and 44b which are formed integrally of the forward wall 16 of the receptacle and which are in end-to-end relation and spaced a distance to receive the circuit board therebetween. The printed circuit board 41 is thereby held at the front wall 16 against movement toward or away from either of the sidewalls 14 or 15.

The printed circuit board 41 carries many of the components of the hearing aid circuit 12 including the transistors, condensers and resistors to be hereinafter more fully pointed out in connection with FIG. 10. The microphone 45 of the circuit is carried in a notch 41a at the lower end of the printed circuit board and confronts an aperture 46 in the cover 24. An insert block 47 fits below the microphone 45 and has its inner end bearing against the printed circuit board at the bottom of the notch 41a, and the outer end of the insert member 47 bears against the cover 24 to retain the lower end of the printed circuit board 41 in fixed position against the bottom wall 16 of the receptacle and between the lugs 44a and 44b therein.

The receptacle 13 has a receiver-mounting shelf 48 formed integrally of the sidewall 15 and projecting slightly inwardly so as to mount the hearing aid receiver 49 and hold the receiver against the tube connector base 20. A pair of cushions 50 and 51 are positioned on opposite sides of the receiver so as to maintain the receiver 49 in spaced relation with the receptacle sidewalls and so as to maintain the receiver 49 and the cushion 51 against the upper edge of the printed circuit board for holding the circuit board against lateral movement.

The circuit board 41 also has a volume control wheel 52 rotatably mounted thereon on a stud portion 53 which is affixed in the printed circuit board 41. The periphery of the volume control wheel 52 projects slightly out of the slot 31a so as to be easily manually manipulated.

The modified form of the invention shown in FIGS. 8 and 9 is constructed identically to that shown in FIGS. 1-7, except that the receptacle sidewalls 14' and 15' each has an inner ledge 16' which support cover 24' so that the outer surface of the cover 24 is flush with the exterior of the sidewalls. The cover 24' has a plurality of inwardly extending tabs 27' which are apertured as at 28' so as to receive a pin 29', the ends of which also extend through apertures 30' in the sidewalls 14' and 15'. In this form of the invention, one of the pins 29' comprises a pivotal mounting for the battery drawer 32' which is otherwise identical to the battery drawer of the first identified form of the invention. In the form of the invention shown in FIGS. 8 and 9, no additional exterior fastening means are necessary for securing the cover 24' to the receptacle, and therefore the need for arm 28 in this form of the invention is eliminated, as is the need for screw 29.

In the circuit shown in FIG. 10, the battery 38 is connected at its negative side to one buss B1 and the positive side of the battery is connected through the spring contact 37 to another buss B2. The terminal 1 of the microphone coil 45 is connected to the base electrode of transistor Q1. The terminal 2 of the microphone coil 45 is connected through a capacitor C1 to the emitter electrode of transistor Q1 and also to the base electrode of transistor Q2. The terminal 2 of the microphone coil is also connected through a resistor R1 to the collector electrode of transistor Q2. The collector electrode of transistor Q1 is connected directly to buss B1. The emitter electrode of transistor Q1 and the base electrode of transistor Q2, which are interconnected, are both connected through

a resistor R2 to the buss B2. The emitter electrode of transistor Q2 is connected directly to buss B2, and the collector electrode of transistor Q2 is also connected through a resistor R3 to buss B1. Collector electrode of transistor Q2 is also connected through a capacitor C2 to the center tap of potentiometer R4. The lower end of potentiometer R4 is connected directly to buss B2, and the upper end of potentiometer R4 is connected directly to the base electrode of transistor Q3. The base and collector electrodes of transistor Q3 are interconnected by a resistor R5, the magnitude of which is selected in order to give a collector current of 1.2 to 1.5 millamps. in transistor Q3. The collector electrode of transistor Q3 is connected through the coil of receiver 49 to the buss B1. The emitter electrode of transistor Q3 is connected directly to buss B2. It will be understood that in a substantially conventional fashion, sounds which are applied to the microphone are amplified and reproduced at the receiver and the sound is transmitted through the sound tube 13a into the person's ear.

Normally the hearing aid 10 will be suspended by the tube 13a from the person's ear and will fit between the pinna and the adjacent portion of the head. The outer portions 15b and 14b of the sidewalls are spaced from any portions of the skin so that perspiration may not enter the housing. In normal use, the battery drawer 32 will be shifted slightly from the position shown in FIG. 1 to the position shown in FIG. 5 to turn the unit on and off, and the volume control wheel 52 may be easily manipulated while the unit is carried on the ear. If it becomes necessary to service or adjust the circuitry of the hearing aid, the cover 24 may be easily removed by first moving the nut 23, then the screw 29 so as to permit the cover to be swung through the dotted position A shown in FIG. 2 and then off the receptacle 13. Access may be readily had to the circuitry. The microphone and printed circuit board 41 may be lifted out and the receiver may also be removed by first slipping the cushion 51 out of the housing. In similar fashion the circuitry and cover may be reassembled in predetermined and fixed relationship.

It will of course be understood that various changes may be made in the form, detail, arrangement and proportion of the parts without departing from the scope of my invention which consists of the matter described herein and set forth in the appended claims.

What I claim is:

1. A hearing aid to be worn behind a person's ear, comprising an elongate housing dimensioned to lie in a generally upright position between the pinna and the adjacent portion of the head, said housing including an elongate and longitudinally upright receptacle having imperforate and integrally formed front, side and upper and lower end walls, the receptacle also having an open rear side, said side walls respectively engaging the pinna and the adjacent portion of the head, and said open rear side facing rearwardly, said sidewalls being shaped to position the rear opening-defining edges thereof away from the pinna and head, a sound tube to be supported on the pinna, a sound-transmitting tube connector sealed in a receptacle wall and connected with the tube, a cover closing the open rear side of the receptacle, removable means releasably securing the cover and receptacle together, hearing aid circuit means in the housing and including a receiver directing sound into the connector and tube and also including a microphone adjacent the cover, the cover having a plurality of openings therein, one of said openings confronting the microphone, said circuit means also including a manual control projecting through one of the openings in the cover to be manually manipulated.

2. A hearing aid to be worn behind a person's ear, comprising an elongate housing dimensioned to lie in a generally upright position between the pinna and the adjacent portion of the head, said housing including an

elongate and longitudinally upright receptacle having imperforate and integrally formed front, side and upper and lower end walls, and said receptacle also having an open rear side, said side walls respectively engaging the pinna and the adjacent portion of the head, and said open rear side facing rearwardly, the forward portions of the receptacle sidewalls converging forwardly toward said front wall to generally follow the forwardly convergent relationship between the head and the pinna of the ear, the rear portions of the sidewalls being substantially parallel and being obliquely oriented with respect to said forward portions to diverge in a rearward direction away from the head and ear pinna, a sound tube to be supported on the pinna, a sound tube connector sealed in one of the receptacle walls and connected with the tube, a cover closing the rear side of the receptacle, removable means releasably securing the cover and receptacle together, hearing aid circuit means in the housing and including a receiver directing sound into the connector and tube and also including a microphone adjacent the cover, the cover having a plurality of openings therein, one of said openings confronting the microphone, said circuit means also including a control projecting through one of the openings in the cover to be manually manipulated.

3. The invention set forth in claim 1 and said sound tube connector being sealed into the top end wall of the receptacle, and means sealing the sound tube to the connector.

4. A hearing aid to be worn behind a person's ear, comprising an elongate housing dimensioned to lie in a generally upright position between the pinna and the adjacent portion of the head, said housing including an elongate and longitudinally upright receptacle having imperforate and integrally formed front, side, and upper and lower end walls, the receptacle having an open rear side, said side walls respectively engaging the pinna and the adjacent portion of the head, and said open rear side facing rearwardly, said sidewalls being shaped to position the rear, opening-defining edges thereof away from the pinna and head, a cover closing the open rear side of the receptacle and having forwardly extending lip portions lying against the exterior sides of the receptacle sidewalls, and said cover also having a plurality of tabs projecting inwardly and lying adjacent the inner sides of the sidewalls and preventing inward flexing of the sidewalls, a sound tube to be supported on the pinna, a sound-transmitting tube connector sealed in the upper end wall of the receptacle, removable means securing the cover and receptacle together, hearing aid circuit means in the housing and including a receiver directing sound into the connector and tube and also including a microphone adjacent the cover, the cover having a plurality of openings therein, one of said openings confronting the microphone, said circuit means also including a control projecting through one of the openings in the cover to be manually manipulated.

5. A hearing aid to be worn behind a person's ear, comprising an elongate housing dimensioned to lie in a generally upright position between the pinna and the adjacent portion of the head, said housing including an elongate and longitudinally upright receptacle having imperforate and integrally formed front, side, and upper and lower end walls and also having an open rear side, said side walls respectively engaging the pinna and the adjacent portion of the head, and said open rear side facing rearwardly, a cover closing the open rear side of the receptacle, removable means releasably securing the cover and receptacle together, hearing aid circuit means in the housing and including a printed circuit board having a forward edge portion engaging the front wall of the receptacle and also having a rear edge portion adjacent the cover, a plurality of lugs on said front wall and engaging the opposite sides of said printed circuit board adjacent the forward edge thereof to secure

the board in stationary condition, said circuit means also including a battery in the housing, removable means supporting the battery in the housing, spring means on the circuit board providing a contact for the battery and also defining a tab lying against the cover and holding the printed board under spring pressure against the front wall of the receptacle and between the lugs thereon, said circuit means also including a receiver, a microphone, and a circuit control, a sound-transmitting tube to be supported on the pinna, a sound-transmitting tube connector sealed in the receptacle wall and connected with the tube and positioned to receive sound from said receiver, the cover having a plurality of openings therein, while said openings confronting the microphone for directing sound thereto and another of said openings accommodating said manual control to facilitate manual manipulation thereof.

6. The invention set forth in claim 5 and said cover having a recess on the inner side thereof receiving and fitting said spring tab and preventing transverse movement of the inner circuit board.

7. The invention set forth in claim 5 wherein said spring tab is disposed adjacent the top of said circuit board, the board having a microphone-receiving notch at the rear edge thereof and adjacent the lower end of said circuit board, the microphone lying in said notch, and a rigid insert below said microphone bearing against the cover and the circuit board at said notch for holding the lower end of the board between said lugs.

8. A hearing aid to be worn behind a person's ear, comprising an elongate housing dimensioned to lie in a generally upright position between the pinna and the adjacent portion of the head, said housing including an elongate and longitudinally upright receptacle having imperforate and integrally formed front, side, and upper and lower end walls and also having an open rear side, said side walls respectively engaging the pinna and the adjacent portion of the head, and said open rear side facing rearwardly, a sound tube to be supported upon the pinna, a sound-transmitting connector sealed in the upper end wall of the receptacle and connected with the tube, a cover closing the open rear side of the receptacle, means releasably securing the cover and receptacle together, a hearing aid circuit means in the housing and including a receiver positioned in the upper end portion of the housing and directing sound into the tube connector, a receiver-supporting shelf in the housing and affixed to one of said sidewalls, a pair of cushions respectively disposed at opposite sides of the receiver and engaging the sidewalls to maintain the receiver on said shelf and in spaced and cushioned relation with respect to the receptacle sidewalls, said circuit means also including a printed circuit board positioned in a vertical position within the housing and oriented in a fore-and-aft position, the printed circuit board having an upper edge engaging said receiver and one of said cushions to be maintained in predetermined position, and said circuit means also including a microphone and a circuit control, the cover having a plurality of openings therein, one of said openings confronting the microphone and another of said openings receiving the circuit control therethrough to be manually manipulated.

9. A hearing aid to be worn behind a person's ear, comprising an elongate housing dimensioned to lie in a generally upright position between the pinna and the adjacent portion of the head, said housing including an elongate and longitudinally upright receptacle having imperforate and integrally formed front, side, and upper and lower end walls and said receptacle also having an open rear side, said side walls respectively engaging the pinna and the adjacent portion of the head, and said open rear side facing rearwardly, the receptacle sidewalls being beveled on the outer side, a cover overlying the open rear side of the receptacle and having a peripheral lip with an oblique inner surface of fit against the beveled receptacle sidewalls, the cover also having a plurality of

tabs projecting inwardly into the receptacle and engaging the inner sides of the receptacle sidewalls, the oblique inner surface of the cover peripheral lip camming the edge of the sidewall against the tabs as the cover is tightened onto the receptacle to securely clamp the sidewall against inward and outward movement, means for supporting the housing behind the ear and transmitting sound into the ear, hearing aid circuit means in the housing for amplifying sound.

10. A hearing aid to be worn behind a person's ear, comprising an elongate housing dimensioned to lie in a generally upright position between the pinna and the adjacent portion of the head, said housing including an elongate and longitudinally upright receptacle having imperforate and integrally formed front, side, and upper and lower end walls, the receptacle also having an open rear side, said side walls respectively engaging the pinna and the adjacent portion of the head, and said open rear side facing rearwardly, said sidewalls being shaped to position the rearward edges thereof away from the pinna and head, a cover closing the open rear side of the receptacle and having a plurality of tabs projecting inwardly along the receptacle sidewalls, said tabs and said receptacle sidewalls having aligned apertures therein, a plurality of pins projecting through said apertures for retaining the cover on the receptacle, hearing aid circuit means in the housing including a microphone ad-

5

10

15

20

25

5 jacent the cover and a receiver adjacent the upper end wall, the cover having a sound-transmitting opening therethrough directing sound to the microphone, and means supporting the housing on a person's ear and directing sound from the receiver into the ear.

11. The invention set forth in claim 10 and said cover having an elongate slot therein, one end of the slot being disposed adjacent one of said pins, a battery drawer in the housing and being swingably mounted at one end of the slot on the corresponding pin to permit swinging of the battery drawer into and out of the housing through said slot for replacement of the battery.

References Cited in the file of this patent

UNITED STATES PATENTS

2,882,348	Erickson	Apr. 14, 1959
2,938,083	Hermann	May 24, 1960
2,950,357	Mitchell et al.	Aug. 23, 1960

FOREIGN PATENTS

210,888	Australia	Oct. 10, 1957
1,049,919	Germany	Feb. 5, 1959

OTHER REFERENCES

"Silvertone True Ear," page 1, February 5, 1958.
"Telex 962 C," page 2, January 1957.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,031,537

April 24, 1962

John F. Rose

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 6, line 74, for "of" read -- to --.

Signed and sealed this 21st day of August 1962.

(SEAL)

Attest:

ESTON G. JOHNSON

Attesting Officer

DAVID L. LADD

Commissioner of Patents