

Nov. 11, 1969

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3,477,067

EAR CUP WITH SPRING SUPPORTED RESILIENT SEAL

Filed May 5, 1966

2 Sheets-Sheet 1

Fig. 1.

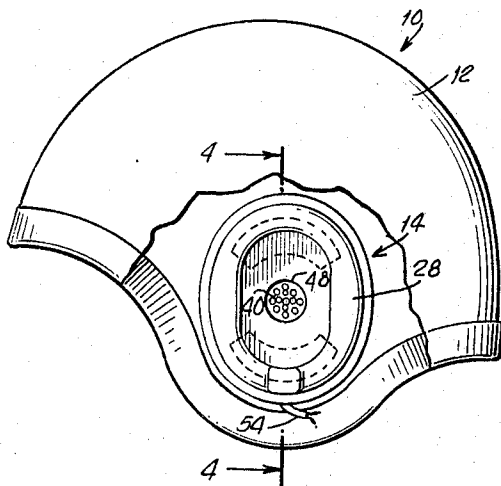


Fig. 2.

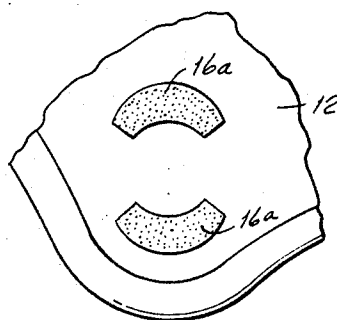


Fig. 3.

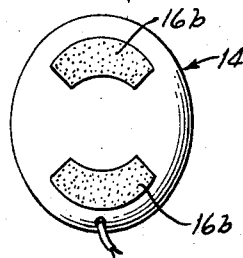
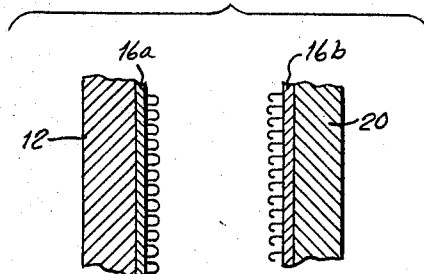
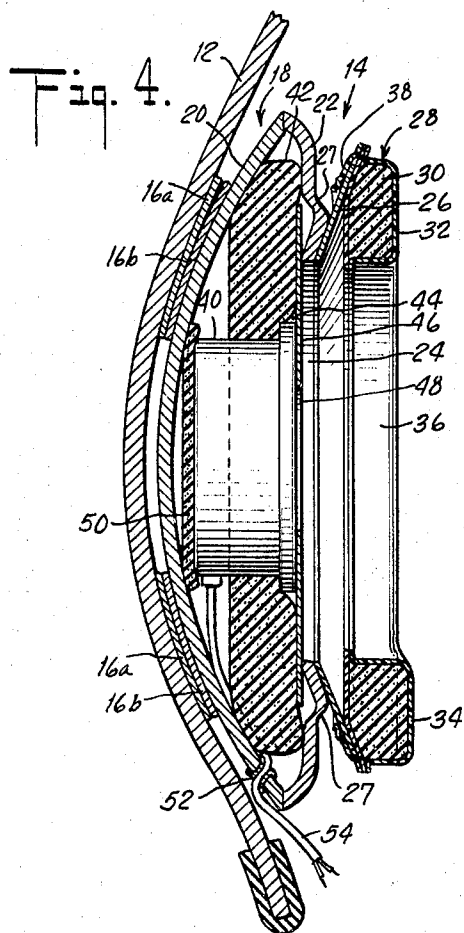


Fig. 3a.



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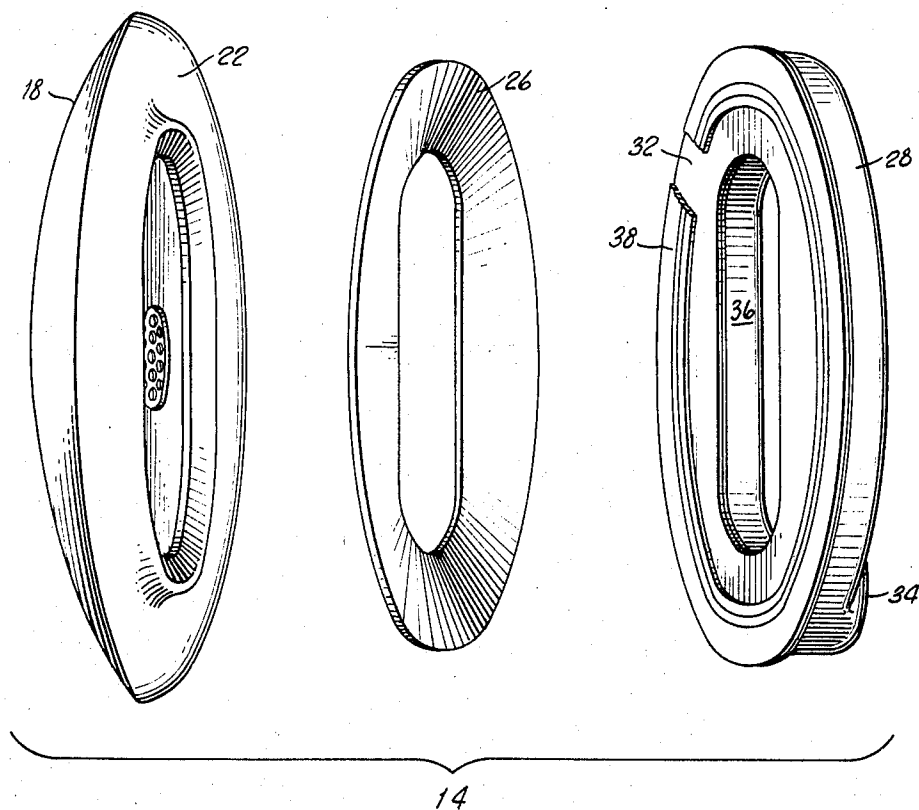


Fig. 5.

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**EAR CUP WITH SPRING SUPPORTED
RESILIENT SEAL**

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10 Claims

ABSTRACT OF THE DISCLOSURE

An ear cup in the form of a rigid shell and including a seal detachably mounted on the shell and supported on a slightly concave annular spring surrounding the ear-receiving opening. The ear cup is adapted for acoustic isolation from, and adjustable connection to, a helmet by means including first and second portions of fabric material known commercially as Velcro.

This invention relates to an ear protector or ear cup, and more particularly to an ear cup of the type adapted for use with a protective helmet.

Protective helmets which are conventionally used to ward off blows and impacts which would otherwise injure the head generally comprise a rigid outer shell enclosing most of the head of the wearer. The rigid helmet shell is of known composition, generally of a plastic binder reinforced by a glass fiber mat, which is capable of being molded to shape as a hollow shell open at the lower side thereof for receiving the head of the wearer.

A typical protective or safety helmet that has been found to be effective for the aforementioned purposes has been described, for example, in U.S. Patent No. 2,926,355 to W. S. Finken, assigned to the assignee of this application.

In such a helmet, the outer shell is commonly supported on a rigging of head bands and head straps which closely engage the head of the wearer but which are spaced from the helmet structure throughout most of their length. Since the head bands and head straps are flexible, the rigid shell structure is free to move to a limited extent with respect to the head of the wearer.

In many environments in which a protective or safety helmet is employed, either the ear must be almost completely shielded from ambient noise because instructions must be furnished to the wearer by means of a transducer while a great deal of noise is present, or, in many instances, the surrounding noise is so deafening that the wearer's ears must necessarily be protected from severe shock.

A major difficulty with the aforescribed class of safety helmets is that, although they provide sufficient protection to the head, they do not allow simple adjustment of the ear protector or cup that is conventionally used with such helmets. Such an ear cup should have ready adjustability so that the protective helmet can serve its functions for a wide range of wearers.

Another principal difficulty is that in the use of such protective helmets it has been found that sound attenuation is not great enough. In other words, the protective helmet itself does not reduce sufficiently incoming sound from the surrounding environment. Nor has it been found that any previously employed ear cup member has contacted with such protective helmet to provide sufficient attenuation while retaining other desired attributes to be considered satisfactory to serve therewith.

Accordingly, it is a primary object of the present invention to provide an improved ear cup especially adapted for use with a protective helmet.

Another object is to provide an ear cup which achieves satisfactory attenuation of external sound.

Another object is to provide an ear cup of sufficient strength to sustain sharp blows and impacts at or near the ear of the wearer but which can be adjustably positioned in a helmet and can be easily removed therefrom.

Another object is to provide such an ear cup which may be worn with comfort, which has an improved conformability to the portion of the head surrounding the ear of the wearer, and which provides for ready removal and replacement of the seal which contacts the head of the wearer.

The above objects are fulfilled by the principal feature of the present invention which resides in the provision of a rigid ear cup including a seal which is uniquely supported on a slightly concave, annular spring. The inner edge of the spring is attached to the edge of the opening for the ear that is provided in the ear cup. Thus the spring is in the form of a flexible flange about that opening. Such flange type of spring accommodates itself very well to the variations in shape of the aural area of the heads of wearers. In other words, the co-action of the seal with the flange type spring allows for ready conformance with the particular shape of the head of the wearer in the area of the ear.

In order to avoid transfer of sound when the ear cup is associated with a helmet shell, means are provided for acoustic isolation of the cup from the shell. This same means is of such a nature as to allow for detachable connection of the ear cup to the shell, and also for adjustability of such connection, that is, for varying the position of the ear cup in the plane of the ear.

The ear-surrounding seal which is tightly fitted over the spring is of soft, resilient construction and preferably comprises a ring of foam rubber or the like and a cover of vinyl over the foam rubber.

An unusual advantage that has been found to exist with the ear cup of the present invention is that there is achieved even greater sound attenuation when the volume of sound is increased.

Other objects, features and advantages of the invention will be understood from the following specification and drawings in which,

FIG. 1 is a side elevational view, partly broken away, of a safety helmet to which an ear cup according to the present invention is affixed.

FIG. 2 is a fragmentary elevational view inside the helmet showing one side thereof, having securing means for the ear cup.

FIG. 3 is a side elevational view of the ear cup showing the side thereof having securing means attached thereto.

FIG. 3A is a fragmentary view of the securing means.

FIG. 4 is a cross-sectional view taken along the line 4—4 of FIG. 1.

FIG. 5 is an exploded view of the parts of the ear cup.

Referring now to FIG. 1, there is shown a protective helmet 10, similar to that shown previously in Patent No. 2,926,355 to W. S. Finken. The helmet 10 comprises a rigid shell 12 having an opening at the lower side thereof for receiving the head of the wearer. The helmet is composed of a suitable material such as a plastic binder which may typically be reinforced by the use of glass or nylon cloth. Alternatively, the helmet may be injection-molded, in which case no reinforcement is required. The shell 12 is generally adapted to be supported on the head of the wearer by means of a rigging comprising a plurality of headband elements and headstraps (not shown).

The rigid shell 12 has affixed thereto in adjustable position a pair of ear cups 14, one of which is shown in the figures. The ear cups 14 are angularly adjustable with

respect to the shell 12 by means of a device commercially known as a Velcro fastener. This device comprises opposing parts, one comprising a plurality of stiffly flexible loops, usually nylon, and the other comprising a plurality of stiffly flexible hooks. When the two parts are pressed together, the hooks intermesh with the loops. One of the parts as shown in FIGS. 2 and 3A and designated 16a, is typically provided in two sections on the inside surface of the shell 12. The other part, 16b, shown in FIGS. 3 and 3A is affixed to the side of the ear cup 14 which makes contact with the inside surface of the shell 12. The part 16a, affixed to the shell 12, consists of a fabric base carrying upstanding hooked elements. The other part 16b that is affixed to the ear cup 14 has a fabric base carrying projecting loops. Thus, when the two parts 16a and 16b are brought together, the looped material becomes interlinked with the aforesaid upstanding hooked elements so that as a result, the ear cup 14 is detachably connected or affixed to the shell 12 and some force is required to separate the two.

In FIG. 4 is shown in vertical section the ear cup 14, comprising a rigid shell 18 which is of generally elliptical shape in the plane thereof which is parallel to the ear as shown in FIG. 1. The contour of a section of the shell 18 in the plane perpendicular to the ear is that of a hollow member having a wall 20 extending about a space within the member. Wall 20 has a flange portion 22 which extends to and defines an opening 24 at the side of the hollow space disposed toward the ear of the wearer. Surrounding the opening 24, on the inner side thereof, and thus further defining the opening, is a slightly concave, annular spring member 26, which is preferably composed of resilient plastic. This spring is in the form of an elliptical annulus which contacts the radially inner edge of the flange 22 at its surface farthest from the helmet, and is secured thereto by cementing. In addition to the spring effect that is obtained by the flexing of spring member 26, a further spring effect can be realized by a preferred construction of the shell 18. As shown in FIG. 4, the wall 20 is constricted at the points designated 27 in the flange portion 22 to provide greater yieldability and therefore conformability in adjusting to the ear of the wearer.

Detachably secured over the edge of the spring member 26 is a sound attenuating seal 28 which also serves as a padding means for providing comfort to the wearer's ear. The seal 28 comprises a ring 30 of an elastically compressible material, such as sponge rubber, sponge plastic such as sponge polyurethane or other suitable material. If desired, the seal 28 may include a liquid, such as glycerine and water, which is contained in an envelope within the ring 30. For the purpose of comfort and for the ready securing of the seal 28 to the spring 26, the elliptically annular ring 30 is loosely covered with a layer 32 of vinyl material which tends to be air-filled. A flap 38 provided at the periphery of the cover 32 is adapted to fit over the radially outer edge surface of the spring 26, as best illustrated in FIG. 4. Thus, the seal 28 is securely held in position, but it may be readily removed and replaced in the event of a defect or in the event that the seal is worn or unsanitary. The cover layer has a protruberant portion 34 for fitting the hollow behind the ear of the wearer. The form of the seal 28, as noted before, is such that an opening 36 is provided which is of the same generally elliptical form as, and generally concentric with, the opening 24 of rigid shell 18 and of adequate area to provide free communication with the sound passage of the ear and with the space within the hollow member. The contour of the surface of the seal 28 and its cover 32 is such as to close off communication with the surrounding environment when the ear cup 14 is pressed against the ear, thereby to attenuate substantially sound from the surrounding environment.

In the use of the ear cup device of the present invention, it is most conventionally associated with a need

to communicate with the wearer. In this case an intercom arrangement is provided comprising an earphone 40 disposed within the hollow space of the rigid shell 18. For support of the earphone 40 a body 42, FIG. 4, of sound-absorbing material such as sponge polyurethane, is disposed within the cup 14. The body 42 is in the form of an elliptical annulus fitting the inner surface of the shell 18, and partly filling the space therein. The sound-absorbing body 42 has a generally centrally disposed pocket 44 formed therein, for receiving earphone 40. In order to retain the earphone in this pocket, a layer 46 of similar sound-absorbing material is adhesively secured to the body 42, the layer 46 having an opening 48 somewhat smaller than the opening of the pocket 44, so that the edge of the layer 46 may bear upon the earphone 40 to retain it in the pocket 44. A cushion 50 is secured to the side of the earphone 40 adjacent the wall 20 so that the earphone does not bear directly against the wall 20. A restricted opening is provided at the bottom of the shell 18 for electrical leads 54 connected to the earphone 40.

Although in the preferred embodiment of the present invention the ear cup 14 has been illustrated in FIG. 4 as having a thickness dimension, that is, a dimension in the plane of FIG. 4 of the order of about three-fourths of an inch, it will be understood that variations may be made in the elliptical shape of this member. Thus, in an alternative embodiment of the ear cup there is provided a much greater thickness on the order of several inches. Such greater thickness is particularly useful when the ear cup is to be cooperatively associated with a helmet of the type having a large swell at the ear portion of the head of the wearer.

Sound attenuation values have been obtained both with the preferred form of the ear cup as illustrated in FIG. 4 and a larger ear cup of the alternative embodiment as noted immediately above. The table below gives the decibels of sound attenuation for each of the frequencies at which such sound attenuation values were taken. In this particular instance, the values are for the use of sponge polyurethane as the sound-absorbing material for the body 42. It will be noted that at the 400 c.p.s. values an anomalous value shown circled in the table was obtained.

		Attenuation (db)	
		Main Embodiment	Alt. Embodiment
45	Freq., c.p.s.:		
	100.....	15	24
	200.....	13	16
	300.....	15	22
	400.....	6	26
	500.....	19	26
	700.....	12	18
50	1,000.....	31	34
	2,000.....	43	34
	3,000.....	47	22
	4,000.....	47	30
	5,000.....	50	36
	6,000.....	53	28
	8,000.....	41	30

I wish to it to be understood that I do not desire to be limited to the exact details of construction shown and described for obvious modifications will occur to a person skilled in the art.

What is claimed is:

1. An ear protector comprising:
 - a rigid cup-shaped shell having an opening therein for receiving the ear of the wearer, an annular flexible spring secured to said shell, and a seal including means for detachable connection of said seal to said spring;
 - said seal comprising a resilient member in generally elliptically annular shape;
 - said spring being concentric with and connected to said resilient member for supporting said member, said spring being concavely disposed about the opening for the ear in said rigid shell, said spring being flexible to provide conformability of the seal to the ear of the wearer.
2. A sound attenuating device comprising an ear protector as defined in claim 1, further comprising a helmet,

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and means for detachable connection of said ear protector to said helmet, said means including first and second portions of material, one portion including a plurality of stiffly flexible loops and the other comprising a plurality of stiffly flexible hooks capable of becoming interlinked, one portion being affixed to said ear protector and the other being affixed to said helmet.

3. The combination as defined in claim 2, wherein the portion including said loops is affixed to said helmet.

4. An ear protector as defined in claim 1, further comprising a body of sound-absorbing material inside the rigid cup-shaped shell and confined thereby for absorbing extraneous sound transmitted into the shell, said body of sound-absorbing material further defining a central pocket adapted to receive an earphone.

5. A sound attenuating device for a head covering having a rigid shell adapted to receive the head of the wearer comprising:

a hollow cup-shaped member providing a rigid wall extending so as to define the periphery of a substantially elliptical opening for receiving the ear of the wearer at one side of said member;

means affixed to the hollow member at the other side thereof for engaging means affixed to said rigid shell thereby to secure detachably the hollow member to the rigid shell;

means surrounding said opening including a slightly concave, elliptically annular spring member;

and a soft resilient seal including a resilient ring and a cover therefor, said cover including a flap defining, with the body of the cover, a pocket receiving said spring member for support of said seal by said spring member.

6. A sound attenuating device comprising:
an ear cup for receiving the ear of the wearer and having a generally elliptical flange portion directed radially inwardly from the rim thereof;
a slightly concave, elliptically annular spring secured to said radially inwardly directed flange portion and defining an ear receiving opening;
cushion means detachably affixed to said spring adjacent said rim and adapted to engage the head of the wearer so as substantially to attenuate external sound from the atmosphere, said cushion means including a flap fitting over the outer peripheral surface of said spring for support of said cushion means by said spring.

7. A sound attenuating device as defined in claim 6, in

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which said elliptical annular spring is composed of a resilient plastic and in which the radially inwardly directed flange portion of the ear cup adjacent said opening is constricted to provide a further spring effect.

8. A sound attenuating device comprising:

a helmet adapted to receive the head of the wearer;
an ear protector including a rigid cup-shaped shell having an opening for receiving the ear of the wearer;
means for detachably securing said ear protector to the helmet, said means including first and second portions of fabric material, each portion providing upstanding elements capable of becoming interlinked, one portion being carried by said ear protector and the other portion being carried by said helmet for juxtapositioning of said portions.

9. A sound attenuating device as defined in claim 8, in which said first and second portions of fabric material are directly affixed to said ear protector and to said helmet respectively.

10. An ear protector comprising:

a rigid cup-shaped shell having an opening therein for receiving the ear of the wearer, an annular flexible spring secured to said shell, and a seal including means for detachable connection of said seal to said spring;

said seal comprising a resilient member in generally elliptically annular shape;

said spring being concentric with and connected to said resilient member for supporting said member, said spring being disposed about the opening for the ear in said rigid shell, said spring being flexible to provide conformability of the seal to the ear of the wearer.

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