Sept. 13, 1960 S. POSEN ET AL 2,952,748

BINAURAL EYEGLASS HEARING AID CONSTRUCTION

Filed June 21. 1955 2 Sheets-Sheet 1

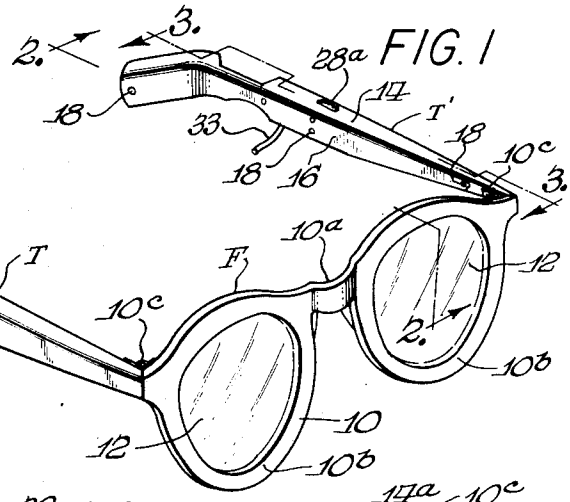


FIG. 1

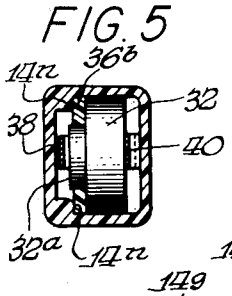


FIG. 5

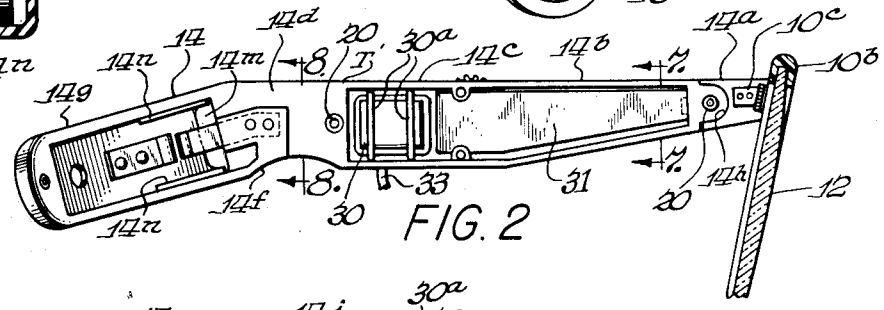


FIG. 2

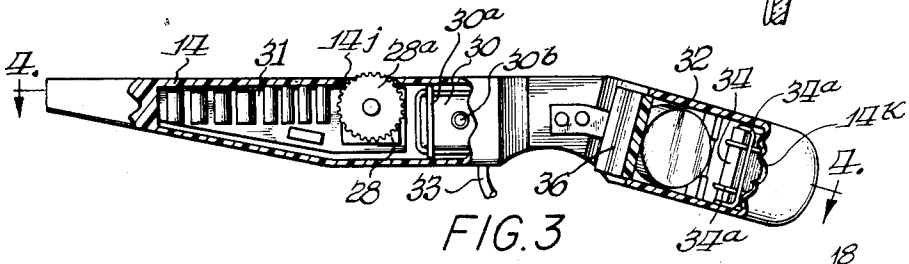


FIG. 3

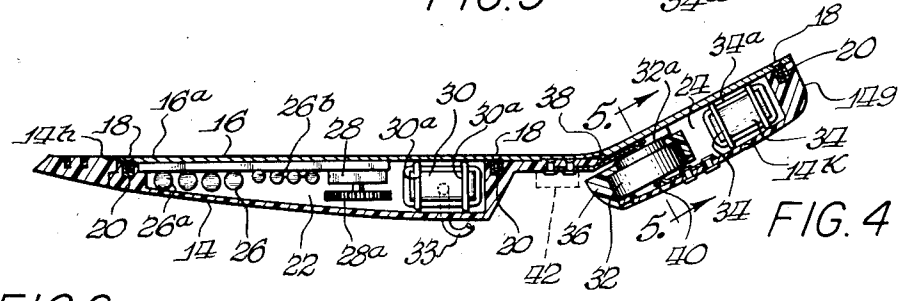
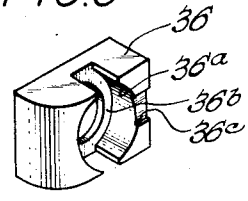


FIG. 4

FIG. 6



INVENTORS
LOUIS A. Mc NABB
SAM POSEN
BY George E. Frost
ATTORNEY

Sept. 13, 1960 S. POSEN ET AL 2,952,748

BINAURAL EYEGLASS HEARING AID CONSTRUCTION

Filed June 21. 1955 2 Sheets-Sheet 2

FIG. 7

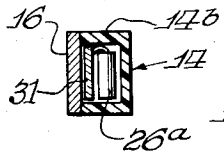


FIG. 8

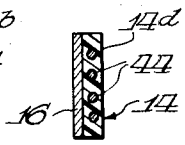


FIG. 9

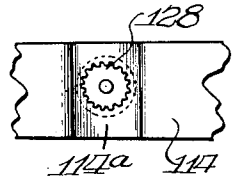


FIG. 10

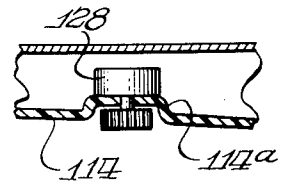


FIG. 11

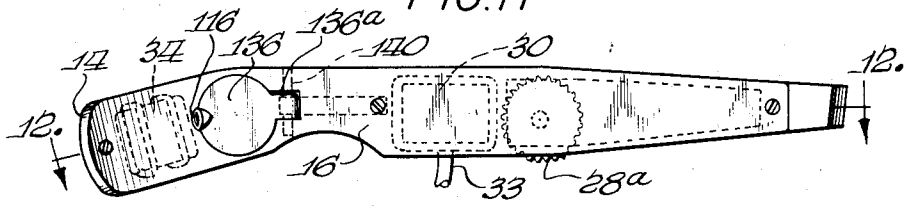


FIG. 12

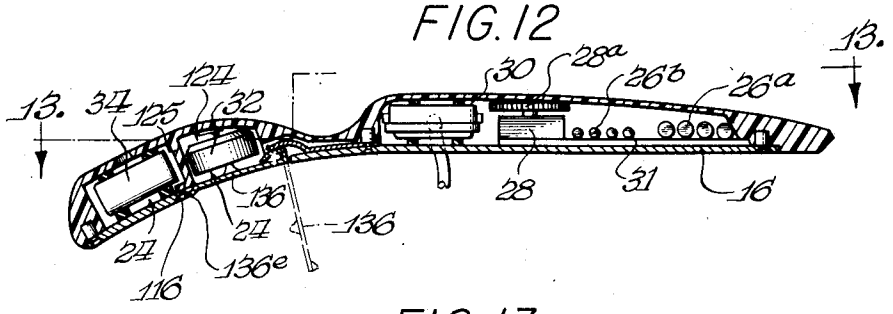


FIG. 13

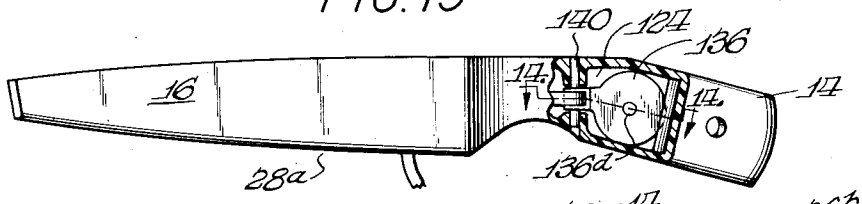


FIG. 14

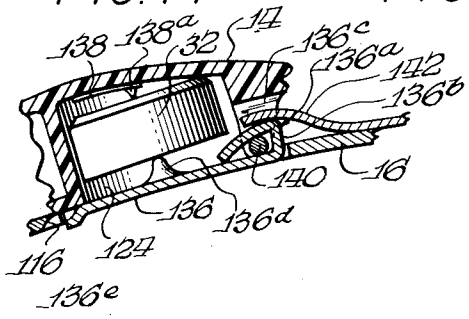
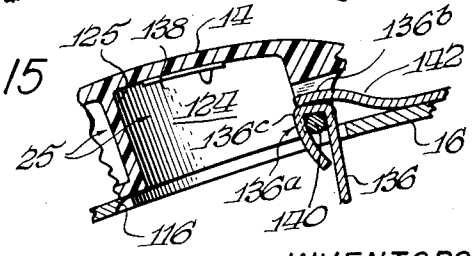


FIG. 15



INVENTORS
LOUIS A. Mc NABB
SAM POSEN
BY George E. Frost
ATTORNEY

United States Patent Office 2,952,748 Patented Sept. 13, 1960

2,952,748

BINAURAL EYEGLASS HEARING AID CONSTRUCTION

Sam Posen, Chicago, and Louis A. McNabb, Glenview, Ill., assignors to Beltone Hearing Aid Company, Chicago, Ill., a corporation of Illinois

Filed June 21, 1955, Ser. No. 516,974

7 Claims. (Cl. 179—107)

This invention relates to an improved hearing aid construction of the eyeglass type adapted for binaural use.

Commercial hearing aids have heretofore been of the type wherein the chassis, battery and microphone are carried in the pocket of the user and the receiver is mounted on the ear piece located in the ear of the user. While such construction is of considerable aid to the hard of hearing, it does give rise to a number of inherent difficulties. One of these is the problem of wiring, for the user must string a cable from the ear piece to his pocket or other location of the hearing aid casing. Necessarily this is troublesome. Also, it is noticeable and often makes the user self-conscious. Additionally, the system is monaural in character since it is usually impossible to provide two separate systems with spaced microphones as required for binaural reception. Still another problem lies in the clothing noises created about the microphone by body movements. While good design can reduce these noises, they can never be entirely eliminated.

In accordance with the present invention an improved hearing aid is provided in eyeglass form. In brief, the "front" or glass carrying portion of the eyeglass frame is made of conventional construction, preferably using a plastic as the glass supporting medium. Each of the "temples" or rearwardly extending bars of the unit is a complete self-contained hearing aid system including its own microphone, battery, receiver, and other parts. The receiver is connected to the ear-piece of the receiver by a flexible plastic sound tube which extends the comparatively short distance from the receiver to the ear. Individual volume controls for the separate hearing aid systems are provided to permit their separate adjustment to the sound levels desired.

The resultant hearing aid is integrated with the eyeglass frame in a manner which attracts minimum attention from observers. Either temple may be replaced by a dummy if hearing loss requiring correction exists in only one ear. Whether a single hearing aid or two are used, the full binaural effect of normal hearing is provided since the microphone in each temple is located in close proximity to the ear. That is, when one ear has normal hearing response it gives binaural hearing in conjunction with a single hearing aid temple, and when both ears are deficient two hearing aid temples serve to give binaural response.

The eyeglass hearing aid construction herein described is also characterized by the absence of wiring extending from one temple to the other, together with the noise and unsightliness normally attendant such wiring.

It is therefore a general object of the present invention to provide an improved hearing aid of the eyeglass type.

More specifically it is an object of the present invention to provide an eyeglass hearing aid wherein each or one of the temples, as desired, defines a unitary hearing aid.

Still another object of the present invention is to provide an eyeglass hearing aid of the binaural type.

Yet another object of the present invention is to provide an improved hearing aid construction in which a separate unit is provided for each ear and may be adjusted to compensate for the hearing loss of that ear.

Further it is an object of the present invention to provide an eyeglass hearing aid wherein the microphone is located adjacent the ear to which sound is supplied.

Another object of the present invention is to provide an eyeglass temple construction including a complete hearing aid.

Still another object of the present invention is to provide an eyeglass hearing aid in which the battery is received in a battery compartment for convenient battery replacement and inconspicuous appearance in normal use.

Other and additional objects of the present invention include the provision of an improved eyeglass hearing aid embodying features of construction, combination, and arrangement wherein the unit is small in size, inconspicuous, modest in weight, self-contained, inexpensive and simple to manufacture and reliable to the end that an apparatus of maximum utility to the hard of hearing is provided.

The novel features which we believe to be characteristic of our invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation, will best be understood by reference to the following description taken in connection with the accompanying drawings in which:

Figure 1 is a view in perspective of a complete eyeglass frame in which one of the temples includes the hearing aid of the present invention and the other temple is a matching dummy;

Figure 2 is a somewhat enlarged cross-sectional view through axis **2—2**, Figure 1, with the inner cover plate of the hearing aid temple removed;

Figure 3 is a somewhat enlarged cross-sectional view through axis **3—3**, Figure 1, with portions of the housing broken away to show the interior construction;

Figure 4 is a cross-sectional view along axis **4—4**, Figure 3;

Figure 5 is an enlarged cross-sectional view through axis **5—5**, Figure 4;

Figure 6 is a view in perspective showing the battery drawer construction;

Figure 7 is an enlarged cross-sectional view through axis **7—7**, Figure 2;

Figure 8 is an enlarged cross-sectional view through axis **8—8**, Figure 2;

Figure 9 is a fragmentary side elevation view of a temple including an alternative volume control construction;

Figure 10 is a fragmentary view like Figure 4 showing the alternative volume control construction of Figure 7;

Figure 11 is a view like Figure 2 but showing an alternate form of the present invention in full elevation form;

Figure 12 is a cross-sectional view through axis **12—12**, Figure 11 with parts in plan view;

Figure 13 is a cross-sectional view through axis **13—13**, Figure 12;

Figure 14 is an enlarged cross-sectional view through axis **14—14**, Figure 13 with the battery shown in plan; and

Figure 15 is a view like Figure 14 with the battery door open and the battery removed.

Referring now to Figure 1, the complete eyeglass frame includes a front F and a pair of temples T and T'. The front F may, for example, include a plastic frame **10** defining a nose bridge **10***a* and a pair of lens-receiving frames **10***b* having temple-supporting hinges **10***c*. The front F may carry a pair of lenses **12** which are normally ground to correct visual defects. In an eyeglass hearing aid construction such as that of the present in-

vention, these lenses may be ground flat if no visual correction is required.

The temples T and T' are riveted or otherwise affixed to the hinges **10***c* as shown. In the specific construction of Figure 1, the temple T is a dummy and is formed of plastic material of the same shape and exterior conformation as the hearing aid temple T', all as shown in Figure 1. As is described in further detail hereinafter, the temple T may, if desired, also be a hearing aid unit or, if desired, the hearing aid temple may be the right temple and the left temple may be a dummy, all as required to overcome the hearing deficiencies of the wearer.

The construction of the hearing aid temple T' is shown generally in Figure 1 and in detail in Figures 2 to 6. It consists of a main housing **14** which is of suitable plastic material and is formed in the shape shown by suitable plastic molding processes. It is of generally channel shaped cross-section as is hereinafter described in further detail. It receives the mating inner cover plate **16** to form the complete casing having cavities (**22** and **24**, Figure 4) within which the hearing aid components are mounted.

The housing **14** is of solid construction in the region **14***a* where it is affixed to the hinges **10***c*. Rearwardly of this region the housing is of U-shaped conformation as shown in Figure 7, and at **14***b*, Figure 2. In this region the housing **14** tapers gradually to increasing depth until the maximum depth is reached in the region **14***c*, as shown. Rearwardly of the region **14***c* the housing **14** is of solid construction at **14***d*. Here the bottom face **14***f* of the housing is of concave shape to seat on the ear of the wearer, thereby sustaining the complete unit in conventional eyeglass fashion. Rearwardly of the portion **14***d*, the housing **14** extends inwardly and downwardly in region **14***g*. The inward tilt of this section of the housing is best shown in Figure 4. The region **14***g* may grip the head of the wearer and thus serve to provide additional support for the complete unit in the same fashion as may be done with conventional eyeglasses.

The housing **14** is closed on its interior side by the cover **16**. As shown best in Figures 1 and 4, this cover is of mating conformation with the housing **14**. Additionally, it is shaped in its forward end **16***a* to fit into the socket **14***h* formed in the housing **14**. The cover **16** is secured in place by the screws **18**, Figures 1 and 4. These are threadedly received in the metal sockets **20** embedded in the housing **14** to form a tight threaded grip.

It will be observed that the housing **14** and the cover **16** cooperate to form a forward chamber **22**, Figure 4, and a rear chamber **24**, Figure 4. The former chamber encloses the circuit components of the hearing aid unit indicated at **26**, the volume control and on-off switch indicated at **28**, and the receiver or sound reproducer indicated at **30**. The chamber **24** encloses the battery **32** and the microphone or sound pick-up unit **34**.

The volume control **28** and the circuit components **26** are mounted on a common chassis or panel **31**, Figure 4, constructed of insulating material. Preferably, this material is a ceramic which carries on one face a printed circuit defining the necessary amplifying circuit, including resistances and the requisite circuit connections. The panel or chassis **31** may carry the transistors **26***a* and the capacitors **26***b* which are the comparatively bulky components which form the amplifying circuits. These components are located on the outboard side of the chassis or panel as shown in Figure 4. As also shown in that figure, the panel **31** may also carry the on-off switch and volume control **28**.

The volume control **28** has an adjusting knob **28***a* which extends through a slot **14***j* formed on the top surface of the housing **14**. As will be seen in Figure 1, this control is rather inconspicuously positioned and may be adjusted by the wearer to suit the particular hearing conditions encountered.

Rearwardly of the on-off switch and volume control **28**, the housing **14** receives the receiver or sound reproducer **30**. This unit is sandwiched in position by a plurality of bands **30***a* of resilient rubber or like material. These serve to insulate the reproducer **30** from vibrations and shock imparted to the housing **14**. The reproducer **30** has a sound output tube shown at **30***b*, Figure 3, which receives the sound tube **33**, Figures 1 and 4. This sound tube is of plastic material approximating the color of the human skin and extends to the ear of the wearer to fit to the plastic ear mold (not shown) in the ear. The ear mold is of conventional construction to fit snugly in the outer ear and has a channel defining a sound tube extending to the inner ear of the wearer. Thus the sound created by the reproducer **30** is channeled into the inner ear of the wearer through the tube **33** and the passage in the ear mold (not shown).

The length of the sound tube **33** is quite short. For example, it may be of the order of one inch long. It thus does not appreciably attenuate the sound and hence serves as an efficient medium to couple the reproducer **30** to the ear of the wearer.

The cavity **24** formed in the rear part of the housing **14** receives the microphone **34** as shown Figures 3 and 4. The microphone is resiliently supported within the cavity by the resilient rubber bands **34***a* which are sandwiched between the microphone and the housing. An opening **14***k* is provided in registration with the sound-receiving face of the microphone **34** to communicate to the microphone the sound incident on the portion **14***g* of the housing **14**.

The cavity **24** receives the battery **32** in the portion forward of the microphone **34**. The battery is received in the drawer **36**, shown in perspective in Figure 6. This drawer has a cylindrical battery-receiving cavity or compartment indicated at **36***a*, Figure 6, which is constricted at its bottom face by the annular web **36***b*. In use, the battery **32** has a terminal **32***a* Figures 4 and 5, which extends through the window defined by the web **36***b* for electrical contact with the inner spring contact **38**, as shown. The outer spring contact **40**, Figures 4 and 5, seats on the bottom face of the battery **32** to form the complete battery connection.

As is seen in Figures 2, 3 and 4, the housing **14** defines a window or opening **14***m* which receives the drawer **36**. The conformation of this window is such as to snugly receive the drawer. Also, the housing **14** defines a pair of rails **14***n*, Figure 2, against which the drawer **36** seats when in place as shown in Figure 5.

The spring contacts **38** and **40** seat against the opposite sides of the battery **32** to hold the drawer in closed position. They also serve to establish electrical contact with the two battery terminals. The resilient pressure of these contacts serves to provide some lock washer action to hold the drawer closed against shock and vibration. The drawer **36** has a notch **36***c* formed in its outer face to pass to outer spring contact **40**.

If desired, a removable block **42**, Fig. 4, may be provided to act as a stop to secure the drawer **36** in inserted position.

As shown in the cross-sectional view of Figure 8 the portion **14***d* of housing **14** serves both as a physical connector and as a carrier for the necessary circuit connections. These circuit connections extend from the microphone **34** (two terminals) and the battery **32** (two terminals) to the portions of the unit inwardly of the portion **14***d*. The necessary connectors may be in the form of wires embedded in the plastic constituting the housing **14** as shown at **44**, Figure 8. Alternatively, printed circuit conductors may be formed on the surface of the housing **14**, especially the inner surface which is covered by the cover **16**.

In use, the hearing aid temple T' serves to pick up sound incident upon the microphone **34**; amplify such sound by the amplifying action of the circuit and components on panel or chassis **31**; and reproduce the same through receiver **30** and tube **33** at the inner ear of the wearer. By design of the circuitry and the characteristics of the microphone **34** and receiver **30**, the frequency characteristics of such sound may be chosen to compensate for the hearing loss of the wearer in the ear to which the tube **33** is connected.

The battery **32** may be a low voltage battery, such as 1.25 volt battery. When it is necessary to replace the battery the user need only remove the drawer **36** (first detaching the stop **42**, if present), replace the battery, and restore the drawer **36** to its inserted position.

It will be observed that the temple T' is a complete unitary self-contained hearing aid unit. Unlike the hearing aid units presenty in use, the unit serves to supply sound only to one ear. Moreover, the microphone **34** is located adjacent that ear, so that the sound reproduced in the ear of the wearer is the sound which actually exists at a region very close to the ear. For this reason the unit serves to reproduce sound in a fashion closely resembling in its directional characteristics the response of a natural human ear.

It is to be particularly noted that with the above construction the directional sense of hearing is fully preserved. In other words, the wearer can detect not only the presence of sound but its direction as well. In this respect the construction of the present invention is unlike the presently used hearing aid constructions which are devoid of a direction sense and accordingly do not serve to give the wearer the same sense of hearing direction as provided by the normal ear.

Further, the construction of the present invention is very flexible. For example, if a person has defective hearing or impaired hearing in the right ear only, the dummy T would be replaced by a hearing aid like that shown at T' but formed on the right temple rather than the left temple. On the other hand, if the user has impaired hearing in both ears, both temples may be hearing aids. Moreover, since the temples are unitary hearing aids requiring no outer circuit connections there is no necessity of providing circuit connections through the front F, with the attendant disadvantages.

Still another advantage of the construction of the present invention is that in the case of a person with impaired hearing of both ears, the characteristics of separate amplifiers may be adjusted to compensate for the losses of the ears individually. Thus, if the impairment of one ear is in one frequency range and that of the other ear is in a different frequency range, the hearing aids provided in the temples may be of corresponding correction characteristics as required to provide a full restoration of hearing in each of the ears.

Figures 9 and 10 show an alternative arrangement of the on-off switch and volume control. As shown in these figures, the housing, indicated at **114**, has a recessed portion **114***a*. The on-off switch and volume control **128** is mounted within the housing **114** so that its shaft extends through this recessed portion to receive the control knob **128***a* as shown.

Figures 11 to 15, inclusive, show another alternative form of the present invention. Parts like those above discussed in connection with the form of the invention of Figures 1–6 are identified with like reference numerals.

In the construction of Figures 11 to 15 the battery **32** is placed in a compartment **124** located at the front part of the rear chamber **24**, compartment **124** being formed by the wall **125** as shown. The bottom face of compartment **124** receives a conducting bar **138** having a contact-making pointed head **138***a*. The latter acts as a stop for the battery **32** and serves to make an effective electrical contact therewith.

The open end of cavity **124** is closed by a conducting door **136**. This door is of circular conformation, as shown in Figure 11, with an outwardly extending ear part **136***a*. As shown in Figures 14 and 15 the part **136***a* extends inwardly and rearwardly to embrace the pin **140** which is embedded in the main housing **14**. This serves to define a hinge permitting the door **136** to swing to the open position of Figure 15 or the closed position of Figure 14 as desired.

The ear part **136***a* of the door **136** is bent in comparatively flat conformation at **136***b* and **136***c*, Figures 14 and 15. These serve as flats to receive the leaf spring **142** which is affixed to the cover **16** by rivets or other suitable means. When the door **136** is in closed position as shown in Figure 14 the flat **136***c* serves yieldably to hold the door in that position. When the door **136** is in the open position of Figure 15 the flat **136***b* serves releasably to hold the door in that position.

The leaf spring **142** serves the additional function of making electrical contact with the door **136**. This door has an inward protrustion **136***d*, Figure 14, which bears against the inside face of the battery **32**. The resulting circuit can be traced from the battery **32** to the protrusion **136***d*, door **136**, ear **136***a* to flat **136***c* and from the flat **136***c* to the spring **142**. The hearing aid circuit connections (not shown) are made to the conducting member **138** and to the conducting spring **142** to energize the hearing aid unit.

As shown in the figures, the door **136** in closed position is nested in the cover **16** so that the inner faces of cover **16** and door **136** are flush and present a smooth surface against the skin of the wearer. The cover **16** has a small recess which mates and cooperates with the outwardly extending portion **138***e* to form a fingernail receiving space within which the fingernail can be inserted to swing the cover **136** to open position.

It will be noted that the construction of Figures 11 to 15 lends itself to a rounded, comparatively smooth—and hence attractive—outer face on the housing **16**. Additionally, the door **136** is located on the inner face of the temple and opens outwardly in such fashion that the door is hidden and the wearing of the temple tends to hold it in closed position.

While we have shown and described specific embodiments of the present invention, it will, of course, be understood that various modifications and alternative constructions may be made without departing from the true spirit and scope of the invention. We therefore intend by the appended claims to cover all such modifications and alternative constructions as fall within their true spirit and scope.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. A hearing aid construction adapted to receive the hinge of the front of an eyeglass frame to form the temple of the complete frame, comprising in combination: an elongated member having hinge receiving conformations at its forward end to receive the hinge and at its rear end extending inwardly to grip the head of the wearer when in use, the member having a constricted portion to fit over the ear of the wearer, said constricted portion defining an inner face coextensive with the inner faces of the other parts of the elongated member to conform to the shape of the head and an outer face with a concavity to receive the ear of the wearer, the member further having inwardly facing channel portions forwardly of the ear receiving portions and rearwardly of the ear-receiving portion; a cover in mating relation with the inside face of the member to close the cavities defined by said channel portions; a hearing aid chassis, volume control, and receiver located in the cavity formed by said member and cover forwardly of the ear-receiving portion; a battery and a microphone located in the cavity formed by the member and the cover rearwardly of the ear-receiving portion; and means connecting the chassis, volume control, receiver, battery and microphone to de-

fine a complete hearing aid system responsive to sounds impinging upon the microphone.

2. A hearing aid construction adapted to receive the hinge of the front of an eyeglass frame to form the temple of the complete frame, comprising in combination: an elongated member having hinge receiving conformations at its forward end to receive the hinge and at its rear end extending inwardly to grip the head of the wearer when in use, the member having a constricted portion to fit over the ear of the wearer, said constricted portion defining an inner face coextensive with the inner faces of the other parts of the elongated member to conform to the shape of the head and an outer face with a concavity to receive the ear of the wearer; a microphone located within the confines of the member to the rear of the ear-receiving portion; a receiver located within the confines of the member forwardly of the ear-receiving portion; and means located within the confines of the member defining a hearing aid including the microphone and receiver.

3. A hearing aid construction adapted to receive the hinge of the front of an eyeglass frame to form the temple of the complete frame, comprising in combination an elongated member having hinge receiving conformations at its forward end to receive the hinge and at its rear end extending inwardly to grip the head of the wearer when in use, the member having a constricted portion to fit over the ear of the wearer, said constricted portion defining an inner face coextensive with the inner faces of the other parts of the elongated member to conform to the shape of the head and an outer face with a concavity to receive the ear of the wearer; a microphone located within the confines of the member to the rear of the ear-receiving portion; a receiver located within the confines of the member forwardly of the ear-receiving portion; means defining a flexible sound tube extending from the receiver to fit in the ear of the wearer; and means located within the confines of the member defining a hearing aid including the microphone and receiver.

4. A binaural eyeglass hearing aid construction comprising in combination: an eyeglass front having hinges at its outboard sides; a pair of temples affixed to the hinges, respectively, each temple being defined by an elongated member extending rearwardly of the hinge and at its rearward portion extending inwardly to grip the head of the wearer when in use, each member having a constricted portion to fit over the ear of the wearer, said constricted portion defining an inner face coextensive with the inner faces of the other parts of the elongated member to conform to the shape of the head and an outer face with a concavity to receive the ear of the wearer, each member having pockets located fore and aft of the ear-receiving portion, the pocket aft of the ear-receiving portion containing a microphone and the pocket fore of the ear-receiving portion containing a receiver, each member further containing means defining a unitary hearing aid system including the microphone and receiver.

5. A temple adapted to be secured to an eyeglass front to form an eyeglass hearing aid including in combination: an elongated member having a comparatively wide intermediate portion defining a pocket, a comparatively thin constricted portion aft of the intermediate portion, said constricted portion defining an inner face coextensive with the inner faces of the other parts of the elongated member to conform to the shape of the head and an outer face with a concavity to receive the ear of the wearer, and a comparatively thick rear gripping portion defining a second pocket; a receiver resiliently supported in the rear part of the pocket of the intermediate portion of the member and having a downwardly protruding tube-receiving sleeve in spaced relation to the member; a microphone located in the pocket of the rear portion of the temple; and means defining a hearing aid system including the microphone and receiver.

6. A hearing aid construction adapted to receive the hinge of the front of an eyeglass frame to form the temple of the complete frame, comprising in combination: an elongated member having hinge receiving conformations at its forward end to receive the hinge and its rear end gripping to grip the head of the wearer when in use, the member fitting over the ear of the wearer; a microphone located within the confines of the member to the rear of the ear-receiving portion; a receiver located within the confines of the member forwardly of the ear-receiving portion, the member forming a battery compartment opening on the head-receiving side thereof when in use; contact elements on the bottom of the compartment to receive and make contact with a battery therein; a conducting door swingably positioned to cover the compartment and make contact with a battery therein, the door having comparatively flat faces positioned in approximately right angle relation to each other; spring contact means adapted to bear against and make contact with the flat faces and releasably hold the door in open or closed position selectively; and, means located within the confines of the member defining a hearing aid including the microphone and receiver.

7. A hearing aid construction adapted to receive the hinge of the front of an eyeglass frame to form the temple of the complete frame, comprising in combination: an elongated member having hinge receiving conformations at its forward end to receive the hinge and its rear end gripping the head of the wearer when in use, the member fitting over the ear of the wearer; a microphone located within the confines of the member to the rear of the ear-receiving portion; a receiver located within the confines of the member forwardly of the ear-receiving portion, the member defining a battery-receiving compartment opening on the head-receiving side of the member; a conducting door swingably received on the member and in the closed position closing the compartment and forming a face generally flush with the face of the head-receiving side of the member, the door being adapted to make electrical contact with a battery in the compartment, the door and the member having mating conformations forming surfaces by which the door may be opened with the finger; and means located within the confines of the member defining a hearing aid including the microphone and receiver.

References Cited in the file of this patent

UNITED STATES PATENTS

2,207,705	Cox	July 16, 1940
2,545,731	French	Mar. 20, 1951
2,568,919	Kaye	Sept. 25, 1951
2,613,282	Scaife	Oct. 7, 1952
2,765,373	Smith	Oct. 2, 1956
2,896,024	Toomey	July 21, 1959

FOREIGN PATENTS

526,640	Belgium	Mar. 15, 1954
723,981	Great Britain	Feb. 16, 1955
990,602	France	Sept. 24, 1951

OTHER REFERENCES

Publication by " A Kumed," April 1955.