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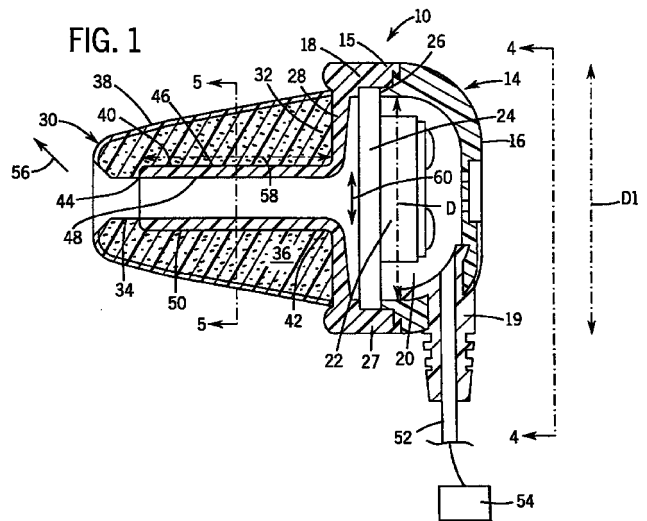
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(54) **A stereophonic earphone apparatus**

(57) A stereophonic earphone apparatus is disclosed for incanal of a user thereof. The apparatus includes a housing which has a first and a second end and which defines an enclosure. An electroacoustic transducer is disposed within the enclosure and a diaphragm is disposed within the enclosure adjacent to the transducer. A resilient anchor having a first and a second extremity is arranged such that the first extremity is removably secured to and extends from a cover of the housing. The anchor is fabricated from a hydrophilic urethane foam having a skinned over outer surface such that when the anchor is compressed, insertion of the anchor within the ear canal is permitted. The foam has a shape restoration memory such that after insertion of the anchor within the ear canal, the foam gradually expands so that the skinned over surface thereof comes into intimate contact with the ear canal so that the apparatus is secured within the ear canal. A tube extends from the cover and is disposed within a passageway defined by the anchor. The tube has an inner and an outer face such that the outer face of the tube extends contiguously along the passageway so that the tube prevents obturation of the passageway while permitting a transmission of sound waves from the diaphragm into the ear canal.



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Description**BACKGROUND OF THE INVENTION****1. Field of the Invention**

[0001] The present invention relates in general to the field of stereophonic earphone apparatus. Specifically, a preferred embodiment of the present invention relates to a stereophonic earphone apparatus for insertion within an ear canal of a user thereof.

2. Discussion of the Related Art

[0002] As is known to those skilled in the art, various earphone arrangements have been proposed for location adjacent to the opening of the ear canal of the user. Thus, a previously recognized problem has been that such earphones have been less than comfortable. Needless to say, it is desirable to have an earphone that can be worn for an extended period without causing discomfort to the wearer thereof.

[0003] Various means have been proposed for supporting earphones so that such earphones comfortably fit the user's ear. However, such prior art arrangements have been less than successful in achieving such objective.

[0004] Also, with the prior art earphone arrangements, there is a tendency for extraneous noise to leak past the earphone into the ear canal of the user thus reducing the quality of the reproduced sound waves.

SUMMARY AND OBJECTS OF THE INVENTION

[0005] By way of summary, the present invention is directed to a stereophonic earphone apparatus for insertion within an ear canal of a user thereof. The apparatus includes a housing which has a first and a second end. The housing defines an enclosure for the reception therein of an electroacoustic transducer. A diaphragm is disposed within the enclosure adjacent to the transducer with the diaphragm defining a peripheral flange which is connected to the housing such that the diaphragm operably cooperates with the transducer for emitting sound waves therefrom. A cover is secured to the second end of the housing such that the diaphragm is disposed between the cover and the transducer.

[0006] A resilient anchor has a first and second extremity, the first extremity being removably secured to and extending from the cover. The anchor is fabricated from a hydrophilic urethane foam having a skinned over outer surface such that when the anchor is compressed, insertion of the anchor within the ear canal is permitted. The foam has a shape restoration memory such that after insertion of the anchor within the ear canal, the foam gradually expands so that the skinned over surface comes into intimate contact with the ear canal. In this manner, the apparatus is firmly secured within the

ear canal.

[0007] The anchor is of a generally conical configuration with the anchor tapering inwardly from the first extremity towards the second extremity. The anchor also defines a longitudinal passageway having a first and a second termination with the first termination being disposed adjacent to the cover and the first extremity of the anchor. A tube extends from the cover and is disposed within the passageway. The tube has an inner and an outer surface the arrangement being such that the outer surface of the tube extends contiguously along the passageway so that the tube prevents obturation of the passageway while permitting transmission of the sound waves from the diaphragm into the ear canal.

[0008] The present invention also includes a method for inserting an earphone within an ear canal of a user thereof, the method comprising the steps of compressing a resilient foam anchor between the user's fingers; subsequently inserting the anchor gently into the ear canal; finally, permitting the foam anchor to gradually expand so that a skinned over outer surface of the foam conforms closely to the shape of the ear canal so that the anchor and a housing attached thereto are comfortably secured relative to the user's ear.

[0009] An effect of the present invention is to enhance the transmission of sound waves from the transducer to the ear canal of the user. A primary object of the invention is to provide an apparatus that is comfortable to wear. Another object of the invention is to provide a unique arrangement which permits the comfortable reception of a resilient anchor within the ear canal of the user thereof so that a high fidelity sonic connection is made between the apparatus and the ear canal of the user.

[0010] A further object of the invention is to provide an earphone apparatus which optimizes a natural acoustic response of the apparatus and provides accurate frequency response thereof.

[0011] These, and other, aspects and objects of the present invention will be better appreciated and understood when considered in conjunction with the following description and the accompanying drawings. It should be understood, however, that the following description, while indicating a preferred embodiment of the present invention, is given by way of illustration and not of limitation. Many changes and modifications may be made within the scope of the present invention without departing from the spirit thereof, and the invention includes all such modifications.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] A clear conception of the advantages and features constituting the present invention, and of the construction and operation of typical mechanisms provided with the present invention, will become more readily apparent by referring to the exemplary, and therefore non-limiting, embodiment illustrated in the

drawing accompanying and forming a part of this specification, wherein like reference numerals designate the same elements in the several views, and in which:

Fig. 1 is a side elevational view, partially in section, of a stereophonic earphone apparatus according to the present invention;

Fig. 2 is a side elevational view of the apparatus shown in Fig. 1 with the resilient anchor compressed prior to insertion thereof within the ear canal of the user;

Fig. 3 is a similar view to that shown in Fig. 2, but shows the resilient anchor gradually expanded so that a skinned over surface thereof comes into intimate contact with the ear canal of the user;

Fig. 4 is a view taken on the line 4-4 of Fig. 1;

Fig. 5 is a sectional view taken on the line 5-5 of Fig. 1;

Fig. 6 is an exploded perspective view of the earphone shown in Fig. 1;

Fig. 7 is a view of the housing viewed from the right hand side of Fig. 1;

Fig. 8 is a view taken on the line 8-8 of Fig. 7;

Fig. 9 is a sectional view taken on the line 9-9 of Fig. 7;

Fig. 10 is a view of a portion of the housing shown in Fig. 1 taken on the line 10-10 of Fig. 9;

Fig. 11 is a view taken on the line 11-11 of Fig. 8;

Fig. 12 is a sectional view of the anchor shown in Fig. 1;

Fig. 13 is a view taken on the line 13-13 of Fig. 12;

Fig. 14 is a view of the cover shown in Fig. 1 with the anchor removed;

Fig. 15 is a sectional view taken on the line 15-15 of Fig. 14;

Fig. 15A is an enlarged view of a portion of the cover shown in Fig. 15;

Fig. 16 is a view taken on the line 16-16 of Fig. 15;

Fig. 17 is a sectional view of an alternative embodiment to the present invention with the anchor removed;

Fig. 18 is a view of the cord relief shown in Fig. 17;

Fig. 19 is a view taken on the line 19-19 of Fig. 18;

Fig. 20 is a sectional view taken on the line 20-20 of Fig. 19;

Fig. 21 is a sectional view taken on the line 21-21 of Fig. 20;

Fig. 22 is a perspective view of a further embodiment of the present invention;

Fig. 23 is a side elevational view of the embodiment shown in Fig. 22;

Fig. 24 is a view taken on the Line 24-24 of Fig. 23;

Fig. 25 is a sectional view taken on the line 25-25 of Fig. 23;

Fig. 26 is a view taken on the line 26-26 of Fig. 23;

Fig. 27 is a perspective view of the embodiment shown in Fig. 22 showing more particularly the housing thereof;

Fig. 28 is an end view of yet another embodiment of the present invention;

Fig. 29 is a view taken on the line 29-29 of Fig. 28;

Fig. 30 is a view taken on the line 30-30 of Fig. 29;

Fig. 31 is a graph comparing the performance of the present invention with the performance of a prior art earphone; and

Fig. 32 is a graph comparing the precision noise against frequency of the earphone according to the present invention in comparison with the performance of a prior art earphone.

DESCRIPTION OF PREFERRED EMBODIMENT

[0013] The present invention and the various features and advantageous details thereof are explained more fully with reference to the non-limiting embodiment described in detail in the following description.

[0014] Referring to the drawings, Fig. 1 is a side elevational view, partially in section, of a stereophonic earphone apparatus generally designated 10 according to the present invention for insertion within an ear canal 12 of a user thereof as shown in Fig. 3.

[0015] The apparatus 10 includes a housing generally designated 14 having a first and a second end 16 and 18 respectively. The housing 14 defines an enclosure 20 for the reception therein of an electroacoustic

transducer 22. A diaphragm 24 is disposed within the enclosure 20 adjacent to the transducer 22. The diaphragm 24 defines a peripheral flange 26 which is connected to the housing 14. The arrangement is such that the diaphragm 24 operably cooperates with the transducer 22 for emitting sound waves therefrom. A cover 28 is secured to the second end 18 of the housing 14 such that the diaphragm 24 is disposed between the cover 28 and the transducer 22.

[0016] Additionally, a resilient anchor, generally designated 30, has a first and a second extremity 32 and 34 respectively, with the first extremity 32 being removably secured to and extending from the cover 28. The anchor 30 is fabricated from a hydrophilic urethane foam 36 having a skinned over outer surface 38. The arrangement is such that when the anchor 30 is compressed as shown in Fig. 2, insertion of the anchor 30 within the ear canal 12 is permitted. The foam 36 has a shape restoration memory such that after insertion of the anchor 30 within the ear canal 12, the foam 36 gradually expands as shown in Fig. 3. As the foam 36 expands, the skinned over surface 38 comes into intimate contact with the ear canal 12 to secure the apparatus 10 comfortably within the ear canal 12.

[0017] Referring generally now to Figs. 1-5, more specifically, the anchor 30 is of truncated conical configuration, the anchor 30 being tapered inwardly from the first extremity 32 towards the second extremity 34. Also, the anchor 30 defines a longitudinal passageway 40 which has a first and second termination 42 and 44 respectively. The first termination 42 is disposed adjacent to the cover 28 and the first extremity 32 of the anchor 30.

[0018] A tube 46 extends from the cover 28 with the tube 46 being disposed within the passageway 40. The tube 46 has an inner and an outer face 48 and 50 respectively so that the outer face 50 of the tube 46 extends contiguously along the passageway 40 so that the tube 46 prevents obturation of the passageway 40 while permitting transmission of sound waves from the diaphragm 24 into the ear canal 12.

[0019] In a more specific embodiment of the present invention, the housing 14 is fabricated from a plastics material. The term plastics material includes polyvinyl chloride (PVC) or any other suitable type of plastic. The electroacoustic transducer 22 includes an electrical conductor 52 for connecting the transducer 22 to a sound reproducing device represented generically by the box 54.

[0020] The diaphragm 24, in a preferred embodiment of the present invention, is fabricated from MYLAR®. MYLAR® is a Registered Trademark of E. I. Du Pont De Nemours and Company. Also, the cover 28 and the tube 46 are fabricated as a one piece molding for directing a transmission therethrough of the sound waves from the diaphragm 24 through the tube 46.

[0021] The skinned over outer surface 38 permits thermal transfer from the ear canal 12 to the foam 36 for

further enhancing conformity of the resilient anchor 30 to the ear canal 12 and for inhibiting transmission of extraneous ambient noise past the resilient anchor 30 into the ear canal 12.

[0022] Additionally, the skinned over outer surface 38 in the vicinity of the second extremity 34 of the anchor 30 is curved inwardly so that the second extremity 34 is of substantially domed-shaped configuration.

[0023] The second termination 44 of the passageway flares outwardly in a direction as indicated by the arrow 56 from the first termination 42 towards the second termination 44 for enhancing a high frequency response of the apparatus 10.

[0024] Also, the tube 46 extends from the first termination 42 of the passageway 40 towards the second termination 44 and more specifically the tube 46 terminates before the second termination 44 of the passageway 40.

[0025] The length 58 and the diameter 60 of the tube 46 are balanced in order to optimize a natural acoustic response of the apparatus 10 and to provide an accurate frequency response thereof.

[0026] More specifically, the length of the anchor in a preferred embodiment to the present invention is 14 millimeters and the diameter thereof at the first end 32 is 13.7 millimeters. The passageway 40 has a diameter of 2.2 millimeters and the flared second end 34 flares outwardly to a diameter of 4.5 millimeters. The anchor tapers from the first end 32 to the second end 34 at an angle of 10 degrees.

[0027] The tube 46 has a length of 11.7 millimeters and an internal diameter of 2.2 millimeters with the external diameter of the tube 46 being 3.2 millimeters.

[0028] Additionally, the foam 36 provides a seal against the ingress into the ear canal 12 of extraneous noise thus providing an extreme base frequency performance.

[0029] Furthermore, the transducer 22 is electrically connected by a cord or electrical cable 52 to audio equipment. Such audio equipment includes a home audio equipment, a portable audio equipment, a computer sound board or any other type of professional sound equipment generically depicted by the box 54.

[0030] In a further aspect of the present invention, an earphone 10 includes a housing 14 having a front face 15, a magnetic circuit or transducer 22 received in the housing 14, a diaphragm 24 magnetically coupled to the magnetic circuit 22, the diaphragm 24 having a diameter D substantially equal to a diameter D1 of the housing 14.

[0031] Resilient member 30 is attached to front face 15 of housing 14 and is aligned with diaphragm 24, for compression insertion into aural meatus or ear canal 12 of a user. Once in the meatus 12, re-expansion occurs so as to provide a high fidelity sonic connection between diaphragm 24 and an eardrum of the user of earphone 10.

[0032] Annular flange 27 extends from front face

15, and flange 27 projects generally normal to the diaphragm 24. Flange 27 fits over and is secured to resilient member 30. Resilient member 30 is preferably of frusto-conical configuration and is fabricated from a hydrophilic urethane foam 36. Member 30 has a

5 [0033] In yet another aspect of the present invention, earphone 10 includes a housing 14, a magnetic circuit or transducer 22 received in the housing 14, a diaphragm 24 magnetically coupled to the magnetic circuit 22. The diaphragm 24 has a diameter D substantially equal to a diameter D1 of the housing 14. A protector plate cover 28 is attached to the housing 14 for covering the diaphragm 24. An annular support flange 27 extends from the protector plate cover 28 and projects generally normal to the cover 28.

10 [0034] Also, resilient member means 30 has a first and a second extremity 32 and 34 and is arranged to fit the first extremity 32 within the annular flange 27 so that the resilient means 30 connects to cover 28 and projects outwardly therefrom. The arrangement is such that when the resilient means 30 is compressed, insertion of the resilient means 30 into an aural meatus 12 of the user is permitted. The subsequent re-expansion of the resilient means 30 provides a high fidelity sonic connection between the diaphragm 24 and an eardrum of the user of the earphone 10.

15 [0035] Fig. 6 is an exploded perspective view of the earphone 10 as shown in Fig. 1 to better illustrate the housing 14, the transducer 22, the cover 28 with the tube 46 extending therefrom, and the resilient member or anchor 30.

20 [0036] Fig. 7 is a view similar to that shown in Fig. 4 with the cord 52 removed from the housing 14.

[0037] Fig. 8 is a view taken on the line 8-8 of Fig. 7 and shows the housing 14 and an annular ridge 15 for securing the housing 14 to the cover 28.

[0038] Fig. 9 is a sectional view taken on the line 9-9 of Fig. 7 and shows an opening 17 for receiving a resilient strain relief 19 shown in Fig. 4 for relieving the cord 52.

25 [0039] Fig. 10 is a view taken on the line 10-10 of Fig. 9 and shows the opening 17 for receiving the relief 19.

[0040] Fig. 11 is a view taken on the line 11-11 of Fig. 8 and shows the annular ridge 15 for fastening the housing 14 to the cover 28.

[0041] Fig. 12 is a sectional view of the anchor 30 shown in Fig. 1 shows the skinned over surface 38 thereof.

[0042] Fig. 13 is a view taken on the line 13-13 of Fig. 12 and shows the skinned over surface 38 extending around the circumference of the anchor 30.

[0043] Fig. 14 is an end view of the cover 28 viewed

from the left hand side of Fig. 1 with the anchor removed therefrom.

[0044] Fig. 15 is a sectional view of the cover 28 taken on the line 15-15 of Fig. 14 showing the tube 46 extending from the cover 28.

[0045] Fig. 16 is a view taken on the line 16-16 of Fig. 15 and shows a lip 21 which cooperates with the ridge 15 of the housing 14 for securing the cover 28 relative to the housing 14.

10 [0046] Fig. 15A is an enlarged view of a portion of the cover 28 circled in Fig. 15. Fig. 15A shows the lip 21 for securing the cover 28 to the housing 14.

[0047] Fig. 17 is a sectional view of a further embodiment of the present invention which includes a tube 46A and a cover 28A which is secured to a housing 14A. The housing 14A defines an opening 17A for the reception therein of a resilient cord strain relief 19A so that the cord 52A is guided into the housing 14A.

15 [0048] Fig. 18 is a side elevational view of the cord strain relief 19A. The rounded shape of the strain relief 19A allows the relief to avoid contact with the user's ear, thus enhancing wearing comfort.

[0049] Fig. 19 is a view taken on the line 19-19 of Fig. 18 and shows the cord relief 19A having cut away portions 23A for permitting flexing of the cord 52A relative to the housing 14A.

20 [0050] Fig. 20 is a sectional view taken on the line 20-20 of Fig. 19 and shows the cord 52A guided by the cord relief 19A.

[0051] Fig. 21 is a sectional view taken on the line 21-21 of Fig. 20 and shows the opening 17A for the reception therein of the cord relief 19A.

[0052] Fig. 22 is a perspective view of a further embodiment of the present invention showing a resilient anchor 30B and a housing 14B.

[0053] Fig. 23 is a side elevational view of the earphone shown in Fig. 22 showing the cover 28B disposed between the anchor 30B and the housing 14B.

25 [0054] Fig. 24 is a view taken on the line 24-24 of Fig. 23 and shows the anchor 30B surrounding the tube 46B.

[0055] Fig. 25 is a sectional view taken on the line 25-25 of Fig. 23 and shows the tube 46B extending through the passageway 40B of the anchor 30B. Additionally, the tube 46B includes an integral outwardly extending annular collar 25B which freely permits insertion of the tube 46B within the passageway 40B of the anchor 30B. However, the collar 25B tends to inhibit axial movement as indicated by the arrow 27B of the anchor 30B relative to the tube 46B. The provision of the collar 25B prevents the anchor 30B from sliding off the tube 46B when the earphone is removed from the ear canal. However, the collar 25B permits removal of the anchor 30B for replacement thereof for hygienic reasons.

30 [0056] Fig. 26 is a view taken on the line 26-26 of Fig. 23 and shows the housing 14B and the opening 17B for the reception therein of the cord relief not

shown.

[0057] Fig. 27 is a perspective view of the earphone shown in Fig. 22 showing the opening 17B and the housing 14B.

[0058] Fig. 28 is an end view of yet another embodiment of the present invention which shows a housing 14C with a cord 52C extending therefrom.

[0059] Fig. 29 is a view taken on the line 29-29 of Fig. 28 and shows the housing 14C and the anchor 30C with a cover 28C disposed therebetween.

[0060] Fig. 30 is a view taken on the line 30-30 of Fig. 29 and shows the tube 46C surrounded by the anchor 30C.

[0061] Fig. 31 is a graph which compares the performance of the earphone 10 according to the present invention with the performance of prior art earphones. In Fig. 31, the performance of the earphone according to the present invention is shown by the line 62 while the performance of one known prior art arrangement is depicted by a graph having a line 64. The performance of a second is shown by line 66.

[0062] The graph of Fig. 31 shows a plot of amplitude vs. frequency response for the stereophonic earphone apparatus of the present invention. The earphone of the present invention (62) is compared in this plot to other stereophones in the an (64, 66). The prior an stereophones' response illustrated in the plot is indicative of the prior art amplitude vs. frequency response in prior art earbud-type stereophones. The direct comparison of the present invention data with representative prior art data demonstrates that present invention provides superior low frequency performance. This low frequency performance is a direct result of the novel features including the improved seal between the ear canal and the resilient member or anchor of the invention. Those skilled in the art will also readily appreciate from the aforementioned graphs that the high frequency response and the extended bass performance is enhanced by the provisions of the present invention.

[0063] Figure 32 is a graph comparing the audio noise amplitude vs. frequency for the stereophonic earphone apparatus according to the present invention with another prior art device. The present invention's noise reduction performance is compared to the noise reduction performance of a prior art foam hearing protector ear plug.

[0064] In Figure 32's frequency vs. amplitude plot of the acoustic noise isolation, the enhanced capability of the invention is illustrated. During testing, the invention is inserted in an artificial ear coupler with microphone and wide band noise is then generated in the area around the subject apparatus and coupler. The plot of Figure 32 in part shows the amount of noise isolation that can be expected from the present invention. Preferably, the present invention is perfectly inserted into an ear canal. The dashed line 68 shows a comparison plot of a typical commercial foam ear plug hearing protector. Base line of noise is also shown.

[0065] In operation of the apparatus according to the present invention, the user compresses the resilient anchor 30 between the user's fingers and then inserts the anchor gently into the ear canal 12 as best shown in Fig. 2. Subsequently, the foam 36 gradually expands so that the skinned over outer surface 38 of the foam conforms closely to the shape of the ear canal 12 so that the anchor and the housing 14 attached thereto are comfortably secured relative to the user's ear as best shown in Fig. 3.

[0066] Additionally, heat from the user's ear flows through the skinned over surface 38 to the foam 36 thus tending to further soften the foam in the vicinity of the lining of the ear canal. Thus, the anchor 30 becomes even more comfortably secured within the ear canal. Further, outside extraneous noises are sealed off from the ear canal by virtue of the close conformity of the skinned over surface 38 with the ear canal 12.

[0067] The present invention provides a unique stereophonic earphone apparatus which comfortably fits within the ear canal of a user and which provides an improved frequency response and enhanced base frequency performance.

[0068] Moreover, the individual components of the apparatus need not be formed in the disclosed shapes, or assembled in the disclosed configuration, but could be provided in virtually any shape, and assembled in virtually any configuration, so that the apparatus may be integrated with other equipment with which it is associated.

[0069] It is intended that the appended claims cover all such additions, modifications and rearrangements. Expedient embodiments of the present invention are differentiated by the appended subclaims.

Claims

1. A stereophonic earphone apparatus for insertion within an ear canal of a user thereof, said apparatus comprising:

a housing having a first and a second end, said housing defining an enclosure;
 an electroacoustic transducer disposed within said enclosure;
 a diaphragm disposed within said enclosure adjacent to said transducer, said diaphragm defining a peripheral flange which is connected to said housing such that said diaphragm operably cooperates with said transducer for emitting sound waves therefrom;
 a cover secured to said second end of said housing such that said diaphragm is disposed between said cover and said transducer;
 a resilient anchor having a first and a second extremity, said first extremity being removably secured to and extending from said cover, said anchor being fabricated from a hydrophilic ure-

- thane foam having a skinned over outer surface such that, when said anchor is compressed, insertion of said anchor within the ear canal is permitted, said foam having a shape restoration memory such that after insertion of said anchor within the ear canal, said foam gradually expands so that said skinned over surface comes into intimate contact with the ear canal to comfortably secure said apparatus within the ear canal;
- said anchor being of generally conical configuration, said anchor tapering inwardly from said first extremity towards said second extremity, said anchor defining a longitudinal passageway having a first and a second termination, said first termination being disposed adjacent to said cover and said first extremity of said anchor; and
- a tube extending from said cover, said tube being disposed within said passageway, said tube having an inner and an outer face, the arrangement being such that said outer face of said tube extends contiguously along said passageway so that said tube prevents obturation of said passageway, while permitting transmission of said sound waves from said diaphragm into the ear canal.
2. An earphone apparatus as set forth in claim 1 wherein said housing is fabricated from a plastics material.
 3. An earphone apparatus as set forth in claim 1 wherein said electroacoustic transducer includes:
 - an electrical conductor for connecting said transducer to a sound reproducing device.
 4. An earphone apparatus as set forth in claim 1 wherein said diaphragm is fabricated from MYLAR®.
 5. An earphone apparatus as set forth in claim 1 wherein said cover and said tube are fabricated as a one piece molding for directing transmission therethrough of said sound waves from said diaphragm through said tube.
 6. An earphone apparatus as set forth in claim 1 wherein said skinned over surface permits thermal transfer from the ear canal to said foam for further enhancing conformity of said resilient anchor to the ear canal and for inhibiting transmission of extraneous ambient noise past said resilient anchor to said ear canal.
 7. An earphone apparatus as set forth in claim 1 wherein said skinned over surface in the vicinity of said second extremity of said anchor, is curved inwardly so that said second extremity is of substantially dome-shaped configuration.
 8. An earphone apparatus as set forth in claim 1 wherein said second termination of said passageway flares outwardly in a direction from said first termination towards said second termination for enhancing a high frequency response of said apparatus.
 9. An earphone apparatus as set forth in claim 1 wherein said tube extends from said first termination of said passageway towards said second termination.
 10. An earphone apparatus as set forth in claim 1 wherein said tube extends from said first termination of said passageway towards said second termination, said tube terminating before said second termination of said passageway.
 11. An earphone apparatus as set forth in claim 1 wherein a length and diameter of said tube are balanced in order to optimize a natural acoustic response of said apparatus and to provide accurate frequency response thereof.
 12. An earphone apparatus as set forth in claim 1 wherein said foam provides a seal against ingress of extraneous noise into the ear canal thus providing an extreme extended bass frequency performance.
 13. An earphone apparatus as set forth in claim 1 wherein said transducer is selectively electrically connected to audio equipment.
 14. An earphone comprising:
 - a housing having a front face;
 - a magnetic circuit received in said housing;
 - a diaphragm magnetically coupled to said magnetic circuit, said diaphragm having a diameter substantially equal to a diameter of said housing;
 - a resilient support member attached to said front face of said housing and aligned with said diaphragm, for compression insertion into an aural meatus of a user and re-expansion so as to provide a high fidelity sonic connection between said diaphragm and an eardrum of a user of the earphone; and
 - an annular flange extending from said front face, said flange projecting generally normal to said diaphragm, said flange fitting over and being secured to said resilient member;
 - said resilient support member being of frusto-

conical configuration, said resilient member being fabricated from a hydrophilic urethane foam having a skinned over outer surface such that when said foam expands, said skinned over surface comes into intimate contact with the aural meatus to comfortably secure the earphone within the aural meatus.

15. An earphone as set forth in claim 14 further including a protector plate cover attached to said housing for covering said diaphragm such that said resilient support member is connected to said protector plate cover.

16. An earphone comprising:

- a housing;
- a magnetic circuit received in said housing;
- a diaphragm magnetically coupled to said magnetic circuit, said diaphragm having a diameter substantially equal to a diameter of said housing;
- a protector plate cover attached to said housing for covering said diaphragm;
- an annular support flange extending from said protector plate cover and projecting generally normal to said cover, and
- resilient support means having a first and a second extremity, said first extremity fitting within said annular flange so that said resilient support means is connected to said cover and projects outwardly therefrom, the arrangement being such that when said resilient support means is compressed, insertion of said resilient support means into an aural meatus of the user is permitted and subsequent reexpansion of said resilient support means provides a high fidelity sonic connection between said diaphragm and an eardrum of the user of the earphone.

17. An earphone as set forth in claim 16 wherein said resilient support means is of frusto conical configuration.

18. A method for inserting an earphone within an ear canal of a user thereof, said method comprising the steps of:

compressing a resilient foam anchor between the user's fingers;

subsequently inserting the anchor gently into the ear canal; and

permitting the foam anchor to gradually expand so that a skinned outer surface of the foam conforms closely to the shape of the ear canal so

that the anchor and a housing attached thereto are comfortably secured relative to the user's ear.

19. A method for inserting an earphone within an ear canal of a user thereof as set forth in claim 18 further including the step of:

allowing heat from the user's ear to flow through the skinned over surface to the foam thus tending to further soften the foam in the vicinity of the lining of the ear canal so that the anchor becomes even more comfortably secured within the ear canal and so that outside extraneous noises are sealed off from the ear canal by virtue of the close conformity of the skinned over surface with the ear canal.

20. The earphone of claim 1 further comprising a collar integral with the tube to inhibit movement of the anchor.

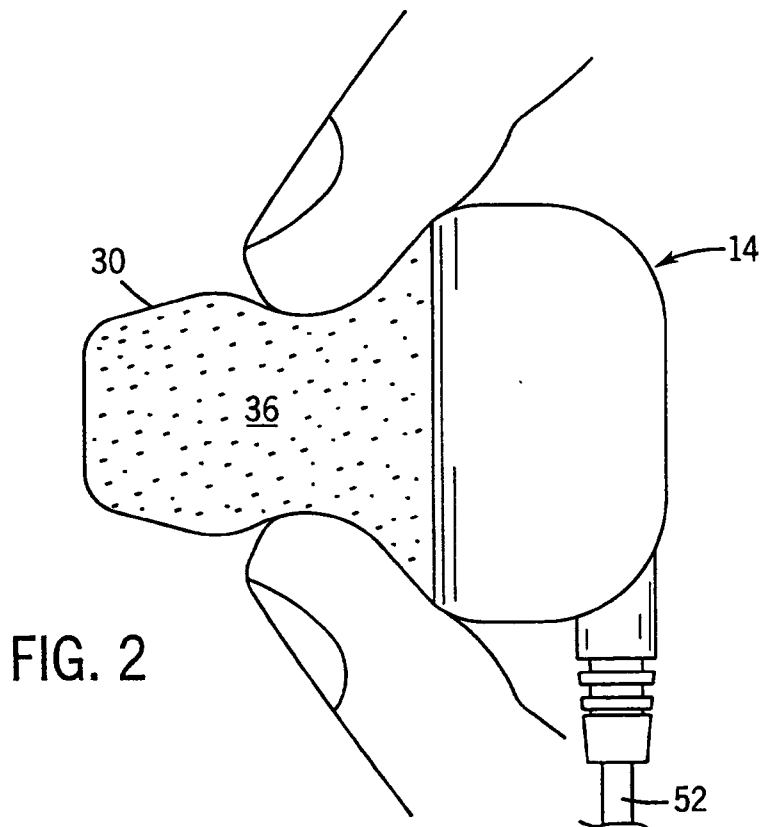
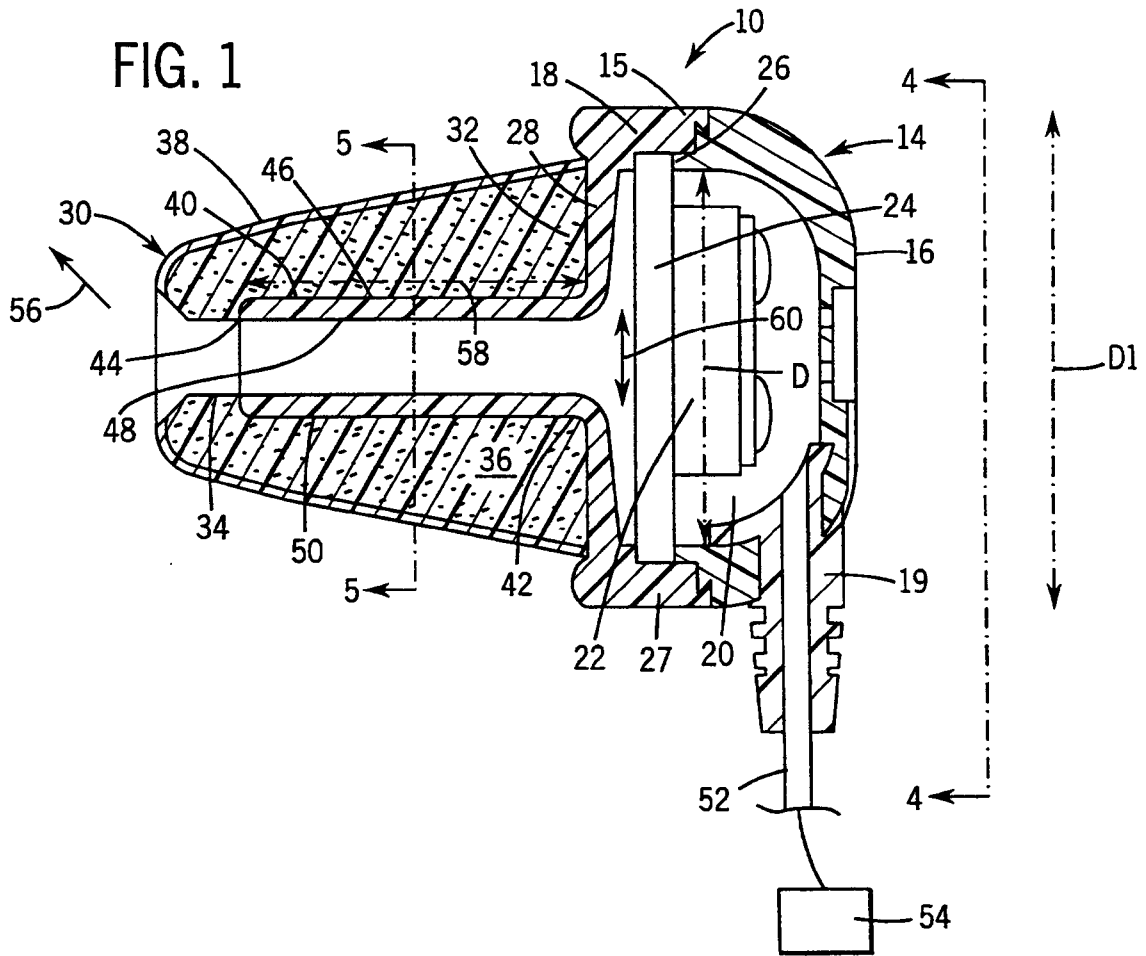
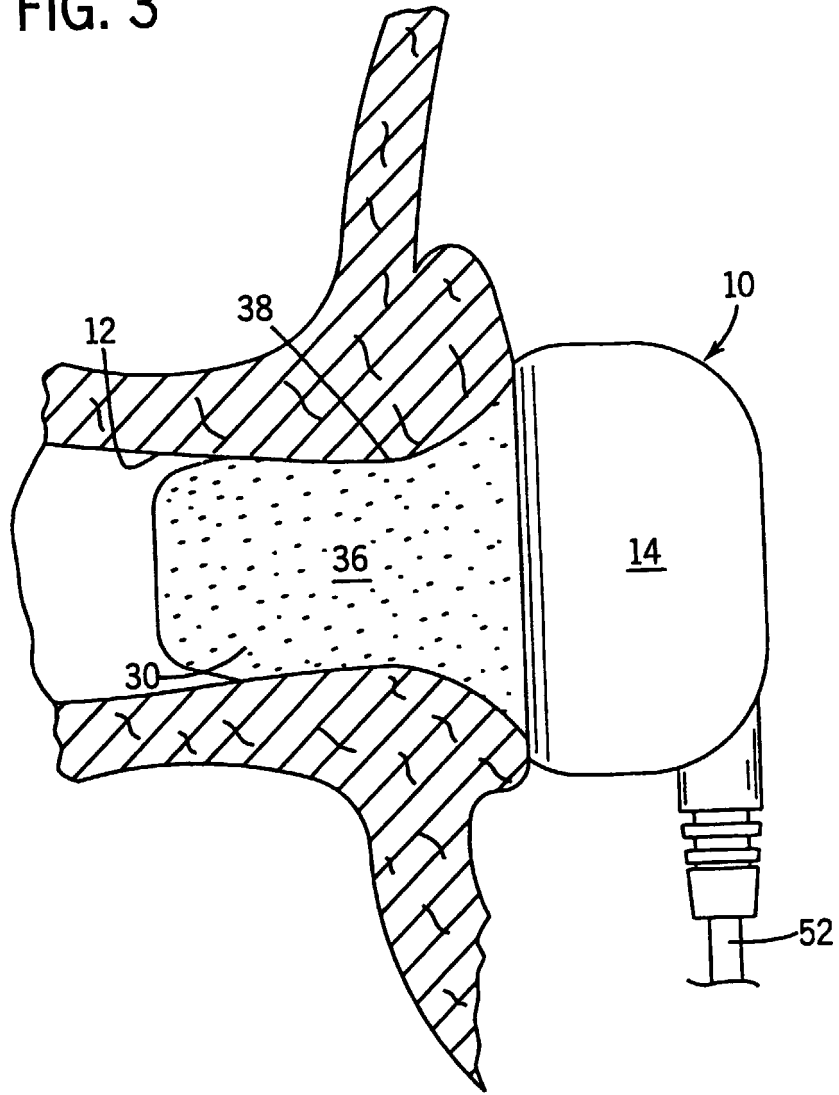
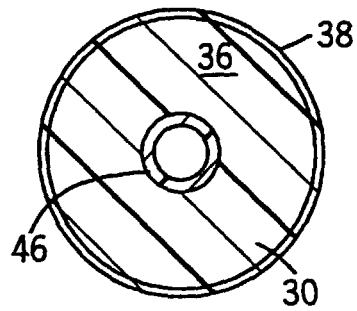
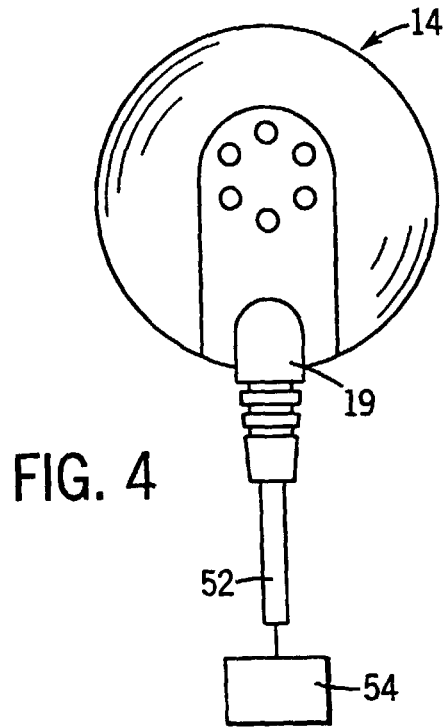


FIG. 3





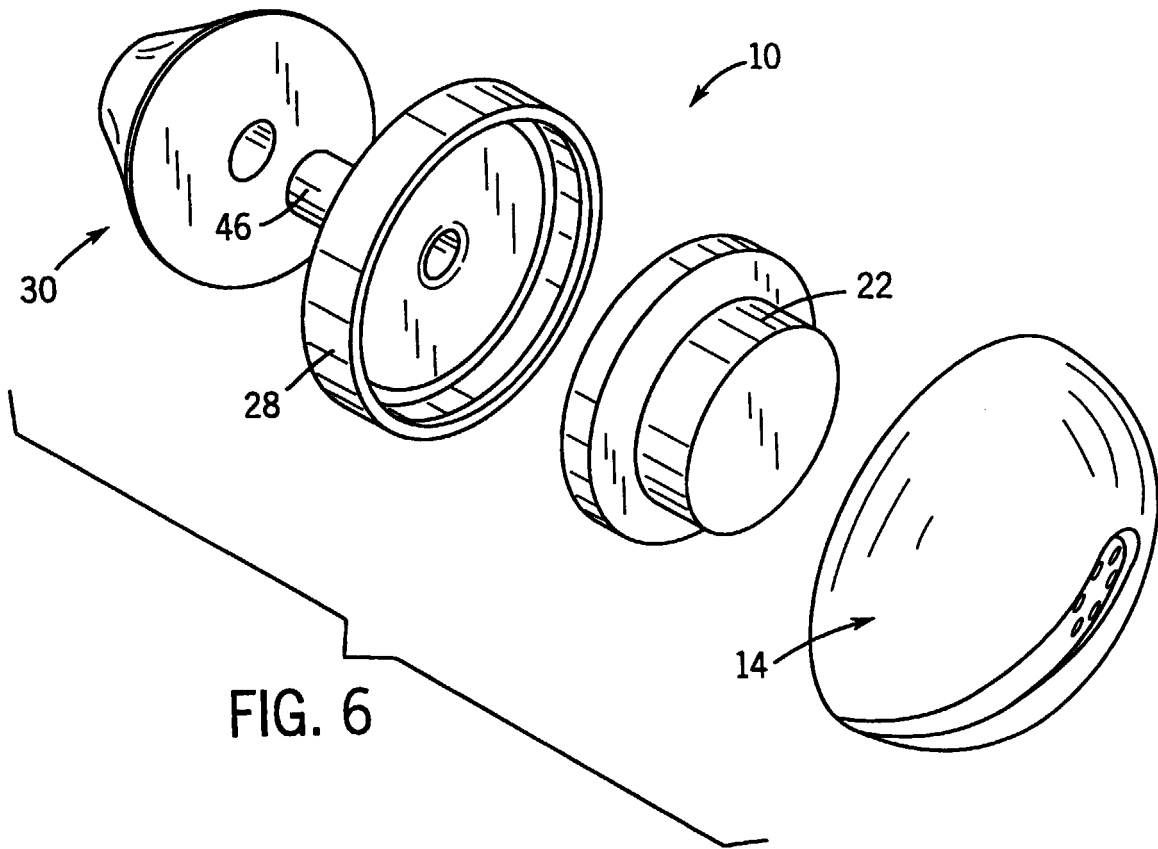


FIG. 7

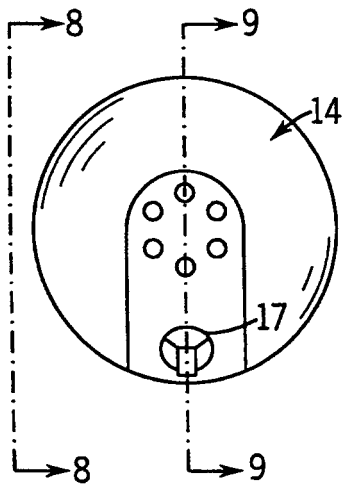


FIG. 8

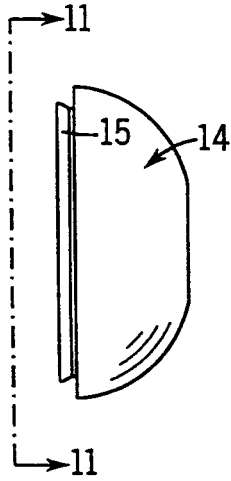


FIG. 9

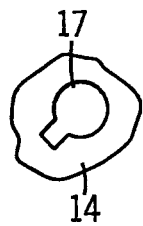
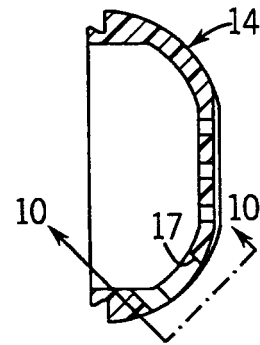


FIG. 10

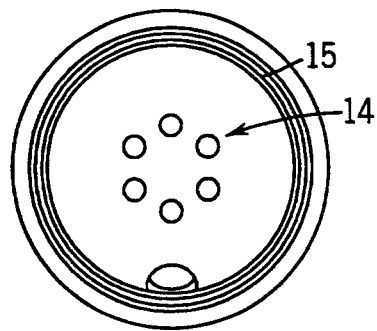


FIG. 11

FIG. 12

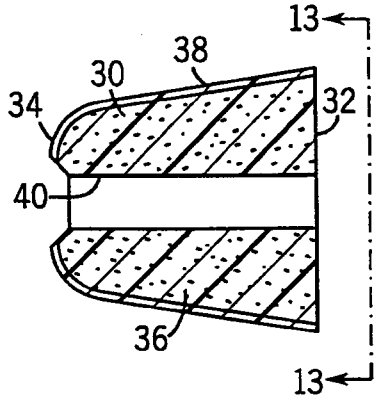


FIG. 13

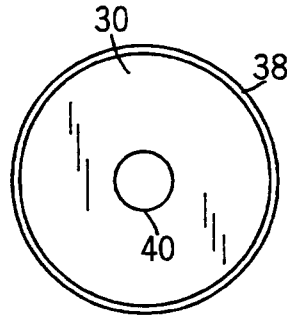


FIG. 14

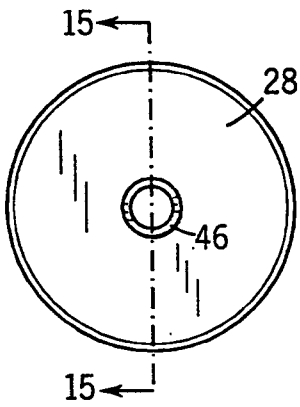


FIG. 15

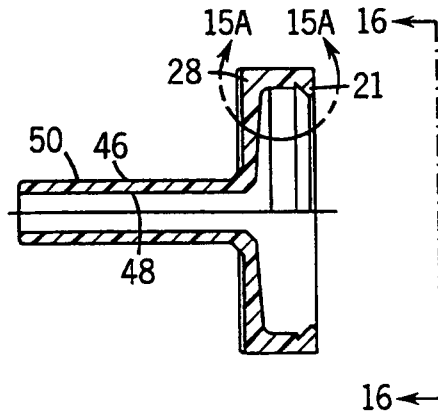


FIG. 16

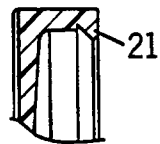
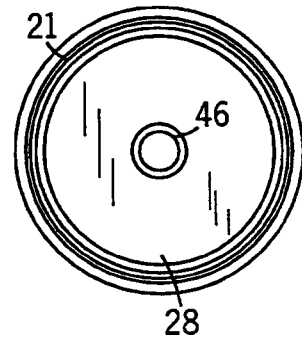


FIG. 15A

FIG. 17

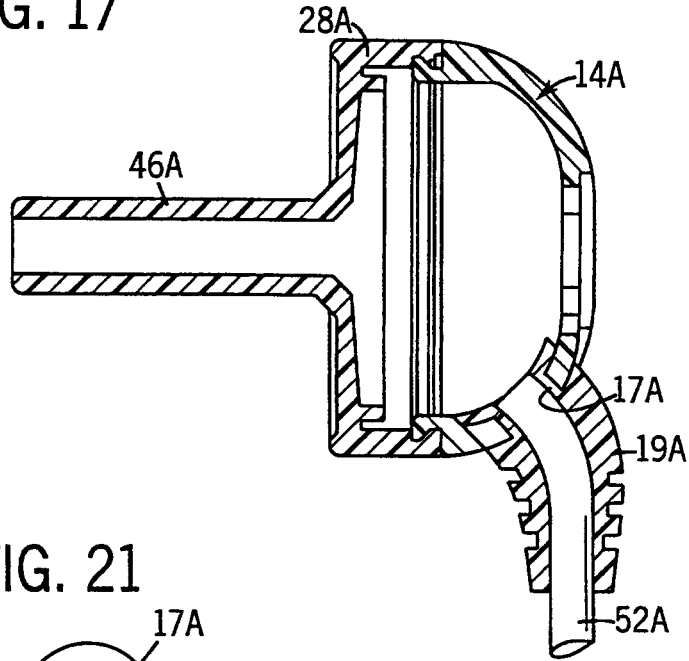


FIG. 21

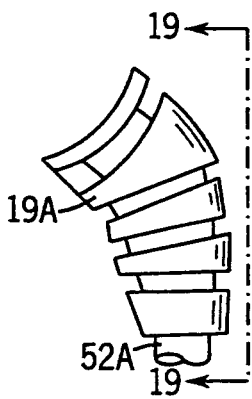
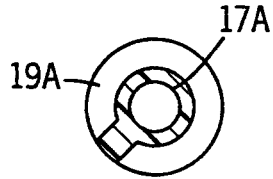


FIG. 18

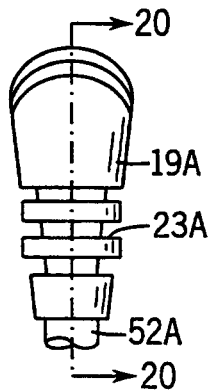


FIG. 19

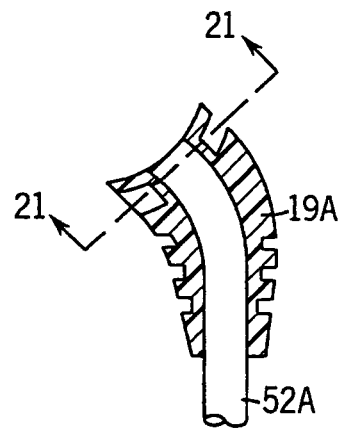


FIG. 20

FIG. 22

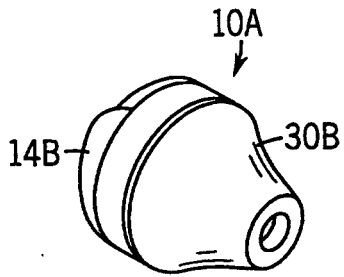


FIG. 23

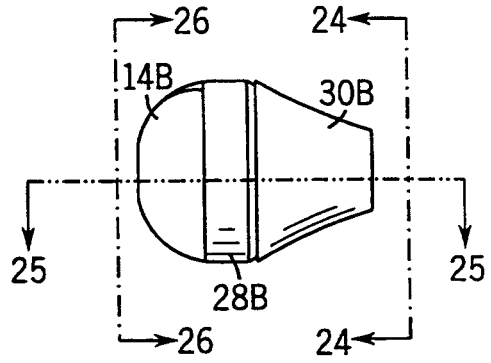


FIG. 24

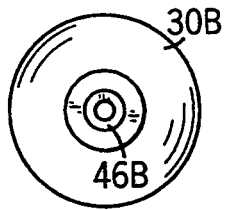


FIG. 25

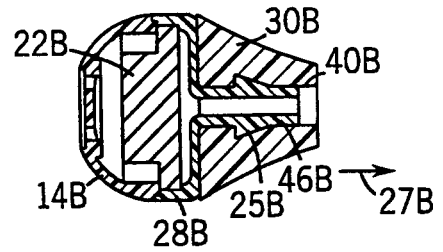


FIG. 26

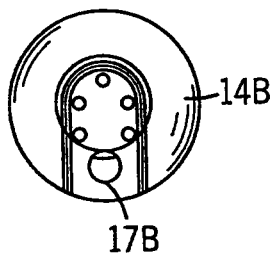
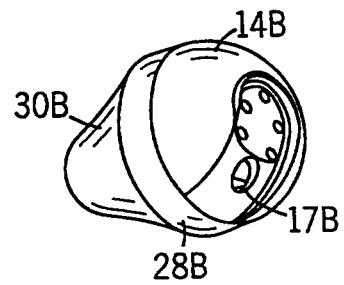


FIG. 27



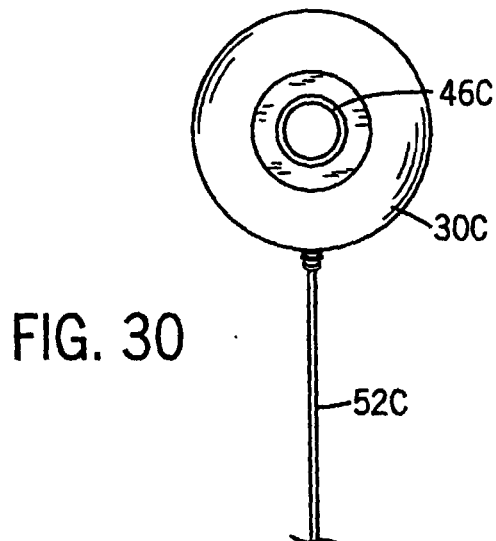
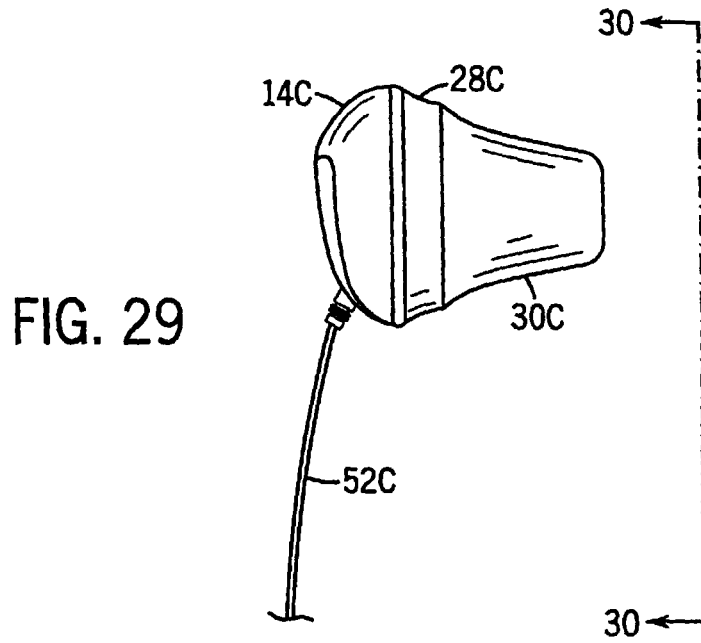
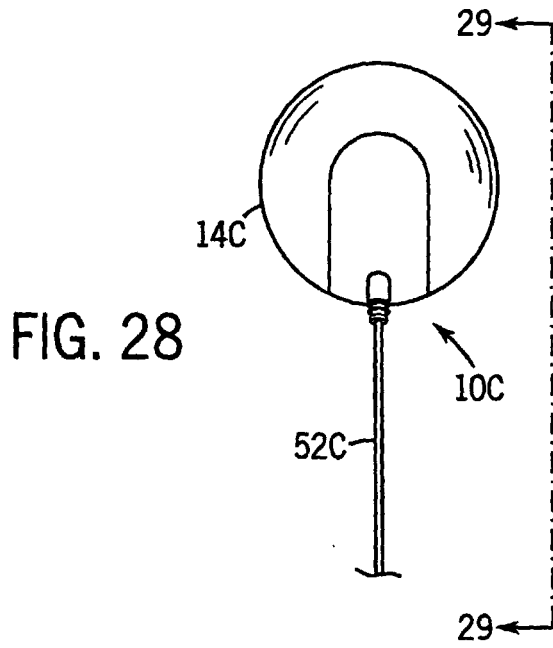


FIG. 31

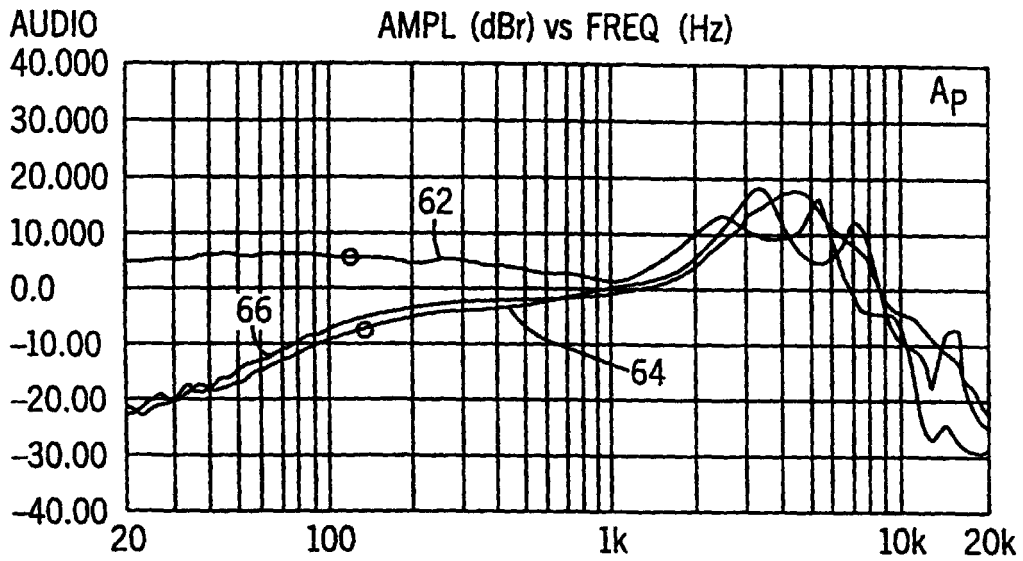


FIG. 32

