

Oct. 10 1967

A. GORDON
METHOD OF PRODUCING FITTED HEARING AID WITH
SOUND AMPLIFIER INCORPORATED THEREIN

3,345,737

Filed Dec. 17, 1963

2 Sheets-Sheet 1

FIG. 1

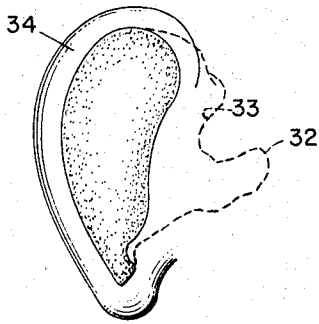


FIG. 2

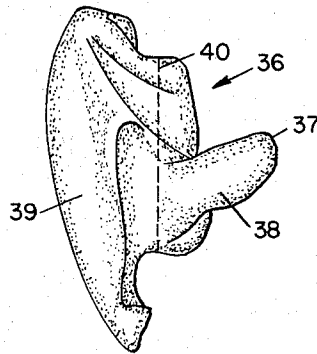


FIG. 3

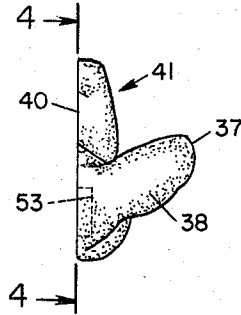


FIG. 4

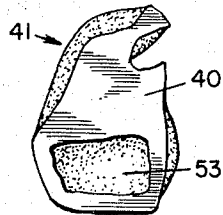


FIG. 6

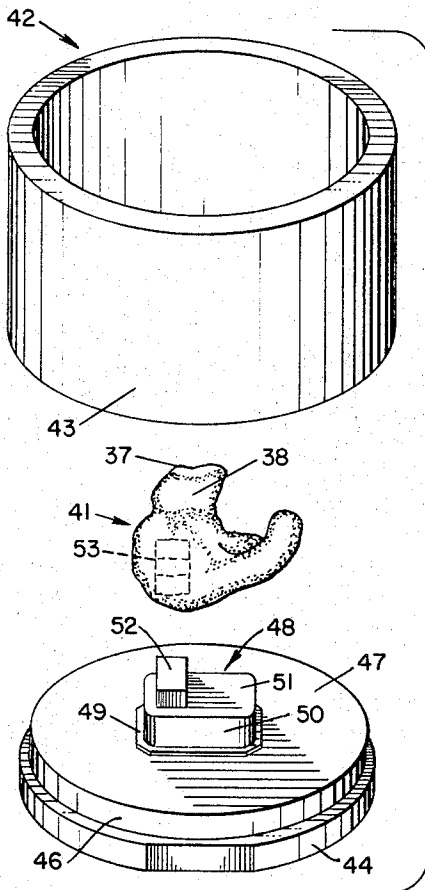
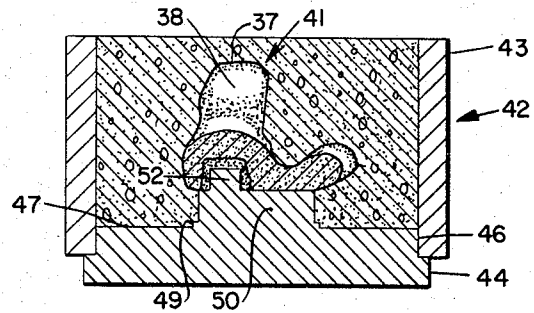


FIG. 7

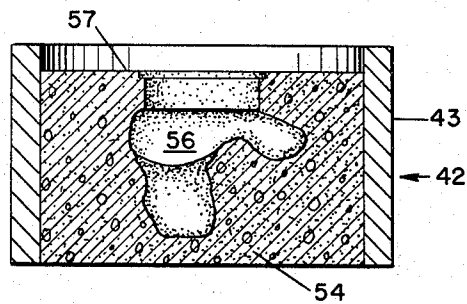


FIG. 5

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FIG. 8

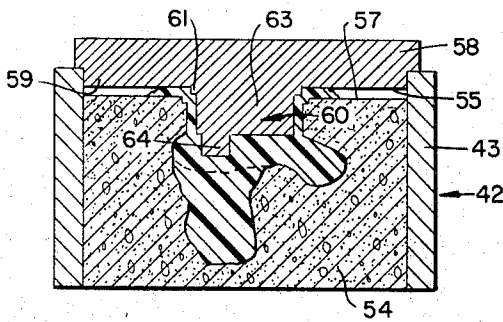


FIG. 9

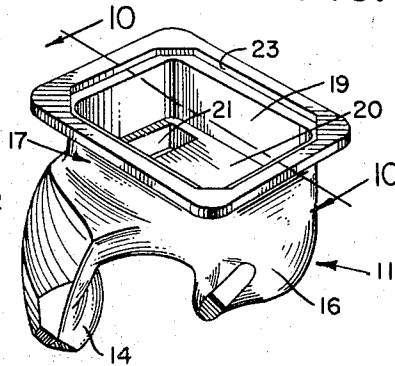


FIG. 10

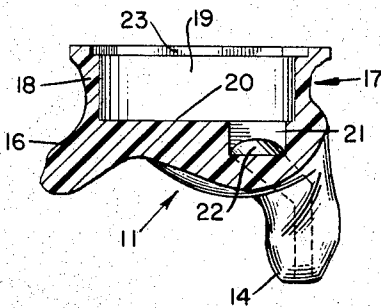


FIG. 11

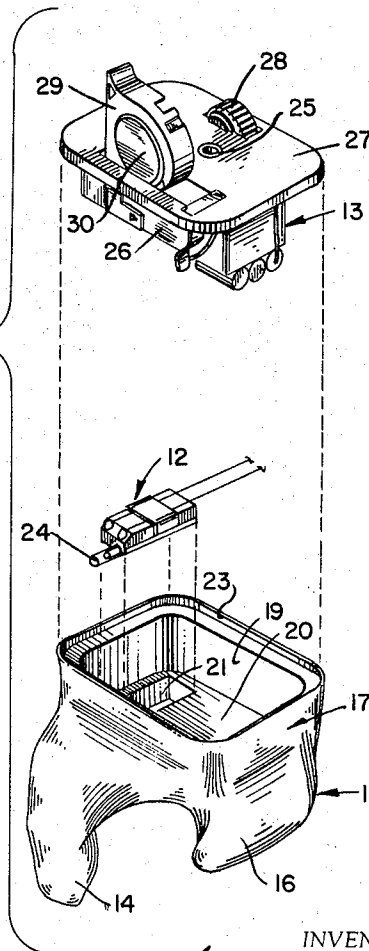
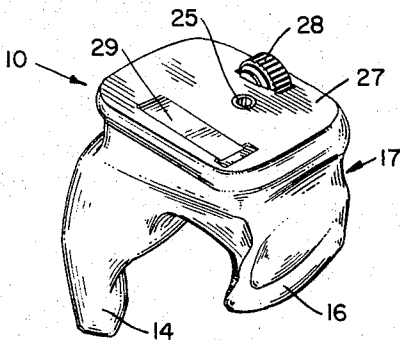


FIG. 12



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3,345,737

METHOD OF PRODUCING FITTED HEARING AID WITH SOUND AMPLIFIER INCORPORATED THEREIN

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7 Claims. (Cl. 29—527)

ABSTRACT OF THE DISCLOSURE

An impression is made in situ of an ear cavity and an external portion thereof is cut away to provide a flat-faced impression, the impressing being then fitted over two predetermined well-defining sections in a mold flask and thereby providing a mold having a cavity comprised of a replica of said impression and of said well-defining sections, producing a casting therefrom and nesting a sound amplifier of predetermined dimensions into said well-defining sections.

The present invention relates generally to improvements in hearing aids and their production and it relates particularly to an improved fitted ear plug carrying a sound amplifying system and a process for producing the same.

With the transistorization of hearing aids and the consequent great miniaturization thereof, many expedients have been proposed for producing reliable devices and with economy of manufacture and maintenance. However, such expedients have not succeeded in supplying devices having such uniformity of construction as to secure the above objectives.

It is therefore a principal object of the present invention to provide an improved hearing aid of standardized form and a method of producing the same.

Another object of the present invention is to provide an improved method for producing an ear plug custom fitted to a subject's ear and yet adapted to receive and support a standardized amplifier and transducer system, all in a most simplified fashion.

A further object of the present invention is to provide an improved fitted ear plug supported hearing aid in which an amplifier and transducer of standard form may be easily applied and removed thereby greatly facilitating the assembly, repair and replacement thereof.

Still a further object of the present invention is to provide a hearing aid of the above nature characterized by its convenience, reliability, low cost, attractive appearance and ease of repair and maintenance, and a simple method for producing the same.

The above and other objects of the present invention will become apparent from a reading of the following description taken in conjunction with the accompanying drawings wherein:

FIGURE 1 is a front perspective view of a human ear to which the improved hearing aid is to be fitted, the ear being shown as filled with an impression forming material;

FIGURE 2 is a rear perspective view of the separated impression;

FIGURE 3 is a rear perspective view of the trimmed and finished impression;

FIGURE 4 is an end view of the impression as seen along line 4—4 in FIGURE 3;

FIGURE 5 is an exploded perspective view of the flask, impression and housing pattern employed in the forming of a mold of the impression;

FIGURE 6 is a vertical sectional view of the assembled flask being filled with a mold forming material;

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FIGURE 7 is a vertical sectional view of the mold with the pattern and end wall removed;

FIGURE 8 is a vertical sectional view of the mold and assembled male or core section, the mold cavity being filled with a casting material;

FIGURE 9 is a perspective view of the finished ear plug;

FIGURE 10 is a sectional view taken along line 10—10 in FIGURE 9;

FIGURE 11 is an exploded perspective view of the finished hearing aid, and

FIGURE 12 is a perspective view of the assembled hearing aid.

In a sense the present invention contemplates the provision of a hearing aid comprising an ear plug including an auditory canal section and a concha section, a casing formed in situ in the outer face of said ear plug and having a molded cavity of predetermined dimensions formed therein, and an amplifier and receiver complementarily housed in said cavity, said canal section having a conventional longitudinal bore formed therein communicating with said cavity and said receiver.

The improved method of producing the hearing aid comprises forming an impression of an ear cavity including at least parts of the auditory canal and the outer ear, positioning a housing-defining pattern of predetermined, fixed dimensions on the face of said impression and form a mold of said impression and said pattern, positioning a well-delineating core of predetermined, fixed dimensions in the cavity of said mold with the peripheral face of said core being spaced from the housing-defining face of said mold cavity, producing a casting in said mold of an ear plug having sections which substantially mate with adjacent parts of the auditory canal and outer ear of said ear, and having a well located in the outer face of said casting, forming an axial bore through said auditory canal section communicating with said well and finally nesting and securing a sound amplifier in said well having a sound output element communicating with said bore.

Referring now to the drawings and more particularly FIGURES 9 to 12 thereof which illustrate a preferred embodiment of the present invention as related to the hearing aid, per se, the reference numeral 10 generally designates the improved hearing aid which comprises an each plug and housing unit 11, a signal-to-sound transducer or receiver 12, and an amplifier 13.

The ear plug unit 13 is integrally formed of an easily castable synthetic organic resin which forms a true replica of a mold cavity, such as the acrylic resins, for example methyl methacrylate or Tenite butyrate or the like, and includes an auditory canal mating section 14, a concha mating section 16 and a housing section 17. The canal and concha sections 14 and 16 are formed to mate with the corresponding parts of the individual subject's ear, as will be hereinafter set forth, the section 14 snugly mating the auditory canal and the concha section 16 mating a part of the outer ear adjacent the auditory canal, and although designated as the concha section may mate a smaller or larger section of the outer ear, as desired in each individual case.

Projecting from the outer face of the concha section 16 is a housing wall 18 which delineates a rectangular housing well 19 provided with a flat base 20 in which is formed a rectangular well or recess 21 of reduced cross-section, the sidewalls of well 19 being vertical and straight. An axial bore 22 is formed along the full length of the canal section 14. Formed on the outer peripheral edge of the housing wall 18 is an upstanding lip the inner face of which delineates with the inner border or shoulder of the wall 18 a plate engaging section or bezel 23. It is important that the well 19, the base 20, the

recess 21, and the bezel 23, all be of predetermined, fixed dimension so that they may receive a complementary receiver and an amplifier as will hereinafter be made clear.

The receiver 12 is of conventional form and snugly nests in the recess 21 and is provided with a sound tube 24 which registers with the sound bore 22. The amplifier 13 may likewise be of standard conventional construction and includes a body member 26 which houses and supports the amplifier network, microphone, energizing battery and volume control element and has its signal output connected to the receiver 12. The body 26 nests in the housing well 19 and is provided with a flat, face panel 27 which snugly nests in and is engaged by the bezel 23 and may be affixed in position by any suitable adhesive or releasable locking means. Mounted on the face panel 27 is a microphone 25 of standard construction and openings are formed in the panel 27 with which register a volume control knob 28 and a swingable battery case 29 which releasably houses an energizing mercury cell 30 or the like. In producing the hearing aid described above in accordance with the present improved method, and as best seen in FIGURES 1 to 9 of the drawings, an impression of the ear is first taken. Thus I employ a conventional plug 32, such as of absorbent cotton, which I insert as is usual into the inner end of the auditory canal 33 of an ear 34 for which a fitted mating ear plug is to be produced. The surface of the outer ear and the auditory canal is coated with a suitable parting agent, for example a mineral oil or a silicone oil, and the outer ear and the auditory canal is then filled with any suitable impression forming material, for example alginate or hydro-colloid material or the like which is permitted to set. The resulting impression 36 is separated from the ear and the inner end 37 of the canal section is cut off. The outer section 39 of the outer ear portion is cut from the concha section along approximately the outer plane 40 to produce the finished ear plug impression 41. It should be noticed that the location and relationship of the cutting plane 40 may be varied as desired to match the respective outer ear.

To produce the ear plug mold, a flask 42 is provided which includes an open ended cylindrical wall 43 the bottom of which is closed by a separable end wall 44 having an upper plug section 46 nesting in the lower end of the wall 43 and having a flat top face 47. A housing pattern 48 is centrally mounted atop the end wall 44 and includes a low bezel delineating base section 49 and a coaxially located block 50 of smaller perimeter than the base section 49. Projecting upwardly from the flat top face 51 of the block 50 is a locating member 52.

A recess 53 of slightly larger dimensions than the locating member 52 is formed by gouging out material from the flat end face 40 of the impression 41 and the recess 53 is brought into engagement with the locating member 52 with the impression face 40 superimposed on the block face 51, wax or other suitable material being placed in the recess 53 to effect a first separable securement of the impression 41 to the pattern 48.

The exposed faces of the impression 41 and pattern 48 and the flask face 47 are preferably coated with a parting agent and the flask is then filled with any fluid molding material, for example conventional dental stone, or the like, levelled off at the top of wall 43 and allowed to set in the usual manner. Thereafter the flask is inverted and the end wall 44 removed with the pattern 48 to provide a mold 54 having a mold cavity 56 mating the plug impression 41 and the housing pattern 48 and having a flat top surface 57 below the upper edge of the inverted wall 43.

There is provided a male mold defining second end wall 58 having a depending section 59 adapted to nest in the upper part of the inverted flask wall 43, and is of less depth than the plug section 46 and has a flat under-

face 55 which is spaced above the top surface 57 of the mold 54. Affixed to the underface of the male mold section 59 is a cavity forming core member 60 which includes a bezel delineating upper section 61, a coaxial main cavity forming block section 63 and a bottom well forming section 64, it being noted that the shape and disposition of the section 64 corresponds to that of the locating member 52. The dimensions of the sections 61 and 63 are less than those of the pattern sections 49 and 52 and suitable indexing marks are provided on the wall 43 and mold plate 58 to facilitate the mating of the mold sections 54 and 58 so that the faces of the mold sections 61 and 63 are parallel to and equally spaced from the corresponding walls of the mold cavity 56 and the mold section 64 is suitably located.

The exposed inside faces of mold cavity 56, mold section 60 and rear faces 55 and 57 are coated with a parting agent and the mold cavity 56 is substantially filled with a synthetic or organic casting resin in an unset or unpolymerized or low polymerized state. The mold plate 58 is assembled to the flask wall 43 in proper orientation relative to the mold cavity 56, the mold section 60 registering with the mold cavity 56 and the excess casting resin being squeezed into the space between the surfaces 55 and 57. Examples of casting resins which may be employed to advantage are methyl methacrylate or Tenite butyrate or the like.

The casting resin is then set or polymerized in any suitable manner such as by heating and by the use of accelerators and catalysts and the mold plate 58 is removed and the plastic casting is separated from the mold 54 in any well known fashion such as by punching the mold 54 from the flask wall 43, and shattering the mold from the casting to free the casting. A bore 22 is then formed in the canal section 14 communicating with the recess 22 formed by the mold section 64 and the casting is then finished and polished to produce the housing ear plug unit 11.

The receiver 12 is thereafter nested in the recess 21 in communication with the sound bore 22 and the amplifier body member 26 is nested in the well 19 formed by the mold section 63 with the border of the face plate 27 engaged by the bezel 23. The face plate 27 may be adhesively secured in the bezel 23 in any suitable manner as aforesaid.

In use the ear plug unit 11 is merely inserted into engagement with the mating ear and may be worn comfortably for indefinite periods and is of attractive appearance and visually unobtrusive and does not in any way interfere with the physical activity of the wearer. The receiver 12 and amplifier 13 are of standardized construction and of predetermined dimensions and may thus be easily removed and inserted in the ear plug housing thereby greatly facilitating the assembly servicing, repair and replacement thereof. Furthermore, by reason of the standardization of the amplifier and receiver unit standard flask and end mold plates may be employed in producing the fitted ear plug units. In all, I have combined a custom fitted ear impression section, with a fixed and standardized cavity molded thereto, so as to receive the complementary receiver and amplifier units. This method thus permits of substantially "mass production" in what has been heretofore considered capable of only completely individual or custom production. Of course, expenses are radically reduced.

While there has been described and illustrated a preferred embodiment of the present invention, it is apparent that numerous alterations, omissions and additions may be made without departing from the spirit thereof.

What is claimed is:

1. The method of producing an ear cavity supported hearing aid comprising forming an impression of an ear cavity including at least parts of the auditory canal and the outer ear, positioning a housing-defining pattern on the face of said impression and forming a mold of said

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impression and said pattern, positioning a well-delineating core in the cavity of said mold with the peripheral face of said core being spaced from the housing-defining face of said mold cavity, producing a casting in said mold of an ear plug having sections which substantially mate with adjacent parts of the auditory canal and outer ear of said ear, and having a well located in the outer face of said casting, forming an axial bore through said auditory canal section communicating with said well, and nesting a sound amplifier in said well having a sound output element communicating with said bore.

2. The method of producing an ear cavity supported hearing aid comprising forming an impression of an ear cavity including at least the concha portion of said ear and the adjacent part of the auditory canal, shaping the outer face of said impression to a substantially flat surface substantially corresponding to the plane of the outer edge of said ear concha portion, superimposing said flat face on the face of a housing-defining pattern and forming a mold of said impression and said pattern, positioning a well-deleting core in the cavity of said mold with the peripheral face of said core being spaced from the housing-defining face of said mold cavity, producing a casting in said mold of an ear plug having sections which substantially mate with adjacent parts of the auditory canal and outer ear of said ear and having a well located in the outer face of said casting, forming an axial bore through said auditory canal section communicating with said well, and nesting a sound amplifier in said well having a sound output element communicating with said bore.

3. The method of producing an ear cavity supported hearing aid comprising forming an impression of an ear cavity including at least the concha portion of said ear and the adjacent part of the auditory canal, shaping the outer face of said impression to a substantially flat surface substantially corresponding to the plane of the outer edge of said ear concha portion, forming a well in said flat face and attaching said impression to a housing-defining pattern provided with a projection registering with said well and having a flat face abutting said flat face of said pattern, forming a mold of said impression and said pattern, positioning a well-delineating core in the cavity of said mold with the peripheral face of said core being spaced from the housing defining face of said mold cavity, producing a casting in said mold of an ear plug having sections which substantially mate with adjacent parts of the auditory canal and outer ear of said ear and having a well located in the outer face of said casting, forming an axial bore through said auditory canal section communicating with said well, and nesting a sound amplifier in said well having a sound output element communicating with said bore.

4. The method of producing an ear cavity supported hearing aid comprising forming an impression of an ear cavity including at least parts of the auditory canal and the outer ear, positioning said impression in a flask having a bottom wall carrying a housing-defining pattern with the outer face of said impression superimposed on an upwardly directed face of said pattern, pouring a mold

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forming material into said flask to form a mold of said impression and pattern, positioning a well-deleting core in the cavity of said mold with the peripheral face of said core being spaced from the housing-defining face of said mold cavity, producing a casting in said mold of an ear plug having sections which substantially mate with adjacent parts of the auditory canal and outer ear of said ear and having a well located in the outer face of said casting, forming an axial bore through said auditory canal section communicating with said well, and nesting and adhesively securing a sound amplifier in said well having a sound output element communicating with said bore.

5. The method of producing an ear cavity supported hearing aid comprising forming an impression of an ear cavity including at least parts of the auditory canal and the outer ear, positioning said impression in a flask having a removable bottom wall carrying a housing-defining pattern with the outer face of said impression superimposed on an upwardly directed face of said pattern, pouring a mold forming material into said flask to form a mold of said impression and pattern, removing said bottom wall and reversing said mold, pouring a casting material into the cavity of said mold, positioning a well-delineating core in the cavity of said mold with the peripheral face of said core being spaced from the housing defining face of said mold cavity and permitting said material to solidify to form a casting in said mold of an ear plug having sections which substantially mate with adjacent parts of the auditory canal and outer ear of said ear and having a well located in the outer face of said casting, forming an axial bore through said auditory canal section communicating with said well, and nesting and securing a sound amplifier in said well having a sound output element communicating with said bore.

6. The method of claim 5 wherein said pattern includes an upper well-defining section and a lower well-defining section of reduced cross-section to form corresponding wells in said casting, and said sound amplifier includes a signal amplifier nesting in said upper well and a signal-to-sound transducer nested in said lower well, and wherein said bore communicates with said lower well.

7. The method of claim 5 wherein said core is mounted on the underface of a wall which is applied to the upper edge of the inverted flask peripheral wall and which has an underface disposed above the upperface of the mold.

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