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(54) IMPROVEMENTS IN OR RELATING TO NOZZLE DEVICES

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(57) **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.

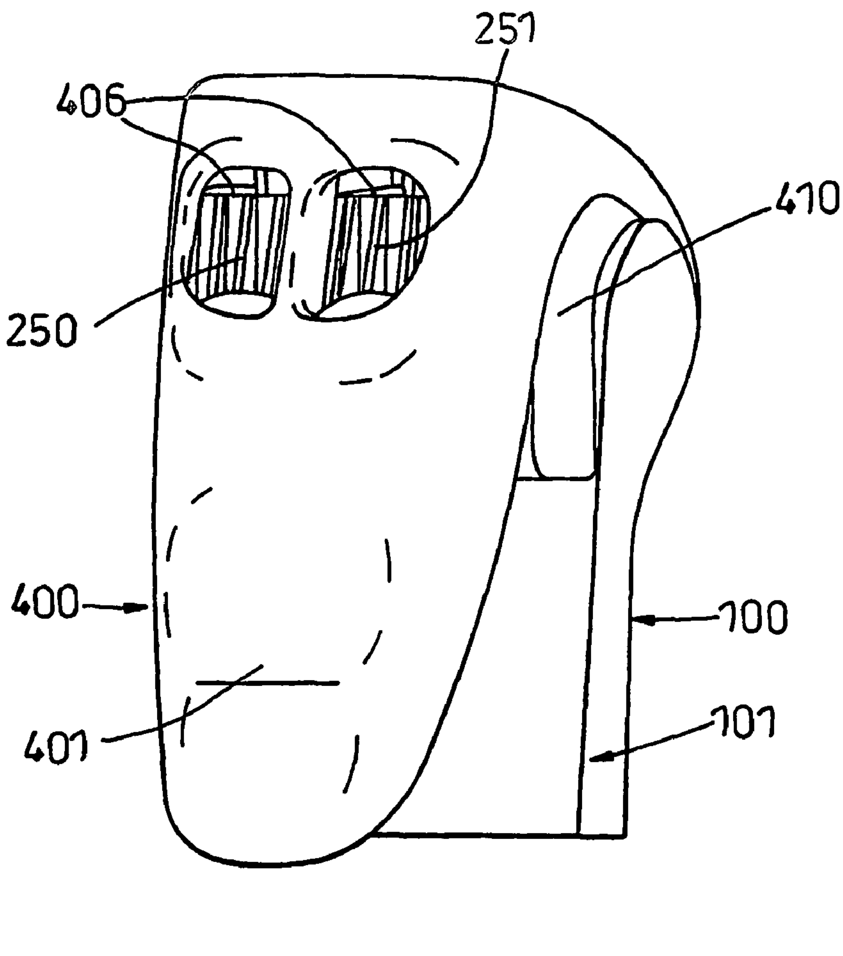
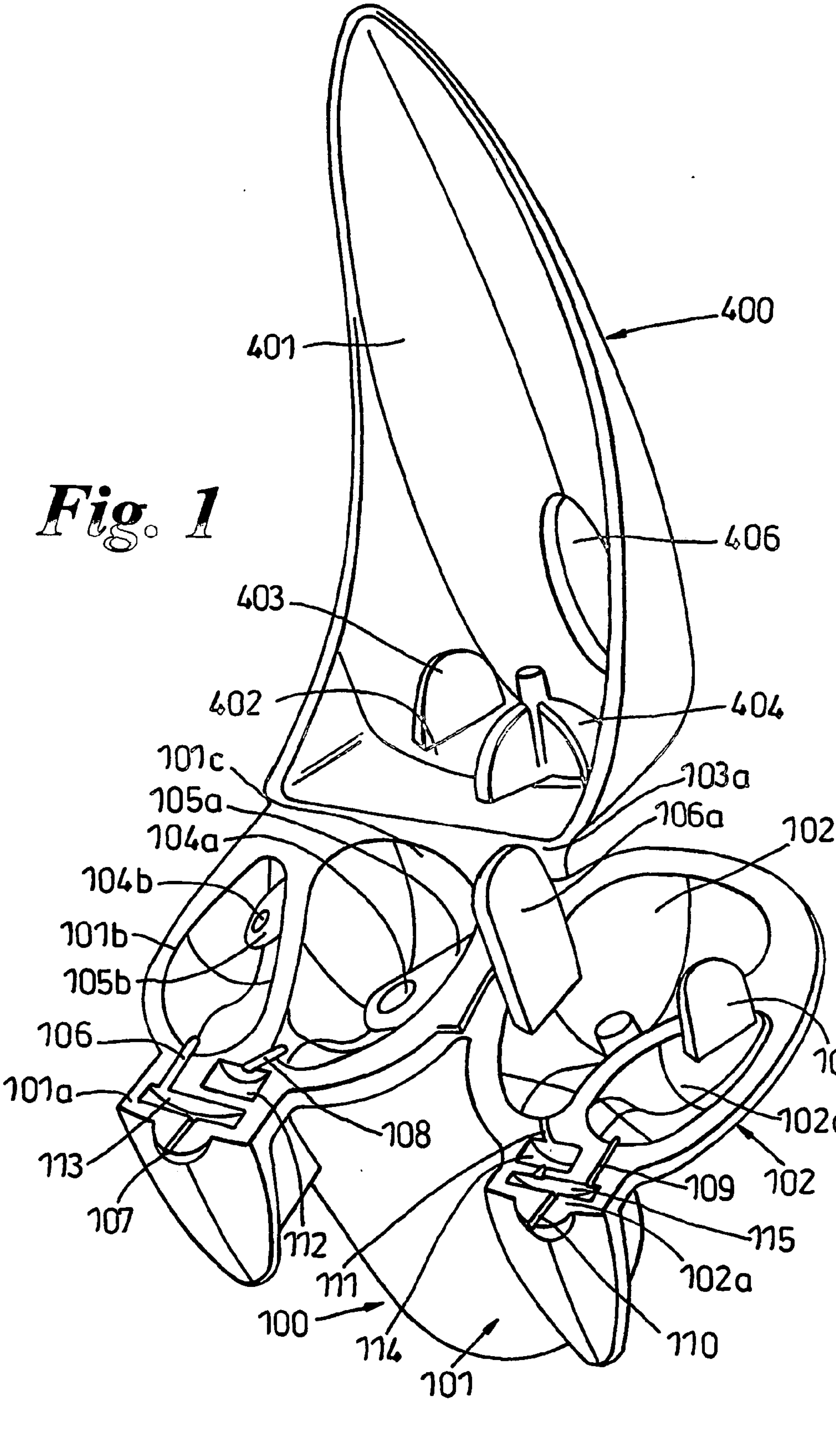


Fig. 1



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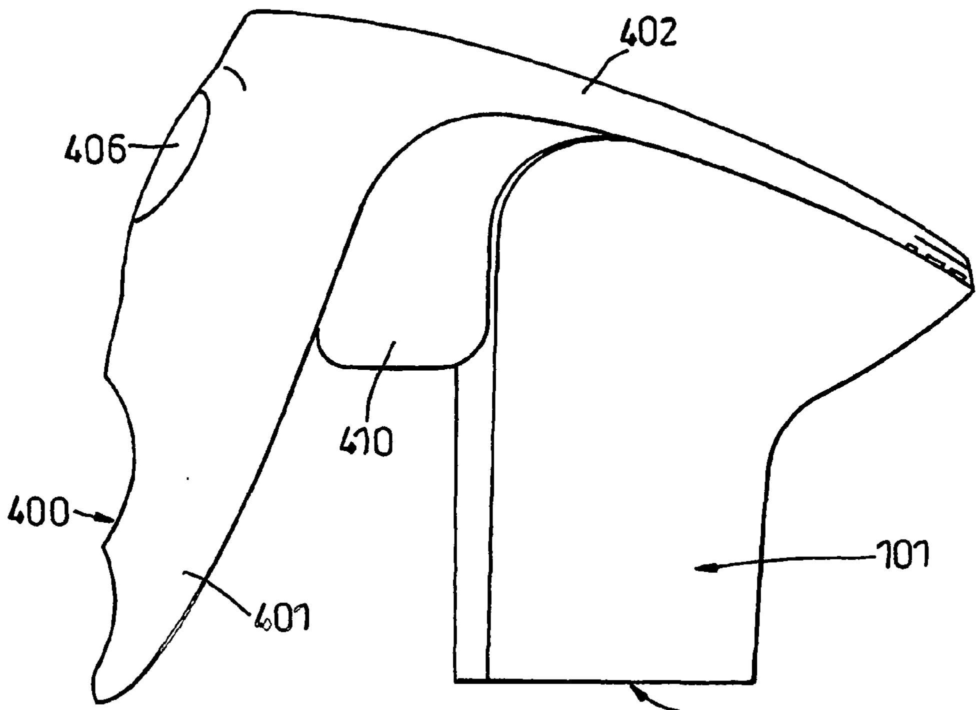

Fig. 2A

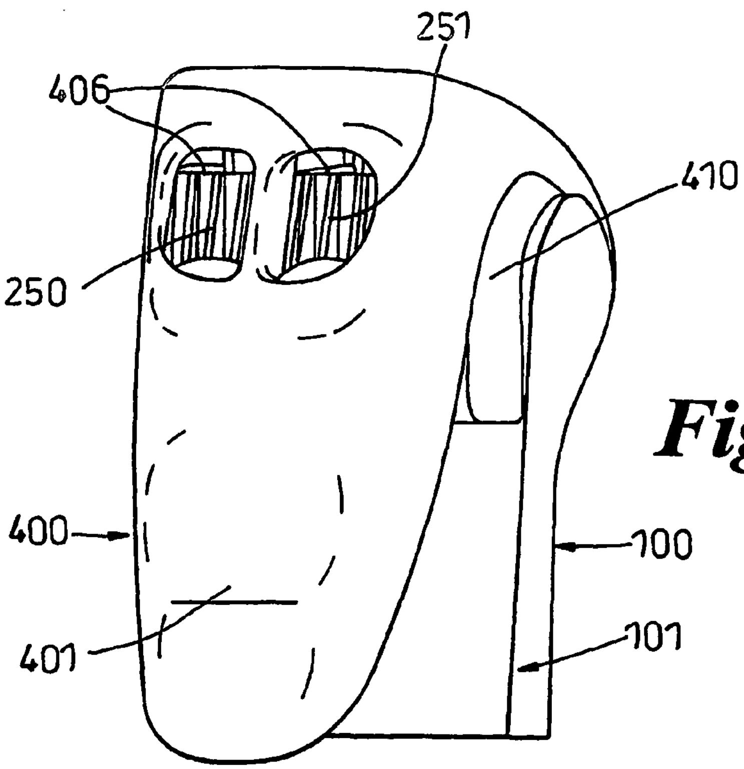

Fig. 2B

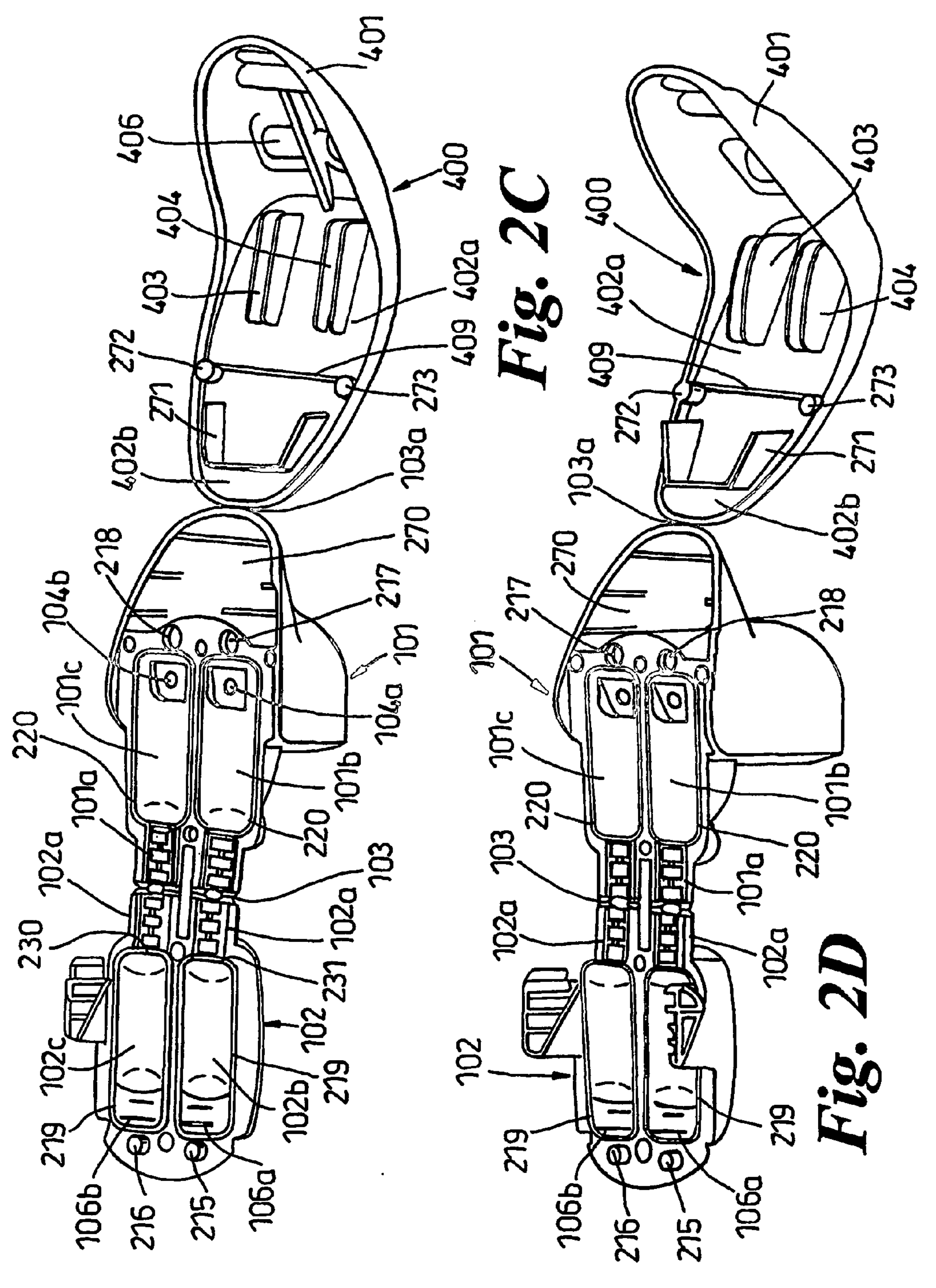
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Fig. 2C

Fig. 2D

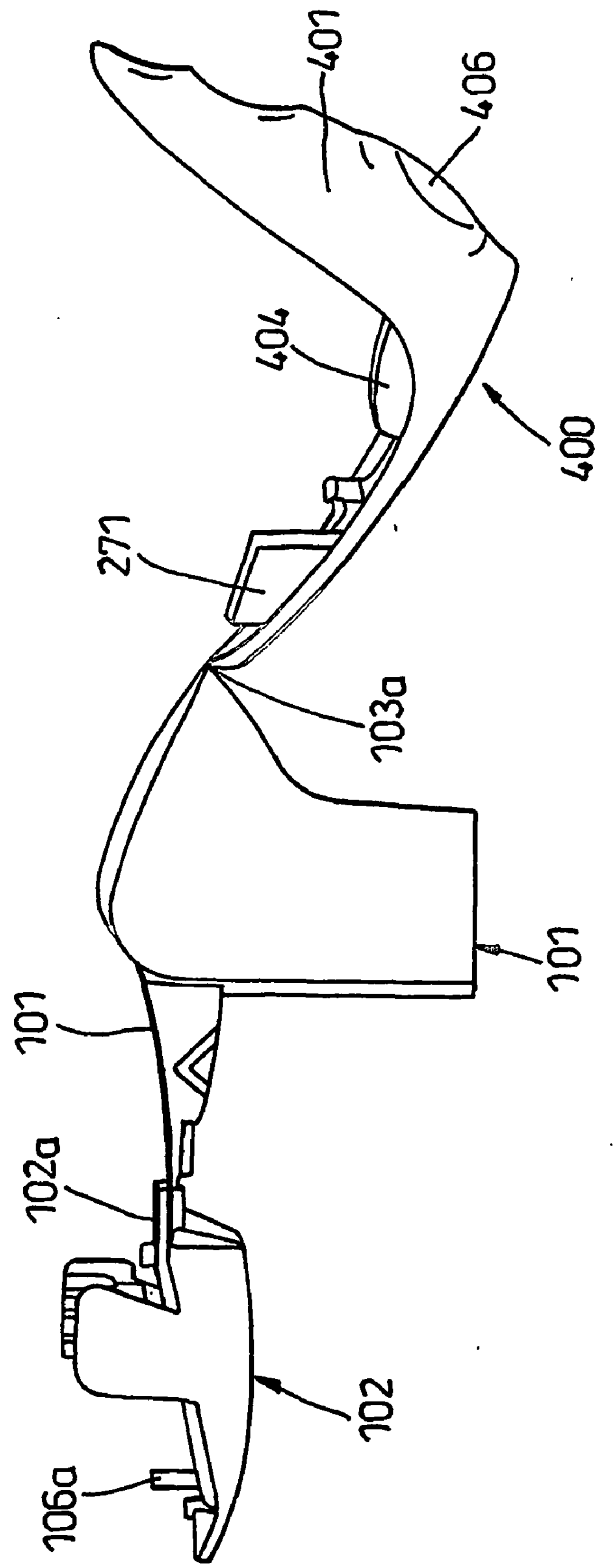

Fig. 2E

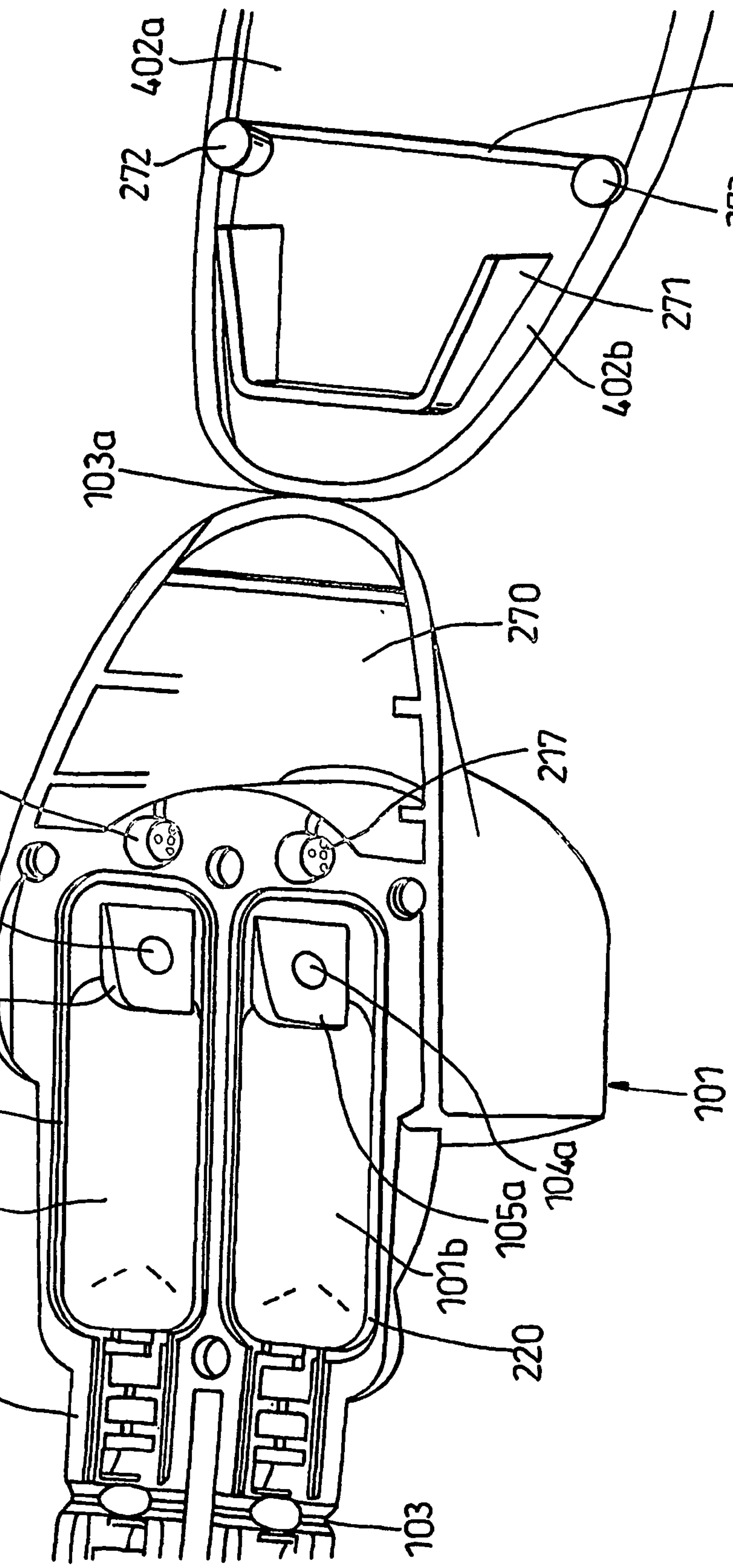
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Fig. 2F

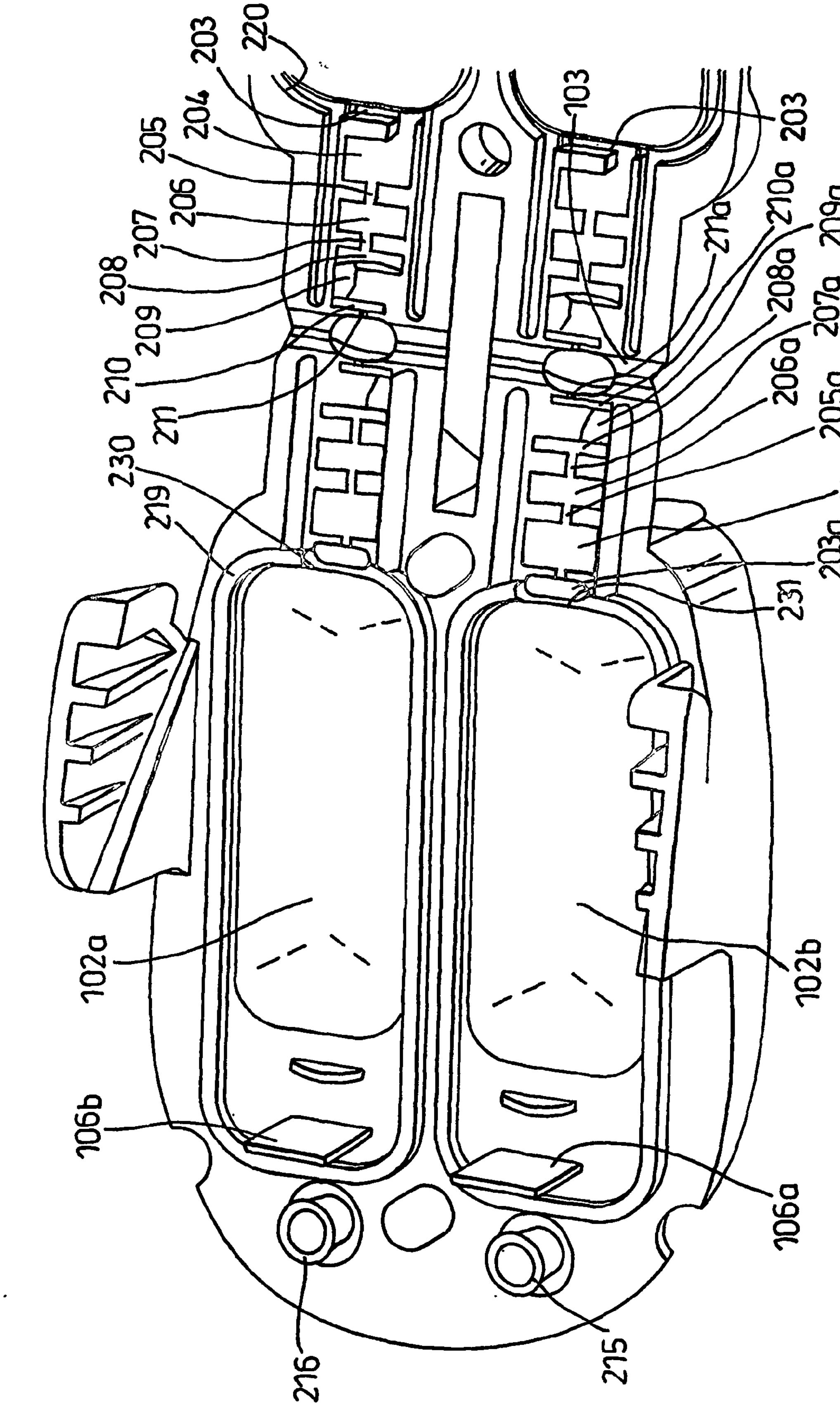
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Fig. 2G

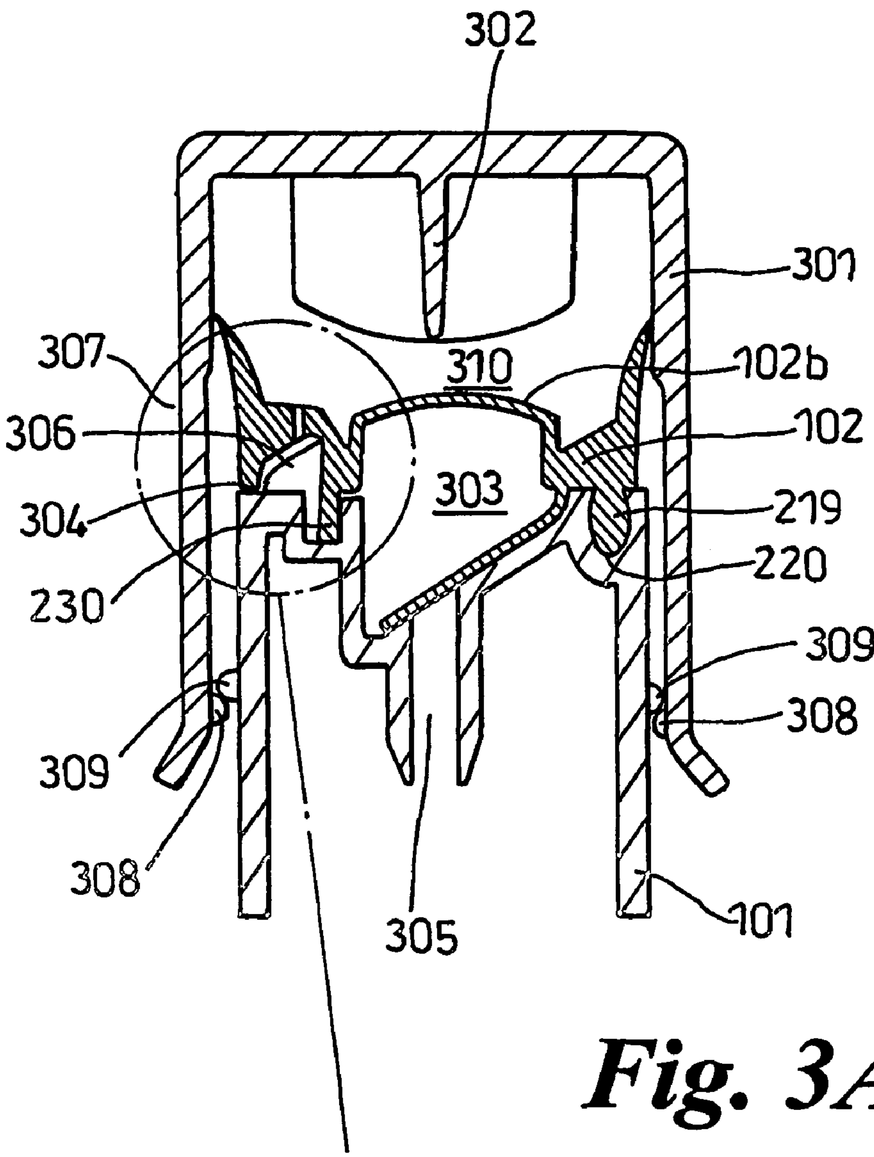
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Fig. 3A

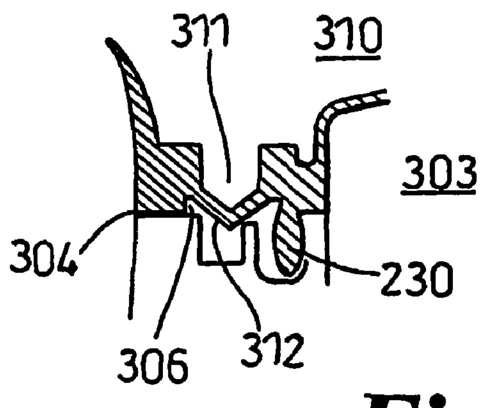
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Fig. 3B

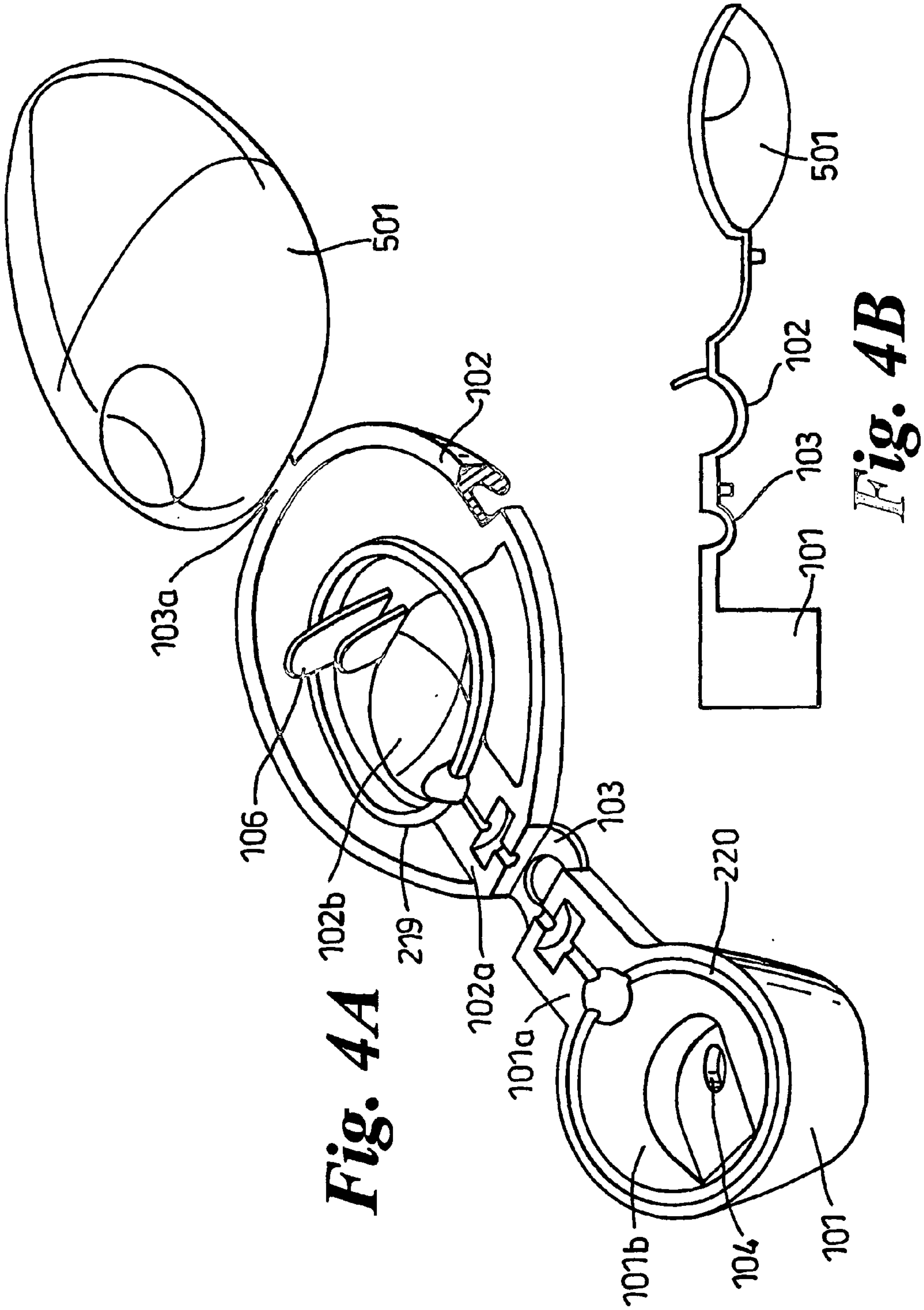
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Fig. 4A

Fig. 4B

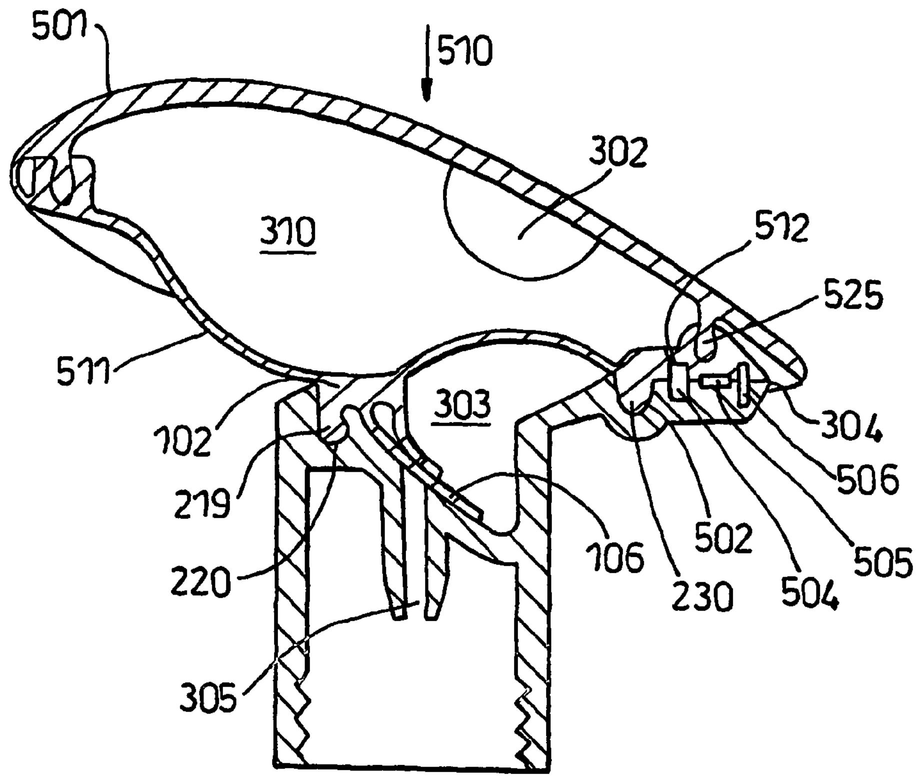
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Fig. 4C

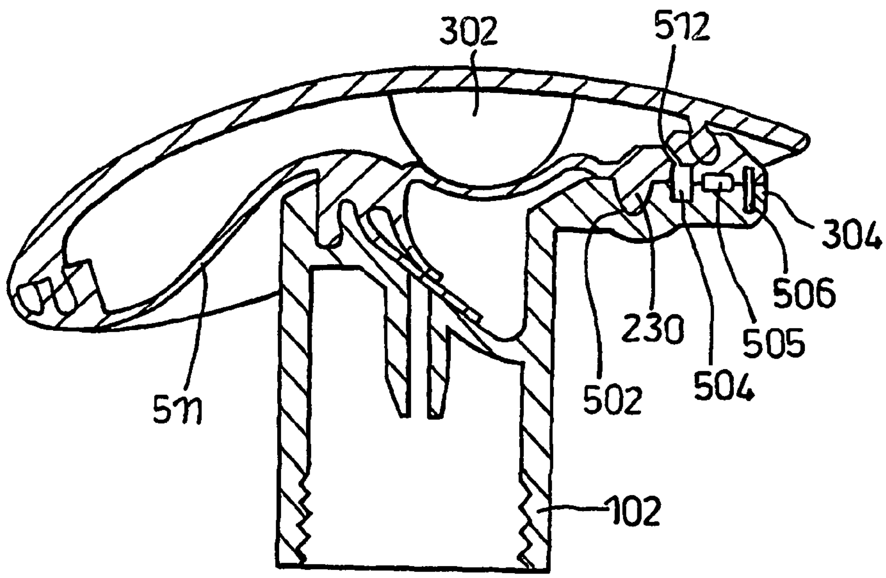
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Fig. 4D

IMPROVEMENTS IN OR RELATING TO NOZZLE DEVICES

[0001] 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.

[0002] Pump-action nozzle devices are commonly used to provide a means by which fluids can be dispensed from a non-pressurised container.

[0003] 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 can be costly to manufacture due to the amount of material required to form the individual components and the assembly processes involved.

[0004] Therefore, there is a desire for a pump-action nozzle device, which is:

[0005] (i) simple in design;

[0006] (ii) utilises less components; and

[0007] (iii) easy to actuate.

[0008] 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 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:

[0009] (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 defmed 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

[0010] (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 least drawn into the first chamber through the inlet valve;

[0011] 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.

[0012] 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 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 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.

[0013] The nozzle device of the present invention is further adapted to solve the problems associated with pump-action nozzle devices of simpler construction disclosed in EP 0 442 858 A2 and U.S. Pat. No. 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.

[0014] 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 gaseous fluid.

[0015] The actuator member may be an arm that an operator pushes to cause the said portion of the body to deform.

[0016] In certain preferred embodiments of the invention, however, the actuator member is a cap that extends over the resiliently deformable portion of the body 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.

[0017] 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 rigid or substantially rigid.

[0018] 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 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.

[0019] In further preferred embodiments of the invention the actuator member is a trigger actuator. Preferably, 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 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 resiliently deform, thereby compressing the chamber and causing fluid present in the chamber to be expelled through the outlet of the device.

[0020] 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 and dispense fluid by pulling the trigger actuator towards the base of the nozzle device.

[0021] 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.

[0022] 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.

[0023] 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.

[0024] 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.

[0025] The actuator member may be a separate component, which can be connected to the nozzle device.

[0026] 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

[0027] 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.

[0028] 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.

[0029] 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.

[0030] 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 though 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.

[0031] 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 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.

[0032] As an alternative, the nozzle device may also be adapted in such a way 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.

[0033] 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 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.

[0034] Preferably, the air chamber is disposed between the actuator member and 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.

[0035] In alternative embodiments, air and fluid from the container may be present in a single chamber, rather than separate chambers. In such cases, fluid 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.

[0036] Whether the additional chamber or chambers contain air or some other fluid drawn from a separate compartment within the container, the contents of the two or more chambers can be ejected simultaneously through the same or separate outlets by simultaneously compressing both chambers together.

[0037] 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 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.

[0038] 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 chamber, and each separate channel may feed fluid into a spray nozzle passageway as discussed above where it is mixed prior to ejection.

[0039] 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 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.

[0040] 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

[0041] 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 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 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 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 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.

[0042] 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.

[0043] 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.

[0044] 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.

[0045] Alternatively, the fluid dispensed may be a gas or mixture of gasses, such as air, for example.

Internal Chambers

[0046] 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 or, alternatively, only a proportion of the fluid present in the chambers may be dispensed, again depending on the application concerned.

[0047] 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.

[0048] One problem with dome-shaped chambers can be that a certain amount 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 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 use.

[0049] 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 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 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.

[0050] 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

[0051] 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 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.

[0052] In preferred embodiments of the invention in which the outlet comprises 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 outlet orifice.

[0053] 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 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 defmed 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 formed by aligning recesses or other formation formed on the abutment surfaces, as illustrated and described in International Patent Publication No. WO 01/89958.

[0054] 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 to be moulded or welded together, then it is preferable that they are made from compatible materials.

[0055] 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 configured to fit into a retaining groove of the other part to form the nozzle device.

[0056] 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 the tool to form the nozzle device and then moulding a suitable plastic material around them to hold the two parts together.

[0057] 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.

[0058] 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.

[0059] 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.

[0060] 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.

Material

[0061] The body of the nozzle arrangement may be made from any suitable material.

[0062] 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 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 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.

[0063] Alternatively, the two parts may both be made from either a rigid or a 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 provided the first portion of the body is if desired.

[0064] 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.

[0065] The expression "rigid plastic material" is used herein to refer to a plastic 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.

[0066] 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.

[0067] 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.

[0068] 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 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.

[0069] 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 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.

[0070] 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 compress the chamber when a pressure is applied and then subsequently returns to its initial resiliently biased configuration when the applied pressure is removed.

[0071] 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 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 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

[0072] In order to function optimally, it is necessary that the outlet of the first 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.

[0073] 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.

[0074] 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.

[0075] 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.

[0076] 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.

[0077] 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 funtioning 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.

[0078] 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 threshold is exceeded.

[0079] 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 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.

[0080] The predetermined minimum pressure that must be achieved within the chamber(s) in order to open the outlet valve will depend on the application 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

[0081] 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.

[0082] Any suitable inlet valve may be used.

[0083] 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 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 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 to cover the inlet opening to the chamber and form the inlet valve.

[0084] 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.

[0085] 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 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.

[0086] 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 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.

[0087] 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 opening and abuts the side edges to further enhance the seal formed.

[0088] 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 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.

[0089] 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 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

[0090] The nozzle device may also be provided with a locking means to prevent the fluid being dispensed accidentally.

[0091] 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.

[0092] 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.

[0093] 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.

[0094] 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 locling tabs. To make the 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.

[0095] 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 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.

[0096] Most preferably, the air leak valve is formed between the upper part and base which define the chamber of the dispenser nozzle.

[0097] 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 it position in which the channel is closed.

[0098] 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.

[0099] 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 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.

[0100] In certain embodiments of the invention it is also preferred that a 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 flared end of the plunger directly, and thus will prevent the seal being exposed to excessive forces.

[0101] 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 the container.

[0102] 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.

[0103] 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, by-passing 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 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 been emitted. No liquid product should be lost during this process.

[0104] 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

[0105] 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.

[0106] Any suitable seal would suffice. For instance, the two parts could be 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.

[0107] Preferably, the seal comprises a male protrusion formed on the abutment 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.

[0108] 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 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.

[0109] In certain embodiments that comprise an outlet passageway the protrusion member may extend across the passageway and form the resiliently 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.

[0110] In certain embodiments of the invention, the male protrusion may be configured to snap fit into the groove or, alternatively, the male protrusion may 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

[0111] 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 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.

[0112] In embodiments where the second chamber additionally comprises an inlet through which fluid is drawn from a fluid source, then two dip tubes will usually be present.

[0113] 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

[0114] 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.

[0115] 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.

[0116] 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.

[0117] 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:

[0118] (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

[0119] (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;

[0120] 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.

[0121] Preferably the nozzle device is as defined above.

[0122] 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, alternatively, just a portion thereof

[0123] Preferably, the nozzle device comprises a means for displacing the piston inwards from its initial position and then subsequently returing it is 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 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

[0124] The nozzle devices of the present invention may be made by any suitable methodology know in the art.

[0125] 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 actuator member.

[0126] 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:

[0127] (i) moulding said parts of the body and said actuator member;

[0128] (ii) connecting said parts of the body together to form the body of the nozzle device; and

[0129] (iii) fitting the actuator member to the body of the nozzle device.

[0130] 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 component part may be made from the same or a different material.

[0131] 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 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 member may then be fitted to the body of the nozzle device as a separate component.

[0132] 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 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.

[0133] It shall be appreciated that integrally formed component parts are preferably formed from the same material in single moulding step.

[0134] 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.

[0135] 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

[0136] 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:

[0137] (i) moulding a first of said parts of the body in a first processing step;

[0138] (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

[0139] (iii) connecting the actuator member to the body of the nozzle device.

[0140] 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 part of the nozzle device and the second part will be the upper part.

[0141] 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:

[0142] (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

[0143] (ii) over-moulding onto the framework or base to form the second of said parts of the assembled nozzle device; and

[0144] (iii) connecting the actuator member to the body of the nozzle device.

[0145] The framework for the second part may be fitted to the base prior to the over-moulding step.

[0146] Alternatively, the over-moulding may take place before the framework for the second part is fitted to the first part.

[0147] 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.

[0148] 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 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 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 passageway and outlet orifice.

[0149] 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:

[0150] (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

[0151] (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

[0152] (iii) connecting the actuator member to the body of the nozzle device.

[0153] 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 one another by a connection element such that said parts are moveable relative to one another, said method comprising the steps of:

[0154] (i) moulding the parts of the body and the actuator member together with said connection elements in a single moulding step;

[0155] (ii) moving said parts of the body into engagement with one another to form the body of the nozzle device; and

[0156] (iii) moving the actuator member into engagement with the body to form the nozzle device.

Blowing Agent

[0157] Preferably, a blowing agent is incorporated into the mould together with 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.

[0158] 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:

[0159] FIG. **1** is a perspective view of an embodiment of a nozzle device according to the third aspect of the invention in a dissembled configuration;

[0160] FIGS. **2**A and **2**B show perspective views of an alternative nozzle device according to the invention;

[0161] FIGS. **2**C, **2**D and **2**E all show perspective views of the embodiment shown in FIGS. **2**A and **2**B with the constituent parts separated to show the internal features;

[0162] FIGS. **2**F and **2**G show magnified views of portions of the nozzle arrangement shown in FIG. **2**C;

[0163] FIGS. **3**A and **3**B show cross-sectional views of a further embodiment of the invention;

[0164] FIGS. **4**A shows a perspective view of a further embodiment of the invention;

[0165] FIG. **4**B shows a side elevation view of the embodiment shown in FIG. **4**A; and

[0166] FIGS. **4**C and **4**D show cross-sectional views of the embodiment shown in FIGS. **4**A and **4**B.

[0167] In the following description of the figures, like reference numerals are used to denote like or corresponding parts in different figures, where appropriate.

[0168] FIG. **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 **103***a* is a trigger actuator **400**.

[0169] 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.

[0170] The base **101**, upper part **102**, trigger actuator **400** and connection elements **103** and **103***a* are integrally formed together in the configuration shown in FIGS. **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.

[0171] 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 **103***a* 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.

[0172] When the base **101** and the upper part **102** are fitted together to form the body of the device, the portion **102***a* of the under surface of the upper part **102** abuts the abutment portion/surface **101***a* of the upper surface of the base **101**. In addition, the recessed portions **101***b* and **101***c* of the upper surface of the base **101** are aligned with corresponding recessed portions **102***b* and **102***c* respectively, that formed in the under surface of the upper part **102** to define two separate internal chambers.

[0173] Each chamber comprises an inlet orifice **104***a* and **104***b* formed in the base. Each inlet orifice is disposed within a respective recess **105***a* and **105***b*, as shown in FIG. **1**. When the upper part **102** is fitted to the base **101**, the resiliently deformable flaps **106***a* and **106***b* are received within the recesses **105***a* and **105***b* respectively. The flaps **106***a* and **106***b* are resiliently biased against the openings of the inlet orifices **104***a* and **104***b* 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 that said flaps are displaced away from the openings of the inlet orifices **104***a* and **104***b* to permit fluid to flow into chambers. Bach inlet orifice **104***a* and **104***b* 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) 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 form the external environment.

[0174] The outlet comprises an outlet passageway and outlet orifice defined by the abutment surfaces **101***a* and **102***a* when they are contacted together. The 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.

[**0175**] Therefore, fluid dispensed from the chamber formed by recesses **101***b*/**102***b* 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 **101***c*/**102***c* during use travels through to the chamber formed by the alignment of recesses **113**/**115**, where it mixes with the fluid dispensed from the other chamber prior to ejection through the outlet orifice.

[**0176**] 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.

[**0177**] 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.

[**0178**] 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 **102***b* and **102***c* 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 **102***b* and **102***c* of the upper part to resiliently deform towards portions **101***b* and **101***c* 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.

[**0179**] 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 FIG. **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 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 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**.

[**0180**] 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.

[**0181**] In embodiments where one chamber, for instance the chamber formed by the alignment of recesses **101***c*/**102***c*, 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 droplets of liquid and assist in the formation of a fine spray when the liquid is dispensed through the outlet.

[**0182**] FIGS. **2**A to **2**G show an alternative embodiment of the invention adapted to dispense two liquids simultaneously in the form of a spray. FIGS. **2**A and **2**B both show perspective view of this embodiment. As for the embodiment shown in FIG. **1**, the body of the device **100** comprises a base **101** and an upper part **102** (not visible in FIGS. **2**A and **2**B). Fitted to the body of the device is a trigger actuator **400**. The trigger actuator **400** is essentially the same as that shown in FIG. **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 lock, tabs **410** can be pushed inwards so that the trigger can slide past them when it is pulled.

[**0183**] One further modification to the trigger actuator can be seen in FIGS. **2**C, **2**D and **2**F. The engagement portion **402** is divided into two segments **402***a* and **402***b*. Segment **402***a* is the portion that engages the resiliently deformable portions **102***b* and **102***c* of the upper part **102**, as previously described, whereas segment **402***b* 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 **402***a* and **402***b* are connected by a rigid beam **409** which forms the pivot point when the trigger handle is pulled. Thus, segment **402***a* pivots relative to the segment **402***b* 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 FIG. **1** because the pivot point has moved along the 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 FIG. **1** requires the trigger to be pulled inwards and downwards.

[**0184**] The parts of the body that form the nozzle device are shown in a dissembled configuration in FIGS. **2**C and **2**D. The internal structure shares many similarities with the embodiment shown in FIG. **1** (as shown by the like reference numerals), but there are some differences.

[**0185**] Firstly, the upper part **102** is connected to the base **101** at the front, rather than at the side, as shown in FIG. **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.

[**0186**] Secondly, the embodiment of the device shown in FIGS. **2**C and **2**D 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 in a similar manner to the outlet passageways of the embodiment shown in FIG. **1**.

[**0187**] The outlet passageways of each chamber therefore differs from the embodiment of FIG. **1** because each chamber comprises a separate outlet passageway formed by the alignment of grooves and/or recesses **203**-**211** formed on the abutment surfaces **101***a* of the base with corresponding grooves and/or recesses **203***a*-**211***a*, as shown in FIG. **2**G.

[**0188**] 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**/**203***a*, **205**/**205***a*, **207**/**207***a* and **209**/**209***a*. The latter chamber is a swirl chamber formed by the alignment of semi-circular recesses **209** and **209***a*. 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 the art and are again used to break up fluid droplets prior to ejection through the outlet.

[**0189**] A further difference over the embodiment shown in FIG. **1** is that the embodiment shown in FIG. **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 **101***a* 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 FIG. **2**G), 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.

[**0190**] 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.

[**0191**] 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.

[**0192**] 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.

[**0193**] Yet another difference with the embodiment shown in FIG. **1** is that the upper part comprises ridge protrusions **219** which encircle each recess (**102***b* and **102***c*) and extend either side of the grooves/recesses **203***a*-**211***a* 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.

[**0194**] FIGS. **3**A and **3**B 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 **106**a extending over the inlet opening **104***a*.

[**0195**] 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 FIG. **3**A is fitted over the upper part **102** of the nozzle arrangement and is configured to be displaced downwards from the upper position shown in FIG. **3**A 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 **102***b* 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** 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 **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.

[**0196**] 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**.

[**0197**] 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**, where the air stream mixes with the liquid dispensed from the chamber **303** in the outlet passageway **306**.

[**0198**] 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**.

[**0199**] In an alternative embodiment, the air chamber outlet **311** may be provided with a one way outlet valve **312**, as shown in FIG. 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 a minimum threshold amount.

[**0200**] 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.

[**0201**] A further embodiment of the present invention is shown in FIGS. 4A-4D. The embodiment shown in these Figures is a nozzle device configured to dispense fluids in the form of a spray. Referring to FIGS. **4**A-**4**D, 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 component, as shown in FIGS. **4**A and **4**B, and subsequently assembled to form the functional device, as shown in FIGS. **4**C and **4**D. In an alternative embodiment of the invention, the over cap **501** could be a separate component part.

[**0202**] In this regard, the upper part **102** fits onto the upper surface of the base **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 **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.

[**0203**] 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.

[**0204**] 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 FIG. **4**D. This movement compresses the air chamber **310** thereby causing air to be expelled into the chamber **504** through the outlet channel **512**. In addition, the protrusion **302** engages portion **102***b* 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 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 FIG. **4**C. This increases the volume of both of the chambers **303** and **310**, and thereby causes the 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).

[**0205**] A pre-compression valve (not shown) is provided in the outlet channel to ensure an air stream is only ejected from the chamber **310** when the pressure therein exceeds a predetermined minimum valve, 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.

[**0206**] Although not shown, the embodiment shown in FIGS. **4**A to **4**D would usually have a lock to prevent the accidental actuation of the device. Any suitable lock could be used.

[**0207**] Although the device shown in FIGS. **4**A to **4**D is adapted to generate a 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.

[**0208**] The actuator members of the embodiments of the invention provide a 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.

[**0209**] The actuator surfaces provided by the embodiments shown in FIGS. **3** and **4**A to **4**D do not deform when a pressure is applied. Thus the configuration 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.

[**0210**] A further advantage of the embodiments shown in FIGS. **4**A to **4**D is that the over cap **501** provides an increased mechanical efficiency due to the leverage provided about the pivot point **525**.

[**0211**] The air chamber **310** shown in FIGS. **3** and **4**A to **4**D 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 FIGS. **1** and **2**. The air from the 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.

[0212] 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.

[0213] The embodiments shown in FIGS. **4**A to **4**D 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 necessary deformability for certain parts of the structure can be provided by making these required sections of a reduced thickness, which imparts the necessary deformability characteristics into the design.

[0214] 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 the device.

[0215] 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.

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 drawn into said chamber from the fluid source 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, the device being configured such that, in use, at least part of the first and second chambers are located outside of a container which forms the fluid source, wherein at least a portion of the body which defines said first and second chambers is configured to:

(a) resiliently deform from an initial resiliently biased configuration to a deformed configuration in response to the application of a pressure, whereby the volume of said first 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 first chamber to increase and fluid to be ejected through the outlet valve; and

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

characterised characterized in that the first chamber contains a liquid and the second chamber contains any liquid or gas when a spray is produced by the device but only air when the device is used as a dispenser, said nozzle device further comprises an actuator member, which extends over at least a portion of said portion of the body, the arrangement being such that the actuator member is moved in a first direction as the result of pressure applied to the actuator to engage said portion of the body and cause it to deform from its initial resiliently biased configuration to reduce the volume of said first chamber, movement of said actuator member in said first direction also causing a reduction in the volume of said second chamber to eject fluid from the second chamber through the second chamber outlet, said actuator member being moved in a second direction generally opposite to the first as said portion of the body returns to its initial resiliently biased position when pressure on the actuator member is removed, movement of the actuator member in the second direction resulting in an increase in the volume of the second chamber, the second chamber being configured to draw a fluid inside as its volume increases to replace the fluid ejected.

2. A pump-action nozzle device according to claim 1, wherein said actuator member is hinged or pivoted at one side of the body and forms a cap over said body with a portion overlapping the body and having means on said overlying portion to engage with said portion of the body and cause it to deform from its initial resiliently biased configuration to compress said first chamber.

3. A pump-action nozzle device according to claim 1, wherein the said device comprises no more than six separate component parts.

4. A pump-action nozzle device according to claim 1, wherein the said device comprises a maximum of three separate component parts.

5. A pump-action nozzle device according to claim 1, wherein the said device comprises two separate component parts.

6. A pump-action nozzle device according to claims **1**, wherein the said device comprises a single component part.

7. A pump-action nozzle device according to claim 1, wherein 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 second chamber when the pressure within the chamber falls below the pressure within the second fluid source by at least a minimum threshold amount.

8. A pump-action nozzle device according to claim 1, wherein the fluid contained in the second chamber is a liquid, which is co-dispensed as a spray with a liquid present in the first chamber.

9. A pump-action nozzle device, according to claim 1, wherein the fluid contained in the second chamber is a gas, which is co-dispensed with a liquid present in the first chamber in the form of a spray.

10. A pump-action nozzle device according to claim 1, wherein the fluid contained in the second chamber is air, the air being mixed with the liquid in the first chamber before being dispensed.

11. A pump-action nozzle device according to claim 10, 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.

12. A pump-action nozzle device according to claim 11, 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 fails below the external pressure by at least a predetermined minimum threshold amount.

13. A pump-action nozzle device according to claim 10, wherein air is drawn back into the second chamber through the outlet when it expands.

14. A pump-action nozzle device according to claim 13, wherein the outlet of the second chamber is provided with a two way valve configured to only permit air 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 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.

15. A pump-action nozzle device according to claim 1, wherein the outlets of said first and second chambers each comprise an outlet passageway that extends from the respective chambers to separate outlet orifices.

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

17. A pump-action nozzle device according to claim 1, wherein the device comprises at least one outlet passageway leading from the outlet of said first and second chambers to at least an outlet orifice, said at least one outlet passageway comprising one or more internal spray-modifying features prior to a final swirl chamber or said at least one outlet orifice, said spray-modifying features being configured to reduce the size of the liquid droplets dispensed through said at least one outlet orifice of the nozzle device during use.

18. A pump-action nozzle device according to claim 17, wherein the internal spray-modifying features include one or more expansion chambers.

19. A pump-action nozzle device according to claim 17, wherein the internal spray-modifying features include two or more expansion chambers.

20. A pump-action nozzle device according to claim 17, wherein the internal spray-modifying features include two swirl chambers.

21. A pump-action nozzle device according to claim 17, wherein the internal spray-modifying features include three or more swirl chambers.

22. A pump-action nozzle device according to claim 17, wherein the internal spray-modifying features include two internal spray orifices.

23. A pump-action nozzle device according to claim 17, wherein the internal spray-modifying features include three or more internal spray orifices.

24. A pump-action nozzle device according to claim 17, wherein the internal spray-modifying features include one or more venturis.

25. A pump-action nozzle device according to claim 17, wherein the internal spray modifying features include at least one swirl chamber.

26. A pump-action nozzle device according to claim 17, wherein said device has at least two outlet passageways and wherein said passageways merge within a spray-modifying feature.

27. A pump-action nozzle device according to claim 26, wherein said spray-modifying feature is a swirl or expansion chamber.

28. A nozzle device according to claim 1, 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.

29. A nozzle device according to claim 1, wherein said actuator is an over-cap that extends over the resiliently deformable portion of the body defining said chamber.

30. A nozzle device according to claim 29, wherein said over cap is slidably mounted to the body of the nozzle device.

31. A nozzle device according to claim 29, wherein said over cap is pivotally mounted to the body of the nozzle device.

32. A nozzle device according to claim 1, wherein said actuator member is a trigger actuator.

33. A nozzle device according to claim 32, 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 from its resiliently biased position when said trigger handle is pulled.

34. A nozzle device according to claim 1, wherein said second chamber is defined between said actuator member and the body of the device.

35. A nozzle device according to claim 34, wherein an actuator surface of said actuator member is formed from a rigid plastic material.

36. A pump-action nozzle device according to claim 1, 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.

37. A pump-action nozzle device according to of claim 1, wherein said nozzle is integrally formed with said container so as to enable fluid stored in said container to be dispensed during use.

38. A pump-action nozzle device according to claim 1, wherein the body of the nozzle device comprises two or more interconnected parts, which, when connected together, define the chamber.

39. A pump-action nozzle device according to claim 38, wherein the chamber of the nozzle device is defined between two interconnected parts.

40. A pump-action nozzle device according to claim 38, comprising an outlet valve, an outlet orifice and an outlet passageway that connects the outlet valve to the outlet orifice, in which the at least two interconnected parts that define the chamber also define at least a portion of the outlet passageway.

41. A nozzle device according to claim 39, wherein the two interconnected parts form the outlet valve between them and also define the entire outlet passageway and the outlet orifice.

42. A nozzle device according to claim 40, wherein the outlet passageway is defined between an abutment surface of one of said parts and an opposing abutment surface of another of said parts.

43. A nozzle device according to any claim 42, wherein one or more of the abutment surfaces comprises one or more grooves and recesses formed thereon which define the outlet passageway when the abutment surfaces are contacted together.

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

45. A nozzle device according to claim 44, wherein said base part is adapted to be fitted to the opening of a container.

46. A nozzle device according to claim 44, wherein said base part also defines the inlet as well as a portion of the passageway leading from the chamber to the outlet.

47. A nozzle device according to claim 44, wherein the upper part is adapted to be fitted to the base so that they define the chamber and an outlet passageway leading to the outlet of the nozzle device between them.

48. A nozzle device according to claim 44, wherein the upper part forms the resiliently deformable portion of the body defining the chamber.

49. A nozzle device according to claims **44**, wherein the outlet valve is integrally formed between the component parts of the body of the nozzle device.

50. A nozzle device according to claim 49, wherein the valve is formed by a portion of one of said component parts being resiliently biased against the other of said parts to close the outlet or a passageway leading thereto, said resiliently biased portion being configured to deform away from the other of said parts to define an open outlet or passageway leading thereto when the pressure within the chamber exceeds the external pressure by at least a minimum threshold amount.

51. A nozzle device according to claim 42, wherein the outlet valve is integrally formed between the abutment surfaces of the at least two parts.

52. A nozzle device according to claim 51, wherein the abutment surface of one of the parts comprises a resiliently deformable valve member that is resiliently biased against the other of said parts to close the outlet orifice or the passageway leading thereto and is 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.

53. A nozzle device according to claim 52, wherein said valve member is in form of a flap or a plug.

54. A nozzle device according to claim 53 wherein a second reinforcing flap or member contacts the opening surface of the flap member, which is resiliently deformable.

55. A nozzle device according to claim 1, wherein 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.

56. A nozzle device according to claim 55, wherein the resiliently deformable flap is formed as an integral extension of the resiliently deformable portion of the body which defines the chamber.

57. A nozzle device according to claim 1, wherein the nozzle device comprises a locking means configured to prevent fluid being dispensed accidentally.

58. A nozzle device according to claim 56, wherein the locking means is integrally formed with the body.

59. A nozzle device according to claims **1**, wherein the device further comprises one or more air leak valves through which air can flow to equalize 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.

60. A nozzle device according to claim 38, 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.

61. A nozzle device according to claim 1, wherein the outlet valve and the inlet valve comprise a one way valve assembly which is capable of forming an airtight seal.

62. A nozzle device according to claim 1, wherein the part of the body that can be displaced inwards to reduce the volume of the chamber and thereby cause fluid present in the chamber to be ejected through the outlet is a piston mounted within a piston channel.

63. A nozzle device according to claim 1, wherein said second chamber contains air, and is arranged to be compressed before said first chamber when said actuator member is operated, thereby causing the air to be compressed before a liquid is expelled from the other chamber.

64. A nozzle device according to claim 1, wherein the device further comprises a third and a fourth chamber.

65. A nozzle device according to claim 1, wherein the parts of the body are permanently fixed together by ultrasonic or thermal welding, and are of compatible materials.

66. A nozzle device according to claim 1, wherein both parts of the body are of the said rigid or flexible material.

67. A nozzle device according to claim 1, wherein a seal is disposed at the join between the interconnected parts of the body to prevent any fluid from leaking out of the nozzle device.

68. A nozzle device according to claim 1, wherein said chambers are arranged side-by-side.

69. A nozzle device according to claim 1, wherein the chambers are arranged one on top of the other.

70. A nozzle device according to claim 1, wherein the main parts of the body are made of a first, rigid plastics material and the deformable portion of body that defines the chamber and the valves are made of a second flexible material over molded on said main parts.

71. A nozzle device according to claim 68, wherein the body further comprises a plastics material over molded about the outlook thereof to seal it, and on the actuator for a soft touch.

72. A container having a pump-action nozzle device according to claim 1, said nozzle device being 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.

73. A container having a pump-action nozzle device according to claim 1, 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

74. A pump-action nozzle device according to claim 62, wherein the piston channel forms either the entire chamber or only a portion thereof.

75.-**89**. (canceled)

90. A pump-action nozzle device adapted to enable liquid stored in a liquid source to be dispensed through said nozzle during use, said nozzle having a body which defines a first chamber having an inlet through which liquid may be drawn into said chamber and an outlet through which liquid present in the chamber may be expelled from the nozzle, said inlet comprising an inlet valve adapted to only permit liquid to flow into the chamber through the inlet when the pressure within the chamber falls below the pressure within the liquid source by at least a minimum threshold amount and said outlet comprising an outlet valve configured to only permit liquid 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:

(a) 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 first 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 first chamber to increase and liquid to be ejected through the outlet valve; and

(b) 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 fail such that further liquid is at least drawn into the first chamber through the inlet valve;

characterized in that: said second chamber is adapted to contain a liquid; at least the first chamber is defined between two interconnected parts, said interconnected parts having opposing abutment surfaces that define between them at least part of an outlet passage leading from the outlet valve of the first chamber to an outlet orifice of the device; and

the nozzle device further comprises an actuator member pivotably mounted to the body and 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.

91. A pump-action nozzle device according to claim 90, wherein the device comprises no more than six separate component parts.

92. A pump-action nozzle device according to claim 90, wherein the device comprises a maximum of three separate component parts.

93. A pump-action nozzle device according to claim 90, wherein the device comprises two separate component parts.

94. A pump-action nozzle device according to claim 90, wherein the device comprises a single component part.

95. A pump-action nozzle device according to claim 90, wherein the second chamber further comprises an inlet equipped with an inlet valve through which a liquid from a second liquid source may be drawn into the second chamber when the pressure within the chamber fails below the pressure within the second liquid source by at least a minimum threshold amount.

96. A pump-action nozzle device according to claim 90, wherein the second chamber does not comprise an inlet and contains a reservoir of a second liquid.

97. A pump-action nozzle device according to claim 96, wherein said second liquid is dispensed in one single actuation.

98. A pump-action nozzle device according to claim 96, wherein said second liquid is dispensed incrementally when the device is actuated.

99. (canceled)

100. A pump-action nozzle device according to claim 90, wherein the outlets of said first and second chambers each comprise an outlet passageway that extends from the respective chambers to separate outlet orifices.

101. A pump-action nozzle device according to claim 90, wherein the outlets of said first and second chambers comprise an outlet passageway that extends from the respective chambers to a common outlet orifice, said passageways merging such that liquid dispensed from each chamber during use mixes within the outlet passageway prior to being dispensed through said outlet orifice.

102. A nozzle device according to claim 90, wherein the actuator surface is a rigid surface that can be pressed by an operator and is configured so that it can 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.

103. A nozzle device according to claim 90, wherein said actuator is an over-cap that extends over the resiliently deformable portion of the body defining said chamber.

104. A nozzle device according to claim 103, wherein said over cap is pivotally mounted to the body of the nozzle device.

105. A nozzle device according to claim 90, wherein said actuator member is a trigger actuator.

106. A nozzle device according to claim 105, 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 from its resiliently biased position when said trigger handle is pulled.

107. A nozzle device according to claim 90, wherein said second chamber is defined between said actuator member and the body of the device.

108. A nozzle device according to claim 90, wherein the actuator surface is formed from a rigid plastic material.

109. A pump-action nozzle device according to claim 90, wherein said nozzle is adapted to be fitted to an opening of a container, so as to enable liquid stored in said container to be dispensed during use.

110. A nozzle device according to claim 90, wherein the two interconnected parts integrally form the outlet valve between them and also define the entire outlet passageway and the outlet orifice.

111. A nozzle device according to claim 90, wherein one or more of the abutment surfaces comprises one or more grooves and recesses formed thereon which define the outlet passageway when the abutment surfaces are contacted together.

112. A nozzle device according to claim 90, wherein one of said interconnected parts is a base part and other of said interconnected parts is an upper part.

113. A nozzle device according to claim 112 wherein said base part is adapted to be fitted to the opening of a container.

114. A nozzle device according to claim 113, wherein said base part also defines the inlet as well as a portion of the passageway leading from the chamber to the outlet.

115. A nozzle device according to claim 112, wherein the upper part is adapted to be fitted to the base so that they define the chamber and the outlet passageway leading to the outlet of the nozzle device between them.

116. A nozzle device according to claim 112, wherein the upper part forms the resiliently deformable portion of the body defining the chamber.

117. A nozzle device according to claim 90, wherein the outlet valve is integrally formed between the interconnected parts of the body of the nozzle device.

118. A nozzle device according to claim 117, wherein the outlet valve is integrally formed by a portion of one of said parts being resiliently biased against the other of said parts to close the outlet or a passageway leading thereto, said resiliently 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.

119. A nozzle device according to claim 118, wherein the outlet valve is integrally formed between the abutment surfaces of the at least two parts.

120. A nozzle device according to claim 119, wherein the abutment surface of one of the parts comprises a resiliently deformable valve member that is resiliently biased against the other of the parts to close the outlet or a passageway leading thereto and is configured to deform away from the other of said parts to define an open outlet or passageway leading thereto when the pressure within the chamber exceeds the external pressure by at least a minimum threshold amount.

121. A nozzle device according to claim 120, wherein said valve member is in the form of a flap or a plug.

122. A nozzle device according to claim 121, wherein a second reconfiguring flap or member contacts the opposing surface of the flap member which is resiliently deformable.

123. A nozzle device according to claim 90, wherein 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 liquid 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.

124. A nozzle device according to claim 123, wherein the resiliently deformable flap is formed as an integral extension of the resiliently deformable portion of the body which defines the chamber.

125. A nozzle device according to claim 90, wherein the nozzle device comprises a locking means configured to prevent liquid being dispensed accidentally.

126. A nozzle device according to claim 125, wherein the locking means is integrally formed with the body.

127. A nozzle device according to claim 90, wherein the device further comprises one or more air leak valves through which air can flow to equalize any pressure differential between the interior of the container and the external environment, but prevents any liquid leaking out of the container if it is inverted.

128. A nozzle device according to claim 90, wherein a sealing means is disposed between said two interconnected parts to prevent any liquid leaking out of the nozzle device.

129. A nozzle device according to claim 90, wherein the device further comprises a third and a fourth chamber.

130. A nozzle device according to claim 90, wherein the parts of the body are permanently fixed together by ultrasonic or thermal welding, and are of compatible materials.

131. A nozzle device according to claim 90, wherein both parts of the body are of the said rigid or flexible material.

132. A nozzle device according to claim 90, wherein said chambers are arranged side-by-side.

133. A nozzle device according to claim 1, wherein the chambers are arranged one on top of the other.

134. A nozzle device according to claim 90, wherein the main parts of the body are made of a first, rigid plastics material and the deformable portion of body that defines the chamber and the valves are made of a second flexible material over molded on said main parts.

135. A pump-action nozzle dispenser according to claim 90, wherein the part of the body which can be displaced inwards to reduce the volume of the chamber and thereby cause liquid in the chamber to be ejected through the outlet is a piston mounted within a piston channel.

136. A pump-action nozzle device dispenser according to claim 135, wherein the piston channel forms either the entire chamber or only a portion thereof. **137**. A container having a pump-action nozzle device according to claim 90 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.

138. A container having a pump-action nozzle device according to claim 90 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.

139.-**153**. (canceled)

154. A pump action nozzle device according to claim 1, wherein said nozzle device comprises at least two component parts for assembly with a snap fit.

155. A pump action nozzle device according to claim 1, wherein said nozzle device comprises at least two component parts for assembly by welding.

156. A pump action nozzle device according to claim 1, wherein said nozzle device comprises at least two component parts for assembly by means of over molding.

157. A pump action nozzle device according to claim 1, wherein said nozzle device comprises at least one component part formed by injection molding, and wherein a blowing agent is incorporated into a mold together with a plastic material.

158. A pump action nozzle device according to claim 1, wherein said nozzle device comprises at least one component part formed from at least two plastic materials using bi-injection molding.

159. A pump action nozzle device according to claim 158, wherein the at least one component part of said nozzle device comprises a base portion formed by means of a bi-injection molding process in which a rigid material is injected into a mold in a first stage and a second relatively flexible material is over molded onto the rigid material in a second stage of the process.

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