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HARD SHELL LIQUID SEAL EARMUFF WITH ISOLATED INNER CLOSE COUPLING EAR SHELL

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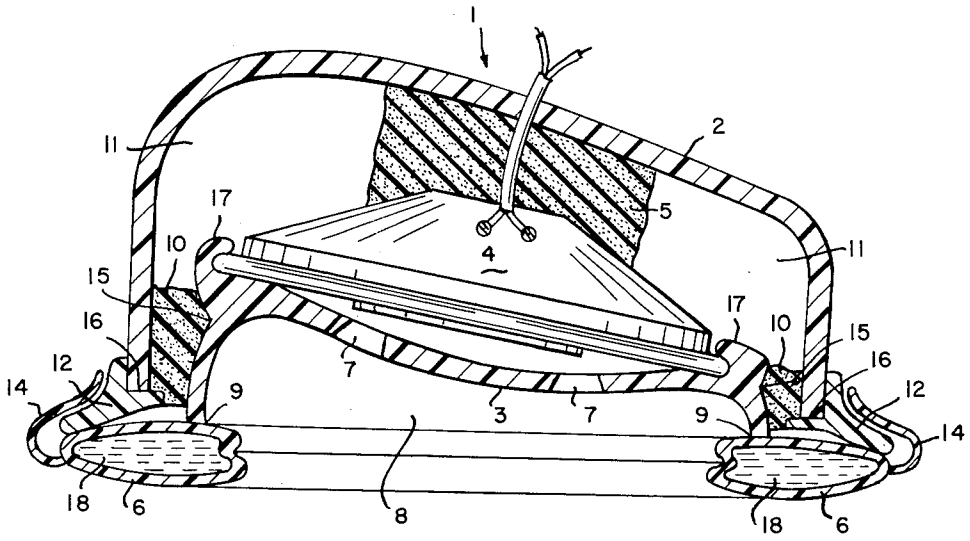

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HARD SHELL LIQUID SEAL EARMUFF WITH ISOLATED INNER CLOSE COUPLING EAR SHELL

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This invention relates generally to acoustical coupling devices and, more particularly, to an acoustical coupling device used in connection with instruments for receiving signals from electro-acoustical transmitting devices.

One of the more serious problems facing manufacturers and designers of acoustical coupling devices, such as earphone headsets for telephone receivers or the like, is to design the unit in such a manner that the receiving efficiency of the telephone receiver is not greatly impaired by externally caused noise. A particular need for such a design is found in the aircraft industry, where it is necessary for ground maintenance crews to have some means of intercommunication while they are working around modern, high performance aircraft, such as jet aircraft. The intense noise generated by jet engines renders earphone headsets of the prior art practically useless, as the sound waves of this noise set up vibrative forces in the construction of former earphones and, due to the utilized construction of former earphones, these forces were transmitted from one member to another until the entire earphone was vibrating.

The effects of this were twofold: one, external noises were permitted to leak under the earcushion to reach the ear of the user; two, the vibrations of the earphone caused the entire headset to jump around on the head of the user, making it not only difficult for him to hear the signals that were being transmitted to him through the receiver, but making it very uncomfortable for him to wear the headset due to its bouncing around on his head.

There are two ways of reducing the effects of such vibrative forces, the first being to provide an acoustical or a mechanical filter, such as those used in an air-conditioning system, and the second to isolate the body or unit from the vibrations.

Since it is desired to produce an earphone that is not only acoustically efficient, but also light in weight, especially when it is to be worn by men actively engaged in sometimes confined places, it becomes too impractical to use acoustical or mechanical filters as they add to the weight and bulk of the earphone. Therefore, the principle of isolating the receiver unit from the remainder of the earphone will provide a lighter, less bulky and more efficient receiving unit.

It is, therefore, an object of the present invention to provide an earcushion providing improved sound attenuation with a minimum of earcushion weight.

It is a further object of the present invention to provide an earcushion of a novel construction providing increased sound attenuation and allowing close coupling of earphone to the user's ear.

It is another object of the present invention to provide an earcushion consisting of an outer casing and an inner shell having a minimum volume comprised to balance comfort against improved acoustical coupling of ear to receiver diaphragm.

A still further object of the present invention is to provide an earcushion for an electrical headset consisting of an outer casing and an inner shell arranged for out-of-phase oscillatory motion relative to each other to damp the effects of vibrative forces impinging externally upon the outer casing.

It is yet another object of the present invention to present an earcushion for an earphone headset comprising an outer casing and an inner shell arranged for relative, opposing oscillatory movement, and resilient means positioned between the casing and the shell to limit the movement of the shell so that the volume of the acoustical cavity defined by a surface of the shell remains minimized and substantially constant to allow close coupling of the receiver diaphragm to the user's ear.

The novel features characteristic of the present invention, as well as additional objects and advantages thereof, will be better understood in the following detailed description of a single embodiment thereof, when read in connection with the accompanying drawing in which:

FIG. 1 is a side view, in section, of an earcushion in accordance with the present invention.

Referring more particularly to FIG. 1, there is shown by way of illustration an earcushion unit indicated generally at **1**, consisting of a hollow, annular outer casing **2**, having an annular peripheral rim **16**. Outer casing is constructed of a light, rigid material, such as plastic, and is similar to the standard ear protector shell currently in use.

An annular, rigid flange **12** is securely attached to rim **16**, as by cementing or gluing, and is further mounted on a circumaural, annular ear pad **6**, being removably secured thereto by flange retaining flap **14**. Ear pad **6** is a fluid filled bag of a pliable material, such as plastic, to allow it to conform to the configuration of the head of the user, thereby providing increased comfort in addition to improved sealing means against external noise. Integral with shell **6** is a flange retaining flap **14** which has the function of holding flange **12** onto ear pad **6**.

Flange **12** is slightly inclined relative to ear pad **6** and is contoured so as to conform to the configuration of the head of the average wearer. Therefore, a downward movement by flange **12** against ear pad **6** acts on the outer portion of ear pad **6**, thereby effecting an improved sealing means against external noise.

An inner shell **3** is mounted on ear pad **6** independently of outer casing **2** and is inclosed completely within outer casing **2**. Inner shell **3** has an upper surface which is contoured to define a retaining ring **17** for sound translating apparatus, such as a sound powered telephone receiver. A lower surface of shell **3** defines an acoustical chamber or cavity **8** which is shaped and contoured to accommodate the ear of the user, whereby the lower surface of shell **3** is pressed into contact with the peripheral margins of the ear. Shell **3** actually contacts ear pad **6** by means of an annular, peripheral rim **9**. Sound openings **7** are provided in shell **3** to allow sound signals to be transmitted from a receiver **4** to the user's ear.

Shell **3** is positioned laterally within casing **2** by means of resilient positioning pads **10**, which are composed of foam or sponge rubber, and are fixed against vertical slipping by securing indentations **15**. It will be understood that, while the specific embodiment of the present invention employs a series of such foam pads in spaced intervals circumferentially of shell **3**, a continuous ring or cup of similar material may be used without departing from the spirit of our invention. In like manner, the securing indentations **15** may take the form of a circumferential groove.

Positioned between the top of receiver **4** and the inner surface of outer casing **2** is buffer pad **5**, also composed of foam or sponge rubber. Thus, it will be seen that inner shell **3** is resiliently isolated with respect to outer casing **2**.

In operation, when the earcushion **1** is worn as part of an earphone headset by a ground crewman, for example, and is subjected to intense noise, such as from a jet aircraft engine, certain vibrative forces will impinge upon the outer surface of casing **2**. These forces will be transferred to flange **12** and, in turn, to ear pad **6**. Since

flange 12 presses against the outer portion of ear pad 6, this outer portion will be compressed against the head of the user, thereby forcing that volume of the fluid filling 18 originally contained in the outer portion of ear pad 6 into the inner portion thereof. Since the fluid filling, generally a liquid, is noncompressible, the hydraulic forces thus set up will be transferred to the rim 9 of inner shell 3, thereby imparting a motion opposite in direction and undiminished in magnitude to shell 3 with respect to casing 2.

As shell 3 starts to move upwardly, buffer pad 5, having been compressed by the downward movement of casing 2, offers resistance to the upward movement of shell 3 and the position of shell 3 remains substantially unchanged.

Inasmuch as the forces against outer casing 2 are vibratory in nature, they will cause casing 2 and shell 3 to oscillate in opening and closing relation; however, due to the elastic isolation of shell 3, casing 2 only will continue to have motion, since the motion of shell 3 is damped to the point of complete cancellation.

In order to provide close coupling of receiver diaphragm to ear, it is necessary that the acoustical cavity 8 remains substantially constant. Since the motion of shell 3 is cancelled, cavity 8 will have a constant volume, thereby allowing close coupling between the diaphragm of receiver 4 and the ear of the user. This will provide for increased signal transmitting efficiency of receiver 4. In addition, the impedance of outer casing 2 and the resilient reactance of the air spaces between outer casing 2 and inner shell 3 offers acoustical insulation against the penetration of external noise to interfere with receiver 4. The sealing action of ear pad 6, due to the downwardly and inwardly movement of flange 12 responsive to vibrative forces against casing 2, prevents external noise from leaking under ear pad 6 to the ear of the user.

While there is illustrated and described herein but a single embodiment of the present invention, it will be apparent to those persons skilled in the art that other modifications and changes are possible without departing from the spirit of the present invention. For example, a foam filled ear pad 6 may be substituted for a fluid filled ear pad, or a fluid of lesser or greater viscosity may be used for a particular application. In addition, employment of a plurality of fluid or foam filled ear pads connected by an orifice rather than a single ear pad may be employed without departing from the spirit of the present invention. Therefore, it is desired that the particular form of the invention described herein be considered illustrative only and not as limiting.

We claim:

1. An ear cushion for an earphone headset comprising an annular, pliable ear pad, a rigid annular flange mounted on said ear pad for pressing engagement therewith, a hollow, shell-like casing fixedly mounted on said flange, an inner shell having one surface thereof contoured to define an acoustical chamber and a second surface thereof contoured to define retaining means for sound receiving apparatus, and said inner shell being yieldably mounted on said ear pad interiorly of said casing for opposed relative movement to said casing in response to external pressure upon said casing.

2. An acoustical coupling device comprising a pliable circumaural ear pad having a fluid filling, a rigid flange mounted on said ear pad for pressing engagement therewith, an annular rigid shell-like casing fixedly mounted on said flange, a rigid shell positioned interiorly of said casing and having a first surface contoured to define acoustical apparatus retaining means and a second surface contoured to define an acoustical cavity terminating ing a peripheral rim, said rim of said shell being mounted on said ear pad independently of said casing, resilient cushioning means mounted between said shell and said casing to isolate said shell with respect to said casing,

whereby vibrative forces caused by sound waves impinging upon the external surface of said casing impart oscillatory motion to said casing and said vibrative forces are transmitted from said casing to said shell through said fluid filling of said ear pad causing oscillatory motion of said shell out of phase with the motion of said casing to cancel the effect of the vibrative forces upon said shell.

3. An acoustical coupling device comprising an annular fluid-filled ear pad for contacting the head of the user, an annular rigid casing mounted on said ear pad for pressing engagement therewith, an annular rigid shell positioned interiorly of said casing and independently mounted on said ear pad, said shell having a first surface contoured to define retaining means for sound receiving apparatus and a second surface contoured to define an acoustical chamber, resilient positioning means mounted between said casing and said shell whereby said shell is isolated from vibrating forces imparted to said casing from external sources.

4. In an earcushion for an electrical headset, an annular circumaural ear pad for contacting the head of the user, said ear pad comprising a thin pliable material having a fluid filling, a hollow shell-like annular casing, a rigid flange fixedly attached to said casing and mounted on said ear pad for pressing engagement therewith, a shell inclosed within said casing having sound translating apparatus retaining means defined by one surface and an acoustical chamber defined by another surface, said acoustical chamber having a volume defined by the limiting surfaces of said chamber when said earcushion is placed against the head of the user, sound translating apparatus fixedly mounted in said retaining means, and resilient positioning means to cushion said sound translating means from vibrating forces imparted to said shell in response to vibrating forces applied externally of said casing, whereby said volume of said acoustical chamber remains substantially constant.

5. An acoustical coupling device comprising a rigid annular casing, a rigid annular shell yieldably positioned within said casing and having a first surface contoured to define retaining means for sound translating apparatus and a second surface contoured to define an acoustical cavity having a volume defined when said coupling device is placed against the head of the user, resilient positioning means mounted between said casing and said shell, and hydraulic means responsive to forces applied to said casing to transmit said forces to said shell causing said shell to move relative to said casing, whereby said resilient positioning means oppose the relative movement of said shell and said casing to allow said volume of said acoustical cavity to remain substantially constant.

6. An earcushion for an earphone headset comprising a circumaural ear pad having a fluid filling for conforming to the contours of the head of the user, a rigid flange yieldably mounted on said ear pad, an annular hollow casing fixedly mounted on said flange, an acoustical shell having a surface thereof contoured to contact the peripheral margins of the ear and mounted on said ear pad independently of said casing and inclosed within said casing, and resilient means positioned between said shell and said casing, whereby vibrative forces caused by sound waves produced externally of said casing tending to impart oscillatory motion to said casing and hence to said shell through said fluid-filling of said ear pad are damped by said resilient means to cancel the oscillatory motion of said shell.

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