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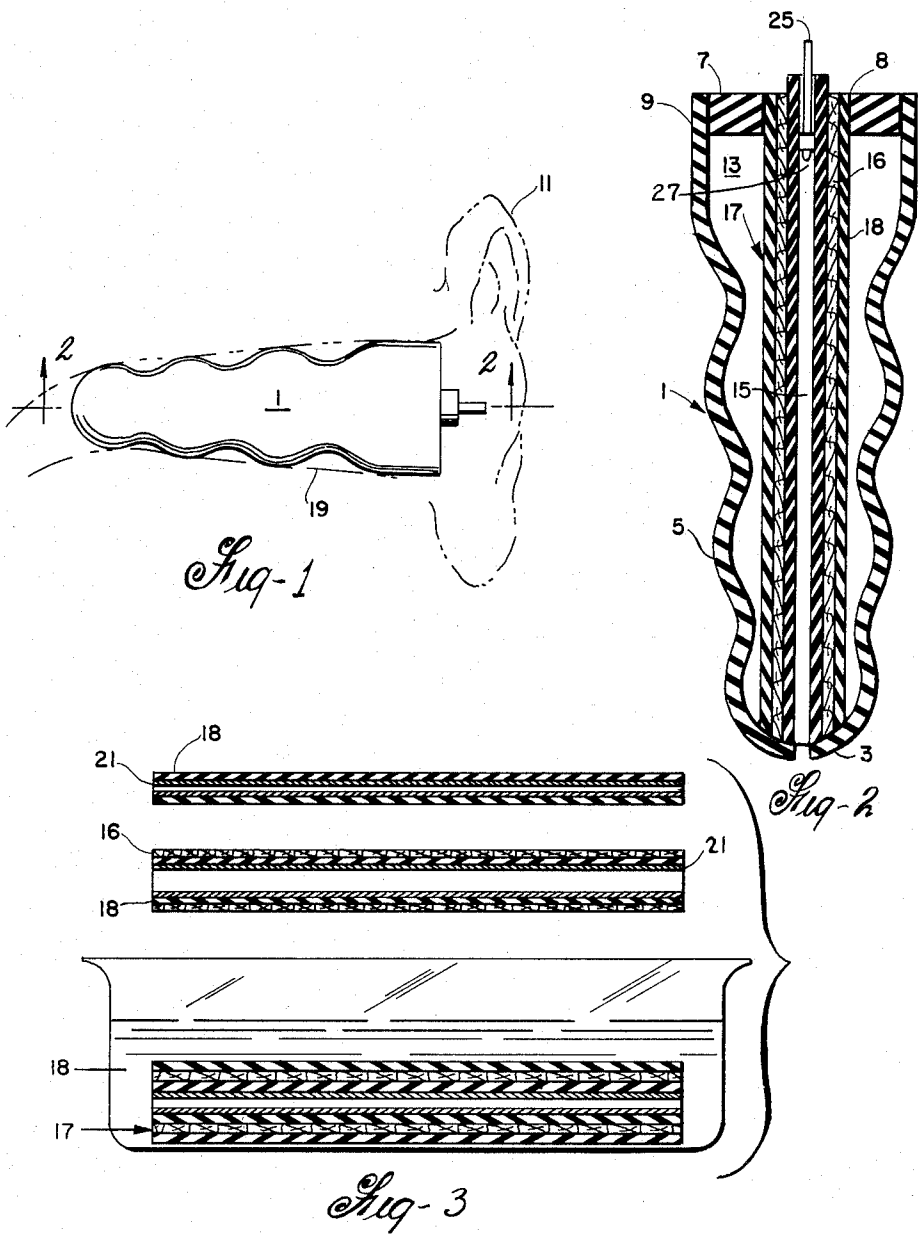
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3,131,241

METHOD FOR MAKING AN IMPROVED EAR PLUG

Original Filed Jan. 27, 1960

2 Sheets-Sheet 1



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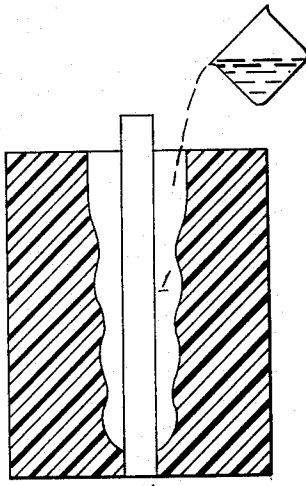


Fig-4

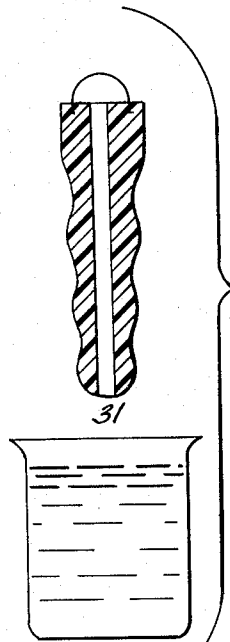


Fig-5

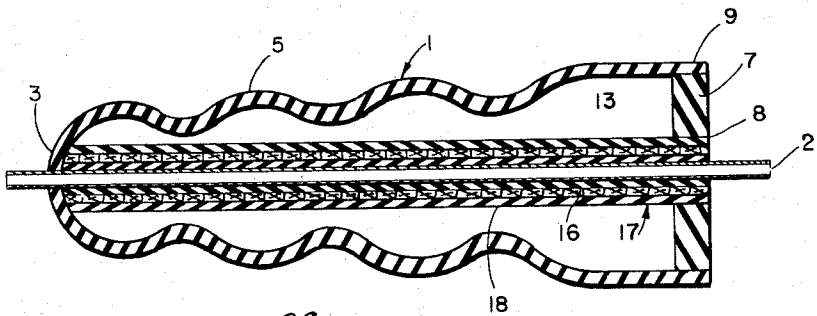


Fig-6

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3,131,241 METHOD FOR MAKING AN IMPROVED EAR PLUG

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Original application Jan. 27, 1960, Ser. No. 5,081. Divided and this application Mar. 26, 1962, Ser. No. 182,693

3 Claims. (Cl. 264—257)
(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This is a divisional application of my copending application Serial Number 5,081, filed January 27, 1960, now abandoned.

The invention relates to a method of making a plug for the external orifice of the ear canal, and is furthermore particularly concerned with devices which may be inserted into the human ear for the purpose of establishing protection for the ear against excessively loud ambient sounds, protection of the outer ear canal against invasion by water or other foreign materials, and finally for the purpose of establishing an air-tight coupling of the external auditory canal to sources of foreign acoustic intelligence. The unique feature in the attainment of these goals is the development of a suitable method for the manufacture of an ear insert device which is better than any existing device in that this particular plug is completely air-tight.

Prior ear insert devices are designed primarily for only one or two of the stated types of uses. They were usually made from solid or relatively stiff materials having only a small degree of localized resilience. Yieldability of the material was too small to prevent differential pressure areas against the sensitive tissues of the skin, thereby resulting in irritations which frequently resulted in inflammatory conditions of the ear.

One of the objects of this invention is to provide a method for the manufacture of a hollow ear plug whereby it has a high degree of yieldability.

Another object of this invention is to provide a plug which obviates the leakage of air between the ear and the insert.

A further object of this invention is to provide a multi-purpose ear plug which is capable of being used to defend against loud noises, to insure protection against water and to become an artificial auditory canal to receive hearing aids, telephone receivers and the like.

A still further object is to provide an improved plug that is simple and compact in construction.

A still further object is to provide an improved ear plug comprising an outer shell of latex rubber of a shape corresponding to the individual wearer's ear for effectively sealing the ear drum from the outside of the ear and, at the same time, being comfortable to wear.

A still further object is the provision of an artificial auditory canal having the attribute and functional efficiency of the natural canal, without the usual disadvantages associated with ear molds, sensory mechanisms and related devices.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description which is considered in connection with the accompanying drawing wherein:

FIG. 1 is an enlarged side elevational view of the plug and a sectional view of a typical human ear showing the plug inserted therein.

FIG. 2 is a longitudinal sectional view along the line 2—2 of FIG. 1.

FIGS. 3 through 6 show the various steps incorporated in the method of making the plug.

As shown in FIG. 1, the ear plug comprises an outer shell 1 preferably formed of soft rubber, either natural or synthetic, being generally shaped to fit an entire ear canal and having its smaller and hereafter designated as the inner end slightly rounded as at 3 and its outer peripheral surface undulated as at 5. This series of spaced undulations around the outer periphery of the shell enable it to be custom-fitted to the wall of the auditory canal so that only a minimum of pressure is required to be applied to the aforesaid wall in order to enable the plug to be completely supported by the ear.

The opposite end of the shell 1 is closed by the grommet or washer 7, having an aperture 8 therein, which is glued or otherwise secured to its wall 9 after the plug has been inserted into the outer shell of the ear 11, substantially as shown, thus forming a confined annular space 13 on the interior.

An elongated channel 15, being enclosed by a sleeve 17, extends from the aperture 8 in the washer 7 along the longitudinal axis of the shell 1 substantially as illustrated in FIG. 2. The sleeve 17 is composed of latex 18, woven thread 16, such as nylon or the like, and a second coating of latex 18. One end of sleeve 17 is secured to the end wall 3 of the shell and the other end of the said sleeve is secured to the washer 7 by gluing or other such means substantially as shown in FIG. 2. This open channel 15 through the shell 1 provides a sound communicating passageway into the auditory meatus of the ear. The sleeve 17, strengthened by the nylon thread, aids in the insertion of the shell into the ear canal.

The said annular space 13 contains air under slight superatmospheric pressure at body temperature, sufficient to gently hold the exterior wall in shape, but permitting it to yield resiliently under slight inward pressure applied from the exterior. As a result, the device, if it has the approximate general shape of an individual's ear canal, as to length, diameter and curvature, will, when placed inside the ear canal, automatically adjust itself to the contour of the wall 19 as illustrated in FIG. 1. In order to effect this result, it is necessary that the material be relatively thin and that the resiliency of the device be supplied principally by the air pressure within the space 13. If the resiliency of the device were furnished primarily by the properties of the material itself, an equalization of pressure along the canal wall 19 would not be possible. Pressure would then be localized because there would be no means for neutralizing unequal forces from one point to the other. With devices made out of latex in accordance with the present invention, local pressure spots are promptly equalized through the medium of the air in space 13.

A method for the preparation of the device described above is shown in FIGURES 3 through 6.

A rod 21 is immersed into a container of latex 18. Afterwards, the latex layer on the rod is covered with stiff nylon thread 16. The rod is then inserted again into the container of latex whereby sleeve 17 is formed on the rod.

The outer shell 1 is formed in the mold as shown in FIGURE 4. The latex is poured into the mold and then allowed to drain off from the mold. This step is repeated until a layer of latex is formed on the inside of the mold. Another way of forming the latex shell is by repeatedly dipping the mold, which has been machined into the desired shape from a block of plastic or the like, into a beaker of latex until the shell is formed on the outside of the mold, as shown in FIGURE 5. The rod 21 encased within the latex-nylon-latex sleeve 17 is placed

longitudinally through the center of the mold (FIG. 4) whereby the layer of latex 18 on the rod contacts the shell at the inner end 3 and is tightly bonded thereto. After a layer of latex has formed along the inside of the mold, the rod 21 is slipped from the sleeve 17 forming an elongated channel 15. The shell 1 is removed from the mold and trimmed to remove the excess latex.

If the mold is to be dipped into a beaker of latex, a hole 31 must be cut longitudinally through the center of the mold so that the rod 21 and sleeve 17 can be positioned therein so that the latex covering 18 makes contact with the end 3 of shell 1. The rod is removed from the sleeve as described hereinabove.

The shell 1 may have the end 7 adapted to receive a removable plug 25, having portion 27 being adapted to slidably and removably fit into the channel 15. By these means with the removal plug inserted into the channel, this device becomes an ear defender against loud ambient noises. In like manner a hearing aid or other such device (not shown) may be substituted for the plug 25.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described herein.

What is claimed is:

1. A method for the manufacture of an ear device so shaped to fit an entire ear canal, said method comprising the following steps:

- (1) providing a mold, said mold being undulated along the peripheral surface and being rounded at one end thereof;
- (2) placing a sleeve of nylon over a rod;
- (3) covering the sleeve of nylon with a layer of latex;
- (4) positioning the rod longitudinally along the center of the mold whereby one end of the rod contacts the rounded end of the mold;
- (5) covering the mold with a coating of latex to form a shell of latex thereon, said shell having the shape of the mold;
- (6) bonding the latex shell to the latex covering the nylon sleeve at the rounded end of the mold;
- (7) slipping the rod from the nylon sleeve to form a hollow elongated channel, bounded by the nylon sleeve covered with latex, along the longitudinal axis of the latex shell;
- (8) removing the shell of latex from the mold.

2. A method for the manufacture of an ear device so

shaped to fit an entire ear canal, said method comprising the following steps:

- (1) providing a mold, said mold being undulated along the peripheral surface and being rounded at one end thereof;
- (2) placing a sleeve of nylon over a rod;
- (3) covering the sleeve of nylon with a layer of latex;
- (4) positioning the rod longitudinally along the center of the mold whereby one end of the rod contacts the rounded end of the mold;
- (5) dipping the mold into latex to form a shell of latex thereon, said shell having the shape of the mold;
- (6) bonding the latex shell to the latex covering the nylon sleeve at the rounded end of the mold;
- (7) slipping the rod from the nylon sleeve to form a hollow elongated channel, bounded by the nylon sleeve covered with latex, along the longitudinal axis of the latex shell;
- (8) removing the shell of latex from the mold.

3. A method for the manufacture of an ear device so shaped to fit an entire ear canal, said method comprising the following steps:

- (1) providing a mold, said mold being undulated along the peripheral surface and being rounded at one end thereof;
- (2) placing a sleeve of nylon over a rod;
- (3) covering the sleeve of nylon with a layer of latex;
- (4) positioning the rod longitudinally along the center of the mold whereby one end of the rod contacts the rounded end of the mold;
- (5) repeatedly pouring latex into the mold to form a shell of latex thereon, said shell having the shape of the mold;
- (6) bonding the latex shell to the latex covering the nylon sleeve at the rounded end of the mold;
- (7) slipping the rod from the nylon sleeve to form a hollow elongated channel, bounded by the nylon sleeve covered with latex, along the longitudinal axis of the latex shell;
- (8) removing the shell of latex from the mold.

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