Sept. 13, 1955 J. S. KNIGHT 2,717,596

CUSHION MOUNTING FOR MASS IMPEDANCE RESONANCE FILTER

Filed April 26, 1954

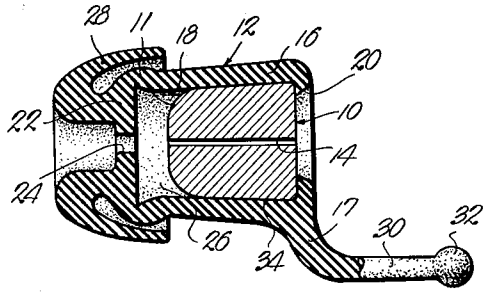

Fig. 2.

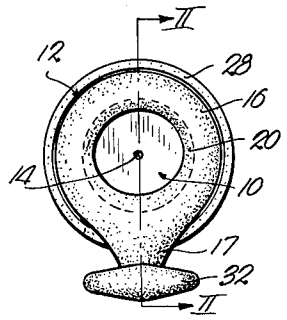

Fig. 1.

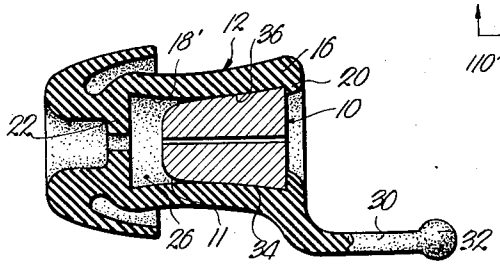

Fig. 3.

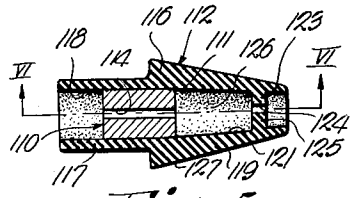

Fig. 5.

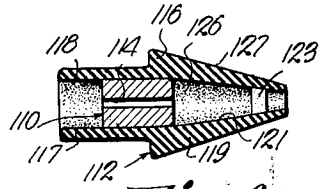

Fig. 6.

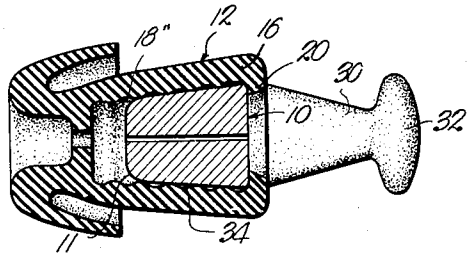

Fig. 4.

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CUSHION MOUNTING FOR MASS IMPEDANCE RESONANCE FILTER

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6 Claims. (Cl. 128—152)

This invention pertains to hearing guards for preventing damage to the inner ear and contiguous brain sections due to blast, shock waves or excessive sound levels. More particularly, this invention relates to improvements over the hearing guard and ear protector illustrated in Fig. 1 of U. S. Letters Patent No. 2,427,664 issued September 23, 1947, of which I am a co-inventor.

Although the broad, general principles utilized in the hearing guard of Fig. 1 of the above-mentioned patent have proven sound in every respect, and the structure therein disclosed has been used to great advantage, it has been discovered that, by certain structural changes of relatively small significance from the standpoint of manufacturing costs, significant improvements in operating results and versatility can be obtained.

Accordingly, it is the primary object of this invention to provide improved cushion mounting structure for mass impedance resonance filters, which makes possible new and improved results not attainable with any known prior construction.

It is another of the most important objects of this invention to provide mounting structure for a generally frusto-conical, heavy mass impedance plug which will prevent shifting of the plug to one side or the other within the mounting and which will, in addition, utilize frictional engagement between the side walls of the mounting chamber and a substantial portion of the side wall of the plug, as well as the inertia of the plug itself, to retard movement of the plug along its axis under the force of external blasts, shock waves and other influences.

Another important object of this invention is to provide improved tab means for use in emplacing and removing the hearing guard from the outer canal of a human ear, which means does not interfere with external parts of the ear and is always disposed for ready access in quickly seating in and removing the hearing guard from the ear.

Still other objects of the invention will be made clear or become apparent as the following specification progresses. Reference is made to the accompanying drawing, wherein:

Figure 1 is an end elevational view of one type of ear protector made in accordance with this invention;

Fig. 2 is a cross sectional view of the form of the invention shown in Figure 1 taken on line II—II of Figure 1;

Fig. 3 is a cross sectional view similar to that of Fig. 2, but showing a modified form of the invention;

Fig. 4 is a cross sectional view similar to that of Fig. 2, but showing still another modified form of the invention;

Fig. 5 is a cross sectional view of another type of ear protector made in accordance with this invention; and

Fig. 6 is a cross sectional view of the form of the invention shown in Fig. 5, taken on line VI—VI of Fig. 5.

The structure by which the improved ear protectors of this invention illustrated in Figs. 1 to 4 inclusive provide structure capable of offering sufficient mass impedance to resist sudden pressure changes with a minimum of exposed area, while providing for the hearing of normal conversation in a quiet environment and the equalizing of air pressure in the outer canal of the human ear, includes, most broadly, a heavy mass impedance member or filter plug designated **10** and cushion mounting means for plug **10** designated **12** in the accompanying drawing.

Plug **10** is preferably formed of lead or other heavy, metallic material and is elongated and substantially frusto-conical in form, having its smaller end slightly rounded as at **11**. Plug **10** has an elongated, axial bore **14** extending longitudinally therethrough to permit the passage of sound waves of frequencies encountered in normal conversation, a bore diameter of approximately .03 inch in a filter plug of approximately .25 inch in length and weighing in the neighborhood of .005 pound having been found satisfactory.

Mounting **12** is preferably formed of rubber or other resilient material and includes an elongated casing portion **16** having an internal, side wall surface **18** of annular, transverse cross section, an inturned annular flange **20** on one end of casing **16**, and a circular disc **22** having a central perforation **24** therein on the opposite end of the casing **16**, thereby presenting a chamber **26** within casing **16** for receiving plug **10** between flange **20** and disc **22**. Annular flange structure **28** is provided on the end of casing **16** adjacent disc **22** for engaging the walls of the outer canal of a human ear and holding mounting **12** in sealed condition therein. Casing **16** includes a flared portion **17** extending substantially radially therefrom adjacent the end of casing **16** carrying flange **20**. An elongated, tapered tab **30** having an elongated knob **32** on the free end thereof extends longitudinally of casing **16** from the flared portion **17** thereof to provide, in conjunction with portion **17**, means which will remain extended from the canal of the ear when mounting **12** is emplaced therein for use in emplacing and removing mounting **12** from the ear.

In the form of the invention particularly illustrated in Fig. 2 of the drawing, the inner surface **18** of casing **16** is longitudinally straight throughout a major portion of its length and is tapered to give chamber **26** a decreasing diameter as the end of casing **16** adjacent flange **20** is receded from. It is also significant that the diameter of chamber **26** adjacent flange **20** is substantially the same as the diameter of plug **10** at its larger end and that the taper of side wall surface **18** as flange **20** is receded from is substantially the same as the taper of the frusto-conical surface **34** of plug **10**. Accordingly, a substantial portion of surface **34** of plug **10** is in frictional engagement with the interior surface **18** of casing wall **16** so that movement of plug **10** toward disc **22** under the influence of external forces impinging thereon from the end of casing **16** carrying flange **20** is retarded, not only by the inertia of plug **10**, but also by the frictional interengagement between surfaces **18** and **34**.

It should also be noted that, due to the fact that the taper of surface **18** is at least as great as the taper of surface **34**, the longitudinal axis of plug **10** cannot shift relative to casing **16** and become jammed within chamber **26**.

In the form of the invention particularly illustrated in Fig. 3, interior surface **18'** of casing wall **16** is longitudinally convex so that the angle of taper thereof throughout a portion **36** of surface **18'** adjacent flange **20** is greater than the uniform angle of taper of surface **34** of plug **10**. This construction serves to further increase the frictional effect between surfaces **18'** and **34**, to further aid the inertia of plug **10** itself in retarding the latter against reciprocation toward disc **22** under various influences.

In the form of the invention particularly illustrated in Fig. 4, inner surface 18'' of casing wall 16 is longitudinally undulated along an angle of taper preferably equal to that of surface 34 of plug 10. The latter described undulating surface 18'' serves to even further increase the frictional effect which may be obtained between surfaces 18'' and 34 to aid in retarding movement of plug 10.

It is significant that the particular surface construction 18 or 18' or 18'' best adapted for use under given circumstances will depend upon local conditions and, accordingly, the degree by which it may be desirable to aid the inertia of plug 10 in yieldably resisting external influences.

Referring now to Figs. 5 and 6 wherein is illustrated another embodiment of ear protector made in accordance with the principles of this invention whereby inertia of a filter plug is aided in resisting external forces by frictional engagement between a substantial portion of its lateral surface and the walls of a resilient, tubular casing in which it is housed. The numeral 110 broadly designates an elongated, preferably cylindrical filter plug provided with a longitudinal bore 114 and disposed within an elongated chamber 126 of tubular, cushion mounting structure broadly designated 112 and formed of resilient material. Plug 110 preferably has one end slightly rounded as at 111.

Mounting structure 112 comprises a casing 116 having an outer cylindrical portion 117 and a tapered portion 119, the latter being adapted to fit within the outer portion of a human ear. That part of chamber 126 within cylindrical casing portion 117 is also cylindrical and of substantially the same transverse cross section as plug 110, in order to accommodate the latter therein with a major portion of the lateral surface of plug 110 in frictional engagement with the internal, side wall surface 118 of casing portion 117. That part 121 of chamber 126 disposed within tapered casing portion 119 is also inwardly tapered as portion 117 is receded from. It will be clear that the tapering of internal casing surface 121 will tend to resist travel of plug 110 in a direction as to the right in Figs. 5 and 6 when plug 110 is advanced by external forces to that part of chamber 126 disposed within tapered casing portion 119. Such action obviously aids the inertia of plug 110 itself and the frictional engagement between the lateral surface of plug 110 and interior casing surface 118 in resisting movement of plug 110 under the influence of external forces.

Opposed, internal flanges 123 and 125 extend into chamber 126 from internal casing wall 121 to present a clearance opening 124 therebetween. Flanges 123 and 125 may be separately formed as illustrated, or could, if desired, constitute an annular type flange similar to disc 22 above described in connection with the other embodiments of the invention. As illustrated, tapered portion 119 of casing 116 need not be annular in transverse cross section and may be defined by an external casing surface 127 of slightly elliptical cross section, other configurations for surface 127 obviously being frustoconical or frusto polygonal, pyramidal. The elliptical configuration is illustrated as the preferred form of this embodiment, since such configuration is normally adapted to provide a tight fit in the outer portion of a human ear under circumstances of maximum comfort. As will be clear from the drawing, the transverse cross section of the tapered part of chamber 126 may also be other than annular and, in the preferred form illustrated, is slightly elliptical, it being observed that such configuration tends to enhance the resistance offered by tapered surface 121 to travel of plug 110 under the influence of external forces.

The operation of this form of the invention obviously involves application of the same principles above described with respect to the forms of the invention illustrated in Figs. 1 to 4 inclusive and will, therefore, be clear to those skilled in the art without further explanation.

It will be obvious to those skilled in the art that certain minor modifications or changes may be made in some of the details of construction of the improved hearing guard contemplated by this invention, without materially departing from the true spirit or intention of this invention. Accordingly, it is intended that this invention shall be deemed limited only by the scope of the appended claims.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. An ear protector comprising a tubular casing of resilient material having an elongated chamber therein, the transverse cross sectional area of the chamber being greater adjacent one end thereof than at a point spaced from said one end thereof; and an elongated, longitudinally perforated, filter plug slidably housed within the chamber and having a zone of transverse cross sectional area greater than the transverse cross sectional area of the chamber at said point, said plug having a major portion of its lateral surface in frictional engagement with the casing.

2. An ear protector comprising an elongated, tubular casing of resilient material having a side wall of annular, transverse cross section, an inturned, annular flange at one end of the casing, and a perforated disc at the opposite end of the casing, presenting an elongated chamber of circular, transverse cross section within the casing; ear engaging structure adjacent said opposite end of the casing adapted for holding the latter in place in the outer canal of the human ear; and an elongated, frusto-conical, filter plug of lesser length than the chamber, having a longitudinal bore therethrough and disposed within said chamber with the larger end of the plug nearest said one end of the casing, the diameter of the larger end of the plug and the diameter of the chamber adjacent said one end of the casing being substantially the same, the diameter of the chamber being inwardly tapered throughout a portion of its length adjacent said one end of the casing as the opposite end of the latter is approached at an angle at least as great as the angle of taper of the plug, whereby the plug is retarded in moving toward said opposite end of the casing by frictional engagement between the side wall of the casing and portions of the plug intermediate the ends of the latter, as well as by the inertia of the plug itself.

3. In the protector as set forth in claim 2, wherein the angles of taper of the chamber and the plug are equal.

4. In the protector as set forth in claim 2, wherein the chamber is tapered convexly of its length.

5. In the protector as set forth in claim 2, wherein the surface of the side wall defining the chamber is undulated longitudinally of the chamber.

6. In the protector as set forth in claim 2, wherein is provided an elongated tab element extending from said one end of the casing in a direction opposite said opposite end of the casing and substantially parallel to the longitudinal axis of the casing, said element having a knob on the free end thereof.

References Cited in the file of this patent

UNITED STATES PATENTS

2,427,664 Dunbar et al. ---------- Sept. 23, 1947