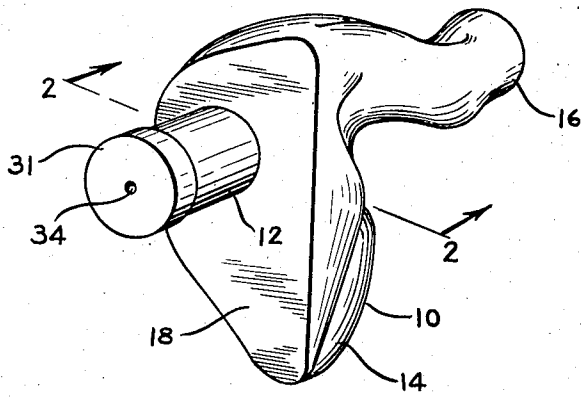
April 14, 1959 R. W. HOCKS ET AL 2,881,759

EAR PROTECTOR

Filed Dec. 10, 1956

Fig. 1



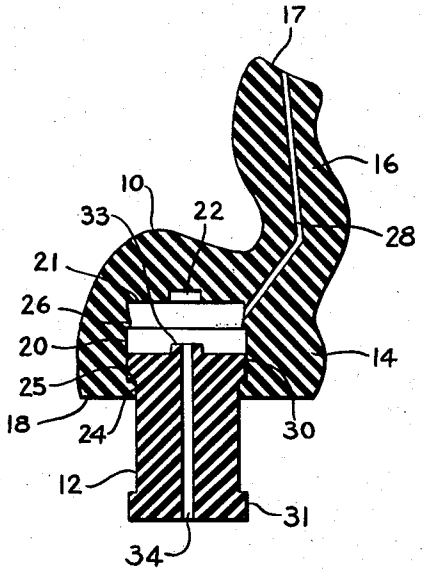


Fig. 2

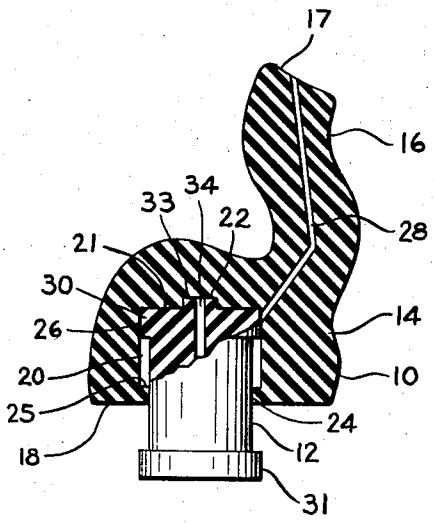


Fig. 3

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EAR PROTECTOR

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9 Claims. (Cl. 128—152)

This invention relates to an improved ear protector or plug for controlling communication between the ear drum and the outside of the ear.

Ear worn protectors or plugs for preventing injury to the ear from noise, fluid or pressure must have a substantially good peripheral seal with the outer ear portion or the auditory canal to be effective for their intended purpose. In order to accomplish such seal, a snug engagement with these rather sensitive parts is necessary, with the result that irritation readily results, and workmen or others who should wear the devices usually remove them rather than suffer the discomfort. Existing ear protectors do not overcome this inherent disadvantage.

In addition to the seal necessary between the protector and the ear, another desirable feature is a valve effective to control communication between the ear drum and the outer ear and capable of being adjusted to remain in readily distinguishable open or closed positions to prevent improper functioning of the device and possible injury to the wearer. It is often desirable, also, that the device be compact in its structure and that it does not have parts which project appreciably beyond the outer ear, so as to avoid engagement with foreign objects.

A primary object is to provide an improved ear protector which is also simple and compact in structure.

Another object of the invention is to provide an improved ear protector comprising soft rubber or soft rubber-like material 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.

Another object is to provide an ear protector having improved means for controlling the transmission of sound to the ear drum.

Another object is to provide a device of the type described which is characterized by its simplicity of construction, use and adjustment.

Another object is to provide an ear protector having resilient means for holding a valve in an auditory passageway in either open or closed positions.

Another object is to provide an ear protector having improved valve means, and, more specifically, to provide valve means which is movable between two or more positions for opening and closing passageways in the ear protector by a simple push-pull manipulation.

Still another object is to provide a device of the type described having a valve with a double seal to insure effective closing of a communicating passageway even when the valve is not completely seated in its closed position.

The ear protector of the present invention is formed of two parts, each being molded or otherwise formed preferably from a soft rubber or a soft rubber-like material such as plastic. The two parts comprise a body member and a valve. The body member is molded to fit the ear of an individual wearer and has an enlarged bore which communicates with a small duct or passageway leading to the ear drum. The valve is mounted in the enlarged bore and has an axial duct or passageway extending therethrough adapted to communicate with the duct in the body member when the valve is open by means of which sound may be transmitted to the ear drum. This valve preferably has longitudinal slidable movement between its open and closed positions.

The invention will be better understood and additional objects and advantages will become apparent from the following description taken in connection with the accompanying drawing which illustrates a preferred form of the invention. It is to be understood, however, that the invention may take other forms, and that all such modifications and variations within the scope of the appended claims which will occur to persons skilled in the art are included in the invention.

In the drawings:

Figure 1 is a perspective view of the ear protector;

Figure 2 is a sectional view taken on the line 2—2 of Figure 1 and showing the valve unseated for allowing sound to be transmitted to the ear drum; and

Figure 3 is a view similar to Figure 2 except that the valve member is seated to cut off the transmission of sound to the ear drum.

Referring in detail to the drawing, the present ear protector comprises two molded parts which are a body member **10** and a valve **12**. Body member **10** is molded to fit the ear of an individual wearer, having a portion **14** which fits the exterior portion of the wearer's ear and having a portion **16** molded precisely to the shape of the wearer's auditory canal, the protector being molded to its predetermined individual shape in a well-known manner. The body member **10** is formed of a soft, flexible rubber or rubber-like material such as plastic, and this flexible member is thus capable of fitting in the ear without damage to the ear or irritation thereof. The portion **16** conforms to the shape of the auditory canal and terminates in an end wall **17** disposed close to the ear drum. To mount the protector in the ear the portion **16** is started into the auditory canal and the protector manipulated with a twisting motion so as to move said portion fully into this canal. Due to the flexibility of the protector, and especially the portion **16**, it is readily inserted and removed without injury or discomfort to the ear.

The body member **10** has an outwardly facing surface **18** and has a longitudinal bore or cavity **20** extending inwardly from the surface **18** and terminating in an end wall **21** having a central recess **22**. The bore **20** is flanged at **24** at its opening, forming an inwardly facing shoulder **25** and adjacent the inner end of the bore **20** is a peripheral bead or flange **26**. Communicating with the bore **20** is a small duct or passageway **28** having one end opening through the end wall **17** of the portion **16** and having its opposite end opening into the bore **20**. Preferably, this latter end opening is in the side wall of the bore **20** for a reason to be described.

The valve **12**, as shown in the illustrated embodiment, is cylindrical and slidable in the cylindrical bore **20** and has a front peripheral flange **30** of approximately the same diameter as the bore **20** and a rear peripheral flange **31**, this latter flange providing a finger grip for sliding the valve longitudinally in the bore. The front wall of the valve **12** has a boss **33** through which opens a duct or passageway **34** extending axially through the valve. When the valve abuts against the inner end wall **21** of the bore **20** the boss **33** seats in the recess **22** to close off the end of the duct **34**. For such push-pull movement, of course, the valve need not be circular in cross section.

The valve **12** is not accidentally displaced from the bore **20** because of the restricted opening formed by the flange

24, although this valve, due to the flexibility thereof and the flexibility of the body member 10, may be readily inserted in the body member in assembly by forcing the flange 30 past the flange 24. Likewise, the valve may be readily removed from the body member when desired. To close the valve it is moved inwardly against the inner end wall 21 of the bore wherein the boss 33 is seated in the recess 22. In this position the sound duct 34 is closed off against the bottom of the recess 22 and the sound duct 28 is closed off by the peripheral surface of the flange 30, these wall surfaces forming a double seal. In moving the valve inwardly to its closed position the flange 30 is distorted sufficiently to ride over the bead 26, and, as this bead is of smaller diameter than the rest of the cylinder, it acts as a detent and applies a frictional grip on the flange 30 to hold the valve firmly in a seated position.

With the present duct arrangement and valve structure, wherein the duct 28 opens in a side wall of the bore 20, communication between the outer ear and the ear drum will nevertheless be cut off at this seal, even through the valve 12 is not completely seated at the bottom of the bore. More specifically, as the end of the duct 28 opens into the side wall of the bore, this opening will be covered by the flange 30 even though the valve may be slightly spaced from its seat, and, therefore, if the wearer in operating the device does not precisely seat the valve against the wall 21, the device will nevertheless provide full protection. Furthermore, as the duct 28 opens into the bore 20 in an angular relation, said opening is elongated longitudinally of the bore whereby the valve may be adjusted in an axial direction to vary the size of the opening and, therefore, control the intensity of sound received at the ear drum. The bead 26 frictionally holds the valve in any of its adjusted positions. To provide maximum transmission of sound through the valve, the valve is retracted sufficiently so that its flange 30 is spaced from the opening of the duct 28, as shown in Figure 2. The bead 26 then prevents casual movement of the valve to its closed position. For still greater sound transmission, the valve 12 may be removed from the body member 10.

The present ear protector is especially advantageous for use by workers who are subjected to noise which would result in injury to the ears in a course of time, although it is to be understood that said protector may also be used to protect the ear from other effects such as water, water pressure or gas pressure. It is particularly useful for protecting the ear against sudden changes in air or water pressure in various occupations and pursuits where persons are subjected to such conditions. As the portion 14 is molded to fit the outer ear of the individual and the portion 16 molded to fit the ear canal, the ear drum is sealed off to the outside as long as the valve 12 is closed, and, as the protector is molded of a flexible material, it will be comfortable to wear without creating any irritation in the ear. The recess 22 and boss 33 provide a positive obstruction in the duct through the protector as long as the valve is seated or substantially seated in that the boss must be removed from said recess before communication exists between the ducts 28 and 34. In addition, as was mentioned before, the duct 28 opens into the side wall of the bore 20 so that there can be no transmission of sound through the protector unless the valve is pulled a substantial distance away from the seat. To obtain the advantage of gradual adjustment, the opening of the duct 28 at the bore 20 is preferably spaced a slight distance from the end wall 21 so that it may be gradually uncovered, upon outward movement of the valve, after the boss is unseated from the recess.

The push-pull manipulation is preferred over a rotary type valve because it eliminates any confusion over the valve position and affords a very simple and economical form of construction utilizing moldable materials. Some of the important features of construction are equally applicable to rotary valves, however, and to valves having both rotary and axial movements. The double seal feature of the valve effectively prevents communication through the device even when the valve is not firmly seated in its closed position and even though the parts may be worn or not originally manufactured with the precision desired.

When the device is worn with a helmet or ear muffs, the valve member may be elongated to project into an opening in the helmet or muff for convenient external manipulation through such opening without removing the head gear. Also, it is within the scope of the invention to employ materials of different sound transmitting characteristics in the device, including liquid, air or vacuum cells, to reduce the transmission of particular frequencies.

Having now described our invention and in what manner the same may be used, what we claim as new and desired to protect by Letters Patent is:

1. An ear protector comprising a flexible body member assuming a configuration to fit outer ear portions and the auditory canal, a cavity in said outer ear portion of said body member, a sound duct in said body member communicating with said cavity, a valve slidable in said cavity in push-pull rectilinear movement between open and closed positions, and a sound duct in said valve having an exterior open end, said valve establishing communication between said two ducts in the open position thereof and closing off said communication when in closed position.

2. An ear protector comprising a flexible body member assuming a configuration to fit outer ear portions and the auditory canal, a cavity in said body member, a sound duct in said body member communicating with said cavity, an elongate plug slidably mounted for longitudinal movement in said cavity between an inner seated position and an outer retracted position, a projecting portion on said plug forming a finger grip exteriorly of said body member, said plug having a sound duct opening through the ends thereof for carrying sound from the exterior of the body member of said cavity, said plug in said retracted position permitting communication of sound through said ducts and into the inner ear and said plug in said seated position closing off communication of sound through said ducts.

3. An ear protector comprising a body member having an outer ear portion and an inner ear portion, a bore in said body member, passageway means extending through said inner ear portion and communicating with said bore, a plug in said bore having longitudinal movement between an inner seated position and a retracted position, duct means in said plug establishing communication between said bore and the exterior of said protector, and a flanged constriction in said bore, said constriction being engageable by said plug in the seated position of said plug.

4. An ear protector comprising a body member adapted to be carried in the ear, a passageway in said body portion, a bore in said body member terminating in an inner end wall, a recess in said wall, a valve slidable in said bore between a seated position against said end wall and a retracted position, a projection on said valve engageable with said recess, and duct means in said valve opening through said projection, said duct means being in communication with said passageway through said bore in the retracted position of said valve and being sealed off in said recess in the seated position of said valve.

5. An ear protector comprising a body member having a portion molded to fit the outer ear and a portion molded to fit the ear canal, a bore in said outer ear portion, a passageway from said bore through said ear canal portion, a plug having an inner end movable in said bore and an outer end projecting therefrom, and a passageway through said plug from end to end.

6. An ear protector comprising a body member having an inner ear portion adapted to be worn in the ear, a bore in said body member, a passageway from one side of said

bore through said inner ear portion, a plug having an inner end slidable in said bore and an outer end projecting therefrom, and a passageway through said plug from end to end, the inter-communicating ends of said passageways in said bore being offset from each other so that they are never in register.

7. An ear protector comprising a one piece integrally molded body member having an inner ear portion adapted to be worn in the ear, a bore in said body member, a passageway from said bore through said inner ear portion, a one piece integrally molded plug having an inner end movable in said bore and an outer end projecting therefrom for manipulative adjustment of the plug, a peripheral flange on said plug within said bore, a peripheral retention flange in the mouth of said bore for holding the plug in the bore, and a passageway through said plug from its projecting portion arranged for communication with said first passageway in one adjusted position of the plug, said plug forming a valve in a different adjusted position to interrupt communication between said passageways.

8. An ear protector comprising a one piece integrally molded body member having a portion molded to fit the

outer ear and a portion molded to fit the ear canal, a bore in said outer ear portion, a passageway from said bore through said ear canal portion, and a valve plug having an inner end movable in said bore and an outer end projecting therefrom for manipulative adjustment of the plug, said valve plug being arranged to close and open said passageway by said manipulative adjustment.

9. An ear protector comprising a molded body member of soft, resilient material having a portion molded to fit the outer ear and a portion molded to fit the ear canal, a passageway through said ear canal portion, a valve member in said outer ear portion arranged for manipulative adjustment to different stable positions for closing and opening said passageway, and flexible detent means for holding said valve member in adjusted position, said valve member being detachably retained in said body member by resilient inter-engagement of the members whereby said valve member is readily removable from said body member.

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