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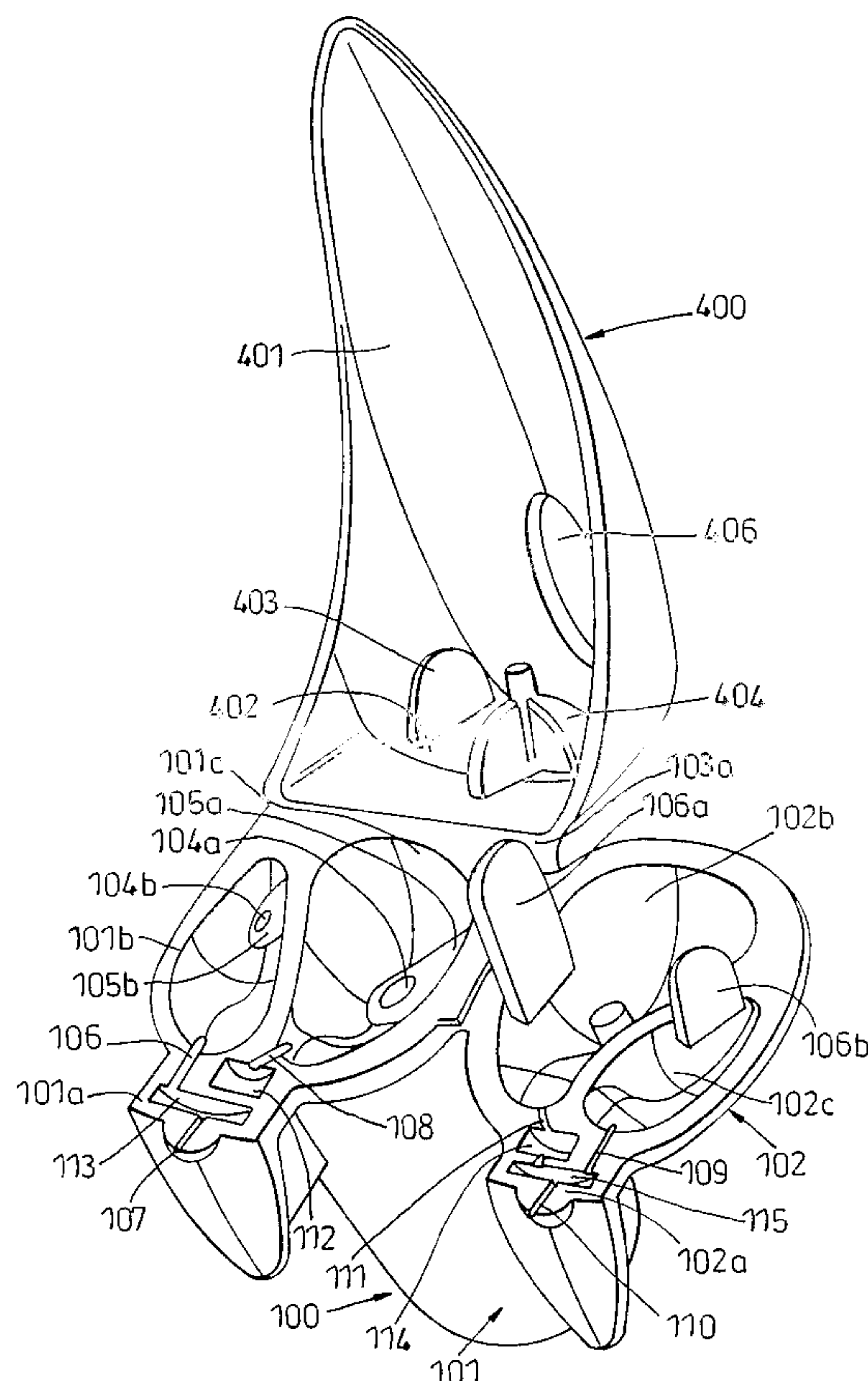
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(57) **Abrégé/Abstract:**

This invention relates to pump-action nozzle devices and methods of making the same. The dispenser nozzles of the invention comprises a body which defines two or more internal chambers, both having outlets and at least one of which has an inlet (104a, 104b) through which fluid may be drawn into said chamber. The inlet comprises an inlet valve and the outlet comprises an outlet

(57) **Abrégé(suite)/Abstract(continued):**

valve. Fluid is dispensed from the dispenser nozzles by applying pressure to an actuator member (400) which in turn engages a resiliently deformable/displacable portion of the body of the device that defines the chamber, thereby compressing the chamber and actuating the dispensing of fluid. The additional chamber(s) may contain further liquids or gaseous substance (e.g. air). In preferred embodiments, the actuator is an over cap or a trigger actuator.

ABSTRACT

This invention relates to pump-action nozzle devices and methods of making the same. The dispenser nozzles of the invention comprises a body which defines two or more internal chambers, both having outlets and at least one of which has an inlet through which fluid may be drawn into said chamber. The inlet comprises an inlet valve and the outlet comprises an outlet valve. Fluid is dispensed from the dispenser nozzles by applying pressure to an actuator member which in turn engages a resiliently deformable/displacable portion of the body of the device that defines the chamber, thereby compressing the chamber and actuating the dispensing of fluid. The additional chamber(s) may contain further liquids or gaseous substance (*e.g.* air). In preferred embodiments, the actuator is an over cap or a trigger actuator.

Improvements in or relating to nozzle devices

This invention relates to improvements in or relating to nozzle devices and, more particularly but not exclusively, to improvements in or relating to pump-action nozzle devices and methods of making such devices.

5 Pump-action nozzle devices are commonly used to provide a means by which fluids can be dispensed from a non-pressurised container.

However, conventional pump-action nozzle devices tend to be extremely complex in design and typically comprise numerous component parts (usually between 10 and 14 individual components). As a consequence, these devices
10 can be costly to manufacture due to the amount of material required to form the individual components and the assembly processes involved.

Therefore, there is a desire for a pump-action nozzle device, which is:

- (i) simple in design;
- (ii) utilises less components; and
- 15 (iii) easy to actuate.

The present invention provides a solution to at least some of the problems associated with conventional pump-action nozzle devices by providing, in a first aspect, a pump-action nozzle device adapted to enable fluid stored in a fluid source to be dispensed through said nozzle during use, said
20 nozzle having a body which defines a first chamber having an inlet through which fluid may be drawn into said chamber and an outlet through which fluid present in the chamber may be expelled from the nozzle, said inlet comprising an inlet valve adapted to only permit fluid to flow into the chamber through the inlet when the pressure within the chamber falls below the pressure within the
25 fluid source by at least a minimum threshold amount and said outlet comprising an outlet valve configured to only permit fluid to flow out of the chamber and be expelled from the nozzle when the pressure therein exceeds the external

pressure at the outlet by at least a minimum threshold amount, and a second chamber which comprises at least an outlet and an outlet valve, wherein at least a portion of the body which defines said first and second chambers is configured to:

5 (i) resiliently deform from an initial resiliently biased configuration to a distended or deformed configuration in response to the application of a pressure, whereby the volume of said chamber defined by said portion of the body is reduced as said portion of the body is deformed from said initial configuration to said distended or deformed configuration, said reduction in
10 volume causing the pressure within the chamber to increase and fluid to be ejected through the outlet; and

(ii) subsequently return to its initial resiliently biased configuration when the applied pressure is removed, thereby causing the volume of the chambers to increase and the pressure therein to fall such that further fluid is at
15 least drawn into the first chamber through the inlet valve;

characterised in that said nozzle device further comprises an actuator member which extends over at least a portion of said portion of the body and which is configured such that the application of a pressure to said actuator causes the actuator member to engage said portion of the body and cause it to
20 deform from its initial resiliently biased configuration to compress said first and second chambers.

The nozzle device of the present invention address many of the drawback of known pump-action spray nozzle devices by providing a device which is extremely simple in design and which will typically comprise no more
25 than six separate component parts that are fitted together to form the assembled nozzle device. In preferred embodiments the device will comprise no more than three component parts or, more preferably, two separate component parts or, even more preferably, the device is formed from a single, integrally formed

component. By "separate component parts" we mean that the parts are not linked in any way, i.e. they are not integrally formed with one another (but each separate component part may comprise one or more integral parts or portions). The key to reducing the number of components lies in the formation of the
5 necessary features integrally within the body of the device. For instance, the chamber, inlet, inlet valve, outlet, and outlet valve can all be defined by the body, thereby reducing the need to include separate components with all the consequential increases in component and assembly costs.

The nozzle device of the present invention is further adapted to solve the
10 problems associated with pump-action nozzle devices of simpler construction disclosed in EP 0 442 858 A2 and US 3,820,689 and EP 0 649 684 by the provision of an actuator member. The actuator member provides a convenient means by which the dispensing of fluid from the first and second chambers can be actuated.

15 Furthermore, the nozzle devices of the present invention additionally provide a means by which two fluids may be dispensed from the nozzle device simultaneously. The nozzle device may comprise a third and a fourth additional chamber for certain applications. Each chamber may comprise a liquid, or one or more of the additional chamber may comprise air or another
20 gaseous fluid.

The actuator member may be an arm that an operator pushes to cause the said portion of the body to deform.

In certain preferred embodiments of the invention, however, the actuator member is a cap that extends over the resiliently deformable portion of the body
25 to form a surface which can be depressed by an operator in order to cause the said portion of the body to deform and thereby actuate the dispensing of fluid from the chamber of the device. Preferably the surface formed by the cap is a continuous surface. Preferably the actuator surface is disposed on the upper surface of the device.

The actuator member may be configured to flex or otherwise deform when a pressure is applied to its external surface so as to enable the resiliently deformable portion of the body defining the chamber to be deformed from its resiliently biased configuration. Preferably, however, the actuator member is
5 rigid or substantially rigid.

In certain preferred embodiments of the invention, the actuator member is configured so that it can slide relative to the body of the nozzle device when a pressure is applied, thereby enabling the resiliently deformable portion of the body to be selectively engaged and displaced from its resiliently biased position
10 in response to the application of a pressure to the actuator. In other preferred embodiments of the invention, the handle is pivotally mounted to the body of the device.

In further preferred embodiments of the invention the actuator member is a trigger actuator. Preferably, the trigger actuator comprises a trigger handle
15 that can be pulled by an operator and an engagement portion configured to engage said portion of the body and cause it to deform from its resiliently biased position when said trigger handle is pulled. The trigger actuator is adapted so that when an operator pulls the trigger, a portion of the engagement portion engages the resiliently deformable portion of the body and causes it to
20 resiliently deform, thereby compressing the chamber and causing fluid present in the chamber to be expelled through the outlet of the device.

It is preferable that the handle of the trigger actuator extends below the outlet in a similar manner to conventional trigger nozzle devices, i.e. enabling an operator to grip the nozzle device, point the outlet in the desired direction
25 and dispense fluid by pulling the trigger actuator towards the base of the nozzle device.

Preferably, the trigger actuator is pivotally mounted to the body of the nozzle device such that pulling the trigger handle causes the engagement portion to pivot and apply pressure to the resiliently deformable portion of the

body of the nozzle device. When the trigger handle is released, the resilience of the resiliently deformable portion of the body of the nozzle device urges the trigger back to its initial “non-pulled” configuration.

The pivotal connection may be formed at any suitable position. For example, the pivot may be provided at an edge of the upper surface (e.g. a front or back edge), or more preferably, the pivotal connection may be on the upper surface at a position, which is displaced from an edge of the device, for example, at or near to the middle of the upper surface of the device. This latter positioning of the pivotal connection has been found to provide a more natural or “familiar” feel to an operator when the trigger is pulled.

The trigger actuator may also be partially or totally over moulded with a flexible plastic to provide a softer contact surface and thus, increase the comfort for the operator when it is grasped. Over-moulding with a flexible plastic can also be applied to the back hinge to strengthen it if desired.

To provide the necessary resilience to the resiliently deformable portion of the chamber, it may be thickened and/or include strengthening ribs that extend across the resiliently deformable body portion.

The actuator member may be a separate component, which can be connected to the nozzle device.

Preferably, however, the actuator is integrally formed with the body. Most preferably, the actuator is linked to the body by a foldable connection element and is configured to pivot about the connection element to enable the said portion of the body to be deformed.

Second chamber

The second chamber may also comprise an inlet through which a fluid from a second fluid source, e.g. a separate compartment of the container to which the device is attached, can be drawn in. In such cases, the second chamber preferably comprises an inlet equipped with an inlet valve.

Alternatively, the second chamber may not comprise an inlet at all. Instead a reservoir of the second fluid may be stored within the second chamber which is either dispensed in one single actuation or, more preferably, the outlet of the second chamber may be configured to only permit a predetermined amount of the second fluid to be dispensed with each actuation.

As a further alternative, the additional fluid contained in the second chamber may be a gas or a mixture of gasses such as air. In the latter case it is particularly desirable to co-eject air in certain application because the mixture of an air stream with another fluid can be exploited to either break up the spray droplets dispensed from the device in the case of spray nozzle device, or modify the properties of the ejected product, e.g. by causing foaming, in the case of more viscous fluids, such as hair mousses, creams, shaving foams etc.

In embodiments where the second chamber or a further an additional chamber for the expulsion of air is present, it shall be appreciated that, once the expulsion of air is complete and the applied pressure is removed thereby allowing the resiliently deformable portion of the chamber to deform back to its initial resiliently biased configuration, more air needs to be drawn into the chamber to replenish that expelled. This can be achieved by either sucking air back in through the outlet (i.e. by making the outlet valve a two way valve) or, more preferably, by drawing air in from the external environment through a separate air inlet. In the latter case, the air inlet is preferably provided with a one-way valve similar to the inlet valve discussed above. This valve will only permit air to be drawn into the chamber and will prevent air being expelled back through the hole when the chamber is compressed.

In most cases, it is desirable to co-eject the second fluid from the second chamber at substantially the same pressure as the air ejected from the first chamber. If the second fluid is air then this will typically require the air chamber to be compressed more (e.g. 5 to 200 times more – depending on the

application concerned) than the fluid/liquid-containing chamber. This may be achieved by positioning the chambers so that, when a pressure is applied, the compression of the air-containing chamber occurs preferentially, thereby enabling the air and liquid to be ejected at the same or substantially the same
5 pressure. For example, the air-containing chamber may be positioned behind the liquid-containing chamber so that, when a pressure is applied, the air chamber is compressed first until a stage is reached when both chambers are compressed together.

As an alternative, the nozzle device may also be adapted in such a way
10 that the pressure with which fluid is released from the second chamber is higher or lower than the liquid pressure, which may be beneficial for certain applications.

When two or more separate compartments are present in the nozzle device, it is problematical getting the outlet valve of each chamber to open at
15 the same time. For this reason, it may be preferable that the arrangement is configured so as to enable the application of a pressure to the resiliently deformable portion of the body to facilitate the distortion/opening of the outlet valves at a predetermined point or time.

Preferably, the air chamber is disposed between the actuator member and
20 the body of the device such that pressing or pulling (in the case of trigger actuators) the actuator towards the body causes the air chamber to be compressed.

In alternative embodiments, air and fluid from the container may be present in a single chamber, rather than separate chambers. In such cases, fluid
25 and air is co-ejected and may be mixed as it flows through the outlet. For example, where the outlet comprises an expansion chamber, i.e. a widened chamber positioned in the outlet passageway, the contents ejected from the

chamber could be split into separate branches of the channel and enter the expansion chamber at different locations to encourage mixing.

Whether the additional chamber or chambers contain air or some other fluid drawn from a separate compartment within the container, the contents of
5 the two or more chambers can be ejected simultaneously through the same or separate outlets by simultaneously compressing both chambers together.

Thus, in certain embodiments, the outlets of said first and second chambers each comprise an outlet passageway that extends from the each respective chamber to separate outlet orifices. In alternative embodiments of
10 the invention, the outlets of said first and second chambers comprise an outlet passageway that extends from the each respective chamber to a single outlet orifice, the passageways merging such that fluid dispensed from each chamber during use mixes within the outlet passageway prior to being dispensed through said outlet orifice.

15 It shall be appreciated that varying the relative volumes of the separate chambers and/or the dimensions of the outlet can be used to influence the relative proportions of constituents present in the final mixture expelled through the outlet. Furthermore, the outlet passageway may be divided into two or more separate channels, each channel extending from a separate
20 chamber, and each separate channel may feed fluid into a spray nozzle passageway as discussed above where it is mixed prior to ejection.

The chambers may be arranged side by side or one chamber may be on top of another. In a preferred embodiment where one of the additional chambers contains air, the additional air chamber is positioned relative to the
25 chamber of the nozzle device so that the compression of the air chamber causes the resiliently deformable portion of the body to deform and compress the chamber of the nozzle device.

The device may further comprise a third and/or a fourth chamber. For instance, two chambers may dispense liquid and a third chamber may dispense air, or all chambers may dispense liquids.

Formation of a spray

5 In certain embodiments of the invention the outlet of the nozzle device may be adapted to generate a spray of the fluid ejected from the chamber of the nozzle device. The outlet of the nozzle device may be adapted to perform this function by any suitable means known in the art. For instance, the outlet orifice of the outlet may be a fine hole configured such that fluid flowing through it
10 under pressure is caused to break up into numerous droplets. In such embodiments, however, it is preferable that the outlet comprises an outlet orifice and an outlet passageway that connects the chamber to the outlet orifice. The outlet valve is preferably disposed within the outlet passageway. It is especially preferred that the outlet passageway comprises one or more internal
15 spray-modifying features that are adapted to reduce the size of liquid droplets dispensed through the outlet orifice of the nozzle device during use. Examples of internal spray modifying features that may be present in the outlet passageway include one or more expansion chambers, one or more swirl chambers, one or more internal spray orifices (adapted to generate a spray of
20 fluid flowing through within the outlet passageway), and one or more venturi chambers. The inclusion of one or more of the aforementioned features is known to affect the size of the spray droplets produced during use of the device. It is believed that these features, either alone or in combination, contribute to the atomisation of the droplets generated. These spray-modifying
25 features, and the effect that they impart on the properties of the spray produced, are known in the art and are described in, for example, International Patent Publication Number WO 01/89958, the entire contents of which are incorporated herein by reference. It shall be appreciated that the provision of

the outlet valve upstream from the outlet passageway and the outlet orifice ensures that the fluid enters the outlet passageway with sufficient force for the liquid to be broken up into droplets and form a spray.

5 In certain embodiments of the invention, the outlet passageway and outlet orifice may be in the form of a separate unit or insert, which can be connected to the outlet of the chamber to form the outlet of the nozzle device. The unit or insert may also be connected to the body of the device by a hinge so as to enable it to be optionally swung into the required position for use and swing out of position when it is not required.

10 In embodiments comprising an air chamber it is preferable that air mixes with liquid dispensed from the other chamber within a spray-modifying feature. Usually the spray-modifying feature will be a an expansion chamber or a swirl chamber.

15 In alternative embodiments of the invention, the liquid present in the chamber may be dispensed as a stream of liquid which is not broken up into droplets. Examples of such liquids dispensed in this form include soaps, shampoos, creams and the like.

Alternatively, the fluid dispensed may be a gas or mixture of gasses, such as air, for example.

20 Internal chambers

The chambers of the nozzle device may be of any form and it shall of course be appreciated that the dimensions and shape of the chambers will be selected to suit the particular device and application concerned. Similarly, all the fluid in the chambers may be expelled when the chambers are compressed
25 or, alternatively, only a proportion of the fluid present in the chambers may be dispensed, again depending on the application concerned.

In certain preferred embodiments of the invention, the chambers will be defined by generally dome-shaped regions of the body, which are resiliently

deformable. Preferably, the dome-shaped regions are formed on the upper surface of the body so that it is accessible for an operator to apply a pressure to cause these regions to resiliently deform.

One problem with dome-shaped chambers can be that a certain amount
5 of dead space exists within the chamber when an operator compresses it, and for some applications it will be preferable that the dead space is minimised or virtually negligible. To achieve this property, it has been found that flattened domes or other shaped chambers whereby the resiliently deformable portion of chamber can be depressed such that it contacts an opposing wall that defines
10 the chamber and thereby expels all of the contents present therein are generally preferred. For this reason, a flattened dome is especially preferred because it reduces the extent with which the dome needs to be pressed inwards in order to compress the chamber and actuate the dispensing of fluid stored therein. It also reduces the number of presses required to prime the chamber ready for the first
15 use.

In some cases, the resiliently deformable portion of the body defining said chamber may not be sufficiently resilient to retain its original resiliently biased configuration following deformation. This may be the case where the fluid has a high viscosity and hence tends to resist being drawn into the
20 chamber through the inlet. In such cases, extra resilience can be provided by the positioning of one or more resiliently deformable posts within the chamber, which bend when the chamber is compressed and urge the deformed portion of the body back to its original resiliently biased configuration when the applied pressure is removed. Alternatively, one or more thickened ribs of plastic could
25 extend from the edge of the resiliently deformable area towards the middle of this portion. These ribs will increase the resilience of the resiliently deformable area by effectively functioning as a leaf spring, which compresses when a pressure is applied to the resiliently deformable portion of the body, and urges

this portion back to its initial resiliently biased configuration when the applied pressure is removed.

Yet another alternative is that a spring or another form of resilient means is disposed in the chamber. As above, the spring will compress when the wall is deformed and, when the applied pressure is removed, will urge the deformed portion of the body to return to its original resiliently biased configuration and, in doing so, urges the compressed chamber back into its original "non-compressed configuration".

The body of the nozzle device

10 The chambers defined by the body may be defined between two or more interconnected parts of the body. It is especially preferred that the chambers of the nozzle device is defined between two interconnected parts, which may be separately formed component parts that fit together to define the chamber or, more preferably, the two parts will be integrally formed with one another as a
15 single component. In the latter case, it is preferred that the two parts are connected together by hinge or foldable connection element which enables the two parts to be moulded together in the same mould and then brought into contact with one another to define the chambers.

In preferred embodiments of the invention in which the outlet comprises
20 the outlet valve, an outlet orifice and an outlet passageway that connects the chambers to the outlet orifice, it is also preferred that the at least two interconnected parts that define the chambers also define at least a portion of the outlet passageway. Most preferably, the two interconnected parts form the outlet valve between them and also define the entire outlet passageway and the
25 outlet orifice.

The outlet passageway is preferably defined between an abutment surface of one of said parts and an opposing abutment surface of another of said parts. One or more of the abutment surfaces preferably comprises one or more

grooves and/or recesses formed thereon which define the outlet passageway when the abutment surfaces are contacted together. Most preferably, each of said abutment surfaces comprises a groove and/or recesses formed thereon which align to define the outlet passageway when the abutment surfaces are
5 contacted together. The grooves and/or recesses preferably extend from the chamber to an opposing edge of the abutment surfaces where, when the abutment surfaces are contacted together, an outlet orifice is defined at the end of the outlet passageway. In preferred embodiments where one or more spray modifying features are present in the outlet passageway, the features may be
10 formed by aligning recesses or other formation formed on the abutment surfaces, as illustrated and described in International Patent Publication Number WO 01/89958.

The two parts of the body may be permanently fixed together by, for example, ultrasonically welding or heat welding. If the base and upper part are
15 to be moulded or welded together, then it is preferable that they are made from compatible materials.

Alternatively, the two parts may be configured to fit tightly/resistively to one another to form the nozzle (e.g. by the provision of a snap-fit connection) in the absence of any welding. For instance, the edges of one part may be
20 configured to fit into a retaining groove of the other part to form the nozzle device.

As a further alternative, a compatible plastic material may be moulded over the join of the two parts to secure them together. This can be achieved by moulding the two components simultaneously in a tool, joining them together in
25 the tool to form the nozzle device and then moulding a suitable plastic material around them to hold the two parts together.

In certain embodiments, the two parts may remain releasably attached to one another so that they can be separated during use to enable the chamber and/or the outlet to be cleaned.

It is most preferred that the two parts of the body of the nozzle device that define the chambers are a base part and an upper part. The base part is preferably adapted to be fitted to the opening of a container by a suitable means, such as, for example, a screw thread or snap fit connection. Furthermore, in addition to forming a portion of the body that defines the chamber, the base part also preferably defines the inlet as well as a portion of the outlet passageway leading from the chambers to the outlet orifice in preferred embodiments.

The upper part is adapted to be fitted to the base so that between them they define the chambers and, in preferred embodiments, the outlet valve, outlet passageway and/or outlet orifice. In certain preferred embodiments of the invention, the base and upper part also define the outlet orifice. It is also preferred that the upper part forms the resiliently deformable portion of the body defining the chambers.

It is preferred that the upper part comprises the first portion of the body and the base comprises the second portion of the body defined above.

20 Material

The body of the nozzle arrangement may be made from any suitable material.

In certain embodiments of the invention where the body comprises two interconnected parts which fit together to define the chambers, the two parts may be made from either the same or different materials. For instance, one of the parts may be made from a flexible/resiliently deformable material, such as a resiliently deformable plastic or rubber material, and the other of said parts may

be made from a rigid material, such as a rigid plastic. Such embodiments are preferred for some applications because the flexible/resiliently deformable material forms the second portion of the body defining the chambers and can readily be deformed by an operator pressing the actuator surface to actuate the
5 ejection of fluid present in the chambers. The flexible material can also provide a soft touch feel for the operator. Such embodiments can be made by either moulding the two parts separately and then connecting them together to form the assembled nozzle arrangement, or moulding the two parts in the same tool using a bi-injection moulding process. In the latter case, the two parts
10 could be moulded simultaneously and then fitted together within the moulding tool or, alternatively, one part could be moulded first from a first material and the second part made from a second material could be moulded directly onto the first part.

Alternatively, the two parts may both be made from either a rigid or a
15 flexible material. The rigid and flexible material may be any suitable material from which the nozzle device may be formed. For instance, it may be formed from metallic material such as aluminium foil or a flexible material such as rubber. Preferably, however, the body of the device is formed entirely from a rigid plastic material, although a flexible plastic material could be used
20 provided the first portion of the body is if desired.

It is preferable that the first portion of the body is formed from a rigid plastic material. Most preferably, the entire pump-action nozzle device (i.e. the body and the actuator) is formed from a single rigid plastic material.

The expression "rigid plastic material" is used herein to refer to a plastic
25 material that possesses a high degree of rigidity and strength once moulded into the desired form, but which can also be rendered more flexible or resiliently deformable in portions by reducing the thickness of the plastic. Thus, a thinned

section of plastic can be provided to form the at least a portion of the body that defines the chamber and which is configured to resiliently deform.

The term “flexible plastic” is used herein to denote plastics materials which are inherently flexible/resiliently deformable so as to enable the resilient displacement of at least a portion of the body to facilitate the compression of the chamber. The extent of the flexibility of the plastic may be dependent on the thickness of the plastic in any given area or region. Such “flexible plastic” materials are used, for example, in the preparation of shampoo bottles or shower gel containers. In the fabrication of a nozzle device of the present invention, portions of the body may be formed from thicker sections of plastic to provide the required rigidity to the structure, whereas other portions may be composed of thinner sections of plastic to provide the necessary deformability characteristics. If necessary, a framework of thicker sections, generally known as support ribs, may be present if extra rigidity is required in certain areas.

The advantage of using a single material for the formation of the nozzle device is that the entire nozzle device can be moulded in a single moulding tool in a single moulding operation, as discussed further below.

The formation of the nozzle device from a single material, particularly in preferred embodiments where the two parts are integrally formed and connected to one another by a foldable connection element or a hinged joint so that the upper part can be swung into contact with the base part to form the assembled nozzle device, avoids the requirement for the assembly of multiple, separate component parts. Furthermore, forming the nozzle device from a single material provides the possibility of welding the two parts together (e.g. by heat or ultrasonic welding) or, if the plastic material is a rigid plastic material, then a snap-fit connection can be formed between the upper part and the base. The latter option also enables the upper part and base to be disconnected periodically for cleaning.

For most applications the nozzle device would need to be made from a rigid material to provide the necessary strength for the actuator surface and enable the two-parts to be either snap fitted or welded together. In such cases, the deformable portion of the body tends to deform only when a certain
5 minimum threshold pressure is applied and this makes the pump action more like the on/off action associated conventional pump-action nozzle devices. However, in certain applications, a flexible material may be preferred.

The second portion of the body configured to resiliently deform could be a relatively thin section of a rigid plastic material which elastically deforms to
10 compress the chamber when a pressure is applied and then subsequently returns to its initial resiliently biased configuration when the applied pressure is removed.

In most cases, however, it is preferable that the abutment surfaces that define the outlet passageway of the outlet are formed from a rigid plastic
15 material. Although flexible/resiliently deformable materials could be used for this purpose they are generally less preferred because any spray-modifying features present will typically need to be precisely formed from a rigid material. Thus, in some embodiments of the invention, one of the two parts that defines the outlet and the chamber may be formed from two materials, namely a rigid
20 material that forms the abutment surface that defines the outlet passageway and the outlet orifice, and a resiliently deformable material that defines the chamber.

Outlet Valve

In order to function optimally, it is necessary that the outlet of the first
25 chamber at least is provided with, or is adapted to function as, a one-way valve. Preferably, both chambers comprise a one way outlet valve, but in some instances the outlet valve for the second chamber may be a two way valve (e.g.

if the second chamber is an air chamber - to permit air to be drawn into the second chamber), as discussed above.

The provision of one way valves enables fluid stored in each chamber to be dispensed through the outlet only when a predetermined minimum threshold pressure is achieved within the chamber (as a consequence of the reduction in the volume of the internal chambers caused by the displacement of the resiliently deformable portion of the body from its initial resiliently biased configuration), and close the outlets at all other times. The closure of the valve when the pressure in the chambers is below a predetermined minimum threshold pressure prevents air being sucked back through the outlet into the chamber when the applied pressure to the resiliently deformable portion of the body is released and the volume of the chamber increases as the resiliently deformable wall re-assumes its initial resiliently biased configuration.

Any suitable one-way valve assembly that is capable of forming an airtight seal may be used. However, it is preferable that the valves are formed by the component parts of the body of the nozzle device. Most preferably, the valves are formed between the abutment surfaces that define outlet passageway.

In certain embodiments of the invention, the outlet valves are formed by one of the abutment surfaces defining the outlet passageway being resiliently biased against the opposing abutment surface to close off a portion of the length of the outlet passageway. In this regard, the valves will only open to permit fluid to be dispensed from the chambers when the pressure within each chamber is sufficient to cause the resiliently biased abutment surface to deform away from the opposing abutment surface and thereby form an open channel through which fluid from each chamber can flow. Once the pressure falls below a predetermined minimum threshold value, the resiliently biased surface will return to its resiliently biased configuration and close off the passageway.

In certain embodiments of the invention, it is especially preferred that the resiliently biased abutment surface is integrally formed with the resiliently deformable portion of the body, which defines the chamber.

In embodiments where the body is made entirely from a rigid plastic material, the resistance provided by the resiliently biased surface (which may be a thin section of rigid plastic) may not be sufficiently resilient to achieve the required minimum pressure threshold for the optimal functioning of the device. In such cases, a thickened rib of plastic, which extends across the passageway, may be formed to provide the necessary strength and resistance in the outlet passageway/valves. Alternatively, a rigid reinforcing rib could be provided above part of the outlet passageway/valves.

In an alternative preferred embodiment, one or more of the outlet valves may be formed by a resiliently deformable member formed on one of said abutment surfaces which extends across the outlet passageway to close off and seal the passageway. The member is mounted to the device along one of its edges and has another of its edges (preferably the opposing edge) free, the free end being configured to displace when the pressure within the chamber(s) exceeds a predetermined minimum threshold value. The free end abuts a surface of the outlet channel to form a seal therewith when the pressure is below the predetermined minimum threshold value. However, when the pressure exceeds the predetermined minimum threshold value, the free end of the member is displaced from the abutment surface of the channel to form an opening through which the fluid present in the chamber(s) can flow to the outlet. Preferably, the resiliently deformable member is positioned within a chamber formed along the length of the outlet channel or passageway. Most preferably, the abutment surface, which forms the seal with the free end of the member at pressures below the minimum threshold, is tapered or sloped at the point of contact with the free end of the member. This provides a point seal contact and provides a much more efficient seal. It will of course be

appreciated that the slope or taper of the abutment surface must be arranged so that the free end of the resiliently deformable member contacts the slope when the pressure within the chamber is below the predetermined minimum threshold, but distends away from it when the predetermined minimum
5 threshold is exceeded.

Alternatively, the valve may be a post or plug formed on the abutment surface of one of the base or upper parts and which contacts the opposing abutment surface to close off and seal the passageway. The post or plug will be mounted to a deformable area of the base or upper part so that when the
10 pressure within the chamber(s) exceeds a predetermined threshold value, the post or plug can be deformed to define an opening through which fluid can flow through the outlet.

The predetermined minimum pressure that must be achieved within the chamber(s) in order to open the outlet valve will depend on the application
15 concerned. A person skilled in the art will appreciate how to modify the properties of the resiliently deformable surface by, for example, the selection of an appropriate resiliently deformable material or varying the manner in which the surface is fabricated (e.g. by the inclusion of strengthening ridges).

Inlet valve

20 To ensure that fluid is only ejected through the outlet when the chamber is compressed by displacing the resiliently deformable portion of the body into the chamber from its initial resiliently biased configuration, it is necessary to provide a one-way inlet valve disposed at or in the inlet of the nozzle device.

Any suitable inlet valve may be used.

25 The inlet valve may be adapted to only open and permit fluid to flow into the chamber when the pressure within the chamber falls below a predetermined minimum threshold pressure (as is the case when the pressure applied to the resiliently deformable portion of the chamber to compress the

chamber is released and the volume of the chamber increases as the resiliently deformable portion reassumes it's initial resiliently biased configuration). In such cases, the inlet valve may be a flap valve which consists of a resiliently deformable flap positioned over the inlet opening. The flap is preferably
5 resiliently biased against the inlet opening and adapted to deform so as to allow fluid to be drawn into the chamber through the inlet when the pressure within the chamber falls below a predetermined minimum threshold pressure. At all other times, however, the inlet will be closed, thereby preventing fluid flowing back from the chamber into the inlet. It is especially preferred that the
10 resiliently deformable flap is formed as an integral extension of the resiliently deformable portion of the body which defines the chamber. It is also especially preferred that the base defines the inlet and the resiliently deformable portion of the body is formed by the upper part. It is therefore the preferred that the upper part comprises the resiliently deformable flap that extends within said chamber
15 to cover the inlet opening to the chamber and form the inlet valve.

Alternatively, the flap may not be resiliently biased against the inlet opening and may instead be disposed over the inlet opening and configured such that it is pressed against the inlet only when the chamber is compressed and the pressure therein increases.

20 Problems can arise, however, with the simple provision of a flap valve that is resiliently biased over the inlet opening. Specifically, over time the elastic limit of the material from which the flap is formed may be exceeded, which may cause it to not function properly. This problem applies particularly to embodiments of the invention in which the flap is formed from a thin section
25 of a rigid material, although it also applies to a lesser extent to flexible materials and can occur due to deformation of the flap when the chamber is compressed, as well as when the flap deforms to open the valve. As a consequence, fluid could leak from the chamber back into the container through the inlet.

For these reasons it is preferable that flap valve comprises a number of adaptations. In particular, it is preferred that the inlet has a raised lip extending around the inlet orifice that the resiliently deformable flap abuts to create a tight seal around the inlet. The provision of a lip ensures a good contact is obtained
5 with the flap. In embodiments where the lip is very small it may be necessary to provide one or more additional support ribs at either side of the inlet opening to ensure that a proper seal is formed and to also prevent the lip from damage.

A further preferred feature is that the flap possesses a protrusion or plug formed on its surface. The protrusion or plug extends a short way into the inlet
10 opening and abuts the side edges to further enhance the seal formed.

It is also preferred that the inlet opening to the chamber is disposed at an elevated position within the chamber so that fluid flows into the chamber through the inlet and drops down into a holding or reservoir area. This prevents fluid resting on the top of the inlet valve over prolonged periods by effectively
15 distancing the inlet opening from the main fluid holding/reservoir area of the chamber and thereby reduces the likelihood of any leaks occurring over time.

It is also preferred that a second reinforcing flap or member contacts the opposing surface of the resiliently deformable flap to urge it into tight abutment with the inlet opening. It is also preferred that the second reinforcing flap
20 contact the opposing surface of the resiliently deformable flap at or close to the portion of the opposing surface that covers the inlet orifice to maximise the vertical pressure of the main flap over the hole. Again this helps to maintain the integrity of the seal.

Lock

25 The nozzle device may also be provided with a locking means to prevent the fluid being dispensed accidentally.

In such embodiments the lock will be integral part of the body and will not be a separate component connected to the body. For instance, the locking

means may be hinged bar or member that is integrally connected to a part of the body (e.g. either the base or upper part) and which can be swung into a position whereby the bar or member prevents the outlet valves from opening.

5 The locking means may also comprise a rigid cover that can be placed over the resiliently deformable portion of the body (i.e. between the actuator member and the resiliently deformable portion) to prevent it being compressed. The cover may be connected to the nozzle device by a hinge to enable it to be folded over when required.

10 In embodiments where the actuator member is a slidably mounted over cap that can be slid downwards to compress the chamber during use, the locking means may the provision of locking detents which engage to prevent the actuator member sliding when the over cap is twisted, thereby preventing the accidental actuation of the device.

15 Alternatively, the locking means may be one or more locking tabs which can be selectively positioned between the body of the device and the actuator member to prevent the actuator being depressed or, in the case of trigger actuators, pulled. The tabs must be removed from engagement with the trigger and/or body of the device to enable the device to be used. For example, the tabs may need to be pressed inward to release the locking tabs. To make the
20 lock childproof, it could also be modified so that it is necessary to initially push the trigger away from the device in order to release the lock.

Air Release/leak Valve

The device may further comprise an air leak through which air can flow to equalise any pressure differential between the interior of the container and
25 the external environment. In some cases, the air leak may simply occur through gaps in the fitting between the dispenser nozzle and the container, but this is not preferred because leakage may occur if the container is inverted or shaken. In preferred embodiments, the dispenser nozzle further comprises an air leak

valve, i.e. a one-way valve that is adapted to permit air to flow into the container, but prevents any fluid leaking out of the container if it is inverted. Any suitable one-way valve system would suffice. It is preferred, however, that the air leak valve is integrally formed within the body of the dispenser or, more preferably, between two component parts of the body of the dispenser.

Most preferably, the air leak valve is formed between the upper part and base which define the chamber of the dispenser nozzle.

Preferably, the air leak valve comprises a valve member disposed within a channel that is defined by the body of the device and connects the interior of the fluid supply to the external environment. Most preferably, the valve member is resiliently biased so as to contact the sides of the channel and forms a sealing engagement therewith to prevent any liquid from leaking out of the container, the valve member being further adapted to either resiliently deform or displace from the sealing engagement with the sides of the channel to define an opening through which air can flow into the container when pressure within the container falls below the external pressure by at least a minimum threshold amount. Once the pressure differential between the interior and the exterior of the container has been reduced to below the minimum threshold pressure, the valve member returns to its position in which the channel is closed.

Preferably, the valve member is in the form of a plunger that extends into the channel and comprises an outwardly extending wall that abuts the sides of the channel to form a seal. Preferably, the outwardly extending wall is additionally angled towards the interior of the container. This configuration means that a high pressure within the container and exerted on the wall of the valve member will cause the wall to remain in abutment with the sides of the channel. Thus, the integrity of the seal is maintained thereby preventing liquid from leaking out through the valve. Conversely, when pressure within the container falls below the external pressure by at least a minimum threshold

amount, the wall is deflected away from the sides of the container to permit air to flow into the container to equalise or reduce the pressure differential.

It is especially preferred that the plunger is mounted on to a deformable base or flap which is capable of some movement when the dome is pressed to
5 displace any residue that may have accumulated in the air leak valve. In addition, the provision of a moveable (e.g. resiliently deformable) element within the air leak valve is preferred because it helps to prevent the valve becoming clogged during use.

In certain embodiments of the invention it is also preferred that a
10 protective cover is provided over the opening of the female tube on the internal surface of the device to prevent liquid present in the interior of the container from contacting the valve member with a high or excessive force when the container is inverted or shaken aggressively. The cover will allow air and some fluid to flow past, but will prevent fluid impacting on the seal formed by the
15 flared end of the plunger directly, and thus will prevent the seal being exposed to excessive forces.

In an alternative embodiment, the channel of the air leak valve may be resiliently deformable instead of the male part. This arrangement can be configured so that the side walls of the channel distort to permit air to flow into
20 the container.

The valve member and channel could be made from the same material or different materials. For instance, they may both be made from a semi-flexible plastic or the female element may be made from a rigid plastic and the male part made from a resiliently deformable material.

25 With certain products stored in containers over time there is a problem associated with gas building up inside the bottle over time. To release the build up of pressure, which can inevitably occur, a release valve is required. The air leak valve described above can be modified to additionally perform this function by providing one or more fine grooves in the side of the channel.

These fine groove(s) will permit gas to slowly seep out of the container, bypassing the seal formed by the contact of the valve member with the sides of the channel, but prevent or minimise the volume of liquid that may seep out. Preferably, the groove or grooves formed in the side walls of the channel is/are
5 formed on the external side of the point of contact between the valve member and the sides of the channel so that it/they are only exposed when the pressure inside the container increases and acts on the plunger to cause it to deform outwards (relative to the container). The plunger will return to its resiliently biased position in which the grooves are not exposed once any excess gas has
10 been emitted. No liquid product should be lost during this process.

Alternatively, the gas pressure within the container could urge the valve member outwards so that it is displaced from the channel and defines an opening through which the gas could flow.

Seal

15 In preferred embodiments of the invention comprising at least two component parts, it is preferred that a seal is disposed at the join between the at least two interconnected parts to prevent any fluid leaking out of the nozzle device.

Any suitable seal would suffice. For instance, the two parts could be
20 welded to one another or one part could be configured to snap fit into a sealing engagement with the other part or have possess a flange around its perimeter that fits tightly around the upper surface of the other part to form a seal therewith.

Preferably, the seal comprises a male protrusion formed on the abutment
25 surface of one of the at least two parts that is received in a sealing engagement with a corresponding groove formed on the opposing abutment surface of the other part when the two parts are connected together.

The seal preferably extends around the entire chamber and the sides of the outlet passageway so that fluid leaking from any position within the chamber and or outlet passageway is prevented from seeping between the join between the two component parts. In certain embodiments where the outlet
5 orifice is not defined between the two component parts of the body, it is preferred that the seal extends around the entire chamber and any portion of the outlet that is defined between the two interconnected parts of the body.

In certain embodiments that comprise an outlet passageway the protrusion member may extend across the passageway and form the resiliently
10 deformable valve member of the outlet valve. This portion of the protrusion will usually be thinner to provide the necessary resilience in the valve member to permit it to perform its function.

In certain embodiments of the invention, the male protrusion may be configured to snap fit into the groove or, alternatively, the male protrusion may
15 be configured to resistively fit into the groove in a similar manner to the way in which a plug fits into the hole of a sink.

Dip Tube

In most cases, a dip tube will be integrally formed with the nozzle, or alternatively the body of the dispenser may comprise a recess into which a
20 separate dip tube can be fitted. The dip tube enables fluid to be drawn from deep inside the container during use and thus, will be present in virtually all cases.

In embodiments where the second chamber additionally comprises an inlet through which fluid is drawn from a fluid source, then two dip tubes will
25 usually be present.

Alternatively, it may be desirable with some containers, particularly small volume containers, such as glues, perfume bottles and nasal sprays, to

omit the dip tube, because the device itself could extend into the container to draw the product into the dispenser nozzle during use, or the container could be inverted to facilitate the priming of the dispenser with fluid. Alternatively, the device may further comprise a fluid compartment formed as an integral part of device from which fluid can be drawn directly into the inlet of the nozzle without the need for a dip tube.

Integral part of container

In most cases it is preferable that the nozzle device is adapted to be fitted to container by some suitable means, e.g. a snap fit or a screw thread connection. In certain cases, however, the nozzle device could be incorporated into a container as an integral part. For instance, the nozzle device could be integrally moulded with various forms of plastic container, such as rigid containers or bags. This is possible because the device can be moulded as a single material and, therefore, can be integrally moulded with containers made from the same or a similar compatible material.

According to a second aspect of the present invention, there is provided a container having a pump-action nozzle device as hereinbefore defined fitted to an opening thereof so as to enable the fluid stored in the container to be dispensed from the container through said nozzle device during use.

According to a third aspect of the present invention, there is provided a container having a pump-action nozzle device as hereinbefore defined integrally formed therewith so as to enable the fluid stored in the container to be dispensed from the container through said nozzle device during use.

According to a further aspect of the present invention, there is provided a pump-action nozzle device adapted to enable fluid stored in a fluid source to be dispensed through said nozzle during use, said nozzle having a body which defines a first chamber having an inlet through which fluid may be drawn into

said chamber and an outlet through which fluid present in the chamber may be expelled from the nozzle, said inlet comprising an inlet valve adapted to only permit fluid to flow into the chamber through the inlet when the pressure within the chamber falls below the pressure within the fluid source by at least a minimum threshold amount and said outlet comprising an outlet valve configured to only permit fluid to flow out of the chamber and be expelled from the nozzle when the pressure therein exceeds the external pressure at the outlet by at least a minimum threshold amount, and a second chamber which comprises at least an outlet and an outlet valve, wherein at least a portion of the body which defines said first and second chambers is configured to:

(i) be displaced from an initial resiliently biased configuration to a distended or deformed configuration in response to the application of a pressure, whereby the volume of said chamber defined by said portion of the body is reduced as said portion of the body is deformed from said initial configuration to said distended or deformed configuration, said reduction in volume causing the pressure within the chamber to increase and fluid to be ejected through the outlet; and

(ii) subsequently return to its initial position when the applied pressure is removed, thereby causing the volume of the chamber to increase and the pressure therein to fall such that fluid is drawn into the chamber through the inlet valve;

characterised in that said nozzle device further comprises an actuator member which extends over at least a portion of said portion of the body and which is configured such that the application of a pressure to said actuator causes the actuator member to engage said portion of the body and cause it to deform from its initial resiliently biased configuration to compress said first and second chambers.

Preferably the nozzle device is as defined above.

In addition, it is also preferable, the part of the body that can be displaced inwards to reduce the volume of the chamber and thereby cause fluid present in said chamber to be ejected through the outlet is a piston mounted within a piston channel. The piston channel may form the entire chamber or,
5 alternatively, just a portion thereof.

Preferably, the nozzle device comprises a means for displacing the piston inwards from its initial position and then subsequently returning it to its initial position. This may be achieved by any suitable means, such as, for example, a trigger or over cap connected to the piston, which can be operated to
10 displace the piston, when desired. Preferably, the trigger actuator is resiliently biased to retain said portion of the body in its initial position in the absence of any applied pressure.

Method of manufacture

The nozzle devices of the present invention may be made by any suitable
15 methodology known in the art.

As previously described, preferred embodiments of the invention comprise a body having two parts (a base and upper part) which fit together to define at least the chamber of the device and, more preferably, the chamber and at least a portion of the outlet. In addition, the device further comprises an
20 actuator member.

According to a further aspect of the present invention, there is provided a method of manufacturing a nozzle device as hereinbefore defined, said nozzle device having a body composed of at least two interconnected parts and comprising an actuator member, said method comprising the steps of:

- 25 (i) moulding said parts of the body and said actuator member;
- (ii) connecting said parts of the body together to form the body of the nozzle device; and

(iii) fitting the actuator member to the body of the nozzle device.

The first and second parts of the body and the actuator member may be separate component parts, in which case the component parts are initially formed and then assembled together to form the nozzle device. Each
5 component part may be made from the same or a different material.

Alternatively, and more preferably, the two parts of the body or one of the parts of the body and the actuator member may be integrally formed with one another and connected by a bendable/foldable connection element. In such cases, the connected parts are formed in a single moulding step and then
10 assembled together with the remaining part to form the nozzle device. For instance, the base and upper part of the preferred embodiments of the device may be integrally formed and connected to one another by a foldable/bendable connection element. Once formed, the upper part can be folded over and connected to the base to form the assembled nozzle device. The actuator
15 member may then be fitted to the body of the nozzle device as a separate component.

In especially preferred embodiments of the invention, the device is formed from a single component part, which comprises the two parts of the body and the actuator member, all integrally formed with one another and
20 connected to one another by foldable/bendable connection elements. Thus, the entire device is formed in a single moulding step from a single material. Once formed, the two parts forming the chamber of the device can be connected together and the actuator member can then be connected into a position whereby it extends across the resiliently deformable portion of the body.

25 It shall be appreciated that integrally formed component parts are preferably formed from the same material in single moulding step.

As an alternative, the nozzle device may be formed by a bi-injection moulding process whereby a first component part the body is formed together with a base or framework for the second part and the remainder of the second

part is then moulded onto the base or framework. Each part may be moulded from the same or a different material. As before, the actuator member may be a separate component part that is then fitted to the body of the nozzle device, or it may be integrally formed with one of the parts of the body.

- 5 Once the two parts of the body are connected to one another to form the assembled body of the device, the two parts may be over moulded with another plastic to hold the two parts together

 According to a further aspect of the present invention, there is provided a method of manufacturing a nozzle device as hereinbefore defined, said nozzle
10 device having a body composed of at least two interconnected parts and further comprising an actuator member, said method comprising the steps of:

- (i) moulding a first of said parts of the body in a first processing step;
- (ii) over-moulding the second of said parts onto the first of said parts
15 in a second processing step to form the body of the nozzle device;
 and
- (iii) connecting the actuator member to the body of the nozzle device.

 The at least two parts are preferably moulded within the same moulding tool in a bi-injection moulding process. Usually the first part will be the base
20 part of the nozzle device and the second part will be the upper part.

 According to a further aspect of the present invention, there is provided a method of manufacturing a nozzle device as hereinbefore defined, said nozzle device having a body composed of at least two interconnected parts and further comprising an actuator member, said method comprising the steps of:

- 25 (i) moulding a first of said parts of the body in a first processing step together with a framework or base for a second of said parts; and

(ii) over-moulding onto the framework or base to form the second of said parts of the assembled nozzle device; and

(iii) connecting the actuator member to the body of the nozzle device.

The framework for the second part may be fitted to the base prior to the
5 over-moulding step.

Alternatively, the over-moulding may take place before the framework for the second part is fitted to the first part.

The over-moulding may be the same material to that of the first part and the framework of the second part or it may be a different material.

10 It is especially preferred that the base is moulded first from a rigid plastic material together with the framework support for the upper part. The framework for the upper part is preferably connected to the base by a hinged or foldable connection member, which enables the framework to be folded over and fitted to the base during the assembly of the final product. The framework
15 is over moulded with a compatible flexible, resiliently deformable plastic material which forms the resiliently deformable portion of the body that defines the chamber. The resiliently deformable plastic material may also form resiliently deformable valve members for the outlet valve and the inlet valve. It may also extend over other parts of the nozzle surface to provide a soft-touch
20 feel to the device when an operator grips it. The rigid framework of the upper part may form an outer edge of the upper part, which forms the point of connection with the base and, in embodiments where a spray nozzle passageway is present, the framework may also form an upper abutment surface which contacts a lower abutment surface formed the base to define the spray
25 passageway and outlet orifice.

According to a further aspect of the present invention, there is provided a method of manufacturing a nozzle device as hereinbefore defined, said nozzle

device having a body composed of at least two interconnected parts and further comprising an actuator member, said method comprising the steps of:

- (i) moulding a first of said parts of the body in a first processing step together with a framework or base for a second of said parts; and
- 5 (ii) positioning an insert portion of the body such that said insert is retained within the framework of the second part of the body when said framework is connected to the first parts of the body, said framework and insert forming the second part of the body; and
- 10 (iii) connecting the actuator member to the body of the nozzle device.

According to a further aspect of the present invention, there is provided a method of manufacturing a nozzle device as hereinbefore defined, said nozzle device having a body composed of at least two interconnected parts and an actuator member, wherein said parts and said actuator member are connected to
15 one another by a connection element such that said parts are moveable relative to one another, said method comprising the steps of:

- (i) moulding the parts of the body and the actuator member together with said connection elements in a single moulding step;
- (ii) moving said parts of the body into engagement with one another
20 to form the body of the nozzle device; and
- (iii) moving the actuator member into engagement with the body to form the nozzle device.

Blowing Agent

Preferably, a blowing agent is incorporated into the mould together with
25 the plastic material. The blowing agent produces bubbles of gas within the moulded plastic that prevent the occurrence of a phenomenon known as sinkage

from occurring. The problem of sinkage and the use of blowing agents in the manufacture of blowing agents to address this problem is described further in the applicant's co-pending International Patent Publication No. WO03/049916, the entire contents of which are incorporated herein by reference.

5 How the invention may be put into practice will now be described by way of example only, in reference to the following drawings, in which:

Figure 1 is a perspective view of an embodiment of a nozzle device according to the third aspect of the invention in a disassembled configuration;

10 Figures 2A and 2B show perspective views of an alternative nozzle device according to the invention;

Figures 2C, 2D and 2E all show perspective views of the embodiment shown in Figures 2A and 2B with the constituent parts separated to show the internal features;

15 Figures 2F and 2G show magnified views of portions of the nozzle arrangement shown in Figure 2C;

Figures 3A and 3B show cross-sectional views of a further embodiment of the invention;

Figures 4A shows a perspective view of a further embodiment of the invention;

20 Figure 4B shows a side elevation view of the embodiment shown in Figure 4A; and

Figures 4C and 4D show cross-sectional views of the embodiment shown in Figures 4A and 4B.

25 In the following description of the figures, like reference numerals are used to denote like or corresponding parts in different figures, where appropriate.

Figure 1 shows a first embodiment of a nozzle device of the present invention. The device, which is adapted to dispense fluids in the form of a spray, comprises a body 100 formed of two parts, namely a base part 101 and

an upper part 102. The base 101 and upper part 102 are connected to one another by a foldable connection element 103. Also attached to the base 101 by a further foldable connection element 103a is a trigger actuator 400.

5 The base 101 is adapted to be fitted to a container (not shown) to permit fluid stored in said container to be drawn to, and dispensed from, said device during use.

The base 101, upper part 102, trigger actuator 400 and connection elements 103 and 103a are integrally formed together in the configuration shown in Figures 1 from a single rigid plastic material in a single moulding operation. Thus, the entire device is formed by a single, integrally formed component part.

To form the assembled nozzle device, the upper part 102 will be folded over about the connection element 103 and fitted to the upper surface of the base 101 to form the body of the device and the trigger actuator will then be folded over about the connection element 103a so that the engagement portion 402 extends across the upper surface of the body of the device and the handle 401 extends downwards at the front of the device.

When the base 101 and the upper part 102 are fitted together to form the body of the device, the portion 102a of the under surface of the upper part 102 abuts the abutment portion/surface 101a of the upper surface of the base 101. In addition, the recessed portions 101b and 101c of the upper surface of the base 101 are aligned with corresponding recessed portions 102b and 102c respectively, that formed in the under surface of the upper part 102 to define two separate internal chambers.

25 Each chamber comprises an inlet orifice 104a and 104b formed in the base. Each inlet orifice is disposed within a respective recess 105a and 105b, as shown in Figure 1. When the upper part 102 is fitted to the base 101, the resiliently deformable flaps 106a and 106b are received within the recesses

105a and 105b respectively. The flaps 106a and 106b are resiliently biased against the openings of the inlet orifices 104a and 104b respectively to form inlet valves. Thus, fluid is only drawn into the two chambers when the pressures within the inlet orifice exceeds the pressure within the chamber such
5 that said flaps are displaced away from the openings of the inlet orifices 104a and 104b to permit fluid to flow into chambers. Each inlet orifice 104a and 104b will be connected to different fluid supplies, such as separate compartments within the container to which the device is attached. Alternatively, one of the chambers may draw air (or any other form of gas)
10 from the container or the external environment. In the latter case, an air inlet could simply be formed within the body of the device to permit air to be drawn in from the external environment.

The outlet comprises an outlet passageway and outlet orifice defined by the abutment surfaces 101a and 102a when they are contacted together. The
15 passageway is formed by the alignment of grooves 106, 107 and 108 with grooves 109, 110 and 111 respectively, and chambers formed within the outlet passageway are formed by the alignment of recesses 112 and 113 with recesses 114 and 115 respectively.

Therefore, fluid dispensed from the chamber formed by recesses
20 101b/102b during use travels through the chamber formed by the alignment of recesses 112/114 and then into the chamber formed by the alignment of recesses 113/115 before being ejected through the outlet orifice. Fluid dispensed from the chamber formed by recesses 101c/102c during use travels through to the chamber formed by the alignment of recesses 113/115, where it
25 mixes with the fluid dispensed from the other chamber prior to ejection through the outlet orifice.

The provision of the chambers formed within the passageway has been found to contribute to the break up of liquid droplets dispensed from the nozzle device, thereby enabling a fine spray to be produced.

The outlet passageway leading from each chamber will also comprise an outlet valve (not shown) positioned up stream from the chambers so that fluid will only be ejected when the pressure within the chamber exceeds a predetermined minimum threshold value. The valve can be formed by the provision of a resiliently deformable flap or other member in the outlet passageway, which can deform from an initial resiliently-biased position in which the passageway is closed to define an opening through which fluid can flow when the pressure within the chamber is at or exceeds the predetermined threshold value.

As previously indicated, the trigger actuator comprises a handle 401 and an engagement portion. When the trigger actuator 400 is folded over the assembled body of the nozzle device, the engagement portion extends across the upper surface of the body and protrusions 403 and 404 formed on the under surface of the engagement portion align with the generally dome-shaped protrusions formed on the upper surface of the body by the portions 102b and 102c of the upper part 102. The trigger actuator is therefore pivotally mounted to the body of the device such that when an operator pulls the downwardly extending handle towards the body of the device, the engagement portion pivots and the protrusions 403 and 404 cause the portions 102b and 102c of the upper part to resiliently deform towards portions 101b and 101c of the base respectively. Hence, the chambers defined by these portions will be compressed thereby causing fluid present therein to be dispensed from the device. The aperture 406 formed in the handle 401 of the device aligns with the outlet so that the fluid ejected from the outlet of the device accesses the external environment.

The device would also preferably comprise sealing means to ensure that the upper part and base are tightly bound together. In the embodiment shown in Figure 1, a plastic can be moulded over the join to create a suitably tight seal. Alternatively, one of the parts may be provided with a ridge protrusion, which
5 encircles the recesses and the sides of the grooves/recesses that define the outlet passageway, and which forms a sealing engagement with a correspondingly shaped groove formed on the opposing abutment surface. The ridge protrusion and corresponding groove will fit tightly together to assist in holding the base 101 and the upper part 102 in tight abutment with one another. The ridge and
10 groove also form a seal that prevents any fluid leaking out of the chambers or outlet passageways and seeping between the upper part 102 and the base 101.

In an alternative embodiment, the air leak valve may be a post or flap positioned within a hole which can resiliently deform to open the passageway when a pressure differential exists, thereby allowing air to flow into the
15 container from the external environment.

In embodiments where one chamber, for instance the chamber formed by the alignment of recesses 101c/102c, contains air, the compression of the chambers together causes the air stream ejected from this chamber to mix with a liquid dispensed from the other chamber. This mixing will break up the
20 droplets of liquid and assist in the formation of a fine spray when the liquid is dispensed through the outlet.

Figures 2A to 2G show an alternative embodiment of the invention adapted to dispense two liquids simultaneously in the form of a spray. Figures 2A and 2B both show perspective view of this embodiment. As for the
25 embodiment shown in Figure 1, the body of the device 100 comprises a base 101 and an upper part 102 (not visible in Figures 2A and 2B). Fitted to the body of the device is a trigger actuator 400. The trigger actuator 400 is essentially the same as that shown in Figure 1, except that the trigger

additionally comprises a double aperture 406 to permit two fluids to be dispensed separately through two separate outlets 250 and 251. In addition, locking tabs 410 can be selectively disposed between the trigger handle 401 and the base 101 to prevent the accidental actuation of the device. To release the
5 lock, tabs 410 can be pushed inwards so that the trigger can slide past them when it is pulled.

One further modification to the trigger actuator can be seen in Figures 2C, 2D and 2F. The engagement portion 402 is divided into two segments 402a and 402b. Segment 402a is the portion that engages the resiliently deformable
10 portions 102b and 102c of the upper part 102, as previously described, whereas segment 402b is configured to engage the rear recess 270 of the body. Protrusions 271-273 assist with the alignment and securing of the portion within the recess 270, and hence, the securing of the trigger actuator to the base 101. The segments 402a and 402b are connected by a rigid beam 409 which
15 forms the pivot point when the trigger handle is pulled. Thus, segment 402a pivots relative to the segment 402b when the trigger is pulled because there is nothing between 404 and 409 to stop to prevent this area deforming. Thus the actuator pivots about this join when the trigger is pulled. This differs to the embodiment shown in Figure 1 because the pivot point has moved along the
20 upper surface of the device to a position proximate to the middle of the device. This has been found to provide a more conventional trigger action in that the trigger can simply be pulled towards the body of the device, whereas the trigger action in the embodiment shown in Figure 1 requires the trigger to be pulled inwards and downwards.

25 The parts of the body that form the nozzle device are shown in a disassembled configuration in Figures 2C and 2D. The internal structure shares many similarities with the embodiment shown in Figure 1 (as shown by the like reference numerals), but there are some differences.

Firstly, the upper part 102 is connected to the base 101 at the front, rather than at the side, as shown in Figure 1. The upper part 102 is therefore simply flipped over by bending/folding the connection element 103 and fitting it to the base 101 to form the assembled nozzle device.

5 Secondly, the embodiment of the device shown in Figures 2C and 2D is also configured to dispense two liquids separately so that they only mix outside of the nozzle device by the merging of the two separate sprays, which is desirable for certain applications. It shall of course be appreciated that in alternative embodiments, the outlet passageways could be configured to merge
10 in a similar manner to the outlet passageways of the embodiment shown in Figure 1.

The outlet passageways of each chamber therefore differs from the embodiment of Figure 1 because each chamber comprises a separate outlet passageway formed by the alignment of grooves and/or recesses 203-211
15 formed on the abutment surfaces 101a of the base with corresponding grooves and/or recesses 203a- 211a, as shown in Figure 2G.

Thus, in the assembled nozzle device, each outlet comprises an outlet orifice and an outlet passageway which comprises four chambers formed by the alignment of recesses 203/203a, 205/205a, 207/207a and 209/209a. The latter
20 chamber is a swirl chamber formed by the alignment of semi-circular recesses 209 and 209a. Thus, fluid dispensed from each chamber during use flows along the passageway, through three expansion chambers and into the swirl chamber whereby rotational flow is induced into the fluid stream prior to ejection through the outlet orifice. Expansion and swirl chambers are known in
25 the art and are again used to break up fluid droplets prior to ejection through the outlet.

A further difference over the embodiment shown in Figure 1 is that the embodiment shown in Figure 2 also comprises two air release valves. The air

release valves are formed by valve members 215 and 216 formed on the under surface of the upper part 102 being received within openings 217 and 218 respectively formed on the abutment surface 101a of the base when the nozzle arrangement is assembled. The openings 217 and 218 both define passageways through which air may flow into the container from the outside in the assembled nozzle arrangement. The tip of the resiliently deformable member is provided with a flared rim (see Figure 2G), the edges of which abut the internal walls of the opening to form an airtight seal. If a reduced pressure exists in the container as a consequence of expelling fluid through the nozzle device, the pressure differential between the interior of the container and the external environment causes the flared rim of the member to deform inwards, thereby permitting air to flow into the container from the external environment. Once the pressure differential has been equalised, the flared rim returns to its initial resiliently biased configuration to prevent any further air flow through the opening. It shall also be appreciated that if the container is inverted, the product cannot leak past the rim of the resiliently deformable member and any pressure that is applied, by squeezing the container for example, simply pushes the flared rim into tighter abutment with the walls of the opening.

In an alternative embodiment, the air leak valve may be a post or flap positioned within a hole which can resiliently deform to open the passageway when a pressure differential exists, thereby allowing air to flow into the container from the external environment.

In a further alternative, the resiliently deformable upper part 102 could comprise a fine slit above an opening similar to openings 217 and 218. This slit could be configured to open when a pressure differential exists.

In yet another alternative, the valve member may be a post or plug formed on the upper part 102 which blocks an opening formed in the base and

is only displaced when the upper part is pressed downwards to actuate the dispensing of the fluid present in the chamber.

Yet another difference with the embodiment shown in Figure 1 is that the upper part comprises ridge protrusions 219 which encircle each recess (102b and 102c) and extend either side of the grooves/recesses 203a – 211a that define each outlet passageway. These protrusions are received in a sealing engagement with corresponding grooves 220 formed on the upper surface of the base 101 when the upper part and base are fitted together. The seal formed prevents any fluid leaking from the chamber or the outlet passageway from seeping between the join between the upper part 102 and the base 101. The ridge protrusion also extends across the outlet passageway to form outlet valve members 230 and 231. This portion of the protrusion can form a flap valve which can deform to permit fluid to flow along the each passageway only when a predetermined minimum threshold pressure is achieved within each chamber. At all other times the valve member closes off the passageway.

Figures 3A and 3B show a further alternative embodiment of the present invention. The body of the nozzle device comprises a base 101 and upper part 102. The base and upper part define an internal chamber 303 with an outlet orifice 304 and inlet 305. The outlet orifice is connected to the chamber by an outlet passageway 306. The outlet also comprises an outlet valve formed by portion 230 of the ridge protrusion 219 and an outlet valve is formed by resiliently deformable flap 106a extending over the inlet opening 104a.

An alternative actuator member in the form of an over cap 301 is slidably mounted to the body of the device. The over cap 301 shown in Figure 3A is fitted over the upper part 102 of the nozzle arrangement and is configured to be displaced downwards from the upper position shown in Figure 3A in response to the application of a pressure such that the protrusion 302 formed on the under surface of the top section of the over cap 301 engages and deforms the resiliently deformable portion 102b of the upper part 102, thereby

compressing the chamber 303 and causing the pressure therein to increase. When a certain threshold pressure is achieved, the valve member 230 will deform to permit fluid present in the chamber to flow through the outlet passageway and be ejected through the outlet orifice 304. An aperture 307
5 formed in the over cap 301 aligns with the outlet 304 when the over cap is depressed so that fluid dispensed through the outlet orifice is ejected into the external environment. The over cap 301 can then be slid back to its initial position, either by the operator lifting the cap or by a resilient means which urges the cap upwards once any downward pressure is removed. An annular lip
10 308 abuts the annular rib 309 formed on the base 101 to limit the upward movement of the over cap 301. The cap 301 may also be twisted so that the lip is further engaged by locking detents which prevent any downward movement, thereby locking the over cap 301 to prevent the accidental actuation of the nozzle device.

15 In addition to providing a means by which the device may be actuated, the over cap 301 also defines a second chamber, which, in this embodiment, is an air chamber 310.

Depressing the over cap downwards causes the air chamber 310 to compress and a stream of air to be ejected through the air chamber outlet 311,
20 where the air stream mixes with the liquid dispensed from the chamber 303 in the outlet passageway 306.

When the applied pressure is released, air may be drawn back into the air chamber 310 through the outlet orifice 304 and air chamber outlet 311. A two way valve (not shown) may be provided in the air chamber outlet 310.

25 In an alternative embodiment, the air chamber outlet 311 may be provided with a one way outlet valve 312, as shown in Figure 3B. When the pressure within the air chamber 310 exceeds a predetermined threshold value the arms of the valve member 312 will deform apart from one another to define an opening through which the air can flow into the outlet passageway 306. In

this case, air will not be able to flow back into the air chamber through the valve 312 so a separate air inlet must be provided. Such an inlet will comprise a one way inlet valve adapted to permit air to flow through the air inlet when the pressure within the chamber 310 falls below the external pressure by at least
5 a minimum threshold amount.

In an alternative embodiment, a separate air plunger may be provided within the air chamber 310 to compress the chamber when the over cap is displaced.

A further embodiment of the present invention is shown in Figures 4A-
10 4D. The embodiment shown in these Figures is a nozzle device configured to dispense fluids in the form of a spray. Referring to Figures 4A-4D, it can be seen this embodiment of the invention is composed of three parts, namely a base 101, an upper part 102 and an actuator member in the form of an over cap or pan handle 501. All three parts can be integrally formed as a single
15 component, as shown in Figures 4A and 4B, and subsequently assembled to form the functional device, as shown in Figures 4C and 4D. In an alternative embodiment of the invention, the over cap 501 could be a separate component part.

In this regard, the upper part 102 fits onto the upper surface of the base
20 101 to define an internal chamber 303, as previously described. During use, fluid is drawn into the chamber 303 through the inlet 305 when the chamber expands, and is expelled through the outlet 304 when the chamber is compressed. To reach the outlet, the fluid in the chamber must firstly reach a pressure that is sufficient to displace the valve member 230 from the valve seat
25 502 so that fluid can flow along the outlet passageway defined between the upper part 102 and the base 101. Various spray modifying features shown by chambers 504, 505 and 506 are formed in the passageway. These chambers have been found to break up the liquid flowing through the outlet passageway during use.

The over cap or pan handle 501 is fitted over the upper part 102 to define an air chamber 310 there between. The over cap is pivotally mounted to the upper part 102 about the connection element 525. The over cap 301 is also rigid so that it provides a firm surface for an operator to press.

5 Pressing the over cap 501 downwards in the direction of arrow 510 causes the over cap to be urged towards the upper surface of the upper part 102, thereby causing the upper part 102 to pivot about said pivot 525 and the side wall 511 of the chamber 310 formed by the upper part 102 to resiliently deform, as shown in Figure 4D. This movement compresses the air chamber 310
10 thereby causing air to be expelled into the chamber 504 through the outlet channel 512. In addition, the protrusion 302 engages portion 102b of the upper part 102 and causes it to distend inwards, thereby comprising the chamber 303 to cause fluid therein to be ejected. The fluid ejected from chamber 303 mixes with the air stream ejected from the air chamber 310 in the chamber 504, which
15 results in the further break up of the droplets of liquid ultimately dispensed through the outlet 304. When the applied pressure is released, the over cap 301 is urged away from the upper part 102 as the side wall 511 deforms back to its initial resiliently biased configuration, as shown in Figure 4C. This increases the volume of both of the chambers 303 and 310, and thereby causes the
20 pressure therein to reduce. This reduction in pressure results in more fluid being drawn into the chamber 303 through the inlet 104 and more air to be drawn into the air chamber 310, either through the outlet 304 and passageway 512, or through a separate one-way air inlet valve (not shown).

A pre-compression valve (not shown) is provided in the outlet channel to
25 ensure an air stream is only ejected from the chamber 310 when the pressure therein exceeds a predetermined minimum value. This valve can be configured to open at the same time as the valve formed by the valve member 230 and valve seat 502 so that fluid from the chamber 303 and an air stream from the chamber 310 are both released into the outlet passageway at the same time.

Although not shown, the embodiment shown in Figures 4A to 4D would usually have a lock to prevent the accidental actuation of the device. Any suitable lock could be used.

Although the device shown in Figures 4A to 4D is adapted to generate a
5 spray, it could equally be a dispenser adapted to eject a volume of liquid at a lower pressure, and not in the form of a spray. The air from the chamber 310 would still mix with the fluid ejected from the chamber and the respective pre-compression valves for each chamber would also be present.

The actuator members of the embodiments of the invention provide a
10 convenient means by which the devices of the present invention may be actuated. The actuator member provides a rigid or substantially rigid handle or surface which an operator engages to apply a pressure.

The actuator surfaces provided by the embodiments shown in Figures 3 and 4A to 4D do not deform when a pressure is applied. Thus the configuration
15 of the surface remains constant during use. Furthermore, the area of the actuator surface is sufficient such that an operator can use any part of their hand, or even arm, to actuate the dispensing of fluid from the container.

A further advantage of the embodiments shown in Figures 4A to 4D is that the over cap 501 provides an increased mechanical efficiency due to the
20 leverage provided about the pivot point 525.

The air chamber 310 shown in Figures 3 and 4A to 4D may also be used in embodiments of the invention that comprise two liquid-containing chambers and which are adapted to simultaneously eject two liquids at the same time. An example of such an embodiment is shown in Figures 1 and 2. The air from the
25 air chamber 310 could be mixed with one or both of the liquids dispensed from these chambers prior to ejection through the outlet of the device.

As a further alternative, a second liquid may be provided in the air chamber 310 instead of air. The chamber 310 could be a self-contained reservoir of liquid and the amount of liquid dispensed with each actuation could

be limited by the dimensions of the outlet channel 512. Alternatively, the chamber 310 may draw fluid a compartment in the container to which it is attached, in a similar manner to the way the chamber 303 is replenished after each actuation.

5 The embodiments shown in Figures 4A to 4D could be made from a single, integrally formed component part, as shown, or could be formed from several separate component parts that are assembled together to form the device. The device would usually be moulded from a rigid plastic. The
10 making these required sections of a reduced thickness, which imparts the necessary deformability characteristics into the design.

 The embodiments shown in the Figures will usually be fitted to a container, which provides a reservoir of liquid to be drawn into the chamber 303. However, in some cases, a liquid reservoir may be integrally formed with
15 the device.

 It shall be appreciated that the description of the embodiments of the invention described in reference to the figures is intended to be by way of example only and should not construed as limiting the scope of the invention.

Claims

1. A pump-action nozzle device adapted to enable fluid stored in a fluid source to be dispensed through said nozzle during use, said nozzle having a body which defines a first chamber having an inlet through which fluid may be
5 drawn into said chamber and an outlet through which fluid present in the chamber may be expelled from the nozzle, said inlet comprising an inlet valve adapted to only permit fluid to flow into the chamber through the inlet when the pressure within the chamber falls below the pressure within the fluid source by at least a minimum threshold amount and said outlet comprising an outlet valve
10 configured to only permit fluid to flow out of the chamber and be expelled from the nozzle when the pressure therein exceeds the external pressure at the outlet by at least a minimum threshold amount, and a second chamber which comprises at least an outlet and an outlet valve, wherein at least a portion of the body which defines said first and second chambers is configured to:

15 (i) resiliently deform from an initial resiliently biased configuration to a distended or deformed configuration in response to the application of a pressure, whereby the volume of said chamber defined by said portion of the body is reduced as said portion of the body is deformed from said initial configuration to said distended or deformed configuration, said reduction in
20 volume causing the pressure within the chamber to increase and fluid to be ejected through the outlet valve; and

(ii) subsequently return to its initial resiliently biased configuration when the applied pressure is removed, thereby causing the volume of the chambers to increase and the pressure therein to fall such that further fluid is at
25 least drawn into the first chamber through the inlet valve;

characterised in that said nozzle device further comprises an actuator member which extends over at least a portion of said portion of the body and which is configured such that the application of a pressure to said actuator causes the

actuator member to engage said portion of the body and cause it to deform from its initial resiliently biased configuration to compress said first and second chambers.

2. A pump-action nozzle device according to claim 1, wherein the body of
5 said device comprises no more than six separate component parts.
3. A pump-action nozzle device according to claim 2 wherein the body of said device comprises a maximum of three separate component parts.
4. A pump-action nozzle device according to claim 3, wherein the body of said nozzle comprises two separate component parts.
- 10 5. A pump-action nozzle device according to claim 4, wherein the body of said nozzle comprises a single component part.
6. A pump-action nozzle device according to any one of the preceding claims, the second chamber further comprises an inlet equipped with an inlet valve through which a fluid from a second fluid source may be drawn into the
15 second chamber when the pressure within the chamber falls below the pressure within the second fluid source by at least a minimum threshold amount.
7. A pump-action nozzle device according to any one of claims 1 to 5, wherein the second chamber does not comprise an inlet and contains a reservoir of a second fluid.
- 20 8. A pump-action nozzle device according to claim 7, wherein said second fluid is dispensed in one single actuation.
9. A pump-action nozzle device according to claim 7, wherein said second fluid is dispensed incrementally when the device is actuated.
10. A pump-action nozzle device according to any one of the preceding
25 claims, wherein the fluid contained in the second chamber is a liquid, which is co-dispensed with a liquid present in the first chamber.

11. A pump-action nozzle device according to any one of claims 1 to 9, wherein the fluid contained in the second chamber is gas, which is co-dispensed with a liquid present in the first chamber.
12. A pump-action nozzle device according to claim 11, wherein the gas is
5 air.
13. A pump-action nozzle device according to claim 12, wherein the second chamber comprises an air inlet to draw more air into the second chamber to replenish that which is dispensed when the resiliently deformable portion of the body is deformed.
- 10 14. A pump-action nozzle device according to claim 13, wherein said air inlet comprises a one-way air inlet valve adapted to only permit air to flow into the second chamber when the pressure within the air chamber falls below the external pressure by at least a predetermined minimum threshold amount.
- 15 15. A pump-action nozzle device according to claim 12, wherein air is drawn back into the second chamber through the outlet when it expands.
16. A pump-action nozzle device according to claim 15, wherein the outlet of the second chamber is provided with a two way valve configured to only permit fluid to flow out of the chamber and be expelled from the nozzle when the pressure therein exceeds the external pressure at the outlet by at least a
20 minimum threshold amount and to only permit air to be drawn back into the chamber when the external pressure at the outlet exceeds the pressure within the second chamber by at least a predetermined minimum threshold amount.
17. A pump-action nozzle device according to any one of the preceding claims, wherein the outlets of said first and second chambers each comprise an
25 outlet passageway that extends from the each respective chamber to separate outlet orifices.

18. A pump-action nozzle device according to any one of claims 1 to 16, wherein the outlets of said first and second chambers comprise an outlet passageway that extends from the each respective chamber to a single outlet orifice, said passageways merging such that fluid dispensed from each chamber
5 during use mixes within the outlet passageway prior to being dispensed through said outlet orifice.

19. A pump-action nozzle device according to claims 17 or 18, wherein the outlet passageway comprises one or more internal spray-modifying features configured to reduce the size of the liquid droplets dispensed through the outlet
10 orifice of the nozzle device during use.

20. A pump-action nozzle device according to claim 19, wherein the internal spray-modifying features are selected from the group consisting of one or more expansion chambers, one or more swirl chambers, one or more internal spray orifices (adapted to generate a spray of fluid flowing through within the outlet
15 passageway), and one or more venturi chambers.

21. A pump-action nozzle device according to claim 19 or 20, wherein said passageway merge within a spray-modifying feature.

22. A pump-action nozzle device according to claim 21, wherein said spray modifying feature is a swirl or expansion chamber.

20 23. A nozzle device according to any one of claims 23 to 28, wherein the actuator surface is a rigid surface that can be pressed by an operator and is configured so that it can slide or pivot towards an opposing portion of the body defining the chamber when a pressure is applied, thereby causing the volume of the chamber to reduce.

25 24. A nozzle device according to any one of the preceding claims, wherein said actuator is an over-cap that extends over the resiliently deformable portion of the body defining said chamber.

25. A nozzle device according to claim 24, wherein said over cap is slidably mounted to the body of the nozzle device.
26. A nozzle device according to claim 24, wherein said over cap is pivotally mounted to the body of the nozzle device.
- 5 27. A nozzle device according to any one of claims 1 to 23, wherein said actuator member is a trigger actuator.
28. A nozzle device according to claim 27, wherein the trigger actuator comprises a trigger handle that can be pulled by an operator and an engagement portion configured to engage said portion of the body and cause it to deform
10 from its resiliently biased position when said trigger handle is pulled.
29. A nozzle device according to any one of the preceding claims wherein said second chamber is defined between said actuator member and the body of the device.
30. A nozzle device according preceding claim, wherein the actuator surface
15 is formed from a rigid plastic material.
31. A pump-action nozzle device according to any preceding claim, wherein said nozzle is adapted to be fitted to an opening of a container so as to enable fluid stored in said container to be dispensed during use.
32. A pump-action nozzle device according to any one of claims 1 to 30,
20 wherein said nozzle is integrally formed with said container so as to enable fluid stored in said container to be dispensed during use.
33. A pump-action nozzle device according to any one of the preceding claims, wherein the body of the nozzle device comprises two or more interconnected parts, which, when connected together, define the chamber.
- 25 34. A pump-action nozzle device according to claim 33, wherein the chamber of the nozzle device is defined between two interconnected parts.

35. A pump-action nozzle device according to claim 33 or 34, wherein the outlet valve, an outlet orifice and an outlet passageway that connects the outlet valve to the outlet orifice, it is also preferred that the at least two interconnected parts that define the chamber also define at least a portion of the outlet
5 passageway.

36. A nozzle device according to claim 34 or 35, wherein the two interconnected parts form the outlet valve between them and also define the entire outlet passageway and the outlet orifice.

37. A nozzle device according to any claim 35 or claim 36, wherein the
10 outlet passageway is defined between an abutment surface of one of said parts and an opposing abutment surface of another of said parts.

38. A nozzle device according to any claim 37, wherein one or more of the abutment surfaces comprises one or more grooves and/or recesses formed thereon which define the outlet passageway when the abutment surfaces are
15 contacted together.

39. A nozzle device according to claims 33 to 38, wherein one of said parts is a base part and other of said part is an upper part.

40. A nozzle device according to any claim 39, wherein said base part is adapted to be fitted to the opening of a container.

20 41. A nozzle device according to claim 39 or claim 40, wherein said base part also defines the inlet as well as a portion of the passageway leading from the chamber to the outlet.

42. A nozzle device according to any one of claims 39 to 41, wherein the upper part is adapted to be fitted to the base so that they define the chamber and
25 the outlet passageway leading to the outlet of the nozzle device between them.

43. A nozzle device according to any one of claims 39 to 42, wherein the upper part forms the resiliently deformable portion of the body defining the chamber.

44. A nozzle device according to any one of claims 39 to 43, wherein the
5 outlet valve is formed between the component parts of the body of the nozzle device.

45. A nozzle device according to claim 44, wherein the valve is formed by a portion of one of said parts being resiliently biased against the other of said parts to close the outlet or the passageway leading thereto, said resiliently
10 biased portion being configured to deform away from the other of said parts to define an open outlet or passage leading thereto when the pressure within the chamber exceeds the external pressure by at least a minimum threshold amount.

46. A nozzle device according to any one of claim 45, wherein the outlet valve is formed between the abutment surfaces of the at least two parts.

15 47. A nozzle device according to claim 45 or 46, wherein one of the abutment surfaces comprises a resiliently deformable valve member that is resiliently biased against the opposing surface abutment surface to close the outlet orifice of the passageway leading thereto and is configured to deform away from the other of said parts to define an open outlet or passage leading
20 thereto when the pressure within the chamber exceeds the external pressure by at least a minimum threshold amount.

48. A nozzle device according to claim 47, wherein said valve member is in the form of a flap or a plug.

49. A nozzle device according to any one of the preceding claims, wherein
25 the inlet valve is a flap valve consisting of a resiliently deformable flap positioned over the inlet opening, said flap being adapted to deform so as to allow fluid to be drawn into the chamber through the inlet when the pressure

within the chamber falls below a predetermined minimum threshold pressure, and subsequent return to its resiliently biased configuration at all other times.

50. A nozzle device according to claim 49, wherein the resiliently deformable flap is formed as an integral extension of the resiliently deformable portion of the body which defines the chamber.

51. A nozzle device according to any one of the preceding claims wherein the nozzle device comprises a locking means configured to prevent fluid being dispensed accidentally.

52. A nozzle device according to claim 26, wherein the lock is integrally formed with the body.

53. A nozzle device according to any one of the preceding claims, wherein the device further comprises one or more air leak valves through which air can flow to equalise any pressure differential between the interior of the container and the external environment, but prevents any fluid leaking out of the container if it is inverted.

54. A nozzle device according to any one of claims 33 to 53, wherein said nozzle device comprises a body formed of at least two interconnected parts that together define the chamber and a sealing means is disposed between said at least two parts to prevent any fluid leaking out of the nozzle device.

55. A container having a pump-action nozzle device as defined in claims 1 to 54 fitted to an opening thereof so as to enable the fluid stored in the container to be dispensed from the container through said nozzle device during use.

56. A container having a pump-action nozzle device as defined in claims 1 to 54 integrally formed therewith so as to enable the fluid stored in the container to be dispensed from the container through said nozzle device during use.

57. A pump-action nozzle device adapted to enable fluid stored in a fluid source to be dispensed through said nozzle during use, said nozzle having a body which defines a first chamber having an inlet through which fluid may be drawn into said chamber and an outlet through which fluid present in the
5 chamber may be expelled from the nozzle, said inlet comprising an inlet valve adapted to only permit fluid to flow into the chamber through the inlet when the pressure within the chamber falls below the pressure within the fluid source by at least a minimum threshold amount and said outlet comprising an outlet valve configured to only permit fluid to flow out of the chamber and be expelled from
10 the nozzle when the pressure therein exceeds the external pressure at the outlet by at least a minimum threshold amount, and a second chamber which comprises at least an outlet and an outlet valve, and wherein at least a portion of the body which defines said chambers is configured to:

(i) be displaceable from an initial resiliently biased configuration to a
15 distended or deformed configuration in response to the application of a pressure, whereby the volume of said chamber defined by said portion of the body is reduced as said portion of the body is deformed from said initial configuration to said distended or deformed configuration, said reduction in volume causing the pressure within the chamber to increase and fluid to be
20 ejected through the outlet; and

(ii) subsequently return to its initial resiliently biased position when the applied pressure is removed, thereby causing the volume of the chambers to increase and the pressure therein to fall such that further fluid is at least drawn into the first chamber through the inlet valve.

25 58. A pump-action nozzle device dispenser according to claim 57, wherein the part of the body that can be displaced inwards to reduce the volume of the chamber and thereby cause fluid present in said chamber to be ejected through the outlet is a piston mounted within a piston channel.

59. A pump-action nozzle device dispenser according to claim 57, wherein the piston channel forms either the entire chamber or only a portion thereof.

60. A method of manufacturing a nozzle device as defined in claims 1 to 59, said nozzle device having a body composed of at least two interconnected parts
5 and comprising an actuator member, said method comprising the steps of:

- (i) moulding said parts of the body and said trigger actuator;
- (ii) connecting said parts of the body together to form the body of the nozzle device; and
- (iii) bringing the actuator member into engagement with the body to
10 form the assembled nozzle device.

61. A method according to claim 60, wherein said parts are moulded separately.

62. A method according to claim 60 or claim 61, wherein said parts are formed from the same or different materials.

15 63. A method according to claim 60, wherein said part two or more of said parts are integrally formed and connected to one another by a connection element that permits the two integrally formed parts to be brought into contact during the assembly of the nozzle device.

64. A method of manufacturing a nozzle device as claimed in claims 1 to 59,
20 said nozzle device having a body composed of at least two interconnected parts and further comprising an actuator member, said method comprising the steps of:

- (i) moulding a first of said parts of the body in a first processing step;
- 25 (ii) over-moulding the second of said parts onto the first of said parts in a second processing step to form the body of the nozzle device; and

(iii) connecting the actuator member to the body of the nozzle device.

65. A method of manufacturing a nozzle device as claimed in claim 64, wherein said over-moulding is carried out in situ.

66. A method of manufacturing a nozzle device as claimed in claims 1 to 59,
5 said nozzle device having a body composed of at least two interconnected parts and further comprising an actuator member, said method comprising the steps of:

- (i) moulding a first of said parts of the body in a first processing step together with a framework or base for a second of said parts;
- 10 (ii) over-moulding onto the framework or base to form the second of said parts of the assembled nozzle device; and
- (iii) connecting the actuator member to the body of the nozzle device.

67. A method of manufacturing a nozzle device as claimed in claim 66, wherein said framework or base is connected to the first by a foldable
15 connection element such that said framework or base can be folded over and fitted to the first part during the assembly of the body of the nozzle device.

68. A method of manufacturing a nozzle device as claimed in claim 66 or 67, wherein said over-moulding is carried out before said framework is fitted to the first part to form the body of the nozzle device.

20 69. A method of manufacturing a nozzle device as claimed in claim 66 or 67, wherein said over-moulding is carried out after said framework is fitted to the first part to form the body of the nozzle device.

70. A method of manufacturing a nozzle device as claimed in claims 1 to 59, said nozzle device having a body composed of at least two interconnected parts
25 and further comprising an actuator member, said method comprising the steps of:

- (i) moulding a first of said parts of the body in a first processing step together with a framework or base for a second of said parts; and
- (ii) positioning an insert portion of the body such that said insert is retained within the framework of the second part of the body when said framework is connected to the first parts of the body, said framework and insert forming the second part of the body; and
- (iii) connecting the actuator member to the body of the nozzle device.

71. A method of manufacturing a nozzle device as claimed in claims 1 to 59, said nozzle device having a body composed of at least two interconnected parts and an actuator member, wherein said parts and said actuator member are connected to one another by a connection element such that said parts are moveable relative to one another, said method comprising the steps of:

- (i) moulding the parts of the body and the trigger actuator together with said connection elements in a single moulding step;
- (ii) moving said parts of the body into engagement with one another to form the body of the nozzle device; and
- (iii) moving the actuator member into engagement with the body to form the nozzle device.

72. A method according to claim 71, wherein said parts are moulded separately.

73. A method according to claim 71 or claim 72, wherein said parts are formed from the same or different materials.

74. A method as claimed in any one of claims 60 to 73, wherein a blowing agent is incorporated into the mould together with the plastic material.

75. A pump-action nozzle device adapted to enable fluid stored in a fluid source to be dispensed through said nozzle during use, said nozzle having a

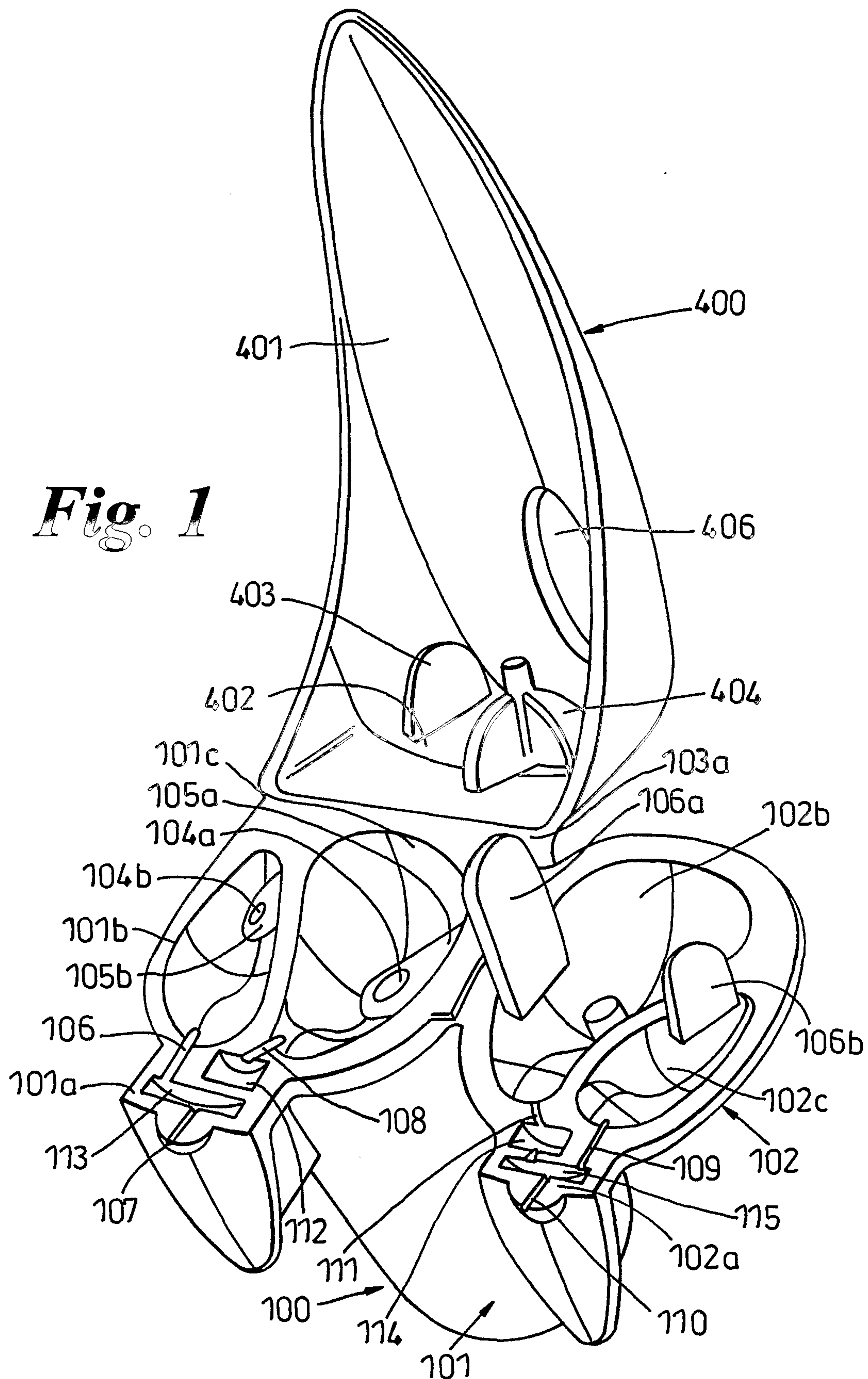
body which defines a first chamber having an inlet through which fluid may be drawn into said chamber and an outlet through which fluid present in the chamber may be expelled from the nozzle, said inlet comprising an inlet valve adapted to only permit fluid to flow into the chamber through the inlet when the
5 pressure within the chamber falls below the pressure within the fluid source by at least a minimum threshold amount and said outlet comprising an outlet valve configured to only permit fluid to flow out of the chamber and be expelled from the nozzle when the pressure therein exceeds the external pressure at the outlet by at least a minimum threshold amount, and a second chamber which
10 comprises at least an outlet and an outlet valve, wherein at least a portion of the body which defines said first and second chambers is configured to:

(i) be displaced from an initial position, in which said chamber assumes its maximum volume, to a distended or deformed configuration in which the volume of said chamber is reduced by the application of a pressure, said
15 reduction in volume causing the pressure within the chamber to increase and fluid to be ejected through the outlet valve; and

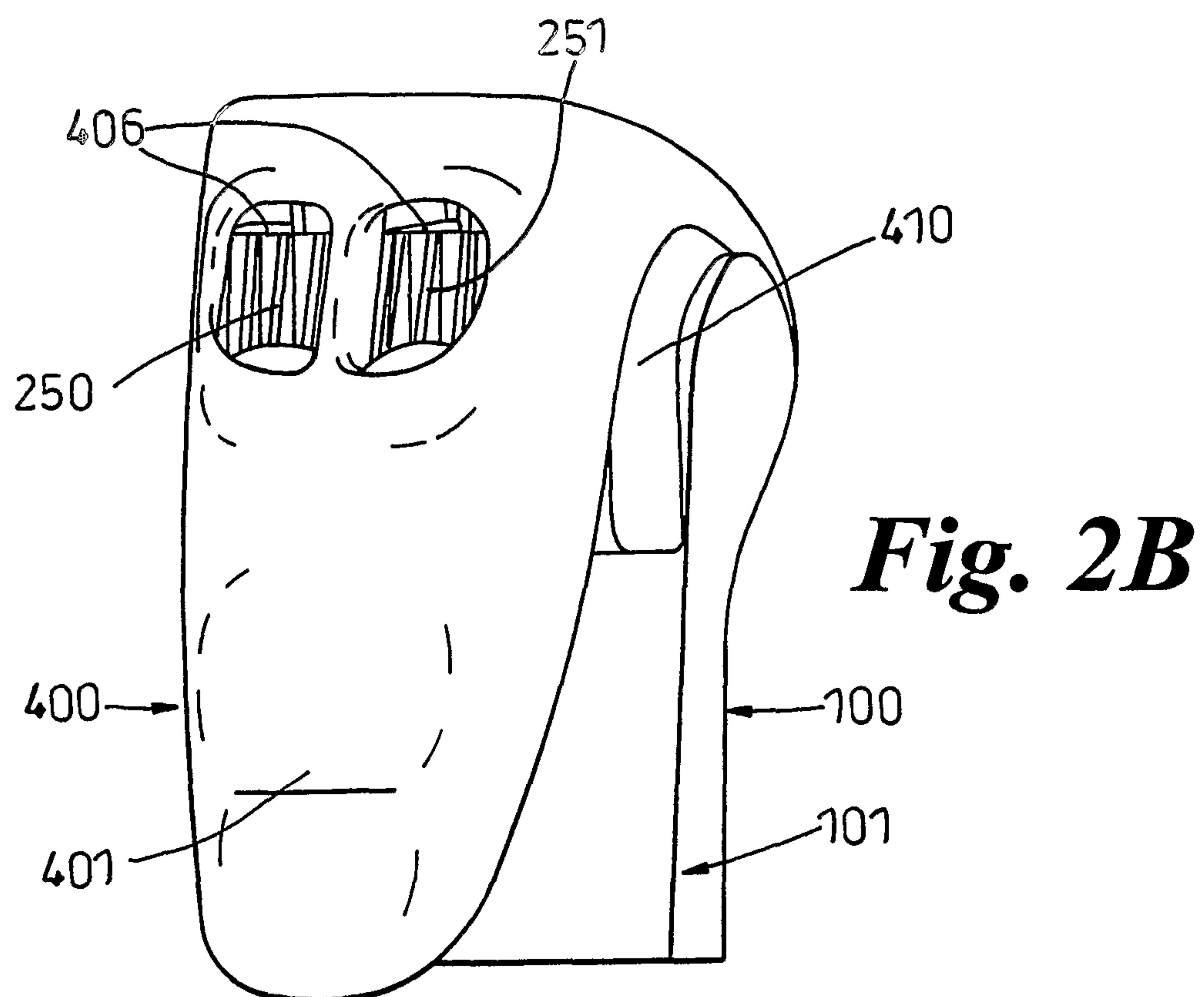
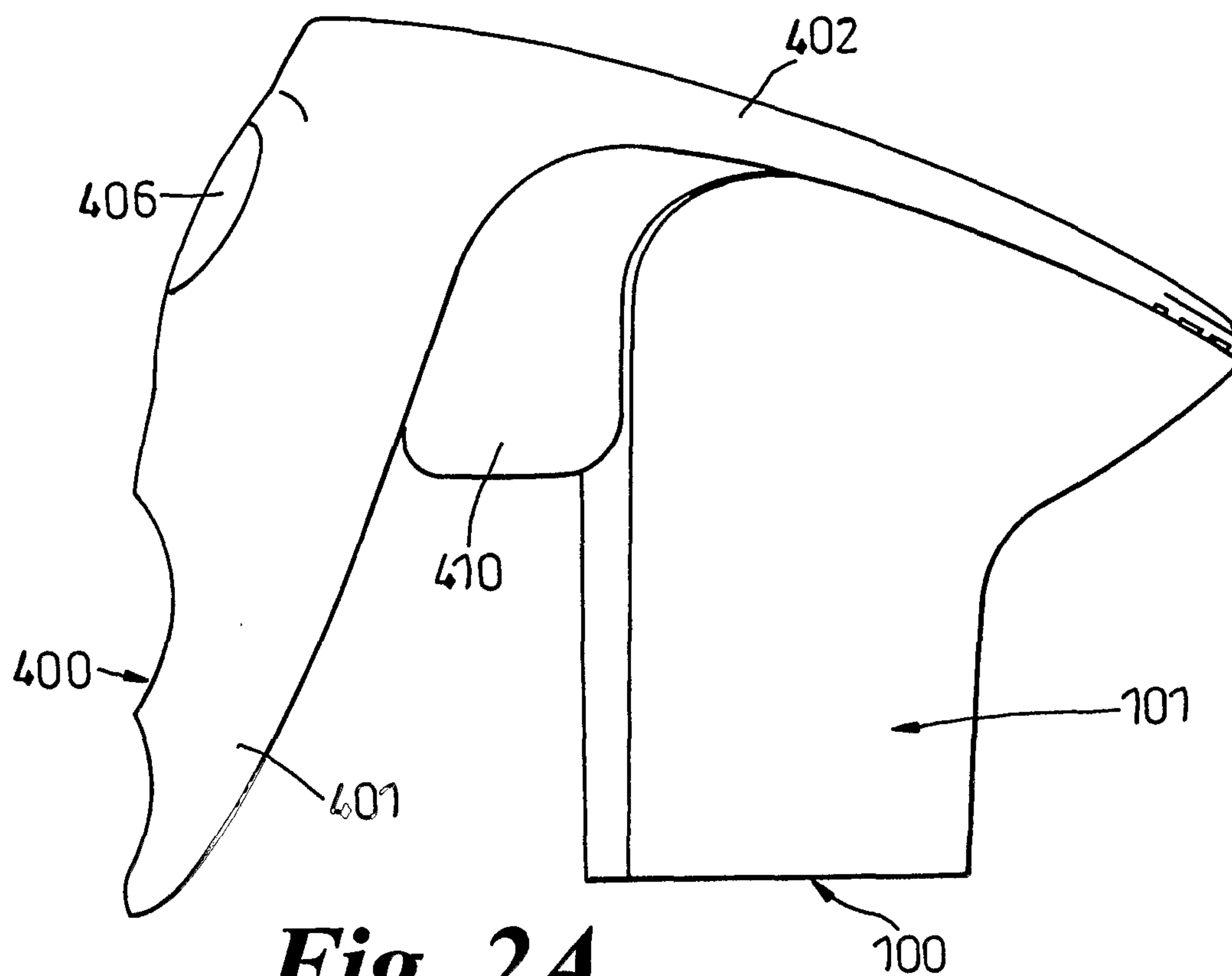
(ii) subsequently return to its initial position when the applied pressure is removed, thereby causing the volume of the chamber to increase and the pressure therein to fall such that fluid is drawn into the chamber through the
20 inlet valve;

characterised in that said nozzle device further comprises an actuator member which extends over at least a portion of said portion of the body and which is configured such that the application of a pressure to said actuator causes the actuator member to engage said portion of the body and cause it to deform from
25 its initial resiliently biased configuration to compress said first and second chambers.

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Fig. 1

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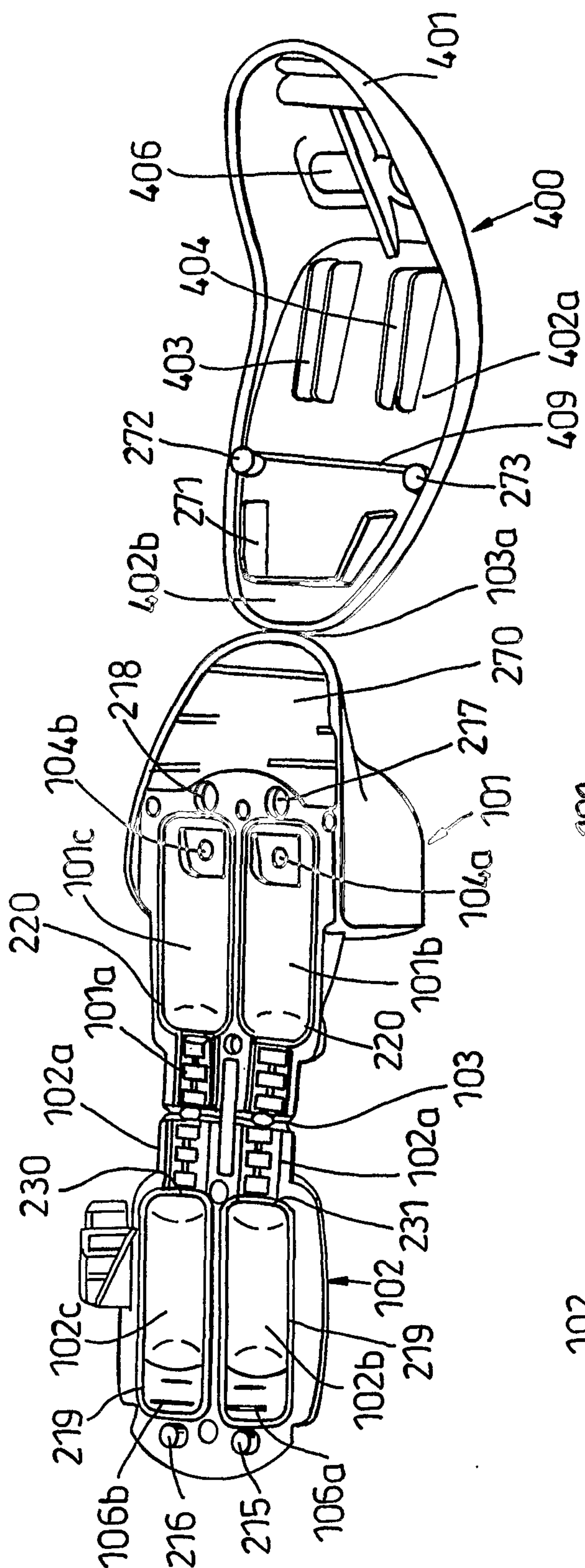


Fig. 2C

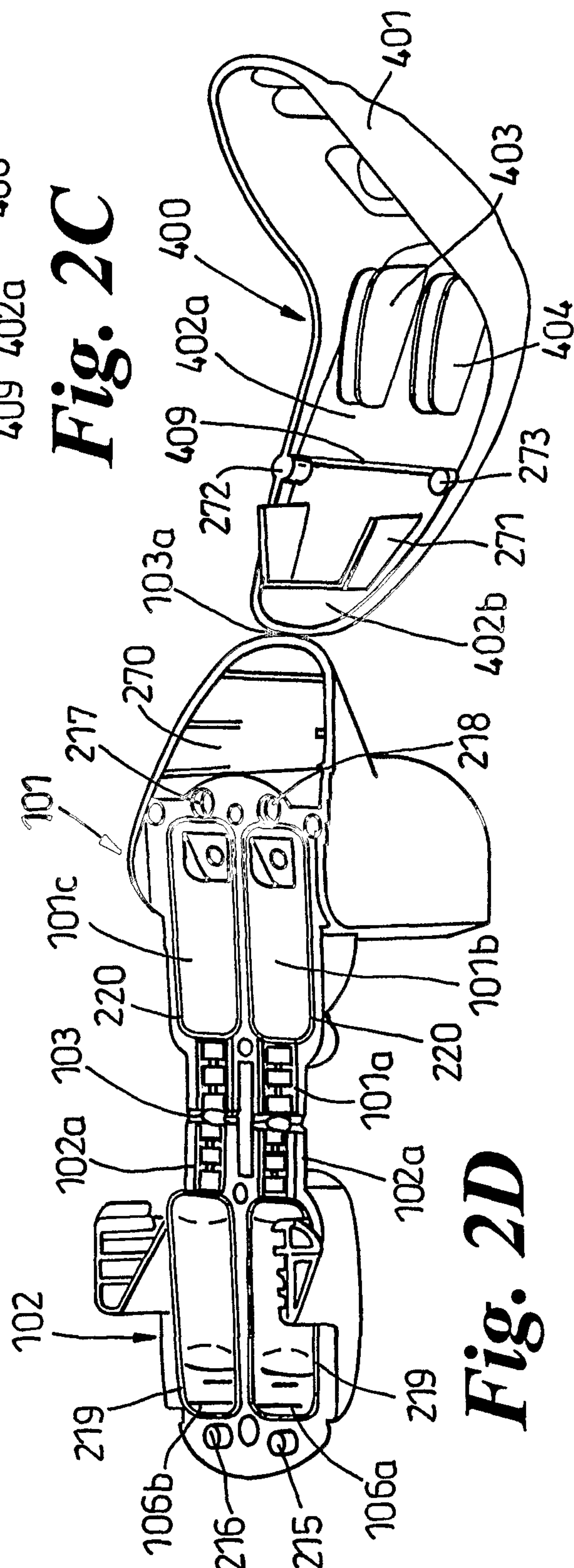
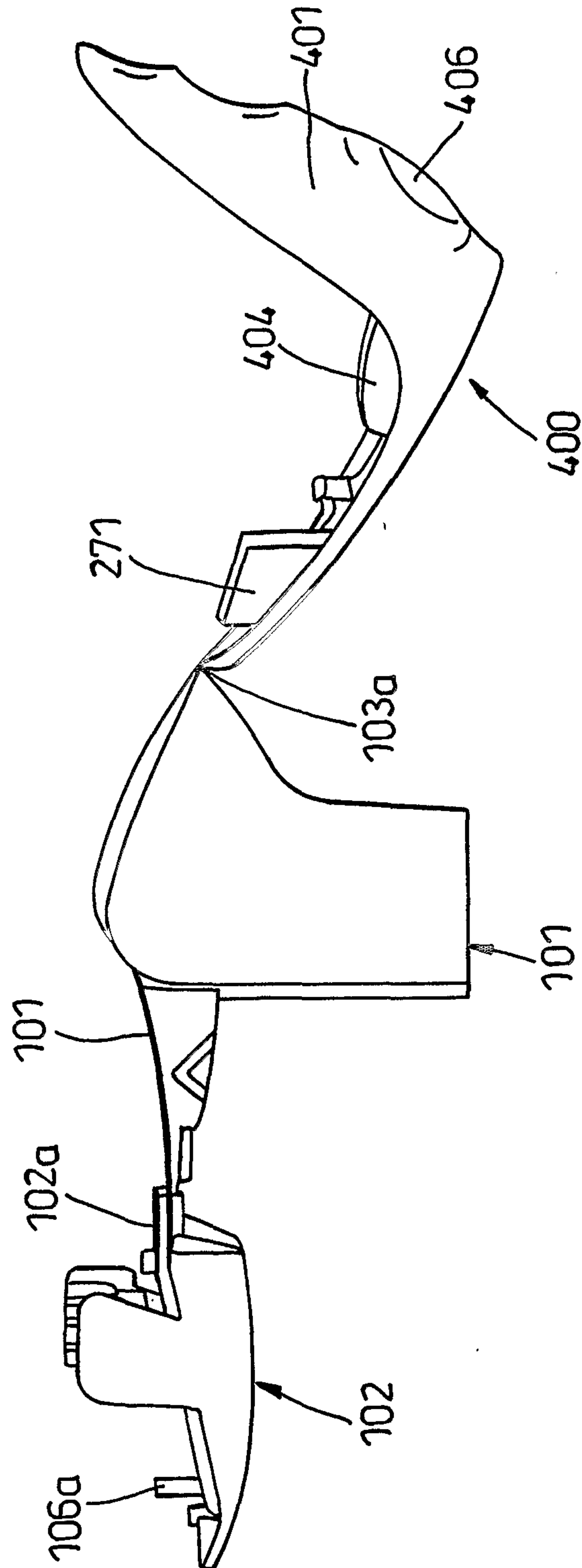


Fig. 2D

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*Fig. 2E*

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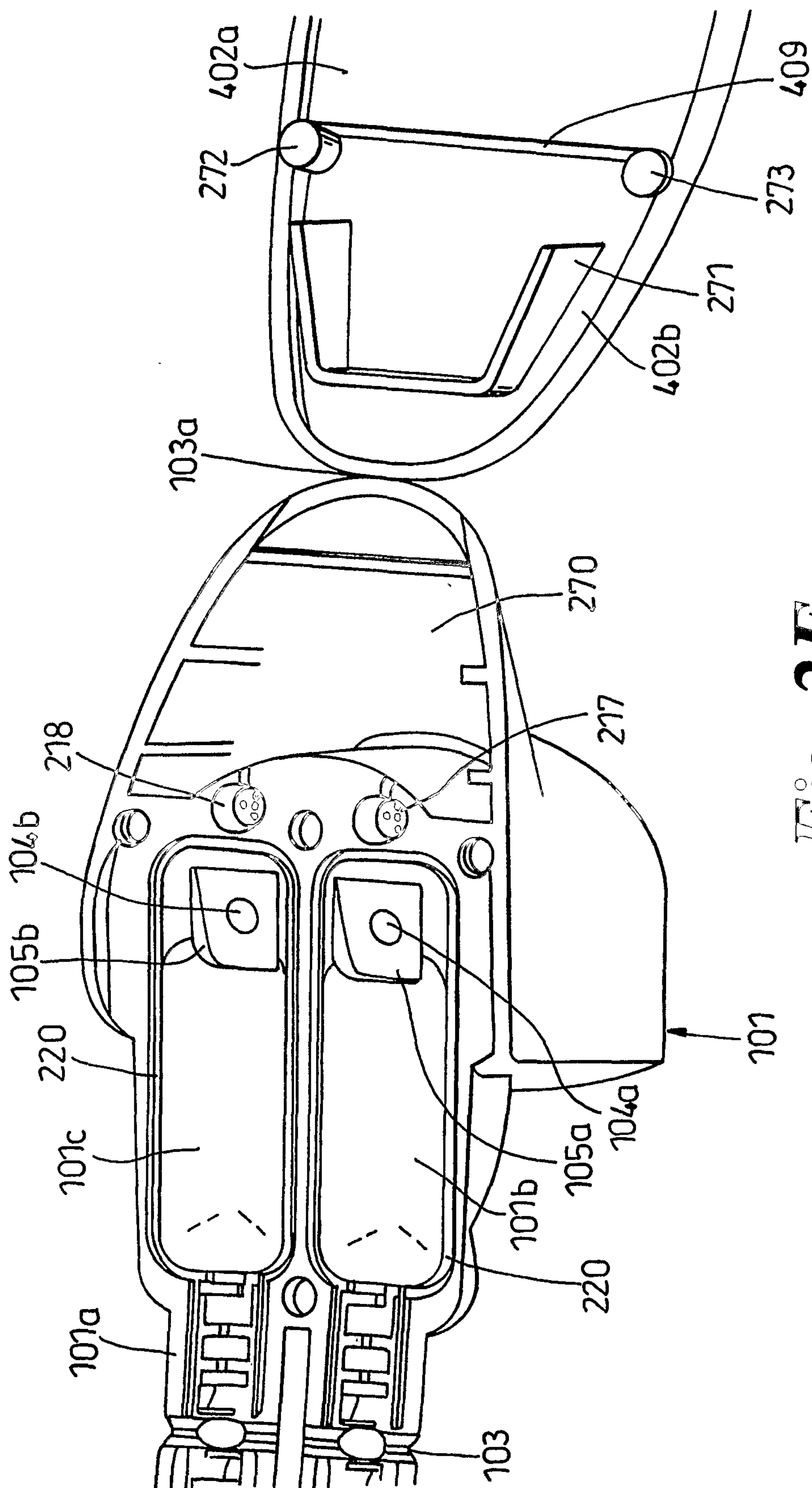
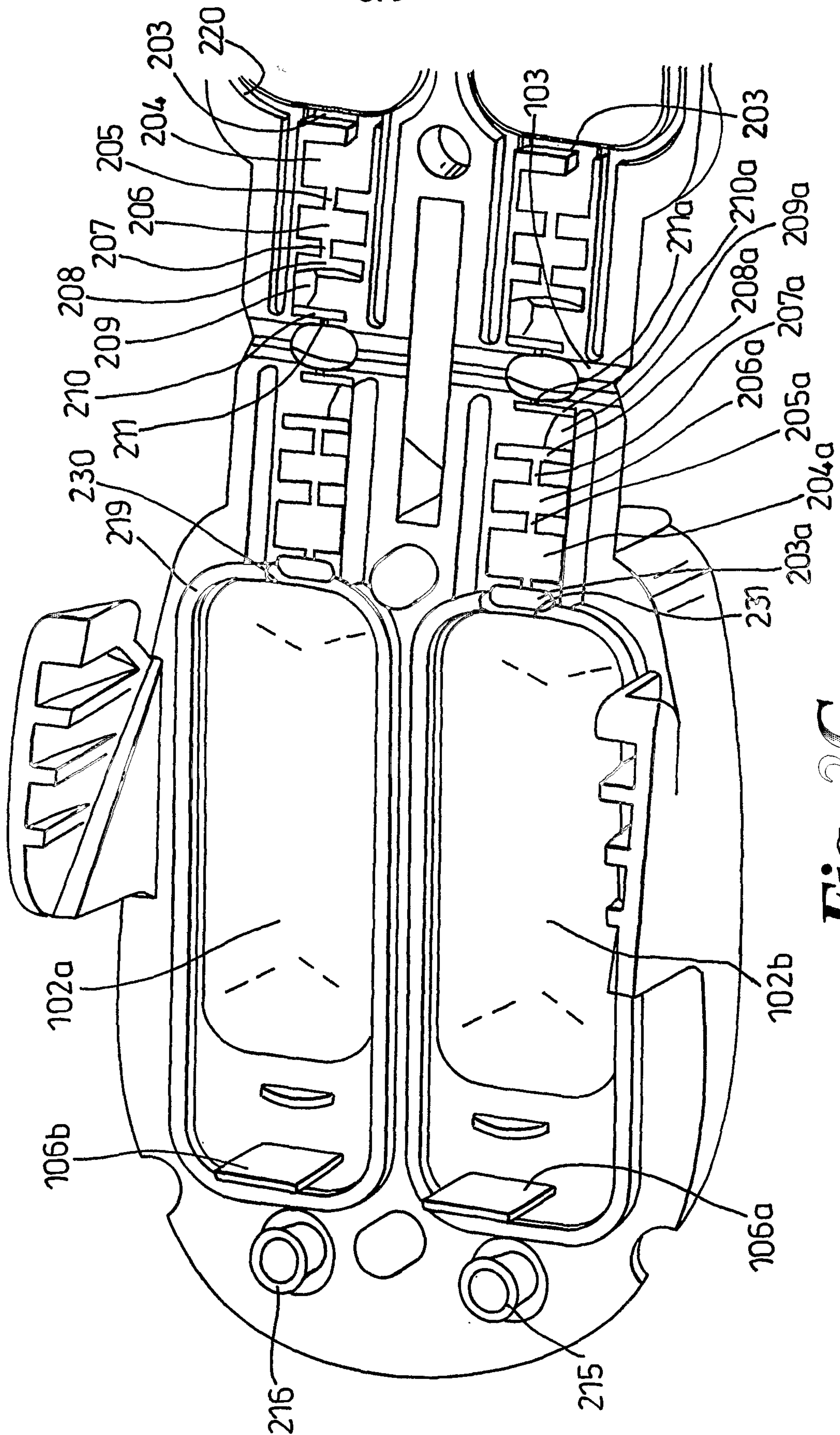


Fig. 2F

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**Fig. 2G**

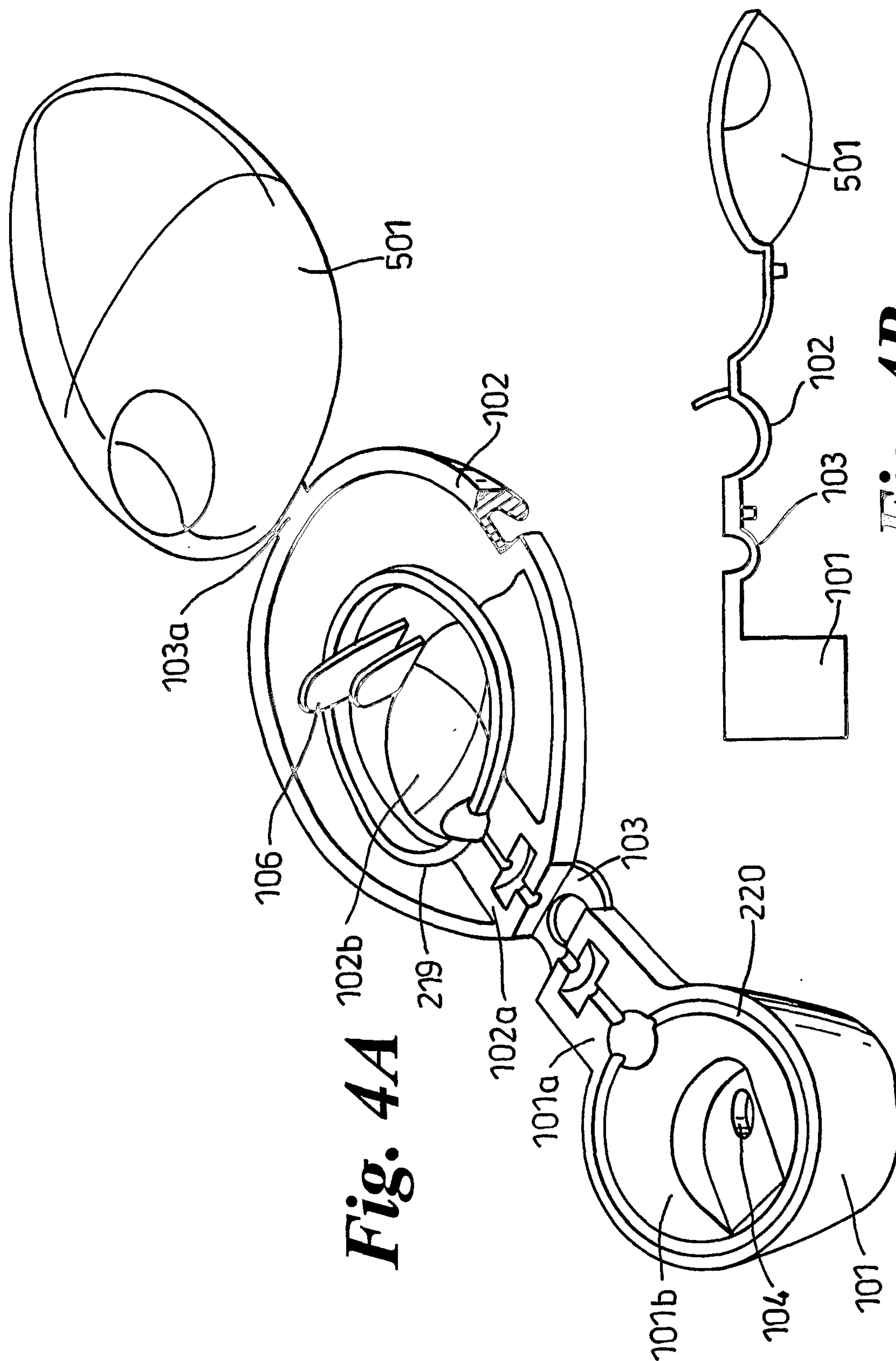
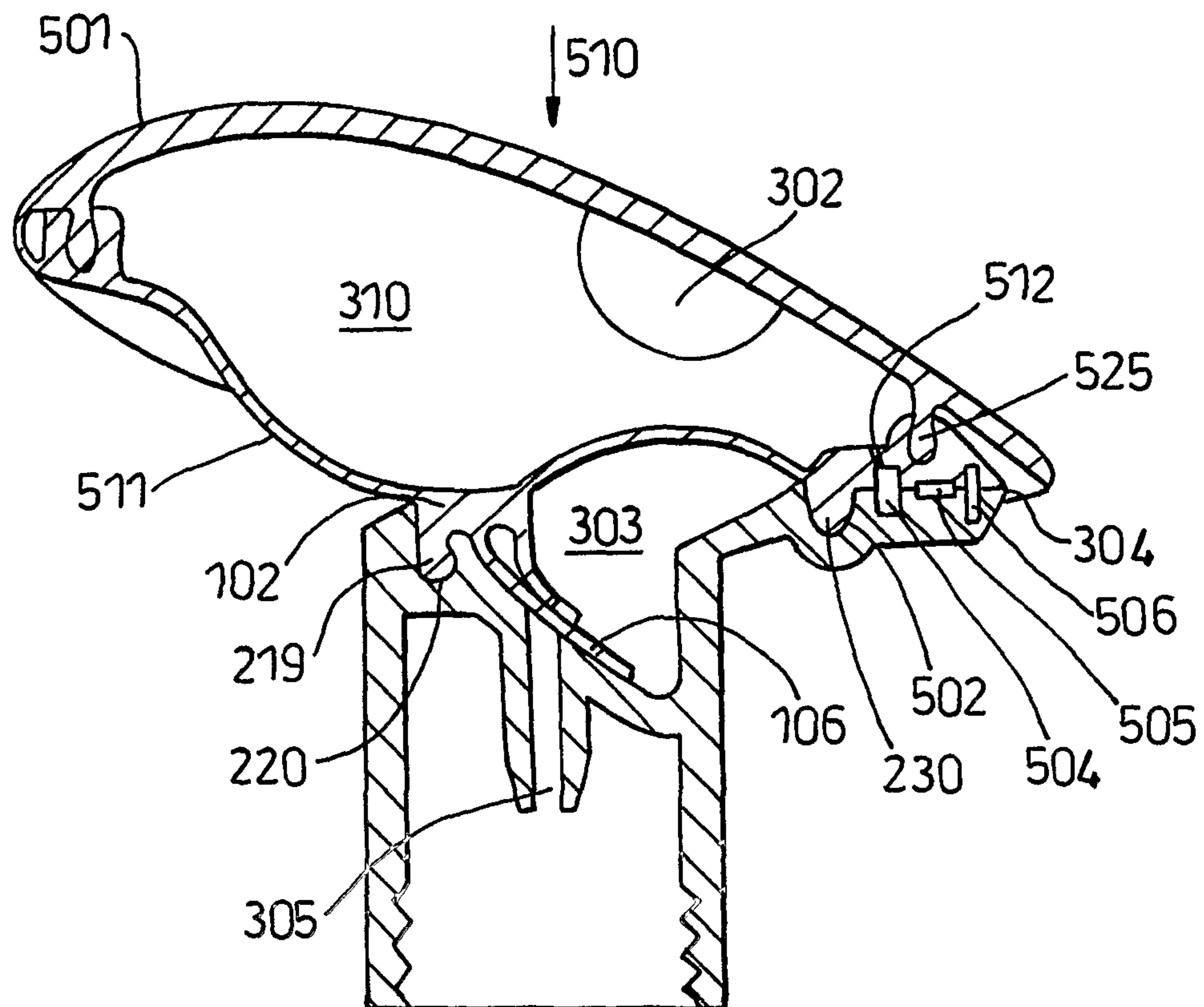
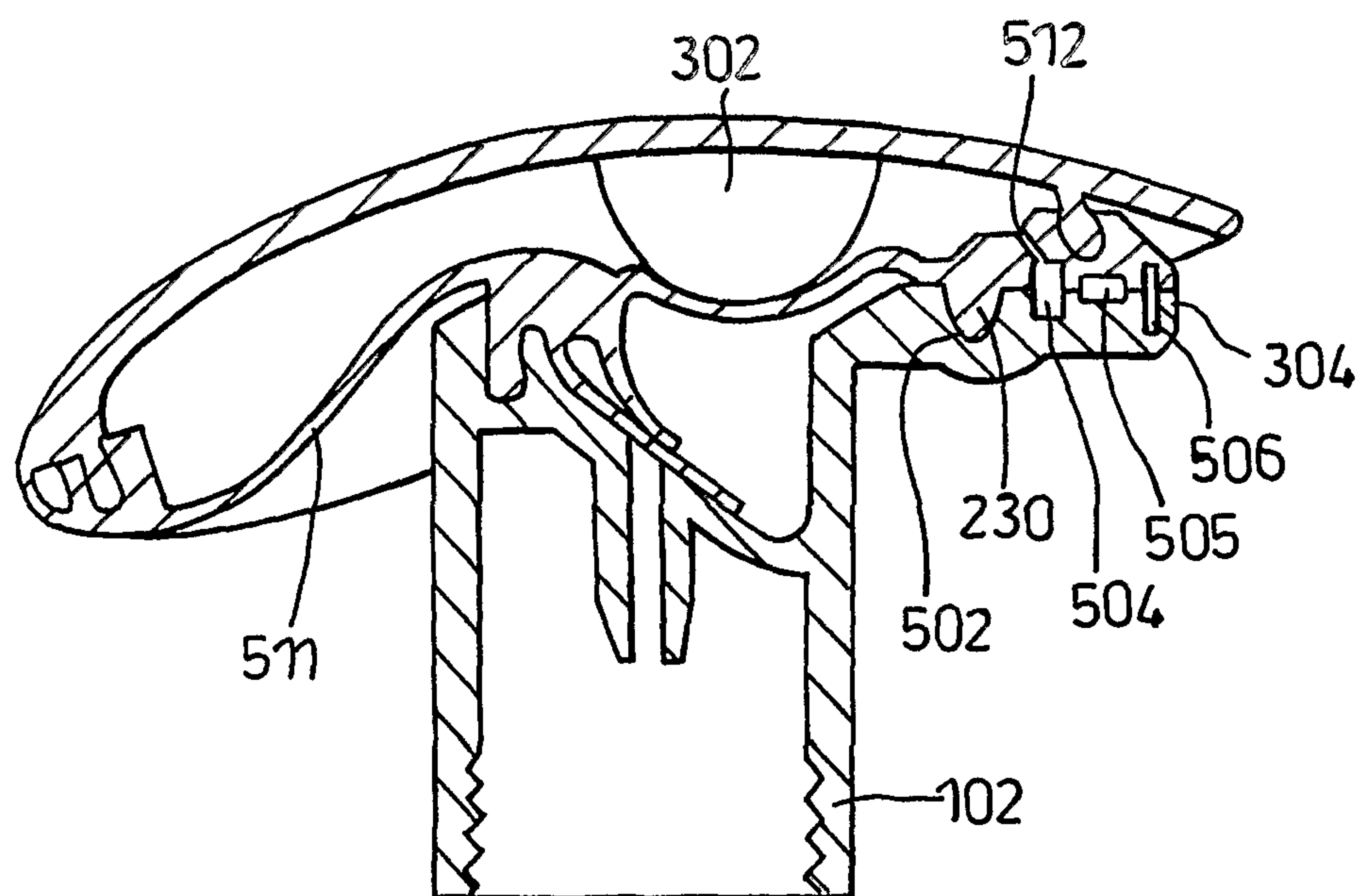


Fig. 4B

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*Fig. 4C**Fig. 4D*

