(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 1 624 839 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
02.04.2008 Bulletin 2008/14

(21) Application number: **04733743.1**

(22) Date of filing: **19.05.2004**

(51) Int Cl.:
A61F 11/00 *(2006.01)* ***A61H 23/00*** *(2006.01)*
A61B 5/00 *(2006.01)* ***A61M 1/00*** *(2006.01)*
F16K 15/18 *(2006.01)* ***A61M 39/22*** *(2006.01)*

(86) International application number:
PCT/AU2004/000655

(87) International publication number:
WO 2004/100844 (25.11.2004 Gazette 2004/48)

(54) **A PORTABLE HAND-OPERABLE DEVICE FOR APPLYING PNEUMATIC PRESSURE PULSES TO AN EAR CANAL**

TRAGBARE HANDBETRIEBENE VORRICHTUNG ZUM AUFBRINGEN VON PNEUMATISCHEN DRUCKIMPULSEN AUF EINEN OHRKANAL

DISPOSITIF MANUEL PORTATIF POUR APPLICATION D'IMPULSIONS DE PRESSION PNEUMATIQUE AU MEAT ACOUSTIQUE EXTERNE

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PL PT RO SE SI SK TR

(30) Priority: **19.05.2003 AU 2003902425**

(43) Date of publication of application:
15.02.2006 Bulletin 2006/07

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Description

Field of the Invention

[0001] The present invention is directed to a portable device that is useful for the treatment and/or alleviation of symptoms of various ear disorders. It is also directed to the use of such a device.

Background of the Invention

[0002] Ménière's disease is a disorder of the inner ear. It is characterised by an endolymphatic hydrops of unknown cause. Symptoms consist of disturbed balance, vertigo, impaired hearing and tinnitus. It has been shown that people suffering from Ménière's disease can achieve relief from symptoms of dizziness and nausea through the application of elevated pressure to the outer and middle ear.

[0003] It is theorised that an air pulse, which applies the pressure to the round window of the inner ear may assist in reversing the flow of toxic potassium ions from the scala tympani to the scala vestibuli. The present invention provides a low cost device designed to allow users to apply elevated pressure levels to their own ears in order to achieve such relief.

[0004] The inventor has also recognised that causing a negative change of pressure in the ear canal may be useful in relieving pain arising from other causes, such as unequal pressure between the middle ear and outer ear that occurs during descent of an aircraft. The present invention also provides a device which may achieve such relief.

[0005] A hand-held device for applying pressure to the ear-canal is described in FR 2 605 516.

Summary of the Invention

[0006] The present invention seeks to provide devices that are simple to operate to provide either a positive or negative change in pressure in the ear canal. The invention also seeks to provide such devices that are portable and hand-operable. The device can therefore be carried by a person and easily used, without the assistance of additional mains or battery electric power, whenever relief is sought from various disorders of the ear.

[0007] The invention is directed to a hand-held and hand-operable device for creating a change in pressure in an external ear canal of a person according to the claims.

Brief Description of the Drawings

[0008] The present invention shall now be described with reference to the following drawings which illustrate preferred embodiments of the invention. These drawings are merely illustrative of how the invention may be put into effect so that the specific form and arrangement of the various features as shown is not to be understood as limiting the invention.

Figure 1 is a perspective view of an air pulsing device according to a first embodiment of the present invention shown with its delivery tube wound onto its case and its cap in place as for storage or transport in a person's pocket.

Figure 2 is a view of the device in Figure 1, shown with the storage cap removed.

Figure 3 is a perspective view of the device in Figure 2 shown with the delivery tube unwound and ready for use.

Figure 4 is a top view of the device shown in Figure 1.

Figure 5 is a side view of the device shown in Figure 1.

Figure 6 is a bottom view of the device shown in Figure 1.

Figure 7 is an end view of the device shown in Figure 1.

Figure 8 is a side view of portion of the device as shown in Figure 3.

Figure 9 is a top view of the portion of the device shown in Figure 8.

Figure 10 is a bottom view of the portion of the device shown in Figure 8.

Figure 11 is an end view of the portion of the device shown in Figure 8.

Figure 12 is an exploded view of the device shown in Figure 2.

Figure 13 is an enlargement of portion of the exploded view in Figure 12.

Figure 14 is a cut-away perspective view of the device according to the first embodiment.

Figure 15 is an exploded view of an air pulsing device according to a second embodiment of the present invention.

Figure 16 is a detailed enlargement of portion of the exploded view in Figure 15.

Figures 17 to 21 are cut away views showing the sequence of operations when using the device according to the second embodiment.

Description of the Preferred Embodiments and Other Examples of the Invention

[0009] Referring to Figures 1 to 14, the air-pulsing device 10 illustrated has a main body portion 12 to which is attached a flexible rubber tube 14 at the end of which is an ear piece 16 which in use is placed in the patient's ear. The main body portion 12 is about palm sized and has a generally squashed slightly-ellipsoidal form, so that it is somewhat discus-shaped, although slightly elongated, with a peripheral rim 24. At one of the elongated ends 18 of the body 12, the tube 14 extends from the rim 24. At the opposite end 19 of the body 12, a rounded groove 20 extends along the rim 24 and this serves as a locating recess for the tube 14 when it is wound into its storage position as shown in Figure 2. The tube 14 wraps along the rim 24 of the body 12 for convenient storage. As shown in Figure 1, an end cap 22 clips onto the end 18 of the body opposite the groove to cover and protect the ear piece 16 and the tube 14 where it extends from the body 12.

[0010] Referring in particular now to Figures 12 and 13, the main body portion 12 has a pressure case 25 formed by fastening together a pressure case base 26 and a pressure case top 30. The pressure case base 26 nests into a bottom cover 28. The pressure case top 30 is covered by a top cover 34 which has a large circular aperture 35 therethrough which is filled by an actuating pad 32. The rim 31 of the actuating pad 32 is glued to the top cover 34 and sandwiched between the pressure case top 30 and top cover 34.

[0011] The tube 14 is made from flexible silicone rubber and has one end 40 located onto a barbed nozzle 42 integrally formed on the pressure case base 26. The nozzle 42 provides a port into the pressure case 25. The second end 44 of the tube 14 is attached to an ear piece adaptor 46 onto which is located an ear piece 48.

[0012] The pressure case base 26 has integrally formed within it a cylindrical chamber or compartment 50 having its longitudinal axis aligned from base 26 to top 30, ie. perpendicular to the plane of the rim 24. Within the cylinder 50 is housed a needle valve 52 which has a cylindrical stem 52a and a softer, conical shaped tip 52b affixed to the bottom end of the stem 52a. The valve 52 is retained by a generally disc-shaped valve retainer 54. Also housed within the cylinder 50 is a plunger 58, which is biased away from the valve retainer 54 by a coil spring 56 in compression. The plunger is biased upwardly against a diaphragm 60 which covers and protrudes through a circular opening 62 in the pressure case top 30. The diaphragm 60 has the general shape of a hat, the crown 61 of which accommodates the upper end 57 of the plunger 58.

[0013] At the bottom 40 of the cylinder 50 is a central circular hole onto which the tapered sealing face 64 of the valve 52 seats. This hole provides a port 49 which opens from the cylinder 50 to the small gap 82 between the pressure case base 26 and the bottom cover 28. The port 49 is a simple parallel bore so that its hard upper edge seals against conical face 64 of the soft tip 52b of the valve 52.

[0014] The end cap 22, pressure case base 26, pressure case top 30, bottom cover 28, and plunger 58 are all made of a suitable engineering grade of rigid plastics material. The actuating pad 32 and pressure diaphragm 60 are made of flexible rubber.

[0015] To assemble the device 10, the pressure diaphragm 60 is first glued around its perimeter to the inside of the pressure case top 30, across the opening 62, in a manner to ensure a tight seal is achieved around the edge. The spring 56, valve 52, valve retainer 54 and plunger 58 are then positioned in the cylinder 50, and the pressure case top 30 and pressure case base 26 are glued together at their respective rims 33 and 29 being careful to ensure that the plunger, valve and spring are free to move axially in the cylinder 50.

[0016] The diaphragm 60 is a thin-walled rubber moulding which has an outwardly extending peripheral flange 66 which seals against the underside of the corresponding inner edge of the opening 62 in the pressure case top 30. The actuating pad 32 is glued into the top cover 34 and a small dob of glue is used to affix the top face of the pressure diaphragm 60 to the bottom face of the pad 32. The rim 29 of the bottom cover 28 is then affixed to the engaging rim 33 of the top cover 34. Locating pins 36 on the top cover (only two of which can be seen in Figure 12) locate into corresponding holes 38 on the bottom cover 28 in order to ensure correct alignment of the rims 29 and 33.

[0017] The ear piece adaptor 46 has a barbed connection (hidden in Figures) by which it is affixed to the free end 44 of the tube 14. The ear piece 48 is removably connected to a protruding tapered nozzle 68 on the ear piece adaptor 46. While the connection between the adaptor 46 and the tube 14 is not intended to be separated, the ear piece 48 is readily removed for replacement.

[0018] The ear piece 48 has a dome-shaped outer end 70 and when placed in an ear canal, the end 70 forms a peripheral seal. The ear piece 48 has an axial bore 71 ending at an opening 72 in the outer end 70. It is desirable for proper treatment of a patient's condition that the ear piece 48 provides a good, generally airtight seal.

[0019] After assembly, if finger pressure is applied to the actuating pad 32, the diaphragm 60 is depressed, so reducing the volume of the air chamber 74 defined by the cylinder 50 and the diaphragm 60. Air is prevented from escaping through the bottom port 49 sealed by valve 52, so is expelled from the chamber 74 through a pair of rectangular ports 76 positioned at diametrically opposite sides of the top edge of cylinder 50.

[0020] The amount of air expelled is controlled by the distance which the diaphragm 60 can be depressed. Maximum depression occurs when the bottom rim 59 of the plunger 58 contacts the upper surface of the valve retainer 54 and the sealing face 64 of the valve is pressed

hard against its co-operating port.

[0021] To allow for the manufacture of devices which vary only in the displacement the plunger is allowed, four pins 55 are moulded on the upper face 53 of the valve retainer 54. The height of these pins may be conveniently adjusted in the tooling used to mould the retainer 54. The longer the pins are the lower the air pressure produced by the device.

[0022] Users of the device 10 to treat Ménière's Disease will either have a ruptured eardrum or a tympanostomy tube fitted so that equal pressures are achieved either side of the eardrum. Therefore the volume into which the device 10 operates includes the middle ear connected cavities. The device 10 will produce safe pressure levels regardless of whether the user has an intact eardrum or not.

[0023] The device generates an elevated pressure change when the user presses the actuating pad 32 which in turn depresses the diaphragm 60. By fully actuating the diaphragm the chamber volume of the main body portion 12 is decreased by a fixed volume, resulting in a pressure increase in both the chamber and the user's ear cavity. The user may also elect to partially actuate the device in order to elevate ear pressure by a smaller amount.

[0024] The pressure elevation is determined by the ratio of starting combined device and ear cavity volume to the combined volume following actuation, as well as the atmospheric pressure.

[0025] To avoid damaging an ear, it is important that a safe maximum pressure and safe minimum pressure are never exceeded when using such a device. A maximum allowable pressure is 350 daPa (decaPascals) above ambient pressure. Maximum pressure is defined by a maximum volumetric displacement of the pressure diaphragm into a minimum user ear canal volume. The device 10 is designed such that the pressure elevation when used in a 7ml ear cavity is 215 daPa $\pm$ 40 above ambient pressure and the maximum possible negative pressure is 20 daPa below ambient. It is important that a negative pressure beyond 100daPa below ambient pressure is not possible with the device A user ear canal volume of 0ml is assumed in determining the maximum pressure to which a user could be exposed. This is equivalent to application to a user's ear with an intact eardrum and wax filled outer ear.

[0026] To prevent the device from producing a significant negative pressure, a friction-controlled valve is used. This valve is closed within the first millimetre or two of movement of the diaphragm as it is pressed, thereby sealing the device. As the diaphragm is further depressed the pressure within the device and connected user ear cavity is elevated.

[0027] When the user presses the diaphragm, the plunger is pressed downwards. The valve stem is frictionally engaged with the bore 80 in the plunger and freely runs through the bore of the retainer 54, so the valve seals port 49 very quickly. Thereafter the plunger is pressed downwards, its bore sliding on the valve stem, until its bottom rim 59 engages the retainer 54 at which time the internal operating volume of the device is at its minimum.

[0028] When the user begins to release the diaphragm, the plunger is pushed upwards by the spring 56 and the valve 52 is drawn upwards by means of the frictional engagement between the valve stem 52a and the bore 80 in the plunger, so the port 49 opens. This releases any pressure from the device and the user's ear cavity, allowing them to return to atmospheric pressure. The port will open within approximately the first millimetre of diaphragm relaxation from any level of diaphragm compression.

[0029] Negative gauge pressures are likely to cause additional discomfort to the user and are therefore to be avoided. If valve sequencing of the type described was not present, then it would be possible for the device to generate negative gauge pressures in a users' ear cavity under the following scenario:

- the diaphragm is depressed whilst the device connected to a user's ear;
- the seal to the outer ear is broken before the diaphragm is released thereby allowing the ear and device cavities to return to atmospheric pressure;
- following full, or even partial equalization, the seal to the ear is re-established;
- the device diaphragm is released thereby increasing the effective cavity volume and reducing the pressure relative to the chamber pressure.

[0030] Turning now to the second embodiment of the invention illustrated in Figures 15 to 21, many of the components are the same configuration as those described above in relation to the first embodiment and so do not need to be described in detail again. Such components are the bottom cover 28, top cover 34, actuating pad 32, pressure case top 30, diaphragm 60, tube 14, ear piece adaptor 46 and ear piece 16.

[0031] From the outside, device 10 of the first embodiment and device 110 of the second embodiment look the same. But whereas the device 10 is used to produce a positive pressure in the ear canal, device 110 is used to produce a negative pressure. This requires a different valving arrangement but many of the same valve sequencing principles apply.

[0032] Referring now to Figures 15 and 16, the main body portion 112 has a pressure case 125 formed by fastening together a pressure case base 126 and a pressure case top 130, which is the same as top 30.

[0033] The pressure case 126 has integrally formed within it a cylindrical chamber or compartment 150. Whereas the device 10 had a needle valve which opened inwardly of the device, the device 110 of the second embodiment has a poppet valve 152 which opens outwardly of the pressure case 125. The poppet valve 152 and pressure case base 126 are assembled with the cylindrical

valve stem 152a extending into the cylinder 150 along the longitudinal axis. A port 149 at the centre of the bottom of the cylinder 150 co-operates with the head 152b of the valve 152 to seal the port 149 when the valve 152 is in its upward most position.

[0034] Below the port 149 is a larger diameter aperture 147 through which the whole of valve 152 is fed upon assembly. A stop plate 154 is glued into position to blank off aperture 147. In its lower-most position the valve head 152 comes into contact with the stop plate 154.

[0035] The bottom wall 184 of the cylinder 150 is raised compared with the equivalent bottom wall in the earlier described embodiment and that raised wall contains the port 149 which is opened and shut by the valve 154. The valve stem 152a is inserted upwardly through the port 149 into the cylinder and the stop plate 154 then placed to fill the aperture 147. The bore 180 in the plunger 158 frictionally engages the valve stem 152a. A coil spring 156 is maintained in compression extending between the bottom wall of the cylinder and the plunger.

[0036] As illustrated in Figure 17, the device 110 is static and ready for first use. The valve head 152b is sealed against the port 149.

[0037] As seen in Figure 18, initial depression of the actuating pad 132 causes the diaphragm 60 to move downwards slightly which in turn presses down the plunger 158. The valve stem 152a is frictionally held within the bore 180 of a socket feature 178 moulded on the inside of the plunger 158. So, as the plunger first moves downwards, the valve 152 opens the port 149 allowing air to flow through the port, then through apertures 186 in the stopper plate and out to atmosphere through the space 182 between the bottom cover 128 and pressure case base 126 and through a gap between the fixed end 40 of the tube and the surrounding covers 28 and 34. This flow of air is shown by the arrows 188 shown in Figure 18. The valve head 152b has just come into contact with the stopper plate and the valve stem has not yet slipped from its friction grip in the bore 180.

[0038] Figure 19 shows the device at the point of full actuation. The valve head has remained in contact with the stopper plate and the plunger has slid down the valve stem 152a, the finger pressure from the user having overcome the friction between the bore 180 and the valve stem. The air flow to atmosphere is shown by arrows 190. In Figure 19 the plunger is shown fully depressed so the system is at its minimum volume. At this stage the device still has atmospheric pressure within it.

[0039] Referring now to Figure 20, the diaphragm has been partly released and the plunger has risen under action from the spring bringing with it, by frictional engagement, the valve. After about 1mm movement, the valve head seals the port. At this point the plunger starts to slip on the stem of the valve.The device is still at atmospheric pressure internally.

[0040] As the plunger continues to rise, the volume of the system increases and the pressure drops, drawing air along the tube 14 as shown by arrow 192.

[0041] As shown in Figure 21 the plunger has continued to rise, with the valve stem sliding in the bore 180 of the plunger, further increasing the volume, drawing further air into the device and lowering the pressure further.

[0042] At the position shown in Figure 21, maximum negative pressure is achieved in the system and the pressure will hold until the seal is broken or the diaphragm is pushed again.

[0043] When the user begins to press the diaphragm again, the valve opens. This releases any negative pressure within the device and the user's ear cavity, allowing them to return to atmospheric pressure.

[0044] It is important to note that the plunger does not act as a piston in the cylinder. Air flows are produced by actuation of the diaphragm which increases and decreases the total volume of the air chamber in the device. As seen in Figure 16 the cylinder has longitudinal slits 176 through its walls which allows free air flow between the piston and the main part of the body of the device.

[0045] It can be seen that the device generates a pressure reduction relative to atmospheric pressure when the user squeezes and releases a diaphragm. By actuating the diaphragm, the effective volume of the device is decreased by a fixed volume. When the diaphragm is released a valve seals the chamber port to atmosphere and the chamber size increases resulting in a reduced pressure in both the chamber and the user's ear cavity. The user may also elect to partially actuate the device in order to reduce the air pressure by a smaller amount than the maximum provided by the design of the device.

[0046] The friction-controlled valve is used to prevent the device from producing a significant positive pressure between actuations. This valve is closed within the first millimetre of movement when the diaphragm is released, thereby sealing the operating cavity from venting to atmosphere. As the diaphragm is further released the pressure within the operating cavity and connected user ear cavity is reduced.

[0047] The valve will open within approximately the first millimetre of diaphragm actuation from any level of diaphragm compression.

[0048] If this type of valve was not present then it would be possible for the device to generate positive gauge pressures in a users' ear cavity under certain conditions of poor sealing to the user's ear, such as when the seal is broken during actuation and then re-established.

[0049] For patient safety, it is important that excessive negative and positive pressures cannot be exceeded under any circumstances of using this device. For the above described second embodiment of the invention, the minimum actuation pressure (maximum amplitude) allowable is 700 daPa gauge (below ambient). The design gives a holding actuation gauge pressure of -500 daPa with a tolerance of +/-40 daPa gauge for normal usage at a nominal ear cavity size of 2 ml and an atmospheric pressure of 10132500daPa. Also it is important that a device of this type cannot be used to create a positive pressure greater than 100 daPa above ambient pressure under

conditions of effective and/or ineffective sealing to the ear.

[0050] It will be also understood that where the word "comprise", and variations such as "comprises" and "comprising", are used in this specification, unless the context requires otherwise such use is intended to imply the inclusion of a stated feature or features but is not to be taken as excluding the presence of other feature or features.

Claims

1. A hand-held and hand-operable device for creating a change in pressure in an external ear canal of a person, said device comprising:

- a body having an interior space forming an air chamber;
- a flexible tube in fluid communication at a first of its ends with said air chamber and, at the second of its ends, with an ear-piece adapted for insertion in said ear canal;
- a finger-actuated diaphragm in an external wall of the air chamber; **characterised in that** the device further comprises:

- within the air chamber, a plunger and a valve means fictionally engaged with said plunger; and

wherein:

- the finger-actuated diaphragm:

- when depressed by a user's finger, moves the plunger from a resting position, and in a first direction, and
- when released by the user's finger, returns to its undepressed position;

- a spring means returns the plunger, in a second direction, to said resting position when said finger depression on the diaphragm is removed;
- initial movement of the plunger in said first direction from said resting position displaces said valve means from a first position to a second position at which the valve means is stopped from further movement in said first direction,
- further movement of the plunger in said first direction causes the plunger to slide relative to the valve means,
- initial said return movement of the plunger in said second direction displaces said valve means from said second position to said first position at which the valve means is stopped from further movement in said second direction,
- further movement of the plunger in said second direction causes the plunger to slide relative to the valve means, and
- either :

- said depression of the diaphragm increases the pressure of the air in said air chamber, or
- said return of the diaphragm to its undepressed position decreases the pressure of the air in said air chamber,

whereby, when the ear-piece is inserted in said ear canal, actuation of the diaphragm causes said increase or decrease of air pressure, generated at the air chamber, to be transmitted through the tube and delivered to the ear canal.

2. A device according to any one of the previous claims wherein the valve means includes a cylindrical valve stem which engages in a close sliding fit within a bore in the plunger and said close sliding fit provides said frictional engagement.

3. A device according to any one of the previous claims wherein the plunger slides axially in a cylindrical chamber formed within said interior space.

4. A device according to any one of the previous claims wherein the diaphragm has a generally hat shape the crown of which accommodates an end of the plunger when in its said resting position.

5. A device according to any one of the previous claims wherein said depression of the diaphragm causes an increase of air pressure to be delivered to the ear canal.

6. A device according to claim 5 wherein the valve means when at said second position has its sealing face pressed against a co-operating port to prevent air flow through that port.

7. A device according to any one of claims 5 or 6 wherein the valve means includes a cylindrical valve stem which is held in a loose sliding fit by a retainer affixed within the cylindrical chamber and, when the valve means is at said first position, the valve means is prevented by the retainer from further movement in said second direction.

8. A device according to claim 7 wherein a coil spring extending between the plunger and the retainer is maintained in compression in order to maintain a thrust pressing the plunger away from the retainer.

9. A device according to any one of claims 1 to 4 wherein said return of the diaphragm to its undepressed position causes a decrease of air pressure to be de-

livered to the ear canal.

10. A device according to claim 9 wherein the valve means when at said first position has its sealing face pressed against a co-operating port to prevent air flow through that port.

Patentansprüche

1. Tragbare und handbetätigbare Vorrichtung zum Erzeugen einer Druckänderung in einem äußeren Ohrkanal einer Person, wobei die Vorrichtung aufweist:

- einen Körper, der einen Innenraum hat, welcher eine Luftkammer ausbildet;
- eine flexible Rohrleitung, die an einem ersten ihrer Enden mit der Luftkammer in Fluidverbindung steht und an dem zweiten ihrer Enden mit einem Ohr-Teil, das zum Einsetzen in den Ohrkanal ausgebildet ist, in Fluidverbindung steht;
- ein finger-betätigbares Diaphragma in einer äußeren Wand der Luftkammer;

dadurch gekennzeichnet, dass die Vorrichtung weiter aufweist:

- innerhalb der Luftkammer einen Kolben und ein Ventilmittel, das mit dem Kolben reibschlüssig in Eingriff steht; und

wobei:

- das finger-betätigbare Diaphragma

  - den Kolben aus einer Ruhestellung und in eine erste Richtung bewegt, wenn es von einem Finger eines Anwenders niedergedrückt wird, und
  - zu seiner nicht niedergedrückten Stellung zurückkehrt, wenn es von dem Finger des Anwenders losgelassen wird;

- ein Federmittel den Kolben in einer zweiten Richtung zu der Ruhestellung rückführt, wenn der Fingerdruck auf das Diaphragma abgebaut wird;
- eine Anfangsbewegung des Kolbens aus der Ruhestellung in die erste Richtung das Ventilmittel von einer ersten Stellung zu einer zweiten Stellung hin verlagert, in der das Ventilmittel von einer weiteren Bewegung in die erste Richtung abgehalten wird,
- eine weitere Bewegung des Kolbens in die erste Richtung den Kolben dazu veranlasst, sich gegenüber dem Ventilmittel zu verschieben,
- anfänglich die Rückkehrbewegung des Kolbens in die zweite Richtung das Ventilmittel von der zweiten Stellung zu der ersten Stellung verlagert, in der das Ventilmittel von einer weiteren Bewegung in die zweite Richtung abgehalten wird,
- eine weitere Bewegung des Kolbens in die zweite Richtung den Kolben dazu veranlasst, sich in Bezug auf das Ventilmittel zu verschieben, und
- entweder:

  - das Niederdrücken des Diaphragmas den Luftdruck in der Luftkammer erhöht oder
  - die Rückkehr des Diaphragmas zu seiner nicht niedergedrückten Stellung den Luftdruck in der Luftkammer verringert,

wodurch ein Betätigen des Diaphragmas, wenn das Ohr-Teil in den Ohrkanal eingesetzt ist, die Erhöhung oder Verringerung des Luftdrucks verursacht, die bei der Luftkammer erzeugt wird, um durch die Rohrleitung übertragen und dem Ohrkanal zugeführt zu werden.

2. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei das Ventilmittel einen zylindrischen Ventilschaft umfasst, der in einem engen Gleitsitz innerhalb einer Bohrung in dem Kolben in Eingriff steht, und wobei der enge Gleitsitz den reibschlüssigen Eingriff bereitstellt.

3. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei der Kolben axial in einer zylindrischen Kammer gleitet, die innerhalb des Innenraums ausgebildet ist.

4. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei das Diaphragma im Wesentliche eine Hutform hat, deren Kalotte ein Ende des Kolbens aufnimmt, wenn der sich in seiner Ruhestellung befindet.

5. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei das Niederdrücken des Diaphragmas eine Erhöhung eines dem Ohrkanal zuzuführenden. Luftdrucks verursacht.

6. Vorrichtung nach Anspruch 5, wobei die Dichtfläche des Ventilmittels gegen eine zusammenwirkende Öffnung gedrückt wird, wenn das Ventilmittel sich in seiner zweiten Stellung befindet, um zu vermeiden, dass Luft durch diese Öffnung fließt.

7. Vorrichtung nach einem der Ansprüche 5 oder 6, wobei das Ventilmittel einen zylindrischen Ventilschaft umfasst, der in einem freien Gleitsitz von einem Rückhalteglied gehalten wird, das innerhalb der zylindrischen Kammer befestigt ist, und das Ventilmittel durch das Rückhalteglied an einer weiteren Be-

wegung in die zweite Richtung gehindert wird, wenn das Ventilmittel sich in seiner ersten Stellung befindet.

8. Vorrichtung nach Anspruch 7, wobei eine Schraubenfeder, die sich zwischen dem Kolben und dem Rückhalteglied erstreckt, unter Vorspannung gehalten wird, um einen Axialdruck aufrecht zu erhalten, der den Kolben von dem Rückhalteglied wegdrückt.

9. Vorrichtung nach einem der Ansprüche 1 bis 4, wobei die Rückkehr des Diaphragmas zu dessen nicht niedergedrückter Stellung eine Verringerung eines dem Ohrkanal zuzuführenden Luftdrucks verursacht.

10. Vorrichtung nach Anspruch 9, wobei die Dichtfläche des Ventilmittels gegen eine zusammenwirkende Öffnung gedrückt wird, wenn sich das Ventilmittel in seiner ersten Stellung befindet, um zu verhindern, dass Luft durch diese Öffnung fließt.

Revendications

1. Dispositif portable et actionnable manuellement pour créer un changement de pression dans un canal auriculaire externe d'une personne, ledit dispositif comprenant

- un corps ayant un espace intérieur formant une chambre à air ;
- un tube flexible en communication fluidique à une première de ses extrémités avec ladite chambre à air et, à la deuxième de ses extrémités, avec une oreillette adaptée pour l'insertion dans ledit canal auriculaire ;
- un diaphragme actionné par le doigt dans une paroi externe de la chambre à air **caractérisé en ce que** le dispositif comprend en outre
- à l'intérieur de la chambre à air, un plongeur et un moyen de soupape mis en prise par friction avec ledit plongeur ; et

où

- le diaphragme actionné par le doigt :

  - quand il est enfoncé par le doigt de l'utilisateur, déplace le plongeur d'une position de repos, et dans une première direction, et
  - quand il est libéré par le doigt de l'utilisateur, retourne à sa position non enfoncée ;
  - un moyen de ressort renvoie le plongeur, dans une deuxième direction, à ladite position de repos quand ladite dépression du doigt sur le diaphragme est supprimée ;
  - un mouvement initial du plongeur dans ladite première direction depuis ladite position de repos déplace ledit moyen de soupape d'une première position à une deuxième position à laquelle le moyen de soupape est empêché de faire un autre mouvement dans ladite direction,
  - un autre mouvement du plongeur dans ladite direction amène le plongeur à coulisser par rapport au moyen de soupape,
  - ledit mouvement initial de retour du plongeur dans ladite deuxième direction déplace ledit moyen de soupape de ladite deuxième position a ladite première position à laquelle le moyen de soupape est empêché de faire un autre mouvement dans ladite deuxième direction,
  - un autre mouvement du plongeur dans ladite deuxième direction amène le plongeur à coulisser par rapport au moyen de soupape, et :

soit

  - ladite dépression du diaphragme augmente la pression de l'air dans ladite chambre à air, ou
  - ledit retour du diaphragme à sa position de non enfoncée diminue la pression de l'air dans ladite chambre à air,

grâce à quoi, quand l'oreillette est insérée dans ledit canal auriculaire, l'actionnement du diaphragme conduit ladite augmentation ou diminution de pression d'air, générée dans la chambre à air, à être transmise par le tube et délivrée au canal auriculaire.

2. Dispositif selon l'une quelconque des revendications précédentes, dans lequel le moyen de soupape comprend une tige de soupape cylindrique qui est en prise en ajustement de coulissement serré avec un alésage dans le plongeur et ledit ajustement de coulissement serré fournit ladite mise en prise par friction.

3. Dispositif selon l'une quelconque des revendications précédentes, dans lequel le plongeur coulisse axialement dans une chambre cylindrique formée dans ledit espace intérieur.

4. Dispositif selon l'une quelconque des revendications précédentes, dans lequel le diaphragme a une forme générale de chapeau dont la couronne reçoit une extrémité du plongeur quand il est dans ladite position de repos.

5. Dispositif selon l'une quelconque des revendications précédentes, dans lequel ladite dépression du diaphragme conduit une augmentation de pression d'air à être délivrée au canal auriculaire.

6. Dispositif selon la revendication 5, dans lequel le moyen de soupape quand il est à ladite deuxième position a sa phase d'étanchéité pressée contre un orifice de coopération pour empêcher un écoulement d'air à travers cet orifice.

7. Dispositif selon l'une quelconque des revendications 5 ou 6, dans lequel le moyen de soupape comprend une tige de soupape cylindrique qui est maintenue dans un ajustement à coulissement lâche par une fixation fixée dans la chambre cylindrique et, quand le moyen de soupape est à ladite première position, le moyen de soupape est empêché par la fixation de faire un autre mouvement dans ladite deuxième direction.

8. Dispositif selon la revendication 7, dans lequel un ressort hélicoïdal s'étendant entre le plongeur et la fixation est maintenu en compression afin de maintenir une poussée pressant le plongeur à distance de la fixation.

9. Dispositif selon l'une quelconque des revendications 1 à 4, dans lequel ledit retour du diaphragme à sa position non enfoncée conduit une diminution de la pression d'air à être délivrée au canal auriculaire.

10. Dispositif selon la revendication 9, dans lequel le moyen de soupape quand il est à la première position a sa face d'étanchéité pressée contre un orifice de coopération pour empêcher un écoulement d'air à travers cet orifice.

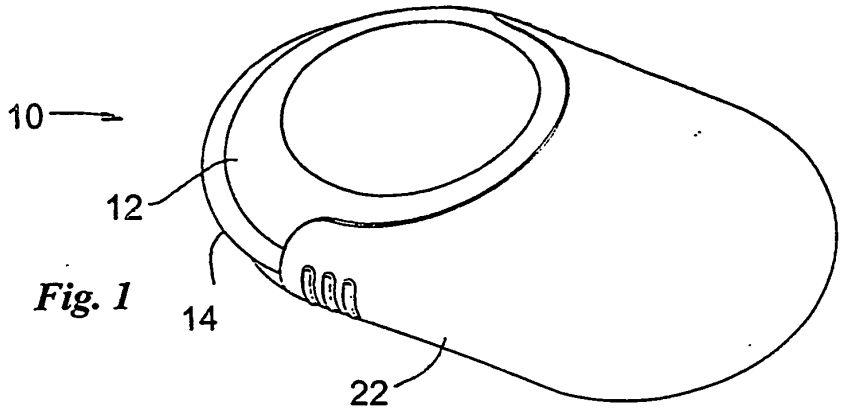


Fig. 1

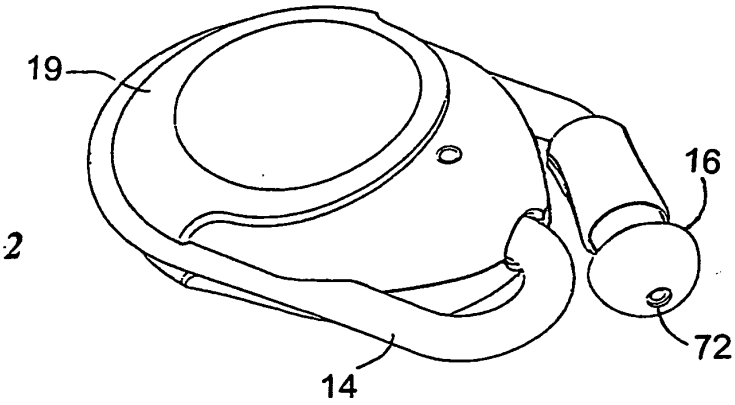


Fig. 2

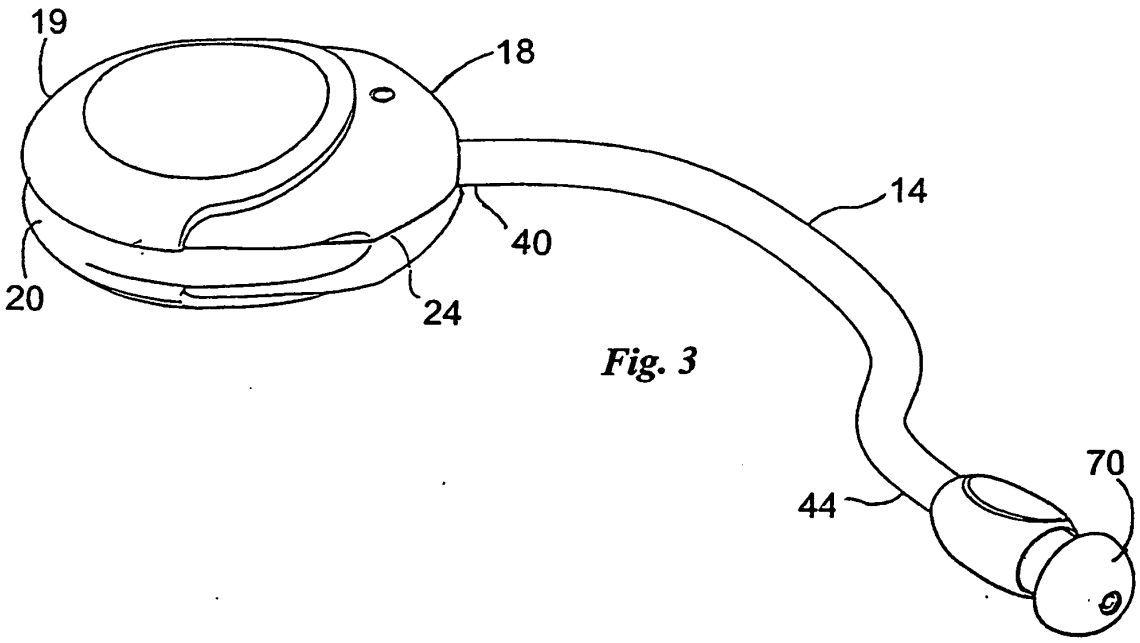


Fig. 3

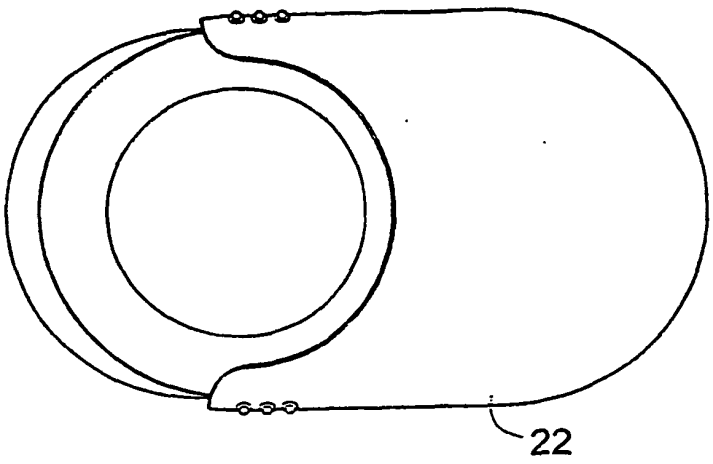


Fig. 4

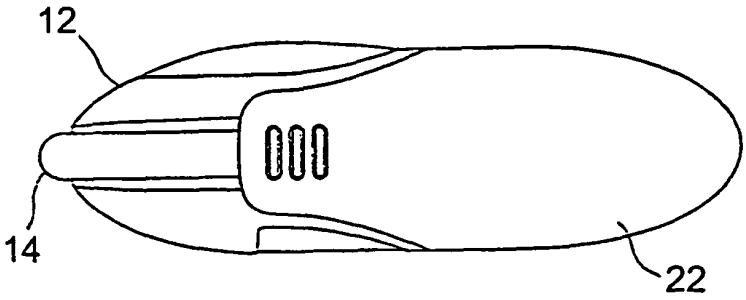


Fig. 5

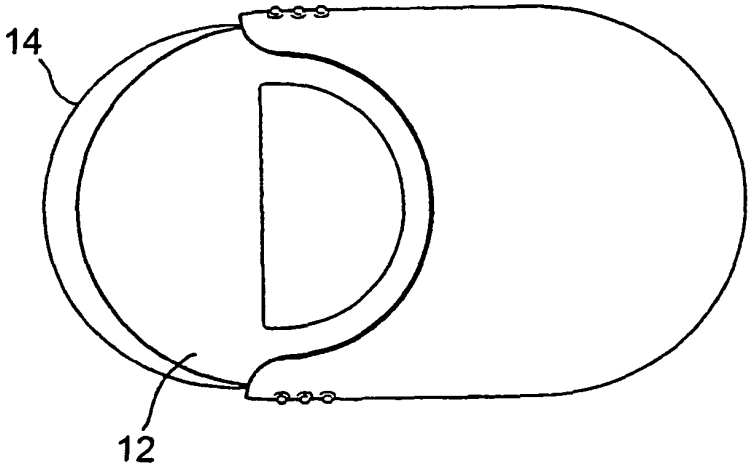


Fig. 6

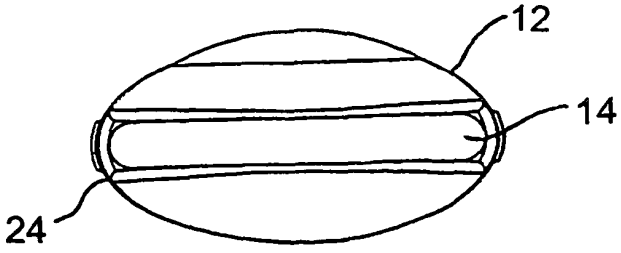
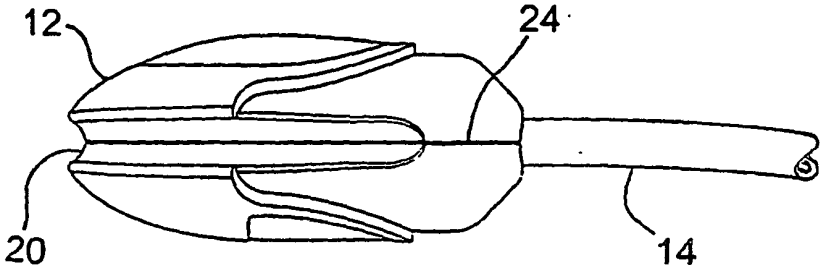


Fig. 7



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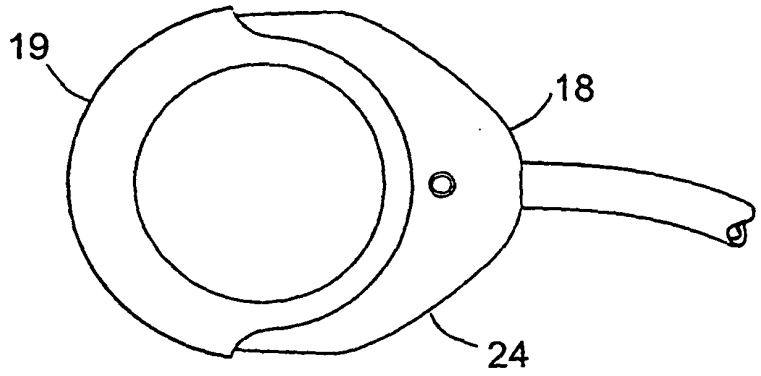

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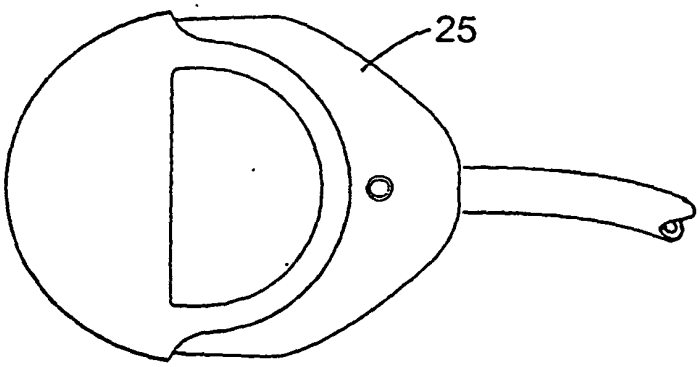
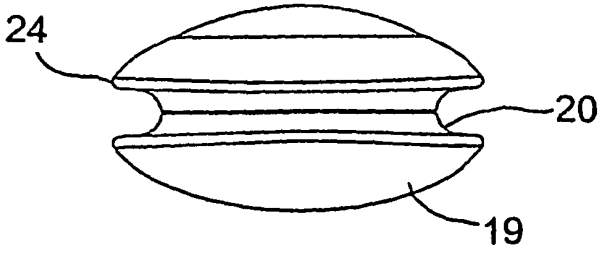


Fig. 10



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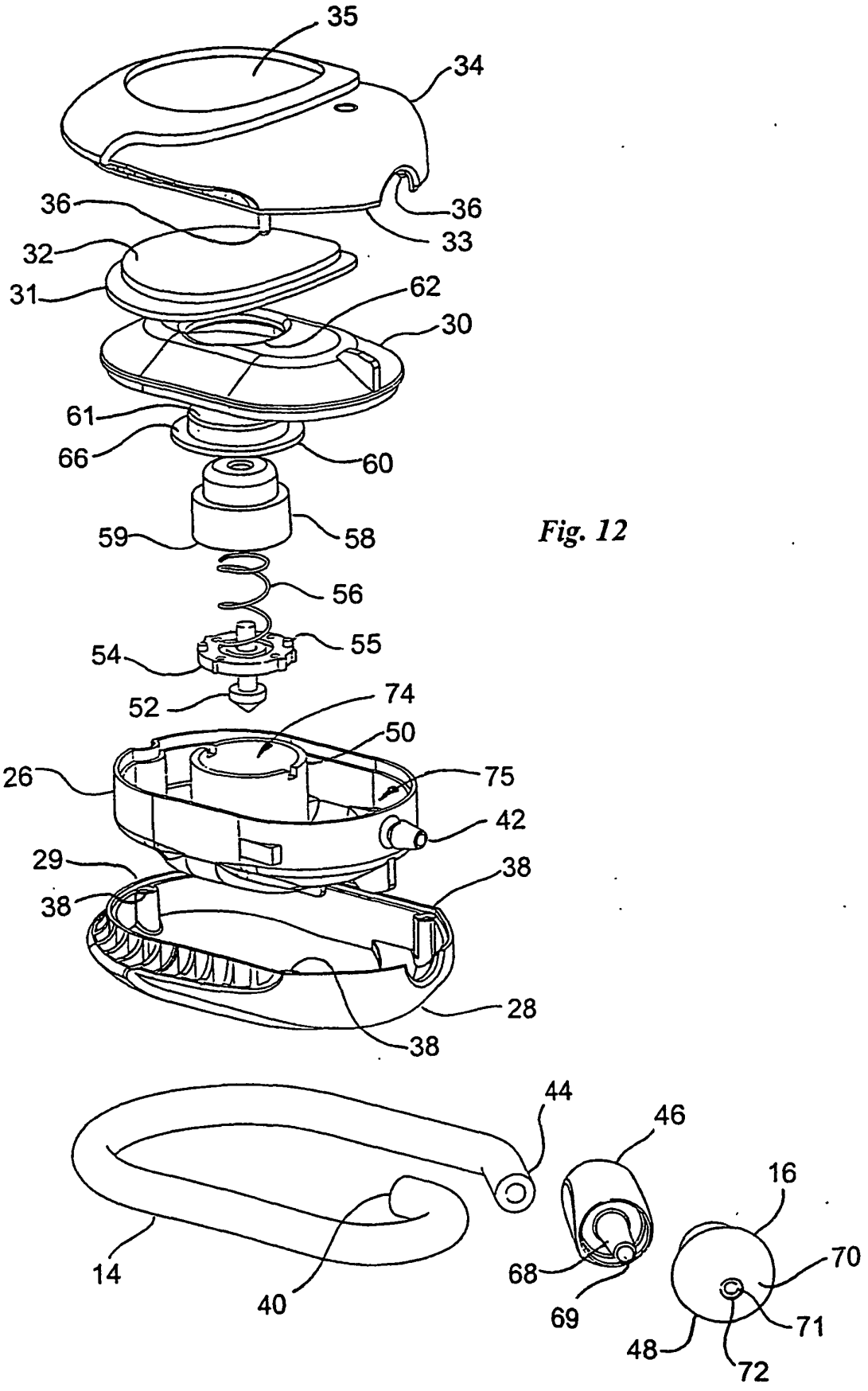
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Fig. 12

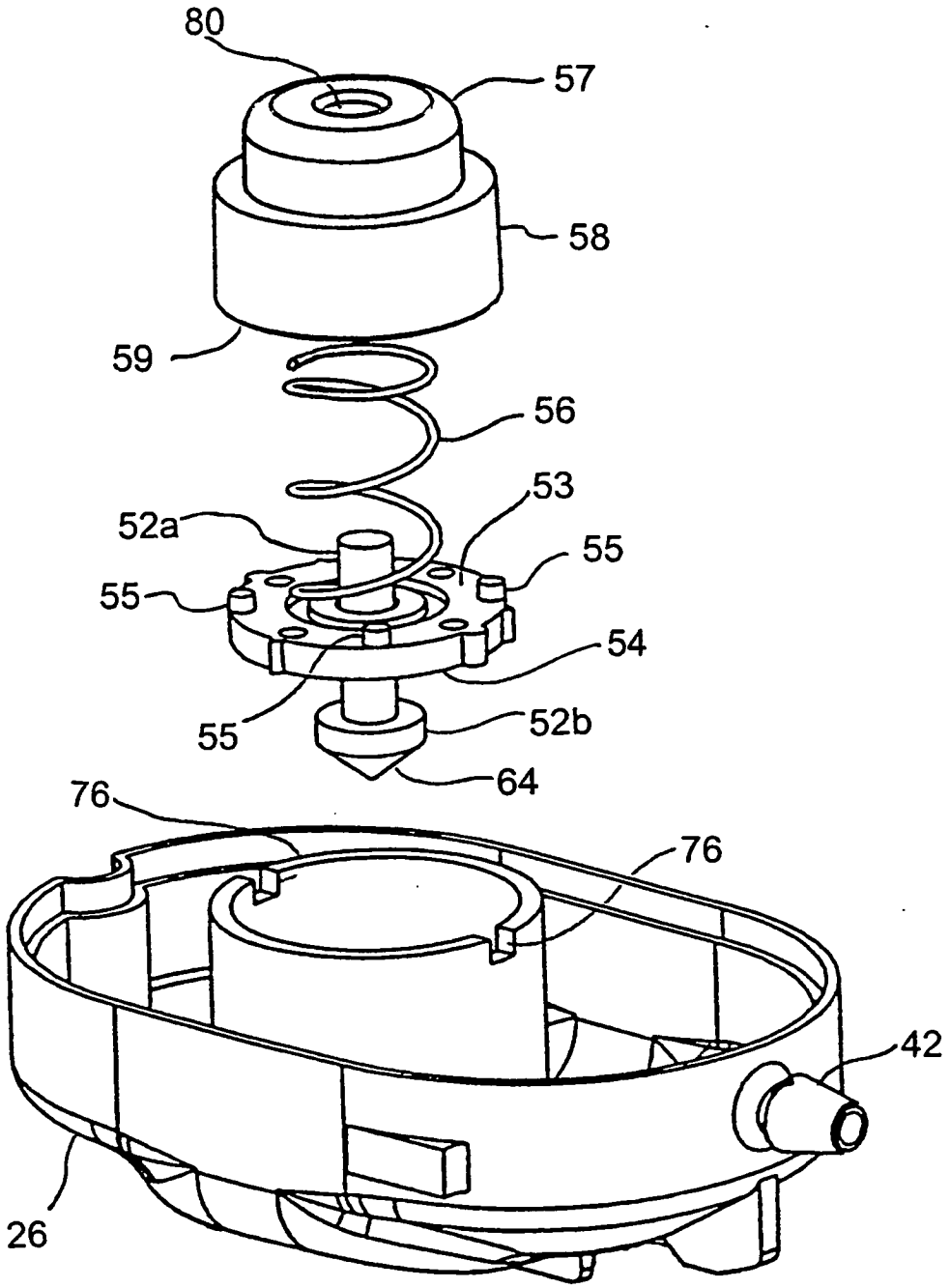
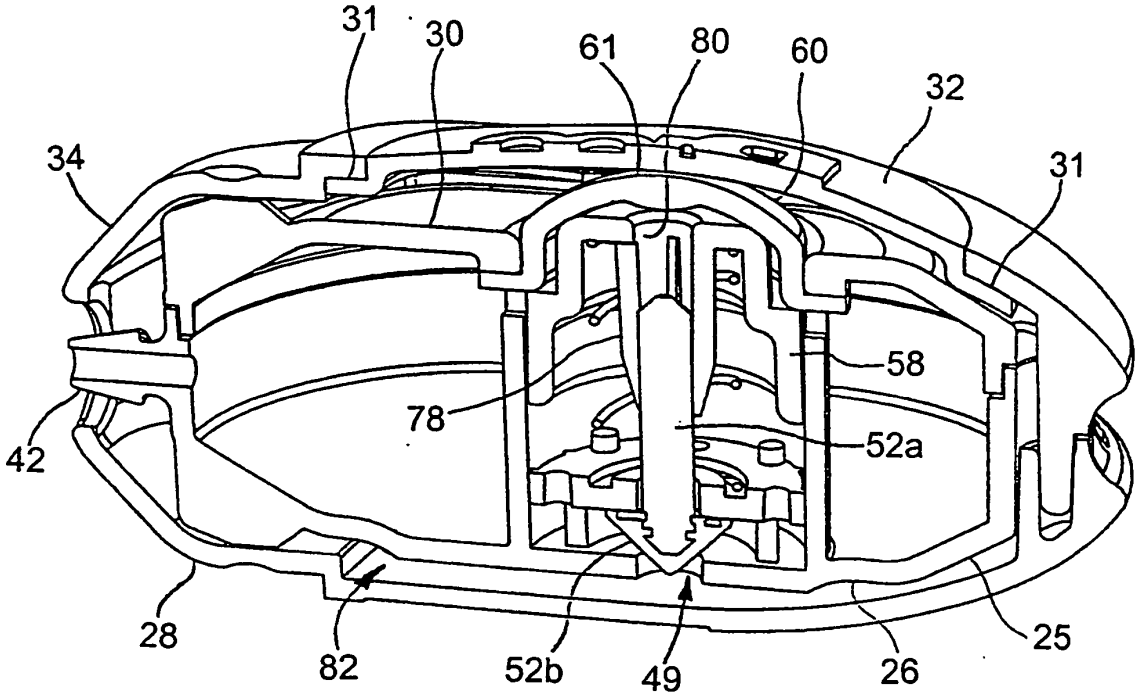


Fig. 13



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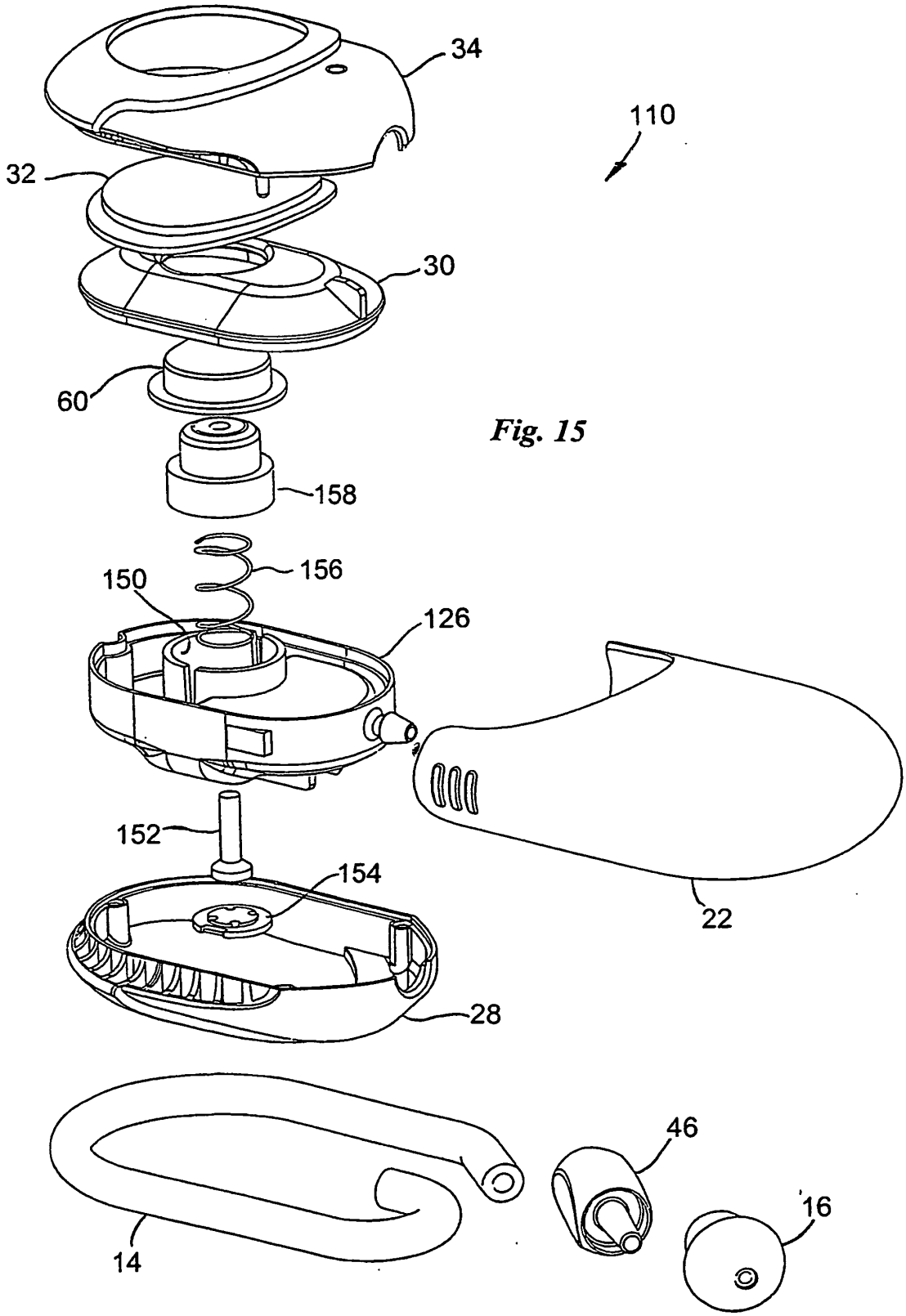

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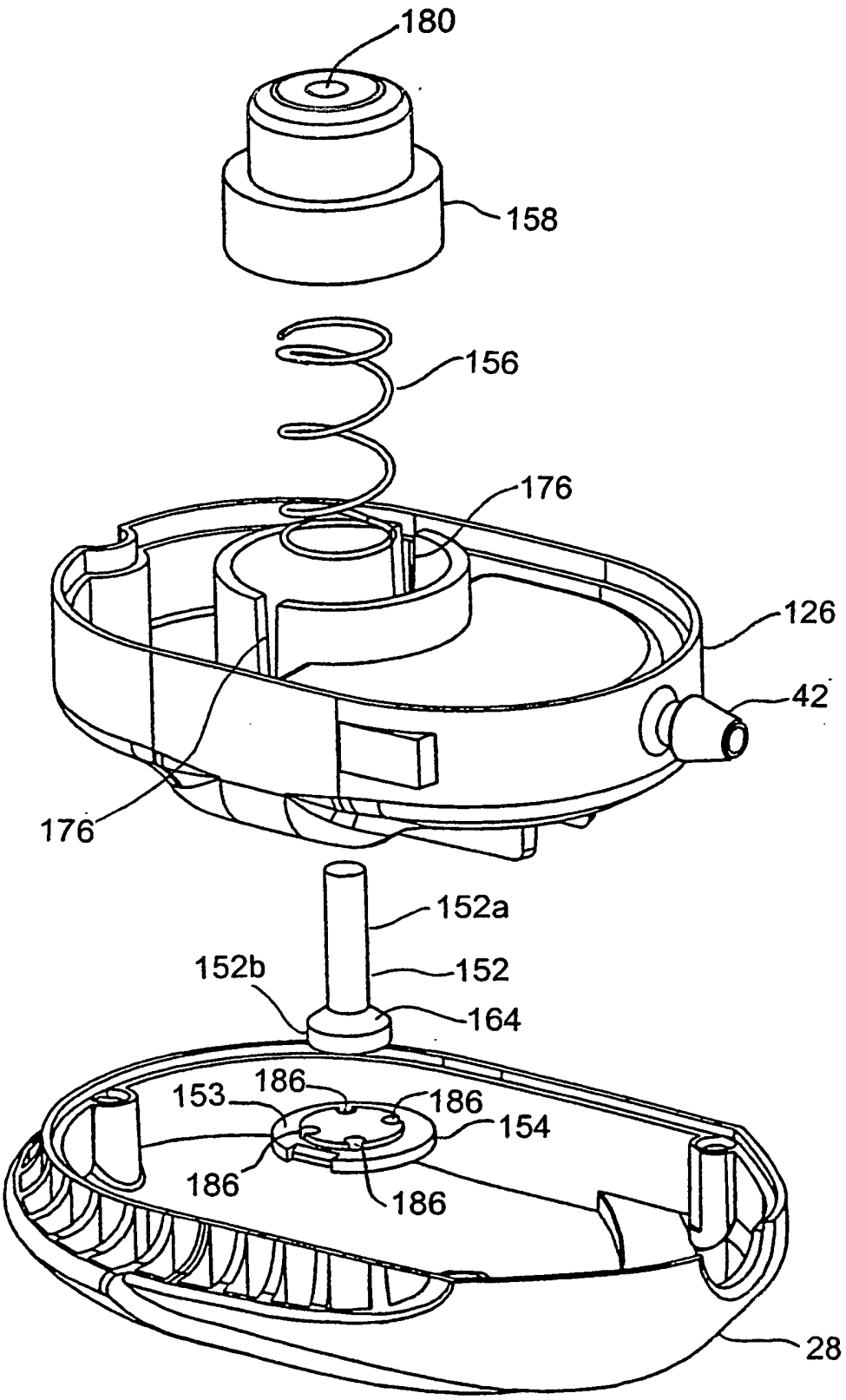
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Fig. 16

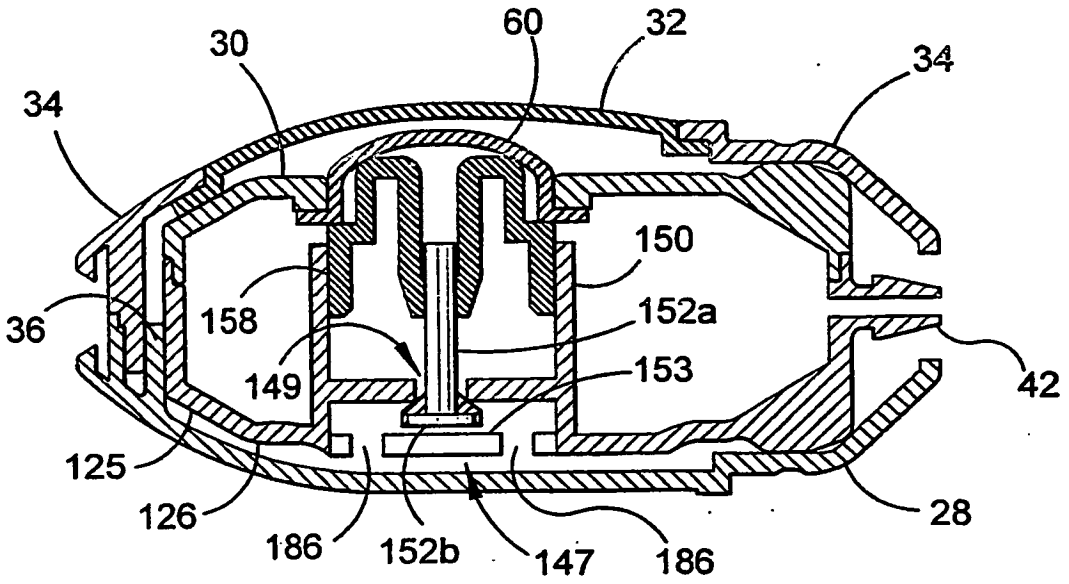
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Fig. 17

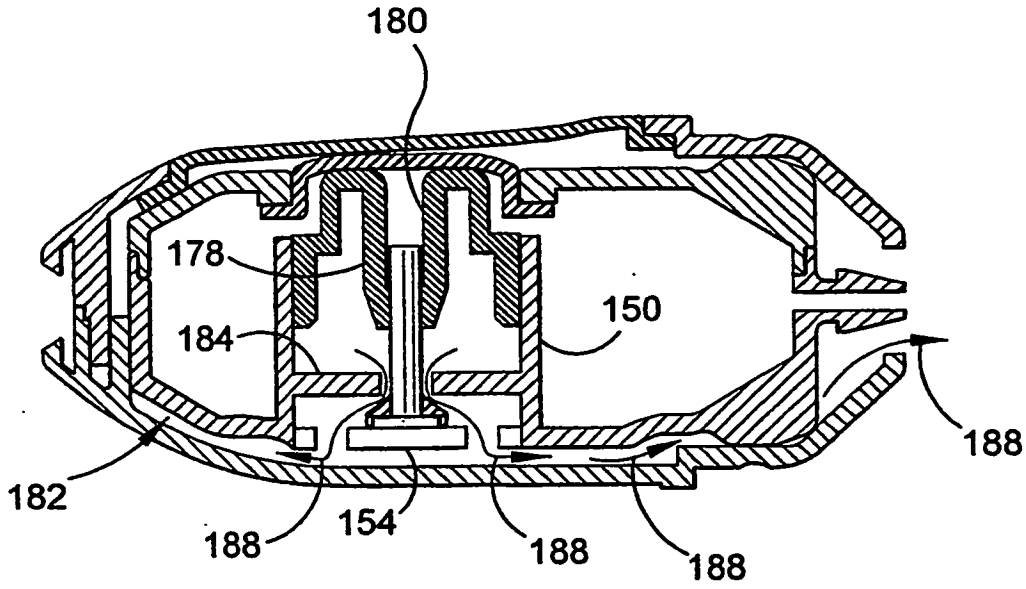
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Fig. 18

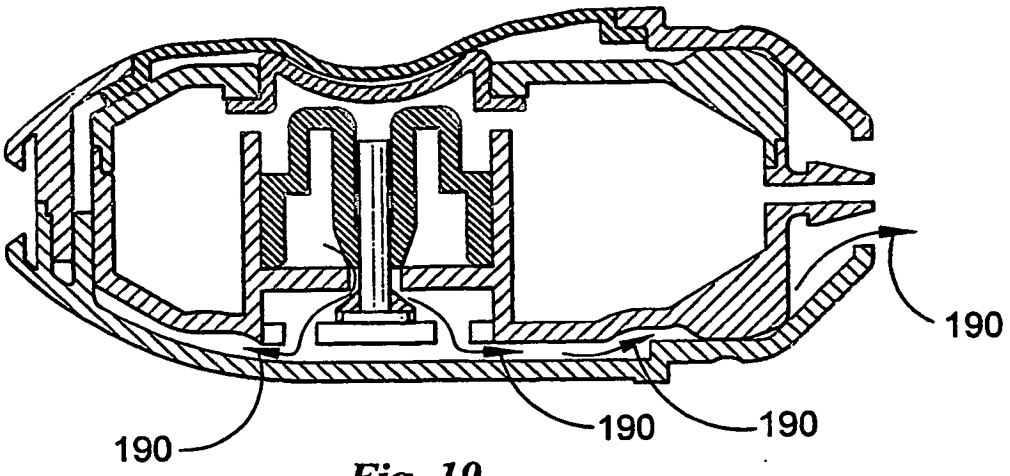

Fig. 19

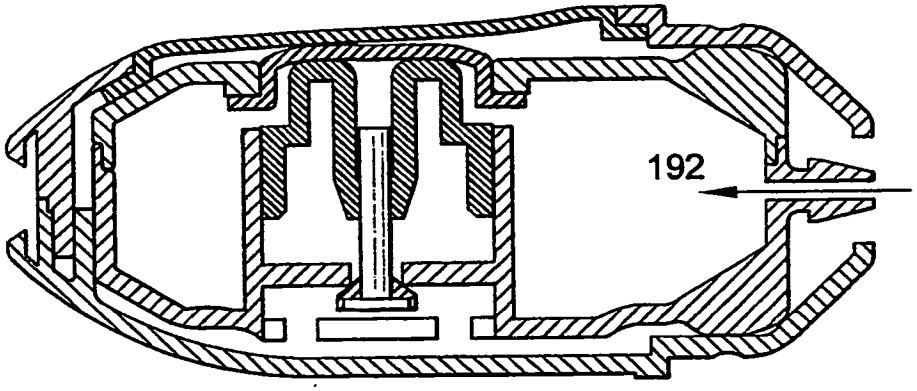

Fig. 20

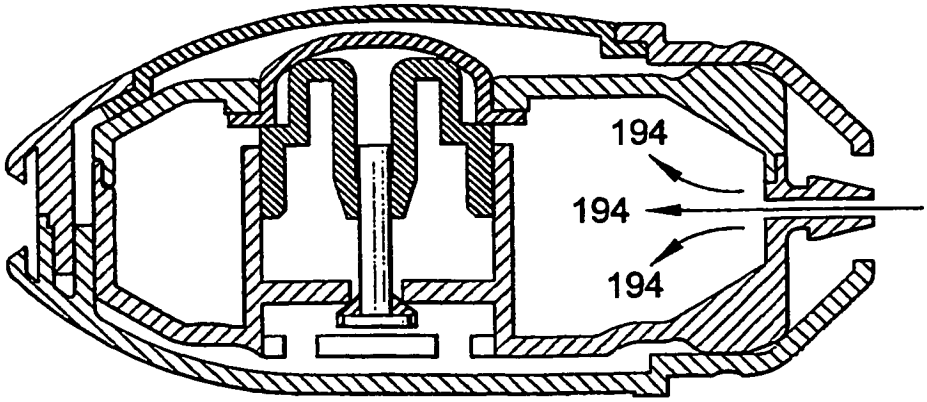

Fig. 21

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- FR 2605516 **[0005]**

专利名称(译)	一种便携式手动操作装置，用于将气动压力脉冲施加到耳道		
公开(公告)号	EP1624839A4	公开(公告)日	2006-09-20
申请号	EP2004733743	申请日	2004-05-19
[标]申请(专利权)人(译)	ENTTEX		
申请(专利权)人(译)	ENTTEX PTY LTD		
当前申请(专利权)人(译)	ENTTEX PTY LTD		
[标]发明人	FRANZ BURKHARD STEPHENS RICHARD MICHAEL PETERS CHRISTOPHER LESLIE		
发明人	FRANZ, BURKHARD STEPHENS, RICHARD, MICHAEL PETERS, CHRISTOPHER, LESLIE		
IPC分类号	A61F11/00 A61H23/00 A61B5/00 A61M1/00 A61M39/22 F16K15/02 F16K15/18		
CPC分类号	A61F11/00 A61M39/22 F16K15/021 F16K15/18		
代理机构(译)	亲爱的LAMBERT，PETER RICHARD		
优先权	2003902425 2003-05-19 AU		
其他公开文献	EP1624839B1 EP1624839A1		
外部链接	Espacenet		

摘要(译)

一种用于在人的耳道中产生压力变化的手持式装置（10）。 它具有内部空间，该内部空间形成气室（50），柱塞（58）和与上述柱塞（58）摩擦接合的阀装置（52），带有听筒（48）的管（14）和手指- 气室（50）的外壁上的驱动隔膜（60）。 隔膜（60）使柱塞（58）从静止位置沿第一方向运动。 弹簧（56）使膜片（60）回到其未压下位置。 柱塞（58）从所述静止位置在所述第一方向上的初始运动将阀（52）从第一位置移位到第二位置，在第二位置处阀装置（52）停止沿所述第一方向的进一步运动。 柱塞（58）在所述第一方向上的进一步运动导致柱塞（58）相对于阀（52）滑动。 装置（10）用于治疗梅尼尔氏病和其他原因引起的耳痛。 A1

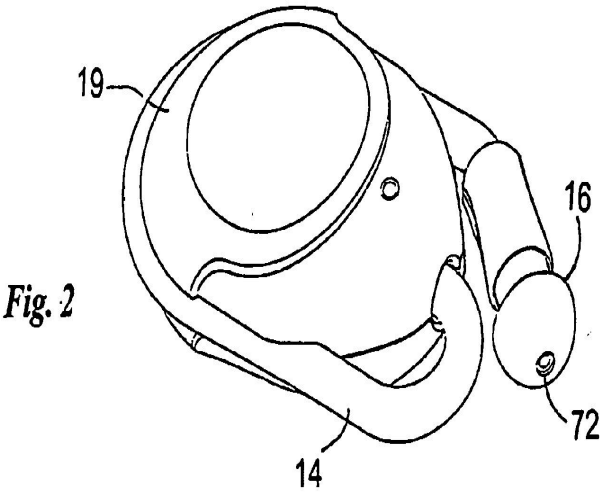

Fig. 2