Nov. 8, 1949 J. BAUM 2,487,038

EAR INSERT FOR EARPHONES

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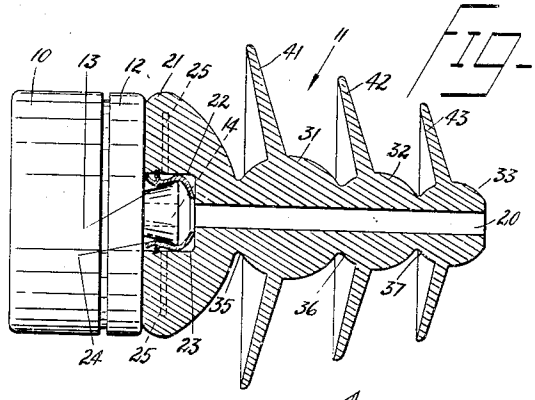



FIG. 1

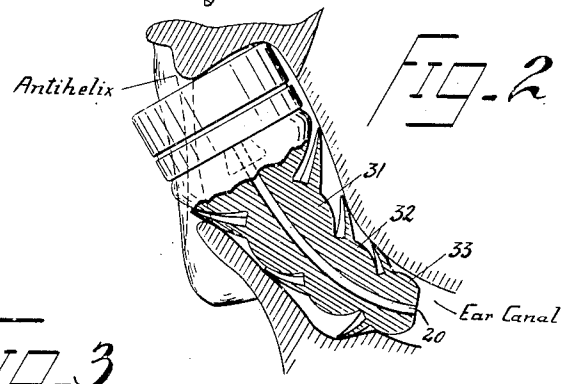



FIG. 2

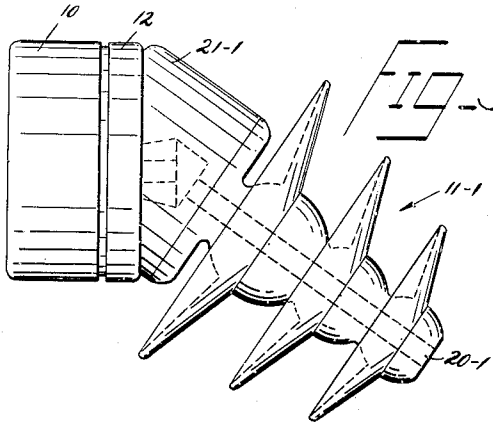



FIG. 3

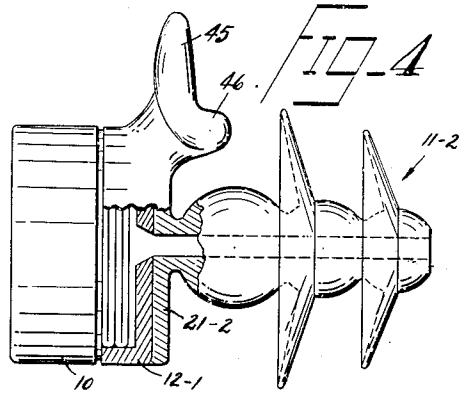



FIG. 4

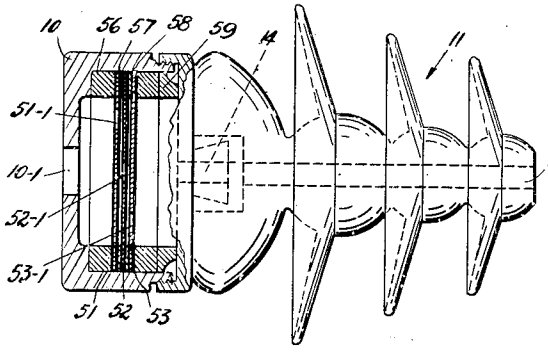



FIG. 5

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## EAR INSERT FOR EARPHONES

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4 Claims. (Cl. 181—23)

1

This invention relates to acoustic devices and it has among its objects a simple, universally-adjustable and foolproof acoustic insert for acoustically coupling a sound outlet opening of a sound transmitting device, such as a hearing-aid earphone, to the ear canal of a person, and prevent direct transmission of sound thereto.

The foregoing and other objects of the invention will be best understood from the following description of exemplifications thereof, reference being had to the accompanying drawings wherein

Fig. 1 shows a vertical cross-sectional view of an acoustic device exemplifying one form of the invention;

Fig. 2 is a horizontal cross-sectional view through an ear with the device of Fig. 1 held therein;

Figs. 3 and 4 are views similar to Fig. 1 of other forms of acoustic devices exemplifying the invention; and

Fig. 5 is a vertical sectional view of an ear-protecting acoustic device equipped with an ear insert of the invention.

Various forms of ear inserts for acoustically coupling a sound outlet opening of a sound transmitting device to the ear canal of a person have been suggested in the past. In hearing aid earphones in connection with which ear inserts are most commonly used, most of the ear inserts are usually made of hard synthetic resin material and molded from a plaster cast so as to fit the outer ear cavity and establish a good acoustic seal between the sound outlet of the receiver and the ear canal, the ear insert serving also to support the receiver on the ear of the user.

Ear inserts are also used in connection with ear protector devices which are placed against the ear for controlling the transmission of the sound in such manner as to prevent excessive sounds, such as caused by a bomb explosion or gun concussion, from injuring the ear organs, while permitting normal sound, such as speech, to be transmitted to the hearing center of the user.

Various attempts have been made in the past to provide a universally-adjustable ear insert for such sound transmitting devices. However, individual ears differ greatly in size and shape and have outer ear cavities of greatly varying configurations. As a result, great difficulties have been encountered with prior adjustable ear inserts because in most cases, the insert either exerted too great pressure or failed to provide a good acoustic seal between its sound transmitting passage and the ear canal.

2

The ear insert arrangements of the present invention, the various novel features of which will be described hereinafter in connection with specific exemplifications thereof, overcome the difficulties encountered with prior art adjustable ear inserts, thereby making it possible to fit ears of a great variety of configurations and sizes with only a few sizes of ear inserts of one standard construction.

Referring to Figs. 1 and 2, a sound transmitting device 10 is provided with an ear insert 11, in the form of a conduit or channel member shaped for insertion into the concha or the outer cavity of an ear. The sound transmitting device 10 may be either a hearing aid earphone, such as described in Carlisle et al. Patent No. 2,344,023, or an ear protector device, such as shown in Fig. 5. The sound transmitting device 10 is housed in a casing, one side of which has a cap wall 12 with a projecting sound outlet knob 13 provided with a sound outlet passage opening 14 from which sound is transmitted to the ear canal of the user.

The ear insert conduit or channel member 11 has formed therein a sound passage 20 extending axially therethrough. The rear end of the channel member 11 serves as a coupling wall section 21 and has formed therein a cavity 22 in which is held the female part of a snap fastener clasp 23 formed of spring metal and having a plurality of spring arms 24 bent to slide on and engage the tapered side surfaces of the sound outlet knob 13 and to retain it tightly in the locked position shown so that the facing wall surfaces of the coupling section 21 and the cap wall 12 form a tight acoustic seal around the cavity space which couples the outlet opening 14 to the sound passage 20 of the insert 11.

The body of the channel member 11 may be made of relatively soft rubber-like material, such as a soft grade of Neoprene. As indicated in Fig. 1, the sheet metal clasp 23 may have, in addition to the spring arms 24, extending from the central ring-shaped anchoring element thereof, a plurality of flat anchoring arms 25 which are embedded in the molded body of the coupling wall section 21 so as to be firmly anchored therein and give it the rigidity required in order that it may serve as a good coupling connection between the channel member 11 and the outlet wall of the sound transmitting device 10. The clasp arrangement shown permits ready removal of the ear insert 11 from the sound transmitting device 10 as well as attachment thereto.

The major part of the ear insert channel mem-

ber is formed of a succession of thick, generally ball-shaped ball-like wall sections 31, 32, 33, which are interconnected to each other and to the coupling wall section 21 by thin and short neck-like wall sections 35, 36, 37. The ball-like wall sections 31, 32, 33 are each made with sufficiently thick walls as to give them great stiffness and prevent substantial distortion of the cross section of the sound-passage portions extending therethrough under the action of external bending forces to which they are subjected when the channel member 11 is inserted into the curved space of the outer ear cavity. The short neck-like junction elements 35, 36, 37 are formed out of thin, flexible wall portions and they are so designed in relation to the thick ball-like wall sections 31, 32, 33 that when the forwardly protruding channel member 11 is bent, for instance, in the manner indicated in Fig. 2, on being inserted into the curved space of the outer ear cavity, only the short neck-like junction portions 35, 36, 37 will be flexed, the thick ball members 31, 32, 33 being provided with walls of sufficient thickness and stiffness to keep open the sound passage portions through the short junction necks 35, 36, 37.

In other words, the wall elements of the relatively thick and longer ball-like members 31, 32, 33 are so proportioned in relation to the thickness and the short length of the junction necks 35, 36, 37 of the channel member that when the ball members 31, 32, 33 are bent at various angles relatively to each other along their junction portions 35, 36, 37, respectively, the sound passage 20 through the junction portions 35, 36, 37 remains open and the entire sound passage 20 of the channel member 11 remains fully effective for transmitting sound from the sound transmitting device 10 toward the ear canal of the user, the mouth of which is engaged by the exterior periphery of the outermost bead member 33, in the manner indicated in Fig. 2.

In an acoustic ear insert channel member of the invention of the type described above, each of the ball-like members 31, 32, 33 of its forward part extending through the ear cavity, has relatively great wall thickness and stiffness sufficient to prevent any substantial deformation of the cross section of the sound passage extending therethrough when the channel member is bent incident to its insertion into its operative coupling position within the ear cavity for completing an acoustically sealed sound passage between the outlet opening of the sound transmitting device and the mouth of the ear canal.

The channel member 11 is given the required flexibility so that it may be readily flexed and assume the bent shape conforming to any peculiar curved shape of the outer ear cavity into which it is inserted, by making each short neck-like wall section 35, 36, 37 sufficiently thin and sufficiently short so as to cause it to readily flex and take up substantially the entire deformation to which the channel member is subjected, while assuring that the stiffness of the adjoining thick ball-like wall sections keeps the sound passage of each short cross section open in its flexed deformed condition.

The neck portions 35, 36, 37, although highly flexible, are also made sufficiently short so that the entire channel member, the principal elements of which are formed by the stiff ball-like elements 31, 32, 33, has the characteristics of a relatively firm post, which, when inserted into the ear cavity, will push the front elements of the channel member toward the mouth of the ear canal and force it into engagement therewith, notwithstanding the great flexibility of the junction neck portions 35, 36, 37.



As shown in Figs. 1 and 2, the forward flexible part of the ear insert channel wall member 11 is provided with a plurality of thin flexible skirt-like protrusions 41, 42, 43 projecting in outward and rearward direction so that upon insertion of the ear insert channel member 11 into the ear cavity, the outer edge region of the individual protrusions 41, 42, 43 will engage and become wedged against the surrounding surface portions of the outer ear cavity for automatically establishing therewith an acoustic seal which prevents propagation of sound through the space of the ear cavity surrounding the exterior of the channel member.

The ear insert of the type shown in Figs. 1 and 2 will readily fit and establish with its exterior elements good acoustic seals with ear cavities of different shapes and configurations and of different sizes. For instance, if an ear insert of the type shown in Figs. 1 and 2 has to fit into an ear cavity of smaller length, the outer bead-like element 33 may be cut off at or below its junction neck element 37. For ears having particularly short ear cavities, both bead-like elements 32 and 33 may be cut off. In general, two or three standard sizes of flexible ear tips of the type described in connection with Figs. 1 and 2 will be sufficient for providing adjustable ear inserts for ears of substantially every size, shape and configuration.

As shown in Fig. 3, a channel member 11—1, similar to that described in connection with Figs. 1 and 2, may be provided with a coupling wall section 21—1 arranged so that the axial direction of the sound passage 20—1 is inclined to the axis of the sound passage in the outlet knob 13 of the sound transmitting device 10.

As shown in Fig. 4, the sound transmitting device 10 may have a cap wall member 12—1 designed to form the rear part of a channel wall member 11—2 of the type described above in connection with Figs. 1 to 3. The cap wall member 12—1 is embodied in the molded rear part 21—2 of the channel member and serves for coupling the channel member to the sound transmitting device, being thus a part thereof. The coupling wall section 21—2 may be molded so as to have formed thereon horn-like extensions 45 provided with grooves 46 arranged to engage and be retained within the fossa and below the underlying portion of the helix so as to be retained and held firmly therein when inserted in the ear, in the manner analogous to that described in the Aber Patent No. 1,753,817.

Fig. 5 illustrates an ear insert of the type described in connection with Figs. 1 to 3 forming part of an ear protector which is designed to control the transmission of sound to the ear so as to prevent bomb explosions, gun concussions and similar abnormal sound phenomena from injuring the ear, while permitting speech and similar sound to be efficiently transmitted to the hearing organs.

The ear protector is shown formed of a plurality of circular sheet elements 51, 52, 53, held in position within the casing elements 10, 12 by a series of spacer washers 56, 57, 58, 59, so as to provide thin air spaces between the individual sheet elements. The several sheet elements are provided with small sound passage openings 51—1, 52—1, 53—1 which are offset relatively to each other so that when one of the sheet elements, for

instance, element 52 is deflected in one direction or the other, its sound passage opening 52—1 will be substantially closed through engagement of the surrounding sheet surface with the facing sheet surface of either sheet element 51 or sheet element 53.

One of the sheet elements, for instance, the central sheet element 51 may be made of limp and light material, such as Vinylite, which has negligible stiffness and resiliency so that it is not set into vibrations by normal speech, but is actuated to close its opening 51—1 by a large air pressure wave or the vacuum reaction following it, which take place when a bomb explosion or gun concussion take place.

The two outer sheet elements 51, 53 may be substantially rigid. Normal speech will be propagated through the sound passage opening 10—1 of the casing 10 and therefrom through the openings 51—1, 52—1, 53—1 of the several sheet elements and the air spaces therebetween toward the sound outlet passage 14, and therefrom through the sound passage 20 in the channel member 11 to the ear canal.

Various other modifications of the invention will suggest themselves to those skilled in the art. It is accordingly desired that in construing the breadth of the appended claims they shall not be limited to the specific details shown and described in connection with the exemplifications of the invention.

I claim:

1. In an ear insert forming part of an ear phone for acoustically coupling the outlet opening of the outlet duct of the ear phone to the ear canal of a person: a conduit member of deformable rubbery material which extends forwardly from the outlet duct into the ear canal and confining an acoustically sealed sound passage connecting said outlet opening to the ear canal, said conduit member having a hollow rear coupling part with a snap connector element for detachable coupling engagement with the exterior of said outlet duct and for maintaining a tight acoustic seal around said outlet opening, the forward part of said conduit member extending from said coupling part to its forward end being formed of a plurality of successive generally ball-like wall sections interconnected to each other and to said coupling part through intermediate short wall sections, said ball-like wall sections being of relatively great wall thickness and stiffness sufficient to prevent closure of said passage when subjected to bending forces exerted by the walls of the ear cavity, said short wall sections being of relatively small wall thickness and sufficiently



short as to cause them to flex and take up substantially the entire deformation to which the conduit member is subjected when operatively connected to the ear canal while the stiffness of the adjoining ball-like wall sections maintains the sound passages of the flexed short wall sections open, said ear insert being shaped to be retained in the ear and serve as the sole support holding said sound transmitting device in its operative position within the ear, said ball-like wall sections along the forward part of the conduit member having a thin flexible skirt-like protrusion projecting in outward direction for providing an acoustic seal between the outer periphery of their wall sections and the facing wall portions of the ear cavity.

2. In an ear insert as claimed in claim 1, in which the snap connector element is of metal and has anchoring portions engaging the surrounding rubbery wall portions of the conduit, and resiliently-yieldable metallic locking portions shaped to resiliently interlock with outer portions of said outlet duct.

3. An ear insert as claimed in claim 1, which contains at least three ball-like channel members interconnected to each other and to the coupling part of said conduit member by said short wall sections, said ball-like wall sections being graduated in over-all transverse direction, with a forward ball-like wall section smaller and a rearward ball-like wall section larger than an intermediate ball-like wall section.

4. In an ear insert as claimed in claim 3, in which the snap connector element has anchoring portions engaging the surrounding rubbery wall portions of the conduit, and resiliently yieldable metallic locking portions shaped to resiliently interlock with outer portions of said outlet duct.

JASPER BAUM.


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