United States Patent

[11] 3,618,600

[72] Inventor **Harry E. Douglass**
3146 N. Verdugo Road, Glendale, Calif. 91208

[21] Appl. No. **812,047**
[22] Filed **Apr. 1, 1969**
[45] Patented **Nov. 9, 1971**

[54] **EAR STOPPLE**
7 Claims, 6 Drawing Figs.

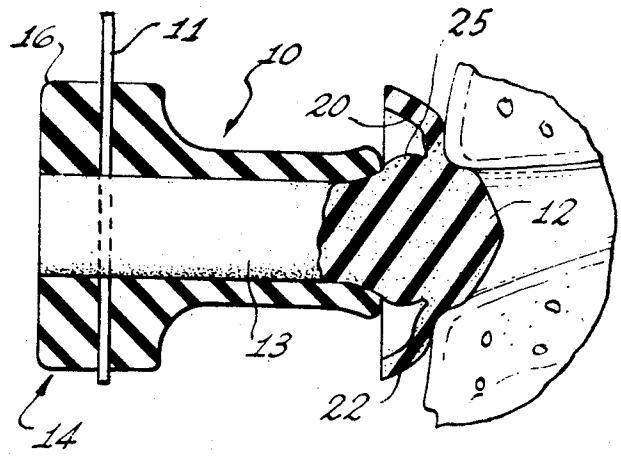
[52] **U.S. Cl.** **128/152**
[51] **Int. Cl.** **A61f 11/02**
[50] **Field of Search** 128/152; 179/182; 2/209

[56] **References Cited**
UNITED STATES PATENTS

1,355,276	10/1920	Schultz	128/152
2,492,183	12/1949	Rosenblatt	128/152
3,080,011	3/1963	Henderson	128/152 UX
3,301,258	1/1967	Glorig	128/152
3,415,246	12/1968	Hill	128/152

Primary Examiner—L. W. Trapp
Attorney—Forrest J. Lilly

ABSTRACT: An ear protector comprising a generally mushroom-shaped soft rubber head and stem, with a harder soft rubber retainer sleeve therearound, and a frustoconical section on the stem between the end portion of the retainer sleeve and the head.



PATENTED NOV 9 1971

3,618,600

PRIOR ART

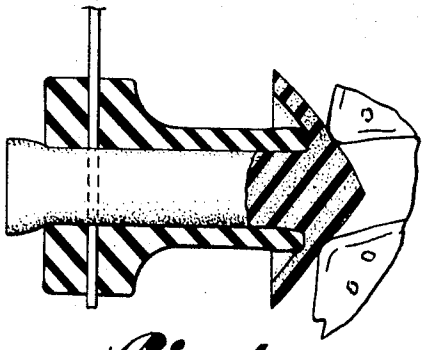


Fig. 1

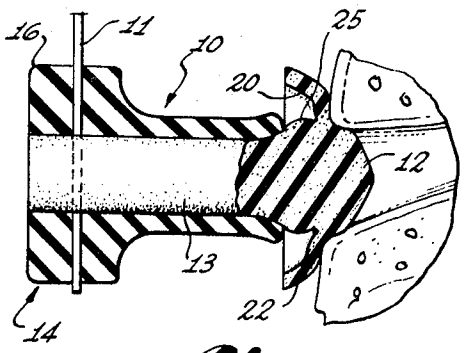


Fig. 2

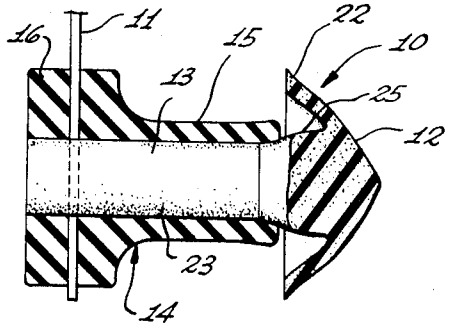


Fig. 3

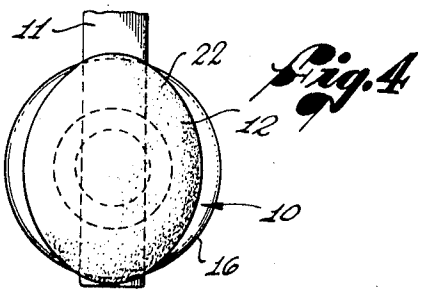


Fig. 4

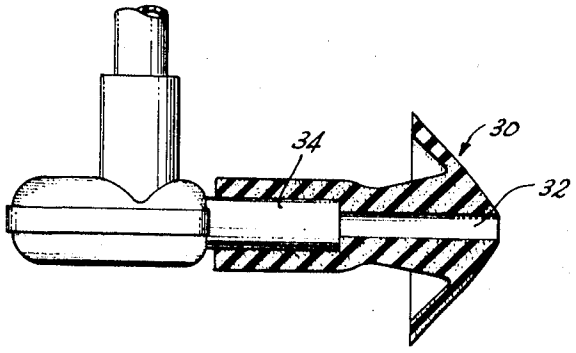


Fig. 6

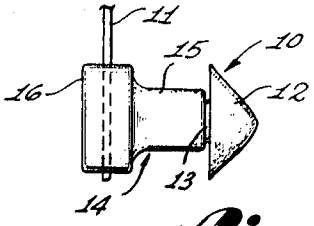


Fig. 5

INVENTOR.
HARRY E. DOUGLASS
BY Forrest J. Lilly
ATTORNEY

EAR STOPPLE

FIELD OF THE INVENTION

This invention relates generally to devices involving ear closures which may be used for any of several purposes, for example, as a protector against high-intensity noise, and, as a second example, as an improved acoustic ear coupler of a modern type of headphone.

BACKGROUND OF THE INVENTION

U.S. Pat. No. 3,301,253 to Dr. Aram Glorig discloses an ear protector which is in wide and increasing usage today. If this ear protector leaves anything to be desired, it is in that it uses a certain relatively soft rubber ear closure, of a sort of mushroom shape, referred to in said patent as a " which engages the shoulder of the ear structure along a relatively narrow band just at the entrance to the ear canal; and to assure true protection, there is used a headband which presses this closure rather tightly throughout the relatively narrow band area, against the said "shoulder" at the entrance to the ear canal. (As a matter of terminology, it is noted that the closure is more "cap" than "plug," in that it does not go into the ear canal to "stop" it in the sense of a stopper in a bottle.) Some individuals experience a degree of discomfort from this condition, i.e., pressure in this narrow band area, particularly after a long period of usage. While this condition is unfortunate, the overall merit of the Glorig ear protector is so great that it experienced wide acceptance. A primary purpose of the present invention is to incorporate in this otherwise excellent ear protector an improvement which increases its comfort without loss of its protective qualities. A feature of the present invention is that this improvement at the same time increases the attenuation of sound otherwise entering the ear by approximately an additional 10 db.

In its second-instanced application, i.e., to headphones, it is addressed to the problem of alleviating the discomfort of certain hard earplugs now commonly employed in radio receiver headphones, such as are, for example, often supplied for passengers' use on airliners. These hard earplugs rub on the ear structure around the entrance to the ear canal, and are the source of discomfort and pain after protracted wearing. A second purpose of the invention, accordingly, is the provision of an improved acoustic headphone ear fitting which can be worn over extensive periods of time without discomfort to the user.

BRIEF SUMMARY OF THE INVENTION

The invention uses, in common with the Glorig ear protector referred to hereinabove, a soft and pliable rubberlike closure head or cap, in the general form of a substantially conical or hemispherical nose, engageable against the shoulder of the ear structure around the entrance to the ear canal Integral with this head or nose is a stem, of the same material, and in the case of an ear protector, this stem is surrounded by a rubberlike retainer sleeve, which is moderately pliable, but considerably harder than the closure head and stem. The ear end of this sleeve is spaced from the closure head by a short distance, and the stem is enlarged in diameter, preferably with a gradually enlarging taper, from a point a little short of the ear end of the sleeve to the closure head. The tapered stem part is large enough at its point of "emergence" from the sleeve as to bulge substantially at that point, so that the sleeve tends to engage endwise against this "bulge," which in all effect is then the part of the closure head against which endwise pressure is exerted by the sleeve to hold the stopple tightly against the entrance to the ear canal. The overall effect is to cause the closure head not only to be pressed against the shoulder area at the entrance to the ear by the compressed and bulged stem, but to spread, or itself become bulged, somewhat, widening and improving its area of contact with the ear structure. The net result is that the ear protector may be designed to press against the ear structure with the same total force, but, engaging the ear structure with less actual pressure

(because of the increased area of pressural contact) discomfort to the ear is reduced. The "bulge" will also be seen to function as a yieldable cushion, to further alleviate discomfort to the user. At the same time, the effectiveness of the sound seal has been improved, apparently because of an enlarged area of contact. In the case of the earphone application, the same closure head and stem are used, but without the sleeve. Coupling to the ear, under moderate headband pressure, is excellent, and, at the same time, complete comfort is achieved even for hours of continuous use.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal sectional view of the ear protector of Glorig U.S. Pat. No. 3,301,253, shown in operational relationship to the canal of a human ear and the external structure thereabout;

FIG. 2 is a view similar to FIG. 1, but showing the improved device of the present invention;

FIG. 3 is a view similar to FIG. 2, but showing the device before application to an ear;

FIG. 4 is an end elevation of the ear stopple of FIG. 3;

FIG. 5 is a side elevation, to 1 to 1 scale, of the ear protector of the invention; and

FIG. 6 shows a modification for a different purpose.

DESCRIPTION OF A PREFERRED EMBODIMENT

The complete device comprises a pair of ear protectors **10**, together with a resilient headband, fragmentarily suggested at **11**, and the entirety of which, in a preferred form, is disclosed in the aforementioned U.S. Pat. No. 3,301,253. Such a headband presses the two ear protectors into the orifices of the ear canals.

Each ear protector comprises a cap, head or nose **12** with an integral stem **13**, and a retainer **14** in the form of a sleeve **15** tightly receiving the stem **13**, and with an enlarged cylindrical head **16** on its outer end.

The heads **12** and stems **13** are molded of soft, pliable rubberlike material, such as neoprene or the like, and a Shore hardness of 9 is preferred. The diameter of stem **13** is roughly comparable with the size of the entrance to the ear canal, and the stem has an expanding taper, i.e., progressive increase of radius, at the end adjacent to the ear. The head **12** of the present embodiment is generally conical, which can be modified by a slight convex curvature, as seen in profile (FIG. **5**). The somewhat pointed apex of the head of the present embodiment is of no particular significance. The stem of the present embodiment may be generally described as mushroom shaped. As seen in end elevation (FIG. **4**), the head is preferably somewhat elliptical, however, having a greater major vertical dimension than its minor horizontal dimension. Alternately, the point of the cone can be rounded off, and the stopple given a more rounded or convex profile.

The closure head **12** of the present embodiment will be seen to be undercut at **20**, so that outside of the stem **13**, the head comprises a soft and nearly limp outwardly tapering wall or lip **22**.

The stem holder or retainer **14** comprises, as mentioned above, integral mounting disc **16** and reduced coaxial sleeve **15**. An axial bore **23** extends through the disc **16** and sleeve **15**. The internal diameter of the bore **23** is typically three sixty-fourths inch less than the normal outside diameter of the stem **13**, and the stem **13** is installed in the bore **23** by longitudinally stretching the stem to reduce its diameter. This may be accomplished by any device, such as long-nosed tweezers, projected through the bore **23** and then clamped onto the extremity of the stem **13**, the head **12** being restrained while the stem **13** is stretched out sufficiently to slide easily into the described bore in the retainer. The plug is thus installed in the retainer. The end of the reduced retainer sleeve **14** is spaced, as shown, from the rearward side of the headwall **22**.

The retainer **14** is preferably also molded of a rubberlike material, such as neoprene, and is compounded to greater

hardness than the head 12 and stem 15. A Shore hardness of 30 is preferred.

In the manufacture of the ear protector once the stem 13 has been inserted inside the retainer, the lower shank 11 of a head band is inserted transversely and diametrically through the enlarged retainer disc 16 and the stem 13, as in the manner of U.S. Pat. No. 3,301,253.

The feature of novelty and principal interest in the present ear protector is that, first, the extremity of the sleeve 15 is spaced somewhat rearwardly from the wall 22 at the junction of the latter with the body of the head 12; and, second, the stem 13 has, at its end against the head 12, a portion 25 of expanding taper in the direction of the head 12. The taper begins somewhat inside the sleeve 15, as shown, and expands in diameter progressively to the wall 22. Actually, the stem is preferably perfectly straight to the point of the beginning of the taper, and is frustoconical from that point to the junction with the wall 22. The stem 13 could, alternatively, be regarded as ending at the beginning part of the taper, and the head could then be regarded as comprised of a nose part 12 confronting the ear, and a tapered part 25 joined at its small end to the stem. The sleeve 15 is of harder rubber than the stem 13 and head 12, but may nevertheless be slightly expanded by the portion of the frustoconical section contained therewithin, as shown. Beyond the end of the sleeve 15, the frustoconical portion of the stem 13 has a slight bulge, owing to the relief from confinement by the sleeve. In other words, the extremity of the sleeve is slightly expanded by the frustoconical section of the stem, and, in turn, slightly confines or compresses the beginning portion of the frustoconical section, so that the latter then bulges slightly beyond the extremity of the sleeve.

When the ear protector is then pressed tightly against the shoulder at the entrance to the ear canal by the spring pressure of the headband, the tapered portion 25 of the stem bulges further, as shown in FIG. 2, and the whole head 12 inclusive of headwall 22 also bulges, and flattens against and widens its area of contact with the surface of the ear structure outside the entrance to the ear canal. The end of the sleeve 15 then, in this state of affairs, acts against the bulge in the tapered section 25, which thus in effect becomes the member against which the sealing pressure from the headband and sleeve 15 is largely exerted. Thus, the area of pressural contact between the head or headwall 22 and the ear structure is widened and increased. Referring back to the prior art form of FIG. 1, it can be seen that the area of force transmission from the end of the sleeve directly against the headwall is largely straight ahead, and concentrated and confined on a narrow area of the shoulder at the entrance to the ear canal. The situation as seen in FIG. 1 is productive of a degree of discomfort which is completely alleviated in the improved case of FIGS. 2–5. The increased area of contact secured in FIG. 2 is quite evident. In addition, the wall 22, separated and freed from direct forcible engagement by the end of the relatively harder sleeve 15, is capable of slight rocking and resilient deformation during the compression in the bulged, tapered portion 25, so as to accommodate uniformly to the external ear surfaces all around the ear canal. In addition, as a most surprising byproduct, of very great importance, the tapered section of the stems results in an immensely improved sound seal. The area of contact is thus evidently substantially increased and distributed, and uniformly pressed into position; and an improvement of the order of 10 db. of attenuation has been determined. A still further desirable function and advantage is that the pressure in the cross section of the stem, i.e., force per unit of cross-sectional area, is necessarily reduced in the region of the "bulge, " which thus has a cushioning action that contributes added comfort to the wearer.

FIG. 5 shows an acoustic earphone. The head or ear coupler is designated at 30, and is of the form of FIGS. 2–5, accepting that it and its stem 31 have an axial bore 32. This axial bore is enlarged at a shoulder 33 to a larger diameter bore 34, and the tube 35 of an acoustic fitting 36 is inserted in bore 32 to shoulder 33. The intercommunicating tube 35, chamber 36, and coupling 37 to a source of sound are conventional. In this case, when the head 30 is pressed against the shoulder around the ear canal, the head 30 bulges, widens its area of contact, and provides a very comfortable fit to the wearer's ear. The action is in part similar to that described in connection with FIGS. 2–5. The taper of the stem toward the closure head will thus be seen to transmit the total force exerted by the spring action of the headband, but with reduced pressure, and an enlarged area over which this reduced pressure is exerted. The enlarged cross section also provides additional stock, so that the stem is less likely to bend, and so reduce the hearing canal 32. The bore 32 of course conveys sound to the wearer, and the device otherwise seals out extraneous sound.

I claim:

1. An ear protector comprised of relatively soft, yieldable, rubberlike material embodying a head engageable with the entrance to the ear canal,

an integral, reduced stem extending outwardly from the center portion of said head, an end portion of said stem toward said head expanding in cross section in the direction toward said head, and

a retainer sleeve of harder, yieldable, rubberlike material tightly surrounding said stem, with an end portion thereof confronting and engageable against said expanding portion of said neck.

2. The subject matter of claim 1, wherein said head is generally mushroom shaped in form.

3. An ear protector comprised of relatively soft, yieldable, rubberlike material embodying a generally mushroom-shaped head adapted for engagement with the shoulder structure of the ear at the entrance to the auditory canal,

a reduced stem having a forward end portion integrally joined with the center portion of said head, said stem extending rearwardly from said head, said end portion of said stem being of frustoconical shape, expanding progressively in cross section in the direction toward said head, and

a retainer sleeve of harder, yieldable, rubberlike material tightly surrounding said stem, the end of said sleeve towards said head being spaced from said head to afford a region of said stem which is unconfined by said sleeve and is adapted to form a bulge under axial compression.

4. The subject matter of claim 3, wherein the frustoconical portion of said stem begins at a point located inwardly of the extremity of said end of said sleeve, and emerges from said sleeve to provide an unconfined tapering portion inwardly of said end of said sleeve adapted to form a bulge in front of said end of said sleeve when compressive pressure exerted between the opposite end of said retainer sleeve and said head.

5. The subject matter of claim 1, wherein the expanding portion of said stem is substantially frustoconical in form.

6. An ear protector comprised of relatively soft, yieldable, rubberlike material embodying a nose-shape closure member adapted for engagement with the shoulder structure of the ear at the entrance to the auditory canal, a pressure-transmitting member joined centrally to the back of said nose-shaped closure member and projecting rearwardly therefrom, said pressure-transmitting member being formed with a sloping sidewall, so as to have a cross-sectional area which reduces from its juncture with the back of said nose-shaped closure member to a lesser area at its rearward extremity, and a stem member extending rearwardly from said rearward extremity of said pressure-transmitting member, and a retainer sleeve of harder, yieldable rubberlike material tightly surrounding said stem member with its forward end spaced rearwardly from said nose-shaped closure member, and positioned to make engagement with the sloping sidewall of said pressure-transmitting member.

7. An ear protector comprised of a body of soft, yieldable, rubberlike material including a noselike portion engageable with the entrance to the ear canal and an integral portion projecting oppositely from said noselike portion, said projecting

portion expanding progressively in the direction toward said noselike portion, and

a retainer tightly surrounding said protecting portion and confronting and being engageable axially against the expanding portion of said body in response to exertion of pressure on said retainer in the direction of said body.

* * * * *