United States Patent

Beguin

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[54] AIR DAMPED HEARING PROTECTOR EARSEAL

[72] Inventor: **Fred P. Beguin,** Sturbridge, Mass.

[73] Assignee: **American Optical Corporation,** Southbridge, Mass.

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[52] **U.S. Cl.** **2/209**

[51] **Int. Cl.** **A41d 1/06**

[58] **Field of Search** ..... 2/208, 209, 174, 203, 3 R; 128/152; 179/156; 181/23

[56] **References Cited**

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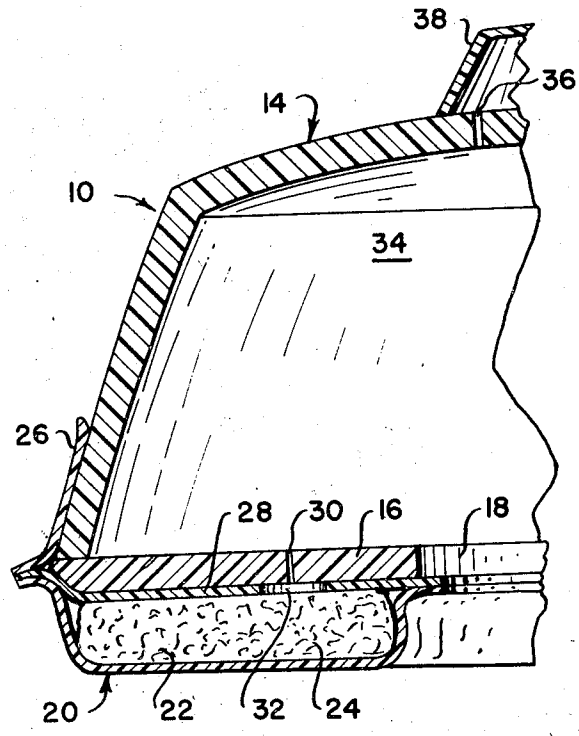
Primary Examiner—Patrick D. Lawson
Assistant Examiner—George H. Krizmanich
Attorney—William C. Nealon, Noble S. Williams and Robert J. Bird

[57] **ABSTRACT**

A hearing protector earcup having an earseal in the form of an annular envelope of highly flexible plastic sheet material held tightly against a rigid inwardly directed flange of the earcup. Capillary holes are provided through the rigid earcup flange in communication with larger openings in the envelope of the earseal wherewith airflow through the capillary orifices, into and from the earseal envelope, is exploited to achieve greater wearing comfort and strong damping of vibrations of the earcup resulting from excitation by ambient low-frequency sound waves. An additional small opening through an outer wall of the cup vents its interior.

5 Claims, 4 Drawing Figures



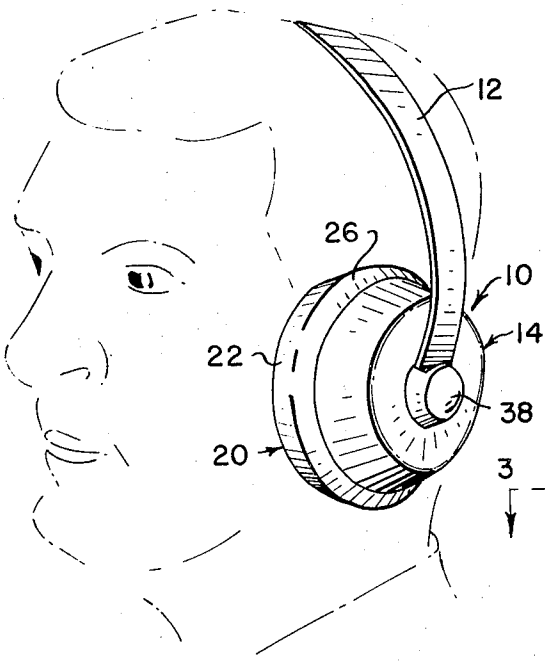


FIG. 1

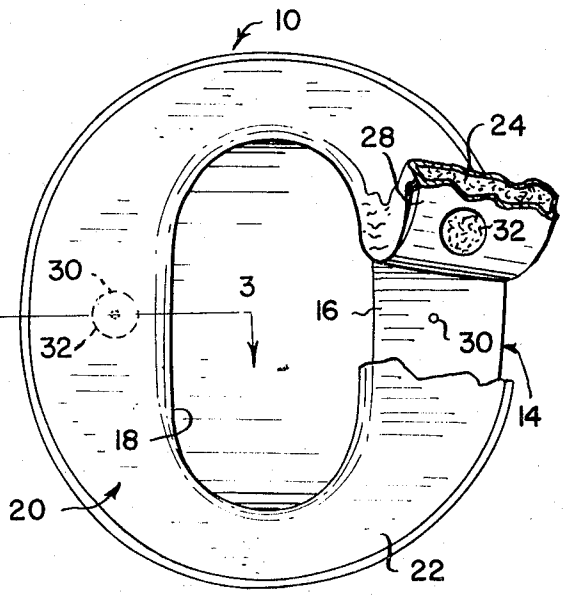


FIG. 2

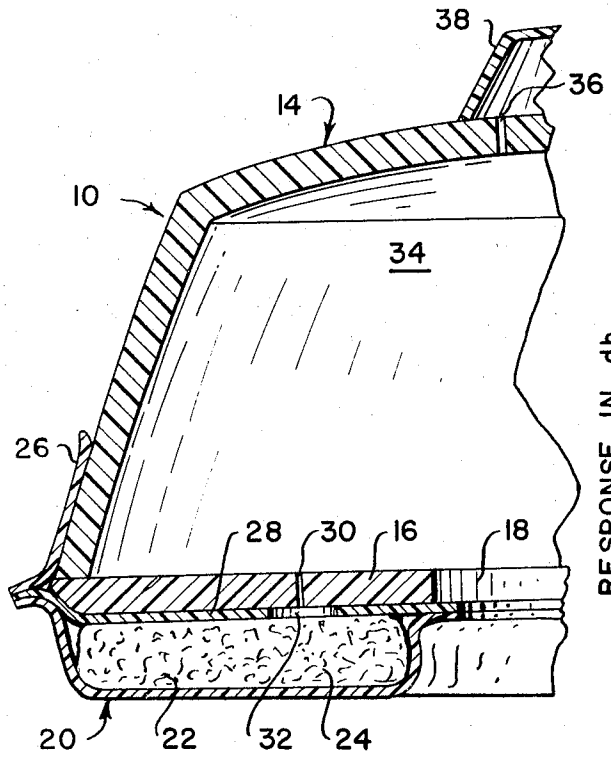


FIG. 3

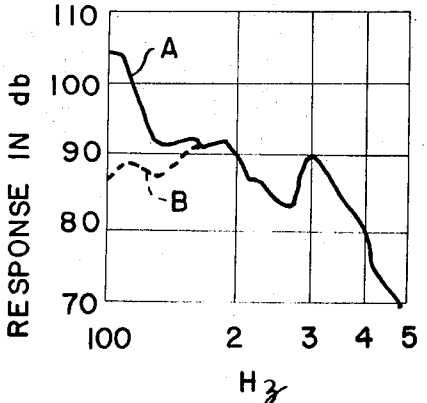


FIG. 4

INVENTOR.
FRED P. BEGUIN
BY
Robley T. Williams
ATTORNEY

AIR DAMPED HEARING PROTECTOR EARSEAL

BACKGROUND OF THE INVENTION

1. Field of the Invention

Hearing protector devices with particular reference to improvements in hearing protector earcups and earseals therefor.

2. Description of the Prior Art

Heretofor it has been attempted to vent the envelopes of hearing protector earcup earseals with holes in the side of the envelopes which rest against the rigid earseal supporting flanges of the earcups. This form of earseal venting, however, fails to provide adequate and proper "breathing" of the earseal as a result of its earcup being pressed against a wearer's head during use whereby the earseal holes become closed by the supporting flange. Closure of the vent holes accordingly permits only a limited collapse of the earseal envelope upon application to the head and prevents it from readily conforming to the shape of the head. This results in less than perfect circumaural acoustical sealing and wearing discomfort. A further result of inadequate "breathing" of the earseal is "-pumping" of the earcup toward and away from the wearer's head in resonance with external low frequency sound vibrations whereby optimum attenuation of ambient noise is not achieved.

Objectives of the present invention are to accomplish greater and longer lasting comfort in the wearing of earcup hearing protector devices and further to achieve greater attenuation of ambient noise, more particularly in the lower frequencies of sound.

The invention will be more fully understood by reference to the following detailed description taken in conjunction with the accompanying drawing.

DESCRIPTION OF THE DRAWING

FIG. 1 is an illustration, in perspective, of use of a hearing protector earcup embodying the present invention;

FIG. 2 is a plan view of the hearing protector earcup showing a portion of its earseal lifted away from its main body for purposes of illustrating a featured part of the present construction;

FIG. 3 is a greatly enlarged fragmentary cross-sectional view of the hearing protector earcup taken along line 3—3 of FIG. 2; and

FIG. 4 is a graphic representation of one example of the improvement in hearing protection offered by the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIGS. 1–3 of the drawing there is illustrated hearing protector earcup **10** which embodies the present invention. Earcup **10** is worn circumaurally and held tightly against the head with a spring steel-supporting headband **12** (FIG. 1) or its equivalent and comprises the usual rigid main body portion **14** having an earseal supporting flange **16** forming an elongated ear-receiving opening **18** in one side of cup **10**.

Positioned against rigid flange **16** is annular earseal **20** having an inner contour size and shape corresponding approximately to that of opening **18** and an outer peripheral contour size and shape corresponding to that of the outer edge of flange **16**, i.e., the outer peripheral contour of main body portion **14** of the earcup.

Earseal **20** comprises an annular peripherally heat sealed envelope **22** of thin and highly flexible plastic sheet material such as polyvinylchloride or its equivalent in function.

Envelope **22**, being contoured to the particular size and shape of supporting flange **16**, contains an internal cushion **24** of soft and highly compliant foam rubber or the like which, in a relaxed or uncompressed state, is of substantially uniform thickness throughout.

Earseal **20** is held against flange **16** by an annular rearwardly directed extension **26** (FIGS. 1 and 3) of a soft, flexible and somewhat elastic sheet material which is similar or identical to the material of envelope **22**. Extension **26** is connected to envelope **22**, e.g., by heat sealing, and holds envelope **22** against flange **16**.

Referring more particularly to FIGS. 2 and 3, it will be seen that capillary holes **30** are formed in flange **16** behind wall **28** of envelope **22** and openings **32** are provided in wall **28** of envelope **22** to establish communication between the interior of envelope **22** and the main inner ear-receiving enclosure **34** of earcup **10**. Openings **32**, being of considerably larger size (e.g., ¼ in. in diameter) than capillary holes **30**, assure clear communication between envelope **22** and enclosure **34** at all times with an allowance for considerable accidental rotational misalignment of earseal **20** relative to flange **16** of earcup **10**.

The term "capillary" is used herein to indicate the desirability of holes **30** being of small diametral size (e.g., within a range of from 0.006 in. to 0.015) wherewith air moving therethrough will meet with sufficient resistance to flow as to achieve strong damping of vibrations or motion of the earcup caused by resonance thereof to low frequency ambient sound. It is also pointed that the capillary holes **30** may be provided in numbers of 1, 2 or more and that use of the expression "number" hereinafter is to be interpreted as meaning several such holes or as few as only one. Two holes **30** have been shown in the drawing for purposes of illustration only.

With earcup **10** in use as shown in FIG. 1, for example, it is pressed firmly against the head by spring tension in headband **12** causing envelope **22** and its internally disposed soft foam rubber cushion **24** to quickly, accurately conform to the shape of areas of the head connected thereby due to venting of envelope **22** through openings **32** and capillary holes **30**. This conformance of earseal **20** to the head shape provides the twofoldness of exceptional wearing comfort and superior noise attenuation; the latter being the result of tight circumaural sealing of the cup and vibration damping resulting from highly viscous (slow) airflow through capillary holes **30**. The minute size of holes **30**, offering resistance to the flow of air therethrough, attenuates the usually encountered "pumping" action of ear cups toward and away from the head of a wearer when the cups are in resonance with low frequency ambient noise.

Noise attenuation curves A and B (FIG. 4) graphically illustrate the results of actual testing of a hearing protector earcup such as that shown and described herein. Curve A represents the response (i.e., the amount of attenuation) in decibels of the experimental earcup with its capillary holes **30** sealed so as to prevent venting of the interior of envelope **22** through flange **16**. Under identical conditions but with capillary holes **30** opened so as to permit venting between the interior of envelope **22** and enclosure **34** according to the present invention, curve B shows, with dotted outline, the considerable improvement in sound attenuation of lower frequency sound between 100 and 140 Hz. This improvement of 14 decibels or more, is directly attributable to the above-described inventive concept. It should be understood, however, that FIG. 4 is presented for illustration purposes only and does not represent limitations of the present invention.

Since a perfect circumaural seal may cause an uncomfortable overpressure to develop at the eardrum when an inwardly directed holding force is applied to the earcup by headband **12**, for example, the present invention also contemplates venting ear enclosure **34**. In this regard, a small diameter hole **36** (FIG. 3) through an outer wall of earcup **10** may be incorporated to maintain substantially constant earcup inner and outer air pressures.

It has been found that the inclusion of a 0.013 inch diameter hole **36**, in a ⅛ inch thickness of wall material of earcup **10** will accomplish desirable venting of enclosure **34** without effecting the noise attenuating capabilities of earcup **10**. Hole **36** may be located beneath dust cap **38** (FIGS. 1 and 3) to avoid plugging thereof by direct exposure to dust and/or other foreign matter.

I claim:

1. The improvement in a hearing protector earcup having an earseal in the form of an annular envelope of flexible sheet material held against a rigid inwardly directed lateral flange of the earcup comprising:

said rigid flange having a number of capillary holes extending therethrough and said one side of said earseal envelope having at least one opening therein, said opening being aligned with one of said capillary holes wherewith communication between the interiors of said envelope and said earcup through said opening and said one capillary hole is established for achieving a damping of vibrations of the earcup and enhanced wearing comfort.

2. The improvement in a hearing protector earcup according to claim 1 wherein said opening in said earseal envelope is of a substantially larger size than the diametral size of any one of said capillary holes.

3. The improvement in a hearing protector earcup according to claim 1 wherein a plurality of said capillary holes and a corresponding number of said openings are provided in said flange and earseal envelope respectively, said openings being disposed in at least approximate alignment with said capillary holes and further each being of substantially larger size than the diametral dimension of any one of said capillary holes.

4. The improvement in a hearing protector earcup according to claim 1 including a ventilative opening extending through a side of said earcup for maintaining substantially equalized air pressure internally and externally of said earcup.

5. The improvement in a hearing protector earcup according to claim 4 still further including a dust cover on said earcup extending over said ventilative opening for protection thereof against collection of ambient foreign matter.

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