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(54) ADJUSTABLE SECURING MECHANISM FOR A SPACE ACCESS DEVICE

VERSTELLBARER BEFESTIGUNGSMECHANISMUS FÜR EINE RAUMZUGANGSVORRICHTUNG
MÉCANISME DE FIXATION RÉGLABLE POUR UN DISPOSITIF D'ACCÈS D'ESPACE

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to systems and methods for securing devices in internal openings, in particular ear canals. More particularly, the present invention relates to apparatus, systems and methods for securing devices and systems in biological and non-biological spaces and openings.

BACKGROUND OF THE INVENTION

[0002] As is well known in the art, many space access devices and systems are designed and configured to be inserted in one or more biological spaces or openings, such as an ear canal, nasal opening, etc. Such devices include hearing aids, ear phones or buds, and oxygen nasal cannula.

[0003] Various space access devices and systems are also designed and configured to be inserted in non-biological spaces or openings, such as a fluid flow lines and conduits. Such devices include conduit inspection and energy, e.g. heat, generating and/or dissipating systems.

[0004] The noted devices and systems often include means of securing the devices and/or systems in internal spaces or openings for a desired period of time, e.g. 1-2 minutes, 24 hours, 1 month, 1 year, etc. Such securing means include, for example, securing rings disposed on the outer surface of the devices, compliant outer layers, and/or conical fins that are adapted to removably secure the device(s) to an interior surface of a space or opening, e.g., an ear canal.

[0005] There are, however, a number of significant drawbacks and disadvantages associated with conventional securing means. A major disadvantage of conventional securing means is that the securing means, e.g., securing rings and compliant outer surfaces, do not include any means for fluid flow through the device or between the device and the internal space or opening when the device is inserted therein. Another drawback is that most of the devices employing the conventional securing means are easily dislodged.

[0006] Another drawback is that most of the devices employing the conventional securing means do not self-adjust or self-conform to the shape of the internal space or opening when the device is inserted therein. Indeed, most known securing devices either have a preset circular shape that may conform adequately to the shape of a space or opening, or are custom made to conform to (or match) the shape of a space or opening.

[0007] A further drawback is that most of the conventional securing means do not include any means for adjusting the force applied to the surface of the space or opening to secure the device therein. Indeed, virtually all known securing means are designed and adapted to apply a predetermined narrow range of force to a space or opening.

[0008] US 5,572,594 describes an ear canal device holder for devices other than speaker/microphone amplification systems that are to be inserted into the canal of the human ear. The device holder is made of a flexible silicone material comprising a body and structural support element(s) such that the device is held within the body of the holder and the body and device are secured in the ear by the structural element(s). In addition the device holder minimizes the attenuation of sound waves that pass through the ear canal to the tympanic membrane, while maximizing comfort and secure fit.

[0009] US 2011/019851 describes systems and methods for providing hearing aid. An open ear canal hearing aid may be provided in accordance with an embodiment of the invention. The hearing aid may include a part that contains electronic components, a passive amplifier, and a securing mechanism. The securing mechanism may include bristles or balloons. The securing mechanism may have various configurations and be adjustable. In some embodiments, the hearing aid may transmit sound via bone conduction and air conduction.

[0010] It would thus be desirable to provide space access devices and systems having securing means that (i) securely engage a surface of an internal space or opening for an extended period of time, (ii) include means to self-conform or self-adjust to the shape of an internal space or opening, (iii) include means for adjusting the force applied to a surface of an internal space or opening, and (iv) include means for fluid flow through the device and/or between the device and a space or opening when the device is inserted therein.

[0011] It is therefore an object of the present invention to provide improved securing means that can be readily employed with devices and systems that are configured to be inserted in one or more biological spaces or openings, such as an ear canal.

[0012] It is another object of the present invention to provide space access devices and systems having securing means that securely engage a surface of an internal space or opening for an extended period of time.

[0013] It is another object of the present invention to provide space access devices and systems having means to self-conform or self-adjust to the shape of an internal space or opening.

[0014] It is another object of the present invention to provide space access devices and systems that include means for adjusting the force applied to a surface of an internal space or opening.

[0015] It is another object of the present invention to provide space access devices and systems that include means for fluid flow through the device and/or between the device and a space or opening when the device is inserted therein.

SUMMARY OF THE INVENTION

[0016] The present invention is defined by the claims, and is directed to securing mechanisms that can be read-

ily employed with devices and systems that are configured to be inserted into an ear canal of a subject.

[0017] The present invention is also directed to space access devices and systems having a securing mechanism that (i) engages a surface of an ear canal for an extended period of time, (ii), include means to self-conform or self-adjust to the shape and size of an ear canal, (iii) includes means for adjusting the force (i.e. securing force) applied to a surface of an ear canal, and (iv) includes means for fluid flow through the device and/or between the device and the ear canal when the device is inserted therein.

[0018] In one embodiment of the invention, provides a device according to claim 1.

[0019] In some embodiments of the invention, the securing mechanism is further configured to provide at least one path for fluid flow therethrough.

[0020] In some embodiments, the securing mechanism is configured to provide at least one path for fluid flow through the securing mechanism and a contact surface.

[0021] In some embodiments of the invention, the securing mechanism has at least one, more preferably, a plurality of contact points that are configured to contact a surface of an ear canal.

[0022] In some embodiments of the invention, the securing mechanism is configured to apply a pressure to a contact surface within a space or opening in the range of 0.005 kPa to 500kPa when an access device having a securing mechanism disposed on an outer surface thereof is inserted in the ear canal.

[0023] In some embodiments, the contact pressure is preferably in the range of approximately 0.01 kPa - 10 kPa.

[0024] In some embodiments of the invention, the space access device comprises an anatomical space access device.

[0025] In some embodiments of the invention, the space access device comprises an in-ear head set or in-ear head-phone.

[0026] In some embodiments of the invention, the space access device comprises a hearing instrument, such as a hearing aid or personal sound amplification product. Advantages of the invention include the provision of biological and non-biological space access devices and systems that are capable of engaging a surface of an ear canal for an extended period of time, and include means for self-conforming or self-adjusting to the shape of the ear canal, means for adjusting the force applied to the surface of the ear canal, means for more evenly distributing the force applied to the surface of the ear canal, and means for fluid flow through and/or between the device and the ear canal when the device is inserted therein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] Further features and advantages will become apparent from the following and more particular descrip-

tion of the preferred embodiments of the invention, as illustrated in the accompanying drawings, and in which like referenced characters generally refer to the same parts or elements throughout the views, and in which:

FIGURE 1 is a side plan view of one embodiment of a securing mechanism, according to the invention; FIGURE 2 is a front plan view of the securing mechanism shown in FIGURE 1, according to the invention;

FIGURE 3A is a side plan view of the securing mechanism shown in FIGURE 1 in a collapsed state, according to the invention;

FIGURE 3B is a front plan view of the securing mechanism shown in FIGURE 1 in a collapsed state, according to the invention;

FIGURE 4A is a further side plan view of the securing mechanism shown in FIGURE 1 in a collapsed state and showing the forces provided thereby, according to the invention;

FIGURE 4B is a further side plan view of the securing mechanism shown in FIGURE 1 inserted in an opening, according to the invention;

FIGURE 5 is a side plan view of one embodiment of an in-ear head set or ear bud or hearing instruments having a securing mechanism associated therewith, according to the invention;

FIGURE 6 is a front plan view of another embodiment of a securing mechanism, according to the invention; FIGURE 7 is a side plan view of the securing mechanism shown in FIGURE 6 having a spiral projecting or contacting member, according to the invention; and

FIGURE 8 is a side plan view of the securing mechanism shown in FIGURE 6 having a linear contacting member, according to the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0028] It is to be understood that the terminology used herein is for the purpose of describing particular embodiments of the invention only and is not intended to be limiting.

[0029] Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one having ordinary skill in the art to which the invention pertains.

[0030] Finally, as used in this specification and the appended claims, the singular forms "a", "an" and "the" include plural referents unless the content clearly dictates otherwise. Thus, for example, reference to "a bristle" includes two or more such bristles and the like.

Definitions

[0031] The term "outwardly projecting member", as used in connection with a securing mechanism of the

invention, means and includes any projection extending from a base member, including, without limitation, fins, bristles, protrusions, ridges, grooves, bubbles, balloons, hooks, looped structure and/or tubes.

[0032] The term "space access device", as used herein, means and includes anatomical or biological and non-biological devices that are designed and adapted to be inserted into a space or opening, such as an ear canal, nasal conduit, esophagus, airway, gastro-intestinal tract, blood vessel, pipe, or conduit.

[0033] The terms "headphone" and headset" are used interchangeably herein and mean and include a listening device that is adapted to receive transmitted sound via wireless or wired communication means. As is well known in the art, conventional headphones and headsets typically include one or more speakers and/or sound production components, which can be in the form of one or two earpieces (often referred to as "ear plugs" or "ear buds").

[0034] The following disclosure is provided to further explain in an enabling fashion the best modes of performing one or more embodiments of the present invention. The disclosure is further offered to enhance an understanding and appreciation for the inventive principles and advantages thereof, rather than to limit in any manner the invention. The invention is defined solely by the appended claims.

[0035] As will readily be appreciated by one having ordinary skill in the art, the present invention substantially reduces or eliminates the disadvantages and drawbacks associated with conventional securing means for space access devices.

[0036] In overview, in some disclosures, the present invention is directed to securing mechanisms that can be readily employed with devices and systems that are configured to be inserted in one or more biological spaces or openings, such as an ear canal.

[0037] In some disclosures, the present invention is directed to anatomical, i.e. biological, and non-biological space access devices and systems having securing mechanisms that (i) securely engages a surface of an internal space or opening for an extended period of time, (ii) include means to self-conform or self-adjust to the shape and size of an internal space or opening, (iii) includes means for adjusting the force applied to a surface of an internal space or opening, (iv) includes means for more evenly distributing the force applied to the surface of the internal space or opening, and (iv) includes means for fluid flow between the device and biological space when the device is inserted therein.

[0038] As discussed in detail below, the securing mechanisms of the invention preferably include at least one, more preferably, a plurality of outwardly projecting members, which, according to the invention, can comprise, without limitation, fins, bristles, protrusions, ridges, grooves, balloons, bubbles, hooks, looped structures and/or tubes.

[0039] According to the invention, the outwardly pro-

jecting members can comprise separate members, i.e. engaged to a base component or, as illustrated in Figs. 1 and 2, integral members 20 projecting from a base 16.

[0040] According to the invention, the securing mechanisms and/or projecting members thereof can comprise various conventional compliant and flexible materials, including, without limitation, silicone, rubber, latex, polyurethane, polyamide, polyimide, nylon, paper, cotton, polyester, polyurethane, hydrogel, plastic, feather, leather, wood, and Nitinol®. In some embodiments of the invention, the securing mechanisms and/or projecting members comprise a polymeric material.

[0041] In some embodiments of the invention, the securing mechanisms and/or projecting members comprise a coated, preferably, compliant and flexible material. According to the invention, the base material can be coated with various materials and compositions to enhance the lubricity, alter the friction, adjust the hydrophobicity, or increase the stability in the chemical, environmental, and physical conditions of the target space or opening of the projecting members.

[0042] The base material can also be coated with or contain various materials to allow for administration of a pharmacological agent or composition to biological tissue.

[0043] The coating material can thus comprise, without limitation, active agents or drugs, such as anti-inflammatory coatings, and drug eluting materials.

[0044] The coating material can also include non-pharmacological agents.

[0045] In a preferred disclosures of the invention, the securing mechanisms of the invention are designed and adapted to self-conform or self-adjust to the shape of the interior surface of an opening (or interior space) of a member (biological or non-biological) when an access device of the invention and, thereby, the projecting members are inserted in the opening and in a constrained state. In some disclosures of the invention, each projecting member is adapted to flex and/or deform to conform to the shape and/or size of the interior surface. In some disclosures of the invention, one or more member(s) is adapted to flex and/or deform to conform to the shape and/or size of the interior surface.

[0046] By way of illustration, in the embodiment shown in Figs. 4A and 4B, the projecting members 20 are designed and adapted to flex and deform, whereby the securing mechanism 12 self-conforms to the shape of the interior surface 32 of the opening 31 of member 30 when the access device 10A is inserted in the opening 31 and the projecting members 20 are in a constrained state (see, e.g., Figs. 3A and 3B).

[0047] Referring to Figs. 6 and 7, in the illustrated embodiment, each of the projecting members 40 are similarly designed and adapted to flex and deform, whereby the securing mechanism 42 self-conforms to the shape of the interior surface of a member opening when the access device 10B is inserted in the opening and the projecting members 40 are in a constrained state.

[0048] In a preferred embodiment of the invention, each projecting member of the invention is also configured and adapted to provide at least one contact point with the ear canal when an access device of the invention is inserted in the opening or space. According to the invention, the contact point(s) can be provided by design or by application. In other embodiments, the access device is configured and adapted such that one or more projecting members or a majority of the members provide at least one contact point with the ear canal.

[0049] Referring back to Fig. 4B, in the noted embodiment, each of the projecting members 20 accordingly includes or provides a contact point 21 at the interface 31 of each projecting member 20 and the interior surface 32 of the member 30.

[0050] As illustrated in Figs. 6 and 7, each of the projecting members 40 similarly includes or provides a contact point 41 that is configured and adapted to contact the interior surface of an opening when the access device 12 is inserted therein.

[0051] According to the invention, the securing mechanisms of the invention are also preferably designed and adapted to apply a pressure (denoted by Arrows " p_1 " in Fig. 4A) to the interior surface of a member opening or interior space (biological or non-biological) when an access device of the invention, e.g. 10A, 10B and/or 10C, is inserted in the opening and the projecting members are in a constrained state (see, e.g., Figs. 3A and 3B). In some embodiments of the invention, each projecting member, e.g., projecting member(s) 20 and/or 40, is adapted to apply a pressure (or force) to the interior surface of a member opening.

[0052] In some embodiments of the invention, the pressure, p_1 , is preferably in the range of 0.005 kPa - 500 kPa. In some embodiments of the invention, the pressure, p_i , is preferably in the range of 0.05 kPa - 10 kPa.

[0053] In some embodiments of the invention, the noted force ranges are provided by varying the number of projections, and/or the pattern of the projections, and/or the pattern of the projections, and/or the size and shape of the projections, and/or the flexibility of the projections, and/or the material(s) comprising the projections, and/or the coating on the material(s) comprising the projections, and/or the surface features of the material(s) comprising the projections, and/or the projection angle with respect to the base and/or contact surface.

[0054] As stated above, the securing mechanism also preferably includes means for fluid flow through the device and/or between the device and an opening or space when the device is inserted therein, in some embodiments of the invention, the securing mechanism includes one or more fluid flow channels. In some embodiments, the flow channels are between the securing mechanism (or projections thereof) and a contact surface.

[0055] In some embodiments, the securing mechanism includes a compressible or flexible portion that is permeable to air.

[0056] In some embodiments, the securing mechanism

includes one or more subsets of the outwardly projecting members, e.g., bristles, protrusions, ridges, grooves, bubbles, balloons, hooks and/or tubes. According to the invention, the subsets can comprise separate members that are attachable via a thin pliable membrane of the same or different material.

[0057] According to the invention, the noted membrane can serve to reduce fluid flow through the separate members. This may be useful, for instance, to further increase sound isolation when the securing mechanism is employed with an in-ear hearing device. In a preferred embodiment, the pliable membrane would, however, still allow for individual movements of the separate members so many of the advantages of conformability are intact.

[0058] In some embodiments of the invention, the membrane restricts (or slows down) fluid flow proximate the securing mechanism, including space access devices and systems in which there exists and in which there does not exist one or more direct paths for fluid to flow through the securing mechanism from one end of the securing mechanism to the other.

[0059] In some embodiments, the membrane completely blocks fluid flow from one end of the securing mechanism to the other.

[0060] As indicated above, Figs. 1 through 4B illustrate an anatomical space access device 10A that includes one embodiment of a securing mechanism 12 of the invention. As discussed above, the securing mechanism includes a plurality of outwardly projecting members 20 that are designed and adapted to flex and deform (see, e.g., Figs. 3A and 3B), whereby the securing mechanism 12 self-conforms to the shape of the ear canal when the access device 10A is inserted in the opening and the projecting members 20 are in a constrained state (see, e.g., Fig. 4B).

[0061] Each of the projecting members 20 of the access device also includes or provides a potential contact point at the interface of each projecting member and the ear canal when the access device 10A is disposed therein.

[0062] Figs. 6 - 7 illustrate another anatomical space access device 10B that includes another embodiment of a securing mechanism 42 of the invention. As also discussed above, the securing mechanism 42 includes at least one, more preferably, a plurality of outwardly projecting members 40 that are designed and adapted to flex and deform, whereby the securing mechanism 42 self-conforms to the shape of the interior surface of a member opening when the access device 10B is inserted in the opening and the projecting members 40 are in a constrained state.

[0063] In some embodiments of the invention, the projecting members 40 extend across a defined length of the device 10B. As illustrated in Fig. 7, in some embodiments, the projecting members 40 extend across the entire length of the device 10B.

[0064] According to the invention, the projecting members can have various configurations. In the embodiment

shown in Fig. 7, the projecting members 40 have a spiral configuration.

[0065] In the embodiment shown in Fig. 8, the projecting members 40 have a substantially straight or liner configuration, which, preferably, extends across the entire length of the access member 10C.

[0066] Each of the projecting members 40 of the access devices 10B, 10C similarly includes or provides a contact point 41 at the interface of each projecting member 40 and the interior surface of a member opening when the device (10B or 10C) is disposed therein.

[0067] According to the invention, the space access devices of the invention, e.g., 10A, 10B and/or 10C can comprise any device that is designed to be inserted into an ear canal (see, for example, Fig. 5).

[0068] In some embodiments of the invention, the space access device includes an electronics-containing portion or region 14 (see, e.g., Fig. 1) that is adapted to receive various electronic components and associated circuitry, such as sensor systems, receivers, amplifiers, batteries, antennae, speakers, energy generating and dissipating means, microphones, sensors, communication modules, pressure sensors, wireless communication components, wired communication components, etc.

[0069] The space access devices of the invention can thus comprise various conventional anatomical and non-anatomical devices and systems, such as physiological sensors, conduit inspection systems, flow sensors, flow restrictors, fluid samplers, pressure sensors, sound or vibration actuators, accelerometers, and mechanisms for releasing particles or fluids into conduits or other fluids, etc. The space access devices can also comprise a radio system or component thereof, e.g., receiver, transmitter, transceiver, microphone, microcontroller, etc.

[0070] As set forth in detail in US patent application No. 12/841,120; the space access devices can also comprise a hearing apparatus, such as a hearing prosthesis or aid.

[0071] The space access devices can additionally comprise headphones or a headset for a portable electronic device, such as a GPS device, CD or DVD player, MPEG player, MP-3 player, cell phone, personal digital assistant (PDA), tablet, laptop, video game system, audio guide system, phone, musical instrument, stethoscope and other medical or industrial instrumentation, smart phone, computer, etc., and/or a combination thereof.

[0072] As discussed in detail below, the space access devices can also comprise headphones (or a headset) for augmented reality glasses, head-mounted displays, and/or heads-up displays.

[0073] As is well known in the art, there are a wide variety of headset types, including over-ear headsets, around-ear headsets, on ear headsets, in-concha headsets, in-ear headsets, etc. Each type of head set has advantages and disadvantages with regard to sound quality, ease of use, aesthetics, user comfort, etc.

[0074] Two popular headset designs are the in-concha headset and the in-ear headset. The in-concha headset

design generally includes a speaker that is, when properly positioned, received within the concha of the ear of a user (generally the area of the ear surrounding the opening of the ear canal). The in-ear headset design generally includes a speaker and/or insert that is at least partially received within the ear canal of a user when properly positioned. These designs are typically compact and are often supported by a small structure that is secured to the external portion of the ear (e.g., with an ear hook) and/or supported and/or retained within the ear by the concha or ear canal in what amounts to an interference fit.

[0075] A major drawback of both the in-concha and in-ear headsets is that wearers often experience discomfort after a period of time of use. The discomfort can be due to one or more of the fitment or breathability of the headset, the type of material of which the headset is composed, the pressure of the headset on the surface of the ear canal, or simply sensitive ears.

[0076] A further drawback of in-concha and in-ear headsets is that they are also easily dislodged during various activities of the wearer, e.g., jogging.

[0077] A further drawback of in-concha and in-ear headsets is that they often fail at maintaining a good alignment between the speaker and the ear canal, which may result in inconsistent sound quality and/or sound volume.

[0078] A further drawback of in-concha and in-ear headsets is that they often limit the amount of ambient sound that enters the ear canal, which can reduce the wearer's environmental awareness and ability to interact with the environment and others in the environment.

[0079] Another drawback is that some headsets require components that need to be molded for a specific user to achieve the desired fit.

[0080] By employing a securing mechanism of the invention with in-concha and in-ear headsets the noted discomfort can, however, be substantially reduced or eliminated. The securing mechanism will also enhance the engagement and hold of the head set in the concha or ear canal(s). The securing mechanism will also enhance the alignment of the headset with the ear canal(s). The securing mechanism will also enhance the ability to hear ambient sounds.

[0081] Referring now to Fig. 5, there is shown one embodiment of an earpiece speaker system (i.e. in-concha or in-ear headset) 50 having a securing mechanism of the invention associated therewith. According to one aspect of the invention, the earpiece speaker system 50 includes an earpiece body 52 through which an audio signal is provided, the earpiece body 52 having a securing mechanism 12, a speaker mount surface, and a plurality of speaker modules interchangeably mountable to the body.

[0082] As illustrated in Fig. 5, the securing mechanism 12 includes a plurality of outwardly projecting members 22. In a preferred embodiment of the invention, the outwardly projecting members comprise a plurality of the bristles, such as the aforementioned bristles and bristles

disclosed in US patent application No. 12/841,120.

[0083] According to the invention, the securing mechanism 12 can also comprise the mechanism 42 shown in Figs. 6, 7 and 8 having projecting members 40.

[0084] The securing mechanism 12 can alternatively comprise or include outwardly projecting protrusions, ridges, grooves, bubbles, balloons, hooks and/or tubes.

[0085] According to the invention, the securing mechanism 12 (or 40) similarly applies a pressure, p_1 , to an interior surface of the ear canal in the range of 0.005 kPa - 500 kPa. In some embodiments of the invention, the pressure, p_1 , is preferably in the range of 0.05 kPa - 10 kPa.

[0086] As will readily be appreciated by one having ordinary skill in the art, the noted pressure exerted to an interior surface of the ear canal by the securing mechanism 12 (or 40) will effectively engage and hold a headset in the concha or ear canal(s) and enhance the alignment of the headset with the ear canal(s), without discomfort to a wearer.

[0087] As indicated above, the noted earpiece speaker system (i.e. in-concha or in-ear headset) 50 can readily be employed with, i.e. a component of, a variety of portable electronic devices, such as a GPS device, CD or DVD player, MPEG player, MP-3 player, cell phone, personal digital assistant (PDA), tablet, laptop, video game system, audio guide system, phone, musical instrument, stethoscope and other medical or industrial instrumentation, smart phone, computer, etc., and/or a combination thereof.

[0088] As also indicated above, the noted earpiece speaker system, i.e. headphones (or a headset) can also be readily employed with, i.e., a component of, augmented reality glasses. According to the invention, communications by and between the headphones (i.e. ear buds) and augmented-reality eyewear, such as GPS directions, phone calls, music, notifications, audio information, etc., can be achieved via conventional wireless systems and associated protocol, including, without limitation, radio frequency (RF) communication, electromagnetic coupling, optical communication (e.g., laser), physical conduction, sound conduction (potentially lower volume or less audible frequencies), electronic signals, etc. Communications by and between the headphones and augmented-reality eyewear can also be achieved via wired connections.

[0089] By virtue of the unique securing means (12 or 40) of the invention, a user of augmented reality eyewear and a space access device, i.e. headphones or headset, of the invention, will be allowed to hear ambient sounds emanating from, the surrounding environment, such as vehicles, people, crossing signals, etc., while receiving direct transmissions from the glasses, e.g., GPS directions, in both ears. Further, by virtue of the directionality and proximity of the receiving transmitters/speakers/receivers that can be employed with the space access devices of the invention, those in the surrounding environment will hear little or none of the transmissions emanat-

ing from the eyewear, headphones, or headset.

[0090] The noted earpiece speaker system, i.e. headphones (or a headset) can also be readily employed with, i.e., a component of, heads-up displays. According to the invention, communications by and between the headphones and heads-up displays can similarly be achieved via conventional wireless systems and associated protocol, including, without limitation, RF communication, electromagnetic coupling, optical communication, physical conduction, sound conduction, electronic signals, etc., and wired connections.

[0091] By virtue of the unique securing means of the invention, a user of a heads-up display and a space access device of the invention will also be allowed to hear ambient sounds emanating from the surrounding environment, including people in close proximity to the user, while receiving transmissions from the heads-up display in both ears. As indicated above, by virtue of the directionality and proximity of the receiving transmitters and/or speakers and/or receivers that can be employed with the space access devices of the invention, those in the surrounding environment will hear little or none of the transmissions emanating from the heads-up display.

[0092] As will readily be appreciated by one having ordinary skill in the art, the space access devices of the invention can also be readily adapted and, hence, effectively employed to receive transmissions and/or communications from various electronic devices, such as field radios, as well as the aforementioned portable electronic devices, augmented-reality eyewear and heads-up displays, when ambient sounds emanating from the surrounding environment are muffled via a secondary headset.

[0093] For example, in a military environment when large artillery is being fired, those in close proximity to the artillery often wear sound deadening headsets to muffle the sounds emanating from the artillery. To receive instructions or commands from a superior, the sound deadening head set must thus be partially or fully removed. As one can readily appreciate, partially or fully removing the sound deadening headset will expose the wearer to the harsh and potentially damaging sounds emanating from the artillery or other explosions, machinery, or gun fire.

[0094] Further, in most instances, a physical signal, such as a tap on a shoulder or a hand gesture, is necessary to alert the wearer of a sound deadening head set that communication with another person is necessary or desired. This can, and in most instances will, delay communications by and between the wearer and another person, which could result in serious injury or death in an emergency situation.

[0095] By employing a space access device of the invention, instantaneous communications by and between a wearer of a sound deadening headset is facilitated without the need to partially or fully remove the head set. The wearer of a sound deadening head set will also remain protected from the potentially damaging ambient noise

while being able to receive direct verbal communications from others, as well as communications from external devices.

[0096] As will be appreciated by one having ordinary skill in the art, not only will use of the space access device(s) of the invention be beneficial to military personnel, but beneficial to police, fire fighters, secret service, homeland security, and like personnel as well. As indicated above, the space access device(s) of the invention will allow such personnel to hear sound transmitted from their earphones (e.g., radio communications) while being able to hear and locate sounds emanating from the surrounding environment, such as footsteps, gun shots, voices of others, etc.

[0097] A unique and seminal feature of the space access devices of the invention is that they allow the user to hear transmissions in BOTH ears (which allows for clearer listening as well as receipt of stereo signals) while still being able to hear the surrounding environment. Currently, people desirous of hearing both the sound transmitted from the headset and sound from the surrounding environment will use one ear bud (placed in one ear) or position a headset over one ear. This only allows "mono" sound to be received by the user (as opposed to stereo) and also adversely affects the ability of the user to locate where ambient sounds are emanating from.

[0098] As will readily be appreciated by one having ordinary skill in the art, the present disclosure provides numerous advantages compared to prior art methods and systems for securing space access devices in internal spaces and openings. Among the advantages are the following:

- The provision of biological and non-biological space access devices and systems that are capable of engaging a surface of an internal space or opening for an extended period of time.
- The provision of biological space access devices and systems that are capable of comfortably engaging a surface of an internal body space or opening for an extended period of time.
- The provision of provision of biological and non-biological space access devices and systems that are capable of engaging a surface of an internal space or opening, and include means to self-conform or self-adjust to the shape of the internal space or opening.
- The provision of provision of biological and non-biological space access devices and systems that are capable of engaging a surface of an internal space or opening, and include means for adjusting the force applied to the surface of the internal space or opening.
- The provision of provision of biological and non-bi-

ological space access devices and systems that are capable of engaging a surface of an internal space or opening, and include means for fluid flow through and/or between the device and the internal space or opening when the device is inserted therein.

Claims

1. A device configured for at least partial insertion within an ear canal, said device comprising:

a securing mechanism and a space access device;

said securing mechanism comprising a housing being attachable to said space access device, where said space access device includes an electronics-containing portion or region including at least a speaker;

said housing comprising a one or more subsets of outwardly projecting members, attached via a base component and having a plurality of contact points, where the plurality of outwardly projecting members are configured to contact a surface of the ear canal when said space access device is at least partially inserted in said ear where the securing mechanism has a means adapted to self-conform or self-adjust to the shape of the ear canal when the space access device is at least partially inserted therein and, the outwardly projecting members are inserted in the ear canal and in a constrained state, wherein said plurality of outwardly projecting members provides at least one fluid flow path therethrough when said device is at least partially disposed in the ear canal, **characterized in that**

the plurality of outwardly projecting members are configured to apply a pressure in the range of 0.005 kPa - 500 kPa to the contact surface within said ear canal, to securely engage a surface of the ear canal for an extended period of time, and

said securing device further comprises a thin pliable membrane configured to reduce or completely block fluid flow through said outwardly projecting members.

2. A device according to claim 1, wherein at least one of said plurality of outwardly projecting members comprises a pharmacological agent coating, said pharmacological agent coating being disposed on an outer surface of said at least one of said outwardly projecting members, said pharmacological agent coating comprising an anti-inflammatory composition.

3. A device according to claim 1 or 2 wherein said out-

wardly projecting members comprise fins.

4. A device according to claim 3, wherein said fins are designed and adapted to flex and deform; and thus, whereby the securing mechanism self-conforms to the shape of the interior surface of the ear canal when the device is inserted in the opening.
5. A device according to claim 1 or 2, wherein the projecting members are designed and adapted to flex and deform; and thus, whereby the securing mechanism self-conforms to the shape of the interior surface of the ear canal when the device is inserted in the opening.
6. A device according to claim 1 or 2, wherein means for adjusting force applied by said projecting members are provided by varying the number of said projecting members, and/or the pattern of said projecting members, and/or the size and shape of said projecting members, and/or the flexibility of said projecting members, and/or the materials comprising said projecting members, and/or the coating on the materials comprising said projecting members, and/or the surface features of the materials comprising said projecting members, and/or the projection angle with respect to the base and/or contact surface.
7. A device according to claim 1 or 2, wherein said space access device comprises a hearing instrument.
8. A device according to claim 1 or 2 wherein said outwardly projecting members comprise bristles.
9. A device according to claim 1, wherein at least one of said outwardly projecting members and/or said housing are coated with a material to provide at least one of: enhancement of lubricity, alteration of friction, adjustment of hydrophobicity, and/or increasing stability in the chemical, environmental, and physical conditions in the ear canal.
10. A device according to claim 1, wherein at least one of said outwardly projecting members and/or said housing are coated with a material to allow for administration of a pharmacological agent or composition.
11. A device according to claim 1 or 2, wherein said thin pliable membrane is configured to reduce fluid flow through said outwardly projecting members.
12. A device according to claim 1 or claim 2, wherein said a thin pliable membrane completely blocks fluid flow from one end of said securing mechanism to the other.

13. A device according to claim 1 or claim 2, wherein said securing mechanism comprises a compressible or flexible portion that is permeable to air.

14. A device according to claim 1 or claim 2, wherein said outwardly projecting members extend across an entire length of said housing.

15. A device according to claim 1 or claim 2, wherein said outwardly projecting members have a spiral configuration.

Patentansprüche

1. Vorrichtung, die zur mindestens teilweisen Einführung in einen Gehörgang gestaltet ist, wobei die Vorrichtung folgendes umfasst:

einen Sicherungsmechanismus und eine Raumzugangsvorrichtung;
wobei der Sicherungsmechanismus ein Gehäuse umfasst, das an der Raumzugangsvorrichtung angebracht werden kann, wobei die Raumzugangsvorrichtung einen Teil umfasst, der Elektronik enthält oder einen Bereich, der mindestens einen Lautsprecher umfasst;
wobei das Gehäuse eine oder mehrere Untergruppen auswärts vorstehender Elemente umfasst, die über eine Basiskomponente angebracht sind und eine Mehrzahl von Kontaktpunkten aufweisen, wobei die Mehrzahl auswärts vorstehender Elemente für einen Kontakt mit einer Oberfläche des Gehörgangs gestaltet ist, wenn die Raumzugangsvorrichtung wenigstens teilweise in das Ohr eingeführt ist, wobei der Sicherungsmechanismus ein Mittel zur Selbstanpassung oder Selbstanpassung an die Form des Gehörgangs aufweist, wenn die Raumzugangsvorrichtung wenigstens teilweise darin eingeführt ist, und die auswärts vorstehenden Elemente in den Gehörgang eingeführt sind und sich in einem eingeschränkten Zustand befinden, wobei die Mehrzahl auswärts vorstehender Elemente mindestens einen Fluidströmungsweg dort hindurch bereitstellen, wenn sich die Vorrichtung wenigstens teilweise in dem Gehörgang befindet, **dadurch gekennzeichnet, dass** die Mehrzahl auswärts vorstehender Elemente so gestaltet ist, dass sie einen Druck im Bereich von 0,005 kPa bis 500 kPa auf die Kontaktfläche in dem Gehörgang ausüben, um über einen längeren Zeitraum sicher mit einer Oberfläche des Gehörgangs einzugreifen; und
wobei die Sicherungsvorrichtung ferner eine dünne, formbare Membran umfasst, die zur Reduzierung oder vollständigen Blockierung von Fluidströmung durch die auswärts vorstehen-

den Elemente gestaltet ist.

2. Vorrichtung nach Anspruch 1, wobei mindestens eines der Mehrzahl auswärts vorstehender Elemente einen Überzug einer pharmakologischen Substanz umfasst, wobei sich der Überzug einer pharmakologischen Substanz auf einer äußeren Oberfläche des mindestens einen der Mehrzahl auswärts vorstehenden Elemente befindet, wobei der Überzug einer pharmakologischen Substanz eine entzündungshemmende Zusammensetzung umfasst. 5
3. Vorrichtung nach Anspruch 1 oder 2, wobei die auswärts vorstehenden Elemente Rippen umfassen. 10
4. Vorrichtung nach Anspruch 3, wobei die Rippen so gestaltet sind und in der Lage sind, sich zu biegen und zu verformen; und wobei sich der Sicherungsmechanismus somit selbst an die innere Oberfläche des Gehörgangs anpasst, wenn die Vorrichtung in die Öffnung eingeführt wird. 20
5. Vorrichtung nach Anspruch 1 oder 2, wobei die vorstehenden Elemente so gestaltet sind und in der Lage sind, sich zu biegen und zu verformen; und wobei sich der Sicherungsmechanismus somit selbst an die innere Oberfläche des Gehörgangs anpasst, wenn die Vorrichtung in die Öffnung eingeführt wird. 25
6. Vorrichtung nach Anspruch 1 oder 2, wobei Mittel zur Anpassung der durch die vorstehenden Elemente ausgeübten Kraft bereitgestellt werden durch Variation der Anzahl der vorstehenden Elemente und/oder der Anordnung der vorstehenden Elemente und/oder der Größe und der Form der vorstehenden Elemente und/oder der Flexibilität der vorstehenden Elemente und/oder der Materialien, aus denen die vorstehenden Elemente bestehen, und/oder der Oberflächenmerkmale der Materialien, aus denen die vorstehenden Elemente bestehen, und/oder des Projektionswinkels in Bezug auf die Basis und/oder die Kontaktoberfläche. 30
7. Vorrichtung nach Anspruch 1 oder 2, wobei die Raumzugangsvorrichtung ein Hörgerät umfasst. 45
8. Vorrichtung nach Anspruch 1 oder 2, wobei die auswärts vorstehenden Elemente Borsten umfassen.
9. Vorrichtung nach Anspruch 1, wobei mindestens eines der auswärts vorstehenden Elemente und/oder das Gehäuse mit einer Substanz überzogen ist/sind, um mindestens eines der folgenden bereitzustellen: eine Verbesserung der Gleitfähigkeit, eine Veränderung der Reibung, eine Anpassung der hydrophoben Eigenschaft und/oder eine Erhöhung der Stabilität unter den chemischen, den die Umgebung betreffenden und den physischen Bedingungen in dem 50

Gehörgang.

10. Vorrichtung nach Anspruch 1, wobei mindestens eines der auswärts vorstehenden Elemente und/oder das Gehäuse mit einer Substanz überzogen ist/sind, um die Verabreichung einer pharmakologischen Substanz zu ermöglichen.
11. Vorrichtung nach Anspruch 1 oder 2, wobei die dünne, formbare Membran so gestaltet ist, dass sie die Fluidströmung durch die auswärts vorstehenden Elemente reduziert. 10
12. Vorrichtung nach Anspruch 1 oder Anspruch 2, wobei die dünne, formbare Membran die Fluidströmung von einem Ende des Sicherungsmechanismus zu dem anderen Ende vollständig blockiert. 15
13. Vorrichtung nach Anspruch 1 oder Anspruch 2, wobei der Sicherungsmechanismus einen verdichtbaren oder elastischen Teil umfasst, der luftdurchlässig ist. 20
14. Vorrichtung nach Anspruch 1 oder Anspruch 2, wobei sich die auswärts vorstehenden Elemente über die ganze Länge des Gehäuses erstrecken. 25
15. Vorrichtung nach Anspruch 1 oder Anspruch 2, wobei die auswärts vorstehenden Elemente eine Schneckengestalt aufweisen. 30

Revendications

1. Dispositif conçu pour une insertion au moins partielle dans un canal auditif, ledit dispositif comprenant : 35
 - un mécanisme de fixation et un dispositif d'accès à l'espace ;
 - ledit mécanisme de fixation comprenant un boîtier pouvant être fixé audit dispositif d'accès à l'espace, ledit dispositif d'accès à l'espace comprenant une partie ou une région contenant de l'électronique comprenant au moins un haut-parleur ;
 - ledit boîtier comprenant au moins un sous-ensemble d'éléments faisant saillie vers l'extérieur, fixés par l'intermédiaire d'un composant de base et ayant une pluralité de points de contact, la pluralité d'éléments faisant saillie vers l'extérieur étant conçus pour entrer en contact avec une surface du canal auditif lorsque ledit dispositif d'accès à l'espace est au moins partiellement inséré dans ladite oreille, le mécanisme de fixation ayant un moyen conçu pour se conformer ou s'ajuster automatiquement à la forme du canal auditif lorsque le dispositif d'accès à l'espace est au moins partiellement inséré 40

- dans celui-ci et, les éléments faisant saillie vers l'extérieur étant insérés dans le canal auditif et dans un état contraint, ladite pluralité d'éléments faisant saillie vers l'extérieur fournissant au moins un chemin d'écoulement de fluide à travers eux lorsque ledit dispositif est au moins partiellement disposé dans le canal auditif, **caractérisé en ce que** la pluralité d'éléments faisant saillie vers l'extérieur sont conçus pour appliquer une pression dans la plage de 0,005 kPa - 500 kPa à la surface de contact à l'intérieur dudit canal auditif, pour venir en prise de manière sûre avec une surface du canal auditif pendant une période de temps prolongée, et ledit dispositif de fixation comprend en outre une fine membrane pliable conçue pour réduire ou bloquer complètement l'écoulement de fluide à travers lesdits éléments faisant saillie vers l'extérieur.
2. Dispositif selon la revendication 1, au moins un de ladite pluralité d'éléments faisant saillie vers l'extérieur comprenant un enrobage d'agent pharmacologique, ledit enrobage d'agent pharmacologique étant disposé sur une surface extérieure dudit au moins un desdits éléments faisant saillie vers l'extérieur, ledit enrobage d'agent pharmacologique comprenant une composition anti-inflammatoire.
 3. Dispositif selon la revendication 1 ou 2, lesdits éléments faisant saillie vers l'extérieur comprenant des ailettes.
 4. Dispositif selon la revendication 3, lesdites ailettes étant conçues et disposées pour fléchir et se déformer ; et ainsi, le mécanisme de fixation se conformant automatiquement à la forme de la surface intérieure du conduit auditif lorsque le dispositif est inséré dans l'ouverture.
 5. Dispositif selon la revendication 1 ou 2, les éléments faisant saillie étant conçus et disposés pour fléchir et se déformer ; et ainsi, le mécanisme de fixation se conformant automatiquement à la forme de la surface intérieure du conduit auditif lorsque le dispositif est inséré dans l'ouverture.
 6. Dispositif selon la revendication 1 ou 2, un moyen pour ajuster la force appliquée par lesdits éléments en saillie étant fourni en faisant varier le nombre desdits éléments en saillie, et/ou le motif desdits éléments en saillie, et/ou la taille et la forme desdits éléments en saillie, et/ou la flexibilité desdits éléments en saillie, et/ou les matériaux comprenant lesdits éléments en saillie, et/ou l'enrobage sur les matériaux comprenant lesdits éléments en saillie, et/ou les caractéristiques de surface des matériaux com-
- prenant lesdits éléments en saillie, et/ou l'angle de projection par rapport à la base et/ou la surface de contact.
7. Dispositif selon la revendication 1 ou 2, ledit dispositif d'accès à l'espace comprenant une prothèse auditive.
 8. Dispositif selon la revendication 1 ou 2, les éléments faisant saillie vers l'extérieur comprenant des poils.
 9. Dispositif selon la revendication 1, au moins l'un desdits éléments faisant saillie vers l'extérieur et/ou ledit boîtier étant revêtus d'un matériau pour fournir : une amélioration du pouvoir lubrifiant, une modification de la friction, un ajustement de l'hydrophobie, et/ou une augmentation de la stabilité dans les conditions chimiques, environnementales et physiques dans le canal auditif.
 10. Dispositif selon la revendication 1, au moins l'un desdits éléments faisant saillie vers l'extérieur et/ou ledit boîtier étant revêtus d'un matériau permettant l'administration d'un agent ou d'une composition pharmacologique.
 11. Dispositif selon la revendication 1 ou 2, ladite fine membrane pliable étant conçue pour réduire l'écoulement de fluide à travers lesdits éléments faisant saillie vers l'extérieur.
 12. Dispositif selon la revendication 1 ou 2, ladite fine membrane pliable bloquant complètement l'écoulement de fluide d'une extrémité dudit mécanisme de fixation à l'autre.
 13. Dispositif selon la revendication 1 ou 2, ledit mécanisme de fixation comprenant une partie compressible ou flexible qui est perméable à l'air.
 14. Dispositif selon la revendication 1 ou 2, lesdits éléments faisant saillie vers l'extérieur s'étendant sur toute la longueur dudit boîtier.
 15. Dispositif selon la revendication 1 ou 2, lesdits éléments faisant saillie vers l'extérieur ayant une configuration en spirale.

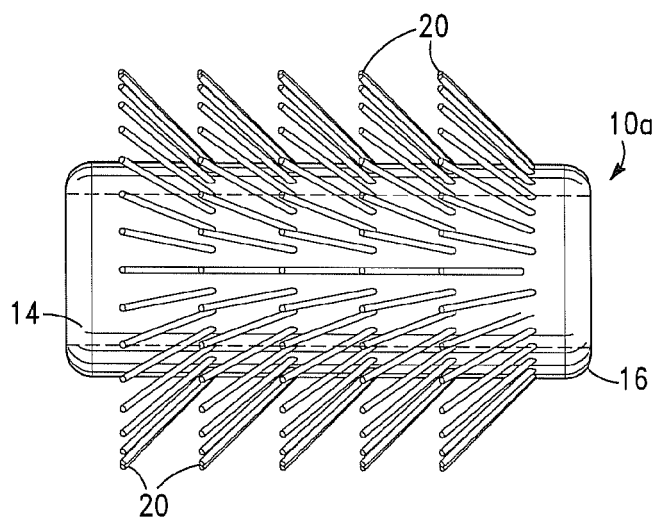


FIG. 1

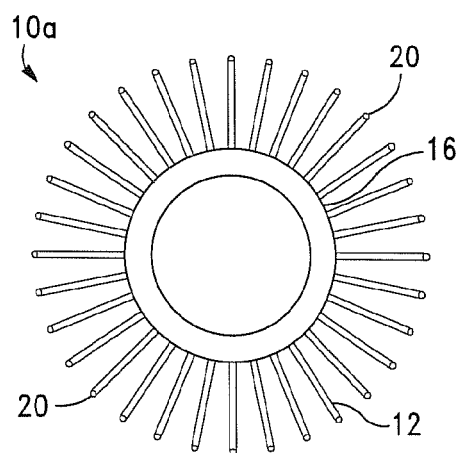


FIG. 2

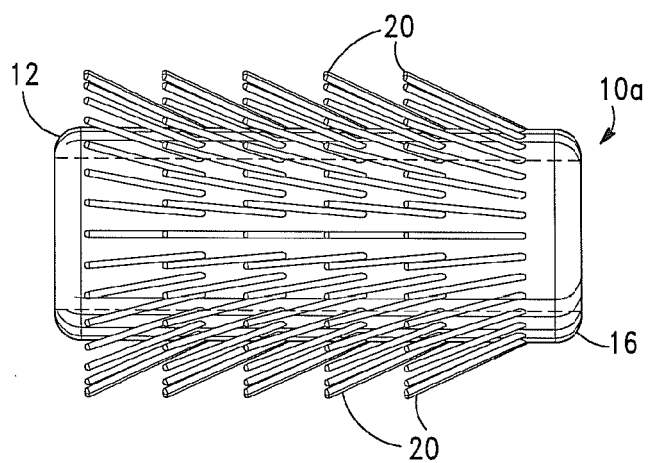


FIG. 3A

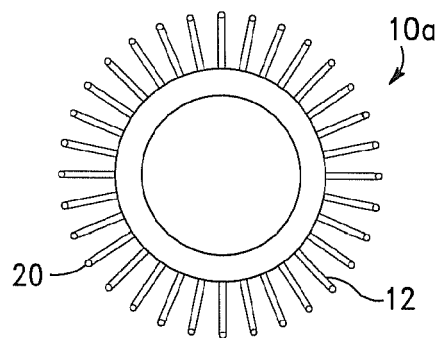


FIG. 3B

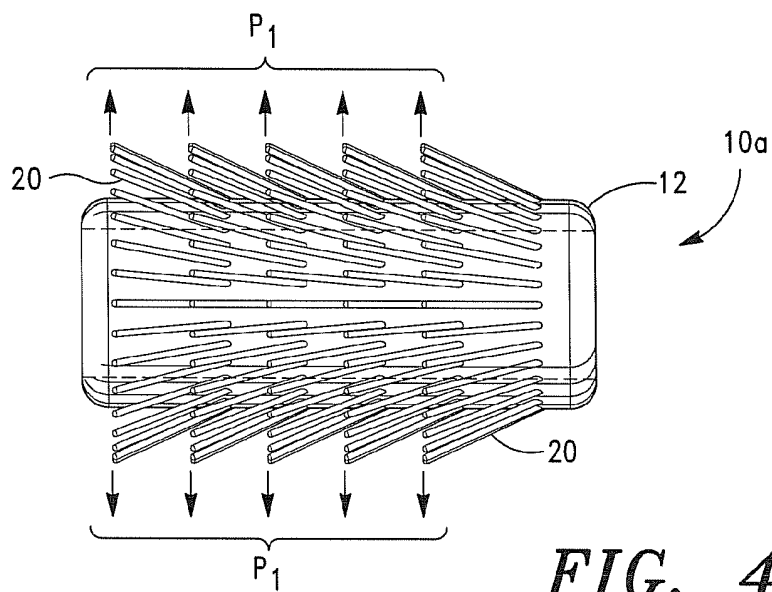


FIG. 4A

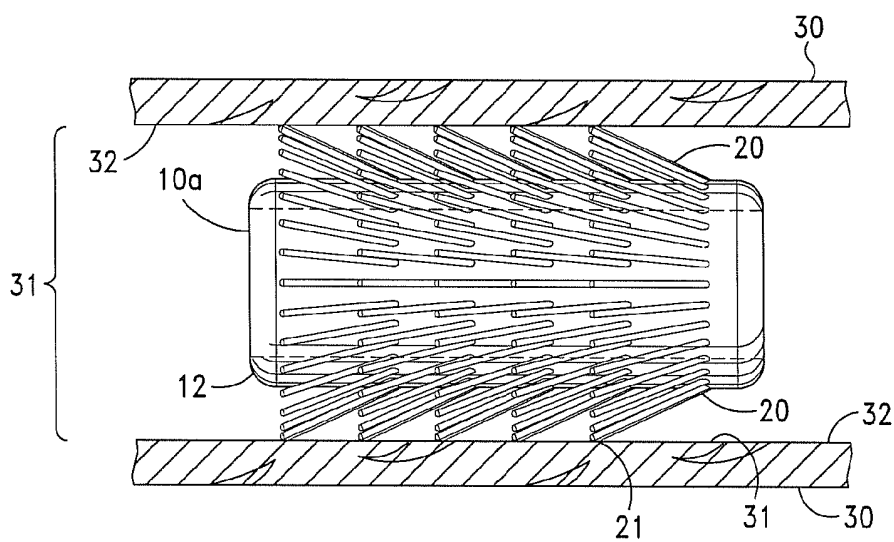


FIG. 4B

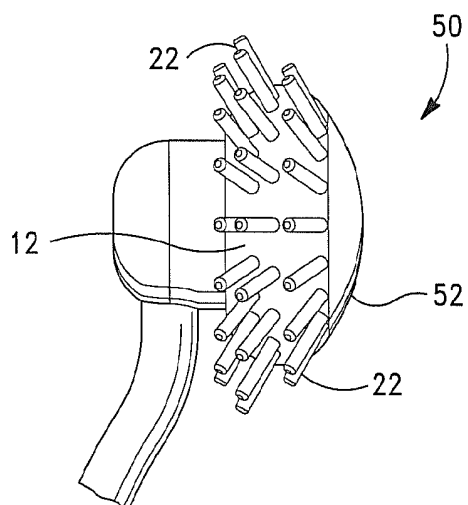


FIG. 5

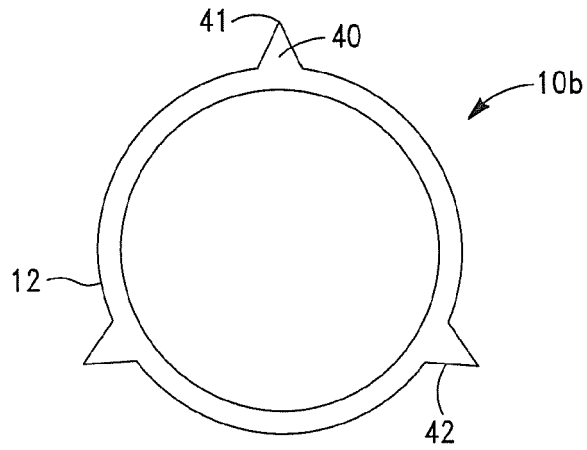


FIG. 6

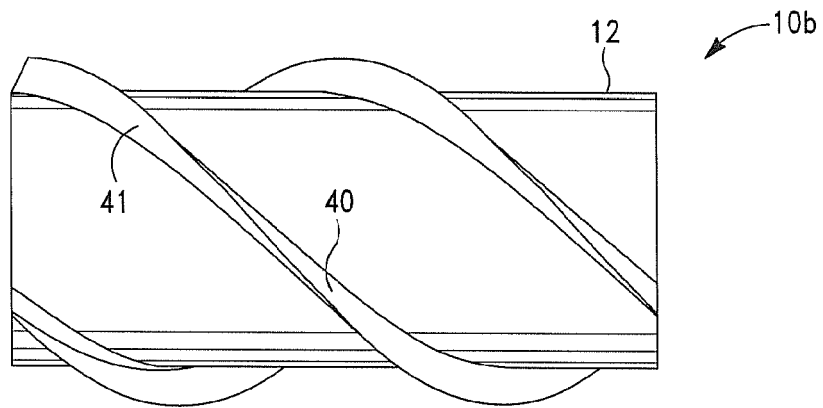


FIG. 7

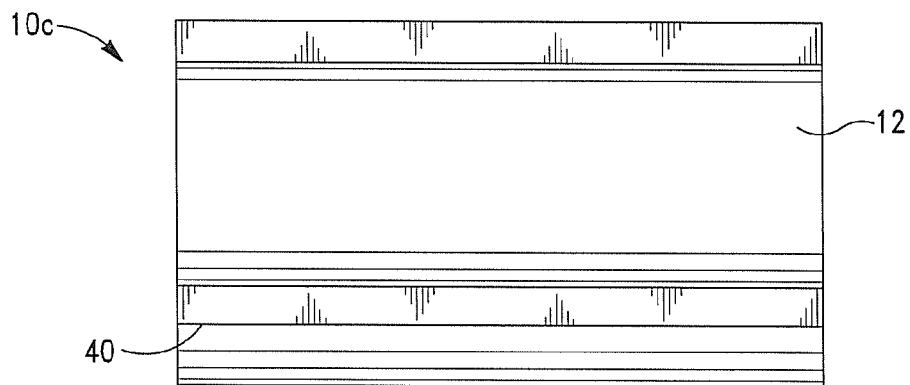


FIG. 8

REFERENCES CITED IN THE DESCRIPTION

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