

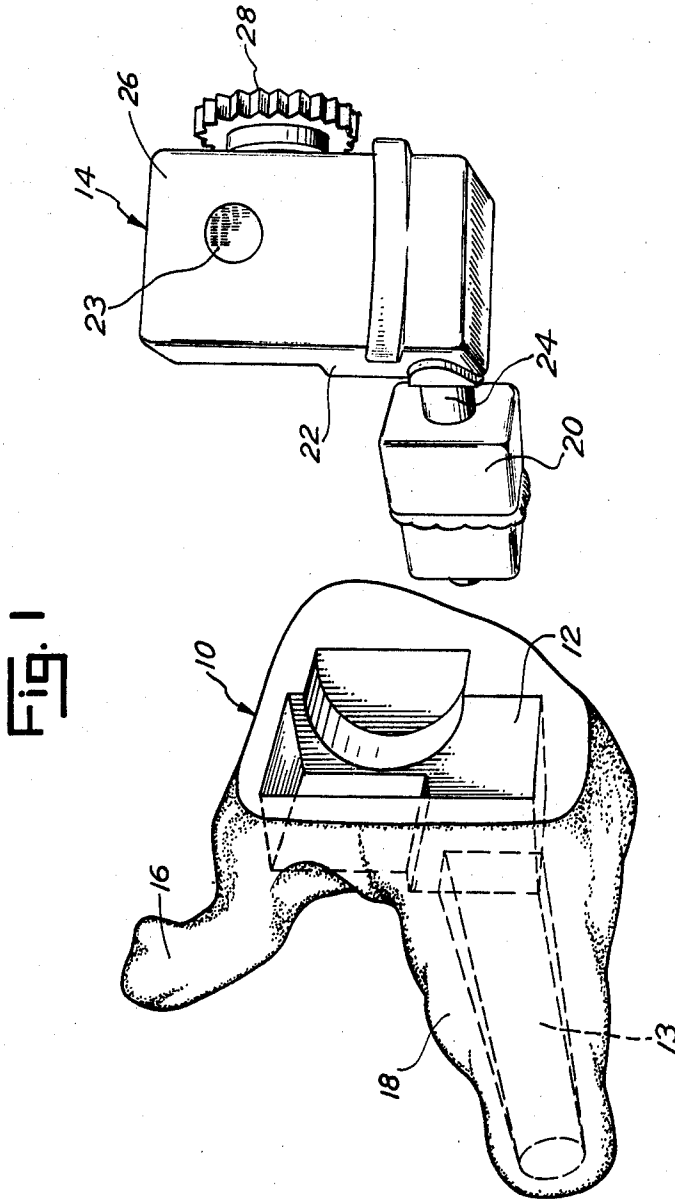
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R. F. PARKS ET AL
PROCESS FOR MAKING CUSTOM EAR MOLDS FOR
IN-THE-EAR HEARING AIDS

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Filed July 10, 1967

2 Sheets-Sheet 1



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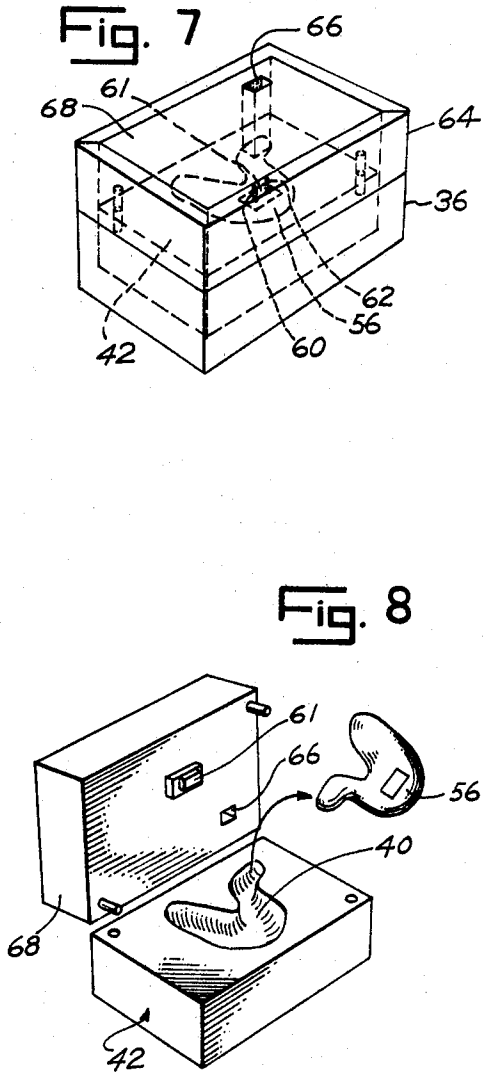
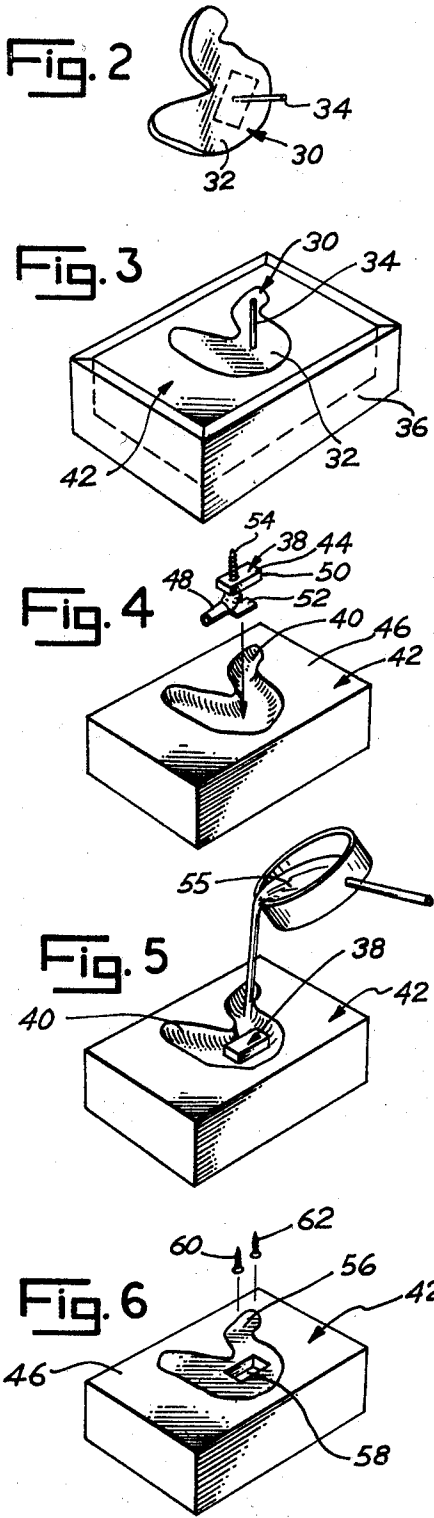
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PROCESS FOR MAKING CUSTOM EAR MOLDS FOR IN-THE-EAR HEARING AIDS

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ABSTRACT OF THE DISCLOSURE

A process for making custom earmolds for hearing aids retained within the ear cavity. The process comprises the steps of (1) taking an impression of the ear cavity, (2) casting in the lower half of a mold, a matrix of the impression, (3) positioning a dummy model of the hearing aid within the matrix, (4) pouring a latex material around the dummy, (5) removing the dummy, (6) casting an epoxy model of the dummy with fasteners protruding from the top of the epoxy model, (7) casting the top half of the mold over the epoxy model and latex impression so that the fasteners become attached to the top half of the mold, (8) separating the mold halves and (9) removing the latex impression. The bottom half of the mold with the matrix of the ear cavity and the top half of the mold with the attached epoxy model of the hearing aid mate to provide a cavity for casting a custom earmold in which the hearing aid is positioned to give optimum audio results with maximum comfort.

BACKGROUND OF THE INVENTION

This invention relates to a method for making hearing aid earmolds which are custom fitted to the ear cavity of the wearer.

The hearing aid has evolved from a cumbersome instrument requiring large batteries with long wires leading into the ear to a comparatively small instrument hidden in the hair or behind the ear. Much of the progress in hearing aids can be attributed to the miniaturization of the various components which comprise a hearing aid. In fact, with transistors and the like, it is now possible to make hearing aids which can be entirely housed within the ear cavity of the wearer.

In-the-ear hearing aids are less conspicuous, and consequently their users are less self-conscious about wearing such devices. Furthermore, being less cumbersome, they are easier to wear.

Such devices usually comprise a hearing aid unit with a plastic or rubber material earmold surrounding the unit. The receiver portion (sound outlet) of the hearing aid unit is held by the earmold in the outer ear cavity leading to the inner ear. For optimum hearing and to prevent sound leaks, the earmold is preferably custom fitted to each individual's ear cavity. Producing a custom fitted in-the-ear hearing aid is a time consuming and expensive operation since all ear cavities vary in size and shape.

Furthermore, the hearing aid unit is preferably precisely positioned within the earmold in the outer ear cavity to prevent ear irritation and provide for optimum hearing. To do this each earmold must be accurately hollowed out to receive a standard size hearing aid unit. Precisely positioning a standard size in-the-ear hearing aid unit in a custom earmold is one of the heretofore difficult problems of in-the-ear hearing aid manufacture.

SUMMARY OF THE INVENTION

In a principal aspect, the present invention comprises a method for making a custom earmold fitted to a particular

individual's ear cavity, yet adapted to receive a standard size hearing aid unit. Generally the method comprises the steps of: forming a master impression of the ear cavity, forming a pattern of the impression with a mold material in the bottom half of a mold, positioning a dummy of the hearing aid within the pattern of the impression, casting a second impression of the ear cavity around the dummy model, removing the dummy model from the casting, forming a model of the dummy in the opening left by the removed dummy, attaching the model of the dummy to the top part of a casting mold, separating the casting mold into its two parts, removing the second impression material from around the model of the dummy, and casting the custom ear mold.

It is thus an object of the present invention to provide an improved method for forming earmolds especially adapted to an individual's ear cavity.

It is a further object of the present invention to provide an improved method for making an earmold into which a standard size hearing aid unit may be inserted.

It is another object of the present invention to provide an improved and economical method for preparing a custom earmold which comprises simplified steps.

These and other objects, advantages, and features of the present invention will be set forth in greater detail by the description which follows:

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is an exploded perspective view of a custom earmold and a hearing aid unit;

FIGURE 2 is a perspective view of the master impression of an ear cavity;

FIGURE 3 is a perspective view of making a pattern of the impression in the bottom half of a mold;

FIGURE 4 is a perspective view illustrating the positioning of the dummy hearing aid within the pattern as formed in FIGURE 3;

FIGURE 5 is a perspective view illustrating the casting of a temporary earmold in the mold cavity illustrated in FIGURE 4;

FIGURE 6 is a perspective view illustrating the temporary case earmold after the dummy hearing aid has been removed;

FIGURE 7 is a perspective view illustrating the casting of the top half of the mold over the lower half of the mold; and

FIGURE 8 is a perspective view illustrating both halves of the final mold prepared to receive a material for making the custom in-the-ear hearing aid earmold.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIGURE 1 illustrates the finished product of a custom earmold 10 having a hollowed out interior region or cavity 12 for receiving the hearing aid unit 14. The earmold 10 has various curved protrusions, such as at 16, which are custom fitted into the conchas of the ear. The earmold also has an ear canal extension 18 which extends into the canal of the ear leading into the inner ear. The receiver 20 of the hearing aid unit 14 extends into the hollow tubular opening 13 in the outer ear canal portion 18 of the earmold 10. The tubular opening 13 provides a direct, uninterrupted sound path to the inner ear from the receiver 20.

The receiver 20 is the speaker portion of the hearing aid unit which provides sound to the wearer of the hearing aid unit. Sound enters the microphone amplifier battery portion 22 through the sound inlet 23 and is sent through the flexible connection 24 to the receiver 20. The connection 24 is flexible to account for varying angles that may occur in the outer canal portion 18 of various earmolds 10 due to the configuration of various person's

ears. A flesh colored cover plate 26 is inserted over the hearing aid to blend the hearing aid unit 14 with the rest of the ear and the earmold 10. A volume control button 28 at the side of the hearing aid is also provided. As noted in the drawing, all the parts of the hearing aid unit 14, including the volume control button 28, are slidably mounted in the cavity 12 and tubular opening 13 defined in the earmold 10.

The process of the present invention is illustrated by FIGURES 2-8 consecutively. In the first step, illustrated in FIGURE 2, a master impression 30 is made of the ear cavity of the person who will be using the hearing aid. This impression 30 is made by techniques well known to those skilled in the art. Preferably the impression 30 will have an outer surface 32 which is substantially parallel to the side of the head and which is substantially flat. Protruding from this outer surface 32 is a rod 34 which facilitates holding, moving, positioning and generally working with the impression 30.

Next, as shown in FIG. 3, using the ear impression 30 as a master, a replica or matrix of the ear cavity is cast in the lower part or drag 36 of a two-part flask. The material used for the casting is preferably dental stone or a suitable substitute. The face 32 of the master 30 is kept in a flush relationship with the top of the drag 36. The master impression 30 is then removed and the ear cavity 40 in the mold 42 of dental stone is sprayed with a silicon mold release or parafin material to prevent cast material from sticking to the mold 42.

A full size dummy model 38 of the hearing aid unit 14 is next positioned in the ear cavity 40 defined in the lower half of the mold 42. The outermost or top surface 44 of the dummy 38 should be positioned flush with the top surface 46 of the lower half of the mold 42.

A receiver section 48 of the dummy model 38 will bend to conform with the particular ear canal of the mold cavity 40. The body 50 and receiver section 48 of the dummy model 38 is spaced from the sides of the mold cavity 40 by cotton cloth shims 52. The cloth shims 52 are about 0.040 inch thick, however, various thicknesses may be used to provide optimum spacing. The dummy model 38 is immobilized in the cavity 40 by clamping the bolt 54 protruding from the upper surface 44 of the dummy 38 in a fixed position.

FIG. 5 illustrates the next step of pouring a silicon rubber material 56 into the ear cavity 40. Poured silicon rubber material 56 occupies all the space of the cavity 40 except that occupied by the dummy model 38. A silicon rubber material preferably used is identified by the tradename "Dow Corning RTV 521."

After the poured silicon material 56 has hardened as illustrated in FIG. 6, the dummy model 38 is removed to reveal the cavity 58. The cloth shims 52 in FIGURE 4 are not removed when the dummy model 38 is taken from the poured silicon rubber material 56. This insures that the cavity 58 defines only the volume of the dummy model 38.

After the dummy model 38 is removed, an epoxy is poured into the space 58 formerly occupied by the dummy model 38. An epoxy which is preferred is "Devcon Plastic Steel." As the epoxy stiffens, two screws 60 and 62 are inserted with their heads down and their points protruding from the epoxy. The epoxy then hardens and cures to form an epoxy model 61.

Next the upper surface 46 of the lower mold 42 is waxed to prevent the upper half of the mold from sticking to the lower half. Care is taken to insure that no wax is applied over the epoxy surface or the silicon rubber material surface. Then the upper part of the flask, or the cope, 64, is positioned over the lower part of the flask or the drag 36. The cope 64 and the drag 36 interlock to prevent sliding and mismatch of the parts of the mold. A flue block is provided leading from the top of the cope 64 to the silicon rubber impression 56.

Next dental stone is poured in the cope 64. The dental

stone is allowed to harden and the flue block is removed to define a flue aperture 66 in the top half of the mold 68. The top half of the mold 68 is then separated from the bottom half 42 as illustrated in FIG. 8.

The screws 60 and 62 which protruded from the epoxy are held in the upper half of the mold 68. This causes the upper half 68 to pull out the ear impression part 56 along with the epoxy model 61. Initially, the ear impression part 56 is still attached to the epoxy model 61. However, the ear impression portion 56 is easily removed or pulled from the epoxy model 61. This results in the completed mold comprising an upper half 68 and a lower half 42 with the earmold cavity or pattern 40 defined in the lower section and the epoxy model 61 attached to the upper section. The epoxy model 61 is precisely positioned within the cavity 40 when the lower half of the mold 42 and the upper half of the mold 68 are mated.

The custom earmold is finally prepared by pouring or molding plastic or rubber-like earmold material into the assembled mold through the flue 66. The material is then allowed to harden around the epoxy model 61 of the hearing aid unit before it is removed from the mold.

What is claimed is:

1. A method for preparing custom-size earmolds for hearing aids especially of the type having all components contained completely within the ear cavity and having the receiver portion of said hearing aid extending into the ear canal, comprising the steps of:

- (a) forming a master impression of an ear cavity;
- (b) forming a replica of said ear cavity from said master impression in a bottom mold;
- (c) positioning temporarily a dummy model of said hearing aid in said replica;
- (d) casting a second impression of said ear cavity in said replica about said dummy model;
- (e) removing said dummy model from said second impression;
- (f) casting a pattern of said dummy model in said second impression with fastening means projecting from said pattern;
- (g) casting a top mold attached to said pattern by said fastening means, said top mold being cast in fixed, redeterminable relationship with said bottom mold;
- (h) removing said second impression, said pattern and said top mold from said bottom mold by separating said top mold from said bottom mold; and
- (i) removing said second impression from said pattern, said pattern remaining in attachment with said top mold in a fixed position.

2. The method of claim 1 including the step of spraying said replica with a mold-release material prior to positioning a dummy model of said hearing aid in said replica.

3. The method of claim 1 including the final step of casting said custom size earmold with said bottom mold and top mold.

4. The method of claim 1 including the intermediate step prior to casting said top mold of coating the mold surface of said bottom mold with a mold release material to insure that said top mold and said bottom mold will separate.

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