

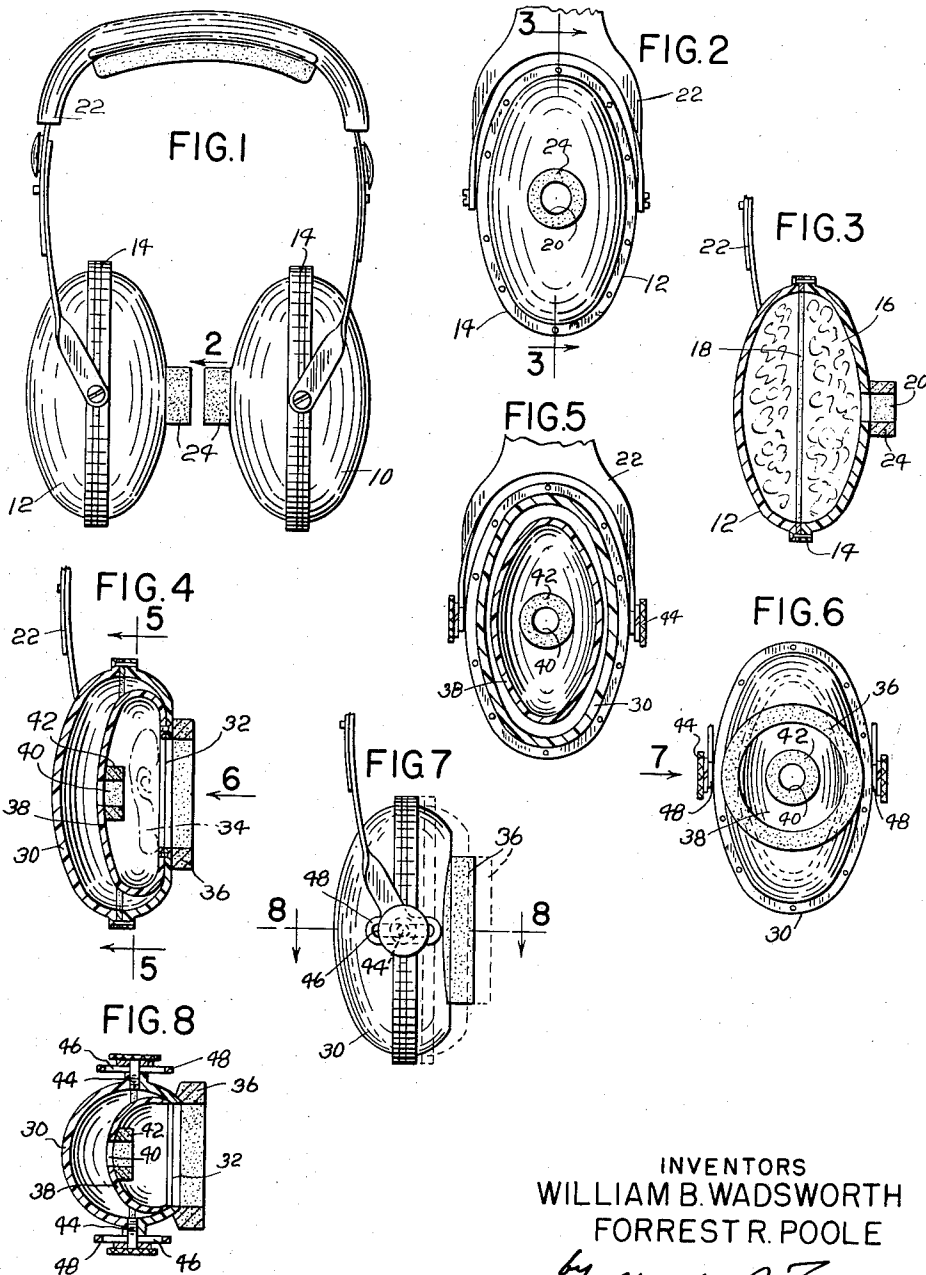
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EAR PROTECTOR

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EAR PROTECTOR

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4 Claims. (Cl. 2—209)

This application is a division of our prior application Serial No. 499,892 filed by us on April 7, 1955, and relates to a new and improved ear protector particularly adapted for the attenuation of sound at all frequencies and particularly in the low frequency field in order to protect the user against the deleterious effects of sound waves and the like; the provision of an improved sound attenuation means to be applied to the ears without using the so-called "ear plug" which fits in the ear canal and which is relatively injurious; the provision of an improved ear protector which attenuates sound to a greater degree than in devices heretofore discovered including ear plugs as well as muff type ear protectors which are known in the prior art.

A further object of the invention resides in the provision of an ear protector which utilizes a completely new principle of acoustics which is briefly that using a hollow rigid body, the attenuation of sound is increased by relatively increasing the volume of the hollow body with reference to the size of a hole in the body which is applied to the ear; in other words, the smaller the hole applied to the ear, with a given volume for the rigid ear protector, the greater is the attenuation of sound, particularly in the low ranges, but at all frequencies.

Further objects of the invention include the provision of a combination ear protector which embodies a hollow shell-type of device which receives and surrounds the auricle of the ear but does not touch it, such as disclosed in our copending patent application Serial No. 449,682 filed August 13, 1954 now abandoned, in combination with the auricle contacting device of the present invention, the new device having a much smaller hole therein and being located within the main hollow body for concurrent use, so that both types are combined in a single unit to provide an extremely high attenuation of sound which accomplishes all the objects of the invention in a manner heretofore thought to be impossible.

Reference is furthermore made to our copending patent application Serial No. 597,161, filed July 11, 1956, now Patent No. 2,899,683, granted August 18, 1959.

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 elevation illustrating the present invention;

Fig. 2 is a view in side elevation of one of the ear protectors, looking in the direction of arrow 2 in Fig. 1, part being broken away;

Fig. 3 is a section on line 3—3 of Fig. 2;

Fig. 4 is a section through a modification;

Fig. 5 is a section on line 5—5 of Fig. 4;

Fig. 6 is a view in front elevation, looking in the direction of arrow 6 in Fig. 4;

Fig. 7 is a view in side elevation of the modification looking in the direction of arrow 7 in Fig. 6; and

Fig. 8 is a section on line 8—8 of Fig. 7.

The present inventors have discovered that the pre-

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cise shape of the ear protector of the muff type is not critical, although the spheroidal type disclosed in said applications above referred to provide greatly improved results over anything known in the prior art. It has been discovered that the diameter of the hole which receives the auricle of the ear, upon being made smaller, increases the sound attenuation without the necessity of increasing the volume of the ear protector, and that increasing the volume of the ear protector increases the attenuation. The spherical protector is a practical embodiment of the underlying principle involved, but it has been found that if the auricle-receiving opening is made smaller, the attenuation of the sound waves is increased, and providing that the protector used is rigid so that it does not vibrate, its shape is not vitally important and may be of any shape other than spherical, although the spherical shape requires minimum material for a given degree of rigidity and hence is a very desirable shape. However, other shapes, such as cylinders or box-shaped constructions may be used if sufficiently rigid to illustrate the present principle, disclosed hereinafter.

Referring now to Figs. 1 to 3 inclusive, there are here shown substantially ovate hollow bodies 10 and 12, each of which may be conveniently made in two halves joined together by a tight flange or seam as at 14. These bodies or hollow ear protectors may receive soft cottony material 16 or even a leather or other fiber-type of diaphragm 18 as desired or convenient.

One of the parts of each housing or shell 10, 12 is provided with a relatively small hole which is illustrated herein in Figs. 2 and 3 at 20. This hole is too small to receive the human ear and as a matter of fact may be reduced in size to a minimum amount which will still provide communication between the canal of the ear and the interior of the rigid bodies 10, 12.

The two ear protectors 10 and 12 may be joined in a headset 22, being fitted over the head in the manner of ear-phones, and the ear protectors 10 and 12 are thus applied to the ears at the opposite side of the head, with the holes 20 communicating with the ear canals. Soft pliable rims 24 may be applied to the surface of the particular shell surrounding the hole 20 to aid in comfort, but in any event it will be seen that the ear auricle itself is engaged by the rim of the hole, or by the soft rim, and the headset is such as to provide for a relatively firm contact of the rim to the auricle or exposed portion of the ear.

It has been found that this construction will substantially obviate all circumambient sound waves and that less pressure than might be expected is required to close the ear canal to external noises and to provide only communication with the hollow interior of the ear protector.

It has been determined that the larger the volume in the bodies 10 and 12, in proportion to the size of the hole 20, the greater is the attenuation of sound; but by maintaining a constant volume in the ear protector and reducing the size of the hole 20, a much greater proportional difference in sound attenuation is achieved. On the other hand, it is a requirement that there shall be a hole 20 or at least a direct communication between the ear canal and the interior of the hollow ear protector.

It may be observed that the bodies 10 and 12 may be of any shape desired, although a spherical or spheroidal shape provides the greatest volume and greatest rigidity for the amount of material required. However, ear protectors of the general shapes disclosed here may be used in order to attain the volume without using a cumbersome, large dimension between the ear itself and the outermost point of the respective shell. Other shapes also may be used, the critical concept residing in the relative propor-

tions of a large volume in the rigid body and a small opening for communication with the ear canal.

A modified form of the invention is shown in Figs. 4 to 8 inclusive wherein a hollow rigid shell 30 of any desired shape is provided with a relatively large opening 32 which actually admits the human ear 34 into the interior of the shell, this relatively large hole having a soft pliable rim 36 more or less as disclosed and described in our above-identified application to contact the skull just around the auricle.

However, in the present case there is provided internally of the shell 30, an additional shell-like support 38 which has a small opening at 40, comparable to that at 20, and having a similar soft pliable rim 42 thereabout.

If this device be substituted for those shown at 10 and 12 and the same headset 22 be utilized, then the rubber rims 36 will closely engage the skull of the user about the ear and sound attenuation effects as previously described in our copending patent applications will be attained with a maximum of comfort and with absolute protection to the ear since there is no contact of the auricle with any part of the device.

However, if additional attenuation of sound is desired, at a possible increase in discomfort, then the ear protector of Figs. 4 to 8 may be further more tightly pushed against the head of the user in order to firmly contact the soft rim 42 with the auricle of the ear while still maintaining a passage for communication between the ear canal and the interior of the shell.

In this way, a maximum of sound attenuation will be provided with some possible discomfort to the user, and of course the soft rim 36 will be highly compressed against the skull in order to maintain sufficient contact between the soft rim 42 and the auricle. Rim 36 may be rather large and highly compressible to achieve this effect.

In order to attain the additional pressure, the headset may be adjusted in the usual way or some means may be provided for adjustment such as that the shells 30 may be provided with threaded pins 44 working in slots 46 in the terminal end portions 48 of the headset 22, so as to provide for clamping of the ear protector 30 more tightly against the head of the user.

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 ear protector comprising a hollow body having an opening therein to admit the ear auricle of a wearer into the body, a rim about the opening to contact the skull about the ear of a wearer, means to press the body against the skull of a wearer, an internal support in the body spaced from the opening and from the wall of the body opposite the opening, means mounting the support in the hollow body, an opening extending completely through the support, said through opening being smaller than the opening in the body and being generally adapted to be aligned with the canal of an ear auricle of a wearer in the body, a rim on the support about said opening in the support, said rim being adapted to contact the auricle, and the opening in the support providing communication between the ear and the interior of the hollow body at the side of the support opposite the ear.

2. An ear protector comprising a hollow body having an opening therein to admit the ear auricle of a wearer into the body, a rim about the opening to contact the skull about the ear of a wearer, means to press the body

against the skull of a wearer, an internal support in the body spaced from the opening, means mounting the support in the hollow body, an opening in the support smaller than the opening in the body and generally adapted to be aligned with the canal of an ear auricle of a wearer in the body, said opening in the support providing communication between the ear and the interior of the hollow body at the side of the support opposite the ear, said support being normally spaced from an average ear auricle of a wearer located in the body, and said support being located in spaced relation with respect to a wall of the body opposite the first-named opening.

3. An ear protector comprising a hollow body having an opening therein to admit the ear auricle of a wearer into the body, a rim about the opening to contact the skull about the ear of a wearer, means to press the body against the skull of a wearer, an internal support in the body spaced from the opening, said support being secured to the hollow body interiorly thereof adjacent the edge of the opening, an opening through the support smaller than the opening in the body and generally adapted to be aligned with the canal of an ear auricle of a wearer in the body, said support being normally spaced from an average ear auricle of a wearer in the body, and means to press the support against the ear auricle of a wearer said opening in the support providing communication between the ear and the interior of the hollow body at the side of the support opposite the ear.

4. 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 of a wearer, said body having a single ear-receiving opening therein providing direct 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 wearer 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 and a partition in said body intermediate the opening and the part of the wall of the body opposite the opening, said partition being provided with a relatively small opening therein which is too small to accommodate the human ear and which is adapted to be aligned with the canal in the human ear when the human ear is located within the body and between the first-named opening and the partition.

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