United States Patent [19]

Leight

[11] **3,872,559**

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[54] **EAR PLUG**

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[52] **U.S. Cl.** **128/152**

[51] **Int. Cl.** **A61f 11/02**

[58] **Field of Search** 128/151, 152; 181/23, 25

[56] **References Cited**

UNITED STATES PATENTS

2,672,863	3/1954	Leight	128/152
3,259,128	7/1966	Leight	128/152
3,736,929	6/1973	Mills	128/152

FOREIGN PATENTS OR APPLICATIONS

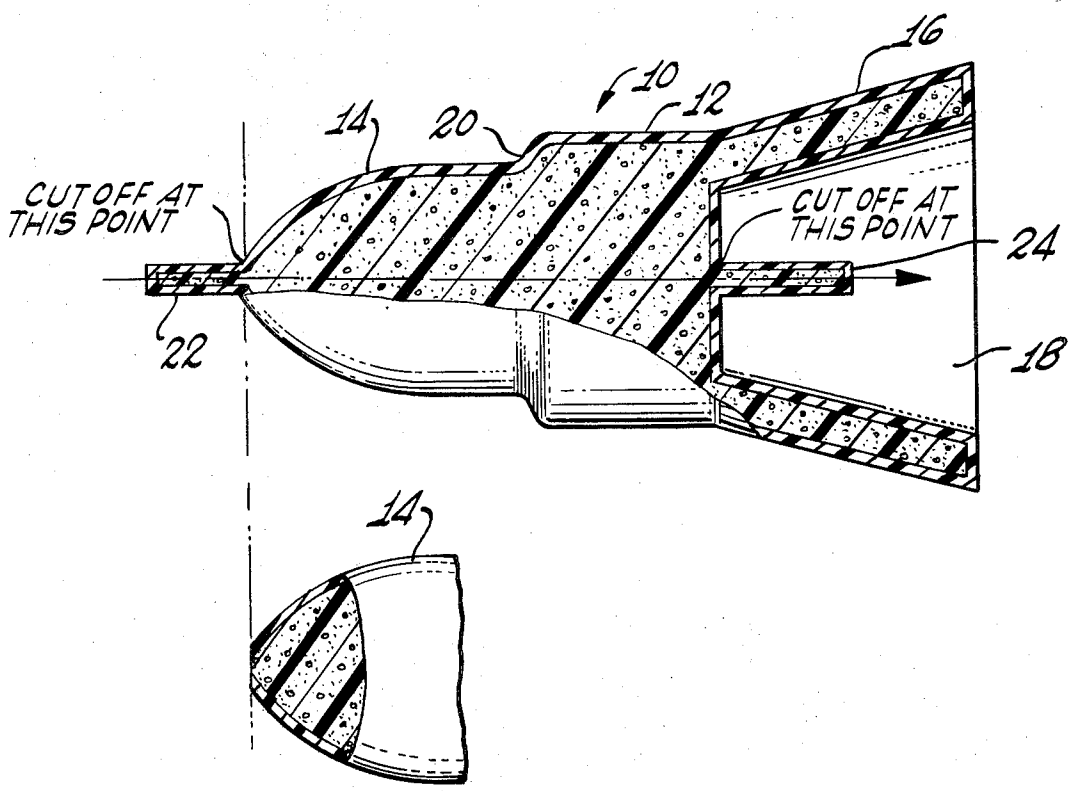
578,613	7/1946	United Kingdom	128/151

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Attorney, Agent, or Firm—Fulwider, Patton, Rieber, Lee & Utecht

[57] **ABSTRACT**

A sound attentuating ear plug molded of a single piece of material intended to fit into the ear canal and be held there without external means. The plug is made of a material having special sound attentuating qualities and is provided with a vent that permits the equalization of pressure within the ear canal and the surrounding atmosphere.

6 Claims, 4 Drawing Figures



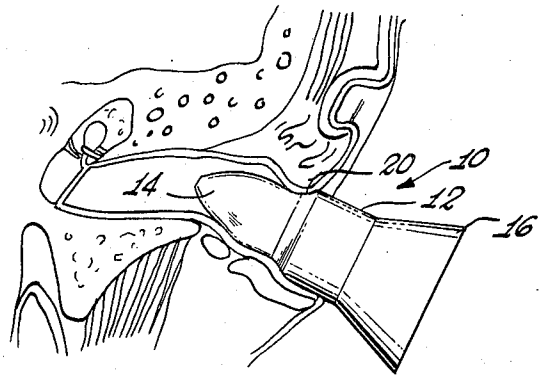


Fig. 1

Fig. 2

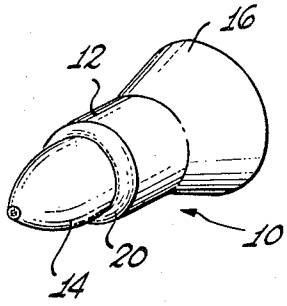
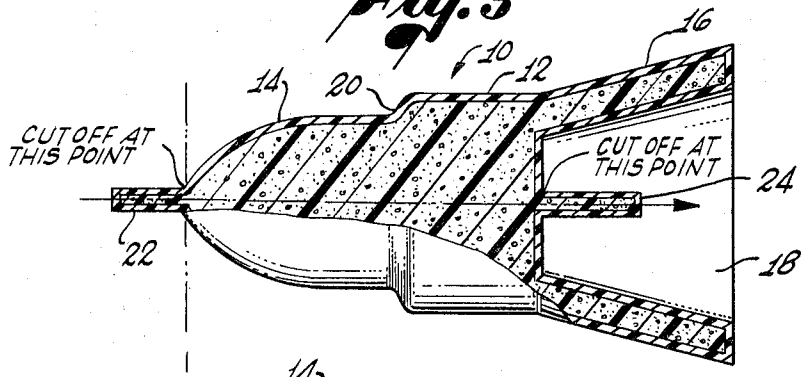


Fig. 3



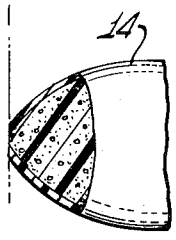


Fig. 4

EAR PLUG

BACKGROUND OF THE INVENTION

This invention is an improvement on the ear plug shown in my prior U.S. Pat. No. 2,672,863, issued Mar. 23, 1954. While that ear plug was a considerable improvement over plugs then previously existing, it had the disadvantage that two separate pieces were required and the plug had to be positioned in a special way so that its insertion into and removal from the ear canal could be best accomplished.

In the present invention, the ear plug is molded as a one-piece member, while retaining the advantages of the two-piece construction previously shown, and the shape of the plug has been improved so that special positioning is no longer required.

SUMMARY OF THE INVENTION

The ear plug of the present invention is molded of a resilient foam material, the material also having the property of forming a "skin" on its outer surface where it is in contact with the mold. Additionally, projections are provided that, when cut off, provide apertures through the skin so that pressure equalization may occur. The ear plug is a unitary member having a cylindrical body, a generally conical section attached to one end of the body, and a hollow flared section attached to the other end of said body.

DESCRIPTION OF THE DRAWING

FIG. **1** is a side elevational view of the improved ear plug indicating how it is installed in the ear and ear canal;

FIG. **2** is a front perspective view of the ear plug;

FIG. **3** is an enlarged view, mainly in cross-section, showing the ear plug as it comes from the mold; and

FIG. **4** is a fragmentary view of the front tip of the ear plug, partially in section, showing the form of the ear plug after it has been trimmed.

DESCRIPTION OF PREFERRED FORM

As best seen in FIGS. **1** and **2**, the improved ear plug **10** of the present invention consists of a generally cylindrical member **10** having a body portion **12**, and end portion **14** at one end of the body, and a hollow flared section **16** at the other end of the body **12**. The body **12** is a cylindrical section and the end **14**, having a somewhat conical shape, is concentric with the body, as is the flared section **16**. The whole device may thus be considered as a solid of revolution, and the recess **18** in the flared portion **16** is also concentric with the axis of the body. It will be noted that the body **12** is somewhat larger in diameter than the end **14**, and the two are joined by a sloping shoulder **20**.

It will be appreciated that the ear plug may be made in different sizes, but to indicate the relative dimensions and to give an indication of a size suitable for most adults, the body **12** may have a diameter of 0.400 in. and the end **14** may have its largest diameter as 0.300 in. The shoulder **20** may be formed at an angle of 45° to the axis, and thus extends radially outward 0.050 in. from the end **14** to the body **12**, and extends the same distance measured along the axis of the ear plug **10**. The maximum diameter of the flared portion **16** may be 0.525 in., and the distance from the junction of the flared portion **16** and the body **12** to the end of the flared portion may be 0.330 in. The body may have

a length of 0.200 in., and the end have a length of 0.400 in. As mentioned, these dimensions are by way of example only and to indicate the proportions of the improved ear plug.

The opening **18** within the hollow flared end **16** forms walls that, in the example given, may have a thickness of 0.065 in., a thickness which has sufficient mechanical strength to permit the ready insertion and removal of the ear plug in the ear, while still not making the plug heavy or clumsy to use.

As indicated in FIG. **3**, when the plug **10** is molded, a tip or projection **22** is molded on the apex of the end **14** and a similar tip **24** is molded in the opening **18** of the flared portion **16**, both the tips **22** and **24** being preferably located on the axis of the plug **10**. It will also be noted in FIG. **3** that the main portion of the plug **20** is of a foam construction, but that a skin portion is formed on the surface adjacent the mold. While the foam portion consists of a material having an open cell form, the skin, in effect, forms a closed surface over the open cells. The tips **22** and **24** have the skin formed on their surfaces, and the tips are of a sufficient diameter, such as 0.035 in., that the central portion of the tips is the open cell configuration of the main portion of the ear plug **10**.

After the plug **10** is removed from the mold, the tips **22** and **24** are cut off, as indicated in FIGS. **3** and **4**, at the point of connection to the plug **10**. As a result, the skin is broken at the axis of the plug, both on the apex of the point **14** and in the opening **18**. Consequently, with the open-cell construction of the ear plug, air may slowly escape from the ear canal to the surrounding atmosphere until the pressures are equalized. If the atmospheric pressure increases, the pressure within the ear canal may again be equalized to eliminate dizziness, vertigo, or other discomfort. It will be realized that the rate of flow of air through the open cell foam will be relatively slow and hence, the pressure equalization will not in any way affect the sound attenuating properties of the ear plug **10**.

While various products may be used for the material of which the ear plug **10** is made, it has been found that one of the most satisfactory materials to make the plug **10** is a foamed neoprene to which a small amount of cellulose floc has been added for maximum attenuation of the sound both by absorption and by blocking of the canal. The material also has the characteristic of forming a thin skin next to the surface of the mold. By way of example, a formula along the following lines has been found to be very satisfactory.

FORMULA

%	Material	Function
50	Neoprene Type W	Basic Polymer
q.s.	Coloring	
less than 1	"ZO 9" (Wax-Like Solid Plasticizer - Wyexley & Co., New Jersey)	Wax Plasticizer
1	Magnesium Oxide	Acid Inhibiter
less than 9	Unicel S - (50% Sodium Bicarbonate, 50% mineral oil)	Blowing Agent
less than 9	Process Oil (Light weight mineral oil)	Softener
about 4	Stearic Acid	Activator for Blowing Agent
3	Zinc Oxide	Cure Activator
less than 6	Lithopone	Toner and Filler
less than 6	Whiting	Filler
less than 1	Naugawhite Powder (Alkylated Bis Phenol)	Anti-Oxidant

FORMULA-Continued

%	Material	Function
less than 1	NA 22 (2-Mercapto-Imidayolin)	Accelerator for Cure
4	Dioctyl Sebecate	Plasticizer
5½	Sodium Bicarbonate	Blowing Agent
1	Titanium Dioxide	Toner
1	Cellulose Floc	Sound Attenuator

It is to be understood that this particular formula is not the only one that will produce satisfactory results, since it is the mechanical qualities of the ear plug that are important, rather than the chemical properties. The principal requirements are that the plug be made of a soft, open-cell, sponge material with a skin formed on its outer surface and with the skin broken to permit the venting of the ear canal.

In using the device, the tip of the ear plug **10** is inserted into the ear canal by inserting the index finger into the cavity **18** and pressing the plug into the ear until the shoulder **20** bears against the portion of the ear surrounding the end of the canal. At this point, the end portion **14** fits into the canal to plug the latter and to reduce the transmission of noise along the canal. The end **14** also acts to hold the plug **10** in the ear. The shoulder **20,** by bearing against the portion of the ear surrounding the entrance to the canal, reduces the amount of sound that is transmitted along the canal and also reduces the sound transmitted by the flesh and bone structure to the inner ear. The weight of the ear plug **10** is very light, and it can thus be worn for long periods of time with a minimum of discomfort. The venting of the canal through the open cell foam prevents changes in atmospheric pressure from causing diziness, vertigo, or other discomfort.

To remove the ear plug **10,** it is only necessary to grasp the wall of the flared section **16** between the thumb and index finger and pull outwardly to remove the tip **14** from the canal. It will be recognized that the flared wall **16** that extends completely around the axis of the ear plug **10** represents an improvement over the form of construction shown in U.S. Pat. No. 2,672,863, where a tab was provided that had to be located in a particular position in the ear so as not to interfere with the structure of the ear, while still permitting the tab to be grasped for removal of the ear plug.

From the foregoing, it will be seen that there has been provided an ear plug fully capable of achieving the objects and securing the advantages heretofore set forth. While a preferred construction has been disclosed, it is to be understood that the patent is not to be limited to the particular form or arrangement of parts herein described and shown, except as limited by the following claims.

I claim:

1. A unitary, resilient ear plug which includes:

a cylindrical body portion;

a generally conical end portion connected to a first end of said body portion coaxially therewith and forming an extension thereof;

a hollow flared portion comprising a wall connected to a second end of said body portion and forming an extension thereof, said flared portion opening in a direction away from said body portion and defining a recess coaxial with said body portion and adapted to receive the tip of a finger whereby said body and end portions of said plug may be urged into position in an ear canal, said flared portion being so sized and positioned that a single thickness thereof may be grasped for removal of said plug from an ear canal;

said body, end, and flared portions comprising a single, unitary structure formed of a self-skinning, resilient, open cell, sponge material having a skin covering the surface thereof; and

a first vent opening in said skin covering on said conical end portion and a second vent opening in said skin covering on said second end of said body portion, said first and second vent openings permitting venting of an ear canal through said open cell foam material when said plug is positioned in the canal.

2. The ear plug of claim **1,** wherein the wall of said hollow flared portion extends outwardly from said body portion, whereby the diameter of said flared portion is at least equal to the diameter of said body portion.

3. An ear plug as defined in claim **1** in which said skin covers all of said structure except for two small areas on opposite ends of said plug to provide for pressure equalization when said plug is in use.

4. An ear plug as defined in claim **1** in which said conical end has a maximum diameter less than that of said cylindrical body, said end and said body being joined by an angularly positioned shoulder.

5. An ear plug as defined in claim **4** in which said skin covers all of said structure except for two small areas on opposite ends of said plug to provide for pressure equalization when said plug is in use.

6. An ear plug as defined in claim **4** in which said conical end is of a size to fit within the ear canal and said shoulder is of a size to bear against the portion of the ear surronding said canal.

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