

Aug. 18, 1959

W. B. WADSWORTH ET AL

2,899,683

EAR PROTECTORS

Filed July 11, 1956

2 Sheets-Sheet 1

FIG. 1

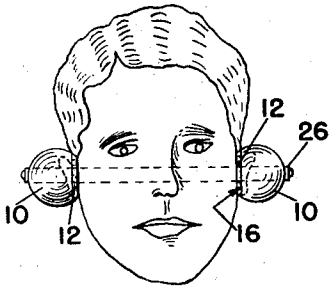


FIG. 2

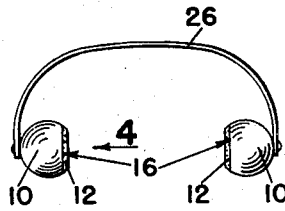


FIG. 3

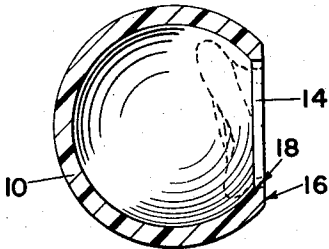


FIG. 4

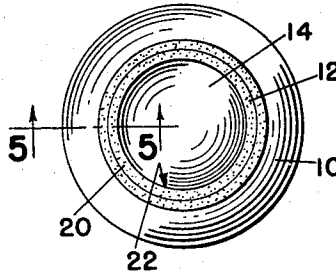


FIG. 5

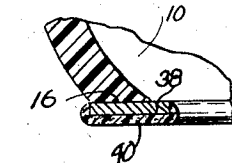
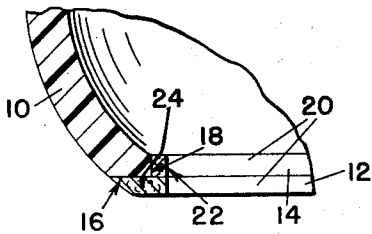
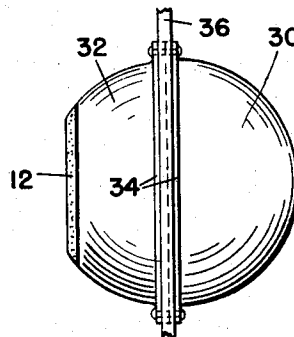


FIG. 7

FIG. 6



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FIG. 8

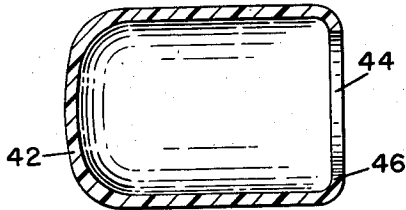


FIG. 9

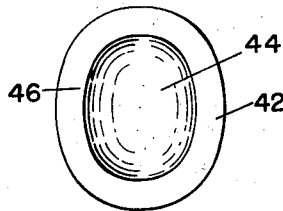


FIG. 10

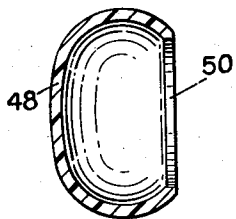
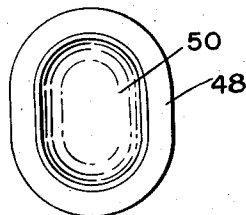


FIG. 11



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2,899,683

**EAR PROTECTORS**

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**Application July 11, 1956, Serial No. 597,161**

**5 Claims. (Cl. 2—209)**

This application is a continuation-in-part of our prior application Serial No. 449,682, filed August 13, 1954 now abandoned.

This invention relates to a new and improved acoustic ear protector device providing against the harmful effects of noise and sound waves, and the principal object of the invention resides in the provision of a device of the class described which completely avoids the use of any kind of ear plug but which instead provides a construction fitting over and surrounding the ear and closely engaging the head of the user in an area surrounding the ear.

Other objects of the invention include the provision of new and improved acoustic means for increased attenuation of sound, particularly at lower frequencies, but wherein attenuation at all frequencies is maintained or increased, whereby the desirable protection of the user against the deleterious effects of sound is provided for at all ranges and particularly in the lower low-frequency ranges which in the prior art have not been possible to protect against in a practical construction.

Other objects and advantages reside in the provision of a specific shape or shapes for the new ear protector, which shape or shapes have been discovered to provide the maximum protection against the transmission or transfer of energy by maintaining the maximum rigidity of the ear protector and the minimum of bodily motion thereof with respect to the head of the wearer, to the end that sound effects are cut down to a minimum degree due to the lack of vibration both within the structure itself and with respect to the head of the user.

Other objects and advantages of the invention will appear hereinafter.

Reference is to be had to the accompanying drawings, in which

Fig. 1 is a view in front elevation illustrating the device in position for use;

Fig. 2 is a plan view of the device;

Fig. 3 is an enlarged sectional view of one of the protectors illustrating the use of the ear protector but in the absence of any cushioning means;

Fig. 4 is an enlarged view in elevation, looking in the direction of arrow 4 in Fig. 2;

Fig. 5 is an enlarged section on line 5—5 of Fig. 4;

Fig. 6 is a view in side elevation of a modification;

Fig. 7 is a view similar to Fig. 5 but showing a modification of the cushion; and

Figs. 8 to 11 illustrate different but substantially equivalent shapes for the devices coming within the scope of the invention.

The present ear protector is in the nature of an enclosure of spherical or spheroidal shape indicated generally at 10. This construction is preferably in the form of a sphere having a relatively small segment removed therefrom forming an entrance therinto large enough for the reception of the human ear. This entrance is made as small as is commensurate with consideration to

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the comfort of the wearer, the lateral dimension or diameter of the truncated spheroid from said entrance to the part of the wall opposite the entrance being considerably greater than merely sufficient to receive the ear auricle, and also it is greater than the corresponding dimension of cup-shaped ear protectors of the prior art, which are provided with relatively larger ear openings.

Many similar but slightly different shapes come within the scope of this invention as illustrated in Figs. 8 to 11, but all forms of the invention are the same insofar as concerns the relation or ratio of the relatively small ear-receiving opening to the size of the device. This relation generally is directed to providing a large volume for the enclosure and a small ear-receiving opening.

The spherical or a spheroidal hollow body in effect has a spherical segment removed of a volume considerably less than one-half the total volumes of the body, but leaving in said body an entrance large enough for the external ear, and a very large reduction in low frequency transmissions of noise is effected, still maintaining effective attenuation at the higher frequencies. In other words, the hole for the ear leaves a hollow body of spheroidal shape (a sphere for instance) having a surface much greater than the corresponding hemisphere without a hole. The periphery and diameter of the hole is less than the major periphery and diameter of the spheroidal or similar shaped body.

Surrounding the edge occasioned by the opening of the spheroid ear protector, there is provided a very thin layer of soft material 12. This material is provided for purposes of comfort to the user and also for taking up slight variations in skull contour, it being pointed out that since the opening 14 in the spheroid body 10 is relatively small, such variations will likewise be small and therefore very little of such soft material is necessary.

One manner in which the soft material 12 may be attached to the edge of the spheroid structure is illustrated in Fig. 5 wherein the edge as at 16 of the spheroid member is provided with a rim or the like at 18 which may be applied separately or made integral with the spheroid structure 10. The layer of soft material 12 may be made in layers or the like as at 20, and these fit over the edges 16 and 18 as shown and may be applied thereto as by cement. The edge of the soft material at 22 is relatively flat and the thickness of the material between edge 22 and the edge 166 is relatively thin as indicated at 24.

It is preferable that the material of the spheroid member 10 should have a relatively high surface density, but in general any material is satisfactory for this purpose. Some commercial plastics or molded glass may be used as well as metallic substances, lead being an example of an effective but heavy material for the purpose.

The ear protectors may be applied to the ears and held in position by means of a spring band 26 or other similar means, but in any event the edges of the protectors should be relatively tightly held to the head of the user surrounding the ear. It is important that motion of the ear protector bodily with reference to the wearer should be held at a minimum and this is a reason why the soft material of the rim is held to a minimum at the section 24 thereof, as it has been found that the softer the material and the greater the thickness thereof, the more vibratory motion may be expected between the ear protector itself and the head of the user. Such motion is not desired and decreases the efficiency of the device, as it allows the transmission of energy due to the vibratory relationship thereof. How-

ever, a thicker soft rim may be used in special cases for added comfort.

Furthermore, the structure 10 itself must be held to maximum rigidity, and the spheroidal type of shape disclosed in all cases herein has been discovered to afford such maximum rigidity. Rigidity of the structure ensures against unwanted vibration of the material of the ear protector itself, as such vibration has been found to aid in the transmission of energy therethrough and thus cuts down the efficiency of the device.

In Fig. 6 there is shown a modification wherein the ear protector is made of two separate parts 30 and 32, the latter having the ear opening and the soft rim 12 thereon. Both of these parts together go to make up a shape similar to that shown in Figs. 3 and 4 and may be provided with flanges 34 secured together by any desired fasteners. In this case, a flexible material of leather or fabric 36 may be utilized to secure the ear protector in a helmet of which the member indicated at 36 may be an integral part.

Fig. 7 shows a slightly different cushion construction at the edge of the protector wherein a rigid rim 38 is applied to the edge 16 and a flanged molded cushion 40 is cemented thereto.

In all cases, soft material within the shell may be used to reduce resonance and to better attenuate sound that may enter the shell. This soft material may be in the form of a pad, or it may be an integral layer, etc.

Figs. 8 and 9 illustrate a form of protector which is of elongated but still spheroidal shape. The body of the device is identified by the numeral 42 and has an end ear-receiving opening 44 which may be restricted as for instance by the flange 46. In any case, the opening is just large enough to receive the ear, as in Figs. 3 and 4, and the surface, volume, and lateral or major axis is large with respect thereto.

Figs. 10 and 11 illustrate a construction wherein the body 48 is somewhat shortened as to lateral dimension, but still the ear-receiving opening 50 is small in ratio to the surface and volume of the body 48.

In addition to the desired rigidity described above, the present construction provides an ear protector in which the spheroidal or other shape hollow body has a very large volume as compared with the size of the opening to admit the ear. Attention is directed to the statement above that the periphery of the ear-receiving hole is less than the major periphery of the body, and this construction provides the relatively great volume of the hollow body with respect to the opening for the ear whereby the hollow body provides a great deal more space therein than is required to receive and comfortably accommodate the human ear. It is to be noted that the lateral dimension of the body from the ear opening to the wall opposite the opening is proportioned so that the ear of the user is positioned between the opening and an intermediate plane parallel to the opening and at a maximum diameter of the body, and that the distance between the opening and this plane is generally the same as or less than the distance from the plane to the wall just opposite the opening. This provides more space in the body than merely necessary to house the ear, see Figs. 1 and 3 wherein the ear auricle is dotted in. The success of the device depends at least in part on these proportions, i.e. the large volume of the body increases the attenuation of the sound waves.

This invention provides an efficient means for protecting the ears against noise in all audible ranges, and

particularly it is emphasized that the present device protects against damage occasioned by the low frequency ranges which have heretofore not been satisfactorily guarded against. At the same time, the present device also attenuates high frequency sound waves, and does not lose effectiveness here, even though being more effective in the low frequency ranges. The ear is physically protected against blows, and since no ear plug is used, the ear is found to be fully protected in all respects.

Having thus described our invention and the advantages thereof, we do not wish to be limited to the details herein disclosed, otherwise than as set forth in the claims, but what we claim is:

1. An acoustical ear protector comprising a substantially rigid imperforate hollow body of substantially spherical shape and of substantial thickness, having an inner diameter substantially greater than the size of the human ear, said body being larger than a hemisphere and having a single substantially circular ear-receiving opening therein communicating with the interior of the hollow body, said opening having a diameter substantially less than the inner diameter of the spherical hollow body.

2. An acoustical ear protector comprising a substantially rigid imperforate hollow body of generally spheroidal shape and of substantial wall thickness, having at least one inner diameter substantially greater than the size of the human ear, said body having a single ear-receiving opening therein providing communication with the interior of the hollow body, said opening having a diameter substantially less than said inner diameter of the hollow body, the latter having a lateral dimension from the ear-receiving opening to the part of the wall of the body opposite the opening, said lateral dimension being proportioned so that the ear of the user may be positioned between the opening and a plane generally parallel to the plane of the ear-receiving opening and in which said inner diameter is located, the distance from the plane including the inner diameter to said part of the wall opposite the opening being at least as great as the distance from the ear-receiving opening to the plane including said inner diameter.

3. An ear protector as recited in claim 2 wherein the hollow body is substantially spherical.

4. An ear protector as recited in claim 2 wherein the distance from the plane including said inner diameter to said opposite part of the wall is greater than the distance from the ear opening to the plane including said inner diameter.

5. An ear protector as recited in claim 2 wherein the plane including the inner diameter is located substantially centrally of the body between the ear opening and the opposite part of the wall.

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